Technical Document F

Part 3: Technical Building Systems

May 2023

Technical Document F

Part 3: Technical Building Systems

Building & Construction Authority, Malta

May 2023

Preamble

This technical document establishes the minimum energy performance requirements for technical building systems applicable to new and renovated dwellings and non-residential buildings intended for human occupancy.

Technical Building Systems

3-1 SCOPING
The scope of these technical requirements, summary of minimum compliance levels and glossary of terms is described.

3-2 BOILERS
Minimum requirements for boilers used for space heating purposes and /or the production of domestic hot water in buildings

3-3 HEAT PUMPS
Minimum requirements for heat pump systems used for space heating purposes and /or the production of domestic hot water in buildings

3-4 UNDERFLOOR HEATING AND COOLING
Minimum requirements for underfloor heating systems used for space heating purposes in buildings

3-5 DOMESTIC HOT WATER: HEATING AND STORAGE
Minimum requirements/resume of domestic hot water generation and containment systems

3-6 SOLAR WATER HEATING
Minimum requirements for indirect solar water heating systems in buildings

3-7 COMFORT COOLING
Minimum performance requirements for mechanical comfort cooling systems

Contents

Part 3 : Technical Building Systems in Malta

3-1 Scoping

I. Minimum requirements for building services in residential and non-residential buildings 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 in Subsidiary Legislation 623.01

II. The requirements addressed in this document will apply for fixed dwelling and non-dwelling services which are being designed and/or installed in:

   a. **New residential and non-residential buildings**
   b. **Existing residential and non-residential buildings undergoing major renovation.**

III. The Ecodesign Directive 2009/125/EC provides a framework for establishing requirements for 'energy-related' products placed on the EU market. In addition, Regulation (EU) 2017/1369 of the European Parliament and of the Council of 4 July 2017 sets a framework for energy labelling and repeals Directive 2010/30/EU. Ecodesign and energy labelling requirements for different products can be found in the energy label and Ecodesign - energy efficiency products page of the official website of the European Union: https://ec.europa.eu/info/energy-climate-change-environment/standards-tools-and-labels/products-labelling-rules-and-requirements/energy-label-and-ecodesign/energy-efficient-products_en

IV. The Ecodesign and energy labelling requirements are coming into force from time to time. Where the energy efficiency requirements (or definitions) mandated by Ecodesign and energy labelling regulations differ from the requirements (or definitions) of this document, the Eco-design and energy labelling requirements (and definitions) shall prevail.

V. Any revised upgrades to the Ecodesign and energy labelling requirements superseding or complementing the regulations and requirements stated in this document are to be adhered to. The upgraded Ecodesign and energy labelling Regulations shall prevail and supersede the Regulations and requirements stated in this document.

VI. Ecodesign and energy labelling requirements referred to in this document are intended only to facilitate the implementation of the Ecodesign and energy labelling regulations. This document does not intend to replace the Ecodesign and energy labelling regulations or to provide "*interpretation*" beyond their intent. Any "*interpretation*" to the requirements provided in this document is superseded by the actual requirements of the regulations themselves. Furthermore, this document only provides the most relevant definitions and requirements of the Ecodesign and energy labelling Regulations in the context of this document.

VII. This document aims to define energy performance requirements for the various building services products and systems in a way that is consistent with the Energy Performance of Buildings (EPB) standards framework and their accompanying technical reports (refer to https://epb.center/epb-standards/). This document is however only intended to facilitate the implementation of the EPB standards and does not intend to replace in any way the EPB standards or to provide "*interpretation*" beyond their intent. Any "*interpretation*" to the EPB standards and/or their accompanying technical reports provided in this document is superseded by the actual EPB standards and/or their accompanying technical reports themselves. Furthermore, this document only cites the most relevant definitions and requirements of the EPB standards in the context of this document

3-2 Boilers

3.2.1 Scope

These minimum requirements apply to boilers used for space heating purposes and/or the production of domestic hot water in buildings, and are governed by Ecodesign Commission Regulation (EU) 813/2013.

3.2.2 Key terms

Combination heater means a space heater that is designed to also provide heat to deliver hot drinking or sanitary water at given temperature levels, quantities and flow rates during given intervals, and is connected to an external supply of drinking or sanitary water;

Seasonal Space Heating Energy Efficiency (SSHEE) is the ratio between the space heating demand for a designated heating season, supplied by a heater and the annual energy consumption required to meet this demand, expressed in percentage (%).

Type B1 boiler means a fuel boiler space heater incorporating a draught diverter, intended to be connected to a natural draught flue that evacuates the residues of combustion to the outside of the room containing the fuel boiler space heater, and drawing the combustion air directly from the room; a type B1 boiler is marketed as type B1 boiler only;

Type B1 combination boiler means a fuel boiler combination heater incorporating a draught diverter, intended to be connected to a natural draught flue that evacuates the residues of combustion to the outside of the room containing the fuel boiler combination heater, and drawing the combustion air directly from the room; a type B1 combination boiler is marketed as type B1 combination boiler only;

Useful efficiency means the ratio of the useful heat output and the total energy input of a boiler space heater, boiler combination heater or cogeneration space heater, expressed in percentage (%), whereby the total energy input is expressed in terms of Gross Calorific Value (GCV) and/or in terms of final energy multiplied by conversion coefficient (CC);

Water heating energy efficiency means the ratio between the useful energy in the drinking or sanitary water provided by a combination heater and the energy required for its generation, expressed in %;

3.2.3 Technologies and Plant considered in this section

a) Gaseous fuel boiler space heaters;
b) Gaseous fuel boiler combination heaters;
c) Liquid fuel boiler space heaters;
d) Liquid fuel boiler combination heaters;
e) Electric boiler space heaters;
f) Electric boiler combination heaters;
g) Cogeneration space heaters;
h) Cogeneration combination heaters;

3.2.4 Minimum Energy Performance Requirements for Boilers

i. All boilers installed shall be of the condensing type.

ii. 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**.

iii. For multiple-boiler systems, the boiler seasonal efficiency of each boiler should be not less than 91% (gross calorific value); and the overall boiler seasonal efficiency ofthe multiple-boiler system, should be not less than the value in **Table 1**.

iv. Minimum requirement for Seasonal Space Heating Energy Efficiency (SSHEE) ratings are indicated in **Table 2.**

v. The relevant minimum controls package in **Table 3** should be adopted.

vi. Each installation shall be accompanied by a declaration signed by the supplier/installer, that installed boiler system is conformant with Regulation 813/2013, where only condensing boilers shall be permitted in dwellings. Since locally, it is not the norm to install shared open flues within residential buildings, the exemption permitted in Regulation 813/2013 to install a non-condensing boiler in the event of a shared flue system **shall not be allowed**.

