


BUILDING KNOWLEDGE
CANADA INC.

OHBA 2015

2017 Energy Efficiency Design and Right-Sizing HVAC

Sponsored by:




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45 Minutes
3 Messages

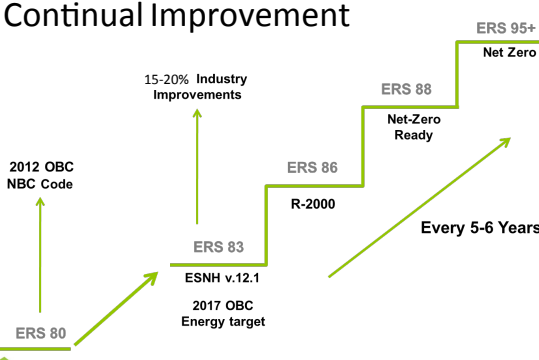
- Understand sizing & loads better
- Recalibrate your HVAC knowledge
- Measure and Monitor



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Continual Improvement



ERS 80

2012 OBC NBC Code

ERS 83

ESNH v.12.1

2017 OBC Energy target

ERS 86

R-2000

ERS 88


Net-Zero Ready

ERS 95+

Net Zero

15-20% Industry Improvements

Every 5-6 Years



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OBC 2012 Part 12.

12.2.1.2. Energy Efficiency Design After December 31, 2016

(3) Except as provided in Sentence (4), the energy efficiency of a *building* or part of a *building of residential occupancy* that is within the scope of Part 9 and is intended for occupancy on a continuing basis during the winter months shall,

(a) be designed to exceed by not less than **15%** the energy efficiency levels required by Sentence 12.2.1.1. (3), or

(b) conform to Chapters 1 and 3 of MMAH Supplementary Standard SB-12, "Energy Efficiency for Housing".



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Component	Compliance Package													
	A	B	C	D	E	F	G	H	I	J	K ⁽¹⁾	L ⁽²⁾	M ⁽³⁾	N ⁽⁴⁾
Ceiling with Attic Space Minimum RSI (R-Value) ⁽¹⁾	8.81 (R50)	8.81 (R50)	8.81 (R50)	8.81 (R50)	8.81 (R50)	8.81 (R50)	8.81 (R50)	8.81 (R50)	8.81 (R50)	8.81 (R50)	8.81 (R50)	8.81 (R50)	8.81 (R50)	8.81 (R50)
Ceiling without Attic Space Minimum RSI (R-Value) ⁽¹⁾	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)
Exposed Floor Minimum RSI (R-Value) ⁽¹⁾	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)
Wall Options	4.23 (R24)	4.75 (R27)	4.75 (R27)	4.23 (R24)	4.23 (R24)	4.23 (R24)	4.23 (R24)	3.87 (R22)	3.87 (R22)	3.87 (R22)	4.23 (R24)	4.23 (R24)	4.23 (R24)	4.23 (R24)
Basement Options	3.52 (R20)	3.52 (R20)	3.52 (R20)	3.52 (R20)	2.11 (R12)	2.11 (R12)	2.11 (R12)	3.52 (R20)	2.11 (R12)	3.87 (R22)	3.87 (R22)	3.52 (R20)	3.52 (R20)	3.52 (R20)
Below Grade Slab Entire surface > 600mm below grade Minimum RSI (R-Value) ⁽¹⁾	0.88 (R5)	—	—	—	—	—	—	—	—	—	—	—	—	—
Edge of Below Grade Slab ≤ 600mm Below Grade Minimum RSI (R-Value) ⁽¹⁾	1.76 (R10)	1.76 (R10)	1.76 (R10)	1.76 (R10)	1.76 (R10)	1.76 (R10)	1.76 (R10)	1.76 (R10)	1.76 (R10)	1.76 (R10)	1.76 (R10)	1.76 (R10)	1.76 (R10)	1.76 (R10)
Heated Slab or Slab ≤ 600mm below grade Minimum RSI (R-Value) ⁽¹⁾	1.76 (R10)	1.76 (R10)	1.76 (R10)	1.76 (R10)	1.76 (R10)	1.76 (R10)	1.76 (R10)	1.76 (R10)	1.76 (R10)	1.76 (R10)	1.76 (R10)	1.76 (R10)	1.76 (R10)	1.76 (R10)
Window Options	1.6	1.6	1.8	1.8	1.8	1.8	1.8	2	1.8	1.8	1.8	1.8	1.8	1.8
Skylights Maximum U-Value ⁽²⁾	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8
Heating Options	90%	90%	94%	94%	90%	94%	92%	94%	92%	94%	90%	94%	90%	90%
Ventilation	—	—	—	—	55%	60%	60%	70%	55%	60%	—	—	—	—
Water Heating	0.57 ⁽³⁾	0.57 ⁽³⁾	0.62	0.67	0.57 ⁽³⁾	0.57 ⁽³⁾	0.62	0.67	0.62	0.67	0.57 ⁽³⁾	0.57 ⁽³⁾	0.8	0.8
	2	3	4	5	6	7	8	9	10	11	12	13	14	14

