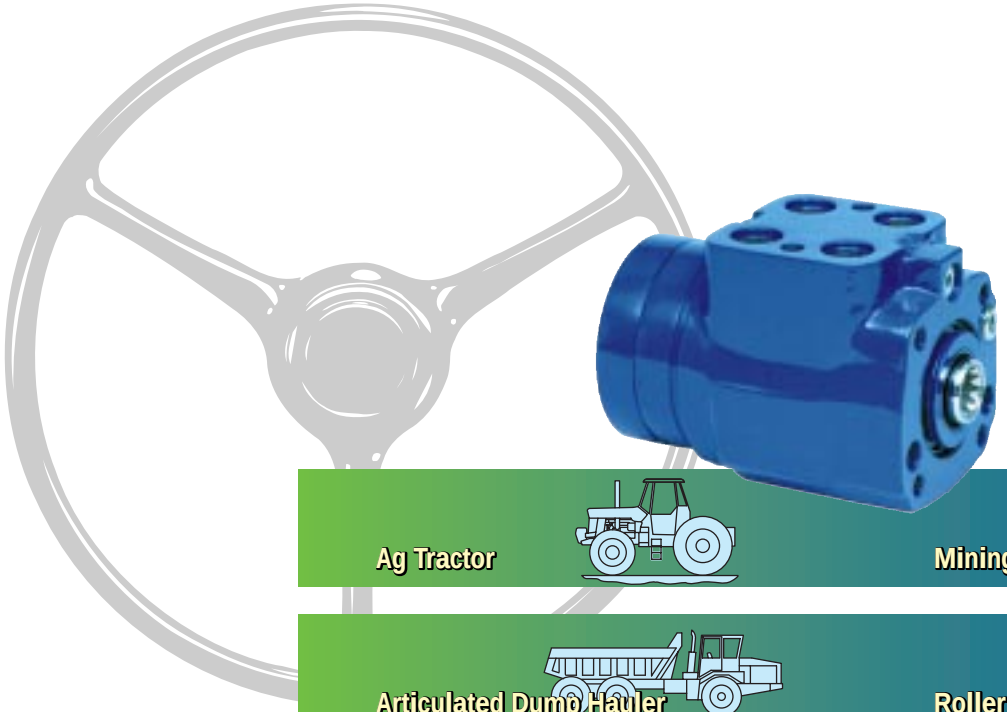
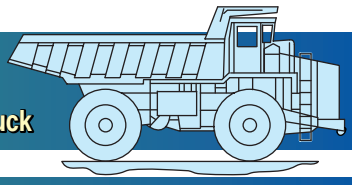
Char-Lynn®
Power Steering

No. 11-872
April, 1999

EATON



Ag Tractor



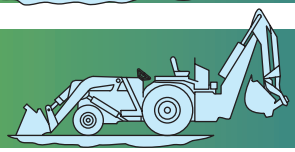
Mining Truck

Articulated Dump Hauler

Roller

Articulated Loader

Rubber Tire Excavator



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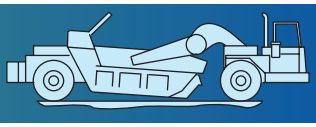
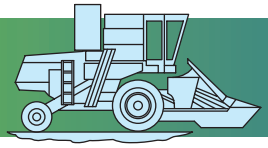
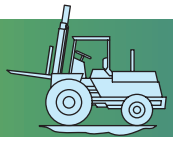


Scraper

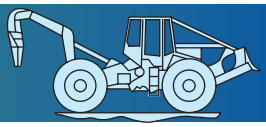


Combine

Site Handler



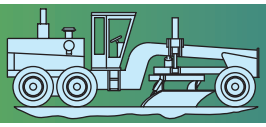
Fork Lift



Skidder

Steering Control Units and Torque Generators

Sprayer



Grader

Sweeper

Lawn and Garden

Transporter

Experienced system design engineers - Systems-based solutions to all your hydraulic needs.

Global manufacturing capability - Manufacturing plants and joint ventures in the U.S., Europe, Japan and China.

Global sales support - Sales offices in the U.S., Scotland, Germany, Singapore, China and Korea.

World's largest distributor network - Over 100 distributors in 50 different countries.

Reliable, robust products - Field-proven leader in the hydraulics industry.

Exceptional product quality - All products manufactured in ISO 9001-certified sites.

Contents

All About Power Steering for that Special Vehicle

Steering Control Units and Torque Generators

Steering System Components and System Accessories

A – General Information

Description and Advantages

Steering Control Unit

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 2	
Displacement	32 - 100 cm^3/r	1.9 - 6.1 in^3/r
Flow	11 - 15 l/min	3 - 4 GPM
Pressure	69 103 bar	1000 1500 PSI

	Series Flex 4	
Displacement	60 - 120 cm^3/r	3.6 - 7.3 in^3/r
Flow	15 - 23 l/min	4 - 6 GPM
Pressure	124 bar	1800 PSI

	Series 3, 6, 12	
Displacement	75 - 740 cm^3/r	4.5 - 45.1 in^3/r
Flow	11 - 45 l/min	3 - 12 GPM
Pressure	172 bar	2500 PSI

	Series 4	
Displacement	45 - 120 cm^3/r	2.8 - 7.3 in^3/r
Flow	15 l/min	4 GPM
Pressure	124 bar	1800 PSI

	Series 110, 230, 450	
Displacement	75 - 740 cm^3/r	4.5 - 45.1 in^3/r
Flow	11 - 76 l/min	3 - 20 GPM
Pressure	172 241 bar	2500 3500 PSI

	Series 20	
Displacement	60 - 985 cm^3/r	3.6 - 60 in^3/r
Flow	38 - 114 l/min	10 - 30 GPM
Pressure	241 bar	3500 PSI

	Series 25	
Displacement	490 - 1230 cm^3/r	30 - 75 in^3/r
Flow	95 - 151 l/min	25 - 40 GPM
Pressure	241 bar	3500 PSI

	Series 40	
Displacement	1230 - 3030 cm^3/r	75 - 185 in^3/r
Flow	151 - 227 l/min	40 - 60 GPM
Pressure	241 bar	3500 PSI

A – General Information
Description and Advantages

Torque Generator

Char-Lynn torque generators have been completely redesigned to meet the needs of the changing market place. 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.

Todays 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.

Series 217, 227

Displacement	76 - 160 cm^3/r	4.7 - 9.6 in^3/r
Flow	15 l/min	4 GPM
Pressure	69 and 172 bar	1000 and 2500 PSI

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.

Steering Columns

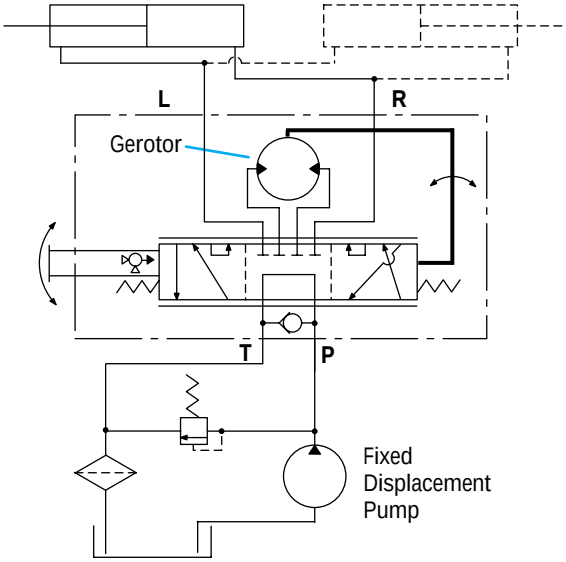
Jacket Length	56 - 836 mm	2.2 - 33 inch
Horn Wire	with and without	with and without
Upper Ends	10 Upper End Types	10 Upper End Types

Hydraulic Circuit Explanation

Neutral Circuits: Open Center and Open Center Power Beyond

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



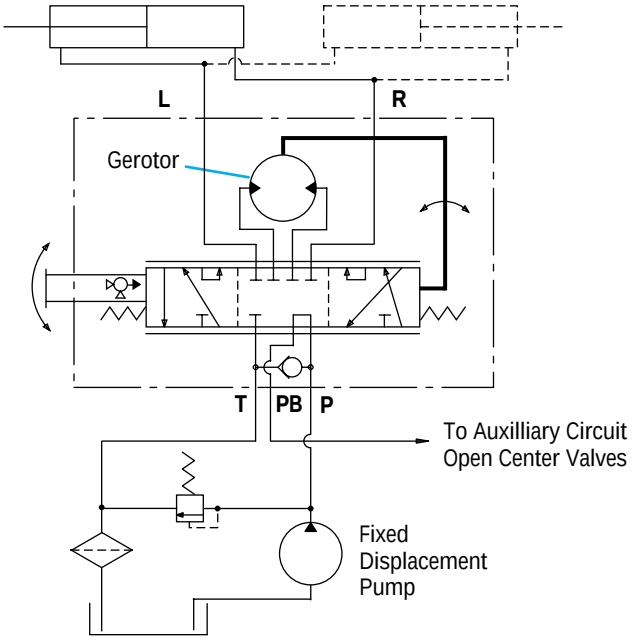
Open Center Power Beyond:

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

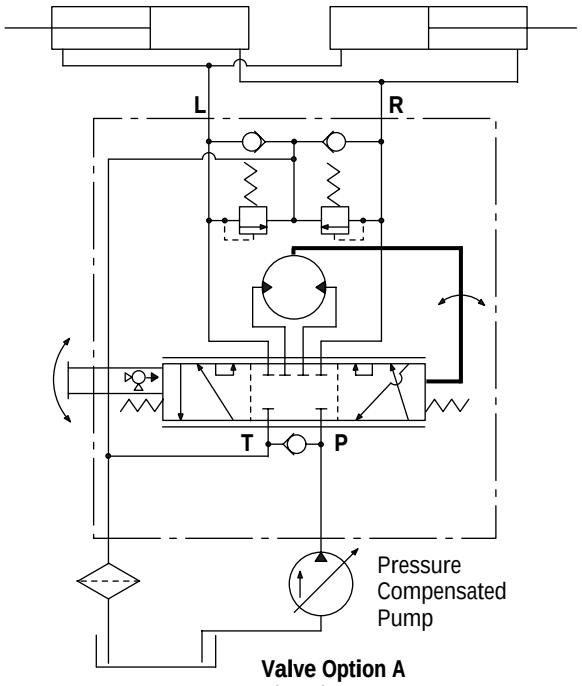
A – General Information

Hydraulic Circuit Explanation

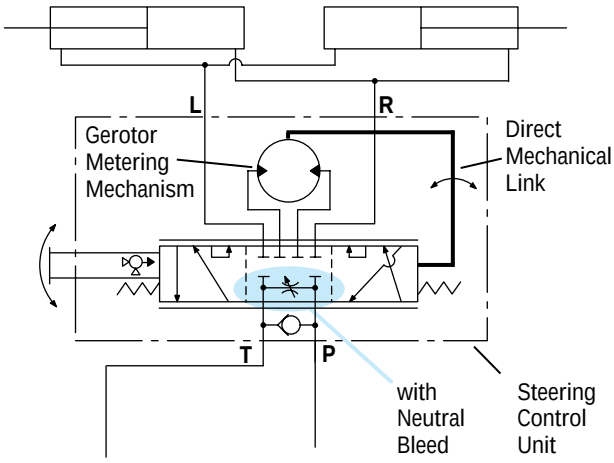
Neutral Circuits: Closed Center

Closed Center:

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



Valve Option A
Closed Center System



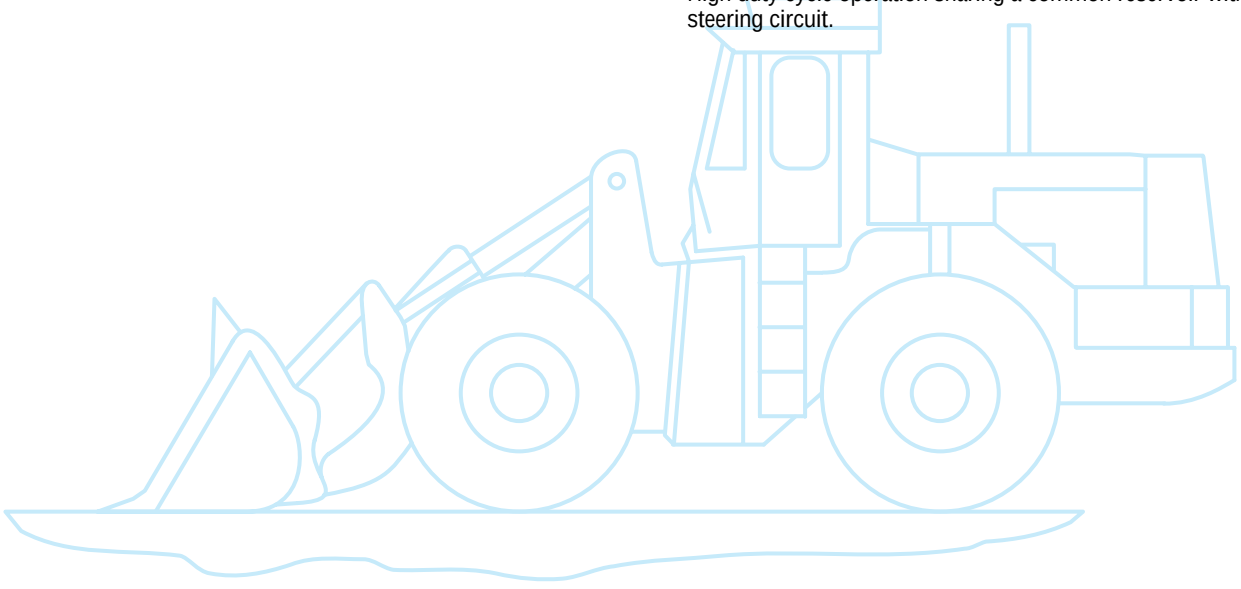
Closed Center with Neutral Bleed

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



A – General Information

Hydraulic Circuit Explanation

Neutral Circuits: 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.

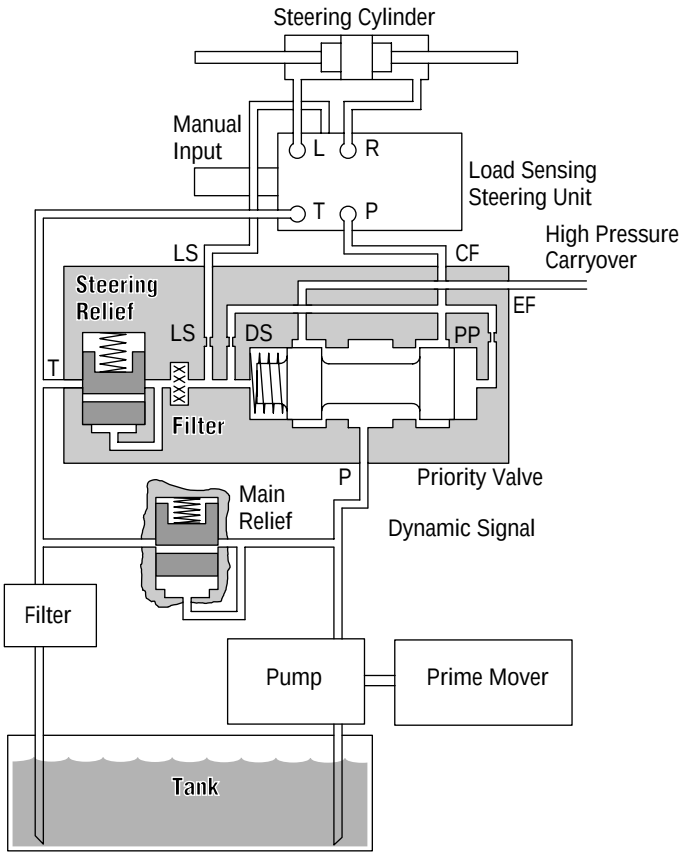
Steering Control Unit — Designed for specific rated flows and control pressures. It must be matched with a control pressure in the priority valve to obtain maximum steering rates. Higher flow rates require higher control pressures. Neutral internal bleed assures component temperature equalization.

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.

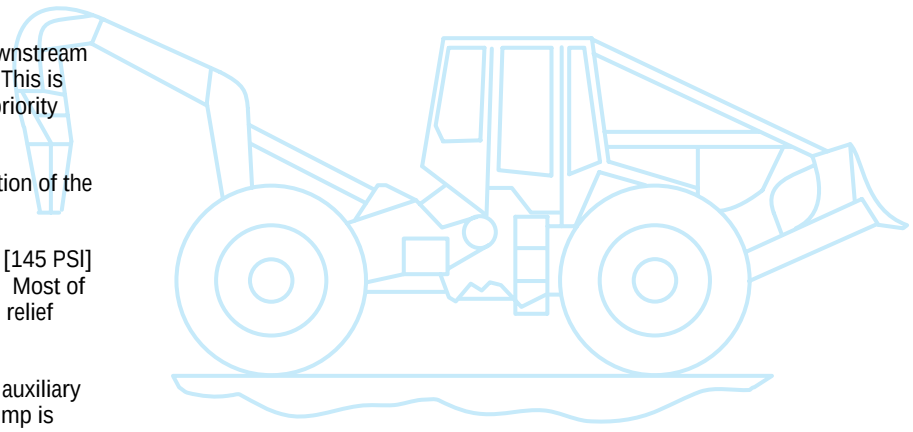
The total system performance depends on careful consideration of the control pressure chosen and pressure drop in the CF line.

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



A – General Information
Hydraulic Circuit Explanation

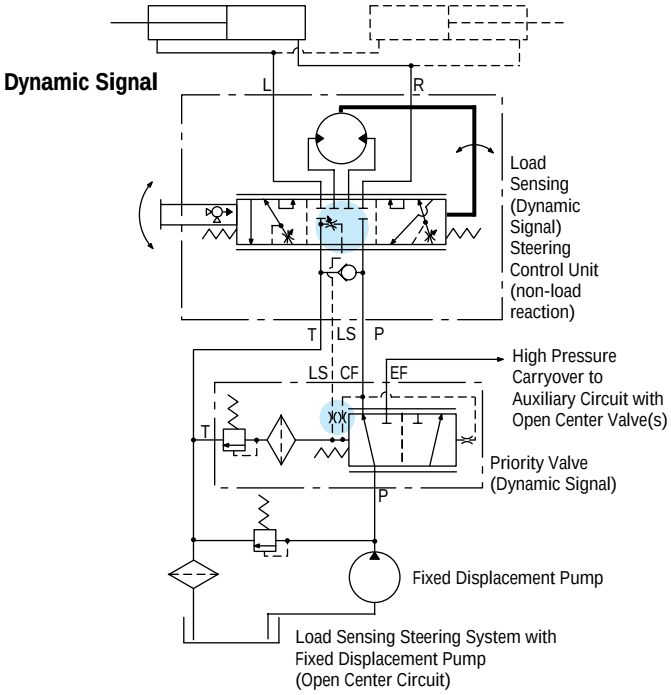
Neutral Circuits: Load Sensing Circuits – Signal Systems

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

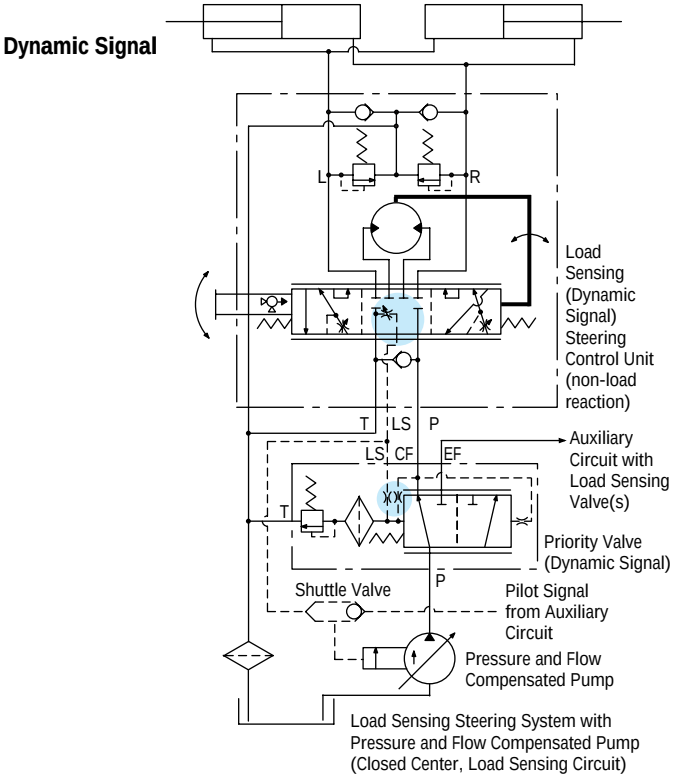
Dynamic Signal — Used for more difficult applications. The dynamic signal systems offer the following benefits:

- 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

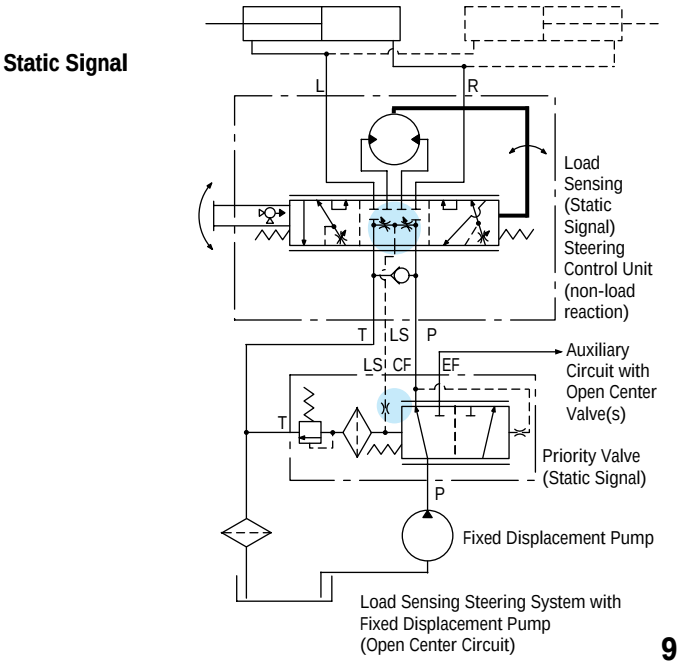


Dynamic Signal – Load Sensing Pump



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.



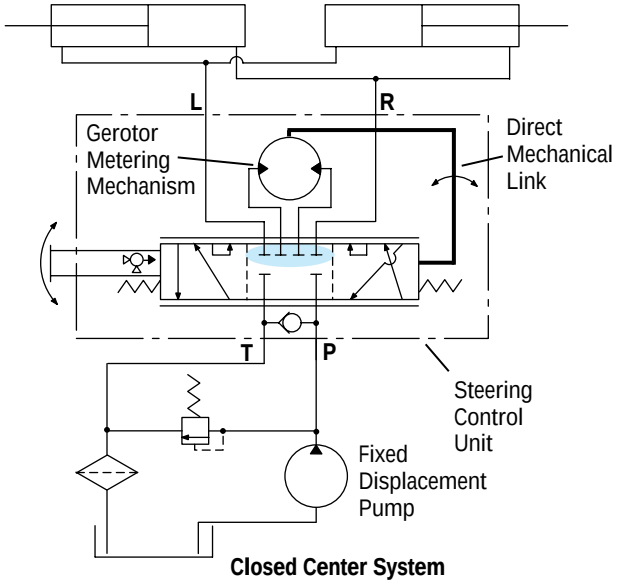
A – General Information

Hydraulic Circuit Explanation

Work Circuits
Non-Load Reaction vs. Load Reaction

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.

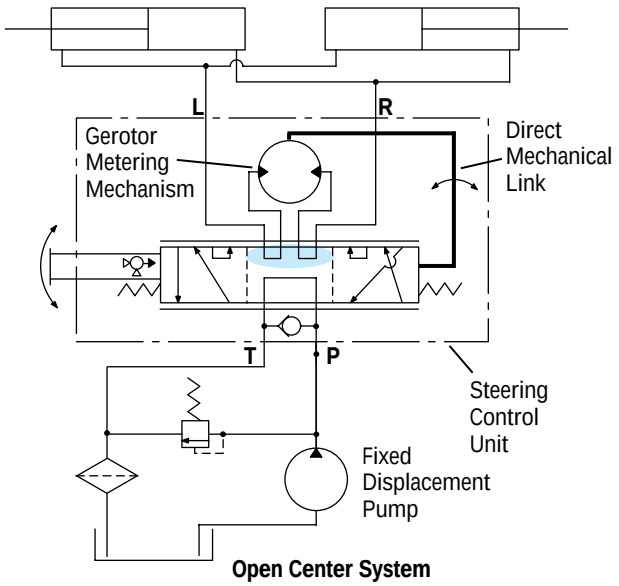


Closed Center System
Non-Load Reaction Circuit

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.**



Open Center System
Load Reaction Circuit

A – General Information

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.

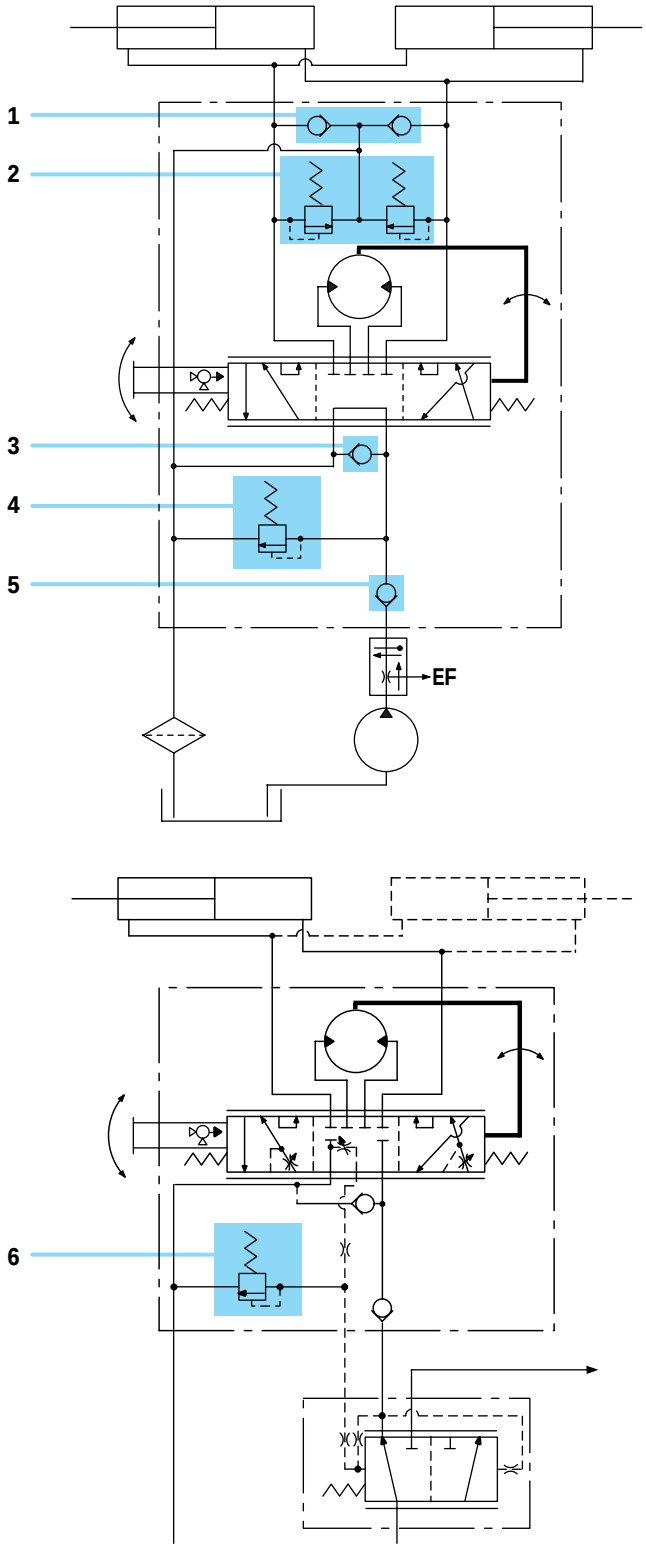
3 Manual Steering Check Valve—converts unit to a hand operated pump for limited manual steering. Included in all units except Series 20, 25, and 40. **

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 cm^3/r [11.3 in^3/r] may require a separate power source for limited operation.



A – General Information

Special Features and Application Information

Manual Steering

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.

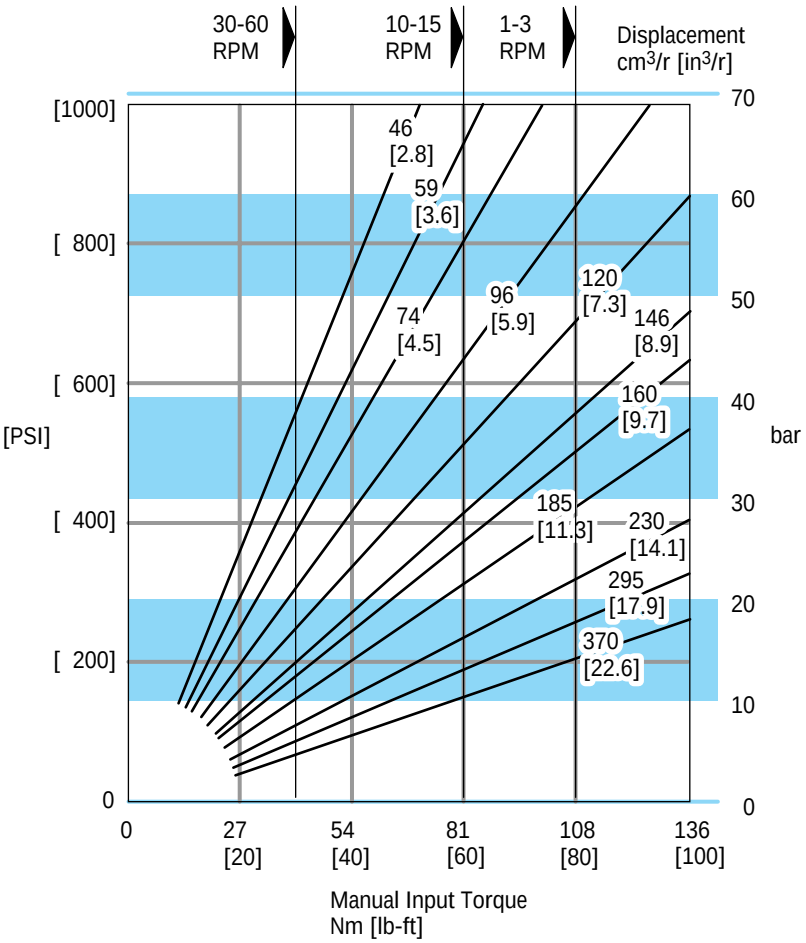
This feature is available in all steering models except for Series 25 and 40.

Use of Graph

1. Determine steering work port pressure required to preform 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.

A – General Information

Special Features and Application Information

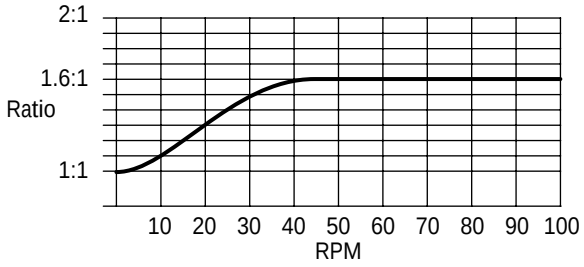
Q-Amp Flow Amplification for Load Sensing Circuits

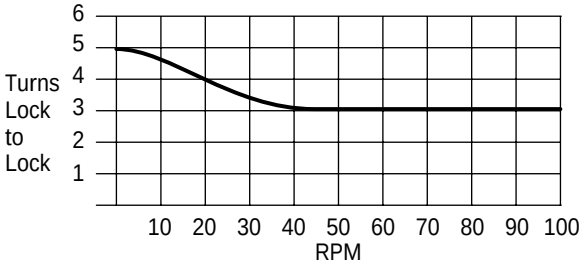
Description

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:**





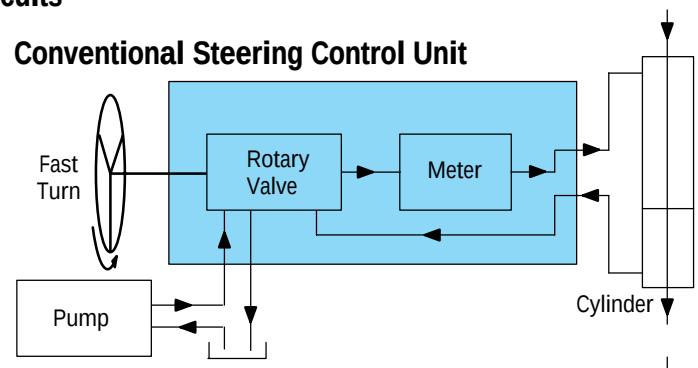
- **Manual Steering:**

  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.

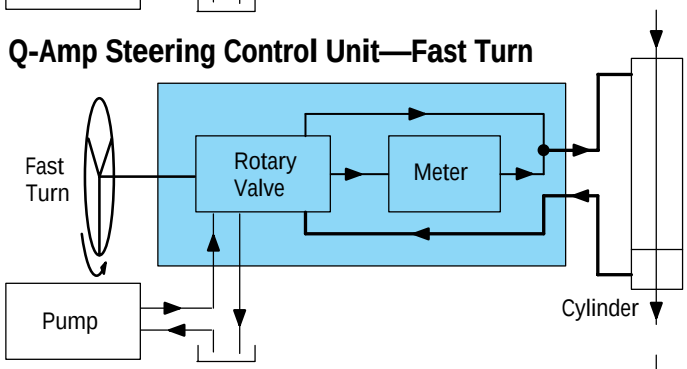
- **Single Cylinder (Unequal area)**

  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.

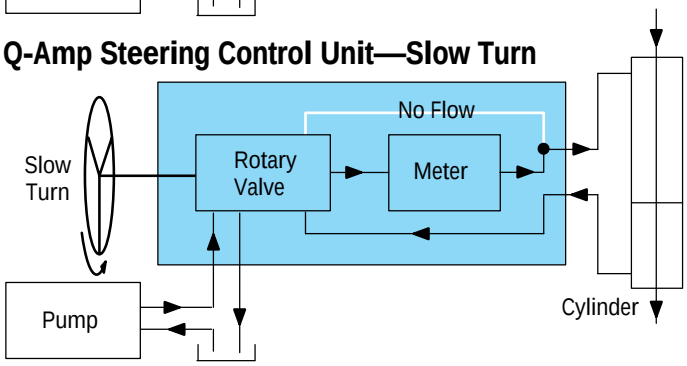
Conventional Steering Control Unit



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.

A – General Information

Special Features and Application Information

Q-Amp Flow Amplification for Load Sensing Circuits

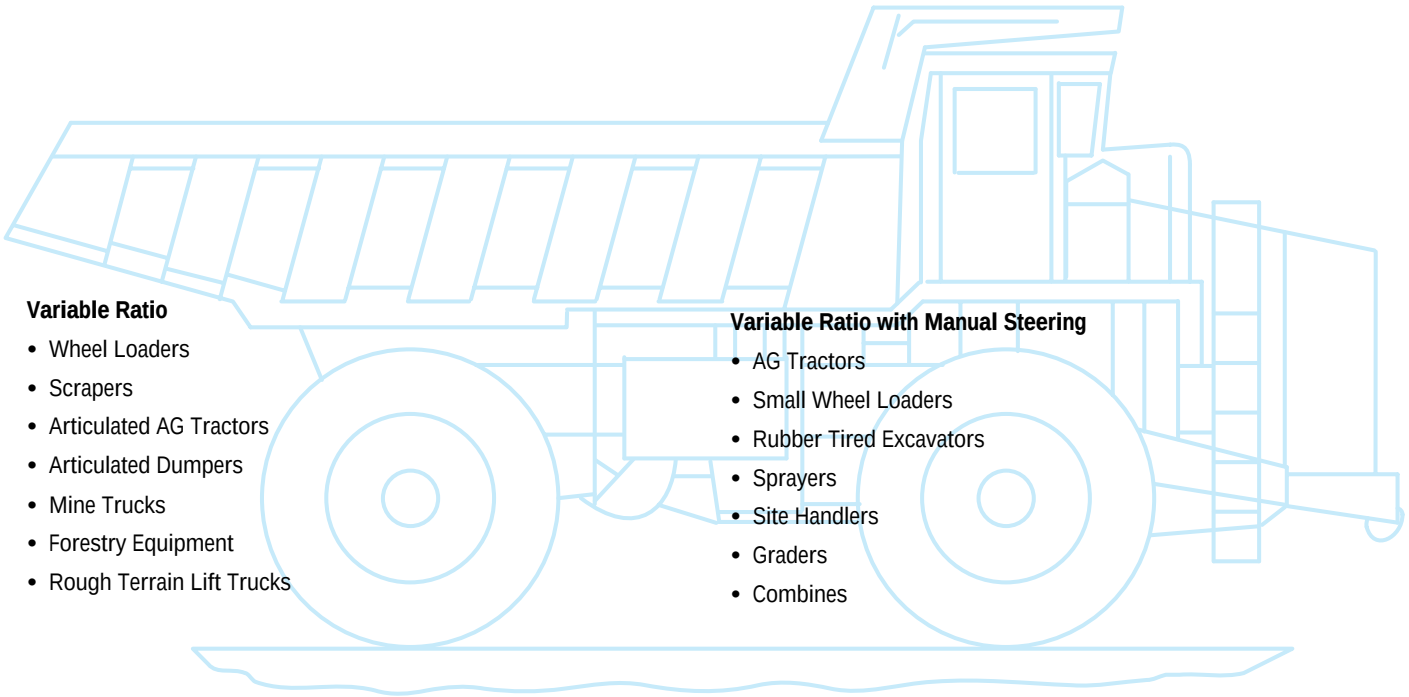
Applications

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 vehicles 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

A – General Information

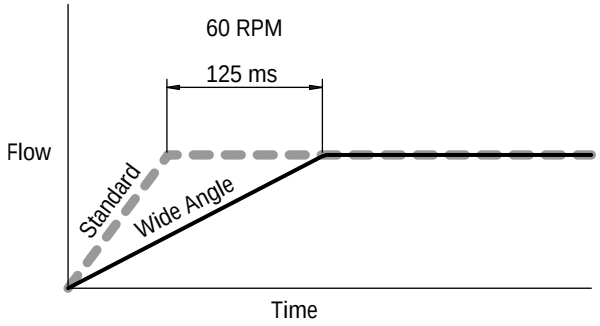
Special Features and Application Information

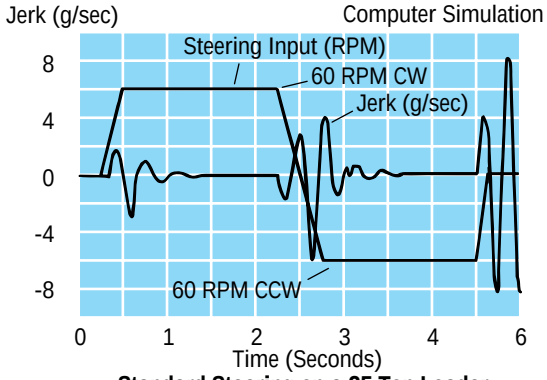
Wide Angle

Description

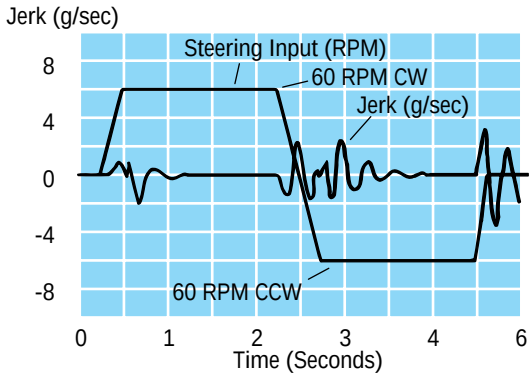
Steering units with wide angle features have been developed to significantly reduce or eliminate the jerky motion of vehicles with articulated steering systems. This has been accomplished by increasing the maximum deflection of the spool relative to the sleeve. Increasing the deflection reduces the gain. 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.





Standard Steering on a 25 Ton Loader



Wide Angle Steering on a 25 Ton Loader

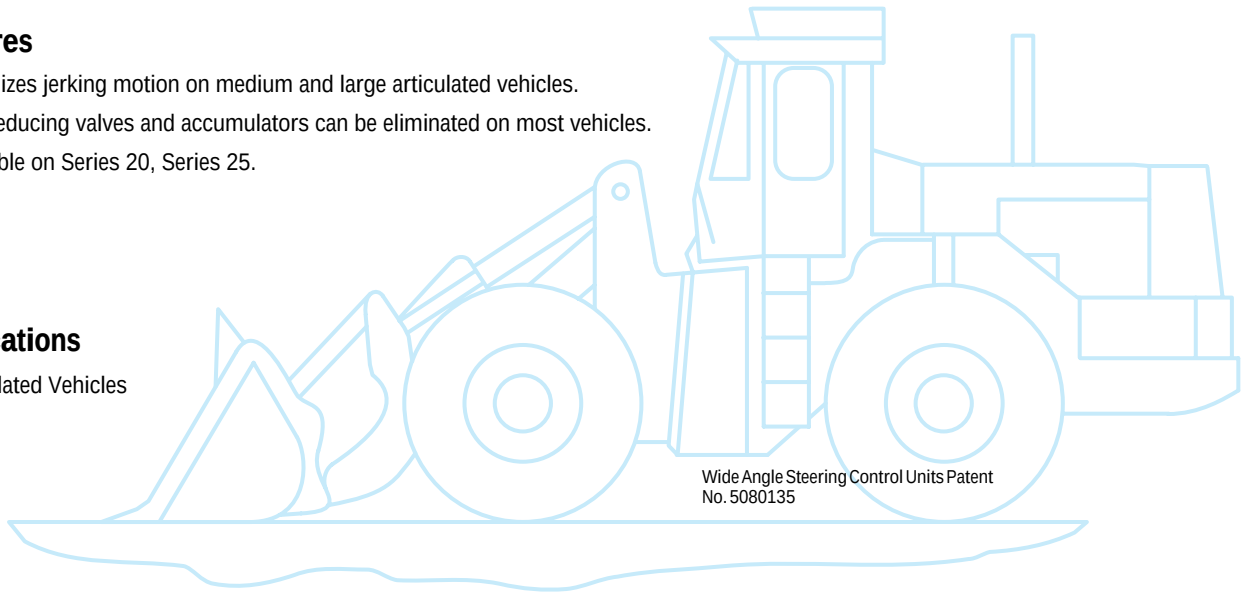
These graphs show a computer simulation of the jerk levels and has been verified by actual vehicle tests.

Features

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

Applications

- Articulated Vehicles



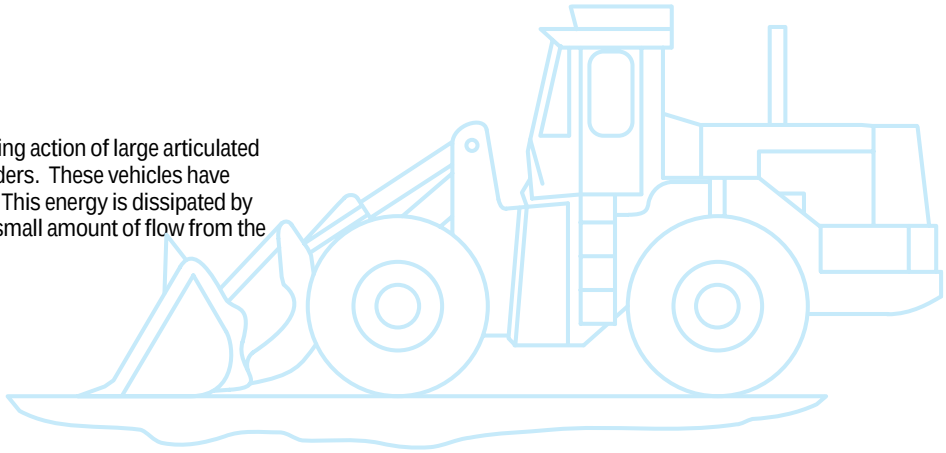
Wide Angle Steering Control Units Patent No. 5080135

Special Features and Application Information

Cylinder Damping

Description

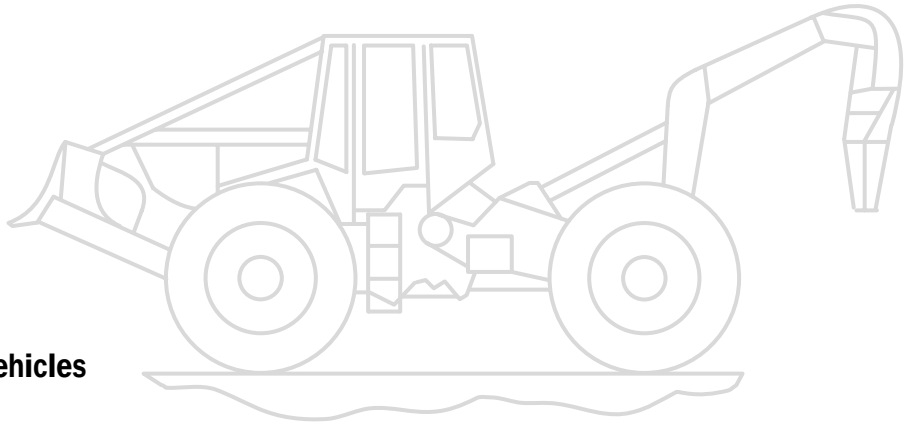
Cylinder damping can help smooth the steering action of large articulated vehicles such as loaders, scrapers, and skidders. These vehicles have overhanging weight with high inertial loads. This energy is dissipated by the cylinder damping orifices which bleed a small amount of flow from the cylinder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



Steering Control Units with Cylinder Damping Patent No. 5080135

Features

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



Applications – Large Articulated Vehicles

- Wheel Loaders
- Skidders
- Scrapers

A – General Information

Special Features and Application Information

EMSS – Electric Motor Signal Switch

Description

Designed to conserve energy on fork lifts and other electrically driven vehicles, the EMSS is a pressure signal capable of driving a switch. When the switch receives a pressure pulse, it signals the electric motor driving the steering pump to start. An electric time relay can turn the pump off when steering is not used.

