DENISON HYDRAULICS
axial piston variable displacement
worldcup series

LT1-00059-1 Replaces 1-AM012-C

DENISON Hydraulics

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ISO 9001
DNV
DNV Certification, Inc.
REGISTERED FIRM

TYPICAL CHARACTERISTICS

Specification	Term	Series 6	Series 7	Series 8
• displacement (theoretical) zero (bar)	$in.^3$/rev. cm^3/rev	6 (98)	7.25 (119)	8.0 (131)
• pressure continuous, max.	psi bar	5000 (345)	5000 (345)	3600 (250)
• intermittent max.	psi bar	6000 (414)	6000 (414)	4500 (310)
• speed, maximum	rev/min	3000	3000	2100
• at "O" inlet	rev./min	2050	1950	1800
• case pressure continuous, max.	psi bar	75 (5,17)	75 (5,17)	75 (5,17)
• intermittent	psi bar	125 (8,6)	125 (8,6)	125 (8,6)
• compensator adjustment: approx. per turn	psi bar	2000 (138)	2000 (138)	2000 (138)
• max. volume adjustment, zero to full stroke turns	screw handwheel	10 16	10 16	10 16
• min. compensator pressure	psi bar	150 (10)	150 (10)	150 (10)
• max. inlet pressure	psi bar	150 (10,4)	150 (10,4)	150 (10,4)
• mounting standard, 4 bolt	SAE	152-4 (D)	152-4 (D)	152-4 (D)
• compensator response* off stroke on stroke	sec sec	0.100 0.150	0.100 0.150	0.100 0.150
• rotating inertia	lb. in^2 kg. m^2	92 (0,027)	92 (0,027)	92 (0,027)
• weight	lbs. kg.	180 (81)	180 (81)	180 (81)

FLUID CONNECTIONS

• port A (inlet) SAE code 61 split flange	in. mm	2-1/2 (62,5)	2-1/2 (62,5)	2-1/2 (62,5)
• port B (system) SAE code 62 split flange	in. mm	1-1/4 31,25	1-1/4 31,25	1-1/4 31,25
• port D,D1 (case drain)	SAE	-16	-16	-16
• port LS (load sensing port)	SAE	-4	-4	-4
• port V (compensator vent)	SAE	-6	-6	-6
• port X (rotary servo)	SAE	-6	-6	-6
• port E, H (rotary servo) (electric & hydraulic stroker inlet)	SAE	-4	-4	-4
• port RV (cylinder relief port)	SAE	-4	-4	-4

* For primary compensator control without limiting orifice

NOTE: New revisions are shown underlined. Pages are marked revised where changes have been made.

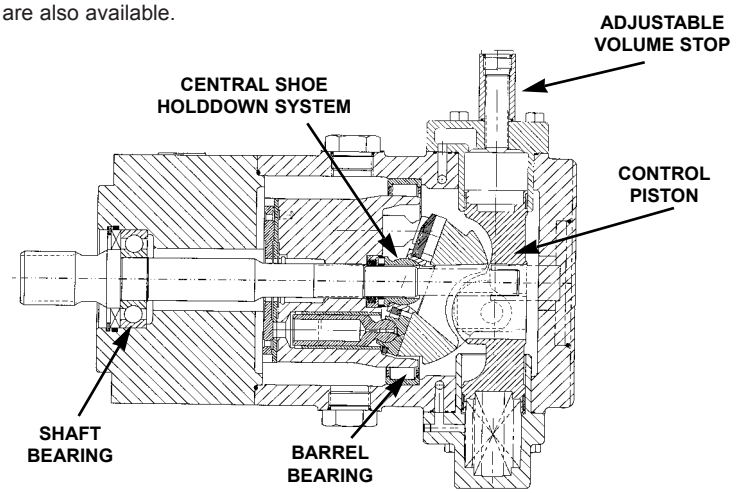
GENERAL

The Denison Hydraulics Worldcup 6, 7, and 8 axial piston pumps feature advance design concepts which are time proven and provide for advance pumping and control concepts.

DESCRIPTION

The main rotating group is the same as in the Goldcup hydrostatic transmissions that have been in service for more than 24 years.

Standard control for the Worldcup units is a pressure Compensator. Additional optional controls are also available.



MOUNTING

This pump is designed to operate in any position. The mounting hub and four bolt mounting flange are in full conformance with SAE standard. The pump shaft must be in alignment with the shaft of the source driver and should be checked with a dial indicator. The mounting pad or adapter into which the fluid pump pilots must be concentric with the pump shaft to prevent bearing failure. This concentricity is particularly important if the shaft is rigidly connected to the driving load without a flexible coupling.

Rear Drive

SAE Size	Coupling* Part No.	Max. Torque In. Lbs.	Rear Seal O-ring ARP
B	031-57170	1852 (209 Nm)	155
BB	031-57171	2987 (338 Nm)	155
C	031-57190	See below	159
D	031-57191	See below	163

*Coupling mate with SAE splined shafts, flat root side fit, SAE J498B (1971) Class 1.

For C and D rear drives, the maximum torque that may be taken from the rear drive is 9,000 In. Lbs. (1017 Nm), **IF** this does not result in a total torque on the main shaft in excess of 11,000 In. Lbs. (1243 Nm). Example: P7W at 5000 PSI (345 bar) and full displacement requires 5770 In. Lbs. (652 Nm). Thus it can then drive a rear torque load up to 5230 In. Lbs. (590 Nm) maximum. If the P7W will never exceed 500 PSI (577 In. Lbs., 65 Nm) then the maximum rear torque is 9,000 In Lbs. (1017 Nm).

Caution: The shaft and seal area of a rear mounted pump will be exposed to the primary pump's case pressure. This can cause damage to the rear mounted pump's shaft seal. For a rear mounted pump without external drain, modification of the pump's shaft seal will be required if case pressure exceeds that which the rear seal can withstand. If the rear mounted pump contains a case drain, the primary and the rear mounted pump case drains may be connected to a common line to equalize the pressures on the shaft seal.

The product information, specifications, and descriptions contained in this publication have been compiled for the use and convenience of our customers from information furnished by the manufacturer; and we can not, and do not, accept any responsibility for the accuracy or correctness of any description, calculation, specification, or information contained herein. No such description, calculation, specification, or information regarding the products being sold has been made part of the basis of the bargain, nor has same created or amounted to an express warranty that the products would conform thereto. **We are selling the goods and merchandise illustrated and described on this publication on an "as is" basis, and disclaim any implied warranty, including any warranty of merchantability or warranty of fitness for any particular purpose whatsoever, with respect to the goods and merchandise sold.** All manufacturer warranties shall be passed on to our customers, but we shall not be responsible for special, indirect, incidental, or consequential damages resulting from the use of any of the products or information contained or described on this publication. Further, we reserve the right to revise or otherwise make product improvements at any time without notification.

Shaft options:

SAE-D splined and keyed, see installation drawing for details.

Shaft Information

Splined: The shafts will accept a maximum misalignment of 0.006" TIR (0,15 mm). Angular misalignment at the male and female spline axes must be less than ±.002 (0.5 mm) per one inch (25.4mm) radius. The coupling interface must be lubricated. Denison Hydraulics recommends lithium molydisulfide or similar grease. The female coupling should be hardened and must conform to SAE-J498B (1971) Class 1 flat root side fit.

Keyed: High strength heat treated keys must be used. Replacement keys must be hardened to 27-34 Rc. The key corners must be chamfered .030"-.040" (.75-1 mm) at 45° to clear radii that exist in the keyway.

Side Load Capability

Both types of shafts will accept a side load of 875 lbs. (396 Kg.) at the center of the spline or key, with a B10 life of 10,000 hours at 1800 RPM.

Piping

Connect inlet and outlet lines to the port block of the pump. The fluid connections are
Inlet: 2-1/2" (62.5 mm), 3000 PSI (207 bar), SAE 4 bolt flange, Code 61
Outlet: 1-1/4" (31.25 mm), 6000 PSI (414 bar), SAE 4 bolt flange, Code 62
Other: SAE straight thread, O-ring seal.

See installation drawing for size.

The maximum case pressure is 75 PSI(5,17 bar) continuous, 125 PSI (8.6 bar) intermittent. Case pressures must never exceed inlet pressure by more than 25 PSI (1,7 bar). When connecting case drain line make certain that drain plumbing passes above highest point of the pump before passing to the reservoir. If not, install a 5 PSI (0,3 bar) case pressure check valve to be certain the case is filled with oil at all times.

The case leakage line must be of sufficient size to prevent back pressure in excess of 75 PSI (5.7 bar) and returned to the reservoir below the surface of the oil as far from supply suction as possible. All fluid lines, whether pipe, tubing, or hose must be adequate size and strength to assure free flow through the pump. An undersize inlet line will prevent the pump from reaching full speed and torque. An undersized outlet line will create back pressure and cause improper outlet operation. Flexible hose lines are recommended. If rigid piping is used, the workmanship must be accurate to eliminate strain on the pump port block or to the fluid connections. Sharp bends in the lines must be eliminated wherever possible. All system piping must be cleaned with solvent or equivalent before installing pump. Make sure the entire hydraulic system is free of dirt, lint, scale, or other foreign material.

Caution: Do not use galvanized pipe. Galvanized coating can flake off with continued use.

SERVICE INFORMATION

These hydraulic products are designed to give long dependable service when properly applied and their systems properly maintained. These general instructions apply to typical systems. Specific instructions for particular equipment can be developed from them. Refer to bulletin S1-AM012.

RECOMMENDED FLUIDS

See DENISON Hydraulics bulletin SPO-AM305 for more information.

MAINTENANCE

This pump is self-lubricating and preventative maintenance is limited to keeping system fluid clean by changing filters frequently. Keep all fittings and screws tight. Do not operate at pressures and speeds in excess of the recommended limit. If the pump does not operate properly, check the Trouble Shooting Chart before attempting to overhaul the unit. Overhauling may be accomplished by referring to the Disassembly, Rework of Wear Parts and Assembly Procedures in service manual S1-AM012.

FLUID CLEANLINESS

Fluid must be cleaned before and continuously during operation by filters that maintain a cleanliness level of NAS 1638 Class 8. This approximately corresponds to ISO 17/14.

PRIMARY CONTROLS

Compensator Control—Code C

The compensator control is located in the cover assembly, it consists of a compensator spool and a pilot-head. It is redesigned for “Low Flow.”

The stroking cylinder is connected to the output port of the compensator spool. The compensator pressure port is internally connected to the discharge port of the pump and the tank port is internally connected to the case drain. The compensator pressure is set at the pilot-head by an adjustment spring.

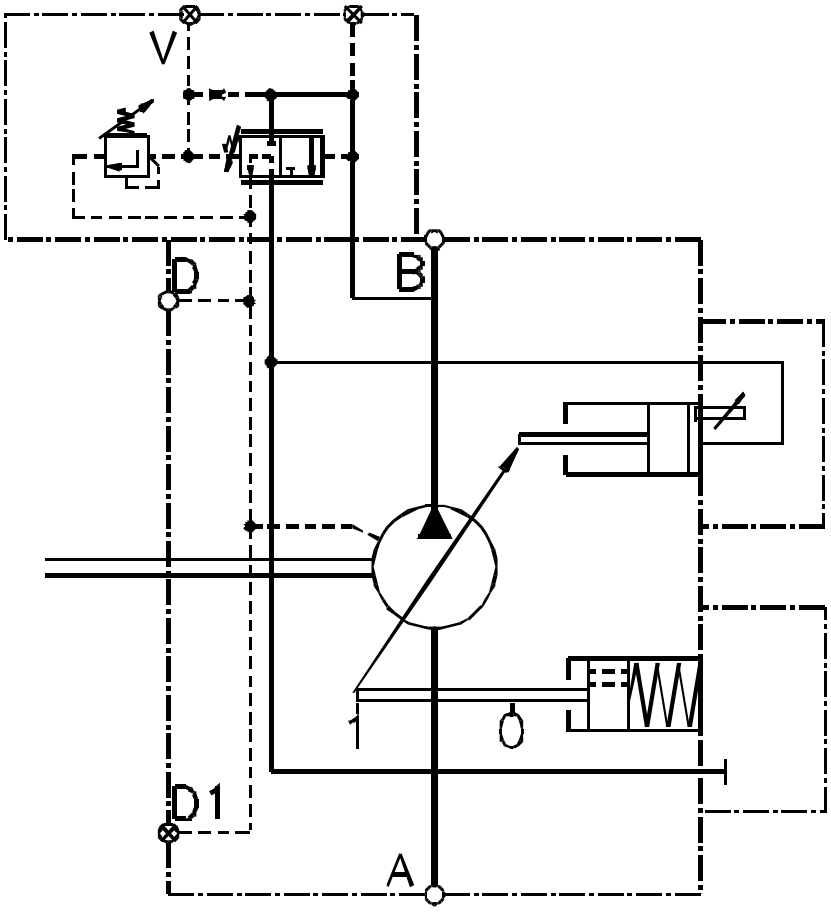
When the pump operating pressure is below the compensator setting, springs push the stroking piston and the hanger to full stroke. The stroking cylinder is connected to the case drain via the compensator spool.

When the pump operating pressure reaches the compensator pressure setting, the pilot-head opens and a pressure drop is created over the orifice, causing the compensator spool to move against the spring force, directing pump discharge pressure to the stroking cylinder. The pump will destroke to maintain set pressure.

When the pump operating pressure decreases below the compensator setting, the pilot head will close and the compensator spool will move under spring force to its offset position, connecting the stroking cylinder to case. The springs will move the stroking piston to full displacement again.

The compensator can be remotely controlled via the vent connection, which also allows for a load sensing circuit. Minimum compensating pressure or vented pressure is approximately 150 psi (10,3 bar).

Note: Use a 0.040 (1mm) orifice in vent line to prevent flooding the compensator during sensing mode.



C10

Rotary Servo Control—Code R

The rotary servo control consists of a four-port rotary servo which directs servo pressure from an external source to the top stroking cylinder or the bottom stroking cylinder. It requires 1 GPM (4 L/min) servo flow at a pressure of 300 psi (21 bar). Normal recommended servo pressure of 300 psi (21 bar) with a maximum pressure of 1000 psi (70 bar). Response can be increased by adding more flow under higher pressure.

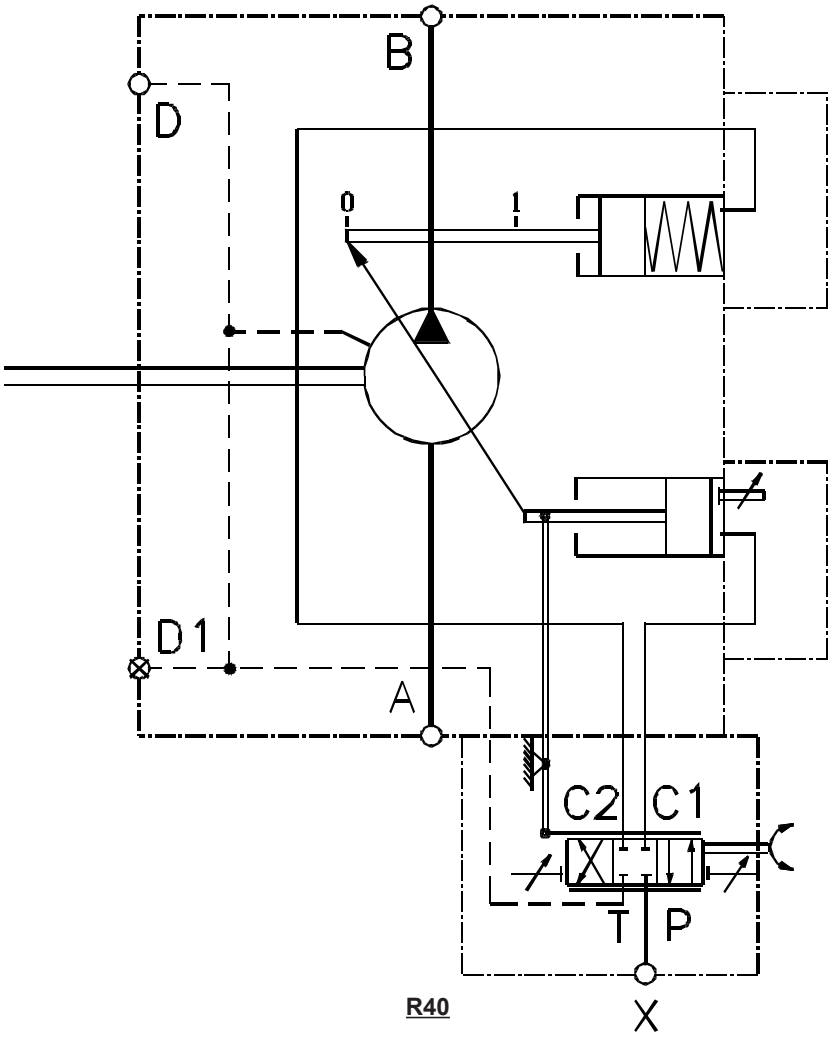
The servo shaft takes a torque of 5-10 lbs-in (0.5-1 Nm) to rotate at 300 psi (21 bar) servo pressure. If we turn the rotary servo shaft counterclockwise, servo pressure port “A” is connected with the top cylinder port “B”and the bottom cylinder port “C” is connected with drain port “D”. This means the stroking piston will move down, causing the hanger to turn counterclockwise, reducing the displacement . The rotary servo moves “zero to “full” angle approximately 38 degrees.

As it moves the hanger will move the rotary servo sleeve counterclockwise until the servo pressure port “A” is closed again by the rotary servo shaft, thus cancelling the input signal after the commanded angle has been followed-up by the stroking mechanism.

