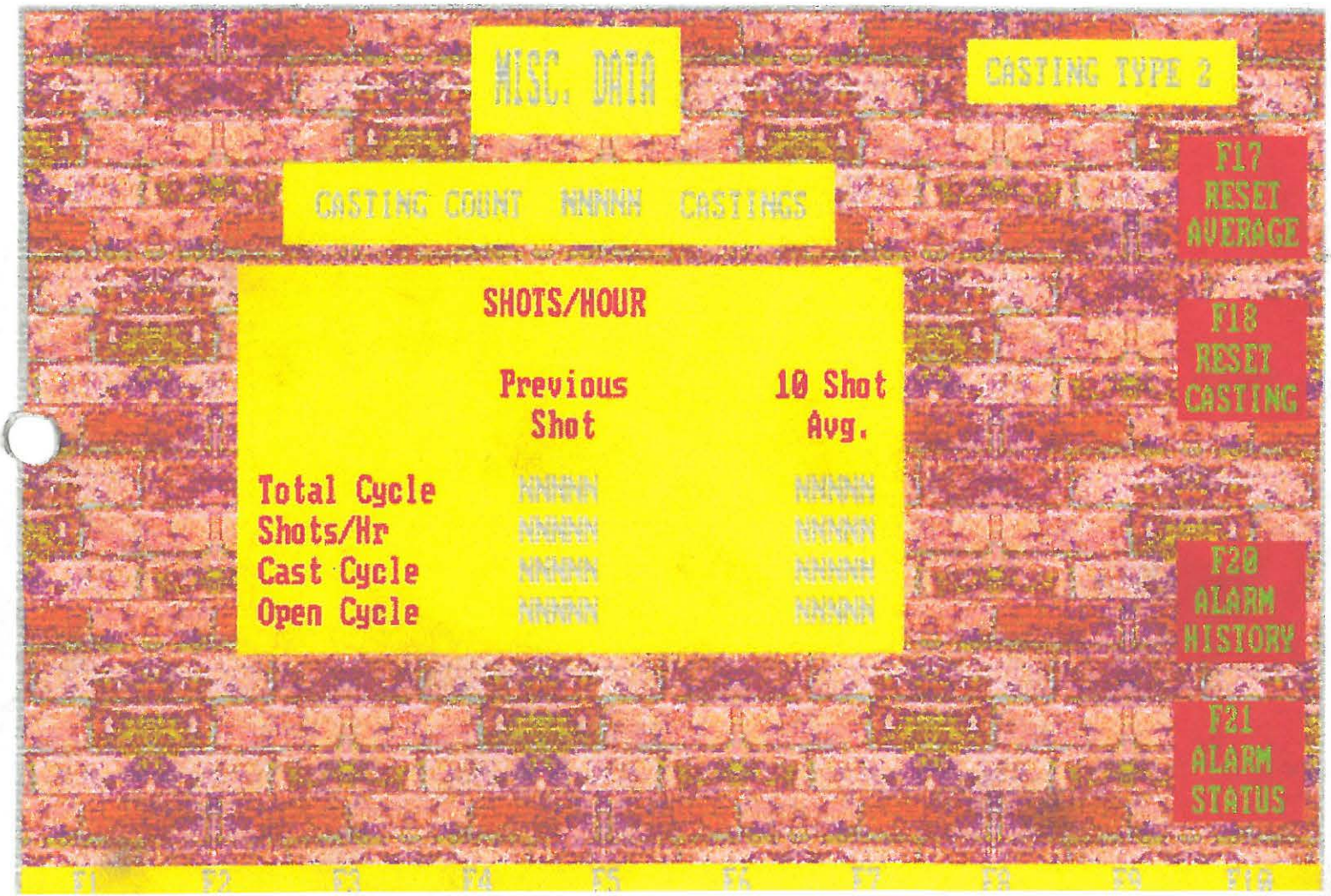
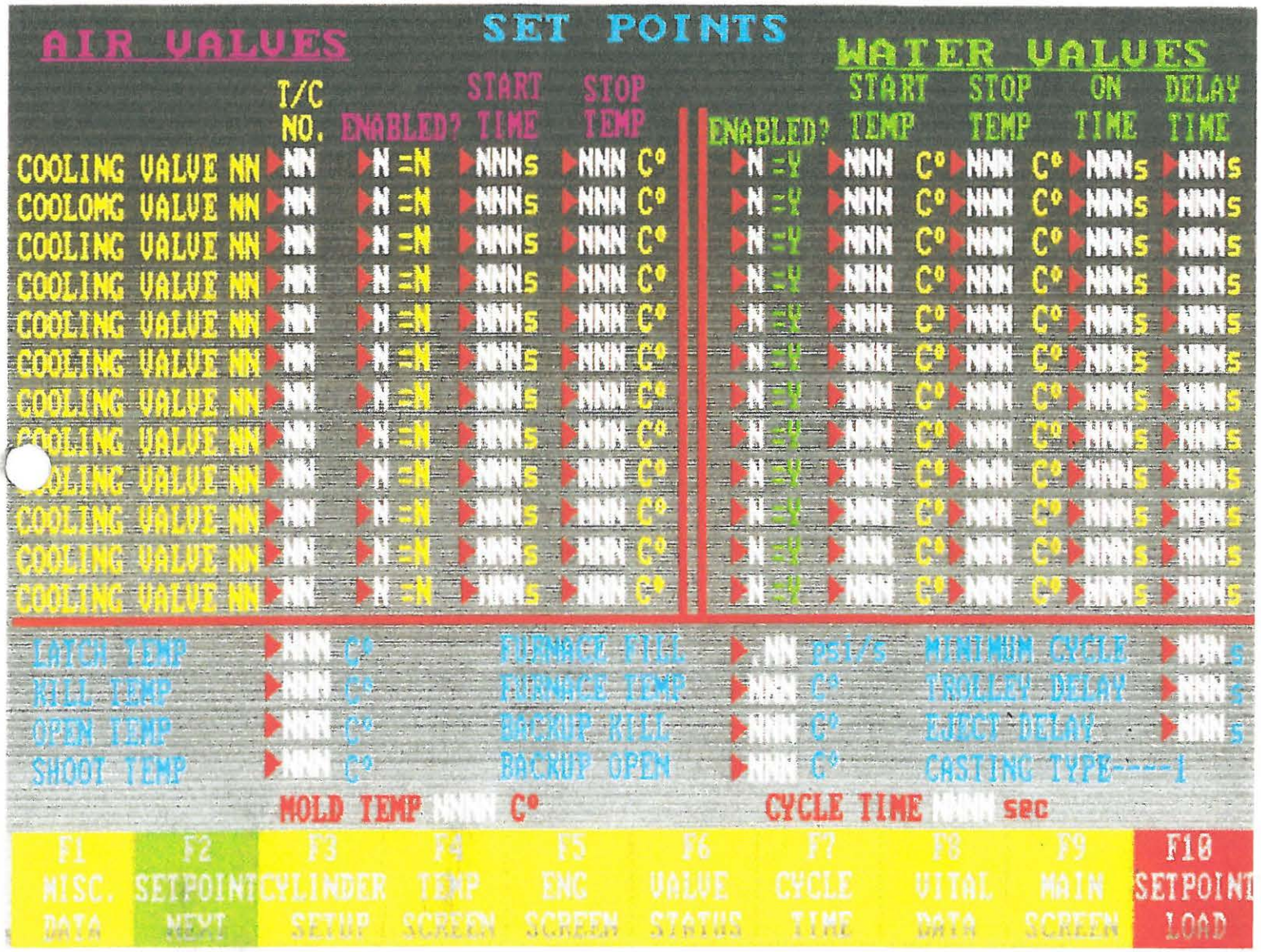
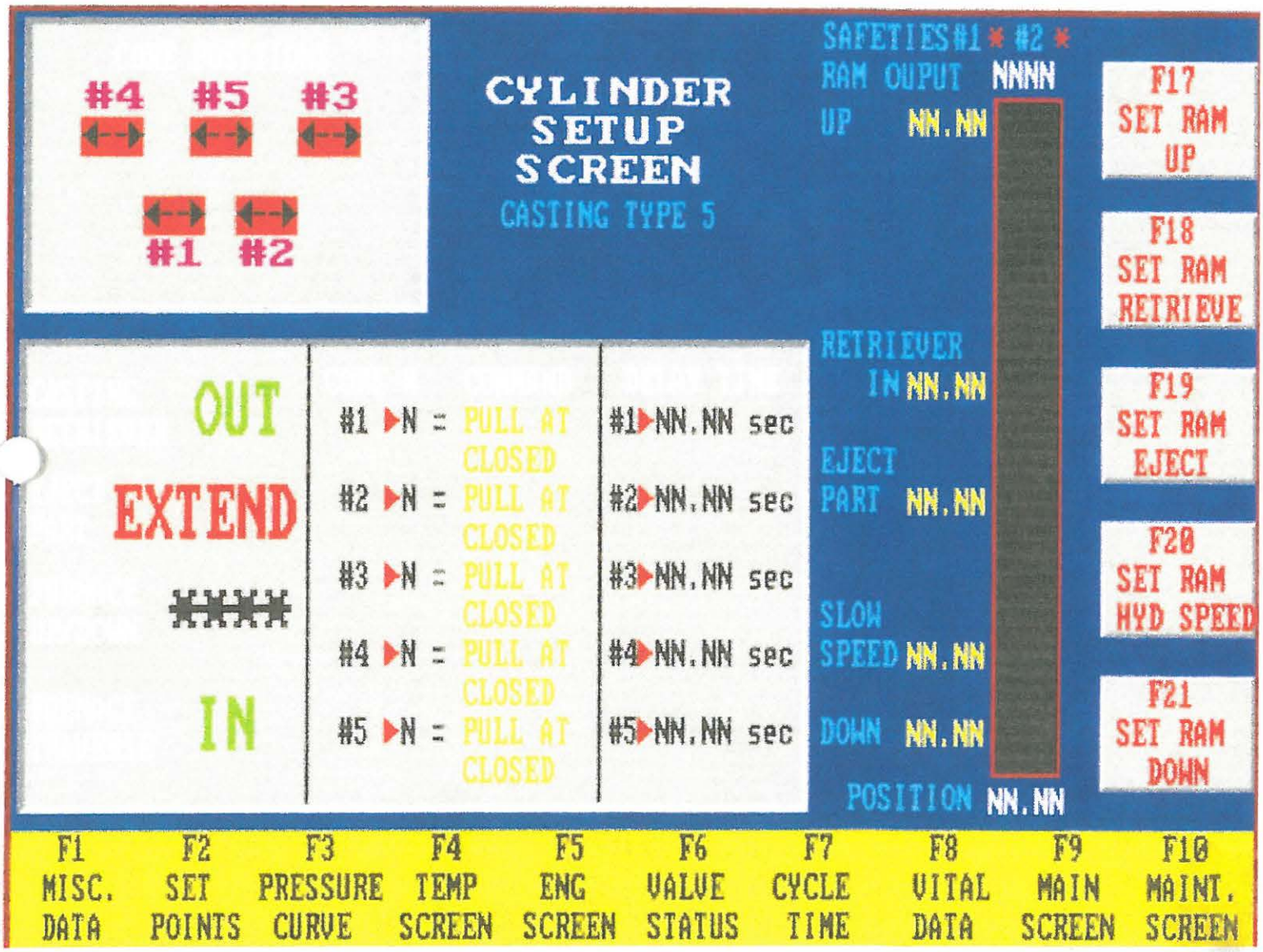
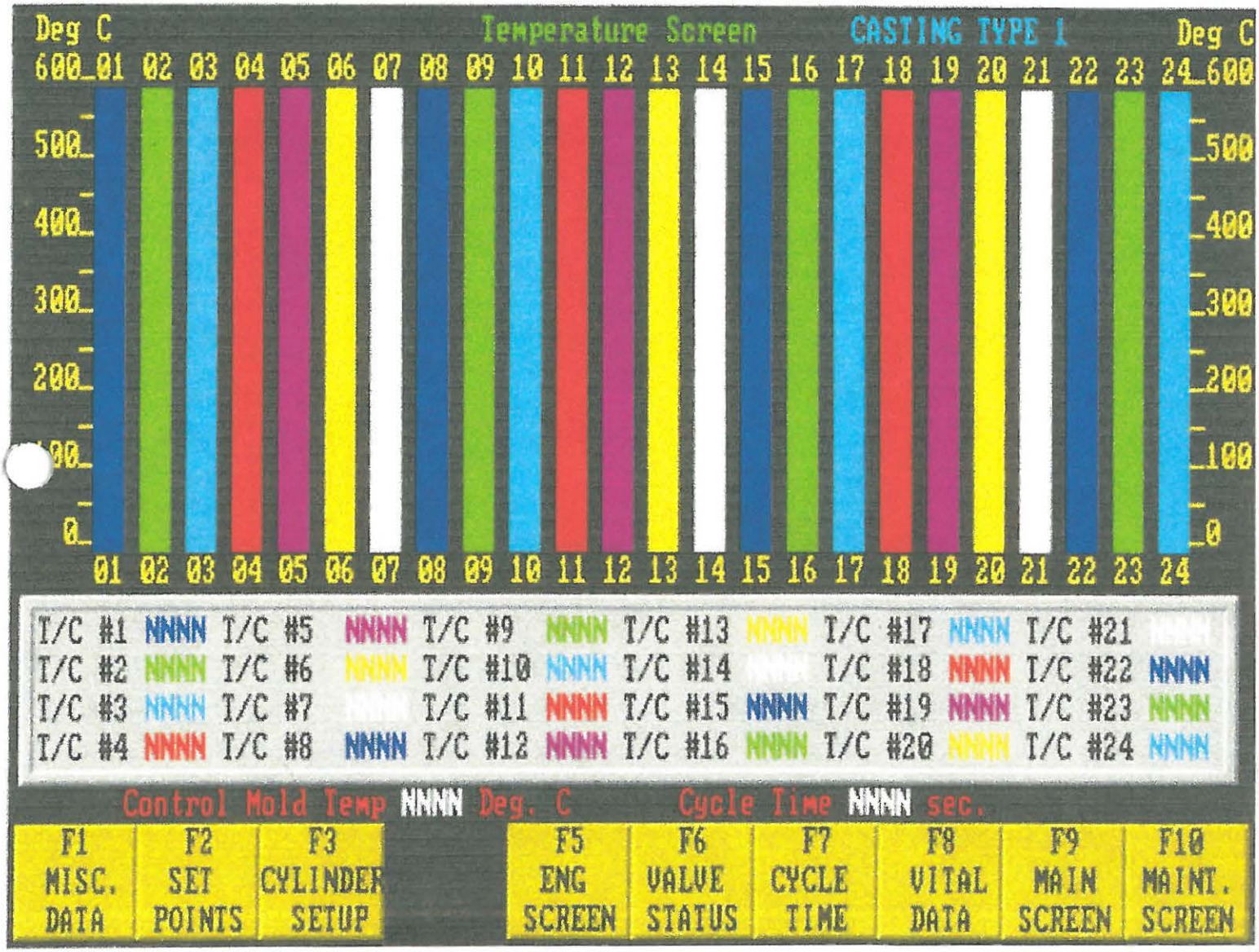

MISC. DATA
CASTING TYPE 2
CASTING COUNT NNNNN CASTINGS
F17 RESET AVERAGE
F18 RESET CASTING
F20 ALARM HISTORY
F21 ALARM STATUS
SHOTS/HOUR
Previous Shot
10 Shot Avg.
Total Cycle NNNNN NNNNN
Shots/Hr NNNNN NNNNN
Cast Cycle NNNNN NNNNN
Open Cycle NNNNN NNNNN


SET POINTS
AIR VALUES
T/C NO.
ENABLED?
START TIME
STOP TEMP
COOLING VALVE NN ▶NN ▶N =N ▶NNNs ▶NNN C°
WATER VALUES
ENABLED?
START TEMP
STOP TEMP
ON TIME
DELAY TIME
▶N =Y ▶NNN C° ▶NNN C° ▶NNNs ▶NNNs
LATCH TEMP ▶NNN C°
KILL TEMP ▶NNN C°
OPEN TEMP ▶NNN C°
SHOOT TEMP ▶NNN C°
FURNACE KILL ▶.NN psi/s
FURNACE TEMP ▶NNN C°
BACKUP KILL ▶NNN C°
BACKUP OPEN ▶NNN C°
MINIMUM CYCLE ▶NNNs
TROLLEY DELAY ▶NNNs
EJECT DELAY ▶NNNs
CASTING TYPE----1
MOLD TEMP NNNN C°
CYCLE TIME NNNN sec
F1 MISC. DATA
F2 SETPOINT NEXT
F3 CYLINDER SETUP
F4 TEMP SCREEN
F5 ENG SCREEN
F6 VALVE STATUS
F7 CYCLE TIME
F8 VITAL DATA
F9 MAIN SCREEN
F10 SETPOINT LOAD


#4 #5 #3
#1 #2
CYLINDER SETUP SCREEN
CASTING TYPE 5
SAFETIES #1 * #2 *
RAM OUPUT NNNN
UP NN.NN
RETRIEVER IN NN.NN
EJECT PART NN.NN
SLOW SPEED NN.NN
DOWN NN.NN
POSITION NN.NN
F17 SET RAM UP
F18 SET RAM RETRIEVE
F19 SET RAM EJECT
F20 SET RAM HYD SPEED
F21 SET RAM DOWN
OUT
EXTEND
IN
#1 N = PULL AT CLOSED
#2 N = PULL AT CLOSED
#3 N = PULL AT CLOSED
#4 N = PULL AT CLOSED
#5 N = PULL AT CLOSED
#1 NN.NN sec
#2 NN.NN sec
#3 NN.NN sec
#4 NN.NN sec
#5 NN.NN sec
F1 MISC. DATA
F2 SET POINTS
F3 PRESSURE CURVE
F4 TEMP SCREEN
F5 ENG SCREEN
F6 VALVE STATUS
F7 CYCLE TIME
F8 VITAL DATA
F9 MAIN SCREEN
F10 MAINT. SCREEN


Deg C
Temperature Screen
CASTING TYPE 1
Deg C
600 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 600
500
400
300
200
100
0
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
T/C #1 NNNN T/C #5 NNNN T/C #9 NNNN T/C #13 NNNN T/C #17 NNNN T/C #21 NNNN
T/C #2 NNNN T/C #6 NNNN T/C #10 NNNN T/C #14 NNNN T/C #18 NNNN T/C #22 NNNN
T/C #3 NNNN T/C #7 NNNN T/C #11 NNNN T/C #15 NNNN T/C #19 NNNN T/C #23 NNNN
T/C #4 NNNN T/C #8 NNNN T/C #12 NNNN T/C #16 NNNN T/C #20 NNNN T/C #24 NNNN
Control Mold Temp NNNN Deg. C
Cycle Time NNNN sec.
F1 MISC. DATA
F2 SET POINTS
F3 CYLINDER SETUP
F5 ENG SCREEN
F6 VALVE STATUS
F7 CYCLE TIME
F8 VITAL DATA
F9 MAIN SCREEN
F10 MAINT. SCREEN

ENGINEERING SCREEN

CASTING TYPE 5

SELECT MOLD T/C #	NN
TEMP RISE MONITOR PRESET	NNNN SEC.
FREEZE UP/PEAK TEMP	NNNN ° C
FREEZE UP TIME	NNNN SEC.
SETPOINT SCREEN TOLERANCE	± NNN

CYCLE TIME NNNN sec

MOLD TEMP NNNN C°

FURNACE

NNNN °C

740
720
700
680
660

PV SP

CV

SETPOINT NNNNN

P GAIN NNNNN

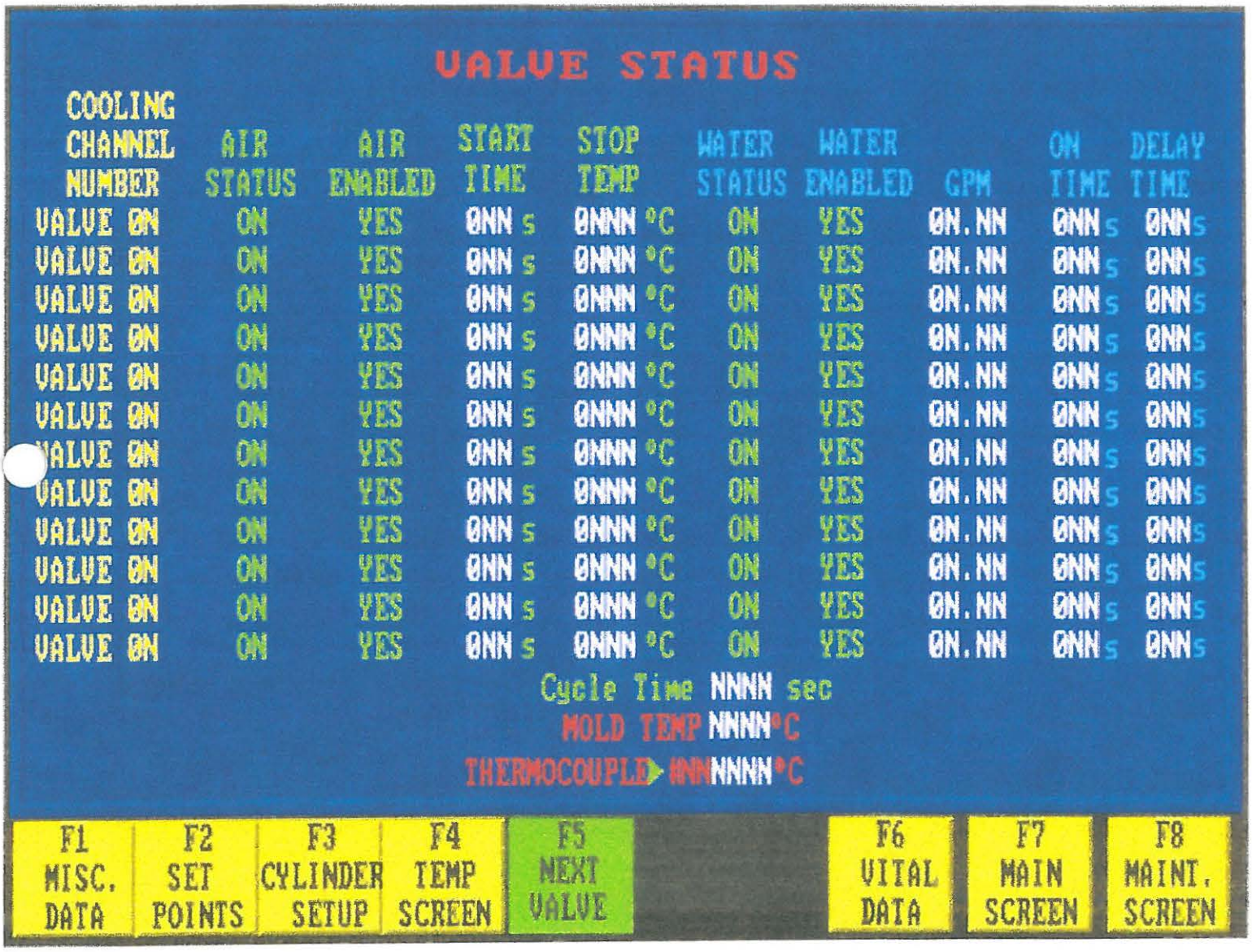
I GAIN NNNNN

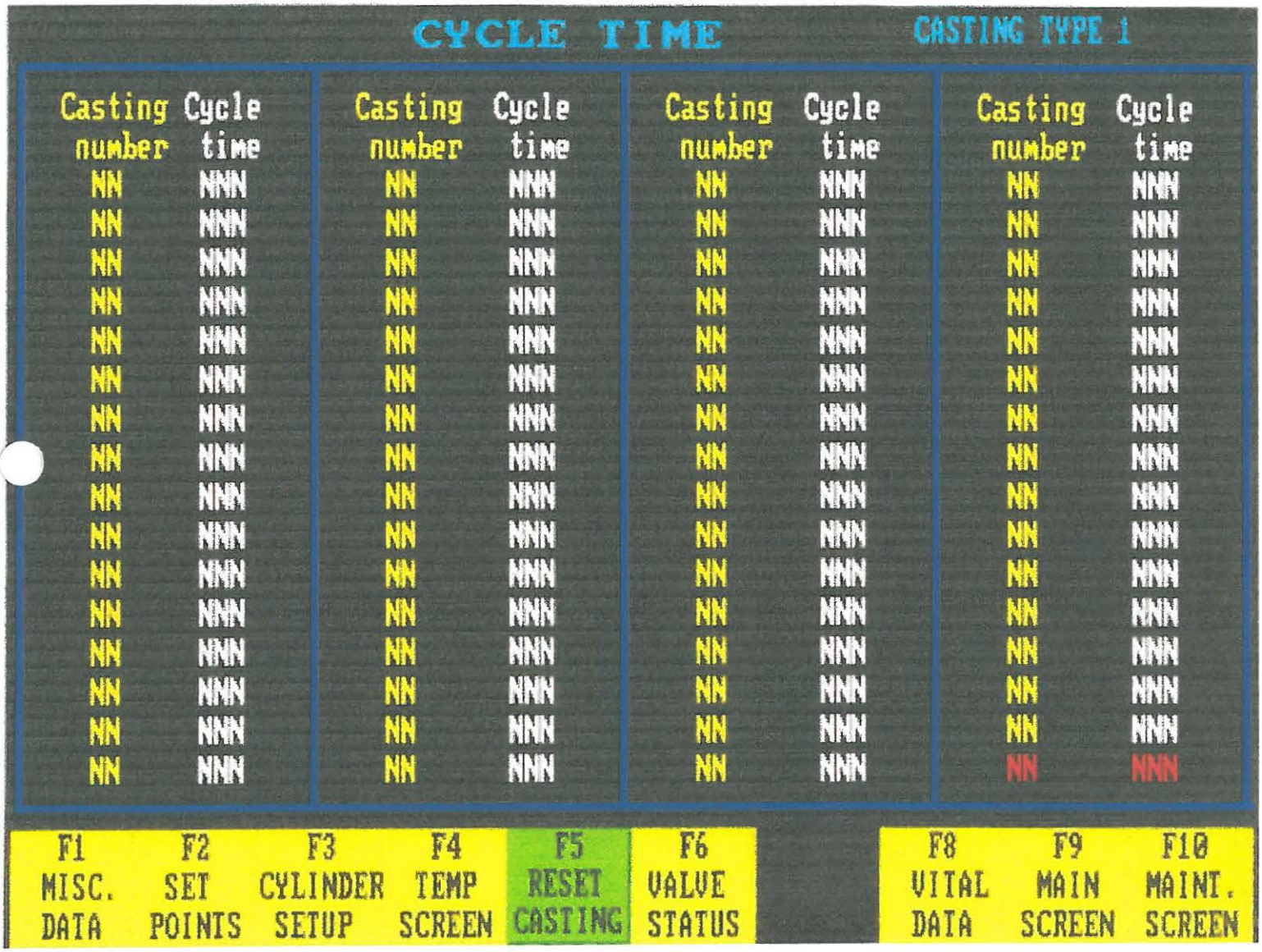
D GAIN NNNNN

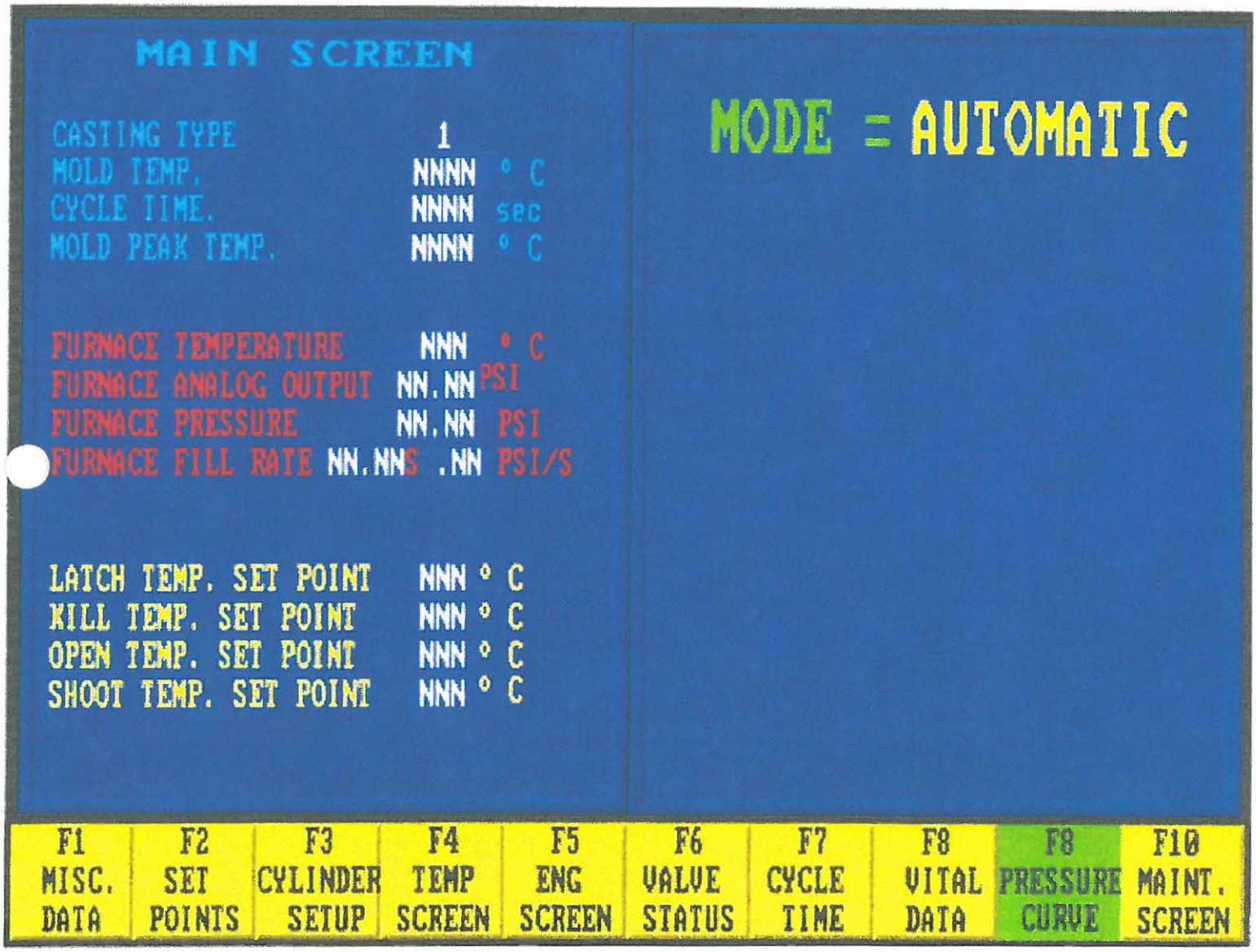
USE THIS PUSHBUTTON WITH CAUTION

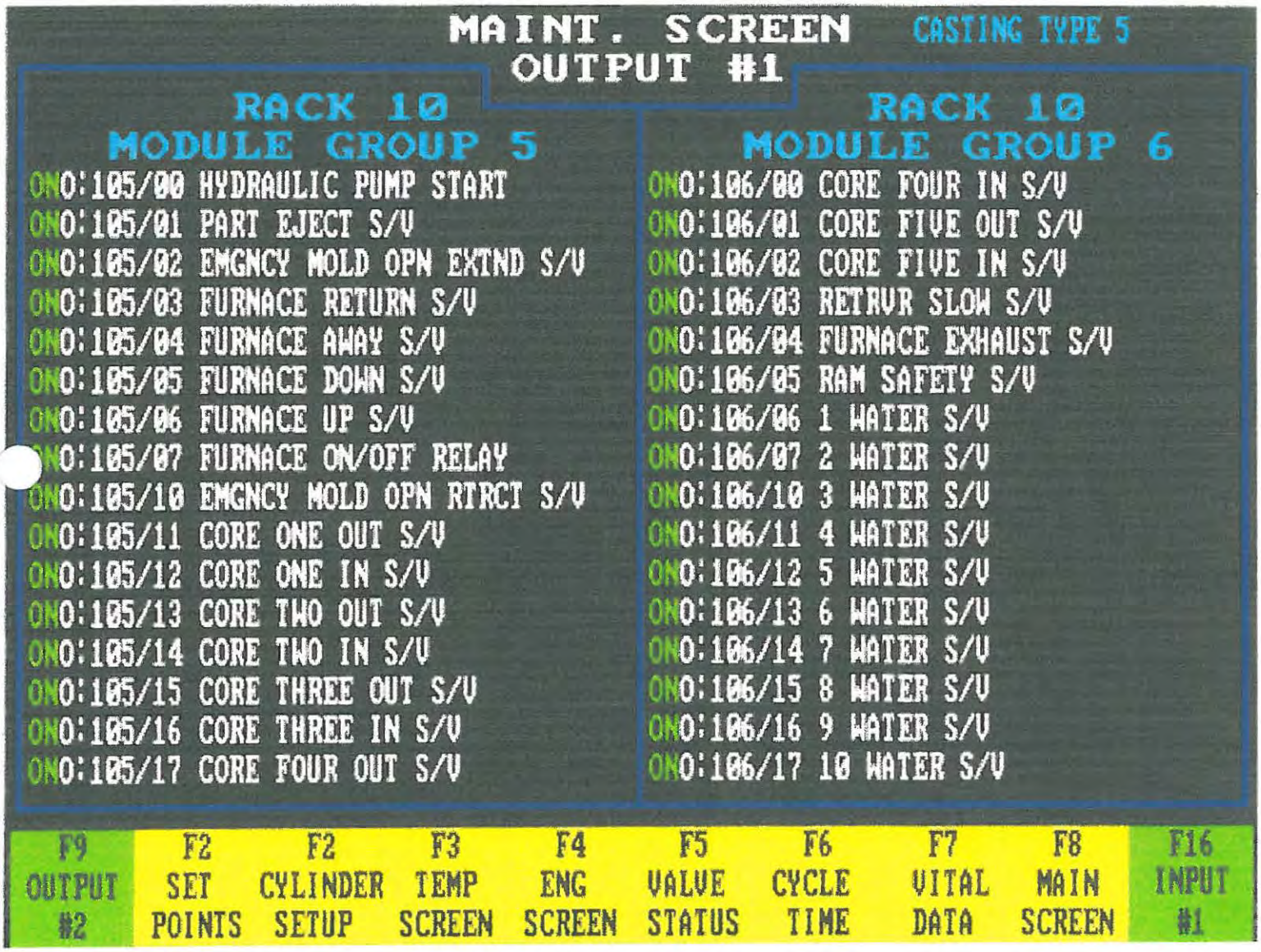
I/R EYE DISABLED F21

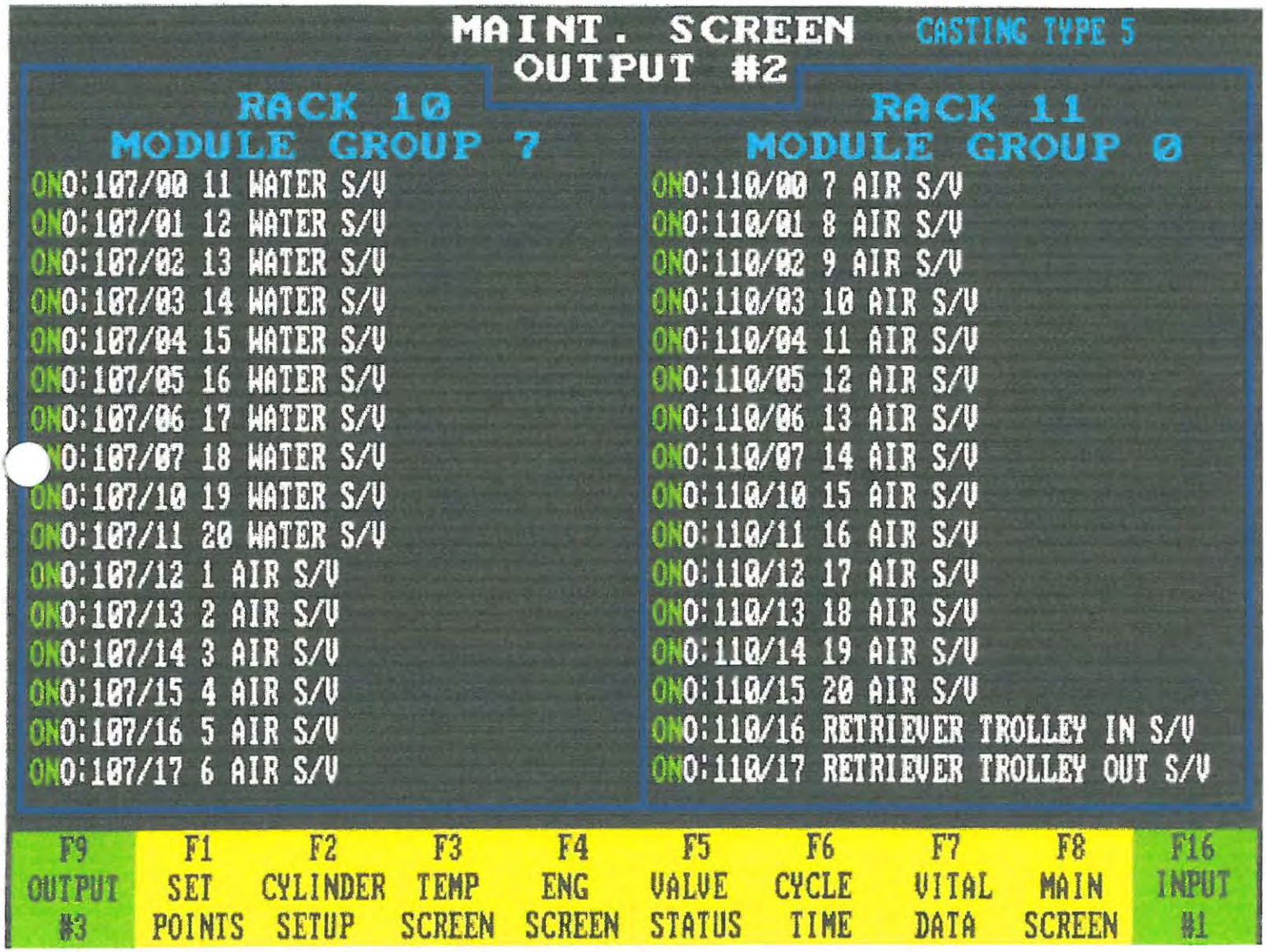
F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
MISC. DATA	SET POINTS	CYLINDER SETUP	TEMP SCREEN	PRESSURE CONTROL	VALVE STATUS	CYCLE TIME	PRESSURE CURVE	MAIN SCREEN	MAINT. SCREEN

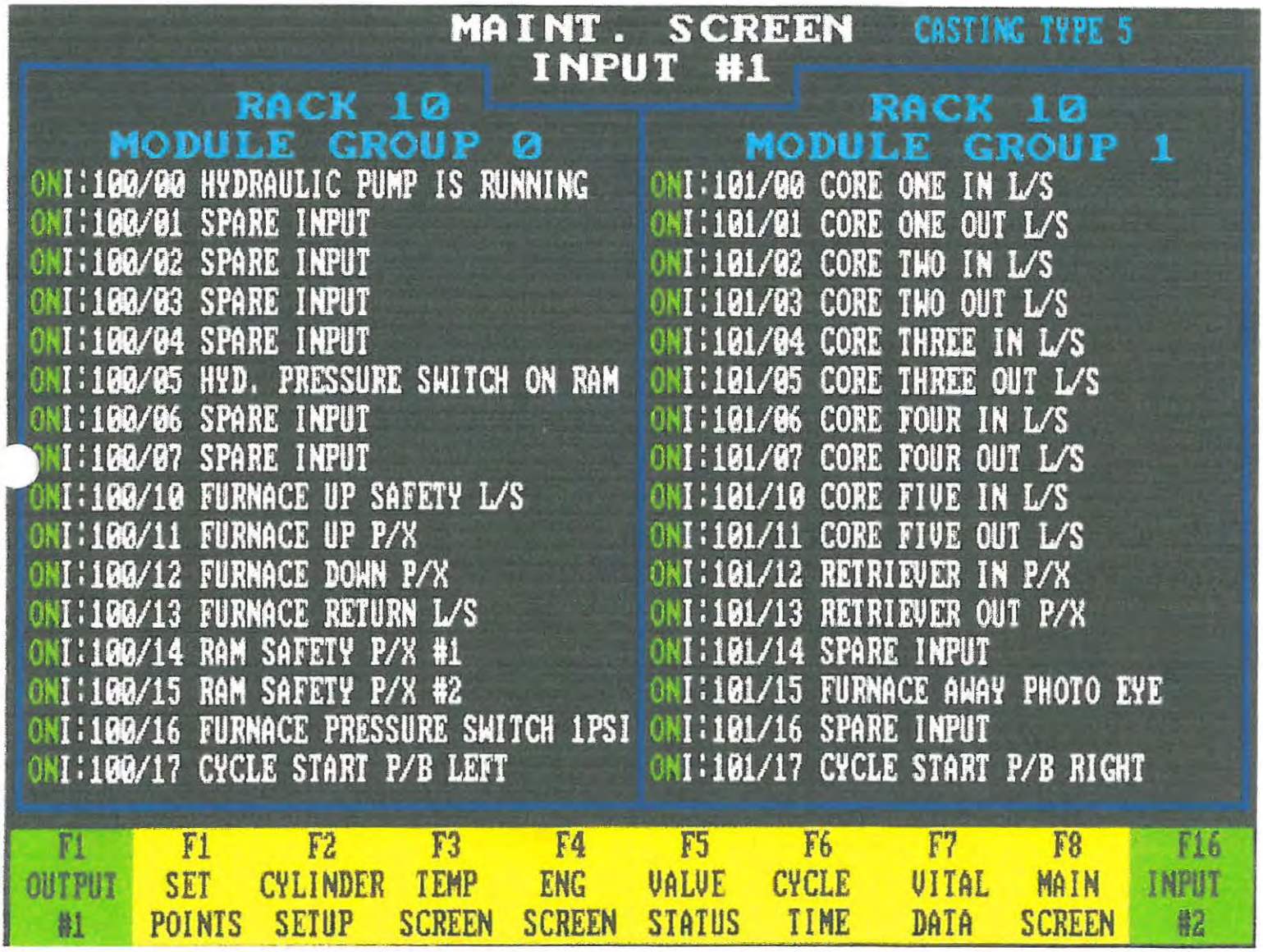

VALVE STATUS
COOLING CHANNEL NUMBER
AIR STATUS
AIR ENABLED
START TIME
STOP TEMP
WATER STATUS
WATER ENABLED
GPM
ON TIME
DELAY TIME
VALVE ØN ON YES ØNN s ØNNN °C ON YES ØN.NN ØNN s ØNN s
Cycle Time NNNN sec
MOLD TEMP NNNN°C
THERMOCOUPLE ▶ ØNNNNNN °C
F1 MISC. DATA
F2 SET POINTS
F3 CYLINDER SETUP
F4 TEMP SCREEN
F5 NEXT VALVE
F6 VITAL DATA
F7 MAIN SCREEN
F8 MAINT. SCREEN

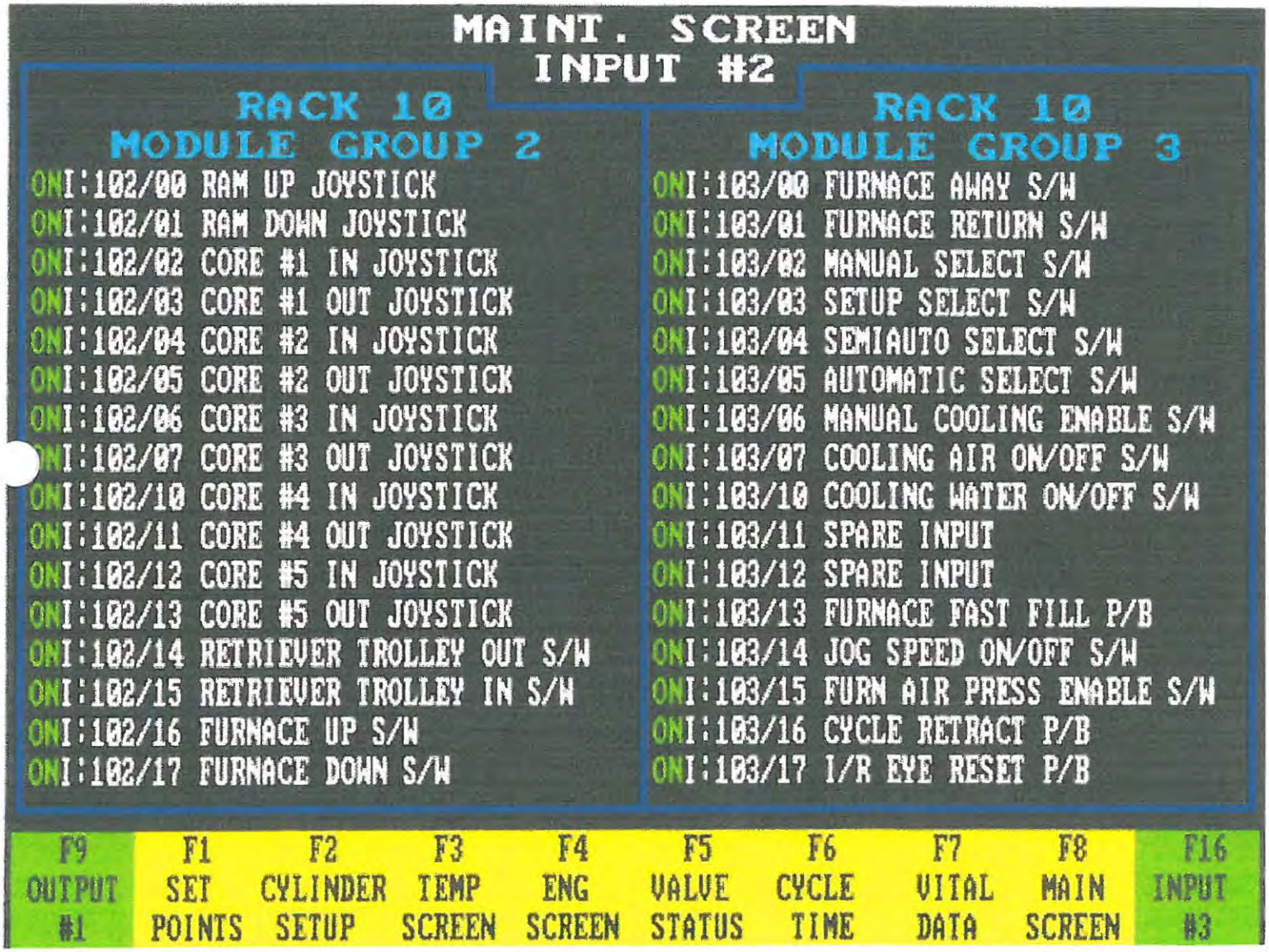

CYCLE TIME
CASTING TYPE 1
Casting number
Cycle time
NN NNN
F1 MISC. DATA
F2 SET POINTS
F3 CYLINDER SETUP
F4 TEMP SCREEN
F5 RESET CASTING
F6 VALVE STATUS
F8 VITAL DATA
F9 MAIN SCREEN
F10 MAINT. SCREEN

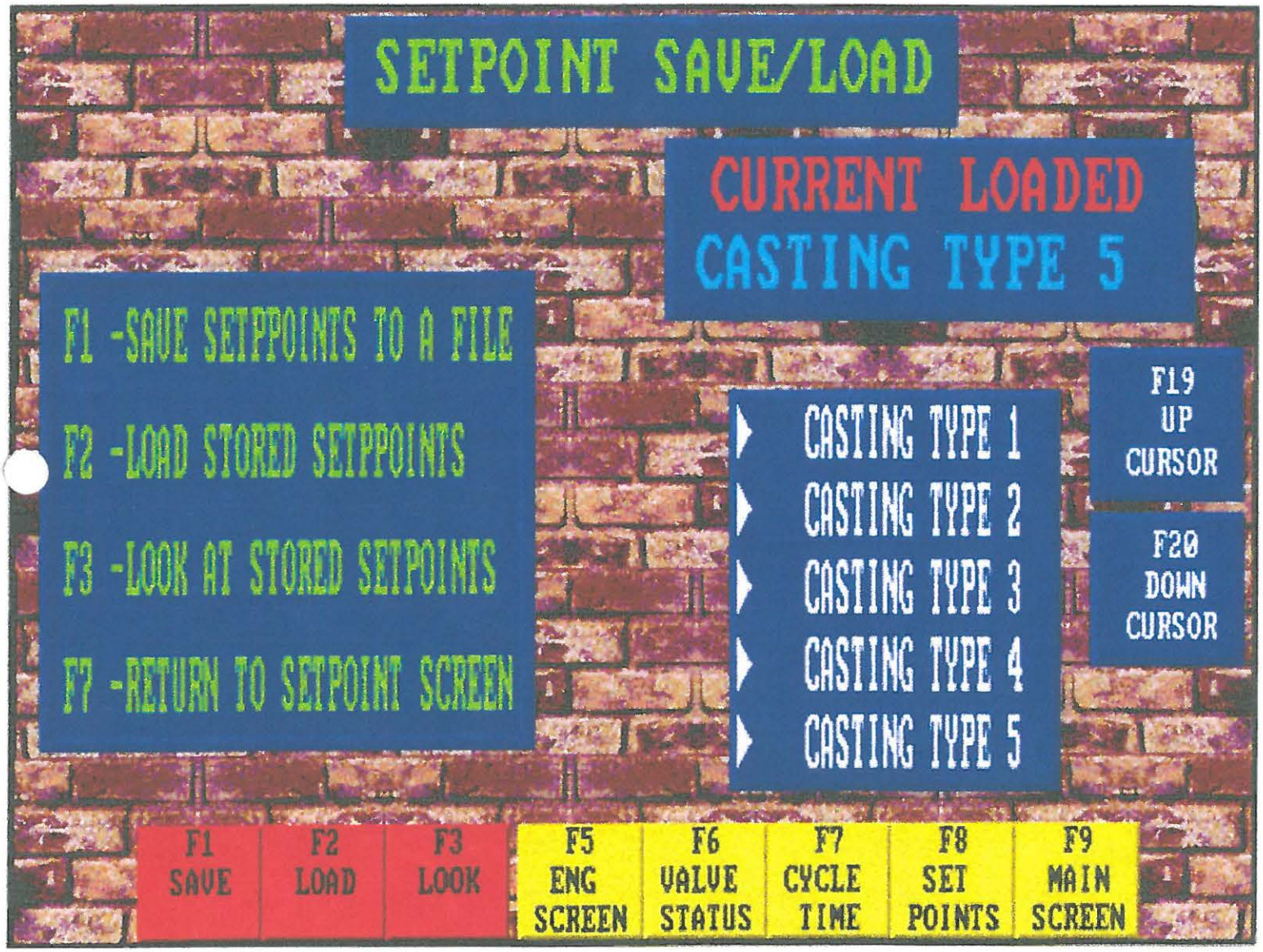

MAIN SCREEN
CASTING TYPE 1
MOLD TEMP. NNNN ° C
CYCLE TIME. NNNN sec
MOLD PEAK TEMP. NNNN ° C
FURNACE TEMPERATURE NNN ° C
FURNACE ANALOG OUTPUT NN.NN PSI
FURNACE PRESSURE NN.NN PSI
FURNACE FILL RATE NN.NNS .NN PSI/S
LATCH TEMP. SET POINT NNN ° C
KILL TEMP. SET POINT NNN ° C
OPEN TEMP. SET POINT NNN ° C
SHOOT TEMP. SET POINT NNN ° C
MODE = AUTOMATIC
F1 MISC. DATA
F2 SET POINTS
F3 CYLINDER SETUP
F4 TEMP SCREEN
F5 ENG SCREEN
F6 VALVE STATUS
F7 CYCLE TIME
F8 VITAL DATA
F8 PRESSURE CURVE
F10 MAINT. SCREEN

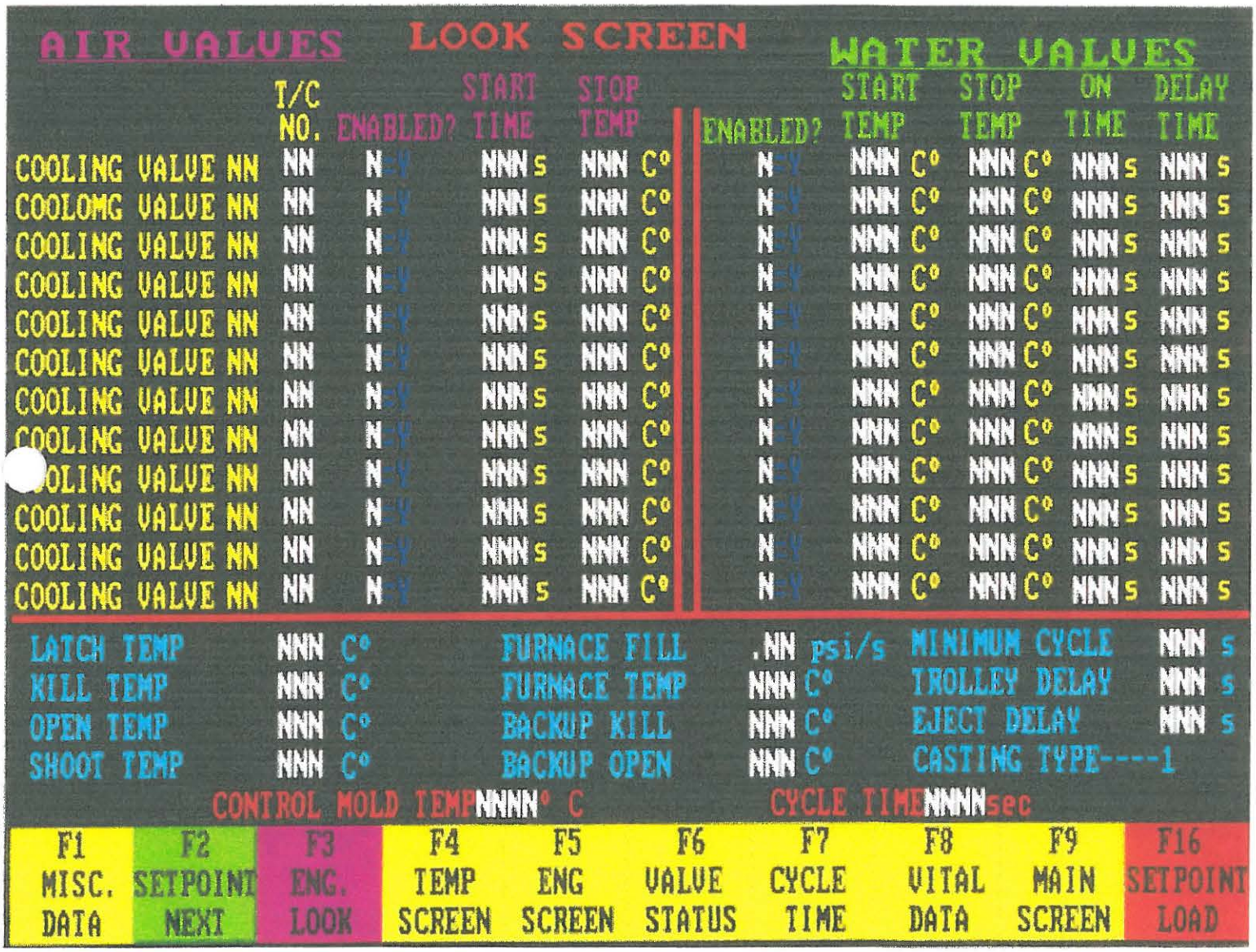

MAINT. SCREEN
CASTING TYPE 5
OUTPUT #1
RACK 10
MODULE GROUP 5
ON O:105/00 HYDRAULIC PUMP START
ON O:105/01 PART EJECT S/V
ON O:105/02 EMGNCY MOLD OPN EXTND S/V
ON O:105/03 FURNACE RETURN S/V
ON O:105/04 FURNACE AWAY S/V
ON O:105/05 FURNACE DOWN S/V
ON O:105/06 FURNACE UP S/V
ON O:105/07 FURNACE ON/OFF RELAY
ON O:105/10 EMGNCY MOLD OPN RTRCT S/V
ON O:105/11 CORE ONE OUT S/V
ON O:105/12 CORE ONE IN S/V
ON O:105/13 CORE TWO OUT S/V
ON O:105/14 CORE TWO IN S/V
ON O:105/15 CORE THREE OUT S/V
ON O:105/16 CORE THREE IN S/V
ON O:105/17 CORE FOUR OUT S/V
RACK 10
MODULE GROUP 6
ON O:106/00 CORE FOUR IN S/V
ON O:106/01 CORE FIVE OUT S/V
ON O:106/02 CORE FIVE IN S/V
ON O:106/03 RETRVR SLOW S/V
ON O:106/04 FURNACE EXHAUST S/V
ON O:106/05 RAM SAFETY S/V
ON O:106/06 1 WATER S/V
ON O:106/07 2 WATER S/V
ON O:106/10 3 WATER S/V
ON O:106/11 4 WATER S/V
ON O:106/12 5 WATER S/V
ON O:106/13 6 WATER S/V
ON O:106/14 7 WATER S/V
ON O:106/15 8 WATER S/V
ON O:106/16 9 WATER S/V
ON O:106/17 10 WATER S/V
F9 OUTPUT #2
F2 SET POINTS
F2 CYLINDER SETUP
F3 TEMP SCREEN
F4 ENG SCREEN
F5 VALVE STATUS
F6 CYCLE TIME
F7 VITAL DATA
F8 MAIN SCREEN
F16 INPUT #1

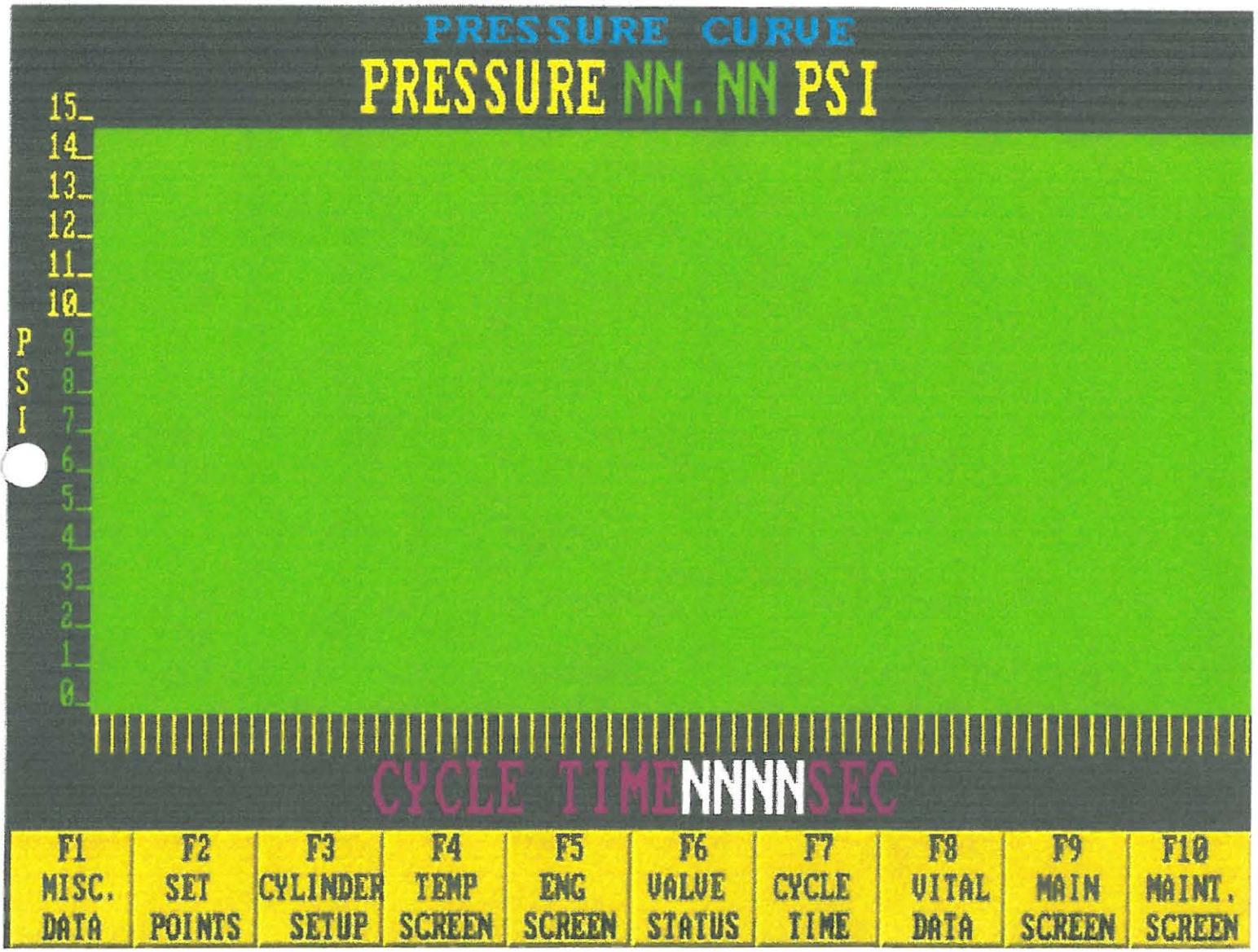

MAINT. SCREEN CASTING TYPE 5
OUTPUT #2
RACK 10
MODULE GROUP 7
ON: 107/00 11 WATER S/V
ON: 107/01 12 WATER S/V
ON: 107/02 13 WATER S/V
ON: 107/03 14 WATER S/V
ON: 107/04 15 WATER S/V
ON: 107/05 16 WATER S/V
ON: 107/06 17 WATER S/V
ON: 107/07 18 WATER S/V
ON: 107/10 19 WATER S/V
ON: 107/11 20 WATER S/V
ON: 107/12 1 AIR S/V
ON: 107/13 2 AIR S/V
ON: 107/14 3 AIR S/V
ON: 107/15 4 AIR S/V
ON: 107/16 5 AIR S/V
ON: 107/17 6 AIR S/V
RACK 11
MODULE GROUP 0
ON: 110/00 7 AIR S/V
ON: 110/01 8 AIR S/V
ON: 110/02 9 AIR S/V
ON: 110/03 10 AIR S/V
ON: 110/04 11 AIR S/V
ON: 110/05 12 AIR S/V
ON: 110/06 13 AIR S/V
ON: 110/07 14 AIR S/V
ON: 110/10 15 AIR S/V
ON: 110/11 16 AIR S/V
ON: 110/12 17 AIR S/V
ON: 110/13 18 AIR S/V
ON: 110/14 19 AIR S/V
ON: 110/15 20 AIR S/V
ON: 110/16 RETRIEVER TROLLEY IN S/V
ON: 110/17 RETRIEVER TROLLEY OUT S/V
F9 OUTPUT #3
F1 SET POINTS
F2 CYLINDER SETUP
F3 TEMP SCREEN
F4 ENG SCREEN
F5 VALVE STATUS
F6 CYCLE TIME
F7 VITAL DATA
F8 MAIN SCREEN
F16 INPUT #1

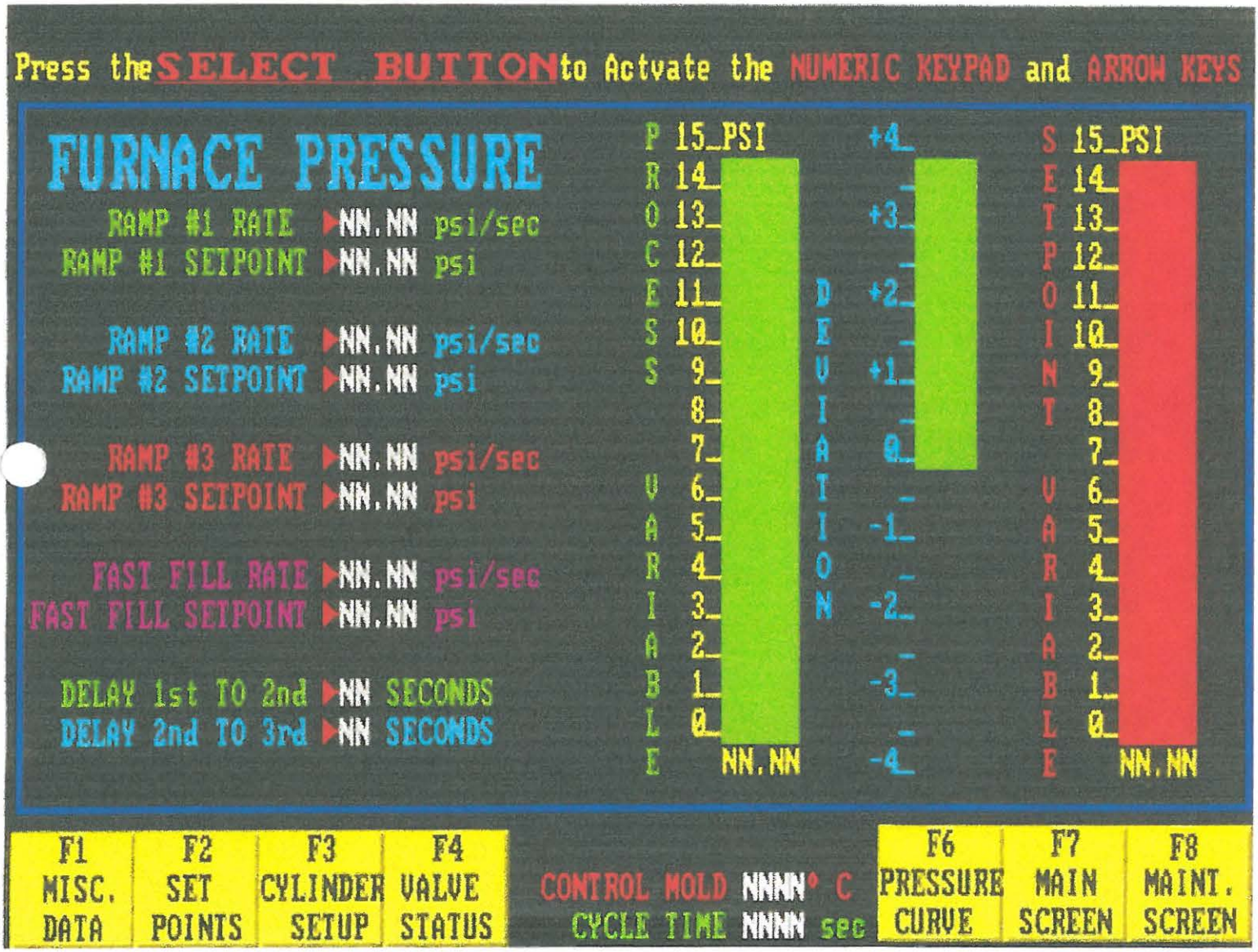

MAINT. SCREEN
CASTING TYPE 5
INPUT #1
RACK 10
MODULE GROUP 0
ONI:100/00 HYDRAULIC PUMP IS RUNNING
ONI:100/01 SPARE INPUT
ONI:100/02 SPARE INPUT
ONI:100/03 SPARE INPUT
ONI:100/04 SPARE INPUT
ONI:100/05 HYD. PRESSURE SWITCH ON RAM
ONI:100/06 SPARE INPUT
ONI:100/07 SPARE INPUT
ONI:100/10 FURNACE UP SAFETY L/S
ONI:100/11 FURNACE UP P/X
ONI:100/12 FURNACE DOWN P/X
ONI:100/13 FURNACE RETURN L/S
ONI:100/14 RAM SAFETY P/X #1
ONI:100/15 RAM SAFETY P/X #2
ONI:100/16 FURNACE PRESSURE SWITCH 1PSI
ONI:100/17 CYCLE START P/B LEFT
RACK 10
MODULE GROUP 1
ONI:101/00 CORE ONE IN L/S
ONI:101/01 CORE ONE OUT L/S
ONI:101/02 CORE TWO IN L/S
ONI:101/03 CORE TWO OUT L/S
ONI:101/04 CORE THREE IN L/S
ONI:101/05 CORE THREE OUT L/S
ONI:101/06 CORE FOUR IN L/S
ONI:101/07 CORE FOUR OUT L/S
ONI:101/10 CORE FIVE IN L/S
ONI:101/11 CORE FIVE OUT L/S
ONI:101/12 RETRIEVER IN P/X
ONI:101/13 RETRIEVER OUT P/X
ONI:101/14 SPARE INPUT
ONI:101/15 FURNACE AWAY PHOTO EYE
ONI:101/16 SPARE INPUT
ONI:101/17 CYCLE START P/B RIGHT
F1 OUTPUT #1
F1 SET POINTS
F2 CYLINDER SETUP
F3 TEMP SCREEN
F4 ENG SCREEN
F5 VALVE STATUS
F6 CYCLE TIME
F7 VITAL DATA
F8 MAIN SCREEN
F16 INPUT #2


MAINT. SCREEN
INPUT #2
RACK 10
MODULE GROUP 2
ONI:102/00 RAM UP JOYSTICK
ONI:102/01 RAM DOWN JOYSTICK
ONI:102/02 CORE #1 IN JOYSTICK
ONI:102/03 CORE #1 OUT JOYSTICK
ONI:102/04 CORE #2 IN JOYSTICK
ONI:102/05 CORE #2 OUT JOYSTICK
ONI:102/06 CORE #3 IN JOYSTICK
ONI:102/07 CORE #3 OUT JOYSTICK
ONI:102/10 CORE #4 IN JOYSTICK
ONI:102/11 CORE #4 OUT JOYSTICK
ONI:102/12 CORE #5 IN JOYSTICK
ONI:102/13 CORE #5 OUT JOYSTICK
ONI:102/14 RETRIEVER TROLLEY OUT S/W
ONI:102/15 RETRIEVER TROLLEY IN S/W
ONI:102/16 FURNACE UP S/W
ONI:102/17 FURNACE DOWN S/W
RACK 10
MODULE GROUP 3
ONI:103/00 FURNACE AWAY S/W
ONI:103/01 FURNACE RETURN S/W
ONI:103/02 MANUAL SELECT S/W
ONI:103/03 SETUP SELECT S/W
ONI:103/04 SEMIAUTO SELECT S/W
ONI:103/05 AUTOMATIC SELECT S/W
ONI:103/06 MANUAL COOLING ENABLE S/W
ONI:103/07 COOLING AIR ON/OFF S/W
ONI:103/10 COOLING WATER ON/OFF S/W
ONI:103/11 SPARE INPUT
ONI:103/12 SPARE INPUT
ONI:103/13 FURNACE FAST FILL P/B
ONI:103/14 JOG SPEED ON/OFF S/W
ONI:103/15 FURN AIR PRESS ENABLE S/W
ONI:103/16 CYCLE RETRACT P/B
ONI:103/17 I/R EYE RESET P/B
F9 OUTPUT #1
F1 SET POINTS
F2 CYLINDER SETUP
F3 TEMP SCREEN
F4 ENG SCREEN
F5 VALVE STATUS
F6 CYCLE TIME
F7 VITAL DATA
F8 MAIN SCREEN
F16 INPUT #3


SETPOINT SAVE/LOAD
CURRENT LOADED
CASTING TYPE 5
F1 -SAVE SETPPOINTS TO A FILE
F2 -LOAD STORED SETPPOINTS
F3 -LOOK AT STORED SETPOINTS
F7 -RETURN TO SETPOINT SCREEN
CASTING TYPE 1
CASTING TYPE 2
CASTING TYPE 3
CASTING TYPE 4
CASTING TYPE 5
F19 UP CURSOR
F20 DOWN CURSOR
F1 SAVE
F2 LOAD
F3 LOOK
F5 ENG SCREEN
F6 VALVE STATUS
F7 CYCLE TIME
F8 SET POINTS
F9 MAIN SCREEN


AIR VALUES
LOOK SCREEN
WATER VALUES
T/C NO.
ENABLED?
START TIME
STOP TEMP
ENABLED?
START TEMP
STOP TEMP
ON TIME
DELAY TIME
COOLING VALVE NN
COOLOMG VALVE NN
LATCH TEMP
KILL TEMP
OPEN TEMP
SHOOT TEMP
FURNACE FILL
FURNACE TEMP
BACKUP KILL
BACKUP OPEN
MINIMUM CYCLE
TROLLEY DELAY
EJECT DELAY
CASTING TYPE----1
CONTROL MOLD TEMP NNNN° C
CYCLE TIME NNNN sec
F1 MISC. DATA
F2 SETPOINT NEXT
F3 ENG. LOOK
F4 TEMP SCREEN
F5 ENG SCREEN
F6 VALVE STATUS
F7 CYCLE TIME
F8 VITAL DATA
F9 MAIN SCREEN
F16 SETPOINT LOAD


PRESSURE CURVE
PRESSURE NN.NN PSI
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
PSI
CYCLE TIME NNNN SEC
F1 MISC. DATA
F2 SET POINTS
F3 CYLINDER SETUP
F4 TEMP SCREEN
F5 ENG SCREEN
F6 VALVE STATUS
F7 CYCLE TIME
F8 VITAL DATA
F9 MAIN SCREEN
F10 MAINT. SCREEN


Press the SELECT BUTTON to Actvate the NUMERIC KEYPAD and ARROW KEYS
FURNACE PRESSURE
RAMP #1 RATE ▶NN.NN psi/sec
RAMP #1 SETPOINT ▶NN.NN psi
RAMP #2 RATE ▶NN.NN psi/sec
RAMP #2 SETPOINT ▶NN.NN psi
RAMP #3 RATE ▶NN.NN psi/sec
RAMP #3 SETPOINT ▶NN.NN psi
FAST FILL RATE ▶NN.NN psi/sec
FAST FILL SETPOINT ▶NN.NN psi
DELAY 1st TO 2nd ▶NN SECONDS
DELAY 2nd TO 3rd ▶NN SECONDS
PROCESS VARIABLE
15_PSI
14_
13_
12_
11_
10_
9_
8_
7_
6_
5_
4_
3_
2_
1_
0_
NN.NN
DEVIATION
+4_
+3_
+2_
+1_
0_
-1_
-2_
-3_
-4_
SETPOINT VARIABLE
15_PSI
14_
13_
12_
11_
10_
9_
8_
7_
6_
5_
4_
3_
2_
1_
0_
NN.NN
F1 MISC. DATA
F2 SET POINTS
F3 CYLINDER SETUP
F4 VALVE STATUS
CONTROL MOLD NNNN° C
CYCLE TIME NNNN sec
F6 PRESSURE CURVE
F7 MAIN SCREEN
F8 MAINT. SCREEN

ENGINEERING LOOK SCREEN

CASTING TYPE 5

SELECT MOLD T/C #	NN
TEMP RISE MONITOR PRESET	NNNN SEC.
FREEZE UP/PEAK TEMP	NNNN ° C
FREEZE UP TIME	NNNN SEC.
SETPOINT SCREEN TOLERANCE	± NNN

CYCLE TIME NNNN sec

MOLD TEMP NNNN C°

FURNACE

NNNN °C

740
720
700
680
660

PV SP

CV

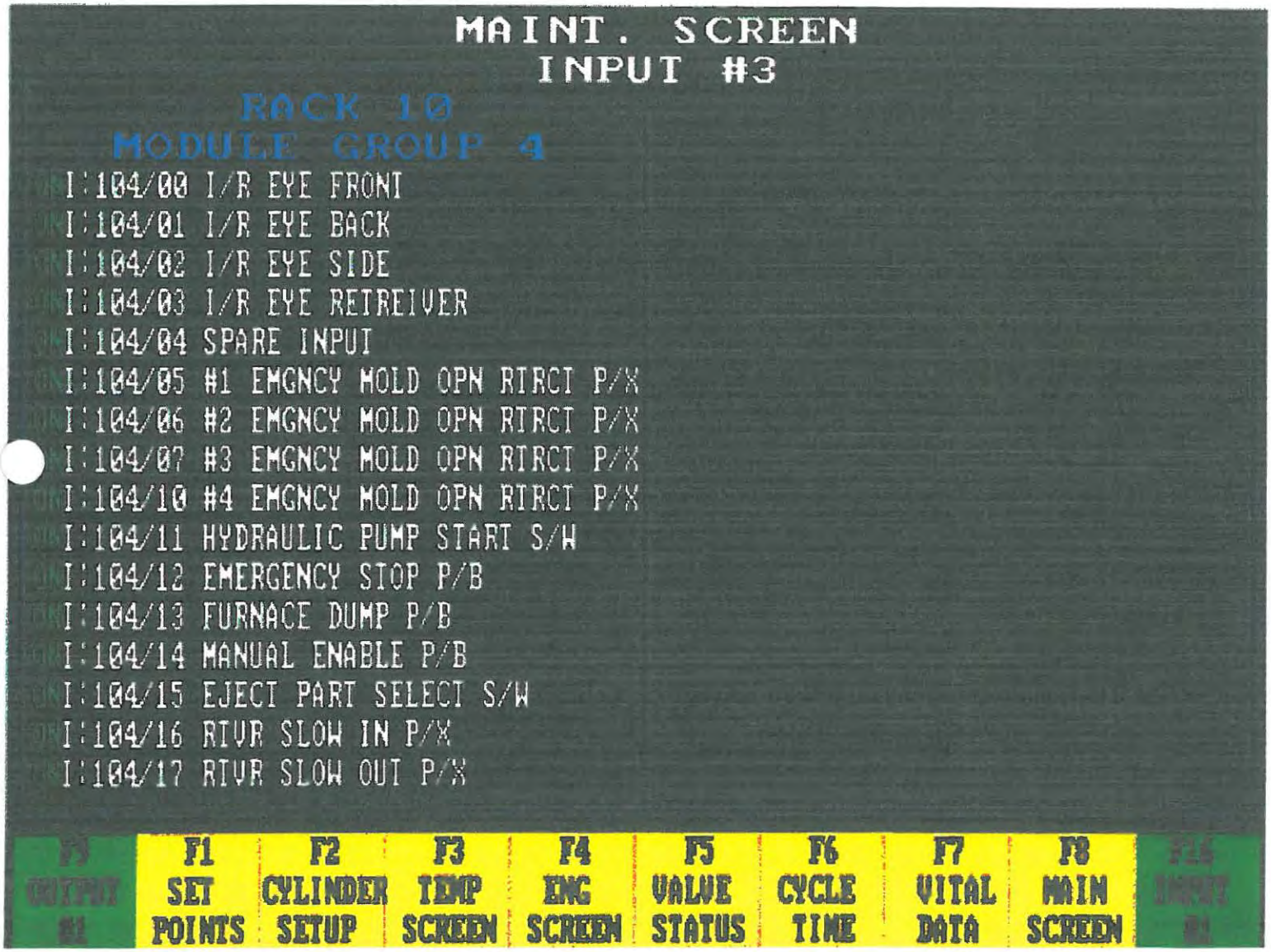
SETPOINT NNNNN

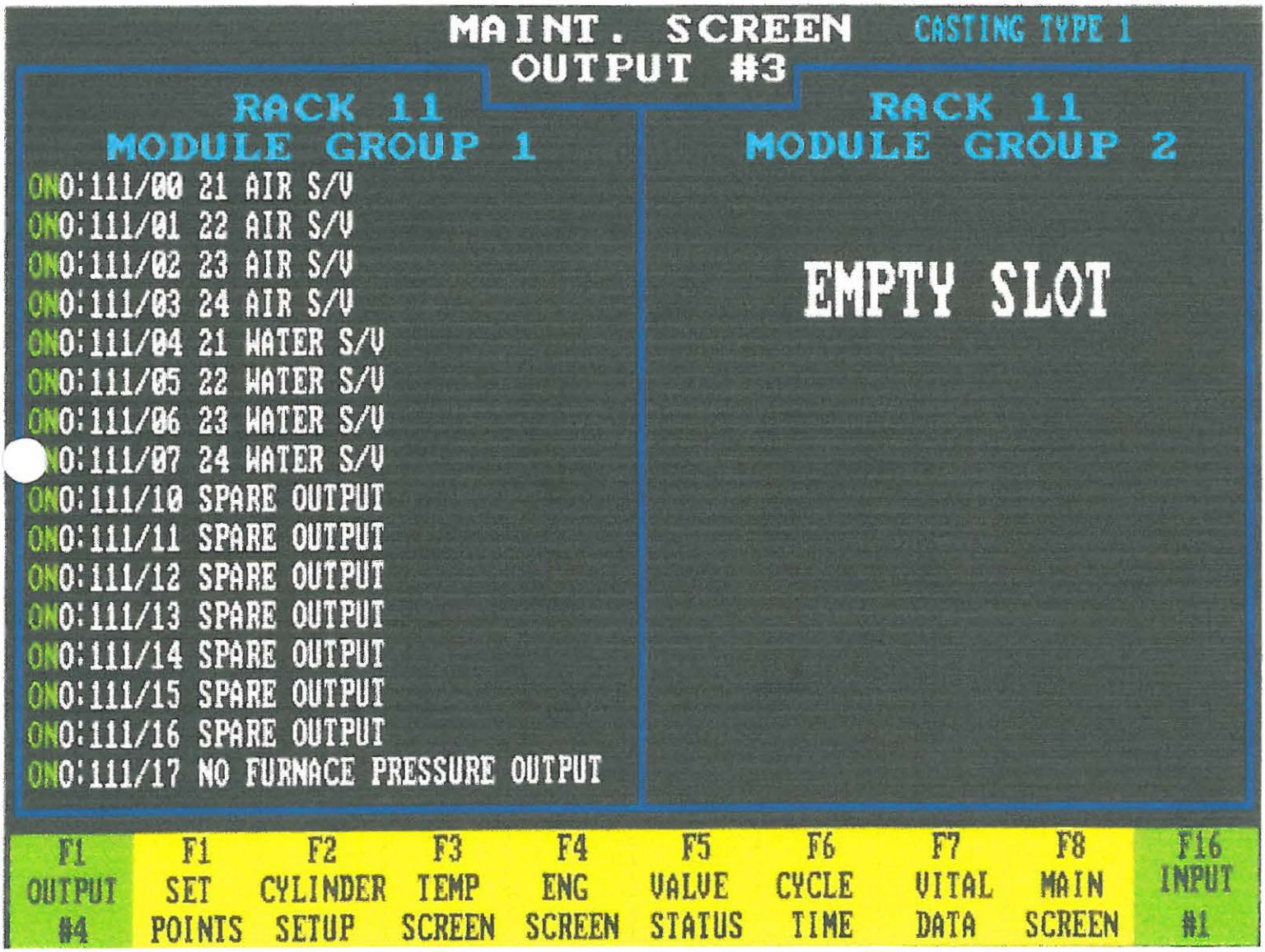
P gain NNNNN

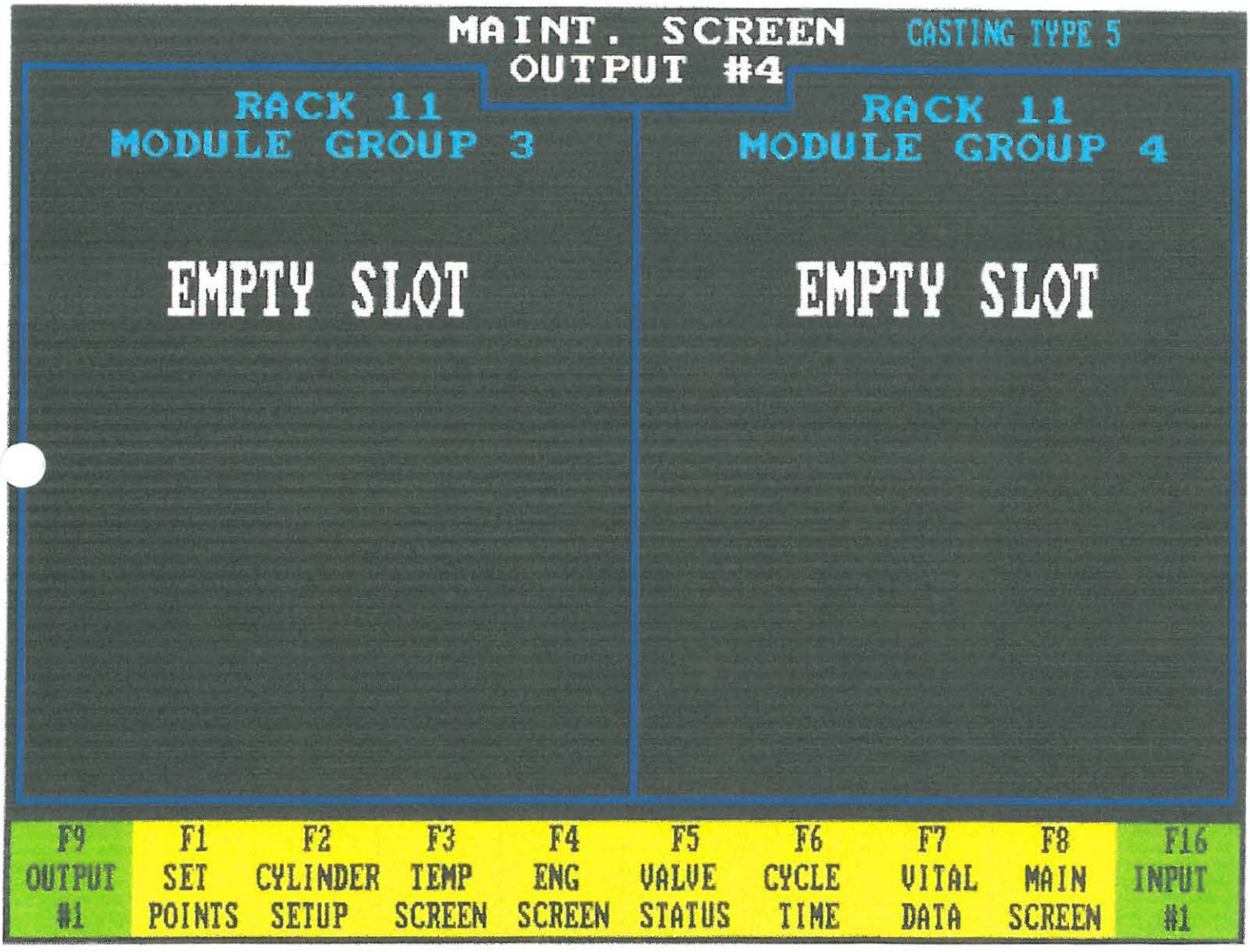
I gain NNNNN

D gain NNNNN

F1 MISC. DATA | F2 SETPOINT LOOK | F3 CYLIND SETUP | F4 TEMP SCREEN | F5 ENG SCREEN | F6 VALVE STATUS | F7 CYCLE TIME | F8 VITAL DATA | F9 MAIN SCREEN | F16 SETPOINT LOAD


MAINT. SCREEN
INPUT #3
RACK 10
MODULE GROUP 4
I:104/00 I/R EYE FRONT
I:104/01 I/R EYE BACK
I:104/02 I/R EYE SIDE
I:104/03 I/R EYE RETREIVER
I:104/04 SPARE INPUT
I:104/05 #1 EMGNCY MOLD OPN RTRCT P/X
I:104/06 #2 EMGNCY MOLD OPN RTRCT P/X
I:104/07 #3 EMGNCY MOLD OPN RTRCT P/X
I:104/10 #4 EMGNCY MOLD OPN RTRCT P/X
I:104/11 HYDRAULIC PUMP START S/W
I:104/12 EMERGENCY STOP P/B
I:104/13 FURNACE DUMP P/B
I:104/14 MANUAL ENABLE P/B
I:104/15 EJECT PART SELECT S/W
I:104/16 RTVR SLOW IN P/X
I:104/17 RTVR SLOW OUT P/X
F1 SET POINTS
F2 CYLINDER SETUP
F3 TEMP SCREEN
F4 ENG SCREEN
F5 VALVE STATUS
F6 CYCLE TIME
F7 VITAL DATA
F8 MAIN SCREEN

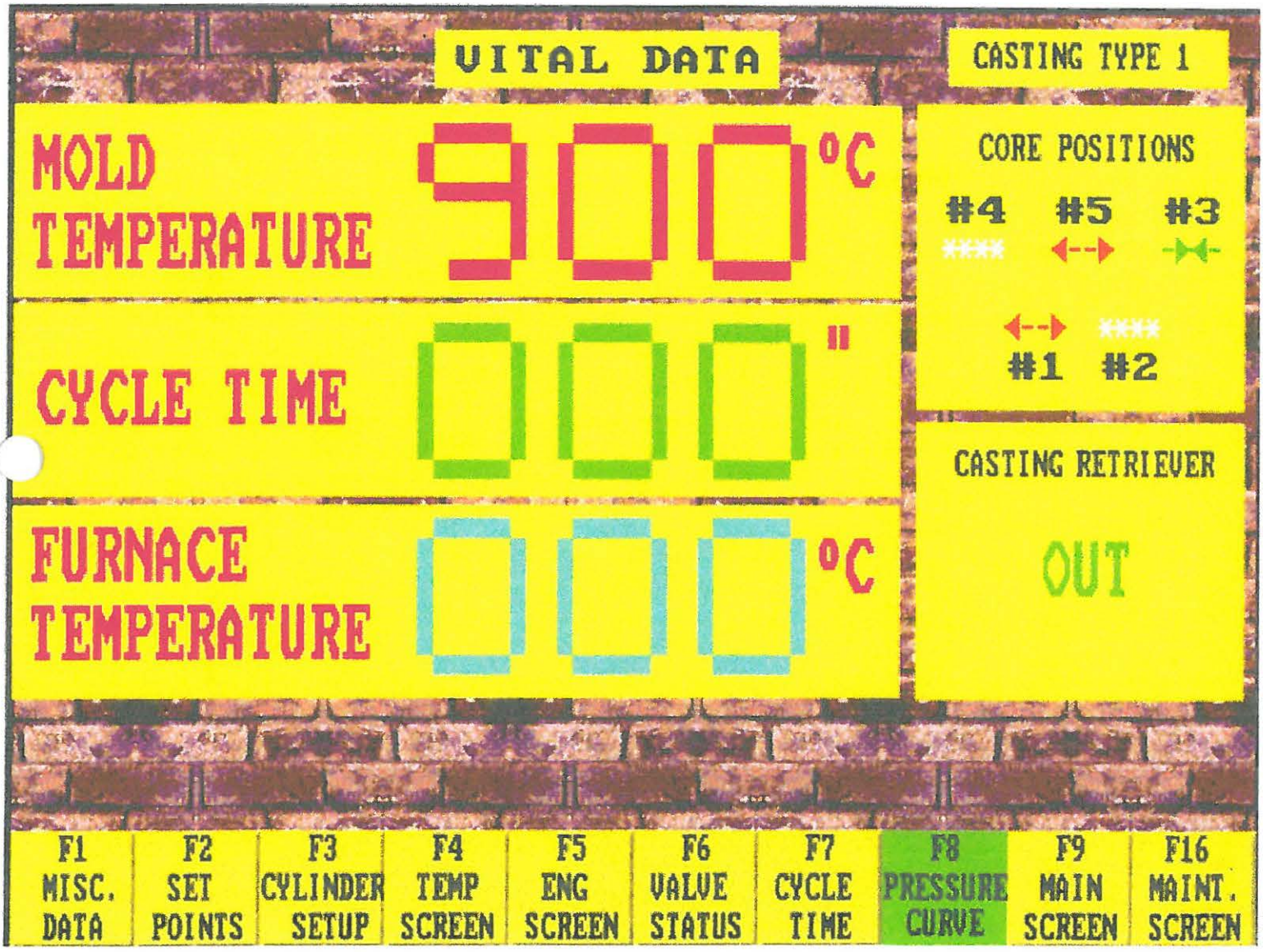

MAINT. SCREEN
CASTING TYPE 1
OUTPUT #3
RACK 11
MODULE GROUP 1
ON: 111/00 21 AIR S/V
ON: 111/01 22 AIR S/V
ON: 111/02 23 AIR S/V
ON: 111/03 24 AIR S/V
ON: 111/04 21 WATER S/V
ON: 111/05 22 WATER S/V
ON: 111/06 23 WATER S/V
ON: 111/07 24 WATER S/V
ON: 111/10 SPARE OUTPUT
ON: 111/11 SPARE OUTPUT
ON: 111/12 SPARE OUTPUT
ON: 111/13 SPARE OUTPUT
ON: 111/14 SPARE OUTPUT
ON: 111/15 SPARE OUTPUT
ON: 111/16 SPARE OUTPUT
ON: 111/17 NO FURNACE PRESSURE OUTPUT
RACK 11
MODULE GROUP 2
EMPTY SLOT
F1 OUTPUT #4
F1 SET POINTS
F2 CYLINDER SETUP
F3 TEMP SCREEN
F4 ENG SCREEN
F5 VALVE STATUS
F6 CYCLE TIME
F7 VITAL DATA
F8 MAIN SCREEN
F16 INPUT #1


MAINT. SCREEN
CASTING TYPE 5
OUTPUT #4
RACK 11
MODULE GROUP 3
EMPTY SLOT
RACK 11
MODULE GROUP 4
EMPTY SLOT
F9 OUTPUT #1
F1 SET POINTS
F2 CYLINDER SETUP
F3 TEMP SCREEN
F4 ENG SCREEN
F5 VALVE STATUS
F6 CYCLE TIME
F7 VITAL DATA
F8 MAIN SCREEN
F16 INPUT #1



Panelview Program
Version 1.00.00
PLC-5/40 Processor

F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
MISC. DATA	SET POINTS	CYLINDER SETUP	TEMP SCREEN	ENG SCREEN	VALVE STATUS	CYCLE TIME	VITAL DATA	MAIN SCREEN	MAINT. SCREEN


VITAL DATA
CASTING TYPE 1
MOLD TEMPERATURE
900
°C
CYCLE TIME
000
"
FURNACE TEMPERATURE
000
°C
CORE POSITIONS
#4 #5 #3
#1 #2
CASTING RETRIEVER
OUT
F1 MISC. DATA
F2 SET POINTS
F3 CYLINDER SETUP
F4 TEMP SCREEN
F5 ENG SCREEN
F6 VALVE STATUS
F7 CYCLE TIME
F8 PRESSURE CURVE
F9 MAIN SCREEN
F16 MAINT. SCREEN

Empire Castings Inc.
Equipment Manual

Model# EC02-A
Serial# AAPM01

Volumne 3, Section 2: Furnace Air System

1: Replacement Parts
-Diagram

Diagram#	Part#/Description	Mfg.
#1	08F7ACSB FILTER 1.5"	SCHRADER BELLOWS
#2	08R713ABSB REG. 1.5"	SCHRADER BELLOWS
#3	BB2ME020R000BS160 PROPORTIONAL VALVE	PROPORTIONAIR
#4	06L14BESB LUBRICATOR	SCHRADER BELLOWS
#5	MB331-301-150-2EA FURNACE PRESSURE INLET VALVE	I.S.I.
#6	06R113ACSB REG 1/4"	SCHRADER BELLOWS
#7	118C 1"@ 25PSI POP SAFETY VALVE	FC KINGSTON
#9	MB331-202-150-2EA FURNACE EHAUST FURNACE EMERGENCY EXH	I.S.I.
#10	4440K71 1-1/2" EHAUST MUFFLER	MCMASTER-CARR

PRESSURE SETTINGS:	#2	SET @ 40 PSI
	#6	SET @ 50 PSI
PRESSURE SWITCHES:	WS1820HR/ADJ	NASON
	NSM1B1.5HR/ADJ	NASON

ROUTINE MAINTENANCE:

* *CHECK LUBRICATOR FLUID LEVEL EACH SHIFT*
* *CHECK REGULATOR SETTINGS EACH SHIFT*
* *CHECK POP-SAFETY VALVE FOR OPERATION AND CONTAMINATION WEEKLY*
* *CHECK MUFFLER FOR CONTAMINATION WEEKLY*

7
6
5
4
3
2
1

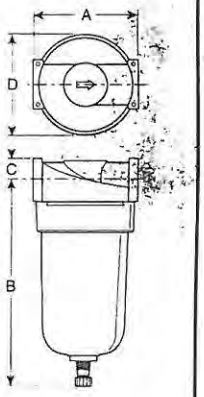
Schrader Bellows®
P.O. Box 631
Akron, Ohio 44309-0631

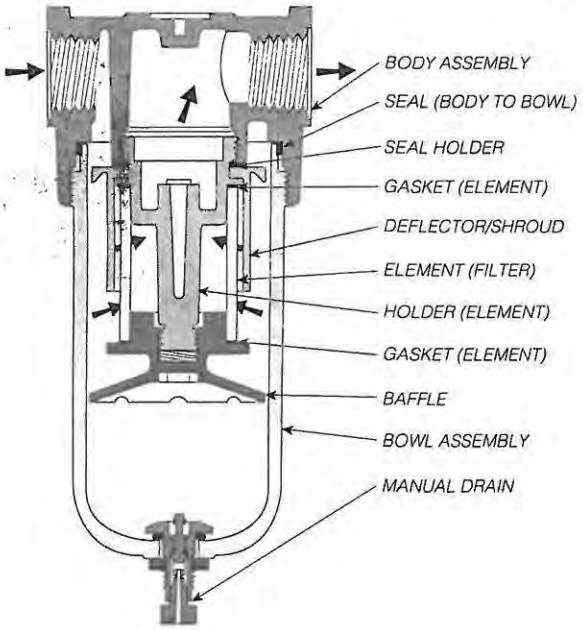
ISSUED: December, 1994
Supersedes: July, 1993

FILTERS 06F, 07F & 08F

FILTER







DIMENSIONS

Model	Port Size	A	B	B (with Auto Drain)	C	D
06F	1/4"-3/8"	2.75	5.77	5.65	.60	2.64
		70mm	147mm	144mm	15mm	67mm
07F	3/8"-1/2"-3/4"	3.24	7.08	6.96	.73	3.03
		82mm	180mm	177mm	19mm	77mm
08F	3/4"-1"-1 1/4"-1 1/2"	5.00	9.38	9.26	1.18	4.84
		127mm	238mm	235mm	30mm	123mm

FILTER MODELS	06F	07F	08F
ELEMENT KIT 40 MICROMETER (1) ELEMENT (FILTER) (2) GASKET (ELEMENT) (1) BAFFLE (1) SHROUD (1) DEFLECTOR (1) SEAL (HOLDER) (1) SEAL (BODY TO BOWL)	PS101SB	PS201SB	PS301BSB
ELEMENT CARTRIDGE KIT, 40 MICROMETER (1) HOLDER (ELEMENT) (1) ELEMENT (FILTER) (2) GASKET (ELEMENT) (1) BAFFLE (1) SHROUD (1) DEFLECTOR (1) SEAL (HOLDER) (1) SEAL (BODY TO BOWL)	PS104SB	PS204SB	PS304CSB
POLYCARBONATE BOWL KIT (1) POLYCARBONATE BOWL WITH MANUAL DRAIN (METAL BOWL 08F) (1) SEAL (BODY TO BOWL)	PS166SB	PS266SB	PS369SB



08F

MAXIMUM PRESSURE AND TEMPERATURE

150 psig @125°F (10 bar @ 52°C) with Polycarbonate Bowl
250 psig @175°F (17 bar @ 80°C) with Metal Bowl
10 psig minimum (0.68 bar) with Automatic Drain

Conversion 1 Bar = 14.5 psi, °C = 5/9 (°F -32)

ACCESSORIES CHART

Accessories listed below are available in complete Filter units.

FILTER MODELS	06F	07F	08F
Automatic drain		PS506SB	
Polycarbonate bowl with automatic drain kit	PS143SB	PS243SB	N/A
25 Micrometer element kit	PS102SB	PS202SB	PS302BSB
5 Micrometer element kit	PS103SB	PS203SB	PS303BSB
Bowl guard kit	PS107SB	PS207SB	N/A
Metal bowl without sight glass automatic drain kit	PS148SB	PS248SB	PS348BSB
Metal bowl with sight glass (Manual Drain)	PS169SB	PS269SB	PS369SB
Mounting bracket kit*	PS109SB	PS209SB	PS309SB

* Not supplied with units, must be ordered separately.

INSTALLATION

1. The equipment to which the filter is attached should be internally cleaned to remove all traces of accumulated oil and dirt. Also, new pipe or hose should be installed between the filter and equipment being protected.
2. Blow all upstream pipe work clear of accumulated dirt and liquids.
3. Select a filter location as close as possible to the equipment being protected and upstream of any pressure regulator.
4. Install filter so that air flows in the direction of arrow on cover.
5. Install filter vertically with the bowl drain mechanism at the bottom. Both free moisture and solids will thus drain into the sump (quiet zone) at the bottom of the bowl (automatic drain models are recommended as standard equipment).

OPERATION & SERVICE

1. Both free moisture and solids are removed automatically by the filter. There are no moving parts.

   Manual drain filters must be drained regularly before the separated moisture and oil reaches the bottom of the lower baffle. Automatic drain models will collect and dump liquids automatically.
3. The filter element should be removed and replaced when the pressure differential across the filter unit is excessive.
4. **To remove the filter element: SHUT OFF AIR SUPPLY and depressurize the unit.**
   a. Unscrew threaded bowl.
   b. Unscrew lower baffle and remove filter element and gaskets (2).
   c. Clean all internal parts, bowl and element before reassembling. See polycarbonate bowl cleaning section.
   d. Install element and gaskets (2).
   e. Attach lower baffle and tighten firmly.
   f. Replace bowl seal; lubricate seal to assist in retaining it in position. Use only mineral base oils or grease. Do NOT use synthetic oils such as esters and do NOT use silicones.
   g. Screw bowl into body.

SAFETY: TRANSPARENT BOWLS

CAUTION:

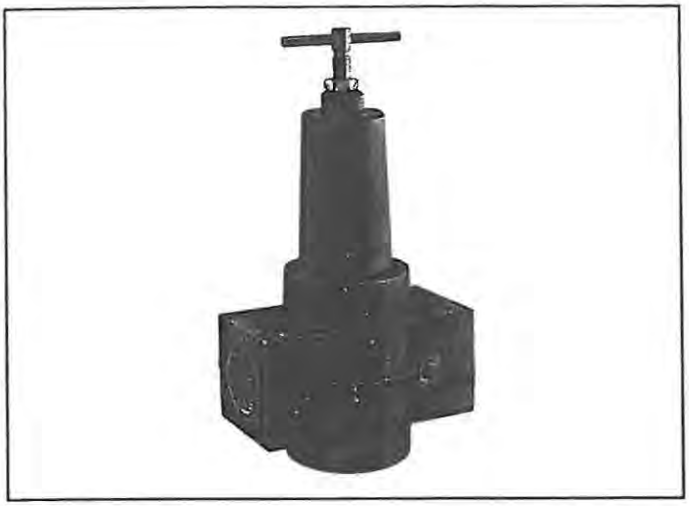
Polycarbonate bowls, being transparent and tough, are ideal for use with Filters and Lubricators. They are suitable for use in normal industrial environments, but should not be located in areas where they could be subjected to direct sunlight, an impact blow, nor temperatures outside of the rated range. As with most plastics, some chemicals can cause damage. Polycarbonate bowls should not be exposed to chlorinated hydro-carbons, ketones, esters and certain alcohols. They should not be used in air systems where compressors are lubricated with fire-resistant fluids such as phosphate ester and di-ester types.

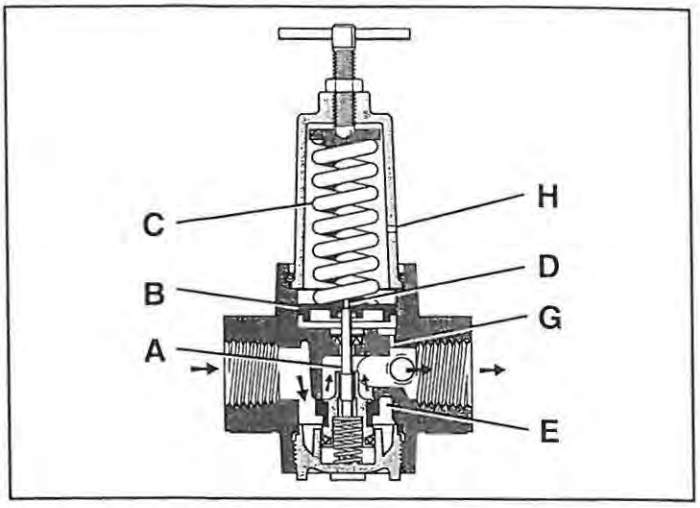
Metal bowls are recommended where ambient and/or media conditions are not compatible with polycarbonate bowls. Metal bowls resist the action of most such solvents, but should not be used where strong acids or bases are present or in salt laden atmospheres. Consult the factory for specific recommendations where these conditions exist.

TO CLEAN POLYCARBONATE BOWLS USE MILD SOAP AND WATER ONLY! DO NOT use cleansing agents such as acetone, benzene, carbon tetrachloride, gasoline, toluene, etc., which are damaging to this plastic.

Bowl guards are recommended for added protection of polycarbonate bowls where chemical attack may occasionally occur.

Air Line Regulators
Hi-Flow 08R Series
3/4, 1, 1-1/4 & 1-1/2 Inch–Basic 1" Body





Features

- Secondary aspiration plus balanced poppet provides quick response and accurate pressure regulation.
- Large reverse flow capability.
- Solid control piston for extended life.
- Two full flow 1/4" gauge ports can be used as additional outlets.
- Easily serviced.

Application

The 08R Hi-Flow series regulators are designed to provide quick response, and accurate pressure regulation for the most demanding Hi-Flow industrial applications. The unique solid piston was designed for long, service-free operation and will not rupture or tear under high cycle or other demanding applications.

⚠ WARNING

Do not connect regulator to bottled gas.
Do not exceed maximum primary pressure rating.
Product rupture can cause serious injury.

Operation

With the T-handle turned fully counterclockwise (no spring load), and pressure supplied to the regulator inlet port, the valve poppet assembly **(A)** is closed. Turning the T-handle clockwise applies a load to control spring **(C)**. This load causes the piston **(B)** and the valve poppet assembly **(A)** to move downward allowing flow across the seat area **(E)** created between the poppet assembly and the body. Pressure in the downstream line is sensed below the control piston **(B)** and offsets the load of spring **(C)**. As downstream pressure rises, poppet assembly **(A)** and control piston **(B)** move upward until the area **(E)** is closed and the load of the spring **(C)** and pressure under piston **(B)** are in balance. A reduced outlet pressure has now been obtained, depending on spring load. Creating a demand downstream, such as opening a valve, results in a reduced pressure under the control piston **(B)**. The load of control spring **(C)** now causes the poppet assembly to move downward opening seat area **(E)** and allowing air to flow to meet the downstream demand. The flow of downstream air is metered by the amount of opening **(E)**.

During low flow requirements, the amount of opening at the seat **(E)** is small, while at high flows it is large. The downstream pressure signal, which regulates the amount of opening, requires an adjustment over this range, in order to attempt a constant output. This adjustment is the orifice **(G)**, which is sized and located in such a manner as to provide a compensation to the downstream pressure signal transmitted to the piston. This effect is called aspiration and its effect is to maintain downstream pressure nearly constant over a wide range of flow demands.

Should downstream pressure exceed the desired regulated pressure, the excess pressure will cause the control piston **(B)** to move upward against control spring **(C)**, open vent hole **(D)**, and vent the excess pressure to atmosphere through the hole in the bonnet **(F)**. (This occurs in the standard relieving type regulator only.)

Specifications

Adjusting Stem & Springs:
Steel

Body:
Aluminum

Bonnet, Piston Stem, Valve Poppet & Cap:
Aluminum

Gauge Ports:
Two Ports – 1/4 Inch
(Can be used as additional Full Flow 1/4 Outlet Ports)

Piston, Cap:
Plastic

Port Threads:
3/4, 1, 1-1/4, 1-1/2 Inch

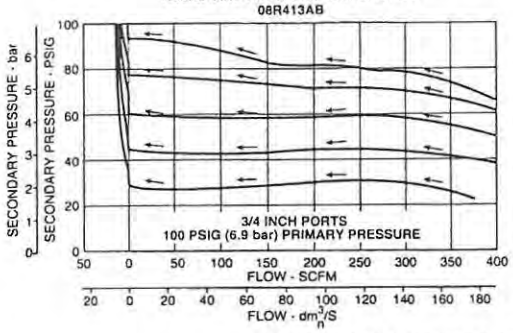
Pressure & Temperature Rating:
0 to 250 PSIG (0 to 17 bar)
32°F to +175°F (0°C to 80°C)

Seals:
Nitrile

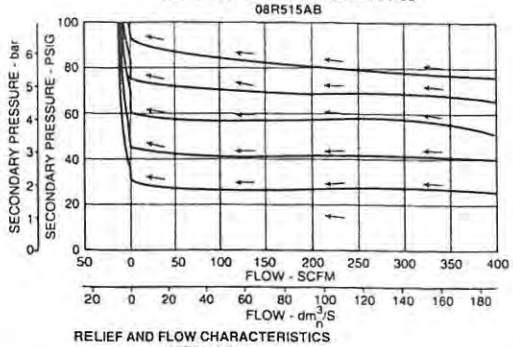
Secondary Pressure Ranges:
Standard Pressure 2-125 PSIG (.14 to 8.6 bar)
Low Pressure 1-60 PSIG (.07 to 4 bar)
High Pressure 5-250 PSIG (.34 to 17.3 bar)

Performance Characteristics

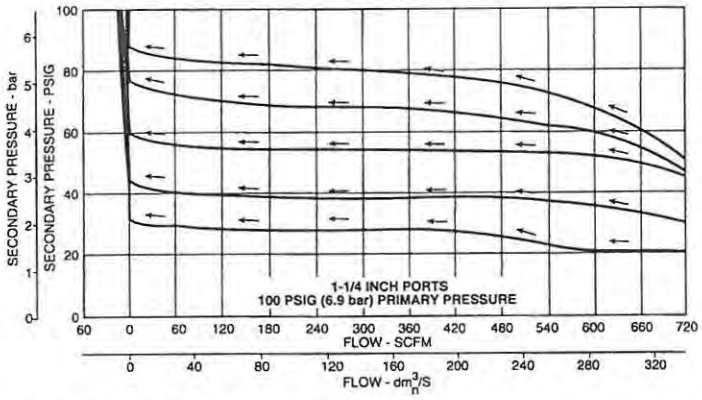
RELIEF AND FLOW CHARACTERISTICS
08R413AB



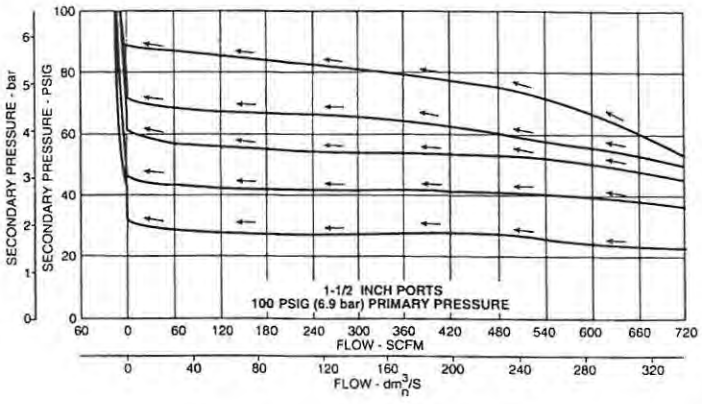
RELIEF AND FLOW CHARACTERISTICS
08R515AB



RELIEF AND FLOW CHARACTERISTICS
08R613AB



RELIEF AND FLOW CHARACTERISTICS
08R713AB



B

Ordering Information

08R	5	13	A	*	SB

Port Size

- 4–3/4 Inch
- 5–1 Inch
- 6–1-1/4 Inch
- 7–1-1/2 Inch

Pressure Range

Without Gauge
- 11. 60 PSIG
- 13. 125 PSIG
- 15. 250 PSIG

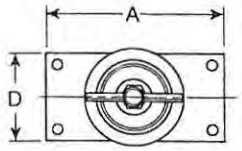
With Gauge
- 16. 60 PSIG
- 18. 125 PSIG
- 21. 250 PSIG

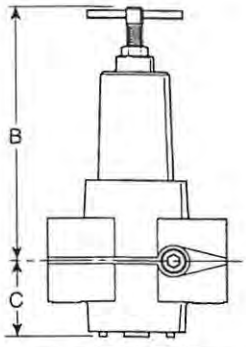
Adjustment

- A. T-Handle, Relieving
- L. T-Handle, Non-Relieving

Engineering Change Designator

Will be entered at factory.





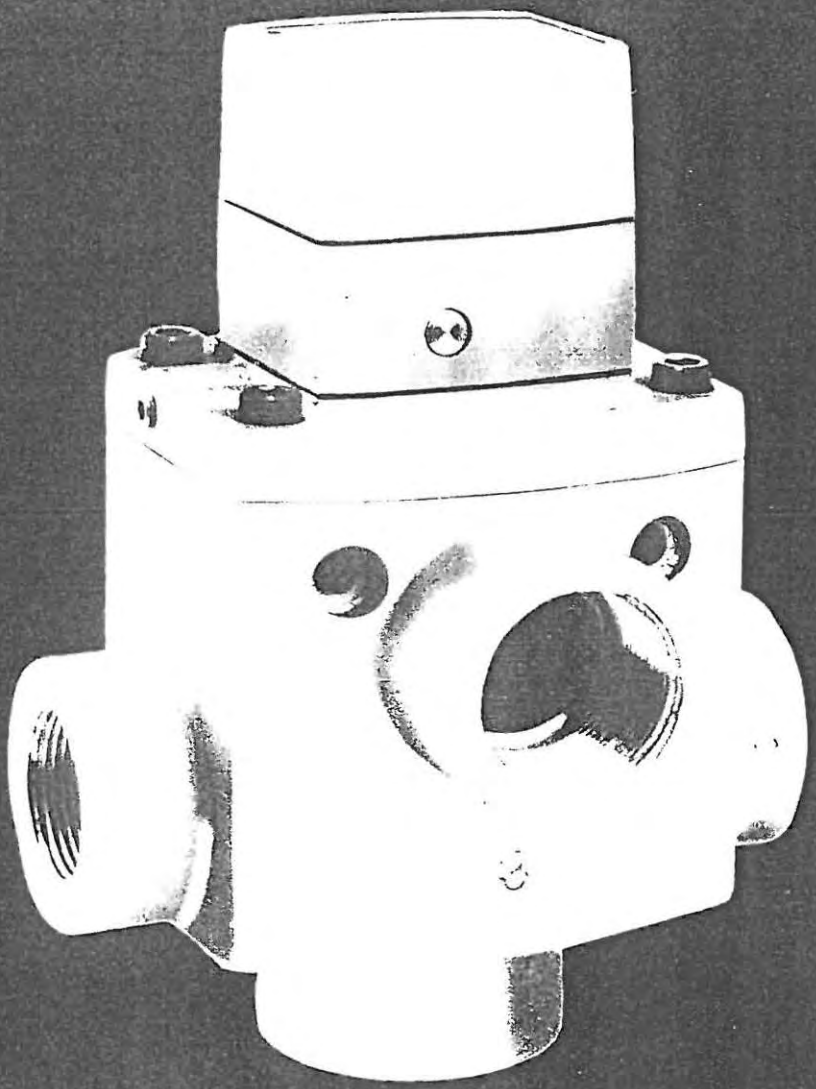
CAUTION:

REGULATOR PRESSURE ADJUSTMENT – The working range of T-handle adjustments is designed to permit outlet pressures within their full range. Pressure adjustment beyond this range is also possible because the T-handle is not a limiting device. This is a common characteristic of most industrial regulators, and limiting devices may be obtained only by special design.

Dimensions:

Model	Port Size Inch	A	B	C	D	Wt.
08R	3/4", 1"	5.00	7.81	2.13	2.96	3.9 lb.
	1-1/4", 1-1/2"	127 mm	198 mm	54 mm	75 mm	1.8 kg

MINI BAZOOKA



MINI BAZOOKA

MINI BAZOOKA: 3-Way, 2-Position, high flow air valves—designed and built for tough industrial applications.

We call it "Mini" because it's a smaller version of the popular industry veteran, the BIG BAZOOKA.

HIGH FLOW: "Mini" in name, "Maxi" in flow . . . over 34 Cv.

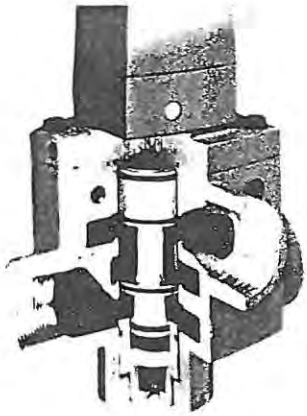
LOW BREAKOUT FRICTION: I.S.I. "THIN LIP" SEALS virtually eliminate breakout friction insuring rapid response . . . even at low pressure.

LONG SERVICE LIFE: Low friction "THIN LIP" SEALS are all VITON®. Maximum life with or without air lubrication.

VERSATILE: Can be piped to provide six different functions.

Use MINI BAZOOKA for 2-Way, 3-Way, selector and divertor applications . . . can be externally piloted for vacuum or low pressure service.

Porting options, operator options, and mounting options make MINI BAZOOKA the most versatile valve of it's type.





USE AS A LOCKOUT

MINI BAZOOKA can be used as a safety lockout.

Use to safely charge or exhaust your pneumatic systems.

Positive padlock in "off" position to guarantee safety while maintenance work is being done.

MINI BAZOOKA with Loc-Master option is provided only as 3-way normally closed.



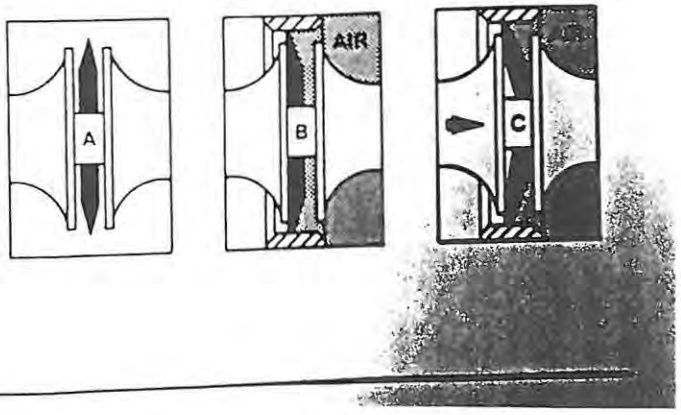
THE I.S.I. PATENTED "THIN LIP" SEAL

The Unique "Thin Lip" Seal:

- offers minimum breakout friction
- provides wiping action that keeps bore clean and evenly distributes lubrication

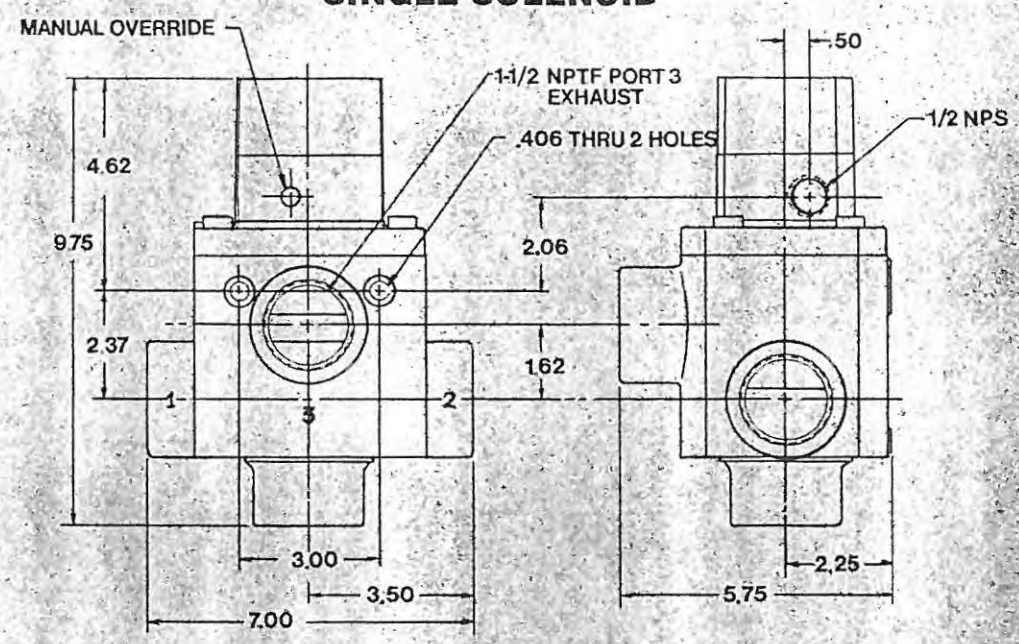
How It Works (Refer to Spool Illustration)

a. "Relaxed" no pressure on either side of seal.
b. Pressure from right moves seal to left expanding it against the bore to sealed position.
c. Force applied from left shifts spool . . . nominal sealing friction causes lip to flex like diaphram. Flexing action reduces breakout friction, this spool can react quickly with very low force requirement.

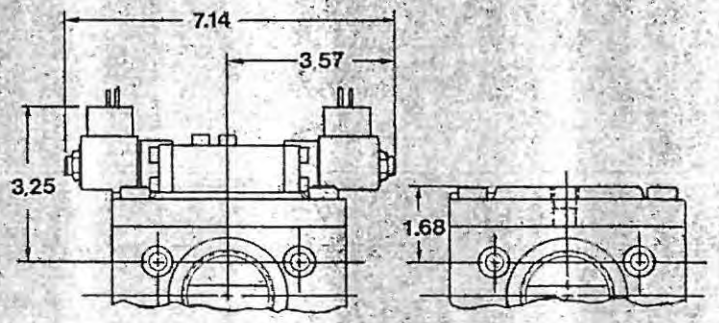


DIMENSIONAL DATA

SINGLE SOLENOID



OPTIONAL OPERATORS



DOUBLE SOLENOID **AIR PILOT**

AIR FLOW DATA

PORT SIZE 1&2	1" NPTF		1¼" NPTF		1½" NPFT	
NORMALLY CLOSED	IN TO OUT	OUT TO EXHAUST	IN TO OUT	OUT TO EXHAUST	IN TO OUT	OUT TO EXHAUST
Cv	24.2	24.2	34.3	33.0	34.3	33.0
MAX. FLOW SCFM @ 80 PSIG	1139	1139	1610	1549	1610	1549

SOLENOID DATA

	120/60 Hz	24VDC
IN RUSH	.25 amps	.5 amps
HOLDING	.11 amps	.5 amps

REPAIR PARTS

SOLENOID PILOT		VALVE BODY		
COMPLETE SOLENOID PILOT ASSY—Non Locking	91A20085	Spool Assy. with Seals	N.C. 90A20158	N.O. 90A20159
Solenoid Assy	09A01033	ORings	08A01064 08A01074	
Coil	26A01000	Spring	07A01077	

MINI BAZOOKA ORDERING INFORMATION

EXAMPLE

MB - 331 - 301 - 125 - 2 - 120V/60HZ

PILOT VALVE OPERATORS

- SINGLE SOLENOID with non-locking manual override spring return. ---------- 331
- DOUBLE SOLENOID (Momentary Contact) ---------- 332
  AIR PILOT Spring Return (Maintained Contact) ---------- 031
  DOUBLE AIR PILOT (Momentary Contact) ---------- 032
  LOC-MASTER Safety Bleed Valve ---------- 045
- SINGLE SOLENOID Explosion Proof (Maintained Contact) ---------- 421
- DOUBLE SOLENOID Explosion Proof (Momentary Contact) ---------- 422

*Non Locking Manual Override Standard on Solenoid Valves

MAIN VALVE OPTIONS

2-WAY—Normally Closed (3 Port Plugged) ---------- 201
2-WAY—Normally Open (3 Port Plugged) ---------- 202
3-WAY—Normally Closed ---------- 301
3-WAY—Normally Open ---------- 302
See Piping Instructions—Shown Below

PORT SIZE DESIGNATION

1" NPTF ---------- 100
1¼" NPTF ---------- 125
1½" NPTF ---------- 150

OPTIONAL

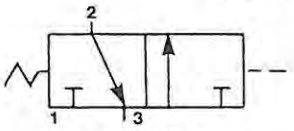
Locking Manual Override ---------- 2

Voltage & Cycles ---------- specify

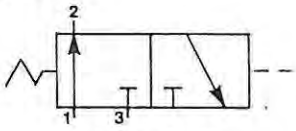
	AC	DC
Standard Voltages	~120/60	12VDC
	240/60	24VDC
	24/60	120VDC

MAIN VALVE BODY DATA

ANSI SYMBOLS



3 Way N.C.



3 Way N.O.

- Valve may be mounted in any position
- Dynamic Seals . . . Viton®
- Maximum Operating Pressure . . . 125 psig
- Minimum Operating Pressure . . . 30 psig
- Media . . . Air only
  External Pilot Available for Low Pressure/Vacuum Applications (specify)

Shipping Weight 121 lbs. approx.

