



# HGF Series

Hydrostatic Steering Unit

Property of CaseColtIngersoll.com

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Catalog HY13-1560-002/US



Property of CaseColtIngersoll.com

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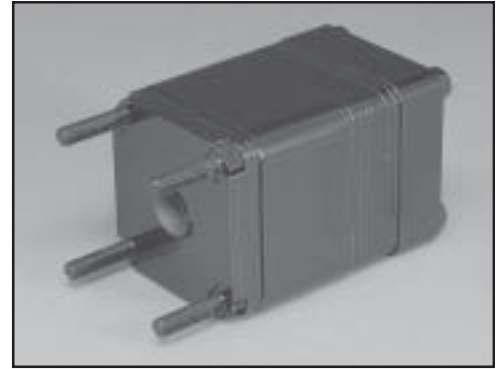
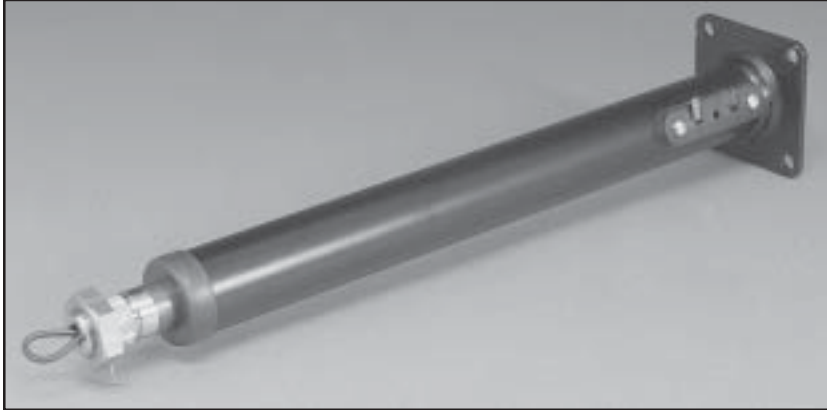
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Hydraguide™ brand hydrostatic steering units were developed to meet the requirements of a broad range of off-highway applications. The HGF series is designed for light duty applications such as lawn and garden equipment, small agricultural equipment, small off-highway vehicles and material handling equipment.



### HGF Series Features

- **Compact Size**—The compact size of the HGF permits mounting in tight spaces to add overall machine design flexibility.
- **Full-Pressure Shaft Seal**—The Parker full pressure input shaft seal is able to withstand full system back pressure up to the pressure rating of the Hydraguide. This enables operation of auxiliary hydraulic functions downstream of steering.
- **Pressure Dams**—Pressure dams provide a barrier of pressurized system oil between metered oil and return. Pressure dam valving provides more precise steering due to the reduction of leakage oil from the metering element.
- **Needle Thrust Bearing**—The needle thrust bearing reduces input torque required to steer, resulting in lower steering efforts.
- **SAE #6 Female O-Ring Ports Standard.**
- **Integral Mounting Studs**—Integral mounting bolts minimize hardware cost and simplify installation, resulting in fewer service parts.
- **Manual Emergency Steering**—A ball check valve allows manual steering in emergencies when pump flow is interrupted. If the vehicle is large enough to require more than 100 ft.-lb. steering wheel torque in the manual mode, another means of emergency steering is recommended.
- **Integral Relief Available**—Five pressure settings from 500 to 1740 psi. Preset to protect steering unit from excessive system pressure.

**Hydraguide™ Series**

———— HGF      X X      X X X

**HGF  
Displacement**

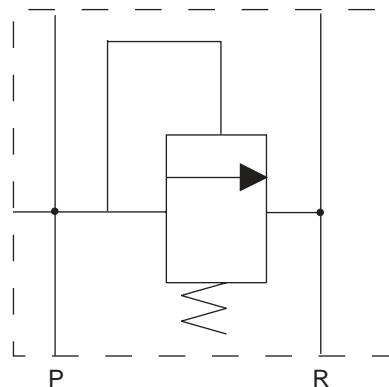
XX	in <sup>3</sup> /rev	cm <sup>3</sup> /rev
08	3.30	54.1
10	4.13	67.7
12	4.95	81.1
16	6.60	108.2
20	8.25	135.2
24	9.90	162.3

X	System	Type
0	Open Center	Nonreversing
1*	Open Center	Nonreversing (low noise)
2	Open Center	Reversing
6	Power Beyond	Nonreversing
3	Power Beyond	Reversing
4	Closed Center	Nonreversing
7	Closed Center	Reversing

\* Only available with port option 2

X	Porting
2	Female #6 SAE O-Ring
4	Female #6 SAE O-Ring Side Port

X	Relief Option
2	No Relief
4	921 psi (64 Bar)
7	1200 psi (83 Bar)
6	1560 psi (108 Bar)
8	1740 psi (120 Bar)



**Example:**

HGF08220 signifies HGF Hydraguide series unit with 3.30 in<sup>3</sup>/rev displacement, open center, nonreversing with female #6 SAE O-Ring ports.