OBC Zone 1 2012

Component	Compliance Package				
	A	B	C	D	E
Ceiling with Attic Space Minimum RSI (R-Value) ⁽¹⁾	10.56 (R60)	10.56 (R60)	10.56 (R60)	10.56 (R60)	10.56 (R60)
Ceiling without Attic Space Minimum RSI (R-Value) ⁽¹⁾	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)
Exposed Floor Minimum RSI (R-Value) ⁽¹⁾	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)	5.46 (R31)
Walls Above Grade Minimum RSI (R-Value) ⁽¹⁾	3.34 + 1.32 α (R19 + R7.5 α)	3.87 (R22)	3.34 + 0.88 α (R19 + R5 α)	4.22 (R24)	3.34 + 0.88 α (R19 + R5 α)
Basement Walls Minimum RSI (R-Value) ⁽¹⁾	3.52 + 1.40 α (R20 + R8 α)	3.52 (R20)	3.52 + 1.40 α (R20 + R8 α)	3.52 + 1.40 α (R20 + R8 α)	3.52 (R20)
Below Grade Slab Entire Surface > 600 mm Below Grade Minimum RSI (R-Value) ⁽¹⁾	—	—	—	—	—
Edge of Below Grade Slab ≤ 600 mm Below Grade Minimum RSI (R-Value) ⁽¹⁾	1.76 (R10)	1.76 (R10)	1.76 (R10)	1.76 (R10)	1.76 (R10)
Heated Slab or Slab ≤ 600 mm Below Grade Minimum RSI (R-Value) ⁽¹⁾	1.76 (R10)	1.76 (R10)	1.76 (R10)	1.76 (R10)	1.76 (R10)
Windows and Sliding Glass Doors Maximum U-Value ⁽²⁾	1.6	1.8	1.6	1.6	1.6
Skylights Maximum U-Value ⁽²⁾	2.8	2.8	2.8	2.8	2.8
Space Heating Equipment Minimum AFUE	90%	96%	94%	96%	92%
HRV Minimum Efficiency	55%	75%	75%	75%	60%
Domestic Hot Water Heater Minimum EF	0.67	0.83	0.67	0.67	0.83
Column 1	2	3	4	5	6

OBC Zone 1 2016

National Building Code 9.36

Section 9.36. Energy Efficiency

9.36.1. General


9.36.1.1. Scope

1) This Section is concerned with the energy used by buildings as a result of

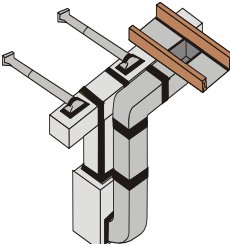
- the design and construction of the building envelope, and
- the design and construction or specification of systems and equipment for
 - heating, ventilating or air-conditioning, and
 - service water heating.

