HUBCITY

marathon™ Motors

HERA-MAX™ Drive Catalog

HM400

The Next Generation of *Gearficient*™ Drives.

A Regal Brand

REGAL

HERA-MAX™

The Next Generation of *Gearficient*™ Drives.

Ordering Information

When ordering, please include the model number of the HERA™ Gear Drive, MAX™ Drive motor, DYNA-MAX™ Brake and M-Encoder™. Include the quantity along with shipping and billing instructions.

Three (3) Ways to Order:

Option 1:

ORDER INDIVIDUAL PARTS BY CATALOG NUMBER.

Option 2:

BUILD YOUR OWN HERA-MAX™ using the Base HERA-MAX™ Cat. No. and adding a Brake, Encoder, Output Shaft and Mounting bases, everything to meet your application needs.
(See example on next page)

Option 3:

For OEM special models, for additional application needs or features, contact your Hub City/Marathon representative.

Discounts & Multipliers

All prices in this catalog are list prices. For discounts and multipliers, contact your local factory representative.

All prices and data are subject to change without notice.

HERA-MAX™ System, Page 10

HERA-MAX™ Cat No.	Output RPM	Output Tq (lb-in)
HM3507	220	1100
HM3506	155	1100
HM3505	113	1100
HM3504	89	1100
HM3503	60	1100
HM3502	40	1100
HM3501	33	1100
HM3500	30	1100
HM4507	226	1300
HM4506	155	1890
HM4505	113	2600
HM4504	90	2600
HM4503	63	2600
HM4502	44	2600
HM4501	33	2600
HM4500	29	2600

DYNA-MAX™, Page 17

DYNA-MAX™ Brake Cat No.	Torque (lb-ft)
A1400	3
A1401	6
A1402	10
A1403	
A1404	15
A1406	20
A1408	25

NOTE:
Review DYNA-MAX™ brake "Application Considerations" on page 16, prior to selecting brake.

Plug-In Output Shafts, Page 12

Solid Single Ext. Cat. No.	Solid Double Ext. Cat No.	HERA™ Series	Worm Ref	Worm Center Distance
A1300	A1310	35	18	1.75”
A1301	A1311		21	2.13”
A1302	A1312		24	2.38”
A1303	A1313	45	24	2.38”
A1304	A1314		26	2.63”
A1305	A1315		30	3.00”
A1306	A1316		32	3.25”

Output Bushing Cat. No.	Bore I.D.
A1380	0.750”
A1381	0.875”
A1382	1.000”
A1383	1.125”
A1384	1.188”
A1385	1.250”

Purchase Order Example:

Step:	Cat No.	Qty.	Description	Order Comments
1	HM3506	5	Base HERA-MAX™	
2	A1406	5	DYNA-MAX™ Brake	Assemble to HERA-MAX™
3	A1452	5	M-Encoders	Assemble to HERA-MAX™
4	A1301	5	Output Shaft	Ship loose with HERA-MAX™
5	A1330	5	B-Base	Ship loose with HERA-MAX™

M-Encoder™, Page 21

M-Encoder™ Cat No.	Fits Shaft Diameter	PPR
A1450	5/8” and 7/8”	512
A1451	5/8” and 7/8”	1024
A1452	5/8” and 7/8”	2048

B-Bases, Page 12

B-Base Cat No.	HERA™ Series	Worm Ref	Worm Center Distance
A1330	35	21	2.13”
A1331		24	2.38”
A1332	45	26	2.63”
A1333		30	3.00”
A1334		32	3.25”

Additional Mountings Available	Page
T-Base	12
F-Flange	12
Vertical Mount	13
Torque Arm	13
Shaft Cover	13

HM3502 with DYNA-MAX™ Brake

HERA™ 35 Gear Reducer

Optional Inserts

Double Extension

Single Extension

Hollow Bushing

T-Base

B-Base

M-Shield™

HERA™ 45 Gear Reducer

56CZ MAX™ Drive Motor

T-Base

B-Base

M-Encoder™

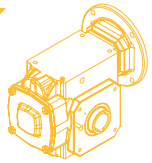
DYNA-MAX™ Brake

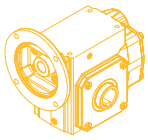
184TCZ MAX™ Drive

M-Shield™

HM4506 with DYNA-MAX™ Brake

TABLE OF CONTENTS





General Information

CANCELLATION AND RETURNS

Stock Product
Stock Product can be returned for credit as defined herein. Equipment must be in original packaging, unused in "as shipped" condition and is **limited to products currently maintained in stock inventory.** All HERA-MAX™ drives and accessories returned must have date codes no older than 36 months from date of manufacture. The minimum restocking charge is 15% of the original net purchase price. Modified and build to order HERA-MAX™ gear drives cannot be returned for credit. Return freight charges are the responsibility of the customer returning the gear drive, motor or accessories. **No returns will be accepted without prior authorization.**

Non-stock Product Cancellation Policy
Cancellation charges for non-stock orders received and entered will be determined based on the percentage of completion in the engineering and manufacturing process, accounting for all costs plus a reasonable profit.

DISCOUNTS AND MULTIPLIERS:

All prices in this catalog are list prices. For discounts and multipliers, contact your local factory representative.

WARRANTY:

HERA™ Gear Reducer
The gear reducer is warranted to be free from defects in material and workmanship under normal use and proper maintenance and conform to proper specifications for three years.

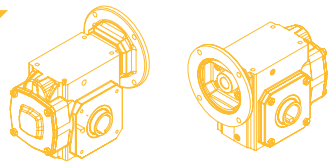
MAX™ Drive Motor
The motor is warranted to be free from defects in material and workmanship under normal use and proper maintenance and conform to proper specifications for three years.

DYNA-MAX™ Brakes
The brake is warranted to be free from defects in material and workmanship under normal use and proper maintenance and conform to proper specifications for three years. **Brake discs are considered a normal maintenance item and are not covered under the DYNA-MAX™ brake's three year warranty.**

M-Encoder™
The M-Encoder™ is warranted to be free from defects in material and workmanship under normal use and proper maintenance and conform to proper specifications for three years.

For more information, refer to the "Terms and Conditions of Sale" (MPN411) located on page 42.

HERA™ Gear Reducer
Energy Savings



The online HERA™ efficiency calculator is designed to calculate energy savings based on known gearbox output torque or known motor horsepower. To use the HERA™ calculator based on gearbox output torque. go to www.hubcityinc.com/energy_calculator/efficiency_calculator.html. By following the simple steps, a quick payback can be determined.

Three modes exist that are located at the top of the calculator that require differing data that will fine tune your savings. The Advanced Mode is shown.

Simple Mode includes inputs from duty cycle, days of operation, energy cost, along with input speed at the gearbox input shaft. Load torque at the gearbox output shaft, current system configuration and HERA™ system configuration.

Basic Mode includes the features set of the Simple Mode along with: current system configuration plus existing motor description, motor rating (HP), motor efficiency. The HERA™ configuration includes new motor description, motor horsepower (HP) and motor efficiency.

The Advanced Mode includes: features set of the simple or base modes with an option for gearbox and motor pricing.

Step 1 - Click on simple, basic or advanced mode at the top of the header.

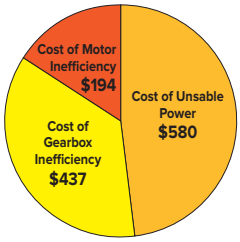
Step 2 - Enter the existing duty cycle of the gear device (up to 24), enter days of the week (1-7), enter the energy cost. Enter the input speed at the gearbox input shaft (3600, 1800, 1200), enter load torque at gearbox output shaft. In the Simple Mode under current system, add a gearbox description and the existing gearbox ratio (7.5 to 60). Under the HERA™ system, select HERA™ model size (35, 45) and then pick a gearbox ratio (7.8 to 59.79). Tip: match the HERA™ ratio that is closest to the existing gearbox.

Step 3 - Hit the calculator button and the efficiency calculator calculates the annual energy cost savings, percentage savings and suggests that a smaller motor could be used saving additional money.

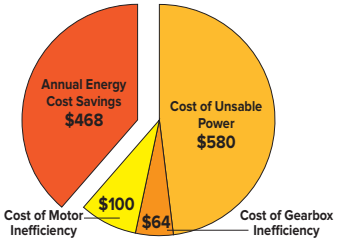
Step 4 - In the upper right hand corner, an icon for a printer is shown if a hard copy is required.

Many motor options are available, but the energy optimized solution is to pick the MAX™ Drive motor which allows for the greatest system savings.

Worm System
Annual Operating Cost (Total) $1,211



HERA System
Annual Operating Cost (Total) $744



Energy Savings Example

	Worm System	HERA System
Gearbox Description	3.25" Worm	HERA45
Gearbox Ratio (to 1)	60/1	59.79
Motor Description	Standard 3-phase	Marathon MAX™ Drive
Motor Rating (HP)	3HP	1.5HP
Motor Efficiency	84.0%	86.5%
Gearbox Operating Efficiency	57%	90%

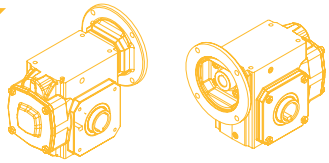
Cost of Usable Power	$580	$580
Cost of Gearbox Inefficiency	$437	$64
Cost of Motor Inefficiency	$194	$100
Annual Operating Cost (total)	$1,211	$744
Annual Energy Cost Savings		**$468**

Individual results may vary.

Go Online to calculate your savings!
www.hubcityinc.com/energy_calculator/efficiency_calculator.html

HERA45 Benefits
- 39% Energy Savings
- Smaller Motor Requirements
- 4700 kW-hrs Saved Annually
- CO2 Savings = Over 2.5 tons

HERA-MAX™ System
Assembled Gear Motors



The best of both worlds... the HERA-MAX™ Drive is a system-maximizing gear drive-motor duo. It incorporates a modular design whereby components can be configured as required... maximizing the versatility and flexibility of the gear drive-motor to the application.

The HERA-MAX™ System is a torque-matched™ motor and right angle gear reducer. The MAX™ Drive motors provide NEMA Premium efficiencies. The HERA™ gear reducer is 90% efficient for all speed ratios, up to 40 points higher than worm gearing. This offers many advantages including lower operating costs, smaller motor requirements and less heat generation.

Designed for applications such as conveyors, packaging machinery, printing equipment, feed processing, bottling equipment, construction machinery, bulk handling, cranes and other commercial or industrial machinery that demand high efficiency, modular versatility and high torque density.

Features:

- MAX GUARD® patented insulation system surpasses the requirements of NEMA MG1, Part 31
- IP56 Severe duty construction, yellow epoxy overcoat and epoxy internal coating for added protection that resists rust and prevents corrosion
- NEMA Premium® meets the 2015 Energy Law for Fractional Motors
- High system efficiency for reduced operating costs
- Two times more torque capacity than a traditional worm gearing
- Smaller footprint and weighs less than other gear drive systems
- Outputs include hollow bore and modular single or double solid shafts
- NEMA Premium® motor is Torque-Matched™ to the HERA™ Gear reducer to optimize the system efficiency
- Plug-n-Play technology to easily attach the M-Encoder™ or the Dyna-MAX™ brake
- The oversized terminal box and the innovative Quick Termination System (QTS™) allows for quick customer connection/disconnection of field devices such as AC inverters
- UL Listed File No. E49747, CSA Certified File No. LR2025, and CE Mark
- 3 year warranty, the longest in the industry

Stock Ratings:

- HERA™ 35 - Up to 1,100 in-lbs of torque
- HERA™ 45 - Up to 2,600 in-lbs of torque
- 0.55 through 6.3 Kilowatts (kW)
- 56CZ and 184TCZ frames

DYNA-MAX™ Brakes:

- DYNA-MAX™ 3 lb-ft through 25 lb-ft. 5/8” and 7/8” shaft sizes

M-Encoder™:

- Incremental magnetic encoder 512, 1024 or 2048 PPR

IP56

MAX GUARD INSULATION SYSTEM

Inverter Duty

NEMA Premium

HERA™ Gear Reducer
Application Considerations - New Application

The ratings for HERA™ Gear Reducers are based on a service factor of 1.0 for uniform load and uniform power source up to 10 hours of operation per day. Use Table 1 (1.0 Service Factor) for applications having a uniform load with up to 10 hours of service duration per day. Use Table 2 (1.25 Service Factor) for applications having a uniform power source and moderate load with up to 10 hours of service duration per day. Use Table 3 (1.5 Service Factor) for over 10 hours service duration per day or heavy shock loading.

To determine the performancey of a HERA™ Gear Reducer for each HERA-MAX™ system when a service factor (SF) is applied, read across the row for a specific gear drive to determine “input amps @ 460V”, “output torque” and”output RPM”. For example, if a HG3507 gear drive is required with a 1.0 SF, the input amps @ 460V is 5.1A, output torque is 1100 lb-in and output rpm is 220. If a 1.25 SF is required the HG 3507 gear reducer input amps @ 460V is 4.3A, output torque is 880 lb-in and output rpm is 221. If a 1.50 SF is required the HG3507 gear reducer input amps is 3.8A, output torque is 773 lb-in and output RPM is 222.

HERA™ Quick Selection for 1800 RPM, 460 volts

TABLE 1

1.0 AGMA Service Factor			
HERA™ Gear Cat No.	Input Amps @ 460V	Output Torque (lb-in)	Output RPM
HG3507	5.1	1100	220
HG3506	4.1	1100	155
HG3505	3.0	1100	113
HG3504	2.5	1100	89
HG3503	2.2	1100	60
HG3502	1.4	1100	40
HG3501	1.0	1100	33
HG3500	0.9	1100	30
HG4507	6.8	1300	226
HG4506	6.8	1890	155
HG4505	6.8	2600	113
HG4504	5.2	2600	90
HG4503	3.7	2600	63
HG4502	2.9	2600	44
HG4501	2.3	2600	33
HG4500	2.0	2600	29

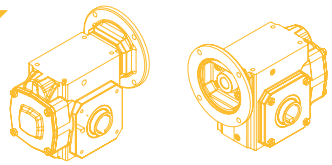
TABLE 2

1.25 AGMA Service Factor		
Input Amps @ 460V	Output Torque (lb-in)	Output RPM
4.3	880	221
3.6	880	156
2.8	880	114
2.2	880	89
2.0	880	61
1.2	880	41
0.9	880	33
0.8	880	30
5.8	1040	226
5.8	1512	155
5.8	2080	113
4.4	2080	90
3.1	2080	63
2.4	2080	44
2.0	2080	33
1.8	2080	29

TABLE 3

1.50 AGMA Service Factor		
Input Amps @ 460V	Output Torque (lb-in)	Output RPM
3.8	733	222
3.2	733	156
2.5	733	114
2.1	733	89
1.9	733	61
1.1	733	41
0.7	733	33
0.6	733	30
5.2	867	227
5.2	1260	156
5.2	1733	114
3.9	1733	91
2.8	1733	63
2.2	1733	44
1.8	1733	34
1.7	1733	29

The American Gear Manufacturers Association (AGMA) classifications are used for product selection. Past experience may indicate that different service factors are required. Consult the factory for unusual or severe applications, when cranes or elevator applications are considered, and whenever there are personal safety concerns.



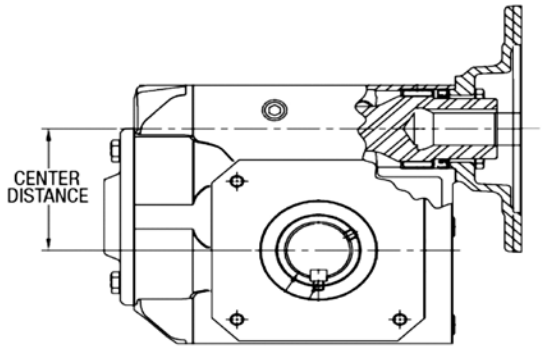
Competitor Worm Interchange Guide

Step 1: Find competitors Stock No. on the charts below

Step 2: Determine current "CENTER DISTANCE" of the competitor unit

Step 3: Determine Output Torque and Output RPM of the competitor unit

Step 4: Match up with the HERA™ Gear Reducer



Solid Output Shaft - NEMA C Flange Reducer (Quill Input)

CENTER DISTANCE (Inches)	1.75	2.06	2.38	2.62	3.00	3.25
HERA - w/plug-in shaft kit	HERA35	HERA35	HERA35			
	—	—	HERA45	HERA45	HERA45	HERA45
HERA35 Single Output Shaft Kit	A1300	A1301	A1302	—	—	—
HERA35 Double Output Shaft Kit	A1310	A1311	A1312	—	—	—
*HERA35 BASE KIT	—	A1330	A1331	—	—	—
HERA45 Single Output Shaft Kit	—	—	A1301	A1304	A1305	A1306
HERA45 Double Output Shaft Kit	—	—	A1313	A1314	A1315	A1316
*HERA45 BASE KIT	—	—	—	A1332	A1333	A1334
BALDOR	F918	F921	F924	F926	F930	F932
BOSTON	F718	F721	F724	F726	F730	F732
Dodge-Tigear-2	17Q	20Q	23Q	26Q	30Q	—
Falk-Omnibox	1175WBM	1206WBM	1238WBM	1262WBM	1300WBM	1325WBM
Morse-Raider	175Q	206Q	237Q	262Q	300Q	325Q

Hollow Bolt Shaft - NEMA C Flange Reducer (Quill Input)

CENTER DISTANCE (Inches)	1.75	2.06	2.38	2.62	3.00	3.25
HERA - HOLLOW BORE	HERA35	HERA35	HERA35	—	—	—
	—	—	HERA45	HERA45	HERA45	HERA45
*HERA35 B-BASE KIT	—	A1330	A1331	—	—	—
*HERA45 B-BASE KIT	—	—	—	A1332	A1333	A1334
BALDOR	HF918	HF921	HF924	HF926	HF930	HF932
BOSTON	HF718	HF721	HF724	HF726	HF730	HF732
Dodge Tigear-2	17QH	20QH	23QH	26QH	30QH	—
Falk Omnibox	1175WBQM	1206WBQM	—	1262WBQM	1300WBQM	1325WBQM
Morse Raider	175QH	206QH	237QH	262QH	300QH	325QH

*B-Base Kit required for foot mounting Interchange

Refer to Page 12 for HERA™ 35 and HERA™ 45 interchange dimensions

HERA™ Gear Reducer
Application Considerations

Gear reducers are power transmission devices that use mechanical gearing components in an enclosed housing to transfer power from a motor to the driven equipment. Gear reducers increase torque and reduce speed from one device to another. The ratings for gear reducers depend on the gear ratio and on the torque required to drive the load. The efficiency of a gear reducer is determined by the types of gearing used such as helical, hypoid, bevel and worm gears.

Typical efficiencies range from 50% to over 90% depending on the type of gearing. As a result, the type of gearing used in an application can have a greater effect on overall system efficiency than the efficiency of the motor itself.

The choice of gear reducer depends upon many factors, including the desired speed ratio, load torque, shaft configuration and mounting.

One of the most popular reducers is the worm gear which is used to transmit power through right angles on non-intersecting shafts. A worm gear consists of a cylindrical worm that meshes with a larger gear, often called a wheel. The worm, which has a screw-type thread, re-quires several revolutions to drive the wheel through a single revolution. Worm gears allow a large speed reduction, typically up to 100:1, in a single reduction package. Worm gears are widely used for speed reductions or increases and for torque multiplication and accuracy enhancements for positioning systems. They are suitable for applications where shock loads are encountered.

