

The Eaton logo, featuring the word "EATON" in a bold, blue, sans-serif font with a white dot over the letter "O".

EATON

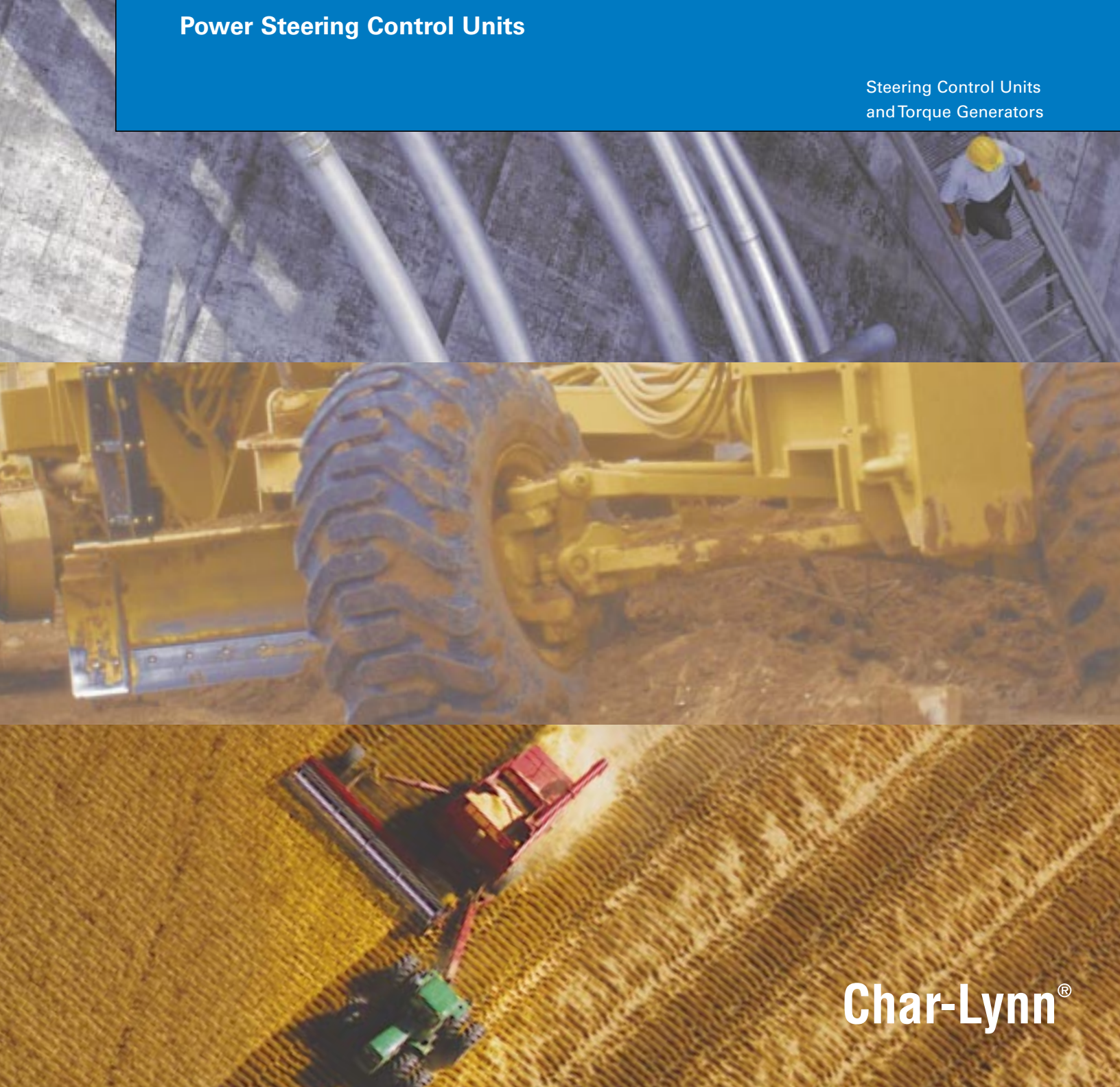
The Char-Lynn logo, featuring the name "Char-Lynn" in a white, sans-serif font.

Char-Lynn

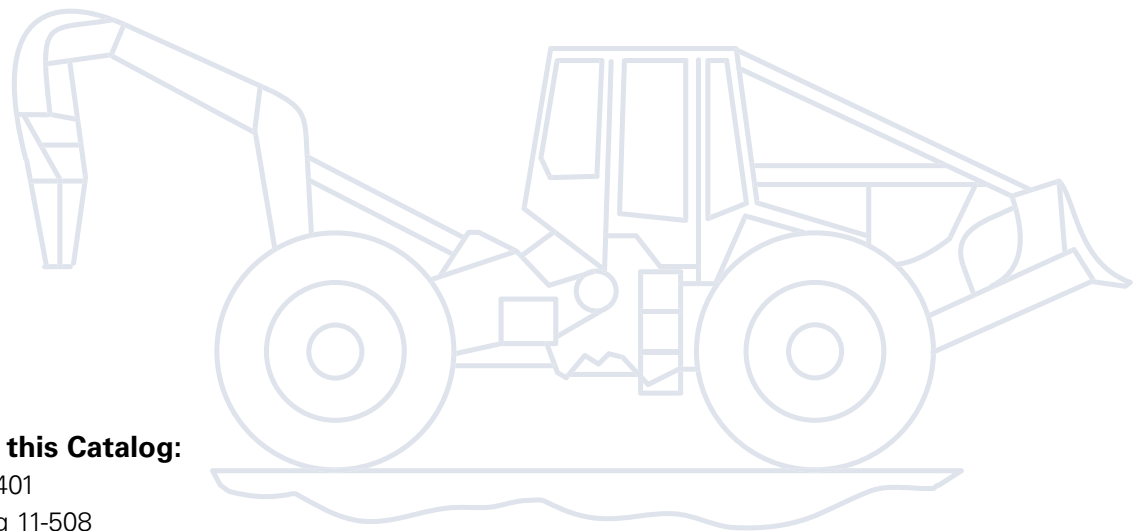
A solid blue horizontal banner containing the section header text.

Power Steering Control Units

Steering Control Units
and Torque Generators

The Char-Lynn logo, featuring the name "Char-Lynn" in a white, sans-serif font with a registered trademark symbol.

Char-Lynn®



Literature Referenced in this Catalog:

- Eaton Technical Bulletin 3-401
- Eaton Flow Divider Catalog 11-508
- Eaton Gear Pumps Series 26 Model 26000 Catalog 11-609

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Information contained in this publication is accurate as of the publication date and is subject to change without notice. Performance values are typical values. Customers are responsible for selecting products for their applications using normal engineering methods.

Steering Control Units

Description and Advantages

The Char-Lynn® steering control unit (SCU) is fully fluid linked. This means there is no mechanical connection between the steering unit, the pump and the steering cylinders. The unit consists of a manually operated directional control servo valve and feedback meter element in a single body. It is used principally for fluid linked power steering systems but it can be used for some servo-type applications or any application where visual positioning is required. The close coupled, rotary action valve performs all necessary fluid directing functions with a small number of moving parts. The manually actuated valve is coupled with the mechanical drive to the meter gear. The control is lubricated and protected by the power fluid in the system and can operate in many environments.

Char-Lynn power steering control units offer the following advantages:

- Minimizes steering linkage—reduces cost, provides flexibility in design.
- Provides complete isolation of load forces from the control station—provides operator comfort.
- Provides continuous, unlimited control action with very low input torque.
- Provides a wide selection of control circuits and meter sizes.
- Can work with many kinds of power steering pumps or fluid supply.

Char-Lynn steering control units are covered by one or more of the following U.S. Patents 25,126; 3,905,728; and 3,953,158. Corresponding foreign Patents pending and issued.

SERIES 5

Displacement	31.5 - 120 cm³/r	1.92 - 7.33 in³/r
Flow	11 - 19 l/min	3 - 5 GPM
Pressure	140 bar	2030 PSI
Series 5 can be found on page 18		

SERIES 10

Displacement	58.7 - 739 cm³/r	3.58 - 45.1 in³/r
Flow	3.8 - 60 l/min	1 - 16 GPM
Pressure	275 bar	4000 PSI
Series 10 can be found on page 24		

SERIES 20

Displacement	60 - 985 cm³/r	3.6 - 60 in³/r
Flow	38 - 114 l/min	10 - 30 GPM
Pressure	241 bar	3500 PSI
Series 20 can be found on page 35		

SERIES 25

Displacement	490 - 1230 cm³/r	30 - 75 in³/r
Flow	95 - 151 l/min	25 - 40 GPM
Pressure	241 bar	3500 PSI
Series 25 can be found on page 42		

SERIES 40

Displacement	1230 - 3030 cm³/r	75 - 185 in³/r
Flow	151 - 227 l/min	40 - 60 GPM
Pressure	241 bar	3500 PSI
Series 40 can be found on page 48		

Torque Generator Customized Steering Columns

Description and Advantages

Torque Generator

Char-Lynn® torque generators have been completely redesigned to meet the needs of the changing marketplace. These torque generators have served the industry well, providing:

- Power assist for vehicle steering.
- Power assist on gates and valves, eliminating the large hand wheels.
- Powerful rotary motion with effortless manual rotary input on numerous other applications.

Today's market includes power steering on electric lift trucks. These new torque generators have been designed with features that greatly improve the operator's comfort as well as the vehicle's performance.

Use the Torque Generator as rotary power assist for:

- Large indexing tables
- Manually operated gates and valves
- Manual positioning devices
- Mechanical steering systems
- Turntables

Customized Steering Columns

Char-Lynn® columns can be custom built to your exact specifications. The column and mounting flange is of a sturdy single weldment design. These columns have high thrust and side load capacity with low shaft torsional friction. A tilt column is also available.

SERIES 217, 227

Displacement	76 - 160 cm³/r	4.7 - 9.6 in³/r
Flow	15 l/min	4 GPM
Pressure	69 and 172 bar	1000 and 2500 PSI

Torque Generators can be found on page 53

STEERING COLUMNS

Jacket Length	56 - 836 mm	2.2 - 33 inch
Horn Wire	with and without	with and without
Upper Ends	10 Upper End Types	10 Upper End Types

Steering Columns can be found on page 72

Neutral Circuits: Open Center and Open Center Power Beyond Hydraulic Circuit Explanation

Open Center:

- Simplest, most economical system
- Uses a fixed displacement pump
- In neutral position pump and tank are connected
- Most suitable on smaller type vehicles

Open Center Power Beyond:

The power beyond steering control unit supplies steering and auxiliary valve functions. The power beyond unit is used on medium pressure, open center (fixed displacement pump) systems.

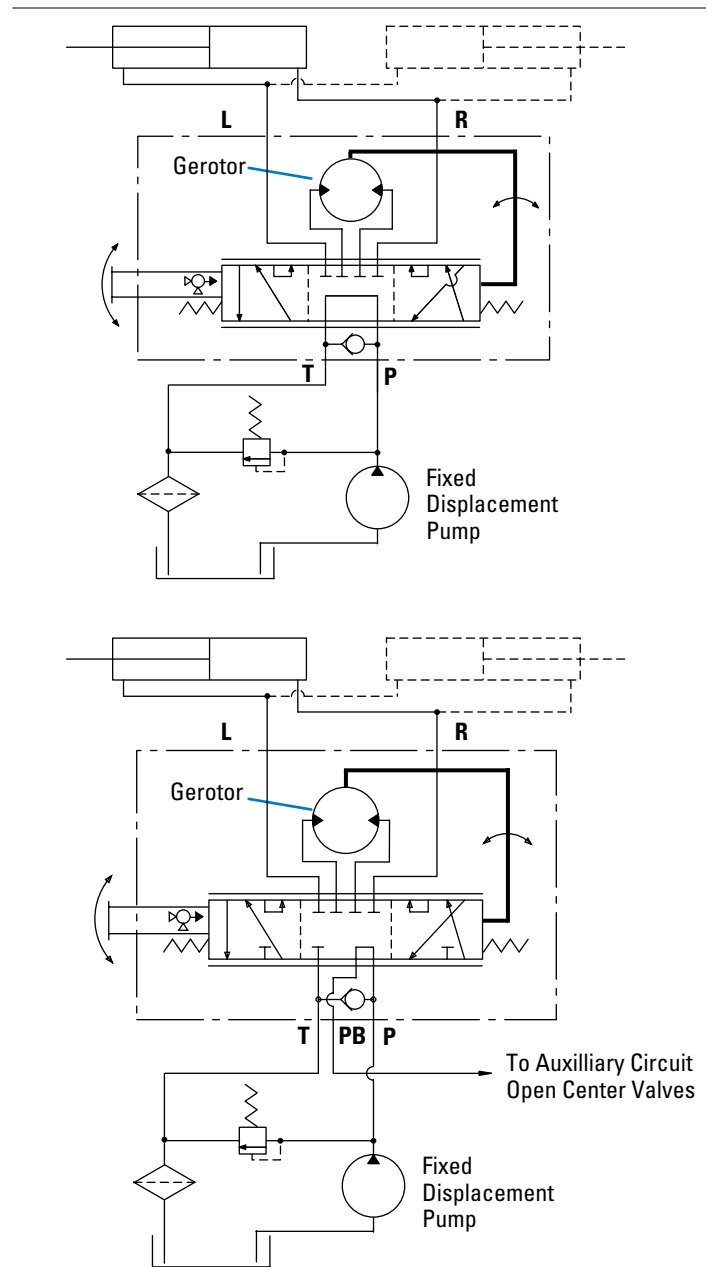
When not steering, the power beyond unit directs all inlet flow to the auxiliary circuit. However once steering is initiated, part of the auxiliary flow is diverted to steering. Since steering has priority, all flow, if required, will be diverted to steering. The tank port of the steering unit has flow only when steering is operated. Thus, flow out of the auxiliary ("PB") port and the tank port will fluctuate or stop depending on steering input.

The following special considerations should be addressed when applying power beyond steering:

- Auxiliary valves (connected to PB) must be open center type. Slight bump or kick may be felt in steering wheel when auxiliary functions are activated during steering operations.
- Pump flow not used for steering is available at power beyond (PB) outlet, except at steering stops where total pump flow goes over the system relief valve. Avoid auxiliary functions that require constant flow while steering.
- Flow is only directed to the tank port when steering is operated. Avoid systems where return flow from tank port is used for auxiliary functions.
- Inlet pressure to the steering unit will be the higher of steering system pressure or auxiliary valve pressure.
- Generally avoid systems where heavy use of auxiliary functions occur while steering.

Applications

- Lawn and Garden Equipment
- Utility Vehicles

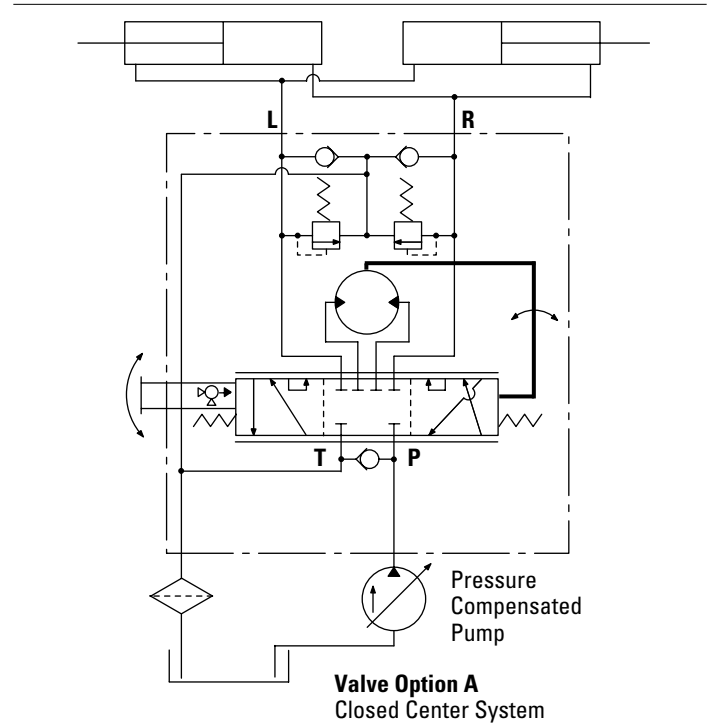


Neutral Circuits: Closed Center

Hydraulic Circuit Explanation

Closed Center:

- Uses a pressure compensated variable displacement pump
- In neutral position pump and tank are disconnected
- Most suitable on large construction equipment



Closed Center with Neutral Bleed

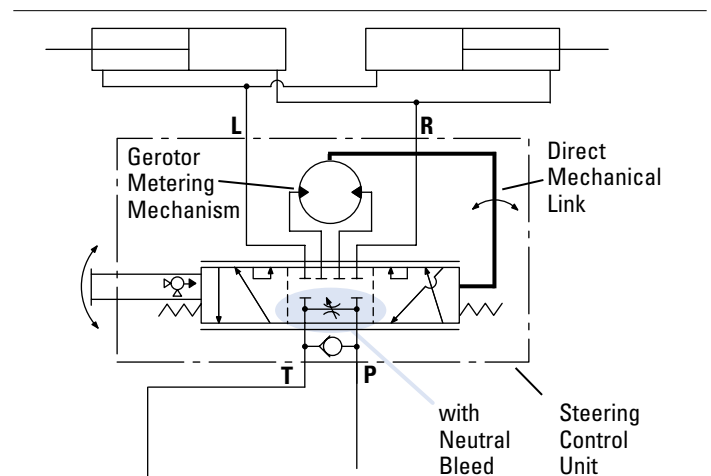
Neutral Bleed Feature

Closed Center Steering Control Units are available with and without neutral bleed feature. Most applications may not require the bleed feature, however, the maximum temperature differential between components within the steering circuit must not exceed specification (50° F or 28° C). Order unit with the bleed feature if the temperature differential may exceed this limit. The neutral bleed feature allows a small flow of fluid to pass through the unit when in neutral to reduce the thermal differential. Typical applications where neutral bleed is required are:

- Remote steering position from power source.
- Extended engine idle operation when vehicle is parked.
- High duty cycle operation sharing a common reservoir with the steering circuit.

Applications

- Construction Industry



Neutral Circuits

Hydraulic Circuit Explanation

Load Sensing Circuits

Char-Lynn® load sensing power steering uses conventional or load sensing power supplies to achieve load sensing steering. The use of a load sensing steering unit and a priority valve in a normal power steering circuit offers the following advantages:

- Provides smooth pressure compensated steering because load variations in the steering circuit do not affect axle response or maximum steering rate.
- Provides true power beyond system capability by splitting the system into two independent circuits. Pressure transients are isolated in each circuit. Only the flow required by the steering maneuver goes to the steering circuit. Flow not required for steering is available for use in the auxiliary circuits.
- Provides reliable operation because the steering circuit always has flow and pressure priority.

Char-Lynn load sensing steering control units and priority valves can be used with open center, closed center or load sensing systems. Use in an open center system with a fixed displacement pump or a closed center system with a pressure compensated pump, offers many of the features of a load sensing system. Excess flow is available for auxiliary circuits. Listed below are the components of a typical load sensing control circuit and a brief application description.

Pump—May be fixed displacement, pressure compensated, or flow and pressure compensated design.

Priority Valve—Sized for design pressure drop at maximum pump output flow rate and priority flow requirements. The minimum control pressure must assure adequate steering flow rate and must be matched with the steering control unit.

A dynamic signal priority valve must be used with a dynamic signal steering control unit.

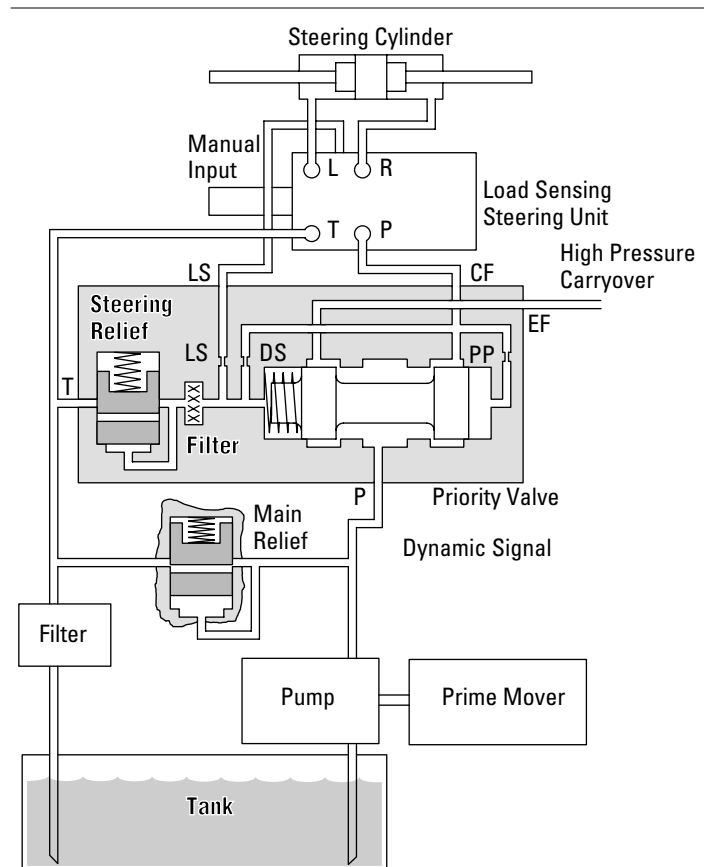
Steering Control Unit—Designed for specific rated flows and control pressures. It must be matched with a control pressure in the priority valve to obtain maximum steering rates. Higher flow rates require higher control pressures. Neutral internal bleed assures component temperature equalization.

LS Line—A LS line is always needed to sense pressure downstream from the variable control orifice in the steering control unit. This is balanced by an internal passage to the opposite side of the priority control spool.

The total system performance depends on careful consideration of the control pressure chosen and pressure drop in the CF line.

Steering Relief Valve—Must be factory set at least 10 bar [145 PSI] above the maximum steering cylinder pressure requirement. Most of the flow will be directed to the auxiliary circuit (EF) when the relief setting is exceeded.

System Main Relief Valve—A pressure relief valve for the auxiliary circuit and/or a main safety valve for the protection of the pump is recommended and sized for the maximum pump output flow rate. If a main relief valve is used, it must be set above the priority circuit steering relief valve pressure setting.



- LS — Load Sensing
- DS — Dynamic Signal
- PP — Pilot Pressure
- CF — Control Flow
- EF — Excess Flow

Neutral Circuits

Hydraulic Circuit Explanation

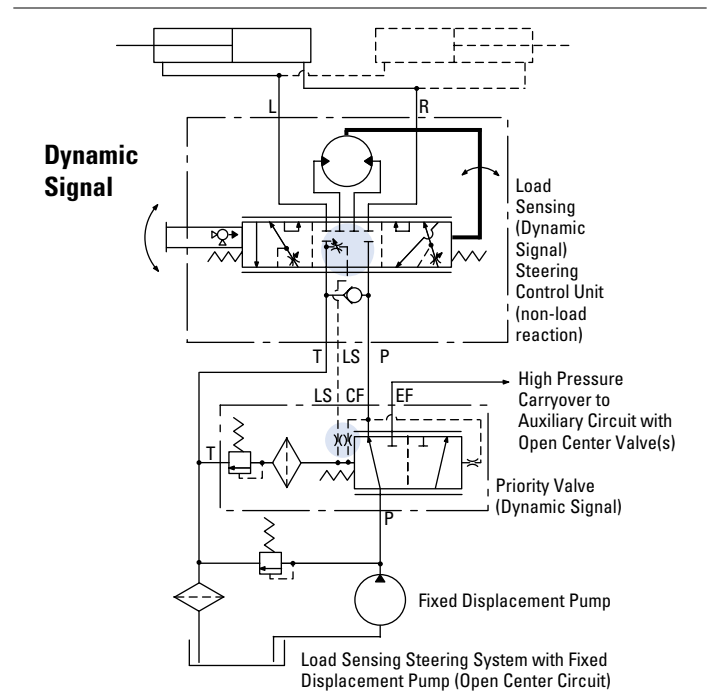
Load Sensing Circuits—Signal Systems

Two types of load sensing signal systems are available—Dynamic and Static.

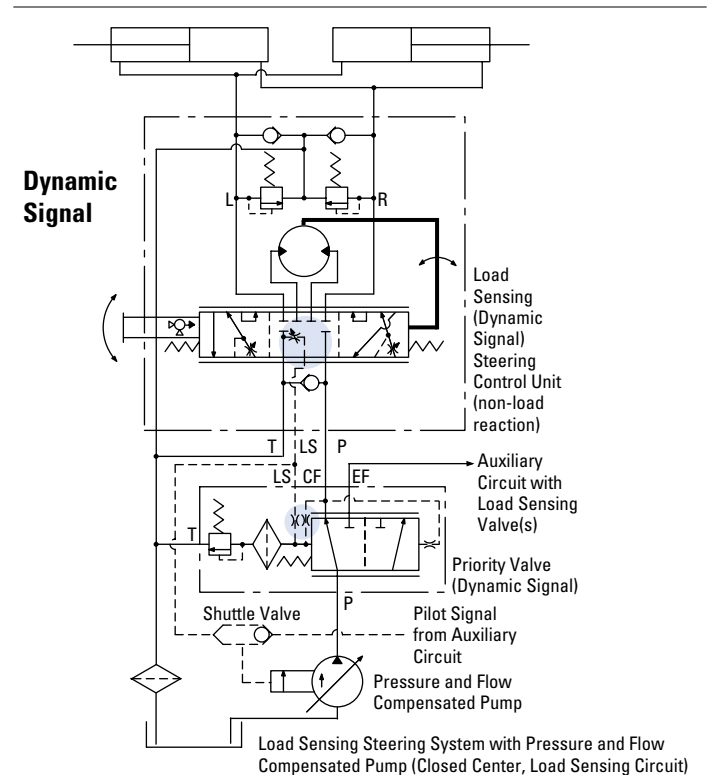
Dynamic Signal—Used for more difficult applications. The dynamic signal systems offer the following benefits:

- Faster steering response.
- Improved cold weather start-up performance.
- Increased flexibility to solve problems related to system performance and stability.

Dynamic Signal—Open Center Pump



Dynamic Signal—Load Sensing Pump



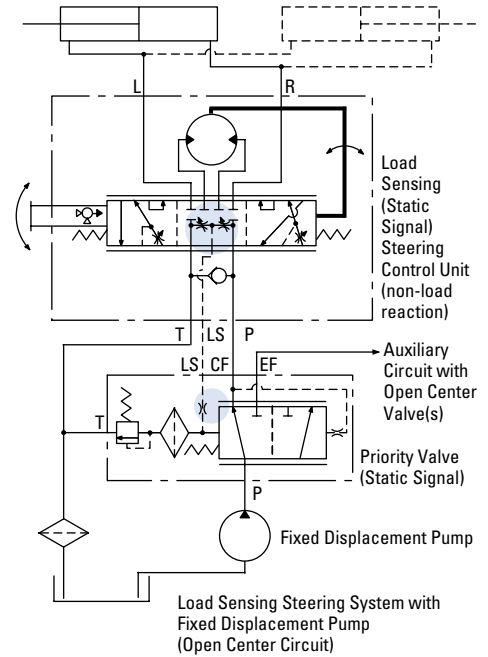
Neutral Circuits

Hydraulic Circuit Explanation

Static Signal—Open Center Pump

Static Signal—Used for conventional applications where response or circuit stability is not a problem. The load sensing pilot line should not exceed 2 meters [6 feet] in length.

Static Signal



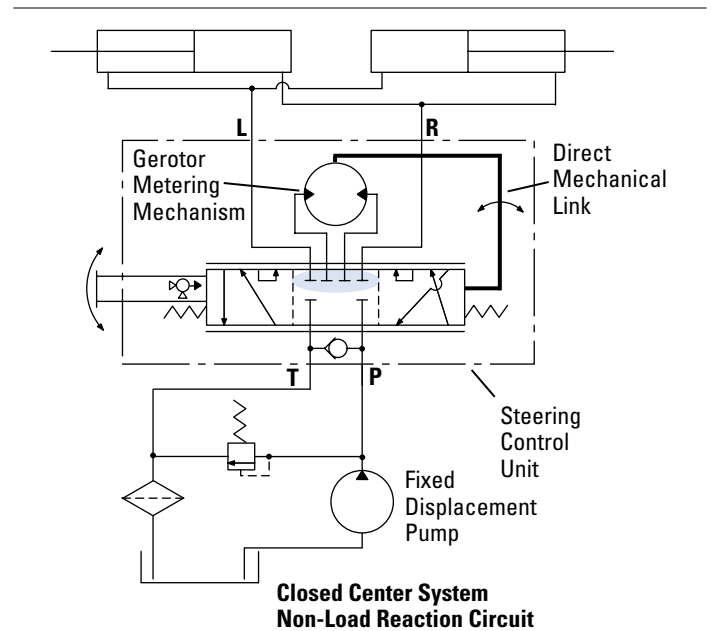
Work Circuits

Non-Load Reaction vs. Load Reaction

Hydraulic Circuit Explanation

Non-Load Reaction

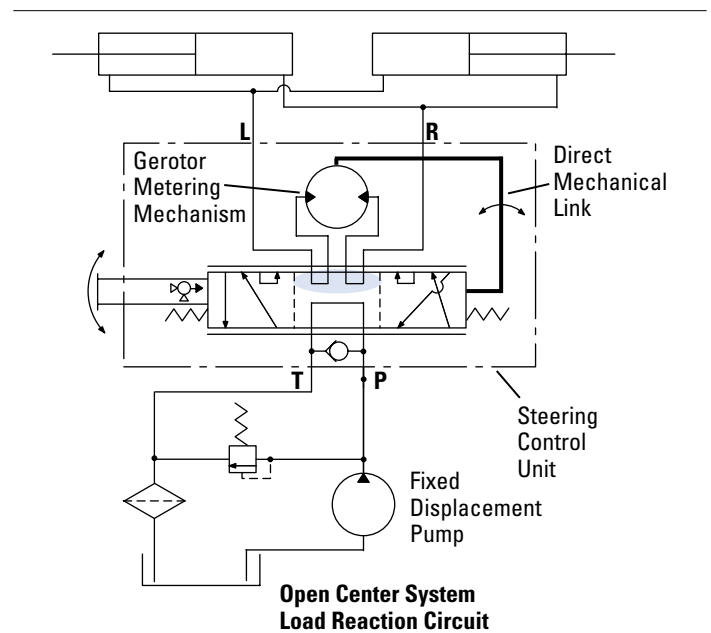
A non-load reaction steering unit blocks the cylinder ports in neutral, holding the axle position whenever the operator releases the steering wheel.



Load Reaction

A load reaction steering unit couples the cylinder ports internally (in the neutral position) with the meter gear set. Axle forces are then allowed to return the steering wheel to its approximate original position. Comparable to automobile steering, gradually releasing the wheel mid turn will allow the steering wheel to spin back as the vehicle straightens.

The cylinder system used with load reaction units **must have equal oil volume** displaced in both directions. The cylinders should be a parallel pair (as shown) or one double rod end unit. **Do not use with a single unequal area cylinder system.**



Steering Units with Integral Valves

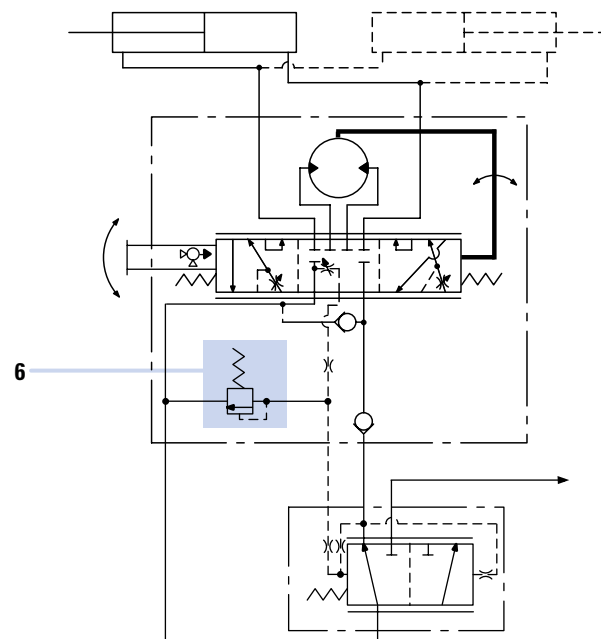
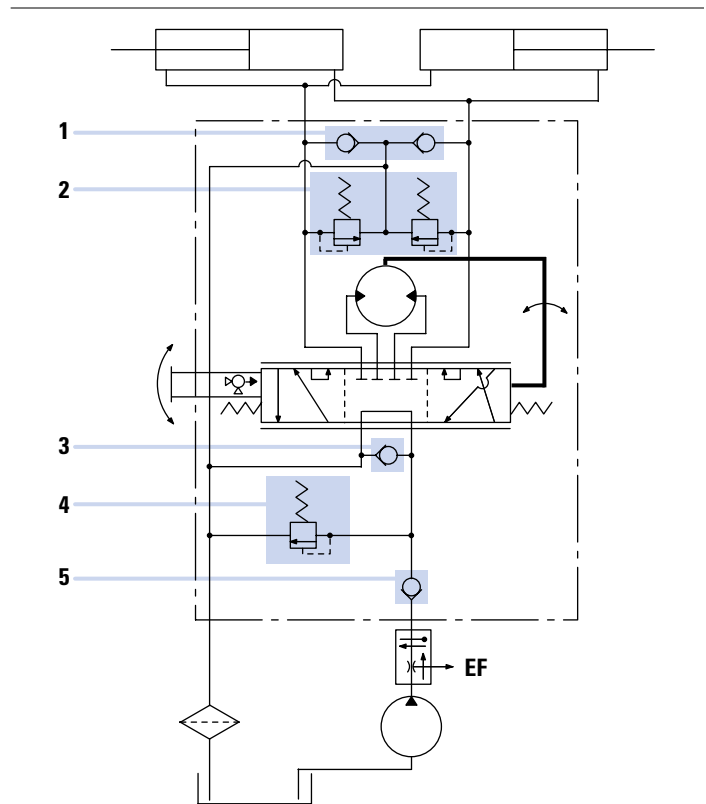
Integral valves are available for the Char-Lynn® steering control unit. Included are: Inlet Relief Valve, Cylinder Port Shock Valves, LS-Relief Valve, and Anti-Cavitation Valves for cylinder ports. In addition, a Manual Steering Check Valve for limited manual steering is included.

The integral valves eliminate the need for a separate valve block, and provides versatility to meet any steering circuit standard.

Valve Description:

- 1 Anti-cavitation check valve for cylinder ports**—(R & L) protects steering circuit against vacuum (cavitation) conditions.
- 2 Cylinder Port Relief Valves**—(R & L) protects hoses against pressure surge created by ground forces on the steered axle.
- 3 Manual Steering Check Valve**—converts unit to a hand operated pump for limited manual steering. Included in all units except Series 20, 25, and 40.**
- 4 Inlet Relief Valve**—limits maximum pressure drop across the steering unit protecting the steering circuit.
- 5 Inlet Check Valve**—prevents oil from returning through the steering unit when pressure on the cylinder side is greater than pressure on the inlet side to prevent steering wheel kick.
- 6 LS-Relief Valve**—Limits maximum pressure in the steering circuit (LS units only)

**Steering units with displacements larger than 185 cm³/r [11.3 in³/r] may require a separate power source for limited operation.



Manual Steering

Description and Advantages

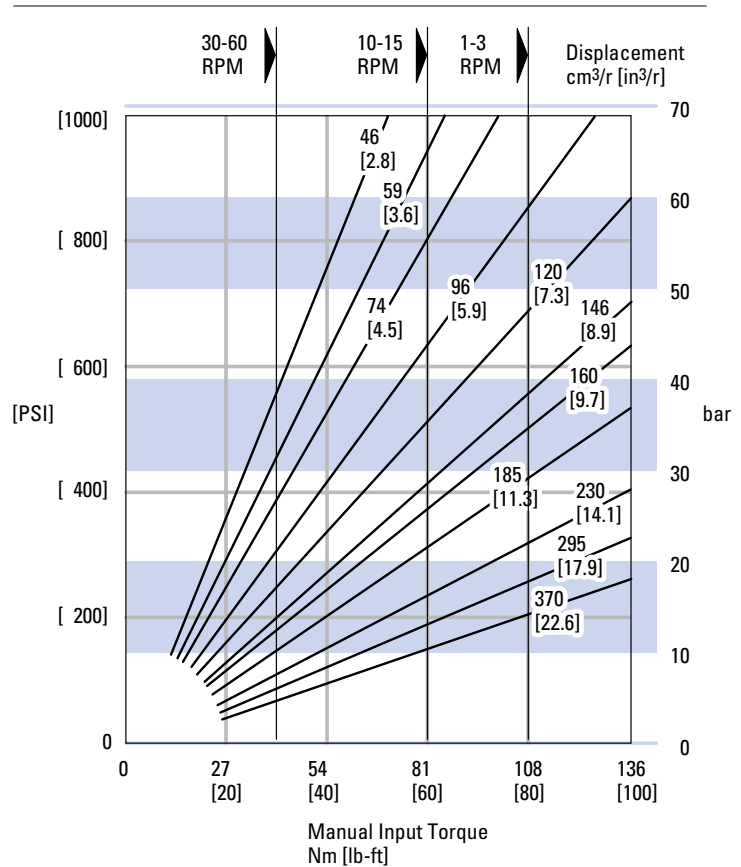
Description

The steering control unit can provide steering flow when the pump or engine fails. It will pump oil through the meter (gerotor) as the operator applies input or torque to the steering wheel which provides limited manual steering.

This feature is available in all steering models except for Series 25 and 40.

Use of Graph

1. Determine steering work port pressure required to perform the desired steering maneuver from vehicle test data. This defines the approximate manual steering pressure level required. Find this value on the vertical axis and construct a horizontal line on the graph.
2. Find the input torque limit on the horizontal axis. Follow this vertically until it crosses the required pressure line of step 1.
3. The maximum steering unit displacement is identified by the first angled line to the left of this intersection.



1) Maximum flow less than 7,6 l/min [2 GPM].

2) Actual steering pressures required and manual steering capabilities must be verified with vehicle testing.

The above curves are intended as a design guide only.

Q-Amp Flow Amplification for Load Sensing Circuits

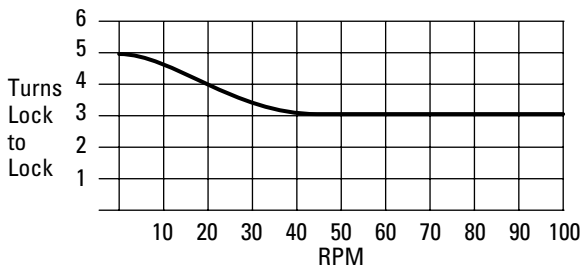
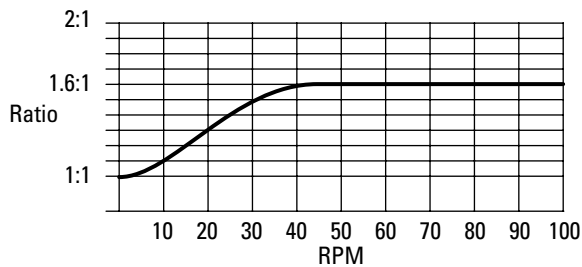
Description and Advantages

Description

Q-Amp steering units have built in variable orifices that provide flow directly to the cylinder without going through the gerotor section. The orifices do not open until after the gerotor begins to rotate and then gradually open until the desired flow is achieved which is proportional to the flow going through the gerotor. A typical Q-Amp unit has a ratio of 1.6 : 1 which means the flow of the cylinder is 1.6 times the flow going through the gerotor when turning the steering wheel at medium to fast speeds. (See model code for available ratios.)

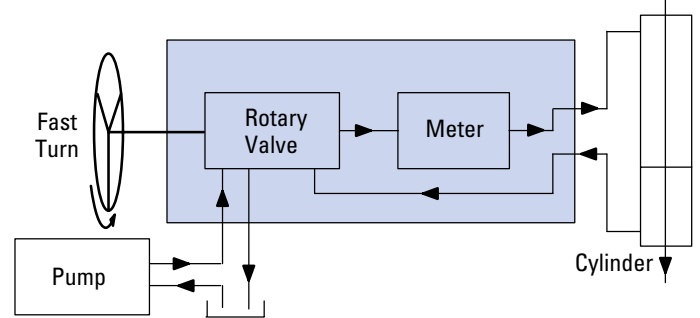
Features

- Variable Ratio

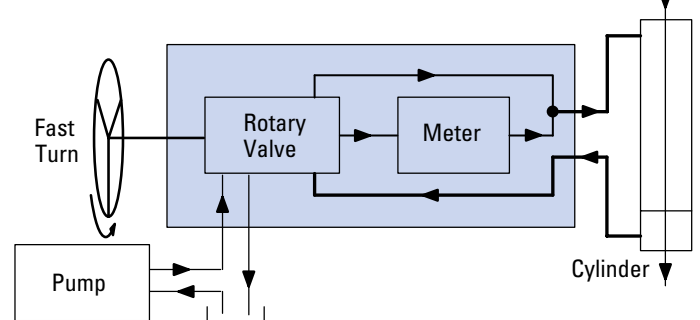


- Manual Steering
Steering a vehicle with loss of engine power may not be possible with a large displacement steering control unit (SCU). Q-Amp with manual feature has the smaller displacement required for manual steering and has the additional flow requirement of the larger displacement SCU for power steering.
- Single Cylinder (Unequal area)
On vehicles with **one single unequal area cylinder** the steering wheel turns lock to lock are more in one direction than the other. When extending the rod one would get more turns than when retracting it. A different Q-Amp ratio while turning in one direction versus the other can be used to give an equal number of turns lock to lock in each direction.

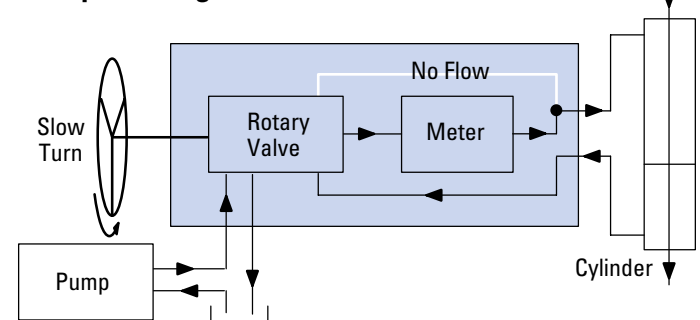
Conventional Steering Control Unit



Q-Amp Steering Control Unit – Fast Turn



Q-Amp Steering Control Unit – Slow Turn



Covered by one or more of the following U.S. and foreign Patents: 4759182, 4862690, 4781219. Unequal area Q-Amp. Patent pending.

