Building America Case Study

Technology Solutions for New and Existing Homes

Replacement of Variable-Speed Motors for Furnaces

Syracuse, New York

PROJECT INFORMATION

Project Name: Evaluation of Concept 3 BPM motors

Location: Syracuse, NY

Partners:

New York State Energy Research and Development Authority (NYSERDA)
www.nyserda.org

Proctor Engineering Group (PEG)
www.proctoreng.com

Tag Mechanical
www.taghomeperformance.com/

Consortium for Advanced Residential Buildings
www.carb-swa.com

Building Component: HVAC

Application: Retrofit, homes with forced air distribution

Year Tested: 2010-13

Applicable Climate Zone(s): Cold climates

PERFORMANCE DATA

Cost of Energy-Efficiency Measure (including labor): approx. $475

Projected Energy Cost Savings: $42/year

Efficient fan motors are becoming more and more common in new furnaces. These brushless, permanent-magnet (BPM) motors can use less than half the power of conventional permanent, split-capacitor (PSC) motors. BPM motors are always recommended for new systems, but what are the options for upgrading existing furnaces with more efficient motors?

With support from NYSERDA and Proctor Engineering Group (PEG),U.S. Department of Energy Building America team Consortium for Advanced Residential Buildings (CARB) has been evaluating the performance of PEG's Concept 3 replacement motor in cold climate homes. This motor—also marketed as the Fieldpiece LER—is designed to be a straightforward replacement for PSC motors in many homes. To date, CARB has upgraded six systems with Concept 3 motors.

Upgrading a fan motor is usually very straightforward. Once familiar with the product, technicians from Tag Mechanical were usually able to replace motors in two hours or less. Not every furnace is appropriate for a Concept 3 upgrade, however. Some larger furnaces have ¾-hp motors, and the Concept 3 is only ½ hp. In addition, some fans have bracket motor mounts; it is much more practical to retrofit Concept 3 motors in furnaces with belly-band mounts.

The fan motors do indeed consume less power. On average, the Concept 3 motors used 126 Watts (23%) less during heating mode and 220 Watts (38%) less during cooling. In "fan only" mode, motors consumed 442 Watts (87%) less on average, but by design they delivered approximately 50% less flow. Overall energy savings, including fan energy savings in the eight homes evaluated to date, averaged $42 per year.

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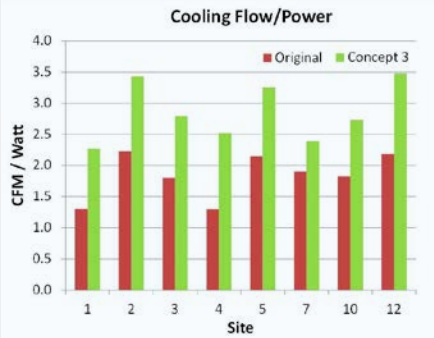
DESCRIPTION

Partly because they were designed primarily for cooling climates, fan savings are more pronounced during cooling operation.



Concept 3 motors can only replace ½-hp or smaller motors. They are also much easier to use in fans that have belly-band mounting systems. Bracket-mount motors (as shown below) require at least twice as much time and effort to replace.

CARB also encountered several furnaces that were probably nearing the end of their useful lives. Replacing furnaces with more efficient, sealed-combustion units (with BPM motors, of course) may be more practical in such circumstances.

For more Information, see the Building America report, *Evaluation of Retrofit Variable-Speed Furnace Fan Motors,* at *www.buildingamerica.gov*

Image credit: All images were created by the CARB team.

Site	Annual Savings		
	Heating and Cooking	Fan Only	Total
1	$11	$26	$37
2	$19	$33	$52
3	$21	$0	$21
4	$43	$0	$43
5	$24	$71	$95
7	$13	$39	$52
10	$8	$0	$8
12	$25	$0	$25
Avg	$20	$21	$42

CARB consistently found less electricity was required to deliver the same amount of heating or cooling with BPM motors. Relatively short run-times, however, led to modest energy savings. For homes that use fan-only operation, additional energy savings can be realized.

Lessons Learned

- Savings are most dramatic in homes where the air handler fan is used often (or even continuously) for filtration or ventilation.
- Higher savings are possible where there are higher cooling loads.
- Oversized systems need to run less often, so fan energy savings are lower.
- In compatible furnaces, installation is straightforward. It requires two hours or less for installation with an experienced technician.
- Installed costs will vary, but $475 may be typical.
- In furnaces with larger motors—or that have flow rates higher than the Concept 3 can deliver—CARB has begun evaluating 1-hp Evergreen IM motors.

Looking Ahead

Based on the results of the study so far, CARB recommend BPM motor upgrades only in special circumstances in cold climate homes:

- Where occupants use the furnace fan often for ventilation or filtration
- There is a large cooling load
- If the furnace or air conditioner, or both, are right-sized and run nearly 2,000 hours per year.

In these instances, the cost of installing a motor in a very old furnace—which may need to be replaced soon—should be weighed against the cost of a new, efficient furnace.

U.S. DEPARTMENT OF ENERGY
Energy Efficiency & Renewable Energy

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www.buildingamerica.gov

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