



International
Standard

ISO 5222-2

**Heat recovery ventilators and
energy recovery ventilators —
Testing and calculating methods for
seasonal performance factor —**

**Part 2:
Sensible cooling recovery seasonal
performance factors of heat
recovery ventilators (HRV)**

*Ventilateurs récupérateurs de chaleur et ventilateurs
récupérateurs d'énergie — Méthodes d'essai et de calcul des
facteurs de performances saisonnières*

*Partie 2: Facteurs de performances saisonnières de la
récupération de froid sensible des ventilateurs récupérateurs de
chaleur (HRV)*

**First edition
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Foreword

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This document was prepared by Technical Committee ISO/TC 86, *Refrigeration and air-conditioning*, SC 6, *Testing and rating of air-conditioners and heat pumps*.

A list of all parts in the ISO 5222 series can be found on the ISO website.

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Heat recovery ventilators and energy recovery ventilators — Testing and calculating methods for seasonal performance factor —

Part 2:

Sensible cooling recovery seasonal performance factors of heat recovery ventilators (HRV)

1 Scope

This document specifies the testing and calculating methods for sensible cooling recovery seasonal performance factor of heat recovery ventilators (HRV) covered by ISO 16494-1.

This document also specifies the test conditions and the corresponding test procedures for determining the sensible cooling recovery seasonal performance factor of HRVs. The rating conditions are those specified in [Annex B](#) and in ISO 16494-1. The procedures of this document can be used for other temperature conditions.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 16494-1:2022, *Heat recovery ventilators and energy recovery ventilators — Method of test for performance — Part 1: Development of metrics for evaluation of energy related performance*

ISO 16494-1:2022/Amd 1:2023, *Heat recovery ventilators and energy recovery ventilators — Method of test for performance: Part 1: Development of metrics for evaluation of energy related performance — Amendment 1*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 16494-1 and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>

3.1

sensible cooling heat recovery

transfer of sensible energy from exhaust air to supply air in the HRVs while cooling

3.2

bypass ventilation function

function for reducing power input of the fans while the heat energy recovered is less than the additional energy input due to overcoming the resistance of recovery heat exchanger during its operation time

Note 1 to entry: The bypass ventilation function makes the supply air and/or exhaust air go through the heat recovery exchanger by bypass way with energy saving control.

**3.3
sensible cooling gross effectiveness**

ϵ_{sc}
measured effectiveness, not adjusted for leakage, motor heat gain, or heat transfer through the unit casing

Note 1 to entry: The sensible cooling gross effectiveness of an HRV, at equal airflow, is described in ISO 16494-1:2022 9.5.

**3.4
net supply airflow**

$Q_{m2,net}$
portion of the leaving supply airflow that originated as enter in supply airflow

Note 1 to entry: The net supply airflow is expressed in kg/s.

Note 2 to entry: The formulae for determining net supply air flow are given in ISO 16494-1:2022, 9.4.1 (ducted units) and 9.4.2 (unducted units).

**3.5
bypass outdoor temperature**

T_b
outdoor temperature in cooling conditions, at which the electricity power reduction for the HRVs by operating in bypass mode is equal to the saving of electricity power input to the cooling system due to the heat recovered by the HRVs

**3.6
seasonal performance factor of sensible cooling recovery**

F_{sc}
ratio of seasonal amount of sensible cooling recovered together with power value of moving air to the whole electricity input of HRVs, under the rating conditions and seasonal outdoor temperature bins selected from this document

**3.7
building cooling balance temperature**

T_{BCB}
outdoor air temperature at which building heat gain equals to heat loss through the building envelope