Q-Amp Flow Amplification for Load Sensing Circuits

Special Features and Application Information

Applications

Articulated vehicles such as wheel loaders, log skidders, scrapers, trucks, and similar vehicles can benefit from this feature.

While roading, a slow movement of the steering wheel (input speed), will not overcorrect steering. Increasing input speed will produce the additional steering flow required to quickly change the vehicle's direction.

For example, operating log skidders in the woods requires very quick steering. This same log skidder on the road would be extremely difficult to steer a straight normal course. The variable ratio feature provides good steering in both conditions.

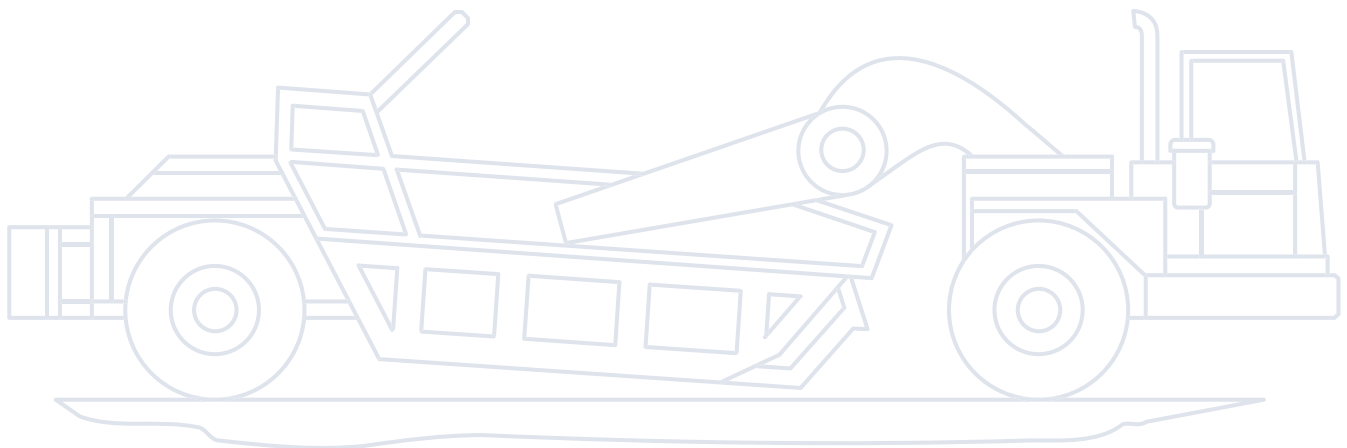
Combines, row crop tractors, and large articulated agricultural tractors also can benefit from this feature when traveling down a field. It will be easier to follow rows or furrows, and still be able to make fast turns at the end of the rows.

Variable Ratio

- Wheel Loaders
- Scrapers
- Articulated AG Tractors
- Articulated Dumpers
- Mine Trucks
- Forestry Equipment
- Rough Terrain Lift Trucks

Variable Ratio with Manual Steering

- AG Tractors
- Small Wheel Loaders
- Rubber Tired Excavators
- Sprayers
- Site Handlers
- Graders
- Combines



Wide Angle

Special Features and Application Information

Description

Steering units with wide angle features have been developed to significantly reduce or eliminate the jerky motion of vehicles with articulated steering systems. This has been accomplished by increasing the maximum deflection of the spool relative to the sleeve. Increasing the deflection reduces the gain. This in turn reduces acceleration and jerk levels and provides overall smoother vehicle performance.

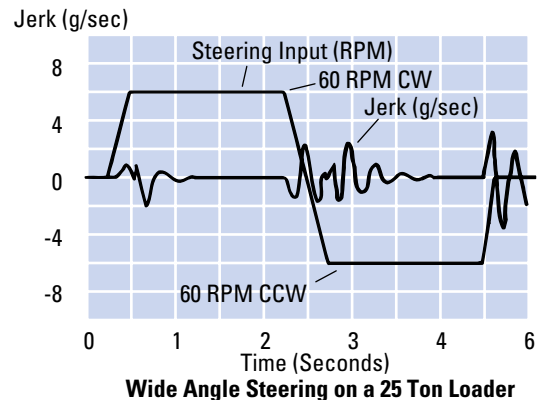
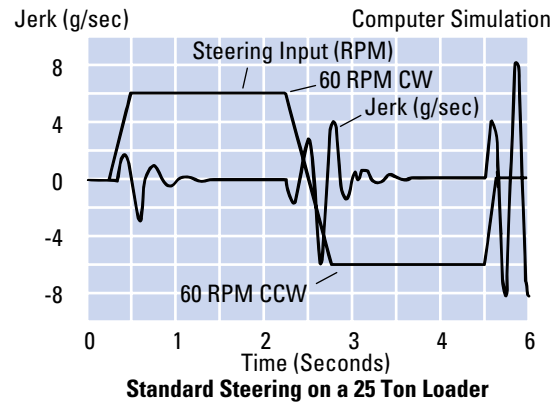
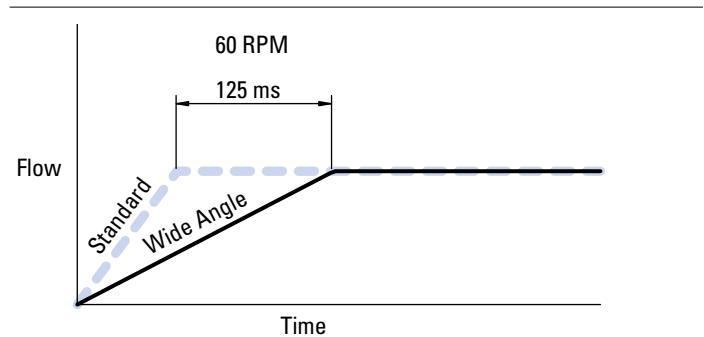
The steering still responds fast enough so the operator does not notice the reduced gain.

Features

- Minimizes jerking motion on medium and large articulated vehicles.
- Jerk reducing valves and accumulators can be eliminated on most vehicles.
- Available on Series 20, Series 25.

Applications

- Articulated Vehicles



Wide Angle Steering Control Units
Patent No. 5080135

These graphs show a computer simulation of the jerk levels and has been verified by actual vehicle tests.

Cylinder Damping

Special Features and Application Information

Description

Cylinder damping can help smooth the steering action of large articulated vehicles such as loaders, scrapers, and skidders. These vehicles have overhanging weight with high inertial loads. This energy is dissipated by the cylinder damping orifices which bleed a small amount of flow from the cylinder port to tank.

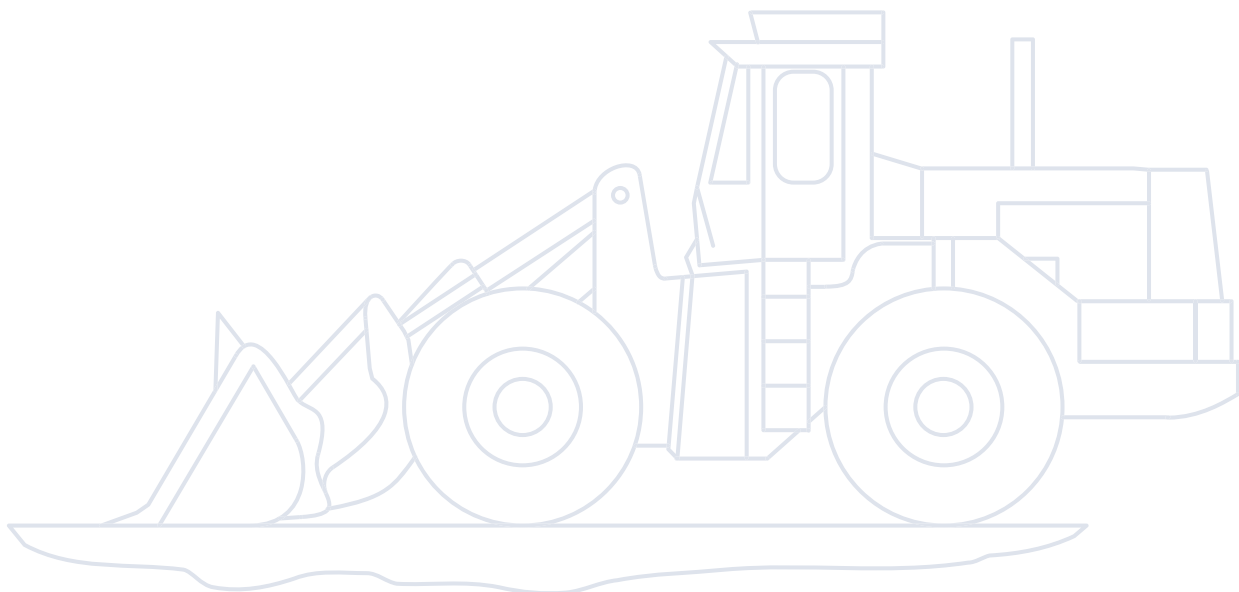
Features

- Reduces jerking motion on medium and large articulated vehicles.
- Available on the following steering control units (Series 450, 20, 25, 40).
- Damps or stabilizes unstable systems.

Applications—Large Articulated Vehicles

- Wheel Loaders
- Skidders
- Scrapers

Steering Control Units with
Cylinder Damping Patent
No. 5080135



Steering Control Units—Series 5

Product Description

Power Beyond Models—Optional power beyond steering control units supply steering and flow to auxiliary valve functions. The power beyond unit is used in open center (fixed displacement pump) systems in the medium pressure range. When not steering, the power beyond unit directs all inlet flow to the excess flow port (power beyond) for use in the auxiliary circuit. Once steering is initiated, and since steering has priority, inlet flow will be diverted to the steering circuit as required. Flow out the excess flow port (power beyond) and tank port will vary or stop depending upon the steering requirement. The tank port of the steering unit has flow only when steering is operating.

The following special considerations should be addressed when applying power beyond functions:

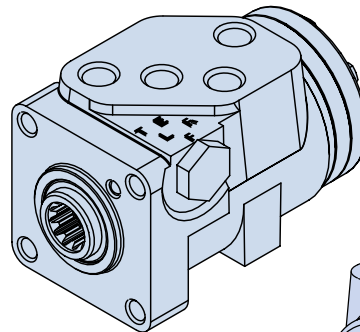
- Auxiliary valves, connected to the power beyond port, must be open center type. A slight bump or kick may be felt in steering wheel when auxiliary functions are activated during steering operations.
- Pump flow not used for steering is available at the excess flow (power beyond) port except at steering stops when total pump flow goes over the system relief valve. Avoid auxiliary functions that require constant flow while steering.
- Flow is only directed to the tank port when steering is operated. Avoid systems where return flow from tank port is used for auxiliary functions.
- Inlet pressure must be higher than the steering or auxiliary circuit pressure settings.
- Generally avoid systems where heavy use of auxiliary functions occur while steering.
- The high pressure model has high strength housing and internal changes to improve durability.

Features

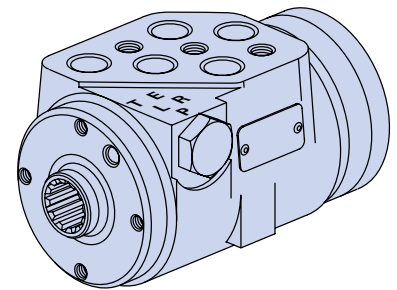
- Open Center
- Load Sensing
- Open Center Power Beyond
- Manual Steering Check Valve
- Inlet Relief Valve

Applications

- Lawn and Garden Equipment
- Turf Equipment
- Golf Course Maintenance Equipment
- Lift Trucks
- Compact Utility Tractors



Option 1: Square Housing
refer to Model Code, page 22



Option 2: Round Housing
refer to Model Code, page 23

SPECIFICATIONS

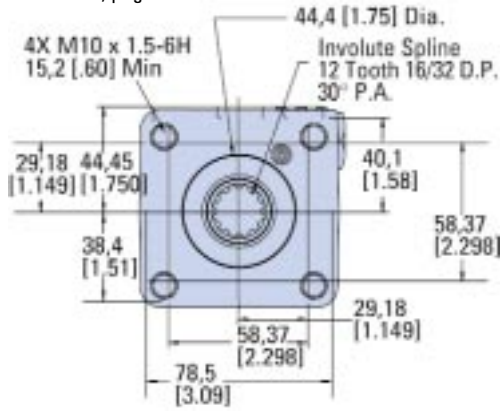
Max. System Pressure	140 bar [2030 PSI]
Max. Back Pressure	10 bar [150 PSI]
Max. System Operating Temperature	93°C [200° F]
Max. Flow	19 l/min [5 GPM]
Max. Differential Between Steering Unit and System Temperature	28° C 50° F
Input Torque	
Powered - Standard	1,7 - 2,8 Nm @ 6,9 bar tank pressure [15 - 25 lb-in @ 100 PSI tank pressure]
Low	1,1 - 2,0 Nm @ 6,9 bar tank pressure [10 - 17.5 lb-in @ 100 PSI tank pressure]
Max. Non Powered	81,4 Nm [60 lb-ft]
Rotation Limits	None
Fluid	Petroleum Based Fluids
Recommended Filtration	ISO 18/13 cleanliness level
Check Valve for Manual Steering	Yes
Optional Relief Valve Settings bar [PSI]	40 [580] 50 [725] 63 [914] 70 [1015] 80 [1160] 90 [1305] 100 [1450] 125 [1812]
Port Options	9/16-18 SAE O-ring 9/16 Plug-O - 06 STC 3/8 BSP Straight thread ports

Steering Control Units—Series 5

Installation Drawing

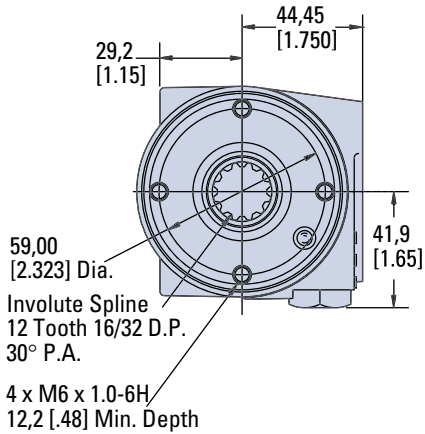
Option 1: Square Housing

refer to Model Code, page 22

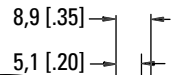


Option 2: Round Housing

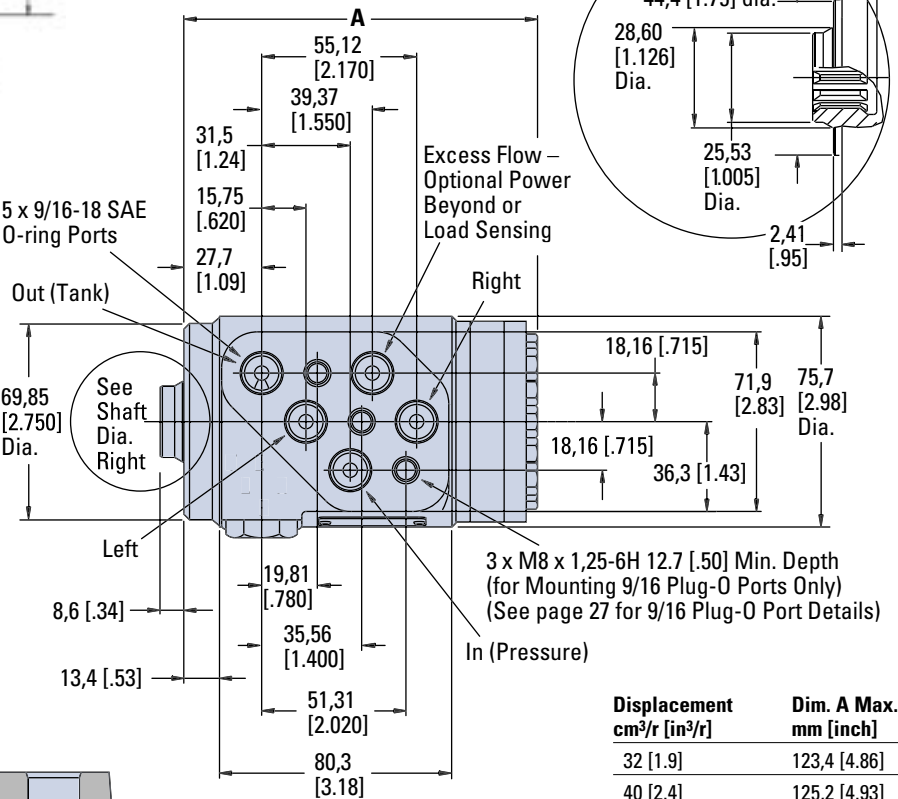
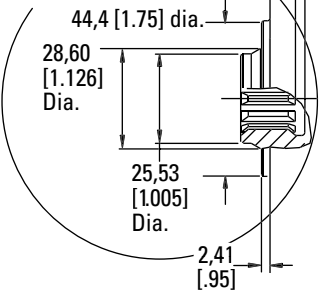
refer to Model Code, page 23



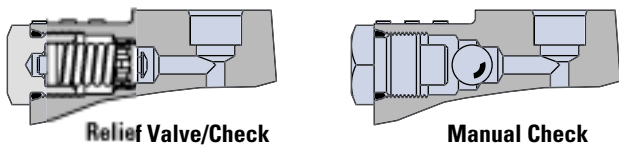
Spline Depth



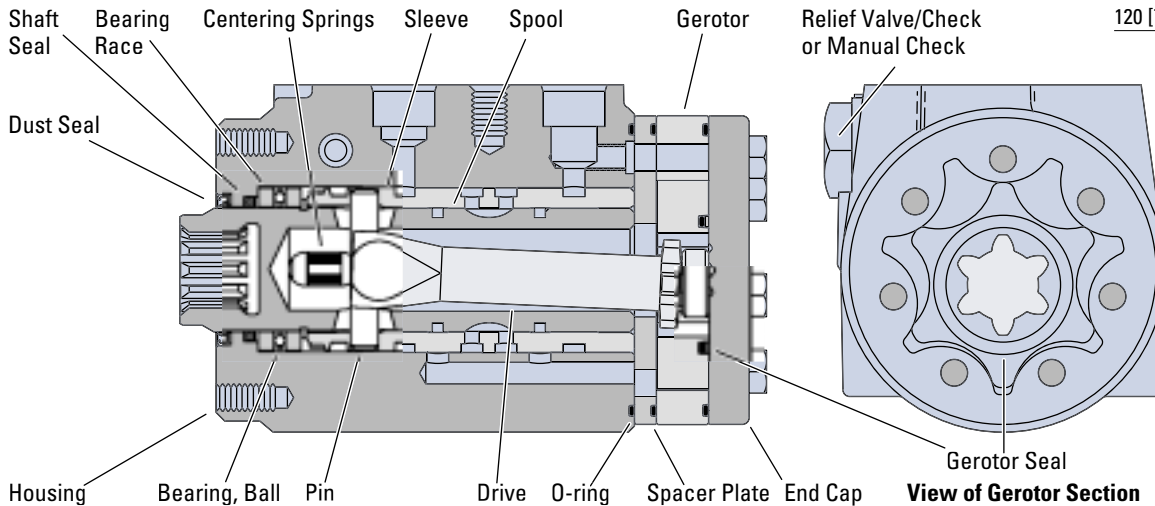
Shaft Diameters



Sectional Drawing



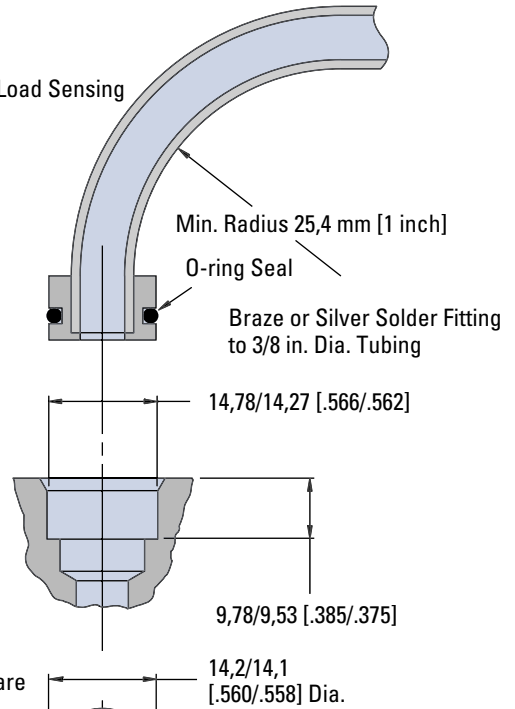
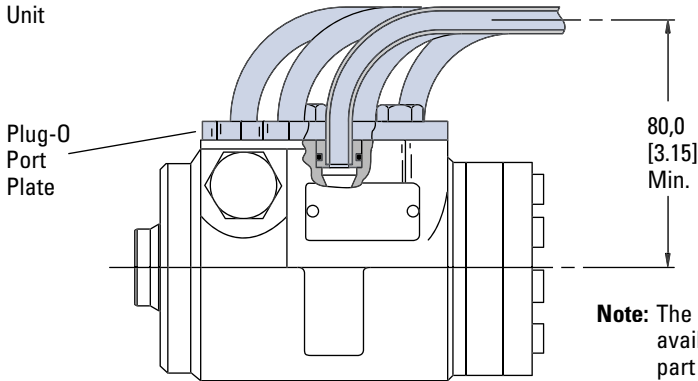
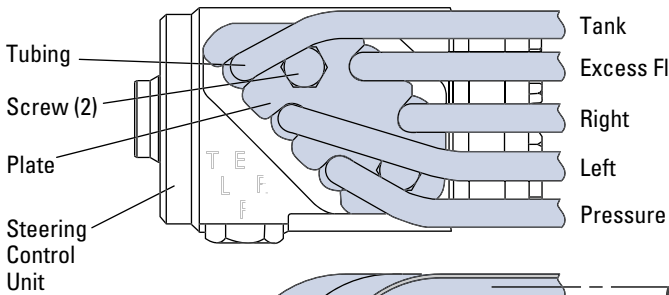
Displacement cm ³ /r [in ³ /r]	Dim. A Max. mm [inch]
32 [1.9]	123,4 [4.86]
40 [2.4]	125,2 [4.93]
51 [3.1]	124,2 [4.89]
63 [3.9]	126,2 [4.97]
74 [4.5]	128,0 [5.04]
100 [6.1]	132,3 [5.21]
120 [7.3]	135,4 [5.33]



Steering Control Units—Series 5

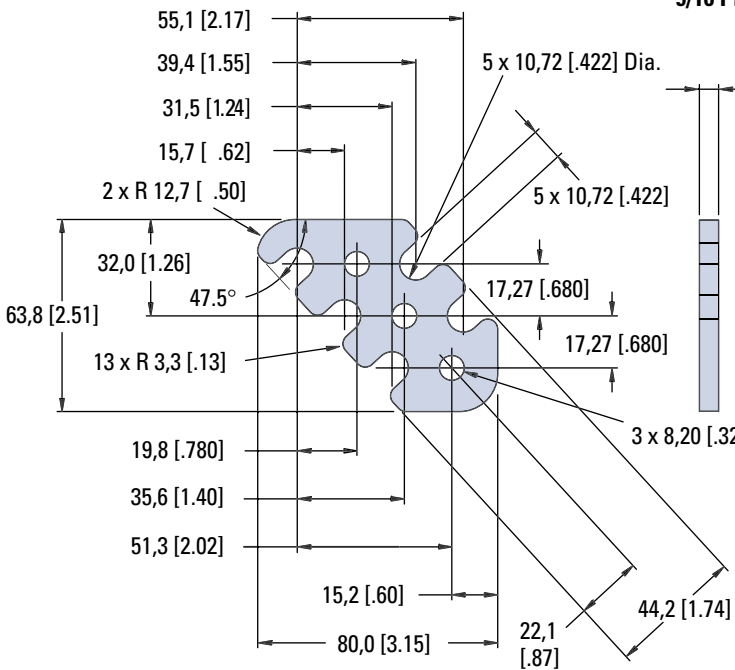
Installation Drawing

Pertaining to Option 2: Round Housing only
****Plug-O Port rated to 103 bar [1500PSI]**

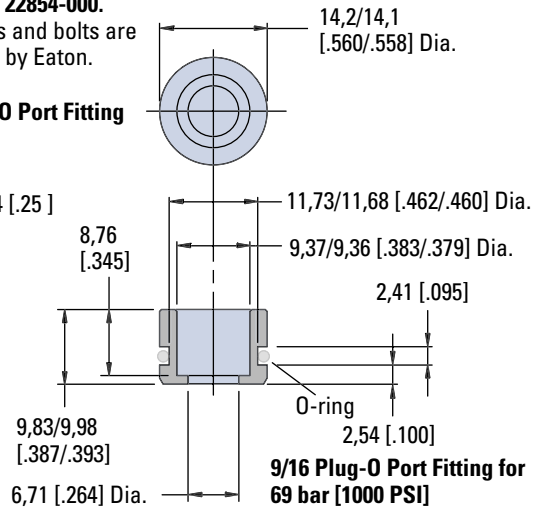


Note: The plug-o port plate is available from Eaton – part number **22854-000**. Other fittings and bolts are **not** supplied by Eaton.

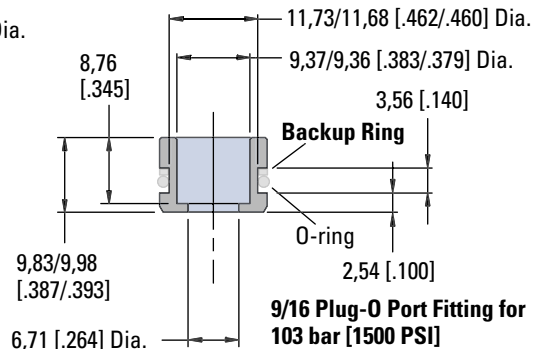
9/16 Plug-O Port Plate



9/16 Plug-O Port Fitting



9/16 Plug-O Port Fitting for 69 bar [1000 PSI]



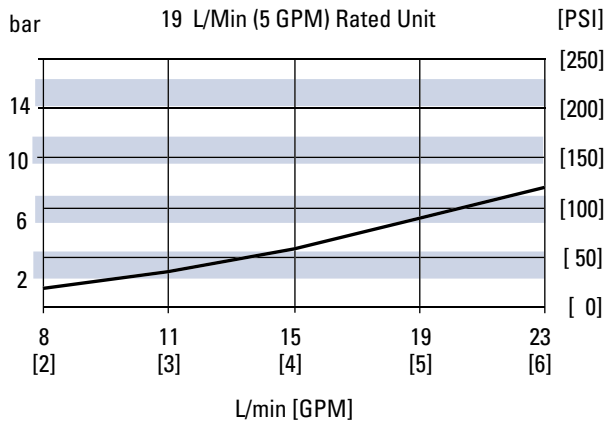
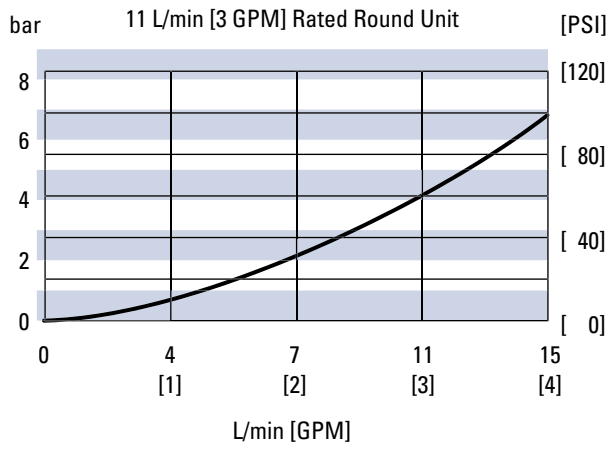
9/16 Plug-O Port Fitting for 103 bar [1500 PSI]

Seal Specifications for Plug-O Fittings
 O-rings — Buna N 90 Durometer Size -013
 Backup Ring — Solid Teflon - Scarf Cut Size -013

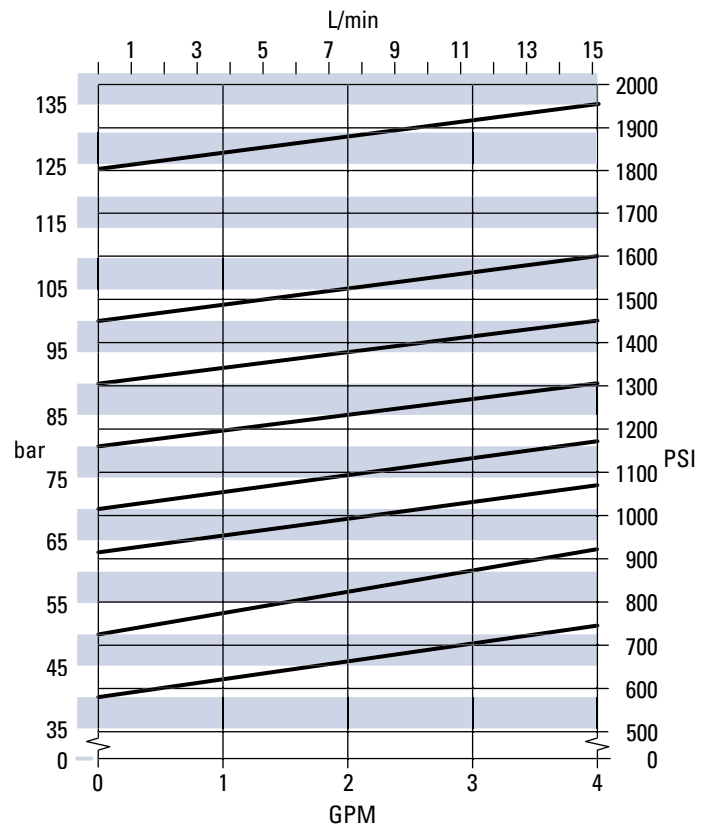
Steering Control Units—Series 5

Performance Data

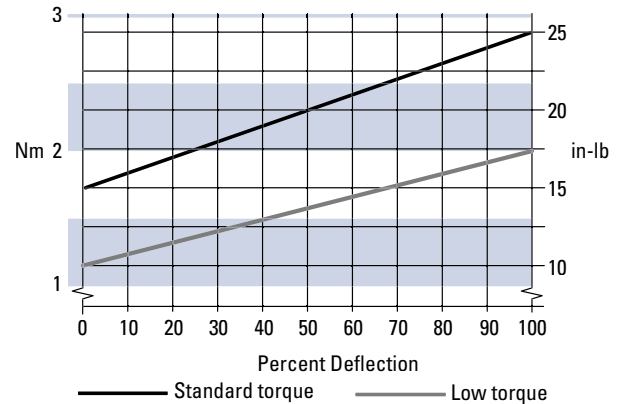
Neutral Pressure Drop Inlet to Auxiliary



Relief Valve Curve

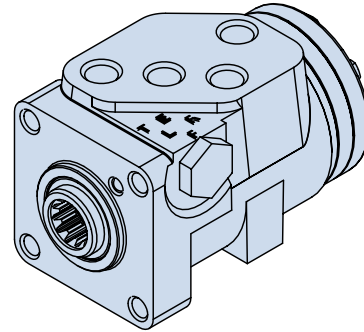


Input Torque Curve



Steering Control Units—Series 5

Model Code – Ordering Information



Square Housing - Option 1

The following 30-digit coding system has been developed to identify all of the configuration options for the Series 5 steering control units. Use this model code to specify a unit with the desired features. All 30-digits of the code must be present when ordering. You may want to photocopy the matrix below to ensure that each number is entered in the correct box.

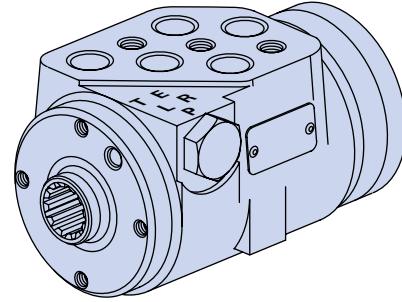
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
A	B	R		C	A			0		A					0	0							A	0			1	0	D	A

Nos	Feature	Code	Description	Nos	Feature	Code	Description
1,2,3	Product Series	ABR	Series 5 Steering Control Unit	18,19,20,21	Ports and Mounting Threads	BAAN	Square 4 x 9/16 SAE Ports, M10 x 1,5 Column Mounting Threads (Use with Open Center)
4	Nominal Flow Rating	1 B	11 l/min [3 GPM] 19 l/min [5 GPM]			BAKN	Square 5 x 9/16 SAE Ports, M10 x 1,5 Column Mounting Threads (Use with Excess Flow)
5	Inlet Pressure Rating	C	140 bar [2030 PSI]			BAEH	Square 5 x 9/16 SAE Ports, M10 x 1,5 Column Mounting Threads (Use with Load Sense)
6	Tank Pressure Rating	A	10 bar [150 PSI]			UAAN	Square 4 x -06 STC Direct Ports, M10 x 1,5 Column Mounting Threads (Use with Open Center)
7-8	Displacement	35 37 39 41 43 46 48	31.5 cm3/r [1.92 in3/r] 39.5 cm3/r [2.41 in3/r] 50.8 cm3/r [3.10 in3/r] 63.1 cm3/r [3.85 in3/r] 73.8 cm3/r [4.50 in3/r] 100 cm3/r [6.10 in3/r] 120 cm3/r [7.33 in3/r]			UBNN	Square 5 x -06 STC Direct Ports, M10 x 1,5 Column Mounting Threads (Use with Excess Flow)
9	Flow Amplification	0	None			UBPN	Square 5 x -06 STC Direct Ports, M10 x 1,5 Column Mounting Threads (Use with Load Sense)
10	Neutral Circuit	A B F	Open Center Open Center, Power Beyond Load Sensing, Dynamic signal			YAAN	Square 4 x G .375 BSP Straight Thread Ports, M10 x 1,5 Column Mounting Threads (Use with Open Center)
11	Load Circuit	A	Non-Load Reaction			YBSN	Square 5 x G .375 BSP Straight Thread Ports, M10 x 1,5 Column Mounting Threads (Use with Excess Flow)
12,13	Valve Options	01 04 05 06	Manual Steering Check Valve Inlet Check Valve, Manual Steering Check Valve Inlet Relief Valve, Manual Steering Check Valve Inlet Relief Valve, Inlet Check Valve, Manual Steering Check Valve			YBRN	Square 5 x G .375 BSP Straight Thread Ports, M10 x 1,5 Column Mounting Threads (Use with Load Sense)
14,15	Integral Inlet Relief Valve Setting	00 18 1J 1Z 26 2G 2T 34 3W	None 40 bar [580 PSI] 50 bar [725 PSI] 63 bar [914 PSI] 70 bar [1015 PSI] 80 bar [1160 PSI] 90 bar [1305 PSI] 100 bar [1450 PSI] 125 bar [1812 PSI]	22	Input Torque	1 3	Low* Standard
16,17	Cylinder Relief Setting	00	None	23	Fluid Type	A	See Eaton Technical Bulletin 3-401
				24	Special Application	0	None
				25,26	Special Feature	AA	None
				27	Paint	1	Black Primer
				28	Identification	0	Eaton Product Number on Nameplate
				29	Mechanical Interface	D	Internal involute spline 12 tooth, 16/32 DP, 30 degree PA
				30	Eaton Assigned Design Code	A	Assigned Design Code

* All low torque units need approval from an Eaton Steering Engineer.

Steering Control Units—Series 5

Model Code – Ordering Information



Round Housing - Option 2

The following 30-digit coding system has been developed to identify all of the configuration options for the Series 5 steering control units. Use this model code to specify a unit with the desired features. All 30-digits of the code must be present when ordering. You may want to photocopy the matrix below to ensure that each number is entered in the correct box.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
A	B	R			A			0		A					0	0						A	0				1	0	D	A

Nos	Feature	Code	Description	Nos	Feature	Code	Description
1,2,3	Product Series	ABR	Series 5 Steering Control Unit	18,19,20,21	Ports and Mounting Threads	BAAH	Round 4 x 9/16 SAE Ports, M6 x 1,0 Column Mounting Threads (Use with Open Center)
4	Nominal Flow Rating	1 B	11 l/min [3 GPM] 19 l/min [5 GPM]			BAKH	Round 5 x 9/16 SAE Ports, M6 x 1,0 Column Mounting Threads (Use with Excess Flow)
5	Inlet Pressure Rating	2 C	69 bar [1000 PSI] 140 bar [2030 PSI]			BAEH	Round 5 x 9/16 SAE Ports, M6 x 1,0 Column Mounting
6	Tank Pressure Rating	A	10 bar [150 PSI]			CAAJ**	Round 4 x 9/16 Plug-O Ports, M6 x 1,0 Column Mounting Threads, M8 x 1,25 Port Face Mounting (Use with Open Center)
7-8	Displacement	35 37 39 41 43 46 48	31.5 cm3/r [1.92 in3/r] 39.5 cm3/r [2.41 in3/r] 50.8 cm3/r [3.10 in3/r] 63.1 cm3/r [3.85 in3/r] 73.8 cm3/r [4.50 in3/r] 100 cm3/r [6.10 in3/r] 120 cm3/r [7.33 in3/r]			CAJJ**	Round 4 x 9/16 Plug-O Ports, M6 x 1,0 Column Mounting Threads, M8 x 1,25 Port Face Mounting (Use with Excess Flow)
9	Flow Amplification	0	None			CATJ**	Round 4 x 9/16 Plug-O Ports, M6 x 1,0 Column Mounting Threads, M8 x 1,25 Port Face Mounting (Use with Load Sense)
10	Neutral Circuit	A B F	Open Center Open Center, Power Beyond Load Sensing, Dynamic signal			UAAH	Round 4 x -06 STC Direct Ports, M6 x 1,0 Column Mounting Threads (Use with Open Center)
11	Load Circuit	A	Non-Load Reaction			UBNH	Round 5 x -06 STC Direct Ports, M6 x 1,0 Column Mounting Threads (Use with Excess Flow)
12,13	Valve Options	01 04 05 06	Manual Steering Check Valve Inlet Check Valve, Manual Steering Check Valve Inlet Relief Valve, Manual Steering Check Valve Inlet Relief Valve, Inlet Check Valve, Manual Steering Check Valve			UBPH	Round 5 x -06 STC Direct Ports, M6 x 1,0 Column Mounting Threads (Use with Load Sense)
14,15	Integral Inlet Relief Valve Setting	00 18 1J 1Z 26 2G 2T 34 3W	None 40 bar [580 PSI] 50 bar [725 PSI] 63 bar [914 PSI] 70 bar [1020 PSI] 80 bar [1160 PSI] 90 bar [1310 PSI] 100 bar [1450 PSI] 125 bar [1812 PSI]	22	Input Torque	1 3	Low* Standard
				23	Fluid Type	A	See Eaton Technical Bulletin 3-401
				24	Special Application	0	None
				25,26	Special Feature	AA	None
				27	Paint	1	Black Primer
				28	Identification	0	Eaton Product Number on Nameplate
16,17	Cylinder Relief Setting	00	None	29	Mechanical Interface	D	Internal involute spline 12 tooth, 16/32 DP, 30 degree PA
				30	Eaton Assigned Design Code	A	Assigned Design Code

* All low torque units need approval from an Eaton Steering Engineer.
** Plug-O ports rated to 103 bar [1500PSI]

Steering Control Units—Series 10

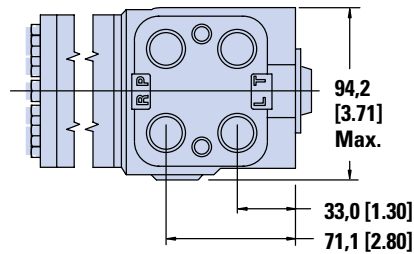
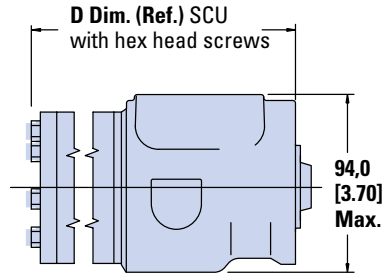
Product Information

Features and Benefits

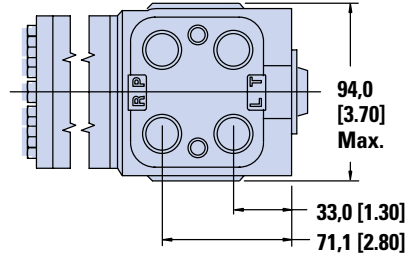
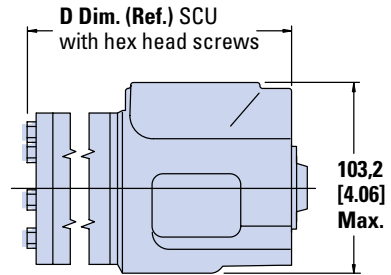
- Robust design with **balanced architecture** is based on existing and proven technology of our current Series 2, Series 20, and Series 25 steering control units (SCU).
- Only Steering Control Unit in the market capable of **275 bar [4000 PSI] continuous pressure rating**.
- Physically and functionally interchangeable to our 3, 4, 6, 12, 110, 230, and 450 units.

Dimensional Data

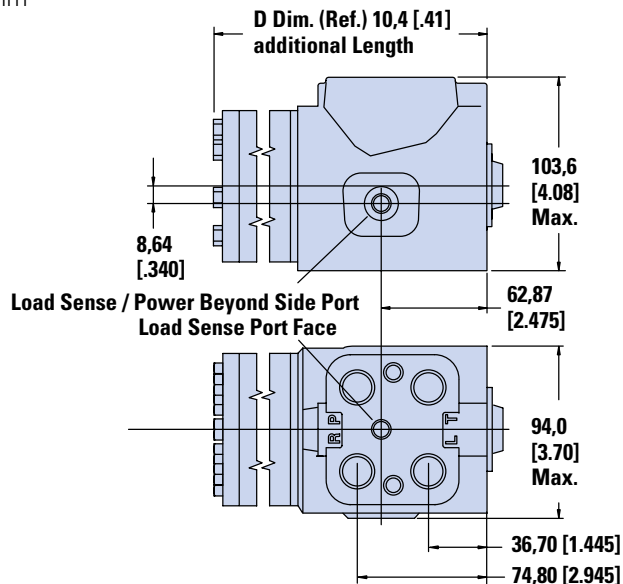
- Column interface is identical.
- Port pattern is identical.
- Load sense hole location on port face has been standardized to one location (see below).
- On Series 10 units, the overall length is increased by approximately 12 mm [0.5 inch].