Table 1: **Minimum heat generator seasonal efficiency for boiler systems**

Fuel type	System	Fuel type
LPG	Single modulating condensing boiler ≤ 2MW output	95%
	Single modulating condensing boiler > 2MW output	92%
	Multiple/cascading condensing modulating boilers	91% for any individual boiler 92% for overall multi-boiler system
Light Heating Oil/Diesel	Single modulating condensing boiler	89%
	Multiple/cascading condensing modulating boilers	87% for any individual boiler 88% for overall multi-boiler system

Note:

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

i. 75% for independent gravity-fed boilers <20.5kW
ii. 85% for independent automatic pellet/woodchip boilers

Table 2: Space heater and combination heater products

Type	Minimum SSHEE (%)
Fuel boiler space heaters with rated heat output ≤ 70 kW and fuel boiler combination heaters with rated heat output ≤ 70 kW, except for type B1 boilers with rated heat output ≤ 10 kW and type B1 combination boilers with rated heat output ≤ 30 kW	86
Type B1 boilers with rated heat output ≤ 10 kW and type B1 combination boilers with rated heat output ≤ 30 kW	75
Fuel boiler space heaters with rated heat output > 70 kW and ≤ 400 kW and fuel boiler combination heaters with rated heat output > 70 kW and ≤ 400 kW	The useful efficiency at 100 % of the rated heat output shall not fall below 86 %, and the useful efficiency at 30 % of the rated heat output shall not fall below 94 %
Natural Gas, Oil, Diesel, LPG heat generators with an output of >400 kW (boilers and condensing boilers)	Not less than 80% from full load (100% load) to intermediate load (30% load)
Electric boiler space heaters and electric boiler combination heaters	36
Electric Warm air heater	31
Cogeneration space heaters	100

Note:

Seasonal Space heating energy efficiency class of heaters shall be Class A or better

Seasonal space heating energy efficiency for low temperature heat pumps and heat pump space heaters shall be Class B or better.

Water heating efficiency class of combination heater shall be Class B or better

Table 3: Minimum controls package for boilers and multiple-boiler systems

DHW System Type	Controls Package
Direct-fired circulator: LPG	a) Automatic thermostat control to shut off the burner/primary heat supply when thedesired 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/instantaneous 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 Time control.
Indirect-fired:LPG and oil	a) Automatic thermostat control to shut off the burner/primary heat supply when thedesired 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.
Electric Water Heater - Storage	a) Automatic thermostat control to interrupt the electrical supply when the desired storage temperature has been reached. b) High limit thermostat (thermal cut-out) to interrupt the energy supply if the system temperature gets too high. c) Manual reset in the event of an over-temperature trip.
Electric Water Heater - Instantaneous	a) 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.) b) Flow/pressure sensor that only allows electrical input should sufficiently flow through the unit be achieved.

3-3 Heat Pumps

3.3.1 Scope

i. These minimum requirements apply to heat pump systems used for space heating purposes and/or the production of domestic hot water in buildings, as identified in **Table 4**.

ii. In case of reverse cycle heat pumps that also provide cooling, Table 5 will show minimum SEER and SCOP requirements for systems units up to 12kW (40,000 BTU). For minimum cooling performance requirements of other systems, refer to Section 7.

Table 4: 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-air	Single package + variable refrigerant flow warm air systems	ISO 13256-2[c]
		Split package	
	Water-to-air	Single package + variable refrigerant flow warm air systems	SM EN 14511-3
	Air-to-air	Split package	
		Single package	SM EN 14511-3
Gas-engine-driven	Available as variable refrigerant flow warm air systems		Available as variable refrigerant flow warm air systems

Note:

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.*

3.3.2 Key Terms

Air conditioner means a device capable of cooling or heating, or both, indoor air, using a vapour compression cycle driven by an electric compressor, including air conditioners that provide additional functionalities such as dehumidification, air-purification, ventilation or supplemental air-heating by means of electric resistance heating, as well as appliances that may use water (either condensate water that is formed on the evaporator side or externally added water) for evaporation on the condenser, provided that the device is also able to function without the use of additional water, using air only;

Comfort fan as defined by Commission Regulation (EU) 206/2012 means an appliance primarily designed for creating air movement around or on part of a human body for personal cooling comfort, including comfort fans that can perform additional functionalities such as lighting;

Double duct air conditioner means an air conditioner in which, during cooling or heating, the condenser (or evaporator) intake air is introduced from the outdoor environment to the unit by a duct and rejected to the outdoor environment by a second duct, and which is placed wholly inside the space to be conditioned, near a wall;

Fan power input (P_F) as defined by Commission Regulation (EU) 206/2012 means the electric power input of a comfort fan in Watt operating at the declared maximum fan flow rate, measured with the oscillating mechanism active (if/when applicable).

Global warming potential (GWP) means the measure of how much 1 kg of the refrigerant applied in the vapour compression cycle is estimated to contribute to global warming, expressed in kg CO_2 equivalents over a 100-year time horizon. GWP of refrigerant gasses can also vary depending on the ratio of mixed gasses, however the following can be used for an indicative guidance in **Table 5**;

Table 5: Examples of GWP of different refrigerant gasses compared GWP of CO_2

Refrigerant	GWP equivalent of CO_2
R-32	675
R-134	1100
R-134a	1430
R-290 (propane)	3
R-717 (ammonia)	0

Off mode is a condition in which the air conditioner or comfort fan is connected to the mains power source and is not providing any function. Also considered as off mode are conditions providing only an indication of off mode condition, as well as conditions providing only functionalities intended to ensure electromagnetic

compatibility pursuant to Directive 2004/108/EC of the European Parliament and of the Council (3);
Rated capacity' (P_{rated}) means the cooling or heating capacity of the vapour compression cycle of the unit at standard rating conditions;

Reversible air conditioner means an air conditioner capable of both cooling and heating;

Seasonal energy efficiency ratio (SEER) is the overall energy efficiency ratio of the unit, representative for the whole cooling season, calculated as the Reference annual cooling demand divided by the annual electricity consumption for cooling;

Seasonal Coefficient of Performance (SCOP) is the overall coefficient of performance of the unit, representative for the whole designated heating season (the value of SCOP pertains to a designated heating season), calculated as the reference annual heating demand divided by the annual electricity consumption for heating;

