Latest R$D of ventilation recovery equipment

National Center of Quality Supervision and Inspection for HVAC equipment

CONTENTS

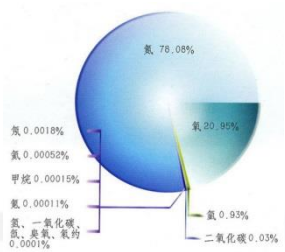
一、 Energy saving to handle outdoor air

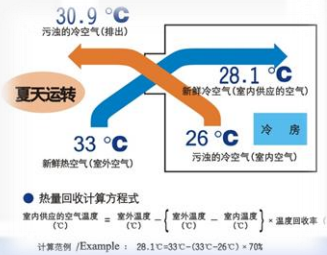
For improving the indoor air quality, it is necessary to introducing the outdoor fresh air into the indoor by natural or mechanical ventilation. This will produce additional energy consumption of the building equipped with HVAC system, due to the temperature or enthalpy difference between Indoor and outdoor air.

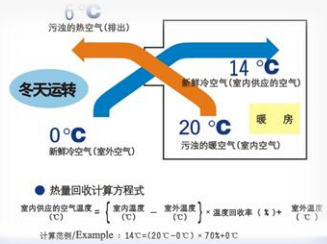
For building energy saving, as the thermal behavior of building envelop construction greatly enhanced, the HVAC system energy consumption ratio of outdoor air handling vs. indoor air handling is not decreased, but increases.

This becomes the big problem for building energy saving.

This needs to develop the outdoor air handling energy recovery equipment for solving the problem.







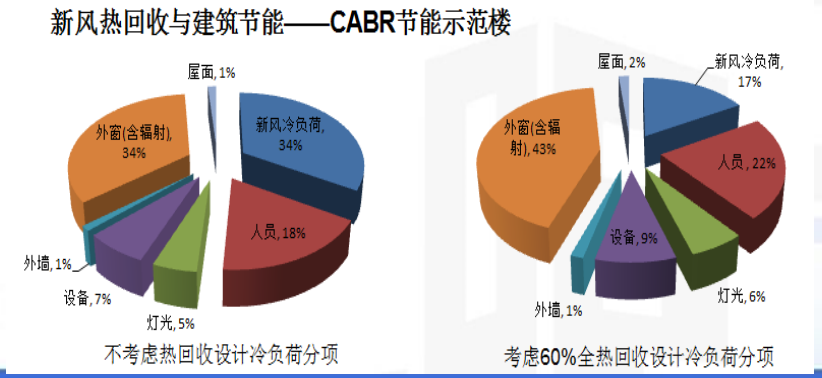
How big is the problem?

The nearly zero energy building (NZEB) at the China Academy of Building Research (CABR) finished in 2014.There are at least 3 kinds of ERVs used in the building and energy recovery efficiency of them are higher than 60%..

By using these ERV euipment，

the ratio of design cooling load of the outdoor air handling vs. total design cooling load varied from 34% to 17% in summer

the ratio of design heating load of the outdoor air handling vs. total design heating load varied from 77% to 57% in winter.



二、 Development of ISO Standard for ERV

SAC/TC143 located in CABR is in charge of communication with ISO/TC86/SC6. Recently years , ISO/TC86/SC6 conducts many ERV field standardization work through WG10，as the WG's member and representative of China , I have been taking part in these work. By now, ISO /TC86/SC6 has developed work below:

Publishing the ISO STD. 'ISO 16494, "Method of Test for the Perform - ance of Heat Recovery Ventilators and Energy Recovery Ventilators'

Preparing :

ISO TR ： Heat recovery ventilators and energy recovery ventilators — Assessment of measurement uncertainty of performance parameters'