4 Symbols and abbreviated terms

Symbol	Description	Unit
c_p	Specific heat of leaving supply air (SA)	kJ/(kg·°C)
E_{sc}	Capacity of seasonal sensible cooling recovery	Wh
F_{sc}	Seasonal performance factor of sensible cooling recovery	Wh/Wh
$L_{sc,t,j}$	Reference outdoor air sensible cooling load at outdoor air bin temperature t_j	W
n_j	Bin hours which the outdoor air bin temperature occurs	h
n	Number of temperature bins	-
$P_{in,t,j}$	Power input to ventilator at outdoor air bin temperature t_j	W
$P_{in,no,t,j}$	Power input to the HRVs to operate the fans at outdoor air bin temperature t_j for all stages, for HRVs without bypass ventilation function	W
$P_{in,by,t,j}$	Power input to the HRVs at outdoor air bin temperature t_j for bin temperature in C_{stage1} or C_{stage2} , for HRVs with bypass ventilation function	W
$P_{vma,t,j}$	Power value of moving air at outdoor air bin temperature t_j	J/s or W
$P_{in,E}$	Electricity power input of seasonal sensible cooling recovery	Wh
$Q_{m2,net}$	Net supply mass flow rate	kg/s
Q_{vwr}	Ventilation air cooling load with recovery	W
Q_v	Ventilation air cooling load without recovery	W

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Symbol	Description	Unit
Q_{ig}	Cooling load generated from internal gain and solar gain etc	W
Q_s	Cooling amount saved by recovery function	W
t_j	The outdoor air bin temperature at bin number j	°C
T_b	Outdoor air temperature when HRVs operates under air bypass ventilation function	°C
T_{BCB}	Outdoor air temperature at which building heat gain equals to heat loss through the building envelope	°C
T_0	The dry bulb temperature of entering exhaust air (RA) under ISO 16494-1:2022 standard testing conditions (T1/T2/T3/T4/T8)	°C
T_{oac}	Lowest outdoor temperature during cooling season	°C
ε_{sc}	Gross sensible cooling effectiveness of HRVs	%
$\phi_{sc,t,j}$	Sensible cooling recovery capacity of the HRVs at outdoor air bin temperature t_j	W

5 Tests

5.1 General requirements

The test conditions used, the accuracy and uncertainties of the instruments used shall conform to [5.2](#) and ISO 16494-1.

5.2 Test conditions

For ε_{sc} , E_{sc} and F_{sc} , there are five standard test conditions T1/T2/T3/T4/T8 corresponding to ISO 16494-1:2022, Table 1. The HRVs shall be tested at one of the five test conditions, which shall be selected to most closely represent the outdoor temperature bin distribution in the region as described in [Annex B](#) and [Annex C](#).

Outdoor temperature bin distribution and bin hours differ from region to region. If the bin hours are set to a certain value for a certain region, the integrated value of cooling load and electric energy consumption can be determined.

[Table 1](#) shows the requirements for the default values and the reference outdoor temperature bin distribution for testing and calculation. If a different outdoor temperature bin distribution is to be set, refer to the setting method as described in [Annex C](#).

Table 1 — Conditions of performance test (cooling)

	Outdoor air temperature (°C)		Indoor air temperature (°C)		Application temperature bin type for calculation
	Dry bulb	Wet bulb	Dry bulb	Wet bulb	
T1	35	23	21	15	In Annex B or C
T2	35	24	24	17	
T3	35	31	27	20	
T4	35	24	27	19	
T8	35	24	25	18	
NOTE Allowable variation of readings is given in ISO 16494-1:2022, Table F.2.					

5.3 Test methods

5.3.1 General

For higher seasonal energy performance, HRVs can be designed with an air flow bypass ventilation function integrating fan speed control or airflow dampers adjustment, which can change the fan power input according to different outdoor temperature conditions, while maintaining necessary aerodynamic performance.

5.3.2 Energy saving stage limit temperature

To assess the energy saving ability of HRVs, the operation stages under the application temperature bin are showed in [Annex A](#) using a schematic diagram.

5.3.3 Sensible cooling recovery performance test

5.3.3.1 Standard condition performance tests

Sensible cooling recovery performance, efficiency as well as airflow and static pressure shall be measured corresponding to the selected standard cooling performance tests conditions in [Table 1](#), conducted in accordance with ISO 16494-1.

