

**FULL LINE FULL LINE FULL LINE**



MANUFACTURING INC.

**Fluid  
Power  
Products**

Made in USA

**PROVEN  
PERFORMERS**

- High Quality
- Low Prices
- Fast Delivery

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## THE CROSS STORY

In 1949 James H. Cross established CROSS Manufacturing in Lewis, Kansas. The first product was an agricultural tie rod cylinder. CROSS now has subsidiaries and marketing worldwide and produces one of the most extensive product lines on today's market.

To provide our customers with the best possible service, all CROSS manufacturing plants are located in Kansas within an eighty mile radius of the main cylinder plant in Lewis. Valves and pumps are manufactured in Hays and adapters and fittings in Pratt. Executive offices are in Overland Park, KS. New products are continuously being developed to meet the ever increasing technological requirement of the market.

Quality and efficiency are the primary goals of all the CROSS production plants. Automated machinery, combined with rigid quality control and personal pride in American workmanship, create the right conditions for the best products at the lowest price.

Knowledgeable research, sales and production personnel, as well as sophisticated computer processing of orders, material and inventory control, offer unique advantages to CROSS customers.

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## PRODUCT WARRANTY POLICY

Cross Manufacturing, Inc. ("Cross") warrants to the original purchaser that the products it manufactures shall be free from defects in material and workmanship.

THIS WARRANTY IS EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES, WHETHER WRITTEN, ORAL OR IMPLIED, INCLUDING THE WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

Cross' obligation under this warranty is limited to the repair or replacement of a defective article or, at Cross' option, the issuing of a credit for the purchase price, for a period of twelve (12) months from the date of first use or eighteen (18) months from the date of shipment from Cross, whichever shall first occur. Buyer shall make such defective article available for inspection by Cross and, if so directed by Cross, shall return the defective article to Cross, transportation prepaid. Replacement articles or parts thereof repaired under this warranty shall be warranted under the terms of this warranty for the remainder of the term of the original warranty or for a period of six (6) months (after such repair or replacement), whichever is longer. Upon expiration of the warranty period, all of Cross' obligation hereunder shall terminate. This warranty shall not apply to any article which shall have been subject to alteration, accident, abuse, misuse, or failure to follow Cross' instructions for installation, operation and maintenance. If a claim under this warranty is refused because the warranty has expired or because, in Cross' opinion, the article has been subject to alteration, accident, abuse, misuse, or failure to follow Cross' instructions for installation, operation and maintenance, the buyer shall be so advised and the unit will be held for a period not to exceed fifteen (15) days pending disposition by buyer. The foregoing shall constitute the sole remedy of the buyer and the sole obligation of Cross.

Cross shall not be liable for indirect, incidental or consequential damages, secondary charges, or loss or expense resulting from (1) any alleged defect in any Cross product to which this warranty applies, (2) the failure of any such product to operate properly or (3) the negligence of others. Cross reserves the right to make design changes at any time without obligation to modify articles previously shipped from Cross.

Only the warranty expressed in this Warranty Policy shall apply and no distributor, corporation or individual is authorized to amend, modify or extend this warranty in any way on resale.

Some states do not allow the exclusion or modification of implied warranties of merchantability and fitness for a particular purpose; nor do some states permit the exclusion or modification of any remedy or measure of damages provided by law for a breach of the implied warranty of merchantability and fitness for a particular purpose. In these states, any exclusion or modification so prohibited or any other provision contained in this warranty which is so prohibited shall not be applicable

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# STANDARD FULL LINE CATALOG

CROSS Manufacturing Inc., one of the world's leading designers and producers of hydraulic systems and components, can provide standard products to meet most system requirements. CROSS hydraulic components are proudly made in the USA. This catalog itemizes those products which can be assembled from standard parts to meet your specific requirement.

## TABLE OF CONTENTS

THE CROSS STORY and PRODUCT WARRANTY POLICY ..... INSIDE FRONT COVER

PUMPS, GEAR TYPE, SERIES 40, 50 and 60 ..... 2

50T PUMP and 50G MOTOR ..... 3

DIRECTIONAL CONTROL VALVES - SECTIONAL, SERIES SS ..... 4

DIRECTIONAL CONTROL VALVES - SBA and SBC ..... 5

DIRECTIONAL CONTROL VALVES - SDV, SA and CONVERTA (SCV-1) ..... 6

DIRECTIONAL CONTROL VALVES - SCA, SCD and SQV ..... 7

SELECTOR VALVES - SERIES SVS and SSD ..... 8

PRESSURE CONTROL VALVES - SERIES SRC and SRD ..... 8

TIE ROD CYLINDERS - SERIES DB, DB-ASAE, DU-ASAE (NPTF porting) ..... 9

TIE ROD CYLINDERS - SERIES DE-ASAE (NPTF), DC, REPHASING DCR and DR..... 10

TIE ROD CYLINDERS - SERIES DB-ORB, DB-ASAE-ORB, DU-ORB, DE-ASAE-ORB...11

TIE ROD CYLINDERS - SERIES DH - 3000 PSI..... 12

WELDED CYLINDERS (STANDARD) - SERIES NU ..... 13

FILTERS - SERIES SF ..... 13

BASIC HYDRAULIC THEORY ..... 14

TERMINOLOGY ..... 15

SAMPLE HYDRAULIC SYSTEMS and USEFUL FORMULAS ..... 16

FAQ - COMMON VALVE QUESTIONS ..... 17

HYDRAULIC PRODUCT SAFETY..... 18

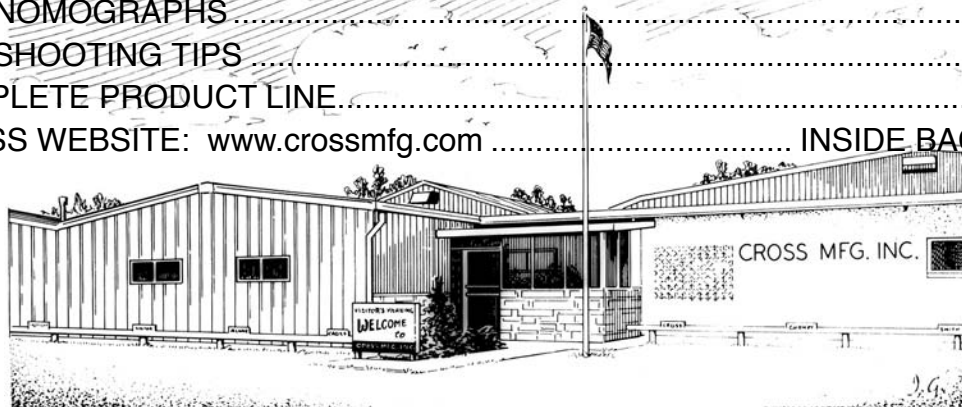
CLOSED CENTER and POWER BEYOND INSTALLATION..... 19

HELPFUL NOMOGRAPHS ..... 20, 21 & 22

TROUBLESHOOTING TIPS ..... 23

THE COMPLETE PRODUCT LINE..... 24

THE CROSS WEBSITE: [www.crossmfg.com](http://www.crossmfg.com) ..... INSIDE BACK COVER





# PUMPS AND MOTORS

CROSS pumps and motors feature advanced design concepts which provide long life, reliable operation and high volumetric efficiency. Pumps may be chain, belt or direct driven by a gas engine or electric motor.\*

## 40 SERIES



## 50 SERIES



## 60 SERIES



### FEATURES:

- Bi-directional rotation for motors.
- Left, right or bi-directional rotation for pumps.
- 3000 psi (3500 psi max. shock press.)
- 3000 rpm max. continuous speed-(Limited to the maximum speed per chart below)

### 40 SERIES

- 5/8 dia. shaft: 9 tooth spline or keyed
- SAE "A" 2-bolt mounting
- SAE #12 (3/4") o-ring ports on bi-rotational pumps and motors.
- SAE #16 (1") o-ring inlet with SAE #12 (3/4") o-ring outlet on single rotation pumps.

### 50 SERIES

- 7/8 dia. shaft: 13 tooth spline or keyed
- SAE "B" 2-bolt mounting.
- SAE #16 (1") o-ring ports on bi-rotational pumps and motors.
- SAE #24 (1 1/2") or SAE #20 (1 1/4") o-ring inlet with SAE #16 (1") o-ring outlet on single rotation pumps.

### 60 SERIES

- 1 1/4 dia. shaft: 14 tooth spline or keyed
- SAE "C" 2 & 4 bolt comb. mounting
- SAE #24 (1 1/2") o-ring ports on bi-rotational pumps and motors.
- 2" split flange inlet with 1 1/4" split flange outlet on single rotation pumps.

### PUMPS

MODEL NUMBER	DISP. CU. IN./REV.	THEO. FLOW RATE (GPM)				
		RPM				
		1000	1500	2000	2500	3000
40P005	0.50	1.7	2.6	3.5	4.3	5.2
40P007	0.75	2.8	4.1	5.5	6.9	8.3
40P010	1.00	3.7	5.5	7.4	9.2	11.0
40P012	1.25	4.9	7.3	9.7	12.1	14.6
40P015	1.50	5.8	8.8	11.7	14.6	17.5
40P018	1.80	7.0	10.5	14.0	17.5	—
50P015	1.52	5.9	8.8	11.8	14.6	17.8
50P019	1.95	7.6	11.4	15.2	19.0	22.8
50P023	2.32	9.0	13.6	18.1	22.6	27.1
50P027	2.74	10.7	16.0	21.4	26.7	32.0
50P033	3.30	12.9	19.3	25.7	32.1	38.6
50P038	3.80	14.8	22.2	29.6	37.0	—
50P052	5.20	20.3	30.4	40.6	—	—
60P040	4.05	15.8	23.7	31.6	39.4	47.3
60P051	5.15	20.1	30.1	40.1	50.2	60.2
60P061	6.15	24.0	36.0	47.9	59.9	71.8
60P071	7.15	27.9	41.8	55.7	69.6	83.6
60P081	8.15	31.8	47.6	63.5	79.4	—
60P092	9.25	36.0	54.1	72.1	90.1	—

### MOTORS

MODEL NUMBER	DISP. CU. IN./REV.	THEO. OUTPUT TORQUE (IN LBS.)				
		PSI				
		1000	1500	2000	2500	3000
40M005	0.50	64	96	127	159	191
40M007	0.75	96	143	191	239	287
40M010	1.00	127	191	255	318	382
40M012	1.25	159	239	318	398	478
40M015	1.50	191	287	382	478	573
40M018	1.80	229	344	459	573	688
50M015	1.52	194	290	387	484	581
50M019	1.95	248	373	497	621	745
50M023	2.32	296	443	591	739	887
50M027	2.74	349	524	698	873	1047
50M033	3.30	420	631	841	1051	1261
50M038	3.80	484	726	968	1210	1452
50M052	5.20	662	994	1325	1657	1987
60M040	4.05	516	774	1032	1290	1548
60M051	5.15	656	984	1312	1640	1968
60M061	6.15	783	1175	1567	1959	2350
60M071	7.15	911	1366	1822	2278	2732
60M081	8.15	1038	1557	2076	2596	3115
60M092	9.25	1178	1768	2357	2946	3535

(Shaded area indicates that single rotation pump with large inlet is required.)

\*See CROSS FM GPM9 for recommended installations. Premium quality anti-wear type oil with a viscosity between 100 and 200 SSU at operating temperatures is recommended. Do not use synthetic fluids. No liability or warranty is assumed for applications using fluids not meeting recommended specifications.



# PUMPS AND MOTORS

## 50T SERIES



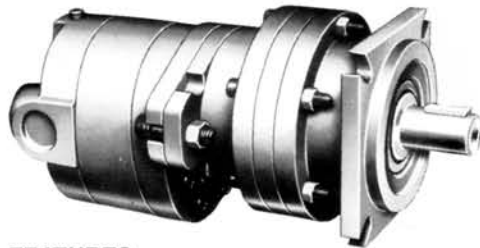
### FEATURES:

- 3000 psi system pressure (2700 psi on 50T038, 2000 psi on 50T052 at full flows)
- Mounting hole for torque arm attachment.
- SAE #20 (1 1/2") o-ring port inlet.
- SAE #16 (1") o-ring port outlet.
- All units left hand rotation.
- Side port location.

The CROSS series 50T pumps are designed to be driven by a 540 rpm PTO and provides a 3:1 speed increase for the pump to provide flow for a variety of farm applications: for example front end loaders, augers and wing fold implements. The thru-type 6 spline internal shaft permits the use of a stub shaft PTO driven accessory which simultaneously drives the pump.

MODEL NUMBER	EFFECTIVE DISPLACEMENT CU.IN./REV.	THEORETICAL FLOW RATE @ 540 RPM
50T015	4.6	9.6 GPM
50T019	5.9	12.3 GPM
50T023	7.0	14.6 GPM
50T027	8.2	17.3 GPM
50T033	9.9	20.8 GPM
50T038	11.4	24.0 GPM
50T052	15.6	32.8 GPM

## 50G SERIES



### FEATURES:

- 3000 psi (3500 psi max. shock pressure).
- SAE #16 (1") o-ring ports.
- Tapered roller bearings.
- Two pressure balanced loading plates.
- Hi-pressure dual-lip shaft seal.
- External drain, motor (1/4" NPTF).
- Dual rotation.
- 1 1/2" dia. keyed output standard.