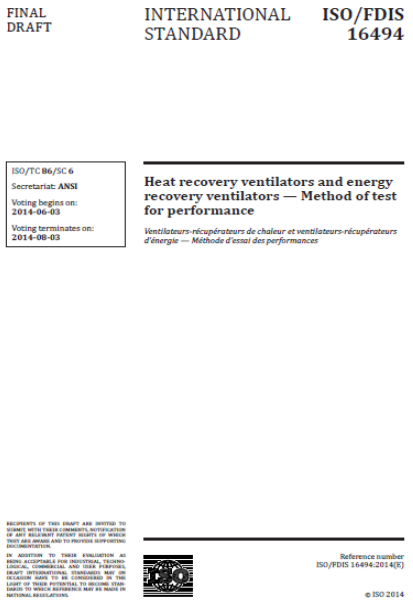
ISO STD. 'Method of Test and Characterization of Performance for Energy Recovery Components'

SAC/TC143（China National Technical Committee 143 on Heating Ventilating and Air Conditioning of Standardization Administration of China）

ISO/TC6/SC6 （International standard organization Technical Committer86/SC6 , mainly focus on the standardization of HVRAC equipment ）

ISO STD. 'ISO 16494

Prescribes a method of testing the ventilation and energy related performance of heat recovery ventilators and energy recovery ventilators that do not contain any supplemental heating (except for defrost), cooling, humidification or dehumidification components.


FINAL DRAFT
INTERNATIONAL STANDARD
ISO/FDIS 16494

ISO/TC 86/SC 6
Secretariat: ANSI
Voting begins on: 2014-06-03
Voting terminates on: 2014-08-03

Heat recovery ventilators and energy recovery ventilators — Method of test for performance

Ventilateurs-récupérateurs de chaleur et ventilateurs-récupérateurs d'énergie — Méthode d'essai des performances

Reference number ISO/FDIS 16494:2014(E)

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It consists of 9 chapters and 7 Annex ,
1 Scop 2Normative references 3Terms and definitions 4Symbols and abbreviated terms 5Airflow test 6Tracer gas tests 7Determination of efficency 8 Performance calculations 9 Test results Annex A-G

P-member voting result : 92% approval

Result of voting

P-Members voting: 12 in favour out of 13 = 92 % (requirement >= 66.66%)

(P-Members having abstained are not counted in this vote.)

Member bodies voting: 2 negative votes out of 15 = 13 % (requirement <= 25%)

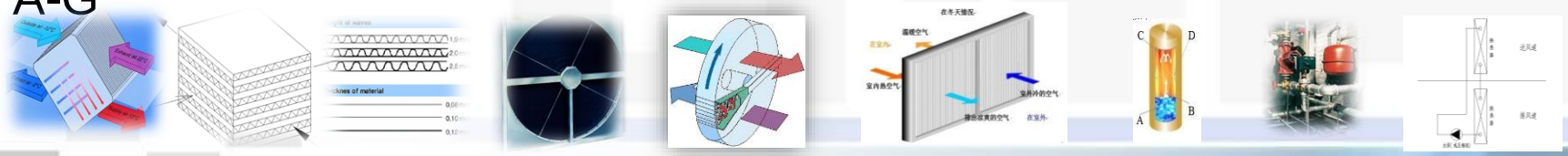
Approved

三、 Present situation of China national standard for ERV

The first National Std. for ERV has published named <air-to air energy recovery equipment>. GB/T20187-2007 . It makes great contributions to keep the production quality and enhance its efficiency in China.

By implying the STD., most of manufactures have made their product performance reach the limited value, this also makes the reality of building energy saving in china.

It consists of 9 chapters and 7 Annex ,1 Scop 2Normative references 3Terms and definitions 4Symbols and abbreviated terms 5 Performance requirements 6Method of testing 7 Inspection rules 8 Mark Package and transportation 9 Product specification Annex A-G



The first National Std. for ERV is published in 2007 , it has lasted for almost 10 years and now is revising by WG in China.

The research work now mainly focus on :

1) Corresponding to the demand of holistic assessment the energy saving performance of building, we are study -ing the methods of identifying the energy recovery efficiency performance varying with the outdoor air condition.