Single duct air conditioner means an air conditioner in which, during cooling or heating, the condenser (or evaporator) intake air is introduced from the space containing the unit and discharged outside this space (such as portable conditioning units);

Standby mode means a condition where the equipment (air conditioner or comfort fan) is connected to the mains power source, depends on energy input from the mains power source to work as intended and provides only the following functions, which may persist for an indefinite time: reactivation function, or reactivation function and only an indication of enabled reactivation function, and/or information or status display;

3.3.3 Technologies and Plant considered in this section

a) Air-to-air heat pumps, driven by an electric motor;
b) Rooftop heat pumps;
c) Heat pump space heaters and heat pump combination heaters;
d) Low-temperature heat pumps (s.a. UFH);
e) Air-to-air heat pumps, driven by an internal combustion engine;
f) Water-to-air single split (non-VRF) heat pumps;
g) Water-to-air multi split /VRF heat pumps;

3.3.4 Minimum Energy Performance Requirements for Heat Pumps

i. Heat pumps should have an SCOP not less than that indicated in **Table 7,** SEER included for ease of reference. SSHEE should not be less than the value in **Table**

6 and feature as a minimum the controls package in **Table 8**. For convenience **Table 6** also features the SEER. **Table 9** shows the maximum **power consumption in off-mode and standby mode** for single, double duct air conditioners and comfort fans as covered by Ecodesign commission Regulation (EU) 206/2012.

ii. 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 feasible installations provide at least 50% of the heating and hot water demand for the building

Table 6: Requirements for minimum energy efficiency of air conditioners, double duct air conditioners and single duct air conditioners Rating in brackets are in line with Regulation 626/2011

	Air conditioners, except double and single duct air conditioners		**Double duct air conditioners**		**Single duct air conditioners**	
	SEER	**SCOP**	**EER $_{rated}$**	**COP $_{rated}$**	**SEER**	**SCOP**
for < 6 kW (ca. 20,000 BTU)	4.60 (B)	3.80 (A)	2.60 (A)	2.60 (B)	2.60 (A)	2.04 (B)
for < 12 kW (ca. 40,000 BTU)	4.30 (C)	3.80 (A)	2.60 (A)	2.60 (B)	2.60 (A)	2.04 (B)

Table 7: Minimum SSHEE for heat pumps

Heat pump type	**SSHEE%**
Air-to-air heat pumps, driven by an electric motor, except rooftop heat pumps	137
Rooftop heat pumps	125
Heat pump space heaters and heat pump combination heaters, except for low-temperature heat pumps	110
Low-temperature heat pumps (s.a. UFH)	125
Air-to-air heat pumps, driven by an internal combustion engine	130
Water-to-air single split (non-VRF) heat pumps	137
Water-to-air multi split /VRF heat pumps	141

Notes

1. **Ecodesign Requirements:** European Commission Regulation No 2016/2281 and 206/2012

Table 8: 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 forbuildings 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.

Table 9: Requirements for maximum power consumption in off-mode and standby mode for single and double duct air conditioners and comfort fans

Power Mode	Power Requirement
Off mode	Power consumption of equipment in any off-mode condition shall not exceed 0,50 W.
Standby mode	The power consumption of equipment in any condition providing only a reactivation function, or providing only a reactivation function and a mere indication of enabled reactivation function, shall not exceed 0,50 W. The power consumption of equipment in any condition providing only information or status display, or providing only a combination of reactivation function and information or status display shall not exceed 1,00 W.
Availability of standby and/or off mode	Equipment shall, except where this is inappropriate for the intended use, provide off mode and/or standby mode, and/or another condition which does not exceed the applicable power consumption requirements for off mode and/or standby mode when the equipment is connected to the mains power source.
Power management	When equipment is not providing the main function, or when other energy- using product(s) are not dependent on its functions, equipment shall, unless inappropriate for the intended use, offer a power management function, or a similar function, that switches equipment after the shortest possible period of time appropriate for the intended use of the equipment, automatically into: — standby mode, or — off mode, or — another condition which does not exceed the applicable power consumption requirements for off mode and/or standby mode when the equipment is connected to the mains power source. The power management function shall be activated before delivery.

3-4 Underfloor and Space Heating and Cooling

3.4.1 Scope

i. These minimum requirements apply to underfloor heating systems used for space heating and cooling purposes in buildings.

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

3.4.2 Key Terms

Circuit is a section of pipes connected to circuit distributor which can be independently switched and controlled.

Circuit distributor is a common connection point for several circuits.

Floor, wall, ceiling heating and cooling system is a system where pipes carrying water with or without additives as a heating or cooling medium are laid in the floor, wall or ceiling.

Surface embedded heating and cooling system is a heating or cooling installation embedded into the enclosure surfaces of the room which is adjoined to the structural base of the enclosure surfaces of the building, directly mounted or with fixing supports, without any open-air gap consisting of circuits of pipes, circuit distributors, control equipment and thermal diffusion layers.

Underfloor heating is in situ flooring constructed as an electrical underfloor heating system.

3.4.3 Technologies and Plant considered in this section

i. These minimum requirements apply to embedded heating and cooling systems used for space heating and cooling purposes in buildings.

ii. Minimum requirements for direct electrical room heating systems and hydronic radiant heating and cooling panel systems are also specified.

iii. Surface embedded heating and cooling systems considered in this section make use of:
   a. Hot/cold water pipes (termed '*water-based surface embedded heating and cooling systems*' for the scope of this document) or

b. Electricity (termed '*room under-floor heating systems*' for the scope of this document).

3.4.4 Minimum Energy Performance Requirements for Underfloor Heating

i. Underfloor heating systems should meet the minimum standards for:

a. controls and safe operating temperatures in **Table 10**;

b. floor insulation and system design to minimise distribution losses in **Table 11**. These minimum requirements shall supersede Table 2 and Table 3 requirements for Dwellings, and Table 2 for non-Dwellings.

c. Screed used should be specific to UFH applications, and should have minimal entrapped air.

Table 10: Minimum standards for control of wet and electric underfloor heating systems

Power Mode	Control Requirement
System temperature control: wet and electric underfloor and space 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: At an individual room level supply, for heating and for comfort, supplied temperature should never exceed 38 degrees 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 and space heating and cooling 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: wetelectric underfloor and space 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 tothe living area. b. Buildings with a total floor area >150 m^2 should have at least two space heatingzones with independent on/off time and temperature control. c. 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 and space 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 11: Minimum standards for floor insulation and minimising distribution losses in wet and electric underfloor heating systems

Installation Method	Insulation Requirements
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 2.3 m^2 K/W . This will require circa 80mm of XPS. 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 2.3 m^2 K/W. This will require circa 80mm of XPS.
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 1.5 m^2 K/W . This will require circa 50mm of XPS.
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 2.50 (m^2 K)/W. This will require circa 90mm of XPS.