5.3.3.2 Determination of performance at application climate

The sensible cooling recovery performance under certain climate temperature bins shall also be determined by calculation using the temperature bins see [Annex B](#) and [Annex C](#).

5.3.4 The determination of bypass outdoor temperature

The manufacturer shall specify the value of bypass outdoor temperature, the laboratory shall verify whether the tested unit has this function and what is the action temperature by test. If the manufacturer does not specify it, the laboratory shall calculate the bypass outdoor temperature as per [Annex D](#) and set it as T_b .

5.3.5 Measurement of power input of heat recovery ventilator with bypass ventilation function

5.3.5.1 The manufacturer may provide information on how to set the bypass ventilation function if requested by the testing laboratories.

NOTE 1 Due to the additional air resistance of heat recovery exchanger, when the heat energy recovered is less than the additional energy input due to overcoming the resistance of recovery heat exchanger during its operation time, the equipment can provide the bypass ventilation function to reduce the additional energy consumption, when only ventilation is necessary.

NOTE 2 When the bypass ventilation function is active, there can be several means to reduce the additional energy consumption, for example, with fan speed control or valve control in the fan's inlet or outlet, etc., to keep the same airflow rate and pressure as the rating performance condition.

5.3.5.2 The tests shall be conducted at the required control set which allows steady state operation of the equipment under the given test conditions.

5.3.5.3 Test of unit with bypass ventilation function and fan speed control:

- a) Set up the bypass ventilation function according to the manufacturer's instructions.
- b) Adjust the test auxiliary device to keep the average pressure value at air outlet and inlet of unit in Figure A.1 of ISO 16494-1:2022/Amd 1:2023 within 5 % of the tested unit's nominal value and the air flow rate larger or equal to its nominal value.

- c) According to ISO 16494-1:2022, measure and record the data of the air flow rate, pressure and electricity power input.
- d) Determine and record the outdoor temperature at which the bypass ventilation function acts, either by the manufacturer's statement, or by measurement. The power input value measured when the bypass ventilation function is activated is recorded as the bypass ventilation function power input, used to calculate F_{sc} corresponding to each outdoor bin temperature in the ventilation period.

5.3.5.4 Test of unit with bypass ventilation function and with electric driving air damper automatically, but without fan speed control:

- a) Set up the bypass ventilation function according to the manufacturer's instructions.
- b) Adjust the test auxiliary device to keep the average pressure value within 5 % of the tested unit's nominal value and the air flow rate larger or equal to its nominal value.
- c) Determine and record the outdoor temperature at which the bypass ventilation function acts, either by the manufacturer's statement, or by measurement. The power input value measured when the bypass ventilation function is on shall be recorded as the bypass ventilation function power input, used to calculate F_{sc} corresponding to each outdoor bin temperature in the ventilation period.

5.3.5.5 Test of unit with bypass ventilation function and without fan speed control and without automatic adjust air damper:

- a) Set up the bypass ventilation function according to the manufacturer's instructions.
- b) According to ISO 16494-1:2022, do not adjust any of the test auxiliary devices during the test after the test of the bypass ventilation function turns on and record the data of air flow rate, the pressure and power input.
- c) Determine and record the outdoor temperature at which the bypass ventilation function acts, either by the manufacturer's statement, or by test.
- d) The power input value measured when the bypass ventilation functions is recorded as the bypass ventilation function power input, used to calculate F_{sc} corresponding to each outdoor bin temperature in the ventilation period.

5.3.6 Measurement of power input of heat recovery ventilator with no bypass ventilation function

For the equipment with no bypass ventilation function, the power input is the same at all stages as specified in [5.3.3.1](#), which shall be used to calculate F_{sc} corresponding to each outdoor temperature bin in the ventilation period.

6 Calculations

6.1 Gross sensible cooling recovery effectiveness (ϵ_{sc})

The gross sensible cooling heat recovery effectiveness of HRVs at rated test condition is described in ISO 16494-1:2022, 9.5.

