

DIN EN 16191:2014-09 (E)

Tunnelling machinery - Safety requirements

Contents		Page
Foreword		5
Introduction		6
1	Scope	7
2	Normative references	7
3	Terms and definitions	10
4	List of significant hazards	12
5	Safety requirements and/or protective measures	14
5.1	General	14
5.2	Specific requirements	14
5.2.1	Sharp corners and edges	14
5.2.2	Hot surfaces	14
5.2.3	Hydraulic hoses, installation and shielding	14
5.2.4	Cutter head	14
5.2.5	Handling of heavy loads	15
5.2.6	Rotation and displacement (axial movement)	16
5.2.7	Structural collapse of the shield	16
5.2.8	Air locks	16
5.2.9	Rock bolting devices	17
5.2.10	Access to and egress from operating positions and servicing points	17
5.2.11	Protection against falling objects, face collapse, rockfall and flood	18
5.2.12	Pipe jacking rigs	18
5.3	Control stations	19
5.3.1	General	19
5.3.2	Ergonomics	19
5.3.3	Visibility	19
5.4	Guards and protective devices	19
5.4.1	General	19
5.4.2	Design of guards	19
5.4.3	Belt conveyor	19
5.4.4	Access to excavation chamber, cutter head or other digging equipment	19
5.4.5	Auger extensions during jacking operations	20
5.5	Control systems	20
5.5.1	Safety and reliability of control systems	20
5.5.2	Control devices	21
5.5.3	Remote control	21
5.5.4	Starting and stopping	22
5.5.5	Warning system	22
5.5.6	Failure of power supply	23
5.6	Towing connection	24
5.7	Laser guidance	24
5.8	Ventilation and the control of dust and gas	24
5.8.1	General	24
5.8.2	Dust control	25
5.8.3	Ventilation	25
5.8.4	Atmospheric changes and ingress of gases	25
5.8.5	Internal combustion engines	26

5.9	Noise	26
5.9.1	General	26
5.9.2	Noise reduction at source at the design stage	26
5.9.3	Information on residual risk	27
5.10	Electrical equipment	27
5.10.1	General	27
5.10.2	Protective measures	27
5.10.3	Cables	28
5.10.4	Transformers	28
5.10.5	Bonding	28
5.10.6	Switch gear	28
5.10.7	Lighting	28
5.10.8	Emergency lighting	29
5.10.9	Electromagnetic compatibility (EMC)	29
5.10.10	Isolation of high voltage power supply	29
5.11	Hydraulic and pneumatic systems	29
5.12	Fire prevention and protection	30
5.12.1	General	30
5.12.2	Fixed fire extinguishing systems	30
5.12.3	Installation of portable fire extinguishers	30
5.12.4	Water curtain on towed back-up equipment	30
5.13	Storage of rescue equipment	30
5.14	Refuge chamber	31
5.15	Probe drilling equipment	31
5.16	Transportation, lifting and assembly	31
5.16.1	Transportation	31
5.16.2	Lifting	31
5.16.3	Assembly	31
5.17	Maintenance	31
5.17.1	General	31
5.17.2	Work on cutter heads or shield-mounted cutter booms and excavators	31
5.17.3	Work on micro tunnelling machines	32
6	Verification of the safety requirements and/or protective measures	32
7	Information for use	32
7.1	General	32
7.2	Emergency information, warning signs and symbols	32
7.2.1	Warning signs	32
7.2.2	Warning devices	32
7.2.3	Symbols	32
7.2.4	Emergency information	32
7.3	Instruction handbook	33
7.3.1	General	33
7.3.2	Operating instructions	34
7.3.3	Maintenance	35
7.4	Marking	35
Annex A (informative)	Examples of tunnelling machines	37
Annex B (normative)	Verification of safety requirements and/or protective measures	41
Annex C (normative)	Noise test code	45
C.1	Scope	45
C.2	A-weighted emission sound pressure levels at working areas	45
C.3	Installation and operating conditions	46
C.4	Information to be recorded and reported	46
C.5	Declaration noise emission values	46
Annex D (normative)	Minimum requirements for refuge chamber	47

D.1	General	47
D.2	Concept and design	47
D.3	Air supply	47
D.4	Visual identification	48
D.5	Power supply	48
D.6	Interior equipment	48
D.7	Instruction manual	48
	Annex ZA (informative) Relationship between this European Standard and the Essential Requirements of EU Directive 2006/42/EC	49
	Bibliography	50