

AUTOMATIONDIRECT.com



# AC and DC Motors



marathon<sup>™</sup>  
Motors

**TOSHIBA**

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Motors

mMTR-1



# Electric Motors

Electric motors are the workhorses of industry, responsible for much of the movement and rotation that needs to be done. Modern electric motors are extremely efficient and reliable. Electric motors are available in both AC or DC designs.

## DC Motors

Industrial DC motors have historically been of the brush type. DC motors with brushes and commutators have a number of differences when compared to AC motors: added maintenance (brush replacement), and more limited speed ranges. AC induction motors have no brushes and have a much longer life expectancy.

DC motor speed is controlled by varying the armature current, while AC motor speed control is achieved by varying the frequency of the alternating current, often with a variable frequency drive (VFD).

On the other hand, DC motors are typically more efficient than AC motors. In many applications, DC motors and drives have better speed control, better torque performance, and can cost less than an equivalent AC motor/drive system.

Brushless DC motors have become available over the last several decades, primarily as a result of the advent of the semi-conductor control circuitry required to operate them, and the availability of high-quality permanent magnets. Brushless DC motors require no brushes or physical commutator and thus have increased service life. They also overcome the speed limitations of the brushed versions

## AC Motors and How They Work

The two most widely used types of AC motors are induction motors and synchronous motors.

The two basic parts of a 3-phase inductive motor are the stator and the rotor. The stator is the stationary outer drum; the rotor is the rotating inner portion of the motor attached to and driving the motor shaft.

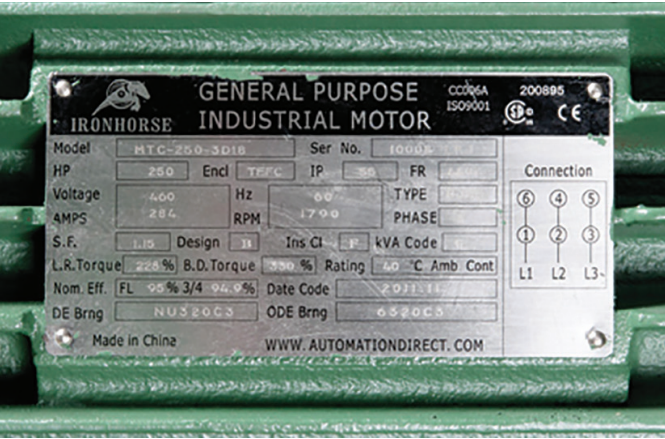
With an induction motor, the magnetic field in the windings of the rotor is ‘induced’ by the magnetic field of the stator. In order for this induction to produce torque, the speed of the rotor’s field must lag the field of the stator’s magnetic field. This speed differential is known as “slip”, and is the reason that induction motors will have a “nameplate rpm” rating that is about 5% less than their synchronous speed.

Synchronous motors operate in lockstep with the frequency of the supply current because their rotors have either permanent magnets or electromagnets generating the rotating electromagnetic field. A synchronous AC motor will run at the motor’s nameplate speed and has no slip. Synchronous motors are more efficient than induction motors and are normally enclosed in a smaller frame when compared to an induction motor of the same horsepower rating. One drawback to synchronous motors is that they must be controlled by a VFD and cannot be controlled across the line.

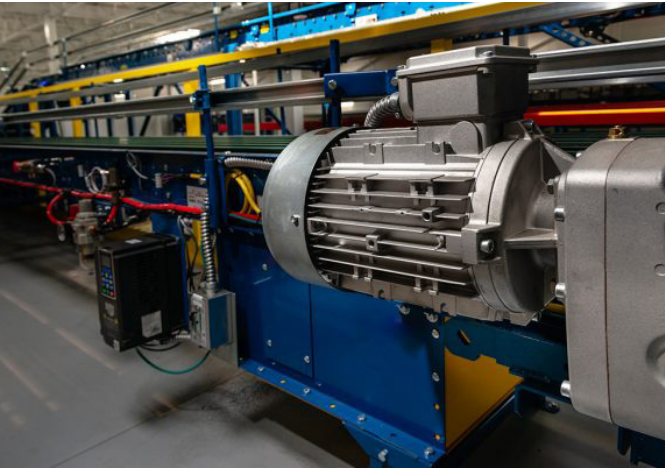
Single-phase AC induction motors are also available. These motors require special circuitry to start (starting capacitors, and centrifugal switches) but operate identically to their 3-phase induction motor counterparts once they are spinning. Single-phase AC induction motors are not compatible with VFDs so they require mechanical devices for speed reduction, such as pulleys or gear reducers. They can also result in higher utility costs due to their inherently unbalanced load on the power grid.

