

# AutomationDirect AC Motors Selection Overview

## EPAcT, High and Premium Efficiency What does it all mean?

### EPAcT (1992)

In 1992, the U.S. Congress passed legislation requiring that general purpose Design A & B motors meet minimum efficiency requirements, and this legislation was called the Energy Policy Act of 1992. Previously, there had been no U.S. standards set forth for motor energy efficiency. Since 1997 (when EPAcT '92 was first enforced), two-, four-, and six-pole general purpose Design A & B motors had to meet EPAcT guidelines. Since then, most general purpose motors manufactured and/or sold in the U.S. have met these requirements.

### Premium Efficiency (EISA 2007)

In December 2010, a new level of energy efficiency mandate went into effect. The Energy Independence and Security Act of 2007 mandated that all AC industrial motors as described below must meet Premium Efficiency standards. The NEMA trade group was instrumental in getting this legislation passed, so many people refer to the high efficiency motors by their nickname – NEMA Premium®. All applicable motors manufactured or imported into the U.S. after December 2010 must meet the Premium Efficiency guidelines.

### Motors Covered Under EISA 2007 (Premium Efficiency Mandate)

**Included – must meet the new Premium Efficiency standards – Industrial AC electric squirrel-cage general-purpose motors as follows:**

Single speed; Polyphase; 1–200 hp with 3-digit frame sizes; 2, 4, & 6 pole (3600, 1800, & 1200 rpm); NEMA design A & B (including IEC equivalent); Continuous rated

**Not Included in Premium Efficiency standards, but must now meet EPAcT standards:**

JM; JP; Round body (footless); 201–500 hp; Fire pump; U-frame; Design C; 8-pole

Certain motors (Inverter/Vector Duty, NEMA design D, etc.) are not covered by EISA 2007.

For full text, visit [www.energy.senate.gov](http://www.energy.senate.gov) and click “ENERGY INDEPENDENCE & SECURITY ACT OF 2007”.

| Nominal Full-Load Efficiency Standards Comparisons (%)      |                   |                    |                   |                    |                   |                    |
|-------------------------------------------------------------|-------------------|--------------------|-------------------|--------------------|-------------------|--------------------|
| Enclosed Electric Motors, Random Wound, 60 Hz, 600V or Less |                   |                    |                   |                    |                   |                    |
| Motor HP                                                    | 1200 rpm [6-pole] |                    | 1800 rpm [4-pole] |                    | 3600 rpm [2-pole] |                    |
|                                                             | EPAcT             | Premium Efficiency | EPAcT             | Premium Efficiency | EPAcT             | Premium Efficiency |
| 1                                                           | 80.0              | 82.5               | 82.5              | 85.5               | 75.5              | 77.0               |
| 1.5                                                         | 85.5              | 87.5               | 84.0              | 86.5               | 82.5              | 84.0               |
| 2                                                           | 86.5              | 88.5               | 84.0              | 86.5               | 84.0              | 85.5               |
| 3                                                           | 87.5              | 89.5               | 87.5              | 89.5               | 85.5              | 86.5               |
| 5                                                           | 87.5              | 89.5               | 87.5              | 89.5               | 87.5              | 88.5               |
| 7.5                                                         | 89.5              | 91.0               | 89.5              | 91.7               | 88.5              | 89.5               |
| 10                                                          | 89.5              | 91.0               | 89.5              | 91.7               | 89.5              | 90.2               |
| 15                                                          | 90.2              | 91.7               | 91.0              | 92.4               | 90.2              | 91.0               |
| 20                                                          | 90.2              | 91.7               | 91.0              | 93.0               | 90.2              | 91.0               |
| 25                                                          | 91.7              | 93.0               | 92.4              | 93.6               | 91.0              | 91.7               |
| 30                                                          | 91.7              | 93.0               | 92.4              | 93.6               | 91.0              | 91.7               |
| 40                                                          | 93.0              | 94.1               | 93.0              | 94.1               | 91.7              | 92.4               |
| 50                                                          | 93.0              | 94.1               | 93.0              | 94.5               | 92.4              | 93.0               |
| 60                                                          | 93.6              | 94.5               | 93.6              | 95.0               | 93.0              | 93.6               |
| 75                                                          | 93.6              | 94.5               | 94.1              | 95.4               | 93.0              | 93.6               |
| 100                                                         | 94.1              | 95.0               | 94.5              | 95.4               | 93.6              | 94.1               |
| 125                                                         | 94.1              | 95.0               | 94.5              | 95.4               | 94.5              | 95.0               |
| 150                                                         | 95.0              | 95.8               | 95.0              | 95.8               | 94.5              | 95.0               |
| 200                                                         | 95.0              | 95.8               | 95.0              | 96.2               | 95.0              | 95.4               |

# AutomationDirect AC Motors Selection Overview

## General-purpose or inverter-duty motor?

### How to choose a general purpose motor vs. an inverter-duty motor

General purpose motors have been around for many years. They are the workhorse of almost every industry. As the use of VFDs (inverters or AC drives) has become commonplace in industry, the construction of general purpose motors was improved to handle many applications. All ADC General purpose 3 phase motors are inverter rated and can withstand the higher voltage spikes produced by all VFDs (amplified at longer cable lengths).

If an application requires precise speed control or high loads at lower speed, a high performance inverter duty motor may be required. These motors are designed run at very slow speeds without overheating. This performance comes at a cost: high performance inverter-duty motors can be much more expensive than general purpose inverter rated motors. Guidelines for choosing an IronHorse general purpose motor vs. a high performance inverter duty motor are given below. If your application falls within the guidelines below, there is no need to apply a high performance inverter-duty motor.

**NOTE:** Marathon high performance, inverter duty motors have limitations as well. Please see the Marathon section for more details.

