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Building America AC Installation Using CheckMe!

Prepared for:
Building Science Corporation
Pulte Homes
Sierra Air

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Creators of CheckMe!®



EXECUTIVE SUMMARY

If central air conditioners in new construction were installed with ensured care they would:

- provide higher value to the homeowner
- reduce callbacks and warranty costs
- increase the prestige of the contractor
- increase the prestige of the homebuilder

Traditionally, changing the way air conditioners are installed have included education, training, and marketing. Experience has shown that these three items alone have not changed the way residential air conditioners perform immediately after installation. The Building America AC CheckMe!® project was designed to address the problem of air conditioner not performing to their designed efficiency.

Air conditioners perform well below their designed efficiency and capacity because of low airflow through the inside coil and incorrect refrigerant charge. This project utilizes a computer expert system (CheckMe!®). **It was designed to ensure that the two critical parameters of airflow and charge are properly tested and set by the installer.** In addition, a number of other installation items are addressed:

The results from 111 new units were impressive:

- Refrigerant charge was correct on 89% of the units. By comparison, on average, less than 35% of new installations have correct charge.^{1 2}
- Only 9% of the units installed under CheckMe!® showed low air flow, while normal installation practice would result in over 70% with low air flow.
- The program spotted one unit with low capacity.
- Conditions present allowed for determining correct charge using superheat or subcooling in 71% of the units during start-up.
- The refrigerant charge adjustment recommended for line set size and length produced proper charge in over 70% of the cases.

¹ "National Energy Savings Potential from Addressing Residential HVAC Installation Problems" Chris Neme, J. Proctor, and S. Nadel. February 1999 Vermont Energy Investment Corporation for United States Environmental Protection Agency.

² This can be raised to 100% if undercharged units with less than 5 degrees target superheat are brought to between 5 and 7 degrees of superheat.

The primary conclusion of the study is that the computer expert system in combination with training as well as builder and contractor support can change the outcomes of efficiency and capacity critical to customer satisfaction.

INTRODUCTION

If central air conditioners in new construction were installed with ensured care they would:

- provide higher value to the homeowner
- reduce callbacks and warranty costs
- increase the prestige of the contractor
- increase the prestige of the homebuilder

Traditionally, changing the way air conditioners are installed have included education, training, and marketing. Experience has shown that these three items alone have not changed the way residential air conditioners perform immediately after installation. The Building America AC CheckMe!® project was designed to address the problem of air conditioner not performing to their designed efficiency.

Air conditioners perform well below their designed efficiency and capacity because of low airflow through the inside coil and incorrect refrigerant charge. The pertinent question is: “How can we change the way air conditioners are installed to obtain the designed performance?” This project utilizes a computer expert system (CheckMe!®). **It was designed to ensure that the two critical parameters of airflow and charge are properly tested and set by the installer.** In addition, a number of other installation items are addressed:

- Setting the outdoor unit (condenser)
- Proper refrigerant line brazing
- Leak testing refrigerant lines
- Proper evacuation of lines and evaporator coil
- Charge testing and correction
- Air flow testing and correction
- Duct system static pressures

Ten technicians working for Sierra Air were trained on and used the system. Two technicians performed the majority of the work, accounting for 88% of the start-ups. A total of 186 air conditioners were installed using CheckMe!®.

The primary conclusion of the study is that the computer expert system in combination with training as well as builder and contractor support can change the outcomes of efficiency and capacity critical to customer satisfaction.

DISCUSSION

Air conditioners perform well below their designed efficiency and capacity because of low airflow through the inside coil and incorrect refrigerant charge.

This program was able to address a portion of the market interaction between the installing HVAC Contractor and the Builder. Implementing an air conditioner installation that meets the manufacturers' standards results in positive benefits to the contractors, the builder, and the homebuyer.

Desired Effects:

The first desired effect is integration of proper AC installation into building practice. The usual installation does not include checking refrigerant charge and airflow with the manufacturers' specified methods. The prevailing methods are only effective in extreme situations. This is evidenced in national studies which show: refrigerant charge off by more than 5% on 60+% of the units, airflow low by more than 50 cfm per ton on 70+% of the units, and an average estimated achievable savings between 24% and 35% depending on the local situation³. Installation according to the manufacturers' specified methods can lead to sustainable change when the contractor and builder can reduce call backs and customer dissatisfaction.

A second desired effect is that builders realize the benefit from a proper installation and that this realization results in increasing their market share or margin.

Intervention

The intervention consisted of training technicians in the proper technique for installing air conditioners. This training was followed by field consulting with the technicians and immediate feedback to the technicians via the CheckMe!® computer program running on the technician's laptop computer on site. Data from each installation were captured and analyzed at Proctor Engineering Group, Ltd (PEG).

³ "National Energy Savings Potential from Addressing Residential HVAC Installation Problems" Chris Neme, J. Proctor, and S. Nadel. February 1999 Vermont Energy Investment Corporation for United States Environmental Protection Agency.