The principle disadvantage of worm gears is that the sliding action produces frictional energy losses within the speed reducer. These losses generate heat which must be absorbed by the lubricant and finally dissipated through the walls of the enclosure. The efficiency ranges from 55% to 94% and drops quickly as the ratio increases due to friction between the worm and wheel.

Additionally, the lower efficiency will frequently require the use of a larger motor, negating the advantage of the lower cost worm gear when compared to other gearing technologies.

HERA™ gear reducers incorporate helical/hypoid gearing which provides constant 90% efficiency across the full range of available ratios.

Due to its higher efficiency and compact design, the HERA™ can deliver twice the torque in half the space and weight when compared to a traditional worm drive. Table 1 below shows the efficiency comparison between a HERA™ and a worm reducer.

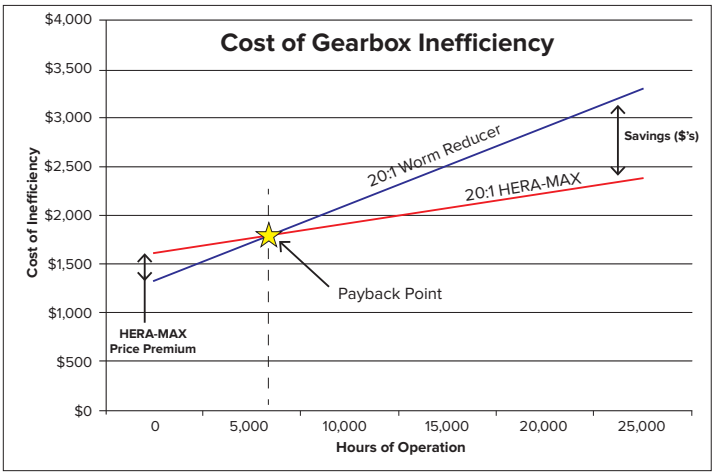
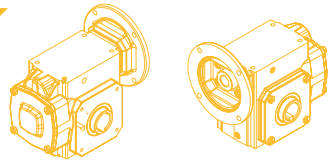


Table 1 **HERA™ Compared to a Traditional Worm Gear**

Gear Drive Systems - The gear reducer is one component in the total gear drive system. A system typically consists of a motor, gear drive, transmission components and the load. Each component in a system will inherently have some inefficiency, and these energy losses multiplied together provide the overall system efficiency.

The following example compares a traditional worm gear with an efficiency of 80% and a standard 56 Frame motor with an efficiency of 72%. The overall system efficiency is 0.80 x 0.72 or 57.6% efficient. Compared to a HERA™ gear reducer with an efficiency of 90% and a MAX™ drive motor with an efficiency of 86.5%. The overall system efficiency would be 0.90 x 0.865 or 77.9% efficient. That's a 20-point efficiency gain, which means energy losses are cut by 52%! Additionally, the MAX™ drive motor is typically one frame size smaller because HERA™ wastes less energy. The MAX™ drive motor is Torque-Matched™ to optimally run the HERA™ drive and is Performance-Matched™ to all PWM AC inverters on the market delivering even great savings.

MAX™ Drive Motor
Application Considerations



Marathon Electric MAX™ Drive motors are rated for continuous operation throughout the rated speed range in a 40°C ambient and for attitudes up to 3300 feet (1000 meters) above sea level. Special application considerations, such as high or low ambient temperature, intermittent ratings, high altitude, duty cycle rated, extended constant horse-power range, special base speed, voltage or frequency, or any other special requirements, should be reviewed by a factory representative.

Constant Torque Loads - Applications include conveyors, elevators, hoists, mixers and converting equipment. These motors provide full rated torque within their listed speed range, without exceeding a Class F temperature rating while under inverter power (many operate at Class B). Ratings in this catalog have been developed, based on extensive testing on IGBT inverters, set at a minimum 3 kHz (or equivalent) current frequency.

MAX™ Drive motors rated for zero RPM continuous duty 1000:1 must be powered by vector drives to produce rated torque without overheating. Optimum zero speed and low speed full torque performance may require a closed loop vector drive (with encoder feedback).

MAX GUARD® Insulation System - MAX™ Drive motors feature the MAX GUARD® insulation system, either in conjunction with Class F or Class H materials. Combining corona-resistant magnet wire (CR200) with our patented "low stress" winding configuration and uncompromised motors quality standards. MAX GUARD® delivers long, dependable motor life under the adverse thermal and dielectric stresses imposed by IGBT-based variable frequency drives. **MAX GUARD® surpasses the requirements of NEMA MG1-2006, Part 31, Section 4.4.2.**

460 Volt (or lower) motors equipped with MAX GUARD® can be operated at any distance from the drive and at any carrier frequency.

The QTS™ as shown on the 56 frame motor.

Torque-Matched™ - The HERA-MAX™ output torque has been optimally matched to the output torque and efficiency of the motor. By torque-matching, the HERA-MAX™ System works as a single unit. The following chart lists the MAX™ Drive Cat. No. Torque-Matched™ to the HERA™ Gear Cat. No., the preferred HERA™ Gear Cat. No. is highlighted in bold.

MAX Drive™ Cat No.	Torque-Matched™ HERA™ Gear Cat No.
MD4507	HG4507
MD4506	HG4506
MD4505	HG4505
MD4504	**HG4504**, HG3507, HG3506
MD3507	**HG3507**, HG3506
MD3506	HG3506
MD4503	**HG4503**, HG3505
MD3505	HG3505
MD3504	**HG3504**, HG4502
MD4502	HG4502
MD4501	**HG4501**, HG3503, HG4500
MD3503	**HG3503**, HG4500
MD4500	HG4500
MD3502	**HG3502**, HG3501, HG3500
MD3501	**HG3501**, HG3500
MD3500	HG3500

Motor Grounding - Frames and accessories of all motors must be grounded in accordance with the National Electric Code (NEC) Article 430. Refer to NEC Article 250 for general information on grounding. Proper grounding of inverter-driven motors is essential to protect personnel and livestock from inverter sourced common mode voltages, which may reach hazardous levels on the frame of ungrounded or poorly grounded motors.

Proper overload protection of the MAX™ Drive motor per the NEC/CE code is required. The motor's nameplate current shall be used to determine the ampere rating of the motor overload protection.

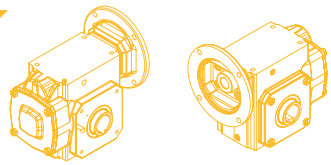
Quick Termination System - The innovative Quick Termination System (QTS™) incorporates three main features in the MAX™ Drive Motor conduit box. 1) two terminal blocks, one for incoming AC power and the DYNA-MAX™ Brake, one for connecting the M-Encoder™. 2) The patented Voltage Change Device (VCD™) (56CZ frame ONLY), which allows for quick voltage changes. 3) Grounding provisions provided in accordance with NEC grounding methods. The QTS™ allows for quick customer connection/disconnection of field devices such as AC inverters.

HERA-MAX™ SYSTEM
Factory Assembled Gear Motors

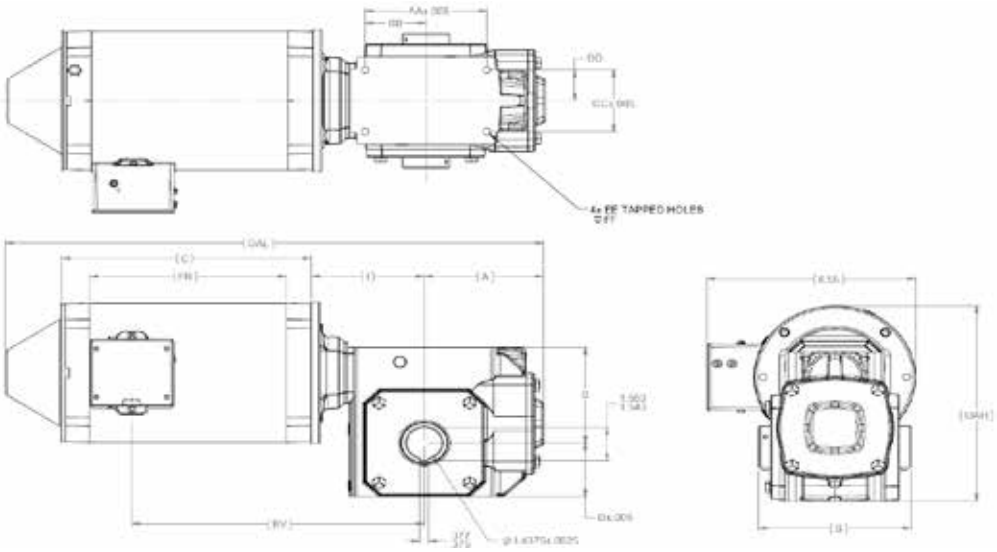
Assembled HERA-MAX™ 35										
Nom. Ratio	Output RPM	Output Torque	Motor Frame	HERA-MAX™ Cat No.	List	Mult	Diagram	HERA™ Gear Cat No.	MAX Drive™ Cat No.	Weight (lbs)
7:1	220	1100	184TCZ	HM3507	**$2,648**	HM1	06	HG3507	MD3507	135
10:1	155	1100	184TCZ	HM3506	**$2,636**	HM1	06	HG3506	MD3506	130
15:1	113	1100	184TCZ	HM3505	**$2,520**	HM1	06	HG3505	MD3505	125
20:1	89	1100	56CZ	HM3504	**$2,245**	HM1	04	HG3504	MD3504	75
30:1	60	1100	56CZ	HM3503	**$2,100**	HM1	03	HG3503	MD3503	71
40:1	40	1100	56CZ	HM3502	**$2,010**	HM1	02	HG3502	MD3502	64
50:1	33	1100	56CZ	HM3501	**$1,974**	HM1	01	HG3501	MD3501	60
60:1	30	1100	56CZ	HM3500	**$1,956**	HM1	01	HG3500	MD3500	60

Assembled HERA-MAX™ 45										
Nom. Ratio	Output RPM	Output Torque	Motor Frame	HERA-MAX™ Cat No.	List	Mult	Diagram	HERA™ Gear Cat No.	MAX Drive™ Cat No.	Weight (lbs)
7:1	226	1300	184TCZ	HM4507	**$3,545**	HM1	07	HG4507	MD4507	235
10:1	155	1890	184TCZ	HM4506	**$3,413**	HM1	07	HG4506	MD4506	196
15:1	113	2600	184TCZ	HM4505	**$3,181**	HM1	07	HG4505	MD4505	160
20:1	90	2600	184TCZ	HM4504	**$3,065**	HM1	06	HG4504	MD4504	155
30:1	63	2600	184TCZ	HM4503	**$2,937**	HM1	06	HG4503	MD4503	147
40:1	44	2600	184TCZ	HM4502	**$2,595**	HM1	06	HG4502	MD4502	115
50:1	33	2600	56CZ	HM4501	**$2,505**	HM1	05	HG4501	MD4501	100
60:1	29	2600	56CZ	HM4500	**$2,476**	HM1	05	HG4500	MD4500	89

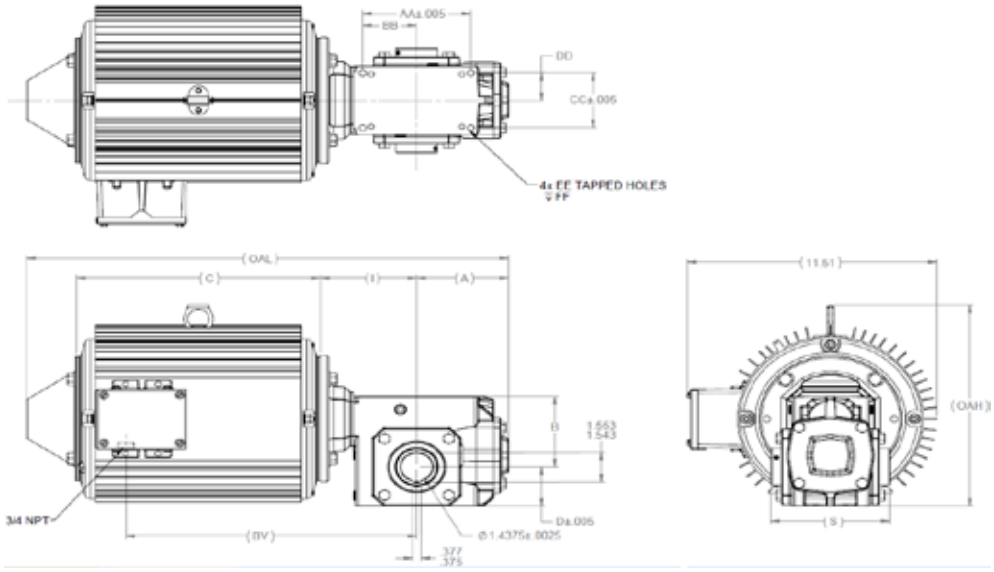
HERA-MAX™ SYSTEM
Dimensions



56/145 Frame (Dimensions in Inches)																
Diagram	**A**	**B**	**C**	**D**	**I**	**FR**	**BV**	**S**	**OAL**	**OAH**	**AA**	**BB**	**CC**	**DD**	**EE**	**FF**
01	4.25	3.69	10.74	2.06	4.44	8.06	11.31	5.50	21.24	7.88	4.19	2.09	2.75	1.38	5/16-18 UNC	0.63
02	4.25	3.69	11.24	2.06	4.44	9.06	12.81	5.50	22.24	7.88	4.19	2.09	2.75	1.38	5/16-18 UNC	0.63
03	4.25	3.69	11.74	2.06	4.44	9.56	13.31	5.50	22.74	7.88	4.19	2.09	2.75	1.38	5/16-18 UNC	0.63
04	4.25	3.69	12.24	2.06	4.44	10.06	13.81	5.50	23.24	7.88	4.19	2.09	2.75	1.38	5/16-18 UNC	0.63
05	4.88	4.44	12.24	2.50	4.63	10.06	14.00	6.25	24.06	9.07	5.00	2.50	2.88	1.44	3/8-18 UNC	0.69



184 Frame (Dimensions in Inches)															
Diagram	**A**	**B**	**C**	**D**	**I**	**BV**	**S**	**OAL**	**OAH**	**AA**	**BB**	**CC**	**DD**	**EE**	**FF**
06	4.25	3.69	11.26	2.06	4.44	13.43	5.50	22.25	10.54	4.19	2.09	2.75	1.38	5/16-18 UNC	0.63
07	4.88	4.44	11.26	2.50	4.63	13.62	6.25	23.08	11.69	5.00	2.50	2.88	1.44	3/8-18 UNC	0.69



HERA-MAX™ System
HERA™ Gear Accessory Kits

TABLE 1

HERA-MAX™ Plug-In Output Shafts

HERA™ Model	Worm Interchange Reference		Cat No. Single Ext.	Cat No. Double Ext.	List Price	Mult	S	T	T2	U	V	W2	X	Y	Keys Included	Weight (lbs)
35	SIZE 18	1.75 CD	A1300	A1310	$55	HM1	8.62	4.31	2.97	0.875	2.05	1.34	3/16 x 3/32	1.13	3/16 x 1/8	4.1
	SIZE 21	2.13 CD	A1301	A1311	$55	HM1	9.33	4.69	2.97	1.000	2.43	1.72	1/4 x 1/8	1.50	1/4 x 1-1/2	4.4
	SIZE 24	2.38 CD	A1302	A1312	$58	HM1	10.28	5.14	2.97	1.125	2.88	2.17	1/4 x 1/8	1.75	1/4 x 1-3/4	4.9
45	SIZE 24	2.38 CD	A1303	A1313	$74	HM1	10.28	5.14	3.45	1.125	2.50	0.69	1/4 x 1/8	1.50	1/4 x 1-1/2	5.2
	SIZE 26	2.63 CD	A1304	A1314	$74	HM1	11.25	5.63	3.44	1.125	2.99	2.18	1/4 x 1/8	2.00	1/4 x 1-3/4	5.7
	SIZE 30	3.00 CD	A1305	A1315	$78	HM1	13.50	6.75	3.45	1.250	4.11	3.30	1/4 x 1/8	2.25	1/4 x 2-1/4	6.6
	SIZE 32	3.25 CD	A1306	A1316	$87	HM1	14.12	7.06	3.45	1.375	4.42	3.64	5/16 x 5/32	2.50	5/16 x 2-3/8	7.3

TABLE 2

HERA-MAX™ B-Base Kits

Gear Drive	Worm Interchange Reference		Cat No.	List Price	Mult	D	V	AA	BB	CC	DD	EE	Weight (lbs)
35	SIZE 18	1.75 CD	No Base Required										
	SIZE 21	2.06 CD	A1330	$72	HM1	2.281	0.22	5	2.05	2.88	1.44	3/8 UNC	1.3
	SIZE 24	2.38 CD	A1331	$80	HM1	2.500	0.38	5	2.05	2.88	1.44	3/8 UNC	2.0
45	SIZE 24	2.38 CD	No Base Required										
	SIZE 26	2.63 CD	A1332	$89	HM1	2.938	0.38	6.38	3.19	3.38	1.69	3/8 UNC	2.5
	SIZE 30	3.00 CD	A1333	$107	HM1	3.250	0.69	7.00	3.50	4.00	2.00	7/16 UNC	4.3
	SIZE 32	3.25 CD	A1334	$118	HM1	3.500	0.88	7.50	3.75	4.00	2.00	7/16 UNC	5.0

TABLE 3

HERA-MAX™ T-Base Kits

Gear Drive	Worm Interchange Reference		Cat No.	List Price	Mult	D	V	AA	BB	CC	DD	EE	Weight (lbs)
35	SIZE 18	1.75 CD	A1340	$85	HM1	2.750	0.63	5.75	2.88	4.50	2.25	0.41	3.0
	SIZE 21	2.13 CD	A1341	$116	HM1	3.000	0.66	6.38	3.19	4.69	2.34	0.47	4.8
	SIZE 24	2.38 CD	A1342	$130	HM1	3.250	0.69	7.06	3.53	4.88	2.44	0.47	9.0
45	SIZE 24	2.38 CD	A1343	$119	HM1	3.250	0.69	7.06	3.53	4.88	2.44	0.47	6.0
	SIZE 26	2.63 CD	A1344	$142	HM1	3.688	0.69	8.00	4.00	5.25	2.63	0.53	7.0
	SIZE 30	3.00 CD	A1345	$167	HM1	4.000	0.69	8.44	4.22	5.88	2.94	0.53	9.5
	SIZE 32	3.25 CD	A1346	$188	HM1	4.375	0.81	9.50	4.75	6.13	3.06	0.53	11.5

TABLE 4

HERA-MAX™ F-Flange Kits

Gear Drive	Worm Interchange Reference		Cat No.	List Price	Mult	S	T	Z	SS	TT	XX	YY	Weight (lbs)
35	SIZE 18	1.75 CD	A1360	$95	HM1	0.44	2.75	3.19	0.38	5.00	0.34	5.88	2.9
	SIZE 21	2.13 CD	A1361	$127	HM1	0.81	2.75	3.56	0.44	6.00	0.41	7.00	4.0
	SIZE 24	2.38 CD	A1362	$140	HM1	0.75	2.75	3.50	0.44	6.27	0.41	7.50	4.5
45	SIZE 24	2.38 CD	A1363	$140	HM1	0.76	3.13	3.88	0.44	6.27	0.41	7.50	4.7
	SIZE 26	2.63 CD	A1364	$147	HM1	0.31	3.13	3.44	0.50	6.67	0.41	8.00	4.5
	SIZE 30	3.00 CD	A1365	$160	HM1	0.15	3.13	3.28	0.50	7.37	0.41	9.00	4.5

For kit dimensional drawings on:
HERA™ 35, refer to page 29. HERA™ 45, refer to page 31.