Series 3, 4, 6, 12



Series 110, 230, 450



New Series 10

Steering Control Units—Series 10

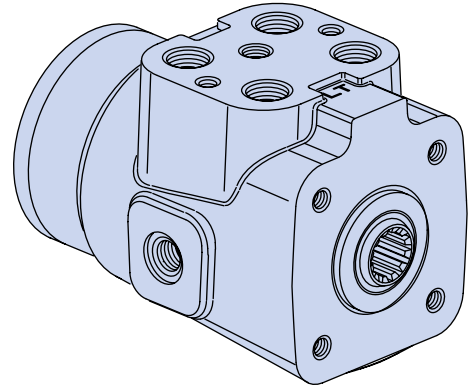
Product Description and Features

Eaton's new Series 10 Steering Control Unit (SCU) facilitates hydraulic fluid flow like no other unit on the market.

The new Series 10 SCU has an unprecedented, continuous pressure rating of 275 bar (4000 psi), making it ideal for heavy-duty equipment, such as construction and agricultural machinery.

Its **high-pressure rating** reduces overall equipment costs, since smaller cylinder sizes can be assigned into the system.

The new Series 10 incorporates proven Eaton technologies. An internal, balanced architecture and a wide-walled sleeve that is 40% thicker than standard designs offer **increased performance** during transient pressure conditions.



PORT SIZES:

Work Ports (4)	Load Sense (LS) Port (1)*
3/4-16 (SAE)	7/16-20
M18 x 1,5 - 6H	M12 x 1,5 - 6H
G 1/2 (BSP) Straight Thread	G 1/4 (BSP) Straight Thread
STC Dash 08**	STC Dash 06**

*Top or side when applicable

**STC® Ports, Aeroquip patented, feature snap to connect technology

Features

- Open Center
- Closed Center
- Load Sensing
- Integral Valves
- Q-Amp
- EMSS
- Bolt on Priority Valve

SPECIFICATIONS

Max. System Pressure	275 bar [4000 PSI]
Max. Back Pressure	21 bar [305 PSI]
Rated Flow	
– Low	7,6 - 15 l/min [2 - 4 GPM]
– Medium	15 - 30 l/min [4 - 8 GPM]
– High	30 - 61 l/min [8 - 16 GPM]
– Low (with Q-Amp)	8 - 19 l/min [2 - 5 GPM]
– Medium (with Q-Amp)	19 - 38 l/min [5 - 10 GPM]
– High (with Q-Amp)	38 - 76 l/min [10 - 20 GPM]
Max. System Operating Temperature	93°C [200° F]
Max. Differential Between Steering Unit and System Temperature	28° C [50° F]
Input Torque Powered	1,1-2,8 Nm @ 6,9 bar back pressure [10-25 lb-in @ 100 PSI back pressure]
Non-Powered	136 Nm [100 lb-ft]
Fluid	See Eaton Technical Bulletin 3-401
Recommended Filtration	ISO 18/13 cleanliness level

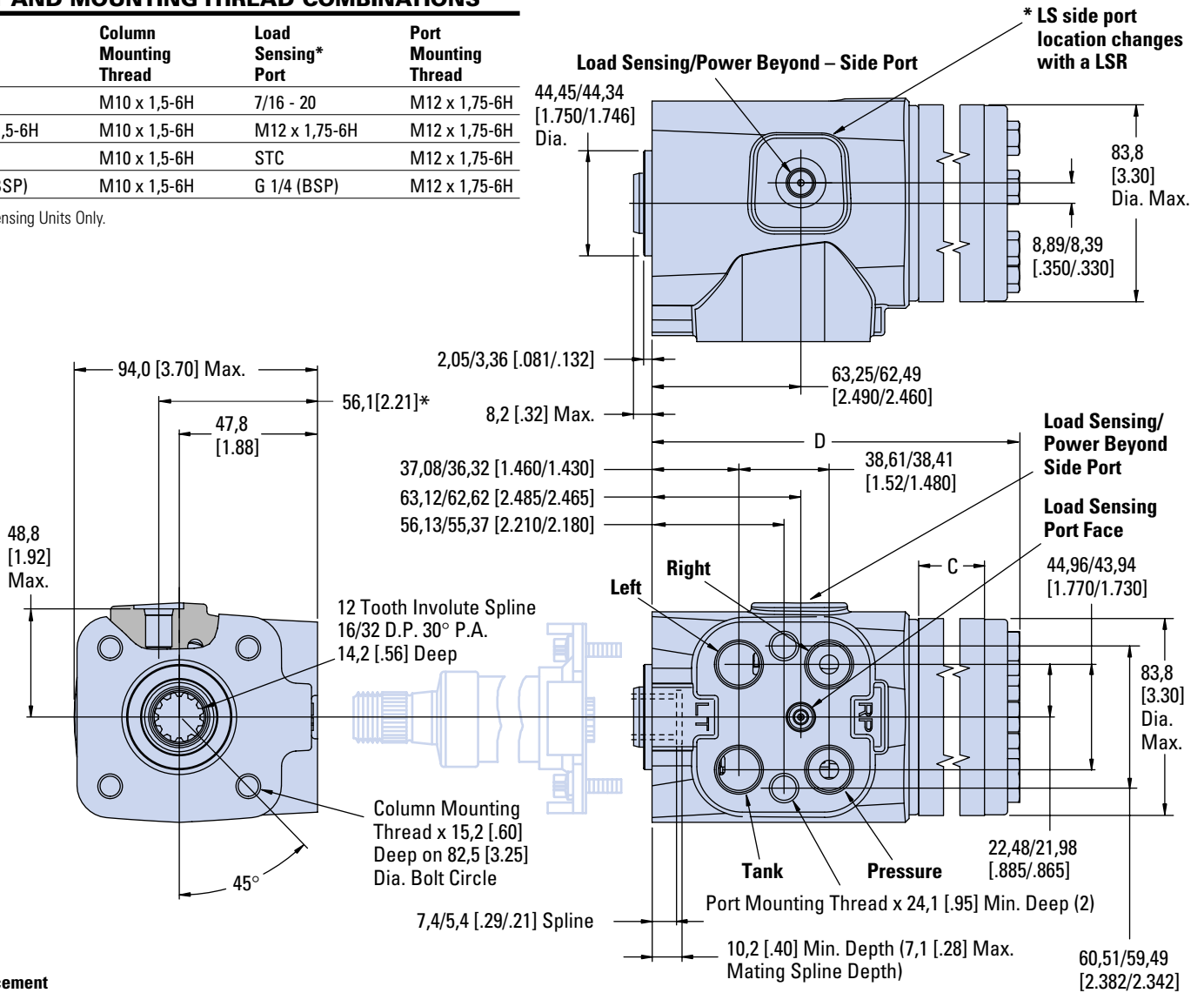
Steering Control Units—Series 10

Installation Drawing

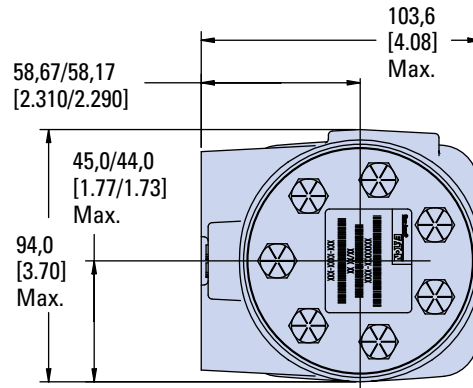
PORT AND MOUNTING THREAD COMBINATIONS

Port	Column Mounting Thread	Load Sensing* Port	Port Mounting Thread
3/4 -16	M10 x 1,5-6H	7/16 - 20	M12 x 1,75-6H
M18 x 1,5-6H	M10 x 1,5-6H	M12 x 1,75-6H	M12 x 1,75-6H
STC	M10 x 1,5-6H	STC	M12 x 1,75-6H
G 1/2 (BSP)	M10 x 1,5-6H	G 1/4 (BSP)	M12 x 1,75-6H

*Load Sensing Units Only.

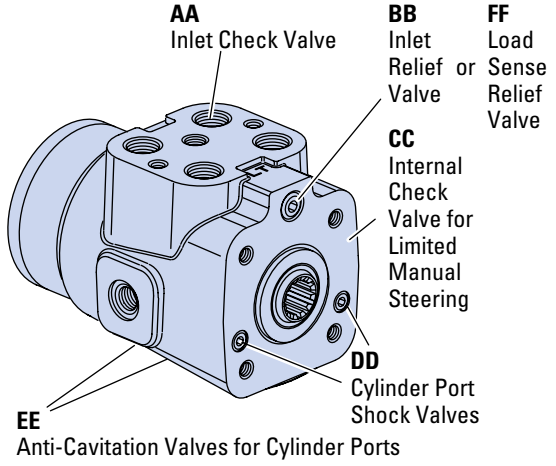
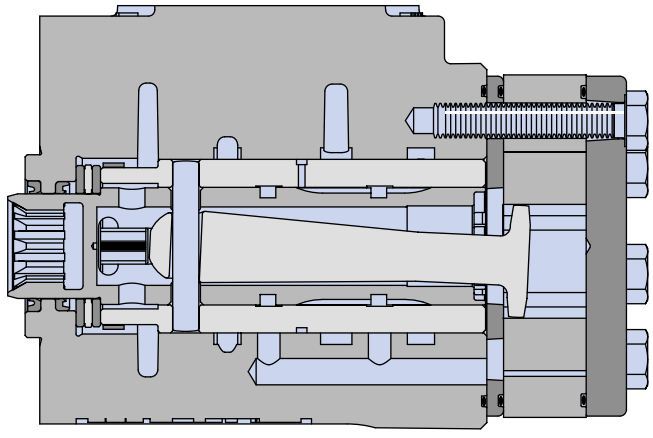
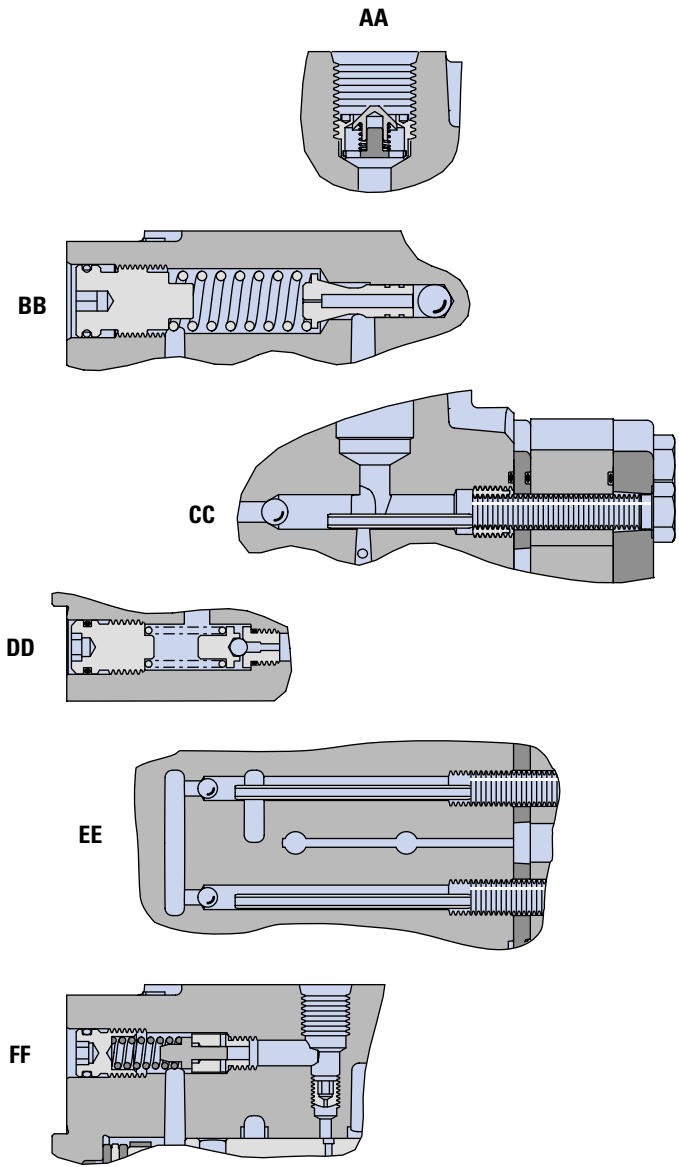


Displacement cm ³ /r [in ³ /r]	Dimension C mm [in.]	Dimension D mm [in.]
60 [3.6]	10,2 [.40]	138,1 [5.44]
75 [4.5]	10,2 [.40]	138,1 [5.44]
95 [5.9]	13,2 [.52]	141,1 [5.56]
120 [7.3]	16,5 [.65]	144,4 [5.69]
146 [8.9]	20,1 [.79]	148,0 [5.83]
159 [9.7]	21,8 [.86]	149,9 [5.90]
185 [11.3]	25,4 [1.00]	153,3 [6.04]
231 [14.1]	31,7 [1.25]	159,7 [6.29]
293 [17.9]	40,4 [1.59]	168,3 [6.63]
370 [22.6]	50,8 [2.00]	178,7 [7.04]
462 [28.2]	63,5 [2.50]	191,4 [7.54]
588 [35.9]	80,8 [3.18]	208,8 [8.22]
739 [45.1]	101,6 [4.00]	229,6 [9.04]



Steering Control Units—Series 10

Sectional Drawing and Integral Valves

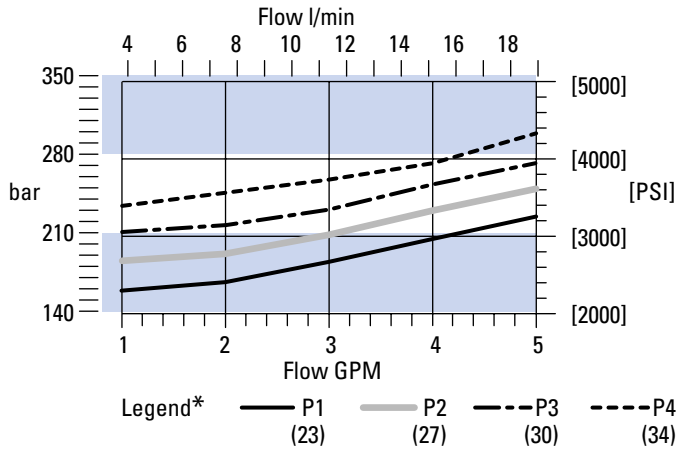


Steering Control Units—Series 10

Performance Data

Cylinder Relief Valve

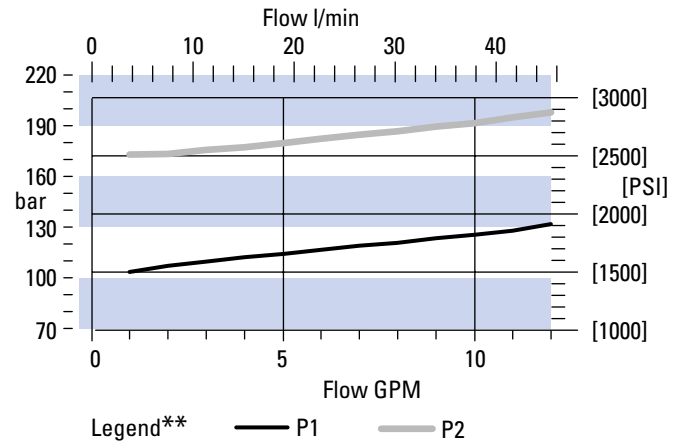
Pressure Drop versus Flow



*The examples above are 4 of 27 pressure settings shown in model code page 11 [Position 19, 20](#)

Inlet Relief Valve

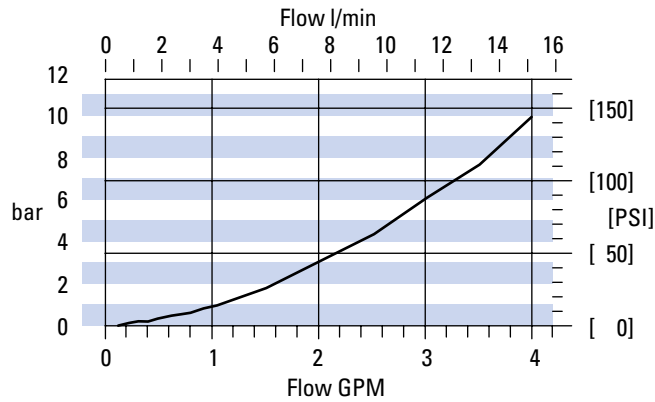
Pressure Drop versus Flow



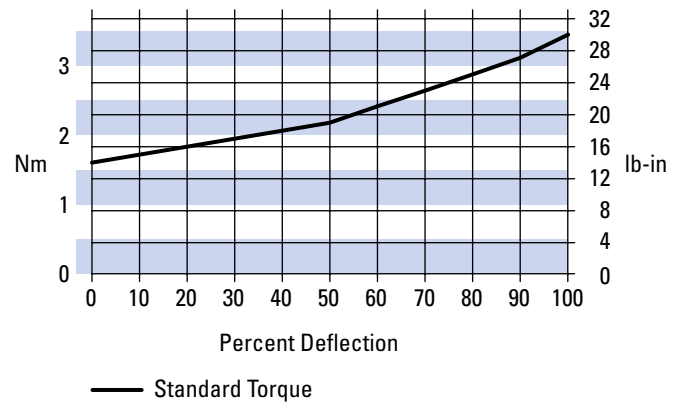
**The examples above are 2 of 24 pressure settings shown in model code page 10 [Position 17, 18](#)

Anti-Cavitation Valve

Pressure Drop versus Flow



Input Torque

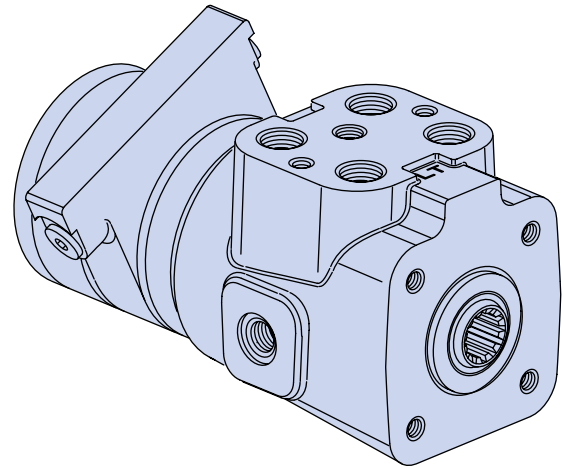


Steering Control Units—Series 10 Dual Displacement

Product Description and Features

The dual displacement steering control unit allows manufacturers of off road vehicles to retain manual steering capabilities while reducing the number of components in their system. By using two displacements in one unit we offer a better solution to manually steer a vehicle in an unpowered mode without the need of a back-up power system—resulting in a more economical machine.

The dual displacement steering unit uses two gerotors and a pressure controlled logic valve. The logic valve switches between two displacements, one displacement for manual steering and the total of both displacements for powered operation. The logic valve is spring returned to the smaller manual displacement when inlet pressure falls below 8 bar [120 psi]. Above 8 bar [120 psi] the logic valve connects both gerotors to provide full powered displacement.



Manual steering capabilities in unpowered mode

- Eliminates the need of a back-up emergency system.
- Engages the small displacement in an unpowered mode and allows manual steering.
- Allows vehicles to meet ISO/TUV road regulations without the need of the currently used emergency system.

Performance in powered mode

- Both gerotors are engaged to steer the vehicle.
- Same performance as other Char-Lynn steering units.

Additional Features

- Steering circuit: Load Sensing Dynamic Signal.
- Max. system pressure: 275 bar [4000 psi].
- Valve options and other features: same as those available on Series 10 (single displacement) units.

DISPLACEMENT CHART:

Gerotor 1 Manual displ.	Gerotor 1 and 2 Powered displ.	Gerotor 1 Manual displ.	Gerotor 1 and 2 Powered displ.
in ³ /rev	in ³ /rev	cm ³ /rev	cm ³ /rev
3.6	9.5	60	156
3.6	10.9	60	179
3.6	12.5	60	205
3.6	13.3	60	218
3.6	14.9	60	244

For any other displacement please see your Eaton Representative.

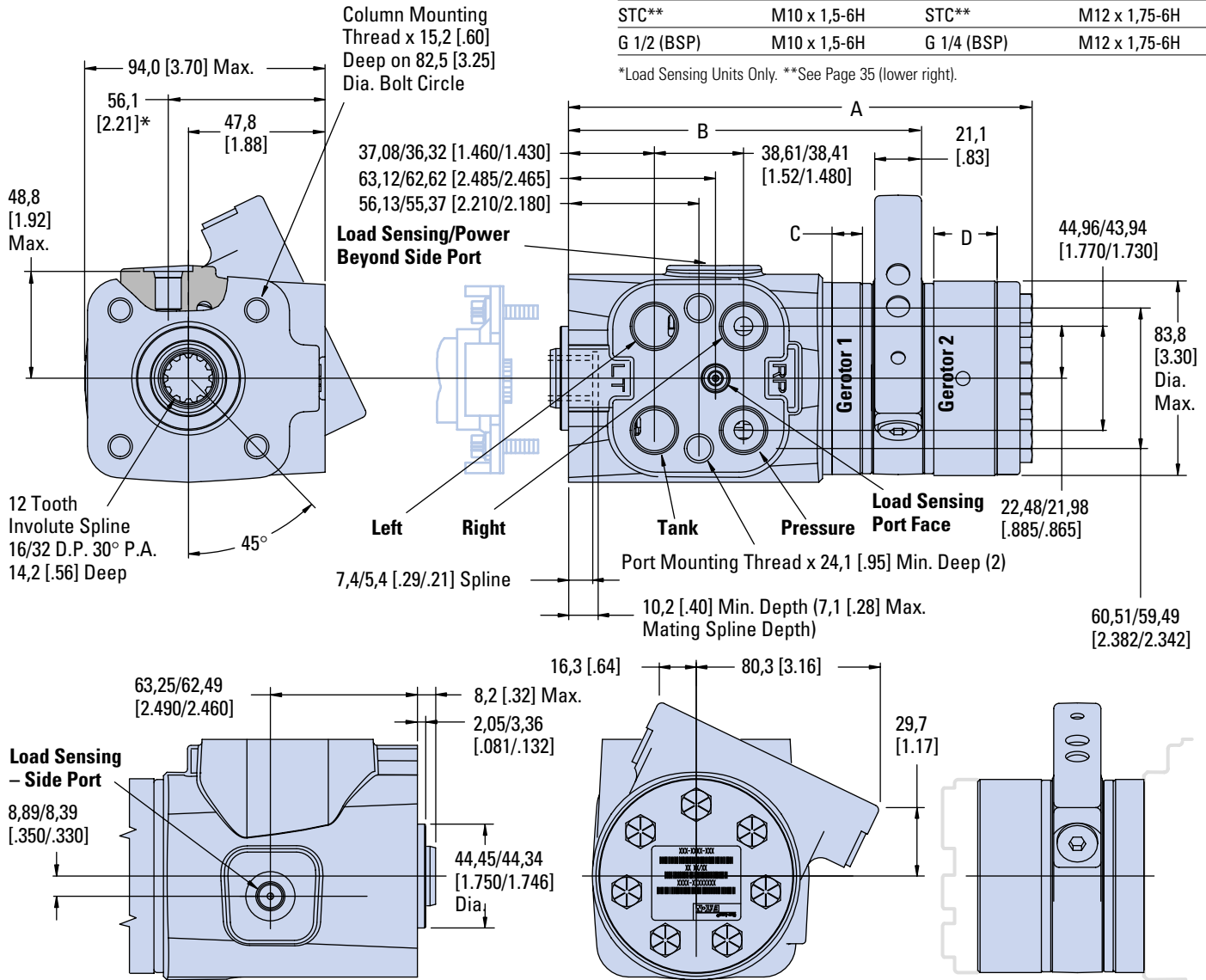
Steering Control Units—Series 10 Dual Displacement

Installation Drawing

PORT AND MOUNTING THREAD COMBINATIONS

Port	Column Mounting Thread	Load Sensing* Port	Port Mounting Thread
3/4 -16	M10 x 1,5-6H	7/16 - 20	M12 x 1,75-6H
M18 x 1,5-6H	M10 x 1,5-6H	M12 x 1,75-6H	M12 x 1,75-6H
STC**	M10 x 1,5-6H	STC**	M12 x 1,75-6H
G 1/2 (BSP)	M10 x 1,5-6H	G 1/4 (BSP)	M12 x 1,75-6H

*Load Sensing Units Only. **See Page 35 (lower right).

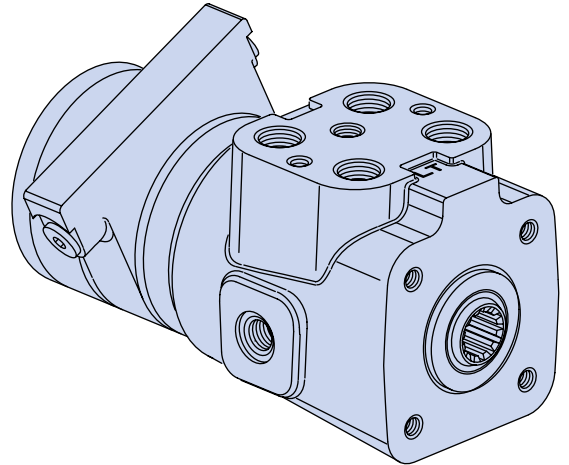
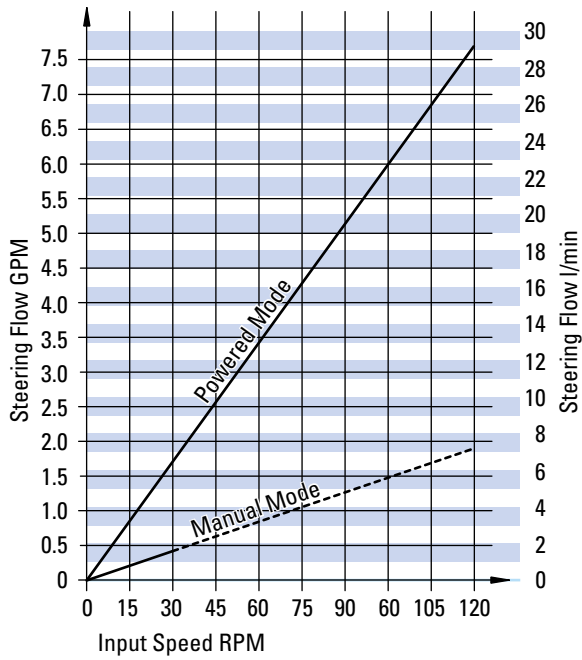


Powered Displacement cm ³ /r [in ³ /r] Gerotor 1 and 2	Dimension B mm [in.]	Dimension A mm [in.]	Manual Displacement cm ³ /r [in ³ /r] Gerotor 1	Dimension C mm [in.]	Displacement cm ³ /r [in ³ /r] Gerotor 2	Dimension D mm [in.]
156 [9.5]	146,5 [5.77]	182,9 [7.20]	60 [3.6]	10,2 [.40]	95 [5.9]	13,2 [.52]
179 [10.9]	146,5 [5.77]	186,2 [7.33]	60 [3.6]	10,2 [.40]	120 [7.3]	16,5 [.65]
205 [12.5]	146,5 [5.77]	189,7 [7.47]	60 [3.6]	10,2 [.40]	145 [8.9]	20,0 [.79]
218 [13.3]	146,5 [5.77]	191,5 [7.54]	60 [3.6]	10,2 [.40]	160 [9.7]	21,8 [.86]
244 [14.9]	146,5 [5.77]	195,1 [7.68]	60 [3.6]	10,2 [.40]	185 [11.3]	25,4 [1.00]

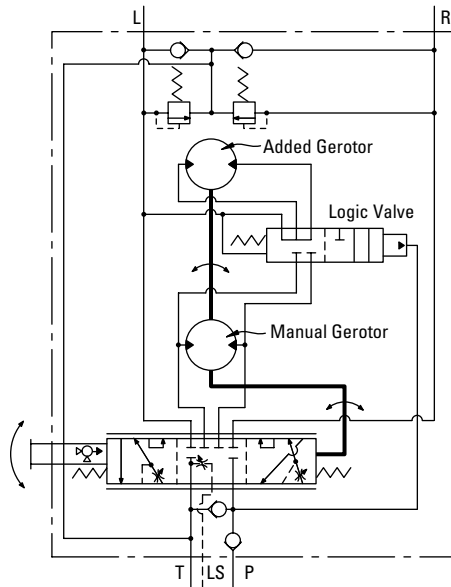
Steering Control Units—Series 10—Dual Displacement

Performance Data (Example)

**Manual 60 cm³/r [3.6 in³/r]
Powered 244 cm³/r [14.9 in³/r]**



Flow vs RPM (for each operating mode)



Steering Control Units—Series 10

Model Code— Ordering Information

The following 32-digit coding system has been developed to identify all of the configuration options for the Series 10 steering control units. Use this model code to specify a unit with the desired features. All 32-digits of the code must be present when ordering. You may want to photocopy the matrix below to ensure that each number is entered in the correct box.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	
A	D	R																			A		A	A			A	A	A	1	0	A

Nos	Feature	Code	Description	Nos	Feature	Code	Description
1,2,3	Product Series	ADR	Series 10 Steering Control Unit	10	Flow Amplification**	A	None (No Q-Amp)
4	Unit Type	A	Standard			B	1.6 : 1.0 Ratio†
		B	Dual Displacement			C	1.6 : 1.0 Ratio (with Manual Steering)†
5	Nominal Flow Rating	1	7,6 - 15 l/min [2 - 4 GPM] (Open Center)			E	2.0 : 1.0 Ratio (with Manual Steering)†
		2	3,8 - 30 l/min [1 - 8 GPM] (Closed Center and LS)			G	1.3 : 1.0 Ratio (with Manual Steering)†
		3	30 - 45 l/min [8 - 16 GPM] (OC, CC, and LS)				†Use with closed center or load sensing only.
		4	8 - 19 l/min [2 - 5 GPM] (Q-Amp)	11	Neutral Circuit	A	Open Center
		5	19 - 38 l/min [5 - 10 GPM] (Q-Amp)			C	Closed Center
		6	38 - 76 l/min [10 - 20 GPM] (Q-Amp)	12	Load Circuit	A	Non-Load Reaction
		7	15 - 30 l/min [4 - 8 GPM] (Open Center)			B	Load Reaction (Open Center 3,8 - 30 l/min [1 - 8 GPM] Only)
6	Inlet Pressure Rating	1	276 bar [4000 PSI]—(Load sensing and closed center)	13,14	Special Spool/Sleeve Modification	00	None
		2	207 bar [3000 PSI]—(Open center)	15,16	Valve Options		
7	Return Pressure Rating	A	21 bar [305 PSI] Max.—(standard rating*)		Manual Steering Check		
		B	10 bar [145 PSI] Max.	01			
8-9	Displacement cm ³ /r [in ³ /r] — Dual Displacement Combined/Manual	03	244 [14.9] / 60 [3.6]	02	•	•	
		04	177 [10.9] / 60 [3.6]	03	•		•
		05	218 [3.3] / 60 [3.6]	04	•	•	•
8-9	Displacement cm ³ /r [in ³ /r]	40	60 [3.6]	05	•		•
		43	75 [4.5]	06	•	•	•
		45	95 [5.9]	07	•	•	•
		48	120 [7.3]	08	•	•	•
		50	145 [8.9]	09	•	•	•
		51	160 [9.7]	10	•	•	•
		52	185 [11.3]	11	•	•	•
		54	230 [14.1]				
		57	295 [17.9]				
		59	370 [22.6]				
		61	460 [28.2]				
		64	590 [35.9]				
		65	740 [45.1]				

* 12 GPM open center requires 145psi back pressure

** All Q-amp applications need approval from an Eaton Applications Engineer

Continued on next page

Steering Control Units—Series 10

Model Code— Ordering Information— Continued

Nos	Feature	Code	Description	Nos	Feature	Code	Description		
17,18	Inlet or Load Sense Relief Valve — bar [PSI]	00	None	21,22,23,24	Ports and Mounting Threads	AAAA	4 x 3/4-20 (SAE) Ports None (No Additional Port) 2 x M12 Mounting Threads Port Face 4 x M10 Mounting Threads Mounting Face		
		18	124 [1800]			AABA	4 x 3/4-20 (SAE) Ports 7/16-20 Load Sensing Port on Side 2 x M12 Mounting Threads Port Face 4 x M10 Mounting Threads Mounting Face		
		19	131 [1900]			AACA	4 x 3/4-20 (SAE) Ports 7/16-20 Load Sensing Port Port Face 2 x M12 Mounting Threads Port Face 4 x M10 Mounting Threads Mounting Face		
		20	138 [2000]				BAAA	4 x M18 x 1,5 - 6H Metric O-ring Ports None (No Additional Port) 2 x M12 Mounting Threads Port Face 4 x M10 Mounting Threads Mounting Face	
		21	145 [2100]				BADA	4 x M18 x 1,5 - 6H Metric O-ring Ports M12 x 1,5 - 6H Load Sensing Port on Side 2 x M12 Mounting Threads Port Face 4 x M10 Mounting Threads Mounting Face	
		22	152 [2200]				BAEA	4 x M18 x 1,5 - 6H Metric O-ring Ports M12 x 1,5 - 6H Load Sensing Port Port Face 2 x M12 Mounting Threads Port Face 4 x M10 Mounting Threads Mounting Face	
		23	158 [2290]				CAAA	4 x G 1/2 (BSP) Straight Thread Ports None (No Additional Port) 2 x M12 Mounting Threads Port Face 4 x M10 Mounting Threads Mounting Face	
		24	165 [2390]						
		25	172 [2490]						
		26	179 [2600]						
		27	186 [2700]						
		28	193 [2800]						
		29	200 [2900]						
		30	207 [3000]						
		31	214 [3100]						
		32	220 [3190]						
		33	227 [3290]						
		34	234 [3390]						
		35	241 [3500]						
		36	248 [3600]						
		37	255 [3700]						
		38	262 [3800]						
		39	269 [3900]						
		40	276 [4000]						
		99	136 [1970]						
19,20		Cylinder Relief Valve — bar [PSI]	00	None					
			23	158 [2290]					
			24	165 [2390]					
			25	172 [2490]					
			26	179 [2600]					
			27	186 [2700]					
	28		193 [2800]						
	29		200 [2900]						
	30		207 [3000]						
	31		214 [3100]						
	32		220 [3190]						
	33		227 [3290]						
	34		234 [3390]						
	35		241 [3500]						
	36		248 [3600]						
	37		255 [3700]						
	38		262 [3800]						
	39		269 [3900]						
	40		276 [4000]						
	41		283 [4100]						
	42	289 [4190]							
	43	296 [4290]							
	44	303 [4390]							
	45	310 [4500]							
	46	317 [4600]							
	47	324 [4700]							
	48	331 [4800]							
	49	338 [4900]							

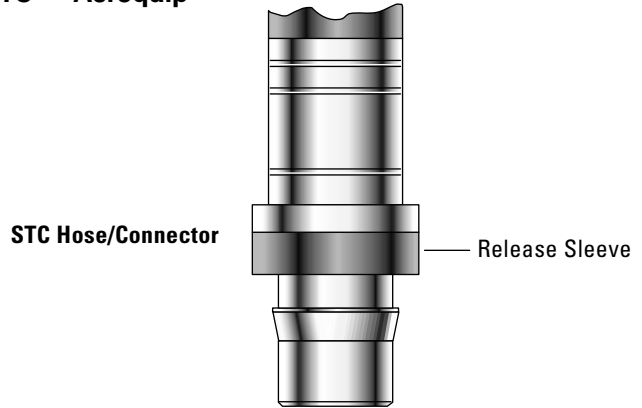
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Steering Control Units—Series 10

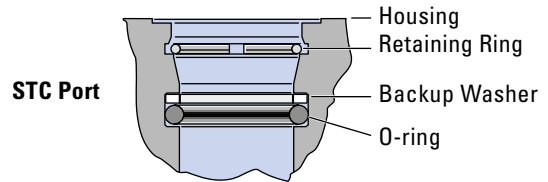
Model Code— Ordering Information— Continued

Nos	Feature	Code	Description
21,22,23,24	Ports and Mounting Threads (continued)	CAFA	4 x G 1/2 (BSP) Straight Thread Ports G 1/4 (BSP) LS Straight Thread Port on Side 2 x M12 Mounting Threads Port Face 4 x M10 Mounting Threads Mounting Face
		CAGA	4 x G 1/2 (BSP) Straight Thread Ports G 1/4 (BSP) LS Straight Thread Port on Port Face 2 x M12 Mounting Threads Port Face 4 x M10 Mounting Threads Mounting Face
		DAAA	Dash 08 STC® Ports None (No Additional Port) 2 x M10 Mounting Threads Port Face 4 x M10 Mounting Threads Mounting Face
		DAHA	Dash 08 STC® Ports *** Dash 06 STC® Port on Side 2 x M10 Mounting Threads Port Face 4 x M10 Mounting Threads Mounting Face
		DAJA	Dash 08 STC® Ports *** Dash 06 STC® Port Face 2 x M10 Mounting Threads Port Face 4 x M10 Mounting Threads Mounting Face
25	Mechanical Interface	A	Internal Involute Spline, 12 Tooth 16/32 DP 30° PA
26	Input Torque	3	Standard
27	Fluid Type	A	See Eaton Technical Bulletin 3-401
28,29	Special Features	AA	None
30	Paints and Packaging	1	Black Primer
31	Identification	0	Eaton Product Number on Nameplate
32	Eaton Assigned Design Code	A	Assigned Design Code

STC®—Aeroquip



Dash 08 Port Face (4)
Dash 06 LS Port Side (1)



Patent numbers: 5,553,895
5,226,682
5,570,910

*** STC with inlet check requires threaded adapter. Contact your Eaton Account Representative for assistance.

Steering Control Units—Series 20

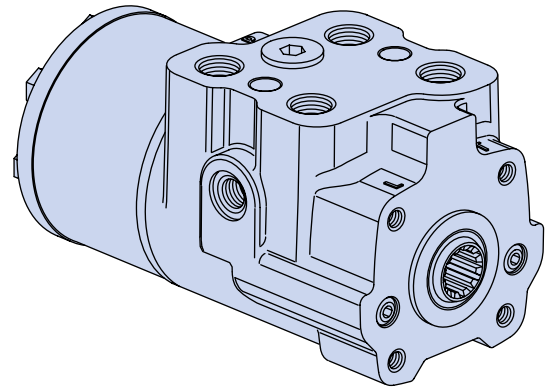
Product Description

The Series 20 steering control unit continues Eaton®'s tradition of innovative design and high quality that began with the first fluid linked power steering system.

You can count on this steering unit to provide the same smooth, predictable steering as the Char-Lynn® steering units that provide dependable, trouble-free steering on applications around the world.

