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Introduction

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

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

For national standards, comments will be reviewed by the relevant UK national committee and the resulting standards published as a British Standard.

UK Vote

Please indicate whether you consider the UK should submit a negative (with supporting technical reasons) or positive vote on this draft. Please indicate if you are aware of any reason why this draft standard should not be published as a British Standard.

Submission of Comments

- **Annotated drafts are not acceptable and will be rejected.**
- All comments should be submitted online at <https://standardsdevelopment.bsigroup.com/>. You will need to register in order to comment.

Template for comments and secretariat observations

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

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9/3016/RR

IEC TC 9 : ELECTRICAL EQUIPMENT AND SYSTEMS FOR RAILWAYS

SECRETARIAT:

France

SECRETARY:

Mr Denis MIGLIANICO

OF INTEREST TO THE FOLLOWING COMMITTEES:

PROPOSED HORIZONTAL STANDARD:



Other TC/SCs are requested to indicate their interest, if any, in this CD to the secretary.

FUNCTIONS CONCERNED:

☐ EMC☐ ENVIRONMENT☐ QUALITY ASSURANCE☐ SAFETY

This document is still under study and subject to change. It should not be used for reference purposes.

Recipients of this document are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

Recipients of this document are invited to submit, with their comments, notification of any local regulations or technical reasons that may exist and should be considered should this proposal proceed, recognizing that failure to address such requirements could result in the need for new or existing "In Some Countries" clauses. (See [AC/22/2007](#) or [NEW GUIDANCE DOC](#)).

TITLE:

Railway applications – Energy measurement on board trains – Part 6: Requirements for purposes other than billing

NOTE FROM TC/SC OFFICERS:

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**RAILWAY APPLICATIONS –
ENERGY MEASUREMENT ON BOARD TRAINS –****Part 6: Requirements for purposes other than billing**

FOREWORD

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International Standard IEC 62888-6 has been prepared by IEC technical committee 9: Electrical equipment and systems for railways.

This standard supplements and/or amends the requirements specified in IEC 62888-1 to IEC 62888-5 which are based on EN 50463.

The text of this standard is based on the following documents:

FDIS	Report on voting
9/2431/FDIS	9/2450/RVD

Full information on the voting for the approval of this International Standard can be found in the report on voting indicated in the above table.

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts in the IEC 62888 series, published under the general title *Railway applications – Energy measurement on board trains*, can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under "<http://webstore.iec.ch>" in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

INTRODUCTION

Three levels are introduced for categorising EMS as described in Clause 1.

This is Part 6 of the IEC 62888 series which consists of the following parts, under the common title *Railway applications – Energy measurement on board trains*:

Part 1: General

Part 2: Energy measurement

Part 3: Data handling

Part 4: Communication

Part 5: Conformance test

Part 6: Requirements for purposes other than billing

This series of International Standards follows the functional guidelines description in Annex A, “Principles of conformity assessment”, of ISO/IEC 17000:2004 tailored to the Energy Measurement System (EMS).

The Energy Measurement System (EMS) provides measurement and data suitable for applications such as energy management, energy saving, billing and others.

This series of International Standards uses the functional approach to describe the EMS and on-ground Data Collecting System (DCS). These functions are implemented in one or more physical devices. The user of this series of standards is free to choose the physical implementation arrangements.

Structure and main contents of the IEC 62888 series

This series of International Standards is divided into six parts. The titles and brief descriptions of each part are given below:

IEC 62888-1 – General

The scope of IEC 62888-1 is the Energy Measurement System (EMS).

IEC 62888-1 provides system level requirements for the complete EMS and common requirements for all devices implementing one or more functions of the EMS.

IEC 62888-2 – Energy measurement

The scope of IEC 62888-2 is the Energy Measurement Function (EMF).

The EMF provides measurement of the consumed and regenerated active energy of a railway traction unit. If the traction unit is designed for use on AC electric traction systems, the EMF also provides measurement of reactive energy. The EMF provides the measured quantities via an interface to the Data Handling System.

The EMF consists of the three functions: Voltage Measurement Function, Current Measurement Function and Energy Calculation Function. For each of these functions, accuracy classes are specified and associated reference conditions are defined. IEC 62888-2 also defines all specific requirements for all functions of the EMF.

The Voltage Measurement Function measures the voltage of the contact line (CL) system and the Current Measurement Function measures the current taken from and returned to the CL system. These functions provide signal inputs to the Energy Calculation Function.

The Energy Calculation Function inputs the signals from the Current and Voltage Measurement Functions and calculates a set of values representing the consumed and regenerated energies. These values are transferred to the Data Handling System and are used in the creation of Compiled Energy Measured Data.

The document has been developed taking into account that in some applications, the EMF should be subjected to metrological principles. The relevant metrological requirements are covered in IEC 62888-2.