6.2 Calculation of seasonal performance factor of sensible cooling recovery (F_{sc})

6.2.1 Reference outdoor air cooling load and sensible cooling recovery capacity

The reference outdoor air cooling load shall be determined by a set of values and is assumed that they change linearly depending on the change in outdoor temperature. The sensible cooling recovery capacity is also assumed to change linearly, see [Figure A.1](#). The conditions for the reference cooling load and recovery capacity are shown in [Table 2](#).

Table 2 — Reference outdoor air sensible cooling load and recovery capacity

	T1	T2	T3	T4	T8
Outdoor air temperature(°C)	Climate bins	Climate bins	Climate bins	Climate bins	Climate bins
T_0 Indoor air temperature(°C)	21	24	27	27	25
Outdoor air cooling load(W)	$L_{sc,t,j}$				
recovery capacity(W)	$\phi_{sc,t,j}$				

The outdoor air sensible cooling load $L_{sc,t,j}$ at outdoor temperature t_j , which is necessary to calculate the seasonal sensible cooling heat recovery, shall be determined by [Formula \(1\)](#):

$$L_{sc,t,j} = Q_{m2,net} \times c_p \times (t_j - T_0) \times 1000 \quad (1)$$

where

- $L_{sc,t,j}$ is outdoor air sensible cooling load at the outdoor temperature t_j (W);
- $Q_{m2,net}$ is the net supply mass flow rate (kg/s);
- T_0 is the dry bulb temperature of entering exhaust air (RA) under ISO 16494-1:2022 standard testing conditions (T1/T2/T3/T4/T8) (°C);
- t_j is the dry bulb temperature of outdoor air corresponding to application temperature bin j (°C).

6.2.2 The characteristics of sensible cooling recovery capacity against outdoor temperature

6.2.2.1 General

The sensible cooling recovery capacity $\phi_{sc,t,j}$ (W) of the HRVs at outdoor temperature bin t_j changes depending on outdoor temperatures, as shown in [Figure A.1](#), and is determined by [Formulae \(2\)](#) to [\(5\)](#).

The stages are described in [Annex A](#).

6.2.2.2 C_{stage1} ventilation with or without bypass ventilation function

For HRVs with bypass ventilation function, recovery capacity $\phi_{sc,t,j}$ at outdoor temperature t_j shall be determined by [Formula \(2\)](#)

$$\phi_{sc,t,j} = -L_{sc,t,j} \quad (2)$$

NOTE For HRVs with bypass ventilation, due to the outdoor temperature is low than the indoor air temperature, the total amount of supply air, which total cooling capacity, can be used as free cooling capacity and be seen as positive contribution to F_{sc} .

For HRVs without bypass ventilation function, recovery capacity $\phi_{sc,t,j}$ at outdoor temperature t_j shall be determined by [Formula \(3\)](#).

$$\phi_{sc,t,j} = L_{sc,t,j} \times \varepsilon_{sc} \quad (3)$$

6.2.2.3 C_{stage2} ventilation with, or without bypass ventilation function at cooling recovery mode

For HRVs with bypass ventilation function, recovery capacity $\phi_{sc,t,j}$ at outdoor temperature t_j shall be determined by [Formula \(3\)](#), where $\varepsilon_{sc} = 0$.

For HRVs without bypass ventilation function, recovery capacity $\phi_{sc,t,j}$ at outdoor temperature t_j shall be determined by [Formula \(3\)](#).

NOTE Depending on the result and the manufacturer's product or system, C_{stage2} can be involved in the F_{sc} calculation.

6.2.2.4 C_{stage3} ventilation at cooling recovery mode

For with or without bypass ventilation function, recovery capacity $\phi_{sc,t,j}$ at outdoor temperature t_j shall be determined by [Formula \(3\)](#).

6.2.3 Power input characteristics of sensible cooling recovery against outdoor temperature

6.2.3.1 General

Power input $P_{in,t,j}$ (W) of the HRVs at outdoor temperature t_j changes depending on outdoor temperatures and corresponding operation functions as shown in [Figure A.1](#), and it is determined by [Formulae \(4\)](#) to [\(5\)](#).