3-5 Domestic Hot Water: Heating and Storage

3.5.1 Scope

i. These minimum requirements apply to domestic hot water (DHW) systems in buildings, as shown in Section 3.5.3. DHW systems considered in this Section are of theconventional direct and indirect gas-fired, oil-fired and electrically-heated types, having dedicated water heaters.

ii. 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.

iii. 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.

3.5.2 Key Terms

Conventional water heater means a water heater that generates heat using the combustion of fossil and/or biomass fuels and/or electric resistance heating elements;

Declared load profile means the load profile when determining water heating energy efficiency;

Fossil fuel means a gaseous or liquid fuel of fossil origin;

Heat Generator means the part of a water heater that generates the heat using one or more of the following processes:
(a) combustion of fossil fuels and/or biomass fuels;
(b) use of electric resistance heating elements;
(c) capture of ambient heat from an air source, water source or ground source, and/or waste heat;

Heat generator water heating energy means the water heating energy efficiency of a heat generator which is part of a solar water heater, expressed in %, established under average climate conditions and without using solar heat input**;**

Heat pump water heater means a water heater using ambient heat from an air source, water source or ground source, and/or waste heat for heat generation;

Hot water storage tank means a vessel for storing hot water for water and/or space heating purposes, including any additives, which is not equipped with any heat generator except possibly one or more back-up immersion heaters;

Smart control means a device that automatically adapts the water heating process to individual usage conditions with the aim of reducing energy consumption;

Standby power consumption as means the rated electrical power consumption of a solar water heater or solar-only system when the pump and the heat generator are inactive, expressed in W;

Standing loss means the heating power dissipated from a hot water storage tank at given water and ambient temperatures, expressed in W;

Storage Volume means the rated volume of a hot water storage tank or a storage water heater, expressed in litres;

Water Heater means a device that:

(a) is connected to an external supply of drinking or sanitary water;
(b) generates and transfers heat to deliver drinking or sanitary hot water at given temperature levels, quantities and flow rates during given intervals; and
(c) is equipped with one or more heat generators;

3.5.3 Technologies and Plant considered in this section

a) Water heaters using fossil fuels;
b) Electric water heaters;
c) Storage water heaters;
d) Hot Water Storage Tanks;

3.5.4 Minimum Energy Performance Requirements for Domestic Hot Water: Heating and Storage

i. Domestic hot water systems should meet the minimum standards for:
   a. heat losses from DHW storage vessels in **Table 12**.
   b. heat generator efficiency shall be as per **Table 1** of this document for fuel driven systems, **Table 2** for electrical heating element driven systems and **Table 7** for Heat Pump Driven systems.
   c. controls in **Table 13** and **Table 14**.

Table 12: Maximum Heat Loss 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 13: 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 14: 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*

3-6 Solar Water Heating

3.6.1 Scope

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

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

3.6.2 Key Terms

Solar water heater means a water heater equipped with one or more solar collectors, solar hot water storage tanks, heat generators and possibly pumps in the collector loop and other parts; a solar water heater is placed on the market as one unit;

3.6.3 Technologies and Plant considered in this section

a) Solar Water Heaters.

3.6.4 Minimum Energy Performance Requirements for Solar Water Heating

i. Indirect solar heating systems should meet the minimum standards for:
   a. circulation pump power, heat-exchanger sizing, system control in **Table 15.**

   b. insulating pipes in a solar primary and secondary systems shall be in line with **Table 22** and **Table 23** of this document. **All hot water distribution pipework shall be adequately insulated throughout, from generation, up to point of distribution**.

Table 15: Minimum standards for indirect solar water heating

System	Considerations
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.

3-7 Comfort Cooling

3.7.1 Scope

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

3.7.2 Key Terms

Air conditioner (rated capacity > 12 kW) means a cooling product that provides space cooling and: (a) of which the indoor side heat exchanger (evaporator) extracts heat from an air-based cooling system (heat source); (b) which has a cold generator that uses a vapour compression cycle or a sorption cycle; (c) of which the outdoor side heat exchanger (condenser) releases this heat to ambient air, water or ground heat sink(s) and which may or may not include heat transfer that is based on evaporation of externally added water; (d) may operate in reverse in which case it functions as a heat pump;

Air-to-air air conditioner (rated capacity > 12 kW) means an air conditioner which has a cold generator that uses a vapour compression cycle driven by an electric motor or internal combustion engine and whereby the outdoor side heat exchanger (condenser) allows heat transfer to air;

Air-to-air heat pump (rated capacity > 12 kW) means a heat pump which has a heat generator that uses a vapour compression cycle driven by an electric motor or internal combustion engine and whereby the outdoor side heat exchanger (evaporator) allows heat transfer from ambient air;

Comfort chiller means a cooling product:
(a) whose indoor side heat exchanger (evaporator) extracts heat from a water-based cooling system (heat source), designed to operate at leaving chilled water temperatures greater than or equal to + 2 °C;
(b) that is equipped with a cold generator; and
(c) whose outdoor side heat exchanger (condenser) releases this heat to ambient air, water or ground heat sink(s);

Fan coil unit means a device that provides forced circulation of indoor air, for the purpose of one or more of heating, cooling, dehumidification and filtering of indoor air, for the thermal comfort of human beings, but which does not include the source of heating or cooling nor an outdoor side heat exchanger. The device may be equipped with minimal ductwork to guide the intake and exit of air, including conditioned air. The product may be designed to be built in or may have an enclosure allowing it to be placed in the space to be conditioned. It may include an electric resistance heat generator designed to be used as back-up heater only;

Heat pump (rated capacity > 12 kW) means an air heating product:
(a) of which the outdoor side heat exchanger (evaporator) extracts heat from ambient air, ventilation exhaust air, water, or ground heat sources;
(b) which has a heat generator that uses a vapour compression cycle or a sorption cycle;
(c) of which the indoor side heat exchanger (condenser) releases this heat to an air-based heating system;
(d) which may be equipped with a supplementary heater;
(e) which may operate in reverse and in this case it functions as an air conditioner;

