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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 reponsible 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, 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.

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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. Custom built steering racks generally have a lead time of 4 weeks ARO.

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:

In this catalog, many categories of parts are only manufactured 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 consequently these are not returnable. All type CF racks are manufactured to client specifications; there are no “standard” models.

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Type CF Power Racks (ratios from 1.57 through 3.14 inches per turn)

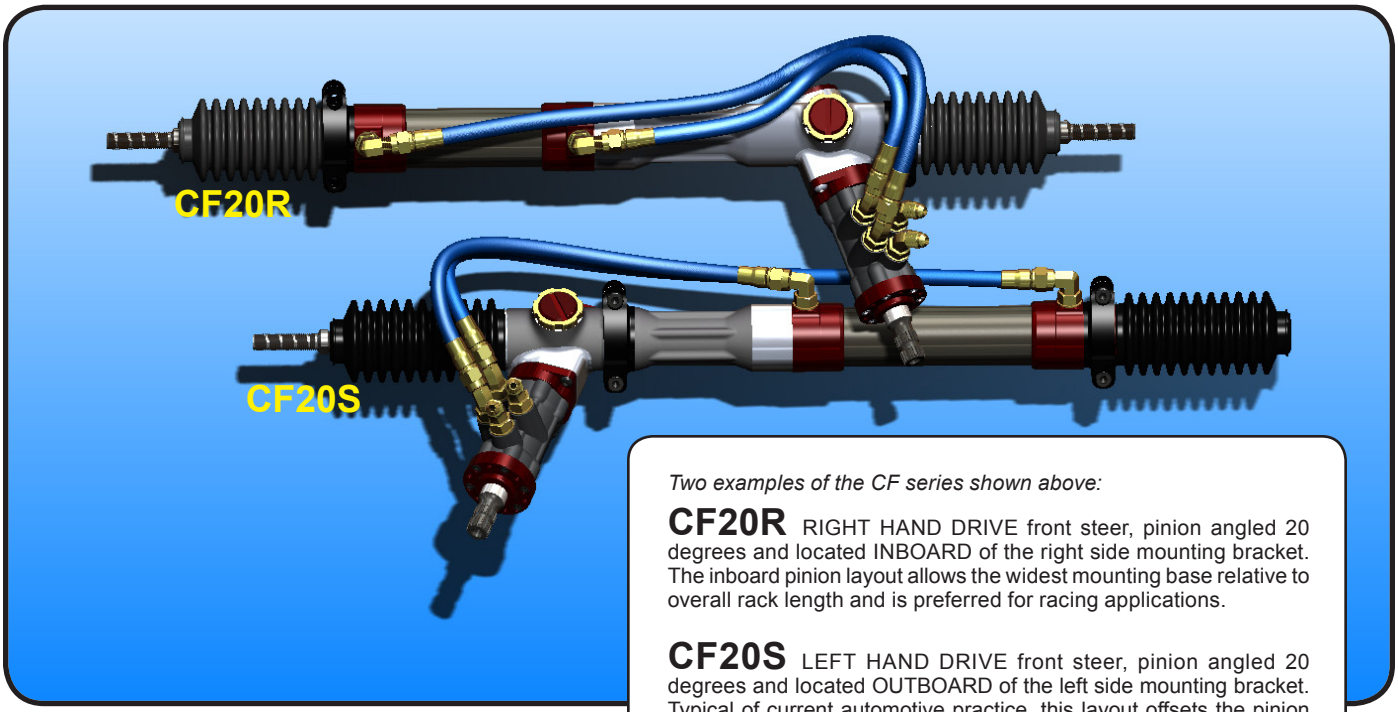
Power steering with integral cylinder and servo, for all types of race cars

CF power racks are custom designed using 3D CAD modeling to conform to your chassis geometry and available space. The basic layouts listed herein are starting points. Dimensions, rack travel, gear ratio and other specific engineering details can be noted on the CF Design Worksheet at the end of this section (or downloaded from the Detailed Tech Info section of the website) and e-mailed to tech@woodwardsteering.com for a prompt quotation. The cost of a CF rack is typically USD4700-5200 FOB our plant, and the lead time for a prototype is five weeks after model approval, with 50% prepayable before we cut metal. Production quantities can be delivered on a schedule to complement your race car production.

Please note that we do not do modifications of OEM steering, nor can we duplicate the steering rack in your street automobile.

The Woodward CF series is the revolutionary answer for racing applications where packaging requirements previously dictated a reliance on power racks of the passenger-car type, with their limited potential for performance at the level required in professionally built race cars. A pure racing design based on our more than 40 years' experience *and manufactured entirely in our own plant,* the CF group constitutes the broadest selection of racing power steering racks offered anywhere in the world. Several models are currently FIA homologated as original equipment in the various GT and LMP classes, and one model is the standard steering for the NASCAR Cup Series.

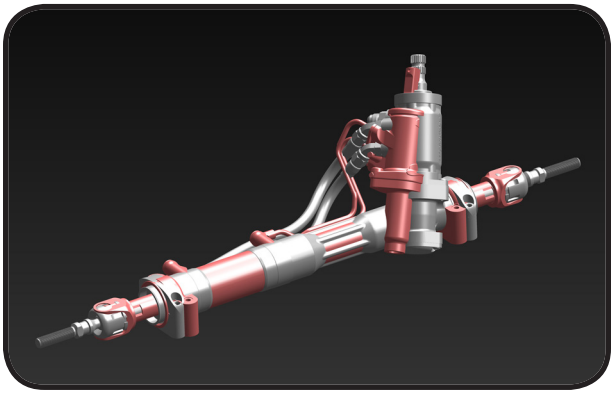
The CF design platform encompasses SEVEN GEAR RATIOS, THREE PINION ANGLES, THREE PISTON SIZES, TWO TIE-ROD END TYPES and a PRACTICALLY UNLIMITED RANGE OF PINION LOCATION. All combinations of these are available in LEFT or RIGHT HAND and in FRONT STEER (rack *ahead* of the front wheels) or REAR STEER (rack *behind* the front wheels). All utilize the high-capacity, hyper-responsive Woodward servovalve, proven for decades in winning cars all over the world from Le Mans to Daytona.



Two examples of the CF series shown above:

CF20R RIGHT HAND DRIVE front steer, pinion angled 20 degrees and located INBOARD of the right side mounting bracket. The inboard pinion layout allows the widest mounting base relative to overall rack length and is preferred for racing applications.

CF20S LEFT HAND DRIVE front steer, pinion angled 20 degrees and located OUTBOARD of the left side mounting bracket. Typical of current automotive practice, this layout offsets the pinion and steering shaft one inch (25 mm) closer to the end of the rack for tight packaging situations.



Rapid Design and Packaging Solutions

Frequently a close replacement for an out-of-production or otherwise unobtainable power rack can be built on short notice at far lower cost than the original by utilizing Woodward's array of standard CF castings—which are designed to support customization well beyond the 24 basic configurations. It usually happens that the replacement version will outperform the original, which typically will have been based on OEM valve internals. Where CAD data of the chassis area surrounding the steering rack is available, we can employ 3D superimposition to check clearance around the engine and gearbox and ensure that the space can be fully utilized with the least compromise of the rack construction.

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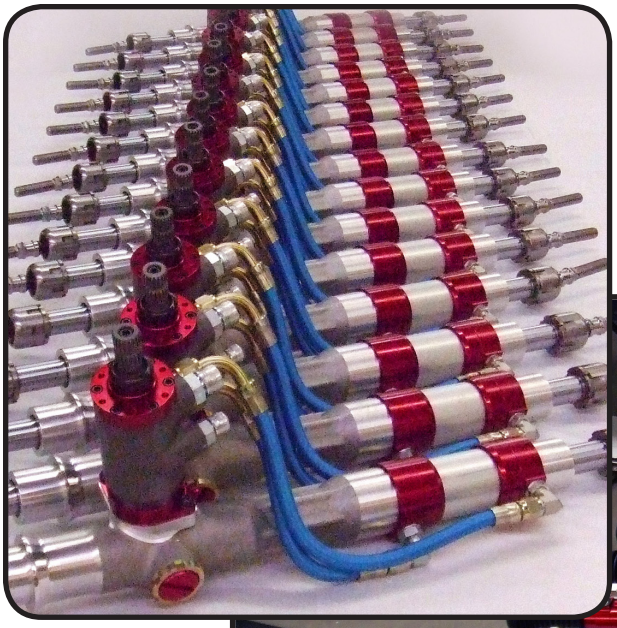
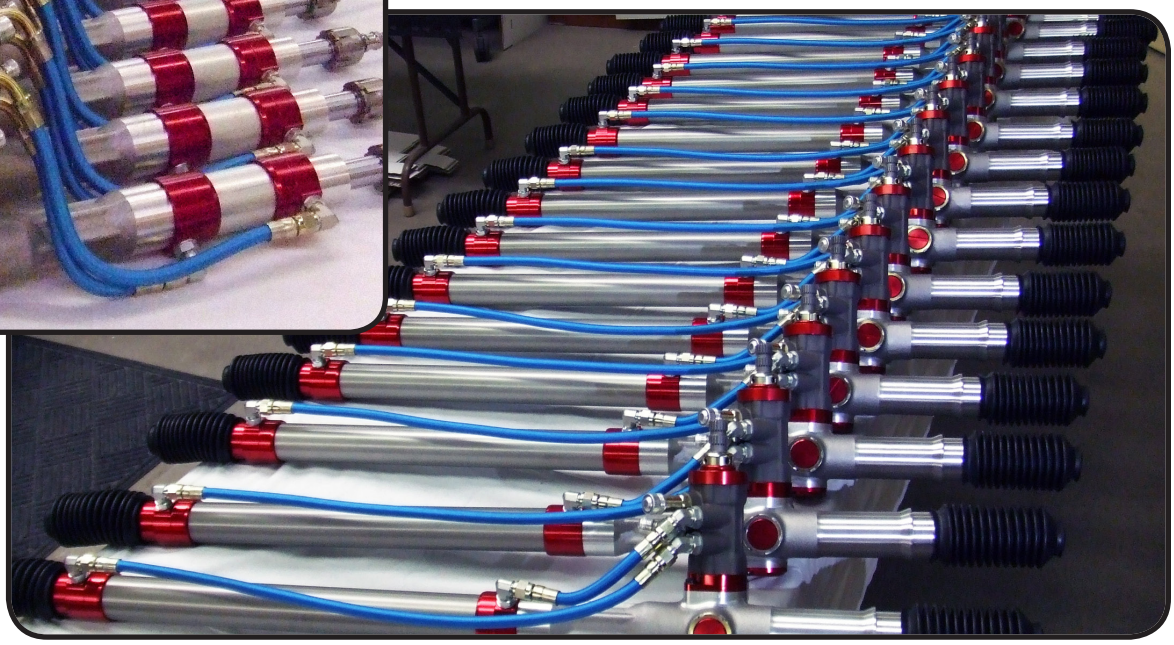