## HGF

Hydraguide™ Series		08	10	12	16	20	24
<b>Displacement</b> (in <sup>3</sup> /rev) (cm <sup>3</sup> /rev)	<b>English</b>	<b>3.30</b>	<b>4.13</b>	<b>4.95</b>	<b>6.60</b>	<b>8.25</b>	<b>9.9</b>
	<b>Metric</b>	54.1	67.7	81.1	108.2	135.2	162.3
<b>Operating Pressure</b> (psi) (Bar)	Maximum	<b>1800</b>	<b>1800</b>	<b>1800</b>	<b>1800</b>	<b>1800</b>	<b>1800</b>
		125	125	125	125	125	125
<b>Operating Temperature</b> (°F) (°C)	Maximum	<b>200</b>	<b>200</b>	<b>200</b>	<b>200</b>	<b>200</b>	<b>200</b>
		93.3	93.3	93.3	93.3	93.3	93.3
<b>Flow</b> (gpm) (liters/min)	Continuous Rated	<b>8</b>	<b>8</b>	<b>8</b>	<b>8</b>	<b>8</b>	<b>8</b>
		30.3	30.3	30.3	30.3	30.3	30.3
	Recommended <sup>2</sup> (120 rpm)	<b>1.71</b>	<b>2.15</b>	<b>2.57</b>	<b>3.43</b>	<b>4.29</b>	<b>5.14</b>
		6.47	8.14	9.73	12.98	16.24	19.45
<b>Weight</b> (lbs) (kg)		<b>8.8</b>	<b>9.04</b>	<b>9.28</b>	<b>9.77</b>	<b>10.25</b>	<b>10.75</b>
		3.99	4.10	4.21	4.43	4.65	4.88
<b>"A" Dimensions<sup>3</sup></b> (in) (mm)		<b>4.37</b>	<b>4.50</b>	<b>4.62</b>	<b>4.87</b>	<b>5.12</b>	<b>5.42</b>
		111.0	114.2	117.3	123.6	130.0	137.5
<b>"B" Dimensions</b> (in) (mm)		<b>5.3</b>	<b>5.4</b>	<b>5.6</b>	<b>5.8</b>	<b>6.1</b>	<b>6.4</b>
		134.6	137.1	142.2	147.3	154.9	162.6

<sup>1</sup> English dimensions are control values; metric values are conversions.

<sup>2</sup> For two handwheel turns per second.

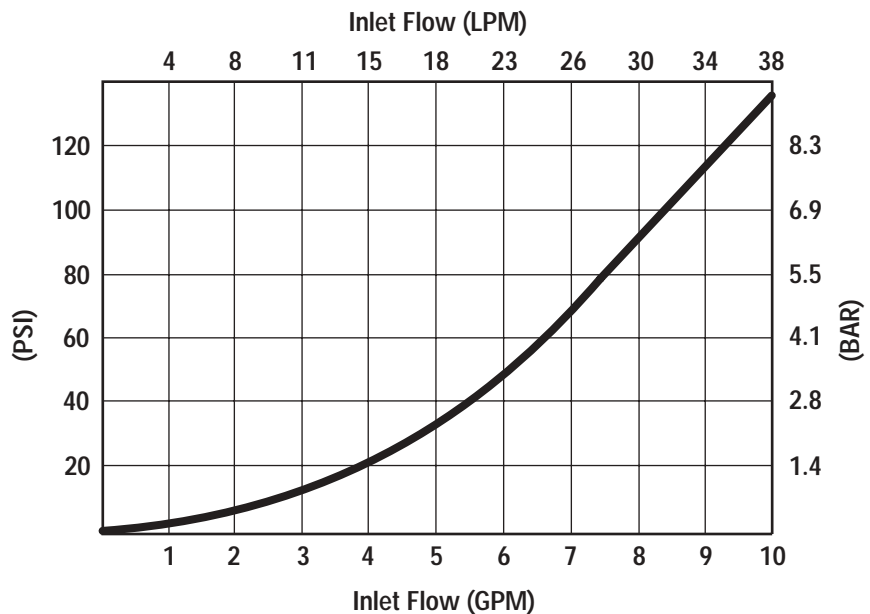
<sup>3</sup> Length from mounting face to end of Hydraguide end.

### Fluid/Filtration

Automatic transmission fluid (ATF) or contact your Parker Sales Engineer for other fluid recommendations.

Use 20-50 micrometer nominal filtration.

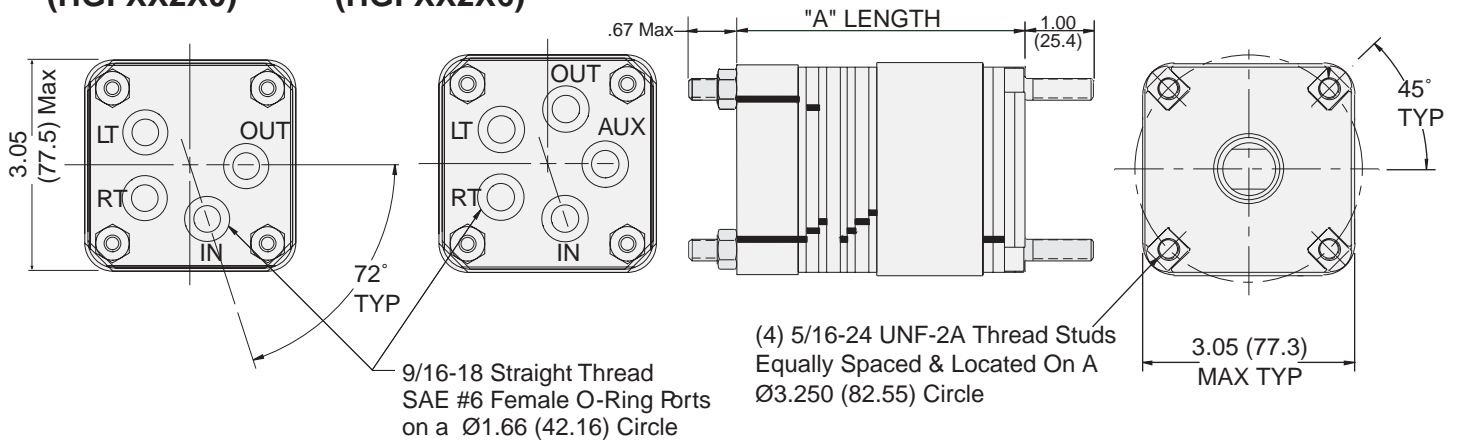
HGF Delta P -vs- Flow at 130° F (54.5° C) (113 SUS)