## How to Specify Motors

If you are replacing a properly-sized motor in an existing application, you can find all the required information on the nameplate of the existing motor.



If you are specifying a motor for a new application, start by determining the voltage, speed and horsepower required along with the application type. Of course, mechanical and environmental considerations are important, but the application is where the selection process should start.



## Determining the Motor Application

The application defines the motor load, speed, acceleration, deceleration and duty cycle of the motor. This all feeds into the horsepower and torque requirements. Control of motor speed and position also determines the type of motor used, and defines whether the motor load is constant or variable horsepower and torque.

There are four main types of applications in industrial automation:

- Variable horsepower and constant torque
- Variable torque and constant horsepower
- Variable horsepower and variable torque
- Positional control or torque control

Gear pumps, cranes and conveyors are examples of variable horsepower and constant torque applications. Constant speed AC and DC motors work well in these applications where the horsepower requirements may vary, but the load remains constant.

## NEMA Design Classifications

There are four different NEMA design classifications for speed, torque, and slip that help determine suitability for various applications:

### NEMA Design A

suitable for a broad variety of applications – such as fans and pumps. Motors have a maximum 5% slip, high to medium starting current, normal locked rotor torque, and normal breakdown torque.

### NEMA Design B

intended for a broad variety of applications with normal starting torque (fans, blowers and pumps). Motors have a maximum 5% slip, low starting current, high locked rotor torque, and normal breakdown torque.

### NEMA Design C

intended for equipment with high inertia starts – like positive displacement pumps. Motors have a maximum 5% slip, low starting current, high locked rotor torque, and normal breakdown torque.

### NEMA Design D

intended for equipment with very high inertia starts (cranes, hoists etc.). Motors have a maximum 5-13% slip, low starting current, and very high locked rotor torque.

## Frame Size and Mounting

Most AC motors today are built to specific NEMA sizes. In small horsepower ranges, many motors are available in a “NEMA 56C” frame size. The “56” refers to the motor frame dimensions. The “C” indicates a “C” face (flange) mountable motor. This is the most popular type of face-mounted motor and has a specific bolt pattern on the shaft end to allow mounting. The critical dimensions on C-face motors are the bolt circle, register diameter, and the shaft size. C-Face motors always have threaded mounting holes in the face of the motor. Many motors are offered with both C-Face mounting options and a rigid orremovable mounting base. As horsepowers increase, a number of different “T” frame designations are used to denote the standard NEMA sizes.

A web unwind or rewind machine is an example of a variable torque and constant horsepower application because the load increases with the diameter of the roll and vice versa. DC motors and servo motors work well here, as well as AC motors with closed-loop vector control drives.

Centrifugal pumps, fans and mixers/agitators require variable horsepower and variable torque. When speed increases, so does the motor load. Variable frequency drives (VFDs) run in V/Hz mode are often used in these applications.

In addition to the standard specifications for motor speed, horsepower, and operating voltage, designers and engineers should also consider NEMA design (speed-torque-slip relationship), enclosure type and cooling provisions (if any), frame size, and mounting options. The following are some guidelines:



## Enclosure Type and Cooling:

Common enclosure types include Open Drip Proof (ODP), Totally Enclosed Fan Cooled (TEFC), and Totally Enclosed Non-Ventilated (TENV).

### Drip Proof Motors

are open frame motors intended for indoor applications in clean environments. Ventilation openings are designed to prevent ingress from falling solids and liquids.