IEC 62888-2 also defines the conformance test of the functions of the EMF and the conformance evaluation of the EMF.

IEC 62888-3 – Data handling

The scope of IEC 62888-3 is the Data Handling System (DHS) and the associated requirements of Data Collecting System (DCS).

The on-board DHS receives, produces and stores data, ready for transmission to any authorised receiver of data on board or on ground. The main goal of the DHS is to produce Compiled Energy Measured Data (CEMD) and transfer it to an on-ground Data Collecting System (DCS). The DHS can support other functions on board or on ground with data, as long as this does not conflict with the main goal.

The DCS on-ground receives CEMD, stores the CEMD and transfer it to upstream servers such as settlement system.

IEC 62888-3 also defines the conformance test of the DHS and for the transfer of CEMD to an on-ground DCS.

IEC 62888-4 – Communication

The scope of IEC 62888-4 is the communication services.

IEC 62888-4 gives requirements and guidance regarding the data communication between the functions implemented within EMS as well as between such functions and other on-board units where data are exchanged using a communications protocol stack over a dedicated physical interface or a shared network.

It includes the board to ground communication service and covers the requirements necessary to support data transfer between DHS and DCS.

IEC 62888-4 also defines the conformance test of the communications services.

IEC 62888-5 – Conformance test

The scope of IEC 62888-5 is the conformance test procedures for the EMS.

IEC 62888-5 also covers re-verification procedures and conformance test in the event of the replacement of a device of the EMS.

IEC 62888-6 – Requirements for purposes other than billing

The scope of IEC 62888-6 is to specify the requirements for EMS to be used for benchmarking, daily energy consumption monitoring, technical research and development.

IEC 62888-6 provides the requirements for monitoring consumed energy on board in daily services in an easy way and the measured data are applicable for general purposes in industry such as energy management, energy saving, etc. However, this part is not applicable for billing purposes.

EMS functional structure and dataflow

Figure 1 illustrates the functional structure of the EMS, the main sub-functions and the structure of the dataflow and is informative only. Only the main interfaces required by this standard are displayed by arrows.

Since the communication function is distributed throughout the EMS, it has been widely omitted for clarity, except for the train to ground communication. Not all interfaces are shown.

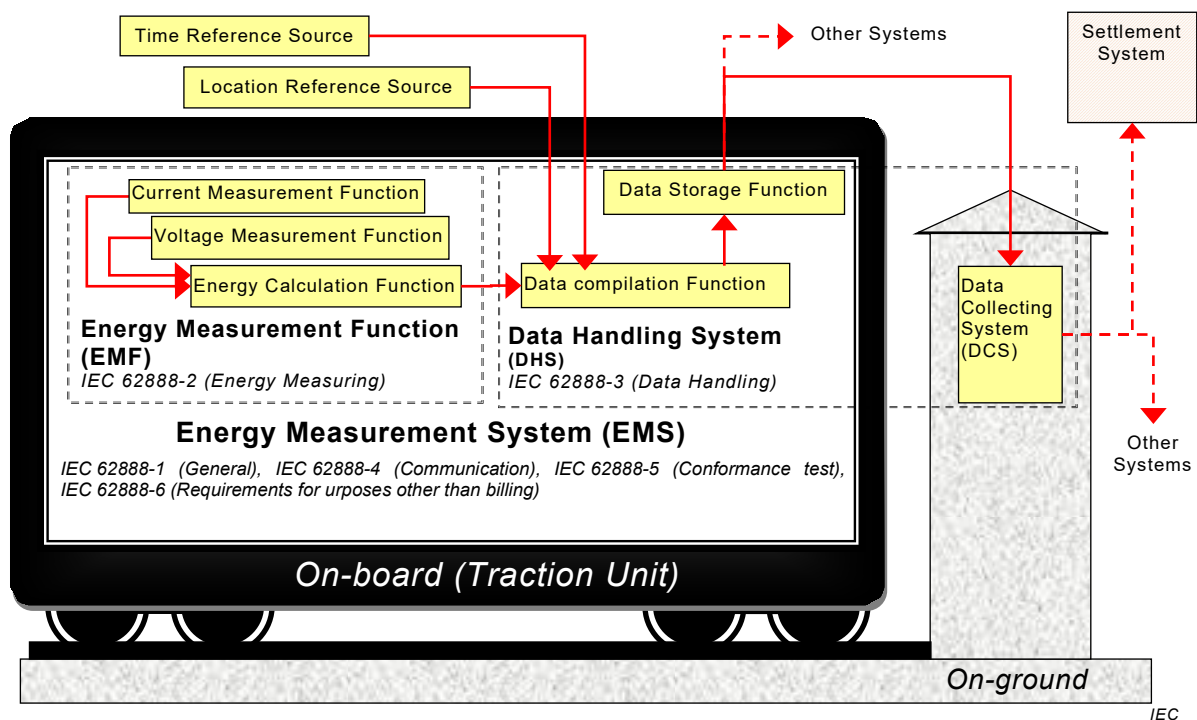


Figure 1 – EMS functional structure and dataflow diagram

RAILWAY APPLICATIONS – ENERGY MEASUREMENT ON BOARD TRAINS –

Part 6: Requirements for purposes other than billing

1 Scope

This part of the IEC 62888 series describes the specific requirements for Energy Measurement System (EMS) to be used for benchmarking, daily energy consumption monitoring, technical research and development.

