

Product Fact Sheet – Air Conditioning: Central (ducted) air conditioning

Table 19. Overview of Central (ducted) air conditioning

Country	MEPS	High Label	S&L metric ¹	Test procedure	Reference test procedure & metric	Test Procedure (*) ²	Energy Performance Metric (*) ³	Notes
China	2.9 - 3.2	3.3 - 3.6 / (5.2)	SEER	GB/T 18836;	ISO13253:1995	N/A	N/A	Ducted, unitary type
China	2.7 - 2.8	3.5-3.6	IPLV ¹	GB/T 18837	ISO 13253 (T1)	N/A	N/A	Multi-connected type
EU	2.16 - 3.6	≥4.1 - ≥ 8.5	SEER ²	Based on EN 14 511:2004; EN12309-2:2000	Eurovent (EN14511-1 (2011))	N/A	N/A	ISO 5151 2010 closely aligned to EN 14511
Mexico		N/A	SEER	NOM-011-ENER-2006	ASHRAE-37:2005	N/A	N/A	Central, packaged or split
US	3.1 - 3.8	≥14.5 (≥ 12); [4.2/(3.5)] ≥14 (≥ 11); [4.1 / (3.2)]	SEER	ISO 5151 T1 for water-cooled; Splits, AHRI 210/240-2006	AHRI 210/240 (2008), ASHRAE-37:2005	N/A	N/A	Central air conditioners (includes split units)
Australia	3.2 - 3.5	5.25	SEER, IPLV	AS/NZS 4776.1.1 and AS/NZS 4776.1.2	AHRI 550/590, ASHRAE 90.1 and Eurovent (EN14511-1 (2011))	N/A	N/A	Liquid chilling packages

Notes:

1. Integrated part load value
2. This refers to ENTR Lot 6 air conditioners >12kW.

(*) Conversion factors

Product

1. An air conditioner is an appliance designed to maintain the temperature of indoor air at a given temperature level for a given heat load to be extracted. There are different types of residential air conditioners. Central air conditioners are generally heat pumps or cooling units installed as part of a building's central heating and cooling system. They use ducts to distribute cooled or dehumidified air to more than one room.

Overview of international situation with regards to S&L for this product category

1. There are some similarities in the test procedures in China, the US, EU and Australia, however significant differences exist, and have not been quantified.

General description of conversion for test procedures and metrics/ efficiency metrics and standards

1. There is very limited information available to develop conversion factors for central air conditioning units. No conversion factors between economies could be determined.

Notes and assumptions

EU: in the EC's Working Document on air heating products, cooling products and high temperature process chillers, EN 14825:2012 is provisionally used as a basis for core test point measurements for comfort chillers, air conditioners and heat pumps, however the efficiency metric is developed further by the regulation itself, to consider e.g. conversion to primary energy; ISO WG3 is developing a new standard for air conditioners/heat pumps with part loads, which may reference EN 14825 and ISO 16358 (see SEAD reference, EU in sources below); EN14511:2007 used in regulation (EU) No 626/2011 on (ducted) room air conditioners, can be found in the Room Air Conditioners fact sheet.

Mexico: Mexico's mandate for Energy Efficiency Standards comes from a generic law, the 'Ley Federal sobre Metrología y Normalización' (Federal Metric and Standardization Law) of July 16, 1992, which defines the Normas Oficiales Mexicanas - NOM (Official Mexican Standards). In general, Mexico adopted energy standards in 1995 and has since established standards for eighteen products. Many of their standards are modeled on those of the US, but have been adapted to local situations and experience from their own program (see APERC source, below). The Mexican standard makes reference to ANSI / ASHRAE 37 Methods of testing for rating unitary air conditioning and heat pump equipment, - also used in US - however the exact relationship has not been assessed.

ANSI / ASHRAE 37: permits the indoor enthalpy test method only - unlike ISO 5151, which also describes the calorimeter room method.

