

Contents

Page

Foreword.....	5
Introduction	6
1 Scope	7
2 Normative references	7
3 Terms and definitions	10
4 List of significant hazards – Hazard analysis and risk assessment	16
5 Safety requirements and/or protective measures	22
5.1 General.....	22
5.2 Mechanical safety	23
5.2.1 General.....	23
5.2.2 Guards	23
5.2.3 Fluid injection.....	24
5.2.4 Loss of stability.....	25
5.2.5 Lifting and transportation of compressor units and parts	25
5.2.6 <i>Slip, trip and fall</i>	30
5.2.7 Speed	30
5.2.8 Loss of main energy supply or short term power interruption.....	31
5.2.9 Reverse running of the compressor	31
5.3 Electrical safety.....	32
5.3.1 Generally applicable	32
5.3.2 Protection from overload	32
5.3.3 Protection from live parts	32
5.3.4 Protection from lightning.....	32
5.3.5 <i>Portable and skid-mounted compressor units</i>	32
5.4 Control systems.....	33
5.4.1 General.....	33
5.4.2 Failure of safety related control system energy supply	33
5.4.3 Start/restart.....	33
5.4.4 Manual suspension of safety functions	34
5.4.5 Electrical control systems	35
5.4.6 Pneumatic and/or hydraulic control systems	36
5.5 Thermal safety.....	36
5.6 Noise	37
5.7 Materials and substances processed, used or exhausted	37
5.7.1 General.....	37
5.7.2 Reactive gases	38
5.7.3 Oxygen compressors	38
5.7.4 Acetylene compressors	40
5.7.5 Compressors for H ₂ S containing gases	41
5.7.6 Nitrogen and other inert gases.....	41
5.7.7 Access closures to process gas containing parts.....	41
5.7.8 Compressor shaft seal systems.....	42
5.7.9 Static seals (Gaskets) for piping	42
5.7.10 Micro-organisms, biological and microbiological substances.....	43
5.7.11 <i>Compressor units driven by internal combustion engines</i>	44
5.8 Fire and explosion	44
5.8.1 General.....	44
5.8.2 Electrostatic phenomena	45
5.8.3 <i>Oil-flooded rotary compressor units</i>	45

5.8.4	Oil-lubricated reciprocating process compressor units	46
5.8.5	Compressor units driven by internal combustion engines	46
5.9	Ergonomic principles	46
5.9.1	General	46
5.9.2	Manual handling of compressor units and parts	47
5.9.3	Portable and skid-mounted compressor units	47
5.10	Integrity of machinery parts and other functional requirements	47
5.10.1	Generally applicable	47
5.10.2	Snow, wind and seismic loads	47
5.10.3	Break-up during operation	48
5.10.4	Low temperature operation	48
5.10.5	Liquid shock	49
5.10.6	Coolant system	49
5.10.7	Process gas temperature rise	49
5.10.8	Turbo compressor	49
5.11	Pressure limiting devices	50
5.11.1	General	50
5.11.2	Installation of pressure limiting devices	50
5.11.3	Design specifications of pressure relief devices	51
5.11.4	Multi stage compressor units	51
5.11.5	Single and multi stage turbo compressors	51
5.12	Information and warning devices	51
6	Verification of safety requirements and/or protective measures	52
6.1	Pressure testing	52
6.1.1	General	52
6.1.2	Acetylene compressors	52
6.2	Leak tightness test for hazardous gases	53
6.3	Test of electrical loops	53
6.4	Test of control systems	53
6.5	Noise	53
6.5.1	General	53
6.5.2	Sound power level of compressors used outdoors	54
6.6	Stability of portable compressor units	54
6.7	Structure of verification	54
7	Information for use	59
7.1	General requirements	59
7.2	Accompanying documents	60
7.2.1	Instruction handbook (Operating Manual)	60
7.2.2	Service instructions	66
7.2.3	Dismantling	68
7.2.4	Qualification	68
7.3	Markings, signs and written warnings	68
7.3.1	Generally applicable	68
7.3.2	Compressor unit enclosures	69
7.3.3	Portable and skid-mounted compressor units	69
7.3.4	Markings (in particular, data plate)	69
Annex A	(informative) Graphical symbols	71
Annex B	(informative) Measure to ensure a safety function while testing a safety device (example)	78
B.1	Shutdown Override Switches	78
B.2	Monitoring	78
Annex C	(informative) Guide to the application of current standards to the functional safety on safety related control of process compressors or compressor units	79
C.1	Introduction	79
C.2	Scope	79
C.3	Standard and code references	79
C.4	Standard abbreviations	80
C.5	Risk reduction process and functional safety	81

C.6	Relationship between EN 1012-3 and the standards for functional safety.....	82
C.7	Process of functional safety.....	84
C.7.1	General.....	84
C.7.2	Risk Assessment.....	85
C.7.3	Allocation of safety function to protection layers.....	90
C.7.4	Safety Requirements Specification.....	91
C.7.5	Design and engineering.....	91
C.7.6	Installation commissioning and validation.....	93
C.7.7	Verification.....	93
C.7.8	Assessment of functional safety.....	93
C.8	Risk assessment of compressor and auxiliary system.....	94
C.9	Responsibilities.....	95
C.9.1	End user and manufacturer.....	95
C.9.2	Compressor or compressor unit manufacturer.....	95
C.9.3	Example 1, using EN 61508, EN 61511.....	97
C.9.4	Example 2, using EN 61508, EN 61511.....	99
Annex ZA (informative)	Relationship between this European Standard and the Essential Requirements of EU Directive 2006/42/EC.....	101
Bibliography	102