**Background:** For many years, AC motors were driven by across-the-line contactors and starters. The electricity sent to the motor was a very clean sine wave at 60Hz. Noise and voltage peaks were relatively small. **However, there were drawbacks:** they only ran electrically at one speed (speed reduction was usually handled by gearboxes or some other, usually inefficient, mechanical means) and they had an inrush of electrical current (when the motor was first turned on) that was usually 5 to 6 times the normal current that the motor would consume. The speed reduction apparatus was expensive and bulky, and the inrush would wreak havoc with power systems and loading (imagine an air conditioning system in an old house - when the compressor would kick on, the lights would dim; now imagine the same circumstances with a motor the size of a small car).

**Note: The following discussion applies only to 3-phase motors.**

**Enter the VFDs (variable frequency drives):** Drives were introduced to allow the speed of these motors to be changed while running and to lessen the inrush current when the drive first starts up. To do this, the drive takes the incoming 60Hz AC power and rectifies it to a DC voltage (every drive has a DC bus that is around 1.414 (sqrt of 2) \* incoming AC Line Voltage).

This DC voltage is then "chopped" by power transistors at very high frequencies to simulate a sine wave that is sent to the motor [see Figure 1]. By converting the incoming power to DC and then reconvert it to AC, the drive can vary its output voltage and output frequency, thus varying the speed of a motor. Everything sounds great, right? We get to control the frequency and voltage going out to the motor, thus controlling its speed.

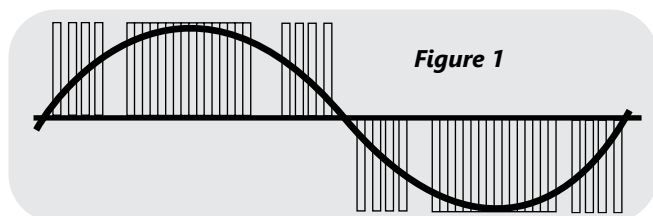


Figure 1

**Some things to watch out for:** A VFD-driven general purpose motor can overheat if it is run too slowly. (Motors can get hot if they're run slower than their rated speed.) Since most general purpose motors cool themselves with shaft-mounted fans, if the motor overheats, bearing and insulation life will be reduced. Therefore there are minimum speed requirements for all motors.

The voltage "chopping" that occurs in the drive actually sends high-voltage spikes (at the DC bus level) down the wire to the motor. If the system contains long cabling, there are actually instances where a reflected wave occurs at the motor. The reflected wave can effectively double the voltage on the wire. This can lead to premature failure of the motor insulation. Long cable lengths between the motor and drive increase the harmful effects of the reflected wave, as do high chopping frequencies (listed in drive manuals as carrier frequencies). Line reactors, 1:1 transformers

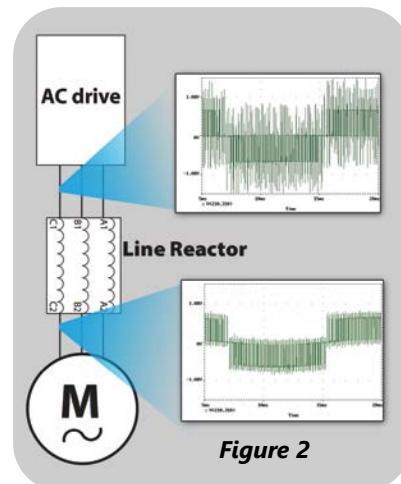


Figure 2

placed at the output of the drive, can help reduce the voltage spikes going from the drive to the motor. Line reactors are used in many instances when the motor is located far from the drive [see Figure 2].

In summary, all ADC general purpose motors are inverter rated and can be run with drives in many applications; however high performance, inverter-duty motors are designed to handle much lower speeds without overheating and they are capable of withstanding higher voltage spikes without their insulation failing. With the increased performance comes an increase in cost. This additional cost can be worth it if you need greater performance.

The considerations for applying IronHorse motors are given below.

### Heat considerations

|                                                              | IronHorse speed ratio                  | For an 1800 RPM motor, minimum IronHorse speed is: |
|--------------------------------------------------------------|----------------------------------------|----------------------------------------------------|
| Variable Torque applications (fans, centrifugal pumps, etc.) | 5:1 (EPAct motors)<br>10:1 (PE motors) | 1800/5 = 360RPM<br>1800/5 = 180RPM                 |
| Constant Torque Applications (conveyors, extruders, etc.)    | 2:1 (EPAct motors)<br>4:1 (PE motors)  | 1800/2 = 900RPM<br>1800/4 = 450RPM                 |

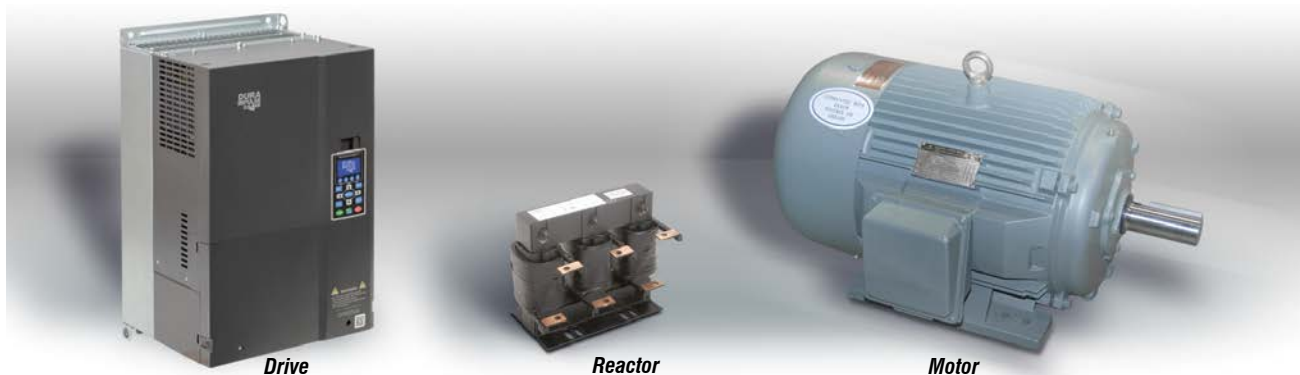
### Voltage Spike considerations

|                                  | Max cable distance from drive to IronHorse motor | Max cable distance with a 3% line reactor between drive and IronHorse motor |
|----------------------------------|--------------------------------------------------|-----------------------------------------------------------------------------|
| For use with 230V and 460V VFDs* | 125 ft                                           | 250 ft                                                                      |