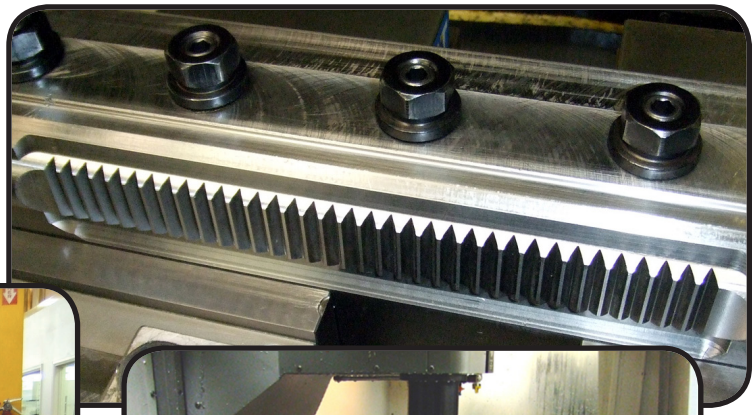
Prototypes to Production Quantities

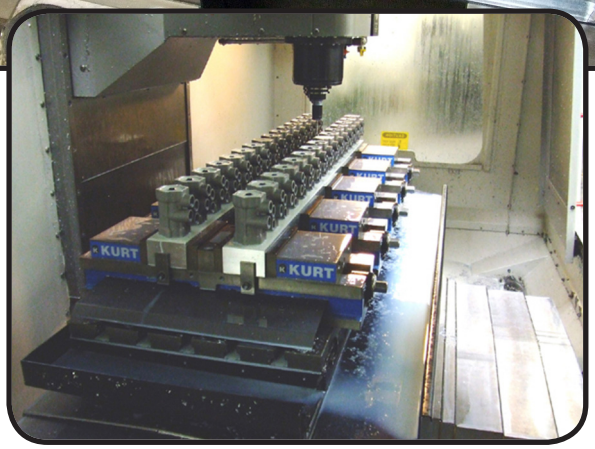
Any of the custom power racks shown on the preceding pages can be built in either right or left hand drive. Woodward can design and manufacture any variation of the CF power steering rack at extremely reasonable cost and rapid first-article delivery, in quantities to supply an entire racing series, an entire production run of a homologated race car, or a single unit designed for a one-off supercar project. Parts, reconditioning service, testing and complete technical support are available in the US and Europe.



Precision Machining

Like all other Woodward rack types, the CF uses no OEM or salvage components. Our rackshafts are manufactured in-house on state-of-the-art CNC equipment, to the exact dimensions needed for the client's project. Other Woodward parts, such as the pinion and valve tower, carry the distinct advantage of being made in production quantities in all their variations and stocked in our plant for ready incorporation into the client's project with the absolute minimum lead time.





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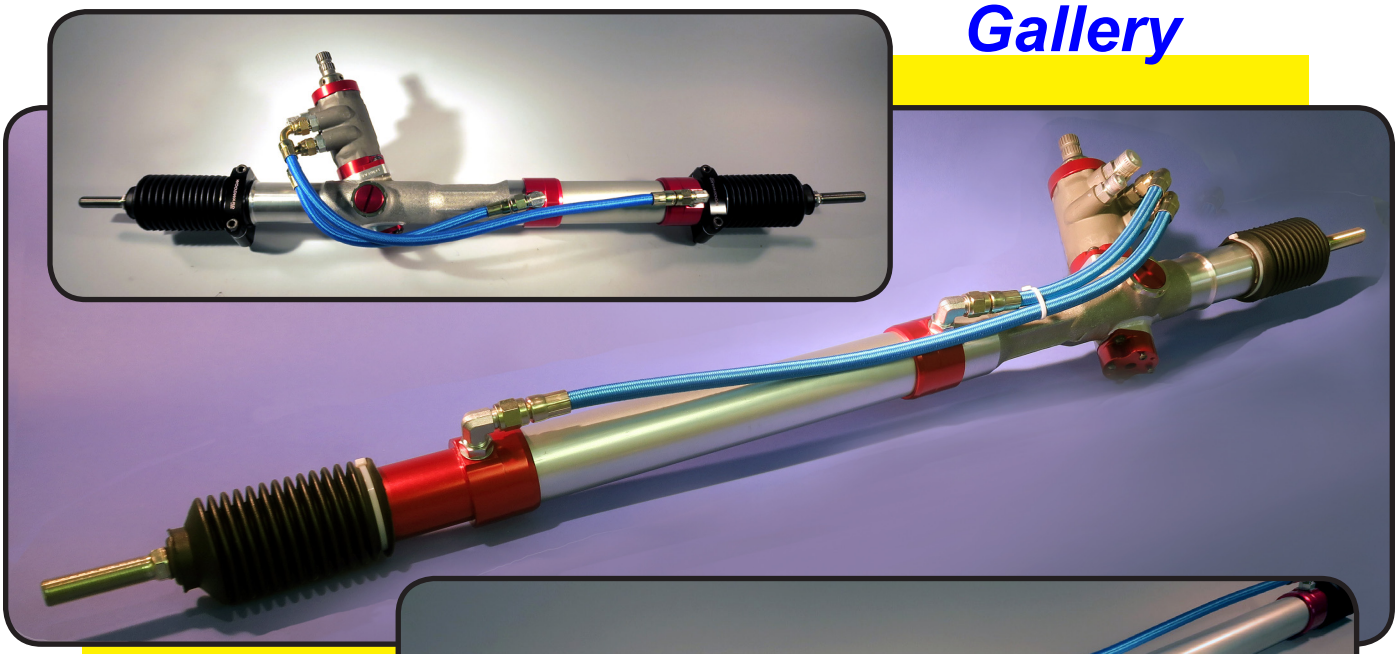
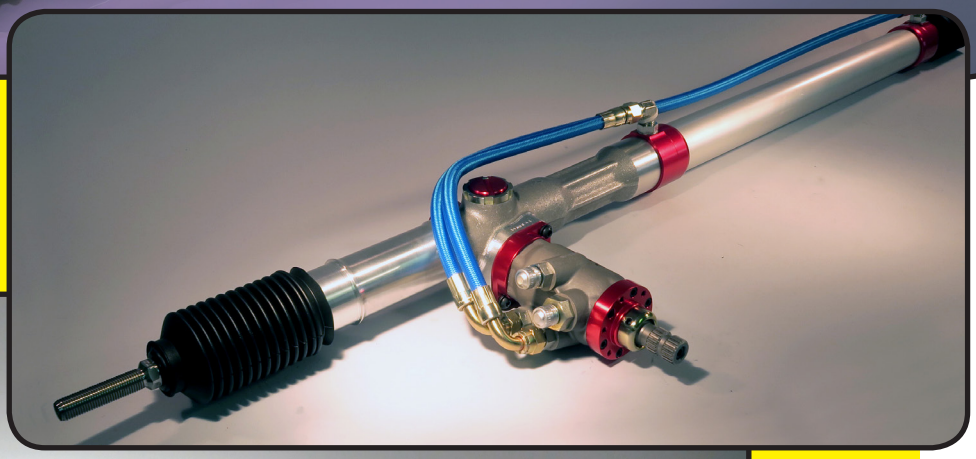
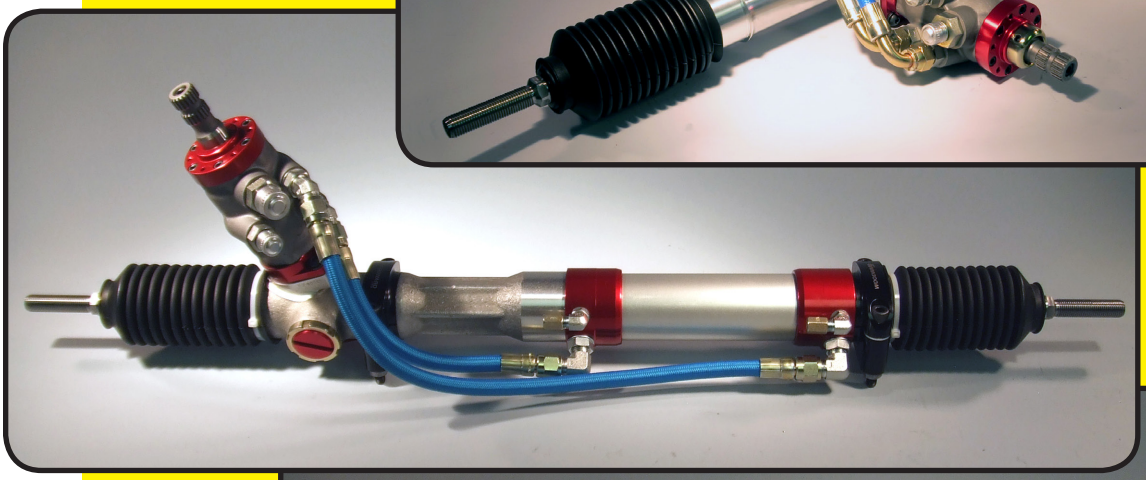
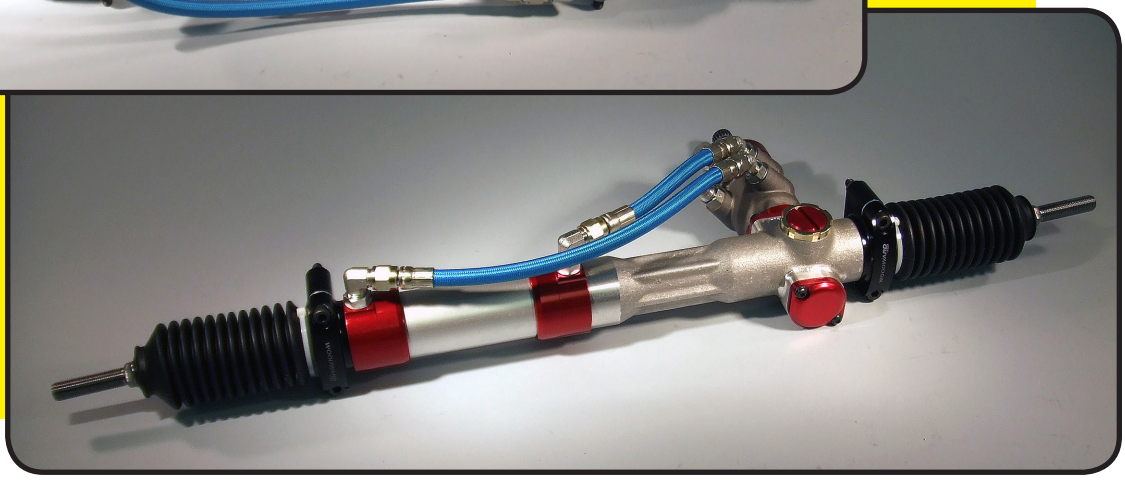
Left hand, right hand, front steer, rear steer, long, short—and everything in between...