PIPING ARRANGEMENTS

APPLICATION	PORT #1	PORT #2	PORT #3
3-Way Normally Closed	Supply	Outlet	Exhaust
3-Way Normally Open	Supply	Outlet	Exhaust
2-Way Normally Closed	Supply	Outlet	Plugged
2-Way Normally Open	Supply	Outlet	Plugged
LOC MASTER 3-Way Normally Closed—Only	Supply	Outlet	Exhaust

PROPORTION-AIR INC.

BR055
10/06/91

R-SERIES R0002-R000A

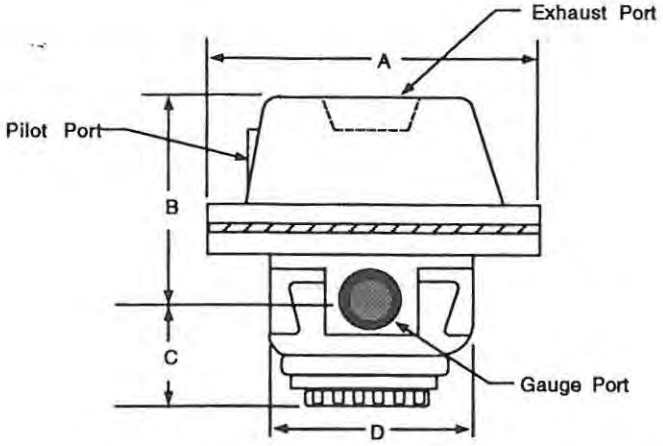


- Diaphragm Type Pilot Operated Regulator
- Flows up to 2000 scfm
- Pressures up to 250 psi
- High Relief Flow

DESCRIPTION

R0002, R0003, R0004, R0006, R0008, R000A

Main Ports	Gauge Ports	Pilot Port	Exhaust Port
1/4 PTF 3/8 PTF 1/2 PTF 3/4 PTF 1 PTF 1-1/4 PTF	1/4 PTF 3/8 PTF 1/2 PTF 1/2 NPTF 1/2 NPTF 1/2 NPTF	1/4 PTF	3/4 PTF



Pipe Size	Dimensions - Inches (mm)			
	A	B	C	D
1/4, 3/8, 1/2, 3/4 3/4, 1, 1-1/4	4.16(106)	3.59(91) 4.11(104)	1.48(38) 1.86(47)	2.71(69) 3.65(93)

SPECIFICATIONS

Type: Relieving Diaphragm with high relief flow

Rated operating conditions-

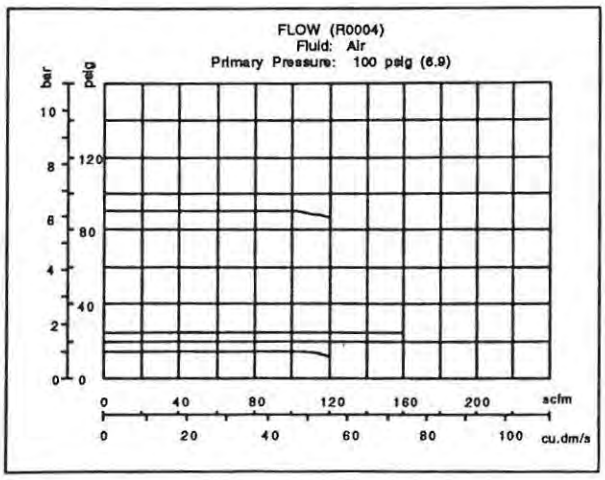
Regulated Pressure:	0 to 250 psig (0.7 to 27.6 bar)
Temperature:	0 to 175 F (-18 to 79 C)

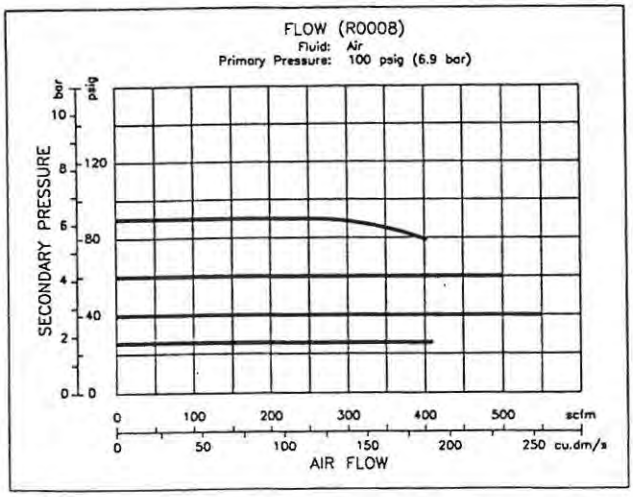
Materials of Construction-

Body:	Zinc
Bonnet:	Aluminum
Bottom Plug:	Acetal
Valve:	Brass
Elastomers:	Buna-N

Flow Curves

Flow curves indicate how secondary pressure changes as flow is increased from a no flow condition. Read curve from left to right.





© PROPORTION-AIR, INC. BOX 218 MCCORDSVILLE, IN USA 46055 (317)335-2602 SALES FAX (317)335-3853 ENGINEERING FAX (317)335-2605

HOW TO ORDER

DS T X 100 G A *

Basic Model Number

Units Available
- V - Vacuum
- T - Calls Out Stainless High Pressure 30-3000 psi Transducer

Electrical Connection
- X - 3 Wire Voltage Output
- I - 2 Wire Current Output
- Y - Mini 3 Pin Plug For All BB2 Voltage Units
- Z - Mini 3 Pin For All BB2 Current Units

Pressure Range psi

DSX, DSI, DSZ } 1 to 300 psi
DST 1 to 3000 psi

Pressure Ranges Available: from 0-1 psi up to 300psi

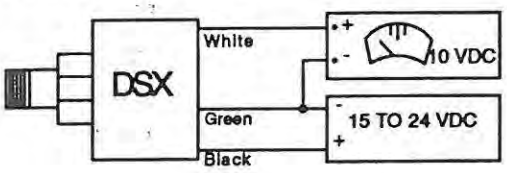
*Stainless steel wetted parts available on DST Models. Ranges available from 0-25 psi up to 3000 psi.

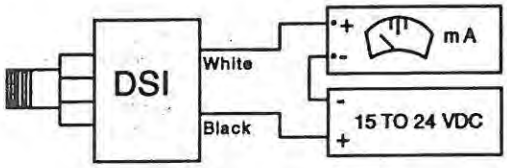
Type
- G - GAUGE
- A - ABSOLUTE

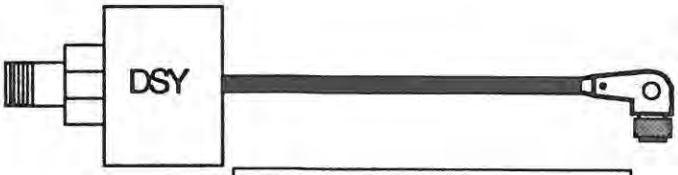
Fitting
- A - 1/4" N.P.T.STD
- B - 1/8" N.P.T.
- C - 1/4" BARB

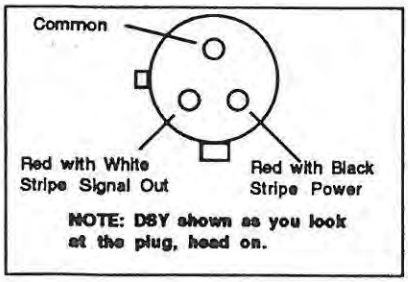
Special

Electrical Connection





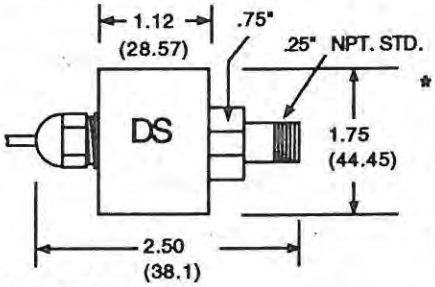




Physical Construction

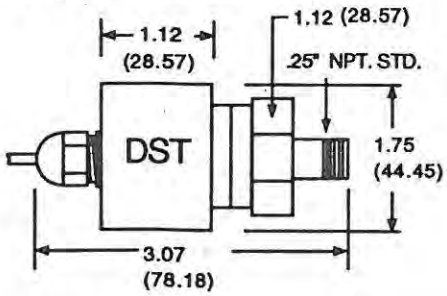
In Inches (mm)

Standard Pressure Transducer



* For DS Transducer with stainless steel nipple specify on S141 option.

High Pressure Transducer



WARRANTY

Proportion-Air products are warranted to the original purchaser only against defects in material or workmanship for one (1) year from the date of manufacture. The extent of Proportion-Air's liability under this warranty is limited to repair or replacement of the defective unit at Proportion-Air's option. Proportion-Air shall have no liability under this warranty where improper installation or filtration occurred. All specifications are subject to change without notice. THIS WARRANTY IS GIVEN IN LIEU OF, AND BUYER HEREBY EXPRESSLY WAIVES, WARRANTIES OR LIABILITIES, EXPRESS, IMPLIED OR STATUTORY, INCLUDING WITHOUT LIMITATION ANY OBLIGATION OF PROPORTION-AIR WITH REGARD TO CONSEQUENTIAL DAMAGES, WARRANTIES OF MERCHANTABILITY, DESCRIPTION, AND FITNESS FOR A PARTICULAR PURPOSE.

WARNING:- Installation and use of this product should be under the supervision and control of properly qualified personnel in order to avoid the risk of injury or death.

BB2 RECALIBRATION PROCEDURE FOR USE WITH BB2/VOLUME BOOSTER COMBINATIONS

Introduction

This information is designed to explain the recalibration procedure for Proportion-Air's BB2/Volume booster control package. All BB2 products come precalibrated from the factory. Should the unit need recalibration, use these instructions as a guide or contact Proportion-Air, Inc. for further details.

The control package consists of the main control body (BB), an external transducer (DS), and a volume booster. The main body of the BB2 has both Zero and Span calibration adjustment on the bottom of the unit. The DS series transducer also has Zero and Span calibration adjustments located on the back next to the electrical cord connection. Usually these calibration adjustments are covered over with black silicone. The calibration adjustments interact with one another as shown in the following diagram (See Fig. 1). Before proceeding, locate the BB and the DS transducer within the assembly and remove them from the volume booster..

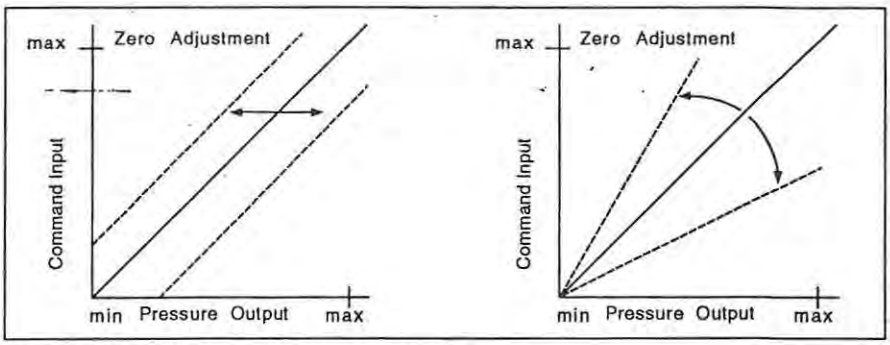


Figure 1 Effects of Zero and Span Adjustments

Calibration Procedure

BEFORE PROCEEDING MAKE SURE THE BB2 IS REMOVED FROM THE VOLUME BOOSTER. THIS PROCEDURE REQUIRES USE OF THE BB2 AND THE DS TRANSDUCER ONLY.

Main Body Calibration

1. Disconnect the DS transducer from the BB2.
2. Locate the Zero and Span adjustments underneath the unit. If adjustments are covered over with black silicone remove it at this time.
3. Using a small screwdriver, turn both the Zero and the Span adjustments 25 turns clockwise. Then turn both adjustments 12 turns counter-clockwise. This will put the unit roughly at mid scale.
4. Connect the power cord to the BB2.
5. Connect the pressure supply to inlet port of the BB2.
6. Connect a gauge or measuring device to outlet port of BB2. Allow some volume (1 cubic inch or better) between the two connections.

   NOTE: SEE SPECIFICATIONS ON INPUT PRESSURE BEFORE PROCEEDING

7. Determine the maximum pressure range from the model number. Apply supply pressure to the BB2 above the max. pressure range.
8. Apply a command signal to the BB2 using the following information.

Model #	Signal
BB2ME or BB2MFE	1VDC
BB2MI or BB2MFI	2.2 mA
BB2MD or BB2MFD	count 25

9. Turn Span adjustment until actual pressure is 80% of maximum pressure range desired (clockwise increases pressure, counterclockwise decreases pressure).
10. Apply minimum command signal to the BB2 using the following information.

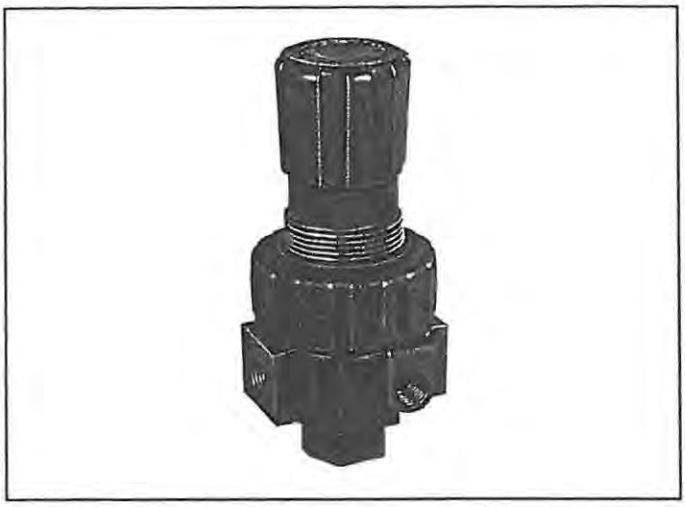
Model #	Signal
BB2ME or BB2MFE	0 VDC
BB2MI or BB2MFI	0 mA
BB2MD or BB2MFD	count 0

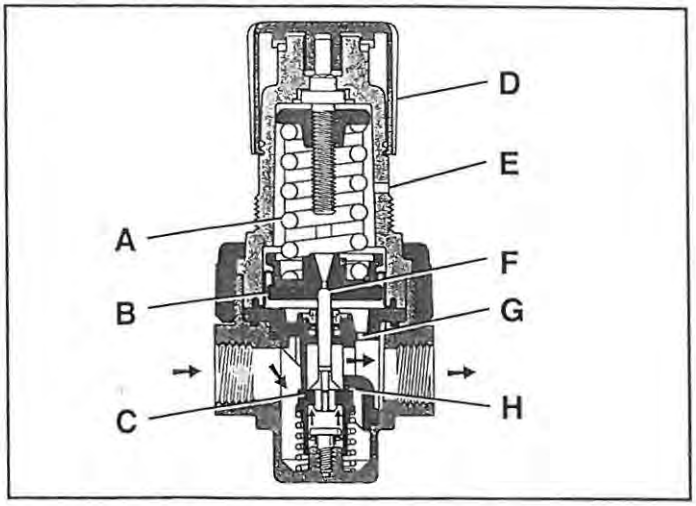
11. Turn Zero adjustment until minimum pressure desired is reached (clockwise decreases pressure, counterclockwise increases pressure).

    NOTE: THE SPAN AFFECTS THE ZERO OFFSET. AFTER MAKING ANY SPAN ADJUSTMENT CHECK THAT MINIMUM PRESSURE SETTING IS AT DESIRED VALUE.

12. Repeat steps 8, 9, 10, 11 until the BB2 is calibrated over entire pressure range.

Air Line Regulators
Standard 07R Series
3/8, 1/2 & 3/4 Inch–Basic 1/2" Body





Features

- Secondary aspiration plus balanced poppet provides quick response and accurate pressure regulation.
- Large reverse flow capability.
- Rolling diaphragm for extended life.
- Two high flow 1/4" gauge ports can be used as additional outlets.
- Easily serviced.
- Removable knob for panel mounting.

Application

The 07R series regulators are designed to provide quick response, and accurate pressure regulation for the most demanding industrial applications. The use of rolling diaphragm design results in significantly longer life, and therefore helps to eliminate maintenance and costly downtime. Rolling diaphragms and balanced poppets are used to provide accurate pressure regulation, and the built in capability of reverse flow **without** the use of check valves.

⚠ WARNING
Do not connect regulator to bottled gas.
Do not exceed maximum primary pressure rating.
Product rupture can cause serious injury.

Operation

With the knob **(D)** turned fully counterclockwise (no spring load), and pressure supplied to the regulator inlet port, the valve poppet assembly **(C)** is closed. Turning the knob clockwise applies a load to control spring **(A)**. This load causes the diaphragm **(B)** and the valve poppet assembly **(C)** to move downward allowing flow across the seat area **(H)** created between the poppet assembly and the body. Pressure in the downstream line is sensed below the diaphragm **(B)** and offsets the load of spring **(A)**. As downstream pressure rises, poppet assembly **(C)** and diaphragm **(B)** move upward until the area **(H)** is closed and the load of the spring **(A)** and pressure under diaphragm **(B)** are in balance. A reduced outlet pressure has now been obtained, depending on spring load. Creating a demand downstream, such as opening a valve, results in a reduced pressure under the diaphragm **(B)**. The load of control spring **(A)** now causes the poppet assembly to move downward opening seat area **(H)** and allowing air to flow downstream. The flow of downstream air is metered by the amount of opening **(H)**.

During low flow requirements, the amount of opening at the seal **(H)** is small, while at high flow it is large. The downstream pressure signal, which regulates the amount of opening, requires an adjustment over this range, in order to attempt a constant output. This adjustment is the orifice **(G)**, which is sized and located in such a manner as to provide a compensation to the downstream pressure signal transmitted to the diaphragm. This effect is called aspiration and its effect is to maintain downstream pressure nearly constant over a wide range of flow demands.

Should downstream pressure exceed the desired regulated pressure, the excess pressure will cause the diaphragm **(B)** to move upward against control spring **(A)**, open vent hole **(F)** and vent the excess pressure to atmosphere through the hole in the bonnet **(E)**. (This occurs in the standard relieving type regulator only.)

Specifications

Adjusting Stem:
Steel

Body:
Zinc

Bonnet, Piston Stem, Valve Poppet & Cap:
Plastic

Collar:
Plastic

Diaphragm:
Nitrile

Gauge Ports:
Two Ports – 1/4 Inch (Can be used as additional High Flow 1/4 Outlet Ports)

Knob:
Plastic

Port Threads:
3/8, 1/2 & 3/4 Inch

Primary Pressure Rating:
Maximum Primary Pressure
250 PSIG (17 bar)

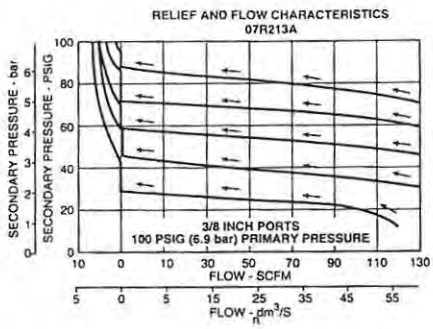
Seals:
Nitrile

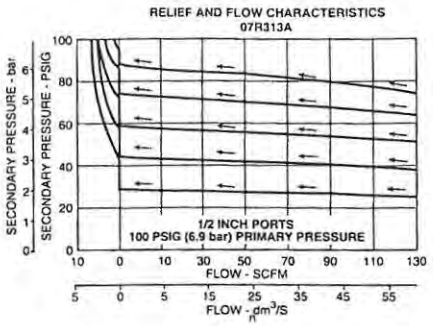
Secondary Pressure Ranges:
Standard Pressure 2-125 PSIG (.14 - 8.6 ba
Low Pressure 1-60 PSIG (.07 - 4 bar)
High Pressure 5-250 PSIG (.34 - 17.3 bar)

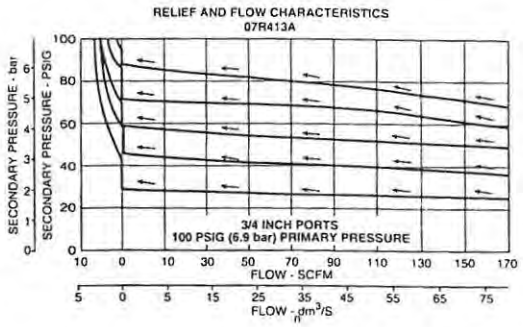
Springs:
Poppet: Stainless
Control: Steel

Temperature Rating:
32°F to 175°F (0°C to 80°C)

Performance Characteristics







B

Ordering Information

07R	3	13	A	*	SB

Port Size

2–3/8 Inch
3–1/2 Inch
4–3/4 Inch

Pressure Range

Without Gauge	With Gauge
11. 60 PSIG	16. 60 PSIG
13. 125 PSIG	18. 125 PSIG
15. 250 PSIG	21. 250 PSIG
24. 30 PSIG Non-Adjustable (Use with V option only)	

Adjustment & Relieving

A. Non-Rising Knob/ Relieving
L. Non-Rising Knob/ Non-Relieving
V. Non-Adjustable, Relieving (24 Option Only)

Engineering Change Designator

Will be entered at factory.

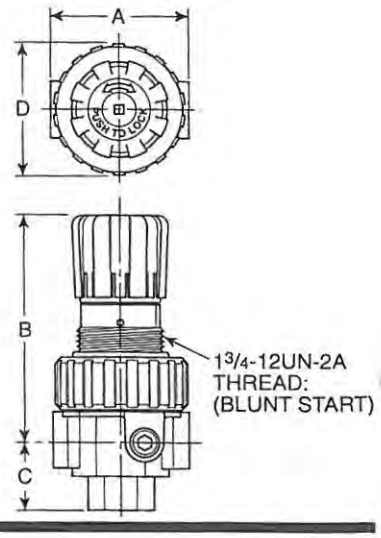
CAUTION:

REGULATOR PRESSURE ADJUSTMENT – The working range of knob adjustments is designed to permit outlet pressures within their full range. Pressure adjustment beyond this range is also possible because the knob is not a limiting device. This is a common characteristic of most industrial regulators, and limiting devices may be obtained only by special design.

Dimensions:

Model	Port Size Inch	A	B	C	D	Wt.
07R	3/8", 1/2" 3/4"	3.24	4.79	1.61	2.74	2.5 lb.
		82 mm	122 mm	41 mm	70 mm	1.1 kg

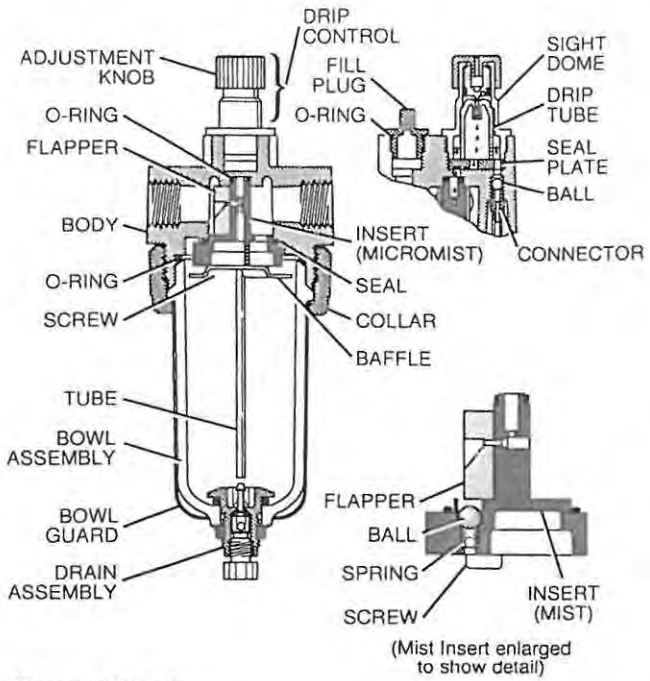
NOTE:
1.76 Dia. (45 mm) minimum hole required for panel mounting.



Schrader Bellows®

P.O. Box 631
Akron, Ohio 44309-0631

Installation and Service Instructions: 2L101BSB
1/4", 3/8" & 1/2" 06L, 16L
3/8", 1/2" & 3/4" 07L, 17L
Mist & Micromist Lubricator
ISSUED: June, 1995
Supersedes: March, 1995
NPR# R06371



Micromist Shown

⚠ WARNING

To avoid unpredictable system behavior that can cause personal injury and property damage:

- **Disconnect air supply and depressurize all air lines connected to this product before installation, servicing, or conversion.**
- **Operate within the manufacturer's specified pressure, temperature, and other conditions listed in these instructions.**
- **Medium must be moisture-free if ambient temperature is below freezing.**
- **Service according to procedures listed in these instructions.**
- **Installation, service, and conversion of these products must be performed by knowledgeable personnel who understand how pneumatic products are to be applied.**
- **After installation, servicing, or conversion, air supply should be connected and the product tested for proper function and leakage. If audible leakage is present, or the product does not operate properly, do not put into use.**
- **Warnings and specifications on the product should not be covered by paint, etc. If masking is not possible, contact your local representative for replacement labels.**

† Trademark E.I. Du Pont de Nemours & Co.

Installation

1. The lubricator should be installed with reasonable accessibility for service whenever possible – repair service kits are available. Keep pipe or tubing lengths to a minimum with inside clean and free of dirt and chips. Pipe joint compound should be used sparingly and applied only to the male pipe – never into the female port. Do not use Teflon† tape to seal pipe joints – pieces have a tendency to break off and lodge inside the unit, possibly causing malfunction.
2. Install lubricator so air flows in the direction of arrow on body.
3. Installation should be upstream of the device it is to lubricate (valve, cylinders, tool, etc.).

Application Limits

These products are intended for use in general purpose compressed air systems only.

With Polycarbonate Bowl

	psig	bar	kPa
Operating Pressure Maximum	**150**	**10.3**	**1000**

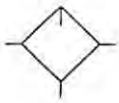
Operating Temperature Maximum +125°F (+52°C)
Operating Temperature Minimum +32°F (0°C)

With Metal Bowl

	psig	bar	kPa
Operating Pressure Maximum	**250**	**17.0**	**1700**

Operating Temperature Maximum +175°F (+80°C)
Operating Temperature Minimum +32°F (0°C)

ANSI Symbol



Operation and Service

1. Filling — The Mist lubricator can be filled without turning off the upstream pressure. Slowly remove the fill plug (black) by turning counterclockwise. This allows the bowl pressure to vent.

   The inlet pressure of the Micromist lubricator must be turned off and depressurized before the fill plug (yellow) is removed. Turn counterclockwise to remove. Fill to oil level line.

   Suggested lubricant:

   Schrader Bellows F442

   Petroleum based oil of 100 to 200 SSU viscosity at 100°F and an aniline point greater than 200°F. (Mobil DTE24 and Sun Company Sunvis 932 are good examples). Do not use oils with adhesives, compound oils containing solvents, graphite, detergents or synthetic oils.
2. Replace the fill plug (by turning clockwise) and seat firmly. Excessive torque is not required. Turn on air supply for Micromist type. The lubricator is now ready for setting.

3. Oil delivery adjustment — To adjust oil delivery, turn adjustment knob on top of the lubricator.

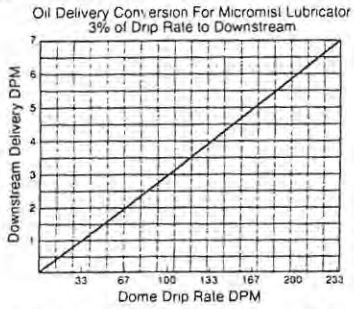
   Leaner — Clockwise

   Richer — Counterclockwise

   By counting the number of drops per minute in the sight dome, you can adjust to your requirements.

   Mist lubricator — Every drop visible in the sight dome goes downstream.

   Micromist lubricator — Approximately 3% of the droplets visible in the sight dome go downstream; adjust drip rate accordingly. Consult oil delivery conversion chart.



   Generally, one drop per minute downstream for every 10 - 15 SCFM flow is satisfactory.

   25 drops per minute equals one (1) ounce per hour - volume of oil passing through the sight dome.

   NOTE: This is a constant density type lubricator which delivers a constant ratio of oil air flow. Therefore, if air flow increases or decreases, oil delivery will be adjusted proportionately. ONLY IF A DIFFERENT RATIO IS DESIRED SHOULD YOUR ADJUSTMENT KNOB SETTING BE CHANGED AFTER YOUR INITIAL SETTING.

4. To replace fill plug:
   A. Turn off air supply and depressurize the unit.
   B. Unscrew fill plug and clean sealing surfaces on lubricator body.
   C. Lubricate the o-ring seal on replacement part with grease included in the kit. Assemble o-ring to fill plug. Install the fill plug and tighten hand tight.
   D. Turn on air supply and check for leakage. If leaks occur - repeat repair procedure.

5. To replace drip control: (see cutaway view)
   A. Turn off air supply and depressurize the unit.
   B. Unscrew drip control by rotating sight dome counterclockwise. Carefully remove seal plate. NOTE: Do not damage surface of body underneath seal plate.
   C. Lubricate seal plate with grease found in the kit. Align pin on underside of seal plate with mating hole in body and install seal plate.
   D. Install sight dome and drip tube. Tighten to 10 – 15 inch pounds of torque.
   E. Turn on air supply and check for leakage. If leaks occur, repeat repair procedure.

6. To service lubricator. (see cutaway view)
   A. Turn off air supply and depressurize the unit.
   B. Unscrew threaded collar and remove the bowl and seal.
   C. Remove the two (2) screws in the body holding the plastic insert. Remove insert, insert seal and o-ring from body.
   D. Clean all internal sealing surfaces and bowl assembly. (See polycarbonate bowl cleaning section).
   E. Lubricate all seals and o-rings with grease found in the kit.
   F. Install bowl o-ring into body. NOTE: The kit contains both 06L/16L and 07L/17L bowl seals. Use the appropriate o-ring and discard the extra one.
   G. Sub-assemble insert, o-ring, seal, check ball and spring (under flapper, 06L/07L only), flapper, baffle (16L/17L only) and mounting screws. NOTE: The flapper must be assembled so that the hole in the flapper lines up with the hole in the insert.
   H. Install insert and tighten the two (2) screws to 10 – 12 inch pounds of torque.
   I. Install bowl into body. Tighten 06L/16L collar to 28 – 32 inch pounds of torque. Tighten 07L/17L collar to 48 – 52 inch pounds of torque.
   J. Turn on air supply and check lubricator for leakage. If leakage occurs, DO NOT OPERATE — conduct repairs again.

SAFETY: Polycarbonate Bowls

⚠ **CAUTION:**

Polycarbonate bowls, being transparent and tough, are ideal for use with Filters and Lubricators. They are suitable for use in normal industrial environments, but should not be located in areas where they could be subjected to direct sunlight, an impact blow, nor temperatures outside of the rated range. As with most plastics, some chemicals can cause damage. Polycarbonate bowls should not be exposed to chlorinated hydrocarbons, ketones, esters and certain alcohols. They should not be used in air systems where compressors are lubricated with fire-resistant fluids such as phosphate ester and di-ester types.

Metal bowls are recommended where ambient and/or media conditions are not compatible with polycarbonate bowls. Metal bowls resist the action of most such solvents, but should not be used where strong acids or bases are present or in salt laden atmospheres. Consult the factory for specific recommendations where these conditions exist.

TO CLEAN POLYCARBONATE BOWLS USE MILD SOAP AND WATER ONLY! DO NOT use cleansing agents such as acetone, benzene, carbon tetrachloride, gasoline, toluene, etc., which are damaging to this plastic.

MAINTENANCE SERVICE KITS	06L/07L Mist 1/4", 3/8" & 1/2"	16L/17L Micromist 3/8", 1/2" & 3/4"
Lubricator Repair Kit	PS718SB	PS748SB
Drip Control and Fill Plug Kit	PS738SB	PS739SB

⚠ WARNING

FAILURE OR IMPROPER SELECTION OR IMPROPER USE OF THE PRODUCTS AND/OR SYSTEMS DESCRIBED HEREIN OR RELATED ITEMS CAN CAUSE DEATH, PERSONAL INJURY AND PROPERTY DAMAGE.

This document and other information from The Company, its subsidiaries and authorized distributors provide product and/or system options for further investigation by users having technical expertise. It is important that you analyze all aspects of your application, including consequences of any failure and review the information concerning the product or system in the current product catalog. Due to the variety of operating conditions and applications for these products or systems, the user, through its own analysis and testing, is solely responsible for making the final selection of the products and systems and assuring that all performance, safety and warning requirements of the application are met.

The products described herein, including without limitation, product features, specifications, designs, availability and pricing, are subject to change by The Company and its subsidiaries at any time without notice.

EXTRA COPIES OF THESE INSTRUCTIONS ARE AVAILABLE FOR INCLUSION IN EQUIPMENT / MAINTENANCE MANUALS THAT UTILIZE THESE PRODUCTS. CONTACT YOUR LOCAL REPRESENTATIVE.

"KINGSTON"

ASME - NATIONAL BOARD CERTIFIED

SAFETY VALVES

FOR COMPRESSED AIR OR INERT GAS APPLICATIONS.
CONSULT FACTORY IF APPLICATION IS AIR OR GAS OVER LIQUID.

Kingston ASME Code, National Board Certified Safety Valves are designed to protect un-fired pres sure vessels from over pressure. Care must be taken to properly size each valve to meet the operating conditions of the system on which it is to be installed. Major considerations are, compressor capacity operating pressure, temperature, tank design, environmental conditions and potential hazards Maximum operating temperature, 250°F (121°C). Application and Installation information can be found on page three of this bulletin.



FIG. 110C



FIG. 112C



FIG. 114



FIG. 115



FIG. 118C



FIG. 119C

Fig. 110C 1/4" & 3/8"MPT only. Construction is of cast bronze body machined brass stem with stainless steel ball, seating on a precisio machined stainless steel seat. Equipped with a protective stem cover an manual test lever. Pressure setting's 25 to 600 PSIG. Approved i Massachusetts and Washington D.C. Canadian registration.

Fig. 112C 1/4", 3/8" & 1/2" MPT sizes. All brass construction with chrom steel ball on a precision machined brass seat. (Stainless steel ball available Specify Fig. 112CSS) Pull Ring for manual testing. All stainless steel con struction availble in 1/4" size only. Specify "All Stainless". Pressure setting 25 to 300 PSIG. Canadian Registration.

Fig. 114 1/4", 3/8", 1/2", 3/4" & 1" MPT. Construction is brass with a Vito seat for maximum seat tightness through the pressure range. Equippe with a protective stem cover and manual test lever. Pressure settings on 1/4 size 25 to 300 PSIG, 3/8" and 1/2", 25 to 275 PSIG, 3/4 and 1", 25 to 25 PSIG. Approved in Massachusetts and Washington D.C. Canadia Registration.

Fig. 115 1/4", 3/8" & 1/2" only. Construction and performance the same a Fig. 114, with exception of having a pull ring for manual testing. Canadian Registration.

Fig. 118C 1/4", 3/8", 1/2" 3/4" & 1" MPT. High caspacity design. Construc tion is brass with a chrome steel ball on a precision machined brass seat. (stainless steel ball is available on 1/4", 3/8" & 1/2" sizes. Specify Fig 118CSS.) Equipped with a pull ring for manual test. Pressure settings fro 25 to 300 PSIG. Canadian Registration.

Fig. 119C 1/4", 3/8", 1/2", 3/4" & 1" MPT. High capacity design, the sam performance and basic design as Fig. 118C, with the exception of the leve for manual testing, and a protective cap over the valve stem. Approved i Massachusetts and Washington D.C. Canadian Registration.

(for valve sizing see Page 2)

SAFETY VALVE INSTALLATION

The following information is of a general cautionary nature only. For specific information consult the appropriate design data and local and industry codes. The F.C. Kingston Co. assumes no responsibility beyond it's stated warranties.

It is essential to the proper operation of safety valves that cleanliness be observed in storage handling, and installation. Each valve should be stored under cover so that foreign matter will not enter the valve or lodge in the inlet or outlet ports. Inspect each valve before installation and make sure that it is clean. Foreign matter can be carried into or through the valve during operation, which may damage the seat, resulting in leakage. Prior to installation of the valve, clean the piping of all foreign matter.

Valves should be mounted vertically. Horizontal mounting could affect the alignment of the moving parts and affect the operation of the valve. If vertical mounting is not possible please consult the factory. The valve should be installed in a location that will not direct the discharge at personnel traffic areas. Mount the valve in a location that will subject it to the least vibration possible. Severe vibration can affect the valve sealing and possibly damage the valve. Valves subject to vibration should be set at as high a pressure over the system operating pressure as is practical to avoid premature opening this is particularly important when the valve is to be used with engine driven system.

Care should be taken not to damage or distort the valve during installation. Use only the wrench flats closest to the bottom of the valve during installation and use the proper size wrench to avoid damage to the surface of the valve and to prevent distortion which can interfere with the valve operation or may alter the set pressure.

Normal installations require that valves be set a minimum of 5 P.S.I. or 10%, whichever is higher, over the operating pressure of the system. When checking the pressure setting of a valve use a test gauge of known accuracy. The first "pop" of a valve can vary considerably from the set pressure. The valve should be operated several times prior to taking a pressure reading. The set pressure can deviate from the marked pressure by plus or minus 2 P.S.I. at settings below 70 P.S.I. and plus or minus 3% at settings of 70 P.S.I. and above.

If a valve is discovered to be leaking it can often be cleared by manually operating the valve or by connecting the valve to a pressure that will cause it to operate. Please note that valves with metal to metal seats are not absolutely "bubble tight" and they will allow a pressure loss over a period of time. Commercial seat tightness is defined by API Standard 527 which is used as a leakage criteria. If a valve has a leak it should be replaced as leaks are self propagating.

Safety relief valves must be inspected and tested for operation periodically. It is the users responsibility to determine the frequency of inspection as he is the only party familiar with the operating conditions and the relative hazards of an inoperative valve. It is recommended that at the very least each valve should be inspected semi-annually. Local ordinances may require more frequent inspection. Testing should be done by operating the valve either through the use of the operating device on the valve or if it doesn't have an operating device it should be connected to a source of pressure that will cause it to operate.

The capacity of a valve should be selected to be over the maximum capacity of the combined sources of air supply, it should also be noted that the capacity should not be over 150% of the supply as the valve may "chatter" when it discharges. Each installation must be properly engineered and flow piping should be sized with reference to establish criteria such as the pressure piping code and ASME Pressure Vessel design data or any applicable design criteria for specific usage. When designing system protection for extreme high or low temperatures or use with gasses other than air consult the factory.

Valves that are capacity certified by the ASME are factory sealed. Tampering, altering, or adjustment of these valves voids any warranty and liability of the manufacturer. Repairs or resetting will be made only by the factory. Please contact the factory prior to returning any valve for service and securely package valves for shipping.

End use of "Kingston" products is the sole responsibility of the user.

We hope that the foregoing information is useful to our customers and if there are any questions about valve usage or installation please contact us and we will be pleased to provide any assistance that we can.

"KINGSTON"

A.S.M.E. RATED CAPACITIES

AIR FLOW IN CUBIC FEET PER MINUTE

SET PRESSURE P.S.I.G.		25	50	75	100	125	150	175	200	225	250	275	300
FIG. 110C	1/4"	25	41	57	74	90	106	122	138	155	171	187	203
	3/8"												
SET PRESSURE P.S.I.G.		325	350	375	400	425	450	475	500	525	550	575	600
FIG. 110C	1/4"	220	236	252	268	284	301	317	333	349	366	382	398
	3/8"												
SET PRESSURE P.S.I.G.		25	50	75	100	125	150	175	200	225	250	275	300
FIG. 112C	1/4"	21	36	50	64	78	92	106	120	134	148	162	176
	3/8"												
	1/2"	33	54	76	97	119	140	162	183	205	226	247	269
FIG. 114	1/4"	22	36	51	65	79	93	108	122	136	151	165	179
	3/8"	29	48	67	86	105	124	143	162	181	200	219	
	1/2"	36	59	83	106	129	153	176	199	223	246	270	
	3/4"	68	112	156	200	244	288	332	376	420	464		
	1"	100	165	230	296	361	426	491	556	621	687		
FIG. 115	1/4"	22	36	51	65	79	93	108	122	136	151	165	179
	3/8"	29	48	67	86	105	124	143	162	181	200	219	
	1/2"	36	59	83	106	129	153	176	199	223	246	270	
FIG. 118C and FIG. 119C	1/4"	45	75	104	133	163	192	222	251	281	310	339	369
	3/8"												
	1/2"	65	107	150	192	234	277	319	361	404	446	488	531
	3/4"	155	256	357	458	559	659	760	861	962	1063	1164	1265
	1"												

Note: Pressure settings available between those listed.
To order specify: 1. Figure Number 2. Pipe Size 3. Pressure Setting

"KINGSTON"

ASME - NATIONAL BOARD CERTIFIED
SAFETY VALVES

DIMENSIONS

FIG. NO.	SIZE	HEIGHT	WEIGHT
110C	1/4"	3-5/8"	8 oz.
	3/8"	3-3/4"	8 oz.
112C	1/4" & 3/8"	3-1/8"	6 oz.
	1/2"	3-3/4"	8 oz.
114	1/4"	3-1/4"	4 oz.
	3/8"	3-1/4"	6 oz.
	1/2"	3-7/8"	8 oz.
	3/4"	4-1/2"	14 oz.
	1"	4-15/16"	1 lb. 2 oz.
115	1/4"	3-1/8"	4 oz.
	3/8"	3-1/4"	5 oz.
	1/2"	4-3/16"	8 oz.
118C	1/4"	3-3/16"	4 oz.
	3/8"	3-9/16"	7 oz.
	1/2"	3-13/16"	8 oz.
	3/4"	5-7/16"	1 lb. 2 oz.
	1"	5-3/4"	1 lb. 6 oz.
119C	1/4"	3-11/32"	5 oz.
	3/8"	3-3/4"	7 oz.
	1/2"	4"	8 oz.
	3/4"	4-1/4"	1 lb. 1 oz.
	1"	5-9/16"	1 lb. 4 oz.

MANUFACTURED BY

F.C.KINGSTON CO.

1007 NORTH MAIN ST. - LOS ANGELES, CALIF. 90012
(213) 221-2106 - FAX (213) 221-6949

Low Pressure Switches

MODEL **NSM**

- Field adjustable versions
- Variety of electrical connections
- Precision setting
- Snap action switch



Shown with 8-32 screw terminals.
Others available.

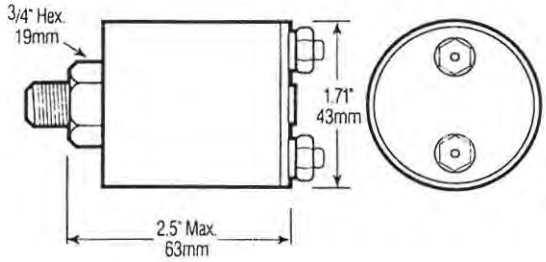
Basic Specifications

Set point range	2-100 PSI (.14-6.8 BAR)
Set point tolerance	±1 PSI (.07 BAR) or 5%
Operating pressure	to 200 PSI (14 BAR)
Burst pressure	300 PSI (20 BAR)
Differential	20%
Current rating	5 AMP
Mounting	NPT zinc
Adjustment	Factory preset/field adjustable

Standard Options

Mounting	⅛, ¼" NPT
Circuitry	A, B, C
Electrical connections	Wire leads, blade, screw terminal
Current rating	10 AMP
Adjustment range	1.5- 5 PSI (.1-.34 BAR) 6- 15 PSI (.4-1.0 BAR) 16- 40 PSI (1.1-2.7 BAR) 41-100 PSI (2.8-6.8 BAR)

Many other variations are available.



MODEL **SP**

- Dual set point circuits available
- Field adjustable versions
- Variety of electrical connections
- Meets MIL-S-12211
- Snap action switch
- Rugged all metal mechanism



Shown with blade terminals.
Others available.

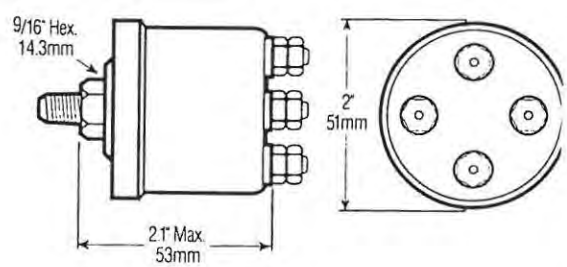
Basic Specifications

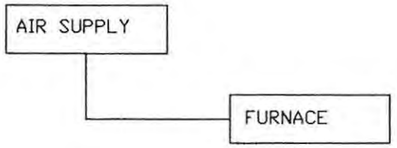
Set point range	2-100 PSI (.14-6.8 BAR)
Set point tolerance	±1 PSI (.07 BAR) or 5%
Operating pressure	to 500 PSI (34 BAR)
Burst pressure	750 PSI (51 BAR)
Differential	20%
Current rating	10 AMP
Mounting	NPT steel
Adjustment	Factory preset/field adjustable

Standard Options

Mounting	⅛, ¼" NPT
Circuitry	A, B, C/dual
Electrical connections	Wire leads, blade, screw terminal, conduit
Adjustment range	3- 7 PSI (.2-.5 BAR) 7- 15 PSI (.5-1.0 BAR) 15- 35 PSI (1.0-2.4 BAR) 30- 75 PSI (2.0-5.1 BAR) 75-100 PSI (5.1-6.8 BAR)

Many other variations are available.





BLOCK DIAGRAM

ITEM	DESCRIPTION	QTY	ECI P/N	MANUFACTURER P/N	MANUFACTURER
62					
61	XXXXXX	X	X	XXXXXX	XXXXXX
60	FILTER–AIR/WATER SEPARATOR 250PSIG	2	X	08F73ACSB–LA8 1–1/2 NPT	SCHRADER BELLOWS
52	MANIFOLD–AIR PRESSURE SWITCH	1	X	5100801	ECI
51					
50					
45					
44					
43					
42					
41					
40					

PARTS LIST

ITEM	DESCRIPTION	QTY	ECI P/N	MANUFACTURER P/N	MANUFACTURER
35	SWITCH–N.C. 20PSI	1	X	WS–18–20R/H/adj	NASON
34	SWITCH–N.C. 1.5 PSI	1	X	NSM–1B–1.5F/H	NASON
33	GUAGE– AIR REGULATOR 0–160psig	2	X	GC 230	DIXON
32	TRANSMITTER–N.C. SW. PRESS. 24VDC	1	X	C206	SETRA
31	GUAGE–REG/FURN. PRESS. 0–30 PSIG	1	X	LNZ–30–25–RC	LENZ
30	GUAGE–LINE AIR PRESS. 0–100PSIG	1	X	LNZ–100–25–RC	LENZ
29	GUAGE–LINE AIR PRESS. 0–160PSIG	1	X	LNZ–160–25–RC	LENZ
20	VALVE–AIR REGULATOR 0–250psig	1	X	06R113ACSB 1/4–NPT	SCHRADER BELLOWS
19	VALVE–PROPORTION AIR	1	X	R000B	PROPORTION AIR
18	FITTING, BULKHEAD	1	X	2705–6–4	SANTA ROSA HYD'S
17	VALVE–EMERG. AIR EXHAUST 1 1/2"	1	X	MB331–202–150–2	AUTOMATION PRODUCTS GRP.
16	"Y" STRAINER 2 1/2"	1	X		
15	VALVE–AIR EXHAUST 2 1/2"	1	X	BB331–201–25 120/60	AUTOMATION PRODUCTS GRP.
14	VALVE–AIR PRESSURE RELIEF 25psi	2	X	FIG. 118C 1"	KINGSTON
13	VALVE–FURN. AIR PRESS. 1 1/2"	1	X	MB331–301–150–2	AUTOMATION PRODUCTS GRP.
12	VALVE–PROPORTIONAL AIR	1	X	BB2ME020S160S19S91S92	PROPORTION–AIR
11	VALVE–AIR REGULATOR 0–250psig	1	X	08R713ABSB	SCHRADER BELLOWS
10	OILER–AIR 250PSIG MAX 175'F	3	X	06L14BCSB	SCHRADER BELLOWS
2	AFTER COOLER	1	X	3000050	ECI
1	FURNACE	1	X	1000001	ECI

PARTS LIST

NOTES:
1. THIS SCHEMATIC IS USED ON AMC 006 MACHINE(S)
2. THE CIRCLED NO.S (#) ARE ITEM NO.S
3. THE "20X" NEXT TO AN ITEM NO., (41) 20X, IS THE QUANITY.
4. REDRAWN FROM AMC006 1900011

REV	DESCRIPTION	DATE	APP'D
–	ENGINEERING RELEASE	19MAY96	

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UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE INCHES TOLERANCES ARE:
FRACTIONS ±1/16 DECIMALS .XX ± .01 .XXX ± .005 ANGLES ±1/2°
MATERIAL:
FINISH:

APPROVALS		DATE
DRAWN BY	RON PERRY	19MAY96
CHECKED BY		
APPROVED BY		
ENGINEERING	J WATERS	19MAY96
MANUFACTURING		
CUSTOMER	AAP	

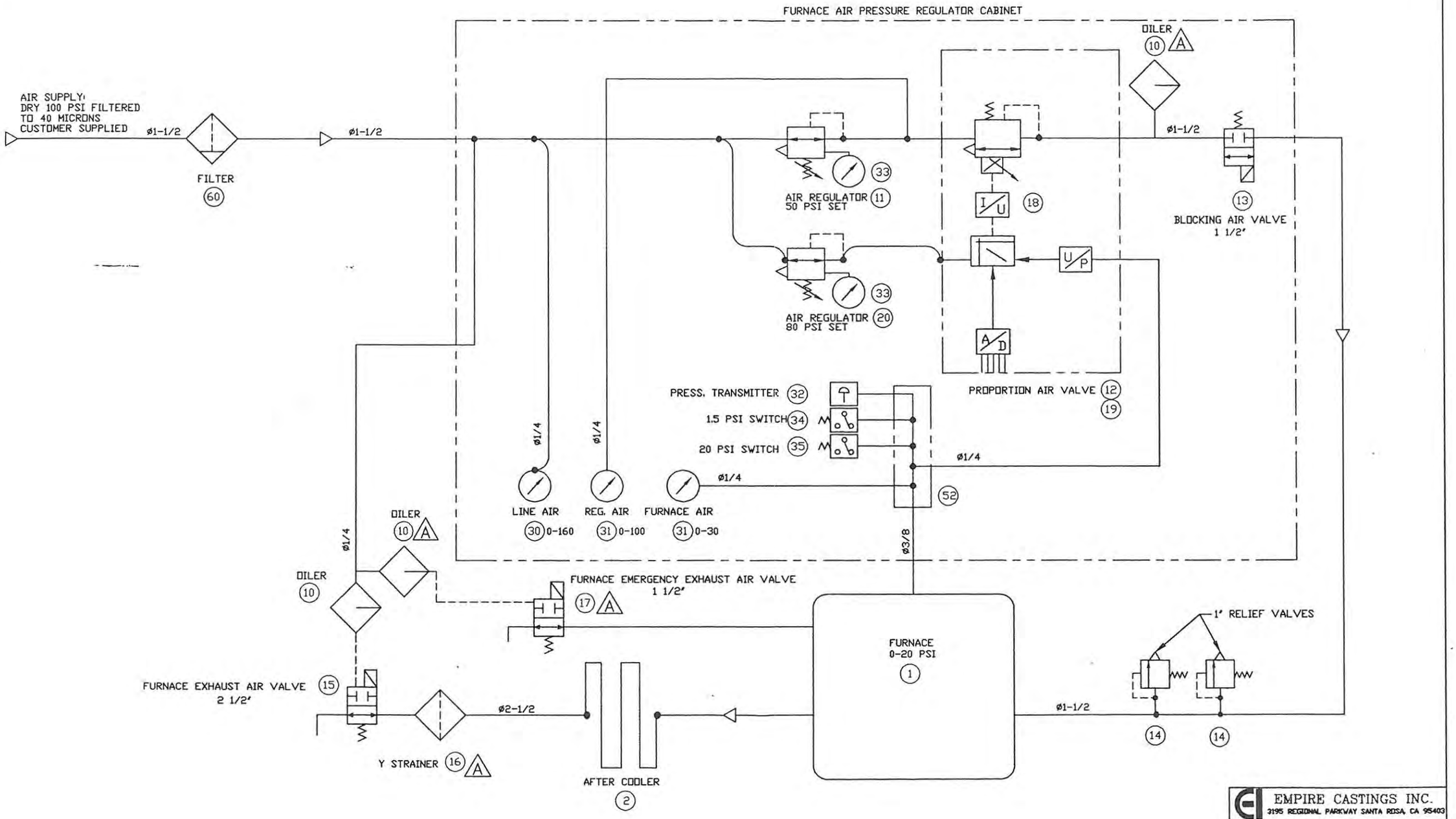
DO NOT SCALE DRAWING

EMPIRE CASTINGS INC.
3195 REGIONAL PARKWAY SANAT ROSA, CA 95403

FURNACE AIR SYSTEM SCHEMATIC

EMPIRE WORK ORDER NO.	EMPIRE DRAWING NO.	
AAPM01	1900011	
NEXT ASSEMBLY NO.	CUSTOMER PART NO.	REV
		–

QTY: 1 PER MACH | SCALE: TO FIT | SHEET 1 OF 2



REV	DESCRIPTION	DATE	APP'D
–	ENGINEERING RELEASE		

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EMPIRE CASTINGS INC.
3195 REGIONAL PARKWAY SANTA ROSA, CA 95403

FURNACE AIR SCHEMATIC

EMPIRE WORK ORDER NO.	EMPIRE DRAWING NO.	
AAPM01	1900012	
NEXT ASSEMBLY NO.	CUSTOMER PART NO.	REV
		–
QTY: 1 PER MACH	SCALED TO FIT	SHEET 2

Empire Castings Inc.
Equipment Manual

Model# EC02-A
Serial# AAPM01

Volumne 3, Section 3 : Furnace Raise/Lower

1: Replacement Parts

Item#	Part#/Description	Mfg.
001	5MSJU 24:1 10"STROKE	NOOK-ACTION JACK
002	GB-15 TYPE B MITRE BOX	NOOK-ACTION JACK
003	93-2000 GEARBOX	VAN RUDEN
004	08400-TDG CASTER	PAYSON
005	101-1035 HYD. MOTOR	CHAR-LYNN
006	1-1/2" KEYED SHAFT	EMPIRE CASTINGS
007	L150 X 3/4 X 1-1/2 L150 X 3/4 X 1 L150 X 1-1/4 X 1-1/2 L150 X 1-3/8 X 1-1/2	LOVEJOY
008	802T-NPTP LIMIT SW.	ALLEN-BRADLEY
009	DG4V3-2C-MU-B660 DIRECTIONAL VALVE	VICKERS
010	DGMFN-3Y-A2W-B2W-41 FLOW CONTROL	VICKERS

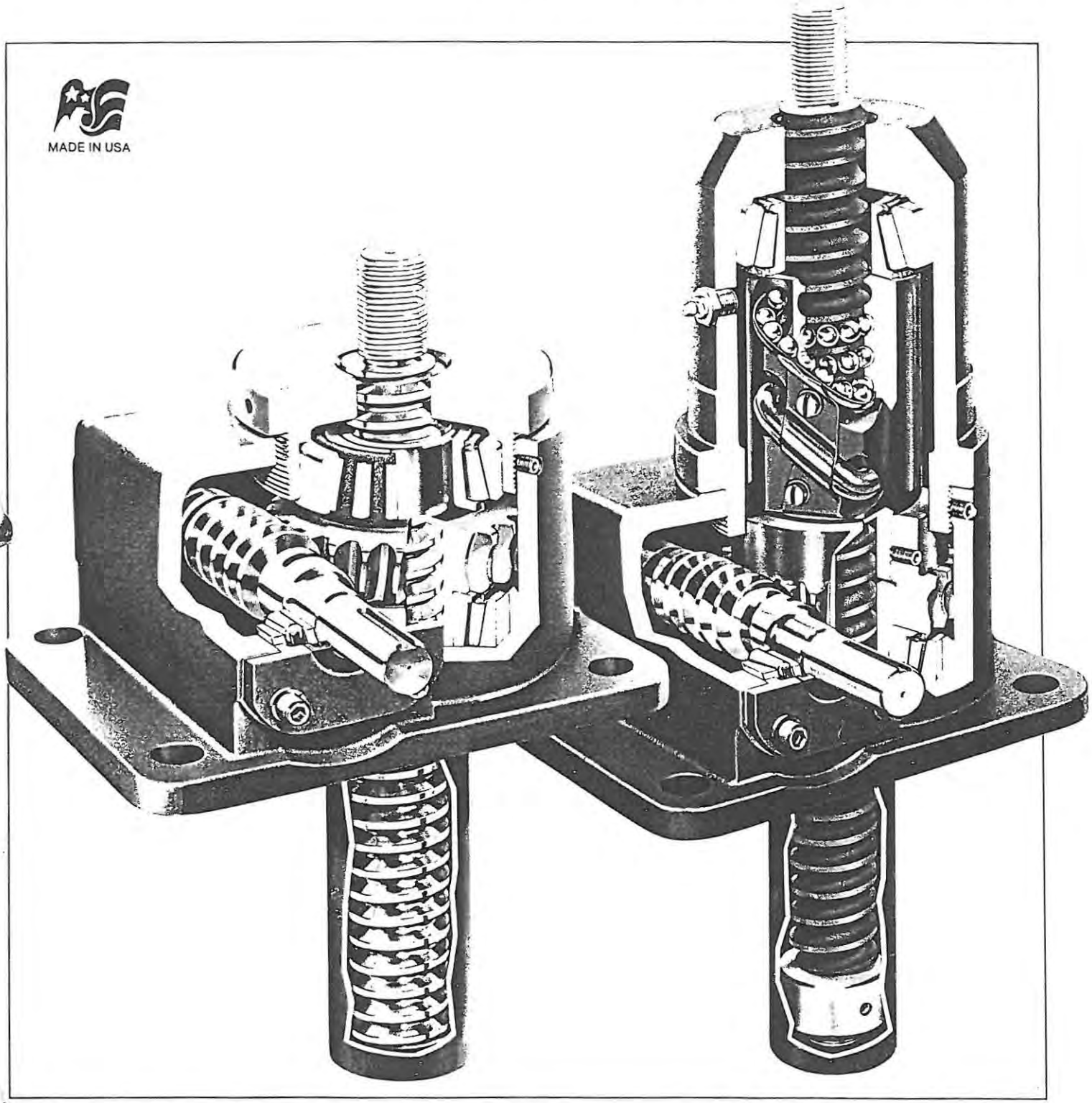
ROUTINE MAINTENANCE:

* *CHECK GEARBOX & JACK OIL LEVEL WEEKLY*
  USE EP-90 OR EQUIV.
* *LUBRICATE ACTION JACK MONTHLY*
  USE EP #1 TYPE GREASE OR EQUIV.
* *LUBICATE ACTION JACK BALL SCREW MONTHY*
  USE 10W30 OIL OR EQUIV. (APPLY WITH CLEAN CLOTH)
* *CHECK BALL SCREW FOR CONTAMINANTS WEEKLY*
* *CHECK LIMIT SWITCH WEEKLY*
* *GREASE GUIDE SHAFT BUSHINGS MONTHLY*

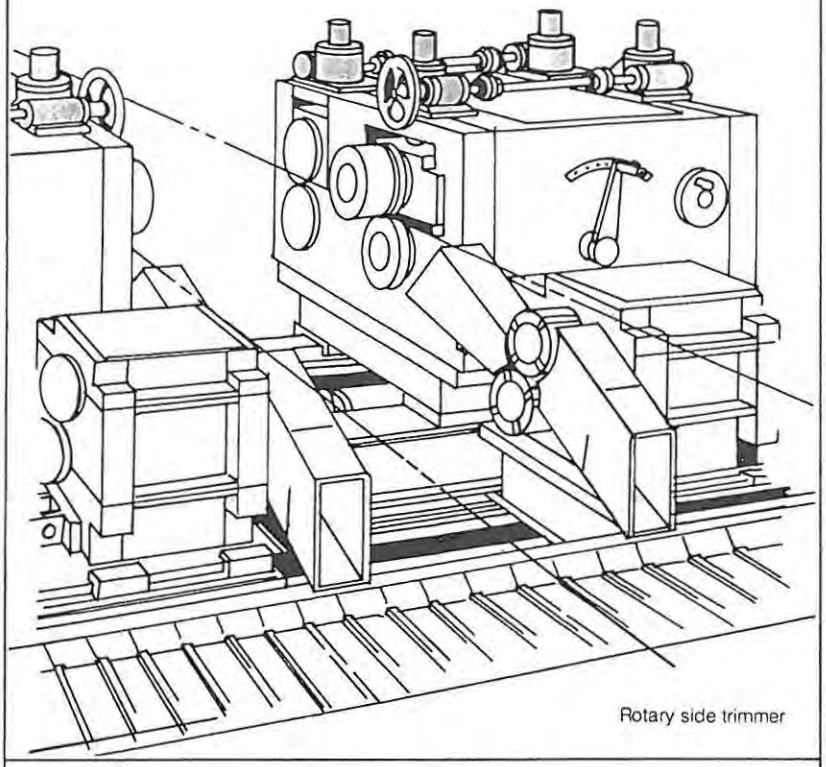
Actionjac™

ELECTRIC CYLINDER JACS
WORM GEAR SCREW JACS

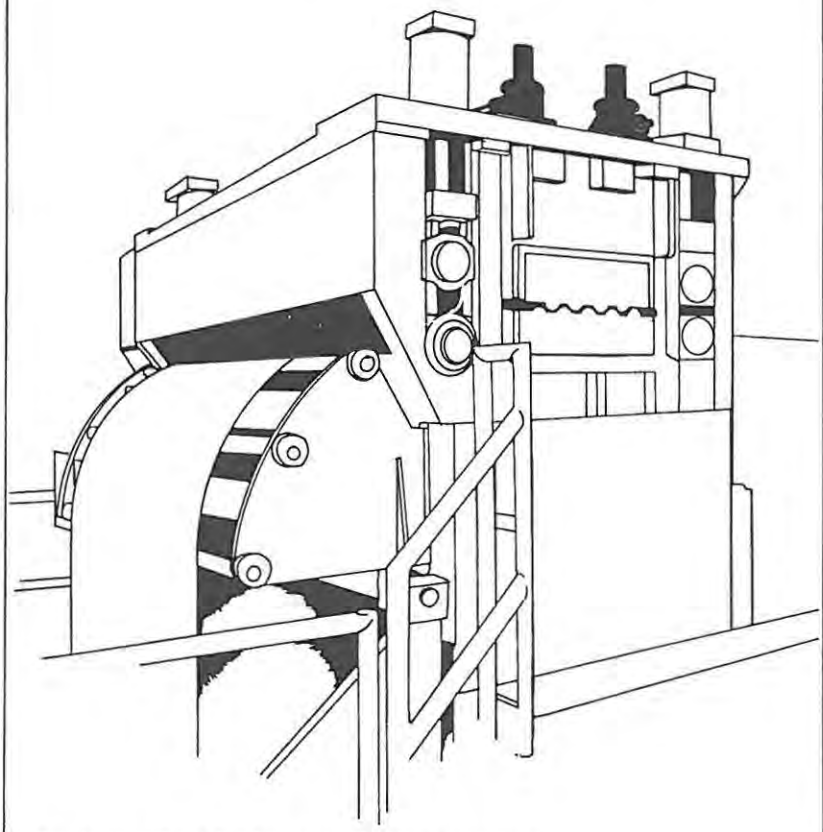
MADE IN USA



NOOK INDUSTRIES
THE LINEAR MOTION PEOPLE



Rotary side trimmer



Strip leveler with height adjustment and back-up adjustment.

1. The ActionJac must have sufficient capacity so as not to be overloaded either dynamically or statically.

2. ActionJacs must be properly aligned in all planes so that the main drive shaft can be turned by hand without evidence of binding.

3. ActionJacs must have design stroke in excess of operating stroke and must not be extended or retracted beyond designed stroke, as serious damage may result.

CAUTION! Extreme care must be used in setting limit switches.

4. The worm shaft speeds in the catalog are shown as a guide to travel rate. DO NOT USE A COMBINATION OF LOAD AND WORM SHAFT RPM WHICH EXCEEDS THE RECOMMENDED HORSEPOWER.

5. Lifting screws must be kept free of dirt. If possible, screws should be booted or returned to retracted position when not in use.

6. The ball screw should be checked periodically for spalling of the raceway. An individual check should be made for excessive backlash between the worm and worm gear. Lash in excess of 30° for ratios 5:1 to 8:1 and 60° for ratios 20:1 and 32:1 indicates the need to replace the worm and worm gear.

The same check between the worm and worm gear is required on the Machine Screw Jac. In addition, end play equal to 1/4 the screw pitch shall require replacement of the screw, worm and worm gear.

7. Lubrication: Unless otherwise specified, ActionJac gear boxes are packed with grease which should be sufficient for one month of normal usage. For normal operation, ActionJacs should be relubricated about once per month using EP #1-Type grease.

Conditions may dictate a more or less frequent lubrication cycle. In extreme conditions, automatic lubrication may be desired.

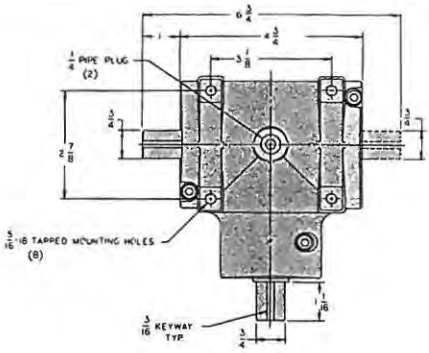
If operating conditions exceed 200° F. or −20° F., consult our Engineering Department.

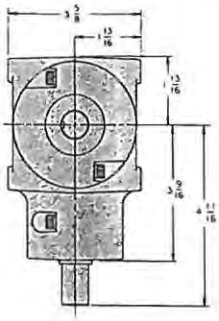
Lifting shafts on Ball Screw ActionJacs need only a light film of 10W30 oil for most applications. This may be applied with a cloth. Instrument grade oil should be used in dirty environments. Lubricants are available for both high and low temperature application. Consult ActionJac Engineering Department for recommendations. Never run a Ball Screw ActionJac dry — an oil film is essential.

STANDARD MITER GEAR BOX ASSEMBLIES (GEAR RATIO 1:1)

ActionJacs™ may be used in tandem or multiple arrangements by connecting shafting, couplings, and gear boxes to raise and lower in unison.

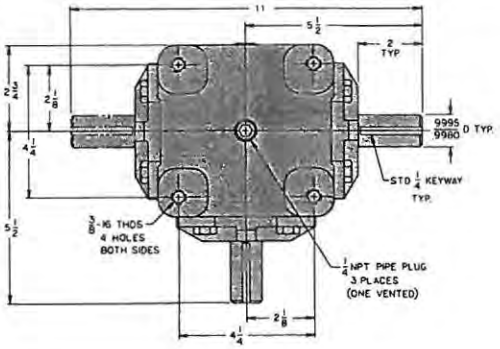
MODEL	RATED LOAD AT 900 RPM	ESTIMATED WT.
GB200	666 IN. LBS @ 900 (9.52 H.P.)	6¼ LBS.





LUBRICATION:
GB 200
Grease packed at time of shipment

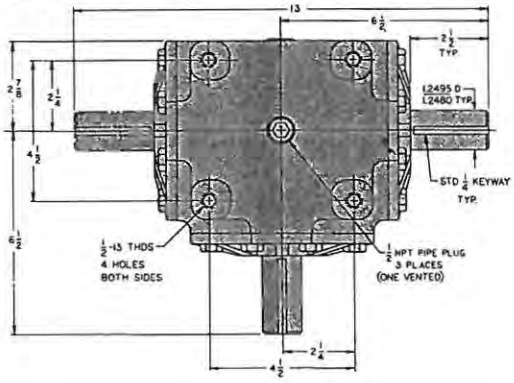
MODEL	RATED LOAD AT 900 RPM	ESTIMATED WT.
GB15	1094 IN. LBS @ 900 (15.62 H.P.)	26 LBS.





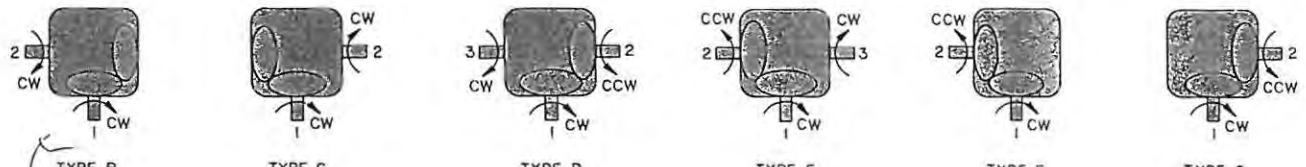
LUBRICATION:
GB 15
Shipped dry
Fill with EP-90
Gear lubricant
Capacity 1 qt.

MODEL	RATED LOAD AT 900 RPM	ESTIMATED WT.
GB12	2712 IN. LBS @ 900 (38.74 H.P.)	39 LBS.



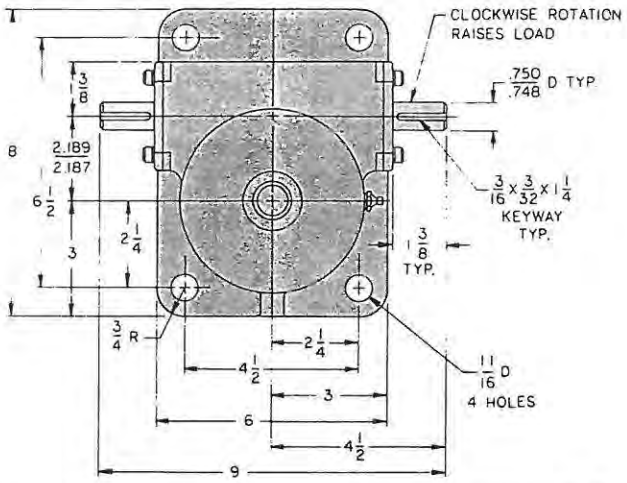


LUBRICATION:
GB 12
Shipped dry
Fill with EP-90
Gear lubricant
Capacity 1 qt.

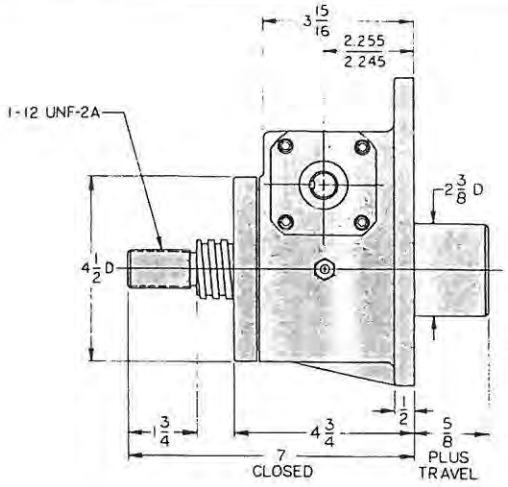


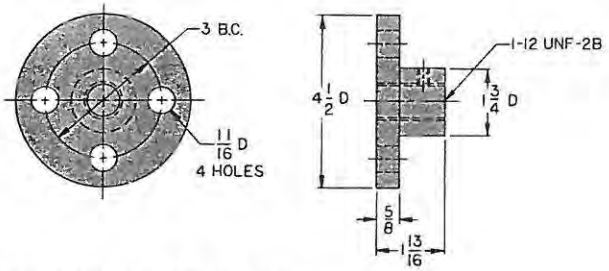
Gears are forged alloy steel. Shafts are stressproof steel ground and polished.
Clockwise (CW) and counterclockwise (CCW) notations indicate direction of shaft rotation when facing outer end of shaft.
All shaft arrangements will operate opposite direction from that shown.
To order specify model number and desired shaft arrangement.

The specifications and data in this publication are believed to be accurate and reliable. However, it is the responsiblity of the product user to determine the suitability of Nook Industries products for a specific application. While defective products will be replaced without charge if promptly returned, no liability is assumed beyond



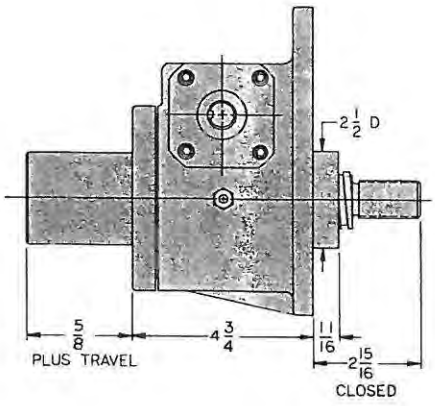
UPRIGHT 5 MSJ-U

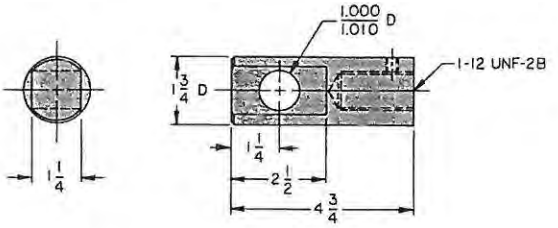




TOP PLATE (OPTIONAL)

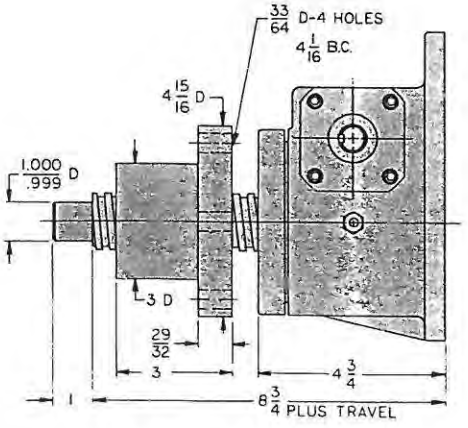
INVERTED 5 MSJ-I





CLEVIS END (OPTIONAL)

UPRIGHT ROTATING 5 MSJ-UR



5 MSJ STANDARD SCREW (.375 IN. LEAD)

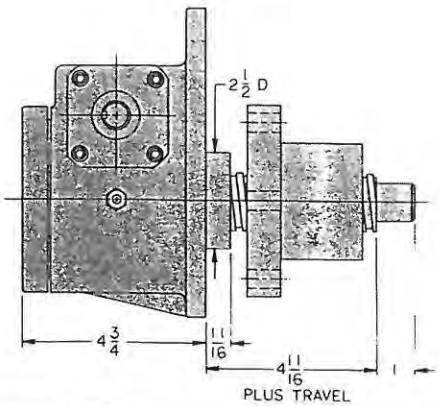
RATIO	TURNS OF WORM PER INCH TRAVEL	TORQUE TO RAISE ONE LB.	MAX. ALLOWABLE H.P.
6:1	16	.0376 IN.-LBS.	3
24:1	64	.0144 IN.-LBS.	3/4

DRAG TORQUE = 10 IN.-LBS.
START TORQUE = 2 X RUNNING TORQUE

LIFTING SCREW OR NUT MUST BE SECURED TO PREVENT ROTATION.
DIMENSIONS FOR REFERENCE ONLY FOR CONSTRUCTION USE CERTIFIED PRINT.

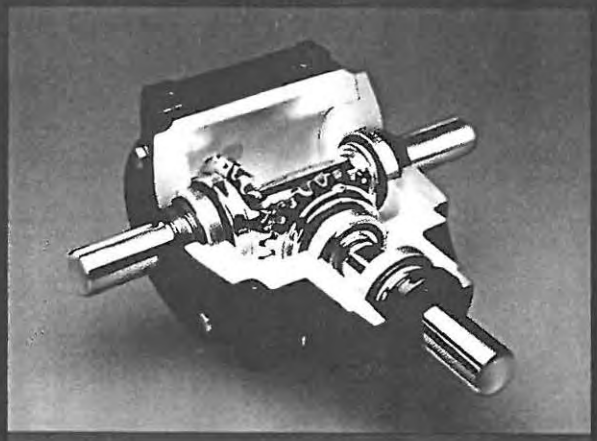
CAUTION!
JAC MAY BE SELF LOWERING IN SOME OPERATING CONDITIONS.

INVERTED ROTATING 5 MSJ-IR

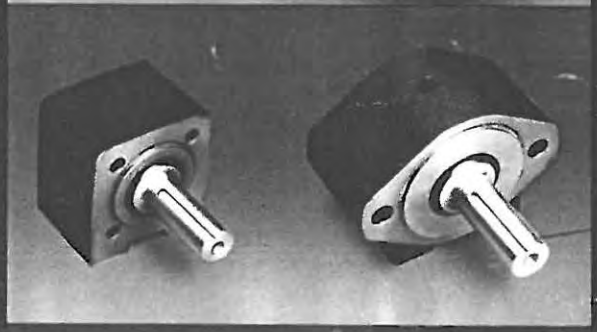


VON RUDEN

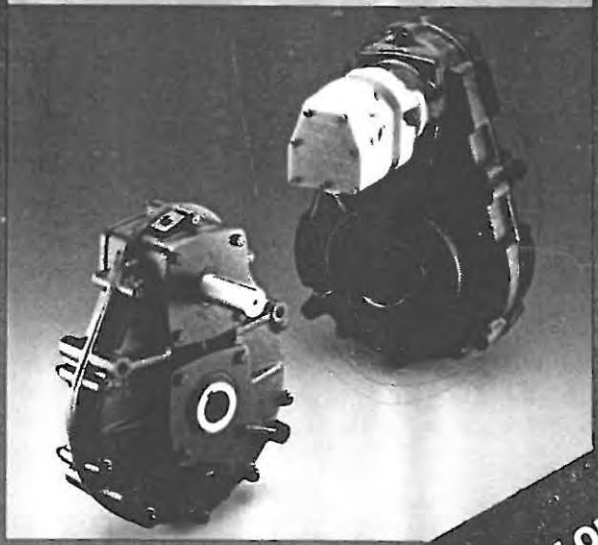
Precision built drive components for mobile and industrial applications



BEVEL GEAR BOXES



OVERHUNG LOAD ADAPTORS
(BEARING BLOCKS)



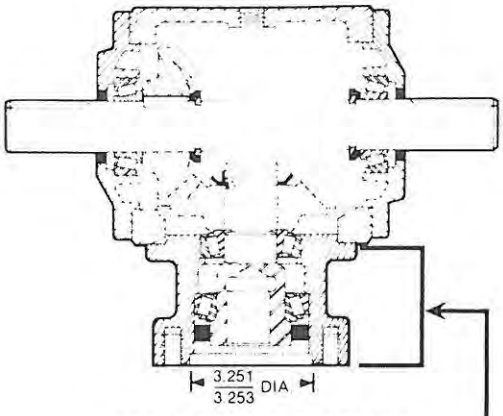
PARALLEL SHAFT-MOUNTED SPEED REDUCERS

CATALOG PC 9150

EMPIRE BEARING COMPANY
15 Maxwell Court
Santa Rosa, Ca 95401
Phone: (707) 544-4220
FAX: (707) 544-3622

Expedite your orders day or night on Von Ruden Fax Line
(612) 682-3954

Hydraulic Motor Driven
Bevel Gear Boxes
Model 93



HYDRAULIC MOTOR MOUNTING FLANGE

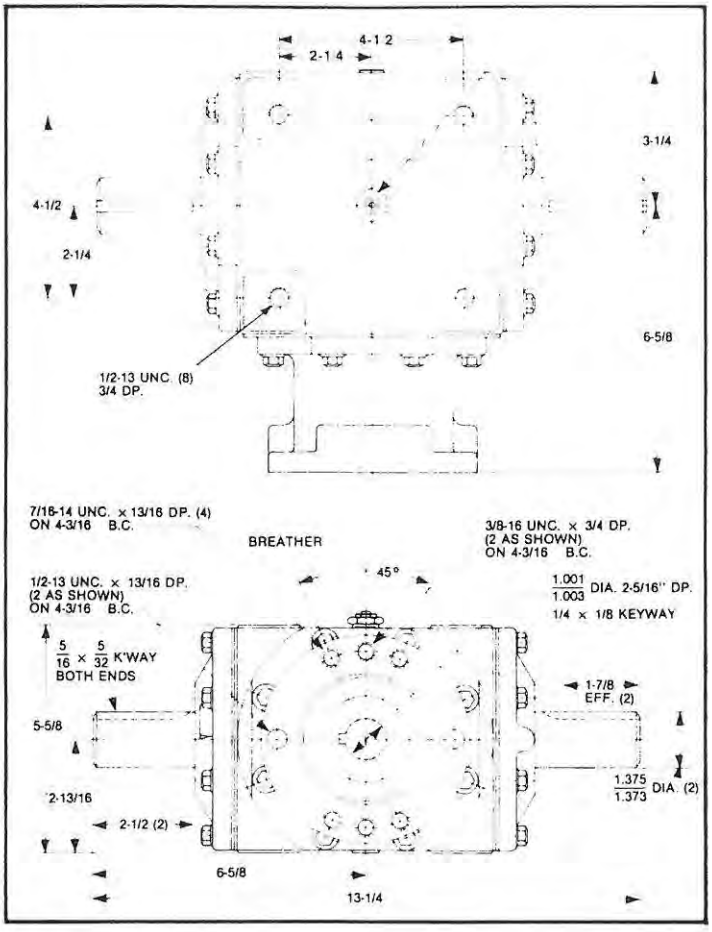
Combined on one flange
SAE A 2-Bolt (3/8" bolts)
SAE A 2-Bolt (1/2" bolts)
Special 4-Bolt (Ross MAB)

KEYWAYS

1.375 Dia Cross Shafts	1.001/1.003 Dia. Input Shaft (Female)
5/16 x 5/32 1⅞" Full Depth	1/4 x 1/8 2-5/16" Deep

Weight: Approx. 43 lbs.
Oil Capacity: Approx. 2.5 pts.

The Model 113 on page 22 can be provided with an SAE C flange.



TORQUE RATINGS (LB.-INCHES)

MODEL NUMBER	GEAR TYPE AND RATIO	RPM→	CONTINUOUS*							INTERMITTENT**
			10	100	300	540	700	1000	1750	
93-2000	Forged 1:1	Input	5181	5181	4003	3363	3110	2362	***	5181
		Output	5181	5181	4003	3363	3110	2362	***	5181
93-2001	Forged 1.35:1	Input	3856	3856	3059	2571	2372	2130	1804	3856
		Output	5206	5206	4130	3471	3202	2876	2435	5206
93-2002	Straight Cut 1.5:1	Input	2659	2659	2537	2127	2074	1768	1508	2659
		Output	3989	3989	3806	3191	3111	2652	2262	3989
93-2003	Straight Cut 2:1	Input	1353	1353	1353	1353	1353	1353	1241	1353
		Output	2700	2700	2700	2700	2700	2700	2482	2700

See rating explanation on Page 7.
See Page 27 for important installation and lubrication information.

*Use gear strength ratings only.
**Pitch line velocity is too fast for proper gear lubrication depending on duty cycle.

INTERMITTENT HORSEPOWER RATINGS*

MODEL NUMBER	GEAR TYPE AND RATIO	INPUT RPM						
		10	100	300	540	700	1000	1750
93-2000	Forged 1:1	.82	8.2	24.6	44.4	57.5	82.2	***
93-2001	Forged 1.35:1	.61	6.1	18.4	33.0	42.8	61.2	107.1
93-2002	Straight Cut 1.5:1	.42	4.2	12.6	22.8	29.5	42.2	73.9
93-2003	Straight Cut 2:1	.21	2.1	6.4	11.6	15.0	21.4	37.6

See rating explanation on Page 7.
See Page 27 for important installation and lubrication information.

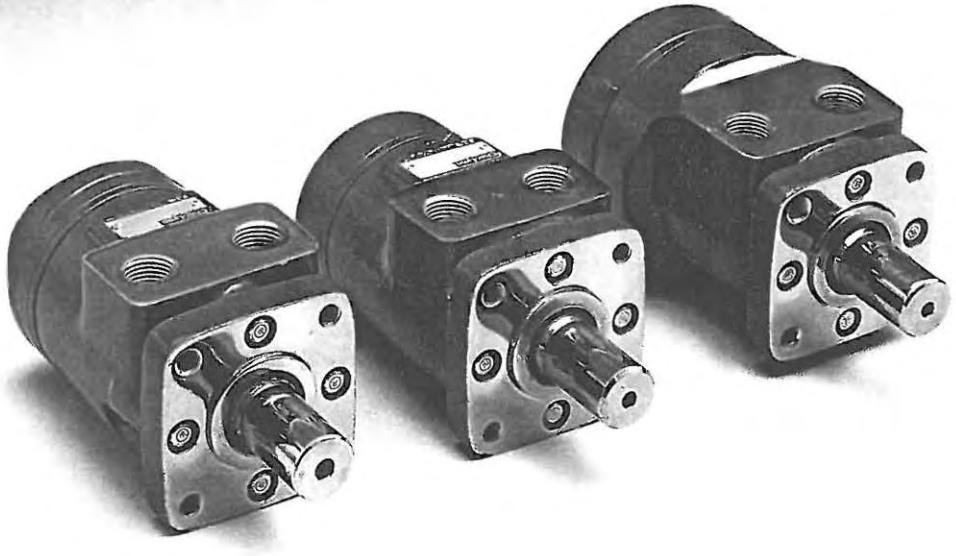
*Use gear strength ratings only.
**Pitch line velocity is too fast for proper gear lubrication depending on duty cycle.

: 1011035 page 15

Char-Lynn®

General Purpose Hydraulic Motors

Catalog 11-885
October 1987



EATON

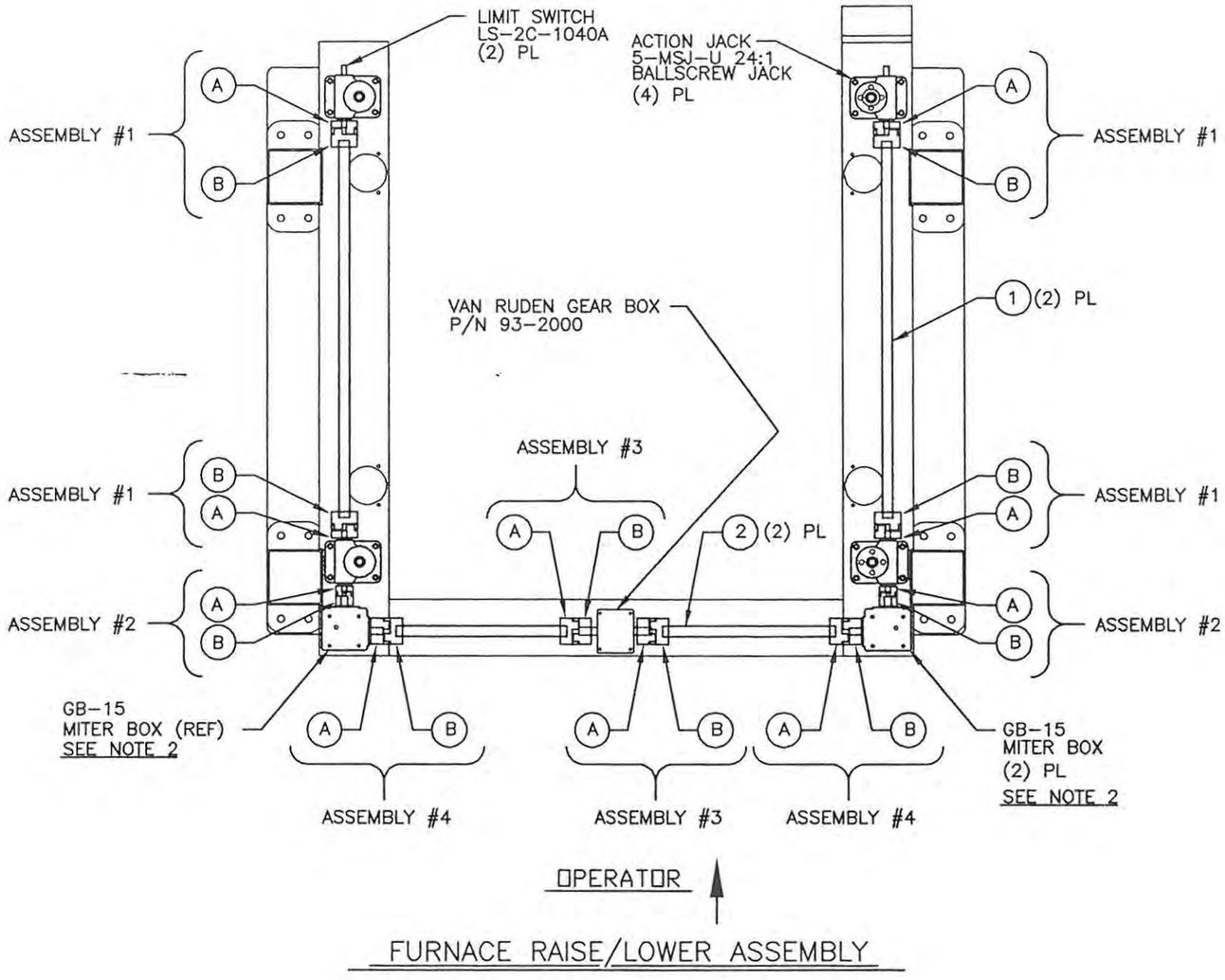
Ordering Information–

Add three digit prefix–101–to four digit number from chart for complete model number–Example–**101**-1700.
Orders will not be accepted without three digit prefix.

H Plus Series

Mounting	Shaft	Port	Displacement (cu. in./rev.) Product Number **101-xxxx**											
			2.2	2.8	3.6	4.5	5.9	7.3	8.9	9.7	11.3	14.1	17.9	22.6
2 Bolt Flange	1" Straight with Woodruff Key	7/8-14 O-ring	**101**-1700	-1033	-1701	-1034	-1035	-1702	-1703	-1036	-1037	-1038	-1039	-1040
		1/2 NPTF	**101**-1704	-1025	-1705	-1026	-1027	-1706	-1707	-1028	-1029	-1030	-1031	-1032
		Manifold	**101**-1708	-1041	-1709	-1042	-1043	-1710	-1711	-1044	-1045	-1046	-1047	-1048
	1" SAE 6B Splined	7/8-14 O-ring	**101**-1721	-1081	-1722	-1082	-1083	-1723	-1724	-1084	-1085	-1086	-1087	-1088
		1/2 NPTF	**101**-1725	-1073	-1726	-1074	-1075	-1727	-1728	-1076	-1077	-1078	-1079	-1080
		Manifold	**101**-1729	-1089	-1730	-1090	-1091	-1731	-1732	-1092	-1093	-1094	-1095	-1096
	1" Straight with .31 D. Crosshole	7/8-14 O-ring	**101**-1796	-1797	-1798	-1799	-1800	-1801	-1802	-1803				
		1/2 NPTF	**101**-1804	-1805	-1806	-1807	-1808	-1870	-1809	-1810				
		Manifold	**101**-1811	-1812	-1813	-1814	-1815	-1816	-1817	-1818				
	1" Straight with .40 D. Crosshole	7/8-14 O-ring	**101**-1819	-1323	-1820	-1324	-1325	-1821	-1822	-1326				
		1/2 NPTF	**101**-1823	-1319	-1824	-1320	-1825	-1826	-1827	-1828				
		Manifold	**101**-1829	-1463	-1830	-1831	-1832	-1833	-1834	-1871				
4 Bolt Flange	1" Straight with Woodruff Key	7/8-14 O-ring	**101**-1749	-1009	-1750	-1010	-1011	-1751	-1752	-1012	-1013	-1014	-1015	-1016
		1/2 NPTF	**101**-1753	-1001	-1754	-1002	-1003	-1755	-1756	-1004	-1005	-1006	-1007	-1008
		Manifold	**101**-1757	-1017	-1758	-1018	-1019	-1759	-1760	-1020	-1021	-1022	-1023	-1024
	1" SAE 6B Splined	7/8-14 O-ring	**101**-1761	-1057	-1762	-1058	-1059	-1400	-1763	-1060	-1061	-1062	-1063	-1064
		1/2 NPTF	**101**-1764	-1049	-1765	-1050	-1051	-1766	-1767	-1052	-1053	-1054	-1055	-1056
		Manifold	**101**-1768	-1065	-1769	-1066	-1067	-1770	-1771	-1068	-1069	-1070	-1071	-1072
	1" Straight with .31 D. Crosshole	7/8-14 O-ring	**101**-1835	-1836	-1837	-1838	-1839	-1840	-1841	-1842				
		1/2 NPTF	**101**-1843	-1497	-1844	-1449	-1352	-1845	-1846	-1847				
		Manifold	**101**-1848	-1466	-1849	-1459	-1850	-1851	-1852	-1853				
	1" Straight with .40 D. Crosshole	7/8-14 O-ring	**101**-1854	-1311	-1855	-1856	-1857	-1858	-1859	-1860				
		1/2 NPTF	**101**-1861	-1313	-1862	-1312	-1314	-1863	-1864	-1315				
		Manifold	**101**-1865	-1305	-1866	-1306	-1307	-1867	-1868	-1869				

101-1869



FURNACE RAISE/LOWER ASSEMBLY

LOVEJOY SHAFT COUPLINGS					
ASSY		P/N – BORE DIA.		TYPE	QTY.
1	A	L-150	(.750)	MODIFIED	4 EACH
	B	L-150	(1.500)	STOCK	
2	A	L-100	(.750)	MODIFIED	2 EACH
	B	L-100	(1.500)	STOCK	
3	A	L-150	(1.500)	STOCK	2 EACH
	B	L-150	(1-3/8)	STOCK	
4	A	L-150	(1.000)	STOCK	2 EACH
	B	L-150	(1.500)	STOCK	

SHAFT SPECIFICATIONS			
ITEM	LENGTH	DIA.	QTY.
1	54.500	1.500	2 EACH
2	24.500	1.500	2 EACH
MITER BOX	NA	1.000	NA
JACK SHAFT	NA	.750	NA
GEAR BOX	NA	1.250	NA

NOTES:

1. REDRAWN FROM AMC006 3416601
2. MITER BOXES MUST BE SHIMMED UP 3/16" (APPROX.) FOR PROPER SHAFT ALIGNMENT

REV	DESCRIPTION	DATE	APP'D
–	ENGINEERING RELEASE	15JAN97	

REVISIONS

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THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE INCHES TOLERANCES ARE:
DECIMALS .XXX ±.005 .XX ±.01 FRACTIONS ±1/16 ANGLES ±1/2°
BREAK SHARP EDGES .010
DRAWING PER ANSI Y14.5

MATERIAL

FINISH

APPROVALS		DATE
DRAWN BY	RON PERRY	15JAN97
CHECKED BY		
APPROVED BY		
ENGINEERING	JIM ALLEN	15JAN97
MANUFACTURING		
CUSTOMER	AAP	

DO NOT SCALE DRAWING

EMPIRE CASTINGS INC.
3195 REGIONAL PARKWAY, SANTA ROSA, CA 95403

FURNACE RAISE/LOWER
"LOVEJOY" COUPLING ASSEMBLIES

EMPIRE WORK ORDER NO.	EMPIRE DRAWING NO.	REV
AAPM01	1600041	–

QTY 1/MACH | SCALE NONE | SHEET 1

Empire Castings Inc.
Equipment Manual

Model# EC02-A
Serial# AAPM01

Volumne 3, Section 4 : Furnace Traverse

1: Replacement Parts

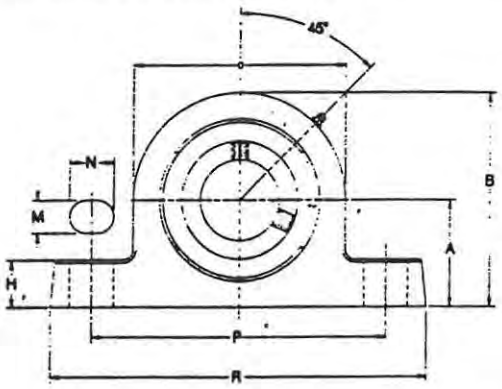
Item#	Part#/Description	Mfg.
001	08400-TDG V-CASTER	PAYSON
002	109-1106	CHAR-LYNN
003	127-2400 RIGIC COUPLG	G&G
004	SPNR-1-1/2 RS BEARING	BCA
005	1-1/2" KEYED SHAFT	EMPIRE CASTINGS
006	DG4V-3S-2C-207-MU11PH560 DIRECTIONAL VALVE	VICKERS
007	DGMFN-3Y-A2W-B2W-41 FLOW CONTROL	VICKERS
008	42GRU-9002 PROX SWITCH	ALLEN-BRADLEY
009	GRP 354P-11.2 X 15FT CABLE CARRIER	GLEASON REEL

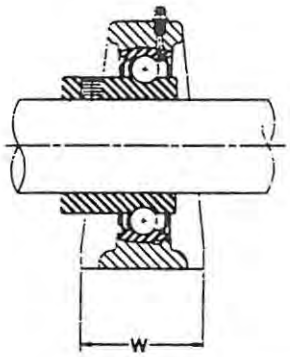
ROUTINE MAINTENANCE:

* *GREASE WHEEL BEARINGS MONTHLY*
* *GREASE DRIVE AXLE BEARINGS MONTHLY*
* *CHECK PROXIMITY SWITCH OPERATION WEEKLY*

SPNR
Pillow Block Set Screw Units

SPNR series pillow blocks combine a precision machined cast iron housing with a narrow inner ring set screw bearing. This self-contained unit offers ease of handling at installation and simplicity in mounting. A relubrication fitting is provided permitting replenishment of the grease as necessary.





DIMENSIONS

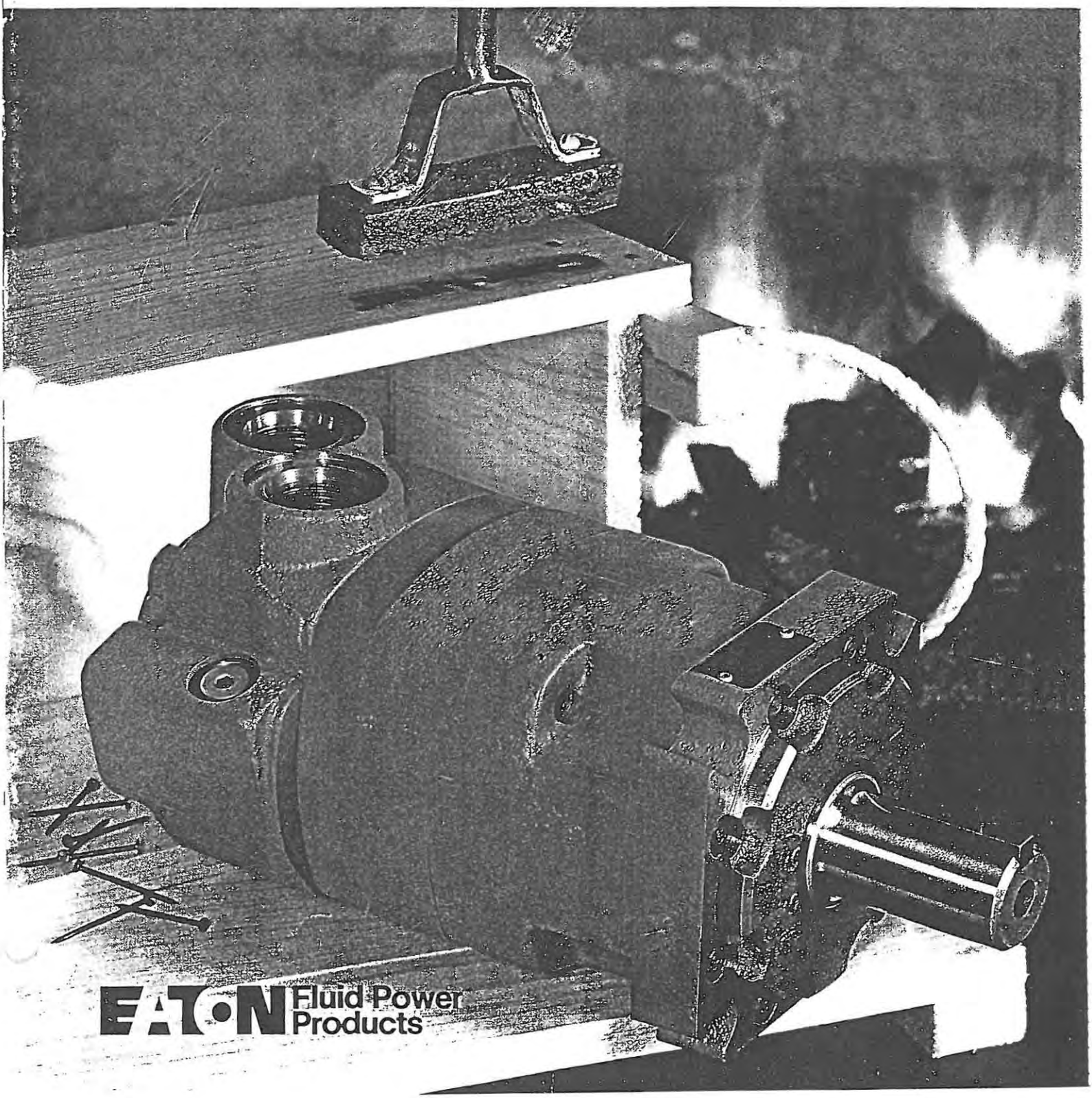
Unit Number	Shaft Dia.	A	B	D	H	M	N	P	R	W	Bearing Number*	Housing Number
SPNR-1/2-RS	1/2	1 3/16	2 1/4	2 1/8	1/2	7/16	9/16	3 1/2	4 3/4	1 1/4	SNPS-008-RR	P-40-RS
SPNR-5/8-RS	5/8	1 3/16	2 1/4	2 1/8	1/2	7/16	9/16	3 1/2	4 3/4	1 1/4	SNPS-010-RR	
SPNR-3/4-RS	3/4	1 5/16	2 9/16	2 1/2	9/16	7/16	5/8	3 7/8	5 1/4	1 1/2	SNPS-012-RR	P-47-RS
SPNR-7/8-RS	7/8	1 7/16	2 13/16	2 3/4	5/8	7/16	5/8	4 1/8	5 1/2	1 5/8	SNPS-014-RR	
SPNR-15/16-RS	15/16	1 7/16	2 13/16	2 3/4	5/8	7/16	5/8	4 1/8	5 1/2	1 5/8	SNPS-015-RR	P-52-RS
SPNR-1-RS	1	1 7/16	2 13/16	2 3/4	5/8	7/16	5/8	4 1/8	5 1/2	1 5/8	SNPS-100-RR	
SPNR-1 1/8-RS	1 1/8	1 11/16	3 9/32	3 3/16	3/4	9/16	3/4	4 3/4	6 5/16	1 3/4	SNPS-102-RR	
SPNR-1 3/16-RSM	1 3/16	1 11/16	3 9/32	3 3/16	3/4	9/16	3/4	4 3/4	6 5/16	1 3/4	SNPS-103-RR	P-62-RS
SPNR-1 1/4 -2RS	1 1/4	1 11/16	3 9/32	3 3/16	3/4	9/16	3/4	4 3/4	6 5/16	1 3/4	SNPS-103-RR2	
SPNR-1 1/4-RS	1 1/4	1 7/8	3 11/16	3 5/8	13/16	9/16	3/4	5	6 9/16	1 7/8	SNPS-104-RR	
SPNR-1 3/8-RS	1 3/8	1 7/8	3 11/16	3 5/8	13/16	9/16	3/4	5	6 9/16	1 7/8	SNPS-106-RR	P-72-RS
SPNR-1 7/16-RS	1 7/16	1 7/8	3 11/16	3 5/8	13/16	9/16	3/4	5	6 9/16	1 7/8	SNPS-107-RR	
SPNR-1 1/2-RS	1 1/2	1 15/16	3 15/16	4	7/8	5/16	3/4	5 1/2	7 1/8	2	SNPS-108-RR	P-80-RS

* SEE PAGE 220 FOR LOAD RATINGS

Char-Lynn®
4000 Series
Hydraulic Motors

Catalog 11-855
June 1980

Char-Lynn



EATON Fluid Power Products

Specifications

Displacement (cu. in./rev.)		6.6	7.9	9.9	12.5	15	19	24
Speed (RPM)	Continuous Flow and Pressure	595	513	414	343	288	236	185
	Peak Flow and Continuous Pressure	752	645	522	432	365	296	233
Flow (GPM)	Continuous	20						
	Peak	25						
Torque (lb. in.)	@ Continuous Pressure	3150	3550	4500	4800	4800	4800	4800
	@ Peak Pressure	4150	4950	6250	6850	6850	6850	6850
Pressure (△PSI)	Continuous	3300	3200	3150	2650	2250	1750	1400
	Peak	4500	4500	4500	3900	3250	2600	2000
	Peak Back Pressure *	1000						

*For continuous back pressure over 300 PSI use an external case drain. Install case drain lines to provide a 25 to 50 PSI case pressure. Always use external case drain in closed loop circuits.

Maximum inlet pressure 4500 PSI. Do not exceed . PSI rating above

Maximum return pressure 4500 PSI. Do not exceed . PSI rating above

Peak conditions assumed to be less than 10% of every minute

Recommended maximum system operating temperature 180° F

Recommended viscosity 100 SUS at operating temperature

Recommended filtration 10 micrometer

For frequent peak pressure conditions or flow and pressures beyond peak ratings consult Minneapolis Division Sales Department.

To assure optimum motor life, run motor for approximately one hour at 30% of rated pressure before application of full load. Be sure motor is properly filled with fluid prior to any load applications.

Performance Data

The charts on next two pages show the typical performance characteristics of Char-Lynn 4000 Series Motors. Given the input flow (GPM) and pressure (PSI) of the hydraulic system, the correct motor size can be determined according to the speed and torque required. Conversely, given the torque (lb. in.) and speed (RPM) required, specifications for an adequate hydraulic system can be determined.

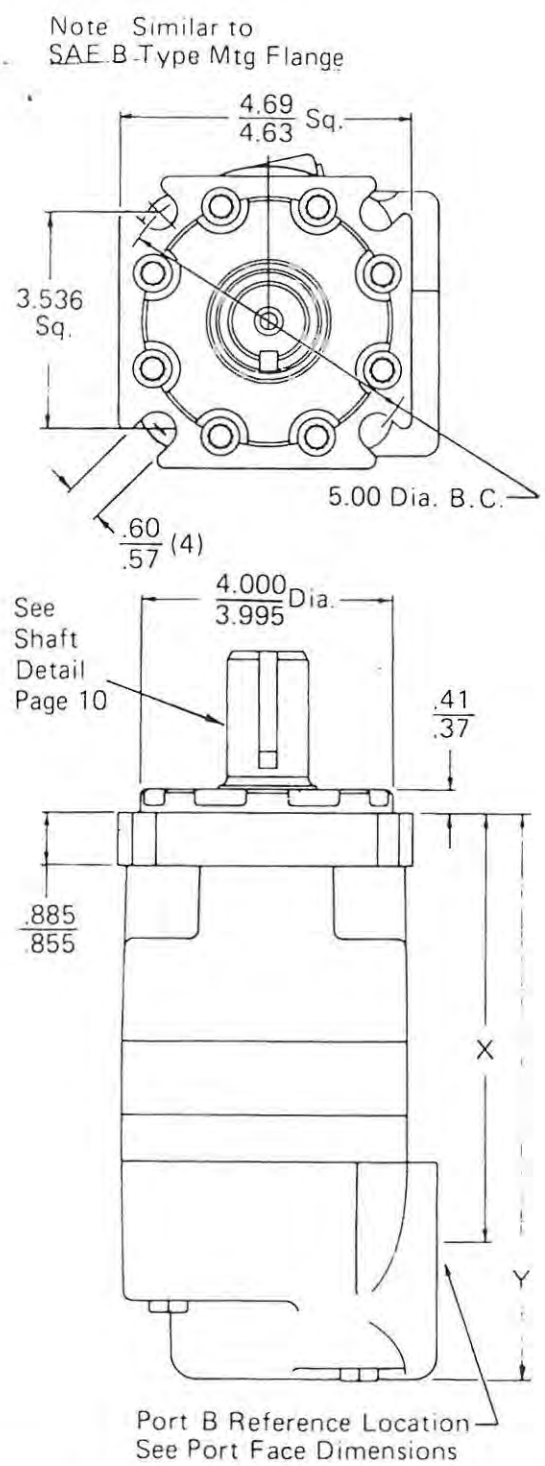
The shaded areas on the charts are shown to help you select the motor with the highest efficiency for the requirements of your application.

Areas indicated by ☐ show areas of performance in which the motors operate at greatest efficiency.

Areas indicated by ☐ show areas of performance in which the motors operate at high efficiency.

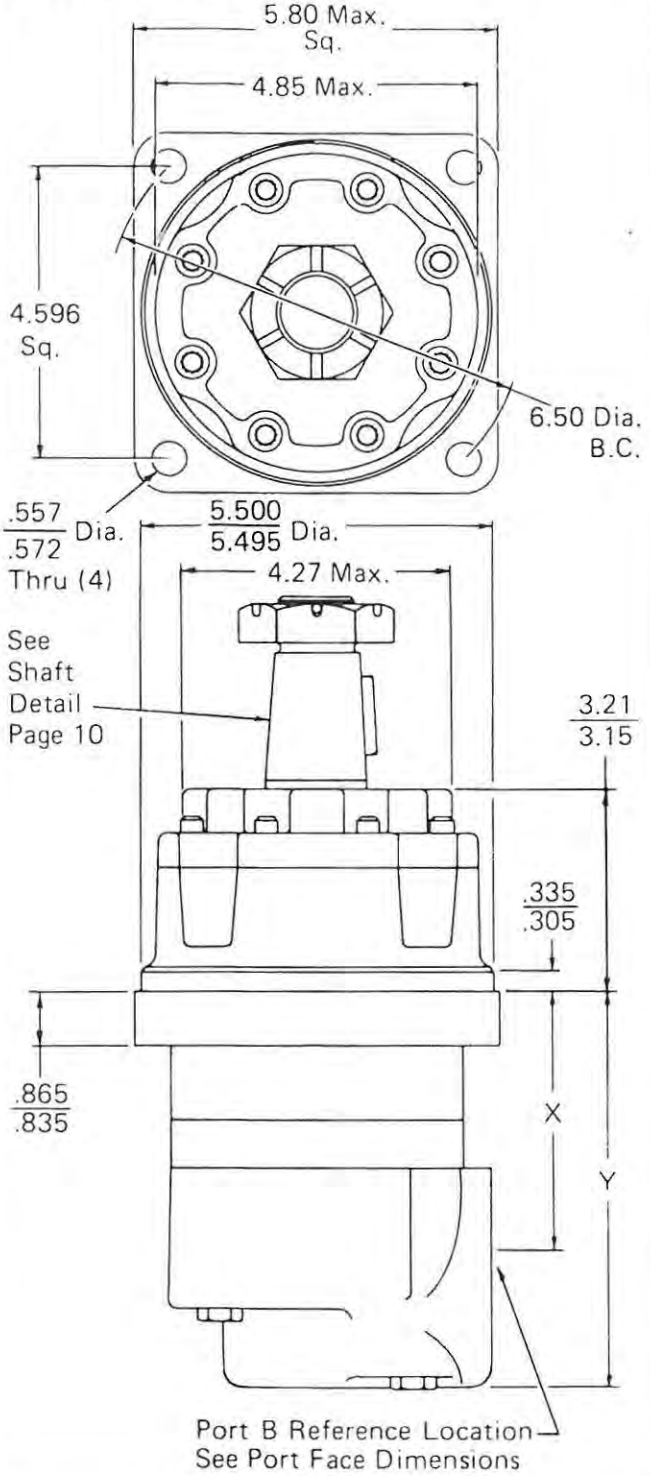
Dimensions and Mounting Data

Standard Motor

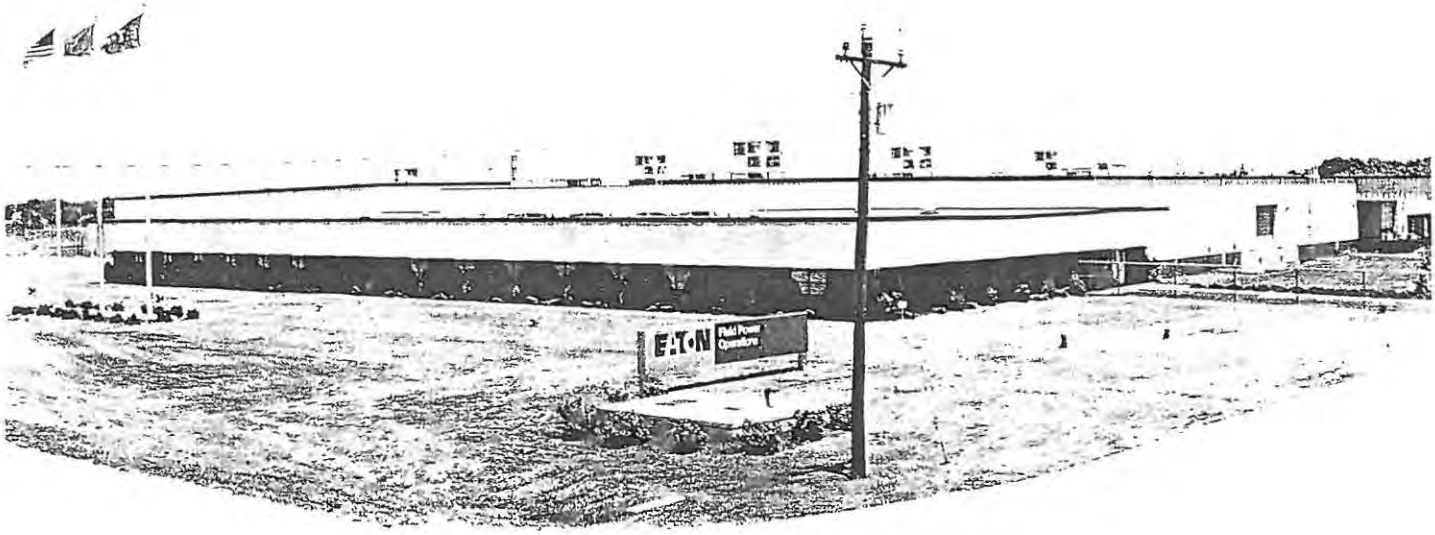


Displacement cu. in/rev	X	Y max.
6.6	6.27/6.16	8.47
7.9	6.44/6.33	8.64
9.9	6.69/6.58	8.89
12.5	7.03/6.92	9.23
15	6.69/6.58	8.89
19	7.03/6.92	9.23
24	7.45/7.34	9.65

Wheel Motor



Displacement cu. in./rev.	X	Y max.
6.6	3.48/3.38	5.68
7.9	3.65/3.55	5.85
9.9	3.90/3.80	6.09
12.5	4.24/4.14	6.43
15	3.90/3.80	6.09
19	4.24/4.14	6.43
24	4.66/4.56	6.85



Shawnee Plant, Shawnee, Oklahoma — All 2000, 4000, 6000 and 10,000 series motors are manufactured at this plant.

Ordering Information

Type of Motor	Type of Shaft	Displacement (cu. in./rev.)/Product Number						
		6.6	7.9	9.9	12.5	15	19	24
Standard Motor	1¼" Str. Keyed	109-1100	109-1101	109-1102	109-1103	109-1104	109-1105	109-1106
	1⅝" Tapered	109-1107	109-1108	109-1109	109-1110	109-1111	109-1112	109-1113
	1¼" Splined	109-1114	109-1115	109-1116	109-1117	109-1118	109-1119	109-1120
Wheel Motor	1¼" Str. Keyed	110-1074	110-1075	110-1076	110-1077	110-1078	110-1079	110-1080
	1⅝" Tapered	110-1081	110-1082	110-1083	110-1084	110-1085	110-1086	110-1087
	1¼" Splined	110-1088	110-1089	110-1090	110-1091	110-1092	110-1093	110-1094
Bearingless		111-1033	111-1034	111-1035	111-1036	111-1037	111-1038	111-1039

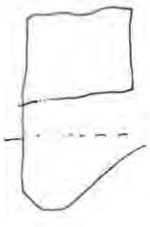
Empire Castings Inc.
Equipment Manual

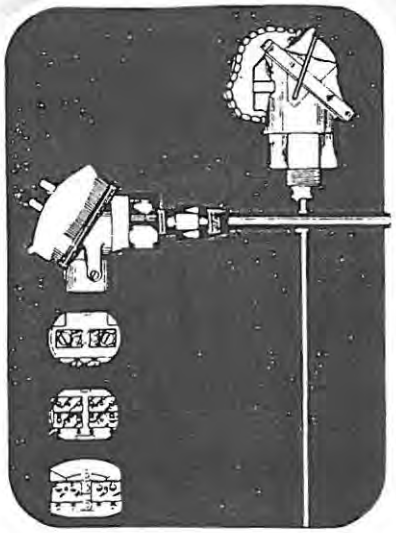
Model# EC02-A
Serial# AAPM01

Volumne 3, Section 5 : Furnace Heating

1: Replacement Parts

Item#	Part#/Description	Mfg.
001	LL75X4034A02 ELEMENT	WESTERN INDUSTRIAL CERAMIC
002	100AMP ALUMINUM BRAID	WESTERN INDUSTRIAL CERAMIC
003	HSS20 STAINLESS CLAMP	EMPIRE BEARING
004	E8K30 THERMOCOUPLE	ROLLOCK
005	PTSC30 SIC TUBE	ROLLOCK
006	IWLSB THEMOCPLE TERM.	ROLLOCK
007	9518K431/4" PACKING	MCMASTER CARR
008	9518K453/8" PACKING	MCMASTER CARR
009	FURNACE BRAID CONNECTOR	EMPIRE CASTINGS INC.
010	CABLE CARRIER	GLEASON REEL
011	MAINTENANCE PROCEDURES	





ROLOCK/CALALLOY

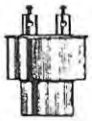
In the West:
Rolock of California, Inc.
1475 Potrero Avenue, South El Monte, CA 91733
(818) 579-3230, Outside California (800) 221-6935
Telex 69-1279 FAX 818 401-3740

In the East:
Rolock of Connecticut, Inc.
1350 Kings Highway, Fairfield, CT 06430
(203) 367-8611, Outside CT (800) 243-9460
Telex 96-4222 FAX 203-367-9852

INDUSTRIAL THERMOCOUPLES
Heads & Connectors

TABLE 21

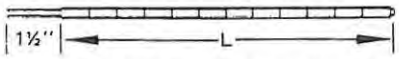
ASSEMBLY CODE	DESCRIPTION	PRICE EA. PART NO.
H Single	 Aluminum Barber-Colman snap cover head 1/2" conduit	
HD Double	1/2" NPT tube	IWH12
	3/4" NPT tube	IWH34
	1" NPT tube	IWH1
–	 Single terminal block for Barber-Colman head	IWSB
–	 Duplex terminal block for Barber-Colman head	IWDB
HS Single	 Cast iron screw cover head 3/4" conduit	
HSD Double	1/2" NPT tube	ILH12
	3/4" NPT tube	ILH34
	1" NPT tube	ILH1
–	 LNS single terminal block	ILSB
–	 LND duplex terminal block	ILDB

ASSEMBLY CODE	DESCRIPTION	PRICE EA. PART NO.
HA Single	 Cast Aluminum screw cover head 3/4" conduit	
HAD Double	1/2" NPT tube	(AL)ILH12
–	 Single terminal block for Gordon head	IGB
–	 Open terminal head for use on platinum thermocouples 7/8–27 thread	IGPH
–	 Ferrule for 11/16"OD ceramic tube	IGPF
–	 Ferrule for 3/8" OD ceramic tube	IGPF3
–	 1/2 x 3/4 NPT steel ferrule for ceramic tubes up to 11/16 OD	IGHF

BASE METAL THERMOCOUPLES

INSULATED THERMOCOUPLES

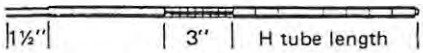
TABLE 23

ASSEMBLY CODE	DESCRIPTION	LENGTH "L"	12"	18"	24"	30"	PER ADD'L. 6" OR FRACTION
	 Insulated with oval insulators	PRICE EACH					
8K	*Chromel/Alumel 8 ga. .128"	PART NO.	E8K–12	E8K–18	E8K–24	E8K–30	
11K	Chromel/Alumel 11 ga. .091"	PRICE EACH / PART NO.	E11K–12	E11K–18	E11K–24	E11K–30	
14K	Chromel/Alumel 14 ga. .064"	PRICE EACH / PART NO.	E14K–12	E14K–18	E14K–24	E14K–30	
20K	Chromel/Alumel 20 ga. .032"	PRICE EACH / PART NO.	E20K–12	E20K–18	E20K–24	E20K–30	
8J	Iron/Constantan 8 ga. .128"	PRICE EACH / PART NO.	E8J–12	E8J–18	E8J–24	E8J–30	
14J	Iron/Constantan 14 ga. .064"	PRICE EACH / PART NO.	E14J–12	E14J–18	E14J–24	E14J–30	
20J	Iron/Constantan 20 ga. .032"	PRICE EACH / PART NO.	E20J–12	E20J–18	E20J–24	E20J–30	

BARE THERMOCOUPLES

	 Bare Thermocouple Elements	PRICE EACH					
–	Chromel/Alumel 8 ga. .128"	PART NO.	EB8K–12	EB8K–18	EB8K–24	EB8K–30	
–	Chromel/Alumel 11 ga. .091"	PRICE EACH / PART NO.	EB11K–12	EB11K–18	EB11K–24	EB11K–30	
–	Chromel/Alumel 14 ga. .064"	PRICE EACH / PART NO.	EB14K–12	EB14K–18	EB14K–24	EB14K–30	
–	Chromel/Alumel 20 ga. .032"	PRICE EACH / PART NO.	EB20K–12	EB20K–18	EB20K–24	EB20K–30	
–	Iron/Constantan 8 ga. .128"	PRICE EACH / PART NO.	EB8J–12	EB8J–18	EB8J–24	EB8J–30	
–	Iron/Constantan 14 ga. .064"	PRICE EACH / PART NO.	EB14J–12	EB14J–18	EB14J–24	EB14J–30	
–	Iron/Constantan 20 ga. .032"	PRICE EACH / PART NO.	EB20J–12	EB20J–18	EB20J–24	EB20J–30	

ANGLE TYPE INSULATED THERMOCOUPLES

	 Angle type thermocouples have 3" of fish-spine insulators at the elbow location. Insert hot leg dimension in inches in place of H.	PRICE EACH					
8K	Chromel/Alumel 8 ga. .128"	PART NO.			EA8K-H-24	EA8K-H-30	
8J	Iron/Constantan 8 ga. .128"	PRICE EACH / PART NO.			EA8J-H-24	EA8J-H-30	

PART NUMBER: For thermocouples of non-standard lengths insert the length in inches desired in place of the last two numbers.

