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Date: 09 August 2024

Origin: International

Latest date for receipt of comments: 02 October 2024

Project No. 2019/00921

Responsible committee: GEL/9 Railway Electrotechnical Applications

Interested committees:

Title: Draft BS EN IEC 62590-3-1BS IEC IEC 62590-3-1:2022 ED1 BS EN IEC 62590-3-1 Railway applications. Fixed installations - Electronic power converters. Part 3-1: AC traction applications. Electronic power compensators.

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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.

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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.	

PROJECT NUMBER: IEC 62590-3-1 ED1	
DATE OF CIRCULATION: 2020-01-31	CLOSING DATE FOR COMMENTS: 2020-04-24
SUPERSEDES DOCUMENTS: 9/2465/NP, 9/2498/RVN	

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	

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TITLE:
Railway applications – Fixed installations – Electronic power converters – Part 3-1: AC traction applications – Electronic power compensators

NOTE FROM TC/SC OFFICERS:
 It is proposed to change the title of the whole serie removing "for substations".
 The new proposed title becomes "Railway applications - Fixed installations - Electronic power converters - Part 3-1: AC traction applications - Electronic power compensators" instead of "Railway applications - Fixed installations - Electronic power converters for substations - Part 3-1: AC traction applications - Electronic power compensators".

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**RAILWAY APPLICATIONS –
FIXED INSTALLATIONS – ELECTRONIC POWER CONVERTERS –
PART 3-1: AC TRACTION APPLICATIONS –
ELECTRONIC POWER COMPENSATORS**

FOREWORD

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International Standard IEC 62590-3-1 has been prepared by IEC technical committee 9: Electrical equipment and systems for railways.

The text of this International Standard is based on the following documents:

FDIS	Report on voting
XX/XX/FDIS	XX/XX/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.

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.

The National Committees are requested to note that for this document the stability date is **20XX..**

THIS TEXT IS INCLUDED FOR THE INFORMATION OF THE NATIONAL COMMITTEES AND WILL BE DELETED AT THE PUBLICATION STAGE.

1 INTRODUCTION

2 Single-phase AC traction systems often require a heavy power load with frequent fluctuation
3 which may lead to a wide range of variation in traction voltage. Keeping the voltage within the
4 optimal range for railway operation is sometimes not easily achieved. Due to their inherent
5 structure, single-phase AC traction systems are prone to voltage fluctuation or power imbalance
6 within the three-phase power network.

7 As the solution for this issue, electronic power compensators can be installed to improve electric
8 power quality by applying power electronics technology. For stable operation, the installed
9 electronic power compensator must be able to withstand phenomena particular to single-phase
10 AC traction systems such as a steep load fluctuations or magnetising inrush current, as well as
11 disturbance from the upstream network. Therefore, specific requirements are needed in
12 addition to the common requirements for substation converters.

13 However, the International Standard for electronic power compensators for AC traction systems
14 has not been issued. Standardisation of typical system configurations and basic requirements
15 and test methods for the equipment will provide principles to railway operators, manufacturers
16 and system integrators who intend to install electronic power compensators.

**RAILWAY APPLICATIONS –
FIXED INSTALLATIONS – ELECTRONIC POWER CONVERTERS –
PART 3-1: AC TRACTION APPLICATIONS –
ELECTRONIC POWER COMPENSATORS**

1 Scope

This part of IEC 62590 specifies the requirements and test methods for electronic power compensators for single-phase AC traction systems. This equipment is used to improve electric power quality inside the traction circuit and/or at the interface to the 3AC power network, applying power electronics technology.

This document applies to equipment which is installed to achieve one or more of the following objectives as its function(s):

- to mitigate voltage fluctuation;
- to improve power factor;
- to reduce three-phase power imbalance at the interface to the 3AC power network.

NOTE In some cases, this type of equipment is used to reduce harmonics from the traction load towards the 3AC power network.

The equipment designed to conform to each particular installation site and the packaged equipment for generic use both fall within the scope of this document.

This document applies to equipment with all possible configurations to implement different technical solutions for compensation, but the equipment consisting of only passive components is excluded.

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 60076 (all parts), *Power transformers*

IEC 60146-1-1:2009, *Semiconductor converters – General requirements and line commutated converters – Part 1-1: Specification of basic requirements*

IEC 60146-2:1999, *Semiconductor converters – Part 2: Self-commutated semiconductor converters including direct d.c. converters*

IEC 60529, *Degrees of protection provided by enclosures (IP Code)*

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

IEC 61936-1, *Power installations exceeding 1 kV a.c. – Part 1: Common rules*

IEC 62236 (all parts), *Railway applications – Electromagnetic compatibility*

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

57 IEC 62590:2019, *Railway applications – Electronic power converters for substations*

58 **3 Terms, definitions and abbreviations**

59 **3.1 Terms and definitions**

60 For the purposes of this document, the terms and definitions given in IEC 62590-1 and the
61 following apply.

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

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

66 **3.1.1**

67 **power quality**

68 characteristics of the electric current, voltage and frequency at a given point in an electric power
69 system, evaluated against a set of reference technical parameters

70 Note 1 to entry: These parameters might, in some cases, relate to the compatibility between electricity supplied
71 in an electric power system and the loads connected to that electric power system.