This part of the IEC 62888 series specifies the requirements for monitoring consumed energy on board in daily services in an easy way and the measured data, which are applicable for general purposes in industry such as energy management, energy saving, etc. This document does not apply for billing purposes.

The practical purposes in industrial fields are, e.g.:

- a) monitoring daily energy consumption of vehicles;
- b) obtaining data on influential factors, such as operational commands and surrounding conditions, in order to analyse relations between operations and energy;
- c) energy management of power flow between vehicles and fixed installations;
- d) implementing investigation tests of research and development for vehicle systems;
- e) energy cost forecasting for analysing overall efficiency and consumption.

The requirements specified in this document supplement and/or amend the requirements specified in IEC 62888-1 to IEC 62888-5.

The energy measurement system (EMS) is categorized in 3 Levels as described in IEC 62888-1:20xx, Table 1. This document applies to Level 2 and Level 3.

In this document unless levels are specially mentioned, both Level 2 and Level 3 apply. If a requirement applies only to one level between Level 2 and Level 3, this condition is clearly specified.

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.

IEC 60044-8, *Instrument transformers – Part 8: Electronic current transformers*

IEC 60850:2014, *Railway applications – Supply voltages of traction systems*

IEC 61287-1, *Railway applications – Power converters installed on board rolling stock – Part 1: Characteristics and test methods*

IEC 62236-3-2, *Railway applications – Electromagnetic compatibility – Part 3-2: Rolling stock – Apparatus*

IEC 62313:2009, *Railway applications – Power supply and rolling stock – Technical criteria for the coordination between power supply (substation) and rolling stock*

IEC 62497-1, *Railway applications – Insulation coordination – Part 1: Basic requirements – Clearances and creepage distances for all electrical and electronic equipment*

IEC 62625-1, *Electronic railway equipment – On board driving data recording system – Part 1: System specification*

IEC 62888-1:20xx, *Railway applications – Energy measurement on board trains – Part 1: General*

IEC 62888-2:20xx, *Railway applications – Energy measurement on board trains – Part 2: Energy measurement*

IEC 62888-3:20xx, *Railway applications – Energy measurement on board trains – Part 3: Data handling*

IEC 62888-4:20xx, *Railway applications – Energy measurement on board trains – Part 4: Communication*

IEC 62888-5:20xx, *Railway applications – Energy measurement on board trains – Part 5: Conformance test*

3 Terms, definitions, abbreviated terms and symbols

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 62888-1 to 5:20xx and the following apply.

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

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

3.1.1

involved party

entity that is involved in designing, manufacturing, supplying and/or using the EMS or parts/components of the EMS

Note 1 to entry: Involved party can be a purchaser, supplier, manufacturer or user. Members of involved parties do not necessarily consist of all of them. Members of the involved parties depend on the provisions of subclauses in this document and are appropriately interpreted.

3.2 Abbreviated terms

For the purposes of this document, the abbreviated terms given in IEC 62888-1 apply.

3.3 Symbols

f_n	rated frequency
$I_{CMF,cth}$	rated continuous thermal current
$I_{CMF,dyn}$	rated dynamic current

170	$I_{\text{CMF,th}}$	rated short-time thermal current
171	$I_{\text{n,CMF}}$	rated primary current of the CMF
172	$I_{\text{n,ECF}}$	rated primary current of the ECF
173	$I_{\text{n,EMF}}$	rated primary current of the EMF
174	$t_{\text{s,r}}$	response time
175	U_{max2}	highest non permanent voltage according to IEC 60850
176	U_{max3}	highest long term overvoltage according to IEC 60850
177	U_{min1}	lowest permanent voltage according to IEC 60850
178	U_{min2}	lowest non permanent voltage according to IEC 60850
179	$U_{\text{n,VMF}}$	rated primary voltage of the VMF
180	ε_{CMF}	maximum percentage (ratio) error allowed in accordance with the selected
181		accuracy class for the CMF
182	ε_{ECF}	maximum percentage error allowed in accordance with the selected accuracy
183		class for the ECF
184	ε_{VMF}	maximum percentage (ratio) error allowed in accordance with the selected
185		accuracy class for the VMF

186 4 Requirements

187 4.1 General

188 4.1.1 Overview

189 The requirements specified in this document apply only in applications not related to billing.
 190 These requirements supplement and/or amend the requirements specified in IEC 62888-1 to
 191 IEC 62888-5. Individual permissions and requirements applicable to Level 2 and Level 3 are
 192 specified in this document. Clauses not mentioned in this document are covered by
 193 IEC 62888-1 to IEC 62888-5.