Features

- Provides much smoother steering function by minimizing jerky motion on articulated vehicles.
- Jerk-reducing valves and accumulators can be eliminated on most vehicles, providing customer savings through fewer components required and reduced system cost.
- **Symmetrical valving** provides passageways and valving that are equally placed, and pressure areas that are staged for minimum internal leakage. This results in balance, precise servo response and uniform left or right steering action.
- Eaton's **high capacity gerotor** provides ample fluid displacement from an even more compact unit than was previously offered.
- A **thicker sleeve design** provides stability, especially during pressure and thermal transient conditions.
- The seal and centering spring designs provide **positive, low-effort steering** feel to ensure excellent vehicle control, an important feature for the vehicles for which these steering control units were designed.
- Load Sensing
- Integral Valves
- Q-Amp
- Wide Angle

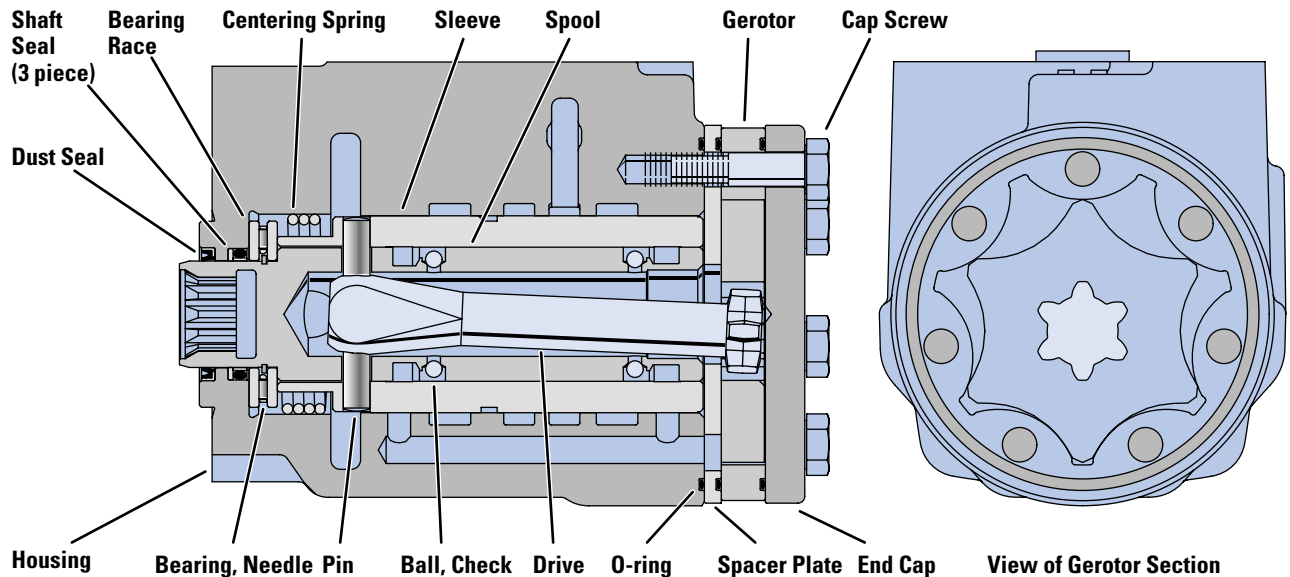
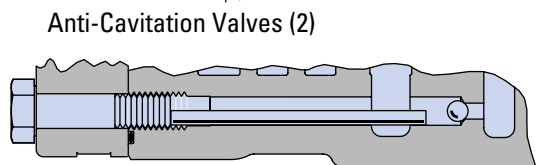
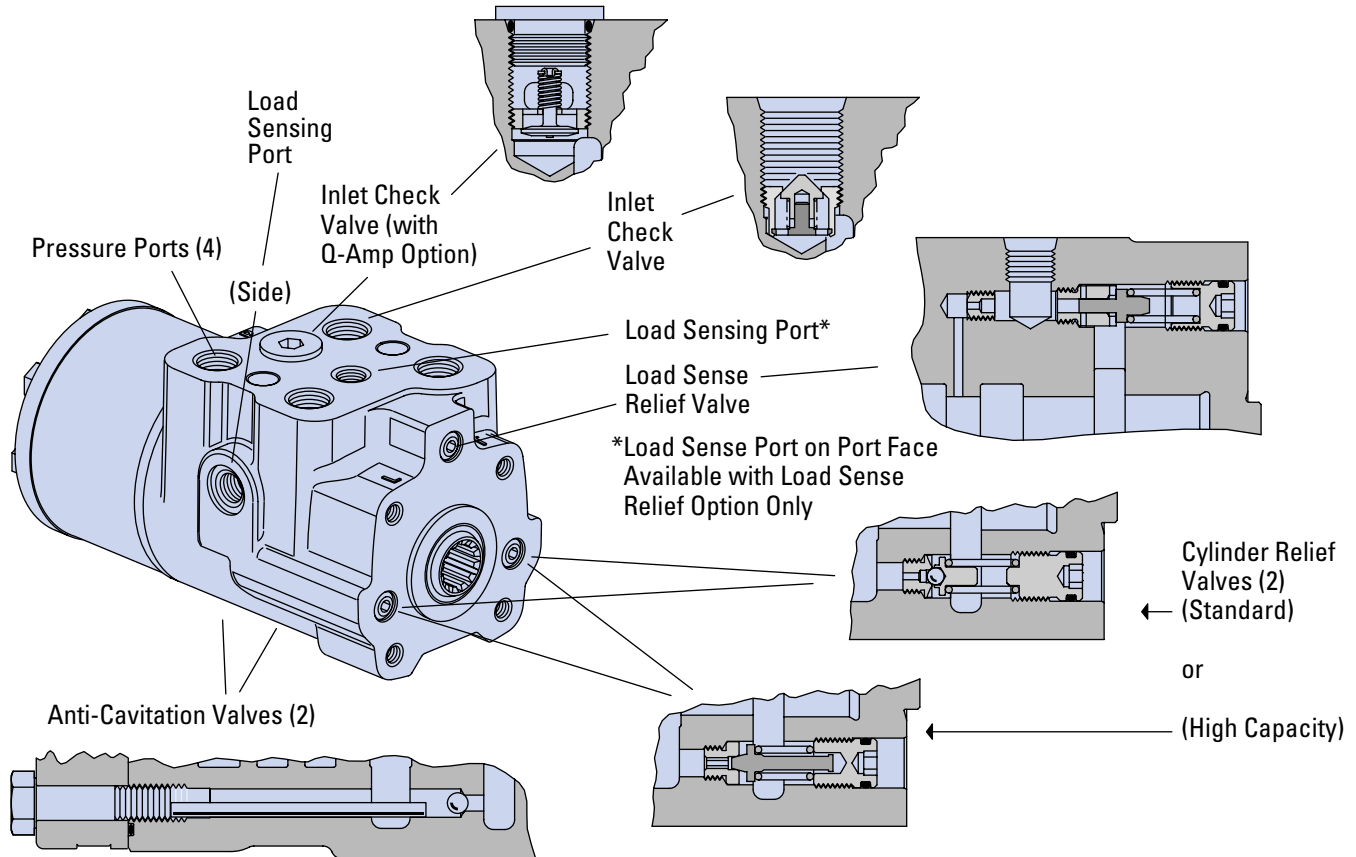


SPECIFICATIONS

Max. System Pressure	241 bar [3500 PSI]
Max. Back Pressure	10 bar [145 PSI]
Rated Flow	95 l/min [25 GPM]
Max. Flow	125 l/min [33 GPM]
Max. System Operating Temperature	93°C [200° F]
Max. Differential Between Steering Unit and System Temperature	28° C 50° F
Input Torque Powered	1,1-2,8 Nm @ 6,9 bar back pressure [10-25 lb-in @ 100 PSI back pressure]
Non-Powered	136 Nm [100 lb-ft]
Fluid	See Eaton Technical Bulletin 3-401
Recommended Filtration	ISO 18/13 cleanliness level

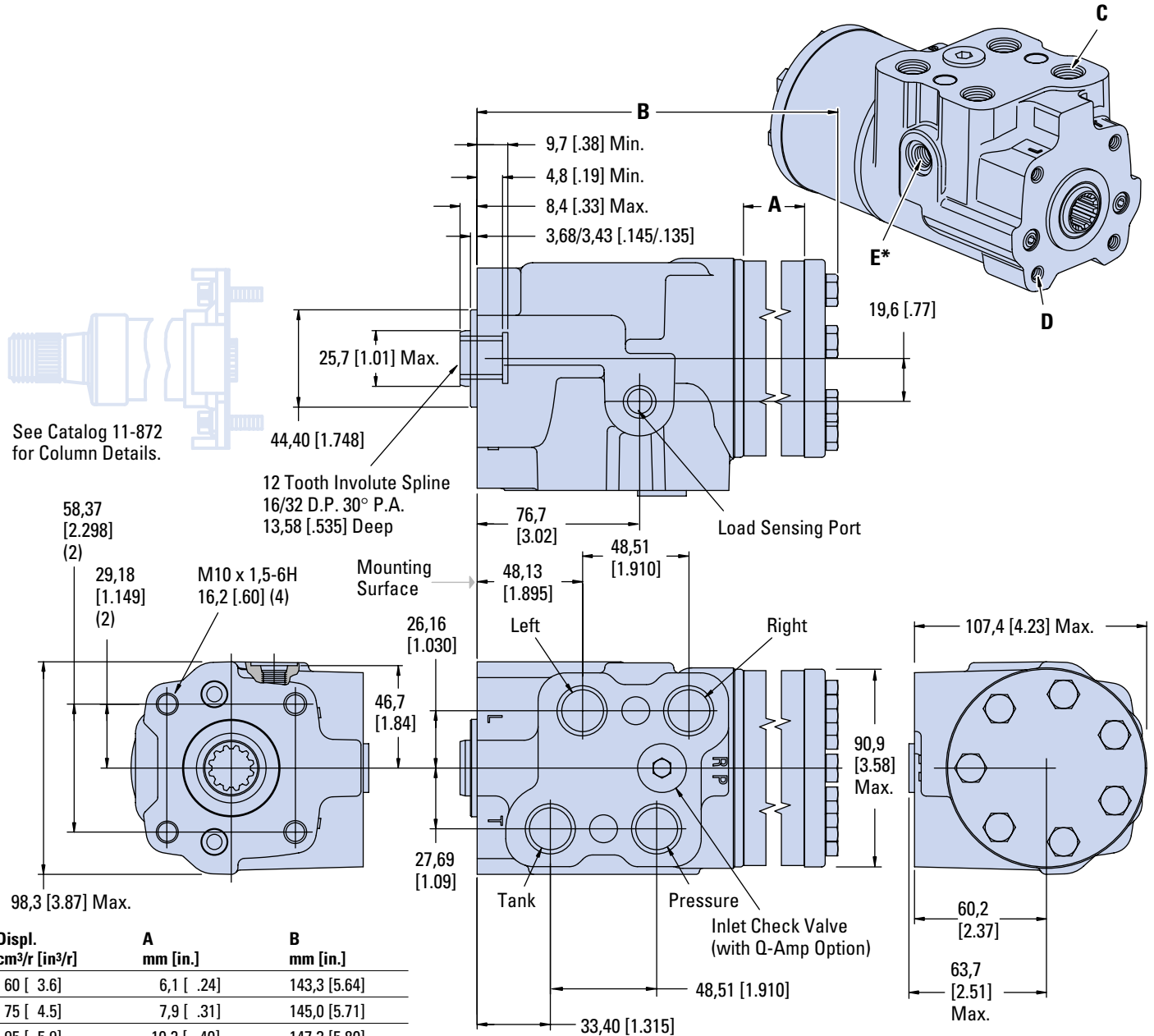
Steering Control Units—Series 20

Sectional Drawing



Steering Control Units—Series 20

Installation Drawing



Displ. cm ³ /r [in ³ /r]	A mm [in.]	B mm [in.]
60 [3.6]	6,1 [.24]	143,3 [5.64]
75 [4.5]	7,9 [.31]	145,0 [5.71]
95 [5.9]	10,2 [.40]	147,3 [5.80]
120 [7.3]	12,7 [.50]	149,9 [5.90]
145 [8.9]	15,5 [.61]	152,7 [6.01]
160 [9.7]	16,8 [.66]	153,9 [6.06]
185 [11.3]	19,6 [.77]	156,7 [6.17]
230 [14.1]	24,4 [.96]	161,5 [6.36]
295 [17.9]	31,0 [1.22]	168,1 [6.62]
370 [22.6]	39,1 [1.54]	176,3 [6.94]
460 [28.2]	48,8 [1.92]	185,9 [7.32]
590 [35.9]	62,2 [2.45]	199,3 [7.85]
740 [45.1]	78,2 [3.08]	215,3 [8.48]
985 [60.0]	103,9 [4.09]	241,0 [9.49]

PORT AND MOUNTING THREAD COMBINATIONS

C	D	E*
3/4–16 UNF 2B**	M10 x 1,5–6H	7/16–20 UNF 2B**
G 1/2***	M10 x 1,5–6H	G 1/4***
M18 x 1,5–6H	M10 x 1,5–6H	M12 x 1,5–6H, M14
M22 x 1,5–6H	M10 x 1,5–6H	M12 x 1,5–6H, M14

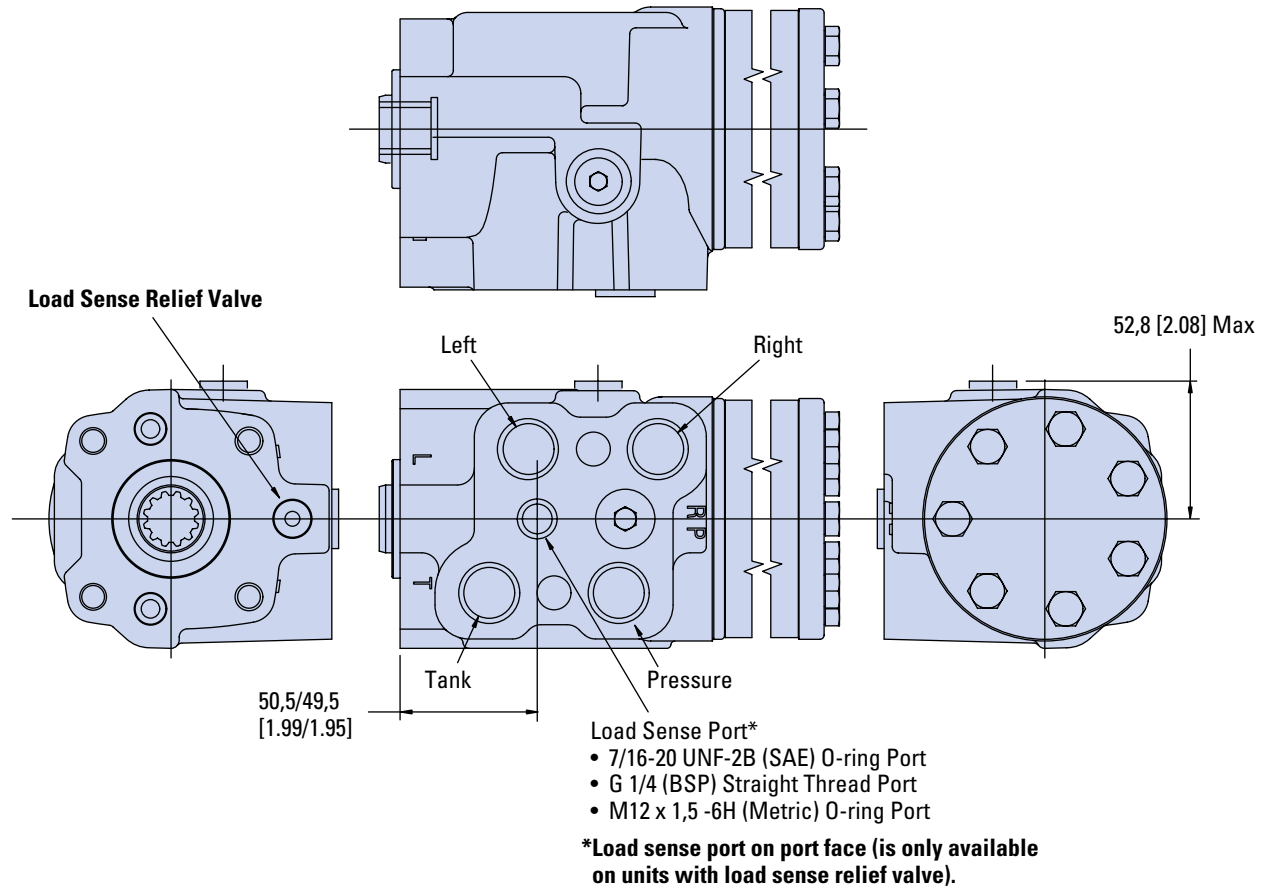
*Load sensing port option—on side (load sense relief port face only - see page 44).

**SAE O-ring Port Port

***BSP Straight Thread Port

Steering Control Units—Series 20

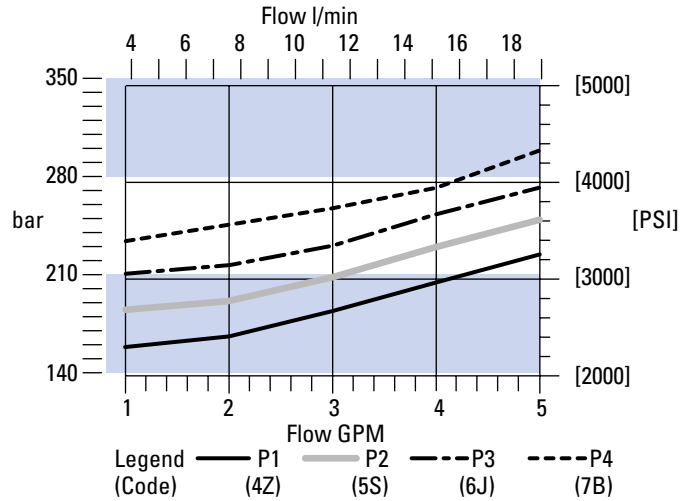
Installation Drawing (Load Sense Relief Option)



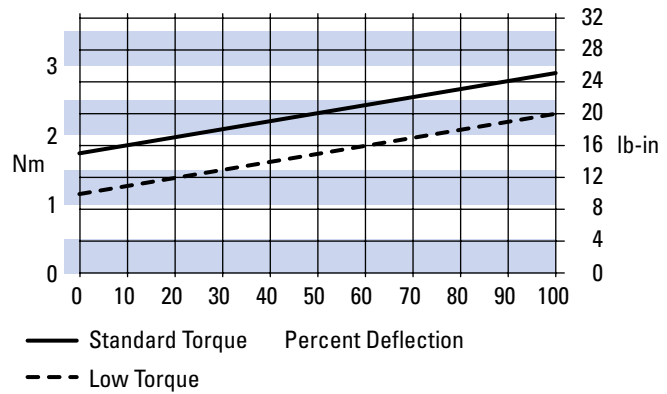
Steering Control Units—Series 20

Performance Data

Cylinder Relief Valve Pressure Drop versus Flow



Input Torque



Steering Control Units—Series 20

Model Code – Ordering Information

Applications

Articulated Vehicles

- Loaders
- Scrapers
- Skidders
- AG Tractors
- Dumpers
- Sprayers
- Forestry Equipment

Rigid Frame Vehicles

- Front End Loaders
- Large Graders
- Mining Trucks
- Transporters
- AG Tractors

The following 29-digit coding system has been developed to identify all of the configuration options for the Series 20 steering control units. Use this model code to specify a unit with the desired features. All 29-digits of the code must be present when ordering. You may want to photocopy the matrix below to ensure that each number is entered in the correct box.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
A	C	C		6	A				F											N		A		A	A	1	0	0

Nos	Feature	Code	Description	Nos	Feature	Code	Description								
1,2,3	Product Series	ACC	Series 20 Steering Control Unit	12,13	Valve Options*										
4	Nominal Flow Rating	4	38 l/min [10 GPM] (Q-Amp)		Manual Steering Check										
		6	76 l/min [20 GPM] (Q-Amp)												
		A	114 l/min [30 GPM] (Q-Amp)												
		7	95 l/min [25 GPM] (Non-Q-Amp)			00									
5	Inlet Pressure Rating	6	Inlet Pressure Rating 241 bar [3500 PSI]	01	•										
				02											
6	Return Pressure Rating	A	10 bar [145 PSI]	09	•										
				10	•										
7-8	Displacement cm ³ /r [in ³ /r]	40	60 [3.6]		Load Sensing Relief Valve Setting										
		43	75 [4.5]												
		45	95 [5.9]												
		48	120 [7.3]												
		50	145 [8.9]												
		51	160 [9.7]												
		52	185 [11.3]												
		54	230 [14.1]												
		57	295 [17.9]												
		59	370 [22.6]												
9	Flow Amplification	0	No Q-Amp		Inlet** Check Valve										
		1	1.6 : 1.0 Ratio (Actual Displ. 185 to 985 cm ³ /r [11.3 to 60.0 in ³ /r])												
		3	2.0 : 1.0 Ratio (Actual Displ. 60 to 370 cm ³ /r [3.6 to 22.6 in ³ /r])												
		10	Neutral Circuit			F	Load Sensing, Dynamic Signal								
								11	Load Circuit	A	Non-Load Reaction				
												D	Non-Load Reaction, Cylinder Damped		

*Not all valve options will work with all unit combinations
 **76 l/min [20 GPM] Max.

14,15	Load Sensing Relief Valve Setting	00	None
		4N	150 bar [2180 PSI]
		50	160 bar [2320 PSI]
		5A	170 bar [2470 PSI]
		5L	180 bar [2610 PSI]
		5Y	190 bar [2760 PSI]
		68	200 bar [2900 PSI]
		6J	210 bar [3050 PSI]
		6V	220 bar [3190 PSI]
		76	230 bar [3340 PSI]
		7G	240 bar [3480 PSI]

Continued on next page

Steering Control Units—Series 20

Model Code— Ordering Information— Continued

Nos	Feature	Code	Description	Nos	Feature	Code	Description		
16,17	Cylinder Relief Valve Setting	00	None	22	Input Torque	1	Low		
		6J	210 bar [3050 PSI]			3	Standard (Includes Stiffer Springs)		
		6V	220 bar [3190 PSI]			23	Fluid Type	A	See Eaton Technical Bulletin 3-401
		76	230 bar [3340 PSI]						
		7G	240 bar [3480 PSI]			24	Special Application Options	0	Not Available
		7T	250 bar [3630 PSI]					1	Wide Angle Deflection
		84	260 bar [3770 PSI]			25,26	Special Features	AA	None
		8E	270 bar [3920 PSI]						
		8R	280 bar [4060 PSI]			27	Paints and Packaging	1	Black Paint
		92	290 bar [4210 PSI]						
9C	300 bar [4350 PSI]	28	Identification	0	Eaton Product Number on Nameplate				
18,19,20,21	Ports and Mounting Threads			AABN	4 x G 1/2 (BSP) Ports with G 1/4 (BSP) Load Sensing Port on Side, M10 Mounting Threads	29	Eaton Assigned Design Code	0	Assigned Design Code
		DACN	4 x 3/4 (SAE) Ports with 7/16 (SAE) Load Sensing Port on Side, M10 Mounting Threads						
		FAFN	4 x M18 (Metric) Ports with M12 (Metric) Load Sensing Port on Side, M10 Mounting Threads						
		FBFN	4 x M18 (Metric) Ports with M14 (Metric) Load Sensing Port on Side, M10 Mounting Threads						
		RACN*	4 x 7/8 (SAE) Ports with 7/16 (SAE) Load Sensing Port on Side, M10 Mounting Threads						
		SAFN*	4 x M22 (Metric) Ports with M12 (Metric) Load Sensing Port on Side, M10 Mounting Threads						
		SBFN*	4 x M22 (Metric) Ports with M14 (Metric) Load Sensing Port on Side, M10 Mounting Threads						
		18,19,20,21	Ports and Mounting Threads (Load Sensing Relief Only)	DADN	4 x 3/4 (SAE) Ports with 7/16 (SAE) Load Sensing Port on Port Face, M10 Mounting Threads				
				AAWN	4 x G 1/2 (BSP) Ports with G 1/4 (BSP) Load Sensing Port on Port Face, M10 Mounting Threads				
				RADN*	4 x 7/8 (SAE) Ports with 7/16 (SAE) Load Sensing Port on Port Face, M10 Mounting Threads				
FAVN	4 x M18 (Metric) Ports with M12 (Metric) Load Sensing Port on Port Face, M10 Mounting Threads								
SAVN*	4 x M22 (Metric) Ports with M12 (Metric) Load Sensing Port on Port Face, M10 Mounting Threads								

*Use with 114 l/min [30 GPM]

Steering Control Units—Series 25

Product Description and Features

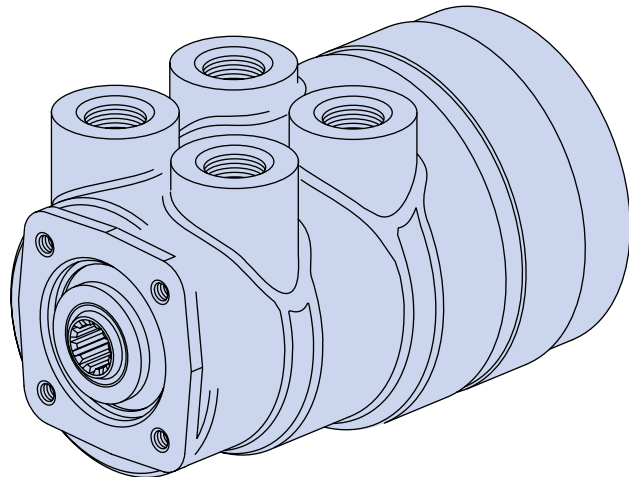
The Series 25 steering control unit includes two patented designs that make it even more responsive, reliable and cost effective.

- Symmetrical valving provides passageways and valving that are equal in both directions and pressure areas that are staged for minimum leakage. This gives balance, precise servo response and uniform steering action in both directions.
- Progressive valving makes it possible to produce the spool/sleeve valve in a way that assures reliability and reduces costs.
- Eaton's high capacity gerotor assembly provides a lot of capacity in a small package.
- Heavier valve components—housing, spool and sleeve—provides stability, especially during pressure and thermal transient conditions.
- The seal and centering spring designs provides positive, low-effort steering feel assuring excellent vehicle control, an important feature on large vehicles for which this steering control was designed.
- Cylinder port relief/check valves are needed on any machine that is subject to high steering cylinder pressures caused by external loads. For example, when one edge of an articulated front end loader bucket encounters an obstruction (external load), the full force of the load and the momentum of the machine cause the machine to buckle at the articulation point and raise pressure in the steering cylinders far in excess of system pressure. This pressure must be relieved to absorb the impact load and prevent damage to the hydraulic systems and to the machine itself.
- The traditional of relieving system pressure involves interruption of cylinder port lines with a variety of fittings and plumbing. By designing cylinder port relief valves integral to the steering control unit housing, Series 25 steering control units equipped with cylinder port relief valves eliminate the additional hardware used to relieve pressure and return oil to the tank.

Features

- Open Center
- Closed Center
- Load Sensing
- Q-amp
- Integral Valves
- Wide Angle
- Pilot Pressure Port*

* This is an added feature that can be used for
1) pilot pressure to priority valve.
2) diagnostics.



SPECIFICATIONS

Max. System Pressure	241 bar [3500 PSI]
Max. Back Pressure	21 bar [300 PSI]
Rated Flow	95 l/min [25 GPM]
Max. Flow	151 l/min [40 GPM]
Max. System Operating Temperature	93°C [200° F]
Max. Differential Between Steering Unit and System Temperature	28° C 50° F
Input Torque Powered	2,8-3,4 Nm @ 6,9 bar back pressure [25-30 lb-in @ 100 PSI back pressure]
Non Powered	†††
Rotation Limits	None
Fluid	ATF Type A and most petroleum based fluids
Recommended Filtration	ISO 18/13 cleanliness level

††† Manual steering is **not** possible without hydraulic power.

Applications

Articulated Vehicles

- Loaders
- Scrapers
- Skidders
- Ag Tractors

Fixed Frame Vehicles

- Large Front End Loaders
- Graders
- Mining Trucks
- Articulated Dump Haulers
- Transporters

Steering Control Units—Series 25

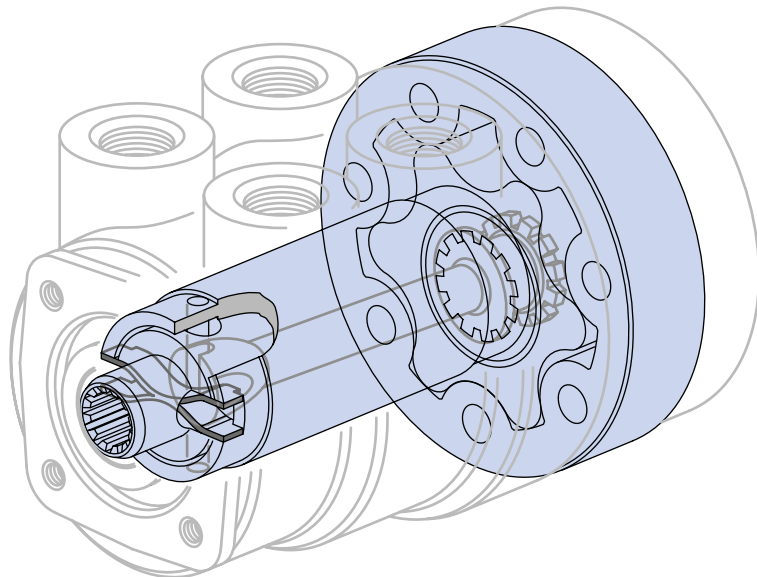
Standard Product Releases

SERIES 25

System	Signal	Load Circuit	Rated Flow l/min [GPM]	O-ring Port Size	Actual Displacement cm ³ /r [in ³ /r]—Product Number				
					490 [30]	625 [38]	795 [48]	985 [60]	1230 [75]
Open Center	N/A	Non Load Reaction	95 [25]	1 1/16-12	251-1001	251-1002	251-1003	251-1004	251-1005
Closed Center	N/A	Non Load Reaction	95 [25]	1 1/16-12	252-1001	252-1002	252-1003	252-1004	252-1005
				1 1/16-12	252-1008**	252-1009**	252-1012**	252-1013**	252-1006**
Load Sensing	Dynamic	Non Load Reaction	95 [25]	1 1/16-12	253-1001	253-1002	253-1003	253-1004	253-1005

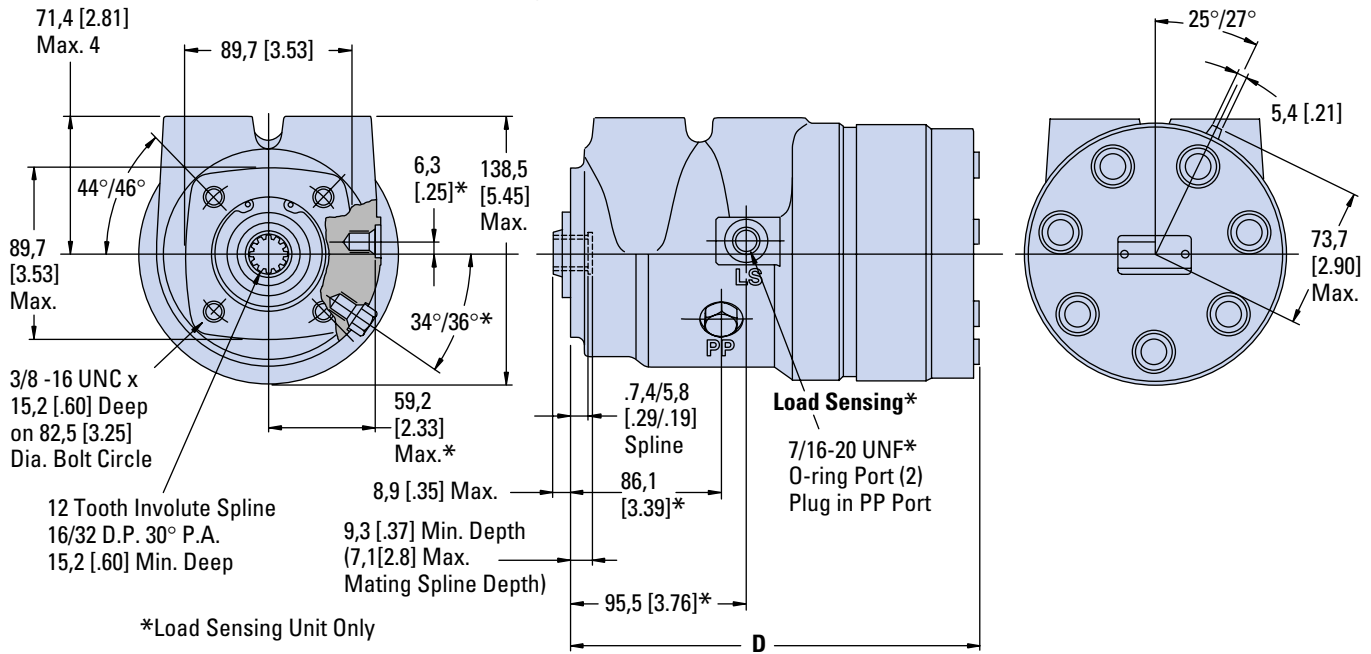
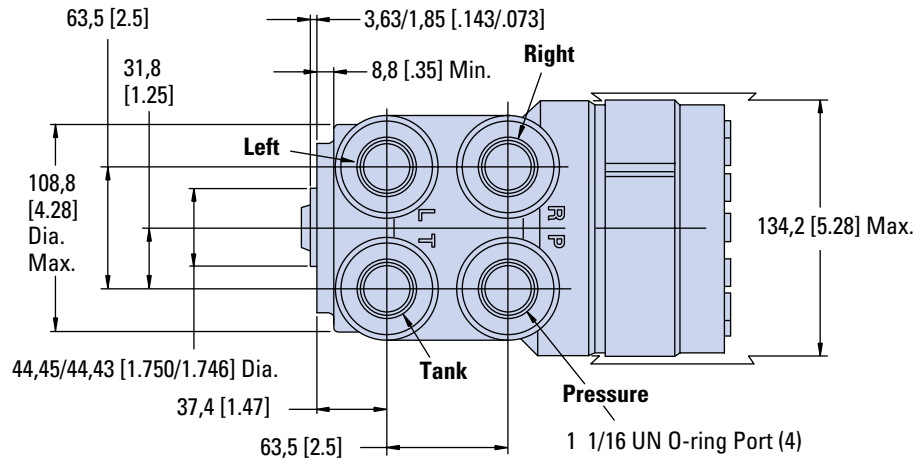
**Closed center units with neutral bleed 2,3 l/min [.6 GPM] at 172 bar [2500 PSI] (see Page 7).

Example: 251-1001-002
 |
 Product Number
 |
 Design Code



Steering Control Units—Series 25

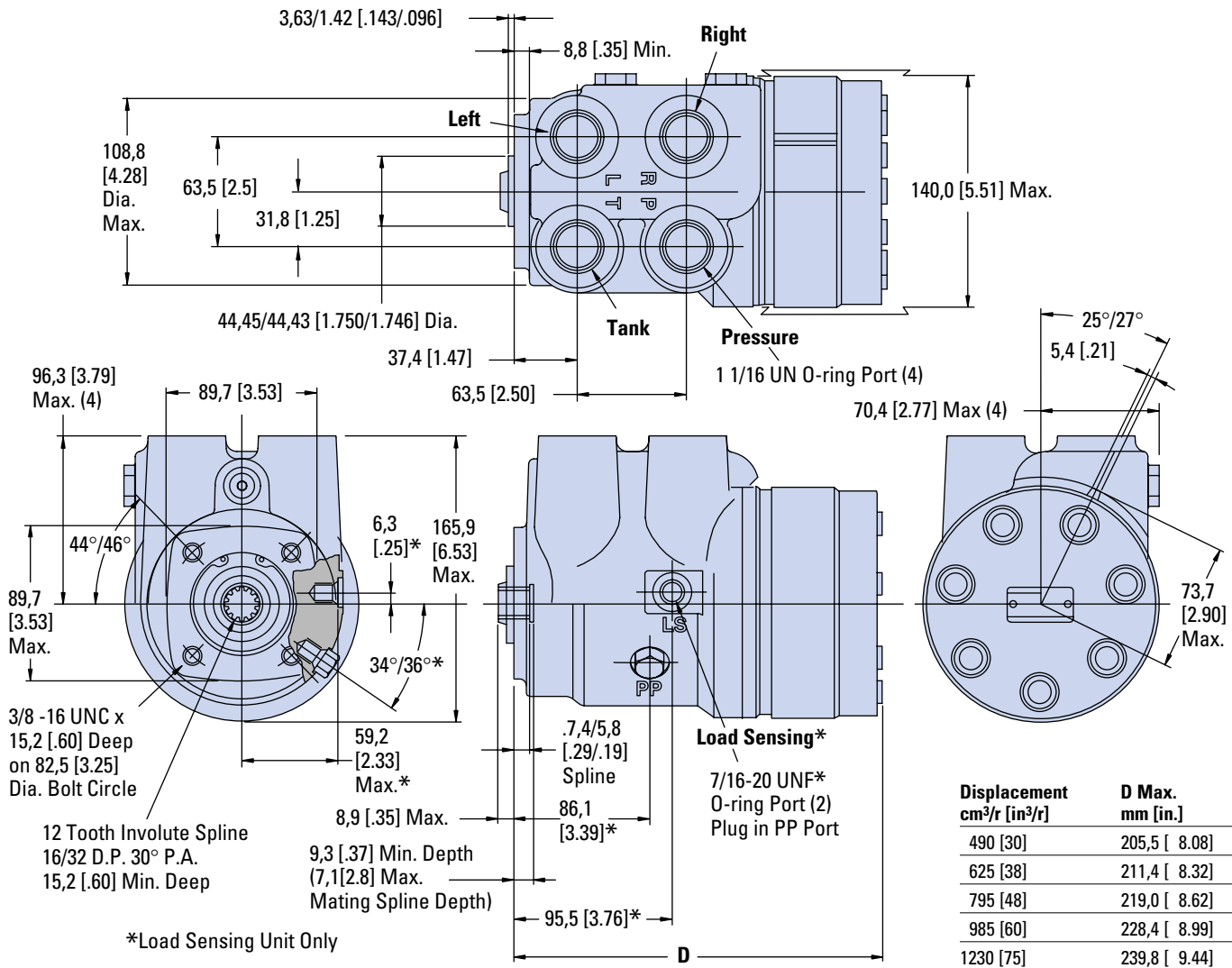
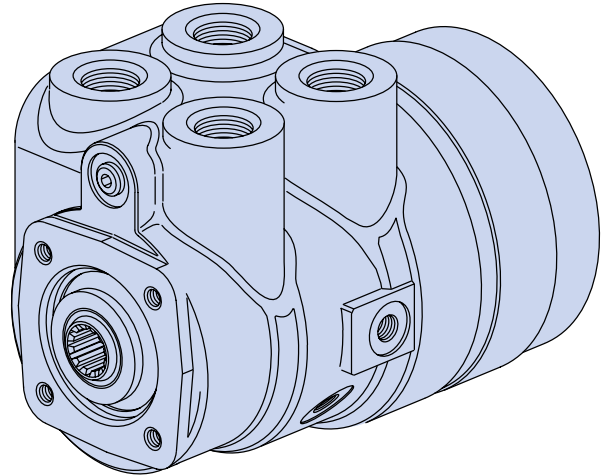
Installation Drawing



Displacement cm ³ /r [in ³ /r]	D Max. mm [in.]
490 [30]	205,5 [8.08]
625 [38]	211,4 [8.32]
795 [48]	219,0 [8.62]
985 [60]	228,4 [8.99]
1230 [75]	239,8 [9.44]

Steering Control Units—Series 25 with Cylinder Relief, Anti-Cavitation

Installation Drawing

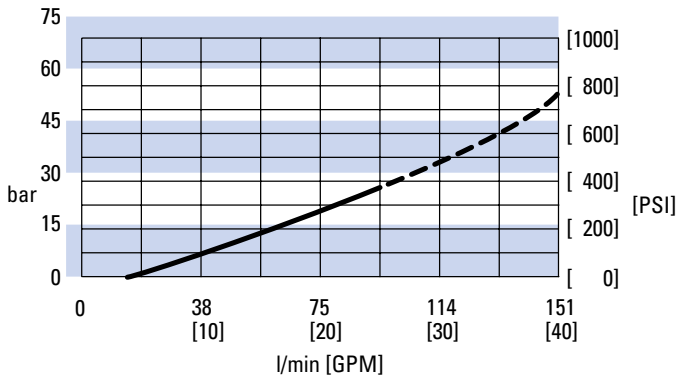


Displacement cm ³ /r [in ³ /r]	D Max. mm [in.]
490 [30]	205,5 [8.08]
625 [38]	211,4 [8.32]
795 [48]	219,0 [8.62]
985 [60]	228,4 [8.99]
1230 [75]	239,8 [9.44]

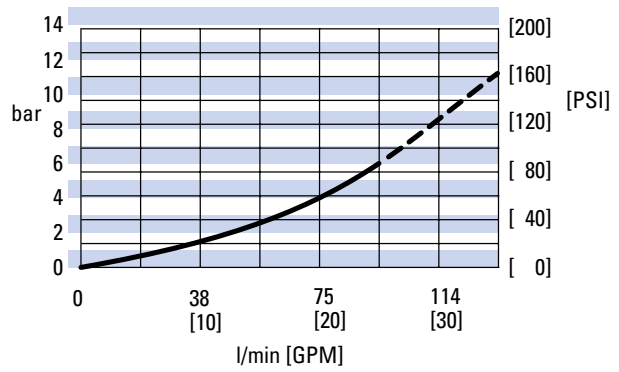
Steering Control Units—Series 25

Performance Data

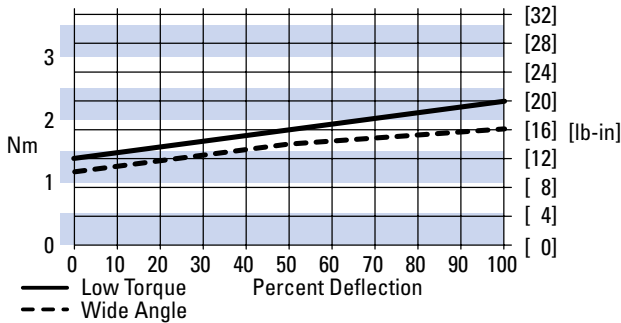
Average Pressure Drop at Full Valve Deflection



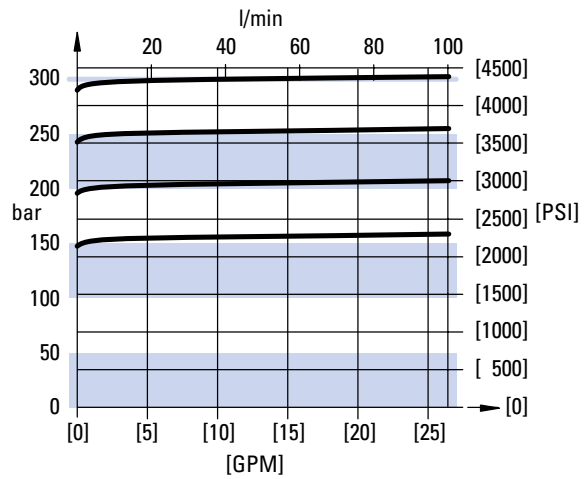
Neutral Pressure Drop - Open Center Fluid Viscosity 25 cSt [120 SUS]



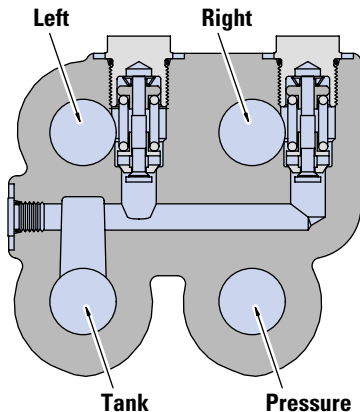
Input Torque



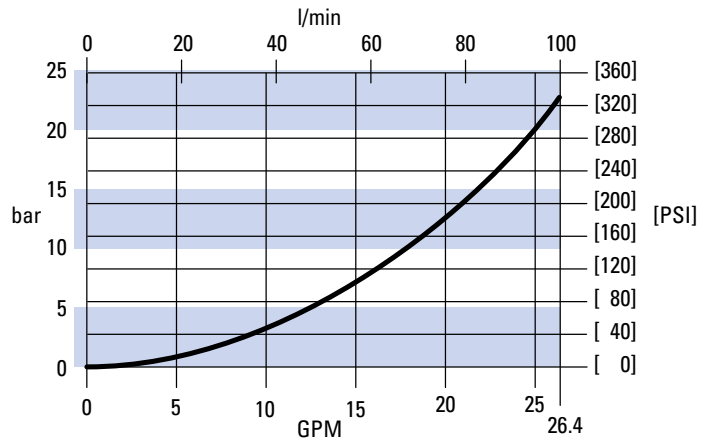
Pressure Relief Characteristics



SCU Valve Section



Check Valve Characteristics



Steering Control Units—Series 25

Model Code – Ordering Information

The following 29-digit coding system has been developed to identify all of the configuration options for the Series 25 steering control units. Use this model code to specify a unit with the desired features. All 29 digits of the code must be present when ordering. You may want to photocopy the matrix below to ensure that each number is entered in the correct box.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
A	B	W		6	A								0	0							3	A		A	A	1	0	C

Nos	Feature	Code	Description	Nos	Feature	Code	Description
1,2,3	Product Series	ABW	Series 25 Steering Control Unit	18,19,20,21	Ports and Mounting Threads	EAAA	4 x 1—1/6 Ports with 3/8-16 UNC Column Mounting
4	Nominal Flow Rating	7	95 l/min [25 GPM]			EAGA	4 x 1—1/6 Ports with 7/16 Load Sensing Port and 7/16 SAE Pilot Pressure Port (Capped) with 3/8-16 UNC Column Mounting (Use with Load Sensing Units Only)
		8	151 l/min [40 GPM] (Q-amp only)			NBDN	4 x M27 with M12—LS and M12 PP (Capped) M10 Mounting Threads (Use with Load Sensing Units Only)
5	Inlet Pressure Rating	6	241 bar [3500 PSI]			NAAN	4 x M27 with M10 Mounting Threads
6	Return Pressure Rating	A	10 bar [150 PSI]	22	Input Torque	3	Standard
7-8	Displacement cm ³ /r [in ³ /r]	62	490 [30]	23	Fluid Type	A	See Eaton Technical Bulletin 3-401
		65	625 [38]	24	Special Applications	00	None
		67	795 [48]			1	Wide Angle (Use with Load Sensing Units Only)
		69	985 [60]	25, 26	Special Features	AA	None
		71	1230 [75]	27	Paint	1	Black Paint
9	Flow Amplification	0	None	28	Identification	0	Eaton Product Number on Nameplate
		1	1.6 : 1.0 Ratio	29	Eaton Assigned Design Code	C	Assigned Design Code
10	Neutral Circuit	A	Open Center				
		C	Closed Center				
		D	Closed Center with Neutral Bleed				
		F	Load Sensing, Dynamic Signal				
11	Load Circuit	A	Non-Load Reaction				
		D	Non-Load-Reaction, Cylinder Damping (Use with Flow Amp and Wide Angle Only)				
12,13	Valve Options	00	None				
		21	Anti-Cavitation Valves, Cylinder Relief Valves				
14, 15	Load Sense Relief Valve Setting	00	None				
16,17	Cylinder Relief Valve Setting	00	None				
		6F	207 bar [3000 PSI]				
		70	224 bar [3250 PSI]				
		7H	241 bar [3500 PSI]				
		83	259 bar [3760 PSI]				
		8L	276 bar [4000 PSI]				
		95	293 bar [4250 PSI]				

Steering Control Units—Series 40

Product Description and Features

The Series 40 steering control unit includes two patented designs that make it even more responsive, reliable and cost effective.