### TEFC Motors

have a fan attached to the rear of the motor shaft to help cool the motor. While there are no ventilation openings in the motor housing the enclosure is not air or liquid-tight. While a TEFC motor may be able to operate at a higher ambient temperature – be careful at low speeds (under VFD control) as the cooling fan is attached to the motor shaft, and may need a certain minimum speed to effectively cool the motor.

### TENV Motors

are also non-ventilated, but the enclosure is not air or liquid-tight.

Additional classifications include Washdown rated motors (TEWD), explosion-proof motors (XPRF), and motors designed for hazardous locations (HAZ).





# IRONHORSE® General purpose AC motors in the most popular sizes

## IronHorse® Rolled Steel Motors

Our most popular IronHorse® motors, the MTR series are available from 1/3 to 3HP, in single- or three- phase and 1800 or 3600 RPM models. All MTR series motors share the following features:

- TEFC enclosure
- Class F winding insulation
- Service Factor: 1.15 across-the-line (1.0 for three-phase inverter applications)
- Industrial gauge steel motor frame and base
- Removable bolt-on – bolt-off base
- NEMA design B, L, or N (varies by model)

starting at  
**\$161.00**



### AC MTR2 Series General Purpose (up to 2hp)

- Single-phase 120/230 VAC from 1/3 to 2hp
- Three-phase 208-230/460 VAC from 1/3 to 3/4hp
- 56C of 56HC frame
- Capacitor start for single-phase models (1.5hp and 2hp motors are also capacitor run)
- 1800 and 3600rpm, electrically reversible

starting at  
**\$214.00**



### AC MTRP Series Premium Efficiency (up to 3hp)

- Premium efficiency
- Three-phase 208-230/460 VAC from 1 to 3hp
- 56HC frame
- 1800 and 3600rpm, electrically reversible

starting at  
**\$167.00**

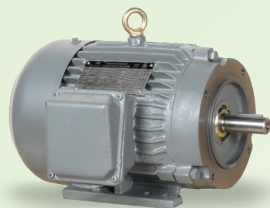


### AC MTRJ Series Jet Pump

- Single-phase 120/230 VAC from 1/3 to 2 hp
- Three-phase 208-230/460 VAC from 1/3 to 3 hp
- 3600rpm
- Built-in thermal protection on single-phase models
- 56J frame with threaded shaft for connection to a jet pump

## IronHorse® Cast Iron Motors

starting at  
**\$295.00**



### AC MTCP2 T-Frame, Premium Efficiency, Cast Iron, Industrial Duty (up to 30hp in TC frame)

- 3-phase 208-230/460 VAC
- Meets or exceeds Premium Efficiency standards
- Cast iron frame has ribbed design for maximum cooling
- Available in 1200, 1800, and 3600rpm, electrically reversible
- TEFC enclosure
- Class F insulation
- Class I, Div 2 hazardous locations
- CSA<sub>US</sub> certified, CE
- Inverter ratings: 20:1 (variable torque); 10:1 (constant torque)
- Two year warranty

*\*See Terms and Conditions for details and restrictions. 2-year warranty on all IronHorse motors!*

## IronHorse® Open Drip-Proof Motors

starting at  
**\$262.00**



### AC MTDP Open Drip-Proof 3-phase Premium Efficiency (up to 50 hp)

IronHorse® MTDP open drip-proof motors range in size from 1hp to 50hp at 1800rpm and 3hp, 5hp and 7.5hp at 3600rpm.

- Open drip-proof enclosure
- Inverter capable
- NEMA design B
- Class F winding insulation
- Service Factor: 1.15 across-the-line (1.0 for inverter applications)
- cURus certified, CE

## IronHorse® Stainless Steel Motors

starting at  
**\$401.00**



### AC MTS Stainless Steel Washdown-Duty 3-phase Premium Efficiency (up to 20hp)

IronHorse® MTS stainless steel washdown 3 phase motors offer 1/3hp to 20HP, various RPM ratings, and TEFC or TENV enclosures. They are built to handle the harshest environments!

