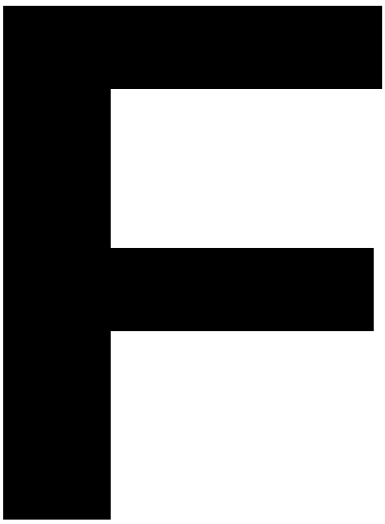

Technical Document

Part 2
Minimum Energy Performance Requirements for Building Services in Malta

Building Regulation Office
Ministry for Transport and Infrastructure
Malta

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Contents

Definition of terms

For the purpose of this document, the following definitions apply:

i. ***Building*** means a roofed construction having walls, for which energy is used to condition the indoor climate;

ii. ***Dwelling*** means a building or building unit used or intended to be used for domestic purposes and usually containing eating, living, sleeping and sanitary facilities;

iii. ***Technical building system*** means technical equipment for the heating, cooling, ventilation, hot water, lighting or for a combination thereof, of a building or building unit;

iv. ***Installation*** means a system providing artificial lighting, water heating, space heating or space cooling or space ventilation in any combination;

v. ***Air-conditioning system*** means a combination of the components required to provide a form of indoor air treatment, by which temperature is controlled or can be lowered;

vi. ***Boiler*** means the combined boiler body-burner unit, designed to transmit to fluids the heat released from burning;

vii. ***Effective rated output*** means the maximum calorific output, expressed in kW, specified and guaranteed by the manufacturer as being deliverable during continuous operation while complying with the useful efficiency indicated by the manufacturer;

viii. ***Heat pump*** means a machine, a device or installation that transfers heat from natural surroundings such as air, water or ground to buildings or industrial applications by reversing the natural flow of heat such that it flows from a lower to a higher temperature. For reversible heat pumps, it may also move heat from the building to the natural surroundings.

Terms which are not defined in the list above shall have the meaning commonly assigned to them in the context wherein they are used.

1. Introduction

1.1 'Minimum requirements for building services in Malta' addresses the mandatory requirements regarding Technical Buildings Systems as laid out in Article 8 of the Energy Performance of Buildings Directive 2010/31/EU (recast), transposed by Legal Notice 376 of 2012 Energy Performance of Buildings Regulations.

1.2 The requirements addressed in this document will apply for fixed building services which are being designed and/or installed in both new and existing buildings.

1.3 The Ecodesign Directive 2009/125/EC provides a framework for establishing requirements for 'energy-related' products placed on the EU market. These requirements are set out in Commission Regulations listed in the document https://ec.europa.eu/energy/sites/ener/files/documents/list_of_ecodesign_measures.pdf.

Ecodesign requirements are coming into force from time to time. Where the energy efficiency requirements mandated by Ecodesign regulations differ from the requirements of this document, the Ecodesign requirements are to be adhered to.

1.4 The contents of this document are based on the 'Non-Domestic Building Services Compliance Guide' and 'Domestic Building Services Compliance Guide', HM Government, 2013 editions for use in England
http://www.planningportal.gov.uk/buildingregulations/approveddocuments/partl/compliance

2. Boilers

2.1 Scope

2.1.1 These minimum requirements apply to boilers used for space heating purposes and/or the production of domestic hot water in buildings.

2.1.2 Boilers considered in this Section are fired either by liquid petroleum gas (LPG), oil or biomass.

2.2 Minimum energy performance requirements for boilers

2.2.1 Where a single boiler is used to meet the heat demand, its boiler seasonal efficiency (gross calorific value) should be not less than the value in Table 1.

2.2.2 For multiple-boiler systems, the boiler seasonal efficiency of each boiler should be not less than 82% (gross calorific value); and the overall boiler seasonal efficiency of the multiple-boiler system, should be not less than the value in Table 1.

2.2.3 The relevant minimum controls package in Table 2 should be adopted.

Table 1 Minimum heat generator seasonal efficiency for boiler systems

Fuel type	**System**	**Boiler seasonal efficiency (gross calorific value)**
LPG	Single-boiler ≤ 2MW output	93%
	Single-boiler > 2MW output	87%
	Multiple-boiler	82% for any individual boiler 87% for overall multi-boiler system
Oil	Single-boiler	84%
	Multiple-boiler	82% for any individual boiler 84% for overall multi-boiler system

Note:

In case of biomass boilers, the efficiency at their nominal load should be at least:

i. 65% for independent gravity-fed boilers <20.5kW
ii. 75% for independent automatic pellet/woodchip boilers

Table 2 Minimum controls package for boilers and multiple-boiler systems

Boiler plant output	Package	Minimum controls
<100kW	A	a. Timing and temperature demand control, which should be zone specific where the building floor area is greater than 150m^2. b. Weather compensation except where a constant temperature supply is required.
100kW to 500kW	B	a. Controls package A above. b. Optimum start/stop control with night set-back outside occupied periods. c. Two-stage high/low firing facility in boiler, or multiple boilers with sequence control to provide efficient part-load performance.
>500kW individual boilers	C	a. Control package A and controls package B. b. For gas-fired boilers and multi-stage oil-fired boilers, fully modulating burner controls.
Note: In case of biomass boilers, the same controls indicated above should be provided, where technically feasible.		