INSULATED TIP: A 7/16" dia. x 1" insulator is cemented to the hot junction tip. Add a "T" suffix to the part number.

CALIBRATION: Calalloy manufactures thermocouple elements to rigid specifications. Wires are matched to Instrument Society of America's RP 1.3 Standard Limits of Error. Special types, sizes, and calibrations can be supplied – prices on request.

THERMOCOUPLE SELECTION: The materials for thermocouples must be selected to meet the conditions of the application. Where sensitivity or speed of response is important the smaller size wires are used. Where long life is the consideration heavier wires are recommended. In selecting a thermocouple it is necessary that it be of the same calibration as the instrument.

*Chromel/Alumel is the trade name of Hoskins Manufacturing Company.

DISCOUNT SCHEDULE

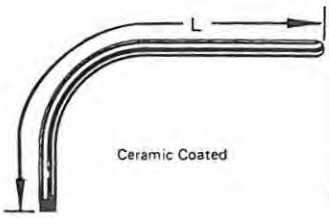
Thermocouples with the same part number (length excepted) may be grouped for quantity discount.

1 – 9	List
10 – 24	5%
25 – 49	10%
50 & over	15%

PROTECTION TUBES

NEIL FLEETWOOD

TABLE 25

ASSEMBLY CODE	DESCRIPTION	LENGTH "L"	12"	18"	24"	30"	36"	42"	48"	60"
"L" LENGTH IN INCHES		PRICE EACH								
I12–"L"	½" IPS Inconel 601	PART NO.	PTI12–12	PTI12–18	PTI12–24	PTI12–30	PTI12–36	PTI12–42	PTI12–48	PTI12–60
		PRICE EACH								
I34–"L"	¾" IPS Inconel 601	PART NO.	PTI34–12	PTI34–18	PTI34–24	PTI34–30	PTI34–36	PTI34–42	PTI34–48	PTI34–60
IB34–"L"	 Ceramic Coated ¾" IPS Inconel 601 Bent									
		PRICE EACH								
		PART NO.			PTIBC34-24		PTIBC34-36			
		PRICE EACH								
		PART NO.			PTIB34–24		PTIB34–36			
C12–"L"	1/2" IPS Type 330 SS	PRICE EACH								
		PART NO.	PTC12–12	PTC12–18	PTC12–24	PTC12–30	PTC12–36	PTC12-42	PTC12-48	PTC12-60
F12–"L"	1/2" IPS Type 446 SS	PRICE EACH								
		PART NO.	PTF12–12	PTF12–18	PTF12–24	PTF12–30	PTF12–36			
CI–"L"	Cast Iron 1 11/16"OD x 15/16"ID 3/4" Internal NPT	PRICE EACH								
		PART NO.	PTCI–12	PTCI–18	PTCI–24					
CC–"L"	Cast Iron Ceramic Coated 1 11/16"OD x 15/16"ID 3/4" Internal NPT	PRICE EACH								
		PART NO.	PTCC–12	PTCC–18	PTCC–24	PTCC–30				

	Hi-Temp Porcelain (MV30 Mullite) 7/16"ID x 11/16"OD Plain End	PRICE EACH								
		PART NO.	PT1116MN-12	PT1116MN-18	PT1116MN-24	PT1116MN-30	PT1116MN-36		PT1116MN-48	PT1116MN-60
	Hi-Temp Porcelain (MV30 Mullite) 1/4"ID x 3/8"OD Plain End	PRICE EACH								
		PART NO.	PT38MN-12	PT38MN-18	PT38MN-24	PT38MN-30	PT38MN-36		PT38MN-48	PT38MN-60
	Hi-Temp Porcelain (MV30 Mullite) 7/16"ID x 11/16"OD 1/2 x 3/4 NPT Ferrule	PRICE EACH								
		PART NO.	PTF1116MN12	PTF1116MN18	PTF1116MN24	PTF1116MN30	PTF1116MN36		PTF1116MN48	PTF1116MN-60
	Hi-Temp Porcelain (MV30 Mullite) 1/4"ID x 3/8"OD 1/2 x 3/4 NPT Ferrule	PRICE EACH								
		PART NO.	PTF38MN-12	PTF38MN-18	PTF38MN-24	PTF38MN-30	PTF38MN-36		PTF38MN-48	PTF38MN-60
	Hi-Temp Porcelain (MV30 Mullite) 7/16"ID x 11/16"OD 7/8" x 27 Ferrule	PRICE EACH								
		PART NO.	PTP1116MN12	PTP1116MN18	PTP1116MN24	PTP1116MN30	PTP1116MN36		PTP1116MN48	PTP1116MN-60
	Hi-Temp Porcelain (MV30 Mullite) 1/4"ID x 3/8"OD 7/8" x 27 Ferrule	PRICE EACH								
		PART NO.	PTP38MN-12	PTP38MN-18	PTP38MN-24	PTP38MN-30	PTP38MN-36		PTP38MN-48	PTP38MN-60
	99.8% Alumina (Al_2O_3) 1/4"ID x 3/8"OD Plain End	PRICE EACH								
		PART NO.	PT38—998-12	PT38—998-18	PT38—998-24		PT38—998-36			
	99.8% Alumina (Al_2O_3) 7/16"ID x 11/16"OD Plain End	PRICE EACH								
		PART NO.	PT1116-998-12	PT1116-998-18	PT1116-998-24		PT1116-998-36			
	1"ID x 1 3/4"OD Silicon Carbide w/collar	PRICE EACH								
		PART NO.	PTSC–12	PTSC–18	PTSC–24	PTSC–30	PTSC–36			

For non-standard sizes, the next larger standard size must be used and a cutting charge of $_____ added to the price.

Machine/Furnace Maintenance and Repair

1. **FURNACE FILL DOOR GASKET MAINTENANCE**
To insure that the fill door gasket material seals properly, the following steps should be taken:
   a) Using a wire brush, periodically "roughen" the gasket.
   b) Be sure that there are no objects between the gasket and the furnace body.
   c) Clean all scale, rust and aluminum chips from the gasket mating surface.
   d) Check that door is properly aligned and retaining bolts are torqued.
   e) If all above have been followed, and pressure leakage is noted at the door, then it may be necessary to remove and install new gasket material.

2. **CHANGING THE GASKET**
It will be necessary at times to change the fill door gasket material. To perform this task, it is recommended to remove the door from the furnace body. Once the door has been removed, place it securely on a bench with the gasket facing up and follow the next steps.
   a) Using a pick, remove the old gasket material by prying it upwards and pulling it out of the groove.
   b) Be careful not to scar or damage the edges of the groove.
   c) After all the material has been removed, clean out the groove using compressed air and steel wool and/or fine emery cloth.
   d) It is recommended that McMaster Carr 9518K453 rope packing or equivalent be used for gasket material.
   e) Only one length of material should be used in each groove.
   f) Carefully run the length of material along the contour of the groove. This will determine the proper length of material to be used. Be sure to follow closely around all corners.
   g) When the two ends of material meet, add an extra 1" (inch) of material for the cut.
   h) Cut the ends of the material at a 45 degree angle so that the two ends overlap . This is very important to insure a proper seal.
   i) Using a rubber or leather mallet hammer the material into the groove until it bottoms out.
   j) Be certain that the two mating ends meet on the longest straight plain of the groove
   k) Once all material has been installed, replace the door.

3. **LUBRICATING THE FURNACE COMPONENTS**

To insure ease of operation of the furnace fill door the following steps should be taken:

a) Using a high-temperature graphite grease periodically lubricate the grease fittings.

b) Using a high-temperature anti-seize compound, periodically lubricate the fill door handle acme thread.

4. **REMOVAL OF FURNACE FILL DOOR**

To perform various maintenance procedures (i.e. installation of new gasket material, see above) it may become necessary to remove the fill door. To safely and properly do this procedure the following steps should be taken:

a) Remove bottom safety pin from hinge rod and remove bottom spacer.

b) Lift door from frame.

c) To replace fill door, reverse procedures.

5. **CLEANING THE FURNACE CAVITY**

To insure the proper quality of the metal, periodic cleaning of the furnace cavity must be included in your routine maintenance schedule. The cleaning procedure is as follows:

a) Raise machine and move to away position for access to feed tube and thermocouple.

b) Turn off main power to glow bars at power cabinet.

c) Remove thermocouple plug and remove the thermocouple and the protection tube.

d) Remove feed tube .

e) The cleaning procedure will be performed through the fill door opening. With the feed tube and thermocouple removed, there is now adequate access to the furnace holding area.

f) To insure the safety of personnel, the use of spats, protective apron, face shield and the minimum of 30 oz. hot mill gloves should be worn at all times during the cleaning process.

g) A cleaning flux such as Aluflux-EV should be used to help release contaminants from furnace walls and bottom (follow manufacturer's instructions).

h) Foundry tools such as skimmers and scrapers will be necessary to adequately scrape the walls and bottom of the furnace.

i) The dross created from the above process must now be skimmed from the surface of the metal.

j) Once the cleaning process is completed, be sure to remove any obstructions from fill door sealing surface which may have been created from aluminum spilling during skimming.

k) The feed tube and thermocouple can now be reinserted into the lid and all connections reestablished.

6. **REPAIRING THE FURNACE CAVITY**
If damage occurs to the cavity or cracks appear, repair to the cavity lining will be needed. Consult the factory for a determination of repairs to be done. Instructions and/or personnel will be supplied at that time.

7. **REPLACING THE FURNACE CAVITY LINING**
In the event that this is needed, consult the factory for instructions. It is recommended that the furnace be returned for this procedure.

8. **REPLACEMENT OF FURNACE AIR FITTINGS**
If the replacement or removal of air fittings becomes necessary, the fitting threads must be coated with a sealant to prevent leakage. A teflon type sealant is recommended.

9. **CHANGING THE HEATING ELEMENT TERMINAL ACCESS COVER GASKET**
Follow the same removal and installation procedures as seen in the section regarding the furnace fill door.
   a) USE ONLY McMaster Carr 9518K453 or equiv.
   b) All bolts that have been removed must have the threads coated with a high-temperature anti-seize compound before reinstallation.

10. **REPLACEMENT OF THE FURNACE HEATING ELEMENTS**
The furnace heating elements will not last for an indefinite period of time, therefore, in time it will be necessary to install a new set of elements. The following procedures should be followed for removal and installation.

   a) Turn off furnace power at the furnace power cabinet. Lock out the disconnect.

   b) Remove the terminal access covers. One cover is on the right hand side and the other is on the left hand side.

   c) Remove the two stainless steel hose clamps on each end of the heating elements(two clamps at each end of the heating element). These clamps hold two aluminum braids. Once the clamps are removed, the aluminum braids may also be removed. Since these braids can be reused, be careful not to damage them. If they are already damaged, then they will need to be replaced.

   d) Remove the Fiberfrax® insulation doughnuts from each end of the heating elements.

e) Carefully slide the heating elements through the access ceramics (one ceramic is located at each end of the furnace). Insure that the heating elements are supported as they are being removed. Upon removal of the elements, a flat surface needs to be provided to support the entire length of the element. A thorough inspection of all elements is required. Any damaged or broken elements must be replaced.

f) Inspect the access ceramics (six total), any damaged or broken ceramics need to be replaced.

g) Reinstall the heating elements. Do not hold onto the end of the element only. Use both hands and support as much of the length of the element as possible. Position the element so that equal lengths of the element extend from the ceramics.

h) Slide a new Fiberfrax® doughnut over each end of the heating elements.

i) Check the condition of the aluminum braid insulation. Replace if damaged or brittle. If damaged insulation is reused, injury or death could result from electrical shock.

j) Arrange the aluminum braid (2 each) on each end of the heating elements so that it lies lengthwise with the heating elements, one braid 180° from the other braid. The braids should have sufficient contact area for two stainless steel hose clamps to hold them in place. Use the furnace wiring schematic for correct element connections.

k) New hose clamps should always be used. DO NOT REUSE OLD HOSE CLAMPS.

l) Tighten the hose clamps to hold the braid for a good snug fit, but not so tight as to break the heating elements.

m) Clean the terminal access cover gaskets with a wire brush. Coat the gasket with a high temp graphite grease.

n) Reinstall the terminal access cover.

o) Turn the power back on for the furnace.

Note. If new elements are installed, it is best to install the elements in sets. Also new elements need to have the transformer taps moved to their lowest settings.

Caution. Under no circumstances is power to be restored when access covers are removed.

11. REPLACEMENT OF THE HEATING ELEMENT TERMINALS

a) Turn off furnace power at the furnace power cabinet. Lock out the disconnect.

b) Remove the terminal access covers. One cover is on the right hand side and the other is on the left hand side.

c) Remove the two stainless steel hose clamps form the heating element terminal. Each terminal has two clamps. These clamps hold two aluminum braids. Once the clamps are removed, the aluminum braids mat also be removed. Since these braids can be reused, be careful not to damage them. If they are already damaged, then they will need to be replaced.

d) On the other side of the heating element terminal is the wire connection to the transformer. Using the appropriate Allen wrench, loosen the two set screws that hold the wire. Once the set screws are loose, removed the wire. Check the wire for deterioration. If the wire insulation is cracked or brittle, replace the wire. REUSING CRACKED OR BRITTLE WIRE COULD CAUSE INJURY OR DEATH AS A RESULT OF ELECTRICAL SHOCK.

e) Remove the heating element terminals by removing the nut and sliding the terminal to the inside of the terminal access port. Check the terminal for damage. Replace if damaged.

f) Remove the terminal insulators and inspect for damage. Also check the condition of the o-rings. Replace any damaged parts. If the o-ring needs to be replaced, make sure it is replaced with original equipment or better o-ring.

g) Reinstall insulators with o-rings into each feed through hole. The insulator with the two o-rings is installed on the terminal access port side of the terminal mounting plate.

h) Reinstall the terminals with the knurled end on the inside of the terminal access port. Tighten the terminal only HAND TIGHT. Use an anti oxidant joint compound on the terminal threads such as Noalox®.

i) Reinstall the transformer wire to the terminal. Use an anti oxidant joint compound on the set screw threads and wire, such as Noalox®.

j) Arrange the aluminum braid (2 each) on each end of the heating element terminal so that it lies lengthwise with the terminal, one braid 180° from the other braid. The braids should have sufficient contact area for two stainless steel hose clamps to hold them in place. Use the furnace wiring schematic for correct element connections.

k) New hose clamps should always be used. DO NOT REUSE OLD HOSE CLAMPS.

l) Tighten the hose clamps to hold the braid for a good snug fit.

m) Clean the terminal access cover gaskets with a wire brush. Coat the gasket with a high temp molybdenum grease.

n) Reinstall the terminal access cover.

o) Turn the power back on for the furnace.

Caution. Under no circumstances is power to be restored when access covers are removed.

12. **MAINTENANCE OF THE FURNACE AIR FILTRATION SYSTEM**

The furnace air system is factory equipped with a 40 micron filtration system with an automatic drain. The drain will discharge moisture in the filter bowl when a critical level is reached. However if excess moisture is noticed to be frequently discharging from the bowl, a maintenance check is advised to be performed on the air system supply. Excess moisture in the air system should be <u>corrected immediately.</u>

The furnace air system filter element should be checked for contamination every 40 hours of operation. If continual contamination is noted, an immediate maintenance check of the air supply should be performed.

For information regarding the replacement of the filter element, consult the manufacturer's brochure included with this manual located in Section 5 : Air/Water System

Failure to maintain an adequate supply of clean, dry air to the furnace air system may cause the following:
-Cause injury to personnel.
-Damage components downstream from the filter system.
-Contaminate the metal.
-Void parts warranty.
-Slow production casting rate.
-Cause considerable down-time.

13. **FURNACE EXHAUST VALVE PILOT PRESSURE LUBRICATION SYSTEM**
The furnace exhaust (dump) valve is equipped with an external pilot air pressure supply. To maintain the valve in proper working condition, the valve must be constantly supplied with 120psig of clean, lubricated air.

The pilot pressure lubricator is located near Furnace Exhaust Valve. This lubricator must be checked EVERY SHIFT, to insure that an adequate supply of lubrication is present.

For instructions on adjustment of the lubricator and specifications on the type of lubricant to be used, consult the manufacturer's brochure included in this manual.
Lack of proper air pressure and lubrication to the Furnace Exhaust Valve Pilot Pressure may result in the following:
-Injury to personnel.
-Damage to components.
-Void parts warranty.
-Slow production casting rate.
-Cause considerable down-time.

14. **FURNACE EXHAUST VALVE REPAIR**
Consult factory for replacement.

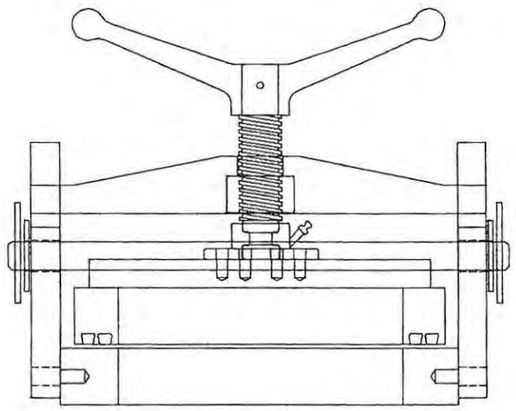
15. **POP SAFETY FURNACE EXHAUST VALVE MAINTENANCE AND REPAIR**
If any damage or corrosion is noted on this valve it must be replaced immediately. No work should be performed on this valve except by authorized personnel of the valve manufacturer.

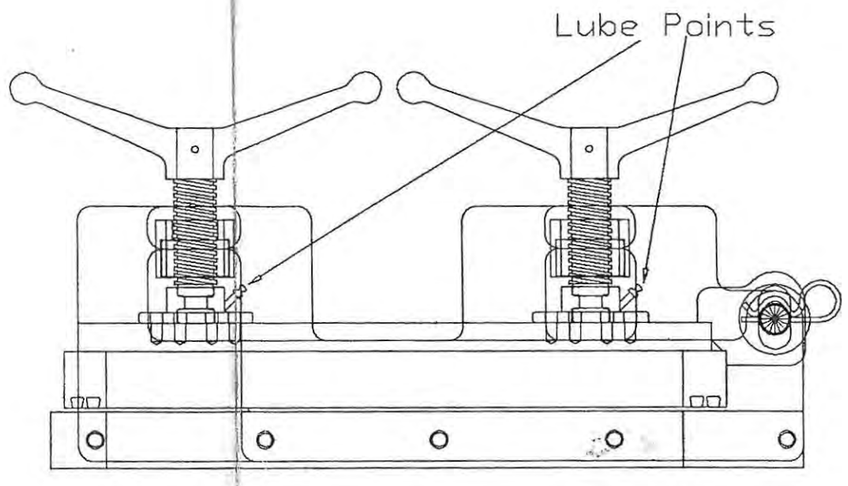
Furnace Air System Maintenance Schedule

1) Daily: Inspect furnace exhaust lubricator for proper fluid level. Fill if necessary.

2) Daily: Inspect furnace exhaust valve muffler (silencer) for contaminants clean and/or replace if necessary.

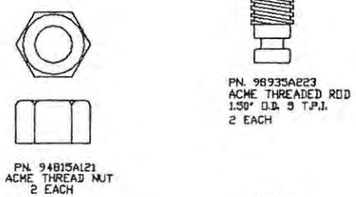
4) Daily: Inspect air filtration system, drain water from separator and clean filters as needed.

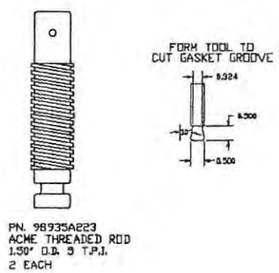




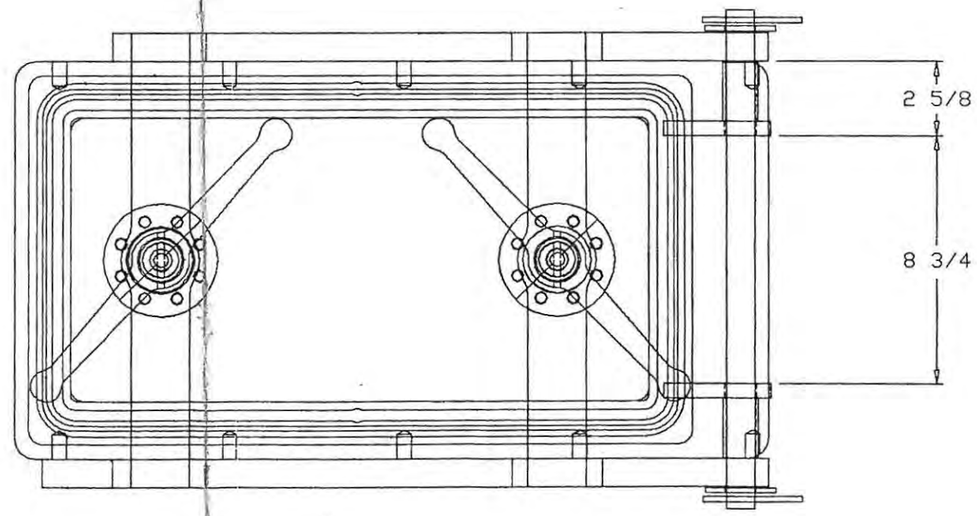
McMASTER-CARR
PRODUCTS CAT. 97











NOTES: UNLESS OTHERWISE SPECIFIED
1. REMOVE ALL BURRS AND SHARP EDGES
2. X

THIRD ANGLE PROJECTION

REV	DESCRIPTION	DATE	BY
–	ENGINEERING RELEASE	X	

REVISIONS

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UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE INCHES
TOLERANCES ARE:
DECIMALS .XXX ±.005 .XX ±.01
FRACTIONS ±1/16
ANGLES ±1/2°
BREAK SHARP EDGES .010
DRAWING PER ANSI Y14.5

MATERIAL
As Specified

FINISH

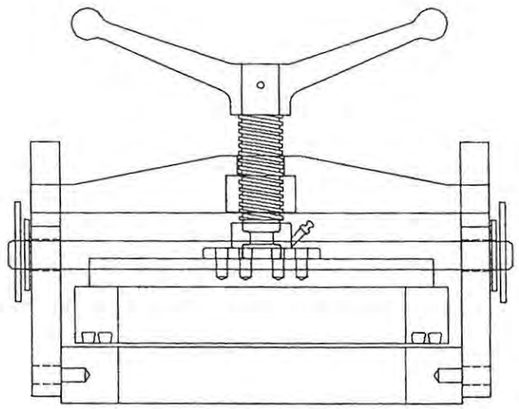
APPROVALS		DATE
DRAWN BY	D Cashwell	9/9/96
CHECKED BY		
APPROVED BY		
ENGINEERING	JIM ALLEN	9/9/96
MANUFACTURING		
CUSTOMER	American Wheel	
DO NOT SCALE DRAWING		

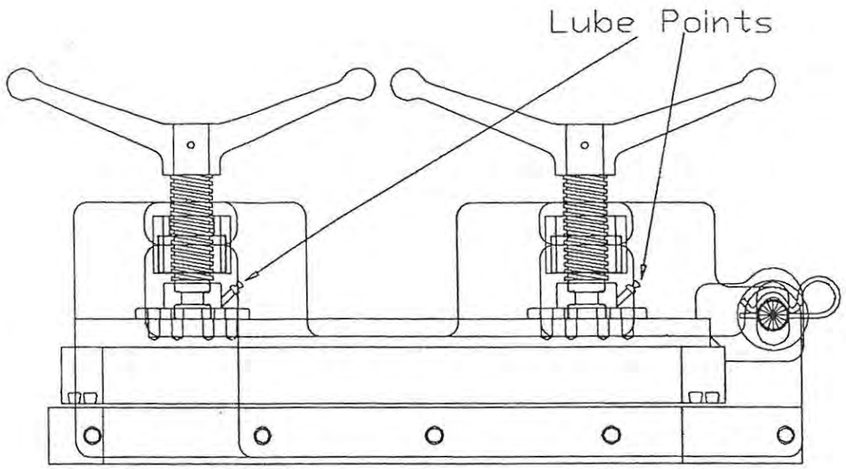
EMPIRE CASTINGS INC.
3195 REGIONAL PARKWAY, SANTA ROSA, CA 95403

Furnace Door Assembly

EMPIRE WORK ORDER NO.	EMPIRE DRAWING NO.	REV
AWM002	100003	–

QTY 1 per mach | SCALE TO FIT | SHEET 1





McMASTER-CARR
PRODUCTS CAT. 97



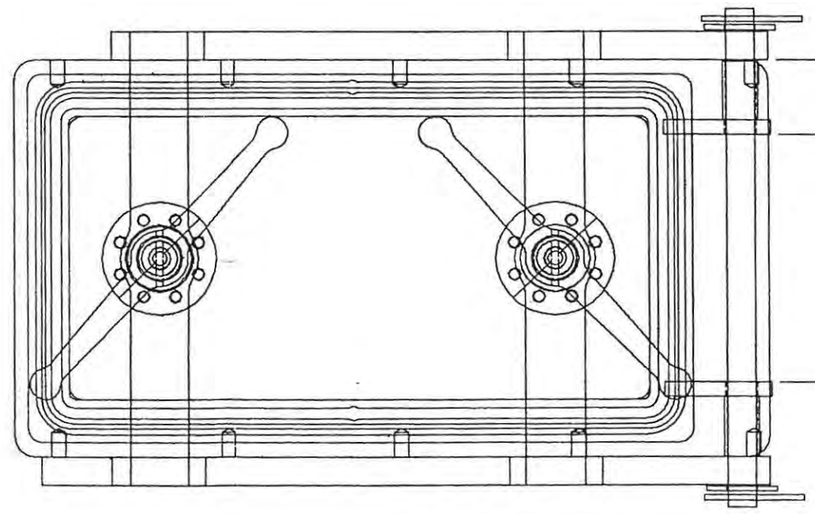












NOTES: UNLESS OTHERWISE SPECIFIED
1. REMOVE ALL BURRS AND SHARP EDGES
2. X

REV	DESCRIPTION	DATE	BY
–	ENGINEERING RELEASE	X	

REVISIONS

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THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE INCHES
TOLERANCES ARE:
DECIMALS .XXX ±.005 .XX ±.01
FRACTIONS ±1/16
ANGLES ±1/2°
BREAK SHARP EDGES .010
DRAWING PER ANSI Y14.5

MATERIAL
As Specified

FINISH

APPROVALS		DATE
DRAWN BY	D Cashwell	9/9/96
CHECKED BY		
APPROVED BY		
ENGINEERING	JIM ALLEN	9/9/96
MANUFACTURING		
CUSTOMER	American Wheel	
DO NOT SCALE DRAWING		

EMPIRE CASTINGS INC.
3195 REGIONAL PARKWAY, SANTA ROSA, CA 95403

Furnace Door Assembly

EMPIRE WORK ORDER NO.	EMPIRE DRAWING NO.	REV
AWM002	100003	–

QTY	SCALE	SHEET
1 per mach	TO FIT	1

Empire Castings Inc.
Equipment Manual

Model# EC02-A
Serial# AAPM01

Volumne 3, Section 9 : Retriever

1: Replacement Parts

Item#	Part#/Description	Mfg.
001	109-1106 HYD MOTOR	CHAR-LYNN
002	GEAR	LINN BEARING CO
003	SR16SX6 GEAR RACK	LINN BEARING CO
004	9733AA2XMA7TL PROXIMITY SWITCH	MICRO SWITCH
005	DV4V-3-2C-MUB660 DIRECTIONAL VALVE	VICKERS
006	N-V-10-K-0 SLOW FUNCTION NEEDLE	MODULAR CONTROLS
007	SV3-10-0-00 SLOW CARTIDGE VALVE	MODULAR CONTROLS

ROUTINE MAINTENANCE:

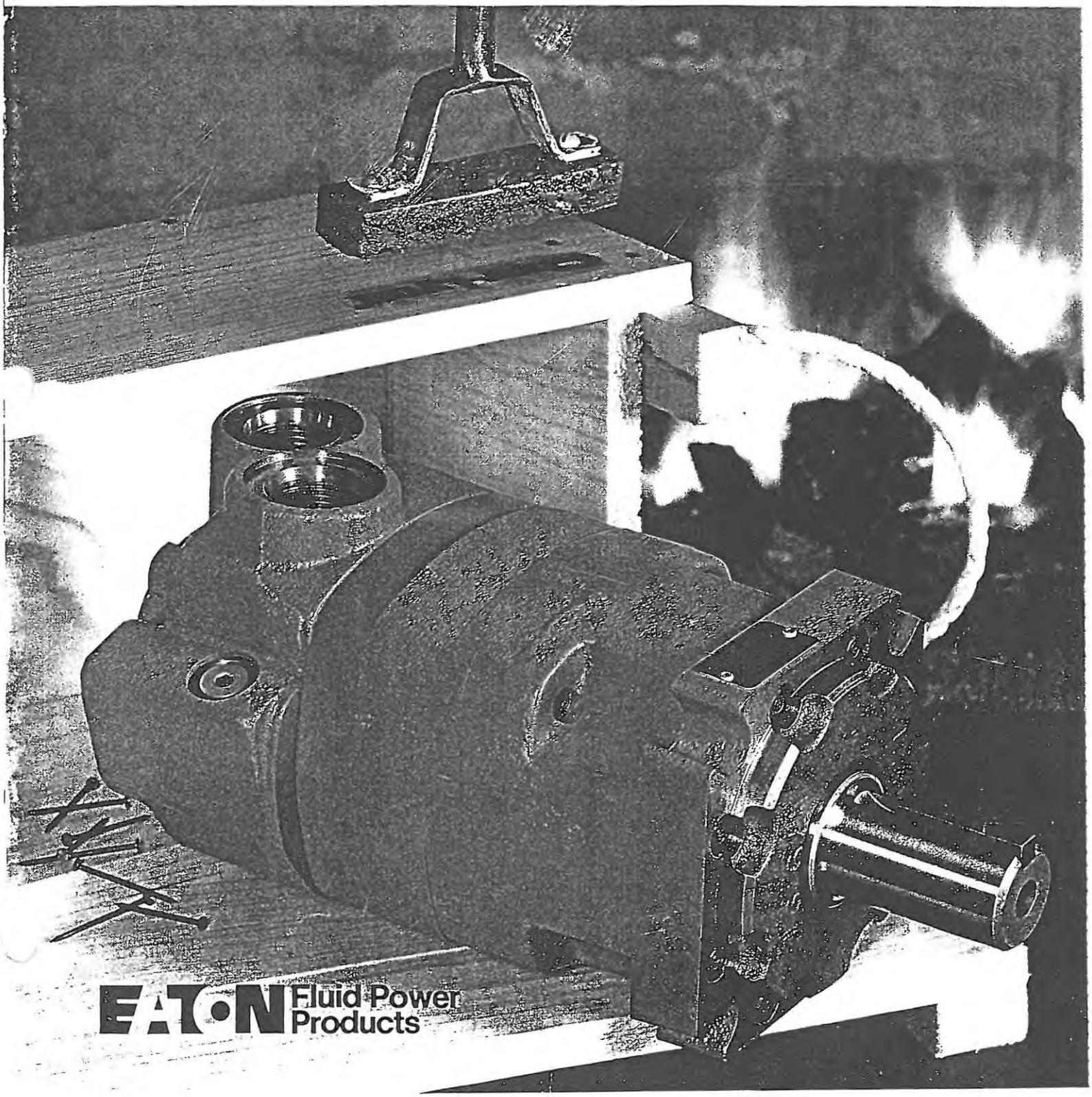
* *GREASE RETIEVER GUIDE BUSHINGS DAILY*
* *CHECK FUNCTIONALITY OF I/R EYE DAILY*
* *CHECK THAT GUARD(S) ARE IN PLACE EACH SHIFT*

CAUTION: DO NOT OPERATE RETRIEVER FUNCTION WITHOUT GUARDS AND/OR INFRA RED EYES IN PLACE AND FUNCTIONING PROPERLY

Char-Lynn®
4000 Series
Hydraulic Motors

Catalog 11-855
June 1980

Char-Lynn



EATON Fluid Power Products

Specifications

Displacement (cu. in./rev.)		6.6	7.9	9.9	12.5	15	19	24
Speed (RPM)	Continuous Flow and Pressure	595	513	414	343	288	236	185
	Peak Flow and Continuous Pressure	752	645	522	432	365	296	233
Flow (GPM)	Continuous	20						
	Peak	25						
Torque (lb. in.)	@ Continuous Pressure	3150	3550	4500	4800	4800	4800	4800
	@ Peak Pressure	4150	4950	6250	6850	6850	6850	6850
Pressure (△PSI)	Continuous	3300	3200	3150	2650	2250	1750	1400
	Peak	4500	4500	4500	3900	3250	2600	2000
	Peak Back Pressure *	1000						

*For continuous back pressure over 300 PSI use an external case drain. Install case drain lines to provide a 25 to 50 PSI case pressure. Always use external case drain in closed loop circuits.

Maximum inlet pressure 4500 PSI. Do not exceed ... PSI rating above

Maximum return pressure 4500 PSI. Do not exceed ... PSI rating above

Peak conditions assumed to be less than 10% of every minute

Recommended maximum system operating temperature 180° F

Recommended viscosity 100 SUS at operating temperature

Recommended filtration 10 micrometer

For frequent peak pressure conditions or flow and pressures beyond peak ratings consult Minneapolis Division Sales Department.

To assure optimum motor life, run motor for approximately one hour at 30% of rated pressure before application of full load. Be sure motor is properly filled with fluid prior to any load applications.

Performance Data

The charts on next two pages show the typical performance characteristics of Char-Lynn 4000 Series Motors. Given the input flow (GPM) and pressure (PSI) of the hydraulic system, the correct motor size can be determined according to the speed and torque required. Conversely, given the torque (lb. in.) and speed (RPM) required, specifications for an adequate hydraulic system can be determined.

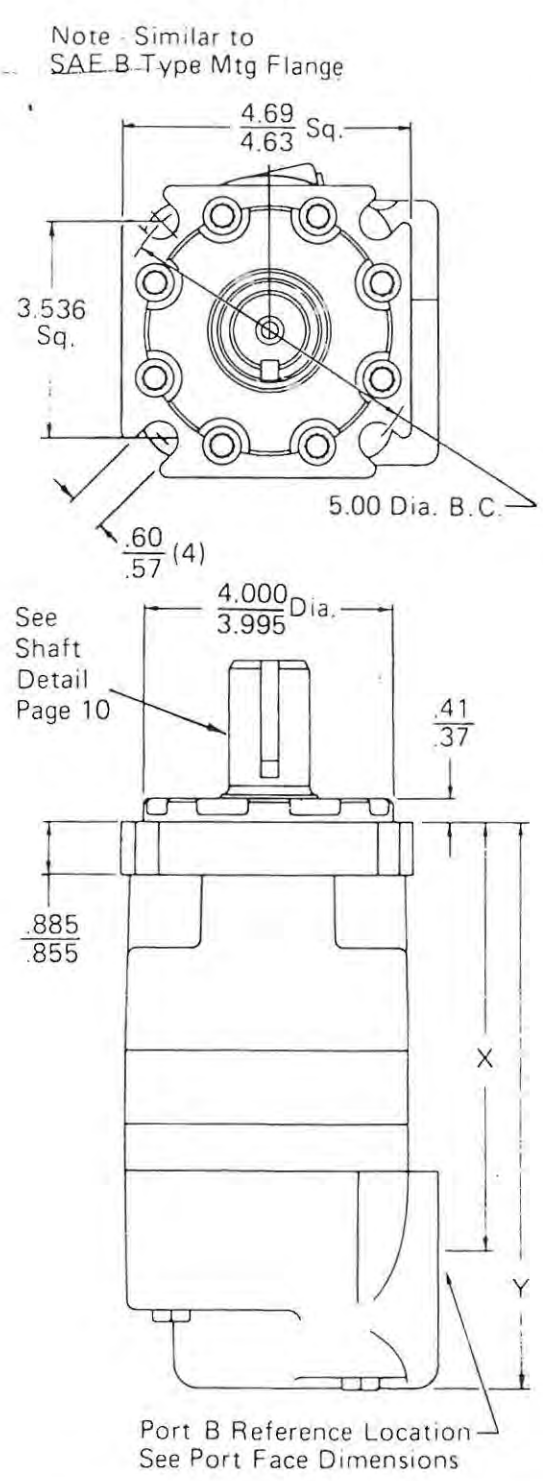
The shaded areas on the charts are shown to help you select the motor with the highest efficiency for the requirements of your application.

Areas indicated by ▭ show areas of performance in which the motors operate at greatest efficiency

Areas indicated by ▭ show areas of performance in which the motors operate at high efficiency

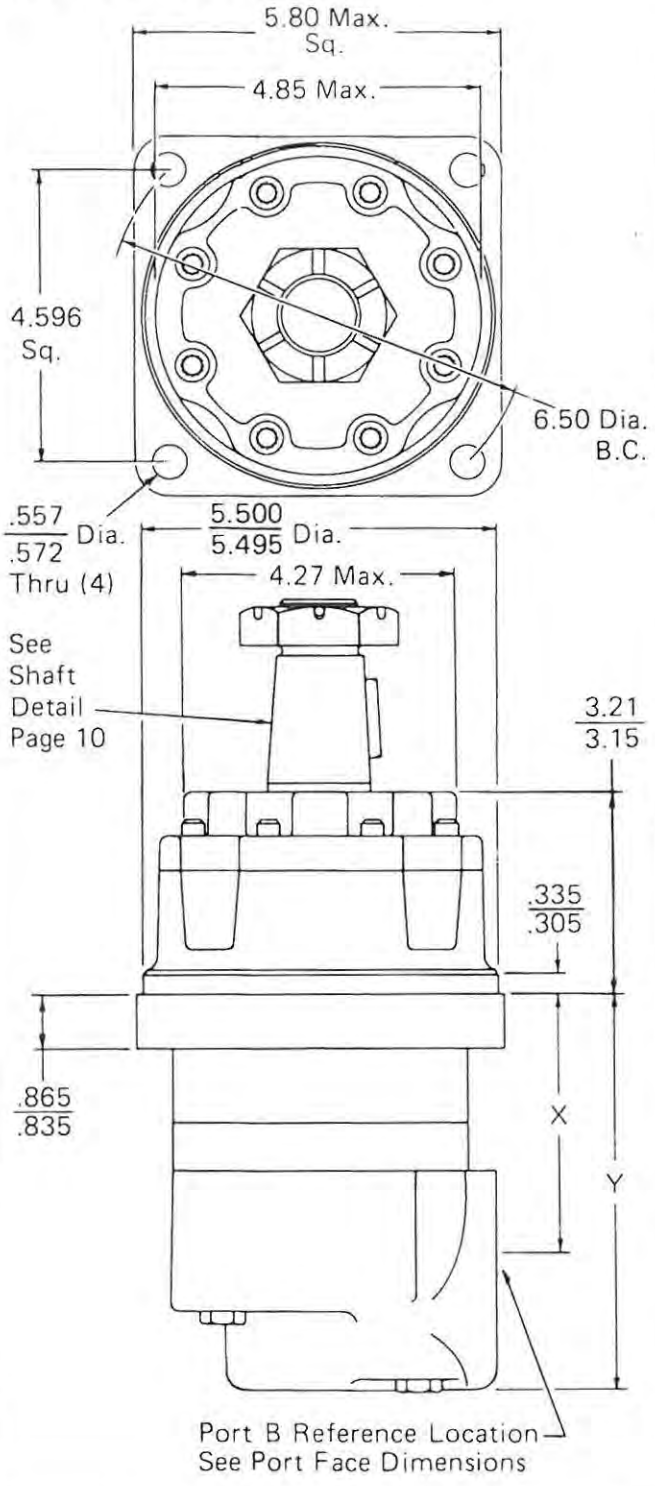
Dimensions and Mounting Data

Standard Motor

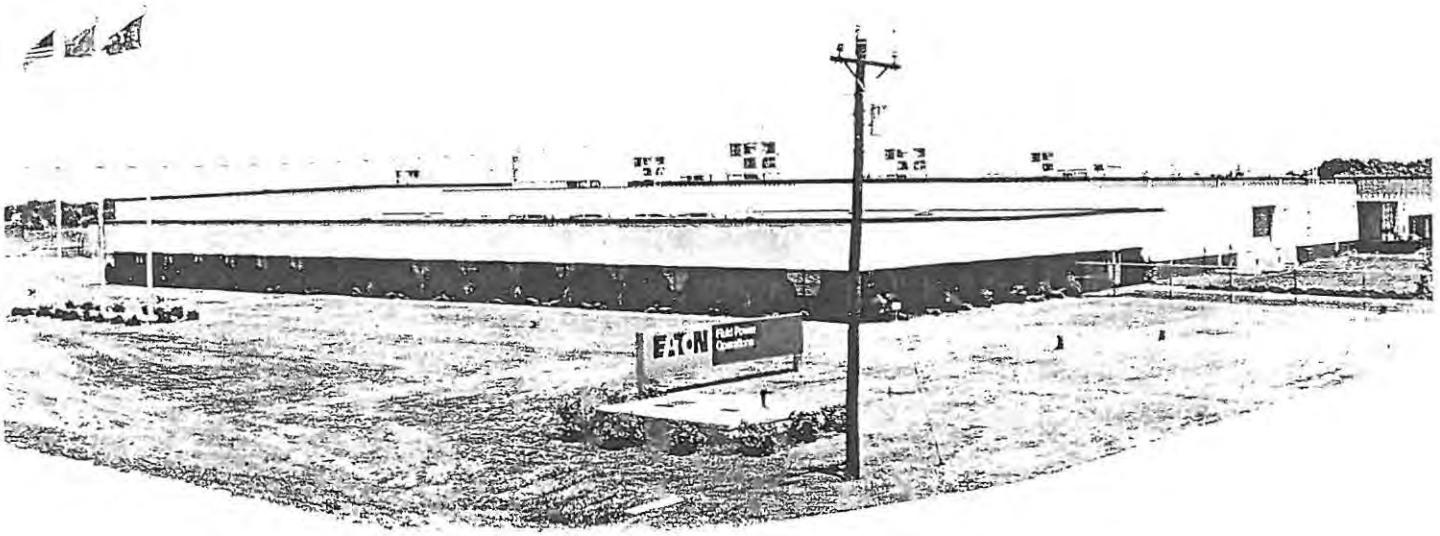


Displacement cu. in./rev.	X	Y max.
6.6	6.27/6.16	8.47
7.9	6.44/6.33	8.64
9.9	6.69/6.58	8.89
12.5	7.03/6.92	9.23
15	6.69/6.58	8.89
19	7.03/6.92	9.23
24	7.45/7.34	9.65

Wheel Motor



Displacement cu. in./rev.	X	Y max.
6.6	3.48/3.38	5.68
7.9	3.65/3.55	5.85
9.9	3.90/3.80	6.09
12.5	4.24/4.14	6.43
15	3.90/3.80	6.09
19	4.24/4.14	6.43
24	4.66/4.56	6.85



Shawnee Plant, Shawnee, Oklahoma — All 2000, 4000, 6000 and 10,000 series motors are manufactured at this plant.

Ordering Information

Type of Motor	Type of Shaft	Displacement (cu. in./rev.)/Product Number						
		6.6	7.9	9.9	12.5	15	19	24
Standard Motor	1¼" Str. Keyed	109-1100	109-1101	109-1102	109-1103	109-1104	109-1105	109-1106
	1⅝" Tapered	109-1107	109-1108	109-1109	109-1110	109-1111	109-1112	109-1113
	1¼" Splined	109-1114	109-1115	109-1116	109-1117	109-1118	109-1119	109-1120
Wheel Motor	1¼" Str. Keyed	110-1074	110-1075	110-1076	110-1077	110-1078	110-1079	110-1080
	1⅝" Tapered	110-1081	110-1082	110-1083	110-1084	110-1085	110-1086	110-1087
	1¼" Splined	110-1088	110-1089	110-1090	110-1091	110-1092	110-1093	110-1094
Bearingless		111-1033	111-1034	111-1035	111-1036	111-1037	111-1038	111-1039

Empire Castings Inc.
Equipment Manual

Model# EC02-A
Serial# AAPM01

Volumne 3, Section 10: Machine Safeguards

1: Replacement Parts

Item#	Part#/Description	Mfg.
001	OTBA5 OPTO SWITCH OPERATOR TWO HAND	BANNER
002	42GRU-9002 I/R EYE *FURNACE TRAVERSE *RETRIEVER PARAMETER *MACHINE PARAMETER	ALLEN-BRADLEY
003	802PR-LABB2 PROX SW. *MOVING PLATEN SAFETY	ALLEN-BRADLEY
004	9733AA2XMA7TL PROX SW *RETRIEVER SET *MOLD OPEN CYL SET	MICRO SWITCH
005	802T-NPTP LIMIT SWITCH *FURNACE RAISE/LOWER *FURNACE TRAVERSE	ALLEN-BRADLEY
006	RAM SAFETY MECHANISM ASSEMBLY DRAWING.	

CAUTION: DO NOT OPERATE MACHINERY IF ANY OF THE ABOVE SWITCHES IS NOT FUNCTIONING PROPERLY

ROUTINE MAINTENANCE:

*INSPECT ALL SWITCHES AND I/R EYES EACH SHIFT FOR PROPER FUNCTION.

*CLEAN RAM SAFETY MECHANISM WEEKLY

OPTO-TOUCH OTB and LTB Series

Ergonomically-designed photoelectric touch switches that require absolutely no physical pressure to operate!

- **Ergonomically-designed photoelectric switches; a superior substitute or replacement for mechanical push buttons**
- **Eliminate hand, wrist, and arm stresses associated with repeated mechanical switch operation: *no physical pressure is required***
- **Greatly reduce risk of Carpal Tunnel Syndrome (CTS), resulting in increased productivity and comfort**
- **OTB and LTB models for 120 or 240V ac and OTB models for 20-30V ac/dc have SPDT e/m output relay (7 amps max., UL/CSA)**
- **OTB models for 10-30V dc have complementary sinking or sourcing outputs, and switch up to 150 mA dc (continuous)**
- **High excess gain circuitry cuts through heavy contamination**
- **Totally immune to ambient light interference, and highly immune even to simultaneous interference sources of EMI and RFI**
- **Integral cable or optional QD (Quick Disconnect) cable fitting**



"QD" model OPTO-TOUCH (OTC Series Field Cover is included).

OPTO-TOUCH OTBs and LTBs are two families of touch-activated optoelectronic switches that have uses in a wide variety of applications. Because OTBs and LTBs require absolutely no physical pressure to operate, they are especially ideal for reducing arm and wrist stresses (such as **carpal tunnel syndrome**, or CTS) in applications that require repeated operator switching motions. **OTB Series models are momentary action initiators. LTB Series models are alternate action switches.** See below for separate descriptions. All models feature an attractive, rugged, ergonomically designed housing and are highly resistant to EMI, RFI, and ambient light interference. Also, their totally-sealed, non-metallic housings make them attractive for use in wet environments, where metal switches would be unsuitable.

Both OTBs and LTBs are designed for reliable service in industrial environments. Housings are of black polysulfone (or red Lexan® for some OTB models) and VALOX®, and are completely non-metallic and fully sealed. Indicator LEDs light for "power on" and "output activated". Models come with either attached 6-foot cable or an integral QD (Quick Disconnect) fitting. QD models require 12-foot long mini-type cables. OTBs and LTBs have a threaded base with M30 x 1.5 external threads and 1/2" NPSM internal threads, which fits most standard automotive-size "jumbo" switch plates and oiltight push button holes. See also model SMB30S bracket, page 354. OPTO-TOUCH OTBs and LTBs are rated NEMA 1, 3, 4, 4X, 12, and 13; IEC IP66. **QD information, dimensions, and mounting information appears on page 354.**

***OTB Series** optical touch buttons are momentary action initiators* that are designed to replace capacitive touch switches and mechanical push buttons. The output of Banner OTB Series optical touch buttons goes "on" whenever an operator's finger (introduced into the touch area of the switch) interrupts the OTB's infrared sensing beam, and stays "on" only for as long as the operator's finger remains in the touch area. OTB Series optical touch buttons are ideal replacements for mechanical push buttons on many types of production machinery.

OTBs are available in models to operate from 105 to 130V ac, 210 to 250V ac, 10 to 30V dc, or 20 to 30V ac/dc. AC and ac/dc OTBs have an SPDT electromechanical output relay capable of switching resistive loads of up to 7 amps. DC OTBs are supplied with either complementary NPN sinking or complementary PNP sourcing outputs, and switch up to 150 mA dc maximum. LED indicators light for "power on" and "output activated".

Specifications and further information for the OTB Series is given on page 352.

***LTB Series** optical touch buttons are alternate action switches* that replace mechanical on/off push buttons and toggle switches. The output of Banner LTB Series optical touch buttons changes state (alternating between "on" and "off") whenever a finger, introduced into the touch area of the switch, interrupts the LTB's infrared sensing beam. This alternate action output makes LTBs especially suitable for room lighting applications.

LTBs are available in models which operate from either 105 to 130V ac or 210 to 250V ac. All models have an SPDT electromechanical output relay capable of switching resistive loads of up to 7 amps (800 watts maximum). LED indicators light for "power on" and "output activated".

Specifications and further information for the LTB Series is given on page 353.

See page 355 for a model summary and ordering information.

OTB Series *Momentary Action* OPTO-TOUCH

Specifications, OTB Series

Supply Voltage: Models for 105 to 130V ac, 210 to 250V ac (50/60 Hz), 10 to 30V dc, or 20 to 30V ac/dc (at 25 mA, exclusive of load). See below.

Output Configuration

AC and ac/dc models: all models SPDT electromechanical relay (one N.O. contact, one N.C. contact).

DC models: OTBVN6 models have complementary NPN sinking outputs; OTBVP6 models have complementary PNP sourcing outputs.

Output Rating

AC and ac/dc models: *Maximum voltage* is 250V ac or 30V dc. *Maximum current* is 7 amps (resistive load), 1 HP max. *Minimum load* is .05 watts (dc), .05VA (ac). *Mechanical life of relay* is 50,000,000 operations (minimum). *Electrical life of relay* is 100,000 operations (minimum) at full resistive load. *Transient suppression is recommended when switching inductive loads.*

DC models: 150 mA maximum load (each output).

On-state saturation voltage <1 volt at signal levels and <1.5 volts at full load. *Off-state leakage current* <1 microamp. Short-circuit protection.

Ambient Light Immunity: 120,000 lux (direct sunlight).

EMI/RFI Immunity: The OPTO-TOUCH is highly resistant to both single and mixed EMI and RFI noise sources.

Operating Temperature Range: -20 to +50°C (-4 to +122°F).

Indicator LEDs: two indicator LEDs. One lights whenever power is "on"; the other lights whenever the output relay is activated.

Construction: Black polysulfone (or Lexan®) and fiber-reinfo VALOX® housing. Electronics fully epoxy-encapsulated. Totally sea non-metallic enclosure. The OTB's threaded base has M30 x 1,5 exte threads and 1/2" NPSM internal threads. Base requires a 1-3/16" diam mounting hole (fits most standard automotive-size "jumbo" legend pl and oiltight pushbutton holes). OPTO-TOUCH OTBs are rated NE 1, 3, 4, 4X, 12, and 13; IEC IP66. *See NOTE regarding sealing, bel

Cable: *DC Quick-disconnect (QD) models* require model MBCC- 4-conductor cable; *AC Quick-disconnect (QD) models* require MB 512 5-conductor cable (both purchased separately). QD cables are 12 long. *Models with attached cable* (non-QD models) are supplied wi feet of PVC-jacketed, 22 AWG 4- or 5-conductor cable.

Environmental Considerations (models with polysulfone housi *Prolonged exposure of the OPTO-TOUCH to direct outdoor sunlight* cause embrittlement of the polysulfone housing. Window glass ef tively filters longer wavelength ultraviolet and provides excellent pro tion from sunlight. Contact the factory Application Engineering Dep ment regarding outdoor applications.

Environmental Considerations (models with Lexan® housing): *Prolonged exposure of the OPTO-TOUCH to **hot water and moist h** **temperature environments*** above 150°F (66°C) should be avoi ***Aromatic hydrocarbons*** (such as xylene and toluene), ***halogen hydrocarbons,*** and ***strong alkalis*** should be avoided. Clean periodic using mild soap solution and a soft cloth. *Avoid strong alkaline mater*

VALOX® is a registered trademark of General Electric Company.

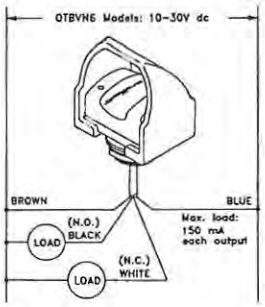
***NOTE** **regarding sealing of mounting hole:** OTB and LTB housings do not form a liquid-tight seal against the mountin surface when the field cover is installed. If a liquid-tight seal of the mounting hole is required, contact the factory Applicatio Engineering Department for information.

Hookup Information: 10-30V DC models

OTBVN6 and OTBVN6QD: complementary sinking outputs

(+) (-)

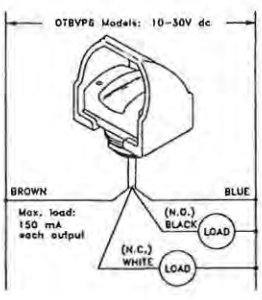
Model OTBVN6QD requires MBCC-412 cable (purchase separately).



OTBVP6 and OTBVP6QD: complementary sourcing outputs

(+) (-)

Model OTBVP6QD requires MBCC-412 cable (purchase separately).



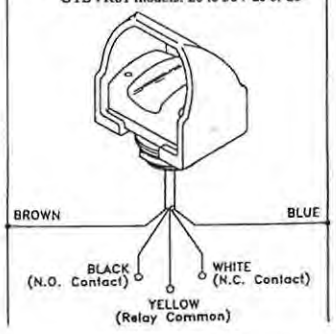
Hookup Information: AC and AC/DC models

Models (include letter "L" to specify Lexan® housing)

OTBA5(L)	120V ac, SPDT electromechanical relay output, 6-foot attached cable
OTBA5(L)QD	120V ac, SPDT electromechanical relay output, QD base (use MBCC-512 cable)
OTBB5(L)	220/240V ac, SPDT electromechanical rela output, 6-foot attached cable
OTBB5(L)QD	220/240V ac, SPDT electromechanical rela output, QD base (use MBCC-512 cable)
OTBVR81(L)	20-30V ac or dc, SPDT electromechanical relay output, 6-foot attached cable
OTBVR81(L)QD	20-30V ac or dc, SPDT electromechanical relay output, QD base (use MBCC-512 cabl

OTBA5 models: 105 to 130Vac
OTBB5 models: 210 to 250V ac
OTBVR81 models: 20 to 30V ac or dc*

*dc power is applied without regard to polarity



LTB Series *Alternate Action* OPTO-TOUCH

Specifications, LTB Series

Supply Voltage: 105 to 130V ac or 210-250V ac (50/60 Hz), depending on model. See listing of available models, below.

Output Configuration: SPDT electromechanical relay (one N.O. contact, one N.C. contact).

Output Rating: *Maximum voltage* is 250V ac or 30V dc. *Maximum current* is 7 amps (resistive load), 800 watts max. *Minimum load* is .05 watts (dc), .05VA (ac). *Mechanical life of relay* is 50,000,000 operations (minimum). *Electrical life of relay* is 100,000 operations (minimum) at full resistive load. *Transient suppression is recommended when switching inductive loads.*

Ambient Light Immunity: 120,000 lux (direct sunlight).

EMI/RFI Immunity: The OPTO-TOUCH is highly resistant to both single and mixed EMI and RFI noise sources.

Operating Temperature Range: -20 to +50°C (-4 to +122°F).

Indicator LEDs: two indicator LEDs. One lights whenever power is "on"; the other lights whenever the output relay is activated.

VALOX® and Lexan® are registered trademarks of General Electric Company.

Construction: Black polysulfone (or red Lexan®) and fiber-reinforced VALOX® housing. Electronics fully epoxy-encapsulated. Totally sealed, non-metallic enclosure. The LTB's threaded base has M30 x 1,5 external threads and 1/2" NPSM internal threads. Base requires a 1-3/16" diameter mounting hole (fits most standard automotive-size "jumbo" legend plates and oiltight pushbutton holes). OPTO-TOUCH LTBs are rated NEMA 1, 3, 4, 4X, 12, and 13; IEC IP66. *See NOTE regarding sealing, page 352.

Cable: *Quick-disconnect (QD) models* require model MBCC-512 cable (purchased separately). MBCC-512 cables are 5-conductor, 12 feet long. *Models with attached cable* (non-QD models) are supplied with 6 feet of PVC-jacketed, 22 AWG 5-conductor cable.

Environmental Considerations:
Prolonged exposure of the OPTO-TOUCH to direct outdoor sunlight will cause embrittlement of polysulfone housings. Window glass effectively filters longer wavelength ultraviolet and provides excellent protection from sunlight.

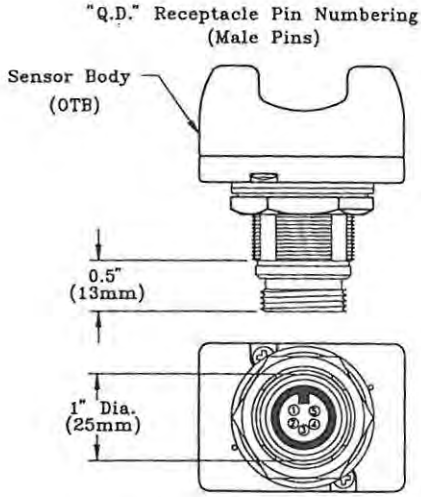
Contact the factory Applications Engineering Department regarding outdoor applications. See page 352 for Lexan® housing considerations.

WARNING... Banner OPTO-TOUCH™ OTB and LTB Series Optical Touch Buttons are intended as general-purpose switches, and are *not* safety devices. Like most solid-state devices, they are equally as likely to fail in the conducting ("on") state as in the non-conducting ("off") state. If OPTO-TOUCH Optical Touch Buttons are used to initiate machines or operations in which false operation of an Optical Touch Button could be dangerous, *point-of-operation guarding devices* or related safety controls must be installed and maintained to meet all appropriate OSHA regulations and ANSI B11 machine safety standards. Never use an OPTO-TOUCH Optical Touch Button as an actuator in an emergency (E-Stop) circuit.

Hookup Information

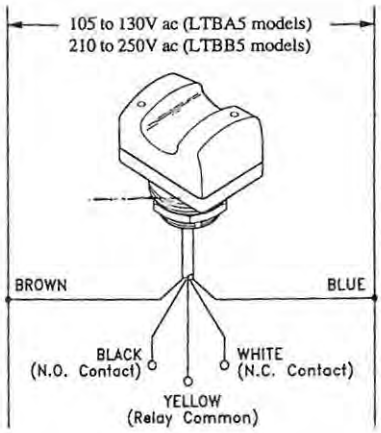
Quick Disconnect (QD) Option

OPTO-TOUCH base, side and end views: five-pin base for all LTBs and ac OTBs



See page 354 for Quick-disconnect (QD) cable information.

OPTO-TOUCH LTB General Hookup



Available models*

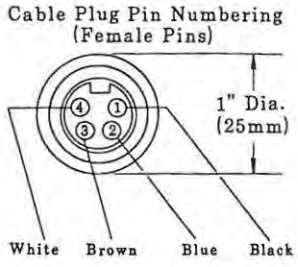
LTBA5(L)	120V ac, SPDT electromechanical relay output, 6-foot attached cable
LTBA5(L)QD	120V ac, SPDT electromechanical relay output, QD-style base (requires MBCC-512 cable)
LTBB5(L)	220/240V ac, SPDT electromechanical relay output, 6-foot attached cable
LTBB5QD(L)	220/240V ac, SPDT electromechanical relay output, QD-style base (requires MBCC-512 cable)

Add letter "L" to model suffix for Lexan® upper housing.

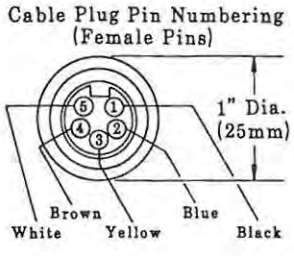
OTB & LTB Series OPTO-TOUCH

Quick Disconnect (QD) Option (order model MBCC-412 or MBCC-512 mini-style cable, see pages 352 and 353)

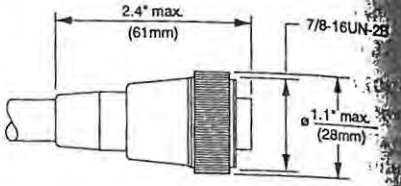
Cable connector, end view, MBCC-412 cable (p/n 25226, for dc models)



Cable connector, end view, MBCC-512 cable (p/n 25496, for ac models)

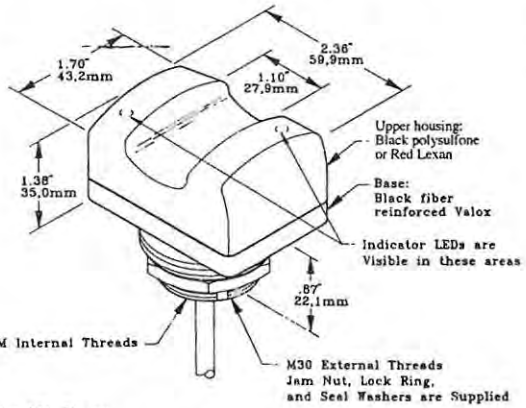


Cable connector, side view (MBCC-412 and MBCC-512 cable)



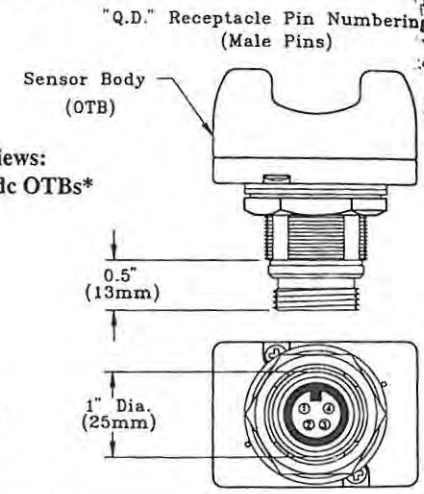
MBCC-412 cable: p/n 25226
MBCC-512 cable: p/n 25496

Dimensions (see also QD models, page 353)



Indicator LED States:
LED 1 turns ON when the unit is powered up
LED 2 follows the action of the output

OPTO-TOUCH base



Side and end views:
4-pin base for dc OTBs*

*for drawing of 5-pin base, see page 353

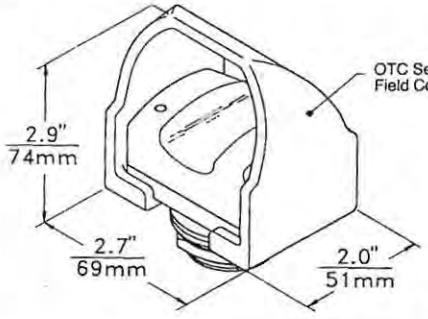
OPTO-TOUCH Field Covers

OPTO-TOUCH Field Covers are designed to prevent inadvertent activation of OPTO-TOUCHs due to objects (loose clothing, debris, etc.) which might accidentally block their sensing beam.

Field covers are constructed of rugged polycarbonate-PET polyester blend, which is capable of absorbing high impacts (even at low temperatures). This material is highly resistant to abrasion and to damage by most chemicals.

Field covers are available in four colors, which can be used to differentiate touch button functions when several are in use.

Model	P/N	Color	Model	P/N	Color
OTC-1-BK	30221	black	OTC-1-RD	30977	red
OTC-1-GN	30979	green	OTC-1-YW	30978	yellow



An OTC Series Field Cover is supplied with every OPTO-TOUCH. See ordering information, next page.

SMB30S Swivel Bracket

The model SMB30S swivel-mount bracket is a versatile means for mounting a Banner OPTO-TOUCH Optical Touch Button. The SMB30S lets you *ergonomically position* the OPTO-TOUCH on most machinery for maximum operator comfort and convenience.

The SMB30S mounts either by its base or flush with a panel. Its swivel ball locks snugly in place when its two clamping bolts are tightened.

Bracket material is black VALOX®. Hardware is stainless steel, and mounting bolts are included.



The photo shows the model SMB30S swivel bracket with an OPTO-TOUCH attached.

OTB & LTB Series OPTO-TOUCH

How to Order

OPTO-TOUCH Optical Touch Buttons are shipped with a black field cover, as standard. A black field cover will be received if the OPTO-TOUCH is ordered by its model number (only). A red, yellow, or green field cover may be specified instead by ordering the OPTO-TOUCH using the appropriate 5-digit part number from the table, below. Field covers may also be ordered separately (page 354).

OPTO-TOUCH Optical Touch Buttons

Part Numbers

OTB models = momentary action

LTB models = alternate action

120V ac	220/240V ac	20-30V ac or dc	10-30V dc	SPDT relay	NPN (sinking)	PNP (sourcing)	Attached 6-foot cable	Quick disconnect	Polysulfone upper housing	Lexan® upper housing	Model	Black Cover	Red Cover	Yellow Cover	Green Cover
●				●			●		●		OTBA5	27986	35058	35078	35098
	●			●			●		●		OTBB5	27987	35062	35082	35102
		●		●			●		●		OTBVR81	33080	35066	35086	35106
			●		●		●		●		OTBVN6	28591	35070	35090	35110
			●			●	●		●		OTBVP6	28589	35074	35094	35114
●				●				●	●		OTBA5QD	28149	35059	35079	35099
	●			●				●	●		OTBB5QD	28150	35063	35083	35103
		●		●				●	●		OTBVR81QD	34078	35067	35087	35107
			●		●			●	●		OTBVN6QD	28585	35071	35091	35111
			●			●		●	●		OTBVP6QD	28590	35075	35095	35115
●				●			●			●	OTBA5L	32167	35060	35080	35100
	●			●			●			●	OTBB5L	32254	35064	35084	35104
		●		●			●			●	OTBVR81L	34040	35068	35088	35108
			●		●		●			●	OTBVN6L	33706	35072	35092	35112
			●			●	●			●	OTBVP6L	34110	35076	35096	35116
●				●				●		●	OTBA5LQD	32255	35061	35081	35101
	●			●				●		●	OTBB5LQD	32256	35065	35085	35105
		●		●				●		●	OTBVR81LQD	34041	35069	35089	35109
			●		●			●		●	OTBVN6LQD	35057	35073	35093	35113
			●			●		●		●	OTBVP6LQD	34997	35077	35097	35117
●				●			●		●		LTBA5	28455	35119	35127	35135
	●			●			●		●		LTBB5	28457	35123	35131	35139
●				●				●	●		LTBA5QD	28456	35120	35128	35136
	●			●				●	●		LTBB5QD	28458	35124	35132	35140
●				●			●			●	LTBA5L	34950	35121	35129	35137
	●			●			●			●	LTBB5L	34951	35125	35133	35141
●				●				●		●	LTBA5LQD	35010	35122	35130	35138
	●			●				●		●	LTBB5LQD	35118	35126	35134	35142



Description

Series 9000 Photoelectric sensors are designed to perform in many harsh environments. Well-sealed, with critical components epoxied in a high-impact, chemically resistant Valox® housing, Series 9000 sensors are designed to withstand temperatures up to 158°F (70°C). The ability to withstand 1200 psi (8270kPa) high pressure, high temperature washdowns makes the Series 9000 ideal for use in tough sensing applications found in packaging, food processing, beverage, and material-handling industries. The sensor will continue to sense objects in many harsh environments with minimum maintenance thanks to the extended sensing ranges that have been built into the line. Extended sensing ranges can provide the additional excess gain needed to minimize lens cleaning and realignment.

These sensors are available in several models that operate with supply voltages from 10V DC (20V AC) to 264V AC/DC, 50/60Hz and are supplied with 6.5ft (2m) cables or quick-disconnect micro- or mini-style connectors.

DC models are available with NPN and PNP outputs. AC/DC models have a solid state isolated normally open output or SPDT electro-mechanical relay outputs.

Polarized Retroreflective models are true polarized sensors, not just anti-glare. Polarized sensors are designed to reject false signals from most shiny materials, including mirror surfaces, and are generally used in those applications where shiny objects such as cans, or objects covered with shrink or stretch wrap, are being detected. Polarized Retroreflective sensors eliminate false pulses from first surface reflections only.

The Series 9000 has highly visible LED indicators that speed alignment. After installation, these easy-to-see diagnostic indicators will keep you informed of the sensor's status.

On/Off sensors offer fast response times—2ms for NPN and PNP DC outputs or isolated Solid State AC outputs.

Timing sensors have built-in selectable timing functions that include On and/or Off Delay, One Shot, and Delayed One Shot. For more details on these sensors, see page 1–178.

Standard Diagnostic sensors have an output that signals that a sensor may be operating in an unstable application (an operating margin between 1.5 and 0.7). For more details on these sensors, see page 1–197.

Heartbeat™ Diagnostic sensors can also warn of an unstable condition. These sensors provide a "heartbeat" signal that eliminates the extra wire normally required to provide a diagnostic signal. The absence of the heartbeat can warn of a problem with the sensor, application, or wiring. For more details on these sensors, see page 1–209.

DeviceNet™ Compatible sensors can be directly connected to the industry-standard open network for industrial devices. These sensors also provide a diagnostic output which signals the host when the operating margin drops below 2.5, but remains above 1. For more details on these sensors, see page 1–217.

Features

- Compact size
- Fast response time
- Switch selectable light or dark operation
- Sensitivity adjustment with single turn potentiometer
- False pulse protection (all models)
- Reverse polarity protection (DC models)
- Short circuit protection (Solid State models)
- Overload protection (DC Solid State models)
- Synchronous detection minimizes effects of ambient light and electrical noise
- High visibility LED alignment and diagnostic indicators
- Designed to perform in most harsh environments

General Specifications

Power Consumption	On/Off, Timing and Heartbeat™ Series: 4 VA max. Diagnostic and DeviceNet™ Network Compatible Series: 2 VA max.
Relative Humidity	5% to 95%
Ambient Temperature	On/Off, timing: -29°F to +158°F (-34°C to + 70°C) Diagnostic and Heartbeat™ Series: +32°F to +158°F (0°C to + 70°C) DeviceNet™ Series: -13°F to +158°F (-25°C to +70°C) Cables: See "Quick-Disconnect Cables" section for cable temperature range.
Lens Material	Acrylic
Approvals	UL listed and CSA certified
Operating Environment	NEMA 3, 4X, 6P, 12, 13 and IP67 (IEC529) Housing rated to 1200 PSI (8270kPa) washdown

1

General Information

Catalog Number Key ..... page 1–17
Typical Wiring Diagrams ..... page 1–17
Dimensions ..... page 1–17

Sensing Modes

On/Off and Timing

Operation ..... page 1–17
Retroreflective ..... page 1–18
Polarized Retroflective ..... page 1–18
Standard Diffuse ..... page 1–18
Long Range Diffuse ..... page 1–18
Transmitted Beam ..... page 1–18
Long Range Transmitted Beam ..... page 1–19
Visible Red Fiber Optic ..... page 1–19
Infrared Fiber Optic ..... page 1–19

Standard Diagnostic

Operation ..... page 1–19
Retroreflective ..... page 1–20
Polarized Retroflective ..... page 1–20
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Heartbeat™

Operation ..... page 1–20
Retroreflective ..... page 1–21
Polarized Retroflective ..... page 1–21
Standard Diffuse ..... page 1–21
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DeviceNet™

Operation ..... page 1–21
Retroreflective ..... page 1–21
Polarized Retroflective ..... page 1–22
Standard Diffuse ..... page 1–22
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Accessories

Mounting Assemblies ..... page 1–40
Quick-Disconnect Cables ..... page 1–39
Reflectors, Reflective Tape ..... page 1–42

Catalog Number Key❶

$$42G\ \underset{a}{R}\ \underset{b}{U} - \underset{c}{920}\ \underset{d}{0} - \underset{e}{QD}$$

a

Operating Modes	
Code	Description
R	On/Off
T	Timing/Logic
D	Diagnostic
N	DeviceNet™

b

Sensing Modes	
Code	Description
U	Retroreflective
P	Standard Diffuse
F	Fiber Optic
R	Trans. Beam Receiver
L	Trans. Beam Light Source

c

Retroreflective Sensing Mode	
Code	Description
900	Standard Retroreflective
920	Polarized Retroreflective
980	Heartbeat Std. Retro.
990	Heartbeat Polarized Retro.

c

Diffuse Sensing Mode	
Code	Description
900	Standard Diffuse
904	Long Range Diffuse
980	Heartbeat Standard Diffuse
984	Heartbeat Lg. Rge. Diffuse

c

Fiber-Optic Sensing Mode	
Code	Description
900	Infrared
910	Visible

c

Trans. Beam Sensing Mode	
Code	Description
900	Standard Trans. Beam
904	Long Rge. Trans. Beam

d

Supply Voltage/Output Type		
Code	Voltage	Description
6	10-30V DC	PNP Heartbeat for use with 1794-IB8S
0	10-40V DC	NPN/PNP Transistor
	10-264V AC/DC 50/60Hz	Trans. Beam Light Source only
1	10-55V DC 20-40V AC 50/60Hz	SPDT Relay
2	70-264V AC/DC 50/60Hz	SPDT Relay
3	45-264V DC 40-264V AC 50/60Hz	Isolated N.O. Power MOSFET
4	90-264V AC 50/60Hz	N.O. SPST Relay
5	90-264V AC 50/60Hz	N.C. SPST Relay

e

DC Connections	
Code	Description
Blank	6.5ft (2m) 300V cable
QD	Micro style QD
QD1	Mini style QD
H	6.5ft (2m) 600V cable

e

AC Connections	
Code	Description
Blank	6.5ft (2m) 300V cable
QD	Mini style QD
QD1	Micro style QD
H	6.5ft (2m) 600V cable

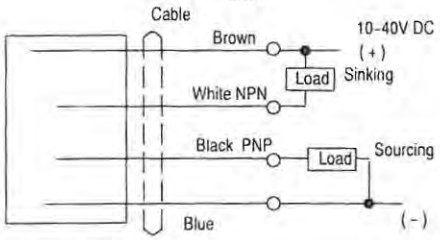
❶ This catalog number key cannot be used to create catalog numbers. Many combinations do not exist. Refer to the Selection Guides to select the available sensors that meet your requirements.

Wiring Diagrams

On/Off and Timing Series (AC and DC)

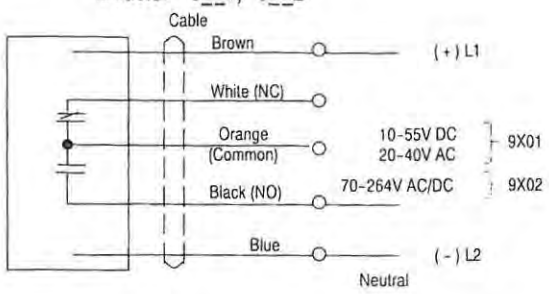
Cable Versions

Model: -9__0



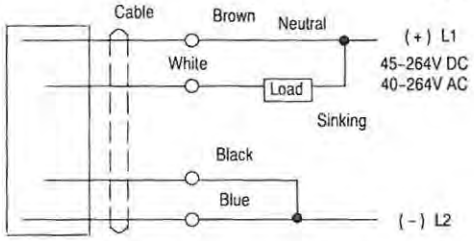
Class 2 Source Required

Models: -9__1, -9__2

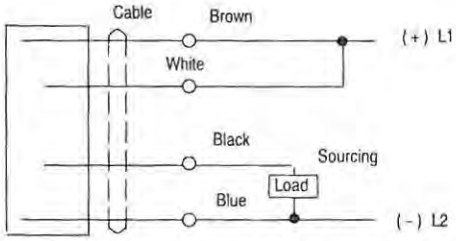


1

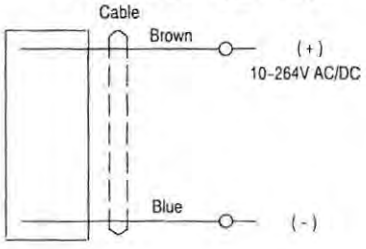
Models: -9__3, -9__3H



Or



Models: 42GRL-90_0, -90_0H



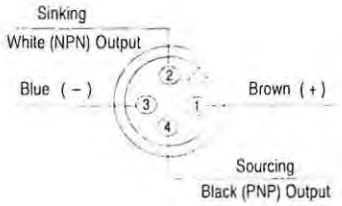
Note: Details regarding connection of Allen-Bradley Series 9000 photoelectric sensors to Allen-Bradley Programmable Controllers can be found Publication 42GR-7.4.

Wiring Diagrams (continued)

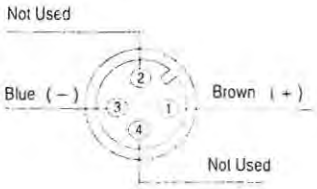
On/Off and Timing Series (AC and DC)

Micro Quick-Disconnect Versions

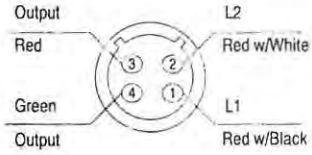
Model: -9__0-QD



Model: 42GRL-90_0-QD



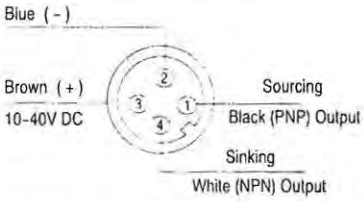
Model: 9__3-QD1



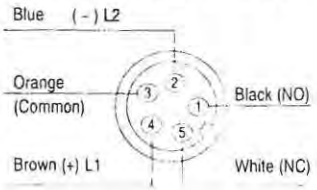
Connect load between red pin and L2

Mini Quick-Disconnect Versions

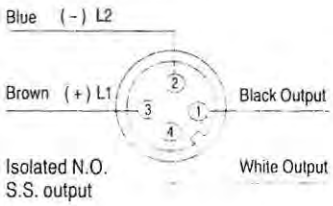
Model: -9__0-QD1



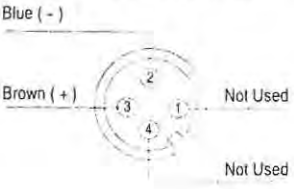
Model: -9__1-QD, -9__2-QD



Model: -9__3-QD



Model: 42GRL-90__-QD



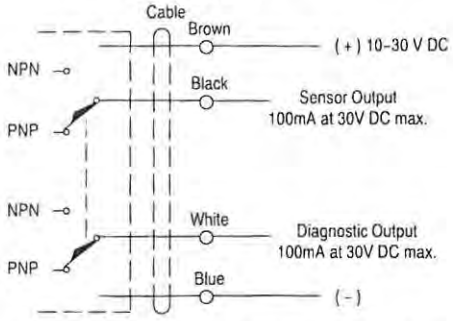
Note: Details regarding connection of Allen-Bradley Series 9000 photoelectric sensors to Allen-Bradley Programmable Controllers can be found in Publication 42GR-7.4.

All wire colors shown refer to Allen-Bradley quick-disconnect cables.

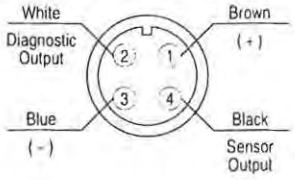
Wiring Diagrams (continued)

Diagnostic Series (DC)

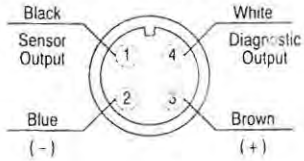
Cable Version



Micro Quick-Disconnect Version (QD)



Mini Quick-Disconnect Version (QD1)

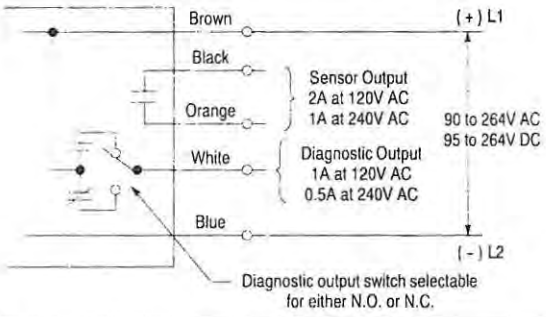


Note: DO NOT connect both an NPN and PNP load at the same time!

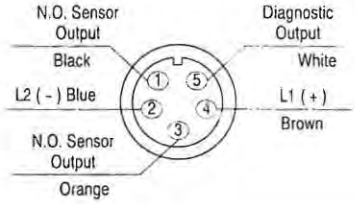
Diagnostic Series (AC)

1

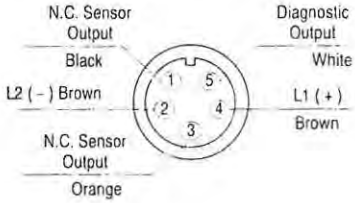
Cable Version



Mini Quick-Disconnect Version (QD) Normally Open

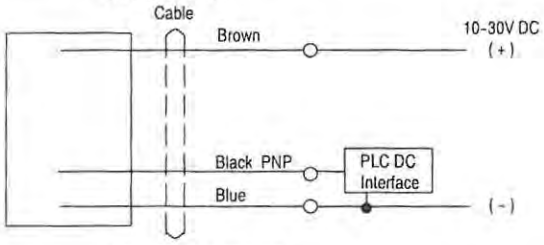


Mini Quick-Disconnect Version (QD) Normally Closed



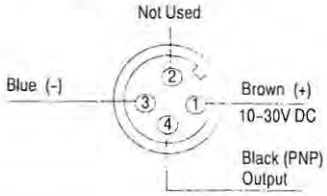
Heartbeat Series (DC)

Cable Version



Class 2 Source Required

Micro Quick-Disconnect Version (QD)

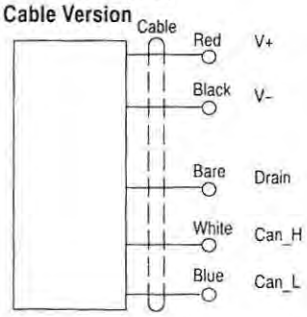


Mini Quick-Disconnect Version (QD1)

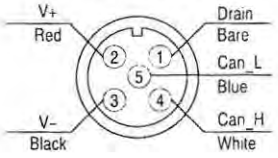


DeviceNet Series (DC)

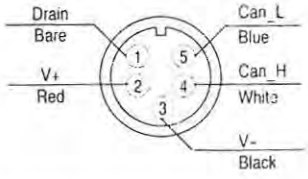
Cable Version



Micro Quick-Disconnect Version (QD)



Mini Quick-Disconnect Version (QD1)



DeviceNet Quick Disconnect cables can be found in the DeviceNet section of this catalog.

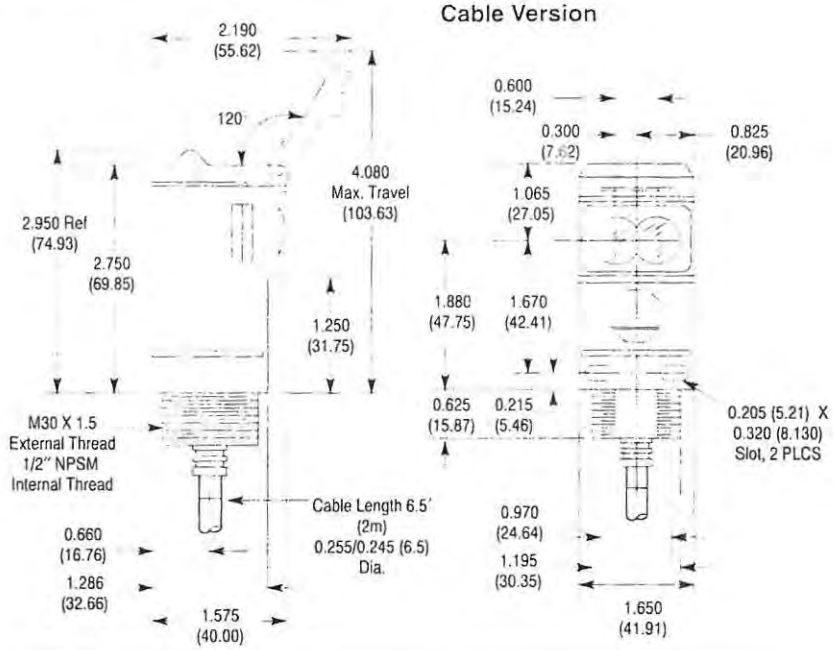
Note: Details regarding hooking up of Allen-Bradley Series 9000 photoelectric sensors to Allen-Bradley programmable controllers can be found i Publication 42GR-7.4.

All wire colors shown refer to Allen-Bradley quick-disconnect cables.

Dimensions—inches (mm)

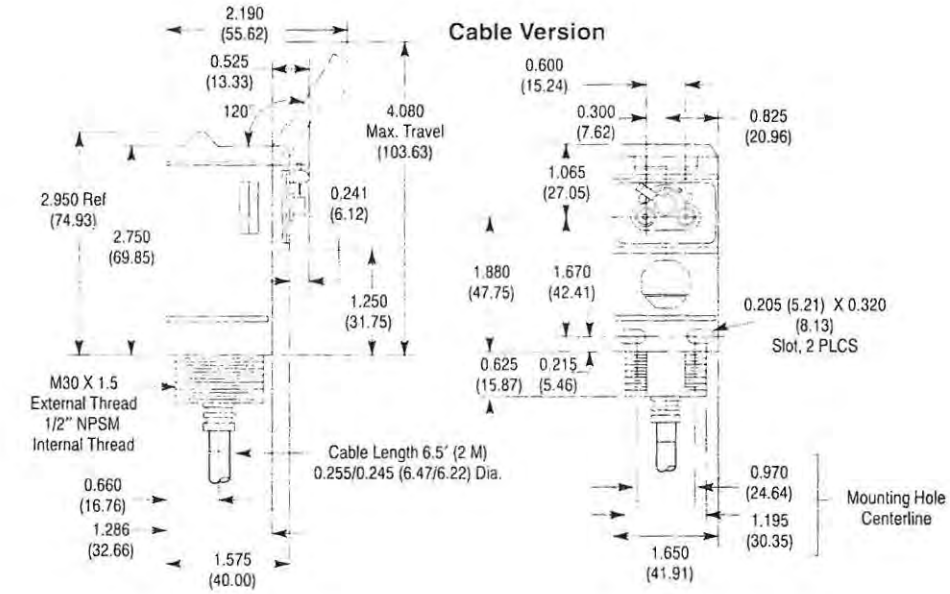
On/Off and Timing, Heartbeat, DeviceNet

Cable Version



Fiber Optic

Cable Version



Connector Version

Micro Style



Mini Style



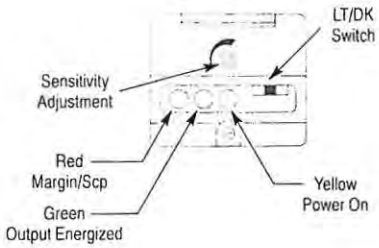
Thread Size

	AC	DC
Micro	1/2-20 UNF 2 Keyways	M12 x 1 1 Keyway
Mini	7/8-16 UN 1 Keyway	

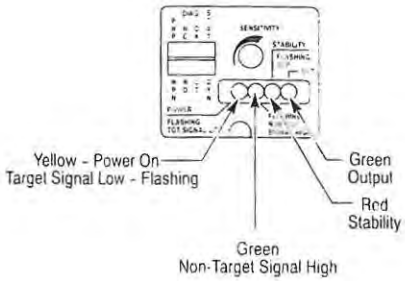
Dimensions—inches (mm) (continued)

On/Off and Timing, Heartbeat, DeviceNet

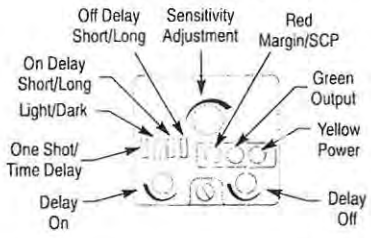
Standard Top View Detail



Diagnostic Top View Detail



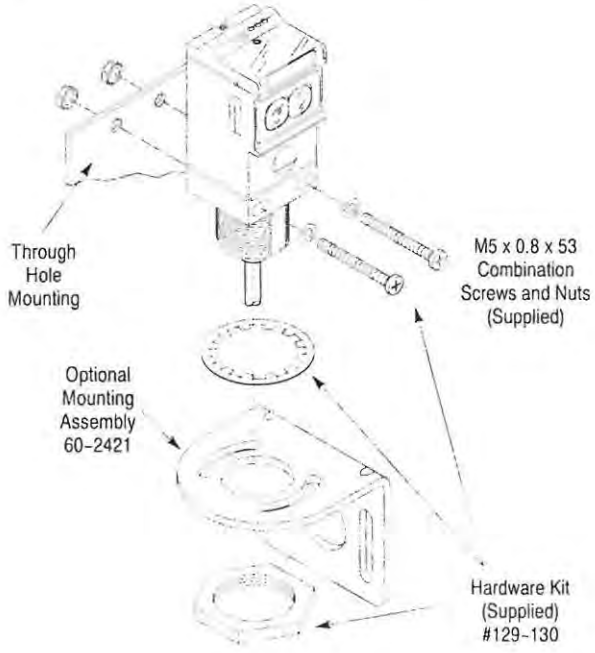
Timing Top View Detail



1

Mounting Kit

Hardware kit #129–130 contains a plastic mounting nut, lock washer, 2 M5 x 0.8 x 53 screws and nuts (supplied with sensor).



INSTALLATION AND OPERATING INSTRUCTIONS
BULLETIN 802–NEUTRAL POSITION PLUG-IN LIMIT SWITCH

WARNING: To avoid electrical shock and/or unintended operation of equipment, disconnect all power to the limit switch and the controlled equipment before proceeding with any repair or adjustment of the limit switch.

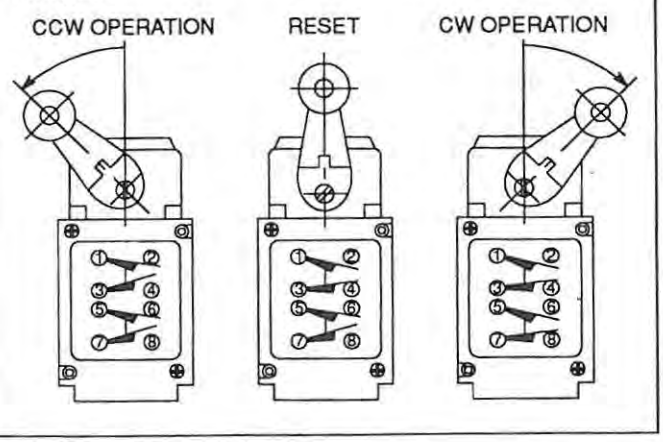
GENERAL

A neutral position limit switch is a device which consists of two separate switching elements contained in a single enclosure. These switching elements are operated in a specific manner with only one of the two being operated at a time.

When the external operator of the device is moved in one direction, one of the switches is operated, the second switch remaining unoperated. Moving the actuator in the opposite direction reverses the switch action; the second switch operates, the first one does not. (See Figure 1 below.)

The operating head and the switch unit used in this style of device are unique and can only be used with one another. Operating heads or switches from other styles of devices cannot be interchanged with these devices.

FIGURE 1



MOUNTING

CAUTION: Position the conduit entering the switch such that any fluid inside the conduit will not drain into the switch enclosure. Apply sealing compound to conduit threads to prevent against entrance of fluids at the joint.

The base may be mounted by either of two methods:

1. Two #10–32 tapped holes are provided for rear mounting.

CAUTION: Make sure the screws used for rear mounting are not so long as to interfere with the screws used to secure the front to the base.

2. Two clearance holes for #10 screws are provided for front mounting.

WIRING

CAUTION: The contacts in each switching element must have the same polarity. The circuit diagram is shown on the nameplate

The pressure type connector terminals in the base will accept #12 AWG and smaller solid or stranded wire. For proper tightening, it is suggested that nothing smaller than #18 AWG be used. Before inserting wire under the pressure plates, strip the insulation approximately 3/8 inch. Tighten all pressure plate terminals whether used or not, to avoid interference with the switch cover.

A grounding screw is located in the terminal base enclosure near the conduit opening. If the grounding screw has a self lifting pressure plate and a wire barrier, the proper installed position of the ground wire is between the pressure plate and the wire barrier in a direction parallel to the edge of the casting. Be sure the ground wire does not interfere with the gasket or with the switch portion of the device.

After wiring has been completed, check that all wires are in the wiring cavity of the terminal block so they will not interfere with the switch when it is plugged into the terminal block. Recheck all wiring terminal screws for tightness.

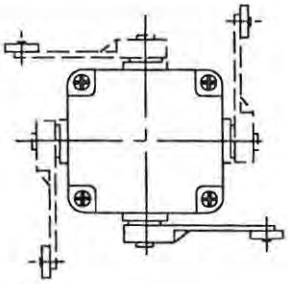
Note: For switches which have been factory wired, check wire color and their position in the terminal block for proper circuit hookup.

When the switch has been plugged into the terminal block, securely tighten the two cover screws to compress the body gasket.

ACTUATOR HEAD POSITIONING

The actuator head may be placed in any of four positions on the switch body. Loosen the four captive screws. Place the head in the desired position and securely retighten the four screws. (See Figure 2 below).

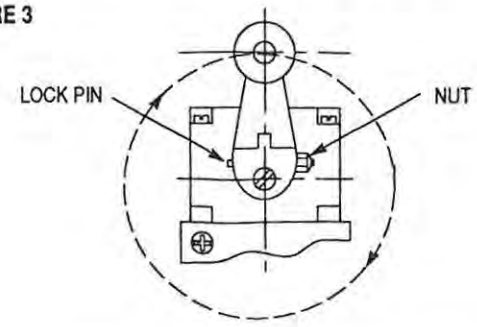
FIGURE 2



LEVER POSITIONING

The lever on rotary actuated devices is adjustable to any position through 360° around the shaft. Loosen the nut, move lever to desired position and securely retighten the nut. (See Figure 3 below).

FIGURE 3



RENEWAL PARTS

If renewal parts or additional lubricant is required, give the bulletin number, catalog number, and series letter found on the nameplate.

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July 1993
Printed in USA

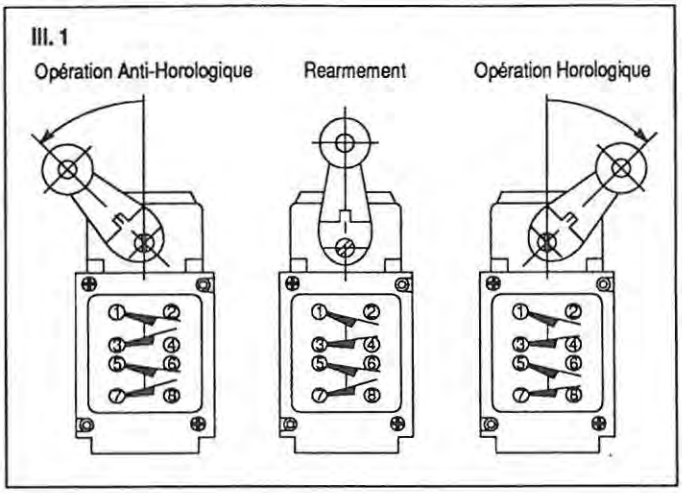
RENSEIGNEMENTS • INSTALLATION ET OPÉRATION — Bulletin 802T — Interrupteurs de position à position neutre enfichables

ATTENTION: Toujours couper toutes sources d'alimentation à l'interrupteur et l'appareil sous commande avant de faire l'entretien ou le réglage sur l'interrupteur. Ceci évitera les chocs électriques ou une opération inattendue de l'appareil sous commande.

Ces interrupteurs se composent de deux interrupteurs dans un boîtier commun. Un mouvement de l'arbre de la tête de commande vers une direction fait fonctionner le premier des interrupteurs; le deuxième interrupteur reste inopérant. Un mouvement de l'arbre en sens inverse fait fonctionner le deuxième interrupteur; le premier reste inopérant.

Les têtes de commande de ce genre d'interrupteur, ainsi que leurs interrupteurs, ne sont pas interchangeables avec tout genre d'interrupteur de position.

Ill. 1



MONTAGE

Le conduit doit être placé de façon à éviter l'entrée des liquides dans l'interrupteur. Sceller aussi les filets du conduit, afin d'éviter l'entrée des liquides.

1. **Montage par l'arrière** – Deux trous filetés à No. 10-32 sont fournis.

À NOTER: Choisir les vis d'une longueur compatible aux vis d'avant, pour éviter l'interférence.

2. **Montage par l'avant** – Deux trous de débourrage (vis No. 10) sont fournis.

CÀBLAGE

ATTENTION: Les contacts de chaque élément interrupteur doivent étre branchés à la même polarité. Voir le schéma des connexions sur la plaque signalétique.

BORNES DE CONNEXION À PRESSION

La gamme des fils à employer est de 18 AWG jusqu'a 12 AWG.

1. Dénuder les fils 3/8"et les insérer sous les plaques à pression.
2. Serrer toutes les vis pour éviter l'interférence avec le couvercle de l'interruptuer.

VIS DE MISE À LA TERRE

La vis de mise à la terre est située dans la base et près du raccordement de conduit. Si la vis est munie d'une plaque de pression à autosoulèvement et d'une barrière, on doit installer le fil de mise à la terre entre la plaque et la barrièr et parallèle avec le côte de la base. S'assurer qu'il n'existe pas de coincement entre le fil et le joint ou l'interrupteur.

INSPECTION

Après que tous les fils sont branchés s'assurer:

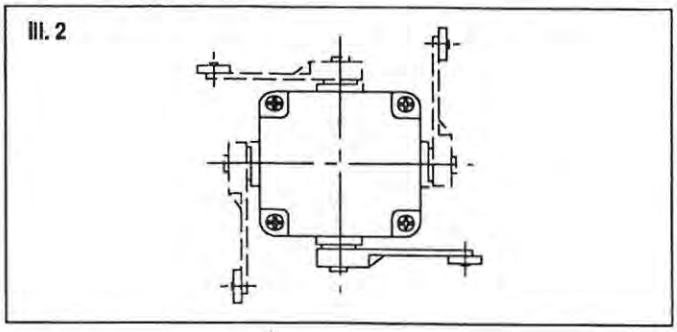
1. Qu'il n'existe pas d'interférence entre les fils et l'interrupteur avant de l'enficher.
2. Que toutes les vis sont bien serrées.
3. Si l'interrupteur est pré–câble à l'usine, que les fils colorés sont branchés correctement.
4. Après que l'interrupteur est enfiché bien serrer les vis du couvercle afin de fournir un bon scellage du joint.

POSITION DE LA TÊTE DE COMMANDE

La tête de commande, poussoir à galet en haut peut être réorientée à 90°:

1. Déserrer les vis.
2. Replacer la tête dans la position requise.
3. Bien serrer les vis, (voir Ill. 2).

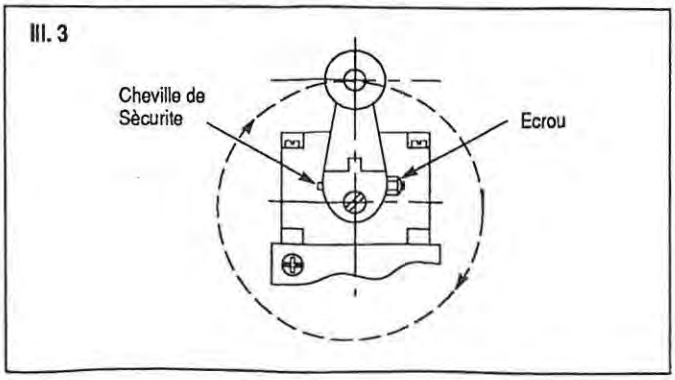
Ill. 2



LEVIERS

Les leviers sont ajustables dans un champ de mouvement de 360°. Déserrer la cheville de sécurité, bouger le levier jusqu' à la position requise er serrer l'écrou, (voir Ill.3).

Ill. 3



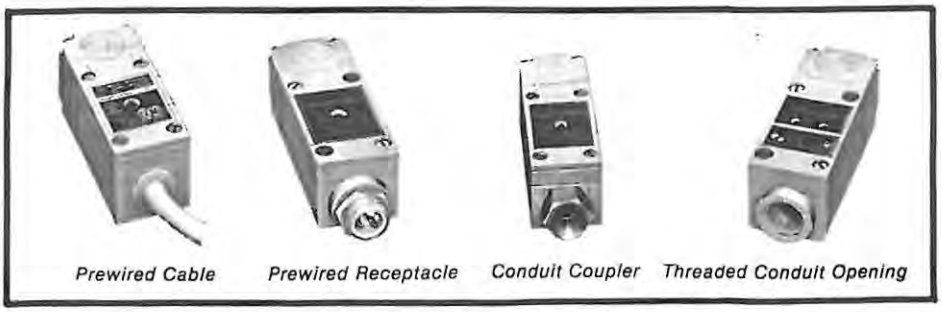
PIÉCES DE RECHANGE OU LUBRIFIANT ADDITIONNEL

Votre commande doit inclure le numéro de catalogue et la lettre de série, imprimée sur la plaque signalétique.

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40146–793–02(A)
July 1993
Imprimé aux. È.U.

INSTALLATION INSTRUCTIONS
Bulletin 802PR • Type LA and Type XA • Series C



IMPORTANT— Save these instructions for future use. For additional information, refer to Publication 802PR-2.1 Product Data.

HAZARDOUS LOCATION SWITCHES — Switches for Hazardous locations meet Division 2: Class I, Groups A, B, C & D; Class II, Groups F & G; and, Class III requirements. For additional information refer to Publication GI-2.8 — A Summary of National Electrical Code Requirements for Hazardous Locations.

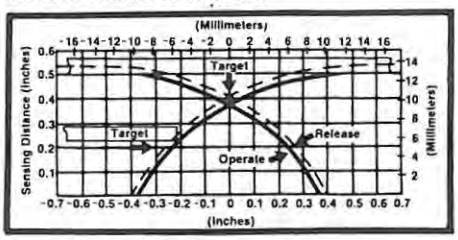


Figure 1. Typical sensing characteristics.

Effects of Target Size and Materials on Sensing Distance—

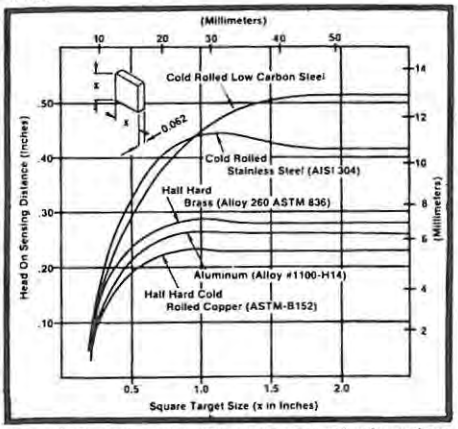


Figure 2. Typical sensing distance vs. target size for various metals.

SPACING BETWEEN SWITCHES— When installing switches side-by-side or face-to-face, the minimum spacings in Figure 3 should be maintained.

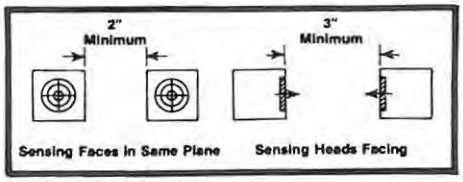


Figure 3. Spacing between switches.

EFFECTS OF NEARBY METAL SURFACES ON SENSING DISTANCES — The sensing distance will increase if the proximity switch is installed so that metal is adjacent to the sensing head surfaces as illustrated in Figure 4.

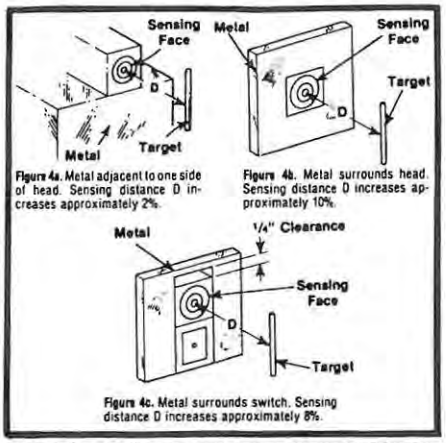


Figure 4a. Metal adjacent to one side of head. Sensing distance D increases approximately 2%.

Figure 4b. Metal surrounds head. Sensing distance D increases approximately 10%.

Figure 4c. Metal surrounds switch. Sensing distance D increases approximately 8%.

Figure 4. Effects of nearby metal surfaces on sensing distances.

WARNING: If a hazardous condition can result from unintended energization of this device, access to the sensing area should be guarded.

WIRING— Connect the proximity switch and load as shown in Figure 5 using AWG #18 through #14 wire (1.0/1.5 mm²). The LED of the switch will be On when the load is energized.

CONNECTION DIAGRAM

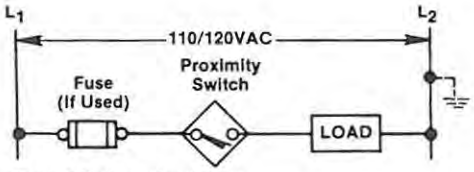


Figure 5. Typical wiring diagram.

NOTE: To guard against the load remaining energized when the switch is in an open condition, the minimum load release current **must** be greater than the maximum leakage current of the proximity switch.

GROUNDING— The Bulletin 802PR does not require a ground connection. The load side of the 110/120V AC source can be grounded as indicated in the connection diagram.

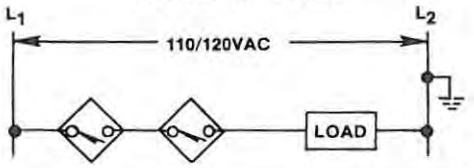
SHORT CIRCUIT PROTECTION — A fuse is recommended in the circuit to provide short circuit protection for the switch. Use a fast acting Type KAW10 or KAX10 fuse.

SERIES CONNECTED SWITCHES—

Normally Open Fixed Output— Do not connect two or more of the switches in series. Erratic operation may result.

Programmable Normally Open/Normally Closed Output — Two switches can be connected in series with a load. For proper operation, the operating load voltage must be less than or equal to the minimum supply voltage less the sum of the on-state voltage drops across the series connected proximity switches. The load will be energized when the OUTPUT LED's of both proximity switches are On.

CONNECTION DIAGRAM



CAUTION: Do NOT connect two or more Bulletin 802PR switches in parallel. Erratic operation may result.

SPECIFICATIONS—

DESCRIPTION	OUTPUT MODE	
	Fixed Normally Open	Programmable Normally Open/Normally Closed
Operating Voltage Range	102V-132V, 50/60 Hz	60V-132V, 50/60 Hz
Load Current Maximum Continuous	1 Ampere to +40°C linearly derated to 0.5 Ampere at +75°C	
Maximum Inrush Minimum	10 Amperes, 1 Second Maximum 0.025 Ampere	
Maximum Leakage Current (Load Off)	0.0065 Ampere	0.0035 Ampere
Maximum Voltage Drop (Load On)	7.5 Volts	
Operating Temperature Range	-25°C to +75°C (-13°F to +167°F)	
Maximum Operate Time Release Time	25 milliseconds 35 milliseconds	25 milliseconds 25 milliseconds
Delay on Power-Up Target Present	200 milliseconds, typical (No output occurs with target absent)	
Sensing Distance	Steel: 0.525" +10% -5%. Refer to Figure 1 Non-Ferrous Metals: 0.25" typical	
Hysteresis (Operate — Release Differential)	0.075" maximum	
Sensing Distance Drift with Temperature	±5% 0°C to +75°C ±10% -25°C to +75°C	±5% +15°C to +50°C ±10% -25°C to +75°C
Maximum Sensing Distance Drift with Voltage	± 0.5% 102V-132V	±1% 90V-132V ±3% 60V-132V
Repeat Accuracy (10 successive operations)	0.001" maximum deviation at constant temperature and supply voltage	
Operating Speed (Operations per minute)	1000	1200 Based on Maximum Operate and Release time

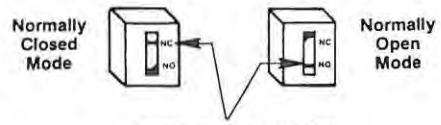
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PROGRAMMABLE OUTPUT SELECTION— The programmable N.O./N.C. proximity switch is factory preset in either the normally open or normally closed output mode.

To change the switch output mode use the following instructions.

1. Remove the lower legend plate on the front of the switch.
2. A line on the recessed rocker indicates the output mode of the switch.
3. To change the output depress the recessed rocker of the switch with a pointed tool.

   Note: Do not use a tool whose point could break and jam the switch.
4. Replace the lower legend plate.



Depress Recessed Rocker Near Indicating Line to Change Output Mode

To return the output mode to its original setting, simply reverse the above procedure. The OUTPUT LED will be ON when the switch output is conducting.

HARD WIRED CONTACTS— When hard wired contacts are connected in parallel with the Bulletin 802PR a surge suppressor MUST BE connected in parallel with the load. Surge suppression is not required when hard wired contacts are connected in series with the load. Recommended surge suppressors for various devices, refer to Publication 802PR-2.1 Product Data.

NOTE: Hard wired contacts that are operating in series or parallel with the Bulletin 802PR Type LA or Type XA will cause a delay of approximately 200 milliseconds. This power-up delay will reduce the maximum number of operations per minute and may result in a momentary de-energization of the load.

CONDUIT COUPLED SWITCHES — Threaded Conduit Opening Bases are suitable for use with flexible conduit. Conduit Coupler Bases are suitable for use with both flexible conduit and rigid conduit. Both bases connect to ½"-14 NPT threaded conduit. Switches with an "S6" suffix in their catalog number are suitable for connection to ISO 20-1.5 threaded conduit.

PREWIRED CABLE SWITCHES — These switches include a prewired cable for connection directly into a junction box. The cable is a two conductor, oil resistant thermoplastic (STO).

PREWIRED RECEPTACLE SWITCHES— These switches include a prewired receptacle suitable for use with the connector-cable assemblies listed in the table below. Figure 6 indicates which two pins of the receptacle are wired internally to terminals 1 and 2. The third pin is not used.

Connector-Cable (Supplied by User)			
Manufacturer	Connector-Cable Part Numbers		
	With 3-Foot Cable	With 6-Foot Cable	With 12-Foot Cable
STANDARD COLOR CODE Green, Black, White			
BRAD HARRISON	40901	40902	40903
JOY	X8984-3	X8984-4	X8984-5
CAM-LOK	E2057-624	E2057-625	E2057-626
AUTOMOTIVE COLOR CODE Green, Red, Red			
BRAD HARRISON	40958	40959	40960
JOY	X8984-13	X8984-14	X8984-15
CAM-LOK	E2057-824	E2057-825	E2057-826

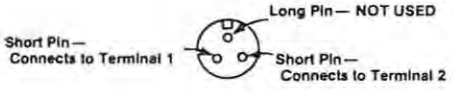


Figure 6. End View of Prewired Receptacle

TROUBLESHOOTING GUIDE— The following guide provides basic troubleshooting information for installation and use of the proximity switch. If a problem occurs, attempt to determine the POSSIBLE CAUSE as listed. Apply the suggested SOLUTION.

NOTE: The switch may continue to operate even if the LED (will not light) is damaged.

Symptom	Output LED Indication [1]		Possible Cause	Solution
	N.O.	N.C.		
LOAD WILL NOT ENERGIZE	OFF	OFF	A. Power supply off.	A. Apply power.
	OFF	ON	B. Incorrect voltage applied.	B. Apply correct voltage.
	OFF	OFF	C. Broken wires or loose connections.	C. Repair wiring or tighten loose connections.
	OFF	ON	D. Improper wiring.	D. Recheck connection diagrams — Rewire accordingly.
	OFF	N/A [2]	E. Target too small or out of the sensing range.	E. Increase target size or move target or switch within sensing range.
	N/A [2]	OFF	F. Target or metal object within sensing range.	F. Remove target or metal object. Refer to EFFECTS OF NEARBY METAL SURFACES.
	OFF	OFF	G. Two or more proximity switches placed too close together.	G. Move Sensing Faces of switches apart. Refer to SPACING BETWEEN SWITCHES.
	ON	ON	H. Load device faulty or incorrect.	H. Replace Load or Size Load Correctly.
LOAD WILL NOT DE-ENERGIZE	ON	N/A [2]	A. Target or metal object within sensing range.	A. Remove target or metal object. Refer to EFFECTS OF NEARBY METAL SURFACES.
	N/A [2]	ON	B. Target too small or out of the sensing range.	B. Increase target size or move target or switch within sensing range.
	ON	ON	C. Two or more proximity switches placed too close together.	C. Move sensing faces of switches apart. Refer to SPACING BETWEEN SWITCHES.
	ON	OFF	D. Improper wiring.	D. Recheck connection diagrams — Rewire accordingly.
	OFF	OFF	E. Load device faulty or incorrect.	E. Replace Load or Size Load Correctly.
LOAD ENERGIZES AND DE-ENERGIZES INTERMITTENTLY	ON & OFF INTERMITTENTLY		A. Broken wires or loose connections.	A. Repair wiring or tighten loose connections.
			B. Target fluctuates in and out of sensing range and hysteresis zone.	B. Stabilize target within the sensing range. Refer to SPECIFICATIONS — Hysteresis.
			C. Two or more proximity switches placed too close together.	C. Move sensing faces of switches apart. Refer to SPACING BETWEEN SWITCHES.

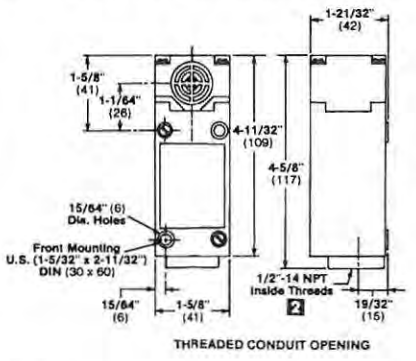
[1] Programmable N.O./N.C. switches have two LED's. The POWER LED will be **ON** when power is applied.

[2] N/A — Not Applicable.

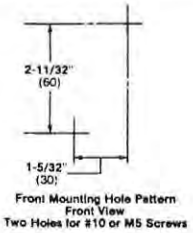
If operation is not resumed, the switch may be inoperative. In that case, replace the switch.

MOUNTING DIMENSIONS

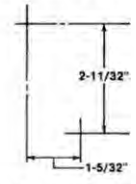
Dimensions shown in parentheses are in millimeters.



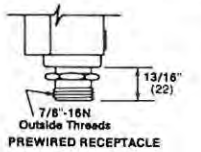
THREADED CONDUIT OPENING



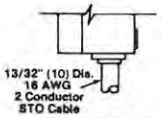
Front Mounting Hole Pattern
Front View
Two Holes for #10 or M5 Screws



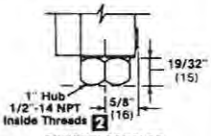
[1] Rear Mounting Hole Pattern
Front View
Two #10-32 Tapped Holes
3/8" (9.5) Deep



PREWIRED RECEPTACLE



PREWIRED CABLE



CONDUIT COUPLER

[1] Type LA only.

[2] Also available with ISO 20-1.5 threads.

ALLEN-BRADLEY

Oak Creek, Wisconsin 53154

Installation Instructions for the **MICRO SWITCH 972 Series 3-Wire DC and 973 Series 2-Wire AC Proximity Sensors**

PK 8041 0

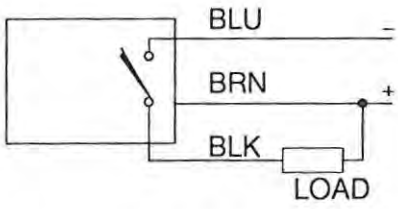
GENERAL SPECIFICATIONS

Parameter	972 Series 3-Wire DC	973 Series 2-Wire AC
Supply Voltage	10 to 30 VDC	20 to 250 VAC
Load Current.	200 mA, max.	5 to 250 mA (12 mm dia.) 5 to 500 mA (18 and 30 mm dia.)
Leakage Current	50 µA, max.	1.7 mA, max.
Voltage Drop	1.5 V max.	< 9.5 V
Current Consumption	12 mA max.	—
Inrush Current	—	2.7 A/8.3 msec
Repeatability, Shielded	± 1%	± 1%
Repeatability, Unshielded	± 3%	± 3%
Hysteresis	2 - 15%	< 15%
Protection	Short circuit, overload, transients	Overload and transients
Sealing*	IP 67, NEMA 4, 6, 6P, 13	IP 67, NEMA 4, 6, 6P, 13
Temperature Range	-25 to +70°C (-13 to +158°F)	-25 to +70°C (-13 to +158°F)
Cable Type	PVC jacket, 22 gage	PVC jacket, 22 gage

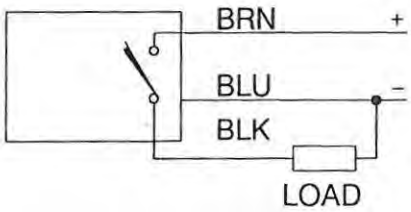
***Application Note:** Enclosures are based, in general, on the broad definitions outlined in NEMA standards. Therefore, it will be necessary for the user to determine that a particular enclosure is adequate when exposed to the specific conditions that might exist in intended applications. Except as might otherwise be noted, all references to products relative to NEMA enclosure types are based on MICRO SWITCH evaluation only.

WIRING DIAGRAMS

NPN (Sinking) N.O.

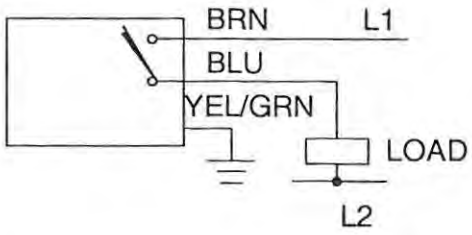


PNP (Sourcing) N.O.



Do not place connecting cables of DC sensors in conduit with AC control wiring. Place in separate conduit or with wiring to other low voltage, low current solid state devices.

2-wire AC with case ground



Connecting cables may be run in conduit with other control wiring without affecting operation. However, they should not be placed in conduit with power wiring. Class 1 wiring is required.

NOTICE

A load must be used when power is applied to AC sensors. Wiring without a load will cause permanent damage.

PLASTIC PACKAGE SENSOR DESCRIPTION

Package Size mm (in.)	Sensing Range mm (in.)	Sensor Type	Sw. Freq.	Standard Target mm (in.)	Output Type	Catalog Listing*
12 (.47) Shielded	2 (.08)	3-wire DC	1.1 kHz	12 (.47)	NPN, N.O. PNP, N.O.	972AA2XP-A3N-L 972AA2XP-A3P-L
		2-wire AC	24 Hz	12 (.47)	N.O. N.C.	923AA2XP-A7T-L 923AA2XP-B7T-L
12 (.47) Unshielded	5 (.20)	3-wire DC	900 Hz	12 (.47)	NPN, N.O. PNP, N.O.	972AB2XP-A3N-L 972AB2XP-A3P-L
		2-wire AC	24 Hz	12 (.47)	N.O. N.C.	923AB2XP-A7T-L 923AB2XP-B7T-L
18 (.71) Shielded	5 (.20)	3-wire DC	600 Hz	18 (.71)	NPN, N.O. PNP, N.O.	972AA3XP-A3N-L 972AA3XP-A3P-L
		2-wire AC	24 Hz	18 (.71)	N.O. N.C.	973AA3XP-A7T-L 973AA3XP-B7T-L
18 (.71) Unshielded	8 (.31)	3-wire DC	400 Hz	18 (.71)	NPN, N.O. PNP, N.O.	972AB3XP-A3N-L 972AB3XP-A3P-L
		2-wire AC	24 Hz	18 (.71)	N.O. N.C.	973AB3XP-A7T-L 973AB3XP-B7T-L
30(1.18) Shielded	10 (.39)	3-wire DC	500 Hz	30 (1.18)	NPN, N.O. PNP, N.O.	972AA4XP-A3N-L 972AA4XP-A3P-L
		2-wire AC	24 Hz	30 (1.18)	N.O. N.C.	973AA4XP-A7T-L 973AA4XP-B7T-L
30 (1.18) Unshielded	15 (.63)	3-wire DC	200 Hz	48 (1.89)	NPN, N.O. PNP, N.O.	972AB4XP-A3N-L 972AB4XP-A3P-L
		2-wire AC	24 Hz	48 (1.89)	N.O. N.C.	973AB4XP-A7T-L 973AB4XP-B7T-L

* Listings shown have 2 meter cables.
-050 listings have 5 meter cables.
-100 listings have 10 meter cables.

WARRANTY/REMEDY

Honeywell warrants goods of its manufacture as being free of defective materials and faulty workmanship. Commencing with date of shipment, Honeywell's warranty runs for 18 months. If warranted goods are returned to Honeywell during that period of coverage, Honeywell will repair or replace without charge those items it finds defective. The foregoing is Buyer's sole remedy and is **in lieu of all other warranties, expressed or implied, including those of merchantability and fitness for a particular purpose.**

For application assistance, current specifications, pricing or name of the nearest Authorized Distributor, contact a nearby sales office. Or call:

1-800-537-6945 USA
1-416-293-8111 Canada
1-815-235-6847 International

Specifications may change without notice. The information we supply is believed to be accurate and reliable as of this printing. However, we assume no responsibility for its use.

While we provide application assistance, personally and through our literature, it is up to the customer to determine the suitability of the product in the application.