China: GB/T 18836 is for Ducted air-conditioning (heat pump) units, references standard ISO 13253; GB/T 18837 is for multi-connected air-conditioner unit. Direct references to ISO 13253 or ISO 5151 have not been found, although the testing document (see sources below) does refer to the climate type of T1, which may be that of either ISO standard. This standard has been revised by: ISO 13253:2011

Australia: for liquid chilling packages, Australia does appear to accept products tested in accordance with AHRI 550/590, ASHRAE 90.1 and Eurovent (which in turn refers to definitions in EN14511-1 (2011), using ESEER, European Seasonal Energy Efficiency Ratio). Fact sheet: http://www.energyrating.gov.au/wp-content/uploads/Energy_Rating_Documents/Fact_Sheets/Cooling/Chillers/factsheet-chiller-standards-regs.pdf

List of sources

Australia: Eurovent: http://www.eurovent-certification.com/en/Certification_Programmes/Programme_Descriptions.php?lg=en&rub=03&srub=01&select_prog=LCP-HP**Mexico:** test method: http://translate.google.co.nz/translate?hl=en&sl=es&u=http://www.conae.gob.mx/work/sites/CO_NAE/resources/LocalContent/6933/11/NOM011ENER2006.pdf&prev=/search%3Fq%3DNOM-011-ENER-2006%26rlz%3D1C1AVNC_enNZ558NZ558%26espv%3D210%26es_sm%3D122APEC (http://aperc.ieej.or.jp/file/2012/12/28/Mexico_2011.pdf)

EU: EC Working Document (Central AC): '20130717_Lot21_ED'; SEAD document Air conditioner webinar (26 Nov, 2013), slide 30

Other: CLASP (2011-2012), Cooling Benchmarking Study

CLASP (2013) Air conditioning Mapping Report: An overview of the Russian market

China: China Energy labeling website (<http://www.energylabel.gov.cn/en/EnergyEfficiencyStandards>); GB/T 18837 <http://www.energylabel.gov.cn/en/images/upFile/634643386875076250.pdf>; GB/T 18837 and GB/T 18836: http://www.energyrating.gov.au/wp-content/uploads/Energy_Rating_Documents/Library/Cooling/Air_Conditioners/2004ac-international-yuezhan.pdf <http://www.energylabel.gov.cn/en/EnergyEfficiencyStandards/FormulationandRevisionofStandards/detail/721.html>

EU: Ecodesign Working Document '20130717_Lot21_TransMethod' p5 on central air conditioning equipment; Working Document on MEPS: '20130717_Lot21_ED'

EU: Regulation (EU) No 626/2011 of 4 May 2011 on room air conditioners (included ducted AC)

US: Central AC: CLASP RAC benchmarking_3 - Testing component 2012

Product Fact Sheet – Air Conditioning: Room air conditioners

Table 20. Overview of Room air conditioners

Country	MEPS	High Label	S&L metric	Test procedure	Reference test procedure & metric	Test Procedure (*)	Energy Performance Metric (*)	Notes
India	2.7	3.3-3.5	EER	IS 1391-1:2005 Part 1 Unitary air conditioners; IS 1391-2:2004 Split air conditioners	Both parts are partially based on ISO 5151	1	N/A	It is not clear from info available how the two standards differ
China		N/A	EER	GB/T 7725-2004; GB 12021.3-2010	ISO 5151: 1994 T1 test condition	1	1.01	Directly comparable with the EU, US, and Japanese steady state requirement.
EU	3.24-3.6	≥ 8.5	SEER	EN 14825	ISO 5151	1	1.13	Differences unknown
South Africa		N/A	N/A	N/A	N/A	N/A	N/A	See notes below
Indonesia		≥12.83 (inverter) ≥10.41 (no inverter)	EER	SNI 04 - 6958-2003	ISO 5151: 2010	1	N/A	
US	2.34 - 2.87	2.8 / (9.4); [2.8 / (9.4)] - 3.2 / (10.8); [2.8 / (9.4)]	EER	ASHRAE-37-1988 or ISO 5151	ISO 5151 T1 class	1.0096(**)	1	Water cooled unit test differs from ISO
Australia	N/A	N/A	EER/AEER	AS/NZS 3823.1.1-1.4	ISO 5151 (non-ducted) ISO 13253 (ducted)	1	N/A	Non-ducted wet bulb conditions differ to ISO 5151

