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## Gas turbine applications — Safety

*Applications des turbines à gaz — Sécurité*



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ISO copyright office  
CP 401 • Ch. de Blandonnet 8  
CH-1214 Vernier, Geneva  
Phone: +41 22 749 01 11  
Email: [copyright@iso.org](mailto:copyright@iso.org)  
Website: [www.iso.org](http://www.iso.org)

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# Contents

	Page
Foreword.....	vii
Introduction.....	viii
<b>1 Scope.....</b>	<b>1</b>
<b>2 Normative references.....</b>	<b>2</b>
<b>3 Terms and definitions.....</b>	<b>4</b>
<b>4 List of significant hazards.....</b>	<b>6</b>
<b>5 Safety requirements.....</b>	<b>6</b>
5.1 General.....	6
5.2 Risk assessment.....	6
5.2.1 Risk assessments requirements.....	7
5.2.2 As low as reasonably practical.....	8
5.3 Modifications and replacement parts.....	8
5.4 Foreseeable misuse.....	8
5.5 Lifetime.....	8
5.6 Hazard combinations.....	8
5.7 Noise reduction at design stage.....	8
5.8 Mechanical.....	9
5.8.1 Guarding.....	9
5.8.2 Accessibility for maintenance.....	9
5.8.3 Casing design.....	10
5.8.4 Gas turbine compressor surge.....	10
5.8.5 Stability and handling.....	10
5.8.6 Overload of couplings, rotating shafts and gears due to torque.....	11
5.8.7 Vibration.....	11
5.8.8 Mechanical failure caused by corrosion.....	11
5.8.9 Design methods and materials.....	11
5.8.10 Gas turbine temperatures.....	12
5.8.11 Environmental loads.....	12
5.8.12 Assembly features.....	12
5.8.13 Couplings.....	12
5.8.14 Rotor bearings.....	12
5.8.15 Rotating part failure.....	12
5.8.16 Foreign object damage (FOD) screen.....	13
5.8.17 Gearbox.....	13
5.8.18 Starting systems.....	13
5.8.19 Low ambient temperature conditions.....	14
5.9 Gas turbine compressor air inlet system.....	14
5.9.1 General.....	14
5.9.2 Inlet air contamination.....	14
5.9.3 Icing monitoring and prevention.....	14
5.9.4 Implosion protection.....	15
5.9.5 Inlet explosion protection.....	15
5.9.6 Waste disposal through combustion.....	16
5.9.7 Recirculation.....	16
5.9.8 Gas turbine compressor air inlet ducting.....	16
5.10 Fuel systems.....	17
5.10.1 General.....	17
5.10.2 Fuel supply quality and supply conditions.....	17
5.10.3 Pressure (leakage) testing.....	17
5.10.4 Fuel supply heating.....	17
5.10.5 Gas fuel systems.....	17
5.10.6 Liquid fuel systems.....	21

5.10.7	Multi-fuel systems	25
5.10.8	Fuel purging	25
5.10.9	Fuel drainage	26
5.11	Combustion supervision	26
5.11.1	General	26
5.11.2	Requirements for ignition	26
5.11.3	Extinction safety time	27
5.12	Exhaust system	27
5.12.1	Damper controls	27
5.12.2	Flexible joint location	27
5.12.3	Exhaust outlet	27
5.12.4	Explosion protection	27
5.13	Enclosures	28
5.13.1	General	28
5.13.2	Enclosure structure	29
5.13.3	Enclosure fire precautions	29
5.13.4	Explosion prevention and protection — Area classification — Ventilation	29
5.13.5	Gas detection	29
5.13.6	Enclosure purging	30
5.13.7	Flammable mist	30
5.13.8	Access and doors	30
5.13.9	Entrapment	31
5.14	Lighting	31
5.15	Fire precautions	31
5.15.1	General	31
5.15.2	Structural fire risk reduction	31
5.15.3	Flammable fluids mitigation and containment	31
5.15.4	Fire protection	32
5.15.5	Fire detection	32
5.15.6	Fire extinguishing systems	33
5.15.7	Water mist extinguishant	34
5.15.8	Extinguishing system controls	34
5.15.9	Escape	36
5.15.10	Uncontrolled release of media and loss of propellant pressure	36
5.15.11	Vessel thermal relief (burst disc)	36
5.15.12	Propellant vessels	36
5.15.13	Release of extinguishant into gas turbine halls, control rooms, etc.	36
5.16	Hazardous area classification and explosion prevention and protection	37
5.16.1	General	37
5.16.2	Area classification	37
5.16.3	Explosion prevention	37
5.16.4	Avoidance or reduction of effective ignition sources	38
5.16.5	Reduction of explosion effects in an enclosed space	39
5.17	Ventilation	41
5.17.1	General	41
5.17.2	Cooling	41
5.17.3	Heating	41
5.17.4	Hazardous area control	41
5.17.5	Hot surfaces	41
5.17.6	Ventilation inlet location	42
5.17.7	Ventilation inlet filtration	42
5.17.8	Ventilation inlet ducting	42
5.17.9	Ventilation outlet location	42
5.17.10	Ventilation monitoring	42
5.18	Fans	43
5.18.1	Fan guards and structural failure	43
5.18.2	Air blast oil coolers	43
5.18.3	Sparking of fan blades	43

