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Calculating Minimum Cooling Flows

Electric motors convert electrical energy into mechanical energy, making it possible to move things, like water. In the process, electric motors produce heat, and that heat must be displaced. Otherwise, the heat will build up in the motor and cause motor failure.

Motors that are located aboveground use the air around them for cooling, sometimes with the assistance of a fan. In the case of a submersible motor, the water being pumped is used to cool the motor and provide a long, reliable service life.

There are two keys to keeping a submersible motor cool: making sure there is water flowing past the motor, and that there is enough of it. Even though the motor is submerged in water, several situations are possible in which water could enter above the motor. In these cases, water will enter at the pump intake and never pass the motor. Examples of this type of situation would be an open body of water, a pump sitting below the casing/ perforations or a top-feeding (cascading) rock well.

In these situations, the motor requires a flow sleeve. Page 6 of the Franklin Application, Installation, Maintenance (AIM) manual explains how a flow inducer sleeve is constructed. One important note: for the flow sleeve to be effective, it must extend past the bottom of the motor. Once water flow past the motor has been confirmed, the amount of flow must also be checked. The minimum values for Franklin Electric motors, in feet per second (ft/s), are as follows:

Motor Type	Minimum Flow
4-inch Super Stainless	= No minimum, but must have some water movement
4-inch High Thrust	= ¼ ft/s
6-inch Motors	= ½ ft/s
8-inch Motors	= ½ ft/s

The flow rates above apply when the motor is operating at or less than service factor amperage in water up to 86 °F (30 °C). These cooling flows must be maintained to ensure a long, dependable service life of a submersible motor. The rate of cooling flow past the motor depends on three things:

1. Amount of water being pumped (gpm)
2. The diameter of the motor
3. The inside diameter of the well casing

The rate of flow past the motor will change if any of these three factors changes. So, how do you know when you have enough cooling flow? There are two ways to answer that question; the easiest is by looking at Table 6 on page 6 of the Franklin Electric AIM manual.

Table 6 Required Cooling Flow

MINIMUM GPM REQUIRED FOR MOTOR COOLING IN WATER UP TO 86 °F (30 °C).			
CASING OR SLEEVE ID INCHES (MM)	4" MOTOR (3-10 HP) 0.25 FT/S GPM (L/M)	6" MOTOR 0.50 FT/S GPM (L/M)	8" MOTOR 0.50 FT/S GPM (L/M)
4 (102)	1.2 (4.5)	-	-
5 (127)	7 (26.5)	-	-
6 (152)	13 (49)	9 (34)	-
7 (178)	20 (76)	25 (95)	-
8 (203)	30 (114)	45 (170)	10 (40)
10 (254)	50 (189)	90 (340)	55 (210)
12 (305)	80 (303)	140 (530)	110 (420)
14 (356)	110 (416)	200 (760)	170 (645)
16 (406)	150 (568)	280 (1060)	245 (930)

As you can see, the size of the motor and well casing are the factors in determining adequate cooling flow. For example, if you have a 6-inch motor set in an 8-inch casing, the table above shows you'll need 45 gpm to maintain the ½ ft/s required cooling flow.

In some cases, your AIM manual may not always be available or you might need to calculate flow yourself. The formula below can be used to calculate the same information as in the table above.

$$\text{Required gpm} = \frac{\text{Required ft/s} \times (\text{casing diameter}^2 - \text{motor diameter}^2)}{0.409}$$

The required feet per second will be ¼ or ½ ft/s, the casing diameter is the inside diameter of the casing and the motor diameter is the diameter of the stator. Standard diameters on Franklin motors are as follows:

Diameter of motor		Diameter of motor^2
4-inch = 3.75	=	14.1
6-inch = 5.38	=	28.9
8-inch = 7.50 (40-100 hp)	=	56.2
8-inch = 7.70 (125-200 hp)	=	59.3

Let's look at a couple of examples, starting with the same example we used earlier. That is, we'll consider a 6-inch motor in an 8-inch casing:

$$\text{Required gpm} = \frac{\text{Required ft/s} \times (\text{casing diameter}^2 - \text{motor diameter}^2)}{0.409}$$

$$\text{Required gpm} = \frac{0.5 \times (8^2 - 5.38^2)}{0.409}$$

$$= \frac{0.5 \times (64 - 28.9)}{0.409}$$

= 43 gpm corresponds to 45 gpm from the table above.

Flow Inducer Sleeve

If the flow rate is less than specified, then a flow inducer sleeve must be used. A flow sleeve is always required in an open body of water. FIG. 1 shows a typical flow inducer sleeve construction. In the case of 4-inch High Thrust, 6-inch, and 8-inch motors, a flow sleeve is always required in an open body of water.

EXAMPLE: A 6" motor and pump that delivers 60 gpm will be installed in a 10" well. From table 6, 90 gpm would be required to maintain proper cooling. In this case adding an 8" or smaller flow sleeve provides the required cooling.

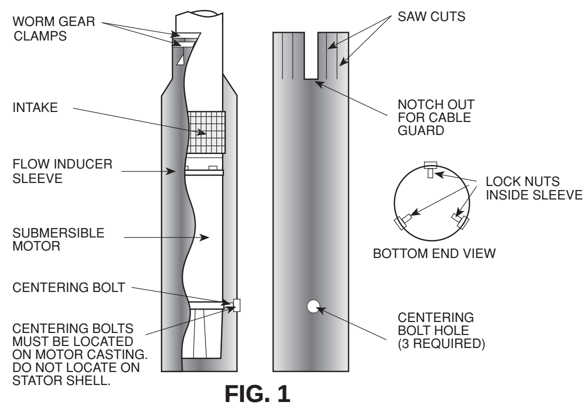

FIG. 1

A submersible motor needs three things for a long service life: a good power supply, a good working environment, and good cooling. That cooling comes from the water being pumped past the motor. To ensure there is enough flow past the motor in your application, refer to Table 6 in your AIM manual or use the formula provided in this Franklin AID. When there is not enough cooling flow present, be sure to utilize a flow sleeve. Keeping a submersible motor properly cooled will provide a long, reliable service life for your water well application.

TOLL-FREE HELP FROM A FRIEND

Contact Franklin's toll-free SERVICE HOTLINE for answers to your water systems questions. When you call, a Franklin expert will offer assistance in troubleshooting your installation and provide answers to your water systems questions.

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QUALITY IN THE WELL

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