



TECHNICAL SPECIFICATION



**Explosive atmospheres –
Part 39: Intrinsically safe systems with electronically controlled spark duration
limitation**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 29.260.20

ISBN 978-2-8322-2734-3

Warning! Make sure that you obtained this publication from an authorized distributor.

CONTENTS

FOREWORD.....	5
INTRODUCTION.....	7
1 Scope.....	8
2 Normative references.....	8
3 Definitions	9
4 Power-i architecture.....	10
5 Requirements for Power-i devices	11
5.1 General.....	11
5.2 Power-i source	11
5.3 Power-i field device	13
5.4 Power-i wiring	14
5.5 Power-i terminator.....	15
5.6 Test instruments for Power-i loop check	15
5.7 Power-i application classes	15
6 System requirements	16
6.1 Selection of the permissible Power- i current class of the Power-i source	16
6.2 Verification of a Power-i system.....	17
7 Assessment and testing	19
7.1 Procedure to define safety-relevant parameters	19
7.2 Type test.....	20
7.3 Routine test	20
8 Marking of Power-i devices	20
8.1 General.....	20
8.2 Examples of marking	20
9 Instructions.....	21
Annex A (normative) Assessment of Power-i safety parameters	22
A.1 General.....	22
A.2 Power-i specific test equipment	22
A.2.1 Power-i universal test equipment.....	22
A.2.2 Power-i dummy load.....	23
A.3 Determination of the safety-relevant parameters for Power-i devices and Power-i wiring	24
A.3.1 General	24
A.3.2 Safety-relevant parameters for the Power-i source.....	24
A.3.3 Safety-relevant parameters for the Power-i field devices	31
A.3.4 Safety-relevant parameters for Power-i wiring.....	34
A.3.5 Safety-relevant parameters for the Power-i terminator.....	36
Annex B (informative) Explanation and details of the Power-i basic concept.....	37
B.1 Physical basics of an ignition.....	37
B.2 Output characteristics of a Power-i source	39
B.3 Measurement and scientific results as basis for Power- i minimum ignition values.....	41
B.3.1 Test setups for the determination of the ignition probability	41
B.3.2 Result of the spark ignition tests and their implementation in Table 3	43

Annex C (informative) Examples of Power-i devices and systems	46
C.1 Power-i application for a solenoid valve	46
C.2 Example of a generally designed Power-i source	47
C.3 Example of a Power-i field device	47
C.4 Example of a Power-i dummy load	48
C.5 Example of a Power-i terminator	48
Annex D (informative) Example of interconnection of Power-i devices including Power-i wiring to a Power-i system	50
D.1 Specific aim and given values	50
D.2 Solution example	50
Figure 1 – The simplest Power-i architecture	10
Figure 2 – Example of complex Power-i concept architecture	11
Figure 3 – Elements of a Power-i source with voltage and current limitation	12
Figure 4 – Example of a universal Power-i field device (basic structure)	14
Figure 5 – Basic assessment procedure for a Power-i system	19
Figure A.1 – Basic principle of the Power-i universal test equipment	23
Figure A.2 – Pulse output between terminals 3 and 1 of Figure A.1	23
Figure A.3 – Basic principle of a Power-i dummy load	24
Figure A.4 – Basic principle of the equipment for the determination of the response time $t_{\text{resp-source}}$	25
Figure A.5 – Example of an oscillogram to determine the response time $t_{\text{resp-source}}$	26
Figure A.6 – Test equipment for the determination of the assessment factor AF_{source} (basic principle)	27
Figure A.7 – Test equipment for the assessment factor test for Power-i source	28
Figure A.8 – Example of an oscillogram from a test of a Power-i source with an assessment factor $AF = 8,29$ for a break spark	29
Figure A.9 – Test equipment for transition pulse test of a Power-i source	30
Figure A.10 – Test equipment for the determination of the assessment factor $AF_{\text{field device}}$ for Power-i field devices (basic principle)	32
Figure A.11 – Test equipment for the transition pulse test of Power-i field devices	33
Figure A.12 – Evaluation parameter of test pulse U_{pulse} for transition pulse test	34
Figure A.13 – Test equipment for the determination of the response time of the Power-i trunk $t_{\text{resp-trunk}}$ (basic principle)	35
Figure B.1 – Example of a typical trace of a break spark supplied with a linearly limited source	38
Figure B.2 – Example of a typical trace of a break spark limited by a Power-i source	38
Figure B.3 – Example of output set of characteristic curves of a Power-i source during load connection	40
Figure B.4 – Basic principle of a Power-i power source for the voltage threshold return mode	41
Figure B.5 – Example of output set of characteristic curves of a Power-i source in the case of a failure	41
Figure B.6 – Test setup with STA for break sparks	42
Figure B.7 – Test setup with STA for make sparks	42
Figure B.8 – Power-i ignition values for voltage class 24V (24 VDC)	43
Figure B.9 – Power-i ignition values for voltage class 32V (32 VDC)	44

