



Solving the Problem of Motor Protection
from Moisture, Water and Dust in
Commercial Refrigerators.



Saving Generation for the Next Generation

Overview

Moisture, water and dust are common causes of motor failure in commercial refrigeration applications like supermarket refrigerated display cases, beverage merchandisers and vending machines. Motor manufacturers address these concerns by listing motor IP ratings, but often a more detailed explanation is needed.

This white paper discusses the meaning and effectiveness of different motor IP ratings in commercial refrigeration applications, and compares moisture, water and dust protection for Wellington ECR motors to the ratings of other common types of refrigeration motors.

1. IP Ratings

Ingress Protection (IP) ratings are a standardized method established by the International Electrotechnical Commission (IEC) to describe the ability of enclosures of electrical devices to withstand exposure to dust particles and water. IP ratings are defined by IEC standard 60529.

IP ratings consist of the letters “IP” followed by two numbers. The first number denotes the degree of protection against foreign objects and dust’s access to hazardous parts. The second number indicates the degree of protection against water. A brief description of the meaning of individual IP ratings can be found in Table 1.

Table 1. Degrees of Protection Indicated by IP Ratings

First Digit			Second Digit		
0		Not protected	0		Not protected
1	>50mm	Protected against any large part of the body such as the back of a hand, and solid foreign objects 50mm Ø and greater	1	Dripping water	Vertically falling drops of water shall have no harmful effect
2	>12.5mm	Protected against fingers and solid foreign objects 12.5mm Ø and greater	2	Dripping water when tilted up to 15°	Vertically falling drops of water shall have no harmful effect when the motor is tilted up to 15° from its normal position
3	>2.5mm	Protected against tools, thick wires and other solid foreign objects 2.5mm Ø and greater	3	Spraying water	Water falling as a spray at angles up to 60° from the vertical shall have no harmful effect
4	>1mm	Protected against most wires, screws and other solid foreign objects 1mm Ø and greater	4	Splashing water	Water splashed from any direction shall have no harmful effect
5	Dust protected	Ingress of dust is not entirely prevented but dust shall not enter in sufficient quantity to interfere with the satisfactory operation of the equipment	5	Water jets	Water projected from a nozzle from any direction shall have no harmful effect
6	Dust tight	Protected against dust so that none enters	6	Powerful water jets	Water projected in powerful jets from any direction shall have no harmful effect
			7	Temporary immersion	Ingress of water in a harmful quantity shall not be possible when the motor is immersed in water under defined conditions of pressure and for up to 30 minutes.
			8	Continuous immersion	The motor is suitable for continuous submersion in water under conditions which shall be specified by the manufacturer

2. The Problem

Electric motors used in refrigeration applications require protection against moisture, water and dust due to the environment found in refrigerated display cases, beverage merchandiser and vending machine condensers and evaporators. Motors are typically exposed to the following elements:

- **Water from condensation forming on metal parts**

- **Water from defrost cycles**

Condensation and water are common in all types of commercial refrigerators.

- **Melting built up ice**

In low temperature applications, it is also not uncommon to find built up ice melting over the motors because of the heat radiated by the motors themselves. This problem is less significant in the case of ECM motors because they generate less heat than shaded pole and PSC induction products.

- **Water jet spraying**

In applications containing food like refrigerated display cases, the lower portion of the display cases is periodically cleaned with water sprayed by a hose in order to meet sanitation and cleanliness standards. Motors are also sprayed during this process.

- **Dust**

The air curtain used in refrigerated display cases is intended to reduce the infiltration of warm and moist ambient air into the cold environment inside the display case. Dust is often introduced through the air curtain and re-circulated by the fan blades. In stand alone applications, dust collected on the night curtains and condenser coils can also be re-circulated and enter the motors.

3. Refrigeration Motors IP Ratings

Shaded pole motors are commonly used in commercial refrigeration applications and are typically rated IP42. These motors may suffer some water ingress, particularly if not mounted horizontally. This will shorten their life. However, water ingress does not usually cause rapid failures, as shaded pole motors have no electronic controls. Also, because of their low efficiency, these motors generate a lot of heat that makes water evaporate more quickly when water droplets do enter the motor.

