MALAYSIAN STANDARD
MS 1525 : 2019
(THIRD REVISION)

CODE OF PRACTICE ON ENERGY EFFICIENCY AND USE OF RENEWABLE ENERGY FOR NON-RESIDENTIAL BUILDINGS

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MALAYSIAN STANDARD
MS 1525 : 2019
(THIRD REVISION)

Chapter 8
ACMV

ASHRAE™

Ir Chen Thiam Leong
DL.F.ASHRAE, FIFireE, FIEM, PE, CE.

CONTENTS

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Major modifications for Chapter 8

a) Wet bulb temperature for Outdoor Design Parameters is revised to 28.0 ^{0}C (previous 27.2 ^{0}C) arising from data presented by the Malaysian Meteorological Department for the period 1981 to 2017.

b) Elaboration on hydronic system on pumping system efficiency to cover all flowrate conditions.

c) Incorporation of fan efficiency grade (FEG) for fan performance.

d) Inclusion of air filter efficiency.

e) Reclassification of ACMV systems into Unitary System and Central System.

Major modifications for Chapter 8 cont'd

f) Introduction of Cooling Seasonal Performance Factor (CSPF).

g) Expansion and revision of Table 22 (previous 21) on Unitary air conditioners, electrically driven: Minimum CSPF - cooling

h) Revision of Table 24 (previous 23) on Water chilling packages, electrically driven: Chiller energy performance rating

i) Revision of Table 26 (previous 25) on ACMV Applied System heat-operated[b]: Minimum COP[c] - cooling

j) Elaboration of System testing and commissioning; Operation and maintenance manual and as-built drawings; as well as Preventive maintenance.

k) New clause on Life cycle analysis.

8. Air-conditioning and mechanical ventilation (ACMV) system

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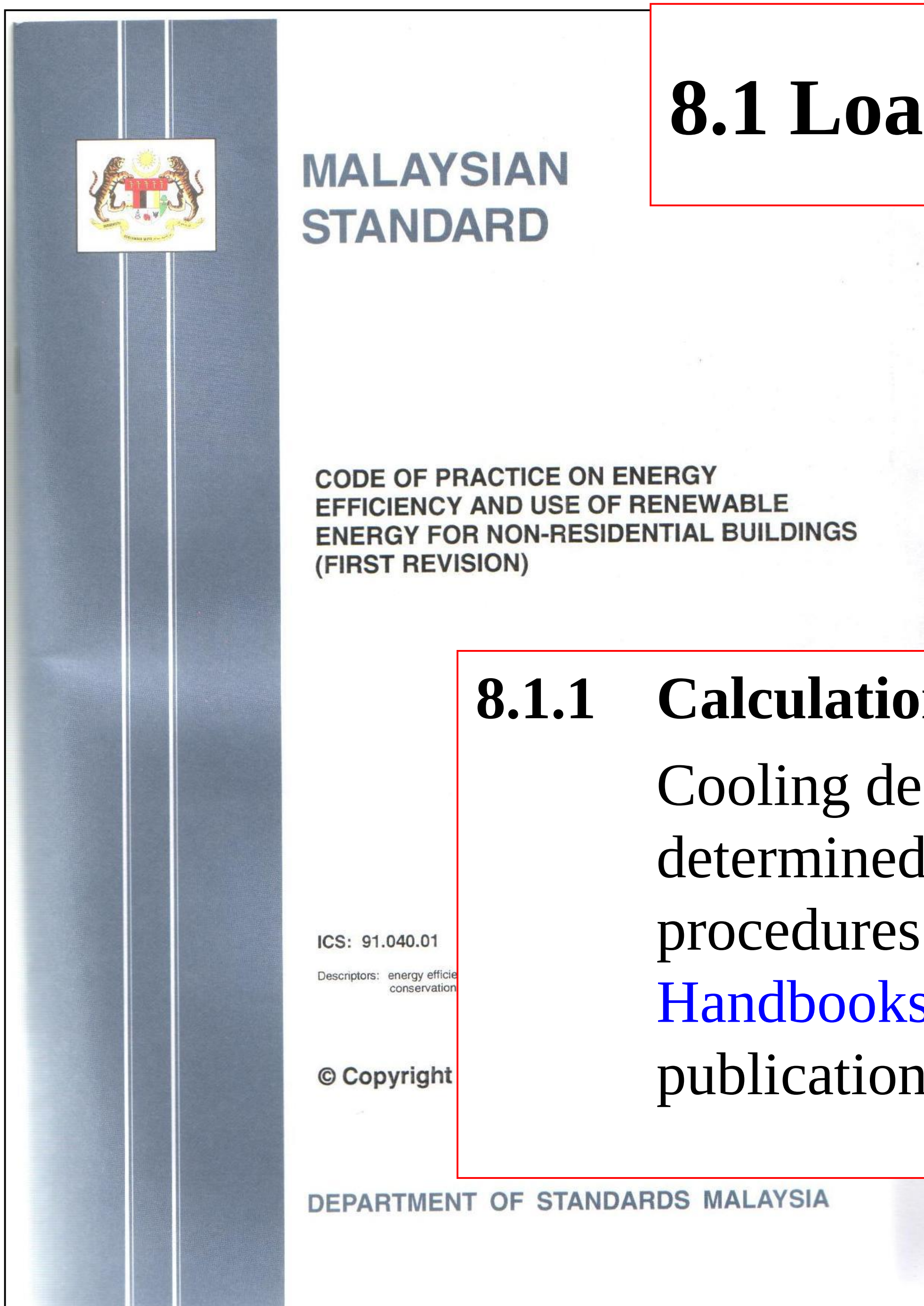
8.1 Load calculations