\* Up to 6kHz carrier frequency

# IronHorse<sup>®</sup> General-Purpose AC Motors

## Using IronHorse General-Purpose Motors with AC Drives



### **AC drive motor control vs. across-the-line motor control**

General purpose AC induction motors are typically controlled by across-the-line starters, i.e. contactors, manual motor starters, etc. However, 3-phase general purpose motors can also be controlled by AC drives under certain conditions. (1-phase AC motors cannot be controlled by typical 3-phase AC drives.)

Across-the-line control applies full voltage to the motor at startup, and has several disadvantages.

- High inrush current - startup inrush current is typically 5-6 times the normal motor full load current, and can significantly increase utility bills.
- Inability to change speeds - the motor runs only at its rated speed.
- Inefficiency in some applications - fan and pump applications require ON/OFF control or valves/dampers to control flow.
- Contact maintenance - arcing caused by high inrush and breaking currents significantly reduce the motor starter's life span.

Many applications can use AC drive control for 3-phase AC induction motors, which has several advantages:

- Lower inrush current at motor startup
- Ability to change motor speed
- Greater efficiency in some applications. - fan and pump applications can use the AC drive to provide both motor control and flow control. The drive can control the flow by varying the motor speed, and therefore eliminate the need for inefficient valves/dampers.
- Solid state power delivery; minimal maintenance.

**NOTE:** AC drive (VFD) control is applicable only for 3-phase AC motors (3-phase AC drives cannot be used to control 1-phase motors)

General purpose AC induction motors are not designed specifically for use with AC drives, so there are three major considerations for AC drive control of 3-phase general purpose motors:

### **1. Heat considerations for AC drive control**

Fan-cooled motors are designed to provide sufficient insulation cooling when the motors run at rated speed. The cooling ability of fans is reduced when motors run at lower speeds, and the insulation in general purpose motors is not designed for this condition. Therefore, there are limitations on how slowly general purpose motors can be continuously run without prematurely causing motor insulation failure.

#### **• Constant Torque (CT) Applications**

**PE motors: 4:1 (1/4 rated speed)**

**EPAct motors: 2:1 (1/2 rated speed)**

The CT minimum continuous speed for an IronHorse general purpose motor is either one quarter or one half of its rated speed, as shown in the motor Performance Data tables. (Constant torque loads require the same amount of torque from the motor regardless of speed; e.g., conveyors, cranes, machine tools.)

#### **• Variable Torque (VT) Applications**

**PE motors: 10:1 (1/10 rated speed)**

**EPAct motors: 5:1 (1/5 rated speed)**

The VT minimum continuous speed for an IronHorse general purpose motor is either one tenth or one fifth of its rated speed, as shown in the motor Performance Data tables. (Variable torque loads require less torque at lower speeds, resulting in less heat generated by the motor; e.g., fans, centrifugal pumps.)

If your application requires motors to run at speeds below those described above, use our Marathon inverter duty motors. Inverter duty motors can run fully loaded at very low speeds without being damaged by overheating.

### **2. Voltage spike considerations for AC drive control**

All AC drives cause large voltage spikes between the drive and the motor, and long cable distances increase these spikes even more. Therefore, there are maximum cable lengths that can be run between the drive and the motor. Line (load) reactors can be installed near the drive output to reduce the voltage spikes.

- 230V and 460V **Without Reactor** – 125 ft maximum cable length between drive and motor

- 230V and 460V **With Reactor** – 250 ft maximum cable length between drive and motor

If your application requires cable lengths longer than those described above, please use our Marathon high performance, inverter-duty motors.

### **3. Carrier frequency limitation for AC drive control**

The AC Drive carrier frequency should be set to 6kHz or less.



# AC Motor Selection – IronHorse® General Purpose Motors

| IronHorse® 1-Phase Motor Selection      |                                  |                   |                           |
|-----------------------------------------|----------------------------------|-------------------|---------------------------|
| Motor Series                            | MTR2                             | MTRJ              | MTF2                      |
| Paint Color                             | Black                            | Black             | Green                     |
| Main Characteristics                    | General Purpose<br>Rolled Steel  | Jet Pump          | Farm Duty<br>Rolled Steel |
| Electrical Characteristics              |                                  |                   |                           |
| Horsepower range                        | 1/3 - 2                          | 1/3 - 2           | 2 - 10                    |
| Base speed                              | 1800; 3600                       | 3600              | 1800                      |
| Standard Voltage                        | 115/208–230 VAC; 115/230 VAC     | 115/230 VAC       | 208–230 VAC               |
| Phase / Base Frequency                  | 1-phase / 60 Hz                  |                   |                           |
| Service Factor                          | 1.15                             |                   |                           |
| Design Code (NEMA)                      | L or N (by model)                | L or N (by model) | L                         |
| Insulation Class                        | Class F                          |                   |                           |
| Insulation System                       | Dip and Bake Twice               |                   | Double VPI                |
| Duty Cycle                              | Continuous                       |                   |                           |
| Thermal protection                      | None                             | Automatic         | Manual                    |
| Hazard Classification                   | None                             |                   |                           |
| Mechanical Characteristics              |                                  |                   |                           |
| Frame size                              | 56C or HC                        | 56J               | 182T - 215T               |
| Enclosure                               | TEFC                             | TEFC              | TEFC                      |
| Enclosure Rating                        | IP43                             |                   | IP55                      |
| Frame material                          | Rolled Steel                     |                   |                           |
| End bracket material                    | Aluminum                         |                   |                           |
| Junction box material                   | Steel                            |                   |                           |
| Fan guard material                      | Steel                            |                   |                           |
| Fan material                            | Polypropylene Plastic            | Plastic           |                           |
| Lead termination                        | Junction Box                     |                   |                           |
| Standard mounting                       | C-Face with Removable Rigid Base |                   | Rigid Base                |
| Drive end shaft slinger                 | Yes                              |                   | V-ring seal               |
| Bearings                                | Ball                             |                   |                           |
| Grease                                  | Mobil Polyrex EM                 |                   | NS7 ENS                   |
| Standard junction box assembly position | F1                               |                   |                           |
| Performance Characteristics             |                                  |                   |                           |
| Constant Torque speed range             | N/A                              |                   |                           |
| Variable Torque speed range             | N/A                              |                   |                           |
| Constant Horsepower speed range         | N/A                              |                   |                           |
| Temperature rise                        | B                                |                   |                           |
| Encoder provisions                      | None                             |                   |                           |
| Other Characteristics                   |                                  |                   |                           |
| Warranty*                               | 2 Years                          |                   |                           |
| Agency Approvals **                     | CSA, CE                          |                   | CE, UR                    |

