

DIN EN ISO 21789:2023-07 (E)

Gas turbine applications - Safety (ISO 21789:2022)

Contents	Page
European foreword.....	6
Annex ZA (informative) Relationship between this European Standard and the essential requirements of Directive 2006/42/EC aimed to be covered	7
Annex ZB (informative) Relationship between this European Standard and the essential requirements of EU Directive 2014/34/EU	9
Foreword.....	11
Introduction.....	12
1 Scope.....	13
2 Normative references	14
3 Terms and definitions	16
4 List of significant hazards.....	18
5 Safety requirements.....	18
5.1 General.....	18
5.2 Risk assessment.....	18
5.2.1 Risk assessments requirements.....	19
5.2.2 As low as reasonably practical.....	20
5.3 Modifications and replacement parts.....	20
5.4 Foreseeable misuse	20
5.5 Lifetime.....	20
5.6 Hazard combinations.....	20
5.7 Noise reduction at design stage	20
5.8 Mechanical.....	21
5.8.1 Guarding.....	21
5.8.2 Accessibility for maintenance.....	21
5.8.3 Casing design.....	22
5.8.4 Gas turbine compressor surge	22
5.8.5 Stability and handling.....	22
5.8.6 Overload of couplings, rotating shafts and gears due to torque.....	23
5.8.7 Vibration.....	23
5.8.8 Mechanical failure caused by corrosion.....	23
5.8.9 Design methods and materials.....	23
5.8.10 Gas turbine temperatures.....	24
5.8.11 Environmental loads.....	24
5.8.12 Assembly features.....	24
5.8.13 Couplings.....	24
5.8.14 Rotor bearings.....	24
5.8.15 Rotating part failure	24
5.8.16 Foreign object damage (FOD) screen.....	25
5.8.17 Gearbox.....	25
5.8.18 Starting systems.....	25
5.8.19 Low ambient temperature conditions	26
5.9 Gas turbine compressor air inlet system.....	26
5.9.1 General.....	26
5.9.2 Inlet air contamination.....	26
5.9.3 Icing monitoring and prevention.....	26

5.9.4	Implosion protection	27
5.9.5	Inlet explosion protection	27
5.9.6	Waste disposal through combustion	28
5.9.7	Recirculation	28
5.9.8	Gas turbine compressor air inlet ducting	28
5.10	Fuel systems	29
5.10.1	General	29
5.10.2	Fuel supply quality and supply conditions	29
5.10.3	Pressure (leakage) testing	29
5.10.4	Fuel supply heating	29
5.10.5	Gas fuel systems	29
5.10.6	Liquid fuel systems	33
5.10.7	Multi-fuel systems	37
5.10.8	Fuel purging	37
5.10.9	Fuel drainage	38
5.11	Combustion supervision	38
5.11.1	General	38
5.11.2	Requirements for ignition	38
5.11.3	Extinction safety time	39
5.12	Exhaust system	39
5.12.1	Damper controls	39
5.12.2	Flexible joint location	39
5.12.3	Exhaust outlet	39
5.12.4	Explosion protection	39
5.13	Enclosures	40
5.13.1	General	40
5.13.2	Enclosure structure	41
5.13.3	Enclosure fire precautions	41
5.13.4	Explosion prevention and protection — Area classification — Ventilation	41
5.13.5	Gas detection	41
5.13.6	Enclosure purging	42
5.13.7	Flammable mist	42
5.13.8	Access and doors	42
5.13.9	Entrapment	43
5.14	Lighting	43
5.15	Fire precautions	43
5.15.1	General	43
5.15.2	Structural fire risk reduction	43
5.15.3	Flammable fluids mitigation and containment	43
5.15.4	Fire protection	44
5.15.5	Fire detection	44
5.15.6	Fire extinguishing systems	45
5.15.7	Water mist extinguishant	46
5.15.8	Extinguishing system controls	46
5.15.9	Escape	48
5.15.10	Uncontrolled release of media and loss of propellant pressure	48
5.15.11	Vessel thermal relief (burst disc)	48
5.15.12	Propellant vessels	48
5.15.13	Release of extinguishant into gas turbine halls, control rooms, etc.	48
5.16	Hazardous area classification and explosion prevention and protection	49
5.16.1	General	49
5.16.2	Area classification	49
5.16.3	Explosion prevention	49
5.16.4	Avoidance or reduction of effective ignition sources	50
5.16.5	Reduction of explosion effects in an enclosed space	51

