

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

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

---

<b>Contents</b>		<b>Page</b>
Foreword .....		6
Introduction .....		7
<b>1</b>	<b>Scope .....</b>	<b>8</b>
<b>2</b>	<b>Normative references .....</b>	<b>9</b>
<b>3</b>	<b>Terms and definitions .....</b>	<b>11</b>
<b>4</b>	<b>List of hazards .....</b>	<b>20</b>
<b>5</b>	<b>Safety requirements, measures and verification means .....</b>	<b>21</b>
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

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