- Symmetrical valving provides passageways and valving that are equal in both directions and pressure areas that are staged for minimum leakage. This gives balance, precise servo response and uniform steering action in both directions.
- Progressive valving makes it possible to produce the spool/sleeve valve in a way that assures reliability and reduces costs.

Eaton®'s high capacity gerotor assembly provides a lot of capacity in a small package.

Heavier valve components—housing, spool and sleeve—provide stability, especially during pressure and thermal transient conditions.

The seal and centering spring designs provide positive, low-effort steering feel assuring excellent vehicle control, an important feature on large vehicles for which this steering control was designed.

Features

- Open Center
- Closed Center
- Load Sensing
- Q-amp
- Pilot Pressure Port*

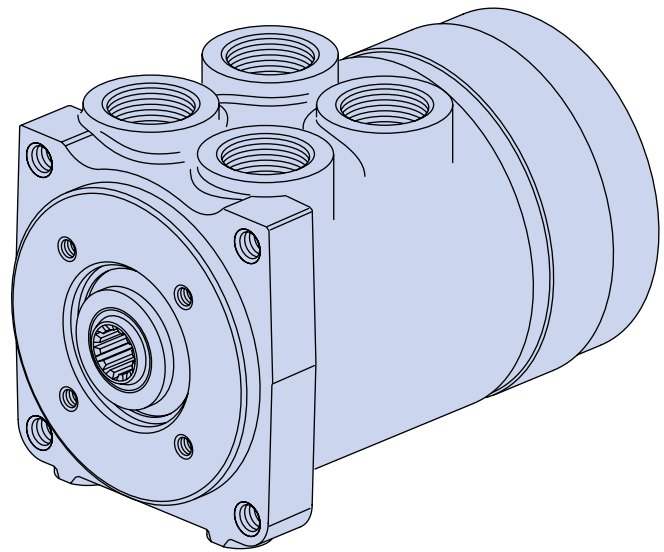
*This is an added feature that can be used for...

- 1)pilot pressure to priority valve.
- 2)diagnostics.

Applications

Articulated Vehicles

- Loaders
- Scrapers Frame Vehicles
- Large Front End Loaders
- Large Graders
- Mining Trucks
- Articulated Haulers
- Transporters



SPECIFICATIONS

Max. System Pressure	241 bar [3500 PSI]
Max. Back Pressure	21 bar [300 PSI]
Rated Flow	151 l/min [40 GPM]
Max. Flow	212 l/min [56 GPM]
Max. System Operating Temperature	93°C [200° F]
Max. Differential Between Steering Unit and System Temperature	28° C 50° F
Input Torque Powered	2,8-3,4 Nm @ 6,9 bar back pressure [25-30 lb-in @ 100 PSI back pressure]
Non Powered	†††
Rotation Limits	None
Fluid	ATF Type A and most petroleum based fluids
Recommended Filtration	ISO 18/13 cleanliness level

††† Manual steering is **not** possible without hydraulic power.

Char-Lynn® steering control units are covered by one or more of the following U.S. Patents 4,033,377 and 4,109,679. Corresponding foreign patents pending and issued.

Steering Control Units—Series 40

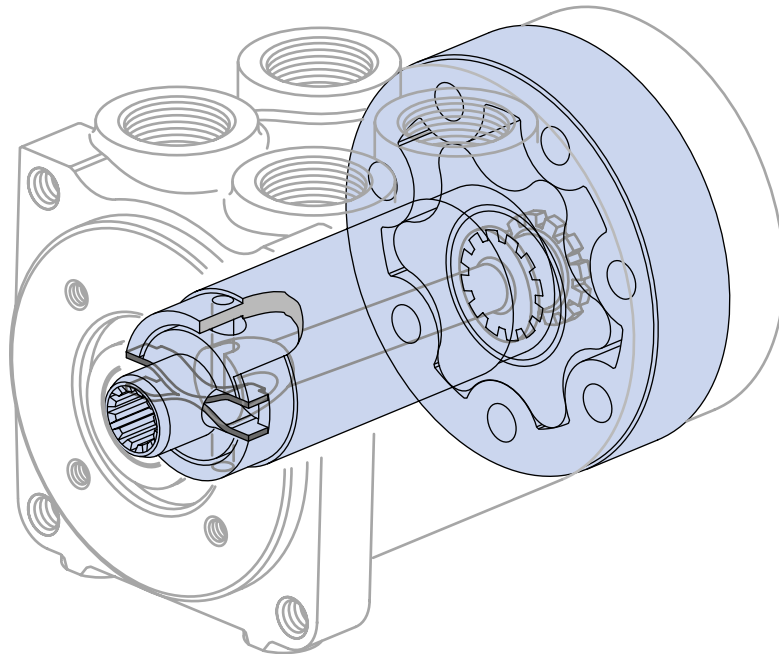
Standard Product Releases

SERIES 40

System	Signal	Load Circuit	Rated Flow l/min [GPM]	O-ring Port Size	Actual Displacement cm ³ /r [in ³ /r]—Product Number				
					1230 [75]	1555 [95]	1965 [120]	2460 [150]	3030 [185]
Open Center	N/A	Non Load Reaction	151 [40]	1 5/16-12	281-1001	281-1002	281-1003	281-1004	281-1005
					282-1010	282-1011	282-1012	282-1013	282-1014
Closed Center	N/A	Non Load Reaction	151 [40]	1 5/16-12	282-1001**	282-1002**	282-1003**	282-1004**	282-1005**
				1 5/16-12					
Load Sensing	Dynamic	Non Load Reaction	151 [40]	1 5/16-12	283-1001	283-1002	283-1003	283-1004	283-1005

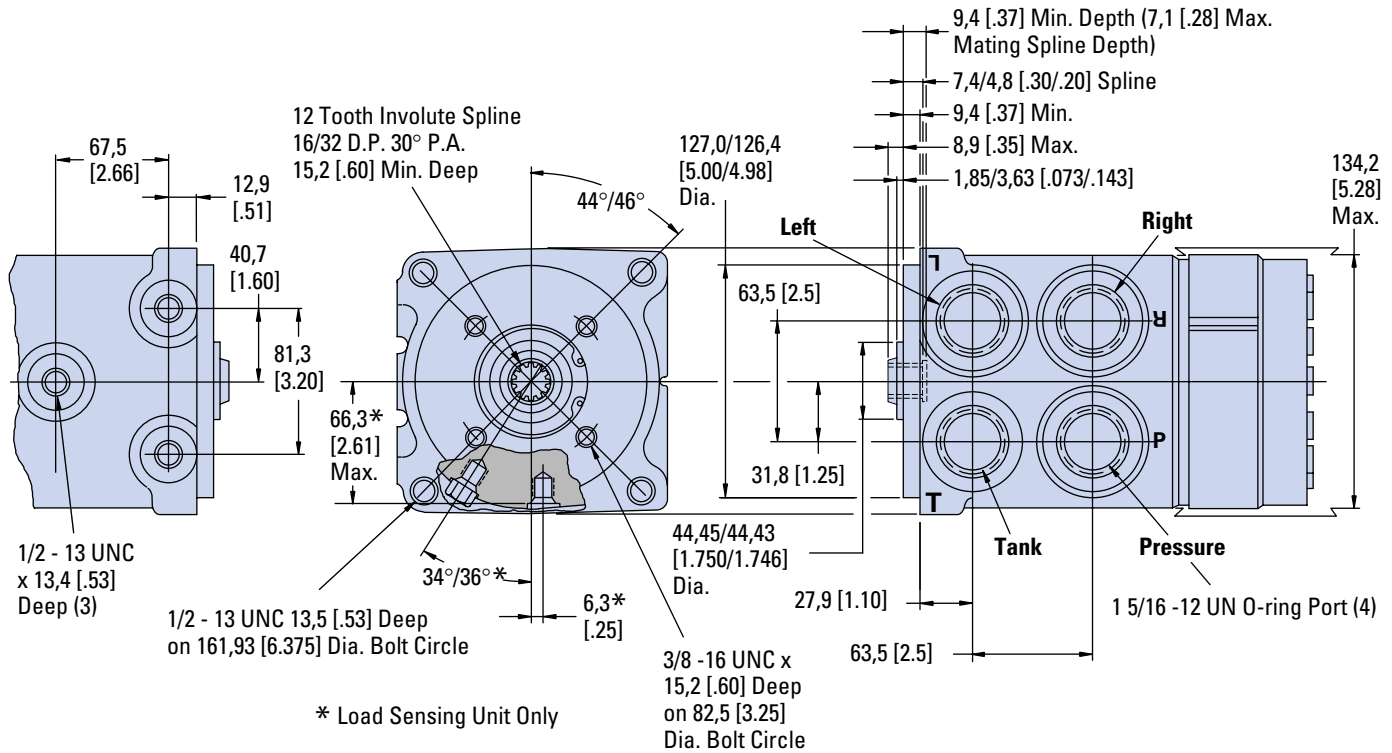
**Closed center units with neutral bleed 2,3 l/min [.6 GPM] at 172 bar [2500 PSI] (see page 7).

Example: 281-1001-002
 |
 | Design Code
 |
 Product Number

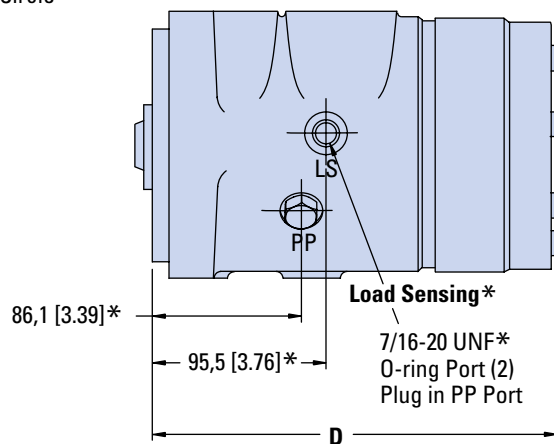


Steering Control Units—Series 40

Installation Drawing



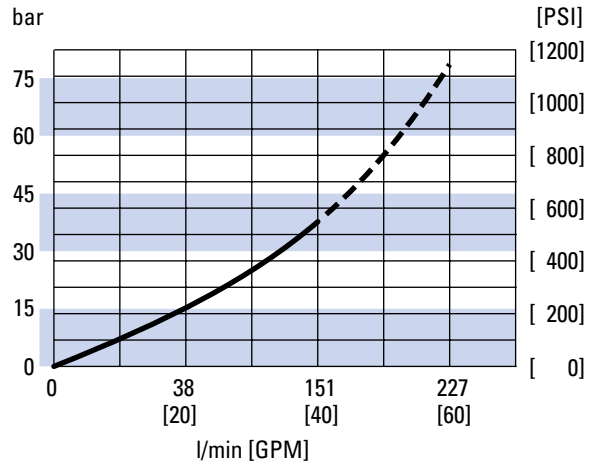
Displacement cm ³ /r [in ³ /r]	D Max. mm [in.]
1230 [75]	230,9 [9.09]
1555 [95]	245,9 [9.68]
1965 [120]	265,2 [10.44]
2460 [150]	288,3 [11.35]
3030 [185]	315,0 [12.40]



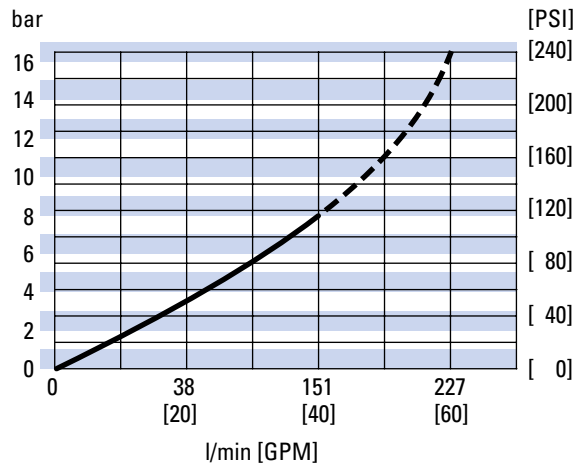
Steering Control Units—Series 40

Performance Data

Average Pressure Drop Through Open Center Load Sensing and Closed Center at Full Valve Deflection



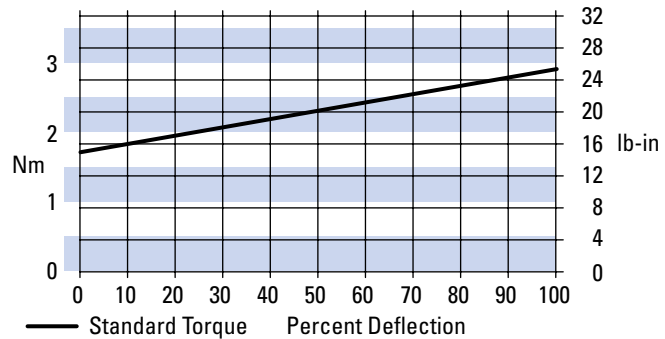
Open Center Neutral Pressure Drop Fluid Viscosity 25 cSt [120 SUS]



Input Torque

Applications

- Articulated and Rigid Dump Trucks
- Mining Trucks
- Paving Equipment



Steering Control Units—Series 40

Model Code – Ordering Information

The following 29-digit coding system has been developed to identify all of the configuration options for the Series 40 steering control units. Use this model code to specify a unit with the desired features. All 29 digits of the code must be present when ordering. You may want to photocopy the matrix below to ensure that each number is entered in the correct box.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
A	B	Y		6	A						0	0	0	0	0	0					3	A	0	0	0	0	0	B

Nos	Feature	Code	Description	Nos	Feature	Code	Description
1,2,3	Product Series	ABY	Series 40 Steering Control Unit	18,19,20,21	Ports and Mounting Threads	GAAA	4 x 1 – 5/16 SAE Ports with 3/8-16 UNC Column Mounting Threads
4	Nominal Flow Rating	8	151 l/min [40 GPM]				
		9	227 l/min [60 GPM] (Q-amp only)				
5	Inlet Pressure Rating	6	241 bar [3500 PSI]			GAGA	4 x 1 – 5/16 SAE ports with 7/16 SAE Load Sensing Port and 7/16 SAE Pilot Pressure Port with 3/8-16 UNC Column Mounting Threads (Use with Load Sensing Only)
6	Return Pressure Rating	B	21 bar [300 PSI]				
7-8	Displacement cm ³ /r [in ³ /r]	71	1230 [75]	22	Input Torque	3	Standard
		74	1560 [95]	23	Fluid Type	A	See Eaton Technical Bulletin 3-401
		76	1970 [120]	24	Special Applications	0	None
		78	2460 [150]	25,26	Special Features	00	None
		80	3030 [185]	27	Paint	0	No Paint
9	Flow Amplification	0	None	28	Identification	0	Eaton Product Number on Nameplate
		1	1.6 : 1.0 Ratio	29	Eaton Assigned Design Code	B	Assigned Design Code
10	Neutral Circuit	A	Open Center				
		C	Closed Center				
		D	Closed Center with Neutral Bleed				
		F	Load Sensing, Dynamic Signal				
11	Load Circuit	A	Non-Load Reaction				
		E	Non-Load Reaction, Cylinder Damping (Use with Q-amp only)				
12,13	Integral Valve	00	None				
14,15	Integral Inlet Relief Valve Pressure Setting	00	None				
16,17	Cylinder Relief Valve Setting	00	None				

Torque Generator

Product Description

Char-Lynn® torque generators have been completely redesigned to meet the needs of the changing marketplace. These torque generators provide power assist for steering, eliminating the large hand wheels on gate valves, and provide powerful rotary motion with effortless manual rotary input on numerous other applications.

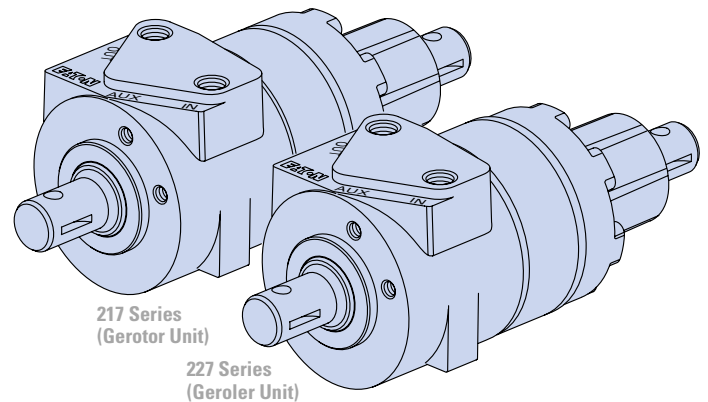
Features

Today's market includes power steering on electric lift trucks. Char-Lynn torque generators have been designed with features that greatly improve the operator's comfort as well as the vehicle's performance.

The increase in port surface area allows for the additional port requirement for units with the following features:

Power Beyond

This version has three ports: Inlet (IN), Tank (OUT), and Excess Flow (EF). In the power beyond configuration, flow not used for priority steering exiting the EF port and is available for the downstream reach function. Flow used for steering will exit the (OUT) port to tank, and cannot be used for auxiliary functions.



Load Sensing

Char-Lynn load sensing torque generators use conventional or load sensing power supplies to achieve load sensing steering. The use of a load sensing torque generator and a priority valve in a normal power steering circuit offers the following advantages:

- Provides smooth pressure compensated steering because load variations in the steering circuit do not affect axle response or maximum steering rate.
- Provides true power beyond system capability by splitting the system into two independent circuits. Only the flow required by the steering maneuver goes to the steering circuit. Flow not required for steering is available for use in the auxiliary circuits.
- Provides reliable operation because the steering circuit always has flow and pressure priority.

Char-Lynn load sensing torque generators and priority valves can be used with open center, closed center or load sensing systems. Used either in an open center system with a fixed displacement pump or a closed center system with a pressure compensated pump, these torque generators offer many of the features of a load sensing system. Excess flow is available for auxiliary circuits.

Torque Generator

Product Description Continued

Open Center with Case Drain

This high pressure open center torque generator allows the exit flow from the Torque Generator to operate another function (for example reach/tilt function of a fork lift vehicle). An external case drain is needed to protect seals and to allow for adequate recentering of spool and sleeve. The flow out the case drain is internal leakage only. This is a series circuit with some special characteristics that should be noted:

- A relief valve is required in the down stream circuit as well as a relief valve protecting the torque generator.
- The pressures in this circuit are additive. If it takes 41 bar [600 PSI] for steering and 55 bar [800 PSI] for the reach circuit, the pump will see 96 bar [1400 PSI].
- The relief valve for steering must always be set higher than the relief valve on the downstream function (reach). The margin between the two must be enough to provide adequate steering in the worst case (fork lift stationary and unloaded).

Anti-Friction Needle Bearings

Torque generators are available with anti-friction needle bearings at the power end to allow for direct mount sprockets or pinions when compactness of application does not allow for outboard bearings.

Gerotor or Geroler® Element

This is a fluid displacement element, consisting of an outer ring gear and an internal star. Manual low torque input actuates the spool of the spring centered spool and sleeve valve, allowing high pressure oil to turn the internal star. This star is coupled with a splined drive to the output shaft and also the sleeve of the spool and sleeve valve. High pressure oil turning the star in this gerotor or Geroler element is generating high output torque.

The Geroler elements have not been offered on torque generators in the past. These Gerolers have rolls incorporated into the outer ring, and the rolls provide rolling contact with the star point, minimizing friction and improving efficiency.

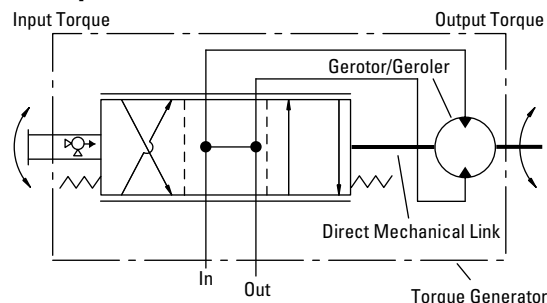
Limited Manual Steering

Relative deflection of the input and output shafts is limited mechanically within the unit so that limited manual steering is still possible in the event of power loss.

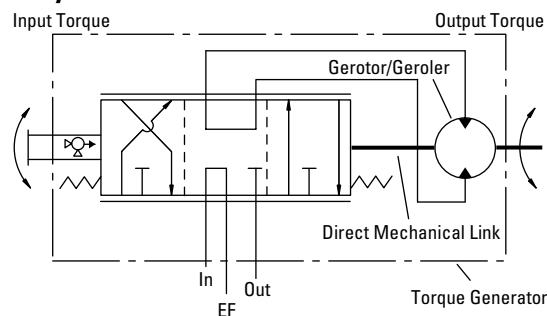
Reaction Torque Resistance

Customer supplied bracket is required for reaction torque resistance.

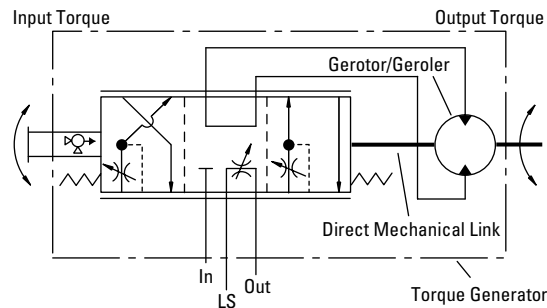
Standard Open Center



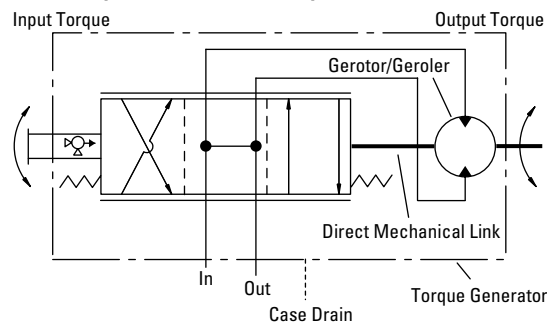
Power Beyond



Load Sensing

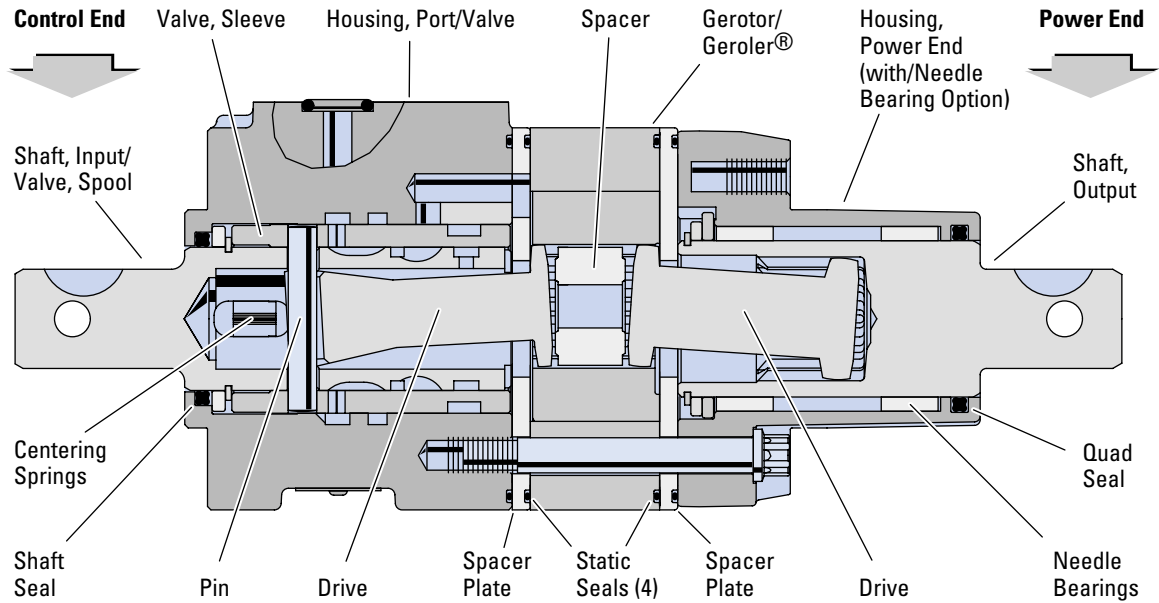


Open Center (with Case Drain)



Torque Generator

Product Information



SPECIFICATIONS 217 SERIES—GEROTOR UNIT

Displacement cm ³ /r [in ³ /r]	76 [4.7]	96 [5.9]	160 [9.7]
Torque Output (at 70 bar [1000 PSI])	62 Nm [550 lb-in]	79 Nm [700 lb-in]	124 Nm [1100 lb-in]
Recommended Flow	11,4 l/min [3 GPM]	13,2 l/min [3.5 GPM]	13,9 l/min [5 GPM]
Max. Operating Speed (at Rated Pressure and Recommended Flow)	125 RPM	118 RPM	102 RPM

SPECIFICATIONS 227 SERIES—GEROLER® UNIT

Displacement cm ³ /r [in ³ /r]	80 [4.9]	102 [6.2]	160 [9.7]
Torque Output (at 70 bar [1000 PSI])	69 Nm [608 lb-in]	86 Nm [760 lb-in]	131 Nm [1160 lb-in]
Recommended Flow	11,7 l/min [3.1 GPM]	15,1 l/min [4 GPM]	18,9 l/min [5 GPM]
Max. Operating Speed (at Rated Pressure and Recommended Flow)	125 RPM	118 RPM	102 RPM

COMMON SPECIFICATIONS 217 AND 227 SERIES

Rated Flow	15,1 l/min [4 GPM]
Max. System Operating Temperature	93° C [200° F]
Input Torque Powered	1,6 - 2,5 Nm [14 - 22 lb-in]
Non-Powered (Max.)	136 Nm [100 lb-ft]
Output Shaft Side Load at Keyway Centerline without Bearing	23 kg [50 lb]
with Bearing	272 kg [600 lb]
Fluid	Most petroleum hydraulic fluids—see your Eaton representative for use of fire-resistant and other special fluids
Recommended Filtration	As needed to maintain ISO 18/13 cleanliness level
Rated Pressure	Depends on model—See chart circuit type below

Circuit Type	In Port	Out Port	Aux. Port	Max. In minus Out
Open Center	69 bar [1000 PSI]	3 bar [50 PSI]	—	—
Power Beyond	138 bar [2000 PSI]	3 bar [50 PSI]	138 bar [2000 PSI]	69 bar [1000 PSI]
Load Sensing	69 bar [1000 PSI]	3 bar [50 PSI]	69 bar [1000 PSI]	—
Open Center w/Case Drain	172 bar [2500 PSI]	103 bar [1500 PSI]	3 bar [50 PSI]	69 bar [1000 PSI]

Torque Generator

Product Information Continued

217 SERIES—GEROTOR UNIT

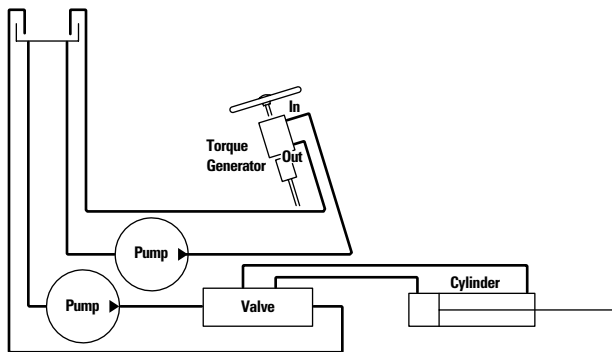
Feature	Ports	Circuit Type	Displacement cm ³ /r [in ³ /r]	Product Number
Machined Mounting			76 [4.7]	217-1049
Faces	9/16-18	Open	95 [5.9]	217-1050
Each End	O-ring	Center	160 [9.7]	217-1048
Machined Mounting			76 [4.7]	217-1030
Faces	Manifold	Open	95 [5.9]	217-1015
Each End		Center	160 [9.7]	217-1020
Power End w/Bearing and			76 [4.7]	217-1051
Machined Faces	Manifold	Open	95 [5.9]	217-1028
		Center	160 [9.7]	217-1052

227 SERIES—GEROLER® UNIT

Feature	Ports	Circuit Type	Displacement cm ³ /r [in ³ /r]	Product Number
Machined Mounting			80 [4.9]	227-1049
Faces	9/16-18	Open	102 [6.2]	227-1050
Each End	O-ring	Center	160 [9.7]	227-1048
Machined Mounting			80 [4.9]	227-1030
Faces	Manifold	Open	102 [6.2]	227-1015
Each End		Center	160 [9.7]	227-1020
Power End w/Bearing and			80 [4.9]	227-1051
Machined Faces	Manifold	Open	102 [6.2]	227-1028
		Center	160 [9.7]	227-1052

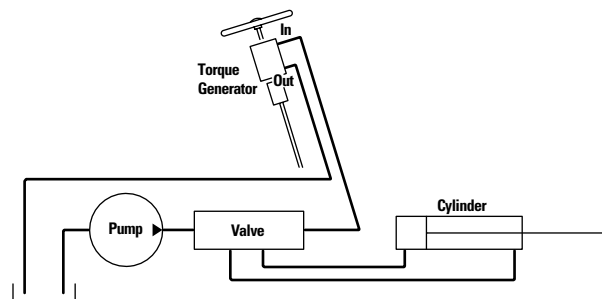
Example: 217-1049-002
 Product Number | Design Code

Circuits for Torque Generator—Conventional Systems



Conventional System with Two Pumps

- Extra cost of two separate circuits



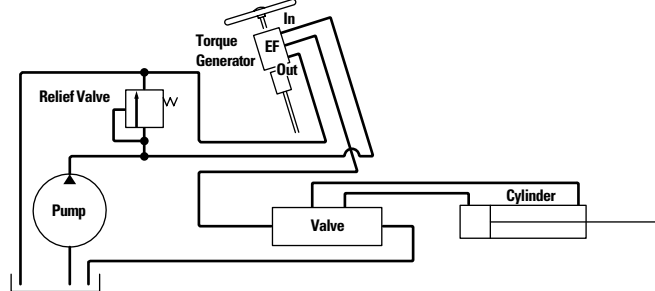
Conventional System with One Pump

- Can result in insufficient steering flow when operating the auxiliary function

Circuits for Torque Generator— Conventional Systems Continued

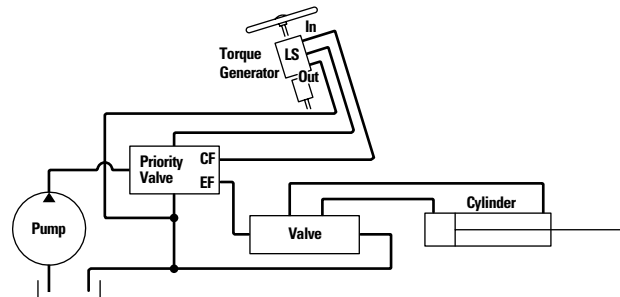
Power Beyond Torque Generator

- Parallel circuit
- Steering has priority
- Simple system
- Single relief valve
- Flow to auxiliary function is reduced while steering



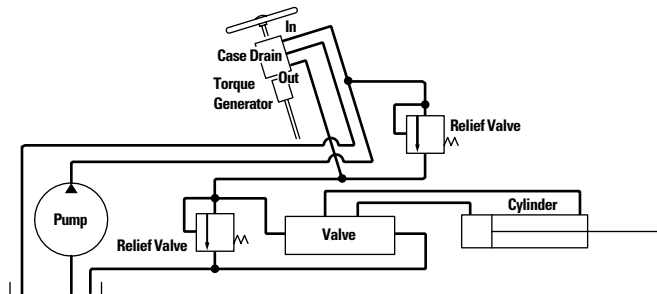
Load Sensing System

- Steering has priority
- Auxiliary function can operate at higher pressure than steering rating; priority valve isolates CF side from EF side pressures.
- Flow to auxiliary functions reduced while steering



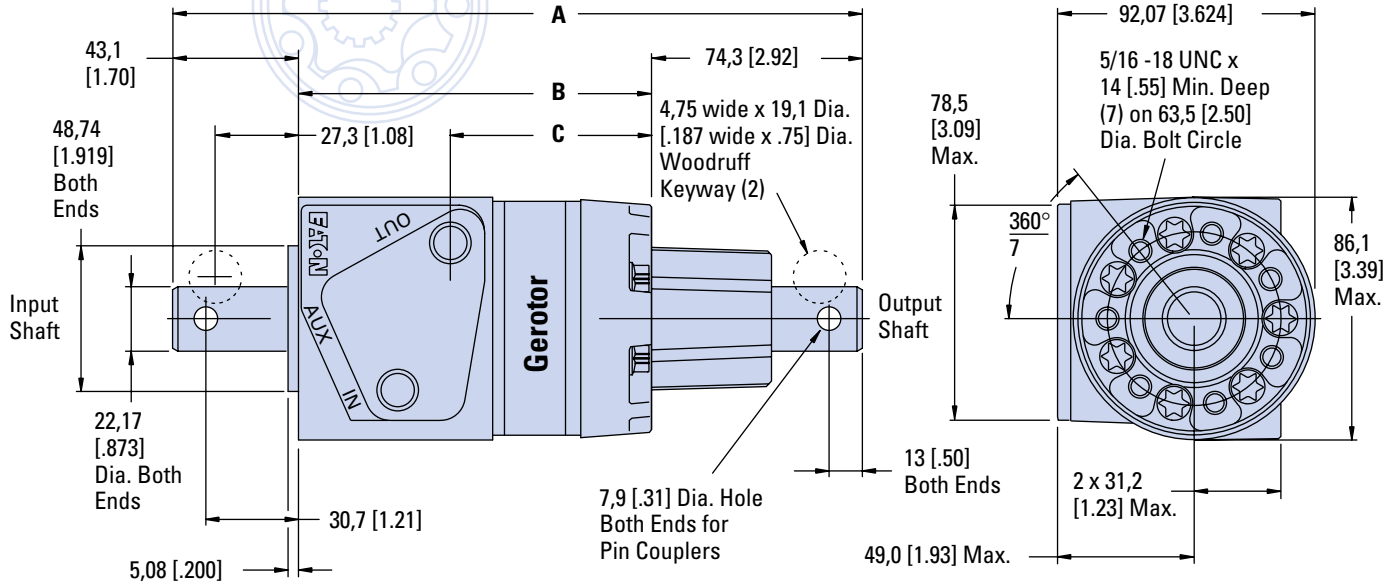
High Back Pressure Torque Generator

- Series circuit; auxiliary and steering pressures are additive
- All flow available to auxiliary function, even while steering
- Separate relief valves required for steering and auxiliary



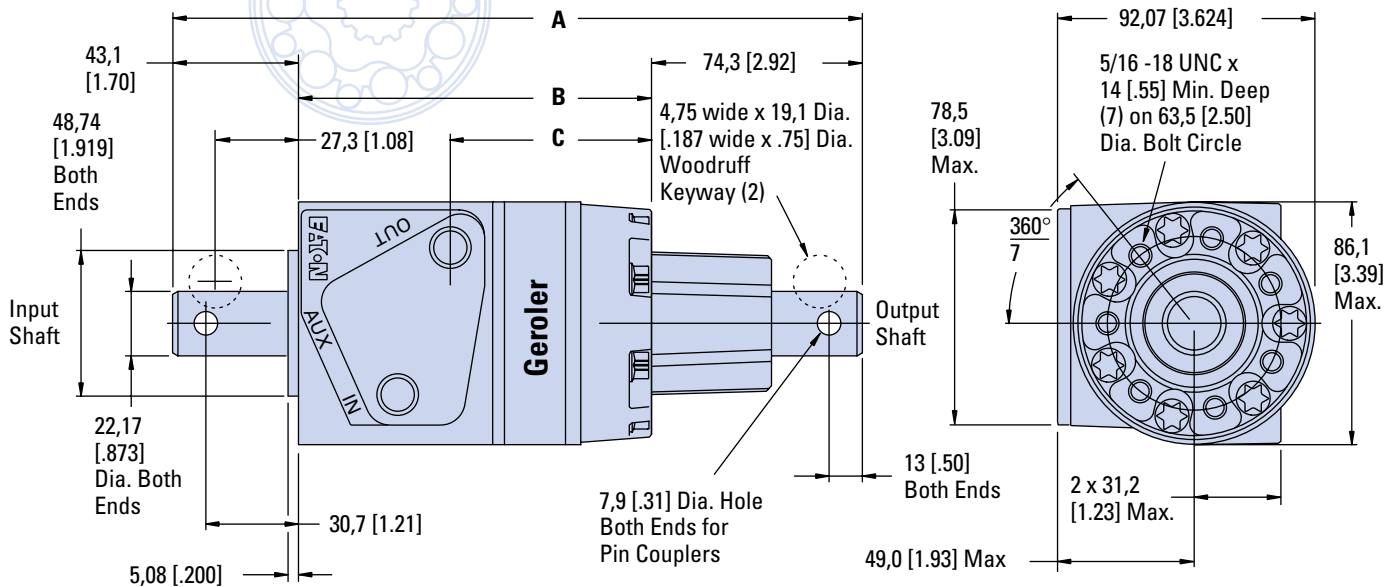
Torque Generator Installation Drawing

217 Series—Gerotor Unit



	Displacement cm ³ /r [in ³ /r]	Dimension mm [inch]		
		A	B	C
217 Series (Gerotor Unit)	96,1 [5.86] 159,6 [9.73]	231,9 [9.13] 240,6 [9.47]	114,5 [4.51] 123,2 [4.85]	60,4 [2.38] 69,3 [2.73]
227 Series (Geroler® Unit)	80,3 [4.90] 101,6 [6.20] 160,0 [9.64]	233,3 [9.18] 237,2 [9.34] 247,5 [9.74]	115,9 [4.56] 119,8 [4.72] 130,1 [5.12]	62,0 [2.44] 65,9 [2.59] 76,2 [3.00]

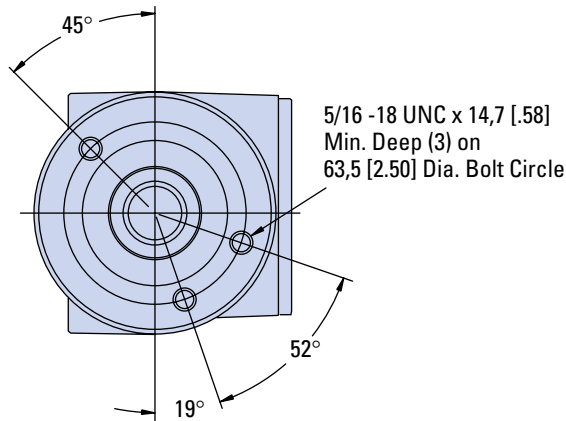
227 Series—Geroler® Unit



Torque Generator

Ports

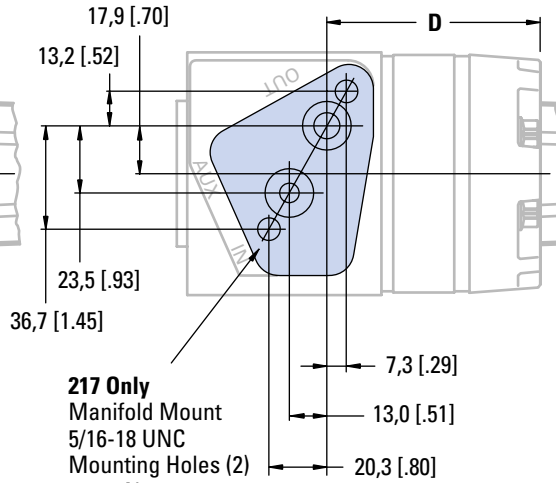
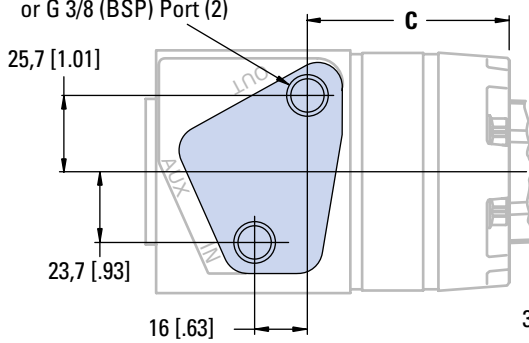
Input End



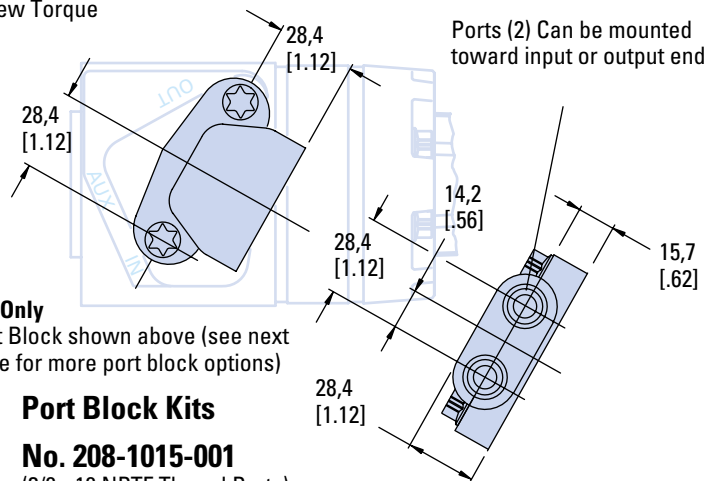
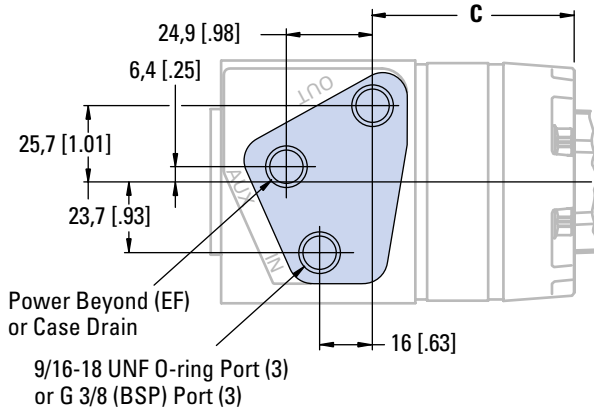
	Displacement cm ³ /r [in ³ /r]	Dimension mm [inch]	
		C	D
217 Series (Geroler® Unit)	96,1 [5.86] 159,6 [9.73]	60,4 [2.38] 69,3 [2.73]	63,5 [2.50] 72,1 [2.84]
227 Series (Gerotor Unit)	80,3 [4.90] 101,6 [6.20] 160,0 [9.64]	62,0 [2.44] 65,9 [2.59] 76,2 [3.00]	

Port Options

9/16-18 UNF O-ring Port (2)
or G 3/8 (BSP) Port (2)



217 Only
Manifold Mount
5/16-18 UNC
Mounting Holes (2)
17-21 Nm
[150-190 lb-in]
Screw Torque



217 Only
Port Block shown above (see next
page for more port block options)

Port Block Kits

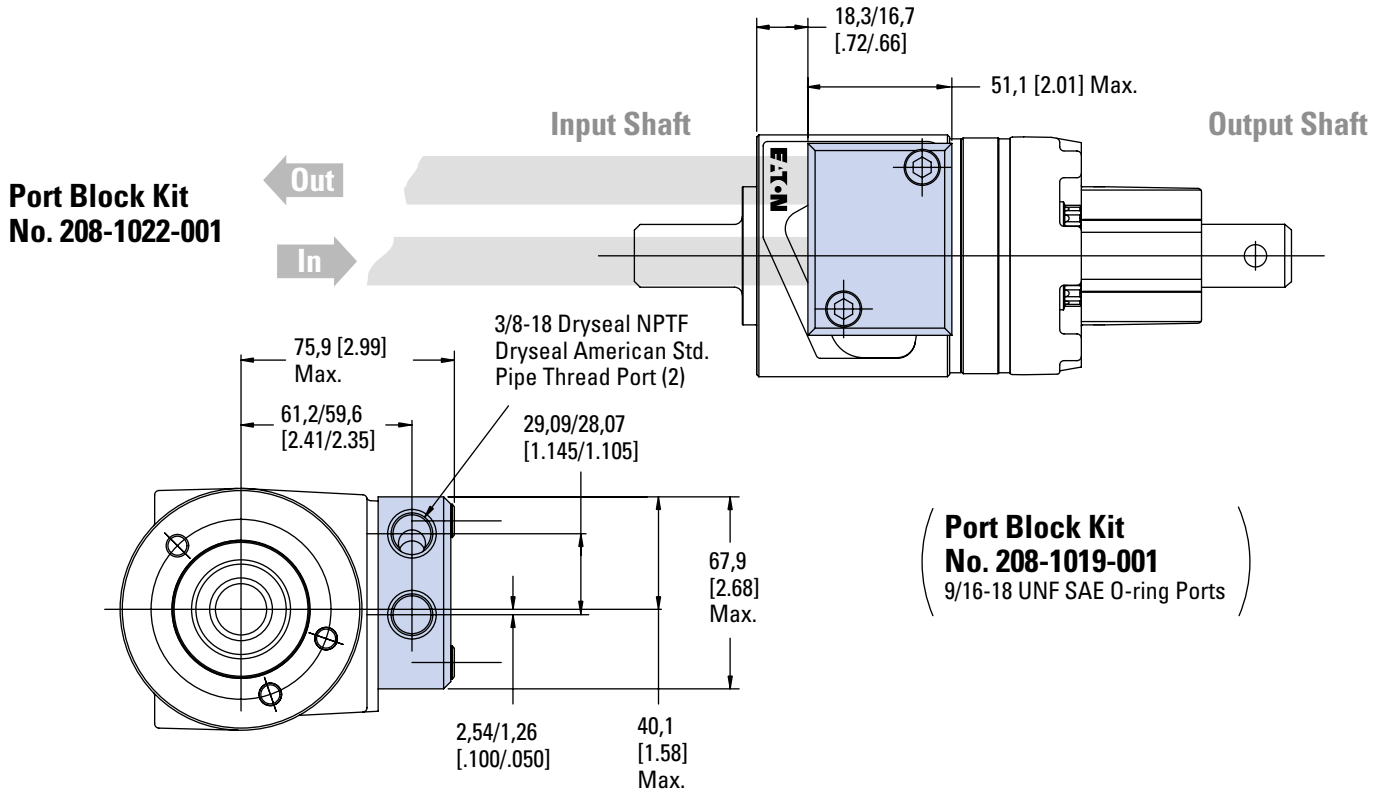
No. 208-1015-001
(3/8 - 18 NPTF Thread Ports)

For proper operation it is recommended that the unit be installed so no radial load or thrust load is applied to either the input or output shafts. Misalignment of shafts will cause binding.