3. Heat pumps

3.1 Scope

3.1.1 These minimum requirements apply to commercial heat pump systems used for space heating purposes and/or the production of domestic hot water in buildings, as identified in Table 3.

3.1.2 In case of reverse cycle heat pumps that also provide cooling refer to Section 7.

Table 3 Heat pump types and associated test standards

Heat pump type	Technology	Sub-technology	Test standard
Electrically-driven warm air	Ground-to-air	Single package + variable refrigerant flow warm air systems	ISO 13256-1[a]
		Energy transfer systems (matching heating/cooling demands in buildings)	
	Water-to-air	Single package + variable refrigerant flow warm air systems	SM EN 14511-3[b]
		Energy transfer systems (matching heating/cooling demands in buildings)	
	Air-to-air	Single package	SM EN 14511-3
		Split system	
		Multi-split system	
		Variable refrigerant flow systems	
Electrically-driven warm water	Ground-to-water	Single package + variable refrigerant flow warm air systems	ISO 13256-2[c]
		Split package	
	Water-to-water	Single package + variable refrigerant flow warm air systems	SM EN 14511-3
		Split package	
	Air-to-water	Single package	SM EN 14511-3
		Split package + variable refrigerant flow warm air systems	
Gas-engine-driven	Available as variable refrigerant flow warm air systems		Generally to SM EN 14511-3

a ISO 13256-1 *Water-source heat pumps. Testing and rating for performance. Part 1: Water-to-air and brine-to-air heat pumps*.
b SM EN 14511-3:2013 *Air conditioners, liquid chilling packages and heat pumps with electrically driven compressors for space heating and cooling. Test methods*.
c ISO 13256-2 *Water-source heat pumps. Testing and rating for performance. Part 2: Water-to-water and brine-to-water heat pumps*.

3.2 Minimum energy performance requirements for heat pumps

3.2.1 Heat pumps should have a COP which is not less than the value in Table 4 and feature as a minimum the controls package in Table 5.

3.2.2 For buildings other than dwellings, the heat pump system can be sized to meet either the full heating and hot water demand or part of it. Economically viable installations provide at least 50% of the heating and hot water demand for the building.

Table 4 Minimum COP for heat pumps

Heat pump type	**Minimum COP at the rating conditions[1]**
All types (except air-to-air with output ≤ 12 kW, absorption and gas-engine) for space heating	2.5
Air-to-air with output ≤ 12 kW for space heating	**Note 2**
All types (except absorption and gas-engine) for domestic hot water heating	2.0
Absorption	0.5
Gas-engine	1.0

Notes

1. Rating conditions are standardised conditions for determining performance specified in SM EN 14511:2013 *Air conditioners, liquid chilling packages and heat pumps with electrically driven compressors for space heating and cooling*.
2. **Ecodesign Requirements:** European Commission Regulation No 206/2012 sets standards for the SCOP of electrically-driven air-to-air heat pumps with an output ≤12kW.

Table 5 Minimum controls package for heat pump systems

Heat source/sink	Technology	Minimum controls package
All types	All technologies	**Controls package A** a. On/off zone control. If the unit serves a single zone, and for buildings with a floor area of 150m^2 or less, the minimum requirement is achieved by default. b. Time control.
Air-to-air	Single package Split system Multi-split system Variable refrigerant flow system	a. Controls package A above. b. Heat pump unit controls for: i. control of room air temperature (if not provided externally) ii. control of outdoor fan operation iii. defrost control of external airside heat exchanger iv. control for secondary heating (if fitted). c. External room thermostat (if not provided in the heat pump unit) to regulate the space temperature and interlocked with the heat pump unit operation.
Water-to-air Ground-to-air	Single package energy transfer systems (matching heating/ cooling demand in buildings)	a. Controls package A above. b. Heat pump unit controls for: i. control of room air temperature (if not provided externally) ii. control of outdoor fan operation for cooling tower or dry cooler (energy transfer systems) iii. control for secondary heating (if fitted) on air-to-air systems iv. control of external water pump operation. c. External room thermostat (if not provided in the heat pump unit) to regulate the space temperature and interlocked with the heat pump unit operation.
Air-to-water Water-to-water Ground-to-water	Single package Split package	a. Controls package A above. b. Heat pump unit controls for: i. control of water pump operation (internal and external as appropriate) ii. control of water temperature for the distribution system iii. control of outdoor fan operation for air-to-water units iv. defrost control of external air side heat exchanger for air-to-water systems. c. External room thermostat (if not provided in the heat pump unit) to regulate the space temperature and interlocked with the heat pump unit operation.
Gas-engine-driven heat pumps are currently available only as variable refrigerant flow warm air systems	Multi-split Variable refrigerant flow	a. Controls package A above. b. Heat pump unit controls for: i. control of room air temperature (if not provided externally) ii. control of outdoor fan operation iii. defrost control of external airside heat exchanger iv. control for secondary heating (if fitted). c. External room thermostat (if not provided in the heat pump unit) to regulate the space temperature and interlocked with the heat pump unit operation.