- 1200, 3600 and 1800 RPM
- IP69K Protection
- Premium Efficiency (EISA Compliant)
- Service factor: 1.15
- Class F insulation with Class B temperature rise
- C-Face with Rigid Base and Round Body (Footless)
- NEMA Design B
- Continuous duty
- 304 stainless steel frame, end bracket, junction box and hardware
- Round welded junction box with epoxy potted leads
- Class I, Div 2 hazardous locations
- BISSC Certified
- In Accordance with NEMA, CSA, UL, and CE

## IronHorse® Farm-Duty Motors

starting at  
**\$577.00**



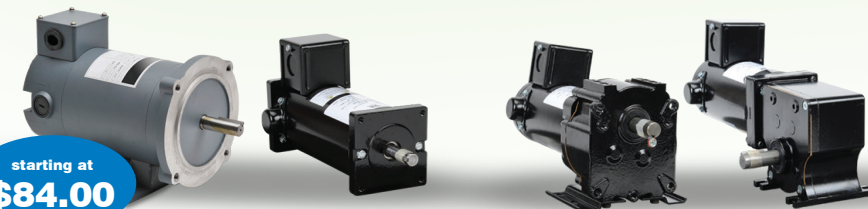
### AC MTF2 TEFC T-frame Single-phase Farm-Duty (up to 10 hp)

IronHorse® MTF2 farm-duty motors are rugged single-phase AC motors designed to withstand the rugged environment of farming and other industrial applications. These motors range in size from 2hp to 10hp and operate on 208-230 VAC.

- IP55 environmental rating
- Class-10 manual-reset locked-rotor thermal protector
- Electrically reversible
- NEMA design L
- Class F winding insulation
- Service Factor: 1.15 @ 230 VAC; 1.0 @ 208 VAC
- cURus certified, CE
- Rolled steel frame

## IronHorse® Permanent Magnet DC Motors (SCR Rated)

starting at  
**\$84.00**



### DC MTPM Motors (up to 2hp)

IronHorse® DC motors are designed for use on unfiltered SCR (thyristor) type and PWM (pulse width modulated) type DC adjustable speed drives, and on across-the-line DC controls. The IronHorse line of DC motors features:

- Simple two-lead connection
- Class F insulation
- Small-frame motors (1/4 hp and under), available models: 12 VDC, 24 VDC, 90 VDC (110 VAC/DC drive), and 180 VDC (230 VAC DC drive)
- Replacement brush sets
- Motors 1/3hp and above: NEMA 56C flange mount
  - 90 VDC (0.33 - 1.5hp)
  - 180 VDC (0.33 - 2.0hp)

### DC MTGR and MTGP Gearmotors (up to 0.25hp)

IronHorse® industrial grade DC gearmotors are designed for use on unfiltered SCR (thyristor) type rectified AC input. They may also be used with PWM (pulse width modulated) type DC adjustable speed drives, and in across-the-line applications.

- 386:1 to 11:1 gear ratios
- Available in 12, 24, and 90
- 1/31 to 1/4hp
- Replacement brush sets
- Models available with parallel or right-angle gear shafts
- Simple two-lead connection
- Class F insulation





## marathon™ Motors 1/4 - 200 hp

These Marathon Electric motor lines have been carefully selected to be performance-matched with the IronHorse, WEG and DURAPULSE series AC drives. The

offering includes models ranging from 1/4 hp to 200 hp, that feature 575 VAC and dual 230/460 VAC voltages as well as base speeds of 1200, 1800, or 3600rpm.

## Marathon 3-phase motors

### Marathon General Purpose Inverter-Rated Motors



#### Globetrotter TEFC Motors

Marathon's most popular inverter rated, TEFC motors are available in a wide range of horsepower ratings.

- Inverter rated (10:1 ratio, Class F insulation)
- Cast-iron models are Div 2/Zone 2 Class 1 (gases), Groups A, B, C, D



#### Globetrotter ODP Motors

Marathon's most popular series of inverter-rated Open Drip-Proof motors are available in a wide range of horsepower ratings at great prices.