5.17	Ventilation	53
	5.17.1 General	53
	5.17.2 Cooling	53
	5.17.3 Heating	53
	5.17.4 Hazardous area control	53
	5.17.5 Hot surfaces	53
	5.17.6 Ventilation inlet location	54
	5.17.7 Ventilation inlet filtration	54
	5.17.8 Ventilation inlet ducting	54
	5.17.9 Ventilation outlet location	54
	5.17.10 Ventilation monitoring	54
5.18	Fans	55
	5.18.1 Fan guards and structural failure	55
	5.18.2 Air blast oil coolers	55
	5.18.3 Sparking of fan blades	55
5.19	Flammable gas detection	55
	5.19.1 Type / selection principles	55
	5.19.2 Location principles	55
	5.19.3 Settings	56
	5.19.4 Enclosures containing hot surfaces — Screening tool	56
	5.19.5 Maintenance and calibration	56
5.20	Control and automatic protection systems	56
	5.20.1 General	56
	5.20.2 Environmental suitability	57
	5.20.3 Ergonomics	57
	5.20.4 Failure	57
	5.20.5 Calibration	57
	5.20.6 Testing	57
	5.20.7 Speed control	58
	5.20.8 Gas turbine emergency shutdown system	58
	5.20.9 Interlocks	59
	5.20.10 Cyber security	59
5.21	Electrical	59
	5.21.1 Design/Installation	59
	5.21.2 Isolation and stored energy	59
	5.21.3 Electrostatic energy and bonding	60
	5.21.4 Water ingress	60
	5.21.5 Lightning	61
	5.21.6 Electromagnetic compatibility (EMC)	61
	5.21.7 Battery installations	61
	5.21.8 Electrical overload	61
	5.21.9 Electrical power failure	61
5.22	Drains, vents and bleeds	62
	5.22.1 General	62
	5.22.2 Vents for flammable gases	62
	5.22.3 Toxic and hazardous emissions	62
	5.22.4 Gas turbine compressor bleeds	63
5.23	Pressure equipment	63
	5.23.1 General	63
	5.23.2 Design	63
	5.23.3 Hazards	63
	5.23.4 Misuse	63
	5.23.5 Handling and operation	63
	5.23.6 Isolation, draining and venting	64
	5.23.7 Fluid injection	64
	5.23.8 Assemblies	64

5.23.9	Safety accessories.....	66
5.23.10	Flexible piping (and metal hoses).....	66
5.23.11	External fire.....	67
5.23.12	Material embrittlement and corrosion.....	67
5.23.13	Ultra-violet (UV) resistant pipework.....	67
5.24	Auxiliary systems.....	67
5.24.1	Lubrication systems.....	67
5.24.2	Water systems.....	68
5.24.3	Hydraulic and pneumatic systems.....	68
5.24.4	Utility air supplies.....	68
5.25	Installation in a hazardous area.....	68
5.26	Unenclosed gas turbines in a hall.....	69
5.27	Decommissioning and disposal.....	70
6	Compliance verification.....	70
6.1	Quality assurance.....	70
6.2	Verification of safety requirements.....	70
7	Information for use.....	70
7.1	General.....	70
7.2	Language.....	71
7.3	Packaging.....	71
7.4	Commissioning.....	71
7.5	Operation.....	72
7.5.1	General.....	72
7.5.2	Safety instructions and emergency procedures.....	72
7.6	Enclosure access.....	73
7.6.1	General.....	73
7.6.2	Risk assessment for accessing enclosures.....	74
7.6.3	Limitations under operational conditions.....	74
7.6.4	Limitations under non-operational conditions.....	74
7.6.5	Access during commissioning and re-commissioning.....	74
7.6.6	Installations in a hazardous area.....	75
7.6.7	Stray electric currents.....	75
7.7	Maintenance.....	75
7.7.1	General.....	75
7.7.2	General maintenance hazards.....	75
7.7.3	Accessibility, isolation and energy dissipation.....	76
7.7.4	Pressure equipment.....	76
7.7.5	Fire protection systems.....	77
7.7.6	Gas detectors.....	77
7.7.7	Control systems: maintenance, calibration and testing.....	77
7.7.8	Hazardous materials and substances.....	78
7.8	Warning signs and notices.....	78
7.9	Noise.....	79
7.10	Permit to work (PTW).....	79
7.11	Training.....	79
7.12	Decommissioning and disposal.....	80
	Annex A (informative) List of significant hazards.....	81
	Annex B (normative) Verification of safety requirements and/or measures.....	93
	Bibliography.....	98