(See Appendix A.)


Targeted is approximately EnerGuide 78 to 80
Performance Path OR Prescriptive Path


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2 More Great 2015 Code Changes



Sealed ducts
30% down to 10%-15%




Low wattage fan motors
Controlled air flow


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HVAC Sizing Rules Changed

F280-12




Determining the required capacity of residential space heating and cooling appliances


- Old version 1993
- New Version in OBC Jan. 2015

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
CSA F280 Biggest Change: Ventilation & Air Leakage





0.3 ACH


+




0.3 ACH

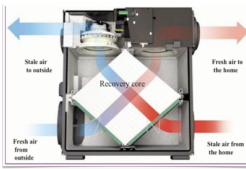
Estimate for 3 bedroom 2000 sq.ft. home
= 480 CFM of straight outside air on the coldest, windiest night of the year.
 = 40% of furnace size installed since 1990

New CSA F280





+



- Recognition of better air tightness
- Recognition of HRVs
- Responsible ventilation rates

Envelope Air Leakage Calculator


Supplemental tool for CAN/CSA-F280

New CSA F280
 Designer can use actual blower door results

Weather Station Description				
Province:	British Columbia			
Region:	Vancouver Island & 41 Area			
Weather Station Location:	Vancouver Island, British Columbia			
Anemometer Height (m):	10			
Local Shielding				
Building Site:	Sheltered			
Walls:	Very heavy			
Flue:	Heavy			
Highest Ceiling Height (m):	6.4			
Building Configuration				
Type:	Detached			
Number of Stories:	Two			
Foundation:	Full			
House Volume (m ³):	266.3			
Air Leakage/Ventilation				
Air Tightness Type:	Tight (Pre-1945) (ACH=10.1)			
Custom BDT Data:	ACH @ 50 Pa:	20.1	ACH @ 50 Pa:	20.1
Mechanical Ventilation (L/s):	Total Supply:	0	Total Exhaust:	0
Flue Size				
Flue #:	#1	#2	#3	#4
Diameter (mm):	0	0	0	0
Envelope Air Leakage Rate				
Heating Air Leakage Rate (ACH/H):				0.587
Cooling Air Leakage Rate (ACH/H):				0.156

New CSA F280
Much better foundation module





Residential Foundation Thermal Load Calculator
Supplemental tool for CAN/CSA-F280

Weather Station Description	
Province:	Manitoba
Region:	Winnipeg
Site Description	
Soil Conductivity:	Normal conductivity, dry sand, loam, clay
Water Table:	Normal (7-10 m, 22-30 Ft)
Foundation Dimensions	
Floor Length (m):	12.4
Floor Width (m):	6.4
Exposed Perimeter (m):	0
Wall Height (m):	2.5
Depth Below Grade (m):	1.75
Window Area (m ²):	0
Door Area (m ²):	0
 Insulation Configuration	
Radiant Slab	
Heated Fraction of the Slab:	0
Fluid Temperature (°C):	33
Design Months	
Heating Month:	1
Foundation Loads	
Heating Load (Watts):	1621

New CSA F280
Windows Modeling Enhancements




Designer can input actual window data
50% of AC loads are due to windows

ENERGY PERFORMANCE RATINGS	
U-Factor (U.S.A-P)	Solar Heat Gain Coefficient
0.30	0.36
ADDITIONAL PERFORMANCE RATINGS	
Visible Transmittance	
0.59	

The original 800-1200 sq.ft starter home

160 MBH 30 MBH

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The new 800-1200 sq.ft starter home

30 MBH 180 MBH






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New Rules in a 2000 sq.ft. Home