\* See Terms and Conditions for motor warranty explanation.

1) For warranty on IronHorse motors below 50hp, warranty service can be arranged through AutomationDirect.

2) For warranty on IronHorse motors 50hp and above, motors must be inspected by a local EASA motor repair or service center; (see AutomationDirect Terms & Conditions).

\*\* To obtain the most current agency approval information, see the Agency Approval Checklist on the specific part number's web page.

\*\*\* 56HC motors are capable of 56C C-face mounting, and are also compatible with 56, 143T, and 145T foot mounting dimensions.



# AC Motor Selection – IronHorse® General Purpose Motors

| IronHorse® 3-Phase Motor Selection         |                                  |                                 |                                         |                                                 |                                                                        |
|--------------------------------------------|----------------------------------|---------------------------------|-----------------------------------------|-------------------------------------------------|------------------------------------------------------------------------|
| Motor Series                               | MTR2/MTRP                        | MTRJ/MTRJP                      | MTDP                                    | MTSP/MTSN                                       | MTCP2                                                                  |
| Paint Color                                | Black                            | Black                           | Blue                                    | Stainless                                       | Gray                                                                   |
| Main Characteristics                       | General Purpose<br>Rolled Steel  | Jet Pump                        | Rolled Steel<br>Open Drip Proof         | Stainless Steel<br>Premium Efficiency<br>IP69K  | Cast-Iron<br>Hazardous Duty                                            |
| Electrical Characteristics                 |                                  |                                 |                                         |                                                 |                                                                        |
| Horsepower range                           | 1/3 - 3                          | 1/3 - 3                         | 1 - 50                                  | 1 - 20                                          | 1 - 300(T)<br>1 - 30(TC)                                               |
| Base speed                                 | 1800; 3600                       | 3600                            | 1800; 3600                              | 1200; 1800; 3600                                | 1200; 1800; 3600                                                       |
| Standard Voltage                           | 208–230/460 VAC;<br>230/460 VAC  | 208–230/460 VAC;<br>230/460 VAC | 208–230/460 VAC                         | 208–230/460 VAC                                 | 208-230/460 VAC; 460VAC                                                |
| Phase / Base Frequency (Hz)                | 3-phase / 60 Hz                  |                                 |                                         |                                                 |                                                                        |
| Service Factor                             | 1.15                             | 1.15                            | 1.15 (sine), 1.0 (drive)                |                                                 | 1.25 (1-200)<br>1.15 (250-300)<br>1.0 (all w/ drive)                   |
| Design Code (NEMA)                         | B                                |                                 |                                         |                                                 |                                                                        |
| Insulation Class                           | Class F                          |                                 |                                         |                                                 |                                                                        |
| Insulation System                          | Dip and Bake                     | Dip and Bake Twice              | VPI                                     | Dip and Bake                                    | Vacuum Impregnation                                                    |
| Duty Cycle                                 | Continuous                       |                                 |                                         |                                                 |                                                                        |
| Thermal protection                         | None                             |                                 |                                         |                                                 |                                                                        |
| Hazard Classification                      | None                             |                                 |                                         | Class 1 / Div 2                                 |                                                                        |
| Mechanical Characteristics                 |                                  |                                 |                                         |                                                 |                                                                        |
| Frame size                                 | 56C or HC - 326T                 | 56J                             | 56C - 326T                              | 56C - 256TC                                     | 143T/TC - 449T                                                         |
| Enclosure                                  | ODP / TEFC                       | TEFC                            | ODP / TEFC                              | TEFC / TENV                                     | TEFC                                                                   |
| Enclosure Rating                           | IP43                             |                                 | IP23                                    | IP69K                                           | IP55                                                                   |
| Frame material                             | Rolled steel                     |                                 | Rolled steel                            | 304 Stainless steel                             | Cast iron                                                              |
| End bracket material                       | Aluminum                         | Aluminum                        | ≤256 frame- Aluminum<br>>256- Cast iron | 304 Stainless steel                             | Cast iron                                                              |
| Junction box material                      | Steel                            | Steel                           | Steel                                   | 304 Stainless steel                             | Cast iron                                                              |
| Fan guard material                         | Steel                            | Steel                           | N/a                                     | 304 Stainless steel                             | Steel                                                                  |
| Fan material                               | Polypropylene plastic            | Plastic                         | N/a                                     | Heat-Resistant Polyethylene                     | Plastic                                                                |
| Lead termination                           | Junction Box                     |                                 |                                         |                                                 |                                                                        |
| standard mounting                          | C-face with removable rigid base |                                 | Rigid base                              | C-face round body and<br>C-face with rigid base | Rigid base, c-face with rigid base<br>(1-100 hp)                       |
| Drive end shaft slinger                    | Yes                              | Yes                             | None                                    | Yes                                             | Yes                                                                    |
| Bearings                                   | Ball                             |                                 |                                         |                                                 | 1-300 hp - 2p, 1-75 hp - 4p & 6p: Ball<br>100-300 hp - 4p & 6p: Roller |
| Grease                                     | Mobil Polyrex EM                 |                                 | NS7 ENS                                 | Mobil Polyrex EM                                |                                                                        |
| Standard junction box<br>assembly position | F1                               |                                 |                                         |                                                 | F1 (field convertible F2)                                              |
| Performance Characteristics                |                                  |                                 |                                         |                                                 |                                                                        |
| Constant Torque speed range                | 4:1                              | 4:1                             | 10:1                                    | 10:1                                            | 10:1                                                                   |
| Variable Torque speed range                | 10:1                             | 10:1                            | 20:1                                    | 20:1                                            | 20:1                                                                   |
| Constant Horsepower speed range            | 1.5:1                            | 1.5:1                           | 1.5:1                                   | 1.5:1                                           | 1.5:1                                                                  |
| Temperature rise                           | B                                |                                 |                                         |                                                 |                                                                        |
| Encoder provisions                         | None                             |                                 |                                         |                                                 |                                                                        |
| Other Characteristics                      |                                  |                                 |                                         |                                                 |                                                                        |
| Warranty*                                  | 2 years                          | 2 years                         | 2 years                                 | 1 year                                          | 2 years                                                                |
| Agency Approvals **                        | CSA, CE                          | CSA,CE                          | CSA                                     | NEMA, CSA, UR, CE, BISCC                        | CSA, ISO9001, CE                                                       |