Unlike conventional systems, the open-center EMSS can use added drain ports to detect the pressure signal independently from the back pressure. This allows the lower-pressure switch setting to generate smooth response steering at start up. The EMSS is available for use in open-center, and load-sensing configurations.

Features

- Helps save energy on battery-driven vehicles.
- Easily and quickly installs on standard SCU configurations.
- Patented design helps provide smooth response at steering start up.
- Can be used in open-center and load-sensing configurations.

Application – Used for Electric Fork Lifts

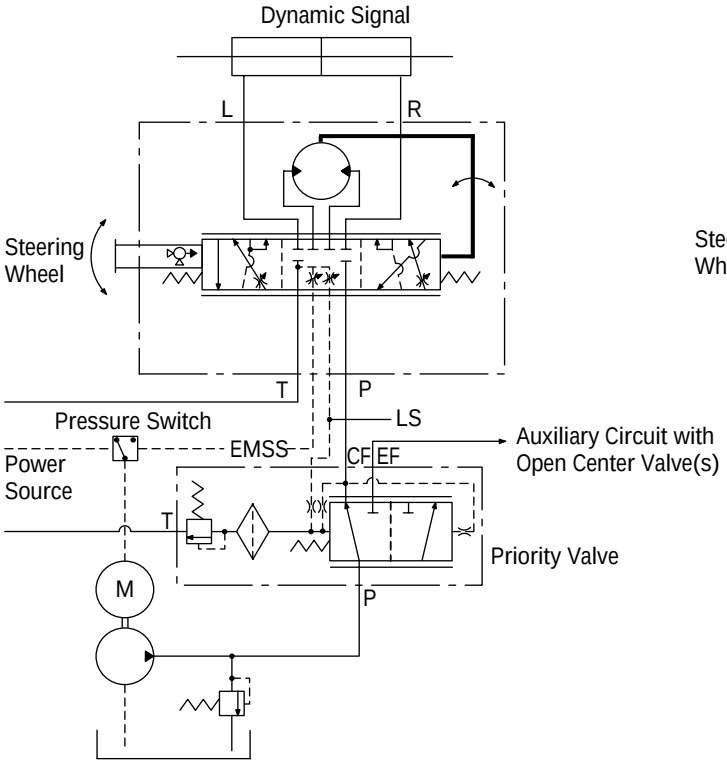
The response of the EMSS port pressure to the steering input with power off, depends on SCU displacement and initial steering rate. Smaller displacements will generate EMSS pressure more quickly, as will a higher initial steering rate. With a 45,9 cm^3/r [2.8 in^3/r] gerotor and 60 rpm initial steering rate, EMSS pressure will rise ~7 bar [100 psi] above tank pressure in 40° or less steering motion. Under the same conditions, a 73,7 cm^3/r [4.5 in^3/r] gerotor takes 60° or less steering wheel motion.

Note: for smooth performance, the pressure switch should be set as low as possible. If the end of steering valve travel is reached before pressure reaches the switch setting, a small “bump” may be felt in the steering wheel.

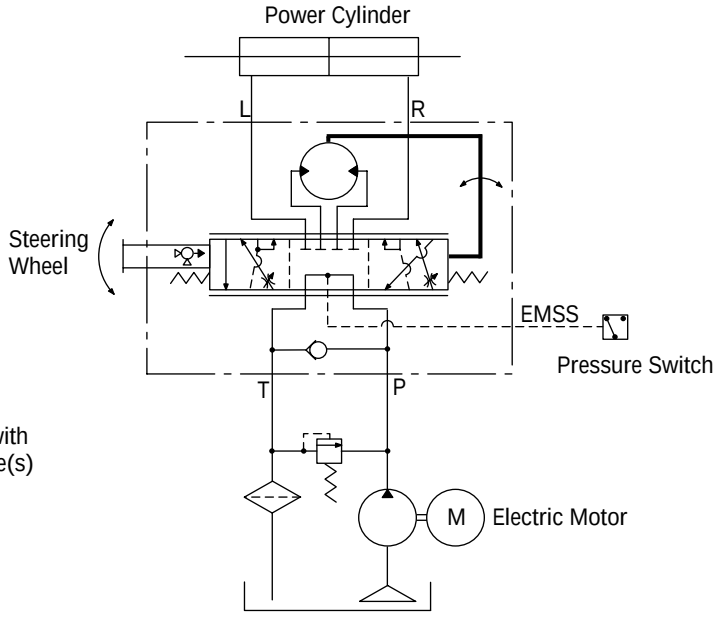
A – General Information

Special Features and Application Information

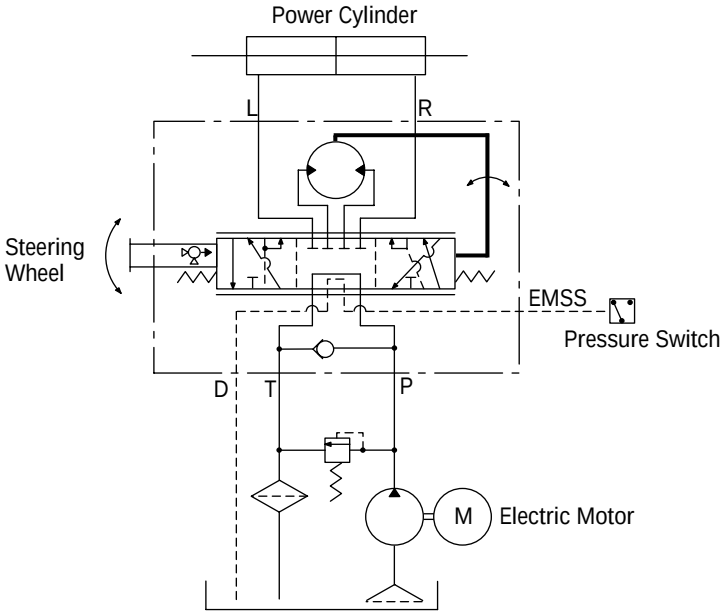
EMSS – Schematics



Load Sensing SCU with EMSS



Open-Center Non-Load Reaction SCU with EMSS



Open-Center Non-Load Reaction SCU with EMSS Port and Drain Port

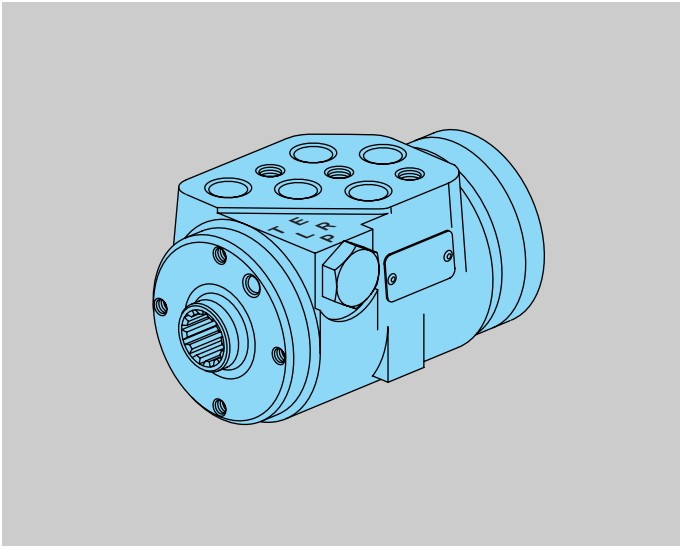
B – Product Information
Steering Control Units — Series 2

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.



Specifications

Max. System Pressure (Standard)	69 bar [1000 PSI]
or	
Max. System Pressure (High Pressure)	103 bar [1500 PSI]
Max. Back Pressure	10 bar [150 PSI]
Max. System Operating Temperature	93°C [200° F]
Max. Flow	15 l/min [4 GPM]
Max. Differential	
Between Steering Unit	28° C
and System Temperature	50° F
Input Torque	
Powered	1,7 - 2,8 Nm @ 6,9 bar tank pressure [15 - 25 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]
Port Options	9/16-18 SAE O-ring 9/16 Plug-O

Features

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

B – Product Information

Steering Control Units — Series 2

Standard Product Releases

Example: 291-1001-121

Product Number

Product Numbers
Series 2 (High Pressure — 103 bar [1500 PSI])

System	Ports	Relief Valve Setting bar [PSI]	Displacement cm^3/r [in^3/r]					
			32 [1.9]	40 [2.4]	51 [3.1]	63 [3.8]	74 [4.5]	100 [6.1]
Open Center Non-Load Reaction	9/16 Inch Plug-O (4)	None	291-1001-121	291-1002-121	291-1003-121	291-1004-121	291-1005-121	291-1006-121
	9/16 -18 Inch SAE (4)	None	291-1007-121	291-1008-121	291-1009-121	291-1010-121	291-1011-121	291-1012-121
Power Beyond Non-Load Reaction	9/16 Inch Plug-O (5)	None	291-5001-121	291-5002-121	291-5003-121	291-5004-121	291-5005-121	291-5006-121
	9/16 -18 Inch SAE (5)	None	291-5007-121	291-5008-121	291-5009-121	291-5010-121	291-5011-121	291-5012-121
Dynamic Signal Load Sensing	9/16 Inch Plug-O (5)	None	293-4001-121	293-4002-121	293-4003-121	293-4004-121	293-4005-121	293-4006-121
	9/16 -18 Inch SAE (5)	None	293-4007-121	293-4008-121	293-4009-121	293-4010-121	293-4011-121	293-4012-121

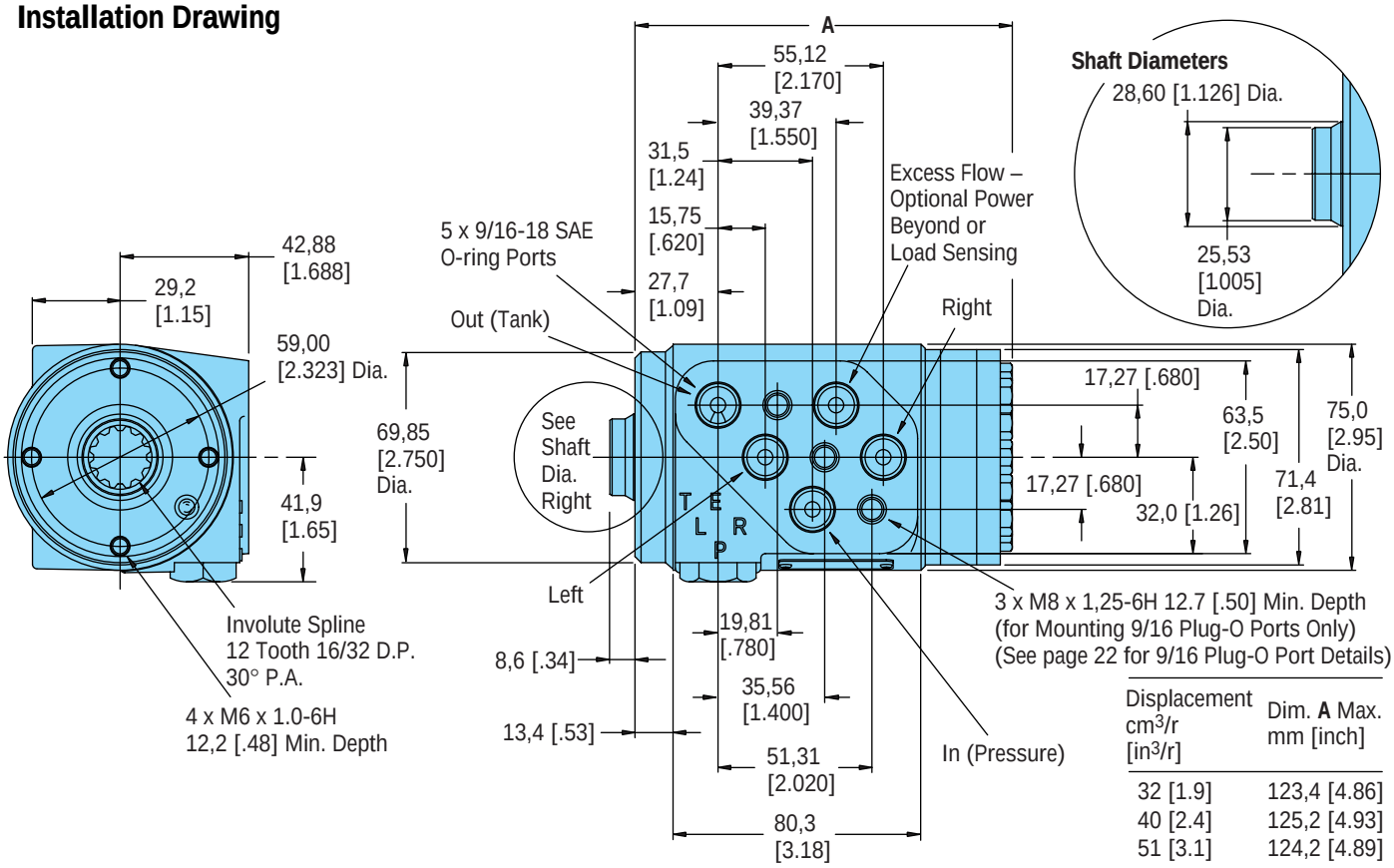
Product Numbers
Series 2 (Standard — 69 bar [1000 PSI])

Open Center Non-Load Reaction	9/16 Inch Plug-O (4)	None	291-1001-001	291-1002-001	291-1003-001	291-1004-001	291-1005-001	291-1006-001
	9/16 -18 Inch SAE (4)	None	291-1007-001	291-1008-001	291-1009-001	291-1010-001	291-1011-001	291-1012-001
Power Beyond Non-Load Reaction	9/16 Inch Plug-O (5)	None	291-5001-001	291-5002-001	291-5003-001	291-5004-001	291-5005-001	291-5006-001
	9/16 -18 Inch SAE (5)	None	291-5007-001	291-5008-001	291-5009-001	291-5010-001	291-5011-001	291-5012-001
Dynamic Signal Load Sensing	9/16 Inch Plug-O (5)	None	293-4001-001	293-4002-001	293-4003-001	293-4004-001	293-4005-001	293-4006-001
	9/16 -18 Inch SAE (5)	None	293-4007-001	293-4008-001	293-4009-001	293-4010-001	293-4011-001	293-4012-001

B – Product Information

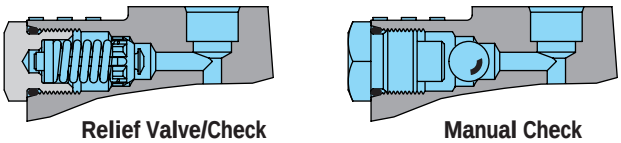
Steering Control Units — Series 2

Installation Drawing

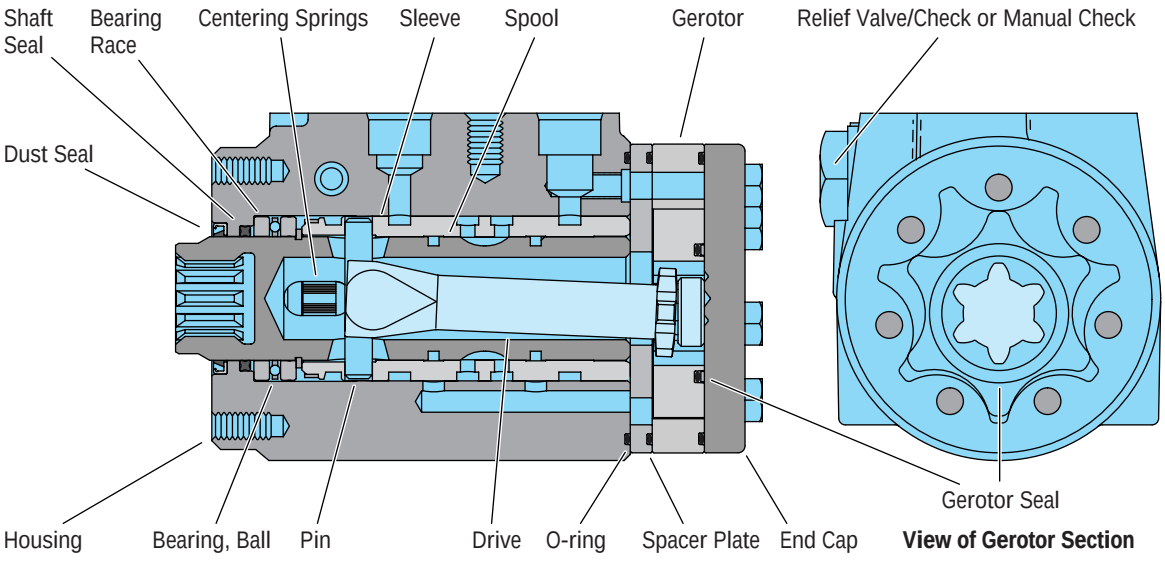


Displacement cm^3/r [in^3/r]	Dim. **A** Max. mm [inch]
32 [1.9]	123,4 [4.86]
40 [2.4]	125,2 [4.93]
51 [3.1]	124,2 [4.89]
63 [3.8]	126,2 [4.97]
74 [4.5]	128,0 [5.04]
100 [6.1]	132,3 [5.21]

Sectional Drawing



Relief Valve/Check **Manual Check**

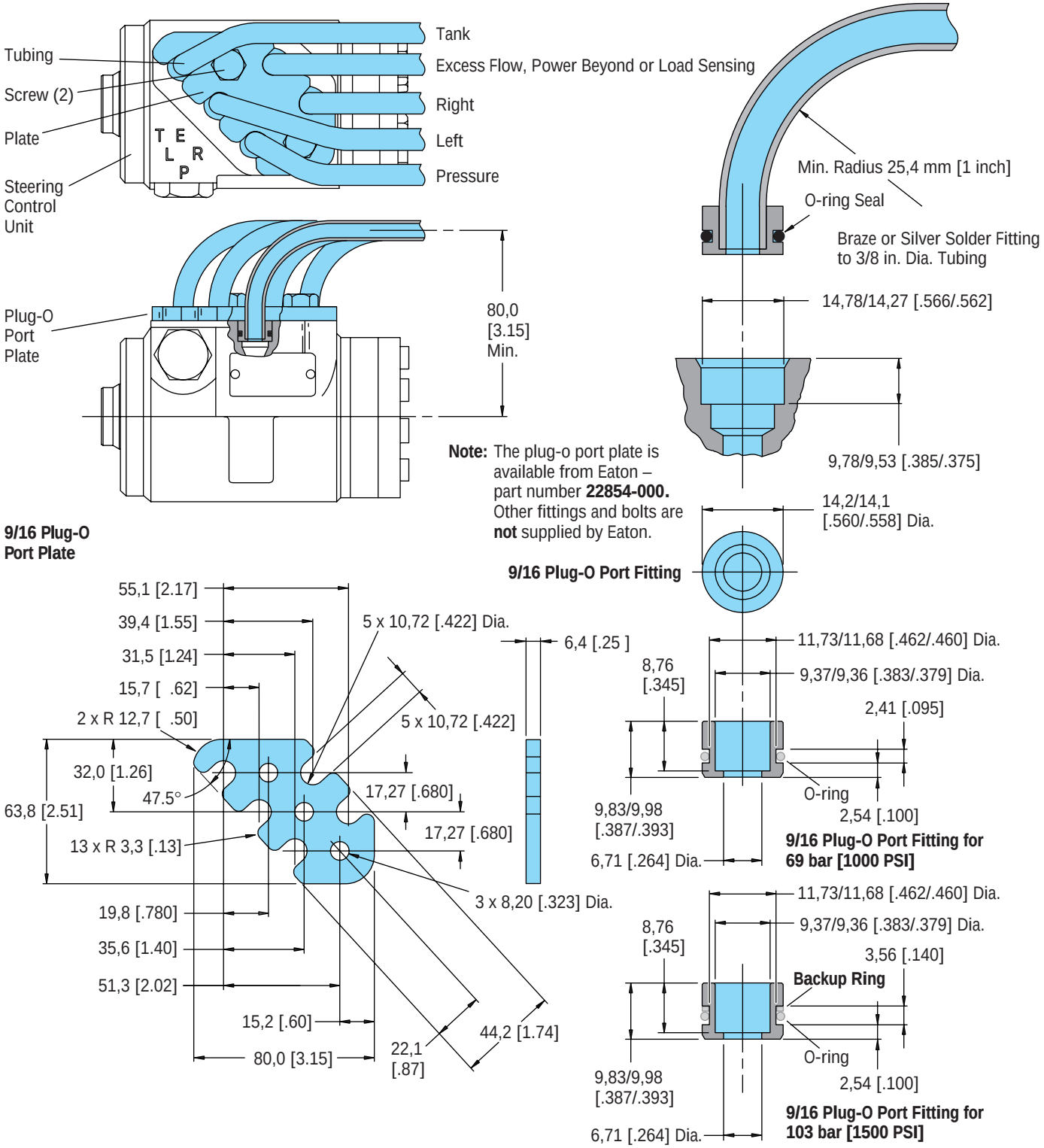


View of Gerotor Section

B – Product Information

Steering Control Units — Series 2

Installation Drawing



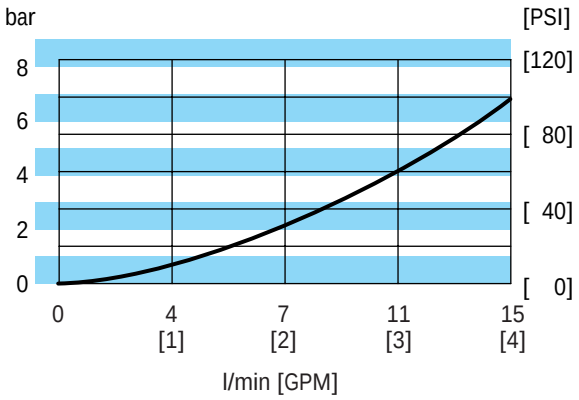
Seal Specifications for Plug-O Fittings	O-rings — Buna N 90 Durometer Size -013 Backup Ring — Solid Teflon - Scarf Cut Size -013

B – Product Information

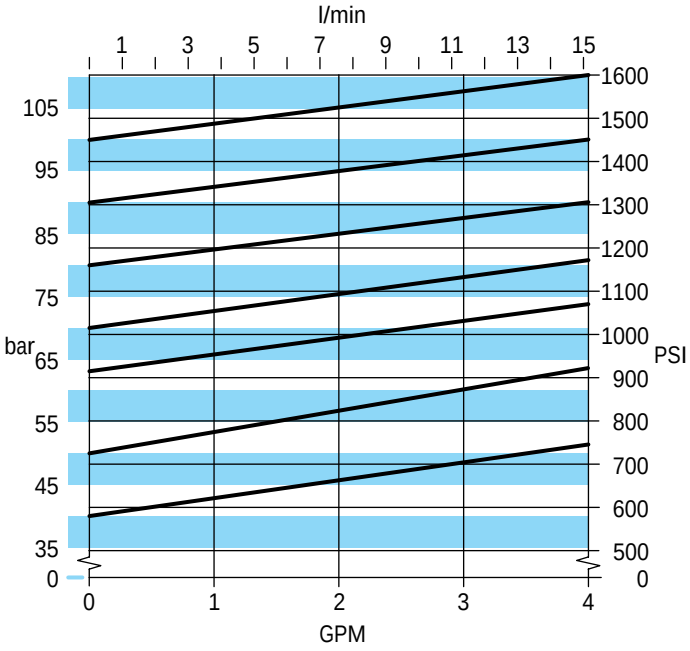
Steering Control Units — Series 2

Performance Data

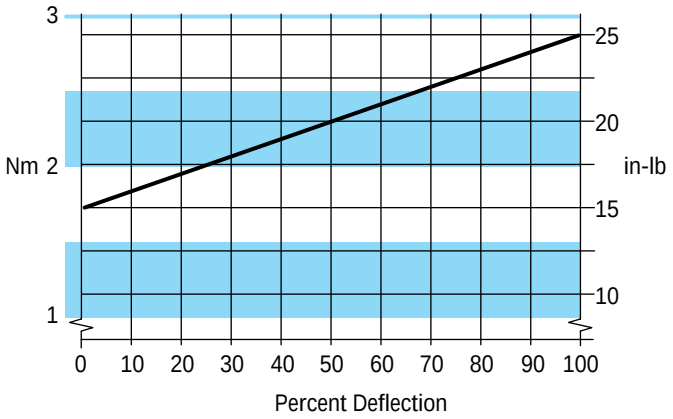
Neutral Pressure Drop Inlet to Auxiliary



Relief Valve Curve



Input Torque Curve



Applications

- Lawn and Garden Equipment
- Turf Equipment
- Golf Course Maintenance Equipment

B – Product Information

Steering Control Units — Series 2

Model Code – Ordering Information

The following 29-digit coding system has been developed to identify all of the configuration options for the Series 2 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.

Model Code — Series 2 Steering Control Unit

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	R						0		A					0	0					3	A	0			1	0	A

Position 1, 2, 3 **Product Series**

ABR ..... Series 2 Steering Control Unit

Position 4 **Nominal Flow Rating**

1 ..... 11 l/min [3 GPM]

2 ..... 15 l/min [4 GPM]

Position 5 **Inlet Pressure Rating**

2 ..... 69 bar [1000 PSI]

3 ..... 103 bar [1500 PSI]

Position 6 **Tank Pressure Rating**

A ..... 10 bar [150 PSI]

Position 7-8 **Displacement $cm^3/r[in^3/r]$**

35 ..... 32 [1.9]

37 ..... 40 [2.4]

39 ..... 51 [3.1]

41 ..... 63 [3.9]

43 ..... 74 [4.5]

46 ..... 100 [6.1]

Position 9 **Flow Amplification**

0 ..... None

Position 10 **Neutral Circuit**

A ..... Open Center

B ..... Open Center, Power Beyond (Excess Flow)

F ..... Load Sensing, Dynamic signal

Position 11 **Load Circuit**

A ..... Non-Load Reaction

Position 12, 13, 14, 15 **Integral Valve and Pressure Settings**

0100 ..... Manual Steering check/No Relief Valve

0518 ..... Manual Steering Check/Inlet Relief Valve - set at 40 bar [580 PSI]

051J ..... Manual Steering Check/Inlet Relief Valve - set at 50 bar [725 PSI]

051Z ..... Manual Steering Check/Inlet Relief Valve - set at 63 bar [914 PSI]

0526 ..... Manual Steering Check/Inlet Relief Valve - set at 70 bar [1020 PSI]

052G ..... Manual Steering Check/Inlet Relief Valve - set at 80 bar [1160 PSI]

052T ..... Manual Steering Check/Inlet Relief Valve - set at 90 bar [1310 PSI]

0534 ..... Manual Steering Check/Inlet Relief Valve - set at 100 bar [1450 PSI]

Position 16,17 **Cylinder Relief Setting**

00 ..... None

Position 18, 19, 20, 21 Ports and Mounting Threads

BAAH ..... 4 x 9/16 SAE Ports, M6 x 1,0 Column Mounting Threads (Use with Open Center)

BAKH ..... 5 x 9/16 SAE Ports, M6 x 1,0 Column Mounting Threads (Use with Excess Flow)

BAEH ..... 5 x 9/16 SAE Ports, M6 x 1,0 Column Mounting Threads (Use with Load Sensing)

CAAJ ..... 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)

CAJJ ..... 5 x 9/16 Plug-O Ports, M6 x 1,0 Column Mounting Threads M8 x 1,25 Port Face Mounting (Use with Excess Flow)

CATJ ..... 5 x 9/16 Plug-O Ports, M6 x 1,0 Column Mounting Threads M8 x 1,25 Port Face Mounting (Use with Load Sensing)

Position 22 **Input Torque**

3 ..... Standard

Position 23 **Fluid Type**

A ..... See Eaton Technical Bulletin 3-401

Position 24 **Special Application**

0 ..... None

Position 25, 26 **Special Feature**

AA ..... None

Position 27 **Paint**

1 ..... Black Primer

Position 28 **Identification**

0 ..... Eaton Product Number on Nameplate

Position 29 **Eaton Assigned Design Code**

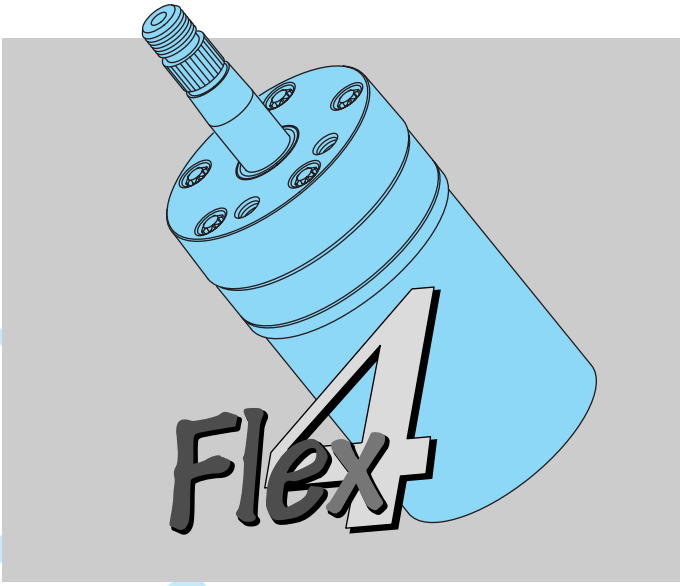
A ..... Assigned Design Code

Product Information

Steering Control Units — Series Flex 4

Product Description and Features

The Flex 4 Series is a new, innovative and patented steering platform. Designed for small and medium size vehicles,this highly flexible unit offers many new features and benefits which enhance those of the proven Char-Lynn steering control unit.



Features:

Neutral Circuits

- Open Center
- Open Center Power Beyond
- Load Sensing

Porting

- Side Ports
- End Ports

Valve Options

- Manual Steering Check
- Inlet Relief Valve
- Inlet Check Valve
- Cylinder Relief Valve*
- Anti-cavitation Valve*

* End Ported Units Only

Column Arrangement

- Integral Column Design
- External Column Design
- Tilt Column Available

Other Features

- Horn Wire
- EMSS* (electric motor signal switch)
- Motion Sensor Adaptable
- 9/16 Plug-O Ports

* EMSS is used as an energy saving device. This option includes an EMSS port which is then connected to a pressure sensor. When steering wheel input is initiated, a signal is sent to activate the motor switch.

Technical Specifications:

Max. System Pressure	124 bar [1800 PSI]
Max. Back Pressure	10 bar [150 PSI]
Displacements	60 cm^3/r [3.6 in^3/r]
	75 cm^3/r [4.5 in^3/r]
	95 cm^3/r [5.9 in^3/r]
	120 cm^3/r [7.3 in^3/r]
Flow Rating	15 l/min [4 GPM]
	23 l/min [6 GPM]
Input Effort – Powered	0,8-1,8 Nm [7-13 lb-in]
Un-powered	81,4 Nm [60 lb-ft] Max

Benefits:

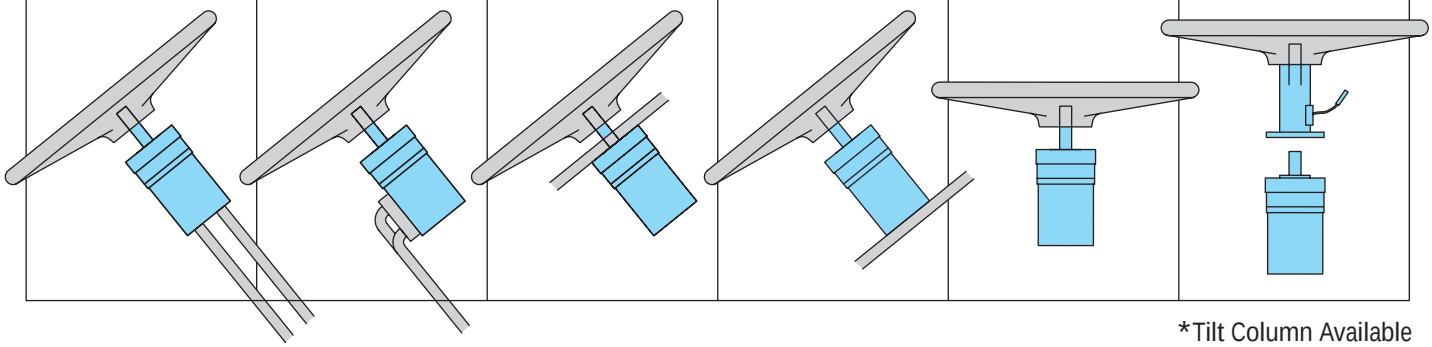
- Reduced total installation cost
- Allows a variety of installation options
- Offers high performance standard
- Operator comfort with smooth steering action and low input torque

Shown Actual Size — Displacement 75 cm^3/r [4.50 in^3/r]

Product Information

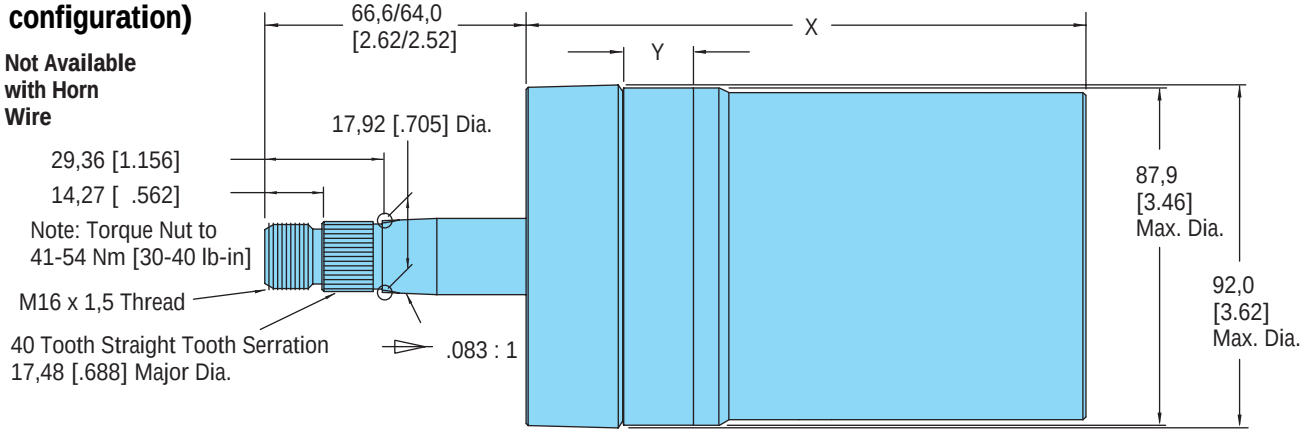
Steering Control Units — Series Flex 4

Port Configuration		Mounting Configuration		Column Interface	
End-Ports	Side-Ports	Top-Mount	Rear-Mount	Integral (Short)	External (Any Length)*

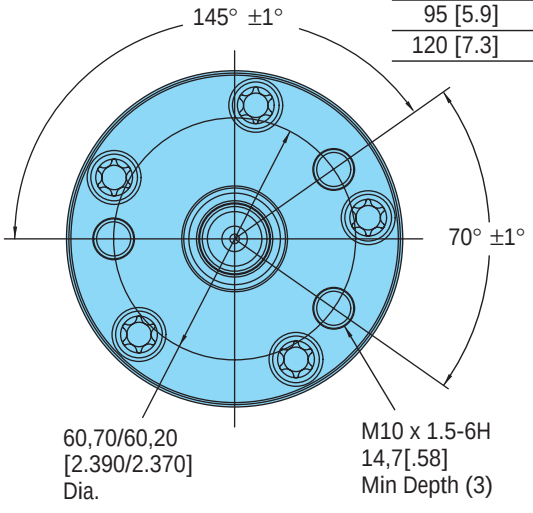


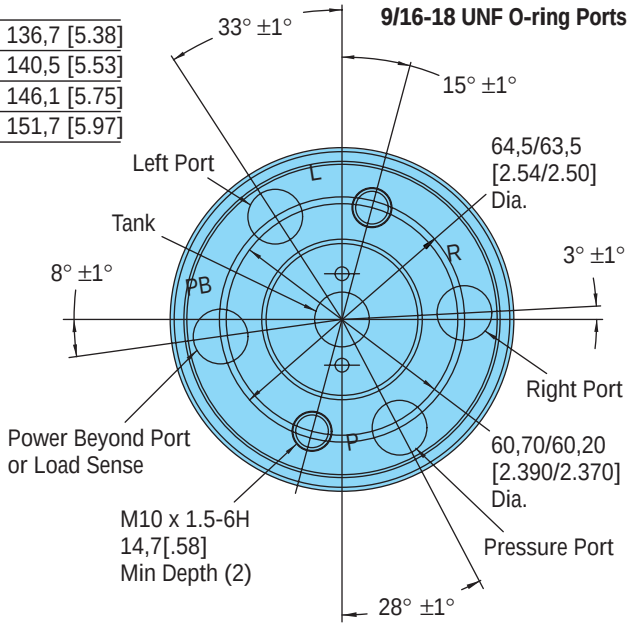
*Tilt Column Available

Installation Drawings — (end-ported unit with integral column configuration)



Displacement cm³/r [in³/r]	Y Dim. Max	X Dim. Max
60 [3.6]	14,35 [.565]	136,7 [5.38]
75 [4.5]	17,93 [.706]	140,5 [5.53]
95 [5.9]	23,52 [.926]	146,1 [5.75]
120 [7.3]	29,11 [1.146]	151,7 [5.97]



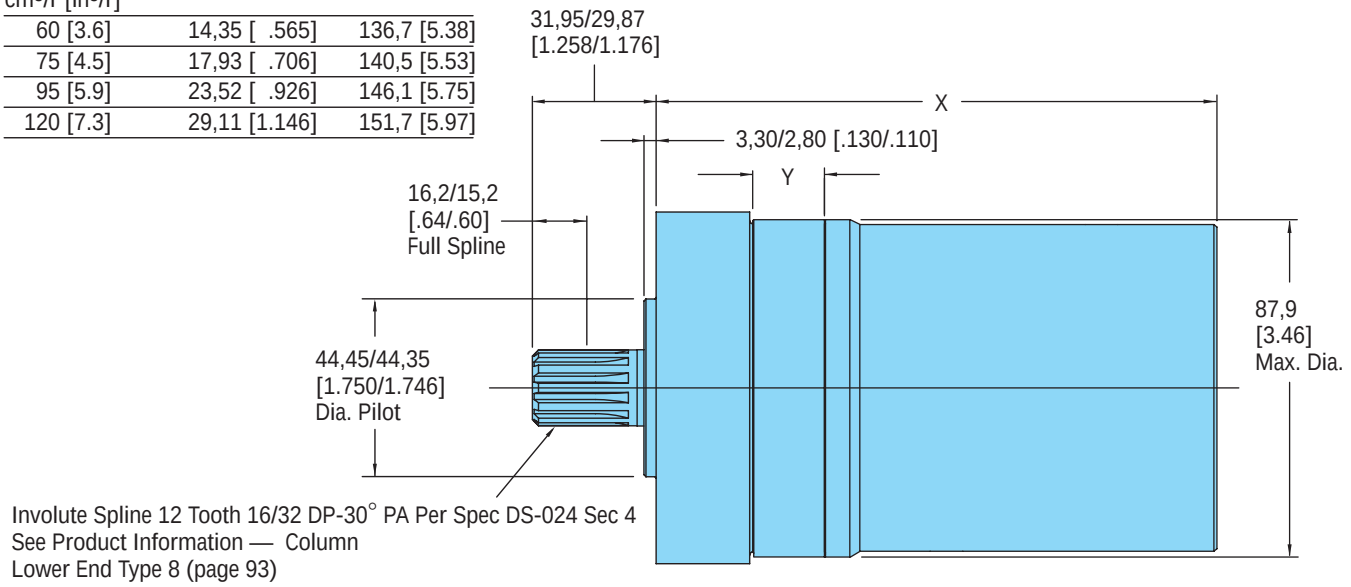


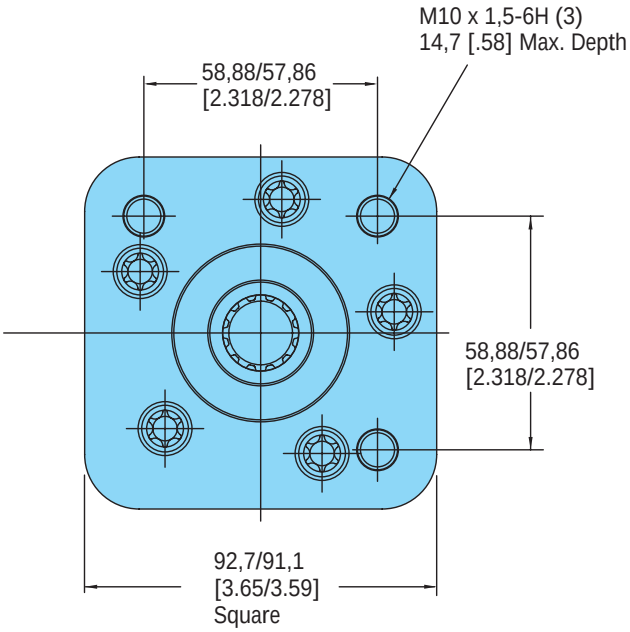
Product Information

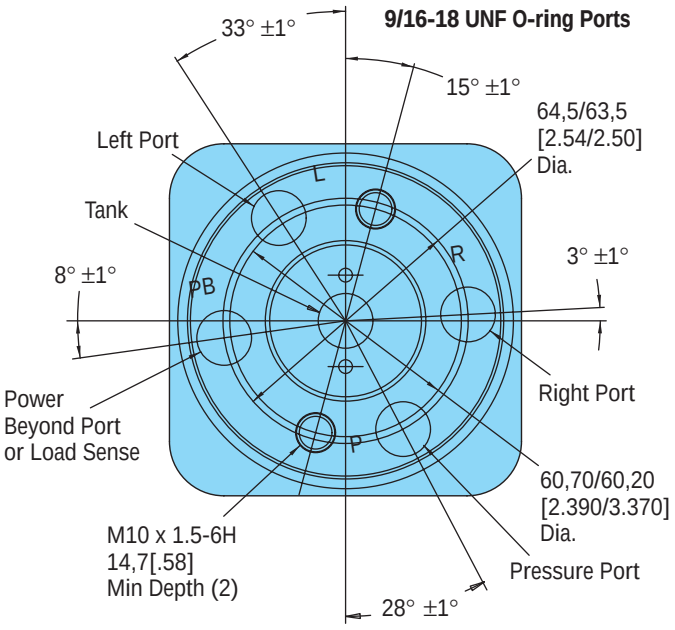
Steering Control Units — Series Flex 4

Installation Drawings — (end-ported unit with external column configuration)

Displacement cm^3/r [in^3/r]	Y Dim. Max	X Dim. Max
60 [3.6]	14,35 [.565]	136,7 [5.38]
75 [4.5]	17,93 [.706]	140,5 [5.53]
95 [5.9]	23,52 [.926]	146,1 [5.75]
120 [7.3]	29,11 [1.146]	151,7 [5.97]



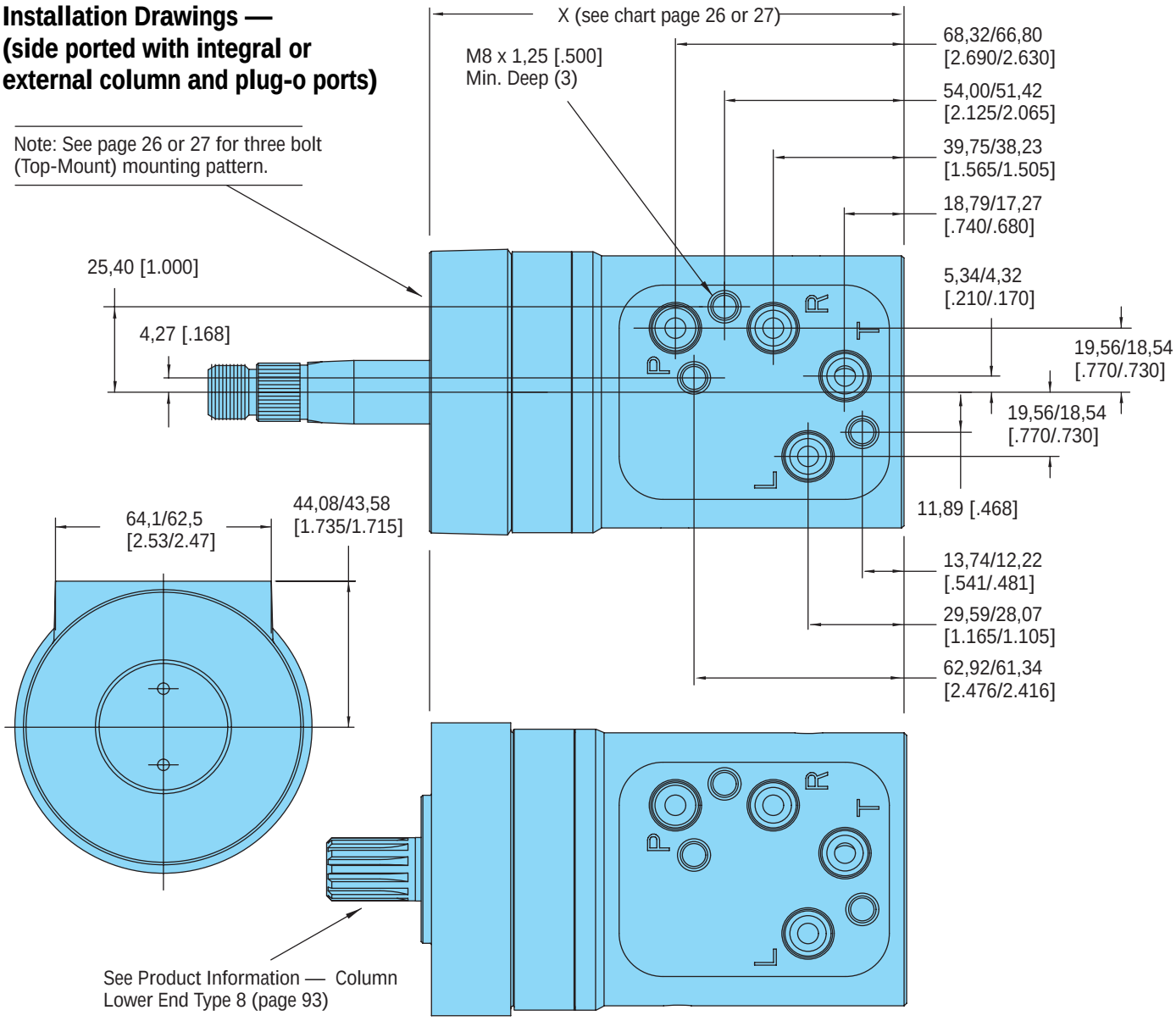




Product Information

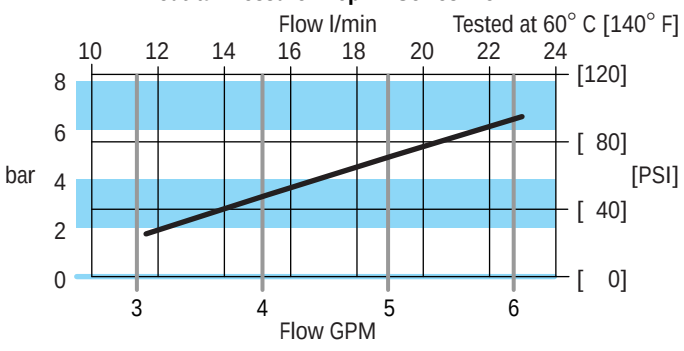
Steering Control Units — Series Flex 4

Installation Drawings — (side ported with integral or external column and plug-o ports)

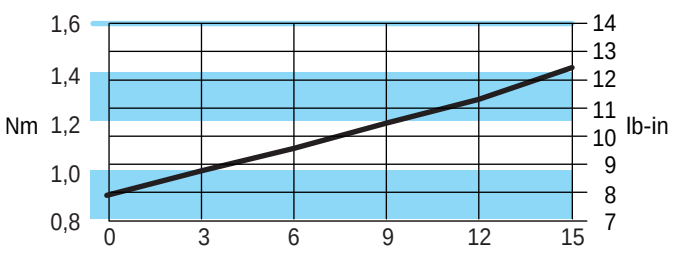


Performance Data

Neutral Pressure Drop — Series Flex 4



Input Torque — Series Flex 4



Product Information

Steering Control Units — Series Flex 4

Applications

- Lifttrucks
- Sweepers
- 50 HP Tractors
- Municipal Vehicles

Product Information

Steering Control Units — Series Flex 4

Model Code Ordering Information

The following 30-digit coding system has been developed to identify all of the configuration options for the Series Flex 4 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.