## Dimensions

## HGF Series

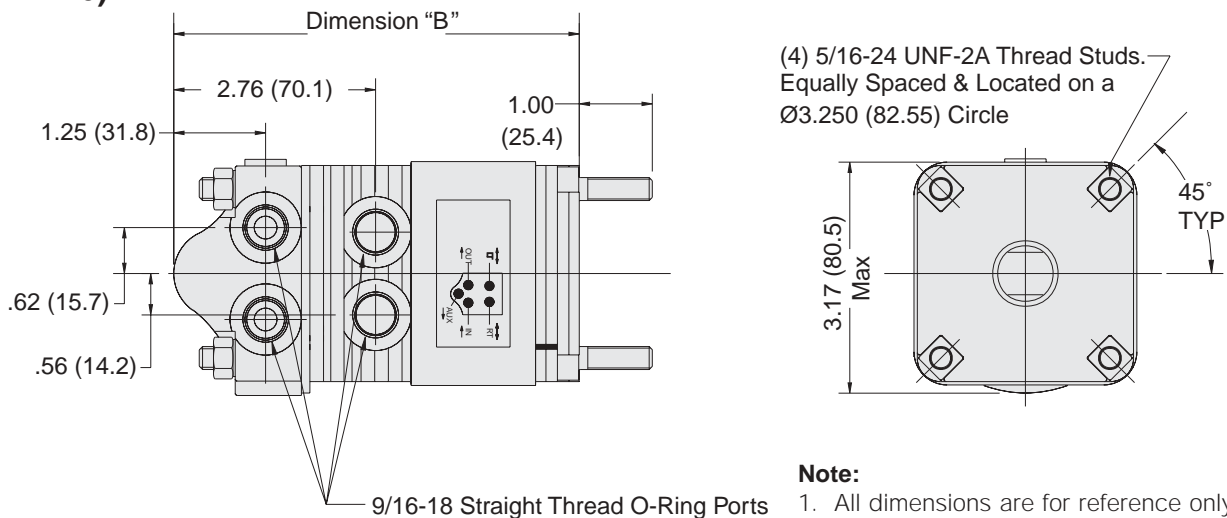
### HGF Open Center (HGFXX2X0)    HGF Power Beyond (HGFXX2X6)



### “A” Dimensions

Series	08	10	12	16	20	24
(in)	4.16	4.28	4.41	4.66	4.91	5.16
(mm)	105.7	108.7	112.0	118.4	124.7	131.1

### HGF Open Center Sideport (HGFXX4X0)



### “B” Dimensions

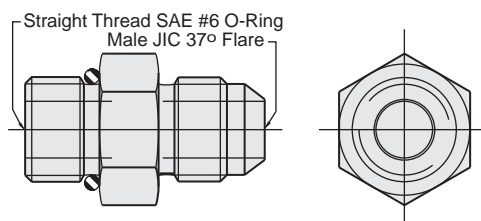
Series	08	10	12	16	20	24
(in)	5.38	5.50	5.63	5.88	6.13	6.38
(mm)	136.6	139.7	143.0	149.3	155.7	162.1

**Note:**

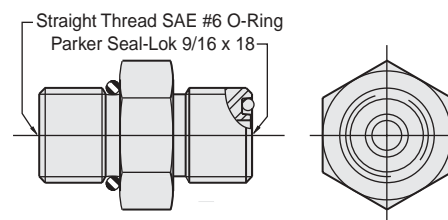
1. All dimensions are for reference only.
2. Add .50 in (12.7 mm) for integral relief. (Porting option 2 only)
3. Reversing units shall be used with balanced area cylinders.

### Adapter Fittings

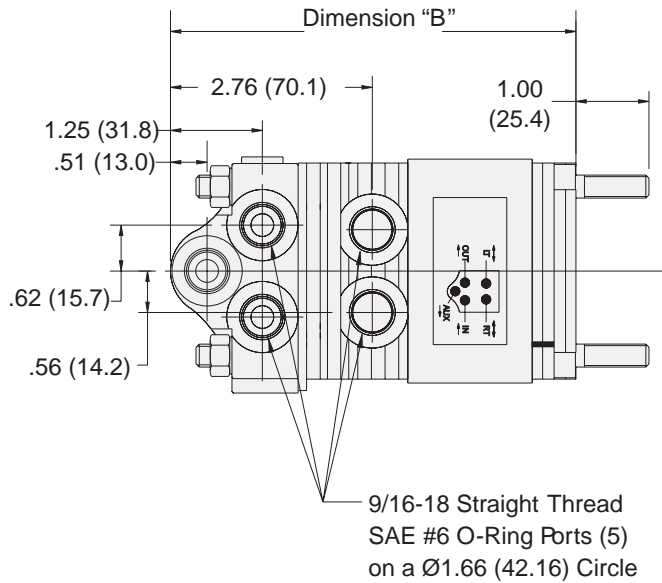
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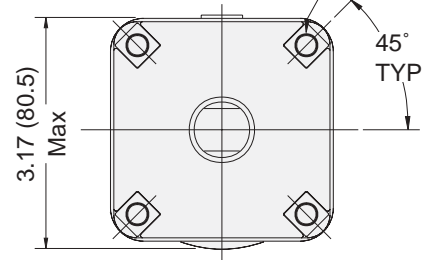
#### 411090A1



## HGF Power Beyond Sideport (HGFXX4X6)



(4) 5/16-24 UNF-2A Thread Studs  
Equally Spaced & Located on a  
Ø3.250 (82.55) Circle