Note: this control requires a minimum servo pressure of 300 psi (21 bar) above case pressure. This must be supplied by the customer or via a rear driven pump.

Stroke Speed Table

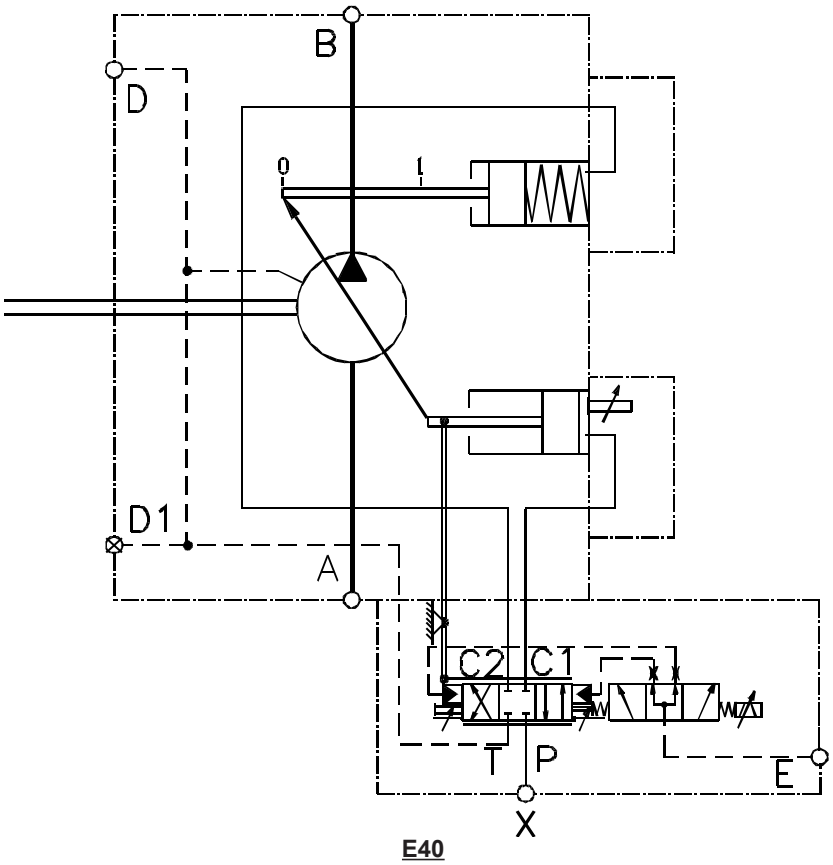
Pressure		Stroke	
Servo	**System**	**On**	**Off**
300 psi (21 bar)	500 psi (34.5 bar)	1.0 Second	0.60 Second
300 psi (21 bar)	5000 psi (345 bar)	0.6 Second	0.86 Second



R40

Electrohydraulic Stroker Control—Code E

This electrohydraulic control actuates the rotary input shaft by means of a hydraulic position. In the zero current condition the jet pipe is centered over the two receiver orifices and generates equal pressure in each receiver. The jet pipe is held in this position by the feedback spring from the piston and the null adjust spring which counter each other and result in a net force of zero on the jet pipe. Assume the current is increased in a polarity that causes the jet pipe to move to the right. This will cause the pressure to increase on the right receiver and fall in the left receiver. Since these pressures are communicated to opposite ends of the piston it will move and in turn move the rotary servo through the arm connecting the piston and rotary servo shaft. The feedback spring is also connected to the arm which continues to move until the force balance re-centers the jet pipe. Thus a new steady state condition is achieved. The control shaft can be manually operated without servo pressure applied to the jet pipe. Spring centering is also available to center the pump when servo pressure is removed from the servo control. **Note: The electrohydraulic control cannot be used if water glycol, phosphate ester, or invert emulsions fluids is used in the system. Note:** This control requires a minimum servo pressure of 300 psi (21 bar) above case pressure. **This must be supplied by the customer or via a rear drive pump.**



E40

Hysteresis: Less than 5%.
Linearity: Within 5%.
Response: 0.5 seconds from zero to full displacement.
Threshold: Less than 2% outside dead band.
Repeatability: Within 2%.
Temperature Null Shift: Less than 2% per 100°F(38°C).
Pressure Null Shift: Less than 2% per 500 psi (35 bar).
Neutral Deadband: 0% or 10% of full current.
Pressure Input: Externally supplied by customer to servo inlet port from any source

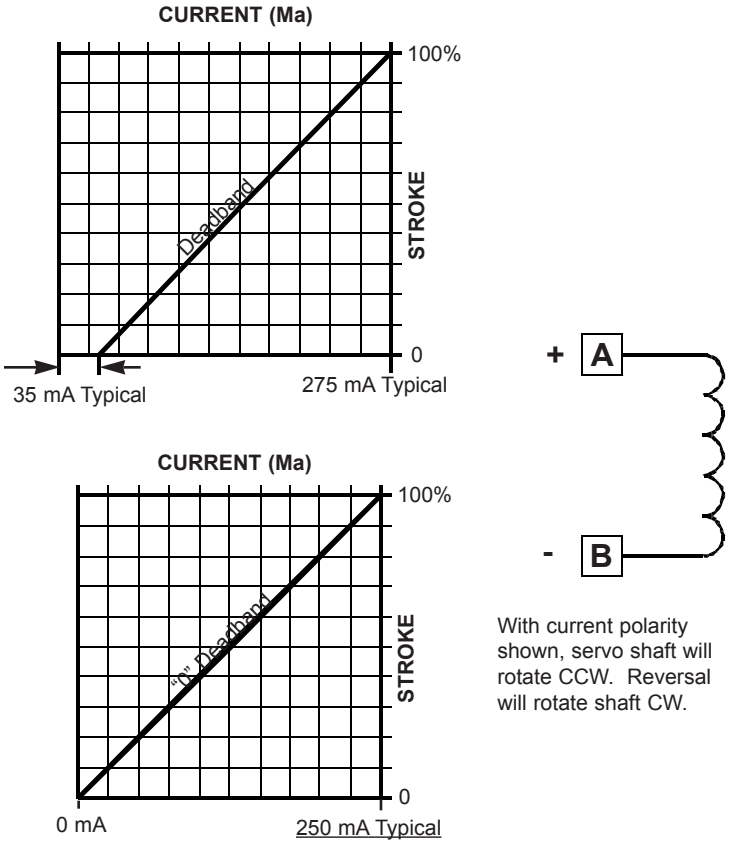
with 400 psi (28 bar) nominal pressure. Pressure range acceptable is 200 to 1000 psi (14 to 70 bar) above pump case pressure.
Coil Resistance: 24 to 30 ohm.
Electrical Input: 275 mA typical to stroke pump over full 19° cam angle, 400 mA maximum. Current source should have at least a 12V DC capability. Absolute maximum current should be limited to 600 mA to avoid damage to coil. Adjustable displacement stops are provided to mechanically limit the stroke to less than maximum.
Note: Control pressure for this control must be provided by the customer or via a rear driven control pump.
Fluid Type: Any fluid compatible with the seals and pump may be used.
SEE* BELOW
See Denison Hydraulics bulletin SPO-AM305 for fluid recommendations.

Fluid Cleanliness: This control is capable of passing particles up to 200 Micron in size. It contains a 75 Micron “last chance” filter screen built into the body. See page 5 for cleanliness specifications.

Jupiter Controls: (used to control the “E” Stroker)
Driver card—S20-11712
Options card—S20-11716
Power supply—S20-11715
Euro card holder—701-00007-8

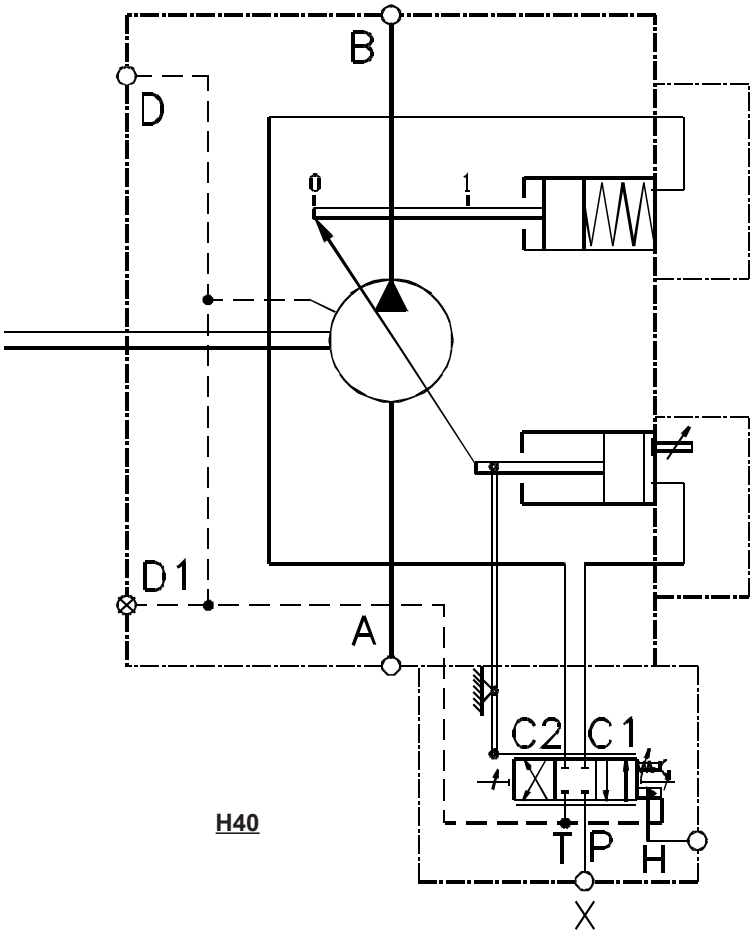
Comments: The control may be manually overridden only if the external pressure source is disconnected or shut off. A torque of approximately 20 lbs-in (2.3 Nm) is required to rotate the shaft with external pressure disconnected. Do not exceed 100 lbs-in (11 Nm). Adjustable max. volume stops are included and may be adjusted from 0—19°.

Note: If the Driver uses Pulse Width Modulation (PWM) the frequency must be 2000 Hz or higher.
***Water glycol, Phosphate Ester, or Invert emulsions including “Skydrol” are fluids that cannot be used with electrohydraulic control.**



Hydraulic Stroker Control—Code H

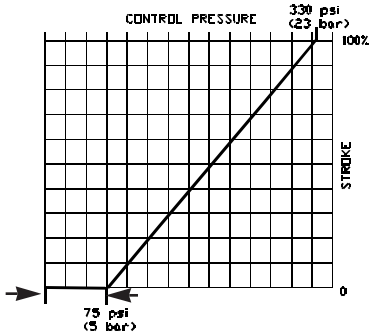
This control actuates the rotary input shaft by means of a hydraulic piston, which is pressurized by an external pressure source. The piston is biased with a spring, which provides zero displacement. When the external pressure is introduced into one of the control ports, the piston exerts a force on the springs. When this force exceeds the precompression force of the spring, the piston begins to move, rotating the rotary servo shaft in proportion to pressure. Removing or reducing the input pressure allows the spring to move the servo shaft back toward the zero displacement position.



H40

Hysteresis: Less than 3%
Linearity: Within 2%
Pressure Input: Control pressure may be from any suitable external source.
Comments: The control may be manually overridden if the external pressure source is disconnected. Do not exceed 100 lbs-In (11Nm) torque on servo shaft in manual mode. Adjustable max. volume stops are included.
Note: Control pressure for this control must be provided by the customer or via a rear driven control pump.
Fluid type: Any fluid compatible with the seals and pump may be used.
see Denison Hydraulics bulletin SPO-AM035 for fluid recommendations.
Fluid Cleanliness: See page 5

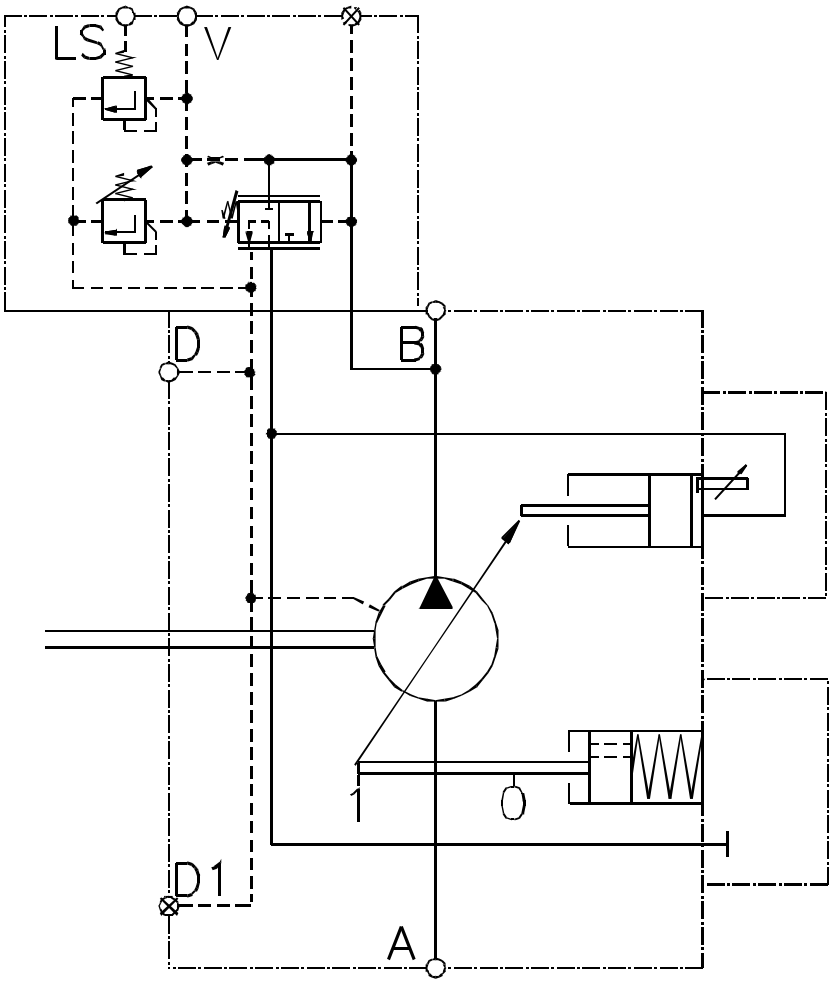
Stroke vs Control Pressure



(Other pressure ranges available)

Load Sensing Compensator
Code L

The compensator has a separate load sensing port with an isolation valve between the spool and the load sense port, so that the load sense port sees zero flow. The vent port is still available and can be used for remote control purposes. When used as a load sense compensator, the added valve bypasses the flow from the spool to the case of the pump, rather than allowing it to pass out the load sense port. In this way, the external load sensing valves see no flow and there is no associated pressure drop, so they become a pure pressure control.

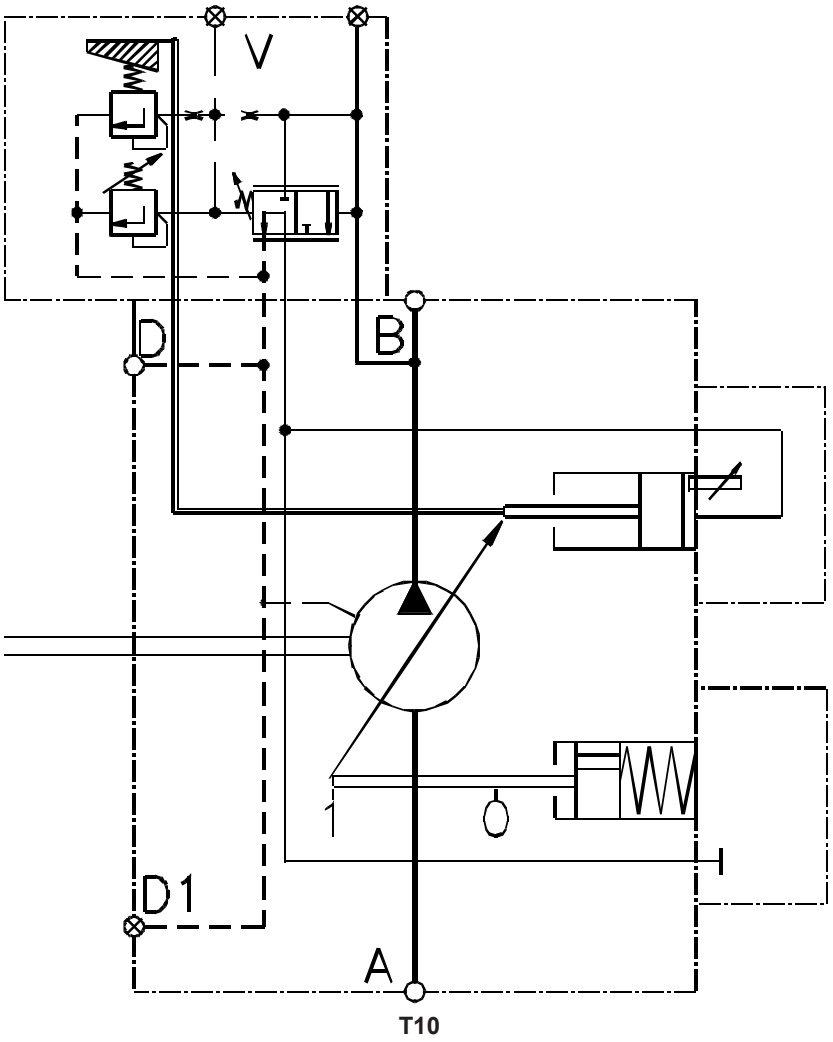


L10

Torque Limiter—Code T

This control is a combined compensator and torque limiter, or, if used as an override, it is a combined compensator override and torque limiter override. The torque limiter control valve is mechanically driven by the pump rocker cam to provide the proper pressure vs. flow relationship to give constant torque. This valve operates in parallel with the standard compensator valve and controls the displacement of the pump through the compensator as a function of pressure.