Model Code — Series Flex 4 Steering Control Units

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	C	Y		4	A			0		A											3	A	0	A	A	1	0		A

Position 1, 2, 3 **Product Series**

ACY ..... Series Flex 4 Steering Control Unit

Position 4 **Nominal Flow Rating**

2 ..... 15 l/min [4 GPM]

3 ..... 23 l/min [6 GPM]

Position 5 **Inlet Pressure Rating**

4 ..... 124 bar [1800 PSI]

Position 6 **Return Pressure Rating (Max)**

A ..... 10 bar [145 PSI]

Position 7-8 **Displacement cm³/r [in³/r]**

40 ..... 60 [3.6]

43 ..... 75 [4.5]

45 ..... 95 [5.9]

48 ..... 120 [7.3]

Position 9 **Flow Amplification**

0 ..... None

Position 10 **Neutral Circuit**

A ..... Open Center

B ..... Open Center with Power Beyond

F ..... Load Sensing, Dynamic Signal

Position 11 **Load Circuit**

A ..... Non-Load Reaction

Position 12, 13 **Integral Valve**

	Manual Steering Check	Inlet Check Valve	End Ported Units Only: Cylinder Relief Valve	End Ported Units Only: Anti-Cavitation Valve	Inlet Relief Valve
01	•				
04	•	•			
05	•				•
06	•	•			•
07	•			•	
08	•	•		•	
09	•		•	•	
10	•	•	•	•	
11	•		•	•	•
12	•	•	•	•	•

Position 14, 15 **Inlet or Load Sense Relief Valve — bar [PSI]**

00 .... None

34 .... 100 [1450]

3V .... 124 [1800]

Position 16, 17 **Cylinder Relief Valve — bar [PSI]**

00 .... None

4Z .... 159 [2310]

5S .... 185 [2680]

Position 18 **P, T, L, and R Port Size**

T ..... 4 x 9/16 -18 UNF-2B SAE O-ring Ports (Side Ported)

V ..... 4 x 9/16 -18 UNF-2B SAE O-ring Ports (End Ported)

C ..... 4 x 9/16 inch Dia. Plug-O Ports (Side Ported)

Position 19, 20 **Additional Ports**

AA ..... None

AD ..... 7/16-20 UNF-2B Load Sensing SAE O-ring Port

Position 21 **Mounting Threads**

U ..... 2 x M10 x 1.5 - 6H Port Face 3 x M10 x 1.5 - 6H Mounting Face

Position 22 **Input Torque**

3 ..... Standard

Position 23 **Fluid Type**

A ..... See Eaton Technical Bulletin 3-401

Position 24 **Special Application**

0 ..... None

Position 25, 26 **Special Features**

AA ..... None

Positon 27 **Paint**

1 ..... Black Primer

Position 28 **Identification**

0 ..... Eaton Product Number on Nameplate

Position 29 **Column Interface**

A ..... Tapered 17,919 [.7055] Dia., .083:1 and serrated 17,50 [.688] Dia. 40 Tooth, M16 x 1.5 - 6g Round Mounting Flange

B ..... External Column, external involute spline, 12 tooth, Square Mounting Flange

Position 30 **Eaton Assigned Design Code**

A ..... Assigned Design Code (-001)

B – Product Information

Steering Control Units — Series 3, 6, 12

Product Description

Traditional power steering units are available for applications that don't require integral valve capabilities. Typical application range from mid size lift trucks to large farm tractors.

The Series 3, 6 and 12 steering control units provide the following features…

- Valving—Reduced hydraulic noise level optimum flow gain characteristics on all models.

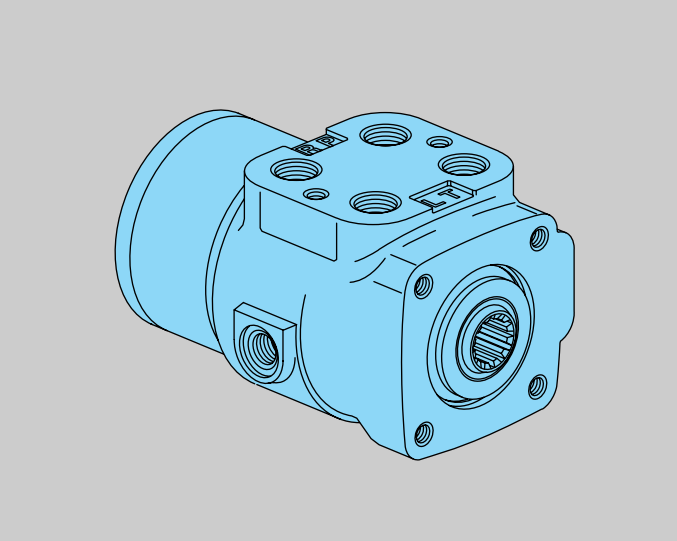
  3 basic systems—Open Center, Closed Center, Load Sensing

  3 flow options—designed for best control in different capacity steering circuits—11 l/min [3 GPM], 23 l/min [6 GPM], 45 l/min [12 GPM] rated flow.

  2 basic load circuits—load reaction, non load reaction
- Directly interchangeable with past and present applications.
- All models can operate at pressures up to 172 bar [2500 PSI]
- Twelve displacements—increments from 75 to 740 cm^3/r [4.5 to 45.1 in^3/r].
- Manual Steering check valve for limited manual steering.
- Available with fixed length columns.

Features

- Open Center
- Closed Center
- Load Sensing



Specifications

Max. System Pressure	172 bar [2500 PSI]
Max. Back Pressure	21 bar [300 PSI]
Rated Flow	
Series 3	7,5 - 15 l/min [2 - 4 GPM]
Series 6	15 - 30 l/min [4 - 8 GPM]
Series 12	30 -60 l/min [8 - 16 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 - 4,0 Nm @ 6,9 bar back pressure† [25 - 35 lb-in @ 100 PSI back pressure] †
Non Powered	136 Nm [100 lb-ft] maximum
Rotation Limits	None
Fluid	ATF Type A and most petroleum based fluids
Recommended Filtration	ISO 18/13 cleanliness level

† Low Torque Option Available

B – Product Information

Steering Control Units — Series 3, 6, 12

Standard Product Releases

Example: 211-1001-002
Product Number
Design Code

Series 3

System	Load Circuit	Rated* Flow l/min [GPM]	Port Size	Actual Displacement cm³/r [in³/r] — Product Number				
				75 [4.5]	95 [5.9]	120 [7.3]	145 [8.9]	160 [9.7]
Open Center	Non Load Reaction	7,5-15 [2-4]	9/16-18	211-1001	211-1002	211-1003	211-1157	—
Closed Center	Non Load Reaction	15 [4]	9/16-18	212-1009	212-1010	212-1011	212-1072	212-1012
	Load Reaction	15 [4]	9/16-18	212-1021	212-1022	212-1023	212-1073	212-1024

Series 6

System	Load Circuit	Rated* Flow l/min [GPM]	Port Size	Actual Displacement cm³/r [in³/r] — Product Number							
				75 [4.5]	95 [5.9]	120 [7.3]	145 [8.9]	160 [9.7]	185 [11.3]	230 [14.1]	295 [17.9]
Open Center	Non Load Reaction	15-30 [4-8]	3/4-16	211-1007	211-1008	211-1009	211-1137	211-1010	211-1011	211-1012	211-1158
	Load Reaction	15-30 [4-8]	3/4-16	211-1047	211-1048	211-1049	211-1159	211-1050	211-1051	211-1052	—
Closed Center	Non Load Reaction	30 [8]	3/4-16	212-1001	212-1002	212-1003	212-1069	212-1004	212-1005	212-1006	212-1070
Load †† Sensing	Non Load Reaction	30 [8]	3/4-16	213-4001	213-4002	213-4045	213-4042	213-4046	213-4043	213-4047	213-4044

Series 12

System	Load Circuit	Rated* Flow l/min [GPM]	Port Size	Actual Displacement cm³/r [in³/r] — Product Number			
				370 [22.6]	460 [28.2]	590 [35.9]	740 [45.1]
Open Center	Non Load Reaction	30-60 [8-16]	3/4-16	211-1038	211-1176	211-1160	211-1041
Closed Center	Non Load Reaction	60 [16]	3/4-16	212-1014	212-1015	212-1071	212-1017
Load †† Sensing	Non Load Reaction	60 [16]	3/4-16	213-4051	213-4048	213-4049	213-4050

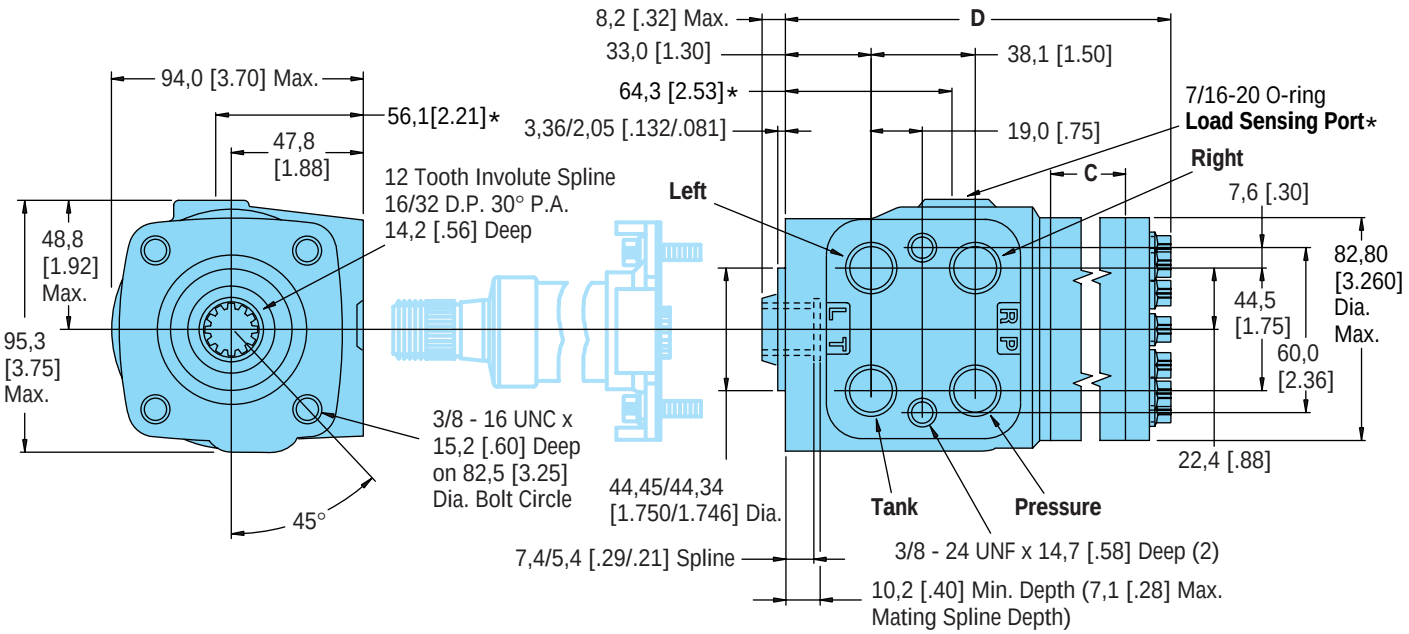
†† Low Torque Centering Springs

* For closed center unit, rated flow is measured at 70 bar [1000 PSI] pressure drop at full valve deflection. For load sensing unit, rated flow is designed for 4,5 bar [65 PSI] pressure drop between inlet (P) and load sensing (LS) port at full valve deflection.

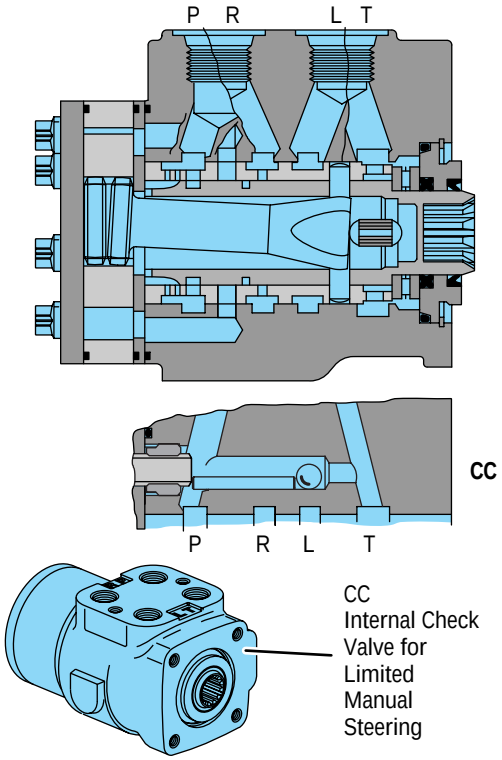
B – Product Information

Steering Control Units — Series 3, 6, 12

Installation Drawing



* Load Sensing Unit Only



Displacement cm³/r [in³/r]	Dimension **C** mm [in.]	Dimension **D** mm [in.]
75 [4.5]	10,2 [.40]	127,6 [5.03]
95 [5.9]	13,2 [.52]	130,7 [5.15]
120 [7.3]	16,5 [.65]	134,0 [5.28]
145 [8.9]	20,0 [.79]	137,6 [5.42]
160 [9.7]	21,8 [.86]	139,4 [5.49]
185 [11.3]	25,4 [1.00]	142,9 [5.63]
230 [14.1]	31,8 [1.25]	149,3 [5.88]
295 [17.9]	40,4 [1.59]	157,9 [6.22]
370 [22.6]	50,8 [2.00]	168,3 [6.63]
460 [28.2]	63,5 [2.50]	181,0 [7.13]
590 [35.9]	80,8 [3.18]	198,3 [7.81]
740 [45.1]	101,6 [4.00]	219,1 [8.63]

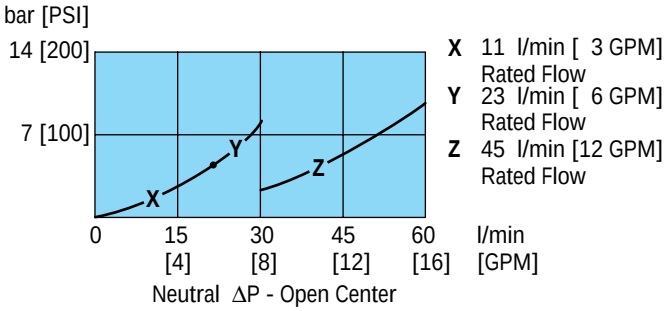
B – Product Information

Steering Control Units — Series 3, 6, 12

Pressure Drop Curves

Open Center Systems

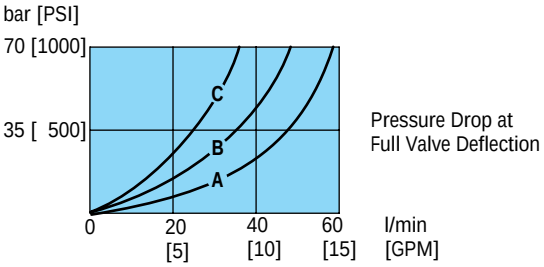
In an open center system, a fixed displacement pump delivers fluid to an open center valve. When steering is inactive, the fluid passes through the valve to the return port with relatively low pressure drop. For steering, this bypass closes to build up pressure to deliver flow through the load circuit.



X 11 l/min [3 GPM] Rated Flow
Y 23 l/min [6 GPM] Rated Flow
Z 45 l/min [12 GPM] Rated Flow

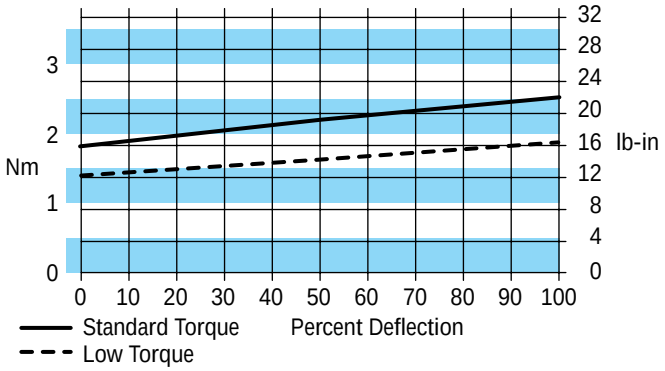
Closed Center and Load Sensing Systems

In a closed center and load sensing system, a pressure compensated variable displacement pump maintains constant pressure supply to a closed center valve. When steering is inactive, the valve is closed to system flow. For steering, the system flow is controlled according to the valve opening and load pressure through the load circuit.



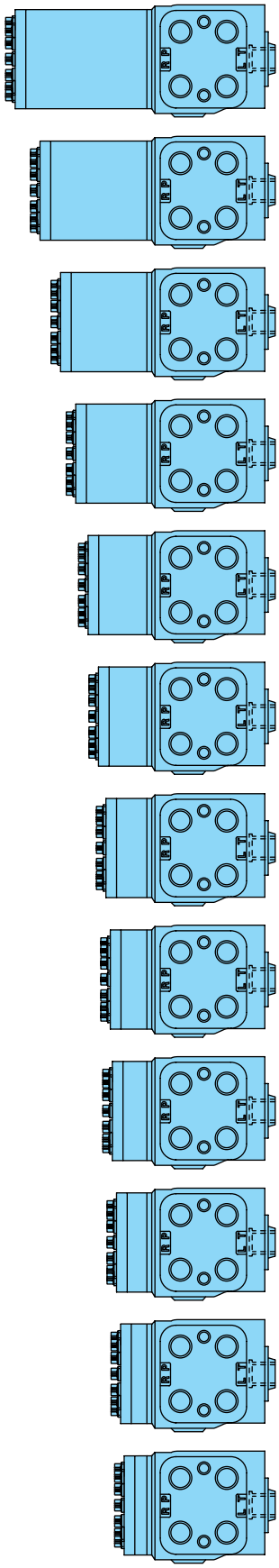
A Closed Center Non Load Reaction
60 l/min [16 GPM] Rated Flow
Load Sensing Non Load Reaction
45 l/min [12 GPM] Rated Flow
B Closed Center Non Load Reaction
45 l/min [12 GPM] Rated Flow
Load Sensing Non Load Reaction
23 l/min [6 GPM] Rated Flow
C Closed Center Non Load Reaction
30 l/min [8 GPM] Rated Flow

Input Torque Series 3, 6, 12



B – Product Information

Steering Control Units — Series 3, 6, 12



Applications

- Agricultural Equipment
- Construction Equipment
- Lawn and Garden Equipment
- Industrial and Material Handling

B – Product Information

Steering Control Units — Series 3, 6, 12

Model Code – Ordering Information

The following 29-digit coding system has been developed to identify all of the configuration options for the Series 3, 6, 12 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.

Model Code — Series 3, 6, 12 Steering Control Units

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	U		5	A			0			0	1	0	0	0	0						A	0	A	A	1	0	B

Position 1, 2, 3 **Product Series**

ABU ..... Series 3, 6, 12 Steering Control Unit

Position 4 **Nominal Flow Rating**

1 ..... 11 l/min [3 GPM]

3 ..... 23 l/min [6 GPM]

5 ..... 45 l/min [12 GPM]

Position 5 **Inlet Pressure Rating**

5 ..... 172 bar [2500 PSI]

Position 6 **Tank Pressure Rating**

A ..... 10 bar [145 PSI]

Position 7-8 **Displacement cm^3/r [in^3/r]**

43 ..... 75 [4.5] — Series 3 Only

45 ..... 95 [5.9] — Series 3 Only

48 ..... 120 [7.3] — Series 3 Only

50 ..... 145 [8.9] — Series 3 Only

51 ..... 160 [9.7] — Series 3 Only

52 ..... 185 [11.3] — Series 6 Only

54 ..... 230 [14.1] — Series 6 Only

57 ..... 295 [17.9] — Series 6 Only

59 ..... 370 [22.6] — Series 12 Only

61 ..... 460 [28.2] — Series 12 Only

64 ..... 590 [35.9] — Series 12 Only

66 ..... 740 [45.1] — Series 12 Only

Position 9 **Flow Amplification**

0 ..... None

Position 10 **Neutral Circuit**

A ..... Open Center

C ..... Closed Center

F ..... Load Sensing, Dynamic Signal

Position 11 **Load Circuit**

A ..... Non-Load Reaction

B ..... Load Reaction (open center Series 3, 6 only)

Position 12, 13 **Integral Valve**

01 ..... Manual Steering check

Position 14, 15 **Integral Inlet Relief Valve Pressure Settings**

00 ..... None

Position 16, 17 **Cylinder Relief Valve**

00 ..... None

Position 18, 19, 20, 21 **Ports and Mounting Threads**

BAAC ..... 4 x 9/16 SAE Ports, 3/8 inch Mounting Threads (Use with 11 l/min [3 GPM Open Center Units Only)

DAAC ..... 4 x 3/4 SAE Ports, with 3/8 inch Mounting Threads (Use with 23,45 l/min [6,12 GPM] Open Center Units Only)

DACC ..... 4 x 3/4 SAE Ports, with 7/16 SAE Load Sensing Port on Side, 3/8 inch Mounting Threads (Use with Load Sensing Units)

Position 22 **Input Torque**

1 ..... Low

3 ..... Standard

Position 23 **Fluid Type**

A ..... See Eaton Technical Bulletin 3-401

Position 24 **Special Application**

0 ..... None

Position 25, 26 **Special Features**

AA ..... None

Positon 27 **Paint**

1 ..... Black Primer

Position 28 **Identification**

0 ..... Eaton Product Number on Nameplate

Position 29 **Eaton Assigned Design Code**

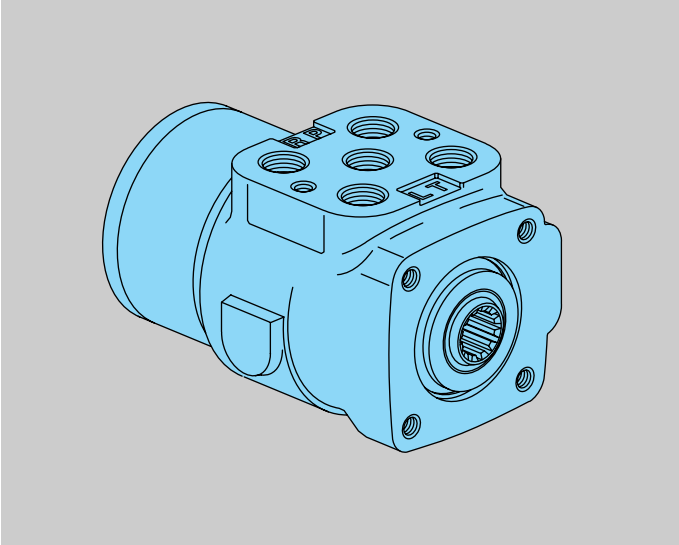
B ..... Assigned Design Code

B – Product Information
Steering Control Units — Series 4

Product Description

This series of power steering units is available for light to medium duty applications on smaller size vehicles. It offers some of the same features of the current Series 3, 6, and 12 .

- Reliability—Uses the same basic design that has been proven in many years of field application in different industries.
- Quality—All parts are produced on high speed time proven tooling.
- Adaptability—Mounting, spline interface, port spacing and columns identical to standard Char-Lynn units offer versatility in installation.
- Performance—Equal to standard Char-Lynn units at respective pressure levels. Valving recenters reliably, preventing overheating or control problems. Valving seals the cylinder ports to prevent control problems due to external forces acting on steering actuator. Low input torque required especially during fast steering maneuvers. Uniform, smooth input effort offers easy and comfortable control.
- 3 Basic Systems—Open center, open center with power beyond, and load sensing.
- Check Valve— for limited manual steering (see page 12).
- All models now operate at pressures up to 124 bar [1800 PSI].



Features

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

Specifications (Four Port)

Max. System Pressure	124 bar [1800 PSI]
Max. Back Pressure	21 bar [300 PSI]
Rated Flow	
4 Port	15 l/min [4 GPM]
Max. System Operating Temperature	93°C [200° F]
Max. Differential Between Steering Unit and System Temperature	28°C 50° F
Input Torque	
Powered	1,7 - 2,8 Nm @ 6,9 bar back pressure [15 - 25 lb-in @ 100 PSI Tank pressure]
Non Powered	81,4 Nm [60 lb-ft] maximum
Rotation Limits	None
Fluid	ATF Type A and most petroleum based fluids
Recommended Filtration	ISO 18/13 cleanliness level

Specifications (Five Port)

Max. System Pressure	124 bar [1800 PSI]
Max. Auxiliary Pressure	124 bar [1800 PSI]
Max. Back Pressure	10 bar [150 PSI]
Rated Flow	
5 Port (Power Beyond)	15 l/min [4 GPM]
Max. System Operating Temperature	93°C [200° F]
Max. Differential Between Steering Unit and System Temperature	28°C 50° F
Input Torque	
Powered	1,7 - 2,8 Nm @ 6,9 bar back pressure [15 - 25 lb-in @ 100 PSI Tank pressure]
Non Powered	136 Nm [100 lb-ft] maximum
Rotation Limits	None
Fluid	ATF Type A and most petroleum based fluids
Recommended Filtration	ISO 18/13 cleanliness level

B – Product Information

Steering Control Units — Series 4

Standard Product Releases

Example: 241-1001-002
Product Number
Design Code

Series 4

System	Signal	Load Circuit	Rated Flow l/min [GPM]	Port Size	Actual Displacement cm³/r [in³/r] — Product Number				
					45 [2.8]	60 [3.6]	75 [4.5]	95 [5.9]	120 [7.3]
Open Center	N/A	Non Load Reaction	15 [4]	9/16-18	241-1001	—	241-1002	241-1003	241-1004
Load †† Sensing	Static	Non Load Reaction	15 [4]	9/16-18	243-1008	243-1009	243-1010	243-1011	243-1012

†† Low Torque Centering Springs

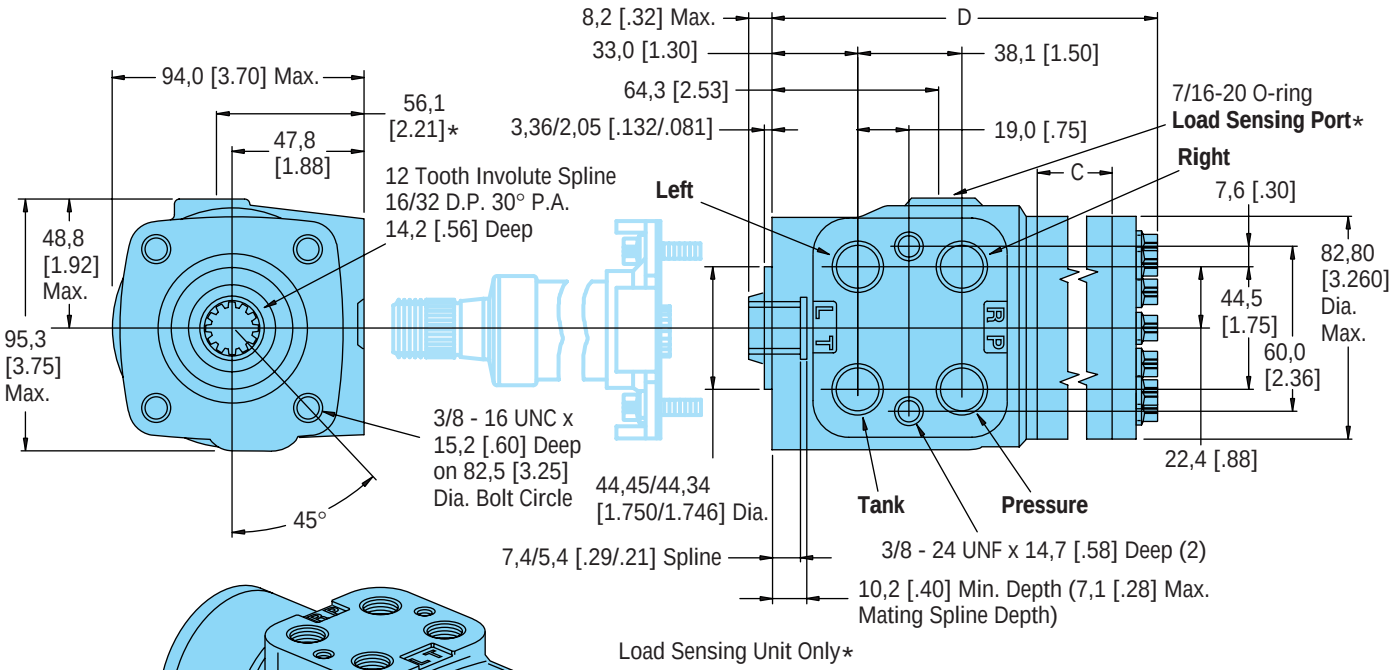
Series 4 with Power Beyond

System	Signal	Load Circuit	Rated Flow l/min [GPM]	Port Size	Actual Displacement cm³/r [in³/r] — Product Number				
					45 [2.8]	60 [3.6]	75 [4.5]	95 [5.9]	120 [7.3]
Open Center	N/A	Non Load Reaction	15 [4]	9/16-18	241-5025	241-5026	241-5027	241-5028	241-5029

B – Product Information

Steering Control Units — Series 4 (Four Port)

Installation Drawing

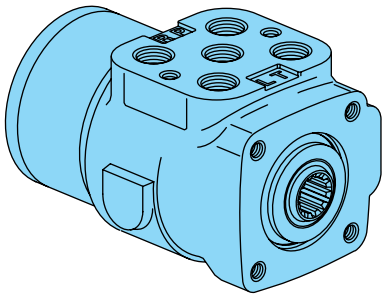


Displacement cm³/r [in³/r]	C Max. mm [in.]	D Max. mm [in.]
45 [2.8]	6,4 [.25]	123,9 [4.88]
60 [3.6]	10,2 [.40]	127,6 [5.03]
75 [4.5]	10,2 [.40]	127,6 [5.03]
95 [5.9]	13,2 [.52]	130,7 [5.15]
120 [7.3]	16,5 [.65]	134,0 [5.28]

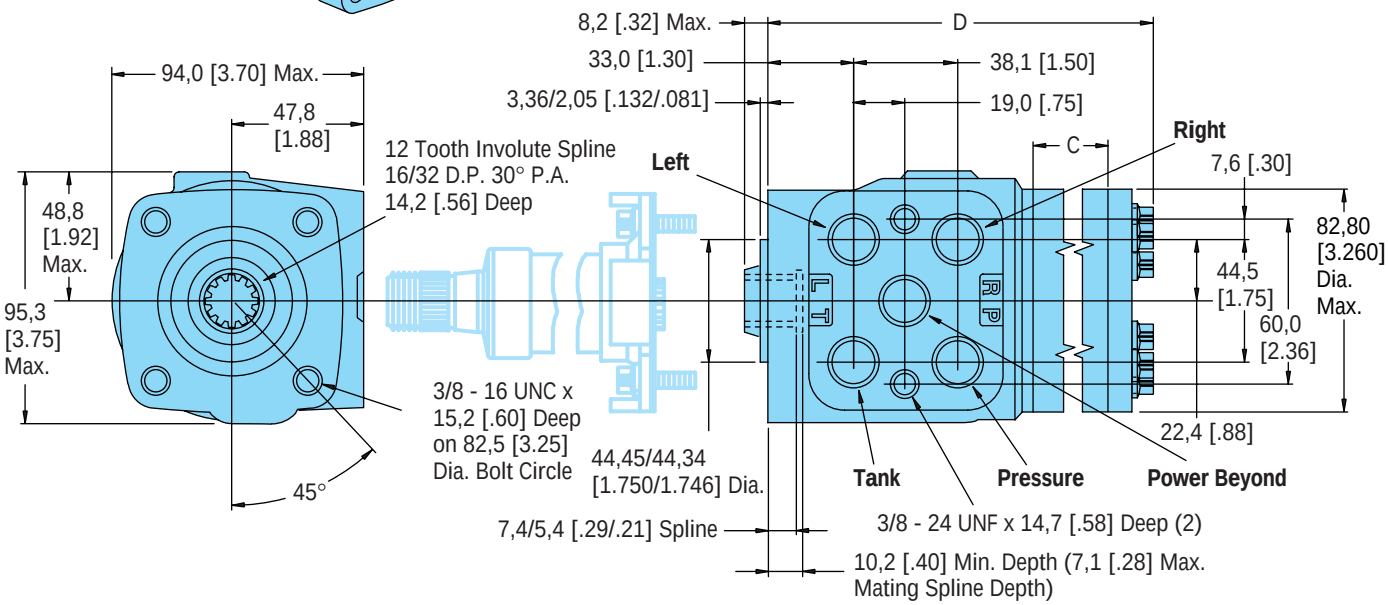
B – Product Information

Steering Control Units — Series 4 (Five Port)

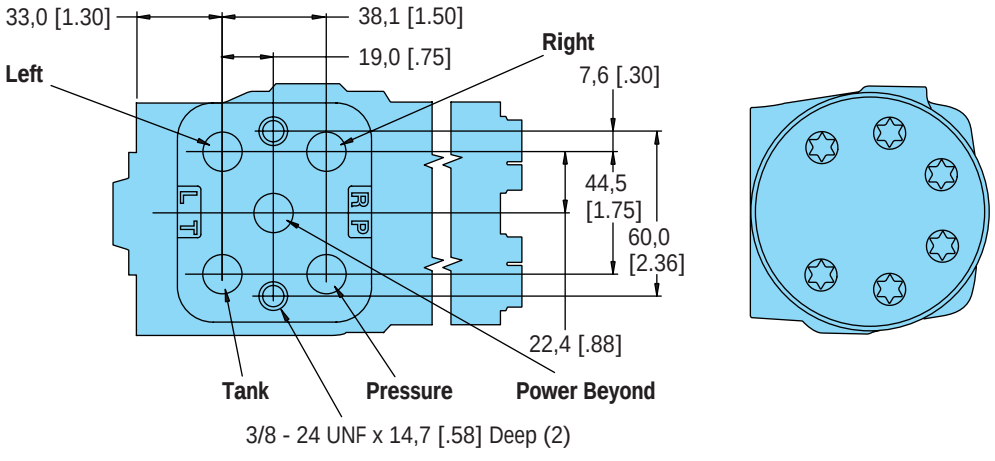
Installation Drawing



Displacement cm³/r [in³/r]	C Max. mm [in.]	D Max. mm [in.]
45 [2.8]	6,4 [.25]	123,9 [4.88]
60 [3.6]	10,2 [.40]	127,6 [5.03]
75 [4.5]	10,2 [.40]	127,6 [5.03]
95 [5.9]	13,2 [.52]	130,7 [5.15]
120 [7.3]	16,5 [.65]	134,0 [5.28]



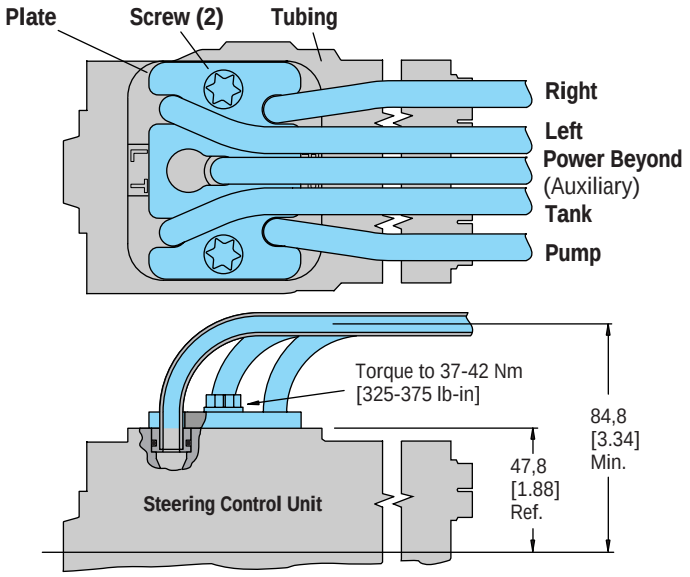
Plug-O Ports **9/18-18 Ports**

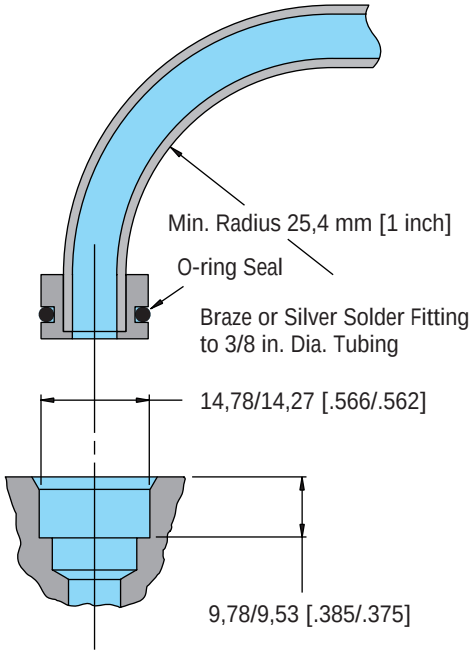


B – Product Information

Steering Control Units — Series 4

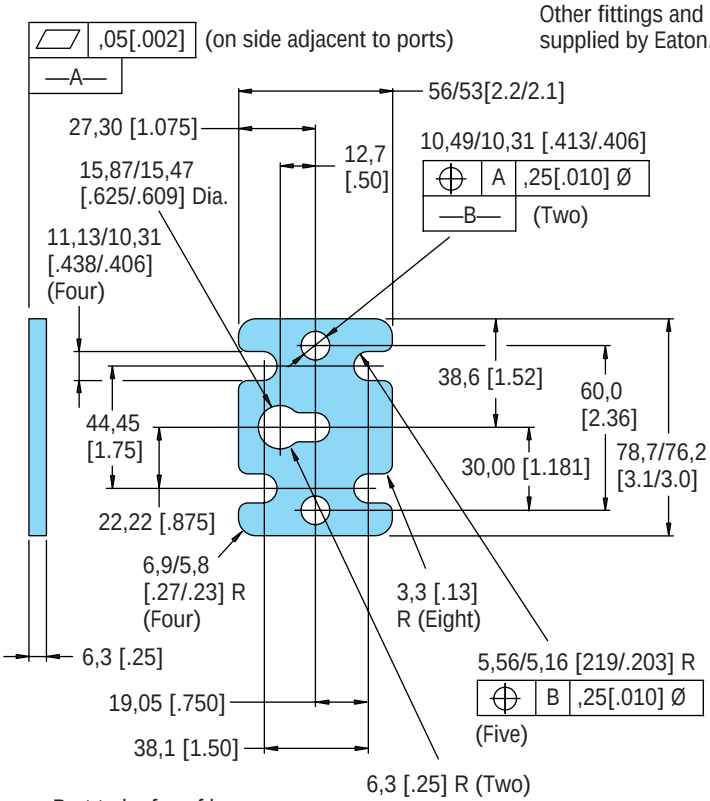
Installation Drawing





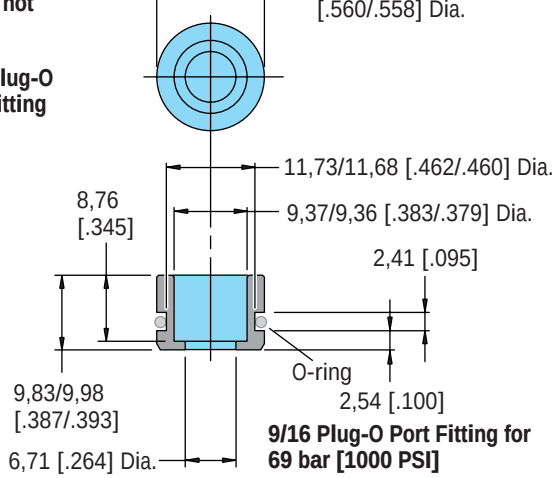
9/16 Plug-O Port Plate

Note: The plug-o port plate is avalable from Eaton – part number **22861-000**. Other fittings and bolts are **not** supplied by Eaton.

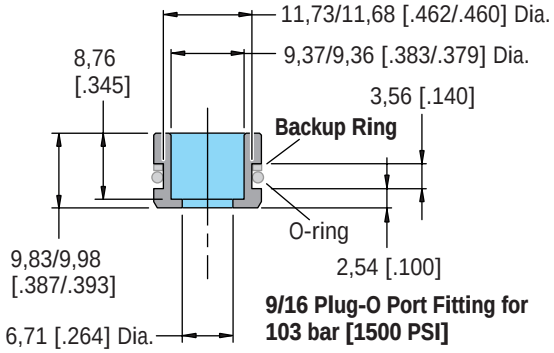


- Part to be fee of burrs
- Tolerance Unless Otherwise Specified
  ,x ± ,5
  ,xx ± ,08
  [.xx ± .01]
  [.xxx ± .003]

9/16 Plug-O Port Fitting



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



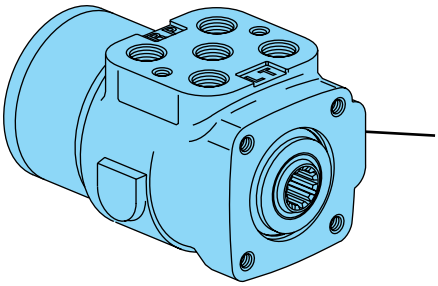
9/16 Plug-O Port Fitting for 103 bar [1500 PSI]

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

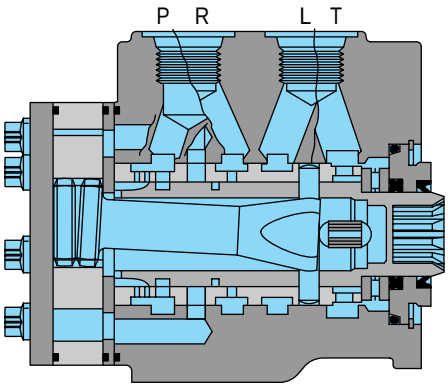
B – Product Information

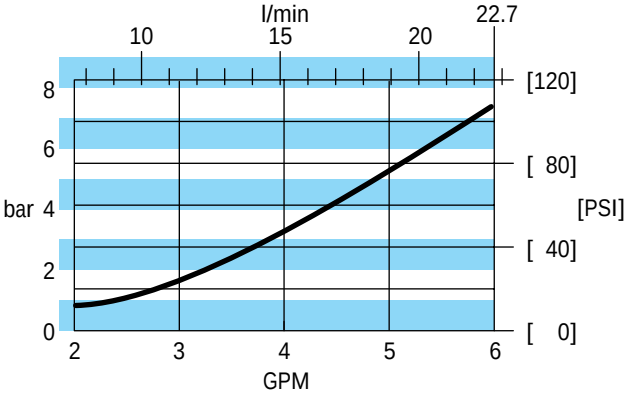
Steering Control Units — Series 4

Performance Data

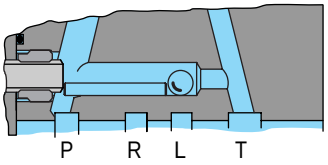


CC
Internal Check Valve for Limited Manual Steering

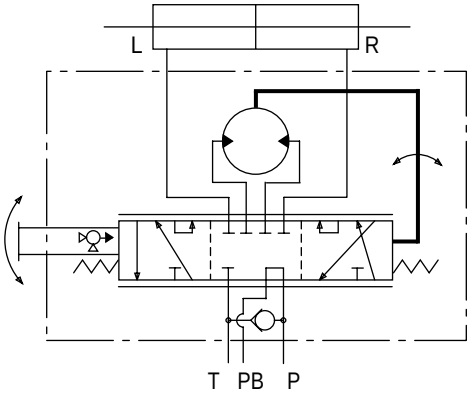


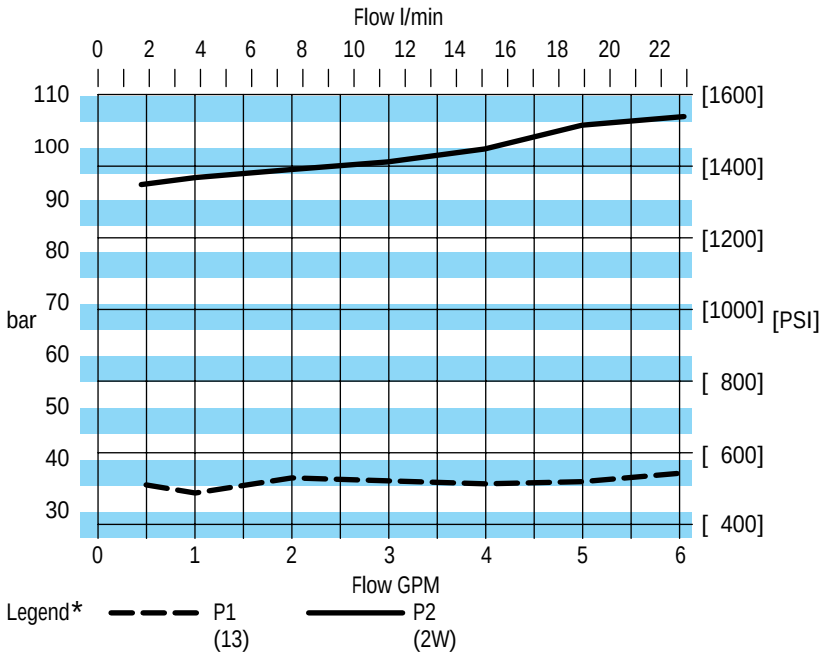


Neutral Pressure Drop Inlet to Auxiliary



CC





Inlet Relief Pressure Rise

*The examples above are two of seven pressure settings shown in model code page 37 Position 14, 15.