Gallery









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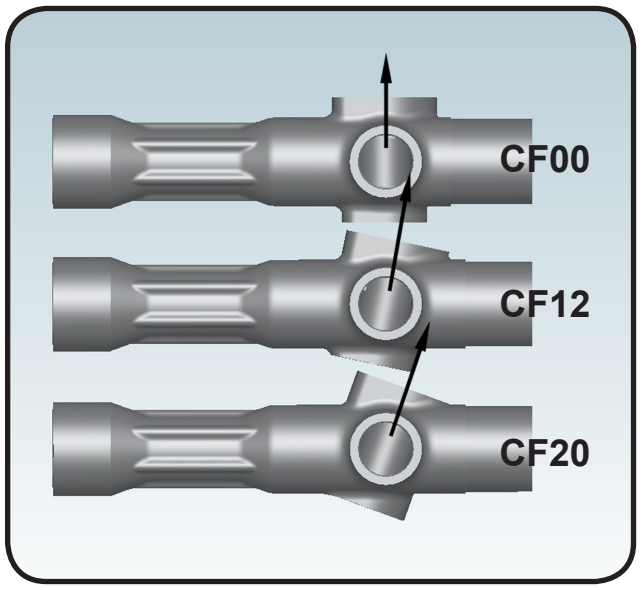
Options *(Next 5 pages)*



Front steer or Rear steer

With the steering rack positioned ahead of the centerline of the front wheels, the pinion engages the rack from beneath. With the steering positioned behind the centerline of the front wheels, the pinion engages the rack from above. If these conditions are not met, the steering will operate in reverse.

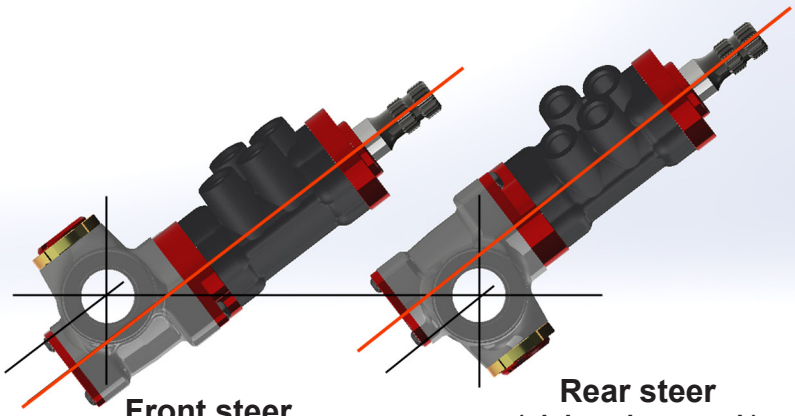
In a front steer layout, the outer ends of the tie rods are located outboard of the kingpin axis to obtain positive Ackerman, or steering toe. In a rear steer layout they are inboard. In this case, rear steer has a packaging advantage because the outer tie rod ends tend not to interfere with the wheels or brakes. However, under severe braking front steer tie rods are loaded in tension whereas in rear steer they are loaded in compression. Because of this, tie rods used for rear steer applications should generally be of stiffer construction.

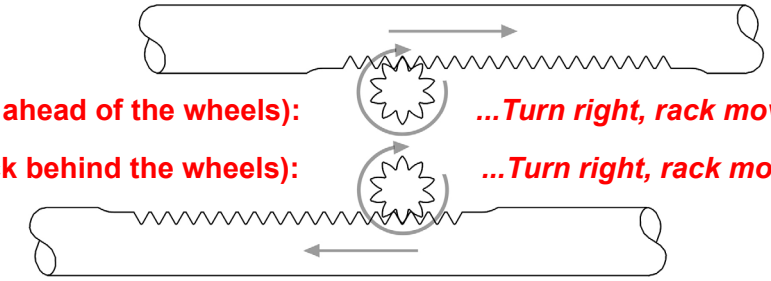
The principal factor in designing for front or rear steer is engine clearance, which is why the vast majority of purpose-built front-engined race cars are front steer.

Three pinion angles in left and right hand

As a general rule, the pinion is angled toward the steering wheel so as to achieve the lowest total angular and parallel misalignment. The smaller the operating angles of the universal joints, the more constant the velocity of steering input. The ideal–seldom achieved–is for the steering column to be connected directly to the pinion spline, as in a single-seater formula car. The straighter the pinion, the lower the frictional and thrust losses (which is, incidentally, why today's racing transmissions are mostly equipped with straight spur gears). Cars with no engine in the front bay should be able to fit one of the CF00 models with a straight pinion. As obstructions (such as an engine) are introduced into the front of the race car it becomes more difficult to align the steering column and pinion, and so the pinion must point to one side. A straight-bank engine may only need a minimally angled pinion such as the CF12, while a forward-mounted V8 or front drive differential may require a CF20 for clearance. The width of the rack plays a part as well; the wider the rack, the farther the pinion can be located to one side.

In cases where the race car is to be based on a production automobile, it is sometimes possible to improve the routing of the steering column by using a straighter pinion angle, especially if the engine is being set back and/or obstructions such as antiroll bars and air conditioning will be relocated or removed. Much of what is possible in this area will depend on the extent of refabrication planned. A kit is available to simplify the welding of rigid brackets to the chassis to replace the usual OEM rubber mounts, after which the rack can be rotated into optimum alignment with the steering shaft and clamped in place.





Front Steer (rack ahead of the wheels): ***...Turn right, rack moves RIGHT***

Rear Steer (rack behind the wheels): ***...Turn right, rack moves LEFT***

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A huge range of steering ratios

A rack and pinion gear ratio is defined as linear rack movement in 360 degrees of pinion rotation. In the CF rack these are available in increments of approximately .26 inch (6,65 mm), from 1.57 inches (40 mm) per turn through 3.14 inches (80 mm) per turn. The slow end of this range is equivalent to most road-vehicle steering, while the quick end is suggested where violent changes in direction are intended, as in autocrossing.