HERA-MAX™ System
HERA™ Gear Accessory Kits

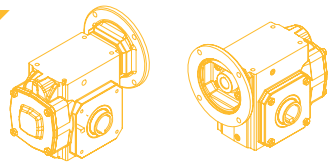


TABLE 5

HERA-MAX™ Vertical Mount Kit

Gear Drive	Cat No.	List Price	Mult	A	B	D	D1	F	G	H	J	K	V	Weight (lbs)
35	A1371	$74	HM1	8.25	5.00	3.00	4.38	7.37	4.50	0.44	4.00	2.00	0.25	4.0
45	A1372	$87	HM1	9.94	6.00	3.38	5.25	8.81	5.38	0.50	4.88	2.44	0.38	8.0

TABLE 6

HERA-MAX™ Torque Arm Kit

Gear Drive	Cat No.	List Price	Mult	A	D	Weight (lbs)
35	A1376	$175	HM1	2.50	2.062	8.5
45	A1377	$188	HM1	3.25	2.50	9.0

TABLE 7

HERA-MAX™ Plug-In Output Bushing

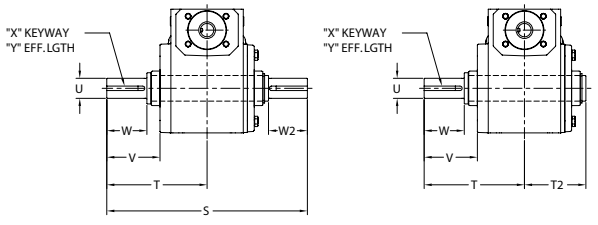
Fits Standard Bore 1 7/16”					
Cat. No.	List Price	Bore #1	Key #2	Key #3	Screw #4
A1380	$139	0.75”	.375”x .25”x3”	.1875”x.1875”x3”x3	1/4-20 x .625”
A1381	$139	0.875”	.375”x .25”x3”	.1875”x.1875”x3”x3	1/4-20x.5”
A1382	$139	1.0”	.375”x .25”x3”	.1875”x.1875”x3”x3	1/4-20x.5”
A1383	$139	1.125”	.375”-.25” Step x 3”	N/A	1/4-20x.5”
A1384	$139	1.1875”	.375”-.25” Step x 3”	N/A	1/4-20x.375”
A1385	$139	1.25”	.375”-.25” Step x 3”	N/A	1/4-20x.375”

TABLE 8

HERA-MAX™ Output Cover

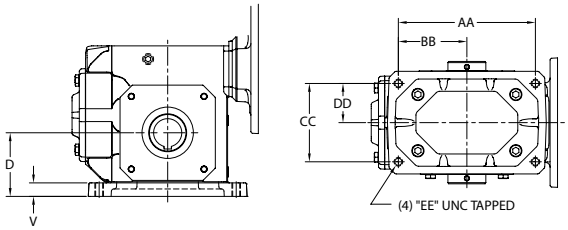
HERA™ Model	Cat. No.	List Price
35	A1390	$61
45	A1391	$61

TABLE 1



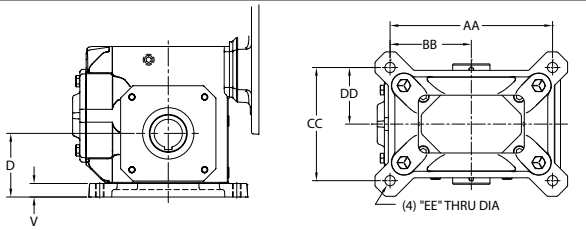
Double Extended Single Extended

TABLE 2



Hera B-bases provide a drop-in mounting solution when replacing comparable rated worm gear reducers.

TABLE 3



Hera T-bases provide a drop-in mounting solution when replacing comparable rated worm gear reducers that also are utilizing a horizontal mounting base.

TABLE 4

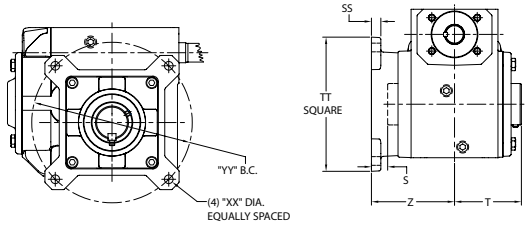


TABLE 5

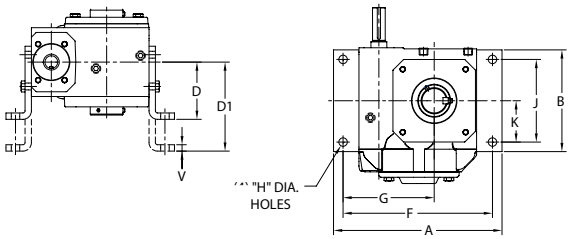


TABLE 6

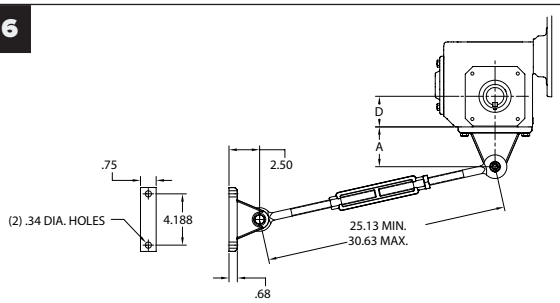


TABLE 7

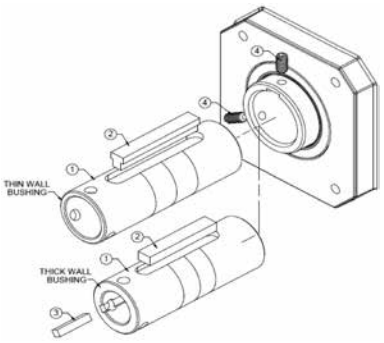
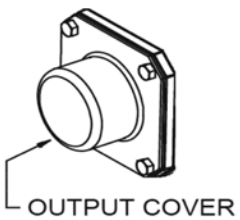


TABLE 8



DYNA-MAX™ Brakes

Overview:

DYNA-MAX™ Brakes are designed to be direct mounted to the non-drive end (ODE) of the MAX™ Drive motor. The compact, direct acting design delivers high torque with one moving part for longer life. The small size allows for increased flexibility when space is a premium. IP56 construction matches the MAX Drive™ motor offering "Mission Critical" performance in the harshest of environments. The HERA™ gear drive's modularity allows it to be dimensionally interchanged with popular worm reducer brands.

The Dyna MAX™ Brake mounting assembly, assures proper alignment preventing brake and motor failures, eliminates damage of brake discs and the motor shaft. All supplied gaskets must remain installed, to retain the IP56 rating.

Features:

- Model 6 incorporates a die cast aluminum bracket, model 4 incorporates a cast iron bracket. Both come with a stamped steel enclosure.
- White primer with yellow enamel overcoat and internal plated hardware that resists rust and prevents corrosion.
- Dual voltage, single phase coil, 230/460 Volt 60 Hertz and 190/380 Volt 50 Hertz
- Class B coil insulation
- NEMA C-Face mounting to non-drive end of motor
- Splined hub provides maximum torque displacement
- 3600 maximum speed matches all applications
- The small air gap provides fast response time and years of trouble-free service
- Brake release is manual release with auto reset for hands-free operations
- Easy to work on without brake disassembly
- CSA Certified, File LR13814
- 3 year warranty

Stock Ratings:

- Model 6 - 3, 6 and 10 lb-ft 56C mount
- Model 4 - 15 and 25 lb-ft 145TC mount

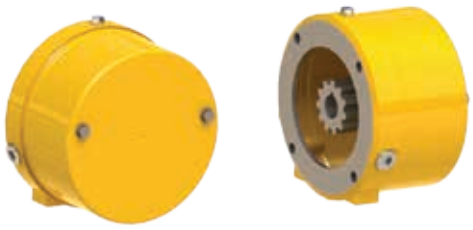
Voltage Ratings:

- Dual voltage, single phase coil, 230/460 Volt 60 Hertz and 190/380 Volt 50 Hertz

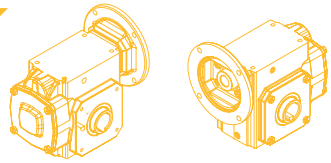
Mounting:

- Horizontal Standard - Vertical shaft up or vertical shaft down must be specified when ordering

Model 4 and Model 6



DYNA-MAX™ Brakes
Application Considerations



The DYNA-MAX™ Brake is an electromagnetic spring-set disc brake that mounts directly onto the opposite drive end of the MAX™ Drive motor.

The spring-set brake is direct acting. It is designed with a single moving part that activates and de-activates the brake operating system.

The brake operates on the principle that while the motor is running with power engaged, an electro-magnet within the brake pulls back the pressure plate allowing the friction discs and the motor's stub shaft to rotate freely. When the motor and brake are not energized torque springs within the brake apply pressure to the discs stopping and holding the motor shaft from rotating.

When the brake is mounted in a vertical position, either above or below the motor, additional disc separating springs are required. Reference Dings Bulletins BK4710, BK4660 and BK4713 when ordering and installing the brake.

Brake Selection - To properly determine which brake is appropriate for the application, the following items need to be considered: brake torque, stopping time, deceleration rate, load weight and speed. Loads can be classified into two categories: non-overhauling and overhauling.

Non-overhauling Loads - A non-overhauling load is where gravitational forces do not change the energy in the system and the internal friction of the system is sufficient to hold the load. There are two methods for determining brake torque for non-overhauling loads.

Method one is to size the brake to the torque of the motor while the second method is to select a brake on the basis of the total system or load inertia to be stopped. Method one is the most common means in selecting a brake and is based on the motor's full-load torque or horsepower and speed. This method is used for simple rotary and linear inertia loads. Brake torque is usually expressed as a percent of the full-load torque of the motor brake and is based on the motor's full-load torque and a predetermined service factor.

Generally, this figure is not less than 100% of the motor's full-load torque.

The following formula can be used to determine the brake's torque:

$$T = \frac{5250 \times HP \times SF}{RPM}$$

Where: T=Brake Torque (lb-ft), 5250 Constant, HP=Motor Horsepower, RPM=Speed, SF=Brake Service Factor

This method allows for the matching of the brake's torque to the motor's horsepower or full-load torque. The brake's nameplate torque represents a nominal static torque. The DYNA-MAX™ Brake direct-acting spring set brake is a fail safe type brake that will hold the load when power is not applied to the brake coil OR when the friction disc(s) wear and the magnetism of the brake coil will not collapse the air gap. At this point the brake air gap must be adjusted and/or the friction discs need to be replaced.

Spring set brakes provide a non repeatable rapid stop and hold action and should not be used in repeat positioning applications. Consult your factory representative for the application of method two, where the load data is known, where high internal loads exist, or where a stop in a specified time or distance is required.

Overhauling Loads - An overhauling load is where gravitational forces change the energy in the system and the internal friction is not sufficient to stop and hold the load. Consult your factory representative.

Service Factor - When application data like system inertia, speed of load and required stopping distances are not defined, a service factor is applied to the basic brake torque calculation. Typically a service factor of 1.4 is used. If inaccurate or variable torques exists a service factor of 2.0 may be used. Consult your equipment or system specialist for details.

When the brake is combined with an AC inverter, Service Factors ranging from 1.0 to 2.0 may be used. The brake must be wired to a separate dedicated power supply in this type of application.

A Service Factor of 1.25 or 125% of the motor full-load torque provides a stop in approximately the same time as that required for the motor to accelerate the load to full-load speed.

NOTE: Brake discs are considered a normal maintenance item and are not covered under the DYNA-MAX™ brake's three year warranty.

Table 1 can be used in the selecting of brake Service Factors. A Service Factor is applied to the basic drive torque calculation. The Service Factor compensates for any tolerance variation, data inaccuracy, unplanned transient torque and potential variations of the friction disc. A brake with a torque rating less than the motor full-load torque is a Service Factor less than 1.0. These holding or soft stop applications must be evaluated by the system designer to ensure adequate sizing and thermal capacity. A brake rated 125% of the motor full-load torque or with a 1.25 Service Factor, provides a stop in approximately the same time as that required for the motor to accelerate the load to full-load speed.

TABLE 1 **Quick Torque and Service Factor Selector - Non-overhauling Loads @ 1800 RPM**

MAX™ Drive Motor Cat No.	HERA-MAX™ System Cat No.	1.0 Service Factor (lb-ft)	1.25 Service Factor (lb-ft)	2.0 Service Factor (lb-ft)
MD3500, MD3501	HM3500, HM3501	3	3	6
MD3502	HM3502	3	6	6
MD3503, MD4500, MD4501	HM3503, HM4500, HM4501	6	6	N/A
MD3504, MD4502	HM3504, HM4502	10	N/A	N/A
MD3505	HM3505	10	15	20
MD3506, MD4503	HM3506, HM4503	15	20	RTF
MD3507, MD4504, MD4505	HM3507, HM4504, HM4505	20	25	RTF
MD4506, MD4507	HM4506, HM4507	25	25	RTF

NOTES: Brakes with a 1.0 Service Factor are not intended for criteria holding applications. Brake discs are considered a normal maintenance item and are not covered under the DYNA-MAX™ brake's three year warranty.

Applications with an overhauling load, such as cranes or hoists, require a brake with sufficient torque to both stop the load and hold it at rest. Table 2 is a quick selector based on CMAA, OSHA, and AISE recommendations for service factors associated with hoist. Consult the factory for applications where cranes or elevators are considered.

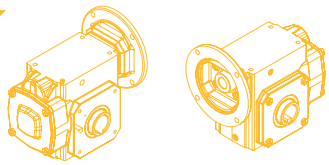
TABLE 2 **Quick Selector - Hoist**

Standard	Basis For Selection Of Brake Torque	Hoist With Single Brake
CMAA*	Motor full load torque	2.0 service factor
OSHA**	Torque required to hoist rated load	2.0 service factor
AISE***	Torque required to hoist rated load	2.0 service factor

Note: All brake torque calculations for cranes/hoists must be approved by the manufacturer and/or end-user
* Crane Manufacturing Association of America, Inc.
** Occupational Safety and Health Association
*** Association of Iron and Steel Engineering

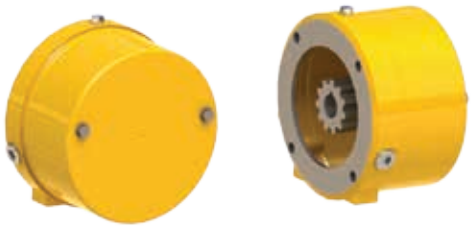
Past experience may indicate that different Service Factors are required. Consult the factory for unusual or severe applications, when cranes or elevator applications are considered, or when there are any safety concerns.

DYNA-MAX™ Brakes
Performance Data



Features:

- Direct acting design with no linkages to break
- One moving part for longer life
- Spring set, electrically released
- Plated internal parts
- Dual voltage, single phase coil, 230/460 Volt 60 Hertz and 190/380 Volt 50 Hertz
- 3 year warranty

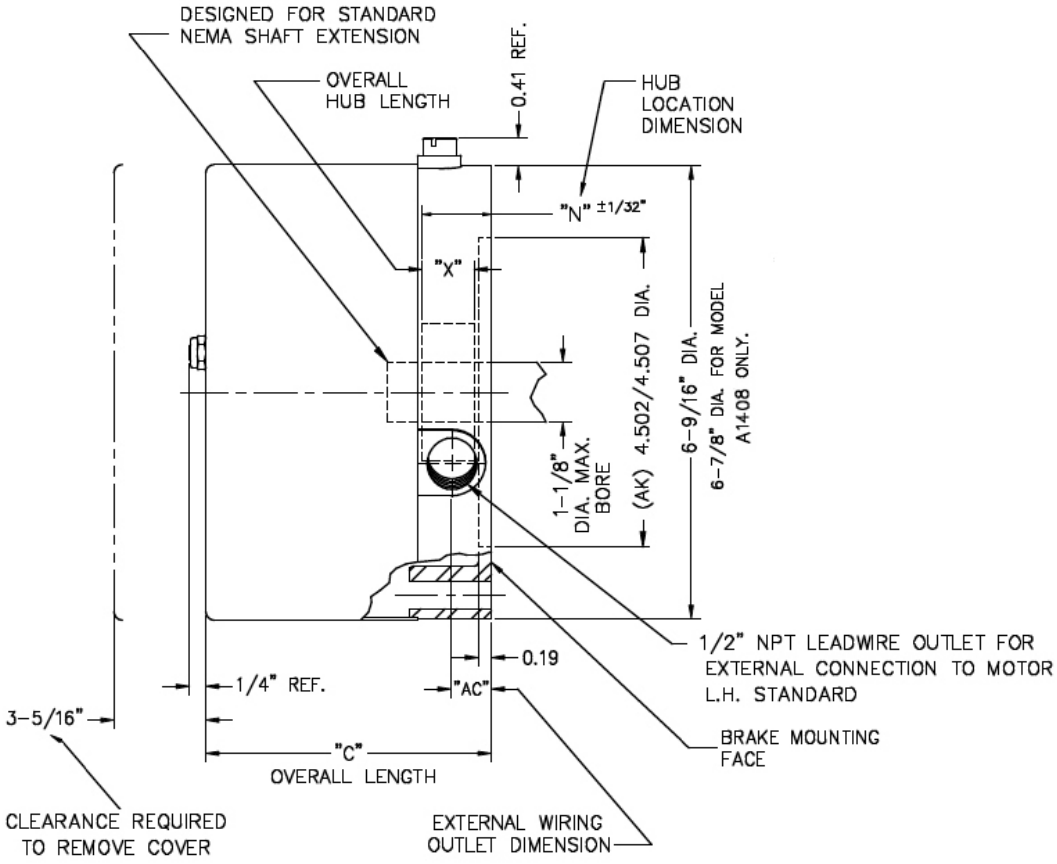


Model 4 and Model 6

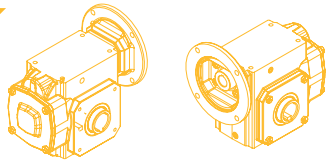
Torque (lb-ft)	Cat No.	List Price	Mult. Symb.	Mounting	Hub Bore Dia.	Construction	Weight (lbs)	Thermal Capacity HPS/Min	Inertia-WK² (lb-ft²)	Dim. (Inches)			
										C	N	X	AC
3	A1400	**$600**	HM1	56C	5/8”	Aluminum C-Face Steel Enclosure	10	6	0.008	4.72	1.68	1.47	1.18
6	A1401	**$695**	HM1	56C	5/8”	Aluminum C-Face Steel Enclosure	10	6	0.013	4.72	1.68	1.47	1.18
10	A1402	**$800**	HM1	56C	5/8”	Aluminum C-Face Steel Enclosure	10	6	0.013	4.72	1.68	1.47	1.18
	A1403	**$802**	HM1	143TC	7/8”	Aluminum C-Face Steel Enclosure	10	6	0.036	5.98	1.50	1.31	1.48
15	A1404	**$937**	HM1	143TC	7/8”	Aluminum C-Face Steel Enclosure	11	6	0.019	5.10	2.00	1.78	1.18
20	A1406	**$1,035**	HM1	143TC	7/8”	Aluminum C-Face Steel Enclosure	11	6	0.019	5.10	2.00	1.78	1.18
25	A1408	**$1,599**	HM1	143TC	7/8”	Cast Iron C-Face Steel Enclosure	19	6	0.024	5.44	2.05	1.83	1.56

NOTES: Spring actuated brakes are designed for stopping and holding a load and are not designed as a positioning brake. Brake discs are considered a normal maintenance item and are not covered under warranty. When mounting the brake vertically, additional disc separating springs are required for above or below motor mounting.