High temperature process chiller means a product:
(a) integrating at least one compressor, driven, or intended to be driven by an electric motor, and at least one evaporator;
(b) capable of cooling down and continuously maintaining the temperature of a liquid, to provide cooling to a refrigerated appliance or system, the purpose of which is not to provide cooling of a space for the thermal comfort of human beings;
(c) that can deliver its rated refrigeration capacity, at an indoor side heat exchanger outlet temperature of 7 °C, at standard rating conditions;
(d) that may or may not integrate the condenser, the coolant circuit hardware or other ancillary equipment;

Multi-split heat pump (rated capacity > 12 kW) means a heat pump incorporating more than one indoor unit, one or more refrigerating circuit, one or more compressors and one or more outdoor units, where the indoor units may or may not be individually controlled;

Primary energy consumption for electricity usage for the purpose of calculating SSHEE and SPCEE is obtained using Conversion Coefficient (CC), known also as Primary Energy Ratio, equal to 2.5

Rooftop heat pump (rated capacity > 12 kW) means an air-to-air heat pump, driven by an electric compressor, of which the evaporator, compressor and condenser are integrated into a single package;

Seasonal Coefficient of Performance (SCOP) is the overall coefficient of performance of a heat pump using electricity, representative of the heating season, calculated as the reference annual heating demand divided by the 'annual energy consumption for heating';

Seasonal Energy Efficiency Ratio (SEER) is the overall energy efficiency ratio of the air conditioner or comfort chiller, representative for the cooling season, calculated as the 'reference annual cooling demand' divided by the 'annual energy consumption for cooling';

Seasonal Space Cooling Energy Efficiency (SSCEE) means the ratio between the reference annual cooling demand pertaining to the cooling season covered by a

cooling product, and the annual energy consumption for cooling, corrected by contributions accounting for temperature control and the electricity consumption of ground water pump(s), where applicable, expressed in percentage (%);

Seasonal Space Heating Energy Efficiency (SSHEE) means the ratio between the reference annual heating demand pertaining to the heating season covered by an air heating product, and the annual energy consumption for heating, corrected by contributions accounting for temperature control and the electricity consumption of ground water pump(s), where applicable, expressed in percentage (%);

Warm air heater means an air heating product that transfers the heat from a heat generator directly to air and incorporates or distributes this heat through an air-based heating system.

Water/brine-to-air air conditioner (rated capacity > 12 kW) means an air conditioner which has a cold generator that uses a vapour compression cycle driven by an electric motor or internal combustion engine and whereby the outdoor side heat exchanger (condenser) allows heat transfer to water or brine;

3.7.3 Technologies and Plant considered in this section

a) Air-to-water chillers with rated cooling capacity, when driven by an electric motor;
b) Water/brine-to-water chillers with rated cooling capacity when driven by an electric motor;
c) Air-to-water comfort chillers, when driven by an internal combustion engine;
d) Air-to-air air conditioners, driven by an electric motor, except rooftop air conditioners;
e) Rooftop air conditioners;
f) Air-to-air air conditioners, driven by an internal combustion engine;
g) Water-to-air single split (non-VRF) heat pumps;
h) Water-to-air multi split /VRF heat pumps

3.7.4 Minimum Energy Performance Requirements for Comfort Cooling

i. 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.

ii. The full load energy efficiency ratio (SEER) of each cooling unit of the cooling plant should be no worse than shown in **Table 16**; and controls should be no worse than shown in **Table 17**.

Table 16: Minimum SSCEE for comfort cooling

Type	SSCEE
Air-to-water chillers with rated cooling capacity < 400 kW, when driven by an electric motor	161
Air-to-water chillers with rated cooling capacity ≥ 400 kW when driven by an electric motor	179
Water/brine-to-water chillers with rated cooling capacity < 400 kW when driven by an electric motor	200
Water/brine-to-water chillers with 400 kW ≥ rated cooling capacity < 1500 kW when driven by an electric motor	252
Water/brine-to-water chillers with rated cooling capacity ≥ 1500 kW when driven by an electric motor	272
Air-to-water comfort chillers, when driven by an internal combustion engine	154
Air-to-air air conditioners, driven by an electric motor, except rooftop air conditioners	189
Rooftop air conditioners	138
Air-to-air air conditioners, driven by an internal combustion engine	167
Water-to-air single split (non-VRF) heat pumps	200
Water-to-air multi split /VRF heat pumps	210

Notes

1. Due to their inefficient nature, Portable single-duct and multiple duct type AC should be discouraged, and should only be sued as a last resort.

Notes

1. **Ecodesign Requirements:** European Commission Regulation No 206/2012 sets standards for the SEER ofelectric 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 17: Minimum standards for indirect solar water heating

	Controls
Cooling plant	a. Multiple cooling units should be provided with control systems 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.

3-8 Air Distribution

3.8.1 Scope

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

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

ii. Ecodesign Commission Regulation (EU) 1253/2014 covers both Residential ventilation units (RVUs) and Non-Residential ventilation units (NRVUs).

iii. This Regulation shall not apply to ventilation units which the electric power input is less than 30W, per air stream (such as small bathroom extractor fans) or axial or centrifugal fans, which are only equipped with a housing. Article 1 of Ecodesign Commission Regulation (EU) 1253/2014 provides a comprehensive list of ventilation units excluded from the scope of this regulation.

3.8.2 Key Terms

Air conditioning system is a combination of appliances designed to supply conditioned air to a space.

Air distribution system in this section refers to either a ventilation system or an air conditioning system.

Air Handling Unit (real unit) is a factory-made encased unit serving as a prime mover of a ventilation or air conditioning installation where outdoor air, recirculated air or extract air is treated, consisting of a fan section where a filter section and heat exchanger may be connected. In addition, the unit may consist of an inlet section with one or more louvres and dampers, a mixing section, heat recovery section, one or more heating and cooling coils, humidifiers, sound attenuators and additional equipment such as controls, measuring sections etc.

Bidirectional Ventilation Unit (BVU) means a ventilation unit which produces an air flow between indoors and outdoors and is equipped with both exhaust and supply fans;

Design nominal air flow condition is the declared nominal air volume flow at a density of 1.2 kg m^{-3}.