Torque Generator— 217 Series

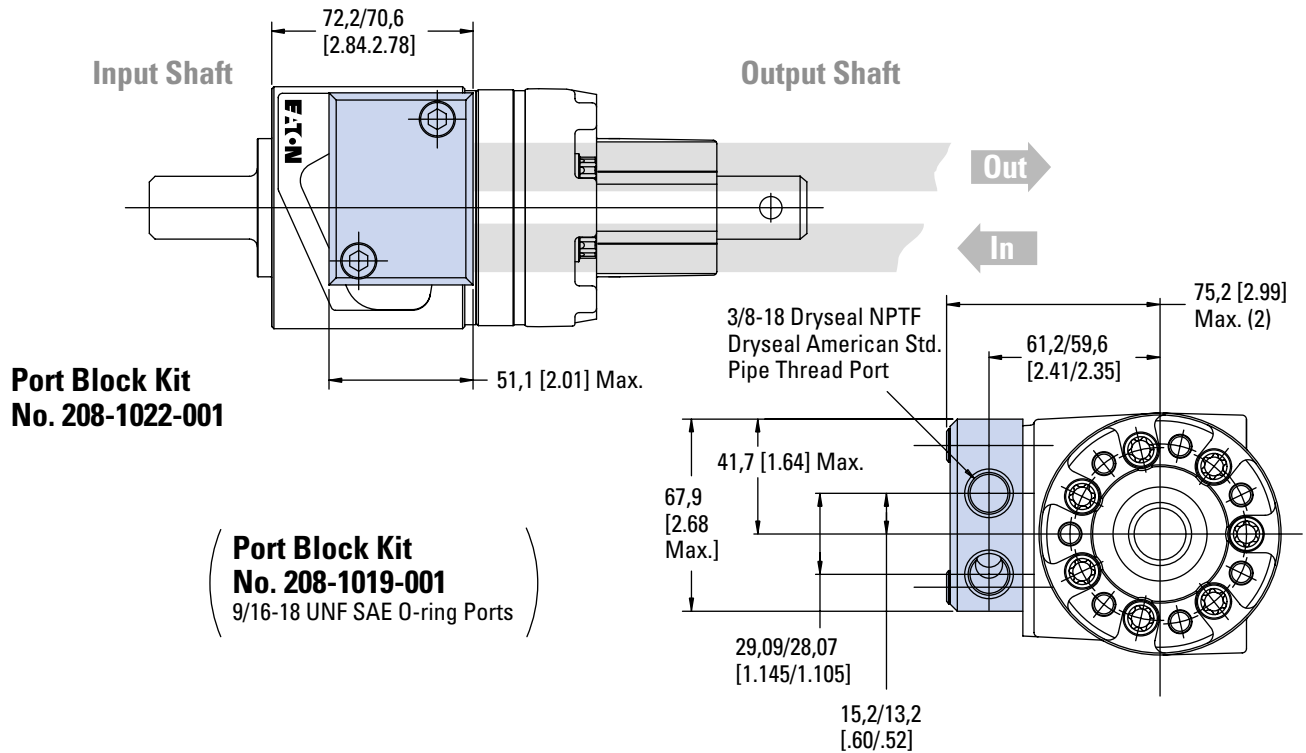
Port Block

Installation Drawing Port Block
with 3/8-18 Dryseal NPTF Ports



Torque Generator— 217 Series Port Block

Installation Drawing Port Block
with 3/8-18 Dryseal NPTF Ports



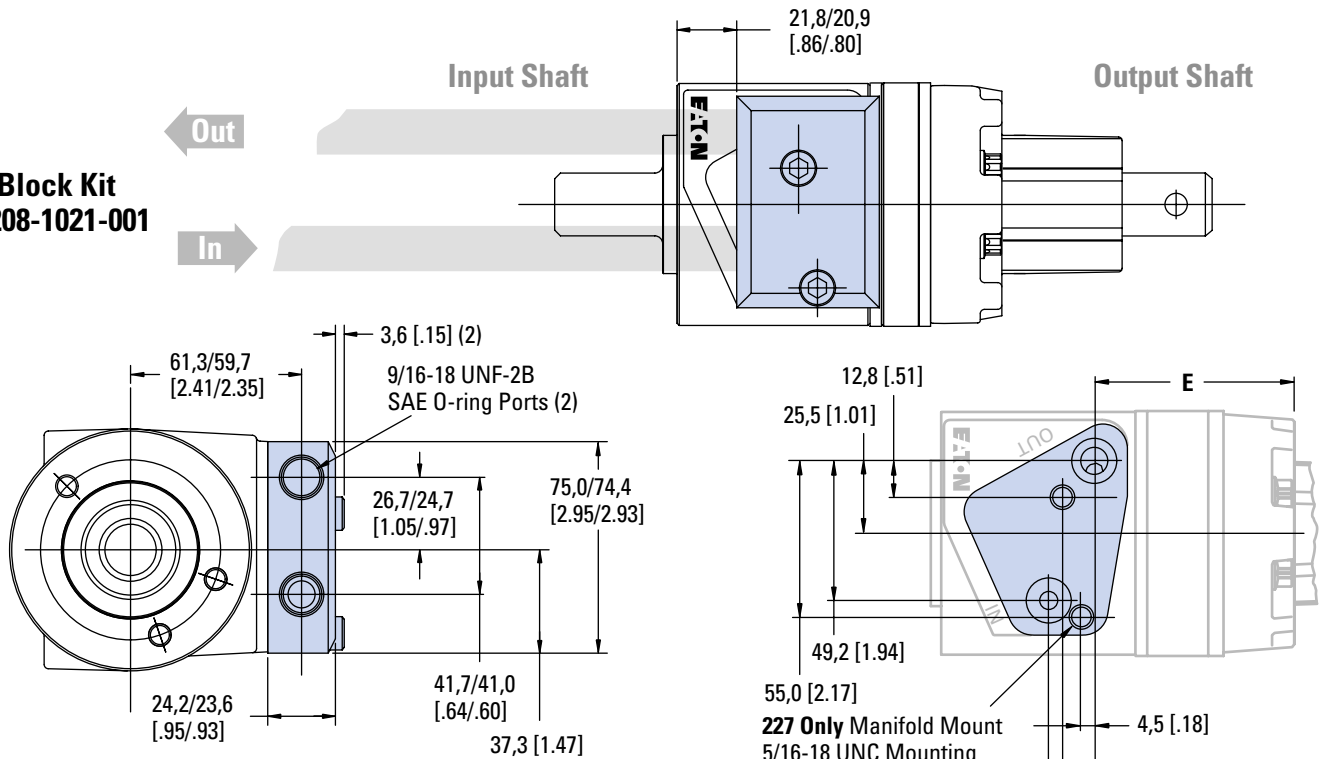
Torque Generator— 227 Series

Port Blocks

Installation Drawing

9/16-18 UNF SAE O-ring Port

**Port Block Kit
No. 208-1021-001**



**Input
Shaft**

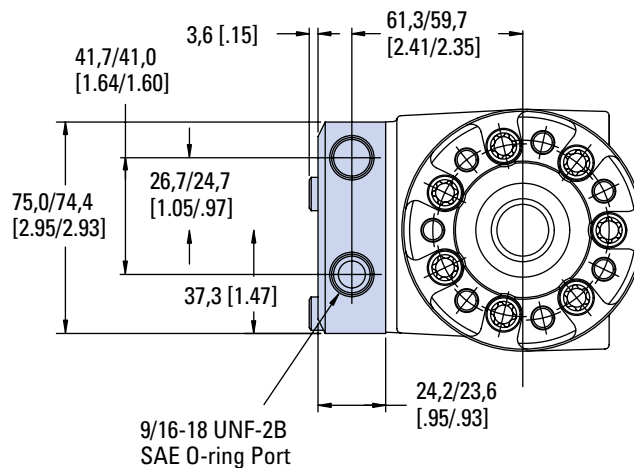
Output Shaft

Out

In

Displacement cm ³ /r [in ³ /r]	Dim. mm [inch]	
	E	
227 Series	80,3 [4.90]	62,0 [2.44]
(Geroler® Unit)	101,6 [6.20]	71,2 [2.80]
	160,0 [9.64]	76,2 [3.00]

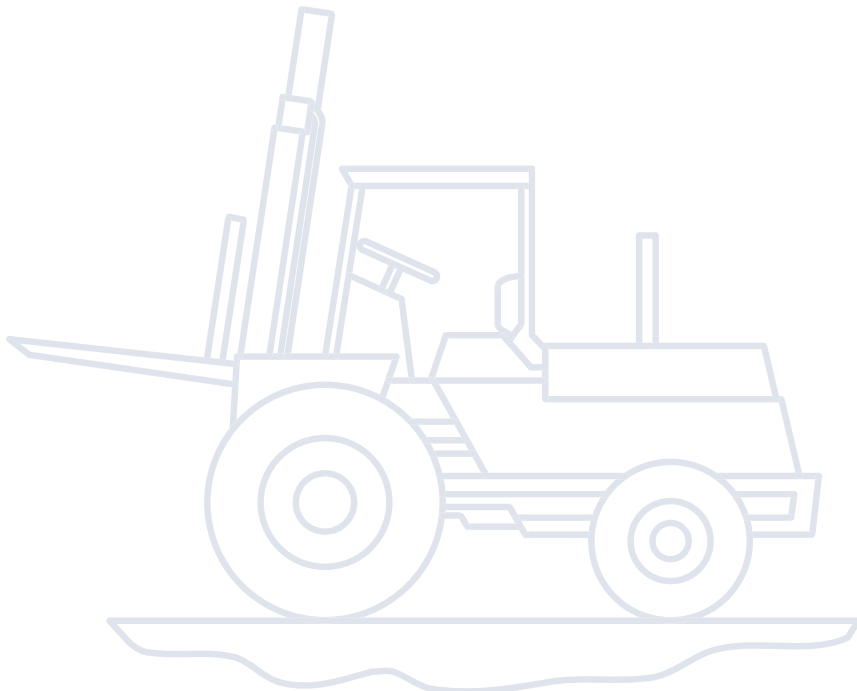
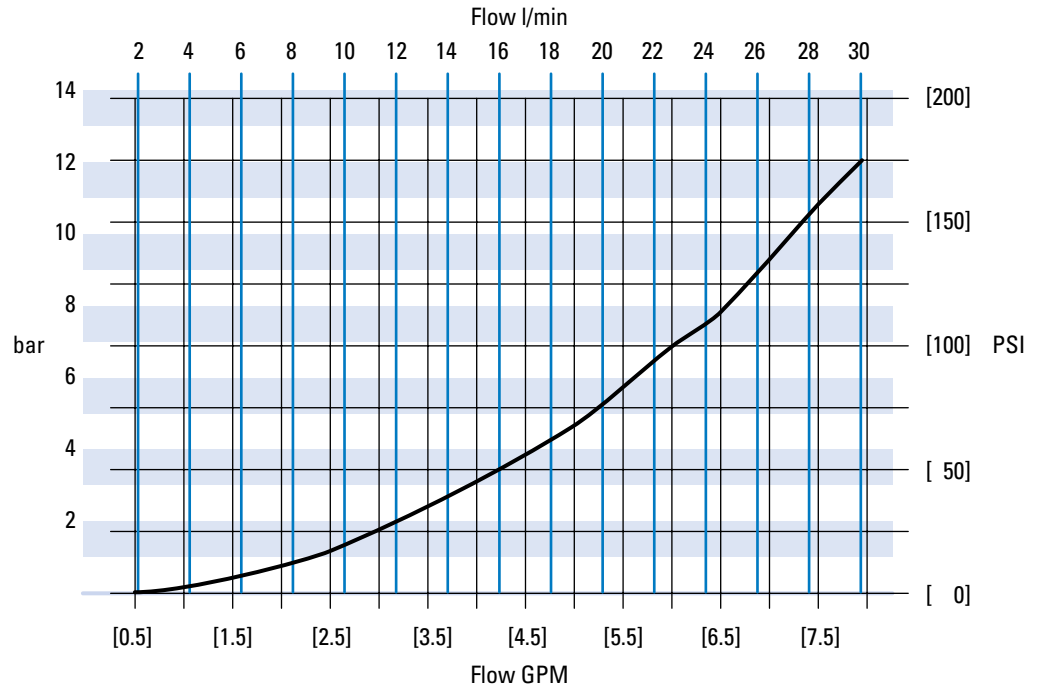
**Port Block Kit
No. 208-1020-001**



Torque Generator

Performance Data

Torque Generator Pressure Drop



Torque Generator

Model Code Ordering Information

The following 20-digit coding system has been developed to identify all of the configuration options for the torque generator. Use this model code to specify a torque generator with the desired features. All 20 digits of the code must be present when ordering. You may want to photocopy the matrix below to ensure that each number is entered in the correct box.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
A	B	P								0	1	A	1	A			A	1	B

Nos	Feature	Code	Description	Nos	Feature	Code	Description		
1,2,3	Product Series	ABP	Torque Generator	9	Ports	A	2 x .625 inch Dia. Manifold Ports with 2 x 5/16-18 UNC Mounting Holes (use with port block) - open center only		
4,5,6	Circuit Type and Ratings —Max	A4A	15,1 l/min [4 GPM] Open Center Inlet 69 bar [1000 PSI] Out 3 bar [50 PSI]			B	3 x .625 inch Dia. Manifold Ports with 3 x 5/16 - 18 UNC Mounting Holes (use with port block)		
		D4C	15,1 l/min [4 GPM] Open Center Power Beyond Inlet 138 bar [2000 PSI] Out 3 bar [50 PSI] Aux. (PB) 138 bar [2000 PSI] Dp (Inlet – out) <69 bar [1000 PSI] (Limited to 76 [4.7], 80 [4.9], 96 [5.9] cm ³ /r [in ³ /r])			C	2 x 9/16 SAE Ports— open center only		
						D	3 x 9/16 SAE Ports		
						E	2 x G3/8 (BSP) Ports— open center only		
						F	3 x G3/8 (BSP) Ports		
		E4B	15,1 l/min [4 GPM] Open Center with High Back Pressure (Case Drain) Inlet 172 bar [2500 PSI] Out 103 bar [1500 PSI] Aux. (CD) 3 bar [50 PSI] Dp (Inlet – out) <69 bar [1000 PSI]			10	Shaft Bearings	0 None 1 Output Shaft Needle Bearings	
						11	Integral Valves	0 None	
						12	Input Torque	1 Standard	
						13	Shaft Ends	A 22,17 [.874] Dia. with Keyway and Cross Hole	
						14	Shaft Seals	1 Quad Rings	
7,8	Displacement cm ³ /r [in ³ /r]					15	Mounting Threads	A 5/16-18 UNC	
		08	76 [4.7] Gerotor			16,17	Special Feature	00 None 01 Port Block Installed	
		10	96 [5.9] Gerotor			18	Paint and Packaging	A Black Primer	
		17	160 [9.7] Gerotor			19	Identification	1 Eaton Product Number on Nameplate	
		58	80 [4.9] Gerotor			20	Eaton Assigned Design Code	B Assigned Design Code	
		60	102 [6.2] Gerotor						
		66	160 [9.6] Gerotor						

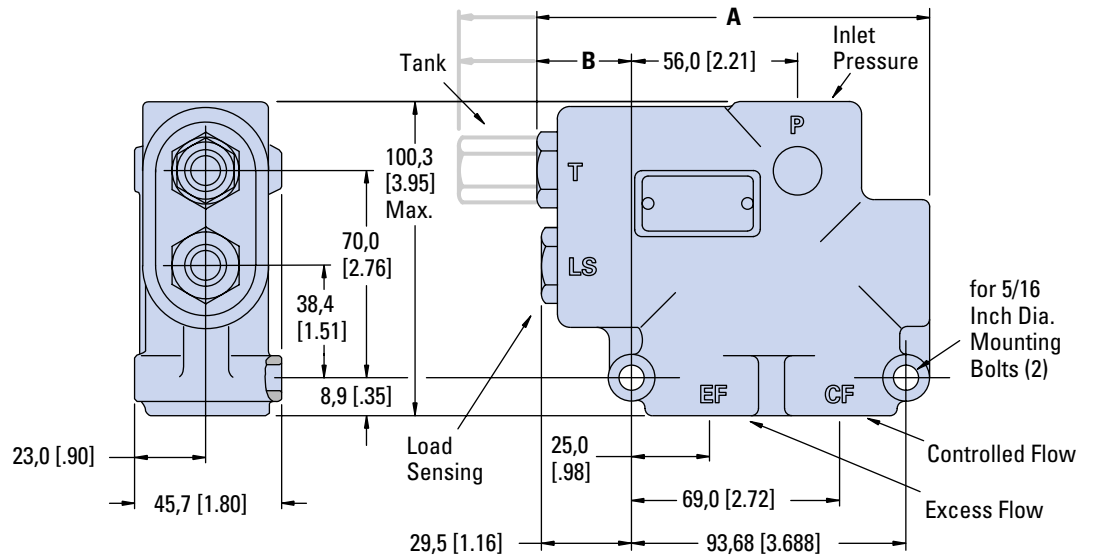
Steering System Components

VLC In-Line Priority Valves

60 l/min [16 GPM] Rate Flow

Dimension	A	B
SAE	136,7 [5.38]	31,2 [1.23]
54,6	Max.	
Metric	160,5 [6.32]	[2.15]
& R(BSP)	Max.	

Housing Qualified for 276 bar [4000 PSI] Rating Per NFPA.
Relief Valve Qualified for 241 bar [3500 PSI].



Code Number	System Pressure bar [PSI]
DD	83 [1200]
HE	120 [1725]
LA	138 [2000]
MC	150 [2175]
NC	160 [2300]
QA	172 [2500]
UA	207 [3000]
VD	230 [3325]
VK	240 [3475]

Control Pressure - bar [PSI] / Product Number

Ports (5)	Port Size	Static Signal	Dynamic Signal	Static Signal	Dynamic Signal	Static Signal	Dynamic Signal
P & EF	7/8 - 14	3,5 [50]	5,2 [75]	5,2 [75]	7,6 [110]	6,9 [100]	10,0 [145]
CF	3/4 - 16	606-1217	606-1232	606-1218	606-1314	606-1219	606-1315
LS & T	7/16 - 20						
P & EF	3/4 - 16	606-1214	606-1327	606-1215	606-1278	606-1216	606-1328
CF	9/16 - 18						
LS & T	7/16 - 20						
P & EF	M22 X 1,5	606-1329	606-1330	606-1331	606-1332	606-1333	606-1334
CF	M18 X 1,5						
LS & T	M12 X 1,5						
P & EF	R 1/2 - 14	606-1335	606-1336	606-1337	606-1338	606-1339	606-1340
CF	R 1/2 - 14						
LS & T	R 1/4 - 19						

Example: 606-1218-00X-QA
 Product Number System Pressure Code Number
 X = Design Level — **NOT** part of Order Number.

The above product number describes a VLC Series with 5,2 bar [75 PSI] control pressure, static signal, 7/8-14 P and EF ports, 3/4-16 CF port, 7/16-20 LS and T ports, 172 bar [2500 PSI] relief valve setting.

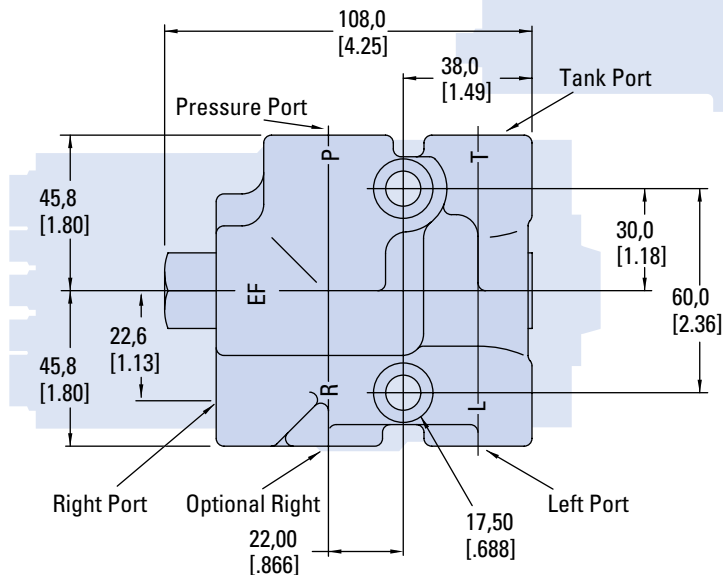
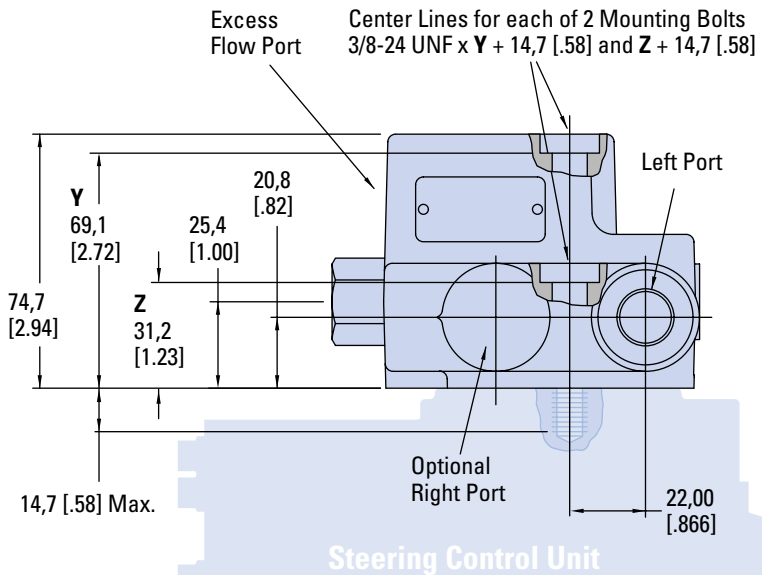
For comprehensive information on all steering system components "Valves" see Eaton catalog 11-508.

Steering System Components

VLC Bolt on Priority Valves (BoPV)

60 l/min [16 GPM]
Rated Flow
Rated Pressure
172 bar [2500 PSI]

(**Use with Series 110,
 230, 450 Steering
 Units Only**)



For comprehensive information on all steering system components "Valves" see Eaton catalog 11-508.

Control Pressure - bar [PSI] / Product Number

Ports (5)	Port Size	Static Signal 3,5 [50]	Dynamic Signal 5,2 [75]	Static Signal 5,2 [75]	Dynamic Signal 7,6 [110]	Static Signal 6,9 [100]	Dynamic Signal 10,0 [145]
P & EF	G 1/2						
CF	G 3/8		612-0003		612-0001		
LS & T	G 3/8						
P & EF	G 1/2						
T, L, & R	G 3/8				612-0005		

Steering System Components

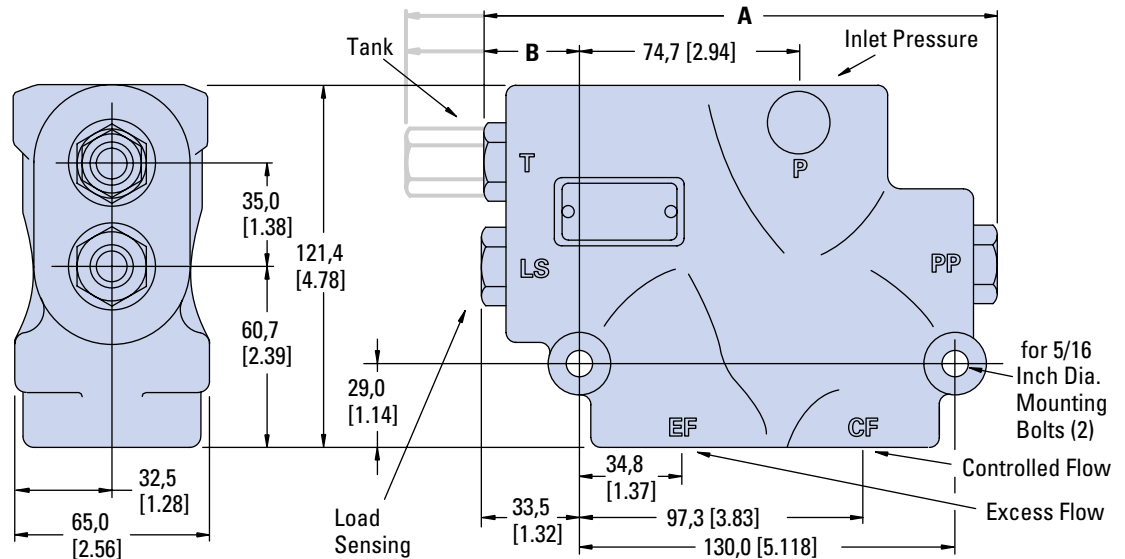
VLE In-Line Priority Valves

**150 l/min [40 GPM]
Rated Flow**

	Dimension	
	A*	B*
SAE	179,3 [7.06] Max.	32,8 [1.29]
Metric & R(BSP)	203,2 [8.00] Max.	56,2 [2.21]

*Note: Add 9,9 [0.39] to A and B
Dimensions for High Pressure Models

Housing Qualified for
262 bar [3800 PSI] Rating
Per NFPA. Relief Valve
Qualified for 172 bar
[2500 PSI] Max.



High Pressure

Relief Valve Qualified for
241 bar [3500 PSI] Max.

Example: 606-1094-00X-QA
 Product Number System Pressure
 Code Number
 X = Design Level — **NOT** part of Order Number.

The product number (above left) describes a VLE Series with 6,9 bar [100 PSI] control pressure, static signal, 1 1/16-12 P and EF ports, 3/4-16 CF port, 7/16-20 LS and T ports, 172 bar [2500 PSI] relief valve setting.

Code Number	System Pressure bar [PSI]
DD	83 [1200]
HE	120 [1725]
LA	138 [2000]
MC	150 [2175]
NC	160 [2300]
QA	172 [2500]
UA	207 [3000]
VD	230 [3325]
VK	240 [3475]

High Pressure*

For comprehensive information on all steering system components "Valves" see Eaton catalog 11-508.

Control Pressure - bar [PSI] / Product Number

Ports (5)	Port Size	Static Signal 4,5 [65]	Dynamic Signal 5,5 [80]	Static Signal 6,9 [100]	Dynamic Signal 8,6 [125]	Static Signal 10,3 [150]	Dynamic Signal 12,8 [185]
P & EF	1 1/16 - 12	606-1093	606-1294	606-1094	606-1295	606-1095	606-1296
CF	3/4 - 16						
LS & T	7/16 - 20						
P & EF	1 1/16 - 12	606-1046	606-1341	606-1047	606-1342	606-1048	606-1343
CF	7/8 - 14						
LS & T	7/16 - 20						
P & EF	1 5/16 - 12	606-1058	606-1344	606-1059	606-1345	606-1060	606-1346
CF	7/8 - 14						
LS & T	7/16 - 20						
P & EF	1 5/16 - 12	606-1141	606-1347	606-1142	606-1348	606-1143	606-1349
CF	1 5/16 - 12						
LS & T	7/16 - 20						
P & EF	1 5/16 - 12	606-1350	606-1282	606-1351	606-1281	606-1352	606-1283
CF	1 1/16 - 12						
LS & T	7/16 - 20						
P & EF	M27 X 2	606-1353	606-1354	606-1355	606-1356	606-1357	606-1358
CF	M18 X 1,5						
LS & T	M12 X 1,5						
P & EF	R 3/4 - 14	606-1359	606-1360	606-1361	606-1362	606-1363	606-1364
CF	R 1/2 - 14						
LS & T	R 1/4 - 19						

High Pressure*

P & EF	1 5/16 - 12	606-1365	606-1321	606-1366	606-1322	606-1367	606-1323
CF	1 1/16 - 12						
LS & T	7/16 - 20						

Steering System Components

VLH In-Line Priority Valves

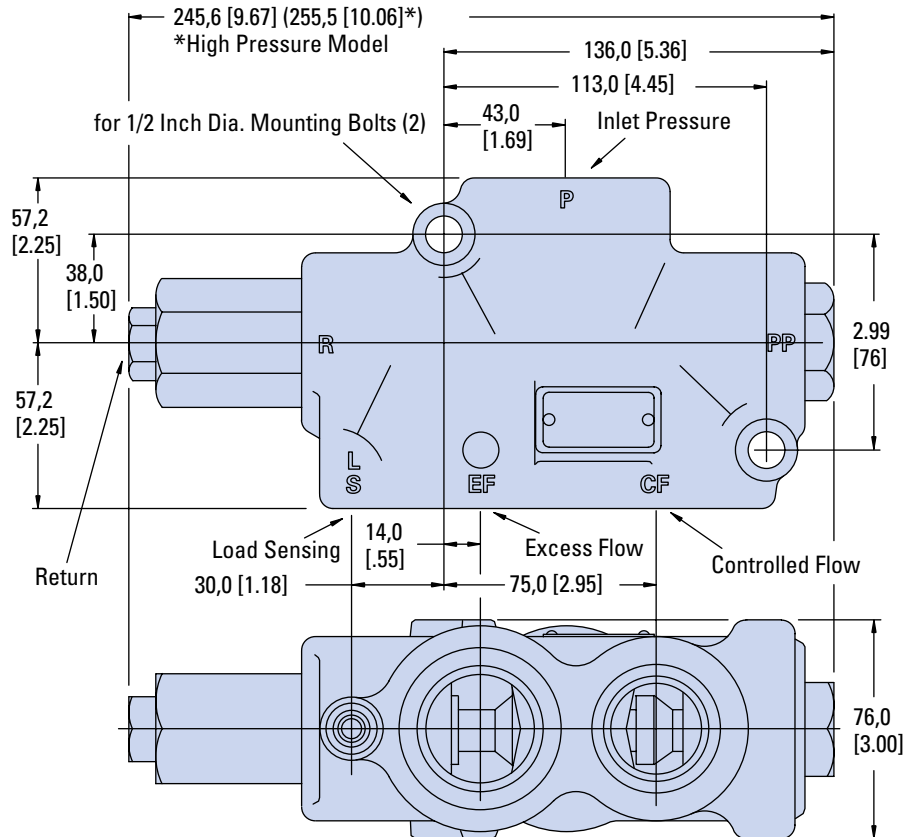
240 l/min [63 GPM] Rated Flow

Code Number	System Pressure bar [PSI]
DD	83 [1200]
HE	120 [1725]
LA	138 [2000]
MC	150 [2175]
NC	160 [2300]
QA	172 [2500]
UA	207 [3000]
VD	230 [3325]
VK	240 [3475]

Housing Qualified for 207 bar [3000 PSI] Rating Per NFPA. Relief Valve Qualified for 172 bar [2500 PSI] Max.

High Pressure

Relief Valve Qualified for 241 bar [3500 PSI]. Housing Qualified for 262 bar [3800 PSI] Max.



Example: 606-1202-00X-QA
 Product Number System Pressure Code Number
 X = Design Level — **NOT** part of Order Number.

The product number (above left) describes a VLH Series with 6,9 bar [100 PSI] control pressure, static signal, 1 5/8-12 P and EF ports, 1 5/16-12 CF port, 7/16-20 LS and R ports, 172 bar [2500 PSI] relief valve setting.

For comprehensive information on all steering system components "Valves" see Eaton catalog 11-508.

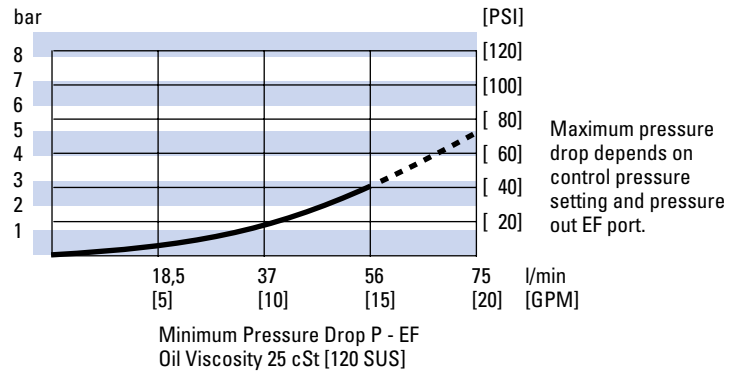
Control Pressure - bar [PSI] / Product Number

Ports (5)	O-ring Port Size	Static Signal 5,2 [75]	Dynamic Signal 5,9 [85]	Static Signal 6,9 [100]	Dynamic Signal 7,6 [110]	Static Signal 10,3 [150]	Dynamic Signal 11,4 [165]
P & EF	1 5/8 - 12	606-1201	606-1288	606-1202	606-1289	606-1203	606-1290
CF	1 5/16 - 12						
LS & R	7/16 - 20						
P & EF	1 5/8 - 12	606-1368	606-1284	606-1369	606-1285	606-1370	606-1286
CF	1 1/16 - 12						
LS & R	7/16 - 20						
P & EF	1 5/8 - 12	606-1189	606-1371	606-1190	606-1372	606-1191	606-1373
CF	3/4 - 16						
LS & R	7/16 - 20						
High Pressure*							
P & EF	1 5/8 - 12	606-1374	606-1316	606-1375	606-1317	606-1376	606-1318
CF	1 1/16 - 12						
LS & R	7/16 - 20						

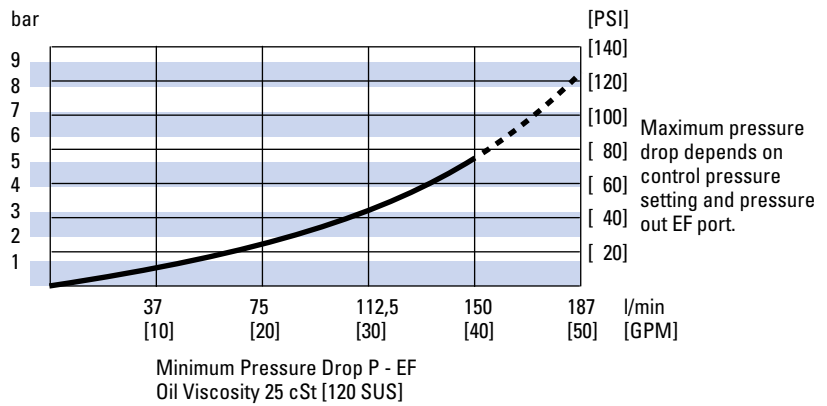
Steering System Components

Pressure Drop Curves for VLC, VLE and VLH Priority Valves

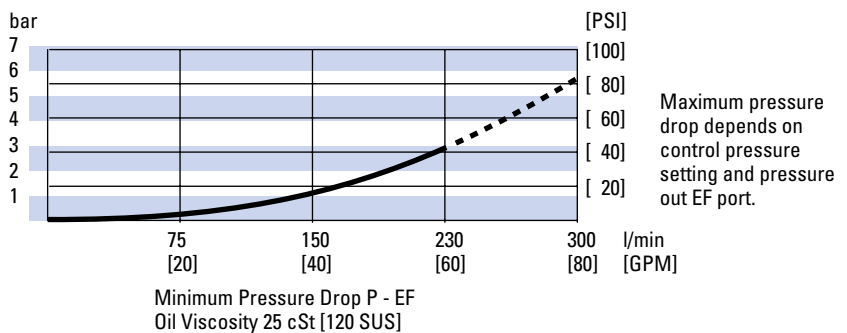
VLC Series



VLE Series

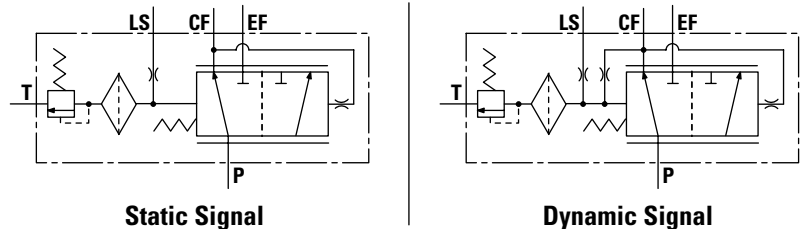


VLH Series



U.S. Patents. Re 26,338; 3,455,210 and 4,043,419 cover circuits using these priority valves. Corresponding foreign patents pending and issued.

Symbols



For comprehensive information on all steering system components "Valves" see Eaton catalog 11-508.

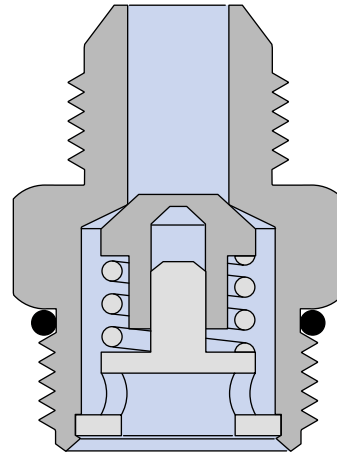
Check Valves

Product Description and Features

These check valves are designed specifically to withstand the rugged duty cycles of a steering system and perform their functions reliably to prevent kickback in the steering wheel.

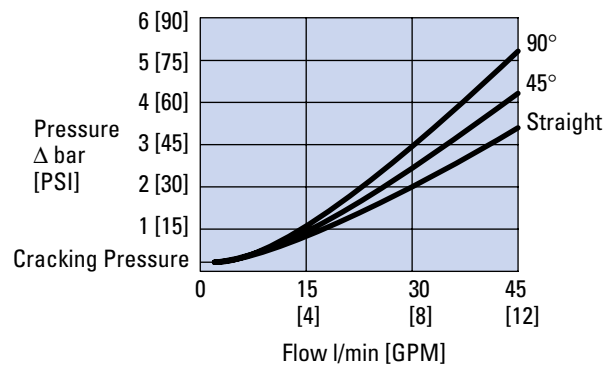
The check valve is installed directly into the pressure port of Char-Lynn® steering control unit. Connection of the hose assembly is either a male 37° end or O-ring face seal (ORS).

