

Exclusion of Warranty

The items in this catalog are intended for use in motorsport competition, i.e. AUTO RACING. No warranty of these components, express or implied, is offered by Woodward Machine Corporation or its subsidiaries, for the following reasons, among others:

(1) Motorsport is inherently dangerous. The conditions of end use of the components are normally hazardous and unpredictable, and are entirely beyond our control; and

(2) The decision as to the suitability of said components for a particular manner of use, or in a particular installation, is made by the user and is likewise beyond our control; and

(3) The application of said components is therefore understood to be experimental.

Liability of Woodward Machine Corporation is therefore limited to the replacement or repair, at our option, of any of our products that we find, upon our inspection, to be defective in materials or workmanship, specifically excluding items damaged as a result of collision, misuse, or neglect.

Warning: The approval of your state department of motor vehicles or your country's Ministry of Transport or other relevant authority, for the use of racing equipment on the public highways should not be assumed. Woodward Machine Corporation does not support nor participate in efforts to obtain such approval. The end user is responsible for not utilizing Woodward racing components in any manner which may contravene local law.

Original Equipment Manufacturers installing Woodward components in vehicles licensed for use on the public highways are responsible for complying with all applicable safety standards.

Purchasers of Woodward equipment for use in race cars subject to homologation by a sanctioning body, e.g. FIA, NASCAR, IMSA, SCCA, etc. are responsible for ensuring that the equipment does in fact conform to current rules.

DOMESTIC AND INTERNATIONAL PRICING:

The prices published in this catalog are in US Dollars and apply to all purchases made with Visa, Mastercard, Discover, or American Express cards, whether issued by US or foreign banks.

Surcharges, previously necessitated by unpredictable and exorbitant fees charged by the credit card brands for processing sales across international borders, no longer apply.

Credit card sales are invoiced and shipped by our subsidiary Racor, Inc.

Business-to-business purchases arranged directly with Woodward Machine Corporation are payable by bank wire transfer.

Please note that any customs duties or clearance fees imposed by the destination country are the responsibility of the recipient. We will gladly include your VAT registration number on the shipping documents but we do not collect or remit taxes.



Terms and Conditions of Sale

Toll-free in USA: 1-888-STEER-US • International: 1-307-472-0550 • E-mail: sales.woodwardsteering@gmail.com

PACKAGING FOR INTERNATIONAL SHIPMENT:

In some cases, international air freight imposes more stringent requirements for packaging. Should this be necessary, any extra cost will be included in our freight quote.

OUR STANDARD FREIGHT CARRIERS AND INSURANCE:

We ship via Federal Express or United Parcel Service, FOB our plant in Mills, Wyoming. Next Day Air and Early AM delivery are available at extra cost for most ZIP codes in the continental US, as is Saturday delivery. Freight insurance is provided free by the carrier up to USD100.00 value, and rises on a very reasonable sliding scale. We ship everything insured for its full value. We can also ship freight collect on your FedEx or UPS account. *We do not ship via Postal Service, as delivery cannot be guaranteed and if your parcel is lost or undelivered it is difficult or impossible to obtain compensation.*

Orders for parts in stock will generally ship the same day if received before noon Mountain Standard Time.

USING OTHER CARRIERS:

Alternatively, we can hold for pickup by the carrier of your choice. However, in these cases we cannot create waybills or submit the export declaration electronically. If your carrier requires that we manually complete their shipping documents we will have to charge for the time. Also, you should be aware that freight companies not having a base of operations in the US will subcontract the pickup to UPS or FedEx and sometimes this can add a week or more before the parcel can actually be placed in transit.

RETURNS OF MERCHANDISE, DOMESTIC:

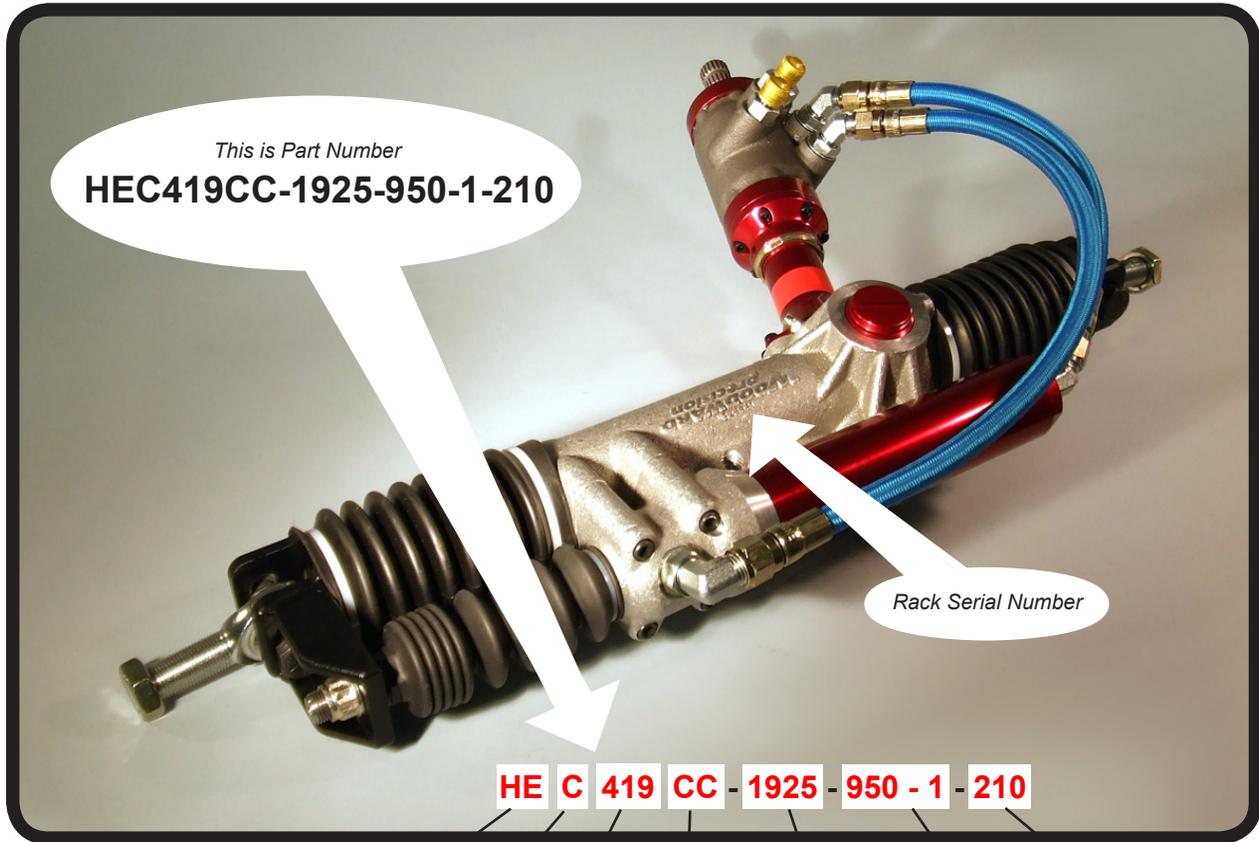
Returned parts may be subject to a charge of up to 20% to defray the cost of inspection, restocking, and repackaging. Returned merchandise must be unused, unmarked and not over 30 days old. We will make adjustment via exchange or credit only. Special order parts, damaged or rusted parts, or "basket cases" are not returnable except in connection with repair orders.

RETURNS OF MERCHANDISE, INTERNATIONAL:

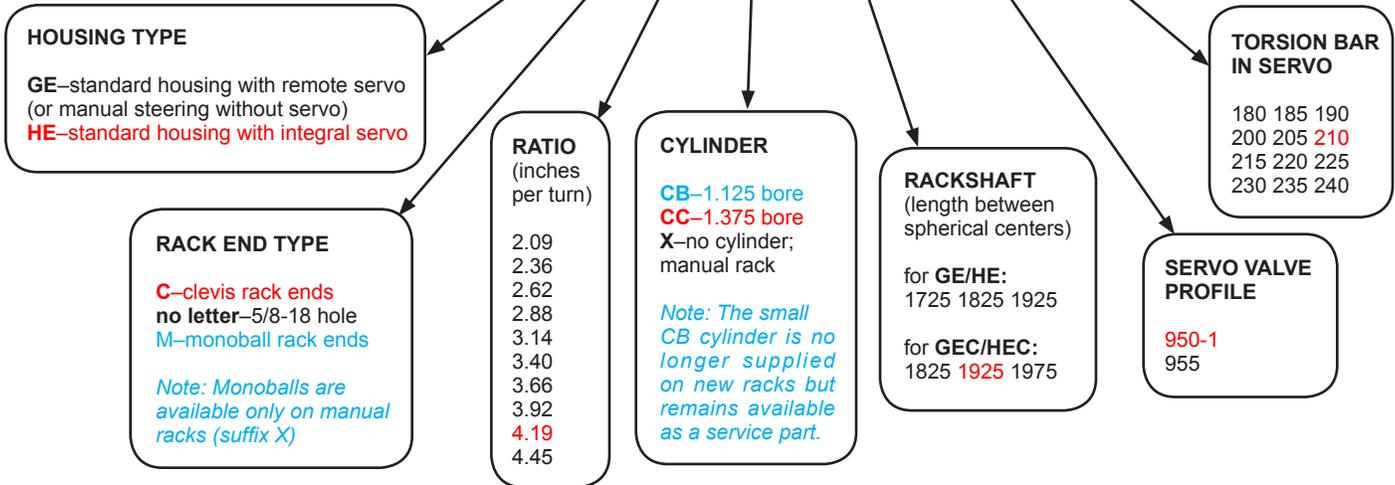
Make absolutely sure to specify in the customs declaration that you are returning goods *manufactured in the U.S.* If this is not done and we receive a bill for import duties, it will be charged to your account.