METAL PACKAGE SENSOR DESCRIPTION

Package Size mm (in.)	Sensing Range mm (in.)	Sensor Type	Sw. Freq.	Standard Target mm (in.)	Output Type	Catalog Listing*
12 (.47) Shielded	2 (.08)	3-wire DC	1.1 kHz	12 (.47)	NPN, N.O. PNP, N.O.	972AA2XM-A3N-L 972AA2XM-A3P-L
		2-wire AC	24 Hz	12 (.47)	N.O. N.C.	973AA2XM-A7T-L 973AA2XM-B7T-L
12 (.47) Shielded Extended Range	4 (.16)	3-wire DC	500 Hz	12 (.47)	NPN, N.O. PNP, N.O.	922AC2XM-A3N-L 922AC2XM-A3P-L
		2-wire AC	24 Hz	12 (.47)	N.O. N.C.	973AC2XM-A7T-L 973AC2XM-B7T-L
12 (.47) Unshielded	5 (.20)	3-wire DC	900 Hz	12 (.47)	NPN, N.O. PNP, N.O.	972AB2XM-A3N-L 972AB2XM-A3P-L
		2-wire AC	24 Hz	12 (.47)	N.O. N.C.	973AB2XM-A7T-L 973AB2XM-B7T-L
18 (.71) Shielded	5 (.20)	3-wire DC	600 Hz	18 (.71)	NPN, N.O. PNP, N.O.	972AA3XM-A3N-L 972AA3XM-A3P-L
		2-wire AC	24 Hz	18 (.71)	N.O. N.C.	973AA3XM-A7T-L 973AA3XM-B7T-L
18 (.71) Shielded Extended Range	8 (.31)	3-wire DC	200 Hz	18 (.71)	NPN, N.O. PNP, N.O.	922AC3XM-A3N-L 922AC3XM-A3P-L
18 (.71) Unshielded	8 (.31)	3-wire DC	400 Hz	18 (.71)	NPN, N.O. PNP, N.O.	972AB3XM-A3N-L 972AB3XM-A3P-L
		2-wire AC	24 Hz	18 (.71)	N.O. N.C.	973AB3XM-A7T-L 973AB3XM-B7T-L
30(1.18) Shielded	10 (.39)	3-wire DC	500 Hz	30 (1.18)	NPN, N.O. PNP, N.O.	972AA4XM-A3N-L 972AA4XM-A3P-L
		2-wire AC	24 Hz	30 (1.18)	N.O. N.C.	973AA4XM-A7T-L 973AA4XM-B7T-L
30 (1.18) Unshielded	15 (.63)	3-wire DC	200 Hz	48 (1.89)	NPN, N.O. PNP, N.O.	972AB4XM-A3N-L 972AB4XM-A3P-L
		2-wire AC	24 Hz	48 (1.89)	N.O. N.C.	973AB4XM-A7T-L 973AB4XM-B7T-L

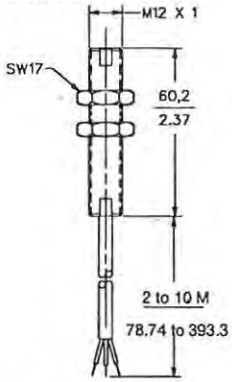
* Listings shown have 2 meter cables.
-050 listings have 5 meter cables.
-100 listings have 10 meter cables.

972 Series, 973 Series Proximity Sensors

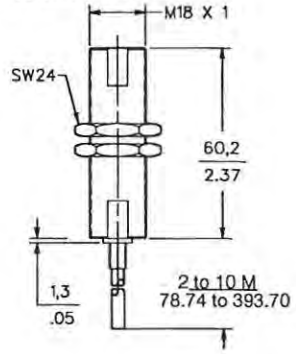
MOUNTING DIMENSIONS (for reference only)

PLASTIC PACKAGES

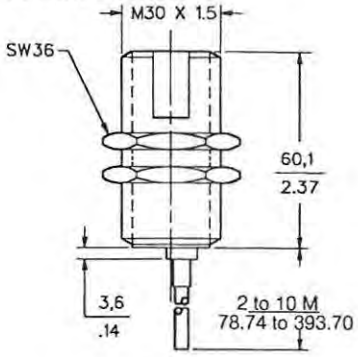
12 mm Diameter



18 mm Diameter

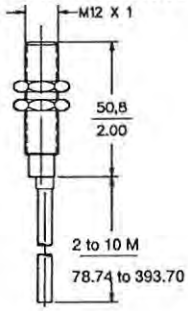


30 mm Diameter

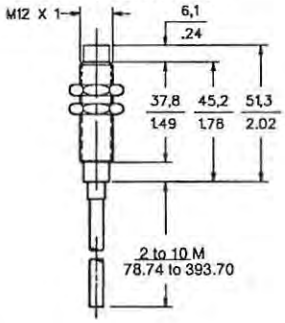


METAL PACKAGES

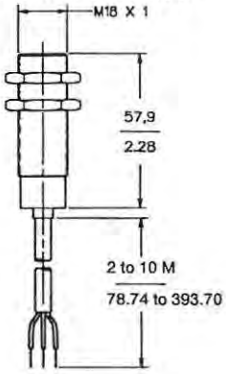
12 mm Shielded



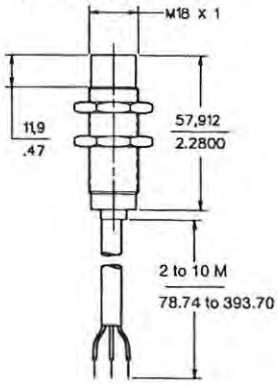
12 mm Unshielded



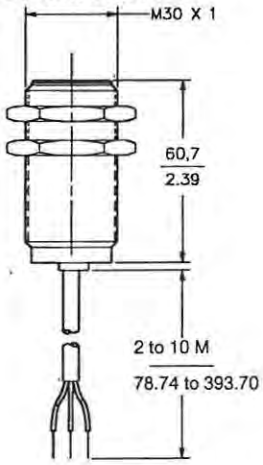
18 mm Shielded



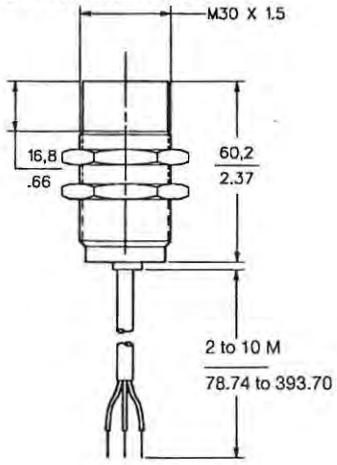
18 mm Unshielded



30 mm Shielded



30 mm Unshielded



Honeywell

Helping You Control Your World

MICRO SWITCH
Honeywell Inc.
11 West Spring Street
Freeport, Illinois 61032

Printed with Soy Ink on 50% Recycled Paper
PK 8041 0 495 Printed in USA

Empire Castings Inc.
Equipment Manual

Model# EC02-A
Serial# AAPM01

Volumne 3, Section 13: Main Ram

1: Replacement Parts

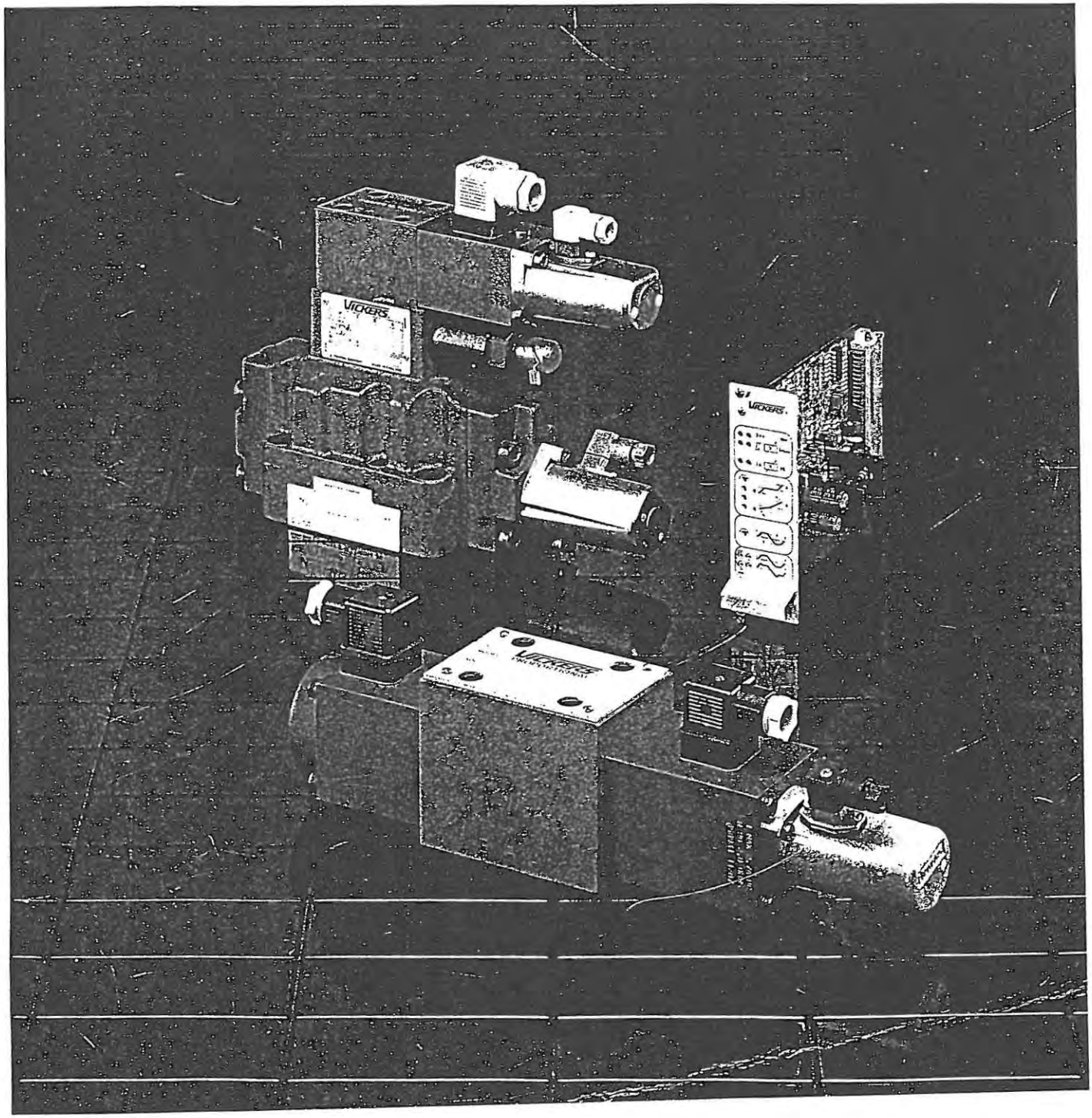
Item#	Part#/Description	Mfg.
001	TY09LAXABAL6609 HYDRAULIC CYLINDER	TJ VICKERS
002	KFDG5V733C160NXVMU1H112 PROPORTIONAL VALVE	VICKERS
003	CBGA-LHN COUNTER BALANCE VALVE	SUN
004	WS-11C-750F/H/ADJX RAM PRESSURE SWITCH	NASON
005	EEA-PAM-561-A32 AMPLIFIER CARD	VICKERS

CAUTION: DO NOT OPERATE MACHINERY IF ANY OF THE ABOVE SWITCHES IS NOT FUNCTIONING PROPERLY

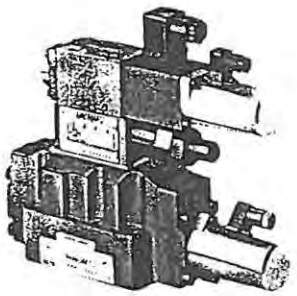
VICKERS

Proportional Directional and Throttle Valves

. . . program your success now
with our innovative range



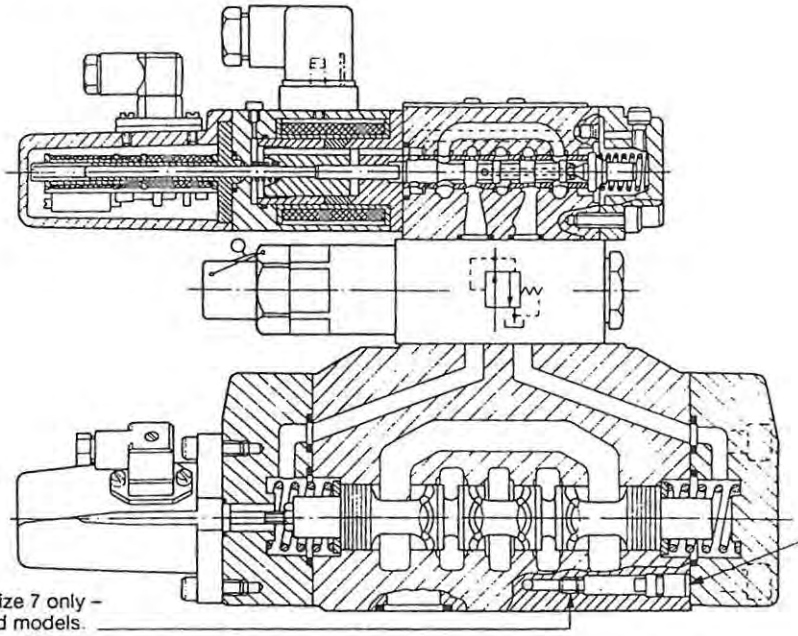
Proportional directional control valves, two-stage design



KFDG5V-5, 3* series and KFDG5V-7/8, 1* series, with main-stage feedback transducers▲
KHDG5V-5/7/8, 2* series, with pilot and main stage feedback transducers▲
ISO 4401-05, 07 and 08 (ANSI/NFPA-D05, D07 and D08)

▲ For amplifier options see page 3.

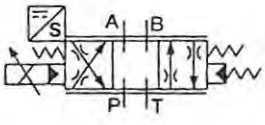
1. Typical section, KHDG5V-7 example



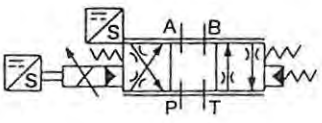
2. Functional symbols and application notes

Simplified symbols

KFDG5V models



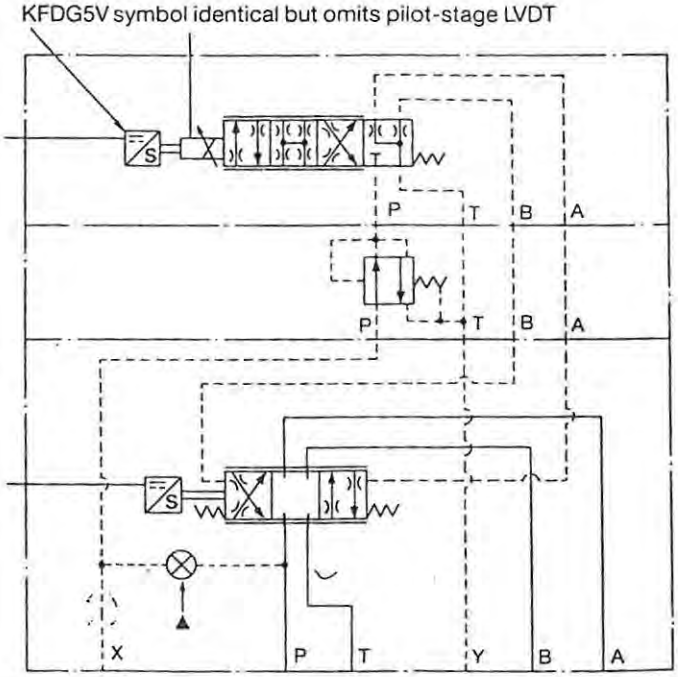
KHDG5V models



▲ See "Application note B" and [5] in "Model codes" on next page.

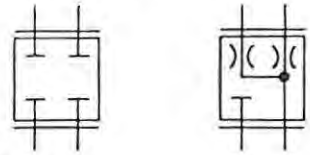
Detailed symbol, KHDG5V example

KFDG5V symbol identical but omits pilot-stage LVDT



Application notes

A. Main-spool options
Spools shown are meter-in/meter-out types
Center-condition options are:



Type 2 spool Type 33 spool

B. Internally piloted models
Differ from detailed symbol on previous page by omission of plug ▲ and the blocking of port X by the mating surface.

C. Flow characteristics
These valves are designed to throttle flow in proportion to command signals. There is no inherent compensation for varying loads but this can be achieved in a number of ways, either electronically or hydraulically. Your Vickers representative can advise on an arrangement to suit your application, a possible hydraulic solution for K*DG5V-7/8 valves being a hydrostat (with associated pilot shuttle adaptor) installed under the valve; see pages 45-47.

3. Model codes

For proportional valves

K * DG5V- * -C*******-(E)X-VM-**
[1] [2] [3] [4] [5]

U1-H1- **
[6]

[1] Feedback arrangement
F = From main stage only
H = From pilot and main stages

[2] Mounting size code (ISO 4401)
5 = 05
7 = 07
8 = 08

[3] Spool type
2 or 33; see "Application note A" above.

[4] Flow rating and metering
At Δp = 5 bar (72 psi) per metering path

Symmetric spools
For K*DG5V-5 valves:
100N = 100 l/min (26 US gpm), for type 2 spools
80N = 80 l/min (21 US gpm), for type 33 spools
For K*DG5V-7 valves:
200N = 200 l/min (52 US gpm), for type 2 spools
160N = 160 l/min (42 US gpm), for type 33 spools
For K*DG5V-8 valves:
300N = 300 l/min (79 US gpm), for type 2 spools
270N = 270 l/min (71 US gpm), for type 33 spools

Asymmetric spools
First figure (***N) is flow rating P-A, or A-T ("A" port flow); last figure (N***) is flow rating P-B, or B-T ("B" port flow)
For K*DG5V-5 valves:
Spool type "2" (2C70N45)
70N45 = 70 l/min (18.5 US gpm), "A" port flow; 45 l/min (11.9 US gpm), "B" port flow
Spool type "33" (33C65N40)
65N40 = 65 l/min (17.2 US gpm), "A" port flow; 40 l/min (10.6 US gpm), "B" port flow
For K*DG5V-7 valves:
Spool type "2" (2C150N85)
150N85 = 150 l/min (40 US gpm), "A" port flow; 85 l/min (22.4 US gpm), "B" port flow
Spool type "33" (33C130N65)
130N65 = 130 l/min (33.3 US gpm), "A" port flow; 65 l/min (17.2 US gpm), "B" port flow
For K*DG5V-8 valves:
Spool type "2" (2C280N200)
280N200 = 280 l/min (74 US gpm), "A" port flow; 200 l/min (52 US gpm), "B" port flow
Spool type "33" (33C250N170)
250N170 = 250 l/min (66 US gpm), "A" port flow; 170 l/min (45 US gpm), "B" port flow

[5] Pilot supply
EX = External thru' integral reducer
X = Internal thru' integral reducer

[6] Design number
10 series for KFDG5V-7/8 models
20 series for KH models
30 series for KFDG5V-5 models
Subject to change. Installation dimensions unaltered for design numbers *0 to *9 inclusive.

Solenoid and LVDT plugs
Supplied with valve.

For supporting products

(see "Contents" table, page 2)

- Power amplifier options
- Power supply unit options
- Electronic accessories
- Pressure hydrostat and pilot shuttle adaptor options
- Mounting surfaces, subplates and bolt kit options
- Portable test equipment

4. Operating data

Performance data is typical with fluid at 36 cSt (168 SUS) and 50°C (122°F) while using the basic Vickers power amplifier.

Max. pressures and min. pilot pressures	See table on next page
Flow rating	See [4] in "Model codes"
Standing current, pilot valve at null: KFDG5V KHDG5V	1,4A 1,6A
Max. current, at 50°C (122°F) ambient	2,7A
Coil resistance, at 20°C (68°F): KFDG5V KHDG5V	2,8Ω 1,7Ω
Relative duty factor	Continuous rating (ED = 100%)
Type of protection, with electrical plugs fitted correctly	To IEC 144 Class IP65
Electrical plugs, supplied with valve	See "Installation dimensions" commencing on page 39
Power capacity envelopes	See graphs on page 38
Flow gain	See graphs on page 38
Hysteresis, with flow thru' P-A-B-T, Δp = 5 bar (72 psi) per metering path (P-A or B-T): KFDG5V KHDG5V	<2% <1%

Continued on next page

Step input response, with flow thru' P-A-B-T, Δp = 5 bar (72 psi) per metering path e.g. P-A, and with max. deadband compensation. Required flow step:	Time to reach 90% of reqd. step:
KFDG5V-5 { 0 to 100%	30 ms (0.030s)
100% to 0	24 ms (0.024s)
+90 to −90%	34 ms (0.034s)
KFDG5V-7 { 0 to 100%	50 ms (0.050s)
100% to 0	54 ms (0.054s)
+90 to −90%	61 ms (0.061s)
KFDG5V-8 { 0 to 100%	67 ms (0.067s)
100% to 0	56 ms (0.056s)
+90 to −90%	75 ms (0.075s)
KHDG5V-5 { 0 to 100%	24 ms (0.024s)
100% to 0	23 ms (0.023s)
+90 to −90%	35 ms (0.035s)
KHDG5V-7 { 0 to 100%	24 ms (0.024s)
100% to 0	23 ms (0.023s)
+90 to −90%	36 ms (0.036s)
KHDG5V-8 { 0 to 100%	37 ms (0.037s)
100% to 0	36 ms (0.036s)
+90 to −90%	57 ms (0.057s)
Frequency response	See graphs on page 39
Reproducibility, valve-to-valve	Optimized by adjustment of deadband compensation, gain and ramp potentiometers on associated Vickers amplifier
Hydraulic fluids, temperature ranges and filtration recommendations	See page 120
Installation dimensions	See pages 39-42
Mass: KFDG5V-5	9,50 kg (20.9 lb) approx.
KFDG5V-7	10,75 kg (23.7 lb) approx.
KFDG5V-8	18,00 kg (39.7 lb) approx.
KHDG5V-5	9,75 kg (21.5 lb) approx.
KHDG5V-7	11,00 kg (24.2 lb) approx.
KHDG5V-8	18,25 kg (40.2 lb) approx.
Installation and commissioning (start-up)	See page 122

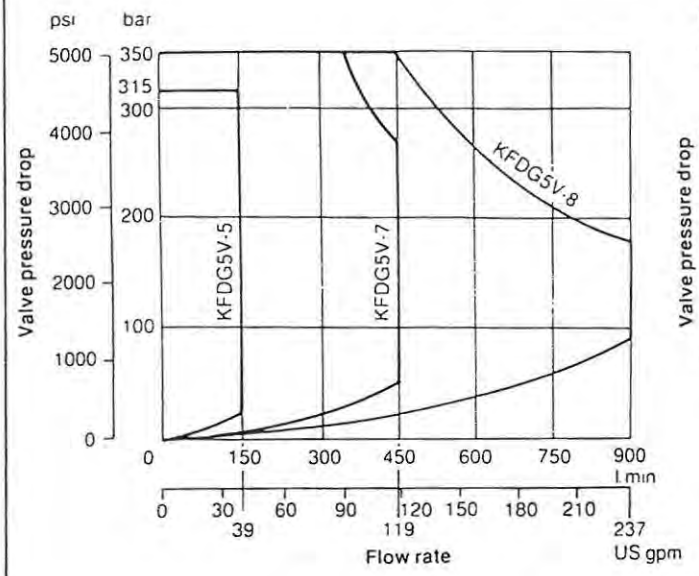
● **Max. pressures, bar (psi)**

Model	Pilot pressure source	Ports P, A & B	T	X	Y
KFDG5V-7/8	Internal or external	350 (5075)▲	350 (5075)	350 (5075)▲	4 (58)
K*DG5V-5	External	315 (4567)	210 (3000)	210 (3000)◪	4 (58)
	Internal	315 (4567)◪	100 (1450)	315 (4567)◪	4 (58)
KHDG5V-7/8	Internal or external	350 (5075)◪	350 (5075)	350 (5075)◪	4 (58)

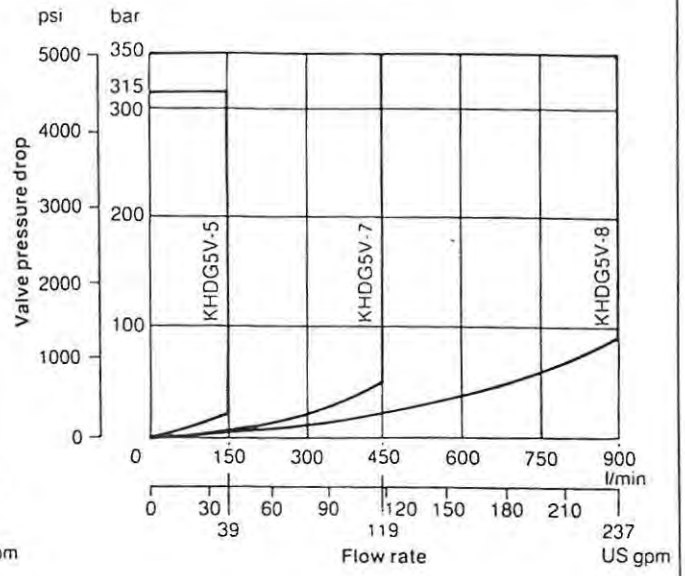
▲ 25 (363) min. pressure at X for externally piloted models or at P & X for internally piloted models.
◪ 45 (653) min. pressure at X for externally piloted models or at P & X for internally piloted models.

Power capacity envelopes
Flow thru' P-A-B-T or P-B-A-T

KFDG5V models

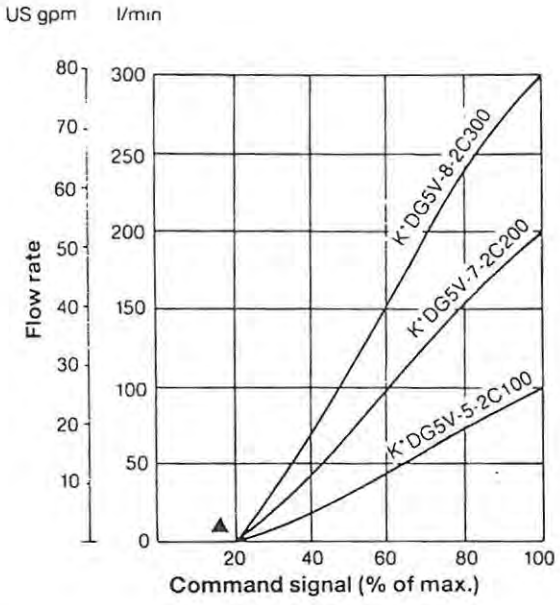


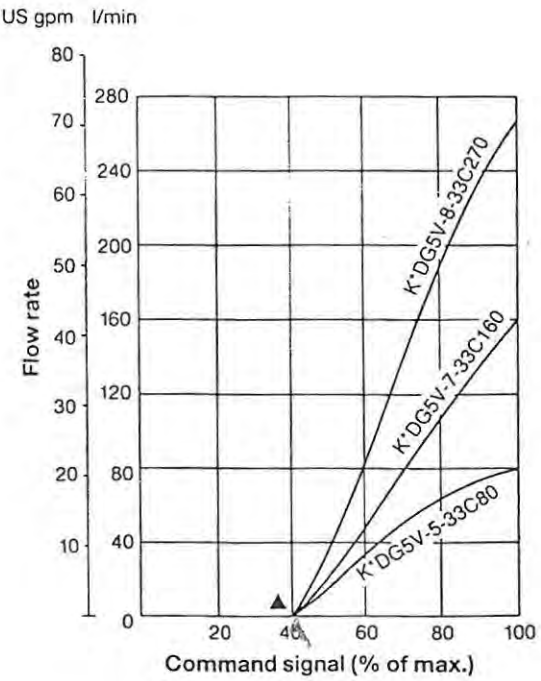
KHDG5V models



● Flow gain KFDG5V and KHDG5V models
At Δp = 5 bar (72 psi) per metering path (e.g. P-A)■, with flow thru' P-A-B-T or P-B-A-T.
Percentage command signals applicable for positive and negative values of command signal. See footnote (▲) relative to point at which flow starts.

Valve sizes and spool types as noted





▲ These points will vary from valve to valve, but can be adjusted using the deadband-compensation feature of the drive amplifier.

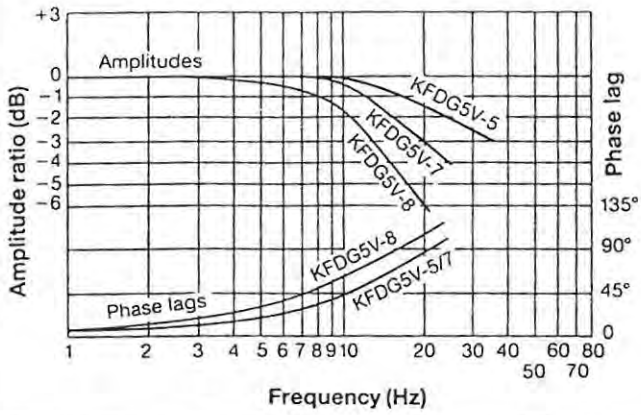
■ At other Δp values flow rates approximate to:

$$Q_x = Q_D \sqrt{\frac{\Delta p_x}{\Delta p_D}}$$

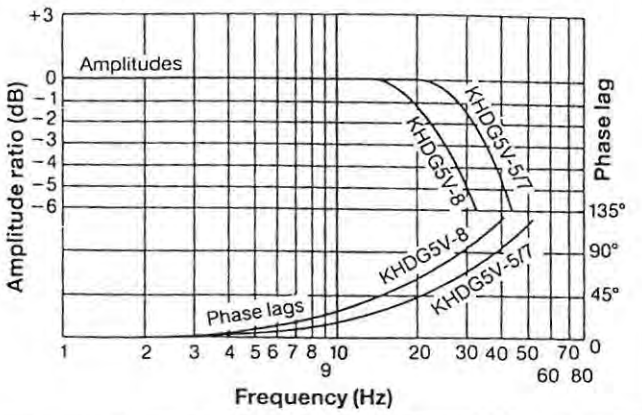
where Q_D = Datum flow rate
Δp_D = Pressure drop at datum flow rate
Δp_x = Required Δp

● **Frequency response, typical**
For an amplitude of ±25% of max. stroke
(center-to-offset) about the 50% position

KFDG5V-5/7/8



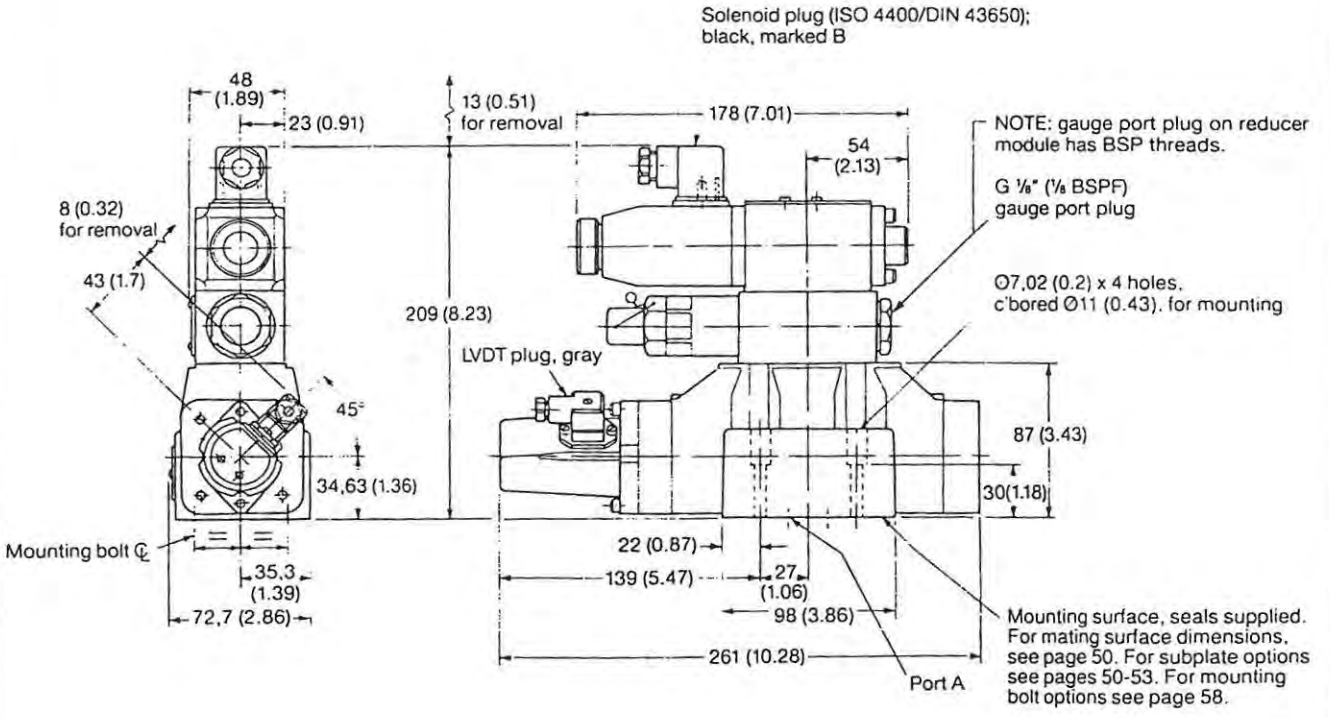
KHDG5V-5/7/8



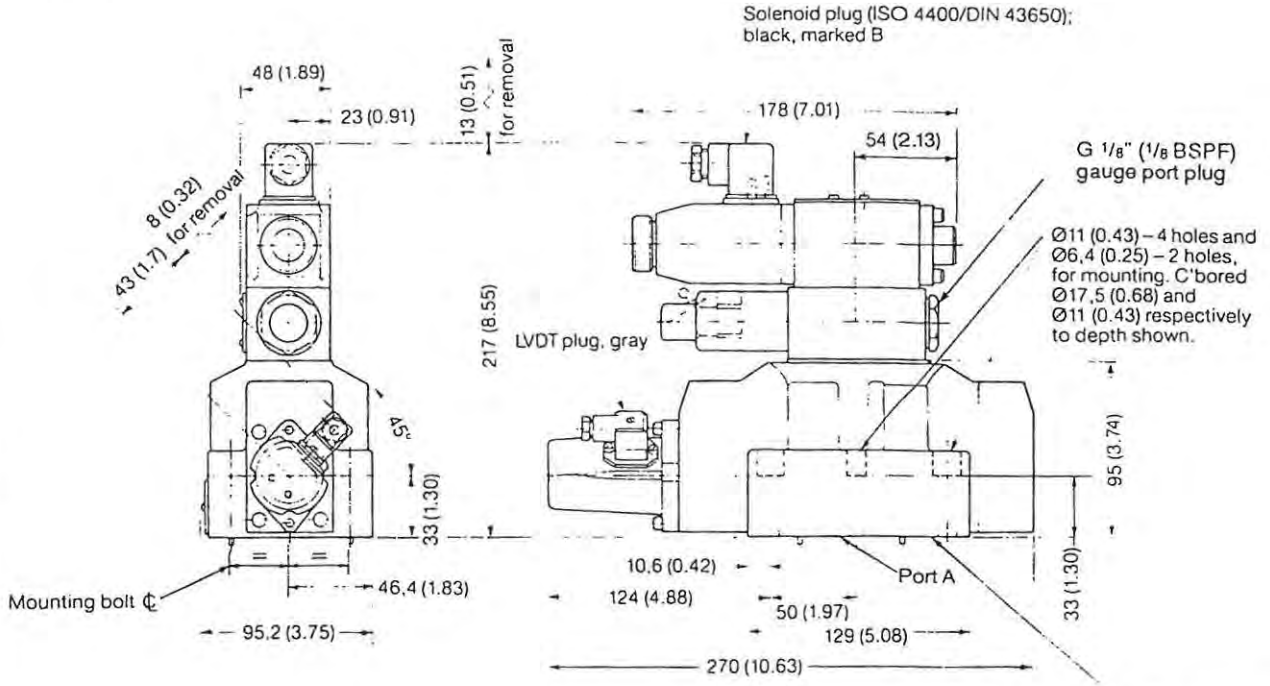
5. Installation dimensions in mm (inches)

3rd angle projection

KFDG5V-5

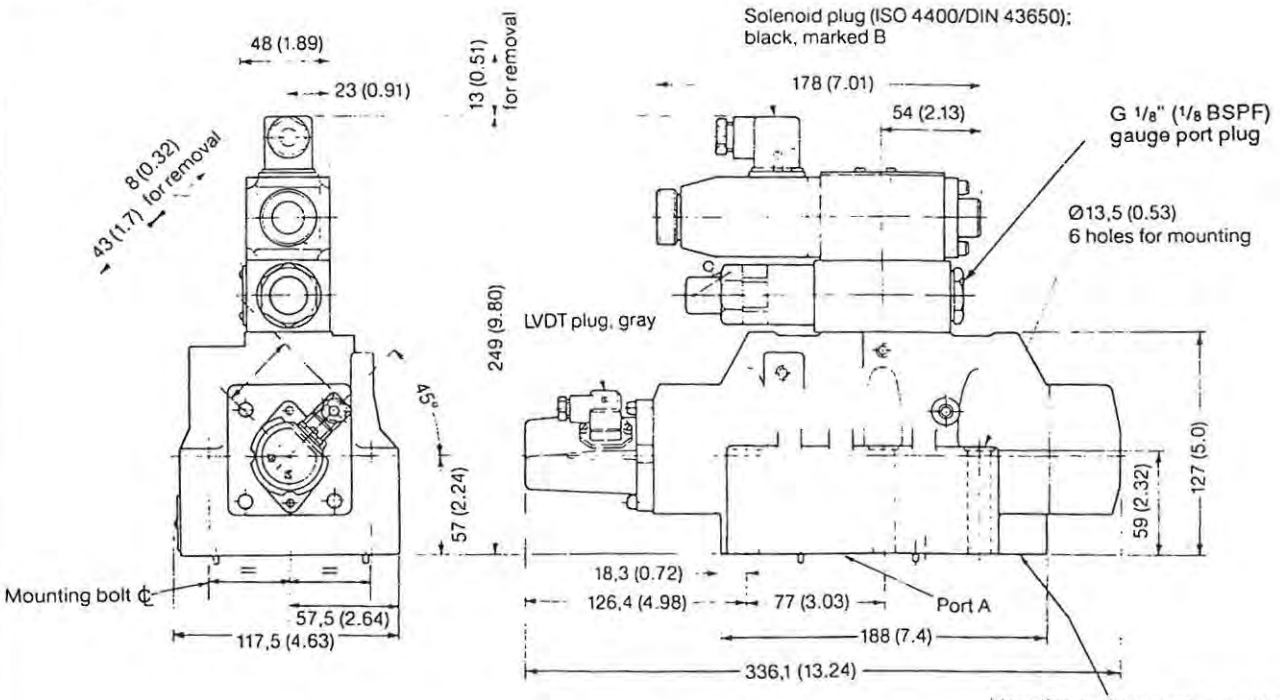


KFDG5V-7



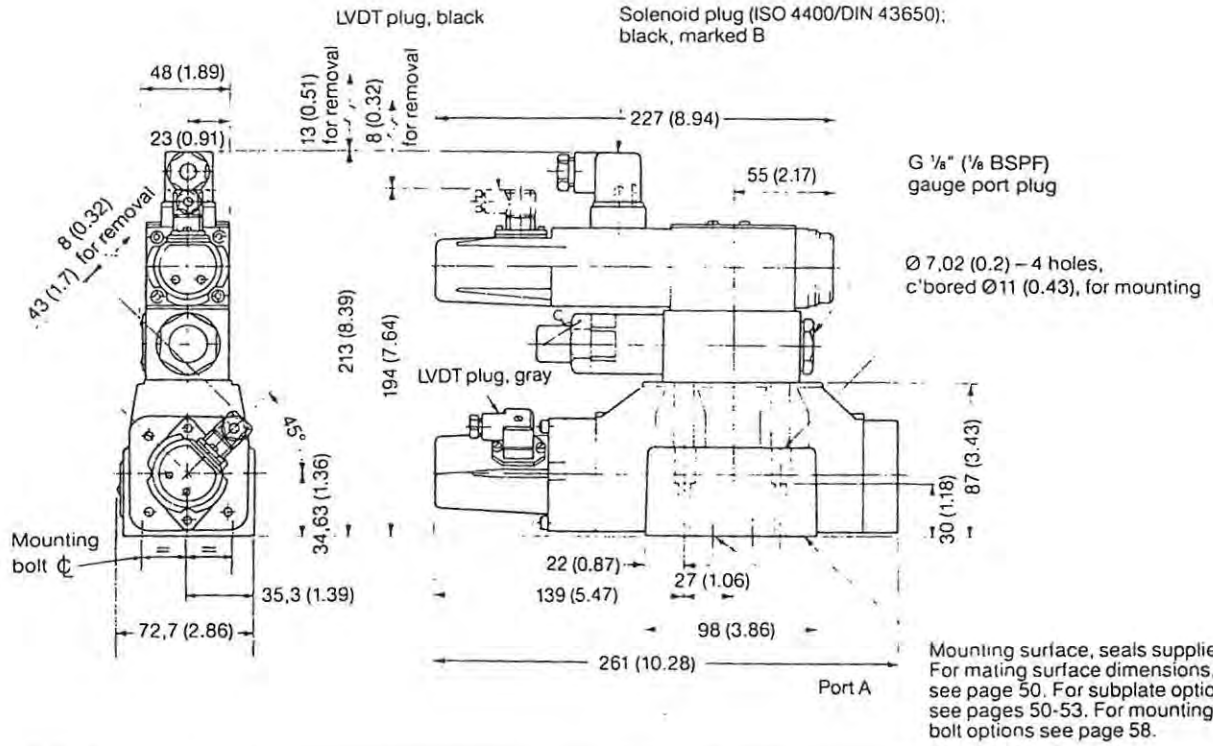
Mounting surface. seals supplied. For mating surface dimensions, see page 54. For subplate options see pages 54 and 55. For mounting bolt options see page 58.

KFDG5V-8



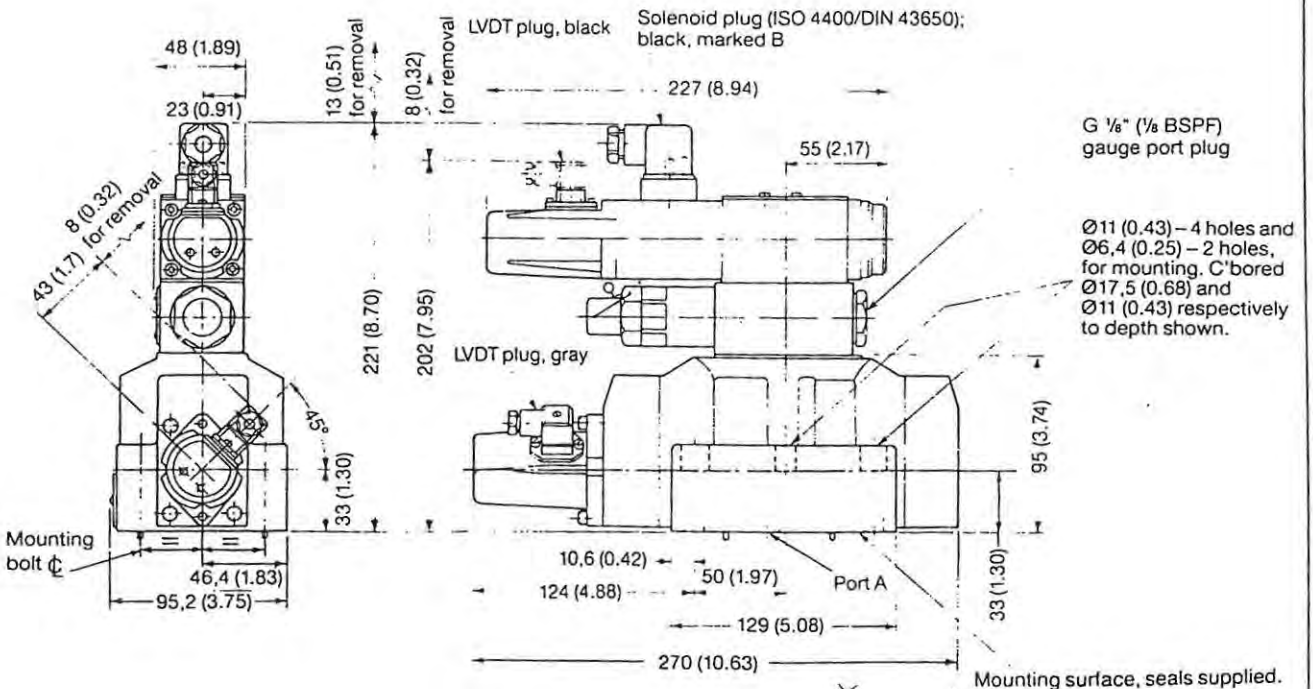
Mounting surface, seals supplied. For mating surface dimensions, see page 56. For subplate options see pages 56 and 57. For mounting bolt options see page 58.

KHDG5V-5



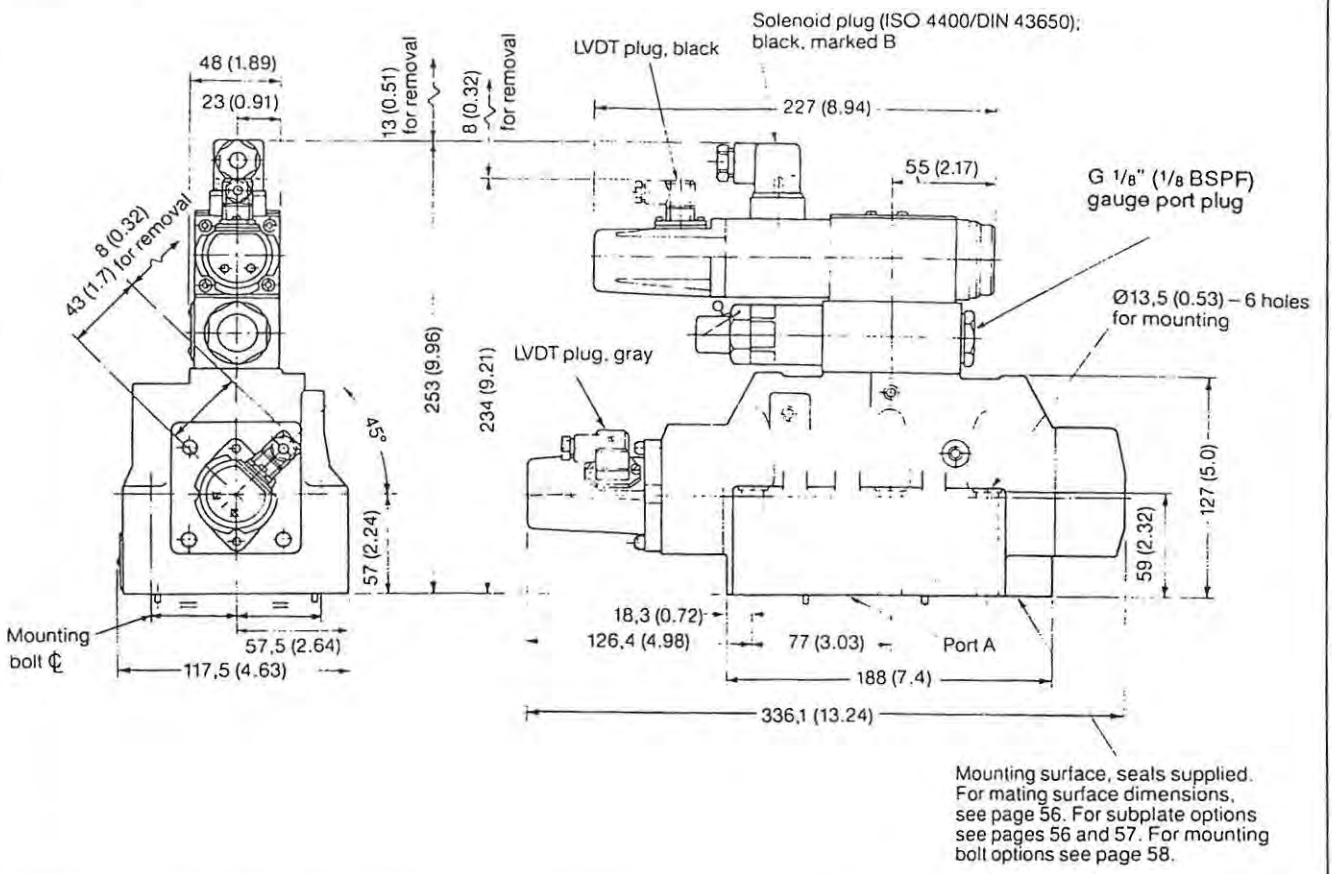
Mounting surface, seals supplied. For mating surface dimensions, see page 50. For subplate options see pages 50-53. For mounting bolt options see page 58.

KHDG5V-7



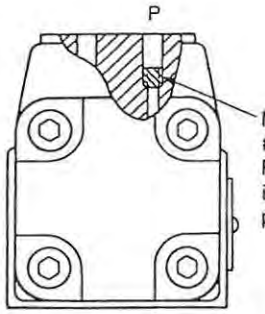
Mounting surface, seals supplied. For mating surface dimensions, see page 54. For subplate options see pages 54 and 55. For mounting bolt options see page 58.

KHDG5V-8

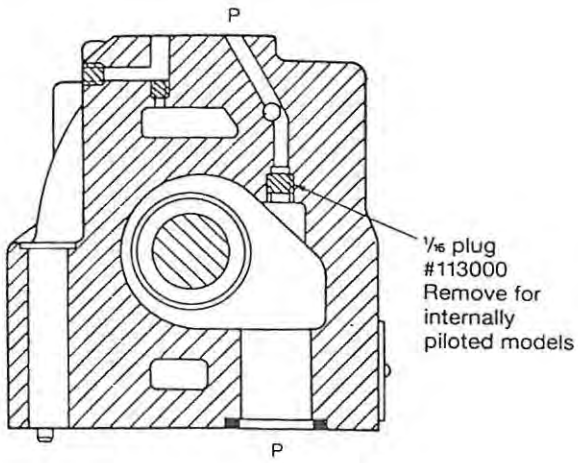


Pilot-supply plug
For K*DG5V-5 and -8, as below
For K*DG5V-7, see page 35

K*DG5V-5 valves
Viewed from port B end of main-stage



K*DG5V-8 valves
Section through port P of main-stage



ELECTRICAL INFORMATION

AC solenoids furnished with this valve are dual frequency types, as shown in the table below. They also resist burnout, which allows time to find and correct problems before solenoid burn-out occurs.

"Solenoids" are identified by a letter in the model number.
Example:
DG4V-3-2C-M-W-B-40

Solenoid Voltage Rating	Identification Letter	Inrush • amps (R.M.S.)	Holding amps	Holding watts	Resistance ohms @ 20° C	Inductance mH
115/120 Vac 60 Hz 110 Vac .50 Hz	B ■	2.0	0.54 0.64	31	33.5	185
230/240 Vac 60 Hz 220 Vac .50 Hz	D ■	1.0	0.27 0.32	31	140	731
24 Vac 60 Hz 50 Hz	N ■	7.8 8.4	2.45 3.15	27 35	1.6	57
6 3 115/120 Vac 60 Hz 110 Vac .50 Hz	B-9 (Low Watt)	1.5	0.31 0.37	17 21	55.0	285
100 Vac 60 Hz 50 Hz	T	1.9 2.1	0.66 0.85	27 35	23.1	150
6 V dc	F	—	6.8	41	0.88	4.07
12 V dc	G ■	—	3.5	41	3.45	16.3
24 V dc	H ■	—	1.7	41	13.9	64.6
32 V dc	DK	—	1.3	41	24.7	114
48 V dc	J	—	0.87	41	55.3	258

3 Valve Models using the low watt "B-9" solenoid are limited to 19 L/min. (5 GPM) and 140 bar (2000 PSI) maximum.

Note: Solenoids are designed to function continuously at ± 10 percent of the rated voltage.
• Maximum peak inrush amps approximately 1.4 × R.M.S. value shown.
■ See DIN standard solenoids information at right.

Solenoid Energizing

Spring centered and spring offset types will be spring positioned unless solenoid is energized continuously. No-spring detented valves may be energized momentarily approximately 0.1 second; when solenoid is de-energized spool will remain in last position attained provided there is no severe shock, vibration or unusual pressure transients.

Electrical Connection

1/2 NPT thread for DG4V-3-**-M-W*-*-40 models are provided on both ends of the terminal box.

The conduit connection readily adapts to connector-receptacle assemblies on the market.

Solenoid Indicator Lights

Light is "on" when there is current at the solenoid coil. Lights are available for various voltages in both AC and DC service.

Canadian Standards Association Certification

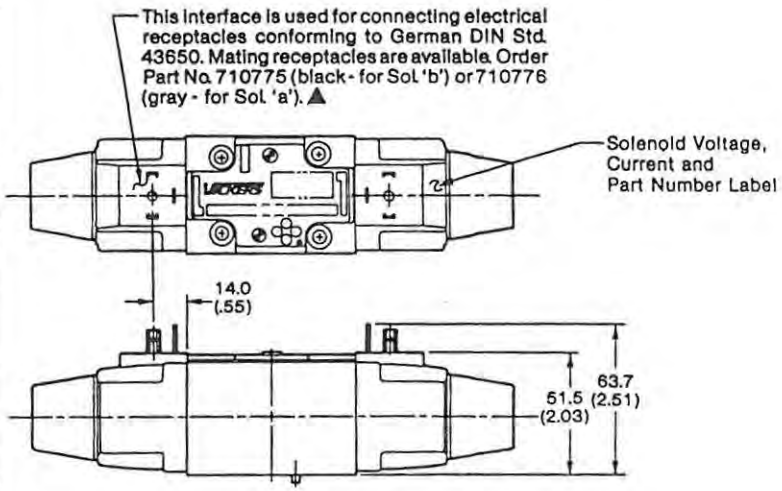
Valves with solenoid letter codes B, D, G, H & N have Canadian standards certification. Identify by adding the -S324 suffix in the model code. This certification does not include models with indicator lights (L) or plug-in devices (PA*/PB) or DIN 43650 plugs.

Lead Wire Insulation

Class "H" on both AC and DC solenoid lead wires.

GERMAN DIN STANDARD 43650 PLUG
MODELS: DG4V-3-**-M-U-*-40

Solenoid coils conforming to DIN 43650 — "AC" or "DC"



▲Plug Connector

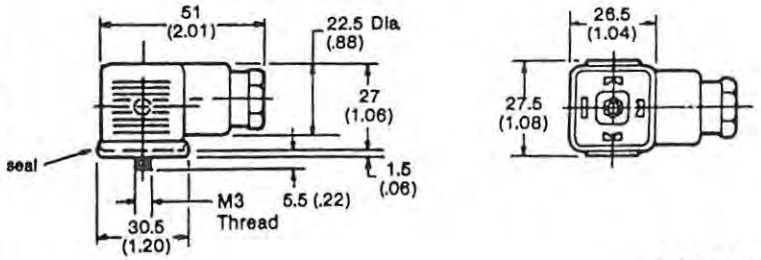
(DIN 43650)
(Order separate of valve)

Means of connection:
screw terminals
Conductor cross-sectional area:
0.5 .....1.5 mm²
Cable collar thread: Pg 11
Cable diameter: 6 .....10 mm

Note

Connectors with indicator lights are available: (order separate of valve)

Voltage	Gray - 'A' Sol.	Black - 'B' Sol.
12-24	977467	977466
100-125	977469	977468
200-240	977471	977470



I-517351-7

MONITOR SWITCH OPTION

Cherry switch, Und. Lab. Listed, 11A, 1/4 H.P. 125/250 V.A.C.

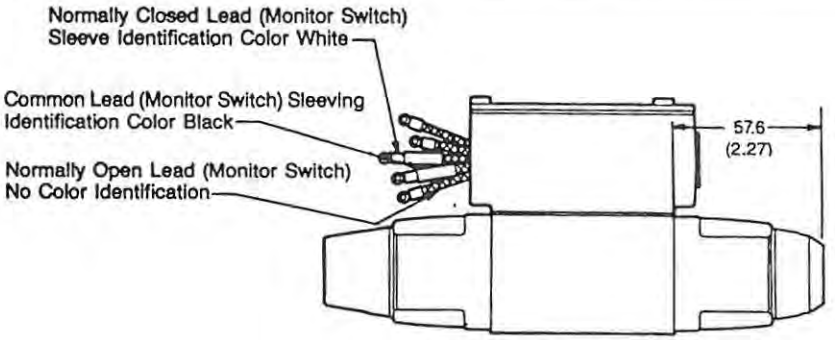
Note

Integral monitor switch permits electrical monitoring of valve spool position and may be wired into control circuit to indicate valve function. For current load vs. life expectancy for the Cherry switch #E923-S1AA contact switch manufacturer.

5 Valve Rating

The tank pressure should not exceed 200 P.S.I. and the valve should not be used above 8 G.P.M. flow.

Monitor switch does not provide for manual override operation nor is monitor switch feature available on models with manual override operator in end cap (*P). Wired monitor switch feature ("S1" and "S2") is available on models with "PA3", "PA5" or "PB" electrical plug-in features. Available for use with spring offset 'A' arrangement only.



MODELS: DG4V-3-*A-MS-W*-**-40**

Monitor Switch: "S" Unwired
"S1" - Wired N.O.
"S2" - Wired N.C.

'NSTA-PLUG OPTION

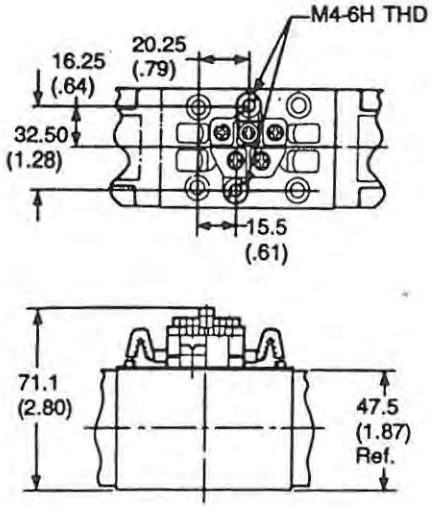
/ickers "Insta-Plug" provides a neans of disconnecting electrical)ower to the valve without ıctually breaking individual wire :onnections. The male half of the lug is attached to the top of the alve body. Solenoid leads are onnected to this half of the plug y Vickers. The mating plug is ttached inside the wire housing. erminals are provided on top of for the convenience of onnecting machine wires.

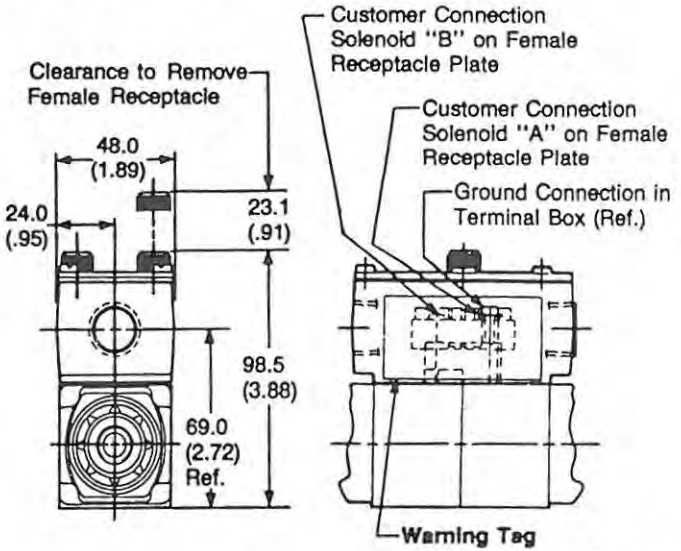
wo thumb screws are used to old the wiring housing with the ımale plug half to the valve. hese screws are captive to void loss on servicing. To sconnect the valve they are osened until clear, allowing the iring housing to be pulled away)m the valve body; thereby sconnecting electrical power to e valve. Note that the ground th post is longer than the other ur, providing a first-make/ st-break ground feature.

The PB configuration includes both the male and female (retained in the wiring housing) halves for a complete plug-in unit.

Solenoid indicator lights can also be furnished with the Insta-Plug feature. When furnished, the lights are pre-wired to the female half of the plug. Solenoids "A" and/or "B" are identified on the identification plate attached to the wiring housing.

MODELS: DG4V-3--M-PB-W*-40**





The right to modification for technical improvements is reserved.

Durch Weiterentwicklung bedingte Änderungen vorbehalten.

Tous droits de modification pour amélioration technique réservés.

Si riservano i diritti di modifiche tecniche.

VICKERS

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Printed in Germany

QuickStart

The Temposonics II QuickStart wiring charts indicate how to wire a Temposonics II transducer in a variety of system configurations. Please read Note 1 below and verify the appropriate system configuration for your installation before proceeding.

If you have any questions, contact MTS at:

- 919-677-0100 for applications assistance

or

- 800-248-0532 for service department

NOTES:

1. *When installing Temposonics II transducers connected to an Analog Output Module (AOM), the gray/white stripe wire MUST be connected to DC ground to ensure proper operation.*

   ***Retro-fit Installations:** When a Temposonics II transducer is installed to replace an original Temposonics transducer with a stroke length of 12 inches or less and connected to an existing AOM, the white/gray stripe wire must be connected to DC ground and the gray/white stripe wire must be connected to TB2-E or Pin E on the AOM.*

2. *The AOM is provided with either strain relief connectors or MS style connectors.*
   - *"TB2-X" indicates the wiring connections to terminal blocks in the AOM (for AOM with strain relief connectors).*
   - *"Pin-X" indicates the pin connections to the 6 pin MS connector.*

Temposonics II Transducer with Analog Output Module (AOM)
(P/N TTSRXXXXX)
neuter transducer - no personality module

Transducer Pin #	*Extension Cable Wire Color (Belden 8105)*	*AOM Connections (See Note 2, above)*
1	white/blue stripe	TB2-B or Pin B
2	blue/white stripe	TB2-B or Pin B
3	white/orange stripe	No Connection
4	orange/white stripe	No Connection
5	white/green stripe	TB2-F or Pin F
6	green/white stripe	TB2-D or Pin D
7	white/brown stripe	TB2-B or Pin B
8	brown/white stripe	TB2-C or Pin C
9	white/gray stripe	TB2-E or Pin E
10	gray/white stripe	TB2-B or Pin B

Easy to use. Tough to abuse.

Temposonics® II linear displacement transducer

When you need to measure absolute position continuously and reliably, the Temposonics II is an easy choice.

A wide range of interface options ma it easy to implement the Temposonics II i your application. You can order the electr inside or outside the transducer head, wit digital and/or analog output in the forma need.

The non-contact, magnetostrictive d means no mechanical wear. No periodic calibration. No scheduled maintenance. A every Temposonics II sensor is designed t NEMA 6 standard for reliable perform an even in the toughest environments.

Temposonics II position sensors provided with a stainless steel, high pres rod. Standard lengths are in stock for fas shipping.

For more information, write: MTS Systems Corporation, Sensors Division, P Box 13218, Research Triangle Park, NC 27709. Fax 919/677-0200. Or call:

1-800/633-7609



Specifications

- Resolution: down to 0.0001 inch
- Repeatability: ± 0.001% of full stroke
- Maximum Hysteresis: 0.0008 inch
- Linearity: 0.05% of full stroke

MTS®

Installation and start-up guidelines for Electronic Amplifiers 12 and 3* series

Einbau- und Inbetriebnahmeanleitung für elektronische Verstärker, Serie 12 und 3*

Amplifier/Verstärker	For Proportional Valve/ Für Proportionalventil
EEA-PAM-511-A-3*	ECG-02
EEA-PAM-513-A-12/3*	KCG-3
EEA-PAM-520-A-12	KD/TG4V-3 + KDG5V-5/7/8
EEF-PAM-523-A-3*	KD/TG4V-3 + KDG5V-5/7/8
EEA-PAM-525-A-12/3*	KD/TG4V-5
EEA-PAM-533-A-3*	KFD/TG4V-3
EEA-PAM-535-A-3*	KFD/TG4V-5
EEA-PAM-541-A-3*	KHDG5V-5/7/8 (zerolapped/Nullschnitt)
EEA-PAM-553-A-3*	KSDG4V-3
EEA-PAM-561-A-12/3*	KFDG5V-5/7
EEA-PAM-568-A-3*	KFDG5V-8
EEA-PAM-571-A-12	CVU-16/25/40-EFP1
EEA-PAM-581-A-3*	KHDG5V-5/7/8

Full technical details of these amplifiers can be found in the catalogs GB-C-2005 and GB-C-2007

Die detailierten technischen Daten dieser Verstärker können den Katalogen D-C-2005 und D-C-2007 entnommen werden.

Article No.
02-111926

GB/D-B-9046 B
10/92

1. Introduction

The operation of this amplifier has been factory-checked before despatch as meeting the specification shown in Vickers catalogs C-2007 and C- 2005.

The amplifier is ready for use as supplied, but it must be properly installed by qualified person using the machine designer's wiring diagram.

2. Pre-Installation Checks

a) Check for any damage received in transit.
b) Ensure that the model code on this amplifier is the correct one for the application.
c) Check that the 24VDC power supply is within the specification.
d) Ensure that no adjustments are made before the amplifier is installed and powered up (see paragraph 4).
e) Ensure that the power is switched OFF before installing it into its edge connector. (Never insert or remove the amplifier while the electronic system is live).

3. Wiring Sizes

Use 3-core screened cable ≥ 0.5 mm² (20 AWG) per wire for signal and LVDT wiring.
For wiring runs between amplifier and solenoid up to 50 metres (164 ft): EEA-PAM-520/3 and EEA-PAM-525 must have a wire cross section of 1.5 mm² (15 AWG).
For all other models use wire of ≥ 1 mm² (18 AWG) cross section.

4. Front Panel Controls

Any of the following controls may be on the front panel (depending on the amplifier type) and can be adjusted as described.

a) Set zero

On amplifier types 511, 513, 541 and 553 this sets the electrical null of the valve.

b) Deadband compensation

The two potentiometers are factory set at 10% (20% for 520/523 models) of valve maximum spool stroke. The setting may be optimised for your application as follows:
Apply a small command signal (e.g. 250mV) and check for hydraulic response from the valve. (For 2 stage valves the correct pilot pressure must be available to obtain response from the main-stage spool). If this does not occur then adjust the applicable potentiometer clockwise until it does. Alternatively, to reduce valve hydraulic response turn the potentiometer counter-clockwise.

c) Gain

The gain potentiometers are factory set for 100% output at 10V command signal. Turning the gain potentiometers clockwise increases gain; turning counter-clockwise reduces gain.

d) Ramps

The factory-setting of ramp potentiometers are:
All amplifiers are set to minimum ramp time.
Turning the controls clockwise increases ramp time; turning counter-clockwise decreases ramp time. On 12 design amplifiers one control adjusts all ramps; on 3* design amplifiers there are separate controls for accelerating and for decelerating ramps.

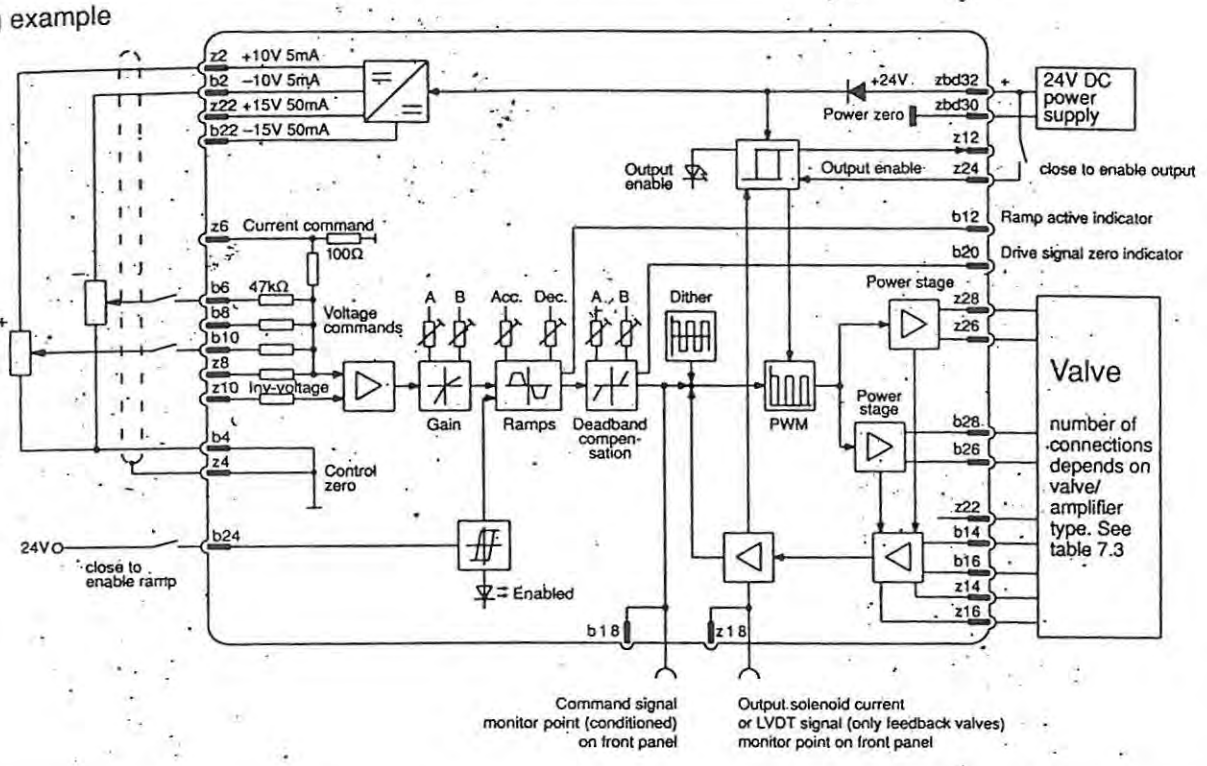
5. Front Panel Indicator Lights (LEDs)

Amplifiers may have some, or all, of the following LEDs, depending on amplifier type:

Panel symbol	Function indicated	Color	Normal working state
24V	Power supply ON	Green	ON
15V	Internal supply ON	Green	ON
	Output enabled	Yellow	ON
	Overload detection	Red	OFF
	LVDT failure	Red	OFF
	Ramps enabled	Yellow	ON
	Current to solenoid (Light intensity varies with solenoid current)	Yellow	ON

7.2 Circuit and connections of 3* design Amplifiers

wiring example



7.3 Valve connection table

This table shows how the different valves have to be connected to the associated amplifier.

Valve type	Amplifier type	Solenoid with LVDT, or hydraulic A	Solenoid with-out LVDT, or hydraulic B	Pilot stage LVDT			Main stage LVDT		
				Pin 1	2	3	Pin 1	2	3
ECG 02	EEA-PAM-511-A-3*	b26/b28	–	–	–	–	–	–	–
KCG-3	EEA-PAM-513-A-12/3*	b26/b28	–	–	–	–	–	–	–
KD/TG4V-3 and KDG5V-5/7/8	EEA-PAM-520-A-12	b26/b28	z26/z28	–	–	–	–	–	–
	EEA-PAM-523-A-3*	b26/b28	z26/z28	–	–	–	–	–	–
KD/TG4V-5	EEA-PAM-525-A-12/3*	b26/b28	z26/z28	–	–	–	–	–	–
KFD/TG4V-3	EEA-PAM-533-A-3*	b26/b28	z26/z28	–	–	–	b14	z22	b16
KFD/TG4V-5	EEA-PAM-535-A-3*	b26/b28	z26/z28	–	–	–	b14	z22	b16
KHDG5V-5/7/8 ero lapped	EEA-PAM-541-A-3*	–	z26/z28	z14	z22	z16	b14	z22	b16
KSDG4V-3	EEA-PAM-553-A-3*	–	z26/z28	–	–	–	b14	z22	b16
KFDG5V-5/7	EEA-PAM-561-A-12/3*	–	z26/z28	–	–	–	b14	z22	b16
KFDG5V-8	EEA-PAM-568-A-3*	–	z26/z28	–	–	–	b14	z22	b16
KVU 16/25/40-PP1	EEA-PAM-571-A-12	b26/b28	–	–	–	–	b14	z22	b16
HDG5V-5/7/8	EEA-PAM-581-A-3*	–	z26/z28	z14	z22	z16	b14	z22	b16

1. Allgemeine Beschreibung

Dieser Verstärker wurde von Vickers bei der Endkontrolle auf Funktion und Betriebssicherheit geprüft und entspricht den Daten aus den Vickers-Katalogen C-2007 und C-2005. Der Verstärker wird einbaufertig geliefert, muß aber entsprechend dem Stromlaufplan des Maschinen-Herstellers von einem Fachmann installiert werden.

2. Prüfungen vor dem Einbau

a) Auf Transportschäden kontrollieren.
b) Prüfen, ob die Typenbezeichnung des Verstärkers mit der Bezeichnung auf der Stückliste der Anlage identisch ist.
c) Prüfen, ob die 24-V-DC-Stromversorgung den Katalogangaben entspricht.
d) Darauf achten, daß der Verstärker vor dem Einbau und der Inbetriebnahme nicht verstellt wird (siehe Abschnitt 4).
e) Die Stromversorgung muß vor dem Einstecken des Verstärkers in die zugehörige Federleiste abgeschaltet sein (niemals den Verstärker stekken oder ziehen, solange die Versorgungsspannung eingeschaltet ist).

3. Leitungsquerschnitte

Für Signal- und Wegaufnehmerverdrahtung 3-adriges, abgeschirmtes Kabel mit einem Querschnitt von ≥ 0,5 mm² pro Ader verwenden.
Für Kabellängen bis 50 m zwischen Verstärker und Magnetventil:
Für EEA-PAM-520/3 und EEA-PAM-525 Leitungsquerschnitt von 1,5 mm² verwenden.
Für alle anderen Typen Leitungsquerschnitt ≥ 1mm² verwenden.

4. Bedienelemente an der Frontplatte

An der Frontplatte können (je nach Verstärkertyp) die folgenden Bedienelemente angeordnet sein; die Einstellung erfolgt gemäß Beschreibung.

a) Nullpunkt

Bei Verstärkertyp 511, 513, 541 und 553 wird damit der elektrische Nullpunkt des Ventils eingestellt.

b) Überdeckungssprung

Die beiden Potentiometer sind werksseitig auf 10% (bei Typen 520/523 20%) des max. Ventilkolbenhubs eingestellt. Die Einstellung kann für die Anwendung des Kunden wie folgt optimiert werden:

Ein kleines Eingangssignal (z.B. 250 mV) anlegen und prüfen, ob das Ventil hydraulisch anspricht. (Vorgesteuerte Ventile benötigen den vorgeschriebenen Steuerdruck, um den Hauptkolben auszulenken). Erfolgt keine Reaktion, zugehöriges Potentiometer im Uhrzeigersinn verstellen, bis das Ventil anspricht. Soll das Ansprechverhalten des Ventils verringert werden, Potentiometer entgegen dem Uhrzeigersinn verstellen.

c) Verstärkung

Die Verstärkungspotentiometer sind werksseitig auf 100% Ausgangsleistung bei einem Eingangssignal von 10 V eingestellt. Durch Verdrehen der Verstärkungspotentiometer im Uhrzeigersinn nimmt die Verstärkung zu, durch Drehen entgegen dem Uhrzeigersinn nimmt sie ab.

d) Rampen

Die Rampenpotentiometer sind werksseitig wie folgt eingestellt:

Alle Verstärker sind auf minimale Rampenzeit eingestellt. Durch Drehen im Uhrzeigersinn nimmt die Rampenzeit zu, durch Drehen entgegen dem Uhrzeigersinn nimmt die Rampenzeit ab. Bei Verstärkern der Baureihe 12 gibt es ein Potentiometer für die Rampeneinstellung; bei Verstärkern der Baureihe 30 sind separate Potentiometer für Beschleunigungs- und Verzögerungsrampen vorhanden.

5. LED-Anzeigen auf der Frontplatte

Je nach Typ sind die Verstärker mit allen oder einigen der folgenden LEDs bestückt:

Symbol	Funktion	Farbe	Normaler Betriebszustand
24V	Versorgungsspannung EIN	Grün	EIN
15V	Steuerspannung EIN	Grün	EIN
	Freigabe Endstufe	Gelb	EIN
	Magnetausgang überlastet	Rot	AUS
	Wegaufnehmer-Fehler	Rot	AUS
	Rampen Freigabe	Gelb	EIN
	Strom zum Magnet (Helligkeit variiert je nach Magnetstrom)	Gelb	EIN

6. Fehlersuche

Bei Ausfall des Verstärkers sind folgende Kontrollen vorzunehmen:

1) Prüfen, ob die Verdrahtung gemäß Herstelleranweisungen richtig erfolgt ist.

2) Prüfen, ob 24V-Versorgungsspannung anliegt und die 24V-LED leuchtet.

3) Prüfen, ob die LED für 15V-Steuerspannung leuchtet (leuchtet die 24V-LED, aber nicht die 15V-LED, ist der Verstärker auszuwechseln).

4) Prüfen, ob der Verstärker freigegeben ist und die LED leuchtet.

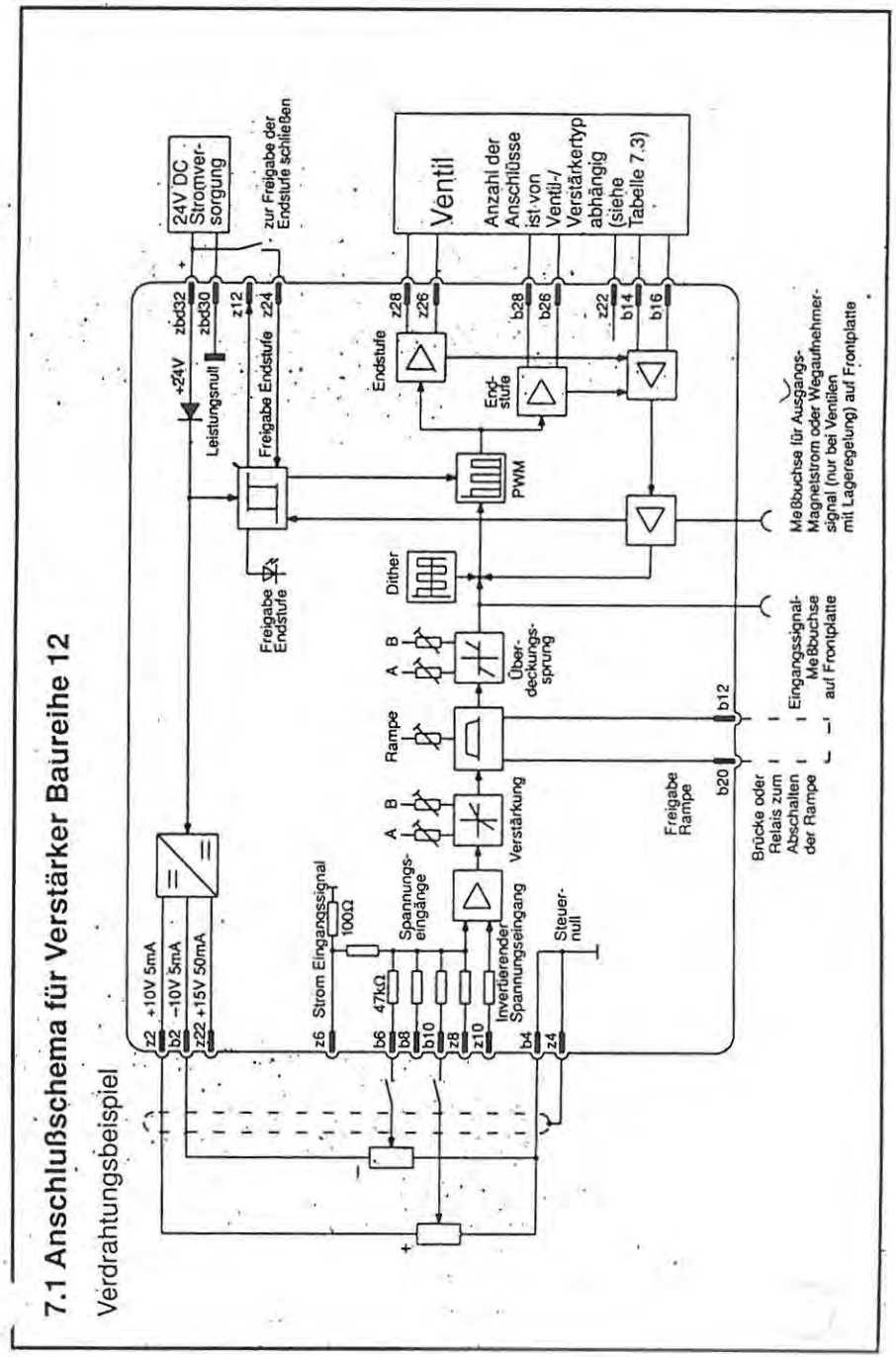
5) Prüfen, ob die LED für Wegaufnehmer-Fehler aus ist (leuchtet die LED, müssen Verdrahtung und Anschlüsse des Wegaufnehmers geprüft werden).
Um die Verstärkerfunktion zu überprüfen, alle Ventilanschlußkabel abklemmen, und Klemme Z22 (+15V) über einen 1,2 KΩ Widerstand mit Klemme b14 verbinden. Bei Verstärkern für zwei Wegaufnehmer EEA-PAM-581/541, zusätzlich Z22 (+15V) über einen 1,2 kΩ Widerstand mit Klemme Z14 verbinden. Sollte danach die LED Wegaufnehmer Fehler nicht aus sein, muß der Verstärker ausgewechselt werden.

6) Prüfen, ob die Magnetausgang Überlast-LED aus ist (leuchtet die LED, muß die Verdrahtung zu den Magneten und der Magnetwiderstand mit einem Ohmmeter geprüft werden. Die gemessenen Werte mit den Katalogwerten vergleichen).

7) Prüfen, ob ein korrektes Eingangssignal anliegt (Meßbuchse an Frontplatte):
- ±5V an Meßbuchse entspricht ±100% Ausgangssignal bei Verstärkern der Baureihe 12
  Bei EEA-PAM-513-A-12 entspricht 10V an Meßbuchse 100% Ausgangssignal.
- ±10V an Meßbuchse entspricht ±100% Ausgangssignal bei Verstärkern der Baureihe 3*

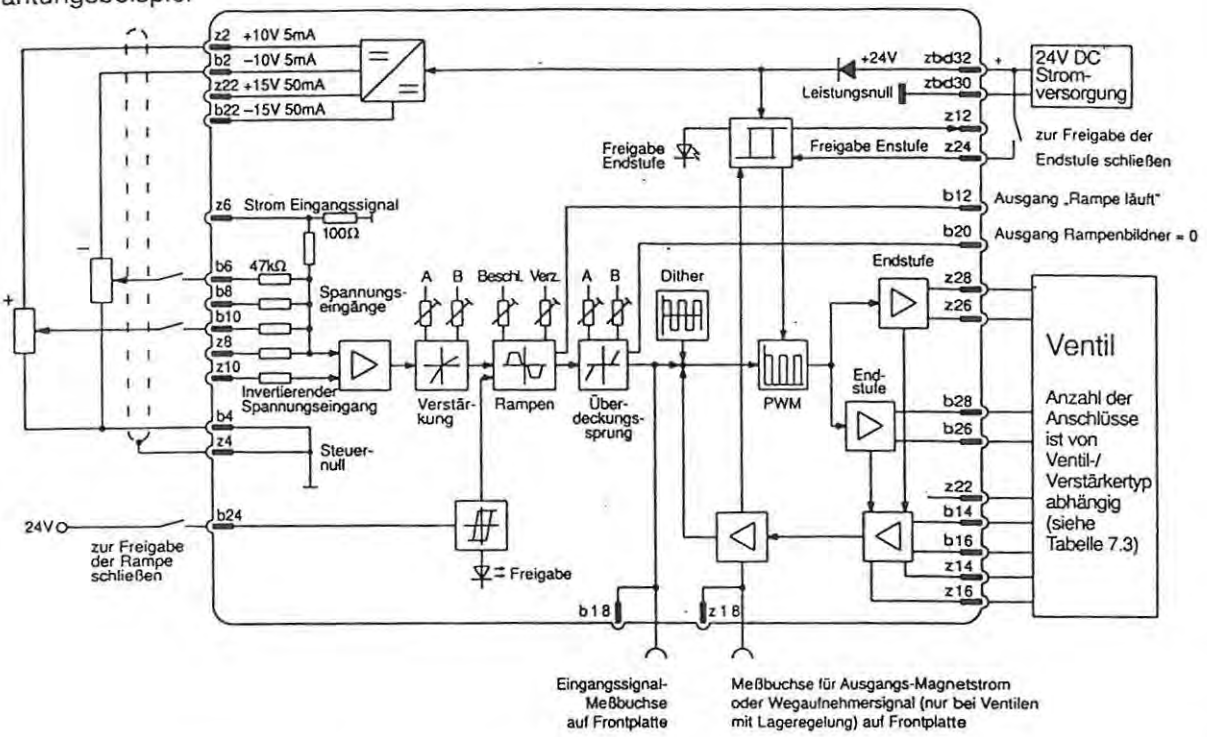
8) Der Magnetstrom (Ventile ohne Lageregelung) oder das Wegaufnehmersignal kann an der Meßbuchse an der Frontplatte gemessen werden.
- Der Magnetstrom kann als Spannungssignal 1V ≙ 1A gemessen werden.
- Wegaufnehmersignal ±5V an Meßbuchse entspricht ±100% Kolbenhub bei Verstärkern der Baureihe 12
- Wegaufnehmersignal ±10V an Meßbuchse entspricht ±100% Kolbenhub bei Verstärkern der Baureihe 3*

Zur Vereinfachung der Fehlerdiagnose können die speziell hierfür entwickelten Testgeräte EHA-TEQ-700-A-20 oder EBA-TEQ-706-A-10 eingesetzt wer welche über die Vickers-Händler erhältlich sind.



7.2 Anschlußschema für Verstärker Baureihe 3*

Verdrahtungsbeispiel

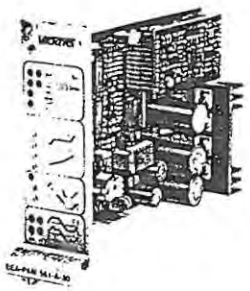


7.3 Ventilanschlußtabelle

In dieser Tabelle ist angegeben, wie die verschiedenen Ventile an den betreffenden Verstärker angeschlossen werden müssen.

Ventiltyp	Verstärkertyp	Magnet mit Wegaufnehmer oder Hydraulikanschluß A	Magnet ohne Wegaufnehmer oder Hydraulikanschluß B	Wegaufnehmer der Vorsteuerstufe			Wegaufnehmer der Hauptstufe		
				Pin 1	2	3	Pin 1	2	3
ECG 02	EEA-PAM-511-A-3*	b26/b28	–	–	–	–	–	–	–
KCG-3	EEA-PAM-513-A-12/3*	b26/b28	–	–	–	–	–	–	–
KD/TG4V-3 und KDG5V-5/7/8	EEA-PAM-520-A-12	b26/b28	z26/z28	–	–	–	–	–	–
	EEA-PAM-523-A-3*	b26/b28	z26/z28	–	–	–	–	–	–
KD/TG4V-5	EEA-PAM-525-A-12/3*	b26/b28	z26/z28	–	–	–	–	–	–
KFD/TG4V-3	EEA-PAM-533-A-3*	b26/b28	z26/z28	–	–	–	b14	z22	b16
KFD/TG4V-5	EEA-PAM-535-A-3*	b26/b28	z26/z28	–	–	–	b14	z22	b16
KHDG5V-5/7/8 mit Nullschnittkolben	EEA-PAM-541-A-3*	–	z26/z28	z14	z22	z16	b14	z22	b16
KSDG4V-3	EEA-PAM-553-A-3*	–	z26/z28	–	–	–	b14	z22	b16
KFDG5V-5/7	EEA-PAM-561-A-12/3*	–	z26/z28	–	–	–	b14	z22	b16
KFDG5V-8	EEA-PAM-568-A-3*	–	z26/z28	–	–	–	b14	z22	b16
KVU 16/25/40-PP1	EEA-PAM-571-A-12	b26/b28	–	–	–	–	b14	z22	b16
HDG5V-5/7/8	EEA-PAM-581-A-3*	–	z26/z28	z14	z22	z16	b14	z22	b16

Power amplifiers



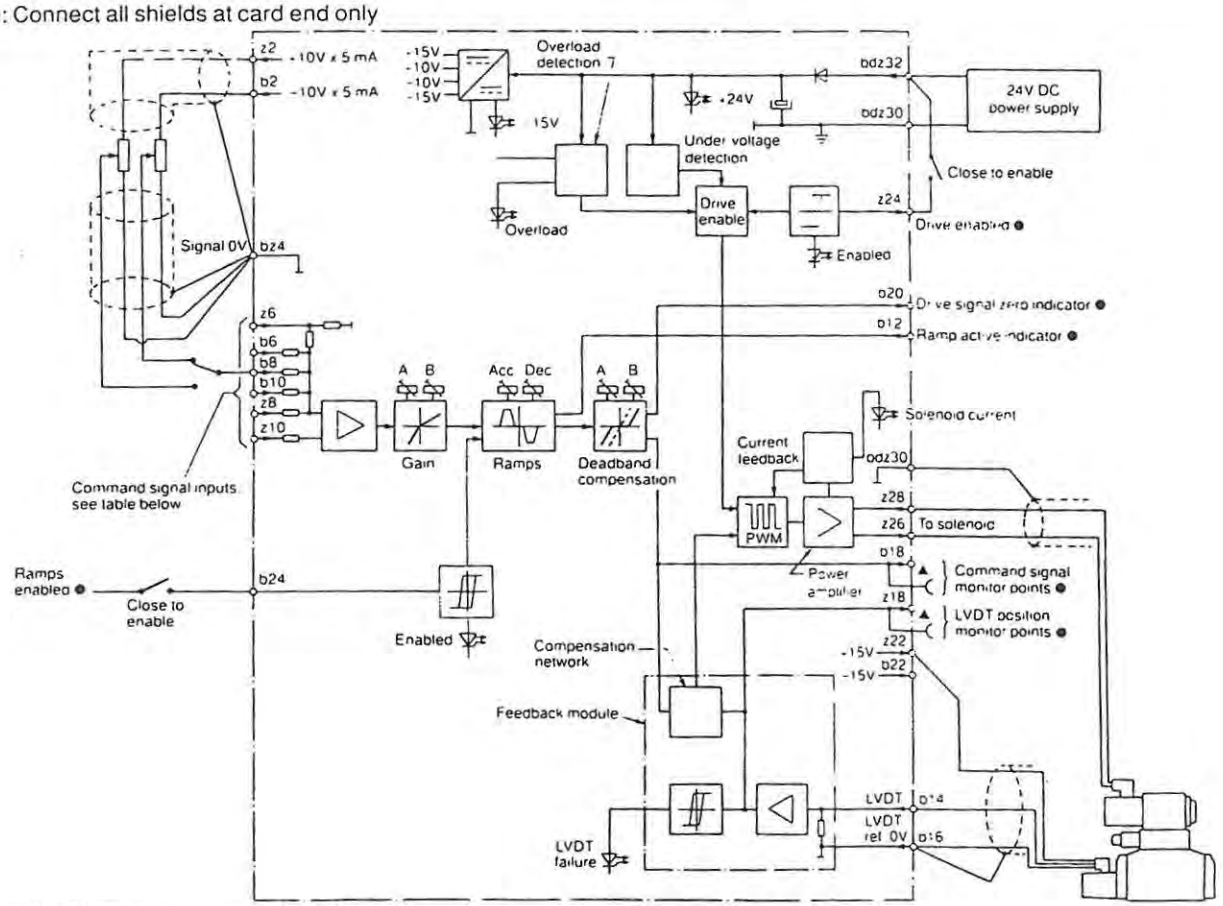
EEA-PAM-561-A-3* series for KFDG5V, 3* series valves
and KFDG5V-7, 1* series valves
EEA-PAM-568-A-3* series for KFDG5V-8, 1* series valves

- Basic valve amplifier
- Voltage and current command inputs
- Gain and deadband compensation
- 2 ramps (acc./dec., 2 quadrant)
- Single 24V DC power supply
- High efficiency, pulse-width modulated coil driver

Warning: To avoid possible uncontrolled movement of actuators on start-up, the power supply to the amplifier must be up to its rated voltage at least 0,5 seconds before pressure is applied to the valve

1. Circuit and connections

Note: Connect all shields at card end only



▲ On front panel
● See under this heading in "Operating data" table on next two pages

Command signals and outputs

Command signal Type	Input pins Ref.	Signal polarity	Secondary pins ref.	Valve flow
Non-inverting voltages	b6/8/10 or z8	+	bz4	P-B
		−		P-A
Non-inverting current	z6	+		P-B
		−		P-A
Inverting voltage	z10	−	Link (connect) *one* of b6/8/10 or z8 to bz4	P-B
		+		P-A
Differential voltage		−	*One* of b6/8/10 or z8	P-B
		+		P-A
	One of b6/8/10 or z8	+	z10	P-B
		−		P-A

2. Operating data

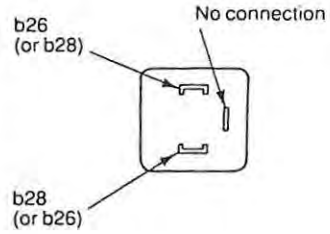
Power requirements	24V DC nominal x 40W Maximum voltage range: 20-40V (including ripple). Maximum ripple: ±10% pk.-to-pk. Amplifier shuts down below 18V DC. Reverse-polarity protected. See "Warning" note at top of previous page
Output voltages, for control: At pins z22 and b22 At pins z2 and b2	 ±15V x 50 mA Ripple <50 mV pk.-to-pk. ±10V (±1%) x 5 mA. Ripple <20 mV pk.-to-pk. Temperature drift <1 mV/°C (<0.5 mV/°F) thru 0-60°C (32-140°F) range. All outputs short-circuit protected
Command signal inputs: Direct-voltage pins Inverting-voltage pin Current pin Voltage range Input impedance (voltage) Current range Input impedance (current)	 b8, b6, z8, b10 z10 z6 ±10V 47 kΩ ±20 mA 100Ω
Power drive, single channel pulse-width-modulated (PWM): Standing solenoid current at zero command signal Working range	 1.4A 1.0 to 1.8A. Short-circuit protected Note: A positive signal to a non-inverting signal pin reduces solenoid current
Dither	Factory set
Deadband compensation, separate controls for both directions from spool-centered position: Factory-setting Adjustment per direction	 10% of max. stroke, from centered position 0 to 50% of max. stroke, from centered position
Gain, separate controls for both directions from spool-centered position: Factory-setting Adjustment per direction	 Max. spool stroke at 10V command signal from centered position 2.5 to 10% of max. spool stroke per 1V from centered position
Ramp time adjustment, linear: Factory-setting Independent adjustments for acceleration and deceleration	 Minimum (50 ms approx.) 50 ms to 5 s, under factory-set deadband compensation and gain conditions as specified above
Feedback from LVDT to b14	4 to 20 mA (100Ω)
Overload detection, factory-set	Automatic reset when fault removed
Drive enabled (power available to solenoid)	Apply >9.8V to <40V at z24 (22 kΩ)
Drive disabled (no power to solenoid)	Apply open circuit or up to 4.5V at z24

Continued on next page

Ramps enabled (valve switching rate limited by ramp potentiometers)	Apply >9,8V to <40V to b24 (47 kΩ)
Ramps disabled (fastest valve switching; ramp circuit bypassed)	Apply open circuit or up to 4,5V to b24
Command signal monitor points, front panel and b18 Output impedance	±10V full scale. Command signal conditioned by deadband compensation, gain and ramp functions 10 kΩ. Short-circuit protected
LVDT (main spool) position monitor points, front panel and z18 Output impedance	±10V at full stroke 10 kΩ. Short-circuit protected
Ramp active indicator, b12: Drive ramping up Drive ramping down Drive not ramping Output resistance	 Output >10V Output <−10V Output 0 ±10V 10 kΩ
Drive signal zero indicator, b20: Drive signal at null (within deadband limits) Drive active Output resistance	 Output = Supply −1.5V; I = 50 mA max. Output = 0 ±2V 50Ω
Ambient temperature range	0 to 60°C (32 to 140°F)
Edge connectors	DIN 41612 F48 male type on the board Mating connector can be F32 or F48 female type
Coding pin hole location	Between b and d9
Installation dimensions and panel display	See next page
Mass	0,33 kg (0.73 lb)
Installation and commissioning (start-up)	See page 122
Supporting products: Power unit options Electronic accessories Portable test equipment	See "Contents" table, page 3

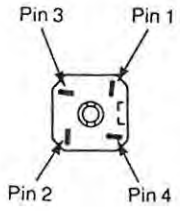
Valve wiring connections

Solenoid connections



Note: Connections *not* polarity sensitive

LVDT connections

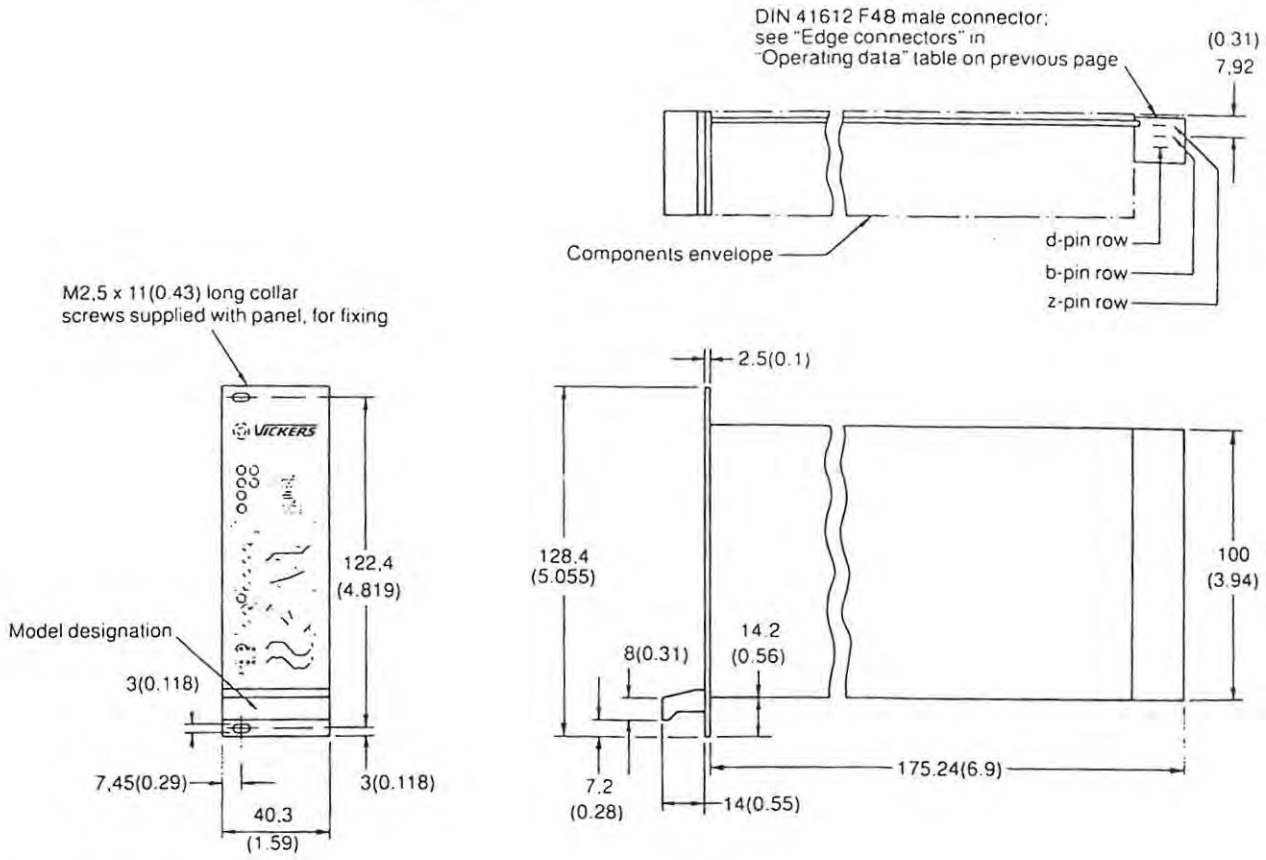


LVDT plug pin	Amplifier pin
1	b14
2	z22
3	b16
4	–

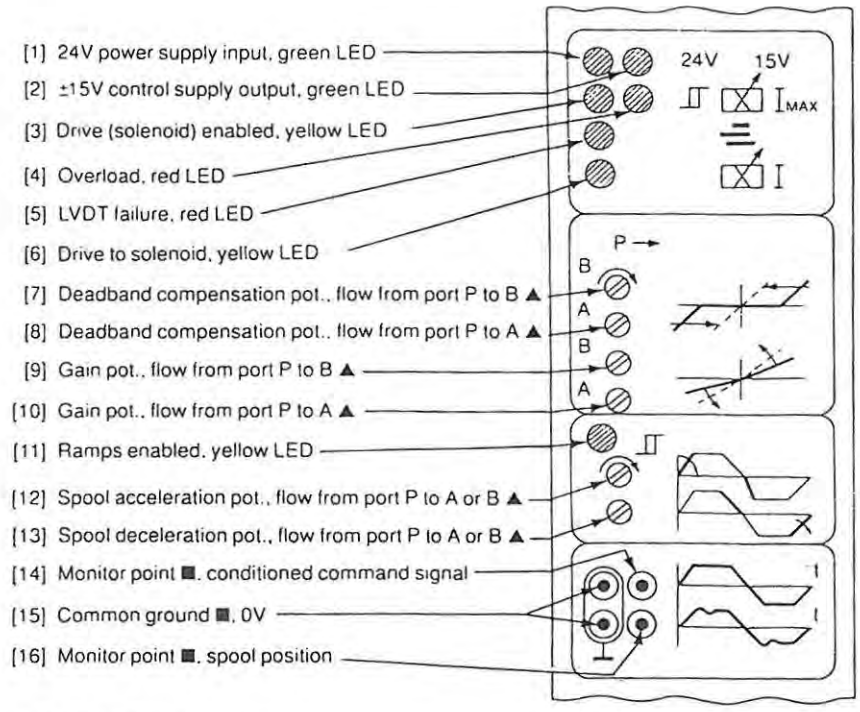
3. Installation dimensions, in mm (inches)

Plug-in unit of 3U height, to IEC 297

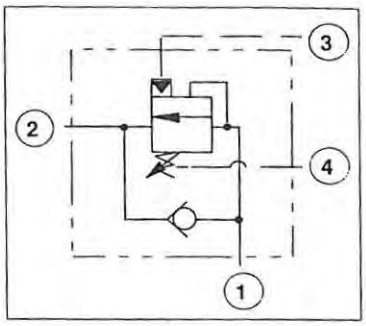
3rd angle projection



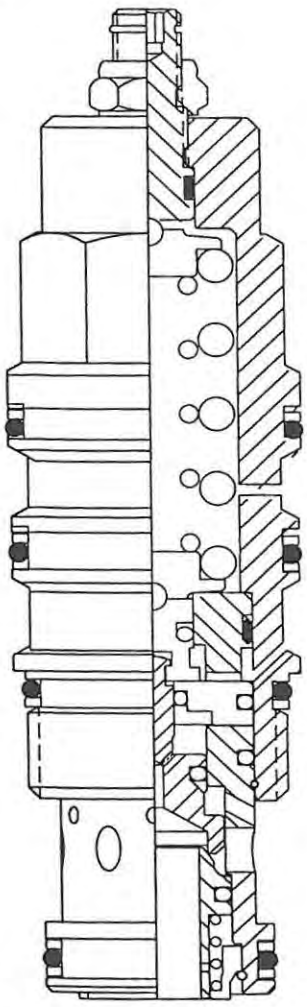
Panel display, full size



▲ Main-stage spool ■ Ø2(0.0787 dia.) sockets



LOAD CONTROL VALVES



TECHNICAL TIPS
LOAD CONTROL VALVES
(LOAD HOLDING AND MOTION CONTROL)

Applications

Because of the wide physical differences in mechanisms that are hydraulically actuated , it is important that SUN offer a wide variety of load holding and motion control cartridges:

- SUN cartridges can be mounted in, at, or near cylinders and motors to protect against hose failure and to improve system "stiffness".
- Some systems have enormous inertia (inductance) due to mass in motion or at rest. Stored energy must be handled very carefully.
- Some mechanical system components also store energy with high compliance (capacitance) due to flexible members, rubber tired platforms, and long hose lines acting as accumulators, while other systems are very stiff. Again, stored energy must be handled very carefully.
- Inductance/capacitance networks are natural oscillators with a wide variation in natural frequencies.

The following information is intended to provide some advice – some rules of thumb – to assist in selecting an appropriate valve for a particular application. It is possible that many different valves will work satisfactorily in a given application. It is also possible that no cartridge listed in this catalog will perform acceptably. SUN has anticipated and prepared for system problems in the following ways:

- All cataloged three port and four port load holding and motion control cartridges are physically and functionally interchangeable (same cavities, same flow path for a given frame size). This makes it easy to empirically optimize system performance.
- In addition to the valves listed in this catalog, SUN regularly manufactures and may carry in stock additional interchangeable cartridges with useful characteristics.
- Emergency manual release screws are available (standard or optional) on most cartridges.
- Malfunctioning cartridges can be removed for easy replacement, inspection, and cleaning without altering adjustment settings. Great care must be taken to assure that machines are mechanically held in position and that cartridges are not under pressure at the time cartridges are removed. **Stored energy can be extremely dangerous.**
- SUN valves are designed for long service but wear and tear on critical seating faces can and does take place. Shock tends to coin seats. Oil–borne contamination and water tends to erode seats. Gentle use tends to burnish and improve seats. Heavy contamination (sludge) can cause working elements to seize and lock valves open or closed.

NOTE: The servicing of hydraulically actuated machinery should always be carried out by trained personnel. Good service manuals are important. Appropriate instruction and warning plates mounted on machines are especially advisable.

SUN's engineers are prepared to discuss the technical performance of specific cartridges. We believe that SUN has had more experience with load holding and motion control cartridges than any other manufacturer and has more cartridges in service than any other manufacturer.

Design Concepts And Features

SUN offers two basic forms of load holding cartridges with several variations of each form.

PILOT CHECK VALVES

SUN three port pilot–to–open check cartridges are **non–modulating, on/off devices** that allow free flow through a check valve from port 2 (inlet) to port 1 (load) and then block reverse flow until a pilot pressure **directly proportional** to the load pressure is sensed at port 3 (pilot) so that a pilot piston can push the check poppet off its seat.

NOTE: When new, pilot–to–open check valves can lock loads with zero or near zero leakage for extended periods (typically 30 minutes or more). Absent nicks in the seating area, silting (even with "clean" oil) will normally produce a zero–leak seal within seconds after closing. Therefore, they are well suited for many clamp holding applications. Care should be taken to see that trapped oil does not contract due to cooling, or expand due to heating, which will lower or raise clamping force.

NOTE: The on/off action of pilot–to–open check valves makes them unsuitable for use with overrunning loads that will cause a loss of pilot pressure. Without pilot pressure the check valve will close until adequate pilot pressure is again restored, causing a ratcheting motion.

NOTE: Three port pilot–to–open check valves should never be used with paired cylinders. Pilot pressure will open the valve with the least load first, transferring the combined load to the second valve at double the pressure.

NOTE: Pilot–to–open check valves are not suited for use with hydraulic motors that leak internally.

COUNTERBALANCE CARTRIDGES

SUN three port counterbalance cartridges (with pilot–to–open assist) are **modulating devices** that allow free flow from port 2 (inlet) to port 1 (load) and then block reverse flow until a pilot pressure **inversely proportional** to the load pressure is sensed at port 3 (pilot). They typically employ a check valve for free flow in one direction, a relief valve to control flow in the other direction, and a pilot that lowers the relief valve setting with pressure. Thermal relief protection is provided in most systems. Deceleration control can be provided when used with open center directional control valves.

NOTE: Counterbalance valves improve motion control on most systems by guaranteeing that the directional valve always sees a positive load pressure, even under overrunning load situations. Because of the inverse pilot ratio, low loads require more pilot pressure and high loads require less pilot pressure. This tends to provide fine motion control and good stability in load moving systems.

NOTE: Counterbalance valves (with pilot–to–open assist) will lock with very low (approaching zero) leakage. Absent nicks in the seating area, silting (even with "clean" oil) will normally produce a zero leak seal within minutes after closing. Counterbalance valves are well suited for load positioning applications.

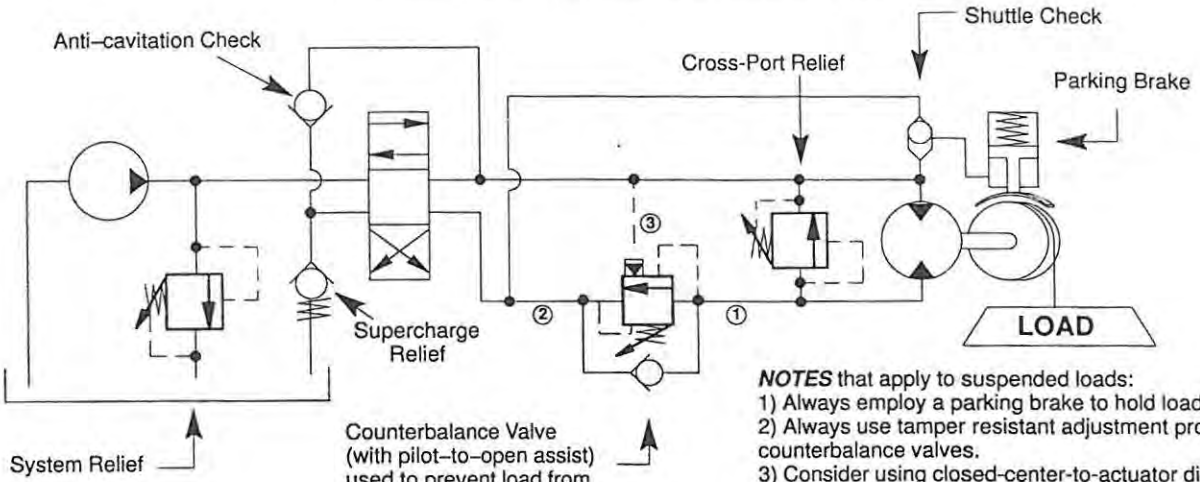
NOTE: Counterbalance valves (with pilot–to–open assist) can sometimes be used with paired cylinders. Because of the inverse pilot ratio the most heavily loaded cylinder will move first, tending to transfer part of the load to the more lightly loaded cylinder until cylinder load pressure is balanced.

NOTE: Counterbalance valves (with pilot–to–open assist) can be used with rotary hydraulic motors to control overrunning loads. (***NOTE:*** Anti–cavitation protection must be provided and mechanical brakes should be used to hold static loads)

LOAD CONTROL VALVES (LOAD HOLDING AND MOTION CONTROL)

MOTOR CIRCUIT

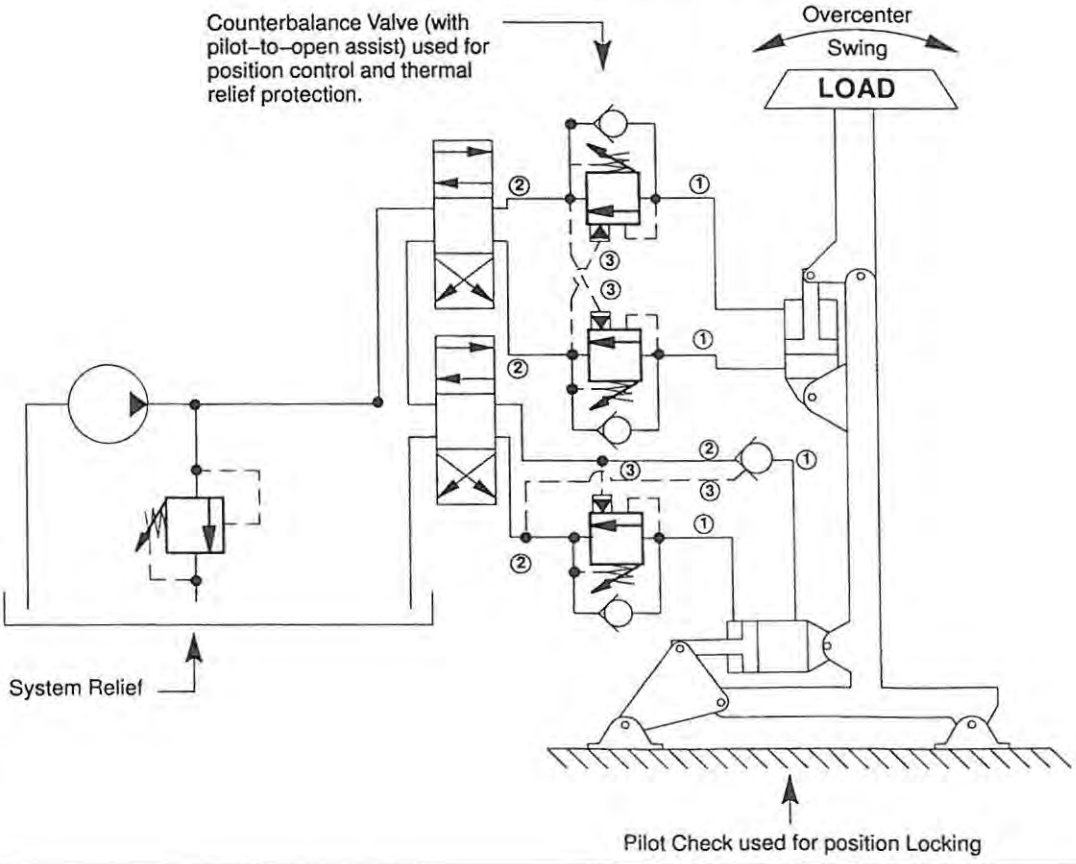
(This drawing is not a real circuit, but is intended for description only.)



NOTES that apply to suspended loads:
1) Always employ a parking brake to hold loads.
2) Always use tamper resistant adjustment protection on counterbalance valves.
3) Consider using closed-center-to-actuator directional valves to provide redundant load stopping, separate cross port relief protection and supercharged anti–cavitation protection, especially with cold oil, long lines, and elevated hydraulic motors.

POSITIONING CIRCUIT

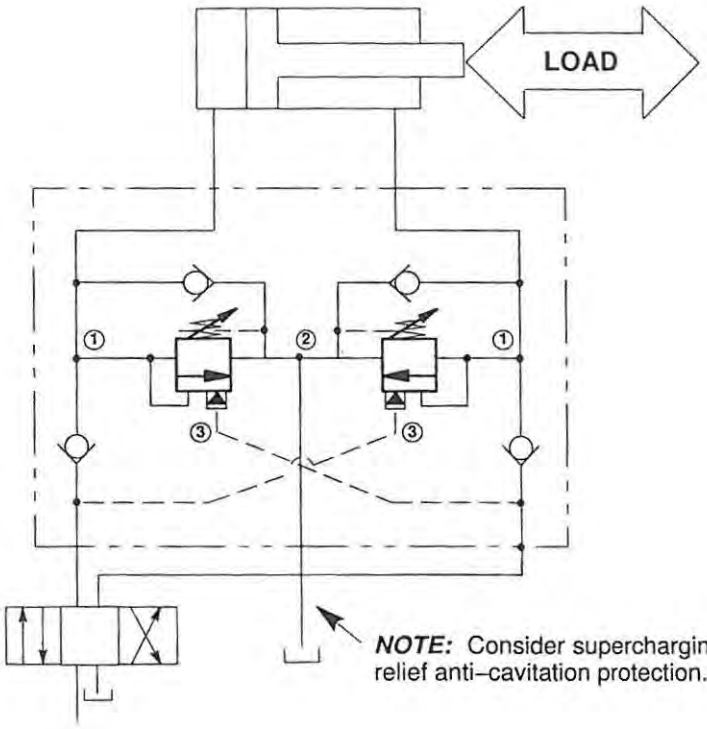
(This drawing is not a real circuit, but is intended for description only.)



LOAD CONTROL VALVES (LOAD HOLDING AND MOTION CONTROL)

LOAD CONTROL AND PURGING CIRCUIT

(This drawing is not a real circuit, but is intended for description only.)



Provides:

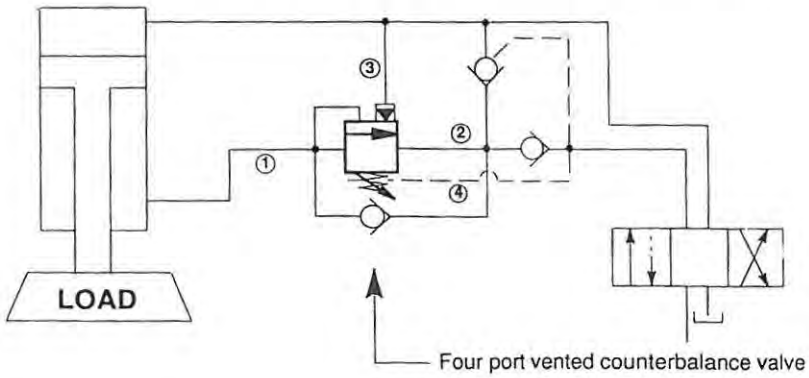
- Load holding
- Counterbalancing
- Cross Port Relief Protection
- Anti–cavitation Make–up Oil
- Air Purging
- Heat Purging
- Dirt Purging
- Cool, clean oil to Actuator

See pages 11.36 (EMK) ; 11.70 (BML); 11.134 (HMN), (KMR).

NOTE: Consider supercharging return line for cross–port relief anti–cavitation protection.

FULL TIME REGENERATIVE CIRCUIT (Same speed up and down)

(This drawing is not a real circuit, but is intended for description only.)



TECHNICAL TIPS
LOAD CONTROL VALVES (LOAD HOLDING AND MOTION CONTROL)

PILOT CHECK VALVES

Three Port Pilot–to–Open Check Valves – CK*B

The performance parameters optimized in SUN's three port pilot–to–open check cartridges are:

- Extremely low leakage on closing. The test specification for new valves is zero leakage. Subsequent use can cause seat damage where contamination or shock are present in systems. Systematic replacement programs may be in order.
- Operating pressures up to 5000 psi.
- Flow capacities to 120 GPM.
- 3:1 pilot ratio, suitable for most applications.
- Optional emergency manual release screw (in case pilot pressure is not available)
- Optional check valve springs (15 psi is the minimum recommended to avoid normal shock damage, 30 psi to avoid severe shock, and 4 psi to avoid cavitation).
- Intentional minor leakage past the pilot piston is standard (port 2 (inlet) to port 3 (pilot) and port 3 to port 2) to purge trapped air in the pilot line (desirable for most circuits). Optional sealed pilot pistons are offered for applications where cross port leakage is undesirable.

NOTE: When piloted open (port 1 (load) to port 2 (inlet)), pressure at port 2 is additive to the pilot pressure required at port 3 (pilot). SUN four port vented pilot–to–open check cartridges (CV*V) should be considered where port 2 is pressurized (For example: regenerative circuits).

NOTE: Back pressure at port 2 directly opposes pilot pressure.

Four Port Vented Pilot–to–Open Check Valves – CV*V

SUN's four port vented pilot–to–open check valves keep the pilot at port 3, and add port 4 (vent) to make the valve insensitive to back pressure at port 2 when the valve is piloted open. The performance parameters optimized in SUN's four port vented pilot–to–open check valves are:

- All of the features listed above except that all valves cataloged have a pilot piston seal to prevent leakage from port 3 to port 4 and vice versa.

NOTE: Port 4 (vent) should never be plugged as seal weepage will eventually cause valves to malfunction.

Pressure Required to Release Load

NOTE: The following equations are idealized. Back pressure at port 2 is excluded from these equations.

Where:

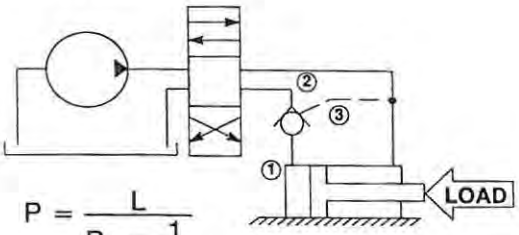
L = Load induced pressure

P = Pilot Pressure required to open valve

P_R = Pilot ratio (e.g. 3:1 = 3)

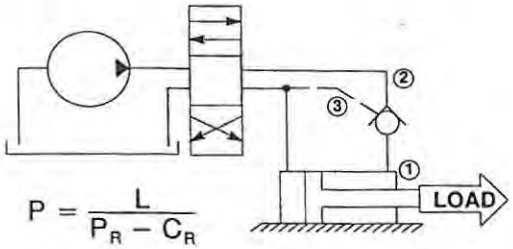
C_R = Cylinder Area Ratio $= \left(\frac{\text{Bore Dia}^2}{\text{Bore Dia}^2 - \text{Rod Dia}^2}\right)$

1) Pilot check on the blind end of the cylinder with a load retracting the cylinder rod.



$$P = \frac{L}{P_R - \frac{1}{C_R}}$$

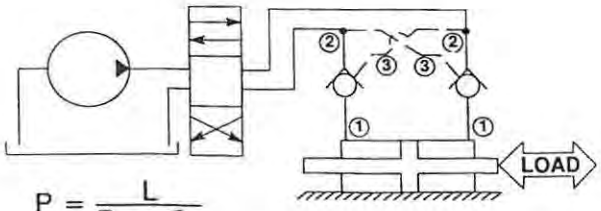
2) Pilot check on the rod end of the cylinder with a load extending the cylinder rod.



$$P = \frac{L}{P_R - C_R}$$

NOTE: It should be noted that the systems will self–lock when the rod diameters are large relative to the cylinder bore and cylinders are loaded to extend (use a counterbalance valve with pilot–to–open assist) with 10:1 ratio.

3) Pilot check on an equal area actuator.



$$P = \frac{L}{P_R - C_R}$$

LOAD CONTROL VALVES (LOAD HOLDING AND MOTION CONTROL)

COUNTERBALANCE CARTRIDGES

Three Port Counterbalance Valves (with Pilot–to–Open Assist) – CB**

The basic purpose of counterbalance valves is to convert negative (overrunning) loads into positive loads so that directional control valves always see a positive load. This greatly simplifies precise motion control. The performance parameters optimized in SUN's three port counterbalance valves (with pilot–to–open assist) are:

- Low leakage on closing. The maximum leakage test specification for new valves is 5 drops/min. leakage at 85% of pressure setting. Subsequent use can cause seat damage when contamination or shock are present in the system. Systematic replacement programs may be in order.
- Low relief valve hysteresis over a wide flow range.
- Good tolerance to oil–borne contamination.
- Very reliable and stable with both hot and cold oil.
- Operating pressures up to 5000 psi.
- Flow capacities to 100 GPM.
- Available with 3:1, 4.5:1, or 10:1 pilot ratios (see note below).
- Adjustment screw can be used to lower setting, thus providing an emergency manual release when pilot pressure is not available.
- Optional check valve springs (25 psi is recommended to avoid normal shock damage and 4 psi to avoid cavitation).
- Intentional minor leakage past the pilot piston is standard on most valves to purge air from the pilot line and improve stability. Sealed pilot pistons are standard on some valves.

NOTE: The setting of counterbalance valves should be at least 1.3 times the load induced pressure. Valves should be selected accordingly.

NOTE: Counterbalance valves should have pressure adjustments set on a test stand if possible, as it is very hard to know how the valve is set when it is in a circuit (1.3 times the maximum load induced pressure should be the minimum).

NOTE: In general, lower pilot ratios provide better motion control and stability, especially on spongy systems (with high capacitance) and with high inertial loads (with high inductance).

NOTE: High pilot ratios generally provide adequate control of motors, (but hydraulically released "deadman" brakes should be used to lock static loads due to motor leakage).

NOTE: High pilot ratios improve hydraulic system efficiency (lower heat generation), sometimes at the cost of stability and motion control.

NOTE: Counterbalance valves should normally not be used in closed loop hydrostatic systems as they can cause overheating.

NOTE: SUN's three port counterbalance cartridges (with pilot–to–open assist) usually work well with the opening characteristics of most directional valve spools (which almost simultaneously open P to A and B to T). SUN's three port counterbalance valves (with pilot–to–open assist) generally work best with meter–in directional valve spools (that open B to T **before** opening P to A). Some meter–out directional valve spools essentially double the load on cylinders by adding pump pressure on top of already loaded cylinders before permitting oil to flow to tank through the counterbalance valve. In these cases, four port vented counterbalance cartridges (CW**) should be considered.

NOTE: System stability can almost always be improved by adding an accumulator in the pilot line (by keeping the pilot pressure steadier).