The torque limiter control used as the primary control on the pump provides both pressure compensator functions and torque limiting functions.



T10

PRIMARY CONTROL OPTIONS

Maximum Volume Screw Control—Code 1

Screw control is similar in action to the handwheel control described in the following paragraph where-in the adjustment is made by raising or lowering the maximum volume stops to regulate pump delivery.

Maximum Volume Handwheel Control Code 2

This control provides a means of manually setting the maximum volume delivered by the pump. Setting is made by use of the the handwheel which positions the cam plate in the desired position.

Maximum and Minimum Volume Stops for the Control Codes "R", "H", and "E" Only—Code 4

The maximum and minimum stops limit the angle of the rotary servo shaft, replacing the Code 1 or Code 2 stops. These stops are fully adjustable and are located in the control cover assembly.

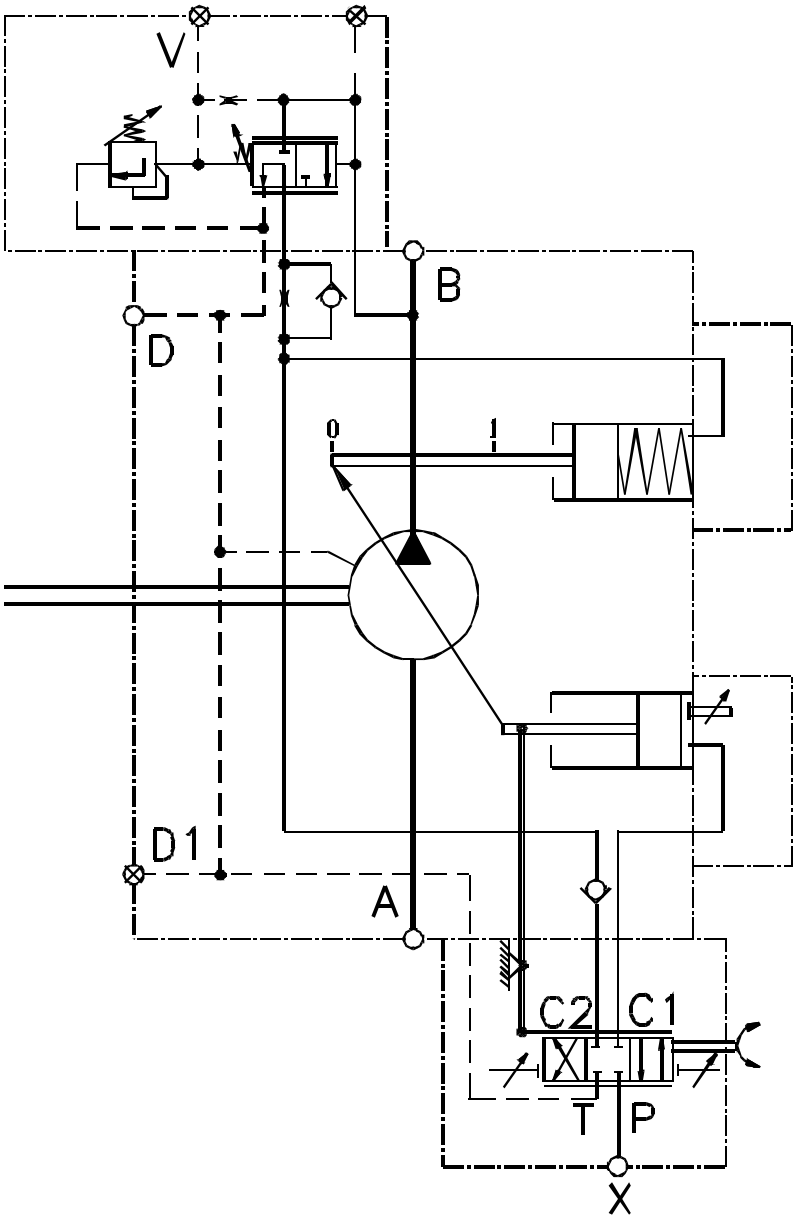
SECONDARY CONTROL OPTIONS

Pressure Compensator Override—Code P

The pressure compensator override is an optional control, used when needed with the rotary, electrohydraulic or hydraulic servo strokers.

In this control the stroking cylinder is spring offset to the zero position. It has the same rotary servo described previously, but in addition, a cover assembly containing the compensator override on the opposite side of the pump. The compensator override control is similar to the compensator control as described before, except the override path to the top stroking cylinder is provided with a check valve and orifice to limit the losses from the top stroking cylinder. The bottom stroking cylinder is interconnected to the rotary servo port “C” but plugged-off from the compensator override.

If the pump operating pressure reaches the compensator pressure setting, discharge pressure is directed to the top stroking cylinder. This causes the stroking piston and hanger to destroke, and the rotary servo sleeve to turn counterclockwise. Now servo pressure is connected via port “P” and port “C1” to the bottom stroking cylinder and port “C2” and port ”T” connecting the top stroking cylinder to case, ready to upstroke to the commanded position, as soon as the operating pressure falls below the override setting.

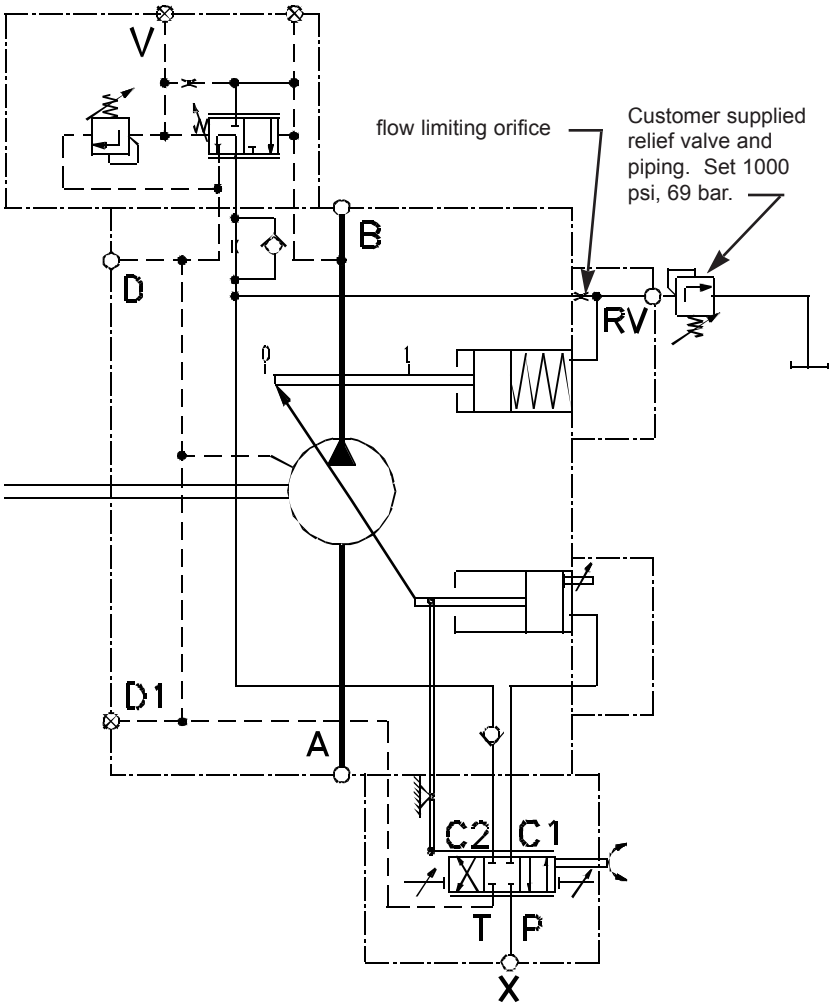


R4P

SECONDARY CONTROL OPTIONS

WARNING: Whenever a primary control “R”, “H”, or “E” is used with secondary control “P” or “T”, where the pump will not be allowed to go to zero stroke, the installation of a special control piston cap must be used where a relief valve can be fitted to insure the pressure cannot reach system pressure “P”. The relief valve shall be set to 1000 psi, 69 bar. The cap shall contain a flow limiting orifice (0.031”, 0.79 mm), to limit the amount of oil escaping through this relief valve.

This orifice will limit the speed of compensator response both off-stroke and on-stroke, therefore a system relief valve is necessary to limit system pressure, and possibly an accumulator to maintain pressure during times of rapidly increasing demand.

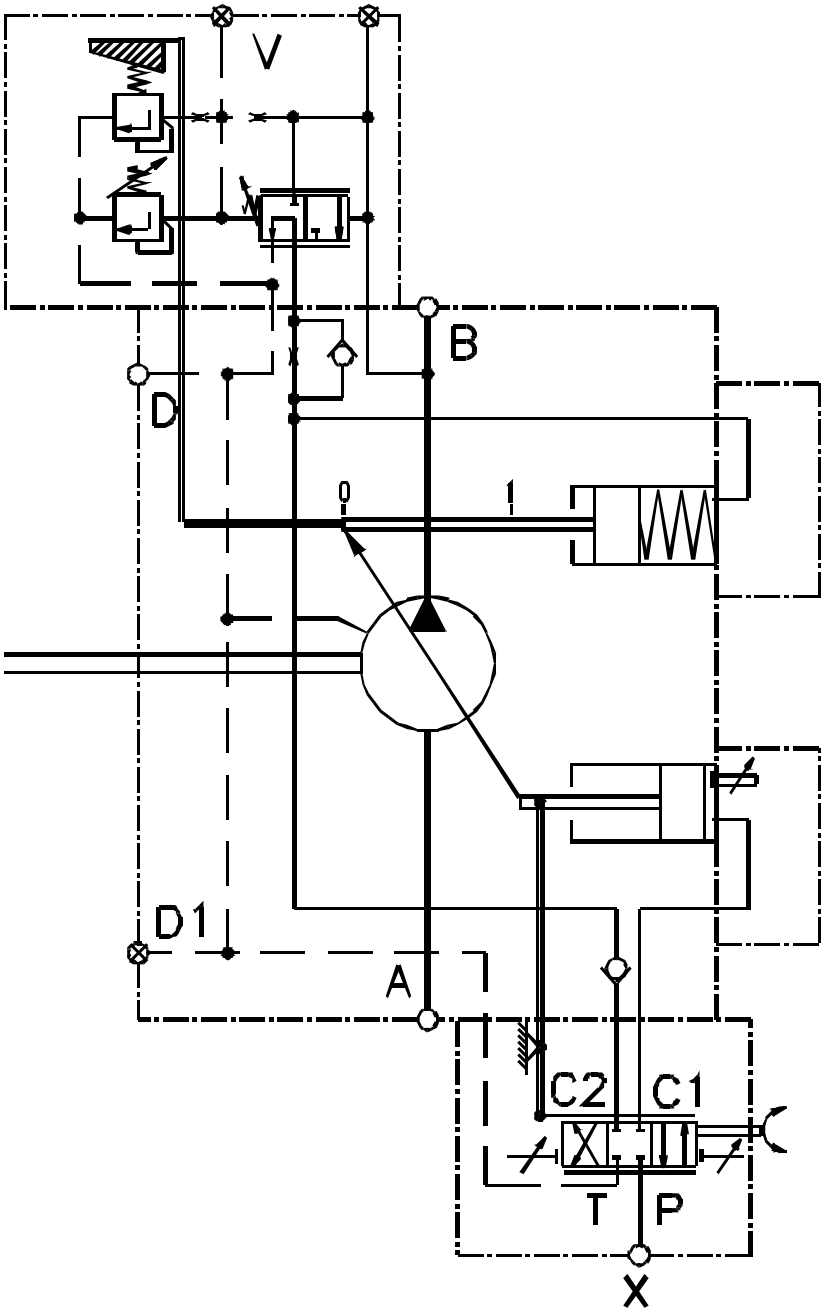


R4P with control relief valve and limiting orifice, for stop set above zero stroke

Torque Limiter Override—Code T

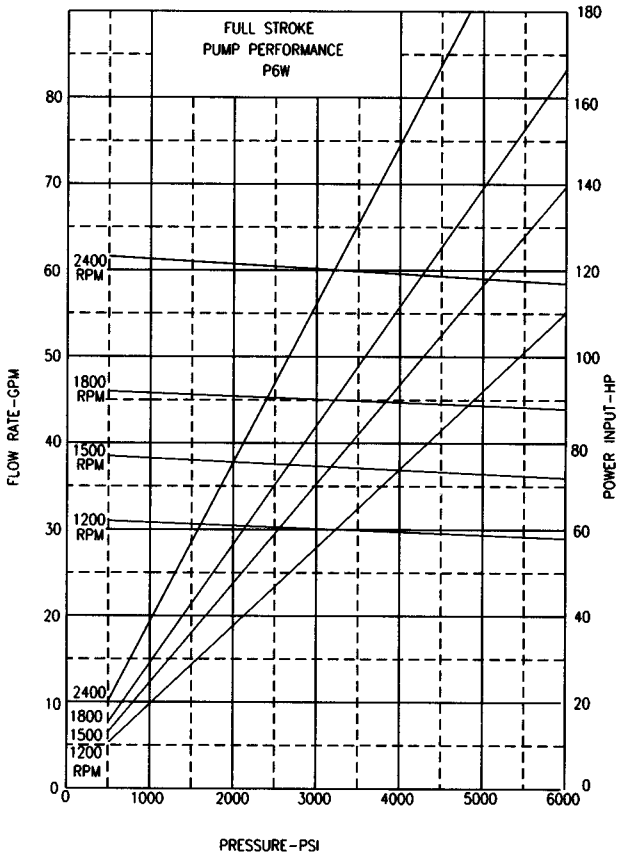
This option can be used as an output control with a rotary servo, hydraulic stroker or electrohydraulic stroker or electrohydraulic stroker as an override when both pressure compensator and torque limiter overrides are available.

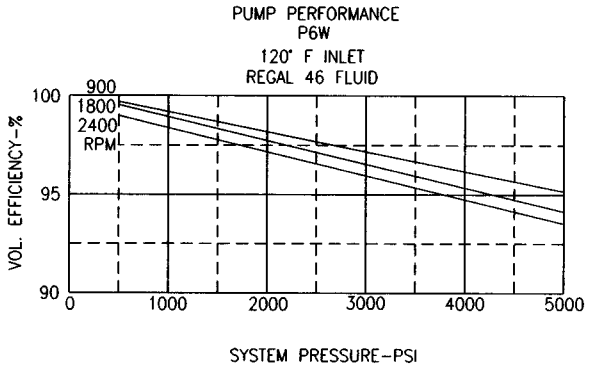
WARNING: Whenever a primary control “R”, “H”, or “E” is used with secondary control “P” or “T,” where the pump will not be allowed to go to zero stroke, the installation of a special control piston cap must be used where a relief valve can be fitted to insure the pressure cannot reach system pressure “P”. See circuit on page 14.