SPECIAL ORDER PARTS:

Throughout this catalog, many categories of parts are shown which are manufactured only on a made-to-order basis. Please note that parts *built or assembled to customer specifications* are generally specialized enough to be otherwise unsalable, and these are consequently not returnable.



HE C 419 CC - 1925 - 950 - 1 - 210



Note: parts used in the example above are in RED; discontinued options are in BLUE

GE/HE rack part numbering system

Our part numbers include as many useful details as possible. Virtually any option can be specified using the codes shown above. Currently, the most popular rack end configuration for oval track racing applications is the SLOTTED CLEVIS. These are made with approximately one inch vertical adjustment above center and 3/16 below center, or, optionally, INVERTED at either or both ends. Clevises allow unlimited vertical swing of the tie rods in both bump and rebound, and they eliminate binding in cases of extreme body roll and suspension travel.

The previous oval-track "standard" rack with vertical 5/8-18 threaded tie rod holes has been newly reengineered with a larger rod bracket. A 5/8 through bolt replaces the previous 1/2 bolt, and the cylinder now has the same larger 1/2-20 piston rod and nut used on clevis racks. The older GE264 or 265 rod brackets and cylinders with the 3/8-24 rod remain available as replacement parts.

Rack Serial Number

The date of manufacture of any Woodward rack and its original purchaser can be traced from the serial number back to 1982, making it possible to verify the exact age of used parts—for example, to reveal when an older steering rack has been swapped into a car for resale. Unfortunately, records kept prior to s/n 1220 were lost. If you have a Woodward rack with a serial number from 101 to 1219, please call or e-mail.

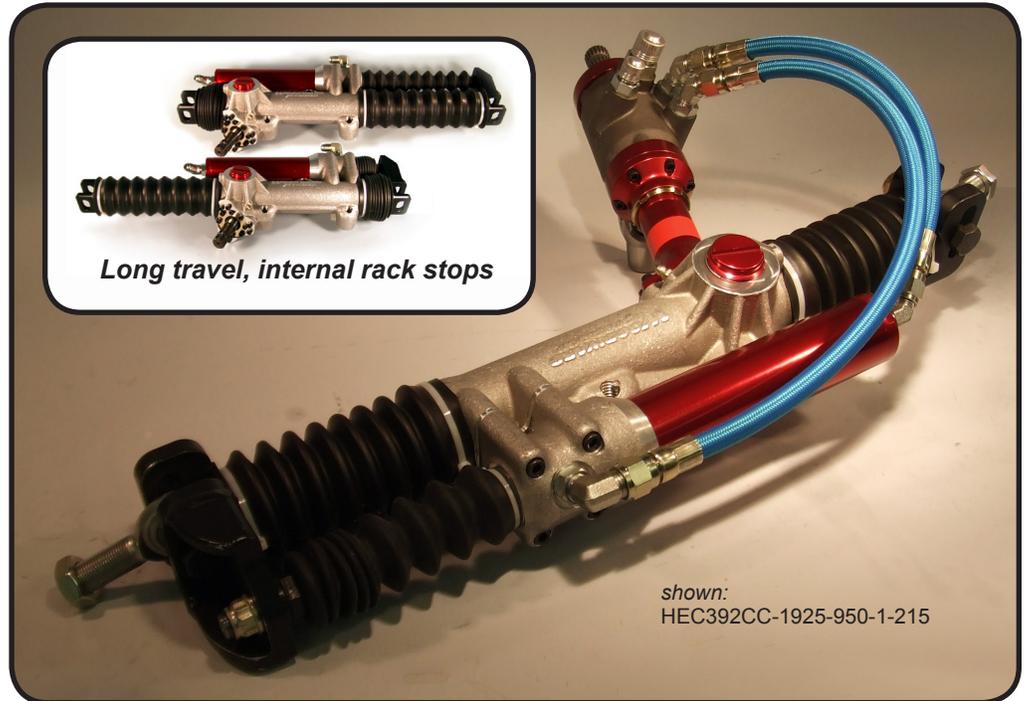
Type HEC Power Racks, lengths 18.25 to 19.75 inches

Power steering with **integral** servo, for **road racing** and **oval track** applications

Equipped with clevis rack ends slotted for bump-steer adjustment, made of 8620 steel and very strong. The piston rod connection is extra rigid to withstand hard shots and rough race tracks.

Includes 5/8 rod ends with 1/2 inch grade 8 through bolts and high-misalignment hat spacers. Internal rack stops allow extra long rack travel without boot damage.

The **HE** designation means the servo is solidly mounted to the rack housing. Because of its splined connection to the pinion, the servo can be separated from an **HE** rack and used inline where necessary for clearance.



