

msac MANUFACTURERS' SERVICE ADVISORY Council HOTLINE

The Manufacturers' Service Advisory Council provides expert answers to your technical questions

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Motor Speeds

I'm looking at a stock motor. It is a three-speed, 1,075 rpm, single-phase, direct-drive blower motor. What are the rpm of the speeds?

Typically, permanent split capacitor and shaded pole designs will vary approximately 100–150 rpm between the speed taps. These speed taps allow the installer to tailor the motor to the installation, possibly selecting different taps for heating and cooling modes.

A motor nameplated 1,075 rpm is most often a six pole design. The rpm differences are the result of speed taps, which are turns of fine wire that are in series with the main winding. So the motor will be weaker on medium speed, and even weaker on low speed. On an installed motor, the actual rpm will be the point where the motor performance curve and fan curve intersect.

Motors have magnetic poles, which are always in pairs. Common designs in HVACR applications include 2, 4, 6 and 8 poles. There is a constant value of 7,200, which relates to 60 cycle alternating current which changes direction 120 times/second, times 60 sec/min-120 x 60 = 7,200. Divide the 7,200 by the pairs of poles: 7,200/2 = 3,600; 7,200/4 = 1,800; 7,200/6 = 1,200; 7,200/8 = 900. The 3,600, 1,800, 1,200 and 900 rpm values are the synchronous speeds. If the rotor turned at the same rate as the electrical fields in the stator, which they do not, in an induction motor, there is a certain amount of slip or variance from the synchronous speed. Nominal motor nameplate rpm are often 3,450, 1,725, 1,075 and 850. Permanent Split Capacitor (PSC) and shaded pole motors typically have more slip and slightly lower nameplate rpm.

How do I figure out rpm differences between speeds? The first question to ask is "What are you trying to accomplish?" Often someone is seeking a replacement for an 800-850 rpm OEM motor and they think they could use one of the lower speeds on a 1,075 rpm motor. This will not work. The OEM motor develops a given horsepower at the lower rpm. A 1,075 rpm motor of the same horsepower would have that rating at the higher rpm. It will be weaker on the lower speed taps. One of the fan laws is: power varies at the cube of the speed.

So, it would take over a 1 hp, 1,075 rpm motor to replace a 1/2 hp, 850 rpm motor.

Question and answer from Dennis Bush, Manager of Market Development, Regal Beloit.

Calculating Refrigerant Charge

I am retrofitting an R-22 air conditioning system to an HFC replacement. We are also extending the lineset. I have the manufacturer's original chart that explains how much R-22 to add per foot of additional line, but I cannot find any charts like that for any of the replacement products. How do I calculate the additional charge?

Before answering the question directly the real question is about the final operating charge of the replacement product. Since it appears you have the original OEM paperwork it is assumed you also have the recommended startup charging instructions. It is also assumed that the replacement HFC will be a blend with glide. Begin by weighing the recovered R-22 and use the following formula to calculate the initial amount of replacement refrigerant. You can get the density of the new refrigerant from the refrigerant manufacturer's data sheet. The density of R-22 at 80°F is 73.9.

$$\text{lb of new} = \frac{\text{lb of original} \times \text{density of new}}{\text{Density of original at } 80^{\circ}\text{F}}$$

Start the system and adjust the charge to obtain the OEM's designated operating criteria. If this is a fixed-orifice system, obtain the proper superheat value. If this is a TXV-equipped unit, charge to the designated subcooling value.

Back to the original question: If you are thinking ahead you have already determined that the above formula can be used to calculate the amount of new refrigerant required to extend the lineset. Determine the additional amount of R-22 required from the OEM table and run the density formula to calculate the additional amount.

Question and answer from Ron Vogl, Technical Marketing Manager, Honeywell International.

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