ATLANTIC

MACHINE TOOLS, INC.

MODEL

H D E

1/4" SHEAR OPERATING, SERVICE & PARTS MANUAL

C1
1/86
10 x 1/4

CAPACITIES:

ATLANTIC MODEL HD 10 x 1/4 HYDRAULIC SHEAR

Length of Cut	122"
Capacity of Cut (Mild Steel, 50,000 PSI)	1/4"
Length of Squaring Arm	40"
Back Gauge Depth Maximum Minimum	29" 1"
Line Voltage	240/480V/3ph/60Hz
Control Voltage	24V
Motor H.P.	15 H.P.
Hydraulic Oil Capacity Type	70 Gal. Mobil DTE 24 or Equivalent
Hydraulic Pressure at Holddowns	1400 PSI
Hydraulic Pressure at Shear Cylinders	3400 PSI
Weight	10,500 lbs.
Dimensions (At Floor)	145"L x 61"W x 68"H

SHEAR CAPACITY CHART

The tensile and/or yield strength of many ASTM steels are specified as minimum values with no limit on the maximum. This chart is based on the actual tensile and/or yield strengths 15,000 PSI above the specified minimum values. Steel exceeding this value must be limited to thinner material than shown in the chart.

The actual physical properties and chemical analysis of a steel may meet more than one specification and/or grade within a specification. In this case the capacities for the specification and/or grade with the highest mechanical properties must be used.

The ASTM specifications listed are those in effect on January 1, 1978.

MILD STEEL SHEAR CAPACITY					.250
ASTM STEELS		TENSILE STRENGTH	YIELD STRENGTH	MINIMUM ELONG.	EQUIVALENT CAPACITY THICKNESS
NO.	GRADE	K.S.I.	K.S.I.	% -2 IN.	(NOMINAL)
A36	-	58-80	36-51	23	.250
	-	58-80	OVER 51	23	.219
A113	A	60-72	33 MIN.	24	.250
	B	50-62	27 MIN.	28	.250
	C	48-58	26 MIN.	29	.250
A131	-	58-71	34 MIN.	24-26	.250
A242	-	70 MIN.	50 MIN.	21	.219
A283	A	45-55	24 MIN.	30	.250
	B	50-60	27 MIN.	28	.250
	C	55-85	30 MIN.	25	.250
	D	60-72	33 MIN.	23	.250
A284	C	60 MIN.	30 MIN.	25	.250
	D	60 MIN.	33 MIN.	24	.250
A285	A	45-85	24 MIN.	30	.250
	B	50-70	27 MIN.	28	.250
	C	55-75	30 MIN.	27	.250
A299	-	75-95	42 MIN.	19	.188
A440	-	70 MIN.	50 MIN.	21	.188
A441	-	70 MIN.	50 MIN.	21	.188
A442	55	55-75	30 MIN.	26	.219
	60	60-80	32 MIN.	23	.219
A514	-	110-130	100 MIN.	18	.188
A515	55	55-75	30 MIN.	27	.188
	60	60-80	32 MIN.	25	.188
	65	65-85	35 MIN.	23	.188
	70	70-90	38 MIN.	21	.188
A516	55	55-75	30 MIN.	27	.188
	60	60-80	32 MIN.	25	.188
	65	65-85	35 MIN.	23	.188
	70	70-90	38 MIN.	21	.188
A517	-	115-135	100 MIN.	16	.188
A537	1	70-90	50 MIN.	22	.219
	11	80-100	50 MIN.	22	.188
A572	42	60 MIN.	42 MIN.	24	.219
	50	65 MIN.	50 MIN.	21	.219
	60	75 MIN.	60 MIN.	18	.219
	65	80 MIN.	65 MIN.	17	.219

SHEAR CAPACITY CHART

MILD STEEL SHEAR CAPACITY					.250
ASTM STEELS		TENSILE STRENGTH K.S.I.	YIELD STRENGTH K.S.I.	MINIMUM ELONG. % -2 IN.	EQUIVALENT CAPACITY THICKNESS (NOMINAL)
No.	GRADE				
A588	-	70 MIN.	50 MIN.	21	.219
A612	OVER .500	81-101	50 MIN.	22	.188
A633	A	63-83	42 MIN.	23	.219
	B	63-83	42 MIN.	23	.219
	C	70-90	50 MIN.	23	.188
	D	70-90	50 MIN.	23	.188
	E	80-100	60 MIN.	23	.188
A635	-	NOT SPECIFIED	NOT SPECIFIED	NOT SPECIFIED	.250
A715	50	60 MIN.	50 MIN.	24	.219
	60	70 MIN.	60 MIN.	22	.219
	70	80 MIN.	70 MIN.	20	.188
	80	90 MIN.	80 MIN.	18	.188

SHEAR CAPACITY CHART

MILD STEEL SHEAR CAPACITY		.250
OTHER STEELS		EQUIVALENT CAPACITY THICKNESS (NOMINAL)
LOW CARBON (.10-.20) PLATE		.250
LOW CARBON (.15-.25) PLATE		---
ANNEALED .40-.50 CARBON H.R. PLATE		.188
A.I.S.I. 4140 H.R. PLATE - ANNEALED		.188
A.I.S.I. 6150 H.R. PLATE - ANNEALED		.188
A.I.S.I. 8620 H.R. PLATE - ANNEALED		.188
FLOOR PLATE		.188
ABRASION RESISTING PLATE (250 BHN MAX.)		.188
ANNEALED STAINLESS STEEL PLATES TYPE 302, 304, 304L, 309, 316, 316L, 410, & 430	$\leq$ 14 LEN.	7 Ga. (.1875)
ANNEALED STAINLESS STEEL PLATES TYPE 302, 304, 304L, 309, 316, 316L, 410, & 430	$\geq$ 16 LEN.	8 Ga. (.164)

MILD STEEL SHEAR CAPACITY	.250
ALUMINUM ALLOYS *	EQUIVALENT CAPACITY THICKNESS (NOMINAL)
1100-0, 1100-H14, 1100-H16 2024-0, 2024-T3, 2024-T4 3003-H14, 5005-H34, 5052-0 5052-H32, 5052-H34, 5086-H32 6061-0, 6061-T6, 7075-T6	.375

*Aluminum alloys may require more clearance under holddowns and at low end of the upper knife. The charts below are for determining shear capacities only and are not to be used for selecting knives. Shear capacity is determined by total shearing load and knife selection is determined by unit pressure on the knives, and hardness and chemistry of the material being sheared. Materials with a hardness of 30 Rc or above and/or those with abrasives included present severe knife problems.

ASTM SPECIFICATION		PRODUCER AND PRODUCT NAME						
NO.	GRADE	NATIONAL STEEL CORP.	OREGON STEEL MILLS	REPUBLIC STEEL CORP.	SHARON STEEL CORP.	UNITED STATES STEEL CORP.	WHEELING-PIT STEEL CORP.	YOUNGSTOWN SHEET & TUBE CO.
A242		NAX-HIGH TENSILE	ORELLOY 242 Typ 1 & Typ 2	REPUBLIC 50	COR-TEN A COR-TEN B	COR-TEN A COR-TEN B	PITT-TEN NO. 1	YOLOY HS YOLOY T-50
A440		NAX-HI MANG	ORELLOY 440					YOMAN
A441		GLS-441	ORELLOY 441	REPUBLIC A-441		TRI-TEN	W-P A-441	YSW A441
A514		N-A-XTRA 100	ORELLOY 100. TYPE A			T-1 T-1A T-1B		
A517		N-A-XTRA 100	ORELLOY 100. Type B			T-1 T-1A T-1B		
A537	CLASS 1		A-537 CL 1			CHAR PAC (NORM)		
	CLASS 11		A-537 CL 11			CHAR PAC (Q AND T)		
A572	42	GLX-42W	ORELLOY 42	X42W	SHARALLOY 45	EX-TEN 45	PITT-TEN X-42W	YSW-42
	50	GLX-50W	ORELLOY 50	X50W	SHARALLOY 50	EX-TEN 50	PITT-TEN X-50W	YSW-50
	60	GLX-60W	ORELLOY 60	X60W	SHARALLOY 60	EX-TEN 60		YSW-60
	65	GLX-65W	ORELLOY 65	X65W		EX-TEN 65		YSW-65
A588		NAX-HIGH TENSILE	ORELLOY 588	REPUBLIC 50	COR-TEN B	COR-TEN B		YOLOY HS
A606	(SHEET)	NAM-HIGH TENSILE		REPUBLIC 50	COR-TEN A	COR-TEN A	PITT-TEN No. 1	YOLOY HS YOLOY T-50
A607	45	GLX-45W		X45W	SHARALLOY 45 C	EX-TEN 45	PITT-TEN X-45W	YSW-45
	50	GLX-50W		X50W	SHARALLOY 50 C	EX-TEN 50	PITT-TEN X-50W	YSW-50
	55	GLX-55W		X55W	SHARALLOY 55 C	EX-TEN 55	PITT-TEN X-55W	YSW-55
	60	GLX-60W		X60W	SHARALLOY 60 C	EX-TEN 60	PITT-TEN X-60W	YSW-60
	65	GLX-65W		X65W		EX-TEN 65		YSW-65
	70					EX-TEN 70		
A715	50						PITT-TEN X-50W	YS-T50
	60							YS-T60
	70							YS-T70
	80							YS-T80

STEEL CROSS REFERENCE CHART

ASTM SPECIFICATION		PRODUCER AND PRODUCT NAME						
NO.	GRADE	ARMCO STEEL CORP.	BETHLEHEM STEEL CORP.	INLAND STEEL CO.	INTERLAKE INC.	JONES B. LAUGHLIN STEEL CORP.	KAISER STEEL CORP.	LUKENS STEEL CO.
A242		HIGH STRENGTH A	MAYARI	COR-TEN A COR-TEN B	COR-TEN A COR-TEN B	NI-CU-TI	KAISALOY 50CR	LUKENS A242
A440			MED MN	HI-MAN	A440	JALTEN-3	KAISALOY 50MM	LUKENS A440
A441		HIGH STRENGTH B	MN V	TRI-STEEL	A441	JALTEN-1 VAN-50	KAISALOY 50MV	LUKENS A441
A514		SSS-100 SSS-100A SSS-100B	RQ-100 RQ-100A RQ-100B			S-90 S-100 S-110		T-1, T-1B T-1A, N-A-XTRA
A517		SSS-100 SSS-100A SSS-100B	RQ-100 RQ-100A RQ-100B			S-100 S-110		T-1, T-1B T-1A N-A-XTRA
A537	CLASS 1	LO-TEMP	RQC-60N					LT-75N
	CLASS 11	SUPER LO-TEMP	RQC-60Q AND T					LT-75QT
A572	42	HIGH STRENGTH C-42	V42	INX-42	I42X	JLX-42	KAISALOY 42-CV	A572-42
	50	HIGH STRENGTH C-50	V50	INX-50	I50X	JLX-50 JLX-50CC VAN-50	KAISALOY 50-CV	A572-50
	60	HIGH STRENGTH C-60	V60	INX-60	I60X	JLX-60 VAN-60	KAISALOY 60-CV	A572-60
	65	HIGH STRENGTH C-65	V65	INX-65		JLX-65		A572-65
A588		HIGH STRENGTH A588	MAYARI B-50	COR-TEN B	COR-TEN B	NI-CU-TI	KAISALOY 50CR	COR-TEN B
A606	(SHEET)	HIGH STRENGTH B	MAYARI R	COR-TEN A	COR-TEN A	NI-CU-TI	KAISALOY 50CR	
A607	45	HIGH STRENGTH C-45	CB/45	INX-45	I45X	JLX-45	KAISALOY 45-CV	
	50	HIGH STRENGTH C-50	CB/50	INX-50	I50X	JLX-50 JLX-50CC VAN-50	KAISALOY 50-CV	
	55	HIGH STRENGTH C-55	CB/55	INX-55	I55X	JLX-55		
	60	HIGH STRENGTH C-60	CB/60	INX-60	I60X	JLX-60 VAN-60		
	65	HIGH STRENGTH C-65		INX-65		JLX-65		
	70	HIGH STRENGTH C-70		INX-70		JLX-70 VAN-70		
A715	50			HI-FORM 50	I50F	VAN-50		
	60			HI-FORM 60	I60F	VAN-60		
	70			HI-FORM 70	I70F	VAN-70		
	80			HI-FORM 80	I80F	VAN-80		

STEEL CROSS REFERENCE CHART

SAFETY IS IMPORTANT !!

Following are excerpts from the ANSI B-11 Standards on owner/ employer responsibilities pertaining to safety in the use and operation of shears.

Please read these and be aware of the safety requirements.

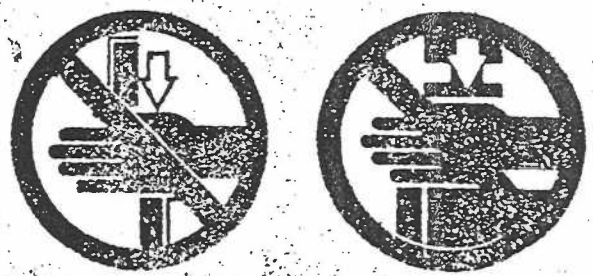
It is suggested that the owner order the B11.4-1983 Standards from American National Standard Institute.

American National Standards Institute, Inc.
1430 Broadway
New York, NY 10018

DANGER

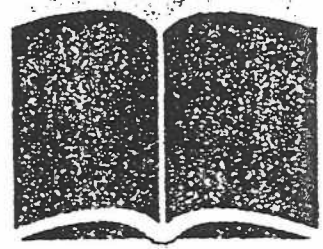
TO REDUCE THE POSSIBILITY OF INJURY . . .

DO NOT PLACE YOUR HANDS BETWEEN THE KNIVES OR BENEATH HOLDDOWNS.



DO NOT PLACE YOUR HANDS BETWEEN MATERIAL BEING SHEARED AND SHEAR TABLE

ALWAYS READ AND UNDERSTAND THE OPERATION, MAINTENANCE AND SAFETY MANUAL BEFORE OPERATING OR SERVICING THIS SHEAR



DO NOT REMOVE THIS SIGN FROM THIS SHEAR

S2
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SAFETY GUIDELINES

SHEAR

- READ AND UNDERSTAND THE OPERATION AND SAFETY MANUAL:
- KNOW HOW TO USE THE OPERATOR CONTROLS AND MODES OF OPERATION:
- OPERATE ONLY WITH SAFEGUARDING PROPERLY INSTALLED
- KNOW THE SET-UP AND PROPER METHOD OF OPERATION
- TEST ALL THE REQUIRED OPERATOR CONTROL STATIONS AND MODES OF OPERATION . . . BEFORE EACH SHIFT, EACH JOB RUN AND AFTER EACH BREAK
- HOLDDOWNS OPERATING WITH ADEQUATE PRESSURE
- MAKE CERTAIN PIECE PART WILL BE CLAMPED BY ONE OR MORE HOLDDOWNS
- DO NOT SHEAR MATERIAL THAT WILL TIP UP WHEN BEING CUT
- DO NOT PLACE YOUR HANDS BETWEEN THE KNIVES OR BENEATH HOLDDOWNS
- DO NOT PLACE YOUR HANDS BETWEEN MATERIAL BEING SHEARED AND SHEAR TABLE
- USE HAND TOOLS FOR SMALL OR NARROW PIECE PARTS
- MAKE CERTAIN EVERYONE IS CLEAR OF FRONT AND REAR OF SHEAR BEFORE OPERATING
- TURN OFF OR LOCKOUT OPERATOR CONTROLS WHEN NOT OPERATING SHEAR
- WHEN YOU LEAVE THE SHEAR:
  - — TURN OFF OR LOCKOUT OPERATOR CONTROLS
  - — TURN POWER OFF

DO NOT REMOVE THIS SIGN FROM THIS SHEAR

S3
1/86

S4
1/86

American National Standard

adopted by the

DEPARTMENT
OF
DEFENSE

see acceptance notice on inside front cover

for machine tools – shears – safety requirements for construction, care, and use

american national standards institute, inc.
1430 broadway, new york, new york 10018

ANSI B11.4-1983

5.1.1.1 Manufacturer. It shall be the responsibility of the manufacturer to equip each new or used shear with one of the following:

(1) A point-of-operation guard

(2) A point-of-operation device

(3) A point-of-operation awareness barrier

5.1.1.2 Employer. It shall be the responsibility of the employer to equip shears with, and ensure the use of, one of the following:

(1) A point-of-operation guard

(2) A properly applied and adjusted point-of-operation device

(3) A point-of-operation awareness barrier

Exception: The requirements given in 5.1.1 shall not apply when the point-of-operation opening is 1/4 inch or less. Also, they shall not apply when the shear is automatically or semiautomatically operated. If manual loading or unloading, or both, of the automatically operated shear is a requirement, safeguarding of the point of operation in accordance with Section 5 shall be provided.

5.1.2 Point-of-Operation Guards. Every point-of-operation guard shall meet the following design, construction, application, and adjustment requirements.

(1) It shall prevent entry of any part of the operator's body into the point of operation by reaching through, over, under, or around the guard.

(2) Compliance with (1) can be achieved by conforming to the dimensions defined in Fig. 1 and given in Table 1.

Table 1
Dimensions, in Inches, for Point-of-Operation Guard*

Maximum Opening under Guard (A)	Minimum Distance to Point of Operation (Hold-Down or Blade) (B)	Maximum Openings (Horizontal/Vertical) in the Guard (C)
1/4	1/2	3/8
3/8	1-1/2	3/8
1/2	2-1/2	1/2
5/8	3-1/2	1/2
3/4	5-1/2†	5/8
7/8	6-1/2†	3/4
1-1/4	7-1/2†	7/8
1-1/2	12-1/2†	7/8
1-7/8	15-1/2†	1-1/4
2-1/8	17-1/2†	1-1/4
Over 2-1/8 to 6	31-1/2†	1-1/4

*See Fig. 1, Details A through E.

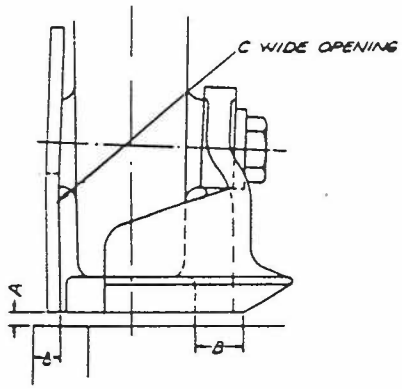
†These dimensions may be reduced by using an awareness barrier. See Table 2.

However, since guarding is not possible in some instances, devices and awareness barriers are recognized as adequate safeguarding. Some shears may require two or more to be used in combination.

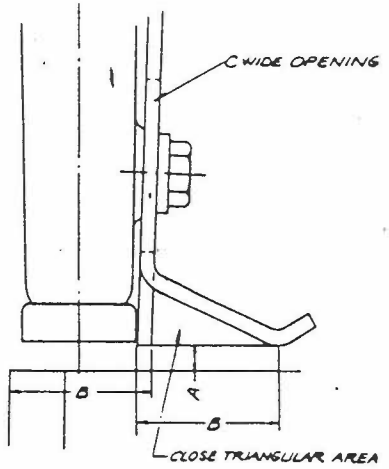
E5.1.1.2 Employer. An opening of 1/4 inch or less is considered so small that it is not possible to inadvertently insert any portion of the hands or fingers within the opening.

Exception: For example, flying cutoff shears or similar shears, installed in the punch press or roll-forming line, may require safeguarding of the point-of-operation to minimize the hazard to employees.

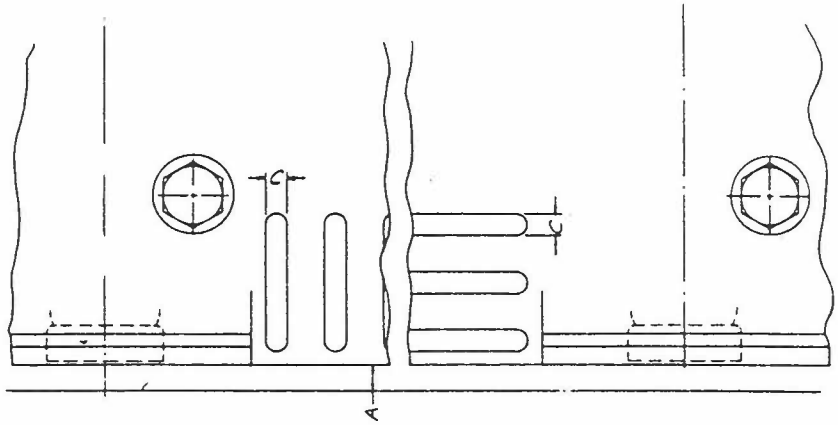
E5.1.2 Point-of-Operation Guards. Point-of-operation guards are the most positive form of protection for preventing injuries at the point of operation



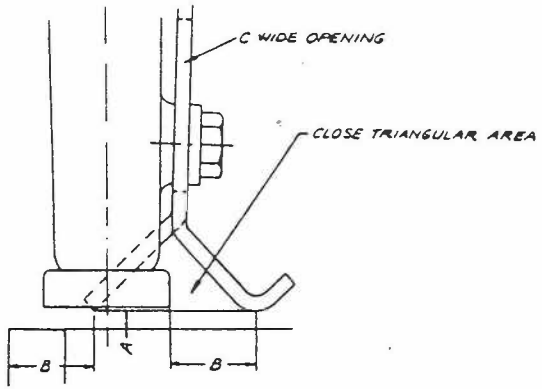
Detail A



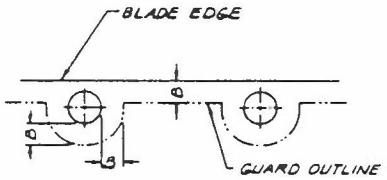
Detail B



Detail C



Detail D



Detail E

Fig. 1
Point-of-Operation Guard

(3) It shall, of itself, create no pinch point between itself and moving machine parts.

(4) It shall utilize fasteners not readily removable by the operator, so as to minimize the possibility of misuse or removal of essential parts.

(5) It shall facilitate its own inspection

(6) It shall offer maximum visibility of the point-of-operation, consistent with requirements (1) through (5).

5.1.2.1 Fixed Guard. A fixed guard, when used, shall be attached securely to the shear.

5.1.2.2 Interlocked Shear Guard. An interlocked shear guard, when used, shall be attached to the shear frame and shall be interlocked with the shear control so that the shear cannot be activated for normal shearing operations unless the guard is in position to conform to the requirements of 5.1.2.

5.1.2.3 Adjustable Guard. An adjustable guard, when used, shall be securely attached to the shear and shall be adjusted and used in conformance with the requirements of 5.1.2.

5.1.2.4 Throat (Gap) Guard. Partial enclosures conforming to the requirements of 5.1.2 insofar as the area of entry which they protect shall be provided on both sides of the point of operation (in the area commonly referred to as the gap or throat) to prevent the operator from reaching around or behind the guard and into the point of operation. These partial enclosures shall not, of themselves, create a pinch point or shear hazard. The guard shall be capable of being removed to facilitate removal of material, shearing, and slitting of material longer than the width of the shear.

5.1.2.4.1 Warning Instructions. When the throat (gap) guard is removed, instructions warning the operator of the hazard must be visible.

5.1.3 Point-of-Operation Devices. A point-of-operation device shall protect the operator by preventing or stopping normal stroking of the shear, or retaining or withdrawing the operator's hands if they are inadvertently placed in the point of operation.

(3) It is recommended that at least 1 inch of clearance be provided to avoid the possibility of pinch points.

(4) It is recommended that a tool such as a box wrench, open-end wrench, socket or key wrench, or an adjustable wrench be required to remove the fasteners rather than having the guard secured by hooks, magnets, wing nuts, or other methods that do not require the use of a tool such as those listed.

(6) The shearing area should be illuminated if sufficient ambient light does not exist.

E5.1.2.3 Adjustable Guard. If the adjustment and operation of the adjustable guard is not closely supervised, inadequate safeguarding may result.

E5.1.2.4.1 Warning Instructions. One suggested instruction is the following: "WARNING: Do not place hands or fingers in this area. Replace guard when not slitting."

E5.1.3 Point-of-Operation Devices. A point-of-operation device does not offer the measure of protection given by a guard. Shearing operations are normally a "hands on material" type job. Fixed safeguarding, awareness barriers, or devices normally can be used for safeguarding. There may be a limited number of applications where only a two-hand control can be used as a point-of-operation safeguarding device.

The use of two-hand controls as a safeguarding device should be limited to these applications and only on shears with a part-revolution clutch or hydraulic shears. If more than one operator is involved, each should have a two-hand operator control station.

This section is intended to clarify that the use of two-hand controls is recognized but not encouraged.

5.1.3.1 Presence-Sensing Point-of-Operation Device. A presence-sensing point-of-operation device, when used, shall protect the operator as specified in 5.1.3 and shall be interlocked into the control circuit to prevent or stop shear actuation if an operator's hand or other part of his body is detected in the sensing field of the device. The following requirements shall apply:

(1) The device shall not, of itself, create any hazard to the operator.

(2) The device shall not be used on machines using full-revolution clutches or on pneumatic power shears.

(3) The device shall not be used as a tripping mechanism.

(4) The device shall be designed for fail-safe operation.

(5) Failure of the light source or power supply, excessive ambient light, temperature variations, or other environmental factors shall not adversely affect the protection offered.

(6) The device shall have full-function monitoring.

(7) Devices containing sensitivity adjustments shall provide operator protection at the lowest or minimum sensitivity adjustment.

5.1.4 Point-of-Operation Awareness Barrier. Where, in guarding the point of entry of material, it is not practical to conform with 5.1.2, the point of entry may be guarded by a point-of-operation awareness barrier similar to those defined in Fig. 2 (Details A and B) and given in Table 2.

E5.1.3.1 Presence-Sensing Point-of-Operation Device

(6) A presence-sensing point-of-operation device should be a self-checking, self-monitoring type that must inhibit further stroking if a fault occurs in the device.

E5.1.4 Point-of-Operation Awareness Barrier. The awareness-barrier concept is that of a barrier that moves to provide additional clearance over the minimum allowed by the entry of the workpiece and that cannot be lifted by the operator without his awareness. Such a guard provides a minimum unrestricted clearance (1/4 inch) in accordance with accepted guard standards and provides restricted access by contact awareness for clearances in excess of 1/4 inch. Additionally, the guard provides visual boundaries to the operator's free and unrestricted movements and establishes the danger-zone boundaries. See Illustration 8.

Additional guarding may be required at the gap (throat).

Table 2
Dimensions, in Inches, for Point-of-Operation Awareness Barrier*

Maximum Opening under Fixed Section of Guard (A)	Minimum Distance, Fixed Section to Blade (B)	Maximum Opening in Fixed Section (Vertical/Horizontal) (C)	Maximum Opening under Movable Section		Minimum Distance from Movable Section to		Maximum Space (F)
			When Down	When Up	Hold-Down (D)	Blade (E)	
3/4	4-3/4	5/8	1/4	3/4	1-1/2	4-3/4	3/8
7/8	5-1/2	3/4	1/4	7/8	1-1/2	5-1/2	3/8
1-1/4	6	3/4	1/4	1-1/4	2	6	3/8
1-1/2	6-1/2	7/8	1/4	1-1/2	2	6-1/2	3/8
1-7/8	7-1/2	1-1/4	1/4	1-7/8	2-3/8	7-1/2	3/8
2-1/8	7-7/8	1-1/4	1/4	2-1/8	2-7/8	7-7/8	1/2
Over 2-1/8 to 6	7-7/8	1-1/4	1/4	Over 2-1/8 to 6	2-7/8	7-7/8	1/2

*See Fig. 2, Details A and B.

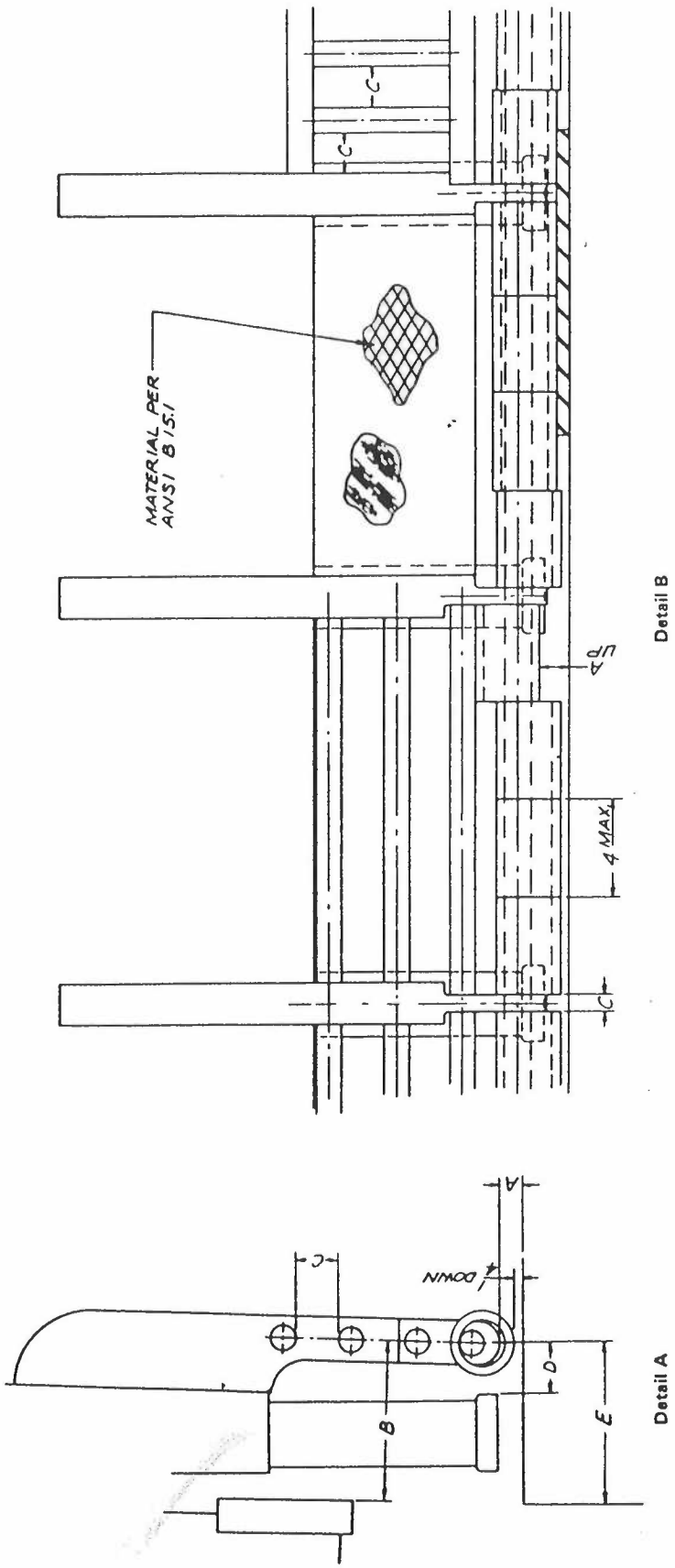


Fig. 2
Point-of-Operation Awareness Barrier

5.1.4.1 Movable Section. The point-of-operation awareness barrier in its free suspended position shall limit unrestricted entry by a clearance of 1/4 inch maximum. Restricted entry requiring lifting of barrier sections shall be provided when material exceeds 1/4 inch in thickness. Lifted sections shall remain in contact with the inserted material by virtue of their own weight so as to allow no clearance for unrestricted entry of fingers, shall be designed to offer resistance to entry, and shall require a distinct effort to lift. The sections shall be limited to 4 inches in length to provide a maximum possible horizontal clearance of 4 inches.

5.1.4.2 Fixed Section. The fixed section shall be in accordance with Table 2. Openings (for visibility) shall not exceed the allowable limits given in Table 2, Column 3. The fixed sections shall not be readily removable by the operator.

5.1.4.3 Warning Sign. A sign that is readily visible to the operator shall be affixed to the shear, warning of the hazards if any portion of the body is placed into or beyond the point-of-operation awareness barrier.

5.2 Safeguarding the Rear of the Shear

5.2.1 Definition of Rear Area. The rear of the shear is the area between the housings, the extremities of the moving shear parts, and the extent of the material being sheared, whichever is greatest.

5.2.2 Responsibility

5.2.2.1 Manufacturer. The manufacturer shall eliminate the hazard by design, where possible, or, if practical, shall provide protection against the hazard in accordance with ANSI B15.1-1972. Where the hazard cannot be eliminated by design or protection, the manufacturer shall advise the employer of the hazard. The employer shall then be responsible for providing protection against the hazard.

5.2.2.2 Employer. The employer shall establish and ensure adherence to safe working procedures regarding the operations required at the rear of the shear and shall provide adequate safeguards to minimize the hazards from moving parts and from sliding or falling material that has been sheared.

E5.1.4.2 Fixed Section. It is recommended that a tool such as a box wrench, open-end wrench, socket or key wrench, or an adjustable wrench be required to remove the fixed section rather than having the fixed section secured by hooks, magnets, wing nuts or other methods that do not require the use of a tool such as those listed.

E5.1.4.3 Warning Sign. Because it is possible for an employee to penetrate this barrier by a special effort, a sign should warn the employee of the danger of doing so. The following is one suggested wording: "WARNING: Do not extend fingers or hands beyond guard or barrier."

E5.2.2.2 Employer. Because of the great variety of methods used in handling material, it is difficult to specify any one way to reduce these hazards. Reduction of hazards may be accomplished by one or more of the following means:

(1) Conveyors behind the shear

(2) A presence-sensing device to restrict shearing when an employee is behind a shear

(3) A pedestrian barrier

(4) A barrier with an interlocked gate

(5) A stop switch located at the rear of the shear

(6) A fence extending between the housings at the rear of the shear

(7) An audible signal controlled by the operator to warn an employee at the rear of the shear

(8) Two-hand control in a fixed safe location interlocked with the primary actuating means

These are some of the methods that may be used to reduce the hazard to the operator or helper (or to warn the operator) when at the rear of the shear.

6. Care

6.1 Responsibility

6.1.1 Instructions

6.1.1.1 Manufacturer. It shall be the responsibility of the manufacturer to furnish instructions with the shear to establish guidelines for the use and care of the shear.

E6.1.1.1 Manufacturer. The manufacturer's literature should be of a general nature, with guidelines on the care of shears. For products with unique characteristics, specific material should be furnished.

6.1.1.2 Modifier or Reconstructor. It shall be the responsibility of any manufacturer modifying or reconstructing a shear to furnish instructions with the modification to establish new or changed guidelines for the use and care of the shear so modified..

E6.1.1.2 Modifier or Reconstructor. Many modifications or rebuilding efforts are so extensive that any original instructions from the original manufacturer are incorrect or meaningless; therefore, the person responsible for the modification should furnish new material.

6.1.1.3 Employer. It shall be the responsibility of the employer to specify safe maintenance procedures and to maintain the shear in safe operating condition.

6.1.2 Installation. It shall be the responsibility of the person(s) installing a shear to use procedures that will allow for a safe installation.

E6.1.2 Installation. A safe installation is one that minimizes the possibility of injury to persons during installation or subsequent operations.

6.1.3 Training of Maintenance Personnel. It shall be the responsibility of the employer to ensure the original and continuing competence of personnel caring for, inspecting, and maintaining shears.

6.1.4 Inspection and Maintenance Records. It shall be the responsibility of the employer to establish and follow a program of periodic and regular inspections of the shears to ensure that all the parts, auxiliary equipment, and safeguards are in safe operating condition and adjustment.

6.1.5 Shutdown Procedure for Shear Inspection. It shall be the responsibility of the manufacturer to recommend a safe shutdown procedure, and of the employer to establish and follow a safe shutdown procedure, before allowing any inspection to be made of a shear.

E6.1.5 Shutdown Procedure for Shear Inspection. For safety inspections not requiring air or electrical power, the following procedure is suggested:

(1) Turn off the drive motor.

(2) Open the disconnect switch and lock out.

(3) On mechanical shears, allow the flywheel to stop completely before attempting any inspection, adjustment, repair, or replacement.

(4) On hydraulic or pneumatic shears, block under the ram.

(5) Turn off air supply and bleed off stored air.

6.1.6 Start-up Procedure. It shall be the responsibility of the manufacturer to recommend a safe start-up procedure, and of the employer to establish and follow a safe start-up procedure, before allowing any operators to operate a shear.

6.1.7 Blade Servicing

6.1.7.1 Manufacturer's Responsibility. It shall be the responsibility of the manufacturer to provide with each new shear instructions that electrical or fluid-power supplies be disconnected from the shear, or that the jog (inch) control be used when performing blade changes or replacements.

6.1.7.1.1 Installation or Changing. It shall be the responsibility of the manufacturer to provide with each new shear complete and clear instructions on the safe procedure to remove, turn, or replace the shear's blades.

6.1.7.1.2 Adjusting. It shall be the responsibility of the manufacturer to provide with each new shear complete and clear instructions on the safe and proper procedure for adjusting blades.

6.1.7.2 Employer's Responsibility. It shall be the responsibility of the employer to ensure that the requirement in 6.1.7.1 is complied with when blade changes or replacements are made.

6.1.7.2.1 Installation or Changing. It shall be the responsibility of the employer to ensure that safe procedures are followed when removing, turning, or replacing blades on a shear.

6.1.7.2.2 Adjusting. It shall be the responsibility of the employer to ensure that safe procedures are followed for the safe and proper adjustment of blades.

7. Use

7.1 Employer Responsibility. It shall be the responsibility of the employer to institute training procedures that will ensure the competence of all personnel associated with the use of shears.

7.1.1 Hazards at the Point of Operation. The employer shall be responsible for the proper installation and continued use of point-of-operation guards, devices, or awareness barriers to ensure operator safety. See Section 5.

7.1.1.1 Hand Tools. To eliminate the need for an operator to place his hands into the point of operation, the employer shall furnish hand tools to assist in the feeding or removal of material into or from the point of operation, when required by a particular shearing operation. These tools shall not be used in lieu of the guards, devices, or barriers required in Section 5.

7.1.1.2 Material Handling

7.1.1.2.1 Manual Handling

(1) When a shear is fed manually, the material being cut shall rest on the table or fixture before the shear is activated.

E6.1.7.1 Manufacturer's Responsiblity. Instructions may be in the form of a sign affixed to the shear or may be in the manual furnished by the manufacturer.

E6.1.7.1.1 Installation or Changing. A specific procedure which would apply to all shears cannot be defined in this standard. All procedures should recommend the blocking of the ram (when possible) to prevent its movement and possible injury to anyone while blade installation or changes are in process.

E7.1.1.1 Hand Tools. An important use of hand tools is to prevent the need for the operator to place his hands or fingers within the point of operation. However, these tools do not prevent the operator from inadvertently placing his hands or fingers within the point of operation. Therefore, a guard, device, or barrier must be used for protection. Some typical hand tools are shown in Illustration 9.

(1) When stock is resting totally on the shear table and must be removed, it is recommended that the operator or helper push the stock, using the palm of his

(2) When the end of the material reaches the shear table, the operator or helper shall not place any portion of his hands underneath the material when it is sheared.

(3) Handling slots are to be used primarily as an aid in the handling or positioning of the material on the shear table.

7.1.1.2.2 Scrap Handling. The employer shall provide means for handling scrap. Scrap cutters, when used in conjunction with scrap-handling systems, shall be safeguarded in accordance with ANSI B15.1-1972.

7.1.1.3 Personal Protective Equipment. It shall be the responsibility of the employer to ensure the use of personal protective equipment or tools that will reduce the hazards at the point of operation or in handling of stock or scrap.

7.1.2 Throat (Gap) Guard. When gap shears are to be used for slitting operations, before any changes are made, the motor shall be turned off. Follow the manufacturer's instructions for blade positioning. When the throat (gap) guard is removed, instructions warning the operator shall be visible.

7.1.3 Instruction of Operators. The employer shall train and instruct the operator in the safe method of work before starting work on any operation covered by this standard. The employer shall ensure by supervision the use of correct operating procedures by personnel involved in shearing operations.

7.1.4 Use of Helpers. A helper, when assisting an operator, shall be positioned out of reach of, or protected from, the point-of-operation hazard and hazards at the rear of the shear.

7.1.5 Work Area. The work area around the shear shall be kept in nonskid suitably illuminated condition. The employer shall provide clearance between machines so that movement of one operator will not interfere with the work of another. Ample room for handling material, workpieces, and scrap shall be provided and the area shall be kept free from obstructions.

7.1.6 Overloading. The employer shall operate his shears within the capacity rating specified by the manufacturer.

7.2 Employee Responsibility. The employer shall ensure that the employee meets the requirements of this standard.

7.2.1 Shear Operator. Each shear operator shall operate the shear in a safe manner to prevent injury to himself or to a helper, if one is assigned to a specific job.

hand or his palm and thumb on the back edge of the stock to keep from being injured when hold-downs engage the material or the knife starts to cut.

E7.1.4 Use of Helpers. See 5.2.2.2.

E7.1.6 Overloading. Overloading may result in machine damage or malfunction and may expose the operator to injury.

E7.2.1 Shear Operator. In order to perform his job in a safe manner, the shear operator should do the following:

(1) Make a preoperation check of all operating controls, blades, material gages, hand-feeding tools, safe-

guarding (if used), and the material being worked.

(2) Check the work area to be sure it is free of objects that would cause the operator or a helper to slip or trip when feeding material.

(3) Use proper work supports, mechanical assists, or helpers when loading or unloading heavy piece parts, sheets, or material.

(4) Wear proper personal protective equipment as specified by the employer for the specific operation being performed.

(5) Make the shear inoperative when leaving a shear unattended.

8. Revision of American National Standards Referred to in This Document

When the following American National Standards referred to in this document are superseded by a revision approved by the American National Standards Institute, Inc, the revision shall apply:

American National Standard Safety Standard for Mechanical Power Transmission Apparatus, ANSI B15.1-1972

American National Standard Specifications for Accident Prevention Signs, ANSI Z35.1-1972

American National Standard Specifications for Accident Prevention Tags, ANSI Z35.2-1968 (R1974)

American National Standard Specifications for Informational Signs Complementary to ANSI Z35.1-1972, Accident Prevention Signs, ANSI Z35.4-1973

American National Standard Safety Color Code for Marking Physical Hazards, ANSI Z53.1-1979

American National Standard Safety Requirements for Design, Use, and Maintenance of Metal and Paper Scrap Processing Equipment, ANSI Z268.1-1973

Electrical Standard for Metalworking Machine Tools and Plastics Machinery, ANSI/NFPA 79-1980

INSTALLATION

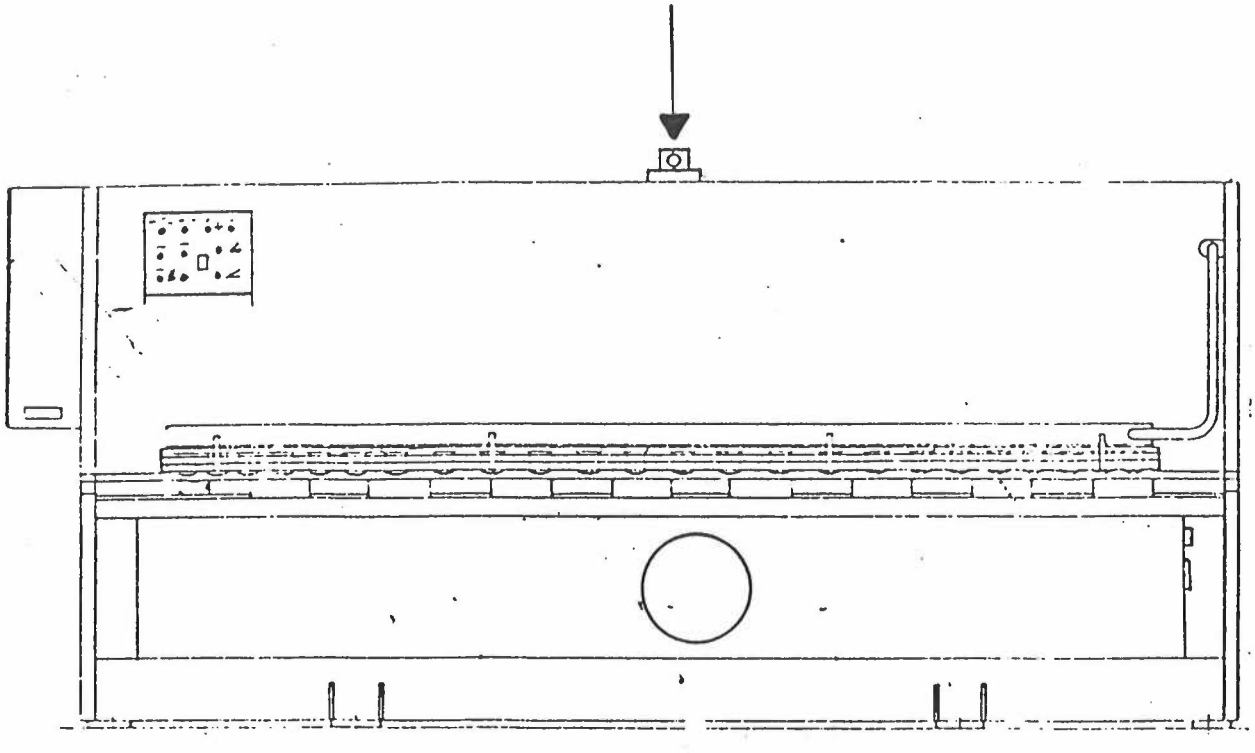
UNLOADING

Lifting eyes are provided on all machines for balanced lifting of the machine by crane.

If a forklift is used it should lift from the front, with care taken to ensure the forks clear any hydraulic apparatus under the rear covers.

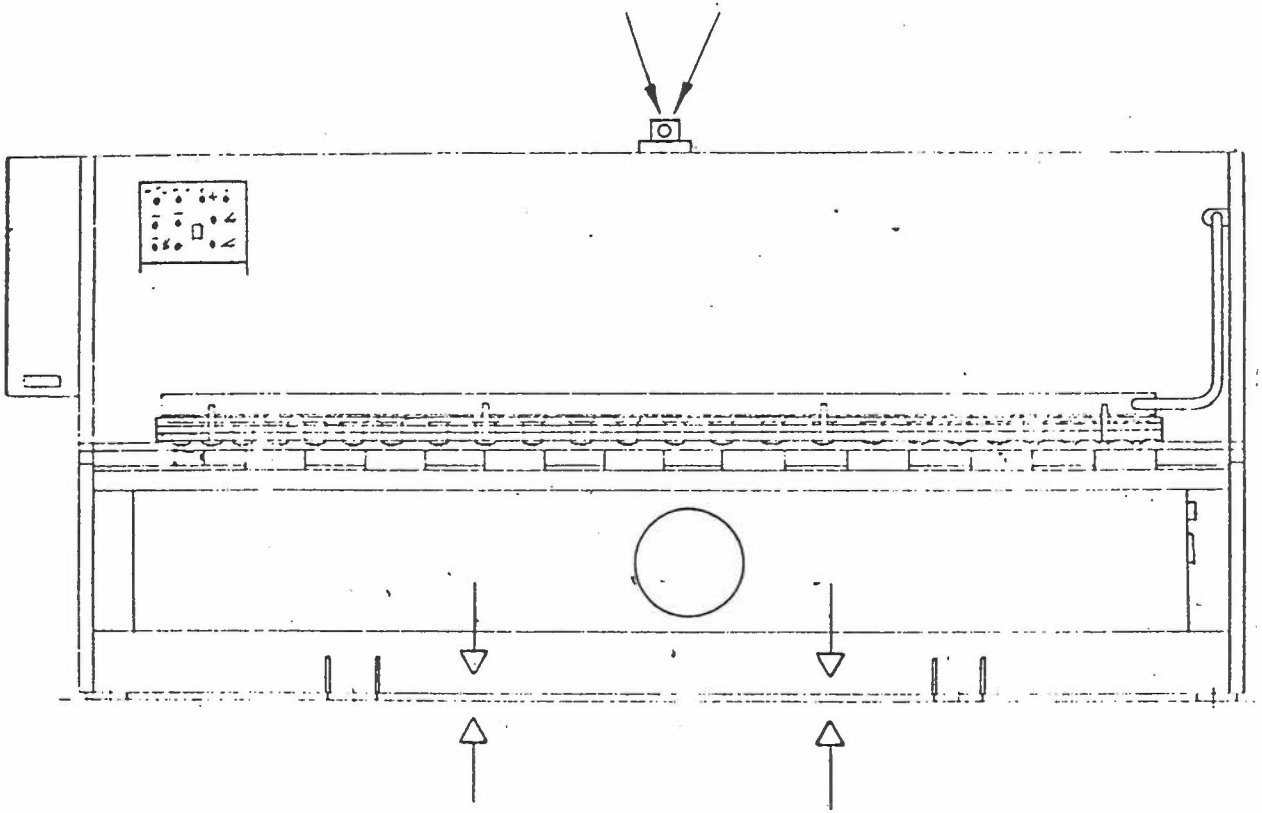
CAUTION: The center of gravity is located approximately at the shear blades, thus allowing the machine to fall forward if it is not properly handled.

Net Weight approximately - 10,500 lbs.



CRANE LIFTING POINT

CHAIN TO MAST FROM THESE POINTS

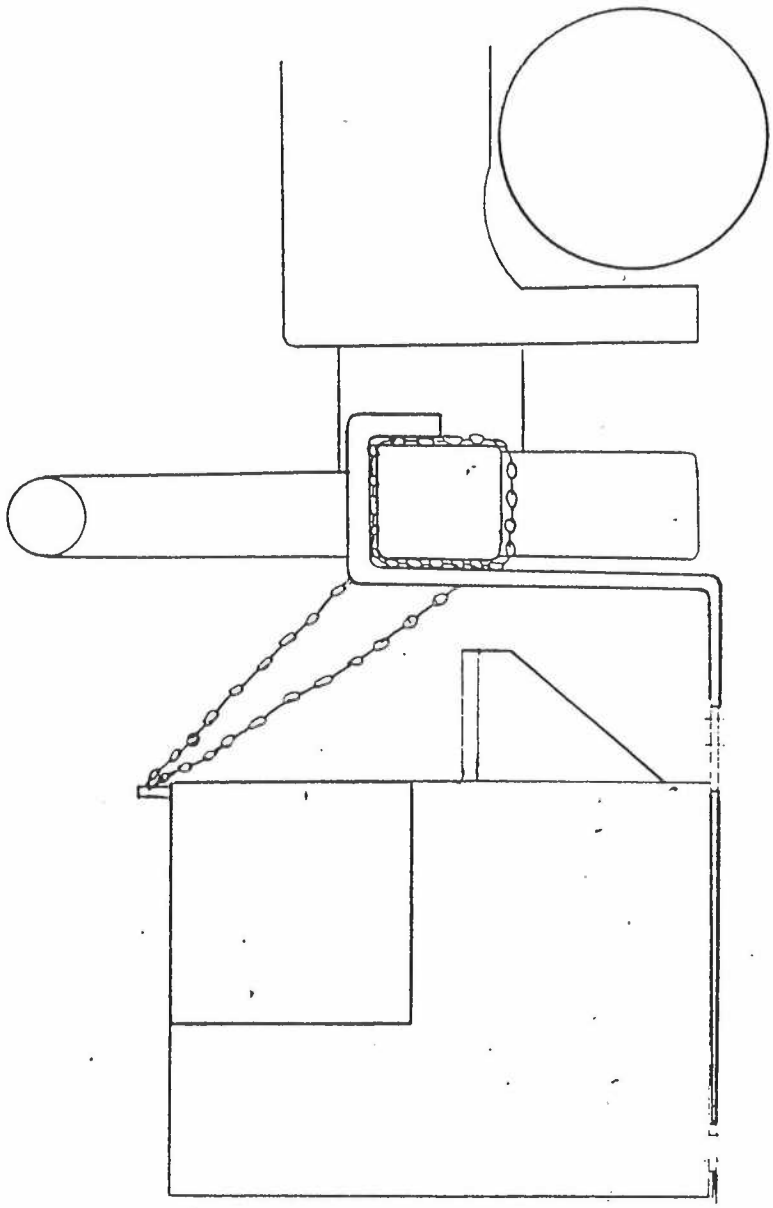


POSITION FORKS FOR EQUAL WEIGHT DISTRIBUTION

FORKLIFT LIFTING POINTS

10 x 1/4
1/86

CHAIN POSITIONED TO MAST



INSTALLATION (con't)

Placement

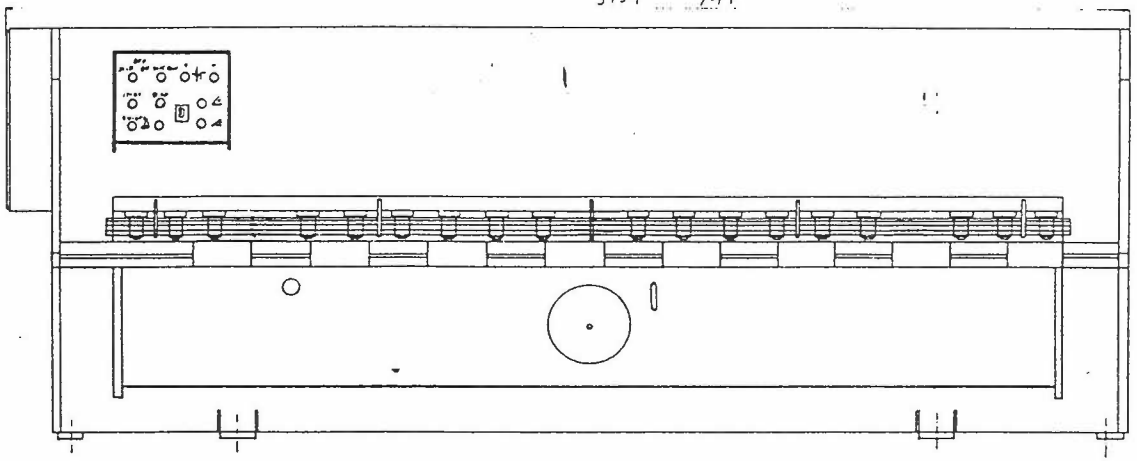
Consideration should be given to the location the machine will be placed to meet the following criteria.

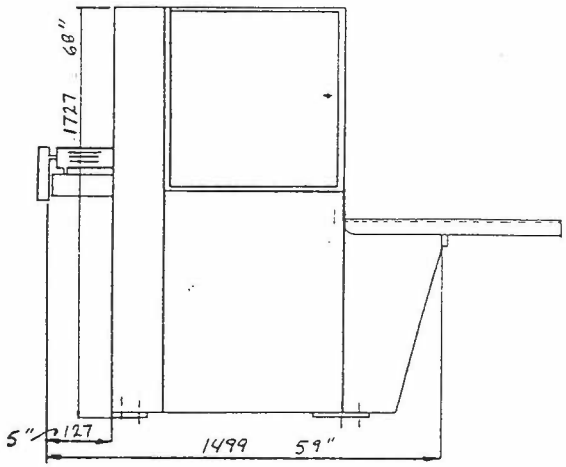
1. Central location for material flow. Both the front and back of the machine should be accessible by your forklift, for delivering parts to be sheared and removing the stacked parts after shearing.

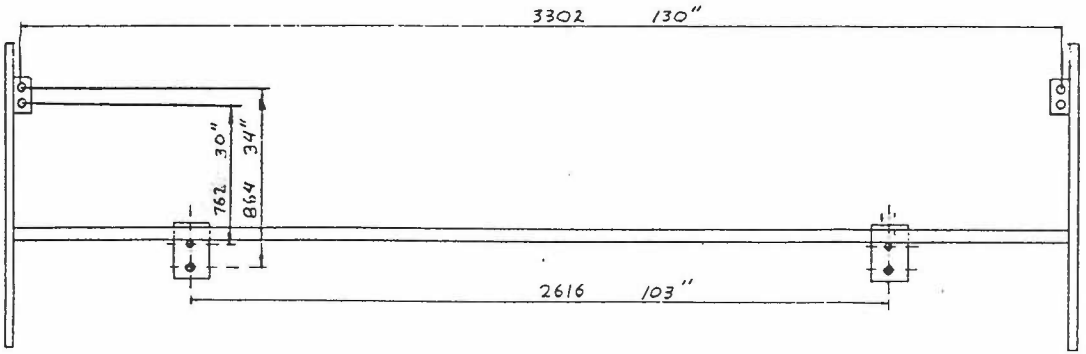
2. The floor should be minimum of 6" reinforced concrete and the machine should not be placed over expansion joints or cracks in the concrete.

The leveling screws must be placed on 8" square 1/4" thick steel plates to ensure accurate leveling. Holes have been provided in the feet if you desire to anchor the machine to the floor. This is desirable but not necessary as the hydraulic design of the machine tends to minimize shock.

Optionally, at customer preference, anchor bolts of 3/4" diameter may be used. Customer shall be responsible for construction of concrete pads and bolt installation per the certified drawings provided.







10 X 1/4 HDE SHEAR
FOUNDATION PLAN

ATLANTIC MACHINE TOOLS
10601 Cullen Boulevard
Houston, Texas 77047

PART NO.	DESCRIPTION

TOLERANCES

10 ÷ 10 ± 0.5	10 ÷ 10 ± 1	10 ÷ 10 ± 2
10.1 ÷ 10.1 ± 0.05	10.1 ÷ 10.1 ± 0.1	10.1 ÷ 10.1 ± 0.2
10.11 ÷ 10.11 ± 0.005	10.11 ÷ 10.11 ± 0.01	10.11 ÷ 10.11 ± 0.02

8 7 6 5 4 3 2 1

15
1/86
10 x 1/4

INSTALLATION (con't)

Leveling

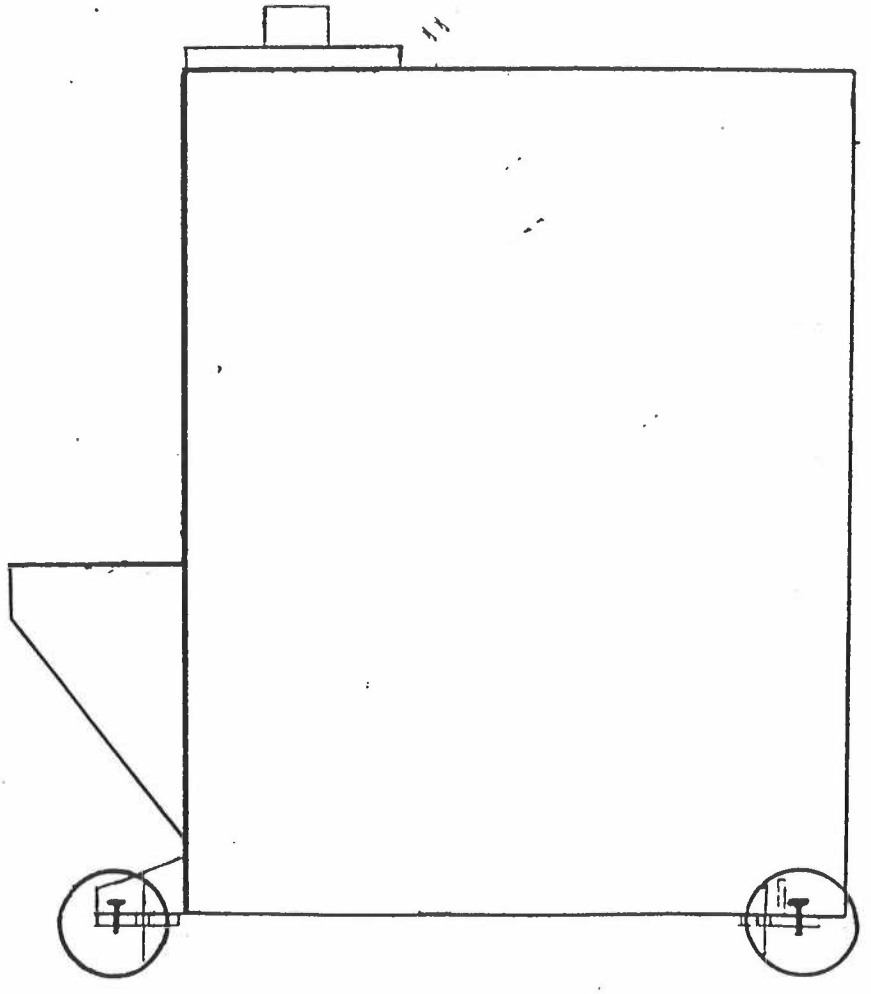
Remove the front finger guard and place a precision level (.001/ft) lengthwise on the machined portion in front of lower blade. In this way you can level the machine left to right using the leveling screws on the front feet.

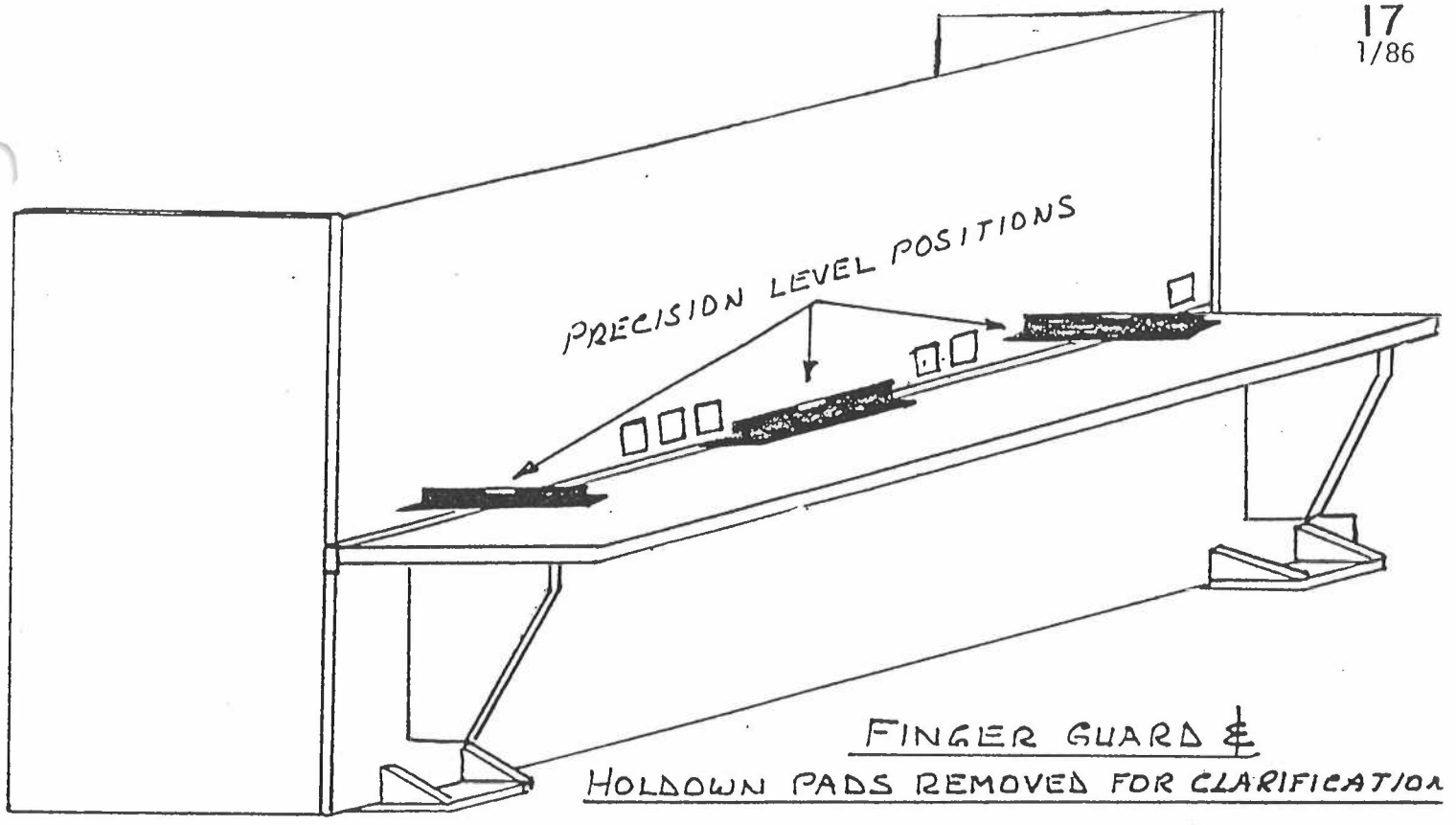
Secondly, place the level on each end of the same machined surface at right angle to the blades and level front to back using the rear leveling screws.

It is important that the machine is properly leveled to avoid twisting the frame.

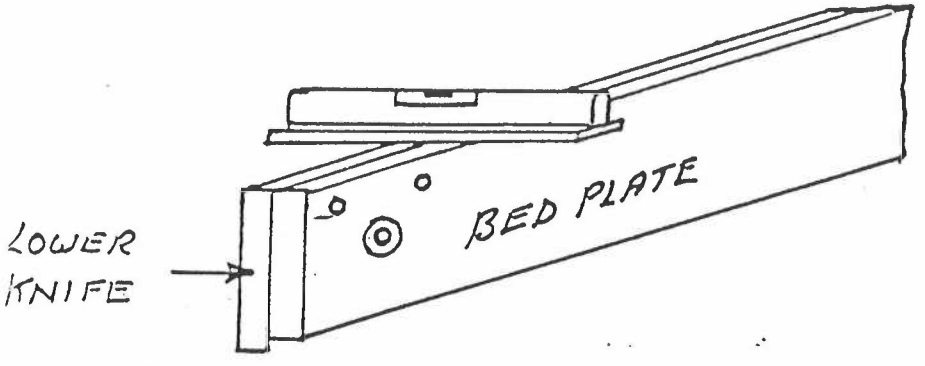
This should be re-checked periodically to ensure accurate blade clearance for the length of the cutting area.

IMPORTANT - Immediately re-install the finger guard after leveling.

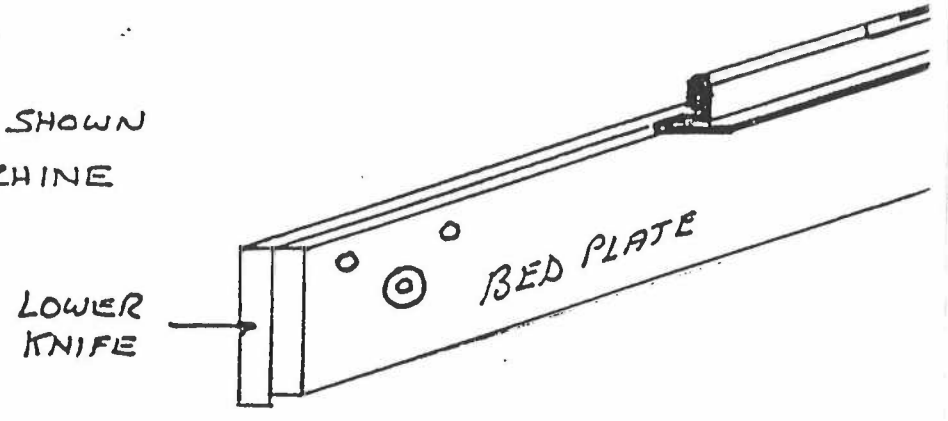




FINGER GUARD & HOLDOWN PADS REMOVED FOR CLARIFICATION



PLACE LEVEL ACROSS AS SHOWN AT BOTH ENDS OF THE MACHINE



PLACE LEVEL ON CENTER OF MACHINE RESTING ON BED PLATE ONLY.

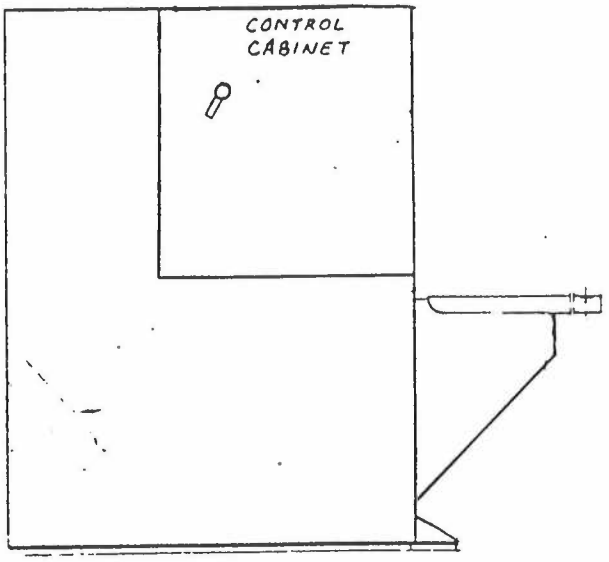
INSTALLATION (con't)

Electrical Connection

The machine is wired to run on 240V or 480V, 3ph, 60 Hz. Generally, the primary voltage the transformer is wired will indicate the voltage the rest of the machine is wired. A fused supply circuit with wire capable of handling the 15 H.P. main motor should be installed to ensure proper operation of the machine at capacity. (See charts on following pages)

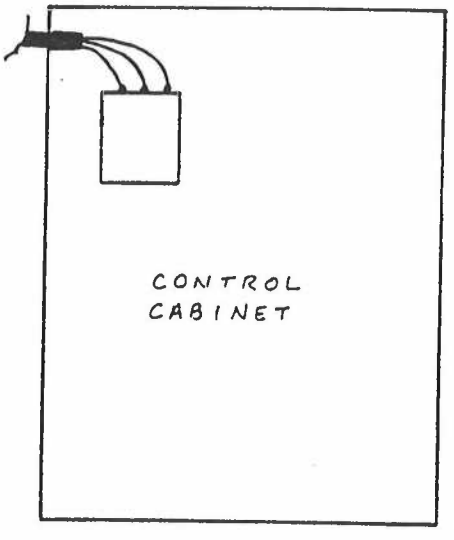
The ground wire should be the same size as the main conductors.

Electric connection is made at the circuit breaker located inside the electric main control box on left hand side of machine (viewed from front).



CIRCUIT BREAKER

240V = EE3-B090
480V = EH3-B040



Protection of Three Phase 230 Volt Motors and

SIZE OF MOTOR ❶ (Table 430-150)		DUAL-ELEMENT FUSE FOR MOTOR RUNNING OVERLOAD PROTECTION (Section 430-32) These Fuses Also Provide Branch Circuit Protection ❷			BRANCH CIRCUIT PROTECTION † (SHORT-CIRCUIT PROTECTION ONLY) (Section 430-52) These Fuses Do Not Give Motor Running Protection ❸					Minimum Size of Starter ❹	Minimum Size of Copper Wire (Table 310-16) ❺		Minimum Size of Trade Conduit ❻
		FUSETRON Dual-Element Fuse or LOW-PEAK Dual-Element Fuse Size		Switch (115% Min. or Hp rated) or Fuseholder Size	Class for Motor Starting Inrush & Code Letter	FUSETRON Dual-Element Fuse or LOW-PEAK Dual-Element Fuse (Time-Delay) †	Switch or Fuseholder Size	Non Time-Delay Fuse †	Switch or Fuseholder Size		AWG or MCM		
HORSE POWER	AMPERE RATING	Motor Rated Not Over 40 C or Not less than 1.15 S F (Max Fuse 125%)	All Other Motors (Max Fuse 115%)							NEMA SIZE	a-TW (60°C) b-THW (75 C) c-THWN (75°C) d-THHN (90°C) e-XHHW♣ (90°C)		For Copper Wire
½	2	2½	2¼	30	Any	4	30	6	30	00	14	a,b,c,d,e	½"
¾	2.8	3½	3 2/10	30	Any	4	30	10	30	00	14	a,b,c,d,e	½"
1	3.6	4½	4	30	Any	6¼	30	15	30	00	14	a,b,c,d,e	½"
1½	5.2	6¼	5 6/10	30	Any	8	30	15	30	00	14	a,b,c,d,e	½"
2	6.8	8	7	30	1 2 3-4	10 10 10	30 30 30	25 20 15	30 30 30	0	14	a,b,c,d,e	½"
3	9.6	12	10	30	1 2 3 4	15 15 15 15	30 30 30 30	30 25 20 15	30 30 30 30	0	14	a,b,c,d,e	½"
5	15.2	17½	17½	30	1 2 3 4	25 25 25 25	30 30 30 30	50 40 35 25	60 60 60 30	1	12	a,b,c,d,e	½"
7½	22	25	25	30	1 2 3 4	35 35 35 35	60 60 60 60	70 60 45 35	100 60 60 60	1	10	a,b,c,d,e	½"
10	28	35	30	60	1 2 3 4	40 40 40 40	60 60 60 60	90 70 60 45	100 100 60 60	2	8 8	a,b,e c,d	¾" ½"
15	42	50	45	60	1 2 3 4	60 60 60 60	60 60 60 60	125 110 90 70	200 200 100 100	2	6 6	a,b c,d,e	1" ¾"
20	54	60	60	100	1 2 3 4	80 80 80 80	100 100 100 100	175 150 110 90	200 200 200 100	3	4 6	a,b,c d,e	1" ¾"
25	68	80	70	100	1 2 3 4	100 100 100 100	100 100 100 100	225 175 150 110	400 200 200 200	3	2 4	a b,c,d,e	1¼" 1"
30	80	100	90	100	1 2 3 4	125 125 125 125	200 200 200 200	250 200 175 125	400 200 200 200	3	1 3 3	a b c,d,e	1¼" 1¼" 1"
40	104	125	110	200	1 2 3 4	150 150 150 150	200 200 200 200	350 300 225 175	400 400 400 200	4	2/0 1	a b,c,d,e	1½" 1¼"
50	130	150	150	200	1 2 3 4	200 200 200 200	200 200 200 200	400 350 300 200	400 400 400 200	4	3/0 2/0	a b,c,d,e	2" 1½"
60	154	175	175	200	1 2 3 4	250 250 250 250	400 400 400 400	500 400 350 250	600 400 400 400	5	4/0 3/0 3/0	a b c,d,e	2" 2" 1½"
75	192	225	200	400	1 2 3 4	300 300 300 300	400 400 400 400	600 500 400 300	600 600 400 400	5	300 250 250	a b c,d,e	2½" 2½" 2"
100	248	300	250	400	1-2 3 4	400 400 400	400 400 400	♦♦ 500 400	600 400	5	500 350	a b,c,d,e	3" 2½"
125	312	350	350	400	1-2-3 4	450 450	600 600	♦♦ 500	600	6	4/0-2/ϕ* 3/0-2/ϕ* 3/0-2/ϕ* 500	a b c d,e	2-2"* 2-2"* 2-1½"* 3"
150	360	450	400	600	1-2-3 4	500 500	600 600	♦♦ 600	600	6	300-2/ϕ* 4/0-2/ϕ*	a b,c,d,e	2-2½"* 2-2"*
200	480	600	500	600	Any	♦		♦♦		6	500-2/ϕ* 350-2/ϕ* 300-2/ϕ*	a b,c d,e	2-3"* 2-2½"* 2-2"*

† If manufacturer's overload relay table states a maximum branch circuit protective device of a lower rating, that lower maximum rating, must be used in lieu of above recommendation (last paragraph 430-52).

♦Use KRP-C Fuses sized at 150% to 250% depending on code letter and starting methods.

♦♦Use KTU Fuses sized at 150% to 300% depending on code letter and starting methods.

*Indicates two sets of multiple conductors and two runs of conduit.

♣For dry locations only.

Use FUSETRON dual-element Fuses or LOW-PEAK dual-element Fuses
FRN or FRN-R (250V.) LPN or LPN-R (250V.)
FRS or FRS-R (600V.) LPS or LPS-R (600V.)

Protection of Three Phase 460 Volt Motors and Circuits

❶ SIZE OF MOTOR (Table 430-150)		❷ DUAL-ELEMENT FUSE FOR MOTOR RUNNING OVERLOAD PROTECTION (Section 430-32) These Fuses Also Provide Branch Circuit Protection			❸ BRANCH CIRCUIT PROTECTION † (SHORT-CIRCUIT PROTECTION ONLY) (Section 430-52) These Fuses Do Not Give Motor Running Protection					❹ Mini-mum Size of Starter	❺ Minimum Size of Copper Wire (Table 310-16)		❻ Mini-mum Size of Trade Conduit
		FUSETRON Dual-Element Fuse or LOW-PEAK Dual-Element Fuse Size		Switch (115% Min. or Hp rated) or Fuseholder Size	Class for Motor Starting Inrush & Code Letter	FUSETRON Dual-Element Fuse or LOW-PEAK Dual-Element Fuse (Time-Delay) †	Switch or Fuseholder Size	Non Time-Delay Fuse †	Switch or Fuseholder Size		AWG or MCM a-TW (60°C) b-THW (75°C) c-THWN (75°C) d-THHN (90°C) e-XHHW♣ (90°C)		
HORSE POWER	AMPERE RATING	Motor Rated Not Over 40 C or Not less than 1.15 S.F (Max Fuse 125%)	All Other Motors (Max Fuse 115%)							NEMA SIZE			For Copper Wire
½	1	1¼	1⅛	30	Any	2	30	3	30	00	14	a,b,c,d,e	½"
¾	1.4	1 6/10	1 6/10	30	Any	2½	30	6	30	00	14	a,b,c,d,e	½"
1	1.8	2¼	2	30	Any	3 2/10	30	6	30	00	14	a,b,c,d,e	½"
1½	2.6	3 2/10	2 8/10	30	Any	4	30	10	30	00	14	a,b,c,d,e	½"
2	3.4	4	3½	30	Any	5	30	15	30	00	14	a,b,c,d,e	½"
3	4.8	5 6/10	5	30	Any	8	30	15	30	0	14	a,b,c,d,e	½"
5	7.6	9	8	30	1 2 3-4	15 15 15	30 30 30	25 20 15	30 30 30	0	14	a,b,c,d,e	½"
7½	11	12	12	30	1 2 3 4	20 20 20 20	30 30 30 30	35 30 25 20	60 30 30 30	1	14	a,b,c,d,e	½"
10	14	17½	15	30	1 2 3 4	20 20 20 20	30 30 30 30	45 35 30 25	60 60 30 30	1	12	a,b,c,d,e	½"
15	21	25	20	30	1 2 3 4	30 30 30 30	30 30 30 30	70 60 45 35	100 60 60 60	2	10	a,b,c,d,e	½"
20	27	30	30	60	1 2 3 4	40 40 40 40	60 60 60 60	90 70 60 45	100 100 60 60	2	8 8	a,b,e c,d	¾" ½"
25	34	40	35	60	1 2 3 4	50 50 50 50	60 60 60 60	110 90 70 60	200 100 100 60	2	6 8 8	a b,e c,d	1" ¾" ½"
30	40	50	45	60	1 2 3 4	60 60 60 60	60 60 60 60	125 100 80 60	200 100 100 60	3	6 6 8 8	a,b c d e	1" ¾" ½" ¾"
40	52	60	60	100	1 2 3 4	80 80 80 80	100 100 100 100	175 150 110 80	200 200 200 100	3	4 6 6	a b c,d,e	1" 1" ¾"
50	65	80	70	100	1 2 3 4	100 100 100 100	100 100 100 100	200 175 150 100	200 200 200 100	3	2 4	a b,c,d,e	1¼" 1"
60	77	90	80	100	1 2 3 4	125 125 125 125	200 200 200 200	250 200 175 125	400 200 200 200	4	1 3 3	a b c,d,e	1¼" 1¼" 1"
75	96	110	110	200	1 2 3 4	150 150 150 150	200 200 200 200	300 250 200 150	400 400 200 200	4	1/0 1 2	a b,c d,e	1½" 1¼" 1"
100	124	150	125	200	1 2 3 4	200 200 200 200	200 200 200 200	400 350 250 200	400 400 400 200	4	3/0 2/0 1/0	a b,c d,e	2" 1½" 1¼"
125	156	175	175	200	1 2 3 4	250 250 250 250	400 400 400 400	500 400 350 250	600 400 400 400	5	4/0 3/0 3/0	a b c,d,e	2" 2" 1½"
150	180	225	200	400	1 2 3 4	300 300 300 300	400 400 400 400	600 450 400 300	600 600 400 400	5	300 4/0	a b,c,d,e	2½" 2"
200	240	300	250	400	1 2 3 4	400 400 400 400	400 400 400 400	♦♦ 600 500 400	600 600 400	5	500 350 300	a b,c d,e	3" 2½" 2"

† If manufacturer's overload relay table states a maximum branch circuit protective device of a lower rating, that lower maximum rating, must be used in lieu of above recommendation (last paragraph 430-52).

♦♦Use KTU Fuses sized at 150% to 300% depending on code letter and starting methods.

♣For dry locations only.

Use FUSETRON dual-element Fuses or LOW-PEAK dual-element Fuses
FRS or FRS-R (600V.) LPS or LPS-R (600V.)

GOULD

I-T-E APPLICATION DATA
GENERAL

TABLE 1—Allowable Ampacities of Insulated Conductors (From NEC Table 310-16)

Not More Than Three Conductors in Raceway or Cable or Direct Burial (Based on Room Temperature of 30°C, 86°F)

	COPPER CONDUCTORS				ALUMINUM CONDUCTORS COPPER CLAD ALUMINUM CONDUCTORS				
AWG MCM	60°C (140°F)	75°C (167°F)	85°C (185°F)	90°C (194°F)	60°C (140°F)	75°C (167°F)	85°C (185°F)	90°C (194°F)	AWG MCM
	TYPES †RUW, †T, †TW, †UF	TYPES †FEPW, †RH, †RHW, †RUH, †THW, †THWN, †XHHW, †USE, †ZW	TYPES V, MI	TYPES TA, TBS, SA, AVB, SIS, †FEP, †FEPB, †RHH, †THHN, †XHHW*	TYPES †RUW, †T, †TW, †UF	TYPES †RH, †RHW, †RUH, †THW, †THWN, †XHHW, †USE	TYPES V, MI	TYPES TA, TBS, SA, AVB, SIS, †RHH, †THHN, †XHHW*	
18	—	—	—	14	—	—	—	—	—
16	—	—	18	18	—	—	—	—	—
14	20†	20†	25	25†	—	—	—	—	—
12	25†	25†	30	30†	20†	20†	25	25†	12
10	30†	35†	40	40†	25†	30†	30	35†	10
8	40	50	55	55	30	40	40	45	8
6	55	65	70	75	40	50	55	60	6
4	70	85	95	95	55	65	75	75	4
3	85	100	110	110	65	75	85	85	3
2	95	115	125	130	75	90	100	100	2
1	110	130	145	150	85	100	110	115	1
0	125	150	165	170	100	120	130	135	0
00	145	175	190	195	115	135	145	150	00
000	165	200	215	225	130	155	170	175	000
0000	195	230	250	260	150	180	195	205	0000
250	215	255	275	290	170	205	220	230	250
300	240	285	310	320	190	230	250	255	300
350	260	310	340	350	210	250	270	280	350
400	280	335	365	380	225	270	295	305	400
500	320	380	415	430	260	310	335	350	500
600	355	420	460	475	285	340	370	385	600
700	385	460	500	520	310	375	405	420	700
750	400	475	515	535	320	385	420	435	750
800	410	490	535	555	330	395	430	450	800
900	435	520	565	585	355	425	465	480	900
1000	455	545	590	615	375	445	485	500	1000
1250	495	590	640	665	405	485	525	545	1250
1500	520	625	680	705	435	520	565	585	1500
1750	545	650	705	735	455	545	595	615	1750
2000	560	665	725	750	470	560	610	630	2000

Correction Factors for Ambient Temperature Over 30°C, 86°F

Ambient Temp. °C	For ambient temperature over 30°C, multiply the ampacities shown above by the appropriate correction factor to determine the maximum allowable load current.								Ambient Temp. °F
31–40	.82	.88	.90	.91	.82	.88	.90	.91	86–104
41–45	.71	.82	.85	.87	.71	.82	.85	.87	105–113
46–50	.58	.75	.80	.82	.58	.75	.80	.82	114–122
51–60	—	.58	.67	.71	—	.58	.67	.71	123–141
61–70	—	.35	.52	.58	—	.35	.52	.58	142–158
71–80	—	—	.30	.41	—	—	.30	.41	159–176

† The load current rating and the overcurrent protection for conductor types marked with an obelisk (†) shall not exceed 15 amperes for 14 AWG, 20 amperes for 12 AWG, and 30 amperes for 10 AWG copper; or 15 amperes for 12 AWG and 25 amperes for 10 AWG aluminum and copper-clad aluminum.

* For dry locations only. See 75°C column for wet locations.

MOTOR DIRECTION

This is important!! Motor direction can be determined by jogging the motor and ensuring it rotates in the direction indicated by the arrows on the motor and pump.

If motor direction is incorrect DO NOT change phasing at motor or motor starter ONLY change phasing at service side of circuit breaker.

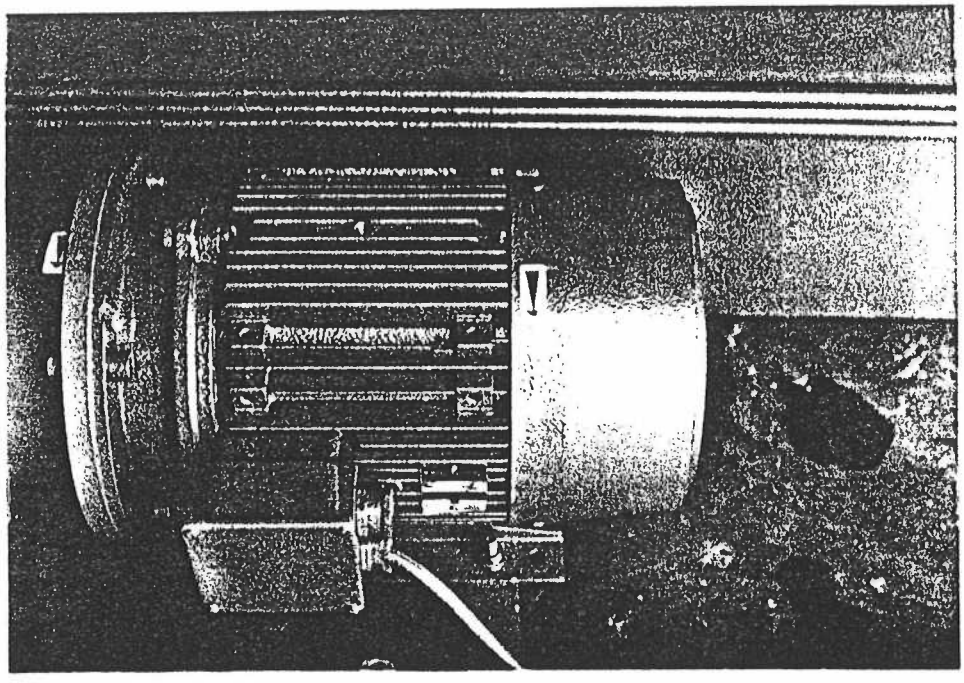
HYDRAULICS

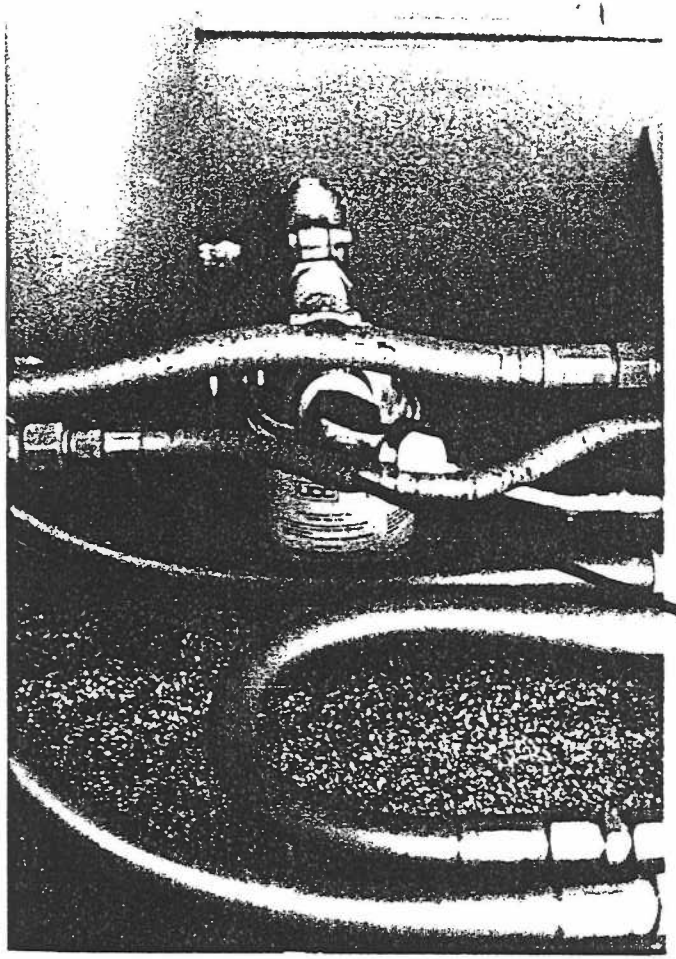
The machine arrived with hydraulic oil in the tank which is an intergral part of the machine frame.

Remove plastic seal from oil filler cap.

The level can be checked by inspecting the sight gauge. If oil is required it should be equivalent to Mobil DTE 24. See lubrication chart on one of the following pages.

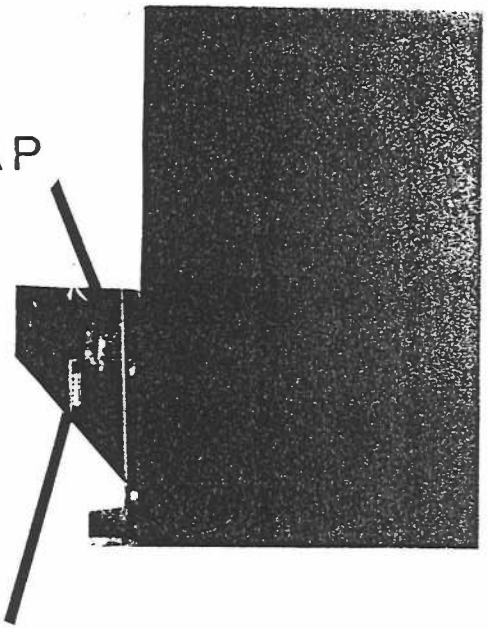
All fittings should be tightened and re-tightened after one month of service.





OIL FILLER CAP

OPTIONAL
OIL FILTER



OIL LEVEL GAUGE

ASTM NO.	H-150 AW	H-215 AW	H-315 AW	-	H-700	-	G-2150	G-315	- -	-	NLGI NO 1	NLGI NO.2	NLGI NO 2	-	-
SPECIFICATION	LIGHT HYD. OIL 135-165 SUS AT 100°F ANTI-RUST, OXIDATION & ANTI-WEAR ADDITIVES	MEDIUM HYD. OIL 194-236 SUS AT 100° F ANTI-RUST, OXIDATION, ANTI-WEAR ADDITIVES	MED.-HEAVY HYD. OIL 284-346 SUS AT 100° F ANTI-RUST, OXIDATION, ANTI-WEAR ADDITIVES	HEAVY HYD. OIL 500-550 SUS AT 100° F ANTI-RUST, OXIDATION & ANTI-WEAR ADDITIVES	HEAVY HYD OIL 630-770 SUS AT 100° F ANTI-RUST, OXIDATION, ANTI-WEAR ADDITIVES	MEDIUM HYD OIL-FIRE RESISTANT 230 SUS AT 100°F PHOSPHATE ESTER BASE	WORM GEAR OIL 1935 TO 2365 SUS AT 100°F 5% ACTIDESS TALLOW	LIGHT E.P. GEAR OIL 284 TO 346 SUS AT 100° F SULF-PHOS.	MEDIUM E.P. GEAR OIL & OIL MIST SYSTEMS 410-510 SUS AT 100°F	MED-HEAVY E.P. GEAR OIL 700 TO 1000 SUS AT 100°F SULF-PHOS.	#1 E.P. GREASE LITHIUM SOAP BASE GREASE	#2 GREASE LITHIUM SOAP BASE WATERPROOF	#2 E.P. GREASE LITHIUM SOAP BASE WATERPROOF	#2 GREASE LITHIUM SOAP BASE WITH 5% MAX MOLYBDENUM DISULFIDE	HEAVY [illegible] GEAR [illegible] ADHESIVE [illegible]
AMOCO	RYKON INDUST. OIL #15	RYKON INDUST. OIL #21	RYKON INDUST. OIL #31	RYKON INDUST. OIL #51	AMOCO AW OIL #65		AMOCO WORM GEAR OIL	PERMAGEAR EP 50		PERMAGEAR EP 70	AMOLITH GREASE #1 EP	AMOLITH GREASE #2	AMOLITH GREASE #2 EP	RYKON MOLY GREASE #2	[illegible]
ASHLAND (VALVOLINE)	ULTRAMAX AW-15	ULTRAMAX AW-20	ULTRAMAX AW-30	ULTRAMAX AW-45	ULTRAMAX AW-70		LIGHT CYLINDER OIL	X-18 MD SAE 80		X-18 MD SAE 80-90	VAL-LITH EP #1	MULTI-LUBE LITHIUM GREASE	VAL-LITH EP #2	SPECIAL MOLY EP GREASE	[illegible]
ATLANTIC RICHFIELD (SINCLAIR)	DURO AW S-150	DURO AW S-215	DURO AW S-315	DURO AW S-465			MODOC CYL. LIGHT			EXTRA DUTY GEAR LUBRICANT 90	LITHOLENE INDUST EP #1	LITHOLENE INDUST.#2	LITHOLENE INDUST. EP #2	ARCO EP MOLY 2 GREASE	[illegible]
CELANESE						CELLULUBE 220									
CITGO	PACEMAKER XD-15	PACEMAKER XD 20	PACEMAKER XD 30	"	"		CITGO COMPOUND OIL 145-5			STANDARD GEAR OIL (MP) 90	CITGO HEP-1	CITGO H-2		CITGO PREM MOLY-LITH GR.2	CITGO OPEN GEAR COMPOUND #2
CONTINENTAL (CONOCO)	SUPER HYDRAULIC 15	SUPER HYDRAULIC 21	SUPER HYDRAULIC 31				INCA OIL	GEAR OIL 50		GEAR OIL 84	EP CONOLITH #1	SUPER LUBE	EP CONOLITH NO.2	SUPER LUBE M	[illegible]
DISKI (LUBRI-PLATE)	LUBRIPLATE HYD. OIL HO-0	LUBRIPLATE HYD. OIL HO-1	LUBRIPLATE HYD. OIL HO-2	LUBRIPLATE HO-2A	LUBRIPLATE HYD. OIL HO-3			LUBRIPLATE APG 80	LUBRIPLATE MIST OIL	LUBRIPLATE APG 90	LUBRIPLATE 630-AA	LUBRIPLATE 630-2	LUBRIPLATE 630-2	LUBRIPLATE MO-LITH NO. 2	LUBRIPLATE GEAR SHIELD EXTRA HD
GULF	HARMONY 43-AW	HARMONY 48 AW	HARMONY 54AW	HARMONY 64AW	HARMONY 74AW	FR FLUID P-43	SENATE 155	E.P. LUBRICANT S50	E.P. LUBRICANT S60	E.P. LUBRICANT S70	GULFCROWN GREASE EP 1	GULFCROWN GREASE 2	GULFCROWN GREASE E.P.#2	GULFLEX MOLY	[illegible]
HOUGHTON	HYDRODRIVE HP-150	HYDRODRIVE HP-200	HYDRODRIVE HP-300	HYDRODRIVE HP-500	HYDRODRIVE MIH 40	HOUGHTOSAFE #1120	MP GEAR OIL 140	MP GEAR OIL 80		MP GEAR OIL 90	COSMOLUBE #1-EP	COSMOLUBE #2	COSMOLUBE #2 EP		[illegible]
EXXON	NUTO H 32	NUTO H 46	NUTO H 68	NUTO H 100	NUTO 150	IMOL S 46	CYLESSTIC TK 460	SPARTAN EP 68	ENMIST EP 100	SPARTAN EP 220	LIDOK EP 1	UNIREX N2	LIDOK EP-2	BEACON Q 2	SURETT N 26*
MOBIL	D.T.E. 24	D.T.E. 25	D.T.E. 26		D.T.E. EXTRA HEAVY DUTY		MOBIL 600 W	MOBILGEAR 626	MOBIL MIST LUBE 27	MOBILGEAR 630	MOBILUX GREASE EP 1	MOBILUX GREASE #2	MOBILUX GREASE EP 2	MOBILGREASE SPECIAL	MOBILTA [illegible]
PENNZOIL	HYDR. & GENERAL PURPOSE OIL #1	HYDR. & GENERAL PURPOSE OIL #2	HYDR. & GENERAL PURPOSE OIL #3	HYDR. & GENERAL PURPOSE OIL #4	HYDR. & GENERAL PURPOSE OIL #5		STEAM CYLINDER OIL #12		-	MULTI-PURPOSE 4090		MULTI-PURPOSE 303	MULTI-PURPOSE 705	EPM MULTI-PURPOSE LUBRICANT	[illegible]
PHILLIPS	MAGNUS A 150	MAGNUS A 215	MAGNUS A 315				HECTOR 2000 S	ALL PURPOSE GEAR OIL SAE 80		ALL PURPOSE GEAR OIL SAE 90	PHILUBE L1	PHILUBE L2	PHILUBE EP 2	PHILUBE M GREASE	PHILSET [illegible]
UNION 76	UNAX AW 150	UNAX AW 215	UNAX AW 315	UNAX AW 465	UNAX AW 700		STEAVAL A (WEST) STEAVAL B-110 (EAST)	MP GEAR LUBE 80		MP GEAR LUBE 90	UNOBA EP #1		UNOBA EP #2	UNOBA MOLY HD #2	GEARTEX HVY
SHELL	TELLUS 22	TELLUS 29	TELLUS 33	TELLUS 41	TELLUS 69		VALVATA J 77	SPIRAX HD 80	OMALA 37	SPIRAX HD 90	ALVANIA EP #1	ALVANIA #2	ALVANIA EP #2	LITHALL MOS	OMALA 46
STANDARD (CALTEX)	CHEVRON EP HYDRAULIC OIL #9	CHEVRON EP HYDRAULIC OIL #11	CHEVRON EP HYDRAULIC OIL #15				CHEVRON CYL OIL 155 PX				CHEVRON DURA-LITH GREASE EP #1	CHEVRON DURA-LITH GREASE #2	CHEVRON DURA-LITH GREASE EP #2	CHEVRON MOLY GREASE 2	CHEVRON [illegible] GREASE #2
STANDARD (OHIO)	INDUSTRON 46	INDUSTRON 48	INDUSTRON 53		INDUSTRON 66		FACTOCYL 650	GEAREP 80		GEAREP 90	FACTRAN EP 1	FACTRAN #2	FACTRAN EP 2	SONTO MOLY LUBE #2	GEAREP 80
SUN	SUNVIS 706	SUNVIS 747	SUNVIS 756	SUNVIS 760	SUNVIS 775		OCCIDENT CYL OIL	SUNEP 1050	SUNMIST 611-2	SUNEP 1070	SUNAPLEX 950EP	PRESTIGE #2	PRESTIGE 742 EP	[illegible]	[illegible]
TEXACO	RANDO HD 32	RANDO HD 46	RANDO HD 68		RANDO HD 150	SAFETYTEX 215	VANGUARD CYLINDER OIL	REGPA 68	TEXAMIST 100	REGPA 220	MULTIFAK EP 1	MULTIFAK #2	MULTIFAK EP #2	MOLYTEX GREASE 2	CRATER [illegible]

INITIAL START-UP

After all procedures of installation are completed and checked you may proceed to run the machine and check operation per the following outline. (See Diagram on Page 012)

1. Turn on branch circuit power.

2. Move disconnect handle on side of main control box to "On" position.

3. Turn key switch #1 to "on" position. At this time the "safe run" #25 light should be illuminated.

   DO NOT RUN MACHINE IF THIS LIGHT DOES NOT ILLUMINATE.

   The "safe run" light is a ground indicator light to ensure that the control circuits are grounded.

   Grounding of the controls is important to keep the machine frame from becoming a conductor in the case of a crushed wire. This helps eliminate the possibility of a machine motion occurring by an accidental short. Determine the cause of the failure and repair before proceeding.

4. Go to rear of machine and set blade gap levers to the "+" (plus) direction.

5. Depress motor start button and listen for motor. The green indicator should illuminate.

6. Ram should rise to top start position. If not immediately stop machine and check motor direction.

7. Take portable footpedal to rear of machine and depress momentarily.

8. Holddown cylinders should clamp and beam should begin moving downward.

9. Re-locate portable foot pedal to front of machine and stroke machine through a couple complete strokes. Ensure that every time foot pedal is depressed that holddowns clamp before upper beam moves.

10. Depress rake "-" (minus) button. Right side of ram should move downward to decrease rake angle and stop before blades are parallel.

11. Depress rake "+" (plus) button. Right side of ram should move upwards increasing rake angle. Also, check to see that digital display counts upward.

OPERATION

CAPACITY

This machine is rated to shear 1/4" thick x 122" steel not normally exceeding a tensile strength of 50,000 PSI.

This does not mean the shear is capable of shearing short lengths of a thicker plate such as 2ft of 3/8" material.

Care should be taken to avoid trying to shear any material with 30 Rockwell C hardness or better. Although the hydraulic nature of the machine will not allow it to be damaged, you can damage the blades (i.e. cracks and chips) by overlading them in a localize area.

ALWAYS be sure that a holddown, preferably 2 holddowns, clamp the part you are attempting to shear.

NEVER place fingers past the guard or under the part you are shearing.

General

Study the diagram outlining the control functions and familiarize yourself with the machine operation before you start to shear material.

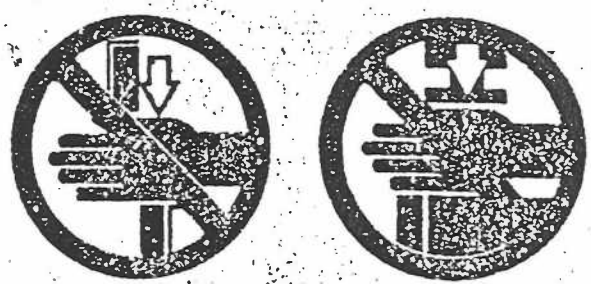
Capacity, Rake Angle, Blade Clearance, Squaring Procedure and Back Gauge operation are important and integral parts of the shearing operation.

Read and understand the following pages before you operate the machine.

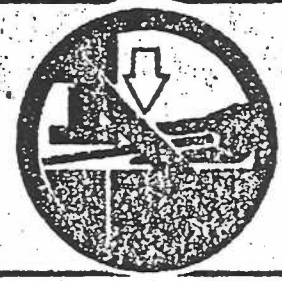
DANGER

TO REDUCE THE POSSIBILITY OF INJURY . . .

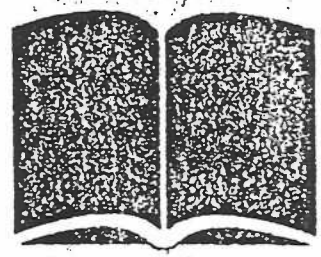
DO NOT PLACE YOUR HANDS BETWEEN THE KNIVES OR BENEATH HOLDDOWNS.



DO NOT PLACE YOUR HANDS BETWEEN MATERIAL BEING SHEARED AND SHEAR TABLE



ALWAYS READ AND UNDERSTAND THE OPERATION, MAINTENANCE AND SAFETY MANUAL BEFORE OPERATING OR SERVICING THIS SHEAR



DO NOT REMOVE THIS SIGN FROM THIS SHEAR

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SAFETY GUIDELINES

SHEAR

- READ AND UNDERSTAND THE OPERATION AND SAFETY MANUAL:
- KNOW HOW TO USE THE OPERATOR CONTROLS AND MODES OF OPERATION:
- OPERATE ONLY WITH SAFEGUARDING PROPERLY INSTALLED
- KNOW THE SET-UP AND PROPER METHOD OF OPERATION
- TEST ALL THE REQUIRED OPERATOR CONTROL STATIONS AND MODES OF OPERATION . . . BEFORE EACH SHIFT, EACH JOB RUN AND AFTER EACH BREAK
- HOLDDOWNS OPERATING WITH ADEQUATE PRESSURE
- MAKE CERTAIN PIECE PART WILL BE CLAMPED BY ONE OR MORE HOLDDOWNS
- DO NOT SHEAR MATERIAL THAT WILL TIP UP WHEN BEING CUT
- DO NOT PLACE YOUR HANDS BETWEEN THE KNIVES OR BENEATH HOLDDOWNS
- DO NOT PLACE YOUR HANDS BETWEEN MATERIAL BEING SHEARED AND SHEAR TABLE
- USE HAND TOOLS FOR SMALL OR NARROW PIECE PARTS
- MAKE CERTAIN EVERYONE IS CLEAR OF FRONT AND REAR OF SHEAR BEFORE OPERATING
- TURN OFF OR LOCKOUT OPERATOR CONTROLS WHEN NOT OPERATING SHEAR
- WHEN YOU LEAVE THE SHEAR:
  - — TURN OFF OR LOCKOUT OPERATOR CONTROLS
  - — TURN POWER OFF

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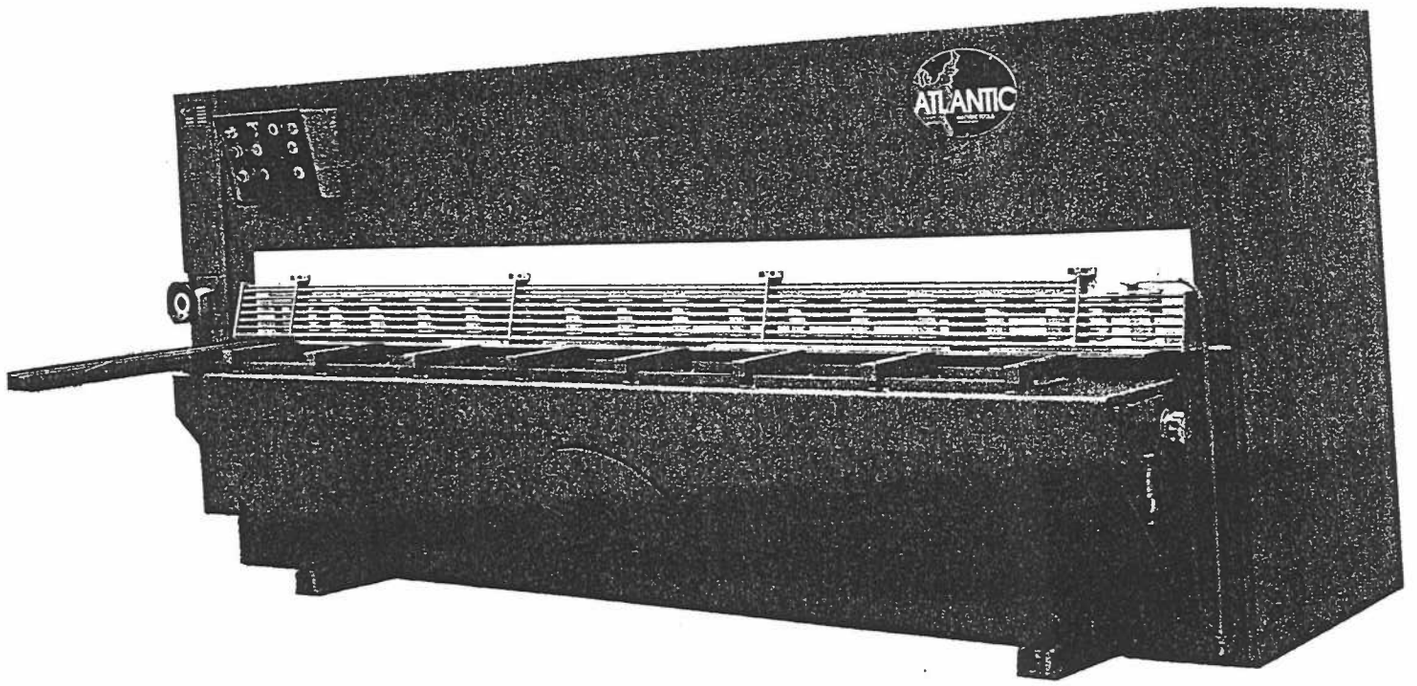
1/86

DO NOT REMOVE THIS SIGN FROM THIS SHEAR



FRONT VIEW

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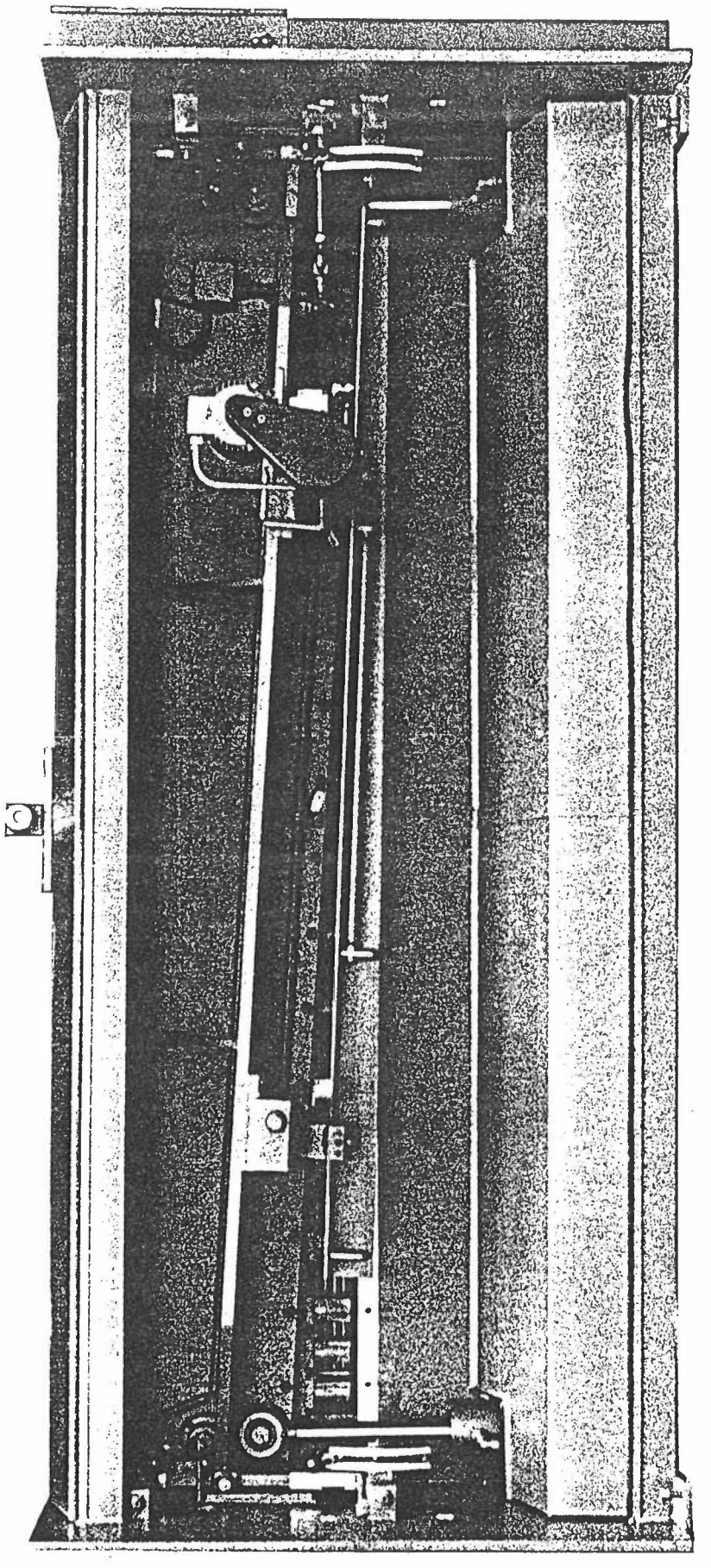
10 x 1/4



REAR VIEW

06
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10 x 1/4

CAPACITIES:

ATLANTIC MODEL HD 10 x 1/4 HYDRAULIC SHEAR

Length of Cut	122"
Capacity of Cut (Mild Steel, 50,000 PSI)	1/4"
Length of Squaring Arm	40"
Back Gauge Depth Maximum Minimum	29" 1"
Line Voltage	240/480V/3ph/60Hz
Control Voltage	24V
Motor H.P.	15 H.P.
Hydraulic Oil Capacity Type	70 Gal. Mobil DTE 24 or Equivalent
Hydraulic Pressure at Holddowns	1400 PSI
Hydraulic Pressure at Shear Cylinders	3400 PSI
Weight	10,500 lbs.
Dimensions (At Floor)	145"L x 61"W x 68"H

SHEAR CAPACITY CHART

The tensile and/or yield strength of many ASTM steels are specified as minimum values with no limit on the maximum. This chart is based on the actual tensile and/or yield strengths 15,000 PSI above the specified minimum values. Steel exceeding this value must be limited to thinner material than shown in the chart.

The actual physical properties and chemical analysis of a steel may meet more than one specification and/or grade within a specification. In this case the capacities for the specification and/or grade with the highest mechanical properties must be used.

The ASTM specifications listed are those in effect on January 1, 1978.

MILD STEEL SHEAR CAPACITY					.250
ASTM STEELS		TENSILE STRENGTH	YIELD STRENGTH	MINIMUM ELONG.	EQUIVALENT CAPACITY THICKNESS
NO.	GRADE	K.S.I.	K.S.I.	% -2 IN.	(NOMINAL)
A36	-	58-80	36-51	23	.250
	-	58-80	OVER 51	23	.219
A113	A	60-72	33 MIN.	24	.250
	B	50-62	27 MIN.	28	.250
	C	48-58	26 MIN.	29	.250
A131	-	58-71	34 MIN.	24-26	.250
A242	-	70 MIN.	50 MIN.	21	.219
A283	A	45-55	24 MIN.	30	.250
	B	50-60	27 MIN.	28	.250
	C	55-85	30 MIN.	25	.250
	D	60-72	33 MIN.	23	.250
A284	C	60 MIN.	30 MIN.	25	.250
	D	60 MIN.	33 MIN.	24	.250
A285	A	45-85	24 MIN.	30	.250
	B	50-70	27 MIN.	28	.250
	C	55-75	30 MIN.	27	.250
A299	-	75-95	42 MIN.	19	.188
A440	-	70 MIN.	50 MIN.	21	.188
A441	-	70 MIN.	50 MIN.	21	.188
A442	55	55-75	30 MIN.	26	.219
	60	60-80	32 MIN.	23	.219
A514	-	110-130	100 MIN.	18	.188
A515	55	55-75	30 MIN.	27	.188
	60	60-80	32 MIN.	25	.188
	65	65-85	35 MIN.	23	.188
	70	70-90	38 MIN.	21	.188
A516	55	55-75	30 MIN.	27	.188
	60	60-80	32 MIN.	25	.188
	65	65-85	35 MIN.	23	.188
	70	70-90	38 MIN.	21	.188
A517	-	115-135	100 MIN.	16	.188
A537	1	70-90	50 MIN.	22	.219
	11	80-100	50 MIN.	22	.188
A572	42	60 MIN.	42 MIN.	24	.219
	50	65 MIN.	50 MIN.	21	.219
	60	75 MIN.	60 MIN.	18	.219
	65	80 MIN.	65 MIN.	17	.219

SHEAR CAPACITY CHART

MILD STEEL SHEAR CAPACITY					.250
ASTM STEELS		TENSILE STRENGTH K.S.I.	YIELD STRENGTH K.S.I.	MINIMUM ELONG. % -2 IN.	EQUIVALENT CAPACITY THICKNESS (NOMINAL)
No.	GRADE				
A588	-	70 MIN.	50 MIN.	21	.219
A612	OVER .500	81-101	50 MIN.	22	.188
A633	A	63-83	42 MIN.	23	.219
	B	63-83	42 MIN.	23	.219
	C	70-90	50 MIN.	23	.188
	D	70-90	50 MIN.	23	.188
	E	80-100	60 MIN.	23	.188
A635	-	NOT SPECIFIED	NOT SPECIFIED	NOT SPECIFIED	.250
A715	50	60 MIN.	50 MIN.	24	.219
	60	70 MIN.	60 MIN.	22	.219
	70	80 MIN.	70 MIN.	20	.188
	80	90 MIN.	80 MIN.	18	.188

SHEAR CAPACITY CHART

MILD STEEL SHEAR CAPACITY		.250
OTHER STEELS		EQUIVALENT CAPACITY THICKNESS (NOMINAL)
LOW CARBON (.10-.20) PLATE		.250
LOW CARBON (.15-.25) PLATE		---
ANNEALED .40-.50 CARBON H.R. PLATE		.188
A.I.S.I. 4140 H.R. PLATE - ANNEALED		.188
A.I.S.I. 6150 H.R. PLATE - ANNEALED		.188
A.I.S.I. 8620 H.R. PLATE - ANNEALED		.188
FLOOR PLATE		.188
ABRASION RESISTING PLATE (250 BHN MAX.)		.188
ANNEALED STAINLESS STEEL PLATES TYPE 302, 304, 304L, 309, 316, 316L, 410, & 430	$\leq$ 14 LEN.	7 Ga. (.1875)
ANNEALED STAINLESS STEEL PLATES TYPE 302, 304, 304L, 309, 316, 316L, 410, & 430	$\geq$ 16 LEN.	8 Ga. (.164)

MILD STEEL SHEAR CAPACITY	.250
ALUMINUM ALLOYS *	EQUIVALENT CAPACITY THICKNESS (NOMINAL)
1100-0, 1100-H14, 1100-H16 2024-0, 2024-T3, 2024-T4 3003-H14, 5005-H34, 5052-0 5052-H32, 5052-H34, 5086-H32 6061-0, 6061-T6, 7075-T6	.375

*Aluminum alloys may require more clearance under holddowns and at low end of the upper knife. The charts below are for determining shear capacities only and are not to be used for selecting knives. Shear capacity is determined by total shearing load and knife selection is determined by unit pressure on the knives, and hardness and chemistry of the material being sheared. Materials with a hardness of 30 Rc or above and/or those with abrasives included present severe knife problems.

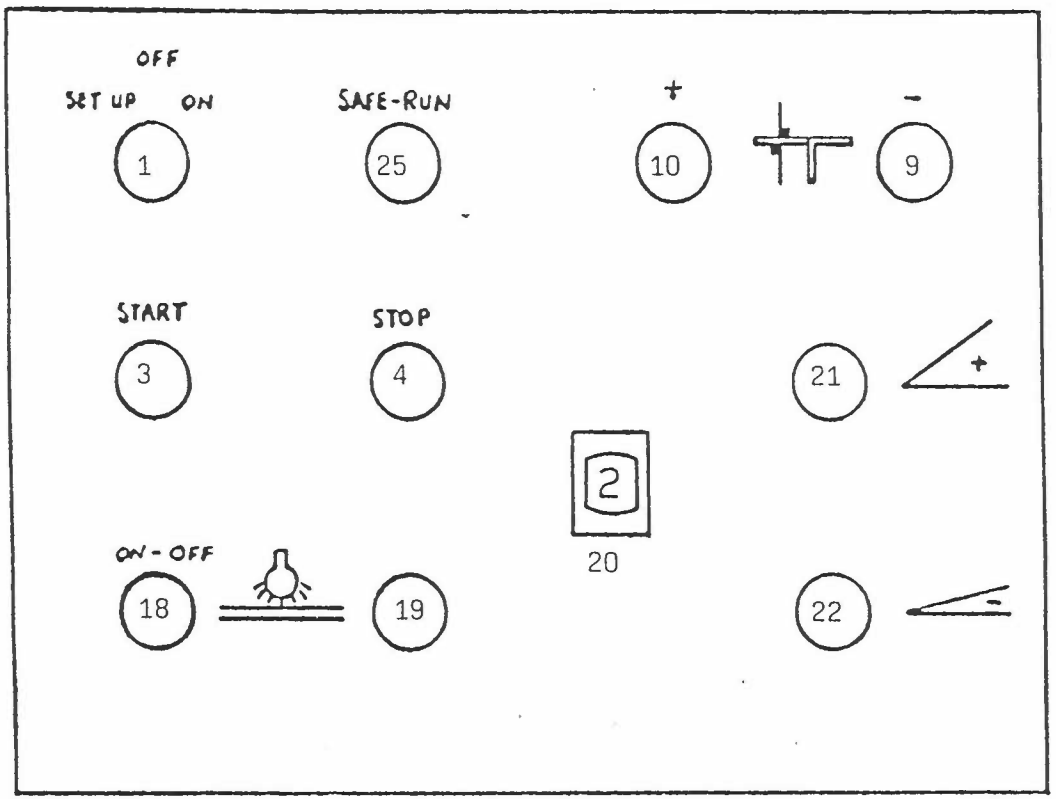
ASTM SPECIFICATION		PRODUCER AND PRODUCT NAME						
NO.	GRADE	ARMCO STEEL CORP.	BETHLEHEM STEEL CORP.	INLAND STEEL CO.	INTERLAKE INC.	JONES B. LAUGHLIN STEEL CORP.	KAISER STEEL CORP.	LUKENS STEEL CO.
A242		HIGH STRENGTH A	MAYARI	COR-TEN A COR-TEN B	COR-TEN A COR-TEN B	NI-CU-TI	KAISALOY 50CR	LUKENS A242
A440			MED MN	HI-MAN	A440	JALTEN-3	KAISALOY 50MM	LUKENS A440
A441		HIGH STRENGTH B	MN V	TRI-STEEL	A441	JALTEN-1 VAN-50	KAISALOY 50MV	LUKENS A441
A514		SSS-100 SSS-100A SSS-100B	RQ-100 RQ-100A RQ-100B			S-90 S-100 S-110		T-1, T-1B T-1A, N-A-XTRA
A517		SSS-100 SSS-100A SSS-100B	RQ-100 RQ-100A RQ-100B			S-100 S-110		T-1, T-1B T-1A N-A-XTRA
A537	CLASS 1	LO-TEMP	RQC-60N					LT-75N
	CLASS 11	SUPER LO-TEMP	RQC-60Q AND T					LT-75QT
A572	42	HIGH STRENGTH C-42	V42	INX-42	I42X	JLX-42	KAISALOY 42-CV	A572-42
	50	HIGH STRENGTH C-50	V50	INX-50	I50X	JLX-50 JLX-50CC VAN-50	KAISALOY 50-CV	A572-50
	60	HIGH STRENGTH C-60	V60	INX-60	I60X	JLX-60 VAN-60	KAISALOY 60-CV	A572-60
	65	HIGH STRENGTH C-65	V65	INX-65		JLX-65		A572-65
A588		HIGH STRENGTH A588	MAYARI R-50	COR-TEN B	COR-TEN B	NI-CU-TI	KAISALOY 50CR	COR-TEN B
A606	(SHEET)	HIGH STRENGTH B	MAYARI R	COR-TEN A	COR-TEN A	NI-CU-TI	KAISALOY 50CR	
A607	45	HIGH STRENGTH C-45	CB/45	INX-45	I45X	JLX-45	KAISALOY 45-CV	
	50	HIGH STRENGTH C-50	CB/50	INX-50	I50X	JLX-50 JLX-50CC VAN-50	KAISALOY 50-CV	
	55	HIGH STRENGTH C-55	CB/55	INX-55	I55X	JLX-55		
	60	HIGH STRENGTH C-60	CB/60	INX-60	I60X	JLX-60 VAN-60		
	65	HIGH STRENGTH C-65		INX-65		JLX-65		
	70	HIGH STRENGTH C-70		INX-70		JLX-70 VAN-70		
A715	50			HI-FORM 50	I50F	VAN-50		
	60			HI-FORM 60	I60F	VAN-60		
	70			HI-FORM 70	I70F	VAN-70		
	80			HI-FORM 80	I80F	VAN-80		

STEEL CROSS REFERENCE CHART

ASTM SPECIFICATION		PRODUCER AND PRODUCT NAME						
NO.	GRADE	NATIONAL STEEL CORP.	OREGON STEEL MILLS	REPUBLIC STEEL CORP.	SHARON STEEL CORP.	UNITED STATES STEEL CORP.	WHEELING-PIT STEEL CORP.	YOUNGSTOWN SHEET & TUBE CO.
A242		NAX-HIGH TENSILE	ORELLOY 242 Typ 1 & Typ 2	REPUBLIC 50	COR-TEN A COR-TEN B	COR-TEN A COR-TEN B	PITT-TEN NO. 1	YOLOY HS YOLOY T-50
A440		NAX-HI MANG	ORELLOY 440					YOMAN
A441		GLS-441	ORELLOY 441	REPUBLIC A-441		TRI-TEN	W-P A-441	YSW A441
A514		N-A-XTRA 100	ORELLOY 100. TYPE A			T-1 T-1A T-1B		
A517		N-A-XTRA 100	ORELLOY 100. Type B			T-1 T-1A T-1B		
A537	CLASS 1		A-537 CL 1			CHAR PAC (NORM)		
	CLASS 11		A-537 CL 11			CHAR PAC (Q AND T)		
A572	42	GLX-42W	ORELLOY 42	X42W	SHARALLOY 45	EX-TEN 45	PITT-TEN X-42W	YSW-42
	50	GLX-50W	ORELLOY 50	X50W	SHARALLOY 50	EX-TEN 50	PITT-TEN X-50W	YSW-50
	60	GLX-60W	ORELLOY 60	X60W	SHARALLOY 60	EX-TEN 60		YSW-60
	65	GLX-65W	ORELLOY 65	X65W		EX-TEN 65		YSW-65
A588		NAX-HIGH TENSILE	ORELLOY 588	REPUBLIC 50	COR-TEN B	COR-TEN B		YOLOY HS
A606	(SHEET)	NAM-HIGH TENSILE		REPUBLIC 50	COR-TEN A	COR-TEN A	PITT-TEN No. 1	YOLOY HS YOLOY T-50
A607	45	GLX-45W		X45W	SHARALLOY 45 C	EX-TEN 45	PITT-TEN X-45W	YSW-45
	50	GLX-50W		X50W	SHARALLOY 50 C	EX-TEN 50	PITT-TEN X-50W	YSW-50
	55	GLX-55W		X55W	SHARALLOY 55 C	EX-TEN 55	PITT-TEN X-55W	YSW-55
	60	GLX-60W		X60W	SHARALLOY 60 C	EX-TEN 60	PITT-TEN X-60W	YSW-60
	65	GLX-65W		X65W		EX-TEN 65		YSW-65
	70					EX-TEN 70		
A715	50						PITT-TEN X-50W	YS-T50
	60							YS-T60
	70							YS-T70
	80							YS-T80

STEEL CROSS REFERENCE CHART

CONTROL FACE



012
1/86
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10 x 1/2

DESCRIPTION OF PENDANT ELECTRIC CONTROLS

#1 SETUP/OFF/RUN Key Switch

PURPOSE: Controls all control voltages to operator console.

A. "Set Up" is intended for blade gap adjustments and diagnostics.
B. "Run" is intended for normal operation of machine. Ram will return to top start position anytime footpedal is released or complete length of cut is completed.

NOTE: Never leave machine unattended with key in switch.

#2 "Motor On" Light

PURPOSE: Light will illuminate when main motor is running.

#3 "Motor Start" Push Button

PURPOSE: Start main motor

#4 "Motor Stop" Push Button

PURPOSE: Stop main motor
NOTE: On some machines this button will lock off and you will need to pull out head of button before you can re-start machine.

#7 "OFF-ON" Length of Stroke Selector (Optional)

PURPOSE: In "ON" position the length of stroke timer is enabled. By adjusting potentiometer #8 the length of stroke of the ram can be controlled by eliminate unnecessary stroke travel and increase production on short cuts.

#8 "Timer Control Knob" - Length of Stroke (Optional)

PURPOSE: Rotation of knob in clockwise direction increases length of stroke when #7 is in "ON" position.
NOTE: If Rake setting is at Maximum (approx. 3^{o}) the lower range of this timer may be ineffective. This condition will give the appearance of a machine malfunction as the holddown will start to come down and then immediately return when you attempt to stroke machine. Increasing the timer by turning the knob clockwise will overcome this condition.

#9 "-" or "Forward" Push Button

PURPOSE: This push button will energize the backgauge in the "-" or Forward direction for setting the dimension of the desired cut.
NOTE: #27 Optional "Auto-Hand" Selector switch must be on "Hand" position.

#10 "+" or "Backward" Push Button

PURPOSE: Same as #9 above

PENDANT ELECTRIC CONTROLS (Con't)

#11 Not Applicable

#12 "Slow-Fast" Selector Switch (Optional)

PURPOSE: This switch selects speed of backgauge operation.

#13-#17 Not Applicable

#18 Shadow Light Indicator

PURPOSE: When shadow lights are on this light will illuminate.

#19 OFF-ON Shadow Light Switch

PURPOSE: This switch turns shadow lights on and off.

#20 Rake Angle Indicator

This number display shows approximate "rake angle" in degrees of cutting blades.
NOTE: Number will change as machine strokes and is only valid when ram is at "top start" position.

#21 Rake Angle "+" Push Button

Depressing this push button increases rake angle.
NOTE: When the "+" Rake Button is held until the maximum rake limit switch is engaged the machine will go into an interlock position after the first stroke of ram. This is caused by the top blade on the left hand side coming down further than normal. To reset, depress the rake "-" push button momentarily.

#22 Rake Angle "-" Push Button

Depressing this push button degreases rake angle.

#25 "SAFE-RUN" Indicator Light

This light must be illuminated anytime "Off-On" key selector #1 is turned on. It's purpose is to guarantee that one side of the control circuit is grounded to the frame of machine. This is important to prevent the frame of the machine from becoming a conductor of a circuit, thereby, bypassing important safety circuits.

IMPORTANT - DO NO OPERATE MACHINE IF THIS LAMP DOES NOT ILLUMINATE

#26 Not Applicable

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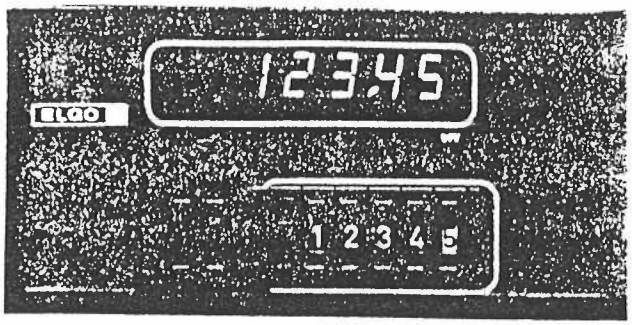
RAKE ANGLE AND BLADE GAP SETTINGS.

FOR 1/4" SHEARS

THICKNESS OF METAL MILD STEEL AND ALUMINUM.	RAKE ANGLE SETTING.	BLADE GAP SETTING.	
		TRIM CUTS.	WIDE DROPS.
16 g. and Thinner.	1 , 2 or 3	1	1
14 g. thru 10 g.	1 , 2 or 3	2	2
7 g. thru 1/4"	2 or 3	2	3
THICKNESS OF METAL STAINLESS STEEL.			
7 g. and Thinner	3	1	1

AUTOMATIC ELECTRONIC READOUT (Optional)



The electronic readout displays backgauge position to two (2) decimal places, i.e. 36.25 inches.

The display is energized anytime there is power to the machine, however, if the main power is lost either by turning off main disconnect or by a local power outage it is necessary in most cases to re-calibrate the display.

To re-calibrate display there are 2 methods as follows:

METHOD #1

A. Turn Auto-Hand Selector Switch #27 to Hand.

B. Using a scale of suitable accuracy measure the distance between backgauge and cutting edge of lower fixed blade. It is best to do this when the backgauge is positioned 3 to 5 inches from blade.

C. Enter the dimension read on scale into control by depressing mechanical counter buttons until desired new numbers are achieved. (Electronic display will not change at this time).

D. Turn off main power supply at disconnect switch on side of Electric Control Panel.

E. Turn On main power supply with disconnect switch.

F. Desired new dimension will now appear in electronic display.

ELECTRONIC READOUT (Con't)

METHOD #2

A. Turn Auto-Hand Selector Switch #27 to Hand.

B. Position backgauge by depressing Forward (-) or Reverse (+) until it is within 6 to 8 inches of fixed lower cutting blade edge.

C. Firmly push piece of scrap metal (Preferably 3/16 - 3/8 thickness) against backgauge and shear same.

D. Measure length of sheared piece.

E. Repeat C, D & E of Method #1

In Hand (#27) position the electronic readout will display backgauge position relative to lower blade.

It must be remembered that the backlash should always be taken up in the screws by first going to a larger dimension than desired and then in slow speed coming back to the desired dimension.

In Auto (27) position the electronics are programed for the following:

A. The backgauge will automatically retract 1/2 - 5/8 inches everytime the ram strokes and then re-position to original position.

B. By inserting a desired dimension in the mechanical counter switches and depressing Start (#30) the backgauge will automatically seek that position.

IMPORTANT

Inspect back of machine before operating either backgauge or stroking machine to insure that all personnel are clear of the area.

NOTE: The backgauge position (display dimension) should be inserted into mechanical number display when machine is turned off at Key switch. This will eliminate having to re-calibrate backstop as often as if the main power is interrupted the display will remain the same.

PAGE O18

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RAKE ANGLE

Rake Angle is the relative angle of the upper blade in relation to the fixed lower blade. It is usually expressed in degrees of inches/ft.

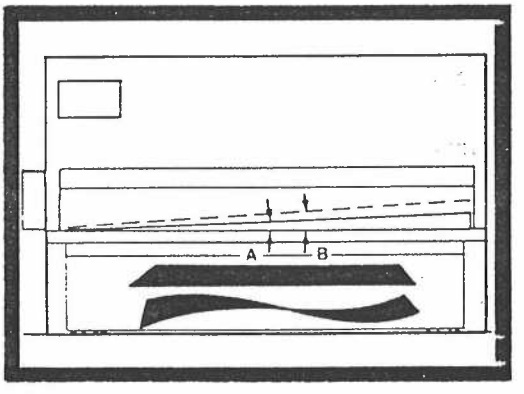
On ATLANTIC machines it is displayed on the control panel giving approximate degrees of angle from 0 thru 3.

The machines are designed for rated thickness capacity with a rake of 3 degrees on the digital display.

As the material thickness being sheared is reduced, the rake angle can be reduced accordingly. This is very helpful in producing a good sheared part as the less rake that is required to shear the part, the less bow and twist will be encountered on the sheared part.

Upper beam must be in upper position to change rake angle. Rake angle must not be changed during shear cycling.

SEE DIAGRAM BELOW



To change the rake, depress either the "+" (plus) or "-" (minus) rake buttons until the desired rake is produced.

IMPORTANT: Motor must be running and key selector in "Run/On" position to change rake.

Blade Clearance

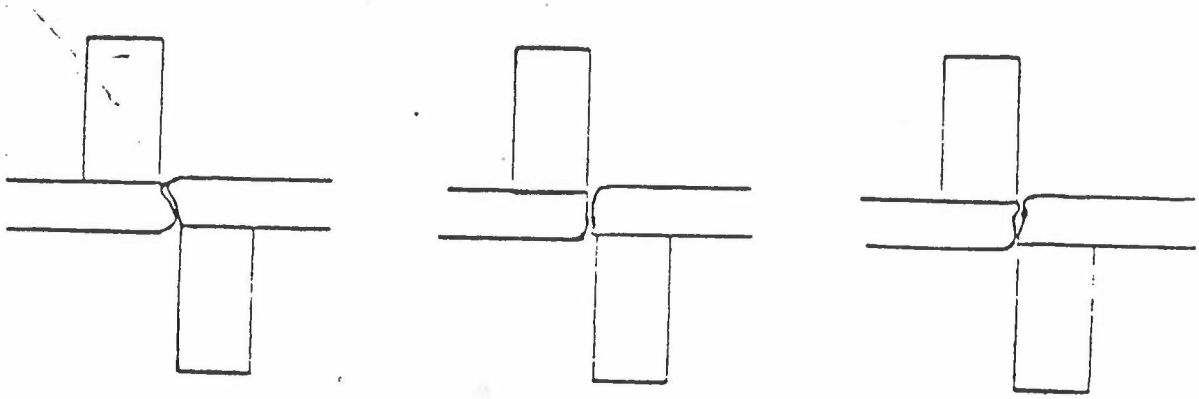
Blade clearance must be set to get a square, clean shear cut on varying thicknesses of metal.

This is done by moving the blade clearance adjustment levers to various detents with the "+" (plus) position (handle down) being the widest blade gap.

When shearing mild steel with back pieces greater than 6 to 8 times material thickness, the blade gap should be set between 7 to 10% of the material thickness. When shearing narrow strips and trim cuts, the blade gap can be closed to approximately 5% material thickness, or just before a double shear results.

Double shear is characterized by a bright polished appearance on the sheared edge from knife penetration and then another polished condition from the blade re-shearing the edge after the fracture occurs..

Setting of the blade gap parameters within the lever movement is accomplished by adjusting the master blade gap assemblies illustrated on following page. Refer to "Blade Change" section in Maintenance for details. Lever adjustment will move blade gap approximately .017" over complete range. Adjusting at master blade gap assemblies allows variance of that range, depending on material being sheared. The widest gap setting is achieved when gap adjustment lever is in the down position.



Too much clearance

Correct clearance

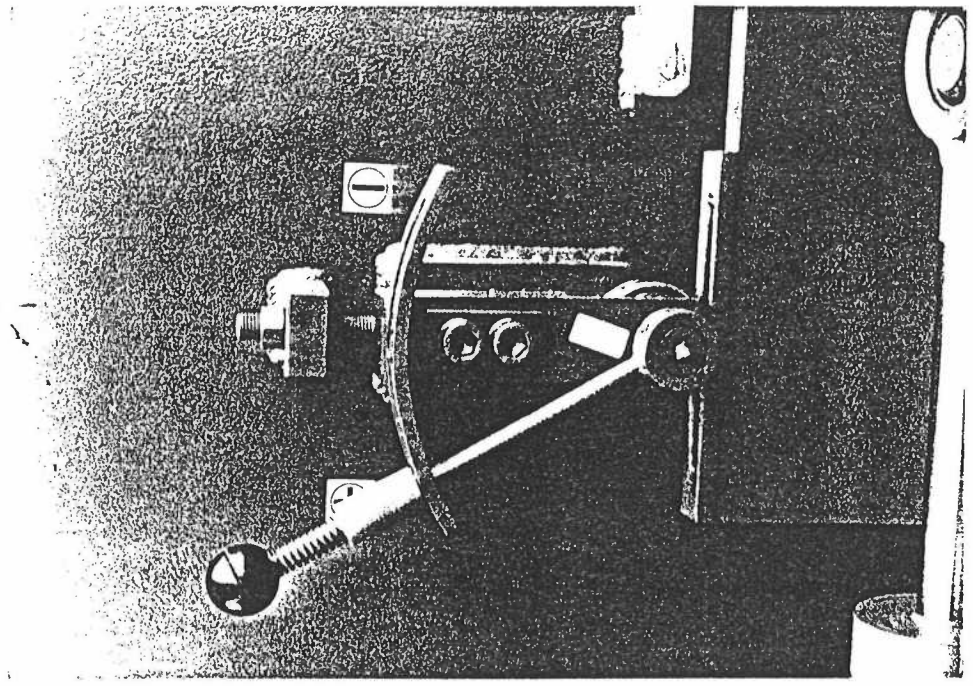
Insufficient clearance

SUGGESTED KNIFE CLEARANCE
Trim cuts - mild steel -
Edge appearance is critical

Metal Thickness	Knife Clearance
10 Gage	.005" to .009"
3/16"	.007" to .013"
1/4"	.010" to .018"
3/8"	.020" to .028"
1/2"	.030" to .040"
5/8"	.040" to .050"
3/4"	.050" to .065"
1"	.070" to .090"
1-1/4"	.090" to .120"
1-1/2"	.110" to .150"

SUGGESTED KNIFE CLEARANCE
Wide drops - mild steel
Edge appearance not important

Metal Thickness	Knife Clearance
1/4"	.025" to .030"
3/8"	.038" to .050"
1/2"	.050" to .070"
3/4"	.075" to .110"
1"	.100" to .150"
1-1/4"	.125" to .180"
1-1/2"	.150" to .220"



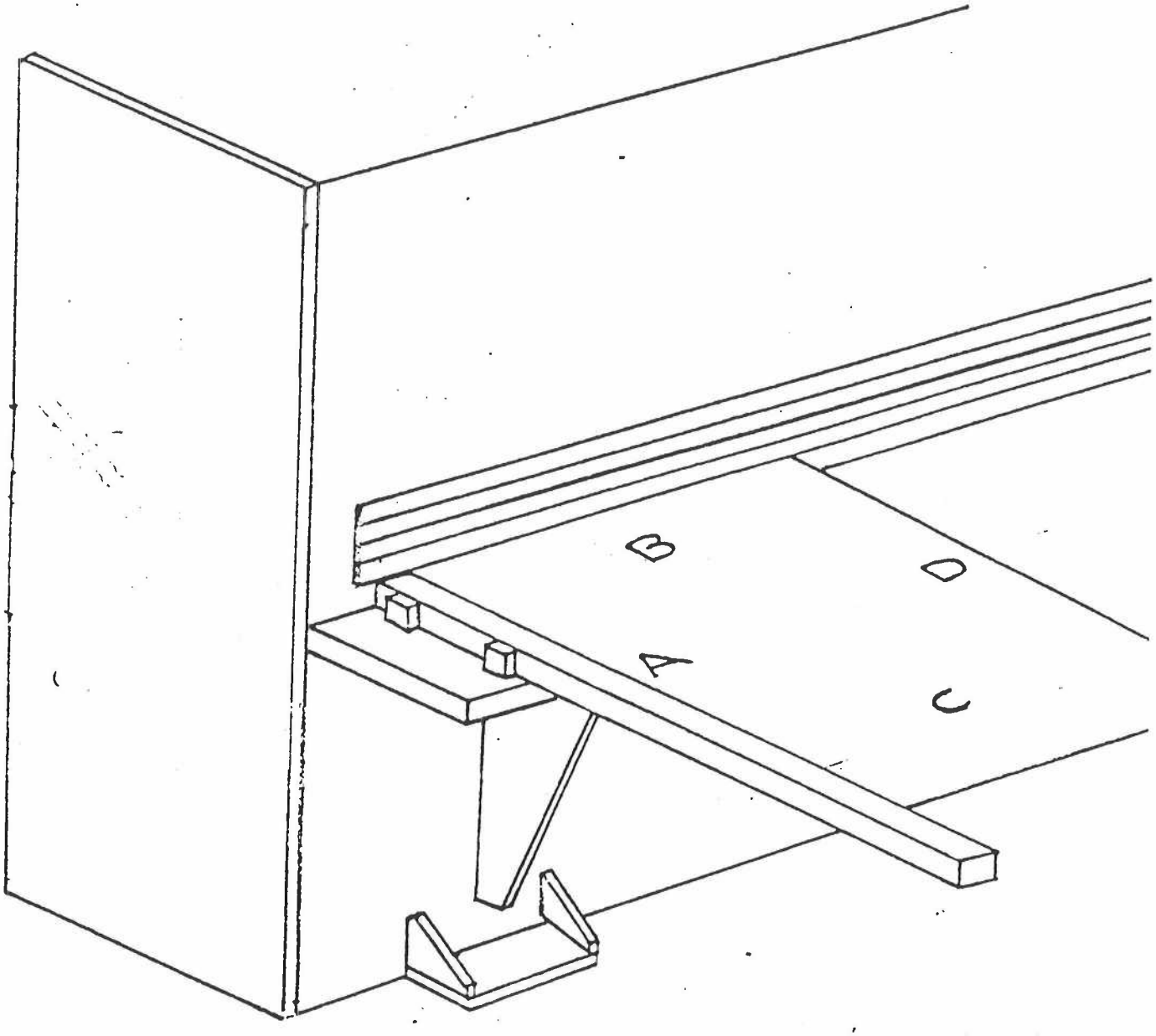
BLADE GAP ADJUSTMENT

Squaring Sequence

A squaring sequence that will result in square blanks is depicted and runs as follows: (1) Trim side A to obtain a straight working side. (2) With side A firmly against the side gauge, shear side B. (3) Turn the sheet over in such a way that side A is again placed against the side gauge and shear side C. (4) Place side C against the side gauge and shear side D (this can also be done using side B as a reference, but it would involve flipping the sheet over again).