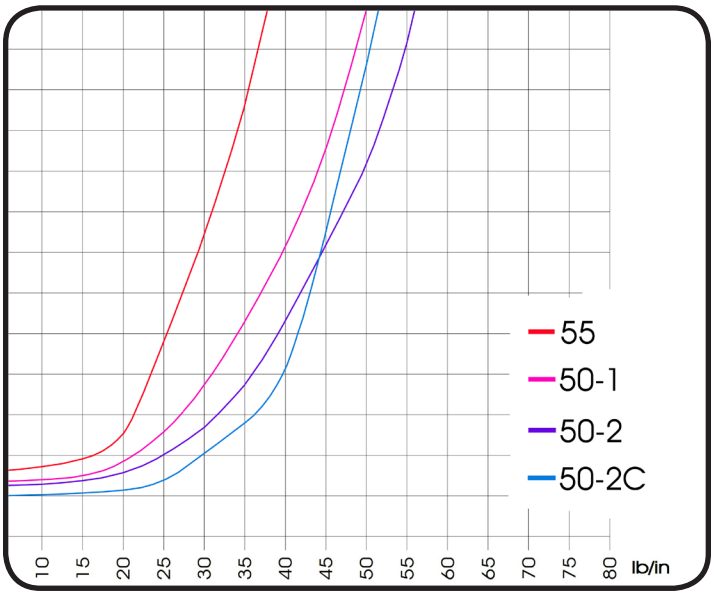
Across the various configurations of CF racks (straight pinion, 12 degree angled pinion and 20 degree angled pinion) there are 35 pinion part numbers. *This is by far the largest selection of steering gears manufactured as standardized race car parts anywhere in the world.* This degree of commitment enables Woodward to respond rapidly with a well-engineered bespoke design for virtually any motorsport application, with steering performance far superior to what can be achieved by modifying an OEM rack.

Woodward pinions are hardened alloy steel with a minimum tensile strength of 235,000 PSI (1,620 MPa).

Three piston choices

A useful tool for the vehicle designer, the CF is now available in three different cylinder diameters, the standard 1.63 bore with an effective piston area of 1.30 square inches (839 mm^2) the 1.75 bore with 1.63 square inches (1052 mm^2) and the new 2.0 “big bore” with 2.35 square inches (1516 mm^2). As a rule of thumb, the maximum theoretical axial force available from the steering is equal to its piston area multiplied by the maximum fluid pressure produced by the pump just below its relief point.

In general, lighter car weight and/or conservative geometry requires less assist, and a smaller piston can be more efficient because it displaces a lower volume. However, heavier cars, or those with high downforce and/or aggressive geometry (high positive caster, large scrub radius, etc), may need a larger piston simply to lessen the load on the pump. The special problem of a mid-engined car with an engine-driven pump is nicely solved with the larger piston, coupled with the larger return porting of the optional 900 series servo. In a mid-engined car the fluid circuit can be long enough to cause a lag in the power steering. In such cases, the larger piston will allow the required steering force to be obtained at an earlier point on the response curve, reducing the load on the pump and eliminating the lag.



Perfectly Matched Power Assist

The Woodward servovalve is manufactured entirely in our plant and, unlike our competitors’ valves, does not utilize any OEM components. It is designed with a combination of torsion-bar-controlled resistance and progressive orifices, making possible the most sensitive and precise power steering available anywhere in the world. Several basic valve profiles plus a range of torsion bars in small stiffness increments, can be matched to any steering ratio, in any type of race car of any weight, and under any conditions of tire loading due to suspension geometry or aerodynamic downforce.

Extremely large internal porting and low turbulence eliminates the sensitivity-robbing hydraulic damping encountered when OEM-based power steering is adapted to race cars. The Woodward servovalve will maintain a very close connection between the driver’s hands and the tire contact patch, even while overcoming impulsive loads from rough track surfaces and responding to rapid steering inputs.

For the race car builder wishing to optimize the power assist during the testing phase of a new race car, the entire servo assembly can be switched out in the field, saving expensive development time for other uses.

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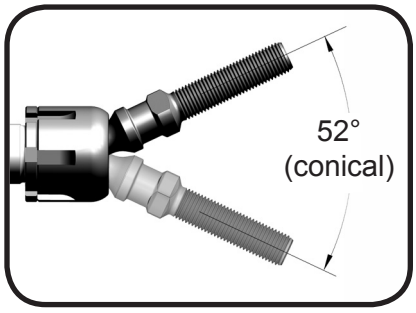
RACK END OPTIONS

1. Low-drag monoballs with adjustable preload

All parts of the monoball rack ends are machined from billet. They have much lower "stiction" (breakaway torque) than ordinary automotive rack ends, almost completely eliminating the drag of suspension movement and delivering enhanced steering response.

Completely disassemblable and re-greasable, with no plastic inserts, the high tensile alloy ball studs are recessed into the ends of the rackshaft for maximum stability and they pivot through a 52° cone. The standard ball studs are threaded 14 mm x 1,5 and are also available in the larger 5/8-18 NASCAR version.



Easy, precise adjustment:

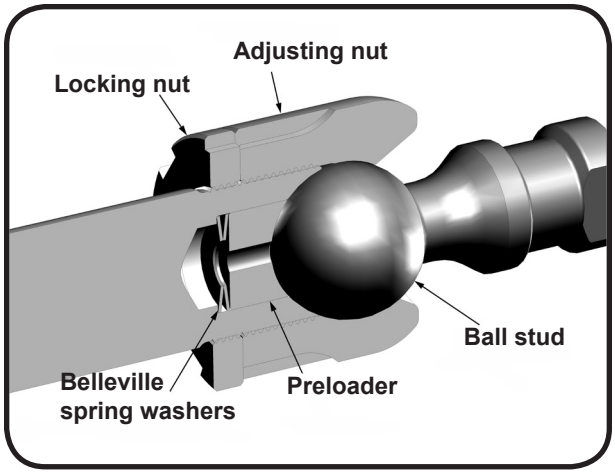
Belleville springs provide a high spring rate over a very short range and can be adjusted to allow free movement with no perceptible play in the steering, according to the mechanic's preference. The stiffness can be further altered with optional spring washers of different thickness.

To set, turn the adjusting nut until the ball stud will not move, and then back off one wrench slot. For the maximum recommended preload back off half a slot, for the minimum preload back off 1-1/2 slots.

Both nuts take the M600-160 hook spanner. The adjuster has 6 slots and the locking nut 7, which allows two wrenches to be positioned for a powerful "squeeze" without applying any turning force to the rack itself.

Always tighten the locking nut and adjusting nut against each other. Never turn the rackshaft with a wrench against the resistance of the pinion.

NOTE: If the rack is being run without rubber boots, the ball will inevitably be exposed to dirt. In such cases, the adjusting nut should be removed and the spherical cavity cleaned, greased and readjusted at every opportunity. If the rack is equipped with rubber boots, it is only necessary to pack grease around the ball and it will stay lubricated. The preferred grease is petroleum base lithium complex with MoS2. *Silicone grease is not recommended for steel-on-steel applications.*

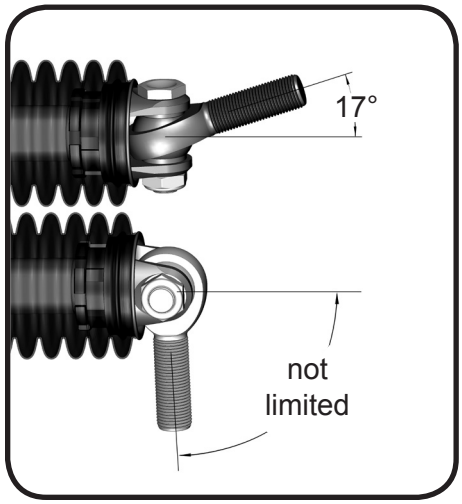


2. New orientable clevises

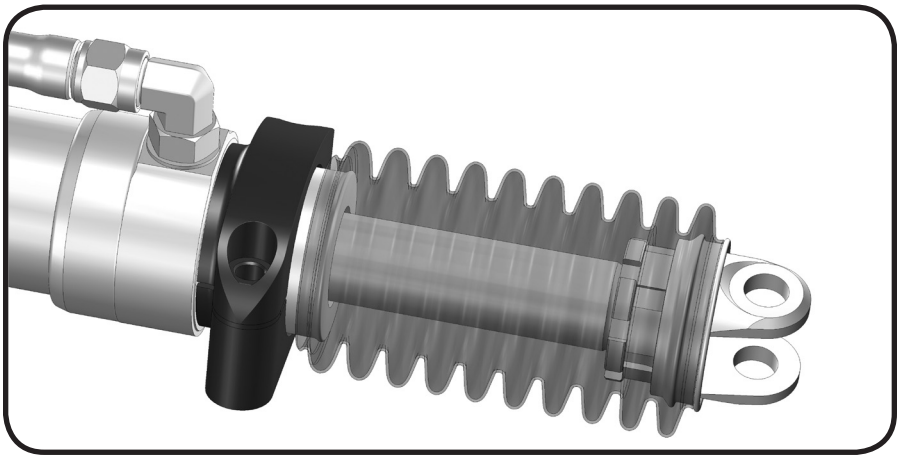
The spherical rod end supplied with the clevis is limited to 17° maximum angular misalignment in the plane of the bolt axis and up to 90° perpendicular to it. While monoballs are generally suited for the majority of racing applications, off-road and rally racing usually involve much greater suspension droop—and clevises, suitably oriented, will meet that requirement.