Mexico	N/A	N/A	EER	NOM-023-ENER-2010	ISO 5151	1.0096**	1	Likely aligned with the US
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(*) Conversion factors

(**) $EER_{NAFTA} = EER_{T1} * 1.0096$

Product

1. An air conditioner is an appliance designed to maintain the temperature of indoor air at a given temperature level for a given heat load to be extracted. There are different types of residential air conditioners. Residential room air conditioners are mounted in windows or through walls and deliver conditioned air to enclosed spaces. Room air conditioners typically extract heat from the room and vent it outdoors. These products are offered in a broad range of sizes and configurations. They are used in homes, apartments, and commercial settings.

2. Room air conditioners include the following: Split-packaged units (also called mini-split or duct free split on the US market); Multi Split packaged units; Single packaged units (typically window air conditioners in Europe, but also packaged terminal air conditioners on the US market); Single duct units; Double duct units; Residential chillers.

Overview of international situation with regards to S&L for this product category

Relative to other product areas, coverage of S&L policies for room AC is expansive: all economies in this study except Russia have introduced requirements for room air conditioners.

1. The great majority of economies reviewed use ISO 5151 at least as the dominant procedure underlining their test procedures.

2. Testing procedures have been converging towards the EER testing procedure from ISO5151, however the annual/seasonal SEERs are beginning to be adopted, and are the focus of future development. This may actually increase differences between requirements, as different economies so far tend to adopt different SEER efficiency metrics. The key areas where potential differences may remain between standards relate to fair reflection of climatic conditions between economies, although these can be standardized/accommodated in a harmonized standard (via a climate zone approach). However the other key issue is the choice of method used within the standards - including ISO 5151 and EN14511, where often either the calorimeter room method or the indoor air enthalpy method may be used: the former is considered more reliable.

3. **Australia:** The Equipment Energy Efficiency (E3) Program is a joint initiative of the Australian, Commonwealth, State and Territory governments and the New Zealand Government. Australian legal instruments fall under the Australian Greenhouse and Energy Minimum Standards (GEMS) Legislation.

4. **China:** Article 14 of the e 1997 National Energy Conservation Law of China (revised 2008) provides the regulatory basis for mandatory energy efficiency standards for energy-consuming products and equipment. China National Institute of Standardization (CNIS) has been revising single-period mandatory energy efficiency standards and developing new standards to follow international best practice while the China Standards Certification Center has launched a new voluntary energy efficiency endorsement labeling program targeting the top 25% most efficient products. The mandatory categorical energy information label known as the China Energy Label was established in 2005. The MEPS program aims to remove the 20% least-efficient products from the markets

targeted. The SEAD Room Air Conditioners report provides further detail.

5. **India:** India has a national standard body, BIS, responsible for formulating and implementing national standards, and production, quality and EMS certification. The Bureau of Energy Efficiency is responsible (under the Energy Conservation Act, 2001) for the Standards and Labeling Program. Laboratories are accredited by the National Accreditation Board.
6. **Mexico:** Mexico's mandate for Energy Efficiency Standards comes from a generic law, the Ley Federal sobre Metrología y Normalización (Federal Metric and Standardization Law) of July 16, 1992, which defines the Normas Oficiales Mexicanas - NOM (Official Mexican Standards). In general, Mexico adopted energy standards in 1995 and has since established standards for eighteen products. Many of their standards are modeled on those of the US, but have been adapted to local situations and experience from their own program (see APERC source, below).
7. **Russia:** GOSTANDART regulations, (prefixed with GOST), contain product energy performance requirements and describe the product's energy test procedure. Mandatory MEPS introduced in the 1980's were converted to voluntary requirements in 2002, but were not effectively implemented. New energy-performance labeling requirements were introduced in 2011 (see CLASP source, below).