194 In the following subclauses square brackets, e.g. [IEC 62888-3:20xx, 4.6.1] in the title indicate
 195 relevant clauses and subclauses of other parts.

196 When lower subclauses of other parts are not listed, provisions of higher subclauses apply to
 197 the lower subclauses.

198 The differences between Level 1, Level 2 and Level 3 are summarized in Annex C.

199 4.1.2 Applications and usage

200 At present the traction equipment and the auxiliary equipment onboard are mainly controlled
 201 by microcomputers installed in the control units. These equipments are equipped with voltage
 202 and current sensors. They can calculate energy using these data.

203 Using these existing infrastructures can make a convenient energy measurement system on
 204 board.

205 The data obtained by these systems may be used in applications other than billing purposes.

206 For these various purposes EMS functions may be different from Level 1.

207 Level 2 is applied to the following applications:

Level 2 is the level for measuring energy consumption on board for applications like energy management, energy saving, benchmarking by suppliers or train operators and others. This level is not applicable for billing.

Level 2 is applied when accuracy requirements need to be raised to ones equivalent to Level 1 by agreement between the involved parties for international comparison or benchmarking purposes.

For instance, energy measurement in Level 2 is applied to the following cases:

- evaluation and comparison of energy consumption of trains among different railway operators;
- evaluation and comparison of energy consumption of trains measured by different parties;
- annual technical report or statistics on energy consumption of trains; and
- evaluation of achievement of technical development of new trains.

Level 3 is applied to the following applications:

On board and board to ground communication networks also become very common and various data can be transferred on the transmission line. This network communicates with the traction equipment and the auxiliary equipment and transfers various data, which can include the voltage, the current and the energy data calculated.

For instance, energy measurement in Level 3 is applied to the following cases:

- internal evaluation of energy consumption of trains in a railway operator;
- pursuit of long term variation of energy consumption of a train;
- evaluation of energy consumption differences depending on different train operation methods;
- display of energy consumption for train drivers in order to assist their energy-saving operation effort;
- accumulation of fundamental energy data for technical development of smart automatic train operation;
- data acquisition for evaluation and improvement of train operation skill;
- acquisition of "Big Data" for train operation assisting system;
- acquisition of relevant energy factor for comprehensive evaluation of train operational skill; and
- statistic analysis of energy consumption trend based on the "Big Data".

4.1.3 Measurement system configuration

For allocating EMS to on board devices, the following system configurations are possible:

- allocating EMF (VMF, CMF and ECF) to separated devices from DHS;
- allocating VMF, CMF and ECF to separate devices or installing them in separate equipment;
- implementing ECF and DHS in same device;
- allocating ECF to on ground DCS (e.g. for research in laboratories).

As stated in 4.1.2, the communication function is distributed throughout the EMS. The obtained data may be not always transferred through the communication networks. On board data can be transferred to ground via data storage media (e.g. removable disk or memory devices) or data download system.

In 0 (informative), some examples of the systems are presented.

4.1.4 Data to be acquired

The data handled in EMS shall be all or part of the following:

- time data;
- energy data (energy value, or voltage data and current data);
- location data;

and separate recording is accepted, e.g.:

- (time data, energy data);
- (time data, location data).

Measures for matching separate data shall be provided, e.g. time data.

4.2 Requirement amendments to IEC 62888-1

4.2.1 General [IEC 62888-1:20xx, 4.1]

The general requirements in IEC 62888-1:20xx, 4.1 are applicable to Level 2 and Level 3.

4.2.2 System level requirements [IEC 62888-1:20xx, 4.2]

4.2.2.1 General [IEC 62888-1:20xx, 4.2.1]

IEC 62888-1:20xx, 4.2.1 is applicable to Level 2 and Level 3.

4.2.2.2 Accuracy [IEC 62888-1:20xx, 4.2.2]

IEC 62888-1:20xx, 4.2.2 is applicable to Level 2 and Level 3.

4.2.2.3 EMS operation and power supply [IEC 62888-1:20xx, 4.2.3]

IEC 62888-1:20xx, 4.2.3 is applicable to Level 2 and Level 3.

4.2.2.4 EMS measuring input [IEC 62888-1:20xx, 4.2.4]

4.2.2.4.1 Installation point of the VMF and CMF [IEC 62888-1:20xx, 4.2.4.1]

IEC 62888-1:20xx, 4.2.4.1 is applicable to Level 2 and Level 3 with the following amendments.