The clevis axis can be rotated and locked in position using two opposing hook spanners. The locking nut takes the same M600-160 wrench as the monoballs, while the clevis uses the smaller M600-150 wrench. The clevis has 6 slots and the locking nut 7, allowing the pair of wrenches to be positioned for a powerful "squeeze" without applying any turning force to the rack itself.

*Always tighten the locking nut and adjusting nut **against each other**. Never turn the rackshaft with a wrench against the resistance of the pinion.*



The clevis boot is extended onto a pressed-on machined aluminum lip, which prevents the boot from being stacked solid and thereby limiting rack travel.



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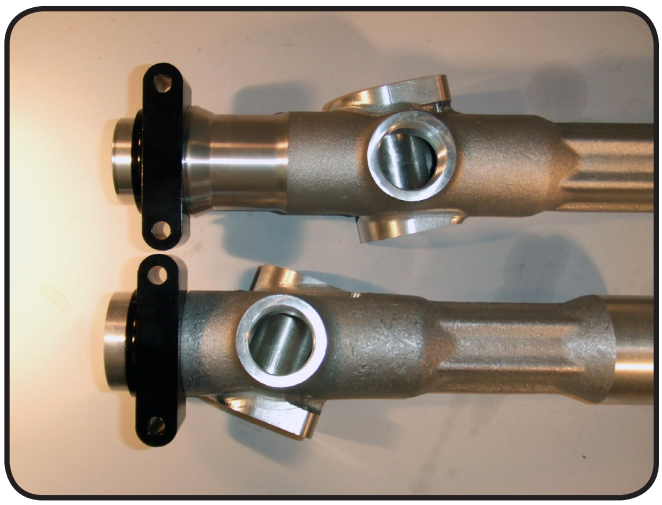
Advanced Housing Options

When the pinion is placed outboard of the mounting clamp (for example, the CF20S model shown on page 3) it necessarily has a fixed location relative to the end of the housing and results in overhang of the rack bushings at that end.

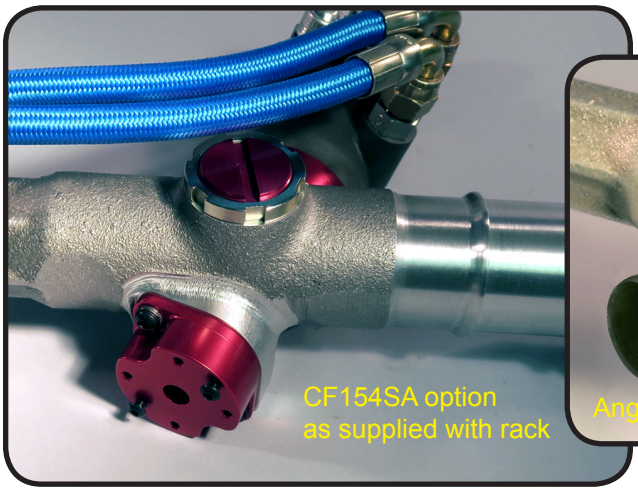
The inboard pinion, on the other hand, can be placed at virtually any specified distance from the center or from the end, subject only to the limitations imposed by rack length and rack travel.

As in the upper example at right, the basic CF housing can be tailored with a machined extension containing the maximum possible bearing length. This increases the stability of the steering because the rack bushings are directly supported by the mount, which carries the loads directly into the chassis—minimizing dynamic toe change (bump steer) caused by deflection.

This is a reliable and frequently performed design modification, and can be incorporated into any CF rack project at very reasonable cost. The need for extending the housing is determined by the dimensional requirements entered on the Design Worksheet found at the end of this section of the catalog (or downloaded from the Detailed Tech Info section).



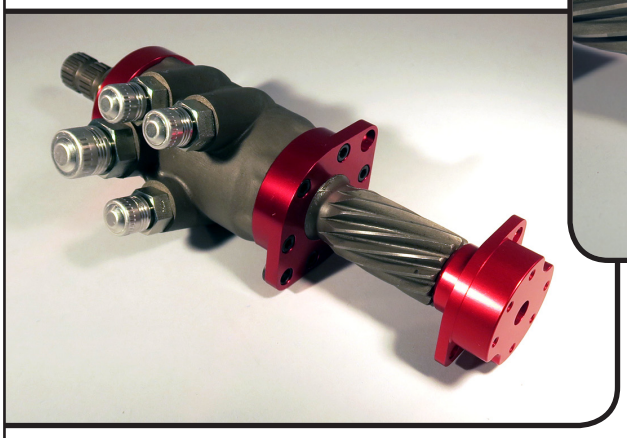
Steering Angle Sensor Mount Option

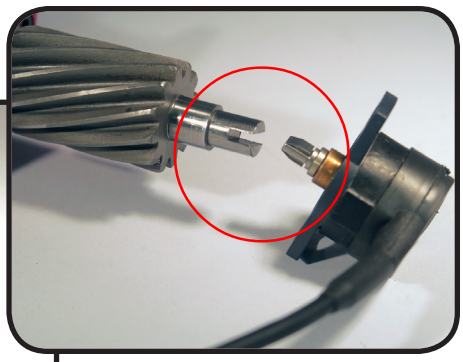


Together with a pinion modified with the addition of a drive adaptor, the optional CF154S pinion bearing cover allows mounting of the popular Novotechnik® rotary potentiometer. A triple hole pattern in the CF154S cover provides six possible routing directions for the cable. The mounting screws supplied with the cover are M4 Torx Button Head with a T15 drive. A 10mm hole provides a positive location for the sensor housing, and full contact between the sensor and the cover excludes dirt and contaminants.

The setup is preinstalled on a CF rack at the factory. Retrofit to older CF racks is possible but may require drilling and tapping a hole in the hardened pinion if it is old enough not to have one. We can perform this modification at the factory either in connection with a rack rebuild or on a servo/pinion assembly. *The kit does not include the sensor itself, which is available separately from any number of motorsport industry sources.*

Steering Angle Sensor Mount Option
CF154SA.....290.46





The drive adapter is machined from 4140 alloy steel and is screwed and bonded into the end of the pinion. As shown above, the slot accommodates the sensor's drive tab which is centered with an integral leaf spring.

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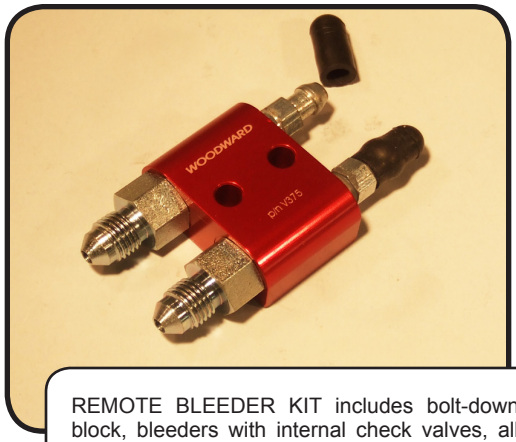
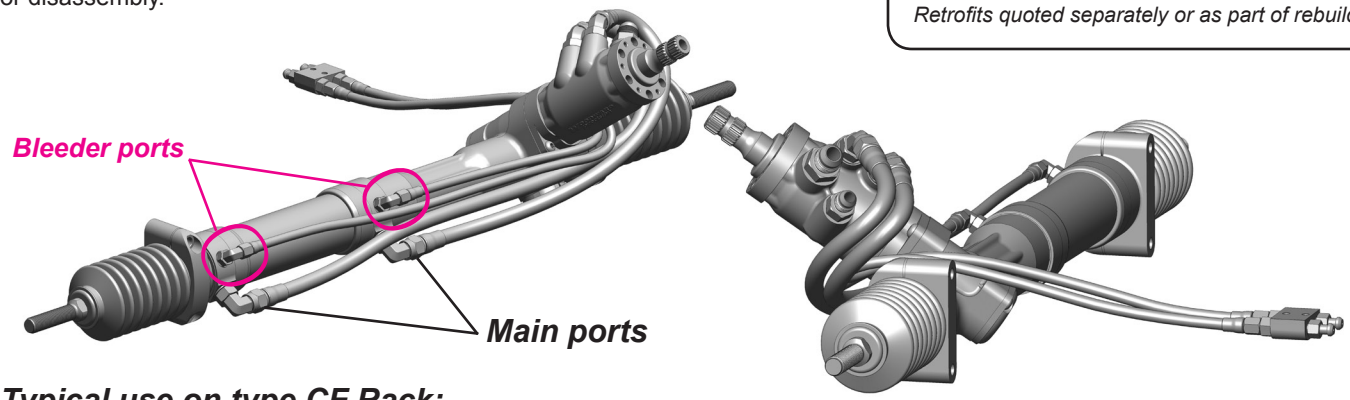
Remote Air Bleed Option

Air is a compressible medium. If present in the fluid it will create weak, chattering, and generally non-positive steering. In order to allow air to escape from the cylinder, its fluid ports must be located within the upper 45 degrees (between 10:30 and 1:30 as installed in the car). Where this is not possible because of interference by other components, the cylinder ends can be machined for a remote bleeder system. This is least expensive if done at the time the rack is originally manufactured, but can be retrofitted in conjunction with a teardown and rebuild.