The importance of getting a truly square blank can be seen from the fact that only 1-degree angular error over a distance of 12 inches will cause an error of 3/16 inch.

Squareness can be achieved by loosening the gauge bar clamping bolts. Then adjust the jacking screws to position the gauge bar square with the shear blades.



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023 thru 027
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OPERATION

BACKGAUGE

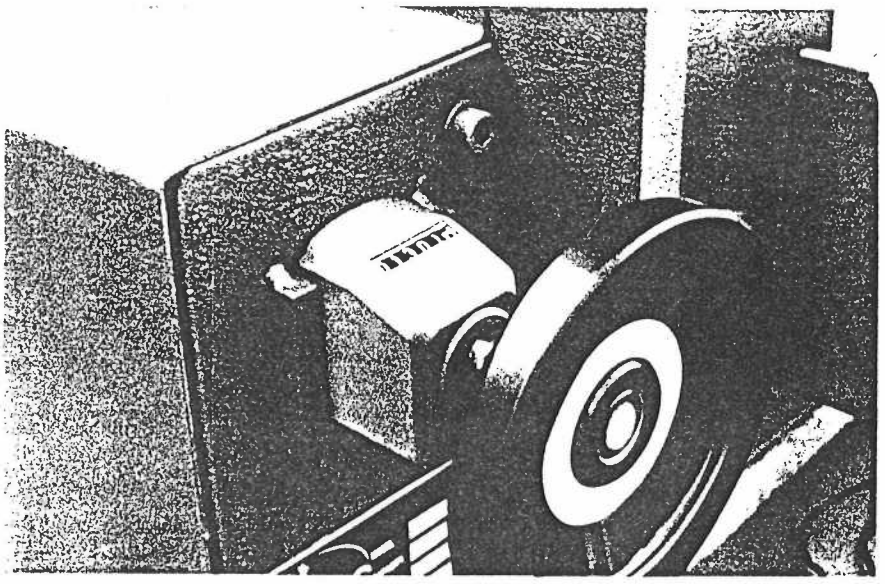
Pushbutton controls for positioning of backgauge are located at front control panel.

Depressing appropriate pushbutton will rapid position gauge to approximately desired position.

Position is displayed on orange counter located behind handwheel.

Final positioning is achieved by rotating handwheel until desired dimension is displayed.

NOTE: Always move backgauge forward for final positioning to compensate for any mechanical play (backlash).



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10x½

CALIBRATION POINT FOR BACKGAUGE READOUT COUNTER

journal of the Fabricator

SERVING METALWORKING INDUSTRIES
WITH EMPHASIS ON THE PROCESSING OF SHEET, COIL, TUBE, PLATE AND STRUCTURALS

Shearing plate and sheet: *principles and methods*

by: Robert L. Rachor
Edward A. Lynch Machinery Co., Inc.

The term "shearing" is derived from the fashion in which the blade edges meet in a progression from one side to the other, the same as you would have in an ordinary pair of scissors. The angle at which the blades are to one another is termed "blade rake angle" and the distance that the blades are separated is termed "blade or knife clearance."

Common machine tool design methods are incorporated in squaring shears so that you will find cast frames, welded frames, bolted frames and combinations of each type.

The hydraulic shear employs direct acting hydraulic cylinders, or hydraulic cylinders with mechanical linkage, whereas the mechanical shear employs an eccentric drive. Both types of shears are built in under-drive and over-drive designs. Inherent in the design is the fact that over-driven shears normally are furnished with a gap or throat depth, whereas underdriven design shears have solid frames and are gapless.

The principle of shearing is explained simply: as the blades come together and contact the material being sheared, the blades penetrate the material until the tensile stress is overcome and a crack or tear, called the slip plane, develops from both sides. (See Figure #1.) The relation of the upper crack to the lower is a function of the blade clearance.

If the planes match a clean cut is produced. (See Figure #2.) If not, a tear occurs if the gap is too great and, if too tight, a tongue develops and is re-cut as the blade passes. This results in a poor edge condition and is commonly called secondary shear.

Twist and bow are a function of the width of the drop, as well as the rake angle of the shear blade. Camber is found in the material as it comes from the mill. In shearing material camber does decrease as the drop width increases, however, the material is the prime factor in camber of parts due to the grain structure rolled into the material. Usually the cut with the grain will produce the best results. (See Figure #3.)

During the shearing process, as the knife continues down and frees the sheared piece from the original metal, the wall of the knife rubs against the metal to cause an area of burnish which extends along the length of the metal where the knife makes contact with it. There is a second burnish area on the sheared piece of material which is caused by rubbing against the wall of the lower knife. A burr occurs on the sheared piece because the fracture starts just above the cutting edge of the knife not at the exact corner of the knife edge. Another burr is formed on the original metal piece by the fracture starting just off the exact corner of the knife edge.

On the top of the original metal, some plastic deformation can be seen as a slightly rounded edge.

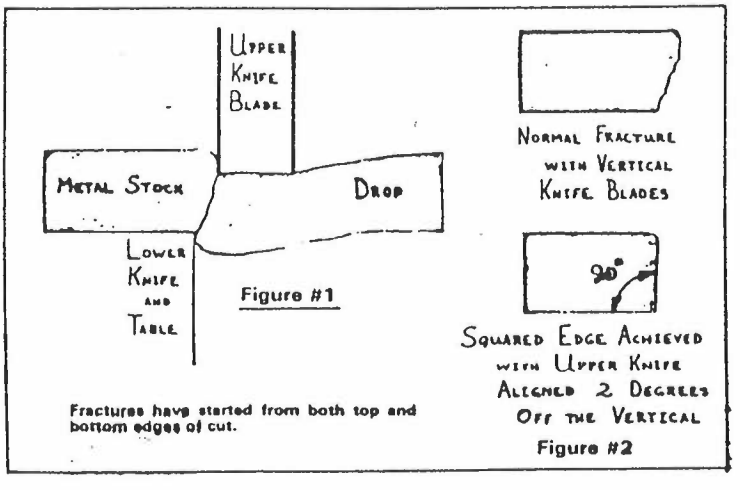

Figure #1

Figure #2

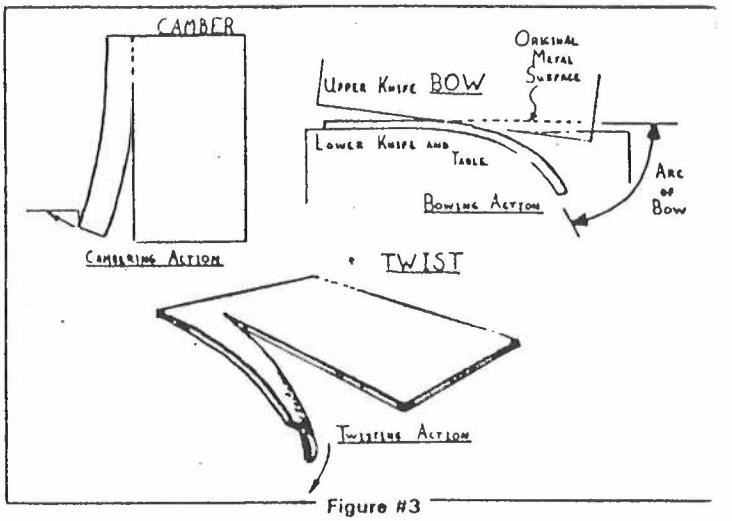

Figure #3

This same rounded edge can be seen on the sheared piece. (The sheared piece is also called a "drop.") (See Figure #4.) The amount of the plastic deformation (rounded edge) is a function of the percent of penetration and the clearance between the knife blades.

As an example, if the percent of penetration is high, say 50%, the knife must enter the metal half way before the fractures meet. This means more plastic deformation than with a piece of harder metal with a percent of penetration of 25% as the knife does not have to enter the harder material more than 1/4 of its thickness to achieve shearing of the metal.

You will find that the upper knife, on most shears, is slanted at an angle of 2° and as a result the knife moves down and back away from the lower knife, and its mounting, as the upper knife holder descends in a straight line. This action assures that the sheared piece will not become wedged between the two knife blades and it helps to concentrate the shearing force in the exact area of blade engagement between the two knives and causes the fractures to start on a straight line parallel to the surface of the knife. (See Figure #5.)

Repeating, as the upper knife holder descends, the knife edge moves father away from the wall of the lower knife and as a result there is no rubbing of the two knife edges and they do not score each other as they pass. The poi at which the two knife edges ar the closest is at the point whe the cut is made on the origin metal, which means that t shearing force is at the knife edg only and is not wasted by pain

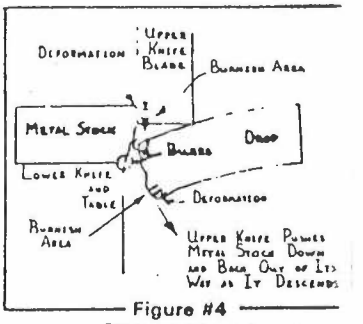

Figure #4
Fractures have met.

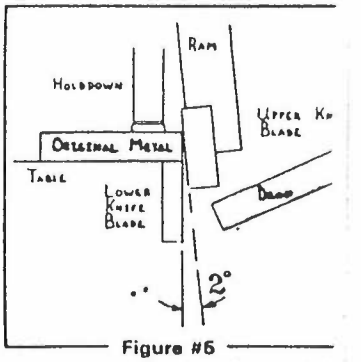

Figure #5
Alignment of upper knife from vertical.

spread across the full width of the knives.

When a shear makes a cut on a piece of metal, it exerts a great deal of force to start the cut and to continue the shearing action. The shear, therefore, must be able to supply adequate tonnage to perform the job and in addition must have adequate hold-down tonnage to make sure that the material is held firmly in place during the shearing operation. Here are some of the factors that affect shearing tonnage.

1. Thickness of the metal.
2. Hardness of the metal.
3. Depth of penetration into the metal.
4. Rake angle of the shear knife blades.
5. Bending forces and resistance of the metal.
6. Clearance between the shear knife blades.
7. Sharpness of the knife.

We will discuss each of the above points but would first state that shear strength is the resistance of a metal against shearing action of shear stress, and it should not be confused with tensile strength which is generally half again as much as the shear strength. (See Figure #6.) Tensile strength is determined by pulling a piece of metal apart on the longitudinal axis whereas shear strength is determined by cutting the piece of metal. Both are expressed in terms of pounds or tons per square inch.

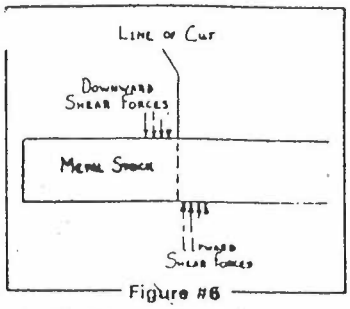

Figure #6

1. Thickness of metal — As the thickness of metal increases, so does the required shearing force. Based on metal thicknesses from ⅛" thick to ¾" thick and assuming that the shearing force required for ⅛" is 1 unit of force, then ¼" would require 3 units of force, ½" would require 4 units of force, ⅝" would require 5 units of force and 6 units of shearing force would be required for ¾" thick material. The relationship is not accurate, however, it does point out that the force requirement increases with the increasing thicknesses.

2. Hardness of metal — Hardness is generally defined in terms of the method of measurement, the most common test being a metal's resistance to indentation. Other hardness tests include resistance to scratching r energy absorption when ruck by a falling body.

There are many hardness tests, some of which are useful in relation to the material as a whole, that is, its "mass" hardness. These tests include the Brinell, Rockwell, Scleroscope and Vickers hardness tests. Some tests relate to the hardness of the constituents or grains of the metal and thus are carried out on a microscale and can be said to measure "particle" hardness. These tests include the Knoop, Eberbach and Bierbaum tests. The tests mentioned are the most widely known, however, there are many others.

Suffice to say that you should be aware of the amount of emphasis that is given to the seemingly simple concept of hardness. It takes quite a laboratory setup to analyze the hardness of metal and it really isn't necessary in most practical applications. Steel producers supply charts and tables of hardness for their various products, however, one should be cautious as metal hardness can vary as much as 50% from piece to piece as a result of the manufacturing method.

3. Penetration depth of the metal — Penetration is usually expressed in the percent of the thickness of the metal being cut. The percent of penetration for various metals can be found in **Figure #7**. The first thing you would notice is that the penetration depth varies depending on the metal, from 2% for partly cold worked steel to 60% for aluminum.

Normally a thick piece of metal will require more penetration than a thin piece of the same metal and harder metals generally require less penetration than softer metals. With less penetration, therefore, less shearing force is needed to part the material and vice-versa. This is why a material such as Titanium, which tests much harder than mild steel takes about the same shearing force as the same thickness of mild steel.

4. Rake angle of shear knife blades — **Figure #8**, in the top portion, shows a view of the shear knives of a plate shear from the front, with the upper and lower knife blades parallel to each other. The shearing force in this illustration is distributed across the entire length of the metal and the shearing force required to shear the drop would be slightly fantastic.

As an example, a 10' section of ½" thick carbon steel, SAE 1020, with a shear strength of 54,000 p.s.i. would require approximately 1,400 tons of force to make a full length cut. In contrast the lower portion on Figure #8 shows a view of the shear knives with the upper knife slanted with respect to the lower knife. This slant is called "rake angle" and its value lies in the fact that the shearing force at any given time is concentrated at the cutting point where the two knife blades intersect.

This cutting point travels across the length of the metal as the upper knife passes the lower knife on its downward stroke, and the shearing force travels with it. Applying a rake angle of ⅛" per foot to the upper knife reduces the shearing force required to approximately 370 tons when cutting the same 10' section of ½" thick carbon steel, SAE 1020, with a shear strength of 54,000 p.s.i. This is a reduction of approximately 75% by simply applying a rake angle to the upper knife. Conversely, reducing the rake angle will increase the tonnage requirement.

Taking the same piece of carbon steel plate and changing the rake angle of the shear knife blades, at a rake angle of ¼" per foot the required shearing force is 940 tons whereas with a rake angle of 1" per foot the shearing force is approximately 230 tons. (See Figure #9.) A similar chart on T-1 material is found in **Figure #10.**

Another way of expressing rake angle would be — percent of blade engagement. As the angle of rake decreases, the amount of upper knife blade engagement in the stock increases. The more blade engagement, the more shearing force is required. With greater blade engagement there

PERCENT PENETRATION FOR TYPICAL METALS - WITH SHEAR STRENGTH

MATERIAL	PERCENT PENETRATION	SHEAR STRENGTH
LEAD	50%	3,500 P.S.I.
TIN	40%	5,000
ALUMINUM	60%	8,000
ZINC	50%	14,000
(Cold Worked)	25%	19,000
COPPER	55%	22,000
(Cold Worked)	30%	28,000
BRASS	50%	32,000
(Cold Worked)	30%	52,000
TOBIN BRONZE	25%	36,000
(Cold Worked)	17a	42,000
STEEL, 0 10C	50%	35,000
(Cold Worked)	38%	43,000
0 40C	27%	62,000
(Cold Worked)	17%	78,000
0 80C	15%	97,000
(Cold Worked)	6%	127,000
1 00C	10%	115,000
(Cold Worked)	2%	150,000
SILICON STEEL	30%	66,000
NICKEL	55%	35,000

Figure #7

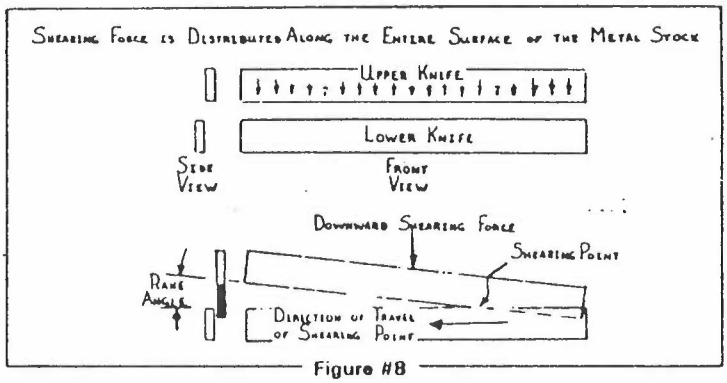

Figure #8

Shear with upper knife set at a rake angle.

RAKE ANGLE AND REQUIRED SHEARING FORCE

RAKE ANGLE APPLIED BETWEEN SHEAR KNIFE BLADES	REQUIRED SHEARING FORCE IN TONS FOR FULL-LENGTH CUT	DIFFERENCE FOR VARYING RAKE ANGLES
1/4" PER FOOT	92 TONS	31 TONS
3/8" PER FOOT	61	15
1/2" PER FOOT	46	9
5/8" PER FOOT	37	6
3/4" PER FOOT	31	5
7/8" PER FOOT	26	3
1" PER FOOT	23	

METAL: MILD STEEL, 1/2" THICK, WITH TENSILE STRENGTH OF APPROXIMATELY 54,000 P.S.I. (SAE 1020)

Figure #9

SHEARING TONNAGE REQUIREMENTS WITH CHANGING RAKE ANGLE AND THICKNESS OF METAL*

METAL THICKNESS	RAKE ANGLE PER FOOT	REQUIRED SHEARING TONNAGE
1/4" THICK	1/4" PER FOOT	46 TONS
5/16"	3/8"	40
3/8"	9/16"	38
7/16"	3/4"	34
1/2"	1"	30

*METAL: T-1, 10 Feet Long, Shear Strength: 100,000 P.S.I.

Figure #10

is more metal to offer resistance to the knife blade at any one time. (See Figure #11.)

With less blade engagement and the shearing force concentrated in a smaller area, the point of knife contact on the metal stock travels faster than it would with a larger blade engagement. The knife, therefore, pushes through the metal faster, however, it must also travel farther and therefore the stroke length must be deeper than for lower rake angles.

Thus, the overall time to make a full length cut will be less for a larger blade engagement because the stroke is shorter. With the upper knife speed remaining constant, complete cuts are made faster using a lower rake angle.

As stated earlier, a shear cuts plate progressively as the knife moves down and across the plate. The rake angle of the shear causes the sheared piece or drop to twist and bow. If the bow is excessive, the strip must be straightened before being used. Bow and twist are only of importance in cutting very narrow strips. Depending upon the rake angle, with drop widths between 4" and 8", the bow becomes negligible. (See Figure #12.) The bow is similar regardless of the thickness of plate. (See Figure #13.) Twist becomes negligible with drop widths of 2" to 3" or above. (See Figure #14.) The permissible bow and twist are dependent upon the length of the drop.

As an example, a 96" long, 1" wide drop cut at ¼" rake would have approximately a 3⅜" bow, which would be objectionable. (See Figure #15.) However, if the same drop were only 36" long, it would follow the curve between 30" and 66" and the bow would be less than ½" which would probably be acceptable. In like manner, 3° of twist would be of no concern if the drop were one foot long, but 30° over ten feet would probably be intolerable. (See Figure #14.)

From the above it is apparent that bow and twist are only of importance in cutting narrow, relatively long drops. The actual amount of bow, twist, and camber are dependent upon the internal stresses of the particular material as well as the characteristics of the metal itself. Thus, individual pieces may differ in actual distortion. However, in every case the bow and twist can be reduced by reducing the rake angle. (See Figures #16 and #17.)

In general, the reduction of bow and twist is in direct proportion to the reduction of the rake angle.

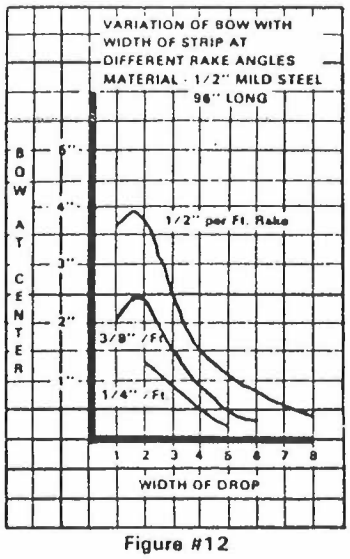

Figure #12

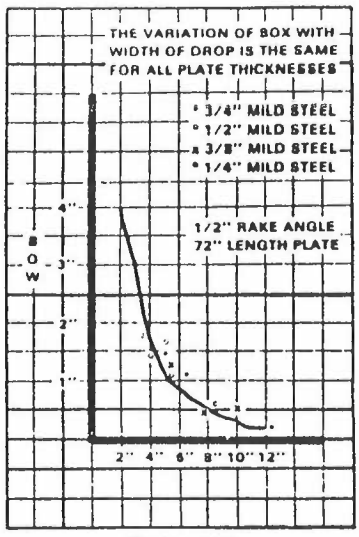

Figure #13

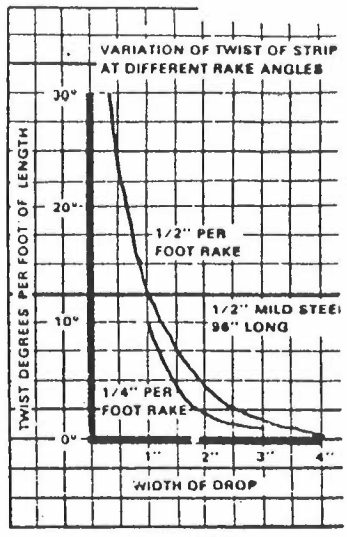

Figure #14

Thus minor differences in rake do not make a substantial improvement. To be of consequence, the reduction must be appreciable. We would stress that the principal objection to increasing the capacity of a shear by increasing the rake angle excessively is that the shear will be perfectly all right for cutting wide drops, but will not be of much use in cutting narrow drops.

5. Bending forces and width of the drop behind the knife — As the upper knife enters the metal, it pushes the metal in an arc of drop away from the original metal. (See Figure #18.) The original metal would be gripped firmly by the holddowns so that it could not move and therefore the sheared piece or drop has to get out of the way of the descending knife.

You can picture the cambering action that takes place as the knife progresses through the cut. The effect of the shearing action is a high degree of camber as the sheared piece or drop moves away from the original metal stock. The drop will not necessarily remain in this distorted shape after the cut is completed. Springback will occur due to the elasticity of the metal and the drop may straighten out completely, depending on the type of metal. If the cambering action forces the drop to bend beyond its elastic limit, the drop will be permanently deformed. (See Figure #19.)

As the shear knife descends into the metal, it creates bending forces perpendicular and horizontal to its movement. These bending forces meet a strong resistance in the metal stock and this resistance increases with length, thickness and hardness.

At this point, it is appropriate to mention that some support for the sheared piece or drop should be provided, especially for heavy plate, otherwise the weight of the unsupported drop may tear off the last inch or so of metal before the knife completes the cut, leaving what is termed a "dog ear" edge on the end of the cut. In addition, the tearing of the plate would cause "drag" on the edge of the lower knife at that point, contributing to premature knife dullness.

Camber, bow and twist in a piece of metal can be caused by inferior metal stock, internal stresses in the metal, insufficient holddown force and high rake angle.

The most common cause of camber is inferior metal. Many times a trim cut of the material being sheared will show a great deal of camber but the rest of the stock will not. Sufficient holddown tonnage is extremely important. Cambering can occur when the action of the tension under the upper knife causes the metal to creep toward the knife edges as the knife is moving through the out. (See Figure #20.) The resulting cut describes an arc and this would indicate that the holddowns are not strong enough.

Camber, as we have stated, will occur when inferior metal is being sheared or if the shear knives are not properly adjusted. Camber is most noticeable when shearing narrow strips of meta — the longer the strip, the easie you can measure the camber.

Bow is defined as deformatio in a direction perpendicular t the surface of a strip. It is gener ally associated with camber i wide strips and with twist i narrow strips, but it may be pres ent by itself. Bow can be mini mized with a low rake angle.

Distortion is twist and is defined as the tendency of a sheared strip to turn spirally around itself.

Twist is one of the most irritating difficulties that may occur during shearing, however, it can be minimized with a low rake angle. No consistent differences in the degree of twist are evident

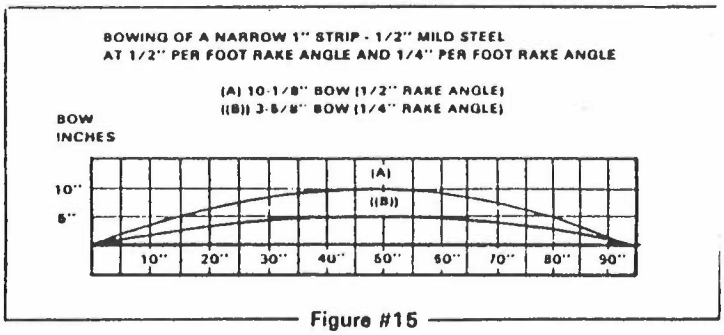

Figure #15

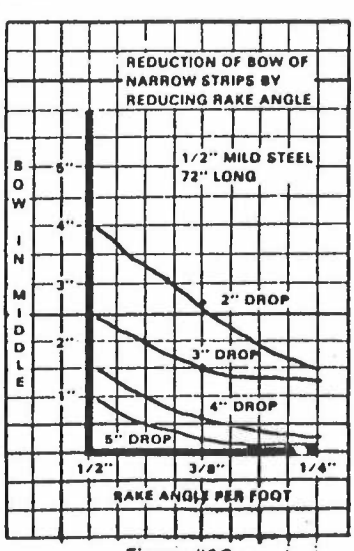

Figure #16

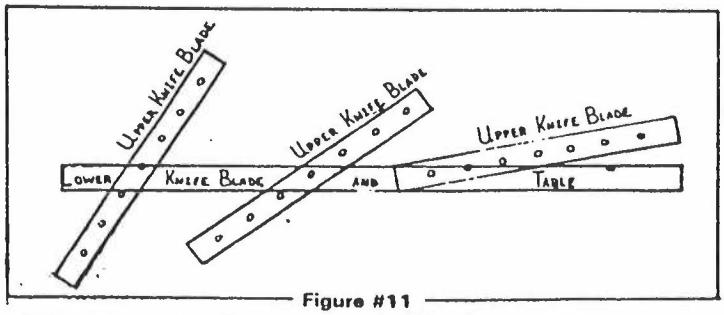

Figure #11

Blade engagement at varying rake angles — the higher the rake — the less engagement. Not every possible rake angle is shown.

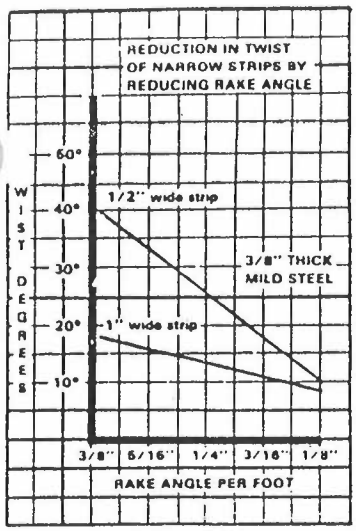

Figure #17

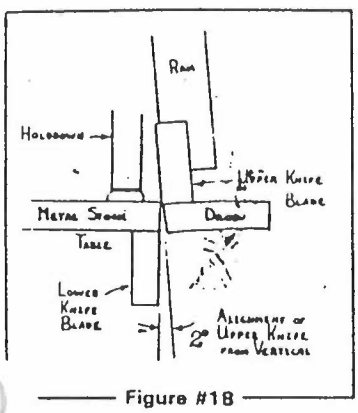

Figure #18

Beginning of cut.

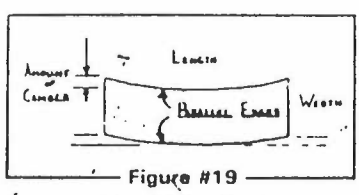

Figure #19

Example of camber.

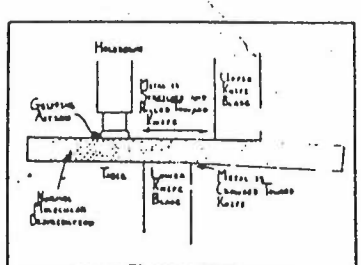

Figure #20

Tension/compression of metal during start of shearing.

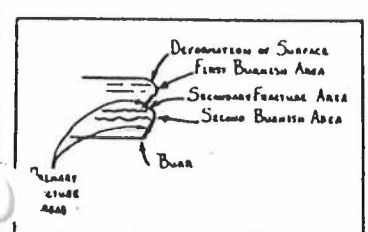

Figure #21

Condition of edge of metal sheared with insufficient clearance.

between shearing across the grain or with the grain of the metal. As with camber, internal stresses in the stock can contribute to twist, however, it is usually caused by excessive bending of the sheared piece or drop during the cut. Heavy sheets twist more than light sheets; soft sheets twist more than hard sheets and narrow strips twist more than wide drops.

6. Clearance between shear knife blades — There are two extremes in setting the distance between the knife blades with respect to the metal being sheared. One extreme is insufficient clearance wherein the two fractures do not meet in a line. The result is that a transverse, secondary fracture must occur to free the drop from the original stock. The pressure of the knife descending will cause this secondary fracture to occur and the cut edge will display a characteristic ragged shape.

The knife rubbing against this secondary shear area will often create a second burnish area along the length of the cut. (**See Figure 21.**) The other extreme is excessive clearance which will result in an edge that resembles a tear more than a clean cut.

The distance between the knife blades could be so great that excessive deformation would occur on the upper edge of the original metal stock with corresponding deformation on the bottom surface of the drop. Excessive clearance wastes shearing force because it brings more bending forces into play and thus encounters more resistance in the metal which the shear must overcome. A recommended knife clearance chart can be found in **Figure 22.**

The principal effect of knife clearance is the appearance of the cut, particularly in shearing wide drops. A second effect is the squareness of the cut which can be controlled by knife clearance. In addition to the appearance, the knife clearance affects to a slight degree the twist of the drop, if the drop is very narrow. Knife clearance also affects the shearing tonnage which in certain circumstances can be lowered by opening the clearance.

It is absolutely essential to change the knife clearance in shearing extremely thin sheets or extremely heavy plate. As an example, very thin stainless steel can only be sheared with very sharp knives and tight knife clearance. In contrast, the only way to get a smooth cut when shearing very heavy plate is to open the knife clearance. Many shear operators have been trained on older shears which did not provide a simple means of knife clearance adjustment. They have become accustomed to accepting a reasonable amount of secondary shear roughness and they do not expect one shear to be able to cut both thin gauge and heavy plate.

A shear of sufficient construction can handle from the very thinnest material to its maximum plate capacity if it incorporates knife clearance and rake adjustment. It is evident that under certain conditions rake angle is of prime consideration, whereas under other conditions knife clearance is most important. A shear having independent rake angle adjustment and independent knife clearance adjustment can operate to your best advantage.

As stated earlier, metal fracture starts off from the wall of the knife just above the cutting edge at a slight angle and unless the knives were tilted about 2° from the vertical, as previously discussed, even with proper clearance, a squared cut would be difficult to achieve. When the proper clearance is set, the fracture occurs so as to produce a clean, squared edge on both the original stock and the sheared piece, or drop.

Clearance therefore affects the angularity of the cut due to the angle and plate of the fracture. It also affects the appearance of the cut, the amount of burr and the amount of shearing tonnage.

7. Sharpness of the knife blades — It is generally agreed that shear knives must be kept sharp. If they are not, operating and material costs will soon mount unnecessarily. A sharp edge on the shear knife will bite into the material more quickly, avoiding excessive deformation of the surface because the shear stress is concentrated in a small area. (**See Figures #23, #24, and #25.**)

Dull edges of shear knives deform the metal surface to a greater degree because the shear stresses are spread out over a larger area. This means that more shearing force will be necessary to start the fractures and make them meet. In addition with dull edges, the tension-compression stage lasts much longer because the fractures have not relieved the stressed areas by separating the metal at those points. (**See Figure #26.**)

Every shear owner should have a controlled re-sharpening program, with at least one extra set of knives available to prevent excessive downtime. There is a point at which the knives should be resharpened and if the knives are used beyond this point, they become dull and the cutting edges suffer from fatigue.

Fatigue is cumulative and starts a chain reaction of more rapid dulling until eventually the edges of the knives spall, break and chip. If the knives are allowed to get into this state, excessive metal must be ground off to restore the blade to good condition and the life of the blade is obviously shortened.

Dullness can also cause heavy burrs on the sheared edge of the stock, excessive wear on the ram guides and may also overload components of the shear if it is already being operated at capacity. This is especially true of mechanical shears due to the nature of the drive system. Dullness of knives can thus be very expensive. Many users carelessly postpone knife sharpening, ignoring the fact that a shear is a precision cutting tool that can easily be damaged if not properly maintained.

It is extremely important that you use the correct shear knives for your operation. The shear manufacturer, or the knife manufacturer, will recommend the proper shear knife for your operation if you will advise him the various types of metal you are shearing as well as the percentage of total shearing each type of metal represents.

Basically, as standard, there are three available kinds of shear knives in common use. *Grade I - tool steel; Grade II - intermediate alloy and Grade III - high carbon, high chrome.* Generally speaking, when shearing aluminum Grade III knives are best; when shearing brass Grade III knives are best; when shearing

TRIM CUTS
EDGE APPEARANCE CRITICAL
RECOMMENDED
KNIFE CLEARANCES
(MILD STEEL)

METAL THICKNESS	KNIFE CLEARANCE
10 Gauge	.005" to .009"
3/16"	.007" to .013"
1/4"	.010" to .018"
3/8"	.020" to .028"
1/2"	.030" to .040"
5/8"	.040" to .050"
3/4"	.050" to .065"
1"	.070" to .090"
1-1/4"	.090" to .120"
1-1/2"	.110" to .150"

SHEARING LARGE PLATES WITH WIDE DROPS
EDGE APPEARANCE NOT IMPORTANT

METAL THICKNESS	KNIFE CLEARANCE
1/4"	.025" to .030"
3/8"	.038" to .050"
1/2"	.050" to .070"
3/4"	.075" to .110"
1"	.100" to .150"
1-1/4"	.125" to .180"
1-1/2"	.150" to .220"

Figure #22

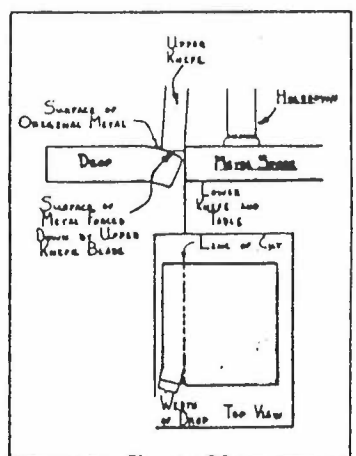

Figure #23

Start of cut through metal stock.

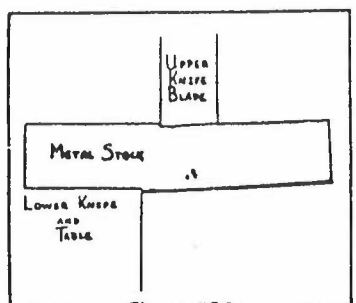

Figure #24

Start of cut: knife blade edges have entered metal, but not yet deep enough to cause permanent deformation.

mild steel up to ¼" thick Grade III knives are best; when shearing mild steel over ¼" thick Grade II knives are best; when shearing Silicon steel Grade III knives are best; when shearing high carbon steel Grade II knives are best; when shearing stainless steel up to 3/16" thick Grade III knives are best and when shearing stainless steel over 3/16" thick Grade II knives are best.

We still strongly urge that you have the shear manufacturer, or the knife manufacturer, recommend the correct grade of knife based on types of materials and percentage of materials being sheared in your operation.

When shearing stock coated with a rust preventative material, the lower knife blade should be swabbed with oil several times a day. The upper blade will pick up its lubrication from the stock. Knives should be kept clean and free of metal particles. If knives become magnetized, they should be removed and de-magnetized to prevent further damage.

Shear knives are furnished with multiple cutting edges. The majority of shears are equipped to handle four-edge blades which are more desirable as they can be rotated three times before regrinding or replacement.

Interesting to note is that a shear knife blade can cut alloys as hard as itself. The point-contact action of the shear in engaging the metal, whereby a sharp knife edge concentrates the shearing force in a very small area of the metal, parting the metal under pressure, permits this to be accomplished. We give you below a few general statements on different types of metal as related to shearing problems encountered and generally recommended clearance and rake angle settings:

ALLOY STEEL -- QUENCHED AND TEMPERED CONSTRUCTIONAL

Derate the shear to 2/3 of the mild steel rating; thus, a shear rated for 1" thick mild steel should be used for shearing up to but not exceeding ⅝" thick constructional alloy steel.

Clearance: 0.010" to 0.015"

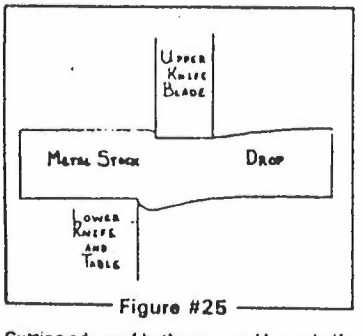

Figure #25

Cutting edges of both upper and lower knife blades are biting into metal beyond point of deformation.

Rake Angle: Use a high rake angle to get the smoothest cuts, but if bow results, flatten the rake angle as required.

ALUMINUM

Aluminum is soft and easily marked by holddowns. Reduce holddown tonnage or use plastic feet on the holddowns. Another solution is to slip a sheet of cardboard or masonite under the holddowns and above the aluminum surface.

Knife Clearance — for sheet up to ⅛" thick: 8% of metal thickness, with 0.012" clearance for thicker plate.

Rake Angle — 2 degrees from horizontal.

CLAD STEEL

Shearing is done with the clad side up. The burr forms on the steel side. When the plate is sheared for subsequent welding, take care to prevent excessive shear droop, which results from shear pressure and breaks the flatness of the plate's clad surface. If the plate edge is to be machined, the shear droop effect can be disregarded.

MAGNESIUM

Heavy sheet and plate should be sheared hot, at 600°F for annealed stock and at 275°-400°F for alloy hot-rolled, depending on the alloy. With hot-shearing, there is shrinkage, so allow for thermal expansion.

Clearance — Take care to set proper clearance. Sheet over 0.065" thick will show a rough, flaky edge with improper clearance. Recommended range is 3-5% of metal stock thickness. Keep clearance as small as possible without scoring the knife blades.

Rake Angle — 30-45 degrees from horizontal.

NICKEL AND NICKEL ALLOY STEELS

For best results, plate, sheet and strip should be sheared in tempered condition.

Lubrication is not required.

The high nickel alloys have good shearing characteristics, but require more power than the same thickness of mild steel.

STAINLESS STEEL

Equipment — derate the shear 50%-75% off its mild steel rating. Thus, derate about 4 or 5 gauges.

Power — Annealed stainless steel requires about twice the power of mild steel.

Knife blades — Use sharp blades of high quality steel, such as solid high carbon, high chrome blades.

Surface Protection — Take great care not to mar the surface, especially when shearing the higher polished stainless steels, such as No. 4, 6, and 7. Use the mill-applied paper, or your own. Keep the shear table covered with clean, heavy corrugated paper or soft cloth. Use fibre or non-metallic holddown feet.

Clearance — Light gauge — 0.001" to 0.0015"

Heavier gauge — 0.0015" to 0.002"

Less clearance may be harmful to knife blades, because of scraping action. On thin gauge stock it may be necessary to use little or no clearance at all, or clearance close enough to cut tissue paper.

Rake Angle — Use as low a rake angle as possible to avoid bow and twist.

SHEARING ALLOYS

A. Some require more tonnage
   1. Stainless
   2. Monel
   3. HY80

Use shear with overload protection.

B. Some are "stringy" and burr of pull through
   1. Stainless (304, 316, 410)
   2. Copper
   3. Brass

Close Knife Clearance
Use Sharp Knives
Increase Rake Angle

C. Some cause bad shock
   1. Some stainless (310, 330, 420)
   2. T1
   3. AR
   4. Checkerplate

Increase Rake
Use Intermediate alloy knives

D. Some are soft and are marked by holddowns
   1. Soft aluminum
   2. Polished stainless

Set Up Timer
Reduce Holddown Tonnage
Use Plastic Feet or Cardboard

E. Some shear with bad horizontal cracks
   1. Magnesium

Shear hot

It is appropriate at this point to mention shearing speed because some confusion exists with respect to how fast a squaring shear should operate. No matter what you hear about shearing speeds and strokes per minute or inches per minute, or whatever, please note that ultimately only two factors really determine how fast a shear should operate, these being *(1) the operator and (2) the job.*

If the operator cannot adjust the speed of the shear to a pace that is comfortable to him, he is almost sure to get in trouble sooner or later. We do not mean to say that he should not try to increase his skill and working speed, however, if the machine is operating faster than he can feed work into it safely, there is potential trouble. The machine will not fatigue or grow careless, however, chances are that the operator might, and will, human nature being what it is.

Similarly, the speed of the shear should be suited to the job being performed. Different jobs

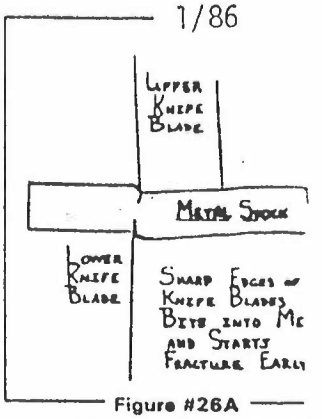

Figure #26A

Short tension/compression stag

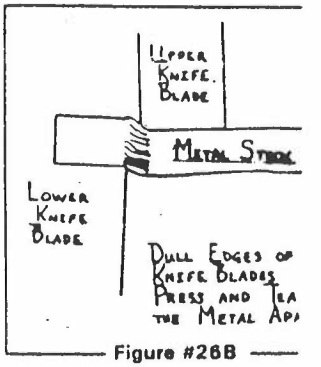

Figure #26B

Long tension/compression stage

have different requirements can cut up small sections f than large sections and gauge sheet faster than h plate. The point is that the should be adjustable to requirements of the job an working speed of the opera

When you consider she speed from the standpoint operator and the job to be you logically arrive at the lem of material handling and away from the shear. time is spent in material h ing than in actual shea Material handling time incr with an increase in the numl cuts, however, size of sheet sheared and thickness o material being sheared are significant because of prob in handling large sheets plates and heavy sheets plates. Even where material hand and readily available operator, handling time exceed 70% of the total el operation time.

The problem of material h ing to and away from the she an entirely different subjec you should consult the s manufacturer for his re mendations. There are se independent manufacturer material handling equip applicable to both mecha and hydraulic squaring sh with whom you can discus problem.

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Key to Symbols

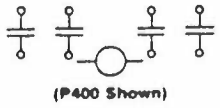
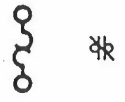
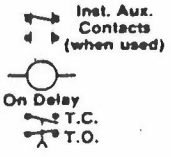
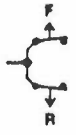
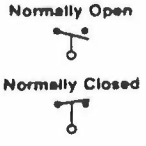
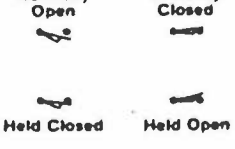
Shown here are the symbols most often used in this book. Although the explanations accompanying the diagrams describe the devices used, familiarity with the various symbols will lead to a quicker understanding of each circuit.

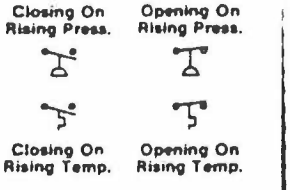
The symbols, device designations, and abbreviations in this book are taken from the NEMA Standard Publication/No. ICS-1-1978.

Wiring Diagram Symbols

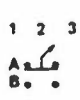
Device		Symbol
Coils	Relay and Switch Coils	Single Winding; Tapped; Permanent Magnet; Economized
Contacts	Normally Closed (N.C.)	Main; Auxiliary
	Normally Open (N.O.)	Main; Auxiliary
	Time Closing	N.O.T.C.; N.C.T.C.
	Time Opening	N.C.T.O.; N.O.T.O.
Contactors	AC Solenoid Type	3 Pole
	Manually Operated	

Device		Symbol
Fuse	General	
Indicating Lights	General	NE - Neon FL - Fluorescent R P - Purple OP - Opalescent O - Orange A - Amber B - Blue C - Clear G - Green R - Red W - White Y - Yellow
Motors	3 Phase Squirrel Cage Induction	
	Single Phase	
Rectifier	Full Wave with Color Code	Yellow AC; DC + Red; DC -; Yellow AC + Red; - Blk; Yel AC Yel

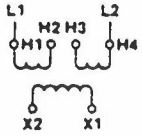
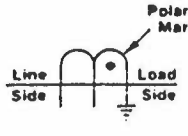
Device		Symbol
Relays	Control	 (P400 Shown)
	Thermal Overload	
	Timing (Pneumatic) (ON-DELAY)	 Inst. Aux. Contacts (when used) On Delay T.C. T.O.
Switches	Anti-Plugging	 F R
	Float Switch	 Normally Open Normally Closed
	Limit Switches	 Normally Open Normally Closed Held Closed Held Open

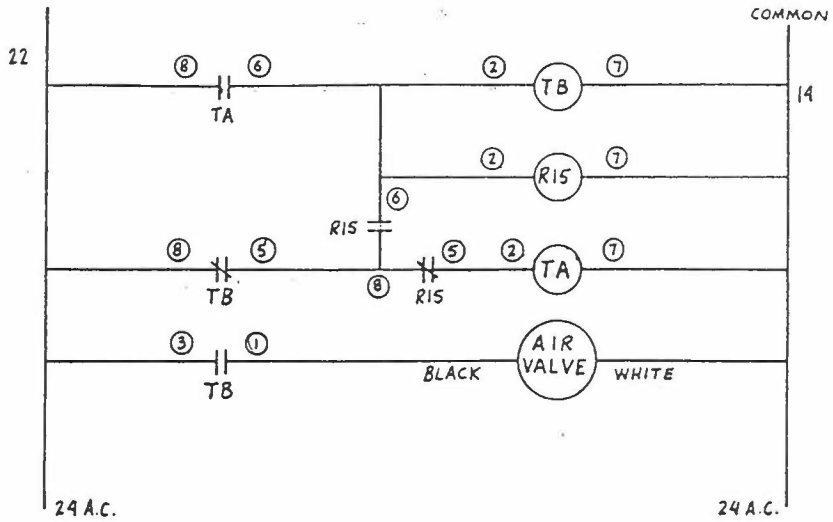
Device		Symbol
Switches	Plugging	 F R
	Pressure and Temperature	 Closing On Rising Press. Opening On Rising Press. Closing On Rising Temp. Opening On Rising Temp.
	Push Button Standard	 NC NO
	Push Button Heavy Duty, Oiltight	 Mushroom Head
	Push Button and Jog Attachment	 Run Jog
	Standard Duty Selector Switch	 2 Position 3 Position
	Heavy Duty Selector 2-Position	 1 2 A B

Letter Sym.	Position 1	Position 2
A	X	
B		X

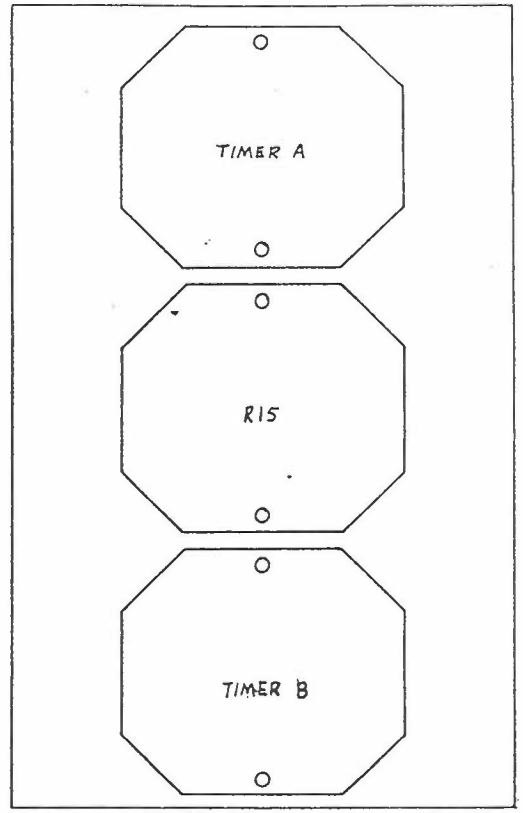
	Heavy Duty Selector 3-Position	 1 2 3 A B

Letter Sym.	Position 1	Position 2	Position 3
A			X
B	X		

	Potential	 L1 L2 H1 H2 H3 H4 X2 X1
Transformer	Current	 Polarity Mark Line Side Load Side



- SET TB TIMER FOR 15 SEC.
- SET TA TIMER FOR 12 HRS.



HDE SHEARS

TOLERANCES (EXCEPT AS NOTED)	REVISIONS NO.	DATE	BY	AUTO LUBE
DECIMAL ±	1			TIMER CIRCUIT
FRACTIONAL ±	2			
ANGULAR ±	3			DRAWN BY / SCALE 1" = 1" / MATERIAL
	4			CHK'D / DATE 1-27-86 / DRAWING NO.
	5			TRACED / APP'D

Crouzet®

and
INSTALLATION
INSTRUCTIONS

Octal Cycle Progress Timer

ATTENTION: Read carefully before attempting to install, operate, or service your Crouzet timer. Retain for future reference.

GENERAL SAFETY INFORMATION

1. Do not connect input to voltages other than those indicated on the timer.
2. Input and contact circuits must have properly rated fuses. Do not overload output contacts.
3. Use wire which has been properly selected according to the NEC.
4. Always disconnect power sources when connecting or disconnecting timer.

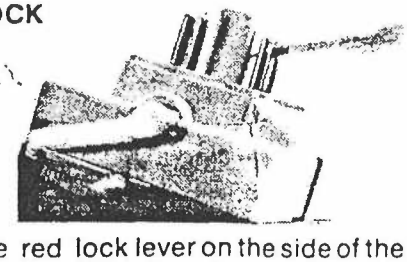
DESCRIPTION

Your Crouzet timer has features and capabilities in one timer that make it suited for a variety of applications.

1. MEMORY

During normal timing modes, if the power is removed from the timer it will automatically reset to beginning of timing cycle. Some applications may require that if power is removed, the timer will remain at that point in the time cycle and start timing from that point when the power is restored. This is accomplished by using a screw driver and rotating the memory screw on bottom of timer 180°. (Refer to diagram on timer case).

2. OCTAL LOCK



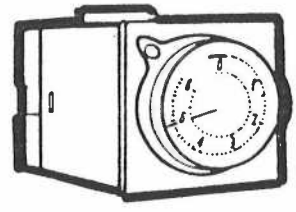
By rotating the red lock lever on the side of the case to the "fixed" position (reading from top of timer), the timer can be securely held in the socket. Note: Care should be taken the lever is in "FREE" position whenever timer is inserted or removed from socket.

3. MULTI-RANGE

Your timer may be operated in any of the three timing ranges available on that particular timer. The timing range is changed by inserting a screw driver into the adjustment screw and rotating it in either direction to desired timing range. There will be slight click when adjustment screw is in proper position.

4. PANEL MOUNT

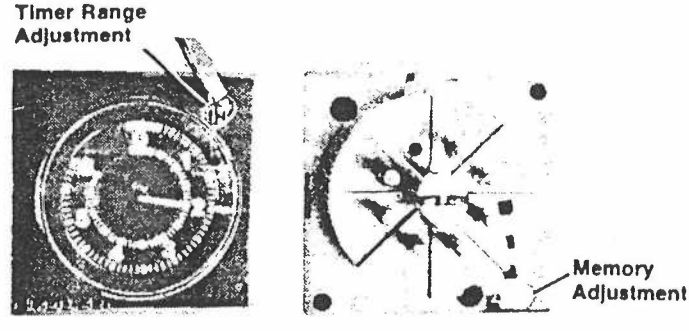
Your timer may be panel mounted by using spring and clips supplied with timer. (Panel cut-out 1.81 x 1.81 inches.)



5. MULTI-FUNCTION

Your timer may be connected to perform a variety of "On Delay", "Interval", or special functions. Although it is not possible to explain or show connections for all types of applications, listed below you will find some typical timing modes explained as well as connection diagrams. In the diagrams shown (except Fig. 5) the load must be the same voltage as the timer circuit. If this is not the case in your application, then modifications to the circuits will be necessary.

TIMING MODES



"ON DELAY"

Control contact or switch closes, timing begins, and instantaneous contacts close (Pins No. 1 and 3). After completion of selected time, delayed contacts transfer (Pins No. 8 and 5 open; Pins No. 8 and 6 close), power is applied to lc d. Control contact or switch opens, power is removed from load and timer resets with contacts returning to original position.

"INTERVAL"

Control contact or switch closes, timing begins, instantaneous contacts close (Pins No. 1 and 3) and power is applied to load. After completion of selected time, delayed contacts transfer (Pins No. 8 and 5 open; Pins No. 8 and 6 close) and power is removed from load. Control contact or switch opens, timer resets to original position.

"ONE SHOT"

Control contact or switch closes, timing begins, instantaneous contacts close (Pins No. 1 and 3). At end of selected time, delayed contacts transfer and power is applied to Pin No. 6 and 200 ms, timer resets.

COMMON CIRCUITS - The following examples show some common circuits used with the Octal Cycle Progress Timer.

, - **"ON DELAY"** - Maintained start switch or contact.

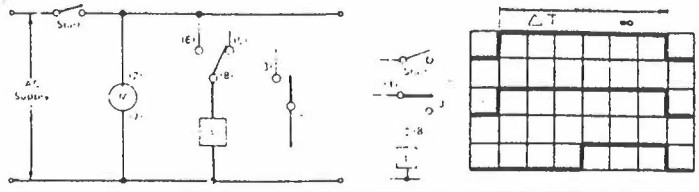


Fig. 2 - "ON DELAY" - Momentary pushbutton or contact (400) milli seconds minimum) to start. Momentary pushbutton or contact opening (200 milli seconds minimum) to reset.

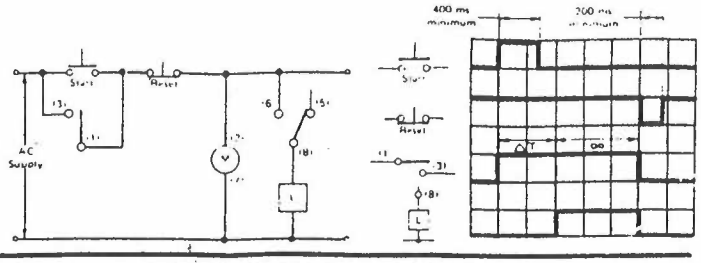


Fig. 3 - "INTERVAL" - Maintained start switch or contact.

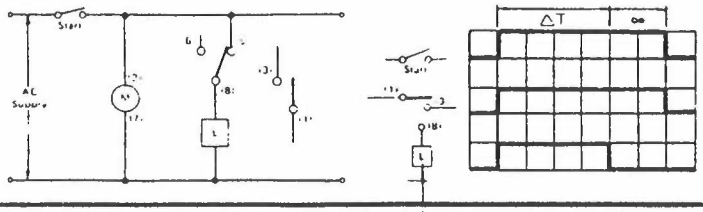


Fig. 4 - "INTERVAL" - Momentary pushbutton or contact closure (400 milli seconds) to start and automatic reset. Momentary pushbutton or contact opening (200 milli seconds min.) to reset during cycle.

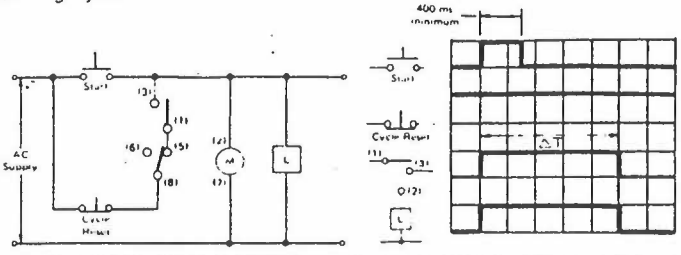


Fig. 5 - "REPEAT CYCLE" - Maintained start switch or contact. (Note: Requires two timers, and one relay, not included). Timer "A" and Timer "B" will alternately operate until start switch or contact is opened.

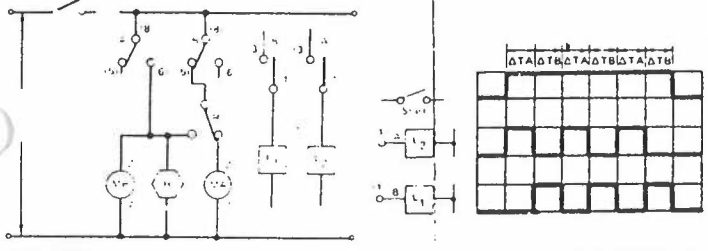
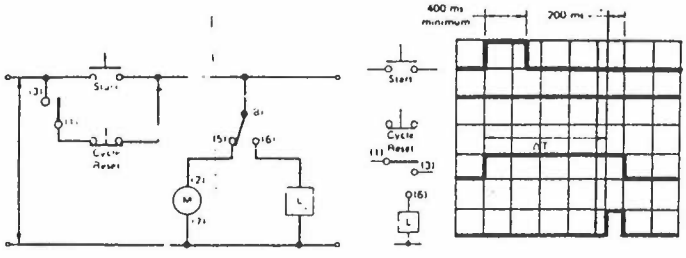


Fig. 6 - "ONE SHOT" - Momentary pushbutton or contact closure (400 milli seconds min.) to start. Auto reset at tend of time or manual cycle reset with momentary pushbutton or contact opening.



SPECIFICATIONS

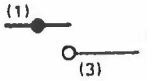
Input Power: 3VA
Repeat Accuracy: ± 1.5%, except ± 4% on 6 sec. range.
Setting Accuracy : ± 2%, except ± 5% on 6 sec. range.
Reset Time: 200 ms
Contact Combination: 1 instantaneous SPST N.O. contact
1 delayed contact SPDT
Contact Rating: Both contacts are 8A 120/250V, 1/3HP 120/240V AC
Temperature Range: Operate -10°C to +55°C
Storage -20°C to +70°C

OCTAL TIMER MODELS

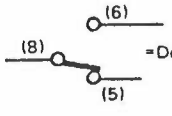
P/N 88 226.509 - 24 VAC - 6 sec/60 sec/12 min - Model 1
P/N 88 226.512 - 24 VAC - 6 min/60 min/12 hrs - Model 2
P/N 88 226.510 - 115 VAC - 6 sec/60 sec/12 min - Model 1
P/N 88 226.513 - 115 VAC - 6 min/60 min/12 hrs - Model 2
220 V available upon request

LEGEND

( ) = Timer pin numbers
Ⓜ = Timer motor
[L] = Load
Ⓡ = Relay (SPDT) not furnished
ms = milli-seconds



= Instantaneous timer contacts



=Delayed time contacts

WARRANTY

Crouzet timers are warranted by Crouzet Controls, Inc (C.C.I.) to the original user against defects in workmanship or materials under normal use for one year after date of shipments. Parts will journey at the addressee's risk

Any part which is determined to be defective material or workmanship and returned to an authorized Crouzet distributor, or to C.C.I. will be repaired or replaced at Crouzet Controls, Inc.'s option. The sender is responsible for all transportation charges to and from C.C.I factory

warranty will not apply to replacements or repairs resulting from normal wear nor from deterioration or accidents which may occur due to negligent handling or misuse of the devices The repair, modification, or replacement of the parts during warranty period will not result in an extension of the equipment warranty period.

WARRANTY DISCLAIMER Crouzet Controls, Inc. has made a diligent effort to illustrate and describe the products in this literature accurately; however, such illustrations and descriptions are for the sole purpose of identification, and do not express or imply a warranty that the products are merchantable, or fit for a particular purpose, or that the products will necessarily conform to the illustrations or description.

Except as provided below, no warranty or affirmation of fact, express or implied, other than as stated in "LIMITED WARRANTY" above is made or authorized by Crouzet Controls, Inc., and Crouzet Controls, Inc.'s liability in all events is limited to the purchase price paid.

Certain aspects of disclaimers are not applicable to consumer products; e.g., (a) some states do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you; (b) also, some states do not allow limitations on how long an implied warranty lasts, consequently the above, limitation may not apply to you; and (c) by law, during the period of this Limited Warranty, any implied warranties of merchantability of fitness for a particular purpose applicable to the customer products purchased by the customer, may not be excluded or otherwise disclaimed.

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1082 7.5M 394ID

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INSTALLATION INSTRUCTIONS

RELAYS

MODELS 1A484A, 1A485A, 3X739A THRU 3X743A & 5X822A THRU 5X827A

FORM 5S1757
05805

DAYTON ELECTRIC MANUFACTURING CO. CHICAGO 60648

1084/298/1N

READ INSTRUCTIONS CAREFULLY BEFORE ATTEMPTING TO INSTALL, OPERATE OR SERVICE DAYTON RELAYS!
RETAIN INSTRUCTIONS FOR FUTURE REFERENCE.

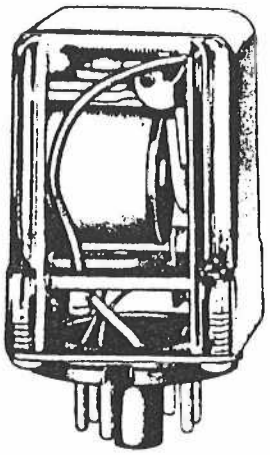


Figure 1

Description

Dayton enclosed octal style plug-in general purpose relays are for use in appliances and industrial control applications. Relays plug into standard 8-pin octal sockets. (3 PDT relays require 11 pin sockets) The dust resistant enclosure provides protection against airborne contaminants.

Specifications

Dayton relays are furnished in any one of three contact configurations: 1) single pole, double throw (SPDT); 2) double pole, double throw (DPDT); or 3) three pole, double throw (3PDT).

Motor load contact ratings are 1/3 HP at 120VAC, 1/2 HP at 240VAC and resistive load current ratings are as follows:

VOLTAGE	1-POLE	2-POLE	3-POLE
120VAC	12 A	12 A	10 A
240VAC	12 A	8 A	6 A
30VAC	10 A	10 A	10 A

The silver alloy contacts are gold flashed to enhance shelf life. Construction is resistant to vibration and changes in humidity and temperature. Dielectric withstanding voltage is 1000 VRM between open contacts and 1500 VRM between all other mutually insulated conductive elements.

General Safety Information

1. Do not use contacts for electrical loads greater than the rated loads given under "Specifications."
2. Make certain that correct voltage is applied to energizing coil as marked on the relay.
3. The energizing coil and contact circuits must be properly protected with fuses or other effective protecting devices.
4. Use electrical wire of size and type that complies with the National Electrical Code and local codes.
5. Avoid installation in excessively moist, hot, or dusty locations.
6. Provide adequate protection to prevent access by unauthorized or unqualified persons.
7. Provide adequate clearance around the relay and socket to prevent short circuiting and to allow servicing access and free air circulation.
8. Make certain that all electrical power is disconnected when installing or removing relay.
9. These relays should not be used in explosive atmospheres or where flammable vapors or fumes may come in contact with the relay. Special explosion proof components must be used for such applications.

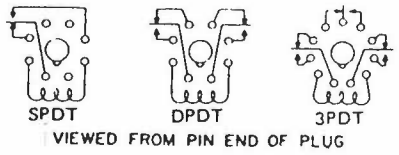


Figure 2 — Pin Configuration

Installation

1. Read "General Safety Information" thoroughly before proceeding with installation.
2. Make certain that all electrical power is shut off before installing relay and socket.
3. Select a location for installing the relay that is free of particle, dust, vapor and gaseous contaminants. These covered relays are recommended for locations where contamination is likely to be encountered.
4. Dayton enclosed octal style plug-in general purpose relays will operate in any mounting position, but vertical mounting with plug-in pins pointing down will give longer life. Horizontal mounting with the relay positioned with the armature on top is the second best mounting position.
5. Enclosed plug-in relays do not require mounting holes. Simply line up the keyway on the center pole with the key slot in the socket receptacle hole and push relay into the socket. Mounting instructions for the socket are provided with the socket.

Maintenance

Periodically check visually for signs that indicate approaching malfunctioning, such as excessive heat, rapid build-up of contaminants, erratic operation, excessive contact wear or pitting. Removal of cover may cause relay to go out of adjustment and is not recommended. Refer to "Trouble Shooting Chart."

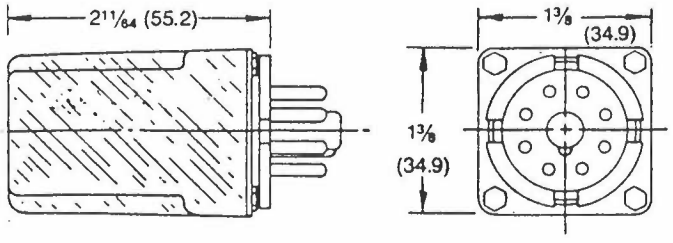


Figure 3 — Dimensions

LIMITED WARRANTY

Dayton relays, Models 1A484A, 1A485A, 3X739A thru 3X743A & 5X822A thru 5X827A, are warranted by Dayton Electric Mfg. Co. (Dayton) to the original user against defects in workmanship or materials under normal use (rental use excluded) for one year after date of purchase. Any part which is determined to be defective in material or workmanship and returned to an authorized service location, as Dayton designates, shipping costs prepaid, will be repaired or replaced at Dayton's option. For warranty claim procedures, see "Prompt Disposition" below. This warranty gives purchasers specific legal rights, and purchasers may also have other rights which vary from state to state.

WARRANTY DISCLAIMER. Dayton has made a diligent effort to illustrate and describe the products in this literature accurately; however, such illustrations and descriptions are for the sole purpose of identification, and do not express or imply a warranty that the products are merchantable, or fit for a particular purpose, or that the products will necessarily conform to the illustrations or descriptions.

Except as provided below, no warranty or affirmation of fact, expressed or implied, other than as stated in "LIMITED WARRANTY" above is made or authorized by Dayton, and Dayton's liability in all events is limited to the purchase price paid.

Certain aspects of disclaimers are not applicable to consumer products; e.g., (a) some states do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you; (b) also, some states do not allow limitations on how long an implied warranty lasts, consequently the above limitation may not apply to you; and (c) by law, during the period of this Limited Warranty, any implied warranties of merchantability or fitness for a particular purpose applicable to consumer products purchased by consumers, may not be excluded or otherwise disclaimed.

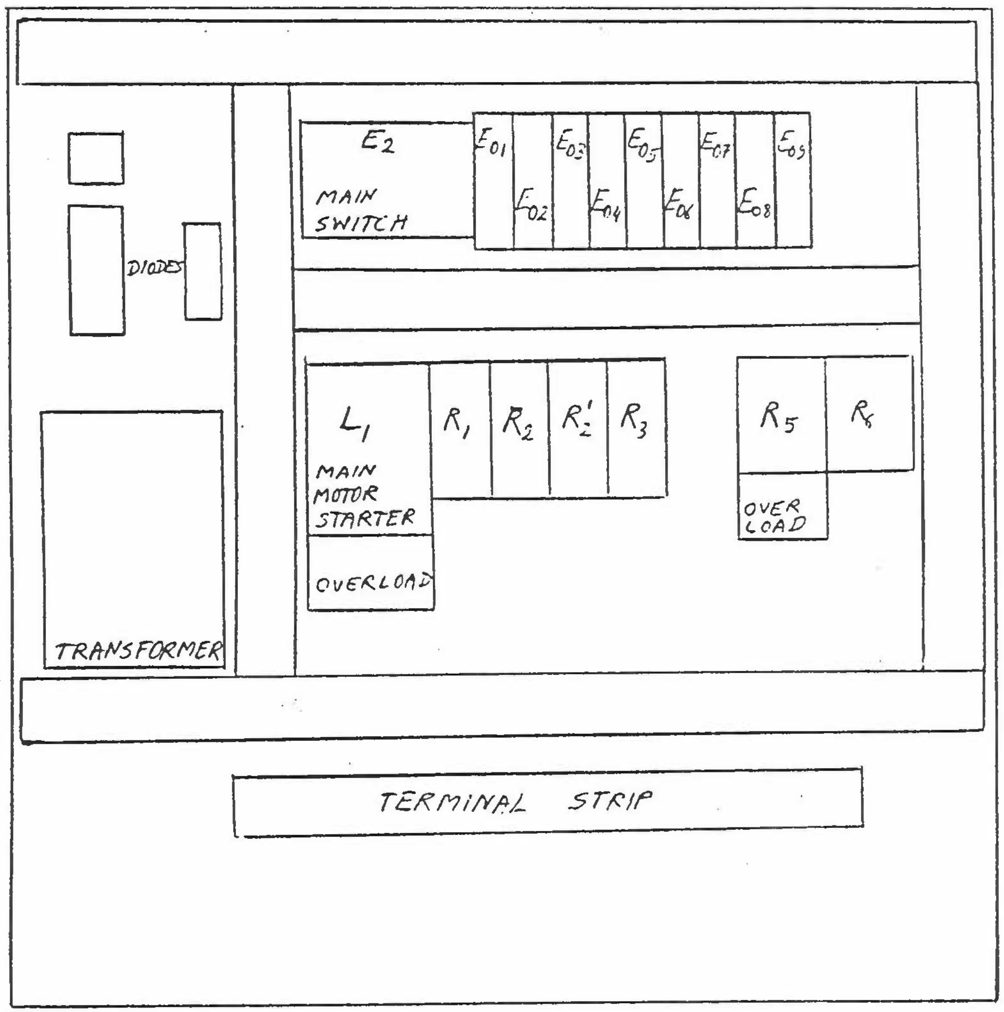
PROMPT DISPOSITION. Dayton will make a good faith effort for prompt correction or other adjustment with respect to any product which proves to be defective within warranty. For any product believed to be defective within warranty, first write or call dealer from whom product was purchased. Dealer will give additional directions. If unable to resolve satisfactorily, write to Dayton at address below, giving dealer's name, address, date and number of dealer's invoice, and describing the nature of the defect. If product was damaged in transit to you, file claim with carrier.

DAYTON ELECTRIC MFG. CO., 5959 W. HOWARD ST., CHICAGO, ILLINOIS 60648

Trouble Shooting Chart

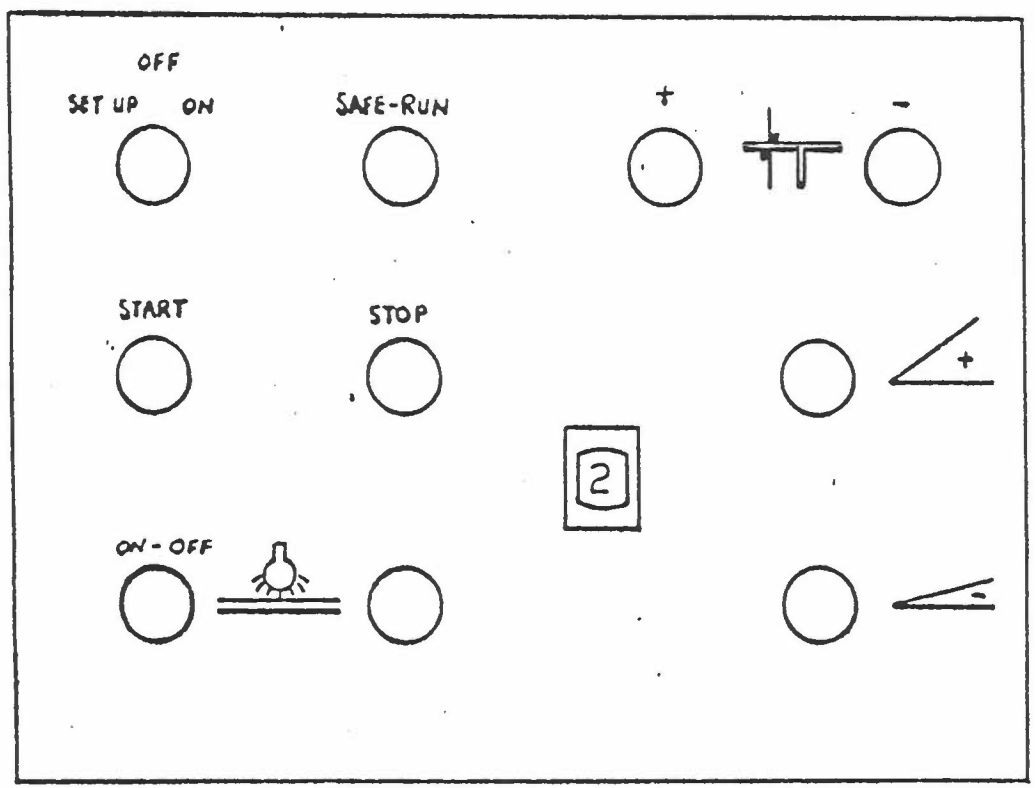
SYMPTOM	POSSIBLE CAUSE(S)	CORRECTIVE ACTION
Load is not energized, or does not operate.	1. Loose Connections. 2. Blown fuses or tripped circuit breakers. 3. Open coil. 4. Incorrect operating control voltage. 5. Relay is incorrectly wired. 6. Operating device that keys relay coil is defective. 7. Load is defective. 8. End of contact life. 9. Bad socket contact.	1. Tighten any loose connection. 2. Check line fuse, control fuses and circuit breakers. 3. Check coil continuity with ohm meter. If open, replace relay. 4. Check control circuit to insure voltage is same as stated on relay. 5. Check wiring to determine if relay is wired as intended. 6. Check that relay will operate when power is supplied directly to its coil. 7. Check that load operates properly when power is applied directly to it. 8. Replace relay. 9. Replace socket.
Load will not de-energize.	1. Incorrect wiring 2. Contacts are shorted.	1. Inspect all connections to insure proper wiring. Remove power from coil to see if load de-energizes. If not, contacts are shorted. Contact armature should move in when power is applied to coil and move out when power is removed. 2. Disconnect power leads to contacts. Check contact continuity with coil de-energized. If there is continuity, replace relay.

CONTROL PANEL

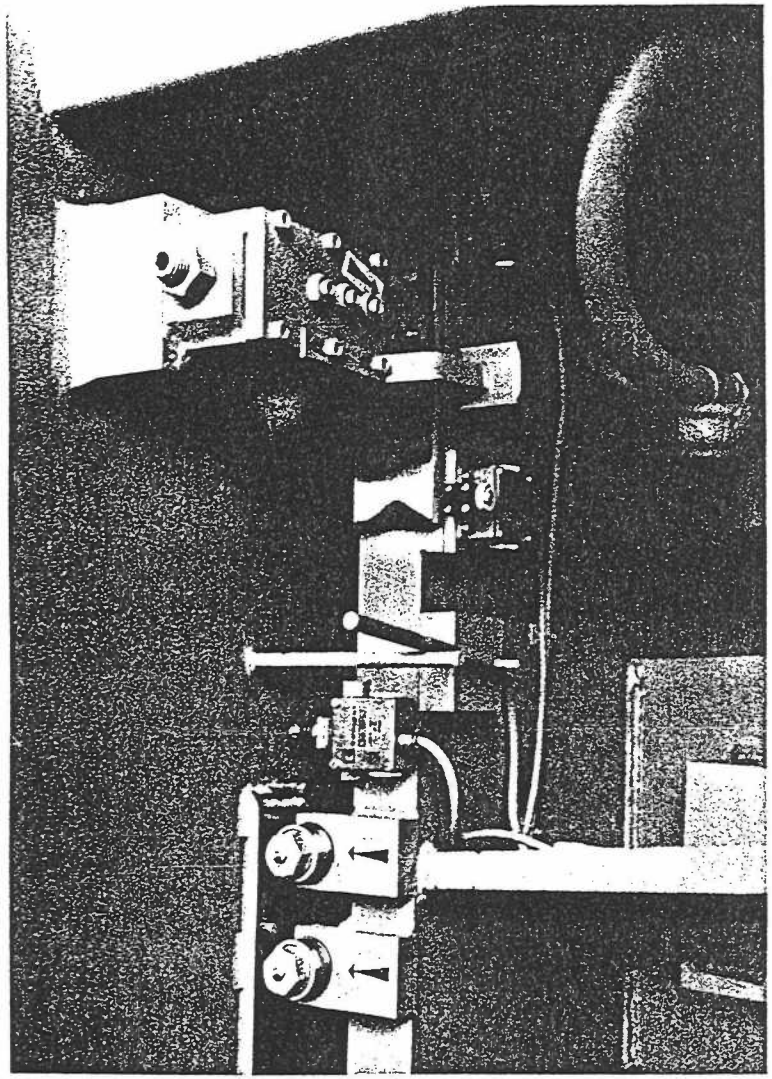


TOLERANCES	REVISIONS			TYPICAL LAY-OUT		
	NO.	DATE	BY	HDE SHEARS		
DECIMAL ±	1			DRAWN BY	SCALE	MATERIAL
FRACTIONAL ±	2			CHK'D	DATE	DRAWING NO
ANGULAR ±	3			TRACED	APP'D	
	4					
	5					

CONTROL FACE

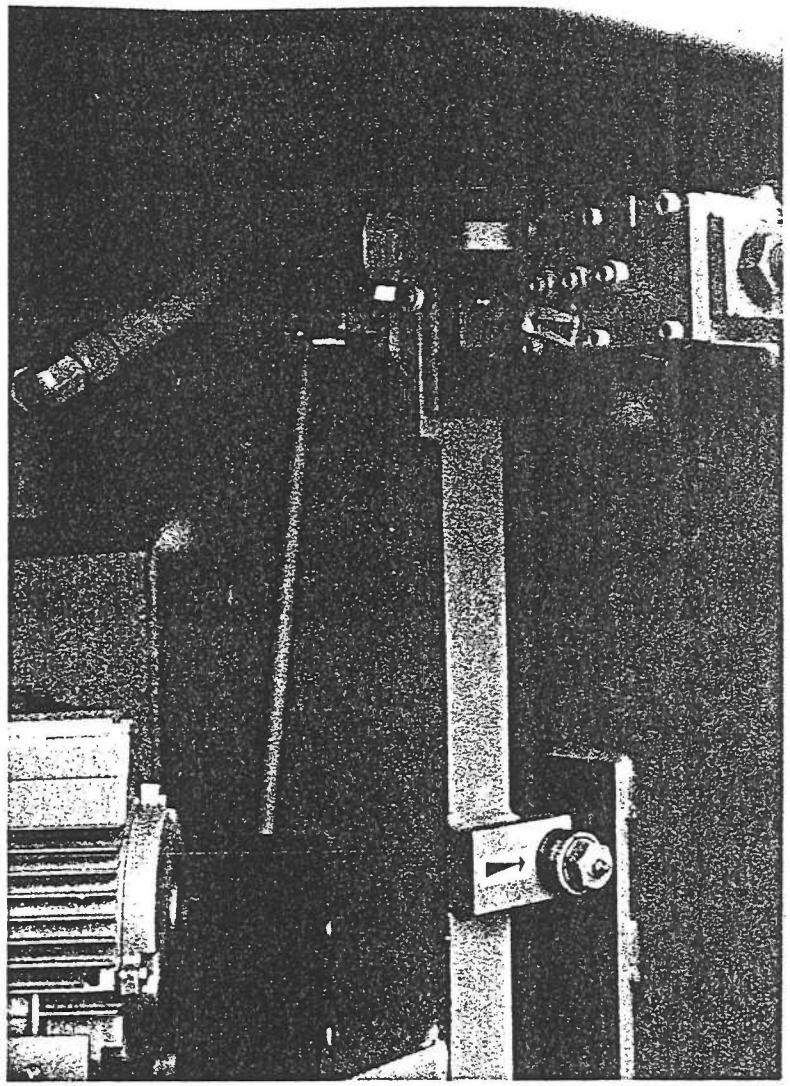


LIMIT SWITCHES VIEWED FROM REAR



LEFT

E2: End of stroke limit switch
E5: Minimum rake limit switch
E6: Maximum rake limit switch



RIGHT

E1: Top stop limit switch
E8: Speed slow down
E8: Only HDS 12 x ¼

LEGEND:

POWER PANEL

A	General Mainswitch IVP 63A	Socomec
L1	Starter LC1-D403BA65	Télémécanique
T1	Overload protection LR1-D63357A65	Id.
E2	01268 + Fuses 13004	Legrand
R5/R6	LC1-D099B	Télémécanique
T2	LR1-D09308BA65	
TR1	0-220-440V/0-24V 0-220V	Van Uffelen
E01/E02	01267 + Fuses 13004	Legrand
E03/E06	01267 + Fuses 13016	Id.
E04/E05	01267 + Fuses 13301	Id.
R1/R2/R3	Aux. relays 6012/24V	Finder

COMMAND PANEL

B1	Key switch ZB2-BG3+ ZB2-BZ10+7ZB2-BE101	Télémécanique
H1/H4	Red pilot light ZB2-BV6+ZB2-BV04 + DL1-CF024	Id.
B2	Stop Button XB2-A42	Id.
B3/H3	Start button with green pilot light ZB2-BW33+ ZB2-BW065 + DL1-CE024	Id.
B4	Switch XB2-BD21	Id.
A1+/A1-	Push button XB2-BA2+ZB2-BE102	Id.

Short Description
The 70 P and 80 P series are fully automatic position control systems, executed in easy to mount up to date plug in technique. Both controllers have the same Hardware and Software, distinctive only in the following points.

Series 70 P
- Small, compact housing; dimensions H = 72 mm, W = 144 mm D = 160 mm including connector.
- 5 digit 10 mm high red LED Actual Position indicator.
- Small, but still easy to operate pushbutton operated coding switches.

Series 80 P
- Still compact housing; dimensions H = 72 mm, W = 288 mm, D = 160 mm including connector.
- 5 digit 20 mm high red LED Actual Position readout.
- Large protected coding switches.
- Also supplied as a free standing unit.
- Buit - in memory agaist mains failure can be provided.

Description of functions

To set machine reference
The Back Stop will be moved to a mechanically preset position. The measured value of this position will be set on the desired value switches and by means of operation of an external key operated switch, transfer this value to the Actual Position indicator. The equipment is now referenced.

The Datum must in principle be preset once only, as the coding switches should be set to the Actual position when the unit is switched off. On switching on again, the unit will automatically display the preset demand position in the Actual position indicator, (for other possibilities, see "memory on mains failure").

Demanded value input
The demanded value is set by pushbutton operated Coding Switches (0.0 - 9999.9 mm). Once start is activated, the preset value is memorised, ie any subsequent changes will be considered only at the next start, and the equipment moves from the original actual position to the demanded position. It means that during execution of positioning, the next demanded position can be preset. (If moving to incorrect position: press Stop button - correct Demand value - press Start button).

Creep distance
The creep distance is dependent on the machine and can be preset at the back of the unit between 1 and 99 mm, by means of coding switches.

The machine automatically starts in creep, when the difference between demand position and actual position is equal to or less than the preset Creep distance.
(Note: Creep distance = Overrun distance for automatic backlash compensation).

Overrun correction on Stop
The Stop signal can be preset at the back of the unit by means of coding switches, between 0.1 and 9.9 mm. During commissioning, the value is first preset to 0.0 and a move executed. The overrun of demanded position will be seen in the Actual Position display and this value can be preset to give the stop signal that much before coincidence.

It is further recommended, that the stop signal is preset after ensuring that the mechanical system gives a constant value.

Example:
The required distance is constantly overrun by 0.3 mm. Set stop correction distance at the back of the unit to 0.3 mm.

Switching from Absolute to Incremental operation
The desired reference distance may be preset as an Absolute or Incremental measurement, by means of closing an external contact.

Absolute Measurement (contact between terminals 20 & 13 open).
In this operating mode, the system controls the movement from the actual position to the preset point, giving the commands "direction - fast speed - slow speed - stop".

Incremental Measurement (contact between terminals 20 & 13 closed).
In this operating mode, the system will move the preset reference distance in the direction of zero, each time start is activated. (Saw with correction is operative). Actual distance is always indicated in absolute terms.

Backlash Compensation
To eliminate errors due to backlash in screw/nut or prinion/rack, the system is arranged to ensure that the desired position is arrived at from one direction only.
- In the direction "zero", the position is reached direcly.
- In the direction "greater", the position will be overrun at creep speed, to a distance equal to the slowdown point distance. The "Running" signal briefly drops out and reverse direction is selected. The drive now runs to the demanded position at creep speed.

Automatic retract
Should it be required that the Back Stop must retract from the desired position during machine cutting stroke and then return to the desired position, this can be achieved by closing a contact from terminal 20 to 12.
The retract distance is preset internally in the unit according to data given at the order stage.

Sawblade width correction
For use with a Sawing Machine, the unit is fitted with Sawblade width correction. The Saw width is set between 0.1 and 9.9 mm on the front of the unit. The Sawblade correction feature is only operative in "Incremental" feed positioning mode, (contact between terminals 20 & 13 closed.

Memory on mains failure
As already described in section "Machine Reference", there is no need for a memory, if the equipment is switched off after arrival at demanded position. On switching on again, the last position in the reference switches is displayed in the Actual value readout.

Optional additional storage memory
(only possible in series 80 P)
Should an anauthorised change be made in the reference value after switch off, it means that on reestablishing supply, a false Actual Value will be displayed and the equipment must be referenced once more.

To prevent this, the series 80 P can be fitted with an electronic memory, such that the Actual position is stored on switch off and reestablished in the display on switch on again, despite whatever is set on the switches.

Memory on switch off during positioning movement
In the series 80 P an additional feature is also available to give overrun security. In this case the equipment is supplied for approx 3 sec. after mains switch off from a back-up supply, so as to register any subsequent movement, before memorising position.

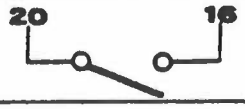
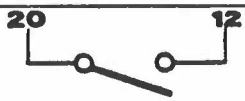
Connections

Plug-in Terminal Block

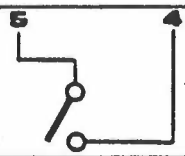
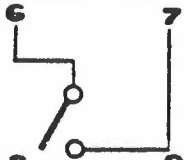
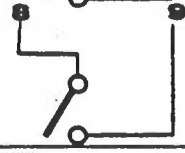
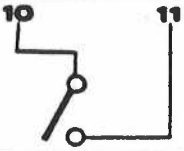
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20

Encoder Use screened cable, screen connected to zero	17	Backwards channel (B)	Encoder Term (4)
	18	Forwards channel (A)	Encoder Term (3)
	19	Supply + 12 V	Encoder Term (2)
	20	Zero OV	Encoder Term (1)

Input Signals, Potential free closing contacts; use screened cable.

Start		Stores preset position distance and activates operating sequence.
Stop		Stops operating sequence. New position can be preset.
Reference value		With this contact closed (eg by external keyswitch), the preset value will be displayed in the readout.
Incremental mode		With this contact closed, the equipment will move the desired distance towards zero, each time start is activated. Actual value readout is still absolute.
Automatic retract		With this contact closed, the Back Stop will move a defined distance back and forth again.

Output signals, Potential free, load 0.5 A 220V (resistive)

Run		Enable contact for the Drive, closed when desired value is greater or smaller than Actual value. Opens when Stop preset point is reached, also momentarily during reversal for backlash compensation.
Slowdown		Closed when distance is greater than the slow running distance. Opens when slowdown point is reached.
Reverse		Closed when desired distance is less than Actual value.
Programm running		Closed, so long as the positioning is taking place Opens when desired distance is achieved at coincidence.

Power Supply	1	Earth
	2	220V/50 Hz * fused at 0.16 A internally
	3	N

* other voltages possible on request.

I-T-E Circuit Breakers
Molded Case
Selection and Application

PROTECTION OF CONDUCTORS—EXCEPT MOTOR CIRCUITS

Match the current rating of the circuit breaker to the ampacity of the conductor. See Table 1 on page 246 for conductor ratings. If ampacity of conductor falls between standard breaker ratings, select the higher circuit breaker current rating.

Check voltage and interrupting rating of circuit breaker to assure that they are adequate for the electrical system.

PROTECTION OF MOTOR CIRCUITS

General

Molded Case circuit breakers are used in motor circuits as a disconnecting means and for short-circuit protection, and should be used in conjunction with motor-running over-current-protection devices. The circuit breaker should have a continuous-current rating of not less than 115% of the motor full-load current, and its characteristics should permit the motor to start without nuisance tripping from motor-inrush current.

When Breaker is Mounted Immediately Ahead of Motor Starter

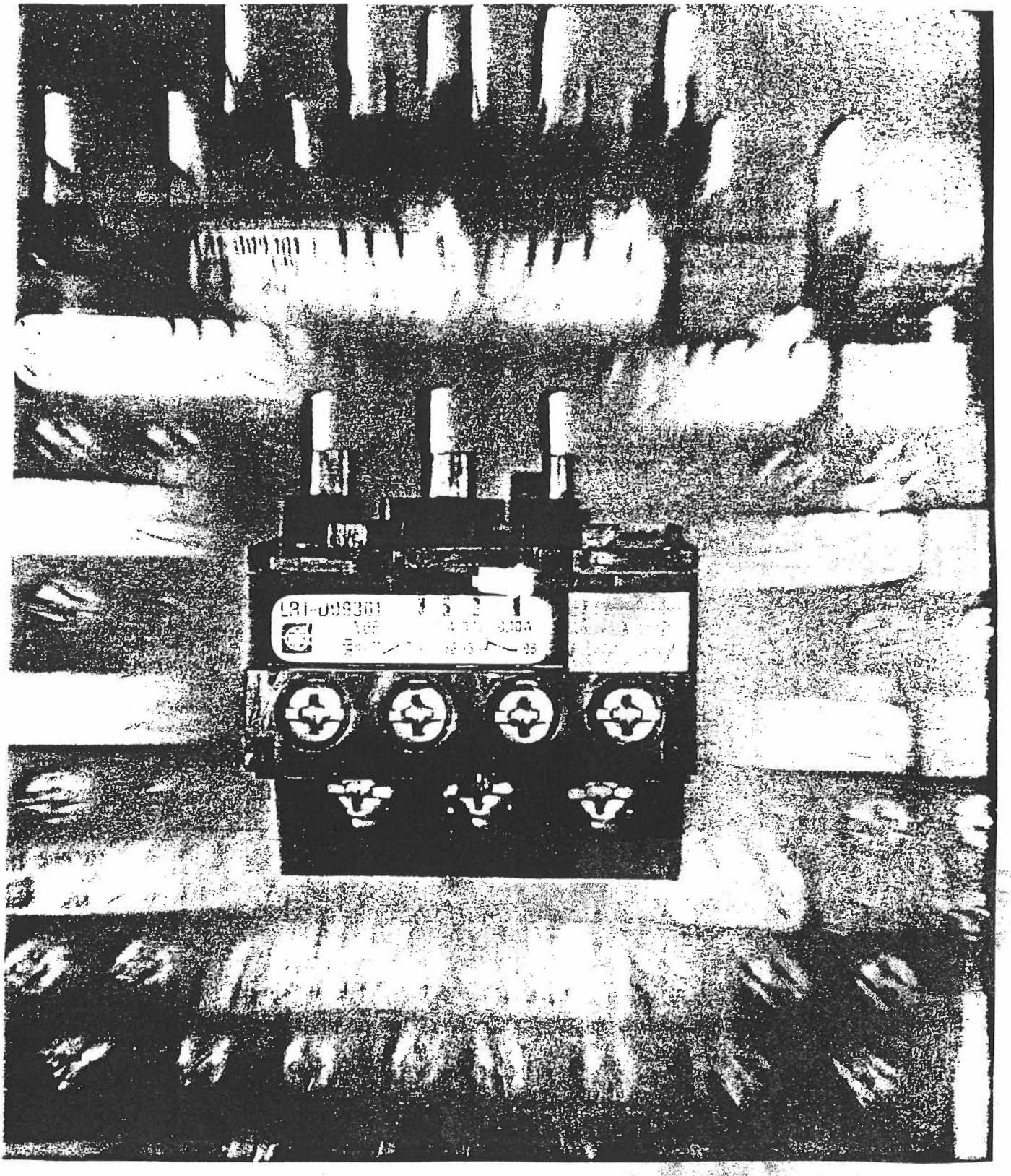
ETI instantaneous-trip circuit breakers are recommended for use in combination motor starters to provide selective short-circuit protection for the motor branch circuit. The adjustable instantaneous-trip feature of the ETI circuit breaker provides for a trip setting slightly above the peak motor-inrush current. With this setting, no delay is introduced in opening the circuit when a fault occurs. This circuit breaker has no time-delay trip element and therefore must be used in conjunction with, and immediately ahead of, the motor-running overcurrent protective device.

Table 1 (When Breaker Is Mounted Immediately Ahead of Motor Starter)

3-Phase Induction Type Motors (ETI circuit breakers for branch circuit use with alternating-current combination, full voltage motor starters).

Motor Horsepower Rating					Circuit Breaker Data			Adjustable Trip Range								Trip Setting Position				
Volts AC					Breaker	Catalog	Continuous									115	200	230	460	575
115	200	230	460	575	Frame	Number	Amperes	Lo	2	3	4	5	6	7	Hi	Volts	Volts	Volts	Volts	Volts
—	—	—	½	½		EF3-A003	3	7	10	12	16	—	—	—	21		—	—	3	2
—	—	—	¾	¾		EF3-A003	3	7	10	12	16	—	—	—	21		—	—	4	3
—	—	—	—	1	EF	EF3-A003	3	7	10	12	16	—	—	—	21	—	—	—	—	4
—	½	½	1	1½		EF3-A005	5	14	18	22	29	—	—	—	41		4	3	3	3
—	—	—	1½	2		EF3-A005	5	14	18	22	29	—	—	—	41		—	—	4	4
½	¾	¾	2	3		EF3-A010	10	27	36	45	58	—	—	—	84	3	3	2	2	3
¾	1	1	3	—	EF	EF3-A010	10	27	36	45	58	—	—	—	84	Hi	4	3	4	—
—	1½	1½	—	—		EF3-A010	10	27	36	45	58	—	—	—	84	—	Hi	4	—	—
1	2	2	—	5		EF3-A010	10	27	36	45	58	—	—	—	84	Hi	Hi	Hi	—	Hi
—	—	—	5	—		EF3-A025	25	75	105	125	170	—	—	—	210	—	—	—	2	—
1½	3	3	7½	7½		EF3-A025	25	75	105	125	170	—	—	—	210	2	3	2	3	2
2	5	5	10	10	EF	EF3-A025	25	75	105	125	170	—	—	—	210	4	Hi	4	4	3
—	—	—	—	15		EF3-A025	25	75	105	125	170	—	—	—	210	—	—	—	—	Hi
—	7½	7½	15	20		EF3-L050	50	160	210	260	330	—	—	—	470	—	4	3	3	3
—	10	10	20	25		EF3-L050	50	160	210	260	330	—	—	—	470	—	Hi	4	4	4
—	15	15	25	30		EF3-H050	50	320	400	475	565	—	—	—	670		4	3	2	2
—	—	—	30	40		EF3-H050	50	320	400	475	565	—	—	—	670		—	—	3	3
—	20	20	40	50	EF	EF3-A100	100	475	630	750	930	—	—	—	1125	—	3	2	2	2
—	25	25	50	60		EF3-A100	100	475	630	750	930	—	—	—	1125		4	3	3	3
—	30	30	60	75		EF3-A100	100	475	630	750	930	—	—	—	1125		Hi	4	4	4
—	40	40	75	100	EF	EF3-H150	150	960	1200	1400	1700	—	—	—	2000		3	2	2	2
—	50	50	100	125	FJ6	FJ63A250	250	1100	1300	1500	1700	1900	2100	2300	2500	—	3	3	3	3
—	60	60	125	150	JL	JL3-A225	225	960	1200	1450	1800	—	—	—	2000		3	3	3	3
—	—	75	150	200		JL3-L400	400	1900	2300	2700	3100	—	—	—	3500		Lo	Lo	Lo	Lo
—	100	100	200	250	JL	JL3-L400	400	1900	2300	2700	3100	—	—	—	3500	—	3	2	2	2
—	125	125	250	300		JL3-L400	400	1900	2300	2700	3100	—	—	—	3500		Hi	4	3	3
—	125	150	300	400		JL3-H400	400	3200	3600	4100	5100	—	—	—	5600		Lo	2	Lo	2
—	150	150	300	400		KM3-L800	800	3200	3600	4100	5100	—	—	—	5600		3	Lo	Lo	2
—	—	200	400	500	KM	KM3-L800	800	3200	3600	4100	5100	—	—	—	5600	—	—	4	3	3
—	—	250	500	—		KM3-H800	800	5000	6100	6700	7400	—	—	—	8000		—	2	2	—

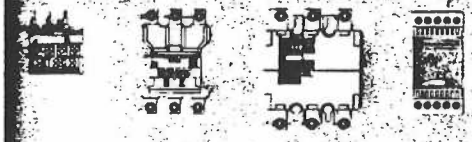
OVERLOADS



Overload relays

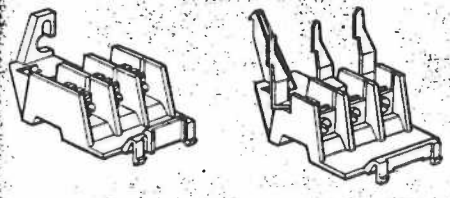
for the protection of power circuits

Basic products



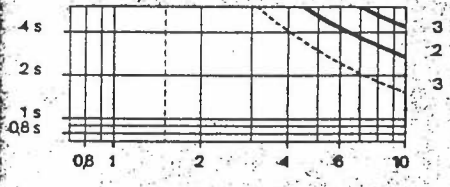
Thermal overload relays 0,1 to 80 A
Thermal overload relays 75 to 1000 A
Thermistor protection unit

Accessories

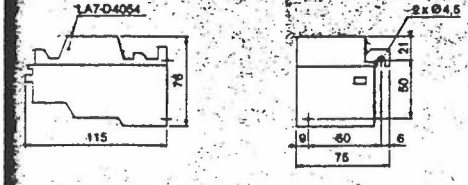


Attachments
Connecting links

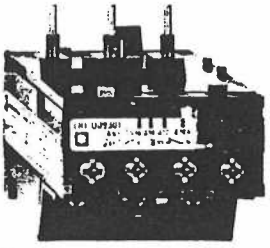
General characteristics



Dimensions



Wiring diagrams



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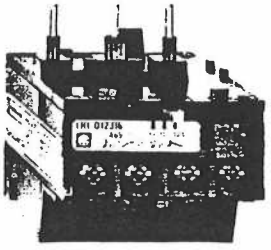
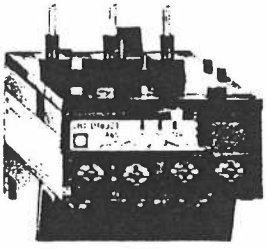
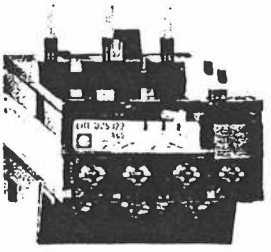


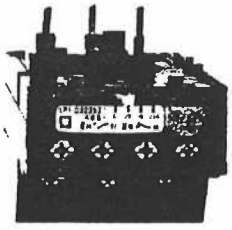
LR1-D12316A65



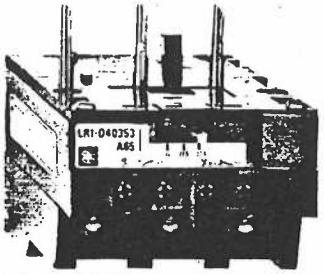
LR1-D16321A65



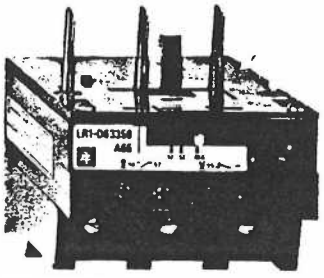
LR1-D25322A65



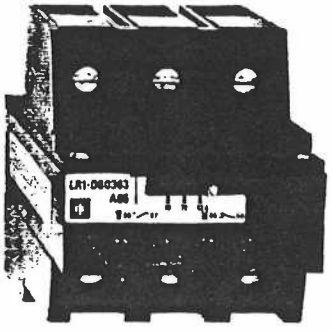
LR1-D32353A65



LR1-D40353A65



LR1-D63359A65



LR1-D80363A65

3 pole thermal overload relays 0,1 to 80 A compensated and differential, with manual reset

For a.c. or d.c. operation

For direct mounting on the contactor (1) (For separate mounting: see page 69)	Maximum standard power rating for 3 phase motors 50/60 Hz AC3 duty						Current setting range	For direct mounting on contactors LC1-	Reference Weight kg	Associated fuse rating Type		
	220V	380V	415V	440V	500V	660V				aM	g1	BS88
	kW hp	kW hp	kW hp	kW hp	kW hp	kW hp	A					
	★	★	★	★	★	★	0,1-0,16	D09 to D32	LR1-D09301A65 0,120	0,25	–	2
	★	★	★	★	★	★	0,16-0,25	D09 to D32	LR1-D09302A65 0,120	0,50	–	2
	★	★	★	★	★	★	0,25-0,40	D09 to D32	LR1-D09303A65 0,120	1	2	2
	★	★	★	★	★	0,37 0,5	0,40-0,63	D09 to D32	LR1-D09304A65 0,120	1	2	2
	★	★	★	★	0,37 0,5	0,55 0,75	0,63-1	D09 to D32	LR1-D09305A65 0,120	2	4	4
	★	0,37 0,5	★	0,55 0,75	0,75 1	1,1 1,5	1-1,6	D09 to D32	LR1-D09306A65 0,120	2	4	6
	0,37 0,5	0,75 1	1,1 1,5	1,1 1,5	1,1 1,5	1,5 2	1,6-2,5	D09 to D32	LR1-D09307A65 0,120	4	6	10
	0,75 1	1,5 2	1,5 2	1,5 2	2,2 3	3 4	2,5-4	D09 to D32	LR1-D09308A65 0,120	6	10	16
	1,1 1,5	2,2 3	2,2 3	2,2 3	3 4	4 5,5	4-6	D09 to D32	LR1-D09310A65 0,120	8	16	16
	1,5 2	3 4	3,7 5	3,7 5	4 5,5	5,5 7,5	5,5-8	D09 to D32	LR1-D09312A65 0,120	12	20	20
	2,2 3	4 5,5	4 5,5	4 5,5	5,5 7,5	7,5 10	7-10	D09 to D32	LR1-D09314A65 0,120	12	20	25
	3 4	5,5 7,5	5,5 7,5	5,5 7,5	7,5 10	10 13,5	10-13	D09 to D32	LR1-D12316A65 0,120	16	25	32
	4 5,5	7,5 10	9 12	9 12	10 13,5	15 20	13-18	D09 to D32	LR1-D16321A65 0,120	20	32	40
	5,5 7,5	11 15	11 15	11 15	15 20	18,5 25	18-25	D09 to D32	LR1-D25322A65 0,120	25	50	50
	7,5 10	15 20	15 20	15 20	18,5 25	–	23-32	D09 to D32	LR1-D32353A65 0,300	40	63	63
	7,5 10	15 20	15 20	15 20	18,5 25	–	28-40	D09 to D32	LR1-D32355A65 0,300	40	80	80
	7,5 10	15 20	15 20	15 20	18,5 25	22 30	23-32	D40, D50, D63	LR1-D40353A65 0,340	40	63	63
	10 13,5	18,5 25	22 30	22 30	22 30	30 40	30-40	D40, D50, D63	LR1-D40355A65 0,340	40	80	80
	11 15	22 30	25 35	25 35	30 40	37 50	38-50	D40, D50, D63	LR1-D63357A65 0,340	63	100	100
★ There are no standard powers for these motors select the overload in relation to the load current	15 20	25 35	30 40	30 40	37 50	45 60	48-57	D40, D50, D63	LR1-D63359A65 0,340	63	100	100
	18,5 25	30 40	37 50	37 50	45 60	55 75	57-66	D40, D50, D63	LR1-D63361A65 0,340	63	100	125
For independent mounting (1)	22 30	37 50	45 60	45 60	55 75	63 85	66-80	–	LR1-D80363A65 0,450	80	125	125

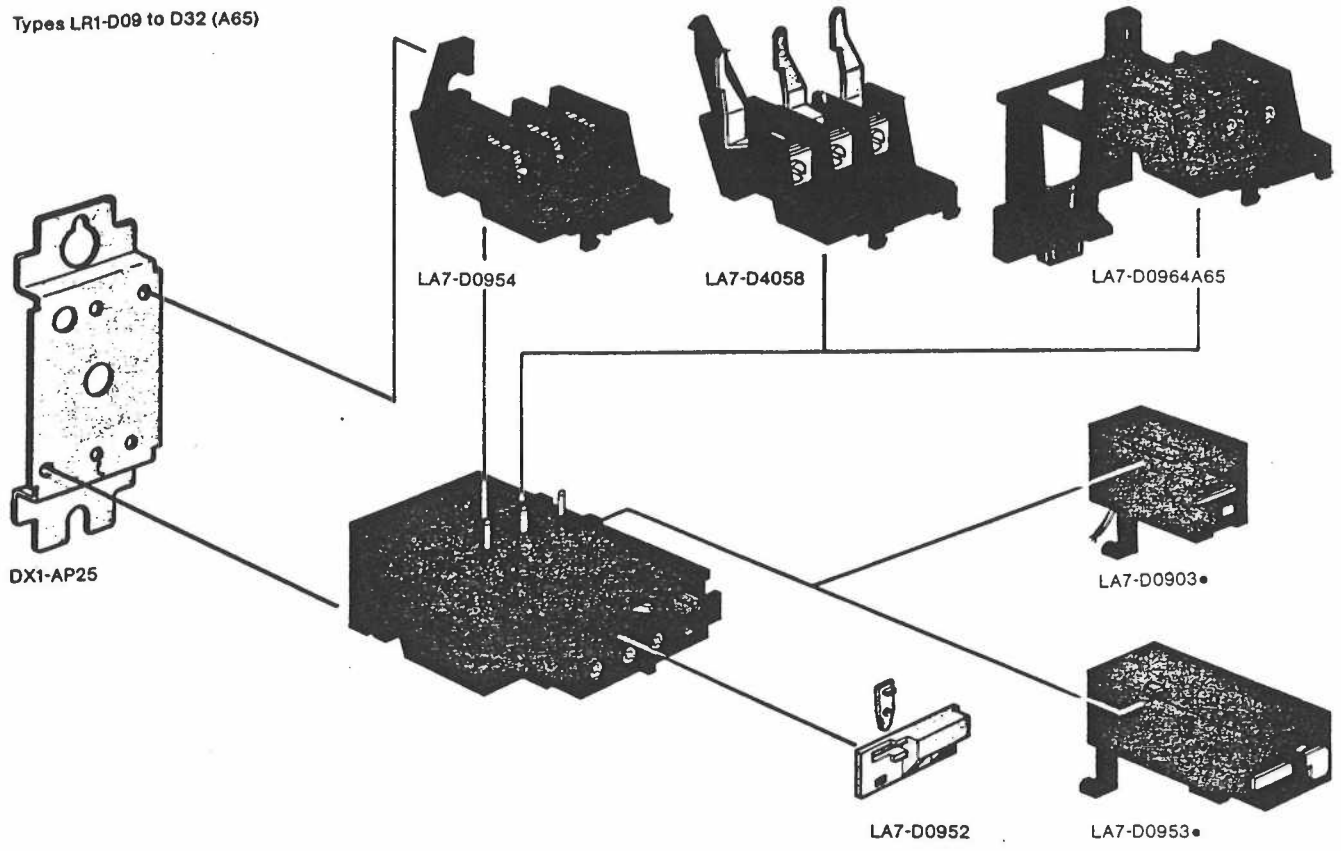
(1) Terminals protected against direct finger contact

Other versions

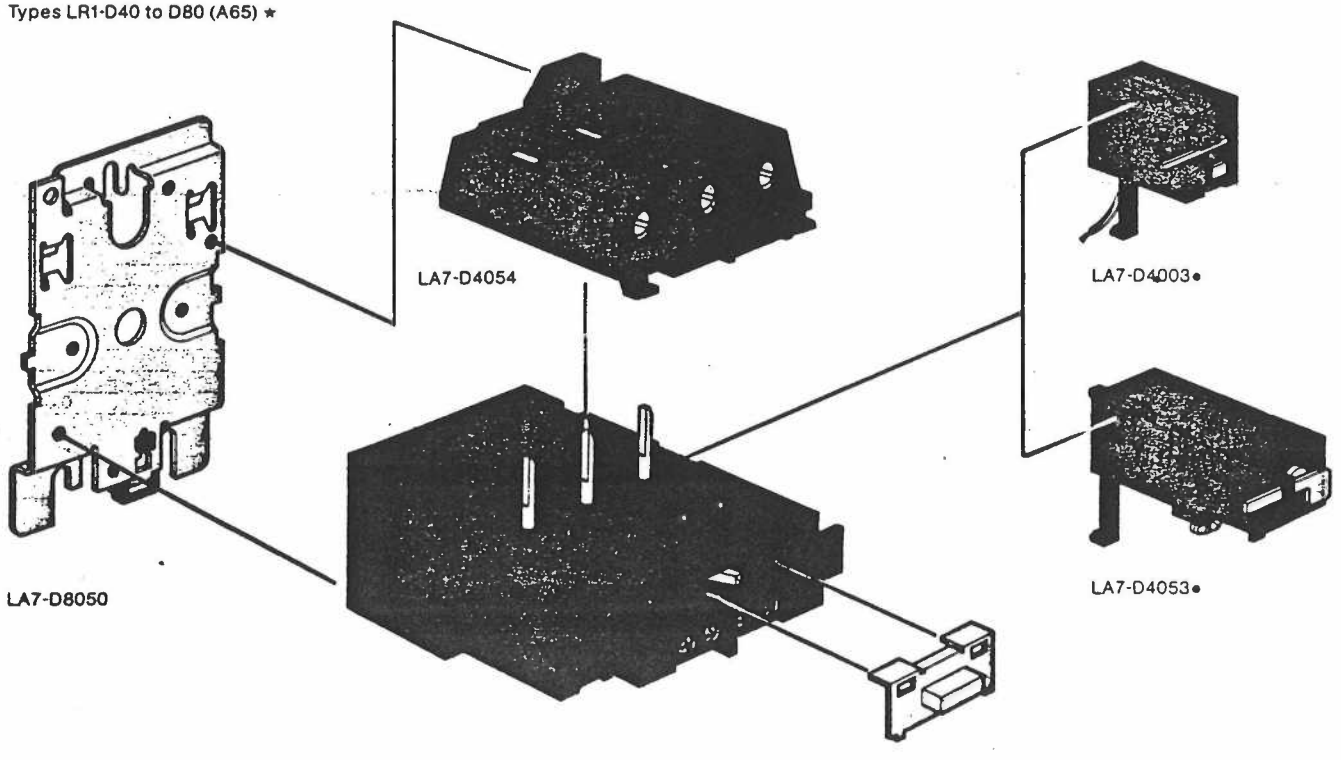
On request we can also supply:
- non-differential overload relays,
- overload relays with automatic reset.

For further information please consult our local agent or representative.

Types LR1-D09 to D32 (A65)



Types LR1-D40 to D80 (A65) ★



★ LR1-D80 supplied as standard mounted on LA7-D4054 adaptor.

Accessories for thermal overload relays

Supplied separately

Illustrations: see opposite page.

Accessories

Description	For use on overload relays type	Reference Add the control voltage letter where necessary (2)	Weight kg
Remote tripping device (1)	LR1-D09 to D32 LR1-F (except LR1-F105, F125)	**LA7-D0903•(2)**	0,040
	LR1-D40 to D80 LR1-F105, F125	**LA7-D4003•(2)**	0,050
Electrical reset device (1)	LR1-D09 to D32 LR1-F (except LR1-F105, F125)	**LA7-D0953•(2)**	0,120
	LR1-D40 to D80 LR1-F105, F125	**LA7-D4053•(2)**	0,120
Lead sealing kit – for relays	LR1-D09 to D25 LR1-F	**LA7-D0952**	0,001
	LR1-D40 to D80	**LA7-D4052**	0,010
Mounting plates – for clip-on mounting on AM1-DL rail or screw fixing on 110 mm centres	LR1-D40 to D80	**LA7-D8050**	0,130
– for screw fixing on 110 mm centres	LR1-D09 to D25	**DX1-AP25**	0,070
	Do not forget to order the terminal block corresponding to the overload size.		
Terminal blocks – for separate mounting of overload on 50 mm fixing centres	LR1-D09 to D25 LR1-D40 to D63 LR1-D80	**LA7-D0954** **LA7-D4054 ★** mounted as standard	0,060 0,165
– for clip-on mounting on AM1-DP200 rail	LR1-D09 to D25	**LA7-D0964A65★**	0,100
– for remote mounting	LR1-F	**LA7-F054**	0,120
– adaptor terminals for mounting on contactors LC1-D40 or LC1-D63	LR1-D09 to D32	**LA7-D4058**	0,050

★ with terminals protected against direct finger contact and with ready to tighten screw.

Connecting links

Overload type LR1	Contactor type	Reference for set of 3 links	Weight kg
D40, D63, D80	LC1-FF4	**LA7-D8065**	0,150
F105 or F125	LC1-FF4	**LA7-FF40**	0,140
	LC1-FG4	**LA7-FG41**	0,150
F160	LC1-FF4	**LA7-FG40**	0,200
	LC1-FG4	**LA7-FG40**	0,200
	LC1-FH4	**LA7-FH41**	0,250
	LC1-FJ4	**LA7-FH40**	0,450
F200	LC1-FG4	**LA7-FG40**	0,200
	LC1-FH4	**LA7-FH41**	0,250
	LC1-FJ4	**LA7-FH40**	0,450
F250 or F315	LC1-FH4	**LA7-FH40**	0,450
	LC1-FJ4	**LA7-FJ40**	0,480
	LC1-FK4	**LA7-FK41**	0,490
F400	LC1-FJ4	**LA7-FJ40**	0,480
	LC1-FK4	**LA7-FK41**	0,490
F500 or F630	LC1-FK4	**LA7-FK40**	0,810
	LC1-FL4	**LA7-FL41**	0,900
F800 or F1000	LC1-FL4	**LA7-FL40**	1,730

(1) Note: The LA7-D coils of the remote tripping and electrical resetting devices cannot remain energised for an unlimited period: 1st operation, 5 seconds; 2nd operation, 3 seconds; 3rd operation, 2 seconds: with a maximum total time on supply of 10 seconds every 10 minutes.
Consumption, inrush and sealed: LA7-D••03 = 165 VA, LA7-D••53 = 250 VA.
(2) Control circuit voltage for LA7-D operating coils.

Volts	24	42	48	110	120	127	220	380	440
50 Hz	B	D	D	F	F	F	M	Q	Q
60 Hz	–	–	D	F	F	–	M	–	Q

General characteristics of overload relays

Thermal overload relays are designed for the protection of a.c. loads against:
- overloads.
- phase failure,
- long starting times and prolonged stalling of a motor.

		LR1-D09 to D25 (A65)	LR1-D32 (A65)	LR1-D40 (A65)	LR1-D63, D80 (A65)	LR1-F105, F125	LR1-F160, F200	LR1-F250 to F400	LR1-F500, F630	LR1-F800, F1000

Environment

Conformity to standards		Standard version IEC 292-1 NF C 63-650, VDE 0660								
Approvals (standard version)		ASE, CSA, ℳ, BV, GL, LROS, RINA, USSR, DEMKO, NEMKO, (FI, UL special version) LR1-D32 (A65): pending				CSA, ℳ, BV, GL, USSR				
Protective terminal shrouds (1)		Integral	Integral	Integral	Integral	Separate	Separate	Separate	Separate	Separate
Protective treatment standard version		TC	TC	TC	TC	TH	TC	TC	TC	TC
special version		TH	–	TH	TH	TH	–	TH	TH	TH
Ambient temperature compensation and operating limits	°C	from −40 to +60	from −40 to +60	from −40 to +60	from −40 to +60	from −40 to +60	from −40 to +60	from −40 to +60	from −40 to +60	from −40 to +60
Ambient temperature for storage	°C	from −60 to +70	from −60 to +70	from −60 to +70	from −60 to +70	from −60 to +70	from −60 to +70	from −60 to +70	from −60 to +70	from −60 to +70

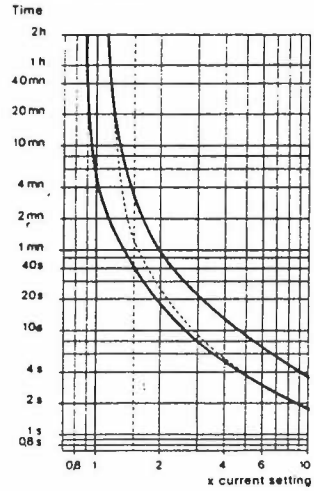
Electrical characteristics of the power circuit and the auxiliary contacts

Power circuit Rated insulation voltage to IEC 158-1	V	660	660	660	660	660	1000	1000	1000	1000
Frequency limits of operating current	Hz	from 0 to 400	from 0 to 400	from 0 to 400	from 0 to 400	from 0 to 400	from 0 to 400	from 50 to 60	from 50 to 60	from 50 to 60
Auxiliary contacts Rated thermal current	A	10	10	10	10	10	10	10	10	10
Power connections Maximum terminal capacity										
Flexible without cable end	mm^2	10	10	16	25	–	–	–	–	–
with cable end	mm^2	4	6	10	16	–	–	–	–	–
Solid	mm^2	6	10	10	25	–	–	–	–	–
Terminal width	mm	10	12	13	connector	15	20	25	30	40
Tightening screw diameter	mm	M4	M4	M5	–	6	8	10	10	12
Control circuit connections		2 (flexible) conductors 2,5 mm^2 maximum								
		(1) For protection against direct finger contact								

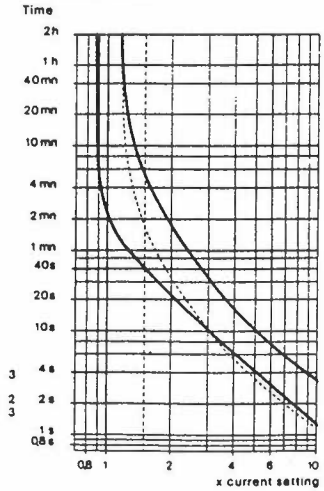
Tripping curves

Average operating times depending on multiples of the set current

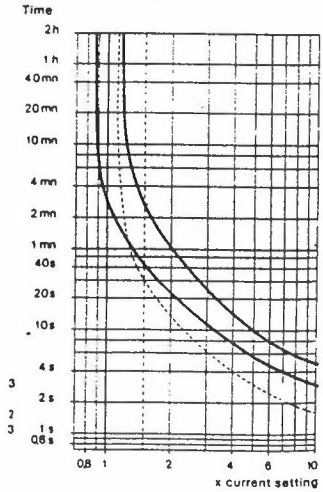
LR1-D09 to D80



LR1-F105, F125



LR1-F160 to F1000



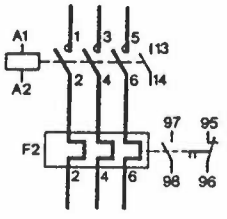
3 ——Balanced operation, 3 phase, from cold state.
3 ·····Balanced operation, 3 phase, after a long period at the set current (hot state).
2 ——Operation following the loss of one phase (single phase tripping) from cold state.

Wiring diagrams

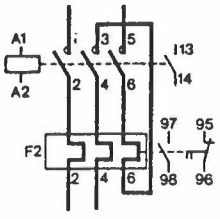
of overload relays

Overload relays
Type LR1-D

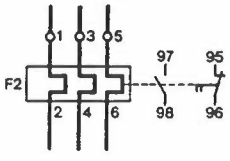
Mounted directy on contactor
For 3-phase circuits



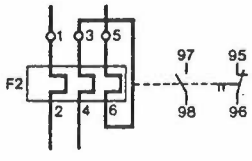
For single-phase circuits



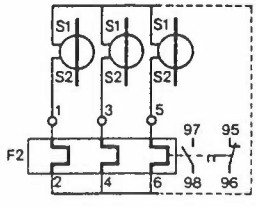
Independently mounted
For 3-phase circuits



For single-phase circuits

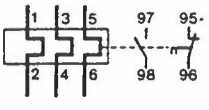


For 3-phase circuits
with 3-current transformers

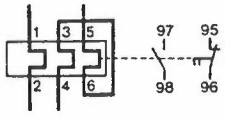


Overload relays
Type LR1-F

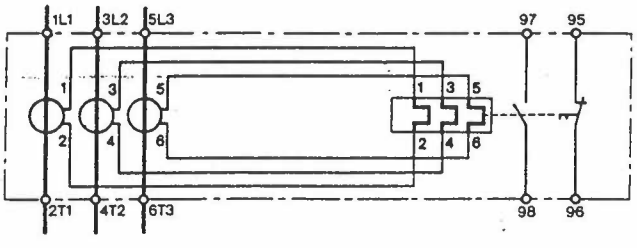
LR1-F105 and F125
For 3-phase circuits



For single-phase circuits

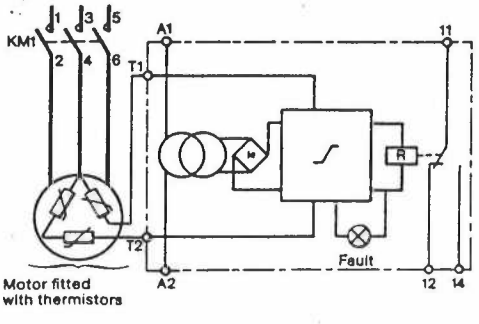


LR1-F160 to F1000
For 3-phase circuits

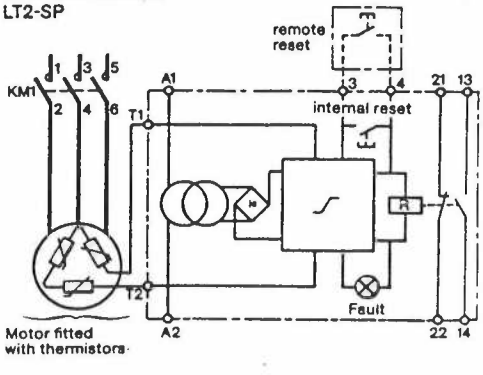


Protection relays
Type LT2-S

Without fault memory
LT2-SE, SA



With fault memory
LT2-SP

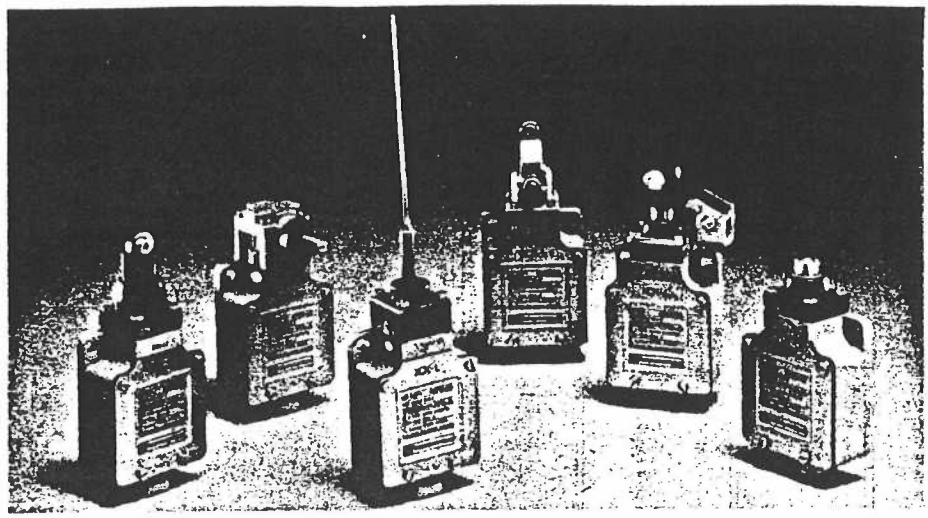


XCK-L Compact General Purpose Electric—Pneumatic

Electric

XCK-L limit switches are easy to install for several key reasons. The contact block is completely accessible from the front when the cover plate is removed, and can be wired or replaced in the field without removing the enclosure from its mounting. All contacts have captive riding saddle clamp terminals. Heads can be indexed to any of four positions. The standard side rotary type is field convertible to clockwise, counterclockwise or both clockwise/counterclockwise operation.

Also available wih pneumatic switching elements (see below).



SPECIFICATIONS

- **Electrical Ratings***

Voltage		120V	240V	480V	600V
AC 60Hz	Make Amps	60	30	15	12
P.F. .35	Break Amps	6	3	1.5	1.2
DC (Amps)		1.1	.55	-	-
Power (Watts)		60	60	60	60

*10 Amp Thermal Current (NEMA A600)

- **Electric Life**
  1 million operations
- **Contact Configurations**
  1NO-1NC: single pole, double throw, positive snap action (L1-TYPE) or slow make, slow break (L5-TYPE)
- **Operating Temperatures**
  -25° to +70°C
  -13° to +158°F
- **Storage Temperatures**
  -40° to +70°C
  -40° to +158°F

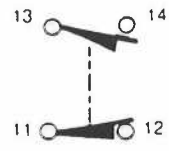
Special Versions Available
Booted versions
Gold contacts

- **Contact Resistance**
  Less than 25mΩ
- **Enclosure**
  NEMA 1, 4, 12, 13
  IP665
- **Housing**
  Diecast zinc alloy
- **Shock Resistance**
  50G
- **Vibration Resistance**
  25G for f = 10 to 500 Hz
- **Mechanical Life**
  20 million - ZCK-D10, D21, D23, G00
  15 million - ZCK-D15, D16, D17
  10 million - ZCK-D06, D08
- **Repeatability**
  0.05mm (0.002 in.) on tripping point
- **Approvals**
  UL File #39281
  CSA File #LR49123-1
  ASE, DEMCO, NEMCO and many other international approvals

- **Standards**
  NEMA A600 P600
  IEC, DIN, VDE and many other international approvals

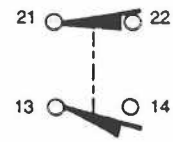
- **Wiring Diagrams**

L1 TYPE



Must be same polarity

L5 TYPE*



Must be same polarity

*For L5 TYPE - Contact 21/22 opens at pretravel (1st step); contact 13/14 closes at 2nd step.

Pneumatic

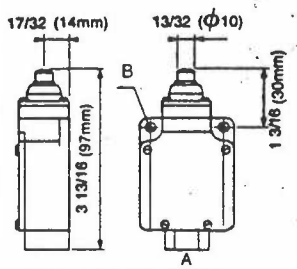
- **Operating Temperature**
  5–120°F
- **Operating Pressure**
  40–120psi
- **Flow**
  12 SCFM @ 100psi
- **Connection**
  5/32" push-in

Note: For additional information concerning our entire line of pneumatic limit switches see Telemecanique *Pneumatic Control Components Catalog.*

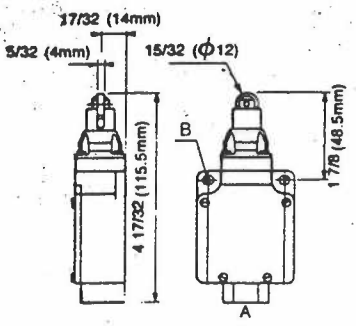
Compact General Purpose Electric—Pneumatic

Approximate Dimensions

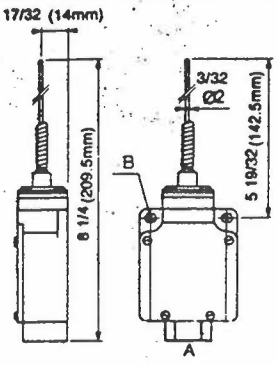
XCK-L110, L510, ZCK-D10



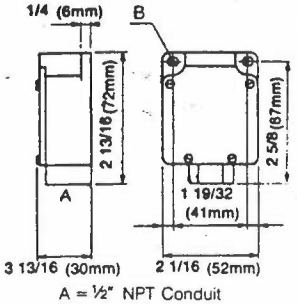
XCK-L102, L502, ZCK-D02



XCK-L106, L506, ZCK-D06

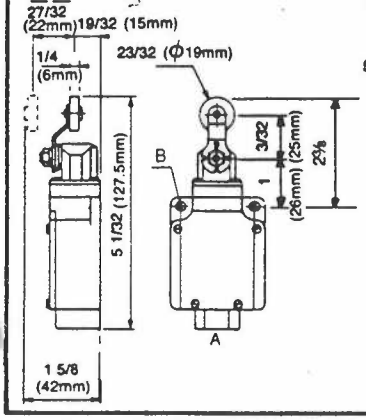


ZCK-L1, L5

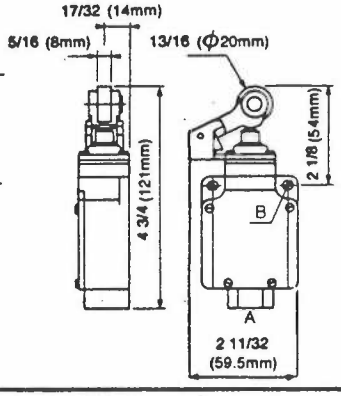


A = ½" NPT Conduit opening

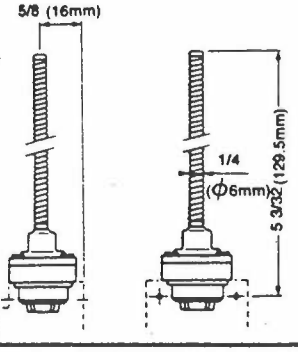
XCK-L115, L515,
ZCK-D15, D16, D17



XCK-L121, L521, ZCK-D21, D23



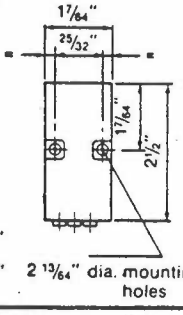
ZCK-D08



B = 5.2mm x 6.2mm mounting holes

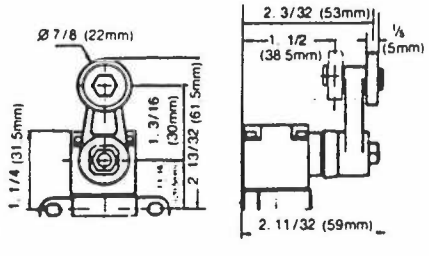
PXCK211

PXCK221

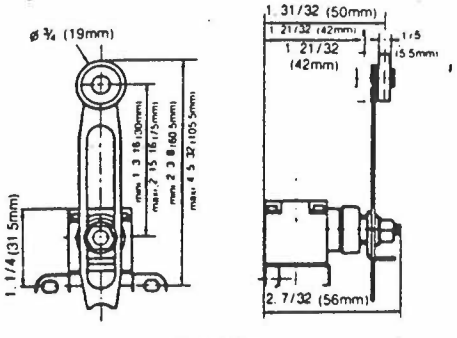


ZCK-G00 Lever Assemblies

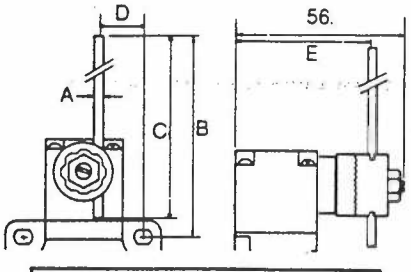
ZCK-Y11 Y13, Y14



ZCK-Y41, Y43



ZCK-Y51, Y52, Y53, Y59

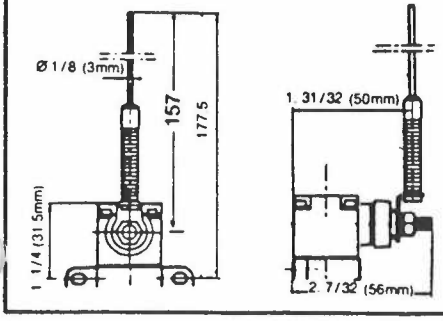


(mm)	A	B①	C②	D	E
ZCK-Y51	Ø 3	131	125	10	49
ZCK-Y52	Ø 3	131	125	10	49
ZCK-Y53	Ø 3	131	125	10	49
ZCK-Y59	Ø 6	206	200	6	47.5

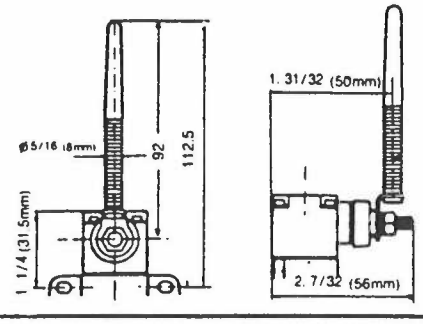
① "B" is max. distance from mounting holes to fully extended rod.

② "C" is overall rod length.

ZCK-Y91



ZCK-Y81



CLIENT : .....
.....
.....

ELECTRICAL DIAGRAMS FOR :

SHEAR ...m x ....kN TYPE TS

SHEAR-SC5
U.S.A

ROBOSOFT
ROZENDAALSTRAAT 6 T-ZONE
8900 IEPER BELGIUM
TEL : 057/21 94 57

D | HEADING | 2

GET : X.B. 20-10-92 | SHEET : SHR-USA-00

2-3

CLIENT : .....
.....
.....