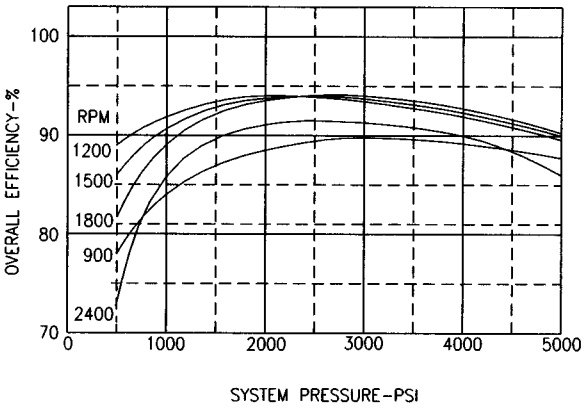


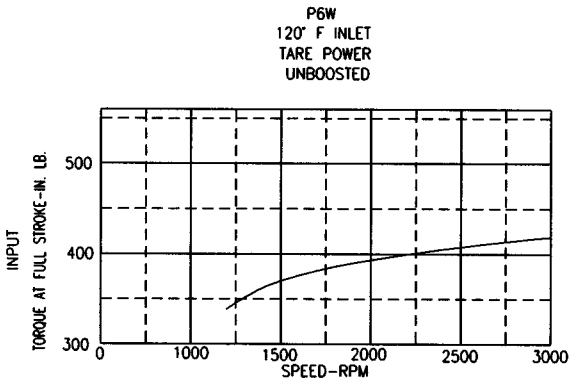
R4T

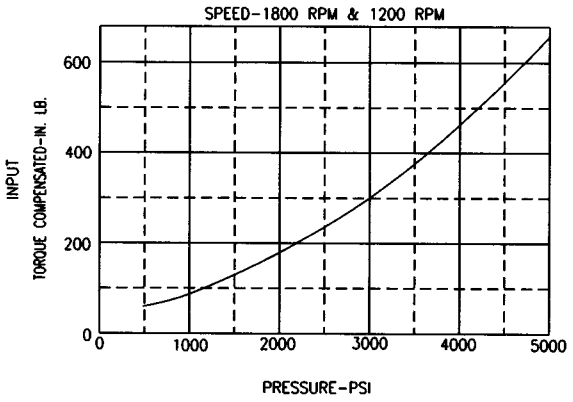
SERIES 6
U.S. DATA

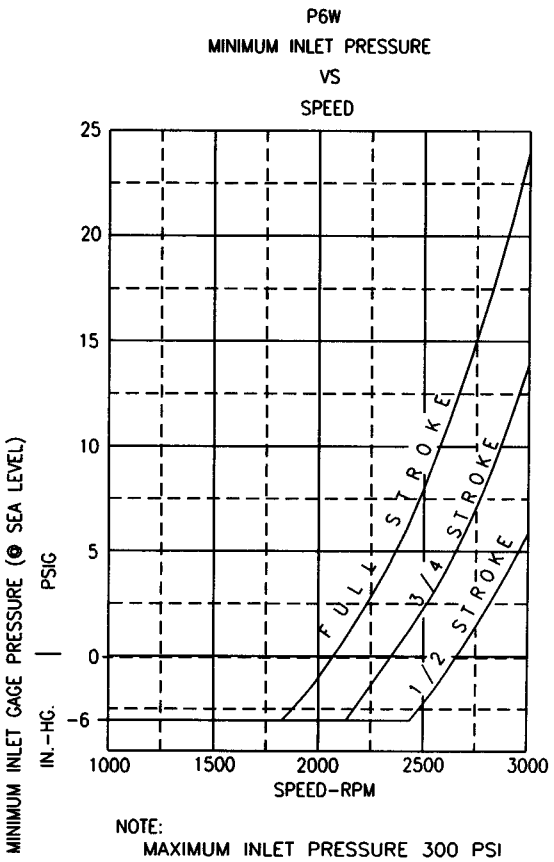






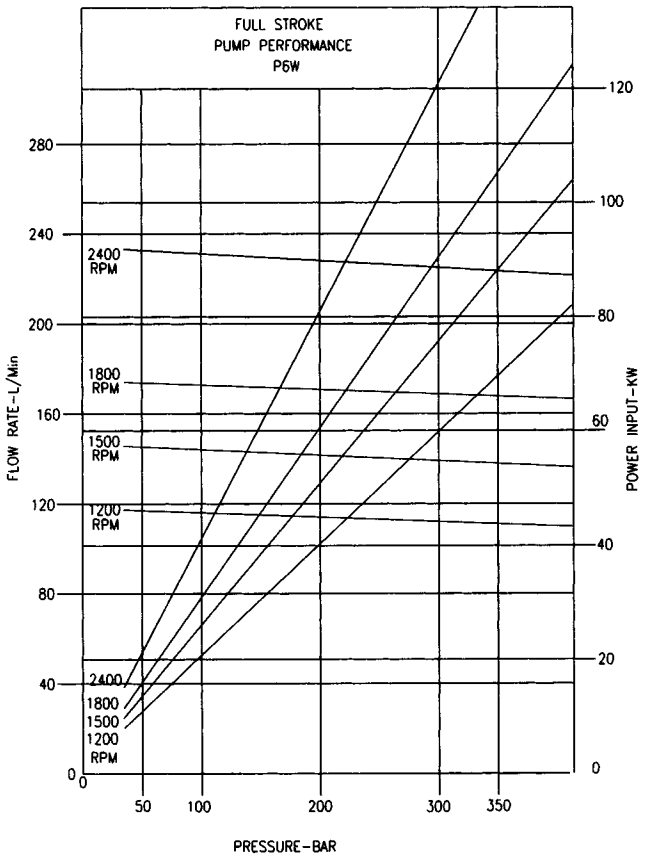


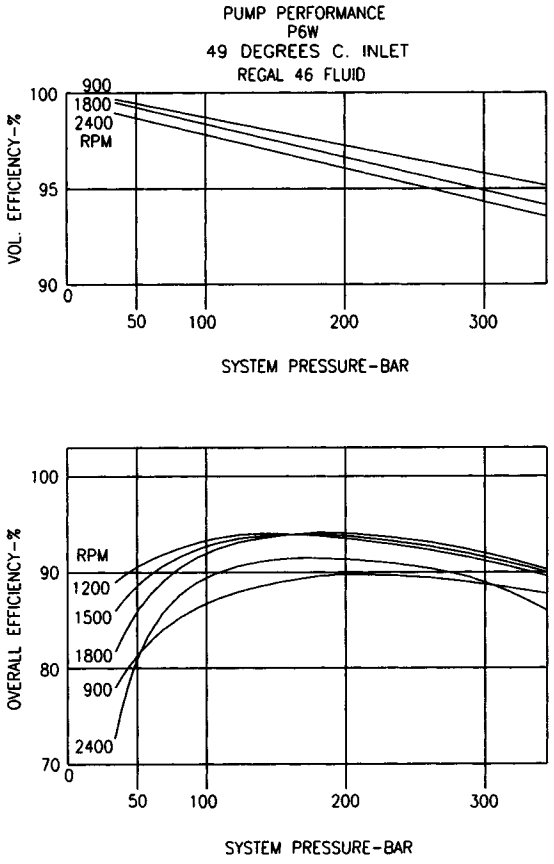


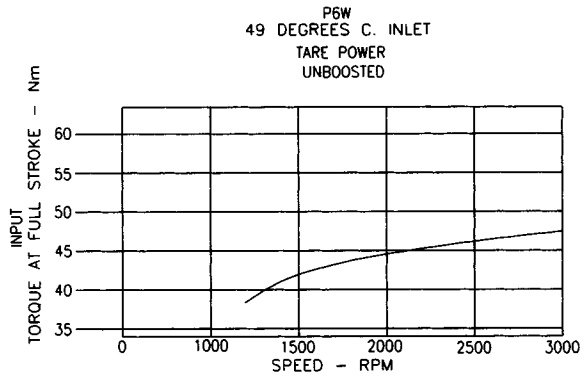


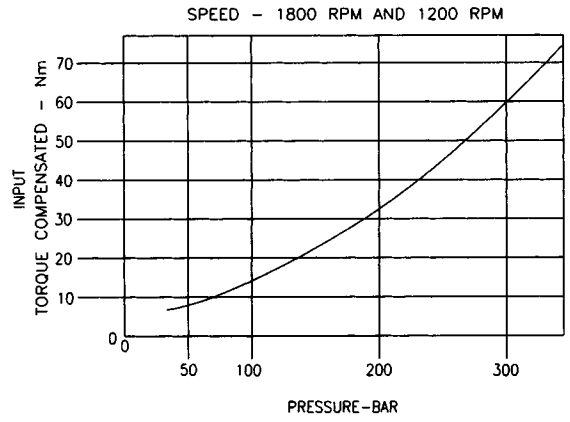
NOTE:
MAXIMUM INLET PRESSURE 300 PSI

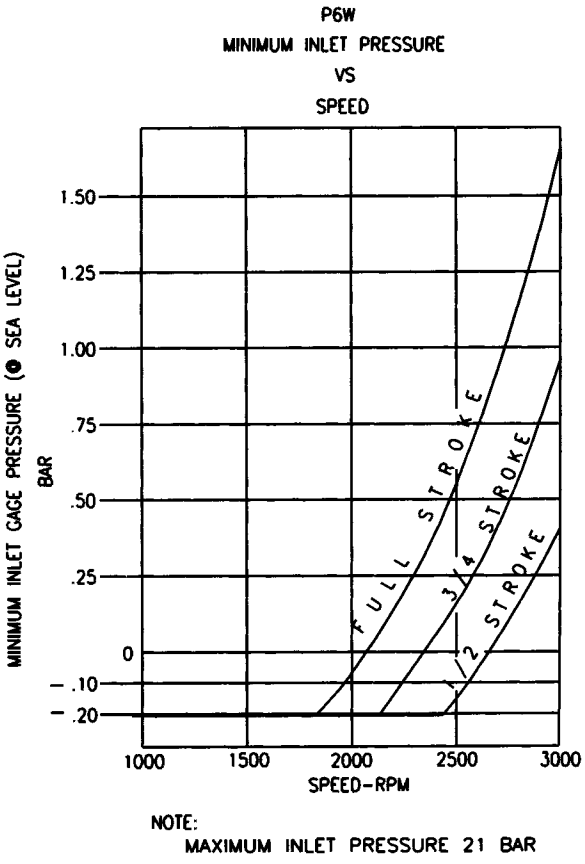
SERIES 6
METRIC DATA





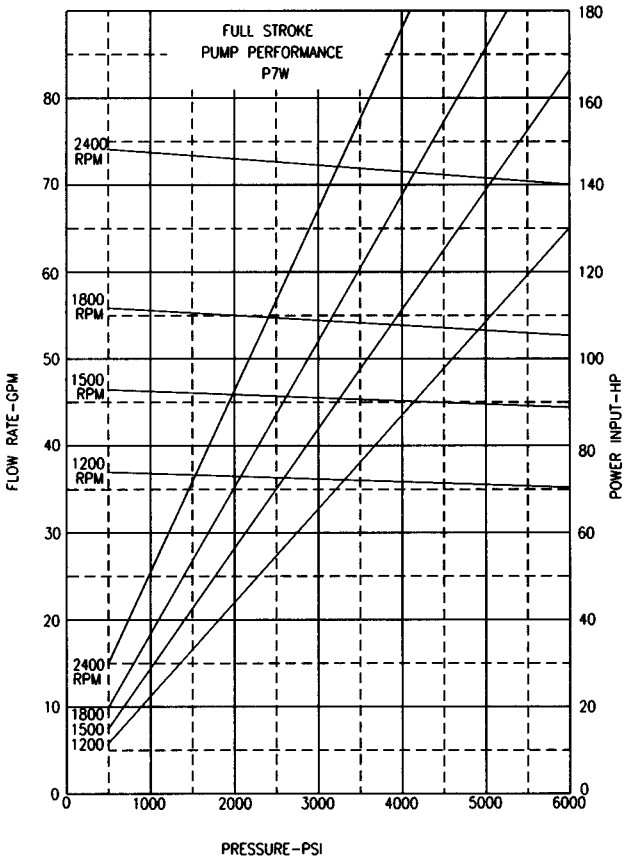


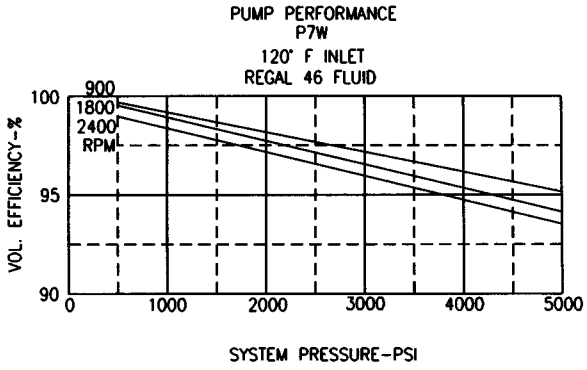


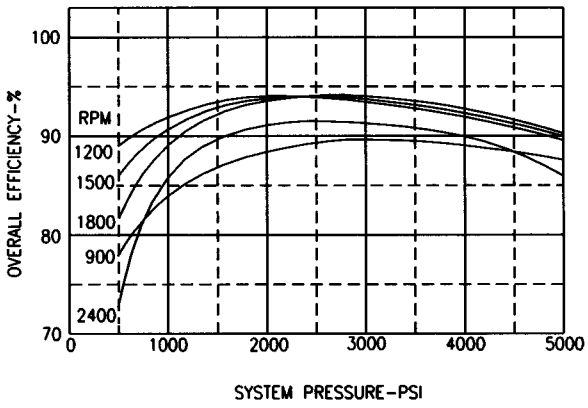


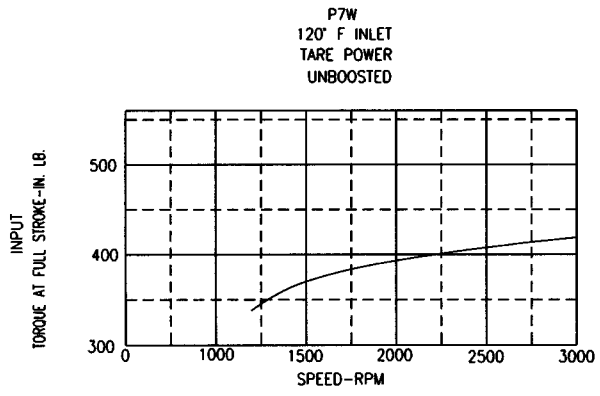
NOTE:
MAXIMUM INLET PRESSURE 21 BAR

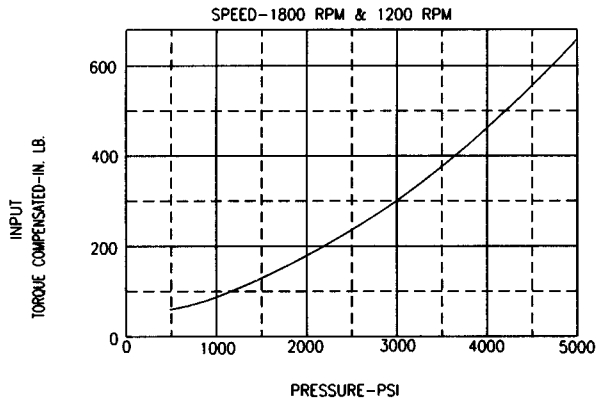
SERIES 7
U.S. DATA

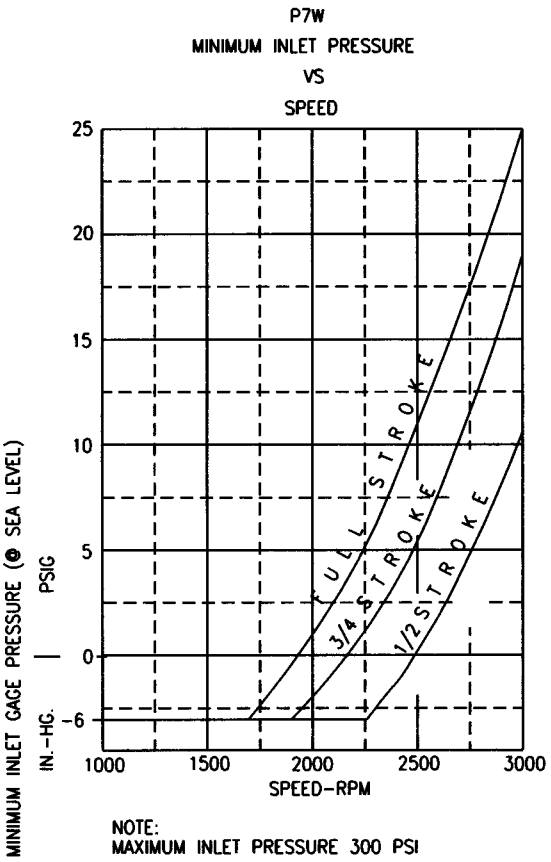






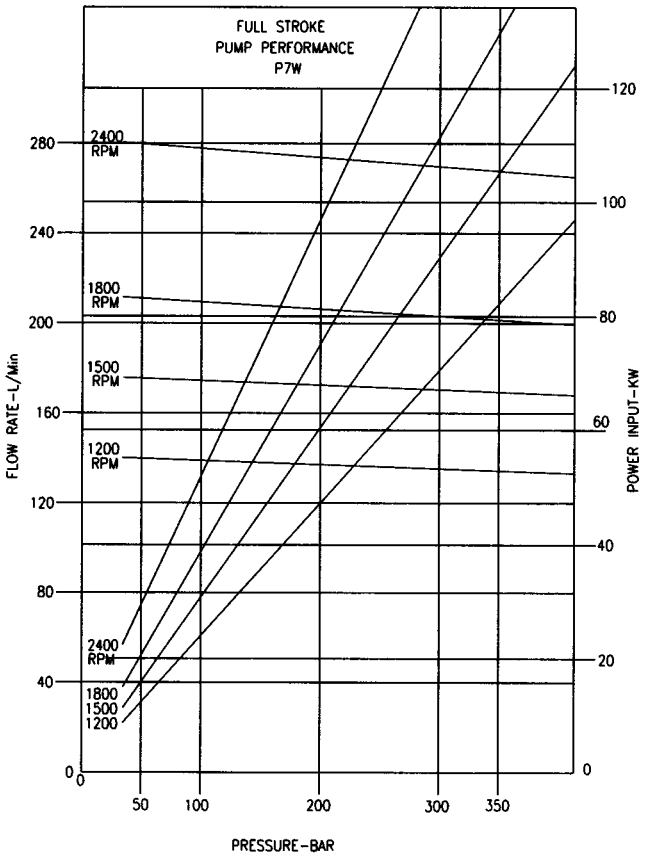


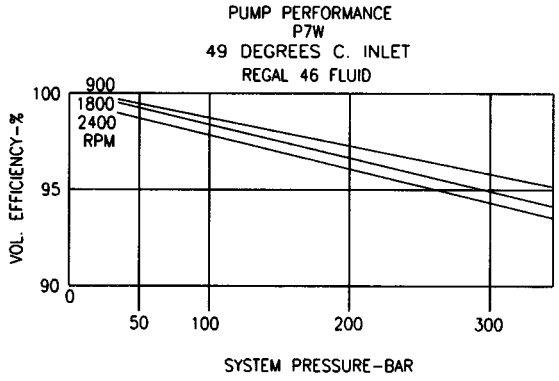


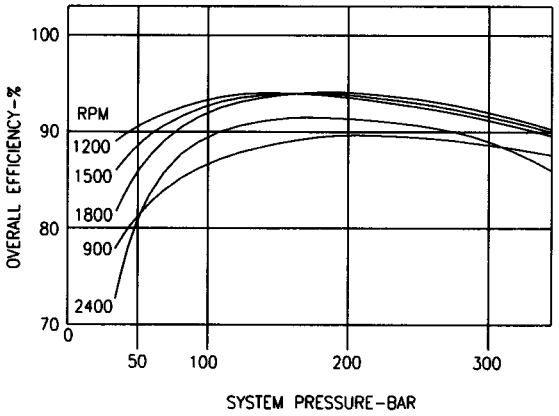


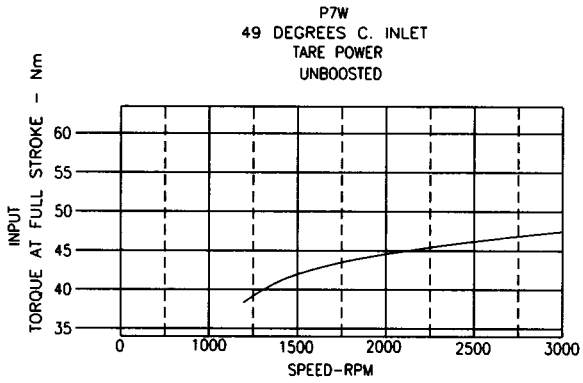
NOTE:
MAXIMUM INLET PRESSURE 300 PSI

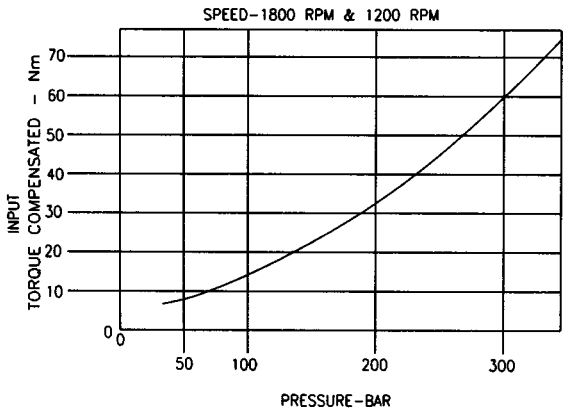
SERIES 7
METRIC DATA

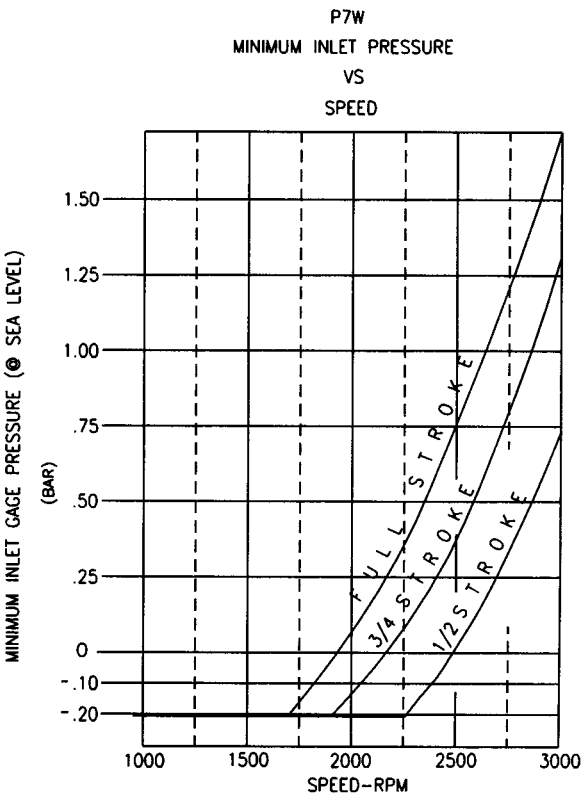






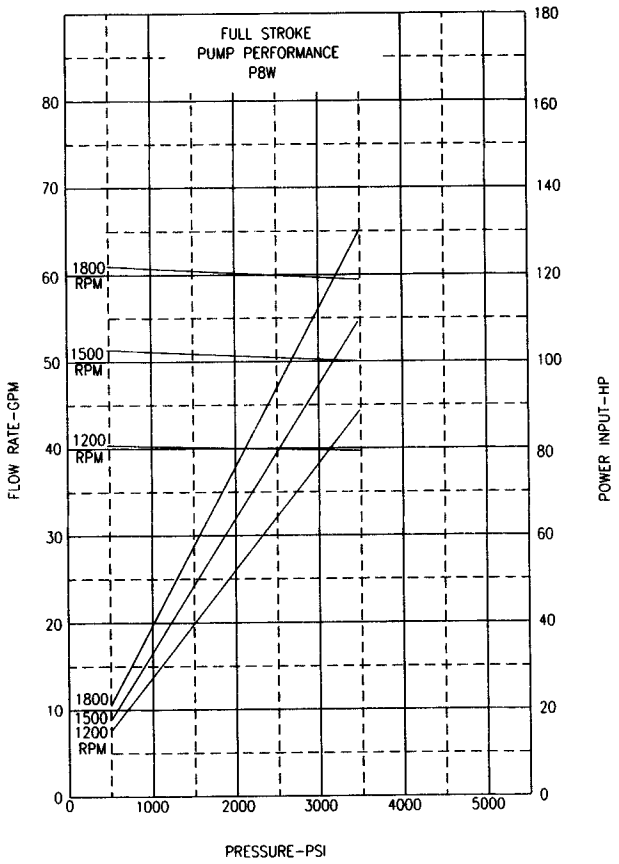


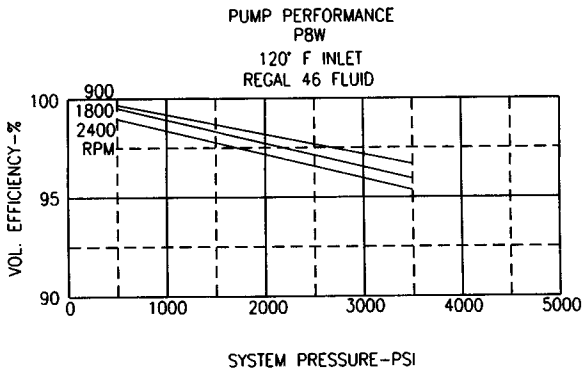


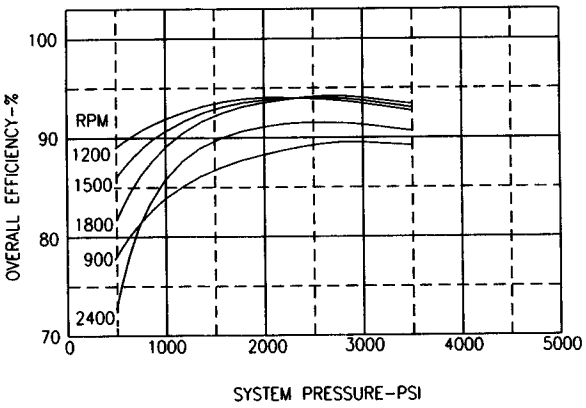


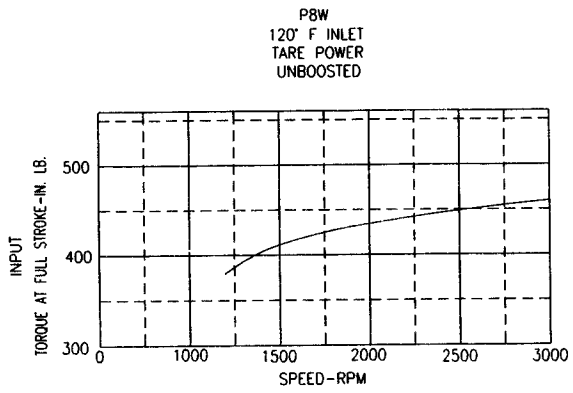
NOTE:
MAXIMUM INLET PRESSURE 21 BAR