Performance Data					Coil Data				
Torque (lb-ft)	Cat No.	Friction Discs	Reaction Time Release-Set	Instruction & Parts Manual	AC Current	VOLTAGE at 60 HZ		VOLTAGE at 50 HZ	
						230	460	190	380
3	A1400	1	15-20ms	BK4710	Inrush/holding	.87/.11	.43/.056	.87/.11	.44/.056
6	A1401	2	15-20ms	BK4710	Inrush/holding	.87/.11	.43/.056	.87/.11	.44/.056
10	A1402	2	15-20ms	BK4710	Inrush/holding	1.22/.17	.60/.08	1.22/.11	.61/.06
	A1403	2	15-20ms	BK4713	Inrush/holding	2.76/.35	1.38/.17	2.76/.35	1.39/.18
15	A1404	3	15-20ms	BK4660	Inrush/holding	1.22/.17	.60/.08	1.22/.11	.61/.06
20	A1406	3	15-20ms	BK4660	Inrush/holding	1.43/.22	.72/.11	1.45/.22	.72/.11
25	A1408	4	15-20ms	BK4660	Inrush/holding	1.43/.22	.72/.11	1.45/.22	.72/.11



M-Encoder™



Overview:

The M-Encoder™ employs a magnetic based technology with high resolution for optimal encoder performance and reliability. The M-Encoder™ is encased in a rugged industrial grade thermo plastic and has a simple two screw mount within the technology cavity that is precision machined into the non-drive end of the motor. Which results in a precise alignment. The M-Shield™ conveniently mounts over the non-drive end (ODE) shaft offering added protection from wet, dirty or corrosive environments. All supplied gaskets must remain installed, to retain the IP56 rating.

The Plug-n-Play connector allows for quick connection to the motor Quick Termination System (QTS™).

The custom molded magnetic target consists of a polymer bonded magnet that posses a wide temperature range, high performance and superior reliability. A superior bonding adhesive technology prevents the target from moving, eliminating damage to the M-Encoder™ or motor shaft, provides a target locator and secures the target to the motor's shaft, thus speeding assembly time.

Features:

- The ribbon cable connector is keyed for fail safe connection of the M-Encoder™ to the provided Plug-n-Play connector, eliminating the possibility of incorrect wiring.
- The M-Shield™ provides maximum moisture protection for the M-Encoder™ and wiring harness.
- Feed-thru shielded cable provides added protection from harsh environments, EMI and vibration.
- The M-Encoder™ is encapsulated in an industrial grade thermal plastic.
- The M-Encoder™ fits on all MAX™ Drive Motors.
- Quick installation; 40% faster to wire than traditional encoder mount and wiring methods.
- The M-Encoder™ cannot be misalignment due to the unique donut hole configuration and simple two screw mounting.
- Magnetic pickup for high resolution 512, 1024 or 2048 pulse per resolution available.
- Quick Termination System (QTS™) for ease of wiring between the M-Encoder™ and motor terminal box which allows for true Plug-n-Play connection.
- No added outboard topology required. The M-Encoder™ mounts within the technology cavity located on the non-drive C-Face proving additional protection.
- M-Encoder™ removal is not required to install the optional DYNA-MAX™ brake. Simply remove the M-Shield™ and install the brake.
- No encoder shaft bearing to degrade performance.
- The M-Encoder™ kit includes two sensor rings, one 5/8" and one 7/8". Will fit any MAX™ Drive motor.
- No additional seals, o-rings or metal housings required, increasing reliability.
- Temperature range: -40° to 125°C
- A superior bonding adhesive tightly secures the custom molded target to the motor shaft, not allowing drift and misalignment. The adhesive is included with the M-Encoder™ kit.
- 3 year warranty

Stock Ratings:

- Incremental magnetic encoder 512, 1024, 2048 PPR

M-Encoder™
Application Considerations

M-Encoder™ Selection - To properly determine which encoder is appropriate for the application, the following items need to be considered: stub shaft size and encoder hole diameter; pulses per revolution; output channels; target mounting; and electrical output characteristics of the receiving device. Receiving devices may consist of AC inverters, PLCs or high speed counters. Some receiving devices have selectable inputs which will provide for additional flexibility when choosing the encoder.

Shaft Size/Encoder Hole Diameter - M-Encoders™ have two ring magnets. Hole diameters are 5/8" and 7/8". The hole diameter is based on the size of the opposite drive end of the motor. The M-Encoder™ shaft pass thru diameter is 1.15" on all models.

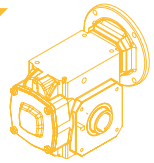
Output Channels - M-Encoders™ have two channels, referred to as Channel A and Channel B which are called quadrature outputs as they are offset by 90 electrical degrees. Channel A leads Channel B for clockwise shaft rotation.

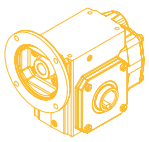
Target Mounting - The M-Encoder™ is mounted within the technology cavity located on the non-drive end of the motor.

Electrical Outputs - The M-Encoders™ output type is a differential line drive. With differential signals, there are two connections for each channel. It provides differential output or complementary signals for noise immunity. Noise immunity is obtained by what is called "common mode rejection". Common mode rejection occurs when noise is present on a differential pair and the differential receiver cancels the noise. Differential line driver is the preferred output type for longer encoder cable lengths because of the inherent noise immunity. Differential line drivers also meet RS-422 Standards when operated at 5 VDC.

Plug-n-Play - The ribbon cable connector is keyed for fail safe connection of the M-Encoder™ eliminating the possibility of incorrect wiring.

M-Encoder™
Performance Data



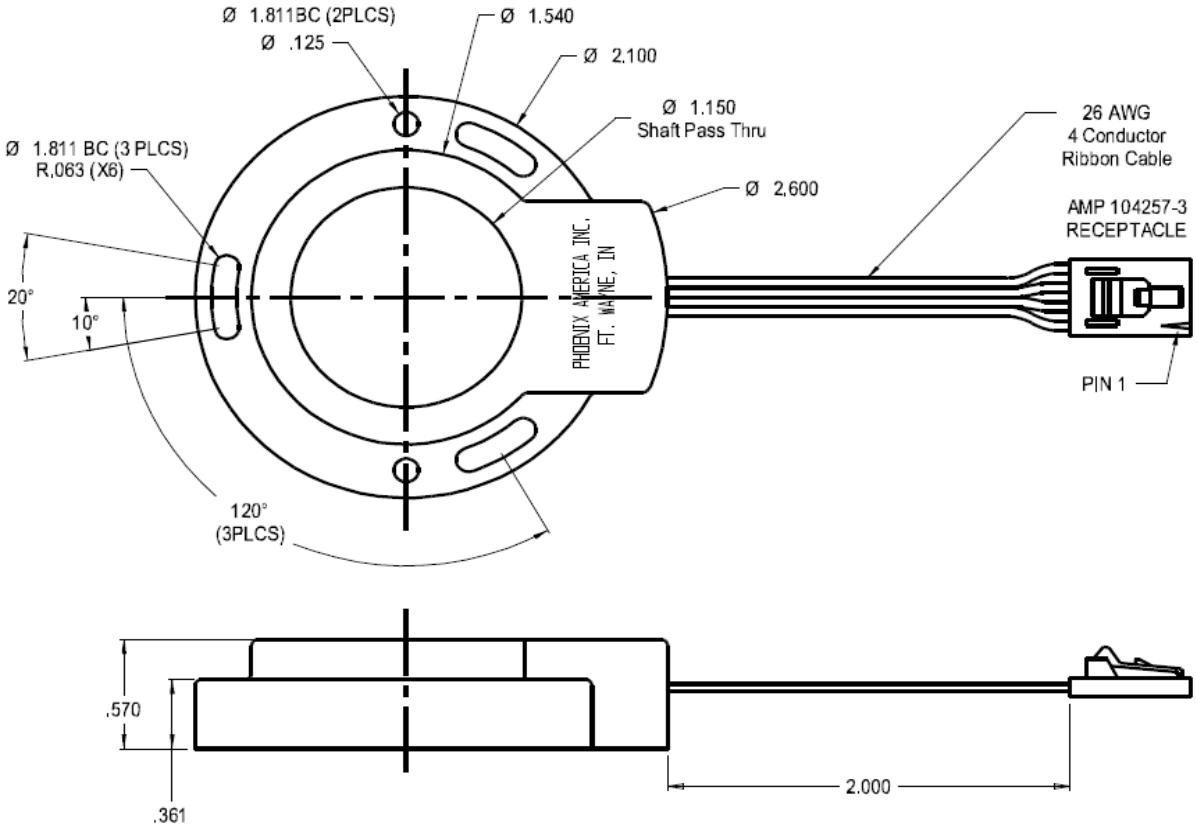


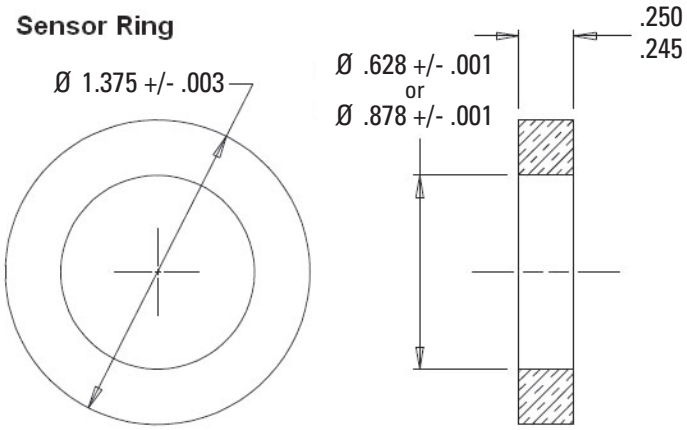
Resolution PPR	ODE Shaft Diameter	Mounting	Sensor Type	Cat No.	List Price	Mult.
512	5/8” or 7/8”	Hollow shaft	Magnet	A1450	**$178**	HM1
1024	5/8” or 7/8”	Hollow shaft	Magnet	A1451	**$178**	HM1
2048	5/8” or 7/8”	Hollow shaft	Magnet	A1452	**$178**	HM1

Performance Data

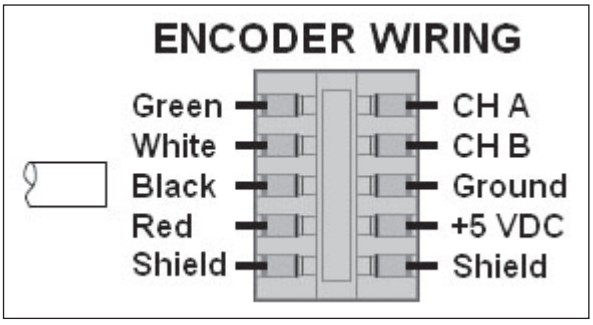
M-Encoder™ Technical Specifications	
Characteristic	**512, 1024, 2048 PPR**
Sensor Type	Magnetic
Code	Incremental
Technology	Hall effect
Output Phases	(A/B): 90° Typical
Output Format	Channel A leads channel B for clockwise rotation of rotor
Output Channels	Two Channel A Quad B
Marker Pulse	Not provided
Input Voltage (VDC)	+5 VDC ±10%
Frequency Response (kHz) @ MAX Resolution	5500 RPM MAX-60 kHz output frequency
Output Current Capacity (Typical/Maximum)	10 mA, Channel A/B
ESD Protection	2 kV
Maximum Shaft RPM	3000 RPM
Overvoltage Protection	Not provided
Reverse Voltage Protection	Not provided
Output Short Circuit Protection	Buffered outputs
Current Consumption	14 mA typical / 30 mA Maximum
Mounting Type	Hollow shaft
Termination	Plug-n-play ribbon connect, terminal block
Operating Temperature (°C)	-40°C / +125°C
Storage Temperature Range (°C)	-40°C / +150°C

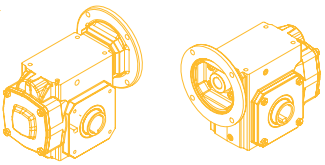
M-Encoder™ Target Specifications	
Characteristic	
Gap / Alignment	Center line of rotor to be 0.350” above M-Encoder™ mounting surface
Material	64 pole neodymium magnet





Both a 5/8" and 7/8" magnetic sensor ring are included with the M-Encoder kit





HM3502 with DYNA-MAX™ Brake

HERA™ 35 Gear Reducer

Optional Inserts

Double Extension

Single Extension

Hollow Bushing

T-Base

B-Base

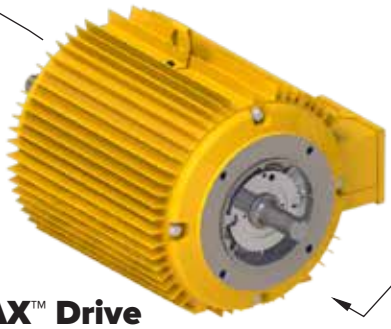
M-Shield™

HERA™ 45 Gear Reducer

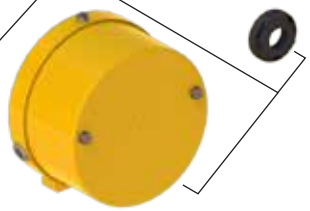
56CZ MAX™ Drive Motor

T-Base

B-Base



M-Encoder™



DYNA-MAX™ Brake

184TCZ MAX™ Drive

M-Shield™

HM4506 with DYNA-MAX™ Brake

MAX™ Drive Motors
1000:1 Constant Torque, TENV, Three Phase

Overview:

MAX™ Drive motors are Torque-Matched™ to optimally operate the HERA™ 35 and 45 gear reducer and Performance Matched™ to all PWM AC inverters.

MAX™ Drive motors use less electrical energy to operate in that they are typically one frame size smaller than traditional motors. The MAX™ Drive motor provides NEMA Premium® efficiencies in all frame sizes, an industry first meeting the 2015 Energy Laws for Fractional motors today!

The non-drive end of the motor incorporates an extended shaft protected by a unique M-Shield™ enclosure. The technology cavity allows for simple and exact placement of the hollow shaft M-Encoder™.

If braking is required, the DYNA-MAX™ brake can be quickly added without removing or disturbing the M-Encoder™. Both devices come prewired with the plug-n-play Quick Termination System (QTS™) for quick assembly.

Features:

- TENV, C-Face Footless - 56CZ and 184TCZ frames
- 230/460V, three phase 60/50 hertz
- NEMA Design B
- Constant torque operation from 0 to base speed
- Continuous duty at 40°C
- Division 2 / Zone 2, Class I (gases), Groups A, B, C and D
- Meets temperature code T3
- NEMA Premium® meets the 2015 Energy Law for Fractional Motors
- Torque Matched™ to HERA™ 35 and 45 gear drives
- MAX GUARD® patented insulation system surpasses the requirements of NEMA MG1, Part 31
- Optimized design for operation with PWM IGBT AC inverter
- Unlimited lead length between the AC inverter and MAX™ Drive motor
- Severe duty construction, yellow epoxy overcoat and epoxy internal coating for added protection that resists rust and prevents corrosion
- Non-drive end extended shaft for accessory mounting of M-Encoder™ and DYNA-MAX™ brake
- Patented Voltage Change Device (VCD™) for ease of switching between 230V or 460V on 56CZ frames ONLY.
- The oversized terminal box and the innovative Quick Termination System (QTS™) allows for quick customer connection/disconnection of field devices such as AC inverters
- UL Listed File No. E49747, CSA Certified File No. LR2025, and CE Mark
- 3 year warranty

Stock Ratings:

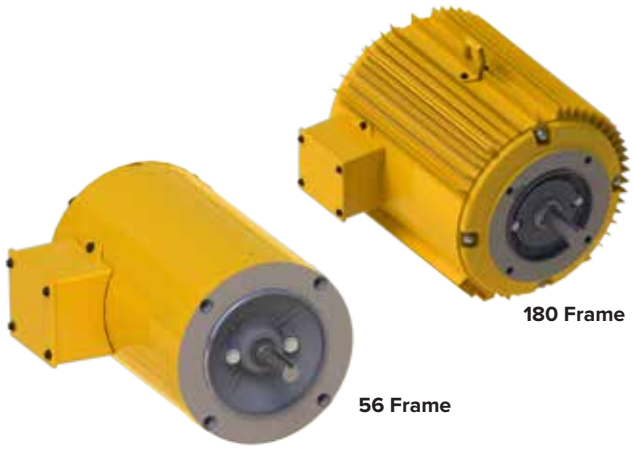
- 0.55 through 6.3 Kilowatts (kW)
- 56CZ and 184TCZ frames

DYNA-MAX™ Brakes:

- DYNA-MAX™ 3 lb-ft through 25 lb-ft. 5/8" and 7/8" shaft sizes

M-Encoder™:

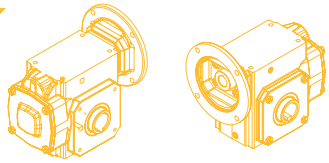
- Incremental magnetic encoder 512, 1024 or 2048 PPR



180 Frame

56 Frame

MAX Drive™ Motors
1000:1 Constant Torque, TENV, Three Phase



Applications:

Designed for AC inverters where up to a 1000:1 constant torque speed range is required. Torque-Matched™ to the HERA™ 35 and 45 gear reducer. Typical uses include material handling, machine tools, conveyors, crane and hoist, packaging equipment and other commercial or industrial machinery installed industry or dirty environments.