MALAYSIAN STANDARD

CODE OF PRACTICE ON ENERGY EFFICIENCY AND USE OF RENEWABLE ENERGY FOR NON-RESIDENTIAL BUILDINGS (FIRST REVISION)

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conservation

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DEPARTMENT OF STANDARDS MALAYSIA

8.1.1 Calculation procedures

Cooling design loads should be determined in accordance with the procedures described in ASHRAE Handbooks, or other equivalent publications.

8.1 Load calculations cont'd

8.1.2 Indoor design conditions

Room comfort condition is dependent on various factors including air temperature, mean radiant temperature, humidity, clothing, metabolic rate and air movement preference of the occupant.

For the purpose of engineering design, room comfort condition shall consider the following three (3) main factors:

- dry bulb temperature;
- relative humidity; and
- air movement (air velocity)

8.1.2 Indoor design conditions cont'd

1. **dry bulb temperature**
2. **relative humidity**
3. **air movement (air velocity)**

The indoor design conditions of an air-conditioned space for comfort cooling should be as follows:

a) Recommended design dry bulb temperature 24^0C to 26^0C
b) Minimum dry bulb temperature 23^0C
c) Recommended design relative humidity 50 % to 70 %
d) Recommended air movement 0.15 m/s to 0.50 m/s
e) Maximum air movement 0.7 m/s

"Occupied space relative humidity shall not exceed 70% at … peak outdoor dew- point conditions…"

MS1525-2001

"Occupied space relative humidity shall be designed
to be limited to 70% or less at … peak outdoor dew- point conditions…"
ASHRAE Standard 62.1-2007: Ventilation for Acceptable Indoor Air Quality

8.1.3 Outdoor design conditions

The recommended outdoor design conditions shall be taken as follows:

a) dry bulb temperature 33.3 °C (92^0F)

b) wet bulb temperature 27.2 °C (81^0F)[2014]

28 ^{0}C (82.4^0F)[2019]

8.2 System and equipment sizing

8.2.5 Hydronic system (pump system efficiency)

8.2.5.1 For air-conditioning water pumping system with total system power exceeding 7.5 kW and operating for more than 750 hours a year, the system efficiency as listed in Table 20 shall apply.

Table 21. Maximum power consumption for pumping system

Type of pumping system	Maximum power consumption [W/(m³/h)]
Condenser water pump	84
Chilled water pump	97

8.2 System and equipment sizing cont'd

Chilled water pumping system provided with three or more control valves to modulate the cooling load should be designed for variable fluid flow and capable of reducing the pump flowrate to 25 % of the design flowrate or to the minimum flowrate required by the cooling equipment to ensure proper operation of the equipment.

8.2.5.2 Each (individual) chilled water pumping system with pump motor exceeding 3.7 kW should be equipped with controls and/or devices (such as variable speed control) so that pump motor demand will not exceed 30 % of the design wattage when operating at 50 % of design water flowrate.

8.2 System and equipment sizing cont'd

8.2.5.3 For multiple chiller installations, provisions should be made such that water flow through each chiller can be isolated when the chiller is shut down. Chillers connected in series (for purpose of increased temperature differential) shall be considered as one chiller.

8.2.5.4 Chilled water systems with design load exceeding 1 000 kWr for comfort air conditioning purposes, should incorporate controls to automatically reset supply water temperature by representative building loads (including return water temperature) or by outdoor air temperature.

Exception:

a) Where a specific temperature is required for process cooling or dehumidifying needs.

b) Hydronic systems such as those using variable flow to reduce pumping energy.

8.4 Controls

8.4.6 Fan System Efficiency

For fan system with air flowrate exceeding 17,000 $m^3/h^{10,000cfm}$ and operating for more than 750 hours a year, the power required by the motor for the entire fan system at design conditions should not exceed 0.42W per m^3/h of air flowrate.