Straight, 45° and 90° elbow configurations are available (see installation drawing next page).



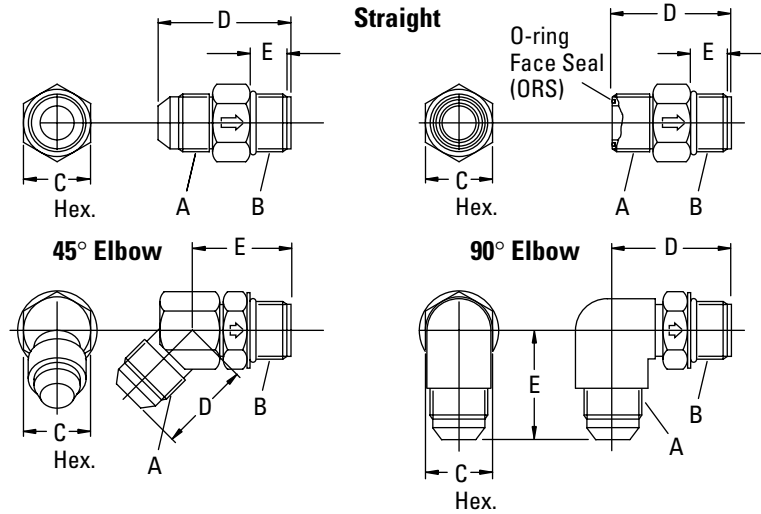
Performance Data

Pressure Drop Curves — Inlet Check Valves



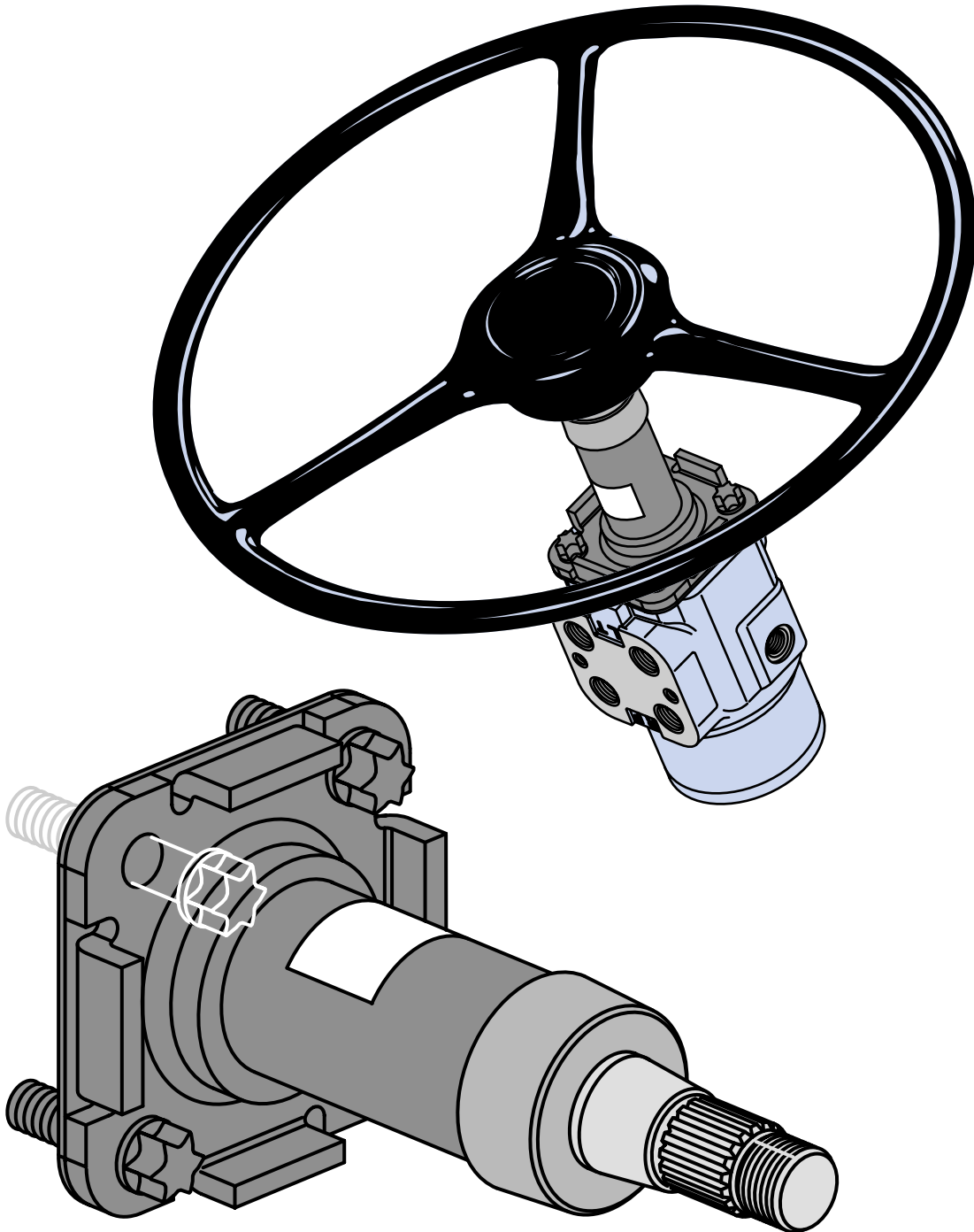
Check Valves

Installation Drawing



Configuration	Product Number	Check Valve Dimensions—mm [in.]				
		A	B	C	D	E
Straight	37° 608-1003	3/4-16	3/4-16	22,23/21,97 [.875/.865]	38,1/36,5 [1.50/1.44]	10,0/ 8,8 [.39/ .35]
	37° 608-1004	9/16-18	3/4-16	22,23/21,97 [.875/.865]	35,6/34,0 [1.40/1.34]	10,0/ 8,8 [.39/ .35]
	ORS 608-1007	13/16-16	3/4-16	22,23/21,97 [.875/.865]	37,4/35,3 [1.47/1.39]	12,7/11,6 [.50/ .46]
	ORS 608-1009	11/16-16	3/4-16	22,23/21,97 [.875/.865]	35,9/33,7 [1.41/ .95]	12,7/11,6 [.50/ .46]
90°	37° 608-1005	9/16-18	3/4-16	22,23/21,97 [.875/.865]	37,6/35,5 [1.48/1.40]	30,0/28,1 [1.18/1.11]
	ORS 608-1013	11/16-16	3/4-16	22,23/21,97 [.875/.865]	41,4/39,4 [1.63/1.55]	26,9/24,9 [1.02/ .94]
45°	37° 608-1006	9/16-18	3/4-16	22,23/21,97 [.875/.865]	21,9/20,3 [.86/ .80]	33,8/31,7 [1.33/1.25]
	37° 608-1016	3/4-16	3/4-16	22,23/21,97 [.875/.865]	25,7/24,1 [1.01/ .95]	33,8/31,7 [1.33/1.25]

Steering Columns



Steering Columns

Description

Char-Lynn® columns can be custom built to your exact specifications. The column and mounting flange is of a sturdy single weldment design. These columns have high thrust and side load capacity with low shaft torsional friction. Columns are painted with low gloss black finish and the shafts are phosphate coated and oil dipped for corrosion protection.

Features

- Low friction bearings to carry thrust and side loads
- Available dust boot to protect against dirt and moisture
- Four jacket types are available
- Two lower ends and ten upper ends are available
- Two different horn wire configurations
- Length available from 56 to 825 mm [2.2 to 32.5 inch]
- Columns can be pre-assembled to steering units per your request

SPECIFICATIONS

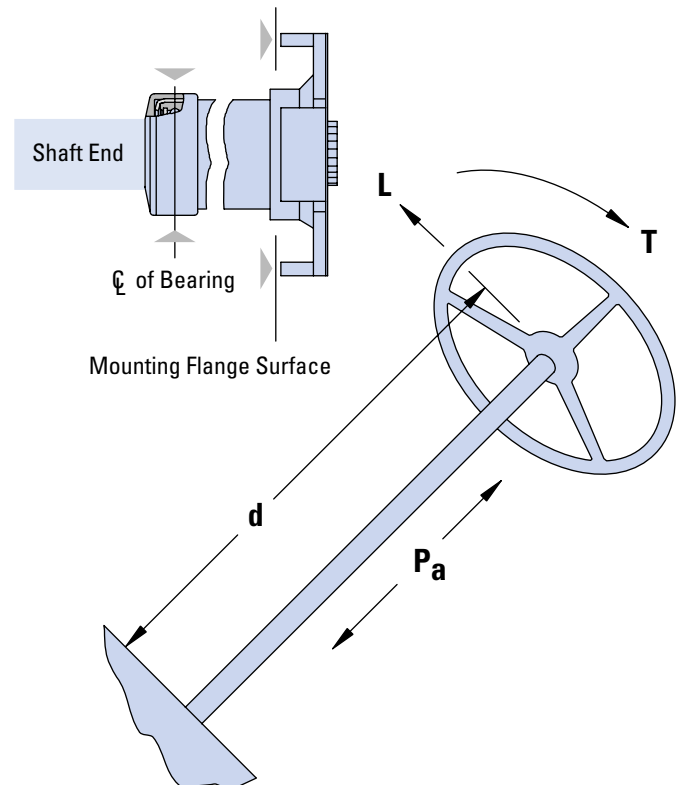
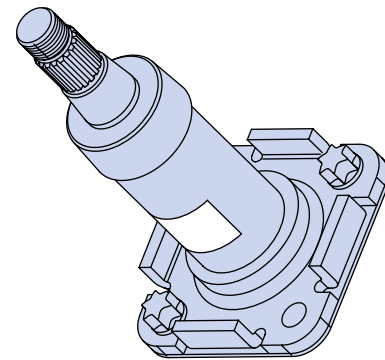
Rated Torsional	81Nm [60 lb-ft]
Rated Bending Moment*	136 Nm [100 lb-ft]
Rated Radial Load**	86 kg [150 lb]
Rated Axial Load	86 kg [150 lb]
Torsional Friction Drag	0,23 kg [2 lb-in]
Recommended Wheel Nut Torque	47 Nm [35 lb-ft]

*Bending moments are taken about the plane of the column mounting surface.

**Radial load at the bearing centerline must not exceed the horizontal bending moment rating.

Five Steps for "How to Order Your Column"

- 1 Select Jacket/Base Type
 - 2 Select Lower Shaft Type
 - 3 Select Upper Shaft End Type
 - 4 Select Length (use suggested standard length)
 - 5 Select Add-On Features
 - a) Horn Wire
 - b) Wire Ends
- Please contact your Eaton Representative if any request differs from our catalog offerings.



Steering Columns

Jacket/Base Type

Example—see model code page 88

Position 4-5

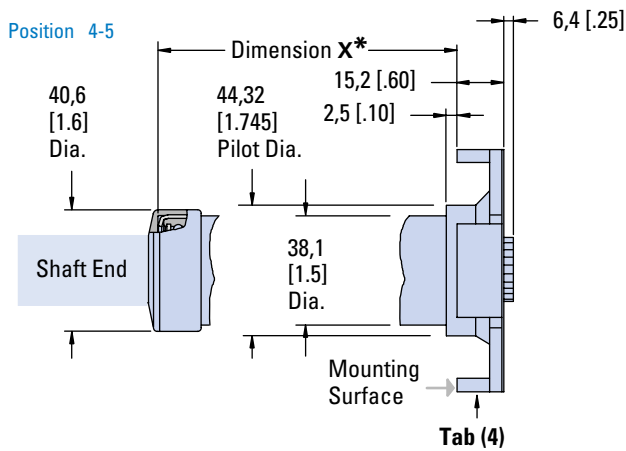
SH Standard with flat flange (No Tabs)

Position 9, 10, 11

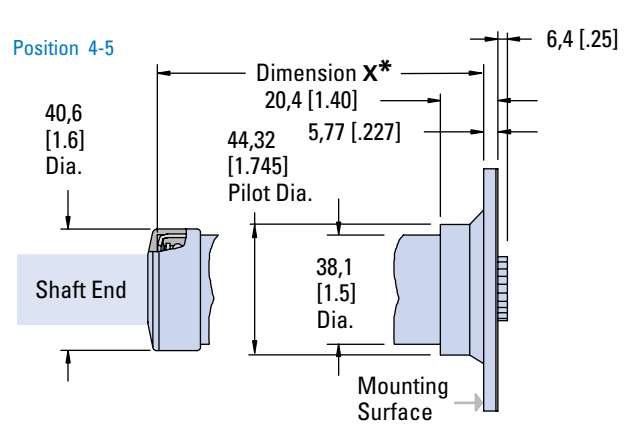
026 66,1 [2.60] (Dimension X)

*Dimension X—see model code page 88 **Position 9, 10, 11** (Jacket Length)

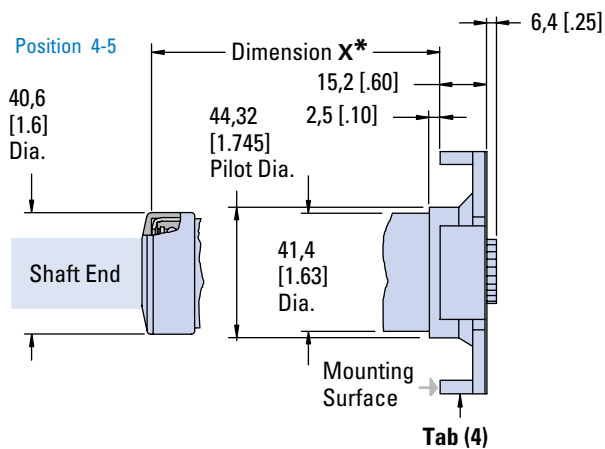
SJ Standard Wall



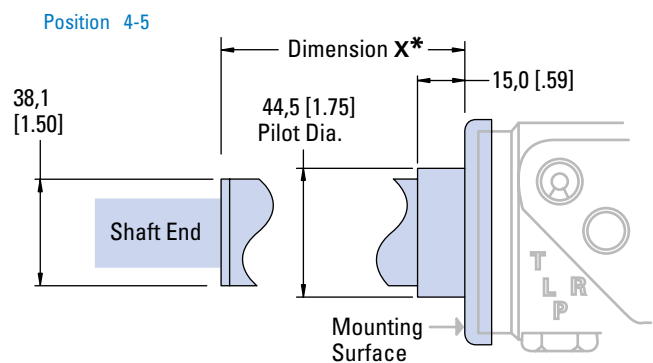
SH Standard Wall



HG Heavy Wall



MM 2 Series



Steering Columns

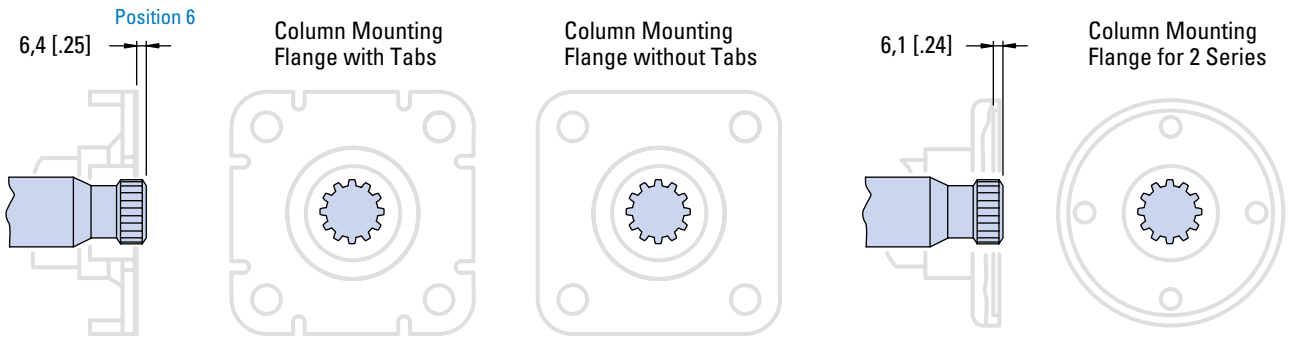
Lower End Type

Example—see model code page 88

Position 6

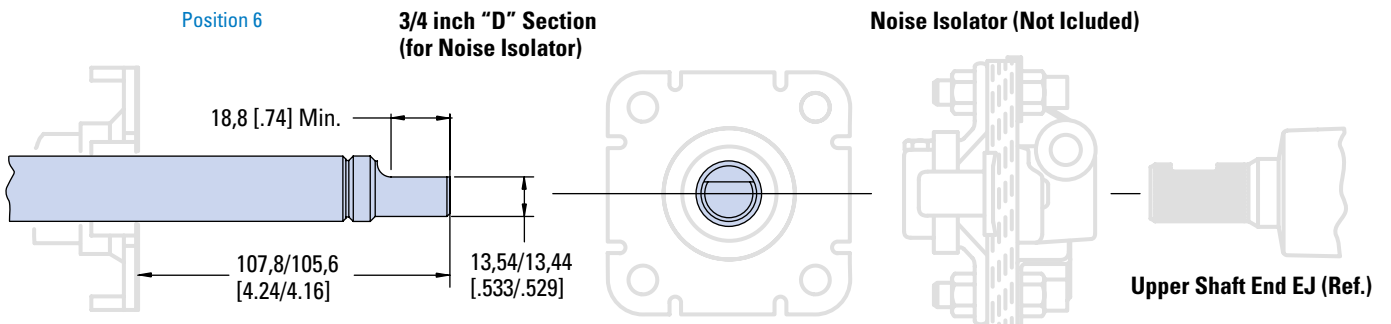
1 12 Tooth Spline for Steering Unit

1

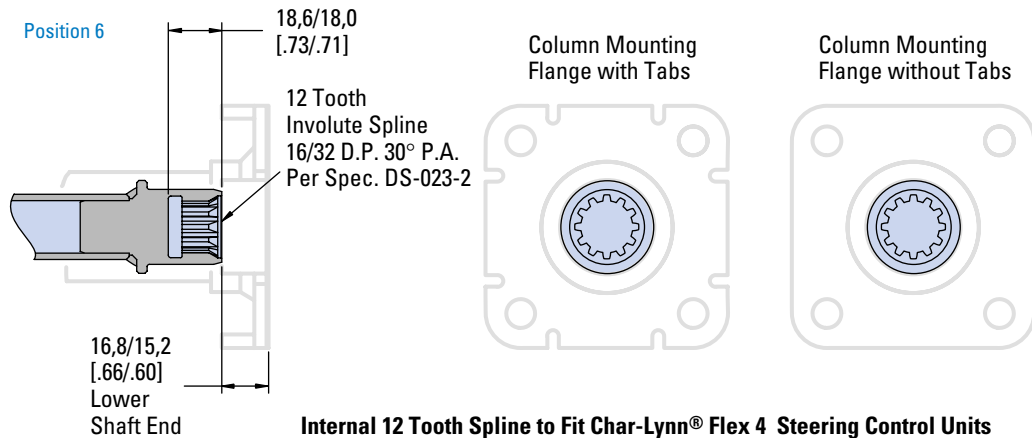


12 Tooth Spline to Fit Char-Lynn® Steering Control Units

3



8



Internal 12 Tooth Spline to Fit Char-Lynn® Flex 4 Steering Control Units

Steering Columns

Upper Shaft End

Example—see model code page 88

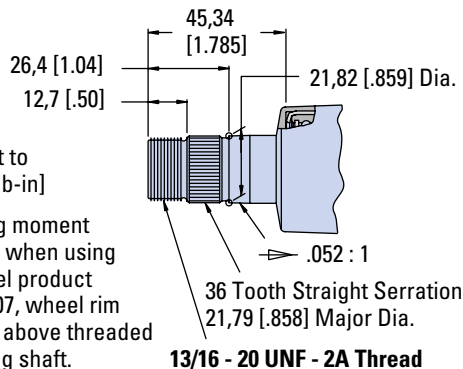
Position 7-8

EJ (36 Tooth Straight Serration)

Not available with horn wire

AJ

Position 7-8

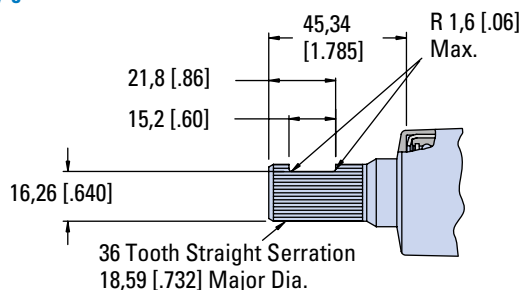


Note: Torque Nut to 41-54 Nm [30-40 lb-in]

For bending moment calculation when using Eaton wheel product No. 209-1007, wheel rim is 22,1 [.87] above threaded end steering shaft.

EJ

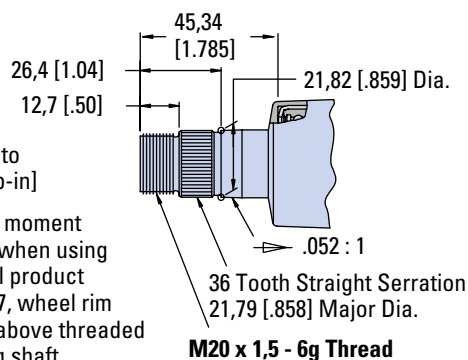
Position 7-8



MJ

Position 7-8

Also Available on Series 2 Column as MK (see page 95)



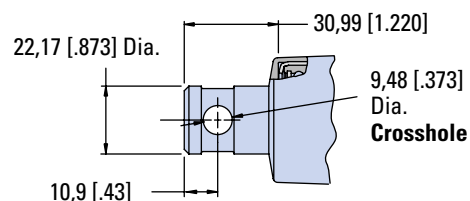
Note: Torque Nut to 41-54 Nm [30-40 lb-in]

For bending moment calculation when using Eaton wheel product No. 209-1007, wheel rim is 22,1 [.87] above threaded end steering shaft.

GC

Position 7-8

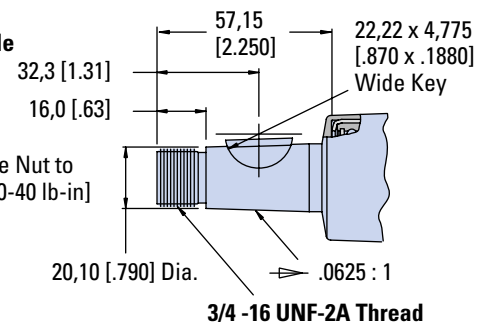
Not Available with Horn Wire



DN

Position 7-8

Not Available with Horn Wire



Note: Torque Nut to 41-54 Nm [30-40 lb-in]

Steering Columns

Upper Shaft End (Continued)

Example—see model code page 88

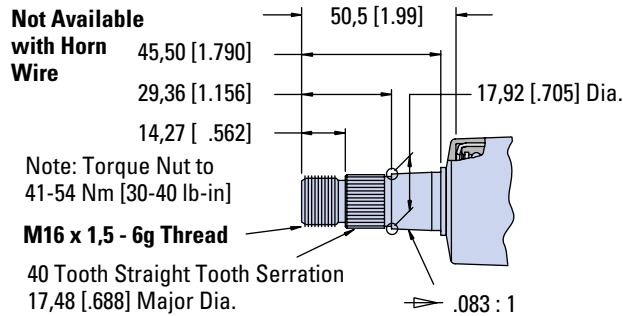
Position 7-8

YM (.050 : 1 Taper M18 x 1,5 - 6g Thread)

Not available with horn wire

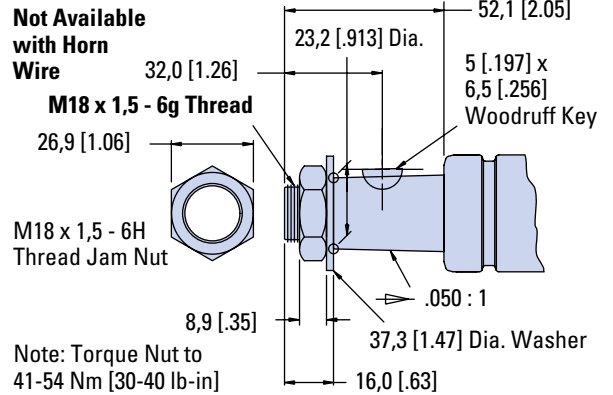
CL

Position 7-8



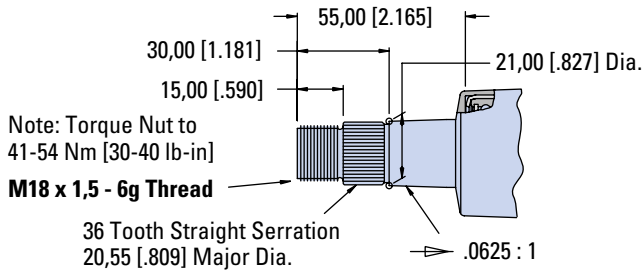
YM

Position 7-8



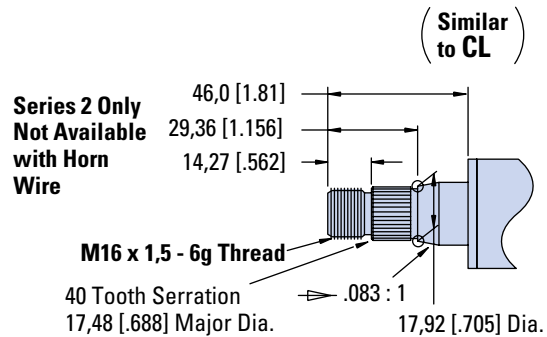
PT

Position 7-8



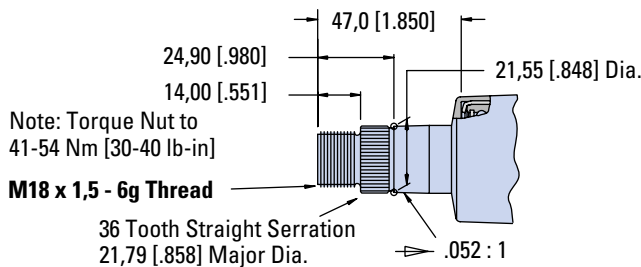
CK

Position 7-8



SV

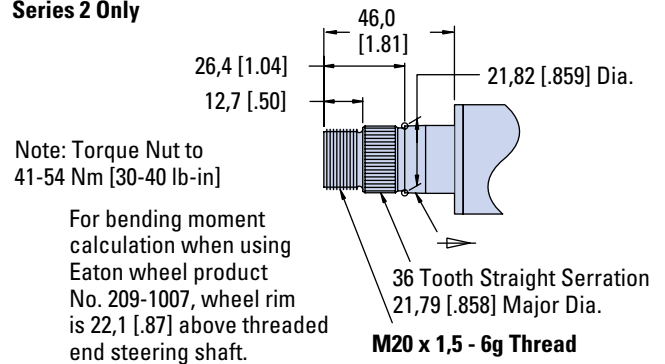
Position 7-8



MK

Position 7-8

Series 2 Only



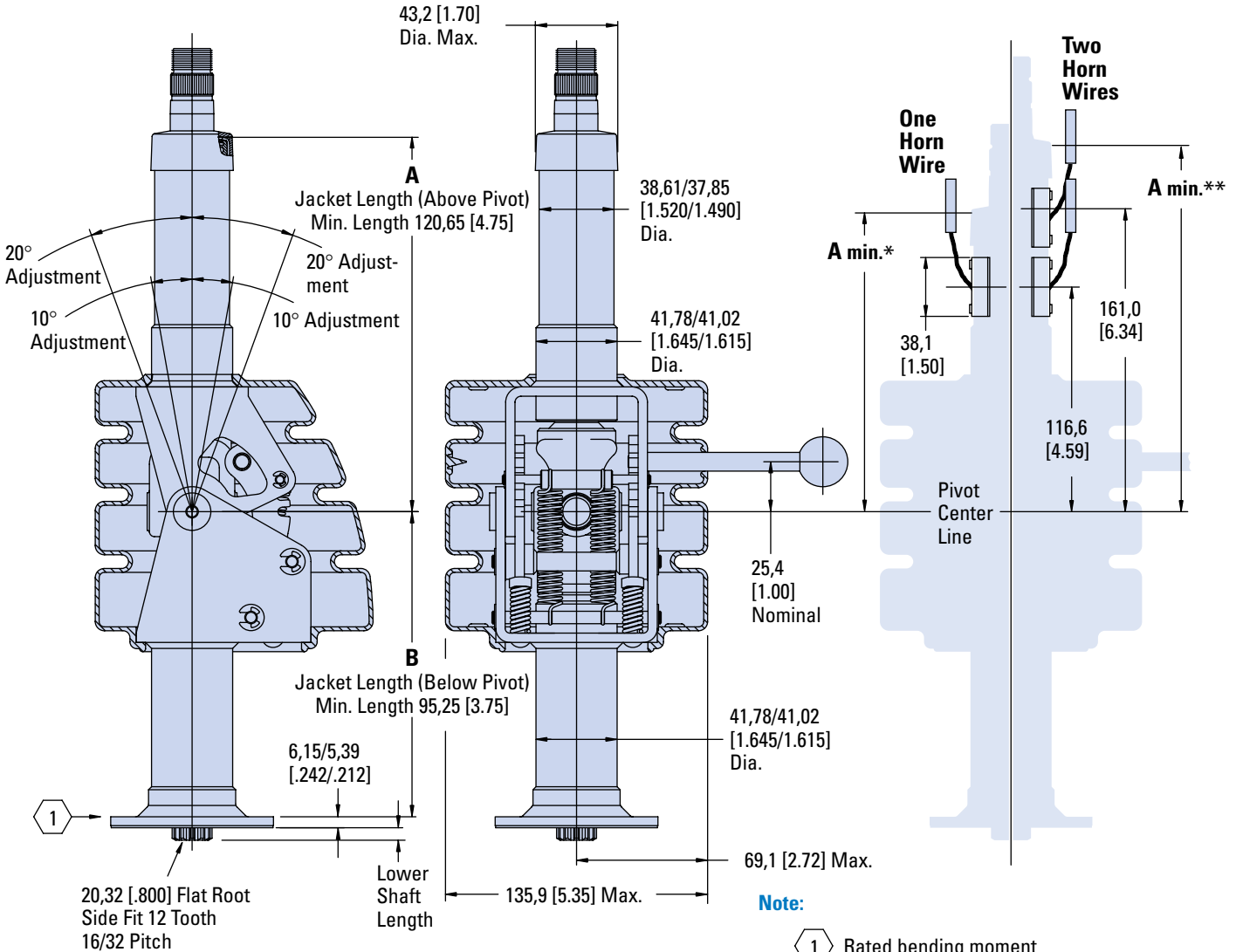
Steering Columns

Tilt Column

Tilt Column—Standard jacket lengths mm [inch]
Dim. A Above Pivot Dim. B Below Pivot

127,0 [5.00]	127,0 [5.00]
190,5 [7.50]	101,6 [4.00]
190,5 [7.50]	546,4 [21.51]

Please contact your Eaton® Representative if any request differs from our catalog offerings. Select add-on features (Position 6 - 21) from the standard column model code (see page 88).



Note:

1 Rated bending moment calculated about point indicated or about centerline of lower column support is 136 Mn [100 lb-ft]. Lever arm for this calculation shall be the distance from point indicated to centerline of radial load.

2 Rated steering shaft torque is 81 Nm [60 lb-ft].

How to Order your Tilt Column:

Model Code — Steering Columns

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
A	C	K	T	A		A	J														A
Position	9	10	11	Dim. A Above Pivot		Dim. B Below Pivot															
	A	A	C	127,0 [5.00]	127,0 [5.00]	190,5 [7.50]	101,6 [4.00]														
	A	A	A	190,5 [7.50]	546,4 [21.51]																

*Dim. A (minimum) above pivot is 165,1 [6.5] (with one horn wire)
 **Dim. A (minimum) above pivot is 203,2 [8.0] (with two horn wires)

Steering Columns— Horn Wire Electrical

Example—see model code page 88

Position 12-16

1A045 Column with one horn wire

Single Wire

01

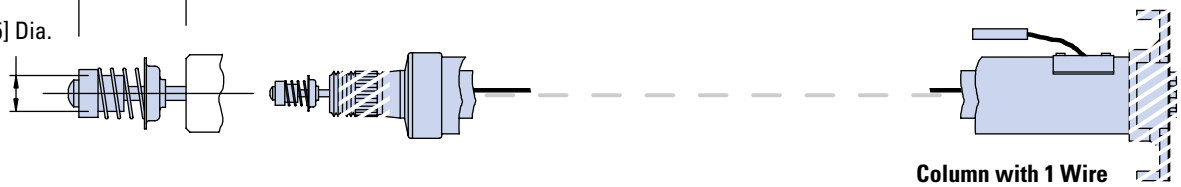
Position 18-19

28,4 [1.12]
9,52 [.375] Dia.

Single Wire

1A045

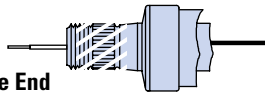
Position 12-16



08

Position 18-19

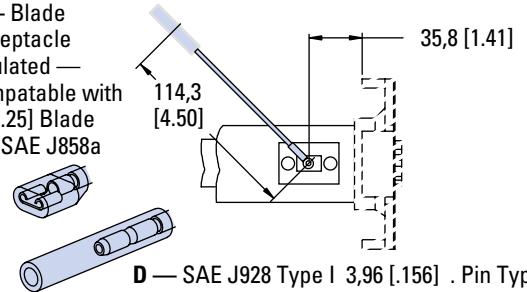
Tinned Bare Wire End



K or D

Position 17

K — Blade
Receptacle
Insulated —
Compatible with
6,4 [.25] Blade
Per SAE J858a



D — SAE J928 Type I 3,96 [.156] . Pin Type
Male Wire End with Double End Female Connector

Two Wire

02

Position 18-19

28,4 [1.12]
9,52 [.375] Dia.

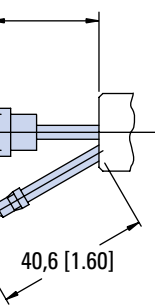
Two Wires

One Horn Button
with Wire Eyelet
(Select with Two Horn Wires)

2B045

Position 12-16

4,8 [.19] Dia.
Stud Eyelet
Type
Wire End

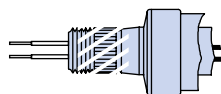


Column with 2 Wires

08

Position 18-19

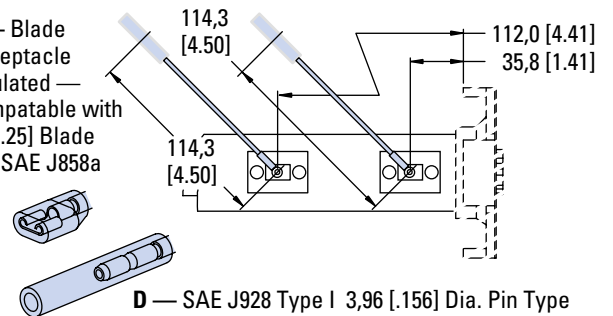
Tinned Bare Wire Ends



K or D

Position 17

K — Blade
Receptacle
Insulated —
Compatible with
6,4 [.25] Blade
Per SAE J858a

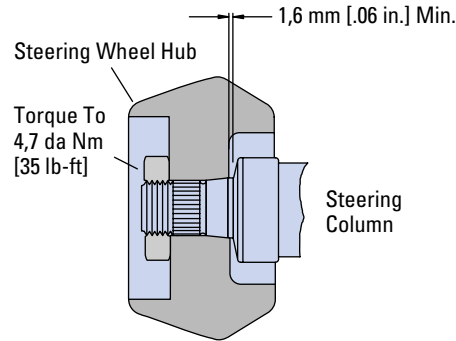


D — SAE J928 Type I 3,96 [.156] Dia. Pin Type
Male Wire End with Double End Female Connector

Column and Wheel Mounting

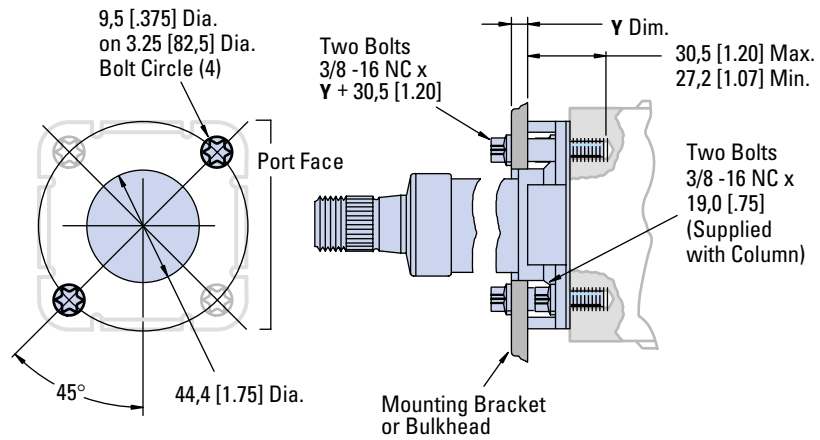
Product Information

Inspect for Minimum Clearance at Assembly



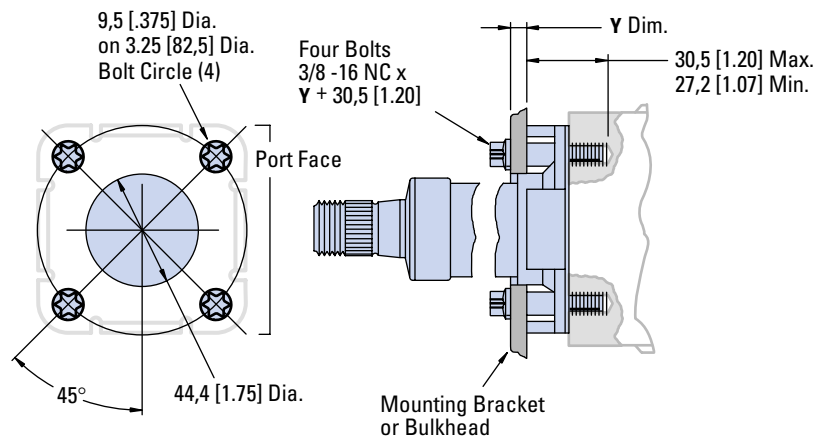
Series 3, 6, 12 and Series 110, 230, 450

Must use two bolts through mounting bracket or bulkhead and two bolts through just the steering column or four bolts through mounting bracket or bulkhead.



Series 20, 25

Must use four bolts through mounting bracket or bulkhead.

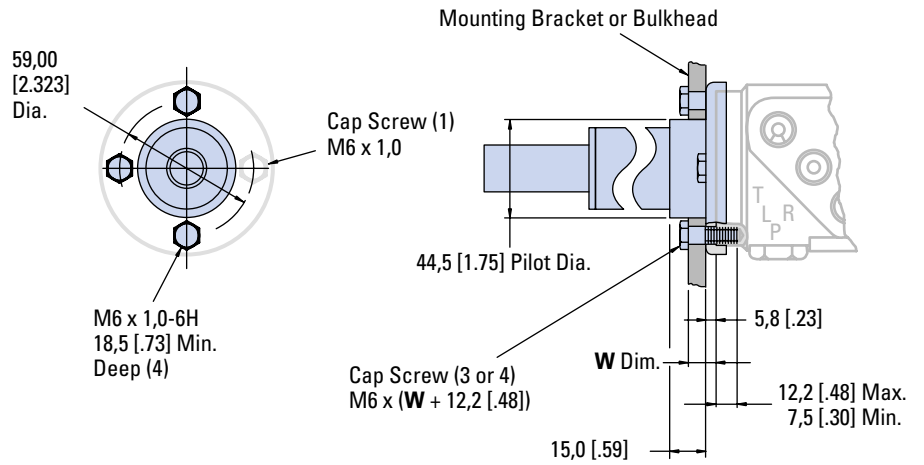


Column Mounting

Product Information

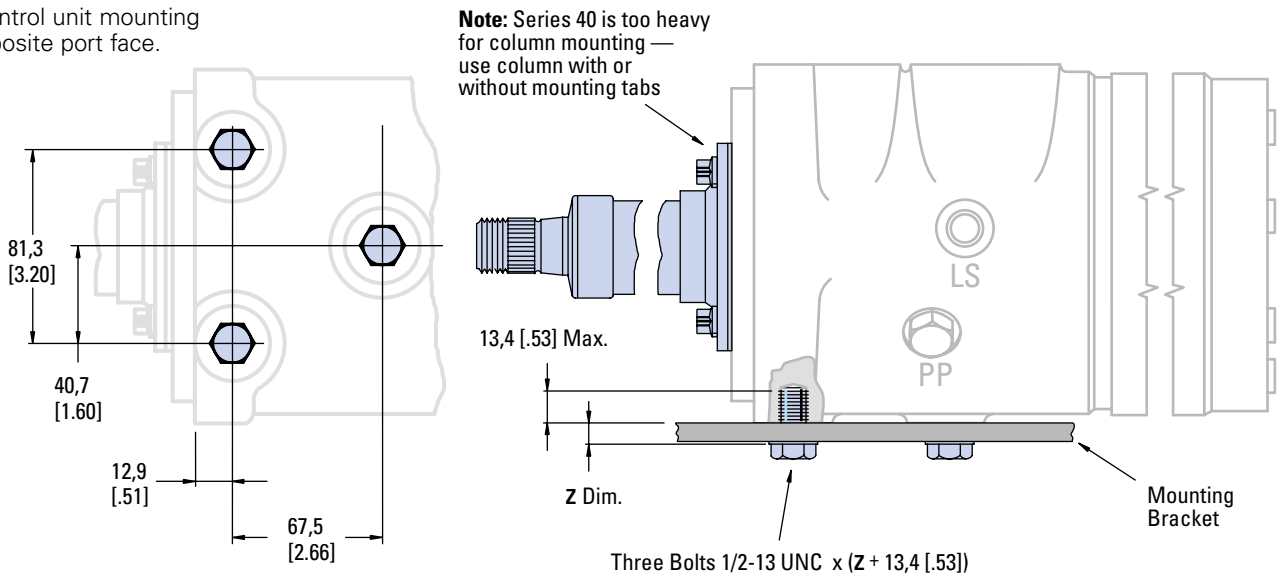
Series 2

Must use three bolts minimum.



Series 40

Must use three bolts into steering control unit mounting bosses opposite port face.



Steering Columns

Model Code Ordering Information

The following 22-digit coding system has been developed to identify all of the configuration options for steering columns. Use this model code to specify a steering column with the desired features. All 22 digits of the code must be present when ordering. You may want to photocopy the matrix below to ensure that each number is entered in the correct box.