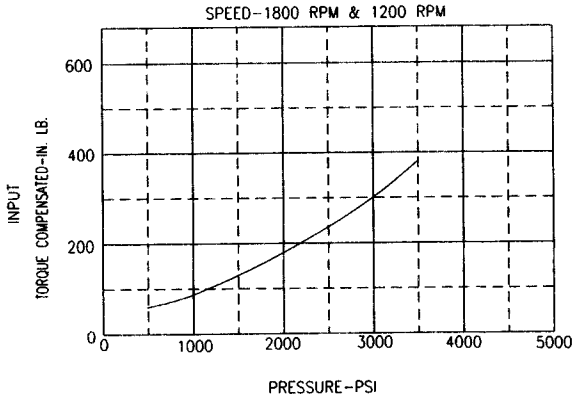
SERIES 8
U.S. DATA

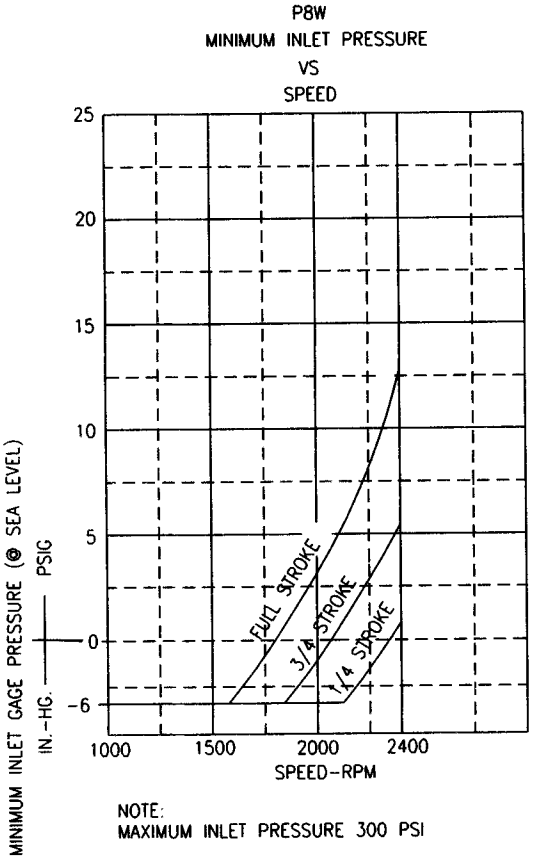




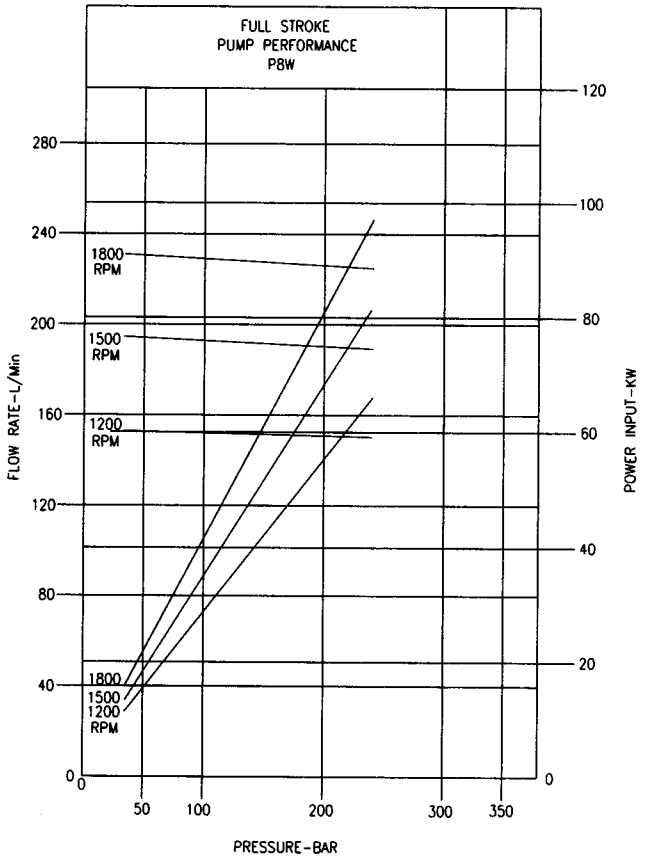


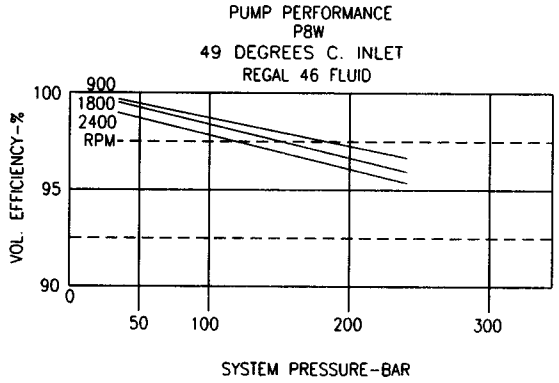


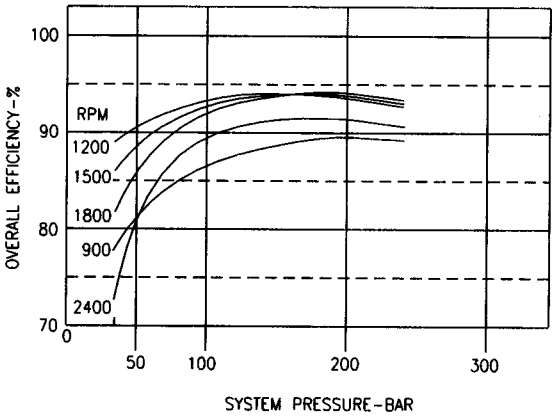


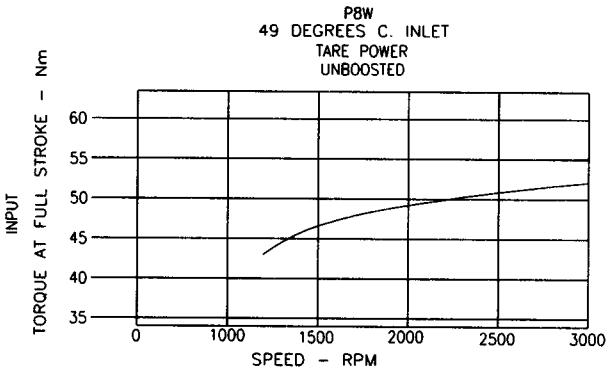


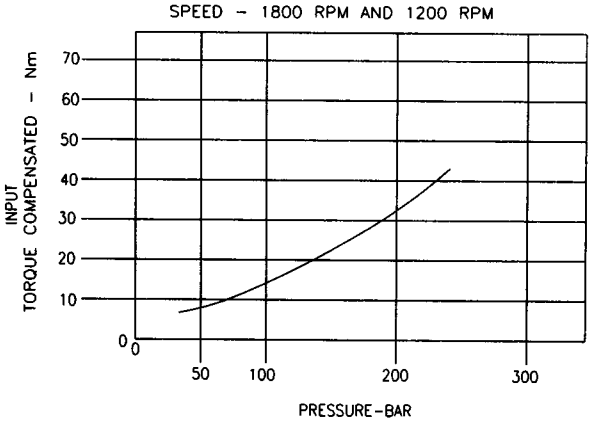
SERIES 8
METRIC DATA

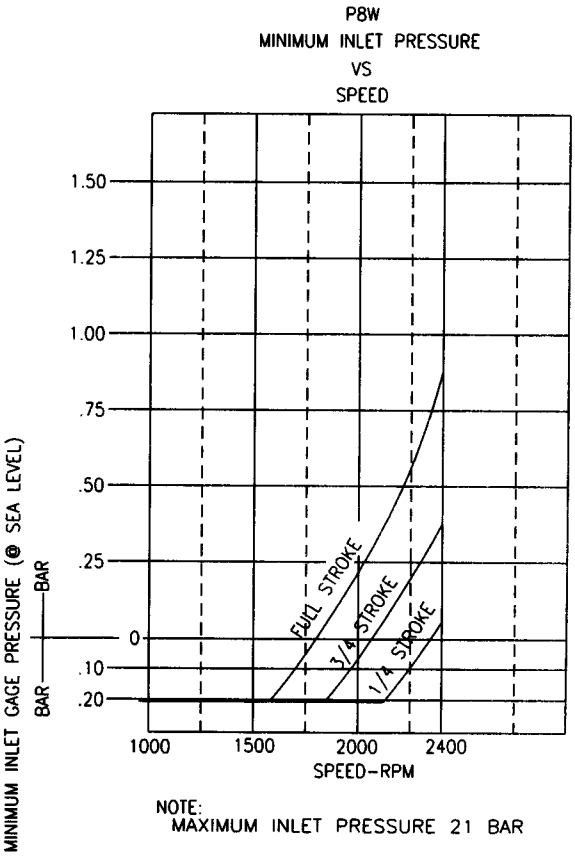






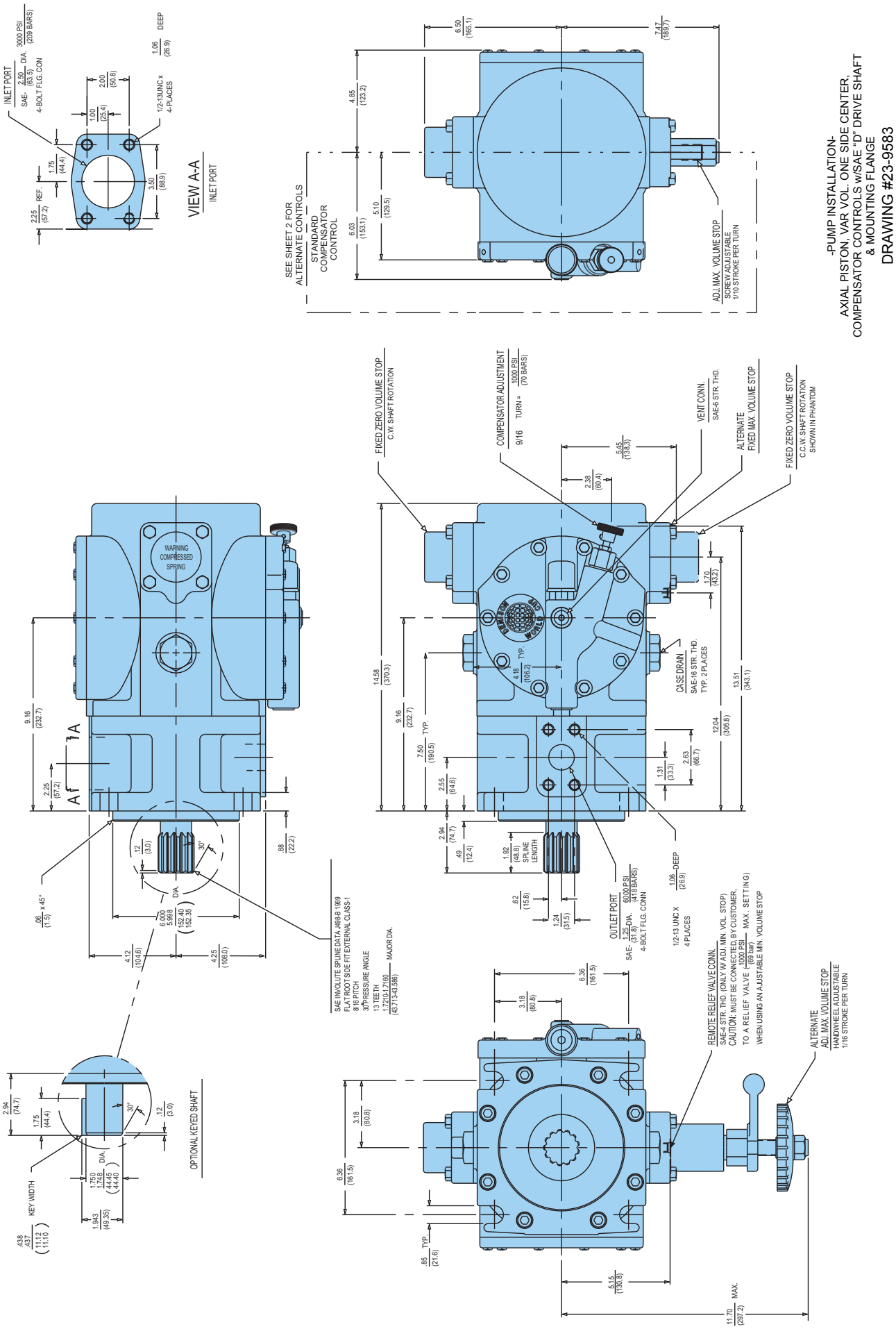


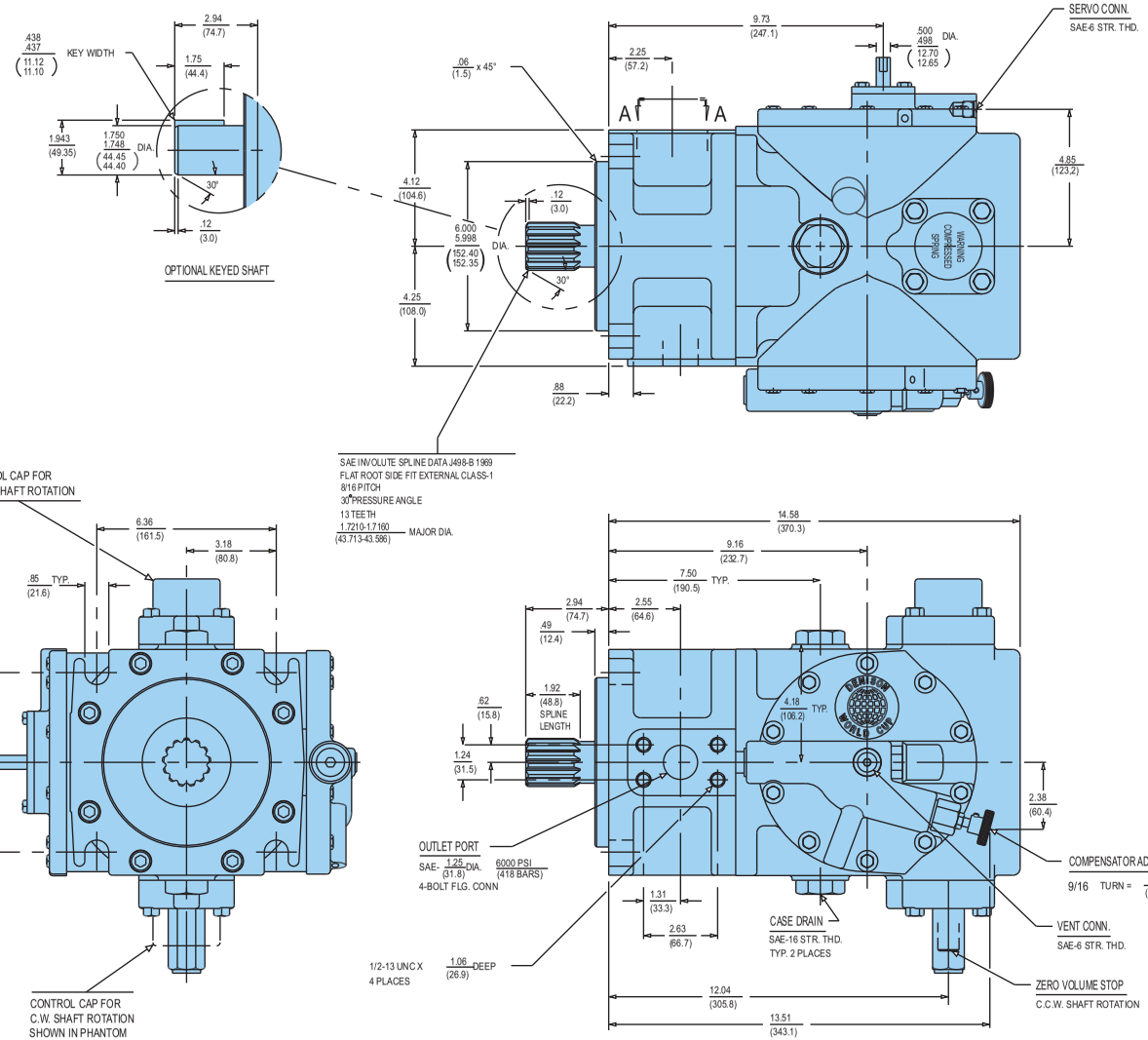


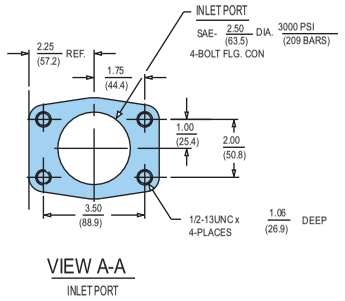


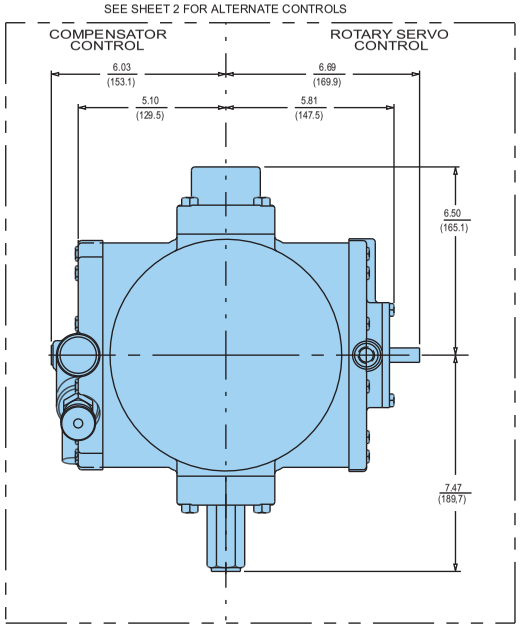
FLUID CONNECTIONS

• port A (inlet) SAE code 61 split flange	in. mm	2-1/2 (62,5)	2-1/2 (62,5)	2-1/2 (62,5)
• port B (system) SAE code 62 split flange	in. mm	1-1/4 31,25	1-1/4 31,25	1-1/4 31,25
• port D,D1 (case drain)	SAE	-16	-16	-16
• port LS (load sensing port)	SAE	-4	-4	-4
• port V (compensator vent)	SAE	-6	-6	-6
• port X (rotary servo)	SAE	-6	-6	-6
• port E, H (rotary servo electric & hydraulic stroker inlet)	SAE	-4	-4	-4
• port RV (cylinder relief port)	SAE	-4	-4	-4


-PUMP INSTALLATION-
AXIAL PISTON, VAR VOL. ONE SIDE CENTER,
COMPENSATOR CONTROLS w/SAE "D" DRIVE SHAFT
& MOUNTING FLANGE
DRAWING #23-9583
INLET PORT
SAE- 2.50 (63.5) DIA. 3000 PSI (209 BARS)
4-BOLT FLG. CON
1.06 (26.9) DEEP
1/2-13UNC x 4-PLACES
VIEW A-A
INLET PORT
SEE SHEET 2 FOR ALTERNATE CONTROLS
