What you need to know about residential furnaces, air conditioners and heat pumps if you’re NOT an HVAC professional

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In accordance with the Department of Labor and Industry’s statute 326.0981, Subd. 11,

“This educational offering is recognized by the Minnesota Department of Labor and Industry as satisfying 1.5 hours of credit toward Building Officials and Residential Contractors continuing education requirements.”

For additional continuing education approvals, please see your credit tracking card.
Test your knowledge!

1. Go to: c3ping.com
2. Enter Ping ID: 6160
3. Enter a name
4. “Waiting for the next question...”
Who’s here?

A. Builder / remodeler
B. Home Performance Consultant
C. Weatherization provider
D. HVAC contractor / distributor
E. Other
Comfort features?

Installation?

Matched for system?
The heating system in MY home is...

A. ... a natural gas or propane furnace
B. ... an oil furnace
C. ... a hot-water or steam boiler
D. ... something else
Efficiency level

Blower technology

Firing Stages
Efficiency level

To condense...  ...or not to condense?

\[ CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O \]
The “gulf of corrosion”
MY furnace is...

A. ...Non-condensing
B. ...Condensing
C. (I’m not sure)
The savings from upgrading from non-condensing to condensing are…

A. 5%
B. 10%
C. 15%
D. 20%
E. 25%
The savings from upgrading from non-condensing to condensing are…

A. 5%
B. 10%
C. 15%
D. 20%
E. 25%
Upgrade to higher efficiency condensing?
Annual Fuel Utilization Efficiency
AFUE
11.2.9.9 Minimum Stack Gas Temperature Difference above Room Temperature Calculate the minimum stack gas temperature difference above room temperature, $\psi_{2,x}$, expressed in °F and defined as follows.

For systems numbered 1-4 and systems 5-8 if (S/F) $\psi_{2,x} = \psi_{2,0,0}$.

For systems numbered 3-8 for which (S/F) $\psi_{2,x} = \psi_{2,0,0}$.

where

$$\psi_{2,x} = \psi_{2,0,0} - 20.0 \text{ min},$$
$$\psi_{2,x} = \psi_{2,0,0} - 12.5 \text{ min},$$
$$\psi_{2,x} = \psi_{2,0,0} - 5 \text{ min}.$$
Firing stages

Single-stage

Multi-stage

Modulating
Two-stage operation
(12 monitored furnaces)

Percent of operating time

Low stage

High stage
Typical modulating furnace

Percent of full output

Percent of operating time
MY furnace is...

A. ...Single-stage
B. ...Multi-stage
C. ...Modulating
D. (I’m not sure)
Blower technology
PSC (Permanent Split-capacitor)

AKA
“Multi-speed”
ECM (Electronically commutated motor)

AKA “variable speed”
Electricity consumption (watts)
Yearly ECM electricity savings

Fan “ON” use
before  after

= $60
= $450
= $0

(@ 13 cents/kWh)
X-13 (trade name)

AKA
“constant torque”
MY furnace has...

A. …a PSC blower
B. …an ECM blower
C. …an X-13 blower
D. (I’m not sure)
Performance (efficiency & comfort)

- Condensing Multi-stage ECM
- Condensing Multi-stage X-13
- Condensing Single-stage PSC
- Non-condensing Single-stage PSC
- Non-condensing Multi-stage PSC
Furnace sizing

40,000 Btuh

60,000 Btuh

80,000 Btuh

100,000 Btuh
Minnesota energy code:

“Oversizing of heating equipment shall not exceed ____ percent of the calculated load requirement”

A. …5
B. …10
C. …20
D. …40
Minnesota energy code:

“Oversizing of heating equipment shall not exceed ____ percent of the calculated load requirement”

A. ...5
B. ...10
C. ...20
D. ...40
What percent of Minnesota furnaces exceed the code limit for oversizing?

A. 15%
B. 30%
C. 60%
D. 95%
What percent of Minnesota furnaces exceed the code limit for oversizing?

A. 15%
B. 30%
C. 60%
D. 95%
Questions about furnaces?
Air conditioner
Efficiency level

Component choices

Cooling Stages

Installation?
Seasonal Energy Efficiency Ratio
SEER
How many hours per year does the average central air conditioner in Minneapolis run?

A. …120 hours
B. …240 hours
C. …325 hours
D. …450 hours
E. …630 hours
How many hours per year does the average central air conditioner in Minneapolis run?

A. ...120 hours
B. ...240 hours
C. ...325 hours
D. ...450 hours
E. ...630 hours
### SEER upgrade savings

<table>
<thead>
<tr>
<th>SEER</th>
<th>Savings (vs SEER 13)</th>
</tr>
</thead>
<tbody>
<tr>
<td>13</td>
<td>$0</td>
</tr>
<tr>
<td>14</td>
<td>$20</td>
</tr>
<tr>
<td>15</td>
<td>$35</td>
</tr>
<tr>
<td>16</td>
<td>$50</td>
</tr>
<tr>
<td>17</td>
<td>$65</td>
</tr>
<tr>
<td>18</td>
<td>$75</td>
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(2.25 tons capacity, 325 annual hours, 13 cents/kWh)
Cooling stages

- Single-stage
- Two-stage
- Modulating
Mini Split
Metering device?

Oversized?

3rd party?
Fixed orifice

Thermostatic expansion valve (TXV)
Airflow adjusted?

Refrigerant charge checked?
What percent of MN A/C systems have improper refrigerant charge or airflow?

A. ...10%
B. ...20%
C. ...40%
D. ...60%
E. ...85%
What percent of MN A/C systems have improper refrigerant charge or airflow?

A. ...10%
B. ...20%
C. ...40%
D. ...60%
E. ...85%
Typical savings: 10%

One in six can save 25%+
A/C sizing

- 3 tons
- 2.5 tons
- 2 tons
What is a “ton” of cooling?

2,000 lb

3 ft 3”

12,000 Btuh
The two jobs of an air conditioner

70%

30%
The three dehumidification killers

- Oversized system
- Airflow too high
- Fan ON setting
Questions about air conditioners?
What about heat pumps?
<table>
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<th>Cost</th>
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<td>$1.00</td>
</tr>
<tr>
<td>Propane furnace (condensing)</td>
<td>$1.80</td>
</tr>
<tr>
<td>Baseboard electric</td>
<td>$4.20</td>
</tr>
<tr>
<td>Heat pump</td>
<td></td>
</tr>
<tr>
<td>@50F</td>
<td>$1.20</td>
</tr>
<tr>
<td>@40F</td>
<td>$1.40</td>
</tr>
<tr>
<td>@30F</td>
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For:

- Natural gas at 75 cents per therm
- Propane at $1.50 per gallon
- Electricity at 13 cents per kWh
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For:

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- propane at $1.50 per gallon
- electricity at 13 cents per kWh
Questions about heat pumps?
Thermostat
Lots of options

- Programmable?
- Connected?
- “Smart”?
- Proprietary?
Where’s the brain?
Questions about thermostats?
Filter
Options

- 1” disposable
- 4” disposable
- Electrostatic
- Filtering efficiency
Minimum Efficiency Reporting Value MERV
Recipe for disaster
Questions about filters?
Thank you!

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