NOTE: System stability can always be improved by adding a meter–out restrictive flow control between the cylinder or motor port and the counterbalance valve (by reducing the metering required of the counterbalance valve).

NOTE: Counterbalance valves can be damaged by severe decompression shock. To prevent shock damage, add a restriction between the cylinder and counterbalance valve.

NOTE: Counterbalance valves are not low pressure devices. Energy cannot be saved by using larger valves. System pressures should generally exceed 750 psi.

NOTE: When counterbalance valves are physically mounted at or near the bottom of cylinders, it is wise to consider providing a pilot line filter, or, at least, a pocket where dirt in the pilot line can settle. Sludge (such as found in reservoir bottoms) can cause valves to seize. **Be thoughtful about valve placement.**

SUN Two Port Counterbalance Valves (Direct Acting Relief Valves with Reverse Free Flow Check) (Not yet cataloged in one cartridge. See RDDA and bodies with reverse free flow check valves on pages 11.19 and 12.08.)

SUN's direct acting relief valves with reverse free flow check are suitable for **counterbalancing constant fixed loads** where the valve can be set at 1.3 times the constant load induced pressure. Performance parameters optimized in SUN's RD*A direct acting relief valves are:

- Low leakage on closing. The test specification for new valves is 10 drops/min. leakage. Subsequent use can cause damage when contamination or shock are present in the system. Systematic replacement programs may be in order.
- Low hysteresis and low leakage on closing. Valves reseat with leakage less than 10 drops/min. at 90% of valve setting.
- Fast opening and closing (2 ms).
- Relative insensitivity to oil–borne contamination.
- Reliability on closing with cold oil and exceptional stability (no oscillation) with hot oil, pressure shocks, or back pressure.

NOTE: Pressure at port 2 (return) will be directly additive to the valve setting.

SUN Three Port Counterbalance Valves (Direct Acting Sequence Valves with Reverse Free Flow Checks) (SC*A–pages 2.12, 2.13)

SUN's direct acting sequence valves with reverse free flow check are suitable for **counterbalancing constant fixed loads** where the valve can be set at 1.3 times the

constant load induced pressure. Port 3 (control spring chamber drain) has been added to make the pressure setting insensitive to back pressure at port 2.

- Low leakage on closing. The test specification for new valves is 5 drops/min. leakage. Subsequent use can cause seat damage when contamination or shock are present in the system. Systematic replacement programs may be in order.
- Built–in reverse free flow check.
- Low hysteresis and low leakage on closing. Valves reseat with leakage less than 10 drops/min. at 90% of valve setting.
- Fast opening and closing (2 ms).
- Relative insensitivity to oil–borne contamination.
- Reliability on closing with cold oil and exceptional stability (no oscillation) with hot oil, pressure shocks, or back pressure.
- Zero pilot flow (nevertheless, the control chamber drain must not be plugged. See note.)

NOTE: Port 3 (control chamber drain) must be connected to maintain a pressure reference in the control chamber. If port 3 is blocked, seal weepage will eventually cause valves to malfunction. Pressure at port 3 will be directly additive to the valve setting.

SUN's Three Port Counterbalance Valves (Reducing/ Relieving Valves) (PP*B–pages 3.10, 3.11)

SUN's reducing/relieving valves are sometimes used to provide a constant force which, for example, can replace counterweights in vertical lifts. (See Technical Tips for reducing/relieving valves on page 3.02)

SUN's Four Port Vented Counterbalance Valves (with pilot–to–open assist) CW*A and CW*G

SUN's four port vented counterbalance cartridges (with pilot–to–open assist) are similar to SUN three port counterbalance valves but add port 4 (vent) as a drain port, which makes the valve insensitive to backpressure at port 2 when the valve is piloted open to allow oil to flow from port 1 (load) to port 2 (valve). Insensitivity to backpressure on port 2 (valve) makes this valve useful in regenerative circuits, with meter–out directional valves, with proportional and servo valves, and in some hydrostatic transmission circuits.

Performance parameters optimized in SUN's four port counterbalance cartridges are similar to three port counterbalance cartridges except that the valves are only available with 3:1 and 5:1 pilot ratios.

NOTE: Port 4 (vent) should never be plugged as seal weepage will eventually cause the valves to malfunction. Pressure at port 4 will be directly additive to valve setting.

Pressure Required to Lower Load

NOTE: The following equations are idealized. Back pressure at port 2 is excluded from these equations.

NOTE: Back pressure at port 2 adds to the effective setting at a rate of 1 plus the pilot ratio times the backpressure. *Example:* Using a 3:1 counterbalance valve with 200 psi of back pressure, the setting increase would be 800 psi.

Where:

L = Load induced pressure

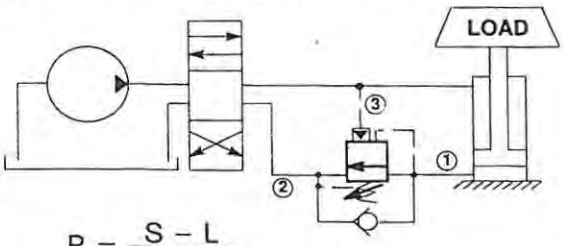
P = Pilot pressure required to lower load

P_R = Pilot ratio of valve (e.g. 3:1 = 3)

S = Setting of Valve

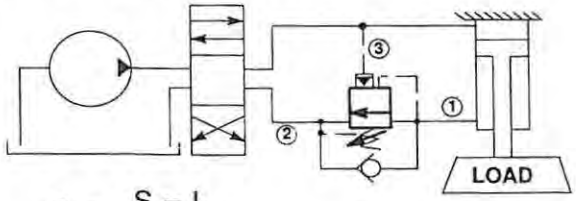
C_R = Cylinder Area Ratio = $\left(\frac{\text{Bore Dia}^2}{\text{Bore Dia}^2 - \text{Rod Dia}^2}\right)$

1) Counterbalance valve on the blind end of the cylinder with a load retracting the cylinder rod.



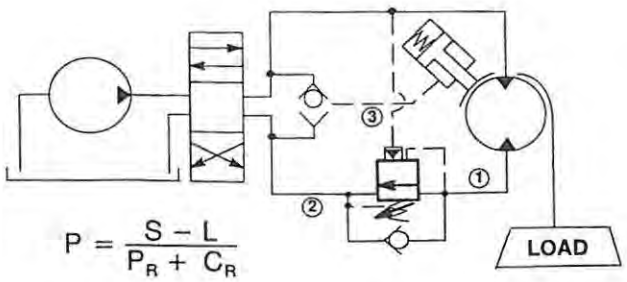
$$P = \frac{S - L}{P_R + \frac{1}{C_R}}$$

2) Counterbalance valve on the rod end of the cylinder with a load extending the cylinder rod.



$$P = \frac{S - L}{P_R + C_R}$$

3) Counterbalance valve on a motor or an equal area actuator with an overrunning load.



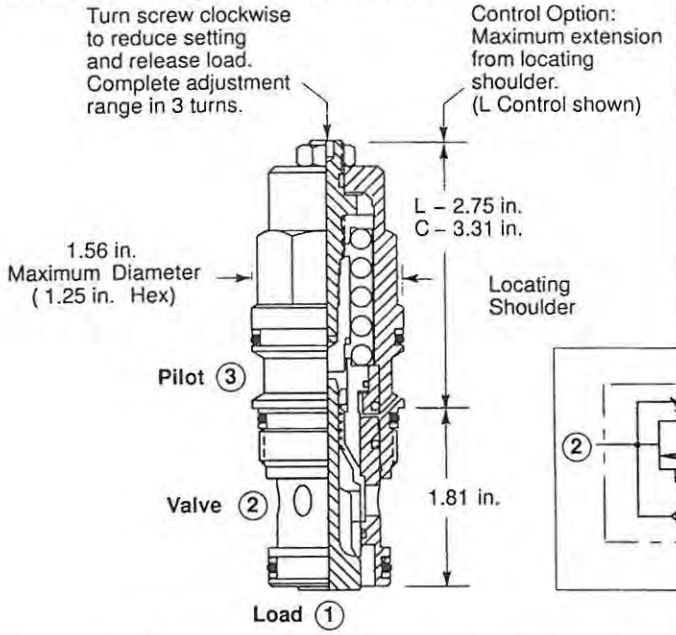
$$P = \frac{S - L}{P_R + C_R}$$

COUNTERBALANCE VALVE

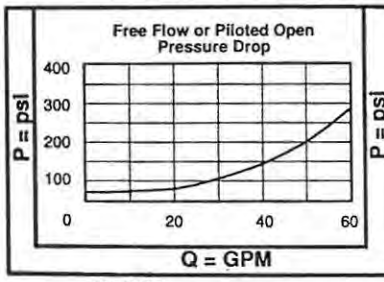
Refer to page 4.02 for further technical information.

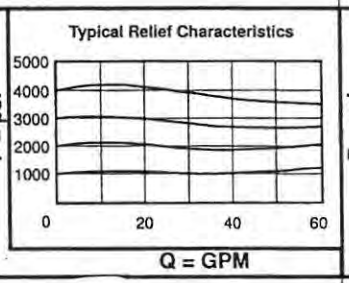
- 3:1 pilot ratio, load holding to 3000 psi (with 4000 psi setting).
- Load reactive pilot assist for overcenter load control applications.

0 to 60 GPM Nominal
Series 3 Cartridge T–17A Cavity
Installation Torque 150 to 160 lb. ft.



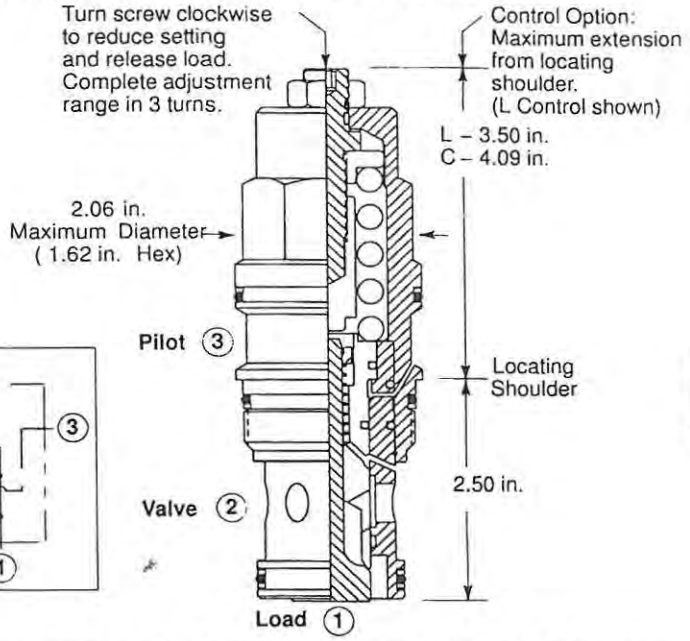
Back pressure at Port 2 may adversely affect operation of valve. (For circuits with back pressure, use CW*A).
Maximum leakage = 5 drops/min. at reseat.
Reseat exceeds 85% of set pressure.



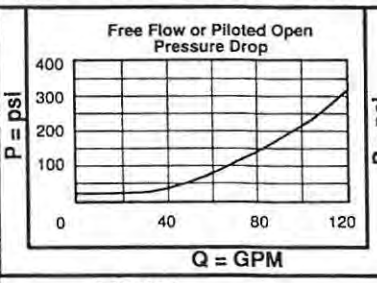


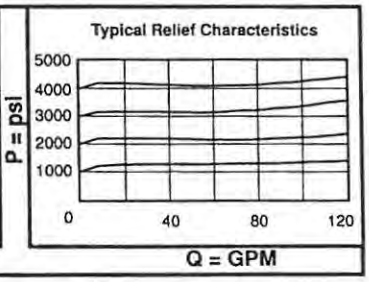
MODEL
CBGA – LHN

0 to 120 GPM Nominal
Series 4 Cartridge T–19A Cavity
Installation Torque 350 to 375 lb. ft.



Back pressure at Port 2 may adversely affect operation of valve. (For circuits with back pressure, use CW*A).
Maximum leakage = 5 drops/min. at reseat.
Reseat exceeds 85% of set pressure.





MODEL
CBIA – LHN

OPTIONS

CB * A – * * * – * * * / *
Basic cartridge from above

CONTROLS
See page x for more details on Optional Controls

L Standard Screw Adjustment

Nonstandard Controls
Tamper Resistant
Factory Set

⊗ADJUSTMENT RANGES
GENERAL PURPOSES
(25 psi Cracking Pressure)

H 1000 to 4000 psi
3000 psi Standard Setting

I 400 to 1500 psi
1000 psi Standard Setting

SPECIAL PURPOSES
(4 psi Cracking Pressure)

A 1000 to 4000 psi
3000 psi Standard Setting

B 400 to 1500 psi
1000 psi Standard Setting

Customer Specified Setting
Stamped on Hex

⊗ ***Setting should be 1.3 times maximum load induced pressure.***

SEALS
N Buna–N

V Viton

BODY
Omit for Cartridge Only
or
See Body Locator Page 4.08

High Pressure Switches

MODEL **WS**

- Field adjustable versions
- Variety of electrical connections
- Patented "O" ring back up mechanism
- Ruggerdized for severe conditions
- Snap action switch



Shown with Hirschman connector.
Others available.

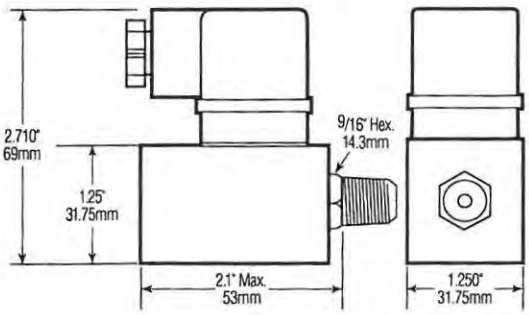
Basic Specifications

Set point range ..... 50-2500 PSI (3.4-170 BAR)
Set point tolerance .. 5%
Operating pressure .. 5000 PSI (340 BAR)
Burst pressure ..... 7500 PSI (510 BAR)
Differential 20%
Current rating ..... 5 AMP
Mounting ..... NPT steel
Adjustment ..... Factory preset/field adjustable

Standard Options

Mounting ..... ⅛, ¼" NPT, SAE "O" ring
Circuitry ..... A, B, C
Electrical connections .. Wire leads, blade, screw terminal, conduit
Current rating ..... 10 AMP
Adjustment range ..... 50- 150 PSI (3.4-10 BAR)
140- 400 PSI (9.5-27 BAR)
300- 800 PSI (20-55 BAR)
700-2500 PSI (47-170 BAR)

Many other variations are available.



MODEL **WL**

- Very high pressure applications
- Field adjustable versions
- Variety of electrical connections
- Patented "O" ring back up mechanism
- Ruggerdized for severe conditions
- Snap action switch



Shown with ½" conduit connector.
Others available.

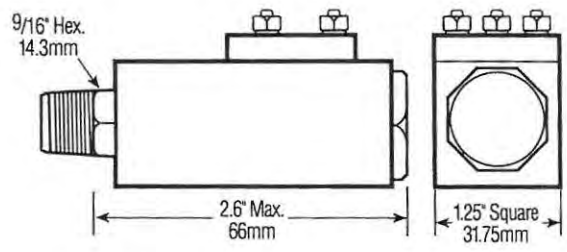
Basic Specifications

Set point range ..... 750-5000 PSI (50-340 BAR)
Set point tolerance .. 5%
Operating pressure .. 5000 PSI (340 BAR)
Burst pressure ..... 7500 PSI (510 BAR)
Differential 20%
Current rating ..... 5 AMP
Mounting ..... NPT steel
Adjustment ..... Factory preset/field adjustable

Standard Options

Mounting ..... ⅛, ¼" NPT, SAE "O" ring
Circuitry ..... A, B, C
Electrical connections .. Wire leads, blade, screw terminal, conduit
Current rating ..... 10 AMP
Adjustment range ..... 750-5000 PSI (50-340 BAR)

Many other variations are available.



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Installation & Instruction Manual for Analog Systems

04-95 550032 Revision E

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GENERAL INFORMATION

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Service:	800-248-0532
Fax:	919-677-0200
SHIPPING ADDRESS	***HOURS***
MTS SYSTEMS CORPORATION Sensors Division 3001 Sheldon Drive Cary, North Carolina 27513	Monday - Thursday 8:00 a.m. to 6:30 p.m. EST or EDT Friday 8:00 a.m. to 4:30 p.m. EST or EDT

The Temposonics II LDT precisely senses the position of an external magnet to measure displacement with a high degree of accuracy and resolution. Using the principle of magnetostriction (see Section 1.1, below), the Temposonics II LDT measures the time interval between the initiation of an interrogation pulse and the detection of a return pulse. A variety of interface devices use the data derived from these two pulses and generates an analog or digital output to represent position.

1.1 Theory of Operation/Magnetostriction

The interrogation pulse travels the length of the transducer by a conducting wire threaded through a hollow waveguide. The waveguide is spring loaded within the transducer rod and exhibits the physical property of magnetostriction. When the magnetic field of the interrogation pulse interacts with the stationary magnetic field of the external magnet, a torsional strain pulse or "twist" is produced in the waveguide. This strain pulse travels in both directions, away from the magnet. At the end of the rod, the strain pulse is damped within the "dead zone" (2.5 inches in length). At the head of the transducer, two magnetically coupled sensing coils are attached to strain sensitive tapes. The tapes translate the strain pulse through coils to an electrical "return pulse". The coil voltage is then amplified in the head electronics before it is sent to various measuring devices as the conditioned "return pulse".

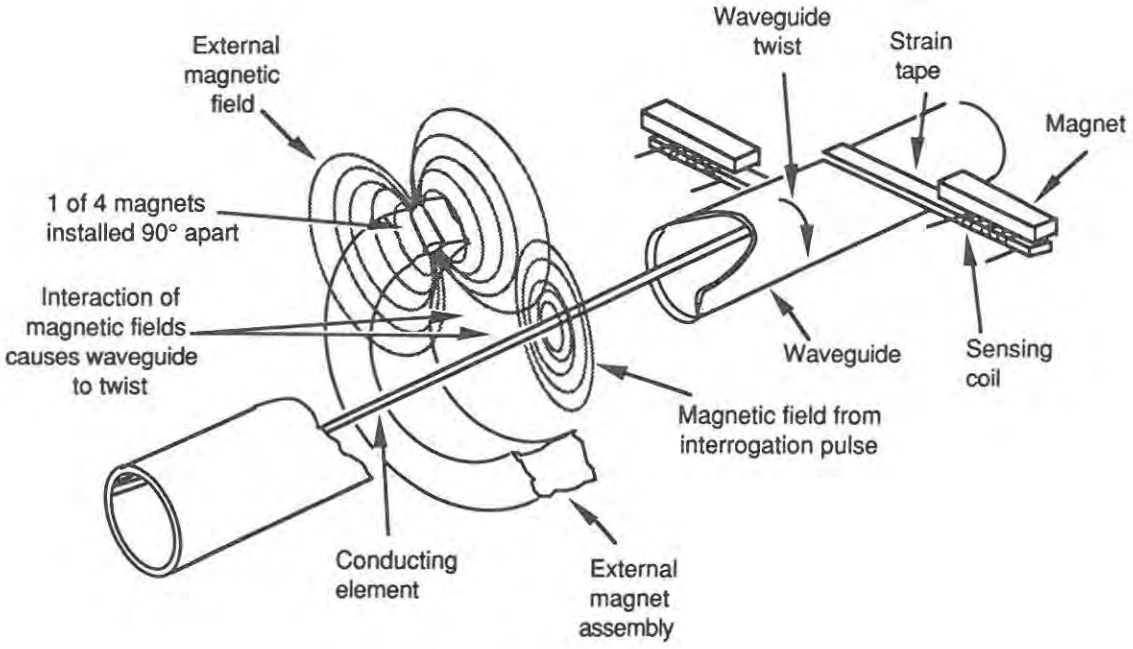


Figure 1-1
Waveguide Interaction

1.2 Standard Specifications

Parameter	Specification
Input Voltage:	± 12 to ± 15 Vdc
Current Draw:	**Transducer Only:** ± 15 Vdc at 100 mA maximum, 25 mA minimum *(current draw varies with magnet position, maximum draw occurs when magnet is at 2 in. (50.6 mm) from the flange and minimum update time is being utilized)* **Transducer with:** • *Analog Personality Module (APM):* ± 15 Vdc (+0, -3V) at 190 mA maximum, 115 mA minimum • *Analog Output Module (AOM):* + 15 Vdc at 250 mA, - 15 Vdc at 65 mA
Displacement:	Up to 25 feet (7620 millimeters)
Dead Space:	2.5 inches (63.5 millimeters)
Electronics Enclosure:	Designed to NEMA 6 specifications *Size*: 2.13 in (54.1 mm). high x 1.75 in. (44.45 mm) dia.
Non-linearity:	< ± 0.05% of full scale or ± 0.002 inch (±0.05 mm), whichever is greater
Repeatability:	± 0.001% of full scale or ± 0.0001 inch (± 0.002 mm)), whichever is greater
Hysteresis:	0.0008 inch (0.02 mm) maximum
Frequency Response:	Stroke dependent, 200 to 50 Hz for strokes ranging from 12 to 100 inches (305 to 2540 mm). Wider response is available.
Temperature Coefficient: Transducer (length dependent): Electronics:	 3 ppm/°F (5.4 ppm/°C) < 0.00011 in./°F (< 0.00503 mm/°C)
Operating Temperature Head Electronics: Transducer Rod: Analog Output Module:	 - 40 to 150 °F (- 40 to 66 °C) - 40 to 185 °F (- 40 to 85 °C) - 40 to 180 °F (- 40 to 82 °C)
Operating Pressure:	Factory Mutual certified to 3000 psi continuous, 8000 psi static
Outputs (absolute) Analog:	 Standard: 0 to 10 Vdc (others voltage outputs are available), Optional: 4 - 20 mA
Output Impedance:	10 Ω
Velocity Output (optional)	0 to ± 10 Vdc, polarity of output defines direction of travel *(optional 4-20 mA velocity output is available -- contact MTS for details)*
Additional Features:	Internal noise rejection circuitry, low ripple filter
Mounting Distances:	• Temposonics II to Analog Output Module: 250 feet • Temposonics II with Analog Personality Module to Rx: 150 feet

1.3 Specifications for Temposonics II LDTs over 200 Inches

Below is a list of specifications that pertain to rigid Temposonics II transducers with active stroke lengths of 200.1 in. (5083 mm) to 300 in. (7620 mm). Special versions of the AOM and DIB must be approved by the Applications Engineering Department when ordering long transducers.

Transducers over 200 inches exhibit characteristics that cause them to have more limited interfacing requirements and to perform differently than units under 200 inches. Contact MTS Sensors Division for a special applications note.

Parameter	Specification
Input Voltage:	• Maximum: ± 15 Vdc, ± 5% at 100 mA • Minimum: ± 15 Vdc at 25 mA *(current draw varies with magnet position, maximum draw occurs when magnet is 2 inches (50.8 mm) from the flange and minimum update time is being used)*
Dead Space:	3 in. (76.2 mm)
Cable Length:	• Maximum cable length for neuter version transducer (i.e., Temposonics II without an integrated Personality Module) which requires the use of external interface electronics (Analog output Module, Digital Interface Box or other signal conditioners) is 50 ft. • Maximum cable length for Temposonics II transducers with Personality Modules (i.e., RPM, DPM APM ..., etc.) is 500 ft.
Magnet Requirement:	Part Number: 201554 or 201553 ONLY

Before beginning installation, be sure you know the following dimensions (as illustrated in Figures 2-1 to 2-3a-c):

- Null Space
- Stroke
- Dead Zone

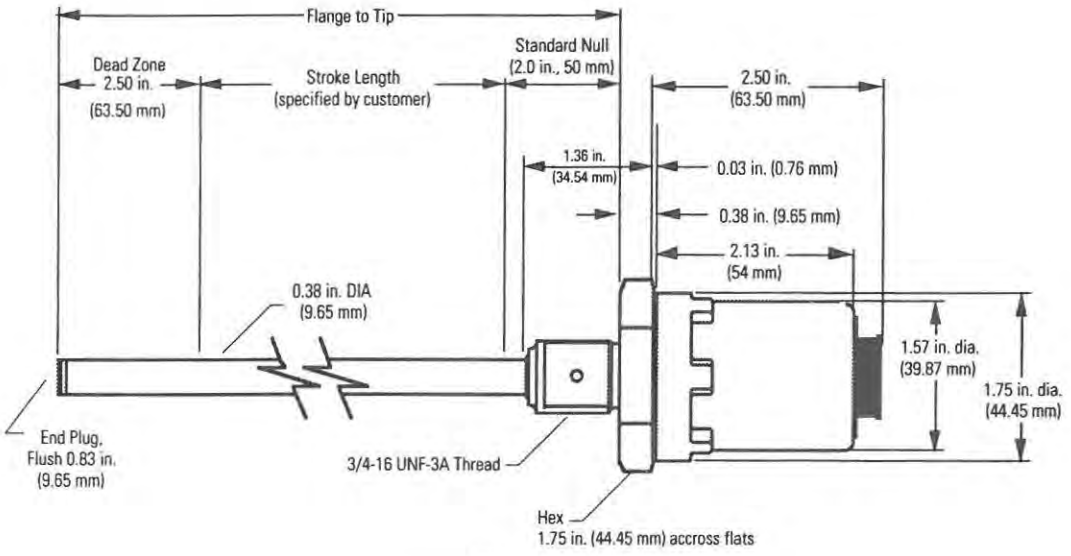


Figure 2-1
Temposonics II Dimension

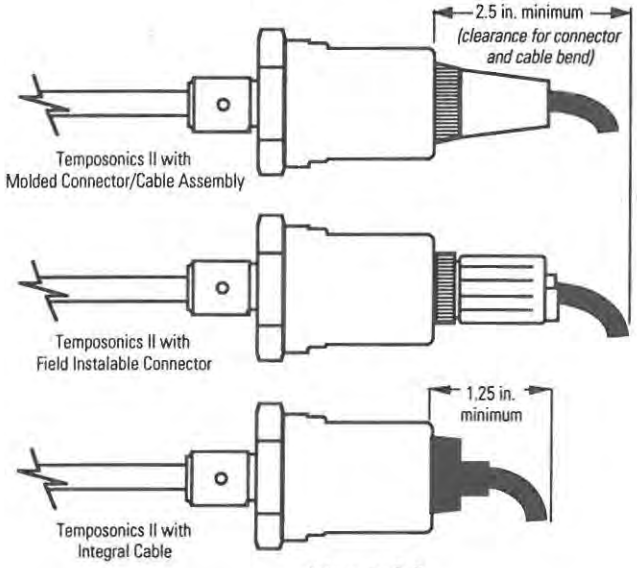


Figure 2-2
Temposonics II Connector/Cable Clearance Requirements

1. Use the 3/4 inch (19 mm), 16 UNF thread of the transducer to mount it at the selected location. Leave room to access the hex head. If a pressure or moisture seal is required, install an O-ring (type MS 28778-8 is recommended) in the special groove . Use the hex head to tighten the transducer assembly.

2. Install the permanent magnet over the LDT rod. Mount the permanent magnet to the movable device whose displacement will be measured. To minimize the effect of magnetic materials (i.e. iron, steel, etc.) on the magnetic field of the permanent magnet, ensure the minimum spacing requirements are met as shown in Figure 2-3a-c. (Any non-magnetic materials can be in direct contact with the permanent magnet without affecting performance.)

3. Extension end plugs can be purchased to extend the dead zone of the transducer from 2.5 inches to 5 or 7 inches for mounting purposes.

NOTE

MTS recommends that an additional 2.5 to 4.5 inches of stroke length be purchased rather than extension end plugs.

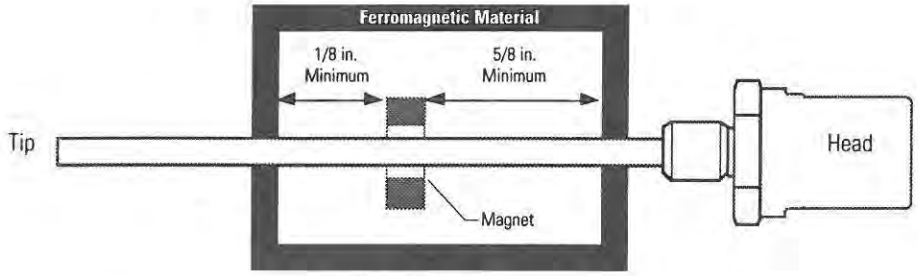


Figure 2-3a
Minimum Magnet Clearance Using Magnetic Supports

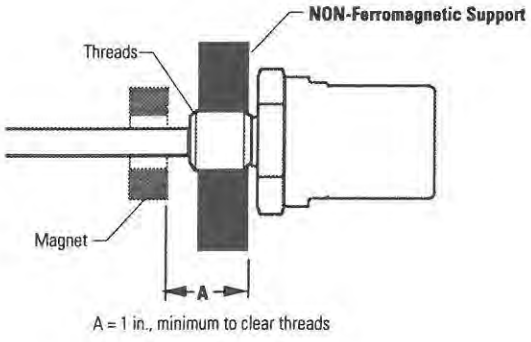


Figure 2-3b
Minimum Null Space Using Non-Magnetic Support

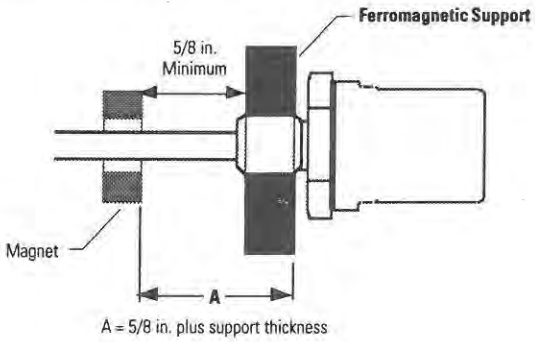


Figure 2-3c
Minimum Null Space Using Magnetic Support

Notes:
1. The magnet must not contact ferromagnetic materials (such as iron or steel). Clearances are required between the surface of the magnet and ferromagnetic material, as shown. Non-ferrous material (such as copper, brass, or 300 series stainless steel) may contact the magnet without affecting transducer performance.
2. Standard Null Space is 2 inches. There is no maximum limit for Null Space. Less then 2 inches can be specified if magnet clearances meet requirements illustrated above.

NOTE

Clearance between the magnet and the transducer rod is not critical. However, contact between the components will cause wear over time. The installation of supports or readjustment of the supports is recommended if the magnet contacts the transducer rod.

4. Move the permanent magnet full-scale to check that it moves freely. If not (if the magnet rubs on the transducer) you can correct this by mounting a support bracket to the end of the transducer. Long transducers may need additional supports to be attached to the transducer rod. Transducer supports are described later in this section.

2.1 Types of Transducer Supports

Long transducers (48 inches or longer) may require supports to maintain proper alignment between the transducer rod and the permanent magnet. When transducer rod supports are used, special, open-ended permanent magnets are required.

Transducer supports attached to the active stroke length must be made of a non-ferrous material, thin enough to permit the permanent magnet to pass without obstruction. Because the permanent magnet does not enter the dead zone, supports connected within the dead zone may be made of any material. The main types of supports are loop, channel, and guide pipe supports.

2.1.1 Loop Supports

Loop supports are fabricated from non-ferrous materials, thin enough to permit free movement of the magnet. Loop supports are recommended for straight transducers. They may be used alone or with channel supports. Figure 2-4 illustrates the fabrication of a loop support.

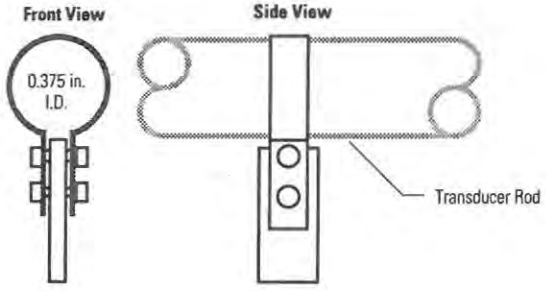


Figure 2-4
Loop Support

NOTE

When open magnets are used, ensure the transducer rod remains within the inside diameter of the magnet throughout the length of the stroke. If the transducer rod is allowed to enter the cut out area of an open magnet, the transducer signal could attenuate or be lost. See Figure 2-7.

2.1.2 Channel Supports

Channel supports, being typically straight, are normally used with rigid transducers. A channel support consists of a straight channel with loop supports mounted at intervals. The loop supports are required to keep the transducer within the channel. Figure 2-5 shows a channel support. Channel supports are available from various manufacturers or may be fabricated.

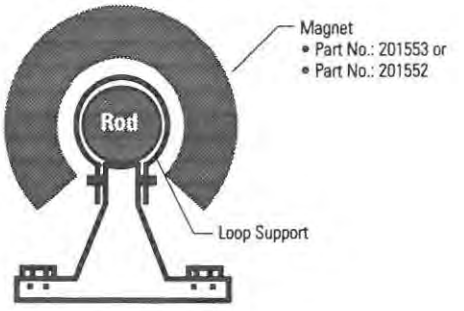


Figure 2-5
Channel Support

2.1.3 Guide Pipe Supports

Guide pipe supports are normally used for flexible transducers. A guide pipe support is constructed of non-ferrous material, straight or bent to the desired shape. As shown in Figure 2-6, both inside and outside dimensions of the pipe are critical:

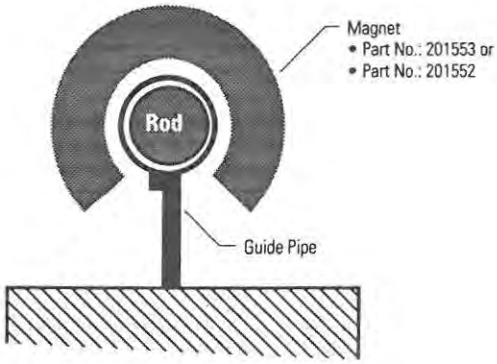


Figure. 2-6
Guide Pipe Support

- Because the transducer rod is installed inside the pipe, the inside diameter of the pipe must be large enough to clear the rod.
- The outside diameter of the pipe must be small enough to clear the magnet.

Refer to pipe manufacturers' specifications and dimensions (schedule 10, 40, etc.) to select the appropriate size pipe. Guide pipe is typically supported at each end of the pipe.

2.2 Open Magnets

When using an open magnet, make sure the rod is positioned at all times within the "active" zone of the magnet. The transducer cannot operate properly unless the entire stroke of the transducer rod is located within this zone. The active zone, as shown in Figure 2-7, lies within the inside diameter of the magnet.



Figure 2-7
Active Zone for Open Magnets

2.3 Spring Loading or Tensioning

The transducer rod (flexible or rigid) can be spring loaded or tensioned using a stationary weight. Attach a spring mechanism or weight to the dead zone of the transducer rod with a clamping device which will not deform the transducer rod. The maximum weight or spring tension is 5 to 7 lbs.

2.4 Cylinder Installation

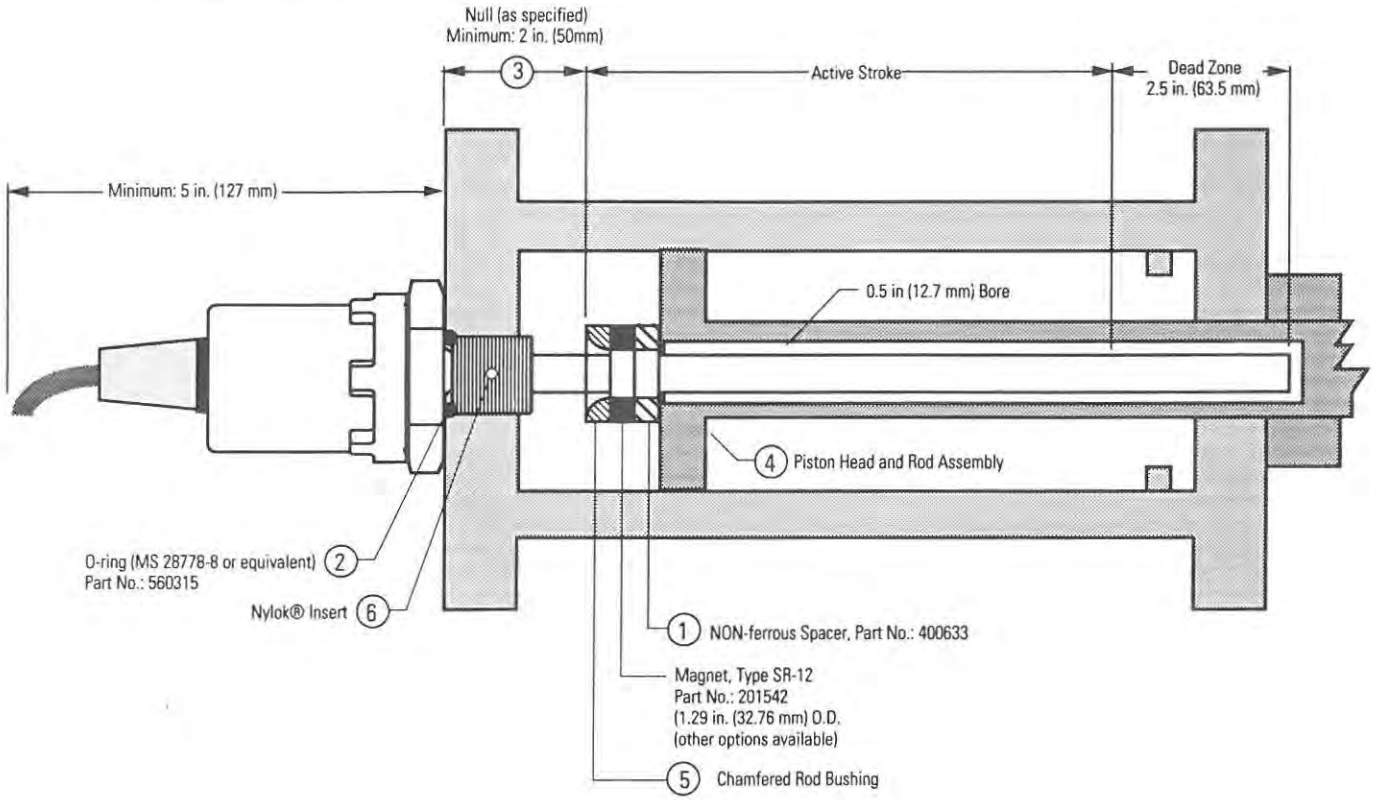
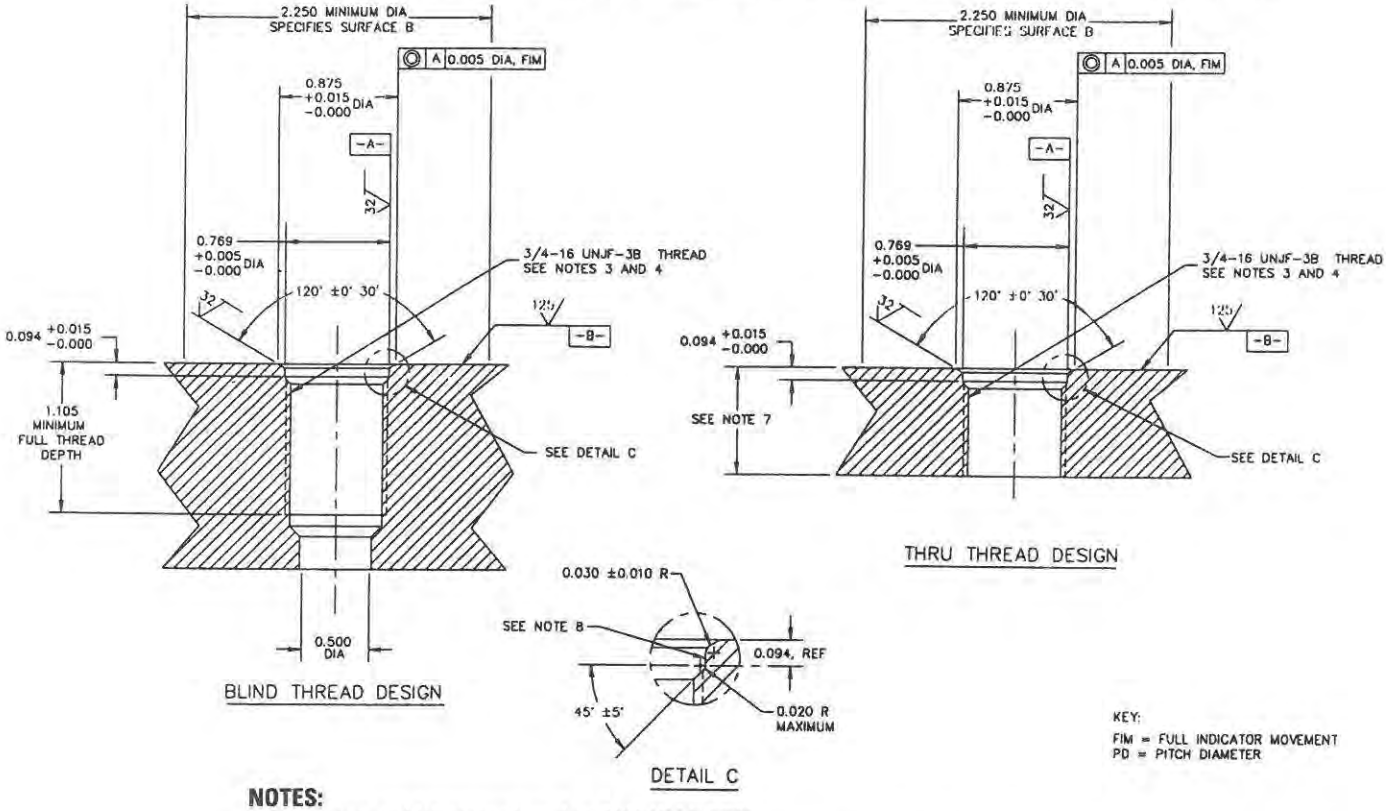


Figure 2-8
Typical Cylinder Installation

Figure 2-8 shows a typical cylinder installation. Review the following before attempting this type of installation.

- Use a non-ferrous (plastic, brass, Teflon®, etc.) spacer [1] to provide 1/8 inch (32 mm) minimum space between the magnet and the piston.
- An O-ring groove [2] is provided at the base of the transducer hex head for pressure sealing. MTS uses mil-standard MS33514 for the O-ring groove. Refer to mil-standard MS33649 or SAE J514 for machining of mating surfaces.
- The null space [3] is specified according to the installation design and cylinder dimensions. The analog output module provides a null adjustment. Make sure that the magnet can be mounted at the proper null position.
- The piston head [4] shown is typical. For some installations, depending on the clearances, it may be desired to countersink the magnet.

- A chamfered rod bushing [5] should be considered for stokes over 5 feet (1.5 meters) to prevent wear on the magnet as the piston retracts. The bushing should be made from Teflon or similar material.
- A Nylok self locking insert [6] is provided on the transducer threads. An O-ring groove is provided at the base of the transducer hex head for pressure sealing.
- The recommended bore for the cylinder rod is 1/2 inch (13 mm). The transducer rod includes a 0.375 inch flush (9.53 mm) end plug. Use standard industry practices for machining and mounting of all components. Consult the cylinder manufacturer for applicable SAE or military specifications.



NOTES:

1. Dimensions and tolerances based on ANSI Y14.5-1982.
2. MTS has extracted all pertinent information from MS33649 to Generate this document.
3. PD must be square with surface B within 0.005 FIM across 2.250 dia minimum.
4. PD must be concentric with 2.250 dia within 0.030 FIM and with 0.769 dia within 0.005 FIM.
5. Surface texture ANSI B46.1-1978.
6. Use o-ring MTS part number 560315 for correct sealing.
7. The thread design shall have sufficient threads to meet strength requirements of material used.
8. Finish counter-bore shall be free from longitudinal and spiral tool marks. Annular tool marks up to 32 micro-inches maximum will be permissible.

Figure 2-9
O-ring Boss Detail

2.5 Installing Magnets

Figure 2-10 below shows the standard magnet types and dimensions. The circular magnet with an outside diameter of 1.29 inches and 0.53 inch inside diameter (Part No. 201542) is the most common and is suitable for most applications. Larger magnets, with an outside diameter of 2.5 inches are typically only used with Temposonics transducers that exceed 200 inches in stroke length. Magnets with a 90 degree cut-out are used in applications that require intermediate supports along the transducer rod.

If upon installation, the null adjustment is inadequate, you can design a coupler with adjustments to mount the magnet to the measured member.

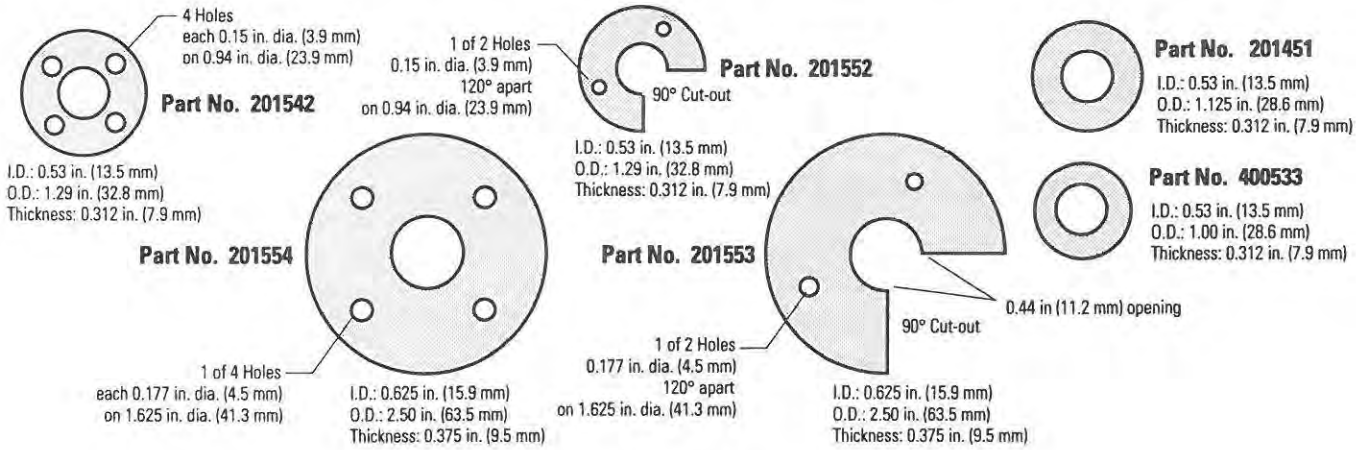
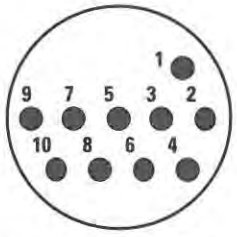


Figure 2-10
Magnet Dimensions

Table 3A
Temposonics II Connections (Neuter Version and with APM)

	Temposonics II Integrated or Extension Cable *(see Note 1)*		Temposonics II Configurations: • **Neuter** - No Personality Module • **APM** - Analog Personality Module	
Pin No.	**Wire Color Code**	**Wire Color Code**	**Neuter**	**APM Option**
1	White/Blue Stripe	White	DC Ground	DC Ground
2	Blue/White Stripe	Brown	Frame	Frame
3	White/Orange Stripe	Gray	-	Displacement Return
4	Orange/White Stripe	Pink	-	Displacement Out
5	White/Green Stripe	Red	VCC	VCC
6	Green/White Stripe	Blue	VEE	VEE
7	White/Brown Stripe	Black	-	-
8	Brown/White Stripe	Violet	Output (return pulse)	-
9	White/Gray Stripe	Yellow	(+) Interrogation (Note 2, 3, 4)	-
10	Gray/White Stripe	Green	(-) Interrogation (Note 2, 3, 4)	-

Notes:
1. Verify if the Temposonics II cable has striped or solid color leads and make connections accordingly.
2. 1 to 4 µs pulse duration.
3. **IMPORTANT:** Connect the unused interrogation lead to ground.
4. When using a Temposonics II transducer with a Digital Personality Module (DPM) or an RS422 Personality Module (RPM), it is recommended that both the positive and negative interrogations leads are used to produce a differential interrogation signal.



Temposonics II 10-Pin Connector

Table 3B
Connections - Original Temposonics Transducer

Original Temposonics Connector Pin Number	Wire Color Code	Signal Function
A	Green or Gray	+ 15 Vdc
B	Black	DC Ground
C	Orange or Brown	Return Pulse *(from LDT)*
D	Blue	- 15 Vdc
E	White	Interrogation Pulse
F	Red	+ 12 Vdc

NOTE

The following checklist is for general diagnostic purposes. Purchase of replacement components should not be based solely on this checklist. Consult MTS Sensors Division for recommendations and factory service before ordering replacement components.

4.1 General

Use the below checklist when operational problems are encountered. The possible causes of faulty output are listed below in order of probability of occurrence, and should be checked in order.

1. Improper power supply/power connection
2. Mismatched system components*
3. Ground loops/improper grounding*
4. Improper wiring
5. Incorrect receiver device or software*
6. Improper magnet mounting
7. EMI noise, affecting transducer or transducer cable
8. Circuit fault within transducer

* *Will cause erratic or unstable output*

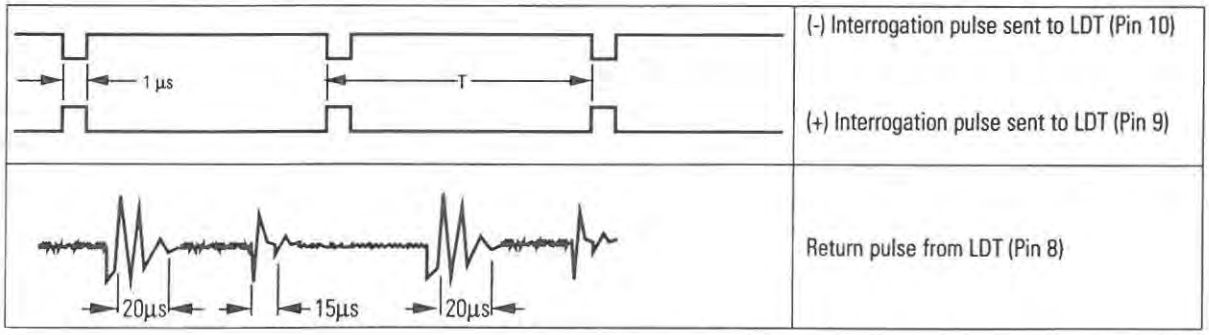


Figure 4-1
Temposonics II Transducer Signals

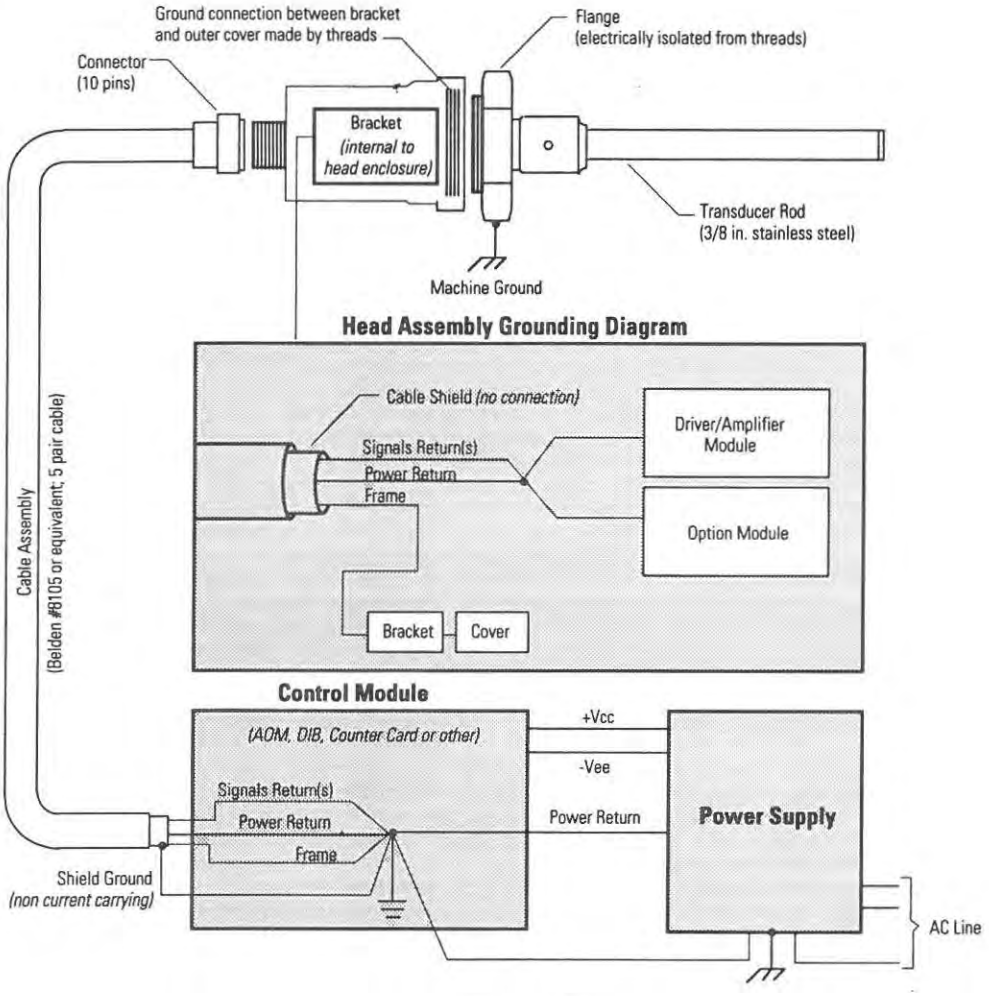


Figure 5-1
Grounding

6. Introduction to Analog Systems

Temposonics II Analog Systems include a Linear Displacement Transducer (LDT), a magnet, and an Analog Personality Module (APM), Analog Output Module (AOM), or an Analog Output Card. See Figures 6-1, 6-2 and 6-3. The APM, AOM and Analog Output Card generate the interrogation pulse, sense the return pulse, and develop the analog output displacement signal (voltage or current).

The Analog Personality Module (Figure 6-1) is installed in the electronics enclosure of the Temposonics II transducer. The Analog Output Module and Analog Output Card are both separate interface devices.

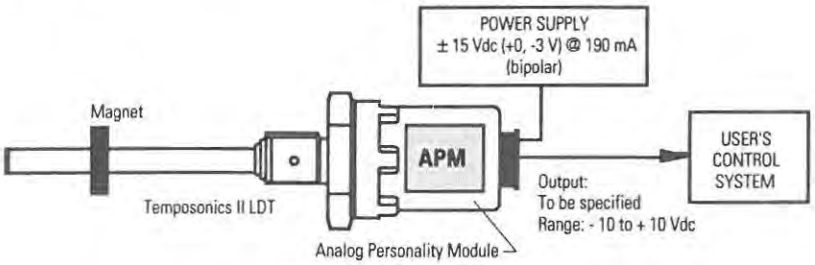


Figure 6-1
Analog System Configuration with Analog Personality Modul;e

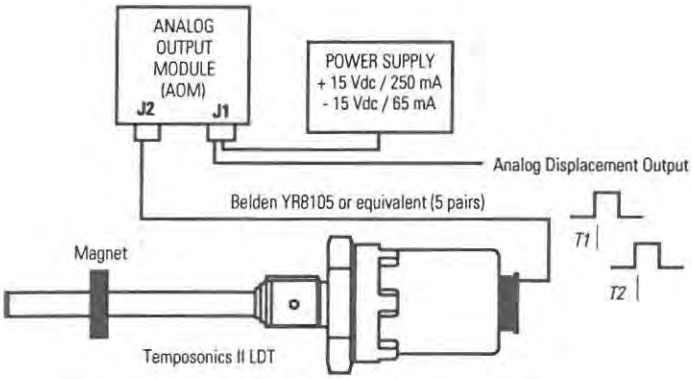


Figure 6-2
Analog System Configuration with Analog Output Module (AOM)

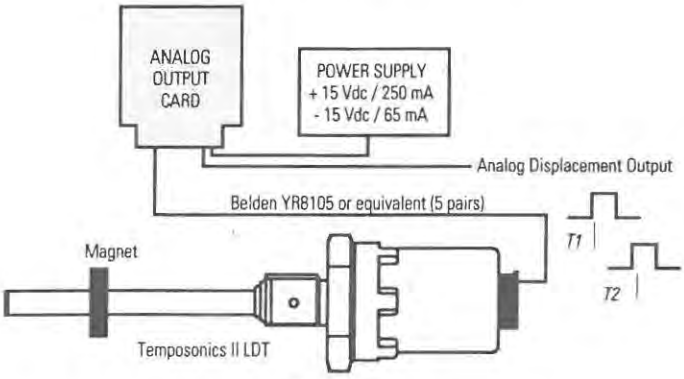


Figure 6-3
Analog System Configuration with Analog Output Card

6.1 Specifications of Analog System Components

6.1a Analog Personality Module (APM)

Parameter	Specification
Power Requirements:	± 15 Vdc (+0, -3) at 190 mA maximum, 115 mA minimum
Output Impedance:	10 KΩ minimum load for voltage output; <10KΩ
Output:	Specified by user, Range: - 10 Vdc to + 10 Vdc, forward or reverse acting
Temperature Requirements:	• Storage: - 40 to 150°F (- 40 to 70°C) • Operating: - 32 to 150°F (-30 to 70°C) • Coefficient: 10 ppm/°F (18 ppm °C)
Maximum Cable Length: (from LDT)	Standard: 250 ft. *(Maximum length is dependent upon on cable type used. If exceeding 250 ft. contact MTS for special requirements>*
Standard Features:	Non-volatile memory permanently stores set-up information. Surface mounted components reduce moment of inertia and enhance shock and vibration resistance of the module.

6.1b Analog Output Module (AOM)

Parameter	Specification
Power Requirements:	+ 15 Vdc (±2%) at 250 mA, < 1% ripple - 15 Vdc (±2%) at 65 mA, < 1% ripple
Output Impedance:	5 KΩ minimum load for voltage output
Velocity Output:	0 to ± 10 Vdc: *positive voltage output as magnet travels away from the transducer's head assembly, negative voltage output as the magnet travels toward the transducer's head assembly*
Temperature Requirements:	• Storage: - 40 to 180°F (- 40 to 82°C) • Operating: - 40 to 180°F (- 40 to 82°C) • Coefficient: 20 ppm/°F (36 ppm/°C)
Standard Features:	• External noise rejection circuitry to eliminate EMI noise from motors, relays and other sources. • Low ripple filter to reduce AC ripple on the output to 1 mV peak.

6.1c Analog Output Card

Parameter	Specification
Power Requirements:	+ 15 Vdc (±2%) at 250 mA, < 1% ripple - 15 Vdc (±2%) at 65 mA, < 1% ripple
Output Impedance:	5 KΩ minimum load for voltage output
Velocity Output:	0 to ± 10 Vdc: *positive voltage output as magnet travels away from the transducer's head assembly, negative voltage output as the magnet travels toward the transducer's head assembly*
Temperature Requirements:	• Storage: - 40 to 180°F (- 40 to 82°C) • Operating: - 40 to 180°F (- 40 to 82°C) • Coefficient: 20 ppm/°F (36 ppm/°C)
Standard Features:	• External noise rejection circuitry to eliminate EMI noise from motors, relays and other sources. • Low ripple filter to reduce AC ripple on the output to 1 mV peak.

The Analog Personality Module (APM) is mounted inside the electronics housing of the Temposonics II linear displacement transducer and produces a direct analog output. No additional interfacing electronics are required.. The APM processes digital data into an analog output via a digital to analog converter (DAC). MTS uses a 16-bit DAC to provide the best available resolution performance, unlike other designs that provide a 12-bit DAC or a sample and hold circuit. The digital hardware, combined with software noise-rejection, gives the APM superior noise immunity.



Analog Personality Module

Typically the APM will be ordered with the Temposonics II transducer. The APM is installed, and the Set Points and output voltages are pre-set at the factory.

In the example below (Figure 7-1) we have a 60 inch stroke, note the indicated active stroke range. Set Points cannot be set within the null or dead space area, they can only be set within the active stroke area. The 13 inch stroke selected in the example is defined by Set Point 1 (set at 4.000 volts) and Set Point 2 (set at 7.538 volts). Set Point voltage values can range from -10 to +10 Vdc.

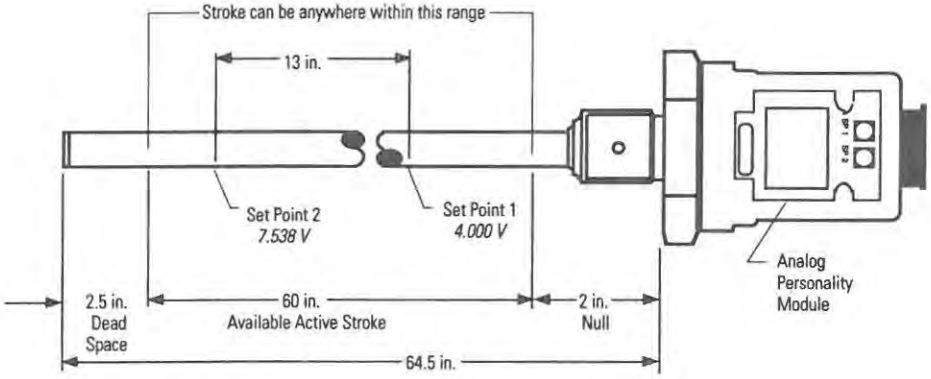


Figure 7-1
Voltage & Displacement - 100% Scaleable.

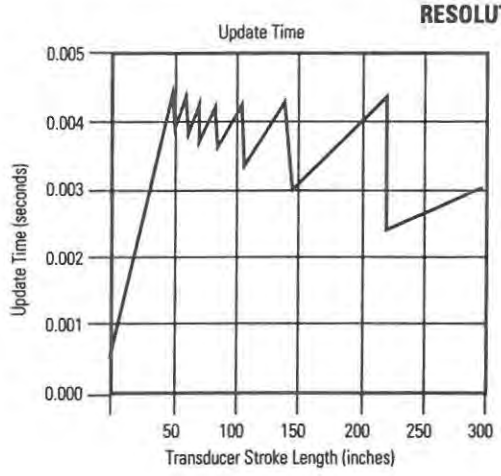
7.1 Performance Modes

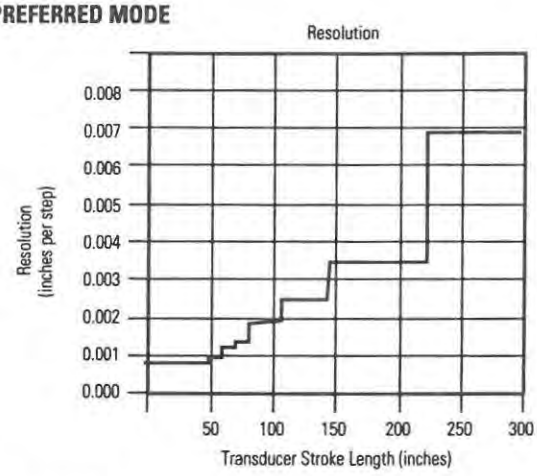
Update time (or response time) for analog systems is based upon the active stroke of the transducer and the resolution desired. To get the best mix of update time and resolution for your particular application, three modes are available with the APM. These modes are as follows:

Resolution Preferred Mode:	In this mode the APM generates a high resolution output while sacrificing update time. For stroke lengths up to 52 inches, the output resolution will be approximately 0.001 inches.
Balanced Mode:	In this mode the APM offers a "balance" between update time and resolution. For stroke lengths up to 250 inches, the output resolution will be approximately 0.003 inches.
Update Preferred Mode:	In the mode the APM produces the fastest possible update time while sacrificing resolution. For stroke lengths up to 300 inches, the output resolution will be approximately 0.007 inches.

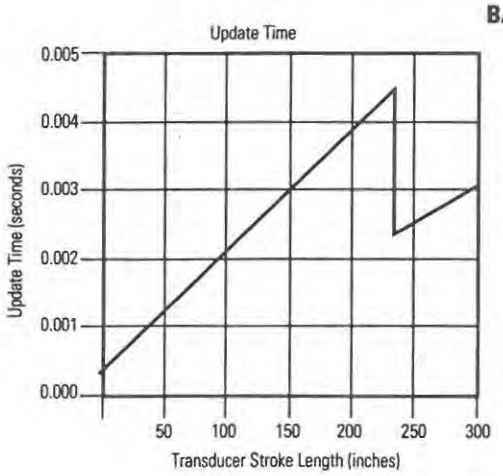
The mode desired is selected at the time of order and factory pre-set. The following charts identify the update time and resolution for each mode.

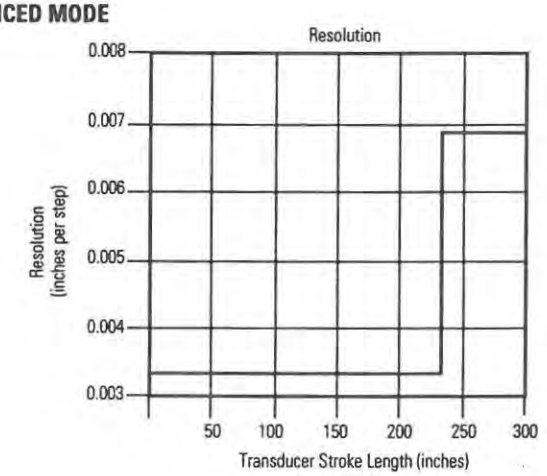
RESOLUTION PREFERRED MODE



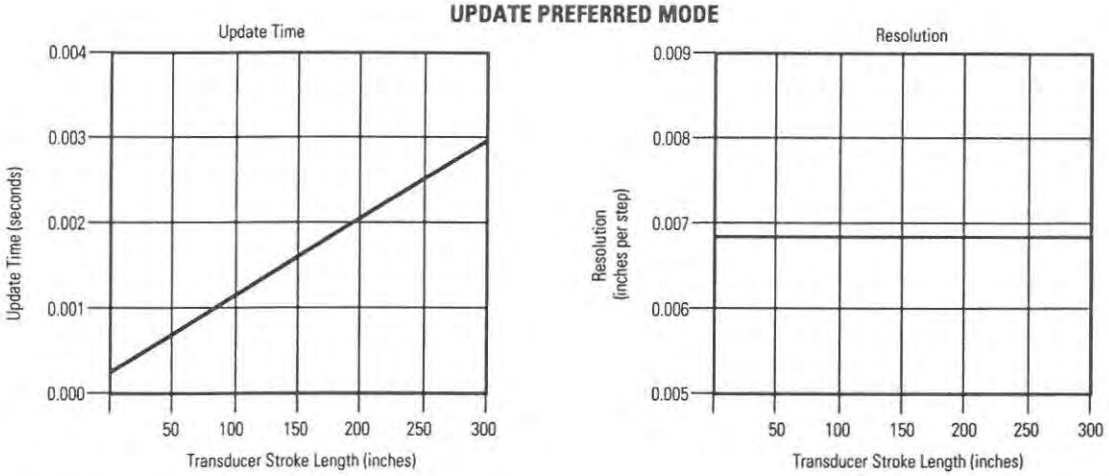


BALANCED MODE





UPDATE PREFERRED MODE



7.2 Wiring

Table 7A
Temposonics II with Analog Personality Module (APM)

	Temposonics II Integrated or Extension Cable *		
Pin No.	**Wire Color Code**	**Wire Color Code**	**Functions w/APM**
1	White/Blue Stripe	White	DC Ground
2	Blue/White Stripe	Brown	Frame
3	White/Orange Stripe	Gray	Displacement Return (GND)
4	Orange/White Stripe	Pink	Displacement Out
5	White/Green Stripe	Red	VCC
6	Green/White Stripe	Blue	VEE
7	White/Brown Stripe	Black	Not Used
8	Brown/White Stripe	Violet	Not Used
9	White/Gray Stripe	Yellow	Not Used
10	Gray/White Stripe	Green	Not Used

* Verify if the cable has striped or solid color leads and make connections accordingly.

This section explains how to adjust and calibrate the Temposonics II LDT system using an AOM.

The AOM includes adjustments for null (zero), and full-scale (span). The adjustments compensate for the following:

- Differences between transducer gradients.
- Small offsets in the magnet position due to mounting.
- Wear in the moving parts of the mechanical system to which the magnet is attached.

In cases where a coupler device is used for adjusting the magnet the coupler is used for coarse adjustments of both null and scale, while the AOM is used for fine adjustments.

8.1 Nominal Range of Adjustment

Null:	Minimum: ± 3/8 in. Maximum: Up to 10% of total stroke or ±2 inches, whichever is smaller
Full-scale:	± 2% of total stroke

Figure 8-1 (next page) shows the location of position adjustments and terminal boards on the AOM.

NOTE

Null adjustment has an overall effect on total scale adjustment. However, scale adjustment has no effect on null adjustment.

8.2 Null and Full-Scale Adjustments

The following procedures calibrate the null position and the full-scale position to the required output levels. Refer to Figure 8-1 for the adjustment locations.

NOTE

The following procedure assumes the standard full-scale 0 to 10 Vdc output is supplied. When other output signals are supplied, use the appropriate signal levels and test equipment for the following adjustments.

1. Disconnect all power from the system. Loosen the four screws securing the AOM cover, and remove the cover.

2. Note the location of terminal board TB1 on the AOM (Refer to Figure 8-1). Connect a DVM (digital voltmeter) across pins A and B of terminal board TB1 to monitor the displacement signal. Apply power to the system.

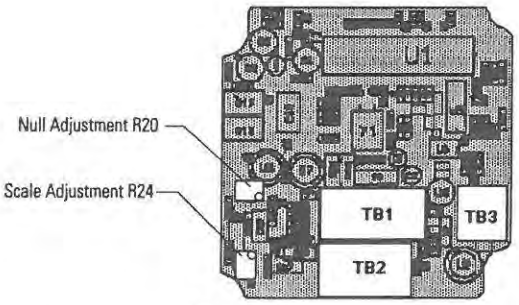


Figure 7-1
Location of Null & Scale Adjustments and Terminal Boards on the AOM.

3. Position the permanent magnet at the specified null position. The null position is specified when the LDT assembly is ordered (typically 2 inches from the transducer head).

4. Use a screwdriver to adjust the null potentiometer (R20) clockwise to increase the value, or counter-clockwise to decrease the value, until you obtain a DVM reading of 0.000 Vdc.

5. Position the permanent magnet for full-scale position (typically 2 inches from the end of the LDT assembly).

6. Use a screwdriver to adjust the scale potentiometer (R24) clockwise to increase the value, or counterclockwise to decrease the value, until you obtain a DVM reading of +10.000 Vdc.

7. Repeat steps 3 to 6 to check the null and full-scale settings. Readjust as necessary.

8. Disconnect the DVM and check overall system operation. If no more adjustments are necessary, replace the AOM cover.

8.3 Velocity Null Adjustment

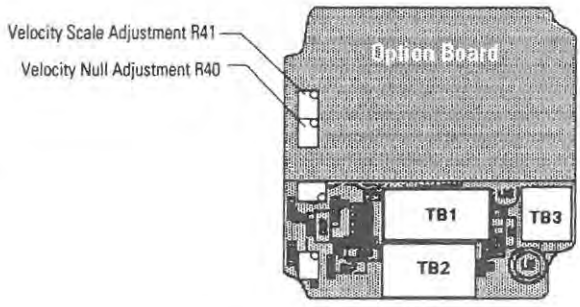


Figure 8-2
Velocity Adjustments on the AOM

The AOM can be provided with an optional velocity output. For those units, velocity null and scale adjustments are provided. The velocity null and velocity scale adjustments are factory set and should not require readjustment. A velocity output signal of 0 (zero) volts represents a static displacement (no motion). A velocity output of 10 volts represents a dynamic displacement or a customer-specified maximum velocity (maximum velocity must be specified at time of order). The direction of motion is indicated by the polarity of the velocity signal; a positive output signal typically indicates that the permanent magnet is moving away from the transducer head (unless otherwise specified for this system). A negative output signal typically indicates that the permanent magnet is moving towards the transducer head.

The following procedure provides the velocity null adjustment. Refer to Figure 8-2.

NOTE

Velocity scale adjustment *may be difficult in the field because it requires precision equipment to control and measure the exact velocity.*

1. Disconnect all power from the system.
2. Loosen the four screws securing the AOM cover, and remove the cover.
3. Note the location of terminal board TB1 on the AOM (Refer to Figure 8-2). Connect a peak reading DVM (digital voltmeter) or oscilloscope across pins C and D of terminal board TB1 to monitor the velocity signal.
4. Apply power to the system.
5. Make sure the permanent magnet is not moving.
6. Adjust the velocity null control (R40) clockwise to increase the value, or counterclockwise to decrease the value, until you obtain a DVM or oscilloscope reading of 0.000 Vdc.
7. Disconnect the DVM or oscilloscope and check overall system operation. If no more adjustments are necessary, replace the AOM cover.

9. Installing the Analog Output Module (AOM)

Dimensions of the AOM are shown below in Figure 9-1. The mounting hole dimensions shown are also stamped on the back of the module. Mount the AOM as shown, using two socket head cap-screws.

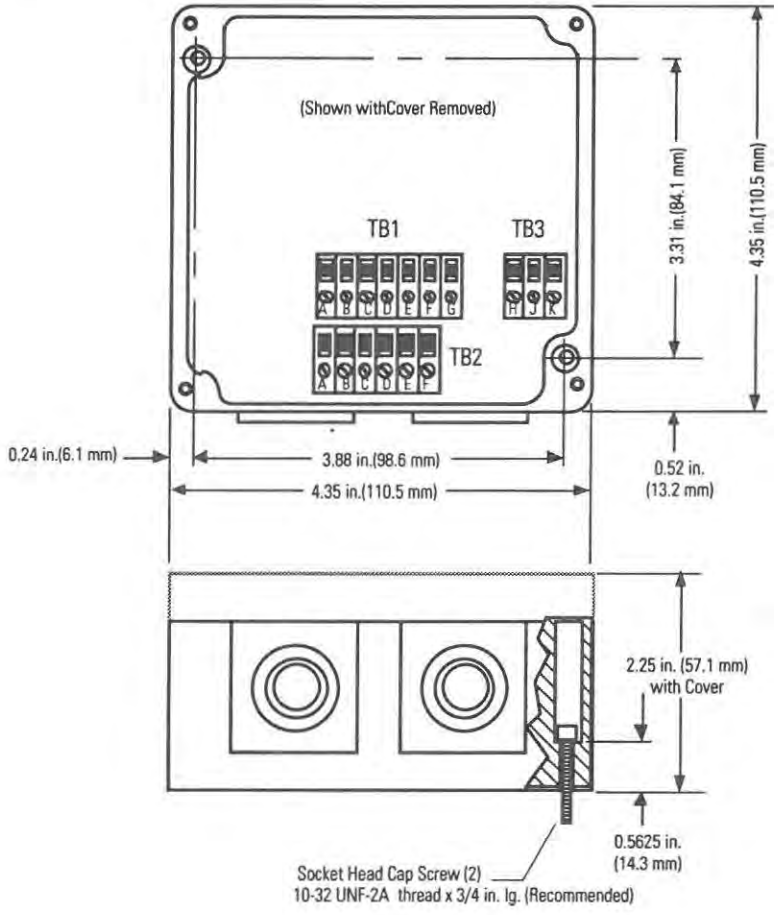


Figure 9-1
AOM Dimensions

1. Mount the AOM in a location within reach of the LDT assembly cable. Standard systems allow the AOM to be mounted 250 feet from the LDT assembly.

2. Connect cable from AOM to the LDT assembly.

3. Adjust the AOM null and full-scale potentiometers (as described in Section 8) to compensate for any offsets due to mechanical installation.

This section describes wiring procedures for analog systems that use the Analog Output Module, including:

- 0 to 10 V displacement (forward and reverse acting)
- -10 to +10 V displacement (forward and reverse acting)
- Ungrounded 4 to 20 mA displacement
- Grounded 4 to 20 mA displacement
- Velocity Outputs
- Dual Channel Outputs

Connections are made between the transducer assembly, the AOM, the customer-supplied power supply, and the customer-supplied receiving device.

10.1 Preparing Cable for Connection to the AOM

The AOM is equipped with two strain relief or two MS (mil-spec) connectors.

A strain relief is used for an un-terminated cable. Prepare the cable as shown in Figure 10-1. It is recommended that you tin the exposed leads to ensure a good connection. Mount the cable to the AOM, ready to make connections to the terminal boards (TB1, TB2, or TB3) inside.

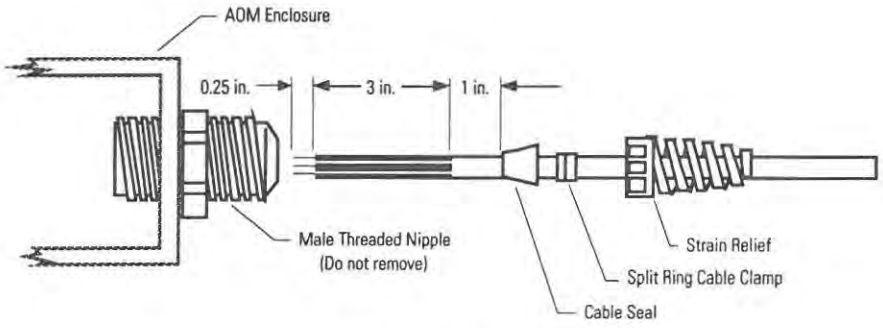


Figure 10-1
Cable Preparation for Strain Relief

When the AOM box is used an optional MS connector can be used with the cable. Cables are available in various lengths from inventory.

10.2 J1 Installation Wiring

The J1 cable provides the AOM voltage inputs from the DC power supply. It also provides displacement outputs to the receiving device.

Take the following steps to connect J1:

1. One of the screws securing the cover of the AOM has a raised head. Connect a ground wire from that screw head to a central earth ground or to the power supply ground (if it is grounded). Only one circuit earth ground should be used to prevent ground loops. (Refer to Figure 5-1 on page 13 of this manual for a full system grounding diagram.)

2. **Strain Relief Only:** Fabricate the J1 cable, and prepare the cable as described earlier. Identify the connections to TB1 and TB3. Refer to pages 29 and 30 to determine the appropriate J1 connections.

3. **MS Connector Only:** Fabricate the J1 cable. Refer to page 31 to determine the appropriate J1 connections. Solder the connections to the MS type connector (Part No. 370017). Use any cable capable of maintaining the signals for the required length. Ensure the solder connections are clean and free of excessive solder. Use heat-shrink over the solder connections to prevent the pins from shorting.

4. Identify the wires at the other end of the cable for connections to the power supplies and the receiving device. Test the cable for shorts.

NOTE

Make sure that the power supply can provide +15 Vdc at 250 mA and -15 Vdc at 65 mA (use a bipolar power supply). The power supply should provide less than 1% ripple with 2% regulation. The power supply should be dedicated to the transducer system to prevent noise and external loads from affecting the system performance.

5. Make sure the power supply is off. Complete the cable connections at the power supply.

! CAUTION !

The input to the receiver electronics should be a passive, resistive device to prevent damage to the AOM.

6. First, make sure there is no voltage present on the receiving device input connections. Then, complete the cable connections to the receiving device.

NOTE

Do not route the J1 cable near high voltage sources.

7. **Strain Relief Only:** Connect the cable to the TB1 and TB3 terminals on the AOM.

8. **MS Connector Only:** Connect the cable to the J1 connector on the AOM.

10.3 J1 Connections for AOM

The AOM is provided with either a strain relief connector, which accepts a pigtailed connection directly into terminals blocks located inside the AOM enclosure, or a threaded MS connectors. Tables 8A through 8F, below, indicate the appropriate connection to make for either configuration. Make sure that you follow the appropriate Table for your specified options.

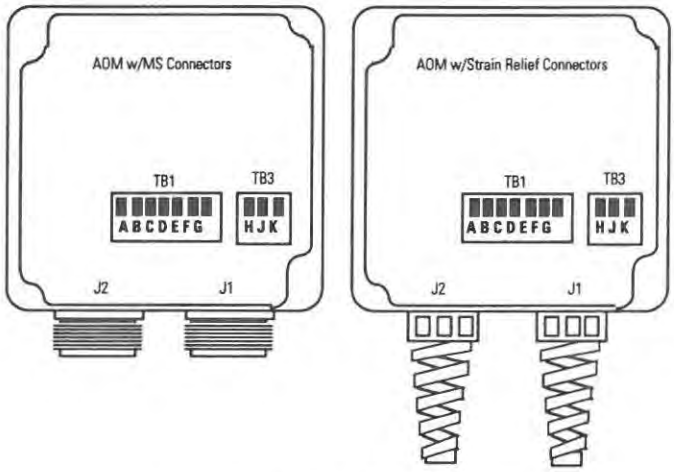


Figure 10-2
AOM w/ Strain Relief and MS Connectors

Table 10A Standard J1 Connections

Strain Relief Connection	*MS Connector Pin Designation*	*Function*
TB1		
A	D	Displacement Output
B	E	Displacement Output Return (ground)
TB3		
H	A	+ 15 Vdc
J	B	- 15 Vdc
K	C	DC Common

Table 10B J1 Connections w/Velocity Output Option

Strain Relief Connection	*MS Connector Pin Designation*	*Function*
TB1		
A	D	(Displacement Output
B	-	Displacement Output Return (ground)
C	E	Velocity Output
D	-	Velocity Output Return (ground)
TB3		
H	A	+ 15 Vdc
J	B	- 15 Vdc
K	C	DC Common

Table 10C J1 Connections w/24 V Power Supply Option

Strain Relief Connection	*MS Connector Pin*	*Function*
TB1		
A	D	(+) Displacement Output
B	E	(-) Displacement Output
TB3		
H	A	24 Vdc
J	No Connection	N/A
K	C	DC Common

Table 10D J1 Connections w/ 24 V Power Supply & Velocity Output Options

Strain Relief Connection	*MS Connector Pin*	*Function*
TB1		
A	D	(+) Displacement Output
B	-	(-) Displacement Output
C	E	(+) Velocity Output
D	-	(-) Velocity Output
TB3		
H	A	24 Vdc
J	No Connection	N/A
K	C	DC Common

Table 10E AOM J1 Connections w/Dual Channel Option

Strain Relief Connection	*MS Connector Pin*	*Function*
TB1		
A	D	Channel 1 (+) Displacement Output
E	E	Channel 2 (+) Displacement Output
TB3		
H	A	+ 15 Vdc
J	B	- 15 Vdc
K	C	DC Common

Table 10F J1 Connections w/Dual Channel & 24 V Power Supply Options

Strain Relief Connection	*MS Connector Pin*	*Function*
TB1		
A	D	Channel 1 (+) Displacement Output
B	E	Channel 2 (+) Displacement Output
TB3		
H	A	24 Vdc
J	No Connection	N/A
K	C	DC Common

10.4 J1 Connection to AOM with MS Connectors

Table 10G Voltage Output

J1 Pin	
A	+ 15 Vdc
B	- 15 Vdc
C	DC Common
D	Displacement Output
E	**Optional:** Pulse Width Modulated Output or Velocity Output

Table 10H Ungrounded 4-20 mA Current Output

J1 Pin	
A	+ 15 Vdc
B	- 15 Vdc
C	DC Common
D	Current Output (source) *
E	Current Output (return)
	** DO NOT ground or damage may result.* *Maximum load resistance: 400Ω*

Table 10I Grounded 4-20 mA Current Output

J1 Pin	
A	+ 15 Vdc
B	- 15 Vdc
C	DC Common and (-) Current (return) *
D	Current (Source)
E	Not connected
	** Maximum load resistance: 500Ω*

10.5 J2 Connections

The J2 cable provides connections between the AOM and the transducer assembly.

Cables up to 20 ft (6 meters) can be fabricated with any high quality multi-conductor cable with an overall shield (Belden equivalent).

Take the following steps to connect J2:

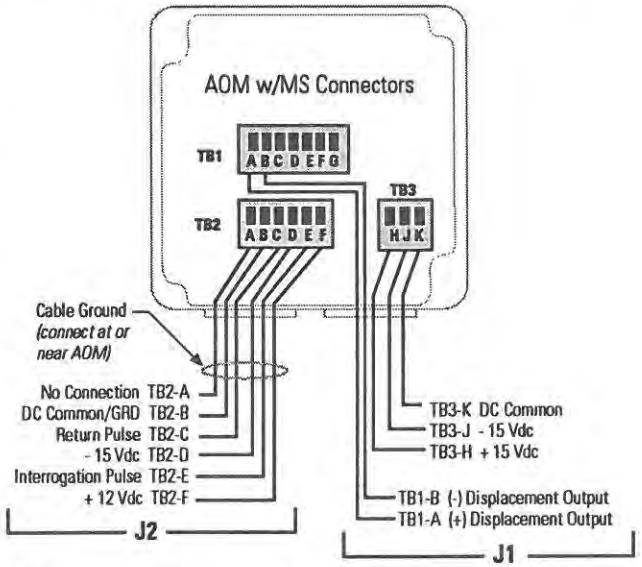
1. It is recommended that you apply an earth ground to the transducer rod. This is typically accomplished by mounting the transducer head to a bracket or machine.

2. **Strain Relief Only:** If necessary, fabricate the J2 cable, and prepare the cable as described earlier. Identify the connections to TB2. Refer to Table 10J (next page) for the J2 connections.

NOTE

Ensure the solder connections are clean and free of excessive solder. Use heat-shrink over the solder connections to prevent the pins from shorting.

3. **MS Connector Only:** If necessary, fabricate the J2 cable. Be sure to use the recommended cable for the required length. The color code refers to cables supplied with the system. Solder the connections to the MS connector supplied with the AOM. Use any cable capable of maintaining the signals for the required length. Ensure the solder connections are clean and free of excessive solder. Use heat-shrink over the solder connections to prevent the pins from shorting.



NOTE:
The connections to TB3 represent wiring for a typical system configuration (i.e., ±15 Vdc power supply and strain-relief connectors). If the AOM is configured with other options (i.e., 24 Vdc power supply, velocity output, MS connectors) refer to pages 25, 26, and 27 for proper wiring.

Figure 10.3
AOM J1 and J2 Connections

Table 10J AOM J2 Connections

J2 Connection (TB 2 A - F)			
Connection	*Wire Color Code **	*Wire Color Code **	*Function*
TB2-A	Not Used	Not Used	No Connection
TB2-B	White/Blue Stripe Blue/White Stripe White/Brown Stripe Gray/White Stripe	White Brown Black Green	DC Common/GND Frame
TB2-C	Brown/White Stripe	Violet	Return Pulse
TB2-D	Green White Stripe	Blue	- 15 Vdc (- 13.5 to - 14.5 Vdc)
TB2-E	White/Gray Stripe	Yellow	Interrogation Pulse
TB2-F	White/Green Stripe	Red	12 Vdc

** Verify if the cable has striped or solid color leads and make connections accordingly.*

4. **Strain Relief Only:** Connect the cable to the TB2 terminals on the AOM and to the transducer.

5. **MS Connector Only:** Connect the cable to the J2 connector on the AOM and to the transducer.

6. Apply power and check the displacement readings at the system electronics.

Table 10K Retrofit Connections -
Temposonics II Replacement of Existing Temposonics I with AOM

	Temposonics II Integrated or Extension Cable (Notes 1, 2)			Analog Output Module (AOM)	
Pin No.	Wire Color Code	Wire Color Code	Functional Description	Terminal Blocks	Military Style (MS) Connectors
1	White/Blue Stripe	White	DC Ground	TB2-B	J2 Pin B
2	Blue/White Stripe	Brown	Frame (Note 3)	TB2-B	J2 Pin B
3	White/Orange Stripe	Gray	Not Used	Not Used	Not Used
4	Orange/White Stripe	Pink	Not Used	Not Used	Not Used
5	White/Green Stripe	Red	VCC (+ 12 Vdc)	TB2-F (Note 4)	J2 Pin F (Note 4)
6	Green/White Stripe	Blue	VEE (- 14.3 Vdc	TB2-D	J2 Pin D
7	White/Brown Stripe	Black	Amp Return (GND)	TB2-B	J2 Pin B
8	Brown/White Stripe	Violet	Amp Output (return pulse)	TB2-C	J2 Pin C
9	White/Gray Stripe	Yellow	(+) Interrogation (Note 5) (See Warning, below)	TB2-E	J2 Pin E
10	Gray/White Stripe	Green	(-) Interrogation (Note 6) (See Warning, below)	TB2-E	J2 Pin B

NOTES:
1. Verify if the cable has striped or solid color leads and make connections accordingly,.
2. Cable: Belden #8105 or equivalent
3. Frame ground is isolated from circuit ground inside the electronics enclosure or "head" of the transducer.
4. Connect to TB2 Pin A if the stoke length exceeds 200 inches.
5. For retrofitting AOMs with stoke lengths greater than 12 inches in stroke length and positive (+) interrogation.
6. For retrofitting AOMs with stoke lengths greater than 12 inches in stroke length and negative (-) interrogation.
7. Shield: Connect extension cable shield at TB2-B or J2 Pin B.

WARNING

Under no condition connect both the positive (+) and negative (-) interrogation wires to TB2-E at the same time. The unused interrogation lead MUST be connected to DC Ground.

11. Analog Output Card

The Analog Output Card is a plug-in type electronics card that performs the same functions as the Analog Output Module (AOM).and can be used as a direct replacement (physically and functionally) for the "old style" Temposonics Electronics Card.

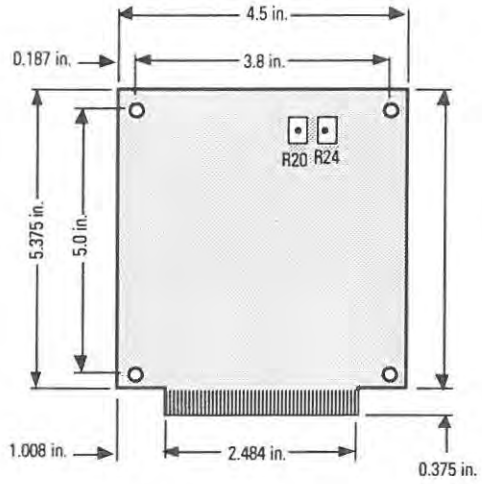


Figure 11-1
Analog Output card Dimensions

The displacement output options available from the Analog Output Cards are as follows:

Voltage Outputs:	• 0 to 10 Vdc (forward and reverse acting) • 0 to -10 Vdc (forward and reverse acting) • -10 to +10 Vdc (forward and reverse acting)
Current Outputs:	• 4 to 20 mA ungrounded (forward and reverse acting) • 4 to 20 mA grounded (forward and reverse acting)

Null (R20) and scale (R24) adjustments are available on the Analog Output Card.

Null Adjustment:	Using a digital volt meter, turn potentiometer (R20) clockwise to increase the voltage output or counter clockwise to decrease the voltage output until null is set at 0.000 Vdc.
Scale Adjustment:	Using a digital volt meter, turn potentiometer (R24) clockwise to increase the voltage output or counter clockwise to decrease the voltage output until full scale output is set at 10.000 Vdc.

The Analog Output Card has a 15 pin edge card connector, the function of each pin is as follows:

Table 11A
Analog Output Card Pin Identification

Pin No.	*Function*
1	DC Ground (Current return for grounded systems)
2	+5 Vdc input (optional)
3	- 15 Vdc input
4	+12 Vdc to transducer
5	+15 Vdc input (+24 Vdc is optional)
6	+15 Vdc to transducer
7	External reference input (optional)
8	-15 Vdc to transducer
9	+ Pulse width modulated signal (standard)
10	+ Pulse width modulated signal (optional)
11	- Pulse width modulated signal (optional)
12	Analog displacement output (current source)
13	Optional current return for 4-20 mA ungrounded output systems
14	Return pulse from transducer
15	Interrogation pulse

The connections from the Temposonics II transducer to the Analog Output Card are as follows:

Table 11B
Temposonics II Connection to Analog Output Card

	Temposonics II Integrated or Extension Cable *(see Note 1)*		
Pin No.	*Wire Color Code*	*Wire Color Code*	*Analog Output Card Pin No.*
1	White/Blue Stripe	White	1
2	Blue/White Stripe	Brown	1
5	White/Green Stripe	Red	4
6	Green/White Stripe	Blue	8
7	White/Brown Stripe	Black	1
8	Brown/White Stripe	Violet	14
9	White/Gray Stripe	Yellow	15
10	Gray/White Stripe	Green	1

NOTE:
1. Verify if the cable has striped or solid color leads and make connections accordingly.
2. Shield wire (drain) can be connected to Pin 1 on the Analog Output Card.

Use the troubleshooting procedures in this section when operational problems are encountered. The procedures are listed in order of frequency of occurrence, and should be completed in the order shown.

NOTE

The following procedures are for general diagnostic purposes. Purchase of replacement components should not be based solely on these procedures. Consult MTS Sensors Division for recommendations and factory service before ordering replacement components.

12.1 General

Make sure the magnet is positioned to move freely along the LDT rod. Trace all wiring from the J1 connector to ensure proper routing.

12.2 Power Supply Check

Perform the following procedure to check the power supply voltages.

1. Remove power and disconnect connector J1 to check open circuit power supply voltages (as described in steps 2 and 3).

NOTE

If voltage is not present in steps 2 and 3, a problem with wiring or the power supply is indicated.

2. Connect a DVM (digital voltmeter) to pins A and C of cable connector J1 if you have MS type connectors, or TB3 pins H and K if you have strain relief connectors. Apply power. The voltage should be +15 Vdc.

3. Connect the DVM to pins B and C of cable connector J1 if you have MS type connectors, or TB3 pins J and K if you have strain relief connectors. The voltage should be -15 Vdc.

NOTE

A low voltage reading in steps 4 and 5 indicates a power supply with an inadequate rating or an excessive voltage drop in the cabling (i.e. improper wire sizes).

4. If the voltage readings are correct, check the power supply voltages under load (as described in steps 5 and 6).

5. Connect a 60 Ω to 75 Ω resistor across Pins A and C of the MS connector or pins H and K of TB3. The voltage across the resistor should be +14.7 Vdc (minimum).

6. Connect a 230 Ω to 250 Ω resistor across Pins B and C. The voltage across the resistor should be -14.7 Vdc (minimum).

12.3 Grounding

Trace all ground and power supply common connections. A single earth ground should be connected to the power supply common (circuit ground). An additional ground is connected to the case of the analog output module (AOM). If the AOM is suspect, remove the mounting screws and place the box on insulating material (i.e. wood) then recheck the output readings.

12.4 Connections

Check the solder connections in the J1 cable. Ensure no cold solder joints are present. Perform a continuity check between the J1 connections to ensure no shorts are present.

12.5 LDT Signals

Disconnect connector J2 from the AOM. Apply power and check the J2 readings, using Figure 12-1. If the voltages are correct, connect J2 and check the signals at pins B and C with an oscilloscope.

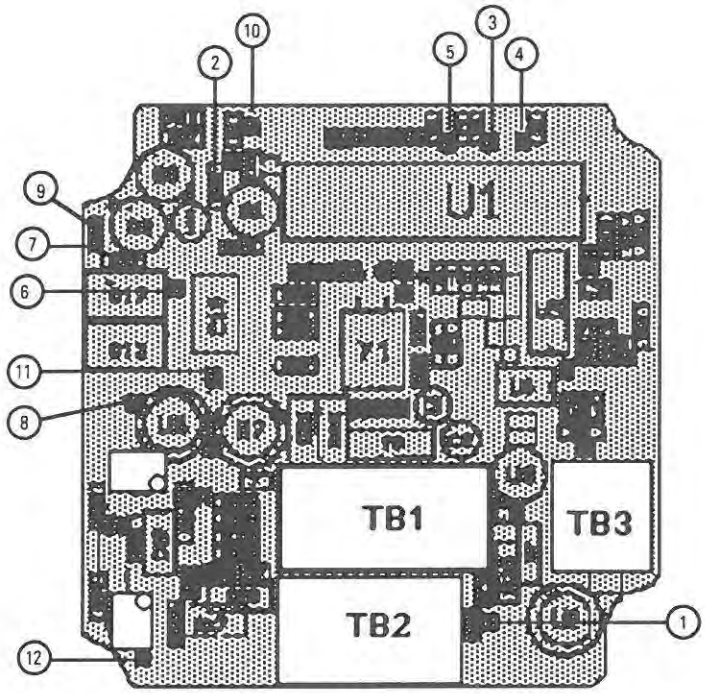


Figure 12-1
Test Point (TP) Locations

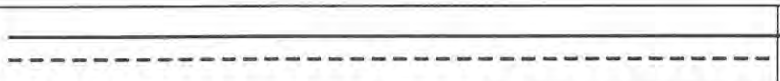
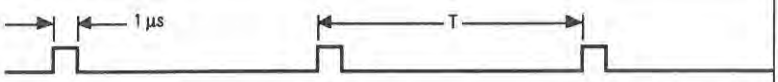
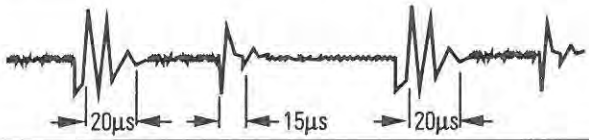
A		5 Volts at Test Point 1 0 Volts, TB3-K
B		3 - 5 Volt interrogation pulse sent to TB2-E
C		Pulse returned from TB2-C (approximately 2 - 3 Volts)
D		TTL level pulse, 3 - 5 Volts located at Test Point 3
E		Pulse-width modulated output 3 - 5 Volts at Test Point 2
F		6 Volts at Test Point 6
G	Test Point #9: 0 to 6 Volts as the magnet moves back and forth.	
H	Test Point #12: 0 to 10 Volts or ± 10 Volts as the magnet moves back and forth. (The 4-20 mA Ungrounded option is 0 to 2 Volts)	
I	TB1-A: Same as H, above.	

Figure 12-2
AOM Signals

NOTE

Do not interchange transducers and AOMs with differing model numbers, without first consulting MTS Sensors Division.

A. If a spare transducer of the same stroke and model number is available, connect the spare transducer to the AOM and check the displacement readings at the system electronics.

B. If a spare AOM of the same stroke model number is available, connect J1, J2 and the ground wire to the spare AOM and check the displacement readings at the system electronics.

Empire Castings Inc.
Equipment Manual

Model# EC02-A
Serial# AAPM01

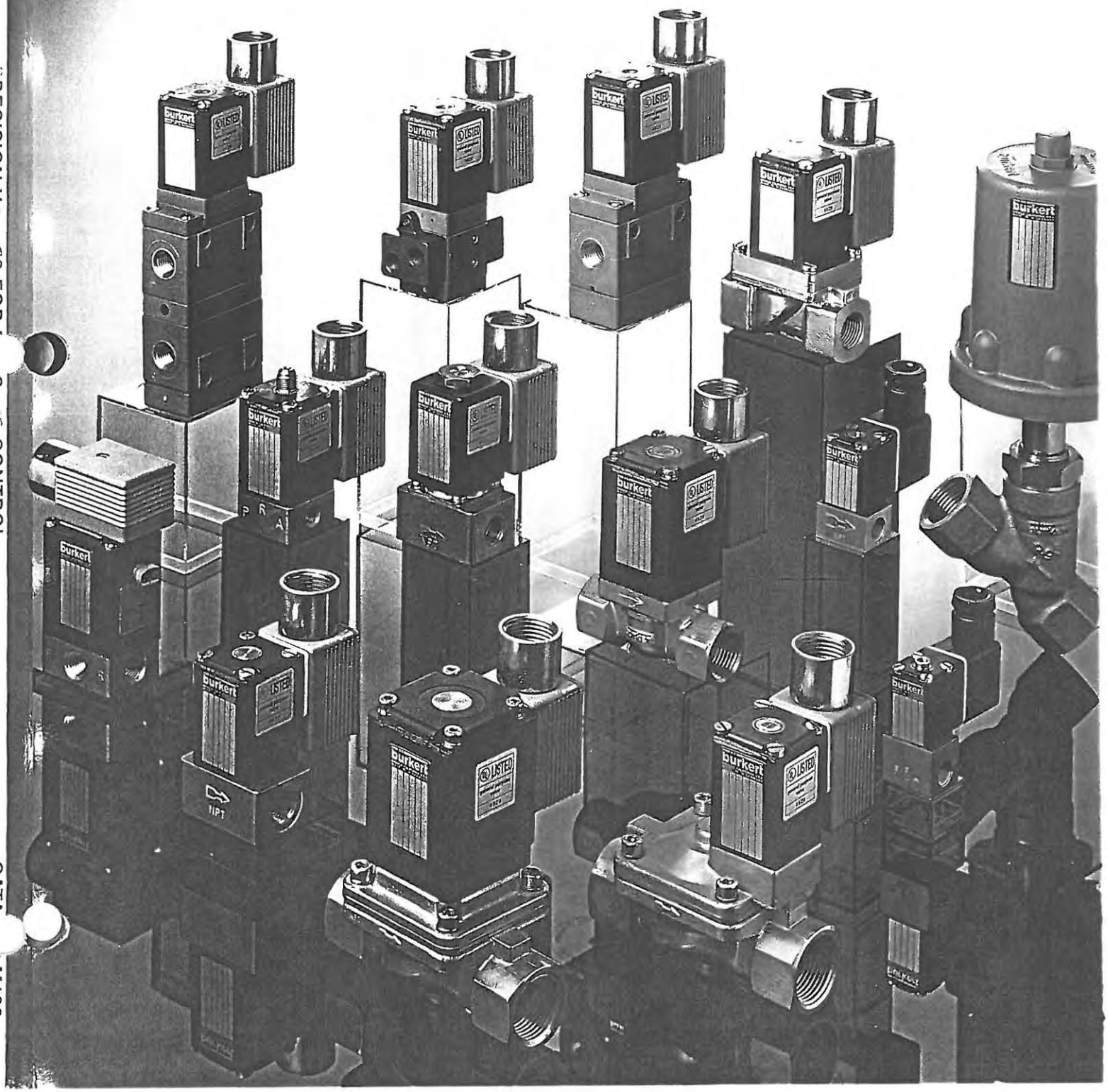
Volumne 3, Section 14: Mold Cooling

1: Replacement Parts

Item#	Part#/Description	Mfg.
001	450075F	BURKERT
002	CCB-10-B-C FLOWSTAT WATER FLOW METER	LAKE MONITOR
003	1/2" BALL VALVE	WATTS
004	SC8316G64 AIR VALVE	ASCO
005	3000-500 UNION O-RING UNION	MANASTRIP
006	LNZ-100-25-RC 100 PSI GAUGE	LENZ
007	968A-8D ADAPTER 1/2" NPT X 1/2" POLY STRAIGHT FITTING	ANDERSON
008	969A-8D ADAPTER 1/2"NPT X 1/2" POLY 90 DEG FITTING	ANDERSON
009	60AE-9 FERRULE	ANDERSON
010	269PPS-8D ADAPTER 1/2"NPT 1/2" POLY 90 SWIVEL FITTING	ANDERSON
011	RMI09.2202JV0S STAUBLI ADAPTER	STAUBLI

bürkert

Precision Valves for Process Control



Bürkert PRECISION VALVES FOR PROCESS CONTROL CATALOG M106

burkert

Standard program

2/2-WAY SOLENOID VALVE FOR NEUTRAL LIQUID AND GASEOUS MEDIA (SLOW CLOSING) 1/2 NPT TO 2-1/2 NPT



Burkert 2/2-way Solenoid valve type 281

Internally piloted valve, with epoxy-encapsulated coil, ported version, brass body with high flow-rates, Viton seal material, temperature range 14ºF to 194ºF, for neutral media such as compressed air, natural gas, water, hydraulic oil (viscosity approx. 2.3X10⁻⁴FT²/SEC). Electrical connection by cable plug (see next page).

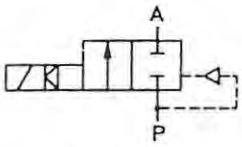
Technical data

Mounting position	any (preferably with the solenoid system upright)
Max. ambient temp.	130ºF
Voltage tolerance	± 10%
Power consumption (in warm state)	AC21VA (inrush) 12VA/8W (hold), DC8W
Opening time (ms)	200-500
Closing time (ms)	1000-4000

Times measured at outlet A on energizing/de-energizing until attainment of pressure rise to 90%/pressure drop to 10% at a working pressure of 85 PSI

Cycling rate	approx. 10-50 c.p.m.
Duty cycle	continuous (100%)

Operation A



2/2-way valve, normally closed, internally piloted.

Approval Code

C = CSA
R = CSA + UR
U = CSA + UL
*Z = CSA + UL + FM, DIV. 2**
*X = FM, DIV. 1***

* FM approved
NONINCENDIVE FOR HAZARDOUS LOCATIONS
CLASS I DIV. 2 GROUP A,B,C,D
CLASS II, DIV. 2 GROUP E,F,G,
CLASS III, DIV. 1 & 2
OPERATION TEMPERATURE T4A

** FM approved
GENERAL PURPOSE VALVE FOR HAZARDOUS LOCATIONS
CLASS I, DIV. 1 GROUP A,B,C,D
CLASS II, DIV 1 GROUP E,F,G,
CLASS III, DIV. 1
OPERATION TEMPERATURE T4

Ordering Key

The part number explanation follows. Insert the required voltage into the part number from the table below.

281 - A - 3/4 - F - BR - 3/4 - * - 08 - U - H - 000

- OPTIONAL FEATURES (003=IMPULSE VERSION) (017=MANUAL OVERRIDE)
- ELECTRICAL CONNECTION (E=SPADE CONNECTION) (H=PLUG REQ'D FOR UL LISTED VALVE) (A=THREE-WIRE LEADS WITH CONDUIT HUB REQUIRED ON FM, DIV. 1 VALVES)
- APPROVAL CODE (R=UL COMPONENT RECOGNIZED) (U=UL LISTED)
- COIL WATT RATING
- COIL VOLTAGE (SEE STANDARD COIL VOLTAGES)
- PORT CONNECTION
- BODY MATERIAL (BR=BRASS)
- SEAL MATERIAL (F=VITON)
- ORIFICE DIAMETER
- VALVE OPERATION
- VALVE TYPE

*Standard Coil Voltages
12/DC 24/60
24/DC 120/60 (Can be used with 110/50)
240/60 (Can be used with 220/50)

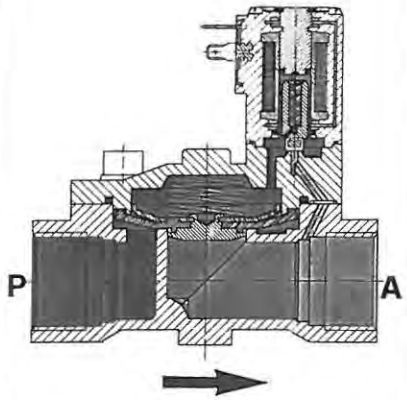
Orifice Diameter (IN)	Cv-Rating		Port Connection (NPT)	Pressure Range (PSI)[2]		Weight (LBS)	Body Material	Part Number
	Water (GPM)	Air (SCFM) [1]		AC	DC			
1/2	4.7	150	1/2	7-230	7-140	1.3	BR	281-A-1/2-F-BR-* (2)-*-08-R-E-000
								281-A-1/2-F-BR-* (2)-*-08-U-H-000
3/4	5.8	190	3/4	7-230	7-140	2.4	BR	281-A-3/4-F-BR-3/4-*-08-R-E-000
								281-A-3/4-F-BR-3/4-*-08-U-H-000
1	12	390	1	7-230	7-140	3.3	BR	281-A-1-F-BR-1-*-08-R-E-000
								281-A-1-F-BR-1-*-08-U-H-000
1-1/4	23	770	1-1/4	7-230	7-140	5.0	BR	281-A-1 1/4-F-BR-1 1/4-*-08-R-E-000
								281-A-1 1/4-F-BR-1 1/4-*-08-U-H-000
1-1/2	23	770	1-1/2	7-230	7-140	5.8	BR	281-A-1 1/2-F-BR-1 1/2-*-08-R-E-000
								281-A-1 1/2-F-BR-1 1/2-*-08-U-H-000
2	47	1500	2	7-230	7-140	10.9	BR	281-A-2-F-BR-2-*-08-R-E-000
								281-A-2-F-BR-2-*-08-U-H-000
2-1/2	47	1500	2-1/2	7-230	7-140	12.5	BR	281-A-2 1/2-F-BR-2 1/2-*-08-R-E-000
								281-A-2 1/2-F-BR-2 1/2-*-08-U-H-000

1) Measured with 85 PSI upstream pressure and 15 PSI pressure drop across valve at a temperature of 68°F.

2) Operation with less than a 7 PSI pressure differential will yield unpredictible flow characteristics.

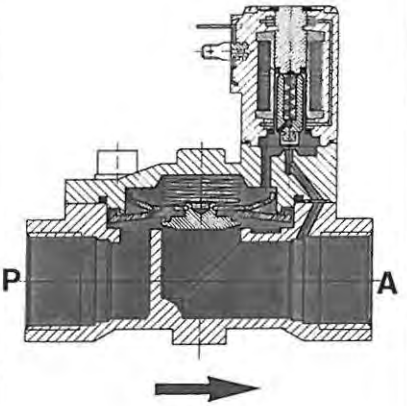
For specialized versions see Burkert main catalog data sheet type 281.

Operating Principle



Closed Position:

When the pilot valve is closed, the medium pressure increases on both sides of the diaphragm by means of a throttling orifice. Since the effective area above the diaphragm is larger, and also because of the action of the spring, the valve remains closed.

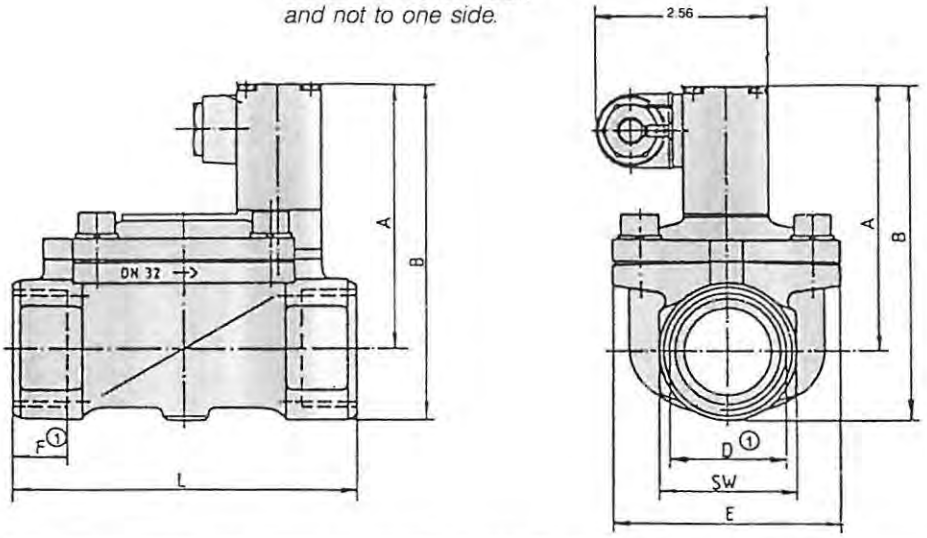


Open position:

When the pilot valve opens, the relief orifice is freed, which causes the pressure to decrease above the diaphragm. The latter is lifted by the pressure of the medium and the valve opens.

Dimensions

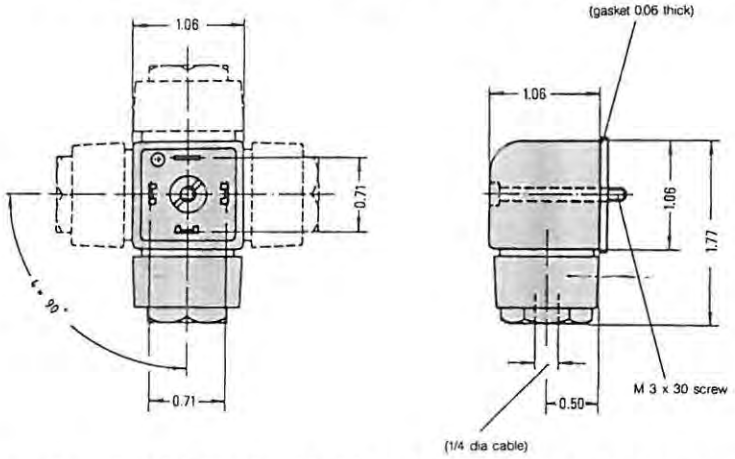
With 1/2 NPT connections the coil is in the middle and not to one side.



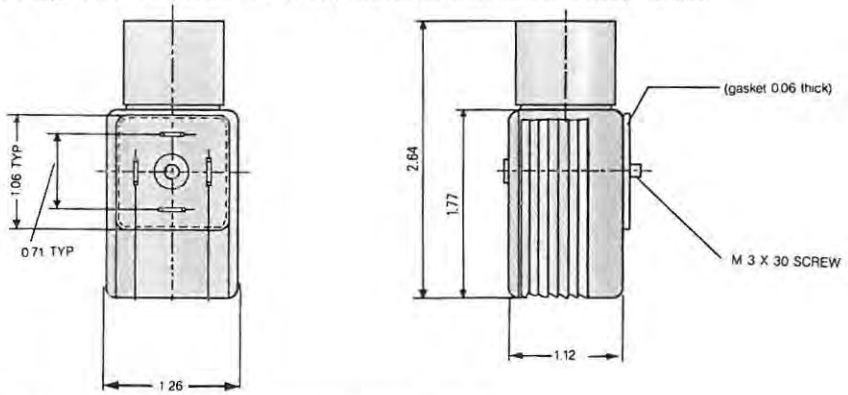
ORIFICE	A	B	D1 (NPT)	F1	E	L	SW width across flats
1/2	3.29	3.84	1/2	0.54	1.57	2.56	1.06
3/4	3.50	4.13	3/4	0.55	2.36	3.94	1.25
1	3.66	4.47	1	0.66	2.76	4.53	1.61
1-1/4	3.86	4.84	1-1/4	0.68	3.35	4.96	2.00
1-1/2	4.02	5.20	1-1/2	0.68	3.35	4.96	2.36
2	4.71	6.09	2	0.69	4.53	6.46	2.76
2-1/2	4.71	6.39	2-1/2	0.93	4.53	7.09	3.35

Cable plug

F plug (P/N A-1050-S001-021-00) not included with valve, order as separate item.



H Plug (P/N A-1053-S001-031-00) Included with all UL Listed valves



We reserve the right to make technical changes.

400 WOG

"KINGSTON"
VERTICAL CHECK VALVES

These spring loaded check valves are constructed along established Kingston lines of highest quality material and workmanship. They give long efficient service with minimum maintenance required.

Valve bodies, spring seats and spring cages are brass. Springs are of stainless steel.

Maximum working pressure 400 psig.

Fig. 224A & 225A — Are designed to screw directly into compressor air receivers or other apparatus. These provide positive non-return or back flow on air and gas service. Seat disc material is of Teflon. A side outlet of 1/8" N.P.T. is provided on Figure 225A, this may be used as connection port to pressure switch unloader systems or test valve for air brake systems. Maximum temperature 350°F (177°C).

Fig. 226A — Inline check valves are for use on air or light liquid service. Seat disc is of Teflon material. The 1/8" N.P.T. port may be used as line connection to pressure switch unloader system or inspection test valve.

Maximum temperature is 350°F (177°C).

Fig. 226 — Inline check valves are the same configuration as Fig. 226A, except without the unloader port. Standard seat disc is of bonded Buna-N material, Teflon is available on request. These valves operate equally well in vertical or horizontal position.

Maximum temperature is 200°F (93°C).



Fig. 224A

F.P.T.	M.P.T.
3/8"	1/2"
1/2"	3/4"
3/4"	3/4"
3/4"	1"
1"	1"
1 1/4"	1 1/4"
1 1/2"	1 1/2"

Fig. 224A



Fig. 225A

F.P.T.	M.P.T.
3/8"	1/2"
1/2"	1/2"
1/2"	3/4"
3/4"	3/4"
3/4"	1"
1"	1"
1 1/4"	1 1/4"
1 1/2"	1 1/2"

Fig. 225A



Fig. 226

F.P.T.	F.P.T.
1/4"	1/4"
3/8"	3/8"

Fig. 226



Fig. 226A

F.P.T.	F.P.T.
1/4"	1/4"
3/8"	3/8"
1/2"	1/2"
3/4"	3/4"

Fig. 226A

MANUFACTURED BY

F. C. Kingston Company

ESTABLISHED 1908

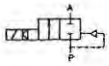
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LOS ANGELES, CALIFORNIA 90012

PRINTED IN U.S.A.

BULLETIN 111-82

bürkert



Instructions de service type 280

Respecter impérativement la notice de montage et d'utilisation. Tenir compte des conditions réelles d'utilisation et respecter les caractéristiques de puissance de l'appareil indiquées sur la fiche technique.
Il appartient à l'utilisateur de suivre ces instructions qui garantissent un fonctionnement correct et une longue durée de vie.

Conception
Distributeur 2/2, pré-piloté, normalement fermé en position de repos (mode de fonctionnement A).

Fluides
Gaz et liquides neutres qui n'attaquent pas le corps en laiton ainsi que le matériau d'étanchéité. Observer la plage de pression admissible mentionnée sur la plaque signalétique.

Montage
Avant le montage, éliminer les impuretés dans les conduites (résidus de soudure, perles de soudure, copeaux métalliques, matériau d'étanchéité). Utiliser un ruban en téflon comme matériau d'étanchéité. La flèche sur le corps indique le sens de passage. Position de montage quelconque; il est recommandé, cependant, d'orienter l'électro-aimant vers le haut car, ainsi, les matières en suspension ne peuvent pas parvenir dans le distributeur pilote (durée de vie prolongée). Un collecteur d'impuretés, monté en aval du distributeur, par exemple notre type 0007, prévient les pannes. Ne pas utiliser le distributeur comme levier lors du vissage. Bien supporter et ajuster les conduites de manière à ce que le corps de distributeur ne soit pas sous contrainte. Il faut que la section des conduites à l'entrée et à la sortie du distributeur soit maximale; éviter les points d'étranglement.

Pièces de rechange
Couper l'alimentation électrique ou débrancher le connecteur. Après avoir desserré les quatre vis sur l'électro-aimant, retirer le distributeur pilote. Desserrer les vis à tête cylindrique affleurantes et déposer le flasque; retirer la membrane et remplacer les pièces endommagées. Pièces de rechange, voir verso.

Raccordement électrique
Observer la tension et le type de courant mentionnés sur la plaque signalétique. Tolérance de tension ± 10%. Raccordement à l'aide du connecteur Bürkert, référence 1050-S001-021, degré de protection IP 65, câble 3x0,75 mm² ou, sur demande, câble moulé. Languette de connexion plate = mise à la terre. Il est possible de tourner l'embout du connecteur de 4x90°. Couple de serrage du connecteur 1 Nm.

Pannes
Vérifier les raccordements, la pression de service et la tension. Orifice d'étranglement dans la membrane obstrué? L'électro-aimant n'attire pas: court-circuit ou coupure des spires de la bobine, encrassement de la partie noyau. Un noyau bloqué ou manquant provoque une surchauffe de la bobine en cas de courant alternatif.

Instrucciones de servicio tipo 280

Deben observarse imprescindiblemente estas instrucciones de montaje y servicio. Asimismo deben tomarse en consideración las condiciones concretas de aplicación y atenerse a los datos de rendimiento del aparato conforme a la hoja de datos. Esto debe estar garantizado por el usuario y es condición previa para un funcionamiento sin problemas con larga duración.

Estructura
Válvula electromagnética de 2/2 vías, servopilotada; cerrada en posición de reposo (funcionamiento A).

Fluido
Gases neutrales y líquidos que no ataquen el material de latón del cuerpo ni el material de la junta. Tener en cuenta el margen de presiones admisible indicado en la placa de características.

Instalación
Antes del montaje, limpiar de suciedad las tuberías (residuos de estaño, perlas de soldadura, virutas metálicas, material obturante). Utilizar cinta de PTFE como material obturante. La flecha en el cuerpo indica el sentido de paso. Posición de montaje discrecional, si bien se recomienda con el sistema magnético orientado hacia arriba, pues así no entran en la servoválvula substancias que se precipiten (mayor duración). Un recogedor de suciedad delante de la válvula, p.ej. nuestro tipo 0007, protege contra averías. No utilizar la válvula como palanca al enroscar. Apoyar y alinear bien las tuberías para no deformar el cuerpo de válvula. Tiene que quedar garantizada la sección completa de las tuberías en la entrada y salida de la válvula, evitando estrangulamientos.

Piezas de recambio
Desconectar la tensión y/o quitar el terminal de cable. Después de soltar los cuatro tornillos en la válvula electromagnética, quitar la servoválvula. Soltar los tornillos de cabeza cilíndrica avellanados, y quitar la brida. Sacar la membrana y sustituir las piezas dañadas. Véanse las piezas de recambio al dorso.

Conexión eléctrica
Atender a tensión y tipo de corriente según placa de características. Tolerancia de tensión ± 10%. Conexión con terminal de cable Bürkert, número de pedido 1050-S001-021; protección IP 65; cable de 3x0,75 mm², u opcionalmente cable embutido. Lengüeta de enchufe plano = conexión a tierra. El elemento terminal de cable puede girarse 4 veces 90°. Par de apriete para terminal de cable: 1 Nm.

Perturbaciones
Verificar conexiones, presión de servicio y tensión. Orificio estrangulador en la membrana obstruido? El imán no atrae: cortocircuito o interrupción en la bobina, núcleo o cámara del núcleo sucios. Un núcleo atascado provoca sobrecalentamiento de la bobina caso de corriente alterna.

bürkert

Istruzioni per l'uso, tipo 280

Osservare assolutamente le istruzioni per il mont gio e l'uso. Inoltre tenere in considerazione le cor zioni concrete di impiego e rispettare i dati di pote dell'apparecchio in base al foglio dei dati tec Queste istruzioni, che vanno osservate dall'ute sono la premessa per un funzionamento perfett lunga durata.

Struttura
Valvola elettromagnetica a 2/2 vie, prepilot chiusa nella posizione di riposo (funzionamento

Fluido
Gas neutrali e liquidi, che non attaccano il mater in ottone del corpo e il materiale di tenuta. Rispett il campo di pressione ammesso in base alla ghetta di identificazione.

Montaggio
Prima del montaggio pulire le tubazioni da impu (residui della saldatura, perle di saldatura, trucio metallo, materiale per guarnizioni). Come mater per guarnizioni impiegare il nastro in PTFE. La fr cia sul corpo della valvola indica la direzione flusso. Posizione di montaggio a piacere, preferi mente con il sistema magnetico rivolto verso l'a poichè in tal modo i sedimenti non arrivano nella vola di pilotaggio (durata più lunga). Il filtro dispo davanti alla valvola, p.e. il nostro tipo 0007, la p tegge da disturbi.
Non impiegare la valvola come leva durante l'avv mento. Sostenere e allineare in modo adeguat tubazioni affinchè il corpo della valvola non ver deformato. Deve essere garantita la sezione co pleta delle tubazioni sull'entrata e sull'uscita d valvola, evitare punti di strozzatura.

Parti di ricambio
Disinserire la tensione o togliere la testa del ca Dopo aver allentato le quattro viti sulla parte mag tica, togliere la valvola di pilotaggio. Allentare le v testa cilindrica svasata e togliere la flangia, estra le membrane e sostituire le parti danneggiate. Pe parti di ricambio vedi il retro.