\* See Terms and Conditions for motor warranty explanation.

1) For warranty on IronHorse motors below 50hp, warranty service can be arranged through AutomationDirect.

2) For warranty on IronHorse motors 50hp and above, motors must be inspected by a local EASA motor repair or service center; (see AutomationDirect Terms & Conditions).

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\*\*\* 56HC motors are capable of 56C C-face mounting, and are also compatible with 56, 143T, and 145T foot mounting dimensions.

# Regal AC Motor Selection – Marathon® & Leeson® 1-phase Motors



| Regal 1-phase Motor Selection             |                                                       |                                    |                                                           |                                                                                                            |                                       |
|-------------------------------------------|-------------------------------------------------------|------------------------------------|-----------------------------------------------------------|------------------------------------------------------------------------------------------------------------|---------------------------------------|
| Series                                    | SST Duck                                              | White Duck                         | JetPump                                                   | General Purpose                                                                                            | Fan & Blower                          |
| Electrical Characteristics                |                                                       |                                    |                                                           |                                                                                                            |                                       |
| Brand                                     | Leeson®                                               | Leeson®                            | Marathon                                                  | Marathon                                                                                                   | Marathon                              |
| Horsepower range                          | 1/3 – 1                                               | 1/3 – 1                            | 1/3 – 2                                                   | 1/4 – 10                                                                                                   | 1/4 – 2                               |
| Base speed (# poles)                      | 1800 (4)                                              | 1800 (4) / 3600 (2)                | 3600 (2)                                                  | 1800 (4) / 3600 (2)                                                                                        | 1800 (4) / 3600 (2)                   |
| Standard voltage                          | 115 / 230                                             | 115/208-230                        | 115 / 230                                                 | 115 / 230, 208 / 230,<br>115 / 208 – 230<br>100 – 120 / 200 – 240,<br>120 / 140 & 100 – 120 /<br>200 – 240 | 115 / 230 (G1115),<br>115 / 208 – 230 |
| Phase / Base frequency (Hz)               | 1 / 60                                                |                                    |                                                           |                                                                                                            |                                       |
| Service factor                            | 1.15                                                  | 1.15                               | 1.0 / 1.15                                                | 1.15 / 1.35                                                                                                | 1.15 / 1.2 / 1.25 / 1.35              |
| Design code (NEMA)                        | N                                                     | N                                  | N/A***                                                    | B, L, N, O                                                                                                 | E, L, N                               |
| Insulation class                          | F                                                     | F                                  | B                                                         | B, B3, F4                                                                                                  | B, B3                                 |
| Insulation system                         | IRIS                                                  | IRIS                               | N/A***                                                    | N/A***                                                                                                     | N/A***                                |
| Duty cycle                                | Continuous                                            |                                    |                                                           |                                                                                                            |                                       |
| Thermal protection                        | None                                                  | None                               | Automatic Reset                                           | Automatic / Manual /<br>None                                                                               | Automatic / Manual /<br>None (C235)   |
| Mechanical Characteristics                |                                                       |                                    |                                                           |                                                                                                            |                                       |
| Frame size (mounting)                     | 56C                                                   | 56 - 56C                           | 56J                                                       | 48 – 215T                                                                                                  | 48 – 56 – 56H                         |
| Enclosure                                 | TEFC                                                  | TEFC                               | TEFC                                                      | DP                                                                                                         | DP                                    |
| Frame material                            | 300 Series Stainless Steel                            | White Epoxy Steel                  | Rolled Steel                                              | Rolled Steel                                                                                               | Rolled Steel                          |
| End bracket material                      | 300 Series Stainless Steel                            | White Epoxy Steel                  | Cast Aluminum, Steel                                      | Cast Aluminum                                                                                              | Cast Aluminum                         |
| Conduit box material                      | 300 Series Stainless Steel                            | White Epoxy/Stainless<br>Cover     | Steel                                                     | Steel                                                                                                      | N/A***                                |
| Fan guard material                        | 300 Series Stainless Steel                            | White Polypropylene                | Steel                                                     | N/A***                                                                                                     | N/A***                                |
| Fan material                              | Polypropylene                                         | Composite                          | Plastic                                                   | N/A***                                                                                                     | N/A***                                |
| Lead termination                          | Conduit box                                           | Conduit box                        | Conduit box Flying Leads<br>(Jxxx Models) .33HP to<br>3HP | Conduit box                                                                                                | NPS Hole                              |
| Standard mounting                         | C-Face with Rigid Base                                | C-Face with Rigid Base<br>& C-face | Footless                                                  | Rigid Base                                                                                                 | Resilient Base                        |
| Drive end shaft slinger                   | No                                                    | No                                 | Yes                                                       | No                                                                                                         | No                                    |
| Paint                                     | N/A                                                   | White Epoxy                        | Gray powder-coat                                          | Gray powder-coat<br>Blue enamel                                                                            | Black powder-coat                     |
| Bearings                                  | Double Sealed                                         |                                    |                                                           | Ball Bearings                                                                                              | Ball Bearings                         |
| Grease                                    | Exxon Polyrex EM                                      |                                    |                                                           |                                                                                                            |                                       |
| Standard conduit box<br>assembly position | F1                                                    | F1                                 | F1                                                        | F1                                                                                                         | F1 (NPS Hole)                         |
| Performance Characteristics               |                                                       |                                    |                                                           |                                                                                                            |                                       |
| Temperature rise                          | N/A***                                                |                                    |                                                           |                                                                                                            |                                       |
| Encoder provisions                        | No                                                    |                                    |                                                           |                                                                                                            |                                       |
| Other Characteristics                     |                                                       |                                    |                                                           |                                                                                                            |                                       |
| Warranty *                                | 12 months from Installation. 18 months from Purchase. |                                    |                                                           |                                                                                                            |                                       |
| Agency listings **                        | UL Recognized, CSA Certified, and CE Mark             |                                    |                                                           |                                                                                                            |                                       |

