Mini Split Heat Pump
QI Best Practices and Diagnostic Procedure

Charlie McCracken
New England HVAC Programs
What we will discuss today

- 2014 Laboratory testing
  - Adjusted charge from 33% to 150%
  - Evaluated Superheat, Capacity, Watts
- 2015 Pilot review
  - 35 Single head MSHPs by 8 trained contractors
  - Helped develop consistent QI protocol
- Quality Installation
  - Sizing, Piping, Leak Testing, Proper Tools
- Multi Head Testing
  - Mitsubishi, Fujitsu, Daikin, LG conform in TEST
  - Other product lines to be evaluated Spring 2017
- 2017 Baseline Study
  - Target: 256 2016 rebated MSHPs SH and MH
  - AC Check and Non Participating Contractors
Typical Lab Test Data

Mitsubishi FH09

Tested at the MEA Training Center
Southborough, MA
November 24-25, 2014
2015 Field Testing

- 35 Units tested
- Single Zone
- Real World Test Data
  - Developed “Passing” Parameters
  - Superheat <5F and Amps < 110% of AHRI
MSHP Information Required

Date: ____________________  Time: __________ AM/PM

Condenser Ambient | Temp  °F DB
Suction Line Pressure  psig
Vapor Line Temp  °F
Return Dry Bulb Temp  °F DB
Return Wet Bulb Temp  °F WB
Supply Dry Bulb Temp  °F DB
Supply Wet Bulb Temp  °F WB

L1:  amps
L2:  amps
# Cooling Mode Diagnoses

<table>
<thead>
<tr>
<th>Status</th>
<th>Superheat</th>
<th>Amps (%) of AHRI</th>
<th>Typical Causes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correctly Installed</td>
<td>&lt; 5 degrees F</td>
<td>&lt;=110%</td>
<td>Correct installation</td>
</tr>
<tr>
<td>Undercharged</td>
<td>&gt; 5 F (often &gt;10)</td>
<td>N/A</td>
<td>Leaky flare connection</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>No charge adjustment made</td>
</tr>
<tr>
<td>Overcharged</td>
<td>Fluctuating, 5-10F</td>
<td>&gt; 110%</td>
<td>Too much refrigerant added</td>
</tr>
<tr>
<td>Line set contamination</td>
<td>Approx. 5F</td>
<td>&gt; 110%</td>
<td>Incorrect vacuum applied/moisture in line</td>
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Amperage from published AHRI rated conditions of 95/80/67F at 230 volts
Quality Installation Checklist

- Sizing
- Piping
- Condensate
- Line Set Covers
- Clearances
- Wall Mounts/Stands
- Surge Protector?
- Homeowner Education
Single Zone Condensers

REQUIRED SPACE

Mitsubishi

Daikin

Fujitsu

CAUTION

- Set the piping length from 4.5ft (1.4m) to 60ft (20m).
- How to remove the stop valve cover.
  - Insert the upper part of the stop valve cover into the outdoor unit to install.
  - Tighten the screws.

Stop valve cover

Floors with poor drainage, use block bases for outdoor unit. Adjust foot height until the unit is level. Otherwise, water leakage or pooling of water may occur.

INDOOR UNIT

Connection cable

[OUTDOOR UNIT]
Quality Installation Best Practices

- Consider Using Line Sets with Better Insulation

3/8” Insulation

1/2” Insulation
- Tear/UV Resistant
- Mold/Mildew Resistant
- Meets Flame/Smoke Rating
Buy a New Flaring Tool and Use Torque Wrenches
Do a Proper Leak Test and Evacuation
Vacuum Refrigerant Lines

- Some OEMs DO NOT specify

Deep Vacuum Chart; Carrier Service Manuals
## Undercharged MSHPs

- **SH> 5F**
- **Note the time stamps in bottom right**

### R-410A

<table>
<thead>
<tr>
<th>Low Pressure</th>
<th>High Pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td>115.0 psig</td>
<td>-</td>
</tr>
<tr>
<td>93.3 min</td>
<td>UNASSIGNED</td>
</tr>
<tr>
<td>130.2 avg</td>
<td>min</td>
</tr>
<tr>
<td>208.9 max</td>
<td>avg max</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Liquid Saturation</th>
<th>Vapor Saturation</th>
</tr>
</thead>
<tbody>
<tr>
<td>- - -</td>
<td>- -</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Low Temp</th>
<th>High Temp</th>
</tr>
</thead>
<tbody>
<tr>
<td>52.8 °F</td>
<td>-</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Superheat</th>
<th>Subcooling</th>
</tr>
</thead>
<tbody>
<tr>
<td>Target</td>
<td>Calc</td>
</tr>
<tr>
<td>UNASSIGNED</td>
<td>14.3 °F</td>
</tr>
</tbody>
</table>

**ManTooth™RSA**

- **1.5 # Under Charged**

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<table>
<thead>
<tr>
<th>Low Pressure</th>
<th>High Pressure</th>
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<tbody>
<tr>
<td>123.8 psig</td>
<td>-</td>
</tr>
<tr>
<td>123.1 min</td>
<td>UNASSIGNED</td>
</tr>
<tr>
<td>123.8 avg</td>
<td>min</td>
</tr>
<tr>
<td>125.2 max</td>
<td>avg max</td>
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<table>
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<th>Low Temp</th>
<th>High Temp</th>
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<tr>
<td>45.1 °F</td>
<td>-</td>
</tr>
</tbody>
</table>