5.19	Flammable gas detection .....	43
5.19.1	Type / selection principles .....	43
5.19.2	Location principles .....	43
5.19.3	Settings .....	44
5.19.4	Enclosures containing hot surfaces — Screening tool .....	44
5.19.5	Maintenance and calibration .....	44
5.20	Control and automatic protection systems .....	44
5.20.1	General .....	44
5.20.2	Environmental suitability .....	45
5.20.3	Ergonomics .....	45
5.20.4	Failure .....	45
5.20.5	Calibration .....	45
5.20.6	Testing .....	45
5.20.7	Speed control .....	46
5.20.8	Gas turbine emergency shutdown system .....	46
5.20.9	Interlocks .....	47
5.20.10	Cyber security .....	47
5.21	Electrical .....	47
5.21.1	Design/Installation .....	47
5.21.2	Isolation and stored energy .....	47
5.21.3	Electrostatic energy and bonding .....	48
5.21.4	Water ingress .....	48
5.21.5	Lightning .....	49
5.21.6	Electromagnetic compatibility (EMC) .....	49
5.21.7	Battery installations .....	49
5.21.8	Electrical overload .....	49
5.21.9	Electrical power failure .....	49
5.22	Drains, vents and bleeds .....	50
5.22.1	General .....	50
5.22.2	Vents for flammable gases .....	50
5.22.3	Toxic and hazardous emissions .....	50
5.22.4	Gas turbine compressor bleeds .....	51
5.23	Pressure equipment .....	51
5.23.1	General .....	51
5.23.2	Design .....	51
5.23.3	Hazards .....	51
5.23.4	Misuse .....	51
5.23.5	Handling and operation .....	51
5.23.6	Isolation, draining and venting .....	52
5.23.7	Fluid injection .....	52
5.23.8	Assemblies .....	52
5.23.9	Safety accessories .....	54
5.23.10	Flexible piping (and metal hoses) .....	54
5.23.11	External fire .....	55
5.23.12	Material embrittlement and corrosion .....	55
5.23.13	Ultra-violet (UV) resistant pipework .....	55
5.24	Auxiliary systems .....	55
5.24.1	Lubrication systems .....	55
5.24.2	Water systems .....	56
5.24.3	Hydraulic and pneumatic systems .....	56
5.24.4	Utility air supplies .....	56
5.25	Installation in a hazardous area .....	56
5.26	Unenclosed gas turbines in a hall .....	57
5.27	Decommissioning and disposal .....	58
<b>6</b>	<b>Compliance verification .....</b>	<b>58</b>
6.1	Quality assurance .....	58
6.2	Verification of safety requirements .....	58

<b>7</b>	<b>Information for use</b>	<b>58</b>
7.1	General	58
7.2	Language	59
7.3	Packaging	59
7.4	Commissioning	59
7.5	Operation	60
7.5.1	General	60
7.5.2	Safety instructions and emergency procedures	60
7.6	Enclosure access	61
7.6.1	General	61
7.6.2	Risk assessment for accessing enclosures	62
7.6.3	Limitations under operational conditions	62
7.6.4	Limitations under non-operational conditions	62
7.6.5	Access during commissioning and re-commissioning	62
7.6.6	Installations in a hazardous area	63
7.6.7	Stray electric currents	63
7.7	Maintenance	63
7.7.1	General	63
7.7.2	General maintenance hazards	63
7.7.3	Accessibility, isolation and energy dissipation	64
7.7.4	Pressure equipment	64
7.7.5	Fire protection systems	65
7.7.6	Gas detectors	65
7.7.7	Control systems: maintenance, calibration and testing	65
7.7.8	Hazardous materials and substances	66
7.8	Warning signs and notices	66
7.9	Noise	67
7.10	Permit to work (PTW)	67
7.11	Training	67
7.12	Decommissioning and disposal	68
	<b>Annex A (informative) List of significant hazards</b>	<b>69</b>
	<b>Annex B (normative) Verification of safety requirements and/or measures</b>	<b>81</b>
	<b>Bibliography</b>	<b>86</b>

## 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](http://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](http://www.iso.org/patents)).