Electronically commutated (ECM) motors require higher degrees of protection to avoid getting the electronic control wet. An IP42 rating leaves the ECM motor open to the ingress of dust and indicates very limited protection against moisture and none against water jet spraying. Because ECM motors typically have ball bearings they can be mounted at any angle so water resistance from all directions is required. Further, short-term water ingress can be hazardous to electronic controls so protection from hose down washings is necessary.

ECM motors for commercial refrigeration applications are offered with varying IP ratings ranging from IP42 to IP66. No motors are built with IP ratings of IP67 or higher, which would indicate their ability to operate unharmed while completely submerged in water for a limited time. Refrigeration applications require tolerance of dust and dirt, although not at extreme levels, and of periodic hose down washings, although not with extreme water pressure or flow rate. IP55 rating is therefore suitable for ECM motors for refrigeration applications.

4. Wellington's ECR Solution

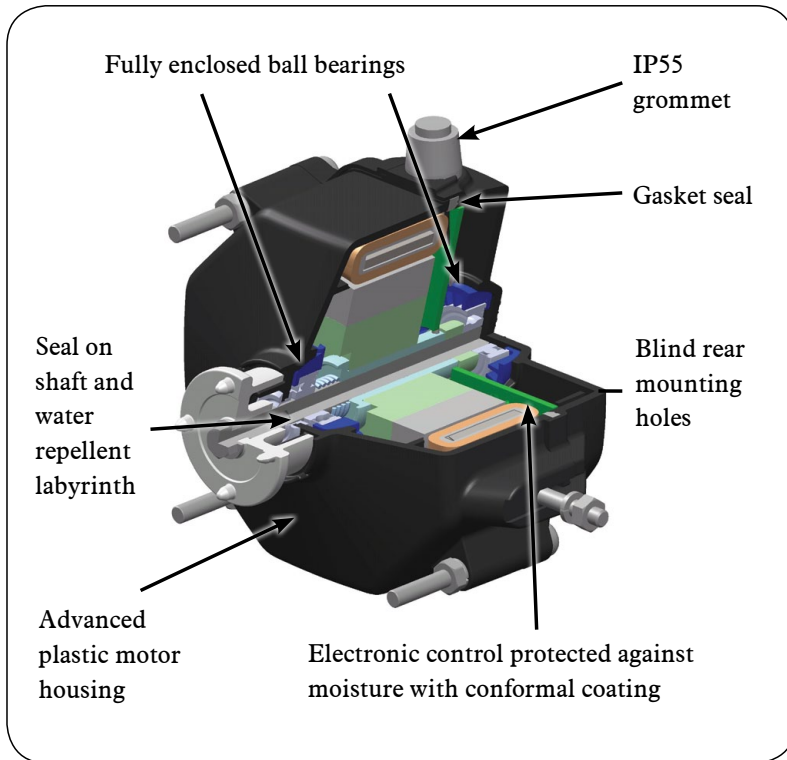
Wellington ECR motors are designed specifically for commercial refrigeration applications and are all available with IP55 rating. This makes them highly resistant to all environments typically found in refrigerated display cases, beverage merchandisers and vending machines, including low temperature applications and those with defrost cycles.

Specifically, Wellington's IP55 ECR motors have been tested for their resistance to water jets according to IEC60529 standard. ECR motors have also passed a 2,500 hours water spray test per MIL-810G part 506.5. During this test, the motor duty cycle was one hour on, five minutes off while under continuous water spray to allow thermal cycling of the air volume inside the motors to maximize the chance of leakage. The test was passed with no failures.

ECR motors have also undergone a two hour dust ingress test per IEC60529.

Wellington ECR motors achieve a degree of protection that allows them to solve all the moisture, water and dust problems typical of commercial refrigeration applications with the design features illustrated in Figure 1 below.

Figure 1. ECR82P/92P Motors' Moisture, Water and Dust Resistance Features.



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About Wellington Drive Technologies Limited:

Wellington Drive Technologies is one of the world's leading suppliers of energy saving, electronically commutated (ECM) motors and fans for the refrigeration, ventilation and appliance industries. As an international supplier of energy saving solutions, Wellington has offices in the United States, Europe, Singapore, New Zealand and Central America. Wellington's advanced technology provides standard and custom solutions that lower energy consumption through design innovation and lower costs through reduced materials usage and electronics design. For more information, visit us at www.wdttl.com, or contact a Wellington office near you.



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