\* See Terms and Conditions for motor warranty explanation.

Marathon warranty service can be arranged through Rexnord Regal service centers. See list of service centers on our website at [www.automationdirect.com](http://www.automationdirect.com).

\*\* To obtain the most current agency approval information, see the Agency Approval Checklist on the specific part number's web page.

\*\*\* Data not available from manufacturer.

# Regal AC Motor Selection - Washdown & General Purpose 3-Phase Motors

| Regal 3-phase General Purpose & Washdown Motor Selection |                                                                               |                                                            |                                         |                           |                                             |                                  |
|----------------------------------------------------------|-------------------------------------------------------------------------------|------------------------------------------------------------|-----------------------------------------|---------------------------|---------------------------------------------|----------------------------------|
| Manuf / Application                                      | Leeson® Washdown                                                              |                                                            | Marathon® General Purpose               |                           |                                             |                                  |
| Series                                                   | SST Duck                                                                      | White Duck                                                 | Jet Pump                                | NEMA Premium® XRI®        | 4-in-1 XRI                                  | Globetrotter                     |
| Electrical Characteristics                               |                                                                               |                                                            |                                         |                           |                                             |                                  |
| HP range                                                 | 1/3 - 2                                                                       | 1/4 - 10                                                   | 1/3 - 2                                 | 1 - 10                    | 1/3 - 3/4                                   | 3-200                            |
| Base speed (# poles)                                     | 1800 (4) and 3600 (2)                                                         |                                                            | 3600 (2)                                | 1200(6), 1800(4), 3600(2) | 1800 (4) and 3600 (2)                       | 1800 (4)                         |
| Standard voltage                                         | 208-230/460                                                                   | 208-230/460 & 230/460V                                     | 208-230/460 (J063A/65A is 230/460 only) | 208-230/460               | 208-230 / 460 and 575                       | 208-230/460 & 230/460V ***       |
| Ph/Base frequency (Hz)                                   | 3 / 60                                                                        |                                                            |                                         |                           |                                             |                                  |
| Service factor                                           | 1.15                                                                          | 1.15 & 1.25 ***                                            | 1.75-1.15 Line 1.0 Drive                | 1.15 (line) ; 1.0 (drive) | 1.15                                        | 1.15                             |
| Design code (NEMA)                                       | A & B                                                                         | B                                                          | B                                       | A (E2001A) B (all others) | B                                           | A or B***                        |
| Insulation class                                         | F                                                                             | F                                                          | B                                       | F                         | F3                                          | F                                |
| Insulation system                                        | IRIS                                                                          | IRIS                                                       | Max Guard                               | CR200 magnet wire         |                                             |                                  |
| Duty cycle                                               | Continuous                                                                    |                                                            |                                         |                           |                                             |                                  |
| Thermal protection                                       | None                                                                          | Some Models                                                | None                                    |                           |                                             |                                  |
| Mechanical Characteristics                               |                                                                               |                                                            |                                         |                           |                                             |                                  |
| Frame size (mounting)                                    | 56C(HC)-143TC- 145TC                                                          | 56(C,HC), 145T(TC), 182T(TC), 184T(TC), 213T(TC); 215T(TC) | 56J(HJ)                                 | 56C - 215TC               | 56C                                         | 182T - 447T                      |
| Enclosure                                                | TENV and TEFC                                                                 |                                                            | TEFC and DP                             | TEFC                      | TENV and TEFC                               | Drip Proof and TEFC              |
| Frame material                                           | Stainless Steel                                                               | Rolled Steel                                               |                                         |                           | Rolled Steel                                | Rolled Steel or Cast-iron***     |
| End bracket material                                     | Stainless Steel                                                               | Steel                                                      | Cast Aluminum, Steel                    | Aluminum                  | Cast Aluminum                               | Steel                            |
| Conduit box material                                     | Stainless Steel                                                               | Steel                                                      |                                         |                           | Steel                                       | Steel                            |
| Fan guard material                                       | Stainless Steel                                                               | Propolyene                                                 | Steel                                   | Plastic                   | Polypropylene                               | Rolled Steel or Cast-iron***     |
| Fan material                                             | Polypropylene                                                                 | Composite                                                  | Plastic                                 | Polypropylene             | Polypropylene                               | Polypropylene                    |
| Lead termination                                         | Conduit Box                                                                   |                                                            |                                         |                           | Conduit box except Terminal block (<1/2 hp) | Conduit box                      |
| Standard mounting                                        | C-Face with and w/o Base ***                                                  |                                                            | C-Face with Rigid Base                  |                           | C-Face with Removable Base                  |                                  |
| Drive end shaft slinger                                  | -                                                                             | -                                                          | No                                      | Yes                       | No                                          | -                                |
| Paint                                                    | N/A                                                                           | White Epoxy                                                | N/A                                     | Blue enamel               | Gray powder                                 | Black powder- coat, Black enamel |
| Bearings                                                 | Ball                                                                          |                                                            |                                         | Ball (C3 fit)             | Ball                                        | Ball                             |
| Grease                                                   | Exxon Polyrex EM                                                              |                                                            |                                         |                           |                                             |                                  |
| Standard conduit box assy. position                      | F1 only & F1/F2 capable***                                                    |                                                            | F1                                      | F3                        | F1 & NPO                                    | F1, F2 reversible***             |
| Performance Characteristics                              |                                                                               |                                                            |                                         |                           |                                             |                                  |
| Constant torque speed range                              | 10:1 TEFC<br>1000:1 TENV                                                      |                                                            | 10:1                                    | 10:1                      | 10:1 (TEFC) 1000:1 (TENV)                   | 10:1                             |
| Variable torque speed range                              | 10:1                                                                          |                                                            | 10:1                                    | 10:1                      | -                                           | 10:1                             |
| Constant HP speed range                                  | 2.1                                                                           | 2.1                                                        | 2:1                                     | 2:1                       | 2:1                                         | 2:1                              |
| Temperature rise                                         | F                                                                             | F                                                          | B                                       | F                         | F                                           | F                                |
| Encoder provisions                                       | No                                                                            | No                                                         | No                                      | No                        | No                                          | No                               |
| Other Characteristics                                    |                                                                               |                                                            |                                         |                           |                                             |                                  |
| Warranty *                                               | 12 months from installation, 18 months from purchase. (through Rexnord Regal) |                                                            |                                         | 3 years                   | 3 years                                     | 3 years                          |
| Agency listings **                                       | UL Recoanized, CSA Certified, CE Mark++                                       |                                                            |                                         |                           |                                             |                                  |