B – Product Information

Steering Control Units — Series 4

Model Code – Ordering Information

The following 29-digit coding system has been developed to identify all of the configuration options for the Series 4 steering control unit. 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.

Model Code — Series 4 Steering Control Units

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	T	2	4	A			0						0	0	0						A		A	A	1	0	B

Position 1, 2, 3 **Product Series**

ABT ..... Series 4 Steering Control Unit

Position 4 **Flow Rating**

2 ..... 15 l/min [4 GPM]

Position 5 **Inlet Pressure Rating**

4 ..... 124 bar [1800 psi]

Position 6 **Return Pressure Rating**

A ..... 10 bar [150 psi]

Position 7, 8 **Displacement cm³/r [in³/r]**

38 ..... 45 [2.8]

40 ..... 60 [3.6]

43 ..... 75 [4.5]

45 ..... 95 [5.9]

48 ..... 120 [7.3]

Position 9 **Flow Amplification**

0 ..... None

Position 10 **Neutral Circuit**

A ..... Open Center

B ..... Open Center with Power Beyond

F ..... Load Sensing Dynamic Signal

Position 11 **Load Circuit**

A ..... Non-Load Reation

Position 12, 13 **Integral Valves**

01 ..... Manual Steering Check Valve

05 ..... Manual Steering Check Valve, Inlet Relief Valve

Position 14, 15 **Integral Inlet Relief Valve Pressure Setting**

00 ..... None

13 ..... 35 bar [508 psi]

1J ..... 50 bar [725 psi]

1Z ..... 63 bar [914 psi]

25 ..... 69 bar [1000 psi]

2G ..... 80 bar [1160 psi]

2W ..... 93 bar [1350 psi]

3M ..... 117 bar [1700 psi]

Position 16, 17 **Cylinder Relief Valve Setting**

00 ..... None

Position 18, 19, 20, 21 **Ports and Mounting Threads**

BAAC ..... 4 x 9/16 SAE Ports, 3/8 Mounting Threads (use with Open Center)

BACC ..... 4 x 9/16 SAE Ports, 7/16 Load Sensing on side, 3/8 Mounting Threads (use with Load Sensing Unit)

BAKC ..... 5 x 9/16 SAE Ports, 3/8 Mounting Threads (use with Power Beyond)

BAMC ..... 4 x 9/16 SAE Ports, 7/16 SAE (EMSS) port on Port face, 7/16 SAE Load Sensing Port on side, 3/8 Mounting Threads (use with Load Sensing EMSS)

Position 22 **Input Torque**

1 ..... Low

3 ..... Standard

Position 23 **Fluid Type**

A ..... See Eaton Technical Bulletin 3-401

Position 24 **Special Application**

0 ..... None

3 ..... EMSS

4 ..... EMSS with Drain

Position 25, 26 **Special Features**

AA ..... None

Position 27 **Paint**

1 ..... Black Primer

Position 28 **Indentification**

0 ..... Eaton Product Number

Position 29 **Design Code**

B ..... Eaton Assigned Number

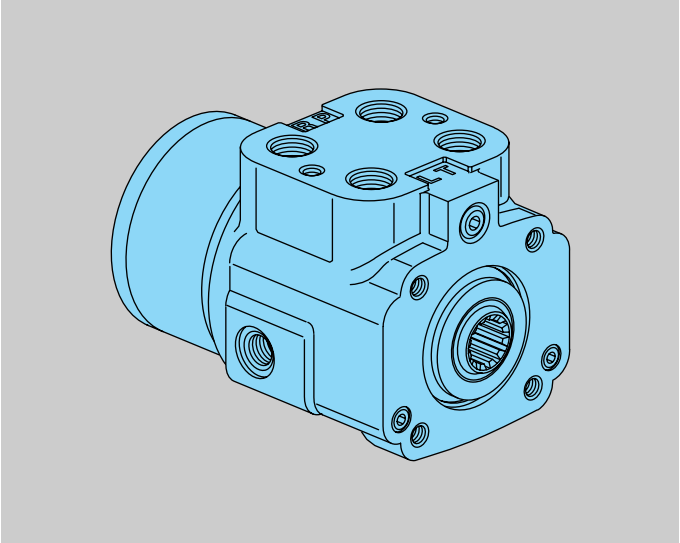
B – Product Information

Steering Control Units — Series 110, 230, 450

Product Description

Up to six integral valves are available for the Char-Lynn Series 110, 230, and 450 steering control unit. Included are: inlet relief valve, cylinder port shock valves, inlet check valves and anti-cavitation valves for cylinder ports. In addition, an internal check valve for limited manual steering is included. This three group series is available with several combinations of valves as well as three different port and mounting bolt combinations. The charts on page 45, 46, and 47 show the most common combinations of each series.

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



Features

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

Specifications

Max. System Pressure	241 bar [3500 PSI]
Max. Back Pressure	21 bar [300 PSI]
Rated Flow	
Series 110	7,5 - 15 l/min [2 - 4 GPM]
Series 230	15 - 30 l/min [4 - 8 GPM]
Series 450	30 -60 l/min [8 - 16 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 - 4,0 Nm @ 6,9 bar back pressure†† [25 - 35 lb-in @ 100 PSI back pressure] ††
Non Powered	136 Nm [100 lb-ft] maximum
Rotation Limits	None
Fluid	ATF Type A and most petroleum based fluids
Recommended Filtration	ISO 18/13 cleanliness level

†† Low Torque Option Available

B – Product Information Steering Control Units — Series 110, 230, 450

Standard Product Releases

Select product number from chart or use model code (page 54 and 55) for combinations that differ from features shown below.

Example: 261-1031-0XX
Product Number
Design Level

The product number (left) describes a Series 110 open center, non-load reaction, 7,5 - 15 l/min [2-4 GPM], 3/4-16 ports, "12" option, 120 cm^3/r [7.3 in^3/r] 124 bar [1800 PSI] inlet relief pressure, 185 bar [2675 PSI] shock valve pressure.

Series 110

System	Signal	Load Circuit	Rated Flow l/min [GPM]	Port Size	Valve Options (see Chart Below)	Actual Displacement cm^3/r [in^3/r] – Product Number		
						75 [4.5]	95 [5.9]	120 [7.3]
Open Center	N/A	Non Load Reaction	7,5-15 [2-4]	3/4-16	**12**	**261**-1029-042	**261**-1408-002	**261**-1031-042
				G1/2 (BSP)	**12**	**261**-1409-002	**261**-1002-042	**261**-1003-042
					01	**261**-1008-002	**261**-1009-002	**261**-1010-002
				M18 x 1,5	**12**	**261**-1328-002	**261**-1410-002	**261**-1411-002
					01	**261**-1022-002	**261**-1023-002	**261**-1024-002

Explanation of valve options

12 Steering Control with:
- Inlet Check Valve
- Cylinder Port Shock Valves — 235 bar [3410 PSI]
- Anti-cavitation Valve for Cylinder Ports
- Inlet Relief Valve — 176 bar [2550 PSI]

01 Steering Control without Integral Valves

Product numbers on this page are steering control units with valve option noted. Use model code on page 54 and 55 when ordering any other valve combinations.

B – Product Information Steering Control Units — Series 110, 230, 450

Standard Product Releases

Select product number from chart or use model code (page 54 and 55) for combinations that differ from features shown below.

Example: 261-1413-0XX
Product Number
Design Code

The product number (left) describes a Series 230 open center, non-load reaction, 15-30 l/min [4-8 GPM], 3/4-16 ports, "12" option, 295 cm^3/r [17.9 in^3/r] 124 bar [1800 PSI] inlet relief pressure, 185 bar [2675 PSI] shock valve pressure.

Series 230

System	Signal	Load Circuit	Rated Flow l/min [GPM]	Port Size	Valve Options (see Chart Below)	Actual Displacement cm^3/r [in^3/r] – Product Number							
						75 [4.5]	95 [5.9]	120 [7.3]	145 [8.9]	160 [9.7]	185 [11.3]	230 [14.1]	295 [17.9]
Open Center	N/A	Non Load Reaction	15-30 [4-8]	3/4-16	**12**				**261**-1412-002	1032-042	1033-042	1034-042	1413-002
				G1/2 (BSP)	**12**				**261**-1159-042	1004-042	1005-042	1006-042	1160-042
					01				**261**-1161-002	1011-002	1012-002	1013-002	1162-002
				M18 x 1,5	**12**				**261**-1414-002	1415-002	1416-002	1330-002	1417-002
					01				**261**-1165-002	1025-002	1026-002	1027-002	1166-002
Load Sensing	Static	Non Load Reaction	30 [8]	3/4-16	**10**	**263**-1029-082	1210-002	1211-002	1212-002	1157-002	1213-002	1034-082	1097-082
				G1/2 (BSP)	**10**	**263**-1173-002	1002-082	1003-082	1214-002	1004-082	1005-082	1215-002	1098-082
					01	**263**-1008-002	1009-002	1010-002	1094-002	1011-002	1012-002	1013-002	1099-002
				M18 x 1,5	**10**	**263**-1216-002	1217-002	1218-002	1219-002	1220-002	1019-082	1020-082	1221-002
					01	**263**-1022-002	1023-002	1024-002	1096-002	1025-002	1026-002	1027-002	1101-002
Load †† Sensing	Dynamic	Non Load Reaction	30 [8]	3/4-16	**10**	**263**-4405-002	4406-002	4407-002	4408-002	4409-002	4045-082	4283-002	4410-002
				G1/2 (BSP)	**10**	**263**-4047-082	4048-082	4049-082	4411-002	4051-002	4052-082	4053-082	4076-082
					01	**263**-4054-002	4055-002	4056-002	4057-002	4058-002	4059-002	4060-002	4077-002
				M18 x 1,5	**10**	**263**-4412-002	4062-002	4413-002	4414-002	4415-002	4066-082	4067-082	4416-002
					01	**263**-4068-002	4069-002	4070-002	4071-002	4072-002	4073-002	4074-002	—

†† Low Torque Centering Springs

The part number prefix 261- (open center units) or 263- (load sensing units) needs to be applied in front of every part number in the table, when ordering.

Explanation of valve options

10 Steering Control with:
- Inlet Check Valve
- Cylinder Port Shock Valves — 235 bar [3410 PSI]
- Anti-cavitation Valve for Cylinder Ports

12 Steering Control with:
- Inlet Check Valve
- Cylinder Port Shock Valves — 235 bar [3410 PSI]
- Anti-cavitation Valve for Cylinder Ports
- Inlet Relief Valve — 176 bar [2550 PSI]

01 Steering Control without Integral Valves

Product numbers on this page are steering control units with valve option noted. Use model code on page 54 and 55 when ordering any other valve combinations, or pressure settings

B – Product Information Steering Control Units — Series 110, 230, 450

Standard Product Releases

Select product number from chart or use model code (page 54 and 55) for combinations that differ from features shown below.

Example: 261-1420-0XX
Product Number **Design Code**

The product number (left) describes a Series 450 open center, non-load reaction, 30-60 l/min [8-16 GPM], 3/4-16 ports, "12" option, 740 cm^3/r [45.1 in^3/r] 124 bar [1800 PSI] inlet relief pressure, 185 bar [2675 PSI] shock valve pressure.

Series 450

System	Signal	Load Circuit	Rated Flow l/min [GPM]	Port Size	Valve Options (see Chart Below)	Actual Displ. cm^3/r [in^3/r] – Product Number			
						370 [22.6]	460 [28.2]	590 [35.9]	740 [45.1]
Open Center	N/A	Non Load Reaction	30-60 [8-16]	3/4-16	**12**	**261**-1226-042	1418-002	1419-002	1420-002
				G1/2 (BSP)	**12**	**261**-1421-002	1422-002	1423-002	1424-002
					01	**261**-1425-002	1426-002	1427-002	1428-002
				M18 x 1,5	**12**	**261**-1234-042	1429-002	1313-002	1430-002
					01	**261**-1431-002	1432-002	1433-002	1434-002
Load Sensing	Static	Non Load Reaction	60 [16]	3/4-16	**09**	**263**-1103-002	1222-002	1159-002	1223-002
				G1/2 (BSP)	**01**	**263**-1047-002	1048-002	1111-002	1112-002
					09	**263**-1224-002	1225-002	1226-002	1227-002
				M18 x 1,5	**01**	**263**-1053-002	1054-002	1117-002	1118-002
					09	**263**-1228-002	1229-002	1230-002	1231-002
Load †† Sensing	Dynamic	Non Load Reaction	60 [16]	3/4-16	**09**	**263**-4417-002	4418-002	4082-082	4419-002
				G1/2 (BSP)	**01**	**263**-4088-002	4089-002	4090-002	4091-002
					09	**263**-4084-082	4085-082	4086-082	4087-082
				M18 x 1,5	**01**	**263**-4096-002	4097-002	4098-002	4099-002
					09	**263**-4420-002	4421-002	4422-002	4423-002

†† Low Torque Centering Springs

The part number prefix 261- (open center units) or 263- (load sensing units) needs to be applied in front of every part number in the table, when ordering.

Explanation of valve options

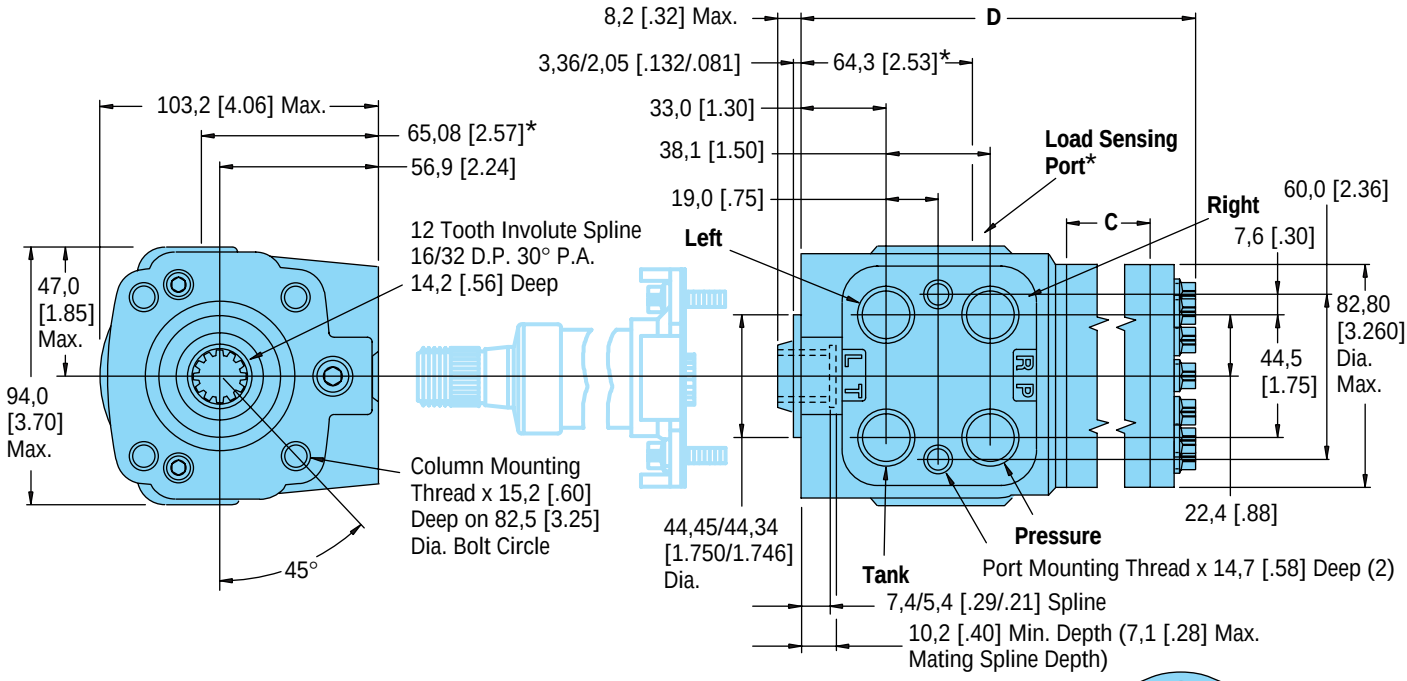
12	Steering Control with: • Inlet Check Valve • Cylinder Port Shock Valves — 235 bar [3410 PSI] • Anti-cavitation Valve for Cylinder Ports • Inlet Relief Valve — 176 bar [2550 PSI]
01	Steering Control without Integral Valves
09	Steering Control with: • Cylinder Port Shock Valves — 235 bar [3410 PSI] • Anti-cavitation Valve for Cylinder Ports

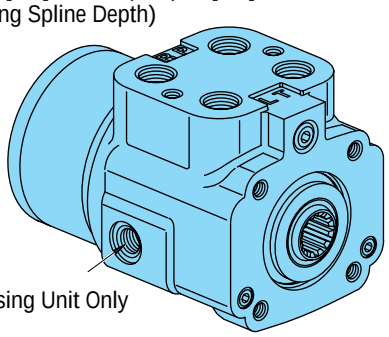
Product numbers on this page are steering control units with valve option noted. Use model code on page 54 and 55 when ordering any other valve combinations.

B – Product Information

Steering Control Units — Series 110, 230, 450

Installation Drawing





LS Port—Load Sensing Unit Only

Displacement cm³/r [in³/r]	Dimension **C** mm [in.]	Dimension **D** mm [in.]
75 [4.5]	10,2 [.40]	127,6 [5.03]
95 [5.9]	13,2 [.52]	130,7 [5.15]
120 [7.3]	16,5 [.65]	134,0 [5.28]
145 [8.9]	20,0 [.79]	137,6 [5.42]
160 [9.7]	21,8 [.86]	139,4 [5.49]
185 [11.3]	25,4 [1.00]	142,9 [5.63]
230 [14.1]	31,8 [1.25]	149,3 [5.88]
295 [17.9]	40,4 [1.59]	157,9 [6.22]
370 [22.6]	50,8 [2.00]	168,3 [6.63]
460 [28.2]	63,5 [2.50]	181,0 [7.13]
590 [35.9]	80,8 [3.18]	198,3 [7.81]
740 [45.1]	101,6 [4.00]	219,1 [8.63]

Port and Mounting Thread Combinations

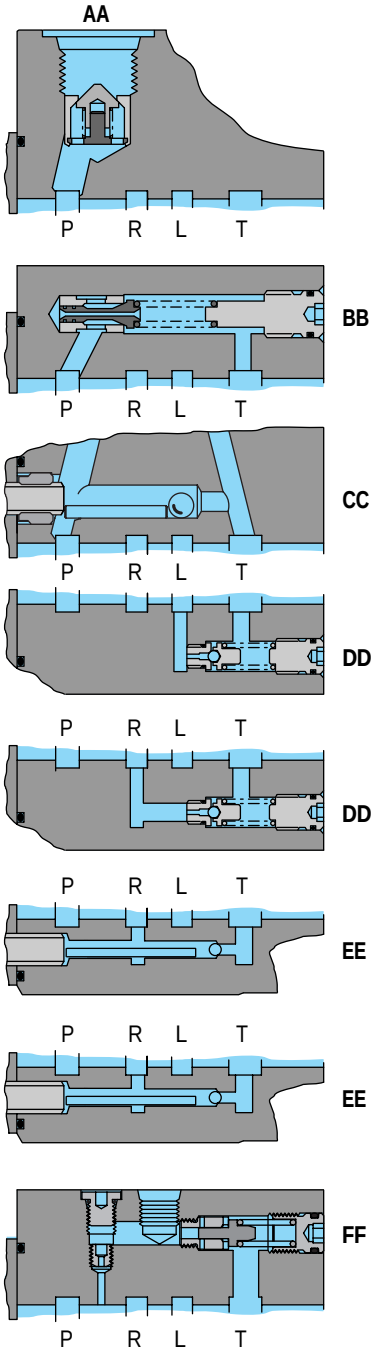
Port	Column Mounting Thread	Load Sensing* Port	Port Mounting Thread
3/4 -16	3/8 - 16	7/16 - 20	3/8 - 24
G1/2 (BSP)	M10 x 1,5	G1/4 (BSP)	M10 x 1,0
M18	M10 x 1,5	M12	M10 x 1,0

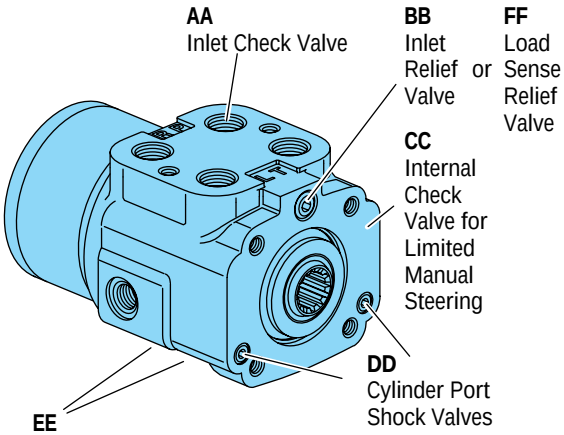
*Load Sensing Units Only.

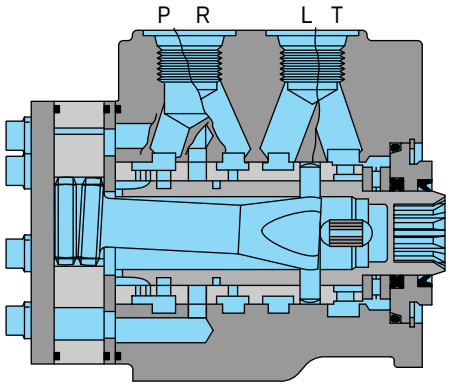
B – Product Information

Steering Control Units — Series 110, 230, 450

Section Drawing and Integral Valves





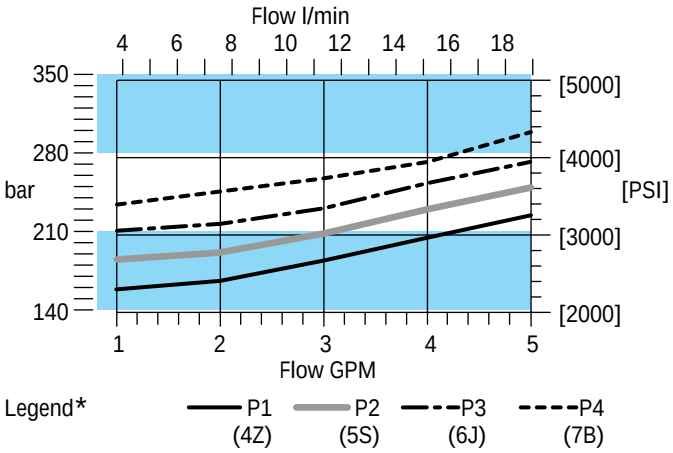


B – Product Information

Steering Control Units — Series 110, 230, 450

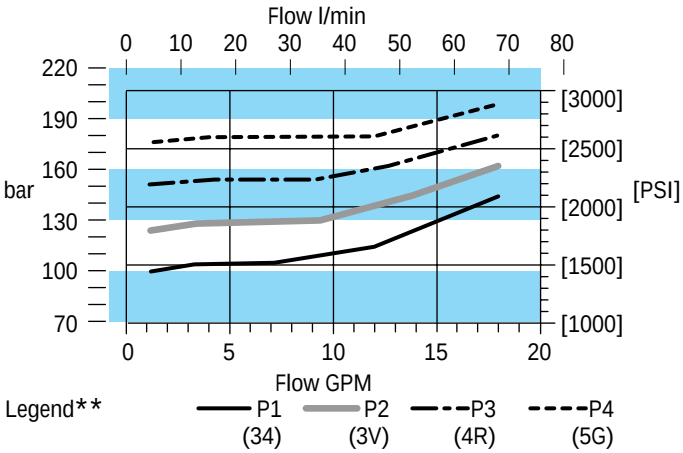
Performance Data

Cylinder Relief Valve Pressure Drop versus Flow



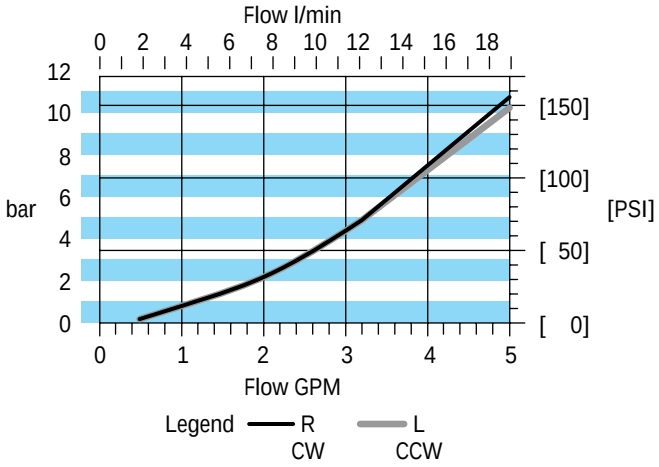
*The examples above are 4 of 22 pressure settings shown in model code page 55 Position 16, 17

Inlet Relief Valve Pressure Drop versus Flow

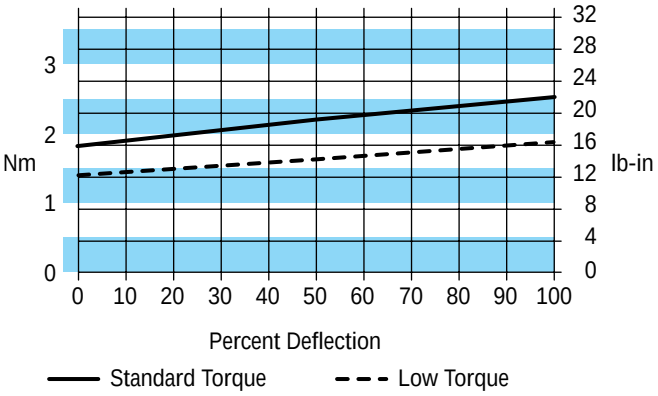


**The examples above are 4 of 31 pressure settings shown in model code page 55 Position 14, 15

Anti-Cavitation Valve Pressure Drop versus Flow



Input Torque Series 110, 230, 450



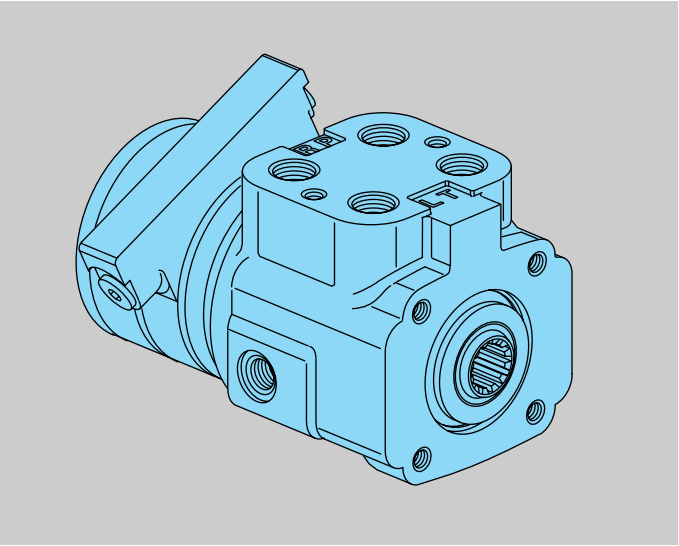
B – Product Information

Steering Control Units — 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: 240 bar [3500 psi]
Valve options and other features: same as available on Series 230 units

Displacement chart:

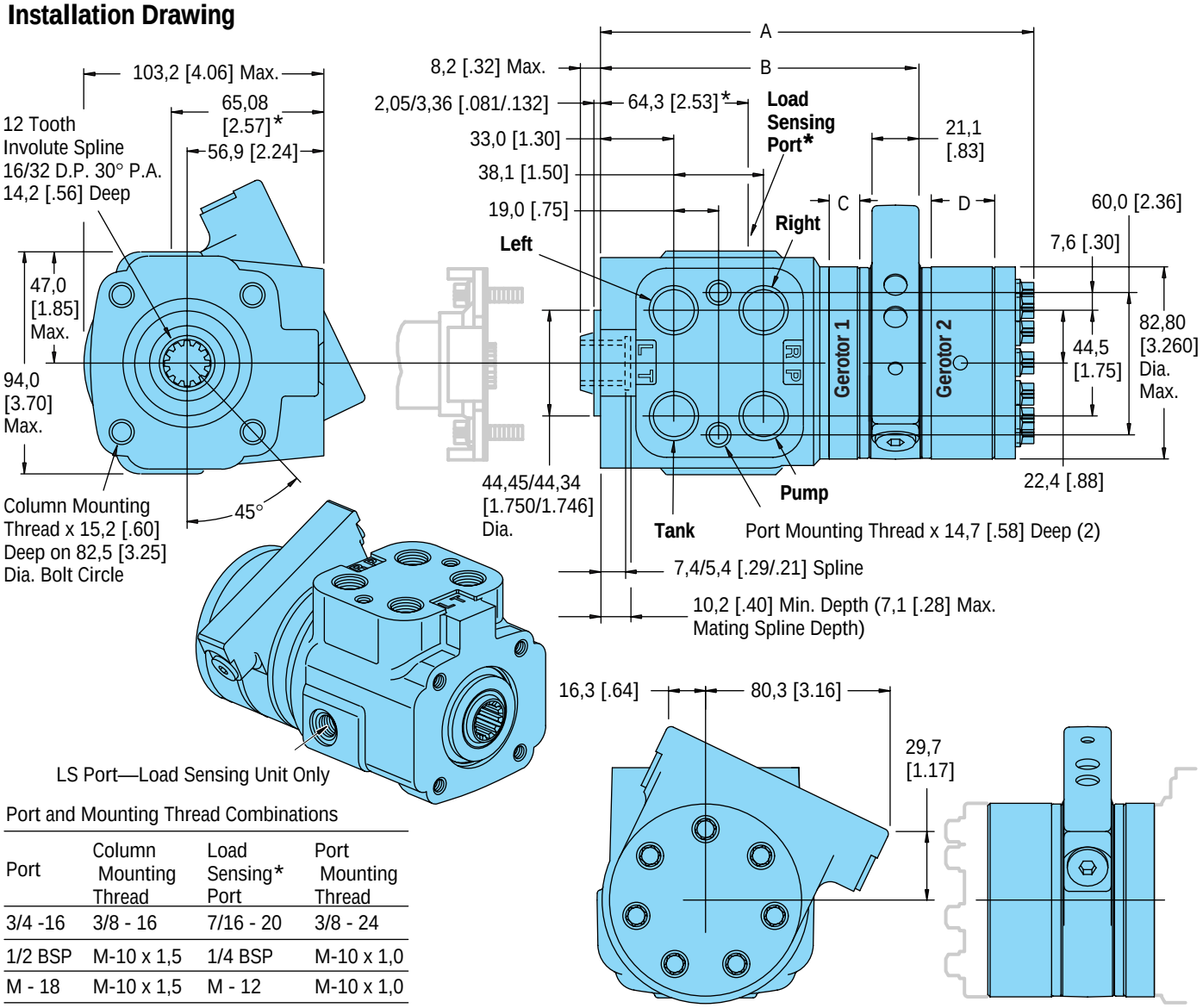
Gerotor 1 Manual displ.	Gerotor 1 and 2 Powered displ.	Gerotor 1 Manual displ.	Gerotor 1 and 2 Powered displ.
in^3/rev	in^3/rev	cm^3/rev	cm^3/rev
3.6	9.5	60	156
3.6	10.9	60	179
3.6	12.5	60	205
3.6	13.3	60	218
3.6	14.9	60	244
4.5	10.4	75	170
4.5	11.8	75	193
4.5	13.4	75	220
4.5	14.2	75	233

For any other displacement please see your Eaton representative

B – Product Information

Steering Control Units — Dual Displacement

Installation Drawing



Port and Mounting Thread Combinations

Port	Column Mounting Thread	Load Sensing* Port	Port Mounting Thread
3/4 -16	3/8 - 16	7/16 - 20	3/8 - 24
1/2 BSP	M-10 x 1,5	1/4 BSP	M-10 x 1,0
M - 18	M-10 x 1,5	M - 12	M-10 x 1,0

*Load Sensing Units Only.

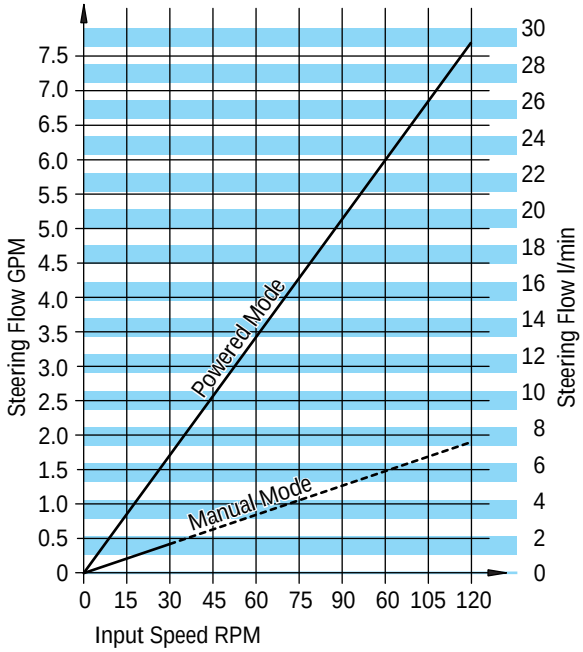
Manual Displacement cm³/r [in³/r]	Dimension C mm [in.]	Displacement cm³/r [in³/r]	Dimension D mm [in.]	**Powered Displacement cm³/r [in³/r]**	Dimension B mm [in.]	Dimension A mm [in.]
Gerotor 1		Gerotor 2		Gerotor 1 and 2		
60 [3.6]	10,2 [.40]	95 [5.9]	13,2 [.52]	156 [9.5]	136,1 [5.36]	172,5 [6.79]
60 [3.6]	10,2 [.40]	120 [7.3]	16,5 [.65]	179 [10.9]	136,1 [5.36]	175,8 [6.92]
60 [3.6]	10,2 [.40]	145 [8.9]	20,0 [.79]	205 [12.5]	136,1 [5.36]	179,3 [7.06]
60 [3.6]	10,2 [.40]	160 [9.7]	21,8 [.86]	218 [13.3]	136,1 [5.36]	181,1 [7.13]
60 [3.6]	10,2 [.40]	185 [11.3]	25,4 [1.00]	244 [14.9]	136,1 [5.36]	184,7 [7.27]
75 [4.5]	10,2 [.40]	95 [5.9]	13,2 [.52]	170 [10.4]	136,1 [5.36]	172,5 [6.79]
75 [4.5]	10,2 [.40]	120 [7.3]	16,5 [.65]	193 [11.8]	136,1 [5.36]	175,8 [6.92]
75 [4.5]	10,2 [.40]	145 [8.9]	20,0 [.79]	220 [13.4]	136,1 [5.36]	179,3 [7.06]
75 [4.5]	10,2 [.40]	160 [9.7]	21,8 [.86]	233 [14.2]	136,1 [5.36]	181,1 [7.13]

B – Product Information

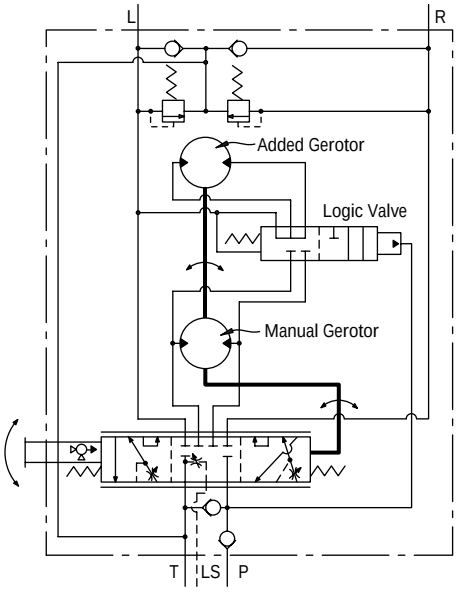
Steering Control Units — Dual Displacement

Performance Data (Example)

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



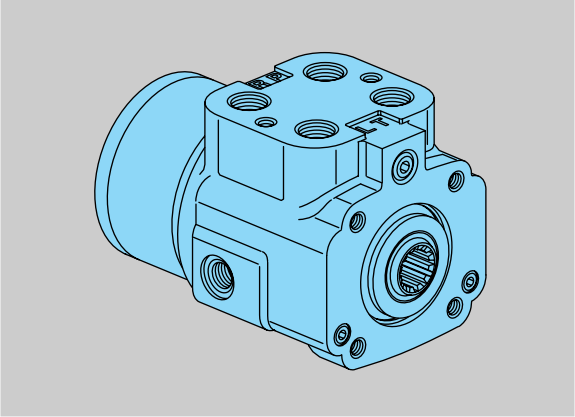
Flow vs RPM (for each operating mode)



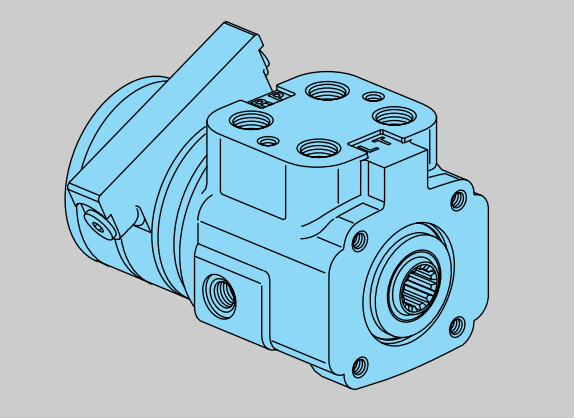
Applications:

- Tractors
- Constuction Equipment
  - Motor Graders
  - Backhoe Loaders

B – Product Information
Ordering Information



Series 110, 230, 450 Steering Control Unit



Dual Displacement Steering Control Unit

Model Code Ordering Information

The following 29-digit coding system has been developed to identify all of the configuration options for the Series 110, 230, 450 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.