General description of conversion for test procedures and metrics/ efficiency metrics and standards

1. ISO 5151 is the procedure common to all local test procedures reviewed, at least in part and is therefore the logical reference. A robust analysis of these standards was carried out by CLASP in its 2012 Benchmarking Study of Room Air Conditioners. Where differences do exist, they are noted in the table above. The specific impact of these differences has not been established, except in the US's case.

Notes and assumptions

India: According to the CLASP 2011 RAC Benchmarking study, the India standards are 'partially based on ISO 5151'. The key apparent difference is that in the India standard, outdoor air humidity is higher (wet bulb). Refrigerant piping is also shorter. It is assumed in the conversion factor that the impacts are small, but significant.

China: Uses the ISO 5151 test standard - no conversion needed

EU: Used ISO 5151 in previous requirements, however, new requirements use an ESEER where each test point is tested using the same method but often different test conditions to ISO5151 and then aggregated differently. New requirements also include standby energy demand.

Single and double-ducted RAC uses the EER metric based on prEN14825:2010 and possibly EN14511:2007, likely to be directly comparable with the ISO 5151 steady state climate class T1 procedure.

Indonesia: Uses the ISO 5151 test standard - no conversion needed

Mexico: NOM-023-ENER-2010 (split type air conditioners) cites ISO 5151 as one of its core references (see sources section below), however the precise relationship between the two test procedures has not been assessed.

South Africa: MEPS are in place in South Africa, however the test used is not known



US: test conditions are very similar ISO 5151 except for a variation in the indoor wet bulb temperature. A test procedure conversion factor, reported in the 2012 CLASP Study is assumed:
 $EER_{NAFTA} = EER_{T1} * 1.0096$

Australia: ISO 5151 is used for non-ducted units, while ISO 13253 is used for ducted units.

List of sources

General: CLASP (2011), Cooling Benchmarking Study;
<http://www.clasponline.org/en/Resources/Resources/PublicationLibrary/2012/Cooling-Benchmarking-Study.aspx>

Cooling the planet, Opportunities for Deployment of Super Efficient Air Conditioners, SEAD/LBNL, April 2013,
<http://www.superefficient.org/Activities/Technical%20Analysis/SEAD%20Room%20Air%20Conditioners%20Report.aspx>

Australia: <http://www.energyrating.gov.au/regulations/product-standards/overview/asnz3823/>

China: China Energy labeling website
(<http://www.energylabel.gov.cn/en/EnergyEfficiencyStandards>); Institutional background:
<http://eneken.ieej.or.jp/data/3694.pdf>

Mexico: http://aperc.ieej.or.jp/file/2012/12/28/Mexico_2011.pdf; reference to ISO 5151:
http://dof.gob.mx/nota_detalle.php?codigo=5171765&fecha=20/12/2010

Russia: CLASP (2013) Air conditioning Mapping Report: An overview of the Russian market



Product Fact Sheet – Air Conditioning: Chillers

Table 21. Overview of Chillers

Country	MEPS	High Label	S&L metric	Test procedure	Reference test procedure & metric	Test Procedure (*)	Energy Performance Metric (*)	Notes
India	2.9/3.16 - 6.3/6.61		COP	ASHRAE 90.1-2004	ASHRAE 90.1-2004	N/A	N/A	Procedure may have been updated to a localized variant
China	2.4 - 4.2	3.2 - 6.1	COP	GB 19577-2004;	GB/T 18430.1 GB/T 18430.2 GB 18070	N/A	N/A	Vapor-compression air and water chillers
EU	N/A draft		Seasonal energy performance ratio	EC Working Document '20130717_Lot2 1_ED'	EN 14825:2012	N/A	N/A	High temperature chiller (process chilling)
EU	N/A draft		SEPR	Annex III, EC Working Doc "CF Ecodesign Lot1isc (Jun2013)"	unknown	N/A	N/A	Low, medium temperature chiller (process chilling)
Australia	2.7 (5.0) / 3.7 (5.5) - 2.7 (6.0) / 4.1 (6.5)		COP	AS/NZS 4776	Possibly AHRI 550/590	N/A	N/A	Chiller

(*) Conversion factors

Product

1. Chillers produce water that is used by building space cooling equipment and many industrial processes.

Overview of international situation with regards to S&L for this product category

1. Standards and/or labels are in place in India, China and Australia. MEPS are in draft form in the EU. The US has ASHRAE 90.1, which is a non-binding industry standard for the efficient design of buildings and building systems.