Measuring points and methods of summation and any other constraints (e.g. losses, wiring, cabling) derived by the actual configuration of the system shall be agreed upon by the involved parties and documented.

Measured data are voltage, current, energy.

The reactive energy should be recorded by agreement between the involved parties.

Summation of measurements is accepted in case of measurement functions distributed in other equipment, e.g. traction converters and auxiliary converters.

It shall be considered that the summation of measurements corresponds to the input of CL. When the power to the auxiliary converter is supplied from CL, measurements from the traction equipment or the auxiliary converter shall be summed individually. When the power to the auxiliary converter is supplied from the traction equipment, e.g. DC link of the traction converter, only measurements of the traction equipment shall be summed.

Examples of installation points are shown in 0 (informative).

Depending on a purpose, energy measurement may be limited only to propulsion energy. The measurement of the reactive energy and the energy of auxiliary circuit is optional by agreement between the involved parties

For AC power supply, taking into account the efficiency and loss of the transformer, the use of secondary or tertiary winding of the transformer for the point of VMF shall be agreed upon by the involved parties.

4.2.2.4.2 Characteristics of electric traction system [IEC 62888-1:20xx, 4.2.4.2]

IEC 62888-1:20xx, 4.2.4.2 is applicable to Level 2 and Level 3.

4.2.2.5 Data handling [IEC 62888-1:20xx, 4.2.5]

4.2.2.5.1 Electric traction system change [IEC 62888-1:20xx, 4.2.5.1]

IEC 62888-1:20xx, 4.2.5.1 is applicable to Level 2 and Level 3.

4.2.2.5.2 Consumption point Identification (CPID) [IEC 62888-1:20xx, 4.2.5.2]

IEC 62888-1:20xx, 4.2.5.2 is applicable to Level 2 and Level 3 with the following amendments.

Consumption point identification (CPID) according to IEC 62888-1 is optional. The method for the identification of the measurement point shall be agreed upon by the involved parties.

4.2.2.6 Reliability, Availability, Maintainability and Safety (RAMS) [IEC 62888-1:20xx, 4.2.6]

IEC 62888-1:20xx, 4.2.6 is applicable to Level 2 and Level 3.

4.2.3 Device level requirements [IEC 62888-1:20xx, 4.3]

4.2.3.1 Marking and availability of essential data [IEC 62888-1:20xx, 4.3.1]

IEC 62888-1:20xx, 4.3.1 is applicable to Level 2 and Level 3.

4.2.3.2 Interfaces [IEC 62888-1:20xx, 4.3.2]

4.2.3.2.1 General [IEC 62888-1:20xx, 4.3.2.1]

IEC 62888-1:20xx, 4.3.2.1 is applicable to Level 2 and Level 3.

4.2.3.2.2 Mandatory interfaces [IEC 62888-1:20xx, 4.3.2.2]

4.2.3.2.2.1 Maintenance and service interfaces [IEC 62888-1:20xx, 4.3.2.2.1]

IEC 62888-1:20xx, 4.3.2.2.1 is applicable to Level 2 and Level 3 with the following amendments.

The maintenance and service interfaces may be used to download the energy data as well.

Access protection shall comply with 4.2.3.2.3.

4.2.3.2.2.2 Operational interfaces [IEC 62888-1:20xx, 4.3.2.2.2]

IEC 62888-1:20xx, 4.3.2.2.2 is applicable to Level 2 and Level 3.

4.2.3.2.2.3 Test interfaces [IEC 62888-1:20xx, 4.3.2.2.3]

IEC 62888-1:20xx, 4.3.2.2.3 is applicable to Level 2 and Level 3 with the following amendments.

If the measurement is carried out temporarily, test interfaces may be omitted by agreement between the involved parties.

In case of EMS as a function included in the function of other equipment, e.g. traction converters or auxiliary converters, internal test functions may be included in order to perform self-testing. In case self-testing is included, the test interfaces may be omitted.

4.2.3.2.3 Access security [IEC 62888-1:20xx, 4.3.2.3]

IEC 62888-1:20xx, 4.3.2.3 is applicable to Level 2 and Level 3 with the following amendments.

In case of EMS as a function included in the function of other equipment, e.g. traction equipment or auxiliary equipment, access to the EMSs is limited to the authorised maintenance persons. Manual logging of access to data like a management table is accepted.

The authorised maintenance persons shall be trained for access to the equipment and the training record shall be maintained for a certain period and be traced by quality system.

4.2.3.3 Data processing and transfer [IEC 62888-1:20xx, 4.3.3]

IEC 62888-1:20xx, 4.3.3 is applicable to Level 2 and Level 3.

4.2.3.4 Software [IEC 62888-1:20xx, 4.3.4]**4.2.3.4.1 General [IEC 62888-1:20xx, 4.3.4.1]**

IEC 62888-1:20xx, 4.3.4.1 is applicable to Level 2 and Level 3.