The CROSS 50G high torque hydraulic motors combine the standard CROSS 50 series motors with a highly efficient 5.33:1 planetary gear reduction unit. These units provide high torque at low speed with excellent starting and running torque characteristics. They are particularly suited to winch and wheel drive applications.

MODEL NUMBER	THEORETICAL OUTPUT TORQUE/PSI				
	1000	1500	2000	2500	3000
50G081	1032	1548	2064	2580	3096
50G0104	1324	1986	2648	3310	3972
50G0124	1575	2363	3150	3938	4726
50G0146	1860	2791	3721	4651	5581
50G0176	2241	3361	4481	5602	6722
50G0203	2580	3870	5160	6450	7740
50G0277	3531	5296	7061	—	—

Gear box assembly only: (SAE B mounting, 7/8" dia. 13 tooth female input)

5P0020-069 1 1/4" dia. 14 tooth output

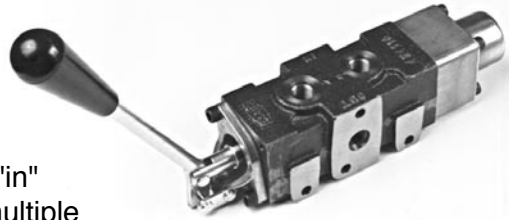
5P0020-073 1 1/4" dia. keyed output



# DIRECTIONAL CONTROL VALVES

## SS SERIES Sectional

This valve offers unique versatility in a compact, yet rugged valve with extremely low leakage and exceptional load holding capability. Each section incorporates threaded "in" and "out" ports so it may be utilized alone ... or stacked for multiple functions. It is large enough to accommodate quick disconnect fittings in the ports and an inlet relief section may be added when required. The SS is ideally suited to the landscape grooming and lawn and garden industries as well as the expanding mobile market.



### FEATURES:

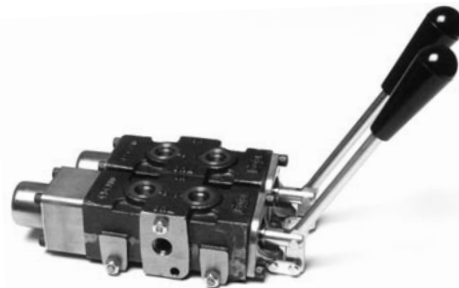
- 3500 PSI operating pressure
- Open (tandem) center
- 9/16-18 (SAE #6) inlet, outlet and work ports
- Outlet may be used to run other valves downstream (*Contact CROSS for guidelines*)
- Load checks to prevent reverse flow when shifting out of neutral in lifting applications
- Optional single handle actuator with protective boot
- 7 GPM flow rating
- Series operation

FUNCTION	STK. #	DESCRIPTION
Inlet section, 9/16-18 side port (without relief cartridge)		1V3531
Body Section, 4-way, 3-position, spring centered	170000	SS1AA0
Body Section, 4-way, 4-position, spring centered w/ float	170500	SSAXA0
Body Section, 4-way, 3-position, spring centered, SC*	170099	SSC1AA0*
Adjustable relief cartridge, 500-1500 psi		1R0134
Adjustable relief cartridge, 1500-3000 psi		1R0135
Adjustable relief cartridge, 3000-4000 psi		1R0136



\* SSC must be specified for the last section in a stack when Inlet Relief section is used. For tie rods, tie rod nuts, and required o-rings, see SS Series parts or price sheet.

Additional spool and actuator options are available:  
request CROSS Form VSS.



## PRE-ASSEMBLED UNITS

FUNCTION	DESCRIPTION	STK. #
SS 1 SPOOL, Adjustable Relief set at 2000, 4-way, 3-pos. Spring Centering, Standard ports and handles	SS001	170704
SS 2 SPOOL (Standard with features as above)	SS002	170705
SS 3 SPOOL, (Standard with features as above)	SS003	170706
SS 4 SPOOL, (Standard with features as above)	SS004	170707
SS 5 SPOOL, (Standard with features as above)	SS005	170708
SS 2 SPOOL, Adjustable Relief set at 2000, 4-way, 4-pos. Float on 1st spool, 4-way, 3-pos. Spring Centering on 2nd spool, Standard ports and handles	SS002	170710



# HYDRAULIC VALVES

## DIRECTIONAL CONTROL VALVES

### SBA, SBA-ORB, SBS Series

The **CROSS SBA series** is a 3-pos., 4-way valve in 1,2 or 3 spool versions with float available. The SBA series features NPTF ports and the SBA-ORB has SAE (ORB) ports. The SBS series has 12 volt solenoid (3-position,4-way). Fully balanced select-fit honed spools with excellent metering characteristics give maximum load holding capability and long life.



#### FEATURES:

- 2500 PSI operating pressure for SBA
- 3000 PSI operating pressure for SBS & SBA-ORB
- 30 GPM flow rate
- SBA: 3/4" NPTF in and out, 1/2" NPTF work ports
- SBA-ORB & SBS: SAE ports, 1 1/16-12 in & out, 3/4-16 work
- Adjustable built-in relief set at 2000 psi
- Spring centered, open and closed center available
- Built-in load checks for lifting
- Field conversion kits:
  - 1V0208 Power Beyond Sleeve (3/4" NPTF)
  - 1V0249 Power Beyond Sleeve (1 1/16-12 SAE)
  - 1V2015 Closed Center Kit (contains 1V0206 & 1R0035)
  - 1V1626 Heavy Duty Handle Assembly
  - 1V1485-02 Single Handle Actuator for 2 & 3 spool models

Model Number		Description	Wt.
Open Center	Closed Center		
SBA2*, SBA2-ORB*	SBA2-CC*, SBA2-CC-ORB*	Single spool, 3-pos.,4way	13
SBA22*, SBA22-ORB*	SBA22-CC*, SBA22-CC-ORB*	Double spool, 3-pos.,4way	21
SBA222*, SBA222-ORB*	SBA222-CC* SBA222-CC-ORB*	Triple spool, 3-pos.,4way,	33
SBS2*		Single spool, 3-pos.,4way, 12 volt	13
SBS22*		Double spool, 3-pos.,4way, 12 volt	21
SBS222*		Triple spool, 3-pos.,4way, 12 volt	33
SBAF2**, SBAF2-ORB**	SBAF2-CC**, SBAF2-CC-ORB**	Double spool, 1st spool 4-pos. float, 2nd spool 3-pos.	21
SBAF2J**, SBAF2J-ORB**	SBAF2J-CC-ORB**	Double spool, 1st spool 4-pos. float, 2nd spool 3-pos., with Joystick	21
SBAF22**, SBAF22-ORB**	SBAF22-CC**, SBAF22-CC-ORB**	Triple spool, 1st spool 4-pos. float, 2nd & 3rd spool 3-pos.	33

#### Applications:

\* For operating double-acting cylinders or a reversible hydraulic motor.

\*\* Float position allows a loader, snow plow or dozer blade to ride the contours of the ground as the machine moves forward.

## FLOW CONTROL VALVE

### SBC2S SBC2S-ORB



The **CROSS SBC2S, SBC2S-ORB series** is a manually adjustable, pressure compensated, priority-type Flow Divider with pressure relief. It provides accurate speed and directional control of motors and cylinders or will operate two separate systems from one pump.

#### FEATURES:

- 2500 PSI operating pressure
- 25 GPM flow rate
- Output volume adj. 0 to 25 GPM

MODEL NUMBER	DESCRIPTION	IN/OUT PORTS	WORK PORTS	WEIGHT (LBS)
SBC2S	Single spool Flow Divider	3/4" NPTF	1/2" NPTF	19
SBC2S-ORB	Single spool Flow Divider	1 1/16-12 SAE	3/4-16 SAE	19



# HYDRAULIC VALVES

## SDV

## LOADER VALVE



The **CROSS DV series** directional control loader valve offers extremely low leakage with outstanding load-holding capability in a compact, space saving model. All ports come out the same surface of the valve and it will fit in a space less than 6 inches wide. Float and regen capabilities, load checks, built-in power beyond and single handle actuator (or std. handles) make this valve ideally suited for the mobile loader market.

### FEATURES:

- 3000 psi operating pressure
- Rated flow capacity 8-10 gpm, 15 gpm
- Parallel operation
- Excellent spool metering
- Integral load check
- Adj. integral differential poppet type relief
- 3/4 -16 (SAE #8) inlet, outlet and pwr. byd.
- 3/4 -16 (SAE #8) work ports
- Built-in power beyond capability
- Single handle actuator ass'y. w/rubber boot or standard handles
- Weight 16 lbs.

MODEL NUMBER (JOYSTICK)	MODEL NUMBER (STANDARD HANDLES)	SIZE	DESCRIPTION	ALL PORTS
SDV10FRJ	SDV10FRH	10 GPM	Double spool, 1st Spool 4-pos. Float w/ Regen 2nd spool	3/4-16 SAE
SDV15FRJ	SDV15FRH	15 GPM	Double spool, 1st Spool 4-pos. Float w/ Regen 2nd spool	3/4-16 SAE
SDV10F2J	SDV10F2H	10 GPM	Double spool, 1st Spool 4-pos. Float w/4-way, 3-pos. 2nd spool	3/4-16 SAE
SDV15F2J	SDV15F2H	15 GPM	Double spool, 1st Spool 4-pos. Float w/4-way, 3-pos. 2nd spool	3/4-16 SAE

## SA SERIES



The **CROSS SA series** directional valve offers differential style relief, load checks and excellent metering in a compact, economical model with parallel flow paths.

### FEATURES:

- 3000 psi operating pressure
- 15 GPM flow rate
- 7/8-14 (SAE #10) inlet and outlet
- 3/4-16 (SAE #8) work ports
- Adj. built-in relief valve, set at 2000 psi
- Parallel operation
- Load holding cylinder port check valves
- Built-in power beyond capability
- Field conversion kits part numbers:
  - 1V2566 - Pwr. byd. sleeve (7/8-14, SAE#10)
  - 1V2572 - Closed center plug
  - 1R0035 - No relief plug for closed ctr.
  - 1V2682 - 2 pos.w/ spr. ctr manual detent kit
  - 1V2683 - 3 pos. manual detent kit

MODEL NUMBER	DESCRIPTION	WEIGHT (LBS)
SA2*	Single spool 3-position, 4 -way	8
SA22*	Double spool 3-position, 4 -way	10
SAF2**	Double spool 1st spool 4-position float, 2nd spool 3-position	10

### Applications:

- \* For operating double-acting cylinders or a reversible hyd. motor.
- \*\* Float position allows a loader, snow plow or dozer blade to ride the contours of the ground as the machine moves forward.

(see AD Valve specifications in CROSS master catalog for additional options)

## CONVERTA (SCV-1)



The **CROSS CONVERTA** can be easily converted to a 3 way valve by using the conversion and port pipe plug supplied with the valve. It can also be converted to a 3-position manual detent valve by ordering a separate detent kit: part # 1V0294.

This valve may be used to operate a double or single acting cylinder, or a reversible or single direction motor when a hold position in neutral is required.

### FEATURES:

- 3 position, 4 way - convertible to 3 position, 3 way
- Open center (only), spring centered to neutral
- 2000 psi maximum operating pressure
- 25 GPM flow rate
- 3/4" NPTF inlet and outlet ports
- 1/2" NPTF work ports
- Built-in relief valve (preset at 2000 psi)
- Weight 9 lbs.

### NOTES:

- Not intended for use in metered lifting circuits.
- Not convertible to pressure kickout.
- Never use a manual detent in a logsplitter application.





# HYDRAULIC VALVES

## SCA2 SCA2-ORB



### ECONOMY VALVE

The **CROSS SCA2, SCA2-ORB** series is a rugged and dependable low cost valve. It is a series type, and is recommended for all general purpose applications except lifting heavy loads in a vertical position. It will operate a double acting cylinder or a bi-directional motor required to hold a load in neutral.

#### FEATURES:

- Open center, spring centered
- 30 GPM flow rate
- Low leakage spool
- SCA2 - 1500 psi fixed relief
- SCA2-ORB - 2000 psi fixed relief

MODEL NUMBER	DESCRIPTION	IN/OUT PORTS	WORK PORTS	WEIGHT (LBS)
SCA2	Single spool 3-position, 4-way	3/4" NPTF	1/2" NPTF	9
SCA2-ORB	Single spool 3-position, 4-way	1 1/16-12 SAE	3/4-16 SAE	9

## SCD2E SCD2E-ORB SCD2E-CC-ORB



### LOGSPLITTER VALVE

The **CROSS SCD2E, SCD2E-ORB** and **SCD2E-CC-ORB** series features manual control in the forward position with pressure kickout to return handle to neutral automatically at the end of the return stroke. It is offered in both open center and closed center versions. (See table below.) Ideal for logsplitters.

#### FEATURES:

- 30 GPM flow rate
- SCD2E, SCD2E-ORB - open center - 2000 psi fixed relief
- SCD2E-CC-ORB - closed center - no relief

MODEL NUMBER	DESCRIPTION	IN/OUT PORTS	WORK PORTS	WEIGHT (LBS)
SCD2E	Single spool, 3-position, 4-way (open center) pressure release detent in	3/4" NPTF	1/2" NPTF	9
SCD2E - ORB	Single spool, 3-position, 4-way (open center) pressure release detent in	1 1/16-12 SAE	3/4-16 SAE	9
SCD2E-CC -ORB	Single spool, 3-position, 4-way (closed center) pressure release detent in	1 1/16-12 SAE	3/4-16 SAE	9

## SQV



### SEQUENCE VALVE

The **CROSS SQV series** valve is a 2-position, 3 port valve designed to alternately operate a pair of agricultural guide marker cylinders. May be used with single acting or double acting marker cylinders.