\* See Terms and Conditions for motor warranty explanation. Marathon warranty service can be arranged through Rexnord Regal service centers. See list of service centers on our website at [www.automationdirect.com](http://www.automationdirect.com).

\*\* To obtain the most current agency approval information, see the Agency Approval Checklist on the specific part number's web page.

\*\*\*Varies by Model

# Regal AC Motors – MAX Series 3-Phase High Performance Inverter-Duty Motors

| Regal 3-Phase High Performance Inverter Duty Motor Selection |                                                             |                                                     |                                             |                         |                                             |
|--------------------------------------------------------------|-------------------------------------------------------------|-----------------------------------------------------|---------------------------------------------|-------------------------|---------------------------------------------|
| Manuf / Application                                          | Marathon MAX Series High Performance Inverter Duty          |                                                     |                                             |                         |                                             |
| Series                                                       | Micro MAX™                                                  | MAX +                                               | Black Max®                                  | Blue Max®               | Symax PMAC                                  |
| Electrical Characteristics                                   |                                                             |                                                     |                                             |                         |                                             |
| HP range                                                     | 1/4 - 10                                                    | 1/2 - 5                                             | 1/4 - 30                                    | 40 - 100                | 1/2 - 10                                    |
| Base speed (# poles)                                         | 1800 (4)                                                    | 1800 (4)                                            | 1800 (4) and 1200 (6)                       | 1800 (4)                | 1800 (6) , 1200(6)- VFD operation only      |
| Standard voltage                                             | 230/460 (<1/2 hp are 230V only)                             | 230/460                                             | 230/460 and 575                             | 230/460                 | 230/460                                     |
| Ph/Base frequency (Hz)                                       | 3 / 60                                                      |                                                     |                                             |                         |                                             |
| Service factor                                               | 1.0                                                         | 1.0                                                 | 1.0                                         | 1.0                     | 1.0                                         |
| Design code (NEMA)                                           | A or B (varies by model)                                    | A (1/2 –1 hp) B (>1hp)                              | A                                           | A                       | n/a                                         |
| Insulation class                                             | H                                                           | F                                                   | F                                           | H                       | F and H                                     |
| Insulation system                                            | CR200 magnet wire                                           | CR200 magnet wire                                   | MAX GUARD®                                  |                         |                                             |
| Duty cycle                                                   | Continuous                                                  |                                                     |                                             |                         |                                             |
| Thermal protection                                           | None                                                        |                                                     | Class F thermostats                         |                         |                                             |
| Mechanical Characteristics                                   |                                                             |                                                     |                                             |                         |                                             |
| Frame size (mounting)                                        | 56C - 215TC                                                 | 56C - 184TC                                         | 56C - 286TC                                 | 324T(C) - 405T(C)       | 56C(Z), 182TC, 184TC, 213TC,215TC           |
| Enclosure                                                    | TENV and TEFC                                               | TENV                                                | TENV                                        | TEFC and TEBC           | TENV and TEFC                               |
| Frame material                                               | Rolled Steel                                                | Rolled Steel (<2hp) Cast-iron (2hp) Aluminum (>2hp) | Rolled Steel w Al face Cast-iron Aluminum   | Cast-iron               | Rolled Steel or Cast-iron (varies by model) |
| End bracket material                                         | Aluminum                                                    | Cast-iron                                           | Aluminum, Cast-iron                         | Cast-iron               | Steel                                       |
| Conduit box material                                         | Steel                                                       | Steel                                               | Steel                                       | Cast-iron               | Steel                                       |
| Fan guard material                                           | Polypropylene                                               | None (all ratings TENV)                             | None (all ratings TENV)                     | Cast-iron               | Rolled Steel or Cast-iron (varies by model) |
| Fan material                                                 | Polypropylene                                               | None (all ratings TENV)                             | None (all ratings TENV)                     | Polypropylene           | Polypropylene                               |
| Lead termination                                             | Conduit box except Terminal block (<1/2 hp)                 | Conduit box                                         | Conduit box                                 | Conduit box             | Conduit box                                 |
| Standard mounting                                            | C-Face with Rigid Base & C-Face Round Body                  | C-Face with Rigid Base                              | C-Face with Rigid Base                      | C-Face with Rigid Base  | C-Face with Rigid Base                      |
| Drive end shaft slinger                                      | No                                                          | No                                                  | No                                          | Yes                     | -                                           |
| Paint                                                        | Black powder- coat; Black enamel                            | Black powder; Black enamel                          | Black enamel                                | Blue enamel             | Black powder- coat; Black enamel            |
| Bearings                                                     | Ball (C3 fit)                                               | Ball (C3 fit)                                       | Ball (C3 fit)                               | Ball (C3 fit)           | Ball                                        |
| Grease                                                       | Exxon Polyrex EM                                            | Exxon Polyrex EM                                    | Exxon Polyrex EM                            | Exxon Polyrex EM        | Exxon Polyrex EM                            |
| Standard conduit box assembly position                       | F1 (1/4 & 1/3 hp) F3 (all others)                           | F1, reversible to F2 (2hp) F1 (all others)          | F1, reversible to F2                        | F1, reversible to F2    | F1                                          |
| Performance Characteristics                                  |                                                             |                                                     |                                             |                         |                                             |
| Constant torque speed range                                  | 20:1 (TEFC) 1000:1 (TENV)                                   | 1000:1                                              | 1000:1 (TENV)                               | 2000:1 (all enclosures) | 20:1                                        |
| Variable torque speed range                                  | –                                                           | –                                                   | –                                           | –                       | 10:1                                        |
| Constant horsepower speed range                              | 2:1                                                         | 2:1                                                 | 2:1 (90–120Hz intermittent @50% duty cycle) | 2:1                     | 2:1                                         |
| Temperature rise                                             | B                                                           | varies by model #                                   | varies by model #                           | F (TEFC) B (TEBC)       | F                                           |
| Encoder provisions                                           | No                                                          | Yes                                                 | Yes                                         | Yes                     | No                                          |
| Other Characteristics                                        |                                                             |                                                     |                                             |                         |                                             |
| Warranty *                                                   | 3 years (through Rexnord Regal for MAX, XRI and 4N1 Motors) |                                                     |                                             |                         |                                             |
| Agency listings **                                           | UL Recoanized, CSA Certified, CE Mark++                     |                                                     |                                             |                         |                                             |

