Mini-Split (MS) Check

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MS CHECK
A Test Procedure to Verify Proper Charge and Amperage

A Cooling Mode Diagnostic Procedure for MSHPs
Developed and Tested over 4 years

Uses Superheat and Amps to Determine
  Proper Charge
  Under Charge
  Over Charge
  Poor Evacuation
Lab Test Data

- Mitsubishi FH09
- MEA Training Center Southborough, MA
- November 24-25, 2014
Lab Test Data

• Daikin RXS15LVJU
• Tested at FW Webb, Woburn MA
• December 9, 2014

Training system (on stand) with short line set, one anomaly in power measurement, otherwise consistent with Mitsubishi test results
Undercharged MSHPs

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

<table>
<thead>
<tr>
<th>R-410A</th>
<th>R-410A</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Low Pressure</strong></td>
<td><strong>High Pressure</strong></td>
</tr>
<tr>
<td><strong>115.0 psig</strong></td>
<td><strong>123.8 psig</strong></td>
</tr>
<tr>
<td>93.3 min</td>
<td>123.1 min</td>
</tr>
<tr>
<td>130.2 avg</td>
<td>123.8 avg</td>
</tr>
<tr>
<td>208.9 max</td>
<td>125.2 max</td>
</tr>
<tr>
<td><strong>Vapor Saturation</strong></td>
<td><strong>Liquid Saturation</strong></td>
</tr>
<tr>
<td><strong>38.5 °F</strong></td>
<td><strong>- - - UNASSIGNED</strong></td>
</tr>
<tr>
<td><strong>Low Temp</strong></td>
<td><strong>High Temp</strong></td>
</tr>
<tr>
<td><strong>52.8 °F</strong></td>
<td><strong>- - - UNASSIGNED</strong></td>
</tr>
<tr>
<td><strong>Superheat</strong></td>
<td><strong>Subcooling</strong></td>
</tr>
<tr>
<td><strong>Target</strong></td>
<td><strong>Calc</strong></td>
</tr>
<tr>
<td><strong>- - - UNASSIGNED</strong></td>
<td><strong>14.3 °F</strong></td>
</tr>
<tr>
<td><strong>Target</strong></td>
<td><strong>Calc</strong></td>
</tr>
<tr>
<td><strong>- - - UNASSIGNED</strong></td>
<td><strong>2.7 °F</strong></td>
</tr>
</tbody>
</table>


1.5 # Under Charged

100%
Overcharged MSHP

- EEV “Hunts” until 8 oz removed, as tech “dumped his hoses” into system
- Note the time stamps in bottom right
- Proper charge reduced power from 8.1 amps to 6.8 amps
## MS Check Diagnostic Matrix

<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 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>
</tr>
</tbody>
</table>

Amperage from published AHRI rated conditions of 95/80/67F at 230 volts
MS Check
Installation Error or Operation Error?
2015 MSHP Inspection in Somerville MA

- Dual Zone Multihead MSHP installed by OEM certified contractor
- Customer is MIT technician & measured power at panel, 2000 watts is too high
- MS Check trained tech observes SH bouncing, advises to remove and weigh
- He recovers 5 ½ # of overcharge!!
- When correct charge installed, drops from 2000 watts to 800 watts = 60% Savings
- This is the same savings as eliminating Night Setback (57%) in Net Zero home

*MS Check* can diagnose Installation OR Operation error
Temperature setbacks (on/off operation)…

- One homeowner complained of temperature unevenness.
- When the data were examined, it was clear that they operated their MSHP in an “on-off” manner rather than using a fixed set point.
- This resulted in wide swings in interior temperature (between 60°F and 70°F+).
- The electricity use showed many hours with the MSHP running at maximum capacity (~2000 W), followed by periods with the unit shut off.
- Electricity consumption was by far the worst among all monitored houses; when compared with simulations, it was the worst-performing house.
- Heating use “57% higher than simulation.”

Ueno and Loomis, 2015 DOE-Building Science Corporation; Long Term Monitoring of Ductless MSHP in Northeast
One homeowner complained of temperature unevenness; when the data were examined, it was clear that they operated their MSHP in an “on-off” manner, rather than using a fixed set point. This resulted in wide swings in interior temperature (between 60°F and 70°F). The electricity use showed many hours with the MSHP running at maximum capacity, followed by periods with the unit shut off. When operated in this manner, the MSHP is heating at its least efficient (maximum output) state. Electricity consumption was a high consumption outlier; when compared with simulations, it was the worst-performing house (heating use 57% higher than simulation).
Multi Head MSHP Evaluation
LG 4 ton/5 zone MSHP RST Thermal, Westwood MA, 4.4.17

- Installed/Attached Capacity = 51,000 BTUh
- Rated BTU (from Engineering tables) = 49,241 BTUh
- Rated EER as Configured = 10.5 EER
- BTU / EER = Watts = 4,950 Watts
- Watts / 230 volts (AHRI) = 20.4 Amps
- Training Room Temp. = 71F
- Expected Amps = 14.5 A = 71% of 20.4 Amps
- Measured Amps OEM iPad = 12.5 Amps
- Measured Amps Multimeter = 13.6 Amps
- Measured Superheat = 3.1F
- **Passing Goal** <5F Superheat and <110% AHRI Amps
MSHP Evaluation - Existing System (2016)
Mitsubishi MUZ-GE18NA MSHP, Hudson MA, 2.22.18

- Installed/Attached Capacity = 17,200 BTUh (for specs…)
- Rated EER as Configured = 10.5 EER (ask Google)
- BTU/h / EER = Watts = 1,638 Watts
- Watts / 230 volts (AHRI) = 7.1 Amps
- Training Room Temp. = 79F
- Expected Amps = 5.6 A = 79% of 7.1 Amps
- Measured Amps UEI meter = 5.3 Amps
- Measured Amps F/P meter = 5.8 Amps
- Measured Superheat = 4.3F
- Passing Goal <5F Superheat and <110% AHRI Amps