Fan efficiency means the static efficiency including motor and drive efficiency of the individual fan(s) in the ventilation unit (reference configuration) determined at nominal air flow and nominal external pressure drop;

Heat Recovery System (HRS) means the part of a bidirectional ventilation unit equipped with a heat exchanger designed to transfer the heat contained in the (contaminated) exhaust air to the (fresh) supply air;

Internal pressure drop of ventilation components (expressed in Pa) means the sum of the static pressure drops of a reference configuration of a BVU or an UVU at nominal flow rate;

Internal specific fan power of ventilation components (SFP_{int}) (expressed in W/(m^3/s)) as is the ratio between the internal pressure drop of ventilation components and the fan efficiency, determined for the reference configuration;

Maximum Flow Rate is the declared maximum air volume flow rate of a ventilation unit that can be achieved with integrated or separately co-supplied controls at standard air conditions (20 °C) and 101325 Pa, where the unit is installed complete (e.g. including clean filters) and according to the manufacturer's instructions, for ducted RVUs the maximum flow is related to the air flow at 100 Pa of external static pressure difference, and for non-ducted RVUs to the air flow at the lowest achievable total pressure difference to be chosen from a set of values of 10 (minimum)-20- 50-100-150-200-250 Pa, whichever is equal or just below the measured pressure difference value;

Maximum internal specific fan power of ventilation components (expressed in W/(m^3/s)) is the specific efficiency requirement for SFP_{int} for VUs within the scope of this Regulation;

Minimum fan efficiency is the specific minimum efficiency requirement for VUs within the scope of this Regulation;

Multi-Speed drive means a fan motor that can be operated at three or more fixed speeds plus zero (‘off’);

Nominal electric power input (P) (expressed in kW) means the effective electric power input of the fan drives, including any motor control equipment, at the nominal external pressure and the nominal airflow;

Nominal flow rate (expressed in m^3/s) means the declared design flow rate of a NRVU at standard air conditions, 20°C and 101325 Pa, whereby the unit is installed complete (for example, including filters) and according to the manufacturer instructions;

Non-Residential Ventilation Unit (NRVU) means a ventilation unit where the maximum flow rate of the ventilation unit exceeds 250 m^3/h, and, where the maximum flow rate is between 250 and 1000 m^3/h, the manufacturer has not declared its intended use as being exclusively for a residential ventilation application;

Residential Ventilation Unit (RVU) means a ventilation unit where:
(a) the maximum flow rate does not exceed 250 m^3/h;
(b) the maximum flow rate is between 250 and 1 000 m^3/h, and the manufacturer declares its intended use as being exclusively for a residential ventilation application;

Specific Fan Power (P_{SFP}) is the amount of electric fan power divided by the air volume flow.

The specific fan power is a simple value to determine the efficiency of the air transportation in a given system. There are several ways to calculate depending on the individual needs of the system or product. Generally, the specific fan power is defined as:

$$P_{SFP} = \frac{P}{q_v} = \frac{\Delta p_{tot}}{\eta_{tot}} = \frac{\Delta p_{stat}}{\eta_{stat}}$$

Where:

P_{SFP} is the specific fan power in $W.m^{-3}$. s
P is the input power of the motor for the fan in W
q_v is the design air-volume-flow through the fan in $m^3.s^{-1}$
ΔP_{tot} is the total pressure difference across the fan
η_{tot} is the overall efficiency of the fan based on total pressure
ΔP_{stat} is the static pressure difference across the fan
η_{stat} is the overall efficiency of the fan based on static pressure

Thermal by-pass facility means any solution that circumvents the heat exchanger or controls automatically or manually its heat recovery performance, without necessarily requiring a physical airflow bypass (for example: summer box, rotor speed control, control of air flow);

Thermal efficiency of a non-residential HRS means the ratio between supply air temperature gain and the exhaust air temperature loss, both relative to the outdoor temperature, measured under dry reference conditions, with balanced mass flow, an indoor-outdoor air temperature difference of 20 K, excluding thermal heat gain from fan motors and from internal leakages;

Unidirectional Ventilation Unit (UVU) means a ventilation unit producing an air flow in one direction only, either from indoors to outdoors (exhaust) or from outdoors to indoors (supply), where the mechanically produced air flow is balanced by natural air supply or exhaust;

Variable-Air-Volume (VAV) system: HVAC system that controls the dry-bulb temperature within a space by varying the volumetric flow of heated or cooled supply air to the space.

Variable Speed Drive (VSD) means an electronic controller, integrated or functioning as one system or as a separate delivery with the motor and the fan, which continuously adapts the electrical power supplied to the motor in order to control the flow rate;

Ventilation system is a combination of appliances designed to supply interior spaces with outdoor air and to extract polluted indoor air.

Ventilation unit (VU) means an electricity driven appliance equipped with at least one impeller, one motor and a casing and intended to replace utilised air by outdoor air in a building or a part of a building;

3.8.3 Technologies and Plant considered in this section

a) Unidirectional ventilation units (UVUs);
b) Bidirectional ventilation units (BVUs);
c) central air conditioning systems;
d) central mechanical ventilation systems with heating, cooling or heat recovery;
e) all central systems not covered by c and d.;
f) zonal supply systems where the fan is remote from the zone, such as ceiling void or roof-mounted units;
g) zonal extract systems where the fan is remote from the zone;
h) local supply and extract ventilation units such as window, wall or roof units serving a single area (e.g. toilet extract);
i) other local ventilation units, e.g. fancoil units and fan assisted terminal variable air volume (VAV) units;
j) kitchen extraction, fan remote from zone with grease filter.

3.8.4 Minimum Energy Performance Requirements for Air Distribution

i. 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.

ii. In order to limit air leakage, air handling units and ventilation ductwork should be made and assembled so as to be reasonably airtight. The classification and testing of airtightness is defined in EN 1507 for rectangular ducts, EN 12237 for round ducts, EN 13180 for flexible ducts, EN 1751 for dampers and valves, EN 13403 for non-metallic ducts made from insulation duct boards and EN 15727 for non-metallic ducts made from plastics or composites predominantly made from plastics WI 00156179, of other components. Testing of installed systems in situ is described in EN 12599 and shall meet **air tightness class ATC4** as defined in EN 16798-3:2017, which is equivalent to the old **B** standard meaning that losses of **up to 2%** are accepted. This can be worked out using $0.009 \times p_t^{0.65} \times 10^{-3}$ yielding a figure in m^3s^{-1}/m^2

iii. To limit air leakage, air handling units shall be made and assembled to be reasonably airtight. This may be demonstrated by achieving **Class L2** air leakage as given in EN 1886:2007. This equates to a performance, equal to, or better than **$0.44ls^{-1}/m^2$**

when tested at a negative pressure of **-400Pa** and **0.63ls^{-1}/m^2** when tested at a positive pressure of **+700Pa**

iv. Air distribution systems shall 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 eco design requirements for energy-related products.

