

DIN EN 416:2020-04 (E)

Gas-fired overhead radiant tube heaters and radiant tube heater systems for no n-domestic use - Safety and energy efficiency

Contents		Page
European foreword		6
1	Scope	7
2	Normative references	8
3	Terms and definitions	9
3.1	System and its constituent parts	10
3.2	Combustion circuit	12
3.3	Adjusting, control and safety devices	13
3.4	Operation of the appliance	15
3.5	Gases	18
3.6	Conditions of operation and measurement	19
3.7	Energy efficiency	22
3.8	Country of destination	23
3.9	Symbols	24
4	Classification of appliances	28
4.1	Classification according gases and categories	28
4.2	Classification according to the mode of evacuation of the combustion products	28
5	Constructional requirements	31
5.1	General	31
5.2	Requirements for adjusting, controls and safety devices	37
5.3	Ignition devices	44
5.4	Main burners	44
5.5	Pressure test points	44
5.6	Injectors	45
5.7	Exhaust gas heat exchanger	45
6	Operational requirements	45
6.1	Test methods	45
6.2	Safety of operation	51
6.3	Oxides of Nitrogen, NO_x	74
6.4	Determination of electrical power consumption	76
7	Energy Efficiency	77
7.1	General principle of measurement and calculation radiant factor	77
7.2	Working space	77
7.3	Test equipment to determine radiant output	77
7.4	Test procedure	81
7.5	Calculation of radiant factor	83
7.6	Determination of thermal efficiency	86
7.7	Test report	87
8	Requirements of energy efficiency (rational use of energy)	87
8.1	General	87
8.2	Seasonal energy efficiency	87
9	Risk assessment	91

10	Marking and instructions	91
10.1	Marking of the appliance and the packaging	91
10.2	Instructions	94
10.3	Presentation	99
10.4	Information Requirements	99
Annex A (informative) National situations		100
A.1	General	100
A.1.1	General	100
A.1.2	Gas rate adjusters, aeration adjusters and regulators	100
A.1.3	Conversion to different gases	100
A.2	Gas connections in the various countries	100
A.3	Flue connections in the various countries	102
Annex B (informative) Typical Systems		103
B.1	Single burner systems	103
B.1.1	Type B appliances with a fan in the combustion circuit	103
B.1.2	Type C appliances with a fan in the combustion circuit	107
B.2	Multi tube heater systems	109
B.2.1	Type D System	109
B.2.2	Type E System	111
B.2.3	Type F systems	112
Annex C (informative) Equivalence rules		113
C.1	Conversion to categories within a restricted Wobbe Index range	113
C.2	Conversion to categories within an identical Wobbe Index range	113
C.3	Conversion to categories within a wider Wobbe Index range	114
Annex D (informative) Calculation of the mass flow rate of flue gases		115
D.1	Flue gas mass flow rate	115
D.2	Quantity of air in the flue gas	115
D.3	Flue gas excess air ratio ()	115
D.4	Quantity of water vapour in the flue gas	116
D.5	Quantity of Nitrogen in the flue gas	116
D.6	Quantity of Oxygen in the flue gas	116
D.7	Dry quantity of flue gas	117
D.8	Quantity of carbon dioxide in the flue gas	117
Annex E (informative) Identification of the types of gas in use in various countries		119
Annex F (normative) Special national conditions		121
Annex G (normative) Calculation of conversions of NO _x		122
G.1	NO _x emission conversion factors (NCV)	122
G.2	NO _x Conversion -- Calculation	123
Annex H (informative) National situations of countries whose national bodies are CEN associate members		125
Annex I (informative) Different types of heat input control		126
Annex J (informative) Radiometer design		127
J.1	Principle radiometer design features	127
J.2	Radiometer technical design	128
J.3	Pyro-electric detector	128
J.4	Ulbricht Sphere	128

Annex K (informative) Radiometer calibration	131
K.1 Radiometer calibration	131
K.2 Black body calibration equipment and procedure	131
K.2.1 General	131
K.2.2 Temperature calibration at reference condition	133
K.2.3 Temperature calibration at higher temperatures	134
K.2.4 Calibration calculation	135
K.3 Calibration procedure in detail, presented as a worked example	136
K.3.1 Calibration Measurements	136
K.3.2 Selecting the average readings	136
K.3.3 Determination of the 1/S sensitivity per temperature	137
K.3.4 Determining the 1/S sensitivity of the radiometer	137
K.3.5 Documentation of calibration results	137
Annex L (normative) Correction of measured radiant output for absorption by H₂O and CO₂	141
L.1 General	141
L.2 Calculation method	143
Annex M (informative) Radiant heat output data - Recording of results	144
M.1 General information to be recorded	144
M.1.1 Test and appliance data	144
M.1.2 Radiometer technical data	144
M.1.3 Measuring plane technical data	144
M.2 Measurement results	145
M.2.1 Test information	145
M.2.2 Test ambient conditions	145
M.2.3 Gas/heat input data	145
M.2.4 Flue gas data	146
M.2.5 Absorption of water vapour and CO ₂ data	146
M.2.6 Irradiation measurement data	146
Annex N (informative) Worked example	147
N.1 General information	147
N.2 Radiometer technical data	147
N.3 Measuring plane technical data	147
N.4 Measurement results	148
N.4.1 Test information	148
N.4.2 Test ambient conditions	148
N.4.3 Gas/heat input data	148
N.4.4 Flue gas data	149
N.4.5 Absorption of water vapour and CO ₂ data	149
N.4.6 Irradiation measurement data	149
Annex O (normative) Flue test probes	150
Annex P (normative) Product information required	155
Annex Q (informative) Derivation of equations to determine thermal efficiency	157
Annex R (normative) Flue gas heat exchanger	159
R.1 General	159
R.2 Materials	159
R.3 Corrosion resistance	159
R.4 Thermal insulation	160
R.5 Gas tightness	161
R.6 Removal of condensate	161

R.7	Non-metallic flue system	161
R.8	Frost protection	161
R.9	Distance to flammable materials	161
R.10	Safety-related equipment	161
R.11	Operation over-pressure when using water as secondary medium	161
R.12	Calculation of the heat transfer performance	162
R.12.1	Test requirements	162
R.12.2	Heat transfer calculations	162
R.12.3	Minimum requirements	163
Annex S (normative) Uncertainty of measurements		164
Annex ZA (informative) Relationship between this European Standard and the ecodesign requirements of Commission Regulation (EU) No 2015/1188 aimed to be covered		166
Bibliography		167