ELECTRICAL DIAGRAMS FOR :

SHEAR ...m x ....kN TYPE TS

SHEAR-SC5
U.S.A

ROBSOFT
ROZENDAALSTRAAT 6 T-ZONE
8900 IEPER BELGIUM
TEL : 057/21 94 57

HEADING

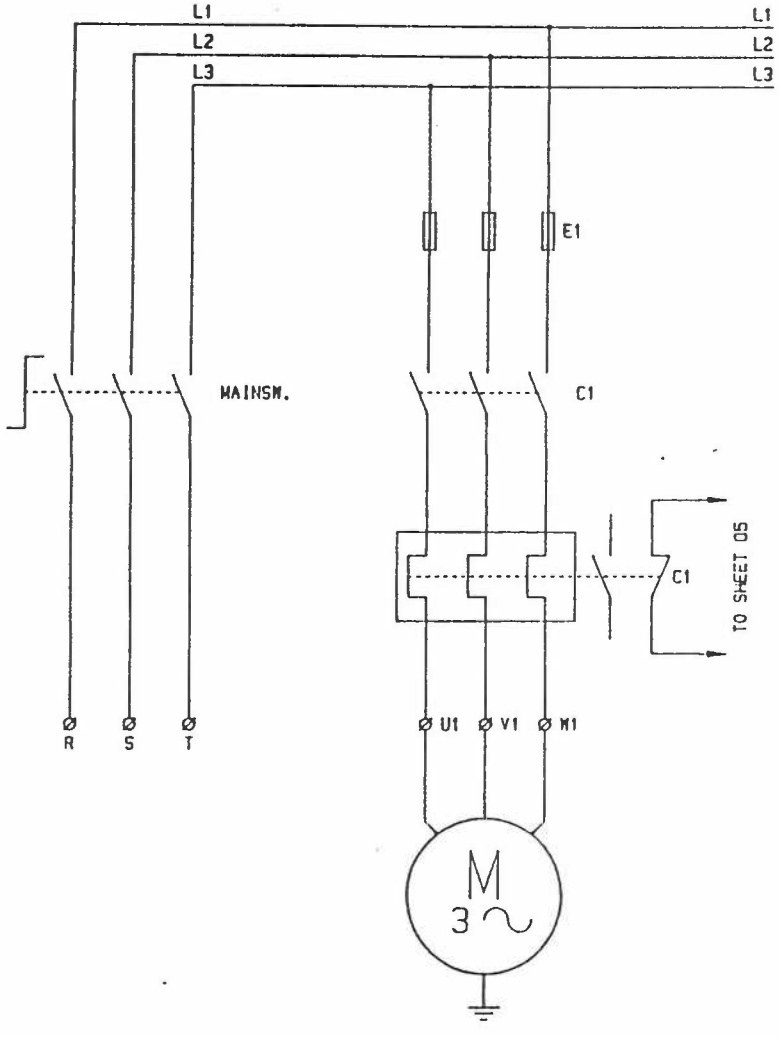
GET : X.B. 20-10-92 | SHEET : SHR-USA-00

NO		CONTENTS
00		HEADING
01		CONTENTS
02		POWER SUPPLIES MOTOR PUMP
03		POWER SUPPLY
04		BACK GAUGE CONTROL
05		START-STOP MOTOR PUMP DIRECT START
06		ELECTROVALVES
07		CUTTING ANGLE INDICATION
08		WIRING PLAN
09		WIRING PLAN
10		*
11		*
12		*
13		*
14		*
15		*

NO		CONTENTS
*		*
*		*
*		*
*		*
*		*
*		*
*		*
*		*
*		*
*		*
*		*
*		*
*		*
*		*
*		*

ROBOSOFT
ROZENDAALSTRAAT 6 T-ZONE
8900 IEPER BELGIUM
TEL : 057/21 94 57

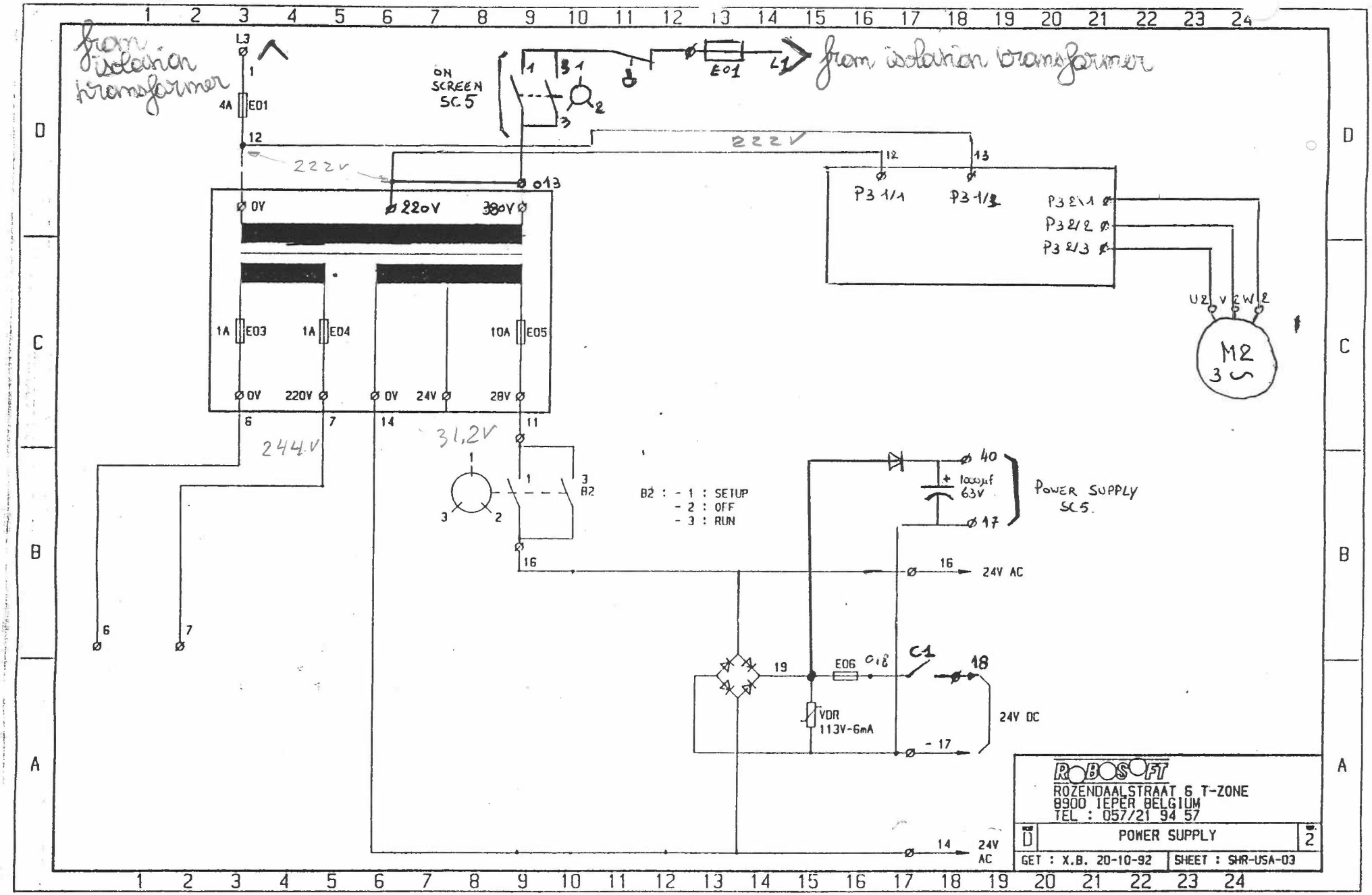
D	CONTENTS	2
GET : X.B. 20-10-92	SHEET : SHR-USA-01	

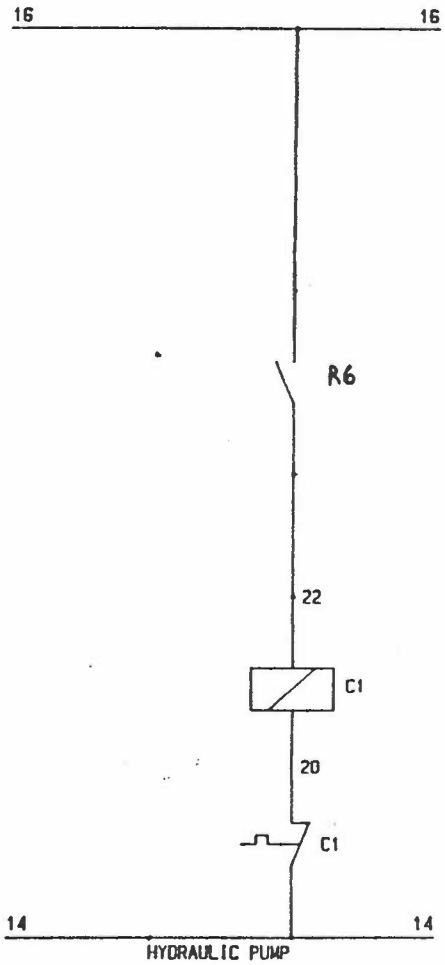


MOTOR HYDRAULIC PUMP

ROBOFT
ROZENDAALSTRAAT 6 T-ZONE
8900 IEPER BELGIUM
TEL : 057/21 94 57

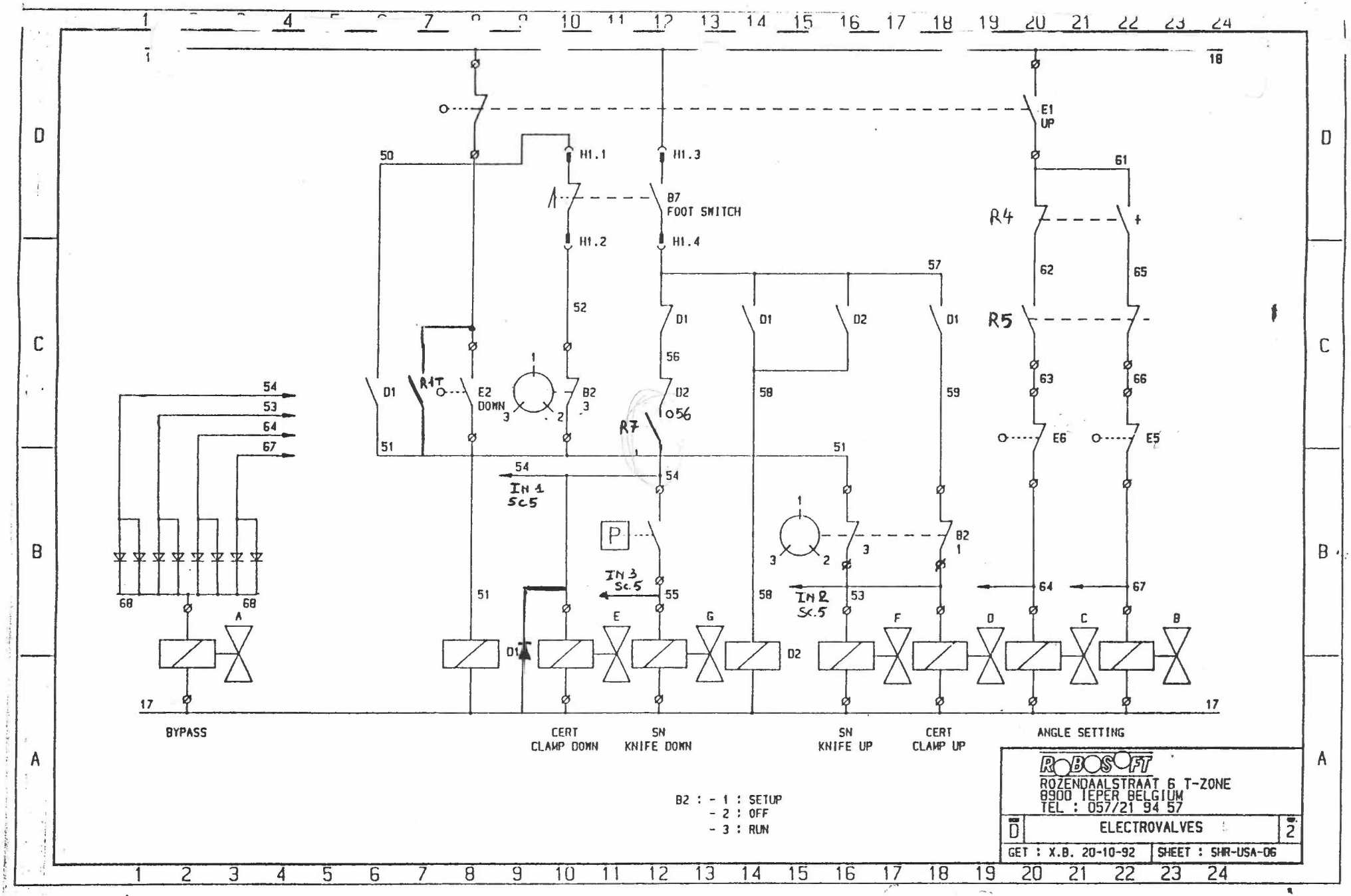
D	POWER SUPPLIES MOTOR PUMP	2
GET : X.B. 20-10-92	SHEET : SHR-USA-02	


from isolation transformer
L3
1
4A E01
12
222V
ON SCREEN SC.5
E01
L1
from isolation transformer
222V
013
0V
220V
380V
12
13
P3 1/1
P3 1/2
P3 1/3
P3 2\1
P3 2/2
P3 2/3
U2 V2 W2
M2
3~
1A E03
1A E04
10A E05
0V
220V
0V
24V
28V
6
7
14
11
244V
31,2V
B2
3
2
1
3
B2 : - 1 : SETUP
- 2 : OFF
- 3 : RUN
16
40
+ 1000µf 63V
17
POWER SUPPLY SC.5.
16
24V AC
6
7
19
E06
018
C1
18
VDR 113V-6mA
24V DC
- 17
14
24V AC
ROBOFT
ROZENDAALSTRAAT 6 T-ZONE
8900 IEPER BELGIUM
TEL : 057/21 94 57
D
POWER SUPPLY
2
GET : X.B. 20-10-92
SHEET : SHR-USA-03



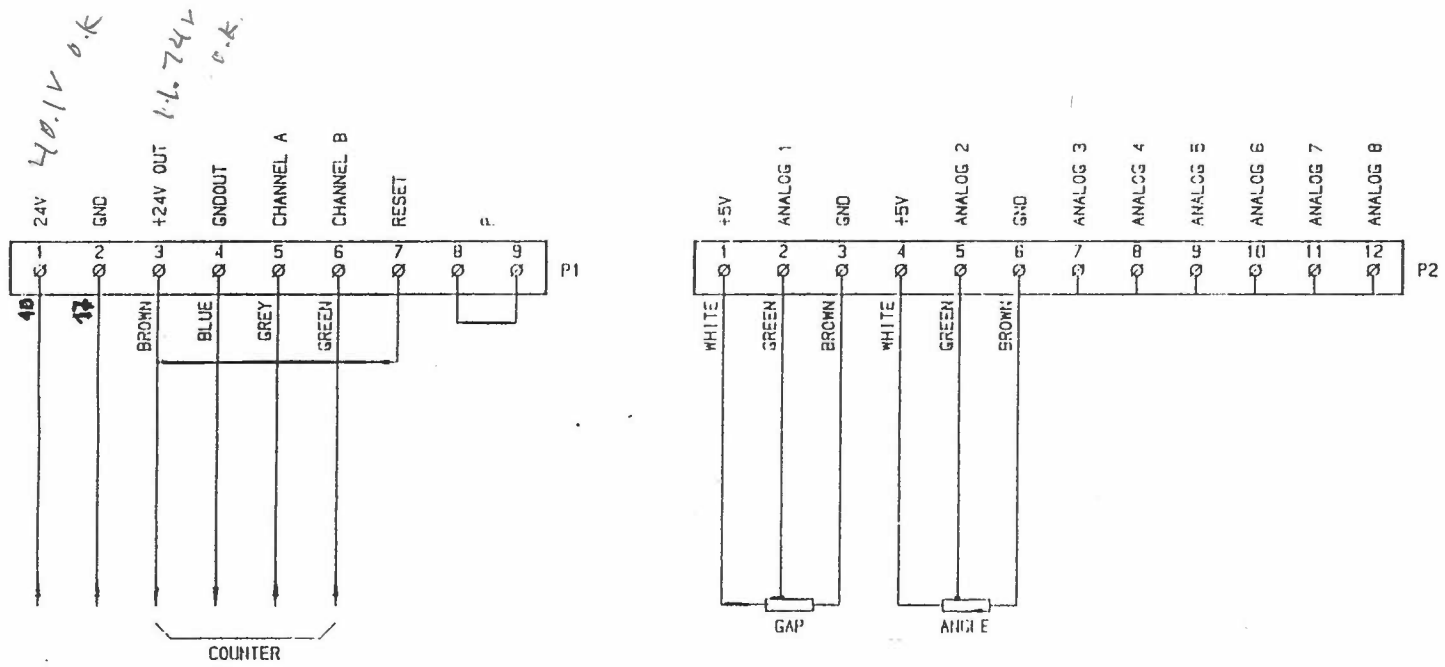
ROBOSOFT
ROZENDAALSTRAAT 6 T-ZONE
8900 IEPER BELGIUM
TEL : 057/21 94 57

D	START - STOP MOTOR PUMP DIRECT START	2
GET : X.B. 20-10-92	SHEET : SHR-USA-05	



ROBOSOFT
ROZENDAALSTRAAT 6 T-ZONE
8900 IEPER BELGIUM
TEL : 057/21 94 57

D	ELECTROVALVES	2
GET : X.B. 20-10-92	SHEET : SHR-USA-06	

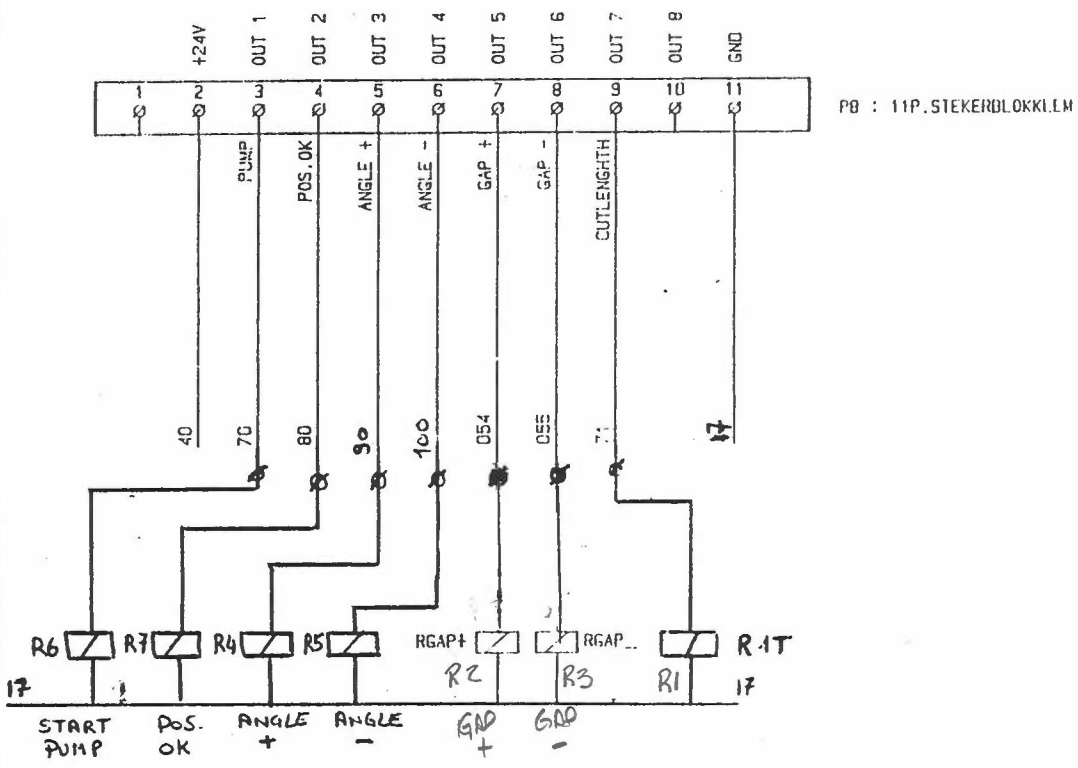


ROBOSOFT
ROZENDAALSTRAAT 6 T-ZONE
8900 IEPER BELGIUM
TEL : 057/21 94 57

POWER SUPPLY AND ANALOG
SC5

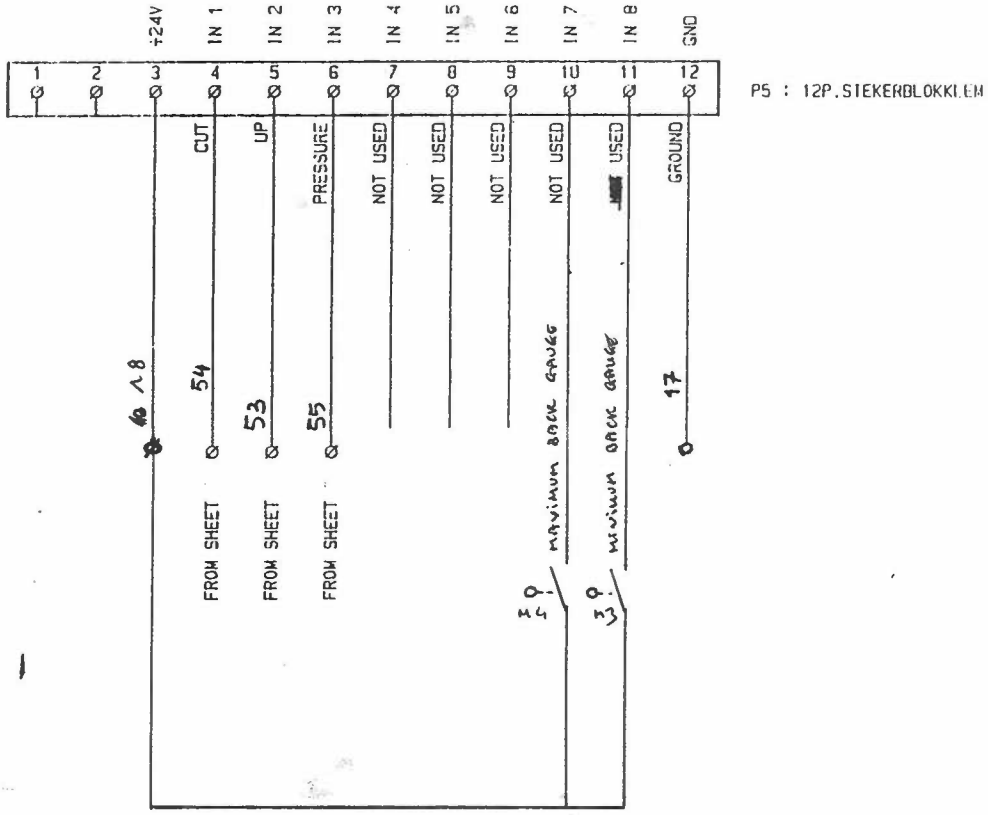
DATE : 02-08-91

SHEET : SC5-SH-00



ROBOSOFT
ROZENDAALSTRAAT 6 T-ZONE
8900 IEPER BELGIUM
TEL : 057/21 94 57

D	OUTPUTS SC5	1
DATE : 02-08-91	SHEET : SC5-SD-10	

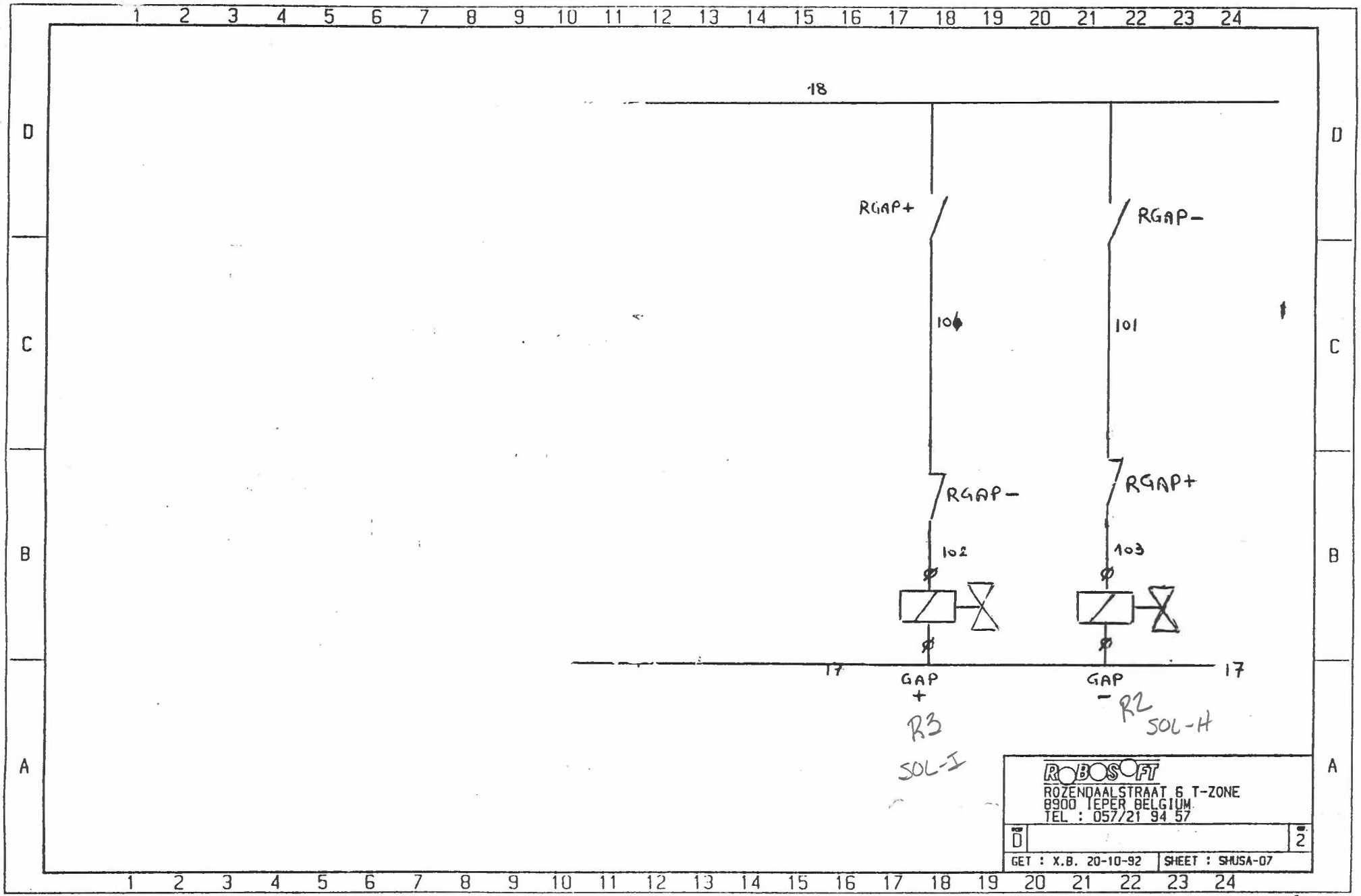


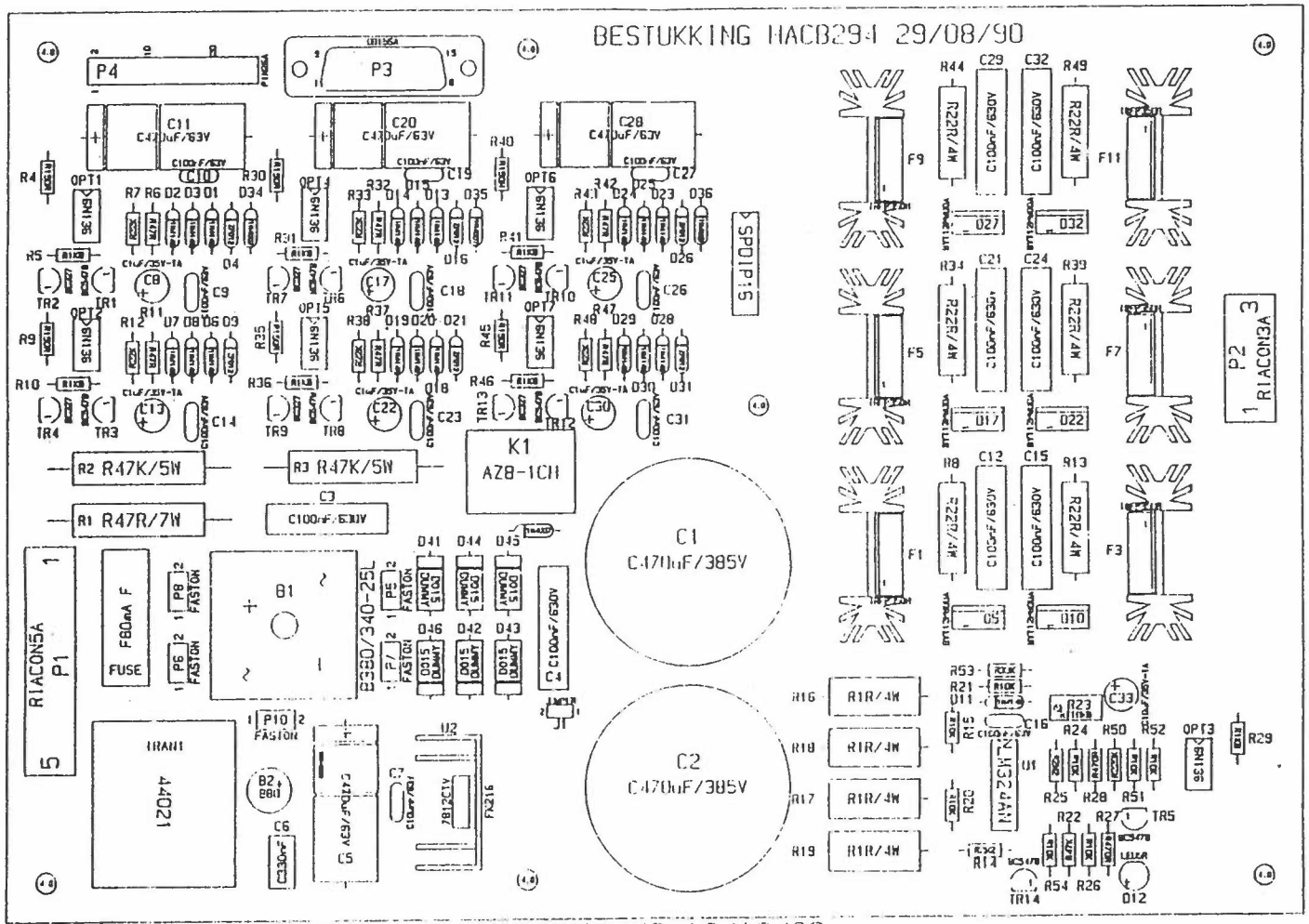
ROBOSOFT
ROZENDAALSTRAAT 6 T-ZONE
8900 IEPER BELGIUM
TEL : 057/21 94 57

INPUTS
SC5

DATE : 02-08-91

SHEET : SC5-SH-09


18
RGAP+
RGAP-
104
101
RGAP-
RGAP+
102
103
17
17
GAP
+
GAP
-
R3
SOL-I
R2
SOL-H
ROBOSOFT
ROZENDAALSTRAAT 6 T-ZONE
8900 IEPER BELGIUM
TEL : 057/21 94 57
D
2
GET : X.B. 20-10-92
SHEET : SHUSA-07



ROBOSOFT T-ZONE 8900 IEPER HACB294V2 19/10/90

MAINTENANCE - LUBRICATION

Hydraulics

After first 500 hours:

- Drain oil
- Replace optional return filter
- Clean pump suction screen filter
- Wipe out inside of tank
- Replace the new oil Mobil DTE 24 or equivalent (refer to lubrication chart on following page)
- Check and refill backgauge gear box reducers (2 on machine) using Mobil 600W or equivalent.

Thereafter every 1500 hours:

- Repeat 500 hour practice
- Lubricate drive chains in backgauge system with No. 2 grease as needed.

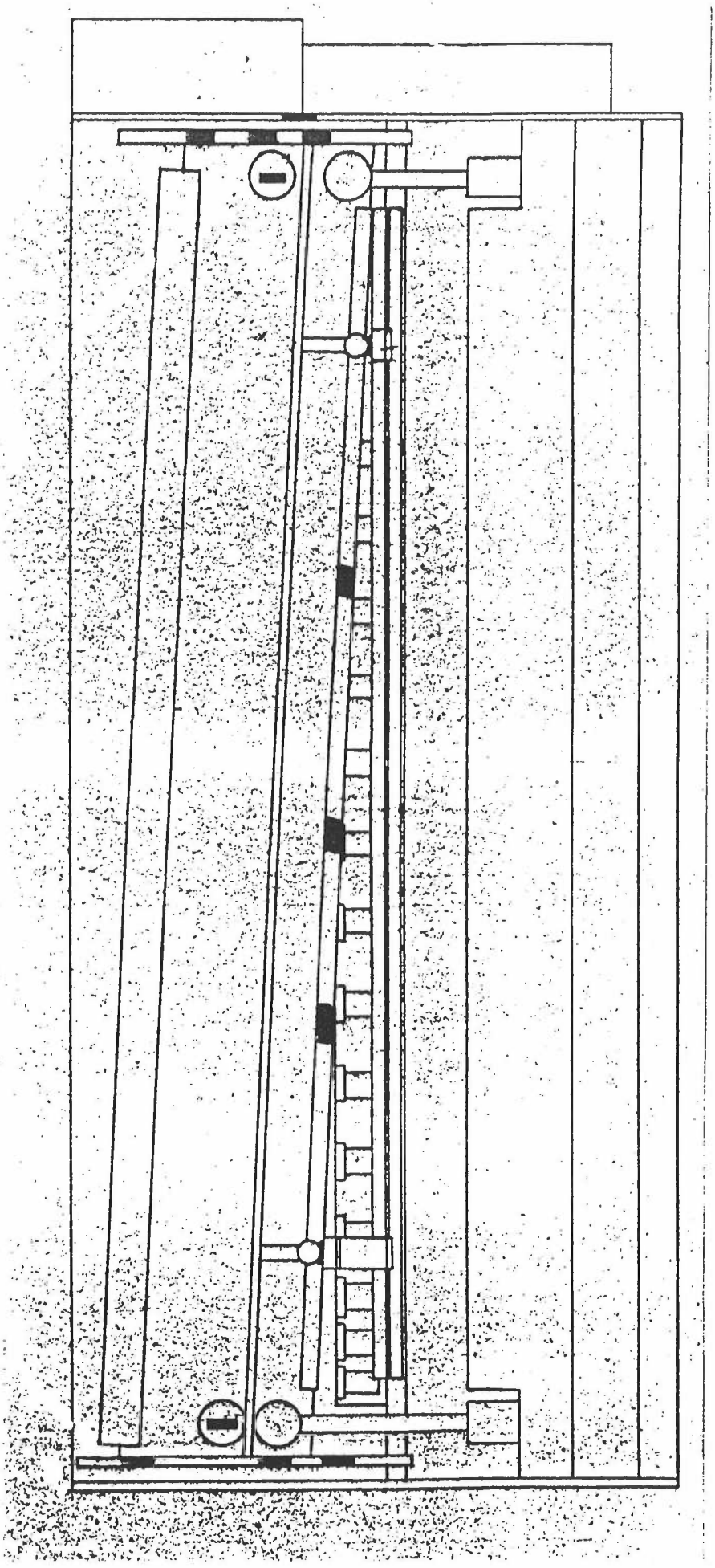
Lubrication Points

Every 2-3 Weeks:

- Apply #2 grease to the backgauge acme screws and the bevel gears driving them.
- Apply #2 grease to Zerk fittings for backgauge drive systems.
- Apply #2 grease to Zerk fittings per following Diagrams.
- Refill Optional Auto-lube reservoir as required with #1 grease, if so equipped.

M2
1/86
10 x 1/4

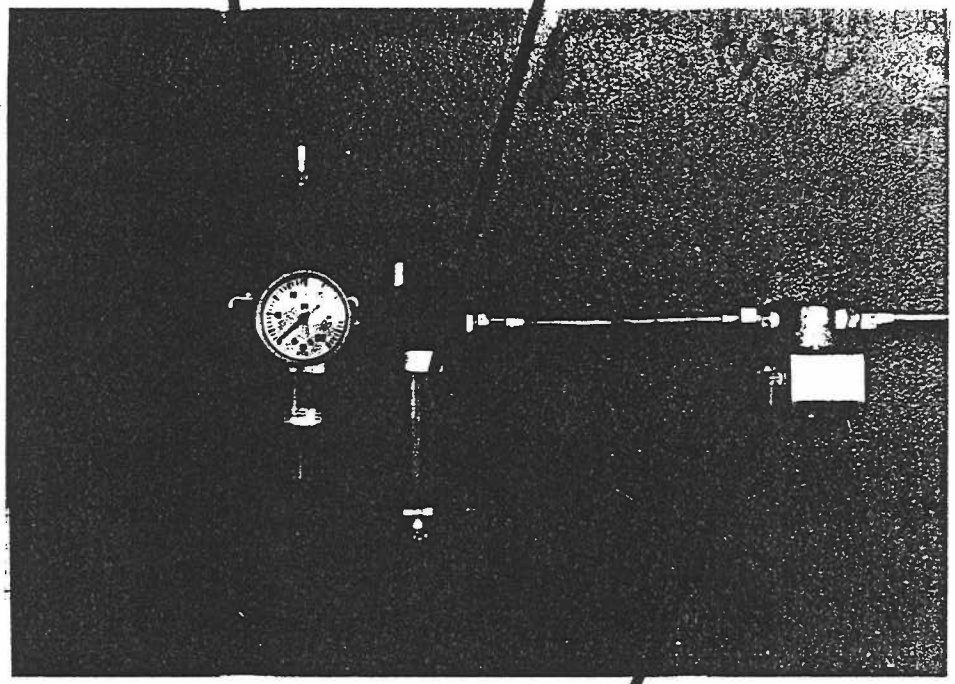
LUBRICATION POINTS

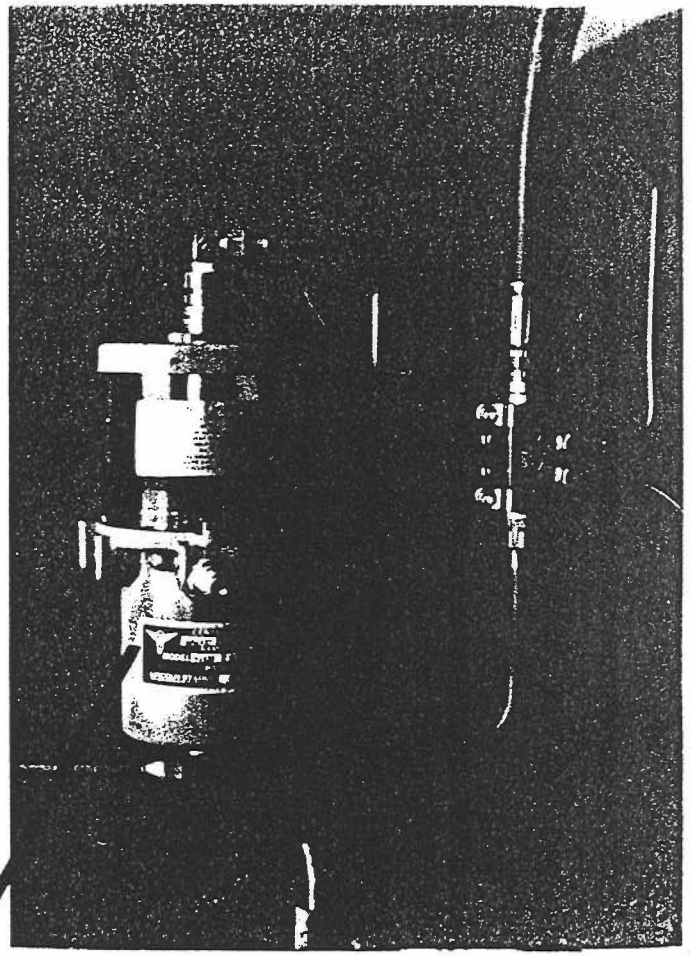


(OPTIONAL)

AIR FILTER
REGULATOR

LUBRICATOR





SOLENOID VALVE

AUTO LUBE RESERVOIR

ASLE NO.	H-150 AW	H-215 AW	H-315 AW	-	H-700	-	G-2150	G-315	-	-	NLGI NO.1	NLGI NO.2	NLGI NO.2	-	
SPECIFICATION	LIGHT HYD. OIL 135-165 SUS AT 100°F ANTI-RUST, OXIDATION & ANTI-WEAR ADDITIVES	MEDIUM HYD. OIL 194-236 SUS AT 100° F ANTI-RUST, OXIDATION & ANTI-WEAR ADDITIVES	MED.-HEAVY HYD. OIL 284-346 SUS AT 100° F ANTI-RUST, OXIDATION, ANTI-WEAR ADDITIVES	HEAVY HYD. OIL 500-550 SUS AT 100° F ANTI-RUST, OXIDATION & ANTI-WEAR ADDITIVES	HEAVY HYD OIL 630-770 SUS AT 100° F ANTI-RUST, OXIDATION, ANTI-WEAR ADDITIVES	MEDIUM HYD OIL-FIRE RESISTANT 230 SUS AT 100°F PHOSPHATE-ESTER BASE	WORM GEAR OIL 1935 TO 2365 SUS AT 100°F 5% ACIDLESS TALLOW	LIGHT E.P. GEAR OIL 284 TO 346 SUS AT 100° F SULP-PHOS.	MEDIUM E.P. GEAR OIL & OIL MIST SYSTEMS 410-510 SUS AT 100°F	MED-HEAVY E.P. GEAR OIL 700 TO 1009 SUS AT 100°F SULP-PHOS.	#1 E.P. GREASE LITHIUM SOAP BASE GREASE	#2 GREASE LITHIUM SOAP BASE WATERPROOF	#2 E.P. GREASE LITHIUM SOAP BASE WATERPROOF	#2 GREASE LITHIUM SOAP BASE WITH 3% MAX MOLYBDENUM DISULFIDE	HEAVY [illegible] ADHESIVE [illegible]
AMOCO	RYKON INDUST. OIL #15	RYKON INDUST. OIL #21	RYKON INDUST. OIL #31	RYKON INDUST. OIL #51	AMOCO AW OIL #65	AMOCO FR FLUID PE-22	AMOCO WORM GEAR OIL	PERMAGEAR EP 50		PERMAGEAR EP 70	AMOLITH GREASE #1 EP	AMOLITH GREASE #2	AMOLITH GREASE #2 EP	RYKON MOLY GREASE #2	AM[illegible] RX
ASHLAND (VALVOLINE)	ULTRAMAX AW-15	ULTRAMAX AW-20	ULTRAMAX AW 30	ULTRAMAX AW-45	ULTRAMAX AW-70		LIGHT CYLINDER OIL	X-18 MD SAE 80		X-18 MD SAE 80-90	VAL-LITH EP #1	MULTI-LUBE LITHIUM GREASE	VAL-LITH EP #2	SPECIAL [illegible]	OPEN GEAR [illegible]
ATLANTIC RICHFIELD (SINCLAIR)	DURO AW S-150	DURO AW S-215	DURO AW S-315	DURO AW S-465			MODOC CYL. LIGHT			EXTRA DUTY GEAR LUBRICANT 90	LITHOLENE INDUST EP #1	LITHOLENE INDUST.#2	LITHOLENE INDUST. EP #2	ARCO EP MOLY [illegible] GREASE	[illegible]
CELANESE						CELLULUBE 220									
CITGO	PACEMAKER XD-15	PACEMAKER XD 20	PACEMAKER XD 30				CITGO COMPOUND OIL 145-5			STANDARD GEAR OIL (MP) 90	CITGO HEP-1	CITGO H-2		CITGO PREM MOLY-LITH GR.2	CITGO OPEN GEA[R] COMPOUND #2
CONTINENTAL (CONOCO)	SUPER HYDRAULIC 15	SUPER HYDRAULIC 21	SUPER HYDRAULIC 31				INCA OIL	GEAR OIL 50		GEAR OIL 84	EP CONOLITH #1	SUPER LUBE	EP CONOLITH NO.2	SUPER LUBE M	[illegible] NO. 7
FISKE (LUBRIPLATE)	LUBRIPLATE HYD. OIL HO-0	LUBRIPLATE HYD. OIL HO-1	LUBRIPLATE HYD. OIL HO-2	LUBRIPLATE HO-2A	LUBRIPLATE HYD. OIL HO-3			LUBRIPLATE APG 80	LUBRIPLATE MIST OIL	LUBRIPLATE APG 90	LUBRIPLATE 630-AA	LUBRIPLATE 630-2	LUBRIPLATE 630-2	LUBRIPLATE MO-LITH NO. 2	LUBRIPLA[TE] GEAR SHI[ELD] EXTRA H[EAVY]
GULF	HARMONY 43-AW	HARMONY 48 AW	HARMONY 54AW	HARMONY 64AW	HARMONY 74AW	FR FLUID P-43	SENATE 155	E.P. LUBRICANT S50	E.P. LUBRICANT S60	E.P. LUBRICANT S70	GULFCROWN GREASE EP 1	GULFCROWN GREASE 2	GULFCROWN GREASE E.P.#2	GULFLEX MOLY	[illegible] LUBCOTE #3
HOUGHTON	HYDRODRIVE HP-150	HYDRODRIVE HP-200	HYDRODRIVE HP-300	HYDRODRIVE HP-500	HYDRODRIVE MIH 40	HOUGHTOSAFE #1120	MP GEAR OIL 140	MP GEAR OIL 80		MP GEAR OIL 90	COSMOLUBE #1-EP	COSMOLUBE #2	COSMOLUBE #2 EP		TENAC "M"
EXXON	NUTO H 32	NUTO H 46	NUTO H 68	NUTO H 100	NUTO 150	IMOL S 46	CYLESSTIC TK 460	SPARTAN EP 68	ENMIST EP 100	SPARTAN EP 220	LIDOK EP 1	UNIREX N2	LIDOK EP-2	BEACON Q 2	SURETT N 26[illegible]
MOBIL	D.T.E. 24	D.T.E. 25	D.T.E. 26		D.T.E. EXTRA HEAVY DUTY		MOBIL 600 W	MOBILGEAR 626	MOBIL MIST LUBE 27	MOBILGEAR 630	MOBILUX GREASE EP 1	MOBILUX GREASE #2	MOBILUX GREASE EP 2	MOBILGREASE SPECIAL	MOBILTA[C] [illegible]
PENNZOIL	HYDR. & GENERAL PURPOSE OIL #1	HYDR. & GENERAL PURPOSE OIL #2	HYDR. & GENERAL PURPOSE OIL #3	HYDR. & GENERAL PURPOSE OIL #4	HYDR. & GENERAL PURPOSE OIL #5		STEAM CYLINDER OIL #12		-	MULTI-PURPOSE 4090		MULTI-PURPOSE 303	MULTI-PURPOSE 705	[illegible] MULTI-PURPOSE LUBRICANT	GEARSHIELD FLUID 3000
PHILLIPS	MAGNUS A 150	MAGNUS A 215	MAGNUS A 315				HECTOR 2000 S	ALL PURPOSE GEAR OIL SAE 80		ALL PURPOSE GEAR OIL SAE 90	PHILUBE L1	PHILUBE L2	PHILUBE EP 2	PHILUBE M GREASE	PHILSTI[C] 91 or D
UNION 76	UNAX AW 150	UNAX AW 215	UNAX AW 315	UNAX AW 465	UNAX AW 700		STEAVAL A (WEST) STEAVAL B-110 (EAST)	MP GEAR LUBE 80		MP GEAR LUBE 90	UNOBA EP #1		UNOBA EP #2	UNOBA MOLY HD #2	GEARIT HVY
SHELL	TELLUS 25	TELLUS 29	TELLUS 33	TELLUS 41	TELLUS 69		VALVATA J 77	SPIRAX HD 80	OMALA 37	SPIRAX HD 90	ALVANIA EP #1	ALVANIA #2	ALVANIA EP #2	LITHALL MFS	OMALA 46
STANDARD (CALIF.)	CHEVRON EP HYDRAULIC OIL #9	CHEVRON EP HYDRAULIC OIL #11	CHEVRON EP HYDRAULIC OIL #15				CHEVRON CYL OIL 155 PX				CHEVRON DURA-LITH GREASE EP #1	CHEVRON DURA-LITH GREASE #2	CHEVRON DURA-LITH GREASE EP #2	CHEVRON MOLY GREASE 2	CHEVRO[N] [illegible] GREASE #2
STANDARD (OHIO)	INDUSTRON 44	INDUSTRON 48	INDUSTRON 53		INDUSTRON 66		FACTOCYL 650	GEAREP 80		GEAREP 90	FACTRAN EP 1	FACTRAN #2	FACTRAN EP 2	SOHIO MOLY LUBE #2	GEAREP [illegible]
SUN	SUNVIS 706	SUNVIS 747	SUNVIS 754	SUNVIS 764	SUNVIS 775		OCCIDENT CYL OIL	SUNEP 1050	SUNMIST 6152	SUNEP 1070	SUNAPLEX 991EP	PRESTIGE #2	PRESTIGE 812 EP	SUNFLEET XL	SUNAPLEX 781 [illegible] PRESTIGE 740A-[illegible]
TEXACO	RANDO HD 32	RANDO HD 46	RANDO HD 68		RANDO HD 150	SAFETYTEX 215	VANGUARD CYLINDER OIL	MEROPA 68	TEXAMIST 100	MEROPA 220	MULTIFAK EP 1	MULTIFAK #2	MULTIFAK EP #2	MOLYTEX GREASE 2	CRATE[X] 2X [illegible] 2X FLU[ID]

MAINTENANCE - SHEAR BLADES

The upper and lower shear blades are the same and each have 4 cutting edges.

Blade Removal

Extreme care must be used when removing shear blades. Either to turn to use another cutting edge or for re-grinding.

The procedure is as follows:

1. With machine motor running, lower rake until upper & lower blades are almost parallel.

2. Turn key selector to "off" position and remove key.

3. Block upper blade beam on each end with wood blocks.

4. Remove blade guard and top table surface plates.

5. Carefully loosen and remove the large allen head bolts on the front of the table retaining the lower blade. Between these bolts you will find small allen head set screws. They should also be loosened as you work your way down the length of the machine.

6. Carefully slide the blade out of the machined pocket in the bed.

   A forklift with the forks against the back of the bed is very helpful for this purpose.

   CAUTION: The use of gloves and extreme care in handling is required to avoid personal injury.

7. Place blade on wooden blocks in a safe place, so as not to create a hazard to other people.

8. Use forklift, die cart, etc. to position under top blade.

9. Repeat Step 5.

10. Lower upper blade and remove from under back of machine.

MAINTENANCE - SHEAR BLADES (con't)

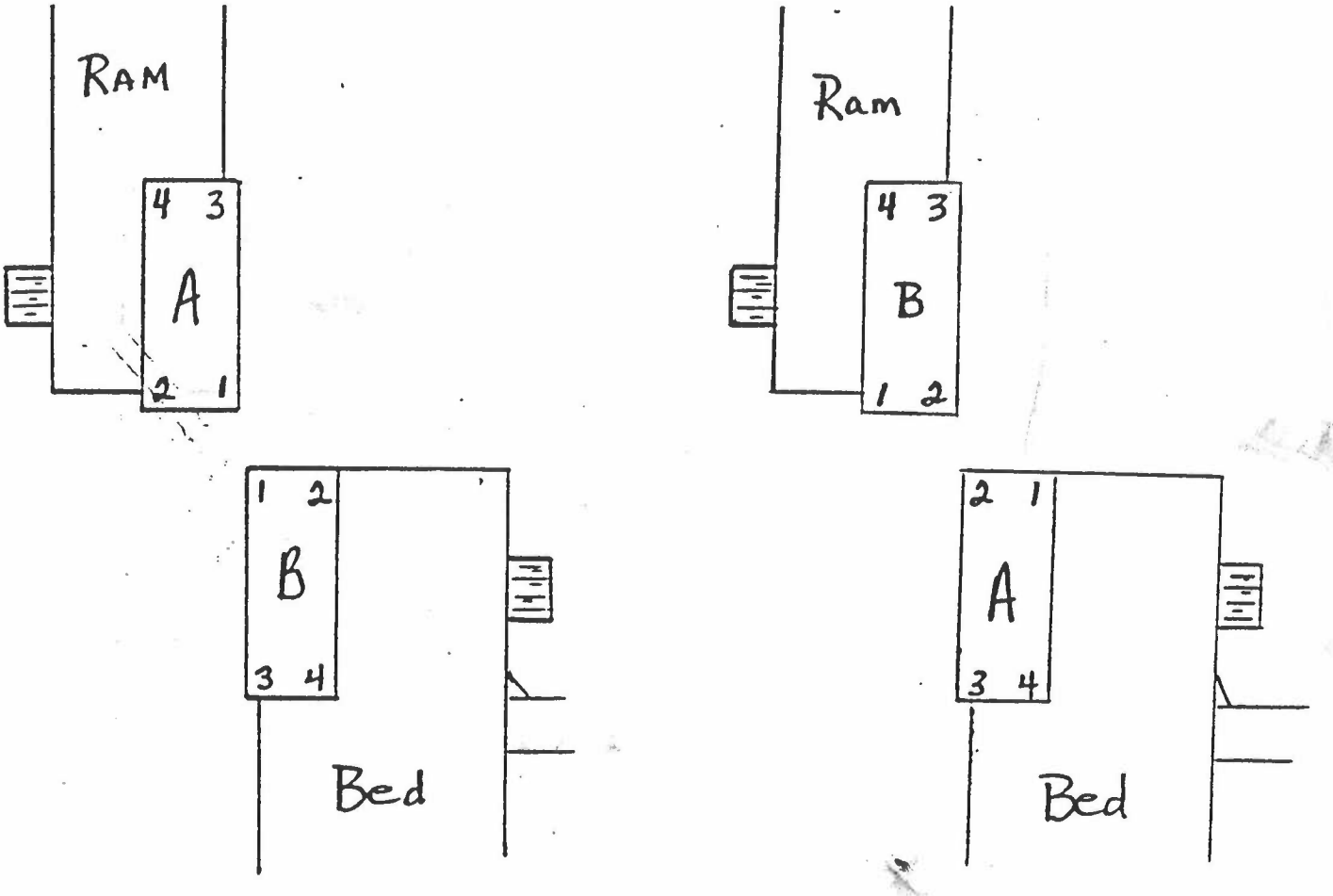
Blade Rotation

The lower blade tends to wear faster than the upper blade due to material sliding over it.

Therefore it is good practice to rotate the upper blade with the bottom blade when you are turning them to present a new cutting edge.

To do this, the bottom blade should be rotated end to end and then placed in the upper blade position so as to expose edge #2 and vice versa for the upper blade.

See diagram below.



MAINTENANCE - SHEAR BLADES (con't)

Re-Installing Blades

1. Using forklift or some suitable lifting device, reposition the top blade in upper beam machined pocket. Loosen Allen head jacking screws. Replace allen head bolts and tighten.

2. Position lower blade in bed machined pocket. Replace allen head bolts and tighten.

3. Remove blocks securing upper beam.

4. Turn key selector switch to "On/Run" and re-start machine.

5. Change rake setting to full rake (digital display on 3).

6. Check and ensure blade gap levers are in "+" (plus) "down" position.

7. Turn key selector to "Setup" and re-start machine.

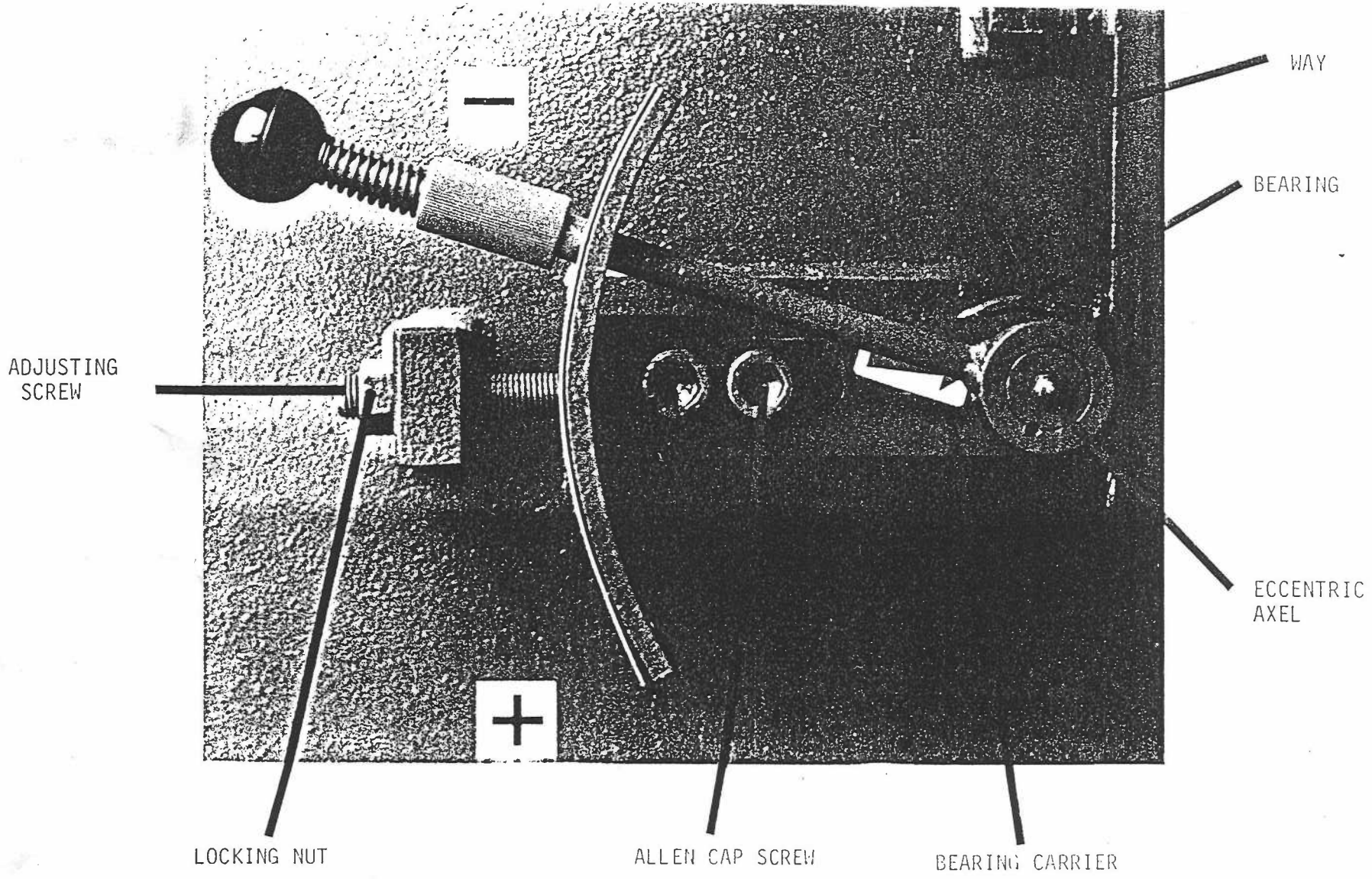
8. Carefully jog upper beam down and check blade clearance at exact point that blades intersect.

   Check clearance at 5 or 6 points along the length of the blades.

9. If the blade gap is in excess of .022" move the blade gap levers to the "-" (minus) "up" position and repeat step 7.

10. If the blade gap is less than .022" loosen lock nut on master adjusting screws and turn them 1/4 turn counter clockwise. Move the blade gap levers to "-" (minus) "up" position and repeat step 7.

11. Final minimum blade gap is now set using the master adjusting screws on the back side of the lever type adjusting mechanism. See diagram.



BLADE GAP ADJUSTMENT

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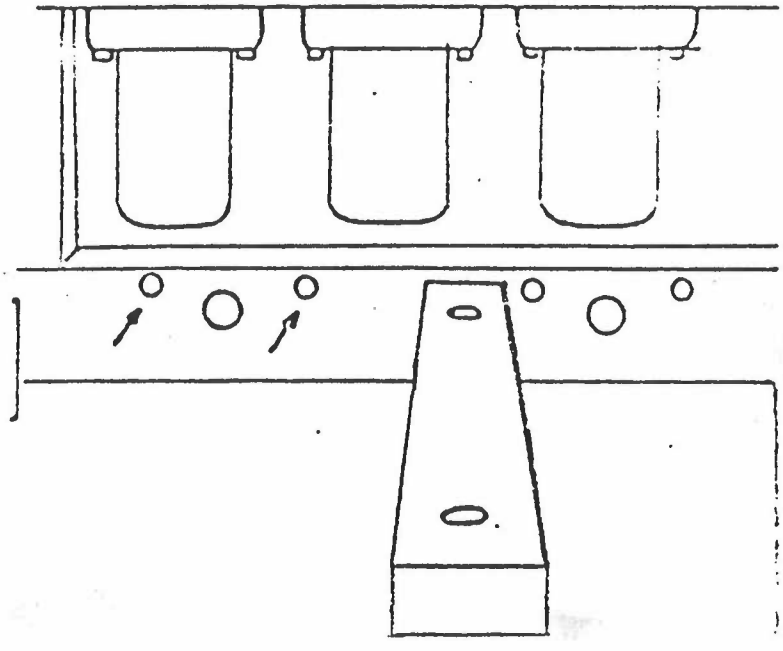
MAINTENANCE - SHEAR BLADES (con't)

Re-Installing Blades (con't)

Turn these bolts clockwise to decrease blade clearance and counter clockwise to increase blade clearance. Minimum blade clearance should never be set less than .004.

EXTREME care should be taken as 1/4 turn of the adjusting bolt is equivalent to 030" change in blade clearance and can result in a crash of the upper and lower knives.

DIAGRAM SHOWING JACK SCREWS



MAINTENANCE - SHEAR BLADES (con't)

Fine Adjustment of Blade Setting

Due to variations in knife thickness after grinding, local clearance along the length of blades may vary. This can be compensated for by the jack screws located between the blade attaching bolts.

The procedure is as follows:

#1. With motor running depress "+" rake button and increase rake to maximum setting.

#2. Turn machine off and remove key.

#3 Locate Main hydraulic valve on manifold. This is the largest double solenoid valve.

#4. Insure that blade gap levers are in "-" position.

#5. Determine which plunger on ends of valve lowers shear beam and depress same so that cutting edges of blades start to interset each other.

#6. With feeler gauge, at exact point of intersection, check blade clearance for desired setting.

#7. Adjust accordingly with jack screws from both front and rear of machine.

#8. Continue step 5-7 checking clearance point every one to two inches along length of blade.

#9. Upon completion re-start machine in "On/Run" key position and ram will return to top.

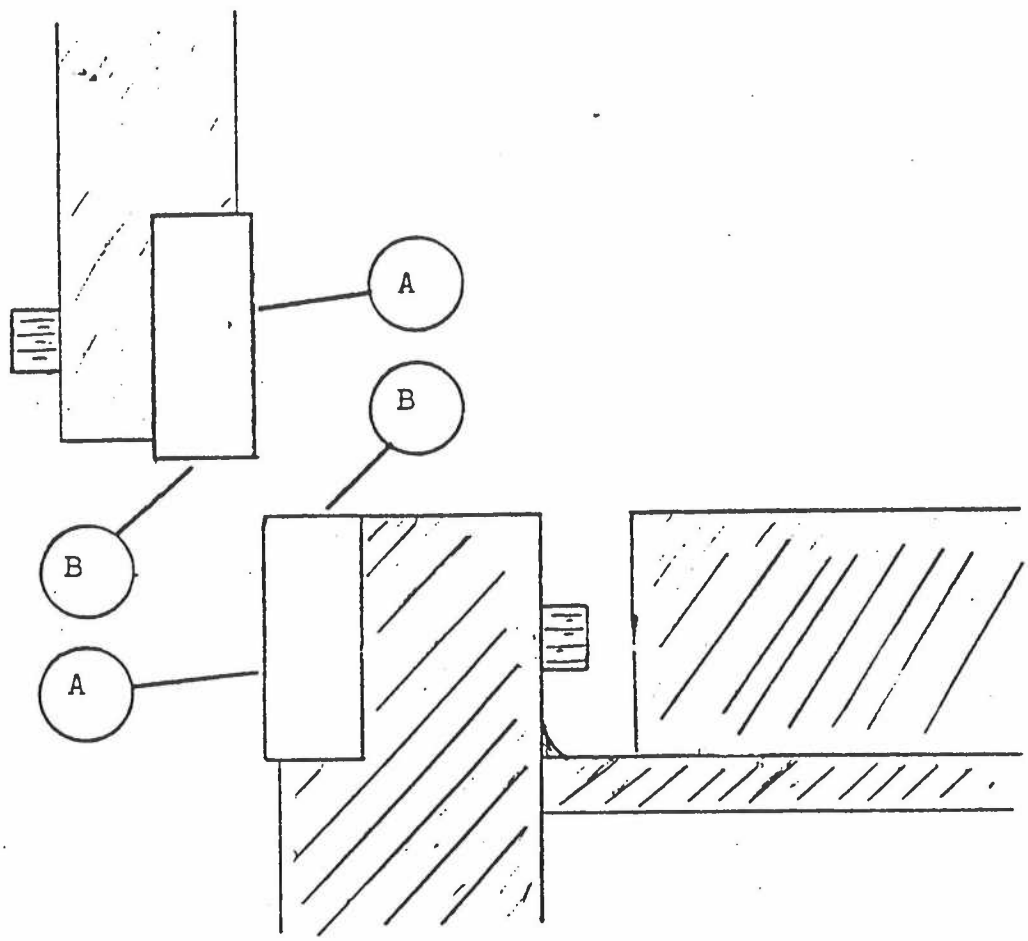
#10. Replace rear hydraulics covers and reinstall guard and table plate.

MAINTENANCE - SHEAR BLADES (con't)

Blade Grinding

The blades are 4 edged design with each surface at 90 degrees to the other. It is very important that they be ground on surface A (per the following diagram) and not on surface B.

Be sure to specify this when the blades are sent for re-grind.



MAINTENANCE (Con't)

Checking & Setting Holddown Pressure & Main Pressure

The holddown pressure is set/checked in following manner:

1. At control pendent turn machine off at key switch and remove key.
2. Attach pressure gauge with range of 0-3000 PSI to pressure tap as indicated in following photos/drawings.
3. Restart machine.
4. Stroke machine **CAUTION** Stay clear of moving shear beam.
5. Read pressure on gauge; it should read 1400 PSI ± 50 PSI.
6. If the correct pressure is not produced after performing #4 and #5 continue on.
7. Unplug electrical connection at pressure switch on manifold and depress foot pedal.
8. Remove cap of pressure relief valve for holddowns per photo/ diagrams.
9. Unlock locknut on adjustment set screw and with allen wrench. SLOWLY turn clockwise for raise pressure; counter clockwise to lower pressure, until gauge reads 1500 PSI. Relock locknut. Reinstall cap.

   IMPORTANT: Never exceed 2000 PSI on holddowns

10. Reconnect electrical connection pressure switch and stroke machine. Pressure gauge should again read 1500 PSI ± 50 PSI.
12. Install pressure gauge with 0 - 5000 PSI range at main pressure tap on manifold.
13. Disconnect wires from end of stroke limit switch (See Limit Switch Section).
14. With footpedal stroke machine until ram comes to bottom. Pressure should develop to 3400 PSI.
15. If correct pressure is not achieved remove cap from main pressure relief, unlock locknut.
16. With footpedal depressed, turn set screw clockwise until pressure reached 3500 PSI, then release footpedal.

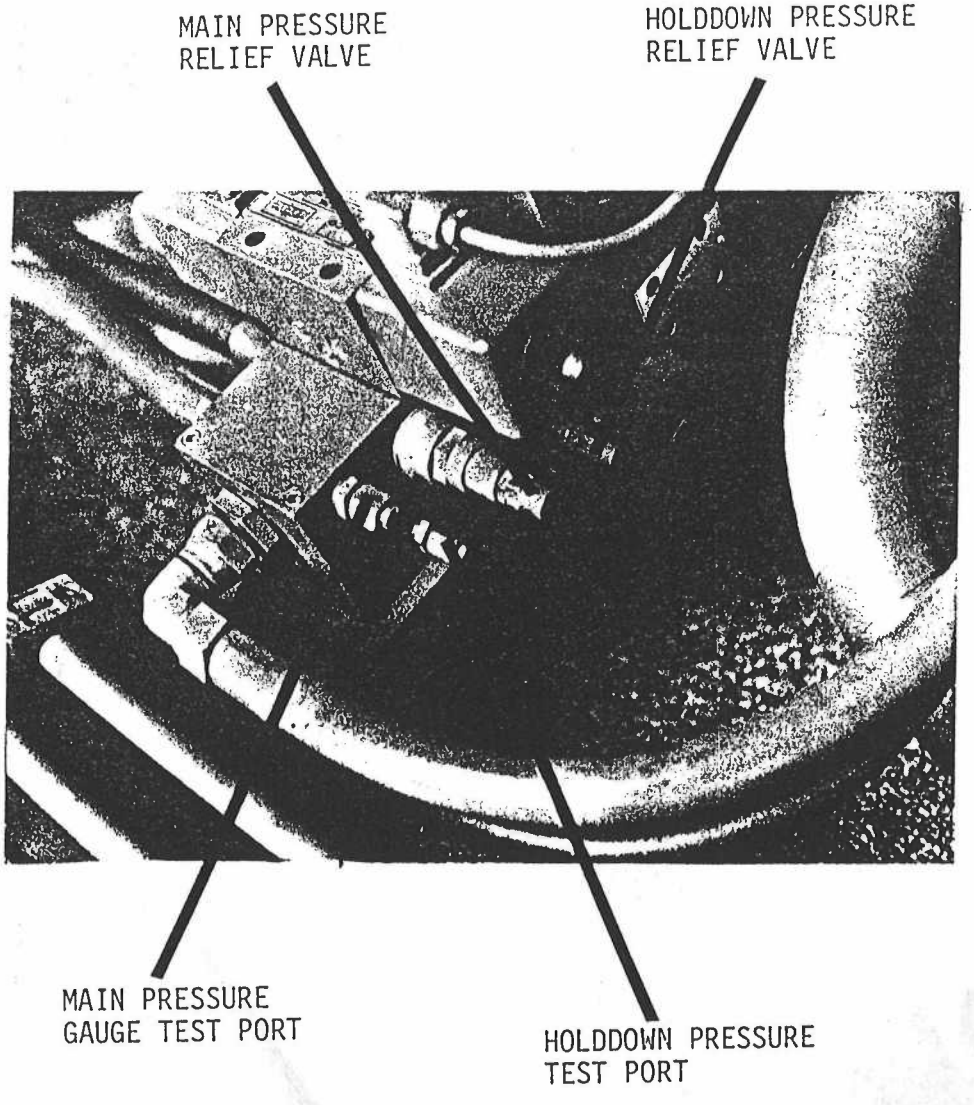
MAINTENANCE (con't)

17. Tighten locknut and reinstall cap.

18. Reconnect wiring on End of Stroke Limit Switch.

19. Turn off Main Motor and remove pressure gauges.

20. Restart machine and fully stroke to insure end of stroke limit switch operates and check for oil leaks.



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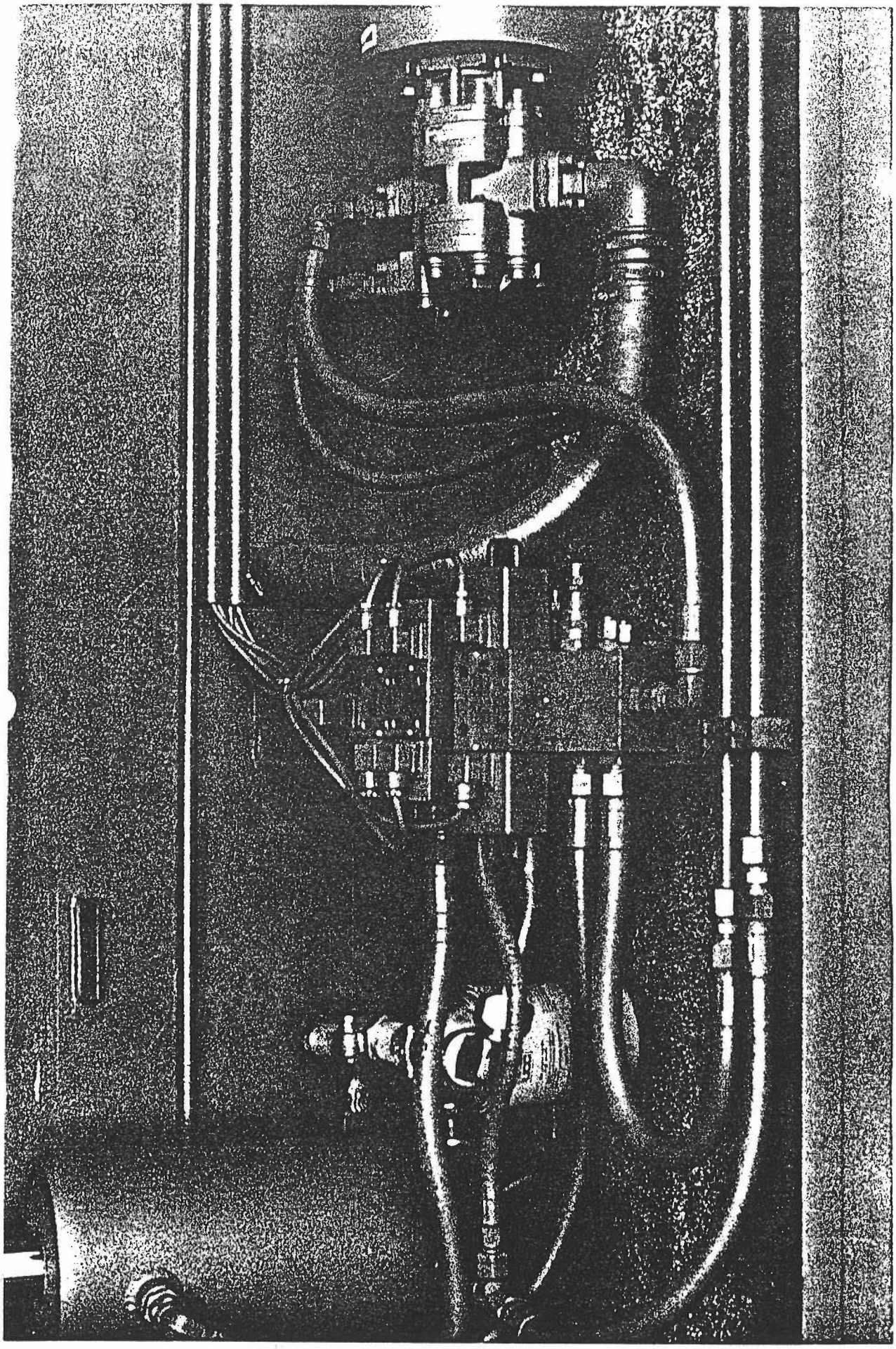
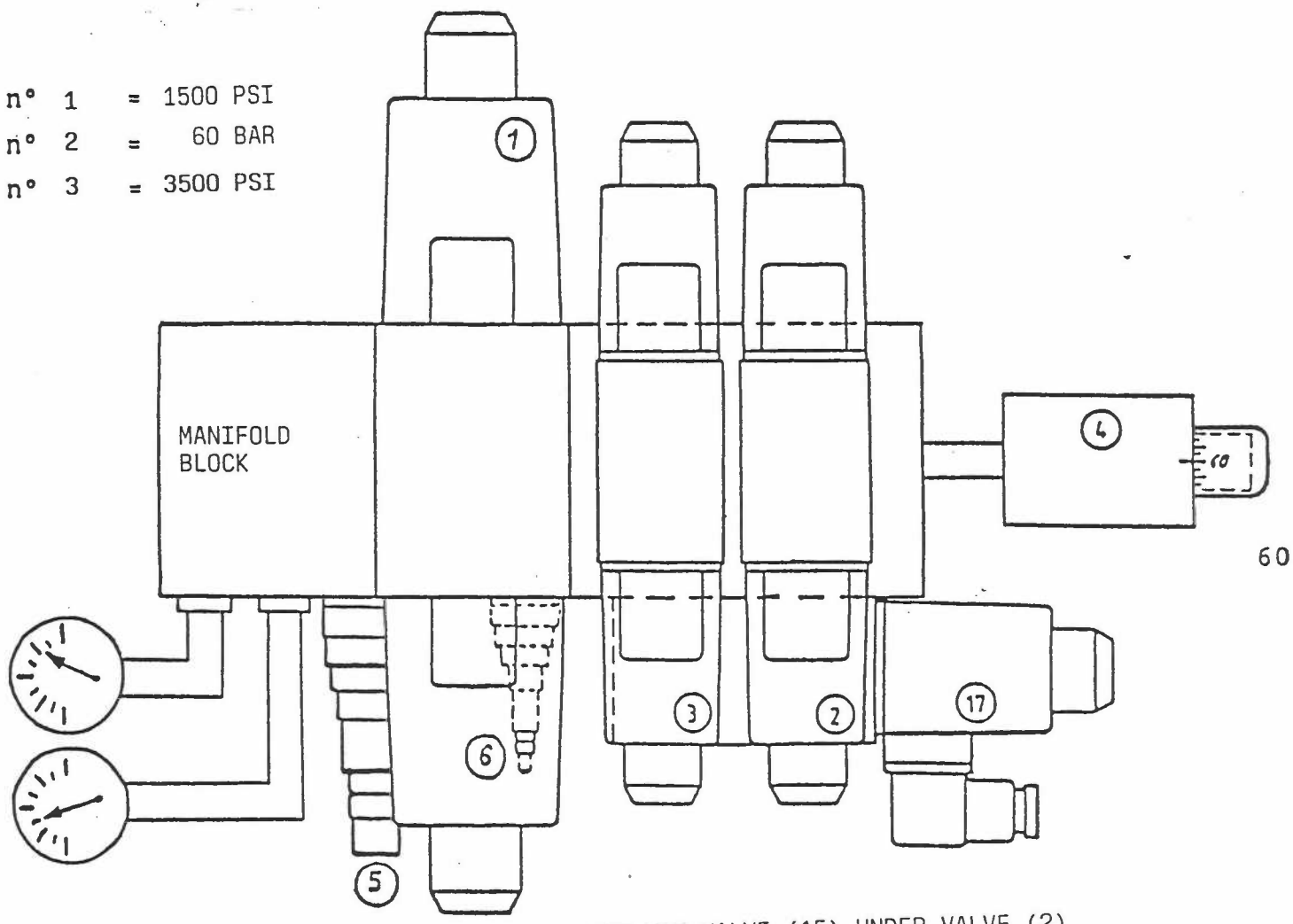


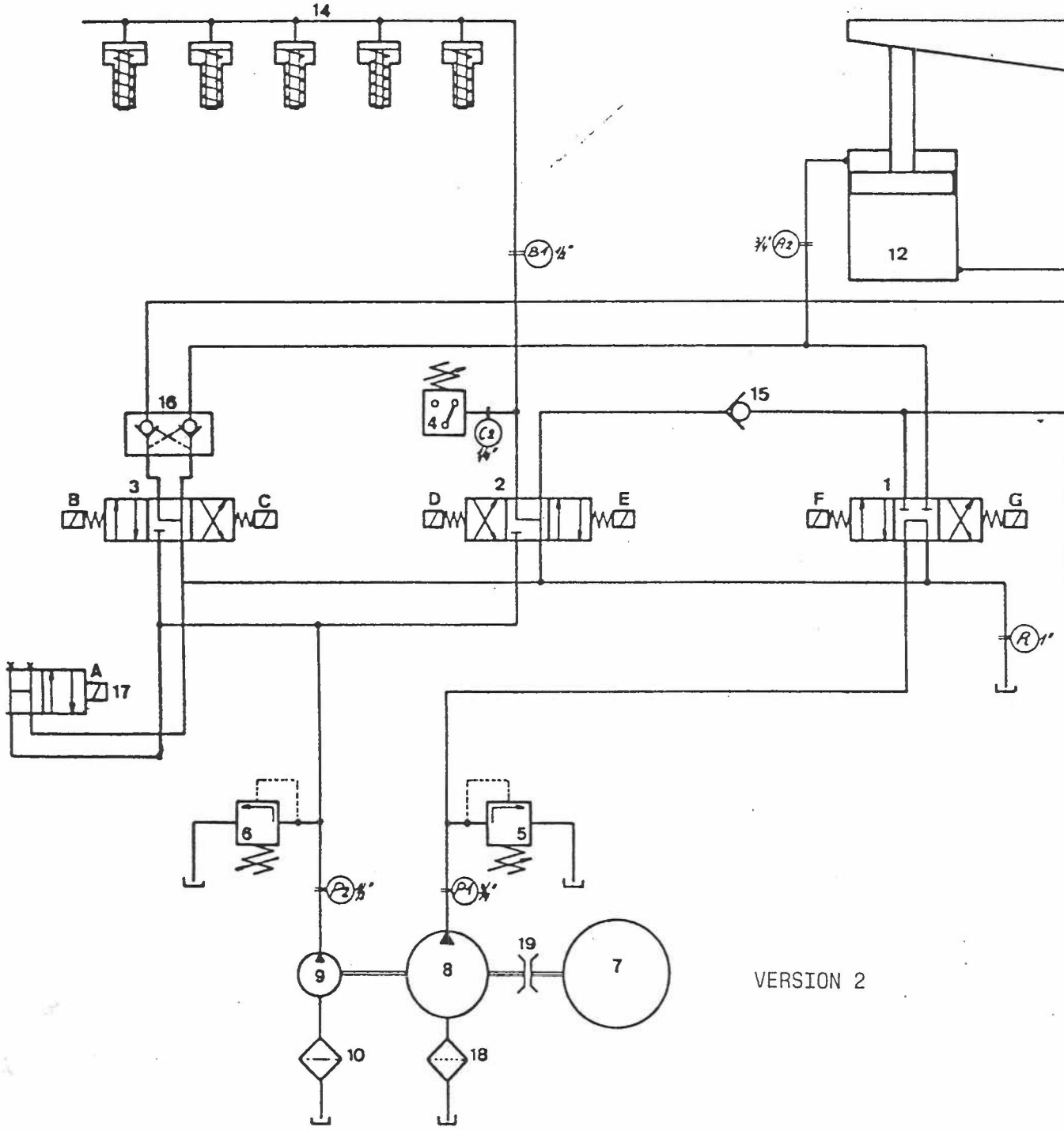
Checkpoint : n° 1 = 1500 PSI
Checkpoint : n° 2 = 60 BAR
Checkpoint : n° 3 = 3500 PSI



ONE WAY VALVE (15) UNDER VALVE (2)
PILOT OPERATED DUAL CHECK VALVE (16) UNDER VALVE (3)

M15

PAGE M16
INTENTIONALLY LEFT OUT



		A	B	C	D	E	F	G
CLAMPS DOWN		●				●		
SHEAR		●				●		●
RAM UP		●			●		●	
RAKE ANGLE	−	●		●				
	+	●	●					

VERSION 2

ATLANTIC MACHINE TOOLS

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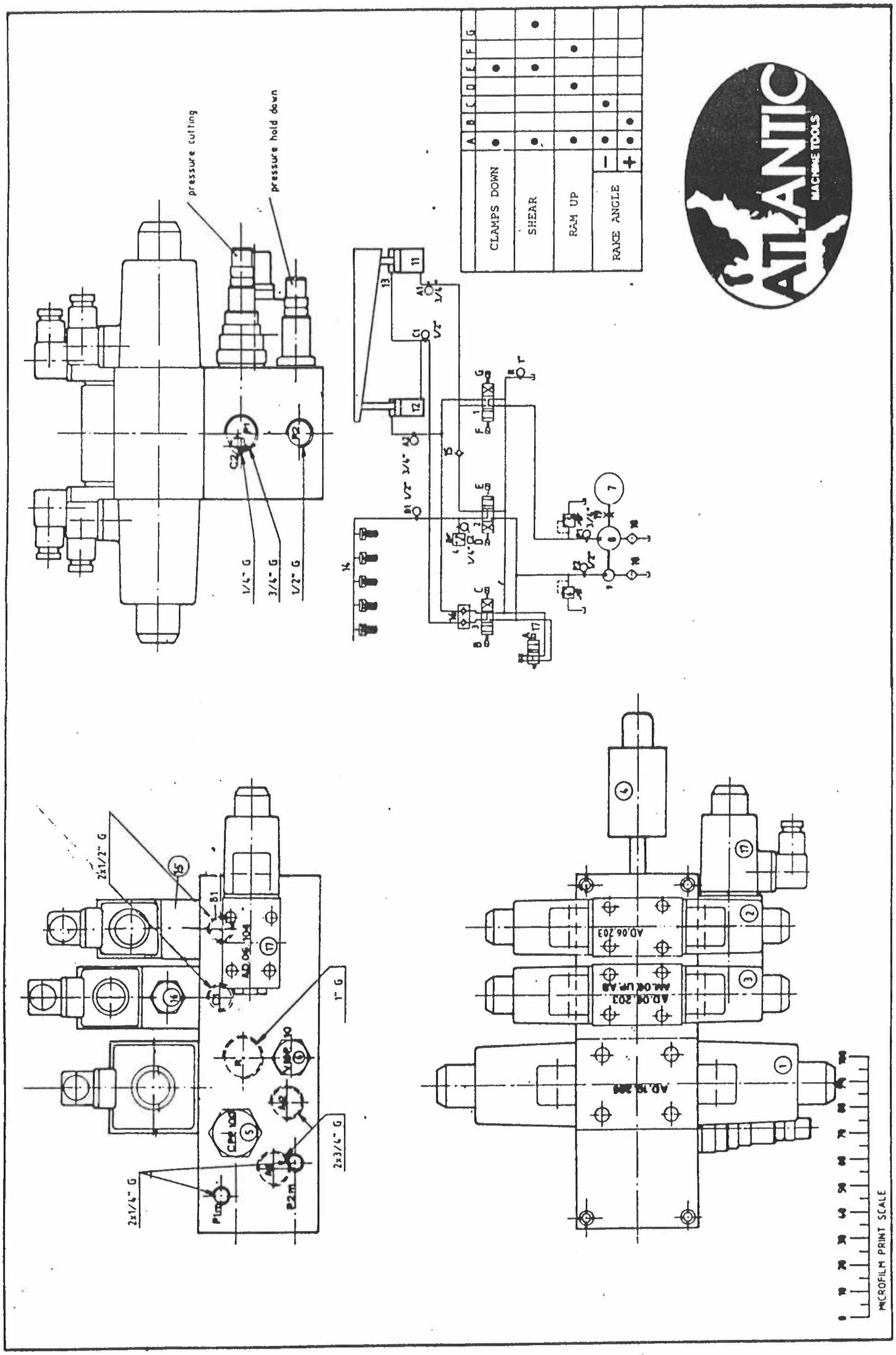

	A	B	C	D	E	F	G
CLAMPS DOWN	●				●		
SHEAR	●				●		●
RAM UP	●			●		●	
RAKE ANGLE −	●		●				
RAKE ANGLE +	●	●					

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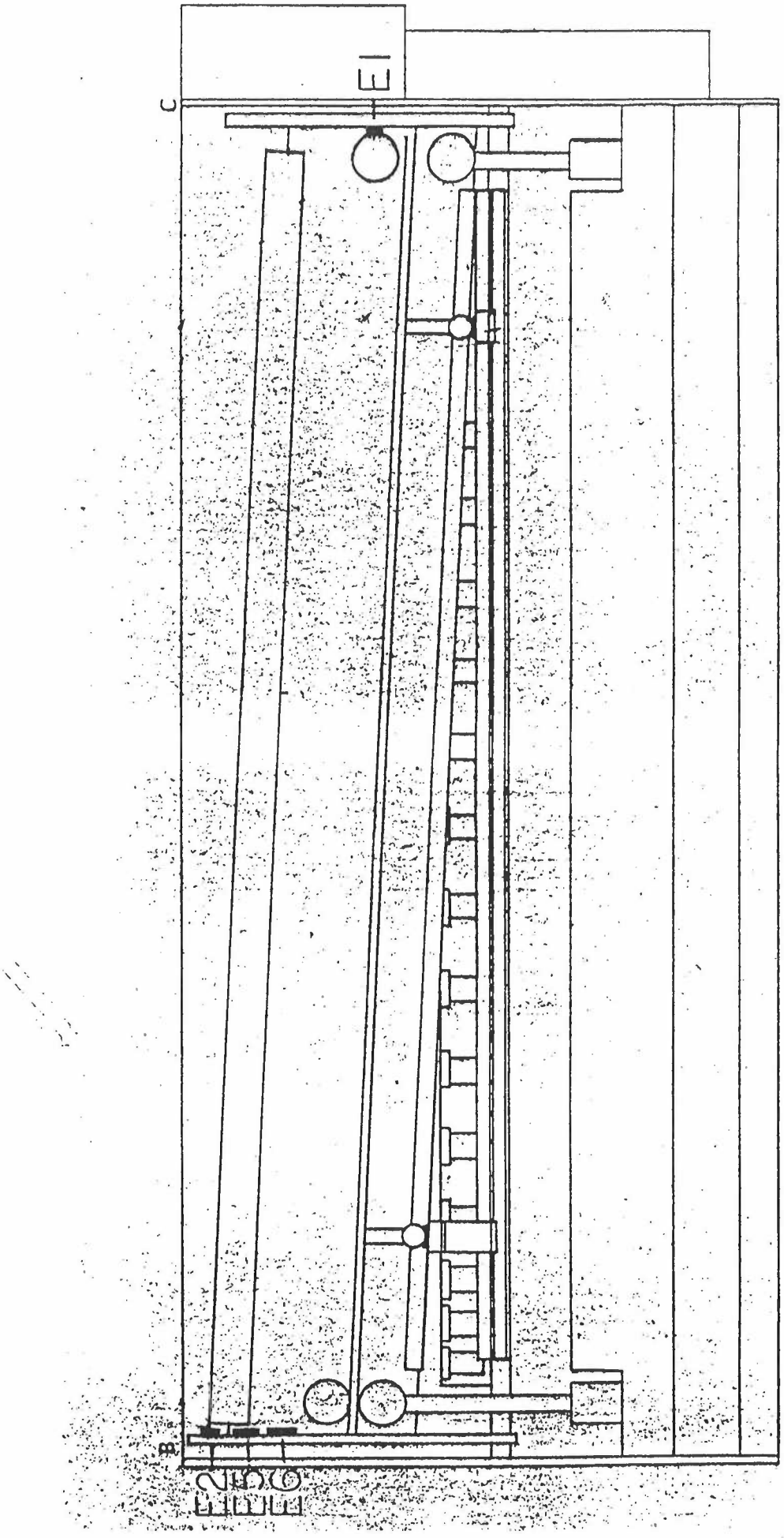
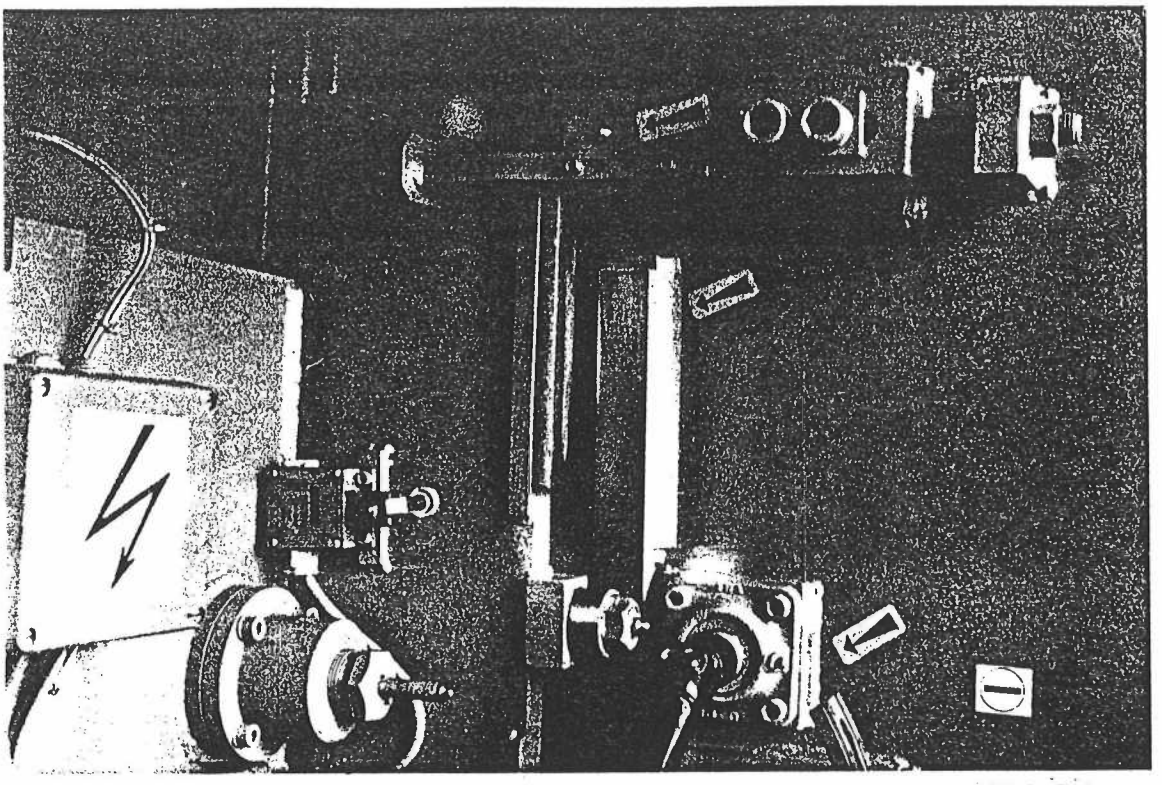
10 × 1/2

10 × 1/4



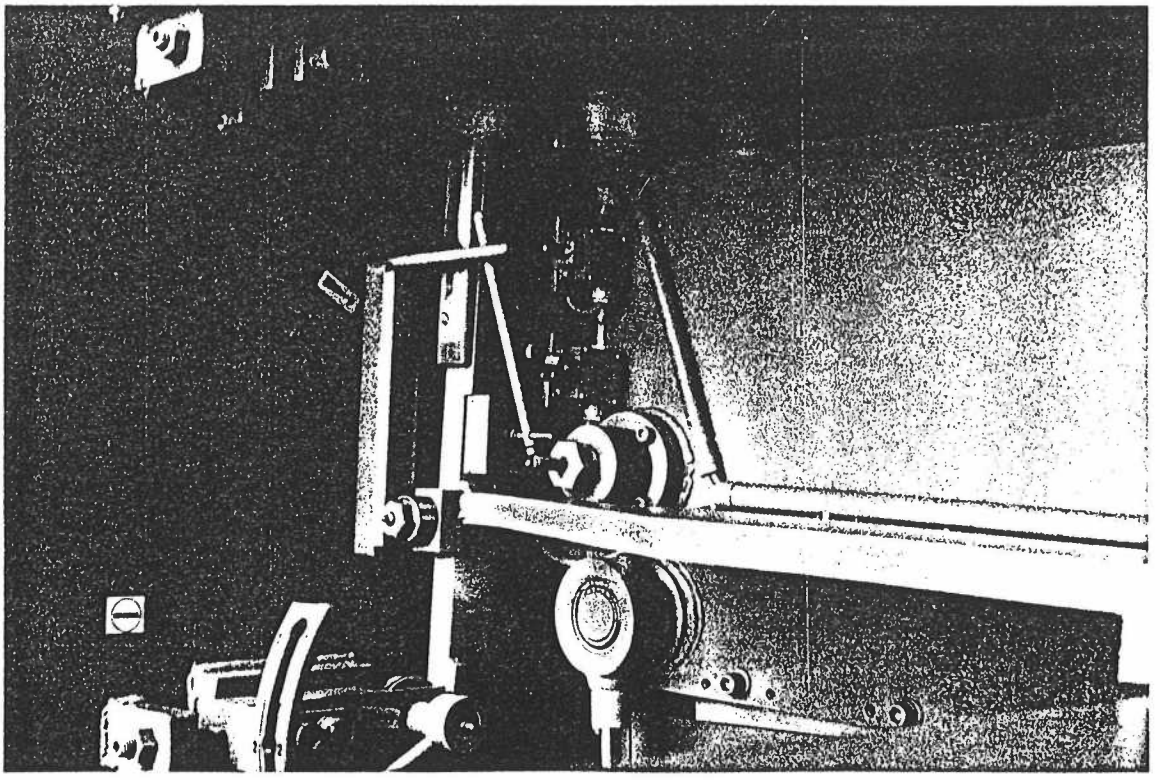
LIMIT SWITCH LOCATIONS

LIMIT SWITCHES
VIEWED FROM REAR



RIGHT

E1 : Top stop limit
E8 : Speed slow down (only HDS 12x¼)



LEFT

E2 : End of stroke limit
E3 : Minimum rake limit
E4 : Maximum rake limit

E1 TOP STOP LIMIT

A. CONTACT CONFIGURATION

#1 Normally closed held open when ram is in up position.

#2 Normally open held closed when ram is in up position.

B. PURPOSE OF SWITCH

#1 To stop upward movement of beam via D1 relay. To require shear ram to come to top position before it can start downward motion again.

#2 To disable rake angle adjustment when shear beam is not in top position.

C. ADJUSTMENT

Adjust so that switch is actuated when ram is up at top position. Check adjustment both at low and high rake settings.

CAUTION: Adjust so switch actuates before hydraulic cylinders run out of stroke.

E2 END OF STROKE LIMIT

A. CONTACT CONFIGURATION

Normally open when ram is in the top position. Momentarily closed at the end of stroke.

B. PURPOSE OF SWITCH

To make the D1 relay circuit de-energizing the hydraulic valves for downward movement of ram and energizing valves for upward movement.

C. ADJUSTMENT

Adjust so that switch actuates at instant blade edges cross each other at right side of machine as viewed from front. Check adjustment at both high and low rake settings.

E5 MAXIMUM RAKE LIMIT

A. CONTACT CONFIGURATION

Normally closed - opened when ram reaches maximum rake.

E5 MAXIMUM RAKE LIMIT (con't)

B. PURPOSE OF SWITCH

To prevent ram from becoming over-raked and thus binding in frame or running out of cylinder stroke.

C. ADJUSTMENTS

Adjust to actuate when shear beam end housings are parallel with end frame. Normally this produces a 3^{o} rake angle between fixed bottom blade and top shear beam blade.

E6 MINIMUM RAKE LIMIT

A. CONTACT CONFIGURATION

Normally closed - Opened when ram reaches minimum rake.

B. PURPOSE OF SWITCH

1. To prevent ram from becoming under-raked and binding in frame.
2. To protect blades from excessive edge pressures due to lack of rake.

C. ADJUSTMENT

Adjust to actuate when blade rake approaches 1^{o} angle while depressing rake button.

E8 TOP STOP SLOW DOWN LIMIT SWITCH (12 x 1/4 only)

A. CONTACT CONFIGURATION

Normally closed - held open when in top start position.

B. PURPOSE OF SWITCH

To slow down ram before final stopping at top position by de-energizing soleniod E.

C. ADJUSTMENT

Adjust to deactivate 1/4 - 3/8 inches before final top stop position.

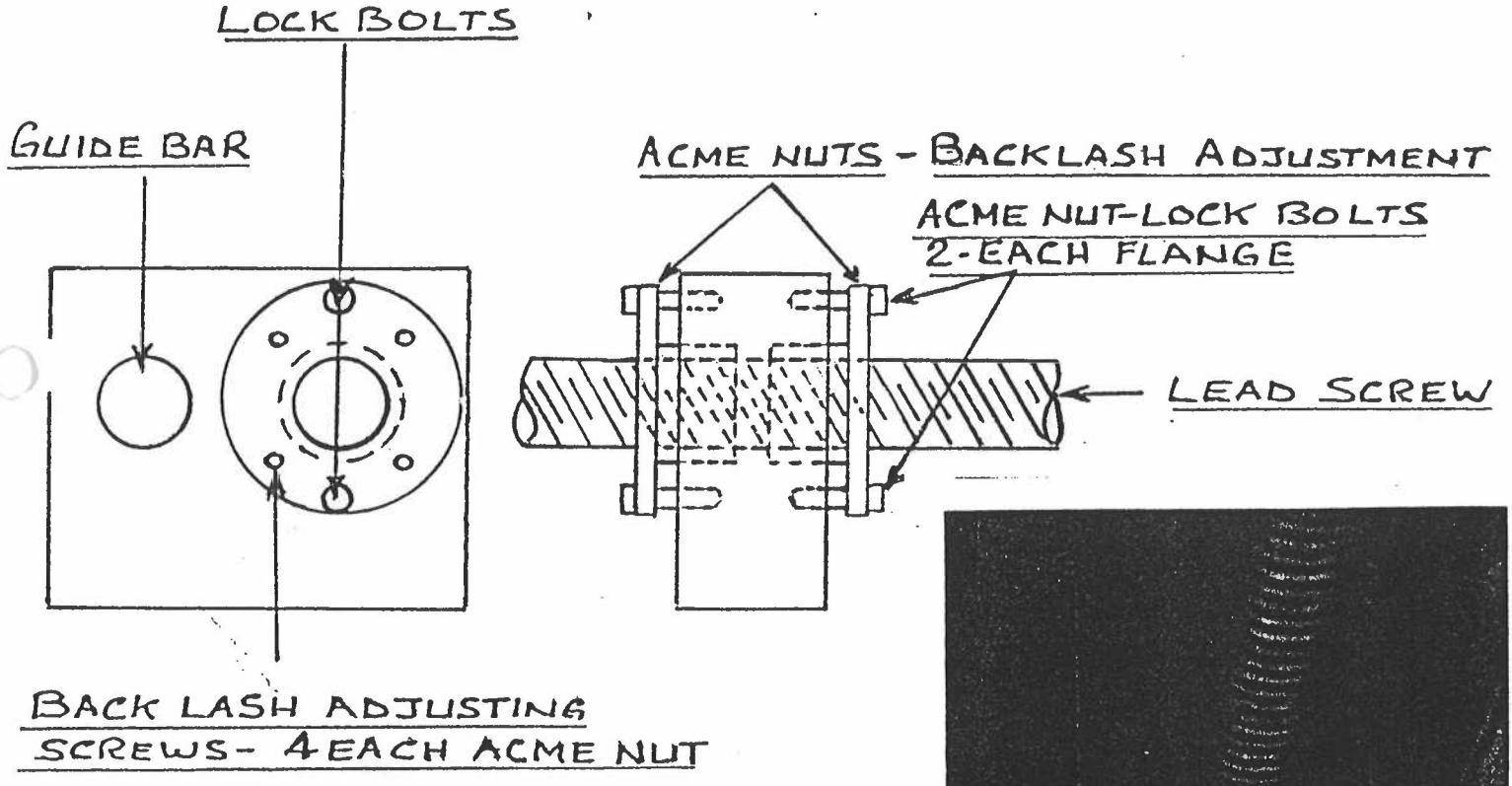
MAINTENANCE (con't)

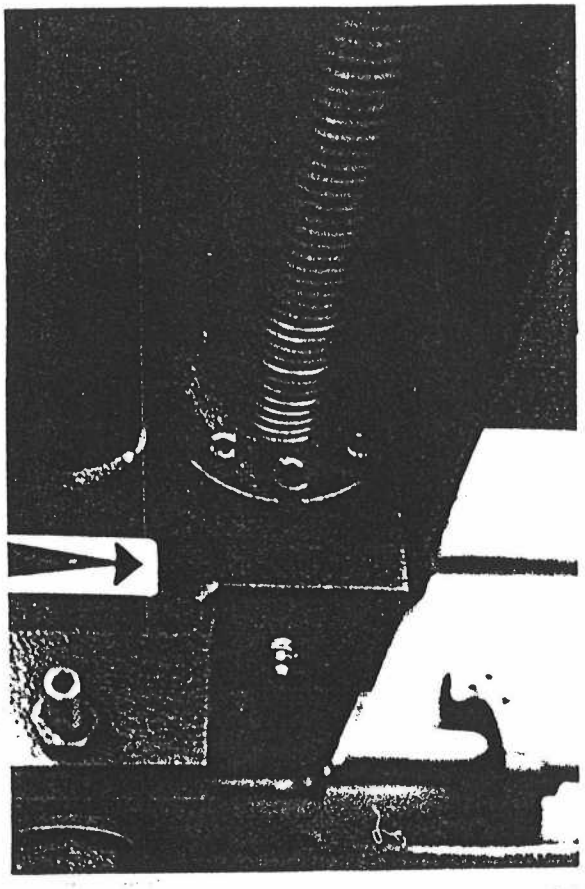
Backgauge Adjustment

Backlash of the backgauge arms is controlled by using two separate acme nuts in each arm assembly.

Tension on both sides of the thread face is achieved by using jacking screws (set screws) and allen cap screws in combination. These locate the acme nuts within the sliding carrier so as to take up wear as it develops in the nuts.

CAUTION should be taken when adjusting backlash so as not be "bind" the assembly, then requiring excess force to reposition the back-gauge.





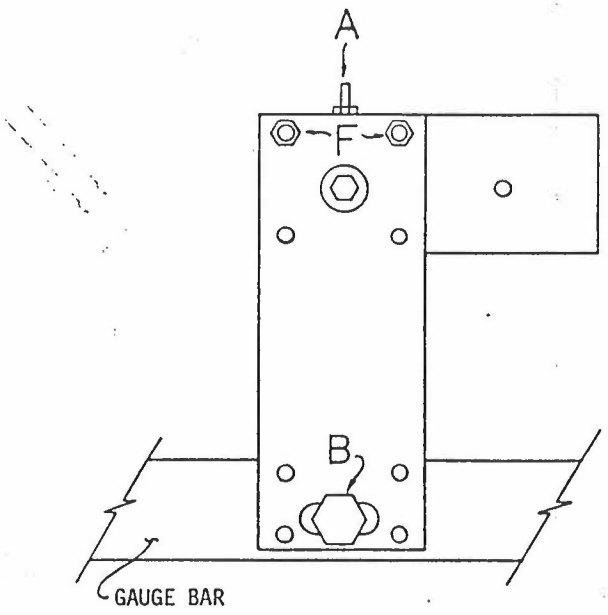
MAINTENANCE (con't)

Back Gauge Adjustment

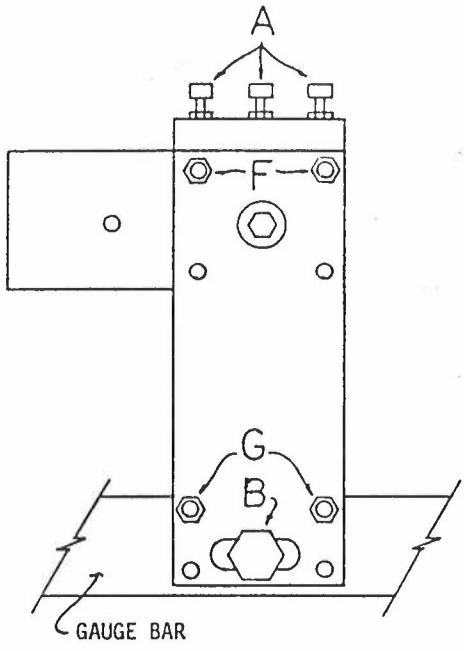
The back gauge is pre-aligned at the factory and checked at time of installation. It should not require adjustment in normal operation.

If adjustment is required, the following must be considered:

1. Parallelism end to end of gauge bar in relation to fixed blade.
2. Straightness overall of gauge bar (bow).
3. Angular referencing of gauge bar face to fixed blade to compensate for change in rake angle and beam travel.



LEFT FROM REAR
(BOTTOM)



RIGHT FROM REAR
(BOTTOM)

MAINTENANCE (con't)

Parellelism End to End

Occasional checks of the backgauge bar are necessary to insure parrellel cuts. This is done as follows:

1. Set backgauge to approximately the 3" position.
2. Use a 3" wide strip of approximately 10 gauge material and shear by placing against gauge bar attachment points. One cut should be made at each point.
3. Compare dimensions of the two cut pieces obtained above.
4. If identical, go to next section.
5. If not identical, and it is different by more than 1/32" overall, adjust as follows:
6. Loosen locking bolts "B" one-half turn; loosen or tighten adjusting jack bolt "A" at appropriate end based on test cuts.
7. Retighten locking bolt "B"
8. Perform test cut again, and follow same procedure until parallelism is satisfactory.

NOTE: Later series 12 x 1/4 Shears do not use this system - refer to following pages on Bow.

BOW

This is a correction of overall straightness of the gauge bar face over the entire length in relation to the fixed blade. Check and adjust as follows:

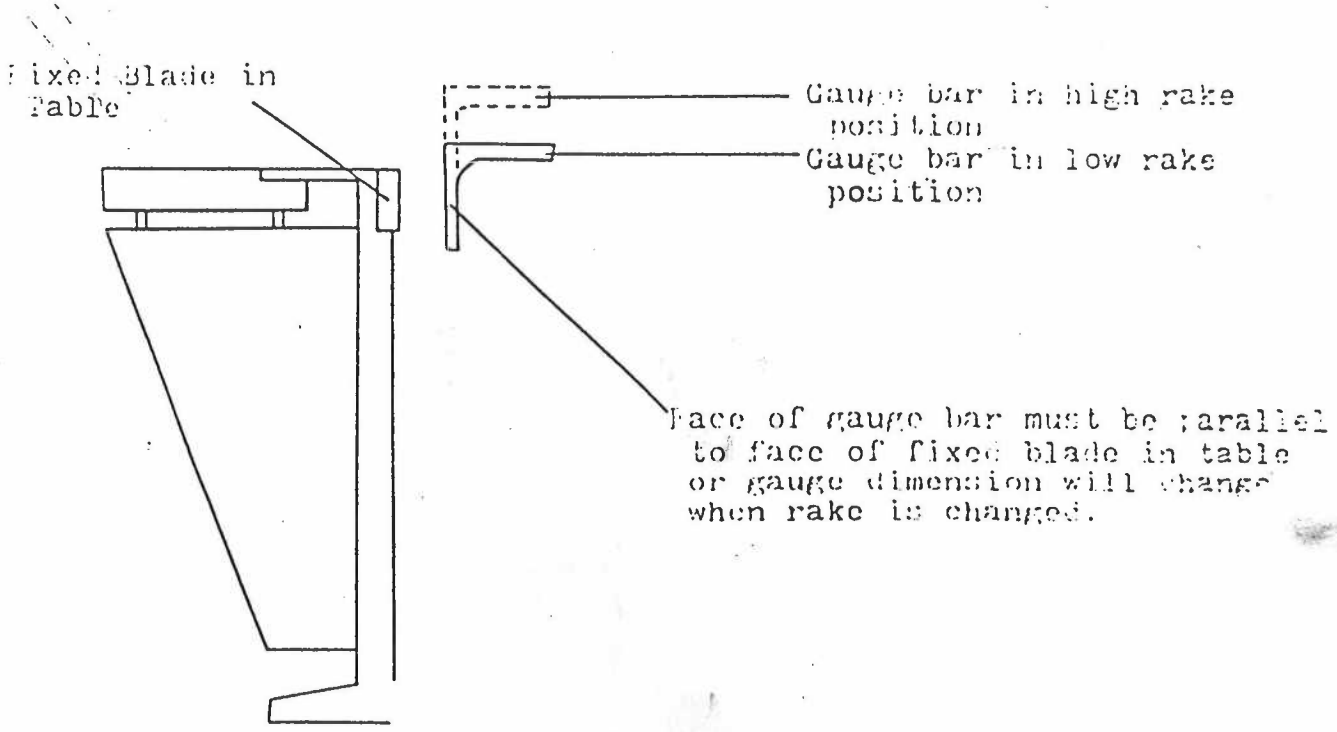
1. Set backgauge position at approximately 3".
2. Use a 3" wide strip of approximately 10 gauge material, and shear 3 test pieces by placing the strip at each end and in the center of the gauge bar.
3. Compare dimensions of the three cut pieces. If identical, go to next section.
4. If not identical, and it is different by more than 1/32" overall, adjust as follows.
5. If center dimension is longer than end dimension, loosen nut "D" and tighten nut "E" any desired amount. Then relock nut "D".

Angular Referencing

Because this machine is a variable rake and has four edged blades, the face of the gauge bar is pre-set at the proper angle to compensate for beam movement relative to the fixed blade.

To check the angle:

1. Put machine on Low rake.
2. Cut test piece of 3" 10 gauge strip, 3" long on each end of the bar.
3. Change rake to high rake, and repeat Step 2.
4. If pieces cut on the same end differ in dimension by more than 1/32", adjust as follows.
5. Loosen all lock nuts on jacking screws "F" and "G" on end where dimension is off (normally left end when viewed from rear).
6. If test piece No. 1 is longer than test piece No. 2, turn jack screws "F" counter clockwise, one-eight (1/8) turn; then make test cut again per No.'s 2 and 3 above. Repeat step 6 as necessary.
7. If test piece No. 1 is shorter than test piece No. 2, turn jack screws "G" counter clockwise one-eight (1/8) turn; then make test cut again per No.'s 2 and 3 above. Repeat Step 7 as necessary.



MAINTENANCE (con't)

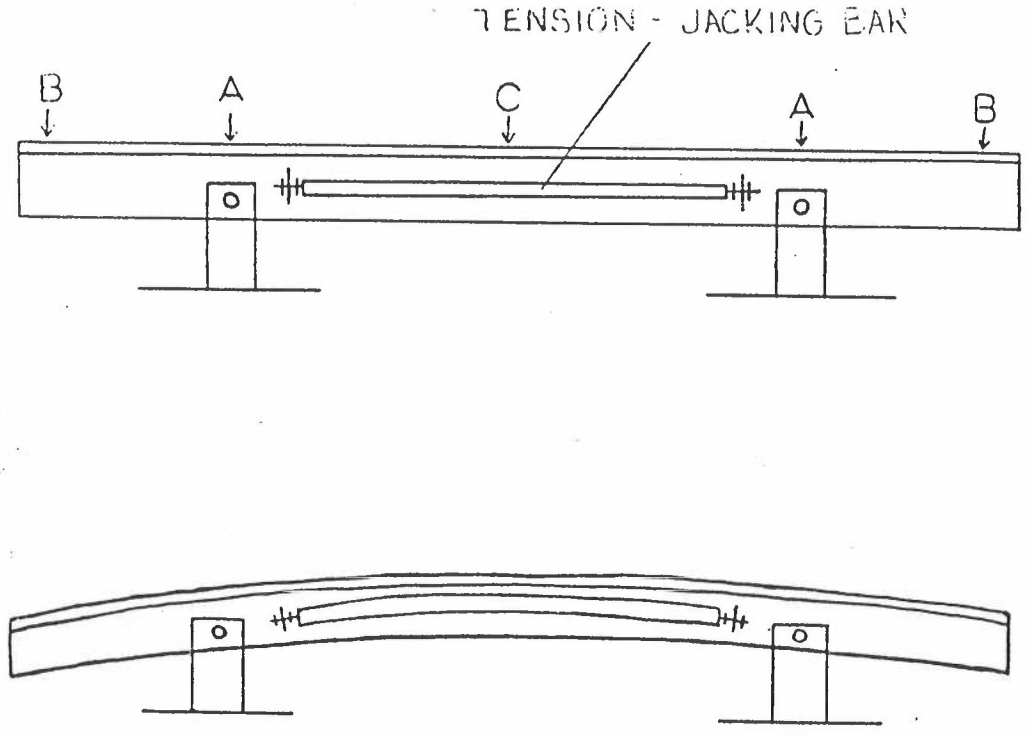
BOW (con't)

6. If center dimension is shorter than end dimension, loosen nut "E" and tighten nut "D" any desired amount. Then relock nut "E".

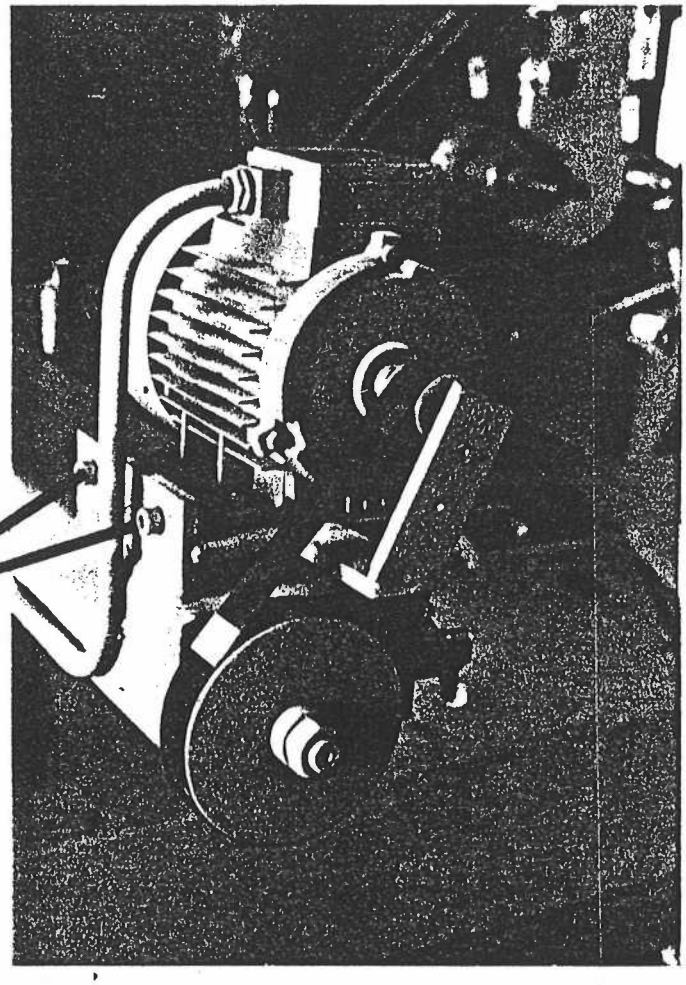
7. Perform test cuts as in No. 2 above, and recheck dimensions. Make adjustments as necessary by repeating steps 5 and 6 above.

BACKGAUGE ADJUSTMENT, BOW, GAUGE BAR STRAIGHTNESS

If backgauge is square at points "A", yet you get different measurements at points "B" and "C", you must adjust tension-jacking bar to push or pull the backgauge bar straight.

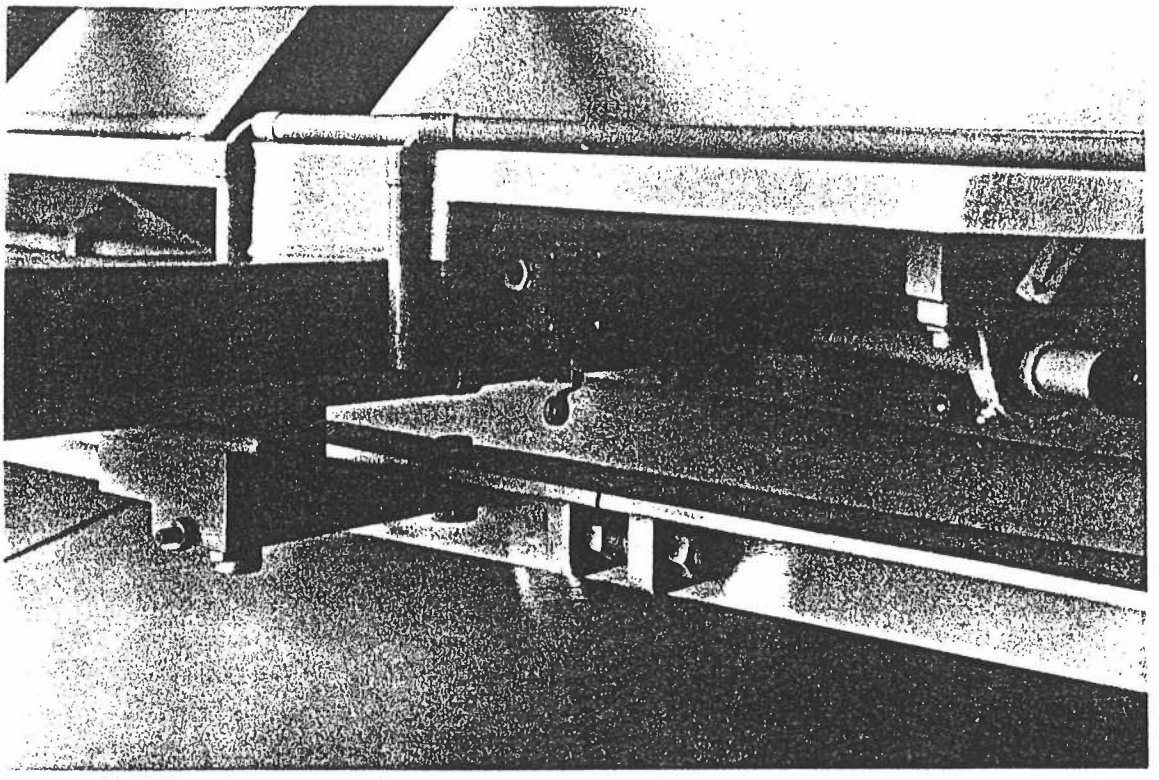


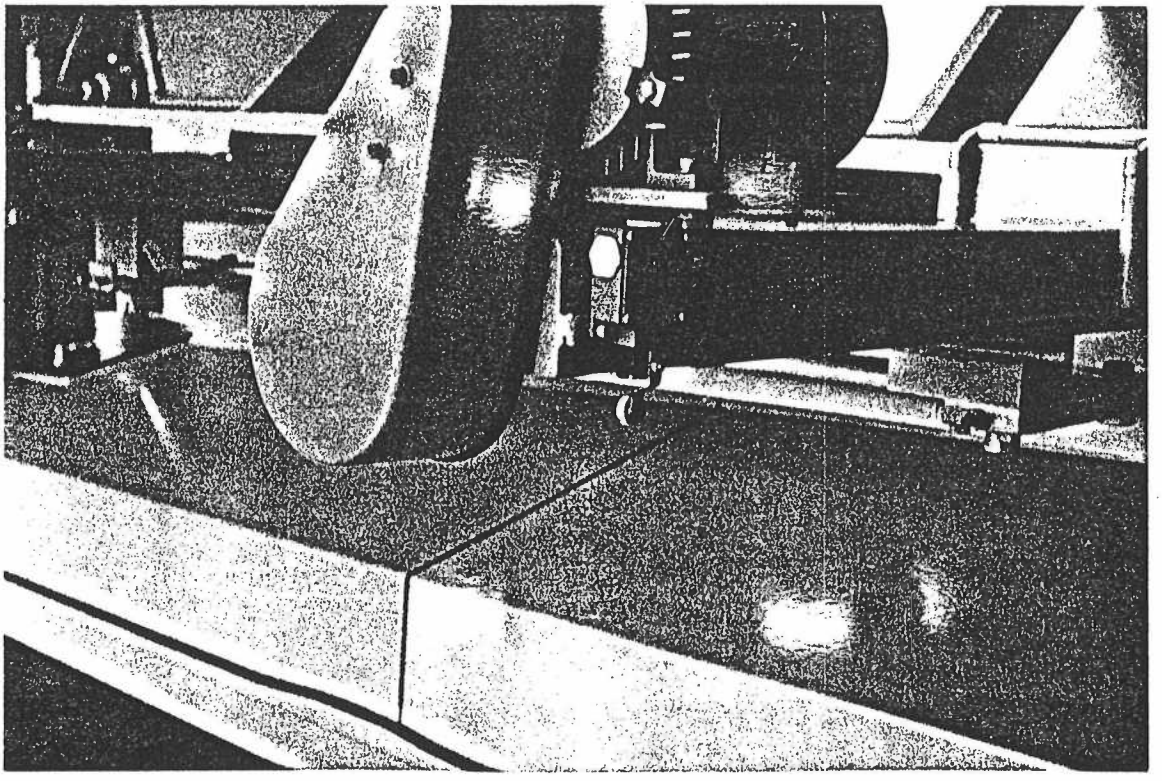
Too much tension on Tension-Jacking bar



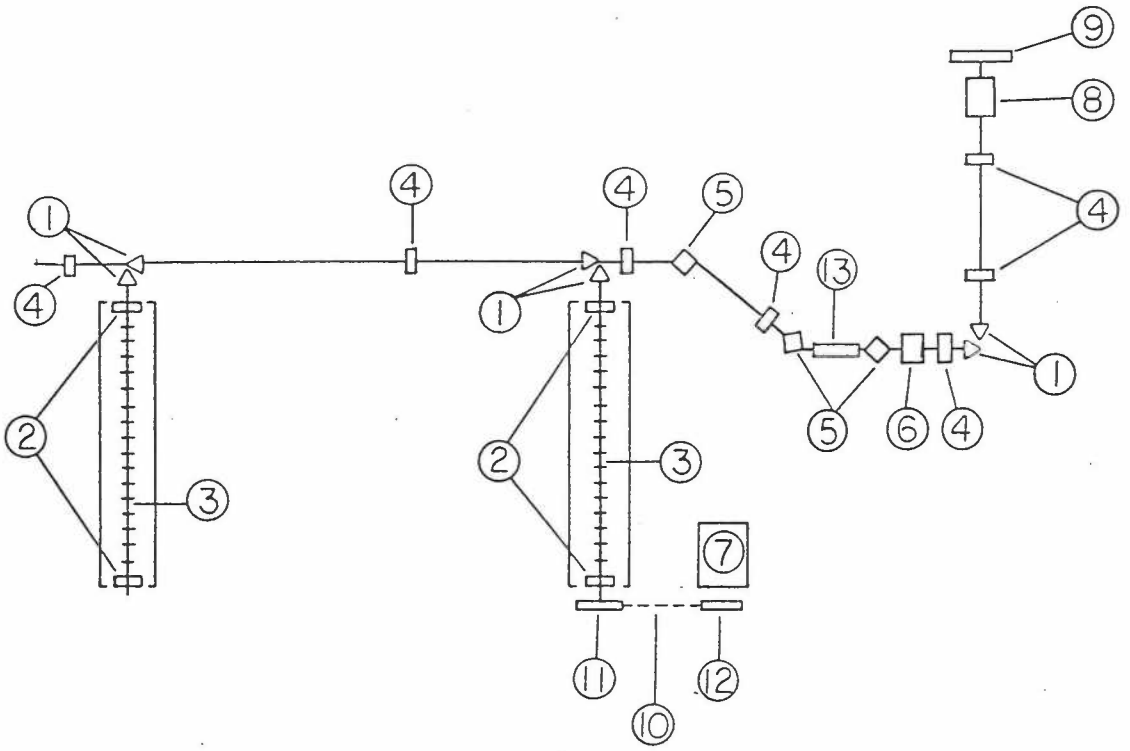
10X1/4 BELT TENSION

BACKGAUGE LIMIT SWITCHES





Adjust Limit Switch levers so that backgauge stops in rapid before running out of travel.



PARTS LIST - 10 x 1/4 Shear

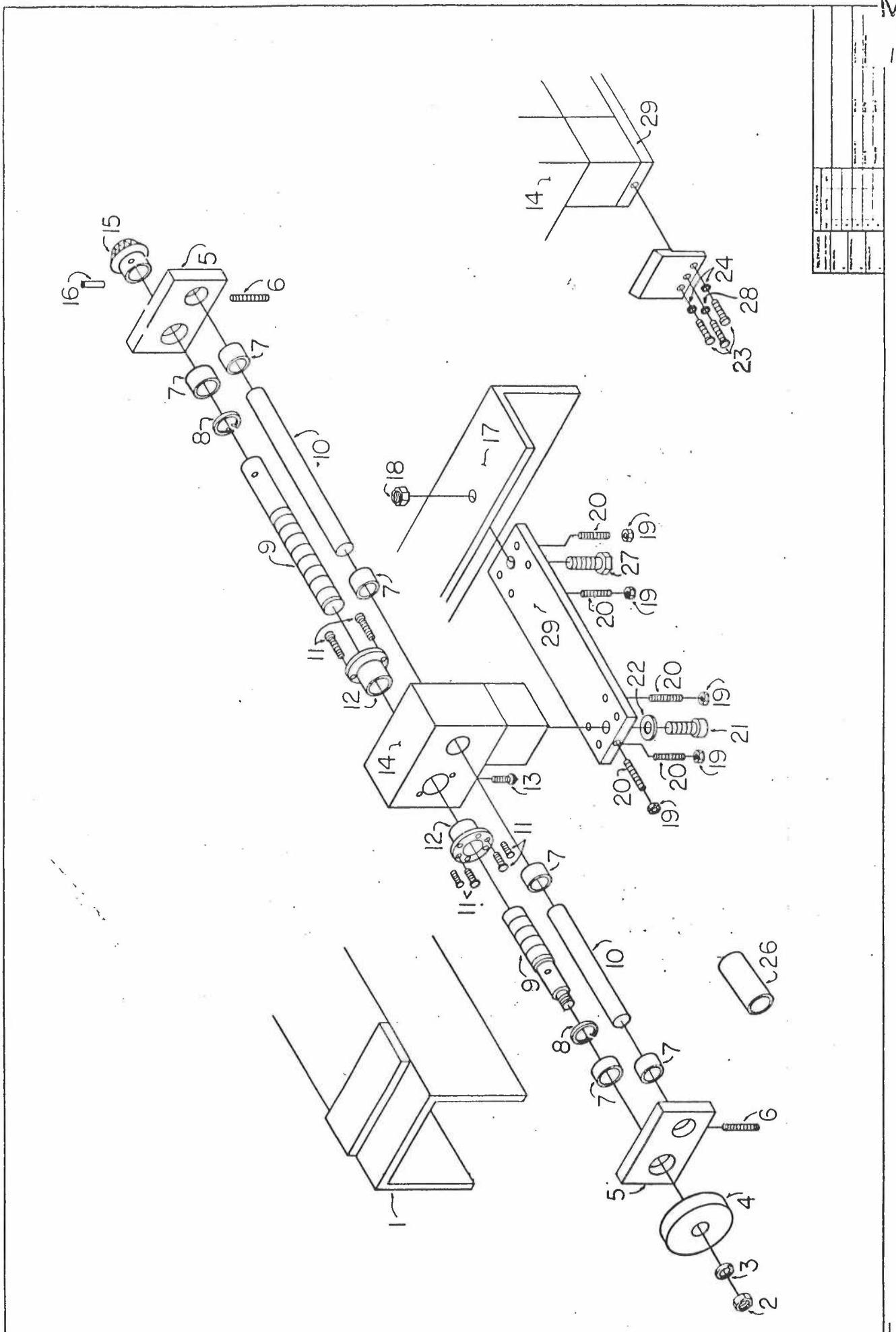
1. Bevel Gear 25 tooth
2. 6205 Roller Bearing
3. Acme Screw 30 mm Dia x 5 mm Pitch
4. SAS25 FAFNIR Pillow Block Bearing
5. U-Joints
6. SCU2S FAFNIR Flange Bearing
7. 1/2 H.P. 900 RPM Motor
8. Siko Counter
9. Handwheel
10. 680-30 Belt
11. 5-1/2" Dia. Pulley
12. 1-1/2" Dia. Pulley
13. Sliding Spline Assy.

TOLERANCES (EXCEPT AS NOTED)	REVISIONS			10X1/4 SHEAR		
DECIMAL ±	NO	DATE	BY	SIMPLIFIED BACKGAUGE		
FRACTIONAL ±	1			DRAWN BY	SCALE	MATERIAL
ANGULAR ±	2			CHK'D	DATE	DRAWING NO
	3			TRACED	APP'D	
	4					
	5					

NO. 10SE-11217

M3
1/86
10x1/

M31
1/86
10 × 1/4



M32
1/86
10 x 1/4

BACKGAUGE PARTS LIST

1. Housing
2. Nut
3. Washer
4. Pulley 5-1/2" Dia.
5. Screw & Guide Bar Carrier
6. Allen Set Screw M10 x 25 mm
7. Oilite Bushing AAM30-40 x 50
8. Internal Snap Ring 52 mm
9. Acme Screw 30 mm Dia. x 5 mm Pitch
10. Guide Bar
11. Allen Cap Screw M6 x 25 mm
12. Acme Nut
13. 1/8 NPT Grease Fitting
14. Carrier Block
15. Bevel Gear 25 Tooth
16. Roll Pin
17. Gauge Bar
18. Nut M16
19. Nut M10
20. Allen Set Screw M10 x 25 mm
21. Allen Cap Screw M20 x 40 mm
22. Washer
23. Allen Cap Screw M8 x 25 mm
24. Lock Nut M8
25. Gauge Bar Adjusting Plate
26. Spacer
27. Screw M16 x 40 mm
28. Washer
29. Gauge Bar Bracket

MAINTENANCE (con't)

Holddown Seal Replacement

Minor seepage is not unusual in normal operation of holddowns. If major seepage occurs there are two possible problems.

1. The O-Ring seal between holddown body and machine frame may be leaking.

2. The seal between the holddown body and the piston may be leaking.

Holddown Removal

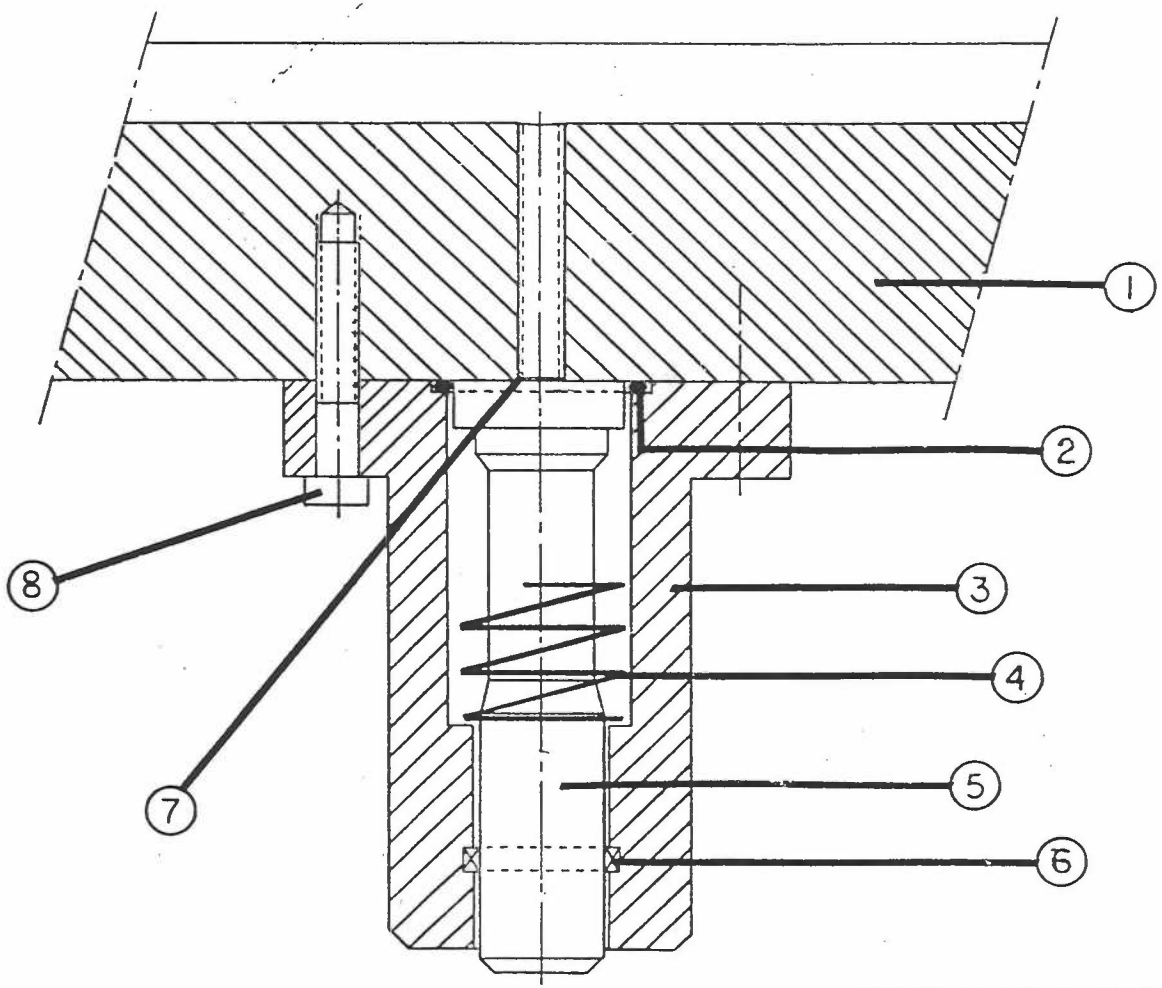
1. Turn off all power and remove key.

2. Place wedge piece under holddown assembly to be removed to support assembly while loosening and removing two allen bolts that hold assembly to shear frame.

3. CAREFULLY remove wedge; holddown assembly is spring tensioned. See drawing on previous page.

4. If leak is determined to be at O-Ring, replace O-Ring with and re-assemble to shear frame.
   CAREFUL: Do Not Pinch O-Ring in this operation.

5. If leak is determined to be at the piston seal, remove the piston and old seal from holddown body. (See drawing on previous page). Replace with new seal. IMPORTANT: This seal is directional, and must be installed with the pressure side upward (as holddown would be mounted to machine).



HOLDDOWN PARTS LIST

1. Holddown Mounting Manifold
2. O-Ring
3. Holddown Body
4. Spring
5. Holddown Piston
6. Piston Seal
7. Oil Port
8. Allen Cap Screw

SEALS

Large S8-42 Merkel
Small S8-25 Merkel

O-RINGS

Large 2-333-N552-90 Parker
Small 2-220-N552-90 Parker

TOLERANCES (EXCEPT AS NOTED)	REVISIONS NO.	DATE	BY	HOLD DOWN ASSEMBLY		
DECIMAL ±	1					
	2					
FRACTIONAL ±	3			DRAWN BY	SCALE	MATERIAL
ANGULAR ±	4			CHK'D	DATE	DRAWING NO
	5			TRACED	APP'D	

M3
1/86

Cylinder Removal

Following reasons:

1. Rod Seal leaking.

2. Leak between cylinder tube and rod end cup seal

3. Internal leak of Piston seals due to wear.
   #3 is characterized by the machine constantly loosing rake. Be positive that there is not a problem elsewhere in the hydraulic system before making this determination. We suggest calling Atlantic to discuss this before removing cylinders.

The following procedure should be followed to remove a cylinder:

1. Start Main Motor and raise ram to top start position.

2. Increase rake angle to full rake.

3. Either support ram with suitable chains secured to stationary frame or block ram with wood blocks to floor.

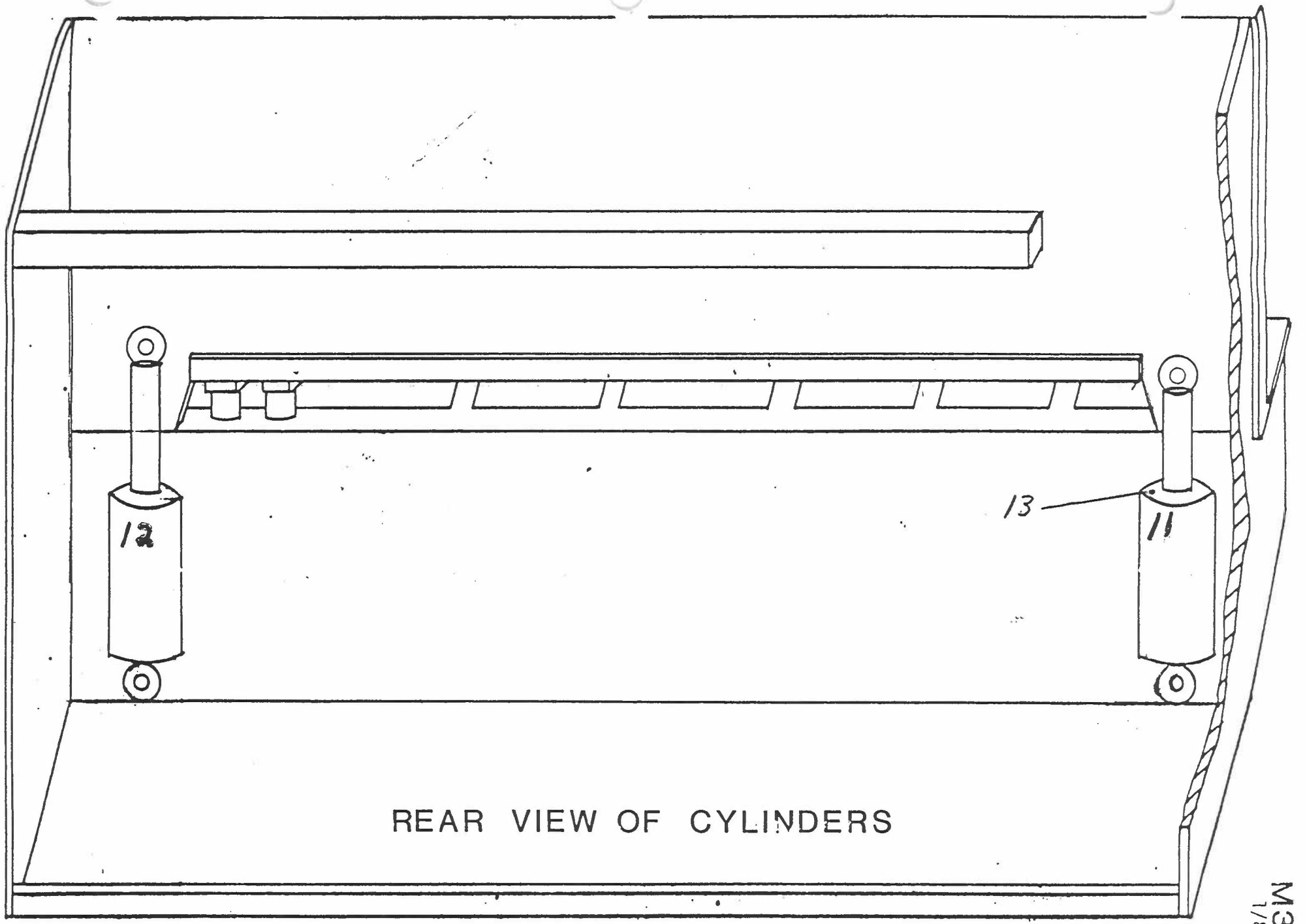
4. Lock out electric power and remove all keys.

5. Depress soleniod plunger on main valve to allow ram to rest on chains/wood blocks.

6. Remove circlips/snap rings retaining I.D. of spherical bearing #2 to both machine frame mount and ram mount.

7. CAREFULLY remove hoses connected to cylinder and collect oil draining from them with suitable container.

8. Slide cylinder assembly rearward and remove from machine.



REAR VIEW OF CYLINDERS

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Cylinder Assembly/Disassembly

NOTE: Clean Assembly thoroughly before beginning. Also, work area bench must be clean and litter free.

1. Unscrew No. 11 Cylinder rod end cap by turning counter clockwise (viewed from rod end).

2. CAREFULLY slide cylinder rod (#9), piston assembly (No.'s 4 & 7), and end cap out of cylinder bore. Do not drag seals across threads in bottom.

3. Remove set screw #8 in threads between #4 piston head and #9 rod.

4. Unscrew piston head in a counter clockwise motion viewed from end of head.

5. Slide #7 piston bottom half off of rod #9. Retract rod #9 through rod end cap #11.

6. Inspect seals and O-rings through-out assembly. Inspect cylinder bore for wear.

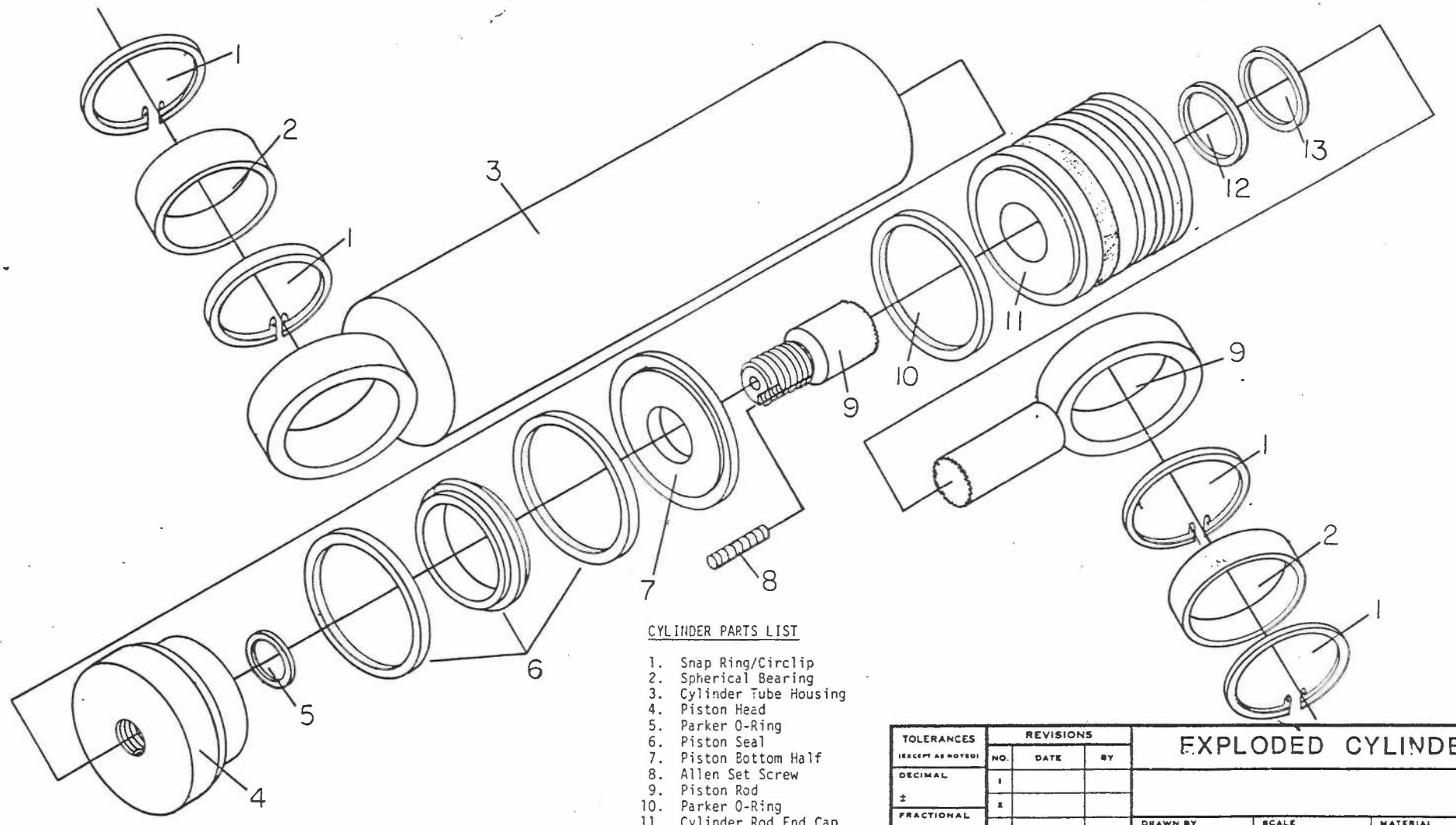
7. Replacement of all seals and O-rings is recommended.

8. Rod packing #12 is a unidirectional seal and must be installed with pressure side facing the interior of the cylinder.

9. Replace other seals in reverse of disassembly instructions.

   WARNING: Care must be taken in replacement of #5 O-ring; it must be replaced on rod #9 prior to assembly of #4 piston head.

10. Re-assembly by reversing above instructions.



CYLINDER PARTS LIST

1. Snap Ring/Circlip
2. Spherical Bearing
3. Cylinder Tube Housing
4. Piston Head
5. Parker O-Ring
6. Piston Seal
7. Piston Bottom Half
8. Allen Set Screw
9. Piston Rod
10. Parker O-Ring
11. Cylinder Rod End Cap
12. Rod Seal
13. Rod Wiper

TOLERANCES (EXCEPT AS NOTED)	REVISIONS			EXPLODED CYLINDER		
DECIMAL ±	NO.	DATE	BY			
	1					
FRACTIONAL ±	2					
	3			DRAWN BY	SCALE	MATERIAL
ANGULAR ±	4			CHK'D	DATE	DRAWING NO
	5			TRACED	APP'D	

NO. 1056-11217

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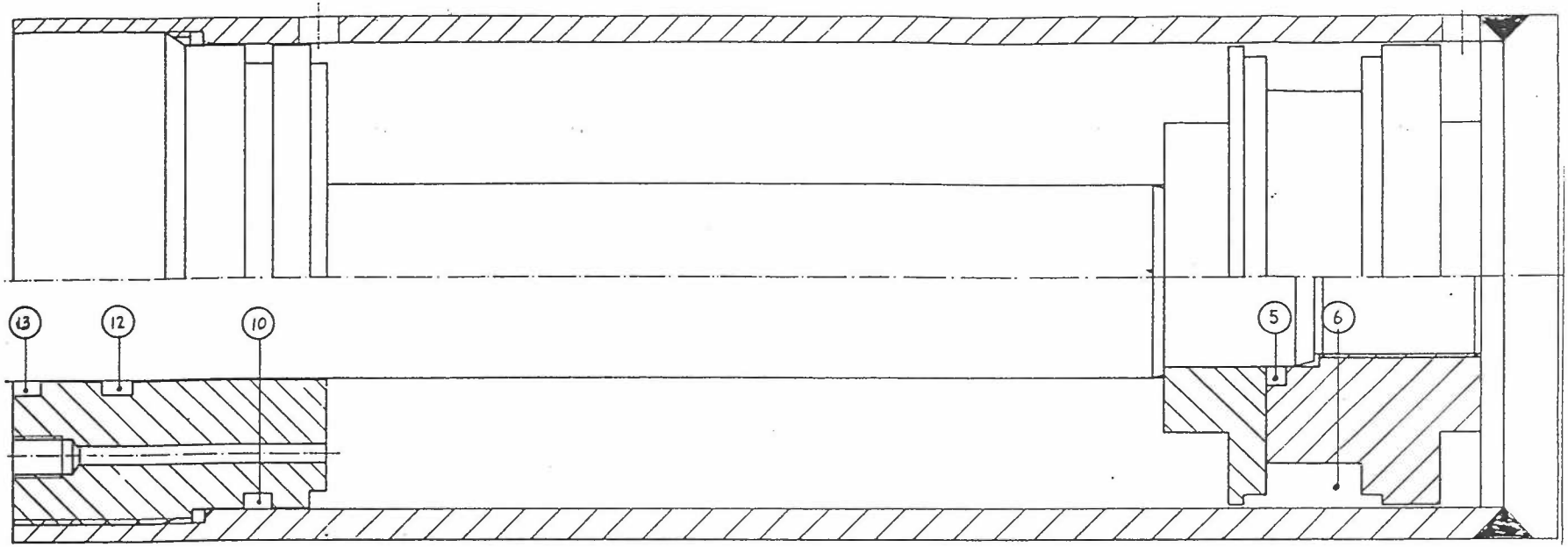


CYLINDER CUTAWAY SHOWING SEALS

SEAL AND O-RING PART NUMBERS

	1/4" SHEAR		1/2" SHEAR	
	#12 Cylinder	#11 Cylinder	#12 Cylinder	#11 Cylinder
13.	P6-40 Merkel	P6-50 Merkel	P6-60 Merkel	P6-60 Merkel
12.	S8-40 Merkel	S8-50 Merkel	S8-60 Merkel	S8-60 Merkel
10.	2-345-N552-90 Parker	2-348-N552-90 Parker	2-439-N552-90 Parker	2-441-N552-90 Parker
5.	5-604-N552-90 Parker	2-328-N552-90 Parker	2-329-N552-90 Parker	2-329-N552-90 Parker
6.	DB433334/1 Dowty	DB472374 Dowty	DB708590 Dowty	DB748629 Dowty

Re-Installation of Cylinder Assembly

1. Replace cylinder assembly into housing on machine.
2. Slide cylinder forward onto mounts.
3. Replace circlips/snap rings.
4. Re-connect all hoses.
5. Turn key switch to set-up/jog position - IMPORTANT Do Not place in "Run/On" position and start motor.
6. Actuate Limit Switch #E2, end of stroke and ensure relay D2 energizes.
7. Depress footpedal momentarily to lift ram off of chains/wood blocks.
8. Shut off machine and remove key.
9. Lower ram to lowest point by depressing plunger on soleniod F of main valve.
10. Carefully loosen hydraulic line on top of #11 cylinder and allow #12 cylinder to fall to complete bottom position.
11. Re-tighten hydraulic line and carefully remove #13 plug in top of #11 cylinder.
12. Place key selector in "Set-up/Jog" position and re-start motor.
13. Actuate and hold actuated limit switch E1.
14. Momentarily have someone depress "+" rake pushbutton until all the aireated oil stream flows from #13 port.
15. Replace #13 plug.
16. De-activate limit switch #E1 and ram will return to top position upon depressing footpedal.
17. Stroke 5 times at maximum rake.
18. Change rake from full "-" to full "+" 5 times.
19. Repeat #17.
20. Shut down machine and remove key.

Ram Bearing and Way Replacement

The machine ram is guided by spherical roller bearings. There are four bearings located in the back side of the ram; there are two spring loaded bearings on the front side of the ram. These guide ram movement during operation. See cutaway drawing on following pages for actual positions.