#### FEATURES:

- 2500 psi operating pressure (3000 psi maximum surge)
- 3/4-16 (SAE#8) ports
- 2 position, 3 ported
- Rugged construction

MODEL NUMBER	RATED GPM	PORT SIZE (SAE)	WEIGHT (LBS)
SQV	2	3/4-16 SAE	6



# SELECTOR VALVES

## SVS SERIES



### FEATURES:

- 2500 psi operating pressure for SVS2 & SVS4
- 3000 psi operating pressure for SVS2-ORB & SVS4-ORB
- Knob actuator
- Hard chrome plated spool

The **CROSS SVS series** selector valves are 2-position, 3 port units designed for maximum performance at an economical price. These valves can be used for uni-directional cylinder and motor control or for selecting one of two circuits from a single pump.

### SVS4 & SVS4-ORB OPTIONAL FIELD KITS

MODEL NUMBER	RATED GPM	PORT SIZE	WEIGHT (LBS)
SVS2	20	1/2" NPTF	2 1/4
SVS2-ORB	20	3/4-16, SAE#8	2 1/4
SVS4	40	3/4" NPTF	6
SVS4-ORB	40	1 1/16-12, SAE #12	6

DESCRIPTION	PART#
Knob	1A0768
Clevis Adapter	1V0930
Handle Adapter	1V0931
Spring Return Ass'y.	1V0932
Two-position detent	1V0934

## SSD4 SERIES



### FEATURES:

- SSD4: 2500 psi operating pressure, 1" NPTF ports
- SSD4-ORB: 4500 psi operating pressure, 1 5/16-12, SAE#16 SAE ports
- Complete handle assembly
- Weight: 9 lbs.

The **CROSS SSD4 series** selector valves are 6 way, 2-position units with cast-in metering notches for smooth operation. They provide an economical way of diverting flow to two separate hydraulic circuits.

### OPTIONAL FIELD CONVERSION KITS

DESCRIPTION	PART#
Knob	1A0768
Clevis Adapter	1V0930
Handle Adapter	1V0931
Spring Return Assembly.	1V0932
Two-position detent	1V0934



# RELIEF VALVES

## SRC SERIES



### FEATURES:

- 500 to 3000 psi adjustment range
- 30 gpm flow rating
- Weight: 4 lbs.

The **CROSS SRC series** dual differential type relief valves are used to protect equal size cylinders or motors from external or shock loads. Oil which passes from one relief valve flows directly to the opposite side of the circuit, thus preventing cavitation. The swing circuit on a backhoe is a good application example.

MODEL NUMBER	DESCRIPTION	PORT SIZE
SRCL	500 to 1500 psi range, set at 1000 psi	3/4" NPTF
SRCH	1500 to 3000 psi range, set at 2000 psi	3/4" NPTF
SRCL-ORB	500 to 1500 psi range, set at 1000 psi	1 1/16-12, SAE #12
SRCH-ORB	1500 to 3000 psi range, set at 2000 psi	1 1/16-12, SAE #12

## SRD SERIES



### FEATURES:

- 500 to 3000 psi adjustment range
- 30 gpm flow rating
- Weight: 2 1/2 lbs.

The **CROSS SRD series** differential type adjustable relief valves provide long life and smooth performance at an economical price. This valve is used to protect pumps from damage due to over-pressurization.

MODEL NUMBER	DESCRIPTION	PORT SIZE
SRDL	500 to 1500 psi range, set at 1000 psi	3/4" NPTF
SRDH	1500 to 3000 psi range, set at 2000 psi	3/4" NPTF
SRDL-ORB	500 to 1500 psi range, set at 1000 psi	1 1/16-12, SAE #12
SRDH-ORB	1500 to 3000 psi range, set at 2000 psi	1 1/16-12, SAE #12



# TIE ROD CYLINDERS

NPTF PORTING

## DB SERIES



CROSS DB cylinders provide long life and reliable operation due to superior design features and quality workmanship.

### FEATURES:

- 2500 psi working pressure (4000 psi max shock)
- 1500 psi on 4" bore, 1000 psi on 5" bore with std. pins
- Precision skived and burnished barrel for long seal life
- Hardened chrome plated rods resist damage and rust
- Double lipped polyurethane rod seal for less leakage
- Rod wipers clean dirt from rod to give long seal life
- Clevis mounting with 1" pin holes
- Ports in line with pins

MODEL NUMBER	BORE (INCH)	STROKE (INCH)	CL. CTR. (INCH)	ROD DIA. (INCH)	PORT SIZE (NPTF)	WEIGHT (LBS.)	MODEL NUMBER	BORE (INCH)	STROKE (INCH)	CL. CTR. (INCH)	ROD DIA. (INCH)	PORT SIZE (NPTF)	WEIGHT (LBS.)
204 DB		4	14.25			16	3504 DB		4	14.25			22
206 DB		6	16.25			17	3506 DB		6	16.25			25
208 DB		8	18.25			19	3508 DB		8	18.25	1 1/4		28
210 DB		10	20.25			20	3510 DB		10	20.25			31
212 DB		12	22.25			21	3512 DB		12	22.25			34
214 DB		14	24.25			22	3514 DB		14	24.25			37
216 DB	2	16	26.25	1 1/16		24	3516 DB*		16	26.25			39
218 DB		18	28.25			25	3518 DB		18	28.25			41
220 DB		20	30.25			26	3520 DB	3 1/2	20	30.25			43
222 DB*		22	32.25			28	3522 DB		22	32.25			46
224 DB*		24	34.25			29	3524 DB		24	34.25			49
226 DB*		26	36.25			30	3526 DB*		26	36.25	1 1/2		52
228 DB*		28	38.25			32	3528 DB*		28	38.25			54
230 DB*		30	40.25			34	3530 DB*		30	40.25			56
2504 DB		4	14.25			16	3532 DB*		32	42.25			58
2506 DB		6	16.25			18	3534 DB*		34	44.25			60
2508 DB		8	18.25			20	3536 DB*		36	46.25			62
2510 DB		10	20.25			22	404 DB		4	14.62		1/2	29
2512 DB		12	22.25			23	406 DB		6	16.62	1 1/4		33
2514 DB		14	24.25			25	408 DB		8	18.62			36
2516 DB*		16	26.25			27	410 DB		10	20.62			40
2518 DB		18	28.25			29	412 DB		12	22.62			44
2520 DB		20	30.25			30	414 DB*		14	24.62			47
2522 DB	2 1/2	22	32.25			32	416 DB*		16	26.62			51
2524 DB*		24	34.25			34	418 DB*		18	28.62			55
2526 DB*		26	36.25			36	420 DB*		20	30.62	1 1/2		58
2528 DB*		28	38.25			38	422 DB*		22	32.62			65
2530 DB*		30	40.25			39	424 DB*	4	24	34.62			71
2532 DB*		32	42.25			41	426 DB		26	36.62			73
2534 DB*		34	44.25			43	428 DB		28	38.62			75
2536 DB*		36	46.25			45	430 DB		30	40.62			77
304 DB		4	14.25	1 1/4		19	432 DB		32	42.62			80
306 DB		6	16.25			21	434 DB		34	44.62			84
308 DB		8	18.25			23	436 DB		36	46.62	2		88
310 DB		10	20.25			25	438 DB*		38	48.62			92
312 DB		12	22.25			27	440 DB*		40	50.62			96
314 DB		14	24.25			29	442 DB*		42	52.62			100
316 DB		16	26.25			31	444 DB*		44	54.62			123
318 DB	3	18	28.25			33	446 DB*		46	56.62			127
320 DB*		20	30.25			35	448 DB*		48	58.62			131
322 DB*		22	32.25			37	508 DB		8	20.25			65
324 DB		24	34.25			39	510 DB		10	22.25	1 1/2		71
326 DB		26	36.25			41	512 DB		12	24.25			88
328 DB		28	38.25			43	516 DB	5	16	28.25			93
330 DB*		30	40.25			45	520 DB		20	32.25			98
332 DB*		32	42.25			47	524 DB		24	36.25	2		108
334 DB*		34	44.25			49	530 DB		30	42.25			126
336 DB*		36	46.25			51							

\* These cylinders are rated for 2500 psi service but the safe operating pressure is greatly reduced due to rod buckling considerations when cylinders are operated in the push mode. Please contact CROSS Engineering for recommendations.

## DB - ASAE SERIES

CROSS DB-ASAE cylinders are the same as the DB units except longer closed center dimensions for use where ASAE cylinders are required. See above for features.



## DU - ASAE SERIES

CROSS DU-ASAE are like the DB-ASAE except rod extension is threaded for mechanical depth control.

MODEL NUMBER	BORE DIA. (INCH)	STROKE (INCH)	CLOSED CTR LGTH (INCH)	ROD DIA. (INCH)	PORT SIZE (NPTF)	CLEVIS PIN DIA. (INCH)	WEIGHT (LBS.)
208DB-ASAE	2			1 1/16	3/8		18
2508DB-ASAE	2 1/2						20
308DB-ASAE	3	8	20 1/4	1 1/4		1	24
3508DB-ASAE	3 1/2				1/2		30
408DB-ASAE	4						37
508DB	5			1 1/2			66
316DB-ASAE	3			1 1/4			35
3516DB-ASAE	3 1/2	16	31 1/2	1 1/2	1/2	1 1/4	51
416DB-ASAE	4			2			65
516DB-ASAE	5						88

**THIS CHART ALSO APPLICABLE TO DU-ASAE CYLINDERS.**

CROSS CYLINDERS are available in a wide variety of sizes and types in addition to the stock cylinders shown in this brochure.

# CROSS TIE ROD CYLINDERS

## DE - ASAE SERIES



CROSS DE-ASAE cylinders are the same as the DB-ASAE cylinders except threaded rod extension with a mechanical depth stop.

**FEATURES:** see DB series

MODEL NUMBER	BORE DIA. (INCH)	STROKE (INCH)	CLOSED CTR LGTH (INCH)	ROD DIA. (INCH)	PORT SIZE (NPTF)	CLEVIS PIN DIA. (INCH)	WEIGHT (LBS.)
208DE-ASAE	2	8	20 1/4	1 1/16	3/8	1	20
2508DE-ASAE	2 1/2			*			21
308DE-ASAE	3			1 1/4	25		
3508DE-ASAE	3 1/2			**	33		
408DE-ASAE	4			1/2	44		

Mechanical depth control collars:

\* 1E6000-1 (1 1/16-12 thread)

\* 1E6001-1 (1 1/4-12 thread)

## DC SERIES



**FEATURES:**

- Hydraulic depth control
- 2500 psi working pressure (4000 psi max shock)
- Precision skived and burnished barrel for long seal life
- Hardened chrome plated rods resist damage and rust
- Double lipped polyurethane rod seal for less leakage
- Clevis mounting • Top ported

MODEL NUMBER	BORE DIA. (INCH)	STROKE (INCH)	CLOSED CTR LGTH (INCH)	ROD DIA. (INCH)	PORT SIZE	CLEVIS PIN DIA. (INCH)	WEIGHT (LBS.)
308DC	3	8	20 1/4	1 1/4	1/2 NPTF	1	31
3508DC	3 1/2			36			
408DC	4			45			
508DC	5			71			
316DC	3	16	31 1/2	1 1/4	1/2 NPTF	1 1/4	40
3516DC	3 1/2			62			
416DC	4			71			
516DC	5			90			
408DC-ORB	4	8	20 1/4	1 1/4	3/4-16	1	45
416DC-ORB	4	16	31 1/2	1 3/4	3/4-16	1 1/4	90

# CROSS REPHASING CYLINDERS

## DCR SERIES



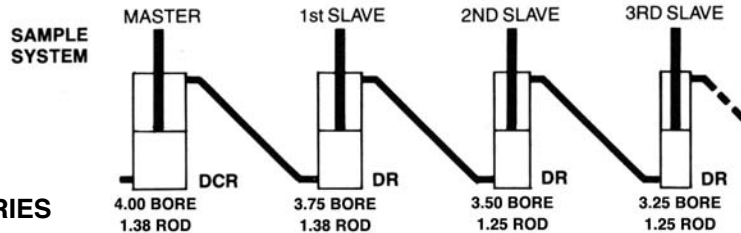
## DR SERIES



DCR and DR cylinders in an internal bypass for synchronizing rephasing cylinders in a series circuit. The DCR also features hydraulic depth control with adjustment from 0 to 8" stroke for use as a master cylinder. All cylinders are plumbed in series as shown in the sample system. Bores and rod diameters are volumetrically matched so that all cylinders rods move equally when stroked. At the end of each stroke, the system is resynchronized through the internal bypass in each cylinder.