2) The testing method for verifying the sustainable high efficiency recovery energy ability.

3) The grade method of the energy recovery ability

4) The technical influence using bypass ventilation and smart control as well as defrost etc.

The compare of ISO std. with GB/T std. of ERV equipment.

1) Both of them involve the main energy saving performance, eg. Air flow rate, Output pressure , input power ,energy recovery effectiveness、net fresh air ratio etc.
2) The scope is differently, GB/T not only involve the ERV, but also involve the recovery Exchanger.
3) ISO std. involves the coefficient of energy COP, effective work (EW),but GB/T not.

$$\mathrm{COE}_{\mathrm{ducted}} = \frac{\left(\left|qm_{2,\mathrm{net}}\left(h_2 - h_1\right)\right| \times 1000\right) + P_{\mathrm{vma}}}{\left(P_{\mathrm{in}}\right)}$$

$$\mathrm{EW} = P_{\mathrm{in}} \times \left(\mathrm{COE}_{\mathrm{ducted}} - 1\right) = \left(\left|qm_{2,\mathrm{net}}\left(h_2 - h_1\right)\right| \times 1000\right) + P_{\mathrm{vma}} - P_{\mathrm{in}}$$

四、Research and development situation of GB/T –ERV

We have achieved some research results, here show one of them.

The analysis of ERV annual energy recovery performance

1. Purpose :

Corresponding to the demand of holistic assessment the energy saving performance of building, analysis the performance tendency varying with the influence factors

$$\eta_{(effectiveness)}=f(\Delta t, \Delta i, \Delta d, \Delta \varphi, v\ldots\ldots)$$

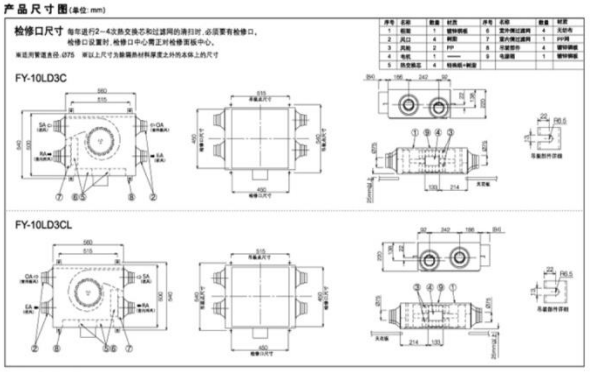
η is the function of$\Delta t, \Delta i, \Delta d, \Delta \varphi$，v……,

2. The testing sample

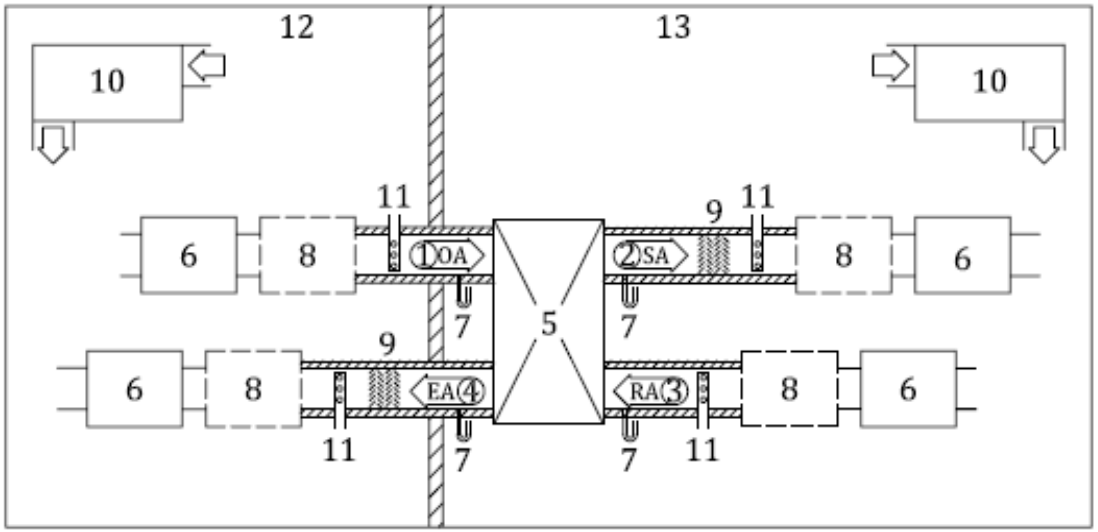
1) Selecting a ERV which is verified to be satisfied with the demand of Std.GB/T21087