Type GEC Power Racks, lengths 18.25 to 19.75 inches

Power steering with **inline** servo, for **road racing** and **oval track** applications

The type **GE** inline servo is functionally identical to the **HE** but is intended for installation anywhere between the firewall and the pinion.

An inline servo does not have to be mounted to the chassis if at least one end is rigidly coupled into the steering shaft (see the preferred servo mounting schemes and parts callout at the end of this section).



Type GEX Manual Racks

Any GE rack can be ordered minus the power steering components (servo, cylinder, rod bracket, hoses) by replacing the code letters which follow the ratio with an **X**, e.g. "GE262**X**-1825." Manual GE racks are not restricted as to rack end type, and can be supplied with any of the following: vertical tie-rod holes, slotted clevises with slot up or down, on-center clevises, or monoballs. On-center clevises and monoballs are shown in the type JL catalog section. Manual rack lengths are likewise unrestricted, and can be supplied in any desired length +/- .030. **Manual racks longer than 19.25 should be ordered as type GL** which is built with a proportionately longer housing to fully support the rackshaft.

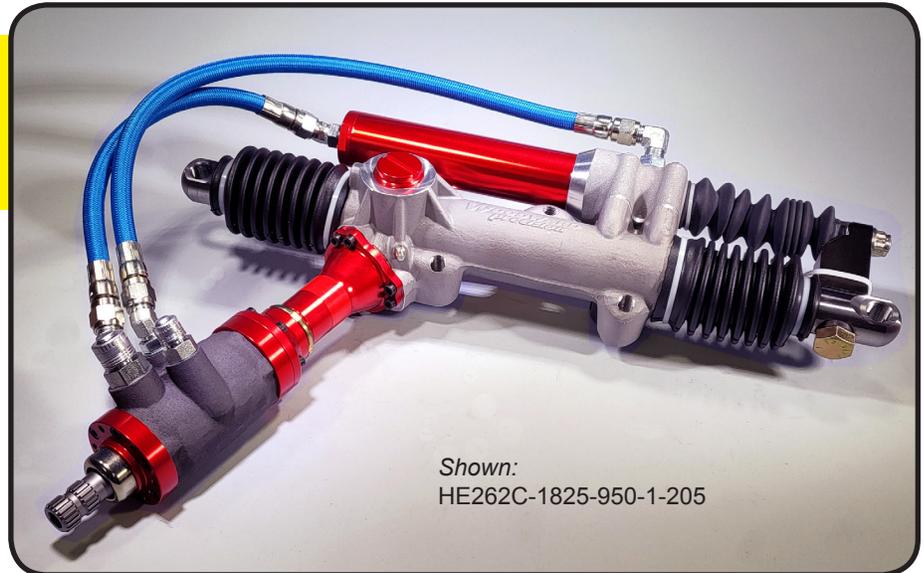
Type HE Power Racks, lengths 18.25 to 19.75 inches

Power steering with **integral** servo, for **road racing** and **oval track** applications

In the type HE the servo is directly mounted to the rack and is rigidly supported by the rack housing.

“Standard” vertical-hole racks are now equipped with a much stronger piston rod connection (a more detailed description appears on the next page).

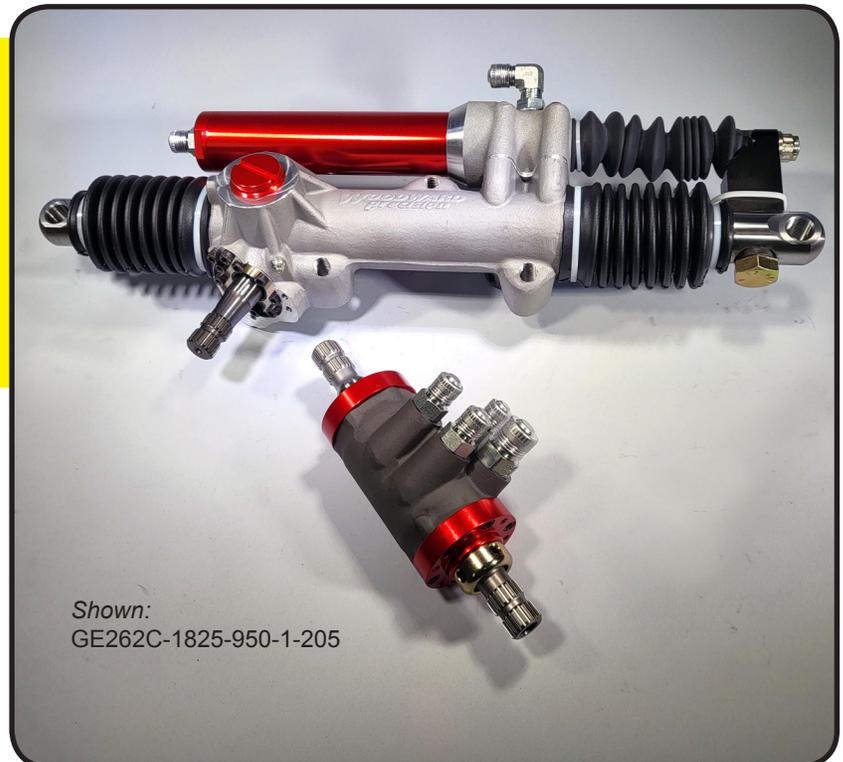
Mechanically simpler than a slotted clevis, the vertical bolt and spacer setup has withstood the test of time and is ideally suited for a tie rod solidly offset a fixed distance above the rack.