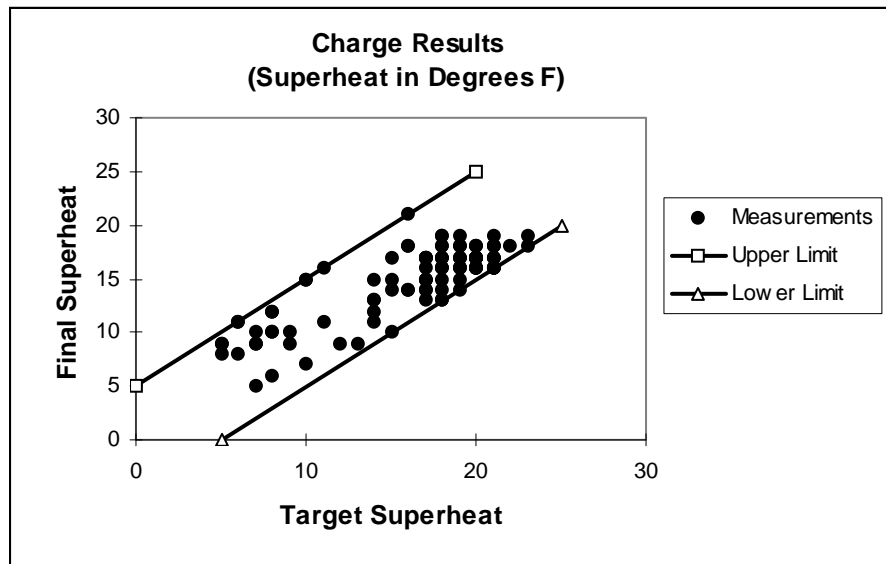
RESULTS

Ten individuals were trained to use CheckMe!®. Seventy one percent of the start-ups completed under CheckMe!® were done by one individual. A second technician performed 17% of the start-ups, with the remaining eight technicians performing a combined 12%.

A detailed analysis of data by subdivision and/or model was not completed. This type of analysis is possible if technicians consistently note the model and subdivision. Data was not available for the level of vacuum achieved or the level of vacuum after isolation.

CheckMe!® prompts the technicians to continue working on the installation until the refrigerant charge was correct. Seventy six percent of the units showed correct charge using the manufacturer's preferred method of test. This compares with a less than 40% showing correct charge on normal installations. Figure 1 shows that units were left with the correct refrigerant charge on all but 20 of the units.

Figure 1. Refrigerant Charge Results

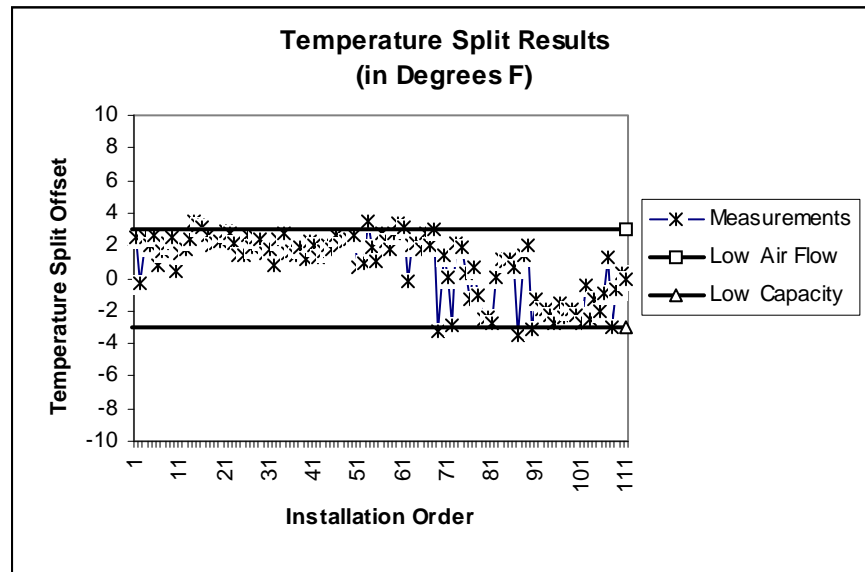


Further analysis of the CheckMe!® data indicated that the charge could have been corrected on the 20 units left with incorrect charge if the technician had made an adjustment to lower superheat. When the conditions present indicate that the target superheat is less than 5°F, the technician should add charge to bring the actual superheat down to between 7°F and 5°F.

When the charge was adjusted to correct superheat over 70% of the time the recommended amount of adjustment (by weight) was the correct adjustment.

Only 9% of the units installed under CheckMe!® showed low air flow, while normal installation practice would result in over 70% with low air flow. At the same time the program showed the viability of spotting problems that could be costly to the contractor and builder. The data displayed in Figure 2 show 17 units had a high temperature split, indicating low airflow and one unit that had a low temperature split indicating a capacity problem. These are potentially call back units or units that may result in customer dissatisfaction. The program spotted these problem units immediately.

Figure 2. Air Flow and Capacity Results



Analysis by static pressures can be achieved when that data is recorded (it was not in these cases).

The First Company air handlers have lower air flow and higher wattage draws than equivalent York units (11.3 amps vs. 8.8 amps respectively).