4.2.3.4.2 Identification of functions implemented in software [IEC 62888-1:20xx, 4.3.4.2]

IEC 62888-1:20xx, 4.3.4.2 is applicable to Level 2 and Level 3.

4.2.3.4.3 Identification and protection of software [IEC 62888-1:20xx, 4.3.4.3]

IEC 62888-1:20xx, 4.3.4.3 is applicable to Level 2 and Level 3 with the following amendments.

In case of EMS as a function included in the function of other equipment, e.g. traction equipment or auxiliary equipment, access to the EMSs is limited to the authorised maintenance persons. Personnel control may be regarded as protection of software by intentional change. Corruption of the software can be detected as a watch-dog timer of control software.

NOTE When a special tool is necessary for changing software, control of the special tool is regarded as protection of software.

4.2.3.4.4 Protection of CEMD and CEMD-related data [IEC 62888-1:20xx, 4.3.4.4]

IEC 62888-1:20xx, 4.3.4.4 is applicable to Level 2 and Level 3 with the following amendments.

In case of EMS as a function included in the function of other equipment, e.g. traction equipment or auxiliary equipment, access to the EMSs is limited to the authorised maintenance persons. Personnel control may be regarded as protection of CEMD and CEMD-related data by intentional change.

The security provisions of the EMS, providing protection of software, system parameters and ensuring this requirement, including any hardware and software solutions, shall be documented and agreed upon by the involved parties.

4.2.3.4.5 Protection against influence by other parts of software [IEC 62888-1:20xx, 4.3.4.5]

IEC 62888-1:20xx, 4.3.4.5 is applicable to Level 2 and Level 3.

4.2.3.4.6 Protection against influence by connecting another device [IEC 62888-1:20xx, 4.3.4.6]

IEC 62888-1:20xx, 4.3.4.6 is applicable to Level 2 and Level 3.

4.2.3.5 Dataflow security [IEC 62888-1:20xx, 4.3.5]

IEC 62888-1:20xx, 4.3.5 is applicable to Level 2 and Level 3 with the following amendments.

In case of EMS as a function included in the function of other equipment, e.g. traction equipment or auxiliary equipment, access to the EMSs can be limited to the authorised maintenance persons. Personnel control may be considered as an adequate dataflow security.

4.2.3.6 Environmental conditions [IEC 62888-1:20xx, 4.3.6]

IEC 62888-1:20xx, 4.3.6 is applicable to Level 2 and Level 3.

4.2.3.7 Mechanical requirements, construction and design [IEC 62888-1:20xx, 4.3.7]

IEC 62888-1:20xx, 4.3.7 is applicable to Level 2 and Level 3.

4.2.3.8 Electrical requirements [IEC 62888-1:20xx, 4.3.8]

IEC 62888-1:20xx, 4.3.8 is applicable to Level 2 and Level 3.

4.3 Requirement amendments to IEC 62888-2

4.3.1 General [IEC 62888-2:20xx, 4.1]

The general requirements in IEC 62888-2:20xx, 4.1 are applicable to Level 2 and Level 3.

4.3.2 Energy Measurement Function (EMF) [IEC 62888-2:20xx, 4.2]

4.3.2.1 General [IEC 62888-2:20xx, 4.2.1]

4.3.2.1.1 Introduction [IEC 62888-2:20xx, 4.2.1.1]

For Level 2 and Level 3, the output data of VMF and CMF may be stored on board for a certain period and transferred with location data and time data to Data Collecting System (DCS) on ground. In this case, the ECF and DHS are realized in on-ground system.

For examples of measurement points see Annex A (informative).

NOTE For the amendments to Annex B in IEC 62888-2:20xx, see 6.3.2.

4.3.2.1.2 General requirements [IEC 62888-2:20xx, 4.2.1.2]

IEC 62888-2:20xx, 4.2.1.2 is applicable to Level 2 and Level 3.

4.3.2.1.3 Identification and marking of the EMF [IEC 62888-2:20xx, 4.2.1.3]

IEC 62888-2:20xx, 4.2.1.3 is applicable to Level 2 and Level 3 with the following amendments.

In case of EMS as a function included in the function of other equipment, e.g. traction equipment or auxiliary equipment, marking of EMF, i.e. VMF, CMF and ECF, is optional and shall be agreed upon by the involved parties.

In case that those functions are installed in other equipment, the marking may be seen when its covers are open. The marking on the outside of the equipment is not required if the information contained is provided by e.g. documents.

For examples of measurement points see 0 (informative).

4.3.2.1.4 Essential information [IEC 62888-2:20xx, 4.2.1.4]

IEC 62888-2:20xx, 4.2.1.4 is applicable to Level 2 and Level 3.