72 [SOURCE: IEC 60050-614:2016, 614-01-01]

73 **3.1.2**

74 **power factor**

75 under periodic conditions, ratio of the absolute value of the active power P to the apparent
76 power S :

77
$$\lambda = \frac{|P|}{S}$$

78 Note 1 to entry: Under sinusoidal conditions, the power factor is the absolute value of the active factor.

79 [SOURCE: IEC 60050-131:2002, 131-11-46]

80 **3.1.3**

81 **electric power compensation**

82 action to improve power quality at a certain point of the circuit

83 **3.1.4**

84 **electric traction system**

85 railway electric distribution network used to provide energy for rolling stock

86 Note 1 to entry: The system includes

- 87 – contact line systems,
- 88 – return circuit of electric traction systems,
- 89 – electric installations, which are supplied from contact lines either directly or via a transformer,
- 90 – electric installations in power plants and substations, which are utilized solely for generation and distribution of
- 91 power directly to the contact line,
- 92 – electric installations of switching stations.

93 [SOURCE: IEC 60050-811:2017, 811-36-21, modified – third dash in the list of the Note 1 to
94 entry was removed.]

95 **3.1.5**

96 **1AC traction system**

97 single phase system with the main purpose to supply motor vehicles

98 [SOURCE: IEC 62590-1 ED1 NPWD, 3.1.23]

99 **3.1.6**

100 **near end <of electric traction system>**

101 area in electric traction system close to the traction substation

102 Note 1 to entry: This term is typically used for the single-side-fed electric traction systems.

103 **3.1.7**

104 **far end <of electric traction system>**

105 area in electric traction system most distant from the traction substation, typically near a
106 sectioning post

107 Note 1 to entry: This term is typically used for the single-side-fed electric traction systems.

108 **3.1.8**

109 **3AC power network**

110 three-phase electric circuit or set of electric circuits, interconnected or having intentional
111 capacitive or inductive coupling between them

112 Note 1 entry: In this document, this term is used to indicate an upstream power supply network from which an
113 electric traction system receives electric power.

114 **3.1.9**

115 **voltage drop <of electric traction system>**

116 voltage drop at the location of vehicle due to impedance of electric traction system as well as
117 impedance of the 3AC power network, measured when traction current flows from or into rail
118 vehicles

119 **3.1.10**

120 **voltage fluctuation**

121 a series of supply voltage changes or a continuous variation of the RMS or peak value of the
122 voltage

123 Note 1 to entry: Whether the RMS or peak value is chosen depends upon the application, and which is used should
124 be specified.

125 [SOURCE: IEC 60050-161:1990, 161-08-05]

126 **3.1.11**

127 **voltage imbalance**

128 in a polyphase system, a condition in which the r.m.s. values of the phase voltages or the phase
129 angles between consecutive phases are not all equal

130 [SOURCE: IEC 60050-161:1990, 161-08-09]

131 **3.1.12**

132 **negative sequence component <of a three-phase system>**

133 one of the three symmetrical sequence components which exists only in an unsymmetrical
134 three-phase system of sinusoidal quantities and which is defined by the following complex
135 mathematical expression:

136
$$X_2 = \frac{1}{3}(X_{L1} + a^2 X_{L2} + a X_{L3})$$

137 where a is the 120 degree operator, and X_{L1} , X_{L2} and X_{L3} are the complex expressions of the
138 phase quantities concerned, and where X denotes the system current or voltage phasors

139 [SOURCE: IEC 60050-448:1995, 448-11-28]

140 **3.1.13**

141 **electronic power converter**

142 operative unit for electronic power conversion, comprising one or more electronic valve devices,
143 transformers and filters if necessary and auxiliaries if any

144 [SOURCE: IEC 60050-551:1998, 551-12-01, modified – Note and Figure 1 were removed]

145 **3.1.14**

146 **self-commutation**

147 a commutation where the commutating voltage is supplied by components within the converter
148 or the electronic switch

149 [SOURCE: IEC 60050-551:1998, 551-16-15]

150 **3.1.15**

151 **line-commutation**

152 an external commutation where the commutating voltage is supplied by the line

153 [SOURCE: IEC 60050-551:1998, 551-16-12]

154 **3.1.16**

155 **electronic power compensator**

156 **static power compensator**

157 equipment to improve power quality of the circuit to which it is connected, controlling current
158 and/or voltage by use of electronic converters

159 **3.1.17**

160 **static var compensator**

161 electronic power compensator consisting of combination of thyristor, capacitor and reactor, or
162 consisting of self-commutation converters which is used to compensate the optimum reactive
163 power from zero to heavy load dynamically by high speed control

164 Note 1 to entry: A STATCOM is also included in this kind of compensators.

165 **3.1.18**

166 **balancer <of traction substation>**

167 electronic power compensator to reduce imbalance and/or voltage fluctuation in the power
168 network side of the traction substation

169 **3.1.19**

170 **railway static power conditioner**

171 **RPC**

172 set of converters which exchanges active power between different sections in the electric
173 traction system as well as injects reactive power

174 Note 1 to entry: Currently, the only configuration that has been used in the already commissioned RPC is that which
175 consists of a pair of self-commutated single-phase inverters connected back-to-back to each other through a common
176 DC link.

177 Note 2 to entry: It is also used to connect two traction circuits supplied by two traction substations, as well as two
178 traction circuits supplied by two single-phase voltage sources of different phases from the same traction substation.