AutomationDirect AC Motors Selection Overview

General purpose or inverter-duty motor?

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

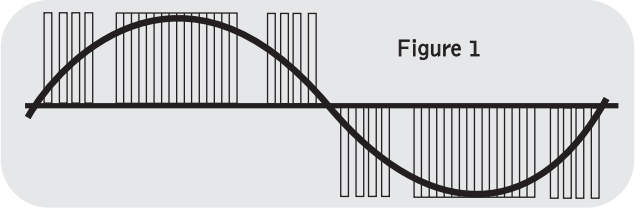
General purpose motors have been around for many years. They are the workhorse of almost every industry. An inverter-duty motor is a much newer concept that was necessary as general purpose motors began to be driven by VFDs (inverters or AC drives). An inverter duty motor can withstand the higher voltage spikes produced by all VFDs (amplified at longer cable lengths) and can run at very slow speeds without overheating. This performance comes at a cost: inverter-duty motors can be much more expensive than general purpose motors. Guidelines for choosing an IronHorse general purpose motor vs. an inverter-duty motor are given below. If your application falls within the guidelines below, there is no need to apply an inverter-duty motor.

NOTE: Marathon 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 reconverting 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.

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 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].

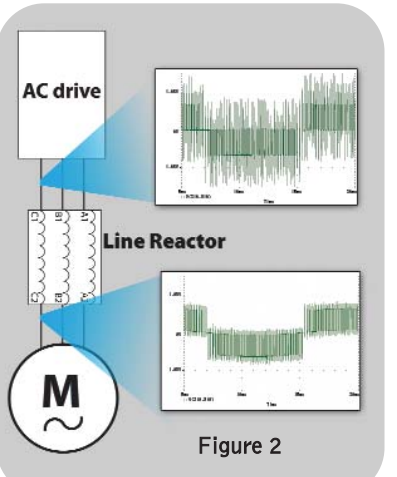


Figure 2

In summary, general purpose motors can be run with drives in many applications; however 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	1800/5 = 360RPM
Constant Torque Applications (conveyors, extruders, etc.)	2:1	1800/2 = 900RPM

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'	250'

** Up to 6kHz carrier frequency*

AC Motor Selection – Three-phase Motors

(Single-phase motors are shown on page 15-13)

3-Phase Characteristic	IronHorse™ 56C Frame 3-Phase	IronHorse™ T & TC Frames	Marathon microMAX™	Marathon Black Max®	Marathon Blue Max®	Marathon NEMA Premium® XRI®	Marathon Blue Chip XRI®
Electrical Characteristics							
Horsepower range	1/3 - 2	1 - 300 (T); 1 - 100 (TC)	1/4 - 10	1/4 - 30	40 - 100	1 - 10	15 - 100
Base speed (# Poles)	1800 (4), 3600 (2)	1200(6), 1800 (4), 3600(2)	1800 (4)	1800 (4) and 1200 (6)	1800 (4)	1200(6),1800(4),3600(2)	1800 (4)
Standard Voltage	208-230/460	208-230/460 (250 & 300 hp 460V only)	230/460 (1/4 hp is 230V only)	230/460 and 575	230/460	208-230/460	230/460 and 575
Insulation Class	F	F	H	F	H	F	F
Insulation System	dip & bake	double dip & bake	CR200 magnet wire	MAX GUARD®		CR200 magnet wire	
Service Factor	1.15 (line) 1.0 (drive)	1.15 (line) 1.0 (drive)	1.0	1.0	1.0	1.15 (line) 1.0 (drive)	1.15
Phase/Base Frequency	3/60						
Design Code (NEMA)	B	A: 10-50 hp 4&6 pole B: all other sizes	A and B for 1/4 - 2 hp	A	A	B	B
Duty Cycle	Continuous						
Thermal protection	None			Class F thermostats		None	
Mechanical Characteristics							
Frame size (mounting)	56C	143T/TC - 405TC/449T	56C - 215TC	56C - 286TC	324T(C)–405T(C)	56C - 215TC	254T - 405T
Enclosure	TEFC	TEFC	TENV and TEFC	TENV	TEFC and TEBC	TEFC	TEFC
Frame material	Rolled Steel frame; Aluminum end bell	Cast Iron	Rolled Steel	Rolled Steel w Al face; Cast Iron	Cast Iron	Rolled Steel	Cast Iron
End bracket material	Aluminum	Cast Iron	Aluminum	Aluminum, Cast Iron	Cast Iron	Aluminum	Cast Iron
Conduit box material	Steel	Cast Iron	Steel	Steel	Cast Iron	Steel	Steel (<326T) Cast Iron (>364T)
Fan guard material	Steel	Steel	Polypropylene	None (all ratings TENV)	Cast Iron	Plastic	Polyprop. (<286T) Cast Iron (>324T)
Fan material	Plastic	Plastic (143T/TC - 445/7T) Aluminum (449T)	Polypropylene	None (all ratings TENV)	Polypropylene	Plastic	Polypropylene
Lead termination	Conduit box	Conduit box	Conduit box except Terminal block - 1/4 hp	Conduit box	Conduit box	Conduit box	Conduit box
Standard mounting	C-Face with Removable Rigid Base	Rigid Base (C-Flange kit available) C-Face with Rigid Base (1-100 hp)	C-Face with Rigid Base & C-Face Round Body	C-Face with Rigid Base	C-Face with Rigid Base	C-Face with Rigid Base	Rigid Base
Drive end shaft slinger	Yes	Yes	No	No	Yes	Yes	Yes
Paint	Black	Epoxy primer / Synthetic alkyd enamel	Black powder-coat	Black enamel	Blue enamel	Blue enamel	epoxy paint
Bearings	Ball	1-75 hp: Ball 100-300 hp: Roller	Ball (C3 fit)	Ball (C3 fit)	Ball (C3 fit)	Ball	Ball (C3 fit)
Grease	Exxon Polyrex EM						
Standard conduit box assembly position	F1	F1 some sizes reversible to F2	F3	F1, reversible to F2	F1, reversible to F2	F3	F1
Performance Characteristics							
Constant Torque speed range	2:1	2:1	20:1 (TEFC) 1000:1 (TENV)	1000:1 (TENV)	2000:1 (all enclosures)	10:1	20:1
Variable Torque speed range	5:1	5:1	-	-	-	10:1	-
Constant Horsepower speed range	1.5:1	1.5:1	2:1	2:1 (90-120Hz intermittent @50% duty cycle)	2:1	2:1	2:1
Temperature rise	B	B	B	F	F (TEFC) and B (TEBC)	F	B
Encoder provisions	No	No	No	Yes	Yes	No	No
Other Characteristics							
Agency listings	cCSAus	CE, cCSAus, EPACT	UL Recognized and CSA Certified				
Warranty*		2 years	3 years (through Marathon Electric)				