- Inverter rated (10:1 ratio, Class F insulation)
- Footed and C-face models available



#### NEMA Premium® Efficiency XRI®

- Compliant with Energy Independence and Security Act of 2007 (EISA 2007)
- Rolled steel construction with C-face and rigid base mounting



#### Jet Pump (Centrifugal) Motors

- TEFC (up to 3hp)
- Stainless steel threaded shaft
- Rated for continuous duty



#### Single-Phase Open Drip-Proof Motors

- Ball bearings
- Capacitor start
- UL recognized and CSA certified
- Sizes from 1/4 - 3hp

## Marathon High-Performance Inverter-Duty Motors



#### MicroMAX™

- TENV and TEFC motors
- Dual mounting options, C-face rigid base and C-face round body
- Cooler running and lighter weight design, allowing an easy transition from permanent magnet DC motors



#### MAX+™ with Encoder

- Integrated Dynapar HS20 1024 ppr encoder
- Optimized for operation with IGBT inverter
- 230/460 VAC, replaces 90 volt and 180 volt permanent magnet DC motors (when used with AC variable frequency drives)



#### Black Max®

- Class F MAX GUARD® insulation system
- Constant torque operation from 0 to base speed on vector drive
- Constant horsepower operation to twice base rpm
- Optional factory-installed encoder available



#### Blue Max® 2000

- Class H MAX GUARD® insulation system
- Constant torque operation from 0 to base speed on vector drive, including TEFC
- Constant horsepower operation to 1.5 times base rpm
- Optional factory-installed encoder available



#### SYMAX PMAC

- Permanent magnet AC motor for use with PMAC compatible VFD only
- 230/460 VAC
- 25% - 40% efficiency improvement vs standard induction motor even under partial load
- High-performance inverter duty (20:1 constant torque)
- Energy savings provide rapid payback (typically less than 18 months)
- Power density benefit that allows for the same horsepower rating in a smaller frame when compared to induction motors



#### Marathon Replacement Encoder Kits

The A772 kit for Black Max, A774 kit for Blue Max TEFC, and A775 kit for Blue Max TEBC motors can be used to replace or add an encoder on these motor series.



## Marathon 1-phase Motors

These general-purpose motor lines from Marathon Electric are available in open drip-proof or washdown duty enclosures. They offer dual 115/230 VAC voltage ratings, and base speeds of 1800 or 3600rpm.



#### Jet Pump (centrifugal) Motors

- TEFC in sizes from 1/3 to 2hp
- Stainless steel threaded shaft
- Rated for continuous duty



#### XRI 4-in-1 General Purpose

- Suitable for horizontal or vertical mounting
- 115/208-230 VAC single-phase





# 1/4 - 10 hp

## Washguard Motors

Designed to withstand the most demanding washdown applications with excellent chemical resistance!



### Leeson Washguard White Duck and SST Duck Motors

Leeson SST and White Duck Washguard motors are some of the toughest available and are suitable for applications requiring harsh duty. They are ideal

for industries such as food processing, chemical processing, pharmaceutical, and beverage/brewing.

### Washguard® Series Features

- Interior corrosion protection
- Shaft seals on both ends of TEFC motors
- Sealed bearings
- Internally locked shafted bearing
- Meets IP55 enclosure protection
- UL Recognized, CSA



#### Washguard® SST Duck 1-phase and 3-phase Motors (stainless steel)

- All exterior components of 300 Series stainless steel, including motor frame, endshield and conduit box castings
- 3-phase 208-230/460 VAC (up to 2hp); 1-phase 115/230 VAC (up to 1hp); 1800 or 3600rpm, depending on model
- C-Face with base or C-face without base
- Moisture resistant sealant between frame and endbells
- Four locations for T-drains provided on each endshield
- Full-fact nameplate is laser etched on the motor frame
- CE mark