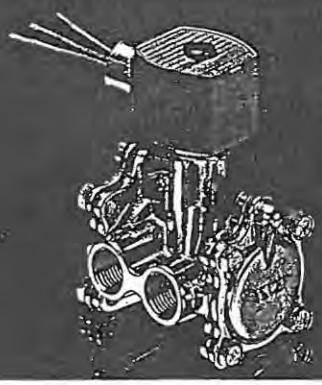
Collegamento elettrico
Rispettare la tensione e il tipo di corrente in base targhetta di identificazione. Tolleranza di tension 10%. Collegamento mediante testa del cavo Bürk numero di ordinazione 1050-S001-021, grado protezione IP 65, cavo 3x0,75 mm² o su richiesta t mite cavo a pressione. Linguetta di innesto piatt collegamento a terra. L'inserto della testa del c può essere ruotato di 4x90°. Coppia di serraggio testa del cavo 1 Nm.

Disturbi
Controllare i collegamenti, la pressione di eserc e la tensione. Il foro di strozzamento nella membr è otturato? L'elettromagnete non attira: cortocirc o interruzione della bobina, il nucleo o l'allogg mento del vano è otturato. Un nucleo bloccat mancante causa, con corrente alternata, il surrisc damento della bobina.

ASCO
Red-Hat II
8316
SERIES

3 WAY PILOT OPERATED
Air and Water Solenoid Valves

Brass Body • 3/8" to 1" N.P.T.



Specifications

Solenoid Enclosures: Valves listed in this series have Red-Hat II molded epoxy solenoids, are identified by the change letter "G" in their catalog numbers, e.g., 8316G54, and are shown in red.

Standard Enclosures:
Red-Hat II — Types 1, 2, 3, 3S, 4 and 4X Combination General Purpose and Watertight.

Optional Enclosures:
Red-Hat II — Types 3, 3S, 4, 4X, 6, 6P, 7 and 9 Combination Explosionproof and Watertight. To order, add prefix "EF" to catalog number.

Additional constructions are available. The Optional Electrical Features Section, page 11, contains descriptions and ordering information for: Open Frame Solenoids • Junction Box Enclosures • Panel Mount Constructions.

Electrical: Standard Voltages: 24, 120, 240, 480 volts, AC, 60 Hz (or 110, 220 volts, AC, 50 Hz)

6, 12, 24, 120, 240 volts, DC

Other voltages are available when required.

Coil: Continuous duty molded Class F.

Nominal Ambient Temperature Ranges: AC Construction: 32°F. to 125°F.
DC Construction 32°F. to 104°F.

Refer to Engineering Section for details.

Valve Parts in Contact with Fluid:
Body — Brass
Seals and Discs — Buna "N"
Diaphragm Assembly — Buna "N" with Brass and Stainless Steel trim
Core Tube — 305 s.s.
Core and Plugnut — 430F s.s.
Core Springs — 302 s.s. and 17-7PH s.s.
Shading Coil — Copper
Pilot Seat Cartridge and Disc Holder — Acetal

Approvals: CSA certified. Refer to Engineering Section for details.

Ordering Information:
Important: We must have catalog number, voltage and Hertz, operating pressure and fluid handled. Use strainers with solenoid valves.

IMPORTANT: A minimum operating pressure differential must be maintained between the pressure and exhaust ports. Supply and exhaust piping must be full area, unrestricted. ASCO flow controls and other similar components must be installed in the cylinder lines only.

SPECIFICATIONS

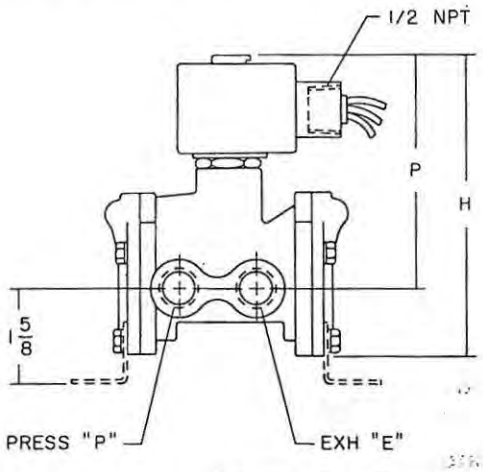
Pipe Size (Ins.)	Orifice Size (ins.)	Cv Flow Factor	Operating Pressure Differential (psi) Min. ①	Max. AC Air-Inert Gas	Max. AC Water	Max. DC Air-Inert Gas	Max. DC Water	Max. Fluid Temp. °F. AC	Max. Fluid Temp. °F. DC	Standard Solenoid Enclosures Red-Hat II–Types 1, 2, 3, 3S, 4 and 4X Brass Body Catalog Number	Constr. Ref. No.	Watt Rating/ Class of Coil Insulation ② AC	Watt Rating/ Class of Coil Insulation ② DC
NORMALLY CLOSED (Closed when de-energized)													
3/8	5/8	3	10	150	125	125	125	180	120	8316G54	1	6.1/F	10.6/F
3/8	5/8	3	10	250	250	250	250	180	120	8316G14	2	17.1/F	22.6/F
1/2	5/8	4	10	150	125	125	125	180	120	8316G64	1	6.1/F	10.6/F
1/2	5/8	4	10	250	250	250	250	180	120	8316G24	2	17.1/F	22.6/F
3/4	11/16	5.5	10	150	125	125	125	180	120	8316G74	3	6.1/F	10.6/F
3/4	11/16	5.5	10	250	250	250	250	180	120	8316G44	4	17.1/F	22.6/F
1	1	13	10	150	125	125	125	180	120	8316G34	5	6.1/F	10.6/F
NORMALLY OPEN (Open when de-energized)													
3/8	5/8	3	10	150	125	125	125	180	120	8316G56	1	6.1/F	10.6/F
3/8	5/8	3	10	250	250	250	250	180	120	8316G16	2	17.1/F	22.6/F
1/2	5/8	4	10	150	125	125	125	180	120	8316G66	1	6.1/F	10.6/F
1/2	5/8	4	10	250	250	250	250	180	120	8316G26	2	17.1/F	22.6/F
3/4	11/16	5.5	10	150	125	125	125	180	120	8316G76	3	6.1/F	10.6/F
3/4	11/16	5.5	10	250	250	250	250	180	120	8316G46	4	17.1/F	22.6/F
1	1	13	10	150	125	125	125	180	120	8316G36	5	6.1/F	10.6/F

Notes:
① 10 psi Minimum Operating Pressure Differential required. Valve vents to "zero" psi.
② On 50 Hertz service, the watt rating for the 6.1/F solenoid is 8.1 watts.

ELECTRICAL INFORMATION

Standard Coil and Class of Insulation	Watt Rating and Power Consumption				Spare Coil Part No.			
		AC			General Purpose		Explosionproof	
	DC Watts	Watts	VA Holding	VA Inrush	AC	DC	AC	DC
F	10.6	6.1	16	30	238210	238310	238214	238314
F	22.6	17.1	40	70	238610	238710	238614	238714

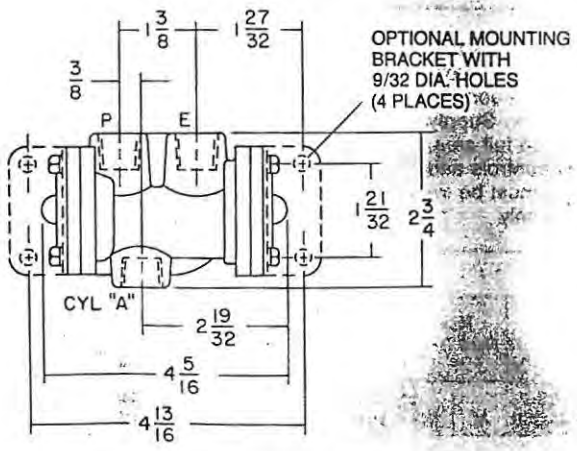
DIMENSIONS (in inches)



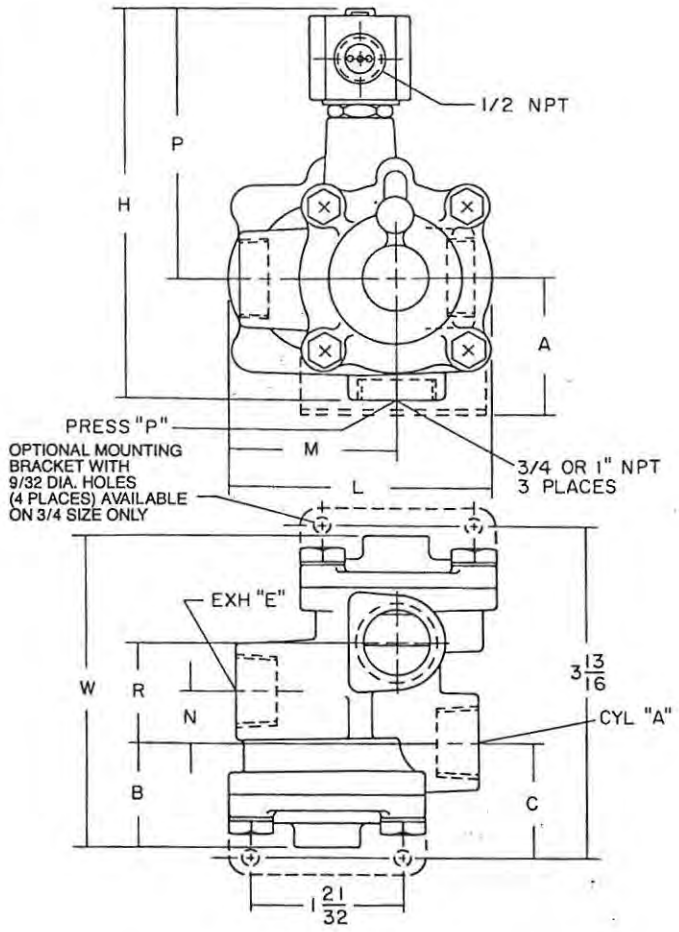
Constr. Refs. 1, 2

Const. Ref. No.	H	P
1	5 1/8	3 15/16
2	5 5/16	4 1/8

IMPORTANT: Valves can be mounted in any position.



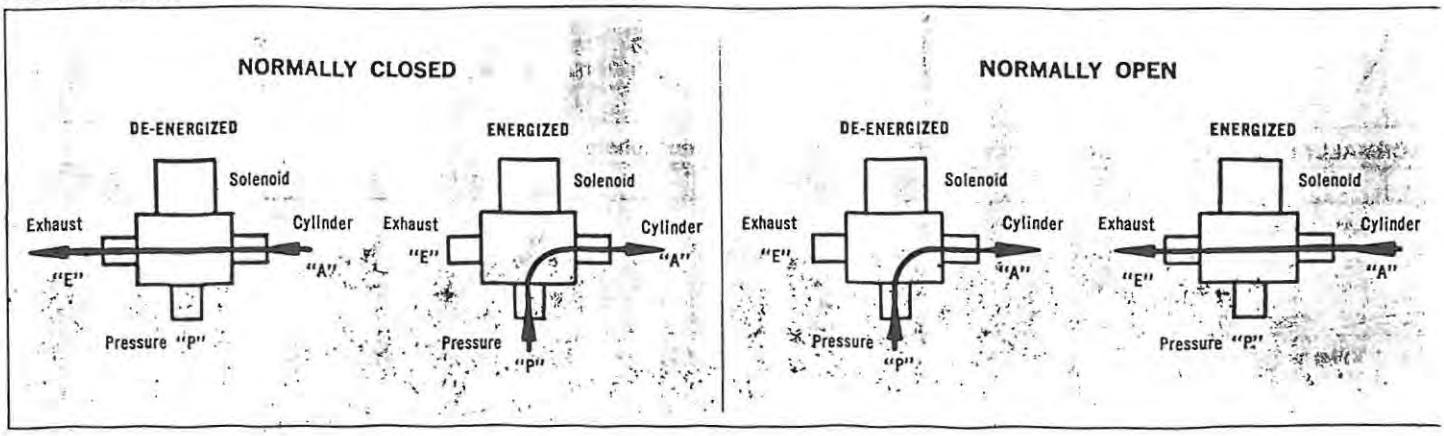
Constr. Refs. 3, 4, 5



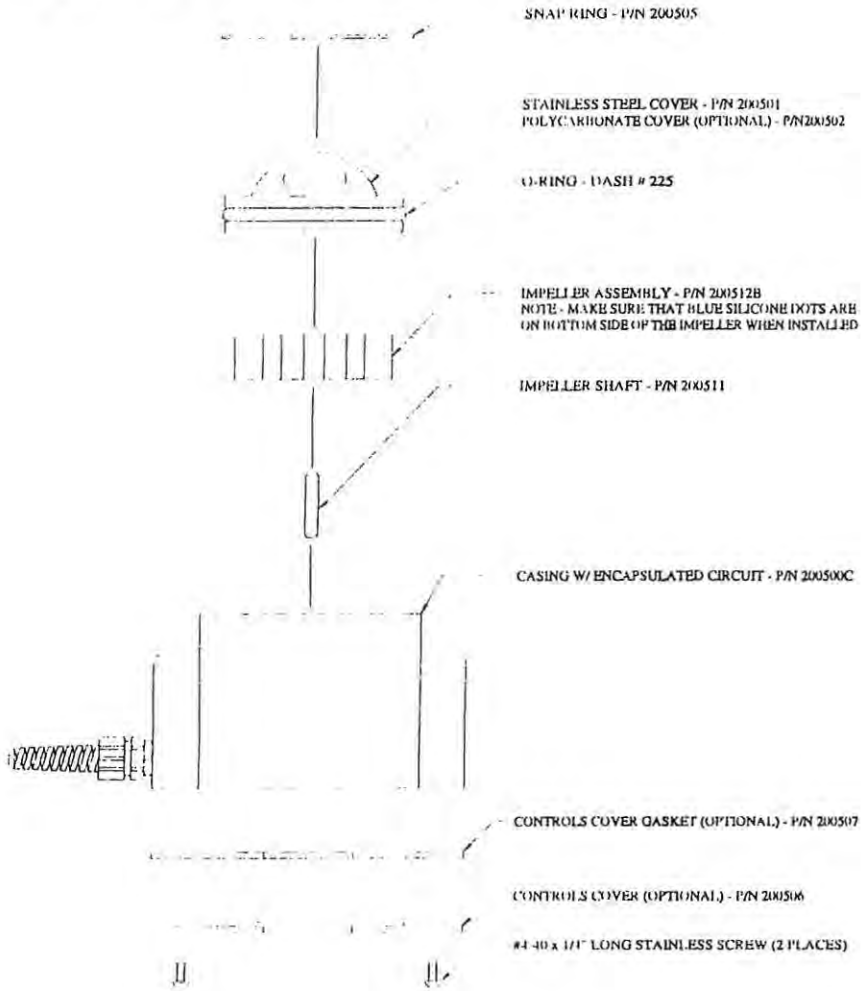
Const. Ref. No.	A	B	C	H	L	M	N	P	R	W
3	1 5/8	1 13/32	1 21/32	6	3 3/8	2 5/32	17/32	4 5/16	1/2	3 5/16
4	1 5/8	1 13/32	1 21/32	6 3/16	3 3/8	2 5/32	17/32	4 1/2	1/2	3 5/16
5	—	1 25/32	—	6 5/8	4 7/16	2 13/16	7/8	4 9/16	1 3/4	5 11/32

Important: Valves can be mounted in any position.

FLOW DIAGRAMS

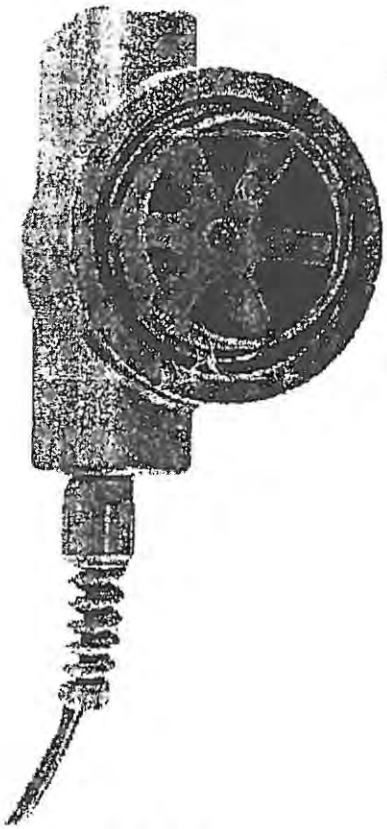


Exploded View and Parts List



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3828 West Mitchell Street
Milwaukee, WI 53215
Tel: (414) 671-3577
FAX: (414) 671-6645
email: lakemon@execpc.com

Installation and Operating Instructions



for

FLOWSTAT

Lake Monitors, Inc. • Milwaukee USA

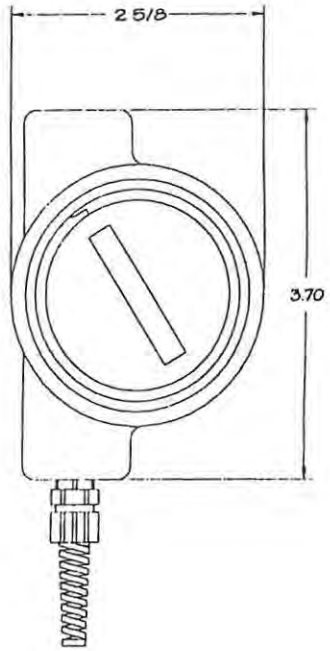
Introduction

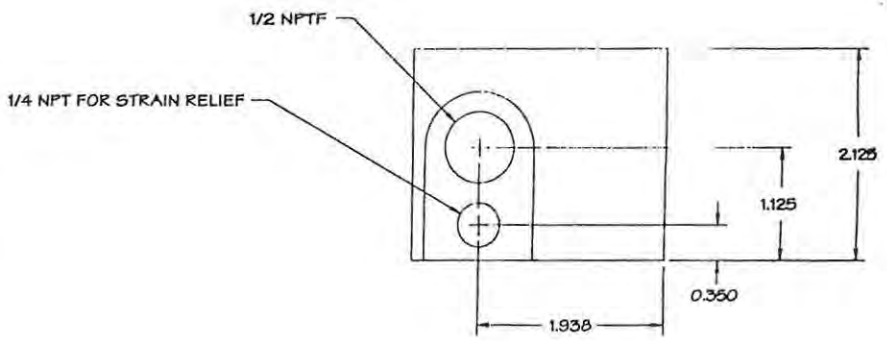
This manual is a service guide produced by the manufacturer. The manual provides specific procedures and/or illustrations for installation, inspection, cleaning and filtration. When properly followed, these procedures will keep your *FLOWSTAT* flowmeter operating dependably for many years.

It is important for operators and maintenance personnel to be safety conscience when operating or repairing equipment. Developing a thorough knowledge of the precautionary areas and following safe operating procedures, can prevent equipment damage and/or personal injury.

Before making any repair, read all of the repair procedures to learn the correct method and all precautions.

Dimensional Drawing





Note1: The *FLOWSTAT* is a bi-directional measuring device. References to "inlet" and "outlet" refer to uni-direction systems.

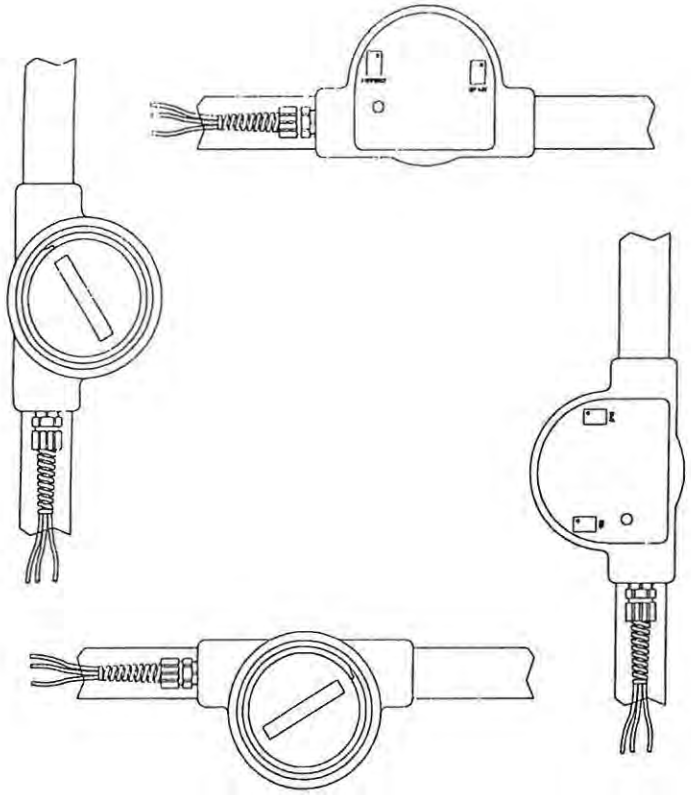


Figure 1
Mounting Orientations

Installation -- Electronic

The *FLOWSTAT* circuit is a two-wire loop-powered design that transmits a 4-20mA signal that is proportional to flow rate. The noise-immune current transmission from the sensor can be routed with low cost two conductor twisted-pair cable. The circuit operates on 12-35 Vdc and requires a source capable of supplying at least 20mA of current. The circuit has built in polarity protection and over-current limiting to protect both the transmitter and what the transmitter is connected to.

1. Connect the red wire from the transmitter sensor to the positive 12-35Vdc power supply output. 801
2. Connect the black wire from the transmitter to the positive side of the loop load (resistor, chart recorder, data acquisition board, meter, etc.). 227 etc

This connection may be labeled "4-20mA Input" or "4-20mA (+)" on some devices.

3. If applicable, connect the negative side of the loop load to negative side of the power supply.
4. Apply power to the system.
5. If everything is operating correctly, the green LED on the sensor will dimly illuminate and 4mA will be flowing in the loop. If there is fluid flowing through the sensor, the current will be higher than 4mA and the LED will be quite bright.

   If the LED does not illuminate:

   - check wiring terminations for good connections
   - check wiring polarity
   - verify correct supply voltage
   - ensure that the load impedance is within allowable limits
   - Apply the DC supply voltage directly across the sensor wires. IF the LED does illuminate, the load is either: too great of impedance or an open circuit. If the LED does not illuminate, the sensor's lead wires or circuit are defective.

6. The installation should be complete.

Service and Maintenance

The sensor is designed to provide years of low maintenance service in industrial environments. As with all mechanical rotating devices, the bearing surfaces will wear with use. The life of the parts will depend on factors such as cleanliness of the fluid, media, mounting orientation, temperature, fluid velocity and frequency of operation. The *FLOWSTAT* sensor was designed with simple field-replacement of the rotating parts in mind. To inspect or replace the rotating components:

1. Relieve pressure in the piping system.
2. Remove the retainer ring that secures the turbine access cover.
3. Remove the access cover with a pliers, taking care not to damage the o-ring seal.
4. Pull out the turbine assembly and the shaft.
5. Inspect the shaft for things that may have wrapped around it.
6. Inspect the turbine bearing surface for wear and elongation. Replace as necessary.
7. Clean any rust off of the magnets that may have accumulated.

8. Reassemble the unit by placing the turbine into the body cavity with the two magnet pockets facing inward. Place the shaft into the turbine hole and guide it into the retaining hole in the body cavity. Lubricate the o-ring seal with some glycerin or other lubricant and press it into the pocket of the body. Replace the retaining ring securely before applying pressure to the system.

Circuit recalibration:

1. Place a milliamp meter into the current loop.
2. Turn off the flow going though the sensor. Adjust the **OFFSET** control for a reading of 4mA on the milliamp meter.
3. Adjust the flow rate though the meter to full flow rate. Adjust the **SPAN** control for a reading of 20mA on the milliamp meter. The two controls are not interactive, so further adjustment should not be necessary.

FLOWSTAT Specifications

Mechanical Specifications

Maximum pressure:	200 PSI clear cover, 500 PSI SS cover
Maximum temperature:	225 F
Measuring range:	0.5-15 GPM
Wetted materials:	316SS, iglide®, Buna and acetal copolymer
Non-wetted materials:	Epoxy, Lexan®, PVC

Electronic Specifications

Power requirements:	12-35Vdc, 20mA
Load driving capacity:	Load (ohms) = 50(Power Supply Voltage - 12)
Trans. Distance:	limited only by wire resistance and supply voltage
LED:	provides power indication
Flow rate accuracy:	2% of full scale
Repeatability:	0.5% of scale
Resolution:	infinite
Response time:	2 seconds to 90%
Over-current protection:	self limiting at 30mA
Fail safe indication:	4 mA

General

Lake Monitors' *FLOWSTAT* flow rate sensor integrates rugged tangential turbine technology with a precision digital to analog conversion circuit hermetically encapsulated within the body of the sensor. The flow transmitter is ideal for measuring flow rates in cooling circuits, HVAC systems and batching operations.

Additional features are:

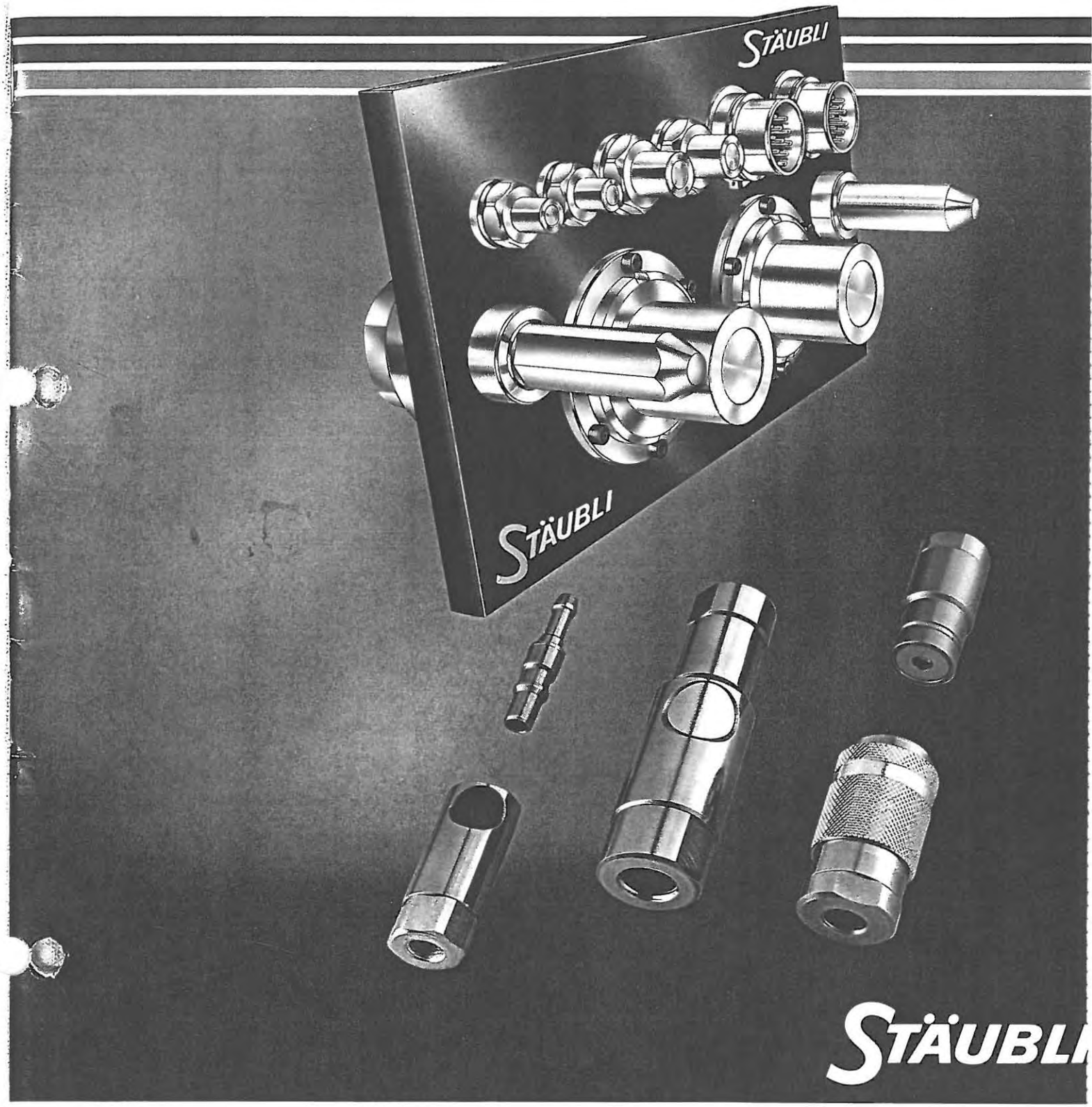
- simple in-the-field serviceability of its moving components,
- the integral 4-20mA circuit design eliminates the need for separate signal conditioning modules,
- units come factory calibrated to your system requirements,
- the low impedance 4-20mA circuit can transmit a "clean" signal, over low-cost wire, for several thousand feet without degradation,
- accurately measures flow in both directions.

Installation -- Mechanical

1. The *FLOWSTAT* has NPT (National Pipe Thread) plumbing connections. Lake Monitors recommends that a paste type pipe sealant be used on these threads. [Teflon tape sealant can be used as long as it is applied in such a way that it will not enter the flow stream. Pieces of Teflon tape can wrap around the turbine and impede its rotation.]
2. The recommended mounting orientation would be any plane that will place the axis of the turbine horizontal with respect to the ground. See FIGURE 1. The unit will operate satisfactorily with its axis at angles other than horizontal, but side loading of the bearing surfaces will lead to premature wear of the rotating parts.
3. For the best flow measurement results, place the inlet (See Note 1 below) of the flow sensor at least 10 straight pipe diameters downstream from any fitting, valve, elbow, reducer, etc. that causes non-stable flow conditions. 'eally, 5 straight pipe diameters should be placed at the outlet of the sensor. If the sensor must be placed closer to a source of non-stable flow than these recommended distances, some instability of the output signal may result. The average signal will be accurate.
4. It is recommended that the sensor be placed in such a position that the round access cover can be removed for cleaning and turbine servicing. It is also recommended that a union be placed near the sensor to allow easy removal.

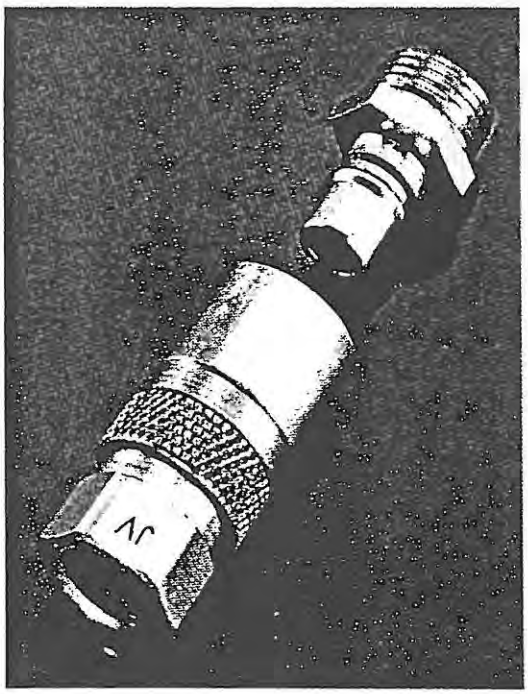
Fluid connection

General program



STÄUBLI mono-couplings

Quick-release couplings for thermosplastic injection mold control



RMI

Quick-release couplings with valves

nominal diam.:
1/4" - 3/8" - 1/2" - 5/8"
working pressure:
230 PSI

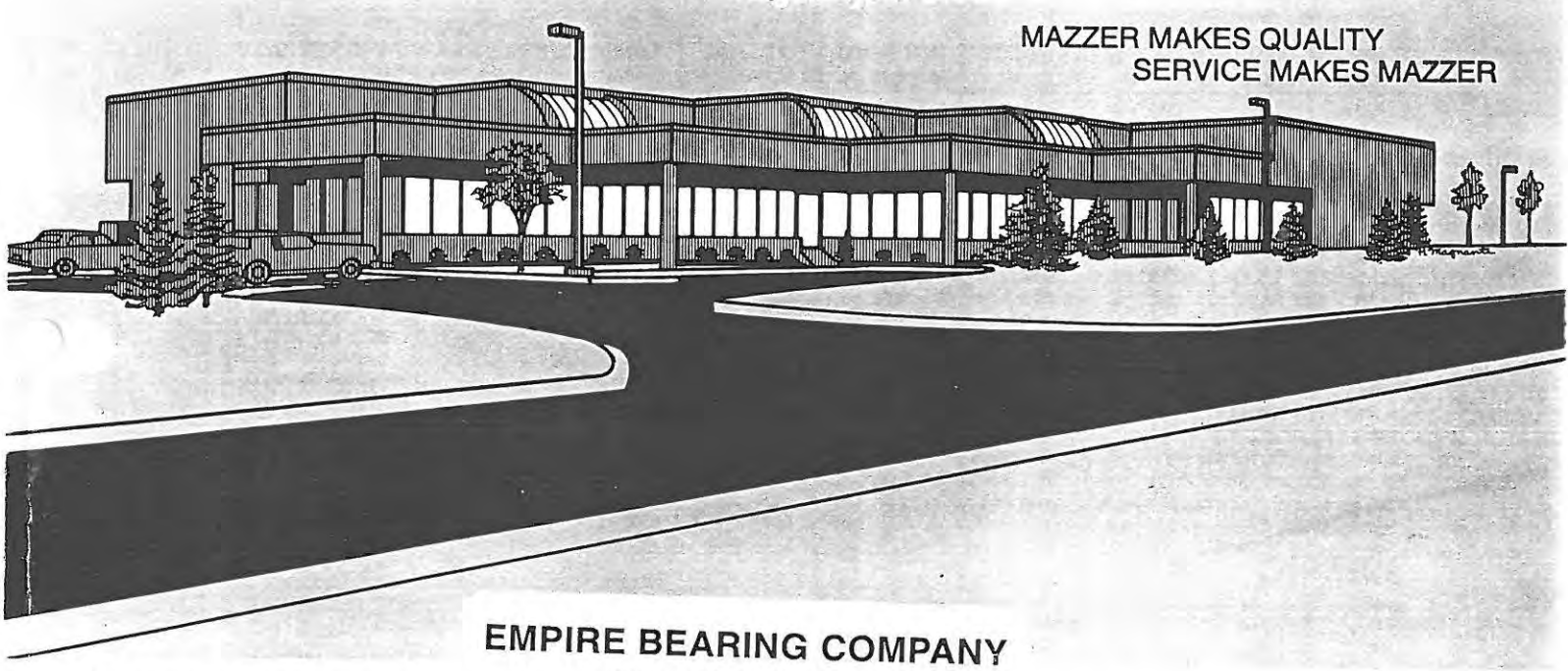
for regulation lines (cold water - hot water - hot oil) for molds used for the injection of thermoplastics, Zamak, aluminum alloys, brass...

single or double shut-off system - excellent flow/size ratio - easy connections and disconnections with a knurled sleeve in the case of recessed plugs

brass

MAZZER

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MAZZER INDUSTRIES, INC. • 1

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MAZZER INDUSTRIES

MAZZER NYLON 11 TUBING

The most universal of all thermoplastic tubing

This formulation for flexible premium tubing is the standard for both general industrial and automotive applications. Its broad temperature range (-60° F., +250° F. continuous) combined with light weight, dimensional stability, chemical resistance and flexibility make it the most universal of all thermoplastic tubing.

- Light weight
- Long fatigue life
- Excellent abrasion resistance
- Broad range of corrosion resistance and chemical compatibility
- Low moisture absorbtion

APPLICATIONS:

- Pneumatics
- Hydraulic
- Vacuum
- Gases
- Lubricants
- Oils
- General Chemicals
- Fluidics
- Machine Tool
- Coolant
- Fuel
- Petrochemicals
- Fresh & salt water

REF. SIZE	O.D. NOM.IN.	I.D. NOM.IN.	WALL THICKNESS NOM.IN.	MIN. BEND RADIUS IN.	O.D. TOL. IN.	I.D. TOL. IN.	MIN BURST PRESSURE PSI @ 75° F.	MAZZER PAC COIL LENGTH
2	1/8	.080	.023	.70	+.002 -.0045	±.004	1000	250 ft.
2.5	5/32	.106	.025	.94	+.002 -.0045	±.004	1000	250 ft.
3	3/16	.118	.035	1.1	+.002 -.0055	±.004	1000	250 ft.
4	1/4	.180	.035	1.5	+.002 -.0055	±.004	1000	250 ft.
-4	-1/4	.126	.062	1.5	+.002 -.0055	±.004	1000	250 ft.
5	5/16	.233	.040	1.85	+.002 -.0055	±.004	1000	200 ft.
- 6	- 3/8	.275	.050	2.25	+.002 -.0055	±.004	1000	150 ft.
- 8	1/2	.375	.062	3	+.002 -.0055	±.004	1000	100 ft.
10	5/8	.500	.062	3.75	±.004	±.004	600	*100 ft.
12	3/4	.560	.095	4.5	±.004	±.004	790	*100 ft.
16	1	.750	.125	6	±.006	±.006	790	*100 ft.

*Conventional Boxes Only

Note: Specified minimum bend radius is for minimal tube flattening
In addition to Mazzer Pac Boxes:
Reels available up to 5000 ft.
Tubing size 2 to 8 available in 100 ft. Slit Pac Bags
Colors: Natural, Black, Red, Blue, Green, Yellow, Orange, Gray
Call for availability of DOT and FDA approved tubing
See Price List for regular in-stock inventory

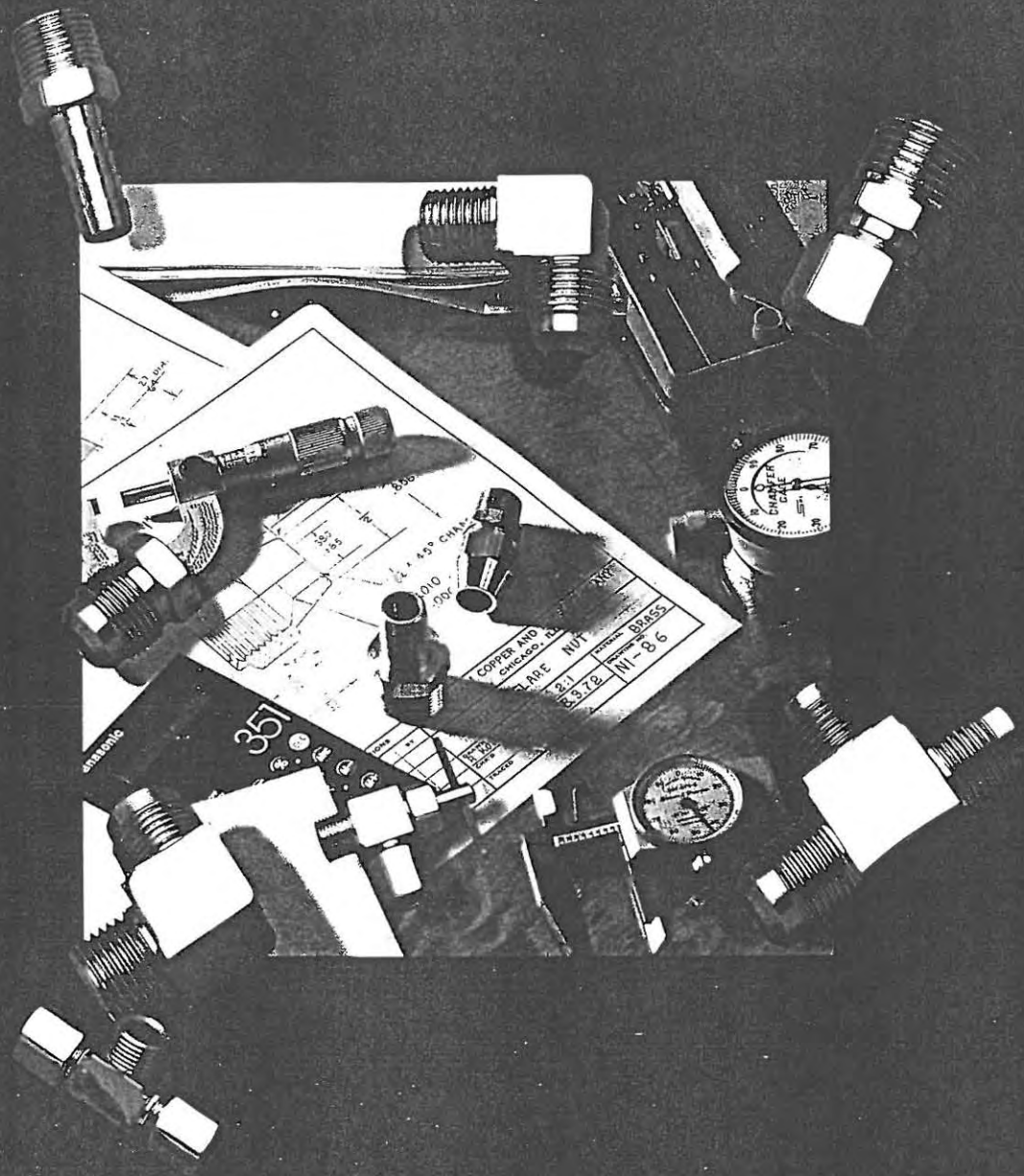
METRIC

REF. SIZE	O.D. NOM. MM.	I.D. NOM MM.	WALL THICKNESS NOM.MM.	MIN. BEND RADIUS MM.	O.D. TOL. MM.	I.D. TOL. MM.	MIN. BURST PRESSURE 24° C. 75° F.	MAZZER PAC COIL LENGTH
0427	4	2.7	.65	24	+.05 -.1	±.1	75 BARS 1086psi	25 meters
0402	4	2	1	24	+.05 -.1	±.1	134 BARS 1956psi	25 meters
0533	5	3.3	.85	30	+.05 -.1	±.1	70 BARS 1015psi	25 meters
0604	6	4	1	36	+.05 -.1	±.1	85 BARS 1233psi	25 meters
0806	8	6	1	48	+.05 -.1	±.1	58 BARS 841psi	25 meters
0855	8	5.5	1.25	50	+.05 -.1	±.1	74 BARS 1074psi	25 meters
1008	10	8	1	60	+.05 -.1	±.1	42 BARS 609psi	25 meters
1075	10	7.5	1.25	70	+.05 -.1	±.1	57 BARS 827psi	25 meters
1210	12	10	1	75	+.05 -.1	±.1	32 BARS 464psi	25 meters
1209	12	9	1.5	84	+.05 -.1	±.1	63 BARS 914psi	25 meters
1412	14	12	1	98	+.05 -.1	±.1	27 BARS 392psi	*25 meters
1411	14	11	1.5	100	+.05 -.1	±.1	52 BARS 754psi	*25 meters
1512	15	12	1.5	105	±.1	±.1	48 BARS 696psi	*25 meters
1613	16	13	1.5	112	±.1	±.1	44 BARS 638psi	*25 meters
1814	18	14	2	126	±.1	±.1	58 BARS 841psi	*25 meters
2015	20	15	2.5	140	±.15	±.15	69 BARS 1000psi	*25 meters
2216	22	16	3	154	±.15	±.15	75 BARS 1088psi	*25 meters
2519	25	19	3	175	±.15	±.15	68 BARS 986psi	*25 meters
2822	28	22	3	196	±.15	±.15	60 BARS 870psi	*25 meters

*Conventional Boxes Only

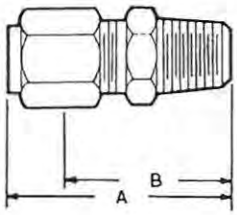
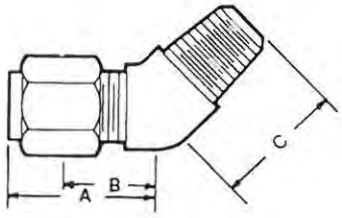
Note: Specified minimum bend radius is for minimal tube flattening.
In addition to Mazzer Pac Boxes:
Reels available up to 1500 meters
Tubing size 0427 to size 1209 available in 25 meter Slit Pac Bags
Colors: Natural, Black, Red, Blue, Green, Yellow, Orange, Gray
Call for availability of DOT and FDA approved tubing
See Price List for regular in-stock inventory

B R A S S
F I T T I N G S
& V A L V E S



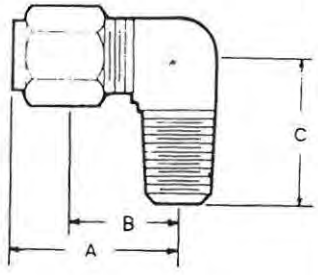
ANDERSON FITTINGS

A-LIGN FITTINGS

DESCRIPTION	PART NUMBER	O.D. TUBE	PIPE THREAD	A	B	C	HEX
968A CONNECTOR TUBE TO MPT							
	968A-2A	1/8	1/8	.98	.78		7/16
	968A-3A	3/16	1/8	1.08	.84		7/16
	968A-3B	3/16	1/4	1.27	1.03		9/16
	968A-4A	1/4	1/8	1.12	.88		7/16
	968A-4B	1/4	1/4	1.21	.97		9/16
	968A-4C	1/4	3/8	1.27	1.03		11/16
	968A-4D	1/4	1/2	1.27	1.00		13/16
	968A-5A	5/16	1/8	1.18	.91		1/2
	968A-5B	5/16	1/4	1.23	.97		9/16
	968A-6A	3/8	1/8	1.22	.94		9/16
	968A-6B	3/8	1/4	1.31	1.07		9/16
	968A-6C	3/8	3/8	1.39	1.09		11/16
	968A-6D	3/8	1/2	1.32	1.06		13/16
	968A-6E	3/8	3/4	1.59	1.31		1-1/16
	968A-8B	1/2	1/4	1.49	1.09		11/16
	968A-8C	1/2	3/8	1.54	1.16		11/16
	968A-8D	1/2	1/2	1.49	1.09		13/16
	968A-8E	1/2	3/4	1.78	1.38		1-1/16
	968A-10C	5/8	3/8	1.54	1.12		13/16
	968A-10D	5/8	1/2	1.54	1.12		13/16
	968A-10E	5/8	3/4	1.80	1.38		1-1/16
	968A-12E	3/4	3/4	1.95	1.50		1-1/16
96945A ELBOW, 45° TUBE TO MPT							
	96945A-4A	1/4	1/8	.90	.66	.56	
	96945A-6B	3/8	1/4	.90	.62	.84	
	96945A-8C	1/2	3/8	1.14	.78	.88	

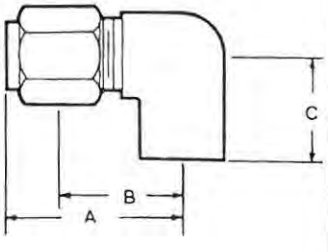
A-LIGN FITTINGS

969A
ELBOW, 90°
TUBE TO MPT



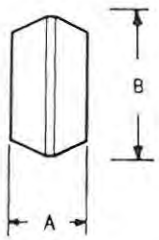
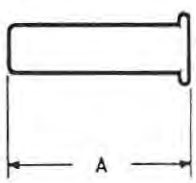
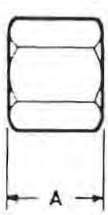
PART NUMBER	O.D. TUBE	PIPE THREAD	A	B	C	HEX
969A-2A	1/8	1/8	.79	.59	.72	
969A-3A	3/16	1/8	.86	.62	.72	
969A-4A	1/4	1/8	.86	.62	.75	
969A-4B	1/4	1/4	.85	.61	.81	
969A-4C	1/4	3/8	.86	.62	.89	
969A-5A	5/16	1/8	.85	.59	.68	
969A-5B	5/16	1/4	.92	.66	.84	
969A-6A	3/8	1/8	1.08	.80	.66	
969A-6B	3/8	1/4	1.08	.80	.93	
969A-6C	3/8	3/8	1.05	.77	.93	
969A-6D	3/8	1/2	1.16	.88	1.12	
969A-8B	1/2	1/4	1.25	.88	1.03	
969A-8C	1/2	3/8	1.25	.88	1.03	
969A-8D	1/2	1/2	1.32	.94	1.12	
969A-10C	5/8	3/8	1.41	1.06	1.12	
969A-10D	5/8	1/2	1.41	1.06	1.16	
969A-12D	3/4	1/2	1.64	1.16	1.18	
969A-12E	3/4	3/4	1.76	1.28	1.31	

970A
ELBOW, 90°
TUBE TO FPT

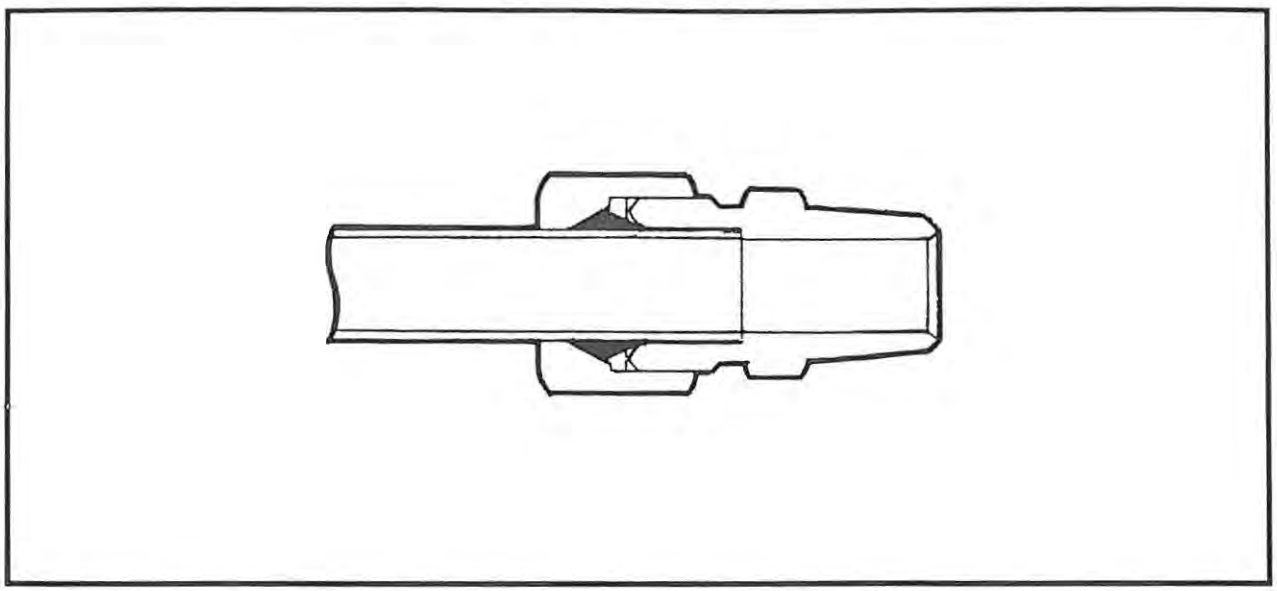


PART NUMBER	O.D. TUBE	PIPE THREAD	A	B	C	HEX
970A-3A	3/16	1/8	1.26	.98	.57	
970A-4A	1/4	1/8	.92	.68	.47	
970A-4B	1/4	1/4	.99	.75	.59	
970A-5A	5/16	1/8	1.33	1.20	.82	
970A-5B	5/16	1/4	1.43	1.15	.50	
970A-6B	3/8	1/4	1.13	.78	.59	
970A-6C	3/8	3/8	1.56	1.26	.61	
970A-6D	3/8	1/2	1.32	.97	.66	
970A-8C	1/2	3/8	1.53	1.19	.66	
970A-8D	1/2	1/2	1.89	1.53	.70	
970A-10D	5/8	1/2	1.41	1.03	.76	

COMPRESSION FITTINGS

DESCRIPTION	PART NUMBER	O.D. TUBE	PIPE THREAD	A	B	C	HEX
60A SLEEVE  REF SAE 060115	60A-2	1/8		.19	.19		
	60A-3	3/16		.22	.27		
	60A-4	1/4		.25	.27		
	60A-5	5/16		.25	.34		
	60A-6	3/8		.25	.41		
	60A-7	7/16		.31	.54		
	60A-8	1/2		.32	.60		
	60AH-8	1/2		.38	.60		
	60A-10	5/8		.32	.72		
	60AH-10	5/8		.38	.72		
	60A-12	3/4		.44	.88		
	60A-14	7/8		.41	1.00		
60AP DELRIN SLEEVE  	60AP-4	1/4		.19			
	60AP-5	5/16		.19			
	60AP-6	3/8		.19			
	60AP-8	1/2		.22			
	60AP-10	5/8		.22			
60AE BRASS INSERT  FOR USE WITH SOFT TUBING.	60AE-4	1/4		.65			
	60AE-5	5/16		.50			
	60AE-6	3/8		.54			
	60AE-8	1/2		.72			
	60AE-10	5/8		.62			
61A NUT  REF SAE 060110	61A-2	1/8		.38			3/8
	61A-3	3/16		.41			7/16
	61A-4	1/4		.44			1/2
	61A-5	5/16		.44			9/16
	61A-6	3/8		.47			5/8
	61A-7	7/16		.50			11/16
	61A-8	1/2		.56			3/4
	61AH-8	1/2		.62			13/16
	61A-10	5/8		.56			7/8
	61AH-10	5/8		.62			15/16
	61A-12	3/4		.68			1-1/8
	61A-14	7/8		.62			1-1/4

COMPRESSION FITTINGS



CONSTRUCTION

+ Three piece unit: body, nut and sleeve
+ Straights and shapes manufactured from CA360, CA345 or CA377 brass

ADVANTAGES

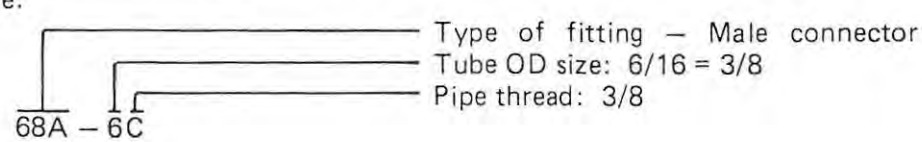
+ No flaring, soldering or other special tubing preparation required.
+ Low cost
+ Wide range of styles and sizes
+ Easy assembly

APPLICATIONS

+ Compatible with copper, brass, aluminum and thermoplastic tubing.
  (Thermoplastic tubing requires the use of a brass insert for support.)
+ Low pressure air, oil, water and gas up to a maximum pressure of 400 psi.
+ Fair vibration resistance. The long nut can be used for greater vibration application.

ORDERING INFORMATION

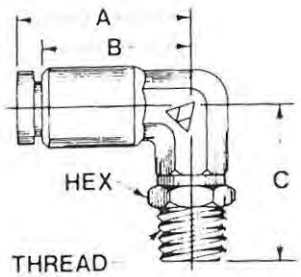
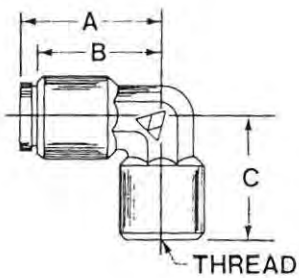
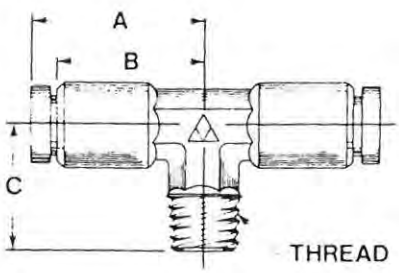
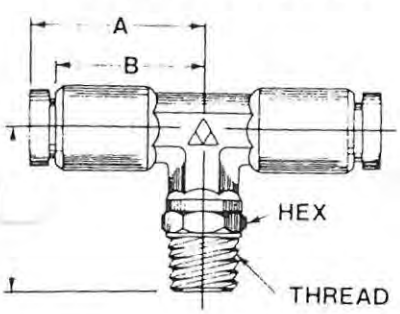
+ Fitting is supplied as an assembly. If the body only is desired, use the prefix "B".
+ Nomenclature example:

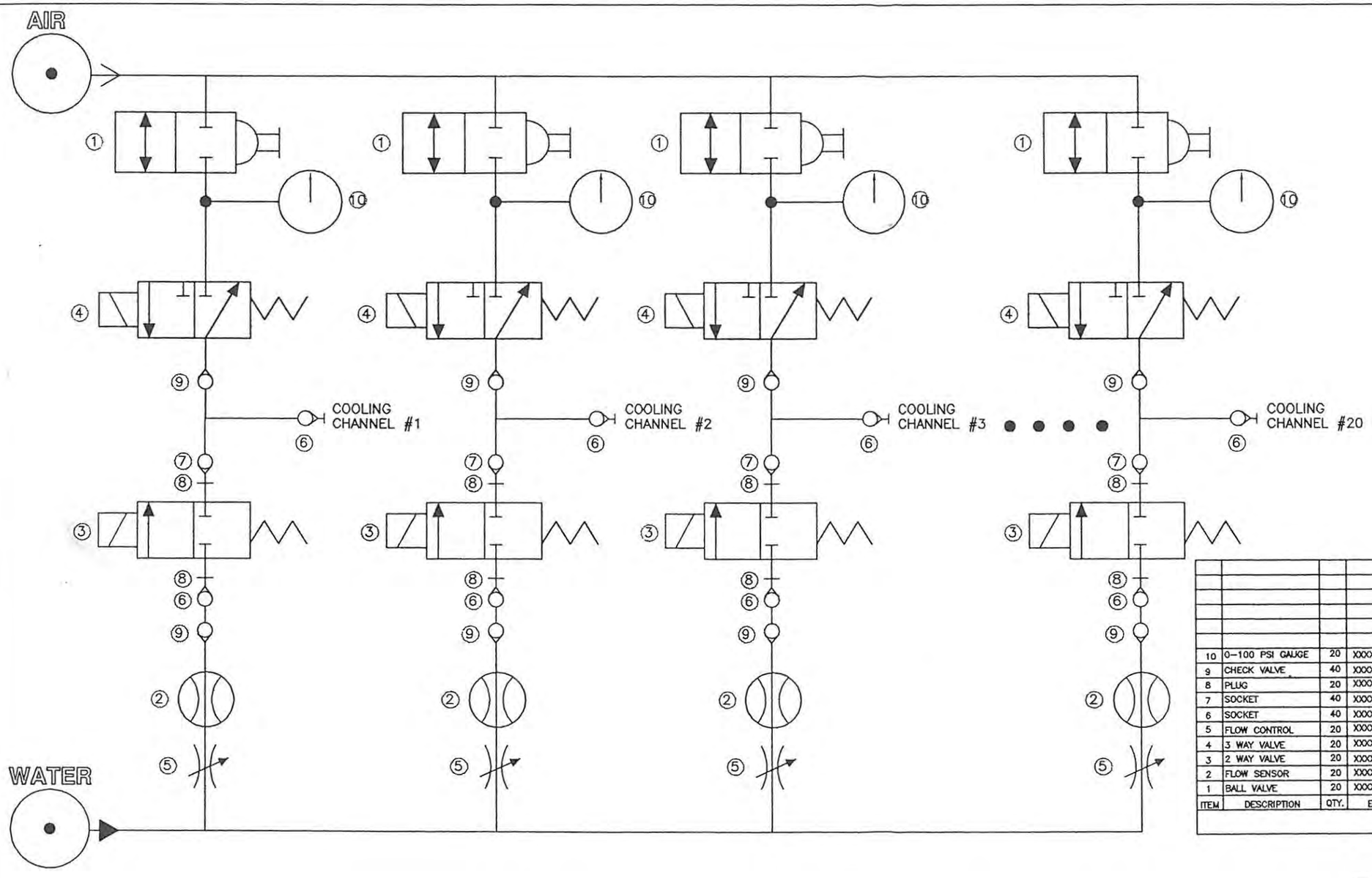


NOTES

+ Current price list represents in stock cataloged items.
+ Non-stock items and special parts are available on a quotation basis.
+ Configurations and dimensions are subject to change without notice.

POLY-PUSH FITTINGS

DESCRIPTION	PART NUMBER	O.D. TUBE	PIPE THREAD	A	B	C	HEX
269PPS 360° SWIVEL ELBOW 	269PPS-2A	1/8	1/8	.77	.65	1.05	
	269PPS-2.5A	5/32	1/8	.79	.66	.87	
	269PPS-4A	1/4	1/8	1.02	.88	1.13	
	269PPS-4B	1/4	1/4	1.02	.88	1.32	
	269PPS-4C	1/4	3/8	1.02	.88	1.32	
	269PPS-6B	3/8	1/4	1.08	.94	1.44	
	269PPS-6C	3/8	3/8	1.08	.94	1.46	
	269PPS-8C	1/2	3/8	1.18	1.04	1.68	
	269PPS-8D	1/2	1/2	1.18	1.04	1.19	
270PP FEMALE ELBOW 	270PP-2.5A	5/32	1/8	.93	.75		
	270PP-4A	1/4	1/8	1.04	.90		
	270PP-6B	3/8	1/4	1.12	.98		
271PPS MALE SWIVEL RUN TEE 	271PPS-2.5A	5/32	1/8	.77	.65	1.15	
	271PPS-4A	1/4	1/8	1.04	.90	1.13	
	271PPS-4B	1/4	1/4	1.04	.90	1.32	
	271PPS-5A	5/16	1/8	1.03	.33	1.05	
	271PPS-6B	3/8	1/4	1.08	.94	1.46	
	271PPS-6C	3/8	3/8	1.08	.94	1.46	
	271PPS-8C	1/2	3/8	1.18	1.04	1.68	
	271PPS-8D	1/2	1/2	1.18	1.04	1.91	
272PPS MALE SWIVEL BRANCH TEE 	272PPS-2.5A	5/32	1/8	.79	.66	1.15	
	272PPS-4A	1/4	1/8	1.04	.90	1.13	
	272PPS-4B	1/4	1/4	1.04	.90	1.32	
	272PPS-5A	5/16	1/8	1.03	.36	1.05	
	272PPS-6B	3/8	1/4	1.10	.96	1.44	
	272PPS-8C	1/2	3/8	1.18	1.04	1.68	
	272PPS-8D	1/2	1/2	1.18	1.04	1.91	



ITEM	DESCRIPTION	QTY.	ECI P/N	MANUFACTURER P/N	MANUFACTURER
10	0–100 PSI GAUGE	20	XXXXXXXX	LNZ100–25–RC–FFBL	LENZ
9	CHECK VALVE	40	XXXXXXXX	XXXXXXXXX	XXXXXXXXX
8	PLUG	20	XXXXXXXX	JPS54	DME
7	SOCKET	40	XXXXXXXX	JS500V	DME
6	SOCKET	40	XXXXXXXX	JS504MV	DME
5	FLOW CONTROL	20	XXXXXXXX	SPN800D	XXXXXXXXX
4	3 WAY VALVE	20	XXXXXXXX	2804/2-PPH-1/2-130/80-00-0-C-0	BURKERT
3	2 WAY VALVE	20	XXXXXXXX	8316G84	ASCO
2	FLOW SENSOR	20	XXXXXXXX	RJB6WB104–20ma	PAUL MONROE
1	BALL VALVE	20	XXXXXXXX	XXXXXXXXXX	XXXXXXXXXXXXX

PARTS LIST

REV	DESCRIPTION	DATE	APP'D
–	ENGINEERING RELEASE		

REVISIONS

APPROVALS	DATE
DRAWN BY J. WATERS	8/16/94
CHECKED BY J. WATERS	8/16/94
APPROVED BY J. WATERS	8/16/94
ENGINEERING J. ALLEN	8/16/94
MANUFACTURING	8/16/94
CUSTOMER AAP	
DO NOT SCALE DRAWING	

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EMPIRE CASTINGS INC.
3195 REGIONAL PARKWAY SANTA ROSA, CA 95403

AIR/WATER SYSTEM SCHEMATIC

EMPIRE WORK ORDER NO.	EMPIRE DRAWING NO.
AAPM01	0800131
NEXT ASSEMBLY NO.	CUSTOMER PART NO. / REV
	–
QTY: 1	SCALE: TO FIT / SHEET 1 OF 1

ROUTINE MAINTENANCE SCHEDULE

DAILY

1. Lubricate main tie rod guide bushings.
2. Lubricate retriever guide bushings.
3. Lubricate ejection system shafts
4. Clean Electrical enclosure filters
5. Inspect hydraulic fluid level (fill if necessary).
6. Inspect level of furnace exhaust valve pneumatic oiler (fill if necessary).
7. Drain all water separators.
9. Check for free movement of Ram Safety Mechanisms (clean and lubricate as necessary).
10. Inspect Hydraulic system for proper operating pressure.
11. Inspect Hydraulic system for proper operating temperature.
12. Inspect machine safety guards and Infra red eyes.

WEEKLY

1. Inspect the daily maintenance schedule log.
2. Inspect all limit switches for proper operation.
3. Inspect all limit switches for proper adjustment.
4. Inspect all limit switch arms for signs of wear.
5. Clean Furnace Cavity.
6. Inspect, Clean and lubricate furnace fill door gaskets. Replace damaged gaskets.
7. Inspect furnace raise/lower mechanism gear box fluid level.
8. Clean furnace raise/lower mechanism ball screws.

MONTHLY

1. Inspect the daily maintenance schedule log.
2. Inspect the weekly maintenance schedule log.
3. Replace hydraulic low pressure filter.
4. Replace hydraulic high pressure filter.
5. Inspect Furnace Traverse gear motor fluid level. Fill if necessary.
6. Torque all Tie Rod bolts.
7. Torque all Machine Vertical and Horizontal Support bolts.
8. Clean and lubricate Ram Safety Mechanism.
9. Clean and lubricate Raise and Lower Safety Mechanism.
10. Sample hydraulic oil for proper cleanliness and viscosity.

EVERY SIX (6) MONTHS

1. Grease Furnace Traverse wheel bearings.

IT IS RECOMMENDED THAT ALL THE ABOVE MAINTENANCE PROCEDURES BE STRICTLY ENFORCED AND THAT ALL SCHEDULED MAINTENANCE BE DOCUMENTED.

Hydraulic Power Unit Oil and Filter Maintenance

PRESSURE FILTER ELEMENT PART NO.: PALL HC9650fdp8H

OFF LINE FILTER ELEMENT PART NO.: PALL HC7400SKN8H

DATE OF OIL SAMPLE (Chem-Trend HF-28)	

DATE OF FILTER CHANGES	PERFORMED BY:

MACHINE BOLT TORQUE VALUES FOR GRADE 8 FASTENERS

Bolt Diameter (inches)	Recommended Torque (foot lbs)	(N-m)
1/4"	12	16
5/16"	24	33
3/8"	40	54
7/16"	70	95
1/2"	105	142
9/16"	150	203
5/8"	205	278
3/4"	365	495
7/8"	590	800
1"	880	1193

Above values are for clean dry threads. For oiled threads multiply by .70

Recommended Lubricants

Pnuematic oilers - Mobil DTE 24 or equivalent
Hydraulic Reservoir - USE CHEM TREND HF-28 HYDRAULIC FLUID ONLY
Gear Boxes - Chevron RPM 80W-90 or equivalent
Guide Bars and Tie Bars - High Temp. Graphite based grease

Empire Castings Inc.
Equipment Manual

Model# EC02-A
Serial# AAPM01

Volumne 3, Section 18: HYDRAULIC VALVES

1: Replacement Parts

ITEM#	PART# DESCRIPTION	MFG.
001	TY09LAXAXBAL6609 MAIN RAM CYLINDER	TJ VICKERS
002	TG09NAA5FA02000 EJECTION CYLINDER	TJ VICKERS
003	TG01CAADXXAL6097 SAFETY CYLINDER	TJ VICKERS
004	TG05GALD3AA02000 EMERGENCY MOLD OPEN	TJ VICKERS

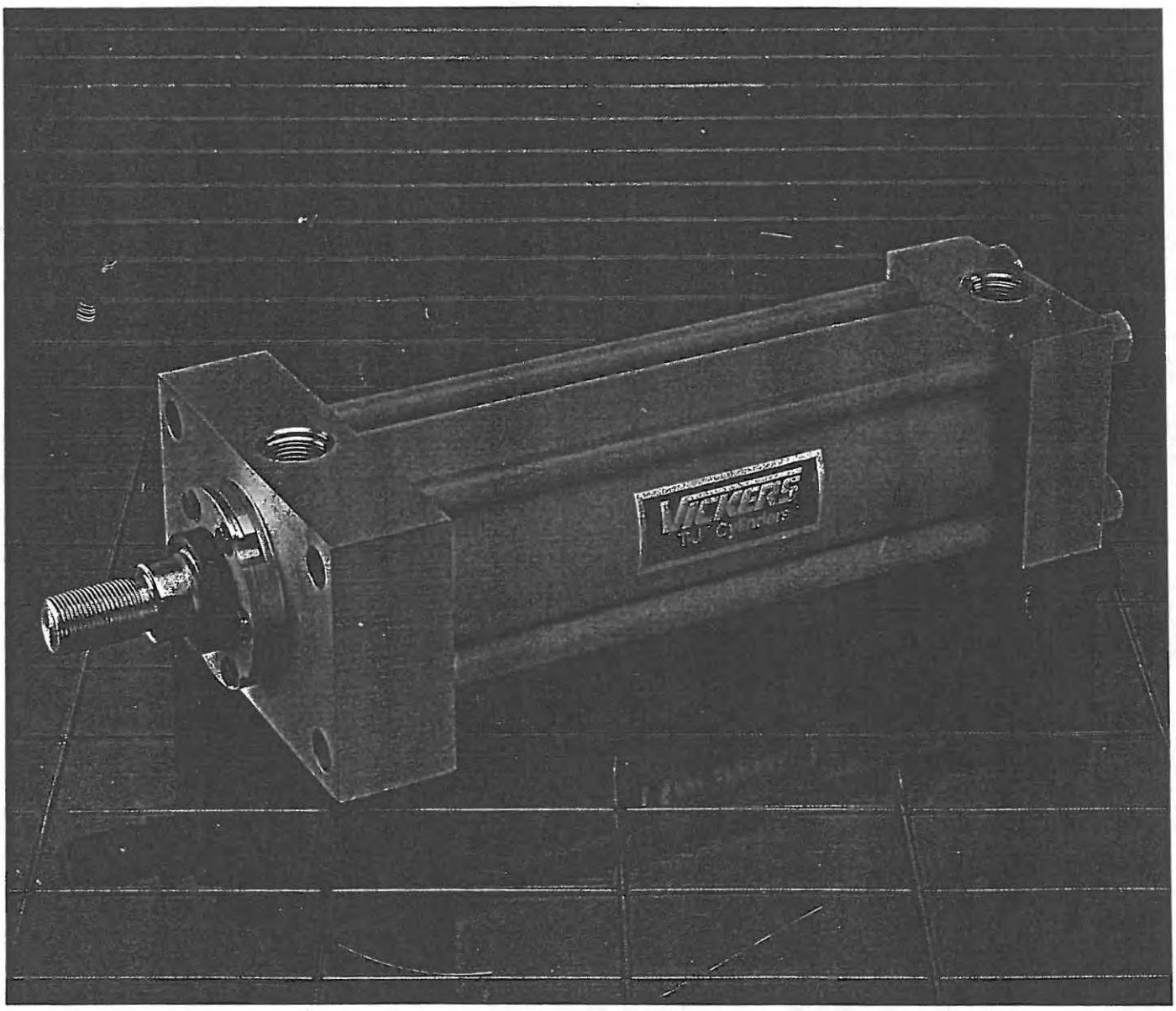
VICKERS

p/n - 7756-1-1/4-12
1028 1194-390

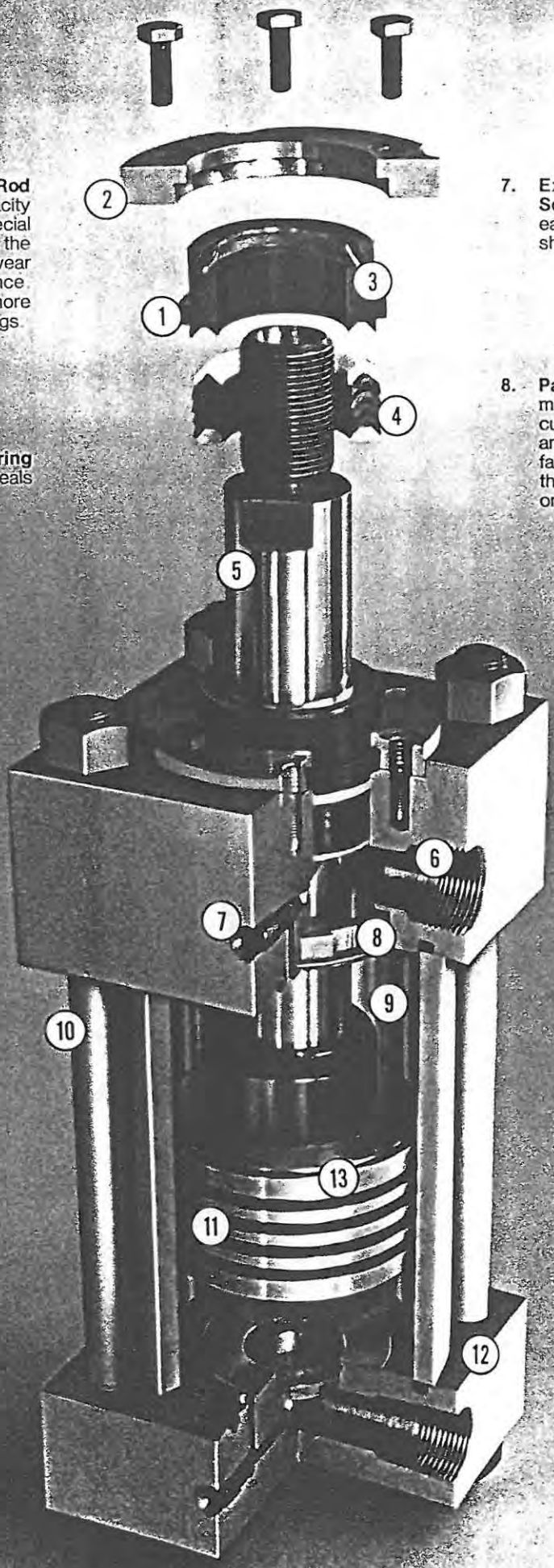
503-826-2131

T-J™ Series TG/TM/TW
High Pressure Hydraulic Cylinders

AC-2-14



Released 11-91



1. **New Fe_3N Nitrided Cast Iron Rod Bearing** provides high load capacity and extremely long life. A special nitriding process surface hardens the close grain cast iron to reduce wear while adding corrosion resistance. Fe_3N Bearings are up to 98% more durable than typical bronze bearings.

2. **QC-100 Quick Change Rod Bearing Assembly** lets you replace rod seals without disassembling cylinder.

3. **Dual Metallic Rod Scrapers** are honed to a knife edge to scrape materials that could damage ordinary elastomer wipers. Their conical shape is tensioned and self compensating for wear. The scrapers are rubber mounted to maintain concentricity with the piston rod.

4. **Pressure Energized Rod Seals** are activated only by operating pressure for minimum friction and wear. Multiple lip seal provides four seals in one. Male bronze seal adapter maintains alignment and permits seal response to pressure.

5. **Hard Chrome Plated Piston Rod.** 100,000 psi minimum yield strength steel, polished to 8 micro inch finish for extra durability.

6. **SAE O-ring** Ports are recommended for maximum reliability. NPT ports are an available option.

7. **Externally Adjustable Cushion Screws** provide simple adjustment for each application. Cushion screws are shown in both cylinder heads.

8. **Patented Super Cushions.** A floating metallic sleeve provides positive cushion sealing with minimum wear and maximum piston acceleration for faster cycles. Complete details on these patented designs are illustrated on page 2.

9. **Hard Chrome Plated Steel Body.** Steel tubing is precision honed to provide optimum surface finish for low friction and maximum piston seal life.

10. **125,000 psi Minimum Yield Strength Steel Tie Rods.**

11. **One Piece Piston** is solid cast iron for maximum bearing surface with easy seal replacement.

12. **Steel Heads and Mountings** provide durability for heavy-duty applications. Machined reliefs provide rapid fluid flow to the piston.

13. **Optional U-cup Seals.** Although automotive type cast iron piston rings are standard on TG cylinders, elastomer U-cup Seals with Teflon* back-up rings are available as a standard option. Glass Filled Teflon (GFT) piston seals are also available as an option.

*Teflon is a DuPont trademark.

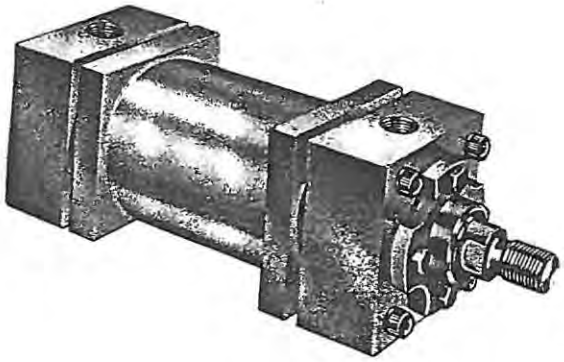
FEATURES

T-J™ cylinders have standard features (thru 8" bore) that are extra cost options or not available on other look-alike NFPA cylinders.

Series TG hydraulic cylinders are available with a patented floating ring super cushion seal. The floating action of the ring permits it to absorb external piston rod side loading without binding. This cushion system also provides positive cushion sealing with minimum wear and maximum piston acceleration on the return stroke.

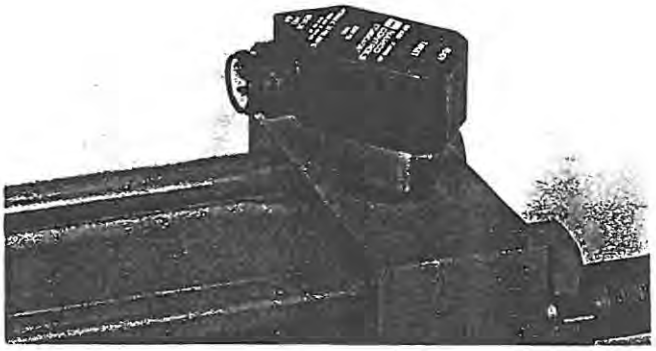
Cushioning is only one of the features that set these cylinders apart from all look-alike NFPA cylinders.

Hard chrome plated rods and bodies are standard at no extra cost, providing extra corrosion resistance and virtually eliminating galling or other damage from normal contaminants. Our QC-100 quick change rod bearing assembly and Fe_3N rod bearing are standard too. They permit easy rod seal replacement without disassembling the cylinder.



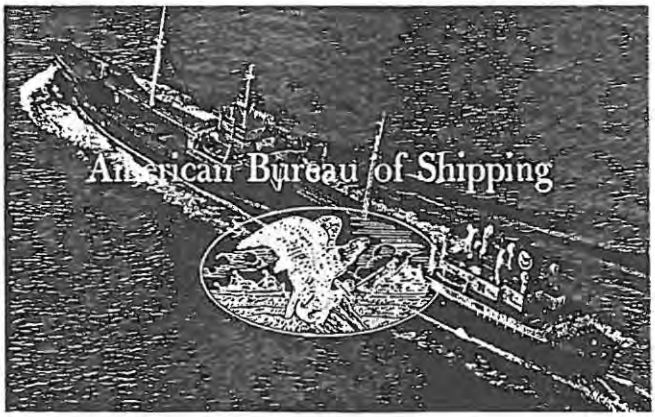
Series TM Welded Flange Cylinders

Square Head Mill-Type Cylinders (Series TM) for high pressure hydraulic service are identical to the Series TG hydraulic cylinders except for the welded body flanges. Flanges are welded to the body and heads are attached with short bolts. This construction eliminates the need for tie rods. See page 56 for available mounting styles and bore sizes.



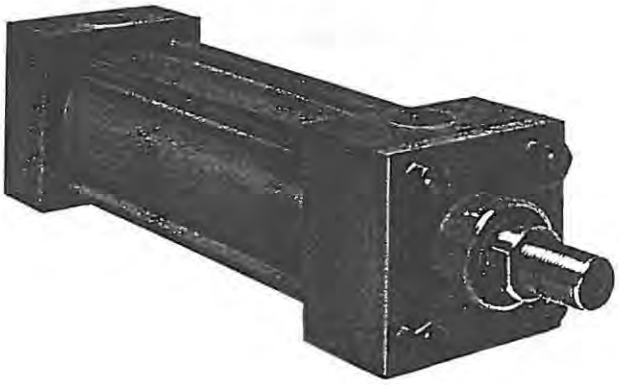
Series PS Proximity Switches

Series PS proximity switches provide a reliable, low cost interface with your controller. They are available normally open or closed and are serviceable with AC or DC current.Vickers T-J offers an extremely broad range of environmentally protected proximity switches which interface with virtually any system (see pages 58-59).



ABS Approved

The American Bureau of Shipping has approved the use of T-J Series TG hydraulic cylinders for shipboard applications. Type Approval provides any customer with the assurance that our cylinders are built to exacting quality standards. Approval consists of design approval, plant survey and field performance approval (see page 57).



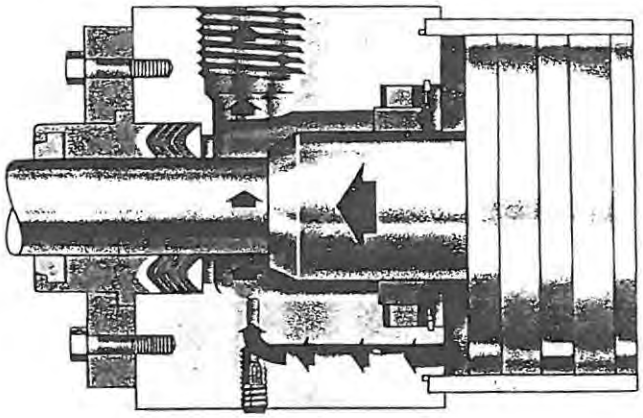
TW High Water Content Fluid Cylinders

Today's HWCF systems require cylinders that are compatible with the water content fluids as well as conventional petroleum based hydraulic fluids.

An intensive development program at Vickers T-J has resulted in a complete line of cylinders compatible with HWCF and hydraulic fluids. This provides you with the ultimate in versatility of fluid selection (see pages 60-61).

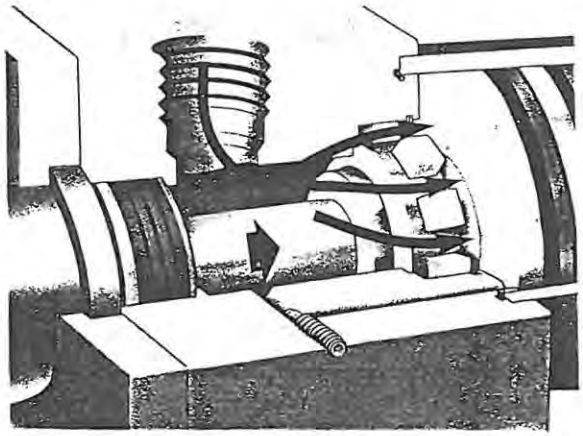
SUPER CUSHIONS PROVIDE FASTER CYCLE TIMES

Cylinder cushions are designed to decelerate the piston velocity near the end of each cylinder stroke to prevent excessive mechanical shock.



To accomplish this the cushion collar contacts a *floating bronze sleeve* which permits a very close seal contact without high loading. The sleeve seats against the head and provides a very effective seal to trap the fluid. Radial loading on the sleeve is minimal. Consistent performance and long life are provided.

Vickers T-J SUPER CUSHIONS permit higher cylinder speed, shorter cycle time and more work per hour.



The sleeve is also free to move in an *axial* direction and functions as a fluid check, which permits nearly full flow for quick acceleration. When the fluid flow is reversed, the sleeve moves off its seat and fluid flows around the slots in the outer sleeve's diameter.

CUSHION FEATURES

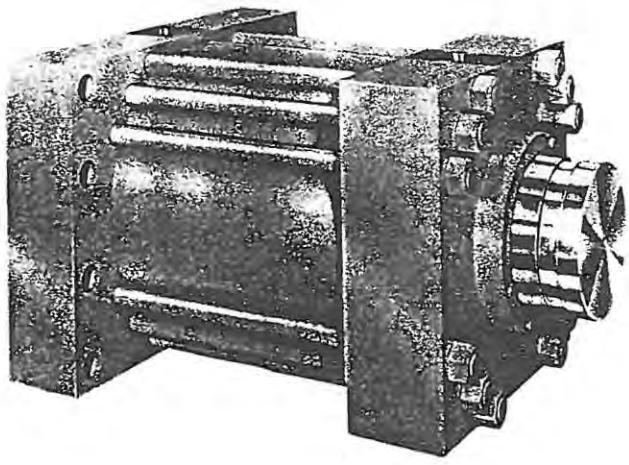
- **Bronze cushion sleeve provides consistent long wearing seal between cushion collar and head**
- **Floating design self-aligns to minimize wear**
- **Check valve action of sleeve provides rapid acceleration out of the cushion**

LARGE BORE FEATURES

Vickers T-J has added 16", 18" and 20" bore sizes to the standard Series TG cylinder.

Following are the large bore features:

1. Quick Change Nitrited Rod Bearing Assembly.
2. Doublle Lip Wipers and Loaded Cup Rod Seals.
3. Hard Chrome Plated, Case Hardened Piston Rod.
4. SAE Four Bolt Flange Ports.
5. Solid Metallic Cushions with Ball Checks and Externally Adjustable Cushion Screw.
6. Precision Honed Steel Body.
7. 125,000 psi Minimum Yield Strength Steel Tie Rods.
8. One Piece Steel Piston with Filled Teflon* Wear Strips on O.D.
9. Steel Heads and Mountings.
10. Energized, Filled Teflon Piston Seal with Two Cast Iron Rings is Standard.



*Teflon is a DuPont Trademark.

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HOW TO ORDER

Vickers T-J has developed an easy system for ordering Series TG and TW Cylinders. This system has been developed to improve our service to you. The part number consists of sixteen alpha-numeric digits which fully describe the most common standard options offered on the Series TG and TW cylinders.

To specify your Series TG or TW cylinder, review the following pages for a full description of each option available and select the desired code.

This part number system will:

- **Simplify the re-order process**
  Each T-J Series TG and TW cylinder is assigned a sixteen digit part number. This number is unique to a particular cylinder description; therefore, when you re-order your Series TG and TW cylinder, you are assured of exactly the same top quality cylinder design.
- **Improve identification**
  Each T-J Series TG and TW cylinder has its sixteen digit number impression stamped in the metal head.

  Each sixteen digit number completely describes a specific cylinder. Seals and replacement components are easily identified in the field.
- **Facilitate communications**
  This fully descriptive number system allows you to work directly with your local T-J sales engineer to identify and service your T-J cylinder.

How to Order TG and TW Cylinders

1	2	3 4	5	6	7
T					
Division Code Enter "T"	**Series** Enter letter code	**Mounting Style** Enter double digit code	**Bore Size** Enter letter code	**Cushion and Position** Enter single digit/letter code	**Rod Size and Type** Enter letter code

CODE	SERIES
G	Hydraulic
W	HWCF
M	Welded Flange

2

CODE	MOUNTING STYLE
01	Side Lug
02	Tapped
04	Keyed Side Lug
05	Keyed Tapped
07	Rod End Flange
08	Rod End Square Flange
09	Rod End Full Thickness Head
10	Clevis
11	Spherical Bushing
12	Blind End Flange
13	Blind End Square Flange
14	Blind End Full Thickness Head
15	Intermediate Trunnion
16	Blind End Trunnion
17	Rod End Trunnion
21	Blind End Extended Tie Rod
22	Rod End Extended Tie Rod
23	Both Ends Extended Tie Rod
24	Basic No Mount
25	DE Side Lug
26	DE Tapped
28	DE Keyed Side Lug
29	DE Keyed Tapped
31	DE Flange
32	DE Square Flange
33	DE Rod End Full Thickness Head
34	DE Intermediate Trunnion
35	DE Head Trunnion
39	DE Rod End Extended Tie Rod
40	DE Both Ends Extended Tie Rod
41	DE Basic No Mount
	DE = Double Rod End

3+4

CODE	BORE SIZE
C	1½"
D	2"
E	2½"
G	3¼"
H	4"
K	5"
L	6"
M	7"
N	8"
R	10"
S	12"
T	14"
U	16"
V	18"
W	20"

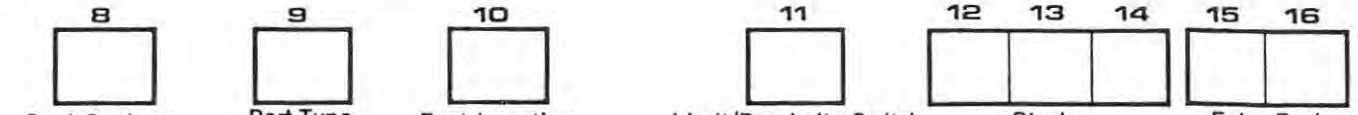
5

CODE	Cushion and Position	
	ROD END	BLIND END
A	0	0
B	0	1
C	0	2
D	0	3
E	0	4
F	1	0
G	2	0
H	3	0
J	4	0
K	1	1
L	1	2
M	1	3
N	1	4
P	2	1
R	2	2
S	2	3
T	2	4
U	3	1
V	3	2
W	3	3
Y	3	4
1	4	1
2	4	2
3	4	3
4	4	4

6

BORE SIZE	ROD SIZE	ROD END TYPE 2	4	5	6
1½"	⅝"	A	B	C	D
	1"	E	F	G	H
2"	1"	A	B	C	D
	1⅜"	E	F	G	H
2½"	1"	A	B	C	D
	1⅜"	E	F	G	H
	1¾"	J	K	L	M
3¼"	1⅜"	A	B	C	D
	1¾"	E	F	G	H
	2"	J	K	L	M
4"	1¾"	A	B	C	D
	2"	E	F	G	H
	2½"	J	K	L	M
5"	2"	A	B	C	D
	2½"	E	F	G	H
	3"	J	K	L	M
	3½"	N	P	R	S
6"	2½"	A	B	C	D
	3"	E	F	G	H
	4"	J	K	L	M
7"	3"	A	B	C	D
	4"	E	F	G	H
	5"	J	K	L	M
8"	3½"	A	B	C	D
	4"	E	F	G	H
	5½"	J	K	L	M
10"	4½"	A	B	C	D
	5½"	E	F	G	H
	7"	J	K	L	M
12"	5½"	A	B	C	D
	7"	E	F	G	H
	8"	J	K	L	M
14"	7"	A	B	C	D
	8"	E	F	G	H
	10"	J	K	L	M
16"	8"	A	B	C	D
	10"	E	F	G	H
18"	9"	A	B	C	D
	10"	E	F	G	H
20"	10"	A	B	C	D

7



8 Seal Options — Enter letter code

9 Port Type and Size — Enter digit code

10 Port Location — Enter letter code

11 Limit/Proximity Switch — Enter single digit/letter code. Enter Letter "A" for none required.

12 13 14 Stroke

15 16 Extra Rod Projection

CODE	SEAL OPTIONS		
	PISTON SEALS	MATERIAL	
		ALL SEALS	SCRAPER RETAINER
A	U	B	B
B	R	B	B
C	F	B	B
D	U	V	V
E	R	V	V
F	F	V	V
G	U	E	E
H	R	E	E
J	F	E	E
K	U	V	B
L	R	V	B
M	F	V	B
N	U	E	B
P	R	E	B
R	F	E	B

8

PISTON SEAL TYPE	
U	"U" Cup - Standard
R	Cast Iron Rings
F	Glass Filled Teflon

MATERIAL	
B	Nitrile (Buna-N) Standard
V	Fluorocarbon (Viton)*
E	Ethylene Propylene (EPR)

9

CODE	Port Type and Size
1	NPTF Dryseal
2	NPTF Dryseal-Oversize
3	SAE Straight Thread
4	SAE Straight Thread-Oversize
5	SAE Straight Thread
6	SAE 4-Bolt Flange

CODE	PORT LOCATION	
	Rod End Position	Blind End Position
A	1	1
B	1	2
C	1	3
D	1	4
E	2	1
F	2	2
G	2	3
H	2	4
J	3	1
K	3	2
L	3	3
M	3	4
N	4	1
P	4	2
R	4	3
S	4	4

10

Single Pole, Double Throw Switch at Position		
CODE	ROD END	BLIND END
B	1	0
C	2	0
D	3	0
E	4	0
F	1	1
G	2	2
H	3	3
J	4	4
K	0	1
L	0	2
M	0	3
N	0	4
PS 200 Proximity Switch at Position		
P	1	0
R	2	0
S	3	0
T	4	0
U	1	1
V	2	2
W	3	3
Y	4	4
1	0	1
2	0	2
3	0	3
4	0	4
Single Pole, Double Throw Double Break Switch at Position		
5	1	1
6	2	2
7	3	3
8	4	4

12 and 13. Length in inches (01 thru 99).
14. Fraction of an inch in sixteenths. This code indicates the cylinder stroke in inches and fraction of an inch in sixteenths (see table below for fraction).

Standard Projection -Enter "00"
15. Length in inches (1 thru 9).
16. Fraction of an inch in sixteenths (0 through F). This code indicates the extra rod projection in inches and fraction of an inch in sixteenths (see table below for fraction).

CODE	FRACTION
0	0"
1	1/16"
2	1/8"
3	3/16"
4	1/4"
5	5/16"
6	3/8"
7	7/16"
8	1/2"
9	9/16"
A	5/8"
B	11/16"
C	3/4"
D	13/16"
E	7/8"
F	15/16"

CUSTOM CYLINDERS

New Cylinders

Although this number has been arranged to cover the vast majority of the available options, there will be occasions when you require an option which cannot be coded. When specifying such an option, enter an "X" in the appropriate location in the sixteen digit part number, then describe your option requirements. For example, you have an application which requires a custom thread on the end of the piston rod. You would enter an "X" in location #7, then add a full description at the end of the part number: "with 1" dia. piston rod with 2" total rod projection with 1" - 14 thread 1½" long."

Replacement Cylinders

Every T-J custom cylinder is assigned a unique design number and this number is contained in the last five digits of the sixteen digit part number. In other words, the "Stroke" and "Extra Rod Projection" locations become the "Design Number" location for custom cylinders. When ordering a replacement cylinder, simply give the sixteen digit part number or the five digit design number to your local T-J Sales Representative.

Replacement Parts

Each design number has a complete bill of materials on file in a quick retrieval computerized storage system to allow our field sales representatives rapid access to assist you in identifying and specifying genuine T-J replacement parts.

*Viton is a DuPont trademark.

Mounting Style

Enter double digit code

		3	4							

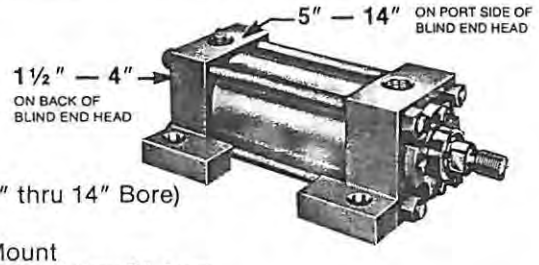
CODE	MOUNTING STYLE	CODE	MOUNTING STYLE
01	Side Lug	22	Rod End Extended Tie Rod
02	Tapped	23	Both Ends Extended Tie Rod
04*	Keyed Side Lug	24*	Basic No Mount
05*	Keyed Tapped	25†	DE Side Lug
07	Rod End Flange	26†	DE Tapped
08	Rod End Square Flange	28†	DE Keyed Side Lug
09	Rod End Full Thickness Head	29†	DE Keyed Tapped
10	Clevis	31†	DE Flange
11	Spherical Bushing	32†	DE Square Flange
12	Blind End Flange	33†	DE Rod End Full Thickness Head
13	Blind End Square Flange	34†	DE Intermediate Trunnion
14	Blind End Full Thickness Head	35†	DE Head Trunnion
15	Intermediate Trunnion	39†	DE Rod End Extended Tie Rod
16	Blind End Trunnion	40†	DE Both Ends Extended Tie Rod
17	Rod End Trunnion	41†	DE Basic No Mount
21	Blind End Extended Tie Rod		

The nineteen standard NFPA mountings with the Series TG and TW give you a broad selection to match the proper mount to your application. T-J offers rigid mounts including side lug mounts, tapped mounts, flange mounts, and extended tie rod mounts, and swivel mounts including clevis mounts and trunnion mounts. A guide to proper mount selection is provided on pages 16 through 27. For custom mounts, enter "XX" in locations 3 and 4 and give a detailed description with drawings.

*Not shown

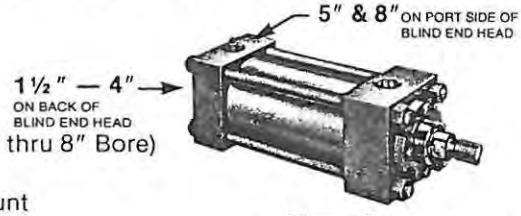
†DE = Double Rod End (Not Shown)

Series TG and TW cylinders are available in all mounting styles listed. Arrows indicate the location of cylinder part numbers.



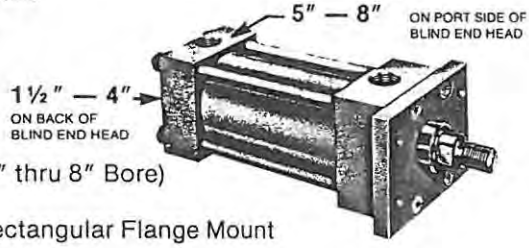
TG01 (1½" thru 14" Bore)

Side Lug Mount
NFPA MS2, 1½" thru 8" Bore



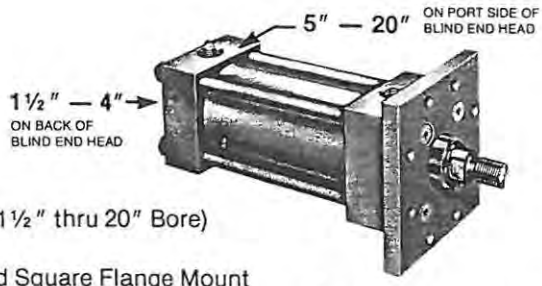
TG02 (1½" thru 8" Bore)

Tapped Mount
NFPA MS4



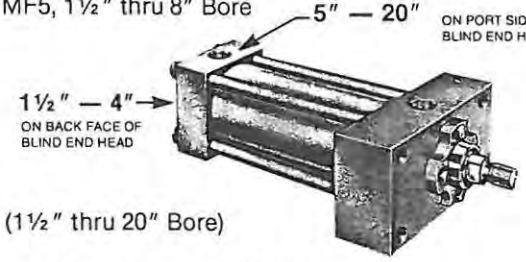
TG07 (1½" thru 8" Bore)

Rod End Rectangular Flange Mount
NFPA MF1
NFPA ME3, 7" thru 14" Bore



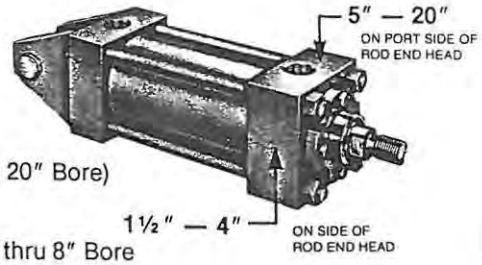
TG08 (1½" thru 20" Bore)

Rod End Square Flange Mount
NFPA MF5, 1½" thru 8" Bore



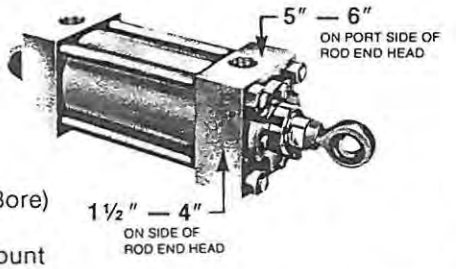
TG09 (1½" thru 20" Bore)

Rod End Full Thickness Head Mount
NFPA ME5, 1½" thru 8" Bore



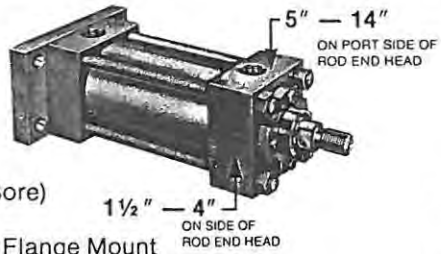
TG10 (1½" thru 20" Bore)

Clevis Mount
NFPA MP1, 1½" thru 8" Bore



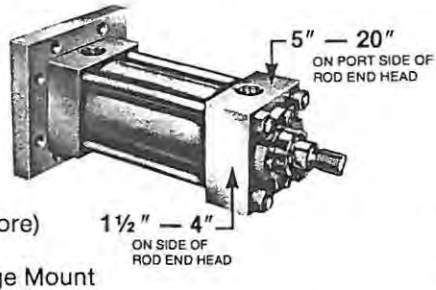
TG11 (1½" thru 6" Bore)

Spherical Bushing Mount



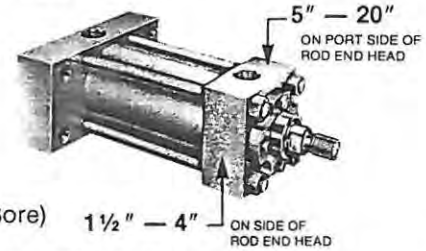
TG12 (1½" thru 14" Bore)

Blind End Rectangular Flange Mount
NFPA MF2, 1½" thru 8" Bore



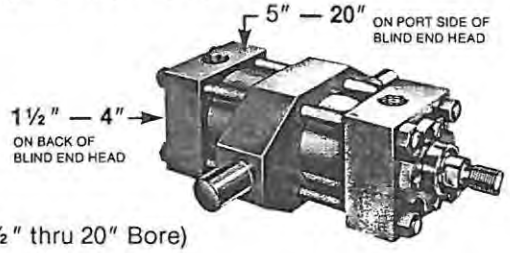
TG13 (1½" thru 20" Bore)

Blind End Square Flange Mount
NFPA MF6, 1½" thru 8" Bore



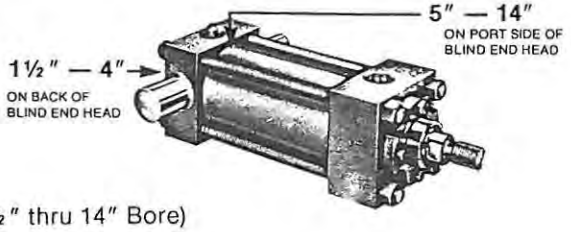
TG14 (1½" thru 20" Bore)

Blind End Full Thickness Head Mount
NFPA ME6, 1½" thru 8" Bore



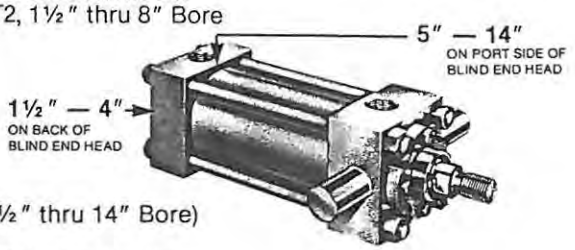
TG15 (1½" thru 20" Bore)

Intermediate Trunnion Mount
NFPA MT4, 1½" thru 8" Bore



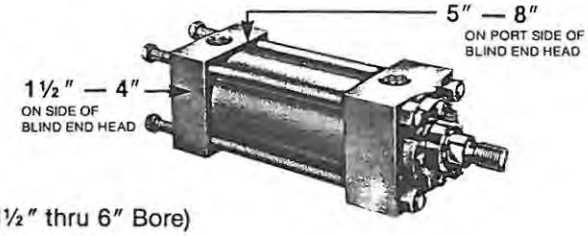
TG16 (1½" thru 14" Bore)

Blind End Trunnion Mount
NFPA MT2, 1½" thru 8" Bore



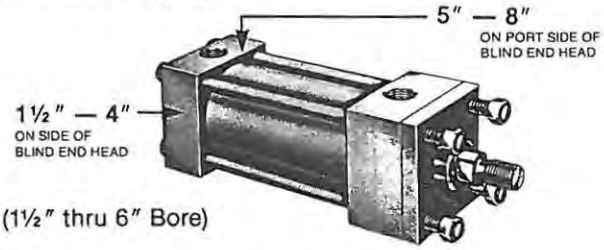
TG17 (1½" thru 14" Bore)

Rod End Trunnion Mount
NFPA MT1, 1½" thru 8" Bore



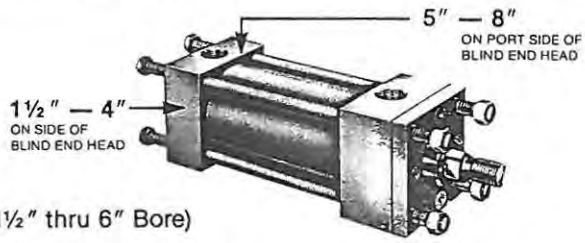
TG21 (1½" thru 6" Bore)

Extended Tie Rods
Blind End Mount, NFPA MX2



TG22 (1½" thru 6" Bore)

Extended Tie Rods
Rod End Mount, NFPA MX3



TG23 (1½" thru 6" Bore)

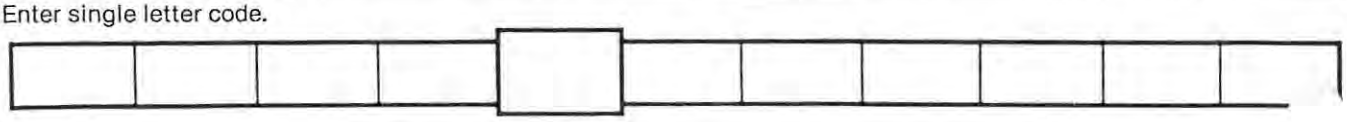
Extended Tie Rods
Both Ends Mount, NFPA MX1

SELECTING THE PROPER MOUNTING

Just as the cylinder bore must be sized to provide the proper force for an application, the cylinder mounting, which will absorb these application forces, must be specified. All Series TG and TW mounts are designed to absorb the full rated force of the cylinder when properly applied. For applications where the motion is linear and parallel to the cylinder rod motion, a rigid mount is recommended. For curvilinear motion, a swivel mount should be chosen. The specifics of each application dictate the correct mounting style. Detailed recommendations are presented on pages 16 through 25.

Bore Size

Enter single letter code.



5

CYLINDER SIZE SELECTION

To select a cylinder for an application, first, determine the maximum push and/or pull force required to do the job. Then, use the chart on this page to select the cylinder that gives the necessary force needed for your application. Please note that the force requirements derived by the formula are theoretically correct and other factors must be considered. One factor is pressure drop (working pressure at the cylinder port will be less than at the pump end) which should be allowed for in your calculations. A margin for overcoming friction in the cylinder must also be added.

In addition, a certain amount of force exerted by a cylinder is counteracted by friction developed through the packing and, to a lesser extent, by the weight of the piston itself. The amount of force required to counteract these forces in T-J cylinders has been reduced to 5% or less of the cylinder's theoretical power, without sacrificing sealing quality.

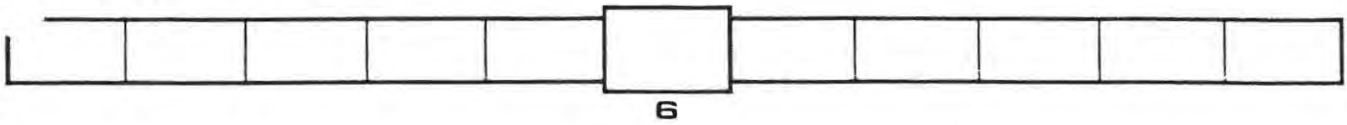
THIS CHART LISTS THE THEORETICAL PUSH AND PULL FORCES THAT TJ CYLINDERS WILL EXERT WHEN SUPPLIED WITH VARIOUS WORKING PRESSURES, PLUS THEORETICAL PISTON VELOCITIES WHEN SUPPLIED WITH 16 FT./SEC. FLUID VELOCITY THROUGH SCHEDULE 80 PIPE.

CODE	Cyl. Bore Dia. Inch	Piston Rod Dia. Inch	Work Area Sq. In.	HYDRAULIC WORKING PRESSURE P.S.I. 500	750	1000	1500	2000	3000	Fluid Required Per In. Of Stroke Gal.	Cu. In.	Port Size Dia. Inch	Fluid Velocity @ 15 Ft./Sec. Flow GPM	Piston Vel. in/Sec.
C	1½	— ⅝ 1	1.767 1.460 .982	883 730 491	1325 1095 736	1767 1460 982	2651 2190 1473	3534 2920 1964	5301 4380 2946	.00765 .00632 .00425	1.767 1.460 .982	½	11.0	24.0 29.0 43.1
D	2	— 1 1⅜	3.141 2.356 1.656	1571 1178 828	2356 1767 1242	3141 2356 1656	4711 3534 2484	6283 4712 3312	9423 7068 4968	.01360 .01020 .00717	3.141 2.356 1.656	½	11.0	13.5 18.0 25.6
E	2½	— 1 1⅜ 1¾	4.909 4.124 3.424 2.504	2454 2062 1712 1252	3682 3093 2568 1878	4909 4124 3424 2504	7363 6186 5136 3756	9818 8248 6848 5008	14727 12372 10272 7512	.02125 .01785 .01482 .01084	4.909 4.124 3.424 2.504	½	11.0	8.6 10.3 12.4 16.9
G	3¼	— 1⅜ 1¾ 2	8.296 6.811 5.891 5.154	4148 3405 2945 2577	6222 5108 4418 3865	8296 6811 5891 5154	12444 10216 8836 7731	16592 13622 11782 10308	24888 20433 17673 15462	.0359 .0295 .0255 .0223	8.296 6.811 5.891 5.154	¾	20.3	9.4 11.5 13. 15
H	4	— 1¾ 2 2½	12.566 10.161 9.424 7.657	6283 5080 4712 3828	9425 7621 7068 5743	12566 10161 9424 7657	18849 15241 14136 11485	25132 20322 18848 15314	37698 30483 28272 22971	.0544 .0440 .0408 .0331	12.566 10.161 9.424 7.657	¾	20.3	6. 7.7 8.3 10.2
K	5	— 2 2½ 3 3½	19.635 16.492 14.726 12.566 10.014	9818 8246 7363 6283 5007	14726 12369 11044 9424 7510	19635 16492 14726 12566 10014	29453 24738 22089 18849 15021	39270 32984 29542 25132 20028	58905 49476 44178 37698 30042	.0850 .0714 .0637 .0544 .0433	19.635 16.492 14.726 12.566 10.014	¾	20.3	4.0 4.7 5.3 6.2 7.8
L	6	— 2½ 3 4	28.274 23.365 21.205 15.708	14137 11682 10602 7854	21205 17524 15904 11781	28274 23365 21205 15708	42411 35047 31807 23562	56548 46730 42410 31416	84822 70095 63615 47124	.1224 .1011 .0918 .0680	28.274 23.365 21.205 15.708	1	33.8	4.6 5.6 6.1 8.3
M	7	— 3 4 5	38.485 31.416 25.919 18.850	19242 15708 12960 9425	28864 23562 19439 14137	38485 31416 25919 18850	57728 47124 38878 28275	76970 62832 51838 37700	115455 94248 77757 56550	.1666 .1360 .1122 .0816	38.485 31.416 25.919 18.850	1¼	60.2	6.0 7.4 8.9 12.3
N	8	— 3½ 4 5½	50.265 40.644 37.699 26.507	25133 20322 18850 13253	37699 30483 28274 19880	50265 40644 37699 26507	75398 60966 56548 39760	100530 81288 75398 53014	150795 121932 113097 79521	.2176 .1759 .1632 .1147	50.265 40.644 37.699 26.507	1½	83.0	6.4 7.9 8.5 12.0
R	10	— 4½ 5½ 7	78.540 62.636 54.782 40.055	39270 31318 27391 20027	58905 46977 41086 30041	78540 62636 54782 40055	117810 93954 82173 60082	157080 125272 109564 80110	235620 187908 164346 120165	.3400 .2711 .2371 .1734	78.540 62.636 54.782 40.055	2	139	6.8 8.5 9.8 13.4
S	12	— 5½ 7 8	113.10 89.34 74.62 62.84	56550 44670 37310 31420	84825 67005 55965 47130	113100 89340 74620 62840	169650 134010 111930 94260	226200 178680 149240 125680	339300 268020 223860 188520	.4896 .3867 .3230 .2720	113.10 89.34 74.62 62.84	2½	199	6.8 8.6 10.3 12.2
T	14	— 7 8 10	153.94 115.46 103.68 75.40	76970 57730 51840 37700	115455 86595 77760 56550	153940 115460 103680 75400	230910 173190 155520 113100	307880 230920 207360 150800	461820 346380 311040 226200	.6664 .4998 .4488 .3264	153.94 115.46 103.68 75.40	2½	199	5.0 6.6 7.4 10.2
U	16	— 8 10	201.06 150.79 122.52	100531 75398 61261	150796 113097 91891	201062 150796 122522	301593 226194 183783	402124 301592 245044	603186 452388 367566	.8704 .6528 .5304	201.06 150.79 122.52	3	310	5.9 7.9 9.7
V	18	— 9 10	254.47 190.85 175.93	127234 95426 87964	190851 143139 131946	254468 190852 175928	381702 286278 263892	508936 381704 351856	763404 572556 527784	1.1016 .8262 .7616	254.47 190.85 175.93	3	310	4.7 6.3 6.8
W	20	— 10	314.16 235.62	157080 117810	235620 176715	314160 235620	471240 353430	628320 471240	942480 706860	1.3600 1.0200	314.16 235.62	3	310	3.8 5.1

To calculate the theoretical forces for pressures not listed, multiply the pressure in psi times the work area shown. To calculate the piston velocity in inches per minute, divide the flow rate in gallons per minute by the listed fluid required per inch of stroke in gallons.

Cushion and Position

Enter single digit/letter code.



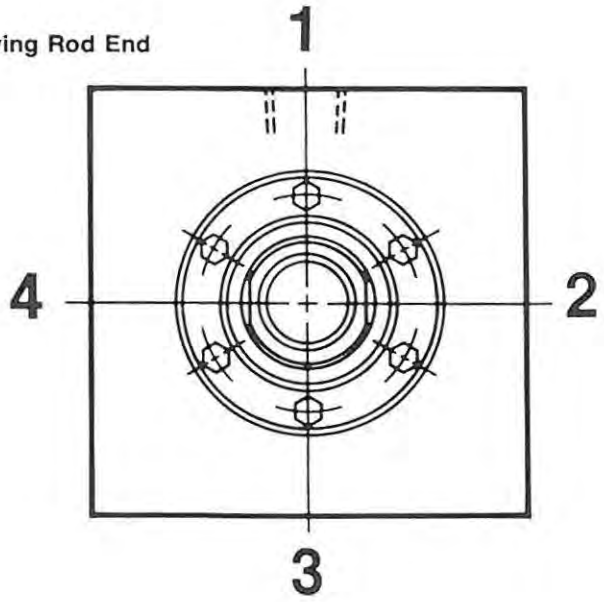
CODE	Cushion and Position		Cylinder	
	Rod End	Blind End	Single Rod End	Double Rod End
A	0	0	NC	NC
B	0	1	CB	CN
C	0	2	CB	CN
D	0	3	CB	CN
E	0	4	CB	CN
F	1	0	CR	CM
G	2	0	CR	CM
H	3	0	CR	CM
J	4	0	CR	CM
K	1	1	CC	CC
L	1	2	CC	CC
M	1	3	CC	CC
N	1	4	CC	CC

Position 3 is standard for all mounting styles except TG01 mounting code. Position 2 is standard for TG01 mounting code only.

CODE	Cushion and Position		Cylinder	
	Rod End	Blind End	Single Rod End	Double Rod End
P	2	1	CC	CC
R	2	2	CC	CC
S	2	3	CC	CC
T	2	4	CC	CC
U	3	1	CC	CC
V	3	2	CC	CC
W	3	3	CC	CC
Y	3	4	CC	CC
1	4	1	CC	CC
2	4	2	CC	CC
3	4	3	CC	CC
4	4	4	CC	CC

Key—

NC = Non-Cushioned
CB = Cushioned Blind End
CR = Cushioned Rod End
CC = Cushioned Both Ends
CN = Cushioned Non-Mounting End
CM = Cushioned Mounting End



Rod Size and Type

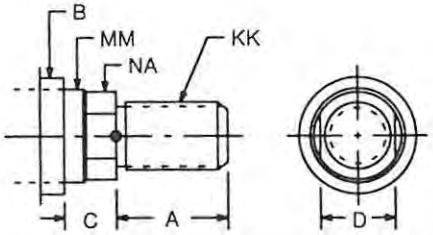
Enter letter code.

						7				

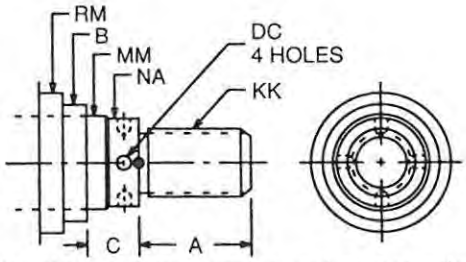
In addition to selecting the appropriate bore, you must specify the appropriate rod size and rod end configuration for your application.

The chart on page 11 gives maximum allowable push strokes at various operating pressures for the standard and alternate rod diameters of Series TG, TM, and TW cylinders. Rod ends on rigid mount cylinders should be supported. Longer strokes are allowable for **pull only** applications. Contact your local Vickers T-J sales engineer for application assistance if necessary.

STANDARD ROD ENDS



Type 5 with male thread on reduced diameter (for rod sizes 5/8" thru 5 1/2") NFPA SM



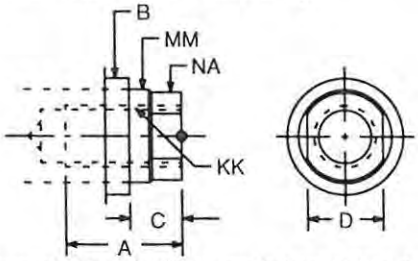
Type 5 with male thread on reduced diameter (for rod sizes 7" thru 10") NFPA SM

ROD END SELECTION

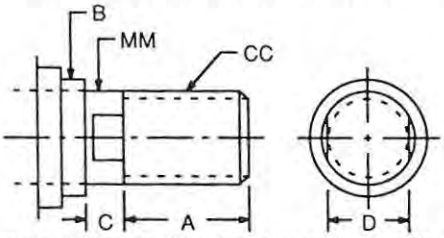
Standard and alternate rod diameters are shown below. If your application requires a custom design, contact your local Vickers T-J sales engineer, and we will build to your requirements.

BORE SIZE	ROD SIZE	ROD END TYPE 2	4	5	6
1 1/2"	5/8"	A	B	C	D
	1"	E	F	G	H
2"	1"	A	B	C	D
	1 3/8"	E	F	G	H
2 1/2"	1"	A	B	C	D
	1 3/8"	E	F	G	H
	1 3/4"	J	K	L	M
3 1/4"	1 3/8"	A	B	C	D
	1 3/4"	E	F	G	H
	2"	J	K	L	M
4"	1 3/4"	A	B	C	D
	2"	E	F	G	H
	2 1/2"	J	K	L	M
5"	2"	A	B	C	D
	2 1/2"	E	F	G	H
	3"	J	K	L	M
	3 1/2"	N	P	R	S
6"	2 1/2"	A	B	C	D
	3"	E	F	G	H
	4"	J	K	L	M

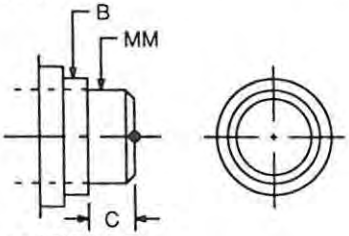
BORE SIZE	ROD SIZE	ROD END TYPE 2	4	5	6
7"	3"	A	B	C	D
	4"	E	F	G	H
	5"	J	K	L	M
8"	3 1/2"	A	B	C	D
	4"	E	F	G	H
	5 1/2"	J	K	L	M
10"	4 1/2"	A	B	C	D
	5 1/2"	E	F	G	H
	7"	J	K	L	M
12"	5 1/2"	A	B	C	D
	7"	E	F	G	H
	8"	J	K	L	M
14"	7"	A	B	C	D
	8"	E	F	G	H
	10"	J	K	L	M
16"	8"	A	B	C	D
	10"	E	F	G	H
18"	9"	A	B	C	D
	10"	E	F	G	H
20"	10"	A	B	C	D
	—	—	—	—	—



Type 2 female thread with wrench flats NFPA SF



Type 4 male thread on full diameter with wrench flats NFPA FM



Type 6 plain end NFPA PL

PISTON ROD END DIMENSIONS

All dimensions in inches.

MM Rod Dia	C	KK THD*	A	B +.000 -.002	D	CC THD*	DC 4 Holes	RM Dia.	NA Dia.
5/8	3/8	7/16-20	3/4	1.124	1/2	5/8-18			9/16
1	1/2	3/4-16	1 1/8	1.499	7/8	1-14			15/16
1 3/8	5/8	1-14	1 5/8	1.999	1 1/8	1 3/8-12			1 5/16
1 3/4	3/4	1 1/4-12	2	2.374	1 1/2	1 3/4-12			1 11/16
2	7/8	1 1/2-12	2 1/4	2.624	1 11/16	2-12			1 15/16
2 1/2	1	1 7/8-12	3	3.124	2 1/16	2 1/2-12			2 7/16
3	1	2 1/4-12	3 1/2	3.749	2 5/8	3-12			2 15/16
3 1/2	1	2 1/2-12	3 1/2	4.249	3	3 1/2-12			3 7/16
4	1	3-12	4	4.749	3 3/8	4-12			3 15/16
4 1/2	1	3 1/4-12	4 1/2	5.249	3 7/8	4 1/2-12	—	7	4 7/16
5	1	3 1/2-12	5	5.749	4 1/4	5-12	—	7 1/2	4 15/16
5 1/2	1	4-12	5 1/2	6.249	4 5/8	5 1/2-12	—	8	5 7/16
7	1	5 1/2-12	7	7.749	—	6 1/2-12	33/64	9 7/8	6 7/8
8	1 1/2	6-12	8	9.249	—	7 1/2-12	49/64	11 3/8	7 7/8
9	1 1/2	6 1/2-12	9	10.249	—	8 1/2-12	49/64	11 3/4	8 7/8
10	1 1/2	7 1/2-12	10	11.499	—	9-12	49/64	13 5/16	9 7/8

Note: The "RM" dimension appears on 10" through 20" bore cylinders, all m[illegible] except models TG07 and TG08.
* UN form and tolerance.

Rod Size and Type

In push applications, a cylinder acts as a loaded column. There are two basic ways to measure the column length. Pivot mounts: the length is measured from the pivot point to the end of the rod in the fully extended position. Flange and other rigid mounts: the exposed piston rod is considered to be the column length with a fixed end at the cylinder which allows longer strokes.

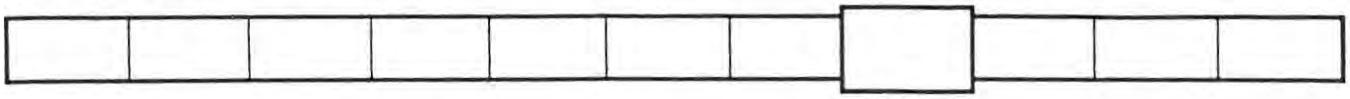
Select your mounting style and locate the column which is closest to but not below your application's operating pressure. The intersection of operating pressure and bore/rod size represents the maximum allowable push stroke. This maximum stroke is based on column loading analysis only and does not consider side loading, stop tube requirements or other cylinder stroke limiters.