See Terms and Conditions for motor warranty explanation.

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

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

3) Marathon warranty service can be arranged through Marathon Electric service centers. See list of service centers on our web site at www.automationdirect.com.

IronHorse® Rolled Steel AC Motors – 3 Phase

56C Frame TEFC Motors – Three-phase – 0.33 to 2 hp

Motor Specifications – Three-phase 56C Frame Motors – 1800 & 3600 RPM										
Part Number	Price	HP	Base RPM	Phase	Voltage	Housing	NEMA Frame	Service Factor	F.L. Amps @ 230V/460V	Approx Weight (lb)
MTR-P33-3BD18	<--->	1/3	1800	3	208-230/460	TEFC rolled steel frame with cast aluminum end bell F1 conduit box location	56C flange mount	1.15	1.6 / 0.8	23
MTR-P33-3BD36	<--->		3600						1.6 / 0.8	23
MTR-P50-3BD18	<--->	1/2	1800						2.0 / 1.0	24
MTR-P50-3BD36	<--->		3600						2.2 / 1.1	24
MTR-P75-3BD18	<--->	3/4	1800						2.8 / 1.4	26
MTR-P75-3BD36	<--->		3600						2.9 / 1.45	26
MTR-001-3BD18	<--->	1	1800						3.6 / 1.8	29
MTR-001-3BD36	<--->		3600						3.6 / 1.8	28
MTR-1P5-3BD18	<--->	1-1/2	1800						4.8 / 2.4	33
MTR-1P5-3BD36	<--->		3600						4.6 / 2.3	34
MTR-002-3BD18	<--->	2	1800						6.0 / 3.0	42
MTR-002-3BD36	<--->		3600						6.0 / 3.0	43

Note: Please review the AutomationDirect Terms & Conditions for warranty and service on this product.