2. There appears to be some confluence in standards towards seasonal performance metrics. However; there are no available sources describing a comparison of these test procedures and a newly developed comparison would require an in-depth assessment of test protocols and results which is beyond the scope of this study.

Notes and assumptions

EU: the 'high temperature chiller' is divided into 2 groups: 1) chillers used for space cooling: includes air-to-water chillers (electric driven motor), water/brine-to-water chillers (electric driven motor), and air-to-water chillers (electric or fuel driven motor), all up to 2 MW cooling capacity. The efficiencies of these products are determined by a seasonal metric related to space cooling loads. For comfort cooling (and not process) chillers, MEPS are determined in part by the GWP of the refrigerant used; 2) high temperature process chiller (electric driven motor) - are intended for industrial process cooling. EN 14825:2012 is cited as a transitional method and is not available. It is applicable in all cases, with the exception of liquid or gaseous fuel sorption heat pumps, where EN 12309 is applicable. The energy efficiency metrics in the EC Working Document build upon these test methods; however the exact relationship is unclear.

Given the concurrent development/review of the EU's SEER - EN 14825:2012 and ISO 5151, and that the steady state conditions of related EERs are the same, it is likely that these two standards also share much in common. However a new EU standard is being developed, and the SEER MEPS calculation in the EU draft regulation includes additional factors relating to temperature control, ground water pump electricity consumption (where applied) and; it is expressed in primary energy terms.

India: Appears to have developed its own standards, due for release in March 2013 - evidence of which has not been found - but it is likely to have been based on the ASHRAE standard.

Australia: According to AHRI/Eurovent: "The rating and testing standards of the Air-Conditioning, Heating and Refrigeration Institute of the US (AHRI) and the European Committee of Air Handling and Refrigeration Equipment Manufacturers (Eurovent) were used as a basis for the Australian/New Zealand Standards".

China: GB/T 18430.1 (commercial/industrial packaged chiller/heat pump applications), GB/T 18430.2 (household equivalent), and GB/T 18430.1 GB/T 18430.2 for positive displacement & centrifugal water-chilling packages/heat pumps refer to GB 19577-2004 (coefficient of performance test) to demonstrate compliance with the Water Chillers Energy Efficiency Label (not freely available). These standards appear to be based on ASHRAE 30-1995 (see sources below).

List of sources

EU: EC working documents '20130717_Lot21_TransMethod' (test methods); '20130717_Lot21_ED' (Ecodesign and test methods)

India:

http://www.rehva.eu/fileadmin/events/eventspdf/REHVA_Seminar_Brussels_18.10.2012/Indian_building_energy_efficiency_and_HVAC_policies_and_standards_codes_system.pdf

Australia: <http://www.energyrating.gov.au/products-themes/cooling/chillers/meps/>

EU: EC Ecodesign Working Document '20130717_Lot21_ED'

China: GB 19577-2004 (coefficient of performance) referred to in

<http://www.energylabel.gov.cn/en/images/upFile/634643387755076250.pdf>;

MEPS and label thresholds:

<http://www.energylabel.gov.cn/en/EnergyEfficiencyStandards/FormulationandRevisionofStandards/detail/734.html>;

Reference to ASHRAE:

http://www.clasponline.org/en/Resources/Resources/StandardsLabelingResourceLibrary/2011/-/media/Files/SLDocuments/2011-03_HarmonizationStudy/HarmonizationStudy-Part2/CLASP_HarmonizationStudyP2_AppendixA.pdf