Figure B.10 – Power-i ignition values for voltage class 40V (40 VDC)	44
Figure B.11 – Ignition energy in relation to the used hydrogen percentage in the gas mixtures	45
Figure C.1 – Simple solenoid valve Power-i application (example)	46
Figure C.2 – Example of a generally styled Power-i field device	47
Figure C.3 – Example of a V-limitation unit (level of protection “ib”)	48
Figure C.4 – Example of a Power-i dummy load.....	48
Figure C.5 – Example of a Power-i terminator.....	49
Table 1 – Definition of Power-i voltage classes.....	16
Table 2 – Definition of Power-i current classes	16
Table 3 – Permitted combinations of Power-i application classes for Power-i sources as a function of the system response time for all Groups (n.a. = not allowed)	17
Table 4 – Power-i current classes of Power-i field devices or Power-i terminators matching the current class of the Power-i source	18
Table 5 – Relevance for Power-i test procedures	20

INTERNATIONAL ELECTROTECHNICAL COMMISSION

EXPLOSIVE ATMOSPHERES –

Part 39: Intrinsically safe systems with electronically controlled spark duration limitation

FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

The main task of IEC technical committees is to prepare International Standards. In exceptional circumstances, a technical committee may propose the publication of a technical specification when

- the required support cannot be obtained for the publication of an International Standard, despite repeated efforts, or
- the subject is still under technical development or where, for any other reason, there is the future but no immediate possibility of an agreement on an International Standard.

Technical specifications are subject to review within three years of publication to decide whether they can be transformed into International Standards.

IEC TS 60079-39, which is a technical specification, has been prepared by subcommittee 31G: Intrinsically safe apparatus, of IEC technical committee 31: Equipment for explosive atmospheres.

The text of this technical specification is based on the following documents:

Enquiry draft	Report on voting
31G/236A/DTS	31G/242/RVC

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

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

A list of all parts in the IEC 60079 series, published under the general title *Explosive atmospheres*, can be found on the IEC website.

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

- transformed into an International standard,
- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

A bilingual version of this publication may be issued at a later date.

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

This part of IEC 60079, which is a Technical Specification, is being issued as a “prospective standard for provisional application” in the field of *Explosive Atmospheres – Intrinsically safe systems with electronically controlled spark duration limitation* because there is an urgent need for guidance on how standards in this field should be used to meet an identified need.

Intrinsically safe systems with electronically controlled spark duration can provide more power available in intrinsically safe circuits while maintaining the level of protection “ib” or “ic”. In addition to limiting the voltage and current (similar to conventional intrinsically safe circuits), the duration of the spark is limited, which also restricts the amount of energy available for ignition.

The general requirements for the installation of IS equipment are applicable to Power-i circuits.

This new technology allows an expansion in the field of industrial applications using the type of protection Intrinsic Safety ‘i’.

This technology, however, requires a new and more extensive approach of the type of protection Intrinsic Safety “i”.

EXPLOSIVE ATMOSPHERES –

Part 39: Intrinsically safe systems with electronically controlled spark duration limitation

1 Scope

This Technical Specification specifies the construction, testing, installation and maintenance of Power-i apparatus and systems which utilise electronically controlled spark duration limitation to maintain an adequate level of intrinsic safety.

This Technical Specification contains requirements for intrinsically safe apparatus and wiring intended for use in explosive atmospheres and for associated apparatus intended for connection to intrinsically safe circuits entering such atmospheres.

This Technical Specification excludes the level of protection “ia” and the use of software-controlled circuits.

This Technical Specification applies to electrical equipment utilising voltages not higher than 40 V d.c. and a safety factor 1,5 for Groups IIB, IIA, I and III. It is also applicable to Group IIC “ic” apparatus with a safety factor 1,0. Group IIC “ib” apparatus with a safety factor 1,5 are restricted to voltages up to 32 V d.c.

This type of protection is applicable to electrical equipment in which the electrical circuits themselves are incapable of causing an explosion of the surrounding explosive atmospheres.

This Technical Specification is applicable to intrinsically safe apparatus and systems which utilise electronically controlled spark duration limitation with the aim of providing more electrical power while maintaining an adequate level of safety.

This Technical Specification is also applicable to electrical equipment or parts of electrical equipment located outside hazardous areas or protected by another type of protection listed in the IEC 60079 series, where the intrinsic safety of the electrical circuits in explosive atmospheres depends on the design and construction of such electrical equipment or parts of such electrical equipment. The electrical circuits located in the hazardous area are evaluated for use in such locations by applying this Technical Specification.

This Technical Specification supplements and modifies the requirements of IEC 60079-0, IEC 60079-11, IEC 60079-14, IEC 60079-17 and IEC 60079-25.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60079-0, *Explosive atmospheres – Part 0: Equipment – General requirements*

IEC 60079-11, *Explosive atmospheres – Part 11: Equipment protection by intrinsic safety “i”*

IEC 60079-14, *Explosive atmospheres – Part 14: Electrical installations design, selection and erection*

[This is a preview - click here to buy the full publication](#)

IEC TS 60079-39:2015 © IEC 2015

– 9 –

IEC 60079-25, *Explosive atmospheres – Part 25: Intrinsically safe electrical systems*