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

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

This document was prepared by Technical Committee ISO/TC 192, *Gas turbines*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 399, *Gas Turbines applications*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This second edition cancels and replaces the first edition (ISO 21789:2009), which has been technically revised.

The main changes are as follows:

- modified to include required annexes for ISO version;
- general update to simplify text;
- updated all cross references.

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

## Introduction

This document is a type-C standard as stated in ISO 12100:2010.

This document is of relevance, in particular, for the following stakeholder groups representing the market players with regard to machinery safety:

- machine manufacturers (small, medium and large enterprises);
- health and safety bodies (regulators, accident prevention organisations, market surveillance etc.)

Others can be affected by the level of machinery safety achieved with the means of the document by the above-mentioned stakeholder groups:

- machine users/employers (small, medium and large enterprises);
- machine users/employees (e.g. trade unions, organizations for people with special needs);
- service providers, e.g. for maintenance (small, medium and large enterprises);
- consumers (in case of machinery intended for use by consumers).

The above-mentioned stakeholder groups have been given the possibility to participate at the drafting process of this document.

The machinery concerned and the extent to which hazards, hazardous situations or hazardous events are covered are indicated in the Scope of this document.

When requirements of this type-C standard are different from those which are stated in type-A or type-B standards, the requirements of this type-C standard take precedence over the requirements of the other standards for machines that have been designed and built according to the requirements of this type-C standard.

Where local or national legislation accepts other established codes or standards, or an alternative international or national standard providing equivalent requirements for achieving risk reduction the use of these alternative codes or standards is permissible.

The extent of the applicability of the references may be limited by the context of the text within this document. Where a dated standard is specified this does not preclude the use of later versions provided that the requirements continue to meet the safety issues and identified hazards detailed in this document. Where a reference is made to a specific clause in a standard only the text of that clause and references therein apply.<sup>1)</sup>

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1) References within NOTES are provisions but not normative provisions of this document and are listed in the Bibliography.



# Gas turbine applications — Safety

## 1 Scope

This document covers the safety requirements for aero derivative and industrial gas turbine prime mover applications using liquid or gaseous fuels and the safety related control and detection systems and essential auxiliaries for all types of open cycles (simple, combined, regenerative, reheat, etc.) used in onshore and offshore applications including floating production platforms.

This document applies to mechanical, electrical, and pressure equipment components and systems necessary for the functionality of the prime mover. For example, but not limited to, a core gas turbine auxiliary gearbox, an output transmission gear box, combustion system, air filtration, gas turbine controls, oil systems, and fuel system. This document also covers integration of safety risks within the overall installation, e.g. exhaust purging or drainage.

This document details the anticipated significant hazards associated with aero derivative and industrial gas turbine prime movers and specifies the appropriate preventative measures and processes for reduction or elimination of these hazards. This document addresses the risks of injury or death to humans and risks to the environment. Equipment damage without risk to humans or the environment is not covered.

The overall objective of this document is to ensure that equipment is designed, constructed, operated and maintained throughout its life in accordance with ISO 12100:2010.

This document approaches gas turbine safety from an international perspective based on the content of existing, recognized ISO and IEC standards to the greatest extent possible. Where no ISO or IEC standard exists, other codes or standards (such as EN, NFPA, etc.) have been included.

Minimum functional safety levels cannot be addressed in this document, as minimum functional safety levels are both application and site specific.

This document excludes the following items;

- exhaust-system structural design;
- driven equipment;
- micro turbines as covered by ISO 19372:2015;
- gas turbines used primarily for direct and indirect propulsion;
- gas turbines used for mobile applications;
- special heat source applications;
- gas turbines in research and development programs;
- compressed-air energy storage plants.

Where appropriate, this document can be used to give general guidance in such applications.

This document is not applicable to machinery or safety components manufactured before the date of its publication.

## 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 1182:2020, *Reaction to fire tests for products — Non-combustibility test*

ISO 3977-1:1997, *Gas turbines — Procurement — Part 1: General introduction and definitions*

ISO 3977-3:2004, *Gas turbines — Procurement — Part 3: Design requirements*

ISO 3977-9:1999, *Gas turbines — Procurement — Part 9: Reliability, availability, maintainability and safety*

ISO 4413:2010, *Hydraulic fluid power — General rules and safety requirements for systems and their components*

ISO 4414:2010, *Pneumatic fluid power — General rules and safety requirements for systems and their components*

ISO 6184-4:1985, *Explosion protection systems — Part 4: Determination of efficacy of explosion suppression systems*

ISO 7010:2019, *Graphical symbols — Safety colours and safety signs — Registered safety signs*

ISO 9355-1:1999, *Ergonomic requirements for the design of displays and control actuators -Part 1: Human interactions with displays and control actuators*

ISO 10441:2007, *Petroleum, petrochemical and natural gas industries — Flexible couplings for mechanical power transmission — Special-purpose applications*