Type GE Power Racks, lengths 17.25 to 19.75 inches

Power steering with **inline** servo, for **road racing** and **oval track** applications

In the type GE the servo is separate from the rack for connection at any convenient point along the steering shaft, using splined couplers and U-joints in one of the recommended configurations illustrated on page 9. An inline servo is functionally identical to a direct-mount servo and can be equipped with the customer's choice of hose adapters, as well as custom hoses.



Type GEX Manual Racks

Any GE rack can be ordered minus the power steering components (servo, cylinder, rod bracket, hoses) by replacing the code letters which follow the ratio with an X, e.g. “GE262X-1825.”

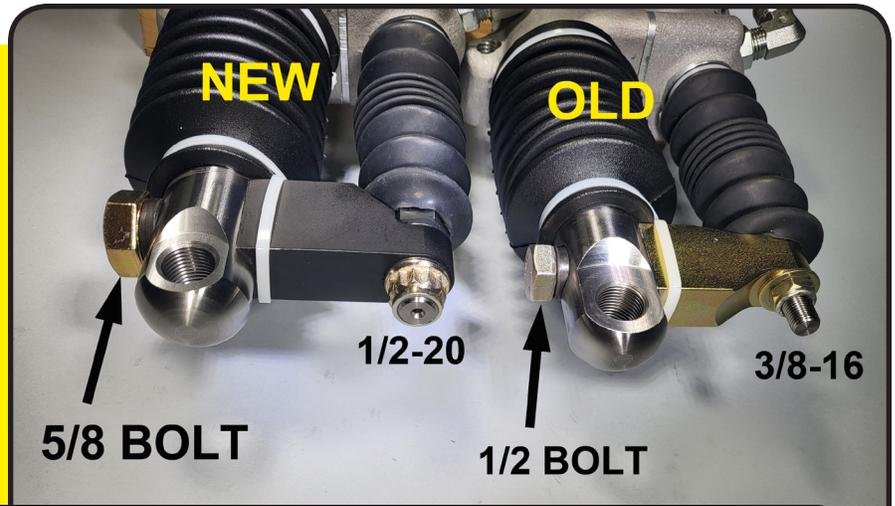
Manual GE racks are not restricted as to rack end type, and can be supplied with any of the following: vertical tie-rod holes (as shown here), slotted clevises with slot up or down, on-center clevises, or monoballs. Manual rack lengths are likewise unrestricted and can be supplied in any desired length +/- .030. Manual racks longer than 19.25 should be ordered as type GL which is built with a proportionately longer housing to fully support the rackshaft. (see the GL/HL section of the catalog).

Rack End Styles:

Vertical 5/8 bolt

The old "standard" vertical bolt hole has been updated to a much stronger design capable of handling elevated pump pressure. The end of the rackshaft is now thicker to accommodate a thicker rod bracket and larger 5/8 through bolt.

The cylinder is now the same as that used on clevis racks, with the larger 1/2-20 threaded end. The boot is retained by a flanged nut with an internal taper which locks it squarely to the piston rod for very high rigidity.



Ratios and rack lengths typically used for pavement tracks and road racing:

GE209C-1725, -1825	1437.98	HE209C-1725, -1825	1488.98
GE236C-1725, -1825	1437.98	HE236C-1725, -1825	1488.98
GE262C-1725, -1825	1437.98	HE262C-1725, -1825	1488.98
GE288C-1725, -1825	1437.98	HE288C-1725, -1825	1488.98
GE314C-1725, -1825	1437.98	HE314C-1725, -1825	1488.98

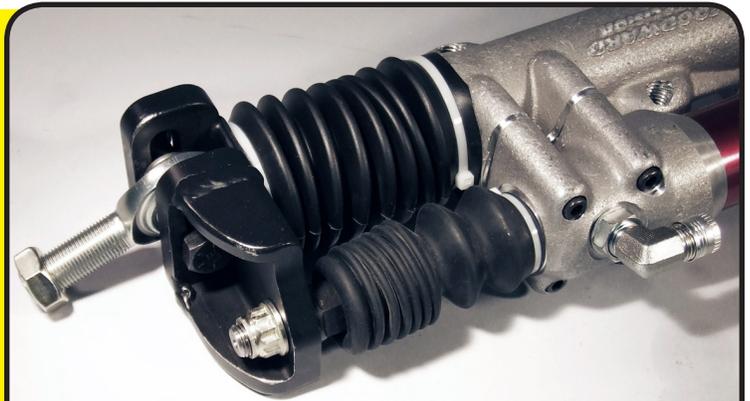
Ratios and rack lengths typically used for dirt track racing and autocross:

GE340C-1825, -1925, -1975	1458.98	HE340C-1825, -1925, -1975	1509.98
GE366C-1825, -1925, -1975	1458.98	HE366C-1825, -1925, -1975	1509.98
GE392C-1825, -1925, -1975	1458.98	HE392C-1825, -1925, -1975	1509.98
GE419C-1825, -1925, -1975	1458.98	HE419C-1825, -1925, -1975	1509.98
GE445C-1825, -1925, -1975	1458.98	HE445C-1825, -1925, -1975	1509.98

Slotted Clevis

Considered by many to be more convenient to adjust for bump steer than the vertical bolt and standoff spacer, slotted clevises are normally supplied "SLOT UP," with one inch adjustment above center and 3/16 below center, but are also available with one or both ends inverted.

When ordering, specify SLOT UP or SLOT DOWN for left, right, or both ends. Clevis racks are complete with 5/8 RH rod ends using 1/2 inch bolts and hat spacers.



Ratios and rack lengths typically used for pavement tracks and road racing:

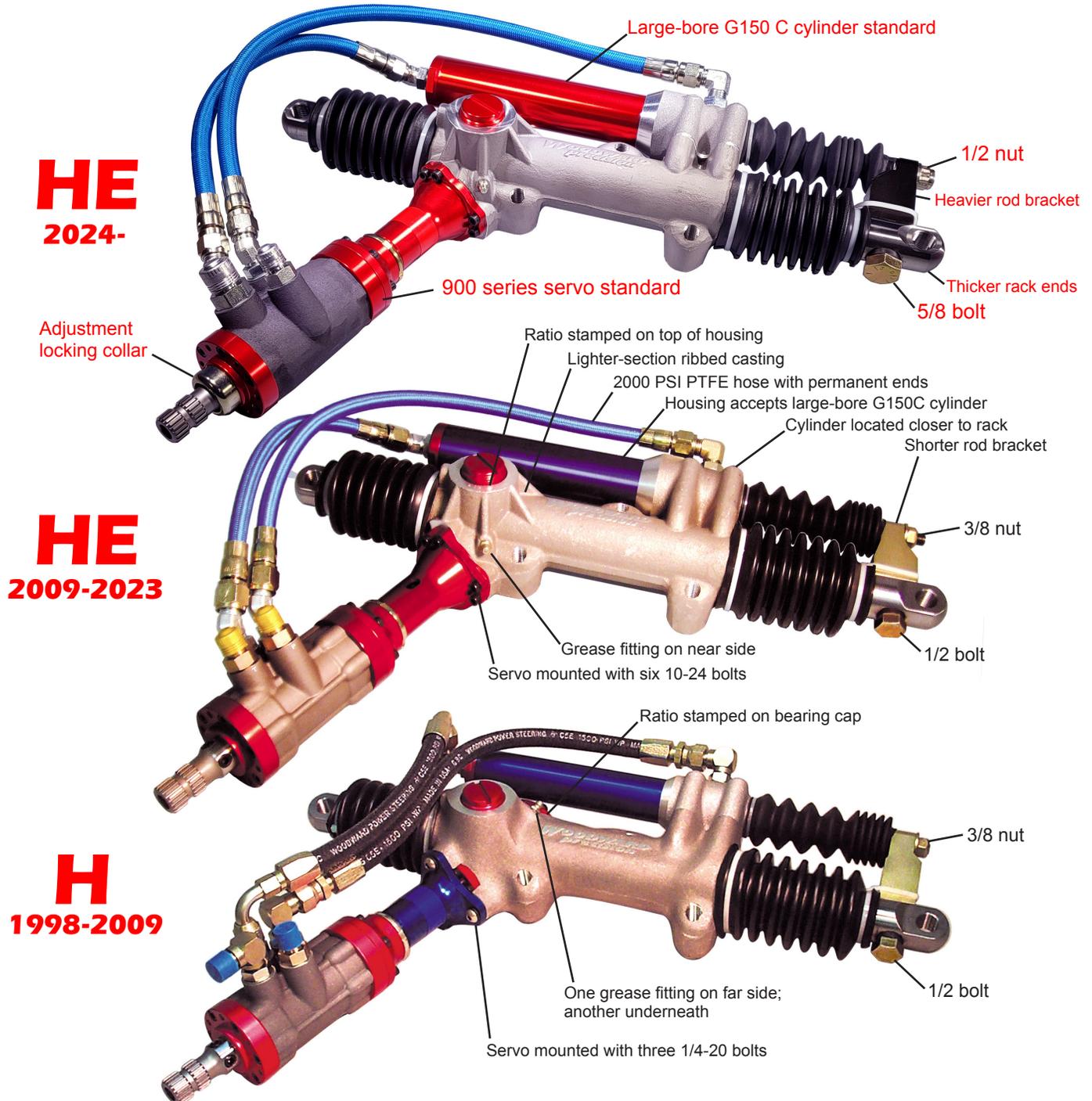
GEC209C-1725, -1825	1513.98	HEC209C-1725, -1825	1564.98
GEC236C-1725, -1825	1513.98	HEC236C-1725, -1825	1564.98
GEC262C-1725, -1825	1513.98	HEC262C-1725, -1825	1564.98
GEC288C-1725, -1825	1513.98	HEC288C-1725, -1825	1564.98
GEC314C-1725, -1825	1513.98	HEC314C-1725, -1825	1564.98