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++Some Symax PMAC models are not CE Mark. See Symax for details

# Leeson® Washguard® Motors Chemical Resistance Comparison

When choosing a Leeson Washguard(Trademark) SST Stainless Steel or White Duck White Epoxy motor, utilize the following chemical comparison chart to determine which may best fit your application.

| CHEMICAL RESISTANCE COMPARISON      |                 |             |                 |
|-------------------------------------|-----------------|-------------|-----------------|
| CHEMICAL NAME                       | % CONCENTRATION | WHITE EPOXY | STAINLESS STEEL |
| <i>Continuous Exposure</i>          |                 |             |                 |
| <b>Fresh Water</b>                  | 100             | Excellent   | Excellent       |
| <b>Salt Water</b>                   | 5               | Excellent   | Excellent       |
| <b>Salt Brine</b>                   | Dilute          | Fair        | Good            |
| <b>Ammonium Hydroxide</b>           | Dilute          | Good        | Excellent       |
| <b>Citric Acid</b>                  | 10              | Good        | Excellent       |
| <b>Ethylene Glycol</b>              | 100             | Excellent   | Excellent       |
| <b>Mineral Spirits</b>              | 100             | Excellent   | Excellent       |
| <b>Sodium Hydroxide</b>             | 5               | Fair        | Excellent       |
| <b>Sodium Hydroxide</b>             | 20              | Fair        | Excellent       |
| <b>Sodium Hydroxide</b>             | 50              | Excellent   | Excellent       |
| <b>Toluene</b>                      | 100             | Fair        | Fair            |
| <b>Animal Fats</b>                  | NA              | Excellent   | Excellent       |
| <b>Mineral Oils</b>                 | NA              | Excellent   | Excellent       |
| <b>Vegetable Oils</b>               | NA              | Excellent   | Excellent       |
| <b>Cutting Oils</b>                 | NA              | Excellent   | Excellent       |
| <b>Detergents</b>                   | NA              | Excellent   | Excellent       |
| <b>Gasoline</b>                     | NA              | Fair        | Fair            |
| <b>Hydraulic Fluid</b>              | NA              | Excellent   | Excellent       |
| <b>Lubricating Oils</b>             | NA              | Excellent   | Excellent       |
| <b>General Weathering</b>           | NA              | Fair        | Excellent       |
| <b>Mold/Mildew</b>                  | NA              | Excellent   | Excellent       |
| <b>Light Abrasion</b>               | NA              | Excellent   | Excellent       |
| <b>Heavy Abrasion</b>               | NA              | Fair        | Excellent       |
| <i>Intermittent Exposure</i>        |                 |             |                 |
| <b>Calcium Hydroxide (Lime)</b>     | 100             | Good        | Excellent       |
| <b>Hydrochloric Acid</b>            | 37              | Good        | Poor            |
| <b>Lactic Acid</b>                  | Dilute          | Excellent   | Excellent       |
| <b>Lactic Acid</b>                  | 100             | Fair        | Fair            |
| <b>Potassium Hydroxide</b>          | 50              | Fair        | Fair            |
| <b>Sodium Hypochlorite (Bleach)</b> | 15              | Excellent   | Excellent       |
| <b>Sulfuric Acid</b>                | 10              | Fair        | Fair            |



Or...