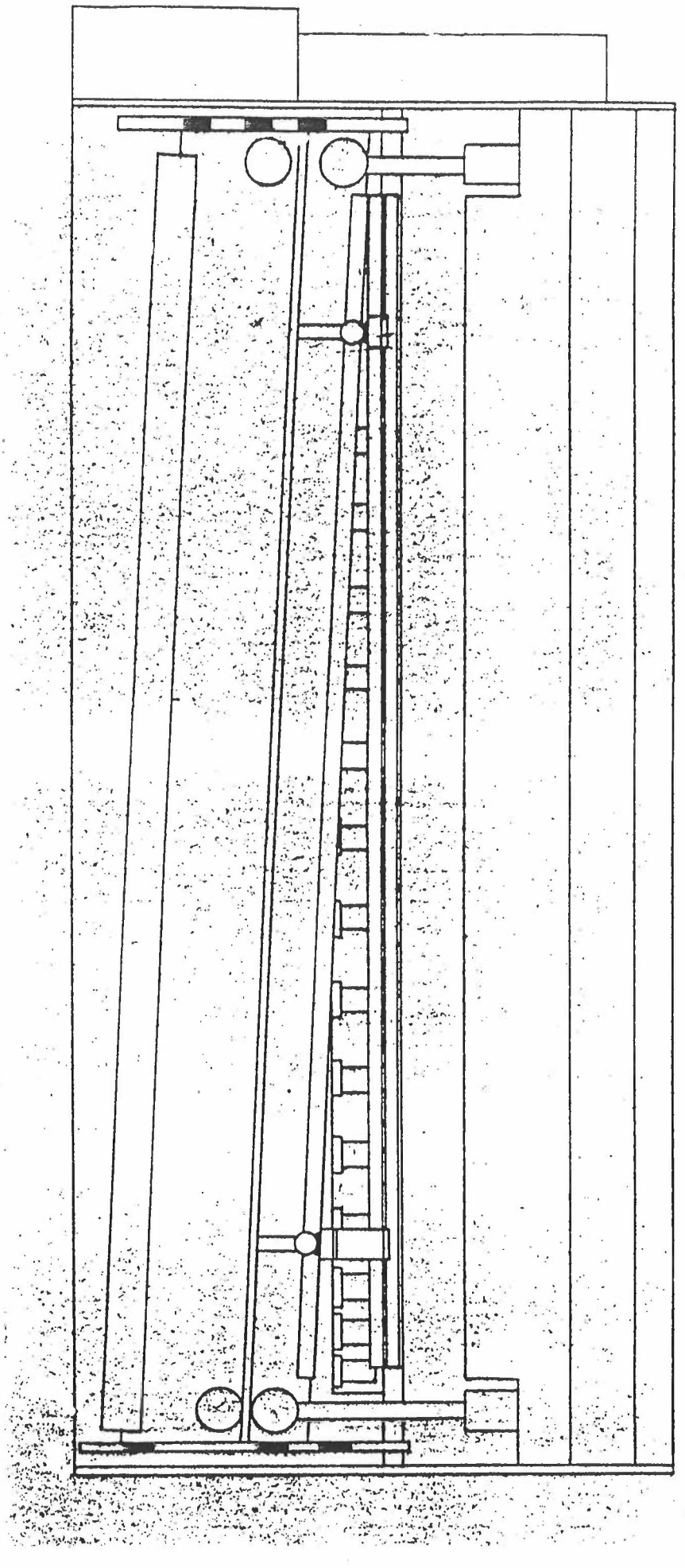
Lower Rear Blade Gap Bearings (#1)

These bearings are mounted on an eccentric axle, rotated by levers with detent positions, used to move the upper ram blade in relation to the low fixed blade to set a blade gap amount. In the event of bearing failure, proceed as follows:

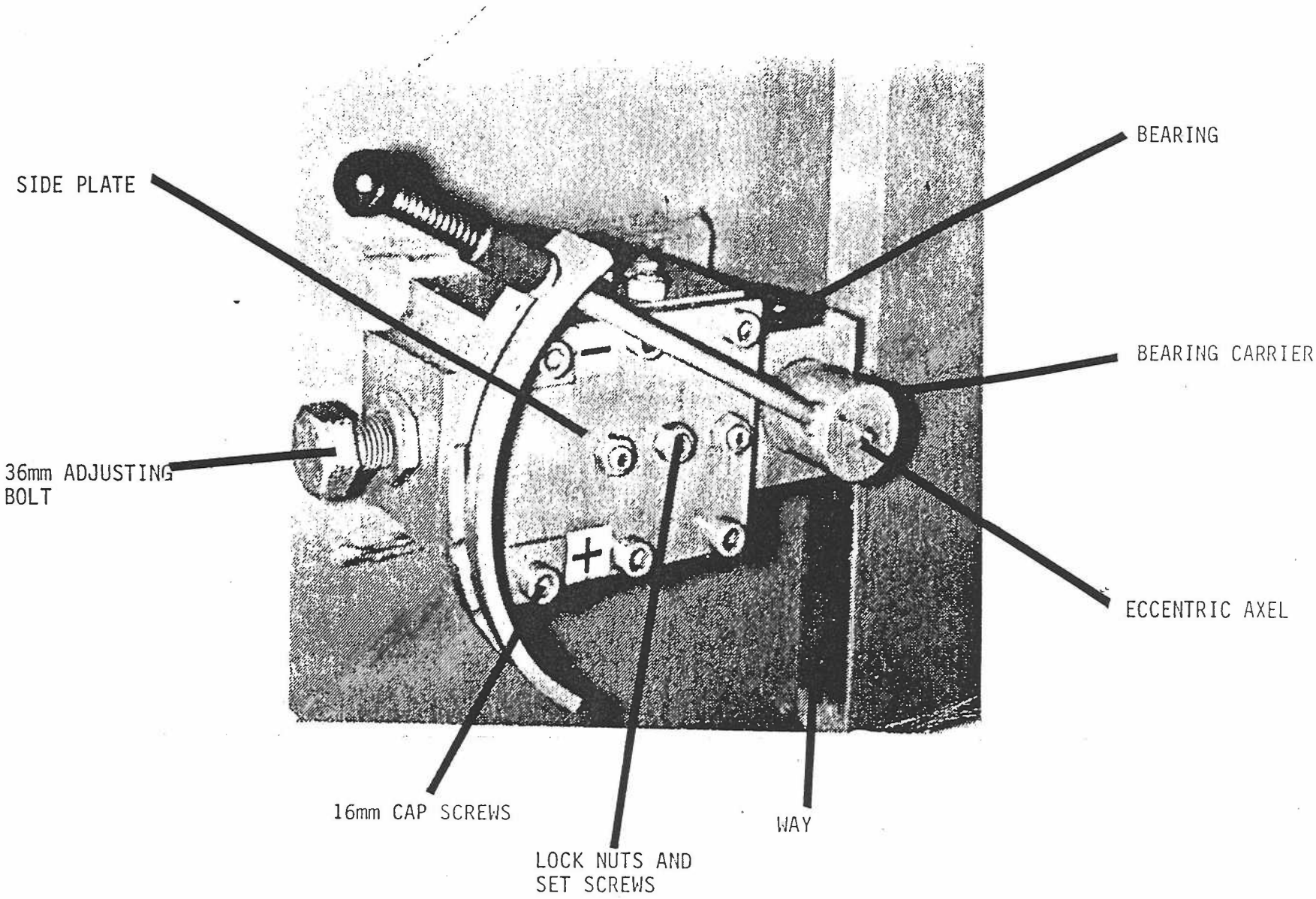
1. Loosen locknuts and set screws on bearing assembly housing.
2. Loosen locknut and turn 36 mm adjusting bolt counter clockwise to remove.
3. Remove 6 - 16 mm Allen cap screws from side plate of bearing carrier housing.
4. Remove bearing carrier from housing.
5. Remove lever handle assembly from bearing axle by removing roll pin and unlocking set screw.
6. Remove axle from bearing carrier housing from 40 mm diameter side. It can only be removed from this direction! Bearing (Nadella FG 40-80 EE or INA #NATV40PP) will then be free for removal and replacement if needed.

Lower Rear Blade Gap Way #1

1. Upon removal of bearing assembly per above instructions, way is accessible for removal and replacement.
2. Pry removable way surface away from mounting base. Way is loosely pinned and easily removable.
3. Way can be reground as required. Replacement can be done by a piece of comparable size oil or air hardened flat steel stock, surface ground for flatness.
4. Reassemble way and bearing system by reversing above procedure. Upon completion, follow blade setting procedure to insure proper gap.



RAM BEARING LOCATIONS



BLADE GAP ADJUSTMENT

M43

10 x 1/2
12 x 1/4

Rear Bearing & Way

1. Install dial indicator with magnetic base to side frame with indicator plunger to ram to closest possible point to the bearing location. Note indicator setting.

2. Loosen locknuts and set screws on bearing assembly housing.

3. Loosen locknut and turn 36 mm adjusting bolt counter clockwise to remove.

4. Remove 6 - 16 mm Allen cap screws from side plate of bearing carrier housing.

5. Remove bearing carrier from housing.

6. Remove set screw holder 40 mm axle in place, and remove axle bearing #FG 40-80 EE Nadella or INA #NATV40PP.

7. Pry removable way surface away from mounting base. Way TS loosely pinned and easily removable.

8. Replace way, if necessary, with a piece of comparable size air or oil hardened flat sheet stock, surface ground for flatness.

9. Replace by reversing above procedure until step involving replacement of 36 mm adjusting bolt.

10. Adjust 36 mm bolt until indicator setting is exactly as at No. 1 above.

Front Spring Pot Bearing (#4)

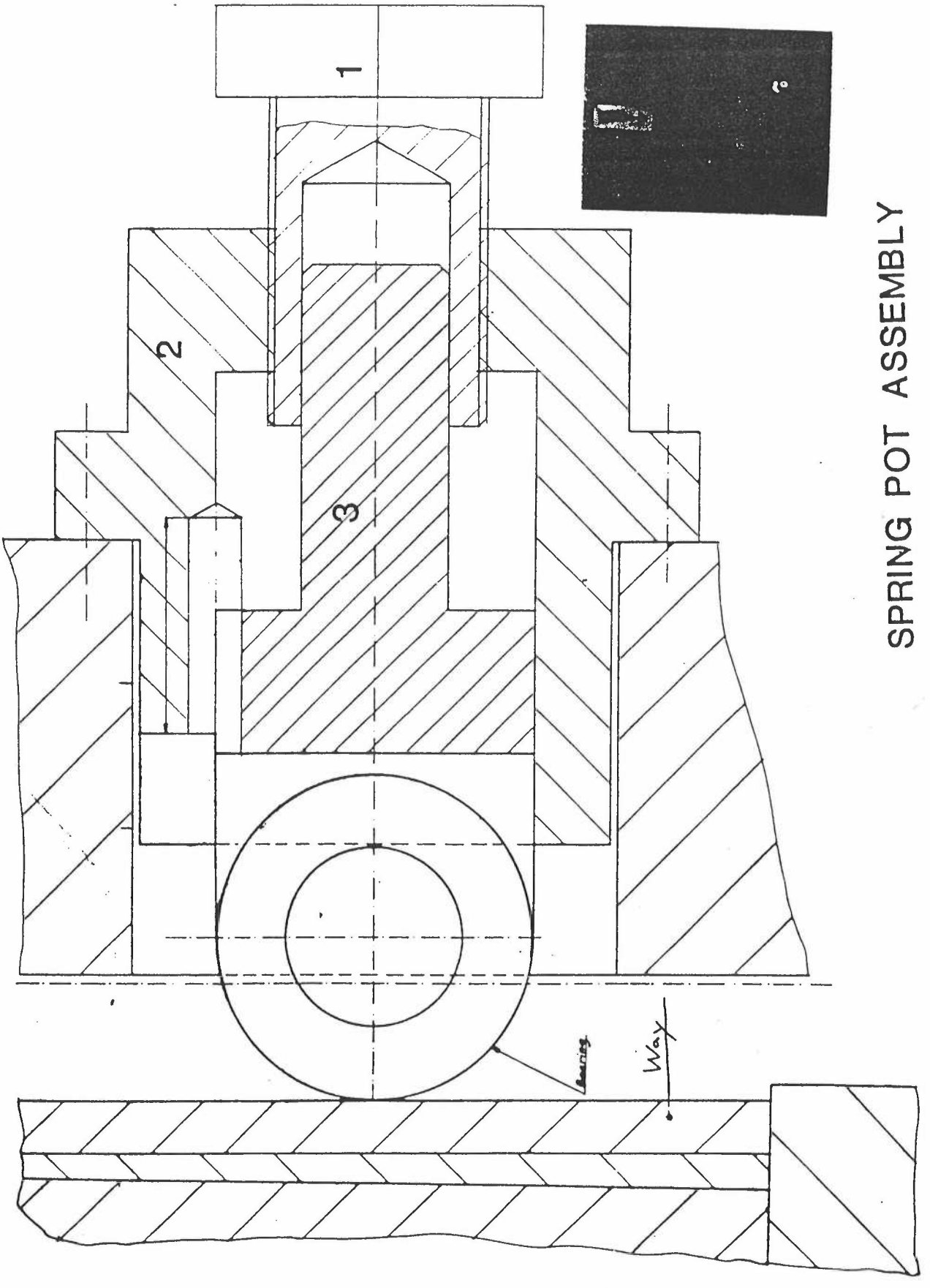
1. Turn nut #1 counter clockwise until it rotates freely by hand. YOU MUST record the number of turns so that upon reassembly the identical spring tension may be achieved.

2. Remove 5 - 12 mm bolts attaching carrier housing to ram (#2) and remove carrier housing.

3. Slide bearing carrier (#3) out of carrier housing.

   CAREFUL: Bearing carrier is preloaded with Bellville Spring; DO NOT Change arrangement of springs.

4. The 30 mm axle and bearing can now be removed from carrier (Bearing No. FG 3062 EE Nadella or INA #NATV30PP).



SPRING POT ASSEMBLY

Front Spring Pot Bearing (#4) (con't)

5. Pry removable way surface away from mounting base. Way TS loosely pinned and easily removable.

6. Replace way, if necessary, with a piece of comparable size air or oil hardened flat sheet stock, surface ground for flatness.

7. Replace by reversing above procedure, making sure to tighten nut #1 the same number of turns as was taken out in Step #1.

End Thrust Ram Bearing (#5)

These bearings will seldom need replacement as they normally carry only a minimal load. However, in mis-operation circumstances, they can be damaged.

1. Unscrew shoulder bolt axle from frame.

2. Replace with Nadella FG 20-47-EE or INA #NATV20PP.

3. Replace way, if necessary, with a piece of comparable size air or oil hardened flat sheet stock, surface ground for flatness.

4. Replace by reversing above procedure.

HYDRAULIC PARTS LIST

MODEL: HDE 10 x ¼

1.	Shear Valve	AARON REXROTH	AD 10.206 54WE10G11/LG24NZC/5
2.	Holddown Valve	AARON REXROTH	AD 06.203 4WE6D33/J24-50NZ5
3.	Rake Angle Valve	AARON REXROTH	AD 06.203 4WE6D33/J24-50NZ5
4.	Pressure Switch	REXROTH	HED40A14/350Z14S
5.	Shear Pressure Relief	AARON	CPP100
6.	Holddown Pressure Relief	AARON	VMP 10
7.	Main Motor	15HP	220/440V-60HZ
8.	Large pump	DOWTY	IP3060
9.	Small pump	DOWTY	IP3020
10.	Oil Filter	UCC	UC-SE-1323
11.	Small Piston/Cylinder Assy. HDL 25	ATLANTIC	0-120
12.	Large Piston/Cylinder Assy. HDL 25	ATLANTIC	0-110
13.	Air Bleeder Screw	1/8 PIPE PLUG	
14.	Holdowns piston/Cylinder Assy.	ATLANTIC	0-306
15.	Check Valve	REXROTH	Z1S6D1-30
16.	Pilot Operated Duel Check	AARON REXROTH	AM 06.UP.AB.10 Z2S6-50
17.	Safety Valve	AARON REXROTH	AD 06.104 Z2S6-50
18.	Oil Filter	UCC	UC-SE-1219
19.	Motor Coupler		
20.	Manifold	ATLANTIC	HDELM25-50

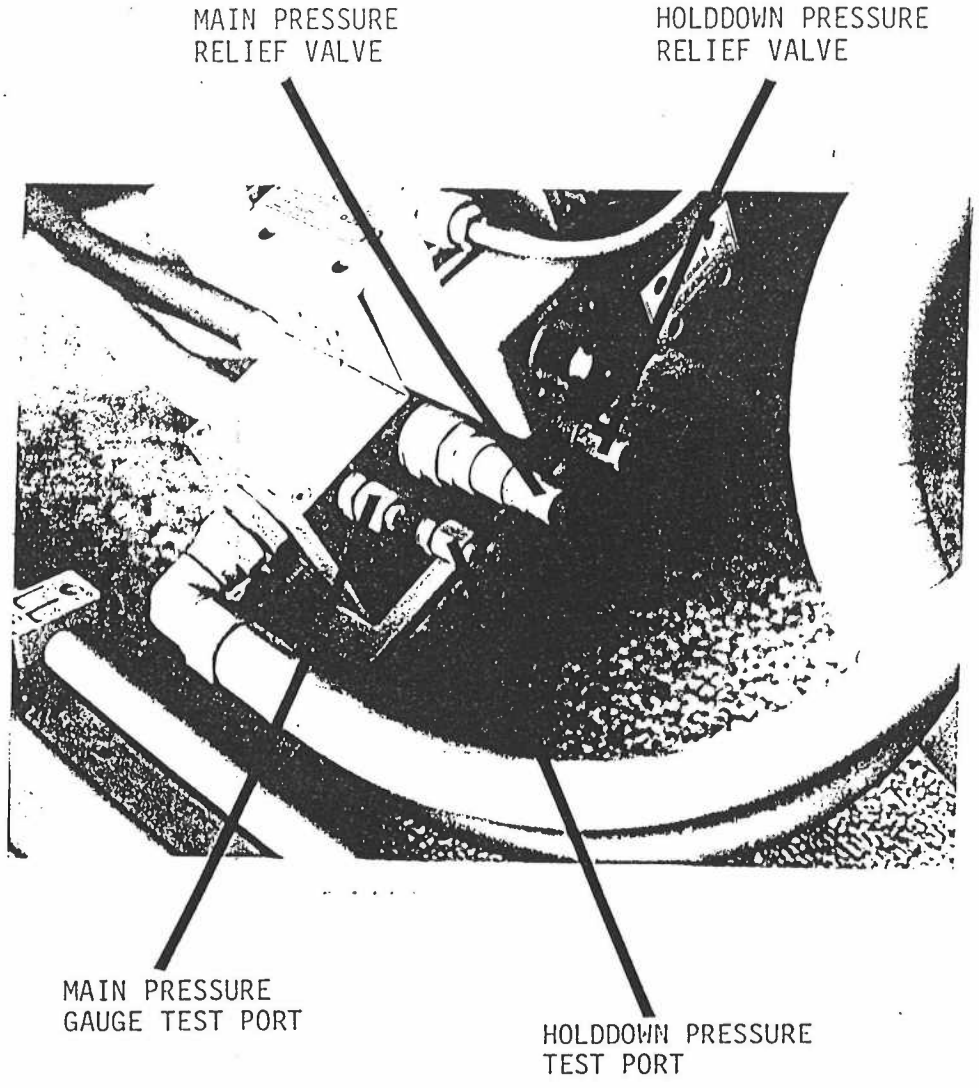
MAINTENANCE (con't)

17. Tighten locknut and reinstall cap.

18. Reconnect wiring on End of Stroke Limit Switch.

19. Turn off Main Motor and remove pressure gauges.

20. Restart machine and fully stroke to insure end of stroke limit switch operates and check for oil leaks.



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H3
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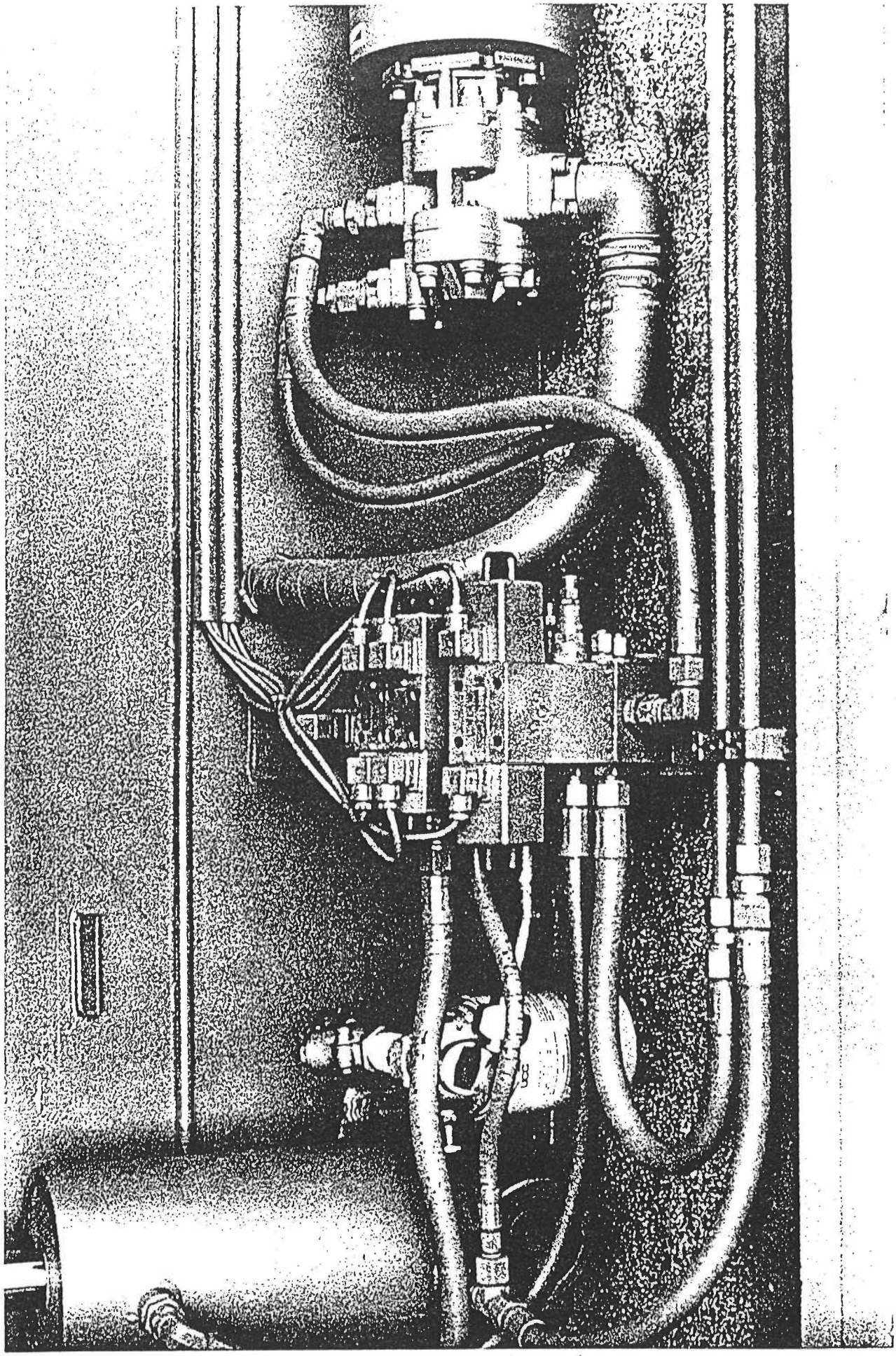
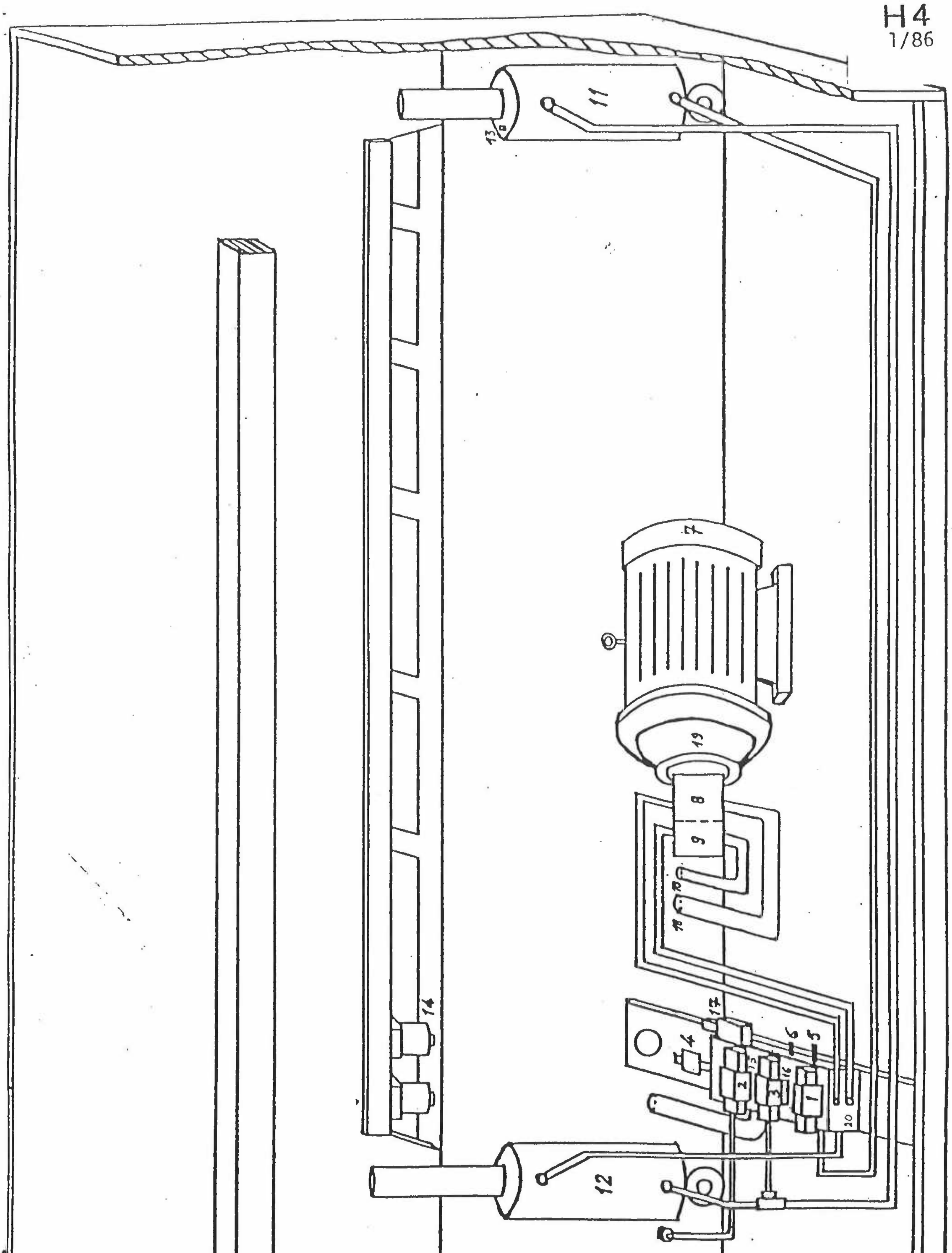
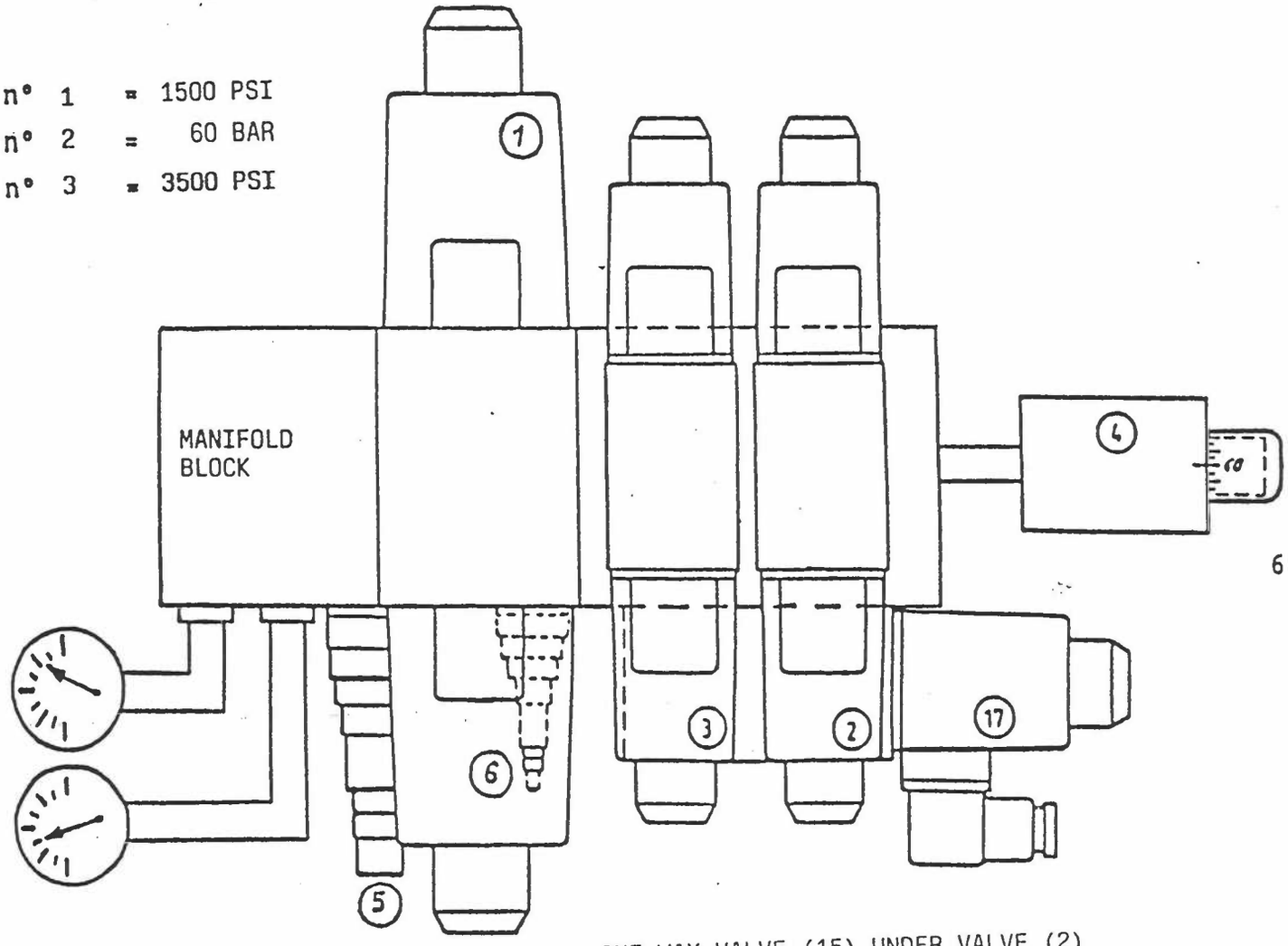


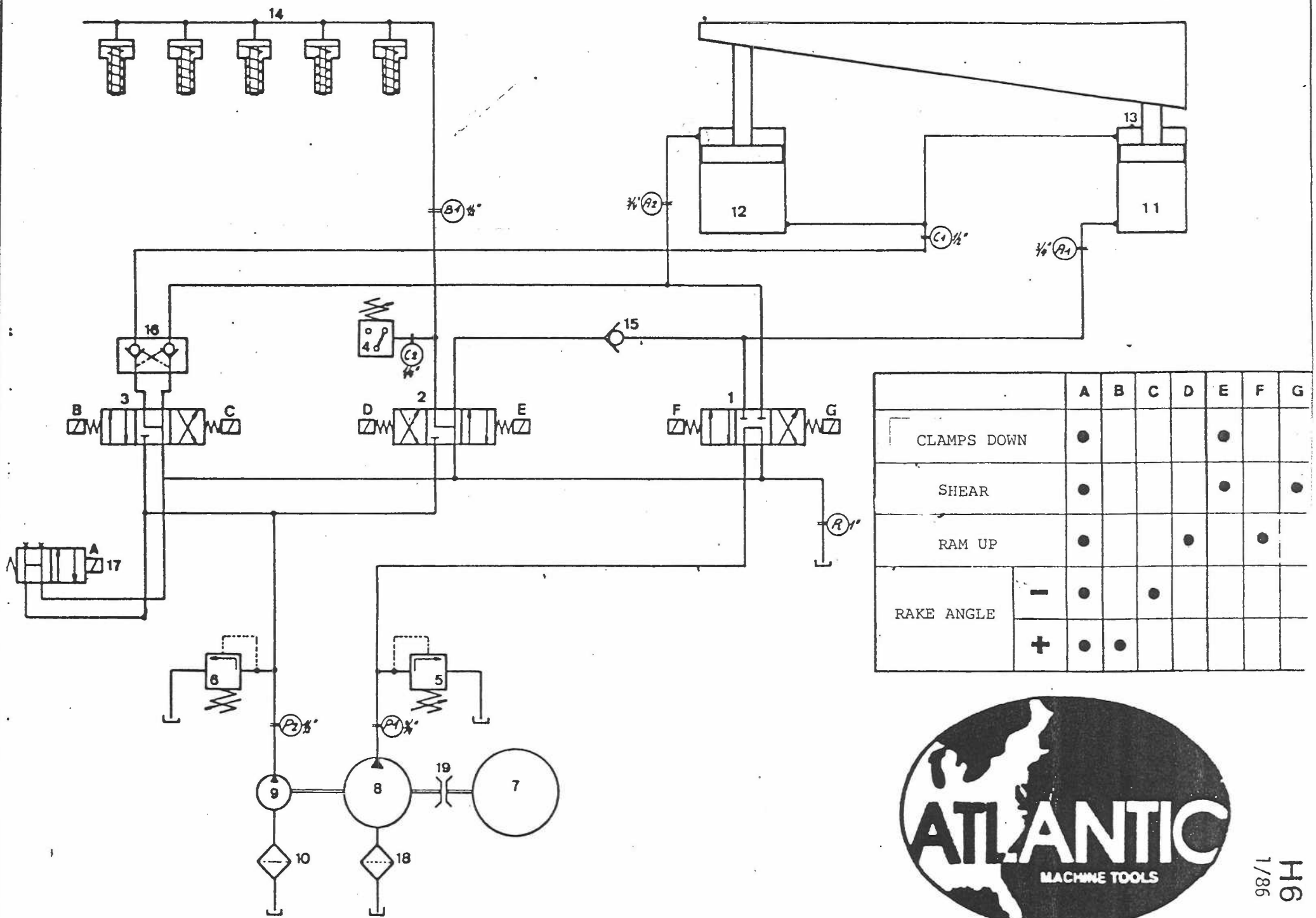
H4
1/86



Checkpoint : n° 1 = 1500 PSI
Checkpoint : n° 2 = 60 BAR
Checkpoint : n° 3 = 3500 PSI

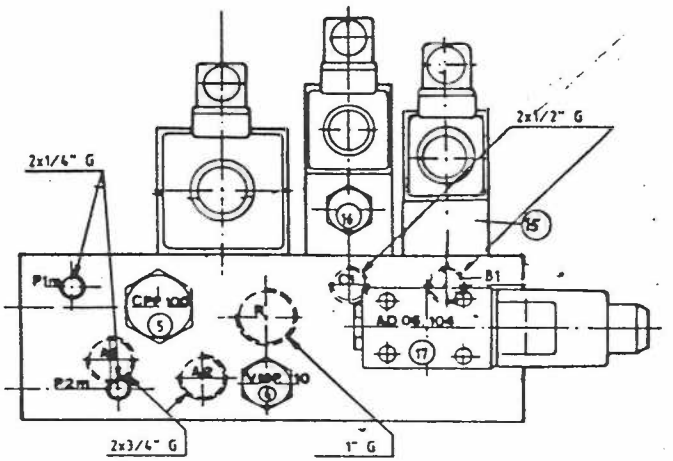


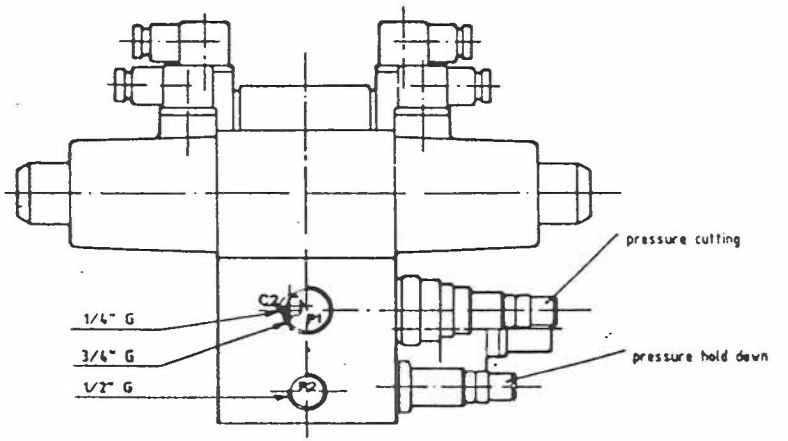
ONE WAY VALVE (15) UNDER VALVE (2)
PILOT OPERATED DUAL CHECK VALVE (16) UNDER VALVE (3)

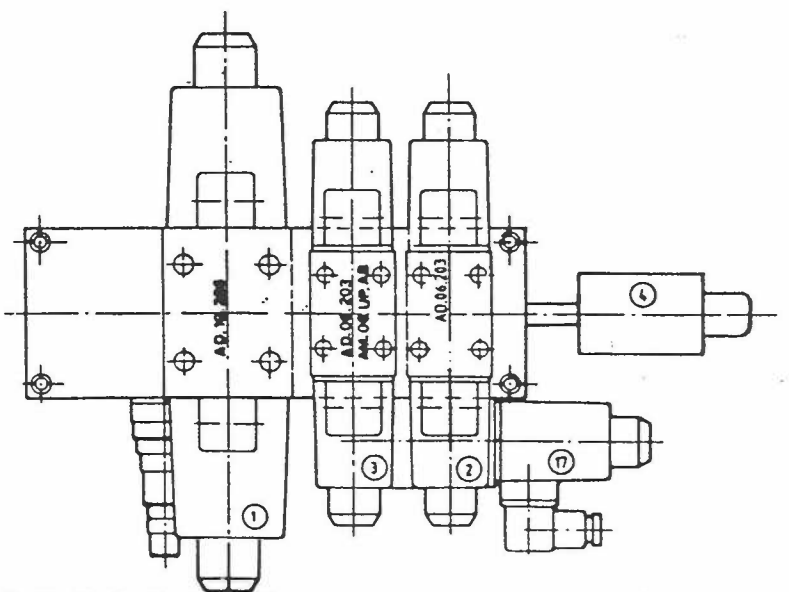


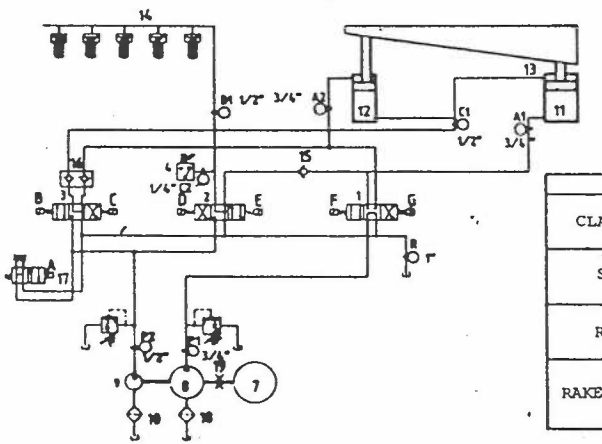
		A	B	C	D	E	F	G
CLAMPS DOWN		●				●		
SHEAR		●				●		●
RAM UP		●			●		●	
RAKE ANGLE	−	●		●				
	+	●	●					

ATLANTIC MACHINE TOOLS









		A	B	C	D	E	F	G
CLAMPS DOWN		•				•		
SHEAR		•				•		•
RAM UP		•			•		•	
RAKE ANGLE	−	•		•				
	+	•	•					

MICROFILM PRINT SCALE

ATLANTIC MACHINE TOOLS

H7
1/86

Rucker Products

GRAPHIC SYMBOLS FOR FLUID POWER DIAGRAMS

3.5 Flow, Direction of

3.5.1 Pneumatic

3.5.2 Hydraulic

3.6 Line, Pneumatic Outlet to Atmosphere

3.6.1 Plain orifice, unconnectable

3.6.2 Connectable orifice (e.g. Thread) by Internal Return

3.7 Line with Fixed Restriction

3.8 Line, Flexible

3.9 Station, Testing, measurement, or power take-off

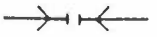
3.91 Plugged port

3.10 Quick Disconnect

3.10.1 Without Checks

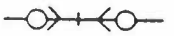
Connected

Disconnected



3.10.2 With Two Checks

Connected



Disconnected

3.10.3 With One Check

Connected

Disconnected

3.11 Rotating Coupling

4. ENERGY STORAGE AND FLUID STORAGE

4.1 Reservoir

Vented

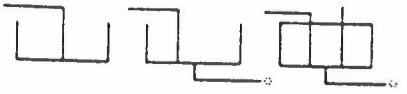
Pressurized

Note: Reservoirs are conventionally drawn in the horizontal plane. All lines enter and leave from above. Examples:

4.1.1 Reservoir with Connecting Lines

Above Fluid Level

Below Fluid Level



* Show line entering or leaving below reservoir only when such bottom connection is essential to circuit function.

4.1.2 Simplified symbol. The symbols are used as part of a complete circuit. They are analogous to the ground symbols of electrical diagrams IEC Several such symbols  may be used in one diagram to represent the same reservoir

4.1.2.1 Below Fluid Level

4.1.2.2 Above Fluid Level
(The return line is drawn to terminate at the upright legs of the tank symbol.)

4.1.2.3 Vented Manifold

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Rucker Products

GRAPHIC SYMBOLS FOR FLUID POWER DIAGRAMS

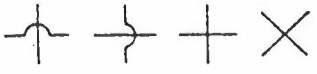
2.4.1 ——————— Solid Line
(Main line conductor, outline, and shaft)

2.4.2 — — — — — Dash Line
(Pilot line for control)

2.4.3 - - - - - - - - - - - Dotted Line
(Drain line)

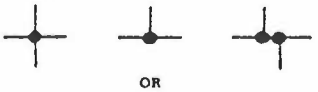
2.4.4 ——— - ——— - ——— Center Line
(Enclosure outline)

2.4.5 Lines crossing (The intersection is not necessarily at a 90° angle.)



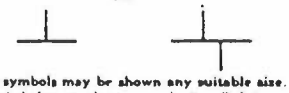
IEC

2.4.6 Lines joining



IEC

OR



IEC

2.5 Basic symbols may be shown any suitable size. Size may be varied for emphasis or clarity. Relative sizes should be maintained. (As in the following example.)

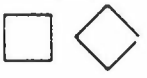
2.5.1 Circle and Semi-Circle

2.5.1.1 Large and small circles may be used to signify that one component is the "main" and the other the auxiliary.

2.5.2 Triangle 

2.5.3 Arrow

2.5.4 Square



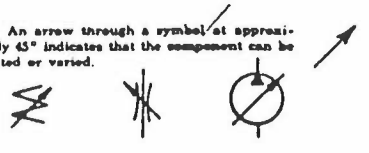
Rectangle

2.6 Letter combinations used as parts of graphic symbols are not necessarily abbreviations.

2.7 In multiple envelope symbols, the flow condition shown nearest an actuator symbol takes place when that control is caused or permitted to actuate.

2.8 Each symbol is drawn to show normal, at-rest, or neutral condition of component unless multiple diagrams are furnished showing various phases of circuit operation.

2.9 An arrow through a symbol at approximately 45° indicates that the component can be adjusted or varied.



2.10 An arrow parallel to the short side of a symbol, within the symbol, indicates that the component is pressure compensated

2.11 A line terminating in a dot to represent a thermometer is the symbol for temperature cause or effect
See Temperature Controls 7.9, Temperature Indicators and Recorders 9.1.2, and Temperature Compensation 10.16.3 and 4

2.12 External ports are located where flow lines connect to basic symbol except where component enclosure symbol is used
External ports are located at intersections of flow lines and component enclosure symbol when enclosure is used, see SECTION 11

2.13 Rotating shafts are symbolized by an arrow which indicates direction of rotation (assume arrow on near side of shaft).

3. CONDUCTOR, FLUID

3.1 ——————— Line, Working (main)

3.2 — — — — — Line, Pilot (for control)

3.3 - - - - - - - - - Line, Liquid Drain

3.4 Line, sensing, etc. such as gauge lines shall be drawn the same as the line to which it connects.

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GRAPHIC SYMBOLS FOR FLUID POWER DIAGRAMS

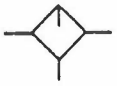
3.4.2 With Automatic Drain

3.5 Desiccator (Chemical Dryer)

3.6 Lubricator

3.6.1 Less Drain

3.6.2 With Manual Drain



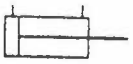
6. LINEAR DEVICES

6.1 Cylinders, Hydraulic & Pneumatic

6.1.1 Single Acting

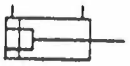
6.1.2 Double Acting

6.1.2.1 Single End Rod



6.1.2.2 Double End Rod

6.1.2.3 Fixed Cushion, Advance & Retract



6.1.2.4 Adjustable Cushion, Advance Only

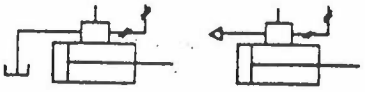
6.1.2.5 Use these symbols when diameter of rod compared to diameter of bore is significant to circuit function.

(Non-Cushion) (Cushion, Advance & Retract)

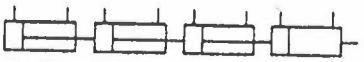
6.2 Pressure Intensifier

6.3 Servo Positioner (Simplified)

Hydraulic Pneumatic



6.4 Discrete Positioner
Combine two or more basic cylinder symbols



7. ACTUATORS & CONTROLS

7.1 Spring

7.2 Manual
(Use as general symbol without indication of specific type: i.e., foot, hand, leg, arm)

7.2.1 Push Button

7.2.2 Lever

7.2.3 Pedal or Treadle

7.3 Mechanical

7.4 Detent
(Show a notch for each detent in the actual component being symbolized. A short line indicates which detent is in use. Detent may be positioned on symbol for drafting convenience.)

GRAPHIC SYMBOLS FOR FLUID POWER DIAGRAMS

4.2 Accumulator

4.2.1 Accumulator, Spring Loaded

4.2.2 Accumulator, Gas Charged

4.2.3 Accumulator, Weighted

4.3 Receiver, for Air or other Gases

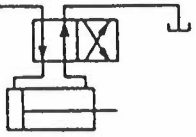
4.4 Energy Source (Pump, Compressor, Accumulator, etc.) This symbol may be used to represent a fluid power source which may be a pump, compressor, or another associated system.

Hydraulic

Pneumatic

Simplified Symbol

Example



5. FLUID CONDITIONERS

Devices which control the physical characteristics of the fluid.

5.1 Heat Exchanger

5.1.1 Heater
Inside triangles indicate the introduction of heat.

Outside triangles show the heating medium is liquid.

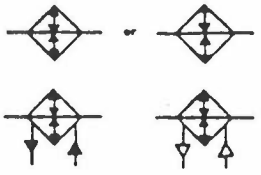
Outside triangles show the heating medium is gaseous.

5.1.2 Cooler

Inside triangles indicate heat dissipation.

(Corners may be filled in to represent triangles.)

5.1.3 Temperature Controller—(The temperature is to be maintained between two predetermined limits.)



5.2 Filter - Strainer

5.3 Separator

5.3.1 With Manual Drain

5.3.2 With Automatic Drain

5.4 Filter - Separator

5.4.1 With Manual Drain

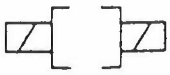
Rucker Products

GRAPHIC SYMBOLS FOR FLUID POWER DIAGRAMS

7.5 Pressure Compensated

7.6 Electrical

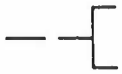
7.6.1 Solenoid (Single Winding)



7.6.2 Reversing Motor

7.7 Pilot Pressure

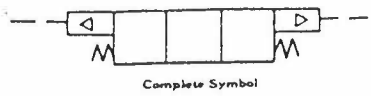
7.7.1 Remote Supply



7.7.2 Internal Supply

7.7.3 Actuation By Balanced Pressure

7.7.4 Pilot Controlled, Spring Centered



7.7.5 Pilot Differential

7.8 Solenoid Pilot

7.8.1 Solenoid or Pilot

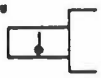
External Pilot Supply

Internal Pilot Supply and Exhaust

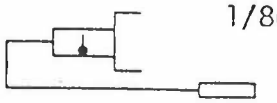
7.8.2 Solenoid and Pilot

7.9 Thermal—A mechanical device responding to thermal change.

7.9.1 Local Sensing



7.9.2 With Bulb for Remote Sensing



7.10 Servo
(This symbol contains representation for energy input, command input, and resultant output.)

Rucker Products

GRAPHIC SYMBOLS FOR FLUID POWER DIAGRAMS

9. INSTRUMENTS & ACCESSORIES

9.1 Indicating and Recording

9.1.1 Pressure

9.1.2 Temperature

9.1.3 Flow Meter

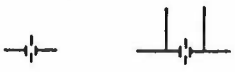
9.1.3.1 Flow Rate

9.1.3.2 Totalizing

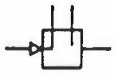
9.2 Sensing

9.2.1 Venturi

9.2.2 Orifice Plate

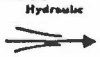


9.2.3 Pitot Tube



9.2.4 Nozzle

Hydraulic



Pneumatic

9.3 Accessories

9.3.1 Pressure Switch

9.3.2 Float Switch

9.3.3 Shuttle

10. VALVES

A basic valve symbol is composed of one or more envelopes with lines inside the envelope to represent flow paths and flow conditions between ports. Three symbol systems are used to represent valve types: single envelope, both finite and infinite position; multiple envelope, finite position; and multiple envelope, infinite position.

10.1 In finite position single envelope valves, the envelope is imagined to move to illustrate how pressure or flow conditions are controlled as the valve is actuated.

10.2 Multiple envelopes symbolize valves providing more than one finite flow path option for the fluid. The multiple envelope moves to represent how flow paths change when the valving element within the component is shifted to its finite positions.

10.3 Multiple envelope valves capable of infinite positioning between certain limits are symbolized as in 10.2 above with the addition of horizontal bars which are drawn parallel to the envelope. The horizontal bars are the means to the infinite positioning function possessed by the valve represented.

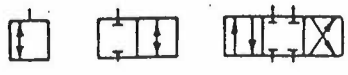
10.4 Envelopes

10.5 Ports

10.6 Ports, Internally Blocked

Symbol System 10.1

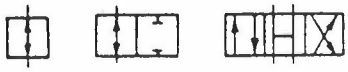
Symbol System 10.2



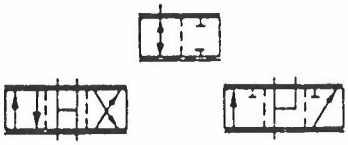
10.7 Flow Paths, Internally Open (Symbol Systems 10.1 & 10.2)

Symbol System 10.1

Symbol System 10.2

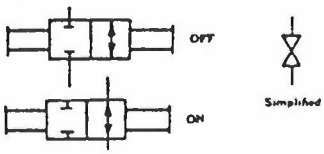


10.8 Flow Paths, Internally Open (Symbol System 10.3)



10.9 Two-Way Valves (2 Ported Valves)

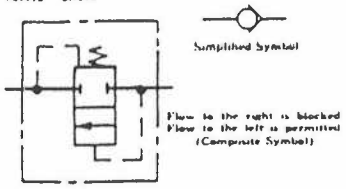
10.9.1 On-Off (Manual Shut-Off)



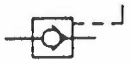
Rucker Products

GRAPHIC SYMBOLS FOR FLUID POWER DIAGRAMS

10.9.2 Check



10.9.3 Check, Pilot-Operated to Open



10.9.4 Check, Pilot-Operated to Close

10.9.5 Two-Way Valves

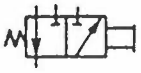
10.9.5.1 Two-Position
Normally Closed Normally Open

10.9.5.2 Normally Open
10.9.5.3 Infinite Position
Normally Closed Normally Open
Complete

10.10 Three-Way Valves

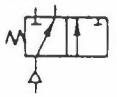
10.10.1 Two-Position

10.10.1.1 Normally Open



10.10.1.2 Normally Closed

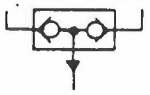
10.10.1.3 Distributor (Pressure is distributed first to one port then the other)



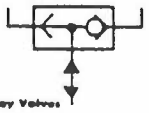
10.10.1.4 Two-Pressure

10.10.2 Double Check Valve. Double check valves can be built with and without 'cross bleed'. Such valves with two poppets do not usually allow pressure to momentarily cross bleed to return during transition. Valves with one poppet may allow 'cross bleed' as these symbols illustrate

10.10.2.1 Without Cross Bleed (One Way Flow)

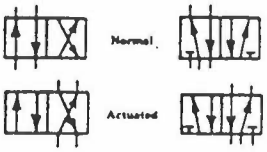


10.10.2.2 With Cross Bleed (Reverse Flow Permitted)



10.11 Four-Way Valves

10.11.1 Two Position

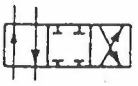


10.11.2 Three Position

(a) Normal

(b) Actuated Left

(c) Actuated Right



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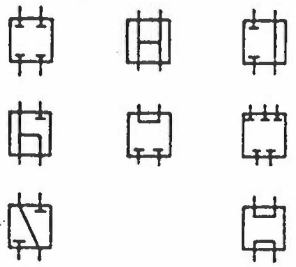
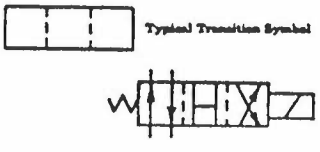
GRAPHIC SYMBOLS FOR FLUID POWER DIAGRAMS

10.11.3 Typical Flow Paths for Center Condition of Three-Position Valves

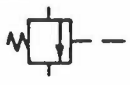


10.11.4 Two-Position, Snap Action with Transition. As the valve element shifts from one position to the other, it passes through an intermediate position. If it is essential to circuit function to symbolize this "in transit" condition, it can be shown in the center position, enclosed by dashed lines.

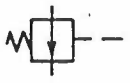


10.12 Infinite Positioning (Between Open & Closed)

10.12.1 Normally Closed

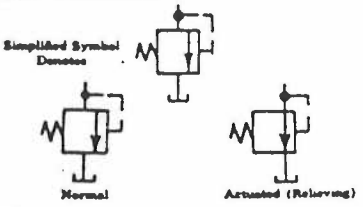


10.12.2 Normally Open



10.13 Pressure Control Valves

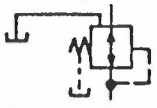
10.13.1 Pressure Relief



10.13.2 Sequence

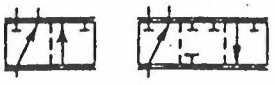
10.13.3 Pressure Reducing

10.13.4 Pressure Reducing and Relieving

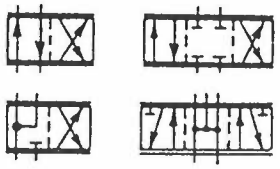


10.13.5 Airline Pressure Regulator (Adjustable, Relieving)

10.14 Infinite Positioning Three-Way Valves



10.15 Infinite Positioning Four-Way Valves



10.16 Flow Control Valves (See 3.7)

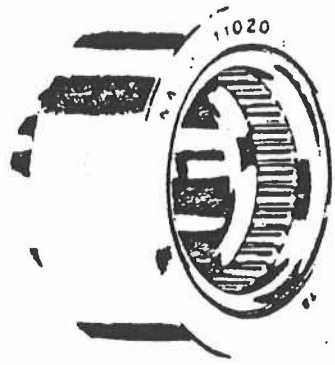
10.16.1 Adjustable, Non-Compensated (Flow control in each direction)

10.16.2 Adjustable with Bypass
Flow is controlled to the right.
Flow to the left bypasses control.

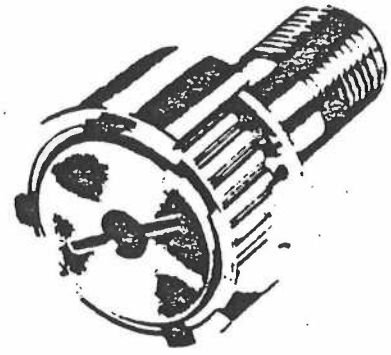
10.16.3 Adjustable and Pressure Compensated with Bypass

10.16.4 Adjustable, Temperature & Pressure Compensated

Type FG



Type Na 11 000



Type GC

REPLACEMENT FOR
NADELLA BEARINGS

CAM FOLLOWERS

BREMEN BEARING COMPANY
U.S. HIGHWAY 6 WEST
BREMEN, INDIANA 46506
219-546-2311

BREMEN cam followers are intended to run directly on cams, ramps and slideways. To enable them to stand up to the conditions imposed : heavy loads usually accompanied by considerable and repeated shock, each type of follower has the following features :

— Heavy section, robust outer ring of heat-treated, high resistance steel, obviating the use of a metal tyre.

— Outer ring having no oil hole or groove which would allow entry of foreign particles and mark the track.

— Outer ring slightly convex, tolerating out-of-parallelism of the faces in contact with no danger of malfunctioning or of the follower edge marking the track.

— Facility for grease renewal from the inside without dismantling.

— Full complement of needles offering the highest dynamic and static capacities.

BREMEN make three types of cam follower, as follows .

Type FG having inseparable inner and outer rings, can be mounted between fork ends or mounted cantilever fashion The retaining plates are fixed to the inner ring and prevent the outer ring moving laterally. A sealed version is also available, type FG ... EE.

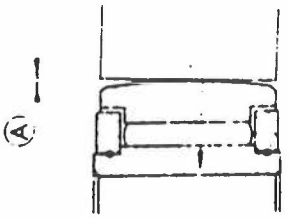
Type Na 11000 having the needles retained in the outer ring and can be used without an inner ring, directly on a hardened shaft. These followers are available with inner rings of 12 mm bore and above and may be used between fork ends or cantilevered.

Type GC having a threaded stud for cantilever mounting and an inseparable outer ring. A sealed version is also available, type GC ... EE.

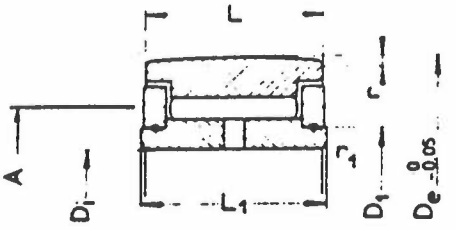
These three types of followers have lubrication holes internally to enable grease to be supplied from the shaft. When the load is heavy or considerable shock is present, the holes should be positioned away from the loaded zone.

Sealed followers, types FG ... EE and GC ... EE, have small seals each side of the outer ring, the material of which does not harden with age. They have been designed to enable used grease to be expelled at the time of regreasing. Although these seals create little friction, for grease lubrication the speed should be limited to 1/6 that of the unsealed followers. (Limiting speeds for unsealed type given in table of dimensions.) Sealed followers should have their operating temperature limited to 100 °C.

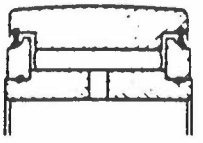
CAM FOLLOWERS types FG, FG .. EE and FG .. EEM — METRIC DIMENSIO



(A) 7 : 1,000 maximum slope for types FG or FG ... EE or FG..EEM



Type FG



Sealed follower Type FG ... EE or FG..EEM

These followers are also available with cylindrical outer rings code : FGL or FGL ... EE or FGL..EEM (h6 tolerance on D_e dimension).

Shaft tolerance on D_i dimension

h5 when load direction is fixed in relation to inner ring

k5 when load is revolving in relation to inner ring.

Ovality + conicity less than half the tolerance.

When using the follower having a cylindrical outer ring (types FGL or FGL ... EE or FGL...EEM) as a bearing, see table on page 59 for shaft and housing tolerances.

FG---- FGL--- FG----EE FGL---EE FG----EEM FGL---EEM	Di	De	Di	A mini	L	L1	r	r1	BASIC CAPACITIES FOR USE AS Bearings (1) Dyn.C lbs.	Bearings (1) Stat.Co. lbs.	Followers (2) Dyn.C lbs.	Followers (2) Stat.Co. lbs.	LIMITING SPEED FOR GREASE LUBRICATION FG--- FGL-- rpm	FG--EE FGL--EE rpm	FG--EEM FGL-EEM rpm	WEIGHT APPROX. g
5 16	5	16	7,1	10	11	12	0,5	0,2	1 200	770	1 090	675	30 000	11 500	14 400	16
6 19	6	19	8,5	12	11	12	0,5	0,2	1 415	985	1 200	865	24 000	10 000	12 500	19
8 24	8	24	10,8	14,5	12	13	0,5	0,3	1 640	1 200	1 570	1 145	19 000	8 300	10 400	37
8 24 15	8	24	10,8	14,5	14	15	0,5	0,3	2 180	1 605	2 090	1 515	19 000	8 300	10 400	44
10 30	10	30	13,8	19,5	14	15	1	0,3	2 852	2 315	2 540	1 900	15 000	6 200	7 750	66
12 32	12	32	16	21,5	14	15	1	0,3	3 165	2 630	2 605	2 020	13 000	5 700	7 100	77
15 35	15	35	18,7	24	18	19	1	0,5	5 055	4 355	3 975	3 165	11 500	5 300	6 600	103
17 40	17	40	22	28	20	21	1	0,5	6 535	5 905	4 715	3 865	9 600	4 500	5 600	155
20 47	20	47	25,7	32,5	24	25	1	0,5	8 220	7 905	6 245	5 325	8 000	3 900	4 900	295
25 52	25	52	30,5	37	24	25	1	0,5	9 390	9 120	6 738	5 795	7 000	3 500	4 400	310
30 62	30	62	35,2	44	28	29	1	0,5	11 565	11 565	9 320	8 645	6 000	2 950	3 700	490
35 72	35	72	41	50	28	29	1	1	12 800	13 140	10 895	10 555	5 200	2 650	3 300	670
40 80	40	80	46,7	56	30	32	1	1	16 845	17 968	13 475	14 375	4 700	2 350	2 900	890
45 85	45	85	52,4	62	30	32	1	1	18 190	19 990	13 815	14 375	4 200	2 150	2 700	970
50 90	50	90	59,1	69	30	32	1	1	19 765	22 235	14 150	14 375	3 700	2 000	2 500	1 040
55 100	55	100	65	75	34	36	2,5	1	23 180	26 815	16 090	16 485	3 300	-	2 200	1 350
60 110	60	110	70	82	34	36	2,5	1	24 325	28 885	18 010	19 350	3 100	-	2 000	1 650
65 120	65	120	74	90	40	42	2,5	1	29 635	35 555	23 090	25 490	2 900	-	1 800	2 350
70 125	70	125	79	92	40	42	2,5	1	30 925	37 955	23 165	25 830	2 700	-	1 800	2 500
75 130	75	130	84	96	40	42	2,5	1	32 185	39 890	23 540	26 280	2 550	-	1 750	2 650
80 140	80	140	92	105	46	48	3	1,5	40 515	52 030	18 140	31 995	2 300	-	1 600	3 400
85 150	85	150	99	112	46	48	3	1,5	42 495	55 880	29 690	34 645	2 150	-	1 500	4 000
90 160	90	160	105	120	52	54	3	1,5	51 433	68 580	35 770	42 245	2 000	-	1 400	5 300
95 170	95	170	110	125	52	54	3,5	1,5	53 000	71 715	38 360	55 610	1 900	-	1 300	6 000
100 180	100	180	116	135	63	65	3,5	1,5	68 370	94 490	49 210	60 935	1 800	-	1 200	8 050
110 200	110	200	128	150	63	65	3,5	2	73 600	104 395	53 700	68 885	1 650	-	1 100	10 000
120 215	120	215	138	160	63	65	3,5	2	77 040	111 626	55 475	74 790	1 500	-	1 050	11 500
130 230	130	230	147	170	75	78	4	2	97 565	144 600	70 840	94 275	1 400	-	1 000	15 500
140 250	140	250	158	180	75	78	4	2	102 195	154 570	77 250	106 335	1 300	-	900	18 500
150 270	150	270	170	195	75	78	4	2	107 920	166 205	82 235	126 675	1 200	-	850	22 000

(1) These basic capacities are only for use with types FGL and FGL .. EE, having cylindrical outer rings and used as bearings mounted in housings

(2) These basic capacities are used for followers having cylindrical or crowned outer rings. They allow for the sharing of the internal forces due to elastic deformation of the outer rings

37° Flared Fittings

Another popular style of fitting used overseas on metric tubing is the 37° flared fitting. This fitting is a three piece flared fitting, and the tubing is flared to a 37° angle and seats on the nose of the fitting as shown in the adjacent diagram.

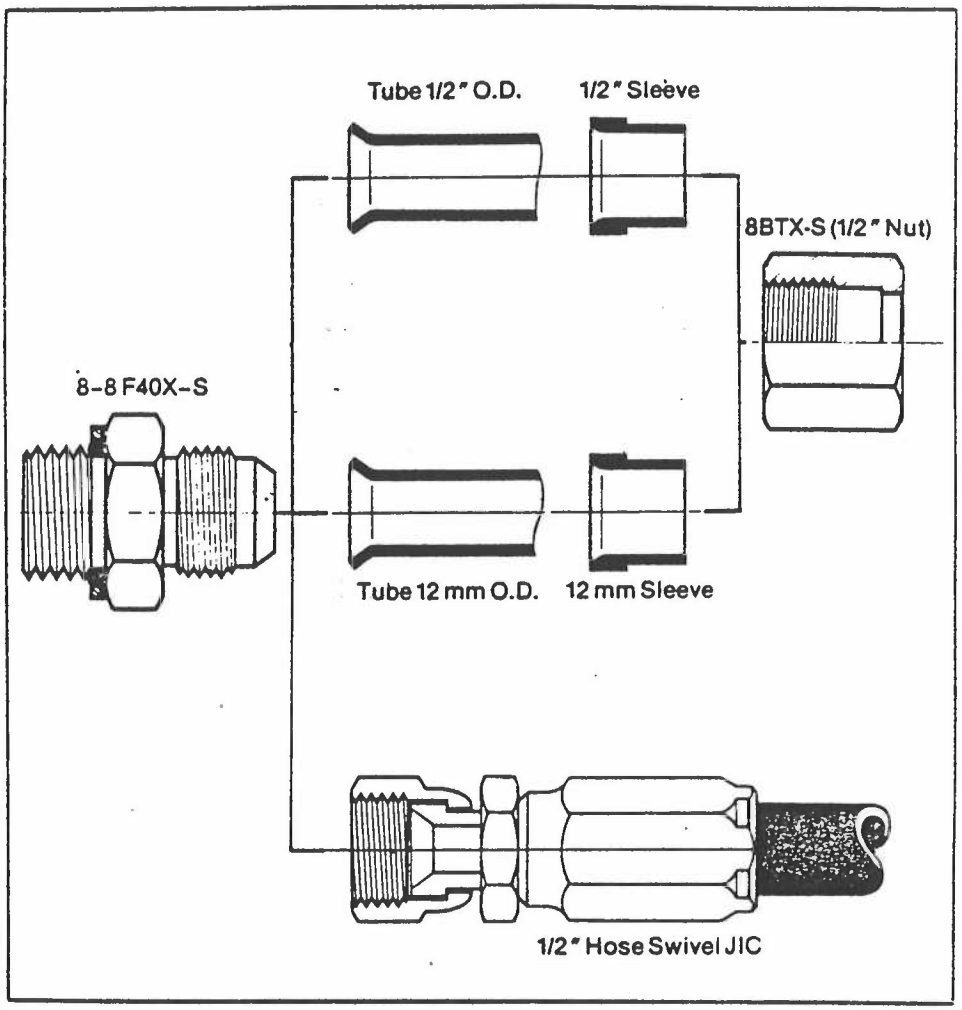
Versatility

This fitting is very popular on a worldwide basis due to its versatility. A single 37° fitting body will accept both inch and metric tubing by simply changing the sleeve. The 37° fitting body without a nut and sleeve is also very popular as a hose adapter. Study the adjacent example to better understand how this works.

The following chart should give you a clearer picture of the flexibility of the 37° system. It gives you every "convertible sleeve" connection for the 37° flare. For example, if you needed to grip a 12 millimeter tube you could use any ½ " 37° flare fitting together with a 12 millimeter sleeve and a standard ½" nut and you would have all the components to seal a 12 mm flared tube.

From this example, you can see that any 37° flare fitting can easily be converted into a metric tube fitting with merely a sleeve change.

This process will also work in reverse — if you have a 37° flare fitting used on a 12 mm tube, you can put a standard ½" sleeve in and change the tube back to inch sizes. This same flare will also accept a ½" JIC hose swivel which further enhances its value in the field.



The preceding example shows how a common Triple-Lok body can connect three different ways:

1. With a 1/2" sleeve, it can connect to a 1/2" tube.
2. With a 12mm sleeve, it can connect to a 12mm tube.
3. Without a nut and sleeve, it can be used as a hose adapter.

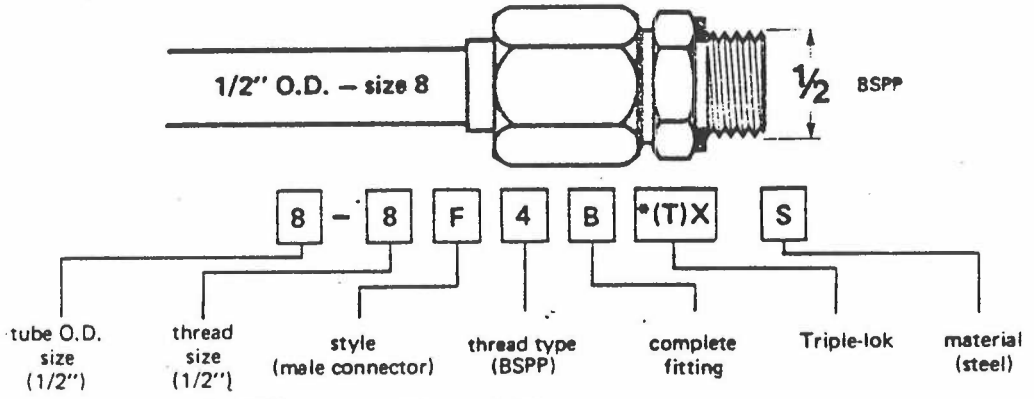
CONVERTIBLE SLEEVE CHART

Inch Size JIC 37	Tube O.D.	Millimeter Sleeve Part Number	Nut Part Number	Thread On Tube Side SAE Straight Thread
1/4	6mm	TX-S 6mm	4 BTX-S	7/16-20
5/16	8mm	5 TX-S	5 BTX-S	1/2-20
3/8	10mm	TX-S 10mm	6 BTX-S	9/16-18
1/2	12mm	TX-S 12mm	8 BTX-S	3/4-16
5/8	14mm	TX-S 14mm	10 BTX-S	7/8-14
5/8	15mm	TX-S 15mm	10 BTX-S	7/8-14
5/8	16mm	10 TX-S	10BTX-S	7/8-14
3/4	18mm	TX-S 18mm	12 BTX-S	1-1/16 - 12
3/4	20mm	20-12 TX-S	20-12 BTX-S	1-1/16 - 12
1-00	25mm	TX-S 25mm	16 BTX-S	1-5/16 - 12
1-1/4	30mm	TX-S 30mm	20 BTX-S	1-5/8 - 12
1-1/4	32mm	20 TX-S	20 BTX-S	1-5/8 - 12
1-1/2	38mm	24 TX-S	24 BTX-S	1-7/8 - 12

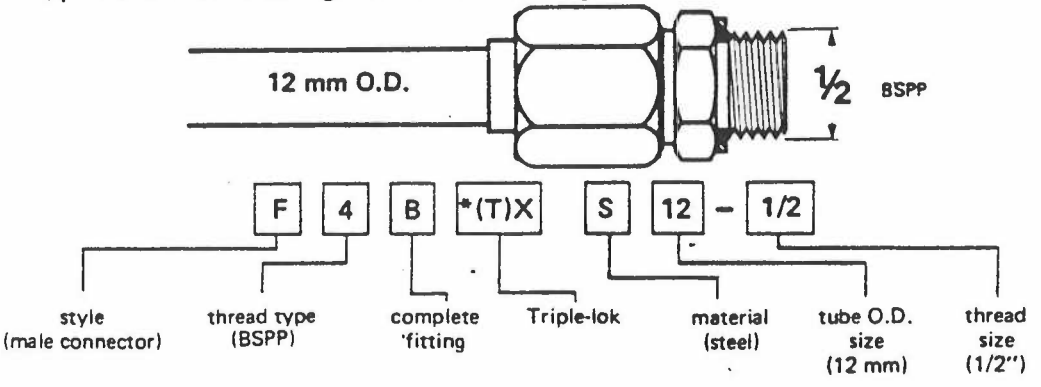
Nomenclature

Triple-Lok fittings part numbers are constructed from symbols that identify the size, the style and material of the fitting.

a) part number of a fitting for inch size tubing



b) part number of a fitting for metric size tubing:



It is necessary to specify:

1) Style:

H — union
E — union elbow
J — union tee
K — union cross
W — bulkhead union
WE — bulkhead union elbow
WN — bulkhead 45° union elbow
WJJ-Long Bulkhead Branch Tee
WJ — bulkhead branch tee
F — male connector
C — male elbow
CC — long male elbow
CCC-extra long male elbow
V — male 45° elbow
S — male branch tee
R — male run tee
G — female connector
WG — female bulkhead connector
D — female elbow
O — female branch tee
M — female run tee
GMO — manometer connection
F6 — swivel nut male adapter
C6 — swivel nut elbow
V6 — swivel nut 45° elbow
S6 — swivel nut branch tee
R6 — swivel nut run tee
TR — tube end reducer
B — nut
T — sleeve
FN — fitting cap
PN — tubing plug

2) Thread type:

without symbol — NPTF Dryseal American Standard Taper
3 — BSPT British Standard Pipe Taper thread to BS 21 — ISO 7
4 — BSPP British Standard Pipe Parallel thread to BS 2779 — ISO 228
5 — UNF 2A unified straight thread
87 — METRIC straight thread ISO-6149
8 — METRIC parallel threads ISO/B2779-NF E03-005

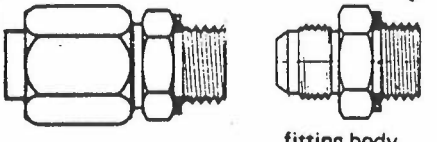
3) Fitting or adapter:

The same Triple-Lok fitting body can be supplied in three different ways.

— with nut and sleeve for metric tubing

— with nut and sleeve for inch tubing

- as a hose adapter without nut and sleeve



complete fitting — fitting body (adapter)

Parker Tube Fittings supplies all Triple-Lok metric fittings in an unassembled condition.

TRIPLE-LOK TORQUE VALUES

To complete the final assembly, this Torque Table which lists the correct torque value in inch lbs. by fitting size and material must be used.

1. Complete all final assembly instructions until the fitting is in the finger-tight condition.
2. Select the torque value given in the table, according to the size and material fitting being assembled.
3. Tighten the nut with the torque wrench until the measurement indicated on the wrench matches the measurement range given in the table.

TORQUE TABLE FOR TRIPLE-LOK FITTINGS

SIZE mm	TRIPLE-LOK FITTING TORQUE INCH LBS.			
	Steel Tube & Fitting Stainless Steel Tube & Fitting		Copper Tube & Brass Fitting Aluminum Alloy Tube & Fitting	
	Minimum	Maximum	Minimum	Maximum
6	50	150	40	65
8	70	200	40	65
10	90	300	75	125
12	150	500	120	250
14,15,16	220	700	180	350
18,20	300	1000	250	500
25	450	1400	375	700
30,32	650	2100	500	900
38	900	3000	600	900

Note: The minimum torque values shown were established on the basis of having a smooth contact surface between the flare and the seat of the fitting.

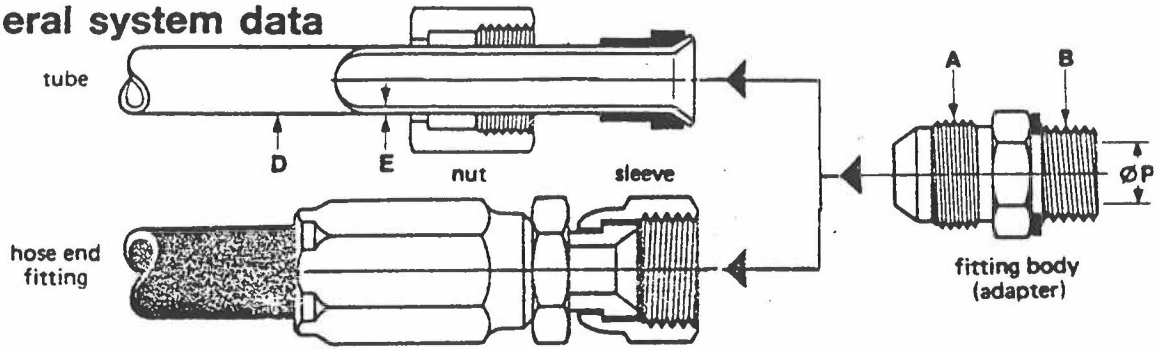
BURST PRESSURE CHART

Burst pressure according to working temperature, size and maximum wall thickness of the steel tube in PSI

Tube O.D. mm	Maximum wall thickness mm	Ambient temperature	250°F	500°F	600°F	700°F	750°F	800°F	850°F
6	1,6	31,200	29,050	25,520	24,080	22,710	20,870	18,120	15,410
8	1,6	25,000	23,270	20,450	19,300	18,200	16,725	14,525	12,350
10	1,6	20,800	19,360	17,010	16,050	15,140	13,910	12,080	10,275
12	2	19,920	18,540	16,290	15,380	14,500	13,320	11,570	9,840
16	2,6	18,250	16,990	14,930	14,090	13,290	12,210	10,600	9,010
20	2,6	17,450	16,240	14,270	13,470	12,700	11,670	10,140	8,620
25	3	14,400	13,400	11,780	11,110	10,480	9,630	8,630	7,110
32	3	11,520	10,720	9,420	8,890	8,380	7,700	6,690	5,690
38	4	11,830	11,000	9,660	9,110	8,600	7,900	6,860	5,810

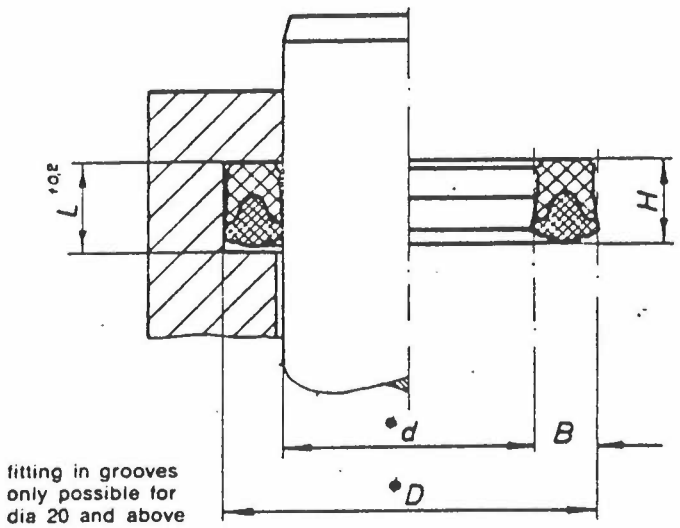
Because of the fitting design there is no minimum tube wall thickness specified with Triple-Lok

general system data



Inch sizes tube		Millimetric tube		Size	Thread A		P	Port thread B		
D O.D. in.	E max. wall thick. in.	D O.D. mm	E max. wall thick. mm	No	SAE straight thread JIC	O.D. mm	Bore diameter	BSPP or BSPT or NPTF threads	UNF male pipe thread	Metric parallel thread
1/4	.065	6	1,5	4	7/16—20	11,11	4,3	1/8	7/16—20	M10 x 1
1/4	.065	6	1,5	4—4	7/16—20	11,11	4,3	1/4		
1/4	.065	6	1,5	4—5	7/16—20	11,11	4,3		1/2 —20	
1/4	.065	6	1,5	4—6	7/16—20	11,11	4,3	3/8	9/16—18	
1/4	.065	6	1,5	4—8	7/16—20	11,11	4,3	1/2		
5/16	.065	8	1,5	5	1/2 —20	12,70	6	1/8	1/2 —20	M12 x 1,5
5/16	.065	8	1,5	5—4	1/2 —20	12,70	6	1/4		
5/16	.065	8	1,5	5—6	1/2 —20	12,70	6	3/8		
5/16	.065	8	1,5	5—8	1/2 —20	12,70	6	1/2		
3/8	.065	10	1,5	6—2	9/16—18	14,29	7,5	1/8		
3/8	.065	10	1,5	6	9/16—18	14,29	7,5	1/4	9/16—18	M14 x 1,5
3/8	.065	10	1,5	6—6	9/16—18	14,29	7,5	3/8		
3/8	.065	10	1,5	6—8	9/16—18	14,29	7,5	1/2	3/4 —16	
1/2	.083	12	2	8—4	3/4 —16	19,05	10	1/4		
1/2	.083	12	2	8	3/4 —16	19,05	10	3/8	3/4 —16	M16 x 1,5
1/2	.083	12	2	8—8	3/4 —16	19,05	10	1/2		M18 x 1,5
1/2	.083	12	2	8—10	3/4 —16	19,05	10		7/8 —14	
1/2	.083	12	2	8—12	3/4 —16	19,05	10	3/4	1.1/16—12	
		14	2		7/8 —14	22,22	12,3	3/8		
		14	2		7/8 —14	22,22	12,3		3/4 —16	
		14	2		7/8 —14	22,22	12,3	1/2	7/8 —14	M18 x 1,5
		14	2		7/8 —14	22,22	12,3	3/4	1.1/16—12	M22 x 1,5
		15	2		7/8 —14	22,22	12,3	3/8		
		15	2		7/8 —14	22,22	12,3		3/4 —16	
		15	2		7/8 —14	22,22	12,3	1/2	7/8 —14	M18 x 1,5
		15	2		7/8 —14	22,22	12,3	3/4	1.1/16—12	M22 x 1,5
5/8	.095	16	2,5	10—6	7/8 —14	22,22	12,3	3/8		
5/8	.095	16	2,5	10—8	7/8 —14	22,22	12,3		3/4 —16	
5/8	.095	16	2,5	10	7/8 —14	22,22	12,3	1/2	7/8 —14	M18 x 1,5
5/8	.095	16	2,5	10—12	7/8 —14	22,22	12,3	3/4	1.1/16—12	M22 x 1,5
		18	2,5		1.1/16—12	26,99	15,5	1/2	3/4 —16	
		18	2,5		1.1/16—12	26,99	15,5		7/8 —14	
		18	2,5		1.1/16—12	26,99	15,5	3/4	1.1/16—12	M22 x 1,5
		18	2,5		1.1/16—12	26,99	15,5	1	1.5/16—12	M27 x 2
3/4	.109	20	2,5	12—8	1.1/16—12	26,99	15,5	1/2	3/4 —16	
3/4	.109	20	2,5	12—10	1.1/16—12	26,99	15,5		7/8 —14	M22 x 1,5
3/4	.109	20	2,5	12	1.1/16—12	26,99	15,5	3/4	1.1/16—12	M27 x 2
3/4	.109	20	2,5	12—16	1.1/16—12	26,99	15,5	1	1.5/16—12	
1	.120	25	3	16—12	1.5/16—12	33,34	21,5	3/4	1.1/16—12	
1	.120	25	3	16	1.5/16—12	33,34	21,5	1	1.5/16—12	M33 x 2
1	.120	25	3	16—20	1.5/16—12	33,34	21,5	1.1/4	1.5/8 —12	
		30	3		1.5/8 —12	41,28	27,5	3/4		
		30	3		1.5/8 —12	41,28	27,5	1		
		30	3		1.5/8 —12	41,28	27,5	1.1/4	1.5/8 —12	M42 x 2
1.1/4	.120	32	3	20—12	1.5/8 —12	41,28	27,5	3/4		
1.1/4	.120	32	3	20—16	1.5/8 —12	41,28	27,5	1		
1.1/4	.120	32	3	20	1.5/8 —12	41,28	27,5	1.1/4	1.5/8 —12	M42 x 2
1.1/2	.157	38	4	24—20	1.7/8 —12	47,63	33	1.1/4		
1.1/2	.157	38	4	24	1.7/8 —12	47,63	33	1.1/2	1.7/8 —12	M50 x 2

COMPACT ROD SEAL
STANDARD METRIC SIZES



fitting in grooves only possible for dia 20 and above

SERIES

1541

Series	Ød	ØD	B	H	L	Ref.-No.
S8- 5	5	12	3,5	6	6,4	L1541-030.115
S8- 6	6	13	3,5	6	6,4	L1541-027.634
S8- 8	8	15	3,5	6	6,4	L1541-007.352
S8-10	10	17	3,5	6	6,4	L1541-007.358
S8-12	12	19	3,5	6	6,4	L1541-007.364
S8-14	14	22	4	6	6,4	L1541-027.629
S8-15	15	23	4	6	6,4	L1541-007.372
S8-16	16	24	4	6	6,4	L1541-027.652
S8-18	18	26	4	6	6,4	L1541-007.379
S8-20	20	28	4	6	6,4	L1541-007.388
S8-22	22	30	4	6	6,4	L1541-007.397
S8-25	25	33	4	6	6,4	L1541-007.407
S8-28	28	36	4	6	6,4	L1541-007.413
S8-30	30	38	4	6	6,4	L1541-027.648
S8-32	32	40	4	6	6,4	L1541-023.604
S8-35	35	43	4	6	6,4	L1541-027.649
S8-36	36	44	4	6	6,4	L1541-007.448
S8-40	40	48	4	6	6,4	L1541-007.461
S8-42	42	50	4	6	6,4	L1541-007.475
S8-45	45	55	5	7,5	8	L1541-007.485

Series	Ød	ØD	B	H	L	Ref.-No.
S8- 50	50	60	5	7,5	8	L1541-007.494
S8- 55	55	65	5	7,5	8	L1541-027.658
S8- 56	56	66	5	7,5	8	L1541-007.513
S8- 60	60	70	5	7,5	8	L1541-007.520
S8- 63	63	75	6	9	9,6	L1541-007.539
S8- 65	65	77	6	9	9,6	L1541-007.545
S8- 70	70	82	6	9	9,6	L1541-007.555
S8- 75	75	87	6	9	9,6	L1541-007.567
S8- 80	80	92	6	9	9,6	L1541-027.655
S8- 85	85	97	6	9	9,6	L1541-007.587
S8- 90	90	102	6	9	9,6	L1541-007.602
S8-100	100	115	7,5	11,3	12	L1541-027.657
S8-110	110	125	7,5	11,3	12	L1541-027.631
S8-115	115	130	7,5	11,3	12	L1541-007.645
S8-125	125	140	7,5	11,3	12	L1541-027.653
S8-140	140	160	10	15	16	L1541-007.671
S8-150	150	170	10	15	16	L1541-007.682
S8-160	160	180	10	15	16	L1541-027.656
S8-180	180	200	10	15	16	L1541-007.703
S8-200	200	220	10	15	16	L1541-007.710

ADDITIONAL SIZES AVAILABLE ON REQUEST

MERKEL-FORSHEDA CORPORATION

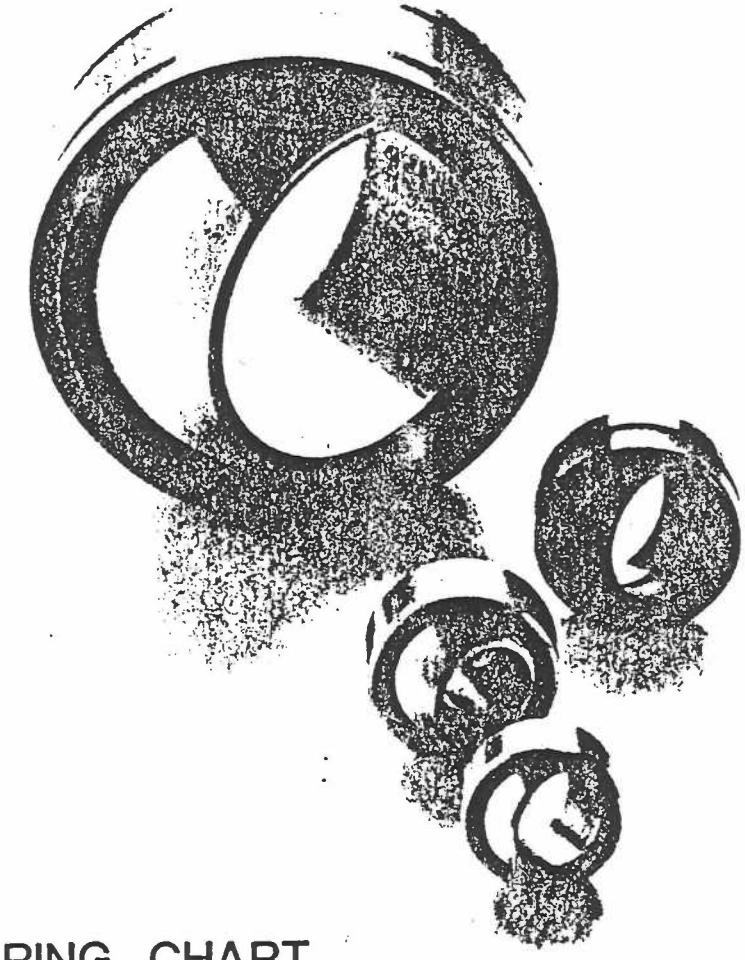
INDEX

CONTENTS — SECTION

MERKEL-FORSHEDA CORPORATION
5375 Naiman Parkway • Cleveland, Ohio 44139
Tel. 216/248-2660 Telex: 985476

DIN 648 dimension series E

Type overview	Nominal range
[1]) GE . . DO	6 — 200 / 320 — 1000
[1]) GE . . DO-2RS	17 — 300
[2]) GE . . UK	6 — 30
[2]) GE . . UK-2RS	35 — 300
[2]) GE . . DW	320 — 1000



[1]) Sliding contact surfaces: steel/steel

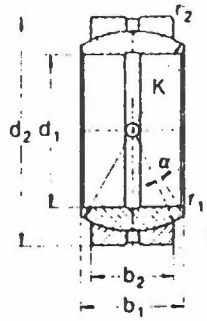
[2]) Sliding contact surfaces: PTFE/hard chrome — maintenance-free

ROD END BEARING CHART

Radial spherical plain bearings

GE . . DO
GE . . DO-2RS

DIN 648 dimension series E



GE . . DO

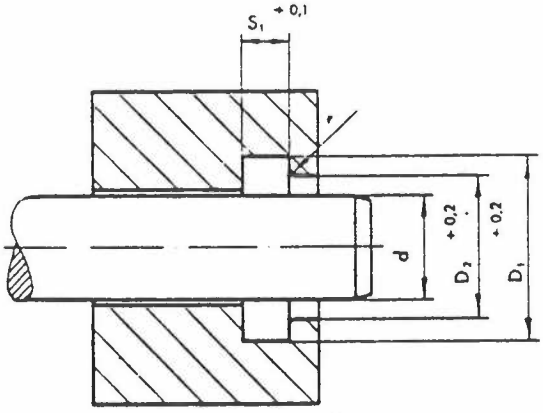
GE . . DO-2RS

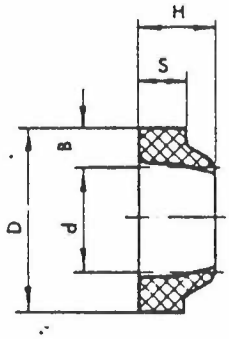
Sliding contact surfaces: steel/steel

Type	Type	d_1	d_2	b_1	b_2	K
GE 6 DO*		6	14 -0,008	6	4	10
GE 8 DO*		8	16	8	5	13
GE 10 DO*		10 -0,008	19	9	6	16
GE 12 DO*		12	22 -0,009	10	7	18
GE 15 DO		15	26	12	9	22
GE 17 DO	GE 17 DO-2RS	17	30	14 -0,12	10 -0,12	25
GE 20 DO	GE 20 DO-2RS	20	35	16	12	29
GE 25 DO	GE 25 DO-2RS	25 -0,010	42 -0,011	20	16	35,5
GE 30 DO	GE 30 DO-2RS	30	47	22	18	40,7
GE 35 DO	GE 35 DO-2RS	35	55	25	20	47
GE 40 DO	GE 40 DO-2RS	40 -0,012	62 -0,013	28	22	53
GE 45 DO	GE 45 DO-2RS	45	68	32	25	60
GE 50 DO	GE 50 DO-2RS	50	75	35	28	66
GE 60 DO	GE 60 DO-2RS	60	90	44	36	80
GE 70 DO	GE 70 DO-2RS	70 -0,015	105 -0,015	49 -0,15	40 -0,15	92
GE 80 DO	GE 80 DO-2RS	80	120	55	45	105
GE 90 DO	GE 90 DO-2RS	90	130 -0,018	60	50	115
GE 100 DO	GE 100 DO-2RS	100 -0,020	150	70 -0,20	55 -0,20	130
GE 110 DO	GE 110 DO-2RS	110	160 -0,025	70	55	140
GE 120 DO	GE 120 DO-2RS	120	180	85	70	160
GE 140 DO	GE 140 DO-2RS	140	210 -0,030	90	70	180
GE 160 DO	GE 160 DO-2RS	160 -0,025	230	105 -0,25	80 -0,25	200
GE 180 DO	GE 180 DO-2RS	180	260 -0,035	105	80	225
GE 200 DO	GE 200 DO-2RS	200	290	130	100	250
	GE 220 DO-2RS	220 -0,030	320	135 -0,30	100 -0,30	275
	GE 240 DO-2RS	240	340 -0,040	140	100	300
	GE 260 DO-2RS	260	370	150	110	325
	GE 280 DO-2RS	280 -0,035	400	155 -0,35	120 -0,35	350
	GE 300 DO-2RS	300	430 -0,045	165	120	375

d_1	r_1	r_2	α	radial internal clearance	load carrying capacity kN static C_0	load carrying capacity kN dynamic C	weig kg/u
6	0,5	0,5	13°	0,032 — 0,068	17,0	3,4	0,005
8			15°		27,5	5,5	0,00
10			12°		40,5	8,15	0,01
12		0,8	11°		54	10,8	0,01
15			8°	0,040 — 0,082	85	17,0	0,02
17	0,8		10°		106	21,2	0,04
20		1,0	9°		146	30	0,06
25			7°	0,050 — 0,100	240	48	0,11
30			6°		310	62	0,14
35	1,0	1,2	6°	0,060 — 0,120	400	80	0,24
40			7°		500	100	0,29
45			7°		640	127	0,38
50			6°		780	156	0,53
60	1,2	1,5	6°	0,072 — 0,142	1220	245	1,0
70			6°		1560	315	1,5
80			6°		2000	400	2,3
90			5°		2450	490	2,7
100			7°		3050	610	4,4
110	1,5		6°	0,085 — 0,165	3250	655	4,9
120			6°		4750	950	7,8
140			7°		5400	1080	11,0
160			8°	0,100 — 0,192	6800	1370	14,0
180			6°		7650	1530	18,5
200			7°		10600	2120	27,5
220	2,0	2,0	8°		11600	2320	35,5
240			8°		12700	2550	40,0
260			7°		15300	3050	51,5
280			6°	0,110 — 0,214	18000	3550	65,5
300			7°		19000	3800	75,0

DIRT WIPERS
STYLE P6 – METRIC SIZES





SERIES

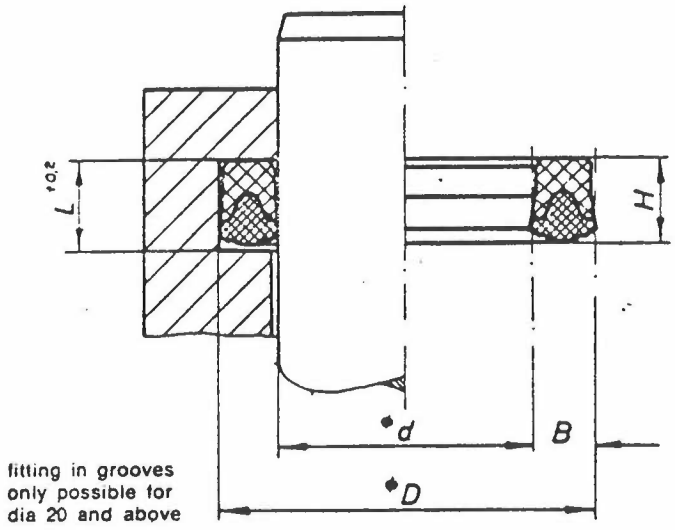
P6

METRIC

Series	Wiper-ring dimensions d	D	B	H	S	Groove-dimensions D1	D2	S1	r	Part #
P6-20	20	28	4	7	5	28,6	23	5,3	1	L 2511-004.784
P6-22	22	30	4	7	5	30,6	25	5,3	1	L 2511-004.788
P6-25	25	33	4	7	5	33,6	28	5,3	1	L 2511-004.792
P6-28	28	36	4	7	5	36,6	31	5,3	1	L 2511-004.798
P6-30	30	38	4	7	5	38,6	33	5,3	1	L 2511-004.799
P6-32	32	40	4	7	5	40,6	35	5,3	1	L 2511-004.805
P6-35	35	43	4	7	5	43,6	38	5,3	1	L 2511-004.808
P6-36	36	44	4	7	5	44,6	39	5,3	1	L 2511-004.811
P6-40	40	48	4	7	5	48,6	43	5,3	1	L 2511-004.816
P6-42	42	50	4	7	5	50,6	45	5,3	1	L 2511-004.820
P6-45	45	55	5	7	5	55,6	48	5,3	1	L 2511-004.827
P6-50	50	60	5	7	5	60,6	53	5,3	1	L 2511-004.835
P6-55	55	65	5	7	5	65,6	58	5,3	1	L 2511-004.846
P6-56	56	66	5	7	5	66,6	59	5,3	1	L 2511-004.849
P6-60	60	70	5	7	5	70,6	63	5,3	1	L 2511-004.853
P6-63	63	73	5	7	5	73,6	66	5,3	1	L 2511-004.859
P6-65	65	75	5	7	5	75,6	68	5,3	1	L 2511-004.869
P6-70	70	80	5	7	5	80,6	73	5,3	1	L 2511-004.881
P6-75	75	87	6	12	7	87,2	81	7,1	1	L 2511-004.892
P6-80	80	92	6	12	7	92,2	86	7,1	1	L 2511-004.909
P6-85	85	97	6	12	7	97,2	91	7,1	1	L 2511-004.917
P6-90	90	102	6	12	7	102,2	96	7,1	1	L 2511-004.928
P6-100	100	112	6	12	7	112,2	106	7,1	1	L 2511-004.944
P6-110	110	122	6	12	7	122,2	116	7,1	1	L 2511-004.961
P6-115	115	127	6	12	7	127,2	121	7,1	1	L 2511-004.968
P6-125	125	140	7,5	16	10	140	132,6	10,1	1,5	L 2511-004.981
P6-140	140	155	7,5	16	10	155	147,6	10,1	1,5	L 2511-005.002
P6-150	150	165	7,5	16	10	165	157,6	10,1	1,5	L 2511-005.013
P6-160	160	175	7,5	16	10	175	167,6	10,1	1,5	L 2511-005.025
P6-180	180	200	10	18	10	200	190	10,2	3	L 2511-005.039
P6-200	200	220	10	18	10	220	210	10,2	3	L 2511-005.050

• ADDITIONAL SIZES AVAILABLE ON REQUEST.

COMPACT ROD SEAL
STANDARD METRIC SIZES



fitting in grooves only possible for dia 20 and above

SERIES

1541

Series	Ød	ØD	B	H	L	Ref.-No.
S8- 5	5	12	3,5	6	6,4	L1541-030.115
S8- 6	6	13	3,5	6	6,4	L1541-027.634
S8- 8	8	15	3,5	6	6,4	L1541-007.352
S8-10	10	17	3,5	6	6,4	L1541-007.358
S8-12	12	19	3,5	6	6,4	L1541-007.364
S8-14	14	22	4	6	6,4	L1541-027.629
S8-15	15	23	4	6	6,4	L1541-007.372
S8-16	16	24	4	6	6,4	L1541-027.652
S8-18	18	26	4	6	6,4	L1541-007.379
S8-20	20	28	4	6	6,4	L1541-007.388
S8-22	22	30	4	6	6,4	L1541-007.397
S8-25	25	33	4	6	6,4	L1541-007.407
S8-28	28	36	4	6	6,4	L1541-007.413
S8-30	30	38	4	6	6,4	L1541-027.648
S8-32	32	40	4	6	6,4	L1541-023.604
S8-35	35	43	4	6	6,4	L1541-027.649
S8-36	36	44	4	6	6,4	L1541-007.448
S8-40	40	48	4	6	6,4	L1541-007.461
S8-42	42	50	4	6	6,4	L1541-007.475
S8-45	45	55	5	7,5	8	L1541-007.485

Series	Ød	ØD	B	H	L	Ref.-No.
S8- 50	50	60	5	7,5	8	L1541-007.494
S8- 55	55	65	5	7,5	8	L1541-027.658
S8- 56	56	66	5	7,5	8	L1541-007.513
S8- 60	60	70	5	7,5	8	L1541-007.520
S8- 63	63	75	6	9	9,6	L1541-007.539
S8- 65	65	77	6	9	9,6	L1541-007.545
S8- 70	70	82	6	9	9,6	L1541-007.555
S8- 75	75	87	6	9	9,6	L1541-007.567
S8- 80	80	92	6	9	9,6	L1541-027.655
S8- 85	85	97	6	9	9,6	L1541-007.587
S8- 90	90	102	6	9	9,6	L1541-007.602
S8-100	100	115	7,5	11,3	12	L1541-027.657
S8-110	110	125	7,5	11,3	12	L1541-027.631
S8-115	115	130	7,5	11,3	12	L1541-007.645
S8-125	125	140	7,5	11,3	12	L1541-027.653
S8-140	140	160	10	15	16	L1541-007.671
S8-150	150	170	10	15	16	L1541-007.682
S8-160	160	180	10	15	16	L1541-027.656
S8-180	180	200	10	15	16	L1541-007.703
S8-200	200	220	10	15	16	L1541-007.710

ADDITIONAL SIZES AVAILABLE ON REQUEST.

MERKEL-FORSHEDA CORPORATION

INDEX

CONTENTS

MERKEL-FORSHEDA CORPORATION

5375 Naiman Parkway • Cleveland, Ohio 44139

Tel. 216/248-2660 Telex: 985476

Parker Series 2- O-Ring Sizes

1	2	3	4	5				6			7				8
Compound Specificat'ns	MIL-P-5516	AMS 7270	AMS 7274	METRIC O-RING SIZE (Units Are In Millimeters)				NOMINAL SIZE			STANDARD O-RING SIZE (Units Are In Inches)				
Parker Compound	PSI-30-5 N304-75	N179-70	N180-70	Actual (b) Per AS 568A				(Inches)			Actual (b) Per AS 568A				
Series No. / Parker Size (a)	AN6227B AN6230B Dash No.	AN12XXXX Part No.	AN123XXX Part No.	I.D.	Tol. (c) ±	W	±	(REF. ONLY) I.D.	O.D.	W	I.D.	Tol. (c) ±	W	±	Series No. / Parker Size (a)
2-134	.....	.....	.....	47.29	.38	2.62	.08	1 7/8	2 1/16	3/32	1.862	.015	.103	.003	2-134
2-135	.....	.....	.....	48.90	.43	2.62	.08	1 15/16	2 1/8	3/32	1.925	.017	.103	.003	2-135
2-136	.....	.....	.....	50.47	.43	2.62	.08	2	2 1/16	3/32	1.987	.017	.103	.003	2-136
2-137	.....	.....	.....	52.07	.43	2.62	.08	2 1/16	2 1/4	3/32	2.050	.017	.103	.003	2-137
2-138	.....	.....	.....	53.64	.43	2.62	.08	2 1/8	2 5/16	3/32	2.112	.017	.103	.003	2-138
2-139	.....	.....	.....	55.25	.43	2.62	.08	2 3/16	2 3/8	3/32	2.175	.017	.103	.003	2-139
2-140	.....	.....	.....	56.82	.43	2.62	.08	2 1/4	2 7/16	3/32	2.237	.017	.103	.003	2-140
2-141	.....	.....	.....	58.42	.51	2.62	.08	2 5/16	2 1/2	3/32	2.300	.020	.103	.003	2-141
2-142	.....	.....	.....	59.99	.51	2.62	.08	2 3/8	2 9/16	3/32	2.362	.020	.103	.003	2-142
2-143	.....	.....	.....	61.60	.51	2.62	.08	2 7/16	2 5/8	3/32	2.425	.020	.103	.003	2-143
2-144	.....	.....	.....	63.17	.51	2.62	.08	2 1/2	2 11/16	3/32	2.487	.020	.103	.003	2-144
2-145	.....	.....	.....	64.77	.51	2.62	.08	2 9/16	2 3/4	3/32	2.550	.020	.103	.003	2-145
2-146	.....	.....	.....	66.34	.51	2.62	.08	2 5/8	2 13/16	3/32	2.612	.020	.103	.003	2-146
2-147	.....	.....	.....	67.95	.56	2.62	.08	2 11/16	2 7/8	3/32	2.675	.022	.103	.003	2-147
2-148	.....	.....	.....	69.52	.56	2.62	.08	2 3/4	2 15/16	3/32	2.737	.022	.103	.003	2-148
2-149	.....	.....	.....	71.12	.56	2.62	.08	2 13/16	3	3/32	2.800	.022	.103	.003	2-149
2-150	.....	.....	.....	72.69	.56	2.62	.08	2 7/8	3 1/16	3/32	2.862	.022	.103	.003	2-150
2-151	.....	.....	.....	75.87	.61	2.62	.08	3	3 3/16	3/32	2.987	.024	.103	.003	2-151
2-152	.....	.....	.....	82.22	.61	2.62	.08	3 1/4	3 7/16	3/32	3.237	.024	.103	.003	2-152
2-153	.....	.....	.....	88.57	.61	2.62	.08	3 1/2	3 11/16	3/32	3.487	.024	.103	.003	2-153
2-154	.....	.....	.....	94.92	.71	2.62	.08	3 3/4	3 15/16	3/32	3.737	.028	.103	.003	2-154
2-155	.....	.....	.....	101.27	.71	2.62	.08	4	4 3/16	3/32	3.987	.028	.103	.003	2-155
2-156	.....	.....	.....	107.62	.76	2.62	.08	4 1/4	4 7/16	3/32	4.237	.030	.103	.003	2-156
2-157	.....	.....	.....	113.97	.76	2.62	.08	4 1/2	4 11/16	3/32	4.487	.030	.103	.003	2-157
2-158	.....	.....	.....	120.32	.76	2.62	.08	4 3/4	4 15/16	3/32	4.737	.030	.103	.003	2-158
2-159	.....	.....	.....	126.67	.89	2.62	.08	5	5 3/16	3/32	4.987	.035	.103	.003	2-159
2-160	.....	.....	.....	133.02	.89	2.62	.08	5 1/4	5 7/16	3/32	5.237	.035	.103	.003	2-160
2-161	.....	.....	.....	139.37	.89	2.62	.08	5 1/2	5 11/16	3/32	5.487	.035	.103	.003	2-161
2-162	.....	.....	.....	145.72	.89	2.62	.08	5 3/4	5 15/16	3/32	5.737	.035	.103	.003	2-162
2-163	.....	.....	.....	152.07	.89	2.62	.08	6	6 3/16	3/32	5.987	.035	.103	.003	2-163
2-164	.....	.....	.....	158.42	1.02	2.62	.08	6 1/4	6 7/16	3/32	6.237	.040	.103	.003	2-164
2-165	.....	.....	.....	164.77	1.02	2.62	.08	6 1/2	6 11/16	3/32	6.487	.040	.103	.003	2-165
2-166	.....	.....	.....	171.12	1.02	2.62	.08	6 3/4	6 15/16	3/32	6.737	.040	.103	.003	2-166
2-167	.....	.....	.....	177.47	1.02	2.62	.08	7	7 3/16	3/32	6.987	.040	.103	.003	2-167
2-168	.....	.....	.....	183.82	1.14	2.62	.08	7 1/4	7 7/16	3/32	7.237	.045	.103	.003	2-168
2-169	.....	.....	.....	190.17	1.14	2.62	.08	7 1/2	7 11/16	3/32	7.487	.045	.103	.003	2-169
2-170	.....	.....	.....	196.52	1.14	2.62	.08	7 3/4	7 15/16	3/32	7.737	.045	.103	.003	2-170
2-171	.....	.....	.....	202.87	1.14	2.62	.08	8	8 3/16	3/32	7.987	.045	.103	.003	2-171
2-172	.....	.....	.....	209.22	1.27	2.62	.08	8 1/4	8 7/16	3/32	8.237	.050	.103	.003	2-172
2-173	.....	.....	.....	215.57	1.27	2.62	.08	8 1/2	8 11/16	3/32	8.487	.050	.103	.003	2-173
2-174	.....	.....	.....	221.92	1.27	2.62	.08	8 3/4	8 15/16	3/32	8.737	.050	.103	.003	2-174

(a) The rubber compound must be added when ordering by the 2-size number (i.e., 2-007 N674-70)

(b) Material with unusual shrinkage during molding will give slightly different dimensions

(c) AS568 included Class I and Class II tolerances. Revision AS568A includes only a single tolerance class as shown

(d) Parker Series b-xxx Parbaks (Anti-Extrusion, Back-Up Rings) are available for use with Series 2-xxx O-rings. See page 5

Parker Series 2- O-Ring Sizes

1	2	3	4	5				6			7				8
Compound Specificat'ns	MIL-P-5516	AMS 7270	AMS 7274	METRIC O-RING SIZE (Units Are In Millimeters)				NOMINAL SIZE			STANDARD O-RING SIZE (Units Are In Inches)				
Parker Compound	PSI-30-5 N304-75	N179-70	N180-70	Actual (b) Per AS 568A				(Inches)			Actual (b) Per AS 568A				
Series No. / Parker Size (a)	AN6227B AN6230B Dash No.	AN12XXXX Part No.	AN123XXX Part No.	I.D.	Tol. (c) ±	W	±	(REF. ONLY) I.D.	O.D.	W	I.D.	Tol. (c) ±	W	±	Series No. / Parker Size (a)
2-175	.....	.....	.....	228.27	1.27	2.62	.08	9	9 3/16	3/32	8.987	.050	.103	.003	2-175
2-176	.....	.....	.....	234.62	1.40	2.62	.08	9 1/4	9 7/16	3/32	9.237	.055	.103	.003	2-176
2-177	.....	.....	.....	240.97	1.40	2.62	.08	9 1/2	9 11/16	3/32	9.487	.055	.103	.003	2-177
2-178	.....	.....	.....	247.32	1.40	2.62	.08	9 3/4	9 15/16	3/32	9.737	.055	.103	.003	2-178
2-201	.....	.....	.....	4.34	.13	3.53	.10	3/16	7/16	1/8	.171	.005	.139	.004	2-201
2-202	.....	.....	.....	5.94	.13	3.53	.10	1/4	1/2	1/8	.234	.005	.139	.004	2-202
2-203	.....	.....	.....	7.52	.13	3.53	.10	5/16	9/16	1/8	.296	.005	.139	.004	2-203
2-204	.....	.....	.....	9.12	.13	3.53	.10	3/8	5/8	1/8	.359	.005	.139	.004	2-204
2-205	.....	.....	.....	10.69	.13	3.53	.10	7/16	11/16	1/8	.421	.005	.139	.004	2-205
2-206	.....	.....	.....	12.29	.13	3.53	.10	1/2	3/4	1/8	.484	.005	.139	.004	2-206
2-207	.....	.....	.....	13.87	.18	3.53	.10	9/16	13/16	1/8	.546	.007	.139	.004	2-207
2-208	.....	.....	.....	15.47	.23	3.53	.10	5/8	7/8	1/8	.609	.009	.139	.004	2-208
2-209	.....	.....	.....	17.04	.23	3.53	.10	11/16	15/16	1/8	.671	.009	.139	.004	2-209
2-210	AN6227B-15	AN123970	AN123870	18.64	.25	3.53	.10	3/4	1	1/8	.734	.010	.139	.004	2-210
2-211	AN6227B-16	AN123971	AN123871	20.22	.25	3.53	.10	13/16	1 1/16	1/8	.796	.010	.139	.004	2-211
2-212	AN6227B-17	AN123972	AN123872	21.82	.25	3.53	.10	7/8	1 1/8	1/8	.859	.010	.139	.004	2-212
2-213	AN6227B-18	AN123973	AN123873	23.39	.25	3.53	.10	15/16	1 3/16	1/8	.921	.010	.139	.004	2-213
2-214	AN6227B-19	AN123974	AN123874	24.99	.25	3.53	.10	1	1 1/4	1/8	.984	.010	.139	.004	2-214
2-215	AN6227B-20	AN123975	AN123875	26.57	.25	3.53	.10	1 1/16	1 5/16	1/8	1.046	.010	.139	.004	2-215
2-216	AN6227B-21	AN123976	AN123876	28.17	.30	3.53	.10	1 1/8	1 3/8	1/8	1.109	.012	.139	.004	2-216
2-217	AN6227B-22	AN123977	AN123877	29.74	.30	3.53	.10	1 3/16	1 7/16	1/8	1.171	.012	.139	.004	2-217
2-218	AN6227B-23	AN123978	AN123878	31.34	.30	3.53	.10	1 1/4	1 1/2	1/8	1.234	.012	.139	.004	2-218
2-219	AN6227B-24	AN123979	AN123879	32.92	.30	3.53	.10	1 5/16	1 9/16	1/8	1.296	.012	.139	.004	2-219
2-220	AN6227B-25	AN123980	AN123880	34.52	.30	3.53	.10	1 3/8	1 5/8	1/8	1.359	.012	.139	.004	2-220
2-221	AN6227B-26	AN123981	AN123881	36.09	.30	3.53	.10	1 7/16	1 11/16	1/8	1.421	.012	.139	.004	2-221
2-222	AN6227B-27	AN123982	AN123882	37.69	.38	3.53	.10	1 1/2	1 3/4	1/8	1.484	.015	.139	.004	2-222
2-223	AN6230B-1	AN123983	AN123883	40.87	.38	3.53	.10	1 5/8	1 7/8	1/8	1.609	.015	.139	.004	2-223
2-224	AN6230B-2	AN123984	AN123884	44.04	.38	3.53	.10	1 3/4	2	1/8	1.734	.015	.139	.004	2-224
2-225	AN6230B-3	AN123985	AN123885	47.22	.46	3.53	.10	1 7/8	2 1/8	1/8	1.859	.018	.139	.004	2-225
2-226	AN6230B-4	AN123986	AN123886	50.39	.46	3.53	.10	2	2 1/4	1/8	1.984	.018	.139	.004	2-226
2-227	AN6230B-5	AN123987	AN123887	53.57	.46	3.53	.10	2 1/8	2 3/8	1/8	2.109	.018	.139	.004	2-227
2-228	AN6230B-6	AN123988	AN123888	56.74	.51	3.53	.10	2 1/4	2 1/2	1/8	2.234	.020	.139	.004	2-228
2-229	AN6230B-7	AN123989	AN123889	59.92	.51	3.53	.10	2 3/8	2 5/8	1/8	2.359	.020	.139	.004	2-229
2-230	AN6230B-8	AN123990	AN123890	63.09	.51	3.53	.10	2 1/2	2 3/4	1/8	2.484	.020	.139	.004	2-230
2-231	AN6230B-9	AN123991	AN123891	66.27	.51	3.53	.10	2 5/8	2 7/8	1/8	2.609	.020	.139	.004	2-231
2-232	AN6230B-10	AN123992	AN123892	69.44	.61	3.53	.10	2 3/4	3	1/8	2.734	.024	.139	.004	2-232
2-233	AN6230B-11	AN123993	AN123893	72.62	.61	3.53	.10	2 7/8	3 1/8	1/8	2.859	.024	.139	.004	2-233
2-234	AN6230B-12	AN123994	AN123894	75.79	.61	3.53	.10	3	3 1/4	1/8	2.984	.024	.139	.004	2-234
2-235	AN6230B-13	AN123995	AN123895	78.97	.61	3.53	.10	3 1/8	3 3/8	1/8	3.109	.024	.139	.004	2-235
2-236	AN6230B-14	AN123996	AN123896	82.14	.61	3.53	.10	3 1/4	3 1/2	1/8	3.234	.024	.139	.004	2-236
2-237	AN6230B-15	AN123997	AN123897	85.32	.61	3.53	.10	3 3/8	3 5/8	1/8	3.359	.024	.139	.004	2-237

(a) The rubber compound must be added when ordering by the 2-size number (i.e. 2-007 N674-70)

(b) Material with unusual shrinkage during molding will give slightly different dimensions.

(c) AS568 included Class I and Class II tolerances. Revision AS568A includes only a single tolerance class as shown.

(d) Parker Series 8-xxx Parbaks (Anti-Extrusion, Back-Up Rings) are available for use with Series 2-xxx O-rings. See page 5

Parker Series 2- O-Ring Sizes

1	2	3	4	5				6			7				8
Compound Specificat'ns	MIL-P-5516	AMS 7270	AMS 7274	METRIC O-RING SIZE (Units Are in Millimeters)				NOMINAL SIZE			STANDARD O-RING SIZE (Units Are in Inches)				
Parker Compound	PSI-30-5 N304-75	N179-70	N180-70	Actual (b) Per AS 568A				(Inches)			Actual (b) Per AS 568A				
Series No. / Parker Size (a)	AN6227B AN6230B Dash No.	AN12XXXX Part No.	AN123XXX Part No.	I.D.	Tol. (c) ±	W	±	(REF. ONLY) I.D.	O.D.	W	I.D.	Tol. (c) ±	W	±	Series No. / Parker Size (a)
2-238	AN6230B-16	AN123998	AN123898	88.49	.61	3.53	.10	3½	3¾	⅛	3.484	.024	.139	.004	2-238
2-239	AN6230B-17	AN123999	AN123899	91.67	.71	3.53	.10	3⅝	3⅞	⅛	3.609	.028	.139	.004	2-239
2-240	AN6230B-18	AN124000	AN123900	94.84	.71	3.53	.10	3¾	4	⅛	3.734	.028	.139	.004	2-240
2-241	AN6230B-19	AN124001	AN123901	98.02	.71	3.53	.10	3⅞	4⅛	⅛	3.859	.028	.139	.004	2-241
2-242	AN6230B-20	AN124002	AN123902	101.19	.71	3.53	.10	4	4¼	⅛	3.984	.028	.139	.004	2-242
2-243	AN6230B-21	AN124003	AN123903	104.37	.71	3.53	.10	4⅛	4⅜	⅛	4.109	.028	.139	.004	2-243
2-244	AN6230B-22	AN124004	AN123904	107.54	.76	3.53	.10	4¼	4½	⅛	4.234	.030	.139	.004	2-244
2-245	AN6230B-23	AN124005	AN123905	110.72	.76	3.53	.10	4⅜	4⅝	⅛	4.359	.030	.139	.004	2-245
2-246	AN6230B-24	AN124006	AN123906	113.89	.76	3.53	.10	4½	4¾	⅛	4.484	.030	.139	.004	2-246
2-247	AN6230B-25	AN124007	AN123907	117.07	.76	3.53	.10	4⅝	4⅞	⅛	4.609	.030	.139	.004	2-247
2-248	AN6230B-26	AB124008	AN123908	120.24	.76	3.53	.10	4¾	5	⅛	4.734	.030	.139	.004	2-248
2-249	AN6230B-27	AN124009	AN123909	123.42	.89	3.53	.10	4⅞	5⅛	⅛	4.859	.035	.139	.004	2-249
2-250	AN6230B-28	AN124010	AN123910	126.59	.89	3.53	.10	5	5¼	⅛	4.984	.035	.139	.004	2-250
2-251	AN6230B-29	AN124011	AN123911	129.77	.89	3.53	.10	5⅛	5⅜	⅛	5.109	.035	.139	.004	2-251
2-252	AN6230B-30	AN124012	AN123912	132.94	.89	3.53	.10	5¼	5½	⅛	5.234	.035	.139	.004	2-252
2-253	AN6230B-31	AN124013	AN123913	136.12	.89	3.53	.10	5⅜	5⅝	⅛	5.359	.035	.139	.004	2-253
2-254	AN6230B-32	AN124014	AN123914	139.29	.89	3.53	.10	5½	5¾	⅛	5.484	.035	.139	.004	2-254
2-255	AN6230B-33	AN124015	AN123915	142.47	.89	3.53	.10	5⅝	5⅞	⅛	5.609	.035	.139	.004	2-255
2-256	AN6230B-34	AN124016	AN123916	145.64	.89	3.53	.10	5¾	6	⅛	5.734	.035	.139	.004	2-256
2-257	AN6230B-35	AN124017	AN123917	148.82	.89	3.53	.10	5⅞	6⅛	⅛	5.859	.035	.139	.004	2-257
2-258	AN6230B-36	AN124018	AN123918	151.99	.89	3.53	.10	6	6¼	⅛	5.984	.035	.139	.004	2-258
2-259	AN6230B-37	AN124019	AN123919	158.34	1.02	3.53	.10	6¼	6½	⅛	6.234	.040	.139	.004	2-259
2-260	AN6230B-38	AN124020	AN123920	164.69	1.02	3.53	.10	6½	6¾	⅛	6.484	.040	.139	.004	2-260
2-261	AN6230B-39	AN124021	AN123921	171.04	1.02	3.53	.10	6¾	7	⅛	6.734	.040	.139	.004	2-261
2-262	AN6230B-40	AN124022	AN123922	177.39	1.02	3.53	.10	7	7¼	⅛	6.984	.040	.139	.004	2-262
2-263	AN6230B-41	AN124023	AN123923	183.74	1.14	3.53	.10	7¼	7½	⅛	7.234	.045	.139	.004	2-263
2-264	AN6230B-42	AN124024	AN123924	190.09	1.14	3.53	.10	7½	7¾	⅛	7.484	.045	.139	.004	2-264
2-265	AN6230B-43	AN124025	AN123925	196.44	1.14	3.53	.10	7¾	8	⅛	7.734	.045	.139	.004	2-265
2-266	AN6230B-44	AN124026	AN123926	202.79	1.14	3.53	.10	8	8¼	⅛	7.984	.045	.139	.004	2-266
2-267	AN6230B-45	AN124027	AN123927	209.14	1.27	3.53	.10	8¼	8½	⅛	8.234	.050	.139	.004	2-267
2-268	AN6230B-46	AN124028	AN123928	215.49	1.27	3.53	.10	8½	8¾	⅛	8.484	.050	.139	.004	2-268
2-269	AN6230B-47	AN124029	AN123929	221.84	1.27	3.53	.10	8¾	9	⅛	8.734	.050	.139	.004	2-269
2-270	AN6230B-48	AN124030	AN123930	228.19	1.27	3.53	.10	9	9¼	⅛	8.984	.050	.139	.004	2-270
2-271	AN6230B-49	AN124031	AN123931	234.54	1.40	3.53	.10	9¼	9½	⅛	9.234	.055	.139	.004	2-271
2-272	AN6230B-50	AN124032	AN123932	240.89	1.40	3.53	.10	9½	9¾	⅛	9.484	.055	.139	.004	2-272
2-273	AN6230B-51	AN124033	AN123933	247.24	1.40	3.53	.10	9¾	10	⅛	9.734	.055	.139	.004	2-273
2-274	AN6230B-52	AN124034	AN123934	253.59	1.40	3.53	.10	10	10¼	⅛	9.984	.055	.139	.004	2-274
2-275	.....	.....	.....	266.29	1.40	3.53	.10	10½	10¾	⅛	10.484	.055	.139	.004	2-275
2-276	.....	.....	.....	278.99	1.65	3.53	.10	11	11¼	⅛	10.984	.065	.139	.004	2-276
2-277	.....	.....	.....	291.69	1.65	3.53	.10	11½	11¾	⅛	11.484	.065	.139	.004	2-277
2-278	.....	.....	.....	304.39	1.65	3.53	.10	12	12¼	⅛	11.984	.065	.139	.004	2-278

(a) The rubber compound must be added when ordering by the 2-size number (i.e. 2-007 N674-70)

(b) Material with unusual shrinkage during molding will give slightly different dimensions

(c) AS568 included Class I and Class II tolerances. Revision AS568A includes only a single tolerance (Class as shown

(d) Parker Series 8 xxx Parbaks (Anti-Extrusion Back-Up Rings) are available for use with Series 2-xxx O-rings. See page 5

Parker Series 2- O-Ring Sizes

1	2	3	4	5				6			7				8
Compound Specificat'ns	MIL-P-5516	AMS 7270	AMS 7274	METRIC O-RING SIZE (Units Are in Millimeters)				NOMINAL SIZE			STANDARD O-RING SIZE (Units Are in Inches)				
Parker Compound	PSI-30-5 N304-75	N179-70	N180-70	Actual (b) Per AS 568A				(Inches)			Actual (b) Per AS 568A				
Series No. / Parker Size (a)	AN6227B AN6230B Dash No.	AN12XXXX Part No.	AN123XXX Part No.	I.D.	Tol. (c) ±	W	±	(REF. ONLY) I.D.	O.D.	W	I.D.	Tol. (c) ±	W	±	Series No. / Parker Size (a)
2-279	....	....	....	329.79	1.65	3.53	.10	13	13 1/4	1/8	12.984	.065	.139	.004	2-279
2-280	....	....	....	355.19	1.65	3.53	.10	14	14 1/4	1/8	13.984	.065	.139	.004	2-280
2-281	....	....	....	380.59	1.65	3.53	.10	15	15 1/4	1/8	14.984	.065	.139	.004	2-281
2-282	....	....	....	405.26	1.91	3.53	.10	16	16 1/4	1/8	15.955	.075	.139	.004	2-282
2-283	....	....	....	430.66	2.03	3.53	.10	17	17 1/4	1/8	16.955	.080	.139	.004	2-283
2-284	....	....	....	456.06	2.16	3.53	.10	18	18 1/4	1/8	17.955	.085	.139	.004	2-284
2-309	....	....	....	10.46	.13	5.33	.13	7/16	13/16	3/16	.412	.005	.210	.005	2-309
2-310	....	....	....	12.07	.13	5.33	.13	1/2	7/8	3/16	.475	.005	.210	.005	2-310
2-311	....	....	....	13.64	.18	5.33	.13	9/16	15/16	3/16	.537	.007	.210	.005	2-311
2-312	....	....	....	15.24	.23	5.33	.13	5/8	1	3/16	.600	.009	.210	.005	2-312
2-313	....	....	....	16.81	.23	5.33	.13	11/16	1 1/16	3/16	.662	.009	.210	.005	2-313
2-314	....	....	....	18.42	.25	5.33	13	3/4	1 1/8	3/16	.725	.010	.210	.005	2-314
2-315	....	....	....	19.99	.25	5.33	.13	13/16	1 3/16	3/16	.787	.010	.210	.005	2-315
2-316	....	....	....	21.59	.25	5.33	.13	7/8	1 1/4	3/16	.850	.010	.210	.005	2-316
2-317	....	....	....	23.16	.25	5.33	.13	15/16	1 5/16	3/16	.912	.010	.210	.005	2-317
2-318	....	....	....	24.77	.25	5.33	.13	1	1 3/8	3/16	.975	.010	.210	.005	2-318
2-319	....	....	....	26.34	.25	5.33	.13	1 1/16	1 7/16	3/16	1.037	.010	.210	.005	2-319
2-320	....	....	....	27.94	.30	5.33	.13	1 1/8	1 1/2	3/16	1.100	.012	.210	.005	2-320
2-321	....	....	....	29.51	.30	5.33	.13	1 3/16	1 9/16	3/16	1.162	.012	.210	.005	2-321
2-322	....	....	....	31.12	.30	5.33	.13	1 1/4	1 5/8	3/16	1.225	.012	.210	.005	2-322
2-323	....	....	....	32.69	.30	5.33	.13	1 5/16	1 11/16	3/16	1.287	.012	.210	.005	2-323
2-324	....	....	....	34.29	.30	5.33	.13	1 3/8	1 3/4	3/16	1.350	.012	.210	.005	2-324
2-325	AN6227B-28	....	....	37.47	.38	5.33	.13	1 1/2	1 7/8	3/16	1.475	.015	.210	.005	2-325
2-326	AN6227B-29	....	....	40.64	.38	5.33	13	1 5/8	2	3/16	1.600	.015	.210	.005	2-326
2-327	AN6227B-30	....	....	43.82	.38	5.33	.13	1 3/4	2 1/8	3/16	1.725	.015	.210	.005	2-327
2-328	AN6227B-31	....	....	46.99	.38	5.33	.13	1 7/8	2 1/4	3/16	1.850	.015	.210	.005	2-328
2-329	AN6227B-32	....	....	50.17	.46	5.33	.13	2	2 3/8	3/16	1.975	.018	.210	.005	2-329
2-330	AN6227B-33	....	....	53.34	.46	5.33	.13	2 1/8	2 1/2	3/16	2.100	.018	.210	.005	2-330
2-331	AN6227B-34	....	....	56.52	.46	5.33	.13	2 1/4	2 5/8	3/16	2.225	.018	.210	.005	2-331
2-332	AN6227B-35	....	....	59.69	.46	5.33	.13	2 3/8	2 3/4	3/16	2.350	.018	.210	.005	2-332
2-333	AN6227B-36	....	....	62.87	.51	5.33	.13	2 1/2	2 7/8	3/16	2.475	.020	.210	.005	2-333
2-334	AN6227B-37	....	....	66.04	.51	5.33	.13	2 5/8	3	3/16	2.600	.020	.210	.005	2-334
2-335	AN6227B-38	....	....	69.22	.51	5.33	.13	2 3/4	3 1/8	3/16	2.725	.020	.210	.005	2-335
2-336	AN6227B-39	....	....	72.39	.51	5.33	.13	2 7/8	3 1/4	3/16	2.850	.020	.210	.005	2-336
2-337	AN6227B-40	....	....	75.57	.61	5.33	.13	3	3 3/8	3/16	2.975	.024	.210	.005	2-337
2-338	AN6227B-41	....	....	78.74	.61	5.33	.13	3 1/8	3 1/2	3/16	3.100	.024	.210	.005	2-338
2-339	AN6227B-42	....	....	81.92	.61	5.33	.13	3 1/4	3 5/8	3/16	3.225	.024	.210	.055	2-339
2-340	AN6227B-43	....	....	85.09	.61	5.33	.13	3 3/8	3 3/4	3/16	3.350	.024	.210	.005	2-340
2-341	AN6227B-44	....	....	88.27	.61	5.33	.13	3 1/2	3 7/8	3/16	3.475	.024	.210	.005	2-341
2-342	AN6227B-45	....	....	91.44	.71	5.33	.13	3 5/8	4	3/16	3.600	.028	.210	.005	2-342
2-343	AN6227B-46	....	....	94.62	.71	5.33	.13	3 3/4	4 1/8	3/16	3.725	.028	.210	.005	2-343

(a) The rubber compound must be added when ordering by the 2-size number (i.e. 2-007 N674-70).

(b) Material with unusual shrinkage during molding will give slightly different dimensions.

(c) AS568 [illegible] as shown.

(d) Parker Series 8-xxx Parbaks (Anti-Extrusion Back-Up Rings) are available for use with Series 2-xxx O-rings. See page 5.

Parker Series 2- O-Ring Sizes

1	2	3	4	5				6			7				8
Compound Specificat'ns	MIL-P-5516	AMS 7270	AMS 7274	METRIC O-RING SIZE (Units Are in Millimeters)				NOMINAL SIZE			STANDARD O-RING SIZE (Units Are in Inches)				
Parker Compound	P5I-30-5 N304-75	N179-70	N180-70	Actual (b) Per AS 568A				(Inches)			Actual (b) Per AS 568A				
Series No. / Parker Size (a)	AN6227B AN6230B Dash No.	AN12XXXX Part No.	AN123XXX Part No.	I.D.	Tol. (c) ±	W	±	(REF. ONLY) I.D.	O.D.	W	I.D.	Tol. (c) ±	W	±	Series No. / Parker Size (a)
2-344	AN6227B-47	.....	.....	97.79	.71	5.33	.13	3⅞	4¼	3/16	3.850	.028	.210	.005	2-344
2-345	AN6227B-48	.....	.....	100.97	.71	5.33	.13	4	4⅜	3/16	3.975	.028	.210	.005	2-345
2-346	AN6227B-49	.....	.....	104.14	.71	5.33	.13	4⅛	4½	3/16	4.100	.028	.210	.005	2-346
2-347	AN6227B-50	.....	.....	107.32	.76	5.33	.13	4¼	4⅝	3/16	4.225	.030	.210	.005	2-347
2-348	AN6227B-51	.....	.....	110.49	.76	5.33	.13	4⅜	4¾	3/16	4.350	.030	.210	.005	2-348
2-349	AN6227B-52	.....	.....	113.67	.76	5.33	.13	4½	4⅞	3/16	4.475	.030	.210	.005	2-349
2-350	.....	.....	.....	116.84	.76	5.33	.13	4⅝	5	3/16	4.600	.030	.210	.005	2-350
2-351	.....	.....	.....	120.02	.76	5.33	.13	4¾	5⅛	3/16	4.725	.030	.210	.005	2-351
2-352	.....	.....	.....	123.19	.76	5.33	.13	4⅞	5¼	3/16	4.850	.030	.210	.005	2-352
2-353	.....	.....	.....	126.37	.94	5.33	.13	5	5⅜	3/16	4.975	.037	.210	.005	2-353
2-354	.....	.....	.....	129.54	.94	5.33	.13	5⅛	5½	3/16	5.100	.037	.210	.005	2-354
2-355	.....	.....	.....	132.72	.94	5.33	.13	5¼	5⅝	3/16	5.225	.037	.210	.005	2-355
2-356	.....	.....	.....	135.89	.94	5.33	.13	5⅜	5¾	3/16	5.350	.037	.210	.005	2-356
2-357	.....	.....	.....	139.07	.94	5.33	.13	5½	5⅞	3/16	5.475	.037	.210	.005	2-357
2-358	.....	.....	.....	142.24	.94	5.33	.13	5⅝	6	3/16	5.600	.037	.210	.005	2-358
2-359	.....	.....	.....	145.42	.94	5.33	.13	5¾	6⅛	3/16	5.725	.037	.210	.005	2-359
2-360	.....	.....	.....	148.59	.94	5.33	.13	5⅞	6¼	3/16	5.850	.037	.210	.005	2-360
2-361	.....	.....	.....	151.77	.94	5.33	.13	6	6⅜	3/16	5.975	.037	.210	.005	2-361
2-362	.....	.....	.....	158.12	1.02	5.33	.13	6¼	6⅝	3/16	6.225	.040	.210	.005	2-362
2-363	.....	.....	.....	164.47	1.02	5.33	.13	6½	6⅞	3/16	6.475	.040	.210	.005	2-363
2-364	.....	.....	.....	170.82	1.02	5.33	.13	6¾	7⅛	3/16	6.725	.040	.210	.005	2-364
2-365	.....	.....	.....	177.17	1.02	5.33	.13	7	7⅜	3/16	6.975	.040	.210	.005	2-365
2-366	.....	.....	.....	183.52	1.14	5.33	.13	7¼	7⅝	3/16	7.225	.045	.210	.005	2-366
2-367	.....	.....	.....	189.87	1.14	5.33	.13	7½	7⅞	3/16	7.475	.045	.210	.005	2-367
2-368	.....	.....	.....	196.22	1.14	5.33	.13	7¾	8⅛	3/16	7.725	.045	.210	.005	2-368
2-369	.....	.....	.....	202.57	1.14	5.33	.13	8	8⅜	3/16	7.975	.045	.210	.005	2-369
2-370	.....	.....	.....	208.92	1.27	5.33	.13	8¼	8⅝	3/16	8.225	.050	.210	.005	2-370
2-371	.....	.....	.....	215.27	1.27	5.33	.13	8½	8⅞	3/16	8.475	.050	.210	.005	2-371
2-372	.....	.....	.....	221.62	1.27	5.33	.13	8¾	9⅛	3/16	8.725	.050	.210	.005	2-372
2-373	.....	.....	.....	227.97	1.27	5.33	.13	9	9⅜	3/16	8.975	.050	.210	.005	2-373
2-374	.....	.....	.....	234.32	1.40	5.33	.13	9¼	9⅝	3/16	9.225	.055	.210	.005	2-374
2-375	.....	.....	.....	240.67	1.40	5.33	.13	9½	9⅞	3/16	9.475	.055	.210	.005	2-375
2-376	.....	.....	.....	247.02	1.40	5.33	.13	9¾	10⅛	3/16	9.725	.055	.210	.005	2-376
2-377	.....	.....	.....	253.37	1.40	5.33	.13	10	10⅜	3/16	9.975	.055	.210	.005	2-377
2-378	.....	.....	.....	266.07	1.52	5.33	.13	10½	10⅞	3/16	10.475	.060	.210	.005	2-378
2-379	.....	.....	.....	278.77	1.52	5.33	.13	11	11⅜	3/16	10.975	.060	.210	.005	2-379
2-380	.....	.....	.....	291.47	1.65	5.33	.13	11½	11⅞	3/16	11.475	.065	.210	.005	2-380
2-381	.....	.....	.....	304.17	1.65	5.33	.13	12	12⅜	3/16	11.975	.065	.210	.005	2-381
2-382	.....	.....	.....	329.57	1.65	5.33	.13	13	13⅜	3/16	12.975	.065	.210	.005	2-382
2-383	.....	.....	.....	354.97	1.78	5.33	.13	14	14⅜	3/16	13.975	.070	.210	.005	2-383
2-384	.....	.....	.....	380.37	1.78	5.33	.13	15	15⅜	3/16	14.975	.070	.210	.005	2-384

(a) The rubber compound must be added when ordering by the 2-size number (i.e., 2-007 N674-70)

(b) Material with unusual shrinkage during molding will give slightly different dimensions.

(c) AS568 included Class I and Class II tolerances. Revision AS568A includes only a single tolerance class as shown.

(d) Parker Series 5 xxx Parbaks (Anti-Extrusion Back Up Rings) are available for use with Series 2 xxx O-rings. See page 5

Parker Series 2- O-Ring Sizes

1	2	3	4	5				6			7				8
Compound Specificat'ns	MIL-P-5516	AMS 7270	AMS 7274	METRIC O-RING SIZE (Units Are In Millimeters)				NOMINAL SIZE			STANDARD O-RING SIZE (Units Are In Inches)				
Parker Compound	PSI-30-5 N304-75	N179-70	N180-70	Actual (b) Per AS 568A				(Inches)			Actual (b) Per AS 568A				
Series No. / Parker Size (a)	AN6227B AN6230B Dash No.	AN12XXXX Part No.	AN123XXX Part No.	I.D.	Tol. (c) ±	W	±	(REF. ONLY) I.D.	O.D.	W	I.D.	Tol. (c) ±	W	±	Series No. / Parker Size (a)
2-385	.....	.....	.....	405.26	1.91	5.33	.13	16	16⅞	3/16	15.955	.075	.210	.005	2-385
2-386	.....	.....	.....	430.66	2.03	5.33	.13	17	17⅞	3/16	16.955	.080	.210	.005	2-386
2-387	.....	.....	.....	456.06	2.16	5.33	.13	18	18⅞	3/16	17.955	.085	.210	.005	2-387
2-388	.....	.....	.....	481.41	2.29	5.33	.13	19	19⅞	3/16	18.955	.090	.210	.005	2-388
2-389	.....	.....	.....	506.81	2.41	5.33	.13	20	20⅞	3/16	19.955	.095	.210	.005	2-389
2-390	.....	.....	.....	532.21	2.41	5.33	.13	21	21⅞	3/16	20.955	.095	.210	.005	2-390
2-391	.....	.....	.....	557.61	2.54	5.33	.13	22	22⅞	3/16	21.955	.100	.210	.005	2-391
2-392	.....	.....	.....	582.68	2.67	5.33	.13	23	23⅞	3/16	22.940	.105	.210	.005	2-392
2-393	.....	.....	.....	608.08	2.79	5.33	.13	24	24⅞	3/16	23.940	.110	.210	.005	2-393
2-394	.....	.....	.....	633.48	2.92	5.33	.13	25	25⅞	3/16	24.940	.115	.210	.005	2-394
2-395	.....	.....	.....	658.88	3.05	5.33	.13	26	26⅞	3/16	25.940	.120	.210	.005	2-395
2-425	AN6227B-88	.....	.....	113.67	.84	6.99	.15	4½	5	¼	4.475	.033	.275	.006	2-425
2-426	AN6227B-53	.....	.....	116.84	.84	6.99	.15	4⅝	5⅛	¼	4.600	.033	.275	.006	2-426
2-427	AN6227B-54	.....	.....	120.02	.84	6.99	.15	4¾	5¼	¼	4.725	.033	.275	.006	2-427
2-428	AN6227B-55	.....	.....	123.19	.84	6.99	.15	4⅞	5⅜	¼	4.850	.033	.275	.006	2-428
2-429	AN6227B-56	.....	.....	126.37	.94	6.99	.15	5	5½	¼	4.975	.037	.275	.006	2-429
2-430	AN6227B-57	.....	.....	129.54	.94	6.99	.15	5⅛	5⅝	¼	5.100	.037	.275	.006	2-430
2-431	AN6227B-58	.....	.....	132.72	.94	6.99	.15	5¼	5¾	¼	5.225	.037	.275	.006	2-431
2-432	AN6227B-59	.....	.....	135.89	.94	6.99	.15	5⅜	5⅞	¼	5.350	.037	.275	.006	2-432
2-433	AN6227B-60	.....	.....	139.07	.94	6.99	.15	5½	6	¼	5.475	.037	.275	.006	2-433
2-434	AN6227B-61	.....	.....	142.24	.94	6.99	.15	5⅝	6⅛	¼	5.600	.037	.275	.006	2-434
2-435	AN6227B-62	.....	.....	145.42	.94	6.99	.15	5¾	6¼	¼	5.725	.037	.275	.006	2-435
2-436	AN6227B-63	.....	.....	148.59	.94	6.99	.15	5⅞	6⅜	¼	5.850	.037	.275	.006	2-436
2-437	AN6227B-64	.....	.....	151.77	.94	6.99	.15	6	6½	¼	5.975	.037	.275	.006	2-437
2-438	AN6227B-65	.....	.....	158.12	1.02	6.99	.15	6¼	6¾	¼	6.225	.040	.275	.006	2-438
2-439	AN6227B-66	.....	.....	164.47	1.02	6.99	.15	6½	7	¼	6.475	.040	.275	.006	2-439
2-440	AN6227B-67	.....	.....	170.82	1.02	6.99	.15	6¾	7¼	¼	6.725	.040	.275	.006	2-440
2-441	AN6227B-68	.....	.....	177.17	1.02	6.99	.15	7	7½	¼	6.975	.040	.275	.006	2-441
2-442	AN6227B-69	.....	.....	183.52	1.14	6.99	.15	7¼	7¾	¼	7.225	.045	.275	.006	2-442
2-443	AN6227B-70	.....	.....	189.87	1.14	6.99	.15	7½	8	¼	7.475	.045	.275	.006	2-443
2-444	AN6227B-71	.....	.....	196.22	1.14	6.99	.15	7¾	8¼	¼	7.725	.045	.275	.006	2-444
2-445	AN6227B-72	.....	.....	202.57	1.14	6.99	.15	8	8½	¼	7.975	.045	.275	.006	2-445
2-446	AN6227B-73	.....	.....	215.27	1.40	6.99	.15	8½	9	¼	8.475	.055	.275	.006	2-446
2-447	AN6227B-74	.....	.....	227.97	1.40	6.99	.15	9	9½	¼	8.975	.055	.275	.006	2-447
2-448	AN6227B-75	.....	.....	240.67	1.40	6.99	.15	9½	10	¼	9.475	.055	.275	.006	2-448
2-449	AN6227B-76	.....	.....	253.37	1.40	6.99	.15	10	10½	¼	9.975	.055	.275	.006	2-449
2-450	AN6227B-77	.....	.....	266.07	1.52	6.99	.15	10½	11	¼	10.475	.060	.275	.006	2-450
2-451	AN6227B-78	.....	.....	278.77	1.52	6.99	.15	11	11½	¼	10.975	.060	.275	.006	2-451
2-452	AN6227B-79	.....	.....	291.47	1.52	6.99	.15	11½	12	¼	11.475	.060	.275	.006	2-452
2-453	AN6227B-80	.....	.....	304.17	1.52	6.99	.15	12	12½	¼	11.975	.060	.275	.006	2-453
2-454	AN6227B-81	.....	.....	316.87	1.52	6.99	.15	12½	13	¼	12.475	.060	.275	.006	2-454
2-455	AN6227B-82	.....	.....	329.57	1.52	6.99	.15	13	13½	¼	12.975	.060	.275	.006	2-455

(a) The rubber compound must be added when ordering by the 2-size number (ex: 2-007 N674-70).