#### Washguard® White Duck Washguard® 1-phase and 3-phase Motors (epoxy coated)

- The original moisture-shedding "duck" motor
- Durable USDA-approved white epoxy finish
- Stainless steel shaft, conduit box cover, nameplate, fan guard
- 3-phase 208-230/460 VAC (up to 10hp); 1-phase 115/230 VAC (up to 1hp); 1800 or 3600rpm, depending on model
- 1800 or 3600rpm models available
- Mounting options include rigid base, C-face with base, and C-face without base.
- Drains for all mounting orientations
- CE mark on 3-phase models



# Rolled Steel

# 1/4 - 3 hp



WEG motors are a leading brand in the industry, recognized for their reliability. These rolled steel construction motors are available for both single-phase and three-phase applications, up to 3hp. Wiring is made easy with color-coded wire

leads and an oversized, rotatable junction box that exceeds the motor's IP55 rating. The frame paint on all WEG motors is rated to withstand up to 500 hours of salt spray while the innovative ventilation system provides improved thermal performance.

### WEG Motor Features (all)

- Class F insulation
- TEFC enclosure with IP55 rating
- Frame sizes: NEMA 56 to 143/145
- Footed, C-face footed or footless mount
- Enclosure: TEFC or TENV
- Certified Class I, Div 2, Groups A,B,C,D
- Aluminum endshields
- Internal bolts, giving a clean surface to the motor
- Double shielded ball bearings on frames 56 to 143/145
- UL, CSA



#### WEG Rolled Steel 1-phase Motors

- 120/230 voltage
- Rated output: 1/4 - 3 hp
- 1800, 3600 rpm
- High starting torque
- NPT threaded holes on terminal box



#### WEG Rolled Steel 3-phase Motors

- 208-230/460 voltage
- Rated output: 1/4 - 3 hp
- 1800, 3600, 1200 rpm
- Constant and variable torque speed ratings for inverter duty



#### WEG Rolled Steel 3-phase Brake Motors

- 208-230/460 voltage
- Spring set, solenoid actuated AC brake – 230/460V
- Rated output: 1/4 - 2 hp
- 1800 rpm
- Manual release brake lever
- Constant and variable torque speed ratings for inverter duty

**Founded in 1961 and known for efficiency and reliability in the industry, WEG is recognized today as one of the world's largest electric motor manufacturers, serving more than 100 countries and five continents. Offering a wide range of motors, WEG also stands out in the supply of dedicated applications offering solutions for many different niches. WEG motors provide high efficiency, low operating costs, extended service life, and, above all, safety.**



Featuring a braking system with high torque and durability, rolled steel brake motors are ideal for equipment that requires fast stops or holding loads for safety and accuracy.

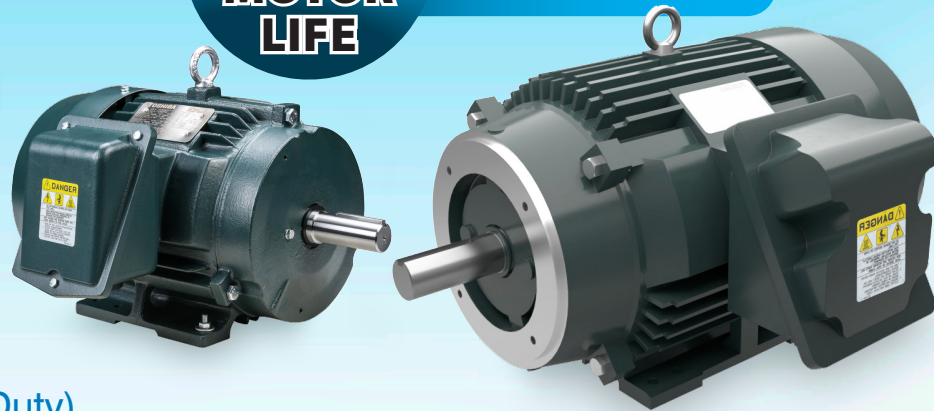


# TOSHIBA

## 1/2 - 100 hp

UPTO  
**10X**  
MOTOR  
LIFE

Designed to  
outlast the others



### EQP Global SD® (Severe Duty)

Whether you are looking for a motor that can withstand the most severe environments or you just want a motor that will last years longer than most, the Toshiba EQP Global® SD series 3-phase motors are what you need. The most common point of failure on a modern AC motor is the bearings.