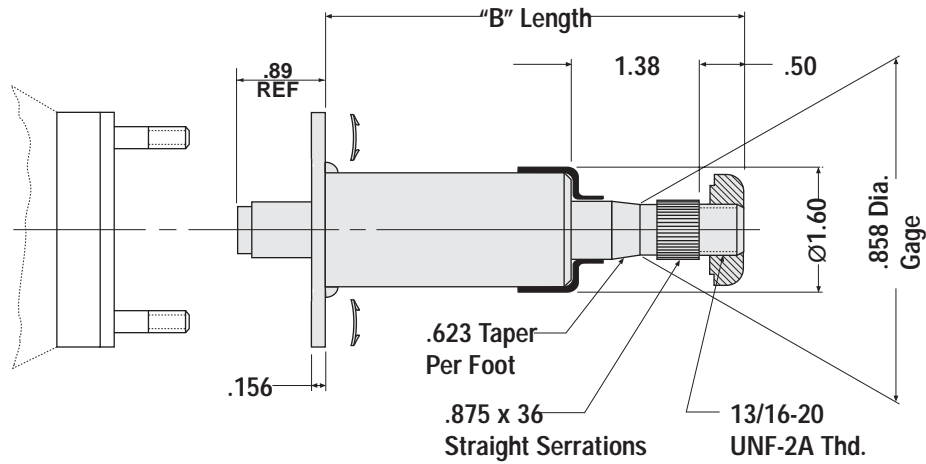
**Note:**

1. All dimensions are for reference only.
2. Add .50 in (12.7 mm) for integral relief. (Porting option 2 only)
3. Reversing units shall be used with balanced area cylinders.

**“B” Dimensions**

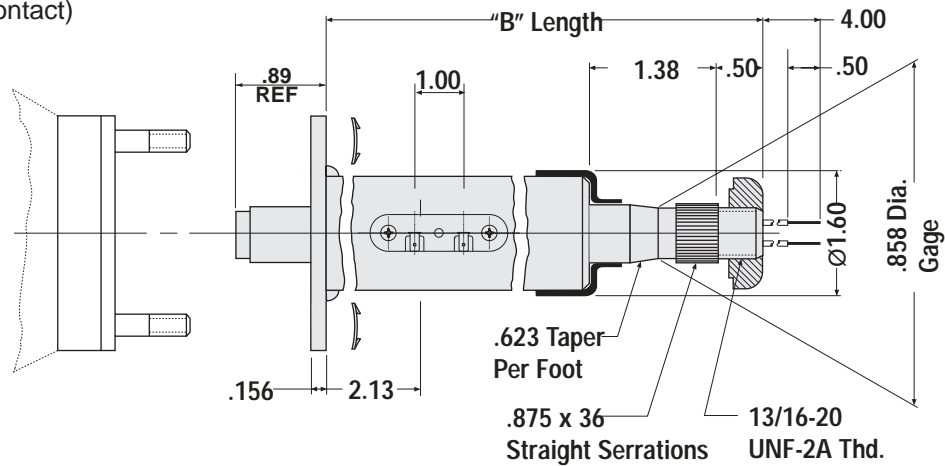
Series	08	10	12	16	20	24
(in)	5.38	5.50	5.63	5.88	6.13	6.38
(mm)	136.6	139.7	143.0	149.3	155.7	162.1

## Standard Column



## Hornwire Column

(Single or Dual Contact)



### Notes:

1. All dimensions are for reference only.
2. Jacket tube diameter of all columns is 1.50 inches.
3. Column support is required for columns longer than 10 inches.
4. For "B" length see HGF Steering Column Selection Chart, page C16.

1560-002.P65.pm





### HGF

	Part Number	"B" Length - in (mm)	Specification
<b>Standard</b>	SKF000780400	4 (101.6)	7/8" x 36; no horn contact
	SKF000780600	6 (152.4)	7/8" x 36; no horn contact
	SKF000780800	8 (203.2)	7/8" x 36; no horn contact
	SKF000781200	12 (304.8)	7/8" x 36; no horn contact
	SKF000781600	16 (406.4)	7/8" x 36; no horn contact
	SKF000782200	22 (558.8)	7/8" x 36; no horn contact
	SKF000782400	24 (609.6)	7/8" x 36; no horn contact
	SKF000783200	32 (812.8)	7/8" x 36; no horn contact
	SKF000783450	34.5 (876.3)	7/8" x 36; no horn contact
<b>Single Hornwire</b>	SKF001780800	8 (203.2)	7/8" x 36; single horn contact
	SKF001781200	12 (304.8)	7/8" x 36; single horn contact
	SKF001781600	16 (406.4)	7/8" x 36; single horn contact
	SKF001782400	24 (609.6)	7/8" x 36; single horn contact
	SKF001783200	32 (812.8)	7/8" x 36; single horn contact
<b>Dual Hornwire</b>	SKF002780800	8 (203.2)	7/8" x 36; dual horn contact
	SKF002781200	12 (304.8)	7/8" x 36; dual horn contact
	SKF002781600	16 (406.4)	7/8" x 36; dual horn contact
	SKF002782400	24 (609.6)	7/8" x 36; dual horn contact
	SKF002783200	32 (812.8)	7/8" x 36; dual horn contact

### HGF

	Part Number	"B" Length - in (mm)	Specification
<b>Standard</b>	SKF000340400	4 (101.6)	3/4" x 40; no horn contact
	SKF000340600	6 (152.4)	3/4" x 40; no horn contact
	SKF000340800	8 (203.2)	3/4" x 40; no horn contact
	SKF000341200	12 (304.8)	3/4" x 40; no horn contact
	SKF000341600	16 (406.4)	3/4" x 40; no horn contact
	SKF000342200	22 (558.8)	3/4" x 40; no horn contact
	SKF000342400	24 (609.6)	3/4" x 40; no horn contact
	SKF000343200	32 (812.8)	3/4" x 40; no horn contact
	SKF000343450	34.5 (876.3)	3/4" x 40; no horn contact
	<b>Single Hornwire</b>	SKF001340800	8 (203.2)
SKF001341200		12 (304.8)	3/4" x 40; single horn contact
SKF001341600		16 (406.4)	3/4" x 40; single horn contact
SKF001342400		24 (609.6)	3/4" x 40; single horn contact
SKF001343200		32 (812.8)	3/4" x 40; single horn contact
<b>Dual Hornwire</b>	SKF002340800	8 (203.2)	3/4" x 40; dual horn contact
	SKF002341200	12 (304.8)	3/4" x 40; dual horn contact
	SKF002341600	16 (406.4)	3/4" x 40; dual horn contact
	SKF002342400	24 (609.6)	3/4" x 40; dual horn contact
	SKF002343200	32 (812.8)	3/4" x 40; dual horn contact

**Notes:**

1. Steering wheel horn button not included in column kits. Order part number 465611 separately.
2. Steering wheel nut included with column.
3. For column lengths or horn wires not shown above, contact your Parker Sales Engineer.