Model Code — Series 110, 230, 450 Steering Control Units

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	V						0			0	1	0	0	0	0						A		A	A	1	0	B

Position 1, 2, 3 **Product Series**
ABV ..... Series 110, 230, 450 Steering Control Unit

Position 4 **Nominal Flow Rating**
1 ..... 11 l/min [3 GPM] (Series 110)
3 ..... 23 l/min [6 GPM] (Series 230)
5 ..... 45 l/min [12 GPM] (Series 450)
4 ..... 38 l/min [10 GPM] (Series 230 Flow Aplification Only)
6 ..... 76 l/min [20 GPM] (Series 450 Flow Aplification Only)

Position 5 **Inlet Pressure Rating**
5 ..... 172 bar [2500 PSI]
6 ..... 241 bar [3500 PSI] (Not available with open center)

Position 6 **Tank Pressure Rating**
A ..... 10 bar [145 PSI]
B ..... 21 bar [300 PSI]

Position 7-8 **Displacement cm³/r [in³/r]**
03 ..... 244 [14.9] / 60 [3.6]
04 ..... 177 [10.9] / 60 [3.6]
05 ..... 218 [13.3] / 60 [3.6]
For any other displacement see your Eaton representative

Dual Displacement

Position 7-8 **Displ. cm³/r [in³/r] (continued –next page)**

B – Product Information

Model Code Ordering Information Continued — Series 110, 230, 450

Position 7-8 Displacement cm³/r [in³/r]

43	75 [4.5]	Series 110 Only
45	95 [5.9]	Series 110 Only
48	120 [7.3]	Series 110 Only
50	145 [8.9]	Series 110 Only
51	160 [9.7]	Series 230 Only
52	185 [11.3]	Series 230 Only
54	230 [14.1]	Series 230 Only
57	295 [17.9]	Series 230 Only
59	370 [22.6]	Series 450 Only
61	460 [28.2]	Series 450 Only
64	590 [35.9]	Series 450 Only
66	740 [45.1]	Series 450 Only

Position 9 Flow Amplification

0 ..... None
1 ..... 1.6 : 1.0 Ratio
2 ..... 1.6 : 1.0 Ratio with Manual Steering
5 ..... 1.3 : 1.0 Ratio with Manual Steering
4 ..... 2.0 : 1.0 Ratio with Manual Steering

Use with Closed Center or Load Sensing Only

Position 10 Neutral Circuit

A ..... Open Center
C ..... Closed Center
F ..... Load Sensing, Dynamic Signal

Position 11 Load Circuit

A ..... Non-Load Reaction
B ..... Load Reaction (open center 110, 230 Series only)

Position 12, 13 Integral Valve

	Manual Steering Check	Load Sensing Relief	Inlet Check Valve	Cylinder Relief Valve	Anti-Cavitation Valve	Inlet Relief Valve
01	•					
04	•		•			
05	•					•
06	•		•			•
07	•				•	
08	•		•		•	
09	•			•	•	
10	•		•	•	•	
11	•			•	•	•
12	•		•	•	•	•
13	•	•	•	•	•	
15	•	•				

Position 14, 15 Inlet or Load Sense Relief Valve — bar [PSI]

00 .... None	**3E** .... 110 [1600]	**4A** .... 138 [2000]
1Y .... 62 [899]	**3K** .... 115 [1670]	**4C** .... 140 [2030]
25 .... 69 [1000]	**3S** .... 121 [1750]	**4H** .... 145 [2100]
2C .... 76 [1100]	**3V** .... 124 [1800]	**4N** .... 150 [2180]
2G .... 80 [1160]	**42** .... 130 [1890]	**4R** .... 152 [2200]
2T .... 90 [1310]	**46** .... 134 [1940]	Continued
34 .... 100 [1450]	**48** .... 136 [1970]	

Position 14, 15— Continued (Inlet or Load Sense Relief Valve) — bar [PSI]

52 .... 162 [2350]	**5C** .... 172 [2490]	**5S** .... 185 [2680]
54 .... 164 [2380]	**5G** .... 176 [2550]	**5Y** .... 190 [2760]
55 .... 165 [2390]	**5L** .... 180 [2610]	**6J** .... 210 [3050]
59 .... 169 [2450]	**5R** .... 184 [2670]	**7K** .... 243 [3520]

Position 16, 17 Cylinder Relief Valve — bar [PSI]

00 .... None	**5S** .... 185 [2680]	**71** .... 225 [3260]
37 .... 103 [1490]	**5Y** .... 190 [2760]	**7B** .... 235 [3410]
3E .... 110 [1600]	**65** .... 197 [2860]	**7M** ... 245 [3550]
42 .... 130 [1890]	**68** .... 200 [2900]	**7V** .... 252 [3650]
4C .... 140 [2030]	**6F** .... 207 [3000]	**83** .... 259 [3760]
4N .... 150 [2180]	**6J** .... 210 [3050]	**8G** .... 272 [3950]
4Z .... 159 [2310]	**6P** .... 215 [3120]	**9C** .... 300 [4350]
59 .... 169 [2450]	**6W** ... 221 [3210]	

Position 18, 19, 20, 21 Ports and Mounting Threads

DAAC ..... 4 x 3/4 SAE Ports, 3/8 inch Mounting Threads
DACC ..... 4 x 3/4 SAE Ports, with 7/16 SAE Load Sensing Port on Side, 3/8 inch Mounting Threads
DAMC ..... 4 x 3/4 SAE Ports, with 7/16 SAE Load Sensing Port on Side, 7/16 SAE EMSS port on Port Face, 3/8 inch Mounting Threads
FAAK ..... (4) M18 O-ring Ports with M10 Mounting threads
FAFK ..... (4) M18 O-ring Ports with M12 O-ring Load Sensing Port on Side, and M10 Mounting threads
AAAK ..... (4) G1/2 (BSP) Ports with M10 Mounting threads
AABK ..... (4) G1/2 (BSP) Ports with G1/4 (BSP) Load Sensing Port on Side, and M10 Mounting threads
AAZK ..... (4) G1/2 (BSP) Ports with G1/4 (BSP) Load Sensing Port on Side G1/4 (BSP) EMSS Port on port Face and M10 Mounting threads
AAUK ..... (4) G1/2 (BSP) Ports with G1/8 (BSP) Drain Port on Port Face, G1/4 (BSP) EMSS Port on Side and M10 Mounting threads
FAYK ..... Use with Bolt-on Priority Valve (see page 85)

Position 22 Input Torque

1 ..... Low
3 ..... Standard

Position 23 Fluid Type

A ..... See Eaton Technical Bulletin 3-401

Position 24 Special Application

0 ..... None
2 ..... Bolt-on Priority Valve (see page 85)
3 ..... EMSS
4 ..... EMSS with drain

Position 25, 26 Special Features

AA ..... None

Positon 27 Paint

1 ..... Black Primer

Position 28 Identification

0 ..... Eaton Product Number on Nameplate

Position 29 Eaton Assigned Design Code

B ..... Assigned Design Code

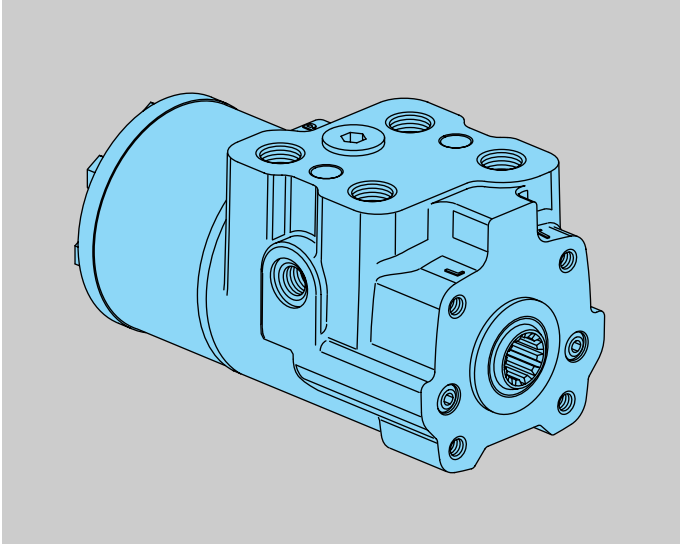
B – Product Information

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

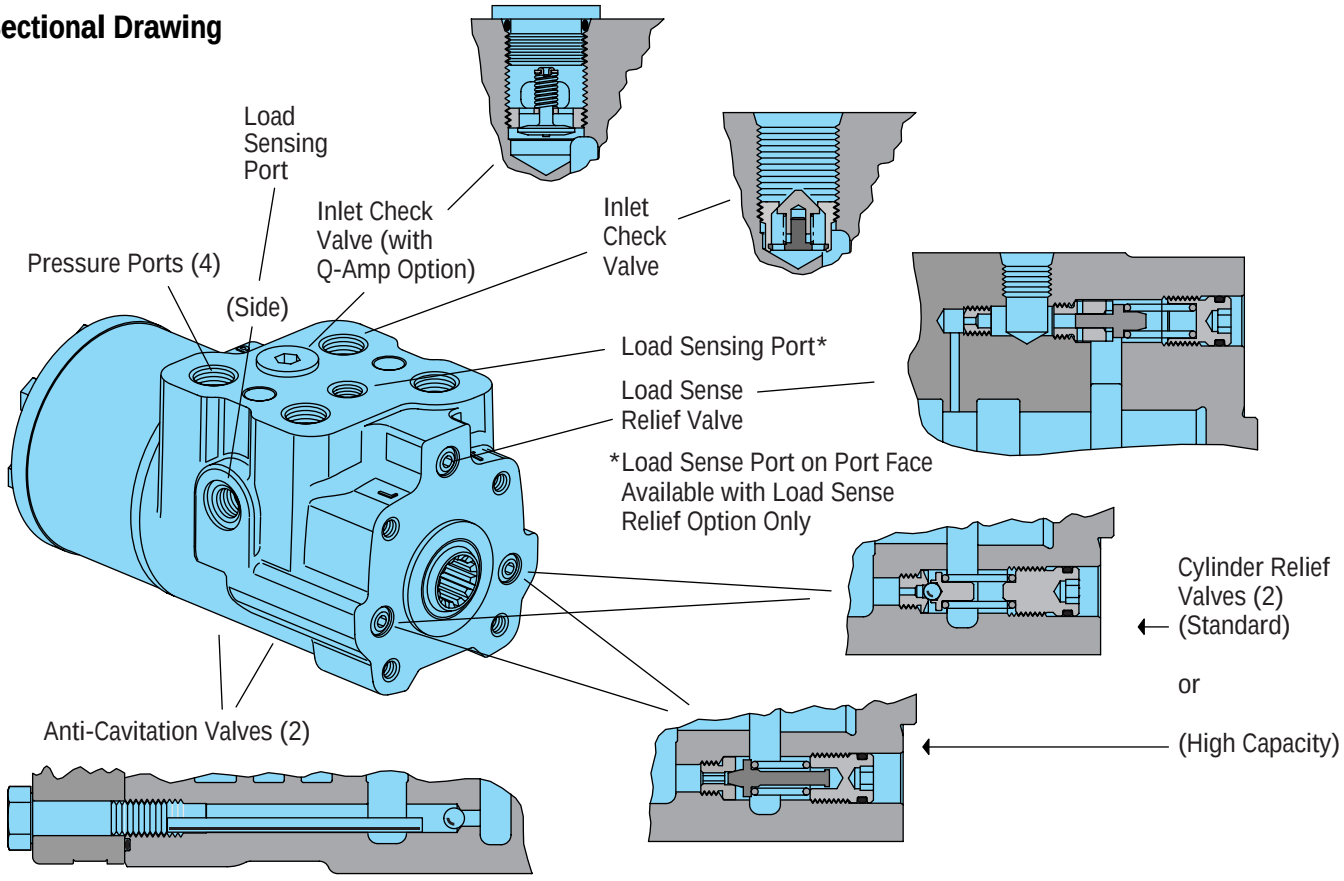
Max. System Pressure	241 bar [3500 PSI]
Max. Back Pressure	10 bar [145 PSI]
Rated Flow	95 l/min [25 GPM]
Max. Flow	125 l/min [33 GPM]
Max. System Operating Temperature	93°C [200° F]
Max. Differential Between Steering Unit and System Temperature	28° C 50° F
Input Torque Powered	1,1-2,8 Nm @ 6,9 bar back 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

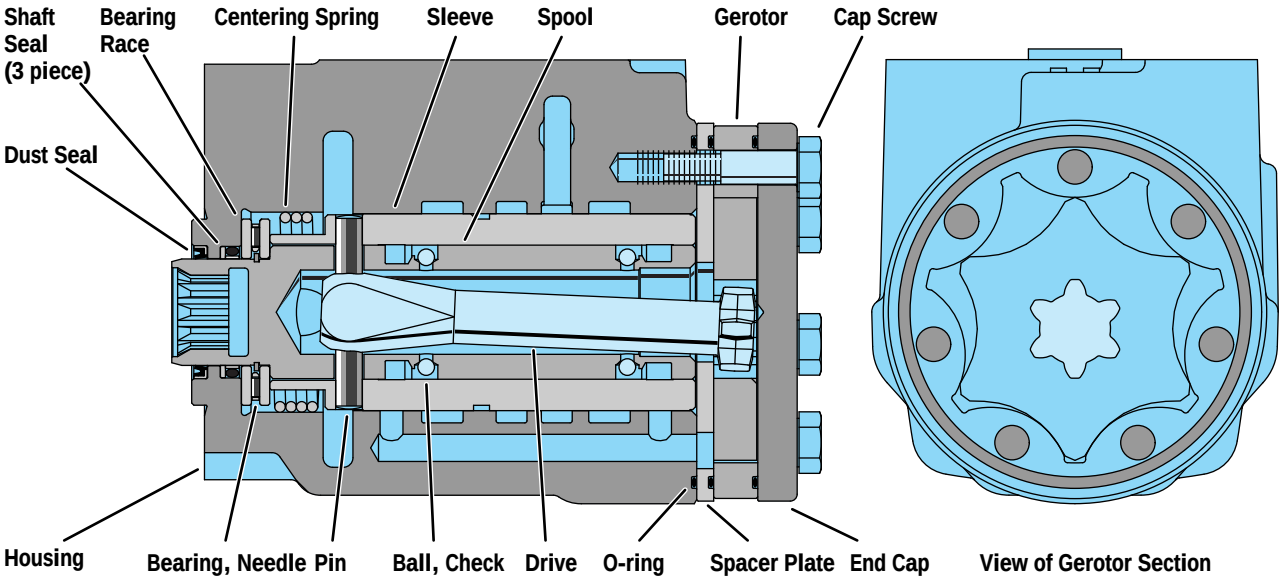
B – Product Information

Steering Control Units — Series 20

Standard Product Releases — Contact Your Eaton Representative

Sectional Drawing

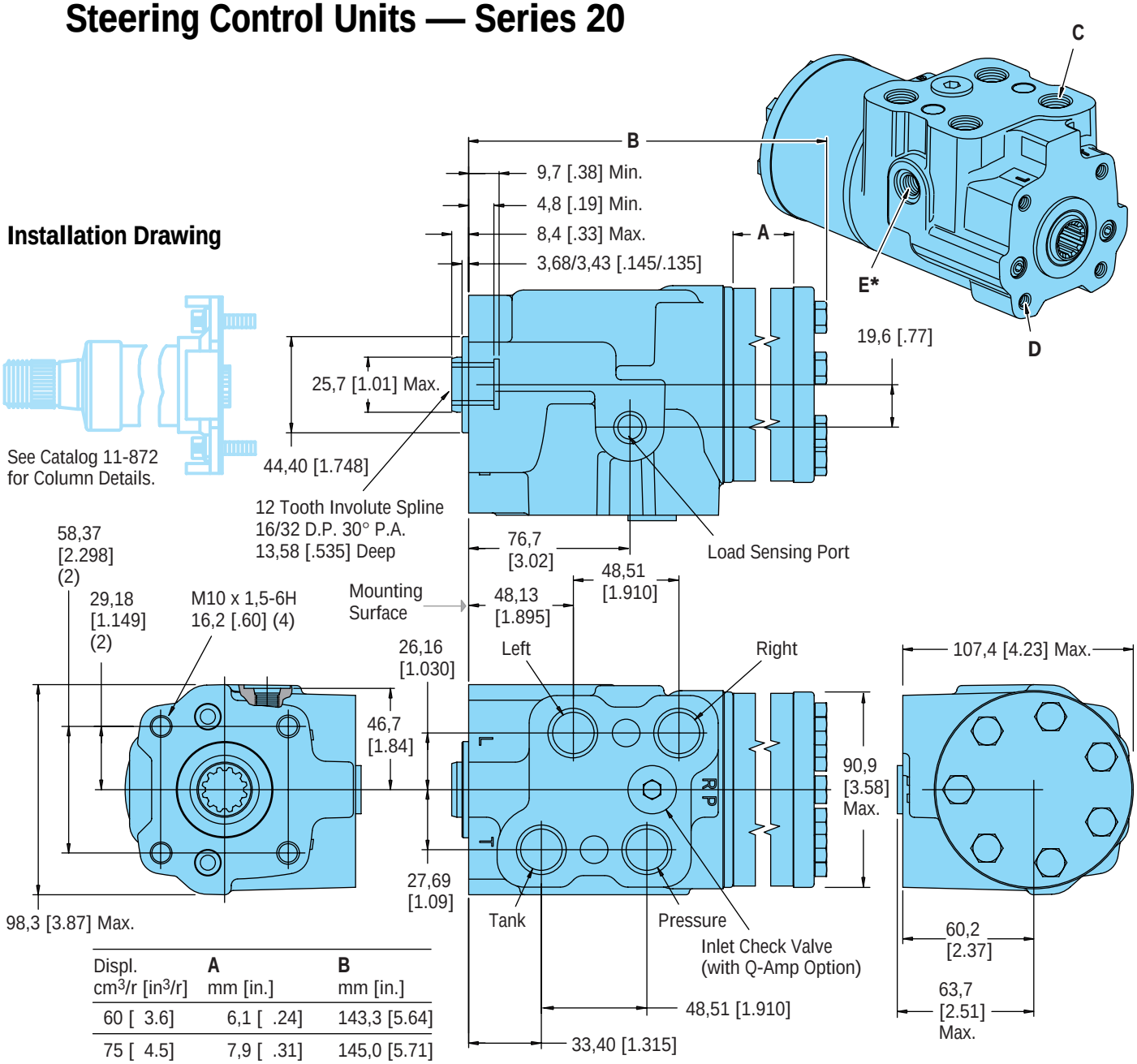




B – Product Information

Steering Control Units — Series 20

Installation Drawing



Displ. cm³/r [in³/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

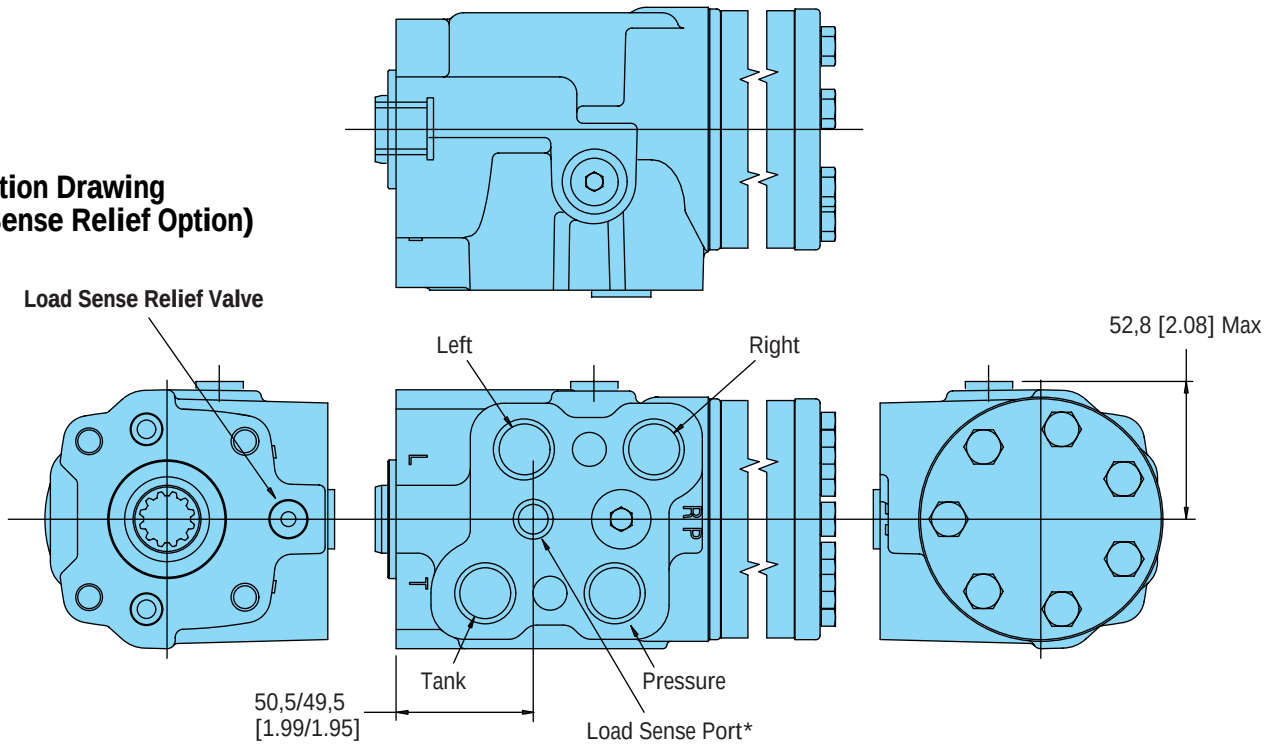
C	D	E*
3/4–16 UNF 2B**	M10 x 1,5–6H	7/16–20 UNF 2B**
G 1/2***	M10 x 1,5–6H	G 1/4***
M18 x 1,5–6H	M10 x 1,5–6H	M12 x 1,5–6H, M14
M22 x 1,5–6H	M10 x 1,5–6H	M12 x 1,5–6H, M14

* Load sensing port option — on side (load sense relief port face only - see page 59) .
**SAE O-ring Port Port
***BSP Straight Thread Port

B – Product Information

Steering Control Units — Series 20

Installation Drawing (Load Sense Relief Option)

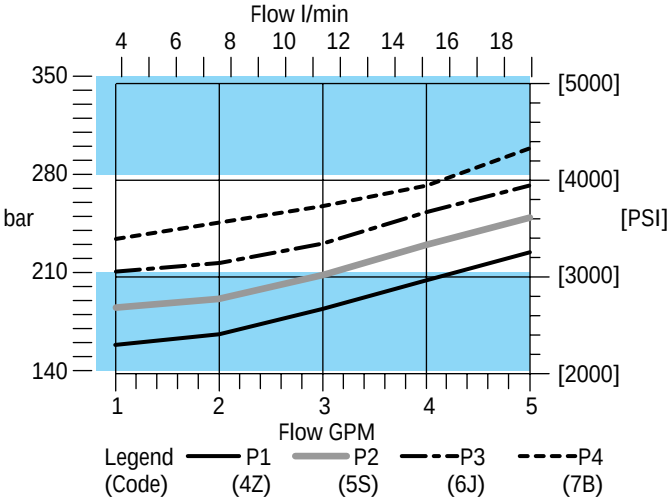


Load Sense Port*
- 7/16-20 UNF-2B (SAE) O-ring Port
- G 1/4 (BSP) Straight Thread Port
- M12 x 1,5 -6H (Metric) O-ring Port

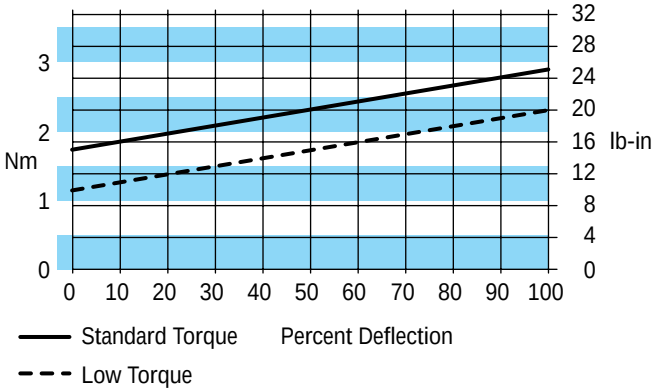
***Load sense port on port face (is only available on units with load sense relief valve).**

Performance Data

Cylinder Relief Valve Pressure Drop versus Flow



Input Torque Series 20

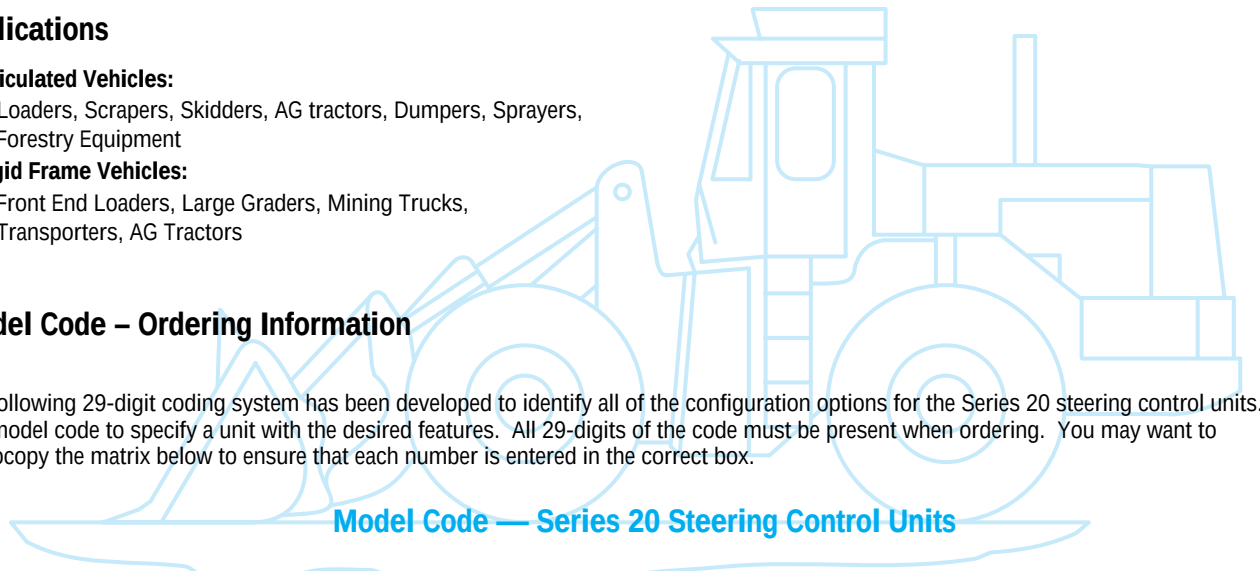


B – Product Information

Steering Control Units — Series 20

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



Model Code – Ordering Information

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.

Model Code — Series 20 Steering Control Units

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

Position 1, 2, 3 **Product Series**

ACC ..... Series 20 Steering Control Unit

Position 4 **Nominal Flow Rating**

4 ..... 38 l/min [10 GPM] (Q-Amp)

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)

Position 5 **Inlet Pressure Rating**

6 ..... Inlet Pressure Rating 241 bar [3500 PSI]

Position 6 **Return Pressure Rating**

A ..... 10 bar [145 PSI]

Position 7-8 **Displacement cm³/r [in³/r]**

40 ..... 60 [3.6] — Use with 38 l/min [10 GPM]
43 ..... 75 [4.5]
45 ..... 95 [5.9]
48 ..... 120 [7.3]
50 ..... 145 [8.9]
51 ..... 160 [9.7]

52 ..... 185 [11.3] — Use with 76 l/min [20 GPM]
54 ..... 230 [14.1]
57 ..... 295 [17.9]
59 ..... 370 [22.6]
61 ..... 460 [28.2]

64 ..... 590 [35.9] — Use with 114 l/min [30 GPM]
66 ..... 740 [45.1]
69 ..... 985 [60.0]

Position 9 **Flow Amplification**

0 ..... No Q-Amp

1 ..... 1.6 : 1.0 Ratio
(Actual Displ. 185 to 985 cm³/r [11.3 to 60.0 in³/r])

3 ..... 2.0 : 1.0 Ratio
(Actual Displ. 60 to 370 cm³/r [3.6 to 22.6 in³/r])

Position 10 **Neutral Circuit**

F ..... Load Sensing, Dynamic Signal

Position 11 **Load Circuit**

A ..... Non-Load Reaction

D ..... Non-Load Reaction, Cylinder Damped

Position 12, 13 **Valve Options***

	Manual Steering Check	Load Sensing Relief	Inlet** Check Valve	Cylinder Relief Valve	Anti-Cavitation Valve
00					
01	•				
02					•
09	•			•	•
10	•		•	•	•
13	•	•	•	•	•
21				•	•
24			•	•	•
40		•	•	•	•

*Not all valve options will work with all unit combinations

**76 l/min [20 GPM] Max.

Continued on next page

B – Product Information

Steering Control Units — Series 20

Model Code – Ordering Information — Continued

Position 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]

Position 16, 17 **Cylinder Relief Valve Setting**

00 ..... None
6J ..... 210 bar [3050 PSI]
6V ..... 220 bar [3190 PSI]
76 ..... 230 bar [3340 PSI]
7G ..... 240 bar [3480 PSI]
7T ..... 250 bar [3630 PSI]
84 ..... 260 bar [3770 PSI]
8E ..... 270 bar [3920 PSI]
8R ..... 280 bar [4060 PSI]
92 ..... 290 bar [4210 PSI]
9C ..... 300 bar [4350 PSI]

Position 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
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

Position 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)**

Position 22 **Input Torque**

1 ..... Low
3 ..... Standard (Includes Stiffer Springs)

Position 23 **Fluid Type**

A ..... See Eaton Technical Bulletin 3-401

Positon 24 **Special Application Options**

0 ..... Not Available
1 ..... Wide Angle Deflection

Position 25, 26 **Special Features**

AA ..... None

Position 27 **Paints and Packaging**

1 ..... Black Paint

Position 28 **Identification**

0 ..... Eaton Product Number on Nameplate

Position 29 **Eaton Assigned Design Code**

0 ..... Assigned Design Code

B – Product Information
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.

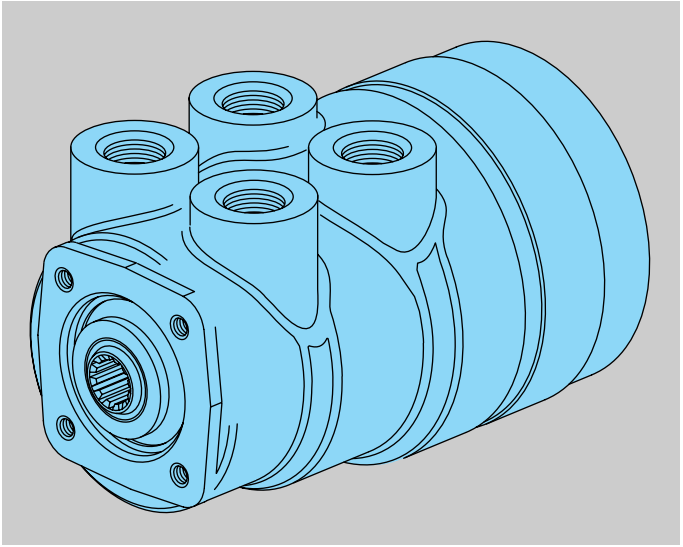
- Symmetrical valving provides passageways and valving that are equal in both directions and pressure areas that are staged for minimum leakage. This gives balance, precise servo response and uniform steering action in both directions.
- Progressive valving makes it possible to produce the spool/sleeve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

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.



Applications

Articulated Vehicles
- Loaders
- Scrapers
- Skidders
- Ag Tractors

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

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.

B – Product Information

Steering Control Units — Series 25

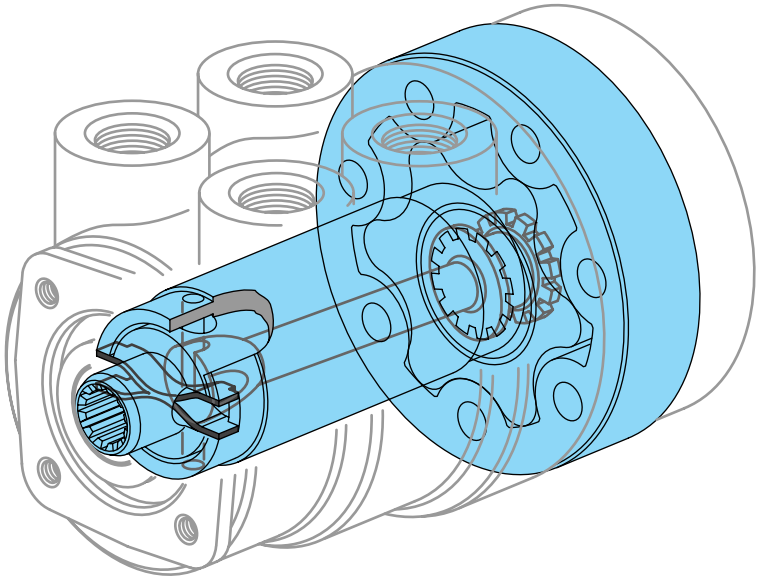
Standard Product Releases

Example: 251-1001-002
Product Number
Design Code

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

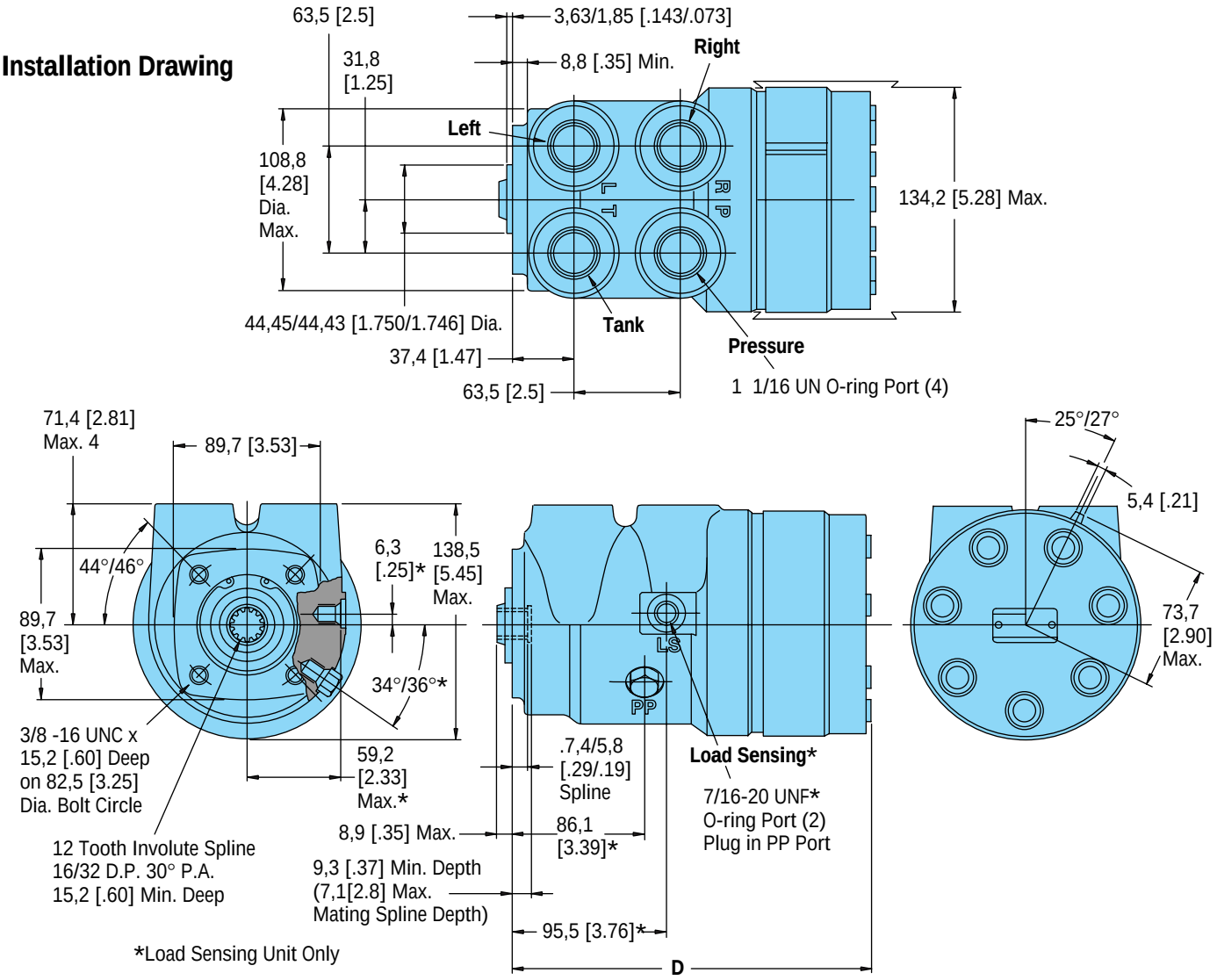
**Closed center units with neutral bleed 2,3 l/min [.6 GPM] at 172 bar [2500 PSI] (see Page 7).



B – Product Information

Steering Control Units — Series 25

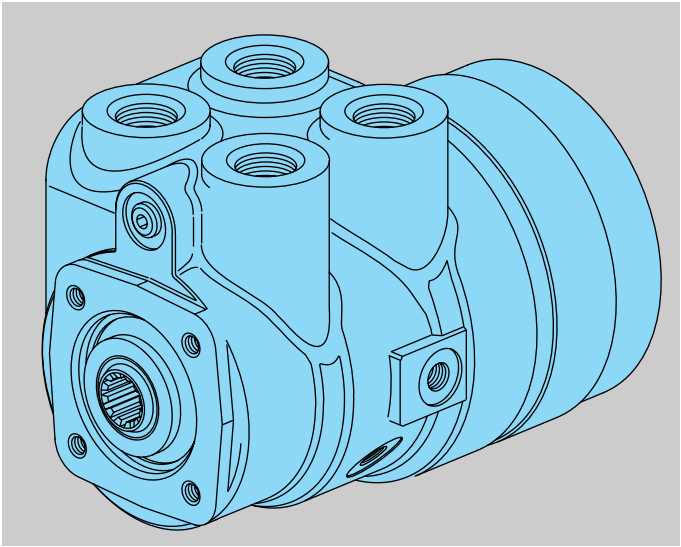
Installation Drawing



Displacement cm³/r [in³/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]

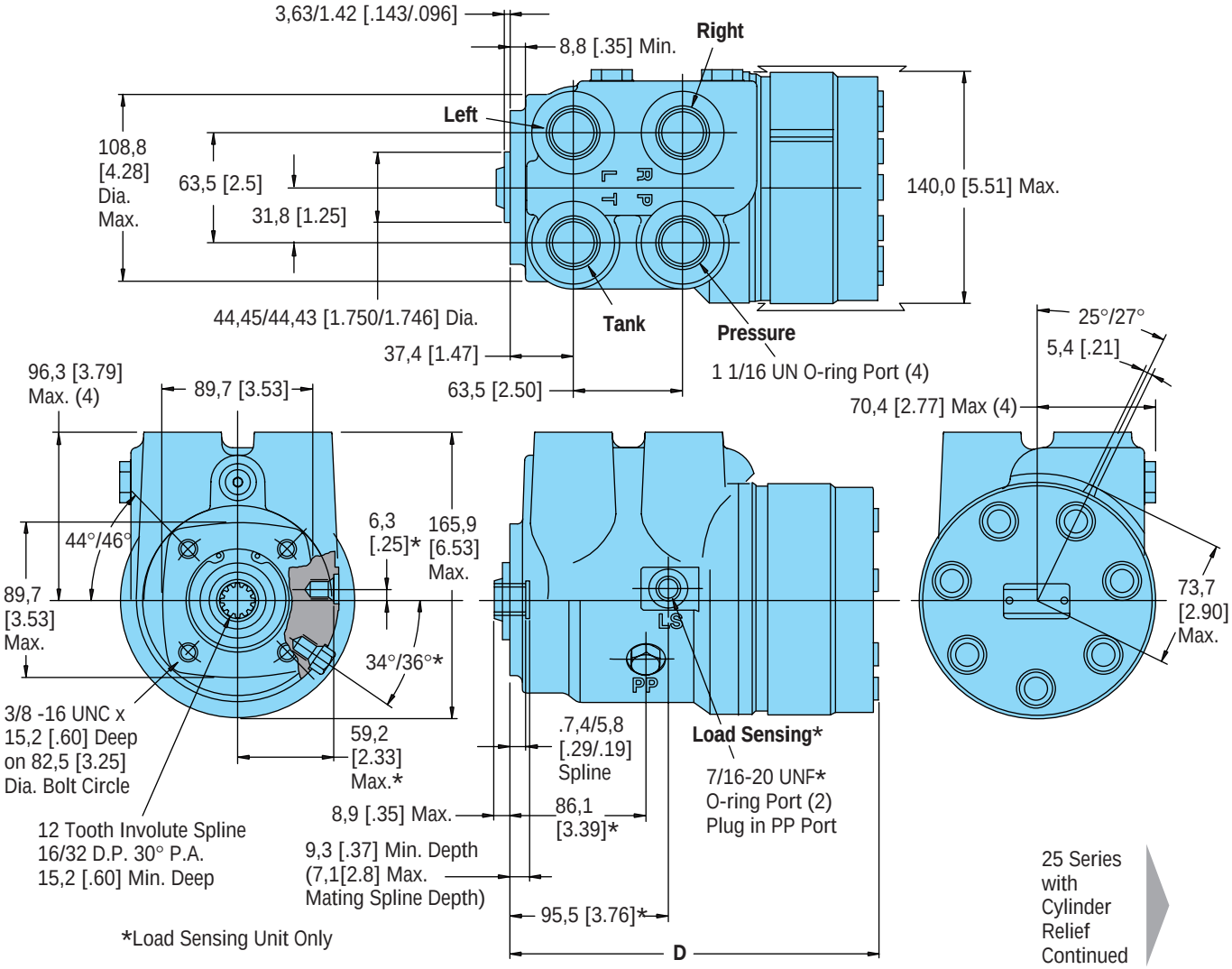
B – Product Information

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



Installation Drawing

Displacement cm³/r [in³/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]



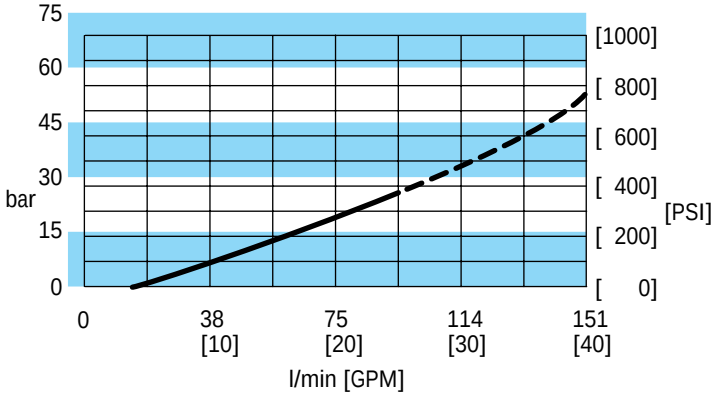
*Load Sensing Unit Only

25 Series with Cylinder Relief Continued

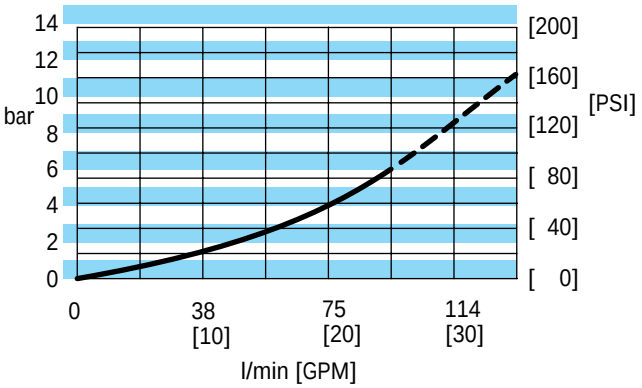
B – Product Information

Steering Control Units — Series 25

Performance Data

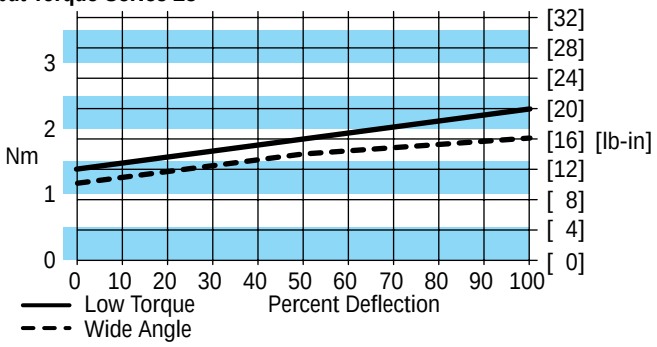


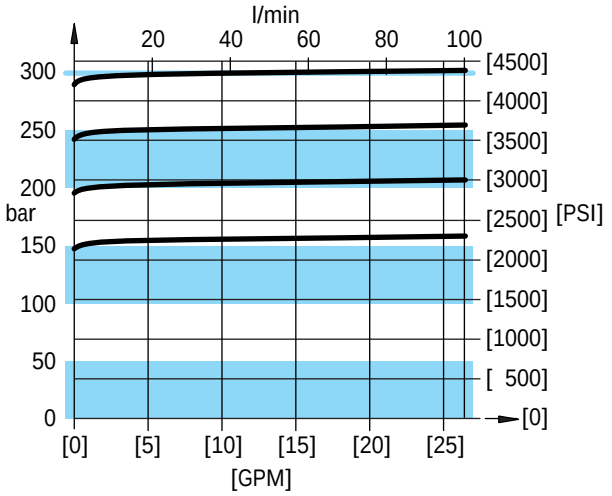
Average Pressure Drop at Full Valve Deflection



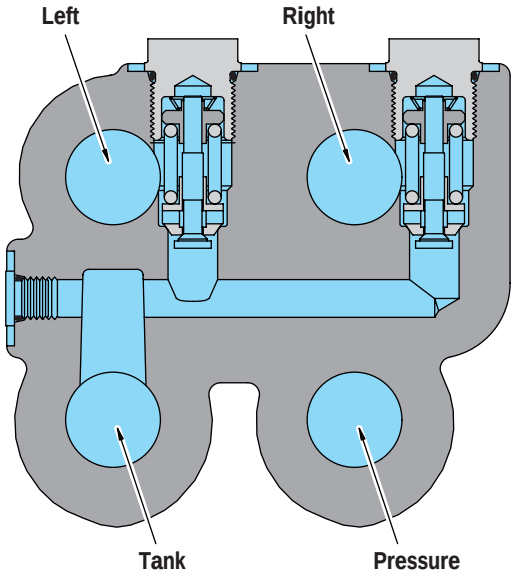
Neutral Pressure Drop - Open Center Fluid Viscosity 25 cSt [120 SUS]

Input Torque Series 25

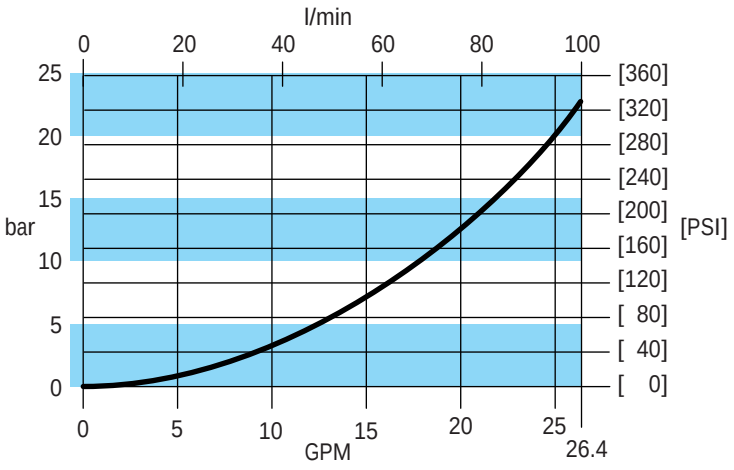




Pressure Relief Characteristics



25 Series SCU Valve Section



Check Valve Characteristics

B – Product Information
Steering Control Units — Series 25

Model Code – Ordering Information

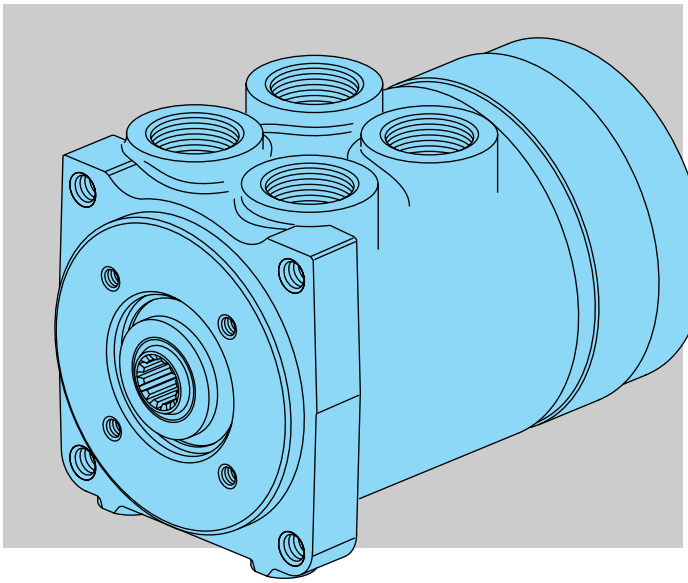
The following 29-digit coding system has been developed to identify all of the configuration options for the Series 25 steering control units. Use this model code to specify a unit with the desired features. All 29-digits of the code must be present when ordering. You may want to photocopy the matrix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

Model Code — Series 25 Steering Control Units

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

Position 1, 2, 3 **Product Series**
ABW ..... Series 25 Steering Control Unit
Position 4 **Nominal Flow Rating**
7 ..... 95 l/min [25 GPM]
8 ..... 151 l/min [40 GPM] (Q-amp only)
Position 5 **Inlet Pressure Rating**
6 ..... 241 bar [3500 PSI]
Position 6 **Return Pressure Rating**
A ..... 10 bar [150 PSI]
Position 7-8 **Displacement cm³/r [in³/r]**
62 ..... 490 [30]
65 ..... 625 [38]
67 ..... 795 [48]
69 ..... 985 [60]
71 ..... 1230 [75]
Position 9 **Flow Amplification**
0 ..... None
1 ..... 1.6 : 1.0 Ratio
Position 10 **Neutral Circuit**
A ..... Open Center
C ..... Closed Center
D ..... Closed Center with Neutral Bleed
F ..... Load Sensing, Dynamic Signal
Position 11 **Load Circuit**
A ..... Non-Load Reaction
D ..... Non Load-Reaction, Cylinder Damping (Use with Flow Amp and Wide Angle Only)
Position 12, 13 **Valve Options**
00 ..... None
21 ..... Anti-Cavitation Valves, Cylinder Relief Valves
Position 14, 15 **Load Sense Relief Valve Setting**
00 ..... None
Position 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]
Position 18, 19, 20, 21 **Ports and Mounting Threads**
EAAA ..... 4 x 1—1/6 Ports with 3/8-16 UNC Column Mounting
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)
NBDN ..... 4 x M27 with M12—LS and M12 PP (Capped) M10 Mounting Threads (Use with Load Sensing Units Only)
NAAN ..... 4 x M27 with M10 Mounting Threads
Position 22 **Input Torque**
3 ..... Standard
Position 23 **Fluid Type**
A ..... See Eaton Technical Bulletin 3-401
Position 24 **Special Applications**
0 ..... None
1 ..... Wide Angle (Use with Load Sensing Units Only)
Position 25, 26 **Special Features**
AA ..... None
Positon 27 Paint
1 ..... Black Paint
Position 28 Identification
0 ..... Eaton Product Number on Nameplate
Position 29 Eaton Assigned Design Code
C ..... Assigned Design Code

B – Product Information
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 provides 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.

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.

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.