2) cut down the inter fan power

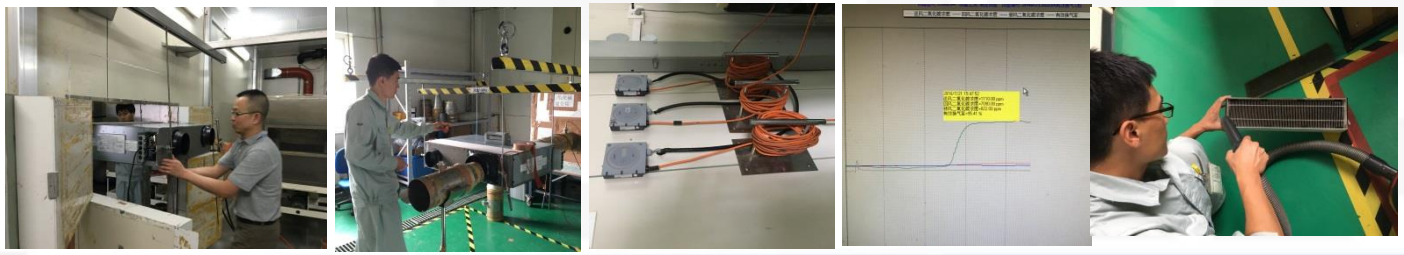
Under the range of the winter and summer testing condition which building may occurs in use, finish the tests according the GB/T21087 by changing the Δt, Δi, Δd, Δφ，v……,investigate `which are the dominate influence factors and how they affect the energy performance and what is its varying tendency.



3. lab intruduction



schematic diagram of lab



4. Part of test results

Function:

$\eta_{[夏季显热]}=f(\Delta t)$、$\eta_{[夏季全热]}=f(\Delta t)$；$\eta_{[冬季全热]}=f(\Delta t)$、$\eta_{[冬季季全热]}=f(\Delta t)$

$\eta_{[夏季显热]}=f(\Delta i)$、$\eta_{[夏季全热]}=f(\Delta i)$；$\eta_{[冬季全热]}=f(\Delta i)$、$\eta_{[冬季季全热]}=f(\Delta i)$

$\eta_{[夏季显热]}=f(\Delta d)$、$\eta_{[夏季全热]}=f(\Delta d)$；$\eta_{[冬季全热]}=f(\Delta d)$、$\eta_{[冬季季全热]}=f(\Delta d)$

$\eta_{[夏季显热]}=f(\Delta \varphi)$、$\eta_{[夏季全热]}=f(\Delta \varphi)$；$\eta_{[冬季全热]}=f(\Delta \varphi)$、$\eta_{[冬季季全热]}=f(\Delta \varphi)$

$\eta_{[夏季显热]}=f(\Delta v)$、$\eta_{[夏季全热]}=f(\Delta v)$；$\eta_{[冬季全热]}=f(\Delta v)$、$\eta_{[冬季季全热]}=f(\Delta v)$

$$\eta_{(effectiveness)}=f(\Delta t, \Delta i, \Delta d, \Delta \varphi, v\ldots\ldots)$$