**FEATURES:**

- 2500 psi working pressure (4000 psi max shock)
- Precision skived and burnished barrel for long seal life
- Hardened chrome plated rods resist damage and rust
- Double lipped polyurethane rod seal for less leakage
- Clevis mounting
- Top porting on DCR
- Ports in line with pins on DR



## DCR SERIES

MODEL NUMBER	BORE DIA. (INCH)	STROKE (INCH)	CLOSED CTR LGTH (INCH)	ROD DIA. (INCH)	PORT SIZE (SAE)	CLEVIS PIN DIA. (INCH)	WEIGHT (LBS.)
3508DCR	3 1/2	8	20 1/4	1 1/4	3/4-16	1	36
408DCR	4			1 3/8		45	
508DCR	5			1 1/2		67	

## DR SERIES

MODEL NUMBER	BORE DIA. (INCH)	STROKE (INCH)	CLOSED CTR LGTH (INCH)	ROD DIA. (INCH)	PORT SIZE (SAE)	CLEVIS PIN DIA. (INCH)	WEIGHT (LBS.)
308DR	3	8	20 1/4	1 1/4	3/4-16	1	24
32508DR	3 1/4						27
3508DR	3 1/2						30
37508DR	3 3/4						34
408DR	4			1 3/8		37	
42508DR	4 1/4			45			
4508DR	4 1/2			52			
47508DR	4 3/4			1 1/2		59	
508DR	5	66					

REPHASING CYLINDERS ARE WIDELY USED ON FOLDING TILLAGE TOOL IMPLEMENTS.



# TIE ROD CYLINDERS



## DB SERIES - ORB



CROSS DB - ORB cylinders provide CROSS proven durability. ORB (SAE) ports assure superior sealing and minimizes port damage due to overtorquing.

### FEATURES:

- 2500 psi working pressure (4000 psi max shock)
- 1500 psi on 4" bore, 1000 psi on 5" bore with std. pins
- Precision skived and burnished barrel for long seal life
- Hardened chrome plated rods resist damage and rust
- Double lipped polyurethane rod seal for less leakage
- Rod wipers clean dirt from rod to give long seal life
- Clevis mounting with 1" pin holes
- Ports in line with pins

MODEL NUMBER	BORE (INCH)	STROKE (INCH)	CL.CTR. (INCH)	ROD DIA. (INCH)	PORT SIZE (INCH)	LBS.	MODEL NUMBER	BORE (INCH)	STROKE (INCH)	CL.CTR. (INCH)	ROD DIA. (INCH)	PORT SIZE (INCH)	LBS.					
204 DB-ORB	2	4	14.25	1.06	9/16-18	16	3504 DB-ORB	3 1/2	4	14.25	1.25	3/4-16	22					
206 DB-ORB		6	16.25			3506 DB-ORB	6		16.25	25								
208 DB-ORB		8	18.25			3508 DB-ORB	8		18.25	28								
210 DB-ORB		10	20.25			3510 DB-ORB	10		20.25	31								
212 DB-ORB		12	22.25			3512 DB-ORB	12		22.25	34								
214 DB-ORB		14	24.25			3514 DB-ORB	14		24.25	37								
216 DB-ORB		16	26.25			3516 DB-ORB	16		26.25	39								
218 DB-ORB		18	28.25			3518 DB-ORB	18		28.25	41								
220 DB-ORB		20	30.25			3520 DB-ORB	20		30.25	43								
224 DB-ORB		24	34.25			3524 DB-ORB	24		34.25	49								
230 DB-ORB	30	40.25	3530 DB-ORB	30	40.25	56												
2504 DB-ORB	2 1/2	4	14.25	1.06	9/16-18	16	3536 DB-ORB	4	4	14.25	1.25	3/4-16	29					
2506 DB-ORB		6	16.25			404 DB-ORB	6		16.25	33								
2508 DB-ORB		8	18.25			406 DB-ORB	8		18.25	36								
2510 DB-ORB		10	20.25			408 DB-ORB	10		20.25	40								
2512 DB-ORB		12	22.25			410 DB-ORB	12		22.25	44								
2514 DB-ORB		14	24.25			412 DB-ORB	14		24.25	47								
2516 DB-ORB		16	26.25			414 DB-ORB	16		26.25	51								
2518 DB-ORB		18	28.25			416 DB-ORB	18		28.25	55								
2520 DB-ORB		20	30.25			418 DB-ORB	20		30.25	58								
2524 DB-ORB		24	34.25			420 DB-ORB	24		34.25	65								
2530 DB-ORB	30	40.25	424 DB-ORB	30	40.25	77												
2536 DB-ORB	36	46.25	436 DB-ORB	36	46.25	92												
304 DB-ORB	3	4	14.25	1.25	3/4-16	19	448 DB-ORB	5	8	20.25	2.00	3/4-16	65					
306 DB-ORB		6	16.25			508 DB-ORB**	10		22.25	71								
308 DB-ORB		8	18.25			512 DB-ORB**	12		24.25	88								
310 DB-ORB		10	20.25			516 DB-ORB**	16		28.25	93								
312 DB-ORB		12	22.25			520 DB-ORB**	20		32.25	98								
314 DB-ORB		14	24.25			524 DB-ORB**	24		36.25	108								
316 DB-ORB		16	26.25			530 DB-ORB**	30		42.25	126								
318 DB-ORB		18	28.25															
320 DB-ORB		20	30.25															
324 DB-ORB		24	34.25															
330 DB-ORB	30	40.25	1.50															
336 DB-ORB	36	46.25																

\* These cylinders are rated for 2500 psi service but the safe operating pressure is greatly reduced due to rod buckling considerations when cylinders are operated in the push mode. Please contact CROSS Engineering for recommendations.

## DB - ASAE ORB SERIES

CROSS DB-ASAE ORB cylinders are the same as the DB - ORB units except longer closed center dimensions for use where ASAE cylinders are required. See above for features.

## DU - ASAE ORB SERIES

CROSS DU-ASAE ORB are like the DB-ASAE except rod extension is threaded for mech. depth control.

## DE - ASAE ORB SERIES

CROSS DU-ASAE ORB are like the DU-ASAE except mech. depth stop included. ( Part # 1E6001-1, 1 1/4-12 thread)

MODEL NUMBER	BORE (INCH)	STROKE (INCH)	CL.CTR. (INCH)	ROD DIA. (INCH)	PORT SIZE (INCH)	LBS.		
208 DB-ASAE ORB	2	8	20.25	1.06	9/16-18	18		
2508 DB-ASAE ORB	2 1/2		20.25			20		
308 DB-ASAE ORB	3		20.25			24		
3508 DB-ASAE ORB	3 1/2		20.25			30		
408 DB-ASAE ORB	4		20.25			37		
508 DB-ASAE ORB	5		20.25			66		
316 DB-ASAE ORB	3		31.50			1.25	3/4-16	35
3516 DB-ASAE ORB	3 1/2		31.50			1.50		51
416 DB-ASAE ORB	4		31.50			2.00		65
516 DB-ASAE ORB	5		31.50			2.00	88	

MODEL NUMBER	BORE (INCH)	STROKE (INCH)	CL.CTR. (INCH)	ROD DIA. (INCH)	PORT SIZE (INCH)	LBS.
308 DE-ORB	3	8	20.25	1.25	3/4-16	25
3508 DE-ORB	3 1/2	20.25	33			
408 DE-ORB	4	20.25	44			



# TIE ROD CYLINDERS



## DH SERIES

Designed for higher pressure systems, the DH features upgraded castings and heavy duty seals to assure peak performance and long and dependable service.

### FEATURES:

- 3000 psi working pressure - see chart
- SAE ports - 9/16-18 on 2" & 2 1/2" bore, 3/4-16 on 3" bore and up
- 1" pins — hardened steel on 3" bore & up

Description	Bore	Stroke	Rod Dia. *	Closed Center	**
208DH-ASAE	2	8	1.06	20.25	3000
210DH		10	1.06	20.25	3000
212DH		12	1.06	22.25	3000
214DH		14	1.06	24.25	3000
216DH		16	1.12	26.25	3000
218DH		18	1.12	28.25	3000
220DH		20	1.12	30.25	3000
224DH		24	1.12	34.25	2370
230DH		30	1.12	40.25	1630
2508DH-ASAE		2 1/2	8	1.25	20.25
2510DH	10		1.25	20.25	3000
2512DH	12		1.25	22.25	3000
2514DH	14		1.25	24.25	3000
2516DH	16		1.25	26.25	3000
2518DH	18		1.25	28.25	3000
2520DH	20		1.25	30.25	3000
2524DH	24		1.25	34.25	2320
2530DH	30		1.25	40.25	1590
308DH-ASAE	3		8	1.25	20.25
310DH		10	1.25	20.25	3000
312DH		12	1.25	22.25	3000
314DH		14	1.50	24.25	3000
316DH-ASAE		16	1.50	31.50	3000
318DH		18	1.50	28.25	3000
320DH		20	1.50	30.25	3000
324DH		24	1.50	34.25	2455
330DH		30	1.50	40.25	1691
336DH		36	1.50	46.25	1231
3508DH-ASAE	3 1/2	8	1.25	20.25	3000
3510DH		10	1.25	20.25	3000
3512DH		12	1.50	22.25	3000
3514DH		14	1.50	24.25	3000
3516DH-ASAE		16	1.50	31.50	3000
3518DH		18	1.50	28.25	3000
3520DH		20	1.75	30.25	3000
3524DH		24	1.75	34.25	3000
3530DH		30	1.75	40.25	2333
3536DH		36	1.75	46.25	1694
408DH-ASAE	4	8	1.25	20.25	3000
410DH		10	1.50	20.62	3000
412DH		12	1.50	22.62	3000
414DH		14	1.50	24.62	3000
416DH-ASAE		16	2.00	31.50	3000
418DH		18	2.00	28.62	3000
420DH		20	2.00	30.62	3000
424DH		24	2.00	34.62	3000
430DH		30	2.00	40.62	3000
436DH		36	2.00	46.62	2240

\* Piston rods are sized with a safety factor of 2.

\*\* Max. PSI at base port due to column buckling.



# WELDED CYLINDERS

## NU SERIES



CROSS NU series cylinders offer precision industrial quality in a standard welded cylinder. The NU features a welded base with a head assembly which permits easy replacement of seals with special tools. O-ring and backup piston seals are standard. For heavy duty applications we offer the NU with a special polyurethane u-cup piston design. (Specify HEAVY DUTY when ordering.)

### FEATURES:

- 2500 psi working pressure (3000 for HEAVY DUTY)
- Close tolerance tubes designed for long cylinder life
- Hardened chrome plated rods resist damage and rust
- Double lipped polyurethane rod seal for less leakage
- Rod wipers clean dirt from rod to give long seal life
- Clevis mounting with 1" pin holes on 2 1/2" thru 4" bore sizes, 1 1/4 on 5" bore
- Ports in line with pins
- 3/8" NPTF ports on 2" bore, 1/2" NPTF on 2 1/2" thru 4" bore, 3/4" NPTF on 5" bore size

\* These cylinders are rated for 2500 psi service but the safe operating pressure is greatly reduced due to rod buckling considerations when cylinders are operated in the push mode. Please contact CROSS Engineering for recommendations.

MODEL NUMBER	BORE DIA. (INCH)	STROKE (INCH)	CL. CENTERS (INCH)	ROD DIA. (INCH)	WEIGHT (LBS.)
208 NU		8	19.50		18
210 NU		10	21.50		20
212 NU		12	23.50		21
216 NU	2	16	27.50	1 1/4	24
220 NU*		20	31.50		27
224 NU*		24	35.50		30
2508 NU		8	19.50		20
2510 NU		10	21.50		22
2512 NU		12	23.50		23
2516 NU	2 1/2	16	27.50	1 1/4	26
2520 NU		20	31.50		29
2524 NU*		24	35.50		32
308 NU		8	19.25		23
310 NU		10	21.25		25
312 NU		12	23.25		27
316 NU	3	16	27.25	1 1/2	31
320 NU		20	31.25		35
324 NU		24	35.25		39
330 NU*		30	41.25		45
336 NU*		36	47.25		51
3508 NU		8	19.25		27
3510 NU		10	21.25		29
3512 NU		12	23.25		31
3516 NU	3 1/2	16	27.25	1 3/4	35
3520 NU		20	31.25		40
3524 NU		24	35.25		44
3530 NU		30	41.25		51
3536 NU*		36	47.25		58
408 NU		8	20.00		39
410 NU		10	22.00		43
412 NU		12	24.00		46
416 NU	4	16	28.00	2	54
418 NU		18	30.00		59
420 NU		20	32.00		61
424 NU		24	36.00		69
430 NU		30	42.00		79
436 NU		36	48.00		89
448 NU*		48	60.00		109
508 NU		8	20.00		68
510 NU		10	22.00		70
512 NU	5	12	24.00	2	74
516 NU		16	28.00		83
520 NU		20	32.00		93



# FILTERS

## SF SERIES



### FEATURES:

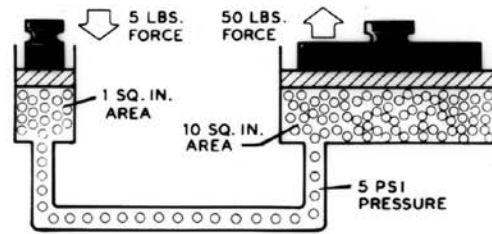
- 200 psi pressure rating
- Operating temp: -20 ° to +300 ° F
- Internal bypass pressure: 15 psi for return line applications
- 1A1699 replacement gauge

The CROSS SF series hydraulic filters feature spin-on, throw away type cartridges. SGF models also include the condition indicator. These units provide full flow efficiency up to the cracking pressure of the through-type bypass relief valve. Good filtration with regular element changes is essential to protect hydraulic components from damage due to contamination. Please see HYDRAULIC SAFETY SHEET (Page 18).