All bare shaft fans should have fan efficiency grade (FEG) of 71 or higher, certified by an independent third party (AMCA or equivalent) and to bear the FEG certified performance seal . The total efficiency of the fan at the design point of operation should be within 15 percentage points of the maximum total efficiency of the fan.

8.4.7 Air Filter Efficiency (NEW)

Air filter efficiency rating shall be based on filter face velocity of 2.5 m/s. To sustain energy efficient fan system performance, the maximum final pressure drop for single stage air filter should not exceed 250 Pa.

8.9 ACMV systems

For the purposes of this part, ACMV systems are considered to be of two basic types:

a) Unitary system

b) Central system

This type of system comprises:

i) Water* distribution

ii) Air distribution

8.10 ACMV unitary system

ACMV unitary system provides, in one (single package) or more (split/multi-split system) factory assembled packages, means for air-circulation, air-cleaning, air-cooling with controlled temperature and dehumidification. The cooling function is electrically operated, and the refrigerant condenser may be air, water or evaporative-cooled.

Where the equipment is provided in more than one package, the separate packages should be designed by the manufacturer to be used together.

Table 23. Unitary air conditioners, electrically driven:
Minimum CSPF - cooling
(Cooling Seasonal Performance Factor)

Equipment		Size	Sub-category	
			Non-Inverter type	Inverter type
Air cooled condenser (or evaporative cooled)	<14.65 kWr	Single split	3.0	3.0
	≥ 14.65 kWr and < 35 kWr	Split/ Package/ Multiple split (including VRF)	3.1	3.7
	≥ 35 kWr	Split/ Package/ Multiple split (including VRF)	3.0	3.2
Water cooled condenser	< 19 kWr	Split/ Package/ Multiple split (including VRF)	3.9	4.7
	≥ 19 kWr and < 35 kWr	Split/ Package/ Multiple split (including VRF)	4.0	4.8
	≥ 35 kWr	Split/ Package/ Multiple split (including VRF)	4.1	4.9

NOTE. The evaluation method to calculate the CSPF shall follow ISO 16358-1 where the reference outdoor bin temperature distribution is used.

2014 Table 21. Unitary air conditioners, electrically driven: Minimum COP - cooling

Equipment	Size	Sub-category	Minimum COP	
			Non-Inverter type	Inverter type [1]
Air conditioners:Air cooled with condenser	<19 kWr	Single Split/Package	2.8	3.0
		Multi-split	2.8	3.2
	≥19 kWr and< 35 kWr	Split or Package	2.8	3.5
	≥ 35 kWr	Split or Package	2.7	2.9
Air conditioners: Water and evaporatively cooled	< 19 kWr	Split or Package	3.6	4.0
	≥ 19 kWr and< 35 kWr	Split or Package	3.7	4.4
	≥ 35 kWr	Split or Package	3.8	4.4

NOTE:1. The COP for the inverter unit is the weighted value, which is calculated based upon the following equation:

$$COP_{weighted} = [\ COP_{100\%} \times 0.40\ ] + [\ COP_{50\%} \times 0.60\ ]$$

2007: Unitary air conditioners, electrically driven:

Equipment	Size	Sub-category	Min. COP
Air cooled with condenser	<19kWr	Split system single package	2.7 COP 2.7 COP
	≥ 19kWr <35kWr	Split system single package	2.6 COP
	≥ 35kWr	Split system single package	2.5 COP
Water and evaporatively cooled	<19kWr	Split system single package	3.0 COP
	≥ 19kWr <35kWr	Split system single package	3.5 COP
	≥ 35kWr	Split system single package	3.6 COP

2001: Unitary air conditioners, electrically driven:

Equipment	Size	Sub-category	Min. COP
Air cooled with condenser	<19kWr	Split system single package	2.6
	≥ 19kWr	Split system single package	2.7
Water and evaporatively cooled	<19kWr	Split system single package	2.9
	≥ 19kWr	Split system single package	2.9

2007: Table 21. Water chilling packages, electrically driven:

Equipment	Size	Min COP or IPLV
Aircooled With condenser	<105kWr (30RT)	2.6 COP(1.36kWe/RT) or 2.8 IPLV
	≥ 105kWr <530kWr(150RT)	2.7 COP(1.30kWe/RT) or 2.8 IPLV
	≥ 530kWr <1060kWr(300RT)	2.8 COP(1.26kWe/RT) or 2.9 IPLV
	≥ 1060kWr	2.9 COP(1.21kWe/RT) or 3.0 IPLV
Watercooled Recip/scroll	All capacities	4.0 COP(0.88kWe/RT) or 4.0 IPLV
Watercooled Rotary	<530kWr(150RT)	4.0 COP or 4.2 IPLV
	≥ 530 < 1060kWr	4.4 COP(0.80kWe/RT) or 4.7 IPLV
	≥1060kWr(300RT)	5.4 COP(0.65kWe/RT) or 5.8 IPLV
Watercooled Centrifugal	<1060kWr(300RT)	5.2 COP(0.68kWe/RT) or 5.5 IPLV
	≥1060kWr(300RT)	**5.7** COP(0.62kWe/RT) or 6.1 IPLV