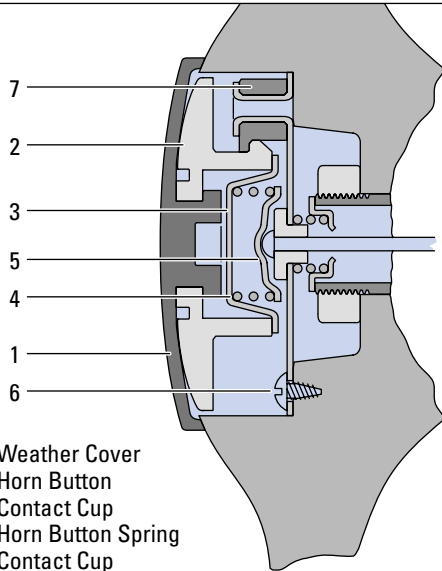
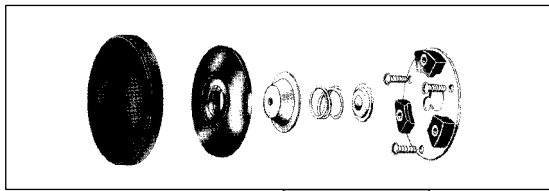
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
A	C	K																	0	0	

Nos	Feature	Code	Description	Nos	Feature	Code	Description				
1,2,3	Product Series	ACK	Steering Column	060		152,4	[6.00]	2 Series Column			
4,5	Jacket/Base Type (page 80)	SJ	Standard (38 mm [1.50 inch] O.D.)	080		203,2	[8.00]				
		MM	Series 2 SCU (38 mm [1.50 inch] O.D.)	100		254,0	[10.00]				
		HG	Heavy Wall (41,4 [1.63 inch] O.D.)	120		304,8	[12.00]				
			Tabbed Flange	140		355,6	[14.00]				
		SH	Standard With flat Flange (38mm [1.50 inch] O.D.) (No Tabs)	160		406,4	[16.00]				
6	Lower Shaft End (see page 81)	1	12 Tooth Spline for Steering Unit	026		66,1	[2.60]		Standard Column without Tabs		
			3/4 inch "D" Section (for Noise Isolator)	036		92,3	[3.63]				
		3	Recessed Internal 12 Tooth Spline (for Flex 4 Steering Unit)	062		157,3	[6.19]				
					081		206,6			[8.13]	
		8				103		260,2		[10.24]	
						111		282,8		[11.13]	
						121		308,2		[12.13]	
						162		409,3		[16.11]	
						182		461,1		[18.15]	
						257		651,6		[25.65]	
7,8	Upper Shaft End (see illustrations and specifications page 82, 83)	AJ	Standard for all rigid and tilt columns Available with or without Horn Wire	276		701,9	[27.63]	Tilt Column Page XXX			
		MJ	Available with or without Horn Wire	302		765,9	[30.15]				
		DN	Not Available with Horn Wire	329		835,7	[32.90]				
		EJ	Not Available with Horn Wire	AAA		190,5	[7.50] Above Pivot				
		GC	Not Available with Horn Wire			546,4	[21.51] Below Pivot				
		CL	Not Available with Horn Wire	AAB		190,5	[7.50] Above Pivot				
		PT	Available with or without Horn Wire			101,6	[4.00] Below Pivot				
		SV	Available with or without Horn Wire	AAC		127,0	[5.00] Above Pivot				
		YM	Not Available with Horn Wire			127,0	[5.00] Below Pivot				
		CK	Not Available with Horn Wire								
9,10,11	Jacket Length mm [in.] (Suggested Std. Dim.) (page 80)	022	56,6 [2.23]	Series 2	12-16	Horn Wire Feature (page 85)	00000	No Horn Wire	Standard Column with Tabs		
		033	82,8 [3.26]				1A045	Single Horn Wire			
		058	147,8 [5.82]				2B045	Two Horn Wires			
		078	197,1 [7.76]		17	Horn Brush Wire Terminal End (page 85)	0	None—Select When No Horn Wire Used			
		099	250,7 [9.87]				D	SAE J928 Pin and Double End Connector			
		108	273,3 [10.76]				K	Blade Receptacle—Insulated (Compatible with SAE J858a)			
		118	298,7 [11.76]				18,19	Shaft End Wire Terminal (page 85)		00	None
		157	399,8 [15.74]							01	One Horn Button (Only with One Horn Wire)
		178	451,6 [17.78]							02	One Horn Button with Wire Eyelet (Select with Two horn Wire)
		253	642,1 [25.28]								Tinned Bare Wire End
		273	692,4 [27.26]							08	
		298	756,4 [29.78]							20,21	Special Feature
		325	826,3 [32.53]				22	Eaton Assigned Design Code			

Steering Columns

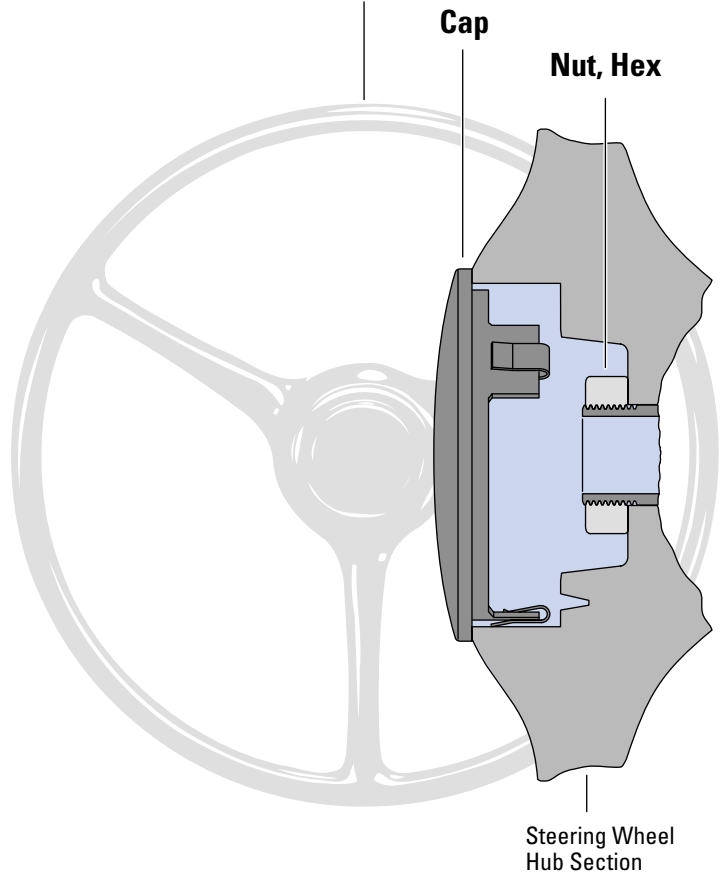
Auxiliary Column Equipment

Horn Button Kit



- 1 Weather Cover
- 2 Horn Button
- 3 Contact Cup
- 4 Horn Button Spring
- 5 Contact Cup
- 6 Screw
- 7 Base Plate Assembly

Steering Wheel



Steering Wheel No. 209-1007

Molded black wheel with three equally spaced spokes, (relatively flat, without recessed hub) diameter 430 mm [17 inch] for column with upper shaft end AJ or MJ.

Note: Steering wheel hub has tapped holes for wheel puller.

Horn Button Kit No. 208-1013

For Char-Lynn® steering column with serrated upper shaft end AJ or MJ and Char-Lynn® 430 mm [17 inch] steering wheel.

Cap No. 209-1005

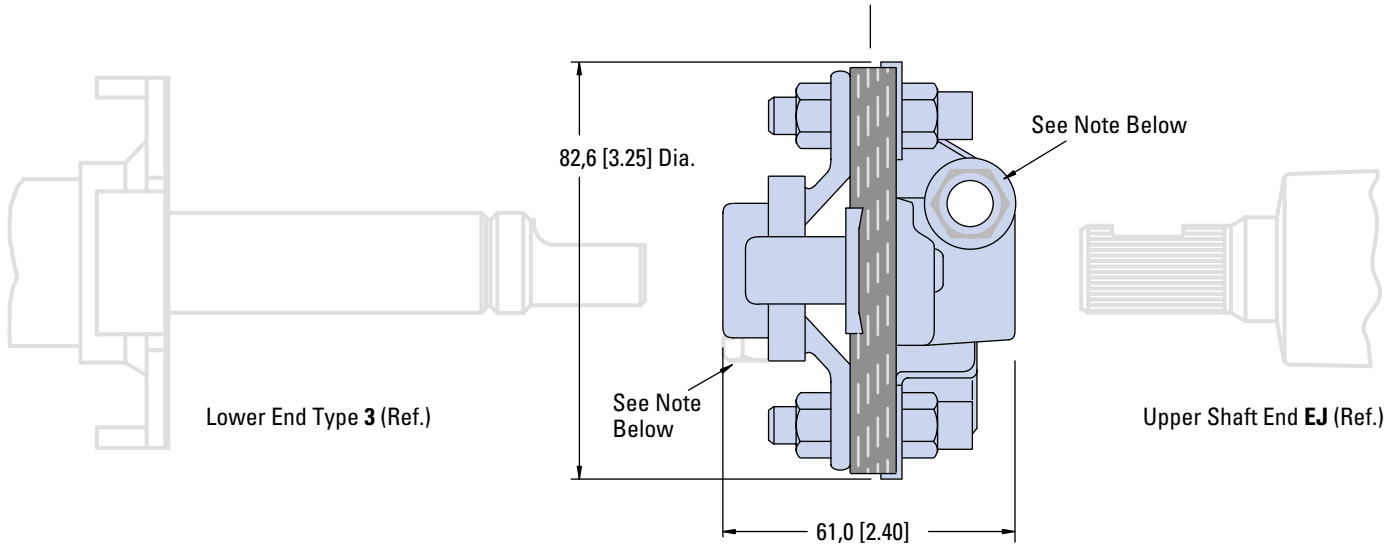
Char-Lynn® steering wheel hub cavity cap, for no horn installations.

Nut, Hex Part Number	Upper Shaft End Configuration (See Page xx, xx)	Thread Size
14517	PT, SV	M18 x 1,5
14593	MJ	M20 x 1,5
14603	CK, CL	M16 x 1,5
21084	AJ	13/16-20 UNF

Steering Columns

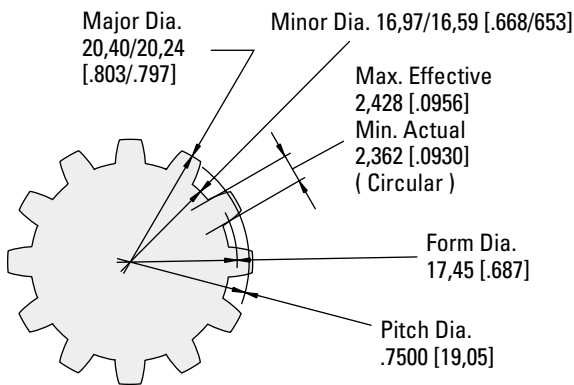
Auxiliary Column Equipment

This Noise Isolator is Available from Eaton—Part Number 208-1017-002



Note: Two screws (3/8-24 UNF x 31,8 [1.25] long — **not included**) are required to join isolator to mating steering columns. Torque screws to 41 Nm [360 lb-in].

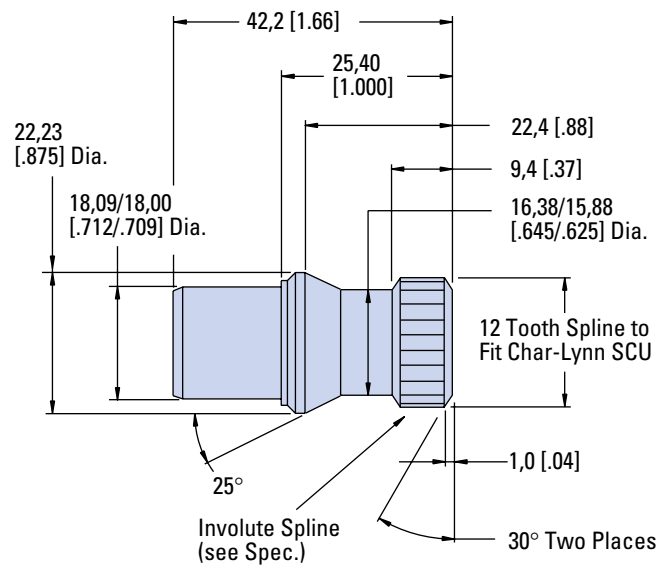
Want to Make your Own Column? You Must use these Spline Specs. Lower Shaft End



Fit	Flat Root Side Fit
Number of Teeth	12
Pitch	16/32
Pressure Angle	30°
Class of Fit	Special
Circular Tooth Thickness	
Max. Effective	2,428 [.0956]
Min, Actual	2,362 [.0930]

Splined End—AISI 8620 Mt'l Case hardened to RC 40-50

This Splined Lower Shaft End Part (as shown below) is Available from Eaton—Part Number 8063



12 Tooth Spline Specification (left)

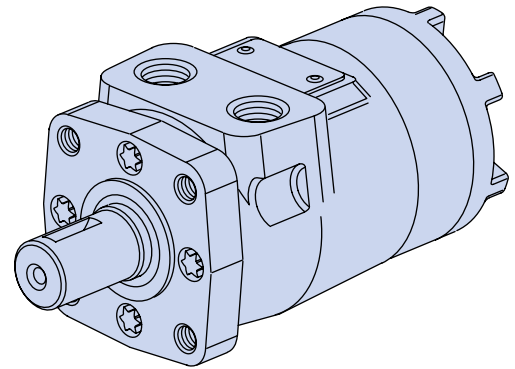
Can be press fit and welded into a 22,22 [.875] OD x 2,16 [.085] wall steel tube.

Steering System— T Series Hydraulic Motors

Product Description

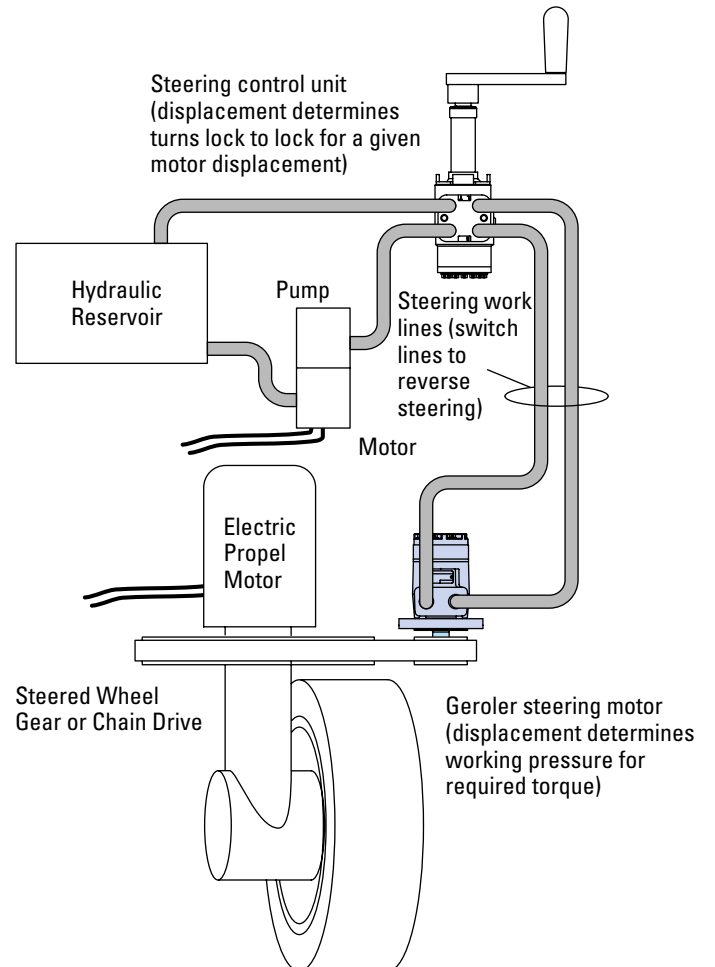
Char-Lynn® T Series low speed, high torque Geroler® motor developed with low speed/low leakage valving specifically for steering applications (see Catalog 11-885 General Purpose Motors H, S, and T Series page 39 Code AB, Position 11-12).

Pressure Capability	
Continuous	155 bar [2250 PSI]
Intermittent	190 bar [2750 PSI]
Speeds	
	up to 1055 RPM
Torque	
Continuous	440 Nm [3905 lb-in]
Intermittent	510 Nm [4515 lb-in]
11 Displacements	
to	36 cm ³ /r [2.2 in ³ /r]
	370 cm ³ /r [22.6 in ³ /r]



Comprehensive T Series Motor Description

(See Char-Lynn General Purpose Motors H, S, T Series Cat. 11-885)



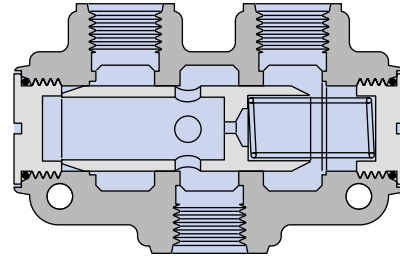
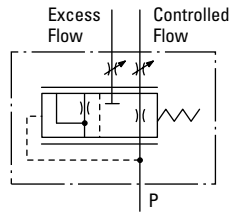
Steering System Components

Flow Divider Valves

Model 32306 Priority Flow Divider

Specifications

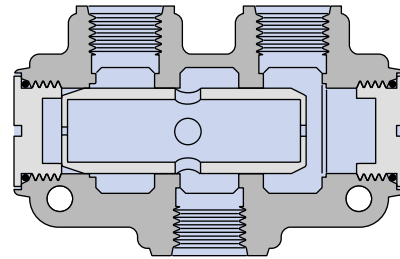
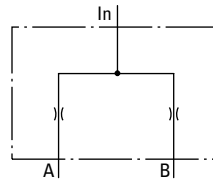
Rated Input Flow	96,6 l/min [25 GPM]
Rated Pressure	172,4 bar [2500 PSI]
Max. Pressure Drop Through Valve at Rated Input Flow	4,5 bar [65 PSI]



Model 32501 Proportional Flow Divider

Specifications

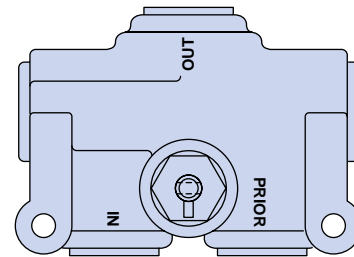
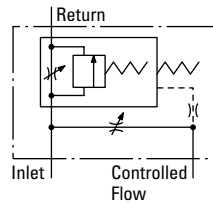
Rated Input Flow	113,6 l/min [30 GPM]
Rated Pressure	172,4 bar [2500 PSI]
Max. Pressure Drop Through Valve at Rated Input Flow	8,6 bar [125 PSI]



Model 32700 Variable Priority Flow Control

Specifications

Rated Input Flow	75,7 l/min [20 GPM]
Rated Pressure	172,4 bar [2500 PSI]
Max. Pressure Drop Through Valve at 56,8 l/min [15 GPM] Input	4,0 bar [48 PSI]
Max. Controlled Flow	36,0 l/min [9.5 GPM]
Controlled Flow Adjustment Range	5,7 - 36,0 l/min [1.5 - 9.5 GPM]
Relief Valve Factory Setting	151,7 bar [2200 PSI] at 36,0 l/min [9.5 GPM]



Comprehensive Flow Divider Description

(see Eaton Flow Divider Catalog 11-508)

Steering System Components

Brake Valve

Product Description

Eaton® Hydraulics' new load-sensing brake valve makes power brakes an economical and efficient feature on lift trucks.

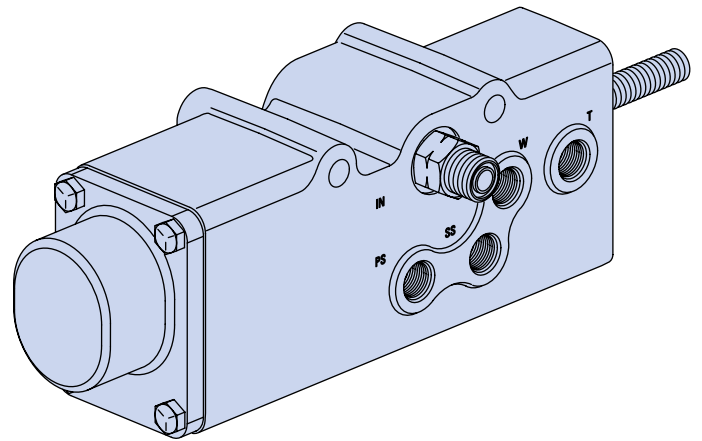
While power brakes in lift trucks can aid productivity, incorporating them into lift trucks has traditionally been expensive. The need for additional flow meant extra plumbing, plus the addition of a dedicated pump or a high pressure accumulator for the brake circuit. The increased system size also meant extra demand on the engine, resulting in reduced fuel economy.

The Eaton brake valve provides a better solution. Used in conjunction with load-sense steering and a priority valve, it can work with an existing system. A dedicated flow source is not required. It also ensures that brakes and steering have priority over the hoist circuit.

Eaton's new brake valve has a shuttle in the sensing port which allows the priority valve to determine whether brakes or steering require higher pressure. The priority valve then shifts to provide adequate flow and pressure for the function with the greatest needs. An integral pressure-compensated flow limiter provides low flow for brake modulation. This feature of the brake valve allows simultaneous braking and steering without steering interruption or pedal kick.

The design of the circuit also increases efficiency. The control flow line of the circuit is connected in parallel to both the brake valve and the steering unit. Thus, brake and steering pressures are not additive during simultaneous operation. The existing steering pressure is usually enough to provide full power braking.

Another feature of the Eaton brake valve is that it accommodates dead engine braking. The valve contains a large internally cored area that acts as a reservoir, providing oil for brake actuation in the manual mode. The valve design allows the volume and pressure required for manual braking to be generated without excessive pedal force. Thus, the load-sensing brake valve offers the benefits of powered brakes and manual brakes in a single package, eliminating the need for an accumulator.



Features

- No dedicated pressure source (separate pump or accumulator) required when the Eaton Power Brake Valve is used
- Reduces plumbing requirements
- Efficient—no parasitic loss
- Self-contained compact package
- Two-stage master cylinder with built-in reservoir provides dead-engine braking
- Lower input efforts and reduced pedal travel for braking
- Optional pilot operated check valve

Specifications—Valve

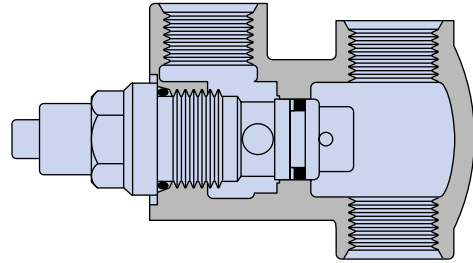
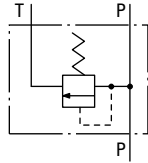
Max. Rated Pressure	205 bar [3000 PSI]
Rated Flow	11 l/min [3.0 GPM]

Steering System Components— Relief Valves

Model 32107 In-Line Relief Valve—Direct Acting Cartridge

Specifications

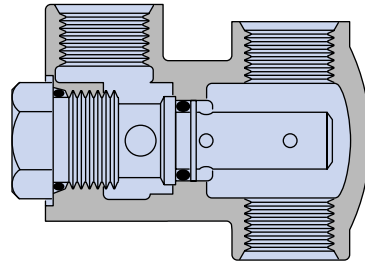
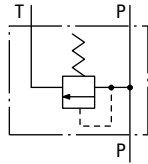
Max. Flow Through Relief Valve	57 l/min [15 GPM]
Relief Valve Setting Range	47–276 bar [675–4000 PSI]
Standard Relief Valve Setting	138 bar [2000 PSI]
Housing Rated Pressure	345 bar [5000 PSI]



Model 32107 In-Line Relief Valve—Pilot Operated Cartridge

Specifications

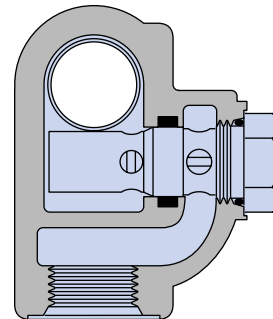
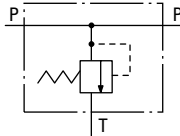
Max. Flow Through Relief Valve	75,7 l/min [20 GPM]
Relief Valve Setting Range	103–241 bar [1500–3500 PSI]
Housing Rated Pressure	345 bar [5000 PSI]



Model 32112 In-Line Relief Valve

Specifications

Max. Flow Through Relief Valve	132,5 l/min [35 GPM]
Relief Valve Setting Range	69–241 bar [1000–3500 PSI]
Housing Rated Pressure	345 bar [5000 PSI]



Comprehensive Relief Valve Description

(see Eaton Relief Valve
Catalog 11-510)

Steering System Components— Gear Pump Series 26

Product Description

Eaton®'s Hydraulics Division has produced gear pumps and motors for many years and has continually improved and upgraded this product line to keep up with the demands of the marketplace. The Series 26 high pressure gear pump is the newest addition to this popular product line.

In developing this new series of gear pumps, Eaton engineers made several significant design changes that have resulted in improved efficiency and quiet operation. The method of lubricating the inlet bearing helps to improve volumetric efficiency for more power output. More power also goes into the pump because of the super polished shaft and gears. This feature also adds to the service life and reliability of the pump. The 13 tooth gears minimize flow ripple that, in turn, reduces noise and vibration.

Features

Quiet Operation

- The 13-tooth gears, versus 10 teeth in previous pumps, minimizes the flow ripple. This reduces noise as well as vibration.
- The improved trap reliefs not only increase power, they also help keep oil flowing smoothly to reduce noise.

Improved Efficiency

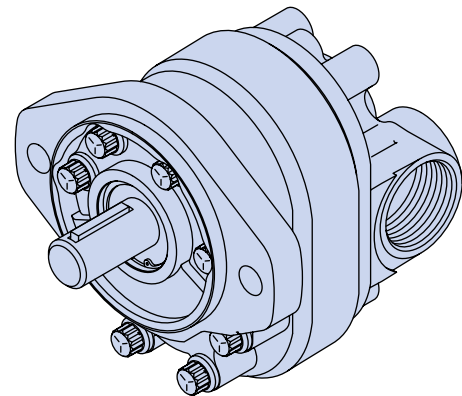
- Improved bearing lubrication system uses inlet oil instead of high pressure oil, improving volumetric efficiency for more power output.
- The super polished shaft and gears improve mechanical efficiency and reduce wear on these components, adding to the service life and reliability of the pump.
- The optimized trapped oil relief areas help reduce pressure ripple for quieter operation. This also decreases the input power requirements.

Field Reversible

- The innovative new wear plate permits simple field reversibility of the pump direction. Simply open the pump, switch the drive gear and idler gear, reposition the plug and reassemble. No extra parts are needed.

Interchangeability

- The Series 26 gear pump has been designed to retrofit equipment using the B1 and B2 gear pumps. Extra shafts, porting, and mounting configurations, as well as 13 available displacements, give you the choices you need for an easy conversion to this superior pump.



GENERAL SPECIFICATIONS

Displacements (13) from	6,6 cm ³ /r [.40 in ³ /r]
to	30,6 cm ³ /r [1.87 in ³ /r]
Mounting Flange	SAE 2 Bolt A
Max. Continuous Pressure	207 bar [3000 PSI]
Max. Intermittent Pressure	241 bar [3500 PSI]
Min. Speeds at Continuous Pressure	750 RPM
Max. Rotating Torque at 0 Pressure	4 Nm [36 lb-in]
Max. Continuous Inlet Temperature	107°C [225°F]
Min. Operating Temperature	-29°C [-20°F]
Max. Inlet Vacuum at Operating Conditions	6.0 in. Hg

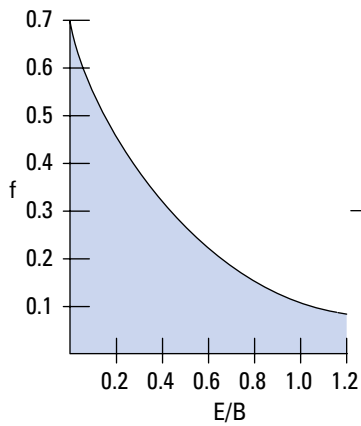
Comprehensive Series 26 Pump Description

(see Eaton Gear Pumps Series 26 Model 26000 Catalog 11-609)

Sizing and Application—

Ackerman Type Steering

Step One: Kingpin Torque



Typical values based on rubber tired vehicles on dry concrete.

$$T = w \cdot f \sqrt{\frac{B^2}{8} + E^2}$$

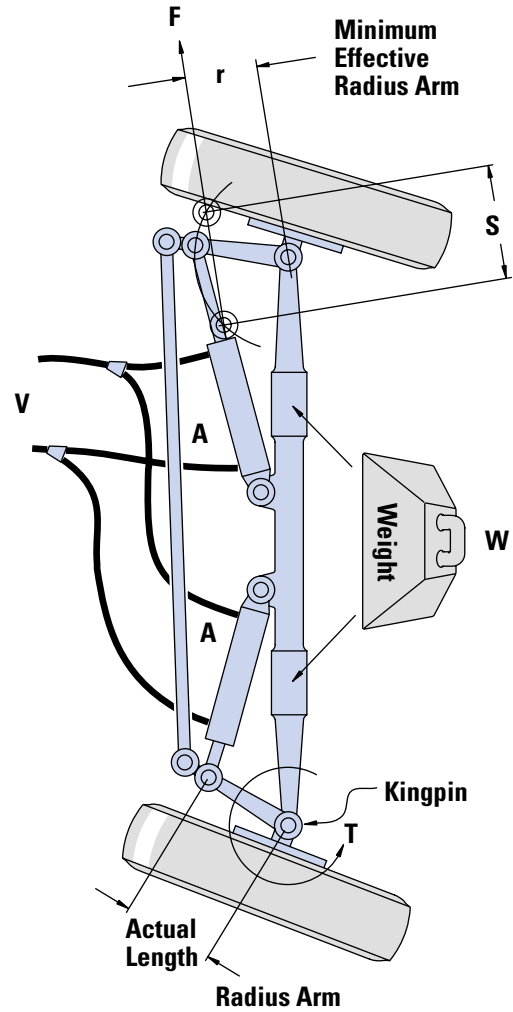
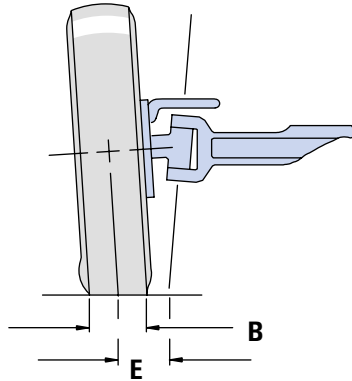
T = Total Kingpin Torque required to steer axle.

W = Vehicle Weight supported by the steered axle.

f = Coefficient of friction (dimensionless). Based on 0.7 as a Maximum. Determine from chart at left.

B = Nominal width of the tire print (see diagram above).

E = Kingpin Eccentric (use nominal tire width).



Sizing and Application

Ackerman Type Steering Continued

Step Two:

Force Required

$$F = \frac{T}{r}$$

F = Force required for the axle.

T = Kingpin torque as determined in Step 1.

The value calculated in Step 1 is the total torque for the axle. If the steered axle is power driven, double this value to approximate the additional dynamic loads.

r = Effective radius arm about the kingpin axis at which the cylinder force is applied. The effective radius is the minimum distance from kingpin to the axis of the cylinder ... not the actual length of the arm.

Cylinder Area

$$A = \frac{F}{P}$$

A = Cylinder area for the axle cylinder set.

F = Force required

P = Hydraulic pressure

For vehicle with a steered axle that can never be overloaded use 80% of the steering circuit relief valve setting. For manually loaded vehicles use 60%. For vehicles that can be severely overloaded use 30%.

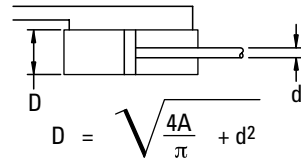
Cylinder Diameter

Once the required cylinder set area is determined, the cylinder diameter can be calculated.

D = Inside diameter of cylinder.

d = Rod diameter as required.

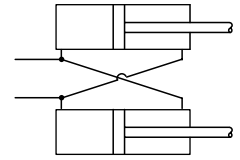
Differential Cylinder



$$D = \sqrt{\frac{4A}{\pi} + d^2}$$

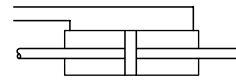
Note: $\left(\frac{d}{D}\right)^2 \leq .15$

Cross Connected Cylinder



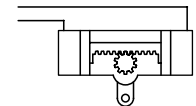
$$D = \sqrt{\frac{2A}{\pi} + \frac{d^2}{2}}$$

Balanced Cylinder



$$D = \sqrt{\frac{4A}{\pi} + d^2}$$

Opposed Cylinder



$$D = \sqrt{\frac{4A}{\pi}}$$

Cylinder Stroke

S = Stroke Length

The cylinder stroke is determined by axle geometry. That is, the required stroke is a function of the radius arm and the total angle through which the arm turns.

Differential Cylinder (Large Volume)

$$V = S \times \frac{\pi}{4} \times D^2$$

Differential Cylinder (Small Volume or Balanced Cylinder)

$$V = S \times \frac{\pi}{4} (D^2 - d^2)$$

Cross Connected Cylinder

$$V = S \times \frac{\pi}{4} (2D^2 - d^2)$$

Cylinder Volume

$$V = \text{Volume} \quad V = S \times A$$

The volume of oil required to move cylinder rod(s) through the entire stroke.

Sizing and Application

Ackerman Type Steering Continued

Step Three:

Selecting Steering Unit Displacement

Before proceeding further, a decision must be made as to the number of steering wheel revolutions desired for the application to steer the axle from full one side to the other. Depending on vehicle usage, this will vary, normally 2 1/2 to 5 1/2 with 4 being a good typical value

$$\text{Displ.} = \frac{V}{N}$$

V = Volume full stroke

N = number of steering wheel revolutions lock to lock

Once this calculation is complete, select the closest standard steering unit displacement from the catalog information.

Now the number of steering wheel revolutions should be recalculated.

$$N = \frac{V}{\text{displ.}}$$

displ. = Steering unit displacement per revolution.

Note: for different cylinder applications, the cylinder volume will be different for right and left turns and the value N will vary accordingly.

Step Four:

Calculating Required Pump Flow

Pump sizing is important to assure adequate power for steering under all operating conditions. The required pump flow can be calculated by the following equation.

$$Q_P = R_{\text{max.}} \times \text{displ.}$$

Q_P (L/min): Required pump flow.

$R_{\text{max.}}$ = Max. steering wheel input of steering control unit (SCU).

displ. = Displacement of steering control unit per revolution.

Before proceeding to evaluation required pump flow the maximum required steering wheel speed must be determined. Typically 120 revolutions per minute (RPM) is used for $R_{\text{max.}}$

- It is important at engine low idle condition that the maximum steering wheel speed should be more than 60 rpm.
- For engine normal idle condition, maximum steering wheel speed should be more than 100 rpm if possible.
- When using open center SCU connected with pump directly, maximum pump flow should be less than 1.4 times of SCU rated flow. Higher flow into SCU increases pressure-loss of the steering system. If higher flow is unavoidable, install a flow divider valve into the system or use a load sensing system.

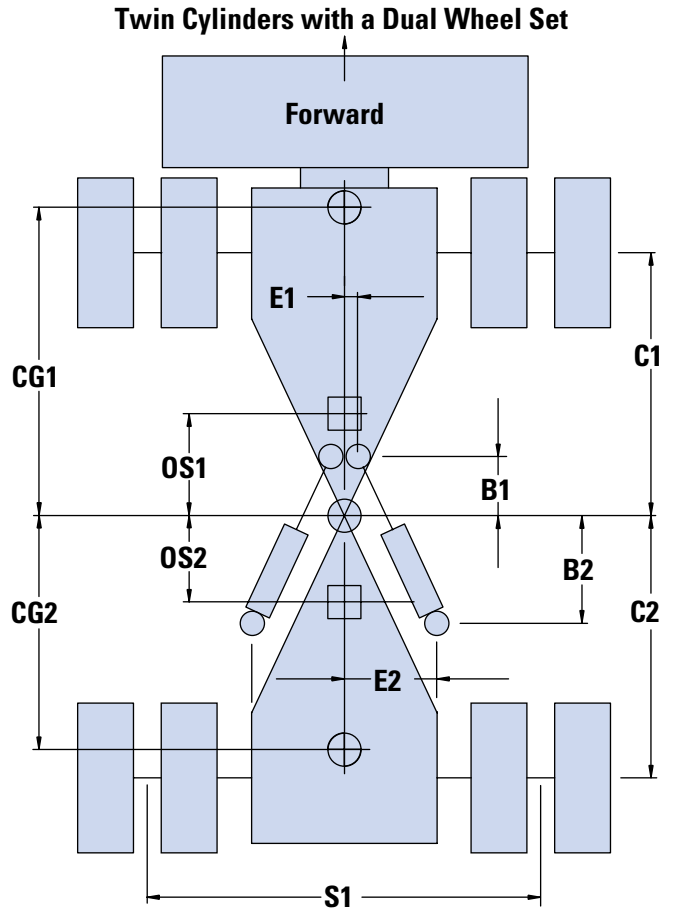
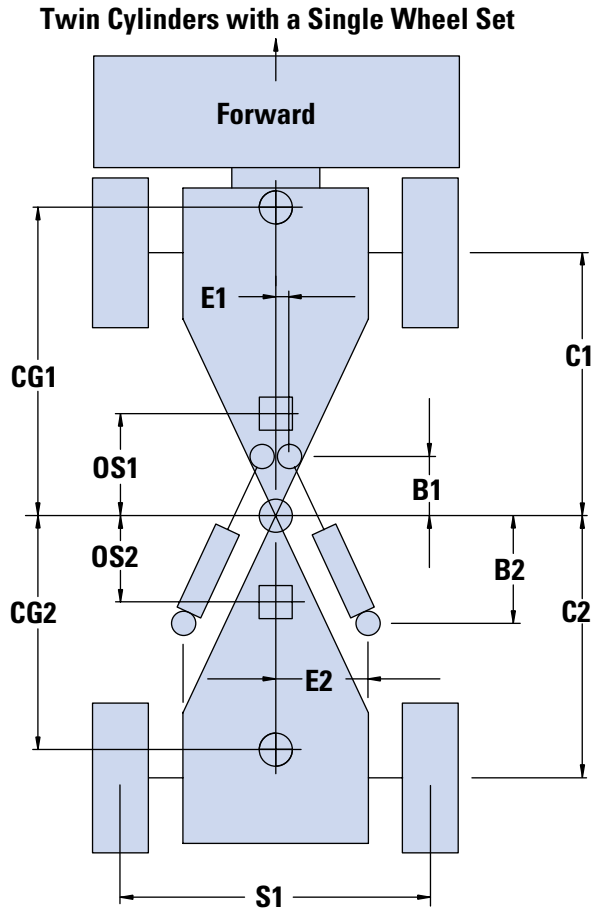
Sizing—Articulated Type Steering

Eaton®'s Hydraulic Division has developed a computer program to assist articulated vehicle designers with a steering system analysis. This analysis can provide basic system sizing, pressure requirements or a complete system analysis including dynamic characteristics.

This analysis is intended to be used as a guide only and is not to be used solely as the final determination of system design. Other factors and variables will have to be considered.

To receive output from this program, provide the required information by using the form on the following page. Contact an Eaton Hydraulics Division Sales Representative or send it to:

Marketing Product Manager—Steering
Eaton Hydraulics
14615 Lone Oak Rd.
Eden Prairie, MN 55344



Sizing—Articulated Vehicle Steering Analysis

Clip out this form or photocopy when needed.

Manufacturer _____

Vehicle Type _____

Model Number _____

Completed By _____ Date _____

Indicate Unit of Measurement Used _____

- | | |
|---|---|
| 1. Turns Lock to Lock _____ | 22. Articulation Angle (lock to lock) _____ |
| 2. Time Lock to Lock _____ | 23. Steering Circuit Line Size, Lengths, Type, Location (please note on schematic ref. 10.) _____ |
| 3. Max. Steering Wheel RPM _____ | 24. Is Steering Through Brakes Statically Required? _____ |
| 4. Cylinder Rod Diameter _____ | 25. Are Locking Differentials Used? Front _____ Rear _____ Both _____ |
| 5. Cylinder Bore Diameter _____ | 26. Is There A Differential Between the Front and Rear Differentials? Yes _____ No _____ |
| 6. Cylinder Stroke _____ | 27. CG1 (Center of Gravity) _____ |
| 7. Pump: GPM Hi Idle _____
GPM Lo Idle _____ | 28. CG2 (Center of Gravity) _____ |
| 8. Steering Relief Pressure _____ | 29. OS1 (Operator Seat) _____ |
| 9. Auxiliary Relief Pressure _____ | 30. OS2 (Operator Seat) _____ |
| 10. Hydraulic Schematic (attach) _____ | 31. Weight - Front Bogey _____ |
| 11. B1 _____ | 32. Weight - Rear Bogey _____ |
| 12. B2 _____ | 33. I1 Mass Moment of Inertia (about CG1) Front _____ |
| 13. C1 _____ | 34. I2 Mass Moment of Inertia (about CG2) Rear _____ |
| 14. C2 _____ | 35. Tire Size _____ Pressure _____
Width _____ Ballast _____ |
| 15. E1 _____ | |
| 16. E2 _____ | |
| 17. S1 _____ | |
| 18. Weight - Front Axle Unloaded _____ | |
| 19. Weight - Rear Axle Unloaded _____ | |
| 20. Weight - Front Axle Loaded _____ | |
| 21. Weight - Rear Axle Loaded _____ | |

NOTE:

- 1-10** Should always be completed; this information is needed for basic steering system sizing.
- 1-26** Needed for sizing and an analysis of steering pressure characteristics.
- 1-35** Needed for a full steering system analysis including dynamic characteristics.

Sizing—Articulated Vehicle Steering Analysis

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| 13. C1 _____ | 35. Tire Size _____ Pressure _____ |
| 14. C2 _____ | Width _____ Ballast _____ |
| 15. E1 _____ | |
| 16. E2 _____ | |
| 17. S1 _____ | |
| 18. Weight - Front Axle Unloaded _____ | |
| 19. Weight - Rear Axle Unloaded _____ | |
| 20. Weight - Front Axle Loaded _____ | |
| 21. Weight - Rear Axle Loaded _____ | |

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