η is the function ofΔt, Δi, Δd, Δφ，v……,

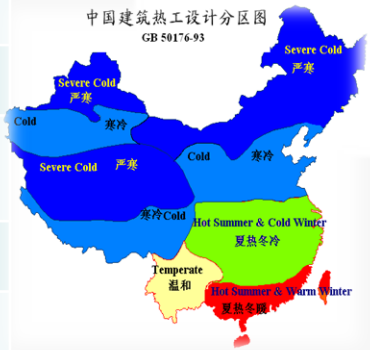
Testing conditions which building use enviroment may occurs

		冬季（Winter）				
zones	代表城市（citys）	干球温度 (dry temp.)	湿球温度 (wet temp.)	焓值 enthalpy	含湿量 huimidity	相对湿度 Relative huimidity
		（℃）	（℃）	（KJ/(kg干））	（g/(kg干））	（%）
Severe winter	哈尔滨 Harbin	-27.10	-27.30	-26.70	0.23	73.00
Cold winter	北京 Beijing	-9.90	-11.62	-8.24	0.71	44.00
hot summer and cold-winter	上海 Shanghai	-2.20	-3.43	3.65	2.35	75.00
hot-summer and warm-winter	广州 Guangzhou	5.20	3.22	15.23	3.98	72.00
Max. Value		34.40	-27.30	-26.70	21.48	75.00

		夏季（Summer）				
zones	代表城市（citys）	干球温度 (dry temp.)	湿球温度 (wet temp.)	焓值 enthalpy	含湿量 huimidity	相对湿度 Relative huimidity
		（℃）	（℃）	（KJ/(kg干））	（g/(kg干））	（%）
Severe winter	哈尔滨 Harbin	30.70	23.90	72.22	16.12	57.00
Cold winter	北京 Beijing	33.50	26.40	82.83	19.13	58.00
hot summer and cold-winter	上海 Shanghai	34.40	27.90	89.33	21.48	61.40
hot-summer and warm-winter	广州 Guangzhou	34.20	27.80	89.34	21.40	62.00
Max. Value		34.40	27.90	89.34	21.48	62.00

(4) Brief reveal of results for energy recovery exchanger only

等含湿量下的热交换效率与温差的关系							
test order number	6	8	9	11	12	average value	range
（℃）(indoor air tempe.)	24	24	24	24	24	24.00	
（g/kg）(indoor air humidity)							7.6-8.5
（℃）(outdoor air tempe.)	35	31.5	31.5	28.3	28	30.86	
（g/kg）(outdoor air humidity)							11-12.2
（℃）(temperature difference)	11	7.5	7.5	4.3	4		
Sensible heat recovery efficiency (high velocity)	45	47	45	47	47	46.20	45-47
Sensible heat recovery efficiency (middle velocity)	44	46	45	45	45	45.00	44-46
Sensible heat recovery efficiency (low velocity)	44	46	43	43	43	43.80	43-46
total heat recovery efficiency (high velocity)	55	54	55	53	53	54.00	53-55
total heat recovery efficiency (middle velocity)	53	51	52	50	50	51.20	51-53
total heat recovery efficiency (low velocity)	49	45	49	48	48	47.80	45-49



五、 Conclusion specification

1. Sensible heat recovery effectiveness almost don't change with the temperature difference (from 4℃to 11℃), under constant indoor / outdoor humidity condition.The variation range is less than 2% vs. different air face velocity.

2 Tatal heat recovery effectiveness almost don't change with the temperature difference (from 4℃to 11℃), under constant indoor / outdoor humidity condition.The variation range is less than 4% vs. different air face velocity.

Thus means：

when analysing energy annual consumption for the outdoor air handling ,under the constant humidity difference ,we can eliminate the influence of I/Odoor air temperature , select an fixed recovery effectiveness for calculation.

In practice , the phenomena that the recovery effectiveness varies with the temperature difference may be the other reasons, maybe the motor reheat or heat leakage or I/O air transfer etc. these need deeply research .

Above is only part of the research results. For more details ,please contact with me.

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谢 谢
THANKS

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Page 7
5th CCHVAC-REHVA seminar

谢谢

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