180 Frame

56 Frame

Features:

- Patented MAX GUARD® insulation system
- Constant torque operation from 0 to base speed
- Voltage Change Device (VCD®) on 56CZ frames
- Continuous duty at 40°C ambient
- Optimized for operation with PWM IGBT AC inverter
- Severe duty construction for "Mission Critical" applications
- M-Encoder™ and DYNA-MAX™ brake provisions included on non-drive end of motor
- UL Recognized, CSA Certified and CE Mark
- 3 year warranty

"MAX Drive™ Systems available using HERA™ 55 and 75 gearboxes - Contact factory for details"

C-Face Footless

RPM	Volts	Motor Frame	Non-Drive End C-Face	Stub Shaft Dia.	Nom. Eff.	F.L. Amps	F.L. Torque lb-ft	Cat No.	List Price	Mult. Symb.	Weight (lbs)
1800	230/460	184TCZ	143TC	7/8"	90.2	10.2/5.1	6.02	MD3507	**$1,474**	HM1	105
1800	230/460	184TCZ	143TC	7/8"	89.5	8.0/4.0	5.67	MD3506	**$1,462**	HM1	100
1800	230/460	184TCZ	143TC	7/8"	89.5	6.0/3.0	4.16	MD3505	**$1,346**	HM1	95
1800	230/460	56CZ	56C	5/8"	86.5	5.0/2.5	3.26	MD3504	**$1,071**	HM1	45
1800	230/460	56CZ	56C	5/8"	86.5	3.4/1.7	2.22	MD3503	**$926**	HM1	41
1800	230/460	56CZ	56C	5/8"	85.5	2.6/1.3	1.49	MD3502	**$836**	HM1	34
1800	230/460	56CZ	56C	5/8"	81.5	2.0/1.0	1.23	MD3501	**$800**	HM1	30
1800	230/460	56CZ	56C	5/8"	81.5	1.8/.9	1.11	MD3500	**$782**	HM1	30
1800	230/460	184TCZ	143TC	7/8"	89.5	13.6/6.8	12.75	MD4507	**$1,966**	HM1	185
1800	230/460	184TCZ	143TC	7/8"	89.5	13.6/6.8	10.59	MD4506	**$1,834**	HM1	146
1800	230/460	184TCZ	143TC	7/8"	89.5	13.6/6.8	7.71	MD4505	**$1,602**	HM1	110
1800	230/460	184TCZ	143TC	7/8"	89.5	10.4/5.2	6.17	MD4504	**$1,486**	HM1	105
1800	230/460	184TCZ	143TC	7/8"	89.5	7.4/3.7	4.29	MD4503	**$1,358**	HM1	97
1800	230/460	184TCZ	143TC	7/8"	86.5	5.6/2.8	3.02	MD4502	**$1,016**	HM1	65
1800	230/460	56CZ	56C	5/8"	86.5	4.6/2.3	2.30	MD4501	**$926**	HM1	50
1800	230/460	56CZ	56C	5/8"	86.5	4.0/2.0	2.01	MD4500	**$897**	HM1	39

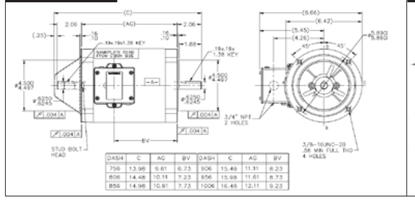
MAX Drive™ Motors
Performance & Dimensional Data

MAX-Drive™ Cat No.	kW	F.l. RPM	Min. RPM	Encl	F.L. Amps 460V	N.L. Amps 460V	L.R. Amps 460V	L.R. Torque (% of F.L.)	B.D. Torque (% of F.L. TQ)	MAX Chp RPM*	F.L. Eff	F.L. Power Factor	Ohms/Ph- Equivalent Wye Circuit (460 Vac) (at rated operating temp. in a 40°C ambient)** R1	R2	X1	X2	XM	Rotor Inertia (lb-ft²)
MD3507	**2.99**	1800	0	TENV	5.1	2.6	42.0	190%	339%	2655	90.2	83.2	1.464	0.990	2.848	4.448	85.3	0.50
MD3506	**2.22**	1800	0	TENV	4.0	1.7	28.0	188%	320%	2655	89.5	78.4	2.355	1.432	4.200	6.162	118.6	0.50
MD3505	**1.63**	1800	0	TENV	3.0	1.5	24.0	231%	354%	2655	89.5	75.7	2.846	1.684	4.976	7.117	136.9	0.35
MD3504	**1.28**	1800	0	TENV	2.5	1.3	20.0	346%	485%	2655	86.5	74.3	4.837	3.784	7.121	7.171	196.3	0.30
MD3503	**0.87**	1800	0	TENV	1.7	1.15	15.5	366%	498%	2655	86.5	73.8	6.887	5.049	9.843	9.749	272.7	0.14
MD3502	**0.58**	1800	0	TENV	1.3	0.7	10.0	300%	408%	2655	85.5	67.1	11.515	7.513	15.251	13.836	388.8	0.12
MD3501	**0.48**	1800	0	TENV	1.0	0.6	7.0	236%	341%	2655	81.5	75.5	19.545	10.947	22.382	18.171	510.8	0.10
MD3500	**0.43**	1800	0	TENV	0.9	0.6	7.0	261%	376%	2655	81.5	72.5	19.559	10.944	22.382	12.665	510.4	0.08
MD4507	**6.38**	1800	0	TENV	6.8	3.2	61.0	278%	400%	2655	89.5	78.0	1.450	1.060	2.100	3.380	63.4	1.20
MD4506	**5.38**	1800	0	TENV	6.8	3.2	61.0	278%	400%	2650	89.5	78.0	1.450	1.060	2.100	3.380	63.4	0.90
MD4505	**3.38**	1800	0	TENV	6.8	3.2	61.0	278%	400%	2650	89.5	78.0	1.450	1.060	2.100	3.380	63.4	0.52
MD4504	**3.07**	1800	0	TENV	5.2	2.6	42.0	185%	328%	2655	89.5	82.3	1.464	0.990	2.848	4.448	85.3	0.50
MD4503	**2.13**	1800	0	TENV	3.7	1.7	28.0	200%	325%	2655	89.5	80.1	2.355	1.432	4.200	6.162	118.6	0.35
MD4502	**1.50**	1800	0	TENV	2.8	1.5	24.0	238%	366%	2655	86.5	75.0	2.846	1.684	4.976	7.117	136.9	0.30
MD4501	**1.14**	1800	0	TENV	2.3	1.3	20.0	280%	361%	2655	86.5	71.0	4.837	3.784	7.121	7.171	196.3	0.14
MD4500	**1.00**	1800	0	TENV	2.0	1.15	20.0	255%	364%	2655	86.5	72.1	4.837	3.785	7.121	7.172	196.1	0.14

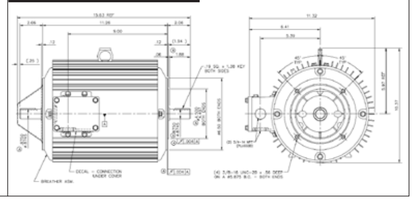
*maximum Constant HP RPM is for direct coupled loads. R1 = Stator Resistance R2 = Rotor Resistance R3 = Stator Reactance X2 = Rotor Reactance XM = Magnetizing Reactance
For 230V data, divide 460V data by 4. **Performance data based on sine wave tests. Performance curves available - Contact Marathon Electric

Dimensional Data:

56CZ Frame

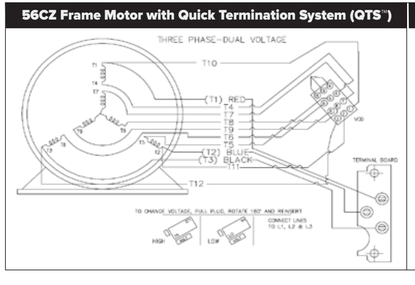


184TCZ Frame

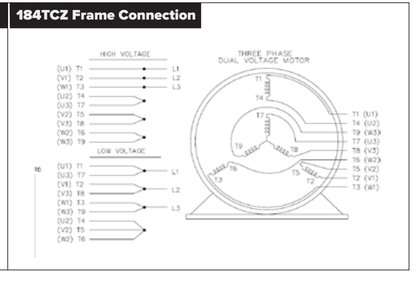


Motor Wiring Diagrams:

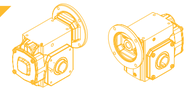
56CZ Frame Motor with Quick Termination System (QTS™)



184TCZ Frame Connection



HERA™ Gear Reducer
High Efficiency Right Angle Gear Reducer



Overview:

The HERA™ right angle gear reducer represents the next generation of gearficient™ reducers. HERA™ is 90% efficient for all speed ratios, up to 40 points higher than worm gearing. This offers many advantages including lower operating costs, smaller motor requirements and less heat generation.

HERA™'s modularity allows it to be dimensionally interchanged with popular worm reducer brands.

HERA™'s high torque density in a small package (up to 2X more torque than traditional worm gearing) produces unparalleled performance in the most demanding applications.

Viton® double lip seals provide protection in dirty, wet and corrosive environments offering "mission critical" performance.

Designed for applications such as conveyors, packaging machinery, printing equipment, feed processing, bottling equipment, construction machinery, bulk handling, cranes and other commercial or industrial machinery that demand high efficiency, modular versatility and high torque density.

Features:

- 90% efficient for all ratios, reducing operating cost
- Two times more torque capacity than a traditional worm gearing
- Up to 40% more efficient than traditional worm gearing
- Four HERA™ configurations can replace 11 sizes of worm reducers
- Helical/hypoid gearing lowers operating temperatures and increases life
- Direct C-Face coupled and Torque-Matched™ to the NEMA Premium® efficient MAX™ Drive motor
- Outputs include hollow bore or modular shafts
- "Generic" bolt pattern on mounting surface for drop-in worm gear drive replacement, center distance: HERA™ 35 from 1.75" to 2.38", HERA™ 45 from 2.38" to 3.25"
- Modular versatility reduces inventory and shipping costs
- PAG 460 premium synthetic lubricant meets USDA Class H1 standards
- Two stage gear ratios from 7:1 to 60:1
- 3 year warranty

Stock Ratings:

- HERA™ 35 - Up to 1,100 in-lbs of torque
- HERA™ 45 - Up to 2,600 in-lbs of torque

MAX™ Drive Motors:

- Torque-Matched™ to the HERA™ Gear Reducer
- 56CZ and 184TCZ frames

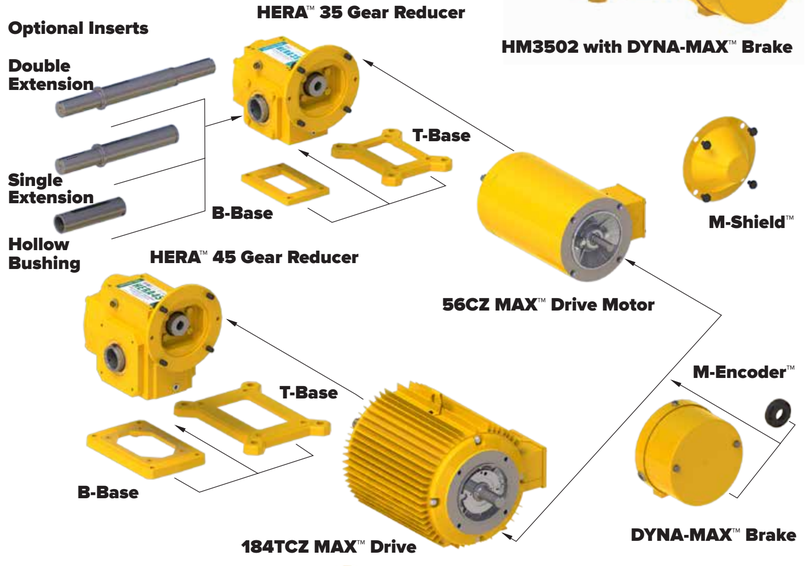
DYNA-MAX™ Brakes:

- DYNA-MAX™ 3 lb-ft through 25 lb-ft. 5/8" and 7/8" shaft sizes

HERA™ Gear 45

HERA™ Gear 35

HM3502 with DYNA-MAX™ Brake



HERA™ 35 Gear Reducers
High Efficiency Right Angle Gear Reducer

Ratio		Imput RPM	Output RPM	Output Torque Rating (lb-in)	EFF	NEMA Motor Input Flange	*Output Bore	*Sleeve Keyway	Cat No.	List Price	Mult	Weight (lbs)
Nom.	Exact											
7:1	8.02:1	1800	220	1100	90%	184TC	1.438	3/8 x 1/8	HG3507	$1,206	HM1	30
10:1	11.42:1	1800	155	1100	90%	184TC	1.438	3/8 x 1/8	HG3506	$1,206	HM1	30
15:1	15.60:1	1800	113	1100	90%	184TC	1.438	3/8 x 1/8	HG3505	$1,206	HM1	30
20:1	19.93:1	1800	89	1100	90%	56C	1.438	3/8 x 1/8	HG3504	$1,206	HM1	30
30:1	29.10:1	1800	60	1100	90%	56C	1.438	3/8 x 1/8	HG3503	$1,206	HM1	30
40:1	43.53:1	1800	40	1100	90%	56C	1.438	3/8 x 1/8	HG3502	$1,206	HM1	30
50:1	52.50:1	1800	33	1100	90%	56C	1.438	3/8 x 1/8	HG3501	$1,206	HM1	30
60:1	58.33:1	1800	30	1100	90%	56C	1.438	3/8 x 1/8	HG3500	$1,206	HM1	30

TABLE 1

HERA 35 Base Gear Reducer - 1.0 Service Factor

CD	A	B	D	E	AA	BB	CC	DD	EE	FF	GG	S	T
2.510	4.25	1.178	2.062	5.750	4.188	2.094	2.750	1.375	5/16 UNC	0.63	0.63	5.50	2.75

G	H	H2	I	I2	J	K	L	M	N	O	R	Weight (lbs)
56CZ	2.27	N/A	4.44	N/A	3/16 x 3/32	5.875	4.501/4.503	0.625	6.61	13/32	0.188	30
145TCZ	2.38	N/A	4.44	N/A	3/16 x 3/32	5.875	4.501/4.503	0.875	6.61	13/32	0.188	30

TABLE 2

HERA 35 Plug-In Output Shafts

Worm Interchange Reference		Single Ext. Cat No.	Double Ext. Cat No.	List Price	Mult	S	T	T2	U	V	W	W2	X	Y	Key Furnished	Weight (lbs)
SIZE 18	1.75 CD	A1300	A1310	$55	HM1	8.62	4.31	2.97	0.875	2.05	1.38	1.34	3/16 x 3/32	1.13	3/16 x 1/8	4.1
SIZE 21	2.06 CD	A1301	A1311	$55	HM1	9.33	4.69	2.97	1.00	2.43	1.76	1.72	1/4 x 1/8	1.50	1/4 x 1-1/2	4.4
SIZE 24	2.38 CD	A1302	A1312	$58	HM1	10.28	5.14	2.97	1.125	2.88	2.24	2.17	1/4 x 1/8	1.75	1/4 x 1-3/4	4.9

TABLE 3

HERA 35 B-Base Kit

Worm Interchange Reference		Cat No.	List Price	Mult	D	V	AA	BB	CC	DD	EE	Weight (lbs)
SIZE 18	1.75 CD	No Base Required										
SIZE 21	2.13 CD	A1330	$72	HM1	2.281	0.22	5.00	2.50	2.88	1.44	3/8 UNC	1.3
SIZE 24	2.38 CD	A1331	$80	HM1	2.500	0.44	5.00	2.50	2.88	1.44	3/8 UNC	2.0

TABLE 4

HERA 35 T-Base Kit

Worm Interchange Reference		Cat No.	List Price	Mult	D	V	AA	BB	CC	DD	EE	Weight (lbs)
SIZE 18	1.75 CD	A1340	$85	HM1	2.75	0.63	5.75	2.88	4.50	2.25	0.41	3.0
SIZE 21	2.13 CD	A1341	$116	HM1	3.00	0.66	6.38	3.19	4.69	2.34	0.47	4.8
SIZE 24	2.38 CD	A1342	$130	HM1	3.25	0.69	7.06	3.53	4.88	2.44	0.47	9.0

*Standard HERA™ dimensions shown.
Other options available - consult factory.

HERA™ 35 Gear Reducer
Dimensional Data

TABLE 5

HERA 35 F-Flange Kits

Worm Interchange Reference		Cat No.	List Price	Mult	S	T	Z	SS	TT	XX	YY	Weight (lbs)
SIZE 18	1.75 CD	A1360	$95	HM1	0.44	2.75	3.19	0.38	5.00	0.34	5.88	2.9
SIZE 21	2.13 CD	A1361	$127	HM1	0.81	2.75	3.56	0.44	6.00	0.41	7.00	4.2
SIZE 24	2.38 CD	A1362	$140	HM1	0.75	2.75	3.50	0.44	6.27	0.41	7.50	4.5

TABLE 6

HERA 35 Vertical Mount Kit

Cat No.	List Price	Mult	A	B	D	D1	F	G	H	J	K	V	Weight (lbs)
A1371	$74	HM1	8.25	5.00	3.00	4.38	7.37	4.50	0.44	4.00	2.00	.025	4.0

TABLE 7

HERA 35 Torque Arm Kit

Cat No.	List Price	Mult	A	D	Weight (lbs)
A1376	$175	HM1	2.50	2.062	8.5

TABLE 8

HERA-MAX™ Plug-In Output Bushing

Fits Standard Bore 1 7/16"

Cat. No.	List Price	Bore #1	Key #2	Key #3	Screw #4
A1380	$139	0.75"	.375"x .25"x3"	.1875"x.1875"x3"x3	1/4-20 x .625"
A1381	$139	0.875"	.375"x .25"x3"	.1875"x.1875"x3"x3	1/4-20x.5"
A1382	$139	1.0"	.375"x .25"x3"	.1875"x.1875"x3"x3	1/4-20x.5"
A1383	$139	1.125"	.375"-.25" Step x 3"	N/A	1/4-20x.5"
A1384	$139	1.1875"	.375"-.25" Step x 3"	N/A	1/4-20x.375"
A1385	$139	1.25"	.375"-.25" Step x 3"	N/A	1/4-20x.375"

TABLE 9

HERA-MAX™ Output Cover

HERA™ Model	Cat. No.	List Price
35	A1390	$61
45	A1391	$61

HERA™ 35 Gear Reducer
Dimensional Data

TABLE 1

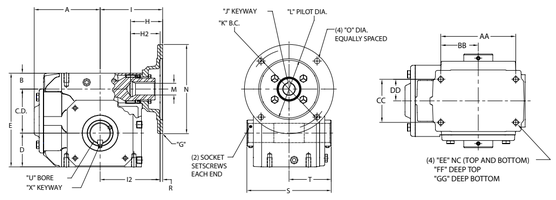


TABLE 2

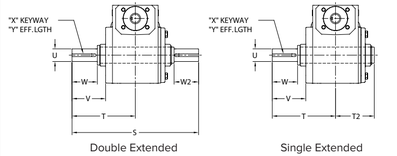
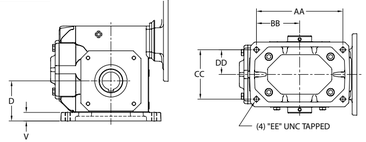
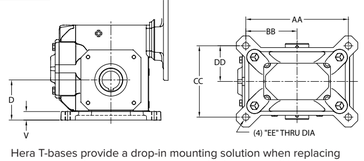


TABLE 3



Hera B-bases provide a drop-in mounting solution when replacing comparable rated worm gear reducers.

TABLE 4



Hera T-bases provide a drop-in mounting solution when replacing comparable rated worm gear reducers that also are utilizing a horizontal mounting base.