4. Underfloor heating

4.1 Scope

4.1.1 These minimum requirements apply to underfloor heating systems used for space heating purposes in buildings.

4.1.2 Underfloor heating systems considered in this Section make use of hot water pipes or electric heating elements as the underfloor heat source.

4.2 Minimum energy performance requirements for underfloor heating systems

4.2.1 Underfloor heating systems should meet the minimum standards for:

a. controls and safe operating temperatures in Table 6;
b. floor insulation and system design to minimise distribution losses in Table 7.

Table 6 Minimum standards for control of wet and electric underfloor heating systems

System temperature control: wet and electric underfloor heating systems	a. All underfloor heating systems, whether warm water or electric, should be fitted with controls to ensure safe and comfortable operating temperatures. b. To prevent damage to floors and occupant discomfort, the temperature of the flow water from warm water systems connected to a high temperature (>60°C) heat source should be controlled using: i. multi-port mixing valves and thermo-mechanical or thermo-electric actuators ii. a separate high-limit thermostat.
Room temperature control: wet and electric underfloor heating systems	a. Each room should have its own thermostat, sensor or programmable thermostat. b. Where two adjacent rooms have a similar function – for example a kitchen and a utility room – it may be appropriate for both rooms to share a single temperature control.
Time control: wet and electric underfloor heating systems	a. Buildings with a total floor area up to 150 m^2 should have at least two space heating zones with independent temperature control, one of which is assigned to the living area. b. Buildings with a total floor area >150 m^2 should have at least two space heating zones with independent on/off time and temperature control. c. For single-storey, open-plan buildings in which the living area is greater than 70% of the total floor area, sub-zoning of temperature control is not appropriate. d. Thick screed floor heating systems (>65 mm) should have facilities for automatic setback of room temperature to a lower level at night or during unoccupied periods.
Boiler control: wet underfloor heating systems only	The heating system controls should be connected so that when there is no demand for heat, the heat source and pump are switched off.

Table 7 Minimum standards for floor insulation and minimising distribution losses in wet and electric underfloor heating systems

Exposed ground floors	a. Ground floors on earth, or suspended floors in contact with outside air, should be insulated to limit downward heat loss, due to the thermal resistance of the applied floor finish, to not more than 10 W/m^2. b. When heat output is not known but the floor finish is specified, the amount of system thermal insulation needed may be calculated based on the sum of the thermal resistance of the floor finish and the underlying heated layer, multiplied by 10. c. Floor heating systems intended for cyclical operation or installed over unheated rooms should be separated from the structural floor by a layer of thermal insulation with a thermal resistance of at least 1.25 (m^2 K)/W.
Intermediate floors with heated rooms below: wet systems	The intermediate floor should have a separating layer of system thermal insulation with thermal resistance as in 'b' above, or not less than 0.75 (m^2 K)/W as specified in MSA EN 1264-4[a].
Intermediate floors with heated rooms below: electric systems	The intermediate floor should have a separating layer of system thermal insulation with thermal resistance as in 'b' above, or not less than 0.5 (m^2 K)/W.

a MSA EN 1264-4:2009 *Water based surface embedded heating and cooling systems. Installation.*

5. Domestic hot water

5.1 Scope

5.1.1 These minimum requirements apply to domestic hot water (DHW) systems in buildings, as shown in Table 8. DHW systems considered in this Section are of the conventional direct and indirect gas-fired, oil-fired and electrically-heated types, having dedicated water heaters.

5.1.2 Central heating boilers which provide space heating and DHW should meet the minimum standards in Section 2; and heat pumps which provide domestic hot water should meet the minimum standards in Section 3.

5.1.3 These minimum requirements also apply to back-up gas and electric systems used with solar thermal hot water systems. Requirements for solar thermal systems can be found in Section 6.

Table 8 Types of hot water systems

Direct-fired circulator: LPG	A system in which the water is supplied to the draw-off points from a hot water vessel in which water is heated by combustion gases from a primary energy source. The unit has no storage volume as water is stored in a supplementary storage vessel.
Direct-fired storage: LPG and oil	A system in which the water is supplied to the draw-off points from an integral hot water vessel in which water is heated by combustion gases from a primary energy source.
Direct-fired continuous flow: LPG	A system in which the water is supplied to the draw-off points from a device in which cold water is heated by combustion gases from a primary energy source as it flows through the water heater. The water heater is situated close to the draw-off points. The unit has no storage volume as water is instantaneously heated as it flows through the device.
Indirect-fired circulator: LPG and oil	A system in which the water is supplied to the draw-off points from a device in which water is heated by means of an element through which the heating medium is circulated in such a manner that it does not mix with the hot water supply. In practice the heat source is likely to be a boiler dedicated to the supply of domestic hot water.
Instantaneous electrically-heated	A system in which the water is supplied to the draw-off points from a device in which cold water is heated by an electric element or elements as it flows through the water heater. The water heater is situated close to the draw-off points. The unit has no storage volume as water is instantaneously heated as it flows through the device.
Storage electrically-heated	A system in which the water is supplied to the draw-off points from a device in which water is heated by an electric element or elements immersed in the stored water. The water heater is situated close to the draw-off points.