<table>
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<th>Subcooling</th>
</tr>
</thead>
<tbody>
<tr>
<td>Target</td>
<td>Calc</td>
</tr>
<tr>
<td>UNASSIGNED</td>
<td>2.7 °F</td>
</tr>
</tbody>
</table>

**ManTooth™RSA**

- **100%**
Overcharged MSHP

- EEV “Hunts” until 8 oz removed
- Note the time stamps in bottom right
Screening Procedure in Cooling

- Always Connect/Disconnect to Service Port while running
- Set MSHP into OEM TEST Mode
  - Or set Thermostat 2-3F< Room, Fan on MH
- Should find most significant issues
- Always follow OEM instructions if charge adjustment is indicated
Screening Procedure in Cooling

- Could be used by:
  - Program QA
  - Contractors to QA technicians
  - Quick determination if system charge is the cause of a customer comfort or bill complaint
# Cooling Mode Diagnosis - Example

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9,000 BTU Tier 2 MSHP  AHRI 16.1 EER = 560 Watts
Watts / (Volts x Power Factor) = Amps
560 w/ (230 v x 0.95 pf) = 2.6 amps at AHRI Rated Conditions
Measured SH = 3.2F
Measured Amps = 2.8 = 108% of AHRI
PASS!
# NEEP MSHP Listing 2016 Summary

<table>
<thead>
<tr>
<th>COOLING Capacity (BTUH) at AHRI 95/80/67</th>
<th>COOLING Watts at AHRI 95/80/67 @ 230 volts</th>
<th>COOLING Amps at AHRI 95/80/67 @ 230 volts</th>
<th>COOLING MassSave H&amp;C Tier 1 18/9 Tier 2 20/11</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ave. 9,000</td>
<td>615</td>
<td>2.8</td>
<td>1</td>
</tr>
<tr>
<td>Ave. 12,000</td>
<td>912</td>
<td>4.2</td>
<td>1</td>
</tr>
<tr>
<td>Ave. 15,000</td>
<td>1,158</td>
<td>5.3</td>
<td>1</td>
</tr>
<tr>
<td>Ave. 18,000</td>
<td>1,370</td>
<td>6.3</td>
<td>1</td>
</tr>
<tr>
<td>Ave. 24,000</td>
<td>1,609</td>
<td>7.4</td>
<td>1</td>
</tr>
<tr>
<td>Ave. 9,000</td>
<td>578</td>
<td>2.6</td>
<td>2</td>
</tr>
<tr>
<td>Ave. 12,000</td>
<td>898</td>
<td>4.1</td>
<td>2</td>
</tr>
<tr>
<td>Ave. 15,000</td>
<td>1,111</td>
<td>5.1</td>
<td>2</td>
</tr>
<tr>
<td>Ave. 18,000</td>
<td>1,400</td>
<td>6.4</td>
<td>2</td>
</tr>
<tr>
<td>Ave. 24,000</td>
<td>1,760</td>
<td>8.1</td>
<td>2</td>
</tr>
</tbody>
</table>
2017 MSHP Baseline Study

- Target of 256 Single and Multi Head Rebated MSHPs will be evaluated
- Installations by Participating and Non-Participating Contractors
- Customers selected at random
- Contractors advised & encouraged to participate in advance, or attend site visit
- No repairs will be made or suggested
Contractor Support Resource

844-615-8315
HVAC@clearesult.com

Mass Save Heating & Cooling
Rhode Island Heating & Cooling
c/o CLEAResult
50 Washington Street
Westborough, MA 01581
Quality Installation Checklist

- MHPI listed: meet at least 18 SEER / 9 HSPF or higher.
- Was a Manual J V8 load calculation performed? (Not a requirement)
- Continuous piping insulation, at minimum R.3 or 3/8" in thickness, is required.
  In no application should there be more than 2" of exposed copper piping following installation.
- Refrigerant lines must be leak tested and evacuated per manufacturer’s recommendations.
  This may be either the deep vacuum or triple evacuation method.
- All visible line sets must run through line set covers, sized accordingly to fit the number of line sets used.
  Covers are level and/or plumb, meeting the expectations of the homeowner.
- Refrigerant lines meet the manufacturer’s minimum and maximum lengths.
  If longer than the precharged distance, technician added _______ oz. per _______’ of line set.
- Condensate piping should be terminated outside in the shortest, most vertical and direct way possible.
  Condensate shall not terminate over walkways where accumulating/hot draining could damage building components.
- Equipment installation shall meet all manufacturers’ specified clearances.
  Typically side-discharge, these condensers require at least 4” between the condenser and any obstruction like a wall.
- Outdoor equipment in heating dominated climate shall be placed on a stand or wall mounted, at minimum 6”
  above grade, or above the seasonal snow line as recommended by local code.
- Condenser should be protected with a UL listed surge protector, either whole home or individual.
- System operation was explained to homeowner, to include: avoiding large set backs and use of auto changeover.