6.2.3.2 C_{stage1} ventilation with, or without bypass ventilation function

Power input at outdoor temperature t_j shall be determined by [Formula \(4\)](#) with bypass ventilation function:

$$P_{in,t,j} = P_{in,by,t,j} \quad (4)$$

and [Formula \(5\)](#) without bypass ventilation function:

$$P_{in,t,j} = P_{in,no,t,j} \quad (5)$$

6.2.3.3 C_{stage2} ventilation with, or without bypass ventilation function at cooling recovery mode

Power input at outdoor temperature t_j shall be determined by [Formula \(4\)](#) with bypass ventilation function and by [Formula \(5\)](#) without bypass ventilation function.

6.2.3.4 C_{stage3} ventilation at cooling recovery mode

Power input at outdoor temperature t_j shall be determined by [Formula \(5\)](#) for with or without bypass ventilation function.

6.2.4 Outdoor temperature bin distribution for cooling

The values of outdoor temperature and bin hours differ from region to region. If the bin-hours are set to a certain value for a specific region, the value of cooling load and electric energy consumption can be determined.

[Annex B](#) shows the reference outdoor temperature bin distribution for cooling.

In case another outdoor temperature bin distribution is set, refer to the method described in [Annex C](#).

6.2.5 Calculation of seasonal sensible cooling recovery capacity (E_{sc})

Seasonal sensible cooling recovery capacity (E_{sc}) shall be determined using [Formula \(6\)](#) from the total sum of sensible cooling recovery at each outdoor temperature t_j .

$$E_{sc} = \sum_{j=1}^n [\phi_{sc,t,j} + P_{vma,t,j}] \times n_j \quad (6)$$

where

E_{sc} is the seasonal sensible cooling recovery capacity of the HRVs;

$\phi_{sc,t,j}$ is the sensible heat recovery capacity of the HRVs at outdoor air bin temperature t_j ;

$P_{vma,t,j}$ is the power value of moving air at outdoor air bin temperature t_j (J/s)

j is the bin number;

n_j is the number of hours in the temperature bin.

6.2.6 Calculation of seasonal sensible cooling recovery power input ($P_{in,E}$)

Seasonal sensible cooling recovery power input $P_{in,E}$ shall be determined using [Formula \(7\)](#) from the total sum of sensible cooling power input at each outdoor temperature t_j .

$$P_{in,E} = \sum_{j=1}^n P_{in,t,j} \times n_j \quad (7)$$

where

j is the bin number;

n_j is the number of hours in the temperature bin.

6.2.7 Calculation of seasonal performance factor for sensible cooling recovery (F_{sc})

The sensible cooling recovery seasonal performance factor (F_{sc}) shall be determined using [Formula \(8\)](#):

$$F_{sc} = \frac{E_{sc}}{P_{in,E}} \quad (8)$$

where

F_{sc} is the seasonal sensible cooling heat recovery seasonal performance factor;

E_{sc} is the seasonal sensible cooling heat recovery capacity of the HRVs;

$P_{in,E}$ is the seasonal sensible cooling heat recovery power input.

7 Test report

The test report shall include:

- a) the simple description of sample;
- b) the International Standard used (including its year of publication);
- c) the results which include at least the following:
 - the list of mandatory test points performed,
 - gross sensible cooling effectiveness and seasonal sensible cooling performance factor (F_{sc}) values under correspond rating condition,
 - the list of optional test points performed,
 - the default values used,
 - the assumed default value of cooling coefficient of performance of air conditioner or refrigeration system.

- d) the deviations from the procedure;
- e) the unusual features observed;
- f) the date of the test.

The cooling seasonal performance factor (F_{sc}) shall be declared with three significant digits, with reference to the reference defined cooling load and to the reference outdoor temperature bin distribution used.

NOTE Refer to [Annex E](#) for a template of the additional data to be collected and calculated results.