## Design Advantages

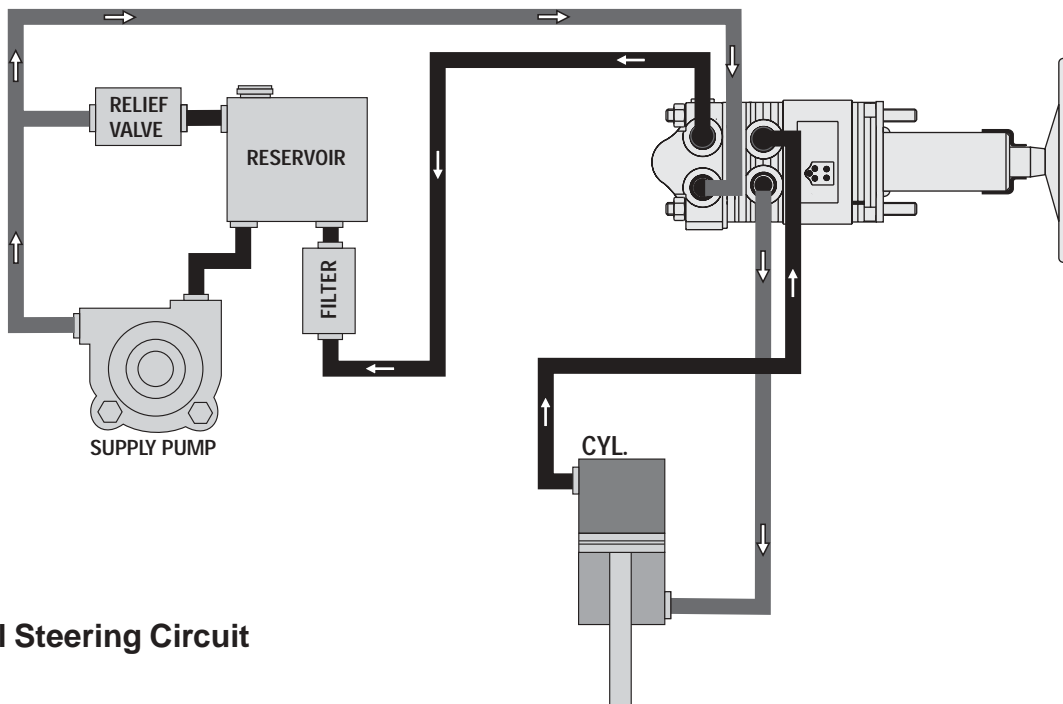
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### Hydraguide™

Each Hydraguide unit consists of a directional control valve and metering section. The valve directs the pressurized oil supplied to and from the cylinder and the Hydraguide metering section. The metering section “meters” out the pressurized oil to the steering cylinder.

The Hydraguide works in conjunction with the vehicle's hydraulic system, which consists of a steering cylinder(s), relief valve, reservoir, filter, fluid lines, and an engine driven pump. The systems must be tailored to the specific vehicle type and service for which it will be used. Parker offers engineering advice and assistance (and encourages use of our engineering assistance) when applying hydrostatic steering to any vehicle.

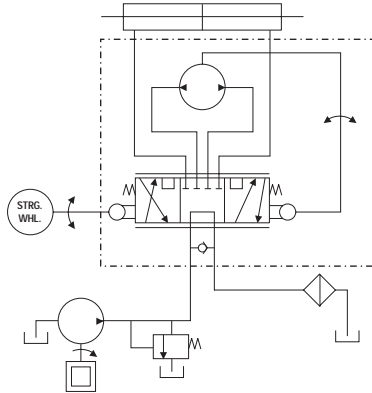
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Typical Steering Circuit

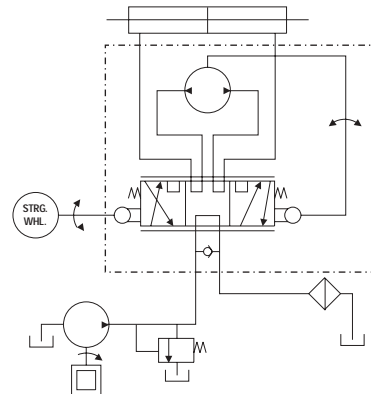
**Open Center, Nonreversing**

The nonreversing unit keeps the steered wheels in the steered position when the operator releases the steering wheel. The cylinder ports are blocked in the neutral valve position. The operator must steer the wheels back to the straight ahead position.



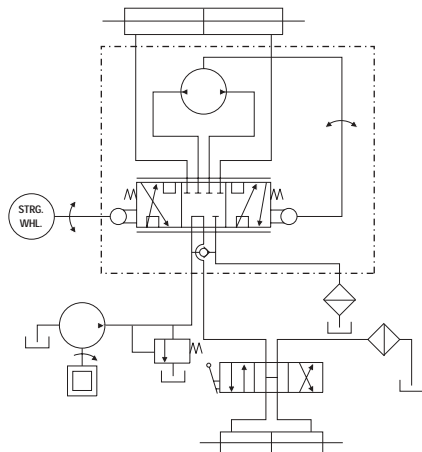
**Open Center, Reversing**

The reversing unit allows the steered wheels to return to the straight ahead position after the operator releases the steering wheel. This happens only if the steering geometry exerts a centering force on the steering cylinder. The cylinder ports are interconnected with the metering section so that the steering wheel follows the wheels back to center position. Reversing steering units should only be used in systems where the opposing cylinder chambers are of equal volume. **DO NOT USE** with a single unequal area/volume cylinder.