STANDARD COMPENSATOR CONTROL
ADJ. MAX. VOLUME STOP
SCREW ADJUSTABLE
1/10 STROKE PER TURN
FIXED ZERO VOLUME STOP
C.W. SHAFT ROTATION
COMPENSATOR ADJUSTMENT
9/16 TURN = 1000 PSI (70 BARS)
VENT CONN.
SAE-6 STR. THD.
ALTERNATE
FIXED MAX. VOLUME STOP
FIXED ZERO VOLUME STOP
C.C.W. SHAFT ROTATION
SHOWN IN PHANTOM
CASE DRAIN
SAE-16 STR. THD.
TYP. 2 PLACES
WARNING
COMPRESSED
SPRING
SAE INVOLUTE SPLINE DATA J498B-1989
FLAT ROOT SIDE FIT EXTERNAL CLASS-1
8/16 PITCH
30° PRESSURE ANGLE
13 TEETH
1.7210/1.7160 (43.713/43.586) MAJOR DIA.
OUTLET PORT
SAE- 1.25 DIA. 6000 PSI (414 BARS)
4-BOLT FLG. CONN
1/2-13 UNC X 4 PLACES
1.06 (26.9) DEEP
REMOTE RELIEF VALVE CONN.
SAE-4 STR. THD. (ONLY W/ ADJ. MIN. VOL. STOP)
CAUTION: MUST BE CONNECTED, BY CUSTOMER,
TO A RELIEF VALVE (1000 PSI (69 BAR) MAX. SETTING)
WHEN USING AN ADJUSTABLE MIN. VOLUME STOP
ALTERNATE
ADJ. MAX. VOLUME STOP
HANDWHEEL ADJUSTABLE
1/16 STROKE PER TURN
OPTIONAL KEYED SHAFT
KEY WIDTH

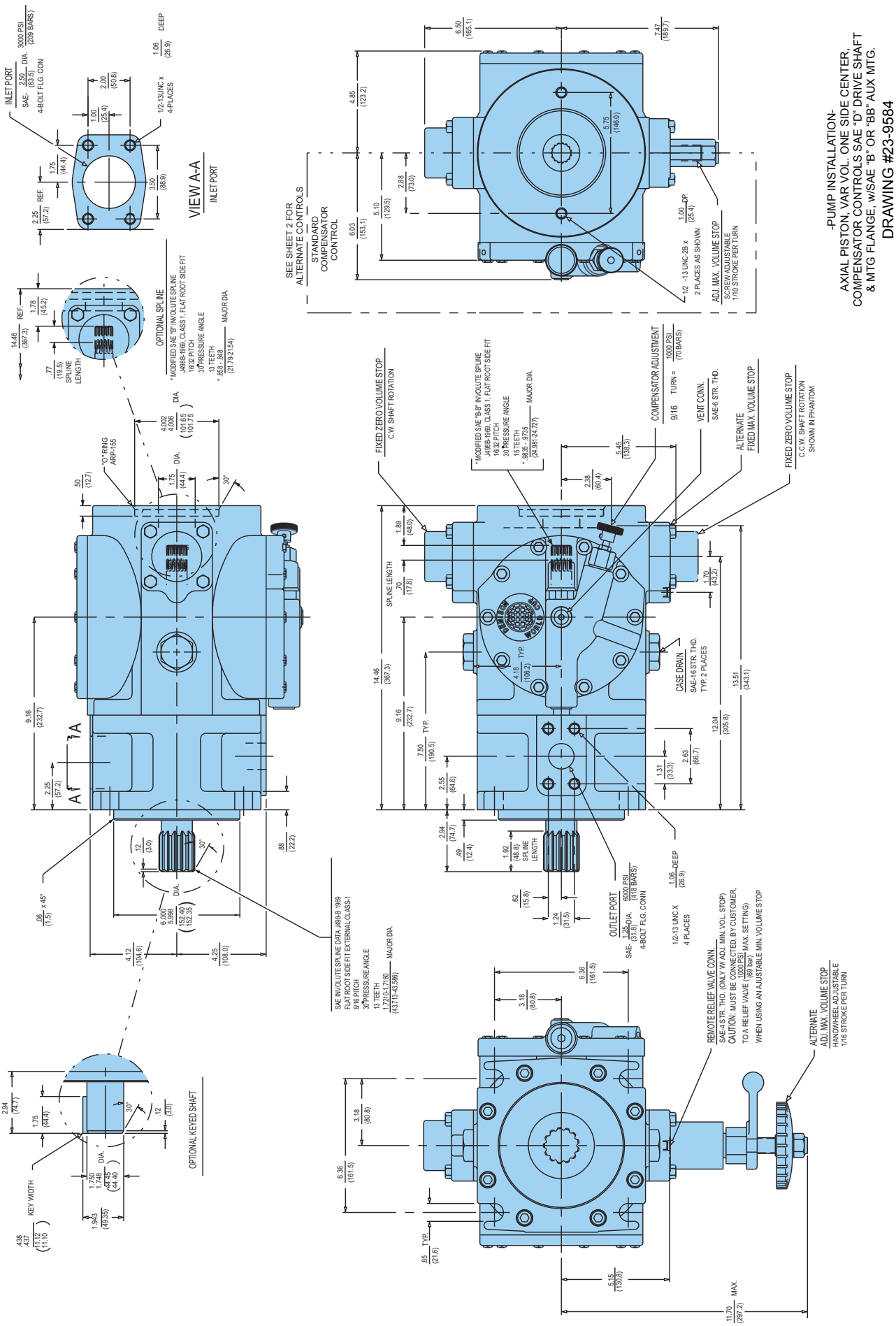


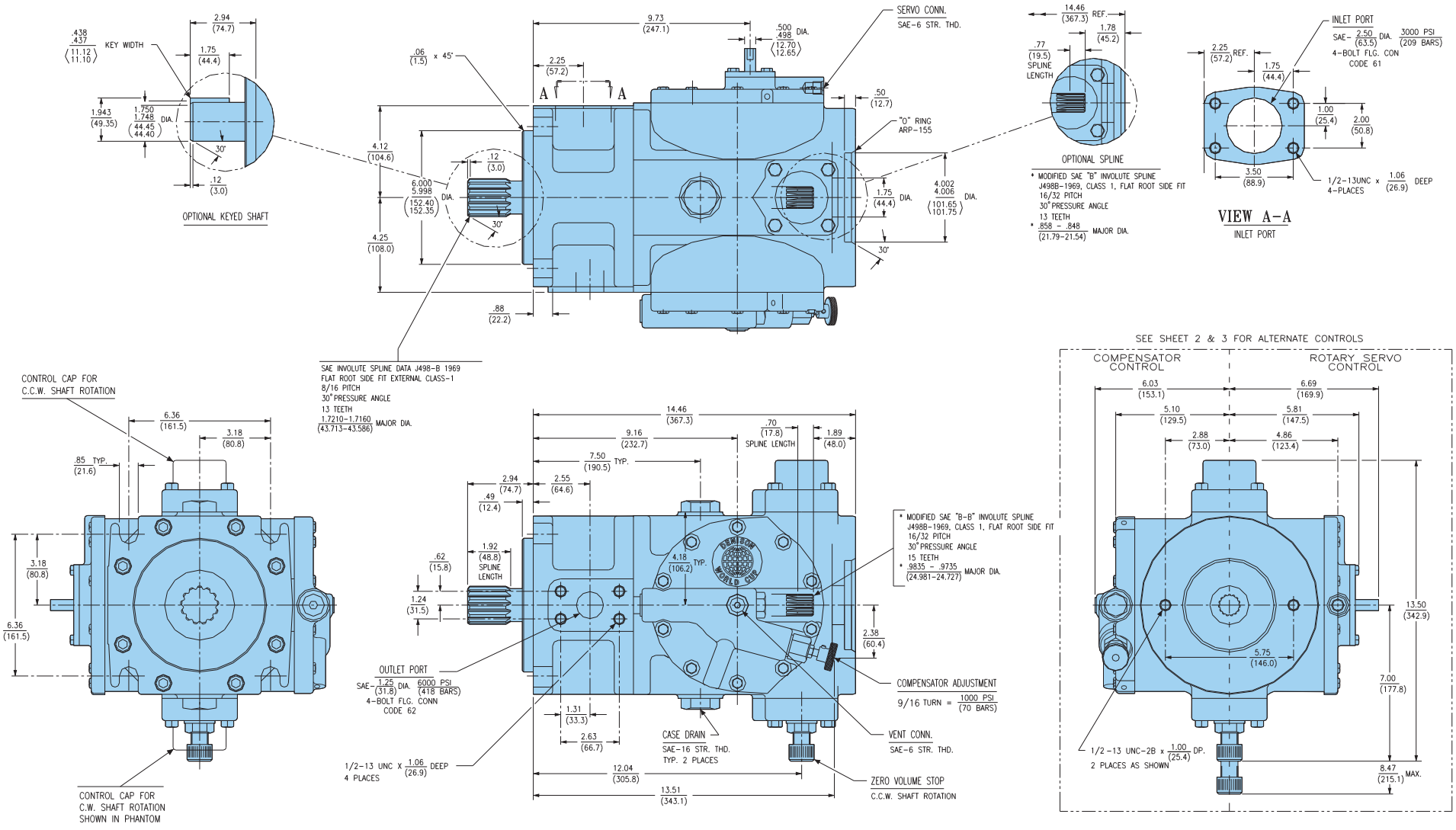




***Warning:** Whenever a primary control “R”, “H”, or “E” is used with secondary control “P” or “T”, where the pump will not be allowed to go to zero stroke, a special control piston cap must be used where a relief valve may be connected to port “RV” and set to 1000 psi , 69 bar maximum.