(b) Material with unusual shrinkage during molding will give slightly different dimensions.

(c) AS568 includes Class I and Class II tolerances. Revision AS568A includes only a single tolerance class.

(d) Parker Series 8 xxx Parbaks (Anti-Extrusion Back Up Rings) are available for use with Series 2 xxx O rings. See page 5.

Parker Series 2- O-Ring Sizes

1	2	3	4	5				6			7				8
Compound Specificat'ns	MIL-P-5516	AMS 7270	AMS 7274	METRIC O-RING SIZE (Units Are In Millimeters)				NOMINAL SIZE			STANDARD O-RING SIZE (Units Are In Inches)				
Parker Compound	PSI-30-5 N304-75	N179-70	N180-70	Actual (b) Per AS 568A				(Inches)			Actual (b) Per AS 568A				
Series No. / Parker Size (a)	AN6227B AN6230B Dash No.	AN12XXXX Part No.	AN123XXX Part No.	I.D.	Tol. (c) ±	W	±	(REF. ONLY) I.D.	O.D.	W	I.D.	Tol. (c) ±	W	±	Series No. / Parker Size (a)
2-456	AN6227B-83	.....	.....	342.27	1.78	6.99	.15	13½	14	¼	13.475	.070	.275	.006	2-456
2-457	AN6227B-84	.....	.....	354.97	1.78	6.99	.15	14	14½	¼	13.975	.070	.275	.006	2-457
2-458	AN6227B-85	.....	.....	367.67	1.78	6.99	.15	14½	15	¼	14.475	.070	.275	.006	2-458
2-459	AN6227B-86	.....	.....	380.37	1.78	6.99	.15	15	15½	¼	14.975	.070	.275	.006	2-459
2-460	AN6227B-87	.....	.....	393.07	1.78	6.99	.15	15½	16	¼	15.475	.070	.275	.006	2-460
2-461	.....	.....	.....	405.26	1.91	6.99	.15	16	16½	¼	15.955	.075	.275	.006	2-461
2-462	.....	.....	.....	417.96	1.91	6.99	.15	16½	17	¼	16.455	.075	.275	.006	2-462
2-463	.....	.....	.....	430.66	2.03	6.99	.15	17	17½	¼	16.955	.080	.275	.006	2-463
2-464	.....	.....	.....	443.36	2.16	6.99	.15	17½	18	¼	17.455	.085	.275	.006	2-464
2-465	.....	.....	.....	456.06	2.16	6.99	.15	18	18½	¼	17.955	.085	.275	.006	2-465
2-466	.....	.....	.....	468.76	2.16	6.99	.15	18½	19	¼	18.455	.085	.275	.006	2-466
2-467	.....	.....	.....	481.46	2.29	6.99	.15	19	19½	¼	18.955	.090	.275	.006	2-467
2-468	.....	.....	.....	494.16	2.29	6.99	.15	19½	20	¼	19.455	.090	.275	.006	2-468
2-469	.....	.....	.....	506.86	2.41	6.99	.15	20	20½	¼	19.955	.095	.275	.006	2-469
2-470	.....	.....	.....	532.26	2.41	6.99	.15	21	21½	¼	20.955	.095	.275	.006	2-470
2-471	.....	.....	.....	557.66	2.54	6.99	.15	22	22½	¼	21.955	.100	.275	.006	2-471
2-472	.....	.....	.....	582.68	2.67	6.99	.15	23	23½	¼	22.940	.105	.275	.006	2-472
2-473	.....	.....	.....	608.08	2.79	6.99	.15	24	24½	¼	23.940	.110	.275	.006	2-473
2-474	.....	.....	.....	633.48	2.92	6.99	.15	25	25½	¼	24.940	.115	.275	.006	2-474
2-475	.....	.....	.....	658.88	3.05	6.99	.15	26	26½	¼	25.940	.120	.275	.006	2-475

(a) The rubber compound must be added when ordering by the 2-size number (i.e., 2-007 N674-70)

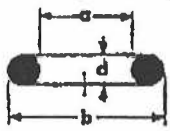
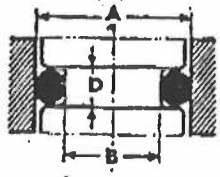
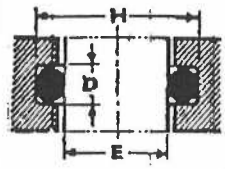
(b) Material with unusual shrinkage during molding will give slightly different dimensions

(c) AS568 included Class I and Class II tolerances. Revision AS568A includes only a single tolerance class as shown.

(d) Parker Series 8-xxx Parbaks (Anti-Extrusion, Back-Up Rings) are available for use with Series 2-xxx O-rings. See page 5

AS568A (PARKER 2-XXX) DASH NUMBERS LISTED IN OTHER SERIES

O-Ring Series	Compound Specification	Parker Compound Number
NAS1593 (e)	MIL-R-25897 (e) Type 1, Class 1	V747-75
NAS1594 (e)	MIL-R-25897 Type 1, Class 2	V709-90
NAS1611	NAS1613	E515-80
MS9021	AMS7271	N506-65
MS9068	AMS3304	S604-70
MS9241	AMS7272	N287-70 (d)
M25988/1 (f)	MIL-R-25988 Class 1, Grade 70	L677-70 (d)
M25988/3 (f)	MIL-R-25988 Class 1, Grade 60	L737-65 (d)
M25988/4 (f)	MIL-R-25988 Class 1, Grade 80	L806-80 (d)
MS29513	MIL-P-5315	N602-70
MS29561	MIL-R-7362	47 071
MS28775	MIL-P-25732	N304-75
M83248/1	MIL-R-83248 Class 1	V747-75/V884-75
M83248/2	MIL-R-83248 Class 2	V709-90/V894-90
M83461	MIL-P-83461	N756-75 (d)
M83485	MIL-R-83485	V835-75 (d)

	O-RING			MOUNTING DIMENSIONS				
								
				PISTON		GROOVE	CYLINDER	
AN 6227 Nr	d	a	b	A	B+0.1 −0	D+0.1 −0	E	H+0 −0.1
1*	1.78	2.90	6.46	5.75 6.00	2.85 3.10	2.4		
2*	1.78	3.68	7.24	6.50 6.90	3.60 4.00	2.4		
3	1.78	4.47	8.03	7.25 7.50 7.70	4.35 4.60 4.80	2.4	5.05 5.35	7.95 8.25
4	1.78	5.28	8.84	8.05 8.50 8.60	5.15 5.60 5.70	2.4	5.85 6 6.15	8.75 8.90 9.05
5	1.78	6.07	9.63	8.85 9.00 9.45	5.95 6.10 6.55	2.4	6.60 6.95	9.50 9.85
6	1.78	7.65	11.21	10.40 11.00 11.15	7.50 8.10 8.25	2.4	8.15 8.50	11.05 11.40
7	1.78	9.25	12.81	11.95 12.00 13.00 13.10	9.05 9.10 10.10 10.20	2.4	9.70 10 10.10	12.60 12.90 13.00
8	2.62	9.19	14.43	13.40 14.00 14.30	9.00 9.60 9.90	3.45	9.85 10 10.60	14.25 14.40 15.00
9	2.62	10.77	16.01	14.95 15.00 16.00	10.55 10.60 11.60	3.45	11.40 12 12.10	15.80 16.40 16.50
10	2.62	12.37	17.61	16.65 17.00 17.85	12.15 12.50 13.35	3.45	12.90 13 13.70	17.40 17.50 18.20
11	2.62	13.94	19.18	18.20 19.00 19.55	13.70 14.50 15.05	3.45	14.40 15 15.25	18.90 19.50 19.75
12	2.62	15.54	20.78	19.75 20.00 21.00 21.25	15.25 15.50 16.50 16.75	3.45	15.95 16 16.85	20.45 20.50 21.35
13	2.62	17.12	22.36	21.30 22.00 23.00	16.80 17.50 18.50	3.45	17.50 18 18.45	22.00 22.50 22.95
14	2.62	18.72	23.96	23.05 24.00 24.70	18.55 19.50 20.20	3.45	19.10 19.50 20	23.60 24.00 24.50
15	3.53	18.64	25.70	24.80 25.00 26.00 26.40	18.50 18.70 19.70 20.10	4.6	19 20 20.40	25.30 26.30 26.70

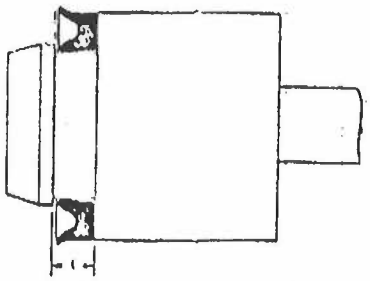
corresponding Nr designation of the R-Series

DIMENSIONS IN MM

* Open grooves necessary for installation of Rings nr 1 and nr 2.

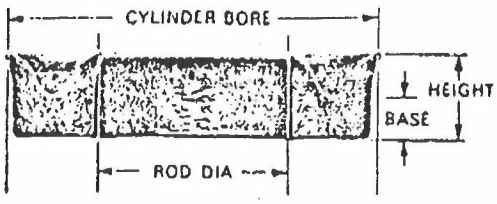
Gaco 'U' Packings Standard Metric Sizes

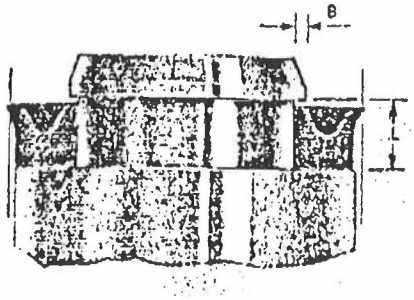
These Packings are normally supplied in Gaco Grade H9 (89 I.R.H.D.)

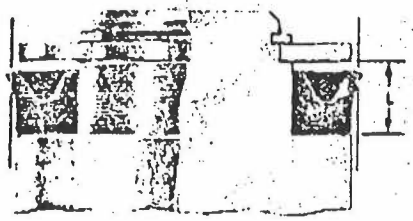


PACKING I.D.	A
5 – 25	3.0
26 – 100	5.0
Over 100	8.0

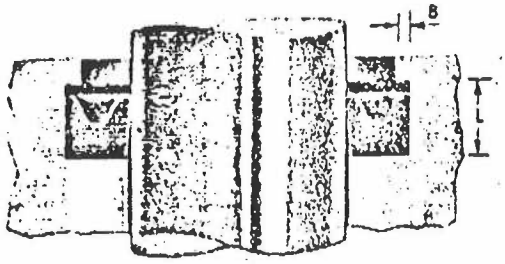
Sizes marked thus‡ conform to BS 1658: 1970
Sizes marked thus • are preferred sizes and should be chosen where

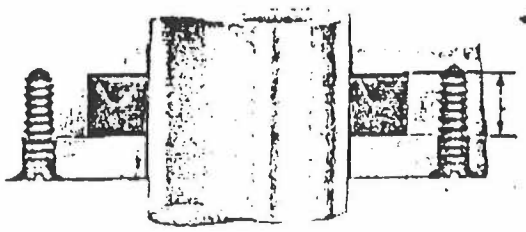






Piston Applications with alternative retention.





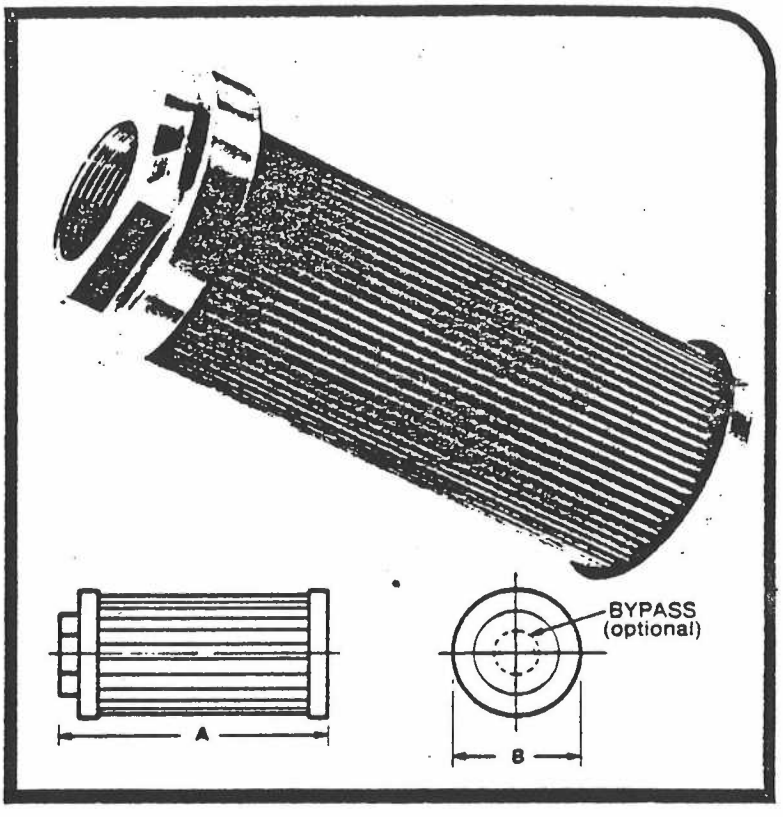
Ref. No.	Cylinder Bore	Rod Dia.	B	Height	Base
UM 125	12	5	1	5	2.5
UM 168	16	8	1	6	3.5
‡ UM 1606	16	6	1	6	3
UM 168	16	8	1	6	3
•UM 1688	16	8	1	8	4
UM 176	17	6	1	6	3
UM 186	18	6	1	8	4
‡ UM 1886	18	8	1	6	3
UM 206	20	6	1	8	4
‡•UM 20108	20	10	1	8	4
UM 2210	22	10	1	6	3
•UM 22108	22	10	1	8	4
‡ UM 22126	22	12	1	6	3
UM 2412	24	12	1	6	3
•UM 241210	24	12	1	10	5
‡ UM 24146	24	14	1	6	3
UM 258	25	8	1	6	3
•UM 251010	25	10	1	10	5
‡ UM 25166	25	16	1	6	3
UM 2610	26	10	1	8	4
•UM 261210	26	12	1	10	5
‡ UM 26166	26	16	1	6	3
UM 2812	28	12	1	10	5
•UM 281410	28	14	1	10	6
•UM 281610	28	16	1	10	6
‡ UM 28186	28	18	1	6	3
UM 3010	30	10	1	10	5
UM 3013	30	13	1	10	6
UM 3015	30	15	1	8	4
•UM 301510	30	15	1	10	5
•UM 301810	30	18	1	10	5
‡ UM 30206	30	20	1	6	3
UM 3214	32	14	1	10	5
UM 3216	32	16	1	8	4
•UM 321610	32	16	1	10	6
‡ UM 32228	32	22	1	6	3
UM 3418	34	18	1	8	4
‡ UM 341910	34	19	1	10	5
•UM 342210	34	22	1	10	5
UM 3512	35	12	1	12	6
UM 3515	35	15	1	10	5
•UM 351812	35	18	1	12	6
‡•UM 352010	35	20	1	10	5
UM 3616	36	18	1	10	5
UM 3620	36	20	1	8	4
•UM 362010	36	20	1	10	5
‡ UM 372210	37	22	1	10	5
•UM 3817	38	17	1	10	6
•UM 3818	38	18	1	10	5
•UM 382210	38	22	1	10	6
‡ UM 382310	38	23	1	10	5
UM 4018	40	18	1	10	5
UM 4020	40	20	1	10	6
•UM 402012	40	20	1	12	6
•UM 402410	40	24	1	10	6
‡•UM 402510	40	25	1	10	6
UM 4222	42	22	1	10	6
UM 4225	42	25	1	8	4
‡ UM 422710	42	27	1	10	5
•UM 423010	42	30	2	10	5
UM 4320	43	20	1	12	6
‡ UM 432810	43	28	1	10	5
UM 4525	45	25	1	10	5
•UM 452512	45	25	1	12	6
‡•UM 453010	45	30	2	10	5
•UM 453210	45	32	2	10	5

UCC® Suction Elements

A complete range of suction strainer elements is available from ½" through 3" NPT. All units are designed to give maximum efficiency at full flow ratings. The filter media are either phosphor bronze or stainless steel mesh, and can be easily cleaned. They are suitable for use with nearly all hydraulic fluids, lubricants, coolants, cutting fluids and mineral oils (the phosphor bronze models are not recommended for water-glycol).

Models are available in 125 micron, phosphor bronze mesh, with no bypass; and in 140 micron, stainless steel mesh, with 3 psi bypass (see ordering charts below). Other mesh sizes available on request in OEM quantities.

"Nominal" flow ratings shown below are based on 5 fps flow velocities in Schedule 40 pipe. Clean elements will pass the nominal flows at or below 0.35 psi pressure drop (mineral oil at approximately 165 SSU).



Model No.	Nominal Flow		Port	Filter Area		Weight		Dimensions A		Dimensions B	
	GPM	L/min.	(NPT.)	in.²	cm²	lbs.	kg.	in	mm	in	mm
NO BYPASS, 125 micron											
UC-SE-1319	5	18	½"	25	160	0.3	0.12	4.0	102	1.8	44
UC-SE-1320	8	31	¾"	40	260	0.5	0.21	5.0	129	2.5	63
UC-SE-1457	14	51	1"	80	520	0.6	0.29	6.3	159	2.5	63
UC-SE-1323	32	120	1½"	128	830	0.9	0.39	5.5	140	3.8	95
UC-SE-1324	32	120	1½"	200	1290	0.9	0.41	8.3	210	3.8	95
UC-SE-1326	52	198	2"	320	2070	1.0	0.47	12.3	311	3.8	95
UC-SE-1327	52	198	2"	400	2580	1.2	0.56	15.0	381	3.8	95
UC-SE-1219	52	198	2"	326	2100	2.2	1.00	6.6	168	6.2	157
UC-SE-1220	75	283	2½"	600	3870	2.6	1.20	8.9	225	6.5	165
UC-SE-1221	115	434	3"	800	5160	3.1	1.40	11.4	289	6.5	165
WITH BYPASS (3 psi full open), 140 micron											
SE12-6-3	8	31	¾"	62	400	0.5	0.23	3.1	78	2.6	67
SE13-8-3	14	51	1"	110	710	0.7	0.32	5.4	136	2.6	67
SE14-10-3	23	88	1¼"	162	1050	1.0	0.45	6.9	174	3.4	86
SE15-12-3	32	120	1½"	225	1450	1.2	0.54	8.1	204	3.4	86
SE16-16-3	52	198	2"	340	2190	1.8	0.82	10.0	225	3.9	100
SE17-20-3	75	283	2½"	400	2580	2.3	1.04	10.1	257	5.1	130
SE18-24-3	115	434	3"	500	3230	3.0	1.36	11.8	298	5.1	130

UCC® Filtered Filler Breathers

UCC Air Breather Filters and Oil Fillers are combination units for filtering the displacement of air into the reservoir and for straining the oil when filling. UCC Air Breather Filters, with or without Oil Filler Strainers, are also available for use with pressurized hydraulic reservoirs. They maintain pressure in the reservoir by means of an integral air relief valve and also incorporate a vacuum breaker.

For use on machine tools, mobile machinery, agricultural equipment, industrial power units, etc.

Designed for HIGH BREATHER CAPACITY.

All breathers incorporate HIGH RETENTION capacity FOAM FILTER ELEMENTS with 15 or 40 micron ratings.

Air intake located on underside of cap to reduce ingestion of dirt and water from the atmosphere, insuring LONGER FILTER LIFE.

Finished in Nickel Chrome to RESIST CORROSION and maintain HIGH QUALITY APPEARANCE.

BAYONET Styles (A, B and F) include mounting plate, strainer basket, gaskets and self-tapping screws. Strainer basket has slotted design and inverse conical end for INCREASED POUR RATE; made of tough Nylon to resist puncture.

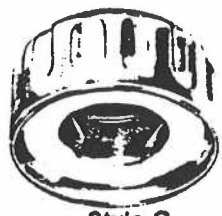
SCREW-IN Styles (D and E) in ¼" and ¾" NPT.

PUSH-ON breather (Style C) fits onto end of 1½" O.D. pipe.

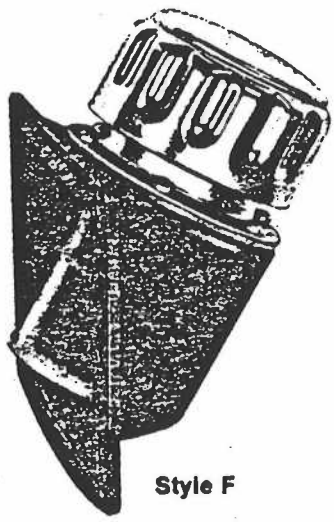
SIDE MOUNTING Bayonet Style (F) for side of reservoir attachment.

For **PRESSURIZED RESERVOIRS**, bayonet style "A" and screw-in style "D" are available with built-in relief valves for 5 psi or 10 psi.

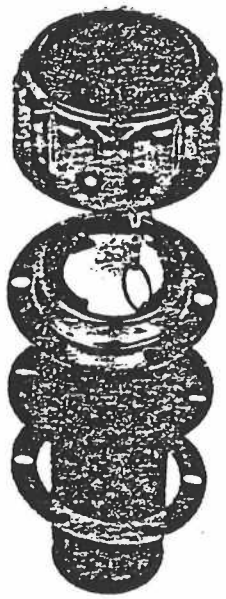
Style D & E



Style C



Style F



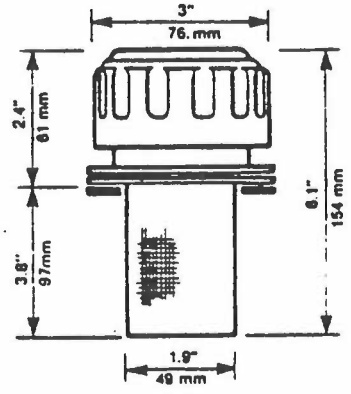
Style A & B

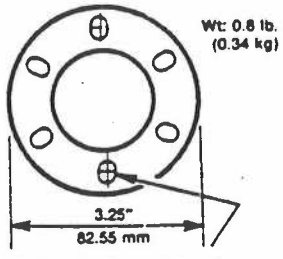
Part Number	Style	Micron Rating	Breather	Description	Capacity** CFM	GPM
UC-AB-1163-40	A	40	Non-pres.	SAE bayonet	25	192
UC-AB-1163-15		15	Non-pres.		15	114
UC-PAB-1730-40-5		40	5 psi-pres.		25	192
UC-PAB-1730-15-5*		15	5 psi-pres.		15	114
UC-PAB-1730-40-10		40	10 psi-pres.		25	192
UC-PAB-1730-15-10*		15	10 psi-pres.		15	114
UC-AB-1380-40	B	40	Non-pres.	Mini-bayonet	10	72
UC-AB-1380-15		15	Non-pres.		5	36
UC-AB-1381-40	C	40	Non-pres.	Push-on	25	192
UC-SAB-1562-40	D	40	Non-pres.	¾" NPT screw-in	25	192
UC-SAB-1562-15		15	Non-pres.		15	114
UC-SPA-1731-40-5		40	5 psi-pres.		25	192
UC-SPA-1731-15-5*		15	5 psi-pres.		15	114
UC-SPA-1731-40-10		40	10 psi-pres.		25	192
UC-SPA-1731-15-10*		15	10 psi-pres.		15	114
UC-SAB-1563-40	E	40	Non-pres.	¼" NPT screw-in	10	72
AB-1163-40-21	F	40	Non-pres.	Sidemount,	25	192
AB-1163-15-21		15	Non-pres.	SAE bayonet	15	114
AB-1163-20	Strainer protector for Style A and F strainer baskets.					
AB-1163-21	Side mount ass'y. (included with style F).					
AB-1163-22	6" stainless steel basket (use with Style A).					

*To special order only, in OEM quantities.

**CFM is airflow rating. GPM refers to equivalent drawdown rate.

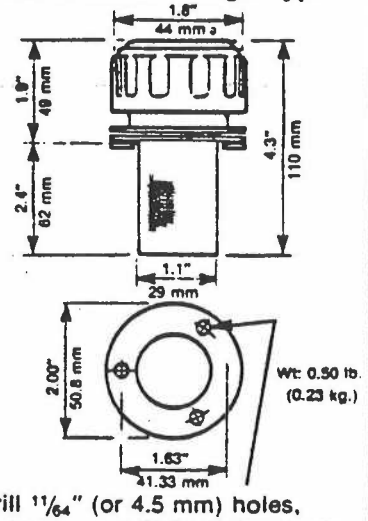
Style A
Air Breather Flange Type





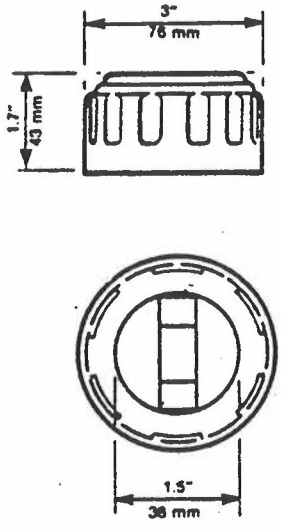
Drill 11/64" (or 4.5 mm) holes, 6 places, on 2.75" (70.0 mm) min. dia. to 2.88" (73 mm) max. dia. bolt circle; for 3/16" (4.76 mm) self tapping screws.

Style B
Air Breather Flange Type



Drill 11/64" (or 4.5 mm) holes, 3 places, on 1.63" (41.3 mm) dia. bolt circle; for 3/16" (4.76 mm) self tapping screws.

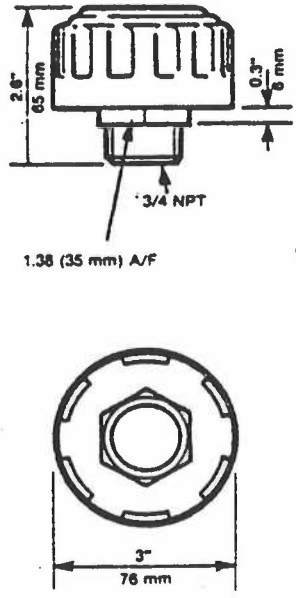
Style C
Air Breather Push On Type



Wt: 0.4 lb. (0.18 kg.)

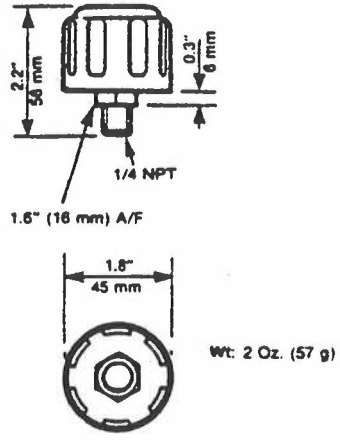
Suitable for 1½" (38 mm) O.D. pipe

Style D
Air Breather Threaded Type



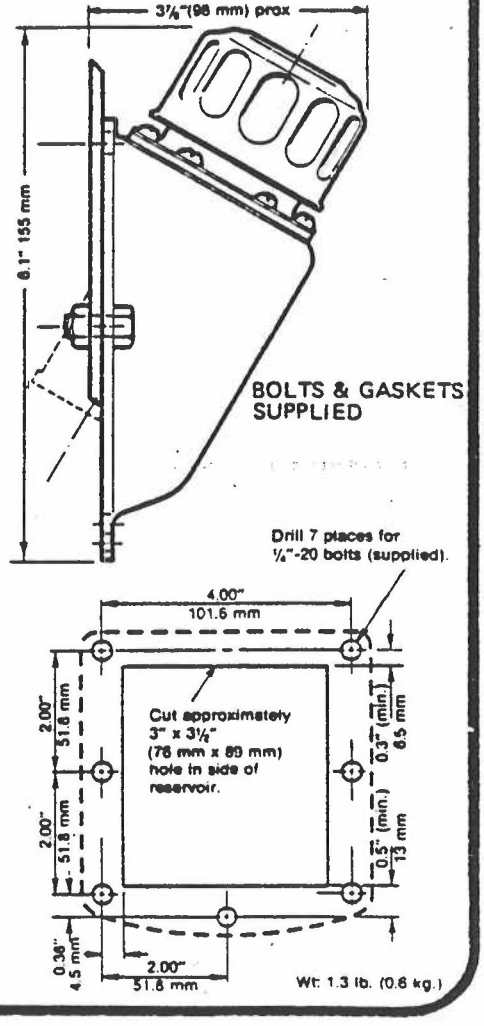
Wt: 0.5 lb. (0.20 kg.)

Style E
Air Breather Threaded Type



ACCESSORIES

Style F
NYLON SIDE MOUNT ASS'Y.
with Style A breather.



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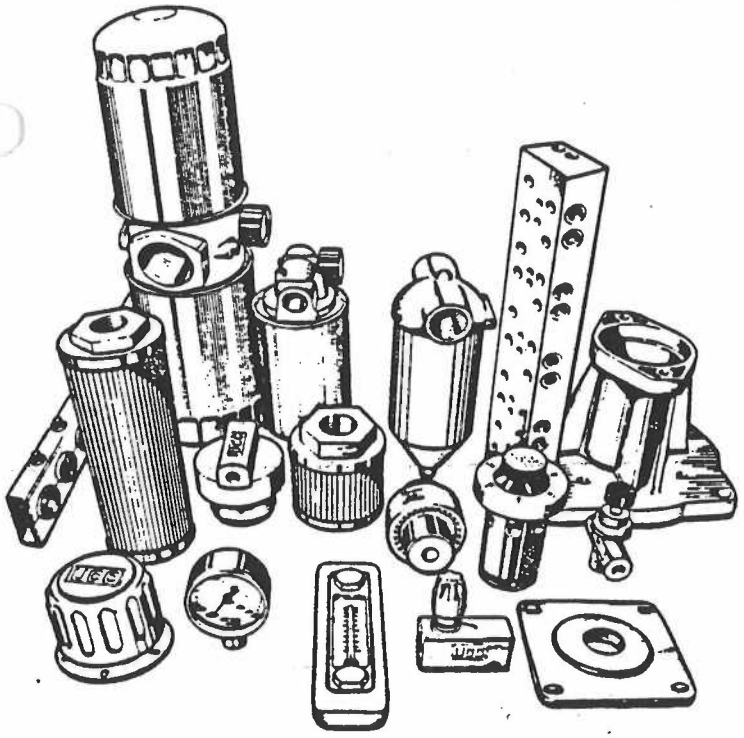

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WEST VIRGINIA (Southern)
WEST VIRGINIA FLUID POWER, INC.
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BASIC HYDRAULICS & IND. EQUIPMENT, LTD.
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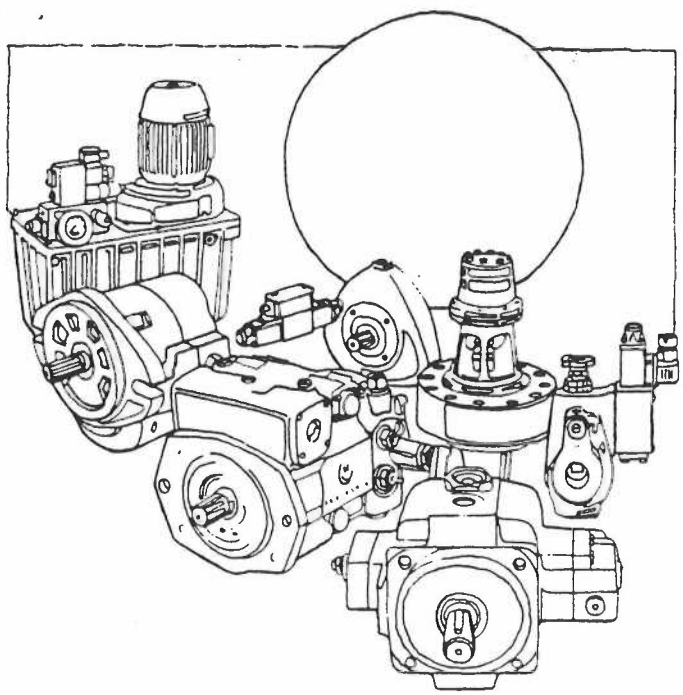
HERLO HIDRAULICA, S.A.
Tlalnepantla, Edo de Mexico ..... (905) 390-4566
(905) 390-3174
Veracruz, Ver. 2-51-65



REXROTH
WORLDWIDE HYDRAULICS

Corporate Offices

THE REXROTH CORPORATION
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P.O. Box 2407
Bethlehem, PA 18018
Telex 847498 . . . . . (215) 694-8300

(Manufacturing, Engineering, Design, Fabrication, Sales, Marketing and Testing)

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MOBILE DIVISION
1700 Old Mansfield Road
Wooster, OH 44691
Telex 986335 . . . . . (216) 262-2010

(Manufacturing, Engineering, Design, Fabrication, Sales, Marketing and Testing)

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Telex 698421 . . . . . (312) 860-1010

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Bloomington, MN 55420 . . . . . (612) 854-7344

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THE REXROTH CORPORATION
Mr. James R. Mollo, Regional Sales Manager
2975 South Park Road - Suite 14
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Mr. C. J. Eisinger, Regional Sales Manager
2000 South Post Oak Road - Suite 2300
Houston, TX 77056 . . . . . (713) 623-8377

REXROTH
WORLDWIDE HYDRAULICS
Bethlehem, Pa. 18018
215/694-8300

Check Valve Type S

Sizes 6 (1/4") to 30 (1 1/2") | up to 4500 PSI

for in-line mounting or as cartridge unit

RA 20377

Description

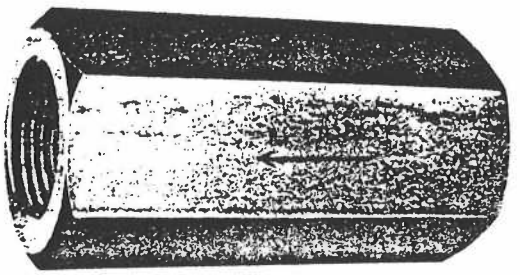
Issue: 1.75—U.S.A.

The check valves type S serve to give leakfree closure in one direction and free return flow in the other.

The stroke of the valve poppet is limited by a stop. The built-in spring supports the closing stroke, and also serves to hold the valve poppet in the closed position.

Four versions are available, with cracking pressures of 7, 22 or 45 PSI or without a spring.

A check valve cartridge is also available, suitable for mounting in manifold blocks. Two models are available: straight or angled valve cartridge.



Ordering Code

Model Number ▶ S | | A | | . | / 5 | *

Check valve	= S	Unit
Size 6 (1/4")	= 6	Size
Size 8 (3/8")	= 8	
Size 10 (1/2")	= 10	
Size 15 (3/4")	= 15	
Size 20 (1")	= 20	
Size 25 (1 1/4")	= 25	
Size 30 (1 1/2")	= 30	
In-line mounting	= A	Connections
Type No. 0 (without spring)	= 0	Design no.
Type No. 1 (cracking pressure 7 PSI) (Standard)	= 1	
Type No. 2 (cracking pressure 22 PSI)	= 2	
Type No. 3 (cracking pressure 45 PSI)	= 3	
none (specified by factory)	= 0	Modification no.

Add further details in clear text

Part numbers for check valve cartridge

Straight valve			
Type	No. 1	No. 2	No. 3
Size 6 (1/4")	301 889	301 896	301 903
Size 8 (3/8")	301 890	301 897	301 904
Size 10 (1/2")	301 891	301 898	301 905
Size 15 (3/4")	301 892	301 899	301 906
Size 20 (1")	301 893	301 900	301 907
Size 25 (1 1/4")	301 894	301 901	301 908
Size 30 (1 1/2")	301 895	301 902	301 909

Angled Valve			
Type	No. 1	No. 2	No. 3
Size 6 (1/4")	301 910	301 917	301 924
Size 8 (3/8")	301 911	301 918	301 925
Size 10 (1/2")	301 912	301 919	301 926
Size 15 (3/4")	301 913	301 920	301 927
Size 20 (1")	301 914	301 921	301 928
Size 25 (1 1/4")	301 915	301 922	301 929
Size 30 (1 1/2")	301 916	301 923	301 930

Technical Data (Valve description: RA 20 000)

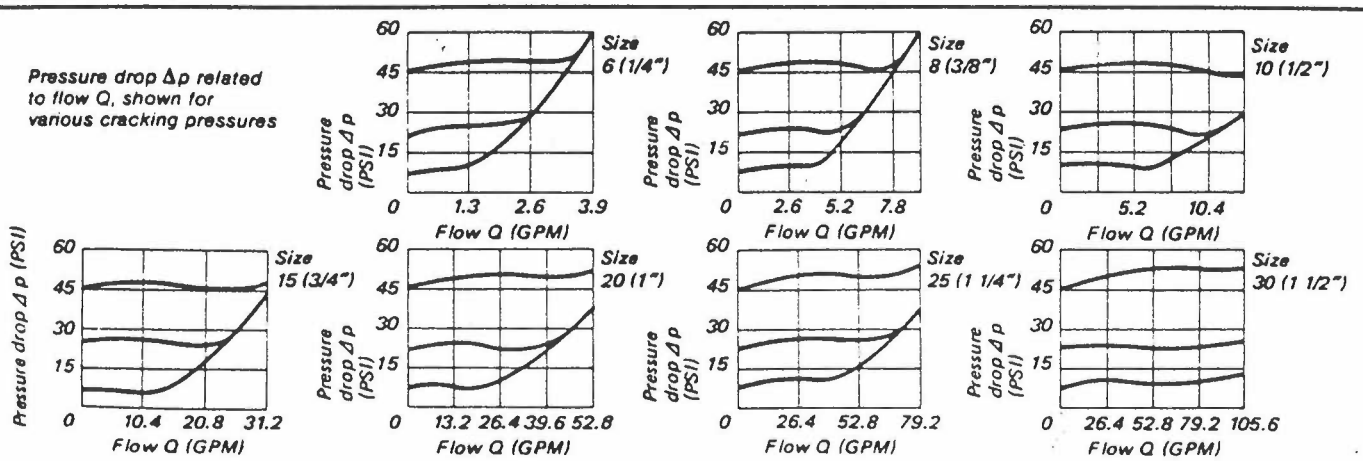
Spares information: RE 20 377-E)

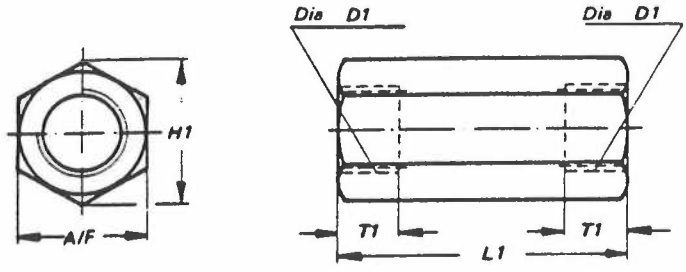
Hydraulic medium	Petroleum Base Fluids
Fluid temperature range	-22°F to +176°F
Viscosity range	35 to 1750 SSU
Max. operating pressrue	4500 PSI

Cracking pressure (PSI)	7 (Type No.1); 22 (No.2); 45 (No.3)						
Size	6(1/4")	8(3/8")	10(1/2")	15(3/4")	20(1")	25(1 1/4")	30(1 1/2")
Flow Rating (GPM) Velocity = 20 ft/s	2.6	4.8	7.9	17.2	30.4	46.3	68.8

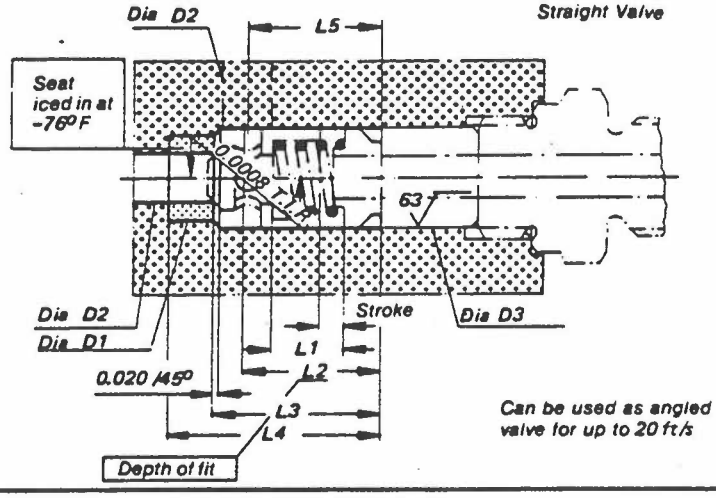
Performance Curves

Pressure drop Δp related to flow Q, shown for various cracking pressures

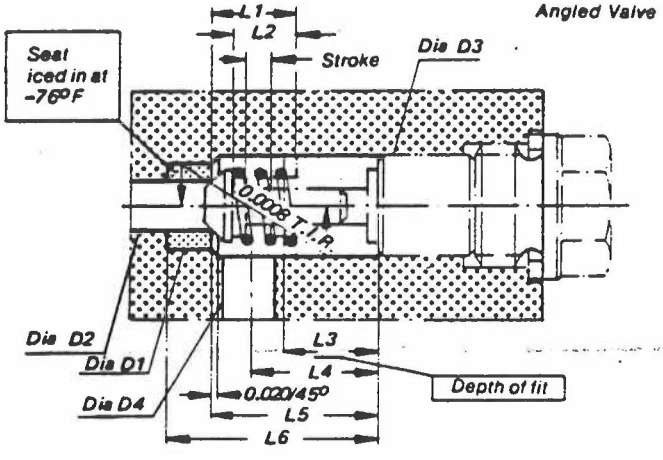




Size	6 (1/4")	8 (3/8")	10 (1/2")	15 (3/4")	20 (1")	25 (1 1/4")	30 (1 1/2")
D1	1/4" NPT	3/8" NPT	1/2" NPT	3/4" NPT	1" NPT	1 1/4" NPT	1 1/2" NPT
H1	0.866	1.102	1.358	1.634	2.087	2.717	2.953
L1	2.283	2.283	2.835	3.346	3.858	4.724	5.197
T1	0.472	0.472	0.551	0.630	0.709	0.787	0.866
A/F	0.748	0.945	1.181	1.417	1.811	2.362	2.559
Weight Lbs	0.22	0.44	0.66	1.1	2.2	4.4	5.5

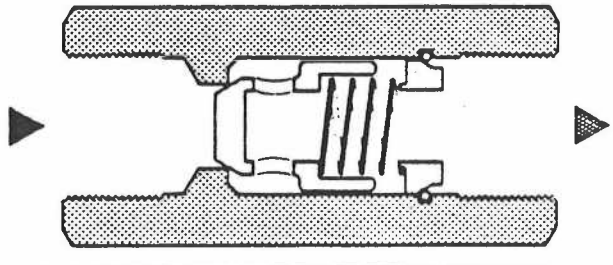


Size	6 (1/4")	8 (3/8")	10 (1/2")	15 (3/4")	20 (1")	25 (1 1/4")	30 (1 1/2")
D1	0.39429 0.39370	0.51251 0.51181	0.67000 0.66929	0.86696 0.86614	1.10318 1.10236	1.41830 1.41732	1.65452 1.65354
D2	0.236	0.315	0.394	0.591	0.787	0.984	1.181
D3	0.43413 0.43307	0.55224 0.55118	0.70972 0.70866	0.94618 0.94488	1.18240 1.18110	1.49759 1.49606	1.73381 1.73228
Stroke	0.157	0.157	0.157	0.197	0.197	0.276	0.276
L1	0.374	0.374	0.453	0.571	0.630	0.965	0.984
L2	0.748	0.709	0.827	1.063	1.142	1.535	1.654
L3	0.858	0.898	1.134	1.433	1.732	2.165	2.480
L4	1.173	1.291	1.528	1.906	2.323	2.874	3.268
L5	0.709	0.709	0.906	1.102	1.299	1.614	1.850
Weight Lbs	0.11	0.11	0.11	0.22	0.44	0.55	0.66



Size	6 (1/4")	8 (3/8")	10 (1/2")	15 (3/4")	20 (1")	25 (1 1/4")	30 (1 1/2")
D1	0.39429 0.39370	0.51251 0.51181	0.67000 0.66929	0.86696 0.86614	1.10318 1.10236	1.41830 1.41732	1.65452 1.65354
D2	0.236	0.315	0.394	0.591	0.787	0.987	1.181
D3	0.43413 0.43307	0.55224 0.55118	0.70972 0.70866	0.94618 0.94488	1.18240 1.18110	1.49759 1.49606	1.73381 1.73228
D4	0.236	0.315	0.394	0.591	0.787	0.984	1.181
Stroke	0.157	0.157	0.157	0.197	0.197	0.276	0.276
L1	0.441	0.464	0.563	0.709	0.740	1.122	1.122
L2	0.374	0.374	0.453	0.571	0.630	0.965	0.984
L3	0.394	0.630	0.630	0.709	0.906	1.220	1.457
L4	0.650	0.846	0.925	1.004	1.181	1.693	1.870
L5	0.807	1.043	1.161	1.339	1.594	2.264	2.500
L6	1.122	1.437	1.555	1.811	2.185	2.972	3.287
Weight Lbs	0.11	0.11	0.11	0.22	0.44	0.55	0.66

Section



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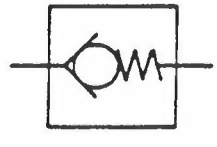


THE REXROTH CORPORATION/BETHLEHEM, PA. 18018
Telex 84-7498
2315 City Line Road L V I P
Phone: 215/694-8300

RA 20 377/1.75 (1) Replaces: RA 22 001 Printed in U.S.A.

REXROTH
WORLDWIDE HYDRAULICS
BETHLEHEM, PA 18018

ENGINEERING DATA SHEET

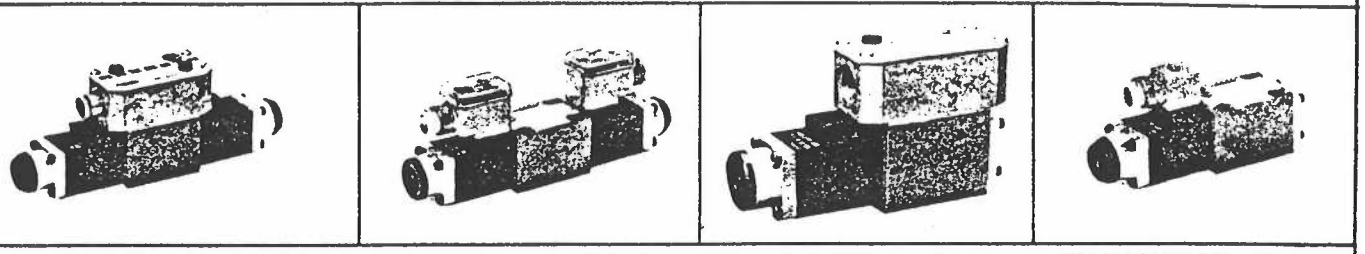
MINIATURE DIRECTIONAL CONTROL VALVE WE 6 (1/4") 4 WAY & 3 WAY VALVE

SOLENOID DIRECT OPERATED SUBPLATE MOUNTING

Mounting to ANSI D01 | 4600 psi (315 bar) | Flow see Page 4

RA 23177

ISSUED: 3-81



4WE 6..50/AG - 24 NDL/5
Central Junction Box with Indicator Lights
Optional Feature "DL"

4 WE6..50/AW 220 - 60 NZ5L/5
4 Way 3-Position with Indicator Light in Plugs.
Optional Feature "Z5L"

4WE 6E50/AND/5
4 Way 2-Position with Terminal Box
Optional Feature "ND/5

4WE 6..50/AW 220 - 60 NZ4/5
4 Way 2-Position with Plug Connector on Solenoid.
Optional Feature "Z4"

GENERAL DESCRIPTION

The 4 way or 3 way directional control valve is used in a hydraulic circuit to control the direction of motion of a hydraulic cylinder or motor. The command signal is electric. The WE6 valve is direct acting, in that the solenoid (2) forces act directly on the spool (3) through a push pin (5). Three position valves, in addition to controlling forward and reverse motion, have a center or neutral position. The flow configuration in the center position is determined by the spool selected. This center position is achieved when the solenoids are de-energized. Centering springs (4) center the spool (3) in the valve body (1).

Pushbutton manual overrides (6) allows the manual operation of the valve in the absence of electrical power. Indicator lights (8) are wired parallel to the solenoid to indicate the electric signal to the solenoid. Indicator lights are an optional feature.

GENERAL SPECIFICATIONS

SOLENOIDS... High efficiency 120 volt-60 Hz has an in-rush of 1.08 amps and 0.38 amps holding.

The solenoids for this valve are of the "wet pin" design and available for A.C. or D.C. operation.

Available Voltages: AC - 42, 110, 127, or 220 - 50Hz.
120, or 220 - 60Hz.
DC - 12, 24, 52, 60, 110, 180, 195, or 220

Power Required: AC - 130VA in-rush 46VA holding
DC - 26W constant

Cycles Per Hour: AC 7,200 DC 15,000

Response Time: Energized AC 30ms. DC 45ms.
De-energized AC 20ms. DC 20ms.

Insulation: NEMA Class B (or better)

Maximum Operating Temperature: 300°F (150°C)

SOLENOID IDENTIFICATION... Consult the spool configuration chart to determine the energized flow pattern of the valve. Solenoids are marked A or B. (Page 2)

OPERATING PRESSURES... Pressure and cylinder ports to 4600 psi (315 bar). Tank port 1500 psi (100 bar) operating with AC solenoids or 2300 psi (160 bar) operating with DC solenoids.

3 WAY VALVE OPERATION... When using spools A or B and the operating pressure exceeds the return line pressure, the T port must be piped to the drain (tank), as a leakage port.

FLOW RATING... See charts (Page 4.) Flow in center position for spools Q and W, as compared to the J spool, is 6% and 3% for the V spool of the normal valve flow area.

OPERATING TEMPERATURE... From -20°F (-30°C) to 160°F (70°C)

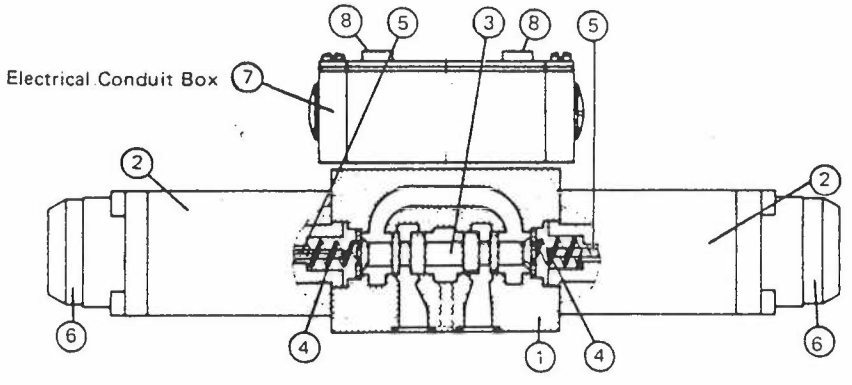
SEALS AND FLUIDS... The Rexroth valves are supplied as a standard with Buna-N seals. These seals are suitable for use with petroleum base hydraulic oils, also most water glycol and water-in-oil emulsions.
As an OPTIONAL FEATURE Viton seals are available which are compatible with most phosphate ester fluids.

VISCOSITY RANGE...35 SSU (2,8cSt) to 1750 SSU (380cSt)

MOUNTING POSITION... Optional

APPROXIMATE WEIGHT...

Single Solenoid Valves	- 2.6 pounds	(1.2 kg.)
Double Solenoid Valves	- 3.5 pounds	(1.6 kg.)
Subplates G341/5	- 1.5 pounds	(0.7 kg.)
G342/5	- 2.6 pounds	(1.2 kg.)
G502/5	- 4.2 pounds	(1.9 kg.)



See "General Description" for Details of Valve Operation

ORDERING CODE

RA 2:

4 WE 6 E B 5X/OF A N DL B08 V

PORTING
3 = 3 way 4 = 4 way

SIZE 6 (1/4") ANSI D01

SPOOL (See chart below)

SINGLE SOLENOID OPERATOR
Omit = Std. 2 or 3 pos. valve
2 pos. valves using spools E thru W only, spring offset-center pos. to one side
A = Solenoid "A" only
B = Solenoid "B" only

DESIGN SERIES

DOUBLE SOLENOID OPERATOR (2 Position)
O = No spring or detent
OF = No spring with detent
Omit = If not required

SEALS
Omit = Buna-N V = Viton

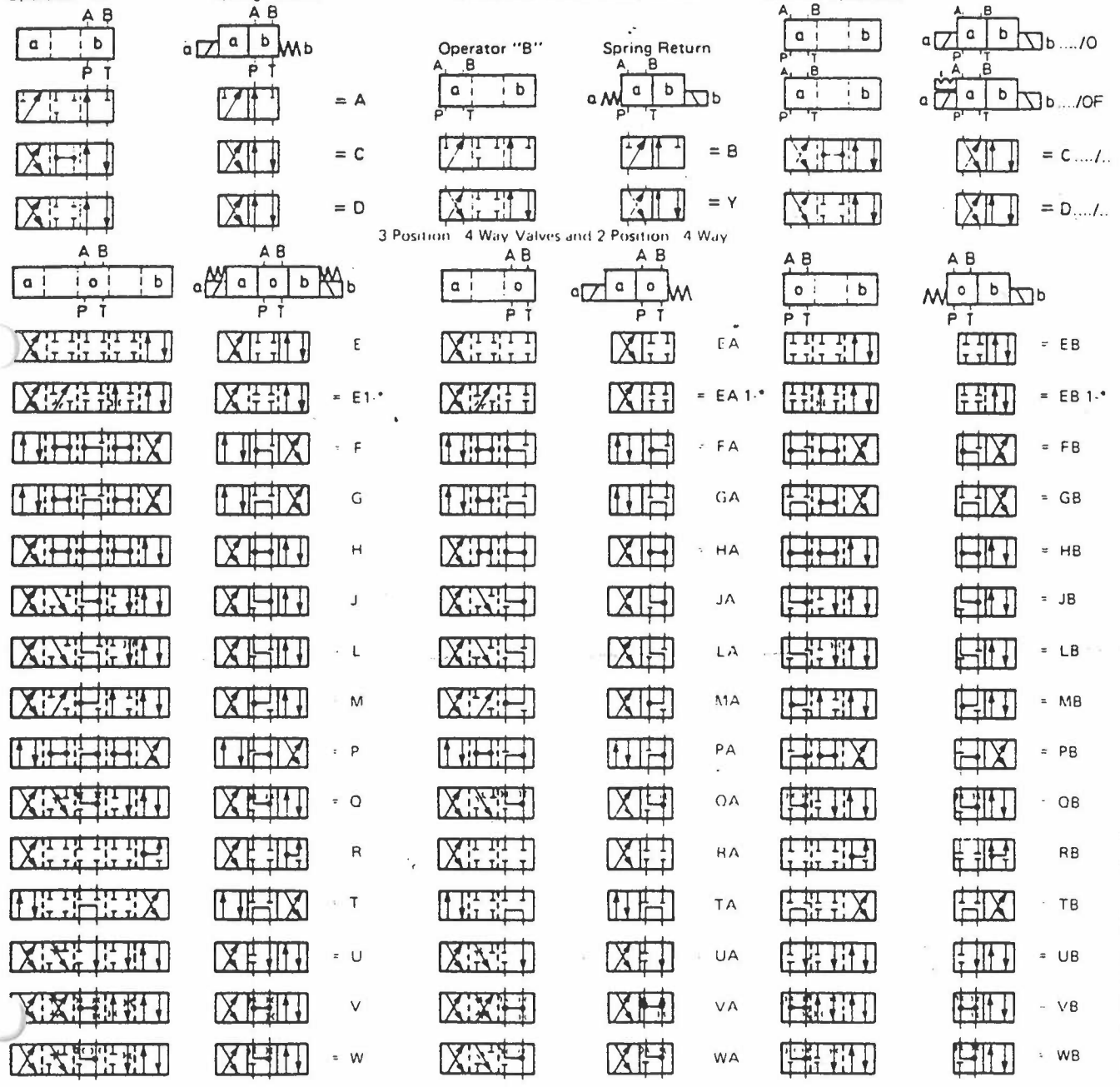
THROTTLE ORIFICE INSERT (Page 5)
Omit = If not required
B08 = Throttle dia. 0.031" (0.8 mm)
B10 = Throttle dia. 0.039" (1.0 mm)
B12 = Throttle dia. 0.047" (1.2 mm)

ELECTRICAL CONNECTIONS refer to Page 5

MANUAL SOLENOID OVERRIDE

SOLENOID VOLTAGES
Omit = 120 volt AC, 60 Hz.
W + Voltage + Hz. = All other AC solenoids
G + Voltage = DC solenoids
W110R = DC solenoid with 110 volt AC rectifier for all frequencies. Order with "Z5" plug only.

Operator "A" | Spring Return | 2 Position - 3 and 4 Way Valves | Operator "B" | Spring Return | Double Operators

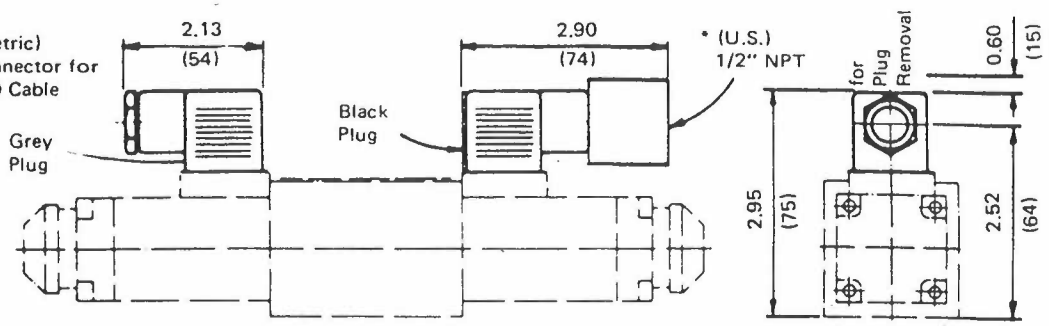


*Spool type E1 P - A B opening first

ELECTRICAL CONNECTIONS | **DIMENSIONS: Inches (mm)**

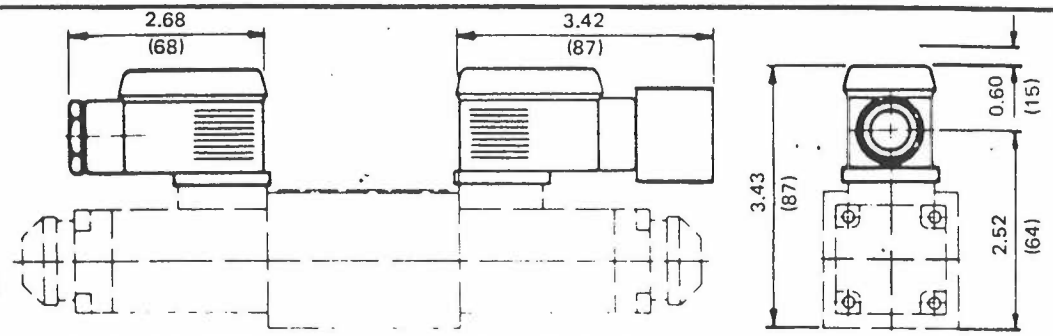
Optional Ordering Code "Z4"

Small Plug Connector



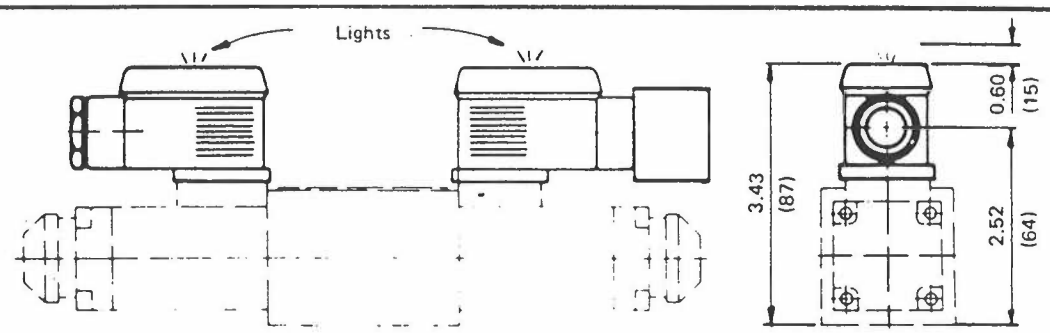
"Z5"

Large Plug or Large Plug Using DC Solenoid With AC Rectifier in the Plug. Feature "WIIOR." (Order also Z5 plug)



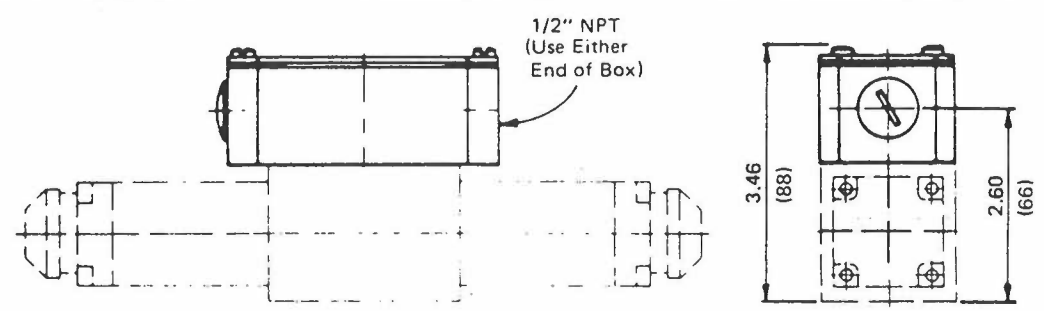
"Z5L"

Large Plug With Indicator Lights



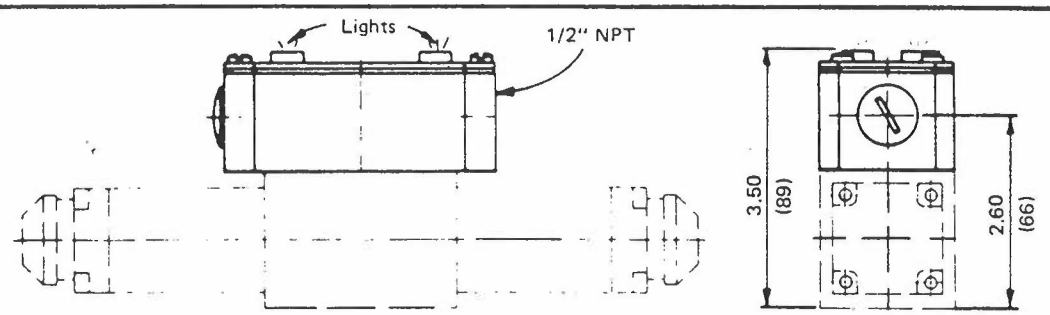
"D"

Central Terminal Box



"DL"

Central Terminal Box with Indicator Lights

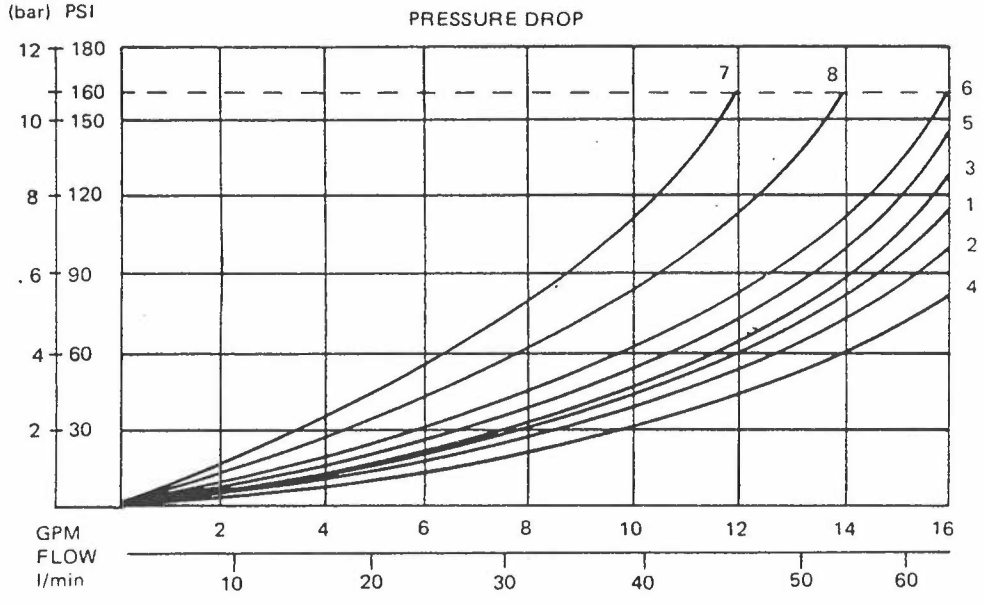


*Plug-in connectors are supplied with 1/2"–14 NPT thread adaptors. Use with seal-tight connectors. Supplied when "/5" appears at the end of ordering code.
Grommet connectors (metric) can be supplied in place of the standard adaptor. When ordering, request "Metric Connectors" in ordering code.

PRESSURE VS. FLOW Test Fluid 172 SSU(36cSt.) at 120°F(50°C) R/ -

Curve No. 7 for "R" spool when shifting from A to B ports.

Curve No. 8 for "G" spool-ports P-T when in spool center position

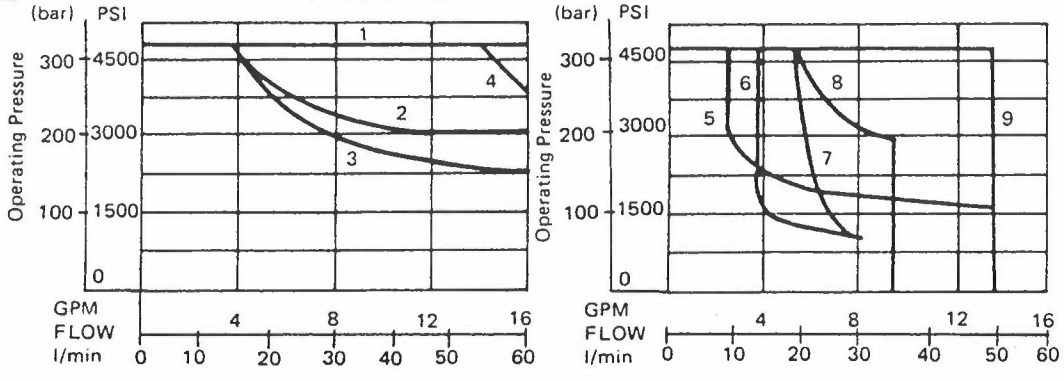


CURVE SELECTION CHART

SPOOL TYPE	FLOW DIRECTION			
	P-A	P-B	A-T	B-T
	Curve Number			
A	3	3	–	–
B	3	3	–	–
C	1	1	3	1
D	5	5	3	3
E	3	3	1	1
F	2	3	3	5
G	5	3	6	6
H	2	4	2	2
J	1	1	2	1
L	1	1	2	2
M	2	4	3	3
P	2	3	3	5
Q	1	1	2	1
R	5	5	4	–
T	5	3	6	6
U	3	1	3	3
V	1	2	1	1
W	1	1	2	2
Y	5	5	3	3

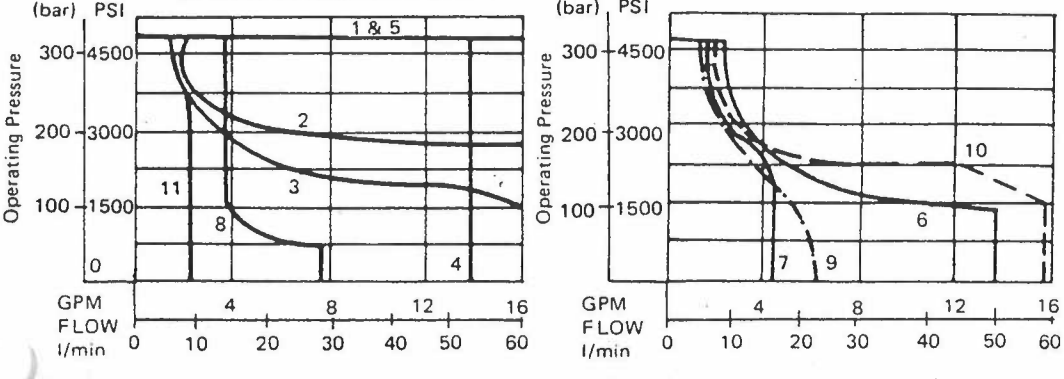
VALVE PERFORMANCE CURVES

OPERATOR DC Solenoid



PERF. CURVE	SPOOL TYPE
1	E1, D/0, C/0, M
2	E
3	J, L, Q, U, W
4	C, D, Y
5	A, B
6	V
7	F, P
8	G, T, R
9	H

OPERATOR AC Solenoid 60 Hz.



PERF. CURVE	SPOOL TYPE
1	E1, C/0, D/0
2	E
3	J, L, Q, U, W
4	C, D, H, Y
5	M
6	A, B
7	F, P
8	V
9	G
10	R
11	T

To maintain optimum efficiency and trouble free spool shifting, it is recommended to use a full flow filtration of 25 microns or less. This filtration will avoid silting in the flow passages which could limit the maximum flow capacity of the valve.

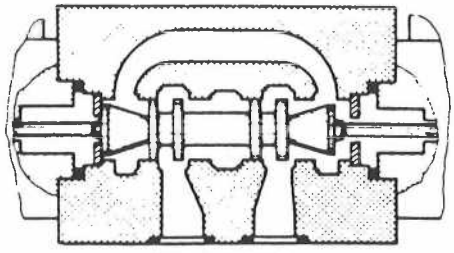
Flow data as shown applies to two directional flows. If only one flow direction, as in the case when Port A or B is plugged, the flow is reduced from that as shown.

OPTIONAL FEATURES

OPTIONAL FEATURE "O" (Without Springs)

The double solenoid, two postion option without springs, is available with spools "C" and "D" only. This no spring version is used for high cycling applications.

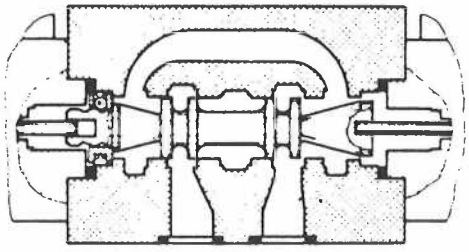
As there are no springs in this valve, it is recommended that the solenoid be continuously energized and that the valve is mounted horitzontally; this prevents spool drift.



4WE6 D 50/AO..

OPTIONAL FEATURE "OF" (Detented and Without Springs)

This optional feature is a detented version of the double solenoid, two position option without springs. It is available with spools "C" and "D" only. The detented version is used in low cycling applications which greatly extends the life of the solenoid. The solenoid requires a short time cycle as the spool will hold its position when the detent is in place. Positioning of the spool requires approximately a time cycle of 100 ms.
As the spool position is held by the detent, continuous energizing of the solenoid is not necessary and the mounting position of the valve is optional.

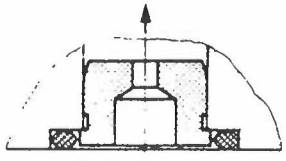


4WE6 D 50/AOF..

OPTIONAL FEATURE "B" (Throttle Orifice Insert)

In applications where high flows are encountered from the pump or accumulators systems, flows could exceed the allowable flow for the valve. Excess flows can cause valve malfunctions and overloading of the solenoid, or the springs will not return the spool for the next cycle.

To avoid valve malfunctions, due to excess flows, three orifice sizes are available and mounted in the valves pressure port.



4WE6 .. 50/A..B..

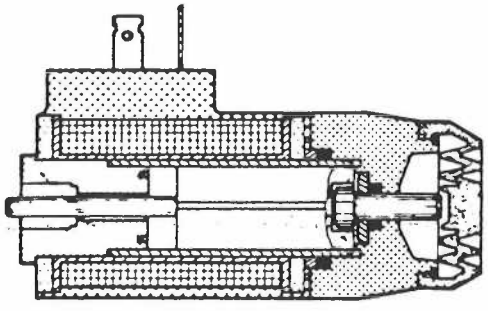
Available Orifices
- Ordering Code B08 orifice diameter 0.031" (0.8 mm)
- Ordering Code B10 orifice diameter 0.039" (1.0 mm)
- Ordering Code B12 orifice diameter 0.047" (1.2 mm)

SOLENOIDS

Solenoids used for the WE6 Design Series 50 valves are of the "wet pin" design. This solenoid was formerly known to the industry as an oil-immersed solenoid. The main advantages of the "wet pin" solenoid are:

The wet pin solenoid is available in designs for operation with AC or DC electrical systems.
The solenoid internal parts are pressure sealed to the tank port within the valve body and are therefore insensitive to moisture and dirt contamination.

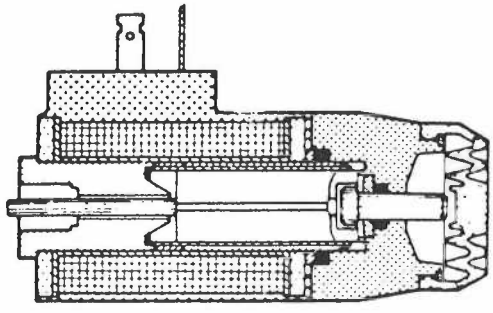
Quiet operation, as the armature movement is cushioned by the surrounding hydraulic oil which also affords an extended operating life due to its exceptional ability to dissipate its heat through the system hydraulic oil.



AC Solenoid

The Rexroth solenoids operate to 300°F (150°C) and exceeds NEMA Class B insulation.

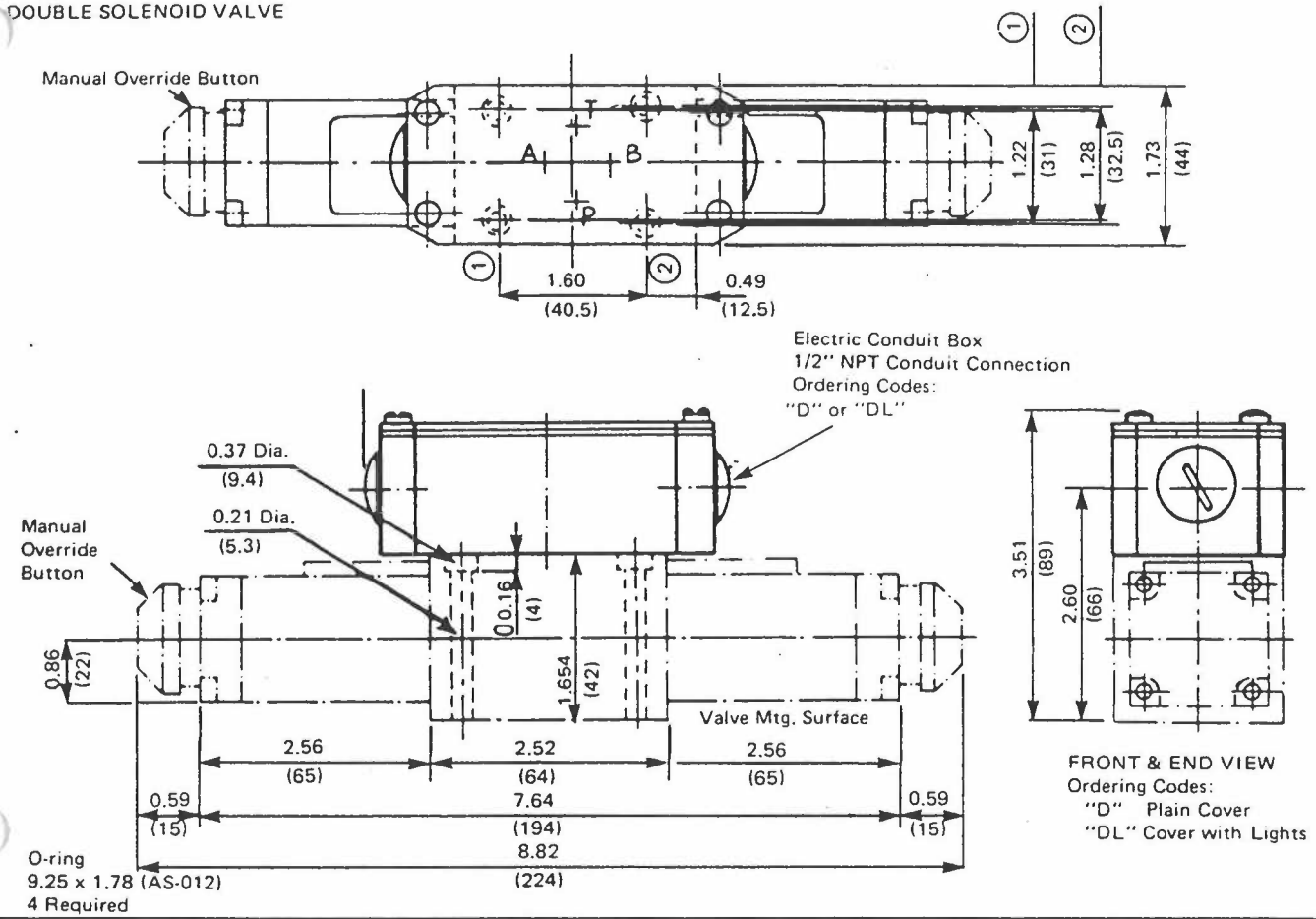
AC Solenoid Features
- Convenient electrical connections by plug-in or central conduit box.
- Fast response - 30 ms.
- No special electrical contact protection required at the relay or pushbutton.



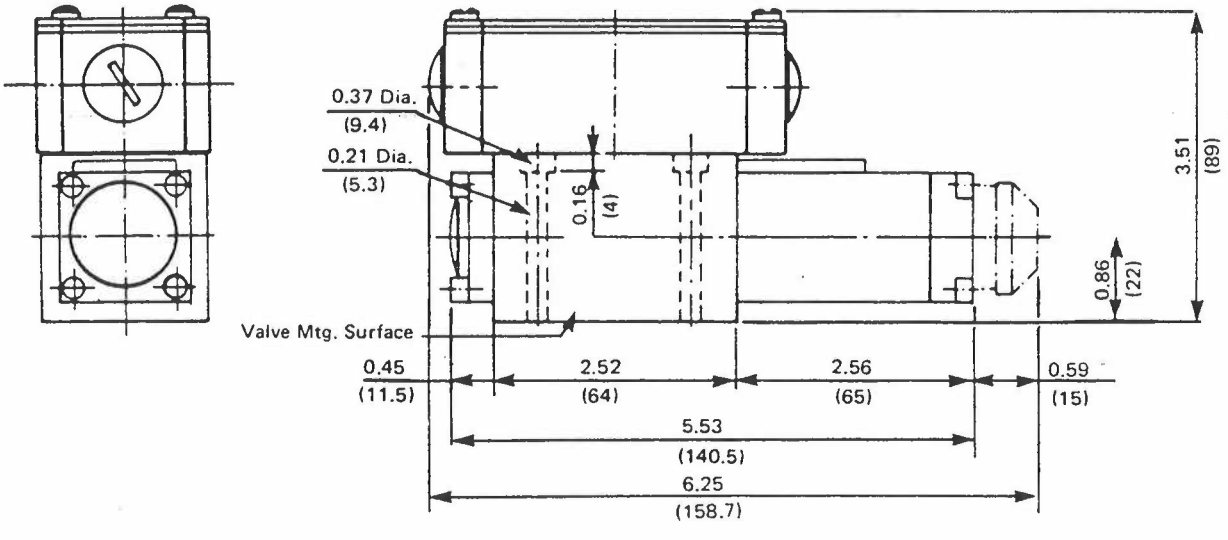
DC Solenoid

DC Solenoid Features
- Will not burn out if mechanical sticking of the spool occurs.
- Can be operated on AC current by a built-in rectifier incorporated in the "Z5" plug-in connector.
- Insensitive to fluctuations in voltages.
- High cycle frequency to - 15,000 cycles per hour.
- Extremely quiet operating.

DOUBLE SOLENOID VALVE

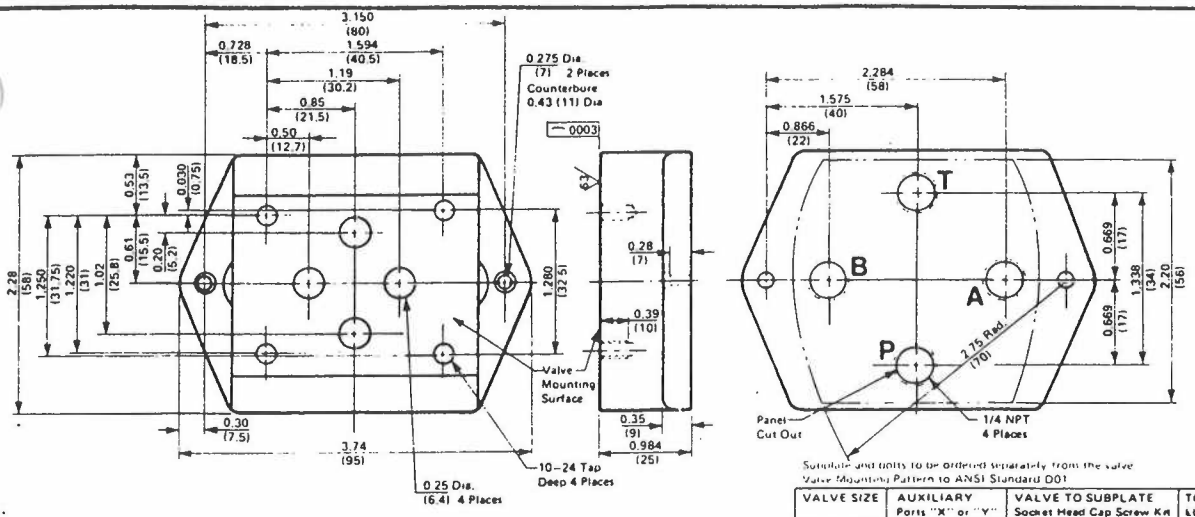


SINGLE SOLENOID VALVE
View Shown with Sol. B (Reverse Dimensions for Sol. A.)



SUBPLATE G341/5 (1/4"NPT)

DIMENSIONS: Inches (mm)

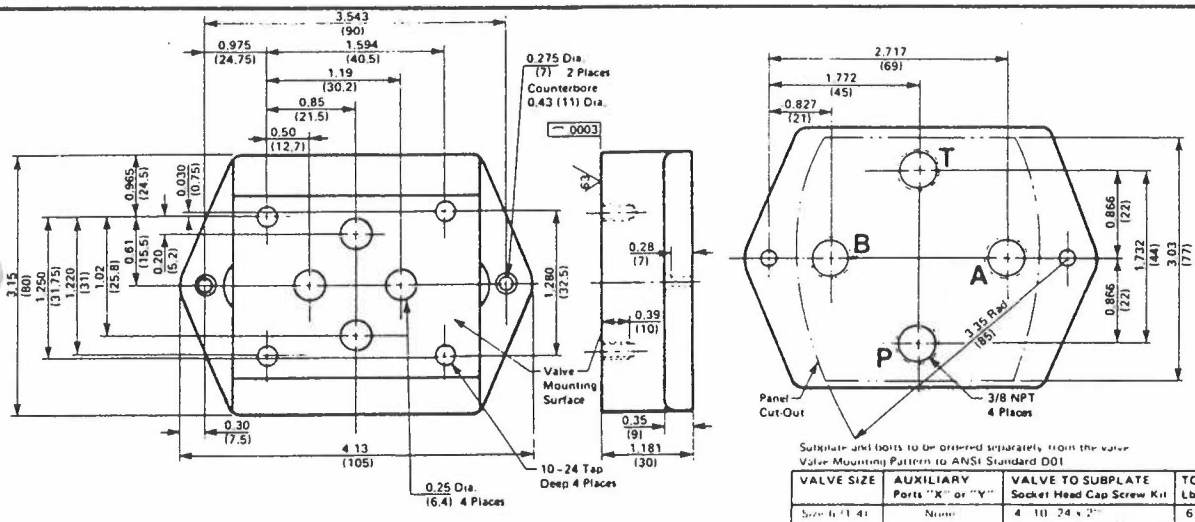


Subplate and bolts to be ordered separately from the valve
Valve Mounting Pattern to ANSI Standard D01

VALVE SIZE	AUXILIARY Ports "X" or "Y"	VALVE TO SUBPLATE Socket Head Cap Screw Kit	TORQUE Lb. Ft. (Nm.)	WEIGHT Pound (Kg.)
Size 6 (1/4)	None	4 - 10 - 24 x 2" Minimum Tensile Strength 180,000 to 195,000 PSI Part Number 833365 4 - 10 - 24 x 2" SHCS	6.6 lb. ft (9 Nm)	4 lbs (1.9 kg.)

SUBPLATE G342/5 (3/8" NPT)

DIMENSIONS: Inches (mm)

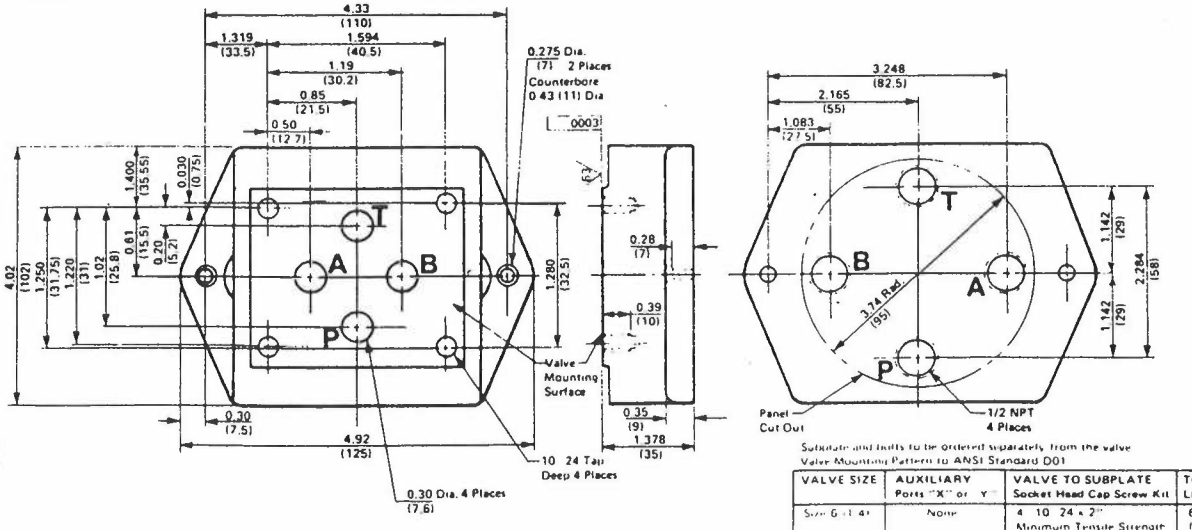


Subplate and bolts to be ordered separately from the valve
Valve Mounting Pattern to ANSI Standard D01

VALVE SIZE	AUXILIARY Ports "X" or "Y"	VALVE TO SUBPLATE Socket Head Cap Screw Kit	TORQUE Lb. Ft. (Nm.)	WEIGHT Pound (Kg.)
Size 6 (1/4)	None	4 - 10 - 24 x 2" Minimum Tensile Strength 180,000 to 195,000 PSI Part Number 833365 4 - 10 - 24 x 2" SHCS	6.6 lb. ft (9 Nm)	4 lbs (1.9 kg.)

SUBPLATE G502/5 (1/2" NPT)

DIMENSIONS: Inches (mm)



Subplate and bolts to be ordered separately from the valve
Valve Mounting Pattern to ANSI Standard D01

VALVE SIZE	AUXILIARY Ports "X" or "Y"	VALVE TO SUBPLATE Socket Head Cap Screw Kit	TORQUE Lb. Ft. (Nm.)	WEIGHT Pound (Kg.)
Size 6 (1/4)	None	4 - 10 - 24 x 2" Minimum Tensile Strength 180,000 to 195,000 PSI Part Number 833365 4 - 10 - 24 x 2" SHCS	6.6 lb. ft (9 Nm)	4 lbs (1.9 kg.)

4WE6 Design Series 5X Maximum Flow Based on System Pressures Using 60 Hz. Solenoids
Maximum Flows are Shown in GPM (L/MIN) to Avoid Malfunction of the Valve

SPOOL TYPE

PRESSURE PSI (BAR)	GPM (L/MIN) FLOWS	A	B	C	D	E	F	G	H	J	L	M	P	Q	R	T	U	V	W	Y	E1	C/O	D/O
725 (50)			13.2 (50)				4.8 (18)	6.6 (25)			15.9 (60)		4.8 (18)		15.9 (60)		15.9 (60)	7.9 (30)	15.9 (60)				
1450 (100)						15.9 (60)		5.3 (20)								2.6 (10)							
2175 (150)			6.6 (25)		13.2 (50)		4.5 (17)	4.2 (16)	13.2 (50)		13.2 (50)		4.5 (17)		13.2 (50)		13.2 (50)	4.0 (15)	13.2 (50)	13.2 (50)		15.9 (60)	
2900 (200)			2.9 (11)			5.3 (20)	2.6 (10)	3.4 (13)			3.4 (13)	15.9 (60)	2.6 (10)		3.4 (13)		3.4 (13)		3.4 (13)				
3625 (250)			2.6 (10)			2.9 (11)	2.1 (8)	3.2 (12)			2.1 (8)			2.1 (8)		2.4 (9)	2.1 (8)		2.1 (8)		3.7 (14)		
4600 (315)						2.1 (8)	1.8 (7)	2.9 (11)			1.6 (6)		1.8 (7)		1.6 (6)	2.1 (8)	1.6 (6)		1.6 (6)		2.6 (10)		

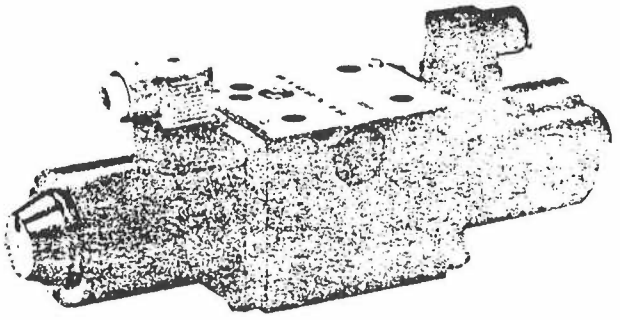
WORLDWIDE HYDRAULICS
MOBILE HYDRAULICS DIVISION
Wooster, Ohio
216/262-2010
INDUSTRIAL HYDRAULICS DIVISION
Bethlehem, Pa.
215/694-8300

3/2, 4/2 and 4/3 Directional Control Valve, Type 5-WE10 With Switching Time Control (5 Chamber Model)

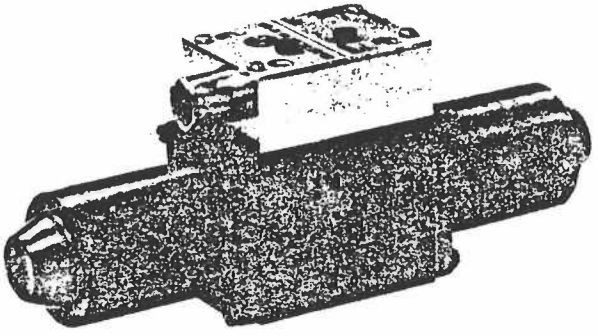
PA 23350

SIZE 10 (D02)	UP TO 4500 PSI	UP TO 26 GPM	ISSUED: 9-8

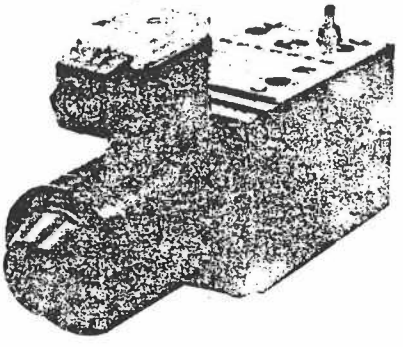
- Direct Solenoid Operated Directional Spool Valve
- Switching Time Control
- Mounting To ANSI D02
- DC Air Gap Solenoids
- With Or Without Manual Solenoid Override
- Individual Electrical Plugs Or Central Terminal Connection
- With Or Without Limit Switch
- 53 Standard Spool Configurations



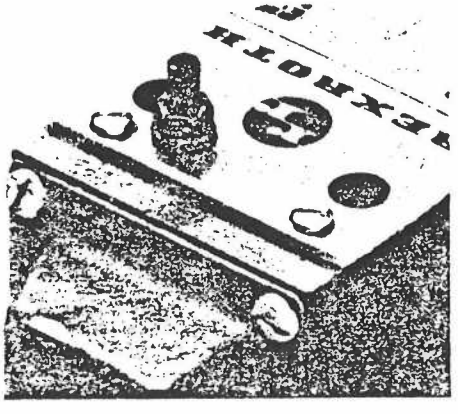
Type 5-4 WE 10 E 10/L.G24 NZ4..C..



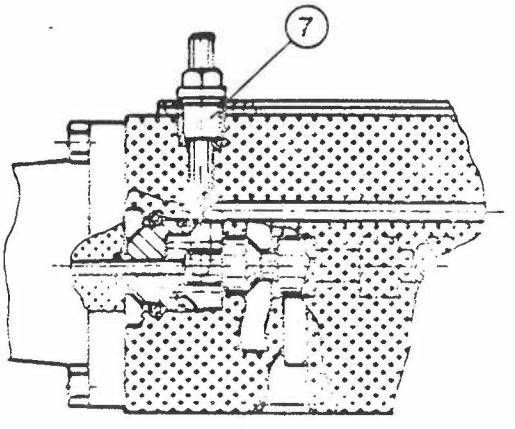
Type 5-4 WE 10 E 10/L.G24 NDL



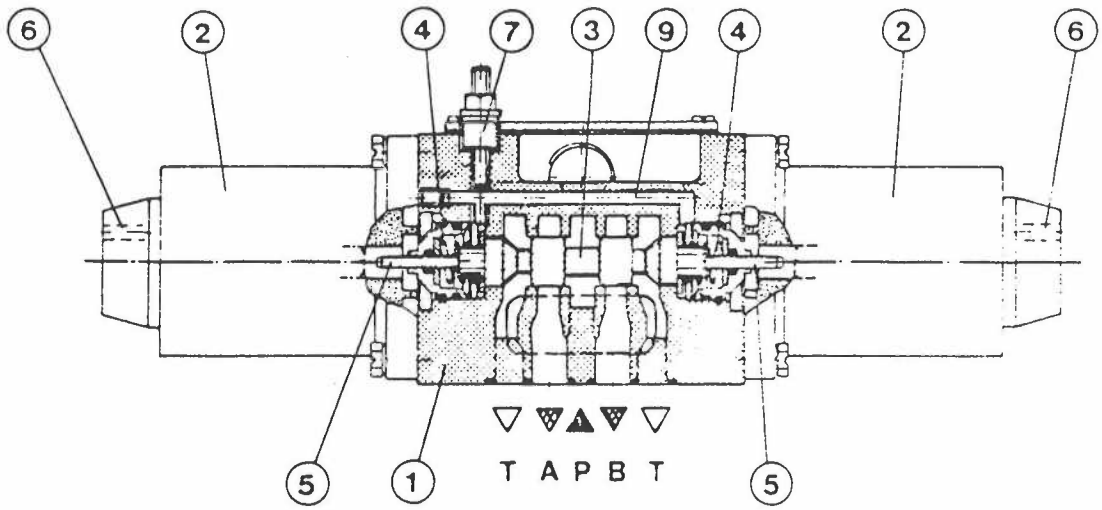
Type 5-4 WE 10 B 10/L.G24 NZ5..C..



Switching Time Control – Model "C"



Throttle Screw



DESCRIPTION

Five port directional control valves type 5-4 WE are solenoid operated directional spool valves. They control the start, stop and direction of an oil flow, and on this model, it is possible to adjust crossover switching time.

The two spring chambers are connected by means of a connecting bore (9). During the switching process, a volume of oil is pushed along the connecting bore from one chamber to the other. If a throttle reduces the diameter of this bore, the switching time will therefore be increased or decreased.

The T lines are not connected to the spring chambers. Smooth switching is possible because any flow forces which occur no longer affect the control spool.

The directional control valve comprises the housing (1), one or two solenoids (2), the control spool (3), one or two return springs (4), as well as an optional device to control the switching time.

When there is no flow through the valve, control spool (3) is held in neutral or starting position (with the exception of the impulse spool) by means of the return springs (4). The control spool (3) is operated by means of air gap DC solenoids (2).

The force of the solenoids (2) affects control spool (3) by means of the plunger (5) and pushes it from its resting position into switching position. This gives free flow from P to A and B to T or P to B and A to T, as required.

When solenoid (2) is de-energized, control spool (3) is returned to its resting position by means of return springs (4).

Optional manual override buttons (6) allow movement of the control spool (3) without energizing the solenoid.

CONTROL OF SWITCHING TIME

The switching time can be delayed if a throttle screw (7) or optional jet (8) is fitted.

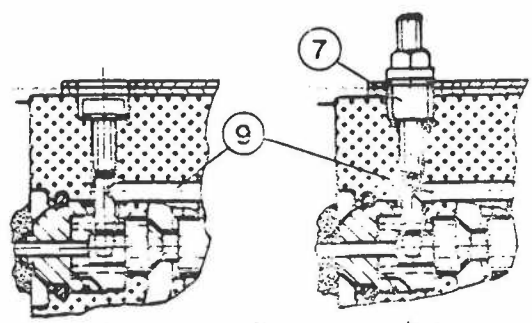
TYPE 5-$\frac{3}{4}$ WE 10..10/L
These are directional control valves without throttle screw or without jet.

TYPE 5-$\frac{3}{4}$ WE 10..10/L..C..
These are directional control valves with throttle screw (7).

TYPE 5-$\frac{3}{4}$ WE 10..10/L..A..
These are directional control valves with jet (8).

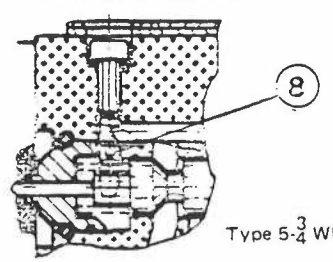
An increase in switching time of 100 ms^{+} is possible when jets are fitted. The increase in switching time depends on the system (i.e. related to pressure, flow and viscosity).

If the throttle device is fitted or disconnected at a later date, the oil must remain in the spring chambers and connecting bore (9), otherwise the alteration to control switching time will not function correctly.



Type 5-$\frac{3}{4}$ WE 10..10/L..

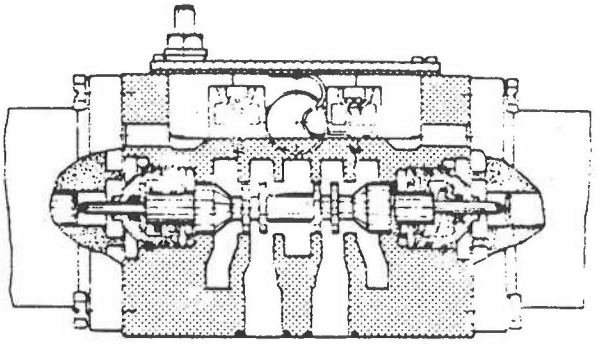
Type 5-$\frac{3}{4}$ WE 10..10/L..C..



Type 5-$\frac{3}{4}$ WE 10..10/L..A..

TYPE 5-$\frac{3}{4}$ WE 10 $\frac{C}{D}$ 10/OL

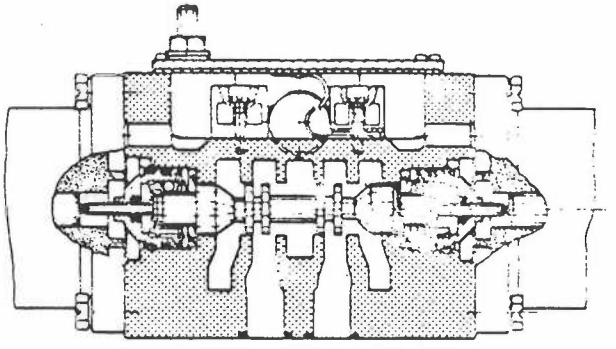
These are directional control valves with 2 switching positions and 2 solenoids, without detent.
A fixed switching position is not possible when there is no flow through the valve.



Type 5-4 WE 10 D 10/OL..

TYPE 5-$\frac{3}{4}$ WE 10 $\frac{C}{D}$ 10/OFL

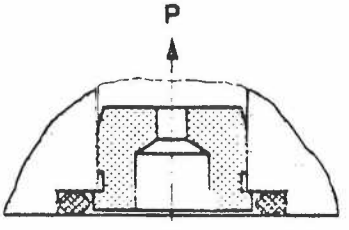
These are directional control valves with 2 switching positions, 2 solenoids, and 2 detents. A switching position is therefore fixed, and continuous energization of the solenoid is unnecessary.



Type 5-4 WE 10 D 10/OFL..

CARTRIDGE THROTTLE

If, due to certain operating conditions during the switching sequences, flows can occur which are larger than the valve performance curves allow, then it is necessary to fit an optional cartridge throttle.
It is available to be fitted in the P line of the directional control valve.

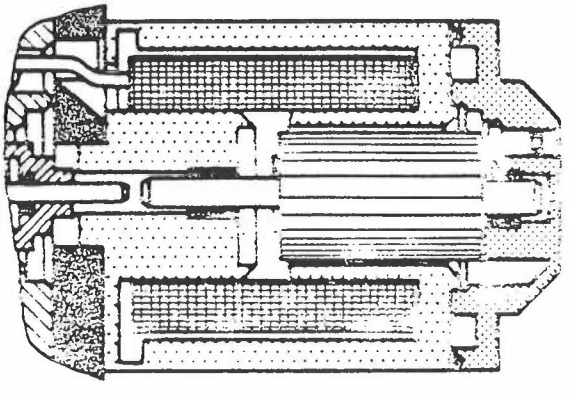


Type 5-$\frac{3}{4}$ WE 10..10/..B..

SOLENOID

Air gap DC solenoids have the following advantages:

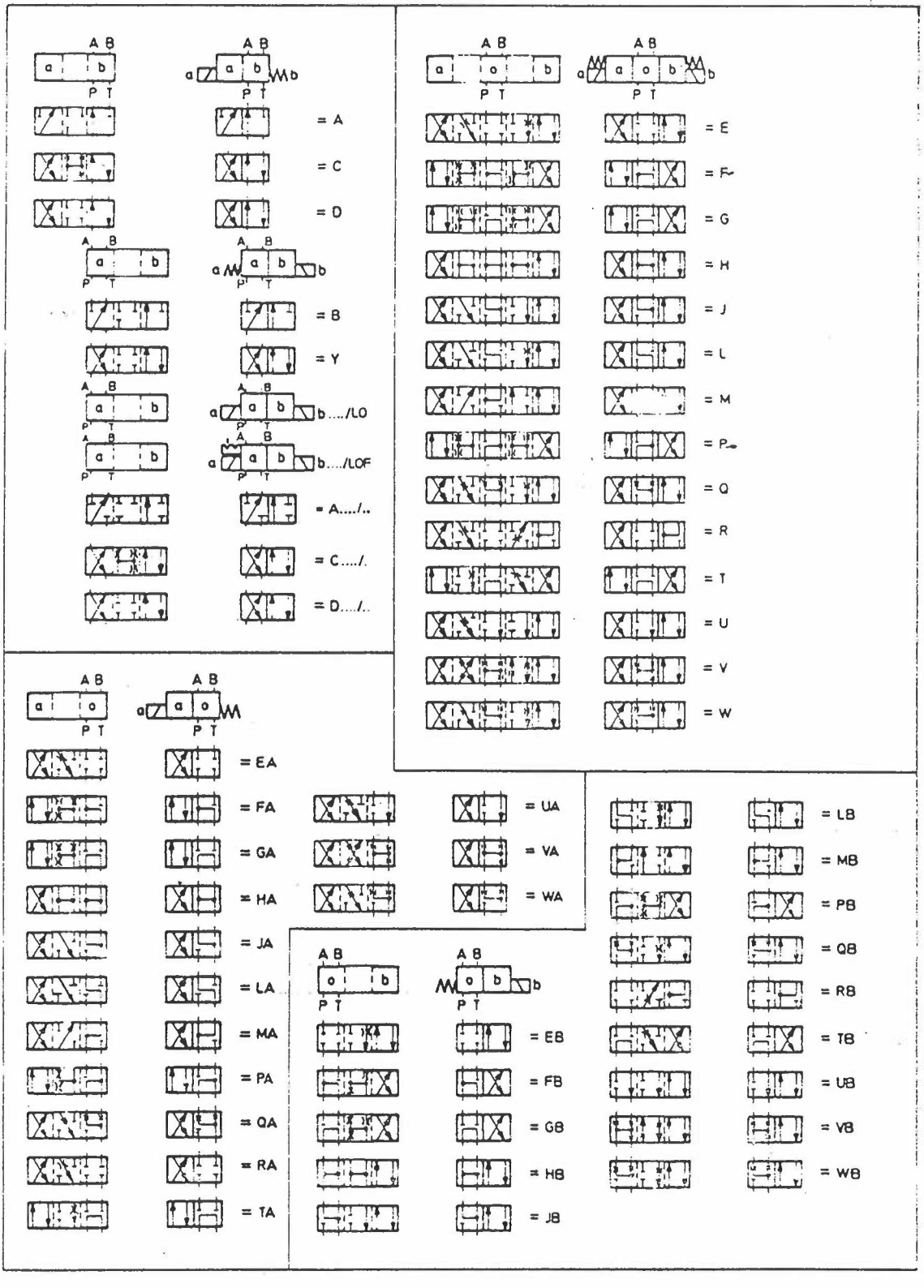
- Smooth switching
- High switching frequency
- Stopping the armature in any intermediate position will not damage the coil
- Unaffected by low voltage, short period excessive voltage, overloading or mechanical sticking
- Connection to AC voltage via rectifier
- It is completely encapsulated
- Long service life



5–4 WE 10 E

PORTING
3 = 3 Service ports
4 = 4 Service ports

SPOOL



10/OF L G24 N V/5 *

DETAILS
Further details to be stated in clear text

SEALS
Omit = Buna-N
V = Viton

SPOOL SPEED CONTROL OPTIONS (Note 2)
Omit = Without switching time control
C = With throttle screw
Cannot be ordered with D, DZ, DZL, DL, L and ZL central terminal box
R (rectifier) with central connection
A 06 = Throttle dia. .024" (0.6mm)
A 07 = Throttle dia. .028" (0.7mm)
A 08 = Throttle dia. .032" (0.8mm)
A 10 = Throttle dia. .039" (1.0mm)
A 12 = Throttle dia. .047" (1.2mm)

"P" PORT FIXED THROTTLE ORIFICE (Note 1)
Omit = Without cartridge throttle
B 08 = Throttle dia. .032" (0.8mm)
B 10 = Throttle dia. .039" (1.0mm)
B 11 = Throttle dia. .043" (1.1mm)
B 12 = Throttle dia. .047" (1.2mm)
B 15 = Throttle dia. .059" (1.5mm)
B 30 = Throttle dia. .118" (3.0mm)

ELECTRICAL CONNECTIONS
For type letter see pages 7 and 9
(Z4 and Z5L with DC current only)

LIMIT SWITCH
Omit = Without limit switch
Y = With limit switch (see page 8)

SOLENOID OVERRIDE
Omit = Without manual override
N = With manual override

SOLENOID VOLTAGE
G 24 = 24 V DC
W 220 R* = DC solenoid with built-in rectifier for 220 V AC, independent of frequency (* with individual connection, plug Z4 and Z5L not possible)

RETURN
Omit = Spring return
O = Without spring return
OF = Without spring return with detent

DESIGN SERIES = 10
Numbered 10 to 19. Installation and connection dimensions remain the same.

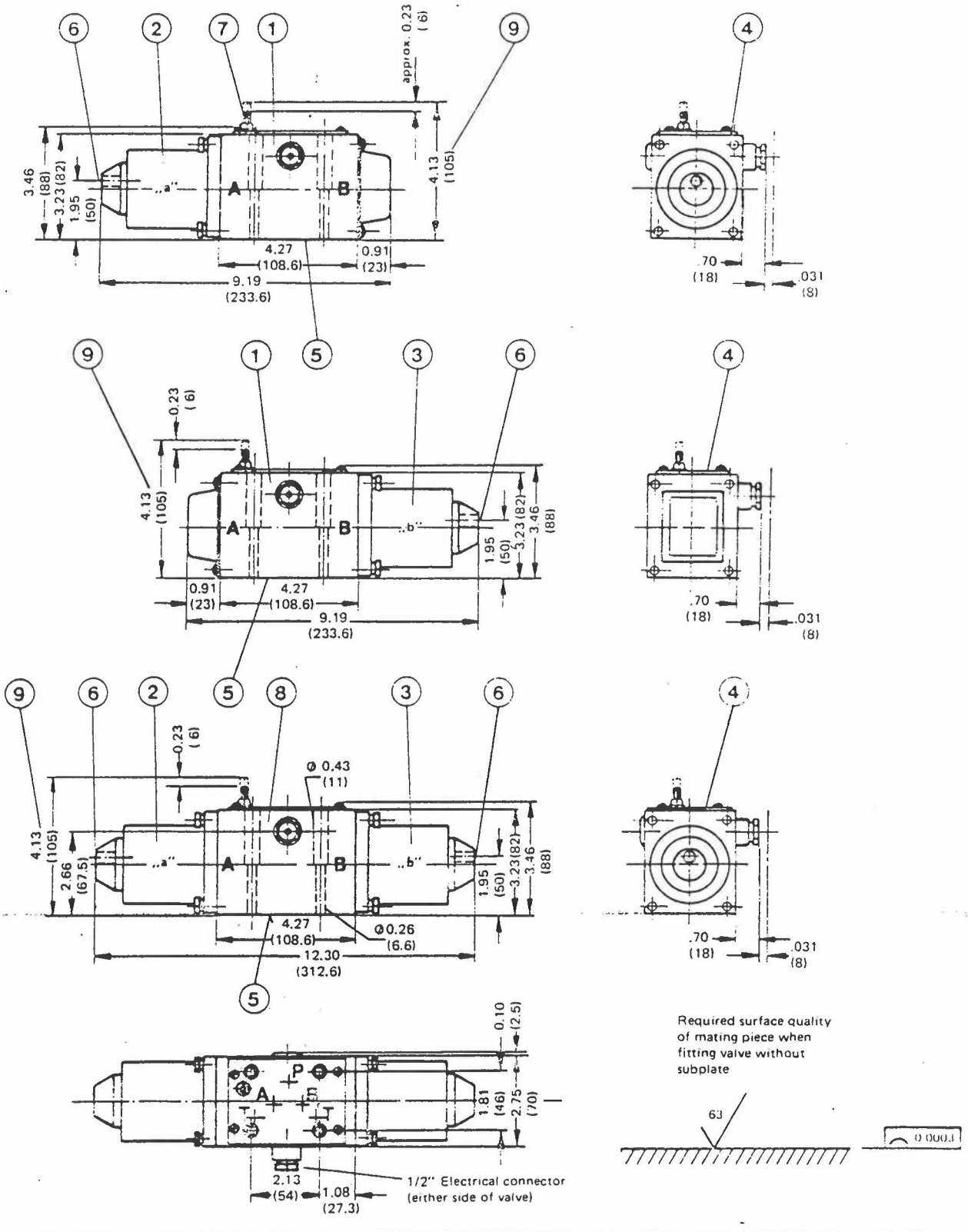
NOTES

1. Cartridge throttle for flow limiting, effective in line P.

2. Screw-in throttle for switching time control, effective in the connection bore of the two spring chambers.

UNIT DIMENSIONS: DIRECTIONAL CONTROL VALVE

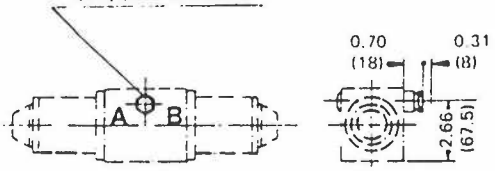
DIMENSIONS: Inches (mm)



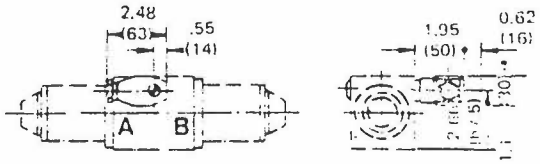
1 Valve for 2 switching positions and single solenoid
2 Solenoid a
3 Solenoid b
4 Nameplate
5 Mounting surface
6 Manual override button
7 Throttle screw
8 Valve for 2 switching positions and 2 solenoids
Valve for 3 switching positions and 2 solenoids
9 Dimensions with open throttle screw

CENTRAL ELECTRICAL CONNECTION

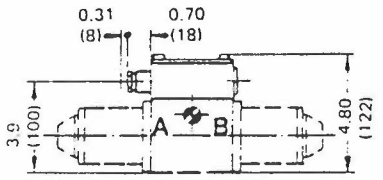
OMIT Central connection on tank port side of valve, cable connection



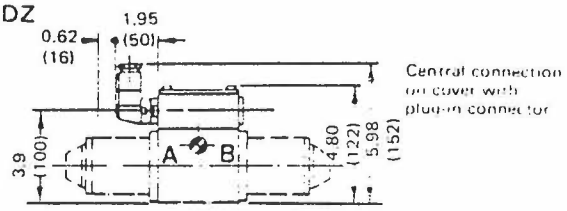
Z Central connection on tank port side of valve, with plug-in connector



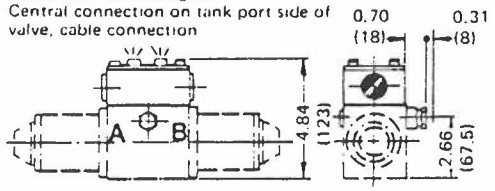
D Central connection on cover with cable connection



DZ

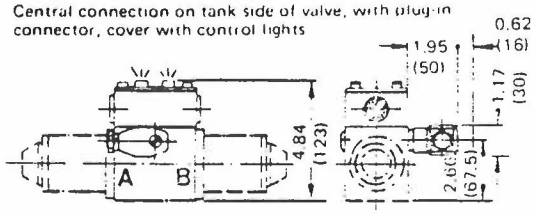


L Cover with control lights
Central connection on tank port side of valve, cable connection

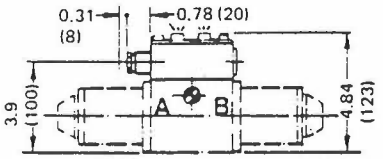


★

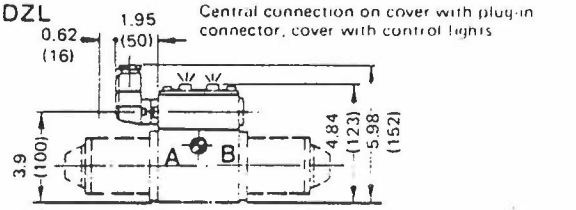
ZL Central connection on tank side of valve, with plug-in connector, cover with control lights



DL Central connection and control lights on cover, cable connection



DZL Central connection on cover with plug-in connector, cover with control lights



ALLOCATION OF TERMINALS, CENTRAL CONNECTION

With 2 solenoids:
solenoid a at terminals 1 and 2
solenoid b at terminals 3 and 4

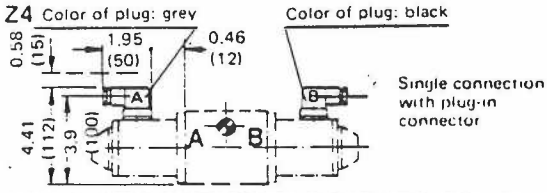
With 1 solenoid:
solenoid always at terminals 1 and 2

With plug connection, the socket can be moved in increments of 30° by means of a toothed ring.

★ To increase the service life of the control lights up to 60 V, we recommend that a diode be connected across the solenoids to suppress switching voltage surge.

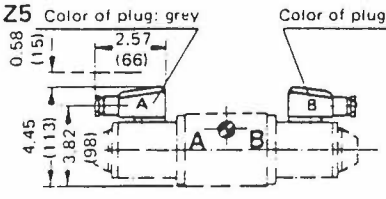
INDIVIDUAL ELECTRICAL CONNECTION

Z4 Color of plug: grey — Color of plug: black



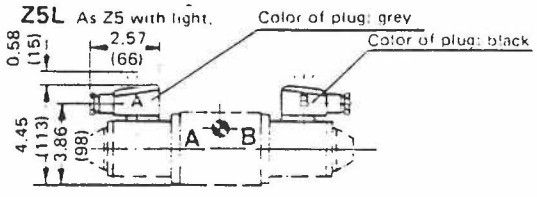
Single connection with plug-in connector

Z5 Color of plug: grey — Color of plug: black

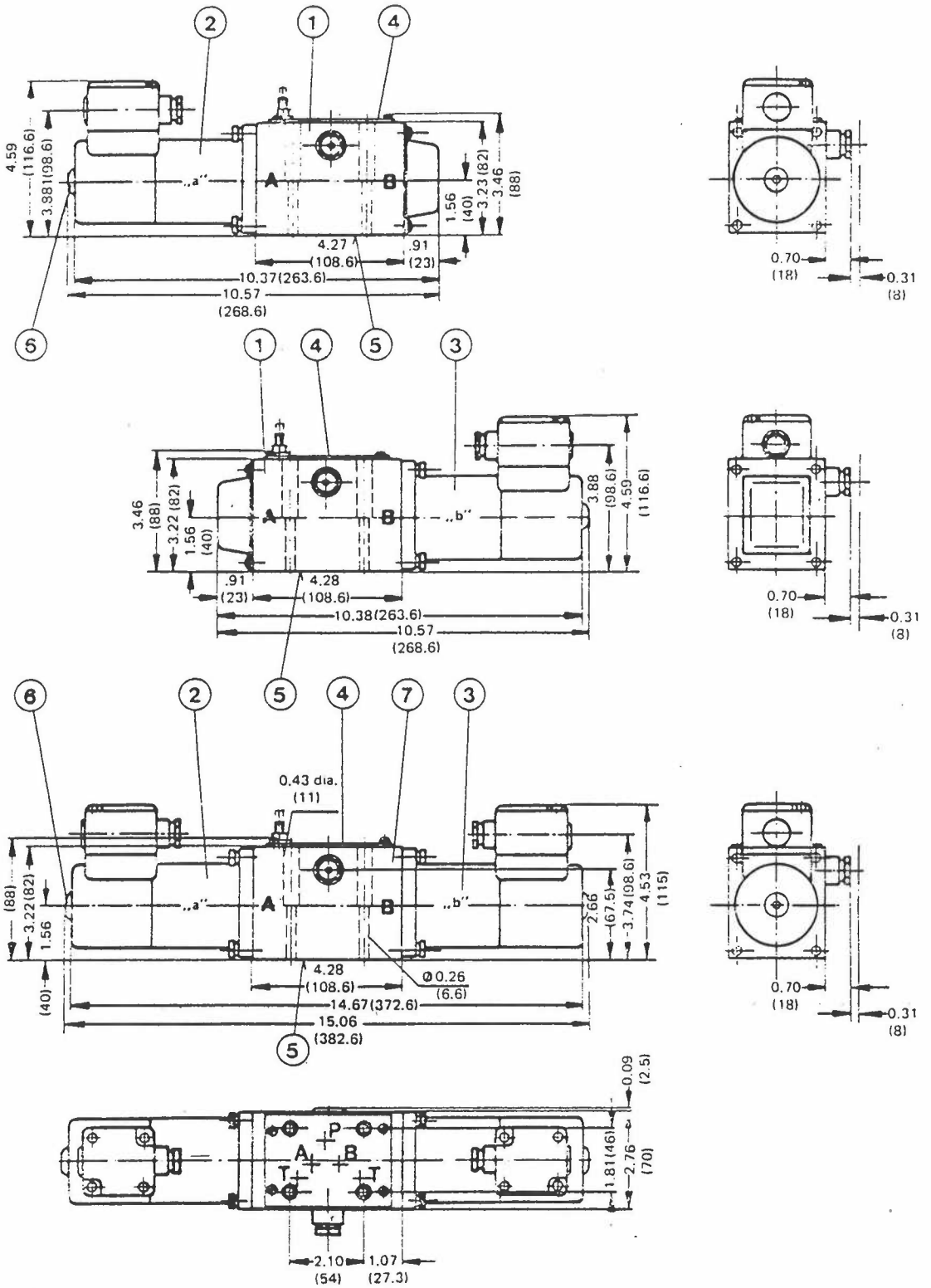


Single connection with large plug-in connector with cable clamps

Z5L As Z5 with light. Color of plug: grey — Color of plug: black



DIMENSIONS: Inches (mm)

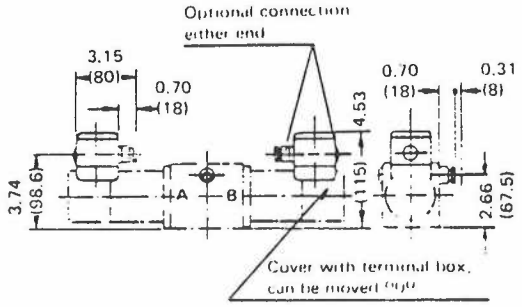


1 Valve for 2 switching positions and single solenoid
2 Solenoid a
3 Solenoid b
4 Nameplate
5 D02 mounting surface
6 Manual override button
7 Valve for 2 switching positions and 2 solenoids
Valve for 3 switching positions and 2 solenoids

ELECTRICAL CONNECTION (SOLENOID WITH BUILT-IN LIMIT SWITCH)

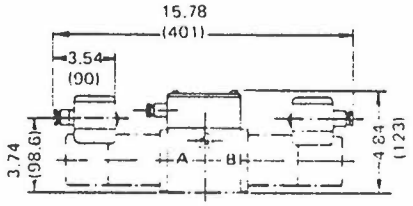
OMIT

Central connection of solenoid on tank port side of valve, with cable connection, limit switch connection on solenoid



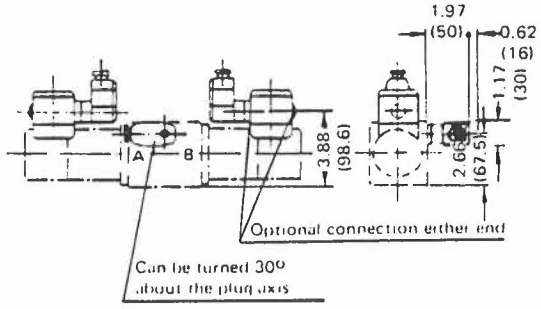
D

Central connection on cover, cable connection, limit switch connection on solenoid



Z

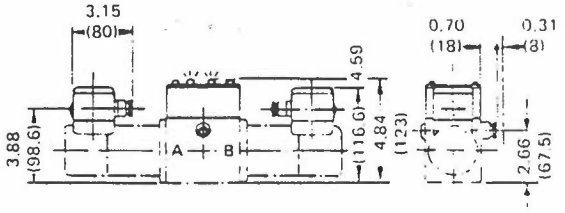
Central connection on tank port side of valve, with plug-in connector, limit switch connection on solenoid



L

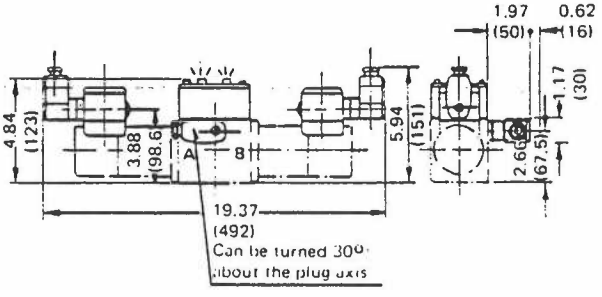
Cover with control lights, cable connection, limit switch connection on solenoid

Connection on tank port side of valve



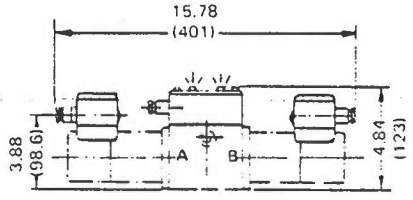
ZL

Central connection on tank port side of valve, with plug-in connector, cover with control lights, limit switch connection on solenoid



DL

Central connection on cover, cover with control lights, cable connection, limit switch connection on solenoid



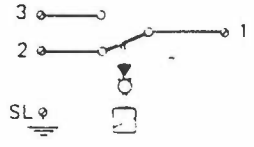
ALLOCATION OF TERMINALS WITH CENTRAL CONNECTION

With 2 solenoids:
solenoid a at terminals 1 and 2
solenoid b at terminals 3 and 4

With 1 solenoid:
solenoid always at terminals 1 and 2

With plug connection, the socket can be moved in increments of 30° by means of a toothed ring

ALLOCATION OF TERMINALS WITH LIMIT SWITCH

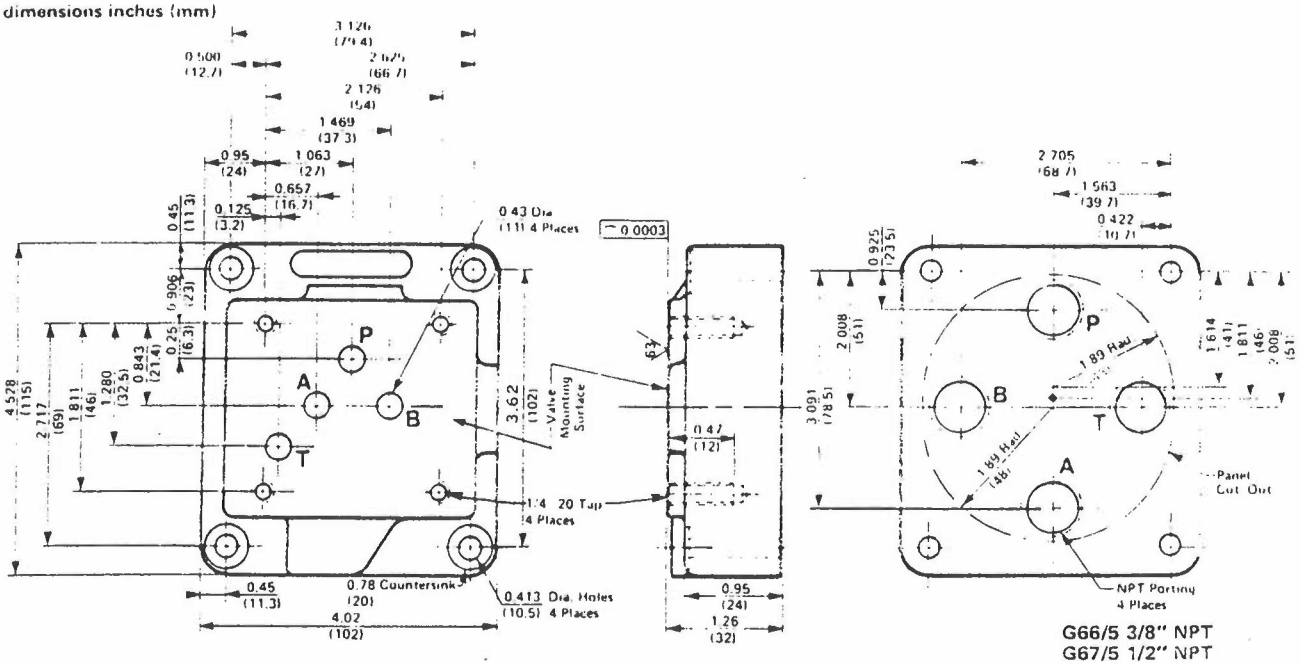


Contact Loading
250 V ~ 5 Amp.
30 V ~ 2 Amp.

UNIT DIMENSIONS: SUBPLATE G66/5 3/8" NPT & G67/5 1/2" NPT

RA 23

dimensions inches (mm)

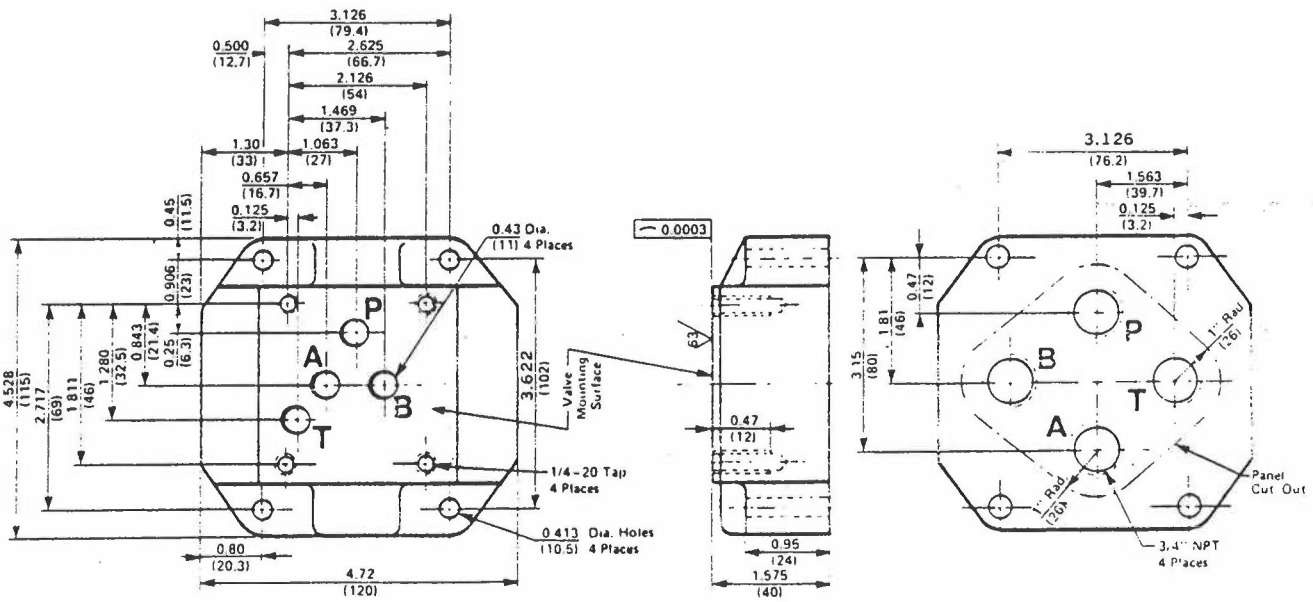


G66/5 3/8" NPT
G67/5 1/2" NPT

Subplate and bolts to be ordered separately from the valve
Valve Mounting Pattern to ANSI Standard D02

VALVE SIZE	AUXILIARY Ports "X", or "Y"	VALVE TO SUBPLATE Socket Head Cap Screw Kit	TORQUE Lb. Ft. (Nm)	WEIGHT Pound (Kg.)
Size 10 (1/2)	None	1/4 - 20 x 2" Minimum Tensile Strength 180,000 to 195,000 PSI Part No 933368 (4) 1/4 - 20 x 2 SHCS	11 lb. ft. (15)	5 lbs. (2.3)

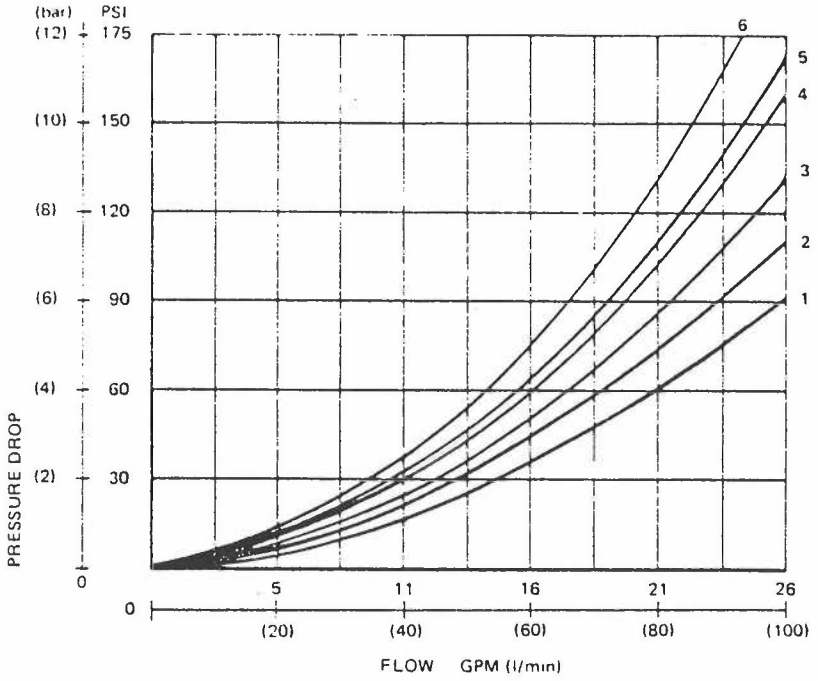
UNIT DIMENSIONS: SUBPLATE G534/5 3/4" NPT



Subplate and bolts to be ordered separately from the valve
Valve Mounting Pattern to ANSI Standard D02

VALVE SIZE	AUXILIARY Ports "X", or "Y"	VALVE TO SUBPLATE Socket Head Cap Screw Kit	TORQUE Lb. Ft. (Nm)	WEIGHT Pound (Kg.)
Size 10 (1/2)	None	1/4 - 20 x 1 3/4 Minimum Tensile Strength 180,000 to 195,000 PSI Part No 933367 (4) 1/4 - 20 x 1 3/4 SHCS	11 lb. ft. (15)	5.6 lbs. (2.5)

PERFORMANCE CURVES (Measured at v = 36 cSt and t = 50° C)

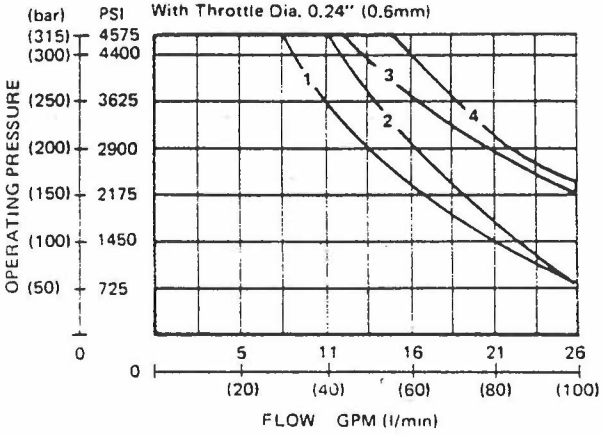


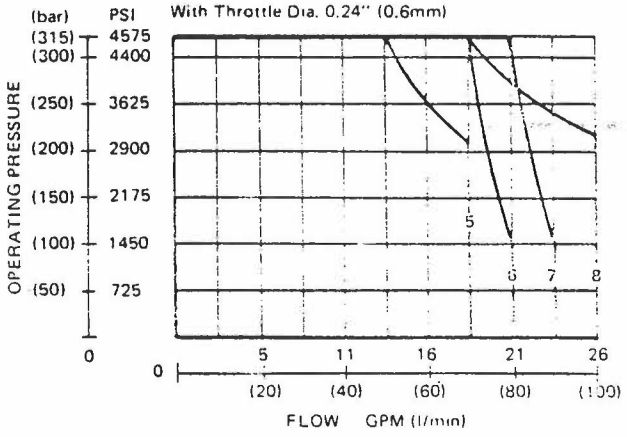
SPOOL TYPE	►FLOW DIRECTION►			
	P-A	P-B	A-T	B-T
A + B	2	2	–	–
C	2	2	3	3
D + Y	2	2	3	4
E	1	1	2	2
F	1	2	2	2
G + T	4	4	5	6
H	1	1	3	4
J	2	2	1	2
L	2	2	1	3
M	1	1	2	3
P	1	1	3	3
Q	2	2	3	3
R	2	5	2	–
U	2	2	2	2
V	2	2	2	3
W	1	1	2	2
Neutral Position		B-T	A-T	P-T
F	–	–	1	3
G + T	–	–	–	4
H	–	–	–	1
P	–	–	–	4
L	–	–	5	–
U	–	–	–	6
Switching Position	P-A	B-A	A-T	P-T
R	–	4	–	–

PERFORMANCE LIMITATIONS (Measured at 175 SSU (36 cSt) and 120°F (50°C)

Because of silting, the switching function of the valves is dependent on the filtration. In order to obtain the maximum flow values shown, a full flow filtration of 25 micron is recommended. The forces acting within the valves also influence the flow performance. On the 4 way valves the flow data shown therefore apply for normal application with 2 flow directions (i.e. from P to A and simultaneously return flow from B to T). (See table.)
If only 1 direction of flow is required, as for example when a 4 way valve with port A or B plugged is used as a 3 way valve, then in critical cases the maximum flow can be considerably lower.

PERFORMANCE LIMIT MEASURED WITH WARM SOLENOIDS AND 10% UNDER-VOLTAGE.



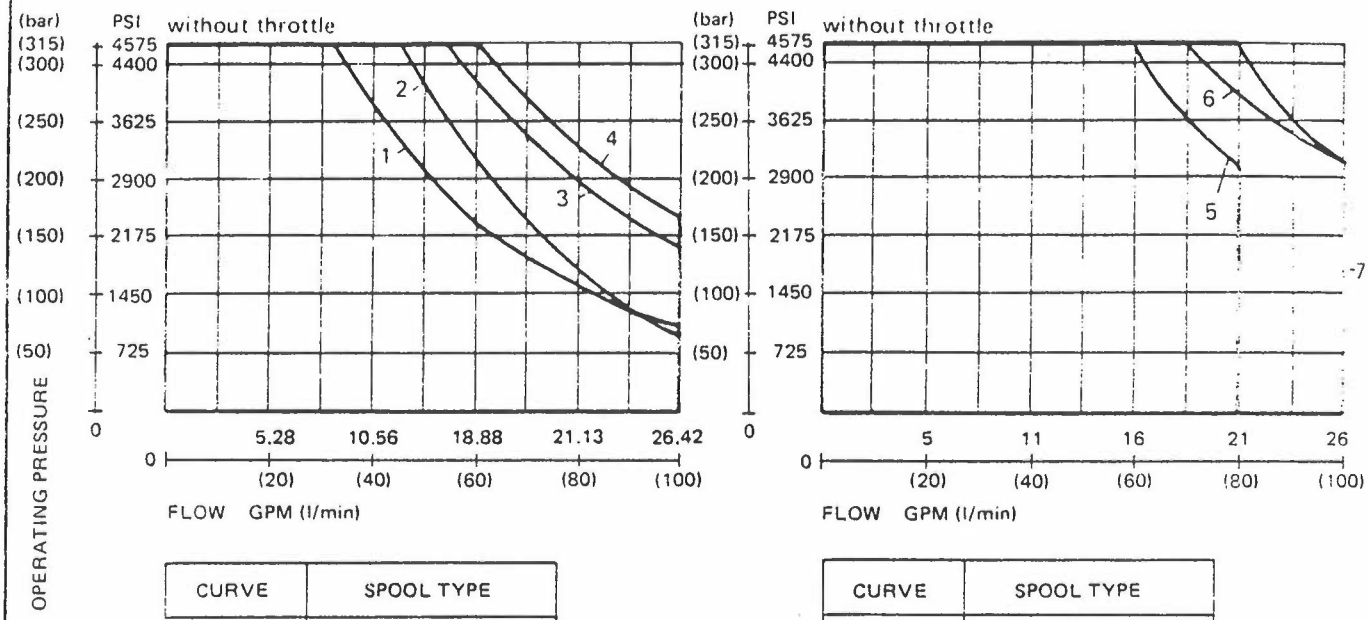


CURVE	SPOOL TYPE
1	A, B, V
2	F + P
3	J
4	W, Q, R, L, U

CURVE	SPOOL TYPE
5	G + T
6	C
7	D, Y
8	E, H, M

PERFORMANCE LIMIT (Measured at v = 36 cSt and t = 50° C)

RA 23



CURVE	SPOOL TYPE
1	A, B, V
2	F + P
3	J
4	L, U

CURVE	SPOOL TYPE
5	G + T
6	W, Q, R
7	E, H, M, C, D, Y

TECHNICAL DATA

HYDRAULIC				
Operating Pressure	– Port A, B, P	PSI (bar)	...4575 (315)	
	– Port T	PSI (bar)	...2175 (150)	
	(With spool types A and B, Port T must be used as drain port, when operating pressure is in excess of 2175 (150 bar)).			
Flow		GPM (l/min)	...26 (100)	
Throttling Area (Switching Position 0)			Spool type Q: 6% of nominal area	Spool type W: 3% of nominal area
Seals & Fluids			The Rexroth valves are supplied as a standard with Buna-N seals. These seals are suitable for use with petroleum base hydraulic oils, also most water glycol and water-in-oil emulsions. Optional Viton seals are available, which are compatible with most phosphate ester fluids.	
Fluid Temperature Range		°F (°C)	-22° F (-30°) to + 160° F (+ 70°)	
Viscosity Range		SSU (cSt)	35 SSU (2.8) to 1750 SSU (380)	
Weight	– Valve with 1 Solenoid	lbs. (kg)	11.4 (5.2)	Approx. 12.76 (5.8) (with limit switch)
	– Valve with 2 Solenoids	lbs. (kg)	14.5 (6.6)	Approx. 17.1 (7.8) (with limit switch)
	– Subplate	lbs. (kg)	5.1 (2.3) 1/2" NPT + 3/8" NPT, approx. 6.1 (2.7) 3/4" NPT	
ELECTRICAL				
Voltages Available		(V=)	12, 24, 42, 60, 96, 110, 180, 195, 220	
Power Requirement		(W)	41	
Duty Cycle			DB	
Switching Time, On		(ms)	60	Without switching time control
Switching Time, Off		(ms)	40	Without switching time control
Ambient Temperature		°F (°C)	...120° F (+50°)	
Coil Temperature		°F (°C)	...300° F (+150°)	With electrical connection the protective conductor (SL ⏚) must be fitted.
Switching Frequency		cycles per hour	...15,000	
Insulation to DIN 40 050			IP 65	

For application to other specifications, please consult REXROTH

REXROTH
WORLDWIDE HYDRAULICS
BETHLEHEM, PA 18018

ENGINEERING DATA SHEET

PILOT OPERATED - PRESSURE RELIEF VALVE
Sandwich Valve With Single Or Double Reliefs
Type ZDB10 (1/2) or Z2DB10 (1/2)

ANSI D02 Mtg.	To 4600 PSI (315 bar)	To 26 GPM (100 l/min)

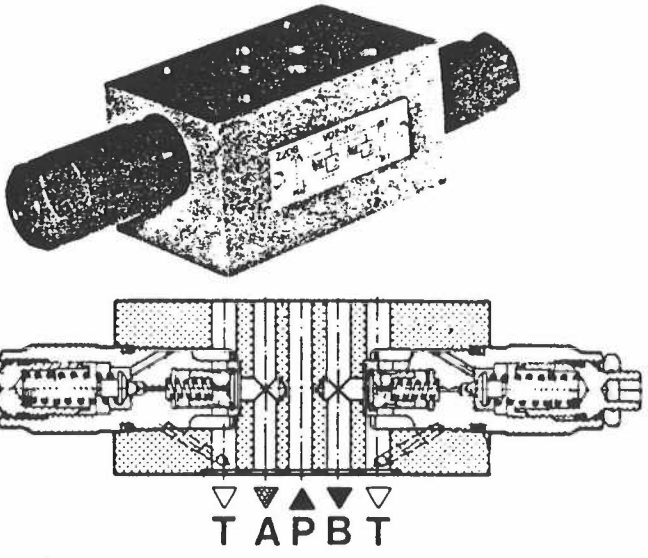
RA
RA 25760
Issued: 9-80

GENERAL DESCRIPTION
The pressure control relief valve ZDB is a single passage relief valve of the sandwich plate design. This valve limits the pressure in either Passage A, B or P Port, to the T Port.