2014 Table 23. Water chilling packages, electrically driven:

Equipment	Size	[1]COP @100% Load at M'sian test Conditions		[a]MPLV @ MS Std Conditions		[2]COP @100% Load at Std AHRI test Conditions		[b]IPLV@ AHRI Std Conditions	
		Min COP	Max kWe/RT	Min COP	Max kWe/RT	Min COP	Max kWe/RT	Min COP	Max kWe/RT
Air cooled, with condenser	< 105 kWr(30RT)	2.79	1.26	3.20	1.10	2.79	1.26	3.66	0.96
	≥ 105 kWr and < 530 kWr(150RT)	2.79	1.26	3.20	1.10	2.79	1.26	3.66	0.96
	≥ 530 kWr and < 1060 kWr(300RT)	2.79	1.26	3.35	1.05	2.79	1.26	3.74	0.94
	≥ 1060 kWr(300RT)	2.79	1.26	3.35	1.05	2.79	1.26	3.74	0.94
Water cooled, positive Displacement (Reciprocating, Scroll, Rotary Screw)	(< 260 kWr) (< 75RT)	4.34	0.81	4.14	0.85	4.51	0.78	5.58	0.63
	> 260 < 530 kWr(150RT)	4.34	0.81	4.14	0.85	4.51	0.78	5.67	0.62
	≥ 530 kWr and < 1060 kWr(300RT)	4.95	0.71	4.45	0.79	5.17	0.68	6.06	0.58
	≥ 1060 kWr(300RT)	5.41	0.65	4.82	0.73	5.67	0.62	6.51	0.54
Water cooled, Centrifugal	< 1060 kWr(300RT)	5.33	0.66	5.02	0.70	5.58	0.63	5.86	0.60
	≥ 1060 kWr(300 to 600 RT)	5.86	0.60	5.41	0.65	6.06	0.58	6.39	0.55
	> 600 RT	**5.96**	0.59	5.58	0.63	6.17	0.57	6.51	0.54

2019 Table 25. Water chilling packages, electrically driven:

Equipment	Size	[1]COP @100% Load at M'sian test Conditions		[a]MPLV @ MS Std Conditions		[2]COP @100% Load at Std AHRI test Conditions		[b]IPLV@ AHRI Std Conditions	
		Min COP	Max kWe/RT	Min COP	Max kWe/RT	Min COP	Max kWe/RT	Min COP	Max kWe/RT
Air cooled, with condenser	< 105 kWr(30RT)	2.93	1.20	3.36	1.05	2.93	1.20	3.84	0.92
	≥ 105 kWr and < 530 kWr(150RT)	2.93	1.20	3.36	1.05	2.93	1.20	3.84	0.92
	≥ 530 kWr and < 1060 kWr(300RT)	2.93	1.20	3.52	1.00	2.93	1.20	3.93	0.90
	≥ 1060 kWr(300RT)	2.93	1.20	3.52	1.00	2.93	1.20	3.93	0.90
Water cooled, positive Displacement (Reciprocating, Scroll, Rotary Screw)	(< 260 kWr) (< 75RT)	4.56	0.77	4.35	0.81	4.74	0.74	5.86	0.60
	> 260 < 530 kWr(150RT)	4.56	0.77	4.35	0.81	4.74	0.74	5.95	0.59
	≥ 530 kWr and < 1060 kWr(300RT)	5.20	0.68	4.67	0.75	5.43	0.65	6.36	0.55
	≥ 1060 kWr(300RT)	5.68	0.62	5.06	0.69	5.95	0.59	6.84	0.51
Water cooled, Centrifugal	< 1060 kWr(300RT)	5.60	0.63	5.27	0.67	5.86	0.60	6.15	0.57
	≥ 1060 kWr(300 to 600 RT)	6.15	0.57	5.68	0.62	6.36	0.55	6.71	0.52
	> 600 RT	**6.26**	0.56	5.86	0.60	6.48	0.54	6.84	0.51

2019 Table 25. ACMV applied system (heat-operated[b]): Minimum COP[c] - cooling

Heat Source			
Direct fired (Gas, Oil)		Indirect fired (Steam, hot water)	
Type X[a]	Type Y[a]	Type X[a]	Type Y[a]
Not applicable 0.6 (2001)	1.20 0.95 0.6 (2001)	0.68 0.6 0.6 (2001)	1.30 1.0 0.6 (2001)

8.16 Life cycle analysis

The owner is encouraged to carry out life cycle analysis of ACMV system performance and efficiency before purchasing new equipment and considering early replacement.

END

tlchen55@gmail.com

THANK YOU