4.3.2.2 Electrical requirements [IEC 62888-2:20xx, 4.2.2]**4.3.2.2.1 Rated voltages [IEC 62888-2:20xx, 4.2.2.1]**

IEC 62888-2:20xx, 4.2.2.1 is applicable to Level 2 and Level 3.

4.3.2.2.2 Rated current [IEC 62888-2:20xx, 4.2.2.2]

IEC 62888-2:20xx, 4.2.2.2 is applicable to Level 2 and Level 3 with the following amendments.

Other rated currents than listed ones in IEC 62888-1:20xx, 4.2.2.2 may be used. The rated primary current ($I_{n,EMF}$) of the EMF shall be agreed upon by the involved parties and recorded into the documentation.

4.3.2.2.3 Rated frequency (f_n) [IEC 62888-2:20xx, 4.2.2.3]

IEC 62888-2:20xx, 4.2.2.3 is applicable to Level 2 and Level 3.

4.3.2.3 Accuracy requirements [IEC 62888-2:20xx, 4.2.3]**4.3.2.3.1 General [IEC 62888-2:20xx, 4.2.3.1]**

IEC 62888-2:20xx, 4.2.3.1 is applicable to Level 2 and Level 3 with the following amendments.

In case functions built in traction converters and/or train communication network are used, the following shall be considered:

- number of digits;
- quantization error;
- sampling periods.

The actual accuracy of the measurement chain shall be recorded into the documentation.

Errors of interface circuits requiring parameter tuning between each function, accuracy of each function (VMF, CMF, ECF) and the total accuracy of EMF shall be stated in the document prepared by the manufacturer.

NOTE For the amendments to informative Annex C in IEC 62888-2:20xx, see 6.3.3.

4.3.2.3.2 Limits of error for the EMF [IEC 62888-2:20xx, 4.2.3.2]

IEC 62888-2:20xx, 4.2.3.2 is applicable to Level 2 and Level 3.

4.3.2.3.3 Reference conditions [IEC 62888-2:20xx, 4.2.3.3]

IEC 62888-2:20xx, 4.2.3.3 is applicable to Level 2 and Level 3.

4.3.2.3.4 Limits of error due to variations in input quantities [IEC 62888-2:20xx, 4.2.3.4]

IEC 62888-2:20xx, 4.2.3.4 is applicable to Level 2.

For Level 3, percentage error limit given in Table 1 apply.

Table 1 – EMF percentage error limits at reference conditions for Level 3

System type	Input quantity range			Percentage error limit	
	Value of current ^a	Value of voltage ^b	PF = Power Factor or sin φ ^c	Active energy	Reactive energy ^d
AC	$30 \% I_n \leq I \leq 120 \% I_n$	$U_{\min 2} \leq U \leq U_{\max 2}$	$0,85 \leq \text{PF}$ or $\sin \varphi = 1$ Inductive	5,2	15
DC	$30 \% I_n \leq I \leq 120 \% I_n$	$U_{\min 2} \leq U \leq U_{\max 2}$	N/A	5,2	N/A

^a I_n is the rated primary current of the EMF.

^b The values of $U_{\min 2}$ and $U_{\max 2}$ are as specified in IEC 60850:2014.

^c The Power Factor is taken from IEC 62313:2009, Table 1. The reactive energy cannot be measured accurately for Power Factor near 1. Therefore the reactive energy is tested at $\sin \varphi = 1$.

^d Percentage error limit is applicable only when the reactive energy measurement is performed.

4.3.2.3.5 Starting conditions [IEC 62888-2:20xx, 4.2.3.5]

IEC 62888-2:20xx, 4.2.3.5 is applicable to Level 2 and Level 3 with the following amendment.

Starting conditions are defined by agreement between the involved parties.

4.3.2.4 Electric traction system change [IEC 62888-2:20xx, 4.2.4]

IEC 62888-2:20xx, 4.2.4 is applicable to Level 2 and Level 3.

4.3.2.5 Re-verification [IEC 62888-2:20xx, 4.2.5]

IEC 62888-2:20xx, 4.2.5 is applicable to Level 2 and Level 3 with the following amendments.

In case of a short term measurement, e.g. when the measurement finishes within the guarantee period of accuracy, re-verification is not necessary.

In case of a term of measurement beyond the guarantee period of accuracy, an accuracy check should be carried out at the proper time in order to verify with the initial conditions.

For the application of Annex D in IEC 62888-2:20xx, see 6.3.4.

4.3.3 Sensors [IEC 62888-2:20xx, 4.3]**4.3.3.1 General [IEC 62888-2:20xx, 4.3.1]**

IEC 62888-2:20xx, 4.3.1 is applicable to Level 2 and Level 3 with the following amendments.

Sensors built in equipment, e.g. traction converters, auxiliary converters, may be used as measuring sensors. The primary voltage and primary current may be measured on the secondary voltage or secondary current of the existing transformer (e.g. traction transformer, auxiliary transformer), as far as the measurements are converted to the primary voltage and primary current. Conversion may be carried out in the individual equipment which, in this case, performs as part of Energy Calculation Function (ECF).