v. The specific fan power of air distribution systems at the design air flow rate should be no worse than in **Table 18**.

vi. 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 19**, the allowed specific fan powers may be increased by the amounts shown to account for the additional resistance.

vii. A minimum controls package should be provided as in **Table 20**.

viii. 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

Table 18: 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 19: 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 20: 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

3.8.5 Minimum Energy Performance Requirements for Heat Recovery in Air Distribution Systems

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

ii. The energy performance of NRVUs covered by Ecodesign Commission Regulation

(EU) 1253/2014 shall abide to but is not limited to the following requirements:

a) Requirement for all NRVUs, except dual use units, to be equipped with a **multi-speed drive or a variable speed drive**.

b) **All Heat recovery systems (except run-around) shall have a thermal efficiency of not less than 73%**

c) **A run-around Heat Recovery system shall have a thermal efficiency of not less than 68%**

d) Requirement for the HRS to have a **thermal by-pass facility.**

e) Minimum fan efficiency for unidirectional ventilation units **smaller than 30kW**, is not less than **6.2%xln(P)+42%,** and for units **larger than 30kW** not less than **63.1%**

f) If a filter unit is part of the configuration the product shall be equipped with a visual signaling or an **alarm in the control system** which shall be activated if the filter pressure drop exceeds the maximum allowable final pressure drop.

g) Maximum **internal specific fan power ($Wm^{-3}s^{-1}$)** of ventilation components for BVUs with run-around HRS with a flow rate of **less than $2m^3s^{-1}$** is **1,600+E-300x0.5q_{nom}-F**

h) Maximum **internal specific fan power ($Wm^{-3}s^{-1}$)** of ventilation components for BVUs with run-around HRS with a flow rate of **more than $2m^3s^{-1}$** is **1,300+E-F**

i) Maximum **internal specific fan power ($Wm^{-3}s^{-1}$)** of ventilation components for BVUs with other HRS with a flow rate of **less than $2m^3s^{-1}$** is **1,100+E-300x0.5q_{nom}-F**

j) Maximum **internal specific fan power ($Wm^{-3}s^{-1}$)** of ventilation components for BVUs with run-around HRS with a flow rate of **more than $2m^3s^{-1}$** is **800+E-F**

k) Not more than **230 $Wm^{-3}s^{-1}$ for UVU with filter**

3-9 Insulation for Pipework and Ductwork

3.9.1 Scope

i. These minimum requirements apply to insulation for all pipework and ducting serving space heating, domestic hot water and cooling systems in buildings. In general any containment conveying a conditioned fluid (air, water or otherwise) must be insulated.

ii. The insulation considered in this Section applies for:

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

c) Any other fluid conveyed by any means, where part of the process requires said fluid to be conditioned (heated or cooled) in order for it to serve its purpose.

3.9.2 Minimum Energy Performance Requirements for Insulation

i. Direct hot water and heating pipework:

a) 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'.

b) The heat losses shown in **Table 21** for different pipe sizes and temperatures should not be exceeded. **Table 23** provides indicative pipe insulation thicknesses for specific parameters.

ii. Cooling pipework:

a) 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.

b) The heat gains in **Table 22** for different pipe sizes and temperatures should not

be exceeded. **Table 23** provides indicative pipe insulation thicknesses for specific parameters.

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 losses for direct hot water and heating 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

Table 23: Maximum heat losses for direct hot water and heating pipes

Outside pipe diameter (mm)	HW Insulation Thickness [1]
17.2	23
21.3	25
26.9	27
33.7	29
42.4	30
48.3	32
60.3	33
76.1	35
88.9	35
114.3	36
139.7	37
168.3	38
219.1	38
≥273.0	39

[1] based on hot water at 60°C, ambient temp 15°C, Plastic pipes, λ = .035
[2] based on chilled water from 5 to 10 °C, ambient temp 25 °C, Plastic pipes, λ = .035

iii. Heating and Cooling Ductwork:

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

b) The heat losses or gains per unit area should not exceed the values in **Table 24**.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 24: Maximum heat losses and gains from 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.*

3-10 Heating and Cooling System Circulators and Water Pumps

3.10.1 Scope

i. These minimum requirements apply to:
   a) Circulators, as defined by Commission Regulation (EU) 622/2012 meaning, an impeller pump, with or without pump housing, which has the rated hydraulic output power of between 1 W and 2500 W and is designed for use in heating systems or in secondary circuits of cooling distribution systems, and;
   b) Water pump as defined by Commission Regulation (EU) 547/2012 is the hydraulic part of a device that moves clean water by physical or mechanical action utilising of one of the following designs:
   c) End suction own bearing (ESOB),
   d) End suction close coupled (ESCC),
   e) End suction close coupled inline (ESCCi),
   f) Vertical multistage (MS-V),
   g) Submersible multistage (MSS);

ii. These minimum requirements exclude:
   i. Water pumps designed specifically for pumping clean water at temperatures below – 10 °C or above 120 °C, except with regard to the information requirements of Regulation No 547/2012 Annex II, points 2(11) to 2(13);
   ii. Water pumps designed only for fire-fighting applications;
   iii. Displacement water pumps;
   iv. Self-priming water pumps.

3.10.2 Key Terms

Circulator means an impeller pump, with or without pump housing, which has the rated hydraulic output power of between 1 W and 2500 W and is designed for use in heating systems or in secondary circuits of cooling distribution systems;

Circulator integrated in a product means a circulator designed to operate as part of a product carrying at least one of the following design details:
(a) the pump housing is designed to be mounted and used inside a product;
(b) the circulator is designed to be speed controlled by the product;
(c) the circulator is designed for safety features not suitable for standalone operation (ISO IP classes);
(d) the circulator is defined as part of product approval or product CE marking;

Clean water means water with a maximum non-absorbent free solid content of 0.25 kg/m^3, and with a maximum dissolved solid content of 50 kg/m^3, provided that the total gas content of the water does not exceed the saturation volume. Any additives that are needed to avoid water freezing down to – 10 °C shall not be considered.