**Open Center, Power Beyond (5-line)**

The Hydraguide has an auxiliary fifth port as a Power Beyond feature to supply fluid to other functions downstream of the Hydraguide (Circuit #1). The Hydraguide automatically takes priority flow for steering, with the remainder available for auxiliary functions. When not steering, all flow is available to auxiliary functions. This system eliminates a flow divider or a separate steering circuit, thus saving energy and component cost.

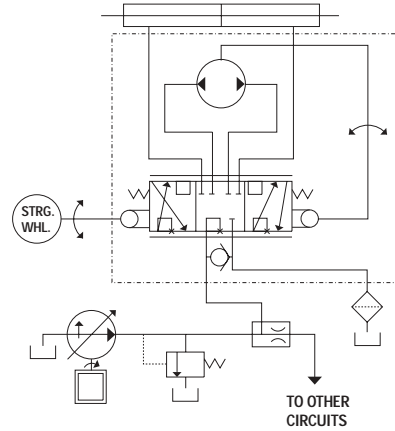


### System Terminology

#### Closed Center System

Closed center systems utilize a variable displacement pump providing variable flow to the steering circuit. All ports of the Hydraguide™ are blocked when the vehicle is not being steered. The amount of flow through the steering circuit depends upon steering speed and displacement of the Hydraguide.

#### Closed Center, Nonreversing

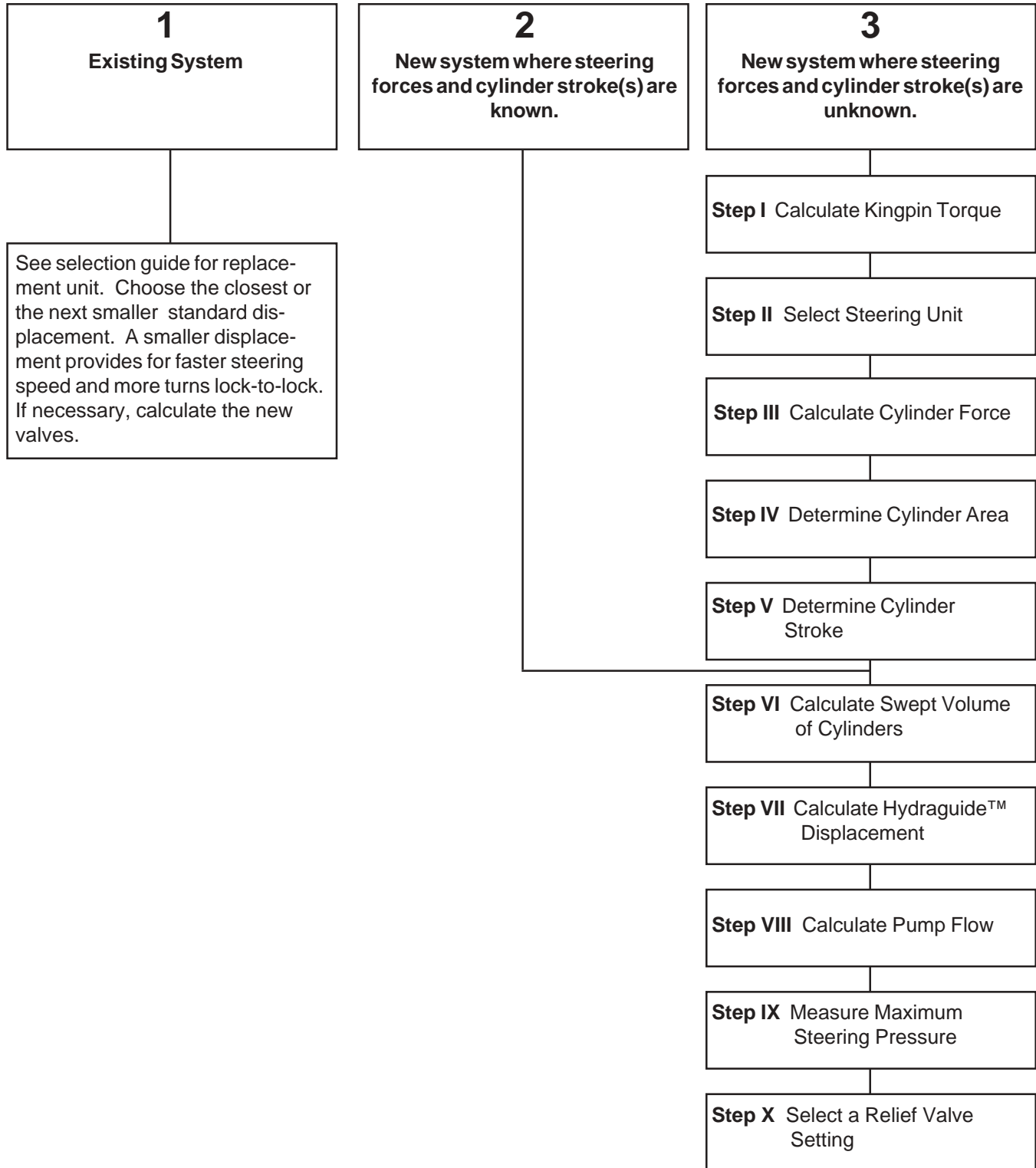


**NOTE:** If the auxiliary circuit requires a large demand from the pump, such that an inadequate amount of pump flow is available for steering, then a flow limiting control valve should be applied to the auxiliary circuit. This is needed to guarantee steering capability under all operating conditions.

## System Design Process

### Flow Chart

Use the following chart as a guide to design hydrostatic steering systems.



## System Design Process

### STEP I Calculate approximate Kingpin torque (KT)

#### 1.1 Determine coefficient of friction:

Select the coefficient of friction ( $\mu$ ) from Chart 1 after calculating E/B. (Kingpin offset/nominal tire width). See Diagram 1.