The Z2DB is a two passage limiting pressure valve containing two relief valve cartridges. This valve is used to limit the pressure in Passages A and B to T. It is also available for cross-over protection for Passages B to A and A to B. See Page 2 for schematic diagrams.

The cartridge used in the ZDB and Z2DB sandwich valves is described in the Engineering Data Sheet RA 25730. The relief cartridge is spring loaded and is a pilot operated relief valve providing excellent response and extreme accuracy.

Valve functions require two tank ports.



GENERAL SPECIFICATIONS
PRESSURE RATING...Port P 1500 PSI (100 bar) or 4600 PSI (315 bar)
PEAK PRESSURE...Port P 5000 PSI (340 bar)
FLOW RATING...(See Performance Curves Page 1)
Size 10 (1/2) 26 GPM (100 l/min)
VALVE WEIGHT...ZDB10 = 4.5 lbs. (2.0 kg.)
Z2DB10 = 5.1 lbs. (2.3 kg.)
STABILITY & REPEATABILITY...±1% of set pressure & ±10 PSI (0.7 bar)
RESPONSE TIME...20 Milliseconds
OPERATING TEMPERATURE...-4°F (-20°C) to 160°F (70°C)

SEALS AND FLUIDS...The Rexroth valves are supplied as a standard with Buna-N seals. These seals are suitable for use with petroleum base hydraulic oils, also most water glycol and water-in-oil emulsions.
As an OPTIONAL FEATURE Viton seals are available, which are compatible with most phosphate ester fluids.
VISCOSITY RANGE...35 SSU (2.8cSt) to 1750 SSU (380cSt)
MOUNTING POSITION...Optional

TECHNICAL DATA

Model Code **Z 2 DB 10 V A 2 – 3X/ 100 V**

RELIEF CARTRIDGE
Omit = One cartridge
2 = Two cartridges

PRESSURE LIMITING CIRCUITS (See Page 2)
With 1 Cartridge
A = Port A to T
P = Port P to T
B = Port B to T
With 2 Cartridges
C = Ports A & B to T
D = Ports A to B & B to A

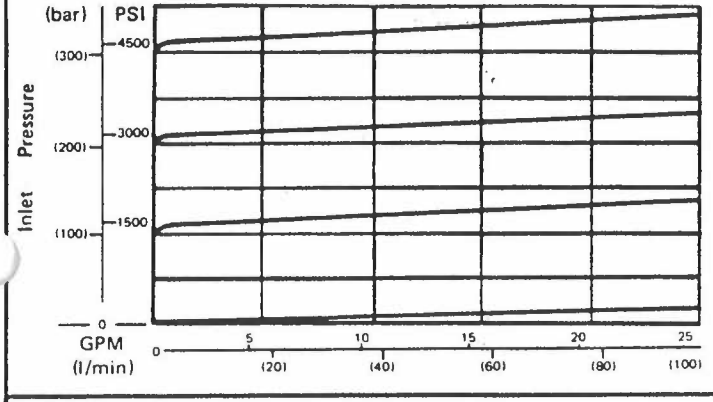
SEALS
Omit = Buna-N
V = Viton

MAXIMUM PRESSURE SETTING
100 = 1500 PSI (100 bar)
315 = 4600 PSI (315 bar)

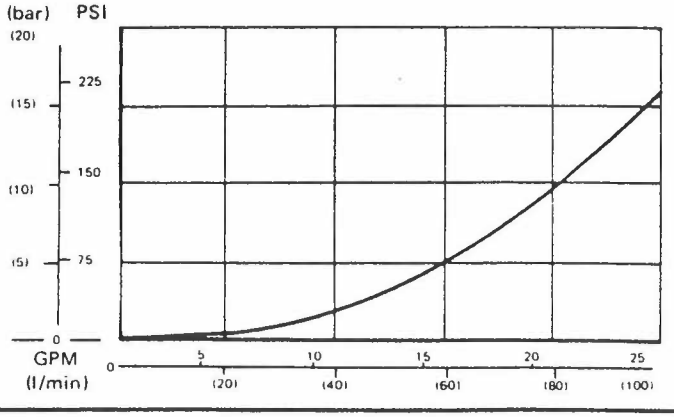
DESIGN SERIES
Numbered 30 to 39 - this number is assigned by the factory and is used for ordering spare parts.

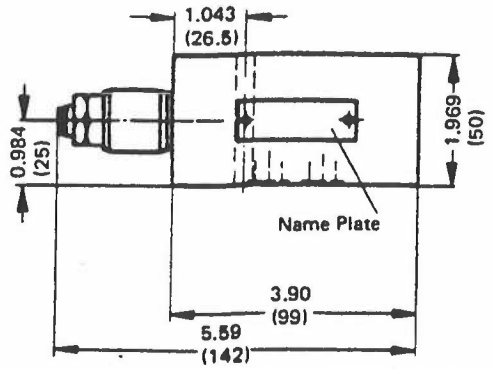
PERFORMANCE CURVES - Tests With 170 SSU (36cSt) and 122°F (50°C)

INLET PRESSURE

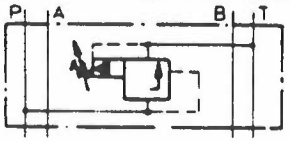


LOWEST PRESSURE SETTING

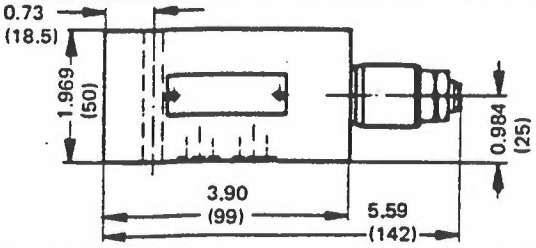


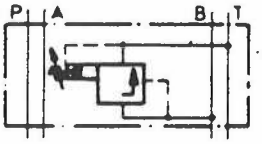


ZDB 10 VA 2-30/$^{100}_{315}$

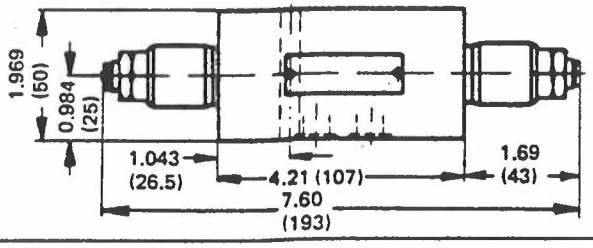


ZDB 10 VP 2-30/$^{100}_{315}$

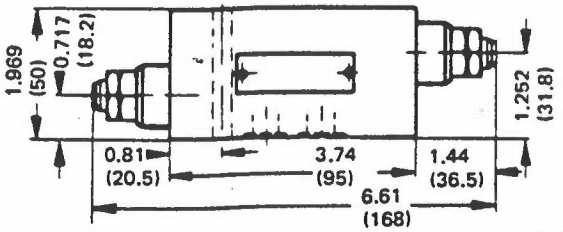


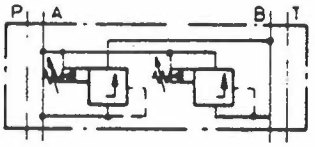


ZDB 10 VB 2-30/$^{100}_{315}$

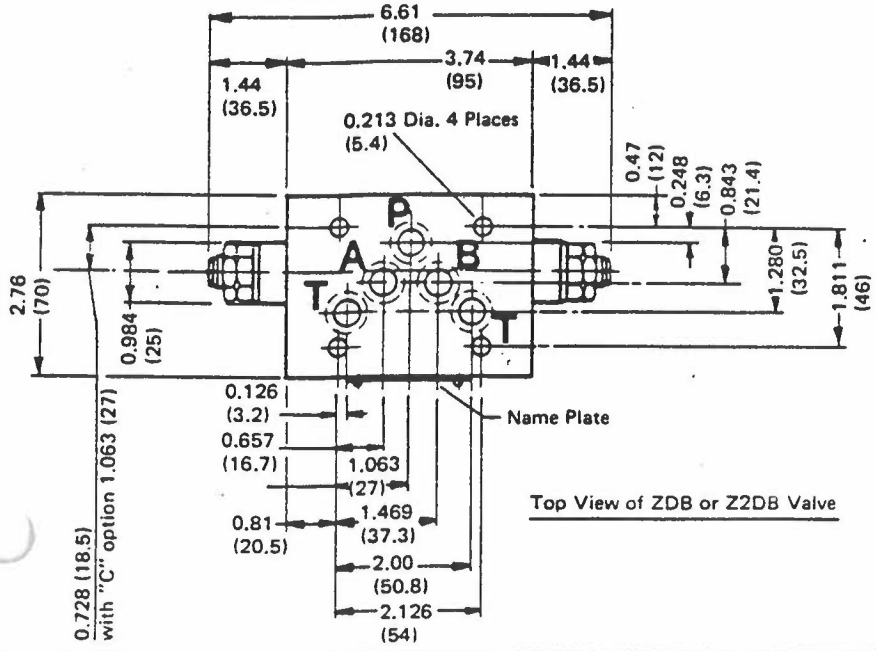


Z2DB 10 VC 2-30/$^{100}_{315}$





Z2DB 10 VD 2-30/$^{100}_{315}$

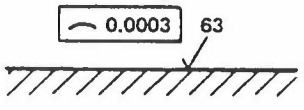


Top View of ZDB or Z2DB Valve

Valve Mounting O-ring 12 x 2
Buna-N 004 255
Viton 004 449

Mounting to ANSI D02 and requires two tank passages.

Flatness of
Manifold Mounting Surface



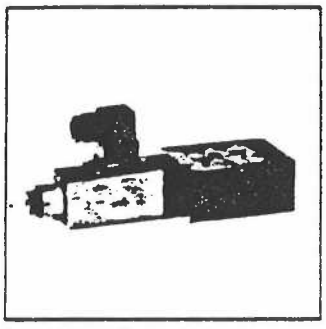
REXROTH
WORLDWIDE HYDRAULICS
BETHLEHEM, PA 18018

ENGINEERING DATA SHEET

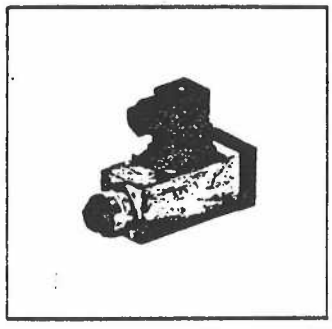
PRESSURE SWITCH
Type HED 4
for Manifold--In-line Threaded--Module Mounting

Mtg. ANSI-D01 or D02	5000 PSI(315 bar)	Piston Design

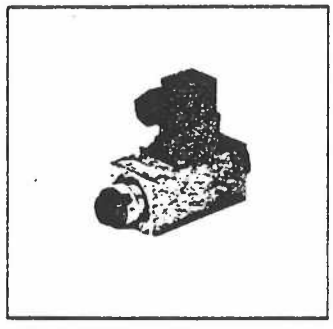
RA
RA 30174
Issued: 8-1-79



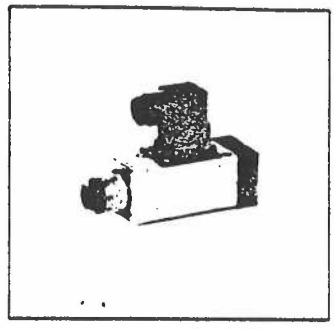
HED 4 OH10/...Z14 with optional sandwich plate
Size 6 valves ANSI-D01
Size 10 valves ANSI-D02



HED 4 OP10/...Z14..
for Manifold Mounting



HED 4 OA10/...Z14..
for In-line Mounting



HED 4 OH10/...Z14..
for mounting on sandwich plate

GENERAL DESCRIPTION...The Rexroth type HED 4 is a direct piston operated hydraulic pressure switch. As hydraulic system pressure is exerted on the piston (2), the piston moves the spring retainer and switch actuator plate (6) against the force of the spring (3), which actuates the switch (5). Adjustment of the pressure switch setting is by means of the adjusting nut and sleeve element (4).

A mechanical stop is built into the assembly to prevent damage should an over pressure occur.

SWITCH CAPACITY...AC 250 volt, 5 amperes
DC 50 volt, 1 ampere
250 volt, 0.2 ampere
(for DC applications, a suppressor across the line is recommended to increase the service life of the switch.)

SWITCH...repeatability accuracy is plus or minus 1% of the pressure setting.
...frequency--120 cycles per minute
SWITCH...single pole, double throw (SPDT)

ELECTRICAL CONNECTION...plug-in connector.

OPERATING TEMPERATURE...-4°F (-20°C) to +160°F (+70°C)

FLUID RECOMMENDATIONS...
Buna-N seals are supplied as a standard. These seals are suitable for use with petroleum base hydraulic oils; and most water glycol or water-in-oil emulsions.

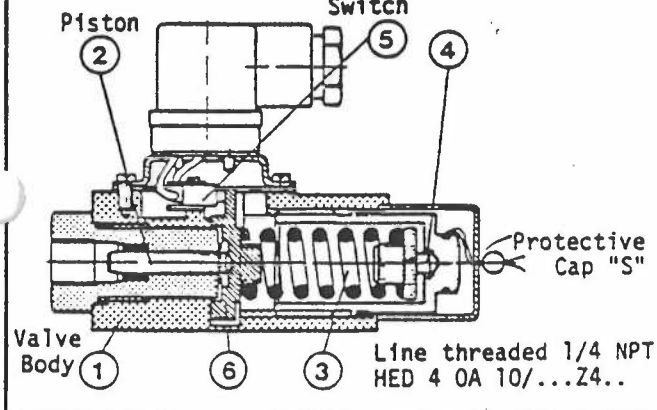
Viton seals are optional. These seals are compatible with most phosphate ester fluids.

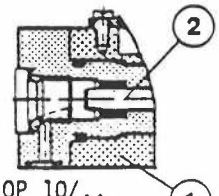
VISCOSITY RANGE...35 SSU(2.8cSt.) to 1750 SSU (380cSt.)

MOUNTING POSITION...optional

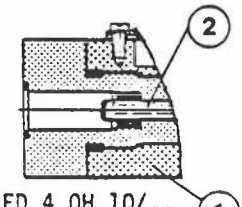
WEIGHT...HED 4 Press. Sw. 1.32 pounds(0.6kg)
Sandwich Plate-Size 6 1.8 pounds(0.8kg)
Sandwich Plate-Size 10 4.2 pounds(1.9kg)

	ORDER CODE	Max. Operating Pressure	-ADJUSTMENT RANGE- Pressure Decreasing	Pressure Increasing
PSI (bar)	50	750 PSI(50 bar)	30 PSI(2 bar) to 675 PSI(46 bar)	60 PSI(4 bar) to 725 PSI(50 bar)
	100	5000 PSI(350 bar)	45 PSI(3 bar) to 1300 PSI(89 bar)	120 PSI(8 bar) to 1450 PSI(100 bar)
	350	5000 PSI(350 bar)	90 PSI(6 bar) to 4600 PSI(322 bar)	300 PSI(20 bar) to 5000 PSI(350 bar)





HED 4 OP 10/..
for manifold mtg.



HED 4 OH 10/..
for mounting on sandwich plate

HED 4		XX					/ 5

MOUNTINGS
Manifold = P
Line = A
Module stacking = H

DESIGN SERIES NO. = XX
Numbered 10 to 19
This number is assigned by the factory and is used for ordering Spare Parts.

PRESSURE SETTINGS
to 750 PSI(50 bar) = 50
to 1500 PSI(100 bar) = 100
to 5000 PSI(350 bar) = 350

SEALS
omit = Buna-N
V = Viton

PROTECTIVE CAP
omit = if not needed
S = if required

PILOT LIGHTS
(order with Z15 plug)
L24 = 24 volt
L110 = 110 volt
L220 = 220 volt

PLUG IN CONNECTORS
Z14 = Standard Plug
Z15 = Large Plug
(use with Pilot Lights)

OPTIONAL FEATURE--Ordering Code "H"-The SANDWICH VALVE--Adaptor Plate, (to be ordered separately)

PRESSURE SWITCH ADAPTER PLATES

SIZE 6-Pressure Switch Adaptor Plate (order by part number shown below flow symbol)

ANSI-D01

Pressure switch effective in line									
Buna-N	308 400	308 401	308 402	308 403	308 404*	308 405	308 406	308 407	308 408
Viton	308 436	308 437	308 438	308 439	308 440*	308 441	308 442	308 443	308 444

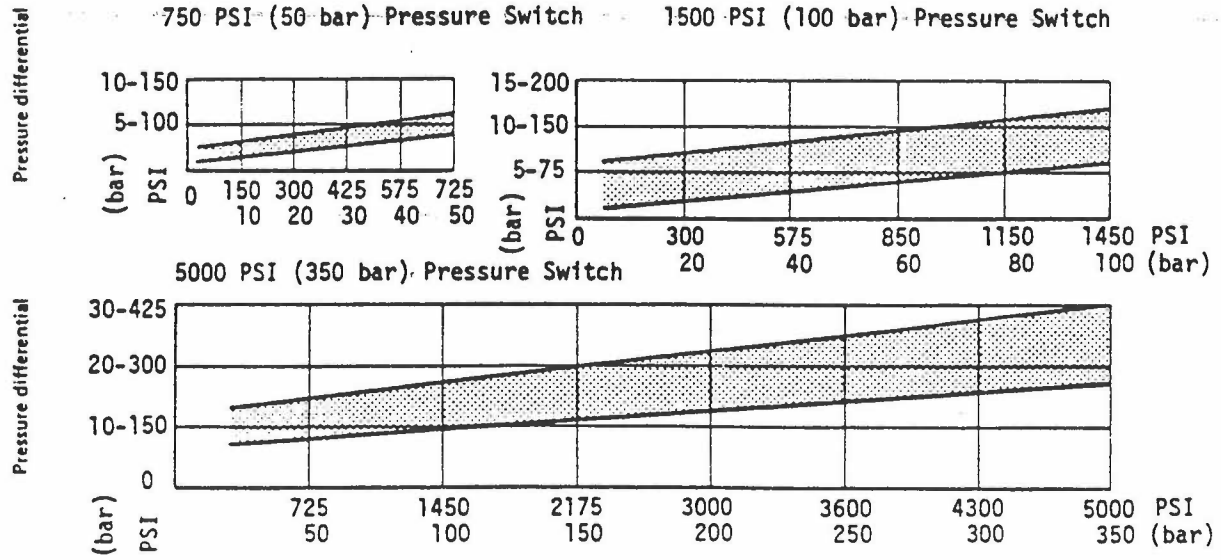
SIZE 10-Pressure Switch Adaptor Plate (Order by part number shown below flow symbol)

ANSI-D02

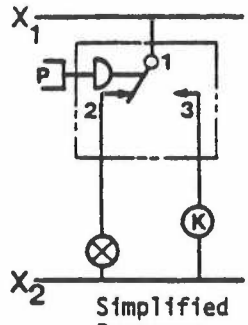
Pressure switch effective in line									
Buna-N	308 409	308 410	308 411	308 412	308 413*	308 414	308 415	308 416	308 417
Viton	308 445	308 446	308 447	308 448	308 449*	308 450	308 451	308 452	308 453

NOTE: * requires two HED 4 Pressure Switches for these flow patterns.

PRESSURE DIFFERENTIAL CHART

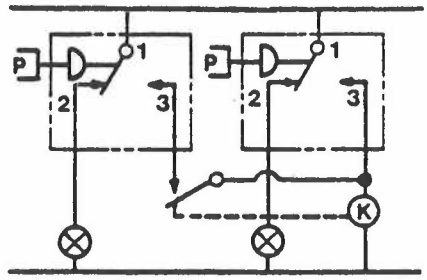


CIRCUIT EXAMPLES for the HED 4 Pressure Switch



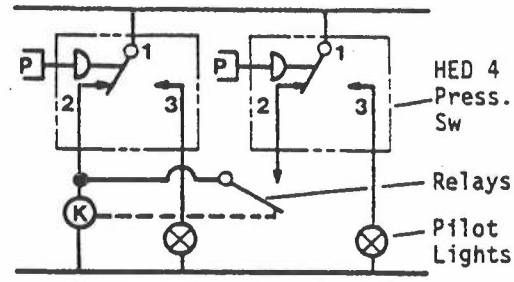
Simplified Pressure Switch Circuit

1 - HED 4



Two normally open switches for adjustable differential control

2 - HED 4



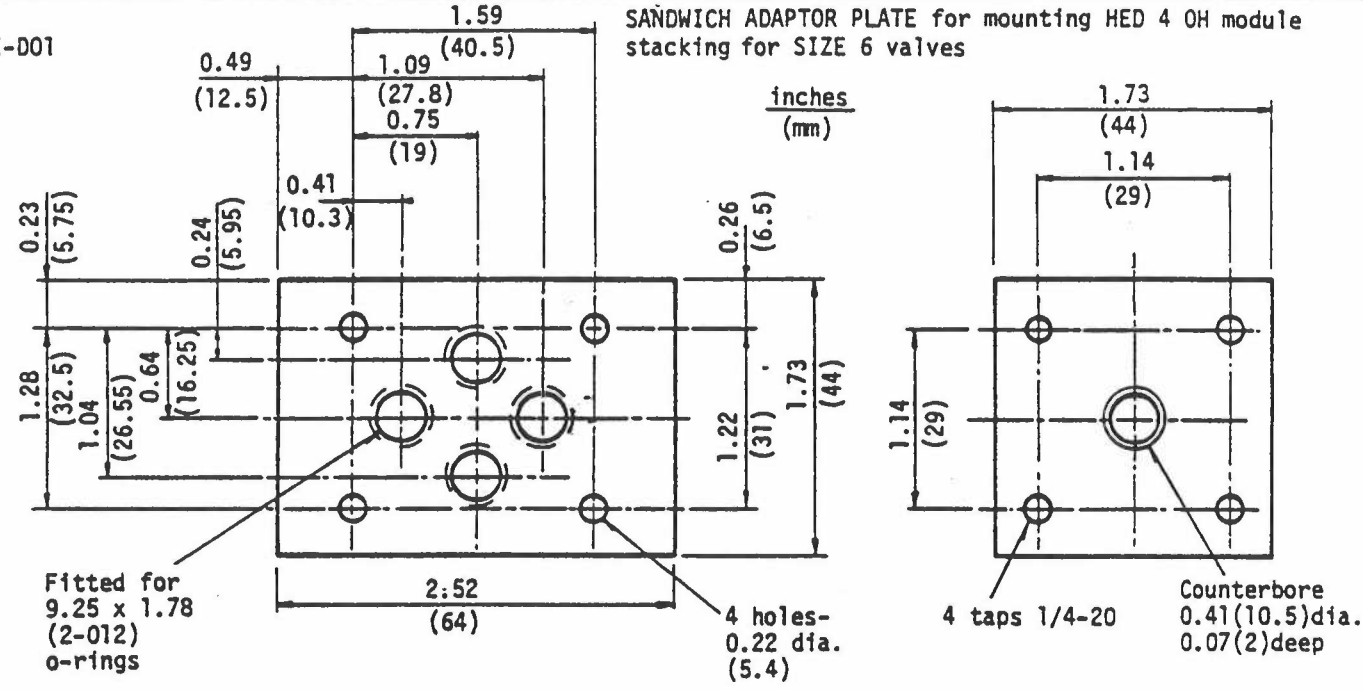
Two normally closed switches for adjustable differential control

2 - HED 4

DIMENSIONS

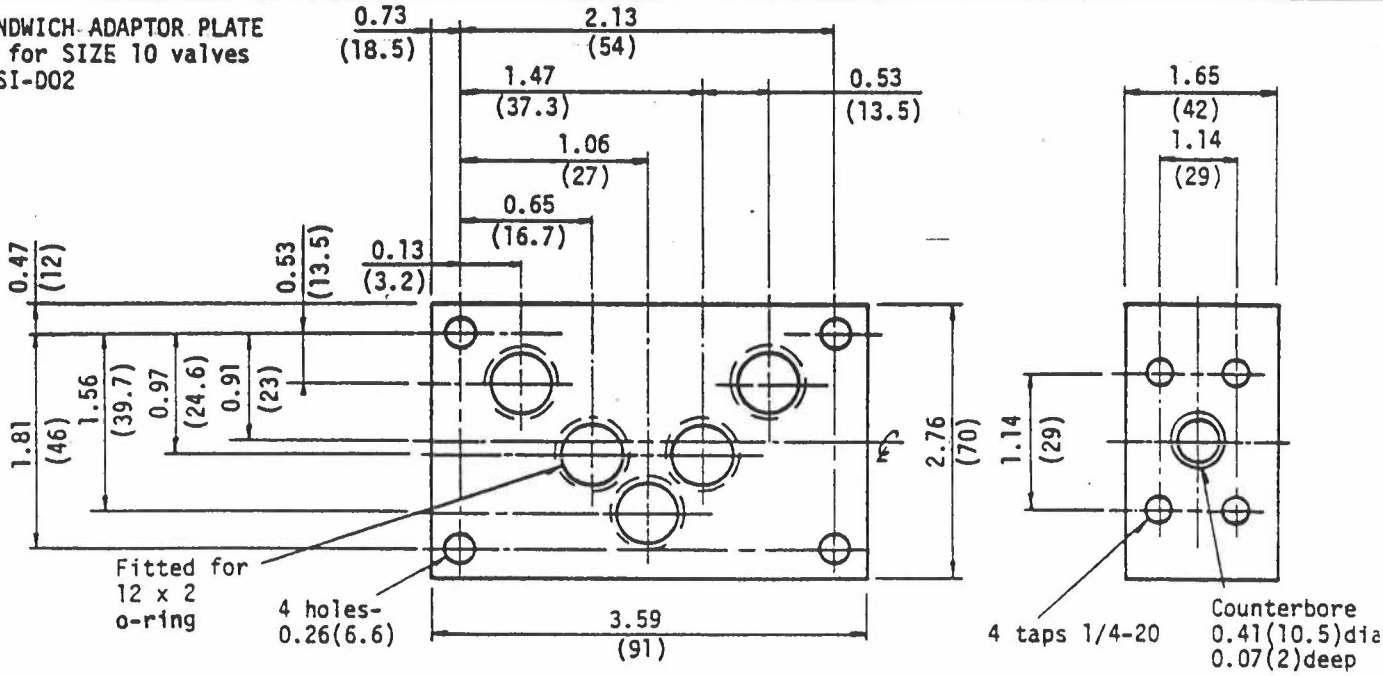
ANSI-D01

SANDWICH ADAPTOR PLATE for mounting HED 4 OH module stacking for SIZE 6 valves

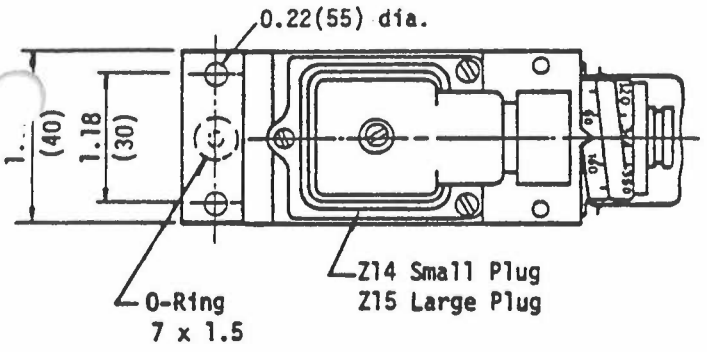


SANDWICH ADAPTOR PLATE for SIZE 10 valves

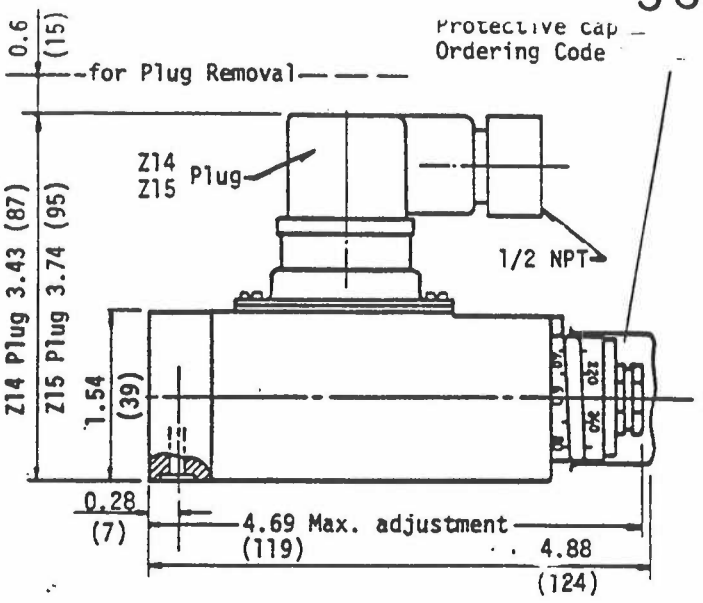
ANSI-D02



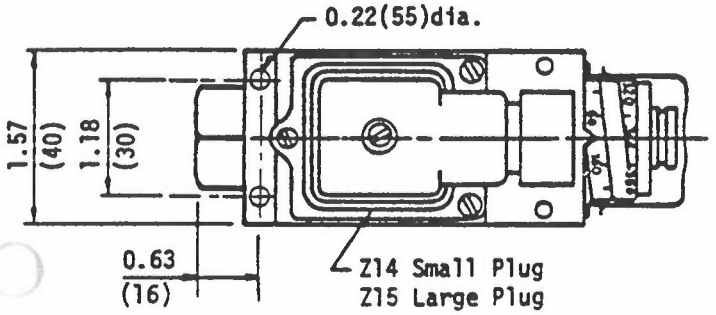
MANIFOLD MOUNTED SWITCH--Ordering Code "P"



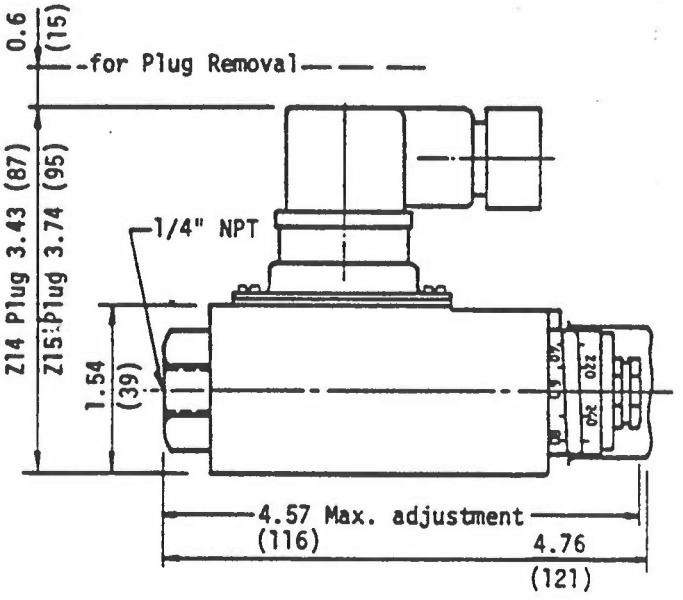
inches
(mm)



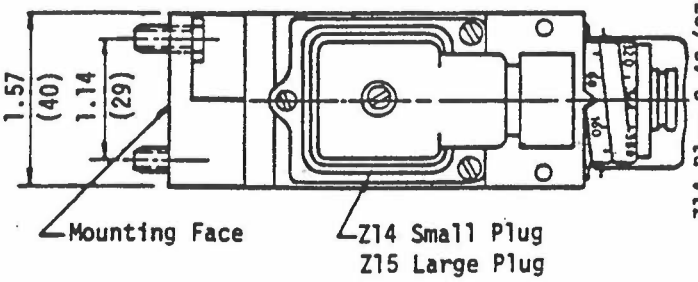
LINE MOUNTED--Ordering Code "A"



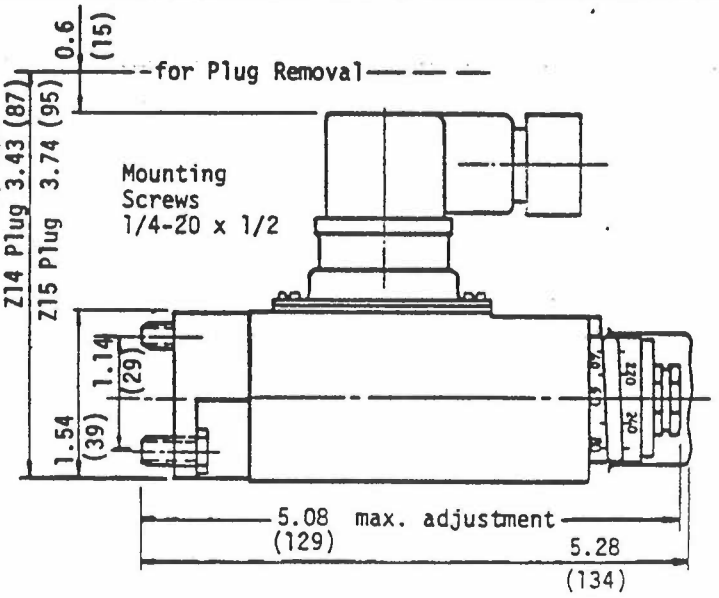
inches
(mm)



MODULE STACKING--Ordering Code "H"



inches
(mm)



MANUALLY OPERATED PUMPS

RESERVOIR CAPACITY - 40 CU. IN.

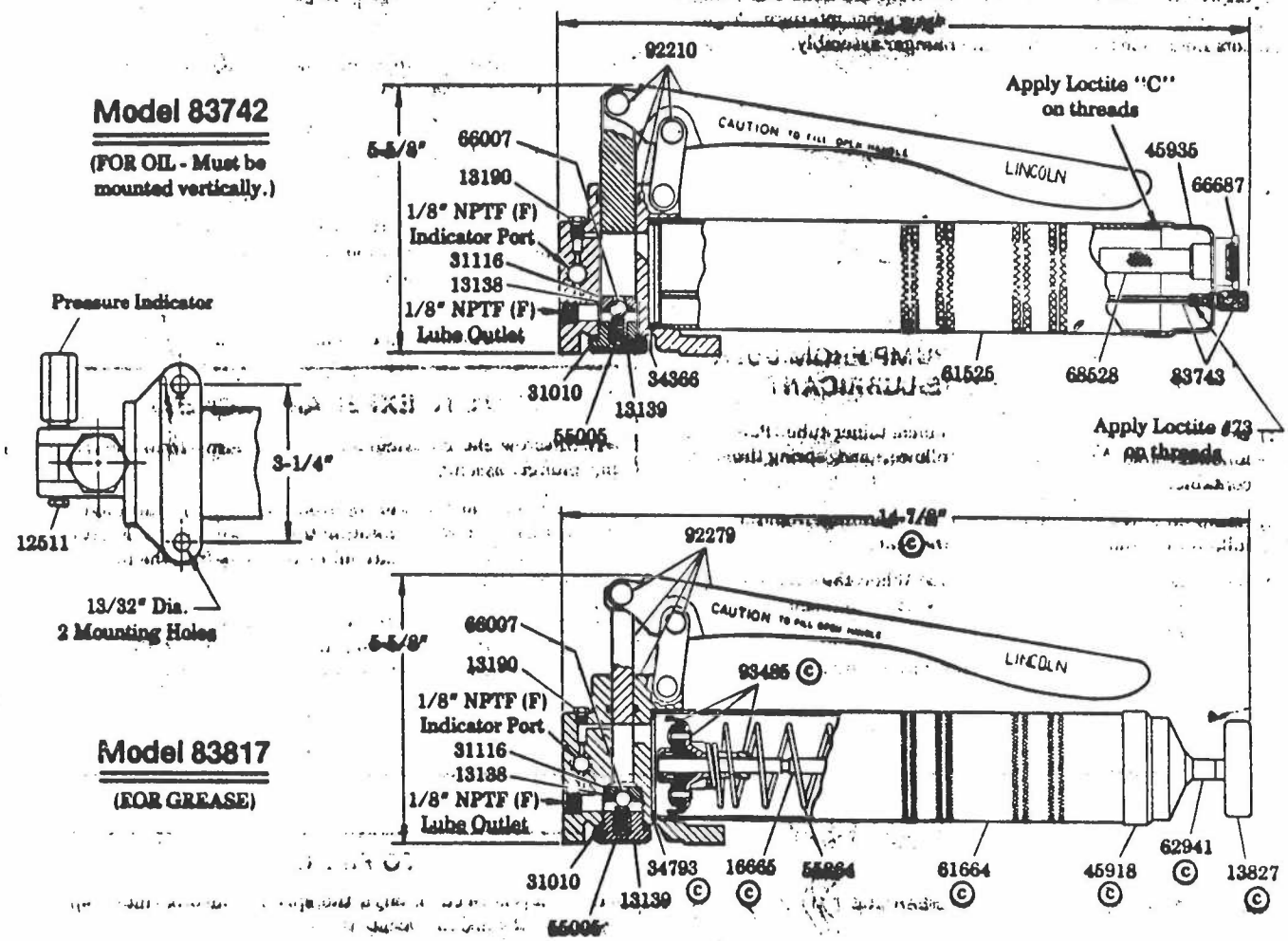
Models 83742 83817 Series "B"

MODEL	LUBRICANT OUTPUT	PRESSURE INDICATOR
83742 (OIL)	*0.36 cu. in. per stroke	83818 (1,000 psi, factory set)
83817 (GREASE)	*0.1 cu. in. per stroke	83821 (2,500 psi, factory set)

*Based on lubricants that are free of entrapped air. Lubricants that are specifically accepted will reduce output of pump.

DESCRIPTION

Models 83742 and 83817 are manually operated multi-stroke pumps used as the pumping unit for a centralized lubrication system on small machines. System should not be large due to small reservoir capacities. Pump should be located on machine or wall for convenience of filling and operating.



Model 83817
(FOR GREASE)

© Indicates change

SERVICE PARTS

PART	DESCRIPTION	PART	DESCRIPTION	PART	DESCRIPTION	PART	DESCRIPTION
12511	Pipe plug	31010	Gasket	55005	Spring	66687	Oil hole cover
13138	Check seat	31116	Gasket	55264	Spring	68528	Strainer
13139	Check cap	34366	Packing	61525	Container tube	83743	Oil gauge
13190	Plug	34793	Packing	61664	Container tube	92210	Handle & plunger assembly
13827	Follower handle	45918	Tube cap	62941	Spacer	92279	Handle & plunger assembly
16665	Follower rod	45935	Tube cap	66007	Ball	93485	Follower assembly

Printed in United States of America FORM 6147A

TO FILL GREASE PUMP FROM BULK LUBRICANT CONTAINER

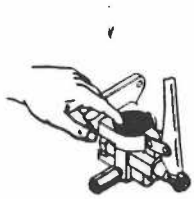
1) R[illegible] container tube from head and plunger assembly.

2) [illegible] lubricant into cavity of the head and plunger assembly.

3) Insert the open end of the container tube into lubricant. Slowly pull the follower handle back while pushing the container tube deeper into the lubricant to prevent air pockets from being pulled into the container tube.

4) When the follower rod is fully extended, pull it sideways to latch the rod groove into the keyhole slot in the container cap.

5) Loosely assemble the filled container tube to the head and plunger assembly. Release the follower rod from the container cap and disengage the follower rod from the follower by rotating the follower handle. Push the follower rod into the container. Slowly unscrew the container tube from the head and plunger assembly until lubricant oozes from the interface. Tighten container tube into the head and plunger assembly.



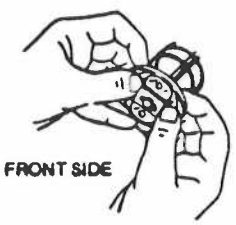
TO CONVERT GREASE PUMP FROM BULK FILL TO CARTRIDGE LUBRICANT

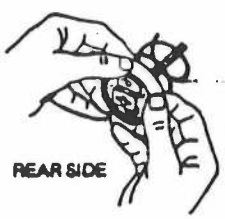
1) [illegible]w the container cap from the container tube. Pull on the [illegible]wer handle to extract the follower and spring from the [illegible]tainer tube.

2) Grasp follower between thumb and forefinger and flip the follower lip from the front side to the rear.

NOTE: The follower resembles a cup. When the grease pump is assembled for use with bulk lubricant, the cup opens toward the head assembly.

3) Reassemble follower into container tube and position with the follower handle so that the container cap can be tightened onto the container tube.

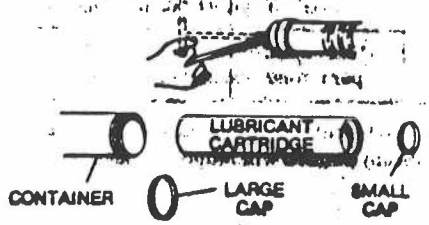




TO INSTALL A LUBRICANT CARTRIDGE IN GREASE PUMP

1) Remove container tube from head and plunger assembly.

2) To remove an empty cartridge, pull back on the follower handle until the follower rod is fully extended. Then, carefully release the follower handle to eject the empty cartridge from the container tube. Pull back on the follower handle. When the follower rod is fully extended, pull it sideways to latch the rod groove into the keyhole slot in the container cap.



3) Remove the caps from both ends of the cartridge and insert the large open end of the cartridge into the container tube.

4) Loosely assemble the container tube to the head and plunger assembly. Extend the pump handle away from the container tube and disengage the follower rod from the container cap. Engage the follower rod with the follower by rotating the follower handle. Exert force on the follower handle until lubricant oozes from the tube and head interface. Tighten container tube into the head and plunger assembly.

5) Disengage the follower rod from the follower by rotating the follower handle. Push the follower rod into the container.

TO EXPEL AIR POCKETS

1) Unscrew the container tube 1-1/2 turns from the head and plunger assembly.

2) Withdraw the follower rod from the container cap and engage it with the follower by rotating the follower handle. Exert force on the follower handle until lubricant oozes from the tube and head interface.

3) Tighten container tube into the head and plunger assembly. Disengage the follower rod from the follower by rotating the follower handle. Push the follower rod into the container.

IMPORTANT

Air pockets in the cartridge lubricant will cause the grease pump to lose its prime.

TO FILL OIL PUMP

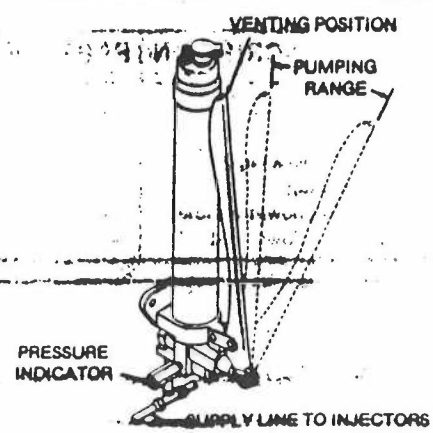
Oil pump is filled through the spring-loaded oil filter cap. A dip stick is provided to indicate the oil level.

OPERATION

CENTRO-MATIC

Manually operated multi-stroke pumps will continue to dispense lubricant and build up pressure with each stroke of the pump handle, within pumping range. Pressure indicator will extend when sufficient pressure is reached to operate the Centro-Matic system (Model 83742 - 1,000 psi or Model 83617 - 2,500 psi). Lubricant pressure operates the inje[illegible] which dispense a measured amount of lubricant into the bearings.

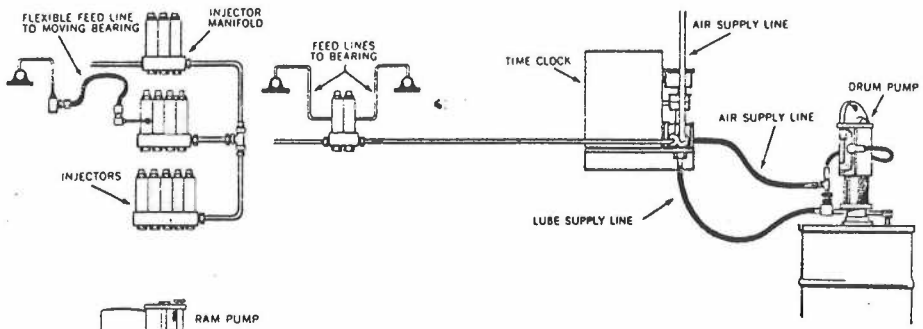
[illegible] pump handle to venting position. System pressure vents back into reservoir and [illegible]ors recharge for next lube cycle.



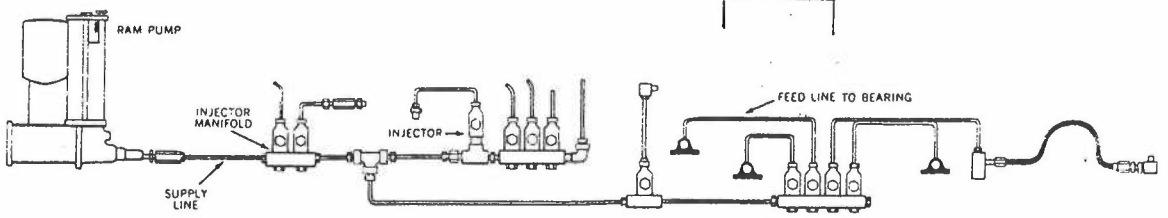
MODULAR LUBE

Manually operated multi-stroke pumps will continue to dispense lubricant with each stroke of the pump handle (handle must remain within pumping range). Operate the pump handle until cycle indicator pin on divider valve indicates lube cycle is complete. Disregard pressure indicator on pump.

THERE'S A CENTRO-MATIC SYSTEM FOR YOU—BECAUSE WE SPECIFICALLY DESIGN IT TO FIT YOUR APPLICATION!



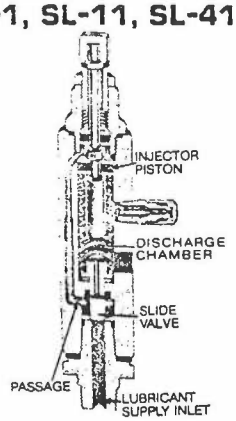
Each Centro-Matic system is different! However, the basic idea of a centralized lubrication system is the same in every case. A pump delivers lubricant through delivery lines to an injector (metering device.) Each injector measures out the correct amount of lubricant required for each bearing.



LUBRICANT INJECTORS

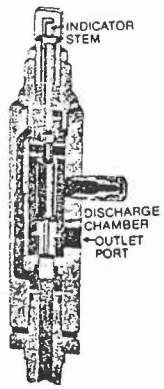
Two types of injectors are available—with top adjustment and side adjustment. They may be used in the same circuit and their selection is made on the basis of bearing lubricant requirements. Injectors may be mounted singly, or may be grouped in manifold at one location.

SL-1, SL-11, SL-41 AND SL-44 (SL-1 Illustrated)



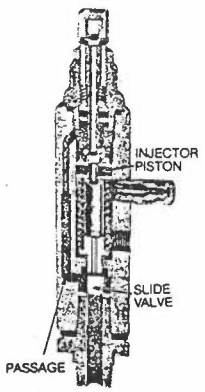
STAGE 1

The injector piston is in its normal or rest position. The discharge chamber is filled with lubricant from the previous cycle. Under the pressure of incoming lubricant, the slide valve is about to open the passage leading to the piston.



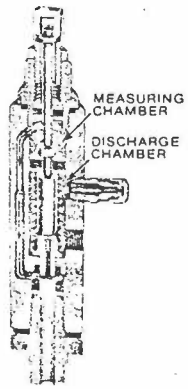
STAGE 2

When the slide valve uncovers the passage, lubricant is admitted to the top of the piston, forcing the piston down. The piston forces lubricant from the discharge chamber through the outlet port to the bearing.



STAGE 3

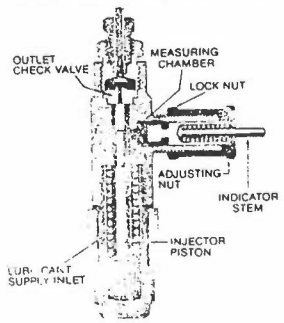
As the piston completes its stroke, it pushes the slide valve past the passage, cutting off further admission of lubricant to the passage. Piston and slide valve remain in this position until lubricant pressure in the supply line is vented (relieved) at the pump.



STAGE 4

After pressure is relieved, the compressed spring moves the slide valve to closed position. This opens the port from the measuring chamber and permits the lubricant to be transferred from the top of the piston to the discharge chamber.

SL-32, SL-33, SL-42 AND SL-43

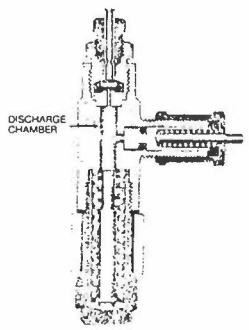


STAGE 1

Incoming lubricant—under pressure from the supply line—moves the injector piston forward. The piston forces a precharge of lubricant from the discharge chamber through the outlet check valve to the feed line.

STAGE 2

When the system is vented (pressure relieved), the piston returns to rest position, transferring lubricant in the measuring chamber to the discharge chamber.



INJECTORS
HIGH PRESSURE
GREASE TYPE
2500 PSIG SYSTEMS

SERIES SL-33 INJECTOR

Lubricant output adjustable up to .003 cubic inches. Injector lubricant outlet ⅛" O.D. tube connector. Each injector manifold includes two No. 45924 vertical mounting clips and two No. 50109 mounting screws, ¼"-20 by ½" long. Use No. 7 drill and ¼"-20 tap to install.

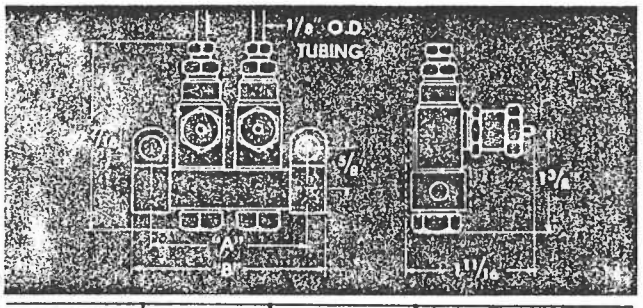
No. 45923 Mounting Clip—For horizontal mounting of injector (two required).


83314


83309-1


83309-2


83438



Model No. Carbon Steel	A. Dim.	B. Dim.	Lubricant Inlet
83314	Replacement Injector		
83900	Single Injector		⅛" NPT male
83309-1	1 1/16"	1⅝"	⅛" NPT female
83309-2	1⅞"	2⅜"	⅛" NPT female
83309-3	2⅝"	3⅛"	⅛" NPT female
83309-4	3 3/16"	3⅞"	⅛" NPT female
83309-5	4⅛"	4⅝"	⅛" NPT female
83309-6	4⅞"	5 13/32"	⅛" NPT female
83309-8	6⅜"	6⅞"	⅛" NPT female
83309-9	7⅛"	7⅝"	⅛" NPT female
83310-1	1 1/16"	1⅝"	¼" O.D. tube
83310-2	1⅞"	2⅜"	¼" O.D. tube
83310-3	2⅝"	3⅛"	¼" O.D. tube
83310-4	3 3/16"	3⅞"	¼" O.D. tube
83438	Replacement injector for existing Series SL-31 manifold.		

STAINLESS STEEL—Same as above except in 300 Series Stainless Steel. Each injector manifold includes two No. 45924-9 stainless steel vertical mounting clips and two No. 50109-9 stainless steel mounting screws.

Model No. Stainless Steel	A. Dim.	B. Dim.	Lubricant Inlet
83314-9	Replacement Injector		
83715-1	1 1/16"	1⅝"	⅛" NPT female
83715-2	1⅞"	2⅜"	⅛" NPT female
83715-3	2⅝"	3⅛"	⅛" NPT female
83715-4	3 3/16"	3⅞"	⅛" NPT female
83715-6	4⅞"	5⅜"	⅛" NPT female
83715-7	5⅝"	6⅛"	⅛" NPT female
83438-9	Replacement injector for SL-31 manifold		

High pressure injectors are designed to inject grease or oil to bearings by supply line pressure developed by the lubricant pump. Output is externally adjustable which permits manual adjustment of lubricant discharge. Visible indicator stem permits visual check of injector operation. Injectors are available in single unit and various manifold body type. Individual injector in a manifold can be easily removed for inspection or repair without removing supply line or disturbing other injectors in the manifold.

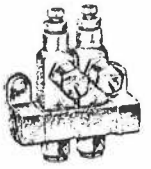
SERIES SL-32 INJECTOR

Lubricant output adjustable up to .008 cubic inches. Injector lubricant outlet ⅛" O.D. tube connector. Each injector manifold includes two No. 45926 vertical mounting clips and two No. 50109 mounting screws, ¼"-20 by ½" long. Use No. 7 drill and ¼"-20 tap to install.

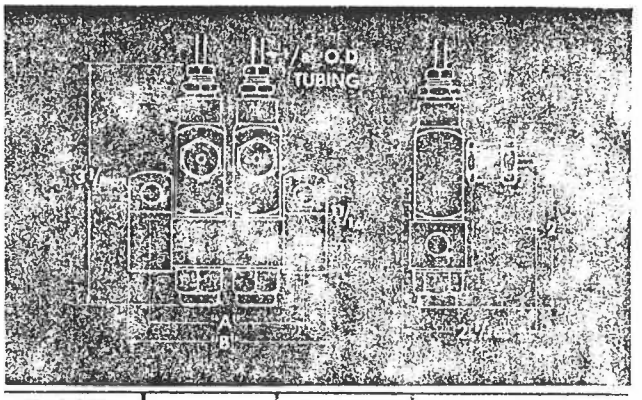

83337


83338


83336-1


83336-2


83437

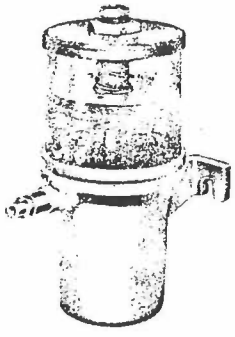


Model No. Carbon Steel	A. Dim.	B. Dim.	Lubricant Inlet
83337	Replacement Injector		
83338	Single Injector		¼" NPT male
83336-1	1¼"	1¾"	¼" NPT female
83336-2	2"	2½"	¼" NPT female
83336-3	2¾"	3¼"	¼" NPT female
83336-4	3½"	4"	¼" NPT female
83437	Replacement injector for existing SL-31 manifold.		

STAINLESS STEEL—Same as above except in 300 Series stainless steel. Each injector manifold includes two No. 45926-9 stainless steel vertical mounting clips and two No. 50109-9 stainless steel mounting screws.

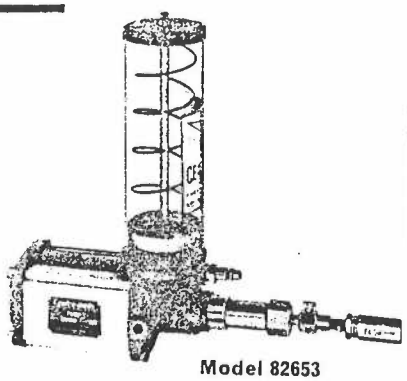
Model No. Stainless Steel	A. Dim.	B. Dim.	Lubricant Inlet
83337-9	Replacement Injector		
83724-1	1¼"	1¾"	¼" NPT female
83724-2	2"	2½"	¼" NPT female
83724-3	2¾"	3¼"	¼" NPT female
83724-4	3½"	4"	¼" NPT female
83437-9	Replacement injector for SL-31 manifold.		

AIR OPERATED

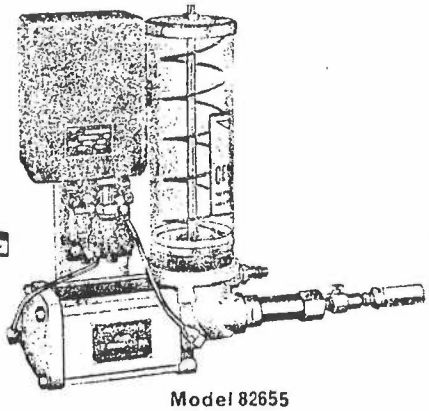


Model 82886

Model 83668



Model 82653



Model 82655

Model 82886—Air operated, single stroke grease pump, requiring air for the forward stroke. The return stroke is spring powered. Designed for use with Series SL-32 and/or SL-33 injectors. Engineered for automatic lubrication of individual production machines. Can be operated by manual, mechanical or electrical control. Includes transparent reservoir with spring loaded double-lip follower, filler nipple and strainer. Dispenses grease up through NLGI #1. Overall dimensions: Height 10⅜"; length 6"; width 5¼".

Model 83668—Same as Model 82886 except has 4 lb. reservoir capacity. Overall dimensions: Height 18½"; length 6"; width 5¼".

Model 82653—Air operated, single stroke grease pump requiring air for both forward and return stroke. Has large capacity output per stroke and large capacity transparent reservoir. For use with Series SL-1, SL-32 and/or SL-33 injectors. Engineered for automatic lubrication of individual production machines. Dispenses grease up through NLGI #1. Can be operated by manual, mechanical or electrical control. Overall dimensions: Height 18½"; length 20"; width 5¼".

Model 83834—Same as Model 82653 except has 25:1 ratio pump and 2.15 cu. in. lubricant output.

Model 82655—Same as Model 82653 except includes Model 84101 Standard Program Timer, No. 68359 Four-Way Electric Solenoid Air Valve and accessories. Time control is adjustable to cycle lubrication system at intervals of 2½ minutes to 4 hours. Electrical power requirements: 115 Volts, 60 Hz., 25 Volt Amps. Solenoid inrush current, .52 amp; holding current, .35 amp.

Model 282655—Same as Model 82655 except includes Model 84102 Standard Program Timer, adjustable to cycle lubrication system at intervals of 15 secs. to 24 min. Electrical power requirements: 115 Volts, 60 Hz., 25 Volt Amps. Solenoid inrush current, .52 amp; holding current, .35 amp.

Model 83551—Same as Model 82655 except incorporates No. 84103 Standard Program Timer and No. 68978 Four-Way Solenoid Air Valve. Electrical power requirements: 220 Volts, 50 Hz., 25 Volt Amps. Solenoid inrush current, .26 amp.; holding current, .18 amp.

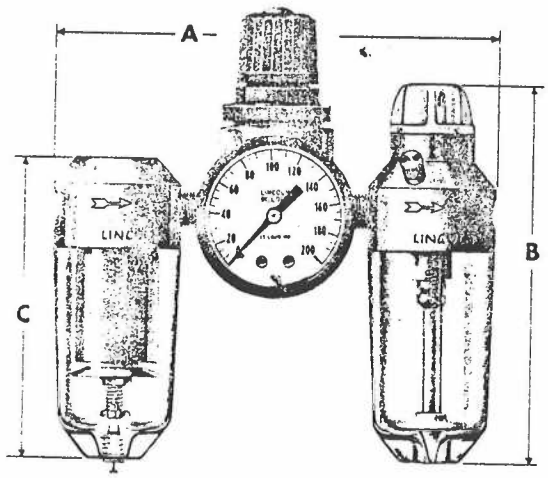
Model 83800—Same as Model 82655 except has 25:1 ratio pump and 2.15 cu. in. lubricant output.

SPECIFICATIONS

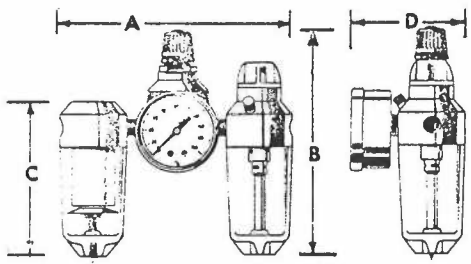
Model	Ratio	Lubricant Output (Per Cycle)	Reservoir Capacity	Air Inlet	Lube Outlet	Lubricant Operating Pressure (PSIG)			
						Type of System	Min.	Max.	Recommended
82886	20:1	.45 cu. in.	1 lb.	¼" NPTF	¼" NPTF	SL-32/SL-33	1200	3500	1500
82653	31:1	1.4 cu. in.	4 lb.	¼" NPTF	¼" NPTF	SL-1 SL-32/SL-33	1850 1200	3500 3500	2500 1500*
82655 282655	31:1	1.4 cu. in.	4 lb.	¼" NPTF	¼" NPTF	SL-1 SL-32/SL-33	1850 1200	3500 3500	2500 1500*
83551	31:1	1.4 cu. in.	4 lb.	¼" NPTF	¼" NPTF	SL-1 SL-32/SL-33	1850 1200	3500 3500	2500 1500*
83668	20:1	.45 cu. in.	4 lb.	¼" NPTF	¼" NPTF	SL-32/SL-33	1200	3500	1500
83800	25:1	2.15 cu. in.	4 lb.	¼" NPTF	¼" NPTF	SL-1 SL-32/SL-33	1850 1200*	3500 3500	2500 1500*
83834	25:1	2.15 cu. in.	4 lb.	¼" NPTF	¼" NPTF	SL-1 SL-32/SL-33	1850 1200	3500 3500	2500 1500*

*500 PSI when used in combination with series SL-1 and/or SL-11.

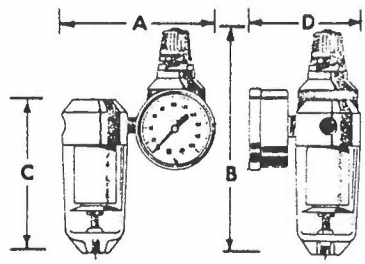
MINIATURE COMBINATION UNITS



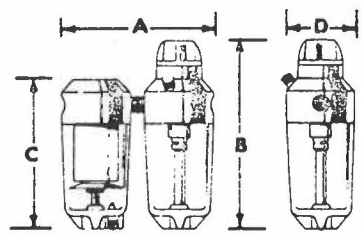
Where space is limited, Lincoln Miniature Combinations offer the perfect solution. These small, economical units fit readily into compact control cabinets or miniaturized circuits. They provide quality construction features and service of regular, full-size units. For use with ¼" pipe size only.



Filter—Regulator—Gauge—Lubricator



Filter—Regulator—Gauge



Filter—Lubricator

	Model	Pipe Size	A	B	C	D
Filter—Regulator—Gauge—Lubricator	83672	¼"	5⅛"	5⅞"	4"	2¾"
Filter—Regulator—Gauge	83673	¼"	3½"	5⅞"	4"	2¾"
Filter—Lubricator	83674	¼"	3½"	4⅜"	4"	1 9/16"

A.R HOSE

No.	Length	I.D.	Working Pressure (psig)	Min. Burst Pressure (psig)	Minimum Bend Radius	Fittings
72060 72120	5 ft. 10 ft.	¼"	300	1300	3"	¼" NPT Male
72A060 72A120	5 ft. 10 ft.	⅜"	250	1250	4"	⅜" NPT Male
72060 72120	5 ft. 10 ft.	½"	200	800	6"	½" NPT Male

SALES AND SERVICE OFFICES

ATLANTA AREA
Lincoln St. Louis
3340 S. Cobb Industrial Blvd., S.E.
P.O. Box 2333
Smyrna, GA 30081
(404) 435-1142
Telex: 54-9536

CHICAGO AREA
Lincoln St. Louis
939 Lee St.
Elk Grove Village, IL 60007
(312) 956-1775
Telex: 280558

CLEVELAND, OH 44128
Lincoln St. Louis
23103 Miles Rd.
(216) 475-2900

DENVER AREA (Sales)
Lincoln St. Louis
8471 East Long Avenue
Englewood, CO 80112
(303) 773-3110

DETROIT AREA
Lincoln St. Louis
468 Orvieto St.
Troy, MI 48084
(313) 362-7620
Telex: 0235299

HOUSTON, TX 77007
Lincoln St. Louis
2170 Taylor St.
(713) 868-6395
Telex: 774062

LOS ANGELES AREA
Lincoln Engineering Co. of Calif.
19877 Quiroz Court
City of Industry, CA 91748
P.O. Box 708
Walnut, CA 91789-0708
(714) 594-0666, (213) 748-0151

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Lincoln St. Louis
280 Midland Ave.
Saddle Brook, NJ 07662
(201) 797-0880, (212) 736-7666
Telex: 134476

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1670 B Winchester Road
P.O. Box 330
Bensalem, PA 19020
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Telex: 83-1659

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Lincoln St. Louis
125 Saco Road
Monroeville, PA 15146
(412) 373-8202

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5497 SE International Way
Milwaukie, OR 97222
(503) 653-0741
Telex: 360171

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Lincoln Engineering Co. of Calif.
3047 Teagarden St.
San Leandro, CA 94577
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Telex: 172729

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D-6909 WALLDORF, WEST GERMANY
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Heinrich Hertz Strasse, Industriegebiet
Postfach 1437
(06227) 33-1[illegible]
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OX16 8AY, [illegible]
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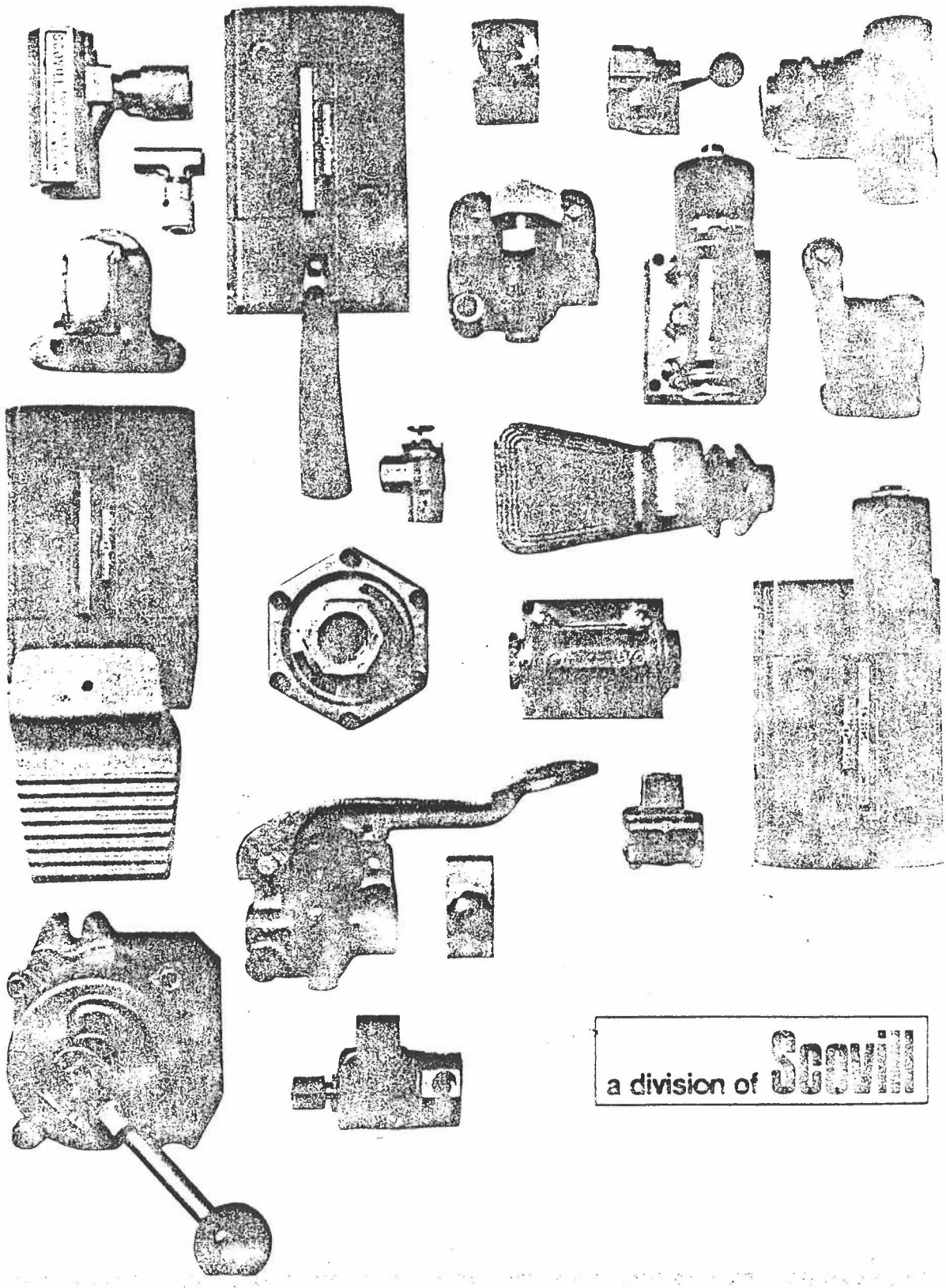
Telex: 837655

DK-2800 KGS. LYNGBY, DENMARK
Lincoln Helios Scandinavia A/S
Vallenshaevej [illegible] P.O. Box [illegible]
(02) 488866
Telex: 43216

schrader bellows

DIRECTIONAL CONTROL VALVES

Catalog VAL-S 80
Revised 9/93



a division of Scovill

CYCLONE DIRECT ACTING SOLENOID VA...
CSA AND UL APPROVED

CYCLONE'S SPECIAL CONSTRUCTION FEATURES

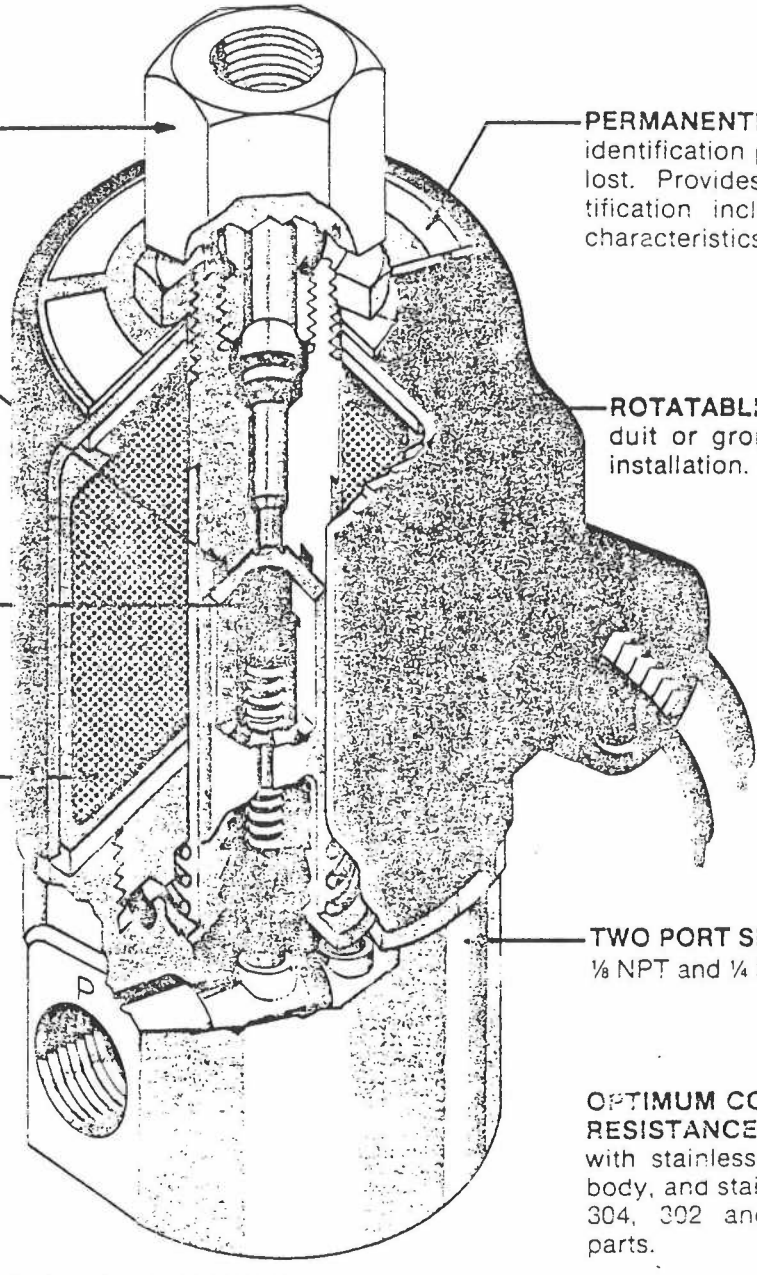
OPTIONAL EXHAUST ADAPTER
allows instant conversion from free venting to piped exhaust without changing valve.

SHADING RING
Copper shading ring standard.

STANDARD FLOATING TOP SEAL
is automatically self-compensating, increasing valve life expectancy up to ten times.

WIDE VARIETY
of coil selections and options to meet almost any application.

CLASS "B" STANDARD
Class "H" optional



PERMANENTLY AFFIXED
identification plate will not get lost. Provides positive identification including electrical characteristics.

ROTATABLE HOUSINGS, conduit or grommet for ease of installation.

TWO PORT SIZES
⅛ NPT and ¼ NPT

STANDARDIZED MOUNTINGS
with two 10-32 threaded mounting holes. Mounting brackets on housing are also available.

OPTIMUM CORROSION RESISTANCE
with stainless steel type 430F body, and stainless steel types 304, 302 and 430F internal parts.

TECHNICAL SPECIFICATIONS

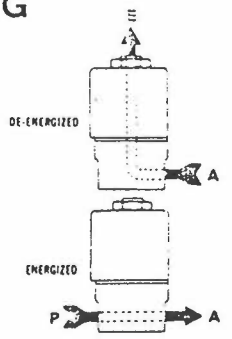
FLOW RATE:
Refer to CV factors in valve part number listings. See page 13 for flow characteristics.
PROOF PRESSURE:
1½ times rated pressure
PORTING:
⅛" and ¼" PTF
ORIFICE DIAMETERS:
[illegible]", [illegible]", [illegible]", 3/32", 1/8", 3/32", 3/16", 1/4"
MAXIMUM COIL TEMPERATURES:
Class "B": 130° C (266° F) (Meets Class "F" specifications also.)
Class H: 180° C (356° F)
MEDIA:
All common media including air, inert gases, water, steam, hydraulic fluids, petroleum products and freon. Consult factory for use with some corrosive media.

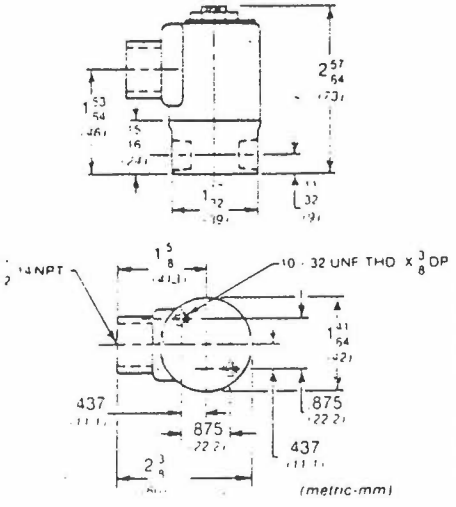
NOTE: When valve is used with steam, water and some petroleum products the plunger assembly insert will normally require modification.
WEIGHT:
1 lb. 3 oz.
ELECTRICAL DATA (120 volts/60 hz)
Inrush current: .298 amp.
Holding current: 180 amp.
Nominal power in continuous duty: 11 watts
Coil response time: 10 milliseconds nominal
Duty cycle: Continuous
MATERIALS:
Body: Stainless steel type 430F or Brass
Internal components: Stainless steel types 302, 304 and 430F copper.
Seals: Buna N standard; viton.

CYCLONE DIRECT ACTING SOLENOID VALVES

3-WAY VALVES, NORMALLY CLOSED, FREE VENTING

- Ordinarily used with air to operate single acting cylinders, or used in pairs to operate double acting cylinders.
- Rotatable housings for ease of electrical connections
- Standard floating top seat
- Operates in any position





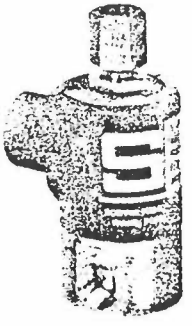
STAINLESS STEEL, STANDARD BODY (Listing for 120 V / 60 Hz.)*

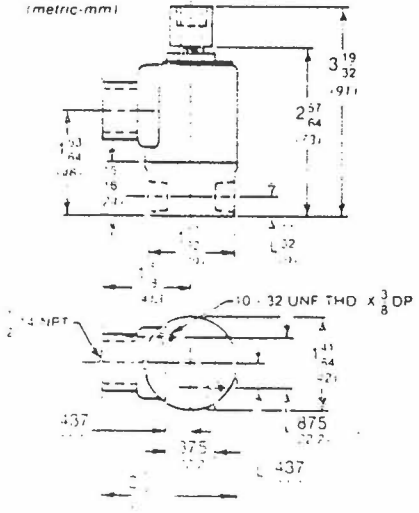
Maximum operating pressure differential PSI		Orifice / Cv				Model Number			
						Grommet Hsg.		Conduit Hsg.	
AC	DC	Body	Cv	Stop	Cv	1/8 NPT	1/4 NPT	1/8 NPT	1/4 NPT
250	250	1/32	.02	1/32	.02	75300-0115	75310-0115	74300-0115	74310-0115
175	175	3/64	.06	1/16	.12	75302-0115	75312-0115	74302-0115	**74312-0115**
125	125	1/16	.10	1/16	.12	75303-0115	75313-0115	74303-0115	**74313-0115**
90	90	3/32	.20	3/32	.21	75304-0115	75314-0115	74304-0115	**74314-0115**
65	65	1/8	.32	3/32	.21	75306-0115	75316-0115	74306-0115	**74316-0115**
40	40	5/32	.42	3/32	.21	75307-0115	75317-0115	74307-0115	74317-0115
20	20	3/16	.52	3/32	.21	75308-0115	75318-0115	74308-0115	**74318-0115**
VAC	5	1/4	.73	3/32	.21	75309-0115	75319-0115	74309-0115	**74319-0115**

Valves in bold type are stocked in local distributors' inventories.

3-WAY VALVES, NORMALLY CLOSED, PIPED EXHAUST

- Same features as three way free venting valves, except these include an exhaust adapter to permit piping of exhaust port.
- Usable on water, oil and non-corrosive fluids, as well as air.
- Standard valves usable to 250 PSI, no minimum pressure.





STAINLESS STEEL, STANDARD BODY (Listing for 120 V / 60 Hz.)*

Maximum operating pressure differential PSI		Orifice / Cv				Model Number			
						Grommet Hsg.		Conduit Hsg.	
AC	DC	Body	Cv	Stop	Cv	1/8 NPT	1/4 NPT	1/8 NPT	1/4 NPT
250	250	1/32	.02	1/32	.02	75400-0115	75410-0115	74400-0115	74410-0115
175	175	3/64	.06	1/16	.12	75402-0115	75412-0115	74402-0115	**74412-0115**
125	125	1/16	.10	1/16	.12	75403-0115	75413-0115	74403-0115	**74413-0115**
90	90	3/32	.20	3/32	.21	75404-0115	75414-0115	74404-0115	**74414-0115**
65	65	1/8	.32	3/32	.21	75406-0115	75416-0115	74406-0115	**74416-0115**
40	40	5/32	.42	3/32	.21	75407-0115	75417-0115	74407-0115	74417-0115
20	20	3/16	.52	3/32	.21	75408-0115	75418-0115	74408-0115	**74418-0115**
VAC	5	1/4	.73	3/32	.21	75409-0115	75419-0115	74409-0115	**74419-0115**

Valves in bold type are stocked in local distributors' inventories.

*Part numbers shown are for 120 volts/60hz. See Ordering Information on page 16 for other electrical characteristics.

CYCLONE SOLENOID REPLACEMENT PARTS

For hazardous duty and J.I.C. solenoid parts consult factory.

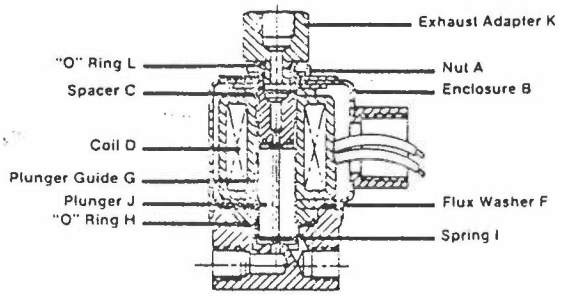
	A Nut Standard*	B Enclosure Conduit Housing*	B Enclosure Grommet Housing	B Enclosure Grommet	C Spacer*	D Coil	F Flux Washer*
3 Way Normally Closed Valves	74300-7020	74300-8001	75300-8001	75300-7002	74300-7008	See Chart Below	74300-7010
3 Way Normally Open Valves	74300-7020	74300-8001	75300-8001	75300-7002	74300-7008		74300-7010
2 Way Normally Closed Valves†	74300-7020	74300-8001	75300-8001	75300-7002	74300-7008		74300-7010
2 Way Normally Open Valves	74300-7020	74300-8001	75300-8001	75300-7002	74300-7008		74300-7010
3 Way Multi-Purpose Valves	74300-7020	74300-8001	75300-8001	75300-7002	74300-7008		74300-7010
3 Way Directional Control Valves	74300-7020	74300-8001	75300-8001	75300-7002	74300-7008		74300-7010

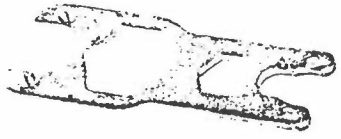
	G Plunger Guide Standard	H "O" Ring*	I Spring	J Plunger	K Exhaust Adapter 1/8"	K Exhaust Adapter 1/4"	L "0" Ring
3 Way Normally Closed Valves	See Chart Below	3454-0008	74300-7015**	74300-8100*	74400-7002	74410-7002	02709-0030
3 Way Normally Open Valves		3454-0008	74200-7001	74200-8100	74400-7002	74410-7002	02709-0030
2 Way Normally Closed Valves†		3454-0008	74500-7001	74100-8100	74400-7002	74410-7002	02709-0030
2 Way Normally Open Valves		3454-0008	74500-7001	74600-8100	74400-7002	74410-7002	02709-0030
3 Way Multi-Purpose Valves		3454-0008	74500-7001	74500-8100	74400-7002	74410-7002	02709-0030
3 Way Directional Control Valves		3454-0008	74500-7001	74600-8100	74400-7002	74410-7002	02709-0030

G Plunger Guide Orifice	G Plunger Guide Standard	GG Plunger Guide Service Unit
1/32	74300-8031	74400-8031
3/64	74300-8046	74400-8046
1/16	74300-8062	74400-8062
3/32	74300-8093*	74400-8093
†None	74100-8001	74100-8000

†2 Way N.C. Valves have no orifice in plunger guide.

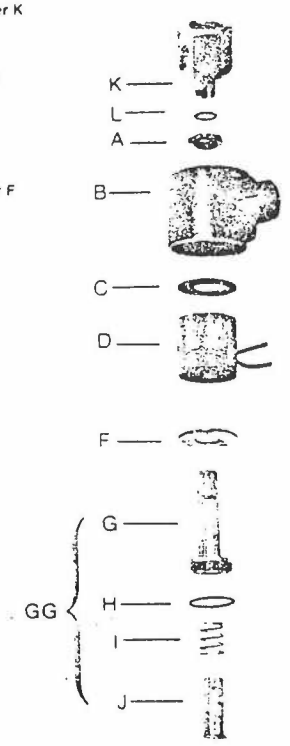
*Solenoid operator, part number 74304-8115, consists of parts marked with an asterisk in chart above and in the coil chart on page 16, and is the 120 volt 60 Hz operator ordinarily furnished.





Pin Spanner Wrench #74000-7100

Fits top nut and plunger guide for quick, easy disassembly of solenoid valves. Prevents damage to plunger. Plated steel.



COIL DATA

Standard
Class "B"—Temp. Range 130°C (226°F)

Optional
Class "H"—Temp. Range 180°C (356°F)

PART NUMBER	AC Volts 50 Hz	AC Volts 60 Hz	DC Volts	Coil Resist.	PART NUMBER	AC Volts 50 Hz	AC Volts 60 Hz	DC Volts	Coil Resist
74000-7141	—	6*	—	.4	74000-7291	—	6*	—	4
74000-7142	—	12*	—	1.25	74000-7292	—	12*	—	1.25
74000-7143	22	24*	6*	4.45	74000-7293	22	24*	6*	4.45
74000-7152	43	48	12*	16.2	74000-7202	43	48	12*	16.2
74000-7153	92	100	24*	65	74000-7203	92	100	24*	65
74000-71[illegible]	110	120*	28	116	74000-7295	110	120*	28	116
74000-71[illegible]	120*	125	36	177	74000-7995	120*	125	36	177
74000-7124	190	—	48*	203					
74000-7156	210	240*	70	610	74000-7296	210	240*	70	610
74000-7166	240*	260	85	910	74000-7996	240*	260	85	910
74000-7155	300	330	110*	1480	74000-7205	300	330	110*	1480
74000-7147	405	460*	135	2380	74000-7297	405	480*	135	2330
74000-7167	440*	520	177	3900	74000-7997	440*	520	177	3900
74000-7156	—	—	230*	6400	74000-7206	—	—	230*	6400

*All coils are designed to a specific voltage as asterisked. However, they may also be utilized for the alternate adjacent voltages as indicated.

CYCLONE SOLENOID VALVES ORDERING INFORMA

7 5 3 1 2 — 0 1 1 5

SERIES	HOUSING TYPE	VALVE TYPE	BODY & PORT SIZE
7	4 Conduit 5 Grommet 7 J.I.C.	0 2 Way N.O. 1 2 Way N.C. 2 3 Way N.O. 3 3 Way N.C. Free Vent 4 3 Way N.C. Piped Exh. 5 3 Way Multi Purpose 6 3 Way Dir. Cont.	0 1/8" S.S. 1 1/4" S.S.

ORIFICE DIA.		
	BODY	STOP
O	1/32	1/32
1	3/64 1/16*	3/64
2	3/64	1/16
3	1/16	1/16
4	3/32	3/32
5	1/8	1/16
6	1/8	3/32
7	5/32	3/32
8	3/16	3/32
9	1/4	3/32

OPTIONS	SEALS	COIL CLASS & HERTZ	VOLTAGE
0 None(Std)	1 Nitrile (Buna) 2 Viton	1 "B" 60 Hz 2 "B" DC 3 "B" 50 Hz 9 "H" 60 Hz 0 "H" DC	1 6 V 2 12 V 3 24 V 5 120V 6 240V 7 480V

*Used in Normally Open 3 Way Valves Only

EXAMPLES:

Solenoid Valve #75312-0115

75	3	1	2	—	0	1	1	5
Valve w/ Grommet Housing	3-way Normally Closed Free Venting	1/4" NPT Standard Stainless Steel Body	3/64" body (orifice dia.) 1/16" stop (orifice dia.)		Standard (No options)	Buna N Seals	Class "B" Coil 60 Hz.	120 Volts

COILS FOR STANDARD AND J.I.C. ENCLOSURES

VOLTAGE	MOLDED COIL CLASS "B" STANDARD		HIGH TEMPERATURE CLASS "H" (OPTIONAL)	
	A.C. 60HZ	D.C.	A.C. 60HZ	D.C.
6	74000-7141	74000-7143	74000-7291	74000-7293
12	74000-7142	74000-7152	74000-7292	74000-7202
24	74000-7143	74000-7153	74000-7293	74000-7203
48	74000-7152		74000-7202	NA.
120	74000-7145	74000-7155	74000-7295	74000-7205
240	74000-7146	74000-7156	74000-7296	74000-7206
480	74000-7147	N.A.	74000-7297	N.A.

Consult factory for other voltage or options.

HAZARDOUS DUTY ENCLOSURES

Underwriters Laboratories	Ambient Environment	NEMA Classification
Class I Group D	Gasoline and Vapors	VII
Class II Group F	Coal, Coke, Carbon Black Dust	IX
Class II Group G	Flour, Starch, Grain Dust	IX
Class II Group E	Metal Dust	IX A

NOMINAL† ELECTRICAL CHARACTERISTICS

COIL CLASS	INRUSH CURRENT AMPERES	HOLDING CURRENT AMPERES
CLASSES "B" & "H" 60 HZ		
6	4.360	2.460
12	3.900	1.580
24	1.660	1.140
48	.844	.710
120	.288	.180
240	.111	.064
480	.065	.041
CLASSES "B" & "H" D.C.		
6	—	1.35
12	—	.74
24	—	.37
110	—	.074

IMPORTANT:
Pump must be installed in a vertical position.

OPERATION OF THE PUMP

Lubricant in the 41514 Transparent Reservoir flows into the cavity in the 92686 Bushing and Plunger Assembly.

Compressed air entering the bottom of the 41238 Air Cylinder (1/4" N.P.T. female) moves the 40477 Piston upward. As the piston moves upward, the plunger is also moved upward into the bushing. As the plunger moves upward, it moves the charge of lubricant from the bushing cavity through the 84174 Outlet Check to the outlet of the pump.

When the air pressure to the 41238 Air Cylinder is relieved, the 55289 Piston Spring moves the piston and plunger downward. In its extreme down position, the plunger has retracted below the bushing port, permitting lubricant to flow into the bushing cavity.

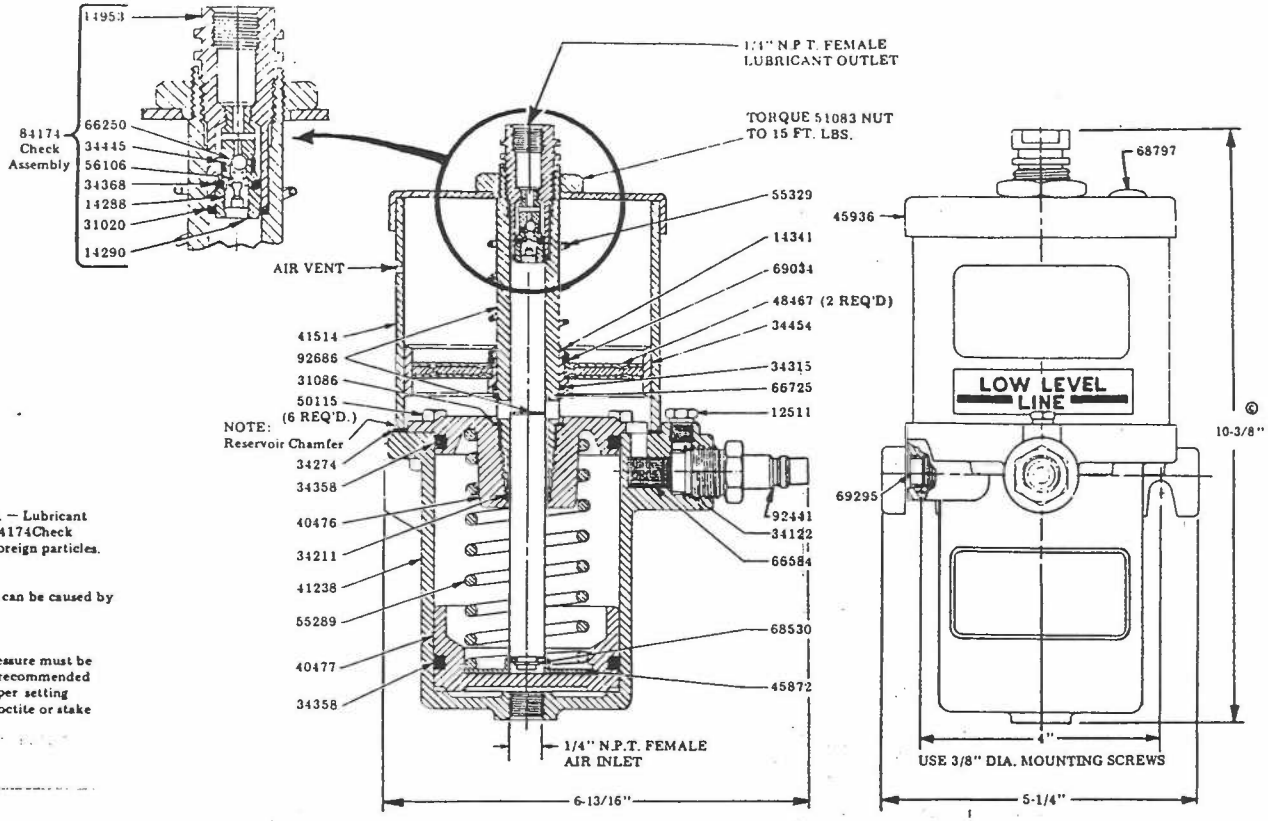
WHAT TO DO IF:

Pump loses prime. — Check lubricant supply.

System fails to cycle and calculated system planning has been followed. — Lubricant may be leaking by the 66250 Ball Check or the 34445 Packing in the 84174Check and Vent Assembly. Remove these parts and examine for presence of foreign particles. Clean, or replace parts if worn or damaged.

Pump fails to operate. — Check air supply. Failure of injectors to cycle can be caused by a leak in the supply line.

NOTE:
In reassembling the 84174 Check and Extension Assembly, the vent pressure must be reset. Vent pressure can be varied by the Adjusting Screw, 14288. The recommended pressure setting is 25 P.S.I. minimum to 75 P.S.I. maximum. An improper setting will affect the pump efficiency. Assemble 14288 with non-hardening Loctite or stake threads after adjusting vent pressure.



SERVICE PARTS

PART NO.	DESCRIPTION	PART NO.	DESCRIPTION	PART NO.	DESCRIPTION
12511	Pipe Plug	*34445	Gasket	*56106	Spring
14288	Ball Stop	*34454	Packing	*66250	Ball
14290	Check Body	40476	Cylinder End	*66584	Strainer
14341	Bushing	40477	Piston	66725	Retaining Ring
14953	Outlet Body	41238	Cylinder Casting	68530	Retaining Ring
*31020	Gasket	41514	Reservoir Assembly	68797	Plug Button
*31086	Gasket	45872	Thrust Washer	69034	Retaining Ring
*34122	Packing	45936	Cover Cap	*69295	Filter
*34211	"O" Ring	48467	Washer	84174	Check Assembly
*34274	Gasket	50115	Machine Screw	92686	Bushing and Plunger Assembly
*34315	"O" Ring	51083	Nut		
*34358	"O" Ring	55289	Spring	92441	Filler Fitting
*34368	"O" Ring	55329	Spring		

*Recommended service parts inventory.

© Indicates Change

AIR OPERATED GREASE PUMP

SINGLE STROKE, SPRING RETURN

Model 82886

Series "H"

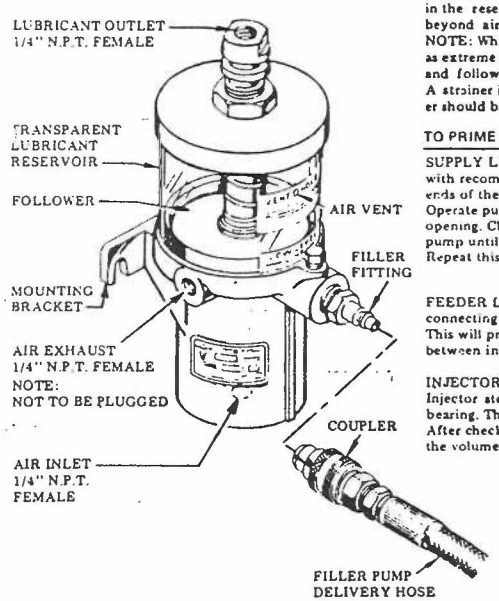
SPECIFICATIONS

Ratio	Lubricant Output (Cu. In.)	Reservoir Capacity	Air Inlet	Lubricant Outlet	LUBRICANT OPERATING PRESSURE (P.S.I.)			
					Type of System	Minimum	Maximum	Recommended
20:1	*.45	1 lb.	1/4" N.P.T. Female	1/4" N.P.T. Female	SL-32 SL-33	1,200 with 60 P.S.I. Air	3,500 with 175 P.S.I. Air	1,500 with 75 P.S.I. Air

*Based on lubricants that are free from entrapped air. Lubricants that are aerated will reduce output of pump.

The 82886 Pump is used as the pumping unit for a centralized lubrication system having a single line circuit of SL-32, or SL-33 Injectors. It is an air operated single stroke spring return pump that discharges .450 cu. in. into the circuit for each pump cycle.

The total quantity of lubricant needed for the lubrication cycle of the system must not exceed the amount of lubricant discharged per pump stroke.



TO FILL RESERVOIR

Use Manual Filler Pump 81834 to fill reservoir through the filler fitting in the pump body. Attach coupler on delivery hose to filler fitting. Stroke filler pump handle until lubricant weepage is noted at air vent hole in the reservoir (lower portion of follower must rise beyond air vent hole to expel entrapped air from lubricant). NOTE: When filling the reservoir, caution should be used as extreme pressure can cause damage to reservoir and follower assembly.
A strainer is located beneath the filler fitting. Strainer should be removed and cleaned periodically.

TO PRIME SYSTEM

SUPPLY LINES: After pump reservoir has been filled with recommended lubricant remove all plugs in dead ends of the injector manifolds and supply lines. Operate pump until lubricant flows from any plug opening. Close opening with plug. Continue operating pump until lubricant flows from another plug opening. Repeat this procedure until all supply lines are primed.

FEEDER LINES: Fill each feed line with lubricant before connecting lines to outlet of injectors and bearings. This will prevent having to cycle each injector to fill line between injector and bearing.

INJECTORS: Check each injector for proper operation. Injector stem moves when injector discharges lubricant to bearing. This may require cycling system several times. After checking injectors for operation adjust injectors for the volume required for each bearing.

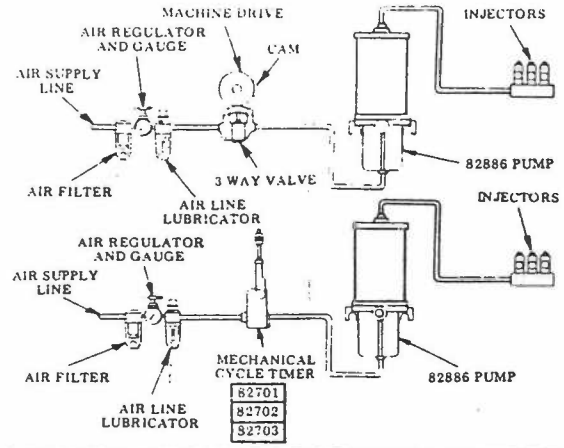
TYPES OF INSTALLATIONS

Frequency of lubrication cycle can be controlled Mechanically, Electrically or Manually.

MECHANICAL CONTROL

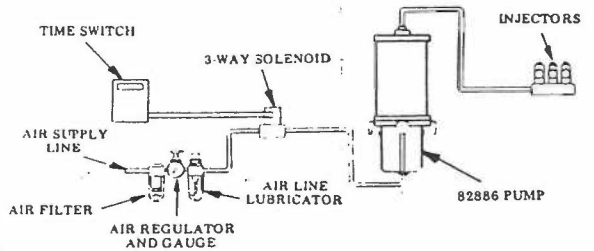
When using mechanical motion of machine to control lubrication frequency, three way valve is engaged by cam permitting air to pass through valve to pump forcing air piston forward and lubricant through supply line to injectors. When the valve is disengaged, air exhausts back through valve and spring in pump returns air piston completing lubrication cycle. Cam dwell on three way valve must be arranged for a minimum of 10 seconds.

When mechanical motion of machine is too rapid to be used as a source of control for frequency of lubrication cycle, a cycle timer with adjustable settings may be used. See separate instructions for Cycle Timers 82701, 82702 and 82703.



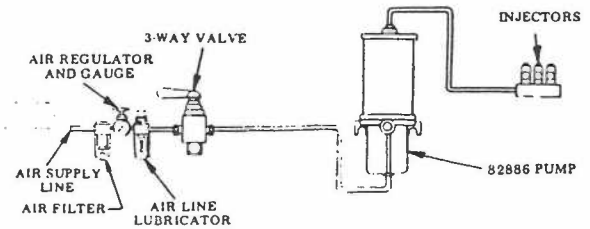
ELECTRICAL CONTROL

Electrical time switch opens three way solenoid valve permitting air to flow to pump forcing air piston forward and lubricant through supply line to injectors. When valve closes, air exhausts back through valve and spring in pump returns air piston completing lubrication cycle. Frequency of cycle can be set as desired by adjustable pins in time switch.



MANUAL CONTROL

Opening three way valve for a minimum of 10 seconds permits air to flow to pump forcing air piston forward and lubricant through supply line to injectors. When valve is closed, air exhausts back through valve and spring in pump returns air piston completing lubrication cycle.

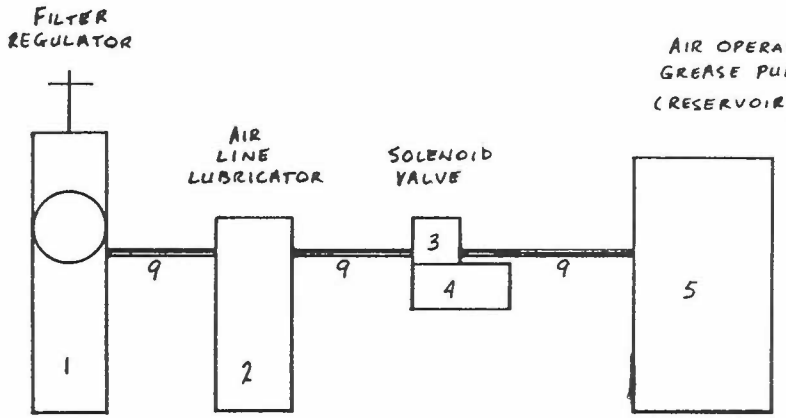


RETAIN THIS INFORMATION FOR FUTURE REFERENCE

When ordering replacement parts, list: Part Number, Description, Model Number, and Series Letter.
LINCOLN ST. LOUIS provides a Distributor Network that stocks equipment and replacement parts.
A list of Authorized Service Departments will be furnished upon request.

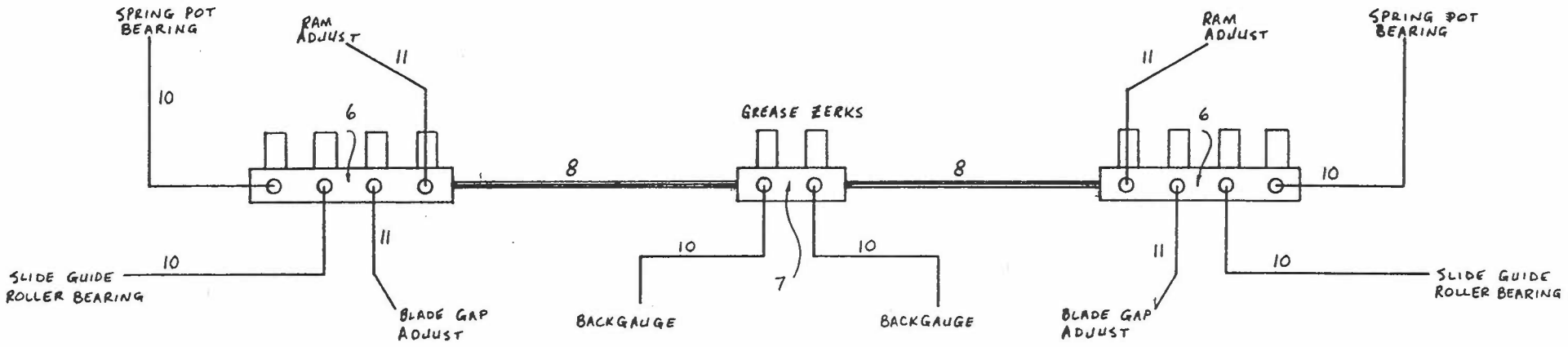
LINCOLN ST. LOUIS
4010 GOODFELLOW BLVD. - ST. LOUIS, MO. 63120 - (314) 383-5900
A DIVISION OF McNEIL CORPORATION

SECTION - C8
PAGE - 65H



PARTS LIST

1. DAYTON SPEEDAIRE 4Z027
2. DAYTON SPEEDAIRE 2Z458A
3. DAYTON SOL. VALVE OPERATING COIL 1A575
4. DAYTON SOL. VALVE BODY 6X542
5. LINCOLN PUMP 82886
6. LINCOLN INTECTOR SERIES SL-32 P/N · 83336-4
7. LINCOLN INTECTOR SERIES SL-33 P/N 83310-2
8. COPPER COATED STEEL TUBE 1/4"
9. COPPER COATED STEEL TUBE 3/8"
10. COPPER COATED STEEL TUBE 1/8"
11. PLASTIC TUBING 1/8"

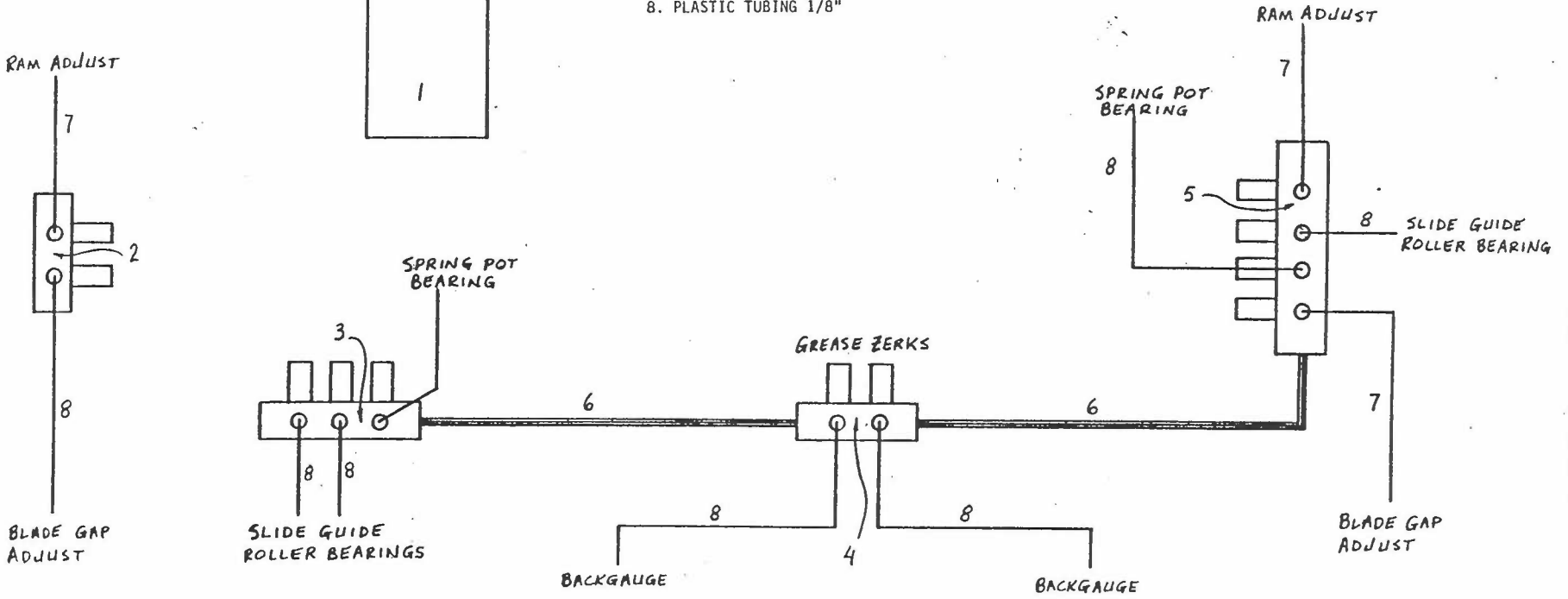


TOLERANCES (EXCEPT AS NOTED)	REVISIONS			HD-HDE SHEAR		
DECIMAL ±	NO.	DATE	BY	AIR AUTO-LUBE SYSTEM		
FRACTIONAL ±	1			DRAWN BY	SCALE NONE	MATERIAL
ANGULAR ±	2			CHK'D	DATE 10-10-85	DRAWING NO.
	3			TRACED	APP'D	
	4					
	5					

AIR OPERATED
GREASE PUMP
(RESERVOIR)

PARTS LIST

1. LINCOLN PUMP 82886
2. LINCOLN INTECTOR SERIES SL-32 P/N 83336-2
3. LINCOLN INTECTOR SERIES SL-32 P/N 83336-3
4. LINCOLN INTECTOR SERIES SL-32 P/N 83310-2
5. LINCOLN INTECTOR SERIES SL-32 P/N 83336-4
6. COPPER COATED STEEL TUBE 1/4"
7. COPPER COATED STEEL TUBE 1/8"
8. PLASTIC TUBING 1/8"



TOLERANCES (EXCEPT AS NOTED)	REVISIONS			HD-HDE SHEAR		
	NO.	DATE	BY	ONE-SHOT LUBE SYSTEM		
DECIMAL ±	1					
FRACTIONAL ±	2					
ANGULAR ±	3			DRAWN BY	SCALE NONE	MATERIAL
	4			CHK'D	DATE 10-10-85	DRAWING NO.
	5			TRACED	APP'D	

English

Suction Line Filtration

It is advisable that the customer check with his pump manufacturer to find the maximum safety inlet pressure drop allowed.

When indicator on Gauge enters red, starting at 5" Hg., Filter must be cleaned. By-pass in operation.

Return Line Filtration

When unit is operated as a Return Line Filter, the red sticker enclosed must be positioned on Gauge.

To do this, customer must first assemble Filter and take a pressure reading of indicator when Filter is clean, and oil is at operating temperature. To this reading, customer must add the number shown in the chart below which corresponds to his flow and type of element. The total of these two figures will give the exact position on the Gauge face where the red sticker must be placed (left-hand edge of sticker in line with Total). This is then the DANGER ZONE. The By-pass valve will open as soon as the needle enters the red portion, which indicates that Filter must be cleaned.

Filter Installation Instructions

When Filter is installed, ensure that at least 1" of clearance below the Filter bowl has been left free, so that dirty elements can be cleaned or replaced.

For convenience and best results, we would advise the customer that the Filter should be assembled in the vertical position; i.e. with Filter bowl downwards.

Please ensure that, when installing Filter, the oil flow is in the direction of the arrow indicated on the top of the casting.

Maximum working pressure:
100 p.s.i. 7,0 bar (100 PSI)
Maximum working temperature:
90° C.

Deutsch

Filterung in der Saugleitung

Wir empfehlen unseren Kunden mit ihren Pumpenlieferanten zu klären, welcher max. Druckabfall am Pumpeneinlass zulässig ist.

Sobald sich der Zeiger des Manometers uber den Wert 5" Hg. in das rote Feld bewegt, muss der Filter gereinigt werden. Das Überströmventil öffnet.

Filterung in der Rücklaufleitung

Bei Verendung als Rücklauffilter muss die mitgelieferte rote Marke auf dem Manometer angebracht werden.

Zu diesem Zweck ist es erforderlich, den Filter einzubauen und den Druck am Manometer im sauberen Zustand des Filters abzulesen. Hierbei muss das Öl Betriebstemperatur haben. Zu diesem Messwert ist der aus der nachstehenden Tabelle zu entnehmende Wert zu addieren, bei dem die jeweilige Durchflussmenge und Elementtype berücksichtigt ist. Die Summe dieser beiden Zahlen gibt die genaue Stelle an der Manometerskala an, an der die rote Marke anzubringen ist. (Der linke Rand der Marke liegt hierbei an dem Summenwert). Das rote Feld stellt dann die GEFAHRENZONE dar. Das Überströmventil wird dann öffnen, sobald der Zeiger in das rote Feld eintritt. Er zeigt damit gleichzeitig an, dass der Filter gereinigt werden muss.

Anweisungen für Filtereinbau

Beim Einbau des Filters ist darauf zu achten, dass mindestens 1" (2.5 cm) Spielraum unter der Filterglocke vorhanden ist, um das Auswechseln oder Reingen von schmutzigen Elementen zu ermöglichen. Aus Zweckmässigkeitsgründen und der einfacheren Wartung halber, empfehlen wir unseren Kunden, den Filter in vertikaler Lage einzubauen, d. h. mit der Glocke nach unten.

Wir bitten beim Einbau des Filters ferner darauf zu achten, dass der Durchfluss in der Richtung des auf der Oberseite des Kopfes eingegossenen Pfeiles erfolgt.

Maximaler Arbeitsdruck: 7,0 bar (100 PSI)
Maximale Arbeitstemperatur: 90° C.

Español

Filtro de Succion

Es aconsejable que el cliente compruebe con su fabricante de bomba la máxima pérdida de carga en la aspiración que ésta puede utilizar.

Cuando el indicador señala la parte roja del manómetro (5" de mercurio), el filtro debe limpiarse. El by-pass está operando.

Filtro de Retorno

Cuando la unidad se utiliza como filtro de retorno la etiqueta roja que se incluye debe pegarse en el manómetro en la posición correcta.

Para hacerlo, el cliente debe montar primero el filtro y efectuar una lectura de la presión cuando el filtro está limpio y el aceite está a temperatura de trabajo. Al valor de esta lectura el cliente debe añadir el número que se indica en la tabla a continuación, la cual corresponde a los valores para cada caudal y tipo de filtros. El total de estos dos valores da la posición exacta del dial del manómetro donde la etiqueta roja debe colocarse, (el borde izquierdo de la etiqueta en línea con el Total). Esto es pues la ZONA DE PELIGRO. La válvula by-pass se abrirá tan pronto como la aguja entre en la parte roja, lo cual indica que el filtro debe limpiarse.

Instrucciones para la Instalacion del Filtro

Al instalar el filtro asegurarse de que le quede por lo menos 25 mm de espacio libre debajo de la taza del mismo a fin de que los elementos sucios puedan ser limpiados o reemplazados.

Para más fáciles y mejores resultados aconsejamos el montaje del filtro en posición vertical, es decir con la taza hacia abajo.

Asegurarse de que, al instalar el filtro, el flujo de aceite circule en la dirección de la flecha indicada en la parte superior del mismo.

Presión máxima de trabajo: 7,0 bar (100 PSI)
Temperatura máxima de trabajo: 90° C.

Français

Filtration sur ligne d'aspiration

Il convient que l'utilisateur s'assure, auprès du constructeur de la pompe, de la perte de charge maximum admissable à l'aspiration.

Lorsque l'aiguille du manomètre pénètre dans la zone rouge, dont le point de depart correspond à 125 mm de mecure, le filtre doit-etre nettoyé, le by-pass est en service.

Filtration sur ligne de retour

Lorsque le filtre est employé sur la ligne de retour, l'indicateur adhésif rouge doit-etre positionné sur le manomètre.

A cet effet, il convient tout d'abord de monter le filtre et d'effectuer une lecture de pression sur l'indicateur lorsque le filtre est propre et l'huile à température de fonctionnement.

Au chiffre ainsi relevé, il faut ajouter le chiffre correspondant au débit et au type d'élément, chiffre donné dans le tableau ci-dessous. Le total de ces deux chiffres donnera la position exacte où il faut placer l'indicateur adhesif rouge sur le cadran du manomètre (le bord gauche de l'indicateur doit-être placé sur la ligne correspondant au total). Ainsi la zone de danger se trouve déterminée.

La soupape du by-pass s'ouvrira aussitôt que l'aiguille pénètrera dans la zone rouge, ceci indique que le filtre doit-être nettoyé.

Instructions pour l'installation du filtre

Lorsque l'on installe le filtre, s'assurer qu'un espace libre d'au moins 1" (25.4 mm) demeure en dessous de la cuve du filtre, de facon que les éléments filtrants sales puissent être nettoyés ou remplacés.

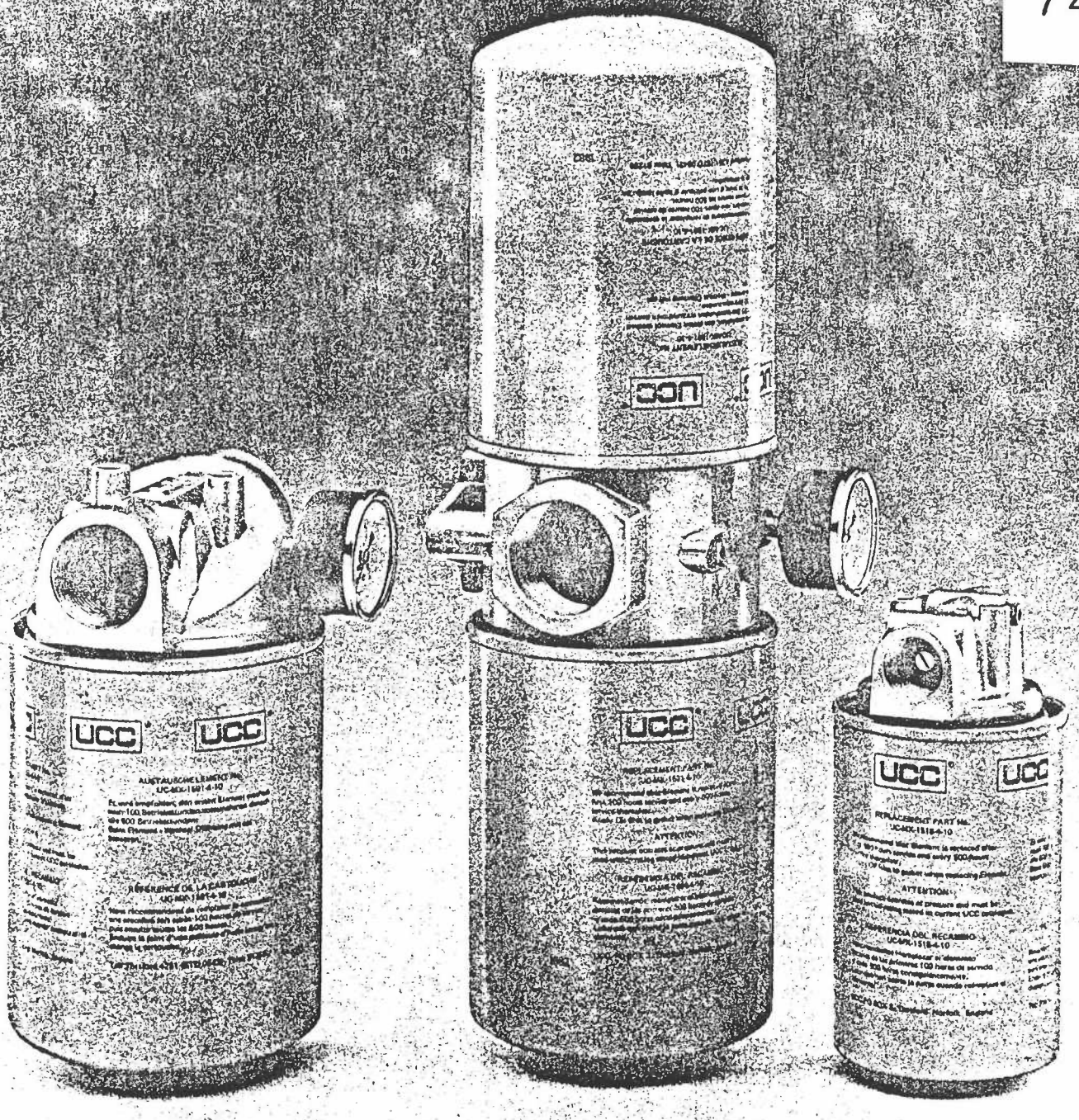
Pour une plus grande facilité de montage et pour obtenir les meilleurs résultats, le filtre doit-être installé en position verticale, c'es-à-dire cuve en bas.

Veuillez vous assurer, lors du montage du filtre, que l'écoulement du l'huile se fasse bien en suivant la flèche indiquée sur la tête coulée.

Pression maximum de service: 7,0 bar (100 PSI)
Température maximum de service: 90°C.

RETURN-LINE INDICATOR CALIBRATION CHART

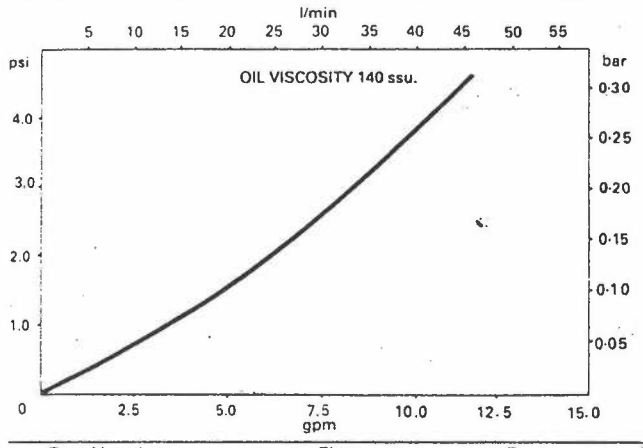
UC-MX-1518-101				UC-MX-1591-101				UC-MX-1720-101			
LPM	GPM	bar	PSI	LPM	GPM	bar	PSI	LPM	GPM	bar	PSI
0 - 10	0 - 2	0,96	14	0 - 30	0 - 6	0,96	14	0 - 100	0 - 22	0,96	14
10 - 20	2 - 4	0,96	14	30 - 60	6 - 13	0,96	14	100 - 200	22 - 44	0,89	13
20 - 30	4 - 6	0,89	13	60 - 90	13 - 20	0,89	13	200 - 250	44 - 55	0.83	12
30 - 40	6 - 9	0,83	12	90 - 120	20 - 27	0,83	12	250 - 300	55 - 66	0,76	11
40 - 50	9 - 11	0,76	11	120 - 150	27 - 33	0,69	10	300 - 350	66 - 77	0,69	10
50 - 60	11 - 13	0,62	9	150 - 180	33 - 40	0,62	9	350 - 400	77 - 88	0,62	9



The UCC range of full flow Maxi – flow Filters fitted with disposable spin-on type elements are available for flows up to 105 gpm (400 l/min) and have a nominal filtration retention of 10 microns. They are designed for use with mineral and petroleum based fluids. Three basic models are available, suitable for return or low pressure use at flow rates of nominally 15 gpm (60 l/min), 48 gpm (180 l/min) and 105 gpm (400 l/min). These figures are based on pressure drop/flow data and suitability for flow rates in excess of these figures should be established after consideration of this data and individual system conditions. Maximum Working Pressure is 100 psi (7 bar). The Filters are equally suitable for Suction Line applications but care must be taken to ensure that the pressure drop across the Filter together with other system losses does not create an excessive sub-atmospheric condition at the pump inlet. For further details consult UCC or their Distributors.

Replacement Element

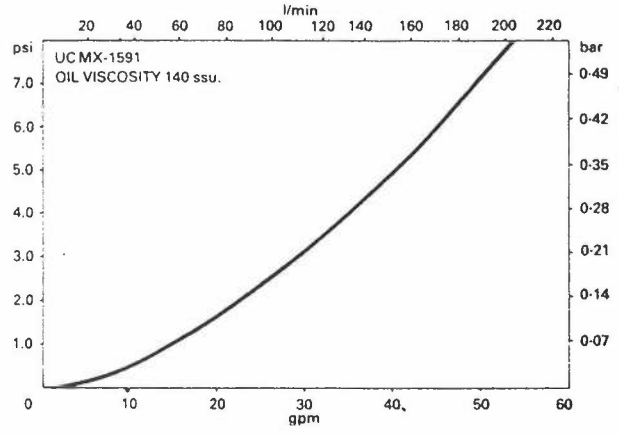
The disposable spin-on type element provides a quick and easy replacement facility giving minimum system downtime. The possibility of depositing contamination into the system when changing the more conventional type of element is eliminated with the disposable element design. Maxiflow spin-on elements are identified by their yellow colour with black characters.

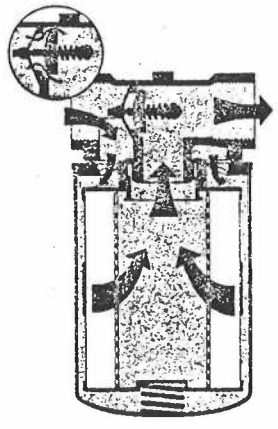


Suction Line Filters
Use these graphs to establish pressure drop (sub atmospheric). It is important to ensure that the total pressure loss due to filter and pipes etc, does not create a depression at the pump inlet exceeding the pump manufacturers recommendations. High viscosity conditions such as might occur during cold start conditions must be taken into account. For further data consult UCC. Suction Filters can be supplied fitted with a by-pass valve set to crack at 2.5 psi (0.17 bar) or with no by-pass.

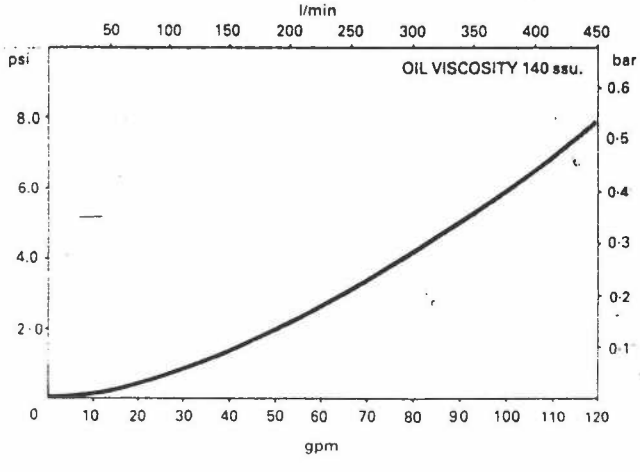
Part Number	Suction Application
UC-MX-*-103	With By Pass - With Indicator
UC-MX-*-104	With By Pass - No Indicator
UC-MX-*-105	No By Pass - With Indicator
UC-MX-*-106	No By Pass - No Indicator

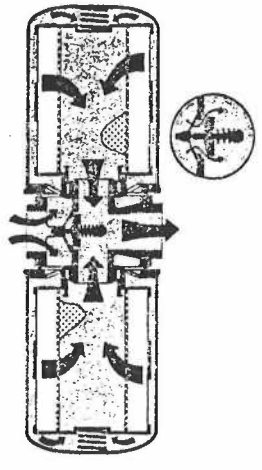
Part Number	Flow gpm	Flow l/min	Ports NPT	Micron Rating	Indicator	By-Pass	Weight lb (kg)	Replacement Element
UC-MX-1518-101	15	60	¾	10	With	With	2.64 (1.20)	UC-MX-1518-4-10
UC-MX-1518-102					Without	With	2.38 (1.03)	





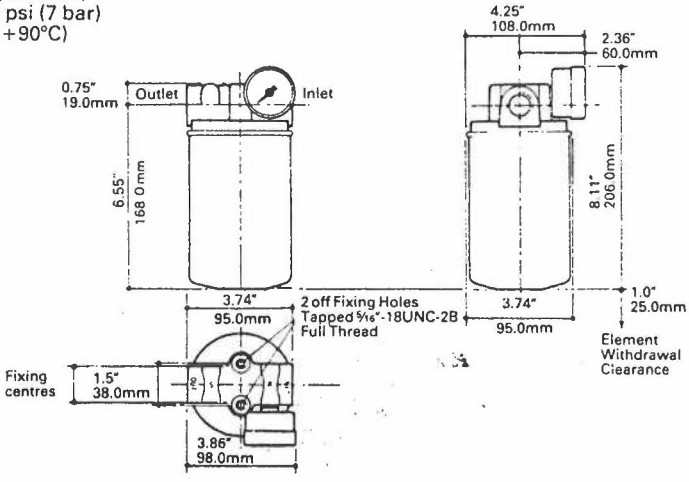
Part Number	Flow gpm	Flow l/min	Ports NPT	Micron Rating	Indicator	By-Pass	Weight lb (kg)	Replacement Element
UC-MX-1591-101	48	180	1¼	10	With	With	5.43 (2.47)	UC-MX-1591-4-10
UC-MX-1591-102					Without	With	5.17 (2.36)	

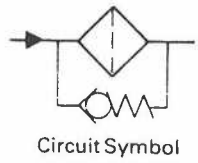


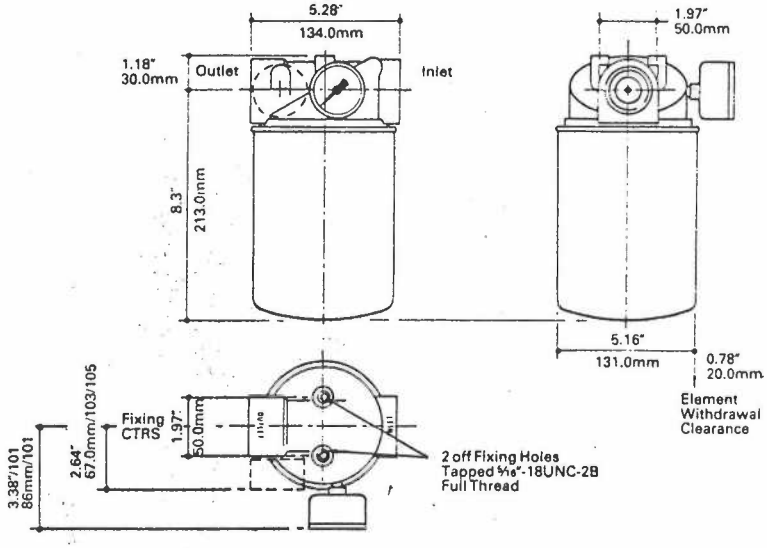


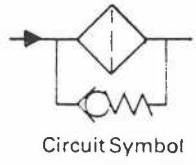
Part Number	Flow gpm	Flow l/min	Ports NPT	Micron Rating	Indicator	By-Pass	Weight lb (kg)	Replacement Element
UC-MX-1720-101	105	400	1½	10	With	With	9.72 (4.42)	UC-MX-1591-4-10
UC-MX-1720-102					Without	With	9.46 (4.32)	2-off

Return Line Filters
Standard By-Pass setting 15 psi (1.05 bar)
Maximum working pressure 100 psi (7 bar)
Maximum temperature +195°F (+90°C)




Circuit Symbol

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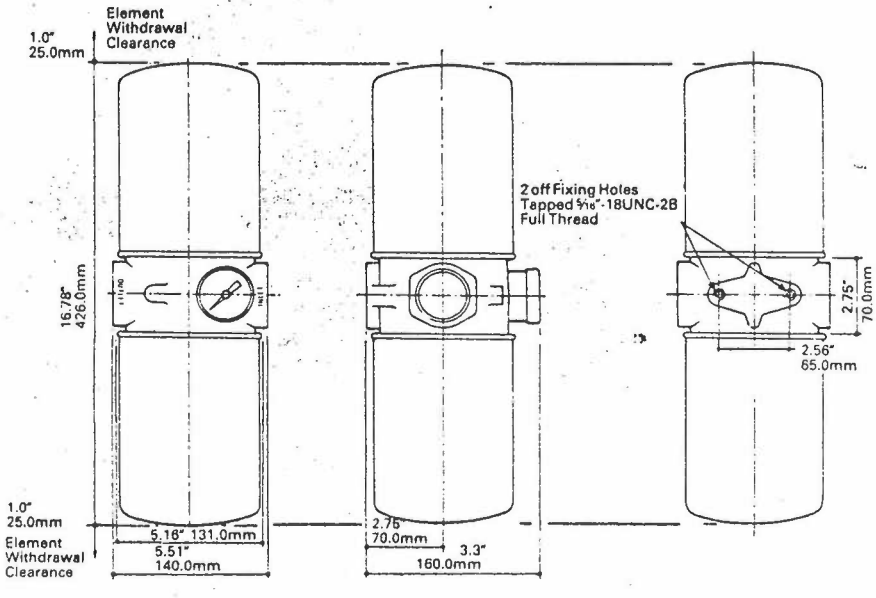
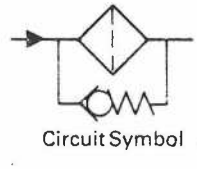



Circuit Symbol

INTRODUCTION

Dowty Industrial Corporation is a member of the Dowty Group of companies, world leaders in the field of mobile, industrial, and aircraft hydraulics.

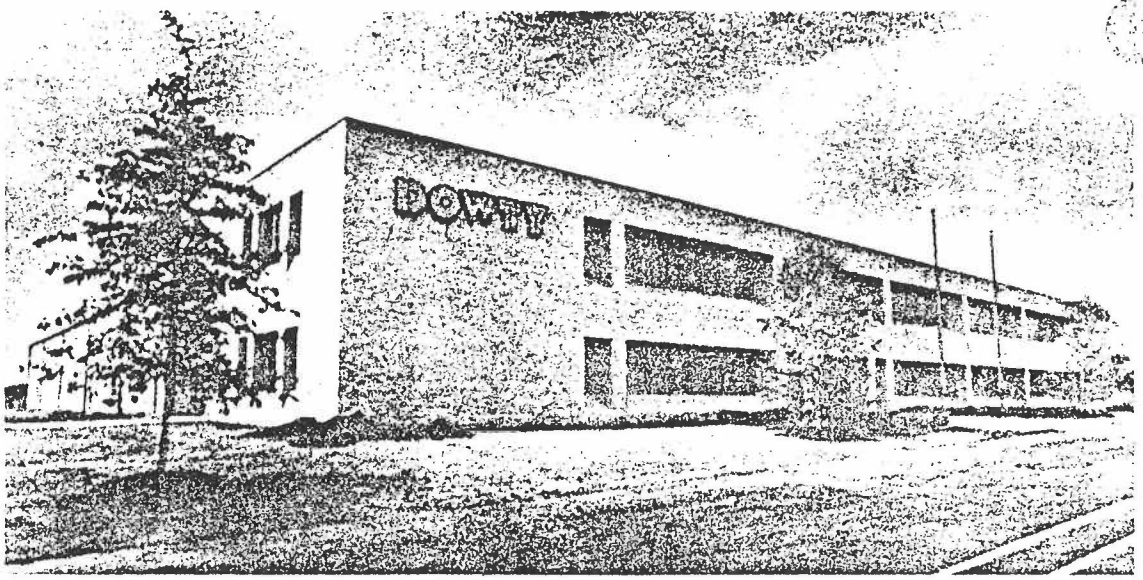
Technical data is available on the following products:

- P3000 gear pumps (single and tandem)
- HM gear motors
- Dowmax high torque—slow speed motors
- Rotary actuators
- Directional control valves
- Circuit valves
- Self-sealing couplings
- Power take-off gear box
- Hand pumps
- Servo valves

Copies of any of these catalogues are available on request from:

HYDRAULIC DIVISION
Dowty Industrial Corporation
P.O. Box 5000
Staverton West, Sully Road
Sterling, Virginia 22170
Phone: (703) 450-5930
Telex: 824459

CONTENTS



DOWTY INDUSTRIAL CORPORATION, STERLING, VIRGINIA

The policy of the company is one of continuous improvement in design. Specification of items may, therefore, be changed without notice.

P3000 GEAR PUMPS

The Dowty P3000 range of gear pumps has five basic frame sizes giving flow capacity ratings from .41 to 83.05 gpm at 1800 rev/min and is designed for continuous operation at 3000 psi (207 bar) in most sizes. Speeds up to 4,000 rev/min within a temperature range of 30°F to 180°F are attainable.
Application data is given on page 20.

P3000 Range

Size Group	Pump Type	Theoretical Displacement		Minimum Delivery U.S. gal./min.		Max Speed at max Continuous Pressure rev/min.	Min Speed at max Continuous Pressure rev/min.	Max Pressure		Page ref
		in^3/rev	cm^3/rev	1800 rev/min.	2400 rev/min.			psi	bar	
P3000 SERIES	0P 3003	0•08	1,23	•41	•61	4000	500	3000	207	
	0P 3004	0•10	1,64	•60	•86	4000	500	3000	207	
	0P 3006	0•13	2,18	•85	1•20	4000	500	3000	207	
	0P 3008	0•18	2,87	1•17	1•62	4000	500	3000	207	
0P	0P 3011	0•23	3,81	1•61	2•22	4000	500	3000	207	4-5
	0P 3013	0•27	4,46	1•91	2•62	4000	500	3000	207	
	0P 3015	0•31	5,14	2•23	3•05	4000	600	3000	207	
	0P 3019	0•38	6,26	2•74	3•73	4000	600	3000	207	
	0P 3025	0•49	8,08	3•64	4•92	3500	600	2525	174	
	1P 3020	0•43	7,03	3•13	4•24	3500	500	3000	207	
	1P 3028	0•58	9,47	4•24	5•74	3500	500	3000	207	
1P	1P 3036	0•73	11,90	5•37	7•26	3500	600	3000	207	
	1P 3044	0•88	14,34	6•51	8•78	3500	500	3000	207	6-7
	1P 3052	1•02	16,77	7•62	10•27	3500	600	3000	207	
	1P 3060	1•17	19,21	8•75	11•79	3500	650	3000	207	
	1P 3072	1•40	22,86	10•51	14•13	3000	650	2525	174	
	2P 3050	1•02	16,67	7•50	10•14	3000	550	3000	207	
	2P 3070	1•39	22,73	10•38	13•99	3000	550	3000	207	
	2P 3090	1•76	28,79	13•22	17•79	3000	650	3000	207	
2P	2P 3105	2•03	33,34	15•27	20•54	3000	600	3000	207	8-9
	2P 3120	2•32	37,88	17•43	23•45	3000	650	3000	207	
	2P 3146	2•78	45,46	21•03	28•24	2500	650	2525	174	
	2P 3158	3•01	49,40	22•76	30•57	2500	650	2525	174	
	3P 3150	2•87	47,01	21•73	29•18	2500	550	*3000	207	
	3P 3180	3•42	56,10	26•04	34•92	2500	600	*3000	207	
3P	3P 3210	3•97	65,16	30•35	40•66	2500	700	*3000	207	10-11
	3P 3250	4•70	77,04	36•10	48•30	2500	700	*2525	174	
	3P 3300	5•61	91,92	43•29	57•85	2000	700	*2000	138	
P4000 SERIES	3P 4150	2•87	47,01	21•73	29•18	2250	650	3600	248	
	3P 4180	3•42	56,10	26•04	34•92	2250	650	3600	248	
	3P 4210	3•97	65,16	30•35	40•66	2250	650	3600	248	
3P	3P 4250	4•70	77,04	36•10	48•30	2250	650	3300	228	12-13
	3P 4300	5•61	91,92	43•29	57•85	2250	650	3000	207	
	3P 4330	6•20	101,6	47•59	63•45	2100	650	2800	193	
	3P 4380	7•12	116,7	54•65	72•86	2000	650	2500	172	

*Maximum pressure depends on duty cycle and application. Please consult Technical Sales Department before ordering.

Pressure Balanced Bushings

The Dowty system of pressure balancing gives:

- Low contact pressures between bush face and gear with increased speed capability, reduction of wear and reduced heating effects.
- Uniform contact pressure for high volumetric efficiency.
- 'Pressure Field Control' to maintain consistent performance characteristics across wide speed, pressure and temperature ranges.

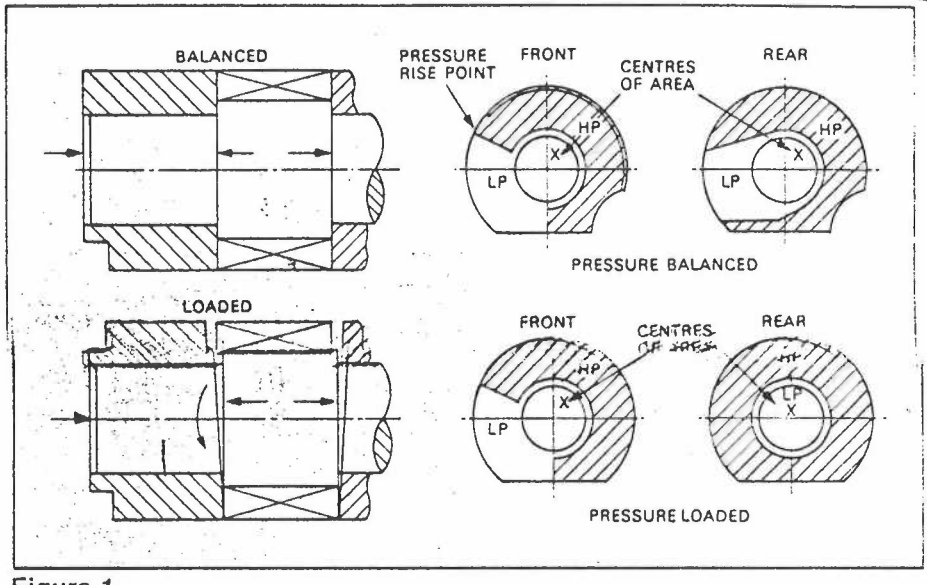


Figure 1

HIGH PRESSURE AREAS SHADED

Induced Flow Lubrication System

The 'Induced Flow Lubrication System' gives Dowty P3000 pumps the greatest possible gain in volumetric performance.

This is due to:

- No pressure energy to dissipate into heat.
- Oil at inlet temperature lubricates and cools the journal bearings.
- Supply of lubricating oil is constant irrespective of delivery conditions.
- Metering problems associated with high pressure lubrication are eliminated.

Referring to Fig. 2 — A depression relative to the general inlet pressure is created in region 1 by the rapidly opening gear tooth space. This depression draws oil from zone 6, down hole 5, across the bottom of the gear spindle and bush, hence along slot 3 and groove 2.