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Annex A (Informative)

The schematic diagram of HRVs cooling (C) operation

For HRVs with energy saving function, the operation stages under the application temperature bins are as follows, which are also shown in [Figure A.1](#) using a schematic diagram.

- a) V_{stage} is when the outdoor temperature is between the highest temperature at which heating is used (T_{oac}), 17 °C, which is the reference value in ISO 16358-2, and the lower temperature at which AC cooling is used (T_{BCB}), 20 °C, which is the reference value in ISO 16358-1. HRV is still used for ventilation.

NOTE 1 T_{oac} is equal to T_{BHB} which is defined in ISO 5222-1.

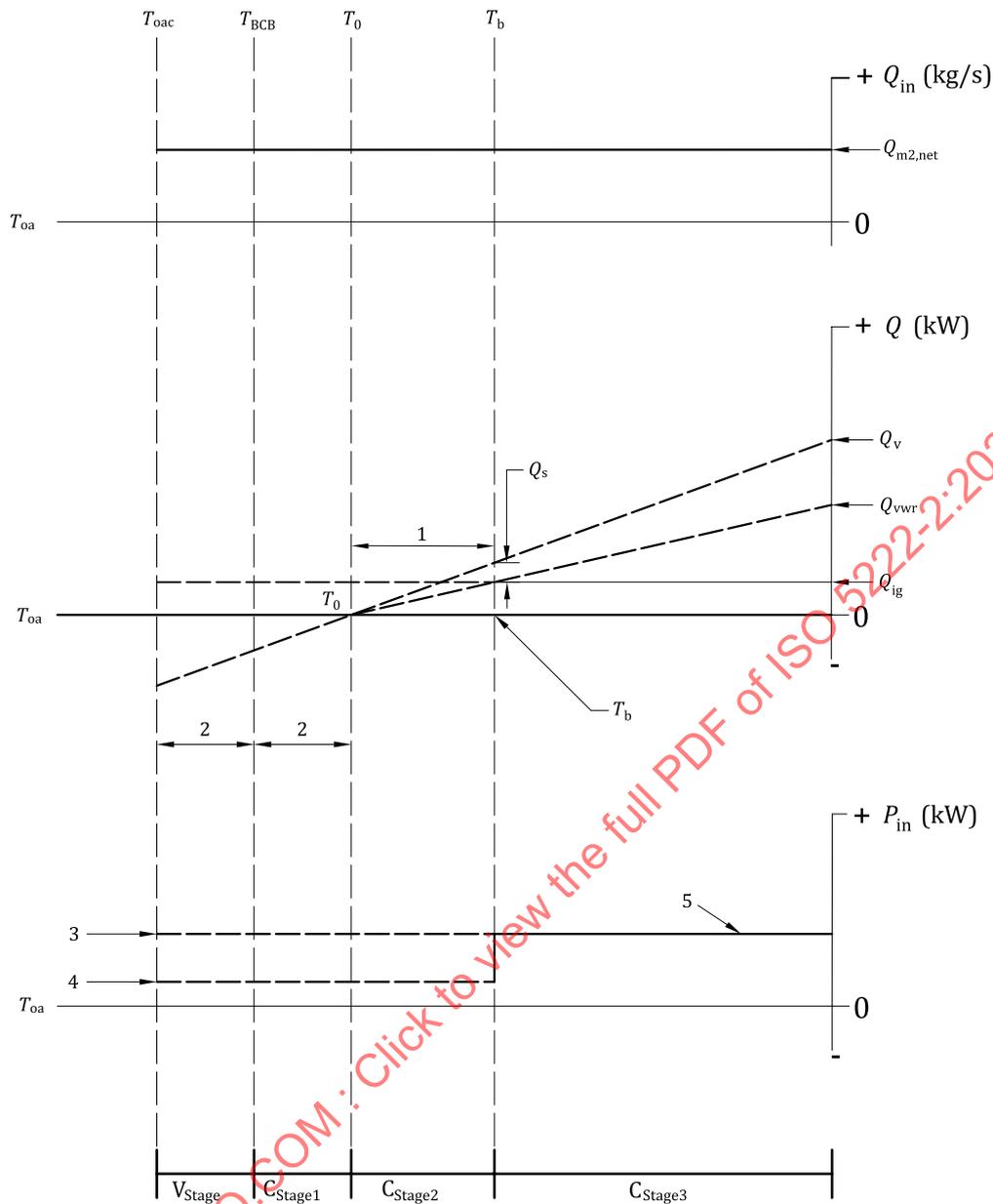
- b) C_{stage1} is when the outdoor air temperature changes from a lower temperature 20 °C (T_{BCB}) to the defined T_0 in [Figure A.1](#). The outdoor air can be used as free cooling for outdoor air, cooling load of outdoor air is assumed negative even though the air conditioner possibly turned on due to the internal heating, which means that cooling recovery is unnecessary in C_{stage1} of [Figure A.1](#). If the recovery function is used, the cooling recovery capacity will be a negative value because it increases the outdoor air cooling load. For ventilation, the fans need to run continually and the electricity power input of fans will vary with or without the bypass ventilation function in HRVs.