5.2 Minimum energy performance requirements for domestic hot water systems

5.2.1 Domestic hot water systems should meet the minimum standards for:

a. heat losses from DHW storage vessels in Table 9;
b. heat generator efficiency (gross calorific value) in Table 10;
c. controls in Tables 11 and 12.

Table 9 Maximum heat losses from DHW storage vessels

Nominal volume (litres)	Heat loss (kWh/24h)	Nominal volume (litres)	Heat loss (kWh/24h)
200	2.1	900	4.5
300	2.6	1000	4.7
400	3.1	1100	4.8
500	3.5	1200	4.9
600	3.8	1300	5.0
700	4.1	1500	5.1
800	4.3	2000	5.2

Notes

a. For guidance on maximum heat losses from DHW storage vessels with a storage volume less than 200 litres, see MSA EN 15450:2007[a].
b. The heat loss from electrically-heated cylinders (volume V litres) should not exceed $1.28 \times (0.2 + 0.051V^{2/3})$ if point-of-use or $1.28 \times (0.051V^{2/3})$ if local.

a MSA EN 15450:2007 *Heating systems in buildings. Design of heat pump heating systems.*

Table 10 Minimum thermal efficiencies for domestic hot water systems

DHW system type	Fuel type	Heat generator seasonal efficiency (gross)	
		Thermal efficiency	Boiler seasonal efficiency
Direct-fired	LPG > 30 kW output	92%	
	LPG ≤ 30 kW output	74%	
	Oil	76%	
Indirect-fired	LPG		81%
	Oil		82%
Electrically-heated		100% assumed	

Table 11 Minimum controls package for gas and oil-fired domestic hot water systems

DHW system type	Controls package
Direct-fired circulator: LPG	a. Automatic thermostat control to shut off the burner/primary heat supply when the desired temperature of the hot water has been reached. b. High limit thermostat to shut off primary flow if system temperature too high. c. Time control.
Direct-fired storage: LPG and oil	a. Automatic thermostat control to shut off the burner/primary heat supply when the desired temperature of the hot water has been reached. b. High limit thermostat to shut off primary flow if system temperature too high. c. Time control.
Direct-fired continuous flow: LPG	a. Outlet temperature of appliance controlled by rate of flow through heat exchanger. b. High limit thermostat to shut off primary flow if system temperature too high. c. Flow sensor that only allows electrical input should sufficient flow through the unit be achieved. d. Time control.
Indirect-fired: LPG and oil	a. Automatic thermostat control to shut off the burner/primary heat supply when the desired temperature of the hot water has been reached. b. High limit thermostat to shut off primary flow if system temperature too high. c. Time control.

Table 12 Minimum controls package for electrically-heated domestic hot water systems

	Storage [a]	Instantaneous [b]
Automatic thermostat control to interrupt the electrical supply when the desired storage temperature has been reached.	Yes	x
High limit thermostat (thermal cut-out) to interrupt the energy supply if the system temperature gets too high.	Yes	x
Manual reset in the event of an over-temperature trip.	Yes	x
High limit thermostat (thermal cut-out) to interrupt the energy supply if the outlet temperature gets too high. (Note: Outlet temperature is controlled by rate of flow through the unit, which on basic units would be by the outlet tap or fitting.)	x	Yes
Flow/pressure sensor that only allows electrical input should sufficient flow through the unit be achieved.	x	Yes

a MSA EN 60335-2-21:2003+A2:2008 *Specification for safety of household and similar electrical appliances. Particular requirements for storage water heaters.*
b MSA EN 60335-2-35:2002+A2:2011 *Specification for safety of household and similar electrical appliances. Particular requirements for instantaneous water heaters*

6. Solar water heating

6.1 Scope

6.1.1 These minimum requirements apply to solar water heating systems of the indirect type, in buildings.

6.1.2 'Direct' solar systems or systems intended to contribute exclusively to space heating or systems providing heat exclusively to heat swimming pools are not considered.

6.2 Minimum energy performance requirements for solar water heating systems

6.2.1 Indirect solar heating systems should meet the minimum standards for:

a. circulation pump power, heat-exchanger sizing, system control in Table 13
b. insulating pipes in a solar primary system in Table 14.