	1982 ERS 70	2012 ERS 80	2017 ERS 83
Heat Loss (BTUs)	78,500 BTUs	37,000 BTUs	32,000 BTUs
Heat Gain (BTUs / Tons)	30,000 BTUs (2.5 Ton)	18,000 BTUs (1.5 Ton)	17,000 BTUs (1.5 Ton)
Annual Energy	47,500 kWh	33,500 kWh	28,500 kWh
Annual Energy \$\$	\$ 5,500	\$ 3,200	\$ 2,700


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New Rules in a 2000 sq.ft. Home


	1982	2012 EGs 80	2017 ERS 83
Load	78,500 BTUs 2.5 tons	37,000 BTUs 1.5 tons	32,000 BTUs 1.5 tons
Air Flow	1200 CFM	700 CFM	550 CFM
Duct sizes			
• Mains	8" x 28"	8" x 18"	8" x 12"
• Branch	6" - 8"	5"	3" - 4"



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Thermal Comfort; Defined

Thermal Comfort Criteria
ASHRAE 55

1. Metabolic Rate
2. Clothing Insulation
3. Air Temperature
4. Mean Radiant Temperature (MRT)
5. Air Speed
6. Humidity





**New Efficient Homes: New HVAC
Issues(and Opportunities!)**

The Old Rules of Thumb Don't Apply



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Part Loads and Intermittent Loads Dominate Comfort





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The challenges of Air system design


1. **Cooling CFM** will outstrip **Heating CFM**. Can ductwork change size with the seasons????
2. New ECM blower motors capable of maintaining higher ESP from 0.2 to .08 and higher.
3. Traditional 50/50 split of available ESP external static pressure(Gas-in-the-tank) may not be the best choice. May increase **COOLING** ESP

	Heating	Cooling
External static pressure	0.50 in H2O	0.50 in H2O
Pressure losses	0.23 in H2O	0.23 in H2O
Available static pressure	0.27 in H2O	0.27 in H2O
Supply / return available pressure	0.13 / 0.14 in H2O	0.13 / 0.14 in H2O
Lowest friction rate	0.066 in/100ft	0.066 in/100ft
Actual air flow	380 cfm	800 cfm
Total effective length (TEL)		412 ft

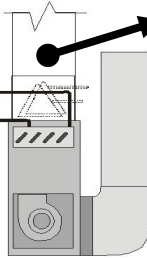
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Simple Testing



0.15" to 0.25"
40 – 60 Pa





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Sealing Ducts Matters!!!

- ▶ Getting air where you need it
- ▶ Allowing balancing & seasonal adjustment to work
- ▶ Empowers zoning to work




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New Reality's in HVAC Design and Performance

Low Load homes need more efficient, effective fans!

- Capable of meeting small loads, part loads and full loads!
- Use 1/5 of original PSC motor types.
- Run efficiently at a variety of speeds (Modulation)
- Enables balanced Temps throughout home
- Enhances Ventilation "Effectiveness"

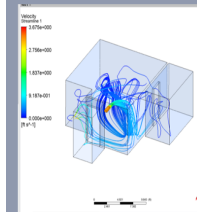


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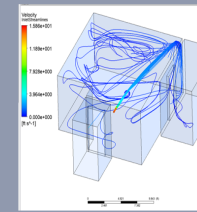
New Reality's in HVAC Design & Performance

Low Load Homes suffer from lack of air flow THROW and MIXING! (Not lack of Returns)