B – Product Information

Steering Control Units — Series 40

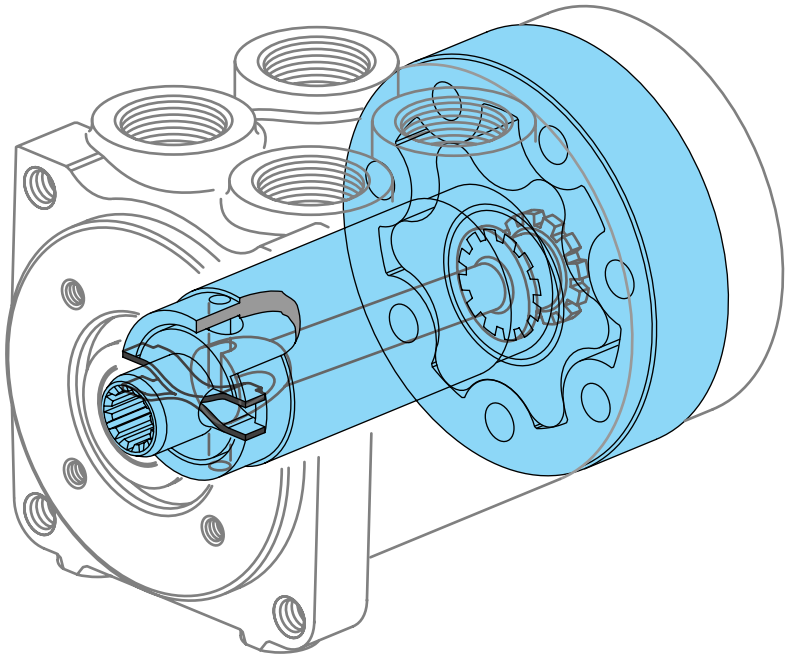
Standard Product Releases

Example: 281-1001-002
Design Code
Product Number

Series 40

System	Signal	Load Circuit	Rated Flow l/min [GPM]	O-ring Port Size	Actual Displacement cm³/r [in³/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
Closed Center	N/A	Non Load Reaction	151 [40]	1 5/16-12	282-1010	282-1011	282-1012	282-1013	282-1014
				1 5/16-12	282-1001**	282-1002**	282-1003**	282-1004**	282-1005**
Load Sensing	Dynamic	Non Load Reaction	151 [40]	1 5/16-12	283-1001	283-1002	283-1003	283-1004	283-1005

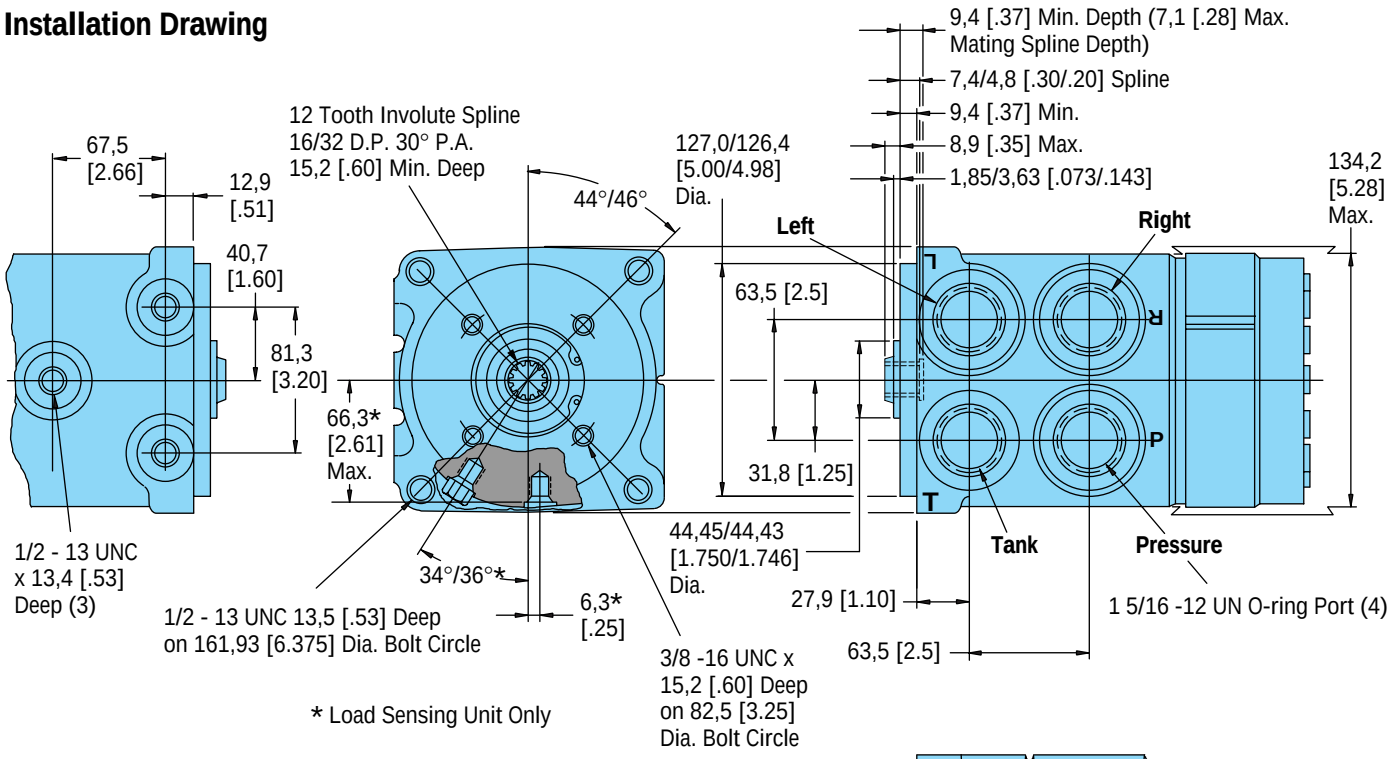
**Closed center units with neutral bleed 2,3 l/min [.6 GPM] at 172 bar [2500 PSI] (see page 7).



B – Product Information

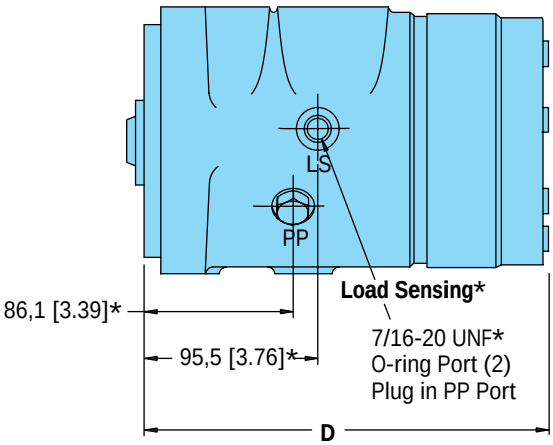
Steering Control Units — Series 40

Installation Drawing



* Load Sensing Unit Only

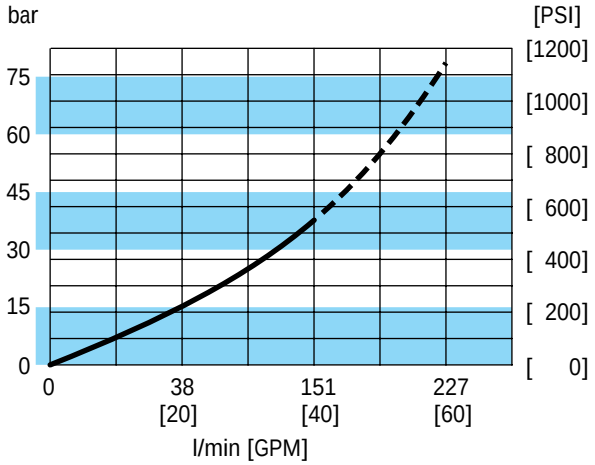
Displacement cm³/r [in³/r]	**D** Max. mm [in.]
1230 [75]	230,9 [9.09]
1555 [95]	245,9 [9.68]
1965 [120]	265,2 [10.44]
2460 [150]	288,3 [11.35]
3030 [185]	315,0 [12.40]



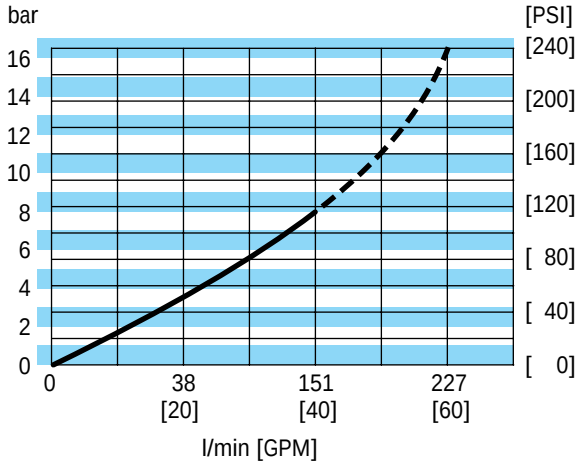
B – Product Information

Steering Control Units — Series 40

Performance Data

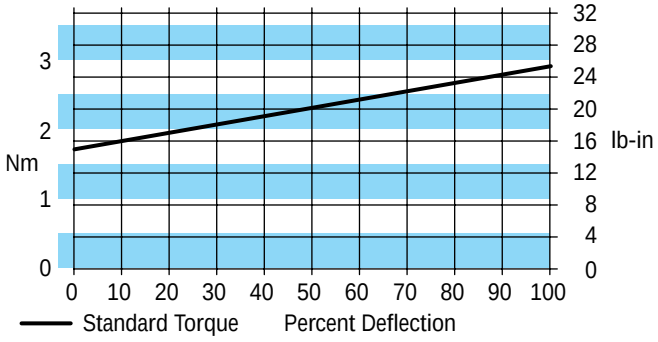


Average Pressure Drop Through Open Center Load Sensing and Closed Center at Full Valve Deflection



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

Input Torque Series 40



Applications

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

B – Product Information

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.

Model Code — Series 40 Steering Control Units

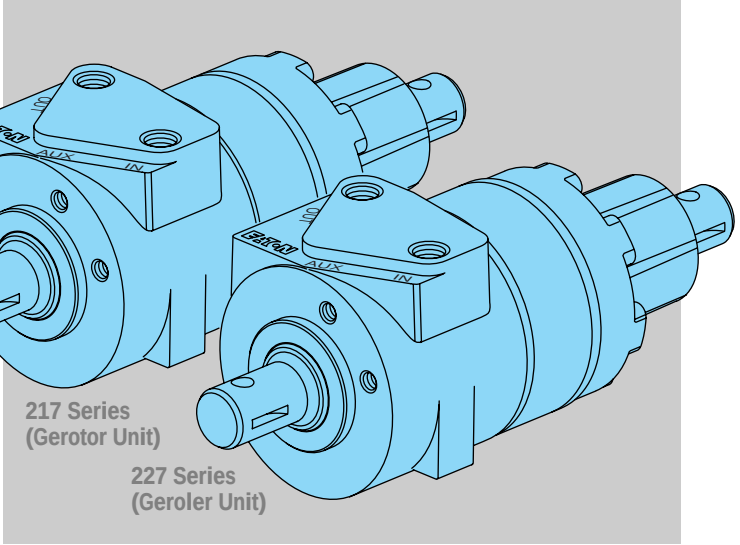
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
A	B	Y		6	A						0	0	0	0	0	0					3	A	0	0	0	0	0	B

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

B – Product Information
Torque Generator

Product Description

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



Features

Todays 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 vehicles performance.

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

• 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. Use in an open center system with a fixed displacement pump or a closed center system with a pressure compensated pump, either way offers many of the features of a load sensing system. Excess flow is available for auxiliary circuits.

B – Product Information
Torque Generator

• 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, these rolls provide rolling contact with the star point, minimizing friction and improving efficiency.

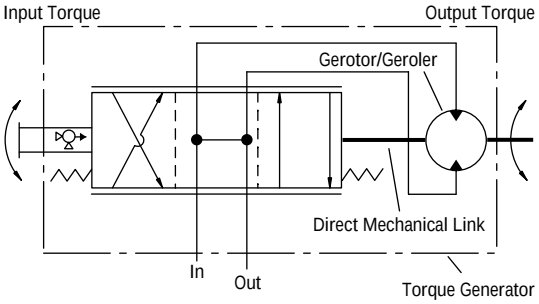
• Limited Manual Steering

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.

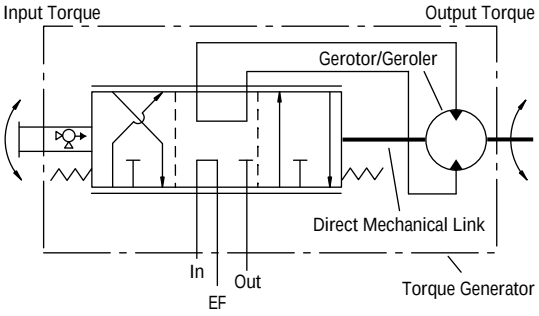
• Reaction Torque Resistance

Customer supplied bracket is required for reaction torque resistance.

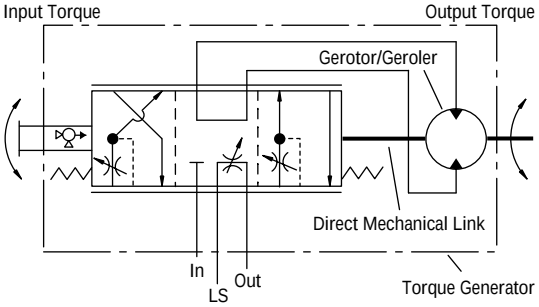
Standard Open Center



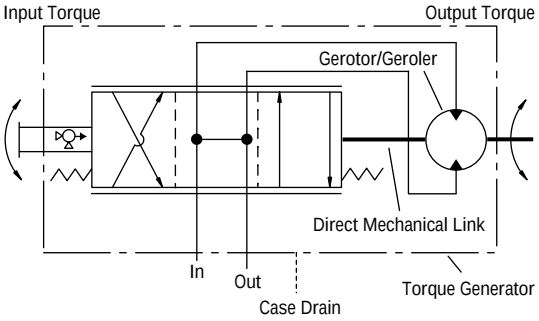
Power Beyond



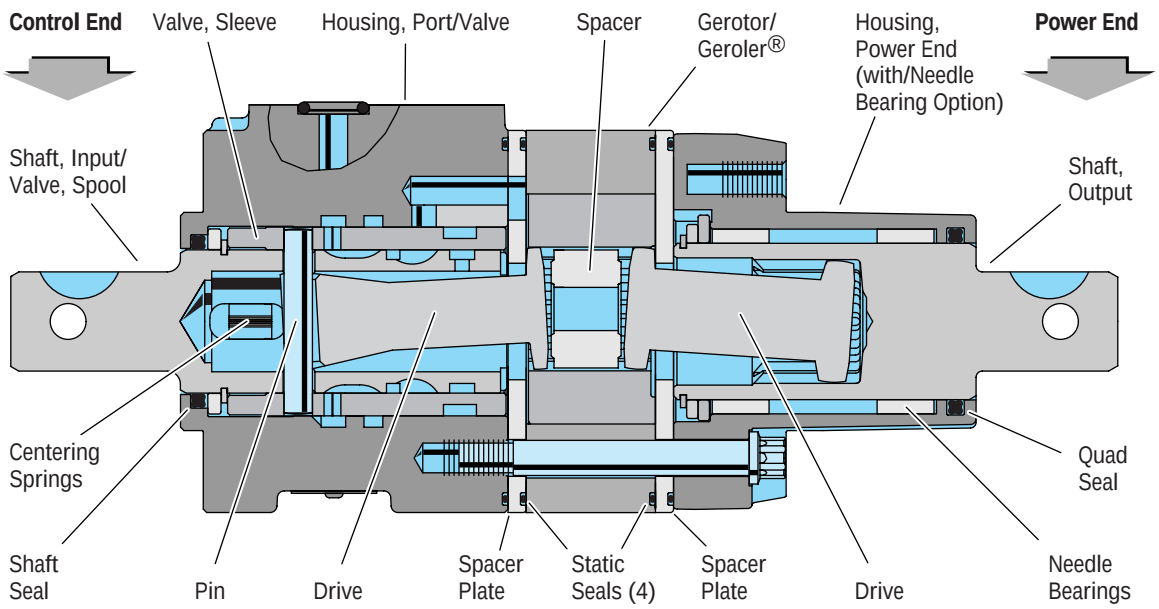
Load Sensing



Open Center (with Case Drain)



B – Product Information Torque Generator



Specifications 217 Series — Gerotor Unit

Displacement cm³/r [in³/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 cm³/r [in³/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]

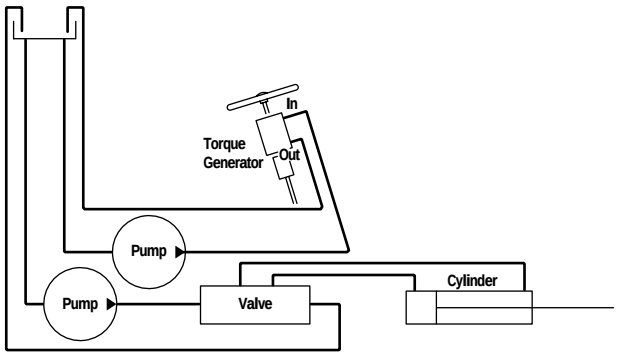
B – Product Information

Torque Generator

Example: 217-1049-002
Product Number
Design Code

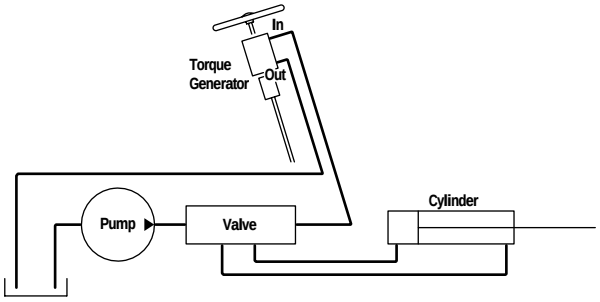
217 Series — Gerotor Unit					227 Series — Geroler® Unit				
Feature	Ports	Circuit Type	Displacement cm^3/r [in^3/r]	Product Number	Feature	Ports	Circuit Type	Displacement cm^3/r [in^3/r]	Product Number
Machined Mounting Faces Each End	9/16-18 O-ring	Open Center	76 [4.7]	217-1049	Machined Mounting Faces Each End	9/16-18 O-ring	Open Center	80 [4.9]	227-1049
			95 [5.9]	217-1050				102 [6.2]	227-1050
			160 [9.7]	217-1048				160 [9.7]	227-1048
Machined Mounting Faces Each End	Manifold	Open Center	76 [4.7]	217-1030	Machined Mounting Faces Each End	Manifold	Open Center	80 [4.9]	227-1030
			95 [5.9]	217-1015				102 [6.2]	227-1015
			160 [9.7]	217-1020				160 [9.7]	227-1020
Power End w/Bearing and Machined Faces	Manifold	Open Center	76 [4.7]	217-1051	Power End w/Bearing and Machined Faces	Manifold	Open Center	80 [4.9]	227-1051
			95 [5.9]	217-1028				102 [6.2]	227-1028
			160 [9.7]	217-1052				160 [9.7]	227-1052

Circuits for Torque Generator — Conventional Systems



Conventional System with Two Pumps

- **Extra Cost of Two Separate Circuits**

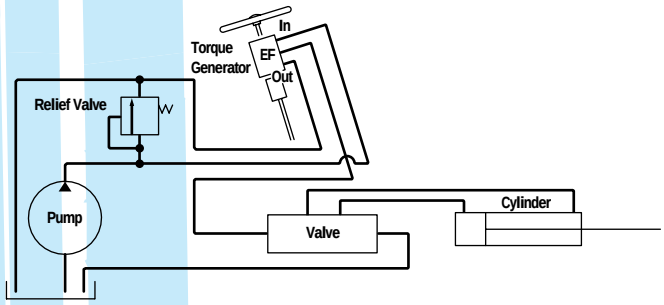


Conventional System with One Pump

- **Can Result in Insufficient Steering Flow when Operating the Auxiliary Function**

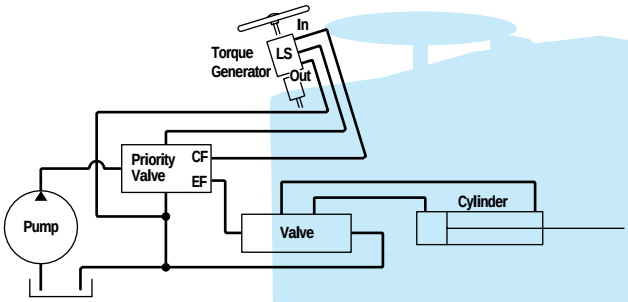
B – Product Information
Torque Generator

Circuits for Torque Generator — Conventional Systems



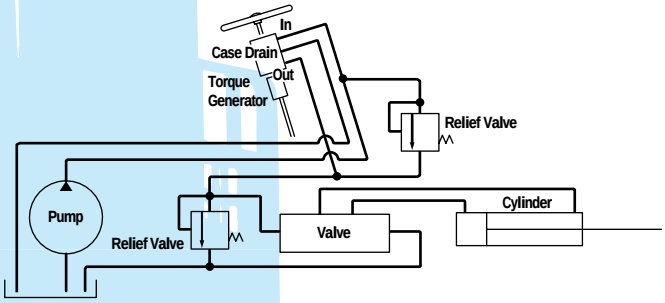
Power Beyond Torque Generator

- **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**



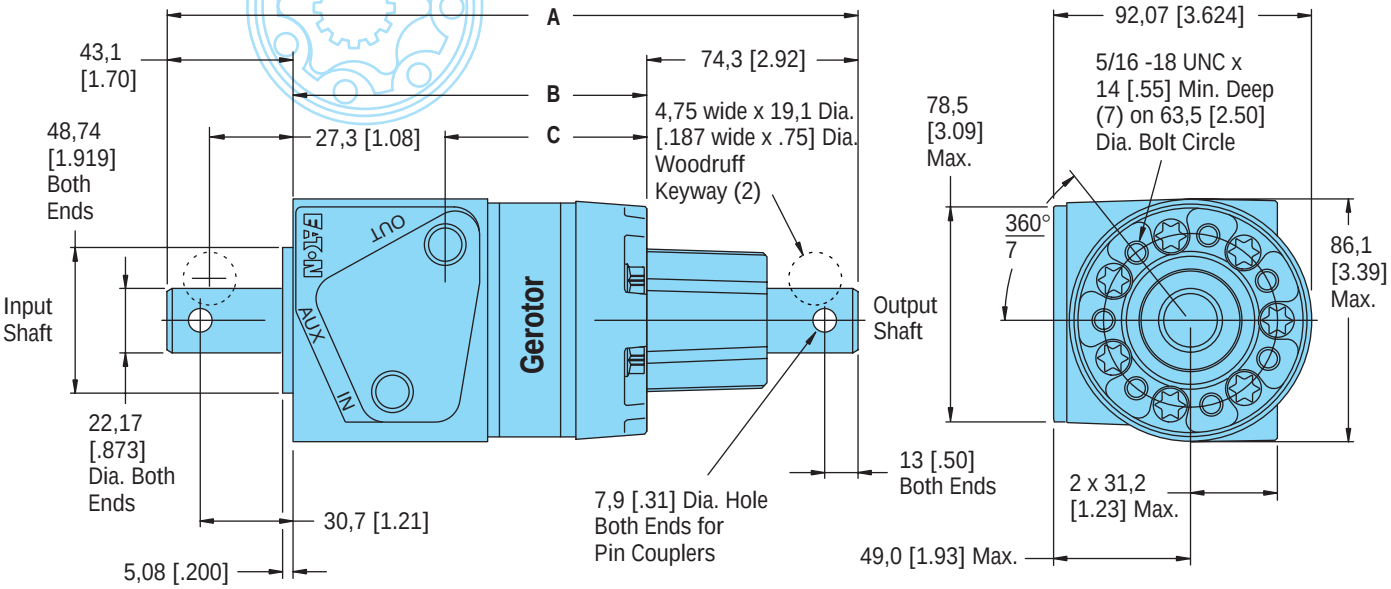
High Back Pressure Torque Generator

- **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**

B – Product Information
Torque Generator

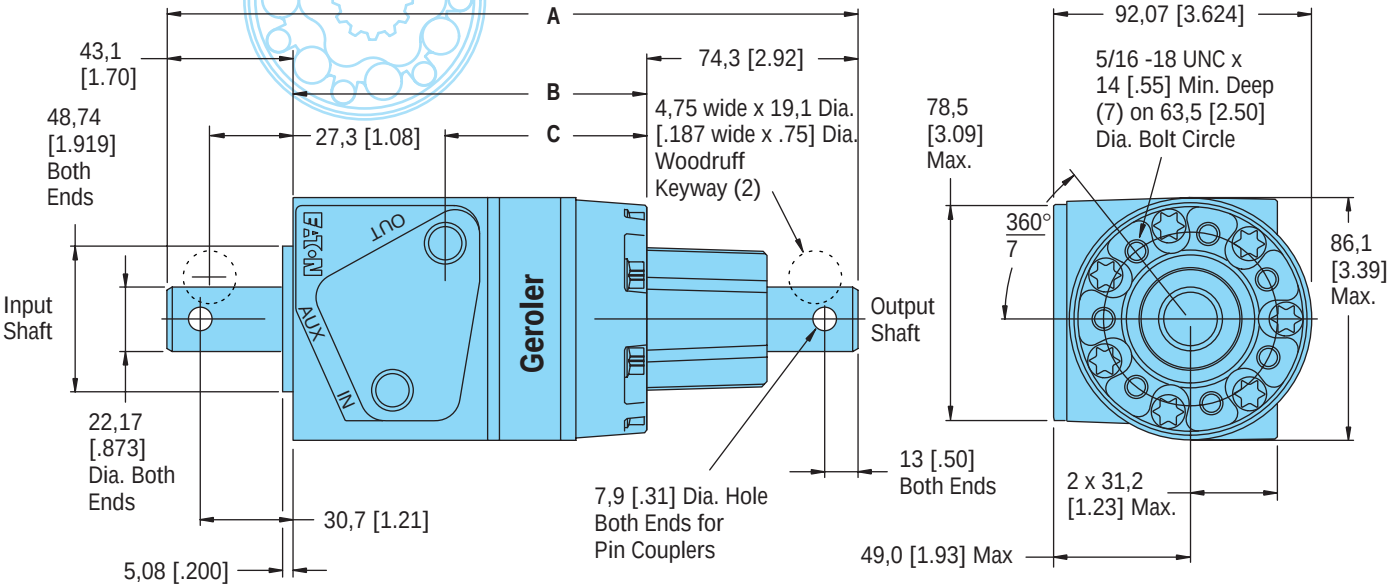
Installation Drawing

217 Series — Gerotor Unit



	Displacement cm³/r [in³/r]	Dimension mm [inch] A	B	C
217 Series (Gerotor Unit)	96,1 [5.86]	231,9 [9.13]	114,5 [4.51]	60,4 [2.38]
	159,6 [9.73]	240,6 [9.47]	123,2 [4.85]	69,3 [2.73]
227 Series (Geroler® Unit)	80,3 [4.90]	233,3 [9.18]	115,9 [4.56]	62,0 [2.44]
	101,6 [6.20]	237,2 [9.34]	119,8 [4.72]	65,9 [2.59]
	160,0 [9.64]	247,5 [9.74]	130,1 [5.12]	76,2 [3.00]

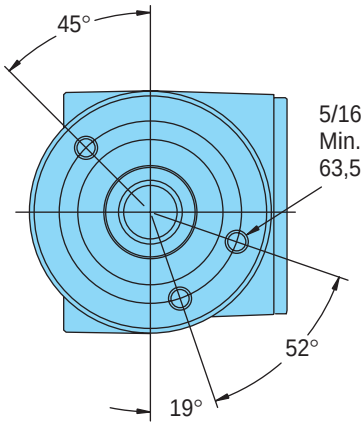
227 Series— Geroler Unit



B – Product Information

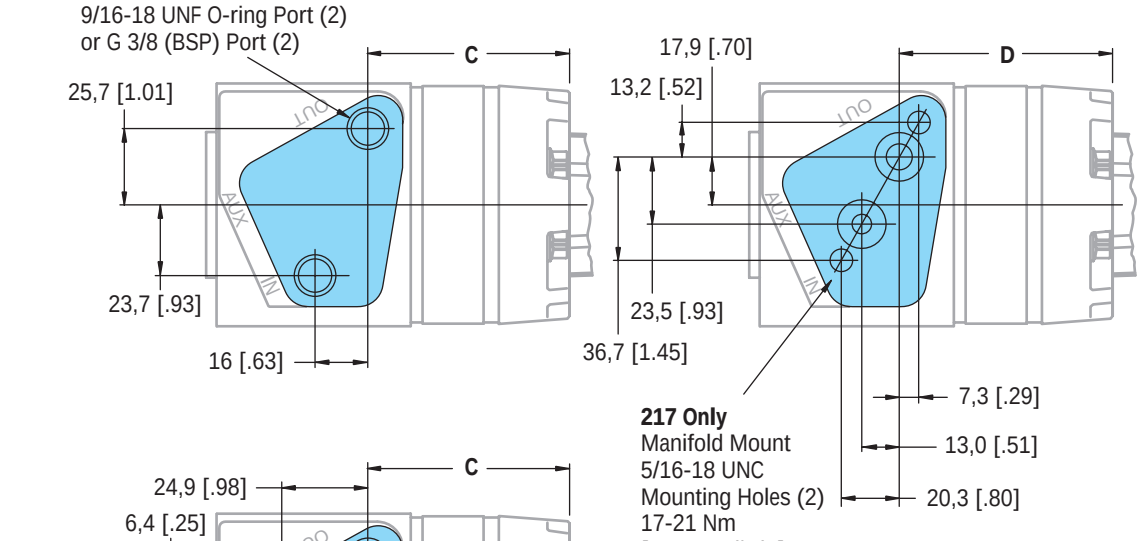
Torque Generator — Ports

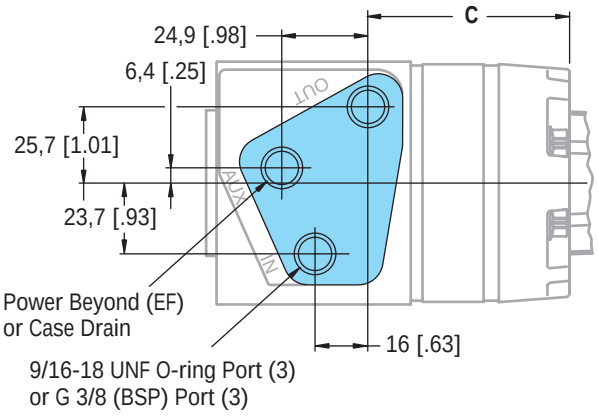
Input End

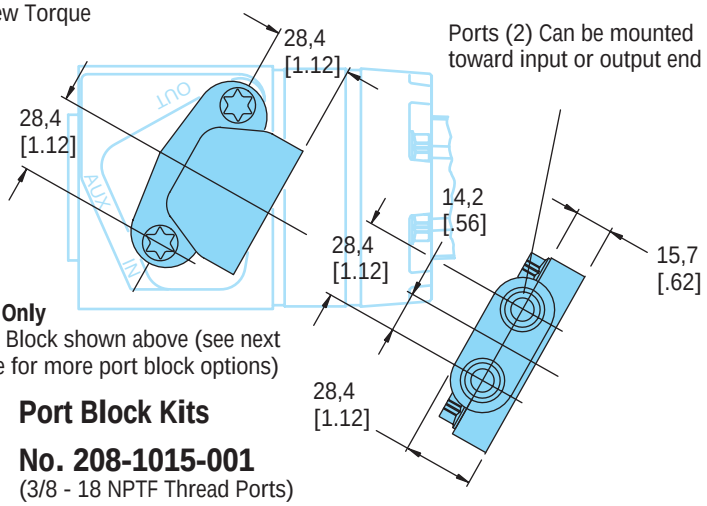


	Displacement cm³/r [in³/r]	Dimension mm [inch] C	D
217 Series (Gerotor Unit)	96,1 [5.86]	60,4 [2.38]	63,5 [2.50]
	159,6 [9.73]	69,3 [2.73]	72,1 [2.84]
227 Series (Geroler® Unit)	80,3 [4.90]	62,0 [2.44]	
	101,6 [6.20]	65,9 [2.59]	
	160,0 [9.64]	76,2 [3.00]	

Port Options







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

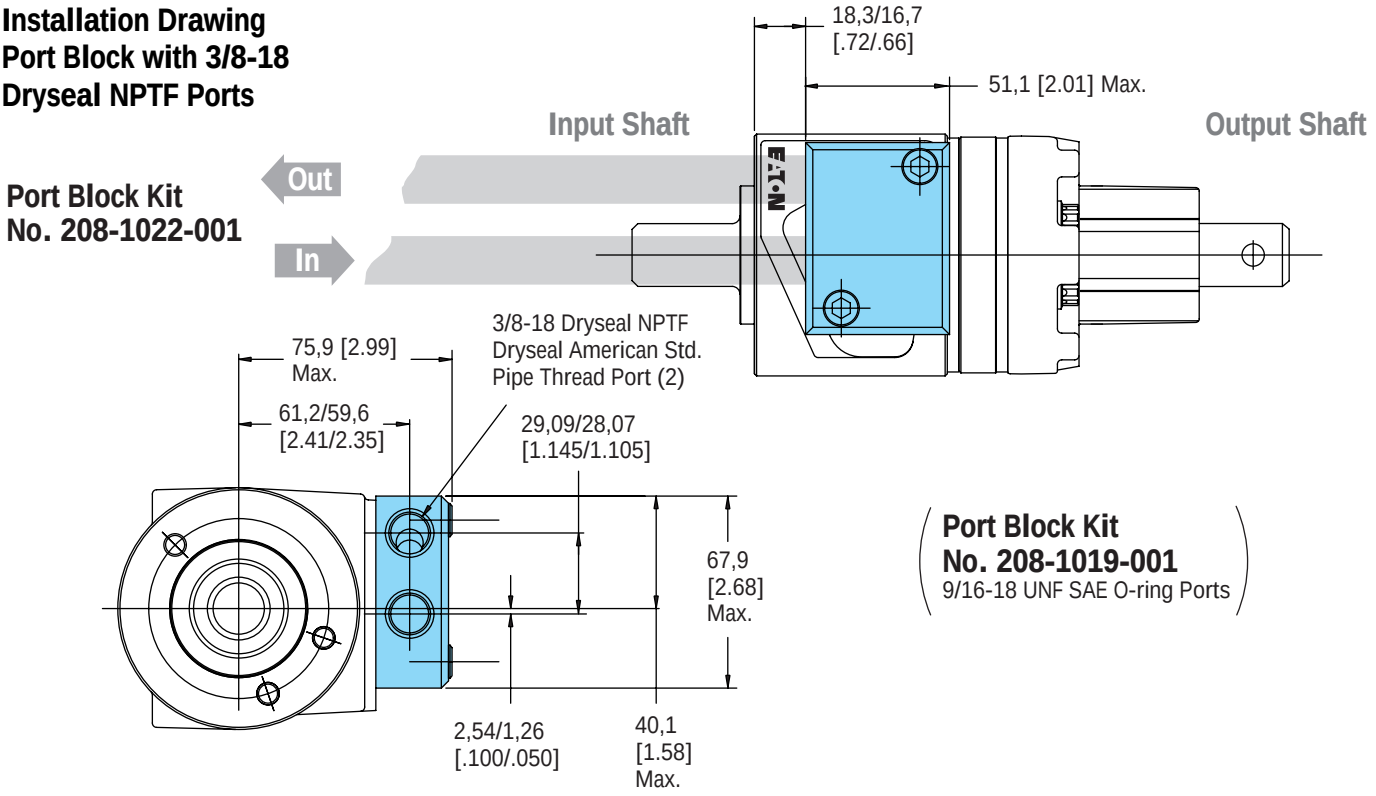
Port Block Kits

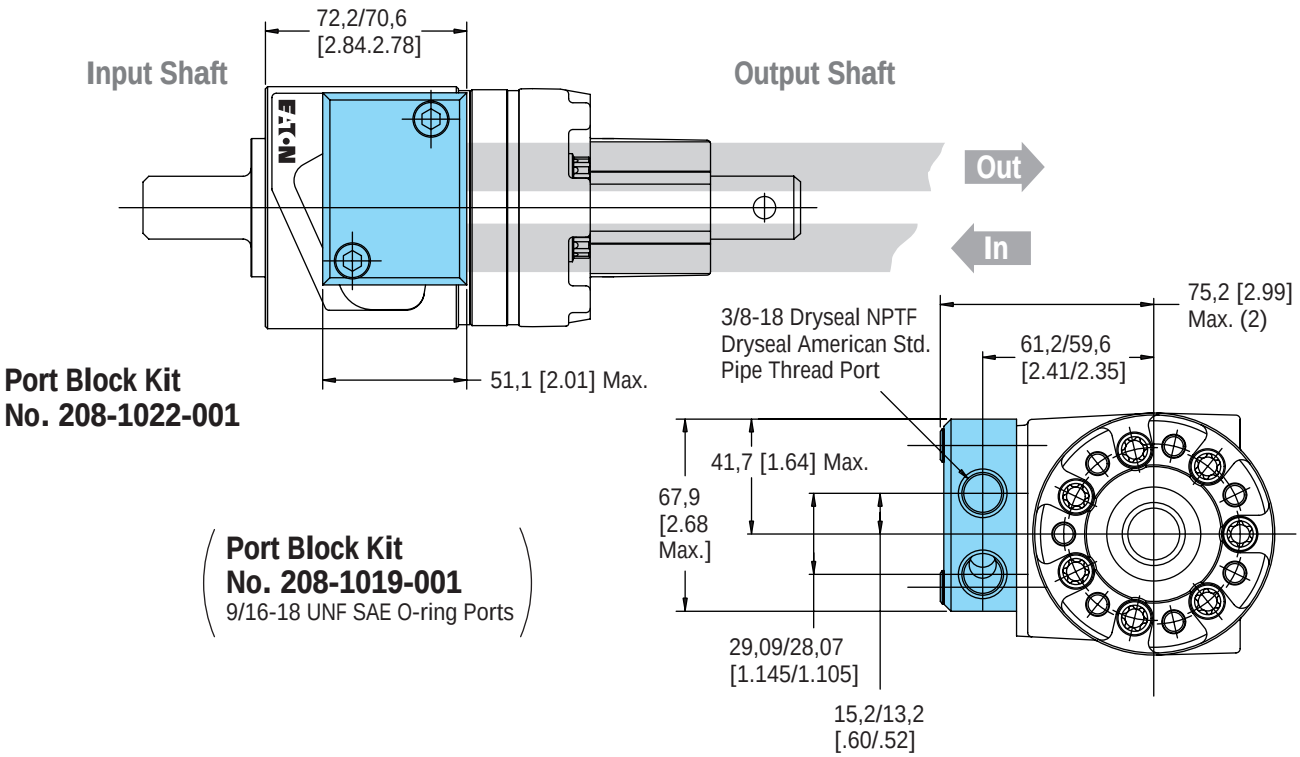
No. 208-1015-001
(3/8 - 18 NPTF Thread Ports)

B – Product Information

Torque Generator — 217 Series Port Block

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

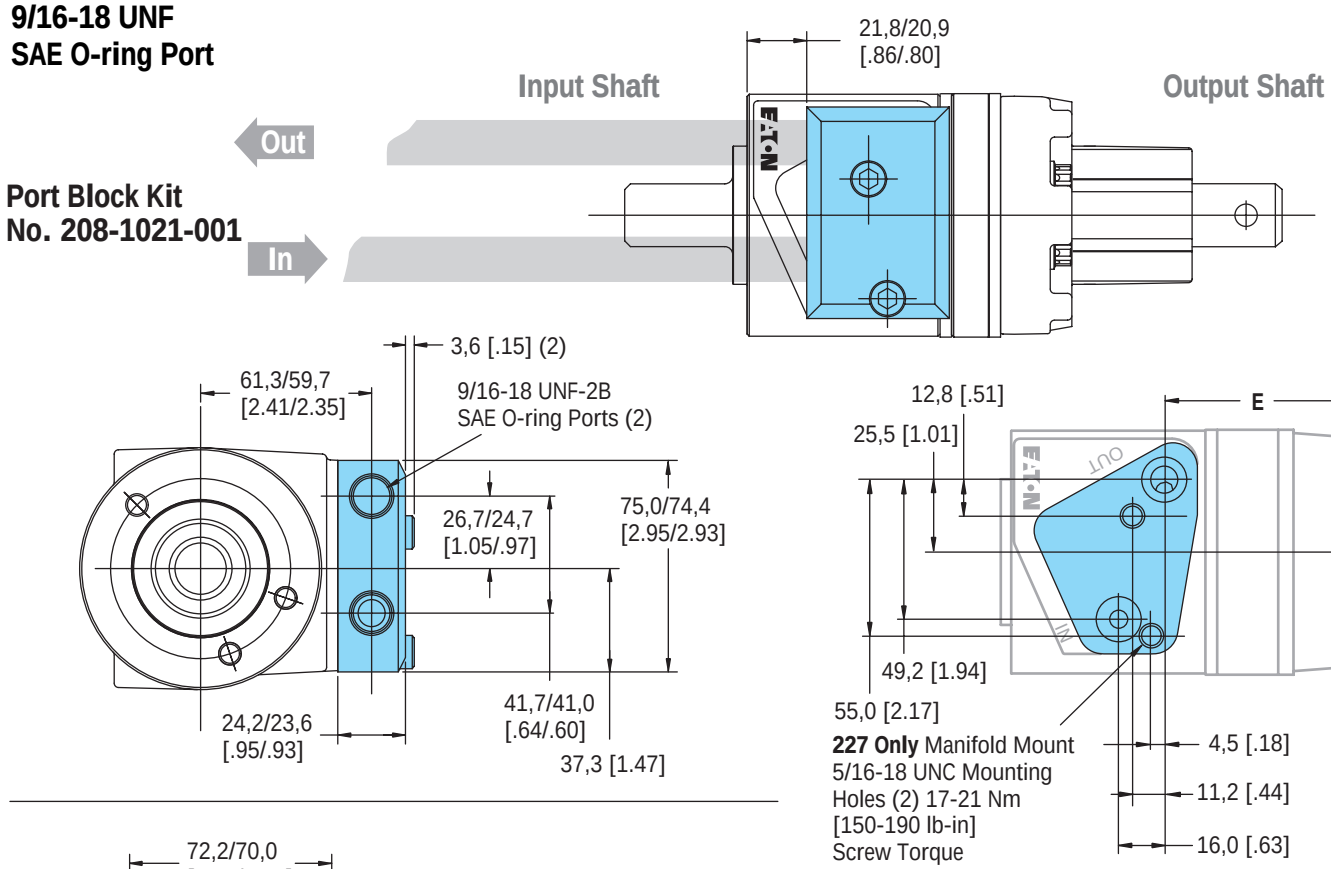


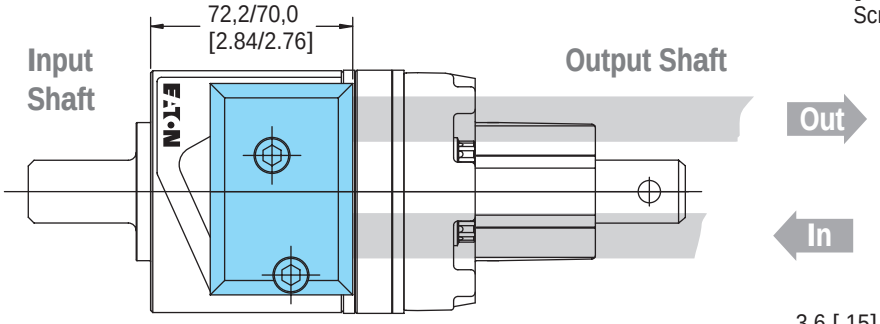


B – Product Information

Torque Generator — 227 Series Port Blocks

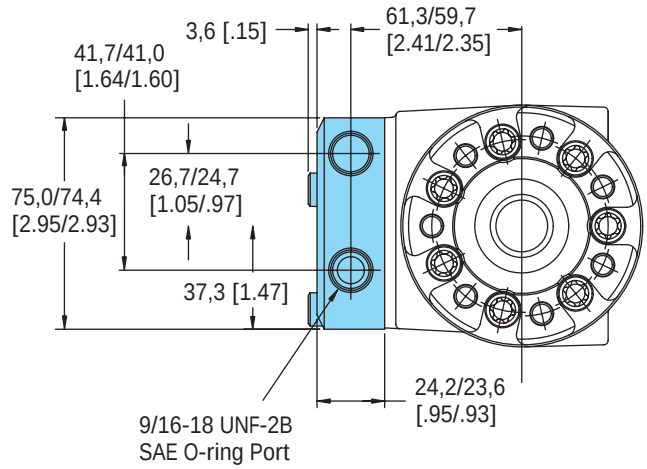
Installation Drawing
9/16-18 UNF
SAE O-ring Port





	Displacement cm³/r [in³/r]	Dim. mm [inch] E
227 Series (Geroler® Unit)	80,3 [4.90]	62,0 [2.44]
	101,6 [6.20]	71,2 [2.80]
	160,0 [9.64]	76,2 [3.00]

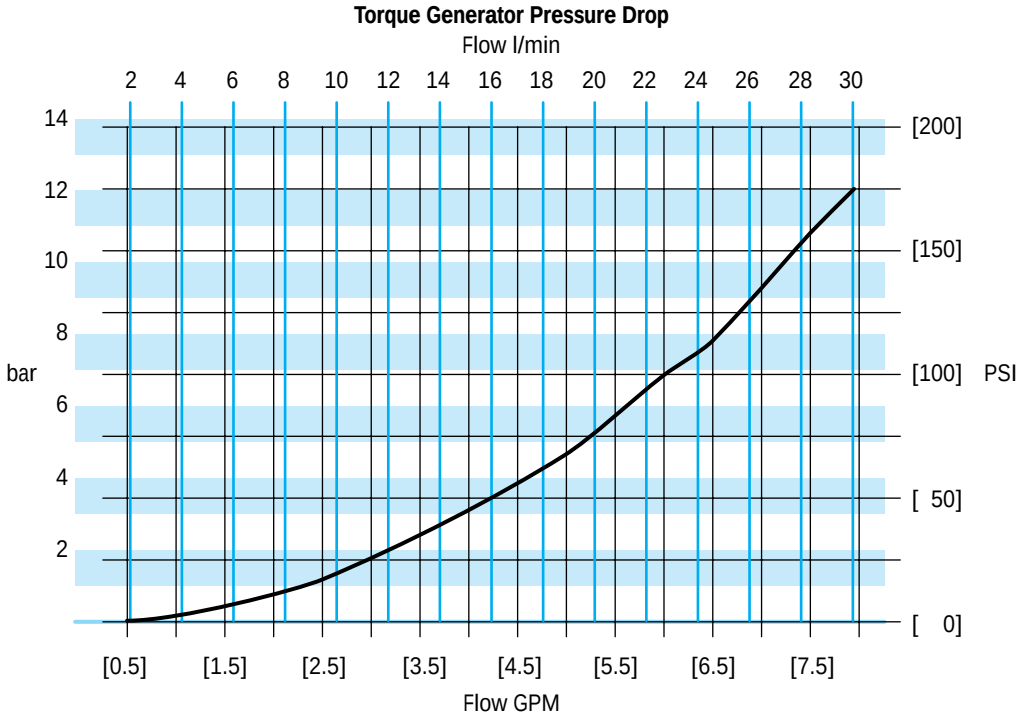
Port Block Kit
No. 208-1020-001



B – Product Information

Torque Generator

Performance Data



B – Product Information

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.