Table 13 Minimum standards for indirect solar water heating

Solar location	Solar collectors should be sited in unshaded locations wherever possible.
Circulation pump power	The electrical input power of the primary pump in the solar system should be less than 50W or 2% of peak thermal power of collector, whichever is the higher.
Heat-exchanger sizing	The heat exchanger between a solar primary and secondary system should be sized so that not less than 0.1 m^2 or equivalent of heat exchanger area is provided per 1 m^2 of solar collector net absorber area.
System control	Solar domestic hot water (DHW) system controls should be fitted to: i. maximise the useful energy gain from the solar collectors into the system's dedicated storage ii. minimise the accidental loss of stored energy by the solar DHW system, whether originating from solar collectors, cold intake or auxiliary heat sources iii. ensure that hot water produced by back-up (auxiliary) heat sources is not used when adequate grade solar pre-heated water is available iv. provide a means of control consistent with the solar system being hydraulically (inherently) secure against the adverse effects of excessive primary temperatures and pressures v. where a separate DHW heating appliance is pre-heated by a solar system, control the appliance where possible such that no extra heat is added if the target temperature is already satisfied from the pre-heat vessel vi. inform the end user of the system's correct function and performance at all times.

Table 14 Minimum standards for insulation of pipework in solar hot water systems

a. All pipes of a solar primary system should be insulated throughout the length of the circuit. The insulation should be suitably rated for the maximum foreseeable pipe temperature applicable, and where external also be resistant to vermin attack and climatic degradation.

b. All other pipes connected to hot water storage vessels, including the vent pipe, should be insulated for at least 1 metre from their points of connection to the cylinder, or insulated up to the point where they become concealed.

c. Heat loss values should not exceed the following values:

Pipe outside diameter (mm)	Maximum heat loss (W/m)
8	7.06
10	7.23
12	7.35
15	7.89
22	9.12
28	10.07
35	11.08
42	12.19
54	14.12

Note

i. In assessing the thickness of insulation required, standardised conditions should be assumed in all compliance calculations, based on a horizontal pipe at 40°C in still air at 15 °C.

7. Comfort cooling

7.1 Scope

7.1.1 These minimum requirements apply to fixed mechanical comfort cooling systems in buildings. Evaporative cooling and desiccant cooling systems are not considered.

7.2 Minimum energy performance requirements for comfort cooling systems

7.2.1 Comfort cooling systems should comply with European Commission Regulation No 327/2011 for fans driven by motors with an electrical input power between 125 W and 500 kW, and Regulation No 206/2012 for systems with a cooling capacity of up to 12 kW, both implementing Directive 2009/125/EC with regards to ecodesign requirements for energy-related products.

7.2.2 The full load energy efficiency ratio (EER) of each cooling unit of the cooling plant should be no worse than shown in Table 15; and controls should be no worse than shown in Table 16.

Table 15 Minimum energy efficiency ratio (EER) for comfort cooling

Type		Cooling unit full load EER
Packaged air conditioners	Single-duct type	2.6
	Other types	2.6
Split and multi-split air conditioners > 12 kW		2.6
Split and multi-split air conditioners ≤ 12 kW		**Note 1**
Variable refrigerant flow systems		2.6
Vapour compression cycle chillers, water-cooled ≤ 750 kW		3.9
Vapour compression cycle chillers, water-cooled > 750 kW		4.7
Vapour compression cycle chillers, air-cooled ≤ 750 kW		2.55
Vapour compression cycle chillers, air-cooled > 750 kW		2.65
Water loop heat pump		3.2
Absorption cycle chillers		0.7
Gas-engine-driven variable refrigerant flow		1.0

Notes

1. **Ecodesign Requirements:** European Commission Regulation No 206/2012 sets standards for the EER of electric mains-operated air conditioners with rated capacity of ≤12kW for cooling.
2. The installer should be competent in the installation of refrigeration and air conditioning systems. Installation should be carried out by an installer approved by the manufacturer or supplier.
3. Exposed refrigeration pipework should be insulated and enclosed in protective trunking to limit accidental damage.
4. Supplementary information: www.eurovent-certification.com

Table 16 Minimum controls for comfort cooling

	Controls
Cooling plant	a. Multiple cooling units should be provided with controls that ensure the combined plant operates in its most efficient modes.
Cooling system	a. Terminal units capable of providing cooling should have integrated or remote time and temperature controls. b. In any given zone simultaneous heating and cooling should be prevented by an interlock.

8. Air distribution

8.1 Scope

8.1.1 These minimum requirements apply to air distribution systems in buildings. The types of air distribution systems considered are:

i. central air conditioning systems;
ii. central mechanical ventilation systems with heating, cooling or heat recovery;
iii. all central systems not covered by a. and b.;
iv. zonal supply systems where the fan is remote from the zone, such as ceiling void or roof-mounted units;
v. zonal extract systems where the fan is remote from the zone;
vi. local supply and extract ventilation units such as window, wall or roof units serving a single area (e.g. toilet extract);
vii. other local ventilation units, e.g. fancoil units and fan assisted terminal variable air volume (VAV) units;
viii. kitchen extract, fan remote from zone with grease filter.

8.2 Specific Fan Power

8.2.1 Specific fan power (SFP) of an air distribution system means the sum of the design circuit-watts of the system fans that supply air and exhaust it back outdoors, including losses through switchgear and controls such as inverters (i.e. the total circuit-watts for the supply and extract fans), divided by the design air flow rate through that system. Specific fan power is a function of the system resistance that the fan has to overcome to provide the required flow rate.