TABLE 5

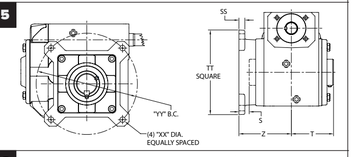


TABLE 6

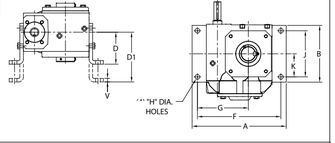


TABLE 7

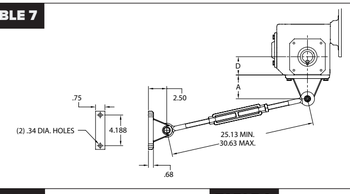


TABLE 8

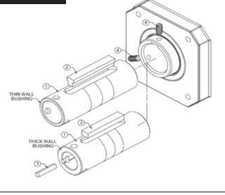


TABLE 9

Ratio		Input RPM	Output RPM	Output Torque Rating (lb-in)	EFF	NEMA Motor Input Flange	*Output Bore	*Sleeve Keyway	Cat No.	List Price	Mult	Weight (lbs)
Nom.	Exact											
7:1	7.8:1	1800	226	1300	90%	184TC	1.438	3/8 x 1/8	HG4507	$1,611	HM1	50
10:1	11.36:1	1800	155	1890	90%	184TC	1.438	3/8 x 1/8	HG4506	$1,611	HM1	50
15:1	15.60:1	1800	113	2600	90%	184TC	1.438	3/8 x 1/8	HG4505	$1,611	HM1	50
20:1	19.50:1	1800	90	2600	90%	184TC	1.438	3/8 x 1/8	HG4504	$1,611	HM1	50
30:1	28.01:1	1800	63	2600	90%	184TC	1.438	3/8 x 1/8	HG4503	$1,611	HM1	50
40:1	39.98:1	1800	44	2600	90%	184TC	1.438	3/8 x 1/8	HG4502	$1,611	HM1	50
50:1	52.50:1	1800	33	2600	90%	56C	1.438	3/8 x 1/8	HG4501	$1,611	HM1	43
60:1	59.79:1	1800	29	2600	90%	56C	1.438	3/8 x 1/8	HG4500	$1,611	HM1	43

TABLE 1

HERA 45 Base Gear Drive Unit - 1.0 Service Factor

CD	A	B	D	E	AA	BB	CC	DD	EE	FF	GG	S	T
3.263	4.88	1.175	2.50	6.938	5.00	2.50	2.875	1.438	3/8 UNC	0.69	0.69	6.25	3.13

G	H	H2	I	I2	J	K	L	M	N	O	R	Weight (lbs)
56CZ	2.27	N/A	4.63	N/A	3/16 x 3/32	5.875	4.501/4.503	0.625	6.61	13/22	0.188	43
184TCZ	N/A	2.89	N/A	5.06	1/4 x 1/8	7.250	8.501/8.503	0.875	9.00	17/32	0.188	50

TABLE 2

HERA 45 Plug-In Output Shafts

Worm Interchange Reference		Single Ext. Cat No.	Double Ext. Cat No.	List Price	MULT	S	T	T2	U	V	W	W2	X	Y	Keys Furnished	Weight (lbs)
SIZE 24	2.38 CD	A1303	A1313	$74	HM1	10.28	5.14	3.45	1.13	2.50	1.77	1.69	1/4 x 1/8	1.50	1/4 x 1-1/2	5.2
SIZE 26	2.63 CD	A1304	A1314	$74	HM1	11.25	5.63	3.44	1.13	2.99	2.25	2.18	1/4 x 1/8	2.00	1/4 x 1-3/4	5.7
SIZE 30	3.00 CD	A1305	A1315	$78	HM1	13.50	6.75	3.45	1.25	4.11	3.38	3.30	1/4 x 1/8	2.25	1/4 x 2-1/4	6.6
SIZE 32	3.25 CD	A1306	A1316	$87	HM1	14.12	7.06	3.45	1.38	4.42	3.69	3.64	5/16 x 5/32	2.50	5/16 x 2-3/8	7.3

TABLE 3

HERA 45 B-Base Kits

Worm Interchange Reference		Cat No.	List Price	Mult	D	V	AA	BB	CC	DD	EE	Weight (lbs)
SIZE 24	2.38 CD	No Base Required										
SIZE 26	2.63 CD	A1332	$89	HM1	2.938	0.38	6.38	3.19	3.38	1.69	3/8 UNC	2.5
SIZE 30	3.00 CD	A1333	$107	HM1	3.250	0.69	7.00	3.50	4.00	2.00	7/16 UNC	4.3
SIZE 32	3.25 CD	A1334	$118	HM1	3.500	0.88	7.50	3.75	4.00	2.00	7/16 UNC	5.0

TABLE 4

HERA 45 T-Base Kits

Worm Interchange Reference		Cat No.	List Price	Mult	D	V	AA	BB	CC	DD	EE	Weight (lbs)
SIZE 24	2.38 CD	A1343	$119	HM1	3.250	0.69	7.06	3.53	4.88	2.44	0.47	6.0
SIZE 26	2.63 CD	A1344	$142	HM1	3.688	0.69	8.00	4.00	5.25	2.63	0.53	7.0
SIZE 30	3.00 CD	A1345	$167	HM1	4.000	0.69	8.44	4.22	5.88	2.94	0.53	9.5
SIZE 32	3.25 CD	A1346	$188	HM1	4.375	0.81	9.50	4.75	6.13	3.06	0.53	11.5

*Standard HERA-MAX™ dimensions shown.
Other options available - consult factory.

HERA™ 45 Gear Reducer
High Efficiency Right Angle Gear Reducer

TABLE 5

HERA 45 F-Flange Kits

Worm Interchange Reference		Cat No.	List Price	Mult	S	T	Z	SS	TT	XX	YY	Weight (lbs)
SIZE 24	2.38 CD	A1363	$140	HM1	0.76	3.13	3.88	0.44	6.27	0.41	7.50	4.7
SIZE 26	2.63 CD	A1364	$147	HM1	0.31	3.13	3.44	0.50	6.67	0.41	8.00	4.5
SIZE 30	3.00 CD	A1365	$160	HM1	0.15	3.13	3.28	0.50	7.37	0.41	9.00	4.5

TABLE 6

HERA 45 Vertical Mount Kit

Cat No.	List Price	Mult	A	B	D	D1	F	G	H	J	K	V	Weight (lbs)
A1372	$87	HM1	9.94	6.00	3.38	5.25	8.81	5.38	0.50	4.88	2.44	0.38	8.0

TABLE 7

HERA 45 Torque Arm Kit

Cat No.	List Price	Mult	A	D	Weight (lbs)
A1377	$188	HM1	3.25	2.50	9.0

TABLE 8

HERA-MAX™ Plug-In Output Bushings

Fits Standard Bore 1 7/16"

Cat. No.	List Price	Bore #1	Key #2	Key #3	Screw #4
A1380	$139	0.75"	.375"x .25"x3"	.1875"x.1875"x3"x3	1/4-20 x .625"
A1381	$139	0.875"	.375"x .25"x3"	.1875"x.1875"x3"x3	1/4-20x.5"
A1382	$139	1.0"	.375"x .25"x3"	.1875"x.1875"x3"x3	1/4-20x.5"
A1383	$139	1.125"	.375"-.25" Step x 3"	N/A	1/4-20x.5"
A1384	$139	1.1875"	.375"-.25" Step x 3"	N/A	1/4-20x.375"
A1385	$139	1.25"	.375"-.25" Step x 3"	N/A	1/4-20x.375"

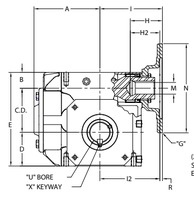
TABLE 9

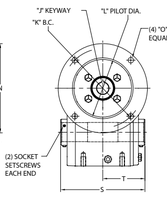
HERA-MAX™ Output Cover

HERA™ Model	Cat. No.	List Price
35	A1390	$61
45	A1391	$61

HERA™ 45 Gear Reducer
Dimensional Data

TABLE 1





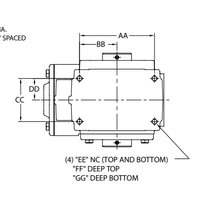
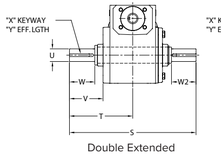
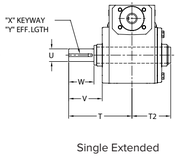


TABLE 2



Double Extended



Single Extended

TABLE 5

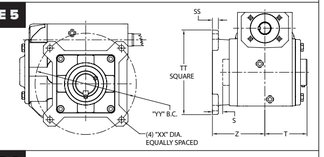


TABLE 6

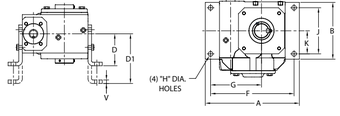
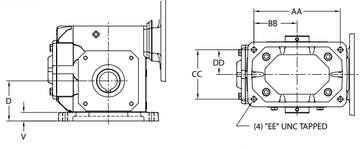


TABLE 3



Hera B-bases provide a drop-in mounting solution when replacing comparable rated worm gear reducers.

TABLE 7

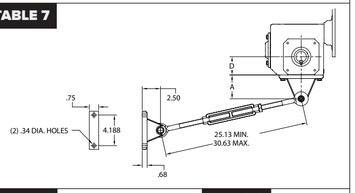
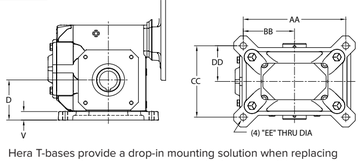


TABLE 4



Hera T-bases provide a drop-in mounting solution when replacing comparable rated worm gear reducers that also are utilizing a horizontal mounting base.

TABLE 8

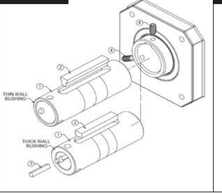


TABLE 9

HM3502 with DYNA-MAX™ Brake

HERA™ 35 Gear Reducer

Optional Inserts

Double Extension

Single Extension

Hollow Bushing

T-Base

B-Base

M-Shield™

56CZ MAX™ Drive Motor

HERA™ 45 Gear Reducer

T-Base

B-Base

M-Encoder™

DYNA-MAX™ Brake

184TCZ MAX™ Drive

M-Shield™

HM4506 with DYNA-MAX™ Brake

HERA™ Gear Reducer
Terminology

AGMA

American Gear Manufacturer's Association.

Backlash

Rotational clearance between gear teeth, usually measured in arc-minutes.

Center Distance (CD)

The ASIC measurement or size reference for worm gear reducers. Generally, the larger the center distance the greater the reduction capacity. Center distance is measured from the centerline of the input shaft to the centerline of the output shaft.

Gear Ratio (N)

Ratio of gearbox input speed to output speed or output torque to input torque. Ratio is typically used to increase torque and/or reduce speed.

N = input speed / output speed

N = output torque / (input torque x efficiency)

Helical Gearing

Parallel-shaft gearing with angled teeth. Advantages include increased load capacity and quieter operation. Helical gearing is inherently very efficient.

Hypoid Gearing

Right-angle, spiral-toothed gearing with offset center-lines. Typically used in automotive differentials.

Input Speed

Gear reducers are best driven at input speeds common in industrial electric motors, typically 1200 or 1800 RPM. This provides sufficient "splash" for the reducer's lubrication system, but not so much as to cause oil "churning". For input speeds under 900 RPM or above 3000 RPM, consult the factory.

Mounting

The HERA™ Gear reducer is designed to be base mounted using B-Base or T-Base accessories. Additional output flange mountings are also available. Consult the factory.

Mechanical Ratings

Mechanical ratings refer to the maximum power a reducer can transmit based on the strength of it's components. The HERA™ provides a 200% safety margin on it's mechanical rating for start-ups and momentary overloads.

Output Shaft

The shaft of a speed reducer assembly that is connected to the load. This may also be called the drive shaft or the slow speed shaft.

Reversing

The HERA™ Gear reducer is designed to be operated bi-directionally on a continuous basis.

Service Factor (SF)

Established by AGMA. Gearing service factors are a means to adjust a reducer's rating relative to an application's load characteristics. Proper determination of an application's service factor is critical to maximum reducer life and trouble-free service. HERA™ Gear reducers have a service factor of 1.0, meaning continuous operation for 10 hours per day or less with no reoccurring shock loads.

Ratio of torque rating to torque load:

SF = Rated torque / Load torque

Torque (T)

Rotational load, typically measured in in-lbs or lb-ft.

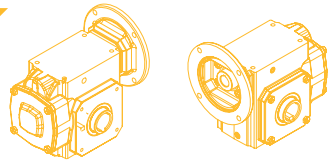
Viton® Seal

Viton® is a brand of synthetic rubber and fluoropolymer elastomer with excellent (400°F/200°C) heat resistance.

Worm Gear

Right-angle gearing that uses a threaded high-speed member and a toothed low-speed member to economically provide high ratios in a single gear reduction. Worm reducers are inherently inefficient.

MAX™ Drive Motor
Terminology



Altitude

The MAX™ Drive motor rated based on an altitude of up to 3300 ft above sea level. At higher altitudes, the air becomes more rarified (less oxygen), and heat is not transferred as efficiently. As such, additional insulation or other active materials may be required to provide proper cooling.

Ambient

The MAX™ Drive motor rated at an ambient (surrounding) temperature of 40°C (104°F). Higher temperatures cause faster degradation of the insulation system, resulting in shorter motor life. The MAX™ Drive motor is designed for operation on inverter power at its Class F insulation limit at full load 1.0 service factor). In most cases, a higher ambient temperature specification will require the next larger frame size; in some, added material within the same frame size is adequate. High ambient requirements should be referred to the factory.

Assembly

Normal assembly position of the MAX™ Drive motor is F1 (terminal box on left side when viewed from the drive end).

Balance

The MAX™ Drive motor is dynamically balanced to achieve vibration levels below NEMA standards.

RPM Range	Standard Balance	Precision Balance
1500-2900	0.15 in/sec	0.08 in/sec
1000-1499	0.15 in/sec	0.08 in/sec
999 & slower	0.12 in/sec	0.08 in/sec

Bearings

MAX™ Drive motors utilize double shielded ball bearings.

Brakes and Brake Provisions

Spring-set, electrically released mechanical disc brakes are available for stopping and/or holding the load. For applications, brake manufacturers recommend a torque rating equal to 140% of the motor full-load torque. In many cases, a 50% or 10-0% rated brake can be utilized; however, the final customer should provide this information. The DYNA™-MAX brake is rated IP56. Provisions include a suitable C-Face bracket and shaft extension to accommodate the (future) addition of a brake. Standard brake motors include brakes suitable for horizontal mounting only.

CE Mark

European compliance mark for all electrical equipment used in the European union.

CR200

Corona Resistant, 200° rated magnet wire is utilized in the MAX™ Drive motor to extend insulation life under the rigors of steep fronted voltage spikes common with today's IGBT inverters.

Continuous Duty

MAX™ Drive motors are designed to operate on a continuous duty basis. Continuous duty is defined by NEMA for operation of loads for over one hour.

Enclosure

HERA MAX™ Systems are rated IP56. These motors are totally enclosed non-ventilated for protection from the ingress of dust and water jets. A yellow epoxy overcoat is applied externally over a primed sub straight. Internally, a green epoxy varnish is applied to the stator and rotor delivering added protection in corrosive and wet environments. All supplied gaskets must remain installed, to retain the IP56 rating.

Encoders

These electronic devices sense rotor speed and direction. A Plug-n-Play connector is pre-wired to provide quick assembly or disconnection of the optional M-Encoders™.

Feed-thru Wiring

The M-Encoder™ is pre-wired with Plug-n-Play connectors through the motor housing providing added protection from vibration and wire nicks. The wire harness is terminated on terminal blocks located within the terminal box.

Frequency

The MAX™ Drive motor is rated at a base operating frequency of 60 Hz. Consult the factory on special frequency applications, as these occasionally require oversizing the motor to the next larger frame size.

MAX™ Drive Motor
Terminology (cont.)

Gasket Material

The MAX™ Drive motor has three gaskets. The conduit box cover gasket is ACCO-PAC material. The conduit box base and the M-Shield™ gaskets are Neoprene.

Ground Lug

All MAX™ Drive motors come with crimp-type grounding provisions in the terminal box. A ground lug is also on all frames.

Hardware

The MAX™ Drive motors incorporate corrosion resistant zinc dichromate-plated Grade B 5 bolts and fasteners.

Hazardous Duty

A type of motor enclosure designed to withstand the explosion of a specified gas or vapor within and to prevent ignition of a specified external gas or vapor by sparks, flashes or explosions that may occur within the motor casing. The MAX™ Drive motor is rated IP56, Division 2/Zone 2, Class I, Groups A, B, C and D.

Insulation

All MAX™ Drive motors come with the exclusive MAX GUARD® insulation system. The insulation incorporates Class H materials which have a total temperature limit of 180°C and maximum allowable temperature rise of 125°C. The MAX™ Drive motor is designed to operate between Class B and F rise, giving the user a generous thermal cushion.

Inverter Duty

A motor manufactured in conformance with NEMA MG1, Part 31 with a higher class of insulation that allows the safe operation of inverter drives.

MAX GUARD®

The MAX™ Drive Motors feature the MAX GUARD® insulation system which combines Class H insulation, Corona-resistant magnet wire (CR200) with our patented “low stress” winding configuration. MAX GUARD® delivers long, dependable motor life under the adverse thermal and dielectric stresses imposed by IGBT-based variable frequency drives. The MAX™ Drive motor can be operated at any cable length and/or carrier frequency.

Nameplates & Auxiliary Nameplates

Nameplate data is provide per NEMA requirements. Special stamping to include additional data is available. Additional (auxiliary) nameplates, showing additional information, are available.

NEMA Premium®

A efficiency specification for motors issued by NEMA.

Performance-Matched™

The MAX Drive™ motor is designed to operate optimally with all IGBT AC inverters without limitations to lead length restrictions at 460V or less. Consult the factory for 575V systems.

QTS

The Quick Termination System (QTS™) allows for quick connections of AC power, DYNA-MAX™ Brake power, and the M-Encoder™. The QTS™ also includes the VCD. The QTS™ is only available on the 56CZ model.

Service Factor

Standard service factor for the MAX™ Drive motor is 1.0 on inverter power.

Severe Duty Construction

MAX™ Drive motors have an epoxy exterior paint over a red primer and an interior coating of epoxy on the rotor and stator bore.

Terminal Blocks

Terminal blocks are provided for the connection of power and control leads in the terminal box.

Terminal Box

The terminal box is rated IP56. It is cast aluminum with gasketed lid internally.

Testing

All motors are tested prior to shipment to ensure proper operation.

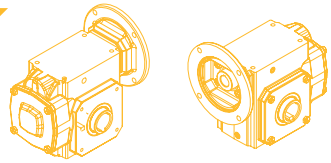
Torque-Matched™

The MAX™ Drive motor is Torque-Matched™ to a specific HERA™ gear reducer. They are designed to operate optimally and are Performance Matched™ to all PMW AC inverters.

Voltage Change Device (VCD)

Patented voltage change device (VCD) for instant voltage change, from high to low voltage or vice-versa.

DYNA-MAX™ Brake
Terminology



Air Gap

Is the space created between the “E” frame and the “I” frame in a direct-acting brake. When the air gap exists, pressure from the torque springs stop and hold the friction discs, motor, application from moving or rotating. When the air gap collapses, torque spring pressure is removed and the friction disc(s) motor and application are allowed to move or rotate.

Brake Reaction Time

Set Time - Total time to rated static torque. Release Time - Time when the power is applied to the brake to the time the operator coil is set to the armature (air gap closes).

Brake Wiring

The factory installed brake is pre-wired to operate in parallel with the motor. Leads are supplied to run power from the brake to a terminal block located in the motor conduit box. When the application is powered by a VFD, a separate dedicated power supply line must be used to power the brake.

Duty Cycle

The time the brake operates in the application. Time is measured in sec/min/hrs “on”, sec/min/hrs “off”, number of cycle in a row and time between cycle in a row and time between cycle periods.

Manual Release

A mechanism in the brake that is manually activated to remove the spring force that holds friction disc(s), motor shaft and system from moving or rotating. Activating the manual release allows the system to rotate or move without power being applied to the brake.

Non-Overhauling Load

Applications like horizontal conveyors that have the load come to a rest and has NO inertia loads or gravity effecting the load.

Overhauling Load

Applications like crane, hoist and elevators that have descending loads. Brake torques should be rated for stopping and holding loads. Gravity should be accounted for when loads come to a rest.

Service Factor

Is the percentage added to the basic drive torque calculation. This percentage takes into account system torque unknowns and application variables.

Static Torque

Is the torque required to start the motor or application moving or rotating.

Thermal Capacity

The ability of a brake to stop and absorb the dissipate heat without exceeding temperature limitations. It is shown as Horsepower per Sec/Minute (HPS/Min).

A Quad B

Refers to the set of output quadrature signals from an incremental encoder to indicate speed and direction.

Code

A system of representation for a finite number of values in a particular sequence.

Differential Line Drive

An output circuit that increases the current and allows the signal greater noise immunity due to using the different signals between two lines.

Direction of Rotation

In a bi-directional incremental encoder, Channel A will lead Channel B for one direction of rotation. If the direction of the rotation is reserved, Channel B will lead Channel A.

Dual Channel

A dual channel encoder produces two incremental outputs. These two outputs are generally in quadrature (90° phase separation) relationship to each other. They are typically referred to as Channel A and Channel B.