Model Code — Torque Generators

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

Position 1, 2, 3 **Product Series**

ABP ..... Torque Generator

Position 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]

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] Δp (Inlet – out) < 69 bar [1000 PSI] (Limited to 76 [4.7], 80 [4.9], 96 [5.9] cm^3/r [in^3/r])

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] Δp (Inlet – out) < 69 bar [1000 PSI]

C4D ..... 15,1 l/min [4 GPM] Load Sensning Dynamic Signal
- **Inlet**..... 69 bar [1000 PSI]
- **Out** ..... 3 bar [50 PSI]
- **Aux. (LS)**.... 69 bar [1000 PSI]

Position 7, 8 **Displacement cm^3/r [in^3/r]**

08 ..... 76 [4.7] Gerotor

10 ..... 96 [5.9] Gerotor

17 ..... 160 [9.7] Gerotor

58 ..... 80 [4.9] Geroler

60 ..... 102 [6.2] Geroler

66 ..... 160 [9.6] Geroler

Position 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

B ..... 3 x .625 inch Dia Manifold Ports with 3 x 5/16 - 18 UNC Mounting Holes (use with port block)

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

Position 10 **Shaft Bearings**

0..... None

1..... Output Shaft Needle Bearings

Position 11 **Integral Valves**

0..... None

Position 12 **Input Torque**

1..... Standard

Position 13 **Shaft Ends**

A ..... 22,17 [.874] Dia. with Keyway and Cross Hole

Position 14 **Shaft Seals**

1..... Quad Rings

Position 15 **Mounting Threads**

A ..... 5/16-18 UNC

Position 16, 17 **Special Feature**

00 ..... None

01 ..... Port Block Installed

Positon 18 **Paint and Packaging**

A ..... Black Primer

Position 19 **Identification**

1..... Eaton Product Number on Nameplate

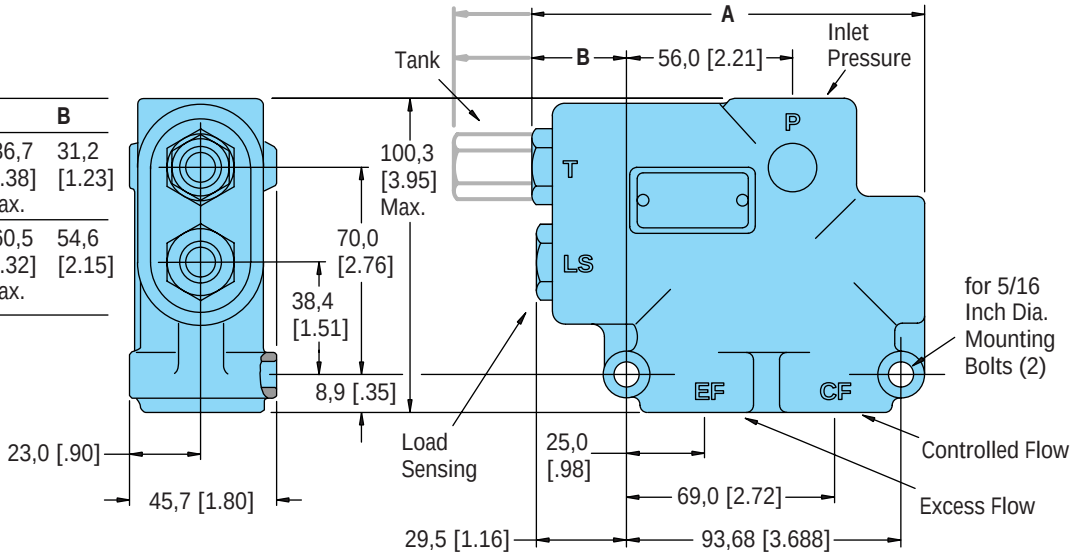
Position 20 **Eaton Assigned Design Code**

B ..... Assigned Design Code

B – Product Information
Steering System Components
VLC In-Line Priority Valves

60 l/min [16 GPM] Rated Flow

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



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 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 CF LS & T	7/8 - 14 3/4 -16 7/16 - 20	606-1217	606-1232	606-1218	606-1314	606-1219	606-1315
P & EF CF LS & T	3/4 - 16 9/16 - 18 7/16 - 20	606-1214	606-1327	606-1215	606-1278	606-1216	606-1328
P & EF CF LS & T	M22 X 1,5 M18 X 1,5 M12 X 1,5	606-1329	606-1330	606-1331	606-1332	606-1333	606-1334
P & EF CF LS & T	R 1/2 - 14 R 1/2 - 14 R 1/4 - 19	606-1335	606-1336	606-1337	606-1338	606-1339	606-1340

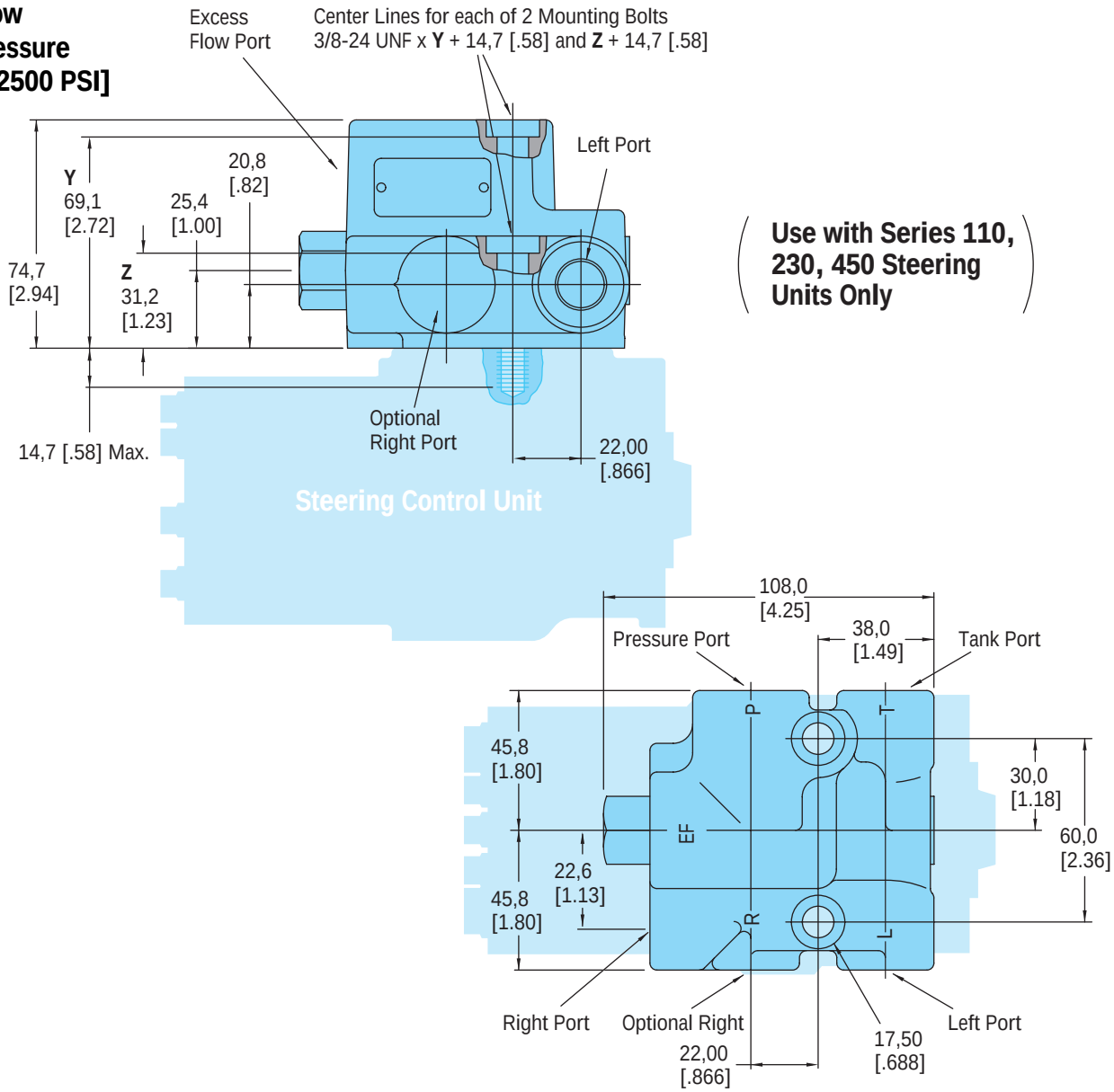
Example: 606-1218-00X-QA
Product Number — **System Pressure Code Number**

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.

B – Product Information
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

		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 CF LS & T	G1/2 G 3/8 G 3/8		612-0003		612-0001		
P & EF T, L, & R	G 1/2 G 3/8				612-0005		

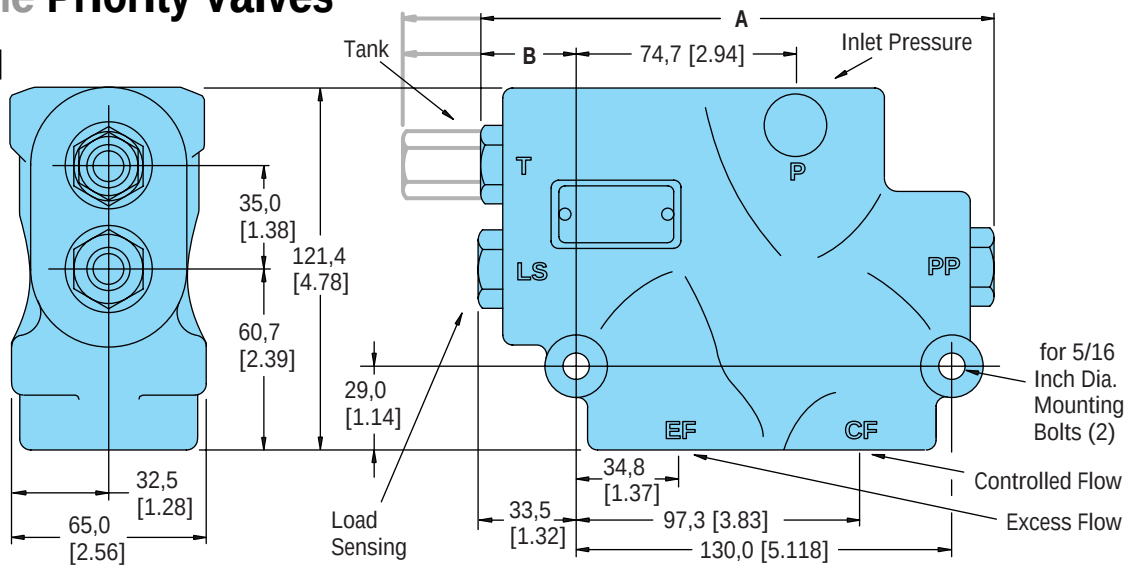
For comprehensive information for all steering system components “Valves” see Eaton catalog 11-508.

B – Product Information
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 [.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.

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*

		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 CF LS & T	1 1/16 -12 3/4 - 16 7/16 - 20	606-1093	606-1294	606-1094	606-1295	606-1095	606-1296
P & EF CF LS & T	1 1/16 -12 7/8 - 14 7/16 - 20	606-1046	606-1341	606-1047	606-1342	606-1048	606-1343
P & EF CF LS & T	1 5/16 -12 7/8 - 14 7/16 - 20	606-1058	606-1344	606-1059	606-1345	606-1060	606-1346
P & EF CF LS & T	1 5/16 - 12 1 5/16 - 12 7/16 - 20	606-1141	606-1347	606-1142	606-1348	606-1143	606-1349
P & EF CF LS & T	1 5/16 - 12 1 1/16 - 12 7/16 - 20	606-1350	606-1282	606-1351	606-1281	606-1352	606-1283
P & EF CF LS & T	M27 X 2 M18 X 1,5 M12 X 1,5	606-1353	606-1354	606-1355	606-1356	606-1357	606-1358
P & EF CF LS & T	R 3/4 - 14 R 1/2 - 14 R 1/4 - 19	606-1359	606-1360	606-1361	606-1362	606-1363	606-1364
High Pressure*							
P & EF CF LS & T	1 5/16 -12 1 1/16 - 12 7/16 - 20	606-1365	606-1321	606-1366	606-1322	606-1367	606-1323

Example: 606-1094-00X-QA

System Pressure Code Number

Product Number

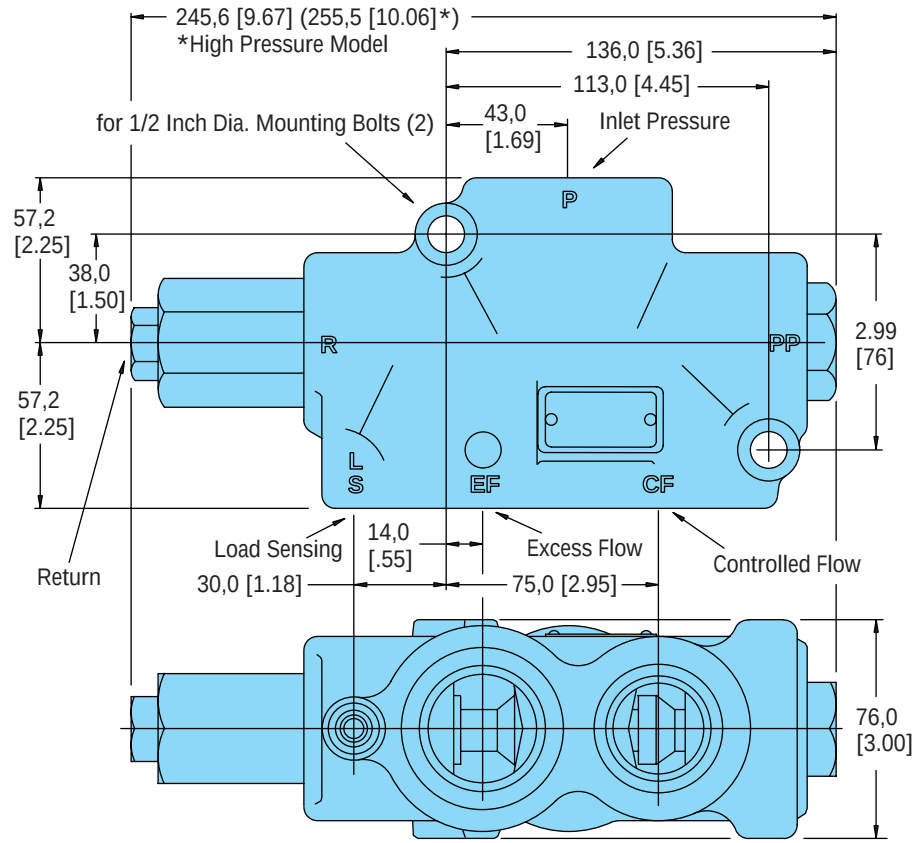
X = Design Level — **NOT** part of order number

The product number (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.

For comprehensive information for all steering system components “Valves” see Eaton catalog 11-508.

B – Product Information
Steering System Components
VLH In-line Priority Valves

240 l/min [63 GPM] Rated Flow



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.

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

Ports (5)	O-ring Port Size	Control Pressure - bar [PSI] / Product Number: 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 CF LS & R	1 5/8 - 12 1 5/16 - 12 7/16 - 20	606-1201	606-1288	606-1202	606-1289	606-1203	606-1290
P & EF CF LS & R	1 5/8 - 12 1 1/16 - 12 7/16 - 20	606-1368	606-1284	606-1369	606-1285	606-1370	606-1286
P & EF CF LS & R	1 5/8 - 12 3/4 - 16 7/16 - 20	606-1189	606-1371	606-1190	606-1372	606-1191	606-1373
High Pressure*							
P & EF CF LS & R	1 5/8 -12 1 1/16 - 12 7/16 - 20	606-1374	606-1316	606-1375	606-1317	606-1376	606-1318

Example: 606-1202-00X-QA
- 606-1202-00X-QA: **Product Number**
- QA: **System Pressure Code Number**

X = Design Level — **NOT** part of Order Number.

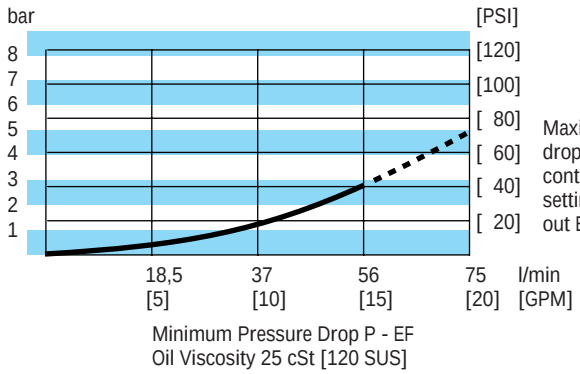
The product number (left) describes a VLH Series with 6,9 bar [100 PSI] control pressure, static signal, 1 5/8-12 P and EF ports, 1 5/16-12 CF port, 7/16-20 LS and R ports, 172 bar [2500 PSI] relief valve setting.

For comprehensive information for all steering system components “Valves” see Eaton catalog 11-508.

B – Product Information

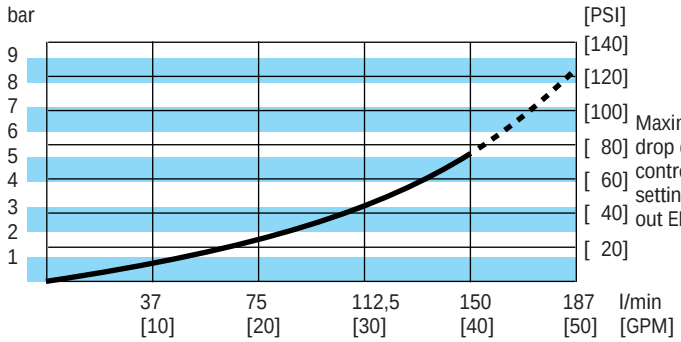
Pressure Drop Curves for VLC, VLE, and VLH Priority Valves

VLC Series



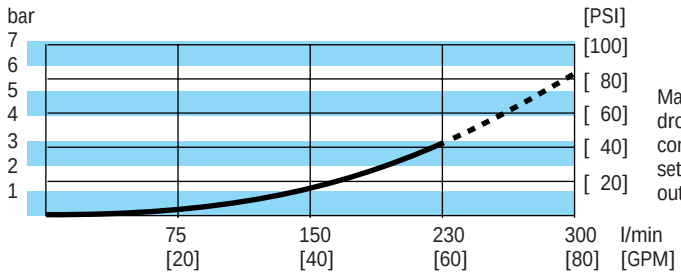
Minimum Pressure Drop P - EF
Oil Viscosity 25 cSt [120 SUS]

VLE Series



Minimum Pressure Drop P - EF
Oil Viscosity 25 cSt [120 SUS]

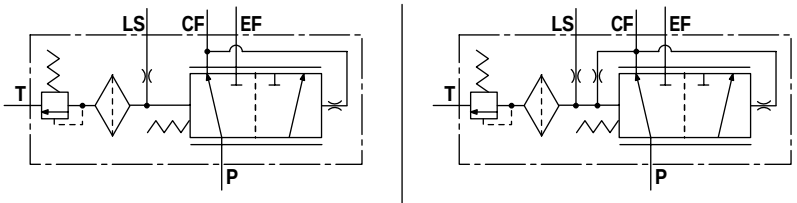
VLH Series



Minimum Pressure Drop P - EF
Oil Viscosity 25 cSt [120 SUS]

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



Static Signal | **Dynamic Signal**

For comprehensive information for all steering system components “Valves” see Eaton catalog 11-508.

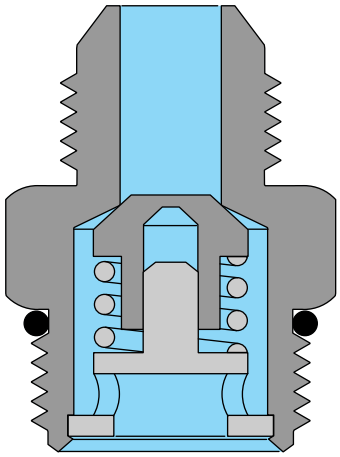
B – Product Information
Steering System Components
Check Valves

Product Description and Features

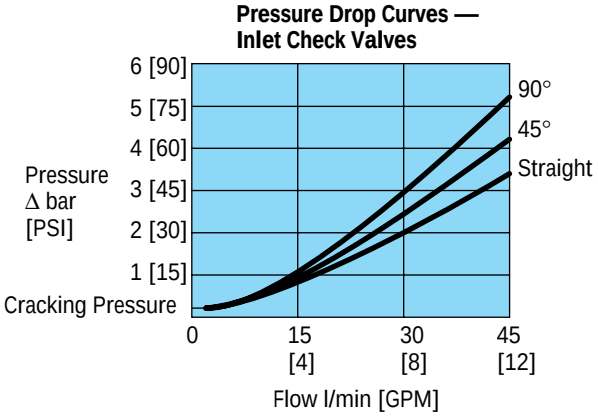
These check valves are designed specifically to withstand the rugged duty cycles of a steering system and perform their functions reliably to prevent kickback in the steering wheel.

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).

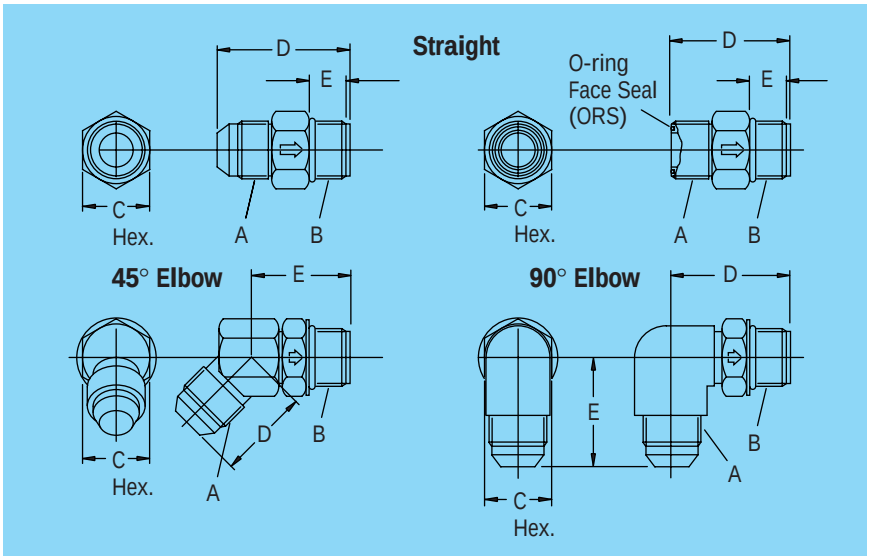
Straight, 45° and 90° elbow configurations are available (see installation drawing below).



Performance Data

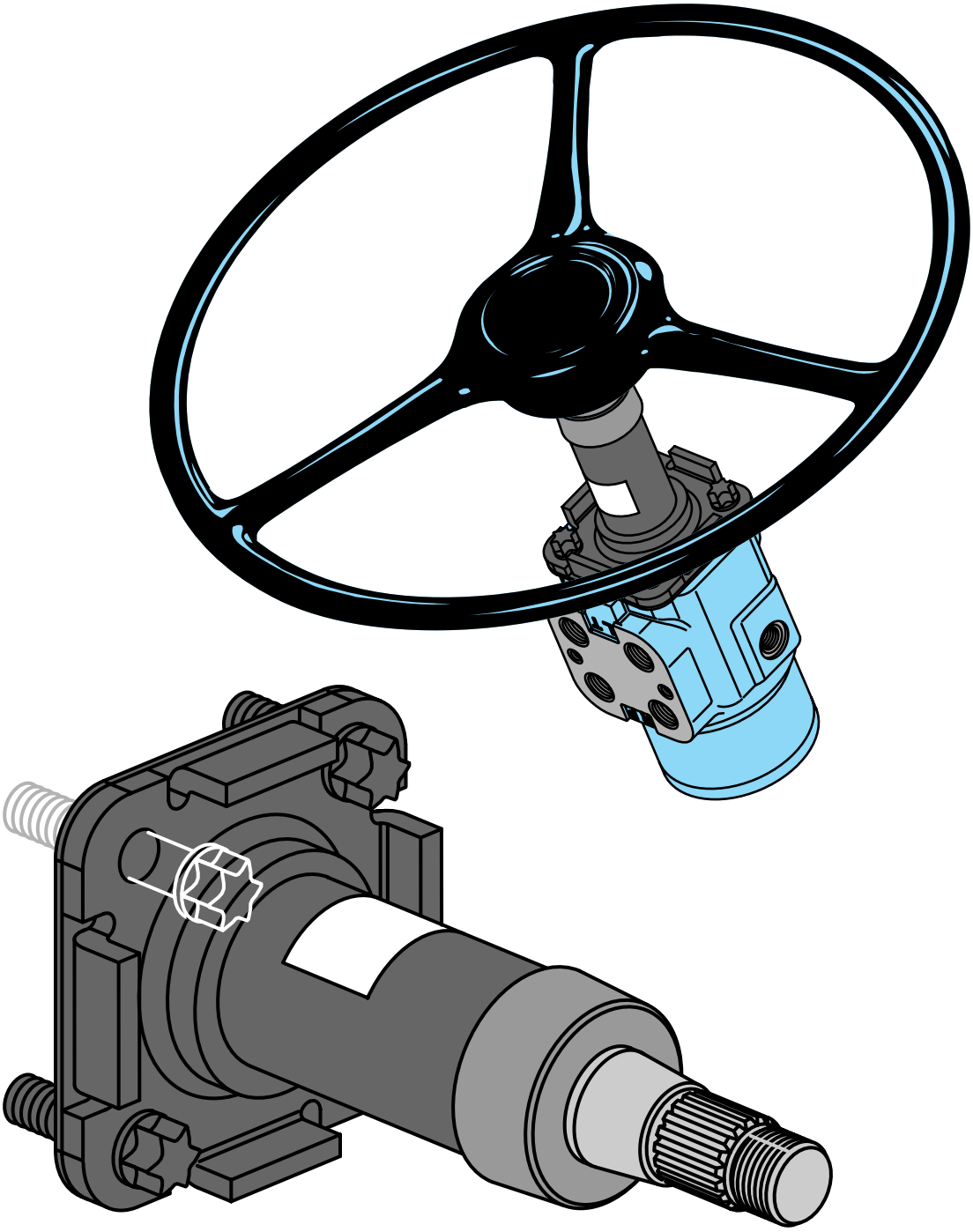


Installation Drawing

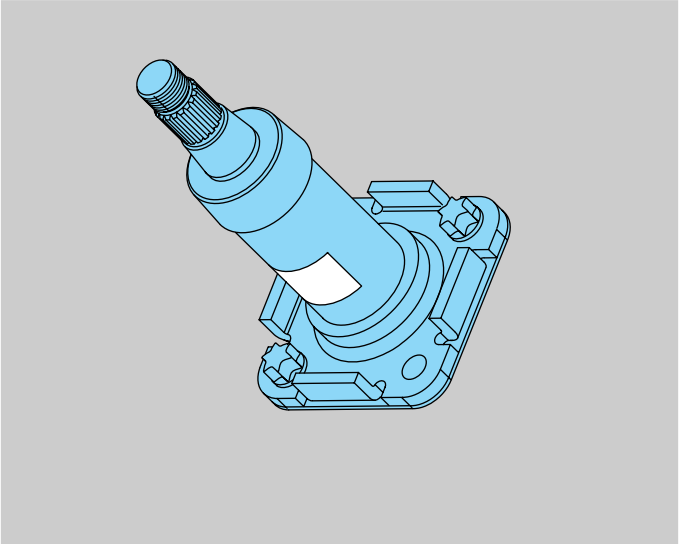


Configuration		Product Number	Check Valve Dimensions — mm [in.]				
			A	B	C	D	E
Straight	37°	608-1003	3/4-16	3/4-16	22,23/21,97 [.875/.865]	38,1/36,5 [1.50/1.44]	10,0/ 8,8 [.39/ .35]
	37°	608-1004	9/16-18	3/4-16	22,23/21,97 [.875/.865]	35,6/34,0 [1.40/1.34]	10,0/ 8,8 [.39/ .35]
	ORS	608-1007	13/16-16	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]

B – Product Information
Steering System Components
Steering Columns



B – Product Information
Steering System Components
Steering Columns

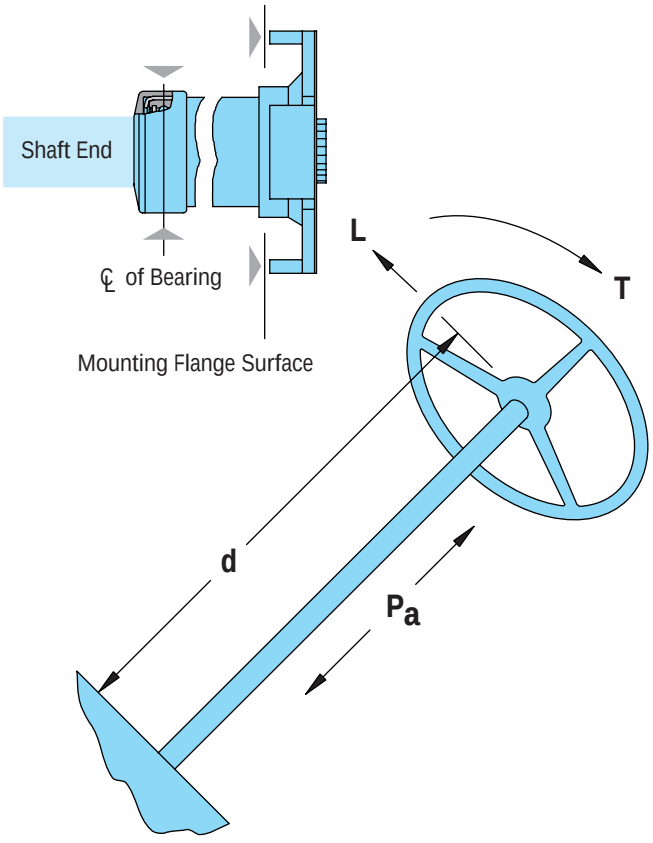


Description

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 tortional 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 Tortional ..... 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]
Tortional 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

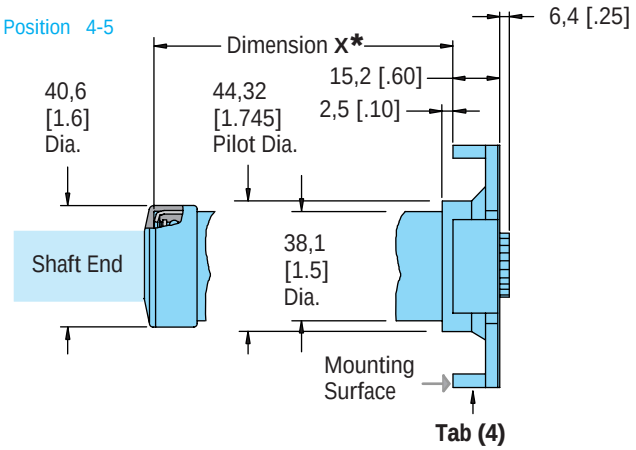
- Please contact your Eaton representative if any request differs from our catalog offerings.

B – Product Information **Column**

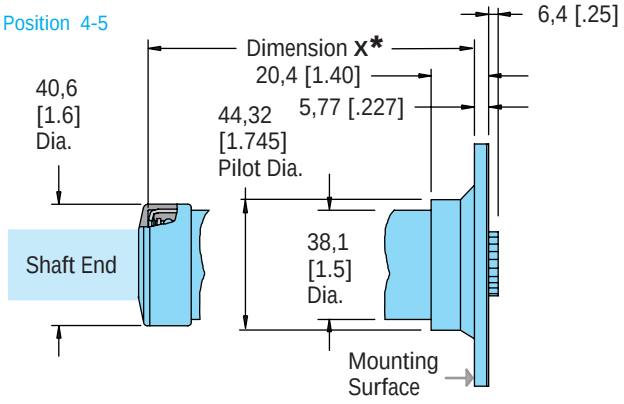
Example — see model code page 100
Position 4-5
SH ..... Standard with flat flange (No Tabs)
Position 9, 10, 11
026 ..... 66,1 [2.60] (Dimension **X)**

Jacket/Base Type *Dimension **X** — see model code page 100 Position 9, 10, 11 (Jacket Length)

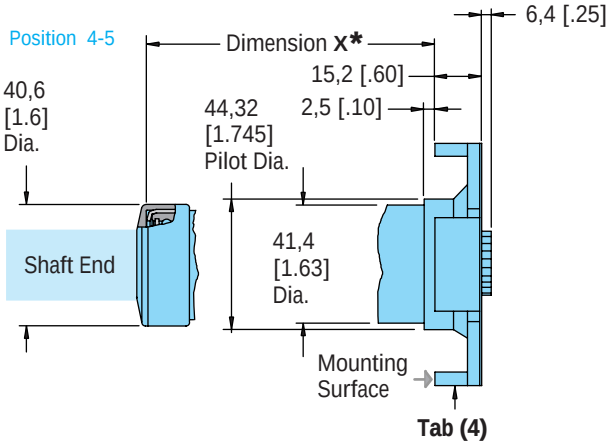
SJ Standard Wall



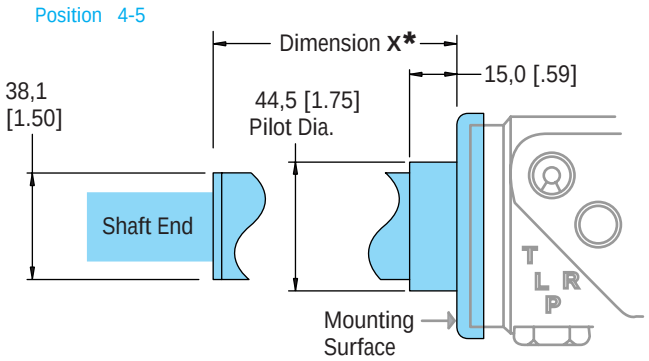
SH Standard Wall



HG Heavy Wall



MM 2 Series

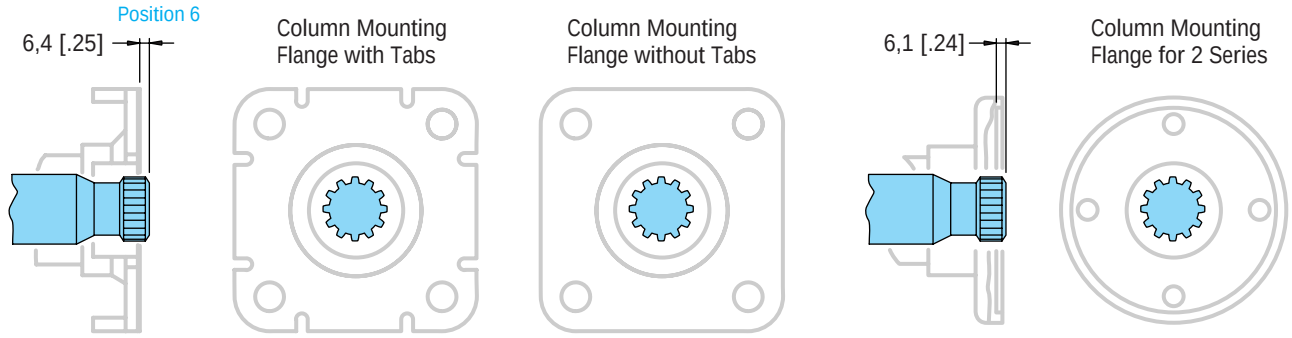


B – Product Information **Column**

Example — see model code page 100
Position 6
1 ..... 12 Tooth Spline for Steering Unit

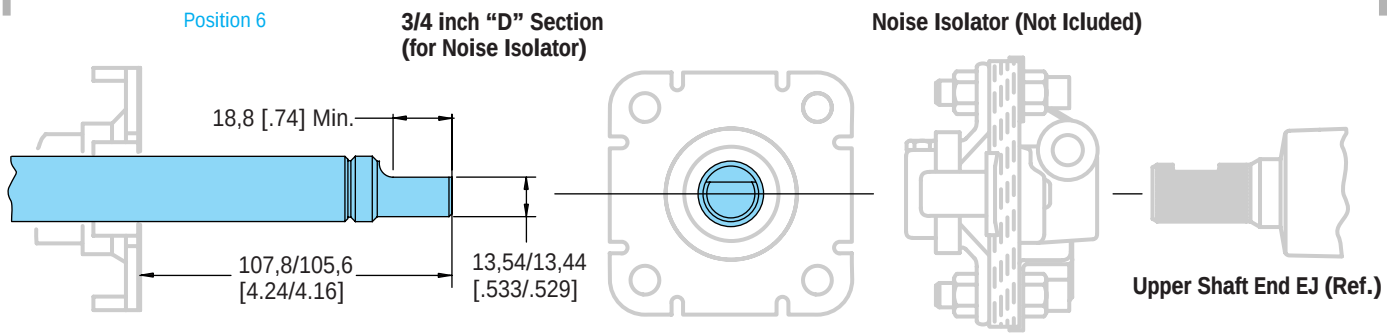
Lower End Type

1

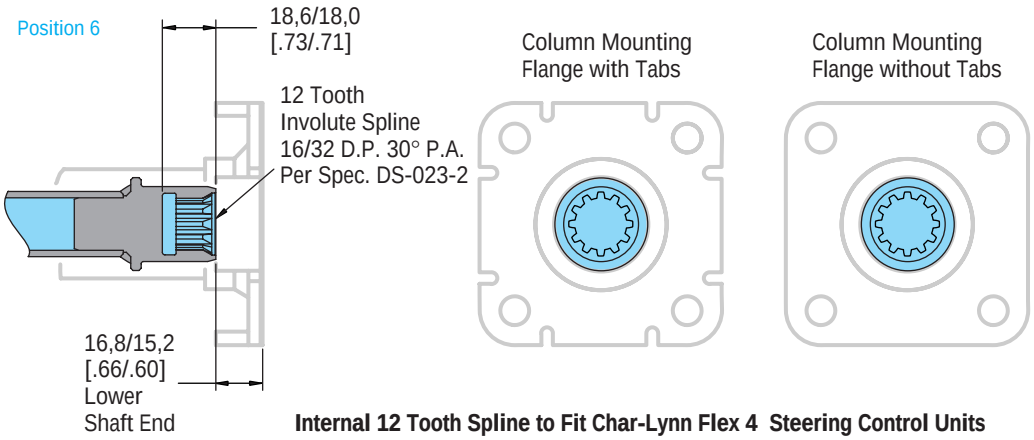


12 Tooth Spline to Fit Char-Lynn Steering Control Units

3



8



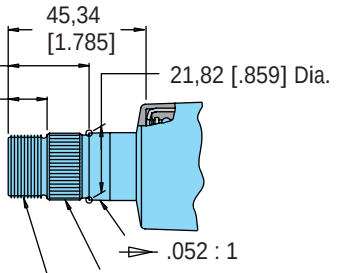
Internal 12 Tooth Spline to Fit Char-Lynn Flex 4 Steering Control Units

B – Product Information Column

Example — see model code page 100
Position 7-8
EJ .....(36 Tooth Straight Serration)
Not available with horn wire

Upper Shaft End

AJ Position 7-8

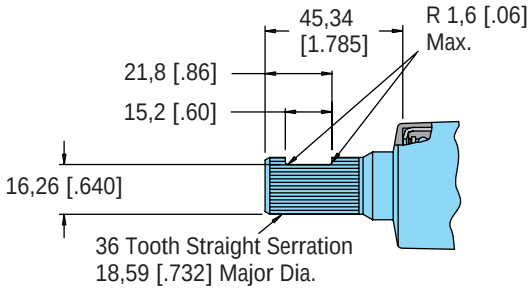


Note: Torque Nut to 41-54 Nm [30-40 lb-in]

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

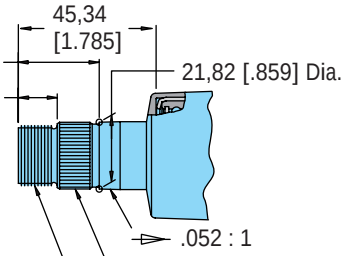
13/16 - 20 UNF - 2A Thread

EJ Position 7-8



MJ Position 7-8

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



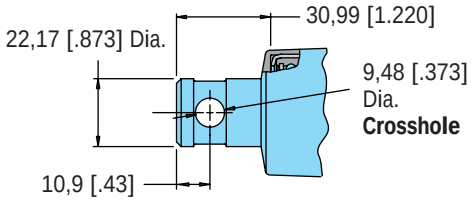
Note: Torque Nut to 41-54 Nm [30-40 lb-in]

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

M20 x 1,5 - 6g Thread

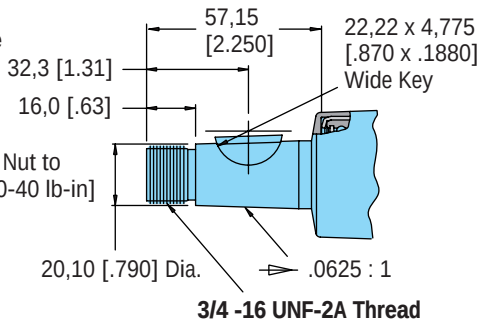
GC Position 7-8

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]

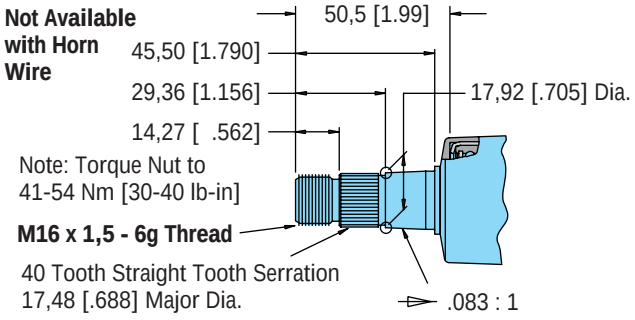
3/4 -16 UNF-2A Thread

B – Product Information Column

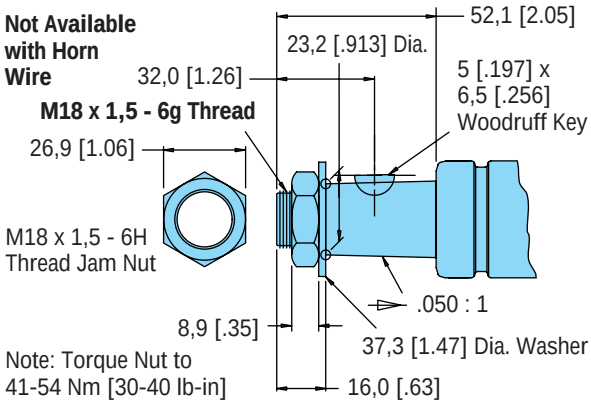
Example — see model code page 100
Position 7-8
YM .....(.050 : 1 Taper **M18 x 1,5 - 6g Thread**)
Not available with horn wire

Upper Shaft End Continued

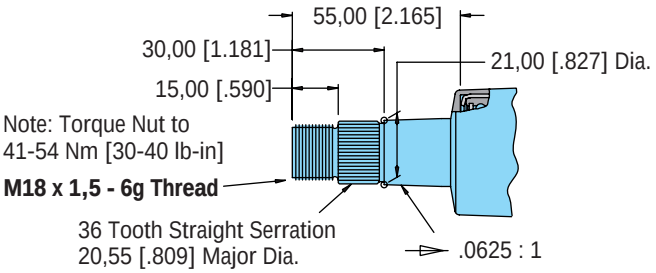
CL Position 7-8



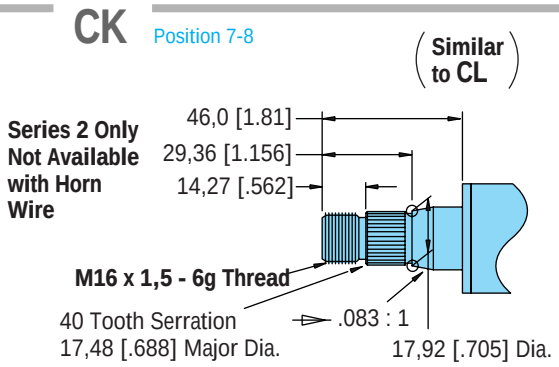
YM Position 7-8



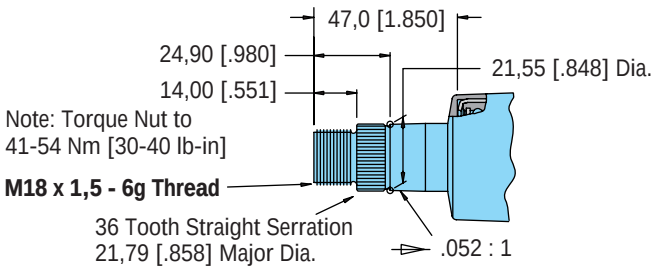
PT Position 7-8



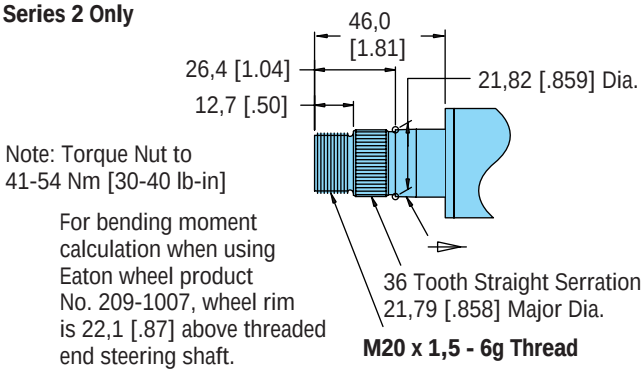
CK Position 7-8



SV Position 7-8



MK Position 7-8

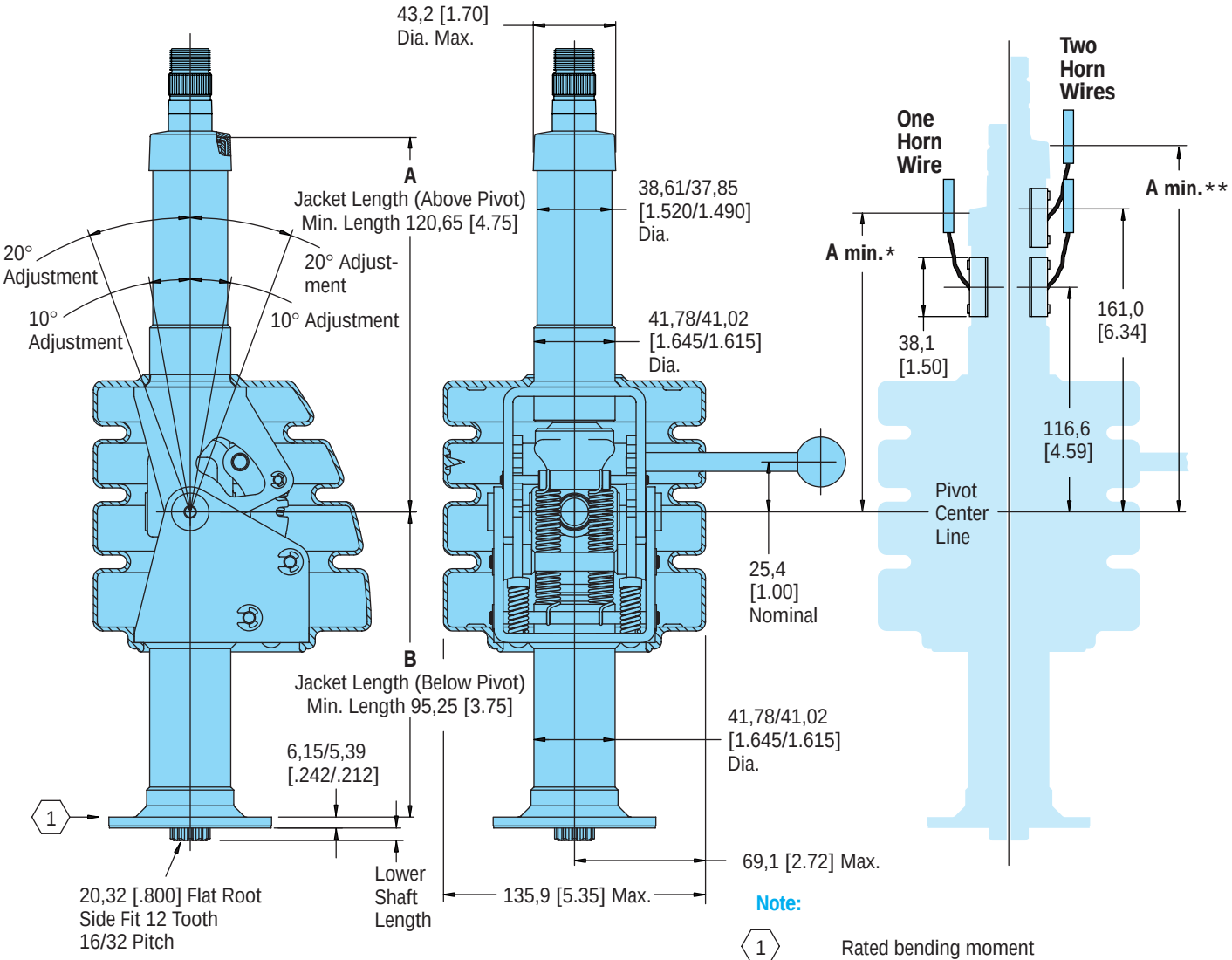


B – Product Information Tilt Column

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]

Select add-on features (Position 6 - 21) from the standard column model code (see page 100).