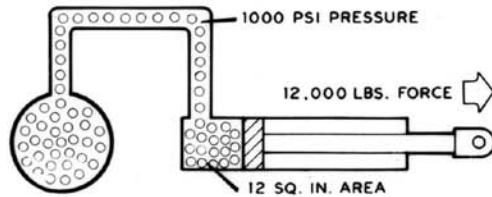
MODEL NUMBER	PORT SIZE (NPTF)	FILTRATION (MICRON)	RATED FLOW (GPM)	WEIGHT (LBS.)	REPLACEMENT ELEMENT PART NUMBER
SF1-10	3/4"	10	20	2	1A9021
SF1-25		25			1A9023
SF2-10	1 1/4"	10	60	6	1A9251
SF2-25		25			1A9253
SGF1-10	3/4"	10	20	2	1A9021
SGF1-25		25			1A9023
SGF2-10	1 1/4"	10	60	6	1A9251
SGF2-25		25			1A9253

# BASIC HYDRAULIC THEORY

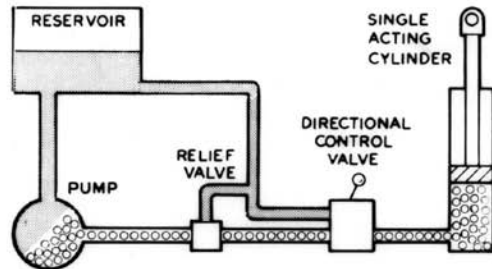
The basis for all hydraulic systems is expressed by Pascal's law which states that the pressure exerted anywhere upon an enclosed liquid is transmitted undiminished, in all directions, to the interior of the container. This principle allows large forces to be generated with relatively little effort. As illustrated, a 5 pound force exerted against a 1 inch square area creates an internal pressure of 5 psi. This pressure, acting against the 10 square inch area, develops 50 pounds of force.



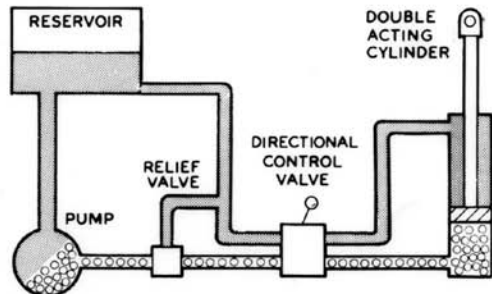
In a basic hydraulic circuit, the force exerted by a cylinder is dependent upon the cylinder bore size and the pump pressure. (There is no force generated unless there is resistance to the movement of the piston). With 1000 psi pump pressure exerted against a 12 square inch piston area (approximately 4" dia.), a force of 12,000 pounds is developed by the cylinder. The speed at which the piston will move is dependent upon the flow rate (gpm) from the pump and the cylinder area. Hence, if pump delivery is 1 gallon per minute (231 cu.in./min.) the cylinder piston will move at the rate of 20 in./min. (231 cu. in. ÷ 12 cu. in./min.).



The simplest hydraulic circuit consists of a reservoir, pump, relief valve, 3-way directional control valve, single acting cylinder, connectors and lines. This system is used where the cylinder piston is returned by mechanical force. With the control valve in neutral, pump flow passes through the valve and back to the reservoir. With the valve shifted, oil is directed to the piston side of the cylinder, causing the piston to move, extending the rod. If the valve is returned to neutral, the oil is trapped in the cylinder, holding it in a fixed position, while pump flow is returned to the reservoir. Shifting the valve in the opposite direction permits the oil to pass through the valve back to the reservoir. The relief valve limits the system pressure to a pre-set amount. Relief valves are commonly incorporated into the directional control valve.

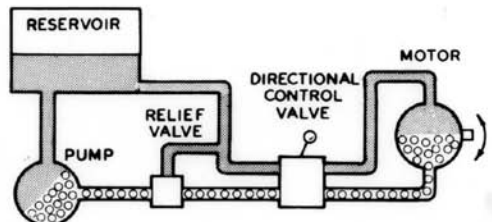


A hydraulic system using a double acting cylinder and a 4-way valve differs from the single acting cylinder system in that the cylinder can exert force in both directions. With the control valve in neutral, flow is returned to the reservoir. When shifted in one direction, oil is directed to the piston side of the cylinder, causing the cylinder to extend. Oil from the rod side passes through the valve back to the reservoir. If the valve is shifted to neutral, oil in the cylinder is trapped, holding it in a fixed position. When the valve is shifted in the opposite position, oil is directed to the rod side of the cylinder, causing the cylinder to retract. Oil from the piston side passes through the valve back to the reservoir.



Cylinder extend force is the result of the pressure (psi) times the piston area (minus any force resulting from the pressure acting against the rod side of the piston). Retract force is a result of the pressure (psi) times the area difference between the rod and the piston (minus any force resulting from pressure acting against the piston side of the cylinder).

Rotary hydraulic motor circuits are basically the same as cylinder circuits. Systems may be uni-directional or bi-directional (as shown). The amount of rotary force (torque) available from the motor is a function of pressure (psi) and motor size. Speed is a function of flow and motor size.



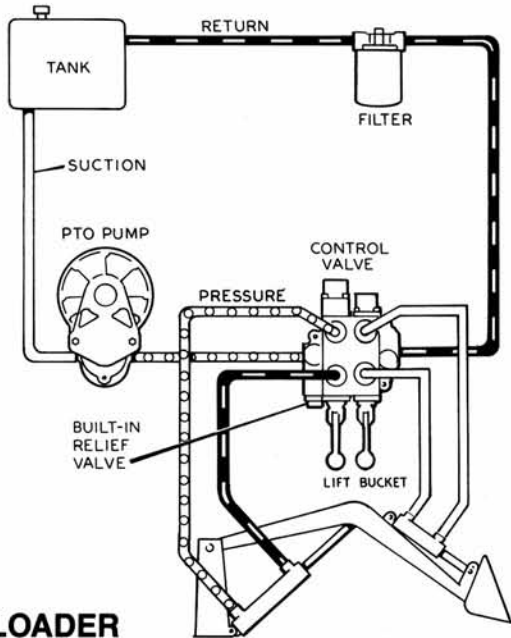
All of the systems described above are open center systems due to the oil flowing through the control valve back to the tank. Most systems are this type. Closed center systems use control valves with the inlet port blocked and variable displacement pumps. With the control valve in neutral, the pump is "de-stroked" to zero flow.



# TERMINOLOGY

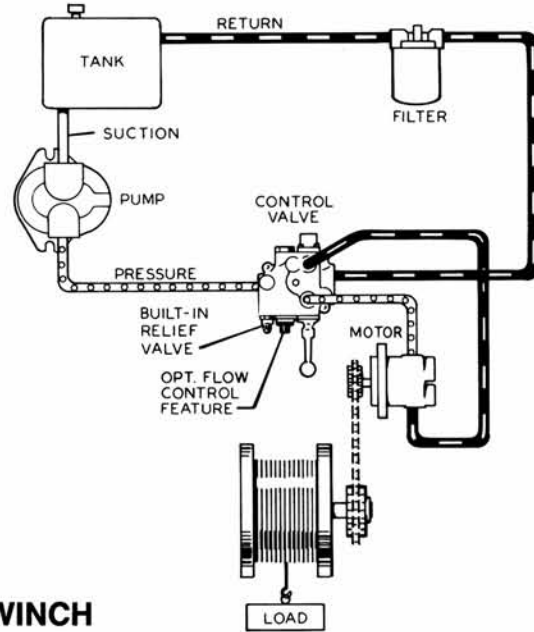
- ACCUMULATOR:** A container which stores fluid under pressure. Used as an energy source or to absorb hydraulic shock. Common types are piston, bladder and diaphragm.
- BLEEDER (BLEED VALVE):** A device for removal of pressurized fluid. Used to bleed air from system.
- CAVITATION:** A gaseous condition within a liquid stream caused when pressure is reduced to the vapor pressure. To be avoided due to destructive effects on pumps and motors.
- CIRCUIT; PILOT:** Used to control a main circuit or component.
- CIRCUIT; REGENERATIVE:** Used to increase cylinder speed by directing rod end discharge to the piston side of the cylinder. Can be incorporated into directional control valve as fourth position.
- CYLINDER:** A device which converts hydraulic energy into linear mechanical motion and force.
- CYLINDER; DOUBLE ACTING:** A cylinder which can apply force and motion in either direction.
- CYLINDER; SINGLE ACTING:** A cylinder which can apply force in one direction only.
- CYLINDER; DEPTH CONTROL:** A mechanical or hydraulic device, adjustable, for limiting cylinder stroke.
- CYLINDER; REPHASING:** A cylinder design which permits the use of two or more cylinders in series, automatically synchronizing cylinder position at the end of each stroke.
- DETENT:** A spring device which maintains the spool of a directional control valve in position.
- DETENT RELEASE:** A mechanical, hydraulic or electrical device for releasing the detent.
- FILTER:** A device incorporated into a hydraulic system to remove contaminants from the oil.
- FITTING:** A device for connecting hose or pipe to hydraulic components.
- FLOAT SPOOL (POSITION):** A spool valve design which connects all ports to the tank (return) port, usually in a detented fourth position, allowing a cylinder or motor to "float".
- FLOW RATE:** The volume of fluid passing through the system or component in gal. per min. (or l/m)
- FLUID POWER SYSTEM:** The transmission and control of power through the use of fluid pressure.
- MOTOR:** A device which converts hydraulic energy into rotary motion, either fixed or variable.
- PORT:** The internal or external terminus of a passage. The point where the fitting is attached.
- PRESSURE:** The force per unit area, expressed in pounds per square inch (psi), bars, or atmospheres.
- PRESSURE; BACK:** The pressure encountered on the downstream or return side of a component.
- PRESSURE; CRACKING:** The pressure at which a pressure operated valve begins to pass fluid.
- PRESSURE; MAXIMUM RATED:** The maximum pressure at which a component should be operated on a continuous basis, usually the relief valve setting at maximum flow rate.
- PUMP:** A device which converts mechanical energy into hydraulic energy, either fixed or variable.
- RESERVOIR:** A container which stores the liquid in a fluid power system.
- SEAL:** A device which prevents or controls the escape or passage of hydraulic fluid.
- VALVE:** A device which controls fluid flow rate, direction, or pressure.
- VALVE; DIRECTIONAL CONTROL:** A device for directing or preventing the oil flow in a system.
- OPEN CENTER (TANDEM) TYPE:** Has the inlet port connected to the outlet (tank) port in neutral.
- CLOSED CENTER TYPE:** Has the inlet port blocked from the outlet and work ports in neutral.
- TWO-WAY:** A 2 port valve with inlet and outlet ports. **THREE-WAY:** A 3 port valve (in, out and work) normally used with a single acting cylinder or uni-directional motor.
- FOUR-WAY:** A 4 port valve (in, out and 2 work) used with double acting cylinders, bi-directional motors.
- TWO, THREE, FOUR POSITION:** The number of positions in which a valve can be positioned.
- SERIES TYPE:** A multiple spool valve in which the return oil from the first spool is directed to the inlet of the second spool (and from the second to the third, etc.). This type valve permits simultaneous operation of two or more functions with the same oil flow. However, the total pressure requirements of all functions are accumulative.
- PARALLEL TYPE:** A multiple spool valve in which the inlet oil is connected to all spools simultaneously. If more than one spool is actuated, the function requiring the lowest pressure will operate first.
- SERIES-PARALLEL TYPE:** A multiple spool valve which has all spools connected to the open center passage in neutral. However, when actuated, the upstream valve takes full priority. The return oil is directed to downstream spools as in a series type valve.
- POWER BEYOND (HIGH PRESSURE CARRYOVER):** A sleeve attachment which permits the oil flow from one valve (when in neutral) to be used by another valve downstream. Hence, a 3-spool valve could be connected to a 2-spool valve to create a 5-spool valve. The first valve takes priority and must have a separate outlet port to return oil from an activator back to the reservoir.
- LOAD CHECK (LIFT CHECK):** A device which prevents a load from dropping when a valve is shifted, until ample pressure and flow is available to hold or move the load.

# SAMPLE HYDRAULIC SYSTEMS



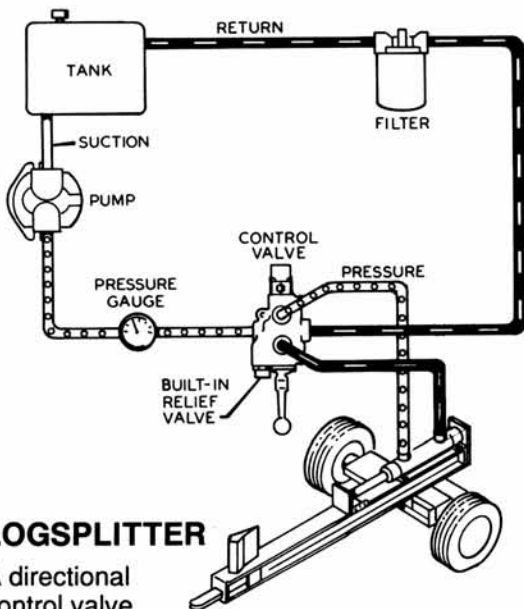
## LOADER

The above system shows a front end loader powered by a PTO driven pump. A 2-spool directional control valve with built-in relief controls the lift and bucket cylinders of the loader. A return line filter is used to prevent contamination.