Encoder

An encoder is a device that translates mechanical motion (such as position, velocity, acceleration, speed, direction) into electrical signals.

Frequency Response

Frequency response for an incremental encoder is the encoder's electronic speed limit or the maximum frequency in kilohertz (1 kHz = 1000 HZ = 1000 cycles/sec).

Hall Effect

A transducer that varies its output voltage in response to a magnetic field.

Hollow Shaft

The shaft of the motor passes through the encoder.

Incremental Encoder

An incremental encoder is an encoder that produces pulses in proportion to distance moved or rotated.

Magnetic Target

A magnetic targets is a magnetized ring with multiple north and south poles lined up around the perimeter of the ring.

Pulses per Revolution (PPR)

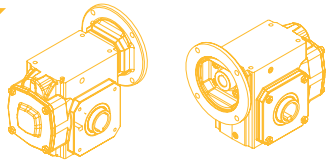
The low voltage output transitions, which indicate shaft movement by the encoder.

Quadrature

A dual output encoder used for bi-directional motion control. One channel leads the other by 90 electrical degrees. By monitoring the phase shift of both Channels A and B, direction can be determined. Another benefit of a quadrature encoder is count multiplication. With an appropriate counter, resolution can be multiplied up to four times.

Resolution

The number of pulses per revolution (PPR) in an encoder.



Important Information - Please Read Carefully

This catalog is not intended to provide operational instructions. Appropriate Marathon Electric Instructions provided with the motor and precautions attached to the motor should be read carefully prior to installation, operation and/or maintenance of the equipment. Injury to personnel or motor failure may be caused by improper installation, maintenance or operation.

The following WARNING and CAUTION information is supplied to you for your protection and to provide you with many years of trouble free and safe operation of your Marathon Electric product:

WARNING

- Disconnect power and lock out drive equipment before working on a motor.
- Always keep hands and clothing away from moving parts.
- The lifting support on the motor is not to be used to lift the entire machine. Only the motor attached directly to the support may be safety lifted by the support.
- Install and ground per local and national codes.
- Discharge all capacitors before servicing a single phase motor.
- Misapplication of a motor in a hazardous environment can cause fire or an explosion and result in serious injury. Only the end user, local authority having jurisdiction, and/or insurance underwriter are qualified to identify the appropriate class(es), group(s), division and temperature code. Marathon Electric personnel can not evaluate or recommend what motors may be suitable for use in hazardous environments, do not operate the motor without all of the grease and drain plugs installed.
- Never attempt to measure the temperature rise of a motor by touch. Temperature rise must be measured by thermometer, resistance, imbedded detector or thermocouple.
- Motors with manual reset thermal protectors may start unexpectedly after the protector trips when the surrounding air is at +20^0 Fahrenheit or lower. If the manual reset protector trips, disconnect motor from its power supply. After the protector cools (five minutes or more), it can be reset and power may be applied to the motor.
- Connect all protective device leads, marked P1, P2, etc., per instructions supplied with the motor.
- Operation of a motor at other than its nameplate rating may result in fire, damage to equipment or serious injury to personnel.
- For safety, Buyer or User should provide protective guards over all shaft extensions and any moving apparatus mounted thereon. The User is responsible for checking all applicable safety codes in his area and providing suitable guards. Failure to do so may result in bodily injury and/or damage to equipment.

CAUTION

- Consult qualified personnel with questions and all electrical repairs must be performed by trained and qualified personnel only.
- For motors name plated as “belted duty only”, do not operate the motor without belts properly installed.
- Motors and/or driven equipment should not be operated faster than their rated speed.
- For inverter applications, follow the inverter manufacturer’s installation guidelines.
- Make sure the motor is properly secured and aligned before operation.

In the event of the resale of any of the goods, in whatever form, Resellers/Buyers will include the following language in a conspicuous place and in a conspicuous manner in a written agreement covering such sale:

> The manufacturer makes no warranty or representations, express or implied, by operation of law or otherwise, as to the merchantability or fitness for a particular purpose of the goods sold hereunder. Buyer acknowledges that it alone has determined that the goods purchased hereunder will suitably meet the requirements of their intended use. In no event will the manufacturer be liable for consequential, incidental or other damages. Even if the repair or replacement remedy shall be deemed to have failed of its essential purpose under Section 2-719 of the Uniform Commercial Code, the manufacturer shall have no liability to Buyer for consequential damages.

Resellers/Buyers agree to also include this entire document including the warnings and cautions above in a conspicuous place and in a conspicuous manner in writing to instruct users on the safe usage of the product.

This information should be read together with all other printed information supplied by Marathon Electric. For more information contact: **Marathon Electric**, Regal Beloit Manufacturing Corporation, 100 E. Randolph St., Wausau, WI 54401. Phone: 715-675-3311 or Fax: 715-675-8030.

Important Information - Please Read Carefully

The following ⚠WARNING ***and*** ⚠CAUTION ***information is supplied to you for your protection and to provide you with many years of trouble free and safe operation of your Hub City product:***

Read ALL instructions prior to operating reducer. Injury to personnel or reducer failure may be caused by improper installation, maintenance or operations.

⚠WARNING

- Written authorization from HUB CITY is required to operate or use reducers in man lift or people moving devices.
- Check to make certain application does not exceed the allowable load capacities published in the current catalog.
- Buyer shall be solely responsible for determining the adequacy of the product for any and all uses to which Buyer shall apply the product. The application by Buyer shall not be subject to any implied warranty of fitness for a particular purpose.
- For safety, Buyer or User should provide protective guards over all shaft extensions and any moving apparatus mounted thereon. The User is responsible for checking all applicable safety codes in his area and providing suitable guards. Failure to do so may result in bodily injury and/or damage to equipment.
- Hot oil and reducers can cause severe burns. Use extreme care when removing lubrication plugs and vents.
- Make certain that the power supply is disconnected before attempting to service or remove any components. Lock out the power supply and tag it to prevent unexpected application of power.
- * Reducers are not to be considered fail safe or self-locking devices. If these features are required, a properly sized, independent holding device should be utilized. Reducers should not be used as a brake.
- Any brakes that are used in conjunction with a reducer must be sized or positioned in such a way so as to not subject the reducer to loads beyond the catalog rating.
- Lifting supports including eyebolts are to be used for vertically lifting the gearbox only and no other associated attachments or motors.
- Use of an oil with an EP additive on units with backstops may prevent proper operation of the backstop. Injury to personnel, damage to the reducer or other equipment may result.
- Overhung loads subject to shaft bearings and shafts to stress which may cause premature bearing failure and/or shaft breakage from bending fatigue, if not sized properly.

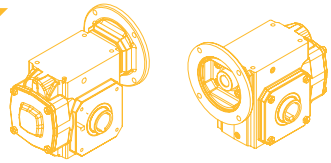
⚠CAUTION

- Test run unit to verify operation. If the unit tested is a prototype, that unit must be of current production.
- If the speed reducer cannot be located in a clear and dry area with access to adequate cooling air supply, Then precautions must be taken to avoid the ingestion of contaminants such as water and the reduction in cooling ability due to exterior contaminants.
- Mounting bolts should be routinely checked to ensure that the unit is firmly anchored for proper operation.

In the event of the resale of any of the goods, in whatever form, Resellers/Buyers will include the following language in a conspicuous place and in a conspicuous manner in a written agreement covering such sale:

> The manufacturer makes no warranty or representations, express or implied, by operation of law or otherwise, as to the merchantability or fitness for a particular purpose of the goods sold hereunder. Buyer acknowledges that it alone has determined that the goods purchased hereunder will suitably meet the requirements of their intended use. In no event will the manufacturer be liable for consequential, incidental or other damages. Even if the repair or replacement remedy shall be deemed to have failed of its essential purpose under Section 2-719 of the Uniform Commercial Code, the manufacturer shall have no liability to Buyer for consequential damages.

Resellers/Buyers agree to also include this entire document including the warnings and cautions above in a conspicuous place and in a conspicuous manner in writing to instruct users on the safe usage of the product.



Gear Drive Warnings & Cautions

IMPORTANT SELECTION INFORMATION

The system of connected rotating parts must be free from critical speed, torsional, or other type vibration, regardless of how induced. The responsibility for this system analysis lies with the purchase of the gear unit.

⚠WARNING

SHIELD ALL ROTATING PARTS

For safety, purchaser or user must provide protective guards over all shaft extensions and any moving apparatus mounted on the unit. The user is responsible for checking and complying with all applicable safety codes in his area and providing suitable guards. Failure to do so may result in bodily injury and/or damage to equipment.

⚠WARNING

Wear protective clothing and eye shields when installing or maintaining unit and machine.

⚠WARNING

A unit cannot be used as an integral part of a machine superstructure which would impose additional loads on the unit other than those imposed by the torque being transmitted, or by any shaft mounted power transmitting device such as sprockets, pulleys, or couplings.

⚠WARNING

Make certain that all tools and other items are clear from rotating parts before starting machine. Stand clear, and start machine slowly to be sure all components are secure and operating properly.

⚠WARNING

For safe operation and to continue the unit warranty, when installing, reinstalling, or replacing a factory installed fastener for servicing purpose, or to accommodate the mounting of guards, shields or other light load imposing devices, or for mounting the unit, it becomes the responsibility of the purchaser or user to properly determine the quality, grade of fastener, thread engagement, load carrying capacity, tightening torque, and the means of torque retention.

COUPLINGS – Flexible couplings to input and output shafts are recommended because they minimize bearing and gear wear caused by slight misalignment. Follow coupling manufacturer's recommendations for installing and shielding.

SHEAVES AND SPROCKETS – When mounting sheaves or sprockets, the center of the load should be located as close to the reducer as possible. Excessive overhung loading could result in early failure of bearing or shaft. Refer to the general catalog or contact Hub City for overhung load ratings. Follow manufacturer's recommendations for installation and shielding.

⚠CAUTION

Do not operate the unit without making sure it contains the correct amount of oil. Do not overfill or underfill with oil, or injury to personnel, unit, or other equipment may result.

⚠CAUTION

Oil should be changed with greater frequency if unit is used in a severe environment such as dusty or humid or high or low temperatures.

⚠CAUTION

Do not mix nonsynthetic and synthetic oil in the unit.

⚠CAUTION

If unit is used in the food drug industry (including animal food) consult the petroleum supplier or HUB CITY for recommendations of lubricants which meet the specifications of FDA, USDA and/or other authoritative bodies have jurisdiction. Standard lubricants are not suitable for these applications or these industries.

⚠CAUTION

Inspect shafts and components for paint, burrs, or other imperfections before installing components. Do not use excessive force or pounding to install components onto unit shafts, as this may cause damage to shafts, bearings, or gears.

PREVENTATIVE MAINTENANCE – Keep shafts and vent plug clean to prevent foreign particles from entering seals or gear case. Inspect periodically for oil leaks.

⚠CAUTION

STORAGE OF HUB CITY REDUCERS – A gearbox does not have a definable shelf life. The main points of deterioration are rusting of non-painted surfaces and drying out of the seal lips. Proper storage of drives in a cool dry place in a carton away from exposure to ultraviolet light should permit protection for approximately one year.

If the unit is to be inoperative for a longer period of time, completely fill the gear case with regular lubricant containing rust and oxidation inhibitors, tag the gear case and any connected motor to prevent operation until the proper oil level is obtained. Do not operate a completely filled gear case. Coat external shafts with a rust preventative oil or grease. At least every three months, rotate the input shaft until the output rotates at least one revolution to ensure all internal parts are coated and that the shaft seals are free and the seal journals are coated with oil.

The most sensitive part of the gearbox is the redial lip seals. Even under ideal storage conditions, the seal lips may deteriorate or take a set, losing their sealing effect and reducing service life. Therefore, it may be necessary to replace the seals prior to putting the units in service depending upon the length and conditions of storage.

HERA-MAX™
Conversion Factors

Force		
Multiply	**By**	**To Obtain**
Newtons	0.225	Pounds (Force)
Pounds (Force)	4.448	Newtons

Torque		
Multiply	**By**	**To Obtain**
Gram-Centimeters	0.014	Ounce-Inches
Kilogram-Meters	7.233	Pound-Feet
Newton-Meters	0.738	Pound-Feet
Newton-Meters	8.851	Pound-Inches
Ounce-Inches	16	Ounce-Inches
Ounce-Inches	0.083	Pound-Feet
Ounce-Inches	72	Gram-Centimeters
Ounce-Inches	0.007	Newton-Meters
Pound-Inches	0.005	Pound-Feet
Pound-Inches	0.063	Pound-Inches
Pound-Inches	0.113	Newton-Meters
Pound-Feet	1.356	Newton-Meters
Pound-Feet	12	Pound-Inches
Pound-Feet	192	Ounce-Inches
Pound-Feet	82.2	Pound-feet
Pound-Feet	1.36 x 102	Dyne-Centimeter

Rotary Inertia		
Multiply	**By**	**To Obtain**
Kilogram-cm^2	0.342	Pound-Inches^2
Kilogram-cm^2	23.81	Pound-Feet^2
Pound-Inches^2	2.926	Kilogram-Centimeters^2
Pound-Feet^2	0.042	Kilogram^2-Meters^2
Pound-Feet^2	421.403	Kilogram-Centimeters^2
Ounce-Inches-Sec^2	72.008	Gram-Centimeter^2
Pound-Inches-Sec^2	1.152	Kilogram-Centimeters-Sec^2

Power		
Multiply	**By**	**To Obtain**
Watts	1	Joules/Sec
Kilowatts	1.341	Horsepower
Horsepower	0.746	Kilowatts
Horsepower	2.545	BTU/Hour
Horsepower	550	Foot-Pounds/Sec
Horsepower	1.056 x 10-5	Ounce-Inches/Sec
Horsepower	746	Watts

Motor Constant		
Multiply	**By**	**To Obtain**
Ounce-Inch-Sec	0.105	Ounce-Inch-RPM
Ounce-Inch-Sec	7.062 x 10-3	Newton-Meter-Sec
Ounce-Inch/RPM	9.55	Ounce-Inch-Sec
Ounce-Inch/RPM	0.067	Newton-Meter-Sec
Newton-Meter-Sec	14.83	Ounce-Inch/RPM
Newton-Meter-Sec	0.014	Ounce-Inch-Sec
Newton-Meter-Sec	0.067	Newton-Meter-Sec

Thermal Capacity		
Multiply	**By**	**To Obtain**
Horsepower-sec/min	12.429	Watts
Watts	0.081	Horsepower-sec/min

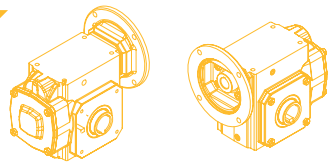
Length		
Multiply	**By**	**To Obtain**
Millimeters	0.039	Inches
Centimeters	0.394	Inches
Meters	39.37	Inches
Meters	3.281	Feet
Inches	25.4	Millimeters
Inches	2.54	Centimeters
Feet	0.305	Meters

Area		
Multiply	**By**	**To Obtain**
Square Millimeters	0.002	Square Inches
Square Centimeters	0.155	Square Inches
Square Meters	10.764	Square Feet
Square Inches	6.452	Square Centimeters
Square Feet	0.093	Square Meters

Volume		
Multiply	**By**	**To Obtain**
Cubic Centimeters	0.061	Cubic Inches
Cubic Meters	35.31	Cubic Foot
Cubic Feet	0.028	Cubic Meters

Temperature		
Celsius	5/9 (F°-32)	
Fahrenheit	(9/5 x C°)+32	

HERA-MAX™
Formulas



Electrical		
Ohms	=	Volts / Amperes (R = E/I)
Amperes	=	Volts / Ohms (I = E/R)
Volts	=	Amperes x Ohms (E = IR)
Synchronous RPM	=	$\frac{120 \times \text{Frequency}}{\text{\# Motor Poles}}$

Time for Motor to Reach Operating Speed:		
Seconds	=	$\frac{WK^2 \text{ (lb-ft)} \times \text{Speed Change (RPM)}}{308 \times \text{Average Accelerating Torque (lb-ft)}}$
1 lb-ft^2 = 0.04214 kg-m^2		
WK^2 = Inertia of Rotor	+	$\frac{\text{Inertia of Load} \times \text{Load RPM}^2}{\text{Motor RPM}^2}$
Average Accelerating Torque	=	$\frac{[(\text{FLT} + \text{BDT}) / 2] + \text{BDT} + \text{LRT}}{3}$
BDT	=	Breakdown Torque
FLT	=	Full-load Torque
LRT	=	Locked-rotor Torque

Power:		
Power (HP)	=	$\frac{\text{Torque (lb-ft)} \times 2\pi \times \text{RPM}}{33000}$

Efficiency:		
Efficiency	=	$\frac{\text{Power Out}}{\text{Power In}}$

Horsepower & Torque:		
Horsepower	=	$\frac{\text{Torque (lb-ft)} \times \text{RPM}}{5252}$
Horsepower	=	$\frac{\text{Torque (lb-in)} \times \text{RPM}}{63025}$
Torque (lb-ft)	=	$\frac{\text{Horsepower} \times 5252}{\text{RPM}}$
Torque (lb-in)	=	$\frac{\text{Horsepower} \times 63025}{\text{RPM}}$

Brake:		
Average dynamic braking torque		
Td	=	$\frac{WK^2 \times \text{RPM}}{308 \times €}$
WK^2	=	Total inertia reflected to brake in lb-ft^2
RPM	=	Shaft speed of brake
€	=	Desired stopping time in seconds
Constant	=	308

Static Torque:		
T	=	F x R (lb-ft)
F	=	Force (lb)
R	=	Pulley or drum radius (ft)

Brake Torque:	=	$\frac{5252 \times P \times SF}{N}$
P	=	HP
N	=	Speed
Constant	=	5252
SF	=	1.4
Use 2.0 to 2.5 SF for cranes and hoists. (consult crane manufacturer or end-user)		

Regal Beloit Corporation
MPN411 Terms and Conditions of Sale

REGAL BELOIT CORPORATION ELECTRICAL GROUP TERMS AND CONDITIONS OF SALE. ALL QUOTATIONS ARE MADE AND ALL ORDERS ARE ACCEPTED BY RETAIL BELOIT CORPORATION ELECTRICAL GROUP SUBJECT ONLY TO THESE TERMS AND CONDITIONS. THROUGHOUT THIS DOCUMENT, REGAL BELOIT CORPORATION ELECTRICAL GROUP SHALL BE REFERRED TO AS SELLER.

1. MODIFICATIONS OF SALES TERMS: Any Terms and Conditions contained in any purchase order or other form of communication from Seller's customers which are additional to or different from these Terms and Conditions shall be deemed rejected by Seller unless expressly accepted in writing by Seller. In general, no modification, amendment, waiver or other change of any of these Terms and Conditions and those contained on the reverse side hereof and/or in attachments hereto ("Terms and Conditions"), or of any of Seller's rights or remedies thereunder, shall be binding on Seller unless expressly accepted in writing by Seller's authorized officers. No course of dealing, usage of trade or course of performance shall be relevant to explain or supplement any of these Terms and Conditions. In case of conflict between the Terms and Conditions printed on this page and those contained on the face side or in attachments hereto, the latter shall control. If any document issued by any party hereto is sent by facsimile or another form of electronic document transmission, the parties hereto agree that (a) the copy of any such document printed on the facsimile machine or printer of the recipient thereof is a counter part original copy thereof and is a "writing", (b) delivery of any such document to the recipient thereof by facsimile or such other form of electronic document transmission is authorized by the recipient thereof and is legally sufficient for all purposes as if delivered by United States mail, (c) the typewritten name of an authorized agent of the party sending such document on any such document is sufficient as a signature thereon on behalf of such party and the intent of such signature is to authenticate the writing, and (d) an electronically stored and reproduced copy of any such document shall be deemed to be legally sufficient evidence of the terms of such document for all purposes.