EQP Global SD motors use oversized 300 series bearings to extend operating life up to 10 times longer than most major motor brands (e.g. Baldor, ABB, etc.) These motors are also rated for Class I, Division 2, Groups A-D hazardous locations and carry a 3-year warranty.

### Motor Features

- Frame sizes: 56C to 405T
- TEFC enclosure
- Inverter duty
- Oversized 300-series bearings
- Low vibration
- Heavy-duty cast iron construction
- Class F insulation with Class B temperature rise
- Every individual motor tested per IEEE112 Method A
- Footed and C-face footed models
- IP55 protection
- Class I, Division 2, Groups A, B, C, D
- UL, UR, CSA
- 230/460 VAC 3-phase
- Rated output: 1/2 - 100 hp
- 1200, 1800, 3600 rpm
- NEMA premium efficiency
- Meets US Department of Energy energy efficiency certification under file CC027B (1hp and larger)
- 3-year warranty



Toshiba EQP Global SD motors are some of the toughest motors available and can withstand the most extreme environments.



## 1/4 - 10 hp



### ACCU-Torq Motors®

U.S. MOTORS is a brand of Nidec, one of the world's largest manufacturers of electric motors. Nidec is on the forefront of technology advancements for "Everything that Spins and Moves". The U.S. MOTORS brand has stood for quality and innovation for more than a century.

The U.S. MOTORS ACCU-Torq® series 3-phase motors are high-performance inverter duty motors that provide a cost-effective solution for applications requiring precise speed control.

### Motor Features

- Constant torque operation; zero to base speed on vector drives
- 5000:1 speed range
- Constant horsepower operation to 2X base speed
- Optimized for operation with variable speed drives (VFDs)
- NEMA Design A
- Normally closed thermostats standard
- Class F insulation
- Continuous duty at 40°C
- Compatible with encoder installation
- 230/460 VAC 3-phase
- Rated output: 1/4 - 10 hp
- 1800 rpm
- NEMA premium efficiency ratings on certain models
- 3-year warranty (1hp and larger)

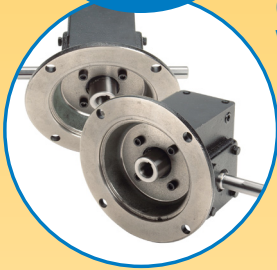


U.S. Motors ACCU-Torq motors are an excellent solution for high-performance applications requiring high torque even at lower speeds.



# Compatible components for AC motors

starting at  
**\$199.00**



## Cast Iron Worm Gearboxes

- Heavy duty
- C-face mounting
- Six ratios: 5:1 to 60:1
- Multiple output shaft options
- Input power: 1 to 5 hp

starting at  
**\$118.00**



## Aluminum Worm Gearboxes

- Light weight – medium duty gears
- Hollow shaft output
- Gear ratios: 10:1 to 100:1
- Input faces: 56C, 145TC, 182/4TC
- Input power: 0.25 to 5 hp

starting at  
**\$488.00**



## Helical Gearboxes

- Heavy duty – cast iron frames
- C-face mounting
- Eight ratios: 5:1 to 60:1
- Sized to handle 1 to 20 hp

starting at  
**\$1,272.00**



## Helical Bevel Gearboxes

- Five frame sizes: 37, 47, 67, 77, 87 mm
- Gear ratios: 5:1, 10:1, 15:1, 20:1, 30:1, 40:1, 60:1
- Input faces: 56C, 145TC, 182/4TC, 213/5TC, 254/6TC
- Drop-in replacement for most popular European right-angle gear reducers



starting at  
**\$14.00**

## Stable™ Motor Slide Bases

Motor slide bases are used to accurately and easily position your motor. Bases are available in sizes that fit all NEMA framed motors from NEMA 56 To NEMA 449T.



Screw  
adjustment  
moves Motor  
Mount bolts