MOUNTING TYPES		RIGID MOUNTS						SWIVEL MOUNT						TRUNION MOUNTS					
		PRESSURE						PRESSURE						PRESSURE					
		500	750	1000	1500	2000	3000	500	750	1000	1500	2000	3000	500	750	1000	1500	2000	3000
BORE	ROD																		
1½"	⅝"	31	24	20	14	10	5	13	10	8	6	4	2	16	12	10	7	5	2
	1"	83	67	57	45	37	28	37	29	25	20	16	12	44	35	30	24	20	15
2"	1"	61	48	40	31	24	16	27	21	18	13	11	7	32	25	21	16	13	8
	1⅜"	118	95	81	64	54	41	52	42	36	28	24	18	63	50	43	34	28	21
2½"	1"	47	36	30	21	15	5	21	16	13	9	7	2	25	19	16	11	8	2
	1⅜"	93	75	63	49	40	28	42	33	28	22	18	13	50	40	34	26	21	15
	1¾"	154	124	106	84	70	54	68	55	47	37	31	24	82	66	56	45	38	29
3¼"	1⅜"	70	54	45	30	25	12	31	24	20	15	11	5	37	29	24	18	13	7
	1¾"	116	93	78	60	49	34	52	41	35	27	22	15	62	49	42	32	26	18
	2"	153	123	105	82	68	50	68	55	47	36	30	22	82	66	56	44	36	27
4"	1¾"	92	72	60	44	34	19	41	32	27	20	15	8	49	39	32	24	18	10
	2"	122	97	82	62	50	33	54	43	36	28	22	15	65	52	44	33	27	18
	2½"	195	156	133	105	87	65	87	70	59	47	39	29	104	83	71	56	46	34
5"	2"	95	74	60	43	32	11	42	33	27	19	14	5	51	39	32	23	17	6
	2½"	153	121	102	78	62	42	68	54	45	35	28	19	82	65	54	42	33	22
	3"	224	179	152	119	99	72	100	80	60	53	44	32	120	96	81	64	53	34
	3½"	308	248	212	168	141	107	137	110	94	75	63	48	164	132	113	90	75	57
6"	2½"	124	97	80	58	44	20	55	43	36	26	19	9	66	52	43	31	23	11
	3"	184	146	122	93	75	50	82	65	54	42	33	22	98	78	65	50	40	27
	4"	334	269	229	181	151	114	149	120	102	81	67	51	178	143	122	97	81	61
7"	3"	154	121	100	74	56	29	69	54	44	33	25	13	82	64	53	39	30	15
	4"	283	226	192	149	123	88	126	101	85	66	55	39	151	121	102	80	66	47
	5"	449	362	309	246	207	158	200	161	138	109	92	70	240	193	165	131	110	84
8"	3½"	184	145	120	89	68	38	82	64	53	40	30	17	98	77	64	47	36	20
	4"	245	194	163	125	100	67	109	86	73	55	44	30	131	104	87	65	53	36
	5½"	475	382	326	258	217	164	211	170	145	115	96	73	253	204	174	138	116	88
10"	4½"	244	192	160	119	92	54	108	85	71	53	41	24	130	102	85	63	49	28
	5½"	373	298	252	195	159	113	166	132	112	86	70	50	199	159	134	104	85	60
	7"	615	495	423	335	281	214	273	220	188	149	125	95	328	264	225	179	150	114
12"	5½"	305	240	200	150	117	70	135	107	89	66	52	31	162	128	107	80	62	37
	7"	506	405	343	268	221	160	225	180	152	119	98	71	270	216	183	143	118	85
	8"	668	537	458	362	302	228	297	239	203	161	134	101	356	286	244	193	161	121
14"	7"	428	339	285	218	174	116	190	151	126	96	77	51	228	181	152	116	93	62
	8"	566	452	383	298	245	176	251	201	170	132	109	78	302	241	204	159	131	94
	10"	898	724	618	491	413	316	399	321	275	218	183	140	479	386	330	262	220	168
16"	8"	489	388	326	249	199	133	217	172	145	146	88	59	261	207	174	132	106	71
	10"	779	625	532	418	347	258	346	278	236	186	154	114	416	333	284	223	185	137
18"	9"	550	436	367	280	224	149	244	194	163	124	99	66	293	233	195	149	119	79
	10"	686	548	463	359	294	209	305	243	206	160	130	93	366	292	247	192	157	111
20"	10"	611	485	407	311	249	166	272	215	181	138	111	74	326	259	217	166	133	88

For pressures above 3,000 psi, consult factory.

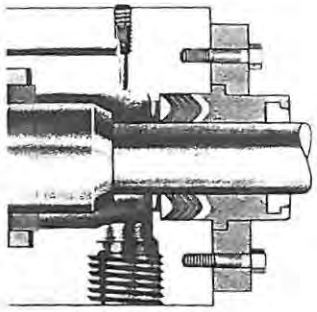
Seal Options

Enter single letter code.

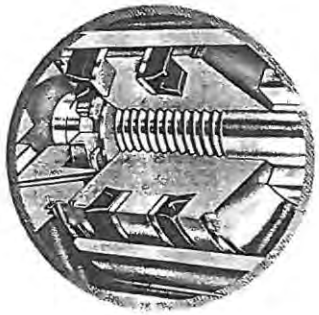


This code indicates both the type of piston seal and seal materials. Select the type of piston seal for your application, then select the seal compound from the compatibility chart below. Insert the code with the appropriate piston seals, seal material and scraper retainer material. Code B is the standard.

PISTON SEAL TYPE		SEAL MATERIAL	
CODE		ALL SEALS	SCRAPER RETAINER
A	"U" Cup	Nitrile	Nitrile
B	Cast Iron Rings	Nitrile	Nitrile
C	G.F.T.	Nitrile	Nitrile
D	"U" Cup	Viton	Viton
E	Cast Iron Rings	Viton	Viton
F	G.F.T.	Viton	Viton
G	"U" Cup	EPR	EPR
H	Cast Iron Rings	EPR	EPR
J	G.F.T	EPR	EPR
K	"U" Cup	Viton	Nitrile
L	Cast Iron Rings	Viton	Nitrile
M	G.F.T.	Viton	Nitrile
N	"U" Cup	EPR	Nitrile
P	Cast Iron Rings	EPR	Nitrile
R	G.F.T.	EPR	Nitrile



Pressure energized v-ring rod seals are standard thru 8" bore.



Cast iron piston rings are standard. Pressure energized "U" Cup piston packings are optional. Elastomer energized glass filled Teflon* (G.F.T.) rings are also available options.

Note: "U" Cups are not available for 16" through 20" bore sizes.

SEAL COMPATIBILITY WITH COMMON FLUIDS

CLASS OF HYDRAULIC FLUID	STANDARD AND OPTIONAL SEAL COMPOUNDS		
	NITRILE (standard)	EPR (optional)	VITON* (optional)
Petroleum Base	Compatible	Not Compatible	Compatible
Phosphate Ester	Not Compatible	Compatible	Compatible[1]
Silicone	Compatible	Compatible	Compatible
Water	Compatible	Compatible	Compatible
Water/Oil Emulsion	Compatible	Not Compatible	Compatible
Water-Glycol	Compatible	Compatible	Compatible
Ethylene Glycol	Compatible	Compatible	Compatible
Auto Trans Fluid	Compatible	Not Compatible	Compatible
Auto Brake Fluid	Not Compatible	Compatible	Not Compatible
Temperature[2] Ranges	-40°F. +250°F.	-65°F. +300°F.	-20°F. +400°F.

*Teflon and Viton are DuPont Trademarks.
[1] Except certain aircraft and commercial fluids
[2] Maximum ratings for continuous exposure

THE ABOVE TECHNICAL DATA REPRESENTS GENERALLY ACCEPTED DESIGN PARAMETERS CONSULT ENGINEERING FOR MORE SPECIFIC APPLICATION DATA.

Port Type and Size

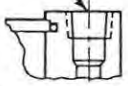
Enter single digit code.

								9		

Series TG and TW cylinders are available in both SAE Straight Thread O-Ring ports and NPTF ports.

For maximum reliability SAE ports are recommended. SAE ports are standard for Series TW.

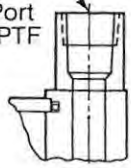
CODE 1



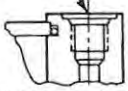
Dryseal NPTF

CODE 2

Oversize Port Dryseal NPTF



CODE 3 & 5



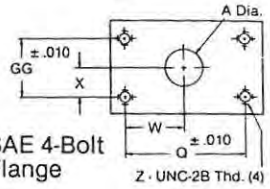
SAE Straight Thread Port O-Ring Seal

CODE 4

Oversize SAE Straight Thread Port O-Ring Seal



CODE 6



SAE 4-Bolt Flange

BORE	MM ROD DIA.	CODE 1	CODE 2	CODE 3	CODE 4	CODE 5	CODE 6
1½	5/8	½	¾	-8	-10		
	1	½	¾	-8	-10		
2	1	½	¾	-8	-10		
	1⅜	½	¾	-8	-10		
2½	1	½	¾	-8	-10		
	1⅜	½	¾	-8	-10		
	1¾	½	¾	-8	-10		
3¼	1⅜	¾	1	-14	—	-12	¾
	1¾	¾	1	-14	—	-12	¾
	2	¾	1	-10	-14	-12	¾
4	1¾	¾	1	-14	—	-12	¾
	2	¾	1	-14	—	-12	¾
	2½	¾	1	-10	-14	-12	¾
5	2	¾	1	-14		-12	¾
	2½	¾	1	-14		-12	¾
	3	¾	1	-14		-12	¾
	3½	¾	1	-14		-12	¾
6	2½	1	1¼	-16		—	1
	3	1	1¼	-16		—	1
	4	1	1¼	-14		-16	1

BORE	MM ROD DIA.	CODE 1	CODE 2	CODE 3	CODE 4	CODE 5	CODE 6
7	3	1¼	1½	-20			1¼
	4	1¼	1½	-20			1¼
	5	1¼	1½	-20			1¼
8	3½	1½	2	-24			1½
	4	1½	2	-24			1½
	5½	1½	2	-24			1½
10	4½	2	2½	-32			2
	5½	2	2½	-32			2
	7	2	2½	-32			2
12	5½	2½		-32			2½
	7	2½		-32			2½
	8	2½		-32			2½
14	7	2½		-32			2½
	8	2½		-32			2½
	10	2½		-32			2½
16	8						3
	10						3
18	9						3
	10						3
20	10						3

NOM. FLG. SIZE	A	Q	W	X	Z	GG
¾	.75	1.875	.94	.44	⅜-16	.875
1	1.00	2.062	1.03	.52	⅜-16	1.031
1¼	1.25	2.312	1.16	.59	7/16-14	1.188
1½	1.50	2.750	1.38	.70	½-13	1.406
2	2.00	3.062	1.53	.84	½-13	1.688
2½	2.50	3.500	1.75	1.00	½-13	2.000
3	3.00	4.188	2.09	1.22	⅝-11	2.438

All dimensions in inches.

Port Location

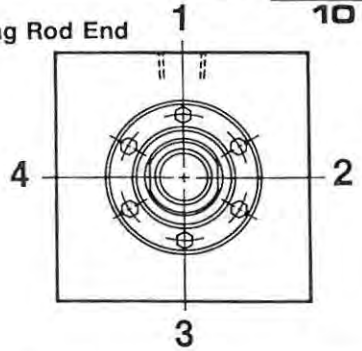
Enter single letter code.

									10	

CODE	Rod End Position	Blind End Position
A	1	1
B	1	2
C	1	3
D	1	4
E	2	1
F	2	2
G	2	3
H	2	4

CODE	Rod End Position	Blind End Position
J	3	1
K	3	2
L	3	3
M	3	4
N	4	1
P	4	2
R	4	3
S	4	4

Viewing Rod End



The standard location for ports is position #1 (Code A). Port locations are identified by viewing the cylinder from the rod end (from the mounting end of double end cylinders) and the numbers are shown in the drawing.

Some mounting styles have location restrictions. Check the Application Guide for your particular mounting style. Where port or port boss interferes with cylinder mounting, mounting takes precedence.

Limit Switches/Proximity Switches

Enter single digit/letter code. — Enter Letter "A" for none required.

11

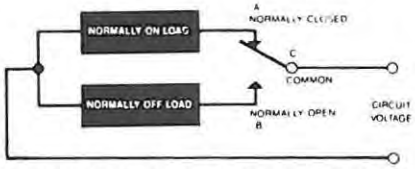
Built-in limit switches are an available option for the Series TG and TW. The options and specifications are summarized below and the codes for the various types are various locations shown below. Consult Bulletin 4098A for complete information on these built in limit switches. In addition, air pilot valves (3-way and 2-way) can be fitted to the Series TG and TW. Information on these valves is also contained in Bulletin 4098A.

Switch "01"		
Code	Rod End	Blind End
B	1	0
C	2	0
D	3	0
E	4	0
F	1	1
G	2	2
H	3	3
J	4	4
K	0	1
L	0	2
M	0	3
N	0	4

Switch "03"		
Code	Rod End	Blind End
5	1	1
6	2	2
7	3	3
8	4	4

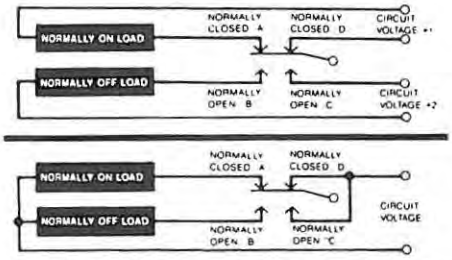
PS 200 Proximity Switch		
Code	Rod End	Blind End
P	1	0
R	2	0
S	3	0
T	4	0
U	1	1
V	2	2
W	3	3
Y	4	4
1	0	1
2	0	2
3	0	3
4	0	4

See pages 58-59 for specifications.



Switch "01" Single pole, double throw (Standard)

15 Amperes	125 Volts AC
	250 Volts AC
	480 Volts AC
⅛ H.P.	125 Volts AC
¼ H.P.	250 Volts AC
¼ Ampere	250 Volts DC
½ Ampere	125 Volts DC

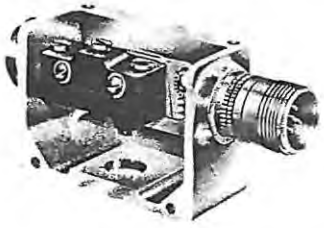


Switch "03" Single pole, double throw, double break (Optional)

15 Amperes	125 Volts AC
	250 Volts AC
1 Ampere	125 Volts DC
½ Ampere	250 Volts DC
¼ H.P.	125 Volts AC
½ H.P.	250 Volts AC



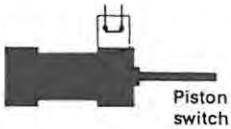
Two different limit switches are available. Both switches come with a ½" pipe conduit connection in the enclosure wall. Switches 01 and 03 are available with quick disconnect plug factory-wired to the limit switch as an option.



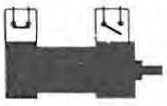


SWITCH MOUNTED ON ROD END ONLY

Piston rod retracted or in motion—switch open.



Piston rod fully extended—switch closed.

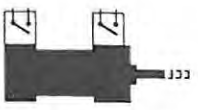


SWITCHES MOUNTED ON BOTH ROD END AND BLIND END

Piston rod fully retracted—blind end switch closed, rod end switch open.



Piston rod fully extended—rod end switch closed, blind end switch open.



Piston rod in motion—both switches open.

Stop Tube and Tie Rod Spacer Selection

As the stroke length of a cylinder increases, the resultant bearing loads on the piston rod become greater. To keep these bearing loads from exceeding design limitations and to obtain optimum life from a cylinder, stop tubes should be specified according to the following procedure:

SPECIFY ONE INCH OF STOP TUBE FOR EACH 10 INCHES (OR FRACTION THEREOF) OF STROKE IN EXCESS OF THE MAXIMUMS LISTED IN THE FOLLOWING TABLE:

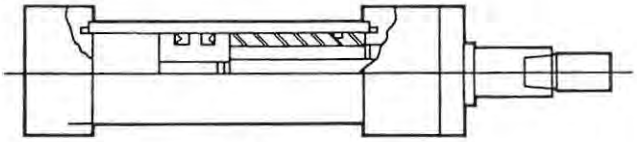
MAXIMUM STROKE PERMISSABLE WITHOUT STOP TUBE

BORE DIAMETER	PIVOT MOUNT CYLINDER (Clevis & Trunnion)	RIGID MOUNT CYLINDER (without rod support)	RIGID MOUNT CYLINDER (with rod support)
1½ & 2 in.	24 in.	30 in.	48 in.
2½ to 4 in.	30 in.	38 in.	48 in.
5 to 14 in.	36 in.	40 in.	48 in.
16 to 20 in.	Consult factory		

STOP TUBE DESIGNS

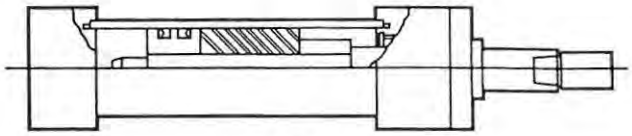
Three typical stop tube designs are illustrated below.

Design A
Used for cylinders non-cushioned on the rod.



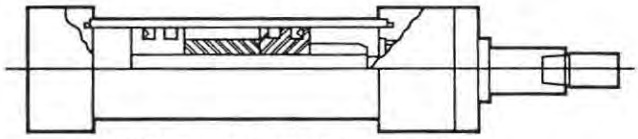
STOP TUBE

Design B
Used for cushioned hydraulic cylinders.



STOP SPACER

Design C
The best choice for a cylinder with an exceptionally long stop tube requirement. Note that the piston's effective bearing area is doubled, in addition to gaining the normal increased minimum distance between bearing points.



DOUBLE PISTON WITH SPACER

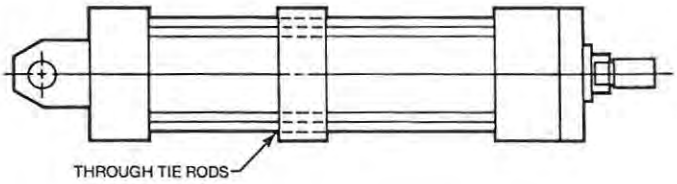
Tie rod spacers and center supports are used to improve the structural rigidity of long stroke tie rod cylinders.

A tie rod spacer or center support should be applied when the stroke length exceeds 20 times the bore diameter.

TIE ROD SPACER

The spacers have through holes for the tie rods and are held in place on the cylinder barrel with a small tack weld or set screw.

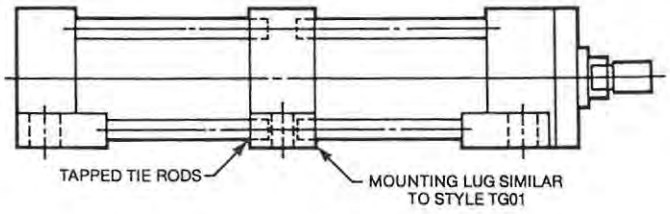
The spacer keeps the tie rod in the proper position around the centerline of the cylinder and acts much like a truss in preventing excessive deflection in a long stroke cylinder that is not rigidly mounted (clevis mount, etc.).



TIE ROD CENTER SUPPORT

The center support has side mounting lugs similar to side lug mount heads and serves as an additional mounting location. The tie rods are studded into the center support and it becomes a load-carrying component of the cylinder assembly.

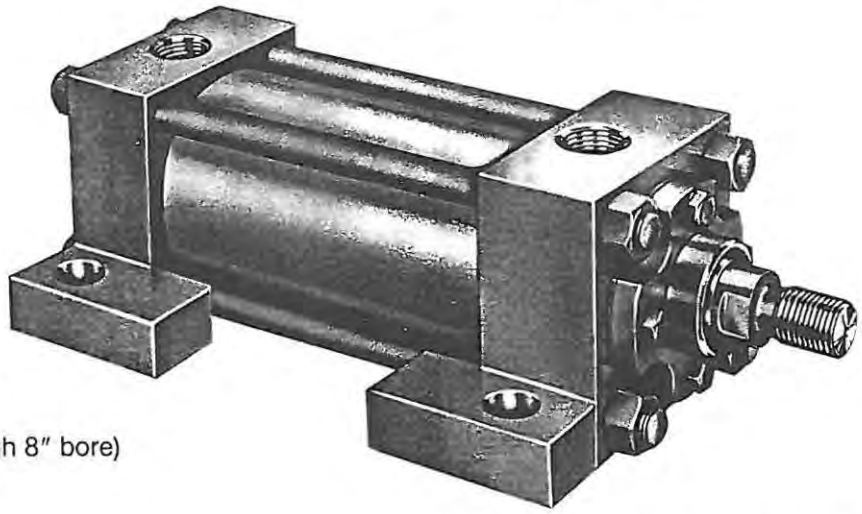
The exact location of the tie rod center support is generally optional, which greatly increases the flexibility in mounting a long stroke cylinder.



SIDE LUG AND TAPPED MOUNTS

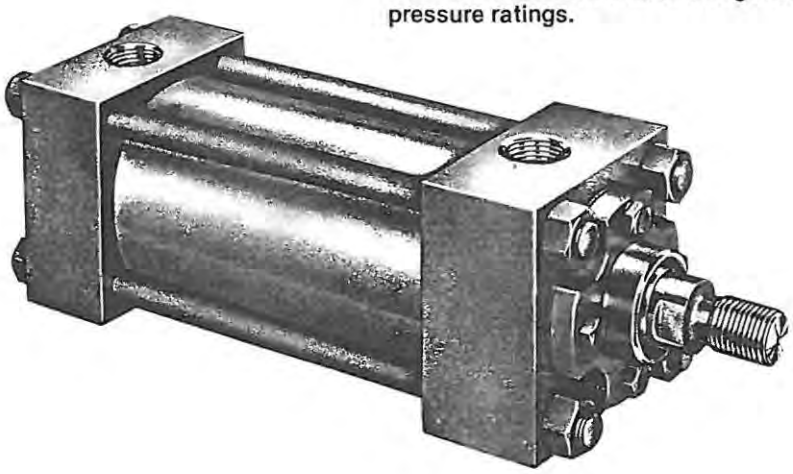
Application Guide

- ☐ Side Lug and Tapped Mounts are for moving loads along a flat guided surface as in a carriage along rails.
- ☐ The mounting surface should be flat and parallel to the centerline of the piston rod.
- ☐ The load should be guided to traverse along the centerline of the piston rod.
- ☐ With unsupported loads, the bearing must absorb more force. For these applications, the larger alternate rod is recommended and stop tubes should be considered.
- ☐ The frame on which the cylinder is mounted must be sufficiently rigid to resist bending moments.
- ☐ Use high tensile socket head cap screws or hex head bolts tightened to the manufacturer's recommended torque.
- ☐ For high shock applications, dowel pins or shear keys should be incorporated in the mounting design. For these applications, consider the Keyed Side Lug Mount or Keyed Tapped Mount.
- ☐ For severe side load applications, consult your local Aeroquip sales engineer.



Side Lug
1½" through 14" Bore
TG01 Hydraulic
TW01 HWCF
NFPA MS2 (1½" through 8" bore)

See individual bore size drawings for maximum allowable pressure ratings.



Tapped
1½" through 8" Bore
TG02 Hydraulic
TW02 HWCF
NFPA MS4

NOTE:

The maximum allowable stroke for push forces is shown on page 11.

For strokes in excess of 30" see page 15 for "stop tube" recommendations.

Ports in positions 2 or 4 may interfere with mounting bolts on some sizes.

Mounting dimensions are the same for both cushioned and non-cushioned cylinders.

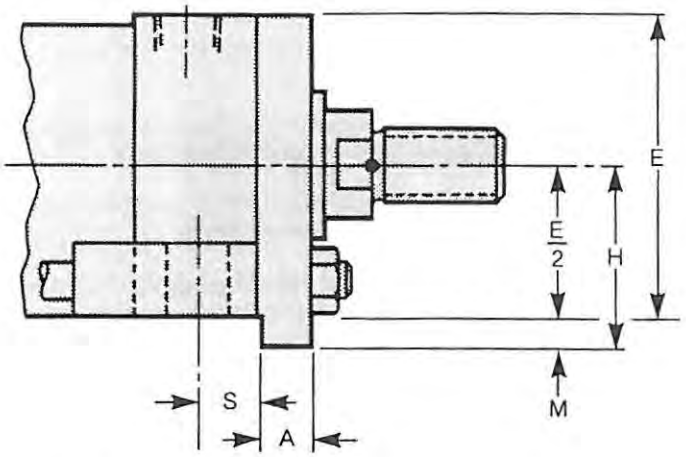
For strokes in excess of 20 times the bore size, see page 15 for "Tie Rod Spacers".

Recommended torque values are listed on page 24.

KEYED SIDE LUG MOUNT

Keyed Side Lug Mount Cylinders Cushioned and Non-cushioned

Modification of TG01 converting it to TG04.



1½" through 8" Bore
TG04 Hydraulic
TW04 HWCF

BORE	E	E/2	A	H	S	M
1½	2½	1.244 / 1.242	.312 / .310	1.438	.438	.188
2	3	1.494 / 1.492	.562 / .560	1.813	.563	.313
2½	3½	1.744 / 1.742	.562 / .560	2.063	.750	.313
3¼	4½	2.244 / 2.242	.687 / .684	2.625	.750	.375
4	5	2.494 / 2.492	.812 / .809	2.938	.938	.438
5	6½	3.244 / 3.242	.812 / .809	3.688	.938	.438
6	7½	3.744 / 3.742	.937 / .934	4.250	1.188	.500
7	8½	4.244 / 4.242	.937 / .934	4.750	1.438	.500
8	9½	4.744 / 4.742	.937 / .934	5.250	1.438	.500

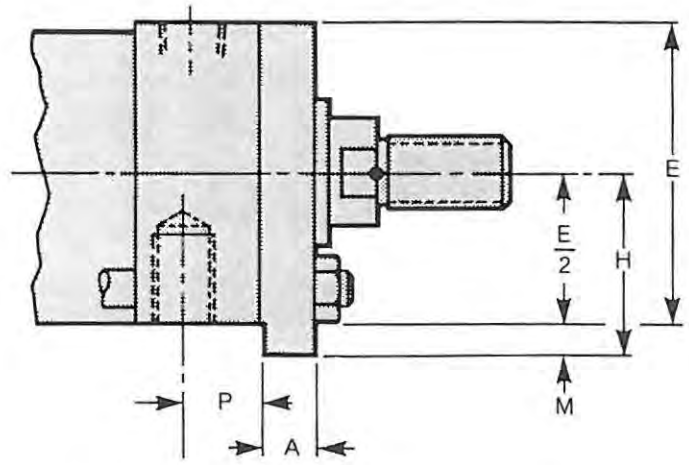
All dimensions in inches.

See individual bore size drawings for maximum allowable pressure ratings.

KEYED TAPPED MOUNT

Keyed Tapped Mount Cylinders Cushioned and Non-cushioned

Modification of TG02 converting it to TG05.



1½" through 8" Bore
TG05 Hydraulic
TW05 HWCF

BORE	E	E/2	A	H	P	M
1½	2½	1.244 / 1.242	.312 / .310	1.438	1.063	.188
2	3	1.494 / 1.492	.562 / .560	1.813	1.063	.313
2½	3½	1.744 / 1.742	.562 / .560	2.063	1.063	.313
3¼	4½	2.244 / 2.242	.687 / .684	2.625	1.188	.375
4	5	2.494 / 2.492	.812 / .809	2.938	1.188	.438
5	6½	3.244 / 3.242	.812 / .809	3.688	1.188	.438
6	7½	3.744 / 3.742	.937 / .934	4.250	1.313	.500
7	8½	4.244 / 4.242	.937 / .934	4.750	1.625	.500
8	9½	4.744 / 4.742	.937 / .934	5.250	1.750	.500

All dimensions in inches.

See individual bore size drawings for maximum allowable pressure ratings.

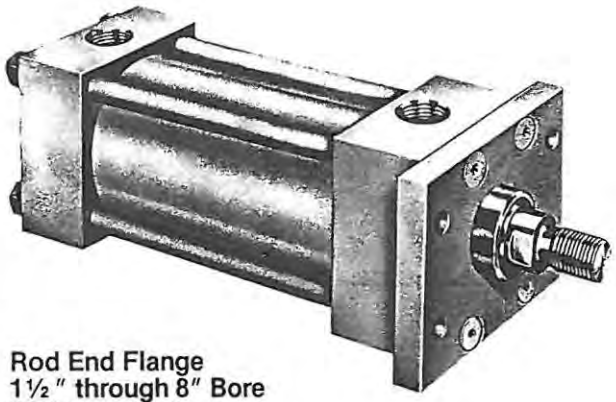
NOTE:

Use drawings for style TG01 or TG02 for dimensions not shown (pages 26-43).

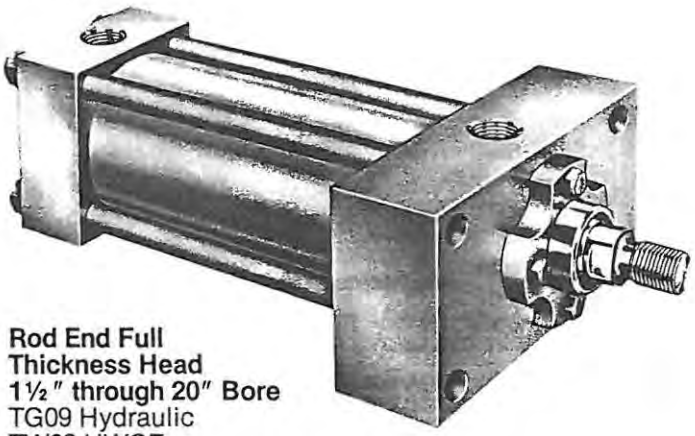
ROD END FLANGE, SQUARE FLANGE, AND FULL THICKNESS HEAD MOUNTS

Application Guide

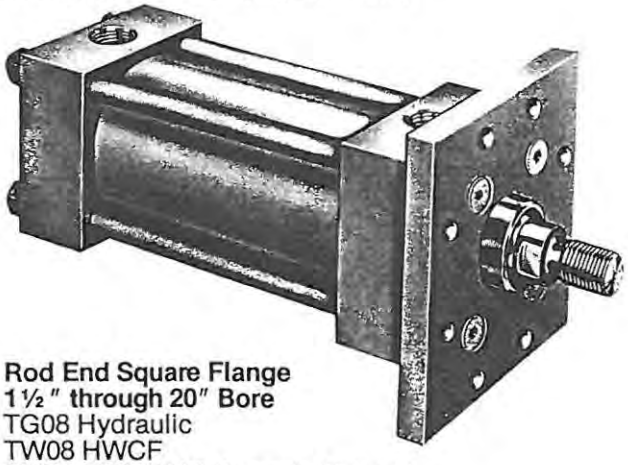
- ☐ These mounts are ideal for straight line force transfer applications in which the cylinder is used in tension (pulling) as in pull presses. For compression applications (pushing), a Blind End Flange Mount is more appropriate.
- ☐ The mounting surface should be flat and the rod end bearing should be piloted into it.
- ☐ The force of the load should be perpendicular to the mounting surface and parallel the centerline of the piston rod. For eccentric loads, the oversize alternate rod is recommended and stop tubes should be considered.
- ☐ The frame on which the cylinder is mounted must be sufficiently rigid to resist bending moments.
- ☐ For heavy duty applications, the Full Thickness Head Mount (TG09, TW09) is recommended.
- ☐ Use high tensile socket head cap screws or hex head bolts tightened to the manufacturer's recommended torque.



Rod End Flange
1½" through 8" Bore
TG07 Hydraulic
TW07 HWCF
NFPA MF1 (1½" through 8" bore)



Rod End Full Thickness Head
1½" through 20" Bore
TG09 Hydraulic
TW09 HWCF
NFPA ME5 (1½" through 8" bore)



Rod End Square Flange
1½" through 20" Bore
TG08 Hydraulic
TW08 HWCF
NFPA MF5 (1½" through 8" bore)

See individual bore size drawings for maximum allowable pressure ratings.

NOTE:

The maximum allowable stroke for push forces is shown on page 11.

For strokes in excess of 30" see page 15 for "stop tube" recommendations.

Mounting dimensions are the same for both cushioned and non-cushioned cylinders.

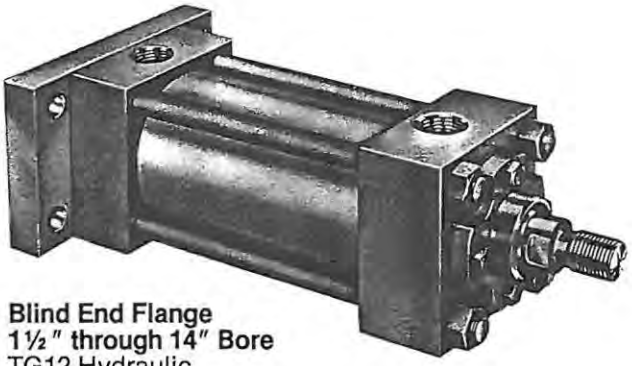
For strokes in excess of 20 times the bore size, see page 15 for "Tie Rod Spacers".

Recommended torque values are listed on page 24.

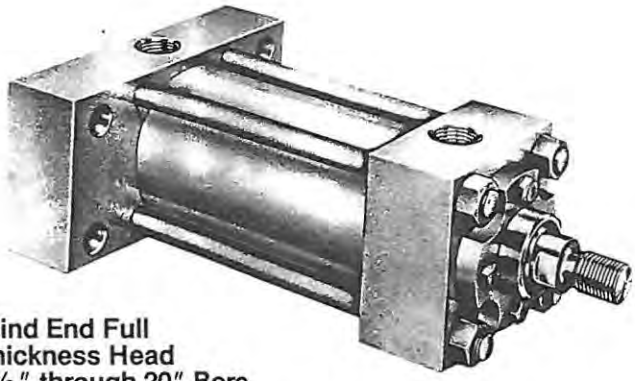
BLIND END FLANGE, SQUARE FLANGE, AND FULL THICKNESS HEAD MOUNTS

Application Guide

- ☐ These mounts are for straight line force transfer applications in which the cylinder is used in compression (pushing) as in push presses. For tension applications (pulling), a Rod End Flange Mount is more appropriate.
- ☐ The mounting surface should be flat and perpendicular to the force of the load.
- ☐ The frame on which the cylinder is mounted must be sufficiently rigid to resist bending moments.
- ☐ For heavy duty applications, the Full Thickness Head Mount (TG14, TW14) is recommended.
- ☐ Use high tensile socket head cap screws or hex head bolts tightened to the manufacturer's recommended torque value.

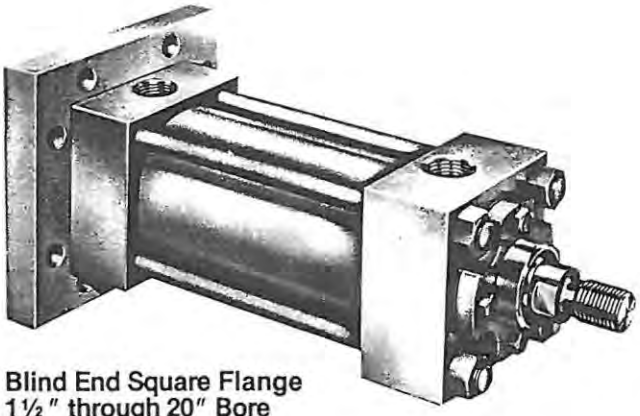


Blind End Flange
1½" through 14" Bore
TG12 Hydraulic
TW12 HWCF
NFPA MF2 (1½" through 8" bore)



Blind End Full Thickness Head
1½" through 20" Bore
TG14 Hydraulic
TW14 HWCF
NFPA ME6 (1½" through 8" bore)

See individual bore size drawings for maximum allowable pressure ratings.



Blind End Square Flange
1½" through 20" Bore
TG13 Hydraulic
TW13 HWCF
NFPA MF6 (1½" through 8" bore)

NOTE:

The maximum allowable stroke for push forces is shown on page 11.

For strokes in excess of 30" see page 15 for "stop tube" recommendations.

Mounting dimensions are the same for both cushioned and non-cushioned cylinders.

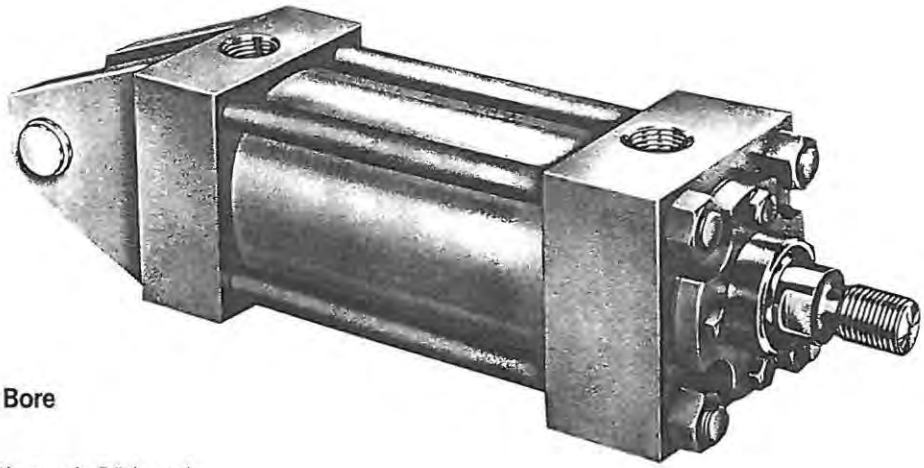
For strokes in excess of 20 times the bore size, see page 15 for "Tie Rod Spacers".

Recommended torque values are listed on page 24.

CLEVIS MOUNT

Application Guide

- ☐ This mount is for applications in which the machine member travels in a curved path within one plane.
- ☐ This mount can be used both in compression (push) and tension (pull). Care must be exercised to prevent rod buckling in compression applications with long strokes. See page 11 for stroke limitations.
- ☐ The centerline of the machine member that attaches to the swivel pin must be perpendicular to the centerline of the piston rod and the curved path must be in one plane only. Any misalignment will cause excess side loading on the bearing and piston. This will lead to premature failure. For applications with small amounts of misalignment, consider the Spherical Bushing Mount.



Clevis
1½" through 20" Bore
TG10 Hydraulic
TW10 HWCF
NFPA MP1 (1½" through 8" bore)

See page 54 for mounting accessories.

See individual bore size drawings for maximum allowable pressure ratings.

NOTE:

The maximum allowable stroke for push forces is shown on page 11.

For strokes in excess of 24" see page 15 for "stop tube" recommendations.

Mounting dimensions are the same for both cushioned and non-cushioned cylinders.

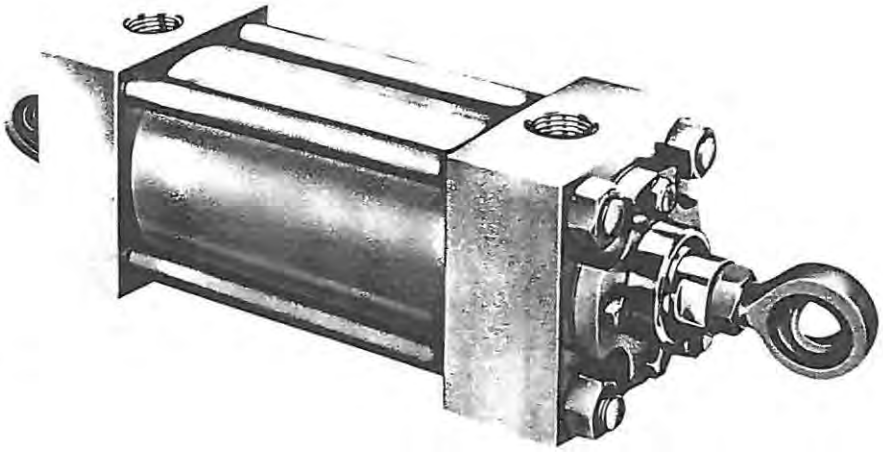
For strokes in excess of 20 times the bore size, see page 15 for "Tie Rod Spacers".

Recommended torque values are listed on page 24.

SPHERICAL BUSHING MOUNT

Application Guide

- ☐ This mount is for applications in which the machine member travels in a curved path in one plane where some misalignment is unavoidable. The amount of allowable misalignment is shown in the chart below.
- ☐ This mount can be used both in compression (push) and tension (pull). Care must be exercised to prevent rod buckling in compression applications with long strokes. See page 11 for stroke limitations.
- ☐ Maximum radial static and dynamic bearing loads must not exceed the recommended ratings shown below.



Spherical Bushing
1½" through 6" Bore
TG11 Hydraulic
TW11 HWCF

See page 55 for mounting accessories.

See individual bore size drawings for maximum allowable pressure ratings.

NOTE:

The maximum allowable stroke for push forces is shown on page 11.

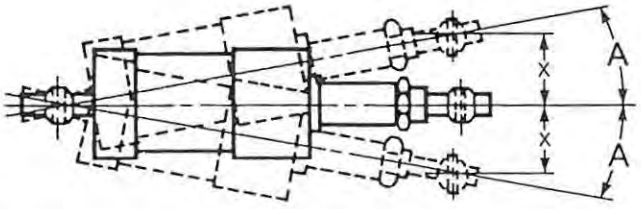
For strokes in excess of 24" see page 15 for "stop tube" recommendations.

Mounting dimensions are the same for both cushioned and non-cushioned cylinders.

For strokes in excess of 20 times the bore size, see page 15 for "Tie Rod Spacers".

The spherical ball bushing in both ends is contained in special high strength steel.

Recommended torque values are listed on page 24.



CAUTION: TO PREVENT ROD EYE SEPARATION LOCK ROD EYE TO PISTON ROD WITH JAM NUT.

Angle A is the recommended maximum angle of misalignment.

To find maximum recommended X distance, multiply the distance between pivot mounting holes (see bore size drawing) by tangent of angle A.

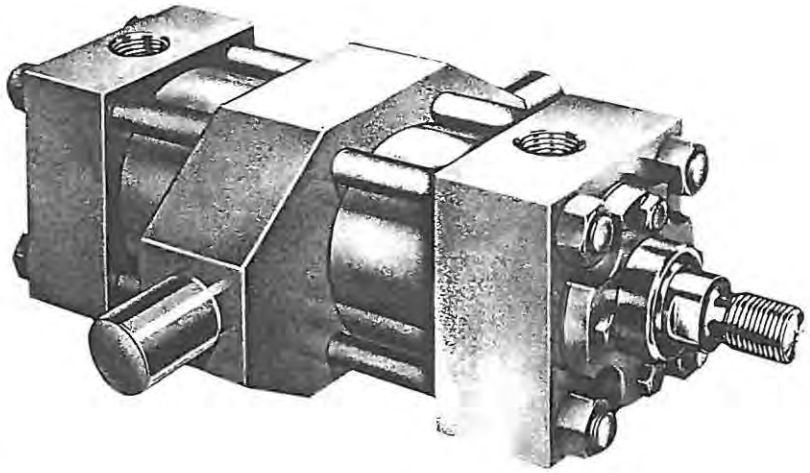
Cyl Bore	Rod Dia.	Mtg. Hole Dia.	Angle A	Tangent of A	Static Load Ratings	
					Radial	Thrust
1½	⅝	½	1.5	.026	8,100	3,200
2	1	¾	2	.035	18,800	7,500
2½	1	¾	2	.035	18,800	7,500
3¼	1⅜	1	2	.035	33,300	13,300
4	1¾	1⅜	2	.035	59,800	24,000
5	2	1¾	2.5	.044	102,000	40,700
6	2½	2	2.5	.044	132,000	53,000

All dimensions in inches.

INTERMEDIATE TRUNNION MOUNT

Application Guide

- ☐ The Intermediate Trunnion Mount is for longer stroke applications in which the machine member travels in a curved path within one plane.
- ☐ On special order, the trunnion can be located anywhere along the body.
- ☐ This mount can be used both in compression (push) and tension (pull) applications.
- ☐ It is recommended that rigidly mounted pillow blocks with bearings at least as long as the trunnion pins be used and be installed as close to the shoulder of the trunnion as possible.



Intermediate Trunnion
1½" through 20" Bore
TG15 Hydraulic
TW15 HWCF
NFPA MT4 (1½" through 8" bore)

See individual bore size drawings for maximum allowable pressure ratings.

NOTE:

The maximum allowable stroke for push forces is shown on page 11.

For strokes in excess of 24" see page 15 for "stop tube" recommendations.

Mounting dimensions are the same for both cushioned and non-cushioned cylinders.

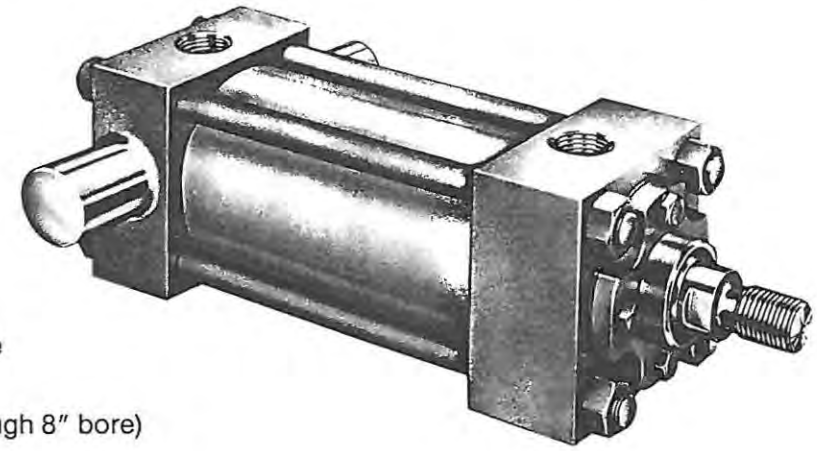
For strokes in excess of 20 times the bore size, see page 15 for "Tie Rod Spacers".

Recommended torque values are listed on page 24.

BLIND END AND ROD END TRUNNION MOUNTS

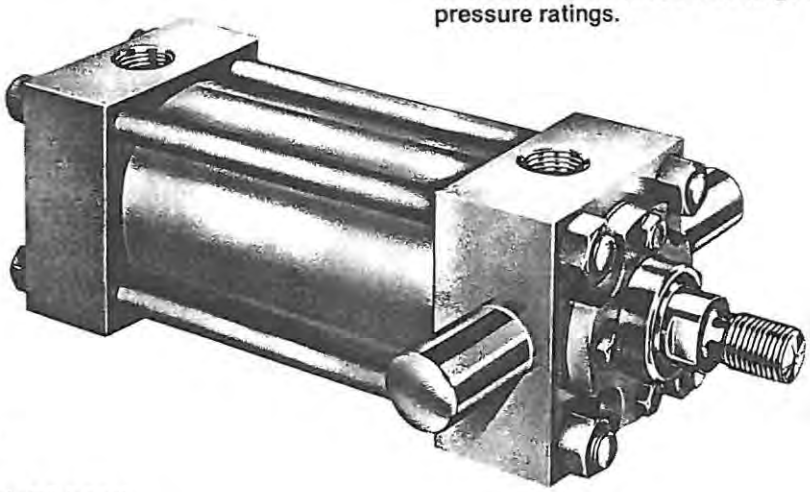
Application Guide

- ☐ These mounts are for applications in which the machine member travels in a curved path within one plane.
- ☐ Either mount can be used both in compression (push) and tension (pull) applications. Rod End Trunnion Mounts provide a longer maximum stroke than Blind End Trunnion Mounts, when used in compression.
- ☐ The trunnion pins are an integral part of the head and can be sleeved to provide an extremely tight fit to the mating machine member and permit curvilinear motion.
- ☐ It is recommended that rigidly mounted pillow blocks with bearings at least as long as the trunnion pins be used and be installed as close to the shoulder of the trunnion as possible.



Blind End Trunnion
1½" through 14" Bore
TG16 Hydraulic
TW16 HWCF
NFPA MT2 (1½" through 8" bore)

See individual bore size drawings for maximum allowable pressure ratings.



Rod End Trunnion
1½" through 14" Bore
TG17 Hydraulic
TW17 HWCF
NFPA MT1 (1½" through 8" bore)

NOTE:

The maximum allowable stroke for push forces is shown on page 11.

For strokes in excess of 24" see page 15 for "stop tube" recommendations.

Mounting dimensions are the same for both cushioned and non-cushioned cylinders.

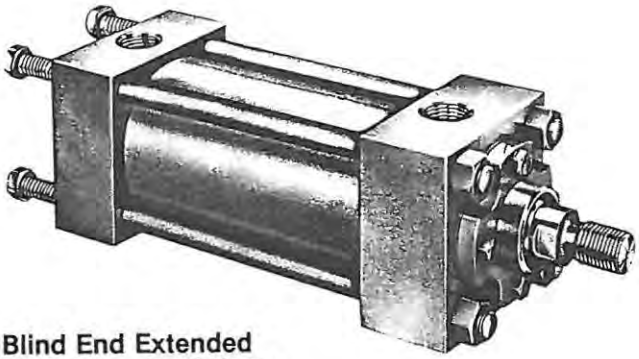
For strokes in excess of 20 times the bore size, see page 15 for "Tie Rod Spacers".

Recommended torque values are listed on page 24.

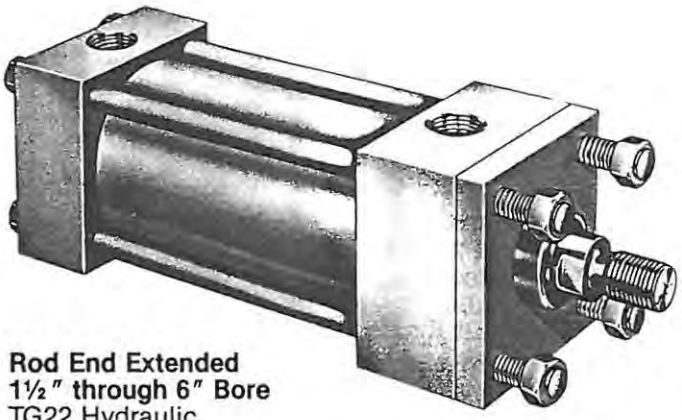
EXTENDED TIE ROD MOUNTS

Application Guide

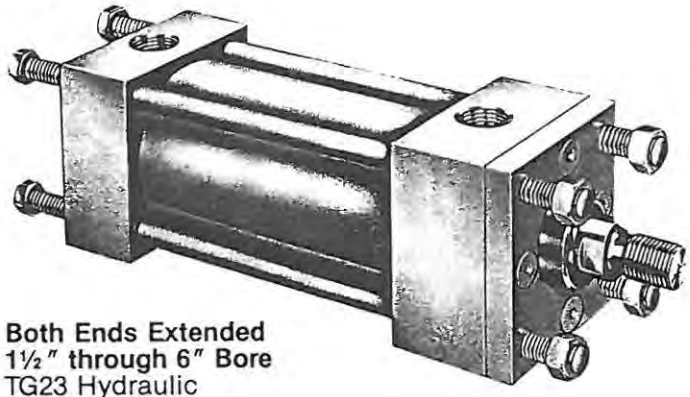
- ☐ These mounts are for straight line force transfer applications. The Rod End Extended Tie Rod Mount is recommended for tension (pulling) applications and the Blind End Extended Tie Rod Mount is recommended for compression (pushing) applications. Both ends Extended Tie Rod Mounts are suited for tension and compression applications or applications where additional hardware is to be attached to the cylinders.
- ☐ The mounting surface should be flat and the frame on which the cylinder is mounted must be sufficiently rigid to resist bending moments.
- ☐ On rod end mount applications, the bearing provides a pilot diameter to align the rod in the mounting frame.
- ☐ Once fitted into the application framework, the nuts which are provided should be torqued to the values listed below. On some, Both Ends Extended Tie Rod Mounts, the nuts must be loosened on the rod end then torqued following assembly to the framework.
- ☐ The force on the rod should be perpendicular to the mounting surface and coincide with the centerline of the piston rod. For eccentric loads, oversized alternate rods are recommended and stop tubes should be considered.



Blind End Extended
1½" through 6" Bore
TG21 Hydraulic
TW21 HWCF
NFPA MX2



Rod End Extended
1½" through 6" Bore
TG22 Hydraulic
TW22 HWCF
NFPA MX3



Both Ends Extended
1½" through 6" Bore
TG23 Hydraulic
TW23 HWCF
NFPA MX1

See individual bore size drawings for maximum allowable pressure ratings.

NOTE:

The maximum allowable stroke for push forces is shown on page 11.

For strokes in excess of 30" see page 15 for "stop tube" recommendations.

Mounting dimensions are the same for both cushioned and non-cushioned cylinders.

For strokes in excess of 20 times the bore size, see page 15 for "Tie Rod Spacers".

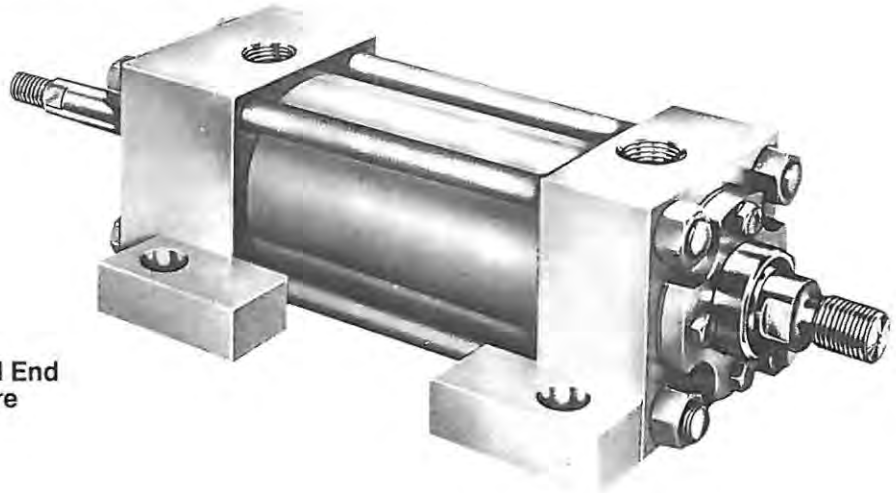
TORQUE VALUES for all mounting styles

	TIE RODS		BEARING RETAINER	
BORE SIZE	TIE ROD DIAMETER THREAD	TIE ROD TORQUE (FT. LBS.)	BEARING RETAINER SCREW SIZE	RETAINER TORQUE (FT. LBS.)
1½"	⅜-24	28	⅜-24	22
2"	½-20	66	½-20	50
2½"	½-20	66	½-20	50
3¼"	⅝-18	150	¼-28	7
4"	⅝-18	150	¼-28	7
5"	⅞-14	360	¼-28	7
6"	1-14	560	¼-28	7
7"	1⅛-12	800	5/16-24	12
8"	1¼-12	1100	5/16-24	12
10"	1½-12	1850	⅜-24	47
12"	1¼-12	1100	⅜-24	47
14"	1½-12	1800	½-20	114
16"	1½-12	1600	½-20	114
18"	1½-12	2000	½-20	114
20"	1½-12	2000	½-20	114

DOUBLE ROD END MOUNTS

Application Guide

- ☐ Double end cylinders are specified when equal displacement is desired on both sides of the piston or when the application is such that another function can be performed simultaneously with a second rod.
- ☐ The single rod mount application data is applicable to double rod end cylinders.



Side Lug Double Rod End
1½" through 14" Bore
TG25 Hydraulic
TW25 HWCF

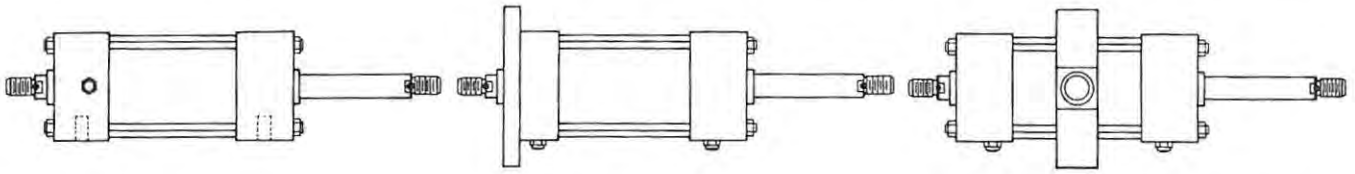
NOTE:

The maximum allowable stroke for push forces is shown on page 11.

For strokes in excess of 24" see page 15 for "stop tube" recommendations.

Mounting dimensions are the same for both cushioned and non-cushioned cylinders.

For strokes in excess of 20 times the bore size, see page 15 for "Tie Rod Spacers".

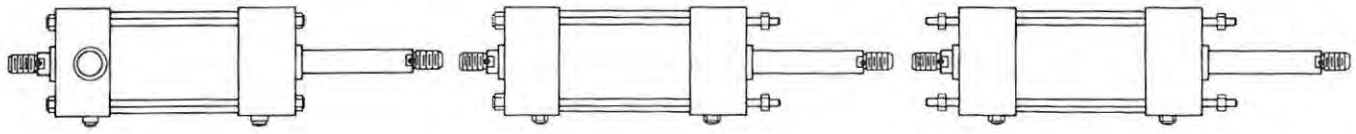


Tapped Mount
1½" thru 8" Bore
TG26 Hydraulic
TW26 HWCF

Flange Mount

Rectangular	Square	Full Thickness
1½" thru 8"	**1½" thru 8"**	**1½" thru 20"**
TG31 Hydraulic	TG32 Hydraulic	TG33 Hydraulic
TW31 HWCF	TW32 HWCF	TW33 HWCF

Intermediate Trunnion Mount
1½" thru 20" Bore
TG34 Hydraulic
TW34 HWCF



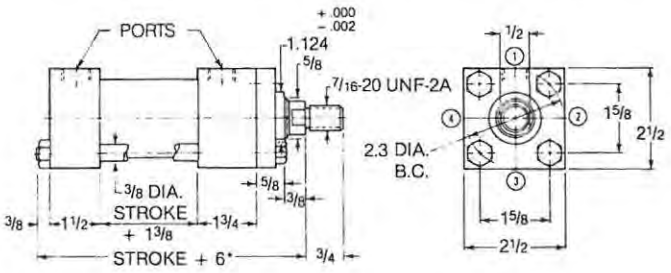
Head Trunnion Mount
1½" thru 14" Bore
Head Trunnion Mount
TG35 Hydraulic
TW35 HWCF

Rod End Extended Tie Rod
1½" thru 6" Bore
TG39 Hydraulic
TW39 HWCF

Both Ends Extended Tie Rod
1½" thru 6" Bore
TG40 Hydraulic
TW40 HWCF

See individual bore size drawings for maximum allowable pressure ratings.

1½" CYLINDER BORE



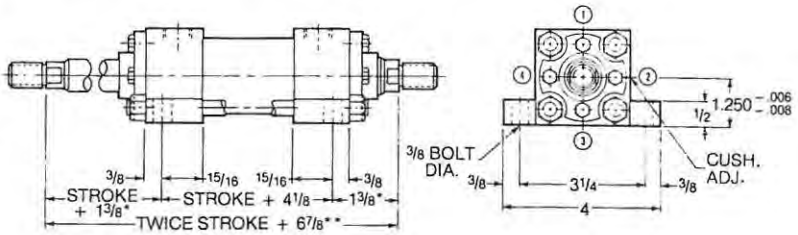
TG24 BASIC CYLINDER

TG25 DOUBLE ROD END SIDE LUG MOUNT

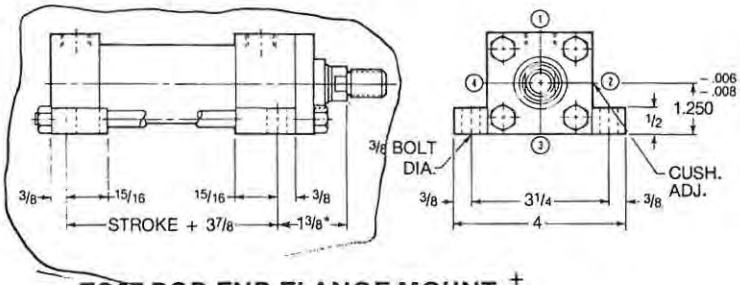
ALTERNATE ROD SIZES AVAILABLE ADD "N" TO ALL DIMENSIONS MARKED WITH "*"								
ROD DIA. MM	N*	A	B	C	KK-Thd.	RD[1]	V[2]	VB[3]
1	3/8	1 1/8	1.499	1/2	3/4-16	2 7/16	1/2	7/8

(1) "RD" Dimensions apply to the following Mounting Codes: 09.
(2) "V" Dimensions apply to the following Mounting Codes: 07, 08, 22, 23.
(3) "VB" Dimensions apply to the following Mounting Codes: 01, 02, 25, 10, 12, 13, 15, 16, 17, 21.

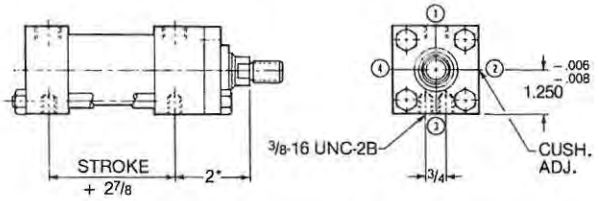
**Means add "N" twice



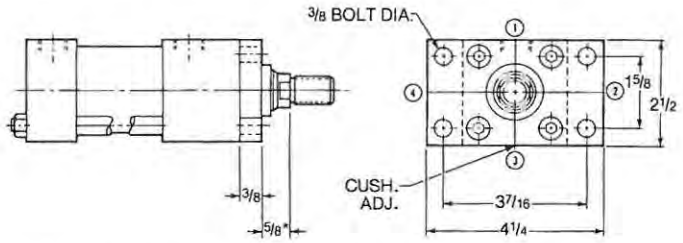
TG01 SIDE LUG MOUNT



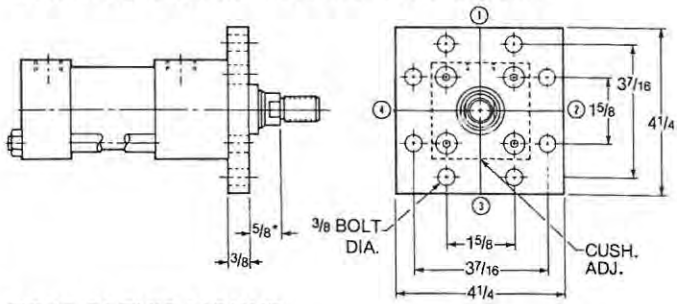
TG02 TAPPED MOUNT



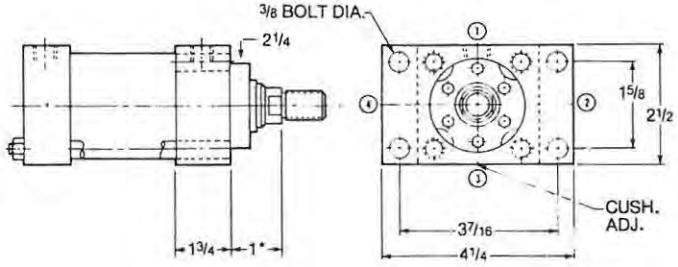
TG07 ROD END FLANGE MOUNT †



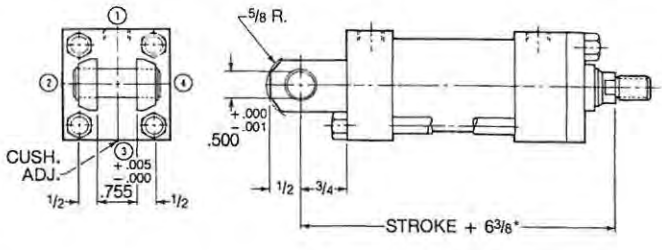
TG08 ROD END SQUARE FLANGE MOUNT



TG09 ROD END FULL THICKNESS HEAD

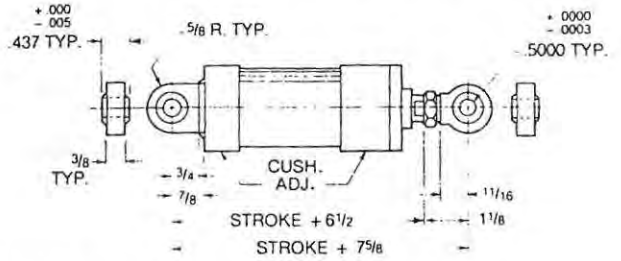


TG10 CLEVIS MOUNT

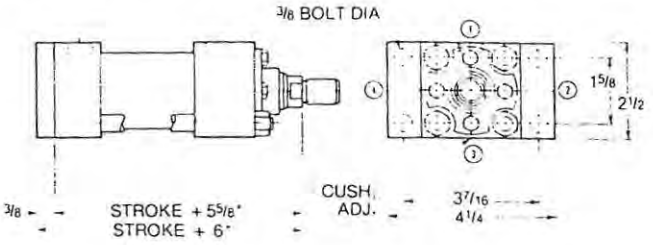


†Maximum working pressure 800 psi (for minimum flange deflection)

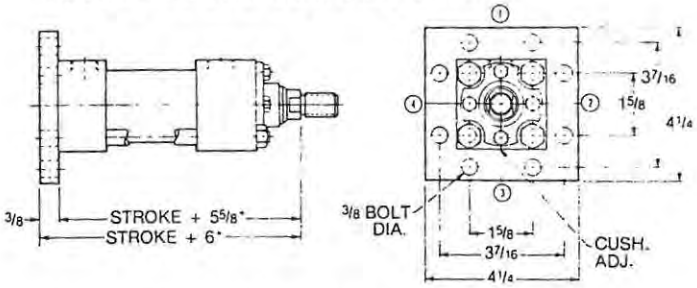
TG11 SPHERICAL BUSHING MOUNT



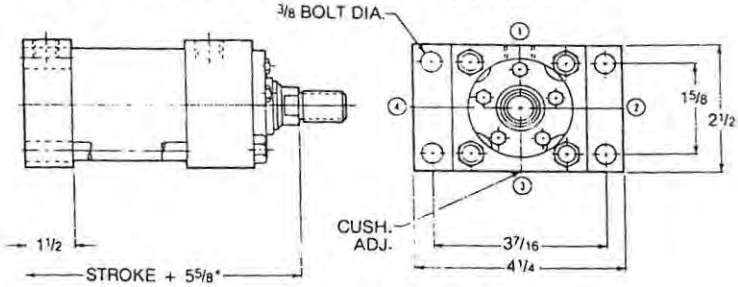
TG12 BLIND END FLANGE†



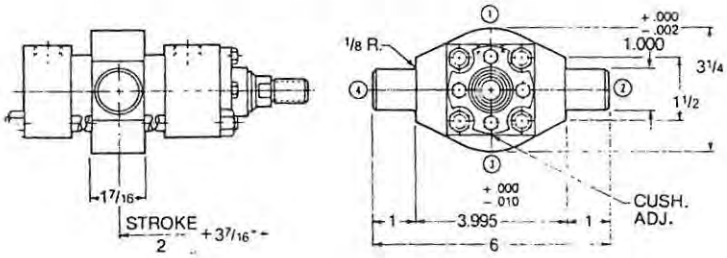
TG13 BLIND END SQUARE FLANGE



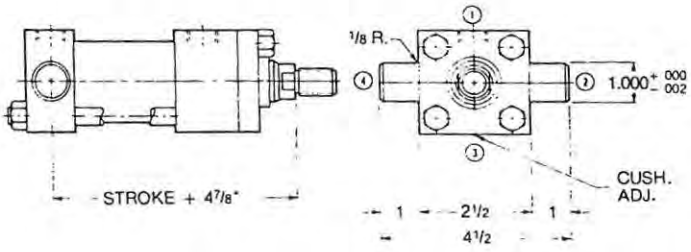
TG14 BLIND END FULL THICKNESS HEAD



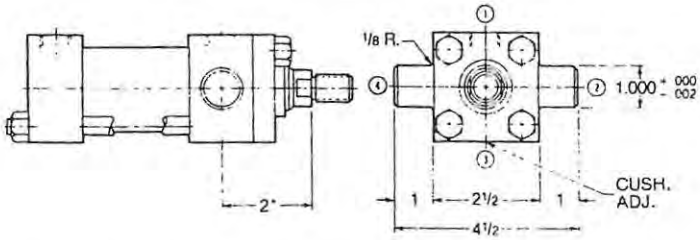
TG15 INTERMEDIATE TRUNNION MOUNT



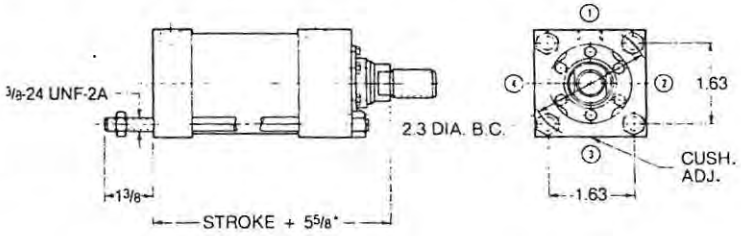
TG16 BLIND END TRUNNION MOUNT



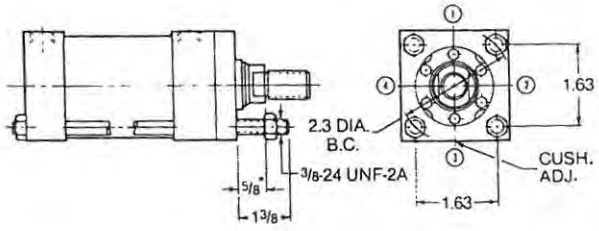
TG17 ROD END TRUNNION MOUNT



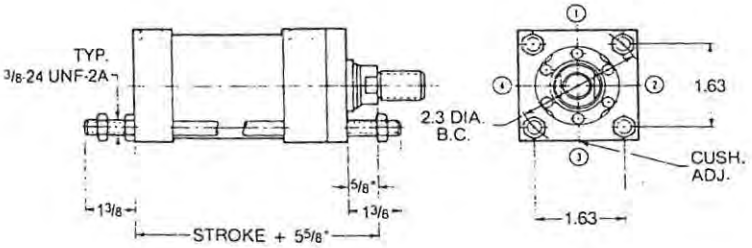
TG21 BLIND END EXTENDED MOUNT



TG22 ROD END EXTENDED MOUNT

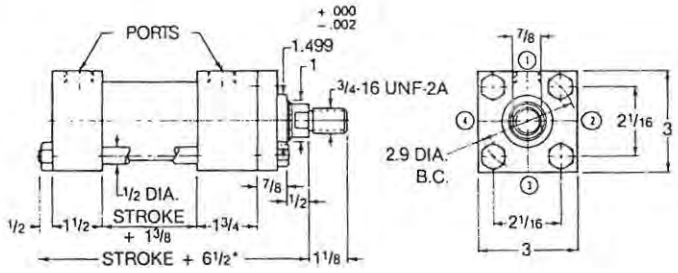


TG23 BOTH ENDS EXTENDED MOUNT



†Maximum working pressure 800 psi (for minimum flange deflection)

2″ CYLINDER BORE



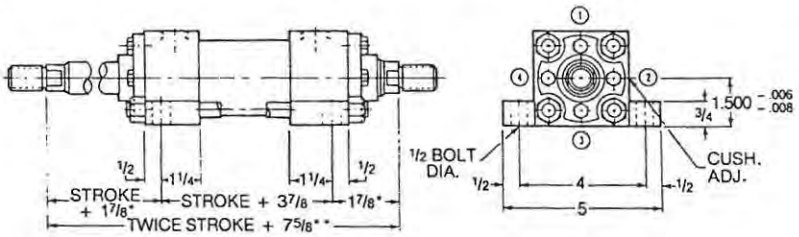
TG24 BASIC CYLINDER

ALTERNATE ROD SIZES AVAILABLE ADD "N" TO ALL DIMENSIONS MARKED WITH "*"								
ROD DIA. MM	N*	A	B	C	KK-Thd.	RD[1]	V[2]	VB[3]
1	3/8	1 1/8	1.499	1/2	1/4-16	2 1/4	3/8	1

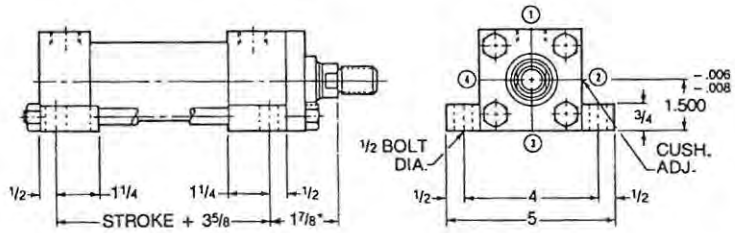
(1) "RD" Dimensions apply to the following Mounting Codes: 09.
(2) "V" Dimensions apply to the following Mounting Codes: 07, 08, 22, 23.
(3) "VB" Dimensions apply to the following Mounting Codes: 01, 02, 25, 10, 12, 13, 15, 16, 17, 21.

**Means add "N" twice

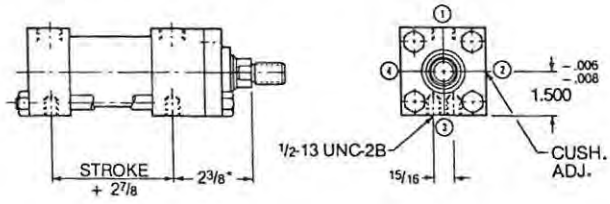
TG25 DOUBLE ROD END SIDE LUG MOUNT



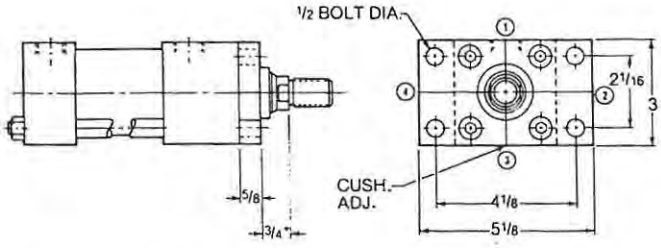
TG01 SIDE LUG MOUNT



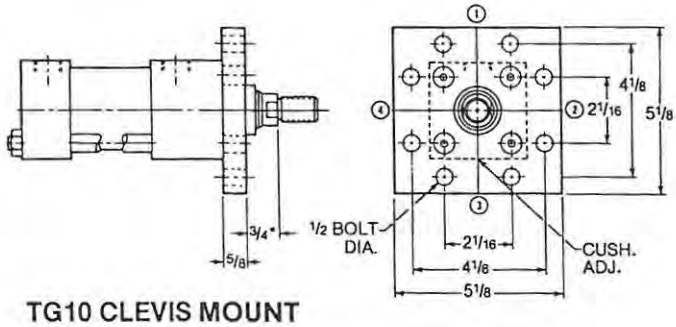
TG02 TAPPED MOUNT



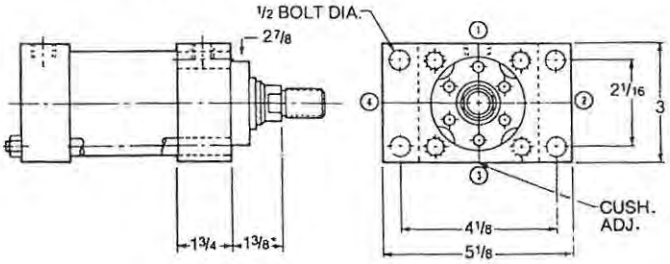
TG07 ROD END FLANGE MOUNT †



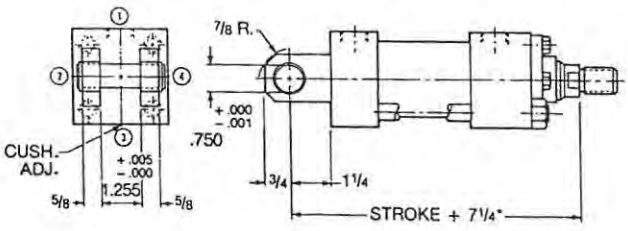
TG08 ROD END SQUARE FLANGE MOUNT



TG09 ROD END FULL THICKNESS HEAD

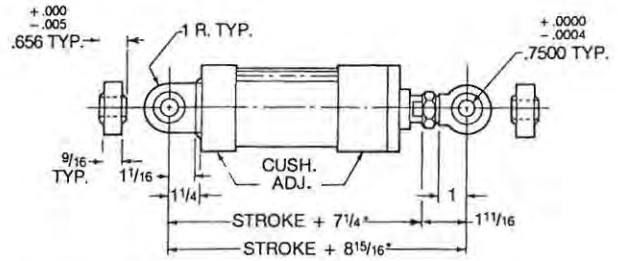


TG10 CLEVIS MOUNT

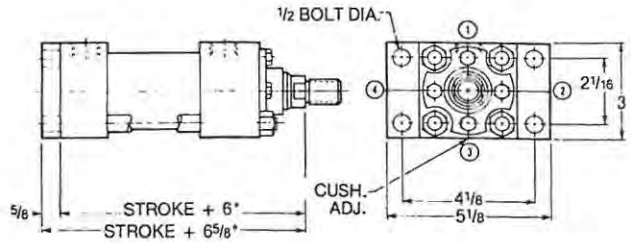


†Maximum working pressure 800 psi (for minimum flange deflection)

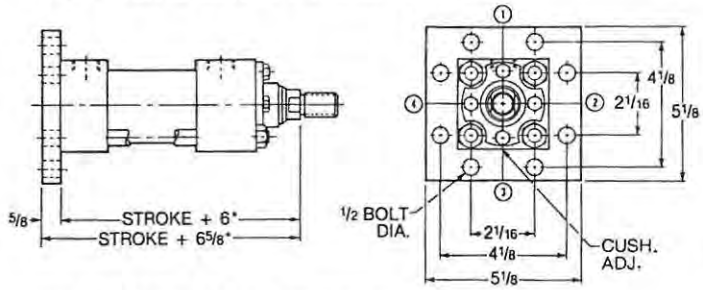
TG11 SPHERICAL BUSHING MOUNT



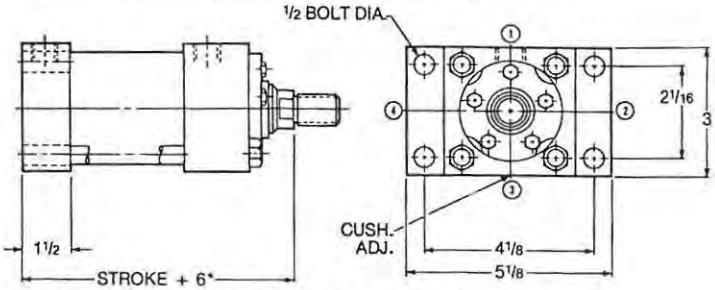
TG12 BLIND END FLANGE †



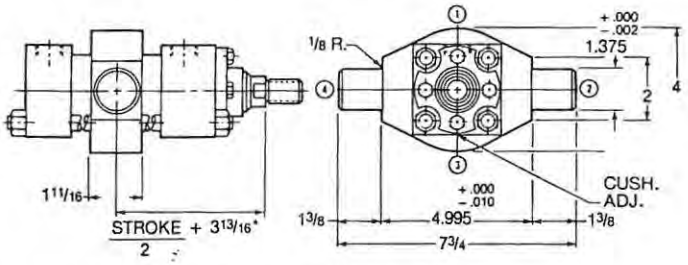
TG13 BLIND END SQUARE FLANGE



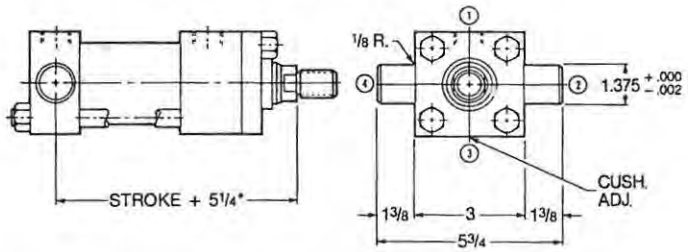
TG14 BLIND END FULL THICKNESS HEAD



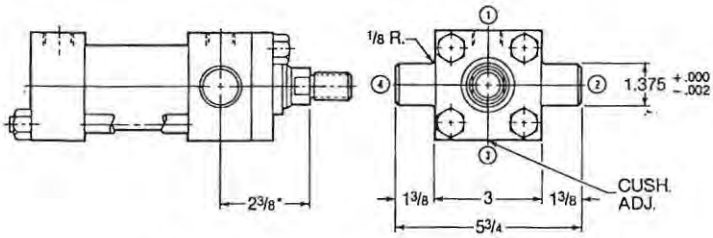
TG15 INTERMEDIATE TRUNNION MOUNT



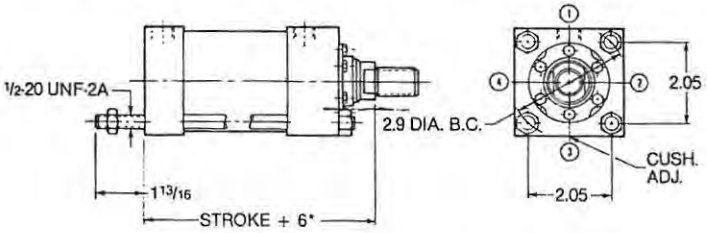
TG16 BLIND END TRUNNION MOUNT



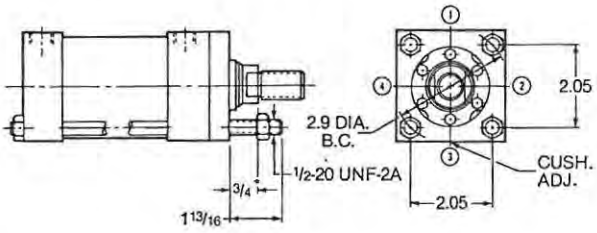
TG17 ROD END TRUNNION MOUNT



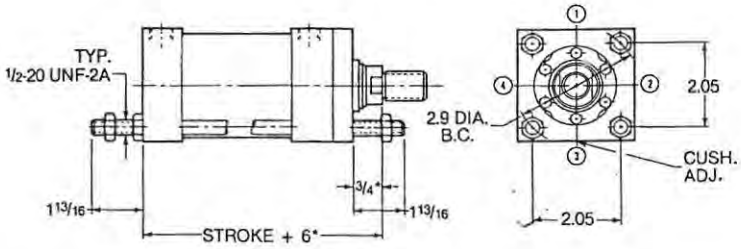
TG21 BLIND END EXTENDED MOUNT



TG22 ROD END EXTENDED MOUNT

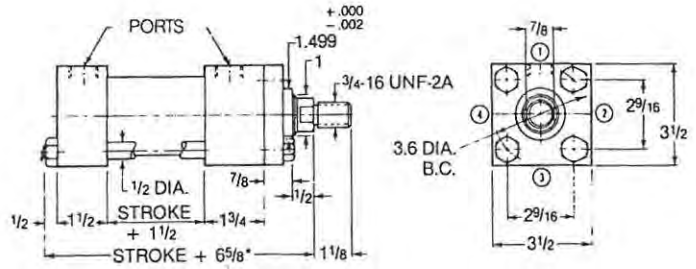


TG23 BOTH ENDS EXTENDED MOUNT



†Maximum working pressure 800 psi (for minimum flange deflection)

2½" CYLINDER BORE



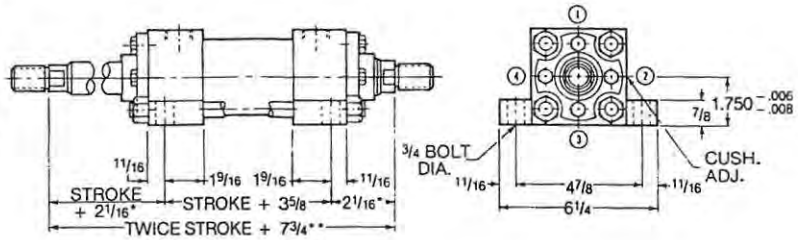
TG24 BASIC CYLINDER

ALTERNATE ROD SIZES AVAILABLE ADD "N" TO ALL DIMENSIONS MARKED WITH "*"								
ROD DIA. MM	N*	A	B	C	KK-Thd.	RD[1]	V[2]	VB[3]
1⅜	¼	1⅝	1.999	⅝	1-14	3⅜	⅜	1
1¾	½	2	2.374	¾	1¼-12	3½	½	1⅛

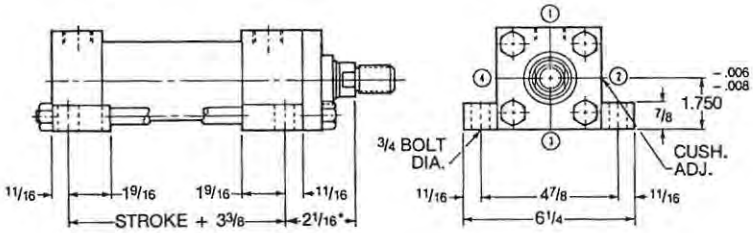
(1) "RD" Dimensions apply to the following Mounting Codes: 09.
(2) "V" Dimensions apply to the following Mounting Codes: 07, 08, 22, 23.
(3) "VB" Dimensions apply to the following Mounting Codes: 01, 02, 25, 10, 12, 13, 15, 16, 17, 21.

**Means add "N" twice

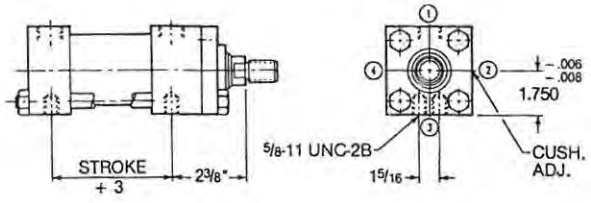
TG25 DOUBLE ROD END SIDE LUG MOUNT



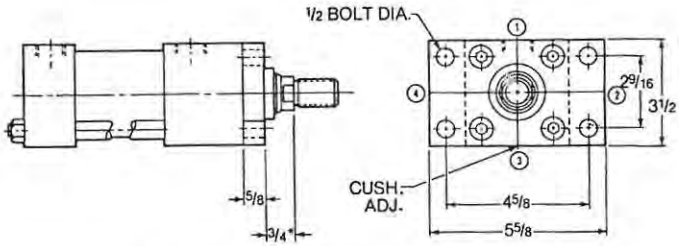
TG01 SIDE LUG MOUNT



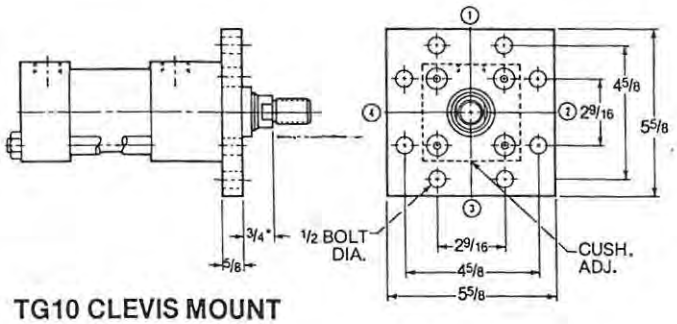
TG02 TAPPED MOUNT



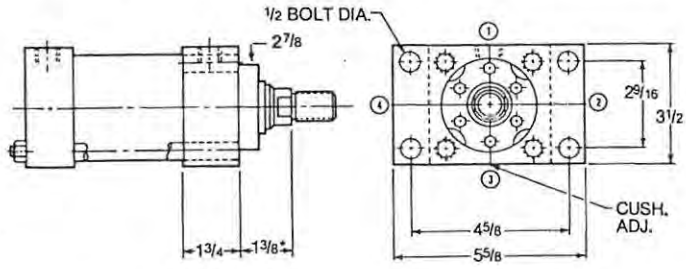
TG07 ROD END FLANGE MOUNT †



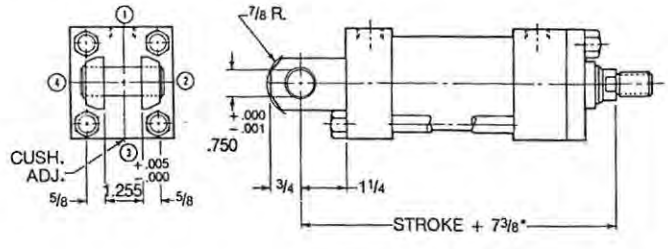
TG08 ROD END SQUARE FLANGE MOUNT



TG09 ROD END FULL THICKNESS HEAD

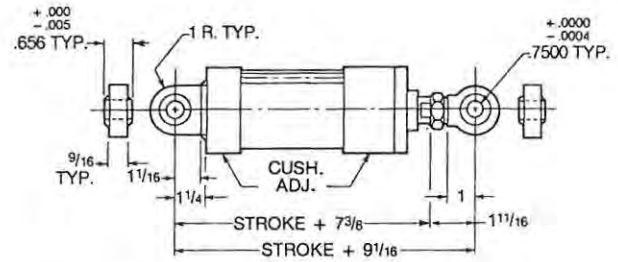


TG10 CLEVIS MOUNT

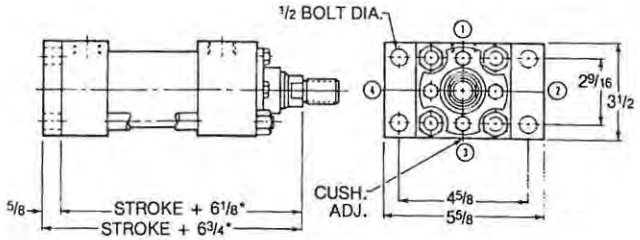


†Maximum working pressure 800 psi (for minimum flange deflection)

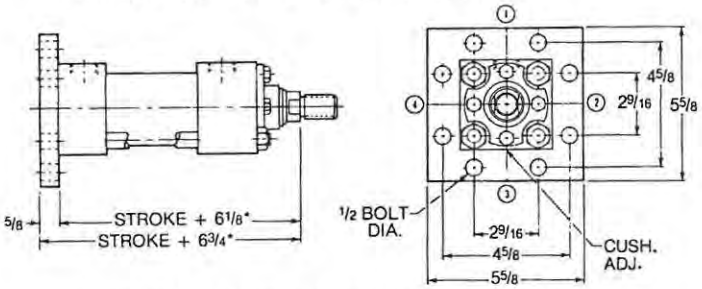
TG11 SPHERICAL BUSHING MOUNT



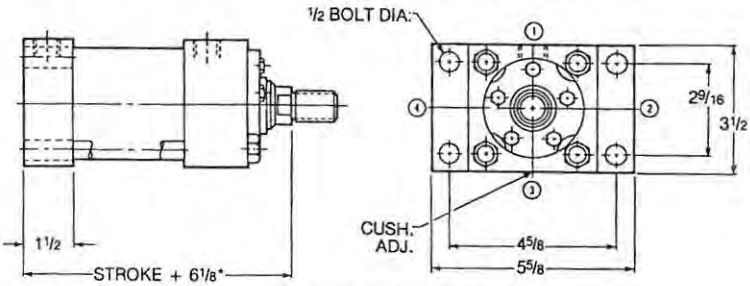
TG12 BLIND END FLANGE†



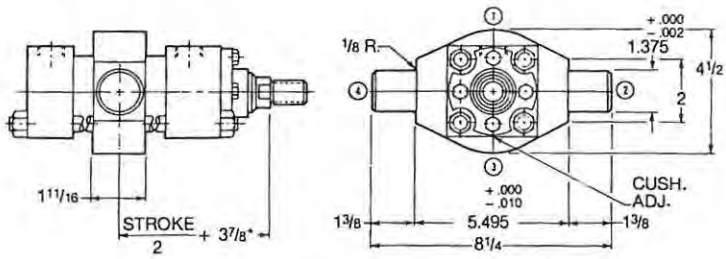
TG13 BLIND END SQUARE FLANGE



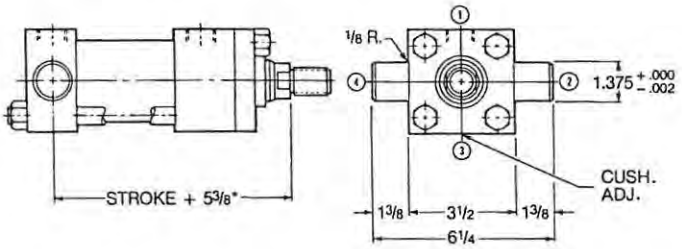
TG14 BLIND END FULL THICKNESS HEAD



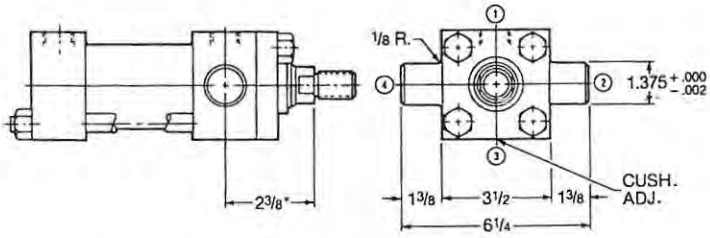
TG15 INTERMEDIATE TRUNNION MOUNT



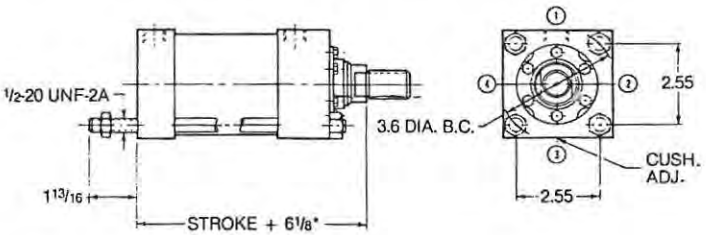
TG16 BLIND END TRUNNION MOUNT



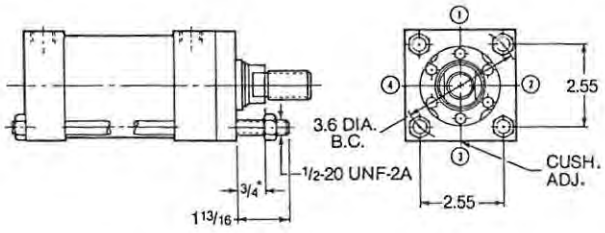
TG17 ROD END TRUNNION MOUNT



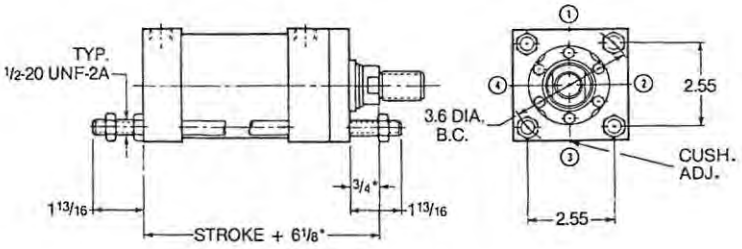
TG21 BLIND END EXTENDED MOUNT



TG22 ROD END EXTENDED MOUNT

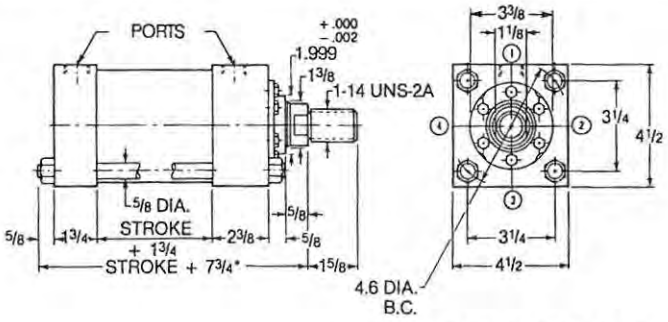


TG23 BOTH ENDS EXTENDED MOUNT



†Maximum working pressure 800 psi (for minimum flange deflection)

3¼" CYLINDER BORE



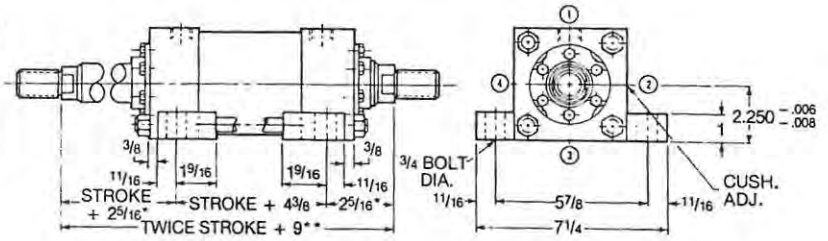
TG24 BASIC CYLINDER

TG25 DOUBLE ROD END SIDE LUG MOUNT

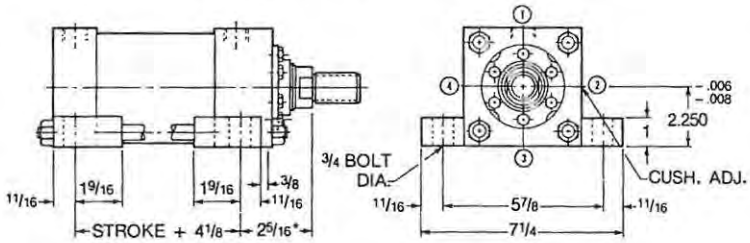
ALTERNATE ROD SIZES AVAILABLE ADD "N" TO ALL DIMENSIONS MARKED WITH "*"								
ROD DIA. MM	N*	A	B	C	KK-Thd.	RD[1]	V[2]	VB[3]
1¾	½	2	2.374	¾	1¼-12	3¾	⅜	⅜
2	⅝	2¼	2.624	⅞	1½-12	4	½	¾

(1) "RD" Dimensions apply to the following Mounting Codes: 01, 02, 25, 10, 12, 13, 15, 16, 17, 21, 09.
(2) "V" Dimensions apply to the following Mounting Codes: 07, 08, 22, 23.
(3) "VB" Dimensions apply to the following Mounting Codes: 01, 02, 25, 10, 12, 13, 15, 16, 17, 21.

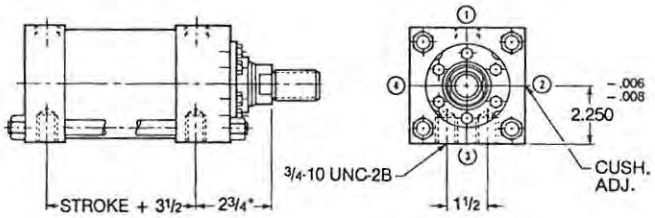
**Means add "N" twice



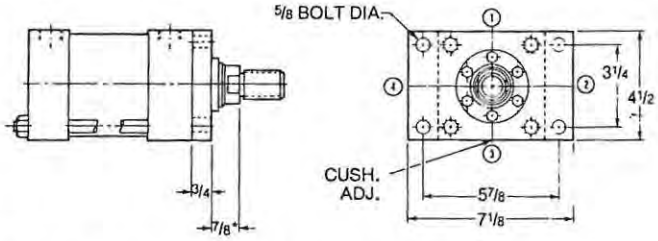
TG01 SIDE LUG MOUNT



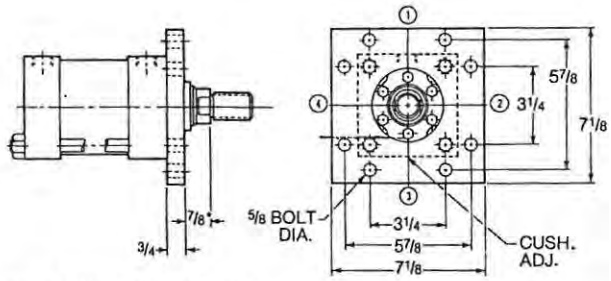
TG02 TAPPED MOUNT



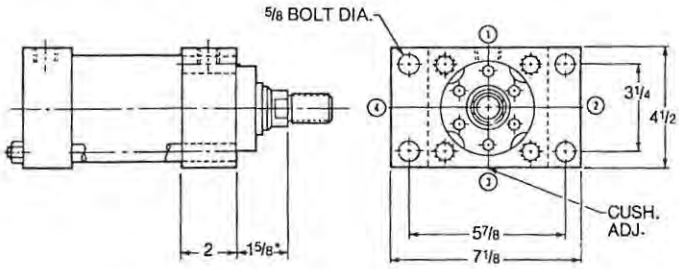
TG07 ROD END FLANGE MOUNT†



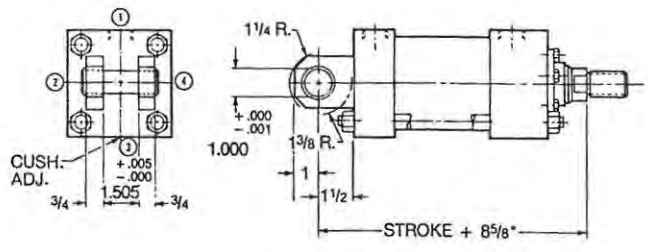
TG08 ROD END SQUARE FLANGE MOUNT



TG09 ROD END FULL THICKNESS HEAD

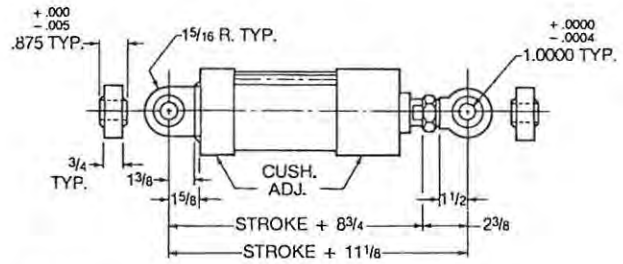


TG10 CLEVIS MOUNT

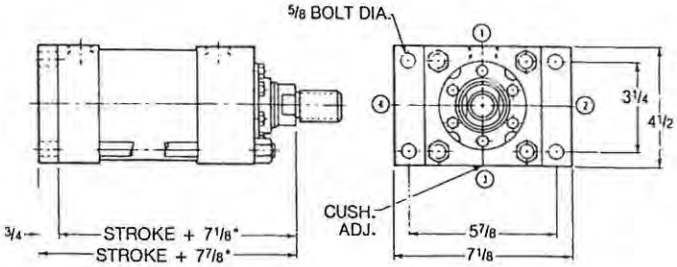


†Maximum working pressure 800 psi (for minimum flange deflection)

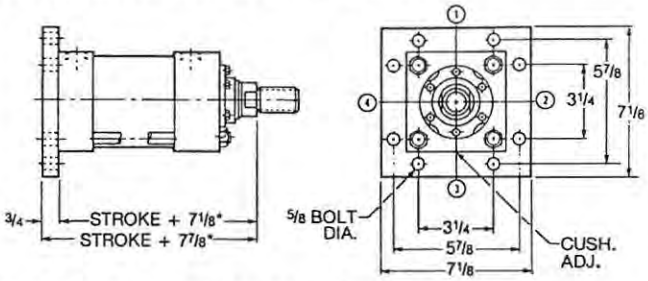
TG11 SPHERICAL BUSHING MOUNT



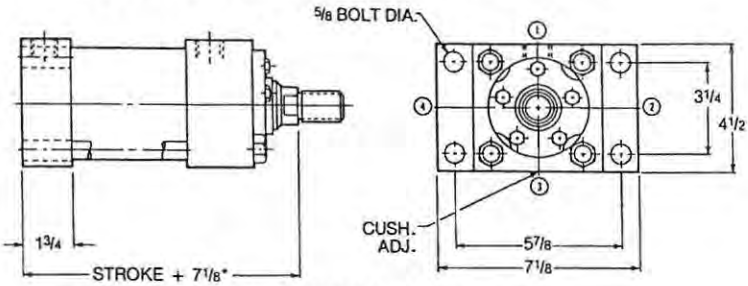
TG12 BLIND END FLANGE †



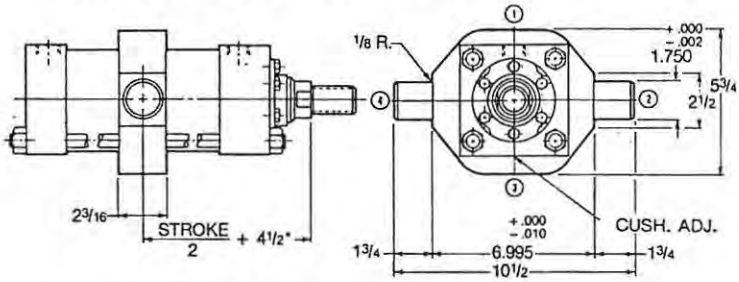
TG13 BLIND END SQUARE FLANGE



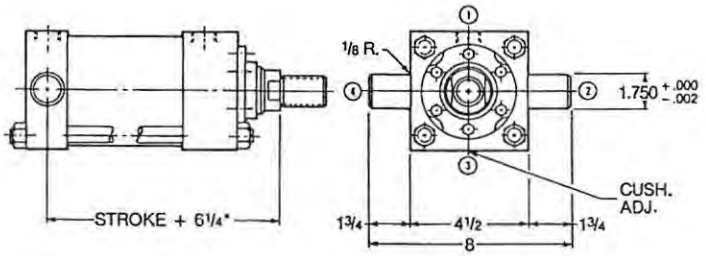
TG14 BLIND END FULL THICKNESS HEAD



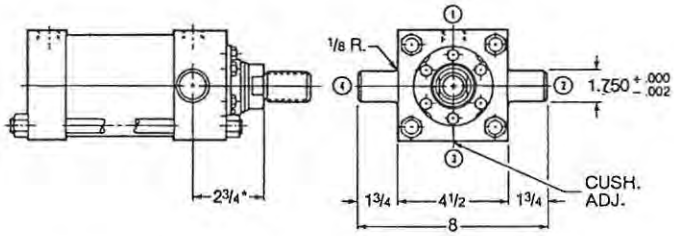
TG15 INTERMEDIATE TRUNNION MOUNT



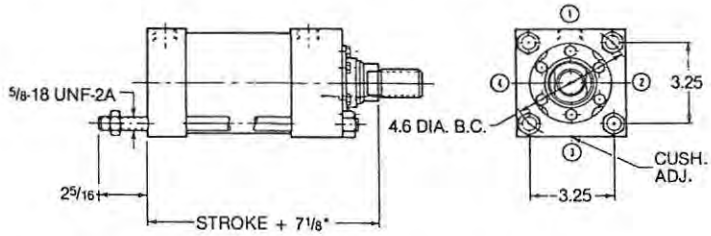
TG16 BLIND END TRUNNION MOUNT



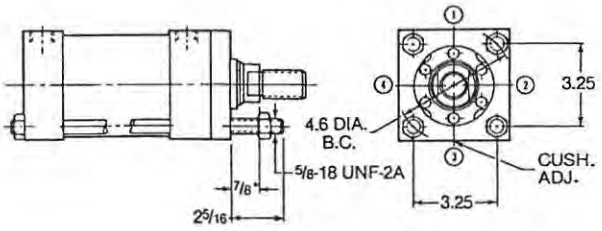
TG17 ROD END TRUNNION MOUNT



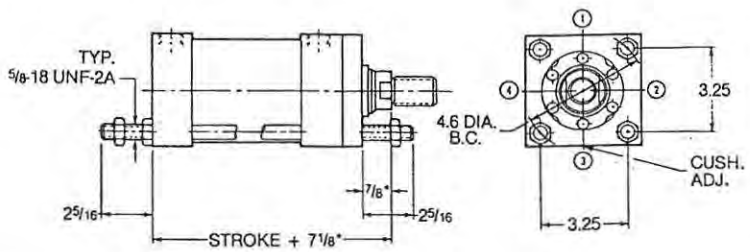
TG21 BLIND END EXTENDED MOUNT



TG22 ROD END EXTENDED MOUNT

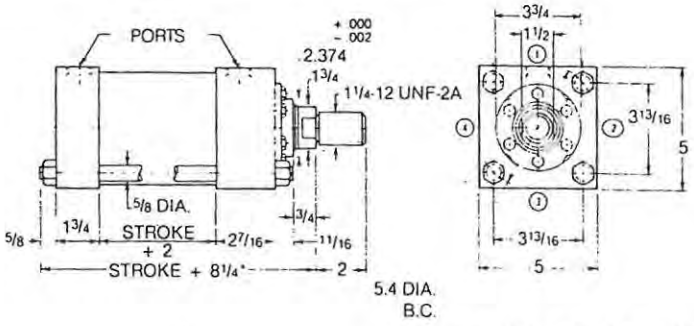


TG23 BOTH ENDS EXTENDED MOUNT



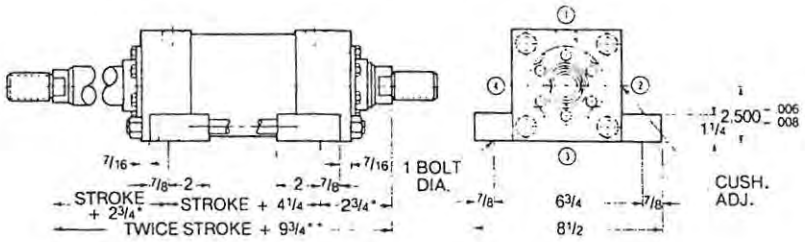
†Maximum working pressure 800 psi (for minimum flange deflection)

4″ CYLINDER BORE



TG24 BASIC CYLINDER

TG25 DOUBLE ROD END SIDE LUG MOUNT

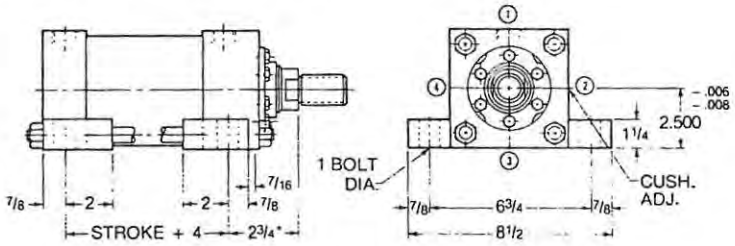


ALTERNATE ROD SIZES AVAILABLE ADD "N" TO ALL DIMENSIONS MARKED WITH "*"								
ROD DIA. MM	N*	A	B	C	KK-Thd.	RD[1]	V[2]	VB[3]
2	1/8	2 1/4	2.624	7/8	1 1/2-12	4	—	1 1/16
2 1/2	3/8	3	3.124	1	1 7/8-12	4 1/2	3/8	1 3/16

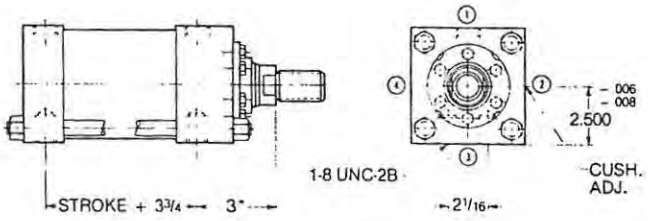
(1) "RD" Dimensions apply to the following Mounting Codes: 01, 02, 25, 10, 12, 13, 15, 16, 17, 21, 09.
(2) "V" Dimensions apply to the following Mounting Codes: 07, 08, 22, 23.
(3) "VB" Dimensions apply to the following Mounting Codes: 01, 02, 25, 10, 12, 13, 15, 16, 17, 21.

**Means add "N" twice

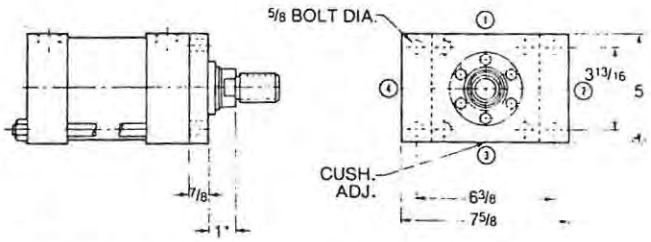
TG01 SIDE LUG MOUNT



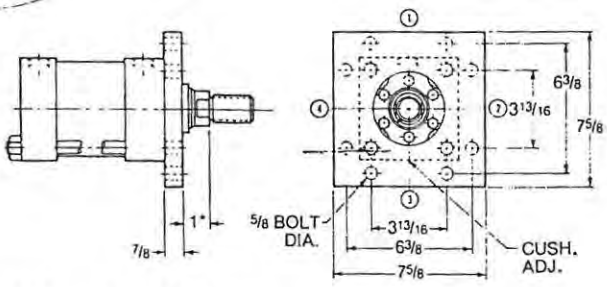
TG02 TAPPED MOUNT



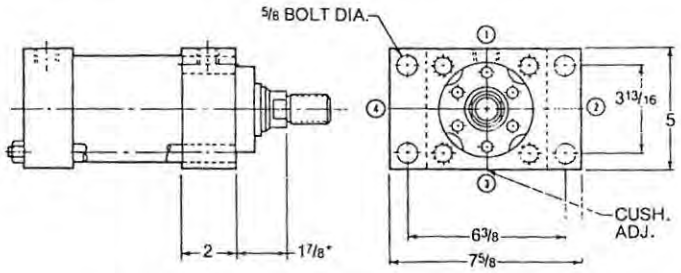
TG07 ROD END FLANGE MOUNT†



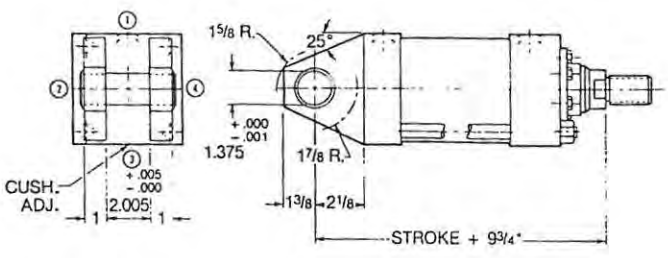
TG08 ROD END SQUARE FLANGE MOUNT



TG09 ROD END FULL THICKNESS HEAD

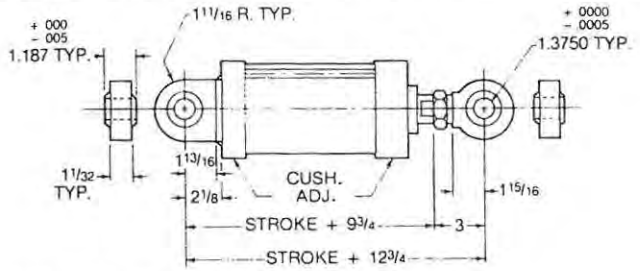


TG10 CLEVIS MOUNT

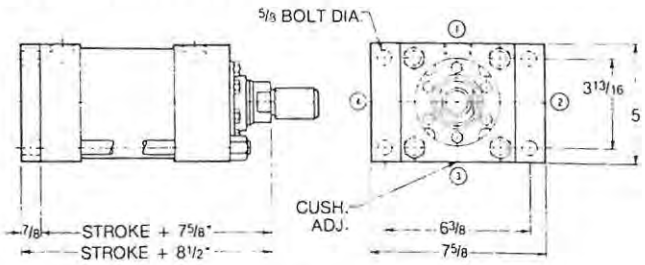


†Maximum working pressure 800 psi (for minimum flange deflection)

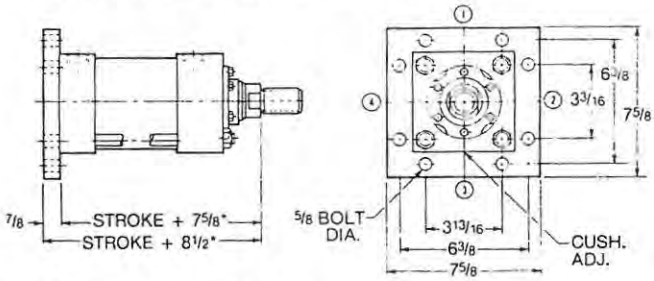
TG11 SPHERICAL BUSHING MOUNT



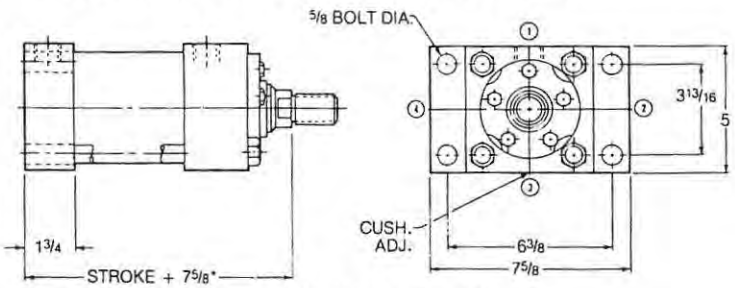
TG12 BLIND END FLANGE†



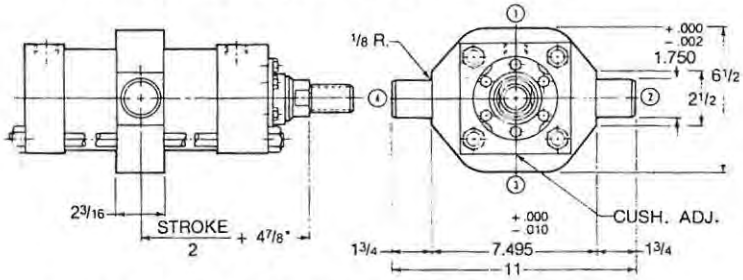
TG13 BLIND END SQUARE FLANGE



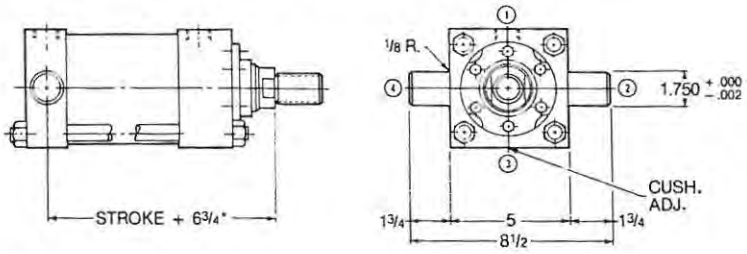
TG14 BLIND END FULL THICKNESS HEAD



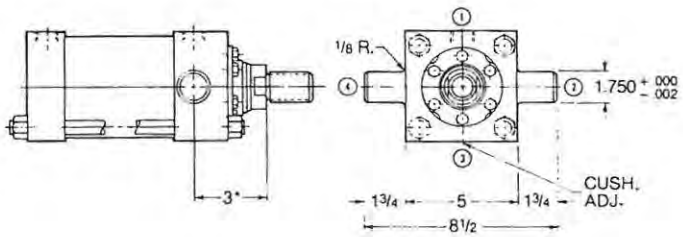
TG15 INTERMEDIATE TRUNNION MOUNT



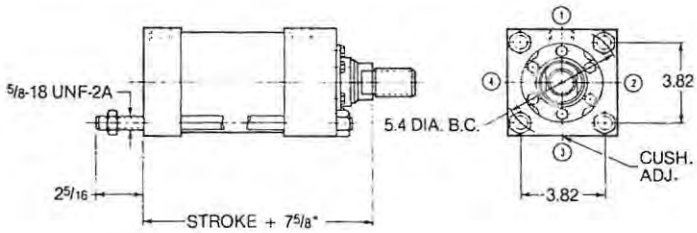
TG16 BLIND END TRUNNION MOUNT



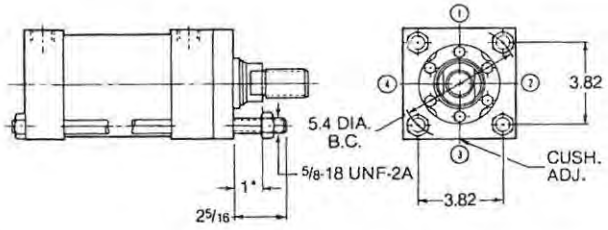
TG17 ROD END TRUNNION MOUNT



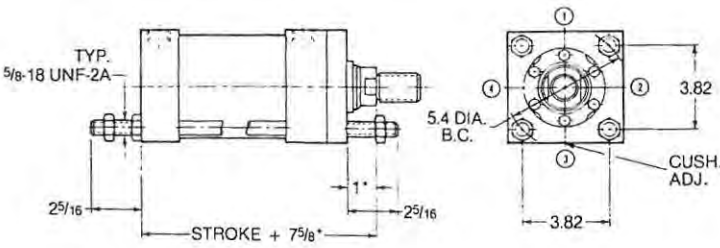
TG21 BLIND END EXTENDED MOUNT



TG22 ROD END EXTENDED MOUNT

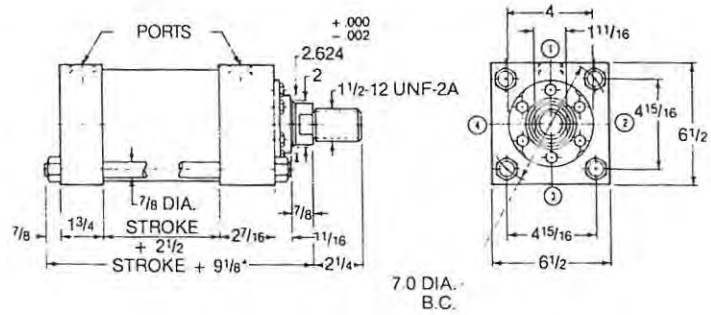


TG23 BOTH ENDS EXTENDED MOUNT



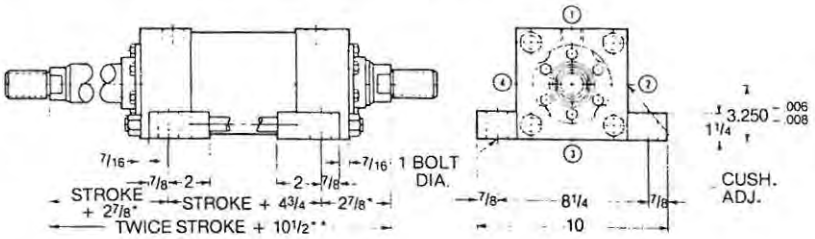
†Maximum working pressure 800 psi (for minimum flange deflection)

5″ CYLINDER BORE



TG24 BASIC CYLINDER

TG25 DOUBLE ROD END SIDE LUG MOUNT



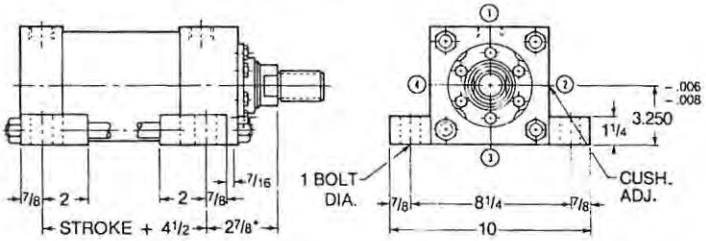
ALTERNATE ROD SIZES AVAILABLE
"N" TO ALL DIMENSIONS MARKED WITH "*"

ROD DIA. MM	N*	A	B	C	KK-Thd.	RD[1]	V[2]	VB[3]
2½	¼	3	3.124	1	1⅞-12	4½	⅜	13/16
3	¼	3½	3.749	1	2¼-12	5½	⅜	13/16
3½	¼	3½	4.249	1	2½-12	5⅞	⅜	13/16

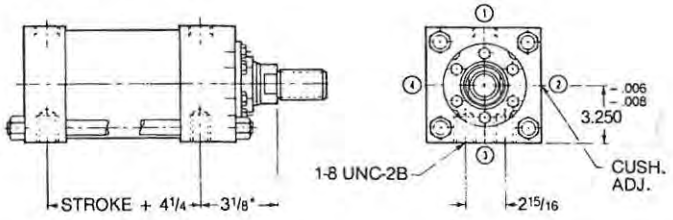
(1) "RD" Dimensions apply to the following Mounting Codes: 01, 02, 25, 10, 12, 13, 15, 16, 17, 21, 09.
(2) "V" Dimensions apply to the following Mounting Codes: 07, 08, 22, 23.
(3) "VB" Dimensions apply to the following Mounting Codes: 01, 02, 25, 10, 12, 13, 15, 16, 17, 21.