Standard register

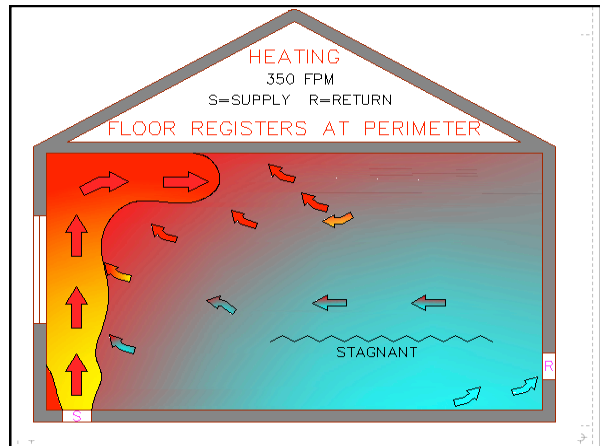


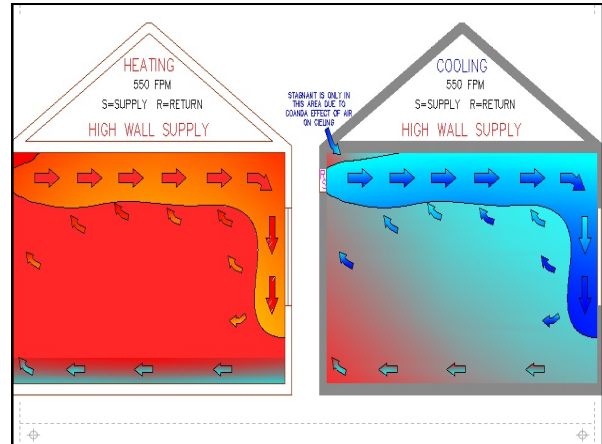
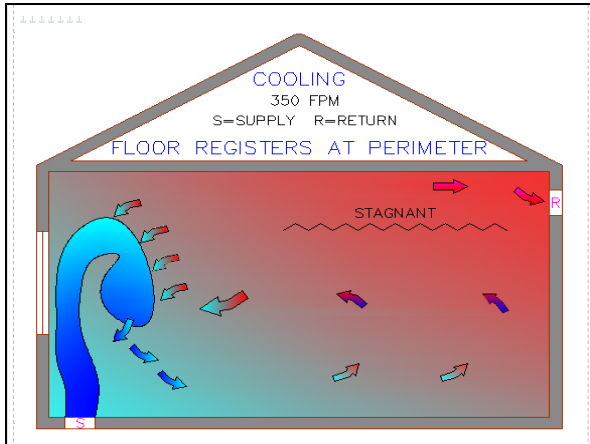
Small diffuser



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Supply Outlet		Throw (ft)									
		Airflow	1	2	3	4	5	6	7	8	9
Higher leakage duct system	20 cfm										
	40 cfm										
Lower leakage duct system	20 cfm										
	40 cfm										





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The challenges and opportunity's Humidity; Too much?

Air conditioning load characteristics have changed.

Sensible cooling requirements may drop slightly BUT Latent loads seem to be increasing.

Increase Latent loads = Increased interior Relative Humidity and resulting Mold/Condensation issues

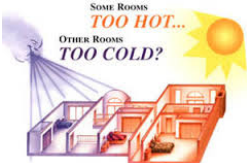
Opportunity for 2 stage AC with dehumidification



Zoned Distribution?

Zoned distribution can handle any design

- ▶ Sun rooms with Intermittent Loads
- ▶ Rec rooms in the basement
- ▶ Get rid of 2 FURNACES and go with single unit with multiple zones



New Homes Need New Solutions

- Smaller equipment
- Dual Fuel applications
- System thinking to deliver air



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Do you know how your current systems perform?

- ▶ Test & monitor now
- ▶ HVAC designers need:
 - ▶ Air tightness data
 - ▶ Window data
 - ▶ Insulation levels



The challenges and opportunity's

Going forward we need to know:

1. Homes are becoming MORE efficient
2. LOADS are dropping
3. EQUIPMENT /LOADS on designer form needs to be MATCHED IN THE FIELD
4. GOOD DUCT SEALING makes a world of difference.
5. ECM OR BRUSHLESS DC MOTORS enable even temperatures throughout home and effective ventilation
6. Air tightness Matters!!! Load reduction(25+%), less drafts, quieter homes
7. Right Sized Ducts are the only way to meet the comfort needs of new LOW LOAD HOMES

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