RESEARCH HIGHLIGHTS

Technical Series 97-117

TESTING FOR LEAKS IN FURNACE HEAT EXCHANGERS

Introduction

The heat exchanger of a gas or oil furnace allows the transfer of heat to the house air and conveys the combustion gases to a vent or chimney. If a furnace heat exchanger is cracked or corroded, gases may pass from the combustion chamber into the house. These gases contain varying amounts of carbon monoxide, nitrogen oxides, and other contaminants. It is wise to vent them rather than introducing them into house air.

Most gas furnace heat exchangers are not perfectly airtight, so some small amount of leakage almost always exists. Identification of this leakage can be very subjective, so that a leak or crack identified by one serviceperson will not cause concern with another serviceperson. With gas furnaces, if a serviceperson identifies major leakage, the furnace is "red-tagged" and must be replaced. It is clear that it is in the homeowner's best interest to ensure that any heat exchanger leakage test properly identifies significant or dangerous leakage and properly passes minor or insignificant leakage. This research project investigated how to improve the field testing of Canadian furnaces, with the emphasis on gas appliances.

Research Program

The research program was comprehensive, involving a literature search, lab and field testing, and contractor training on the preferred test method. Forty-one utilities across Canada and the US replied to a questionnaire on the test methods used by their servicepeople in assessing heat exchanger leakage. The replies identified fifteen different test methods. From this sample, a selection of preferred test methods were selected. These methods were tested on a group of furnaces, assembled from "red-tagged" appliances taken from customers' homes. Finally, a contractor was hired to train servicepeople in the preferred procedure, and a sample of actual houses was to be tested in different parts of the country. If the servicepeople found problems with the selected test method during field implementation, the test protocol could be improved and refined prior to releasing it to all other utilities.

Findings

Responses to the survey show that all correspondents initially used a visual inspection of the furnace heat exchanger and the burner flame as the first step in problem identification. The burner flame will often be blown about if there is a major leak in the lower part of a gas furnace heat exchanger. However, unless the heat exchanger is removed from the furnace (a complicated and expensive job), much of it will be hidden from a cursory visual inspection. Half the respondents used other checks as well, and these techniques ranged from smoke bombs and oderants to the measurement of tracer gases or CO_2 in the plenum. Most of those surveyed were confident of the accuracy of their chosen method.

Laboratory testing took place on 13 red tagged furnaces at the Canadian Gas Research Institute (CGRI). Three leakage test methods were selected from the assortment of available tests: a smoke pencil test, a CO_2 tracer test, and a tracer gas test developed by the American Gas Association (AGA). Each of the furnaces underwent the three tests, then the furnaces were disassembled,

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inspected, and pressure tested to produce an accurate measurement of the leakage area. Some of the red tagged furnaces did not have appreciable leaks. The criteria used for evaluation of the tests was that they were to accurately predict both large leakage areas and acceptably small leaks. The AGA procedure proved to be the most successful of the three tests, with a reasonable prediction of furnace condition on ten of these thirteen appliances.

After the laboratory testing above, it became clear that there were two tests being cited as the AGA tracer test: one described as the original and one offered by a manufacturer/distributor. Procedures varied slightly between them, although both used detection of a tracer gas in the burner compartment by a sensing probe in the circulation air ducting. When the CGRI laboratory explored the differences between the two procedures, it found that neither could repeatably and accurately predict the leakage areas of all furnaces. The technical committee overseeing the work suggested modifications to both procedures. These too were tested in the lab and were found to be unsuccessful. The current state of this research suggests that there are no reliable quantitative test procedures for determining the leakage areas of gas furnaces.

Implications for the Homeowners

The failure of the research to find a reliable test method means that furnace servicepeople will continue to use subjective and largely inaccurate test methods. It is likely that a thorough visual inspection will identify major corrosion damage or crackage of the heat exchanger. Marginal cracks are less apt to be properly diagnosed, and may result in adequate furnaces being taken out of service too soon, or, conversely, a significant leak in a hard-to-see location not being detected. The best current defences against dangerous situations would include annual furnace servicing (including a combustion gas analysis) and the use of a CO detector which may alert householders to dangerously high combustion gas leakage.

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Housing Research at CMHC

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