

DIN 4140:2008-03 (E)

Insulation work on industrial installations and building equipment - Execution of thermal and cold insulations

Contents		Page
Foreword		6
1	Scope	6
2	Normative references	6
3	Terms and definitions	10
4	General requirements	15
4.1	Principles	15
4.2	Preconditions for construction	15
4.3	Preconditions for beginning insulation work	15
4.4	Requirements for building materials and components	17
4.5	Requirements relating to execution	18
4.5.1	General	18
4.5.2	Prevention of convection	18
4.5.3	Protection against ingress of water	19
4.5.4	Removal of condensation from the inside of claddings of hot objects	20
4.5.5	Thermal stress in reinforcing profiles	20
4.5.6	Longitudinal thermal expansion	20
4.5.7	Inclusion of meteorological and traffic loads	21
4.5.8	Contact prevention	21
4.6	Protection against corrosion	21
4.7	Fire protection	22
5	Insulation of hot objects	22
5.1	Insulation materials and their workmanship	22
5.1.1	General	22
5.1.2	Insulation with mineral wool (MW)	23
5.1.3	Insulation with calcium-magnesium-silicate fibre (CMS)	25
5.1.4	Insulation with ceramic fibres	25
5.1.5	Insulation with calcium silicate (CS)	26
5.1.6	Insulation with silicate wool	26
5.1.7	Insulation with microporous insulants	27
5.1.8	Insulation with polyurethane/polyisocyanurate rigid foam (PUR/PIR)	28
5.1.9	Insulation with polyurethane in-situ foam (PUR)	29
5.1.10	Insulation with expanded polystyrene foam (EPS)	29
5.1.11	Insulation with extruded polystyrene foam (XPS)	29
5.1.12	Insulation with cellular glass (CG)	30
5.1.13	Insulation with flexible elastomeric foam (FEF)	31
5.1.14	Insulation with polyethylene foam (PEF)	31
5.1.15	Insulation with phenolic foam (PF)	32
5.1.16	Insulation with melamine resin foam	32
5.1.17	Insulation with expanded perlite (EP)	32
5.2	Means of fastening insulation	32
5.3	Expansion joints	32
5.4	Examples of hot insulation systems	32
5.5	Hot insulation systems with sound insulation requirements	32
5.6	Examples of hot insulation systems with sound insulation requirements	33
6	Cold insulation	33

6.1	Insulation materials and their workmanship	33
6.1.1	General	33
6.1.2	Cold insulation with mineral wool (MW) and other fibrous insulants	33
6.1.3	Cold insulation with polyurethane/polyisocyanurate rigid foam (PUR/PIR)	34
6.1.4	Cold insulation with polyurethane in-situ foam (PUR)	34
6.1.5	Cold insulation with expanded polystyrene foam (EPS)	34
6.1.6	Cold insulation with extruded polystyrene foam (XPS)	34
6.1.7	Cold insulation with cellular glass (CG)	34
6.1.8	Cold insulation with elastomeric foam (FEF)	34
6.1.9	Cold insulation with polyethylene foam (PEF)	35
6.1.10	Cold insulation with phenolic foam (PF)	35
6.1.11	Cold insulation with expanded perlite (EP)	35
6.2	Means of fastening cold insulation systems	35
6.2.1	General	35
6.2.2	Adhesives	35
6.2.3	Mechanical fastening	36
6.3	Vapour retarders	36
6.3.1	Materials for vapour retarders	36
6.3.2	Execution	36
6.4	Expansion joints	37
6.5	Examples of cold insulation systems	38
6.6	Cold insulation with sound insulation requirements	38
6.7	Examples of cold insulation systems with sound insulation requirements	38
7	Insulation of installations with alternating temperatures	38
8	Other components of insulation systems	39
8.1	Supporting structures	39
8.1.1	General	39
8.1.2	Dimensioning and design	39
8.2	Spacer-ring constructions	39
8.2.1	General	39
8.2.2	Dimensioning	39
8.2.3	Spacer-ring constructions for hot insulations	40
8.2.4	Spacer-ring constructions for cold insulations	40
8.3	Claddings	41
8.3.1	General	41
8.3.2	Claddings made of flat sheets	42
8.3.3	Claddings made of profiled sheet metal	44
8.3.4	Execution	44
8.3.5	Cladding sheets	45
8.3.6	Claddings for prefabricated insulated pipe systems	47
8.3.7	Mastic	47
8.3.8	Bitumen-based claddings	47
8.3.9	Cladding of rigid plastic sheeting	47
8.3.10	Claddings of embossed aluminium foils	48
8.3.11	Other casings	48
8.4	Insulation of pipe fittings	48
8.4.1	General	48
8.4.2	Removable boxes and caps	49
8.4.3	Cold insulation for expansion compensators	51
8.4.4	Cold insulation on flanges	51
8.4.5	Cold insulation at fittings	52
8.4.6	Name plates	53
8.4.7	Cooling zones/tracer heating systems located on the outside	53
8.5	Bolsters	54
8.5.1	General	54
8.5.2	Materials for bolsters	54
8.5.3	Execution of supports in cold insulations	54
	Annex A (informative) Design of hot and cold insulation systems	57