8.2.2 The specific fan power of an air distribution system should be calculated as follows:

$$\mathbf{SFP = (P_{sf} + P_{ef}) / q}$$

SFP is the specific fan power demand of the air distribution system (W/(l.s))

$\mathbf{P_{sf}}$ is the total fan power of all supply air fans at the design air flow rate, including power losses through switchgear and controls associated with powering and controlling the fans (W)

$\mathbf{P_{ef}}$ is the total fan power of all exhaust air fans at the design air flow rate including power losses through switchgear and controls associated with powering and controlling the fans (W)

q is the design air flow rate through the system, which should be the greater of either the supply or exhaust air flow (l/s). Note that for an air handling unit, q is the largest supply or extract air flow through the unit.

8.3 Minimum energy performance requirements for air distribution systems

8.3.1 Air handling systems should be capable of achieving a specific fan power at 25% of design flow rate no greater than that achieved at 100% design flow rate.

8.3.2 In order to limit air leakage, air handling units and ventilation ductwork should be made and assembled so as to be reasonably airtight.

8.3.3 The specific fan power of air distribution systems at the design air flow rate should be no worse than in Table 17.

8.3.4 Where the primary air and cooling is provided by central plant and by an air distribution system that includes the additional components listed in Table 18, the allowed specific fan powers may be increased by the amounts shown to account for the additional resistance.

8.3.5 A minimum controls package should be provided as in Table 19.

8.3.6 Air distribution systems should comply with European Commission Regulation No 327/2011 for fans driven by motors with an electrical input power between 125 W and 500 kW, and Regulation No 206/2012 for fans with an electrical input power ≤125W, both implementing Directive 2009/125/EC with regards to ecodesign requirements for energy-related products.

Table 17 Maximum specific fan power in air distribution systems

System type	SFP (W/(l.s))
Central balanced mechanical ventilation system with heating and cooling	1.6
Central balanced mechanical ventilation system with heating only	1.5
All other central balanced mechanical ventilation systems	1.1
Zonal supply system where fan is remote from zone, such as ceiling void or roof-mounted units	1.1
Zonal extract system where fan is remote from zone	0.5
Zonal supply and extract ventilation units, such as ceiling void or roof units serving single room or zone with heating and heat recovery	2.0
Local balanced supply and extract ventilation system such as wall/roof units serving single area with heat recovery	1.8
Local supply or extract ventilation units such as window/wall/roof units serving single area (e.g. toilet extract)	0.4
Other local ventilation supply or extract units	0.6
Fan assisted terminal VAV unit	1.2
Fan coil unit (rating weighted average*)	0.6
Kitchen extract, fan remote from zone with grease filter	1.0
* The rating weighted average is calculated by the following formula: $\frac{P_{mains,1} \times SFP_1 + P_{mains,2} \times SFP_2 + P_{mains,3} \times SFP_3 + \ldots}{P_{mains,1} + P_{mains,2} + P_{mains,3} + \ldots}$ where P_{mains} is useful power supplied from the mains in W.	

Table 18 Extending specific fan power for additional components

Component	SFP (W/(l.s))
Additional return filter for heat recovery	+0.1
HEPA filter	+1.0
Heat recovery – thermal wheel system	+0.3
Heat recovery – other systems	+0.3
Humidifier/dehumidifier (air conditioning system)	+0.1

Table 19 Minimum controls for air distribution systems

System type		Controls package
Central mechanical ventilation with heating, cooling or heat recovery	Air flow control at room level	Time control
	Air flow control at air handler level	On/off time control
	Heat exchanger defrosting control	Defrost control so that during cold periods ice does not form on the heat exchanger
	Heat exchanger overheating control	Overheating control so that when the system is cooling and heat recovery is undesirable, the heat exchanger is stopped, modulated or bypassed
	Supply temperature control	Variable set point with outdoor temperature compensation
Central mechanical ventilation with heating or heat recovery	Air flow control at room level	Time control
	Air flow control at air handler level	On/off time control
	Heat exchanger defrosting control	Defrost control so that during cold periods ice does not form on the heat exchanger
	Heat exchanger overheating control	Overheating control so that when the system is cooling and heat recovery is undesirable, the heat exchanger is stopped, modulated or bypassed
	Supply temperature control	Demand control
Zonal	Air flow control at room level	On/off time control
	Air flow control at air handler level	No control
	Supply temperature control	No control
Local	Air flow control at room level	On/off
	Air flow control at air handler level	No control
	Supply temperature control	No control

8.4 Heat recovery in air distribution systems

8.4.1 Air supply and extract ventilation systems including heating or cooling should be fitted with a heat recovery system where economically feasible.

8.4.2 The minimum dry heat recovery efficiency with reference to the mass flow ratio 1:1 should be no less than that shown in Table 20.

Table 20 Minimum dry heat recovery efficiency for heat exchangers

Heat exchanger type	Dry heat recovery efficiency (%)
Plate heat exchanger	50
Heat pipes	60
Thermal wheel	65
Run around coil	45

9. Insulation for pipework and ductwork

9.1 Scope

9.1.1 These minimum requirements apply to insulation for pipework and ducting serving space heating, domestic hot water and cooling systems in buildings.