Displacement water pump means a water pump that moves clean water by enclosing a volume of clean water and forcing this volume to the outlet of the pump;

Drinking water circulator means a circulator specifically designed to be used in the recirculation of water intended for human consumption

End suction close coupled inline water pump (ESCCi) means a water pump of which the water inlet of the pump is on the same axis as the water outlet of the pump;

End suction close coupled water pump (ESCC) is an end suction water pump of which the motor shaft is extended to also become the pump shaft;

End suction own bearing water pump (ESOB) is an end suction water pump with own bearings;

End suction water pump means a glanded single stage end suction rotodynamic water pump designed for pressures up to 16 bar, with a specific speed n_s between 6 and 80 rpm, a minimum rated flow of 6 m^3/h (1.667l/s), a maximum shaft power of 150 kW, a maximum head of 90 m at nominal speed of 1450 rpm and a maximum head of 140 m at nominal speed of 2900 rpm;

Glanded means sealed shaft connection between the impeller in the pump body and the motor. The driving motor component remains dry;

Glandless circulator means a circulator with the rotor directly coupled to the impeller and the rotor immersed in the pumped medium;

Product means an appliance that generates and/or transfers heat;

'Specific speed' (n_s) means a dimensional value characterising the shape of the water pump impeller by head, flow, and speed (n):

$$n_s = n \left[\frac{\sqrt{Q_{BEP}}}{\left({}^{1}/_{i} . H_{BEP}\right)^{0.75}} \right] min^{-1}$$

where:

- 'Head' (H) means the increase in the hydraulic energy of water in meters [m], produced by the water pump at the specified point of operation,
- 'Rotational speed' (n) means the number of revolutions per minute [rpm] of the shaft,
- 'Flow' (Q) means the volume flow rate [m 3 /s] of water through the water pump,
- 'Stage' (i) means the number of series impellers in the water pump,
- 'Best efficiency point' (BEP) means the operating point of the water pump at which it is at the maximum hydraulic pump efficiency measured with clean cold water,

Rated flow means the head and flow that the manufacturer will guarantee under normal operating conditions;

Rotodynamic water pump means a water pump that moves clean water by means of hydrodynamic forces;

Self-priming water pump means a water pump that moves clean water, and which can start and/or operate also when only partly filled with water;

Standalone circulator means a circulator, designed to operate independently from the product;

Submersible multistage water pump (MSS) means a multistage (i > 1) rotodynamic water pump with a nominal outer diameter of 4" (10.16 cm) or 6" (15.24 cm) designed to be operated in a borehole at nominal speed of 2900 rpm, at operating temperatures within a range of 0 °C and 90 °C;

Vertical multistage water pump (MS-V) means a glanded multistage (i > 1) rotodynamic water pump in which the impellers are assembled on a vertical rotating shaft, which is designed for pressures up to 25 bar, with a nominal speed of 2900 rpm and a maximum flow of 100 m^3 /h (27.78l/s);

Water pump is the hydraulic part of a device that moves clean water by physical or mechanical action and is of one of the following designs:
— End suction own bearing (ESOB),
— End suction close coupled (ESCC),
— End suction close coupled inline (ESCCi),
— Vertical multistage (MS-V),
— Submersible multistage (MSS);

3.10.3 Technologies and Plant considered in this section

a) heating system glandless circulators, both standalone and integrated in products;
b) heating and cooling system water pumps.

3.10.4 Minimum Energy Performance Requirements for Fluid Circulators and Pumps

Heating system glandless circulators and heating and cooling system water pumpsshould meet the minimum standards as hereunder:

i. 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:
   a) **Standalone glandless circulators**, other than those specifically designed for primary circuits of thermalsolar systems and of heat pumps, should have an **Energy Efficiency Index (EEI) no greater than 0.27**.
   b) **Standalone glandless circulators and glandless circulators integrated in**

products should have an **EnergyEfficiency Index (EEI) no greater than 0.23.**

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

iii. 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.

iv. If a water pump is used on a closed loop circuit and the motor is rated at more than 750W (1HP), 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.

3-11 Lighting

3.11.1 Scope

i. These minimum requirements apply to lighting in buildings.

ii. This Section considers:

a) general interior lighting and display lighting in case of buildings other than dwellings;

b) internal and external lighting in case of dwellings.

3.11.2 Minimum Energy Performance Requirements for Lighting

i. In case of ***buildings other than dwellings***:

a) 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**.

b) 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.

c) The following lux levels shown in **Table 27** can be used as an indication as per CIBSE Guide A. Overdesigning is not suggested unless for valid reasons, such as health.

Table 25: 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. b. Low energy light fittings should have lamps with a luminous efficacy greater than 85 lumens per circuit-watt. c. Light fittings whose sole purpose if to provide temporary lighting for wardrobes and cabinetry shall be excluded from these requirements.
Fixed external lighting	a. All lamps are controlled by a timer delay presence sensor that switches off the fitting once area becomes unoccupied, and/or b. All lamps automatically controlled so as to switch off when daylight is sufficient, and/or c. Light fittings are installed on a timer over riding manual controls. d. Lamp efficacy shall be greater than 85 lumens per circuit-watt
Display Lighting	a. Lamp efficacy shall be greater than 85 lumens per circuit-watt b. All lamps automatically controlled so as to switch off when daylight is sufficient

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 lightingor 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 fileformat. (This could involve logging the hours run and the dimming level, and relating this to the installed load.)

Table 27: Non-Dwelling Light Level Guidance

Room Type	Lux Level
Bank Circulation Space	300
Bar	100-200
Seminar Rooms	300
Exhibition Hall	300
Garages	75-300
Commercial Kitchens	500
Public Toilets	200
Waiting Areas	200
Office Space	300-500
Restaurants	50-200

ii. In case of ***dwellings:***

a) Fixed internal and external lighting should meet the minimum standards for efficacy and controls in **Table 28**.

Table 28: 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. b. Low energy light fittings should have lamps with a luminous efficacy greater than 85 lumens per circuit-watt. c. Light fittings whose sole purpose if to provide temporary lighting for wardrobes and cabinetry shall be excluded from these requirements.
Fixed external lighting	a. All lamps are controlled by a timer delay presence sensor that switches off the fitting once area becomes unoccupied, and/or b. All lamps automatically controlled so as to switch off when daylight is sufficient, and/or c. Light fittings are installed on a timer over riding manual controls. d. Lamp efficacy shall be greater than 85 lumens per circuit-watt

b) The following lux levels shown in **Table 29** can be used as an indication as per CIBSE Guide A. Overdesigning is not suggested unless for valid reasons, such as health.

Table 29: Dwelling Light Level Guidance

Room Type	Lux Level
Bedroom	100
Bathroom	150
Hall	100
Kitchen	150-300
Living Rooms	50-300
Stairs	100
Toilets	100