2. ACCEPTANCE OF ORDERS: Acceptance by Seller of Buyer's purchase order(s) is expressly conditioned upon Buyer's assent to these Terms and Conditions. Buyer will be deemed to have assented to such Terms and Conditions unless Seller receives written notice of any objections within fifteen (15) days after Buyer's receipt of this form and in all events prior to any delivery or other performance by Seller of Buyer's order.

3. QUOTATIONS: Quotations by Seller shall be deemed to be offers by Seller to sell the Goods described therein subject to these Terms and Conditions, and acceptance of such offers is expressly limited to acceptance by Buyer of all of these Terms and Conditions within thirty (30) days from the date of the quotation. Purchase orders submitted by Buyer for the Goods quoted by Seller shall be subject to and will be deemed to constitute acceptance of these Terms and Conditions. All purchase orders will be subject to approval by Seller.

4. PRICES; PRICE CHANGES: All prices are net F.O.B. shipping point and are subject to change without notice. In the event of a change in Seller's prices, the price for Goods unshipped will be the price in effect on the date of shipment. If Seller's quoted price was based upon delivery to and acceptance by Buyer of a specified quantity of Goods, such price shall be subject to adjustment if Buyer does not accept the quantity at the times specified in Seller's quotation, and Buyer will be invoiced at Seller's standard price without quantity discounts, if any, for the quantity of Goods actually accepted by Buyer.

5. TAXES: In addition to any prices, Buyer shall pay the amount of any present or future manufacturer's tax, retailer's occupation tax, use tax, sales tax, excise tax, duty, custom, inspection or testing fee, or any other tax, fee or charge of any nature whatsoever imposed by any governmental authority, on or measured by the transaction between Seller and Buyer. In the event Seller is required to pay any such tax, fee or charge, Buyer shall reimburse Seller thereof; or, in lieu of such payment,Buyer shall provide Seller at the time the order is submitted with an exemption certificate or other document acceptable to the authority imposing such tax, fee or charge.

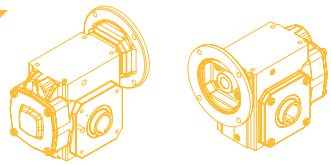
6. TERMS OF PAYMENT: All orders are subject to the approval of Seller. Terms of payment are cash in full no later than thirty (30) days from date of shipment, without discount. If, during the period of performance of an order, the financial condition of Buyer is determined by Seller not to justify the terms of payment specified, Seller may demand full or partial payment in advance before proceeding with the work, or satisfactory security or guarantees that invoices will be promptly paid when due, or, at its option without prejudice to other lawful remedies, may defer delivery or cancel this contract. If delivery is deferred, the Goods may be stored as provided in Section 9 hereof and Seller may submit a new estimate of cost for completion based on prevailing conditions. If Buyer defaults in any payment when due, or in the event any voluntary or involuntary bankruptcy or insolvency proceedings involving Buyer are initiated by or against Buyer, then the whole contract price shall immediately become due and payable upon demand, or Seller,at its option without prejudice to its other lawful remedies, may defer delivery or cancel this contract. Prorata payments shall become due as shipments are made. If shipments are delayed by the Buyer for any cause, payments shall become due from the date on which Seller is prepared to make shipment and storage shall be the Buyer's risk and expense as provided in Section 9 hereof. If manufacture is delayed by the Buyer for any cause, a partial payment based upon the proportion of the order completed shall become due from the date on which Seller is notified of the delay.

7. DELIVERY; RISK OF LOSS: All sales are F.O.B. Seller's plant or other point of shipment designated by Seller. Shipping dates are estimates only which are not guaranteed and are based upon prompt receipt from Buyer of all necessary shipping and other information. Seller reserves the right to make delivery in installments, all installments to be separately invoiced and paid for by Buyer when due per invoice, without regard to subsequent deliveries. Delivery of Goods to a commercial carrier at Seller's plant or other loading point shall constitute delivery to Buyer, and any risk of loss and further cost and responsibility thereafter for claims, delivery, loss or damage, including, if applicable, placement and storage, shall be borne by Buyer. When Goods are delivered by Seller's truck, unloading at Buyer's dock shall constitute delivery to Buyer. Claims for shortages or other errors in delivery must be made in writing to Seller within ten (10) days after receipt of shipment and failure to give such notice shall constitute unqualified acceptance and a waiver of all such claims by Buyer. Claims for loss or damage to Goods in transit by common carrier must be made to the carrier and not to Seller. Freight and handling charges by Seller may not reflect actual freight charges prepaid to the carrier by Seller due to incentive discounts earned by Seller based upon Seller's aggregate volume of freight tendered to a carrier or when a carrier must be used which charges a rate which is different than the rate upon which Seller's freight and handling charges were based. When shipments are delivered in Seller's private trucks Buyer will be charged an amount approximating the prevailing common carrier rate.

8. EXCUSABLE DELAYS; FORCE MAJEURE: Seller shall not be liable for any ordinary, incidental, or consequential loss or damage as a result of Seller's delay in or failure of delivery or installation due to (i) any cause beyond Seller's reasonable control, (ii) an act of God, act of the Buyer, embargo or other government act, authority, regulation or request, fire, theft, accident, strike, slowdown or other labor disturbance, war, riot, delay in transportation, or (iii) inability to obtain necessary labor, materials, components, or facilities. Should any of the aforementioned events of force majeure occur, Seller, at its option, may cancel Buyer's order with respect to any undelivered Goods or extend the delivery date for a period equal to the time lost because of delay. Notice of such election shall be given promptly to Buyer. In the event Seller elects to so cancel the order, Seller shall be released of and from all liability for failure to deliver the Goods, including, but not limited to, any and all claims on behalf of Buyer for lost profits, or any other claim of any nature which Buyer might have. If shipping or progress of the work is delayed or interrupted by Buyer, directly or indirectly, Buyer shall pay Seller for all additional charges resulting there from.

9. STORAGE: If the Goods are not shipped within thirty (30) days after notification has been made to Buyer that it is ready for shipping, for any reason beyond Seller's control, including Buyer's failure to give shipping instructions, Seller may store the Goods at Buyer's risk and expense in a warehouse or on Seller's premises, and Buyer shall pay all handling, transportation and storage costs at the prevailing commercial rates promptly following Seller's submission of invoices for such costs.

10. WARRANTIES TO DISTRIBUTORS AND INDUSTRIAL OR COMMERCIAL CUSTOMERS: This warranty is extended only to Seller's distributors and industrial or commercial customers and does not apply to consumer purchasers. Warranty Period - Motors (a) The Seller warrants motors manufactured by or for it to be free from defects in materials and workmanship and to conform to its written specifications for a period of twelve (12) months from date of first use or eighteen (18) months from date of manufacture, whichever period shall expire first. Warranty Period - Generators (a) The Seller warrants standby generators manufactured by or for it to be free from defects in materials and workmanship and to conform to its written specifications for a period of twenty-four (24) months from date of startup, thirty (30) months from date of shipment, or one-thousand (1,000) hours in use, whichever period shall expire first; (b) Seller warrants continuous duty generators manufactured by or for it to be free from defects in materials and workmanship and to conform to its written specifications for a period of twelve (12) months from date of startup or eighteen (18) months from date of shipment, whichever period shall expire first. Certain Electrical Group Goods are warranted for different periods of time under specific conditions. Buyer must consult the current product catalog or internet site to confirm this warranty period. Warranty Remedies- If, prior to expiration of the foregoing applicable warranty period, any of such Goods shall be proved to Seller's satisfaction to be defective or nonconforming, Seller will repair or replace such defective Goods or components thereof, F.O.B. Seller's plant or other destination designated by Seller, or will refund or provide Buyer with a credit in the amount of the purchase price paid therefor by Buyer, at Seller's sole option. Buyer's exclusive remedy and Seller's sole obligation under this warranty shall be limited to such repair or replacement, F.O.B. Seller's plant or other destination designated by Seller, or refund or credit by Seller, and shall be conditioned upon Seller's receiving written notice of any defect within a reasonable period of time (but in no event more than sixty (60) days after it was discovered or by reasonable care should have been discovered. In no event shall Seller's liability for such defective or nonconforming Goods exceed



the purchase price paid by Buyer therefor. Exclusions- This warranty does not: (i) cover shipping expenses to and from Seller's factory or other destination designated by Seller for repair or replacement of defective Goods or any tax, duty, custom, inspection or testing fee, or any other charge of any nature related thereto, nor does it cover the costs of disassembling or removing defective Goods or reassembling, reinstalling, or testing repaired or replaced Goods or finishing the reinstallation thereof;(ii) apply and shall be void with respect to Goods operated in excess of rated capacity or otherwise not in accordance with installation, maintenance, or operating instructions or requirements, to Goods repaired or altered by others than Seller or Seller's authorized service agencies, or to Goods which were subjected to abuse, negligence, misuse, misapplication, accident, damages by circumstances beyond Seller's control, to improper installation (if by others than Seller), operation, maintenance or storage, or to other than normal use or service;and (iii) apply to equipment or components not manufactured by or for Seller. With respect to Goods or components not manufactured by Seller, Seller's warranty obligations shall in all respects conform and be limited to the warranty actually extended to Seller by its suppliers, but in no event shall Seller's obligations be greater than those provided under Seller's warranty set forth in this Section 10. THE FOREGOING WARRANTIES ARE IN LIEU OF ALL OTHER EXPRESS AND IMPLIED WARRANTIES (EXCEPT TITLE), INCLUDING,WITHOUT LIMITATION, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. NO EMPLOYEE, REPRESENTATIVE, OR AGENT OF SELLER OTHER THAN AN OFFICER OF SELLER IS AUTHORIZED TO ALTER OR MODIFY ANY PROVISION OF THIS SECTION 10 OR TO MAKE ANY GUARANTEE, WARRANTY, OR REPRESENTATION, EXPRESS OR IMPLIED, ORALLY OR IN WRITING, WHICH IS CONTRARY TO THE FOREGOING. Any description of the Goods, whether in writing or made orally by Seller or Seller's agents, specifications, samples, models, bulletins, drawings, diagrams, engineering sheets or similar materials used in connection with Buyer's order are for the sole purpose of identifying the Goods and shall not be construed as an express warranty. Any suggestions by Seller or Seller's agents regarding use, application or suitability of the Goods shall not be construed as an express warranty unless confirmed to be such in writing by Seller's authorized officer.

11. LIMITATIONS OF LIABILITY;CONSEQUENTIAL DAMAGES: Nuclear Use Disclaimer- Goods sold by Seller are not intended for use in connection with any nuclear facility or activity. If so used, Seller disclaims all liability for any nuclear damage, injury or contamination, and Buyer shall indemnify and hold Seller, its officers, agents, employees, successors, assigns and customers harmless from and against any and all losses, damages or expenses of whatever form or nature (including attorneys' fees and other costs of defending any action) which they or any of them may sustain or incur, whether as a result of breach of contract, warranty, tort (including negligence) or otherwise, by reason of such use. Consequential Damage Disclaimer- Seller's liability with respect to Goods proved to its satisfaction to be defective within the warranty period shall be limited to repair, replacement or refund as provided in Section 10 hereof, and in no event shall Seller's liability exceed the purchase price of the Goods involved. Seller shall not be subject to any obligations or liabilities, whether arising out of breach of contract, warranty, tort (including negligence) or other theories of law, with respect to Goods sold or services rendered by Seller, or any undertakings, acts or omissions relating thereto. Without limiting the generality of the foregoing, Seller specifically disclaims any liability for property or personal injury damages, penalties, special or punitive damages, damages for lost profits or revenues, loss of use of Goods or any associated Goods, cost of capital, cost of substitute products, facilities or services, downtime, shutdown, or slowdown costs, or for any other types of economic loss, and for claims of Buyer's customers for any such damages. SELLER SHALL NOT BE LIABLE FOR AND DISCLAIMS ALL CONSEQUENTIAL, INCIDENTAL AND CONTINGENT DAMAGES WHATSOEVER. EVEN IF THE REPAIR OR REPLACEMENT REMEDY SHALL BE DEEMED TO HAVE FAILED OF ITS ESSENTIAL PURPOSE UNDER SECTION 2-719 OF THE UNIFORM COMMERCIAL CODE, SELLER SHALL HAVE NO LIABILITY TO BUYER FOR CONSEQUENTIAL DAMAGES, SUCH AS LOST PROFITS, LOST REVENUE, DAMAGE TO OTHER GOODS OR LIABILITY OR INJURY TO A THIRD PARTY.

12. INDEMNIFICATION BY BUYER: Buyer shall indemnify, hold harmless, and defend Seller and Seller's employees and agents from and against any and all damages, liability, claims, losses, and expenses (including reasonable attorneys' fees, court costs, and out-of-pocket expenses) arising out of or resulting in any way from claims by customers of Buyer or third parties against Seller alleging a breach of contract or warranty by Seller to the extent that such damages, liability, claims, losses, and expenses which may be payable by Seller to Buyer pursuant to and as limited by Seller's warranty and damage obligations as contained in Sections 10 and 11 hereof so as to effectively limit Seller's obligations to customers of Buyer or third parties to those set forth in Sections 10 and 11 hereof.

13. PATENT INDEMNIFICATION: Seller will, at its own expense, defend or settle any suits that may be instituted against Buyer for alleged infringement by the Goods of any United States patent, provided that: (a) such alleged infringements consist of the use of the Goods for any of the purposes for which such Goods were sold; (b) Buyer shall have made all payments for such Goods then due hereunder; (c) Buyer shall give Seller immediate notice in writing of any such suit and transmit to Seller immediately upon receipt of all processes and papers served upon Buyer; and (d) Buyer shall permit Seller through its counsel, either in the name of Buyer orin the name of Seller, to defend such suit(s) and give all needed information, assistance and authority to enable Seller to do so. In case of a final award of damages in any such suit, Seller will pay such award but will not be responsible for any compromise or settlement made without its written consent. In case the Goods itself is in such suit held to infringe any valid patent issued in the United States and its use enjoined, or in the event of a settlement or compromise approved by Seller which shall preclude future use of the Goods sold to Buyer hereunder, Seller shall, at its own expense and at its sole option, either: (a) procure rights to continue using such Goods; (b) modify the Goods to render it non-infringing; (c) replace the Goods with non-infringing Goods; or (d) refund the purchase price paid by Buyer for the Goods after return of the Goods to Seller. Notwithstanding the foregoing, Seller shall not be held responsible for infringements of combination or process patents covering the use of Goods in combination with other Goods or materials not furnished by Seller. The foregoing states the entire liability of Seller for patent infringement, and IN NO EVENT SHALL SELLER BE LIABLE FOR CONSEQUENTIAL OR INCIDENTAL DAMAGES ATTRIBUTABLE TO AN INFRINGEMENT nor for infringement based on the use of the Goods for a purpose other than that for which sold by Seller. As to any Goods furnished by Seller to Buyer manufactured in accordance with designs proposed or furnished by Buyer or any claim of contributory infringement resulting from the use or resale by Buyer of Goods sold hereunder, Buyer shall indemnify Seller for any award made against Seller or settlement by Seller for any patent, trademark or copyright infringements including attorneys' fees and defense costs.

14. SECURITY AGREEMENT AND FINANCING STATEMENTS: To secure payment of the purchase price and of all monies which may be due hereunder, and performance of all of Buyer's obligations hereunder, Buyer hereby grants to Seller a security interest in all Goods sold by Seller, and agrees to execute such other Security Agreements and Financing Statements as Seller may reasonably request.

15. INSURANCE: Until payment in full of the purchase price, Buyer shall maintain insurance covering all Goods sold by Seller to Buyer in such amounts and against such risks as is customary by companies engaged in the same or similar business and similarly located, and shall, upon Seller's request, furnish evidence of such insurance satisfactory to Seller.

16. DRAWINGS; OTHER DESIGN DATA: All specifications, drawings, designs, data, information, ideas, methods, tools, gages, dies, fixtures, patterns and/or inventions made, conceived, developed or acquired by Seller in connection with procuring and/or executing Buyer's order will vest in and inure to Seller's sole benefit notwithstanding any changes therefor which may have been or may be imposed by Seller. Buyer shall not give, loan, exhibit, sell or transfer to any person not then employed by Buyer and authorized to receive such information, or to any organization or entity, any drawing, photograph or specification furnished by Seller or reproduction thereof which may enable such person, organization or entity to furnish similar Goods or parts therefor.

17. RETURN OF GOODS: No Goods or part shall be returned to Seller without written authorization and shipping instructions first having been obtained from Seller.

18. ASSIGNMENT AND SUBCONTRACTING: None of the Buyer's rights under any order shall be assigned by the Buyer to any other person, whether by operation of law or otherwise, without Seller's prior written approval. Seller may, without the necessity of obtaining Buyer's prior written consent, subcontract the production of all or any portion of the Goods.

19. CANCELLATION: No order submitted to Seller may be cancelled by Buyer without the prior written consent of Seller, which consent will at all times be conditioned on Buyer's agreement to pay Seller's cancellation charge. For finished Goods which in Seller's judgement is readily resalable to others, the cancellation charge shall be 15% of the invoice price of the Goods. For all other cancellations, the cancellation charge shall amount to all cost and expenses incurred by Seller and arising out of or in connection with Buyer's order, net of recoverability, but in no event less than 10% of the invoice price of the Goods or more than the invoice price.

20. GENERAL: Governing law- These Terms and Conditions, and the contract of sale between Seller and Buyer, shall be governed by and construed in accordance with the laws of the State of Wisconsin. Seller and Buyer hereby agree that any legal action deemed necessary by either party hereto shall be brought in the Circuit Court in and for Seller County, Wisconsin and hereby consent to the personal jurisdiction of such court in any such action over the parties hereto. The rights and obligations of Seller and Buyer shall not be governed by the provisions of the United Nations Convention on Contracts for the Internal Sale of Goods. Attorneys' Fees- Buyer agrees to pay all of Seller's costs and expenses of collection and related litigation, including but not limited to attorneys' fees and costs. Severability- The invalidity, in whole or in part, of any of the provisions of these Terms and Conditions, shall not affect the enforceability of any of the other provisions thereof. Applicability- The Terms and Conditions as stated herein are applicable as of the date of this printing and until such time as changed by Seller.

Since 1892, **HUB CITY** has a reputation for producing tough, dependable driveline components for industry and agriculture worldwide. As a world-class manufacturer, HUB CITY provides the technology, expertise and support to perfectly integrate our products into your application. Whether your application requires a standard, modified standard or custom product, HUB CITY will always be at the heart of what drives your world.

www.hubcityinc.com

Since 1913, **Marathon Electric** has developed a reputation for conservative motor designs and highly engineered products used in a vast array of commercial and industrial applications around the world.

Our inverter duty motors are the motor of choice for the leading AC drive manufacturers around the globe. The microMax®, BlueMAX® and BlackMAX® motors control pumps, drive fans and blowers, run conveyors and are used in thousands of mission critical applications where reliability and performance are the driving criteria.

marathon™ Motors

www.marathonelectric.com

Marathon Electric and Hub City have built on their legacy of innovation by introducing HERA-MAX Drive™. Together, they can provide total system efficiency with energy savings of up to $550* per year. Just one more thing only Regal Beloit can deliver through two of its industry leaders.

*Based on 60/1 ratio, 2600in. Lbs. output torque, 1800 rpm input, 24/5 duty cycle

MADE IN THE USA

A Regal Brand

REGAL

HM400/SP/3-13/5000/CAV