9.1.2 The insulation considered in this Section applies for:

i. pipework serving: hot water; low, medium and high temperature heating; and cooling
ii. ductwork serving: heated; cooled; and dual-purpose heated and cooled air.

9.2 Minimum energy performance requirements for insulation

9.2.1 Direct hot water and heating pipework:

i. Pipework serving space heating and hot water systems should be insulated in all areas outside of the heated building envelope. In addition, pipes should be insulated in all voids within the building envelope and within spaces which will normally be heated, if there is a possibility that those spaces might be maintained at temperatures different to those maintained in other zones. The guiding principles are that control should be maximised and that heat loss from uninsulated pipes should only be permitted where the heat can be demonstrated as 'always useful'.

ii. The heat losses shown in Table 21 for different pipe sizes and temperatures should not be exceeded.

9.2.2 Cooling pipework:

i. Cooling pipework should be insulated along its whole length in order to provide the necessary means of limiting heat gain. Control should be maximised and heat gain to uninsulated pipes should only be permitted where the proportion of the cooling load relating to distribution pipework is proven to be less than 1% of total load.

ii. The heat gains in Table 22 for different pipe sizes and temperatures should not be exceeded.

9.2.3 Heating and cooling ductwork:

i. Ducting should be insulated along its whole length in order to provide the necessary means of limiting heat gains or heat losses.

ii. The heat losses or gains per unit area should not exceed the values in Table 23. Where ducting may be used for both heating and cooling, the limits for chilled ducting should be adopted since these are more onerous. (Heat gains are shown as negative values.)

Table 21 Maximum heat losses for direct hot water and heating pipes

Outside pipe diameter (mm)	Heat loss (W/m)			
	Hot water[1]	Low temperature heating[2]	Medium temperature heating[3]	High temperature heating[4]
		≤ 95°C	96°C to 120°C	121°C to 150°C
17.2	6.60	8.90	13.34	17.92
21.3	7.13	9.28	13.56	18.32
26.9	7.83	10.06	13.83	18.70
33.7	8.62	11.07	14.39	19.02
42.4	9.72	12.30	15.66	19.25
48.3	10.21	12.94	16.67	20.17
60.3	11.57	14.45	18.25	21.96
76.1	13.09	16.35	20.42	24.21
88.9	14.58	17.91	22.09	25.99
114.3	17.20	20.77	25.31	29.32
139.7	19.65	23.71	28.23	32.47
168.3	22.31	26.89	31.61	36.04
219.1	27.52	32.54	37.66	42.16
≥273.0	32.40	38.83	43.72	48.48

Note
To ensure compliance with the maximum heat loss criteria, insulation thicknesses should be calculated according to MSA EN ISO 12241[a] using standardised assumptions:

[1] Horizontal pipe at 60°C in still air at 15°C
[2] Horizontal pipe at 75°C in still air at 15°C
[3] Horizontal pipe at 100°C in still air at 15°C
[4] Horizontal pipe at 125°C in still air at 15°C

a MSA EN ISO 12241:2008 *Thermal insulation for building equipment and industrial installations. Calculation rules.*

Table 22 Maximum heat gains for cooled water supply pipes

Outside diameter of steel pipe on which insulation has been based (mm)	Heat gain (W/m)		
	Temperature of contents (°C)		
	>10 [1]	*4.9 to 10.0* [2]	*0 to 4.9* [3]
17.2	2.48	2.97	3.47
21.3	2.72	3.27	3.81
26.9	3.05	3.58	4.18
33.7	3.41	4.01	4.60
42.4	3.86	4.53	5.11
48.3	4.11	4.82	5.45
60.3	4.78	5.48	6.17
76.1	5.51	6.30	6.70
88.9	6.17	6.90	7.77
114.3	7.28	8.31	9.15
139.7	8.52	9.49	10.45
168.3	9.89	10.97	11.86
219.1	12.27	13.57	14.61
≥273.0	14.74	16.28	17.48

Notes

i. To ensure compliance with the maximum heat gain criteria, insulation thicknesses should be calculated according to MSA EN ISO 12241[a] using standardised assumptions:
   [1] Horizontal pipe at 10°C in still air at 25°C
   [2] Horizontal pipe at 5°C in still air at 25°C
   [3] Horizontal pipe at 0°C in still air at 25°C

ii. It is important to ensure that the risk of condensation is adequately controlled

a MSA EN ISO 12241:2008 *Thermal insulation for building equipment and industrial installations. Calculation rules.*

Table 23 Maximum heat losses and gains for insulated heating, cooling and dual-purpose ducts

	Heating duct[1]	Dual-purpose duct[2]	Cooling duct[3]
Heat transfer (W/m^2)	16.34	-6.45	-6.45

Note

To ensure compliance with maximum heat transfer criteria, insulation thicknesses should be calculated according to MSA EN ISO 12241[a] using standardised assumptions:
   [1] Horizontal duct at 35°C, with 600 mm vertical sidewall in still air at 15°C
   [2] Horizontal duct at 13°C, with 600 mm vertical sidewall in still air at 25°C
   [3] Horizontal duct at 13°C, with 600 mm vertical sidewall in still air at 25°C

a MSA EN ISO 12241:2008 *Thermal insulation for building equipment and industrial installations. Calculation rules.*

10. Heating and cooling system circulators and water pumps

10.1 Scope

10.1.1 These minimum requirements apply to circulators and water pumps when used in closed heating and cooling water systems such as HVAC systems.