Please contact your Eaton representative if any request differs from our catalog offerings.



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]
	A	A	B	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)

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].

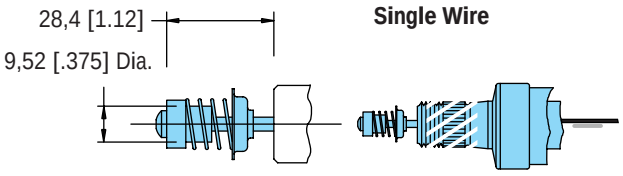
B – Product Information

Column — Horn Wire Electrical

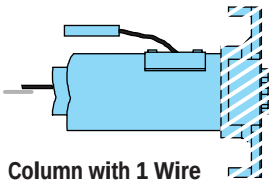
Example — see model code page 100
Position 12-16
1A045 .....Column with one horn wire

Single Wire

01 Position 18-19

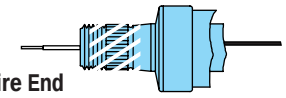


1A045 Position 12-16



Column with 1 Wire

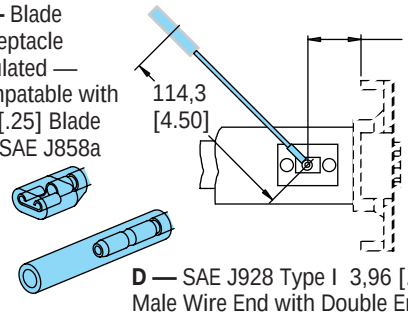
08 Position 18-19



Tinned Bare Wire End

K or D Position 17

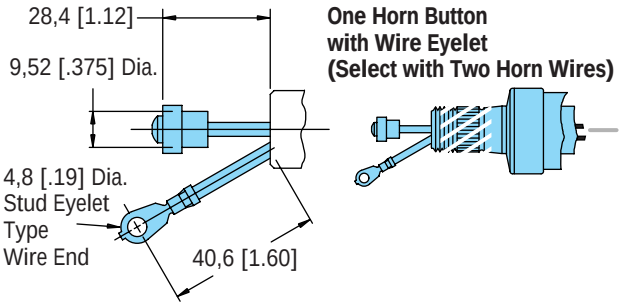
K — Blade Receptacle Insulated — Compatable with 6,4 [.25] Blade Per SAE J858a



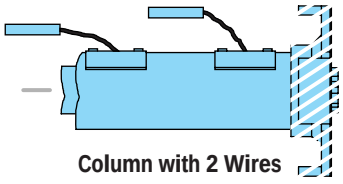
D — SAE J928 Type I 3,96 [.156] . Pin Type Male Wire End with Double End Female Connector

Two Wire

02 Position 18-19

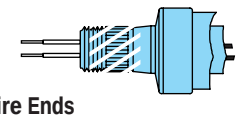


2B045 Position 12-16



Column with 2 Wires

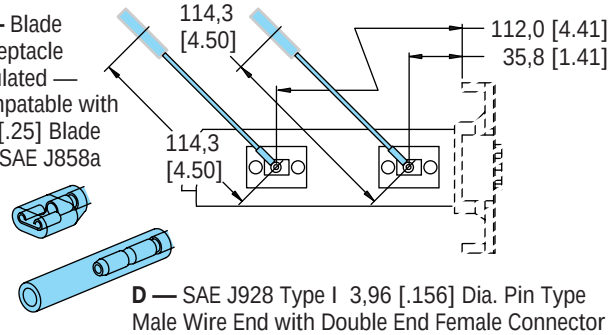
08 Position 18-19



Tinned Bare Wire Ends

K or D Position 17

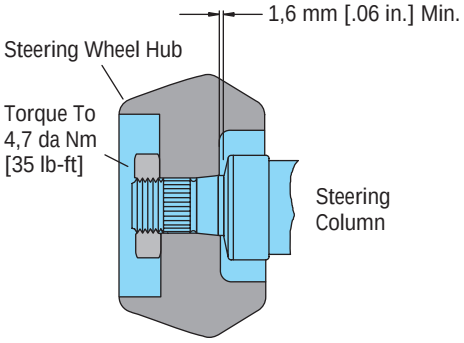
K — Blade Receptacle Insulated — Compatable with 6,4 [.25] Blade Per SAE J858a



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

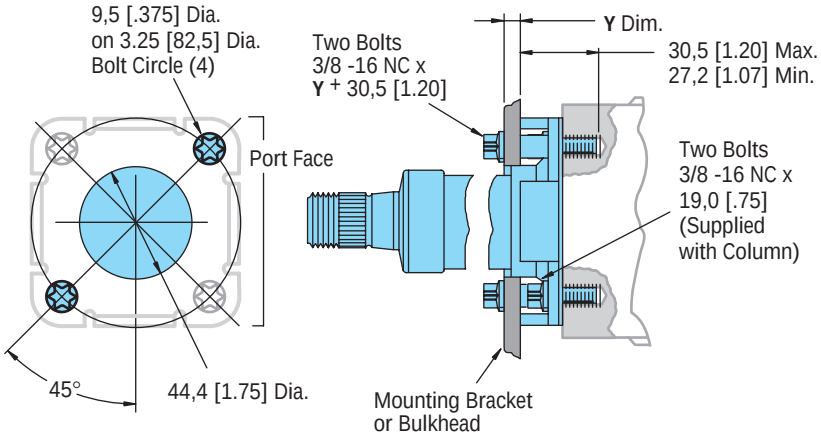
B – Product Information Column and Wheel Mounting

Inspect for Minimum Clearance at Assembly



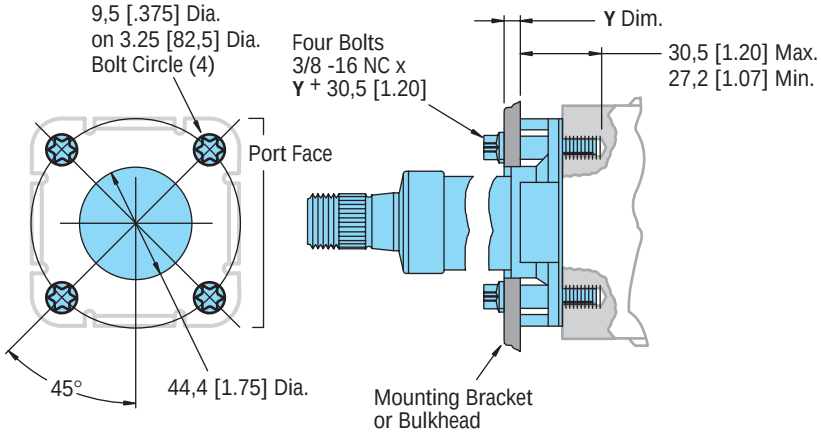
Series 3, 6, 12 and Series 110, 230, 450

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



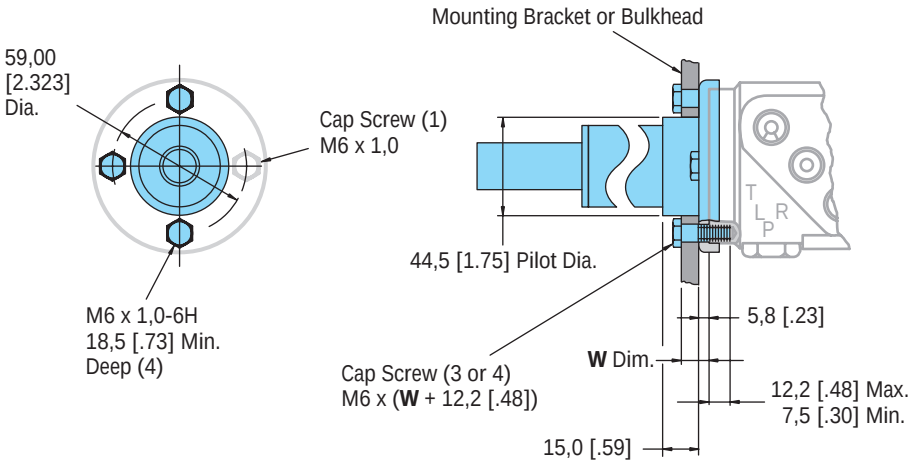
Series 20, 25

Must use four bolts thru mounting bracket or bulkhead.

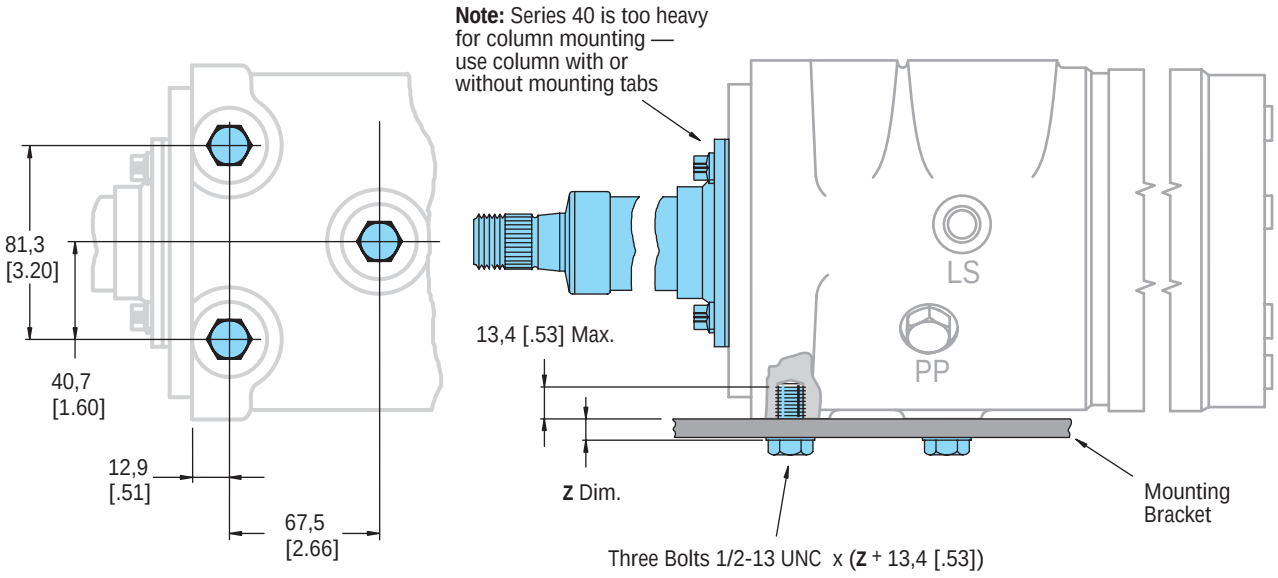


B – Product Information **Column Mounting**

Series 2 **Must use** three bolts minimum.



Series 40 **Must use** three bolts Into steering control unit mounting bosses opposite port face.



B – Product Information 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.

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																	0	0	

Position 1,3 **Product Series**

ACK ..... Steering Column

Position 4, 5 **Jacket/Base Type (see page 92)**

SJ ..... Standard (38 mm [1.50 inch] O.D.)
MM ..... Series 2 SCU (38 mm [1.50 inch] O.D.)
HG ..... Heavy Wall (41,4 [1.63 inch] O.D.) Tabbed Flange
SH ..... Standard With flat Flange (38mm [1.50 inch] O.D.) (No Tabs)
TA ..... Tilt Column with Flat Flange

Position 6 **Lower Shaft End (see page 93)**

1 ..... 12 Tooth Spline for Steering Unit
3 ..... 3/4 inch "D" Section (for Noise Isolator)
8 ..... Recessed Internal 12 Tooth Spline (for Flex 4 Steering Unit)

Position 7, 8 **Upper Shaft End (see illustrations and specifications — page 94, 95)**

AJ ..... Standard for all rigid and tilt columns Available with or without Horn Wire
MJ ..... Available with or without Horn Wire
DN ..... Not Available with Horn Wire
EJ ..... Not Available with Horn Wire
GC ..... Not Available with Horn Wire
CL ..... Not Available with Horn Wire
PT ..... Available with or without Horn Wire
SV ..... Available with or without Horn Wire
YM ..... Not Available with Horn Wire

(Standard Column and Tilt Column)

CK ..... Not Available with Horn Wire
MK ..... Available with or without Horn Wire

(Series 2)

Position 9, 10, 11 **Jacket Length - mm [in.] (Suggested Std. Dim.) — page 92**

022 ..... 56,6 [2.23]
033 ..... 82,8 [3.26]
058 ..... 147,8 [5.82]
078 ..... 197,1 [7.76]
099 ..... 250,7 [9.87]
108 ..... 273,3 [10.76]
118 ..... 298,7 [11.76]
157 ..... 399,8 [15.74]
178 ..... 451,6 [17.78]
253 ..... 642,1 [25.28]
273 ..... 692,4 [27.26]
298 ..... 756,4 [29.78]
325 ..... 826,3 [32.53]

(Standard Column **with** Tabs)

060 ..... 152,4 [6.00]
080 ..... 203,2 [8.00]
100 ..... 254,0 [10.00]
120 ..... 304,8 [12.00]
140 ..... 355,6 [14.00]
160 ..... 406,4 [16.00]

(2 Series Column)

026 ..... 66,1 [2.60]
036 ..... 92,3 [3.63]
062 ..... 157,3 [6.19]
081 ..... 206,6 [8.13]
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]
276 ..... 701,9 [27.63]
302 ..... 765,9 [30.15]
329 ..... 835,7 [32.90]

(Standard Column **without** Tabs)

AAA ..... 190,5 [7.50] Above Pivot
546,4 [21.51] Below Pivot
AAB ..... 190,5 [7.50] Above Pivot
101,6 [4.00] Below Pivot
AAC ..... 127,0 [5.00] Above Pivot
127,0 [5.00] Below Pivot

(Tilt Column page 96)

Position 12-16 **Horn Wire Feature — page 97**

00000 ..... No Horn Wire
1A045 ..... Single Horn Wire
2B045 ..... Two Horn Wires

Position 17 **Horn Brush Wire Terminal End — p 97**

0 ..... None—Select When No Horn Wire Used
D ..... SAE J928 Pin and Double End Connector
K ..... Blade Receptacle — Insulated (Compatible with SAE J858a)

Position 18, 19 **Shaft End Wire Terminal — p 97**

00 ..... None
01 ..... One Horn Button (Only with One Horn Wire)
02 ..... One Horn Button with Wire Eyelet (Select with Two horn Wire)
08 ..... Tinned Bare Wire End

Position 20, 21 **Special Feature**

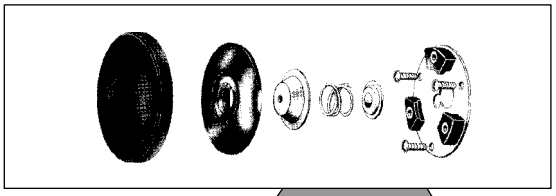
00 ..... None

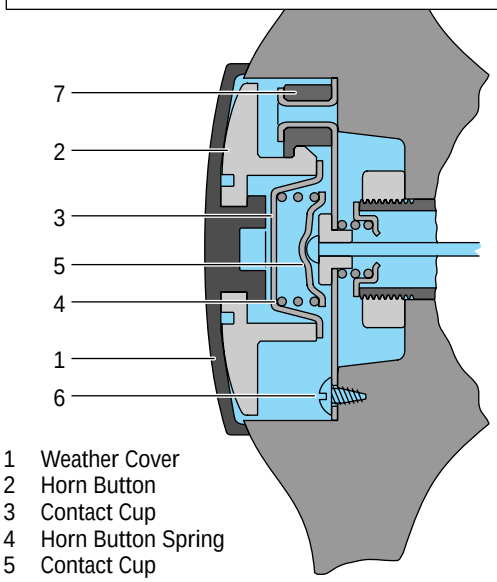
Position 22 **Eaton Assigned Design Code**

B – Product Information

Auxiliary Column Equipment

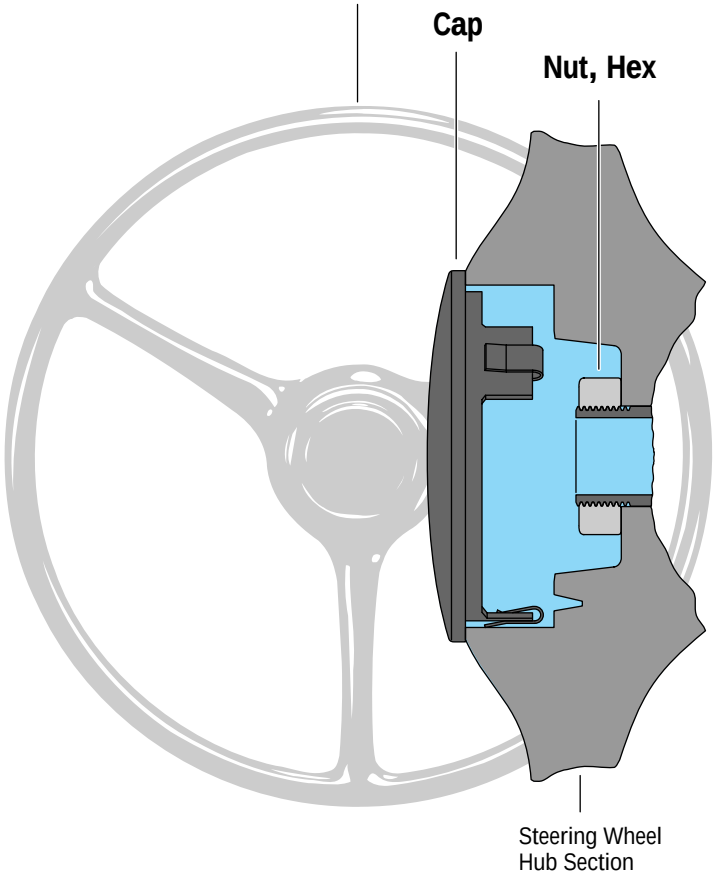
Horn Button Kit





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 CharLynn 430 mm [17 inch] steering wheel.

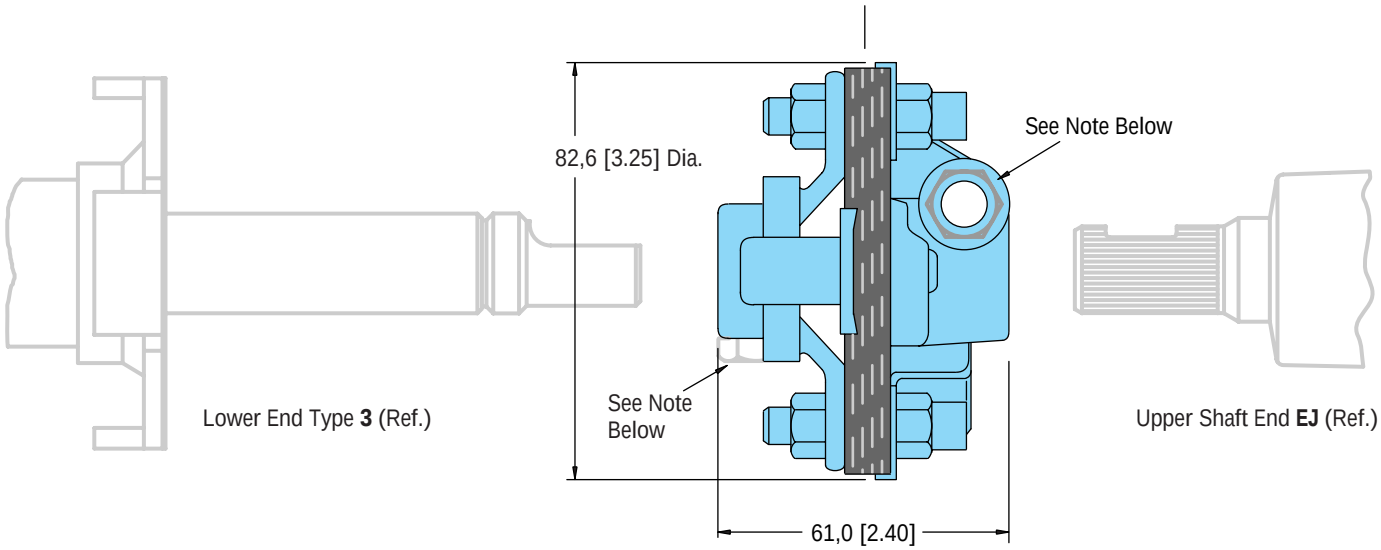
Cap ..... No. 209-1005
Char-Lynn steering wheel hub cavity cap, for no horn installations.

Nut, Hex Part Number	Upper Shaft End Configuration (See Page 94, 95)	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

B – Product Information

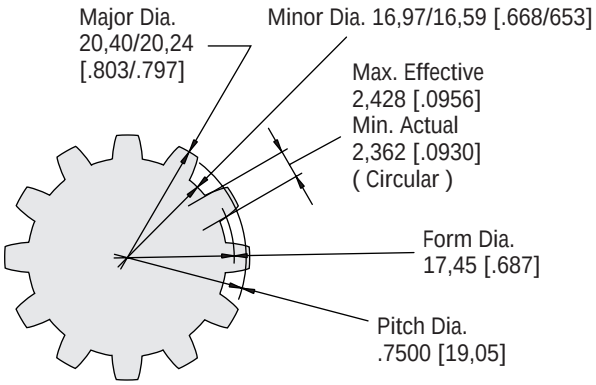
Auxiliary Column Equipment

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].

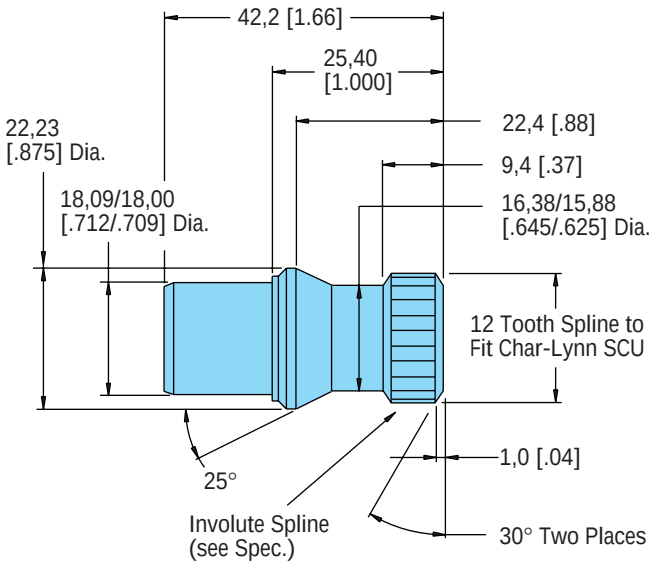
Want to Make your Own Column? You Must use these Spline Specs. — Lower Shaft End



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

B – Product Information
Steering System Components
T Series Hydraulic Motors

Product Description

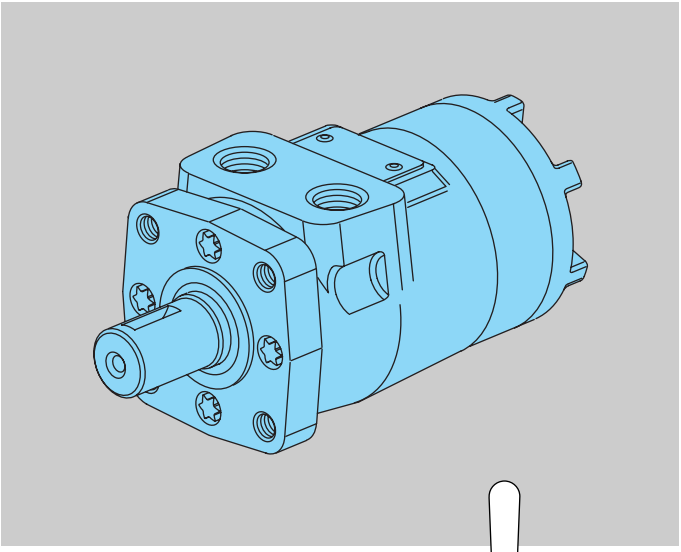
Char-Lynn T Series low speed, high torque Geroler® motor developed with low speed/low leakage valving specifically for steering applications (see Catalog 11-885 General Purpose Motors H, S, and T Series page 39 Code AB, Position 11-12).

Pressure Capability
- **Continuous** ..... 155 bar [2250 PSI]
- **Intermittent** ..... 190 bar [2750 PSI]

Speeds ..... up to 1055 RPM

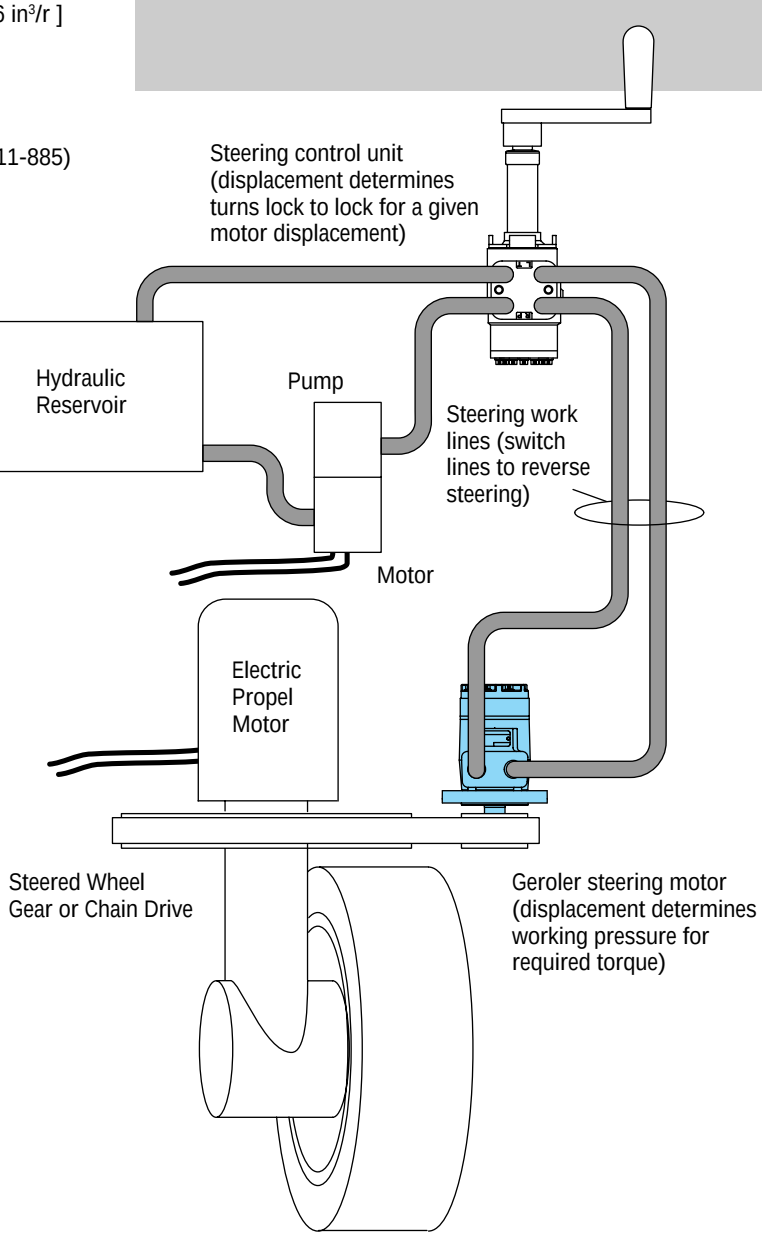
Torque
- **Continuous** ..... 440 Nm [3905 lb-in]
- **Intermittent** ..... 510 Nm [4515 lb-in]

11 Displacements ..... 36 cm^3/r [2.2 in^3/r]
to ..... 370 cm^3/r [22.6 in^3/r]



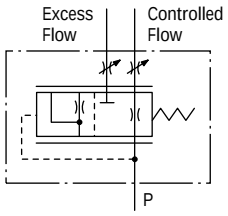
Comprehensive T Series Motor Description

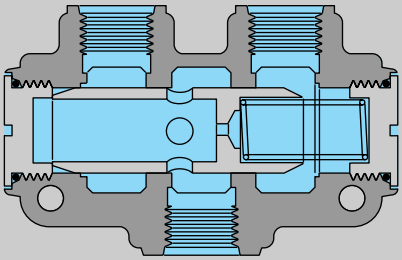
(see Char-Lynn General Purpose Motors H, S, T Series Cat. 11-885)



B – Product Information
Steering System Components
Flow Divider Valves

Model 32306 Priority Flow Divider

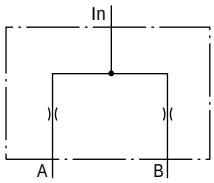


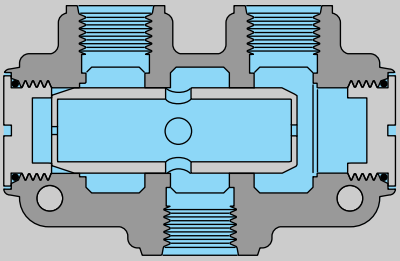


Specifications

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

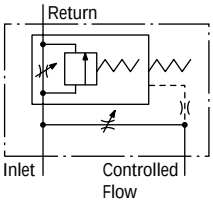


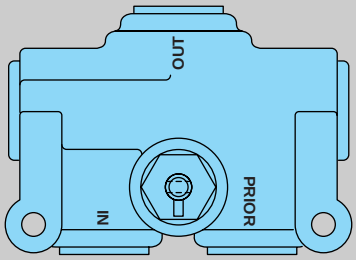


Specifications

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





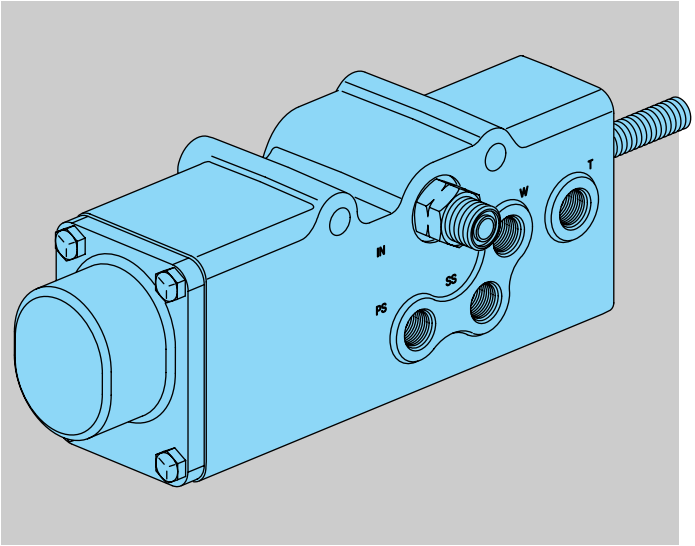
Specifications

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)

B – Product Information
Steering System Components
Brake Valve



Product Description and Features

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.

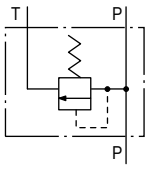
Features

- **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**

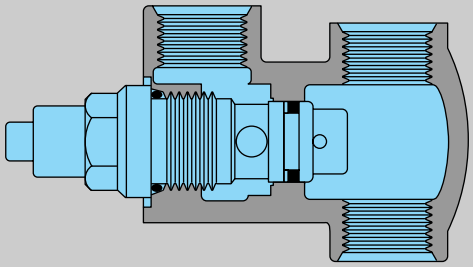
Specifications — Valve

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

B – Product Information
Steering System Components
Relief Valves

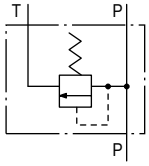


Model 32107
In-Line Relief Valve–
Direct Acting Cartridge

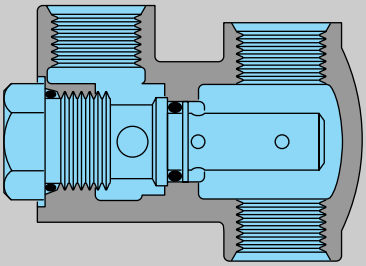


Specifications

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]

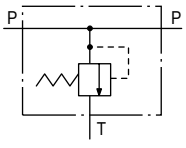


Model 32107
In-Line Relief Valve–Pilot
Operated Cartridge

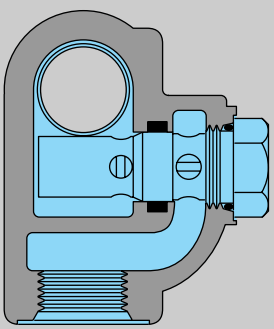


Specifications

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]

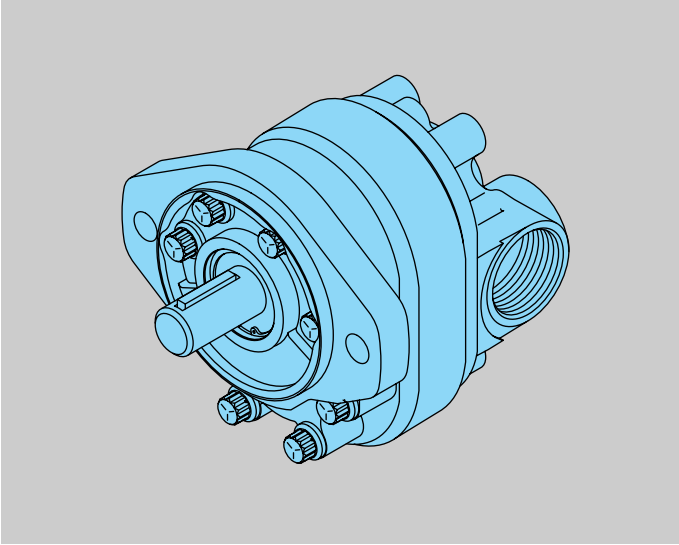
Comprehensive Relief Valve Description
(see Eaton Relief Valve Catalog 11-510)

B – Product Information
Steering System Components
Gear Pump Series 26

Product Description

Eaton's Hydraulics Division has produced gear pumps and motors for many years and 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.

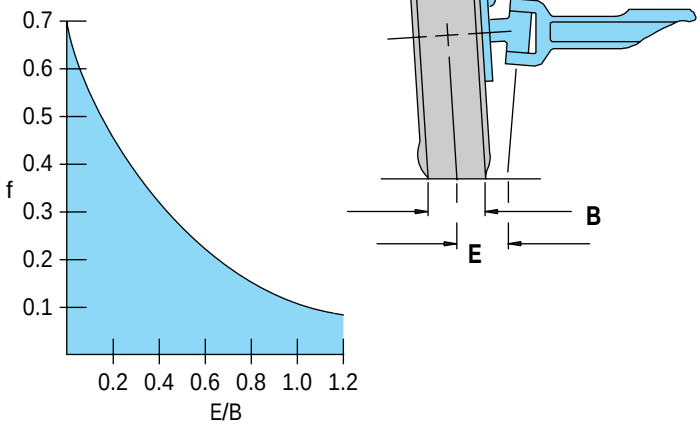
General Specifications

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)

C – Sizing
Ackermann Type Steering

Step One:
Kingpin Torque



Typical values based on rubber tired vehicles on dry concrete.

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

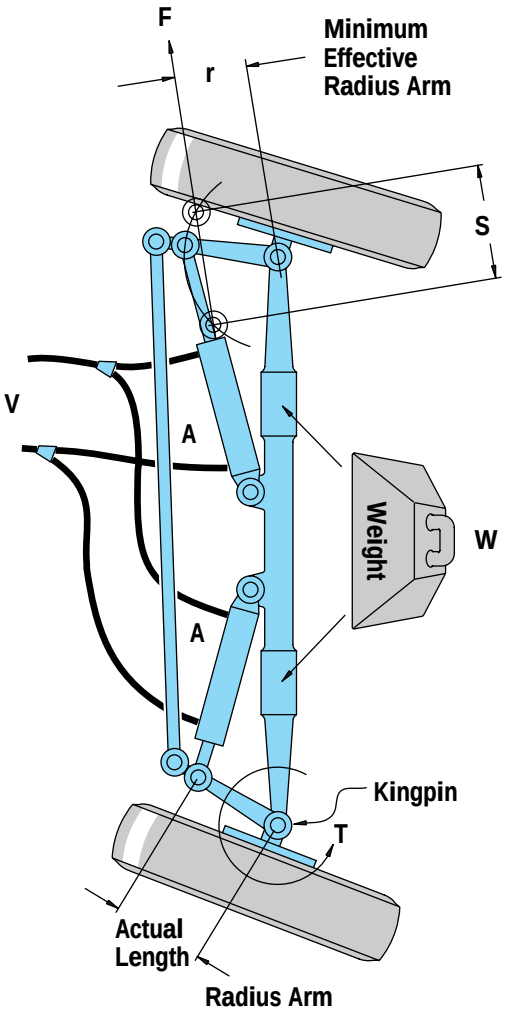
T = Total Kingpin Torque required to steer axle.

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).



C – Sizing
Sizing and Application

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%.

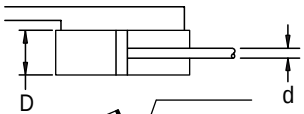
Cylinder Diameter

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

D = Inside diameter of cylinder.

d = Rod diameter as required.

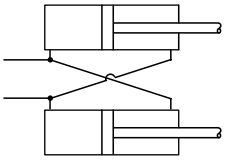
Differential Cylinder



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

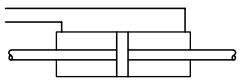
Note: $\left(\frac{d}{D}\right)^2 \leq .15$

Cross Connected Cylinder



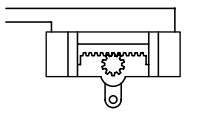
$D = \sqrt{\frac{2A}{\pi} + \frac{d^2}{2}}$

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

Cross Connected Cylinder $V = S \times \frac{\pi}{4}\left(2D^2 - d^2\right)$

Cylinder Volume

V = Volume

V = S x A

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

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.

$Q_P = \text{Rmax.} \times \text{displ.}$

Q_P (L/min): Required pump flow.

Rmax = 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 Rmax.

- 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 increase 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.

C – Sizing
Articulated Type Steering

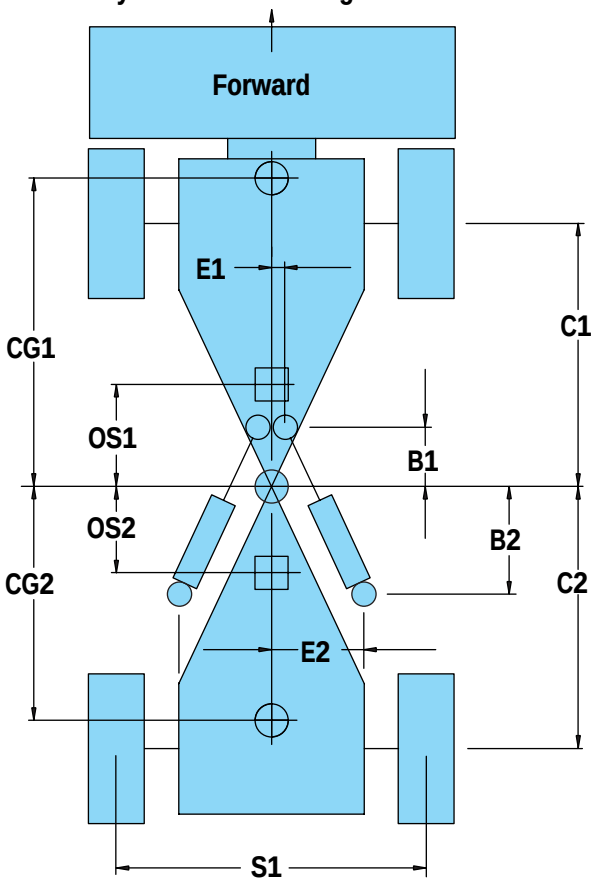
Eaton's Hydraulic Division has developed a computer program to assist articulated vehicle designers with a steering system analysis. This analysis can provide basic system sizing, pressure requirements or a complete system analysis including dynamic characteristics.

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.

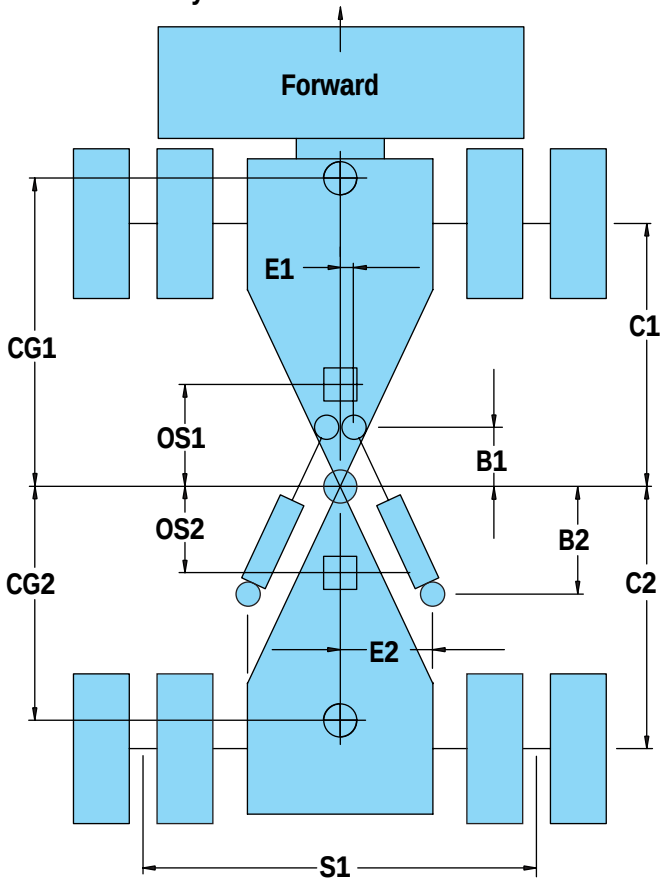
To receive output from this program, provide the required information by using the form on the following page. Contact an Eaton Hydraulics Division sales representative or send it to:

Marketing Product Manager — Steering
Eaton Hydraulics Division
15151 Highway 5
Eden Prairie, MN 55344

Twin Cylinders with a Single Wheel Set



Twin Cylinders with a Dual Wheel Set



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

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.

C – Sizing

Articulated Vehicle Steering Analysis

Keep this form with catalog and photocopy when needed.

Manufacturer _____

Vehicle Type _____

Model Number _____

Completed by _____ Date _____

Indicate Unit of Measurement Used _____

1. Turns Lock to Lock _____
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