Instead of installing brake bleeders directly in the cylinder adapters (in what is often one of the least accessible places on a race car) the cylinder is connected through ordinary AN-3 brake hoses to a block containing the bleeders. This light, compact block is fastened to the chassis in a location easily reached by the mechanic with a 5/16 or 8mm box-end wrench. The bleeders are equipped with internal check valves which prevent air from being drawn back into the cylinder as it reverses direction. This allows each side to be quickly and easily purged of air with the steering under pressure, without dismantling or disassembly.



REMOTE BLEEDER KIT includes bolt-down block, bleeders with internal check valves, all hose adapters, and AN/JIC-3 O-ring ports machined in the rack at time of order.
V375 ..... 221.45
Retrofits quoted separately or as part of rebuild

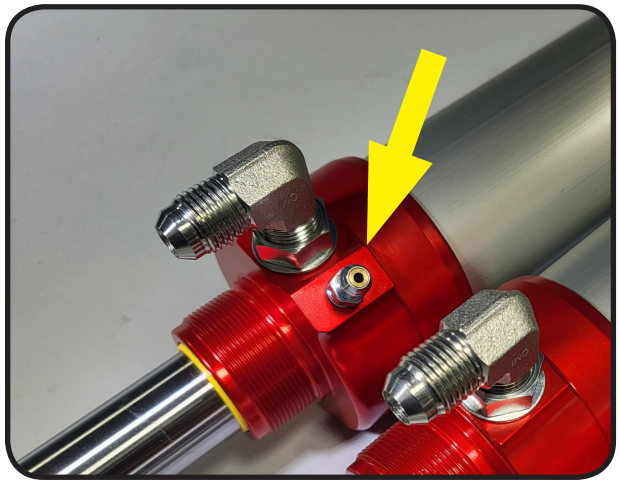


Typical use on type CF Rack:

The difficult packaging challenge shown above involved a RHD Rear Steer rack which had to fit immediately behind—and almost in contact with—the dropped portion of a front-sump engine. Because the lines had to stay below the top of the rack, the main ports could not vent the top of the cylinder. The smaller -3 bleeder fittings offered the necessary clearance and the block could be mounted in an accessible spot well away from the rack.

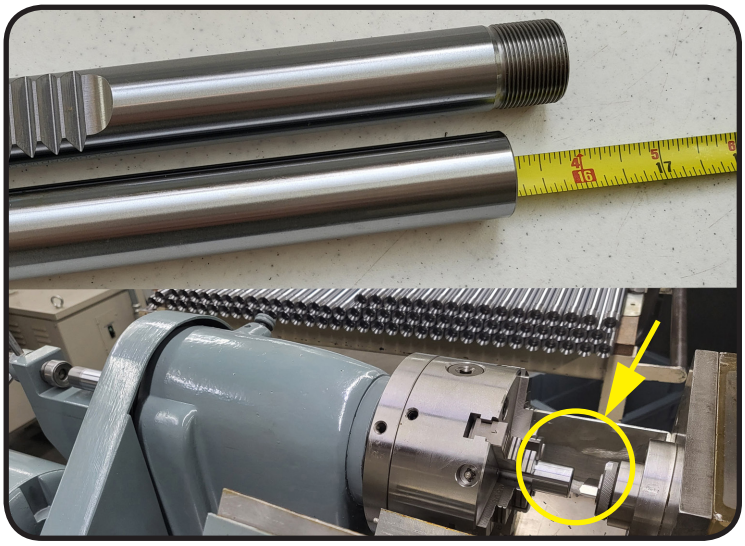
Direct Air Bleed Option

Where practical—and accessible—brake bleeders can be installed directly in a cylinder adapter provided with a boss. At present this feature is only available on the XX size cylinder.



Gundrilling Option

We have precision deep-hole drilling capability to a depth of 30 inches (760 mm). Significant weight can be removed from the steering by drilling the rackshaft, which is the heaviest single component. The longer the steering rack, the greater the proportional weight reduction.



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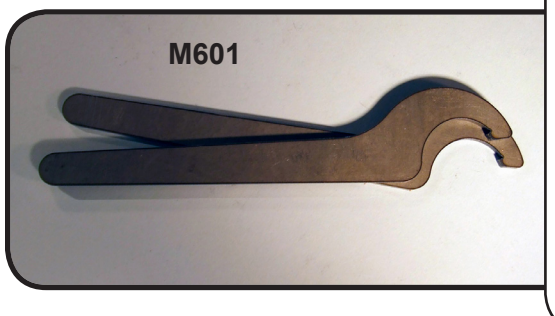
Monoball and Clevis parts and tools

Clevis **CF712** **54.37**
(includes boot lip installed)
Boot lip **CF713** **12.40**
Locking nut **CF411** **16.66**
Shear bolt w/nut **CF513** **18.75**
5/8 rod end **FSB8-10** **34.94**
(includes hat spacers installed)
Hat spacers (pair) **CF515** **12.25**

Monoball adjuster **CF410** **54.37**
Locking nut **CF411** **18.10**
Ball stud 14mm x 1.5 **CF412** **86.20**
Ball stud 5/8-18 **CF412N** **86.20**
Bronze preloader **CF405** **30.40**
Belleville spring .022 **CF403** **2.23**
Belleville spring .032 **CF404** **2.28**

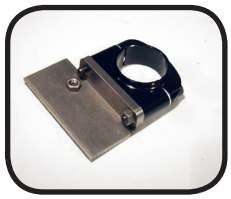


Hook-type spanner wrenches and sets

These wrenches fit perfectly and provide a more positive grip than general-purpose jointed hook spanners. The overall length of about 9 inches (228mm) provides plenty of leverage—no need to use a hammer and screwdriver. Heat treated 4130 alloy steel.

2-pc. set for monoballs **M601 (pair of M600-160)** **61.50**
2-pc. set for clevises **M602 (one M600-160 and one M600-150)** **61.50**
3-pc. set—covers both clevises and monoballs **M603** **90.35**

Single wrench fits 1.50 dia. clevis **M600-150** **32.75**
Single wrench fits 1.60 dia. jam nut or monoball **M600-160** **32.75**



Steel bracket kit, machined and pre-tacked
CF35FB **42.49**

Mounting Bracket Fabrication Kit

Made of 1018 cold-rolled steel with holes machined to match the CF35 mounting clamps supplied with the rack, these semifinished brackets are extra tall to allow trimming to fit against a typical convoluted steel OEM crossmember. A highly useful accessory when discarding the OEM rubber mounting in the course of converting a street automobile into a race car, they can also be integrated into a welded space frame. They can be used with lock nuts, or standard nuts can be welded in place where space will not permit wrench access. CF racks mount with either M8 or 5/16 socket head bolts.

Additional parts and technical resources

A 36-page Parts and Service manual is available for download. Click the Detailed Tech Info button at the top of the homepage, then click link 3c. From that page you can open either the manual or the parts list. The manual was written for use by NASCAR Cup teams and refers specifically to the steering rack used in the Nextgen, but the service and troubleshooting instructions apply generally to any type CF rack. The manual also lists an array of special service tools not shown here.

The Design Worksheet which appears at the end of this catalog section is also downloadable from Detailed Tech Info as link 3a. The worksheet is the essential tool for specifying the dimensional and mechanical data for a type CF rack to fit your application.

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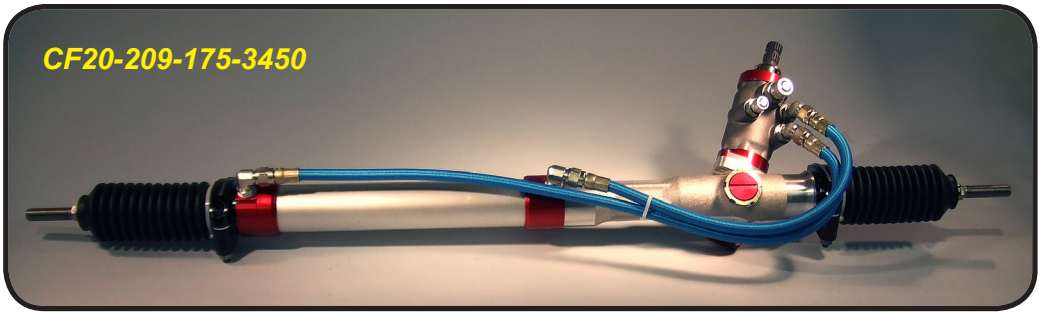
Basic CF Configurations

A CF rack starts as one of the 24 basic layouts listed on the following pages according to pinion angle, hand, and location. We can configure these in an infinite range of rack lengths and with any of the options listed above. To obtain a quote, enter your dimensional and mechanical requirements on the Design Worksheet at the end of this catalog section (or download it from Detailed Tech Info) and email to tech@woodwardsteering.com.

1. Left Hand Drive with 20 degree angled pinion



CF20

LHD front steer, pinion angle 20 degrees left

Pinion INBOARD of the left side mounting bracket. An INSET pinion allows the widest mounting of the rack relative to its overall length and is preferred for racing applications wherever possible. Can be built in any rack length from 24 inches (610 mm) up and with speeds of 1.57 (40), 1.83 (46,5), 2.09 (53), 2.36 (60), 2.62 (67), 2.88 (73), and 3.14 (80).