Chart 1 (Rubber tires on dry concrete)

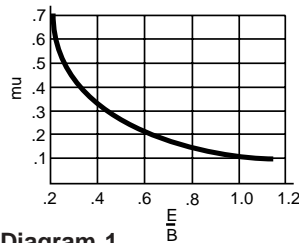
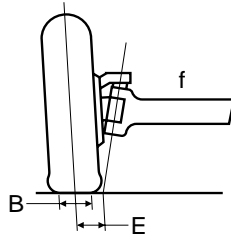


Diagram 1



#### 1.2 Calculate Kingpin torque:

$$KT = W (\mu) \sqrt{\frac{B^2}{8} + E^2}$$

**NOTE:** If steered axle wheels are driven (powered), double KT.

**Where:**

- KT** = Kingpin torque in inch-pounds
- W** = Weight on steered axle in pounds (Use maximum overloaded weight anticipated.)
- $\mu$**  = Coefficient of friction
- B** = Nominal Tire width (inches)
- E** = Kingpin offset (inches) at the intersection with the ground

### STEP II Select steering unit

For small garden tractor-type vehicles, select an HGF — for larger vehicles select HGA or HGB. The purpose of this is to establish what pressure to use in Step IV.

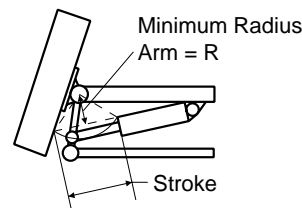
### STEP III Calculate approximate cylinder force (CF)

$$CF = \frac{KT}{R}$$

**Where:**

- KT** = Kingpin torque (inch-pounds)
- R** = Minimum radius arm (inches) (see Diagram 2)

Diagram 2



### STEP IV Calculate cylinder area (CA)

$$CA = \frac{CF}{P}$$

**Where:**

- CF** = Cylinder force (pounds)
- P** = Pressure (psi) (This is the pressure rating of the steering unit chosen.)

Select the next *larger* common cylinder bore size available. If one cylinder is used, use the *rod end area* only and, if two are used, use the *rod end area plus the head end area* to select the cylinder (Step VI).

### STEP V Determine cylinder stroke

Calculate using diagram 2 as a guide and the desired vehicle turning circle.

### STEP VI Calculate swept volume (SV) of the cylinder(s)

#### 6.1. One balanced cylinder, double acting



**SV** = (Bore area - rod area) x cylinder stroke

$$SV = \frac{\pi}{4} [B^2 - R^2] \times S$$

#### 6.2. One unbalanced cylinder, double acting



##### a. Head side

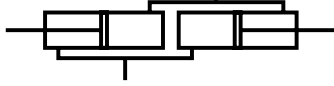
$$SV = \frac{\pi \times B^2}{4} \times S$$

##### b. Rod side

Same as 6.1 above

### System Design Process

#### 6.3. Two unbalanced cylinders, double acting



$$SV = \frac{\pi \times S}{4} (2B^2 - R^2)$$

**Where:**

- SV** = Swept volume (volume of oil to move cylinder full stroke) in cubic inches
- B** = Bore diameter (inches)
- R** = Rod diameter (inches)
- S** = Cylinder stroke (inches)

#### STEP VII Calculate Hydraguide™ displacement (HD)

$$HD = \frac{SV}{n}$$

**Where:**

- SV** = Swept volume in cubic inches from Step VI
- n** = Number of steering wheel turns lock-to-lock (from one end of cylinder stroke to the other). This ranges from 3 to 6 depending on the type of vehicle.

When one single rod cylinder is used, calculate n for each direction because it will be different. Select the next closest displacement. If desired, recalculate n as follows:

$$n = \frac{SV}{\text{Displacement of selected Hydraguide™}}$$

#### STEP VIII Calculate minimum pump flow (Q)

$$Q = \frac{HD \times SS \times 60}{231}$$

**Where:**

- Q** = Pump flow (gallons/minutes/revolutions)
- HD** = Hydraguide displacement (cubic inches)
- SS** = Steering speed (revolutions/seconds) (Ideal speed of steer = 120 rpms.)

#### Steering Speed

The minimum normally considered is 1 rev/sec (60 rpm). An example would be an articulated vehicle. This depends on the safety considerations for avoidance of obstacles under minimum *and* maximum flow conditions during all speed possibilities of the vehicle.

1.5 rev/sec (90 rpm) is common, and 2 rev/sec (120 rpm) is considered about the maximum input speed achievable by an average person.

If the steering wheel speed becomes greater than the pump flow, a dramatic increase in steering wheel effort is felt.

#### STEP IX Measure maximum steering pressure on prototype vehicle

Compare this pressure with the pressure rating of the Hydraguide. If it is higher, return to the last part of Step III and recalculate through Step IX again.

#### STEP X Select a relief valve setting

The cracking pressure of the relief valve, which is usually defined as the pressure when the relief valve starts to open and discharge flow to the return line, should be greater than the maximum pressure measured on the vehicle.

The full flow pressure of the relief valve, which is defined as the pressure when maximum flow is going over the relief valve, must not exceed the pressure rating on the steering unit.

**NOTE:**

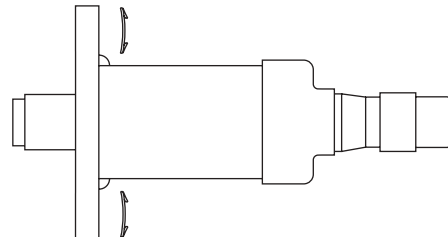
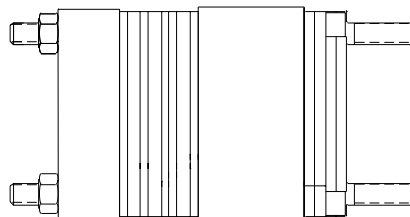
Reversing units used with balanced area cylinders.