Annex B (informative) Reference values for insulation material properties	67
Annex C (informative) Means of fastening for insulation materials	74
Annex D (informative) Examples of cold insulation design	76
Bibliography	85
Figures	
Figure 1 - Minimum distances between insulated objects and between insulated objects and other components of vessels, installations, columns and tanks	16
Figure 2 - Minimum distances between insulated objects and between insulated objects and other components of pipe systems	16
Figure 3 - Minimum dimensions and distances of insulated objects; pipes with flanges	17
Figure 4 - Fastening using pins and clips (using the example of boiler or duct wall insulation a) with and b) without air gap)	27
Figure 5 - Expansion joint in vertical position (insulation material: cellular glass)	37
Figure 6 - Expansion joints in objects in horizontal position	38
Figure 7 - Number and location of lever fasteners for removable boxes	50
Figure 8 - Cold insulation for expansion compensator	51
Figure 9 - Cold insulation of flanges	52
Figure 10 - Cold insulation of pipe fitting	53
Figure 11 - Loose support for horizontal and vertical pipes, pipe insulation of polyurethane (PUR) in-situ foam or polyurethane (PUR) semi-sections (with or without shiplap edges)	55
Figure 12 - Loose supports for horizontal and vertical pipes, bolsters made of section segments, pipe insulation made of polyurethane (PUR) in-situ foam	55
Figure 13 - Pipe supports	56
Figure D.1 - Supports for horizontal vessels (insulated bolsters in the saddle)	76
Figure D.2 - Supports for horizontal vessels	76
Figure D.3 - Loose support with sliding board - Detail from Figure D.2	77
Figure D.4 - Fixed points without sliding board - Detail from Figure D.2	77
Figure D.5 - Support for vertical vessels with outriggers	77
Figure D.6 - Support for vertical vessels	77
Figure D.7 - Anchoring at the fixed point - Detail from Figure D.4	78
Figure D.8 - Detail from Figures D.5 and D.6	78
Figure D.9 - Horizontal section through column with penetrations	79
Figure D.10 - Supports for vessels with even base (with surface completely resting on insulation material)	80
Figure D.11 - Supports for vessels with even base (ring support)	81

Figure D.12 - Supports for double-wall tank	82
Figure D.13 - Supports for double-wall tank (outer tank closed)	83
Figure D.14 - Support for spherical tank	84
Tables Table 1 - Contact corrosion of metal combinations	22
Table 2 - Standard fastenings for mats	23
Table 3 - Materials for spacer-ring constructions and bolsters in cold insulations systems (reference values)	41
Table 4 - Allowable temperatures for cladding materials	42
Table 5 - Sheet thicknesses, overlaps and fasteners for claddings made of flat sheets	43
Table 6 - Sheet thicknesses and overlaps for claddings not subjected to mechanical stressing	43
Table 7 - Sheet thicknesses for flat claddings with a maximum cross-sectional dimension > 1 500 mm or 1 500 mm	43
Table 8 - Commonly used sheet metal for claddings	46
Table 9 - Sheet thicknesses for removable boxes and caps made of steel and lengths of lever fasteners	50
Table 10 - Sheet thicknesses for removable boxes and caps of aluminium sheet and lengths of lever fasteners	50
Table A.1 - Design of hot insulation systems	57
Table A.2 - Design of hot insulation systems with sound insulation requirements	62
Table A.3 - Design of cold insulation systems	64
Table A.4 - Design of cold insulation systems with sound insulation requirements	66
Table B.1 - Reference values for insulation material properties	67
Table C.1 - Means of fastening for insulation materials	74