

DIN EN 746-2:2011-02 (E)

Industrial thermoprocessing equipment - Part 2: Safety requirements for combustion and fuel handling systems

Contents		Page
Foreword		6
Introduction		7
1	Scope	8
2	Normative references	9
3	Terms and definitions	11
4	List of hazards	20
5	Safety requirements, measures and verification means	21
5.1	General	21
5.2	Gaseous fuels	21
5.2.1	Gas pipework	21
5.2.2	Required safety devices	24
5.2.3	Combustion air and pre-purging the combustion chamber and flue passages	30
5.2.4	Supply of pre-mixed fuel gas/air	32
5.2.5	Burners	33
5.2.6	Automatic burner control systems	37
5.3	Liquid fuels	39
5.3.1	Liquid fuel pipework	39
5.3.2	Required safety devices	42
5.3.3	Combustion air and pre-purging the combustion chamber and the flue passages	45
5.3.4	Liquid fuel atomisation	47
5.3.5	Burners	47
5.3.6	Automatic burner control systems	49
5.4	Solid fuels	51
5.4.1	Pulverised solid fuel pipework	51
5.4.2	Graded fuel pipework (applicable to grate burners and fluidised beds)	52
5.4.3	Required devices (for pulverised fuels and fluidised beds)	53
5.4.4	Combustion air and pre-purging of the combustion chamber and flue passages	54
5.4.5	Burners	54
5.4.6	Automatic burner control systems (pulverised fuel)	56
5.5	Multiple fuels	56
5.5.1	General	56
5.5.2	Fuel circuit	57
5.5.3	Combustion air supplies	57
5.5.4	Operation of the safety devices	57
5.5.5	Air/fuel ratio	57
5.6	Oxygen or oxygen-enriched combustion air	57
5.6.1	General	57
5.6.2	Suitability for oxygen service	57
5.6.3	Sealing materials for oxygen pipework	57
5.6.4	Pipework	58
5.6.5	Pipes velocities	58
5.6.6	Fittings	58
5.6.7	Blow off and venting lines	58
5.6.8	Manual torches	58
5.6.9	Safety devices against gas backflow	59

5.6.10	Safety devices against oxygen backflow in mixture with other substances	59
5.6.11	Material requirements	59
5.7	Design requirements for electrical and electronic equipment for control system and protective system	59
5.7.1	General	59
5.7.2	Requirements for protective systems	60
5.7.3	Fault assessment for a hardwired protective system	64
5.7.4	Electrical power failure	70
5.7.5	Reset	70
6	Verification of the safety requirements and/or measures	72
7	Information for Use	77
7.1	General	77
7.2	Marking	77
7.3	Instruction handbook	78
7.3.1	General	78
7.3.2	Description of equipment	78
7.3.3	Inspection procedures	79
7.3.4	Commissioning, start-up and operating procedures	79
7.3.5	Shut-down procedures	80
7.3.6	Maintenance procedures	80
7.3.7	Documentation	80
Annex A (informative)	Typical Examples of IThE, Fuels and Burners	81
A.1	List - Machines concerned, descriptions, functions	81
A.1.1	List of IThE	81
A.2	Classification of fuels	84
A.2.1	Gaseous fuels	84
A.2.2	Liquid fuels	84
A.2.3	Solid fuels	84
A.3	Classification of burners	85
A.3.1	Gaseous fuels	85
A.3.2	Liquid fuels	85
A.3.3	Solid fuels	85
Annex B (informative)	Technical terms	86
Annex C (informative)	Typical examples of piping and components	101
Annex D (informative)	Methods for burner start-up	111
Annex E (normative)	Maximum allowable pressure	118
Annex ZA (informative)	123
Bibliography	124
Figures	Figure 1 -- Block diagram of control/protective and heated system	60
	Figure 2 a -- Example for requirements of 5.7.2 a	61
	Figure 2 b -- Example for requirements of 5.7.2 b	62
	Figure 2 c -- Example for requirements of 5.7.2 c	63
	Figure 2 d -- Example for requirements of 5.7.2 d	63
	Figure 3 -- Fault assessment for the hardwired section of a protective system	65
	Figure 4 -- Consideration of fault tolerance time and safety time for IThE	66

Figure 5 -- Examples for wiring of fuel shut-down with hardware diversity of the disconnecting devices	67
Figure 6 -- Example for wiring of fuel shut-down with diverse functionality of the disconnecting devices	68
Figure C.1 -- Single burner equipment	101
Figure C.2a -- Multiple burner equipment - Central pipework - Example a two burners system	102
Figure C.2b -- Multiple burner equipment - Central pipework - Example b	103
Figure C.2c -- Multiple burner equipment - Central pipework - Example c	104
Figure C.3a -- Multiple burner equipment - Zone pipework - Example a	105
Figure C.3b -- Multiple burner equipment - Zone pipework - Example b	106
Figure C.3c -- Multiple burner equipment - Zone pipework - Example c	107
Figure C.4 -- Multiple burner equipment (burner pipework)	108
Figure C.5 -- Central pipework for low cycling applications	109
Figure C.6 -- Draft breaks	110
Figure D.1 -- Direct main burner ignition at full rate (see Table 3, Column 2, QF max 120 kW)	111
Figure D.2 -- Direct main burner ignition at reduced rate with slow opening valve (see Table 3, Column 3, QF max 360 kW)	111
Figures D.3 and D.4 -- Direct main burner ignition at reduced rate with by-pass start gas supply (see Table 3, Column 4)	112
Figures D.5 and D.6 -- Direct main burner ignition at reduced rate with limited start gas input (see Table 3, Column 4)	113
Figures D.7 and D.8 -- Main burner ignition with independent pilot burner (see Table 3, Column 5, QF max 120 kW)	114
Figures D.9 and D.10 -- Main burner ignition with independent pilot burner (see Table 3, Column 5, QF max 360 kW)	115
Figures D.11 and D.12 -- Main burner ignition with independent pilot burner (see Table 3, Column 5)	116
Figures D.13 and D.14 -- Main burner ignition with independent pilot burner (see Table 3, Column 5)	117
Figure E.1 -- Piping referred to clause a) group 1 of Annex E	119
Figure E.2 -- Piping referred to clause a) group 2 of Annex E	120
Figure E.3 -- Piping referred to clause b) group 1 of Annex E	121
Figure E.4 -- Piping referred to clause b) group 2 of Annex E	122
Table 1 -- Maximum safety times for natural draught burners operating in open air	34
Table 2 -- Maximum safety times for natural draught burners operating in combustion chamber	35

Table 3 -- Maximum safety times for forced and induced draught burners	36
Table 4 -- Maximum safety times	48
Table 5 -- Materials requirements	59
Table 6 -- Verification of the safety requirements and/or measures	72
Table B.1 -- English - German - French	86
Table B.2 -- German - English - French	91
Table B.3 -- French - English - German	96