The primary current may be calculated by summing the measurements of the distributed current sensors.

The energy at the consumption point may be calculated by the primary voltage and the summed primary current or by the individual energy calculated by the primary voltage and the individual converted primary current.

4.3.3.2 General requirements [IEC 62888-2:20xx, 4.3.2]**4.3.3.2.1 General [IEC 62888-2:20xx, 4.3.2.1]**

IEC 62888-2:20xx, 4.3.2.1 is applicable to Level 2 and Level 3.

4.3.3.2.2 Insulation requirements [IEC 62888-2:20xx, 4.3.2.2]

IEC 62888-2:20xx, 4.3.2.2 is applicable to Level 2 and Level 3 with the following amendment.

Insulation withstand of the primary side shall be according to IEC 62497-1.

4.3.3.2.3 Requirements for outputs [IEC 62888-2:20xx, 4.3.2.3]**4.3.3.2.3.1 General [IEC 62888-2:20xx, 4.3.2.3.1]**

IEC 62888-2:20xx, 4.3.2.3.1 is applicable to Level 2 and Level 3 with the following amendment.

The requirements on dataflow security are listed in 4.2.3.5.

4.3.3.2.3.2 Requirements for dedicated analogue outputs [IEC 62888-2:20xx, 4.3.2.3.2]

IEC 62888-2:20xx, 4.3.2.3.2 is applicable to Level 2 and Level 3.

4.3.3.2.3.3 Requirements for digital dedicated or digital shared outputs [IEC 62888-2:20xx, 4.3.2.3.3]

IEC 62888-2:20xx, 4.3.2.3.3 is applicable to Level 2 and Level 3 with the following amendment.

Requirements for communication protocols stack and communication security are listed in 4.5.2.2, 4.5.2.3 and 4.5.2.4.

4.3.3.2.3.4 Burden requirements [IEC 62888-2:20xx, 4.3.2.3.4]

IEC 62888-2:20xx, 4.3.2.3.4 is applicable to Level 2 and Level 3.

4.3.3.2.3.5 Essential information [IEC 62888-2:20xx, 4.3.2.3.5]

IEC 62888-2:20xx, 4.3.2.3.5 is applicable to Level 2 and Level 3 with the following amendment.

In case that sensors built in the equipment on board of train are used for EMF, their specifications shall be given in an accompanying document.

4.3.3.3 Voltage sensors [IEC 62888-2:20xx, 4.3.3]**4.3.3.3.1 Electrical requirements [IEC 62888-2:20xx, 4.3.3.1]****4.3.3.3.1.1 Rated primary voltage ($U_{n,VMF}$) [IEC 62888-2:20xx, 4.3.3.1.1]**

IEC 62888-2:20xx, 4.3.3.1.1 is applicable to Level 2 and Level 3.

4.3.3.3.1.2 Rated secondary values for analogue sensors [IEC 62888-2:20xx, 4.3.3.1.2]

IEC 62888-2:20xx, 4.3.3.1.2 is applicable to Level 2 and Level 3.

4.3.3.3.1.3 Rated secondary output signal for analogue sensors [IEC 62888-2:20xx, 4.3.3.1.3]

IEC 62888-2:20xx, 4.3.3.1.3 is applicable to Level 2 and Level 3 with the following amendment.

Considering that Level 2 and Level 3 may use built-in devices, the preferred values shall be intended as informative.

4.3.3.3.1.4 Rated output burden for analogue sensors [IEC 62888-2:20xx, 4.3.3.1.4]

IEC 62888-2:20xx, 4.3.3.1.4 is applicable to Level 2 and Level 3 with the following amendment.

Considering that Level 2 and Level 3 may use built-in devices, the preferred values shall be intended as informative.

4.3.3.3.1.5 Influence of input overvoltage [IEC 62888-2:20xx, 4.3.3.1.5]

IEC 62888-2:20xx, 4.3.3.1.5 is applicable to Level 2 and Level 3.

4.3.3.3.1.6 Response time ($t_{s,r}$) [IEC 62888-2:20xx, 4.3.3.1.6]

IEC 62888-2:20xx, 4.3.3.1.6 is applicable to Level 2 and Level 3.

4.3.3.3.1.7 Bandwidth requirements for electronic sensors [IEC 62888-2:20xx, 4.3.3.1.7]

IEC 62888-2:20xx, 4.3.3.1.7 is applicable to Level 2 and Level 3.

4.3.3.3.1.8 Power frequency withstand voltage for earthed terminals [IEC 62888-2:20xx, 4.3.3.1.8]

IEC 62888-2:20xx, 4.3.3.1.8 is applicable to Level 2 and Level 3.