- c) C_{stage2} is when the outdoor air temperature changes from T_0 to T_b . The outdoor air cooling load will increase, but the electricity consumption of fans to overcome the additional air resistance of the heat recovery exchanger itself is greater than the equivalent electricity consumption calculated using the cooling recovery amount to convert it to. To save energy, the supplying and exhausting airflow through the heat recovery exchanger can go through the bypass ventilation function, so the electricity power input of fans for ventilation may be different for the units with or without the bypass ventilation function.

NOTE 2 The temperature T_b for HRVs with bypass ventilation function can be confirmed in the laboratory when turning on the energy saving control function during operation. For HRVs without bypass ventilation function, T_b does not exist.

- d) C_{stage3} is when the outdoor air temperature changes from T_b to the highest temperature, the outdoor air cooling load will continue to increase with the outdoor temperature increasing. At this stage the bypass ventilation function of the ventilation should be closed. The electrical power input of fans for ventilation is constant for HRVs with or without the bypass ventilation function, due to the bypass ventilation function being closed.

NOTE 3 The methods for determine the temperature T_b see [Annex D](#).



Key

- | | | | |
|--------------|---|---|---|
| T_{BCB} | building cooling balance temperature | 2 | free cooling by outside air |
| T_b | bypass outdoor temperature | 3 | fan power without bypass ventilation function |
| T_{oa} | outdoor temperature axial | 4 | fan power with bypass ventilation function |
| Q_s | amount saved by recovery function | 5 | fan power during recovery |
| $Q_{m2,net}$ | net supply mass flow rate | | |
| Q_{vwr} | ventilation air cooling load with recovery | | |
| Q_{ig} | cooling load generated from internal gain and solar gain, etc. | | |
| Q_v | ventilation air cooling load without recovery | | |
| T_{oac} | lowest outdoor temperature during cooling season | | |
| T_0 | the dry bulb temperature ISO 16494-1 standard testing conditions (T1/T2/T3/T4/T8) | | |
| 1 | recovery not beneficial because power input exceeds energy savings | | |

Figure A.1 — Operation stages for HRVs

Annex B
(informative)

The default outdoor temperature bin distribution for cooling

B.1 Sample climate bins

The bin limit temperature of starting cooling is 17 °C for all climates type when cooling.

B.2 Cooling

[Table B.1](#) shows the default outdoor temperature bin distribution.

NOTE The calculation of cooling seasonal performance factor can also be undertaken for other temperature bin distributions as shown in [Annex C](#).