## WINCH

The diagram shows a winch powered by a hydraulic motor. The directional control valve with built-in relief features optional flow control to control the speed of the winch. The hydraulic pump and motor must be matched to the torque requirements of the winch.



## LOGSPLITTER

A directional control valve with optional pressure kickout feature controls a double acting cylinder. A pressure gauge is recommended to help spot potential system problems. The tank should be at least one and a half times the pump gpm output and the oil level must remain above the pump intake at all times. (Request CROSS LGS9 for more detailed information.)

## USEFUL FORMULAS

PSI	=	$\frac{\text{FORCE}}{\text{AREA}}$
CYL. AREA (sq. in.)	=	$\pi r^2$
FORCE (lbs.)	=	PSI X AREA
CYL. SPEED (ft. per sec.)	=	$\frac{.3208 \times \text{GPM}}{\text{AREA}}$
HORSEPOWER	=	$\frac{\text{PSI} \times \text{GPM}}{1714}$
HORSEPOWER (Fluid motor)	=	$\frac{\text{TORQUE (in. lbs.)} \times \text{RPM}}{63025}$
TORQUE (in. lbs.)	=	$\frac{\text{PSI} \times \text{DISP. (cu. in.)}}{2\pi}$
RPM	=	$\frac{231 \times \text{GPM}}{\text{DISP. (cu. in.)}}$
GPM (Pump outflow)	=	$\frac{\text{RPM} \times \text{DISP. (cu. in.)}}{231}$

(NO ALLOWANCE HAS BEEN MADE FOR COMPONENT EFFICIENCY)

# COMMON VALVE QUESTIONS & ANSWERS:

**HOW DO I HOOK UP THE VALVE?** Inlet and outlet are marked on the directional valves. For standard valves hook up diagrams are shown on the bottom of the box. A and B (C, D, E and F if applicable) ports go to the cylinder ports. For VS and SD series see the box or call CROSS.

**WHAT VALVE SHOULD I USE FOR LIFTING?** For safety, a valve with a load check (Series AD/SA, BA or SS) is necessary in order that the load does not drop before it begins to raise again when you are shifting out of the neutral position. The load check is a spring loaded poppet which prevents the oil from backflowing until enough pressure is created to raise the load.

**WHAT VALVE DO I NEED FOR A LOADER?** The most popular models are the SAF2 and SBAF2 which have a float position on the first spool allowing the oil to circulate to permit the bucket to ride the contours of the ground. The second spool is for a two way cylinder and is spring centered to neutral. Others are the SA22 and SBA22 which are spring centered to neutral on both spools but feature no float. SS valves may also be used for loaders.

**I HAVE A JOHN DEERE.** (or any other closed center system). **CAN I USE A STANDARD VALVE?** All SA and SBA valves are convertible to closed center by installing a closed center plug and no relief plug as shown in literature shipped with the valve. Valves may also be ordered already converted to closed center. These valves feature a tighter spool to minimize creeping.

**HOW DO I HOOK UP SEVERAL VALVES IN SERIES?** Replace the conversion plug on the outlet side of the SA or SBA valve with a power beyond sleeve. Connect this line to the inlet of the second valve. Run a tank line from the outlet of the first valve (has priority) back to the reservoir.

**HOW DO I CHANGE THE RELIEF OR BYPASS SETTING ON A VALVE?** Always use a pressure gauge in the inlet to assure precise results. An SBA valve may be adjusted by turning the adjustment screw under the acorn nut on the handle end of the valve. Clockwise will increase pressure. The CONVERTA or CA relief is shim adjustable. The spring in older CONVERTA and CA valves is rated to 1750. To increase the pressure to 2000 a different spring (#1A0685) plus shims (1A0682) are necessary. Do not exceed the recommended psi for the valve.

**WHAT IS THE #1V0294 DETENT KIT?** This manual detent fits the SBA or CONVERTA. The valve handle (and spool) stays wherever it is placed until moved by the operator.

**CAN I PUT A FLOAT OPTION ON A STANDARD VALVE?** No, the end of the spool as well as the lands are different so a standard valve will not accept a float detent. Spools are matched to the individual valve bodies so changing a valve spool in the field is not feasible.

**CAN I PUT A PRESSURE KICKOUT ON A STANDARD VALVE?** Pressure kickout or automatic return to neutral requires a special internal machining which must be done at the factory when the valve is manufactured. (It is a standard feature on the SCD2E - logsplitter valve.)

**CAN I USE A STANDARD VALVE FOR A SINGLE ACTING CYLINDER?** No. A standard double acting (sometimes called 4-way) has no place for the pump oil to go as you are exhausting or lowering the cylinder. Consequently, the oil goes over the relief and overheats the system. Valves with spools for single acting applications may be special ordered from the factory. The CONVERTA is convertible to single acting.

**HOW DO I IDENTIFY A VALVE?** The CROSS computer stock number is stamped on the handle end of the valve body on all valves manufactured since 1989. On older valves the "Z" casting number is on the back side of the valve.

**HOW DO I INSTALL PIPE FITTINGS?** Never use teflon tape...a pipe port is a tapered thread and it is very easy to crack a casting if teflon tape is used. Use of liquid pipe sealant is the only approved installation method. Torque values are as follows: 1/2" NPTF - 32 to 40 ft. lbs.; 3/4" NPTF - 40 to 48 ft. lbs.

# HYDRAULIC PRODUCT SAFETY



**WARNING :** Valve lever (spool) may "stick" (not center) under certain conditions allowing the hydraulic equipment to continue to operate and could cause serious injury, death or equipment failure.

**VALVE SAFETY:** Read and follow instructions carefully. Failure to observe instructions and guidelines may cause serious injury, death or equipment failure. A sticking valve (spool bind) may be caused by one or more of the following factors:

**DIRTY OIL:** Oil must be filtered to a minimum of 25 microns. Filters should be changed regularly - spin-on types after 50 hours of initial use and then after every two hundred fifty hours of use. Use of a condition indicator is recommended. Consult your tractor or implement owner's manual for filtration and changing recommendations for internal systems.

**OIL REQUIREMENTS:** Premium quality anti-wear type oil with a viscosity between 100 and 200 SSU at operating temperatures. Certain synthetic oils may cause spool seals to swell and the valve to stick. If in doubt, call CROSS Engineering.

**IMPROPER HOOK UP OR MOUNTING:** Always use the proper size fittings. Hook up "in" & "out" as noted on the valve body. Do not overtorque pipe fittings. (Use liquid pipe sealant only – cracked ports are not covered under warranty.) Mounting surfaces should be flat and care should be used when tightening mounting bolts. Over-tightened bolts can cause spool bind and casting breakage. When hooking a valve in series, always use a power beyond sleeve. Consult your tractor or implement manual to make sure you have the proper quick disconnect line connected to the inlet of the remote valve.

**MISAPPLICATION:** Always use the proper valve for the job. CONVERTA, CD, CS or CA valves should never be used for metered heavy load lifting - loaders or similar applications. Use an open center valve for open center applications and a closed center valve for closed applications. If in doubt, check with your tractor dealer. Contact CROSS if the valve allows the hydraulic equipment to creep excessively.

**MAINTENANCE:** Make sure all bolts are tightened and torqued to the recommended specification. Bent or broken parts should not be used. Replace immediately. Always use exact replacements. Always protect valve spool from paint overspray.

Faulty quick disconnects can cause high back pressures and sticking spools. Check quick disconnects periodically to make sure they are functioning properly. If valve spool does not center or appears to stick, do not use!



## PUMPS & MOTORS SAFETY:

A relief or bypass in your hydraulic system is necessary to prevent pump from breakage due to overpressurization. Use correct fittings and proper oil as noted in the technical service manual packed with each unit. Change oil as recommended by your implement or tractor manufacturer.



## CYLINDER SAFETY:

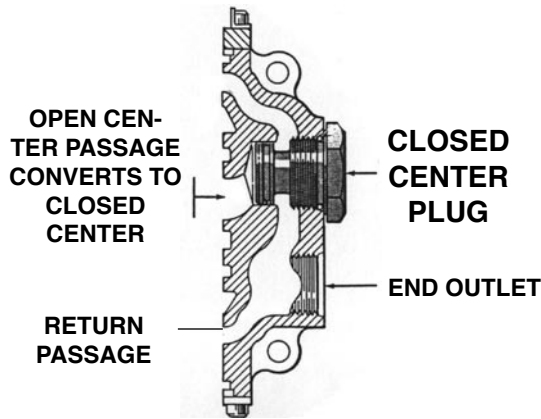
Check clevis clearances before, during and after extending the cylinder and before using the cylinder under pressure to avoid possible injury, or bent or broken rods caused by binding. (Bent or broken rods are not covered under warranty.) Never operate a cylinder above recommended pressures. Never use a cylinder as a safety device when transporting equipment.



## PINHOLE LEAKS:

If you observe a pinhole leak, discontinue use of the component. If oil has penetrated your skin or contacted your eye, seek medical attention immediately!

# CLOSED CENTER CONVERSION



This option provides for conversion from **open center** to **closed center** by blocking the open center flow passage with the closed center plug as shown. It may be used in any standard CROSS SA or BA valve featuring the conversion plug/power beyond machining in the BYD port.

The valve may also be ordered already converted to closed center. (See table) These valves have less clearance between the spool and body so leakage between the spool and valve body which may result in creeping of the cylinder is minimized.

OPEN CENTER VALVE	CLOSED CENTER PLUG	NO RELIEF PLUG	CLOSED CENTER VALVE
SA2 SA22 SAF2	1V2572	1R0035	
SBA2, SBA2-ORB SBA22, SBA22-ORB SBA222, SBA222-ORB SBAF2, SBAF2-ORB SBAF22, SBAF222-ORB	1V0206 CONTAINED IN 1V2015 KIT	1R0035	SBA2-CC, SBA2-CC - ORB SBA22-CC, SBA22-CC - ORB SBA222-CC, SBA222-CC - ORB SBAF2-CC, SBAF2-CC - ORB SBAF22-CC, SBAF22-CC - ORB

**To convert an open center valve,** remove the short conversion plug and replace it with the closed center plug as shown. The relief on the handle end of the valve must be replaced with a no relief plug. ((See table for part numbers.) **Failure** to replace the relief will result in **chattering** caused by the constant bypass of oil and will build excessive heat in the system. An outlet must be

plumbed to the tank to dump the oil from the return passage.

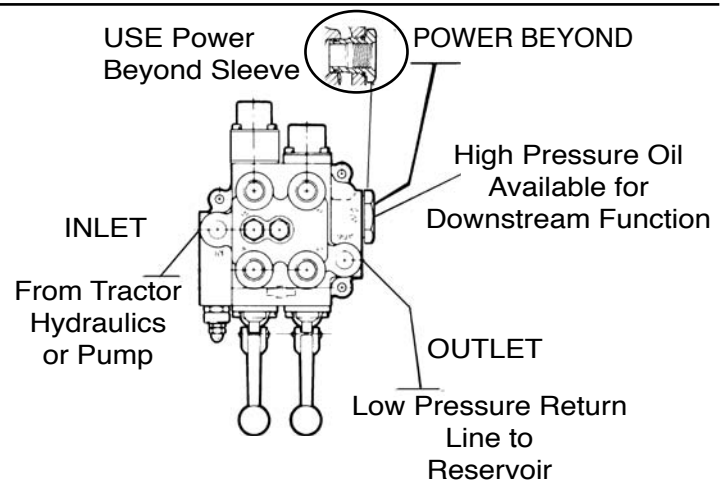
Any restriction in the tank line of a closed center system caused by faulty quick couplers, a collapsed hose, etc. will damage the spool seals, washers and handle bracket (BA only) resulting in external leakage around the spool. Reversing the tractor valve so that the outlet rather than the inlet is pressurized would have the same effect. These possible problems must be remedied within the system.

In a closed center system, the neutral pressure sometimes causes leakage between the pressure core and the work ports enabling the cylinders to drift or creep. (Reworking the valve at the factory to a class 1A spool fit will minimize this problem. Valves with class 1A spool fit may be special ordered from

**Valves manufactured as closed center do not contain a relief** and should **never** be installed in an open center system or converted to open center due to the possibility of personal injury or system damage!