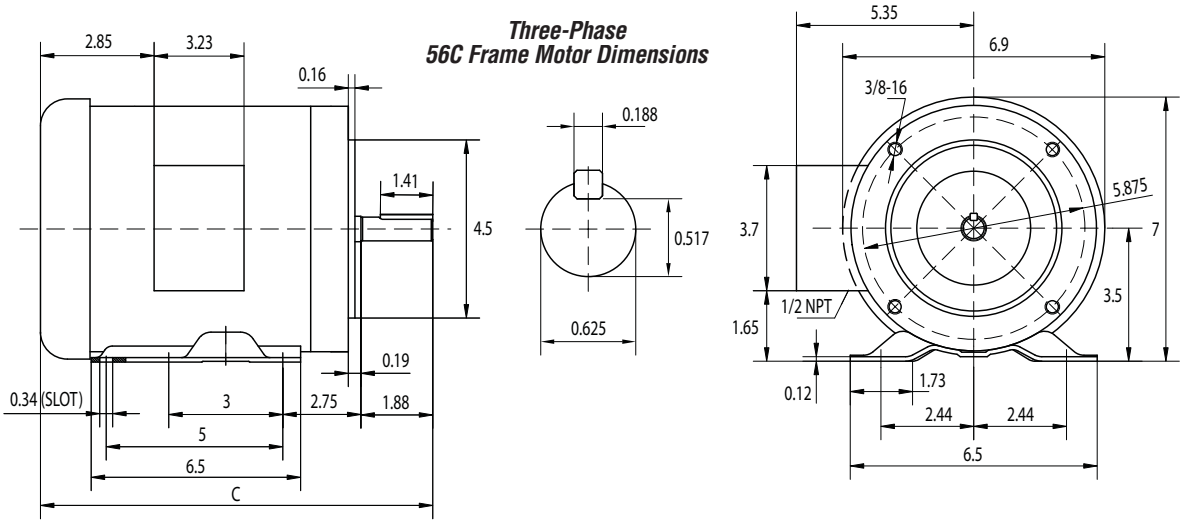
Performance Data – Three-phase 56C Frame Motors (460V data except as indicated) – 1800 & 3600 RPM															
Part Number	HP	NEMA Design	FL RPM	Minimum Speed (rpm)		Current @ 230V/460V (Amps)			Torque (lb·ft)			Maximum Speed (rpm)		FL Efficiency (%)	FL Power Factor	Rotor Inertia ($lb{\cdot}ft^2$)
				CT	VT	No Load	Full Load	Locked Rotor	Full Load	Locked Rotor	Break -down	CHP*	Safe			
MTR-P33-3BD18	1/3	B	1725	900	360	0.53 / 0.27	1.6 / 0.8	8 / 4	1.02	2.55	2.81	2700	5400	67.0	0.70	0.058
MTR-P33-3BD36			3450	1725	690	1.2 / 0.59	1.6 / 0.8	9 / 5	0.50	3.0	3.0	5400		57.0	0.71	0.084
MTR-P50-3BD18	1/2		1725	900	360	0.67 / 0.33	2.0 / 1.0	12 / 6	1.52	3.80	4.18	2700		69.0	0.72	0.068
MTR-P50-3BD36			3450	1725	690	1.4 / 0.7	2.2 / 1.1	14 / 7	0.75	4.4	4.5	5400		62.0	0.71	0.095
MTR-P75-3BD18	3/4		1725	900	360	0.93 / 0.47	2.8 / 1.4	18 / 9	2.29	5.73	6.30	2700		71.0	0.74	0.075
MTR-P75-3BD36			3450	1725	690	1.5 / 0.75	2.9 / 1.45	17 / 8.9	1.13	6.0	5.8	5400		67.0	0.78	0.107
MTR-001-3BD18	1		1725	900	360	1.2 / 0.6	3.6 / 1.8	24 / 12	3.02	7.55	8.31	2700		73.0	0.76	0.086
MTR-001-3BD36			3450	1725	690	1.7 / 0.85	3.6 / 1.8	25 / 13	1.50	7.9	7.1	5400		69.0	0.82	0.122
MTR-1P5-3BD18	1-1/2		1725	900	360	1.53 / 0.77	4.8 / 2.4	36 / 18	4.57	10.28	11.43	2700		75.0	0.78	0.108
MTR-1P5-3BD36			3450	1725	690	1.8 / 0.9	4.6 / 2.3	29 / 17	2.25	11.2	8.4	5400		72.0	0.85	0.143
MTR-002-3BD18	2		1725	900	360	2.0 / 1.0	6.0 / 3.0	48 / 24	6.09	13.70	15.23	2700		77.0	0.80	0.143
MTR-002-3BD36			3450	1725	690	3.4 / 1.7	6.0 / 3.0	57 / 30	3.06	18.9	13.4	5400		75.0	0.78	0.188

** Maximum Constant HP RPM is for direct coupled loads.*

IronHorse Rolled Steel AC Motors

56C Frame TEFC Motors – Three-phase – 0.33 to 2 hp – Dimensions

Three-Phase
56C Frame Motor Dimensions



C = 12.2"; 0.33 to 1hp motors
C = 12.6"; 1.5hp MTR-1P5-3BD18
C = 12.2"; 1.5hp MTR-1P5-3BD36
C = 13.8"; 2hp MTR-002-3BD18
C = 12.4"; 2hp MTR-002-3BD36

UNITS = INCHES

MTR-xxx-3BDxx IronHorse Motors
(3-phase rolled steel)

Compatible components for IronHorse motors

starting at <---> begin on page 15-50

IronHorse worm gearboxes

- Three output types: Dual Shaft, Right Hand Shaft and Hollow Shaft
- Four frame sizes: 1.75", 2.06", 2.37", 2.62"
- Six ratios: 5:1, 10:1, 15:1, 20:1, 40:1, 60:1
- IronHorse gearboxes utilize C-face mounting interfaces for C-face motors
- Worm gear reducer mounting bases are also available for ease of installation

starting at <---> begin on page 15-48

Stable™ Motor Slide Bases

Motor slide bases are used to accurately and easily position your motor. Available in sizes from NEMA 56 - NEMA 449T, you can use these bases to mount all Marathon motors. See the motor and base selection chart on page 15-49.