Table B.1 — The default outdoor temperature bin distribution for cooling

Bin number j	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total
Outdoor temperature t_j °C	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	-
Bin hours n_j	n_1	n_2	n_3	n_4	n_5	n_6	n_7	n_8	n_9	n_{10}	n_{11}	n_{12}	n_{13}	n_{14}	n_{15}	-
Reference bin hours (n_j) h	100	139	165	196	210	215	210	181	150	120	75	35	11	6	4	1 817

Table B.2 — Default hours for the calculation of seasonal performance factor for sensible cooling recovery

HRV	AC turn on and keeping ventilation (h) (C_{stage1} to C_{stage3})
Cooling	1 817

Annex C (informative)

Calculating method for seasonal performance factor when setting a specific application cooling load

C.1 General

Under application conditions, outdoor air cooling load varies widely from one region of the world to another region depending on climactic conditions, the operating strategy of air conditioners and heat pumps as well as HRVs.

In order to evaluate and compare the seasonal performance factor among HRVs, it is necessary to establish the method used under application conditions and different operating strategies.

For this purpose, this annex provides steps and method.

C.2 Application outdoor air temperature Bin

Referring to the reference climate data of application location using HRVs, statistics and classification work shall be carried out and a table of outdoor climate bin hours shall be completed as per [Annex B](#).

C.3 Set of specific application condition of HRVs

C.3.1 The temperature of air conditioners put into active mode shall be set.

C.3.2 The thermal comfort indoor temperature shall be set as the initiative temperature for existing outdoor air cooling load.

C.3.3 Test the gross sensible cooling recovery effectiveness at the indoor air temperature as per [C.3.2](#) while the outdoor air temperature shall remain the same as in [Table C.1](#)

C.4 Calculation of the sensible cooling performance factor of HRVs

Under the redefined conditions provided above, calculation of the seasonal performance factor for sensible cooling recovery (F_{sc}) is made in accordance with the provisions specified in [6.2](#).

Table C.1 — Sample template of outdoor temperature bin distribution for cooling

Bin number j	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total
Outdoor temperature t_j °C																-
Fractional bin hours																
Bin hours n_j	n_1	n_2	n_3	n_4	n_5	n_6	n_7	n_8	n_9	n_{10}	n_{11}	n_{12}	n_{13}	n_{14}	n_{15}	-
Reference bin hours (n_j) h																

Table C.2 — Sample template of default hours for the calculation of seasonal performance factor for sensible cooling recovery

HRV	AC turn on and keeping ventilation (h) (C_{stage1} to C_{stage3})
Cooling	

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Annex D (normative)

The calculation of bypass outdoor temperature

The outdoor temperature T_b influences the F_{sc} rating of unit. Lower values of T_b results in improved seasonal energy saving performance.

NOTE Manufacturers can optimize the selections and design of HRVs by enhancing the efficiency of fans and motors as well as the effectiveness of heat recovery exchangers, also decreasing resistance of the airflow channels and selecting better speed control device of fans.

For HRVs without bypass ventilation function, there is no T_b .

For HRVs with bypass ventilation function, the T_b shall be calculated using [Formula \(D.1\)](#):

$$T_b = T_0 + \frac{(P_{in,no,t,j} - P_{in,by,t,j}) \times E_{ER}}{\varepsilon_{sc} \times Q_{m2,net} \times c_p * 1000} \quad (D.1)$$

where

- T_b is the bypass temperature of unit, (°C);
- T_0 is the dry bulb temperature of entering exhaust airflow temperature (RA) corresponding to ISO 16494-1:2022 standard testing conditions (T1/T2/T3/T4/T8) (°C);
- ε_{sc} is the gross sensible cooling recovery effectiveness of HRVs at rated test condition (%);
- $P_{in,no,t,j}$ is the power input to the HRVs to operate the fans at outdoor air temperature T_b for HRVs without bypass ventilation function, (W);
- $P_{in,by,t,j}$ is the power input to the HRVs to operate the fans at outdoor air temperature T_b for HRVs with bypass ventilation function, (W);
- E_{ER} is the ratio of energy efficiency of air conditioner operating at cooling, assumes a default as 2,5 at T1, 2,7 at T2, 3,0 at T3 and 3,0 at T4 ,2,8 at T8 or manufacture's data;
- $Q_{m2,net}$ is the net supply mass flow rate (kg/s);
- c_p is the specific heat of leaving supply air (kJ/(kg·°C)).