# POWER BEYOND INSTALLATION

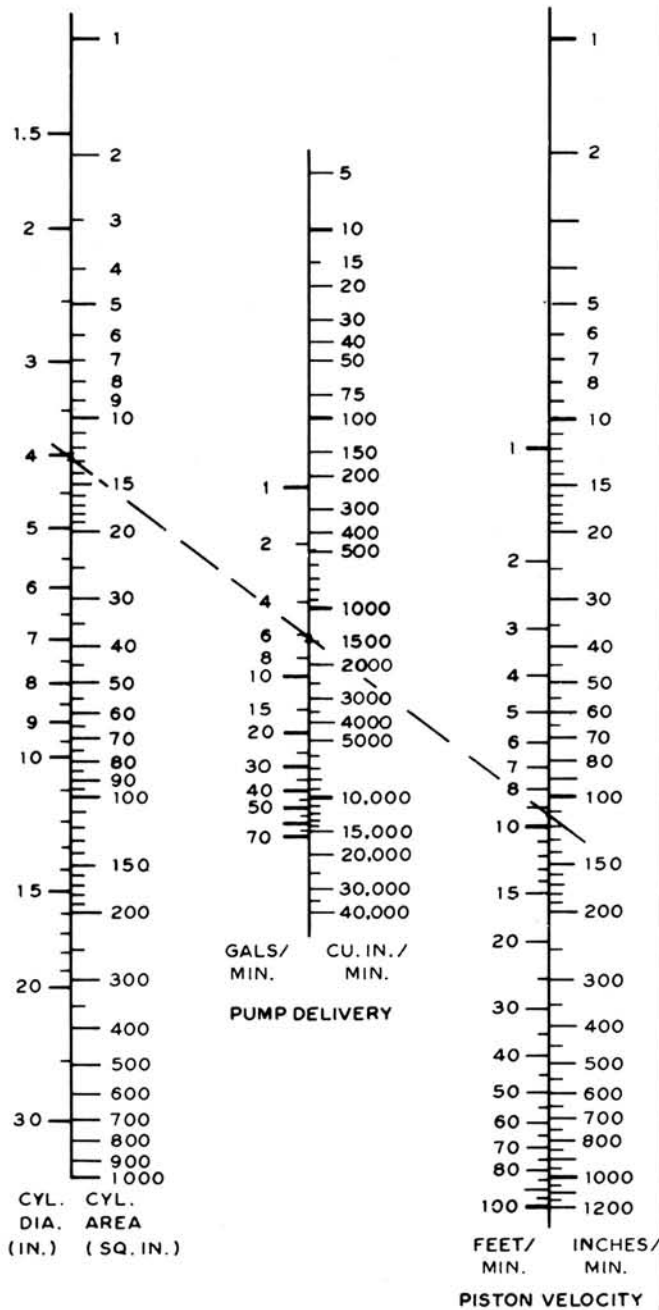
SLEEVE ASSEMBLY PART #'S		
BA	1V0208	3/4" NPTF
	1V0209	7/8-14 SAE
	1V0249	1 1/16-12 SAE
SA/AD	1V2566	7/8-14 SAE



# HELPFUL NOMOGRAPHS

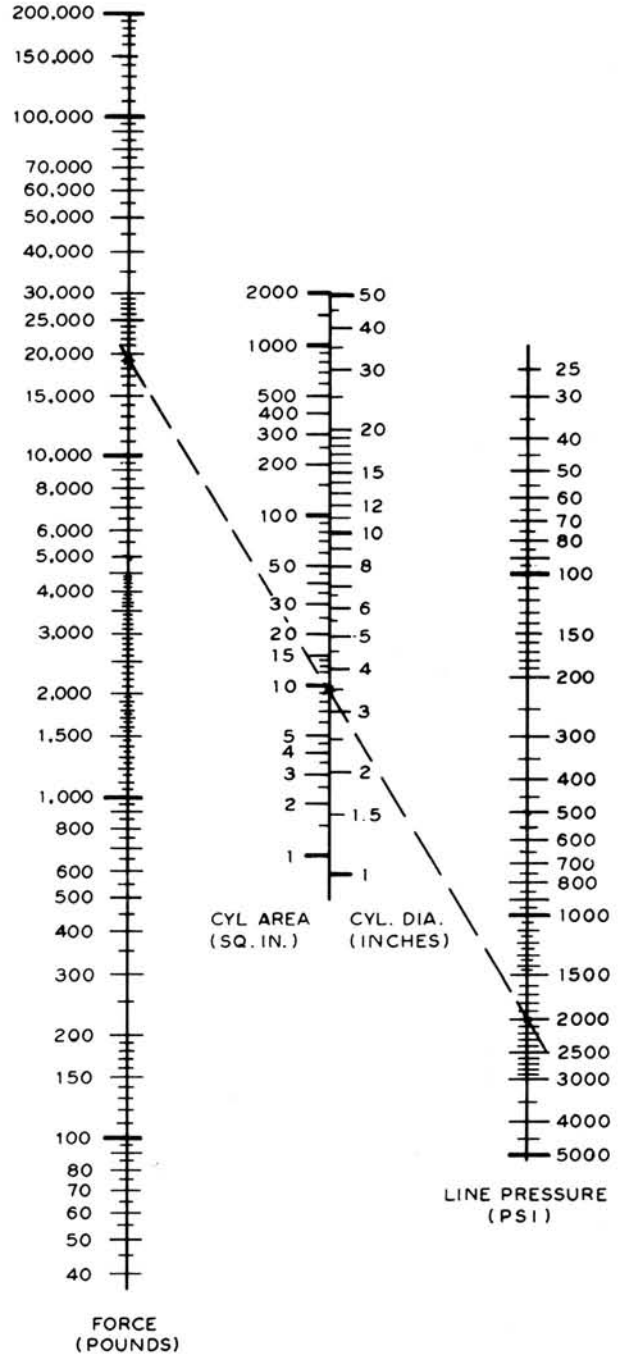
## CYLINDER SPEED

$$\text{Pump Delivery} = \frac{\text{Cylinder Area} \times \text{Piston Velocity}}{(\text{Cu. In. per Min.}) \quad (\text{Square Inches}) \quad (\text{Inches per Minute})}$$



## CYLINDER FORCE

$$\text{Force} = \frac{\text{Cylinder Area} \times \text{Line Pressure}}{(\text{Pounds}) \quad (\text{Square Inches}) \quad (\text{Pounds Per Sq. In.})}$$



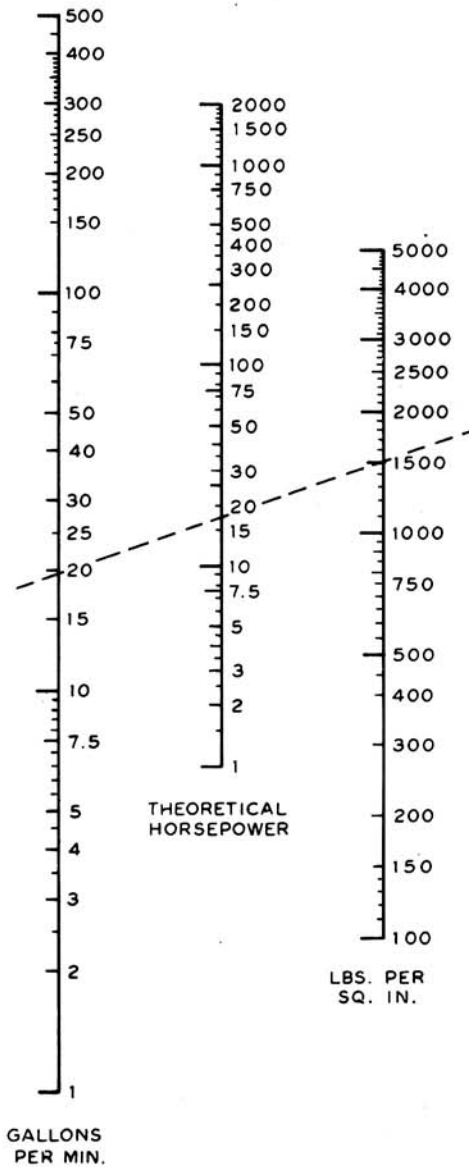
# HELPFUL NOMOGRAPHS

## PUMP and MOTOR HORSEPOWER

$$HP = PSI \times GPM \times 0.000583$$

$$PUMP\ DRIVE = THL.\ HP \div EFFICIENCY$$

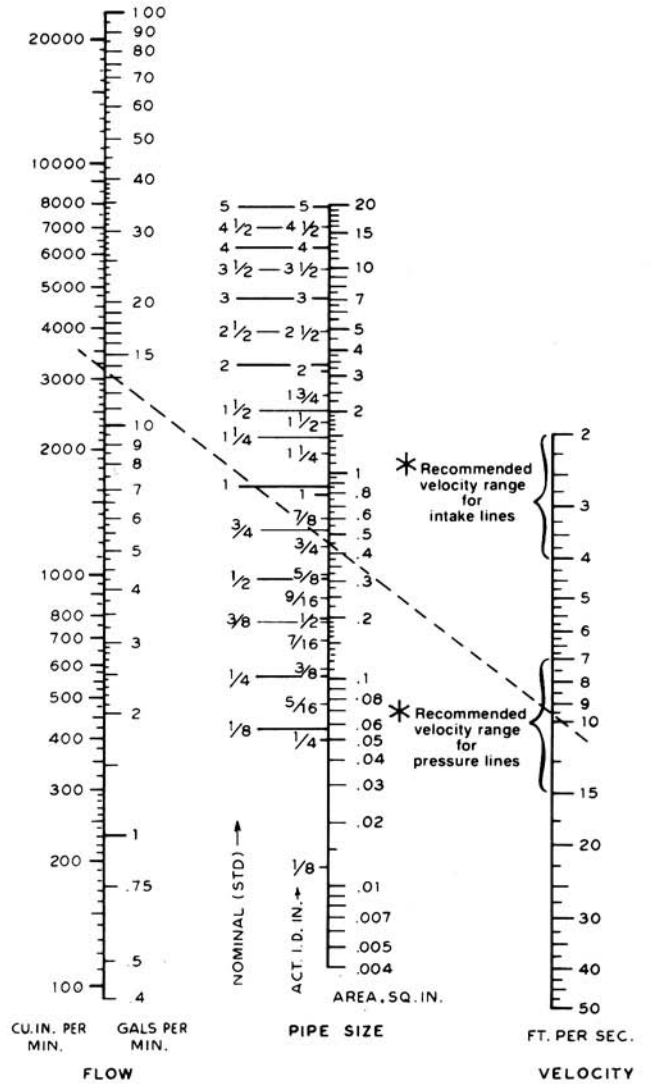
$$MOTOR\ OUTPUT = THL.\ HP \times EFFICIENCY$$



## PIPE FLOW CAPACITY

$$AREA = \frac{GPM \times 0.3208}{VELOCITY (FT./SEC.)}$$

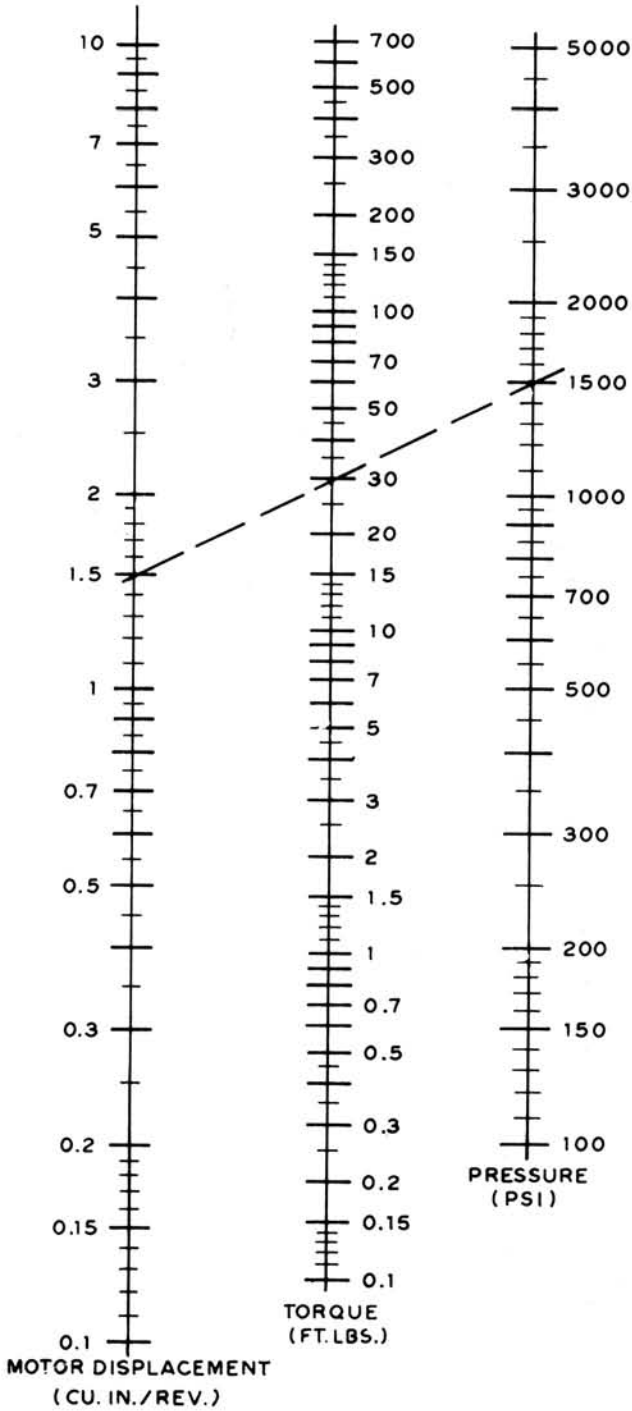
\* Recommendations are for oils having a maximum viscosity of 315 S.S.U. at 100 F. operating at temperatures between 65 F. and 155 F.