10.1.2 This Section considers:

i. heating system glandless circulators, both standalone and integrated in products;

ii. heating and cooling system water pumps.

10.2 Minimum energy performance requirements for glandless circulators and water pumps

10.2.1 Heating system glandless circulators and heating and cooling system water pumps should meet the minimum standards in Table 24.

Table 24 Minimum standards for heating system glandless circulators and heating and cooling system water pumps in buildings

a. In accordance with European Commission Regulation No 622/2012 (amending 641/2009) implementing Directive 2009/125/EC with regard to ecodesign requirements for glandless circulators up to 2.5 kW:
   i. Standalone glandless circulators, other than those specifically designed for primary circuits of thermal solar systems and of heat pumps, should have an Energy Efficiency Index (EEI) no greater than 0.27.
   ii. Standalone glandless circulators and glandless circulators integrated in products should have an Energy Efficiency Index (EEI) no greater than 0.23.

b. Variable speed glandless circulators should be used on variable volume systems.

c. Water pumps should comply with the requirements of European Commission Regulation No 547/2012 implementing Directive 2009/125/EC with regard to ecodesign requirements for water pumps.

d. If a water pump is used on a closed loop circuit and the motor is rated at more than 750W, then it should be fitted with or controlled by an appropriate variable speed controller on any variable volume system. On water pump booster sets with an open loop circuit, the static head should be checked before an appropriate variable speed controller is used.

11. Lighting

11.1 Scope

11.1.1 These minimum requirements apply to lighting in buildings.

11.1.2 This Section considers:

i. general interior lighting and display lighting in case of buildings other than dwellings;
ii. internal and external lighting in case of dwellings.

11.2 Minimum energy performance requirements for lighting

11.2.1 In case of ***buildings other than dwellings***:

i. Interior lighting should meet the minimum standards for efficacy (averaged over the whole area of the applicable type of space in the building) and controls in Table 25. The lighting should be metered to record its energy consumption in accordance with the recommended minimum standards in Table 26.

ii. Display lighting, where provided, should be controlled on dedicated circuits that can be switched off at times when people will not be inspecting exhibits or merchandise, or being entertained.

Table 25 Minimum lighting efficacy with controls

General lighting in office, industrial and storage spaces		**Initial luminaire lumens/circuit-watt**
		60
Controls	**Control factor**	**Reduced luminaire lumens/circuit-watt**
A daylit space with photo-switching with or without override	0.90	54
B daylit space with photo-switching and dimming with or without override	0.85	51
C unoccupied space with auto on and off	0.90	54
D unoccupied space with manual on and auto off	0.85	51
E space not daylit, dimmed for constant illuminance	0.90	54
A + C	0.80	48
A + D	0.75	45
B + C	0.75	45
B + D	0.70	42
E + C	0.80	48
E + D	0.75	45
General lighting in other types of space		The average initial efficacy should be not less than 60 lamp lumens per circuit-watt
Display lighting		The average initial efficacy should be not less than 22 lamp lumens per circuit-watt

Table 26 Minimum standards for metering of general and display lighting

	Standard
Metering for general or display lighting	a. kWh meters on dedicated lighting circuits in the electrical distribution, or b. local power meter coupled to or integrated in the lighting controllers of a lighting or building management system, or c. a lighting management system that can calculate the consumed energy and make this information available to a building management system or in an exportable file format. (This could involve logging the hours run and the dimming level, and relating this to the installed load.)

11.2.2 In case of ***dwellings***:

Fixed internal and external lighting should meet the minimum standards for efficacy and controls in Table 27.

Table 27 Minimum standards for fixed internal and external lighting

	Minimum standard
Fixed internal lighting	a. For internal lights, provide low energy light fittings (fixed lights or lighting units) in the main dwelling spaces (excluding infrequently accessed spaces used for storage, such as cupboards and wardrobes). b. Low energy light fittings should have lamps with a luminous efficacy greater than 45 lamp lumens per circuit-watt and a total output greater than 400 lamp lumens. c. Light fittings whose supplied power is less than 5 circuit-watts are excluded.
Fixed external lighting	Where fixed external lighting is installed, provide light fittings with the following characteristics: a. Either: i. lamp capacity not greater than 100 lamp-watts per light fitting, and ii. all lamps automatically controlled so as to switch off after the area lit by the fitting becomes unoccupied, and iii. all lamps automatically controlled so as to switch off when daylight is sufficient. b. Or: i. lamp efficacy greater than 45 lumens per circuit-watt, and ii. all lamps automatically controlled so as to switch off when daylight is sufficient, and iii. light fittings controllable manually by occupants.