ISO 10494:2018, *Turbines and turbine sets — Measurement of emitted airborne noise — Engineering/survey method*

ISO 11086:1996, *Gas turbines — Vocabulary*

ISO 11925-2:2020, *Reaction to fire tests — Ignitability of products subjected to direct impingement of flame — Part 2: Single-flame source test*

ISO 12100:2010, *Safety of machinery — General principles for design — Risk assessment and risk reduction*

ISO 12499:1999, *Industrial fans — Mechanical safety of fans — Guarding*

ISO 13732-1:2006, *Ergonomics of the thermal environment — Methods for the assessment of human responses to contact with surfaces — Part 1: Hot surfaces*

ISO 13732-3:2005, *Ergonomics of the thermal environment — Methods for the assessment of human responses to contact with surfaces — Part 3: Cold surfaces*

ISO 14118, *Safety of machinery — Prevention of unexpected start-up*

ISO 14120:2015, *Safety of machinery — Guards — General requirements for the design and construction of fixed and movable guards*

ISO 14122-1:2016, *Safety of machinery — Permanent means of access to machinery — Part 1: Choice of fixed means and general requirements of access*

ISO 14123-1:2015, *Safety of machinery — Reduction of risks to health resulting from hazardous substances emitted by machinery — Part 1: Principles and specifications for machinery manufacturers*

ISO 14691:2008, *Petroleum, petrochemical and natural gas industries — Flexible couplings for mechanical power transmission — General-purpose applications*

ISO 19353:2019, *Safety of machinery — Fire prevention and fire protection*

- ISO/IEC 80079-20-1:2017, *Explosive atmospheres – Part 20-1: Material characteristics for gas and vapour classification – Test methods and data*
- ISO 80079-36:2016, *Explosive atmospheres — Part 36: Non-electrical equipment for explosive atmospheres — Basic method and requirements*
- ISO 80079-37:2016, *Explosive atmospheres — Part 37: Non-electrical equipment for explosive atmospheres — Non-electrical type of protection constructional safety "c", control of ignition sources "b", liquid immersion "k"*
- IEC 60079-0:2017, *Explosive atmospheres — Part 0: Equipment — General requirements*
- IEC 60079-10-1:2015, *Explosive atmospheres – Part 10-1: Classification of areas – Explosive gas atmospheres*
- IEC 60079-13:2017, *Explosive atmospheres – Part 13: Equipment protection by pressurized room "p" and artificially ventilated room "v"*
- IEC 60079-14:2013, *Explosive atmospheres — Part 14: Electrical installations design, selection and erection*
- IEC 60079-17:2013, *Explosive atmospheres — Part 17: Electrical installations inspection and maintenance*
- IEC 60079-29-1:2016+A1:2020, *Explosive atmospheres — Part 29-1: Gas detectors — Performance requirements of detectors for flammable gases*
- IEC 60079-29-2:2015, *Explosive atmospheres — Part 29-2: Gas detectors — Selection, installation, use and maintenance of detectors for flammable gases and oxygen*
- IEC 60079-32-2:2015, *Explosive atmospheres – Part 32-1: Electrostatics hazards - Tests*
- IEC 60204-1:2016, *Safety of machinery — Electrical equipment of machines — Part 1: General requirements*
- IEC 60204-11:2018, *Safety of machinery — Electrical equipment of machines — Part 11: Requirements for equipment for voltages above 1 000 V AC. or 1 500 V DC. and not exceeding 36 kV*
- IEC 60529, *Degrees of protection provided by enclosures (IP Code)*
- IEC 60695-1-10:2016, *Fire hazard testing – Part 1-10: Guidance for assessing the fire hazard of electrotechnical products – General guidelines*
- IEC 60695-1-11:2014, *Fire hazard testing – Part 1-11: Guidance for assessing the fire hazard of electrotechnical products – Fire hazard assessment*
- IEC TR 61000-5-1:1996, *Electromagnetic compatibility (EMC) — Part 5: Installation and mitigation guidelines — Section 1: General considerations — Basic EMC publication*
- IEC TR 61000-5-2:1997, *Electromagnetic compatibility (EMC) — Part 5: Installation and mitigation guidelines — Section 2: Earthing and cabling*
- IEC 61000-6-2:2016, *Electromagnetic compatibility (EMC) — Part 6-2: Generic standards - Immunity standard for industrial environments*
- IEC 61000-6-4:2018, *Electromagnetic compatibility (EMC) — Part 6-4: Generic standards - Emission standard for industrial environments*
- IEC 62305:2010 (all parts), *Protection against lightning*
- IEC 62485-2:2010, *Safety requirements for secondary batteries and battery installations – Part 2: Stationary batteries*