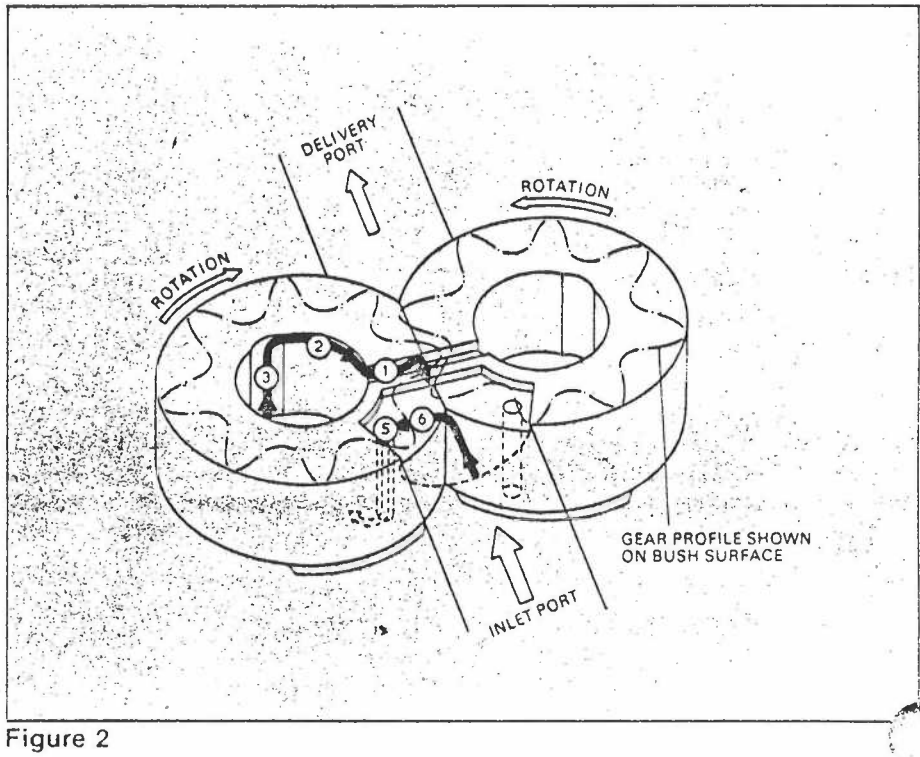


Figure 2

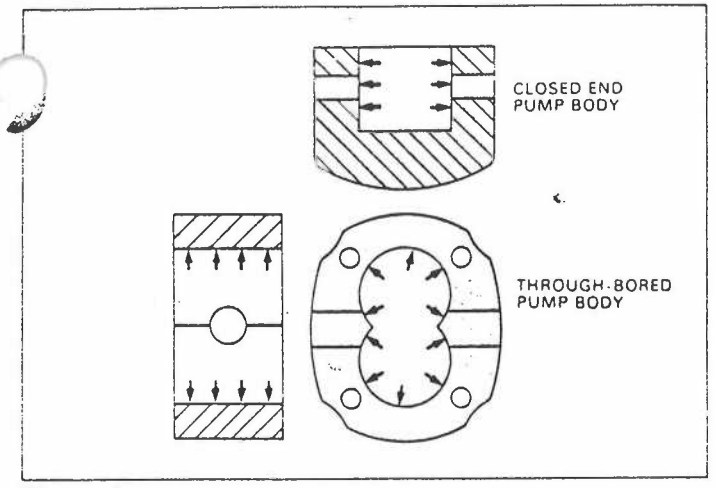


Figure 3

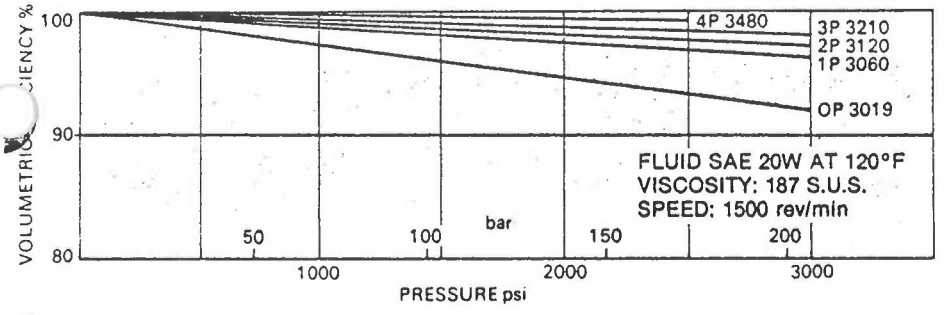
High Duty Casing

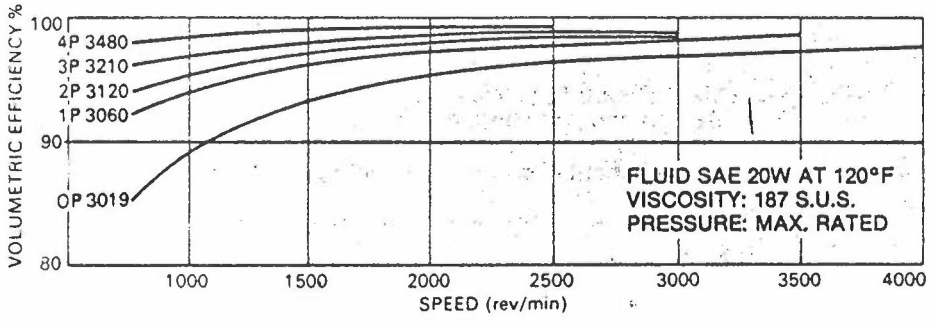
The open-ended pump casing design gives:

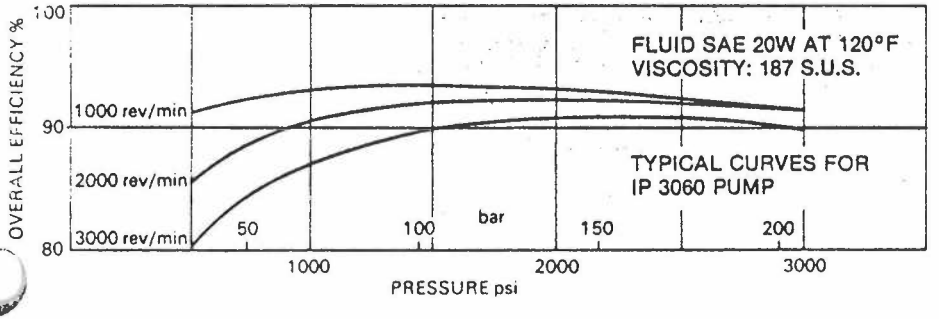
- Optimised body section for minimum material and maximum fatigue life.
- Precise bearing alignment resulting in lower wear.
- Elimination of high stress concentrations found in closed-ended designs.
- Close machining tolerances for low internal leakage.

Typical efficiency changes with operating conditions

The graphs shown are typical test results obtained from production units but in no way guarantee the performance of any individual unit.
For specific performance refer to section on the relevant pump.



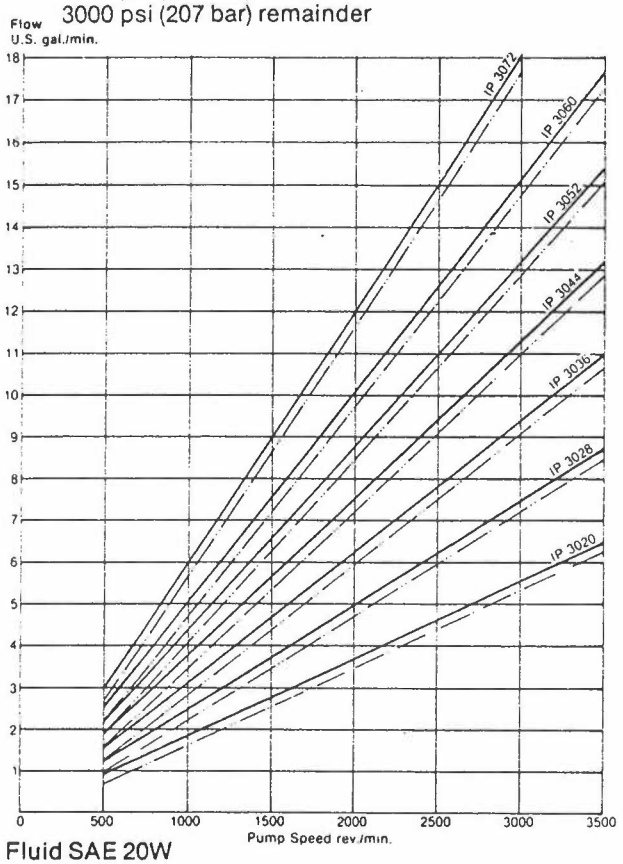




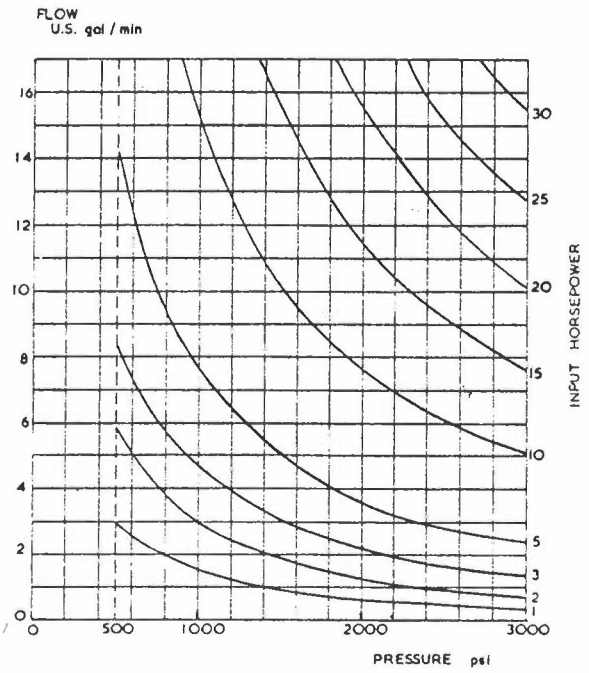
DOWTY

Typical Performance

Theoretical Flow _____
Flow at max Pressure _ . _ . _ . _ .
2525 psi (174 bar) 1P 3072
3000 psi (207 bar) remainder

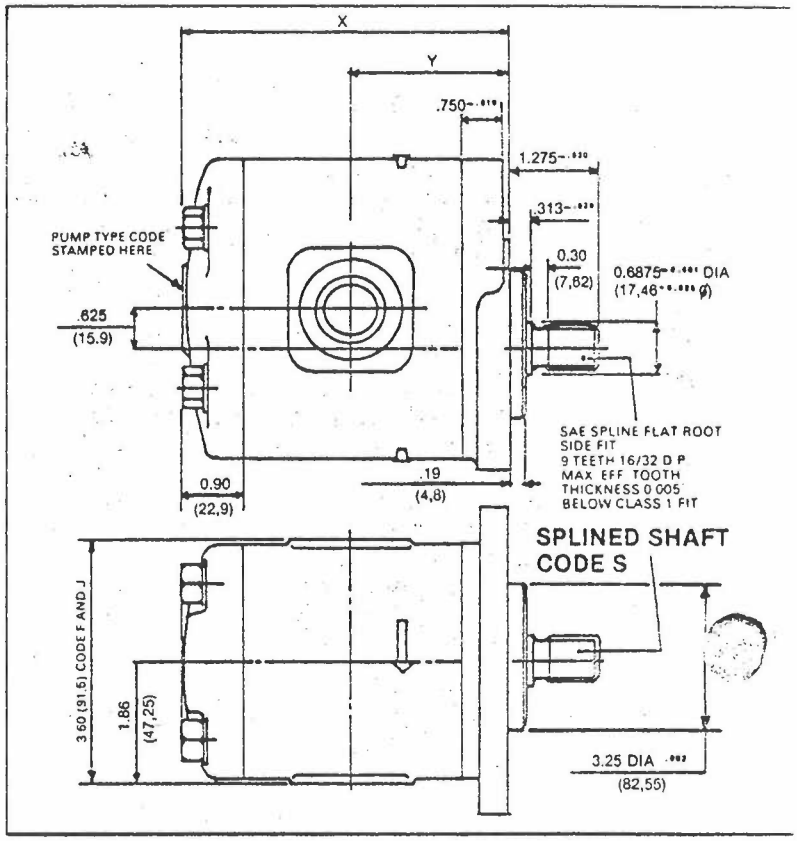


Fluid SAE 20W
Fluid Temperature 50°C



Group 1P Installation Dimensions

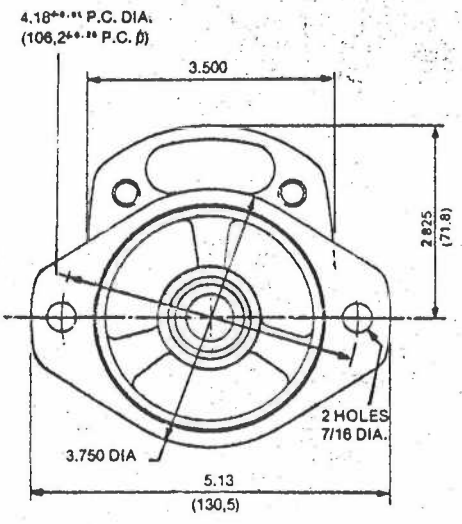
All dimensions in inches with mm equivalents in brackets.
Pump rotation Anti-clockwise as shown.
Pump weight 6 lb (2,7 kg) average, without connectors.



The variable dimensions X and Y are tabulated below. All other dimensions are common to group 1 pumps. Design improvements may lead to dimensional changes and these figures should be confirmed before use.

Pump Type	Dimension X —0·050 in (1,27 mm)		Dimension Y —0·030 in (0,76 mm)	
	In	mm	In	mm
1P 3020	3·48	88,4	1·69	43,0
1P 3028	3·61	91,7	1·75	44,5
1P 3036	3·73	94,7	1·81	46,0
1P 3044	4·44	112,8	2·16	55,0
1P 3052	4·56	115,8	2·23	56,6
1P 3060	4·68	118,9	2·29	58,2
1P 3072	4·86	123,4	2·38	60,5

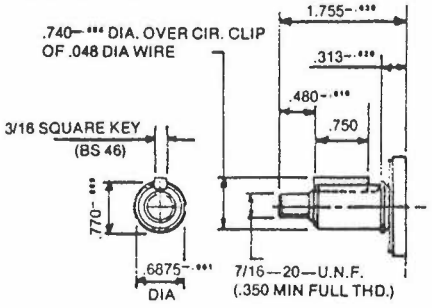
To widen the range of application of Group 2P pumps, variants are available embodying the features illustrated below. Each feature is identified by a code letter and this must be used in conjunction with the Coding Chart when ordering.



Illustrated code A/C SSJB

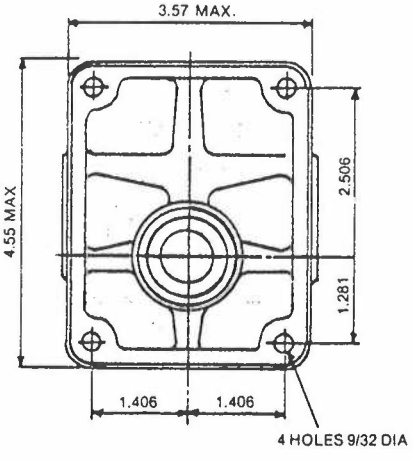
DRIVE SHAFTS

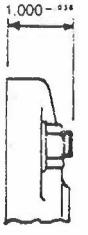
Parallel Shaft Code P



MOUNTING FLANGES

4-Bolt Mounting Flange Code D



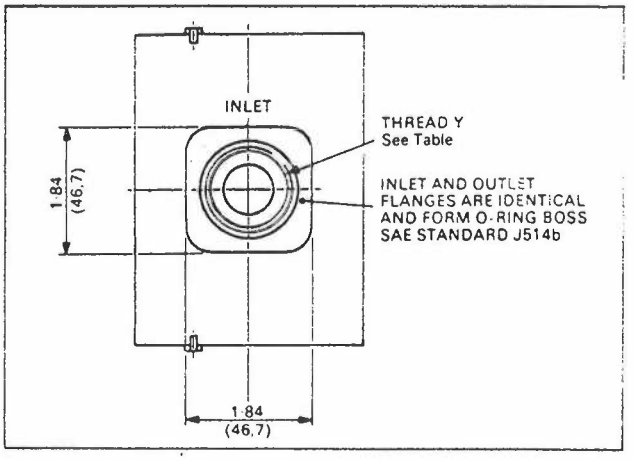


SCRAP VIEW OF END COVER

Body Ports Code J

Threaded ports (SAE O-Ring)
Minimum thread depth:—
7/8 in — 14 UN 0•650 in (16,5 mm)
1-1/16 in — 12 UN 0•750 in (19 mm)
1-5/16 in — 12 UN 0•750 in (19 mm)

Pump Size	Thread Y	
	Inlet	Outlet
1P 3020	1-1/16" — 12 UNF	7/8" — 14 UNF
1P 3028	1-1/16" — 12 UNF	7/8" — 14 UNF
1P 3036	1-1/16" — 12 UNF	7/8" — 14 UNF
1P 3044	1-5/16" — 12 UNF	1-1/16" — 12 UNF
1P 3052	1-5/16" — 12 UNF	1-1/16" — 12 UNF
1P 3060	1-5/16" — 12 UNF	1-1/16" — 12 UNF
1P 3072	1-5/16" — 12 UNF	1-1/16" — 12 UNF



APPLICATION DATA

PUMP DRIVES

Direct Drive

Drive to the pump shaft must be arranged so that the shaft is relieved of all side and end loads. A coupling allowing a minimum of 0·010 in (0,25 mm) radial and axial displacement must be chosen. A list of approved couplings is given below:

Crowned Tooth Gear Coupling

Renold Chain Coupling

Quill Shaft
Splines must allow sufficient radial movement

Turboflex Coupling
Two couplings needed to ensure radial alignment

Hardy Spicer Coupling
Two couplings needed to ensure radial alignment.
Large angle between pump and connecting shafts to be avoided.

Splined shaft pumps must not be plugged directly into the rigidly supported mating shaft of a prime mover. This can cause very high side loading to be imposed unless the concentricity of the driving and driven shafts, when under load, is of a very high order.

Indirect Drive

Side drives by gear, chain or toothed belt can be accommodated but allowance must be made for the extra side load that these drives impose on the pump bearings. In general, the larger the gear, sprocket or pulley diameter and the closer this is to the pump mounting flange the less the load on the pump bearings. However, the loading must be carefully calculated and our technical staff will be pleased to assist in this.

Vee belt drives are not recommended for the standard pump range. Pumps with supported bearings are being developed for use with Vee belt drive.

Parallel and tapered shaft pumps are supplied with a shaft key which must be hand fitted when the coupling is assembled. On no account must the key, or coupling be fitted, or removed by hammering or levering; this will damage the pump internally.

PUMP ROTATION

The word ROTATION is embossed on the mounting flange and two embossed arrows will be found on the pump body. The arrow adjacent to the word ROTATION indicates the direction in which the drive shaft must be turned to operate the pump. This is always stated as clockwise or anti-clockwise, as viewed on the end of the drive shaft.

PUMP MOUNTING

The pumps are two (or in some cases four), bolt flange mounted with pilots making for simplicity of installation. The counterbore to receive the mounting flange pilot should have a 0·040 in (1mm) chamfer at 45° on the pump side to insure proper seating. To minimize vibration which can be transmitted to the pump by rigid pipe runs, it is good ractice to use flexible hose immediately adjacent to the pump in both the suction and pressure lines.

PUMP SUCTION LINE

The suction line must be as large as possible and free from sharp bends so that depression at the pump inlet is a minimum. There must be no possibility of air entering the line and a positive head of oil should be arranged where practicable. The maximum depression that can be continuously tolerated at the pump inlet is 8 in Hg (0,25 atu) below atmospheric pressure. Greater depressions, occurring under cold start-up conditions, are permissible for short periods.

OIL RESERVOIR

It is recommended that the reservoir capacity is at least twice the pump output per minute at maximum pump speed. The pump suction line should draw oil from a point several inches above the tank bottom to avoid sludge deposits, and the return line should be submerged to limit frothing of the oil. The suction and return connections should be positioned as far apart as possible so that oil circulation is promoted within the tank to assist convection cooling. A baffle plate fitted between the two connections will help to do this.

Displacement volume for rams and actuators must be allowed for by providing adequate air space and breathing. For this purpose an oil filter/breather must be fitted to the filling orifice in the top surface of the tank. This should comprise a fine mesh strainer for the filling orifice and an air filter to prevent the entry of dust particles through the breather. Check the oil level regularly and use only clean, approved oil when topping-up.

FILTRATION

Dirt is the enemy of any hydraulic system. Adequate filtration must be provided to ensure that harmful dirt particles are trapped. As an absolute minimum standard the system must have a suction line strainer and a return line filter.

The strainer is fitted to the pump suction line inside the reservoir and should be of 100 mesh construction (0·006 in or 0,15 mm gap). It must be of sufficient size to prevent cavitation and to allow for partial obstruction after a period of service.

The return line filter must be a 10 micron filter of the renewable element type. So that it can cope with partially clogged conditions and return line surges it must be capable of passing twice the maximum pump flow at the minimum operating temperature of the system. Under cold start-up conditions by-passing is permissible for a short period.

The filter element must be changed at regular intervals.

OPERATING TEMPERATURE

These pumps are designed to operate continuously between 30°F and 180°F. This range can be extended to —5°F and 220°F for intermittent operation. The operating temperature will influence the choice of oil used to ensure that the maximum inlet depression is not exceeded. This will, in turn, fix the minimum speed at which the pump can be operated at full pressure.

OIL

Only good quality, mineral-based oils must be used in these pumps. For normal temperature operation SAE 20W oils are recommended, but in cold climates SAE 10W oils must be used. Our technical staff will be pleased to advise on the choice of oils most suitable for any particular application.

NOTE

In cases of continuous operation, where maximum rated conditions could occur simultaneously, the Technical Sales Department should be consulted.

CODING CHART 0P, 1P, 2P, 3P, 4P

ORDERING

Pumps are ordered by quoting the appropriate code reference set out in the Coding Chart.

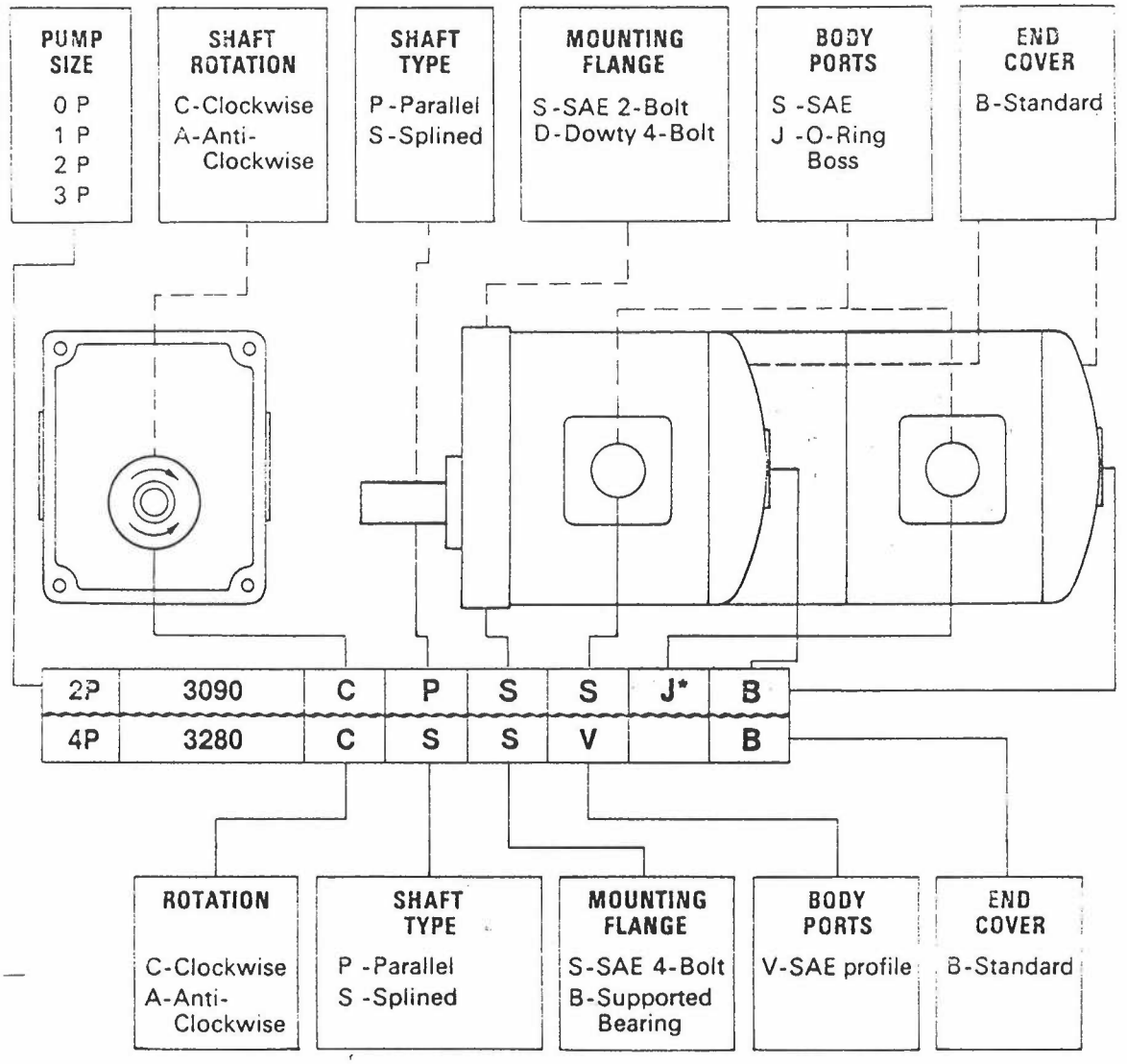
The coding forms an abbreviated specification of the pump required and is stamped on the pump end cover to provide identification.

TANDEMS

For ordering purposes tandem pumps are coded in a similar manner to single pumps. See Coding Chart below.

Quote the: Frame sizes
Type numbers and flow ratings
Code letters

Example: 3P-1P 3180-3052 CPSS JB



FOR TANDEM PUMPS

Body ports are coded twice; front pump first.

DOWTY INDUSTRIAL CORPORATION

HYDRAULIC DIVISION

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STERLING, VIRGINIA 22170
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DOWTY HYDRAULIC UNITS LTD

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ENGLAND
Telephone: CHELTENHAM (0242) 21411

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AJAX ONTARIO CANADA L1S2G8
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7 Pearl Court
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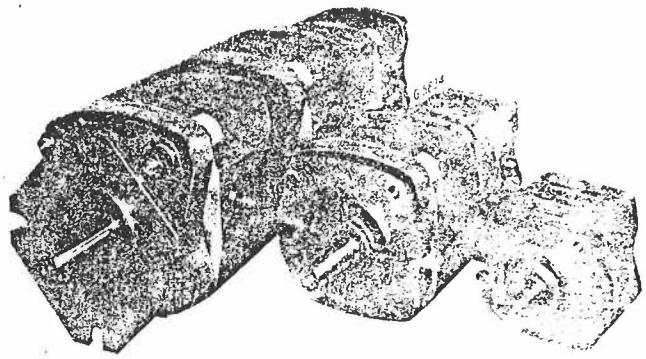


High-Pressure Internal Gear Pumps Type IPH

(Licence Eckerle)

Principle

IPH high-pressure pumps are internal gear pumps with axial and radial compensation. As a result of special design features and an optimum hydrostatic force equilibrium, they are suitable for high continuous operating pressures in conjunction with very high efficiency.

The short involute type teeth of the pinion and self-centering ring gear have a large angle of mesh and operate without flank clearance, so that pressure and delivery pulsation is small.

Special application possibilities

As a result of the reliable high operating pressures, the IPH pumps can also be used for applications which hitherto were confined to piston pumps. Compared to piston pumps, the suction behaviour of the IPH gear pumps is considerably better, which means that they can be installed independently of the oil tank without a feed pump.

Because of the particularly low noise level even at the highest operating pressures, the IPH pumps can also be used for applications where the utilisation of higher pressures was precluded up to the present time because of excessive noise or where expensive soundproofing measures were necessary.

Combinations

IPH pumps of similar or different sizes can be combined to form multiple flow units.

When combining IPH pumps with low pressure pumps of type IPN, the range of possible applications is widened still further. Such combinations allow simply operated pump switchings with booster stage and one or more high pressure stages for machines such as presses, cutters and perforators.

Advantages

- Peak pressures up to 330 bar
- High continuous operating pressure (250 to 300 bar)
- High efficiency over the entire operating pressure range (over 90%)
- High volumetric efficiency (over 97% at 300 bar)
- Very low noise level (for example less than 78 dB (A) at bar and a delivery of 75 litres per minute)
- Long service life (trials in the fatigue test running to 18 million load changes from 0 to 300 bar)
- Good suction behaviour (up to 0,6 bar at the suction connection of the pump)
- Low delivery and pressure pulsation (2% to 3%)
- No maintenance
- Complete range of pump models from 3,6 to 125 cm^3 per rev delivery
- Price advantage as opposed to comparable pump designs
- Compact and attractive styling
- Straightforward construction for easy maintenance
- Any desired fitting position
- Radial and axial loading of the drive shaft is permitted without supplementary bearing (e. g. belt drive)
- Can be combined to form multiple flow pumps
- Can be combined with low pressure pumps type IPN

Characteristic data

Design	internal gear pump
Mounting	SAE flange mounted
Drive	connection flange according to SAE
Direction of rotation	clockwise or anticlockwise
Suction pressure	0,6 bar (min), 2 bar (max)
Continuous pressure	up to 300 bar (see table)
Peak pressure	330 bar (see table)
Drive power	up to 170 kW
Volumetric efficiency	η_v up to 98% at 300 bar
Overall efficiency	η_0 up to 92% at 300 bar
Delivery volume	3,6 cm³/rev to 125,9 cm³/rev
Pressure medium	mineral oil 20 to 40 cSt (2,9 to 5,35° E) at 50° C
Temperature of pressure medium	− 15° C to + 70° C

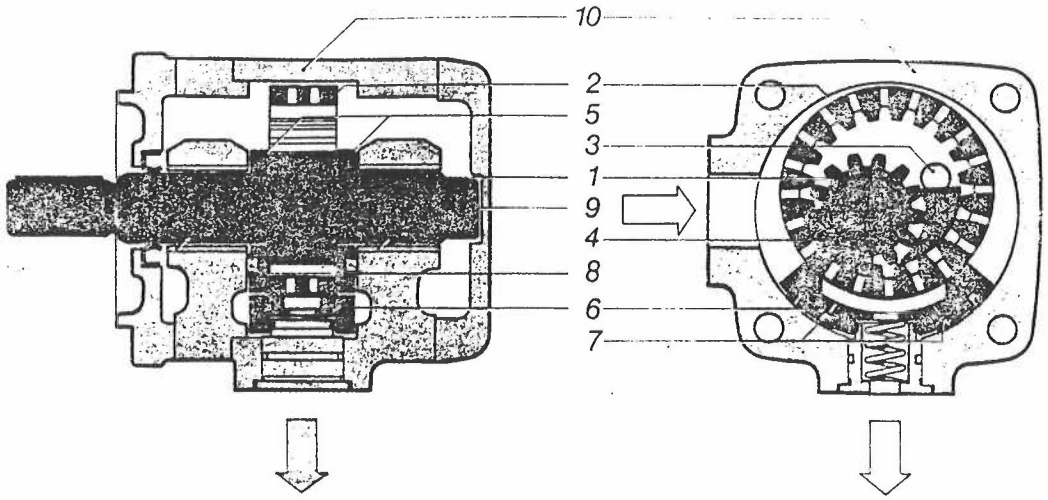


Figure 1 Simplified view shows construction of the IPH pumps

1 pinion shaft	*3* filler pin	*5* axial discs	*7* radial pressure area	*9* elastic bearing
2 ring gear	*4* filler	*6* control shell	*8* axial pressure area	*10* casing parts

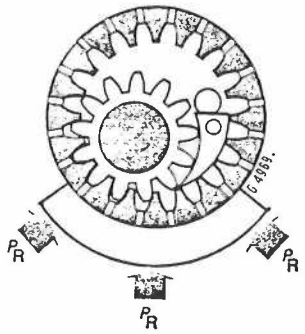


Fig. 2.1
Illustration of IPH radial compensation

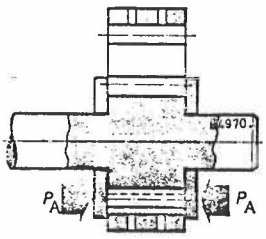


Fig. 2.2
Illustration of IPH axial compensation

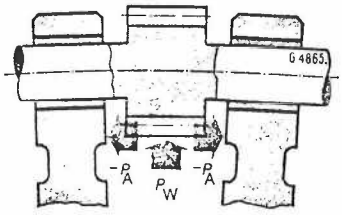


Fig. 2.3
Illustration of IPH elastic bearing

Construction and mode of operation

Construction and mode of operation are described with reference to **Figure 1.**

Pinion shaft *1* is driven, and by virtue of its gear teeth drives the ring gear 2. This pinion shaft is supported in specially designed bearings in the casing. The ring gear with its internal teeth is pushed by the control shell 6 further into mesh with the pinion teeth and at the same time against filler *4*. The radial force exerted by the control shell on the ring gear is generated by the operating pressure in the radial areas 7. The filler which is not fixed is restrained in the circumferential direction by the filler pin *3* fitted in the casing. The ring gear is guided by the axial discs 5 at its faces. These are arranged on the pinion shaft and are supported tangentially on the filler.

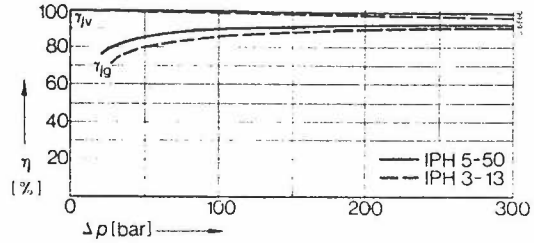


Figure 3 Graphs of efficiency measured at 1450 min^{-1}
η_v = volumetric η_g = overall efficiency

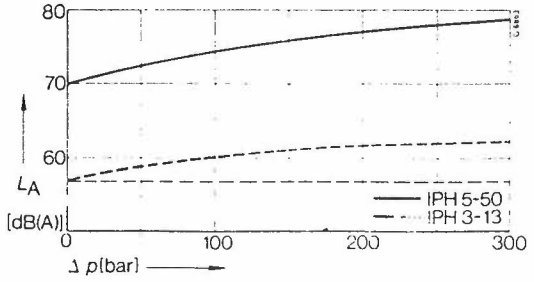


Figure 4 Sound level measured at 1450 min^{-1} at a distance of 1 meter in the sound-ranging room

When the pair of gears rotate, oil is drawn into the case and consequently into the space between the pinion and the ring gear. The two gears rotate completely free through 180°. The tooth chambers are filled at a low flow velocity. As a result of almost gap-free sealing of the tooth chambers of pinion and ring gear relative to the filler and the axial discs, the oil is conveyed practically without any loss into the pressure chamber of the control shell and on to the oil-pressure connection of the casing. In the interest of low bearing and frictional stresses, the pressure chamber is restricted to the smallest possible dimension by means of special construction. As a result of this, sealing members such as axial discs and filler can be kept extremely small.

The effects of each construction feature are as follows:

IPH radial compensation (see figure 2.1)

The radial compensation forces + P_R are generated in the control shell by the pressure areas and are proportionate to the operating pressure. With a slight force, the ring gear is pushed by the control shell into the pinion teeth and against the filler. This results in sealing of the pressure chamber at the gear teeth side by eliminating flank clearance, and between the ring gear filler and pinion it also produces a sealing which is largely free of leak gaps.

IPH axial compensation (see figure 2.2)

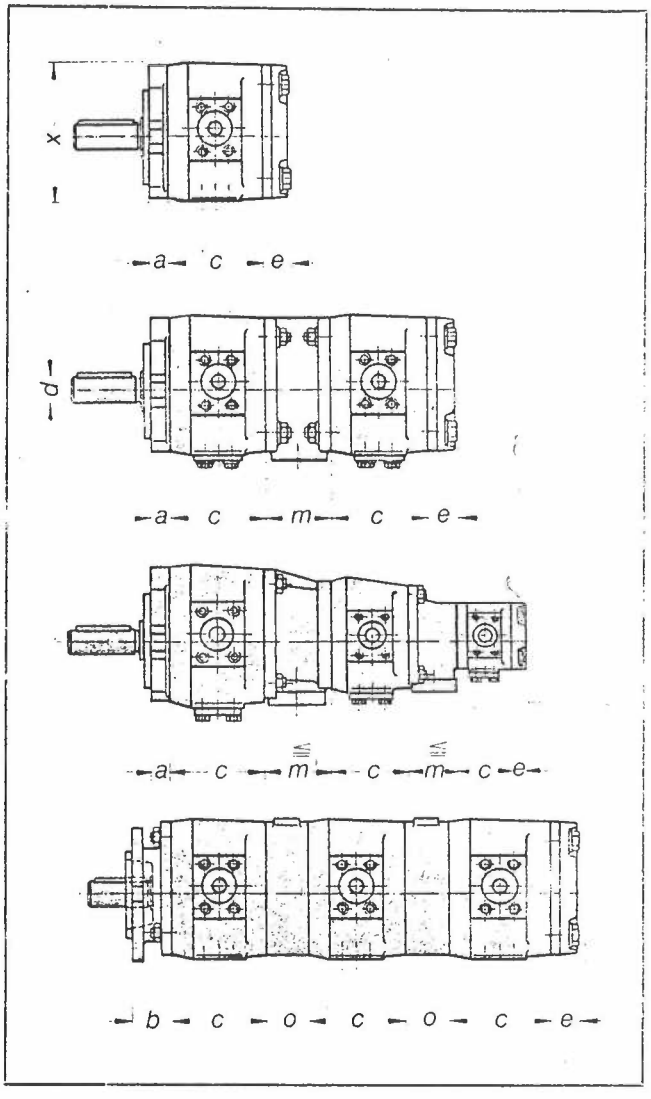
The axial compensation forces + P_A are generated in the axial discs by the pressure areas *B* and, as in the case of the radial areas, they are proportionate to the operating pressure. With slight pressure in the area of the pressure chamber, the axial discs are forced on to the lateral of the ring gear, pinion shaft and filler. As a result, the axial leak gaps between the rotating and the stationary parts are extraordinarily small. By virtue of exactly determined radial and axial compensation with the relatively small forces, the pressure chamber has the best possible sealing for all operating conditions, even after an extended period of operation.

IPH elastic bearing (see figure 2.3)

The hydraulic loading + P_W from the pressure chamber acts on the pinion shaft and flexes it. If no special constructive measures were taken, there would be side loads on the bearings with such high operating pressures. In order to avoid these loads, the pinion shaft is mounted in the casing by means of elastic bearing supports. Because of the reaction forces − P_A of the axial compensation forces + P_A, these IPH elastic bearings are arranged at an angle in proportion to the operating pressure. Consequently, the bearings of the pinion shaft are inclined in such a manner for each operating pressure that all detrimental loads are eliminated. The plain bearings are automatically lubricated by the pressure medium and are virtually wear free.

IPH gearing

IPH gearing is of the short involute type specially designed for the IPH high-pressure gear pump. The large angle of mesh, as well as the fact that the radial compensation provides for the without flank clearance, further reduces the delivery and pressure pulsation; pulsation is low anyway in the case of pumps with internal gear teeth. All this contributes extensively to the low operating noise of the pump.



Some characteristic values and dimensions — We reserve the right to make technical improvements

Basic model Delivery size	Delivery volume cm³/rev	Speed min⁻¹ min	Speed min⁻¹ max	Delivery litres/min at 1500 min⁻¹	Pressures bar Conti. press.	Pressures bar Peak press.	Weight kp	Principal dimensions mm d	a	b	c	e	x	m	o
Group A															
IPH 2 — 3,5	3,6	600	3600	5,4	250	300	2,7	18_{h7}	19	—	64	19,5	98	34	—
IPH 2 — 5	5,24	600	3600	7,85	250	330	2,8	18_{h7}	19	—	69	19,5	98	34	—
IPH 2 — 6,3	6,55	600	3600	9,8	250	315	2,9	18_{h7}	19	—	73	19,5	98	34	—
IPH 2 — 8	8,18	600	3000	12,3	250	300	3,0	18_{h7}	19	—	78	19,5	98	34	—
IPH 3 — 10	10,2	600	3000	15,3	300	330	5,6	20_{h7}	13,5	—	88	33	116	36 - 40	—
IPH 3 — 13	13,3	600	3000	20,0	250	315	5,8	20_{h7}	13,5	—	94	33	116	36 - 40	—
IPH 3 — 16	15,8	600	3000	23,7	250	300	6,0	20_{h7}	13,5	—	99	33	116	36 - 40	—
Group B															
IPH 4 — 20	20,7	500	3000	31,0	300	330	9,5	25_{h7}	20	50	102	40	146	66 - 70	48
IPH 4 — 25	25,7	500	3000	38,6	250	315	10,0	25_{h7}	20	50	108	40	146	66 - 70	48
IPH 4 — 32	32,3	500	3000	48,5	250	300	10,5	25_{h7}	20	50	116	40	146	66 - 70	48
IPH 5 — 40	40,8	400	3000	61,2	300	330	19,0	32_{h7}	22	55	138	44	195	80 - 90	55
IPH 5 — 50	50,3	400	3000	75,4	250	315	20,0	32_{h7}	22	55	145	44	195	80 - 90	55
IPH 5 — 64	63,9	400	3000	95,8	250	300	21,0	32_{h7}	22	55	155	44	195	80 - 90	55
IPH 6 — 80	81,3	300	2500	121,9	300	330	34,0	40_{h7}	26	63	171	50	242	90 - 110	56
IPH 6 — 100	101,6	300	2500	152,4	250	315	36,0	40_{h7}	26	63	181	50	242	90 - 110	56
IPH 6 — 125	125,9	300	2500	188,8	250	300	38,0	40_{h7}	26	63	193	50	242	90 - 110	56

The permissible peak pressures are based on a switch-on time of 15% with a maximum cycle time of 1 minute.

IPH pumps of Group A manufacturers are Otto Eckerle, D-7502 Malsch, Benzstraße 6, and IPH pumps of Group B Voith Getriebe KG, D-7920 Heidenheim, Alexanderstraße 2.

Suppliers
Single pumps are supplied by the above manufacturers. Multiple pump units up to and including size 4, which are exclusively or for the larger part combined with pumps of group A, are supplied by Otto Eckerle. All other pump combinations are supplied by Voith Getriebe KG.

REPAIR INSTRUCTIONS

1. General remarks

Figures shown in brackets represent illustration and respective item numbers.

With any exchange of primary pump components, subsequent running in on a test stand is necessary. In such a case, the pump must be returned to Heidenheim for repair. Further details under 4. below.

Great attention should be paid to cleanliness when undertaking repair work, since even the smallest particles of dirt can upset the function of the pump.

2. Removal of the pump

Use no force when removing the pump. Extract coupling parts using the thread provided in the pinion shaft (1-3/b).

3. Dismantling of the pump

Observe the correct sequence of dismantling with the casing parts and mark accordingly. Confusion may lead to change of direction of rotation!

Remove key (3/16).

IPH 3 (Design with Ermeto pressure connection)	IPH 2 to 6 (Design with SAE pressure connection
Undo screws (2/39) and lift off complete pressure connection (2/37+40+41), sealing ring (2/36) and spring (2/34),	Remove circlip (1+3/35) and spring (1+3/34) or, with older design, unscrew guide screw (3/c) 5 mm,

in order to release spring tension on the control piston.

Undo screws (1-3/51), with older design IPH 4 to 6 also screws (3/6). Remove end cover (1-3/48) and, if fitted, connection flange (3/2) or adaptor housing (3/54+60).

Press off bearing cover (1-3/9) via recess (1+3/1) using either screwdriver or lever.

Remove the following in sequence: filler pin (1-3/22), thrust plate (1-3/14), spring rod (3/19) or dowel (1+2/20), filler (1-3/21), pinion shaft (1-3/17), ring gear (1-3/28), thrust plate (1-3/15), control piston (1-3/27) with spring washers or plain washers (2/26), profile

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seals (1-3/25), support washers (2+3/24), according to design, and radial support rings (1-3/23) sealing ring (1-3/31) and support ring (1-3/32).

4. Inspection, exchange and repair

Carefully wash all parts in petrol. In the case of wear or damage to the following parts, the pump must be returned to Heidenheim for repair.

For this reason, first examine:

Pinion shaft (1-3/17) and ring gear (1-3/28)	For cracks in teeth, scoring, axial and radial wear.
Filler (1-3/21) and thrust plates (1-3/14+15)	For scoring and wear on sliding surfaces.
Bearing cover (1-3/9, 2/24) and bearing casing (1-3/30)	For wear and galling on axial sealing surfaces.
Control piston (1-3/27)	For wear and galling on sliding surfaces.
Filler pin (3/22)	For damage

In the case of damage to the following parts, repair work may be undertaken on one's own.

Examine:

Filler pin (1+2/22)	For damage
Sealing components (1-3/5, 10, 12, 13 23, 24, 25, 31, 32, 36, 42, 43, 52)	For hardening, cracking and wear

IPH 4 to 6

Track ring (3/11)	For scoring

Prior to exchange, the old track ring must be ground through until it breaks open. Caution:

Do not damage the pinion shaft! Heat the new track ring up to 80-100°C and push on to the pinion shaft.

IPH 2 to 6

Other components listed in the spare parts list no. C 782 may also be renewed.

5. Re-assembly

All components must be meticulously clean. When assembling, apply a thin film of oil to each.

IPH 3 (Ermeto pressure connection)

Place sealing ring (2/5) in bearing cover (2/47) and this on housing (2/3/) (note pump direction of rotation, pressure connection downwards, locating hole to locating hole).

Press centring sleeve (2/29) fully home into the locating hole of the bearing cover and press the bearing cover on to the housing. Push sealing ring (2/31) on to guide piston (2/33) and insert this in the bore of bearing housing (2/30).

IPH 2 to 6 (SAE pressure connection)

Fit support ring (1-3/32) and sealing ring (1-3/31) to guide piston (1+3/c; 2/33).

Complete the control piston.
NB: According to operating fluid and design of pump, different parts are required. Exact details are to be gathered from spare parts lists G 782, edition from August 1980.

Turn the radial support ring until it lines up with the shape of the control piston.

Illustr. 4/2 shows the design with the radial support ring, support washer, and profile seal.

Stick sealing ring (1-3/13) in the form shown and axial piston (1-3/12) into position in thrust plates (1-3/14+15) using grease. Axial pistons should slide in easily otherwise they must be remachined.

Insert the complete control (1-3/27) in its correct position (see illustr. 4/1 for differences in chamfer.

Then install the following parts in sequence in the housing:

Locating bush (3/18) (with new design), complete thrust plate (1-3/12+13+15), ring gear (1-3/28), pinion shaft (1+2/17 or 3/17+11), filler (1-3/21), dowel (1+2/20) IPH 2, 3, and older designs of IPH 4), or spring rod (3/19) (IPH 4 to 6), complete thrust plate (1-3/12+13+14), and filler pin (1-3/22). Flat toward pinion shaft.

With IPH 4 to 6, stick bush (3/18) into the bearing cover using grease and, with IPH 3+4, insert locating sleeve (2+3/29) into housing (1+3/30). With IPH 2, 5+6, insert locating pin (1+3/7) into housing (1+3/30).

Place sealing ring (1/10 or 2+3/5) into bearing cover and press this on to housing (1-3/30) using a rubber hammer.

With the older design IPH 4, tighten up the bearing cover by means of 2 socket cap screws M 12x80 (3/6) to 9 mkp.

Place sealing ring (1-3/5) on to bearing cover (1-3/9).

Make sure that with IPH 2, 5 and 6, locating pins (1/7 or 3/7+8) are inserted.

IPH 4 to 6 (Individual or primary pumps)

Press oil seal (3/4) with dust lip facing outwards into flange (3/2):

To prevent damage or turning inside out of the sealing lip - pump sucking air causes damage - push assembly sleeve (5/1) on to the pinion shaft, fill the oil seal with grease between dust and sealing lips, and press the flange on to bearing cover (3/9).

The assembly sleeve (5/1) can either be self-fabricated or purchased from Voith under index no. 50.7097.10 for IPH 4, 50.7098.10 for IPH 5 and 50.7099.10 for IPH 6.

IPH 2 to 6

Place sealing ring (1-3/5) into housing (1+3/30 or 2/47) and fit end cover (1-3/48) or adaptor housing (3/54 or 60).

Tighten screws to:

IPH 2 and 3	2.5 mkp
IPH 4	9.0 mkp
IPH 5	20.0 mkp
IPH 6	40.0 mkp

IPH 3 (Ermeto pressure connection)

Fit spring (2/34) and sealing ring (2/36). Screw up the complete pressure connection flange

IPH 2 to 6 (SAE pressure connection)

Fit spring (1+3/34) and circlip (1+3/35) or - with older design - tighten guide screw (1+3/c).

Check the pump for smoothness of action:

Screw a bolt into thread of pinion shaft (1-3/b) - using a locknut with anticlockwise pump - and turn the shaft with a torque wrench. If the following values are exceeded, the pump must be checked again for correct assembly.

IPH 2	0.6 mkp
IPH 3	0.6 mkp
IPH 4	1.0 mkp
IPH 5	1.4 mkp
IPH 6	1.8 mkp

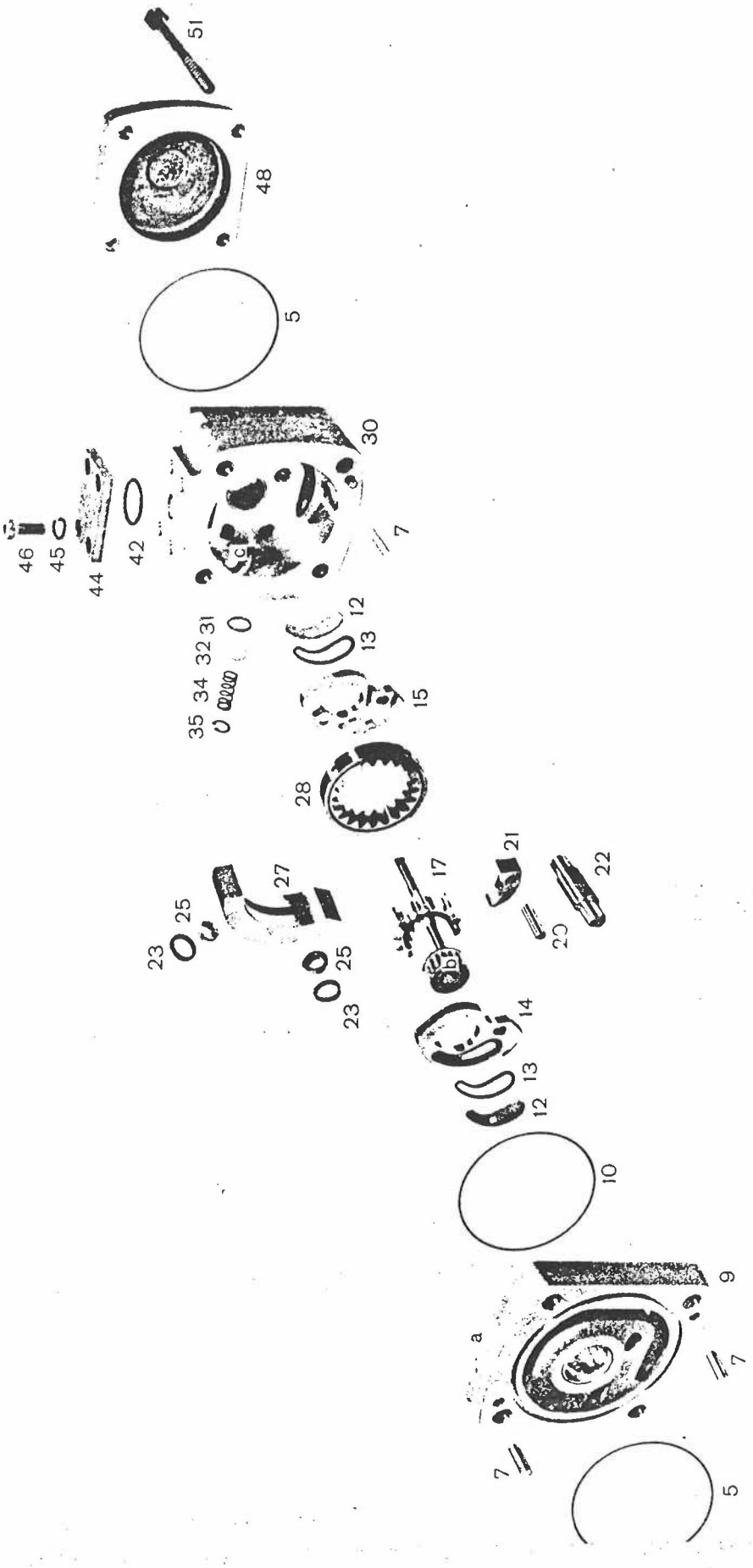
4. Installation of the pump

Direction of rotation of pump and drive must conform (note marking on the pump). Under no circumstances must force be applied when fitting coupling element (use the thread provided in the pump shaft). Fill the pump with oil from the intake side before installing. Briefly switch on and off the plant before test running (re-check direction of rotation with electromotors). In order to bleed the plant, allow the pump to run briefly at zero pressure. Adjust the pressure relief valve and lock.

Exact details relating to installation and commissioning of IPH pumps are contained in publication G 742 e.

IPH 2

Fig. 1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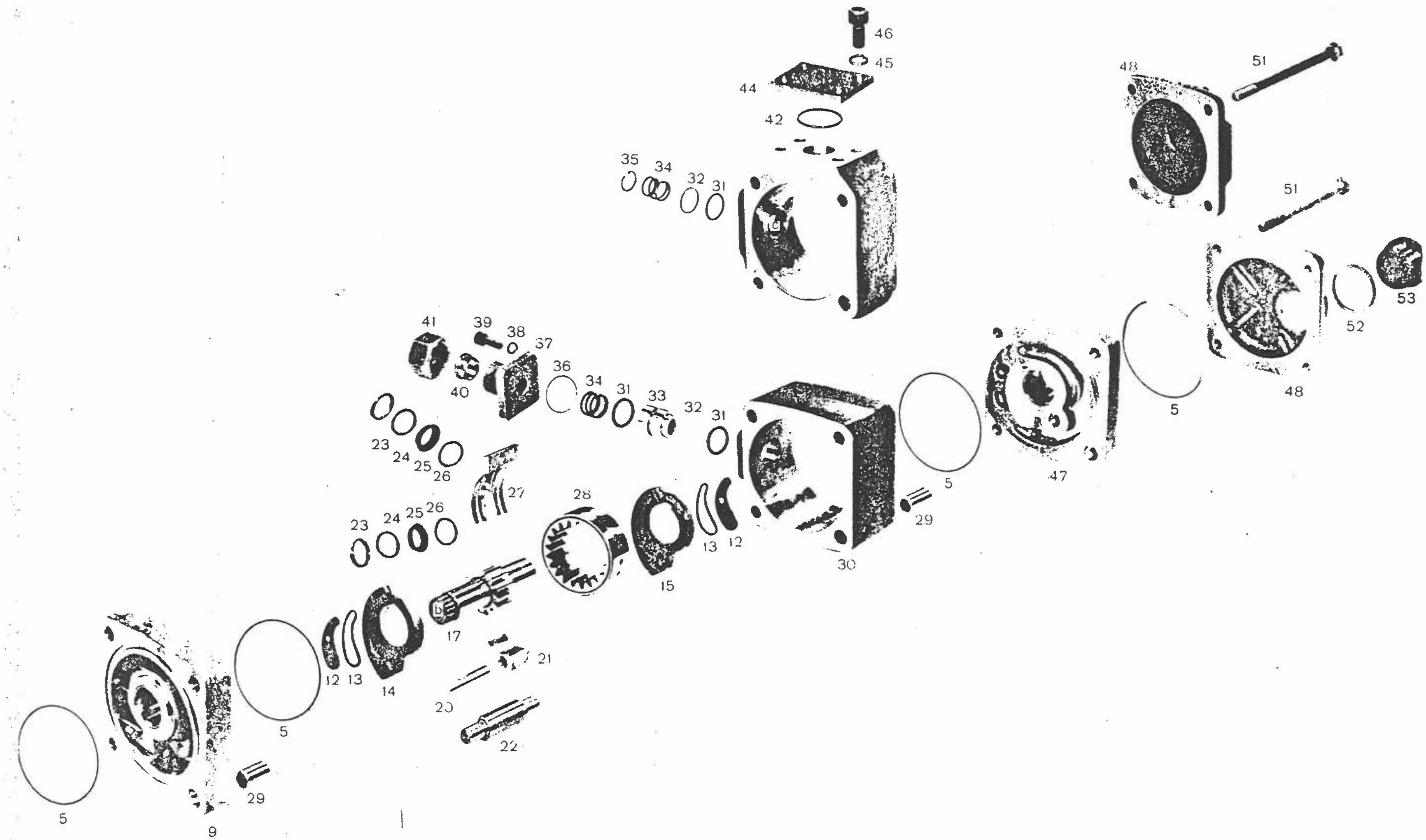

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IPH 3

Fig. 2

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Fig. 3

Fig. 4

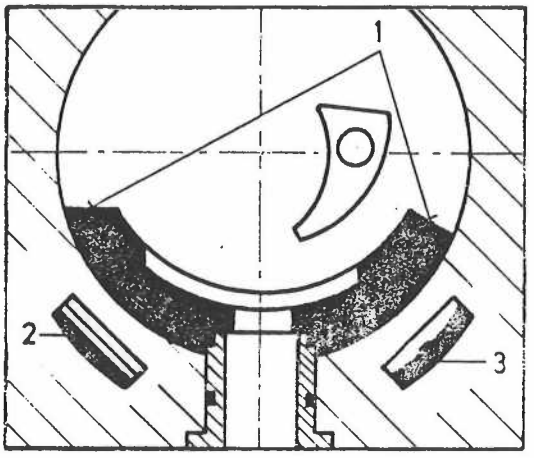
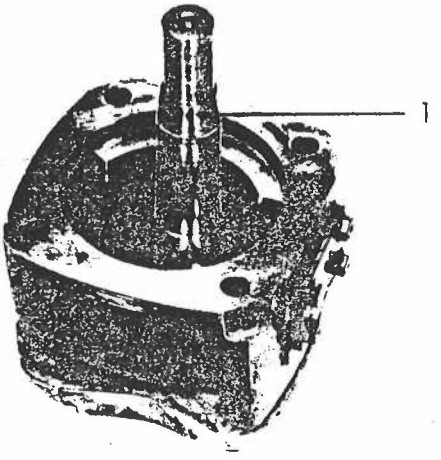
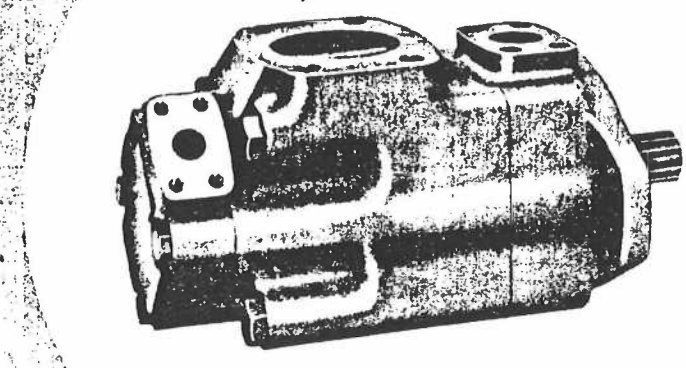


Fig. 5



Pump with clockwise direction of rotation

SPERRY VICKERS



VANE TYPE DOUBLE PUMP

SERVICE PARTS INFORMATION

2520V*****-***20(L)-282/283

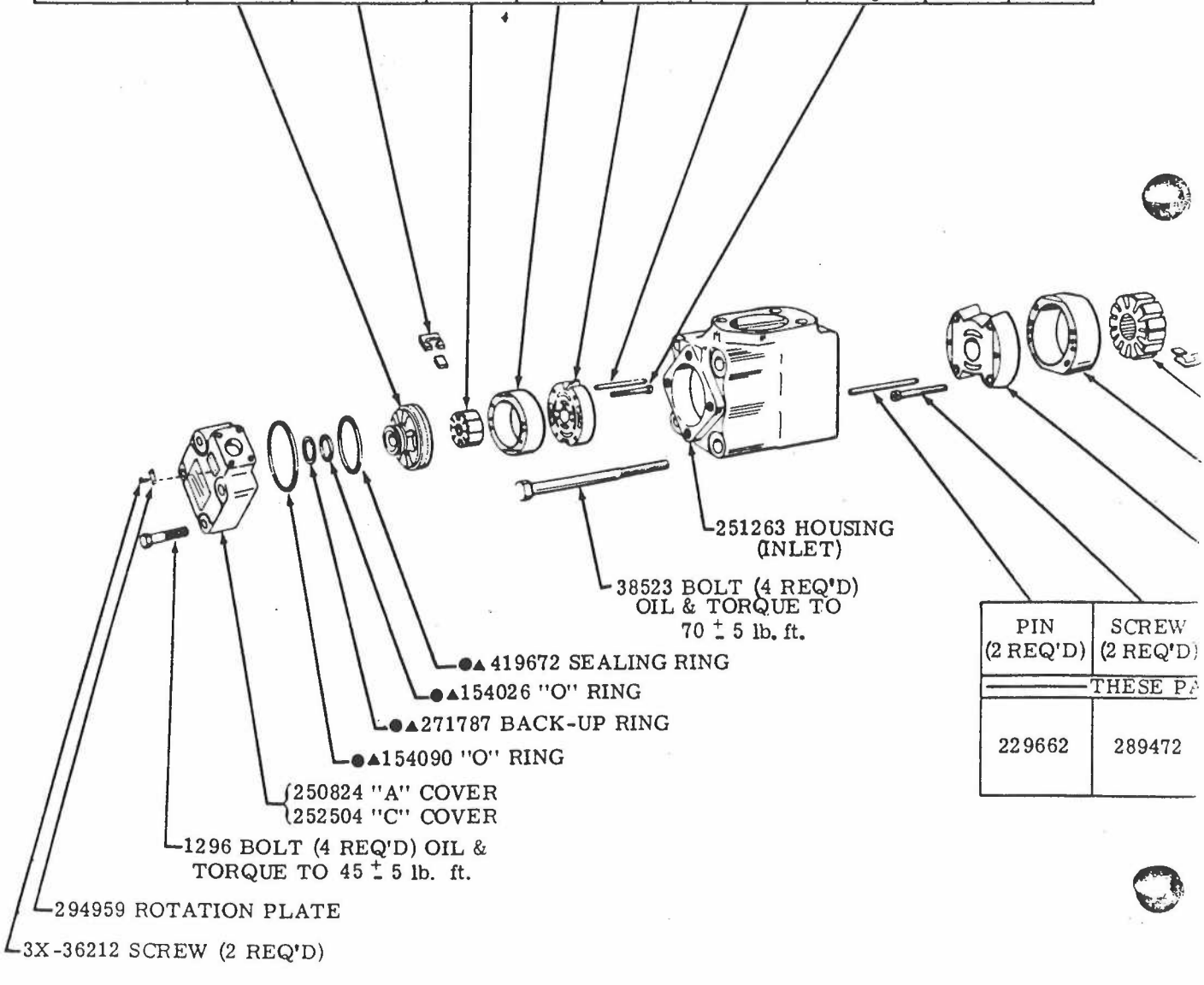
SPERRY VICKERS
TROY, MI. 48084

Released 9-1-81

I-3186-S

□ NOTE
SEALS MUST BE COMPLETELY WETTED AT TIME OF ASSEMBLY WITH AN SAE 10W MOTOR OIL OF "SE" QUALITY OR AN INDUSTRIAL HYDRAULIC OIL EQUIVALENT. ASSEMBLE SEAL WITH LIP TOWARD THE BEARING.

CAPACITY COVER END PUMP (GPM)	OUTLET PLATE	VANE KIT (10 VANES & INSERTS)	ROTOR	RING	INLET PLATE	PIN (2 REQ'D)	SCREW (2 REQ'D)	CART. KIT	F3 CART. KIT
	THESE PARTS ARE INCLUDED IN CARTRIDGE KIT								
2520V****2	584382	922741	402690	388683	584384	158465	289473	585478	588573
2520V****5				333624				585471	588574
2520V****8				333625				585473	588575
2520V****11		922743	403539	333626	584385			585475	588576
2520V****12				353901				585476	588577
2520V****14				353902				585477	588578



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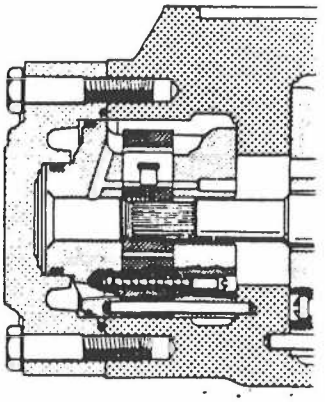

PIN (2 REQ'D)	SCREW (2 REQ'D)	CART. KIT	F3 CART. KIT
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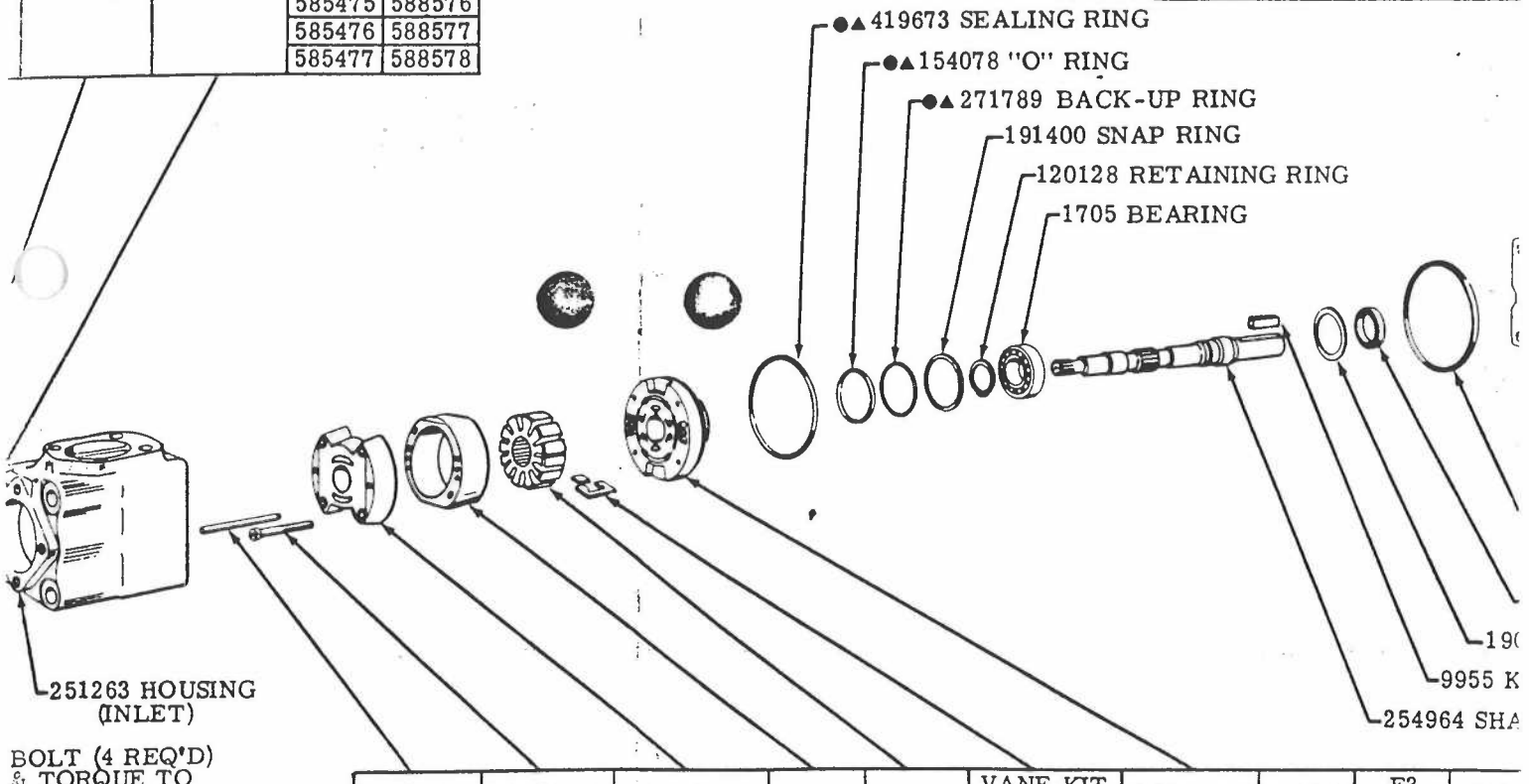
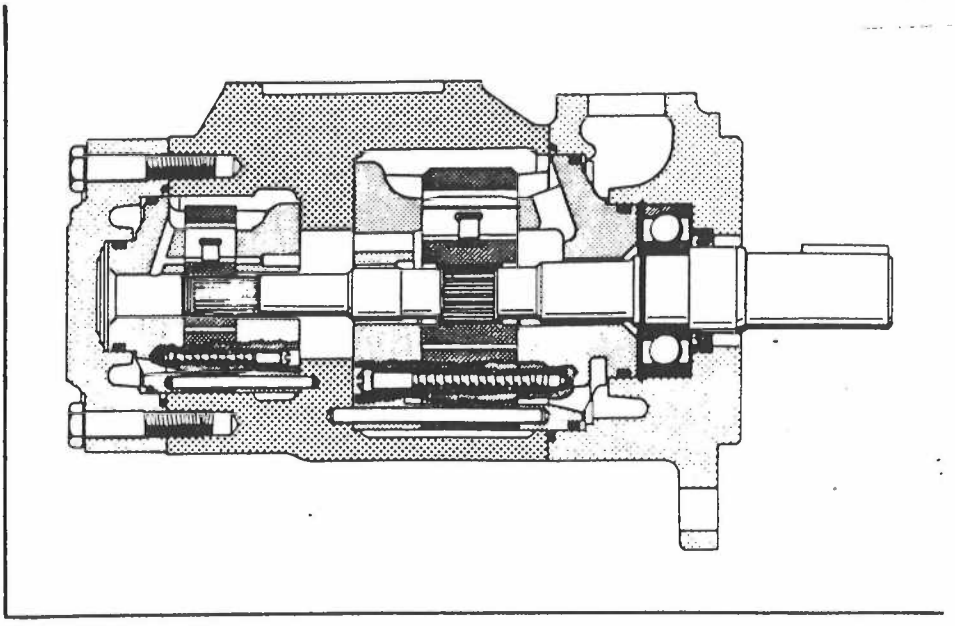
		585471	588574
		585473	588575
		585475	588576
		585476	588577
		585477	588578

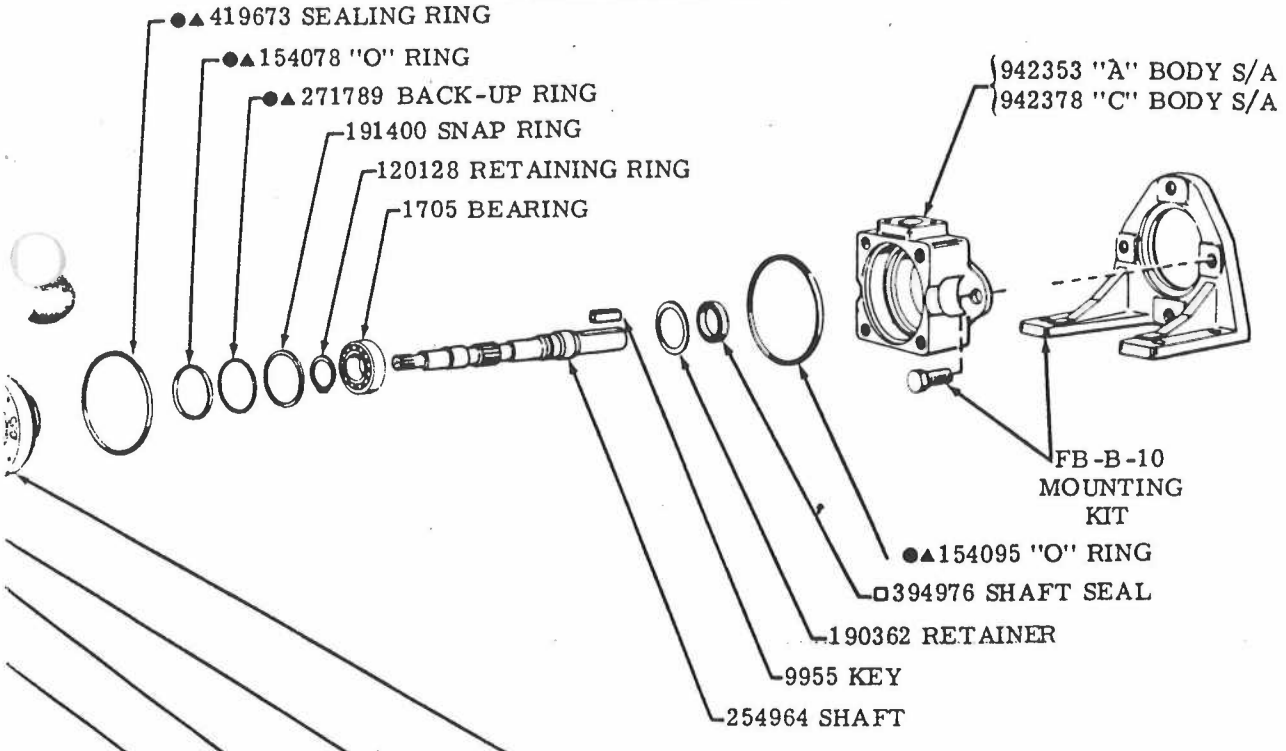


PIN (2 REQ'D)	SCREW (2 REQ'D)	INLET PLATE S/A	RING	ROTOR	VANE KIT (12 VANES & INSERTS)	OUTLET PLATE	CART KIT	F3 CART KIT	CAP SHA PUM
THESE PARTS ARE INCLUDED IN CARTRIDGE KIT									
229662	289472	591016	584610	584618	941214	588690	591002	591095	25
			584612				591003	591096	252
			584614				591004	591097	252
			584616				591005	591098	252

CAUTION

INDIVIDUAL CARTRIDGE PARTS ARE NOT INTERCHANGE. WITH SIMILIAR PARTS OF THE PREVIOUS DESIGN. COMP CARTRIDGES ARE INTERCHANGEABLE WITH THE PREV DESIGN.





LET TE S/A	RING	ROTOR	VANE KIT (12 VANES & INSERTS)	OUTLET PLATE	CART KIT	F3 CART KIT	CAPACITY SHAFT END PUMP (GPM)
ARE INCLUDED IN CARTRIDGE KIT							
1016	584610	584618	941214	588690	591002	591095	2520V12
	584612				591003	591096	2520V14
	584614				591004	591097	2520V17
	584616				591005	591098	2520V21

▲INCLUDED IN 922856 SEAL KIT

F3 EQUIVALENT SEAL KIT 919303

●ALSO INCLUDED IN CARTRIDGE KIT

SEE PARTS DRAWING I-3963-S FOR PORT FLANGE DATA

CAUTION

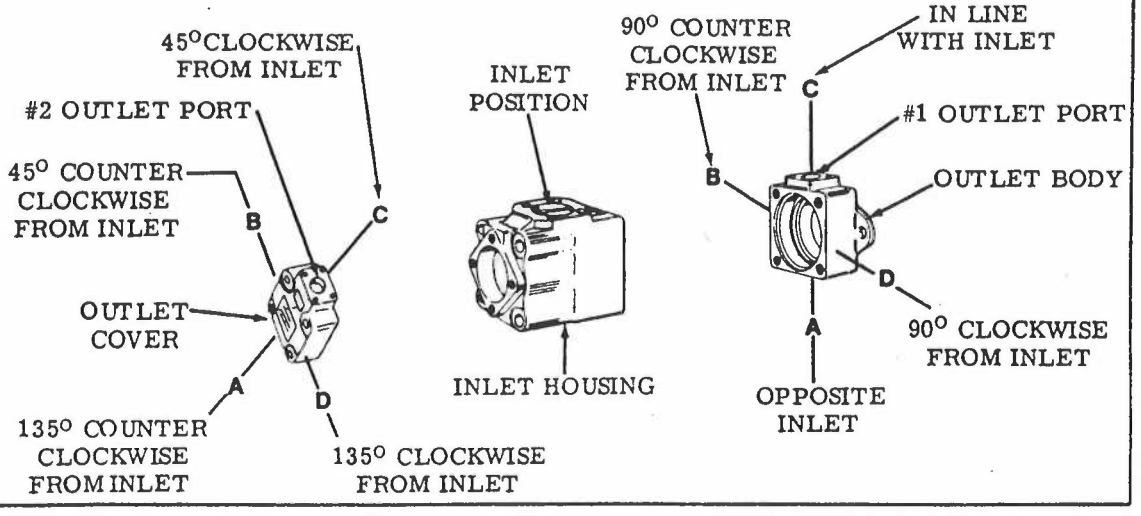
INDIVIDUAL CARTRIDGE PARTS ARE NOT INTERCHANGEABLE WITH SIMILIAR PARTS OF THE PREVIOUS DESIGN. COMPLETE CARTRIDGES ARE INTERCHANGEABLE WITH THE PREVIOUS DESIGN.

MODEL CODE BREAKDOWN

F3 · 2520 V ** A* (*) · 1 ** 20 (L) · 28*

- VITON SEALS (OMIT IF NOT REQUIRED)
- SERIES
- VANE TYPE
- CAPACITY - SHAFT END PUMP (RATING AT 1200 RPM-100 PSI)
- PORT CONNECTIONS
  A - SAE 4-BOLT FLANGE
  C - SAE STRAIGHT THD.
- CAPACITY - COVER END PUMP (RATING AT 1200 RPM - 100 PSI)
- SHAFT
  1 - STRAIGHT WITH SQUARE KEY STD.
- #1 OUTLET PORT POSITION
- #2 OUTLET PORT POSITION
- DESIGN
- ROTATION (VIEWED FROM SHAFT END)
  L - LEFT HAND (C'CLOCKWISE)
  OMITTED-RIGHT HAND
- 282 - SAE 2 BOLT MTG.
  283 - FOOT MTG.

OUTLET PORT POSITIONS
VIEWED FROM COVER END



PARTS ORDERING

PARTS ARE THE SAME FOR BOTH RIGHT AND LEFT HAND ROTATION. WHEN ORDERING SPARE CARTRIDGE PARTS, IT IS RECOMMENDED THEY BE OBTAINED IN CARTRIDGE KITS. KITS ARE ASSEMBLED AND TESTED BY SPERRY VICKERS FOR EITHER RIGHT OR LEFT HAND ROTATION. IF LEFT HAND ROTATION IS REQUIRED, IT SHOULD BE SPECIFIED ON PARTS ORDER BY ADDING SUFFIX "L" TO CARTRIDGE KIT NUMBER: EXAMPLE, 591002-L.

nsure sustained efficiency and maximum trouble-free life of this precision equipment, initial and continuous ration of the fluid medium to 35 microns absolute or less is essential. (For information pertaining to Sperry Vickers economical filters, see bulletin 81-216.)

Litho in U. S. A.

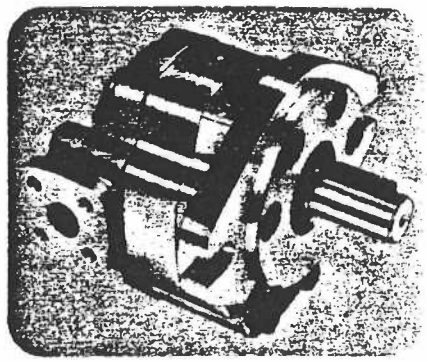
High pressure gear pumps

G5, 20 design single and multiple pumps;
GPC4, 30 design single and multiple pumps and
GPCT4, 30 design through-drive pumps

Characteristics

Displacements
G5 pumps ..... 5,1 to 25,0 cm^3/r per section
GPC(T)4 pumps .... 21,0 to 65,6 cm^3/r per section
Speeds ..... 400 to 4000 r/min
Pressures ..... up to 250 bar

Contents



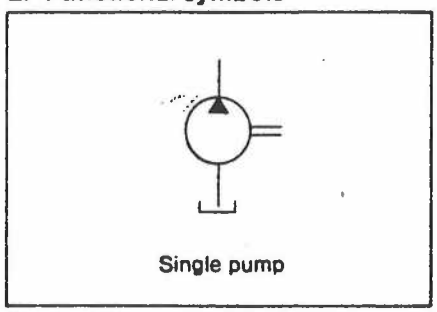
1. General description

These high pressure fixed displacement external gear pumps achieve high efficiencies by virture of pressure compensation of axial and radial clearances. Simple sandwich construction ensures consistent high quality production and operational reliability.

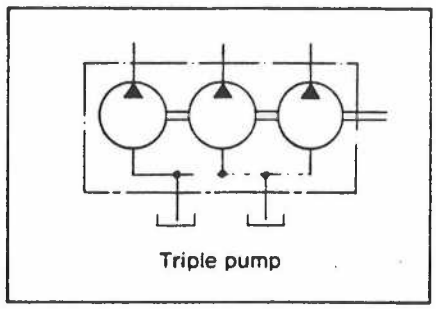
G5 and GPC4 models can be in single or multiple versions. GPCT4 through-drive models have rear ends accepting suitable single or multiple pumps (gear, vane or piston designs) to form multiple pumps of up to four sections.

Optional features include:
- Rectangular or SAE mounting flanges.
- Keyed cylindrical, splined or tapered shafts.
- Flanged or G threaded (BSPF) ports for G5 models. SAE or square flange options for GPC (T) 4 models
- Clockwise or anticlockwise rotation to order.

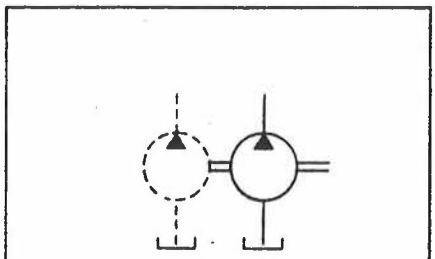
2. Functional symbols



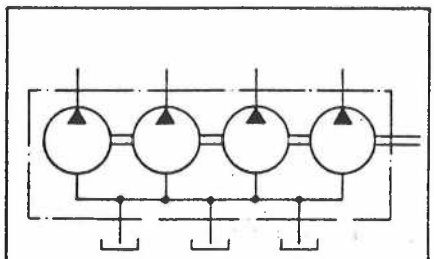
Single pump



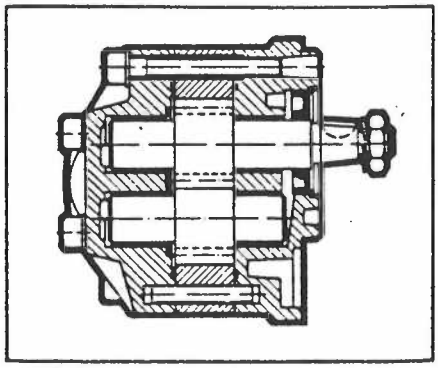
Triple pump

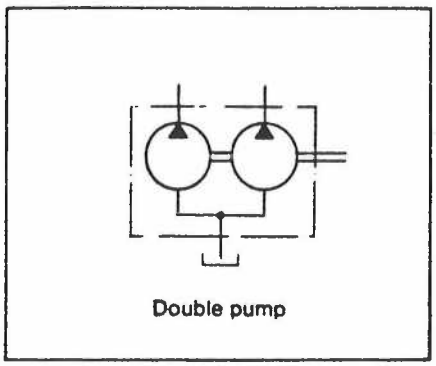


Through-drive pump



Quadruple pump





Double pump

Technical Information GB-V-205

3. Model code

G5 pumps

G5- (-* *)(-* *)(-* *)**
1 2 3 4

-* ** * -20 *
5 6 7 8 9

1 Geometric displacement
Single pump or largest displacement section (shaft end) of multiple pumps

5 = 5,1 cm³/r	12 = 12,6 cm³/r
6 = 6,4 cm³/r	16 = 15,9 cm³/r
8 = 8,1 cm³/r	20 = 19,9 cm³/r
10 = 10,0 cm³/r	25 = 25,0 cm³/r

2 Geometric displacments
3 Successive sections of multiple
4 pumps. Displacment of each section to be equal or less than that of the previous section. Displacment range as in 1
Omit for single pumps and as appropriate for double and triple pumps.

5 Mounting flange
A = SAE "A" 2-hole oval (ISO 3019/1)
F = Rectangular flange, small ø spigot
H = Rectangular flange, large ø spigot

6 Shaft end

Code	Shaft type	Usage with mounting flange
9	Tapered	With type "F"
10	Tapered	Option with type "H"
13	Cylindrical	Option with type "A"
14	Splined (DIN 5480)	Option with type "H". Also used with type "A" for fitment to GPCT4 pumps; See second page of "Installation dimensions" section
15	Splined (SAE "A")	Option with type "A"

7 Port types

Code	Type	Usage with pump mounting flange
For single pumps:		
F	Flanged	With type "H" or option with type "F"
R	Tapped	With type "A" or option with type "F"
For multiple pumps:		
F	Flanged	With type "H" or option with type "F"
R	Flanged inlet, tapped outlet	With type "A" or option with type "F"

8 Design number
Subject to change. Installation dimensions unaltered for design numbers 20 to 29 inclusive.

9 Direction of shaft rotation
(Viewed at shaft end)
R = Right hand (clockwise)
L = Left hand (anti-clockwise)

GPC4 and GPCT4 pumps

GPC(T)4- (-* *)(-* *)(-* *)**
1 2 3 4 5

-* ** F* (*)-30*
6 7 8 9 10 11

1 Through-drive option
For single pumps only.
Omit for standard single pumps and all multiple pumps.

2 Geometric displacment
Single pump or largest displacement section (shaft end) of multiple pumps

20 = 21,0 cm³/r	40 = 42,0 cm³/r
25 = 26,2 cm³/r	50 = 52,5 cm³/r
32 = 32,8 cm³/r	63 = 65,6 cm³/r

3 Geometric displacements
4 Successive sections of multiple
5 pumps. Displacement of each section to be equal or less than that of the previous section.
Displacement range as in 2

Omit for single pumps and as appropriate for double and triple pumps.

6 Mounting flange
B = SAE "B" 2-hole oval and 4-hole square combined (ISO 3019/1)
C = SAE "C" 2-hole oval and 4-hole square combined (ISO 3019/1)
H = Rectangular flange

7 Input shaft end

Code	Shaft type	Usage with mounting flange
1	Cylindrical (SAE "B")	Option with type "B"
2	Cylindrical (SAE "C")	Option with type "C"
6	Splined (SAE "B")	Option with type "B"
7	Splined (SAE "C")	Option with type "C"
12	Tapered	With type "H"

8 Flanged port combinations, 4-bolt type

Code	Type	Pump Type	Pump Mounting flange
F1	SAE	Single	"B" & "C"
F3	Non-SAE	Single	"H"
F4	SAE	Multiple	"B" & "C"
F5	SAE inlet non-SAE outlet	Multiple	"H"

9 Rear mounting pad (GPCT4 pumps)
A = SAE "A", 2-hole oval flange
B = SAE "B", 2 and 4-hole flanges
Omit for GPC4 pumps.

10 Design number
Subject to change. Installation dimensions unaltered for design numbers 30 to 39 inclusive

11 Direction of shaft rotation
(Viewed at input shaft end)
R = Clockwise
L = Anti-clockwise

For port flange kits
Consult your Sperry Vickers representative

For rear-end shaft couplings (GPCT4 pumps)
See "Mounting information" on final page.

4. Operating data

● Pressure limits

Inlet port(s)

Min. continuous	−0,2 bar
Min. intermittent	−0,35 bar
Max.	+2,0 bar

Outlet port(s)
Max. pressure

G5-5	200 bar
G5-6 to 16 inclusive	250 bar
G5-20	200 bar
G5-25	160 bar
GPC(T)4-20 to 40 inclusive	250 bar
GPC(T)4-50	230 bar
GPC(T)4-63	200 bar

Note: For all pumps, check that shaft loadings for individual applications do not exceed the limits given in section "Drive shaft rotation and load limits" three pages on.

● Speed limits

Model	Speed limits (r/min) at max. pressure	
	Max.▲	Min.△
G5-5	4000	900
G5-6	4000	1000
G5-8	4000	1000
G5-10	4000	900
G5-12	3600	900
G5-16	3300	900
G5-20	3100	750
G5-25	2800	600
GPC(T)4-20	3300	900
GPC(T)4-25	3300	900
GPC(T)4-32	3150	900
GPC(T)4-40	3000	900
GPC(T)4-50	2700	800
GPC(T)4-63	2500	700

▲Max. speed for a multiple pump is the lowest of the max. speeds for its constituent sections

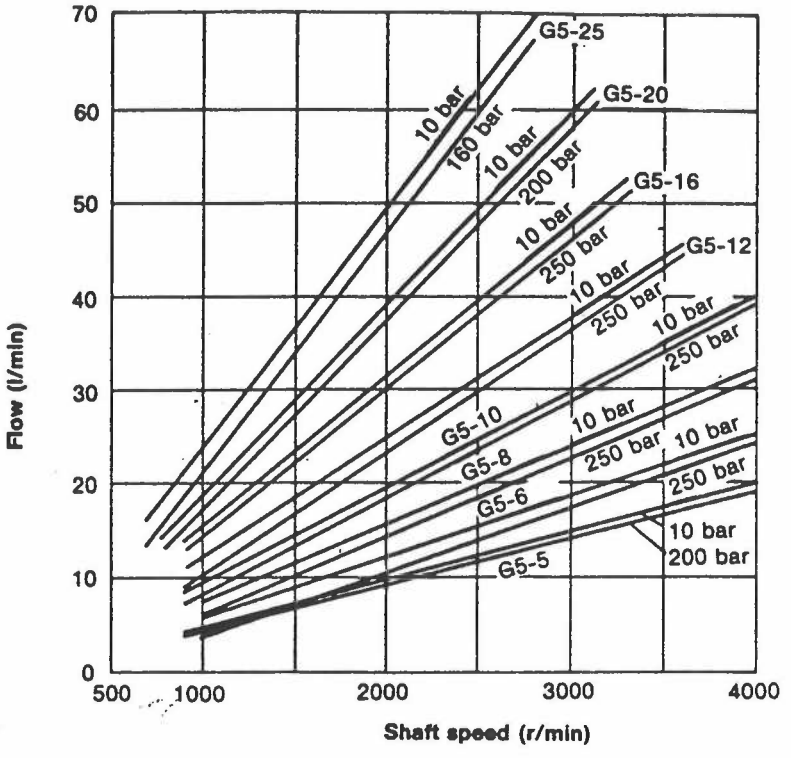
△Min. speed for a multiple pump is the highest of the min. speeds for its constituent sections

* See "Pressure limits, outlet port(s)" above

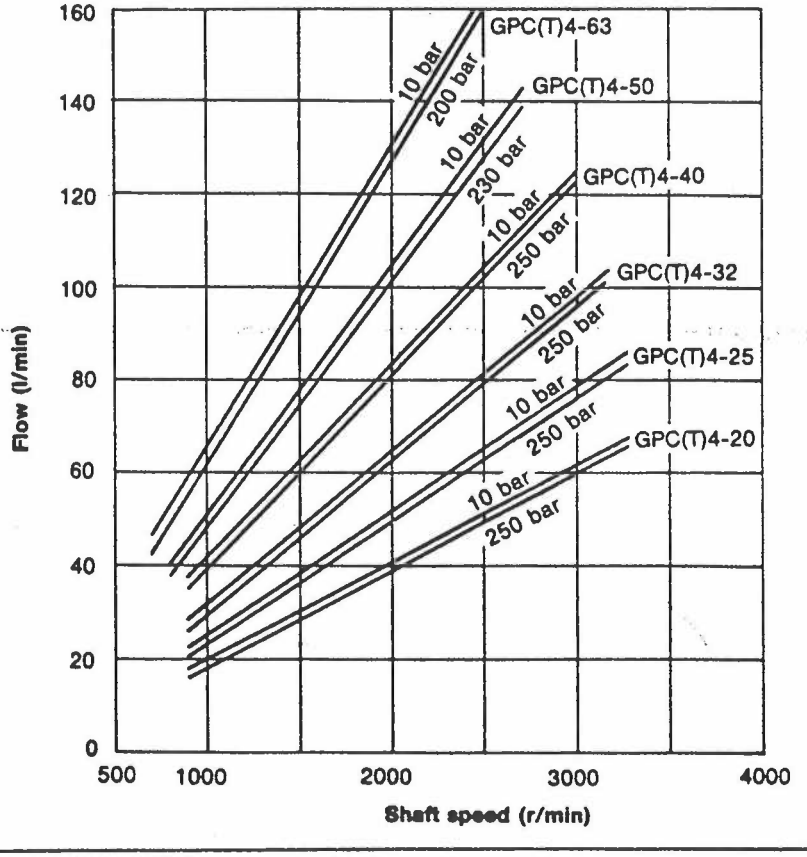
● Performance data
Typical with mineral oil at 36 cSt

Effective flow/shaft speed

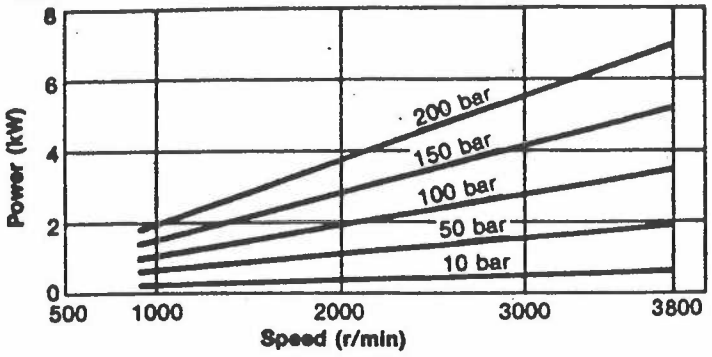
G5 pumps



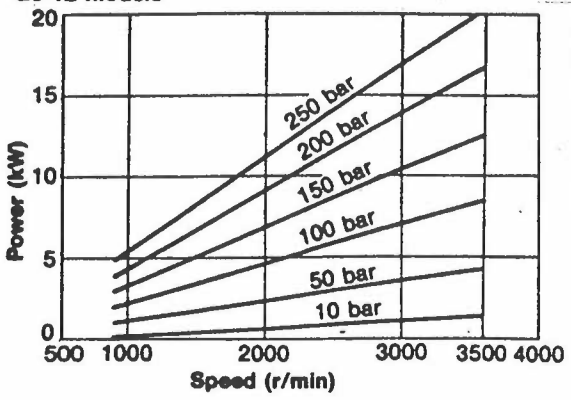
GPC(T)4 pumps



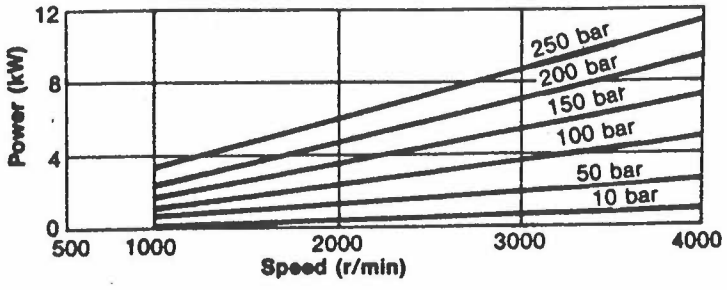
G5-5 models



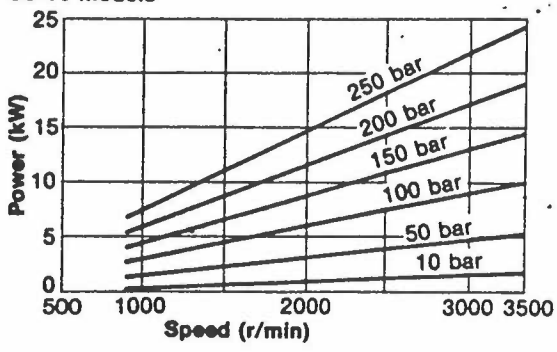
G5-12 models



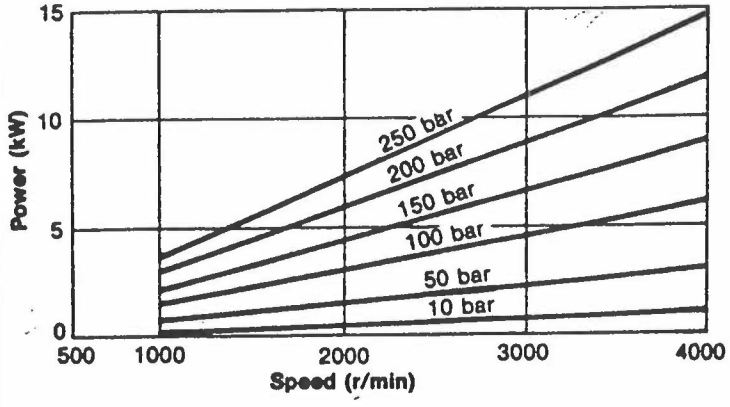
G5-6 models



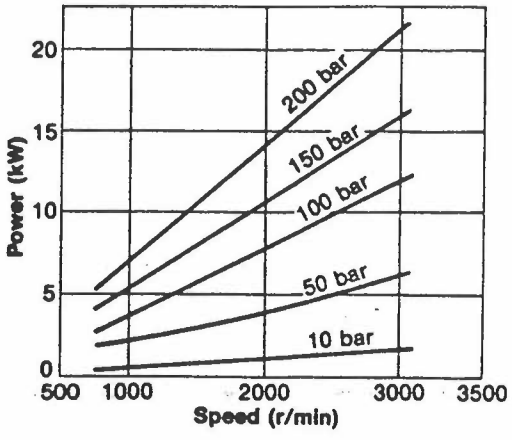
G5-16 models



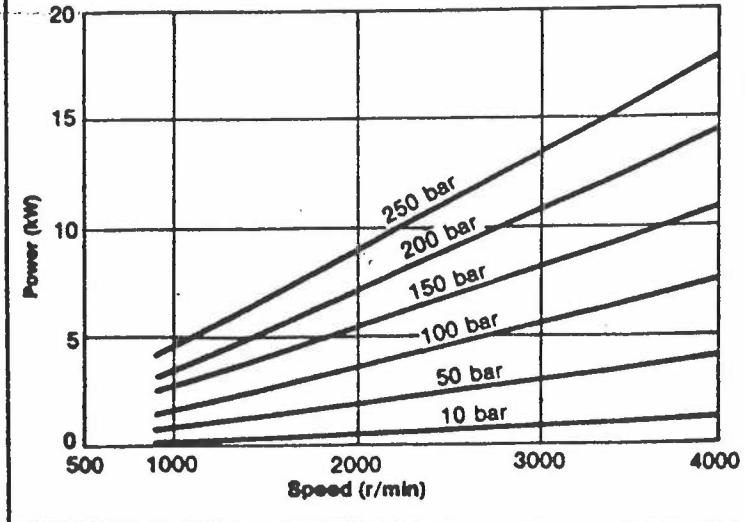
G5-8 models



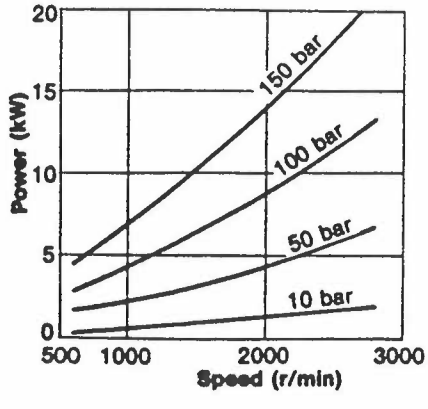
G5-20 models



G5-10 models

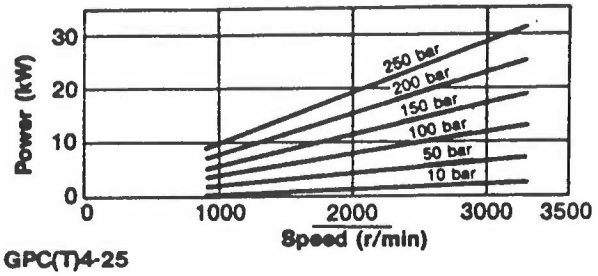


G5-25 models

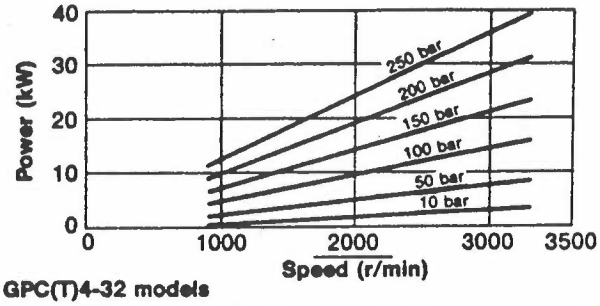


Input power/shaft speed
GPC(T)4 pumps

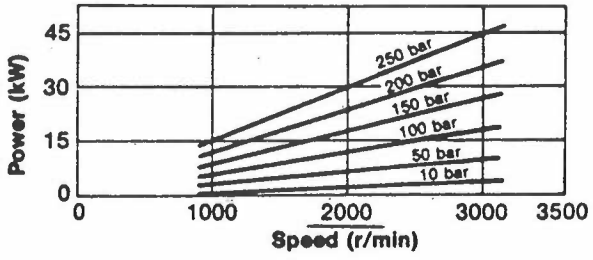
GPC(T)4-20 models



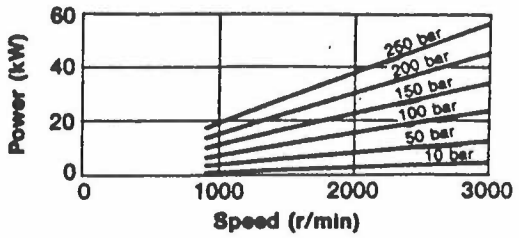
GPC(T)4-25



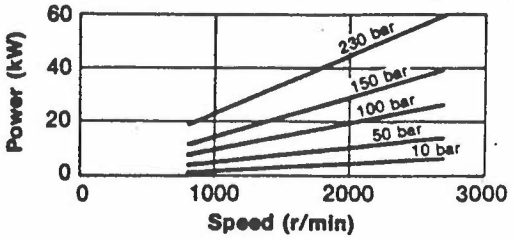
GPC(T)4-32 models



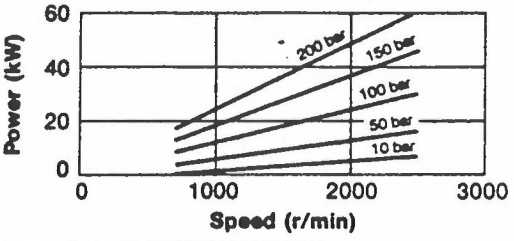
GPC(T)4-40 models



GPC(T)4-50 models



GPC(T)4-63 models



● Noise levels

Typical values measured at 210 bar and 1500 r/min with oil at 32 cSt and 42°C

Pump	dB(A)
G5-16	65
GPC4-20	67

● Hydraulic fluids

Antiwear hydraulic oils. For further information about these oils see data sheet GB-V-920, related to industrial usage, or GB-V-930 for mobile applications.

The extreme operating viscosity range is from 750 to 7 cSt for all pumps except the G5-5 for which the minimum is 10 cSt. The recommended running range for all pumps is from 40 to 20 cSt.

Consult your Sperry Vickers representative if fire-resistant fluids are to be used because they may necessitate some changes to the performance limits.

● Temperature limits

Ambient

Min. ..... −20°C
Max. ..... +80°C

Fluid

Max. continuous ..... +95°C
Max. intermittent ..... +110°C

Note: Viscosities at these temperatures must stay within the limits specified in the "Hydraulic fluids" section.

● Filtration requirements

25 µm absolute or finer.

● Drive shaft rotation and load limits

Rotation

Clockwise or anticlockwise (viewed at the shaft end) to order.

Torque loading G5 and GPC4 models

For all pumps—singles and multiples check that shaft loadings for each application do not exceed the limits in the following table where

p_1, p_2, p_3 & p_4 = Max. pressure (bar) of section (referenced from the shaft end) for the application.

V_1, V_2, V_3 & V_4 = Displacement (cm^3/r) of section (referenced from the shaft end) for the application.

Basic model	Shaft type	Max. total shaft load: Check for all models that: $p_1 \cdot V_1 + p_2 \cdot V_2 + p_3 \cdot V_3 + p_4 \cdot V_4$	Additional check for triple and quadruple models that: $p_2 \cdot V_2 + p_3 \cdot V_3 + p_4 \cdot V_4$
G5	10 & 13	$\leq 0{,}8 \times 10^4$	$\leq 0{,}4 \times 10^4$
	15	$\leq 0{,}34 \times 10^4$	
	14	$\leq 0{,}8 \times 10^4$	
GPC4	1	$\leq 2{,}15 \times 10^4$	$\leq 1{,}15 \times 10^4$
	6	$\leq 1{,}55 \times 10^4$	
	2,7 & 12	$\leq 2{,}3 \times 10^4$	

Torque loading GPCT4 through-drive models

The above checks apply also to GPCT4 models and their rear pumps. The additional check applies to all sections of the rear pump, $p_2 \cdot V_2$, $p_3 \cdot V_3$ and $p_4 \cdot V_4$ applying to the shaft end section and any successive sections respectively.

Drive arrangement

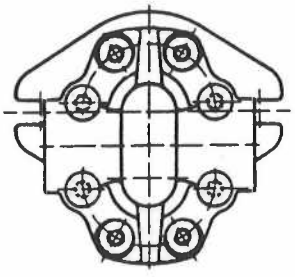
Direct drive through a flexible coupling is preferred. If an indirect drive is required, consult your Sperry Vickers representative.

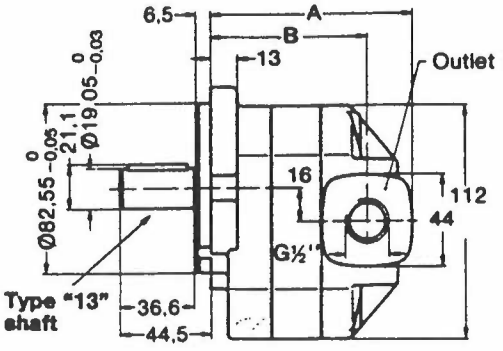
5. Installation dimensions

In mm unless otherwise indicated

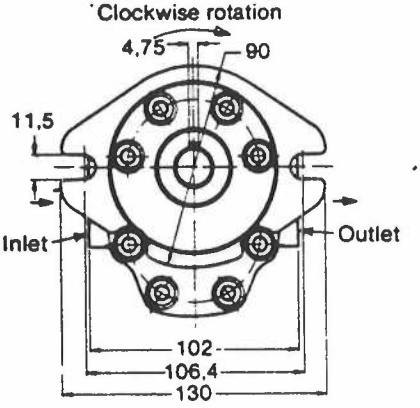
1st angle projection

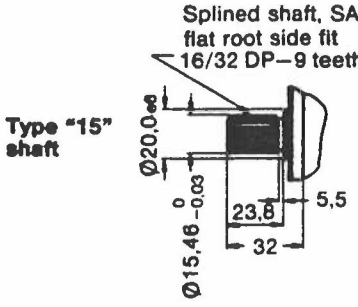
G5--A**R single pumps, SAE "A" oval mounting flange models**

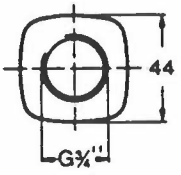




For anti-clockwise rotation the inlet and outlet port locations are interchanged



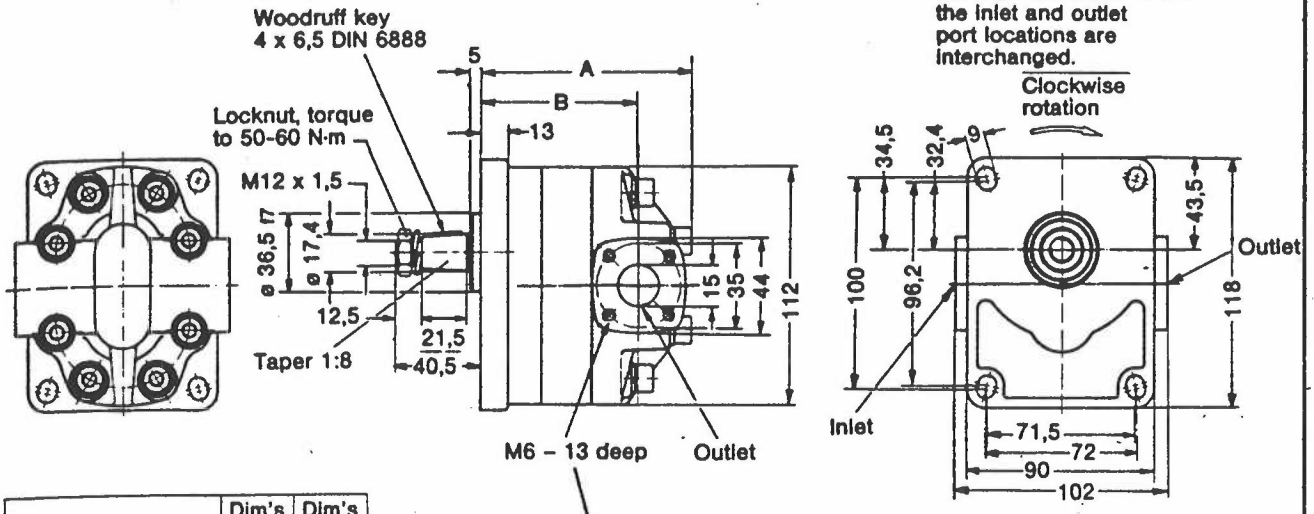




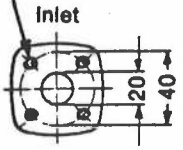
Inlet coaxial with outlet

G5-**-F9 single pumps, rectangular mounting flange (small ø spigot) models

1st angle projection



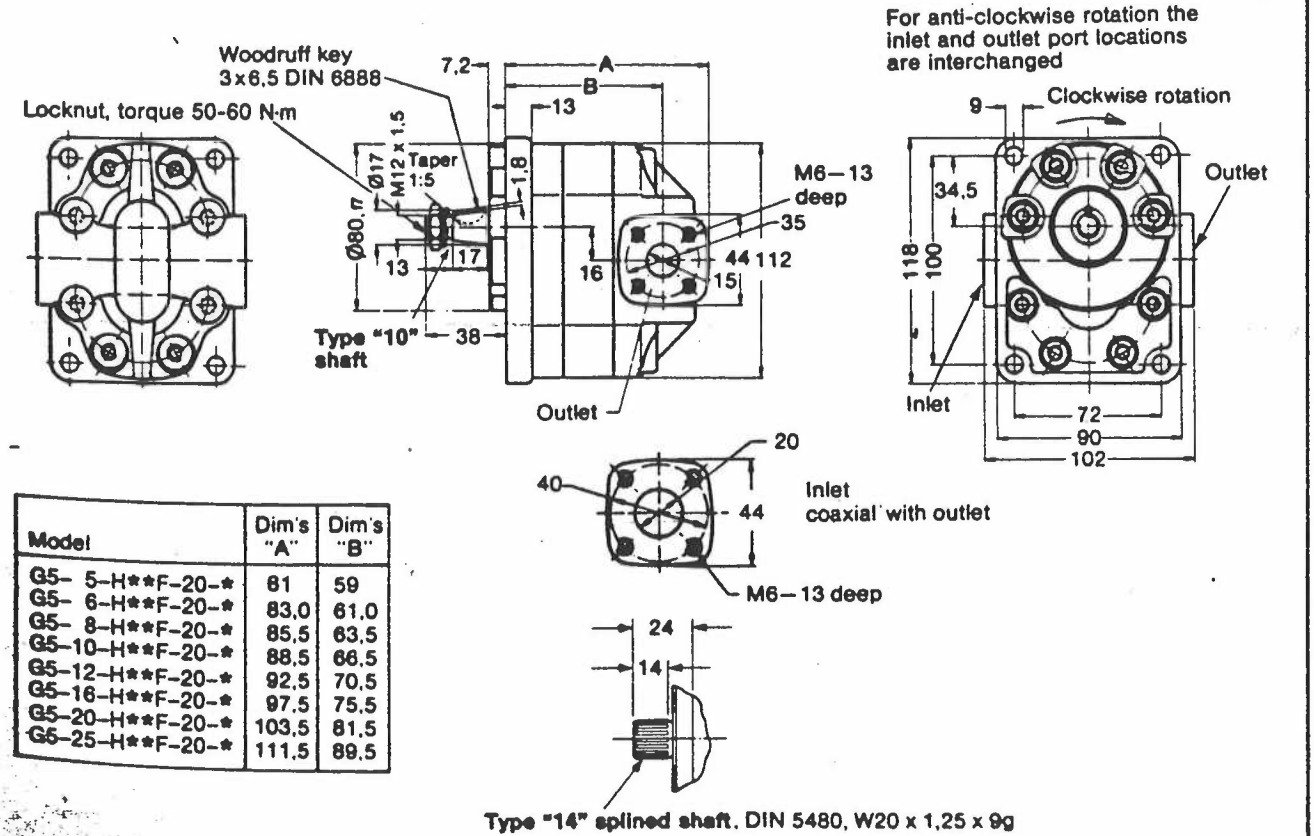
Model	Dim's "A"	Dim's "B"
G5- 5-F9*-20-*	84	59,0
G5- 6-F9*-20-*	86	61,0
G5- 8-F9*-20-*	88,5	63,5
G5-10-F9*-20-*	91,5	66,5
G5-12-F9*-20-*	95,5	70,5
G5-16-F9*-20-*	100,5	75,5
G5-20-F9*-20-*	106,5	81,5
G5-25-F9*-20-*	114,5	89,5



G5--F9F models, flanged ports**

G5--F9R models, tapped ports**
As flanged port models but without M6 tapped holes. Ports tapped centrally:
Inlet = G¾"
Outlet = G½"

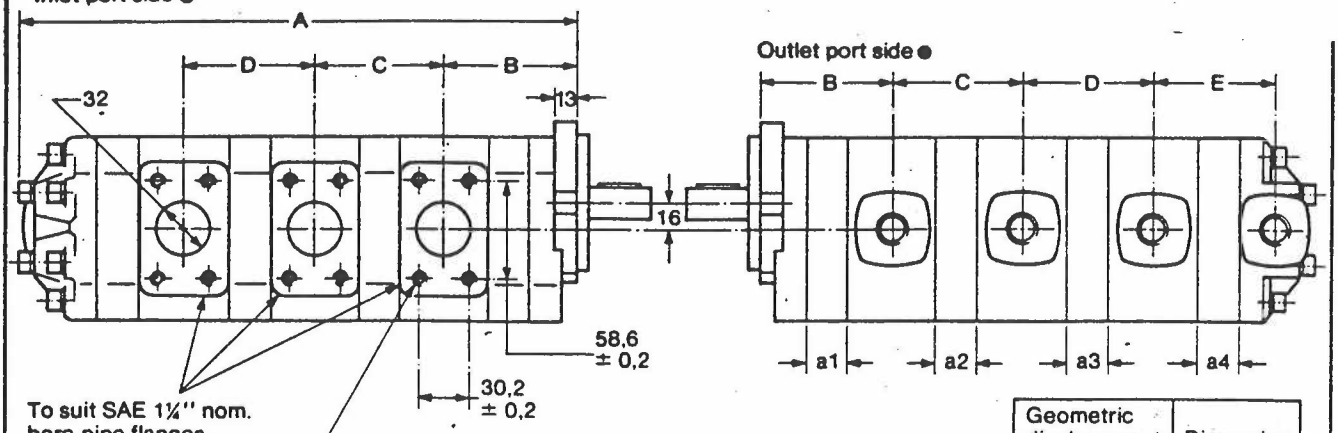
G5-**-H**F single pumps, rectangular mounting flange models (large ø spigot)



Model	Dim's "A"	Dim's "B"
G5- 5-H**F-20-*	81	59
G5- 6-H**F-20-*	83,0	61,0
G5- 8-H**F-20-*	85,5	63,5
G5-10-H**F-20-*	88,5	66,5
G5-12-H**F-20-*	92,5	70,5
G5-16-H**F-20-*	97,5	75,5
G5-20-H**F-20-*	103,5	81,5
G5-25-H**F-20-*	111,5	89,5

Type "14" splined shaft, DIN 5480, W20 x 1,25 x 9g

G5 multiple pumps, all models



To suit SAE 1¼" nom. bore pipe flanges. All inlet ports must be connected, in parallel, to the reservoir.

M10 x 20 min. full thread depth, four holes per port

● For clockwise rotation pumps. Interchanged on anti-clockwise rotation models

Multiple pump arrangement	Models	Dimension A▲	B▲	C▲	D▲	E*
Double	G5-*-A G5-*-H	127+a1+a2	56+a1	–	–	49+a2
	G5-*-F	130+a1+a2				
Triple	G5-*-A	184+a1+a2+a3		54+a2	–	49+a3
Quadruple	G5-*-H	238+a1+a2+a3+a4			54+a3	49+a4

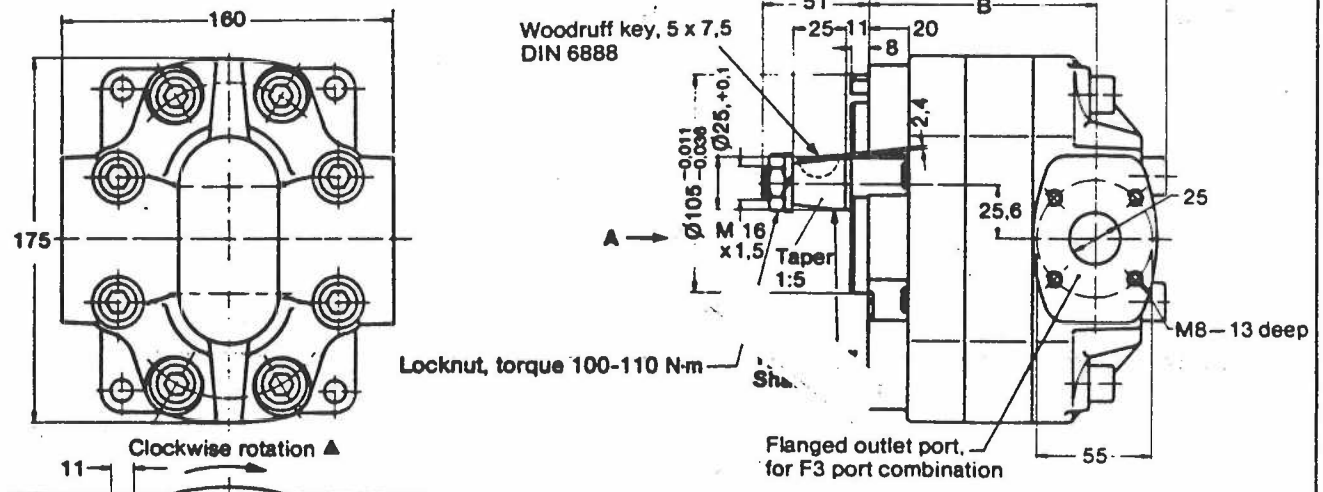
▲ Along inlet and outlet port sides. Inlet ports are one fewer in number than outlets.

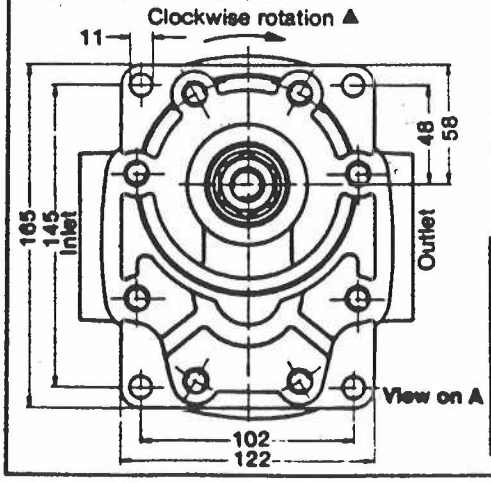
* Along outlet port side only.

Geometric displacement ref. See "Model code"	Dimension a1, a2, a3 or a4 (mm)
5	8,0
6	10,0
8	12,5
10	15,5
12	19,5
16	24,5
20	30,5
25	38,5

All other dimensions and mounting flange, outlet port and shaft end options as for single pumps. See the two previous pages.

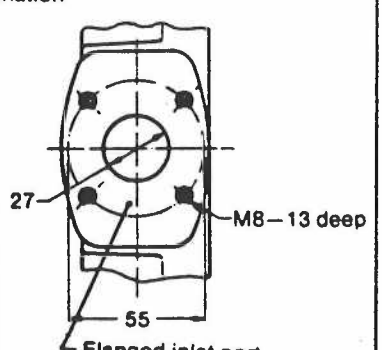
GPC4-**-H12F3 single pumps, rectangular mounting flange models



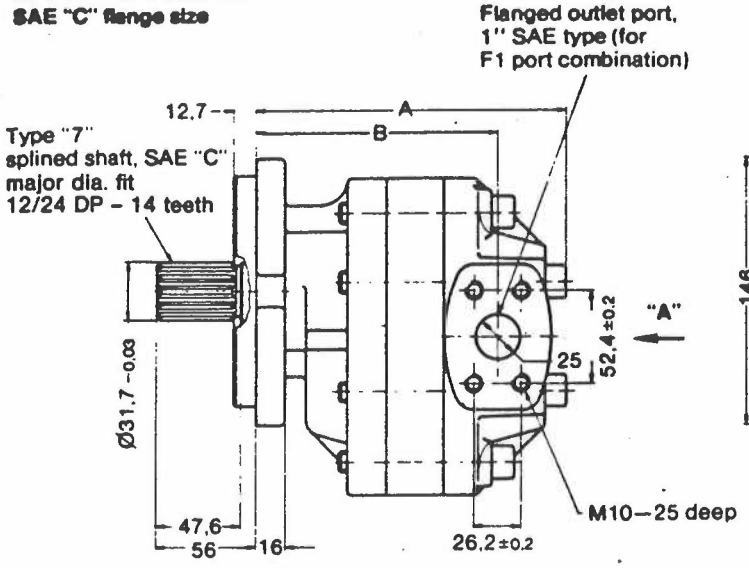


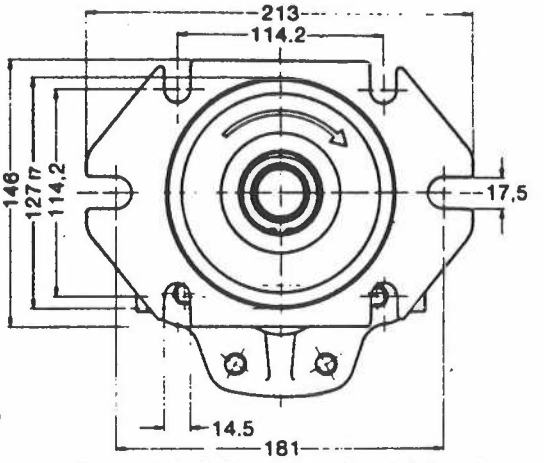
▲ For anticlockwise rotation the inlet and outlet port locations are interchanged

Model	Dim's "A"	Dim's "B"
GPC 4–20–H 12 F3 –30–*	130	93
GPC 4–25–H 12 F3 –30–*	134	97
GPC 4–32–H 12 F3 –30–*	139	102
GPC 4–40–H 12 F3 –30–*	146	109
GPC 4–50–H 12 F3 –30–*	154	117
GPC 4–63–H 12 F3 –30–*	164	127

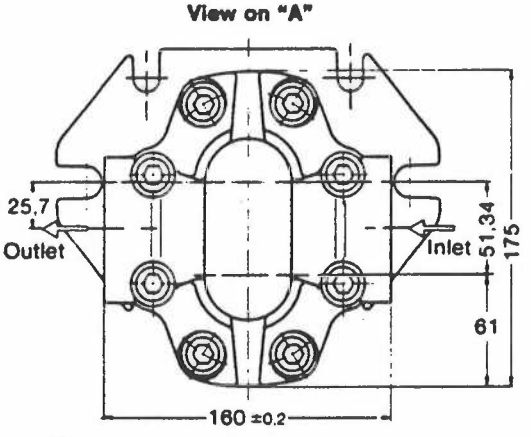


GPC4--C*F1 models**
SAE "C" flange size





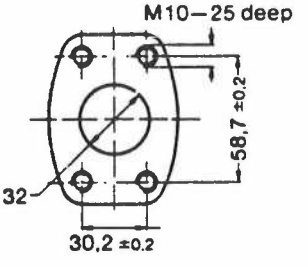
For anticlockwise rotation the inlet and outlet port locations are interchanged.



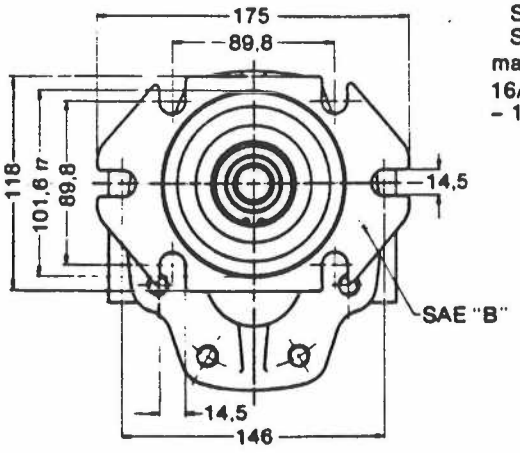
Dimensions also applicable to SAE "B" flange models

Model	Dim's "A"	Dim's "B"
GPC 4–20–**F1–30–*	157	119
GPC 4–25–**F1–30–*	161	123
GPC 4–32–**F1–30–*	166	128
GPC 4–40–**F1–30–*	173	135
GPC 4–50–**F1–30–*	181	143
GPC 4–63–**F1–30–*	191	153

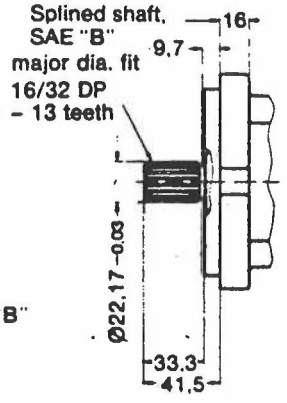
Flanged inlet port, 1¼" SAE type (for F1 port combination) coaxial with outlet



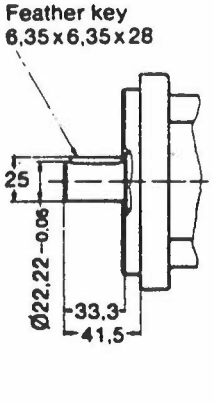
GPC4--B*F1 models**
SAE "B" flange size



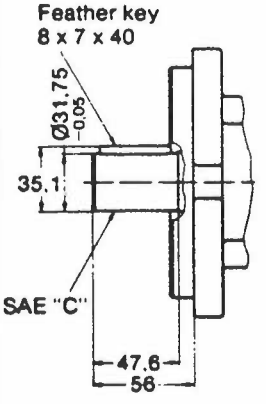
Other dimensions as for SAE "C" size models above



Type "6" shaft

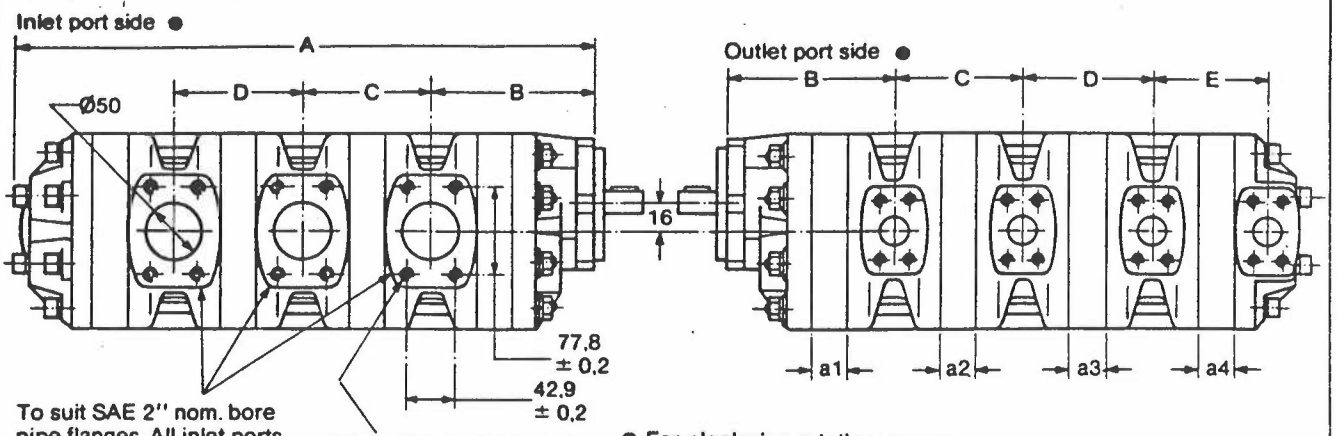


Type "1" shaft



Type "2" shaft

GPC4 multiple pumps, all models



To suit SAE 2" nom. bore pipe flanges. All inlet ports must be connected, in parallel, to the reservoir

M12 x 22 min. full thread depth, four holes per port.

● For clockwise rotation pumps. Interchanged on anti-clockwise rotation models

Multiple pump arrangement	Mounting flange	Dimension				
		A▲	B▲	C▲	D▲	E*
Double (outlet)	S.A.E.	220+a1+a2	113,5+a1	—	—	70+a2
	Rectangular	194+a1+a2	87 +a1			
Triple (outlet)	S.A.E.	300+a1+a2+a3	113,5+a1	80+a2	—	70+a3
	Rectangular	274+a1+a2+a3	87 +a1			
Quadruple (outlet)	S.A.E.	380+a1+a2+a3+a4	113,5+a1		80+a3	70+a4
	Rectangular	354+a1+a2+a3+a4	87 +a1			

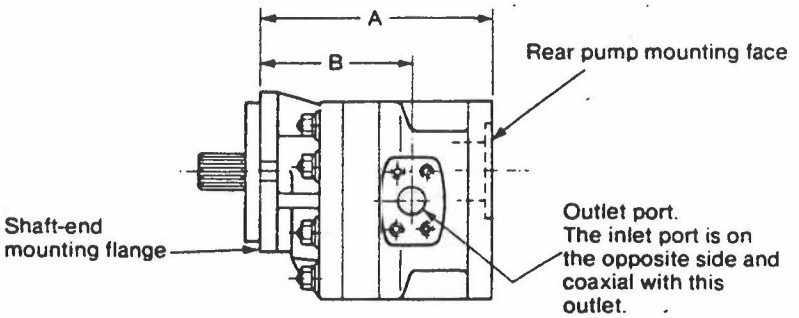
▲ Along outlet and inlet port sides. Inlet ports are one fewer in number than outlets.

* Along outlet port side only.

Geometric displacement ref. See "Model code"	Dimension a1, a2, a3 or a4 (mm)
20	16
25	20
32	25
40	32
50	40
63	50

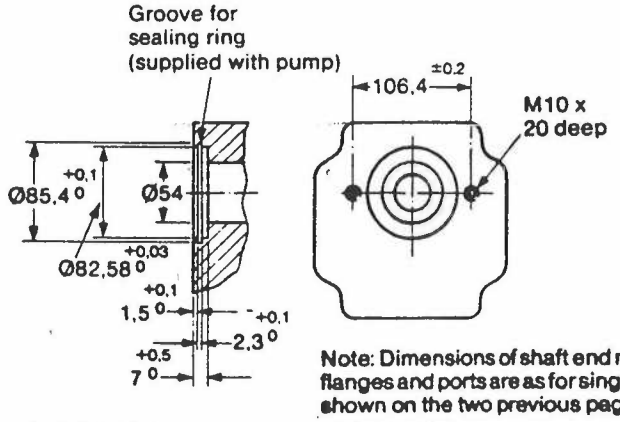
All other dimensions and mounting flange, outlet port and shaft end options as for single pumps. See the two previous pages.

GPCT4 through-drive models

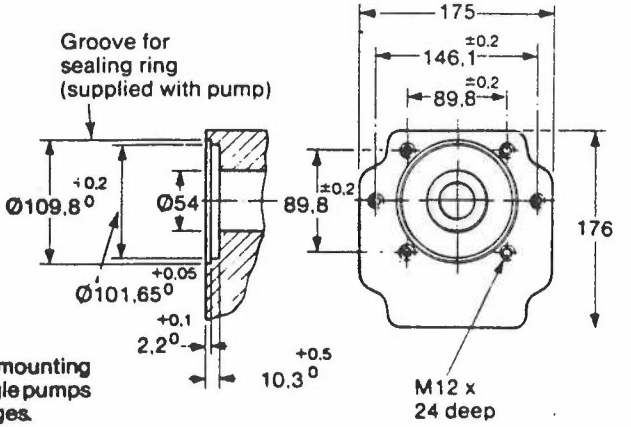


Model	Shaft-end mounting flange			
	SAE		Rectangular	
	A	B	A	B
GPCT4-20	194	119	168	93
GPCT4-25	198	123	172	97
GPCT4-32	203	128	177	102
GPCT4-40	210	135	184	109
GPCT4-50	218	143	192	117
GPCT4-63	228	153	202	127

GPCT4-**-***F*A models
Rear pump mounting, SAE "A" size



GPCT4-**-***F*B models
Rear pump mounting, SAE "B" size



Note: Dimensions of shaft end mounting flanges and ports are as for single pumps shown on the two previous pages.

6. Mass, approx.

Single pumps

Model	kg
G5-5	1,9
G5-6	2,0
G5-8	2,1
G5-10	2,2
G5-12	2,3
G5-16	2,4
G5-20	2,5
G5-25	2,7
GPC4-20-C	8,3
GPC4-25-C	8,6
GPC4-32-C	9,0
GPC4-40-C	9,4
GPC4-50-C	9,7
GPC4-63-C	10,2

Note:
For GPC4-**-B models, subtract 0,5 kg
For GPC4-**-H models, subtract 1,5 kg
For GPCT4-**-C models, add 2,7 kg
For GPCT4-**-B models, add 2,2 kg
For GPCT4-**-H models, add 1,2 kg
(GPCT4 masses include tail-end pump shaft coupling)

Multiple pumps

(Note: In all cases, for "ax" factors see table.)

Model	kg
G5 series	
Double pumps	2,45 + a1 + a2
Triple pumps	3,60 + a1 + a2 + a3
Quadruple pumps	4,80 + a1 + a2 + a3 + a4
GPC4--**(-**-**)-C series**	
Double pumps	7,5 + a1 + a2
Triple pumps	10,5 + a1 + a2 + a3
Quadruple pumps	13,5 + a1 + a2 + a3 + a4

Note:
For GPC4-**-**(-**-**)-B models, subtract 0,5 kg
For GPC4-**-**(-**-**)-H models, subtract 1,5 kg

GPCT4 series

Currently, these comprise a GPCT4 shaft-end single pump plus a G5 or GPC4 single, double or triple tail-end pump, or a PVE 19 or 21 variable displacement piston pump.

Masses for GPCT4, GPC4 and G5 sections can be summed from the appropriate values listed above. For PVE19 or 21 tail-end pumps, see separate leaflet GB-MV-302.

"ax" factors for multiple pumps
Sequence starts at shaft-end section (a1)

Basic model	Geometric displacement ref.	Mass (kg) a1 shaft-end section	Mass (kg) a2, a3 or a4 section
G5	5	0,46	0,45
	6	0,56	0,50
	8	0,63	0,55
	10	0,71	0,65
	12	0,82	0,75
	16	0,92	0,90
	20	1,11	1,10
	25	1,30	1,15
GPC4	20	3,20	2,6
	25	3,50	2,9
	32	3,85	3,15
	40	4,30	3,55
	50	4,65	3,95
	63	5,15	4,40

7. Mounting information

G5 and GPC4 models

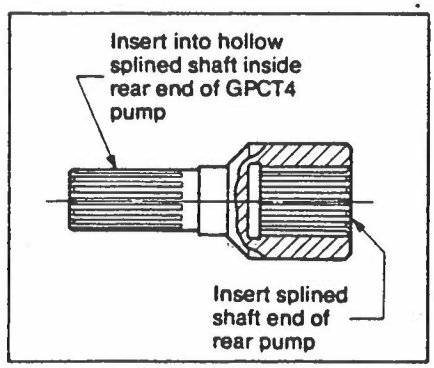
Mounting attitude unrestricted.

GPCT4 models

These through-drive pumps have rear ends designed for direct assembly to suitable single or multiple pumps having SAE "A" 2-hole or SAE "B" (or "BB"), 2 or 4-hole mounting flanges.

Because the GPCT4's inlet port is open to the rear coupling area, any pump mounted to it must be capable of sealing this by the sealing ring (supplied with the GPCT4 pump) and the rear end pump. If the rear mounting pad is capped instead of used to mount a pump, it must be sealed to prevent fluid leakage and ingress of air.

Shaft connection is made by appropriate couplings as illustrated below:



Typical rear-end pumps and sh couplings are:

Model	SAE mount-ing flange	Shaft coupling
G5-** (-**-**) –A14 single, double or triple gear pump. See first three pages of "Installation dimensions" section.	A	C4-14
GPC4-** (-**-**) – B6 single, double or triple gear pump. See the three previous pages.	B	C4-6
PVE 19 or 21 variable displacement piston pump. See leaflet GB-MV-302	B	C4-22

Other pumps having SAE "A" or "B" mounting flanges may be used dependent on drive torque limits (see the fifth page), masses and suitable splined drive shafts. Consult your Sperry Vickers representative.

The GPCT4 pump itself is not restricted as to mounting attitude but when assembled to a rear pump any restrictions will be as for the latter.

8. Ordering procedure

General

Pumps and port flanges must be ordered as, and are supplied as separate items. Ask your Sperry Vickers representative for details of available port flange options.

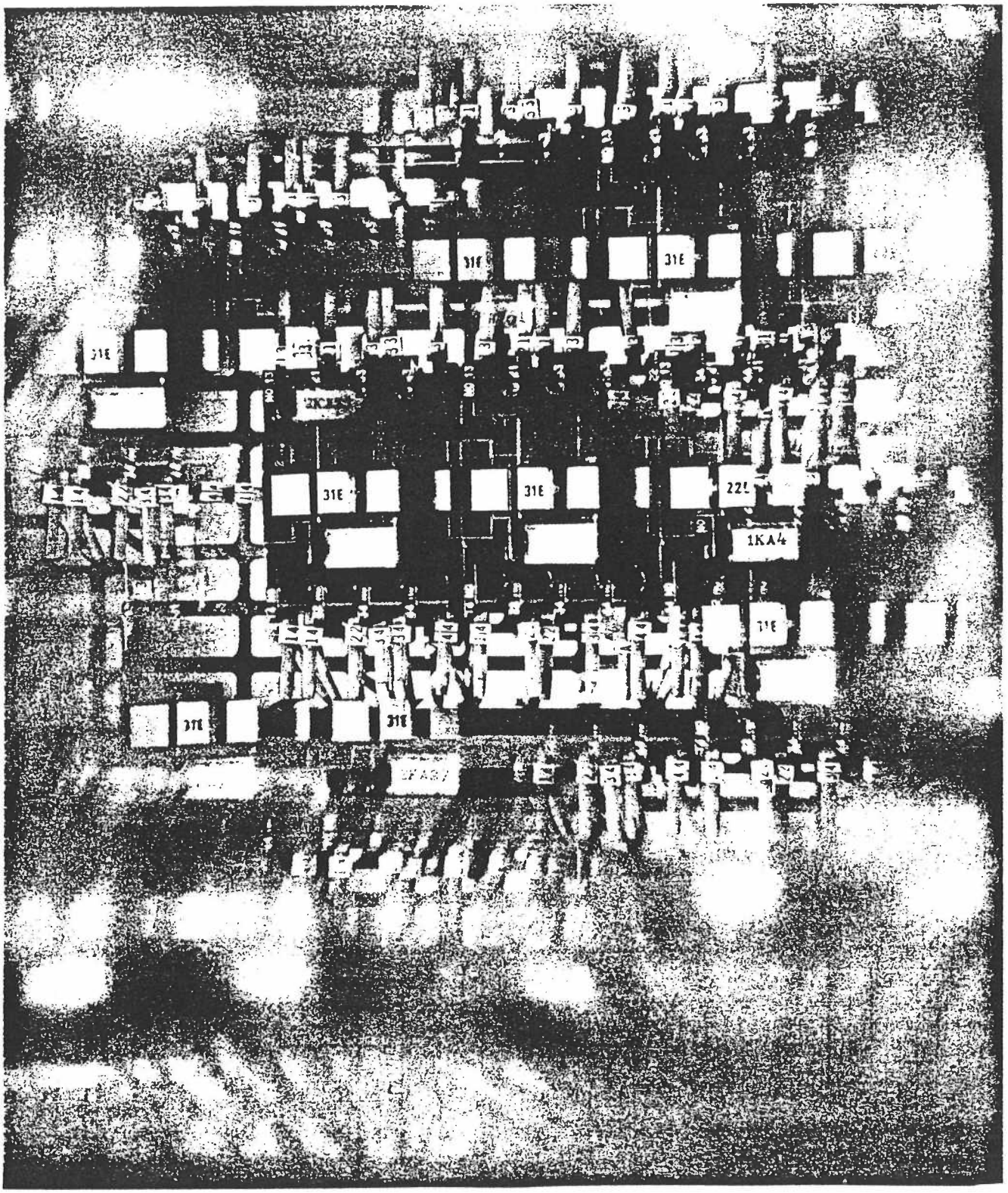
Please state full model designations and quantities required when ordering items.

Through-drive pump combinations

In addition to ordering the GPCT4 through-drive pump, the rear-end pump and any port flanges as separate items, the rear-end shaft coupling must be ordered similarly e.g.

2 off GPCT4-63-C2F1A-30R
through-drive pump
2 off G5-10-A14R-20R rear-end pump
2 off C4-14 shaft coupling

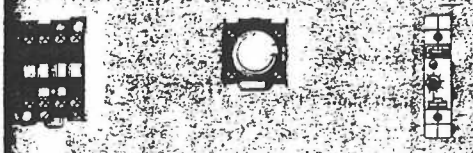
RELAYS



Control relays and timers

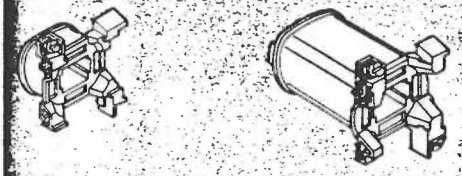
for processing using relay logic

Basic products



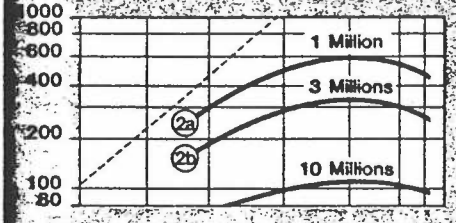
A.C. control relays
D.C. control relays
Electronic timers

Spare parts



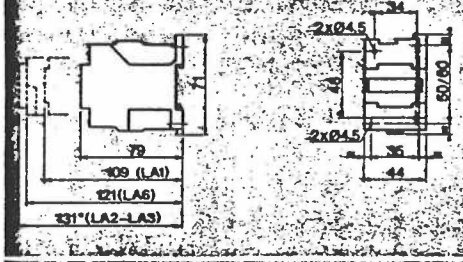
Coils

General characteristics

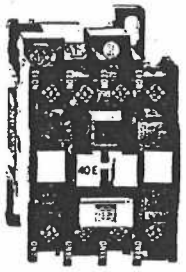


Control relays
Electronic timers

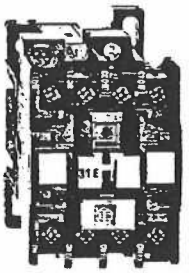
Dimensions



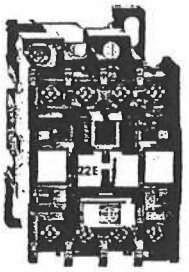
Wiring diagrams



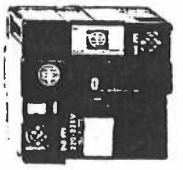
CA2-DN140●A65



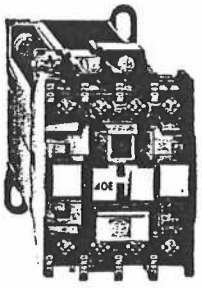
CA2-DN1319●A65



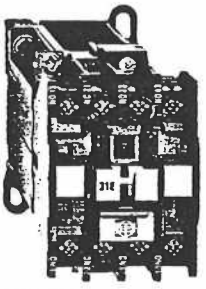
CA2-DN1229●A65



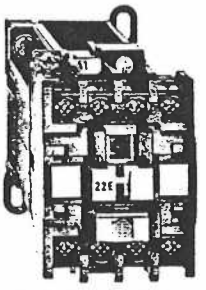
LA6-DK01●



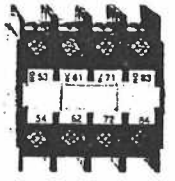
CA2-DN240●A65



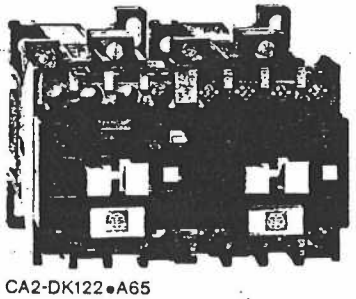
CA2-DN2319●A65



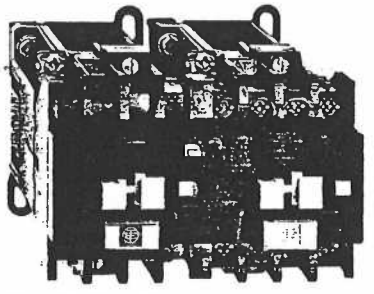
CA2-DN2229●A65



LA1-D22A65



CA2-DK122●A65



CA2-DK222●A65

LA2-D22A65

Control relays

Control circuit: a.c. or d.c.

Characteristics : see pages 121 and 122
Dimensions : see page 120
Wiring diagrams: see page 120

Control relays
– Relays fixed by clipping-on to AM1-DP 35 mm omega rail or by screw fixing.
– Terminals protected against direct finger contact.