-PUMP INSTALLATION-
AXIAL PISTON, VAR VOL. ONE SIDE CENTER, SERVO CONTROLS w & w/o OVERRIDE CONTROLS,
w/SAE “D” DRIVE SHAFT & MOUNTING FLANGE
DRAWING #23-9614

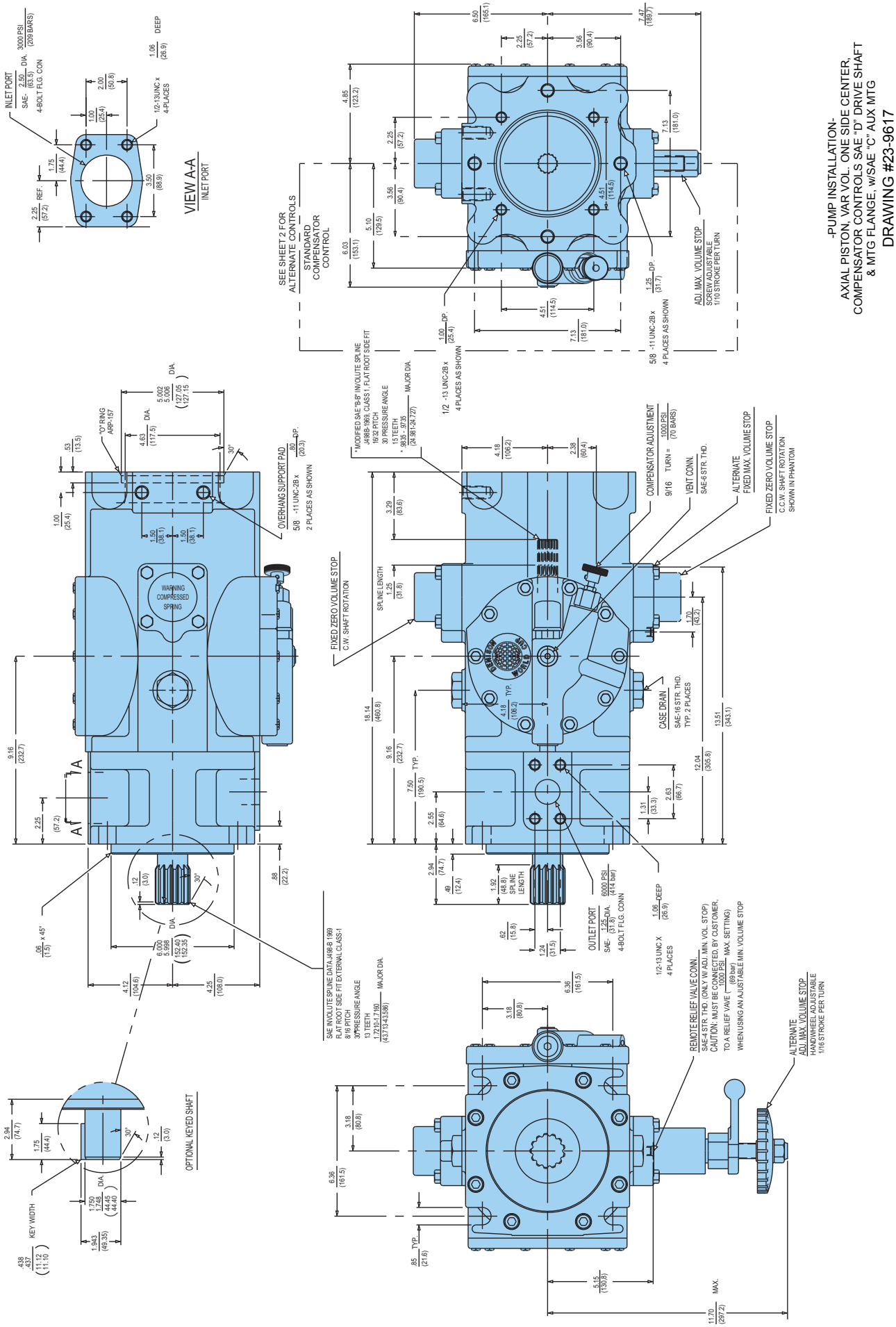

-PUMP INSTALLATION-
AXIAL PISTON, VAR VOL. ONE SIDE CENTER,
COMPENSATOR CONTROLS SAE "D" DRIVE SHAFT
& MTG FLANGE, w/SAE "B" OR "BB" AUX MTG.
DRAWING #23-9584
VIEW A-A
INLET PORT
OPTIONAL SPLINE
OPTIONAL KEYED SHAFT
SEE SHEET 2 FOR ALTERNATE CONTROLS
STANDARD COMPENSATOR CONTROL
FIXED ZERO VOLUME STOP
C.W. SHAFT ROTATION
COMPENSATOR ADJUSTMENT
VENT CONN.
ALTERNATE FIXED MAX. VOLUME STOP
FIXED ZERO VOLUME STOP
C.C.W. SHAFT ROTATION
SHOWN IN PHANTOM
CASE DRAIN
OUTLET PORT
REMOTE RELIEF VALVE CONN.
ALTERNATE ADJ. MAX. VOLUME STOP
HANDWHEEL ADJUSTABLE
1/16 STROKE PER TURN
ADJ. MAX. VOLUME STOP
SCREW ADJUSTABLE
1/10 STROKE PER TURN

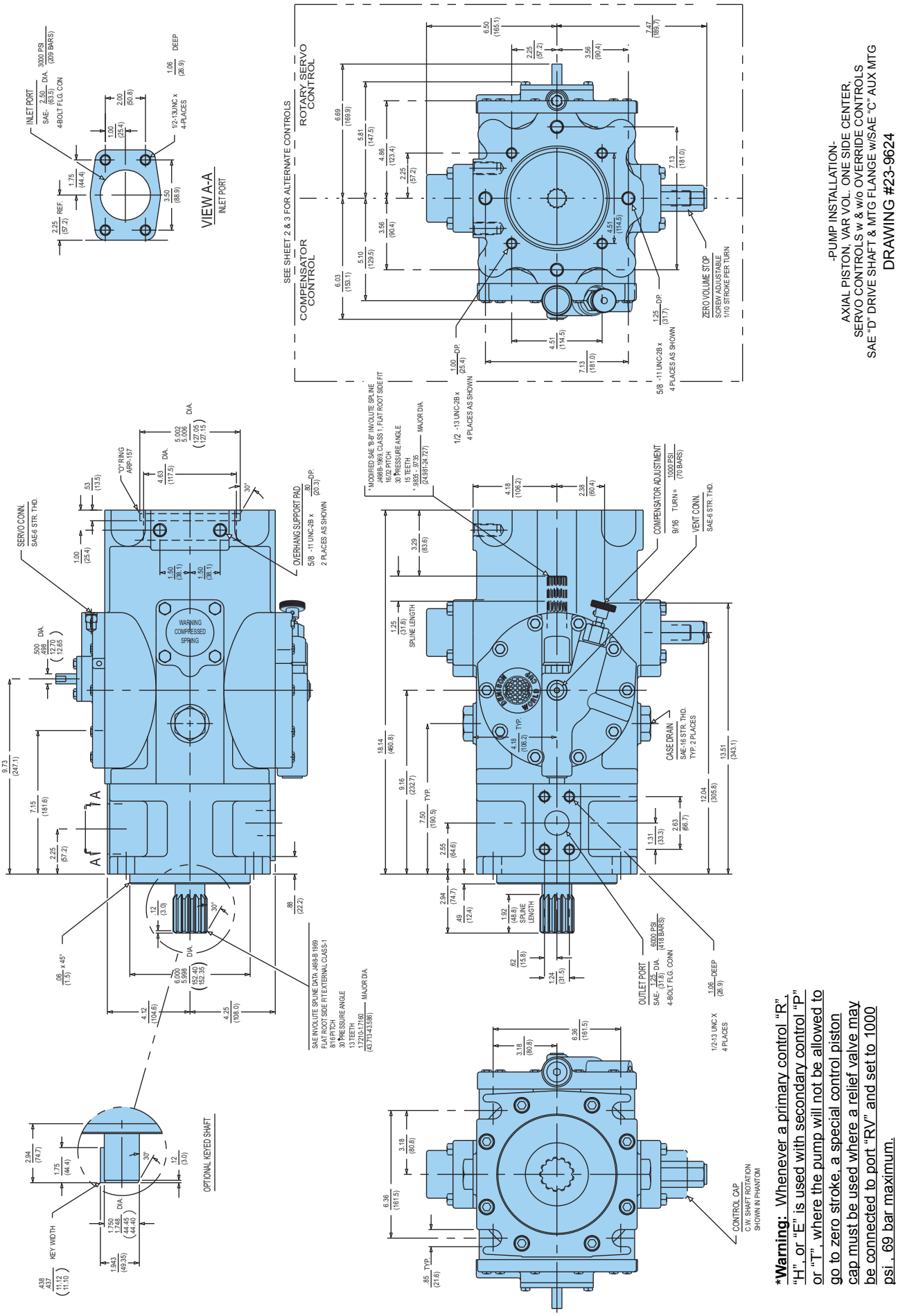


NOTE: "DIMENSIONS IN PARENTHESIS ARE METRIC"

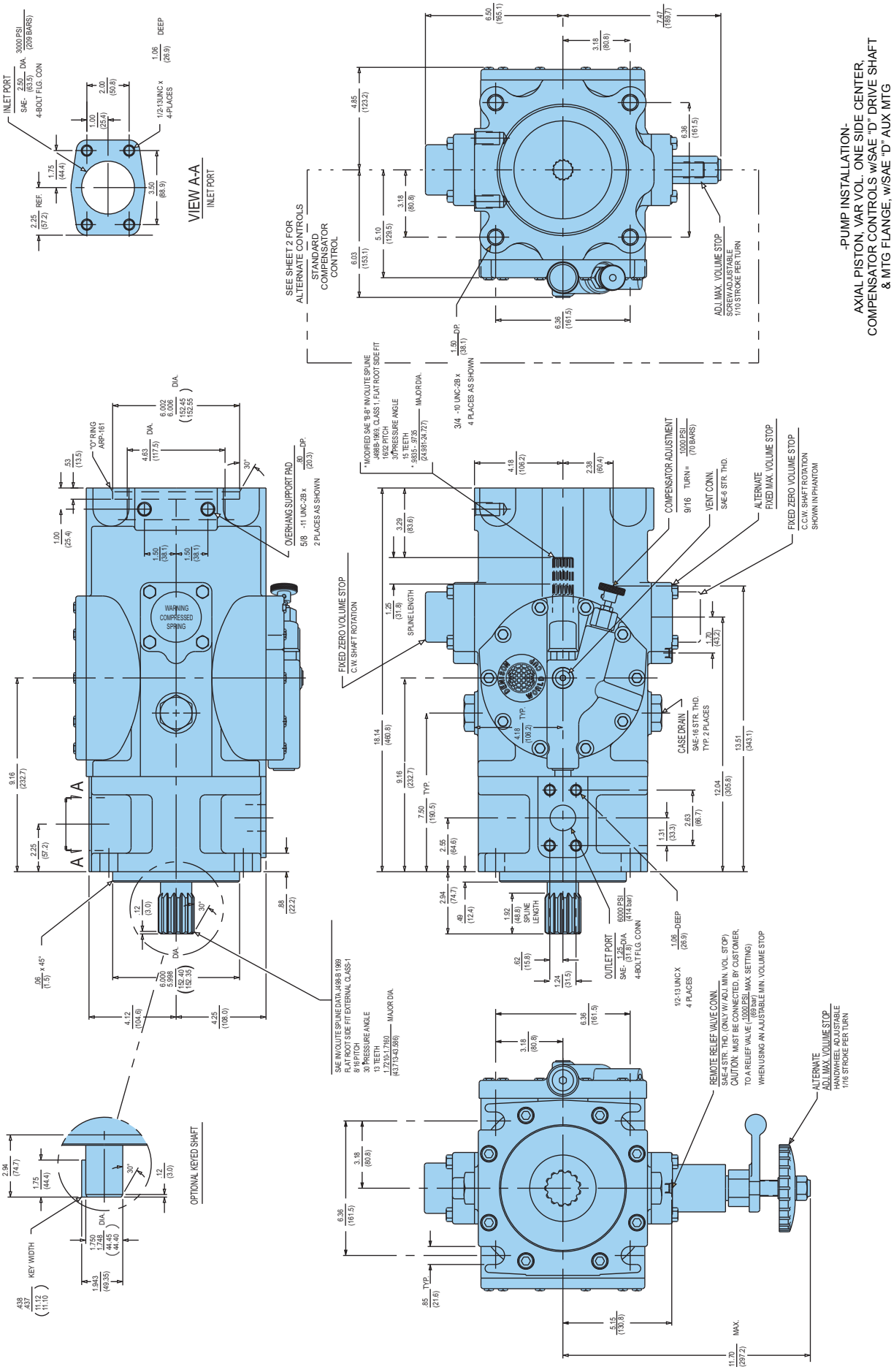
***Warning:** Whenever a primary control "R", "H", or "E" is used with secondary control "P" or "T", where the pump will not be allowed to go to zero stroke, a special control piston cap must be used where a relief valve may be connected to port "RV" and set to 1000 psi , 69 bar maximum.

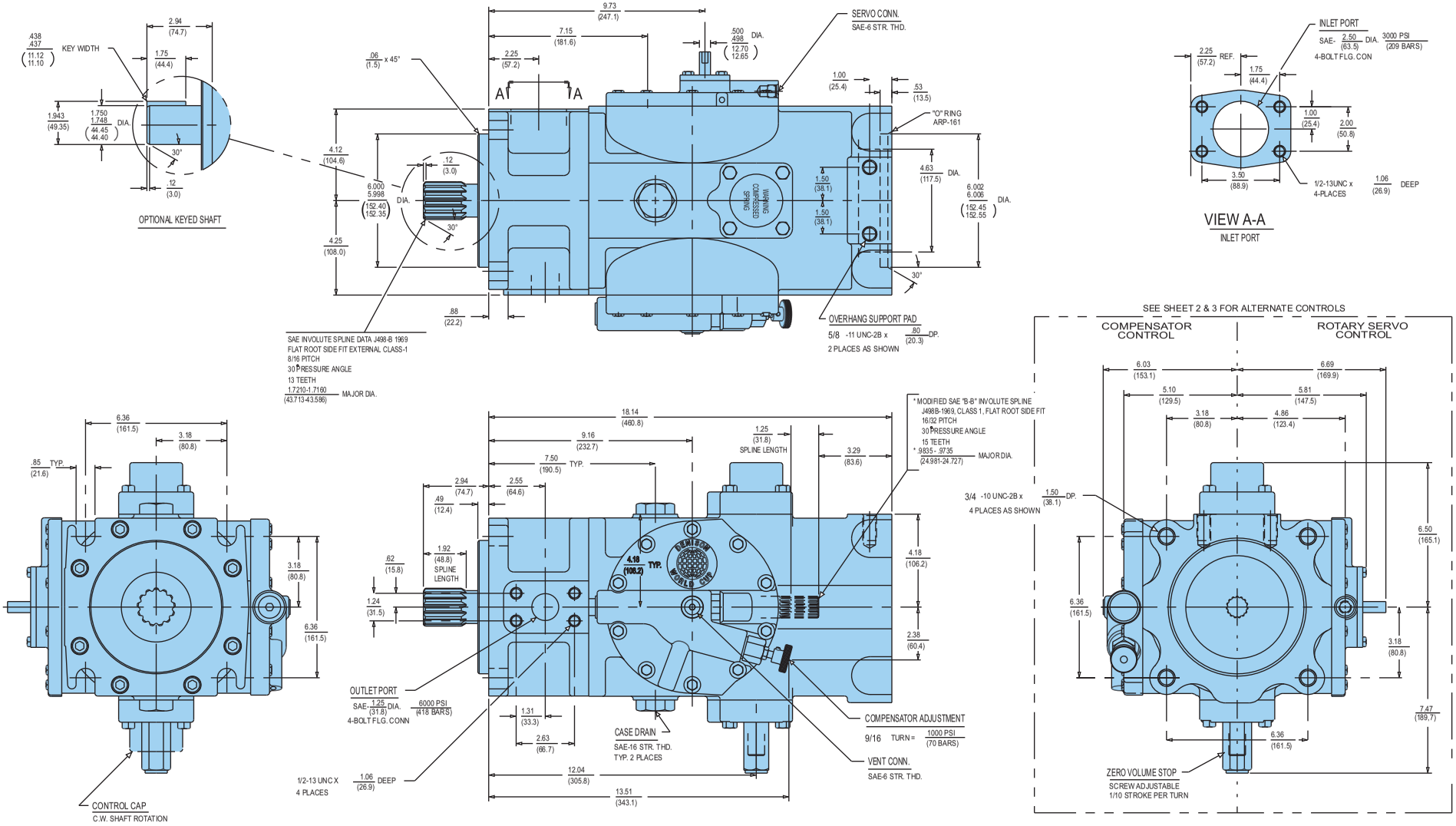
-PUMP INSTALLATION-
AXIAL PISTON, VAR VOL. ONE SIDE CENTER,
SERVO CONTROLS w & w/o OVERRIDE CONTROLS,
SAE "D" DRIVE SHAFT w/SAE "B" OR "BB" AUX MTG
DRAWING #23-9612