CF20S

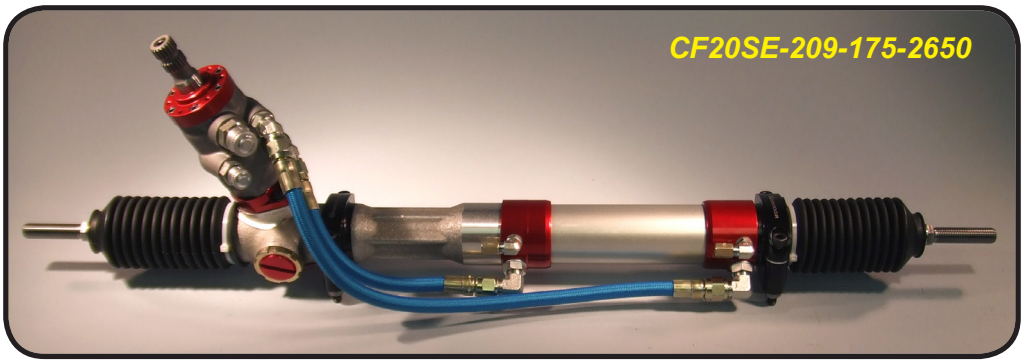
LHD front steer, pinion angle 20 degrees left

Pinion OUTBOARD of the left side mounting bracket. Consistent with production automotive practice, an OFFSET pinion provides increased clearance around the pinion and steering shaft for tight packaging situations. Can be built in any rack length from 24 inches (610 mm) up and with speeds of 1.57 (40), 1.83 (46,5), 2.09 (53), 2.36 (60), 2.62 (67), 2.88 (73), and 3.14 (80).

CF20E

LHD rear steer, pinion angle 20 degrees left

Pinion INBOARD of the left side mounting bracket. An INSET pinion allows the widest mounting of the rack relative to its overall length and is preferred for racing applications wherever possible. Can be built in any rack length from 24 inches (610 mm) up and with speeds of 1.57 (40), 1.83 (46,5), 2.09 (53), 2.36 (60), 2.62 (67), 2.88 (73), and 3.14 (80).



CF20SE

LHD rear steer, pinion angle 20 degrees left

Pinion OUTBOARD of the left side mounting bracket. Consistent with production automotive practice, an OFFSET pinion provides increased clearance around the pinion and steering shaft for tight packaging situations. Can be built in any rack length from 24 inches (610 mm) up and with speeds of 1.57 (40), 1.83 (46,5), 2.09 (53), 2.36 (60), 2.62 (67), 2.88 (73), and 3.14 (80).

2. Left Hand Drive with 12 degree angled pinion

CF12

LHD front steer, pinion angle 12 degrees left

Pinion INBOARD of the left side mounting bracket. An INSET pinion allows the widest mounting of the rack relative to its overall length and is preferred for racing applications wherever possible. Can be built in any rack length from 24 inches (610 mm) up and with speeds of 1.57 (40), 1.83 (46,5), 2.09 (53), 2.36 (60), 2.62 (67), 2.88 (73), and 3.14 (80).

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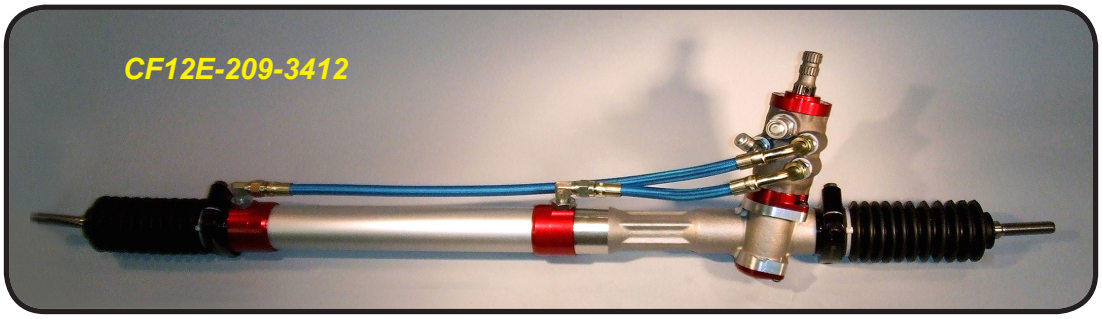
CF12S
LHD front steer, pinion angle 12 degrees left
Pinion OUTBOARD of the left side mounting bracket. Consistent with production automotive practice, an OFFSET pinion provides increased clearance around the pinion and steering shaft for tight packaging situations. Can be built in any rack length from 24 inches (610 mm) up and with speeds of 1.57 (40), 1.83 (46,5), 2.09 (53), 2.36 (60), 2.62 (67), 2.88 (73), and 3.14 (80).



CF12E
LHD rear steer, pinion angle 12 degrees left
Pinion INBOARD of the left side mounting bracket. An INSET pinion allows the widest mounting of the rack relative to its overall length and is preferred for racing applications wherever possible. Can be built in any rack length from 24 inches (610 mm) up and with speeds of 1.57 (40), 1.83 (46,5), 2.09 (53), 2.36 (60), 2.62 (67), 2.88 (73), and 3.14 (80).

CF12SE
LHD rear steer, pinion angle 12 degrees left
Pinion OUTBOARD of the left side mounting bracket. Consistent with production automotive practice, an OFFSET pinion provides increased clearance around the pinion and steering shaft for tight packaging situations. Can be built in any rack length from 24 inches (610 mm) up and with speeds of 1.57 (40), 1.83 (46,5), 2.09 (53), 2.36 (60), 2.62 (67), 2.88 (73), and 3.14 (80).

3. Left Hand Drive with Straight pinion

CF00
LHD front steer, straight pinion
Pinion INBOARD of the left side mounting bracket. An INSET pinion allows the widest mounting of the rack relative to its overall length and is preferred for racing applications wherever possible. Can be built in any rack length from 24 inches (610 mm) up and with speeds of 1.57 (40), 1.83 (46,5), 2.09 (53), 2.36 (60), 2.62 (67), 2.88 (73), and 3.14 (80).

CF00S
LHD front steer, straight pinion
Pinion OUTBOARD of the left side mounting bracket. Consistent with production automotive practice, an OFFSET pinion provides increased clearance around the pinion and steering shaft for tight packaging situations. Can be built in any rack length from 24 inches (610 mm) up and with speeds of 1.57 (40), 1.83 (46,5), 2.09 (53), 2.36 (60), 2.62 (67), 2.88 (73), and 3.14 (80).

CF00E
LHD rear steer, straight pinion
Pinion INBOARD of the left side mounting bracket. An INSET pinion allows the widest mounting of the rack relative to its overall length and is preferred for racing applications wherever possible. Can be built in any rack length from 24 inches (610 mm) up and with speeds of 1.57 (40), 1.83 (46,5), 2.09 (53), 2.36 (60), 2.62 (67), 2.88 (73), and 3.14 (80).

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CF00SE
LHD rear steer, straight pinion
Pinion OUTBOARD of the left side mounting bracket. Consistent with production automotive practice, an OFFSET pinion provides increased clearance around the pinion and steering shaft for tight packaging situations. Can be built in any rack length from 24 inches (610 mm) up and with speeds of 1.57 (40), 1.83 (46,5), 2.09 (53), 2.36 (60), 2.62 (67), 2.88 (73), and 3.14 (80).

4. Right Hand Drive with 20 degree angled pinion

CF20R
RHD front steer, pinion angle 20 degrees right
Pinion INBOARD of the right side mounting bracket. An INSET pinion allows the widest mounting relative to overall length and is the preferred style for racing applications wherever possible. Can be built in any rack length from 24 inches (610 mm) up and with speeds of 1.57 (40), 1.83 (46,5), 2.09 (53), 2.36 (60), 2.62 (67), 2.88 (73), and 3.14 (80).

CF20RS
RHD front steer, pinion angle 20 degrees right
Pinion OUTBOARD of the right side mounting bracket. Consistent with production automotive practice, an OFFSET pinion provides increased clearance around the pinion and steering shaft for tight packaging situations. Can be built in any rack length from 24 inches (610 mm) up and with speeds of 1.57 (40), 1.83 (46,5), 2.09 (53), 2.36 (60), 2.62 (67), 2.88 (73), and 3.14 (80).

CF20RE
RHD rear steer, pinion angle 20 degrees right
Pinion INBOARD of the right side mounting bracket. An inset pinion allows the widest mounting relative to overall length and is the preferred style for racing applications wherever possible. Can be built in any rack length from 24 inches (610 mm) up and with speeds of 1.57 (40), 1.83 (46,5), 2.09 (53), 2.36 (60), 2.62 (67), 2.88 (73), and 3.14 (80).

CF20RSE
RHD rear steer, pinion angle 20 degrees right
Pinion OUTBOARD of the right side mounting bracket. Consistent with production automotive practice, an OFFSET pinion provides increased clearance around the pinion and steering shaft for tight packaging situations. Can be built in any rack length from 24 inches (610 mm) up and with speeds of 1.57 (40), 1.83 (46,5), 2.09 (53), 2.36 (60), 2.62 (67), 2.88 (73), and 3.14 (80).