# HELPFUL NOMOGRAPHS

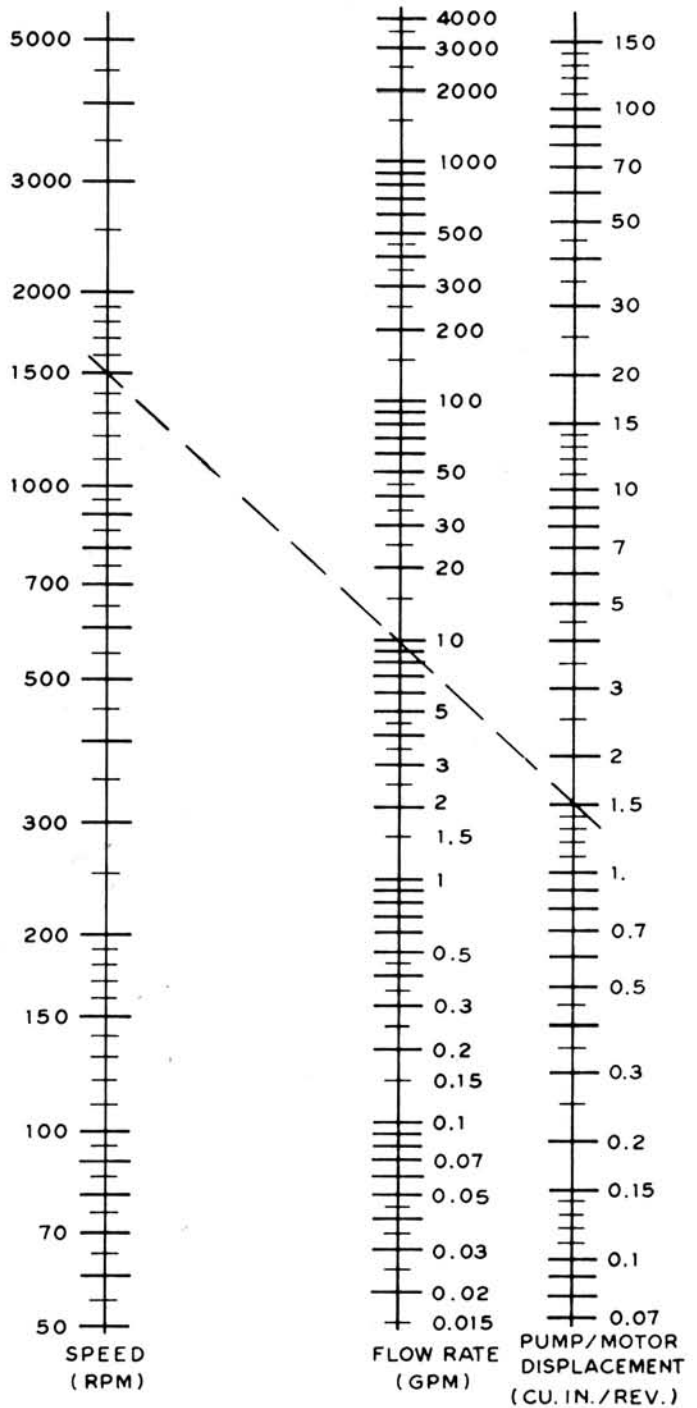
## HYDRAULIC MOTOR TORQUE

$$\text{TORQUE} = \frac{\text{DISPL.} \times \text{PRESSURE}}{24 \pi}$$



## HYDRAULIC MOTOR SPEED

$$\text{FLOW RATE} = \frac{\text{SPEED} \times \text{DISPL.}}{231}$$







# TROUBLE SHOOTING TIPS

## FINDING AND SOLVING PROBLEMS:

Please read and observe the HYDRAULIC PRODUCT SAFETY SHEET before proceeding further. Your safety is important to us!

Gradual or sudden loss of pressure or flow resulting in a loss of power is common in hydraulic system failure. Any one of the system's components may be at fault. These step-by-step procedures should help you locate and remedy the problem quickly.

### 1. SYSTEM INOPERATIVE

- **No oil in system, insufficient oil in system.** Fill system. Check for leaks.
- **Wrong oil in system.** Refer to specifications. Change oil.
- **Filter dirty or clogged.** Drain oil and replace filter or filter element.
- **Oil line restriction.** Oil lines dirty or collapsed. Clean or replace.
- **Air leaks in pump suction line.** Repair or replace as necessary.
- **Worn or dirty pump.** Clean, repair or replace. Check alignment. Check for contaminated oil. Drain and flush system.
- **Badly worn components (valves, cylinders, etc.)** Examine and test for internal or external leakage. Replace faulty components. Check for cause of wear.
- **Leakage.** Check all components, particularly the relief valve for proper settings. Refer to technical manuals.
- **Excessive load.** Check unit specifications for load limits.
- **Slipping or broken pump drive.** Repair or replace belts, couplings, etc. Check for proper alignment or tension.

### 2. SYSTEM OPERATES ERRATICALLY

- **Air in system.** Check suction side of system for leaks. Repair.
- **Cold oil.** Allow ample warm-up period.
- **Dirty or damaged components.** Clear or repair as necessary.
- **Restrictions in filters or lines.** Clean and/or replace elements or lines.

### 3. SYSTEM OPERATES SLOWLY

- **Oil viscosity too high, cold oil.** Allow oil to warm up before operating machine.
- **Low pump drive speed.** Increase engine speed (check manual for recommendations.)
- **Air in system.** Check suction side for leaks. Repair.
- **Badly worn pump, valves, cylinders, etc.** Repair or replace as needed.
- **Restrictions in filters or lines.** Clean and/or replace elements or lines.
- **Improper adjustments.** Check orifices, relief valves, etc. Adjust per manual.
- **Oil leaks.** Tighten fittings. Replace seals or damaged lines.

### 4. SYSTEM OPERATES TOO FAST

- **Wrong size or incorrectly adjusted restrictor.** Replace or adjust as necessary.
- **Engine running too fast.** Reduce engine speed.

### 5. OVERHEATING OF OIL IN SYSTEM.

- **Oil passing thru relief valve for excessive time.** Return control valve to neutral when not in use.
- **Incorrect oil, low oil, dirty oil.** Use recommended oil, fill reservoir, clean oil, replace filter elements.
- **Engine running too fast.** Reduce engine speed.
- **Excessive component internal leakage.** Repair or replace component as necessary.
- **Restriction in filters or lines.** Clean and/or replace elements or lines.
- **Malfunctioning oil cooler.** Clean or repair.

### 5. OVERHEATING OF OIL IN SYSTEM. (cont'd.)

- **Insufficient heat radiation.** Clean dirt and mud from reservoir and components.
- **Malfunctioning component.** Repair or replace.
- **Reservoir too small.** Recommended size is 1 1/2 times pump gpm.

### 6. FOAMING OF OIL

- **Incorrect, low or dirty oil.** Replace, clean or add oil as needed.
- **Air leaks.** Check suction line and component seals for suction leaks. Replace.

### 7. NOISY PUMP

- **Low oil level, incorrect oil, foamy oil.** Replace, clean or add oil as needed.
- **Suction line plugged or too small, inlet screen plugged.** Clean or replace. Follow instructions packed with unit.
- **Use of pipe fitting in inlet.** Replace with correct fitting.

### 8. BLOWN SHAFT SEAL

- **Pump: wrong pump shaft rotation.** Replace seal. Refer to installation instructions.
- **Motor: failure to hook up drain line.** Replace seal. Refer to installation instructions.

### 9. LEAKY PUMP OR MOTOR

- **Damaged or worn shaft seal.** Replace seal. Check for misalignment.
- **Loose or broken parts.** Tighten or replace.

### 10. LOAD DROPS WITH CONTROL VALVE IN NEUTRAL

- **Leaking cylinder seals or fittings.** Replace worn parts.
- **Control valve not centering when released.** Check linkage. Check for spool binding. Repair.

### 11. CONTROL VALVE DOES NOT CENTER (Binding)

- **See Hydraulic Product Safety sheet.**
- **Valve linkage misaligned.** Repair.
- **Tie-bolts too tight (stack valves).** Loosen as necessary.
- **Valve damaged.** Repair or replace.
- **Handle bracket screws loose.** Tighten.

### 12. CONTROL VALVE LEAKS EXTERNALLY

- **Tie-bolts too loose (stack valves).** Tighten as necessary.
- **Seals damaged or worn.** Replace.
- **Back pressure or restriction in tank line.** Check quick couplers. Use power beyond when necessary.
- **Cracked port or body.** Replace. (see Hyd. Prod. Safety)

### 13. CYLINDER LEAKS EXTERNALLY

- **Seals damaged or worn.** Replace.
- **Rod damaged.** Replace.

### 14. CYLINDER LOWERS WITH VALVE IN "METER UP" POSITION

- **Damaged or leaky load check.** Replace check.
- **Leaking cylinder seal.** Replace seal.
- **Use of a valve without loadcheck.** Replace with recommended valve.



## The Complete Product Line

*Made in America...Serving the World*

CROSS Manufacturing Inc. produces one of the most extensive hydraulic component lines on the market today. In addition to the wide range of products offered in this Full Line catalog, CROSS also offers numerous and diverse options and configurations to accommodate the needs of the marketplace and our customers. Many non-standard options are already configured within our system and are available within normally short lead times. Special design requirements are reviewed by our Engineering and Technical staff.

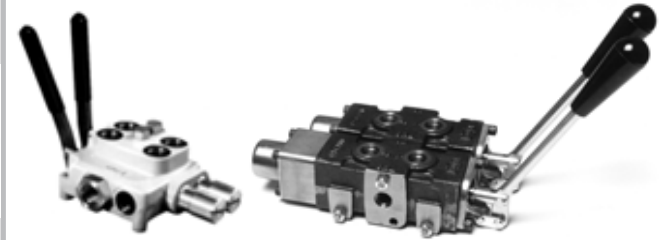
CROSS was established in 1949 and is still privately owned and operated. CROSS distributes worldwide and supplies hydraulic components for many markets: agricultural, mobile, material handling, logging, utility, construction, mining and forestry. CROSS has been ISO 9001 certified since 1998. We invite you to browse our full product line and look forward to serving your hydraulic needs!



**Tie Rod Cylinders, Standard and Custom Welded Cylinders** rated up to 3000 psi - standard and custom mountings. 1 1/2 through 5 inch bore sizes.



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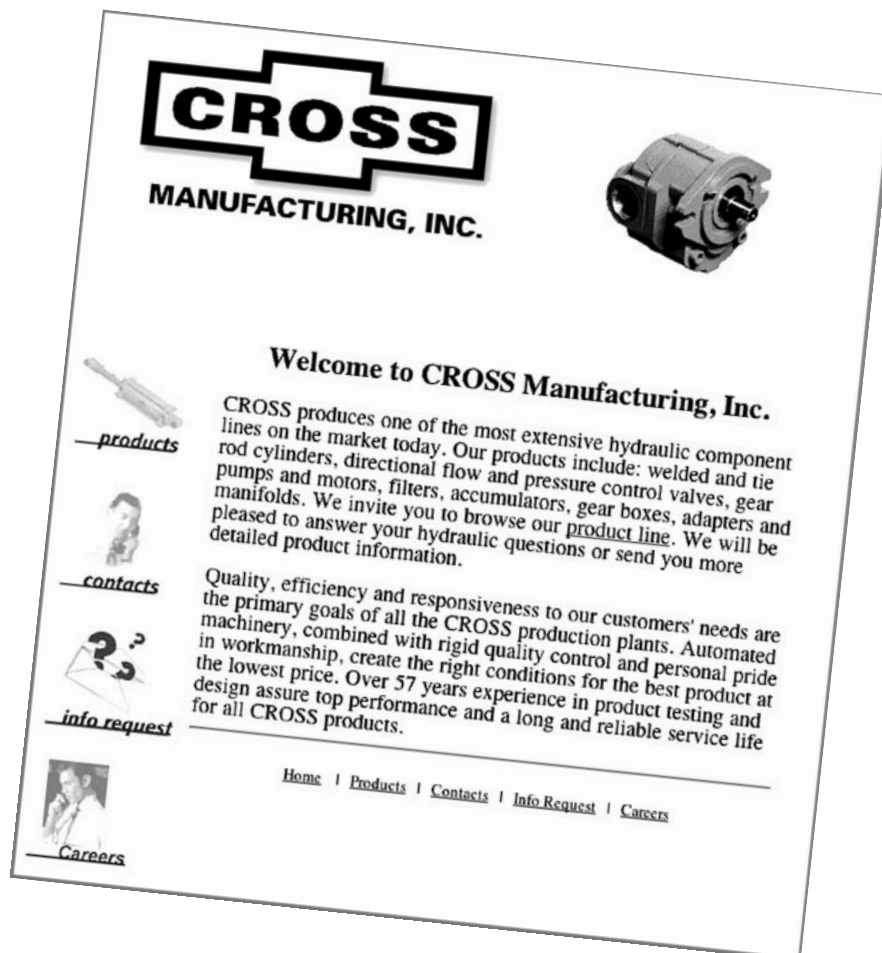
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From the opening screen of our web site, click on the [info request](#) at the bottom left (or at the bottom of the screen). You will be directed to a form where you can fill in your name, address, e-mail address and relevant information. There is also a box for your comments or additional requests. After clicking the [submit logo](#) at the bottom, you will be directed to a listing of available literature. If you need a PDF reader, you can also download that here. For your convenience, we have listed the size of each PDF so that if you have a storage allotment for your e-mail, you may want to request files in smaller groups.

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## **CROSS MANUFACTURING, INC.**

[www.crossmfg.com](http://www.crossmfg.com)

100 James H. Cross Blvd., Lewis, Kansas 67552

Ph: 620-324-5525

Fax: 620-324-5737