Type	Number of contacts	Composition	Basic ref. to be completed Replace the • by the letter corresponding to the control voltage and frequency (4)	Weight kg
Control circuit: a.c. operation				
Instantaneous	4	4 N/O	**CA2-DN140•A65**	0,350
		3 N/O + 1 N/C	**CA2-DN1319•A65**	0,350
		2 N/O + 2 N/C	**CA2-DN1229•A65**	0,350
Latch/memory	4	2 N/O + 2 N/C	**CA2-DK122•A65**	0,710
Control circuit: d.c. supply without economy resistor				
Instantaneous	4	4 N/O	**CA2-DN240•A65**	0,600
		3 N/O + 1 N/C	**CA2-DN2319•A65**	0,600
		2 N/O + 2 N/C	**CA2-DN2229•A65**	0,600
Latch/memory	4	2 N/O + 2 N/C	**CA2-DK222•A65**	1,170

Mechanical latch adder block for CA2-DN

Uniatch operation	Basic reference to be completed by the control voltage letter (5)	Weight kg
Manual or electric	**LA6-DK01•**	0,070

or
auxiliary contact block (terminals protected against direct finger contact and ready to tighten screws

Type		Composition	References	Weight kg
Instantaneous		1 N/O + 1 N/C	**LA1-D11A65**	0,030
		2 N/O	**LA1-D20A65**	0,030
		2 N/C	**LA1-D02A65**	0,030
		2 N/O + 2 N/C	**LA1-D22A65**	0,050
		1 N/O + 3 N/C	**LA1-D13A65**	0,050
		4 N/O	**LA1-D40A65**	0,050
		4 N/C	**LA1-D04A65**	0,050
		2 N/O + 2 N/C (1)	**LA1-D1111A65**	0,050
(1) including 1 pair of make before break contacts		3 N/O + 1 N/C	**LA1-D31A65**	0,050
or Time delay (N/O + N/C)	On energisation	0,1 to 3 s (2)	**LA2-D20A65**	0,080
		0,1 to 30 s	**LA2-D22A65**	0,080
		1 to 30 s (3)	**LA2-D221A65**	0,080
		10 to 180 s	**LA2-D24A65**	0,080
	On de-energisation	0,1 to 3 s (2)	**LA3-D20A65**	0,080
(2) With extended scale from 0,1 to 0,6 s		0,1 to 30 s	**LA3-D22A65**	0,080
		10 to 180 s	**LA3-D24A65**	0,080

(3) With switching time of 40 ms ± 5 between the opening of the N/C contact and the closing of the N/O contact. (For star-delta starters).

(4) Standard control circuit voltages.

Volts ~ **CA2-D**	**24**	**42**	**48**	**110**	**120**	**127**	**220**	**240**	**380**	**415**	**440**	**480**	**500**	**600**	**660**
50 Hz	B	D	E	F	–	G	M	U	Q	N	N	–	S	–	Y
60 Hz	–	–	D	F	F	–	M	M	–	–	N	N	–	S	X

Volts ⎓ **CA2-D**	**12**	**24**	**36**	**48**	**60**	**72**	**110**	**125**	**220**	**240**	**250**	**440**	**600**
Standard coils	J	B	C	E	EG	EN	F	FE	M	UC	UC	R	X
Wide range coils	JW	BW	CW	DW	–	EW	FW	–	MW	–	–	–	–

(5) Standard control circuit voltages.

Volts ~ **LA6-DK**	**24**	**42**	**48**	**110**	**120**	**127**	**220**	**240**	**380**	**415**	**440**	**480**	**500**	**600**	**660**
50/60 Hz	B	D	E	F	G	G	M	U	Q	N	R	–	S	–	Y

Operating coil characteristics: see page 120

Volts ⎓ **LA6-DK**	**24**	**36**	**48**	**60**	**72**	**110**	**125**	**220**	**240**	**250**	**440**	**660**
d.c.	B	C	E	–	EN	F	G	M	U	UC	–	–

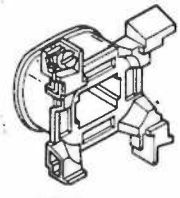
Other versions

For other control circuit voltages between 24 and 660 V 50/60 Hz or between 12 and 600 V d.c. ⎓.
Please consult our local agent or representative.

Spare parts and accessories

Coils for CA2-D control relays

A.C. operation



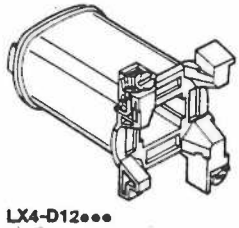
LX1-D09•••

Standard coils (consumption 50/60 Hz: Inrush 60 to 84 VA, sealed 8 VA)

Nominal voltage	Operating range Un 50 Hz (1) min	max	Un 60 Hz (1) min	max	Reference	Voltage code letter	Resistance at 20 °C	Inductance circuit closed	Weight
V	V	V	V	V			Ω ± 10%	H	kg
24	22.5	25	25	27	**LX1-D09024**	B	5.98	0.22	0.070
42	39	45	43	49	**LX1-D09042**	D	18.9	0.70	0.070
48	46	50	50	55	**LX1-D09048**	E	24.5	0.89	0.070
110/120	102	117	110	130	**LX1-D09110★**	F	122	4.68	0.070
127	118	133	131	144	**LX1-D09127**	G	176	6.24	0.070
220/240	204	230	219	244	**LX1-D09220★**	M	505	18.7	0.070
240	231	251	245	266	**LX1-D09240**	U	615	22.3	0.070
380	352	397	387	439	**LX1-D09380**	Q	1520	55.7	0.070
415	398	442	440	481	**LX1-D09415**	N	1870	68.6	0.070
500	495	517	533	600	**LX1-D09500**	S	2910	96.7	0.070
600	559	602	619	664	**LX1-D09600**	X	3610	130	0.070
660	603	665	-	-	**LX1-D09660**	Y	4620	164	0.070

(1) Operating limits: 0.85 Un min to 1.1 Un max (for a temperature ≤ + 55 °C)
★ Dual frequency as standard

D.C. operation



LX4-D12•••

Standard coils (average consumption: 8 watts)

Nominal voltage	Operating range at 55 °C max Un min (2)	Un max (2)	Reference	Voltage code letter	Resistance at 20 °C	Inductance circuit closed	Weight
V	V	V			Ω ± 10%	H	kg
12	11	13	**LX4-D12012**	J	17	0.35	0.165
24	23	26	**LX4-D12024**	B	71	1.50	0.165
36	33	37	**LX4-D12036**	C	140	2.90	0.165
48	46	51	**LX4-D12048**	E	270	5.60	0.165
60	57	63	**LX4-D12060**	EG	415	8.50	0.165
72	72	81	**LX4-D12072**	EN	665	13.50	0.165
110	106	118	**LX4-D12110**	F	1438	30	0.165
125	119	134	**LX4-D12125**	FE	1790	37	0.165
220	204	229	**LX4-D12220**	M	5400	110	0.165
250	228	255	**LX4-D12250**	UC	6700	136	0.165
440	411	461	**LX4-D12440**	V	21880	440	0.165
600	589	660	**LX4-D12600**	X	45115	900	0.165

(2) Operating limits: 0.85 Un min to 1.1 Un max (for a temperature ≤ + 55 °C)

Wide range coils (average consumption: 6.5 watts)

Operating range (3) at ambient temperature ≤ 55 °C min	max	≤ 70 °C min	max	Reference	Voltage code letter	Resistance at 20 °C	Inductance circuit closed	Weight
V	V	V	V			Ω ± 10%	H	kg
7.2	19	8	16.5	**LX5-D12012**	JW	22	0.70	0.200
16	40	17.5	35	**LX5-D12024**	BW	96	2.90	0.200
23	55	25	48	**LX5-D12036**	CW	190	4.40	0.200
30	73	33	64	**LX5-D12048**	DW	361	10	0.200
54	110	49	96	**LX5-D12072**	EW	677	19	0.200
71	167	72	146	**LX5-D12110**	FW	1780	49	0.200
140	327	154	286	**LX5-D12220**	MW	6355	170	0.200

(3) Limits that guarantee correct operation of the unit for the maximum ambient temperature shown.

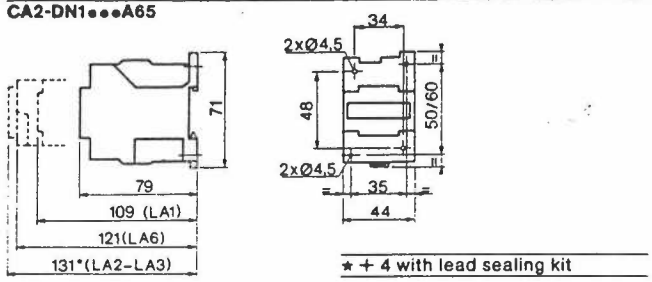
Dimensions, mounting and wiring diagrams

of control relays and electronic timers

Characteristics: see pages 122 and 12

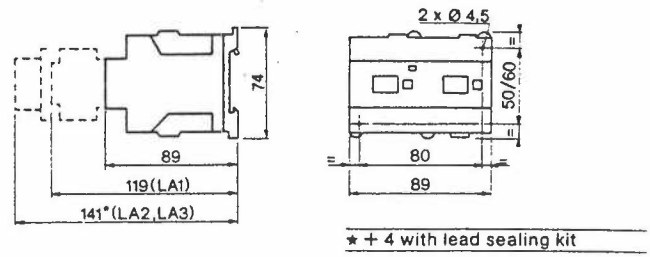
Dimensions of control relays

CA2-DN1•••A65



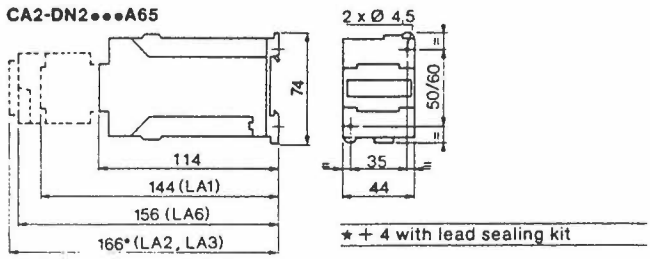
★ + 4 with lead sealing kit

CA2-DK1•••A65



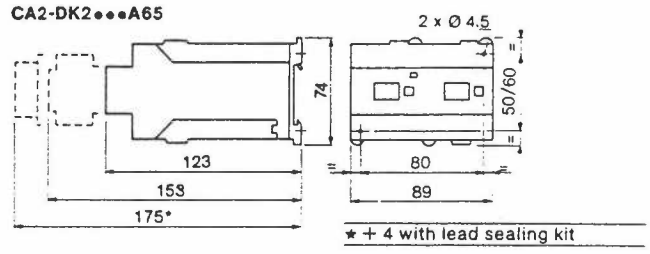
★ + 4 with lead sealing kit

CA2-DN2•••A65



★ + 4 with lead sealing kit

CA2-DK2•••A65

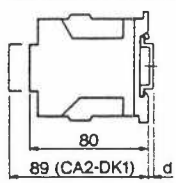


★ + 4 with lead sealing kit

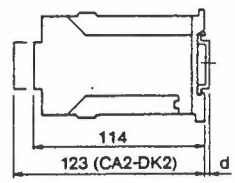
Mounting of control relays and timers

Direct clip-on mounting on AM1-DP or DE rail

CA2-DN1•••A65, DK1•••A65

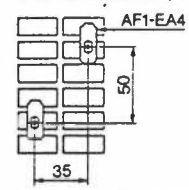


CA2-DN2•••A65, DK2•••A65

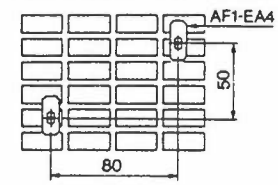


On pre-slotted plate AM1-PA

CA2-DN1•••A65, DN2•••A65

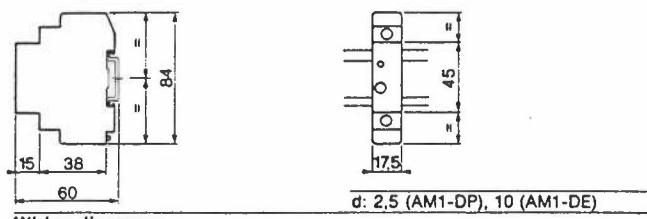


CA2-DK1•••A65, DK2•••A65



Direct clip-on mounting on AM1-DP or DE rail

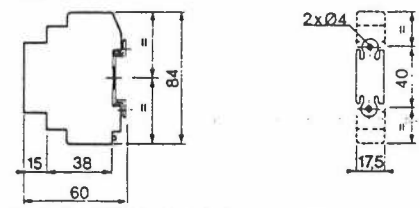
RE1-LA, LC



d: 2,5 (AM1-DP), 10 (AM1-DE)

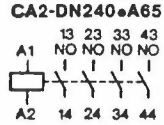
On panel with AM1-PT01 mounting plate

RE1-LA, LC

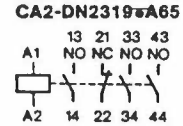


Wiring diagrams of control relays

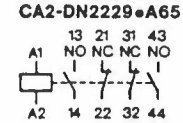
CA2-DN140•A65
CA2-DN240•A65



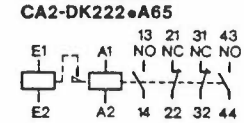
CA2-DN1319•A65
CA2-DN2319•A65



CA2-DN1229•A65
CA2-DN2229•A65



CA2-DK122•A65
CA2-DK222•A65



Wiring diagrams of auxiliary contact blocks

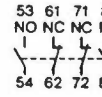
Instantaneous

LA1-D11A65

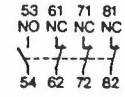
LA1-D20A65

LA1-D02A65

LA1-D22A65

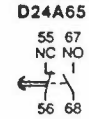


LA1-D13A65

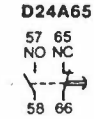


Time delay

LA2-D20A65, D22A65, D24A65

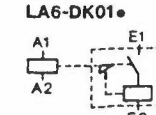


LA3-D20A65, D22A65, D24A65



Mechanical latch

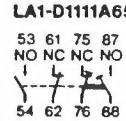
LA6-DK01•



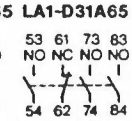
LA1-D40A65

LA1-D04A65

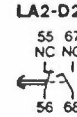
LA1-D1111A65



LA1-D31A65

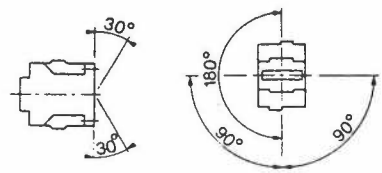


LA2-D221A65



General characteristics of control relays

Environment

Conformity to standards		IEC 158-1, 337-1 and 255, NF C 63-110, 63-140 and 45-250 VDE 0660, BS 5424, CEI, NBN, NEN, SABS, GOST
Approvals	a.c. devices	ASE, CSA, DEMKO, NEMKO, FI, UL, BV, GL, LROS, USSR
	d.c. devices	ASE, CSA, DEMKO, NEMKO, UL, BV, GL, USSR
Protective treatment	Standard version	TC; TH for the auxiliary contact blocks
	Special version	TH
Ambient temperature	Storage	− 60 to + 80 °C
	Operating, conforming to b2 of IEC 255 (0,85 to 1,1 Un)	− 5 to + 40 °C
	Permissible operating limits at Un	− 50 to + 70 °C
Operating position	Operation, without derating, in the positions indicated	
Cabling capacity	1 or 2 wires, flexible or solid	1,5 or 2,5 mm²

Control circuit characteristics

Rated insulation voltage	Conforming to IEC 158-1 and 255, BS 5424		660 V
	Conforming to VDE 0110		750 V
	Conforming to CSA C22-2 No. 14		600 V
Permissible voltage variation			0,85 to 1,1 Un
Drop out voltage		a.c.	Between 30 and 60 % Un
		d.c.	Between 10 and 65 % Un
Average consumption	Alternating current 50-60 Hz	Inrush	70 VA
		Sealed	8 VA
	Direct current	Inrush or sealed	8 W (6,5 W for wide range coils)
Operating times (at rated voltage and 20 °C)	Between energisation of the coil and the opening of the N/C contacts	a.c.	9 to 20 ms
		d.c.	35 ms
	Between energisation of the coil and the closing of the N/O contacts	a.c.	15 to 22 ms
		d.c.	40 ms
	Between de-energisation of the coil and the opening of the N/O contacts	a.c.	5 to 15 ms
		d.c.	10 ms
	Between de-energisation of the coil and the closing of the N/C contacts	a.c.	7 to 20 ms
		d.c.	15 ms
Maximum time of supply voltage loss	without affecting the energised state of the relay	a.c.	≤ 2 ms
		d.c.	≤ 4 ms
Minimum impulse time	For latching or unlatching the latch/memory relay type CA2-DK	a.c.	40 ms
		d.c.	100 ms
Mechanical life	CA2-DN and instantaneous adder blocks		20 million operations
	CA2-DK		10 million operations
	Time delay adder blocks		5 million operations
Maximum operating rate		a.c.	3 operations per second
		d.c.	1 operation per second

References : see page 118
Dimensions : see page 120
Wiring diagrams: see page 120

Instantaneous and time delay contact characteristics

Number of circuits	CA2-DN and CA2-DK		4
Maximum insulation voltage	Conforming to IEC 158-1 and 255, VDE 0110, BS 775		660 V
	Conforming to CSA C22-2 No. 14		600 V
Rated thermal current			10 A
Minimum switching capacity	With Umin = 6 V or Imin = 10 mA		0.6 VA
Making capacity	Conforming to IEC 337-1, Irms:	a.c.	140 A
		d.c.	250 A
Short time rating	Duration: -	1 s	100 A
		500 ms	120 A
		100 ms	180 A
Insulation resistance	Between contacts, between contacts and earth and across open contacts (even on a worn relay)		> 10 MΩ
Non-overlap time	Guaranteed between N/C and N/O contacts on energisation and on de-energisation		1.5 ms
Overlap time	Guaranteed between N/C and N/O contacts on LA1-D1111 adder blocks		1.5 ms
Time delay (adder blocks LA2-D and LA3-D)	Repeat accuracy		± 2 %
	Loss of accuracy up to 500,000 operations		+ 15 %
	Loss of accuracy due to ambient temperature		0.25 % per °C

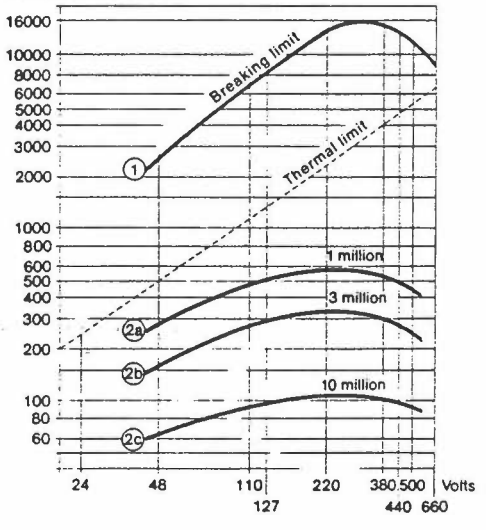
Rated power of contacts

① : Breaking limit of instantaneous and time delay contacts:
50 operations with at least
10 second intervals
(breaking current = making current;
Cos φ = 0.7).

② : Contact life
• instantaneous and time delay
– for 1 million operations (2a)
– for 3 million operations (2b)
• instantaneous
– for 10 million operations (2c).

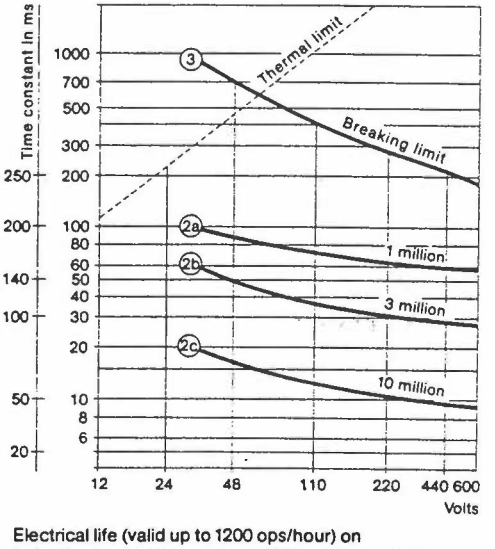
③ : Breaking limit of instantaneous and time delay contacts:
20 operations with at least
10 second intervals and
with current passing
for 0.5 second per operation.

Alternating current duty category AC11
Power broken in VA



Electrical life (valid up to 3600 ops/hour) on inductive load such as the coil of an electro-magnet: making current (Cos φ 0.7) = 10 times the breaking current (Cos φ 0.4).

Direct current duty category DC11
Power broken in W



Electrical life (valid up to 1200 ops/hour) on inductive load such as the coil of an electro-magnet without economy resistor, the time constant increasing with power.

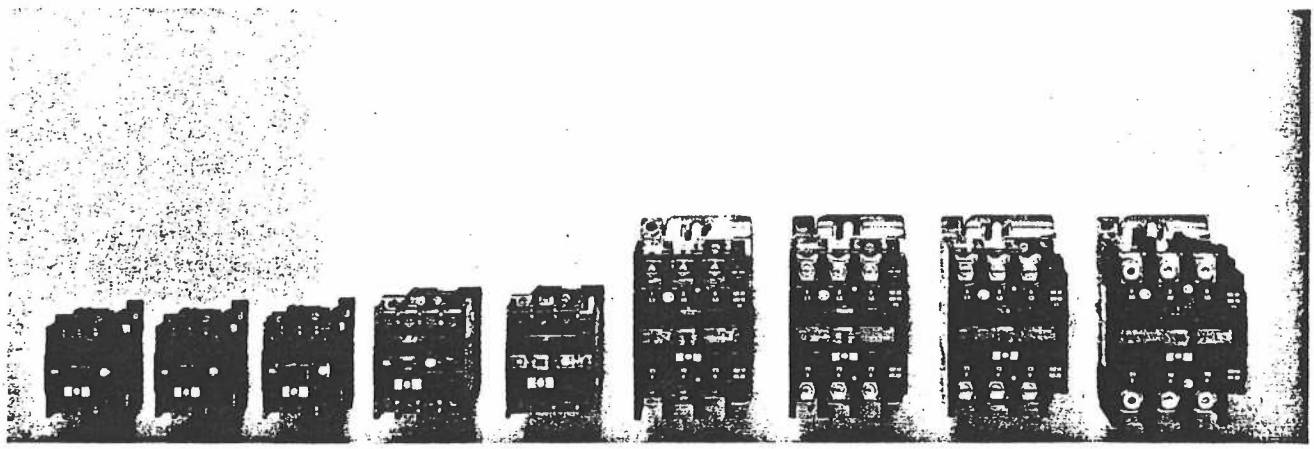
Characteristics of the LA6-DK01 mechanical latch block

The function of this block is to mechanically latch in the closed position the contactor or control relay with which it is associated.
Unlatching can be electrically controlled or manually operated by local push-button.
For remote electrical unlatching the command signal can be either pulsed (min. 10 msec) or maintained (auto cut-out after 15 msec by integral contact).
Important: The LA6-DK unlatch coil and the operating coil of the associated contactor or control relay must **not** be energised simultaneously.
The two control circuits can be of different types and voltages.
Minimum power supply required: 60 VA a.c.: 50 W d.c.
Minimum command signal duration: 10 msec.
Control circuit voltages: 24 to 660 V a.c.; 24 to 250 V d.c.

Contactor panorama

Type LC1-D contactors

For motor control from 9 to 80 A
For distribution circuits from 25 to 125 A



Size		LC1-D09	LC1-D12	LC1-D17	LC1-D25	LC1-D32	LC1-D40	LC1-D50	LC1-D63	LC1-D80
Maximum rated voltage		660 V	660 V	660 V	660 V	660 V	660 V	660 V	660 V	660 V

For motor control

Maximum rated current 3 phase ~ 440 V - 50/60 Hz		9 A		12 A		16 A		25 A		32 A		40 A		50 A		63 A		80 A	
		kW	*hp*	kW	*hp*	kW	*hp*	kW	*hp*	kW	*hp*	kW	*hp*	kW	*hp*	kW	*hp*	kW	*hp*
Maximum standard	220 V	2,2	*3*	3	*4*	4	*5,5*	5,5	*7,5*	7,5	*10*	11	*15*	15	*20*	18,5	*25*	22	*30*
power rating	380 V	4	*5,5*	5,5	*7,5*	7,5	*10*	11	*15*	15	*20*	18,5	*25*	22	*30*	30	*40*	37	*50*
for AC3 duty	415/440 V	4	*5,5*	5,5	*7,5*	9	*12*	11	*15*	15	*20*	22	*30*	25	*35*	37	*50*	45	*60*
Θ < 55°C	500 V	5,5	*7,5*	7,5	*10*	10	*13,5*	15	*20*	18,5	*25*	22	*30*	30	*40*	37	*50*	55	*75*
	660 V	5,5	*7,5*	7,5	*10*	7,5	*10*	15	*20*	18,5	*25*	30	*40*	33	*45*	37	*50*	45	*60*
Reference ★		LC1-D093●A65		LC1-D123●A65		LC1-D173●A65		LC1-D253●A65		LC1-D323●A65		LC1-D403●		LC1-D503●		LC1-D633●		LC1-D803●	
Composition		3P+N/O (1)		3P+N/O (1)		3P+N/O (1)		3P+N/O (1)		3P+N/O (1)		3P+N/O+N/C		3P+N/O+N/C		3P+N/O+N/C		3P+N/O+N/C	

For distribution circuits

Maximum thermal current	Ith	25 A	25 A	40 A	40 A	50 A	60 A	80 A	80 A	125 A
Référence ★	3 pole	LC1-D093●A65	LC1-D123●A65	LC1-D173●A65	LC1-D253●A65	LC1-D323●A65	LC1-D403●	LC1-D503●	LC1-D633●	LC1-D803●
Composition		3P+N/O (1)	3P+N/O (1)	3P+N/O (1)	3P+N/O (1)		3P+N/O+N/C	3P+N/O+N/C	3P+N/O+N/C	3P+N/O+N/C
	4 pole	–	LC1-D123●A65	–	LC1-D254●A65	–	LC1-D404●	–	LC1-D634●	LC1-D804●
			4P		4P		4P		4P	4P

★ Basic reference to be completed, see table below

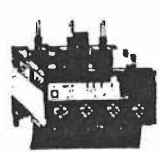
Adder blocks

Instantaneous	Reference
1N/O+1N/C	LA1-D11A65
2N/O	LA1-D20A65
2N/O+2N/C	LA1-D22A65
3N/O+1N/C	LA1-D31A65
4N/O	LA1-D40A65
4N/C	LA1-D04A65

Time-delay 1N/O+1N/C	Reference
On energisation	
0,1 to 3 sec.	LA2-D20A65
0,1 to 30 sec.	LA2-D22A65
10 to 180 sec.	LA2-D24A65
On de-energisation	
0,1 to 3 sec.	LA3-D20A65
0,1 to 30 sec.	LA3-D22A65
10 to 180 sec.	LA3-D24A65

Latch	Reference★
	For D09 to D32
	LA6-DK01●
	For D40 to D63
	LA6-DK02●A65
	For D80
	LA6-DK03●A65

Overload relays

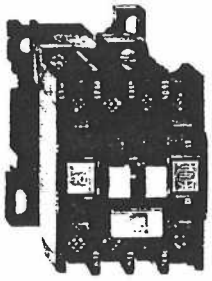


Setting range. A	Reference	Setting range. A	Reference	Setting range. A	Reference
0,1 to 0,16	LR1-D09301A65	4 to 6	LR1-D09310A65		
0,16 to 0,25	LR1-D09302A65	5,5 to 8	LR1-D09312A65	23 to 32	LR1-D40353A65
0,25 to 0,40	LR1-D09303A65	7 to 10	LR1-D09314A65	30 to 40	LR1-D40355A65
0,40 to 0,63	LR1-D09304A65	10 to 13	LR1-D12316A65	38 to 50	LR1-D63357A65
0,63 to 1	LR1-D09305A65	13 to 18	LR1-D16321A65	48 to 57	LR1-D63359A65
1 to 1,6	LR1-D09306A65	18 to 25	LR1-D25322A65	57 to 66	LR1-D63361A65
1,6 to 2,5	LR1-D09307A65	23 to 32	LR1-D32353A65	For separate mounting	
2,5 to 4	LR1-D09308A65	28 to 40	LR1-D32355A65	63 to 80	LR1-D80363A65

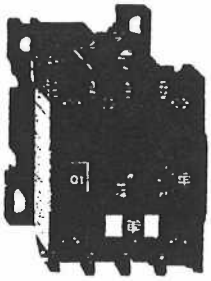
★ Basic reference to be completed: Replace the ● by the letter(s) corresponding to the control circuit voltage and frequency.
Example: LC1-D093MA65

Volts		24	42	48	110	120	127	220	240	380	415	440	480	500	600	660
50 Hz	LC1-D09 to D80	B	D	E	F	–	G	M	U	Q	N	N	–	S	–	Y
60 Hz	LC1-D09 to D17	–	–	D	F	F	–	M	M	–	–	N	N	–	S	X
	LC1-D25, D32	–	–	D	F	F	–	L	L	–	–	N	N	–	SC	X
	LC1-D40 to D80	–	–	D	K	K	–	P	P	–	–	Q	Q	–	WE	SF
50-60Hz	LA6-DK	B	D	E	F	G	G	M	U	Q	N	R	–	S	–	Y

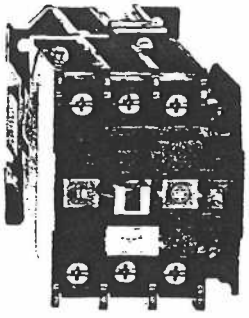
(1) These contactors are also available with 3P+N/C. Replace the 3 in the reference by a 9. Ex.: LC1-D099●A65



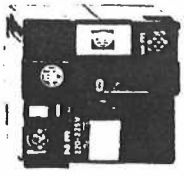
LC1-D093•A65



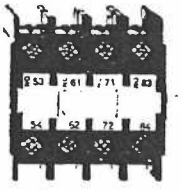
LC1-D129•A65



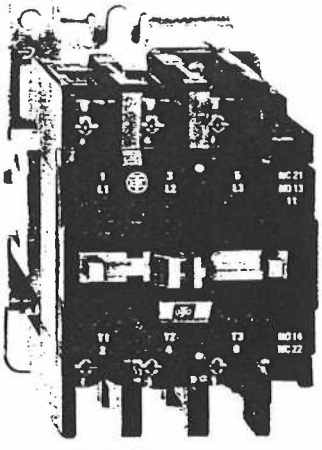
LC1-D323•A65



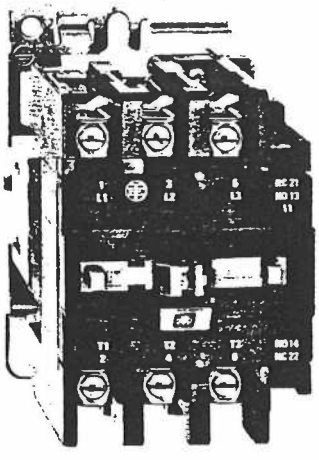
LA6-DK01•



LA1-D22A65

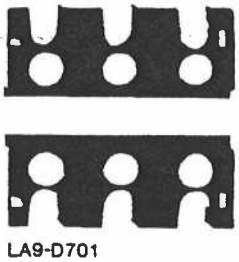


LC1-D403•

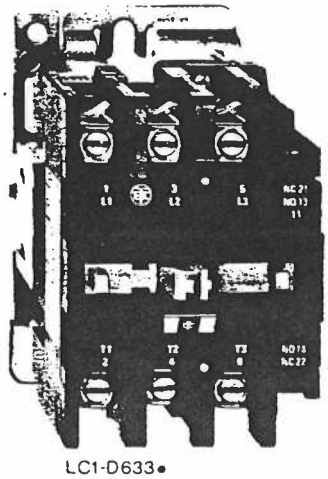


LC1-D503•

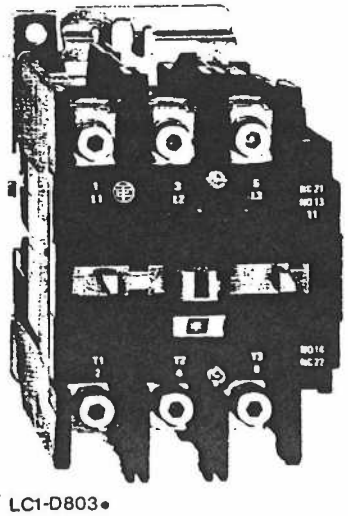
LA2-D22A65



LA9-D701



LC1-D633•



LC1-D803•

LA9-D703

3 pole contactors 9 to 80 A (AC3)

Power circuit: a.c.
Control circuit: a.c.

	Three phase motor control (category AC3) Maximum current rating 440 V	Maximum standard power rating 220V	380V	415V	440V	660V	Non inductive loads (cat. AC1) Max. current	Composition	Basic reference to be completed Replace the • by the letter corresponding to the control circuit voltage and frequency (4)	Weight
	A	kW hp	kW hp	kW hp	kW hp	kW hp	A			kg
Contactors LC1-D09 to D32••A65 – Clip-on mounting on to AM1-DP 35 mm ⊥ omega rail or screw fixing. – Power terminals are protected against direct finger contact and are fitted with ready to tighten screws.	9	2,2 3	4 5,5	4 5,5	4 5,5	5,5 7,5	25	3 P + 1 N/O 3 P + 1 N/C	**LC1-D093•A65** **LC1-D099•A65**	0,320 0,320
	12	3 4	5,5 7,5	5,5 7,5	5,5 7,5	7,5 10	25	3 P + 1 N/O 3 P + 1 N/C	**LC1-D123•A65** **LC1-D129•A65**	0,320 0,320
	16	4 5,5	7,5 10	9 12	9 12	7,5 10	32	3 P + 1 N/O 3 P + 1 N/C	**LC1-D173•A65** **LC1-D179•A65**	0,350 0,350
	25	5,5 7,5	11 15	11 15	11 15	15 20	40	3 P + 1 N/O 3 P + 1 N/C	**LC1-D253•A65** **LC1-D259•A65**	0,490 0,490
	32	7,5 10	15 20	15 20	15 20	18,5 25	50	3 P + 1 N/O 3 P + 1 N/C	**LC1-D323•A65** **LC1-D329•A65**	0,550 0,550
Contactors LC1-D40 to D80 – Clip-on mounting on to AM1-DL 75 mm ⊥ omega rail or screw fixing. – Power terminals can be protected against direct finger contact by shrouds, to be ordered separately (see below)	40	11 15	18,5 25	22 30	22 30	30 40	60	3P+1N/O+1N/C	**LC1-D403•**	1,070
	50	15 20	22 30	25 35	30 40	33 45	80	3P+1N/O+1N/C	**LC1-D503•**	1,070
	63	18,5 25	30 40	37 50	37 50	37 50	80	3P+1N/O+1N/C	**LC1-D633•**	1,100
	80	22 30	37 50	45 60	45 60	45 60	125	3P+1N/O+1N/C	**LC1-D803•**	1,440

Mechanical latch adder blocks with manual or electrical tripping

For contactors LC1-D09 to D32	**LA6-DK01•**	0,070
For contactors LC1-D40 to D63	**LA6-DK02•A65**	0,090
For contactors LC1-D80	**LA6-DK03•A65**	0,090

or
Additional auxiliary contact blocks
– Terminals are protected against direct finger contact and are fitted with ready to tighten screws

Description	Composition	Reference Weight kg	Description	Utilization	Reference	Weight kg
1 block of 2 or 4 instantaneous contacts	1 N/O + 1 N/C	**LA1-D11A65**	or 1 block of time delay contacts 1 N/O + 1 N/C	On-energisation		
	2 N/O	**LA1-D20A65**		0,1 to 3 s (2)	**LA2-D20A65**	0,080
	2 N/C	**LA1-D02A65** 0,030		0,1 to 30 s	**LA2-D22A65**	0,080
	2 N/O + 2 N/C	**LA1-D22A65**		1 to 30 s (3)	**LA2-D221A65**	0,080
	1 N/O + 3 N/C	**LA1-D13A65**		10 to 180 s	**LA2-D24A65**	0,080
	4 N/O	**LA1-D40A65**		On-de-energisation		
	4 N/C	**LA1-D04A65**		0,1 to 3 s (2)	**LA3-D20A65**	0,080
	2N/O+2N/C(1)	**LA1-D1111A65**		0,1 to 30 s	**LA3-D22A65**	0,080
	3N/O+1N/C	**LA1-D31A65** 0,050		10 to 180 s	**LA3-D24A65**	0,080

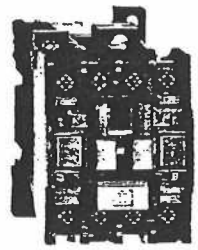
(1) including 1 pair of make before break contacts
(2) with extended scale from 0,1 to 0,6 secs
(3) with switching time of 40 ms ± 5 between the opening of the N/C contact and the closing of the N/O contact. (For star-delta starters)

	Utilization	Reference	Weight kg
Power terminal protection shrouds	For contactors LC1-D403, D503, D633	**LA9-D701**	0,015
	For contactors LC1-D803	**LA9-D703**	0,015

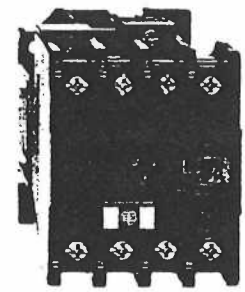
(4) Standard control circuit voltages

	Volts	24	42	48	110	120	127	220	240	380	415	440	480	500	600	660
For contactors	50 Hz **LC1-D09 to D80**	B	D	E	F	–	G	M	U	Q	N	N	–	S	–	Y
	60 Hz **LC1-D09, D12, D17**	–	–	D	F	F	–	M	M	–	–	N	N	–	S	X
	D25, D32	–	–	D	F	F	–	L	L	–	–	N	N	–	SC	X
	D40 to D80	–	–	D	K	K	–	P	P	–	–	Q	Q	–	WE	SF
For mechanical latch adder blocks	50/60 Hz **LA6-DK**	B	D	E	F	G	G	M	U	Q	N	R	–	S	–	Y

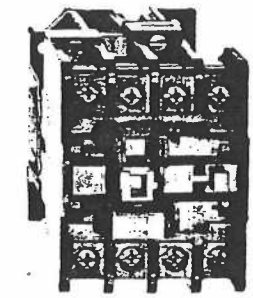
Other versions
Contactors with clip on fixing, power terminals not protected (variant A60).
Contactors for special applications.
Contactors operating on d.c. control circuit supply.
For further information please consult our local agent or representative.



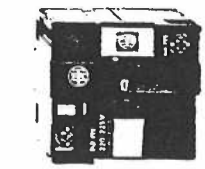
LC1-D128•A65



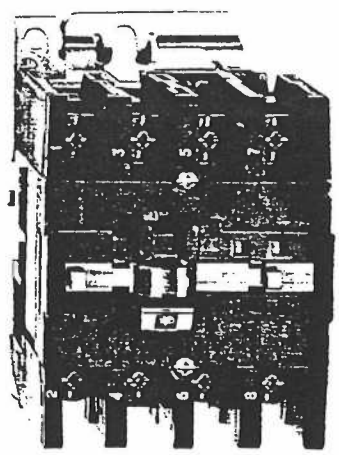
LC1-D254•A65



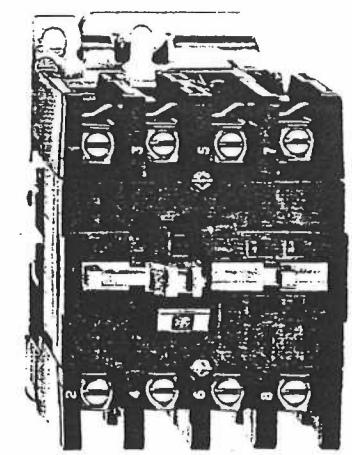
LC1-D258•A65



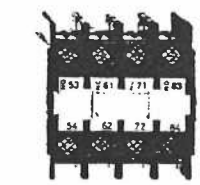
LA6-DK01•



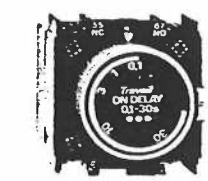
LC1-D404•



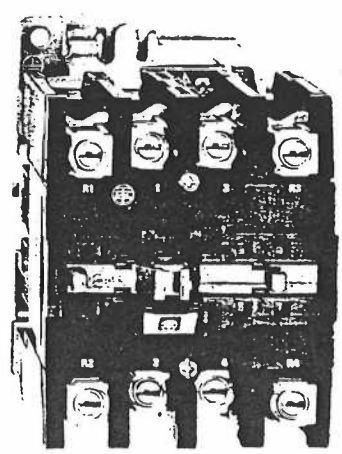
LC1-D634•



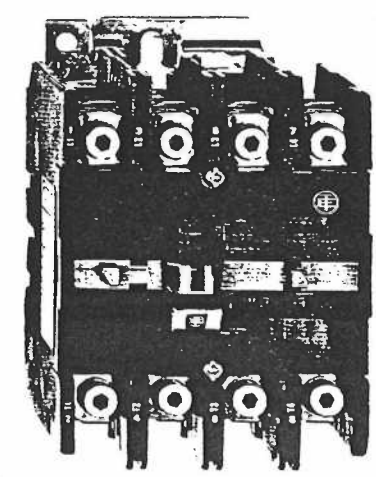
LA1-D22A65



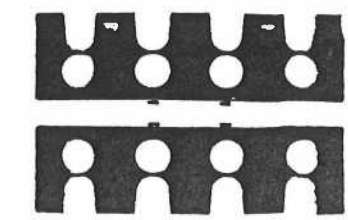
LA2-D22A65



LC1-D638•



LC1-D804•



LA9-D705

4 pole contactors 25 to 125 A (AC1)

Power circuit: a.c.
Control circuit: a.c.

	Distribution circuits (category AC1) Maximum thermal current (Θ ≤ 40 °C)	Maximum operating voltage	Composition of main poles (For auxiliary contacts use additional contact blocks)	Basic reference to be completed Replace the • by the letter corresponding to the control circuit voltage and frequency (3)	Weight
Contactors LC1-D12 to D25••A65 – Clip-on mounting on to 35 mm AM1-DP omega rail or screw fixing. – Power terminals are protected against direct finger contact and are fitted with ready to tighten screws.	A	V			kg
	25	660	4 N/O	**LC1-D123•A65**	0,320
			2 N/O + 2 N/C	**LC1-D128•A65**	0,320
	40	660	4 N/O	**LC1-D254•A65**	0,490
			2 N/O + 2 N/C	**LC1-D258•A65**	0,490
Contactors LC1-D40 to D80 – Clip-on mounting on to 75 mm AM1-DL omega rail or screw fixing. – Power terminals can be protected against direct finger contact by shrouds to be ordered separately (see below).	60	660	4 N/O	**LC1-D404•**	1,070
			2 N/O + 2 N/C	**LC1-D408•**	1,070
	80	660	4 N/O	**LC1-D634•**	1,100
			2 N/O + 2 N/C	**LC1-D638•**	1,100
	125	660	4 N/O	**LC1-D804•**	1,470
			2 N/O + 2 N/C	**LC1-D808•**	1,470

	Utilization	Basic reference to be completed by the control circuit voltage letter (3)	Weight kg
Mechanical latch adder blocks with manual or electrical tripping	For contactors LC1-D12 and D25	**LA6-DK01•**	0,070
	For contactors LC1-D40 and D63	**LA6-DK02•A65**	0,090
	For contactors LC1-D80	**LA6-DK03•A65**	0,090

	Description	Composition	Reference	Weight kg
or Additional auxiliary contact blocks – Terminals are protected against direct finger contact and are fitted with ready to tighten screws.	1 block of 2 or 4 instantaneous contacts	1 N/O + 1 N/C	**LA1-D11A65**	0,030
		2 N/O	**LA1-D20A65**	
		2 N/O	**LA1-D02A65**	
		2 N/O + 2 N/C	**LA1-D22A65**	
		1 N/O + 3 N/C	**LA1-D13A65**	
		4 N/O	**LA1-D40A65**	
		4 N/C	**LA1-D04A65**	
		2N/O + 2N/C(1)	**LA1-D1111A65**	
		3N/O + 1N/C	**LA1-D31A65**	

Description	Utilization	Reference	Weight kg
or 1 block of time-delay contacts 1 N/O + 1 N/C	On energisation		
	0,1 to 3 s (2)	**LA2-D20A65**	0,080
	0,1 to 30 s	**LA2-D22A65**	0,080
	10 to 180 s	**LA2-D24A65**	0,080
	On de-energisation		
	0,1 to 3 s (2)	**LA3-D20A65**	0,080
	0,1 to 30 s	**LA3-D22A65**	0,080
	10 to 180 s	**LA3-D24A65**	0,080

(1) including 1 N/O and 1 N/C make before break
(2) extended scale from 0,1 to 0,6 secs

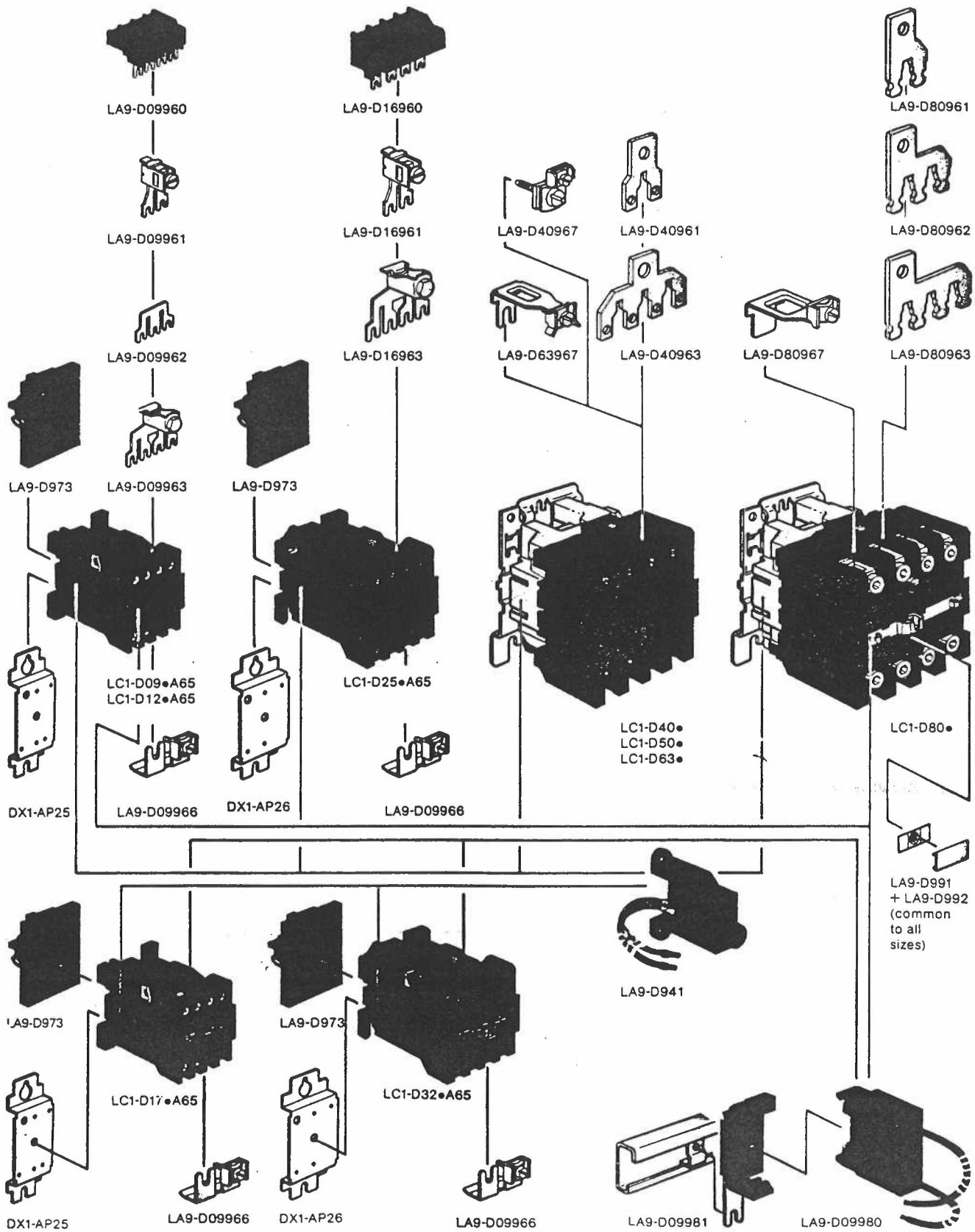
	Utilization		Reference	Weight kg
Power terminal protective shrouds	For contactors	LC1-D404, D408, D634	**LA9-D702**	0,015
		LC1-D638	**LA9-D705**	0,015
		LC1-D804	**LA9-D704**	0,015
		LC1-D808	**LA9-D706**	0,015

(3) Standard control circuit voltages

	Volts	24	42	48	110	120	127	220	240	380	415	440	480	500	600	660
For contactors	50 Hz **LC1-D12 to D80**	B	D	E	F	–	G	M	U	Q	N	N	–	S	–	Y
	60 Hz **LC1-D12**	–	–	D	F	F	–	M	M	–	–	N	N	–	S	X
	D25	–	–	D	F	F	–	L	L	–	–	N	N	–	SC	X
	D40	–	–	D	K	K	–	P	P	–	–	Q	Q	–	WE	SF
For mechanical latch adder blocks	50/60 Hz **LA6-DK**	B	D	E	F	G	G	M	U	Q	N	R	–	S	–	Y

Other versions

Clip-on fixing contactors, power terminals not protected (variant A60).
Contactors for special applications.
Contactors operating on d.c. control circuit supply.
For further information please consult our local agent or representative.

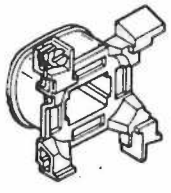

LA9-D09960
LA9-D16960
LA9-D80961
LA9-D09961
LA9-D16961
LA9-D40967
LA9-D40961
LA9-D80962
LA9-D09962
LA9-D16963
LA9-D63967
LA9-D40963
LA9-D80967
LA9-D80963
LA9-D973
LA9-D09963
LA9-D973
LC1-D09•A65
LC1-D12•A65
LC1-D25•A65
LC1-D40•
LC1-D50•
LC1-D63•
LC1-D80•
DX1-AP25
LA9-D09966
DX1-AP26
LA9-D09966
LA9-D991
+ LA9-D992
(common
to all
sizes)
LA9-D941
LA9-D973
LA9-D973
LC1-D17•A65
LC1-D32•A65
DX1-AP25
LA9-D09966
DX1-AP26
LA9-D09966
LA9-D09981
LA9-D09980

Accessories for LC1-D contactors

	Description		For use with contactors LC1-	Sold in lots of	Unit reference	Weight kg
For power and control connections	**4-pole termination adaptor** suitable for cable size	de 10 mm²	D09, D12	1	LA9-D09960	0,025
		de 25 mm²	D25	1	LA9-D16960	0,070
	Links for parallel connection of	2 poles	D09, D12	10	LA9-D09961	0,005
			D25	10	LA9-D16961	0,060
			D40, D50, D63	2	LA9-D40961	0,050
			D80	2	LA9-D80961	0,060
		3 poles★	D09, D12	10	LA9-D09962	0,003
			D80	1	LA9-D80962	0,080
		4 poles	D09, D12	2	LA9-D09963	0,002
			D25	2	LA9-D16963	0,017
			D40, D50, D63	2	LA9-D40963	0,070
	★ star coupling		D80	2	LA9-D80967	0,100
	Second coil connection		D09 to D32	10	LA9-D09966	0,006
	Control circuit take-off from main pole		D40	10	LA9-D40967	0,003
			D50, D63	10	LA9-D63967	0,003
			D80	10	LA9-D80967	0,010
For fixing	**M4 screw with captive washer** for contactor mounting on panel		D09 to D32	20	LA9-D898	0,005
	Clip-on mounting plate for use on 1 DZ5-MB rail		D09 to D32	1	LA9-D973	0,020
	Mounting plate for use on 2 DZ5-MB rails 110 mm fixing centres		D09 to D17	1	DX1-AP25	0,070
			D25, D32	1	DX1-AP26	0,080
	Sliding clamp for use on DZ5-MB rail	with M4 thread	D09 to D32	100	DZ5-ME8	0,010
		with M6 thread	D40 to D80	100	DZ5-ME5	0,010
	Captive clip nut for fixing on pre-slotted plate	with M4 thread	D09 to D32	100	AF1-EA4	0,005
		with M6 thread	D40 to D80	100	AF1-EA6	0,008
For protection and referencing	**Miniature fuse holder** (5 x 20 mm) with 4A fuse - 250 V		D09 to D80 (except D804, D808)	1	LA9-D941	0,025
	Clip-on coil suppressor Clips onto front of contactor		D09 to D80	1	LA9-D09980	0,030
	Support for independent mounting of suppressor		Mounting on rail DZ5-MB or fixing by Ø M4 screw	1	LA9-D09981	0,010
	Lead sealing shroud		for LA2-D, LA3-D	1	LA9-D901	0,005
	Pad of 40 referencing legends		D09 to D80	10	LA9-D991	0,001
	Legend protector		D09 to D80	100	LA9-D992	0,005

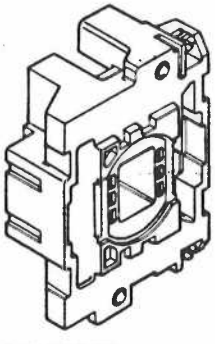
Coils for LC1-D contactors

Spare parts
a.c. supply



LX1-D09220

Standard voltages	Operating range (1) 50 Hz min	50 Hz max	60 Hz min	60 Hz max	Reference	Voltage reference letter (2)	Resistance at 20°C	Inductance, closed circuit	Weight
V	V	V	V	V			Ω ± 10%	H	kg
LC1-D09, D12 and D17									
Standard coils (consumption; 50/60 Hz): inrush (cos φ 0,8) 60 to 84 VA, sealed (cos φ 0.3) 6.5 to 9.5 VA									
24	22.50	25	25	27	**LX1-D09024**	B	5.98	0.22	0,070
42	39	45	43	49	**LX1-D0942**	D	18.90	0.70	0.070
48	46	50	50	55	**LX1-D09048**	E	24.50	0.89	0.070
110	102	117	110	140	**LX1-D09110**	F	122	4.68	0.070
127	118	133	131	144	**LX1-D09127**	G	176	6.24	0.070
220	204	230	219	244	**LX1-D09220**	M	505	18.70	0.070
240	231	251	245	266	**LX1-D09240**	U	615	22.30	0.070
380	352	397	387	439	**LX1-D09380**	Q	1520	57.70	0.070
415	398	442	440	481	**LX1-D09415**	N	1870	68.60	0.070
500	495	517	533	600	**LX1-D09500**	S	2910	96.70	0.070
600	559	602	619	664	**LX1-D09600**	X	3610	130	0.070
660	603	685	–	–	**LX1-D09660**	Y	4620	164	0.070
LX1-D09 110 and 220 coils are dual voltage as standard.									
LC1-D25 and D32									
Standard coils (consumption; 50/60 Hz): inrush (cos φ 0.8) 90 to 125 VA, sealed (cos φ 0.3) 9 to 12 VA									
24	22	25	25.5	28	**LX1-D25024**	B	4.19	0.21	0.080
42	39	44	43	49	**LX1-D25042**	D	13.37	0.68	0.080
48	45	51	50	56	**LX1-D25046**	E	17.50	0.90	0.080
110	105	112	109	122	**LX1-D25110**	F	90	4.81	0.080
127	119	130	131	140	**LX1-D25127**	G	113.70	5.92	0.080
–	189	215	207	240	**LX1-D25200**	L	290	15.60	0.080
220	216	232	241	253	**LX1-D25220**	M	379	21.05	0.080
240	233	258	254	279	**LX1-D25240**	U	457	23.08	0.080
380	371	414	406	439	**LX1-D25380**	Q	1160	61.30	0.080
415	415	440	440	480	**LX1-D25415**	N	1447	75.50	0.080
500	470	504	515	549	**LX1-D25500**	S	1843	97.30	0.080
–	505	524	550	600	**LX1-D25510**	SC	2180	112	0.080
600	571	620	628	682	**LX1-D25600**	X	2672	135.50	0.080
660	621	690	–	–	**LX1-D25660**	Y	3280	163.90	0.080
LX1-D25 110 and 415 coils are dual voltage as standard									
LC1-D40, D50, D63 and D80									
Standard coils: Consumption; 50Hz inrush (cos φ 0.6) 180 to 235 VA, sealed (cos φ 0.3) 18 to 25 VA. Consumption; 60Hz inrush (cos φ 0.6) 220 to 275 VA, sealed (cos φ 0.3) 22 to 31 VA.									
24	24	27	29	32	**LX6-D40024**	B	1.56	0.09	0.270
42	41	43	48	51	**LX6-D40042**	D	4.3	0.26	0.270
48	48	53	57	63	**LX6-D40048**	E	6.2	0.36	0.270
–	93	99	110	120	**LX6-D40093**	K	22.8	1.25	0.270
110	110	124	130	147	**LX6-D40110**	F	32.5	1.90	0.270
127	125	137	148	162	**LX6-D40127**	G	42	2.50	0.270
–	185	199	220	240	**LX6-D40185**	P	98	5.40	0.270
220	220	234	260	276	**LX6-D40220**	M	130	7.60	0.270
240	235	249	277	294	**LX6-D40240**	U	155	8.70	0.270
380	376	406	440	480	**LX6-D40380**	Q	390	22	0.270
415	407	440	481	519	**LX6-D40415**	N	480	26	0.270
–	480	499	550	600	**LX6-D40480**	WE	614	36	0.270
–	500	547	601	645	**LX6-D40500**	S	685	39	0.270
–	548	599	646	707	**LX6-D40550**	SF	840	47	0.270
–	660	720	–	–	**LX6-D40660**	Y	1260	68	0.270



LX6-D40220

(1) These values correspond to the nominal supply voltage. Operating range: from 0.85 of the minimum voltage to 1.1 of the maximum voltage.
(2) Voltage reference letter used to complete the basic contactor reference.

Definitions of terms used

Altitude	The rarefied atmosphere at high altitudes reduces the dielectric strength and the cooling effect of the air and hence the thermal rating of the contactor (if the temperature does not lower simultaneously).
Utilization category	The standards define a certain number of standard utilization categories for contactors. Each category is characterized by the values of the currents and voltages, expressed as multiples of the rated operational current (Ie) and of the rated operational voltage (Ue) and other test conditions used in the definitions of the rated making and breaking capacities. For contactors defined by their utilization category, it is therefore unnecessary to specify separately the rated making and breaking capacities.
Rated operational current (Ie)	This is defined taking into account the rated operational voltage, the utilization category and the ambient temperature around the contactor.
Rated thermal current (Ith)	This is the current that the contactor is capable of withstanding for a period of eight hours with the main contacts remaining closed for the entire period without the temperature rise of its several parts exceeding specified limits.
Short time rating	This is the current that a closed contactor can sustain for a short time under prescribed conditions without overheating.
Electrical life	This is the number of on-load switching operations that the contactor can perform without maintenance. Electrical life depends upon the utilization category, the rated operating current and the rated operating voltage.
Mechanical life	This is the number of no-load switching operations that the contactor can perform without mechanical failure or maintenance.
Load factor (m)	This is the ratio between the time that the current flows (t) and the duration of the cycle (T). $m = \frac{t}{T}$ The duration of the cycle equals the time the current flows + time at rest.
Pole impedance	This represents the sum of the impedance of all the circuit components between the input terminal and the output terminal. It comprises a resistive component (R) and an inductive component ($X = L\,\omega$). The total impedance is therefore a function of the frequency and is normally expressed for 50 Hz. This average value is given for the pole at rated current.
Breaking capacity	This is the rms current value that the contactor can break in accordance with the conditions imposed by the standard IEC 158-1, ($\cos\varphi = 0.35$). The value increases as the supply voltage decreases.
Making capacity	This is the rms current value that the contactor can make in accordance with the conditions imposed by the standard IEC 158-1. In practice, the making capacity is independent of the rated voltage.
Rated operating power (expressed in kW or hp)	A contactor is designed to control a nominal rated power corresponding to a standard motor. The rated operational current is assumed to be similar to that given in the standards for a 4 pole squirrel cage motor.
Operating time (expressed in ms)	– Closing time: this is the time between the appearance of voltage at the coil terminals and the making of the main poles. – Opening time: this is the total time taken from the instant the supply to the coil is broken to the separation of the main poles. To obtain the breaking time, add the time taken for the arc to extinguish.
Rated operational voltage (Ue)	This the voltage value which, combined with a rated operational current determines the use of the contactor and on which the making and breaking capacities, the type of service and the utilization category are based. For 3 phase circuits, it is stated as the voltage between phases.
Rated insulation voltage (Ui)	This is the value of voltage which is referred to in dielectric tests determining leakage paths and distances. The specifications are not identical for all standards, the nominal value selected for each of them can sometimes be different. Except in special cases such as in rotor resistance short-circuiting, rated insulation voltage is the maximum value of the rated operating voltage.

Contactor selection guide

according to the application

Utilization category according to IEC 158-1

The standard utilization categories define the values of current that the contactor must make or break.

The values depend on:
- the nature of the load: squirrel cage or slip-ring motor, resistance,
- the conditions under which the making or breaking takes place: motor stalled or running, reversing, plugging.

Category AC1

Applies to all types of a.c. load with a power factor not less than 0.95 (Cos $\varphi \geq 0.95$).

Examples: Heating, distribution.

Category AC2

This category applies to starting, plugging or inching of slip-ring motors.
On closing the contactor makes the starting current which is 2.5 times that of the rated motor current.
On opening, the contactor breaks the starting current at a voltage that does not exceed that of the supply voltage.

Examples: Hoisting, metallurgy.

Category AC3

Applies to squirrel cage motors with breaking during normal running.
On closing the contactor makes the starting current which is between 5 and 7 times the rated motor current.
On opening the contactor breaks the rated motor current; at which point the voltage at the contactor terminals is approximately 20% of the supply voltage. Breaking is light.

Examples: All standard squirrel cage motors and, by extension, the stator or the stator switching of slip-ring motors used on automatic machines.
Lifts, escalators, conveyors, bucket elevators, compressors, pumps, fans, mills, mixers, air conditioning, refrigeration, valves.

Categories AC4

These categories cover applications with plugging or inching of squirrel cage or slip-ring motors.
The contactor makes and breaks the starting current which may be as high as 5 to 7 times the rated motor current. The voltage on breaking at low motor speed is approximately equal to the supply voltage. Breaking is severe.

Examples: Printing machines, wire drawing machines, machine tools with inching, metallurgy, hoisting.
Similarly: solenoid valves, clutches, electro-magnets.

Electrical life

The following table gives the desired electrical life of a contactor as a function of the operating rate, the duty and the service required without replacement.

Number of operations per hour	Working hours per day.	Millions of operations Number of years 1	2	3	4	5	10
30	8	0.06	0.12	0.18	0.24	0.30	0.6
	16	0.12	0.24	0.36	0.48	0.60	1.2
	24	0.18	0.36	0.54	0.72	0.90	1.8
150	8	0.3	0.6	0.9	1.2	1.5	3.0
	16	0.6	1.2	1.8	2.4	3.0	6.0
	24	0.9	1.8	2.7	3.6	4.5	9.0
600	8	1.2	2.4	3.6	4.8	6.0	12.0
	16	2.4	4.8	7.2	9.6	12.0	24.0
	24	3.6	7.2	10.8	14.4	18.0	36.0

Example:

A production machine is required to operate 16 hours a day at 150 operations an hour for 5 years. According to the table (based on 21 working days per month) the required electrical life of the contacts is 3 million operations.

To select a contactor according to the electrical life required, the rated operating power or current and the utilization category, refer to the tables and curves shown on the next two pages.

Contactor selection guide

according to the utilization category

Use in category AC1

Rated operating current

Contactor size		LC1-D09 A65	LC1-D12 A65	LC1-D17 A65	LC1-D25 A65	LC1-D32 A65	LC1-D40	LC1-D50	LC1-D63	LC1-D80	LC1-FF4	LC1-FG4	LC1-FH4	LC1-FJ4	LC1-FK4	LC1-FL4	LC1-FX4
														2 bars			
With cable size (c.s.a. in mm^2)		4	4	6	10	10	16	25	25	50	95	150	240	30x5	40x5	60x5	100x5
Maximum current in Amps with ambient temperature	⩽40°C	25	25	32	40	50	60	80	80	125	200	270	350	500	700	1000	1600
	⩽55°C	20	20	26	32	44	55	70	70	100	180	240	300	430	580	850	1350
	⩽70°C	17	17	22	28	35	42	56	56	80	160	180	250	340	500	700	1100

Increase in operating current by paralleling of poles

Apply the following coefficients to the current values given above. These take into account the often unbalanced current distribution between poles: 2 poles in parallel: K = 1,6 3 poles in parallel: K = 2,25 4 poles in parallel: K = 2,8

Use in category AC3

Operating current and power rating (ambient temperature ⩽55°C)

Contactor size		LC1-D09 A65	LC1-D12 A65	LC1-D17 A65	LC1-D25 A65	LC1-D32 A65	LC1-D40	LC1-D50	LC1-D63	LC1-D80	LC1-FF4	LC1-FG4	LC1-FH4	LC1-FJ4	LC1-FK4	LC1-FL4	LC1-FX4
Maximum current rating AC3 in A up to U ⩽ 440 V		9	12	16	25	32	40	50	63	80	115	185	265	400	500	630	780
Maximum power rating P in kW (for standard motors)	220 V	2,2	3	4	5,5	7,5	11	15	18,5	22	30	55	75	110	147	200	220
	380 V	4	5,5	7,5	11	15	18,5	22	30	37	55	90	132	200	250	335	400
	415 V	4	5,5	9	11	15	22	25	37	45	59	100	140	220	280	375	425
	440 V	4	5,5	9	11	15	22	30	37	45	59	100	140	250	295	400	425
	500 V	5,5	7,5	10	15	18,5	22	30	37	55	75	110	160	257	355	400	450
	660 V	5,5	7,5	7,5	15	18,5	30	33	37	45	90	132	200	335	400	450	475
	1000 V	–	–	–	–	–	–	–	–	–	65	100	147	185	355	450	450

Maximum operating rate (depending on the power rating and the on-load factor) (Θ ⩽ 55°C)

On load factor	Power rating	LC1-D09 A65	LC1-D12 A65	LC1-D17 A65	LC1-D25 A65	LC1-D32 A65	LC1-D40	LC1-D50	LC1-D63	LC1-D80	LC1-FF4	LC1-FG4	LC1-FH4	LC1-FJ4	LC1-FK4	LC1-FL4	LC1-FX4
⩽85%	P	1200	1200	1200	1200	1000	1000	1000	1000	750	750	750	750	500	500	500	500
⩽85%	0,5 P	3000	3000	2500	2500	2500	2500	2500	2500	2000	2000	2000	2000	1200	1200	1200	1200
⩽25%	P	1800	1800	1800	1800	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	600

Use in categories AC4-AC2

Maximum breaking current according to the duty (ambient temperature ⩽55°C)

Ops/hour ★ and on-load factor		LC1-D09 A65	LC1-D12 A65	LC1-D17 A65	LC1-D25 A65	LC1-D32 A65	LC1-D40	LC1-D50	LC1-D63	LC1-D80	LC1-FF4	LC1-FG4	LC1-FH4	LC1-FJ4	LC1-FK4	LC1-FL4	LC1-FX4
from 150 and 15% to 300 and 10%	A	30	40	45	75	80	110	140	160	200	280	380	560	780	1100	1400	1600
from 150 and 20% to 600 and 10%	A	27	36	40	67	70	98	120	148	170	250	350	500	700	950	1250	1400
from 150 and 30% to 1200 and 10%	A	24	30	35	56	60	80	100	132	145	215	300	400	600	750	950	1100
from 150 and 55% to 2400 and 10%	A	19	24	30	45	50	62	80	110	120	170	240	320	450	600	720	820
from 150 and 85% to 3600 and 10%	A	16	21	25	40	45	53	70	90	100	125	170	230	350	500	660	710

★ Do not exceed the maximum number of mechanical operations

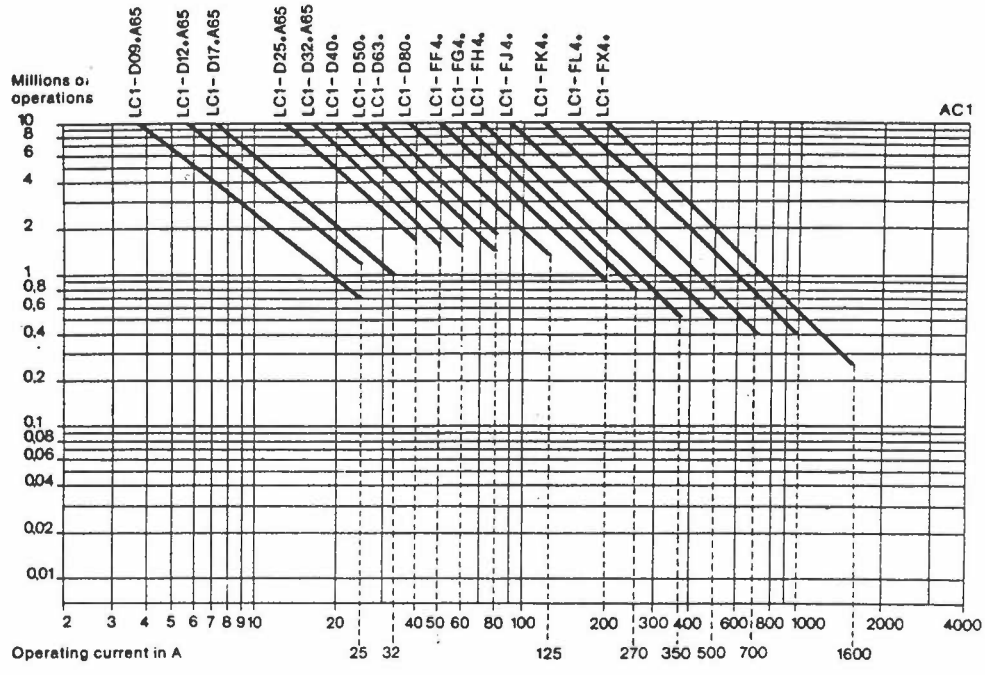
Plugging

The current varies from the maximum plug-braking current to the rated motor current.
The current values must be compatible with the making and breaking capacities of the contactor.
As breaking normally takes place at a current value at or near the stalled current, contactor selection can be made using the criteria given for categories AC2-AC4.

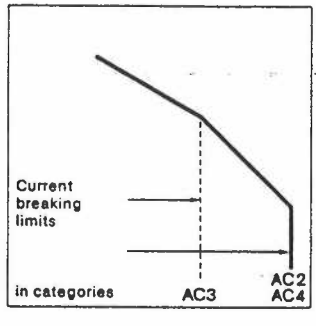
Contactor selection guide

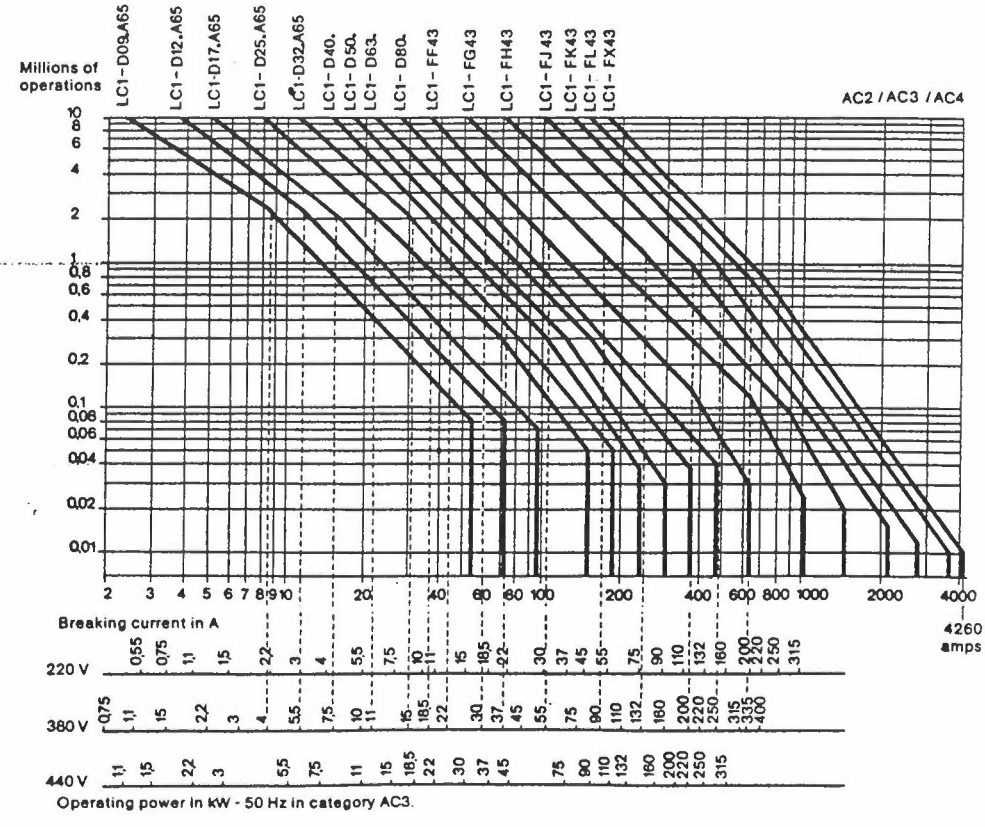
according to the required electrical life

Electrical life in utilization category AC1
(U ≤ 440 V)



Electrical life in utilization categories AC2-AC3-AC4
(U ≤ 440 V)





Contactor selection guide

for the control of squirrel cage motors
Direct-on-line starting

Selection guide

Continuous or intermittent duty up to 30 operations per hour

Motor (1) 220 V		380 V		415 V		440 V		3-pole contactor (2)	3-pole differential thermal overload relay	3 fuses (3) Type aM	g1
kW	hp	kW	hp	kW	hp	kW	hp	Size	Reference	Rating (A)	
		0,37	0,5			0,55	0,75	LC1-D093•A65	LR1-D09306A65	2	4
		0,55	0,75			0,75	1	LC1-D093•A65	LR1-D09307A65	4	6
0,37	0,5	0,75	1	1,1	1,5	1,1	1,5	LC1-D093•A65	LR1-D09307A65	4	6
0,55	0,75	1,1	1,5					LC1-D093•A65	LR1-D09308A65	6	10
0,75	1	1,5	2	1,5	2	1,5	2	LC1-D093•A65	LR1-D09308A65	6	10
1,1	1,5	2,2	3	2,2	3	2,2	3	LC1-D093•A65	LR1-D09310A65	8	16
				3	4	3	4	LC1-D093•A65	LR1-D09312A65	12	20
1,5	2	3	4	3,7	5	3,7	5	LC1-D093•A65	LR1-D09312A65	12	20
		3,7	5					LC1-D093•A65	LR1-D09314A65	12	20
2,2	3	4	5,5	4	5,5	4	5,5	LC1-D093•A65	LR1-D09314A65	12	20
3	4	5,5	7,5	5,5	7,5	5,5	7,5	LC1-D123•A65	LR1-D12316A65	16	25
3,7	5			7,5	10	7,5	10	LC1-D173•A65	LR1-D16321A65	20	32
4	5,5	7,5	10	9	12	9	12	LC1-D173•A65	LR1-D16321A65	20	32
		9	12					LC1-D253•A65	LR1-D25322A65	25	50
		10	13,5					LC1-D253•A65	LR1-D25322A65	25	50
5,5	7,5	11	15	11	15	11	15	LC1-D253•A65	LR1-D25322A65	25	50
7,5	10	15	20	15	20	15	20	LC1-D323•A65	LR1-D32353A65	32	63
9	12			18,5	25	18,5	25	LC1-D403•	LR1-D40355A65	40	80
10	13,5	18,5	25	22	30	22	30	LC1-D403•	LR1-D40355A65	40	80
11	15							LC1-D403•	LR1-D63357A65	63	100
		22	30	25	35	25	35	LC1-D503•	LR1-D63357A65	63	100
15	20					30	40	LC1-D503•	LR1-D63359A65	63	100
		25	35	30	40			LC1-D633•	LR1-D63359A65	63	100
				33	45	33	45	LC1-D633•	LR1-D63361A65	63	100
18,5	25	30	40	37	50	37	50	LC1-D633•	LR1-D63361A65	63	100
		33	45	40	54	40	54	LC1-D803•	LR1-D80363A65	80	125
22	30	37	50	45	60	45	60	LC1-D803•	LR1-D80363A65	80	125
		40	54			51	70	LC1-FF43	LR1-F105	100	160
		45	60	51	70	55	75	LC1-FF43	LR1-F105	100	160
25	35	51	70	55	75	59	80	LC1-FF43	LR1-F105	100	160
30	40	55	75	59	80			LC1-FF43	LR1-F125	125	200
		59	80			63	85	LC1-FG43	LR1-F125	125	200
33	45							LC1-FG43	LR1-F160	160	250
37	50	63	85	63	85	75	100	LC1-FG43	LR1-F160	160	250
40	54	75	100	75	100	80	110	LC1-FG43	LR1-F160	160	250
45	60	80	110	80	110	90	125	LC1-FG43	LR1-F160	160	250
51	70			90	125			LC1-FG43	LR1-F200	200	315
55	75	90	125	100	136	100	136	LC1-FG43	LR1-F200	200	315
						110	150	LC1-FH43	LR1-F200	200	315
						129	175	LC1-FH43	LR1-F250	250	400
59	80	100	136	110	150	132	180	LC1-FH43	LR1-F250	250	400
63	85	110	150	129	175	140	190	LC1-FH43	LR1-F250	250	400
		129	175	132	180			LC1-FH43	LR1-F315	315	500
75	100	132	180	140	190			LC1-FH43	LR1-F315	315	500
		140	190	147	200	147	200	LC1-FJ43	LR1-F315	315	500
		147	200	150	205	150	205	LC1-FJ43	LR1-F315	315	500
80	110	150	205	160	220	160	220	LC1-FJ43	LR1-F315	315	500
						180	245	LC1-FJ43	LR1-F400	400	630
90	125	160	220	180	245	185	250	LC1-FJ43	LR1-F400	400	630
100	136	180	245	185	250	200	270	LC1-FJ43	LR1-F400	400	630
110	150	185	250	200	270	220	300	LC1-FJ43	LR1-F400	400	630
		200	270	220	300	250	340	LC1-FJ43	LR1-F500	500	800
129	175							LC1-FK43	LR1-F500	500	800
132	180	220	300	250	340	257	350	LC1-FK43	LR1-F500	500	800
140	190	250	340	257	350	280	380	LC1-FK43	LR1-F500	500	800
147	200					295	400	LC1-FK43	LR1-F630	630	800
				280	380			LC1-FL43	LR1-F630	630	800
		257	350	295	400	300	410	LC1-FL43	LR1-F630	630	800
		280	380	300	410	315	430	LC1-FL43	LR1-F630	630	800
150	205	295	400	315	430	335	450	LC1-FL43	LR1-F630	630	800
160	220	300	410	335	450	355	480	LC1-FL43	LR1-F630	630	800
180	245	315	430	355	480	375	500	LC1-FL43	LR1-F630	630	800
185	250							LC1-FL43	LR1-F800	800	1000
200	270	335	450	375	500	400	545	LC1-FL43	LR1-F800	800	1000
		355	480					LC1-FX43	LR1-F800	800	1000
		375	500	400	545			LC1-FX43	LR1-F800	800	1000
220	300	400	545	425	580	425	580	LC1-FX43	LR1-F800	800	1000

(1), (2) and (3) : see opposite page.

Contactor selection guide

for the control of squirrel cage motors
Star-delta starting

Selection guide ★

Continuous or intermittent duty up to 30 operations per hour

Motor (1) 220 V			380 V			415 V			440 V			Star-delta starter (2)	3-pole differential thermal overload relay	3 fuses (3) Type aM	g1
kW	hp	In/√3	kW	hp	In/√3	kW	hp	In/√3	kW	hp	In/√3			(A)	(A)
			9	12	10,7							LC3-D123•	LR1-D12316A65	20	32
			10	13,5	11,6							LC3-D123•	LR1-D12316A65	20	32
5,5	7,5	11,6	11	15	12,8	11	15	12,2	11	15	11,7	LC3-D123•	LR1-D12316A65	25	50
7,5	10	15,7	15	20	17,4	15	20	16,2	15	20	15,4	LC3-D173•	LR1-D16321A65	32	63
9	12	18,6										LC3-D173•	LR1-D25322A65	40	80
10	13,5	20,3				18,5	25	20,3	18,5	25	19	LC3-D173•	LR1-D25322A65	40	80
11	15	22,6	18,5	25	21,5	22	30	23,2	22	30	22,6	LC3-D173•	LR1-D25322A65	40	80
			22	30	25,5				25	35	26,3	LC3-D403•	LR1-D40353A65	50	100
15	20	30,2	25	35	30,2	25	35	27,3	30	40	29,9	LC3-D403•	LR1-D40353A65	63	100
						30	40	31,9				LC3-D403•	LR1-D40355A65	80	125
						33	45	34,8	33	45	33,6	LC3-D403•	LR1-D40355A65	80	125
18,5	25	37,1	30	40	34,8	37	50	38,3	37	50	37,1	LC3-D403•	LR1-D40355A65	80	125
			33	45	39,4							LC3-D403•	LR1-D63357A65	80	125
			37	50	41,8							LC3-D403•	LR1-D63357A65	80	125
						40	54	41,2	40	54	38,9	LC3-D503•	LR1-D63357A65	80	125
22	30	43,5	40	54	45,8	45	60	46,4	45	60	44,1	LC3-D503•	LR1-D63357A65	80	125
			45	60	49,3				51	70	48,1	LC3-D503•	LR1-D63359A65	100	160
25	35	49,3	51	70	56,8	51	70	52,2	55	75	52,2	LC3-D503•	LR1-D63359A65	100	160
						55	75	58				LC3-D503•	LR1-D63361A65	125	200
30	40	59,7	55	75	60,9	59	80	60,9	59	80	56,3	LC3-D503•	LR1-D63361A65	125	200
33	45	65,5	59	80	65				63	85	63,2	LC3-D803•	LR1-D63361A65	125	200
			63	85	67,9	63	85	66,7				LC3-D803•	LR1-D80363A65	160	250
37	50	73	75	100	80	75	100	78,3	75	100	72,5	LC3-D803•	LR1-D80363A65	160	250
40	54	77,7							80	110	76	LC3-FF43•	LR1-F105	160	250
45	60	87	80	110	85,3	80	110	80	90	125	85	LC3-FF43•	LR1-F105	160	250
51	70	98,6										LC3-FF43•	LR1-F125	200	315
55	75	106	90	125	98,6	90	125	95,7	100	136	94	LC3-FF43•	LR1-F125	200	315
59	80	113	100	136	109	100	136	106				LC3-FF43•	LR1-F125	200	315
63	85	118	110	150	119	110	150	116	110	150	104	LC3-FF43•	LR1-F125	200	315
			129	175	141	129	175	134	129	175	122	LC3-FG43•	LR1-F160	250	400
75	100	139	132	180	142	132	180	140	132	180	125	LC3-FG43•	LR1-F160	250	400
			140	190	151	140	190	145	140	190	132	LC3-FG43•	LR1-F200	315	500
			147	200	159	147	200	151	147	200	137	LC3-FG43•	LR1-F200	315	500
80	110	151	150	205	163	150	205	157	150	205	143	LC3-FG43•	LR1-F200	315	500
90	125	171	160	220	174	160	220	163	160	220	149	LC3-FG43•	LR1-F200	315	500

★ Not all of the components referred to in the selection table are detailed in this catalogue. For further information please consult our local agent or representative.

Direct-on-line starting

(1) The ratings shown are standard for 220, 380, 415 and 440 V motors. The overload relays should preferably be set to the motor f.l.c. shown on the motor rating plate or to the value given in the table on page 257. For other power ratings select the overload with the appropriate range (see pages 63 and 65) the associated contactor and the fuses with ratings equal to or immediately greater than In.
(2) The complete LC1-D contactor reference is obtained by replacing the • by a letter indicating the operating coil voltage: see tables page 17.
LC1-F contactors are supplied without coils. Coils to be ordered separately, see page 19.
(3) The fuse ratings shown provide a type "C" coordination with the contactor and associated overload relay (in accordance with IEC recommendations).

Star-delta starting

(1) The power and current ratings shown are standard for 220, 380, 415 and 440 V motors.
The overload relay should preferably be set to 0,58 x the f.l.c. shown on the motor rating plate or to the value given above in column In/√3.
(2) The complete LC3-D starter reference is obtained by replacing the • by a letter indicating the operating coil voltage: see tables page 27.

Example

Direct-on-line starting

For a 5,5 kW motor at 380 V, use an LC1-D123•A65 contactor with an overload relay type LR1-D12316A65 set at 11,5 A.

Star-delta starting

For a 30 kW motor at 380 V, use an LC3-D403• starter with an overload relay type LR1-D40355A65 set at 34,8A (35A).

General characteristics of contactors

Control circuit: a.c.

		LC1-D09•A65	LC1-D12•A65	LC1-D17•A65	LC1-D25•A65	LC1-D32•A65	LC1-D40	LC1-D50	LC1-D63	LC1-D80
Number of poles		3 or 4	3 or 4	3	3 or 4	3	3 or 4	3	3 or 4	3 or 4
Rated current for AC3 duty (1)	A	9	12	16	25	32	40	50	63	80
Max. continuous current, AC1 duty (2)	A	25	25	32	40	50	60	80	80	125
Rated operational voltage	V	660	660	660	660	660	660	660	660	660

Environment

Conformity to standards (standard version)		IEC 158-1, NF C 63-110, VDE 0660, BS 5424, JEM 1038								
Approvals (standard version)		ASE, CSA, UL, DEMKO, NEMKO, BV, GL, LROS, RINA, USSR (LC1-D17 and D32 - Approvals pending)								
Protective terminal cover (3)		Integral	Integral	Integral	Integral	Integral	Separate	Separate	Separate	Separate
Protective treatment standard version		TC	TC	TC	TC	TC	TC	TC	TC	TH
special version		TH	TH	TH	TH	TH	TH	TH	TH	–
Ambient temperature for storage	°C	from – 60 to + 80	from – 60 to + 80	from – 60 to + 80	from – 60 to + 80	from – 60 to + 80	from – 60 to + 80	from – 60 to + 80	from – 60 to + 80	from – 60 to + 80
for operation	°C	from – 50 to + 70	from – 50 to + 70	from – 50 to + 70	from – 50 to + 70	from – 50 to + 70	from – 50 to + 70	from – 50 to + 70	from – 50 to + 70	from – 50 to + 70
Operating altitude	m	3000	3000	3000	3000	3000	3000	3000	3000	3000
Operating position with respect to normal vertical mounting plane		± 30°	± 30°	± 30°	± 30°	± 30°	± 30°	± 30°	± 30°	± 30°

Pole characteristics

Rated insulation voltage IEC 158-1	V	660	660	660	660	660	660	660	660	660
conforming to VDE 0110 grC	V	750	750	750	750	750	750	750	750	750
Frequency limits of operating current	Hz	from 25 to 400	from 25 to 400	from 25 to 400	from 25 to 400	from 25 to 400	from 25 to 400	from 25 to 400	from 25 to 400	from 25 to 400
Maximum continuous current, Ith for AC1 duty conforming to IEC Ambient temperature Θ ≤ 40°C	A	25	25	32	40	50	60	80	80	125
Making capacity conforming to IEC 158-1	A	250	250	300	450	550	800	900	1000	1100
Breaking capacity 220-380-415-440 V	A	250	250	300	450	550	800	900	1000	1100
500 V	A	175	175	250	400	480	800	900	1000	1100
conforming 660 V	A	85	85	120	180	200	400	500	630	640
to IEC 158-1 1000 V	A	–	–	–	–	–	–	–	–	–
Short time rating duration: 1 s	A	225	225	270	400	500	720	810	900	990
provided no current 5 s	A	130	130	190	220	270	430	500	600	720
flows during preceding: 10 s	A	100	100	130	200	260	320	400	510	640
15 minutes for LC1-D 30 s	A	70	70	90	120	180	200	210	230	350
1 hour for LC1-F 1 mn	A	56	56	70	100	140	170	190	200	250
Ambient temperature 3 mn	A	35	35	50	60	80	110	125	125	150
Θ ≤ 40°C 15 mn	A	30	30	40	50	60	80	90	90	135
Protection against short-circuits By fuses (maximum size)										
• Motor circuit type aM	A	12	16	20	25	32	63	63	63	80
(with thermal overload) type g1	A	20	25	32	50	63	100	100	100	125
• Non-motor circuit type g1	A	25	25	32	40	50	63	80	80	125
Impedance per pole	mΩ	2,5	2,5	2,5	2	2	1,5	1,5	1	0,8
Heat dissipation per pole AC1 duty	W	1,56	1,56	2,5	3,2	5	5,4	9,6	6,4	12,5
at rated current AC3 duty	W	0,20	0,36	0,6	1,25	2	2,4	3,7	3,9	5,1
Terminal capacity maximum c.s.a. Number of conductors		1 2	1 2	1 2	1 2	1 2	1 2	1 2	1 2	1 2
Bars	mm²	– –	– –	– –	– –	– –	– –	– –	– –	– –
Flexible without cable end	mm²	4 4	4 4	6 6	10 6	10 10	16 10	25 16	25 16	50 35
Flexible with cable end	mm²	2,5 2,5	2,5 2,5	4 4	4 4	6 6	10 10	16 16	16 16	50 25
Solid without cable end	mm²	4 4	4 4	6 6	6 –	10 10	10 10	25 –	25 –	50 –
Cable with lug	mm²	– –	– –	– –	– –	– –	– –	– –	– –	– –
Cable with connector	mm²	– –	– –	– –	– –	– –	– –	– –	– –	– –

(1) Ambient temperature ≤ 55°C (2) Ambient temperature ≤ 40°C (3) Protection against direct finger contact

	LC1-FF4	LC1-FG4	LC1-FH4	LC1-FJ4	LC1-FK4	LC1-FL4	LC1-FX4
	3 or 4	3 or 4	3 or 4	2, 3 or 4	2, 3 or 4	2, 3 or 4	3 or 4
A	115	185	265	400	500	630	780
A	200	270	350	500	700	1000	1600
V	1000	1000	1000	1000	1000	1000	1000

Environment

	IEC 158-1, NF C 63-110, VDE 0660, BS 5424, JEM 1038						
	ASE, CSA, UL, BV, GL, (LROS, RINA, USSR, NORSK VERITAS, pending)						
	Separate	Separate	Separate	Separate	Separate	Separate	Not available
	TH	TH	TH	TH	TH	TH	TH
	–	–	–	–	–	–	–
°C	from −60 to +80	from −60 to +80	from −60 to +80	from −60 to +80	from −60 to +80	from −60 to +80	from −60 to +80
°C	from −50 to +70	from −50 to +70	from −50 to +70	from −50 to +70	from −50 to +70	from −50 to +70	from −50 to +70
m	3000	3000	3000	3000	3000	3000	3000
	± 30°	± 30°	± 30°	± 30°	± 30°	± 30°	± 30°

Pole characteristics

V	1000		1000		1000		1000		1000		1000		1000	
V	1500		1500		1500		1500		1500		1500		1500	
Hz	from 25 to 400		from 25 to 400		from 25 to 400		from 25 to 400		from 25 to 400		from 25 to 400		from 25 to 400	
A	200		270		350		500		700		1000		1600	
A	1250		1800		2450		4000		5000		6300		8000	
A	1250		1800		2450		4000		5000		6300		7100	
A	1050		1600		2200		3500		4500		5400		6100	
A	800		1150		1750		3000		3500		5000		5000	
A	400		600		800		1120		2500		3200		3200	
A	1100		1500		2200		3600		4200		5050		6250	
A	1100		1500		2200		3600		4200		5050		6250	
A	1100		1500		2200		3600		4200		5050		6250	
A	640		920		1230		2400		3200		4400		5600	
A	520		740		950		1700		2400		3400		4600	
A	400		500		620		1200		1500		2200		3000	
A	320		400		460		1000		1200		1600		2200	
A	125		200		315		400		500		630		800	
A	200		315		500		630		800		800		1000	
A	200		315		400		500		800		1000		2 x 800 (4)	
mΩ	0,45		0,36		0,32		0,28		0,18		0,12		0,10	
W	18		26		39		70		88		120		250	
W	6		12		22		45		45		48		60	
	1	2	1	2	1	2	–	2	–	2	–	2	–	2
mm	–	20 x 3	–	25 x 3	–	32 x 4	–	30 x 5	–	40 x 5	–	60 x 5	–	100 x 5
mm²	–	–	–	–	–	–	–	–	–	–	–	–	–	–
mm²	–	–	–	–	–	–	–	–	–	–	–	–	–	–
mm²	–	–	–	–	–	–	–	–	–	–	–	–	–	–
mm²	95	–	150	–	240	–	–	150	–	240	–	–	–	–
mm²	95	–	150	–	240	–	–	–	–	–	–	–	–	–

(4): Do not connect in parallel before checking with fuse manufacturer

General characteristics of contactors

Control circuit: a.c.

Control circuit characteristics

			LC1-D09•A65	LC1-D12•A65	LC1-D17•A65	LC1-D25•A65	LC1-D32•A65	LC1-D40	LC1-D50	LC1-D63	LC1-D80
Nominal control voltage	50 Hz	V	12 to 660	12 to 660	12 to 660	12 to 660	12 to 660	12 to 660	12 to 660	12 to 660	12 to 660
	60 Hz	V	12 to 660	12 to 660	12 to 660	12 to 660	12 to 660	12 to 660	12 to 660	12 to 660	12 to 660
Operating limits											
pick-up	50/60 Hz	% Un	0,85 to 1,1	0,85 to 1,1	0,85 to 1,1	0,85 to 1,1	0,85 to 1,1	0,85 to 1,1	0,85 to 1,1	0,85 to 1,1	0,85 to 1,1
drop-out	50/60 Hz	% Un	0,3 to 0,55	0,3 to 0,55	0,3 to 0,55	0,3 to 0,55	0,3 to 0,55	0,3 to 0,6	0,3 to 0,6	0,3 to 0,6	0,3 to 0,6
Average consumption											
a.c. supply 50 Hz	Inrush	VA	70	70	70	110	110	200	200	200	200
	Sealed	VA	8	8	8	11	11	20	20	20	20
60 Hz	Inrush	VA	80	80	80	115	115	200	200	200	200
	Sealed	VA	8	8	8	11	11	20	20	20	20
Heat dissipation at 50 and 60 Hz		W	1,8 to 2,7	1,8 to 2,7	1,8 to 2,7	3 to 4	3 to 4	6 to 10	6 to 10	6 to 10	6 to 10

Average operating time at nominal voltage Un (in milliseconds)

Closing time is measured from the switch-on of the control supply to the initial contact of the main poles. Opening time is measured from the instant of disconnection of the coil voltage to the separation of the main poles.

Closing	m.sec	12 to 22	12 to 22	12 to 22	15 to 24	15 to 24	20 to 26	20 to 26	20 to 26	20 to 35
Opening	m.sec	4 to 12	4 to 12	4 to 12	5 to 19	5 to 19	8 to 12	8 to 12	8 to 12	6 to 20

Note: The arcing time depends upon the circuit controlled by the poles. For 3-phase current arcing time is normally less than 10 ms. The load is isolated from the supply after a time equal to the sum of the opening time and the arcing time.

Mechanical life in millions of operations		20	20	20	20	20	20	20	20	10
Maximum operating rate mechanical operations (ambient temperature ≤ 55 °C)	ops/h	3600	3600	3600	3600	3600	3600	3600	3600	3600

Characteristics of mechanical latch blocks

		LA6-DK01	LA6-DK01	LA6-DK01	LA6-DK01	LA6-DK01	LA6-DK02 •A65	LA6-DK02 •A65	LA6-DK02 •A65	LA6-DK03 •A65
Control circuit voltage	V 50/60 Hz	24 to 660	24 to 660	24 to 660	24 to 660	24 to 660	24 to 660	24 to 660	24 to 660	24 to 660
Minimum operating power	VA	60	60	60	60	60	100	100	100	100

Manual or electrical unlatching (pulsed or maintained).
The LA6-DK unlatch coil and the LC1-D operating coil must not be energised simultaneously.
Supply to coil broken after 15ms by integral contact . Minimum pulse time to energise de-latch coil: 10 ms.
In addition, the DK02 and DK03 have 1N/C contact which automatically cuts the supply to the coil.
Duration of impulse = operating time of contactor + 20 ms.

Characteristics of auxiliary contact blocks

Rated thermal current		A	10	10	10	10	10	10	10	10	10
Rated insulation voltage conforming to	IEC 158-1	V	660	660	660	660	660	660	660	660	660
	VDE 0110 grC	V	750	750	750	750	750	750	750	750	750
Cabling: Number of wires			2	2	2	2	2	2	2	2	2
Maximum c.s.a.		mm^2	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5

Power ratings:

Instantaneous Type LA1-D and time delay Types LA2-D/LA3-D for contactors LC1-D

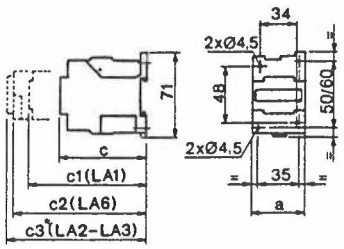
	V	48	110/127	220	380	440	660
(a.c. switching) 1 million ops.	VA	300	500	600	520	500	390
3 million ops.	VA	160	300	330	300	280	190
10 million ops.	VA	70	100	110	100	100	80
Occasional making/breaking capacity	VA	3000	7000	12000	15000	14000	13000

Electrical life (valid up to 3600 operations per hour) on inductive load, such as the coil of an electromagnet: making current (Cos φ 0,7) = 10 times the breaking current (Cos φ 0,4).

Dimensions

of LC1-D contactors
of LC2-D reversing contactors
of LC3-D star-delta starters

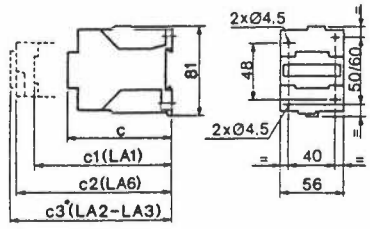
LC1-D09••A65, D12••A65, D17••A65



LC1-	a	c	c1	c2	c3
D09••A65, D12••A65	44	79	109	121	131
D17••A65	45	84	114	126	136

★ + 4 with lead sealing kit

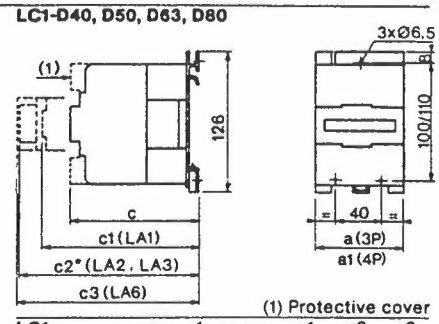
LC1-D25••A65, D32••A65



LC1-	c	c1	c2	c3
D25••A65	94	124	133	146
D32••A65	99	129	138	151

★ + 4 with lead sealing kit

LC1-D40, D50, D63, D80



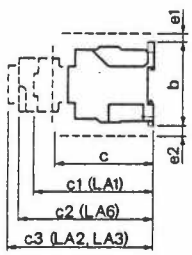
(1) Protective cover

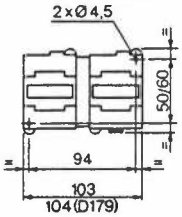
LC1-	a	a1	c	c1	c2	c3
D40, D50, D63	75	85	112	142	164	165
D80	85	96	121(2)	151	173	170

★ + 4 with lead sealing kit
(2) + 3 with protective cover

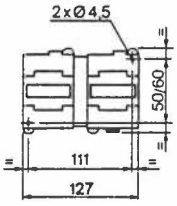
LC2-D099•A65, D12••A65, D179•A65, D25••A65, D329•A65

D09, D12, D179





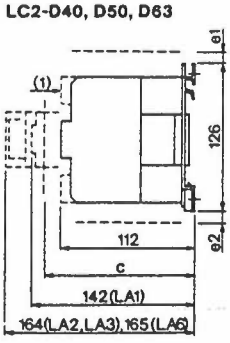
D25, D329

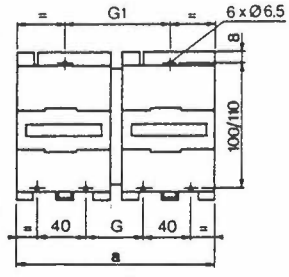


LC2-	b	c (3P)	c (4P)	c1	c2	c3	e1 (3P)	e2 (4P)
D099•A65	71	85	–	109	121	131	7	–
D12••A65	71	85	79	109	121	131	7	8
D179•A65	71	92	–	114	126	136	10	–
D25••A65	81	100	100	124	133	146	10	5
D329•A65	81	112	–	129	138	151	20	–

LA2, LA3: + 4 with lead sealing kit
c, e1 and e2: cabling included

LC2-D40, D50, D63

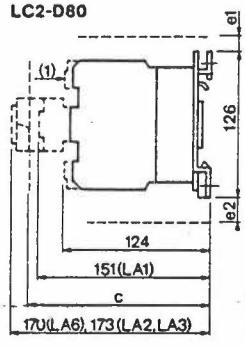


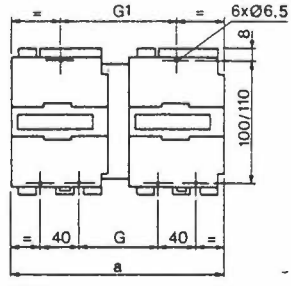


(1) protective cover
LA2, LA3: + 4 with lead sealing kit
c, e1 and e2: cabling included

LC2-	a	c D40	c D50	c D63	e1 D40	e1 D50	e1 D63	e2 D40	e2 D63	G	G1
3P	165	137	148	148	10	5	5	–	–	50	90
4P	182	115	–	133	–	–	–	11	11	57	97

LC2-D80

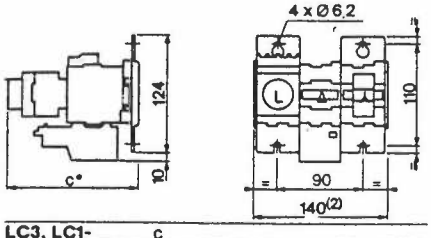




(1) protective cover
LA2, LA3: + 4 with lead sealing kit
c, e1 and e2: cabling included

LC2-D80	a	c	e1	e2	G	G1
3P	182	158	13	–	57	97
4P	207	158	–	20	71	111

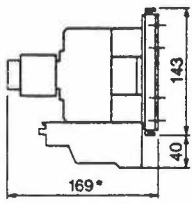
On mounting plate:
Mounted by Telemecanique: **LC3-D123, D173**
Mounted by customer: **LC1-D123, D173 (1)**



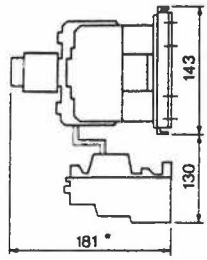
LC3, LC1-	c
D123	140
D173	144

★ + 4 mm with lead sealing kit
(1) Line contactor (L)
(2) + 20 mm with mechanically interlocked star and delta contactors
Note: L: KM2; Δ: KM3; λ: KM1

LC3-D403, D503
LC1-D503 (1)

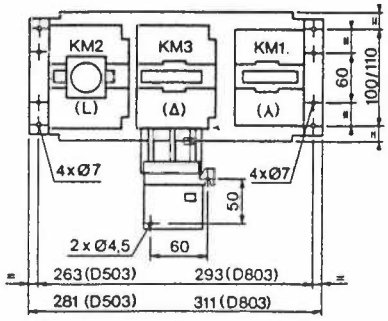


LC3-D803
LC1-D803 (1)



★ + 4 mm with lead sealing kit
(1) Line contactor (L)

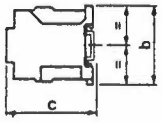
LC3-D403, D503, D803
LC1-D503, D803 (1)



Mounting

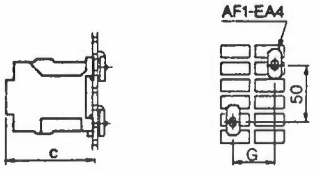
of LC1-D contactors

LC1-D09••A65 to D32••A65
On AM1-DP200 or DE200 rail



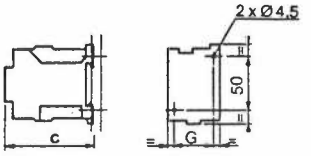
LC1-	D09, D12	D17	D25	D32
b	71	71	81	81
c on AM1-DP200	82	87	98	103
c on AM1-DE200	90	95	106	111

On pre-slotted plate AM1-PA, PB, PC



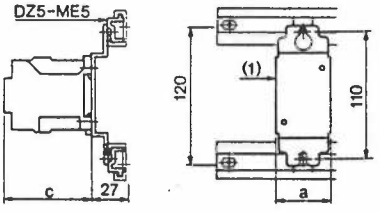
LC1-	D09, D12	D17	D25	D32
c	79	84	94	99
G	35	35	40	40

On base plate



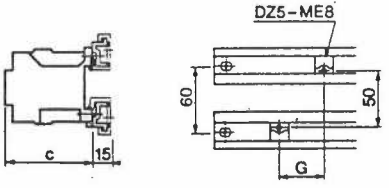
LC1-	D09, D12	D17	D25	D3
c	79	84	94	9
G	35	35	40	4

LC1-D09••A65 to D32••A65
On 2 DZ5-MB mounting rails at 120 mm fixing centres



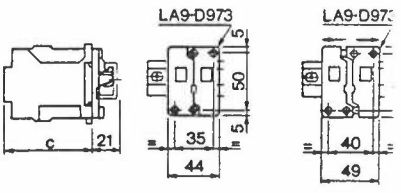
LC1-	D09, D12	D17	D25	D32
a	45	45	57	57
c	79	84	94	99
(1)	DX1-AP25		DX1-AP26	

On 2 DZ5-MB mounting rails at 60 mm fixing centres



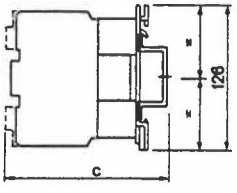
LC1-	D09, D12	D17	D25	D32
c	79	84	94	99
G	35	35	40	40

On 1 DZ5-MB rail with clip-on mounting plate



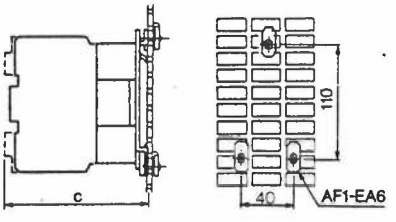
LC1-	D09, D12	D17	D25	D3
c	79	84	94	9

LC1-D40 to D80
On AM1-DL mounting rail



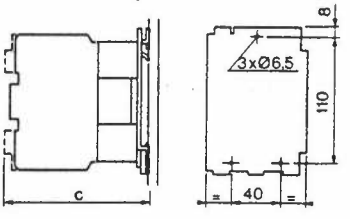
LC1-	D40	D50	D63	D80
c	129	129	129	141

On pre-slotted plate AM1-PA, PB, PC



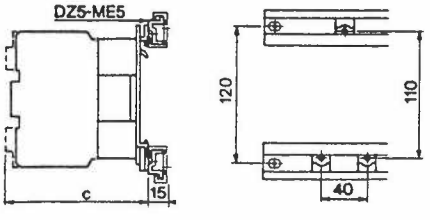
LC1-	D40	D50	D63	D80
c	112	112	112	124

On base plate



LC1-	D40	D50	D63	D8
c	112	112	112	12

LC1-D40 to D80
On 2 DZ5-MB mounting rails at 120 mm fixing centres

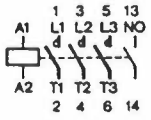


LC1-	D40	D50	D63	D80
c	112	112	112	124

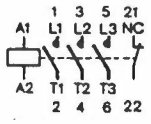
Wiring diagrams for contactors

3-pole contactors

LC1-D093 to D323 (A65)



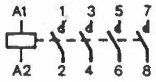
LC1-D099 to D329 (A65)



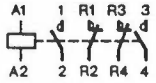
LC1-D403 to D803

4-pole contactors

LC1-D254 (A65) to D804

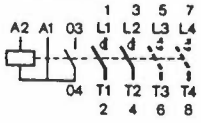


LC1-D128, D258

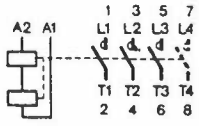


LC1-D408 to D808

LC1-FF to FL 2 to 4 poles with coil LX1-F (~)



LC1-FX4 3 to 4 poles
~ or ⎓



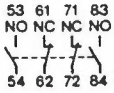
Auxiliary contacts blocks for LC1-D contactors

Instantaneous 1 N/O + 1 N/C
LA1-D11A65

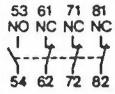
Instantaneous 2 N/O
LA1-D20A65

Instantaneous 2 N/C
LA1-D02A65

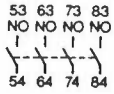
Instantaneous 2 N/O + 2 N/C
LA1-D22A65



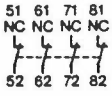
Instantaneous 1 N/O + 3 N/C
LA1-D13A65



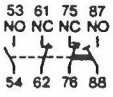
Instantaneous 4 N/O
LA1-D40A65



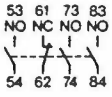
Instantaneous 4 N/C
LA1-D04A65



Instantaneous 2 N/O + 2 N/C including 1 pair make before break
LA1-D1111A65



Instantaneous 3 N/O + 1 N/C
LA1-D31A65



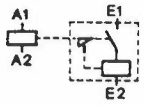
Time delay on energisation 1 N/O + 1 N/C
LA2-D20A65, D22A65, D24A65

LA2-D221A65

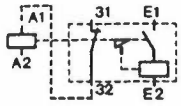
Time delay on de-energisation 1 N/O + 1 N/C
LA3-D20A65, D22A65, D24A65

Mechanical latch blocks

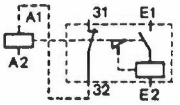
For LC1-D09 to D32
LA6-DK01•



For LC1-D40 to D63
LA6-DK02•A65

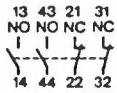


For LC1-D80
LA6-DK03•A65

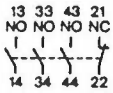


Auxiliary contact blocks for LC1-F contactors

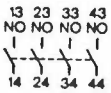
Instantaneous 2 N/O + 2 N/C
LA1-F221



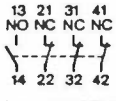
Instantaneous 3 N/O + 1 N/C
LA1-F311

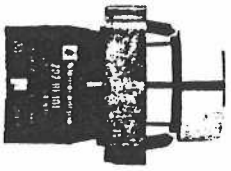


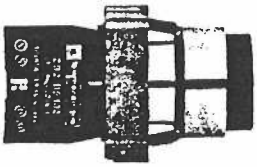
Instantaneous 4 N/O
LA1-F401

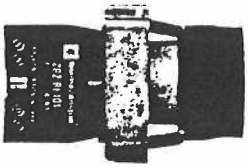


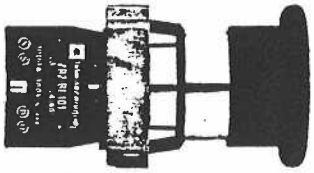
Instantaneous 1 N/O + 3 N/C
LA1-F131

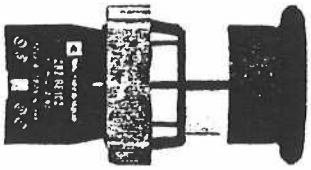


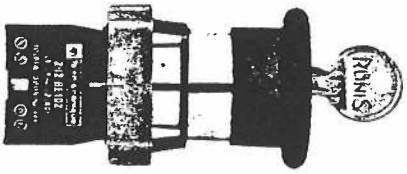

XB2-BA21

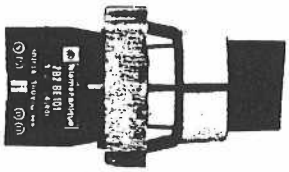

XB2-BL42

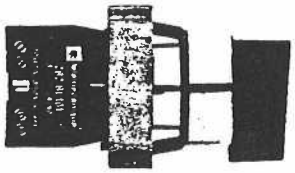

XB2-BP21

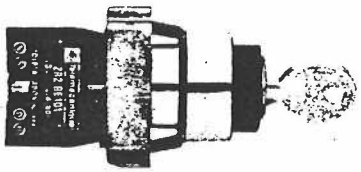

XB2-BC21


XB2-BS542


XB2-BS142


XB2-BD21

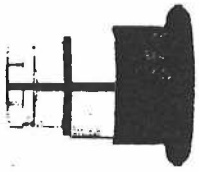

XB2-BJ21


XB2-BG21


ZB2-BZ101

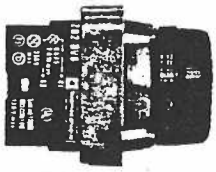

ZB2-BA2


ZB2-BZ102

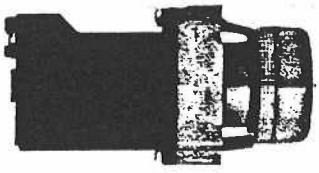

ZB2-BS54

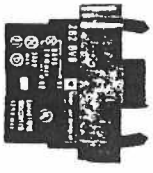

ZB2-BZ101


ZB2-BG2

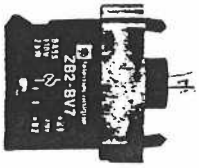

XB2-BV63


XB2-BV74

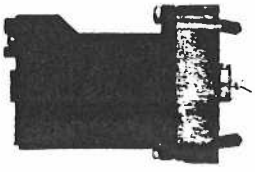

XB2-BV45


ZB2-BV6


ZB2-BV03


ZB2-BV7


ZB2-BV04


ZB2-BV4


ZB2-BV05

Control and signalling units

Ø 22,2 mm (fixing)

Screw and captive cable clamp connections

	Description	Contact	Colour	Reference Complete unit	=	Sub-assembly references Body	+	Head
Push-buttons circular heads, chromium plated metal bezels	Flush	N/O	Black	**XB2-BA21**	=	**ZB2-BZ101**	+	**ZB2-BA2**
			Green	**XB2-BA31**	=	**ZB2-BZ101**	+	**ZB2-BA3**
		N/C	Red	**XB2-BA42**	=	**ZB2-BZ102**	+	**ZB2-BA4**
			Weight kg	0,070		0,040		0,030
	Projecting	N/C	Red	**XB2-BL42**	=	**ZB2-BZ102**	+	**ZB2-BL4**
			Weight kg	0,070		0,040		0,030
	Booted	N/O	Black	**XB2-BP21**	=	**ZB2-BZ101**	+	**ZB2-BP2**
			Green	**XB2-BP31**	=	**ZB2-BZ101**	+	**ZB2-BP3**
		N/C	Red	**XB2-BP42**	=	**ZB2-BZ102**	+	**ZB2-BP4**
			Weight kg	0,070		0,040		0,030
	Mushroom head Ø 40 mm	N/O	Black	**XB2-BC21**	=	**ZB2-BZ101**	+	**ZB2-BC2**
		N/C	Red	**XB2-BC42**	=	**ZB2-BZ102**	+	**ZB2-BC4**
			Weight kg	0,090		0,040		0,050
Mushroom head stay put "Emergency stop" push-buttons circular heads, chromium plated metal bezels	Ø 40 mm Turn to release	N/C	Red	**XB2-BS542**	=	**ZB2-BZ102**	+	**ZB2-BS54**
			Weight kg	0,095		0,040		0,055
	Ø 40 mm Key release (Ronis key No. 455)	N/C	Red	**XB2-BS142**	=	**ZB2-BZ102**	+	**ZB2-BS14**
			Weight kg	0,130		0,040		0,090
Selector switches circular heads, chromium plated metal bezels	Standard handle	2 position N/O	Black	**XB2-BD21**	=	**ZB2-BZ101**	+	**ZB2-BD2**
			Weight kg	0,085		0,040		0,045
		2 position N/O + N/C	Black	**XB2-BD25**	=	**ZB2-BZ105**	+	**ZB2-BD2**
			Weight kg	0,100		0,055		0,045
		3 position N/O + N/O	Black	**XB2-BD33**	=	**ZB2-BZ103**	+	**ZB2-BD3**
			Weight kg	0,095		0,055		0,040
	Long handle	2 position N/O	Black	**XB2-BJ21**	=	**ZB2-BZ101**	+	**ZB2-BJ2**
			Weight kg	0,085		0,040		0,045
		3 position N/O + N/O	Black	**XB2-BJ33**	=	**ZB2-BZ103**	+	**ZB2-BJ3**
			Weight kg	0,100		0,055		0,045
	Key operated key No. 455	2 position N/O	Withdrawal from left	**XB2-BG21**	=	**ZB2-BZ101**	+	**ZB2-BG2**
			Weight kg	0,115		0,040		0,075
		3 position N/O + N/O	Withdrawal from centre	**XB2-BG33**	=	**ZB2-BZ103**	+	**ZB2-BG3**
			Weight kg	0,125		0,055		0,070

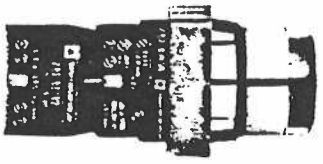
Supplementary contact blocks: see page 140.

	Supply	Voltage	Colour	Reference Complete unit	=	Sub-assembly reference Body	+	Head
Pilot lights circular heads, chromium plated metal bezels	Direct supply Bulb BA 9s not included	≤ 380 V	Green	**XB2-BV63**	=	**ZB2-BV6**	+	**ZB2-BV03**
			Red	**XB2-BV64**	=	**ZB2-BV6**	+	**ZB2-BV04**
			Yellow	**XB2-BV65**	=	**ZB2-BV6**	+	**ZB2-BV05**
			Weight kg	0,070		0,045		0,025
	With series resistor Bulb BA 9s 130 V supplied	220 to 250 V	Green	**XB2-BV73**	=	**ZB2-BV7**	+	**ZB2-BV03**
			Red	**XB2-BV74**	=	**ZB2-BV7**	+	**ZB2-BV04**
			Yellow	**XB2-BV75**	=	**ZB2-BV7**	+	**ZB2-BV05**
			Weight kg	0,080		0,055		0,025
	With transformer incorporated 1,2 VA Bulb BA 9s 6 V supplied	110 V: 50 Hz 110-120 V: 60 Hz	Green	**XB2-BV33**	=	**ZB2-BV3**	+	**ZB2-BV03**
			Red	**XB2-BV34**	=	**ZB2-BV3**	+	**ZB2-BV04**
			Yellow	**XB2-BV35**	=	**ZB2-BV3**	+	**ZB2-BV05**
		220 V: 50 Hz	Green	**XB2-BV43**	=	**ZB2-BV4**	+	**ZB2-BV03**
			Red	**XB2-BV44**	=	**ZB2-BV4**	+	**ZB2-BV04**
			Yellow	**XB2-BV45**	=	**ZB2-BV4**	+	**ZB2-BV05**
			Weight kg	0,130		0,105		0,025

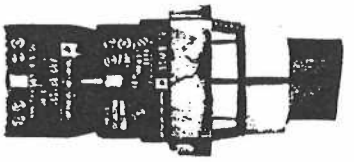
Bulb for direct supply: BA 9s incandescent type: V ≤ 130 V, maximum power 2,6 W.
Neon bulbs 110 V ≤ U ≤ 380 V, Ø max. 11 mm, length 28 mm maximum. (See page 140.)

Other versions

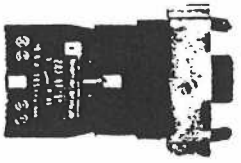
Bodies with tag connectors, contacts for low current switching or time delay contacts.
Push-button heads of different colours "mushroom head" push-pull, stay-put.
Key selector switches with other position combinations, with other key numbers.
Black metal bezels for push-buttons, selector switches and pilot lights.
Pilot lights and illuminated push-buttons with transformer for other supply voltages from 24-600 V (50 or 60 Hz) with white, blue or clear lenses. Flashing or variable luminosity pilot lights.
For further information please consult our local agent or representative.



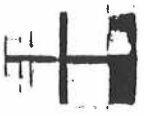
XB2-BW3365



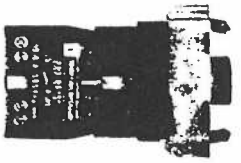
XB2-BK12365



ZB2-BW065

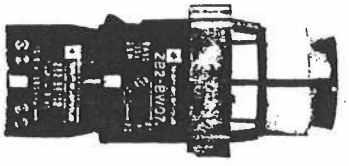


ZB2-BW33

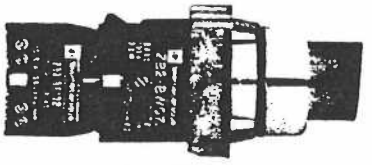


ZB2-BW065

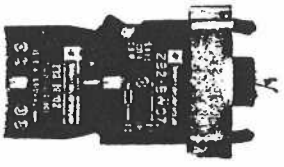
ZB2-BK123



XB2-BW3475

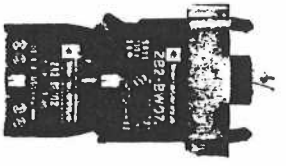


XB2-BK12475



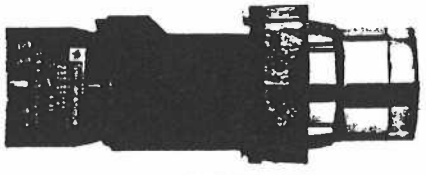
ZB2-BW075

ZB2-BW34



ZB2-BW075

ZB2-BK124



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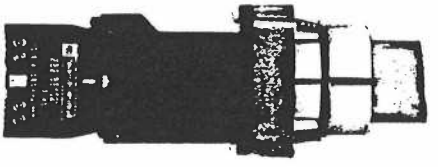
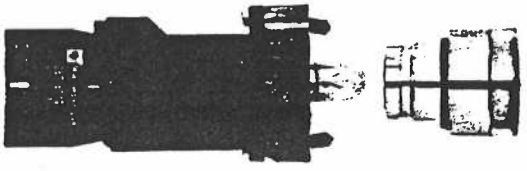
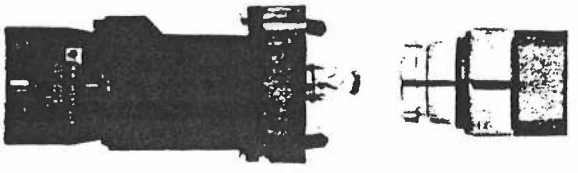


XB2-BK13545



ZB2-BW045

ZB2-BW35



ZB2-BW045

ZB2-BK135

Ø 22,2 (fixing)

Screw and captive cable clamp connections

Flush illuminated push-buttons with circular heads and chromium plated metal bezels 1 N/O+1 N/C contact

Type	Voltage	Colour	Reference of complete unit	Sub-assembly references − Body	+ Head
Direct supply Bulb BA9s not included	< 380 V	Green	XB2-BW3365	− ZB2-BW065	+ ZB2-BW33
		Red	XB2-BW3465	− ZB2-BW065	+ ZB2-BW34
		Yellow	XB2-BW3565	− ZB2-BW065	+ ZB2-BW35
		Weight kg	0,100	0,075	0,025
With series resistor Bulb BA9s 130 V supplied	220 to 250 V	Green	XB2-BW3375	− ZB2-BW075	+ ZB2-BW33
		Red	XB2-BW3475	− ZB2-BW075	+ ZB2-BW34
		Yellow	XB2-BW3575	− ZB2-BW075	+ ZB2-BW35
		Weight kg	0,105	0,080	0,025
With transformer incorporated 1,2 VA Bulb BA9s 6 V supplied	110 V: 50 Hz 110-120 V: 60 Hz	Green	XB2-BW3335	− ZB2-BW035	+ ZB2-BW33
		Red	XB2-BW3435	− ZB2-BW035	+ ZB2-BW34
		Yellow	XB2-BW3535	− ZB2-BW035	+ ZB2-BW35
		Weight kg	0,160	0,135	0,025
	220 V: 50 Hz	Green	XB2-BW3345	− ZB2-BW045	+ ZB2-BW33
		Red	XB2-BW3445	− ZB2-BW045	+ ZB2-BW34
		Yellow	XB2-BW3545	− ZB2-BW045	+ ZB2-BW35
		Weight kg	0,160	0,135	0,025

Illuminated selector switches with circular heads and chromium plated metal bezels 1 N/O+1 N/C contact

Type	Voltage	Colour	Reference of complete unit	Sub-assembly references − Body	+ Head
2 position stayput					
Direct supply Bulb BA9s not included	< 380 V	Green	XB2-BK12365	− ZB2-BW065	+ ZB2-BK123
		Red	XB2-BK12465	− ZB2-BW065	+ ZB2-BK124
		Yellow	XB2-BK12565	− ZB2-BW065	+ ZB2-BK125
		Weight kg	0,110	0,075	0,035
With series resistor Bulb BA9s 130 V supplied	220 to 250 V	Green	XB2-BK12375	− ZB2-BW075	+ ZB2-BK123
		Red	XB2-BK12475	− ZB2-BW075	+ ZB2-BK124
		Yellow	XB2-BK12575	− ZB2-BW075	+ ZB2-BK125
		Weight kg	0,115	0,080	0,035
With transformer incorporated 1,2 VA Bulb BA9s 6 V supplied	110 V: 50 Hz 110-120 V: 60 Hz	Green	XB2-BK12335	− ZB2-BW035	+ ZB2-BK123
		Red	XB2-BK12435	− ZB2-BW035	+ ZB2-BK124
		Yellow	XB2-BK12535	− ZB2-BW035	+ ZB2-BK125
		Weight kg	0,170	0,135	0,035
	220 V: 50 Hz	Green	XB2-BK12345	− ZB2-BW045	+ ZB2-BK123
		Red	XB2-BK12445	− ZB2-BW045	+ ZB2-BK124
		Yellow	XB2-BK12545	− ZB2-BW045	+ ZB2-BK125
		Weight kg	0,170	0,135	0,035
3 position stayput					
Direct supply Bulb BA9s not included	< 380 V	Green	XB2-BK13365	− ZB2-BW065	+ ZB2-BK133
		Red	XB2-BK13465	− ZB2-BW065	+ ZB2-BK134
		Yellow	XB2-BK13565	− ZB2-BW065	+ ZB2-BK135
		Weight kg	0,110	0,075	0,035
With series resistor Bulb BA9s 130 V supplied	220 to 250 V	Green	XB2-BK13375	− ZB2-BW075	+ ZB2-BK133
		Red	XB2-BK13475	− ZB2-BW075	+ ZB2-BK134
		Yellow	XB2-BK13575	− ZB2-BW075	+ ZB2-BK135
		Weight kg	0,115	0,080	0,035
With transformer incorporated 1,2 VA Bulb BA9s 6 V supplied	110 V: 50 Hz 110-120 V: 60 Hz	Green	XB2-BK13335	− ZB2-BW035	+ ZB2-BK133
		Red	XB2-BK13435	− ZB2-BW035	+ ZB2-BK134
		Yellow	XB2-BK13535	− ZB2-BW035	+ ZB2-BK135
		Weight kg	0,170	0,135	0,035
	220 V: 50 Hz	Green	XB2-BK13345	− ZB2-BW045	+ ZB2-BK133
		Red	XB2-BK13445	− ZB2-BW045	+ ZB2-BK134
		Yellow	XB2-BK13545	− ZB2-BW045	+ ZB2-BK135
		Weight kg	0,170	0,135	0,035

Bulb required for direct supply: type BA9s incandescent bulb U < 130 V, maximum power 2,6 W.
Neon bulb 110 V < U < 380 V, Ø max 11 mm, maximum length 28 mm (DL1-C●●●●, see page 140).

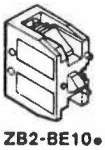
Sub-assemblies for supplementary contact adaptation (see page 140).

Other versions

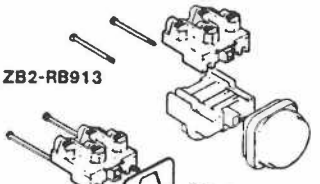
Bodies for illuminated push-buttons and selector switches:
with transformers for other voltages from 24 to 600 V (50 or 60 Hz),
with contacts for low current switching or with tag connections.
Heads with white, blue or clear push-buttons, heads with black bezels.
For further information please consult our local agent or representative.

Spare parts and accessories

for manual control and signalling units Ø 22 and Ø 30

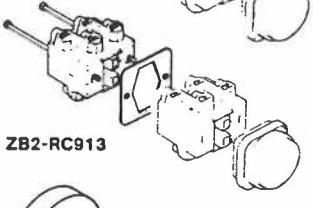


ZB2-BE10•



ZB2-RB913

ZB2-RA914



ZB2-RC913

ZB2-MP022

DL1-BA•••

DL1-FA•••

DL1-C••••

DL1-EA•••

ZB2-MV001

ZB2-MV004

ZB2-MZ51

XBF-X13

Additional contact blocks

Description	Reference	Weight kg	Description	Reference	Weight kg
Sub-assemblies to provide additional contacts					
On XB2-B with 1 or 2 contacts, to provide a 2, 3, 4, 5 or 6 contact body or a spare 1st or 2nd element					
N/O contact	**ZB2-BE101**	0.015	N/C contact	**ZB2-BE102**	0.015
On XB2-M units with 1 or 2 C/O contacts for a total of 2, 3 or 4 C/O contacts (with spacers and screws)					
2nd C/O contact	**ZB2-RB913**	0.050	3rd and 4th C/O contacts	**ZB2-RC913**	0.100
3rd C/O contact	**ZB2-RA914**	0.055			
Spare contact blocks, break before make (standard)					
1st or 3rd C/O contact	**ZB2-RA91**	0.040	2nd or 4th C/O contact	**ZB2-RB91**	0.040
Spare contact blocks, make before break					
1st or 3rd C/O contact	**ZB2-RA92**	0.040	2nd or 4th C/O contact	**ZB2-RB92**	0.040
Resistor block for XB2-MV pilot lights and XB2-MW illuminated push-buttons					
220/240 V supply	**ZB2-MV04**	0.030	380/415 V supply	**ZB2-MV05**	0.030

Spare parts

Neoprene boots for XB2-MP push-buttons (with locking ring)					
Black	**ZB2-MP022**	0.035	Red	**ZB2-MP024**	0.035
Green	**ZB2-MP023**	0.035	Yellow	**ZB2-MP025**	0.035
Lenses for XB2-MV pilot lights (with gasket)					
Green	**ZB2-MV903**	0.005	Yellow	**ZB2-MV905**	0.005
Red	**ZB2-MV904**	0.005	Clear	**ZB2-MV907**	0.005
Lenses for XB2-MW illuminated push-buttons					
Green	**ZB2-MW903**	0.010	Yellow	**ZB2-MW905**	0.010
Red	**ZB2-MW904**	0.010	Clear	**ZB2-MW907**	0.010

Bulbs

Sold in lots of 10

Incandescent type for Ø 22.2 mm units
BA9s base: max dia. 11 mm; max length 28 mm

Voltage	Power	Unit Reference	Weight kg
6 V	1.5 W	**DL1-CB006**	0.002
12 V	2.6 W	**DL1-CE012**	0.002
24 V	2.6 W	**DL1-CE024**	0.002
48 V	2.6 W	**DL1-CE048**	0.002
130 V	2.6 W	**DL1-CE130**	0.002

Neon type for Ø 22.2 mm units
BA9s base: max dia. 11 mm; max length 28 mm

Voltage	Unit Reference	Weight kg
110 V	**DL1-CF110**	0.002
220 V	**DL1-CF220**	0.002
380 V	**DL1-CF380**	0.002

Incandescent type for Ø 30.5 mm units
Maximum power 5 W, maximum dia. 18 mm, maximum length 35 mm

Type BA15d				
6 V	**DL1-BA006**	0.010	48 V	**DL1-BA048**	0.010
12 V	**DL1-BA012**	0.010	110/160 V	**DL1-BA160**	0.010
24 V	**DL1-BA024**	0.010	220/260 V	**DL1-BA260**	0.010
Type E14					
6 V	**DL1-FA006**	0.005	48 V	**DL1-FA048**	0.005
12 V	**DL1-FA012**	0.005	110/160 V	**DL1-FA160**	0.005
24 V	**DL1-FA024**	0.005	220/260 V	**DL1-FA260**	0.005
Type BA9s					
6 V	**DL1-CB006**	0.002	24 V	**DL1-CA024**	0.005
12 V	**DL1-CA012**	0.005			
Type E10/13					
6 V	**DL1-EA006**	0.002	24 V	**DL1-EA024**	0.002
Type BA7s (for signalling lamps with incorporated transformer)					
6 V - 200 mA	**DL1-GA006**	0.002			
Adaptors					
BA15d/E14	**ZB2-MY001**	0.002	BA15d/E10/13	**ZB2-MV004**	0.007
BA15d/BA9s	**ZB2-MV005**	0.007			

Tools

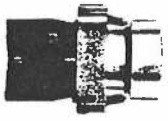
Bezel tightening tool	**ZB2-MZ5**	0.165	Extractor for BA15d or E14 bulbs	**ZB2-AZ6**	0.025
Tool for mounting XB2-MR units	**ZB2-MZ51**	0.030	Extractor for BA7s or BA9s bulbs	**XBF-X13**	0.005

Selection guide for control and signalling units

2 ranges of dust and damp protected units with double break self-cleaning contacts

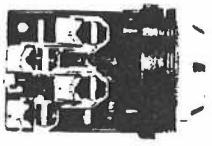
References : see pages 127 to 133
Characteristics: see pages 142 and 143
Dimensions : see page 147

Which range?



XB2-B (Ø 22.2), if you need

- Maximum adaptability for a minimum number of parts in stock.
- Rapid combination of all types of control heads, in all colours, with different types of contact bodies.
- A large number of buttons and pilot lights in the minimum amount of space, example: small enclosures, control desks, control panels for small and medium size machines (fixing centres 30 x 40).
- Compact overall dimensions (fixing centres and depth).
- Rear fixing (by 2 screws).



XB2-M (Ø 30.5), if you need

- Standard double pole changeover contact blocks.
- Monoblock equipment, with non-transformable head.
- Equipment for use in an environment where gloves are worn, example: steel works, foundries, chemical plants, cement works, construction industry.
- Front fixing by bezel.

Which type of unit in the range?

Flush push-button — for general use.

Booted push-button — for better protection in dusty atmospheres.

Mushroom head push-button — for emergencies (or frequent repetitive action: operated with the palm rather than the finger).

Selector switch — for selection with indication.

Key operated selector switch — for use restricted to authorized personnel.

Illuminated push-button — for a compact combination of signalling and control.

Which colour? (Recommended colour code, generally to IEC 73)

Push-buttons

	Significance	Typical applications
Red	**Action in case of emergency**	• Emergency stop. • Fire alarm.
	Stop or off	• General stop. • Stop one or several motors. • Combined stop/ reset.
Yellow	**Intervention**	• Manual intervention to prevent abnormal conditions arising. • Override function during an automatic cycle.
Black or Green	**Start or on**	• General start. • Start one or several motors. • Start of machine elements. • Close an automatic switching device.

Pilot lights

	Significance	Explanation	Typical applications
Red	**Alarm or danger**	Warning of potential danger or of a situation requiring immediate action.	• Lubrication system failure. • Essential item of plant stopped by action of a protection unit. • Danger to persons from exposed live or moving parts.
Yellow	**Attention or caution**	Change or imminent change of conditions.	• Abnormal pressure level. • Overload – acceptable for a short duration only.
Green	**Safety**	Indication of a safe condition or authorisation to proceed	• Cooling liquid circulating. • Automatic boiler control in operation. • Machine ready for start or re-start.

Illuminated push-buttons

These same recommendations apply equally to illuminated push-buttons. However the significance of the colour used must comply with both sets of requirements: for pilot lights, when the button is illuminated and for push-buttons when functioning as a push-button.
If correct colour selection is difficult, a clear lens should be used.

General characteristics of control and signalling units

Ø 22,2 (fixing)

References : see pages 127 to 131
Selection guide: see page 141
Dimensions : see page 147

Environment

Conformity to standards	**XB2-B, XD2-P :** IEC 337-1, IEC 337-2, NF C 63-140, ASE 0119, ASE 1003, BS 4794, VDE 0660 part 2, UL 506, UL 508, CSA C 22-2 n° 14, CSA C 22-2 n° 66. **XB2-EV :** IEC 337-2.
Approvals	**XB2-B** standard version: CSA: push-buttons and selector switches A600-Q600; pilot lights and illuminated push-buttons d.c. supply (120 V max); pilot lights and illuminated push-buttons with transformer (110/6 V and 220/6 V). UL: push-buttons and selector switches A600-Q600; pilot lights and illuminated push-buttons d.c. supply (120 V max); pilot lights and illuminated push-buttons with transformer (110/6 V and 220/6 V). ASE, DEMKO, NEMKO, SEMKO, BUREAU VERITAS, SÄHKÖTARKASTUSKESKUS, USSR, GL. **XD2-P**, standard version: CSA A600-Q600.
Protective treatment	Standard version: "All climates".
Ambient temperature	Operating: −25 to +70°C. Storage: −40 to +70°C.
Resistance to vibration	Ø 60 mm mushroom head: 8 g. Other push-buttons: 15 g. Small joystick controllers: 5 g (from 40 to 500 Hz). Conforming to IEC 68-2-6.
Resistance to shock	Push-buttons: 70 g. Mushroom head push-buttons: 15 g. Selector switches: 200 g. Conforming to IEC 68-2-27.
Protection against electric shock	**XB2-B, XD2-P:** Class I, conforming to IEC 536 and NF C 20-030. **XB2-EV:** Class II, conforming to IEC 536 and NF C 20-030.
Degree of protection conforming to IEC 529 and NF C 20-010	**XB2-B, XD2-P:** IP 65: flush and projecting, illuminated and non-illuminated push-buttons (mounted). IP 66: booted and mushroom head push-buttons, selector switches, pilot lights and small joystick controllers (mounted). IP 40: double-headed push-buttons (IP 65 on request). **XB2-EV:** IP 40.
Mechanical life	1 million operations (latching mushroom head push-buttons: 300.000 operations).

Contact block characteristics

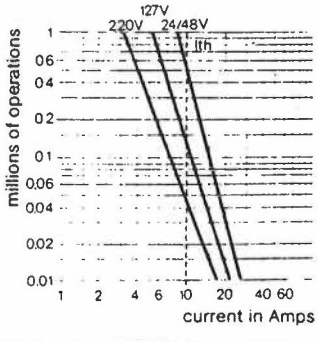
Nominal thermal current	10 A conforming to IEC 337-1, NF C 63-140, UL 508, CSA C 22-2 n° 14, VDE 0660 part 2.
Nominal insulation voltage	500 V conforming to NF C 20-040, VDE 0110, IEC 158-1, 600 V conforming to UL 508, 600 V conforming to CSA C 22-2 n° 14.
Insulation category	Group C conforming to NF C 20-040 and VDE 0110.
Contact operation	Slow break N/O or N/C.
Contact resistance	< 25 mΩ.
Operating force	Flush or projecting push-buttons – with 1 N/O contact: 10 N – with 1 N/C contact: 8 N. Additional contacts – N/O: + 5 N – N/C: + 3 N.
Terminal referencing	Conforming to CENELEC EN 50013.
Short circuit protection	10 A cartridge fuses, gI or N conforming to IEC 337-1B and VDE 0660 part 2.

Rated power
conforming to IEC 337-1
duty categories AC11-DC11

Operating frequency: 3.600 ops/hour
Load factor: 0,5

AC supply ~ (ac) 50-60 Hz

Inductive circuit



DC supply ⎓ (dc)

Power broken in Watts
for 1 million operations

Voltage V	**24**	**48**	**120**
	65	48	40

Cabling	**XB2-B, XD2-P:** Screw and captive cable clamp terminals. Capacity: minimum 1 x 0,5 mm², maximum with or without cable end: 2 x 1,5 mm² or 1 x 2,5 mm² or by cable clips conforming to NF C 20-120 (on request). **XB2-EV:** On captive screw and clamp terminals or tabs 6,35 x 0,8 or twice 2,8 x 0,8.

General characteristics of control and signalling units

Ø 30.5 (fixing)

References : see page 133
Selection guide: see page 141
Dimensions : see page 147

Environment

Conformity to standards	IEC 337-1, NF C 63-140, VDE 0660 part 2, CSA C 22-2 No. 14, UL 508 and 486.
Approvals	**XB2-M** standard version: CSA: push-buttons and selector switches 600 V ~ (a.c.) and ⎓ (d.c.) heavy duty ASE, DEMKO, NEMKO, BUREAU VERITAS, SÄHKÖTARKASTUSKESKUS. UL: push-buttons and selector switches 600 V ~ (a.c.) heavy duty ⎓ (d.c.) 60 W. **XB2-M** special version: CSA: pilot lights and illuminated push-buttons, direct supply (250 V max) or via integral transformer (24/6 V to 600/6 V). UL: pilot lights and illuminated push-buttons direct supply (240 V max) or via integral transformer (24/6 V to 600/6 V).
Protective treatment	Standard version: "All climates". "TH" on request.
Ambient temperature	Storage: −40 to +70°C. Operating: −25 to +70°C.
Operating position	All positions.
Resistance to vibration	Pushbuttons, selector switches and pilot lights: > 15 g (20 to 500 Hz) conforming to IEC 68-2-6. Mushroom head pushbuttons: > 7 g (20 to 500 Hz) conforming to IEC 68-2-6.
Resistance to shock	50 g conforming to IEC 68-2-27.
Electric shock protection	Class I conforming to IEC 536 and NF C 20-030.
Degree of protection	IP 65 conforming to IEC 529 and NF C 20-010.
Mechanical life	Pushbuttons, selector switches: 1 million operations. Latching mushroom head pushbuttons: 300,000 operations.

Contact block characteristics

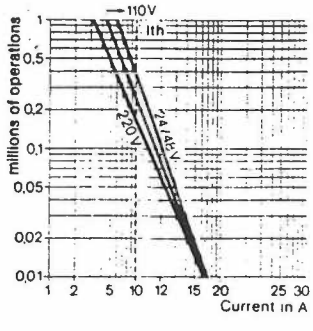
Rated thermal current	10 A conforming to IEC 337-1, NF C 63-140, VDE 0660 part 2, CSA C 22-2 No. 14.
Rated insulation voltage	500 V a.c. and d.c. conforming to IEC 158-1, NF C 20-040, VDE 0110. 600 V a.c. and d.c. conforming to CSA C 22-2 No. 14.
Insulation category	Group C conforming to NF C 20-040 and VDE 0110.
Contact operation	Single pole, double break, self-wiping C/O contacts (separate contact blocks must be used for different phases or polarities).
Resistance across terminals	< 25 mΩ.
Operating force	For a pushbutton with 1 C/O contact block: 11 N; with 2 C/O contact blocks: 20 N.
Terminal referencing	Conforming to CENELEC EN 50013.
Short-circuit protection	10 A cartridge fuses, gl or N conforming to IEC 337-1B and VDE 0660.

Power rating
Conforming to IEC 337-1
utilization categories AC 11 and DC 11

Operating rate: 3,600 ops/h
Load factor: 0.5

Alternating current ~ (ac) 50-60 Hz

Inductive circuit



Direct current ⎓ (dc)
Power broken in W
for 1 million operations

Voltage V	24	48	110
	100	85	65

Cabling	Screw and captive cable clamp terminals. Capacity: 1x2.5 mm² or 2x1.5 mm² max. with or without cable ends.

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