Ratios and rack lengths typically used for dirt track racing and autocross:

GEC340C-1825, -1925, -1975	1535.98	HEC340C-1825, -1925, -1975	1586.98
GEC366C-1825, -1925, -1975	1535.98	HEC366C-1825, -1925, -1975	1586.98
GEC392C-1825, -1925, -1975	1535.98	HEC392C-1825, -1925, -1975	1586.98
GEC419C-1825, -1925, -1975	1535.98	HEC419C-1825, -1925, -1975	1586.98
GEC445C-1825, -1925, -1975	1535.98	HEC445C-1825, -1925, -1975	1586.98

Rack type recognition

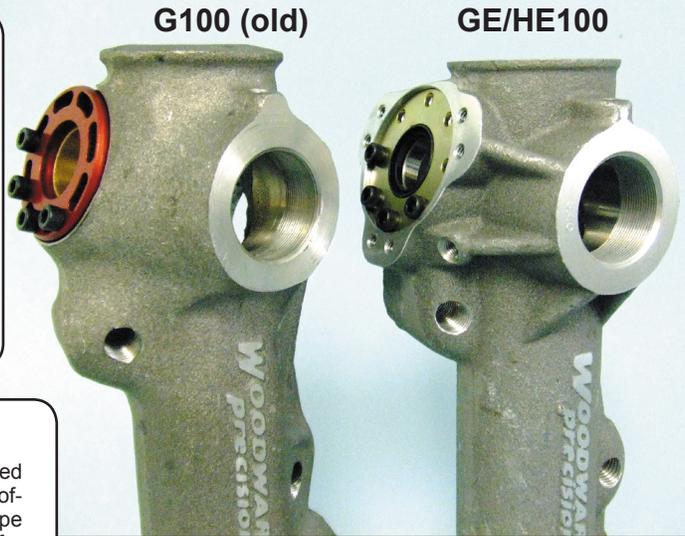
Beginning in 2008, Woodward oval-track rack models underwent a comprehensive redesign which lightened the casting and converted sleeve-bearing pinions to ball bearings. Because almost every detail of our racks was re-engineered and improved, *almost no internal parts are interchangeable between the former types G and H, and the later versions GE and HE.* The illustration below points out the readily identifiable external features which distinguish, as an example, a current type HE rack from an old type H rack. Before sending a used rack in for rebuild, verify that it's the newer HE design, as all type H parts were exhausted as of January 2013 except for rackshafts, rack bushings, and servo and cylinder components, which are still current and retrofittable. Since any type G or H rack still in service is by now *at least* fifteen years old, we recommend that it be replaced with one of the current models shown in this section of the catalog.



Please note that not all current features or options may be shown in the above illustration. The hose routing and servo port orientation are two elements which can be reconfigured to fit customers' chassis and engine installations. Improvements and new features are periodically introduced as running production changes. The next page compares the major individual parts in their pre-2009 and current versions.

GE/HE housing replaced both G and H

The former H rack, with its mounting provision for direct mounting of the servo, was distinct from the former type G which had no such provision and could be used only with an inline or remote servo. The current GE/HE rack housing can be used either way. When built as a type GE the servo mounting holes have bolts installed in them to exclude dirt. Except for the bolt hole at the upper left, which goes through to the interior, these bolts can be discarded and the cast boss cut or ground off if desired. However, leaving the mounting provision intact enables a GE rack to be converted to an HE at a later time by adding the servo adapter.



New design is more compact

Computer-designed material distribution has greatly increased the stiffness and load-carrying ability of the current housing while offering an extra .25 inch of usable rack travel over the previous type G and H housings. The grease fitting has also been relocated for improved access in the car. The pinion area now packs 50% greater ball-bearing capacity into a shorter space and allows the cylinder to be mounted closer to the rack without compromising the alignment of the pinion with the steering shaft.



GE500 (current)



E500D (old)

Specific-ratio machining

A five-axis machining process specifically locates the pinion bore for each ratio. The old design used a large assortment of eccentric bearing caps to accommodate different pinions, and was limited to a very coarse adjustment. The current caps have a very small eccentricity which allows the gear backlash to be set to virtually zero while preserving free conjugate action and eliminating any need for drag-inducing preload.