-PUMP INSTALLATION-
AXIAL PISTON, VAR VOL. ONE SIDE CENTER,
COMPENSATOR CONTROLS SAE "D" DRIVE SHAFT
& MTG FLANGE, w/SAE "C" AUX MTG
DRAWING #23-9617
VIEW A-A
INLET PORT
SEE SHEET 2 FOR
ALTERNATE CONTROLS
STANDARD
COMPENSATOR
CONTROL
ADJ. MAX. VOLUME STOP
SCREW ADJUSTABLE
1/10 STROKE PER TURN
OVERHANG SUPPORT PAD
5/8 -11 UNC-2B x
2 PLACES AS SHOWN
"O" RING
ARP-157
WARNING
COMPRESSED
SPRING
FIXED ZERO VOLUME STOP
C.W. SHAFT ROTATION
COMPENSATOR ADJUSTMENT
1000 PSI
(70 BARS)
9/16 TURN =
VENT CONN.
SAE-6 STR. THD.
ALTERNATE
FIXED MAX. VOLUME STOP
FIXED ZERO VOLUME STOP
C.C.W. SHAFT ROTATION
SHOWN IN PHANTOM
CASE DRAIN
SAE-16 STR. THD.
TYP. 2 PLACES
OUTLET PORT
SAE- 1.25 DIA.
4-BOLT FLG. CONN
6000 PSI
(414 bar)
REMOTE RELIEF VALVE CONN.
SAE-4 STR. THD. (ONLY W/ ADJ. MIN. VOL. STOP)
CAUTION: MUST BE CONNECTED, BY CUSTOMER,
TO A RELIEF VAVE (1000 PSI MAX. SETTING)
(69 bar)
WHEN USING AN ADJUSTABLE MIN. VOLUME STOP
ALTERNATE
ADJ. MAX. VOLUME STOP
HANDWHEEL ADJUSTABLE
1/16 STROKE PER TURN
OPTIONAL KEYED SHAFT
KEY WIDTH
SAE INVOLUTE SPLINE DATA JASR-B 1969
FLAT ROOT SIDE FIT EXTERNAL CLASS-1
8/16 PITCH
30° PRESSURE ANGLE
13 TEETH
1.72/0.1-1.7160
(43.713-43.586)
MAJOR DIA.
*MODIFIED SAE "B-B" INVOLUTE SPLINE
J498B-1969, CLASS 1 FLAT ROOT SIDE FIT
16/32 PITCH
30 PRESSURE ANGLE
15 TEETH
* 38.35 - 37.85
(24.381-24.727)
MAJOR DIA.
1/2 - 13 UNC-2B x
4 PLACES AS SHOWN
5/8 -11 UNC-2B x
4 PLACES AS SHOWN
SPLINE LENGTH
1.25
(31.8)
SPLINE
LENGTH
1.92
(48.8)



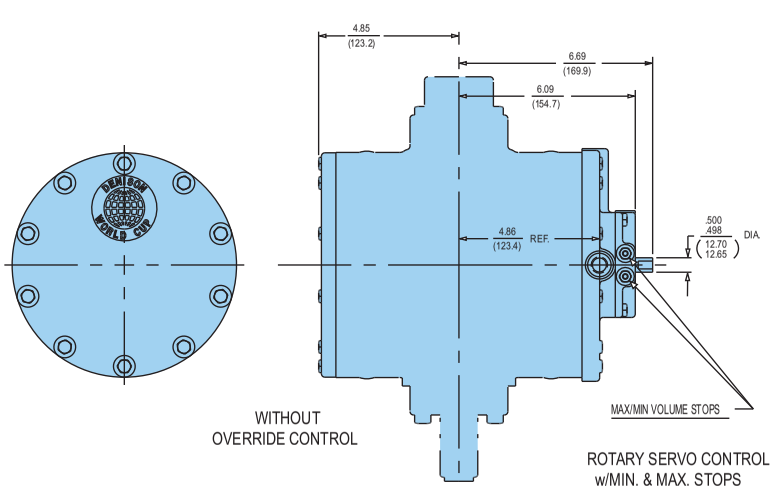
***Warning:** Whenever a primary control "R", "H", or "E" is used with secondary control "P" or "T", where the pump will not be allowed to go to zero stroke, a special control piston cap must be used where a relief valve may be connected to port "RV" and set to 1000 psi , 69 bar maximum.


-PUMP INSTALLATION-
AXIAL PISTON, VAR VOL. ONE SIDE CENTER,
COMPENSATOR CONTROLS w/SAE "D" DRIVE SHAFT
& MTG FLANGE, w/SAE "D" AUX MTG
DRAWING #23-9618
VIEW A-A
INLET PORT
SEE SHEET 2 FOR
ALTERNATE CONTROLS
STANDARD
COMPENSATOR
CONTROL
ADJ. MAX. VOLUME STOP
SCREW ADJUSTABLE
1/16 STROKE PER TURN
FIXED ZERO VOLUME STOP
C.W. SHAFT ROTATION
COMPENSATOR ADJUSTMENT
VENT CONN.
ALTERNATE
FIXED MAX. VOLUME STOP
CASE DRAIN
OUTLET PORT
REMOTE RELIEF VALVE CONN.
ALTERNATE
ADJ. MAX. VOLUME STOP
HANDWHEEL ADJUSTABLE
1/16 STROKE PER TURN
OVERHANG SUPPORT PAD
OPTIONAL KEYED SHAFT
WARNING
COMPRESSED
SPRING



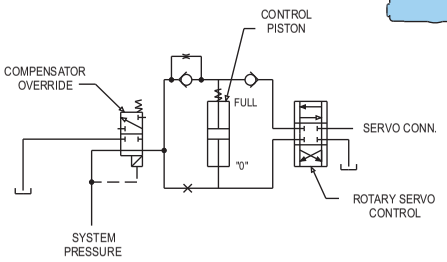
***Warning:** Whenever a primary control "R", "H", or "E" is used with secondary control "P" or "T", where the pump will not be allowed to go to zero stroke, a special control piston cap must be used where a relief valve may be connected to port "RV" and set to 1000 psi , 69 bar maximum.

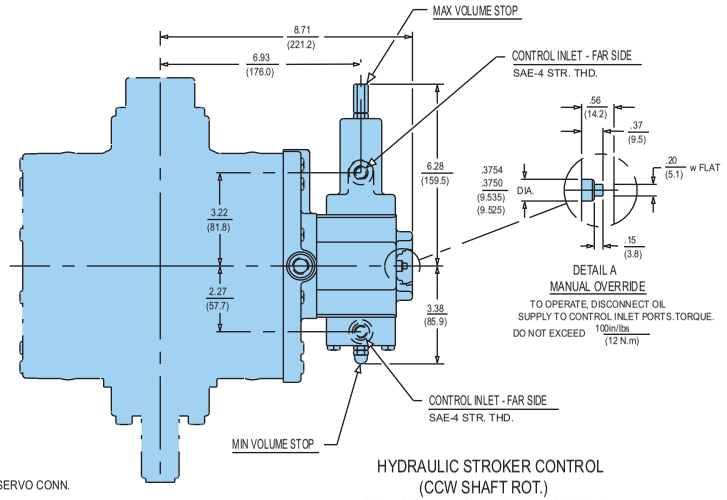
-PUMP INSTALLATION-
AXIAL PISTON, VAR VOL. ONE SIDE CENTER,
SERVO CONTROLS w & w/o OVERRIDE CONTROLS
SAE "D" DRIVE SHAFT & MTG FLANGE w/SAE "D" AUX MTG
DRAWING #23-9626



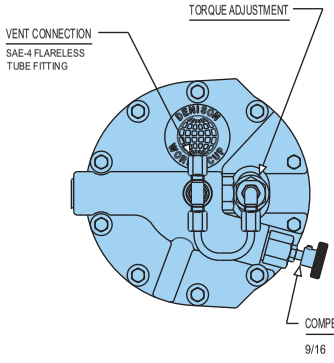
WITHOUT
OVERRIDE CONTROL

ROTARY SERVO CONTROL
w/MIN. & MAX. STOPS
(CCW SHAFT ROT.)

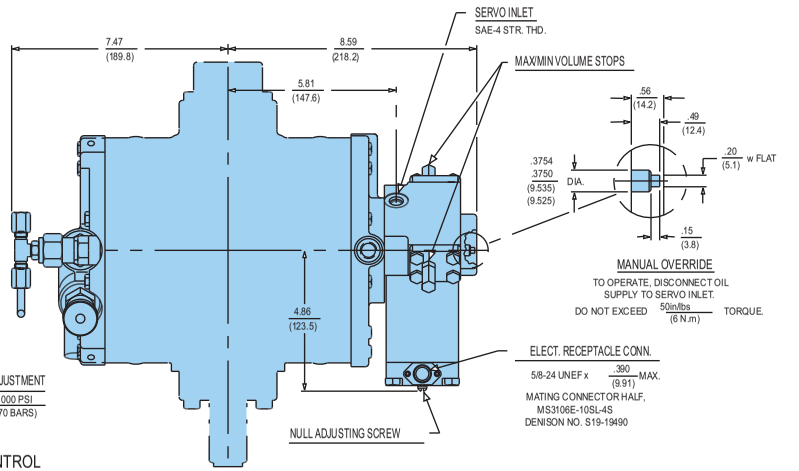




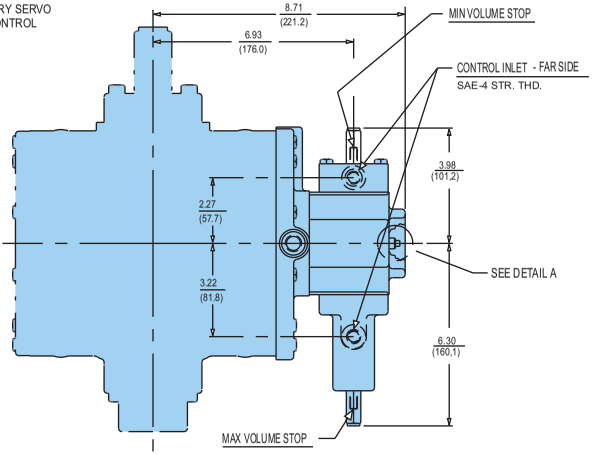
HYDRAULIC STROKER CONTROL
(CCW SHAFT ROT.)
w/MIN. & MAX. VOLUME ADJUSTMENT



COMPENSATOR CONTROL
w/TORQUE LIMITER



ELECTRO HYDRAULIC STROKER
(CCW SHAFT ROT.)
w/MIN. & MAX. VOLUME ADJUSTMENT



HYDRAULIC STROKER CONTROL
(CW SHAFT ROT.)
w/MIN. & MAX. VOLUME ADJUSTMENT

-PUMP INSTALLATION-
AXIAL PISTON, VAR VOL. ONE SIDE CENTER,
SERVO CONTROLS SAE “D” DRIVE SHAFT
& MTIG FLANGE, w & w/o OVERRIDE CONTROLS,
SAE “D” DRIVE SHAFT w/SAE “B” OR “BB” AUX MTG

DRAWING #23-9614

World Cup pumps — Model number sheet

Example model code:

Revised 6/24/02

	P	6	W	-2	R	1	*	-C	0	0	-BB	0	
Pump	P												
Displacement													
6.00 cu.in./rev. (98 cc/rev.)		6											
7.25 cu.in./rev. (119 cc/rev.)		7											
8.00 cu.in./rev. (131 cc/rev.)		8											
Type													
Standard version			W										
Test stand version			T										
Shaft													
Splined SAE-D (for W type pumps only)				-1									
Keyed SAE-D (for W type pumps only)				-2									
Splined AND-10266 (for T type pumps only)				-3									
Rotation													
Clockwise					R								
Counter-clockwise					L								
Seals													
Nitrile (Buna N)						1							
EPR (not available when using "E" primary control)(pump will be unpainted unless other						4							
Flourocarbon (Viton)						5							
Military specification MIL-P-25732						6							
Design letter (assigned by manufacturer)							*						
Primary controls													
Compensator								-C					
Load sensing compensator (50 PSI pressure drop)								-L					
Load sensing compensator (200 PSI pressure drop)								-M					
Rotary servo								-R					
Torque limiter								-T					
Hydraulic servo								-H					
Electro-hydraulic servo								-E					
Primary control options													
None (for C, L, M, R, & T primary controls only)									0				
Maximum volume screw (for C, L, M, & T primary controls only)									1				
Maximum volume handwheel (for C, L, M, & T primary controls only)									2				
Remote access volume adjustment (for C & T primary controls only)									3				
Maximum & minimum volume adjustment (for R, H, & E primary controls only)									4				
Secondary controls													
None										0			
Compensator override (for R, H, & E primary controls only)										P			
Torque limiter override (for R, H, & E primary controls only)										T			
Note: Whenever P or T are chosen, if you have an application where the pump will not be allowed to go to zero stroke, the installation of a special control piston cap must be used so that a relief valve can be fitted to ensure the pressure cannot reach system pressure. See circuit on page 14 of sales catalog.													
External drive													
None											-0		
SAE-B (SAE 101-2) with SAE-B (SAE 22-4) coupling											-B		
SAE-B (SAE 101-2) with SAE-BB (SAE 25-4) coupling											-BB		
SAE-C (SAE 127-4) with SAE-C (SAE 32-4) coupling											-C		
SAE-D (SAE 152-4) with SAE-D (SAE 44-4) coupling											-D		
External mounting													
No external pump mounted												0	
External pump mounted (requires special modification "-M2")(must be separately specified)												1	
Special modification													
None													omit
No paint													-NP
Other special modification (example: tandem pumps)													-M2

Allowable controls

C00,C10,C20,C30,L00,L10,L20,M00,M10,M20
T00,T10,T20,T30,R00,R40,R0P,R4P,R0T,R4T
E40,E4P,E4T,H40,H4P,H4T

DEFINITION & UNIT

displacement	in^3/rev x 16.387 = cm^3/rev	cm^3/rev x 0.06102 = in^3/rev
flow	gpm x 3.78 = L/min	L/min x 0.2642 = gpm
power	hp x 0.7457 = kW	kW x 1.341 = hp
torque	lb-ft x 1.3567 = Nm	Nm x 0.7376 = lb-ft
pressure	lbs/in^2 (psi) x 0.06895 = bar lbs/in^2 (psi) x 6.895 = kPa	bar x 14.50 = lbs/in^2 (psi) kPa x 0.1450 = lbs/in^2 (psi)
weight	lb x 0.4536 = kg	kg x 2.205 = lbs
force	lb x 4.448 = N	N x 0.2248 = lbs
volume	in^3 x 16.387 = cm^3	cm^3 x 0.06102 = in^3
area	in^2 x 6.452 = cm^2	cm^2 x 0.1550 = in^2
length	in x 25.4= mm	mm x 0.03937 = in
temperature	$\frac{\text{degree F-32}}{1.8}$ = °C	1.8 x (°C+32) = ° F
viscosity	*c*St x 1.0 = mm^2/sec SSU ≅ cSt x 4.25 + 14	mm^2/sec x 1.0 = *c*St 20 cSt ≅ 99 SSU

FLUID POWER FORMULAS

Pump input torque	*lbs. in.*	$\frac{\text{pressure(psi) x displacement } (in^3/rev)}{2p \text{ x mech. eff.}}$
Pump input power	*hp*	$\frac{\text{rpm x } (in^3/rev) \text{ x (psi)}}{395934 \text{ x overall eff.}}$
Pump output flow	*U.S. gpm*	$\frac{\text{rpm x } (in^3/rev) \text{ x volumetric eff.}}{231}$
Fluid motor speed	*rpm*	$\frac{\text{231 x flow rate(U.S. gpm) x volumetric eff.}}{\text{displacement (in3/rev)}}$
Fluid motor torque	*lbs. in.*	$\frac{\text{pressure(psi) x displacement } (in^3/rev) \text{ x mech. eff.}}{2p}$
Fluid motor power	*hp*	$\frac{\text{rpm x } (in^3/rev) \text{ x (psi) x overall eff.}}{395934}$
(metric)		
Pump input torque	*Nm*	$\frac{\text{pressure(bar) x displacement } (cm^3/rev}{20p \text{ x mech. eff.}}$
Pump input power	*kW*	$\frac{\text{rpm x } (cm^3/rev) \text{ x (bar)}}{600000 \text{ x overall eff.}}$
Pump output flow	*Lpm*	$\frac{\text{rpm x } (cm^3/rev) \text{ x volumetric eff.}}{1000}$
Fluid motor speed	*rpm(min^{-1}) (tr/mn)*	$\frac{\text{1000 x flow rate (Lpm) x volumetric eff.}}{\text{displacement (cm3/rev)}}$
Fluid motor torque	*Nm*	$\frac{\text{pressure(bar) x displacement } (cm^3/rev) \text{ x mech. eff.}}{20p}$
Fluid motor power	*kW*	$\frac{\text{rpm x } (cm^3/rev) \text{ x (bar) x overall eff.}}{600000}$

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