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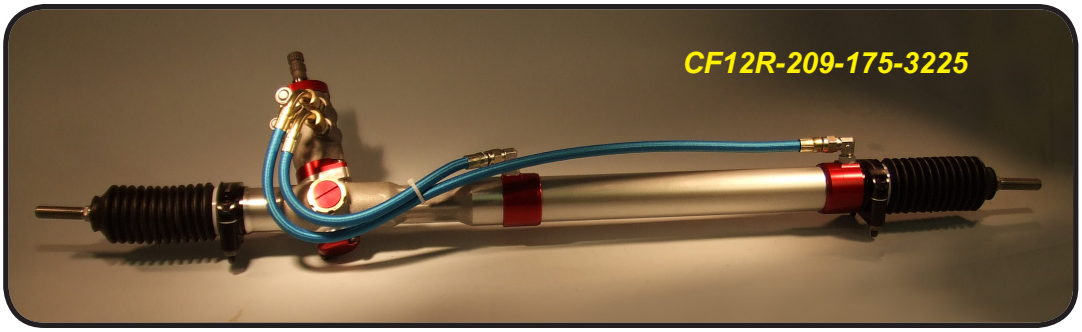
5. Right Hand Drive with 12 degree angled pinion



CF12R
RHD front steer, pinion angle 12 degrees right
Pinion INBOARD of the right side mounting bracket. An INSET pinion allows the widest mounting relative to overall length and is the preferred style for racing applications wherever possible. Can be built in any rack length from 24 inches (610 mm) up and with speeds of 1.57 (40), 1.83 (46,5), 2.09 (53), 2.36 (60), 2.62 (67), 2.88 (73), and 3.14 (80).

CF12RS
RHD front steer, pinion angle 12 degrees right
Pinion OUTBOARD of the right side mounting bracket. Consistent with production automotive practice, an OFFSET pinion provides increased clearance around the pinion and steering shaft for tight packaging situations. Can be built in any rack length from 24 inches (610 mm) up and with speeds of 1.57 (40), 1.83 (46,5), 2.09 (53), 2.36 (60), 2.62 (67), 2.88 (73), and 3.14 (80).

CF12RE
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Pinion INBOARD of the right side mounting bracket. An INSET pinion allows the widest mounting relative to overall length and is the preferred style for racing applications wherever possible. Can be built in any rack length from 24 inches (610 mm) up and with speeds of 1.57 (40), 1.83 (46,5), 2.09 (53), 2.36 (60), 2.62 (67), 2.88 (73), and 3.14 (80).

CF12RSE
RHD rear steer, pinion angle 12 degrees right
Pinion OUTBOARD of the right side mounting bracket. Consistent with production automotive practice, an OFFSET pinion provides increased clearance around the pinion and steering shaft for tight packaging situations. Can be built in any rack length from 24 inches (610 mm) up and with speeds of 1.57 (40), 1.83 (46,5), 2.09 (53), 2.36 (60), 2.62 (67), 2.88 (73), and 3.14 (80).

6. Right Hand Drive with straight pinion

CF00R
RHD front steer, straight pinion
Pinion INBOARD of the right side mounting bracket. An INSET pinion allows the widest mounting relative to overall length and is the preferred style for racing applications wherever possible. Can be built in any rack length from 24 inches (610 mm) up and with speeds of 1.57 (40), 1.83 (46,5), 2.09 (53), 2.36 (60), 2.62 (67), 2.88 (73), and 3.14 (80).

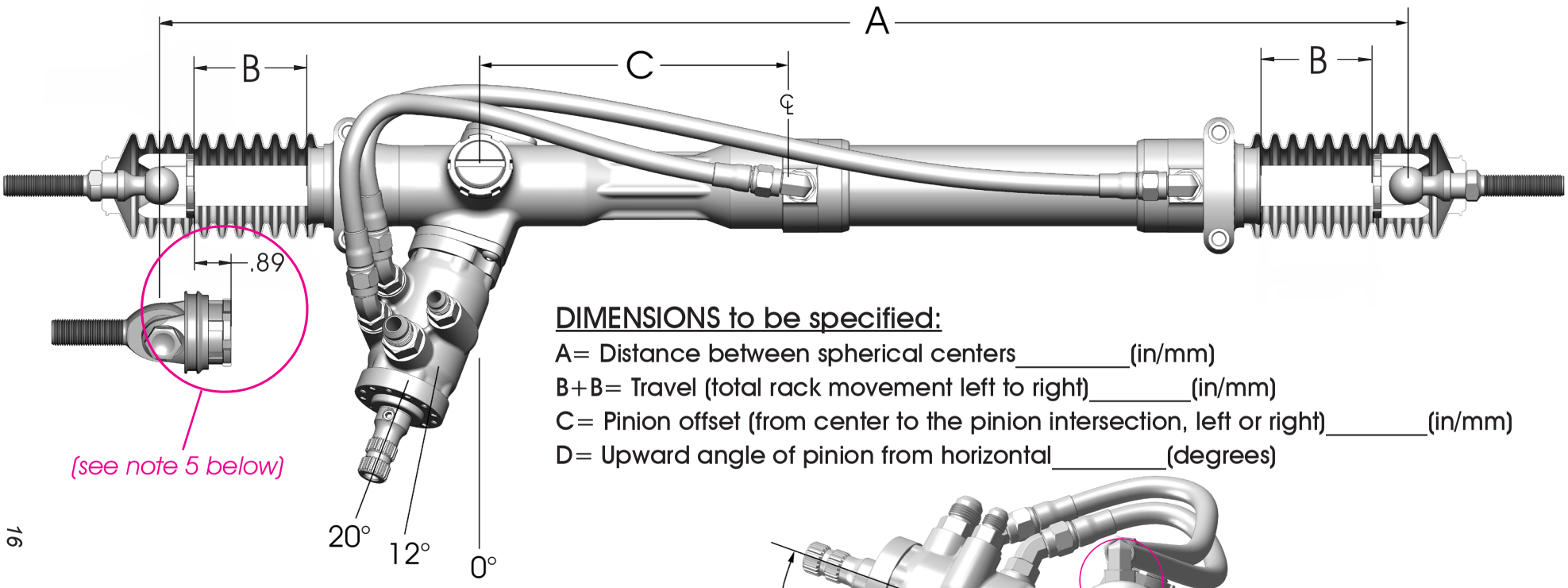
CF00RS
RHD front steer, straight pinion
Pinion OUTBOARD of the right side mounting bracket. Consistent with production automotive practice, an OFFSET pinion provides increased clearance around the pinion and steering shaft for tight packaging situations. Can be built in any rack length from 24 inches (610 mm) up and with speeds of 1.57 (40), 1.83 (46,5), 2.09 (53), 2.36 (60), 2.62 (67), 2.88 (73), and 3.14 (80).

CF00RE
RHD rear steer, straight pinion
Pinion INBOARD of the right side mounting bracket. An INSET pinion allows the widest mounting relative to overall length and is the preferred style for racing applications wherever possible. Can be built in any rack length from 24 inches (610 mm) up and with speeds of 1.57 (40), 1.83 (46,5), 2.09 (53), 2.36 (60), 2.62 (67), 2.88 (73), and 3.14 (80).

CF00RSE
RHD rear steer, straight pinion
Pinion OUTBOARD of the right side mounting bracket. Consistent with production automotive practice, an OFFSET pinion provides increased clearance around the pinion and steering shaft for tight packaging situations. Can be built in any rack length from 24 inches (610 mm) up and with speeds of 1.57 (40), 1.83 (46,5), 2.09 (53), 2.36 (60), 2.62 (67), 2.88 (73), and 3.14 (80).

Data needed to model a type CF custom steering rack

(Scan and return completed form to tech@woodwardsteering.com)



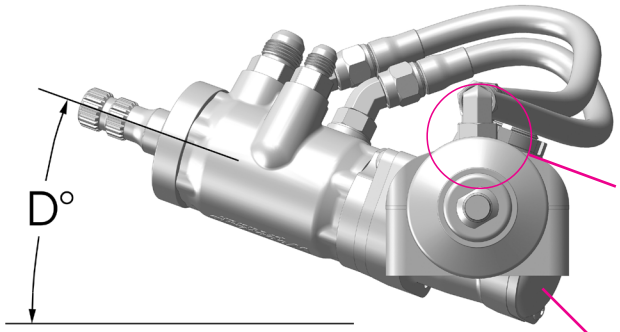
DIMENSIONS to be specified:

A= Distance between spherical centers_____(in/mm)

B+B= Travel (total rack movement left to right)_____(in/mm)

C= Pinion offset (from center to the pinion intersection, left or right)_____(in/mm)

D= Upward angle of pinion from horizontal_____(degrees)



Note: cylinder ports must be oriented within 15° of vertical. If not possible, bleeders will be required.

The mounting clamps can be at any angle, but unless requested otherwise will be modeled as if bolted to a horizontal surface.

BASIC CONFIGURATION (circle one):

1. **Left hand** or **right hand** drive
2. **Front steer** or **rear steer** (rack *ahead of* or *behind* the front wheels)
3. **Pinion angle** (left or right); **0**, **12** or **20** degrees
4. **Gear ratio** (distance the rack must move in one turn);
the choices are (inches/mm): **1.57/40, 1.83/47, 2.09/53, 2.36/60, 2.62/67, 2.88/73 or 3.14/80**
5. **Monoball** or **Clevis** rack ends *(note: for a given length A, clevises occupy more of distance B than monoballs. To provide clearance for the same rack travel, the housing of a clevis rack must be correspondingly shorter).*

Additional information that is usually helpful: car weight (with driver and fuel), type of racing, expected maximum tie rod force, and special factors such as driven front wheels. Note that the hose ports of the servovalve can be oriented in 60° steps to clear obstacles such as chassis members. Unless requested otherwise, we will model the rack with hoses routed around the outside as above.