GE313 (current)

GE400 (current)



E400D (old)

All-ball-bearing pinion

The new pinions are supported by THREE ball bearings for increased radial load capacity and reduced friction. This feature adds significantly to the useful life of the rack, since pinion bushing wear and eventual misalignment of the gear teeth is completely eliminated. The stacked pair of ball bearings used to resist thrust loads was proven effective over many years and has been retained in the new design. A pressed-in lip seal to exclude dirt and pressure-washer fluid replaces the o-ring formerly used.

Inline Servo Layouts

Installation of the servo in the steering column is functionally identical to a servo attached to the rack, and will frequently offer better clearance in a crowded component area, for example to avoid interference with a left-mounted dry-sump pump or fuel pump, an existing set of exhaust headers, or just a wide engine block located close to the steering rack.

A major advantage on a any car exposed to severe contact, such as dirt track racing, is that the servo is less vulnerable to crash damage if located back between the frame rails. Another factor in favor of an inline servo is its location farther rearward in the car (and importantly in the case of oval track racing, farther to the left). Three proven reliable installation schemes are presented below.

Case 1

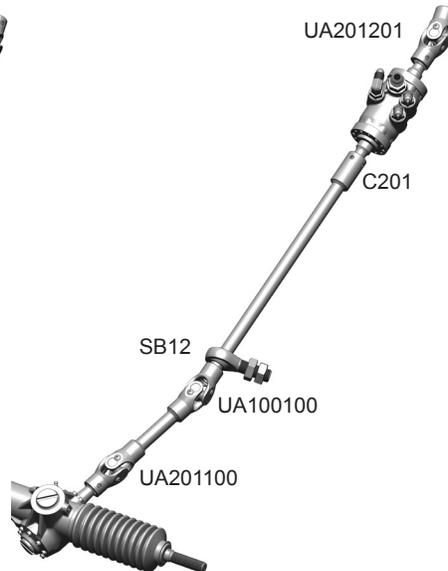


The simplest way to install a servo inline is to couple it into the intermediate shaft at any convenient point between the firewall bearing and the pinion. Since all the parts between the two u-joints are rigidly clamped together, the servo should be considered a solid part of the shaft.

It is not necessary to bolt the servo housing to the chassis nor restrain it against rotation; its torque reaction is internal.

Since the two u-joints in this case are at opposite ends of what is essentially a single shaft, their yokes should be *in phase*, i.e., aligned like the opposite ends of a driveshaft.

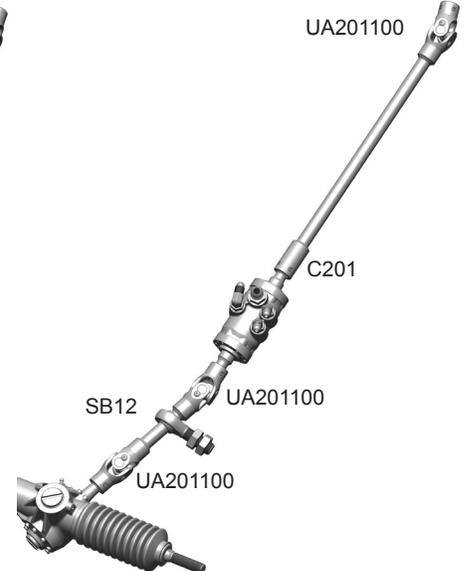
Case 2



If it is impossible to reach the pinion in a straight line from the firewall bearing, the intermediate shaft can be divided with a third universal joint. Because this u-joint is not connected to a fixed object (such as the firewall or the steering gear) it must be stabilized—as close to the joint as possible. In this instance an SB12 bearing is used on the upper section, but it could just as well be used on the lower, depending on which location were easiest to provide with a suitable mounting tab.

Note that the u-joint yokes on the lower shaft section are in phase. The servo is effectively part of the upper shaft section and its u-joint yokes should also be in phase.

Case 3



Here the Servo is again part of the upper section of a two-piece intermediate shaft, but is placed at its lower end, alongside the engine block. In this instance an SB12 bearing stabilizes the u-joint from the lower shaft section because the servo occupies the upper section.

Again, note that the u-joint yokes on the lower shaft section are in phase. The servo in this case remains part of the upper shaft section, and those u-joints should also be in phase.

Rigidly Mounting the Servo

The above methods all have the servo acting as a part of the shaft, so that its internal parts are free to rotate without any side loads. The only instance where the servo *must* be mounted against the chassis is when it is forced to act as a bearing, that is, with a universal joint at both ends. If such placement is unavoidable, the servo will perform perfectly well when mounted using the bracket shown at right. However, just as with any of the “floating” positions shown above, make sure the input and output U-joints are in phase (as if the servo were just one simple uninterrupted shaft) and the unit is bolted down securely.

Do not isolate the bracket from the chassis with rubber (or, for that matter, with any damping material). Rubber will allow it to rebound from torque input, which will cause the entire front end to shimmy as the wheel is turned.