#### HGF Series

- Open Center
- Closed Center
- Power Beyond

#### Operating Parameters:

- 1800 PSI
- 8 GPM
- 3.3 to 9.9 cu. in.



#### Typical Systems:

Turf, Material Handling, General Purpose, and Light Agricultural Vehicles.

## Hydraguide™ System Data Sheet

Date \_\_\_\_\_

Salesperson \_\_\_\_\_

Phone \_\_\_\_\_ Fax. \_\_\_\_\_

### 1. Customer

Company \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_ Zip Code \_\_\_\_\_ Country \_\_\_\_\_

Customer Contact \_\_\_\_\_ Telephone \_\_\_\_\_ Fax \_\_\_\_\_

E-Mail Address \_\_\_\_\_

### 2. Vehicle

- Truck       Tractor       Lift Truck       Earth Mover      Other \_\_\_\_\_  
 Articulated       Ackerman       Tricycle       4-Wheel

### 3. Vehicle Specifications

3.1 Number of Steered Wheels \_\_\_\_\_  Front Wheel Steer     Rear Wheel Steer     Articulated

3.2 Gross Vehicle Weight and Maximum Weight on Steered Axle:

G.V.W. \_\_\_\_\_ Lbs. (Kg) G.F.E.W. \_\_\_\_\_ Lbs. (Kg)

### 4. Steering Unit

#### Operating Parameters

4.1 Number of Hand Wheel Turns Requested: \_\_\_\_\_ 4.1.1 Steering Effort @ Expectations \_\_\_\_\_ In Lb (Kg. cm.)

4.2 Speed of Steer (Seconds - Lock to Lock): Low Idle \_\_\_\_\_ Sec. High Idle \_\_\_\_\_ Sec.

4.3 Displacement of Steering Unit: \_\_\_\_\_ In.<sup>3</sup>/Rev. (cc/Rev.)

4.4  Reversing (Load Reactive) (Open Cylinder)     Non-Reversing (Non-Load Reactive) (Closed Cylinder)

4.5  Power Beyond       Open Center       Closed Center       Load Sense

4.6 Options       Shock Valves (Crossovers)       Anticavation Checks \_\_\_\_\_

Relief Valve in Steering Unit     Yes     No    Setting \_\_\_\_\_ PSI/Kg/cm<sup>2</sup>

4.7 Hose Line Size \_\_\_\_\_

### 5. Steering Cylinder

5.1 Number Used \_\_\_\_\_ Balanced     Yes     No

5.2 Bore \_\_\_\_\_ In. (cm)      5.2.1 Stroke \_\_\_\_\_ In. (cm)      5.2.2 Rod Dia. \_\_\_\_\_ In (cm)

5.3 Amount of Stroke Used \_\_\_\_\_ In. (mm)

5.4 Cylinder Cross Port Relief Valves     Yes     No    Pressure Settings \_\_\_\_\_ PSI (Kg/cm<sup>2</sup>)

5.5 Cylinder Line Size (I.D.) \_\_\_\_\_ Length \_\_\_\_\_

5.6 Expected Maximum Pressure \_\_\_\_\_



Hydraguide™ System Data Sheet

6. Pump

Model Number \_\_\_\_\_

Displacement:  Fixed  Variable

6.1 Flow Control  Yes  No  Integral  External

6.2 Pressure Relief  Integral  External Maximum Relief Setting \_\_\_\_\_ PSI (Kg/cm²)

6.3 Flow Divider  Yes  No

6.4 Pump Flow High Idle \_\_\_\_\_ GPM (L/min.) Low Idle \_\_\_\_\_ GPM (L/min)

6.5 Flow Available Maximum Steering Flow \_\_\_\_\_ GPM (L/min.) Minimum Steering Flow \_\_\_\_\_ GPM (L/min)

6.6 Full Engine Speed \_\_\_\_\_ RPM Idle Engine Speed \_\_\_\_\_ RPM

7. Reservoir

7.1 Capacity \_\_\_\_\_ Gal.

7.2 Location \_\_\_\_\_

Integral with Pump  Yes  No Separate \_\_\_\_\_ (Head Relative to Pump)

7.3 Filtration \_\_\_\_\_ Micron  Normal  Absolute

7.4 Expected Operating Temperature \_\_\_\_\_

8. Column and Steering Wheel Data

8.1 Steering Wheel Diameter \_\_\_\_\_ (In/cm)

8.2 Shaft Serration  3/4 x 40  7/8 x 36 Other \_\_\_\_\_

8.3 Upper Column Extension \_\_\_\_\_ Length Extended  Yes  No

8.4 Length Required \_\_\_\_\_ In/(cm)

Additional Information:

Multiple horizontal lines for additional information input.







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**Parker Hannifin Corporation**

## About Parker Hannifin Corporation

Parker Hannifin is a leading global motion-control company dedicated to delivering premier customer service. A Fortune 500 corporation listed on the New York Stock Exchange (PH), our components and systems comprise over 1,400 product lines that control motion in some 1,000 industrial and aerospace markets. Parker is the only manufacturer to offer its customers a choice of hydraulic, pneumatic, and electromechanical motion-control solutions. Our Company has the largest distribution network in its field, with over 7,500 distributors serving nearly 400,000 customers worldwide.

## Parker's Charter

To be a leading worldwide manufacturer of components and systems for the builders and users of durable goods. More specifically, we will design, market and manufacture products controlling motion, flow and pressure. We will achieve profitable growth through premier customer service.

## Product Information

North American customers seeking product information, the location of a nearby distributor, or repair services will receive prompt attention by calling the Parker Product Information Center at our toll-free number: 1-800-C-PARKER (1-800-272-7537). In Europe, call 00800-C-PARKER-H (00800-2727-5374).

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Catalog HY13-1560-002/US  
5000, 02/03, EcoQuest Printing