**Means add "N" twice

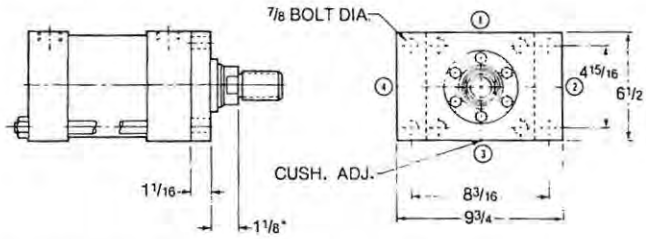
TG01 SIDE LUG MOUNT



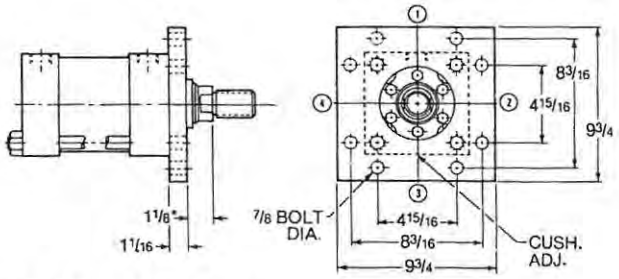
TG02 TAPPED MOUNT



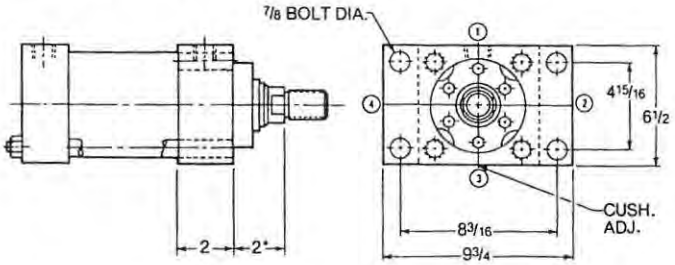
TG07 ROD END FLANGE MOUNT†



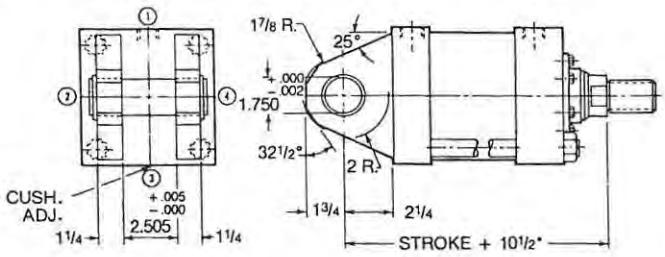
TG08 ROD END SQUARE FLANGE MOUNT



TG09 ROD END FULL THICKNESS HEAD

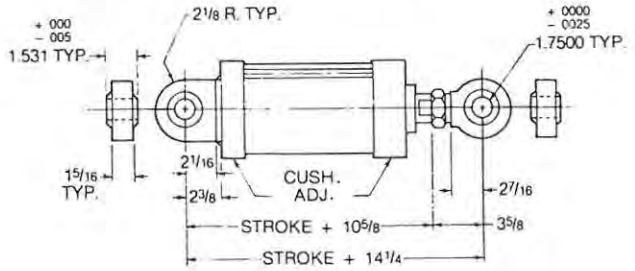


TG10 CLEVIS MOUNT

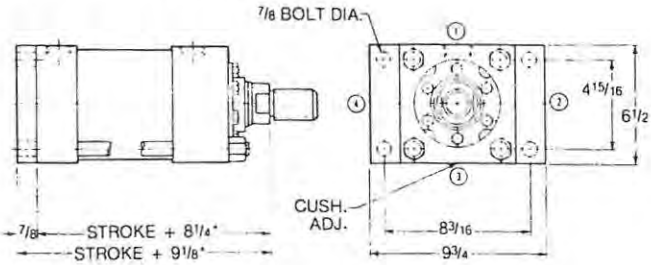


†Maximum working pressure 800 psi (for minimum flange deflection)

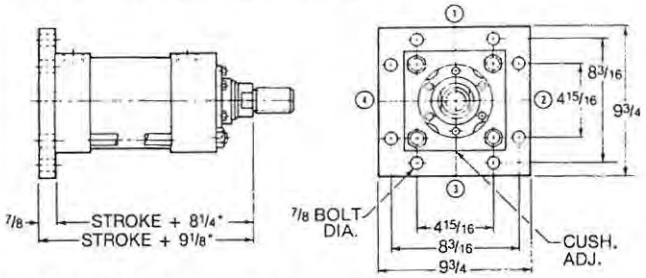
TG11 SPHERICAL BUSHING MOUNT



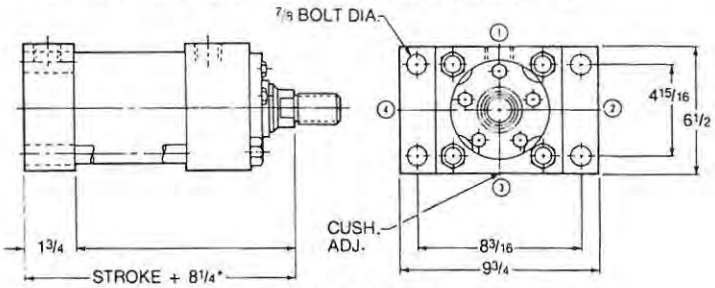
TG12 BLIND END FLANGE †



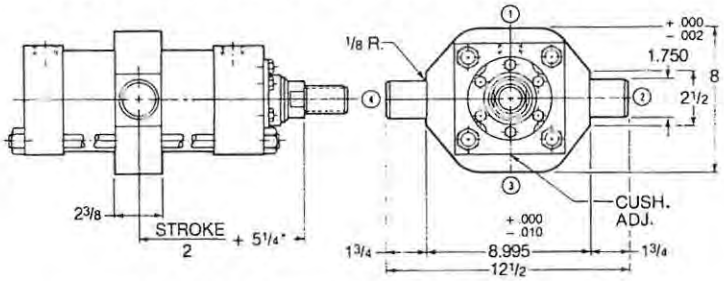
TG13 BLIND END SQUARE FLANGE



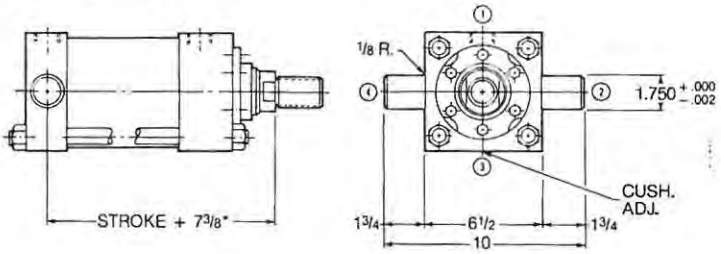
TG14 BLIND END FULL THICKNESS HEAD



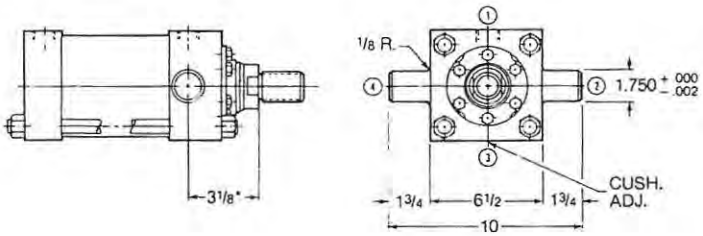
TG15 INTERMEDIATE TRUNNION MOUNT



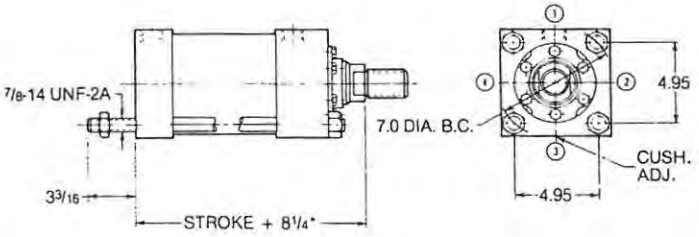
TG16 BLIND END TRUNNION MOUNT



TG17 ROD END TRUNNION MOUNT

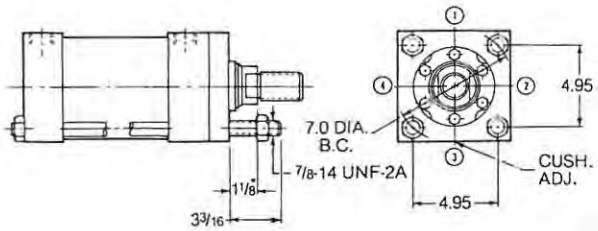


TG21 BLIND END EXTENDED MOUNT

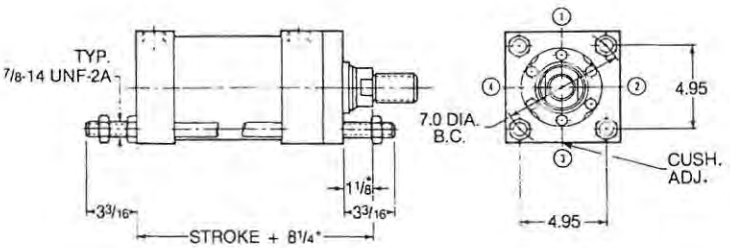


TG22 ROD END EXTENDED MOUNT

Elevation

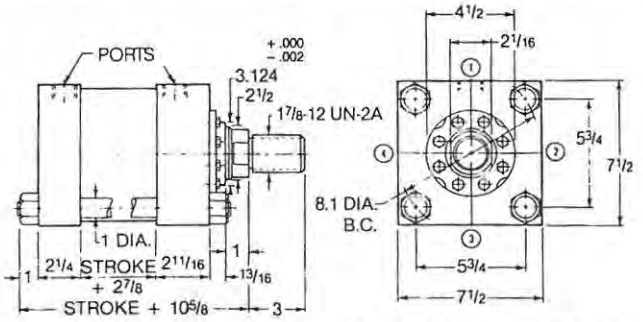


TG23 BOTH ENDS EXTENDED MOUNT



†Maximum working pressure 800 psi (for minimum flange deflection)

6″ CYLINDER BORE



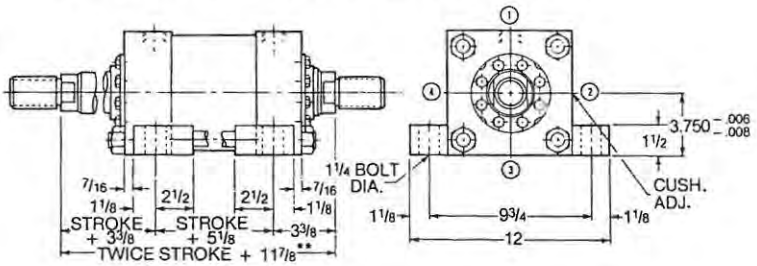
TG24 BASIC CYLINDER

TG25 DOUBLE ROD END SIDE LUG MOUNT

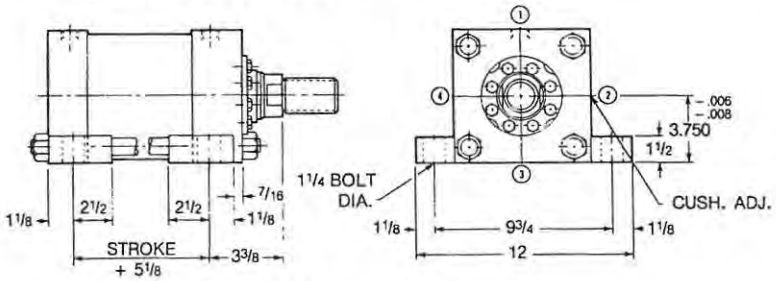
ALTERNATE ROD SIZES AVAILABLE ADD "N" TO ALL DIMENSIONS MARKED WITH "*"								
ROD DIA. MM	N*	A	B	C	KK-Thd.	RD[1]	V[2]	VB[3]
3	—	3½	3.749	—	2¼-12	5½	—	—
4	—	4	4.749	—	3-12	6⅜	—	—

(1) "RD" Dimensions apply to the following Mounting Codes: 01, 02, 25, 10, 12, 13, 15, 16, 17, 21, 09.
N*, V[2], VB[3], C - Dimensional Change

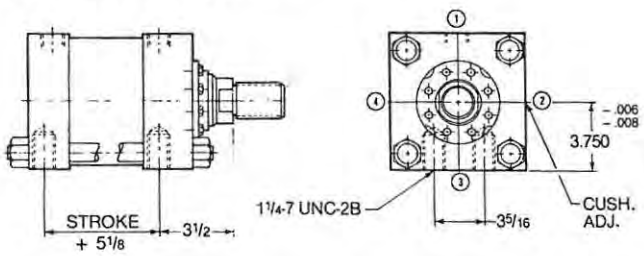
**Means add "N" twice



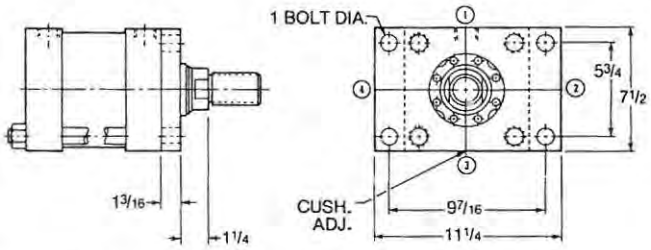
TG01 SIDE LUG MOUNT



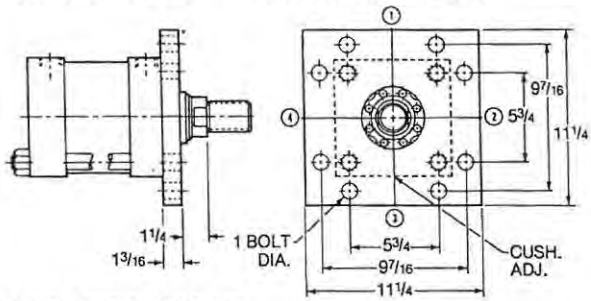
TG02 TAPPED MOUNT



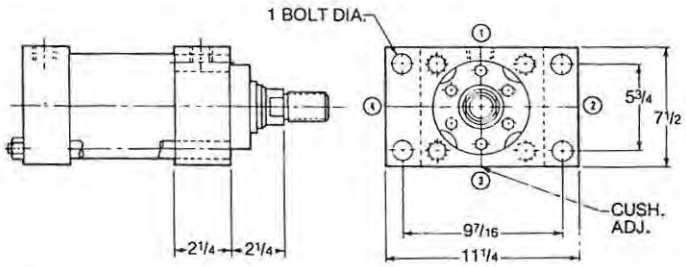
TG07 ROD END FLANGE MOUNT †



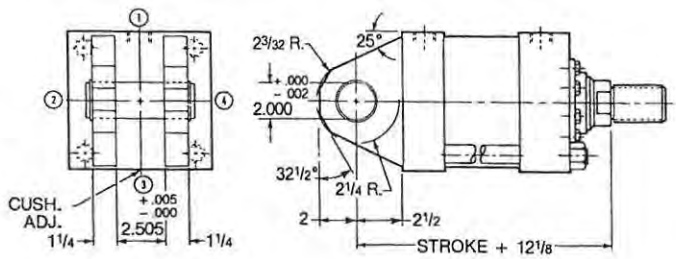
TG08 ROD END SQUARE FLANGE MOUNT



TG09 ROD END FULL THICKNESS HEAD

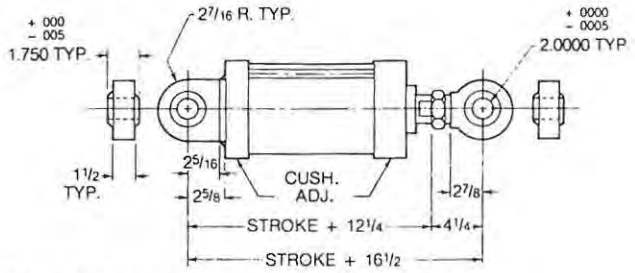


TG10 CLEVIS MOUNT

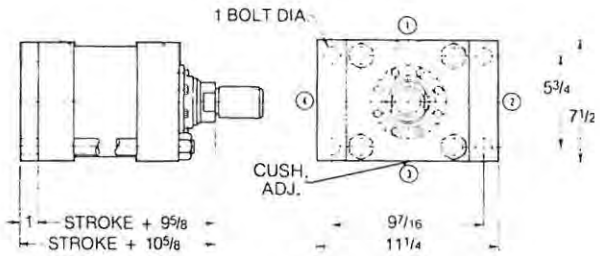


†Maximum working pressure 800 psi (for minimum flange deflection)

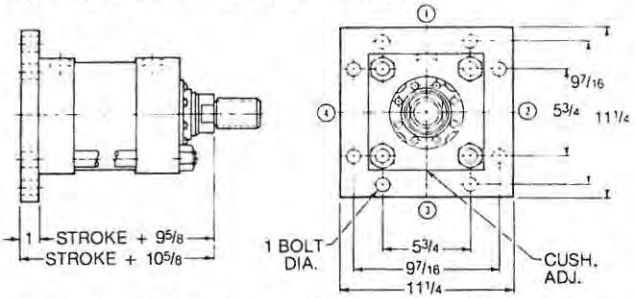
TG11 SPHERICAL BUSHING MOUNT



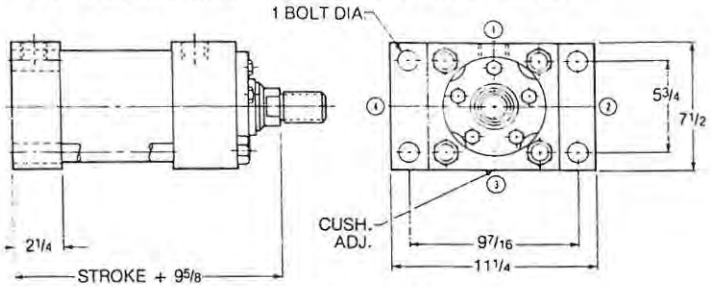
TG12 BLIND END FLANGE†



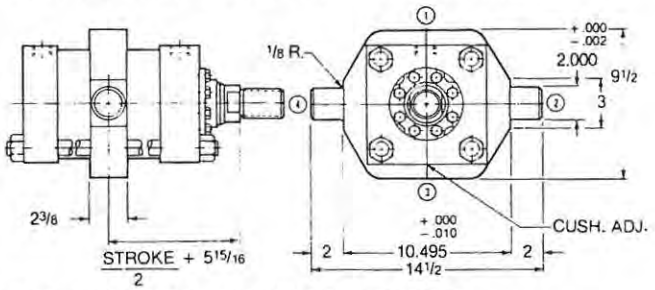
TG13 BLIND END SQUARE FLANGE



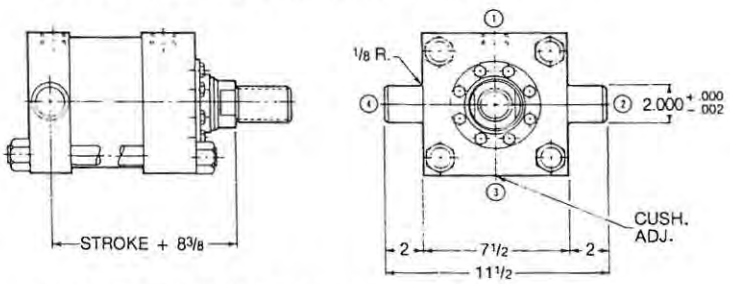
TG14 BLIND END FULL THICKNESS HEAD



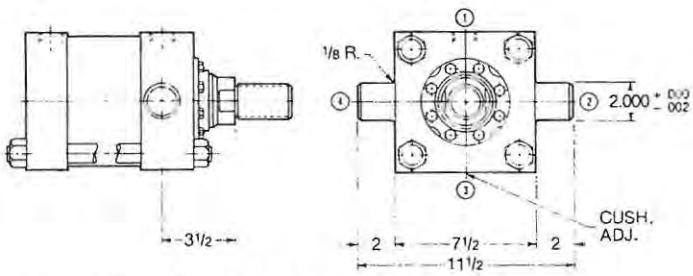
TG15 INTERMEDIATE TRUNNION MOUNT



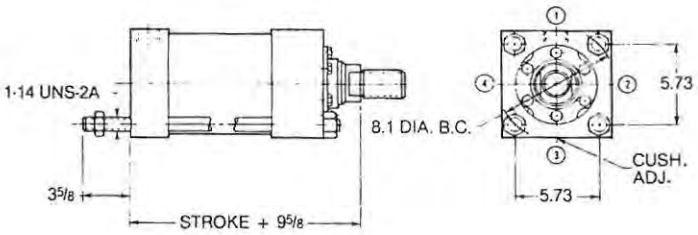
TG16 BLIND END TRUNNION MOUNT



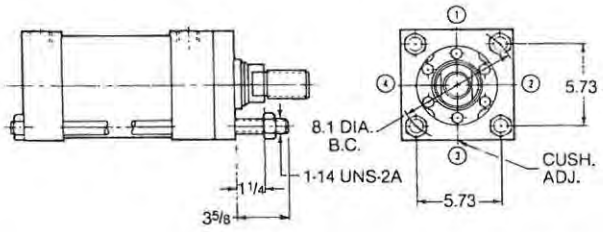
TG17 ROD END TRUNNION MOUNT



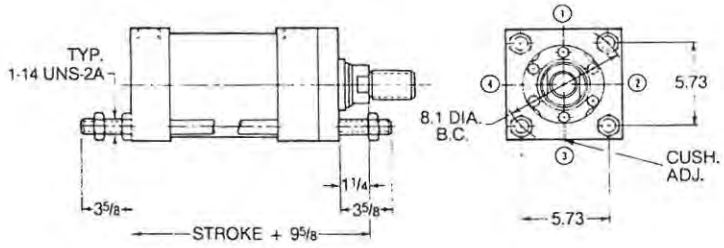
TG21 BLIND END EXTENDED MOUNT



TG22 ROD END EXTENDED MOUNT

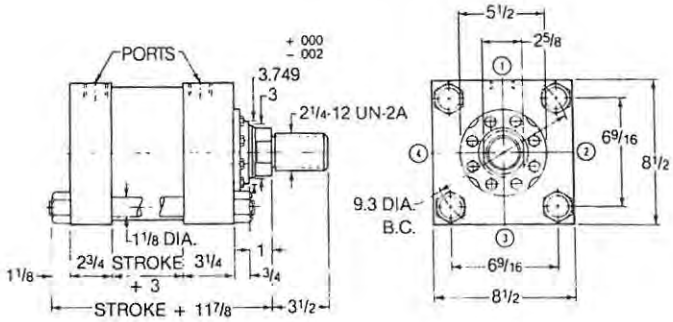


TG23 BOTH ENDS EXTENDED MOUNT



†Maximum working pressure 800 psi (for minimum flange deflection)

7″ CYLINDER BORE



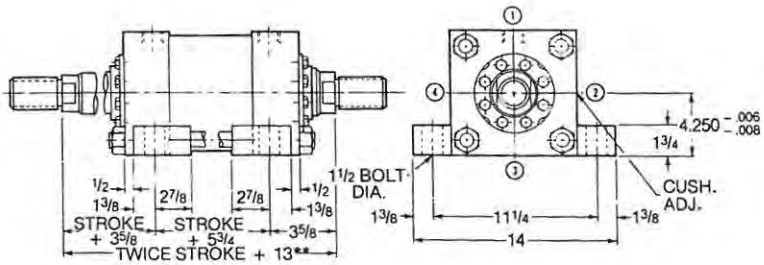
TG24 BASIC CYLINDER

TG25 DOUBLE ROD END SIDE LUG MOUNT

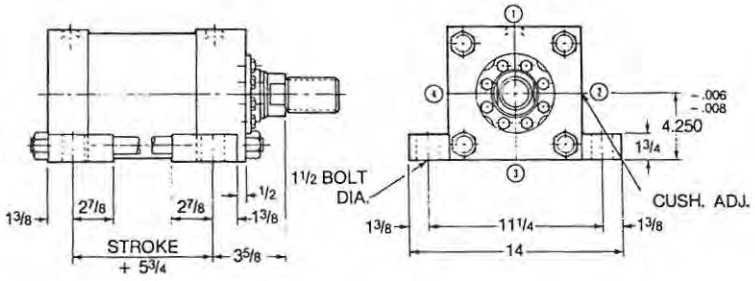
ALTERNATE ROD SIZES AVAILABLE ADD "N" TO ALL DIMENSIONS MARKED WITH "*"								
ROD DIA. MM	N*	A	B	C	KK-Thd.	RD[1]	V[2]	VB[3]
4	—	4	4.749	—	3-12	6⅜	—	—
5	—	5	5.749	—	3½-12	7	—	—

(1) "RD" Dimensions apply to the following Mounting Codes: 01, 02, 25, 10, 12, 13, 15, 16, 17, 21, 09.
N*, V[2], VB[3], C - Dimensional Change

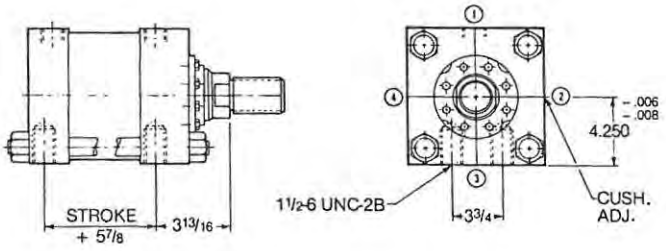
**Means add "N" twice



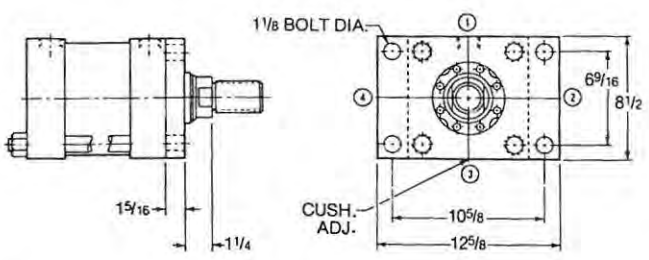
TG01 SIDE LUG MOUNT



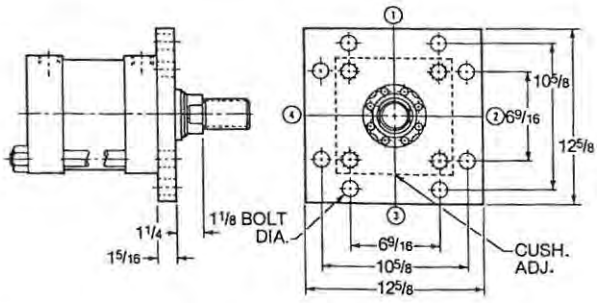
TG02 TAPPED MOUNT



TG07 ROD END FLANGE MOUNT †

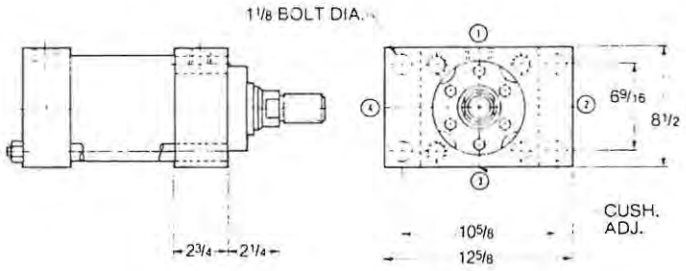


TG08 ROD END SQUARE FLANGE MOUNT

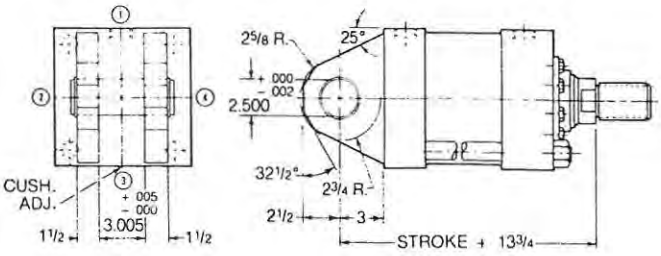


†Maximum working pressure 800 psi (for minimum flange deflection)

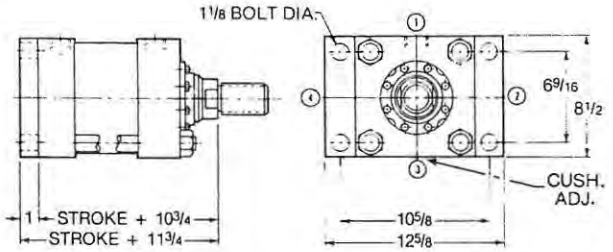
TG09 ROD END FULL THICKNESS HEAD



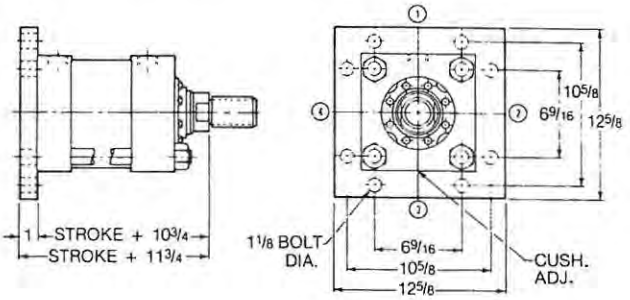
TG10 CLEVIS MOUNT



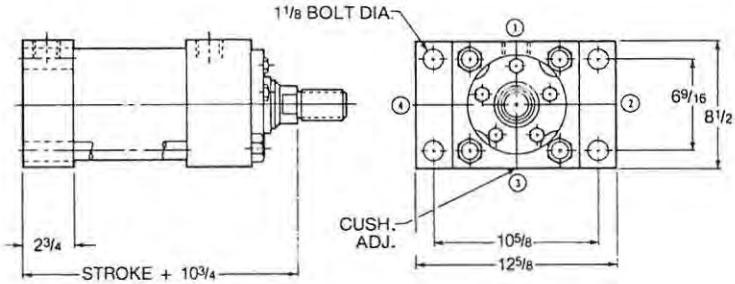
TG12 BLIND END FLANGE†



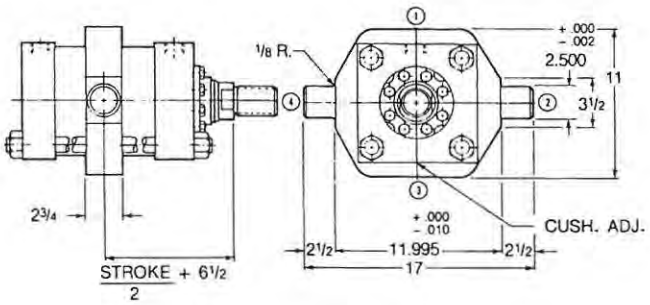
TG13 BLIND END SQUARE FLANGE



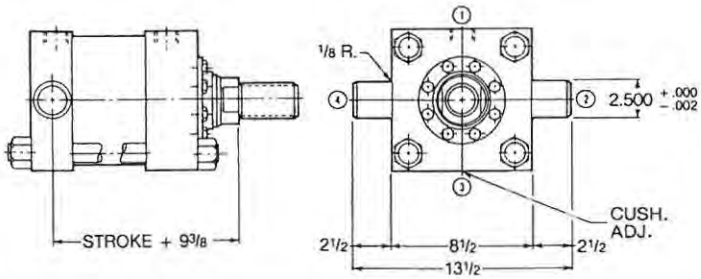
TG14 BLIND END FULL THICKNESS HEAD



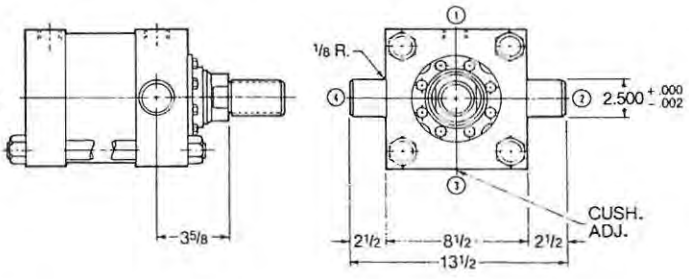
TG15 INTERMEDIATE TRUNNION MOUNT



TG16 BLIND END TRUNNION MOUNT

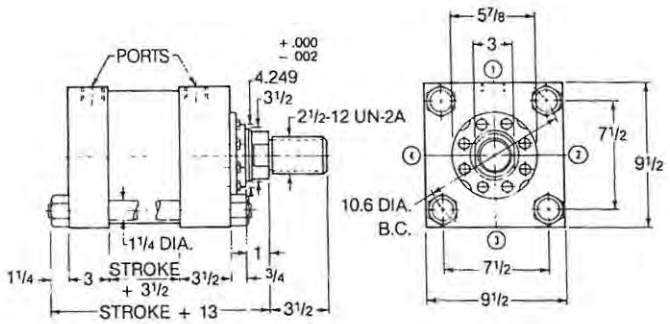


TG17 ROD END TRUNNION MOUNT



†Maximum working pressure 800 psi (for minimum flange deflection)

8″ CYLINDER BORE



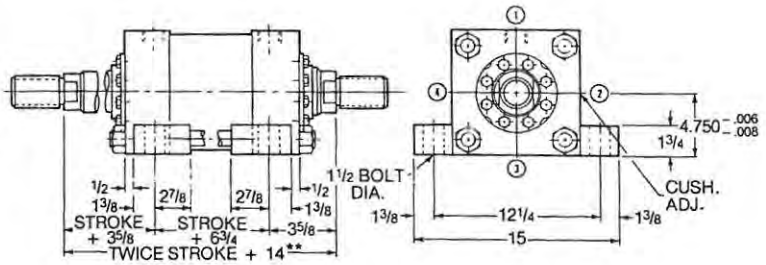
TG24 BASIC CYLINDER

TG25 DOUBLE ROD END SIDE LUG MOUNT

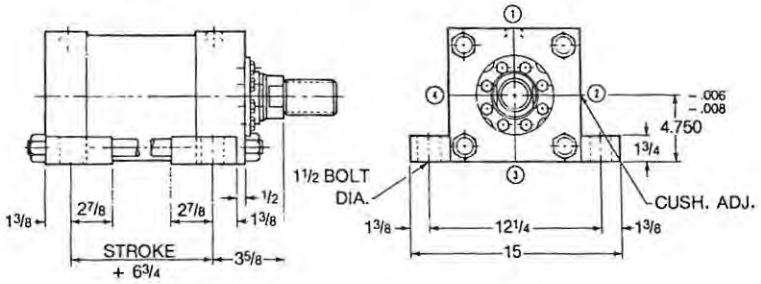
ALTERNATE ROD SIZES AVAILABLE ADD "N" TO ALL DIMENSIONS MARKED WITH "*"								
ROD DIA. MM	N*	A	B	C	KK-Thd.	RD[1]	V[2]	VB[3]
4	—	4	4.749	—	3-12	6⅜	—	—
5½	—	5½	6.249	—	4-12	7⅞	—	—

(1) "RD" Dimensions apply to the following Mounting Codes: 01, 02, 25, 10, 12, 13, 15, 16, 17, 21, 09.
N*, V[2], VB[3], C - Dimensional Change

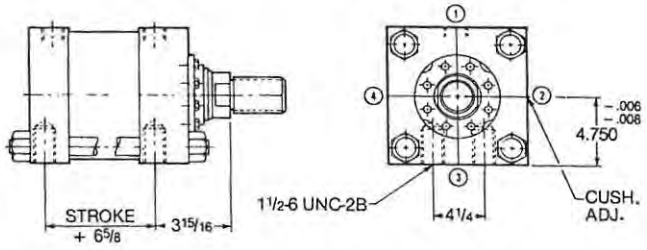
**Means add "N" twice



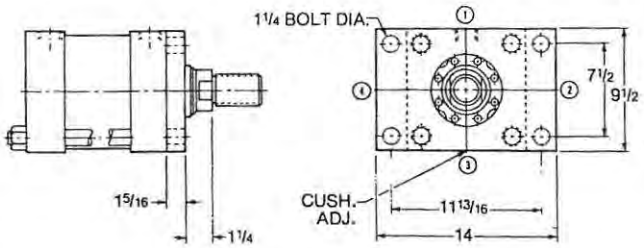
TG01 SIDE LUG MOUNT



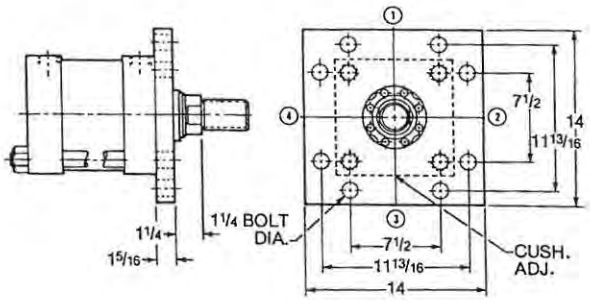
TG02 TAPPED MOUNT



TG07 ROD END FLANGE MOUNT†

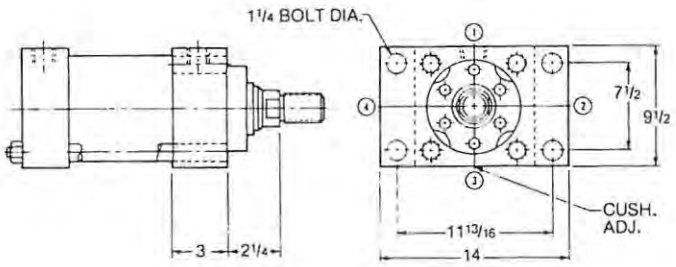


TG08 ROD END SQUARE FLANGE MOUNT

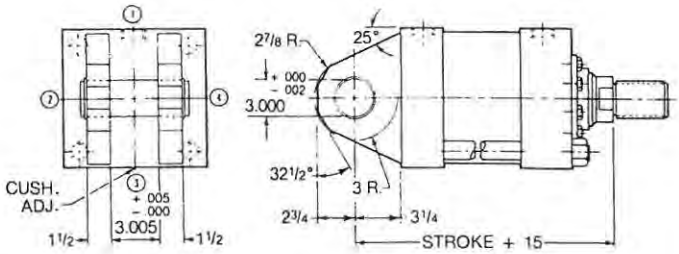


†Maximum working pressure 800 psi (for minimum flange deflection)

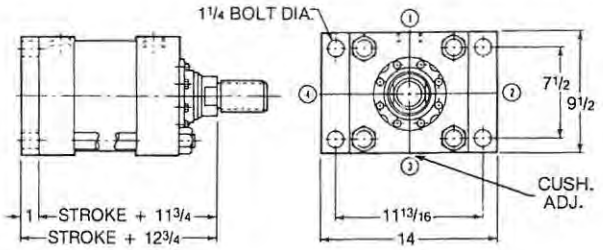
TG09 ROD END FULL THICKNESS HEAD



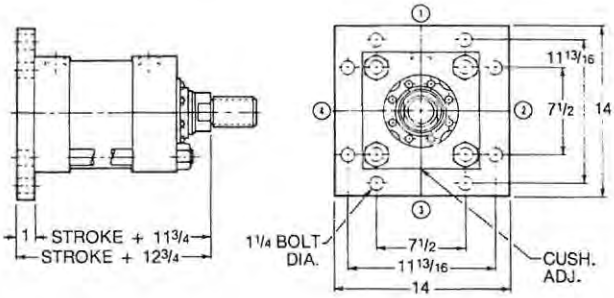
TG10 CLEVIS MOUNT



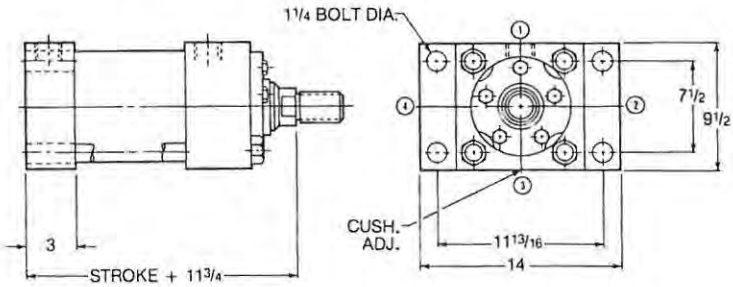
TG12 BLIND END FLANGE †



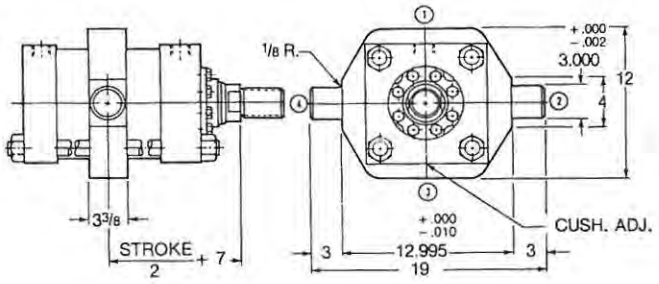
TG13 BLIND END SQUARE FLANGE



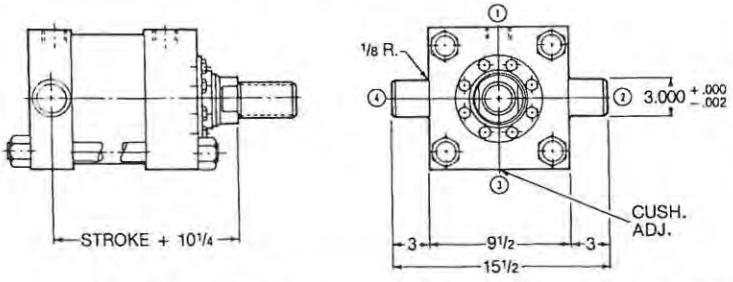
TG14 BLIND END FULL THICKNESS HEAD



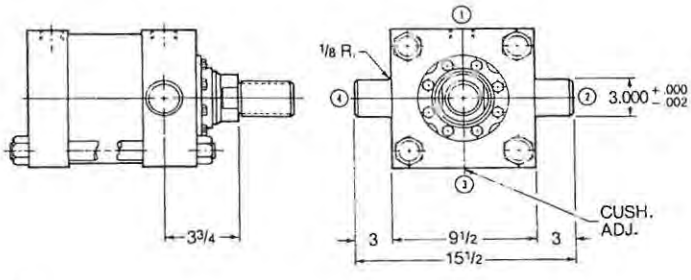
TG15 INTERMEDIATE TRUNNION MOUNT



TG16 BLIND END TRUNNION MOUNT

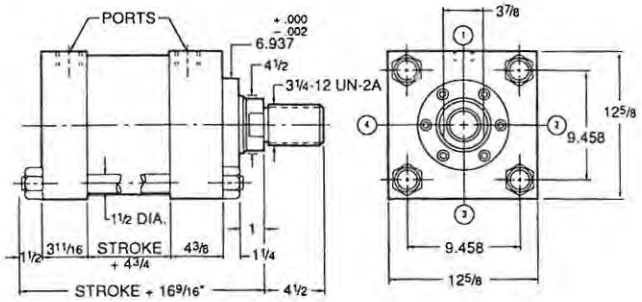


TG17 ROD END TRUNNION MOUNT



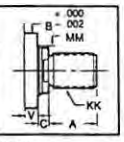
†Maximum working pressure 800 psi (for minimum flange deflection)

10″ CYLINDER BORE



TG24 BASIC CYLINDER

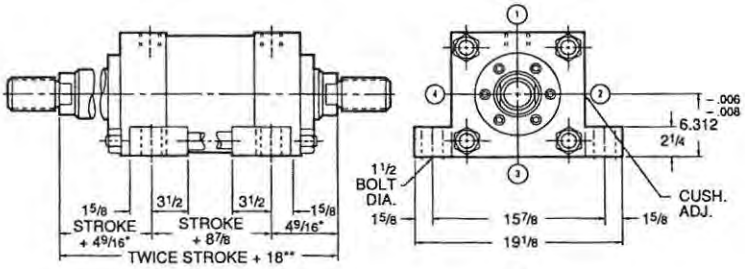
ALTERNATE ROD SIZES AVAILABLE ADD "N" TO ALL DIMENSIONS MARKED WITH "*"							
ROD DIA. MM	N*	A	C	DC	KK-Thd.	B[2]	V[1]
5½	¼	5½	1	—	4-12	8.187	1½
7	¼	7	1	33/64	5½-12	9.687	1½



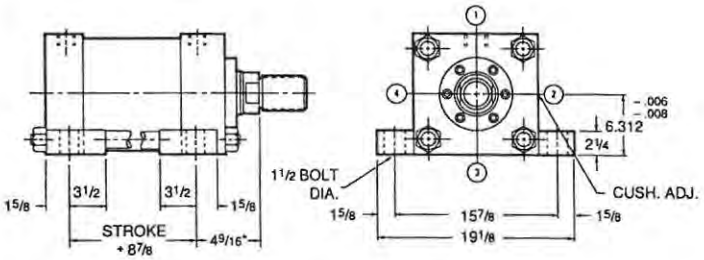
(1) "V" dimensions apply to the following Mounting Codes: 01, 10, 12, 13, 14, 15, 16, 17, 25.
(2) "B" dimensions apply to the following Mounting Codes: All

** Means add "N" twice

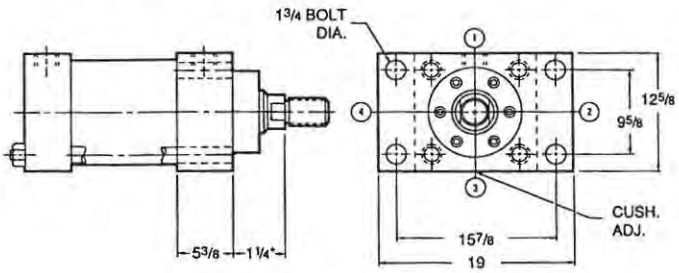
TG25 DOUBLE ROD END SIDE LUG MOUNT



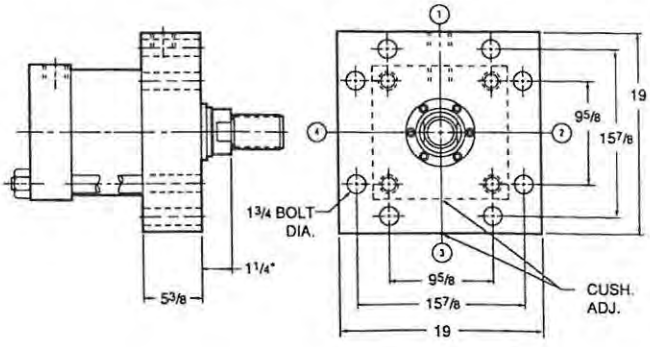
TG01 SIDE LUG MOUNT



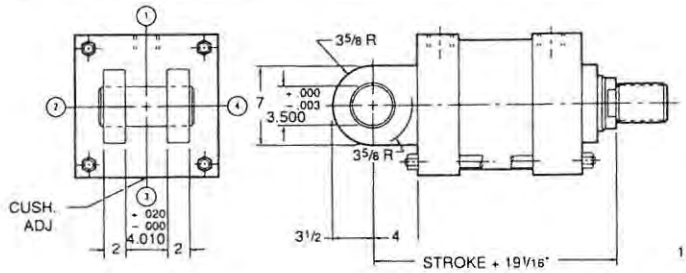
TG09 ROD END FULL THICKNESS HEAD



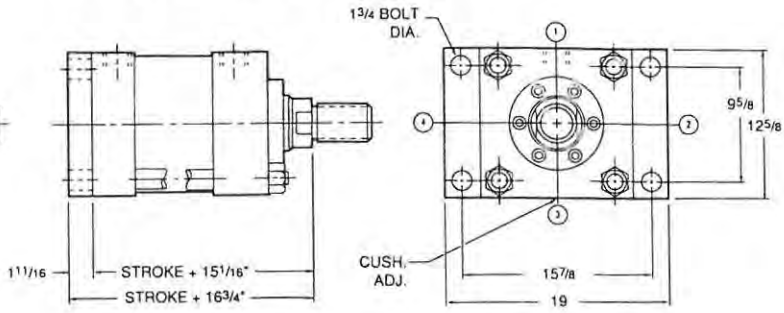
TG08 ROD END SQUARE FLANGE MOUNT



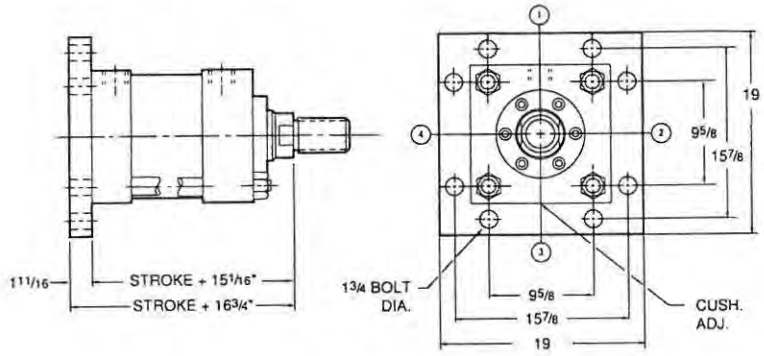
TG10 CLEVIS MOUNT



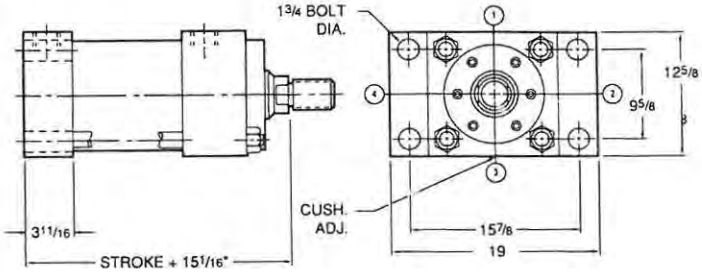
TG12 BLIND END FLANGE MOUNT



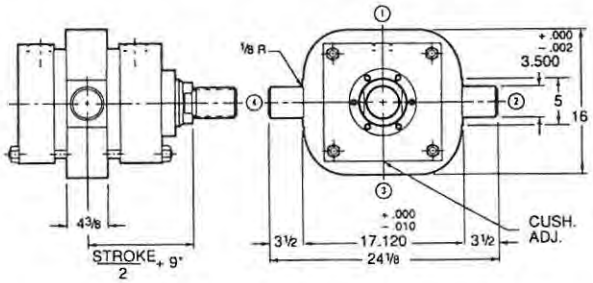
TG13 BLIND END SQUARE FLANGE



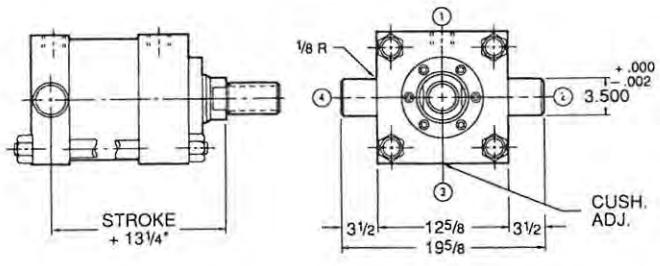
TG14 BLIND END FULL THICKNESS HEAD



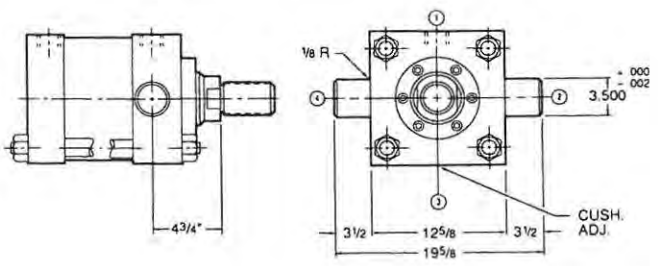
TG15 INTERMEDIATE TRUNNION MOUNT



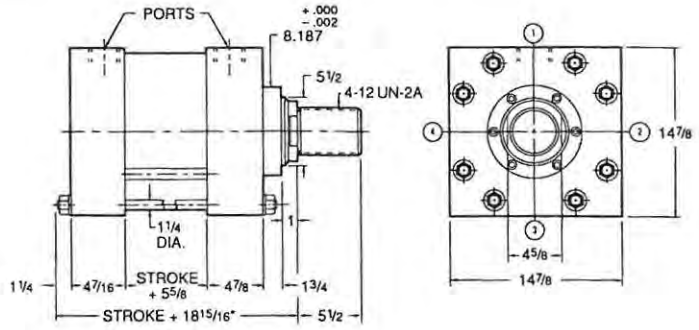
TG16 BLIND END TRUNNION MOUNT



TG17 ROD END TRUNNION MOUNT



12″ CYLINDER BORE



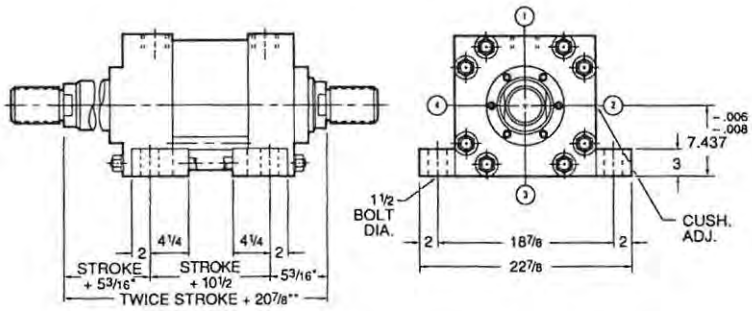
TG24 BASIC CYLINDER

ALTERNATE ROD SIZES AVAILABLE ADD "N" TO ALL DIMENSIONS MARKED WITH "*"								
ROD DIA. MM	N*	A	C	DC	KK-Thd.	B[3]	V[1]	VB[2]
7	¼	7	1	33/64	5½-12	9.687	1⅞	2
8	1¼	8	1½	49/64	6-12	10.687	1⅞	2½

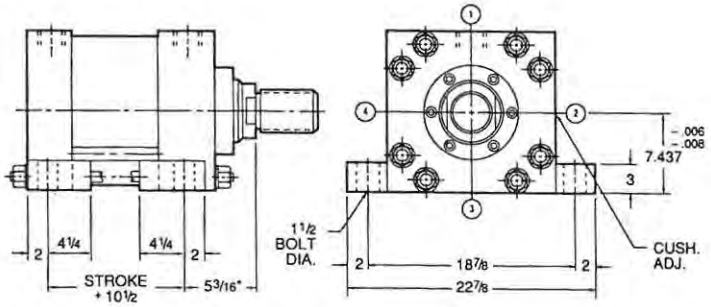
(1) "V" dimensions apply to the following Mounting Codes: 01, 10, 12, 13, 14, 15, 16, 17, 25.
(2) "VB" dimensions apply to the following Mounting Codes: 01, 10, 12, 13, 14, 15, 16, 17, 25.
(3) "B" dimensions apply to the following Mounting Codes: All

** Means add "N" twice

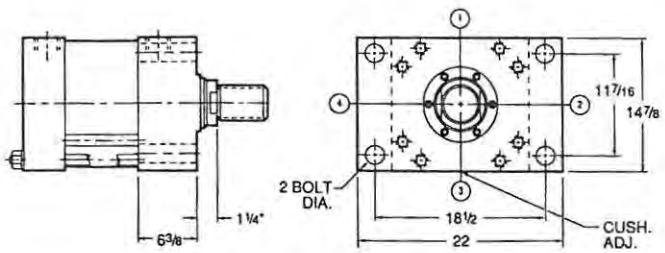
TG25 DOUBLE ROD END SIDE LUG MOUNT



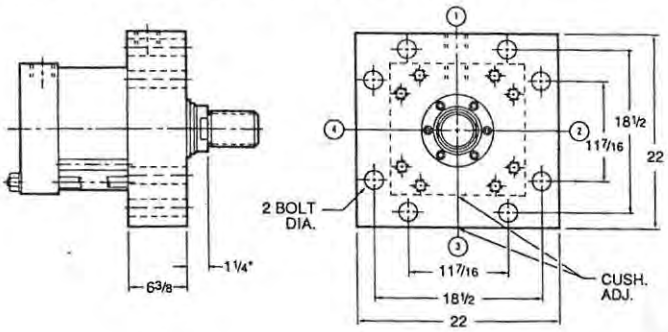
TG01 SIDE LUG MOUNT



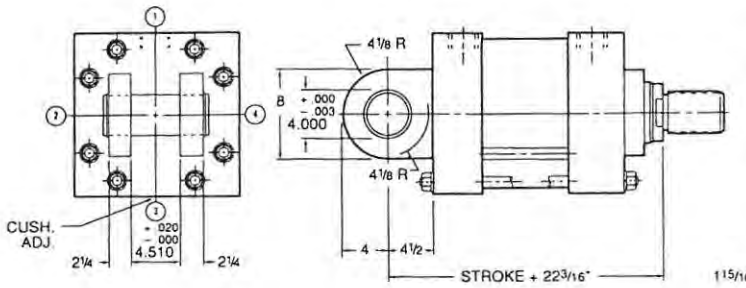
TG09 ROD END FULL THICKNESS HEAD



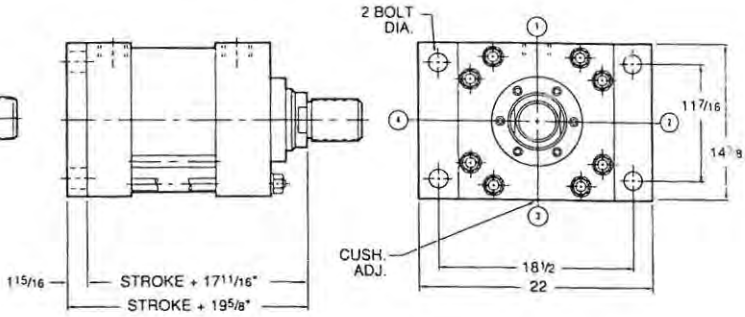
TG08 ROD END SQUARE FLANGE MOUNT



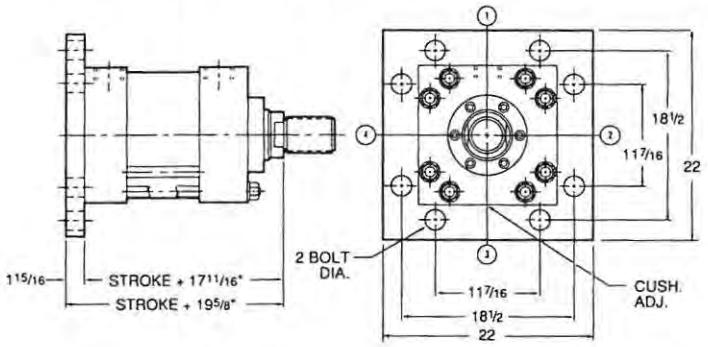
TG10 CLEVIS MOUNT



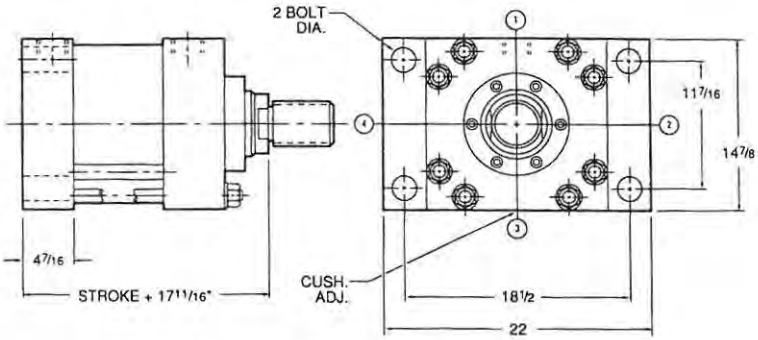
TG12 BLIND END FLANGE



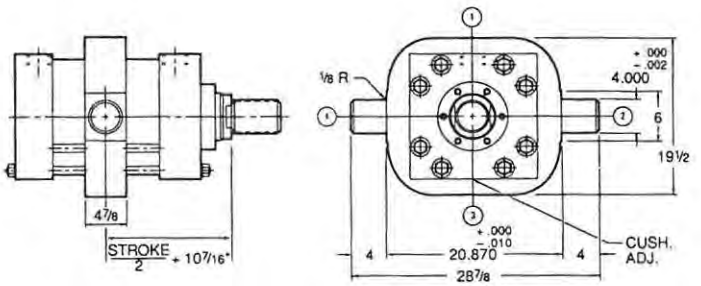
TG13 BLIND END SQUARE FLANGE



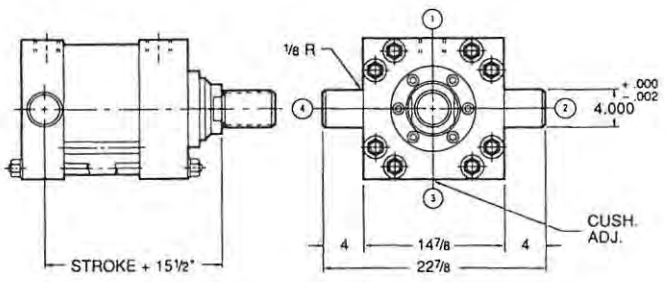
TG14 BLIND END FULL THICKNESS HEAD



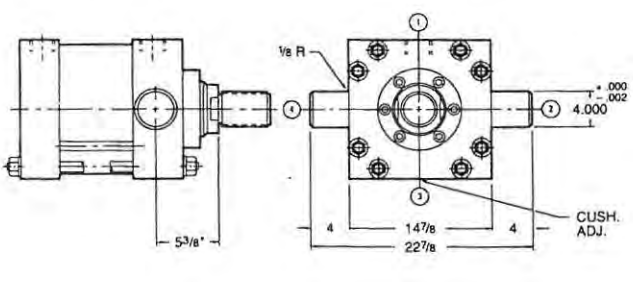
TG15 INTERMEDIATE TRUNNION MOUNT



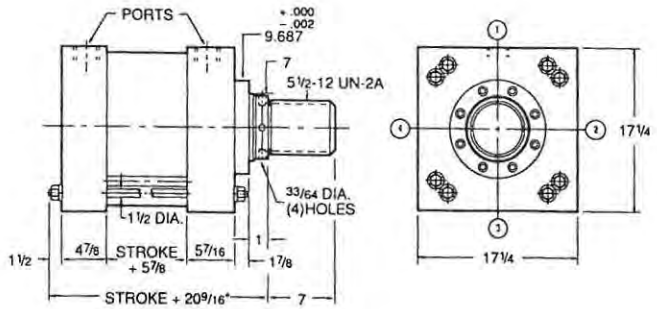
TG16 BLIND END TRUNNION MOUNT



TG17 ROD END TRUNNION MOUNT



14″ CYLINDER BORE



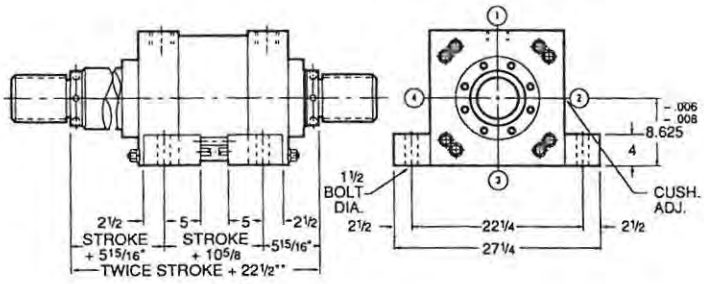
TG24 BASIC CYLINDER

ALTERNATE ROD SIZES AVAILABLE ADD "N" TO ALL DIMENSIONS MARKED WITH "*"								
ROD DIA. MM	N*	A	C	DC	KK-Thd.	B[3]	V[1]	VB[2]
8	1¼	8	1½	49/64	6-12	10.687	17/8	25/8
10	1¾	10	1½	49/64	7½-12	12.687	17/8	31/8

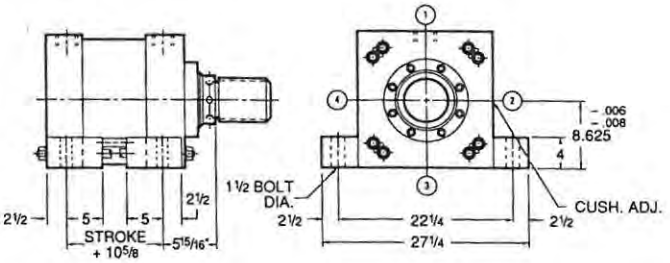
(1) "V" dimensions apply to the following Mounting Codes: 01, 10, 12, 13, 14, 15, 16, 17, 25.
(2) "VB" dimensions apply to the following Mounting Codes: 01, 10, 12, 13, 14, 15, 16, 17, 25.
(3) "B" dimensions apply to the following Mounting Codes: All

** Means add "N" twice

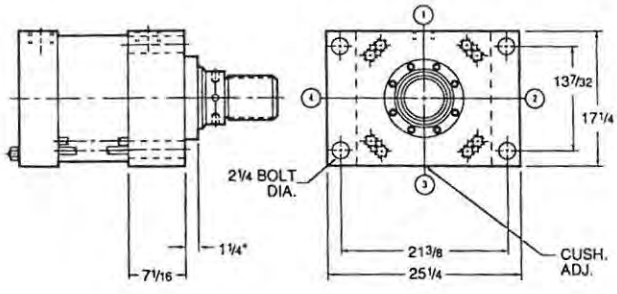
TG25 DOUBLE ROD END SIDE LUG MOUNT



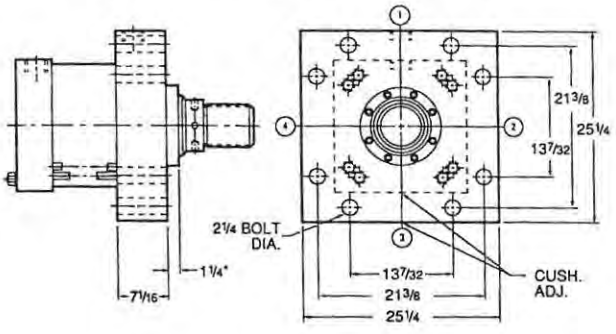
TG01 SIDE LUG MOUNT



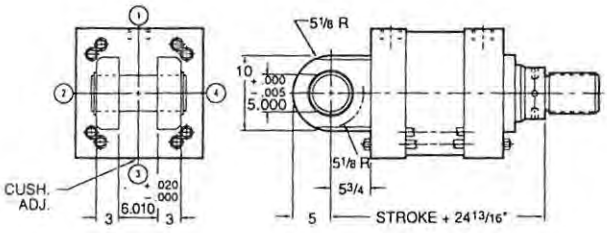
TG09 ROD END FULL THICKNESS HEAD



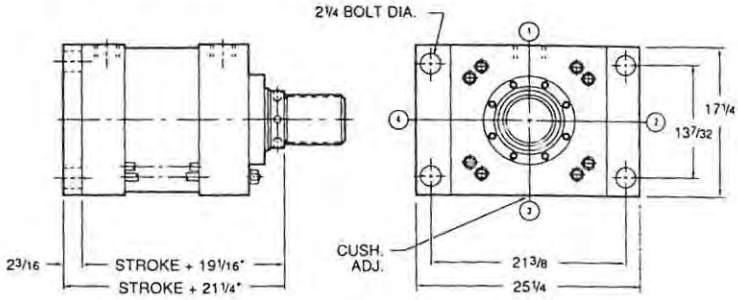
TG08 ROD END SQUARE FLANGE MOUNT



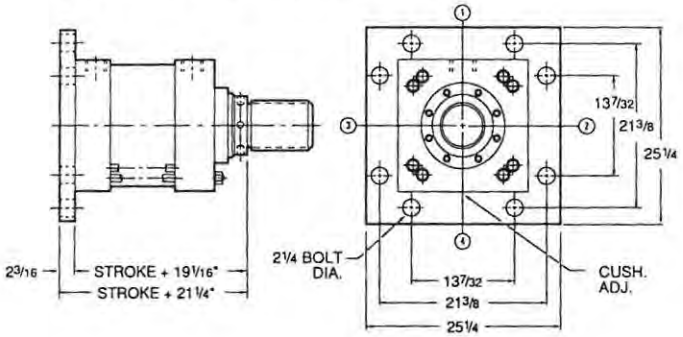
TG10 CLEVIS MOUNT



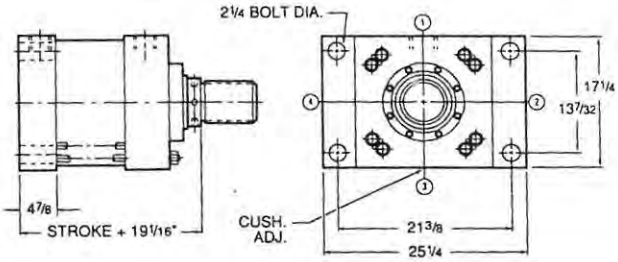
TG12 BLIND END FLANGE



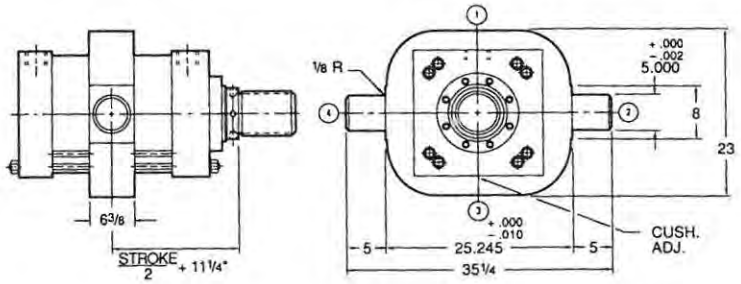
TG13 BLIND END SQUARE FLANGE



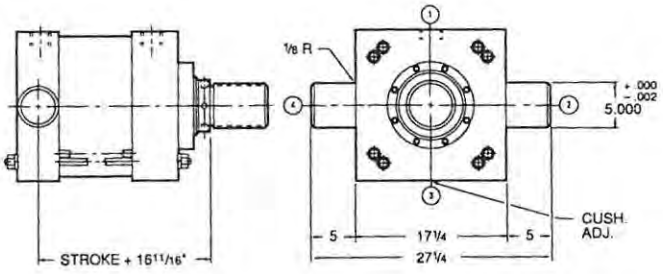
TG14 BLIND END FULL THICKNESS HEAD



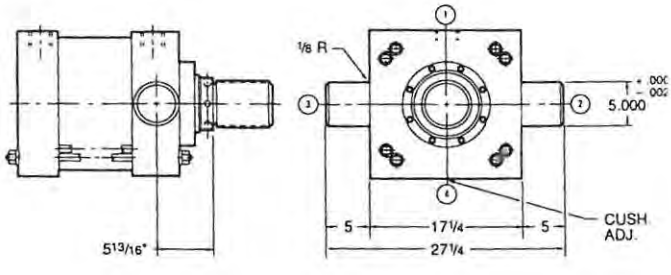
TG15 INTERMEDIATE TRUNNION MOUNT



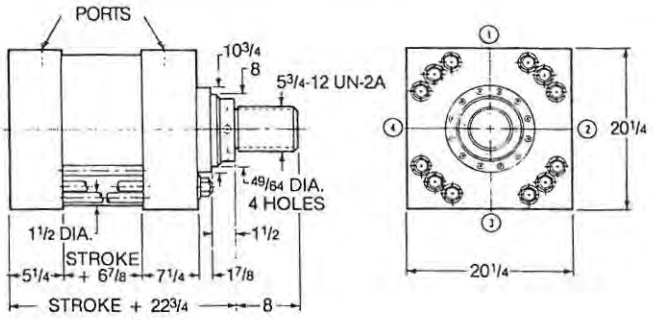
TG16 BLIND END TRUNNION MOUNT



TG17 ROD END TRUNNION MOUNT



16″ CYLINDER BORE

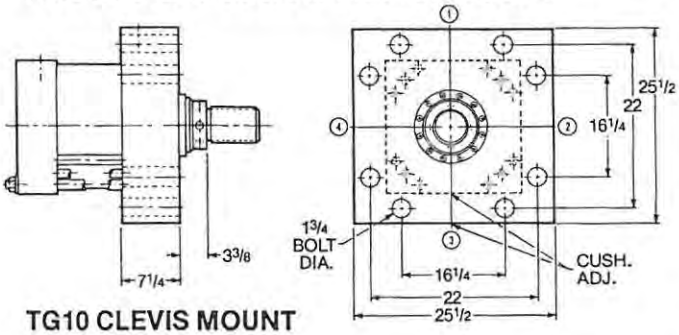


TG24 BASIC CYLINDER

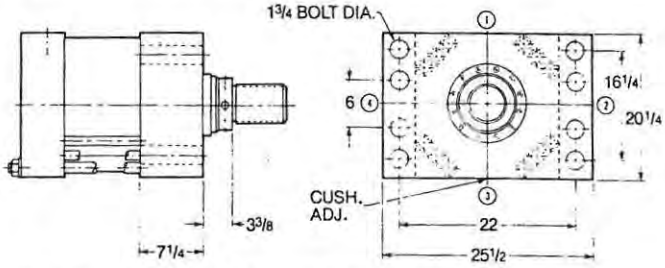
ALTERNATE ROD SIZES AVAILABLE ADD "N" TO ALL DIMENSIONS MARKED WITH "*"									
ROD DIA. MM	N*	A	C	DC	KK-Thd.	B[1]	RM[2]	V[3]	VB[4]
10	—	10	—	4 9/64	7 1/4-12	12.688	12 3/4	—	—

(1) "B" Dimensions apply to the following Mounting Codes: 09, 08.
(2) "RM" Dimensions apply to the following Mounting Codes: All.
N*, C, V[3], VB[4] - No Dimensional Change

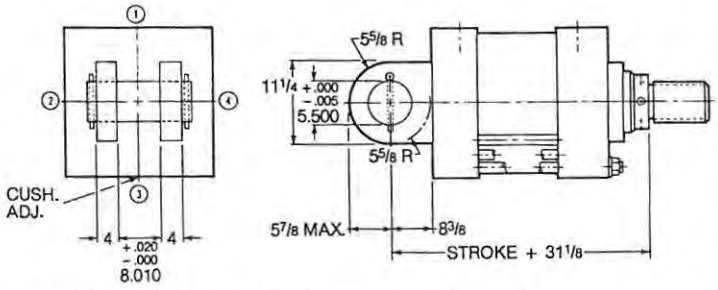
TG08 ROD END SQUARE FLANGE MOUNT



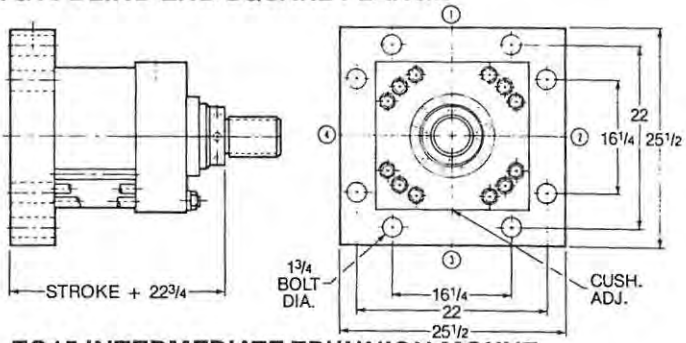
TG09 ROD END FULL THICKNESS HEAD



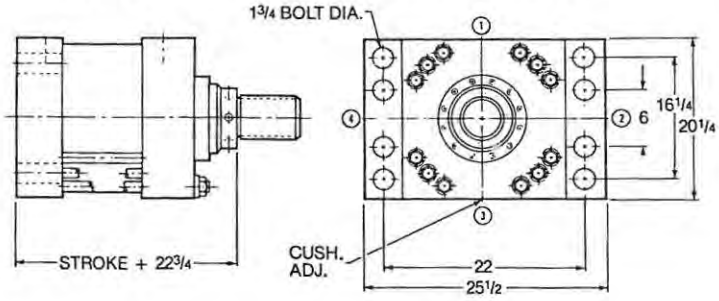
TG10 CLEVIS MOUNT



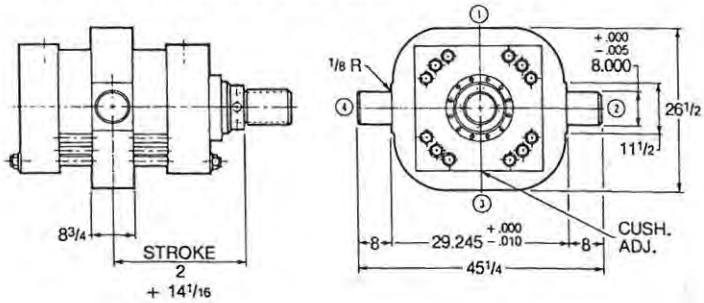
TG13 BLIND END SQUARE FLANGE

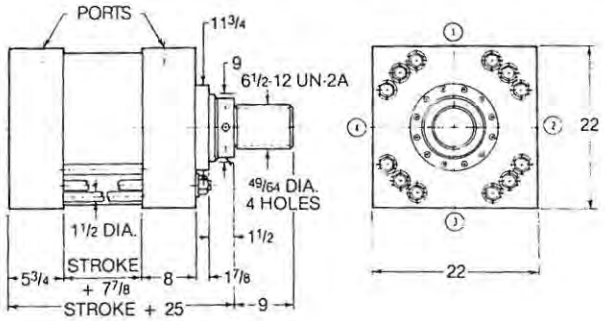


TG14 BLIND END FULL THICKNESS HEAD



TG15 INTERMEDIATE TRUNNION MOUNT



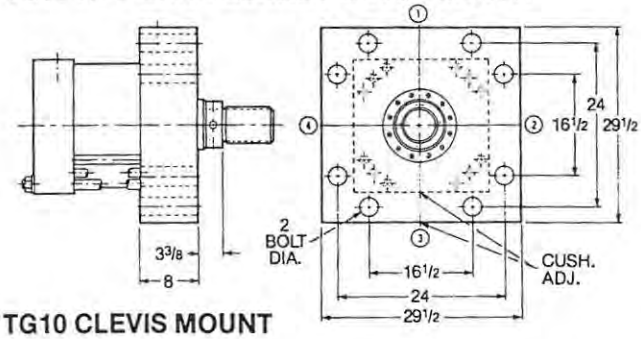


TG24 BASIC CYLINDER

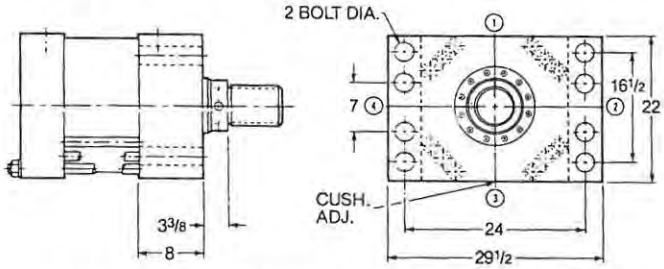
ALTERNATE ROD SIZES AVAILABLE ADD "N" TO ALL DIMENSIONS MARKED WITH "*"										
ROD DIA. MM	N*	A	C	DC	KK-Thd.	B[1]	RM[2]	V[3]	VB[4]	
10	—	10	—	49/64	7/4-12	12.688	12 3/4	—	—	

(1) "B" Dimensions apply to the following Mounting Codes: 09, 08.
(2) "RM" Dimensions apply to the following Mounting Codes: All
N*, C, V[3], VB[4] - No Dimensional Change

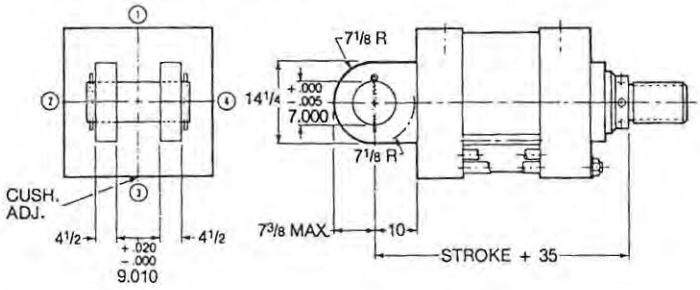
TG08 ROD END SQUARE FLANGE MOUNT



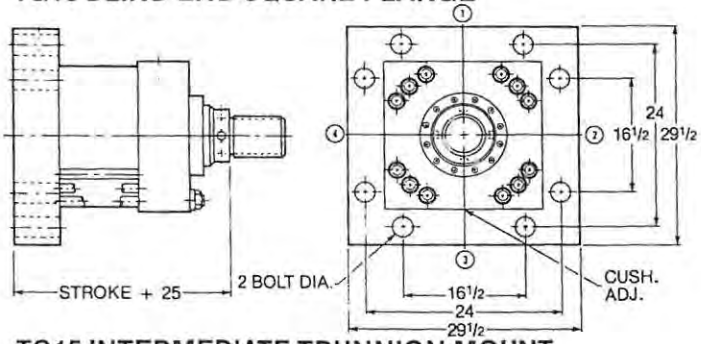
TG09 ROD END FULL THICKNESS HEAD



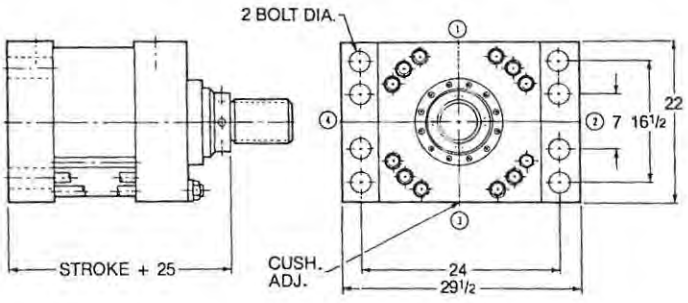
TG10 CLEVIS MOUNT



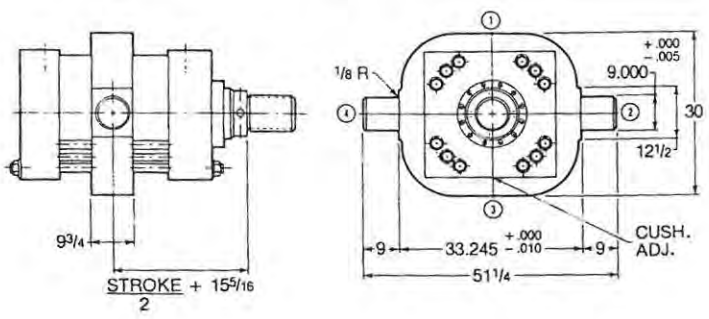
TG13 BLIND END SQUARE FLANGE



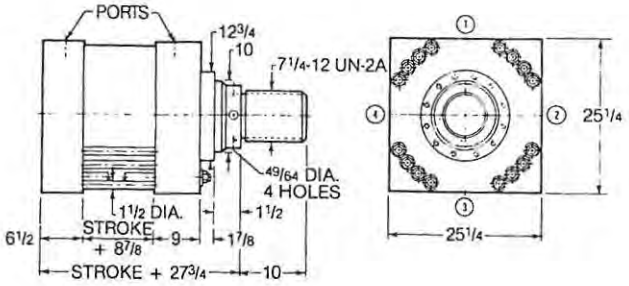
TG14 BLIND END FULL THICKNESS HEAD



TG15 INTERMEDIATE TRUNNION MOUNT

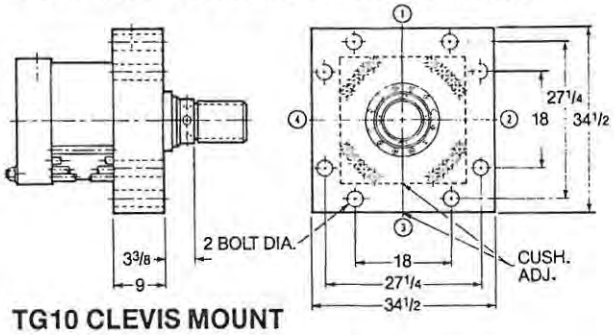


20″ CYLINDER BORE

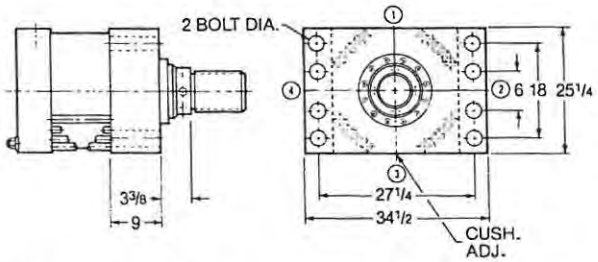


TG24 BASIC CYLINDER

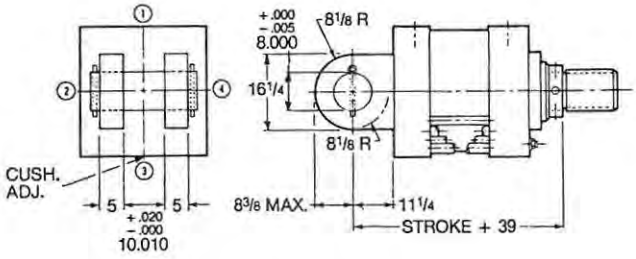
TG08 ROD END SQUARE FLANGE MOUNT



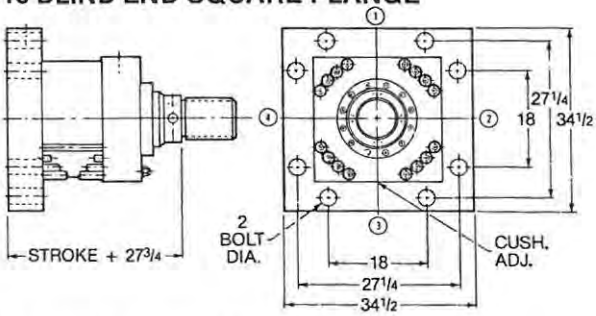
TG09 ROD END FULL THICKNESS HEAD



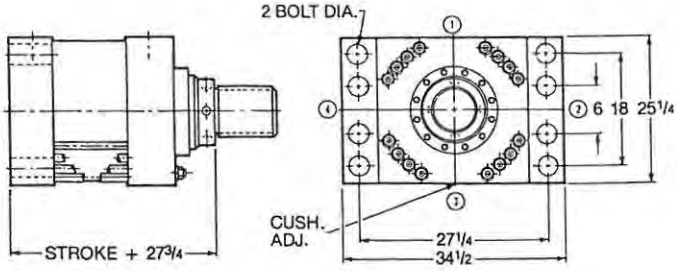
TG10 CLEVIS MOUNT



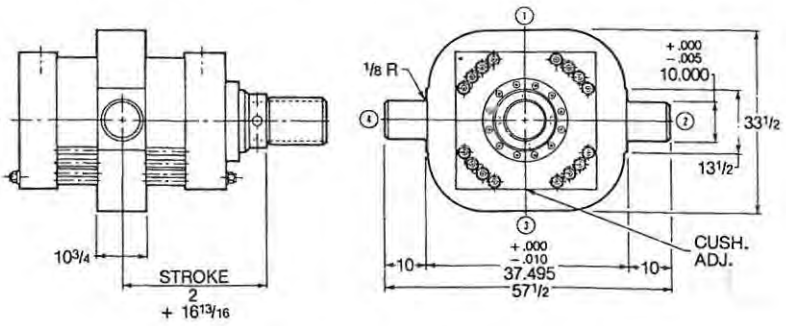
TG13 BLIND END SQUARE FLANGE



TG14 BLIND END FULL THICKNESS HEAD



TG15 INTERMEDIATE TRUNNION MOUNT



APPROXIMATE NET WEIGHTS OF SERIES TG, TW AND TM CYLINDERS

Weights shown are based on cylinders with standard rod diameter and single rod end. All weights are expressed in pounds.

Double end cylinder weight is equal to 1.15 times chart weight plus weight due to stroke.

Example:

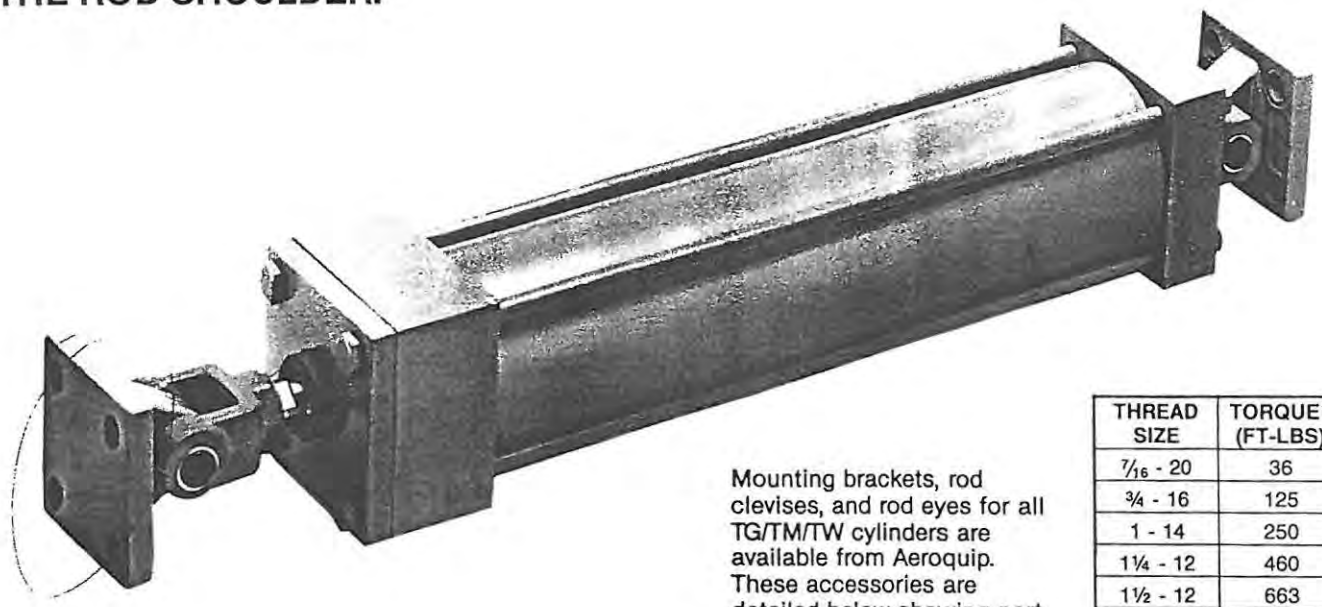
TG25E, 3¼" bore, 18" stroke
(34.0) (1.15) + (2.18) (18) = 39.1 + 39.2 = 78.3 lbs.

CYLINDER MOUNTING STYLE												
BORE	TG01	TG07	TG08	TG10	TG12	TG13	TG15 TG09 TG14	TG16 TG17	TG21 TG22	TG02 TG23	Add per inch of stroke	
											Single End	Double End
1½	7.8	7.7	7.9	7.6	8.2	9.1	10.6	7.7	7.5	7.7	.49	.58
2	13.0	12.7	14.2	13.2	14.0	15.7	18.0	12.7	12.0	12.4	.81	1.03
2½	19.5	17.3	19.0	17.6	19.1	21.1	22.9	17.0	16.4	16.8	1.06	1.28
3¼	34.0	33.0	37.0	34.0	36.7	40.4	46.0	33.0	31.5	32.2	1.76	2.18
4	48.8	45.0	49.3	50.2	50.4	55.0	58.7	44.0	42.5	43.3	2.23	2.91
5	84.0	84.3	91.0	92.4	81.0	98.4	101	79.3	80.0	81.3	3.90	4.79
6	136	131	143	141	144	154	155	125	125	128	5.17	6.56
7	204	194	210	215	209	223	235	191	186	190	6.47	8.47
8	273	264	285	293	284	302	323	260	256	263	8.91	11.63
10	575	686	855	611	644	597	723	553	548	537	15.64	20.14
12	953	1129	1388	980	1040	1119	1186	897	888	887	21.85	28.58
14	1477	1691	2014	1538	1566	1681	1939	1362	1334	1330	30.48	41.38
16,18,20	CONSULT FACTORY											

APPROXIMATE ACCESSORY WEIGHTS							
ROD EYE		ROD CLEVIS		EYE BRACKET		SWIVEL PIN	
Part No.	Wt.	Part No.	Wt.	Part No.	Wt.	Part No.	Wt.
S-1-560	.38	S-1-562-10	.56	S-1-552-M	.94	S-1-583-10	.12
S-460	1.25	S-462-10	1.56	S-452-M	3.19	S-483-10	.38
S-660	2.50	S-662-10	3.31	TG780100	7.17	S-683-10	.75
S-1060	5.94	S-1062-10	9.25	S-1052-M	11.7	SH-483-10	1.88
SH-560	11.4	SH-562-10	14.62	TG7801C0	22.0	SH-583-10	3.88
SH-660	15.1	SH-662-10	21.0	TG780200	34.5	SH-683-10	4.94
SH-760	27.0	SH-762-10	36.0	TG780280	55.4	SH-783-10	9.00
SH-860	35.0	SH-862-10	43.0	TG780300	72.5	SH-883-10	12.8
SH-1060	61.5	SH-1062-10	88.0	SH-1052-M	113.0	SH-1083-10	22.9
SH-1260	87.3	SH-1262-10	121.0	SH-1252-M	171.0	SH-1283-10	33.4
SH-1460	182.0	SH-1462-10	269.0	SH-1452-M	304.0	SH-1483-10	69.2

CYLINDER ACCESSORIES

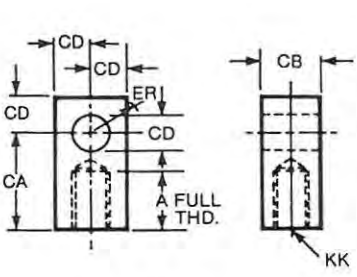
ALL ROD ACCESSORIES MUST BE TORQUED AGAINST THE ROD SHOULDER.



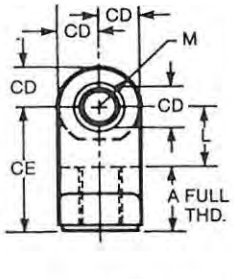
Mounting brackets, rod clevises, and rod eyes for all TG/TM/TW cylinders are available from Aeroquip. These accessories are detailed below showing part numbers and all pertinent dimensional data. When ordering, please specify the part name and part number.

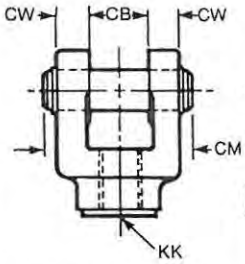
THREAD SIZE	TORQUE* (FT-LBS)
7/16 - 20	36
3/4 - 16	125
1 - 14	250
1 1/4 - 12	460
1 1/2 - 12	663
1 7/8 - 12	944
2 1/4 - 12	1315
2 1/2 - 12	5050
3 1/4 - 12	7940
4 - 12	12560
5 1/2 - 12	16275
6 - 12	21600
7 1/2 - 12	37700

*Recommended torque values using MoS_2 lubricant with 0.12 coefficient of friction.

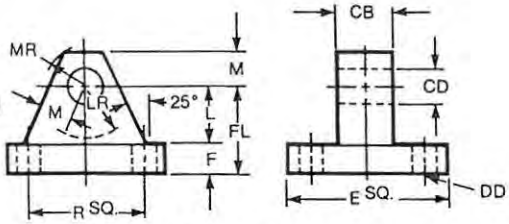


ROD EYE





ROD CLEVIS (includes swivel pin and retaining rings)

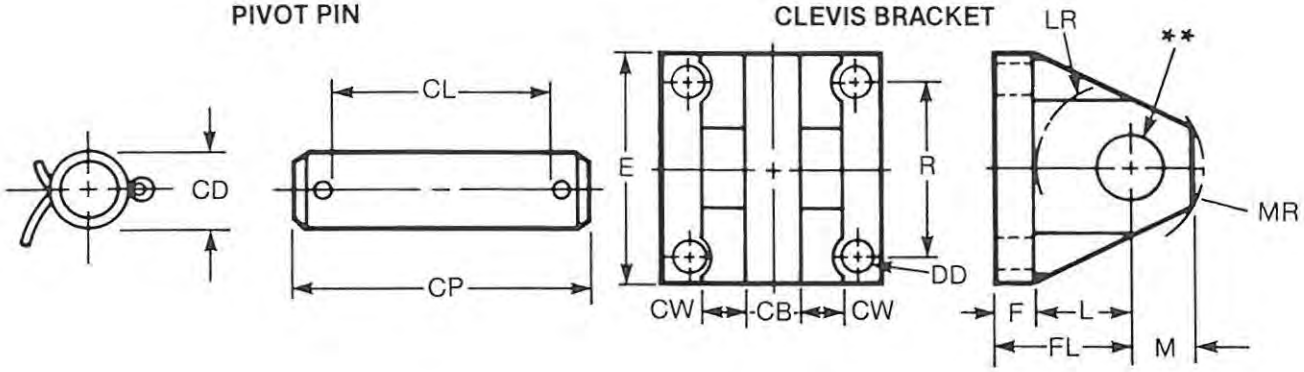


MOUNTING EYE BRACKET (for clevis mount cylinders)

NH (NUMBER OF HOLES)

CYLINDER DIAMETER (STD)	ROD Diameter	A	E	F	L	M	R	CA	CB	CD	CE	CM	CW	DD	NH	ER	FL	KK-THD	LR	MR	ROD EYE Part No.	ROD CLEVIS Part No.	EYE BRACKET Part No.	SWIVEL PIN Part No.
1 1/2	5/8	3/4	2 1/2	3/8	3/4	1/2	1.63	1 1/2	3/4	1/2	1 1/2	2	1/2	3/8	4	45/64	1 1/8	7/16-20 UNF-2B	1/16	19/32	S-1-560	S-1-562-10	S-1-552-M	S-1-583-10
2, 2 1/2	1	1 1/8	3 1/2	5/8	1 1/4	3/4	2.55	2 1/16	1 1/4	3/4	2 3/8	2 3/4	5/8	1/2	4	1 1/16	1 7/8	3/4-16 UNF-2B	1 1/8	7/8	S-460	S-462-10	S-452-M	S-483-10
3 1/4	1 3/8	1 5/8	4 1/2	7/8	1 1/2	1	3.25	2 13/16	1 1/2	1	3 1/8	3 9/32	3/4	5/8	4	1 27/64	2 3/8	1-14 NS-2B	1 3/8	1 1/4	S-660	S-662-10	TG780100	S-683-10
4	1 3/4	2	5	7/8	2 1/8	1 3/8	3.82	3 7/16	2	1 3/8	4 1/8	4 9/32	1	5/8	4	1 15/16	3	1 1/4-12 UNF-2B	1 7/8	1 5/8	S-1060	S-1062-10	S-1052-M	SH-483-10
5	2	2 1/4	6 1/2	1 1/8	2 1/4	1 3/4	4.95	4	2 1/2	1 3/4	4 1/2	5 7/16	1 1/4	7/8	4	2 13/16	3 3/8	1 1/2-12 UNF-2B	2	1 7/8	SH-560	SH-562-10	TG7801C0	SH-583-10
6	2 1/2	3	7 1/2	1 1/2	2 1/2	2	5.73	5	2 1/2	2	5 1/2	5 7/16	1 1/4	1	4	2 13/16	4	1 7/8-12 UN-2B	2 1/4	2 3/32	SH-660	SH-662-10	TG780200	SH-683-10
7	3	3 1/2	8 1/2	1 3/4	3	2 1/2	6.58	5 13/16	3	2 1/2	6 1/2	6 7/16	1 1/2	1 1/8	4	3 17/32	4 3/4	2 1/4-12 UN-2B	2 3/4	2 5/8	SH-760	SH-762-10	TG780280	SH-783-10
8	3 1/2	3 1/2	9 1/2	2	3 1/4	2 3/4	7.50	6 1/8	3	3	6 3/4	6 7/8	1 1/2	1 1/4	4	4 1/4	5 1/4	2 1/2-12 UN-2B	3	2 7/8	SH-860	SH-862-10	TG780300	SH-883-10
10	4 1/2	4 1/2	12 5/8	1 11/16	4	3 1/2		7 5/8	4	3 1/2	8 1/2	8 7/16	2	1	12		5 11/16	3 1/4-12 UN-2B	3 3/4		SH-1060	SH-1062-10	SH-1052-M	SH-1083-10
12	5 1/2	5 1/2	14 7/8	1 15/16	4 1/2	4		9 1/8	4 1/2	4	10	9 7/16	2 1/4	1	16		6 7/8	4-12 UN-2B	4 1/4		SH-1260	SH-1262-10	SH-1252-M	SH-1283-10
14	7	7	17 1/4	2 3/16	5 3/4	5		11 3/4	6	5	12 3/4	12 1/2	3	1	20		7 15/16	5 1/2-12 UN-2B	5 1/4		SH-1460	SH-1462-10	SH-1452-M	SH-1483-10

T-J Spherical Bushing Mounted Cylinder Accessories



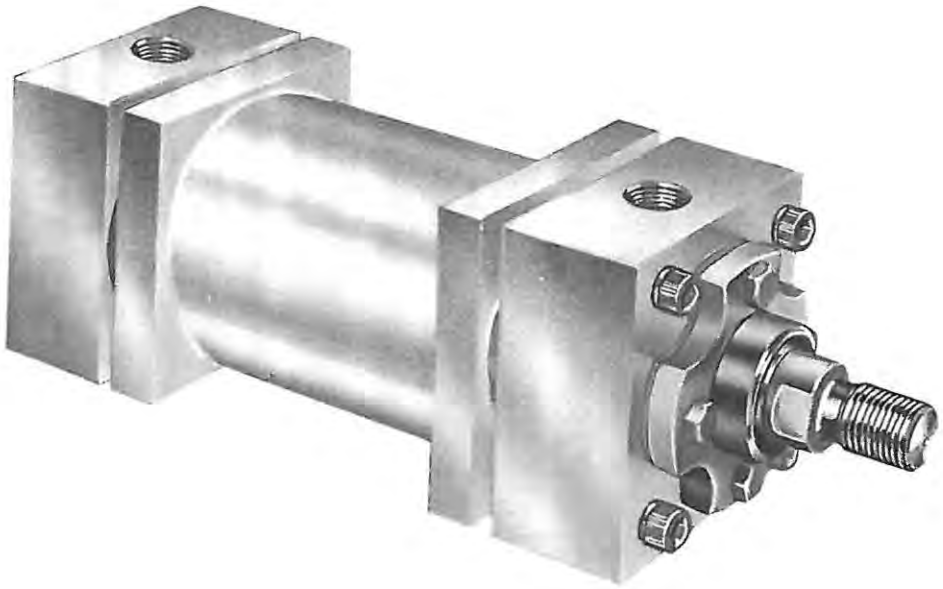
NOTE: Use jam nut to lock rod eye to piston rod.

All dimensions in inches.

BORE		1½"	2, 2½"	3¼"	4"	5"	6"
Clevis Bracket, Pivot Pin and Jam Nut Dimensions	CB	.467 .472	.686 .691	.935 .940	1.247 1.251	1.591 1.596	1.810 1.815
	CD	.4997 .4992	.7497 .7492	.9996 .9991	1.3745 1.3739	1.7495 1.7489	1.9995 1.9989
	CL	1.47	1.94	2.44	3.25	4.09	4.31
	CP	2.19	2.69	3.19	4.31	5.19	5.38
	CW	½	⅝	¾	1	1¼	1¼
	DD	⅜	½	⅝	⅝	⅞	1
	E	2½	3½	4½	5	6½	7½
	F	⅜	⅝	¾	⅞	⅞	1
	FL	1⅛	1⅞	2¼	3	3⅛	3½
	L	¾	1¼	1½	2⅛	2¼	2½
	LR	⅝	1⅛	1⅜	1⅞	2⅛	2⁷⁄₁₆
	M	½	¾	1	1⅜	1¾	2
	MR	⅝	⅞	1¼	1⅝	1⅞	2³⁄₃₂
	R	1.63	2.55	3.25	3.82	4.95	5.73
	Jam Nut Size	7⁄16-20	¾-16	1-14	1¼-12	1½-12	1⅞-12
Spherical Rod Eye w/Bushing Part Number*		S-1-560-SAB	S-460-SAB	S-660-SAB	S-1060-SAB	SH-560-SAB	SH-660-SAB
Replacement Bushing Only Part Number*		6803-8	6803-12	6803-16	6803-22	6803-28	6803-32
SAB Clevis Bracket Part Number‡		S-1-552-M-SAB	S-452-M-SAB	S-652-M-SAB	S-1052-M-SAB	SH-552-M-SAB	SH-652-M-SAB
Pivot Pin Assy. Part Number‡		6856A-1-10	6856A-2-10	6856A-3-10	6856A-4-10	6856A-5-10	6856A-6-10
Jam Nut Part Number		5202-008	5202-003	5202-005	5202-012	5202-015	5202-019

* Included in Cylinder Assembly ‡ Order Separately ** See CD For Pin Size

SERIES TM WELDED FLANGE



Series TM welded flange cylinders are identical to Series TG cylinders except tie rods are replaced by welded body flanges and socket head cap screws. All the other fine features of the Series TG cylinder are included in the Series TM as well. In addition, the welded flange construction provides added rigidity for tough "mill-type" applications and maintenance-free operation.

The dimensional information for the Series TG cylinders included in this catalog also applies to the Series TM for all Series TM bore sizes and mounting styles offered. Please consult the factory for any special requirements for bore sizes or mounting styles not shown.

The Series TM is available in the bore sizes and mounting styles listed at the right.

BORE SIZES	CODE	MOUNTING STYLE
1½", 2", 2½", 3¼"	10	Clevis
	01	Side Lug
	02	Tapped
	09	Rod End Full Thickness Head
	11	Spherical Bushing
1½", 2", 2½", 3¼"	14	Blind End Head
4", 5"	15	Intermediate Trunnion
6", 7", 8"	16	Blind End Trunnion
	17	Rod End Trunnion
	24	Basic No Mount
	25	Side Lug DE
	26	Tapped DE
	33	Rod End Full Thickness Head DE
	34	Trunnion DE
	35	Head Trunnion DE
	41	Basic No Mount DE

Series TG Hydraulic Cylinders ABS Approved



ABS Type Approval of Series TG Cylinders Is Your Assurance of Quality.

The American Bureau of Shipping (ABS) develops rules for testing equipment based on sound naval architecture and marine engineering principles. As a non-partisan technical organization, ABS is impartial, authoritative, and scientific.

Stringent Requirements.

ABS Type Approval is a form of quality assurance. The ABS staff, aided by computer, continually updates technical information gathered from naval architects, marine engineers, and vessel personnel to establish testing and inspection parameters. From these guidelines, stringent requirements are developed for subsequent testing of TG cylinders.

Exhaustive Testing

Fully trained field surveyors take on the task of testing, inspecting, and evaluating the material and components that go into TG cylinders. In addition, the ABS surveyors inspect and evaluate in-plant operations to ensure compliance with the rules for Type Approval. Design stress review, quality audits, and special quality control standards has enabled T-J Series TG Cylinders to meet Type Approval for all shipboard (non-steering gear) applications.

Superior Quality

ABS criteria is designed to evaluate equipment for marine applications. Type Approval provides any customer with the assurance that T-J cylinders are built to exacting quality standards. In addition to Type Approval, Vickers T-J has the capability to obtain certification for steering gear requirements to cover virtually the full range of marine applications. ABS Type Approval means quality, and that provides customers with cost-efficient benefits like longer service and lower maintenance.

Type Approval Standard Specifications

Heavy Duty Service - Meets or exceeds applicable NFPA Standards.

Cylinder Construction - Square Head - tie-rod design.

Nominal Pressure - Up to 3000 psi (5000 psi non-shock). Exceptions noted on pages 26-43.

Standard Fluid - Petroleum base.

Bore Sizes - 1½" thru 8".

Mounting Styles - 15 standard styles, all NFPA interchangeable, including:

SIDE LUG MOUNT	3 styles
TAPPED MOUNT	1 style
FLANGE MOUNT	4 styles
CLEVIS MOUNT	1 style
TRUNNION MOUNT	3 styles
EXTENDED TIE-ROD MOUNT	3 styles

Cushions - Floating metallic sleeve cushions, one or both ends.

Piston Rod Diameters - ⅝" to 5½"

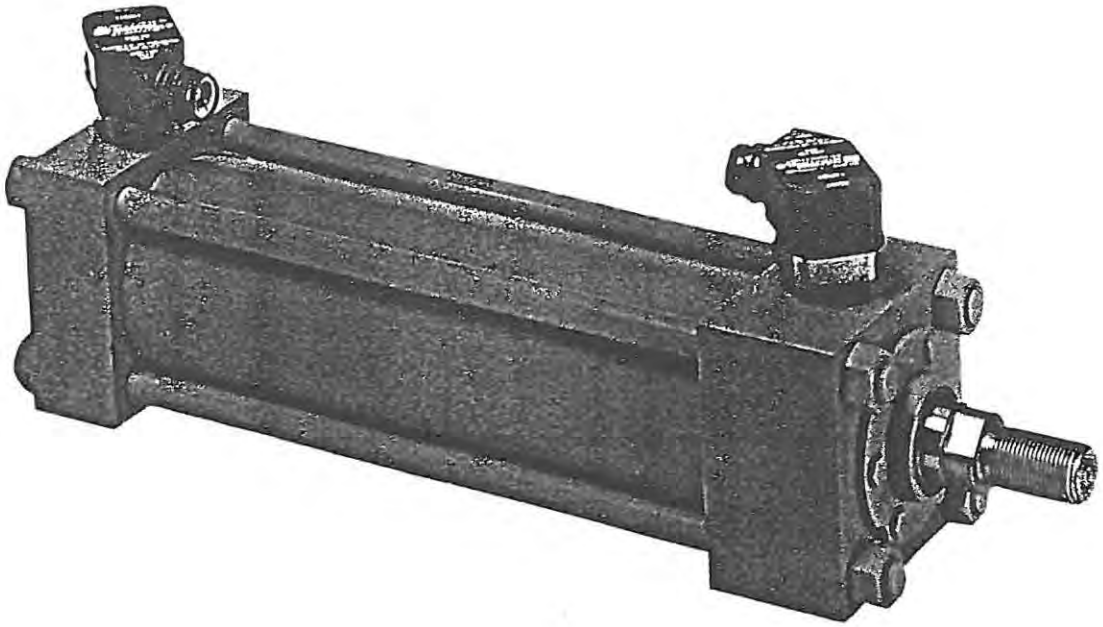
Rod Ends - 4 standard options, specials to order.

Piston Seal - Cast iron piston rings standard; U-cup seals with Teflon* back-up rings available as standard alternate.

Mounting Accessories - Consult factory for applicable ABS approved materials.

*Teflon is a DuPont trademark.

PS 200 PROXIMITY SWITCHES

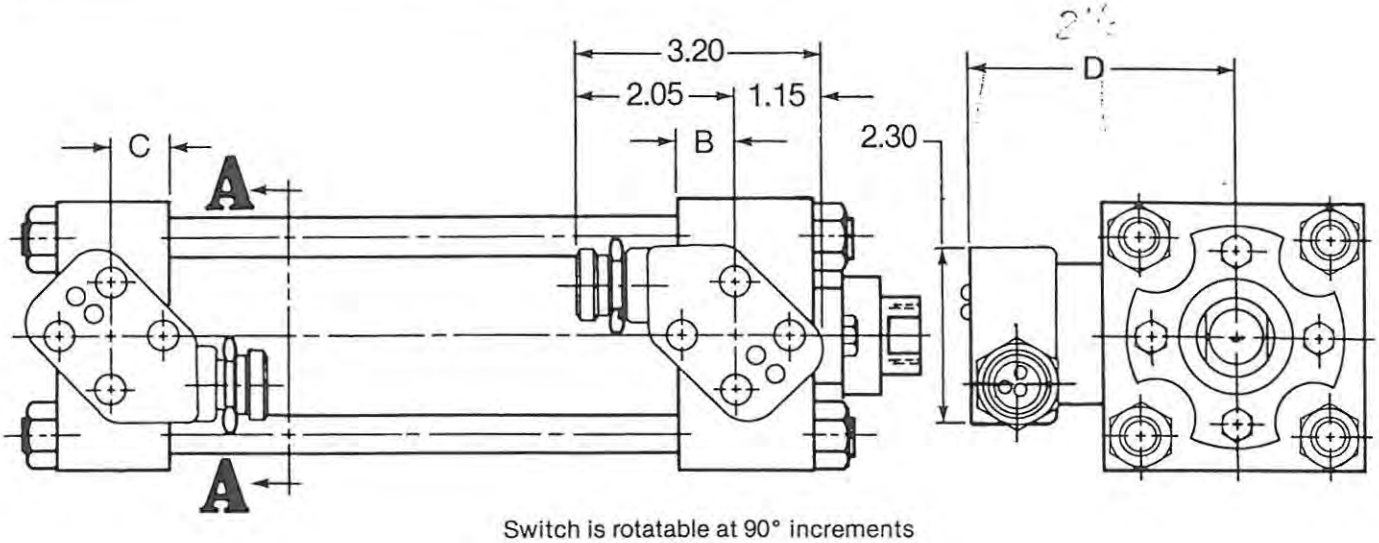


PS 200 proximity switches for Series TG cylinders are an inductive type switch with a sensing probe that "looks" at the cushion collar or button providing full extend or full retract indication. Since the probe is in the cylinder, harsh, external environments do not affect sensing. The 2-wire circuit will operate on AC and DC. It operates as reliably as a programmable controller. PS 200 switches meet UL requirements for 3000 psi hydraulic cylinders. Four mounting holes allow 90° rotation increments.

Short Circuit Protection is a standard feature on the PS 200 Proximity Switch. SCP protects the switch from shorts in the load or line. Upon sensing a short condition the switch assumes a non-conducting mode. The fault condition must be removed and power turned off to reset, preventing automatic restarts. Indication of the switch in SCP mode is both LEDs flashing.

	SERIES PS200
	2-Wire AC/DC
Pressure	3000 psi/5000 psi nonshock
Sensing Range	0.08″ ± 10%
Operating temp. rang . .	−20° to 70°C
Repeatability	.001″
Switching Differential . .	10%
Supply Voltage	20-220 V AC/DC
"On-State" Voltage Drop	10V @ 5-500 mA
Load Current max.	0.5 Amp
Inrush Current	3 Amp
Quiescent Current	1.7 mA maximum
Indicating LED's: standard	1) Power on/non-conducting 2) Target present (Both flashing = SCP mode)

N.O.
Pilot end



Switch is rotatable at 90° increments from position shown.

¼-20 mounting screws to be torqued to 12 to 15 foot pounds.

O-rings required:
(1) Size – 115 per switch
(1) Size – 116 per spacer

BORE SIZE	ROD DIA	SWITCH 7550-	SPACER 7551-	B	C	D
1½	5/8	1.225	—	.75	—	3 7/16
	1	1.225	—	.75	—	3 37/64
	B.E.	1.225	—	—	.66	3 3/16
2	1	1.225	—	.75	—	3 11/16
	1⅜	1.225	—	.75	—	3 49/64
	B.E.	1.225	—	—	.78	3 5/16
2½	1	1.225	344	.75	—	3 13/16
	1⅜	1.225	344	.75	—	3 13/16
	1¾	1.225	469	.88	—	3 61/64
	B.E.	1.725	344	—	.78	3 13/16
3¼	1⅜	1.725	250/281	.88	—	4½
	1¾	1.725	250/281	.88	—	4½
	2	1.225	125	1.00	—	4 7/64
	B.E.	2.375	312/250	—	.91	4 17/32
4	1¾	1.725	406	1.00	—	4 5/8
	2	1.725	406	1.00	—	4 5/8
	2½	1.225	156	.88	—	4⅜
	B.E.	2.375	344	—	.91	4 9/16
5	2	2.375	312/250	1.00	—	5 17/32
	2½	2.375	312/250	.88	—	5 17/32
	3	1.725	281	.94	—	5¼
	3½	1.725	406	1.00	—	5⅜
	B.E.	3.750	500/469	—	.91	5 15/16

All dimensions in inches.

BORE SIZE	ROD DIA	SWITCH 7550-	SPACER 7551-	B	C	D
6	2½	2.375	312	.94	—	5 25/32
	3	2.375	312	.94	—	5 25/32
	4	1.725	156	.94	—	5⅝
	B.E.	3.750	312/250	—	.84	6 1/32
7	3	2.875	312/250	.94	—	6 17/32
	4	2.375	312	.94	—	6 9/32
	5	1.725	156	.94	—	6⅛
	B.E.	3.750	188	—	.84	6 5/32
8	3½	2.875	188	.94	—	6 21/32
	4	2.875	375	.94	—	6 27/32
	5½	2.375	312/250	.94	—	7 1/32
	B.E.	4.560	375/250	—	.84	7 3/32
10	4½	3.750	—	.94	—	8 1/32
	5½	3.750	500	.94	—	8 17/32
	7	2.875	438	.94	—	8 15/32
	B.E.	3.750	—	—	.84	8 1/32
12	5½	4.560	188	.94	—	9 11/32
	7	3.750	188	.94	—	9 11/32
	8	3.750	500/188	.94	—	9 27/32
	B.E.	4.560	188	—	.84	9 11/32
14	7	4.990	250	.94	—	10 19/32
	8	4.560	312	.94	—	10 21/32
	10	3.750	438	.94	—	10 25/32
	B.E.	4.990	250	—	.84	10 19/32

Other Vickers T-J Actuator Products

Series TA/TB Spacemaker Cylinders

- Meet all JIC recommendations
- 250 psi nominal pressure for air service
- 1000 psi nominal pressure for hydraulic service
- 3/4" through 8" bore sizes
- 9 standard mounting styles
- 3/8" through 2 1/4" piston rod diameters
- Clean, threaded design

Catalog 4111

Series TF/TF/TL Cylinders

- Meet NFPA and JIC standards
- 250 psi nominal pressure for air service
- 500 to 1000 psi nominal pressure for hydraulic service
- 1 1/2" through 14" bore sizes
- 17 standard mounting styles
- 5/8" through 5 1/2" piston rod diameters

Catalog 4110

Series TJ Air Cylinders

- Meet all JIC recommendations
- 100 psi nominal pressure
- 1 1/2" through 8" bore sizes
- 7 standard mounting styles
- 1/2" through 1 3/8" piston rod diameters
- 3 standard rod ends
- Cushions – resilient lip seal available as an option, one or both ends

Catalog 4112

Series TP Air Cylinders

- Meet NFPA and JIC standards
- 250 psi nominal pressure for air service
- 1 1/2" through 8" bore sizes
- 12 standard mounting styles
- QR-70 super cushion for longer life

Catalog 4093

Series TS, LESA™ I Electrohydraulic Servo Actuator

The Vickers T-J LESA I Actuator combines the durability of our Series TG heavy duty hydraulic cylinder with a precision linear displacement feedback transducer for use in closed loop electrical motion control systems.

- 2" through 5" bore sizes
- 8 standard mounting styles
- 1 3/8" through 2 1/2" piston rod diameters

Catalog 4108

Digital Servo Controller

To simplify the application and installation of our LESA actuators, we present our Digital Servo Controller (DSC). Newly developed digital technology allows us to offer a comprehensive, user-friendly motion controller with menu-driven programming. Available in both single- and dual-axis versions, our DSC will satisfy a broad range of motion profiling and input/output requirements.

Catalog 4123

Series TY, LESA™ II Electrohydraulic Servo Actuator

The Vickers T-J LESA II is similar to the LESA I, combining a high performance cylinder, precision feedback transducer, and control valve mount all in one package. The LESA II, however, features a high-value, modular cylinder design, interchangeable with other NFPA tie rod cylinders.

- 3000 psi nominal pressure for hydraulic service
- 2" through 5" bore sizes
- 5 standard NFPA mounting styles
- 1 3/8" through 2 1/2" piston rod diameters

Catalog 4144

Other Vickers T-J Locations

Vickers, Incorporated
T-J Actuator Products
7638 Pacific Avenue
White City, Oregon 97503–1091
U.S.A.
Phone: 503-826-2131
Fax: 503-826-3344

Vickers, Incorporated
T-J Actuator Products
RT 1, Box 17
250 Courtland Road
Decatur, Alabama 35603–9709
U.S.A.
Phone: 205-353-2001
Fax: 205-351-9224

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FAX (602) 747-6607

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FAX (805) 392-1468

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FAX (602) 437-8344

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FAX (206) 439-7881

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Series TW HWCF Cylinder

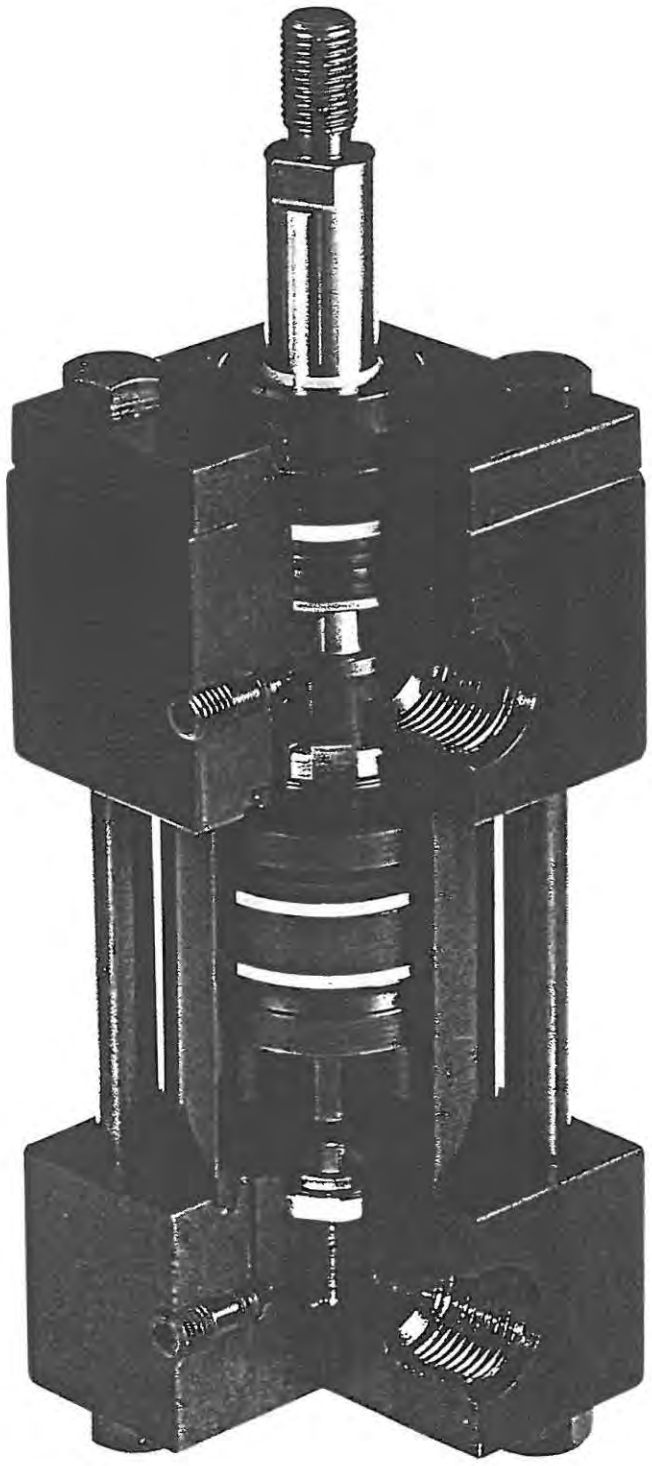
The lower lubricity of high water content fluids requires bearings and seals different than those used in conventional hydraulic cylinders.

T-J has found that fine grain cast iron with a nitriding treatment has the greatest durability. The salt-bath nitriding treatment improves the bearing properties, reduces friction and gives a corrosion resistant finish. T-J uses this finish on the cast iron bearing, piston and cushion collar.

Hard chrome plated piston rods and cylinder bodies provide maximum seal life and resistance to abrasion and vapor phase corrosion of high water content fluids.

To avoid the incompatibility of paint and HWCF's, T-J finishes all external parts with black oxide.

T-J uses two new seal compounds, TCN (nitrile) and TSV (fluorocarbon). These provide excellent seal life when used with HWCF's or petroleum based fluids.



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- 3/8" through 2 1/4" piston rod diameters
- Clean, threaded design

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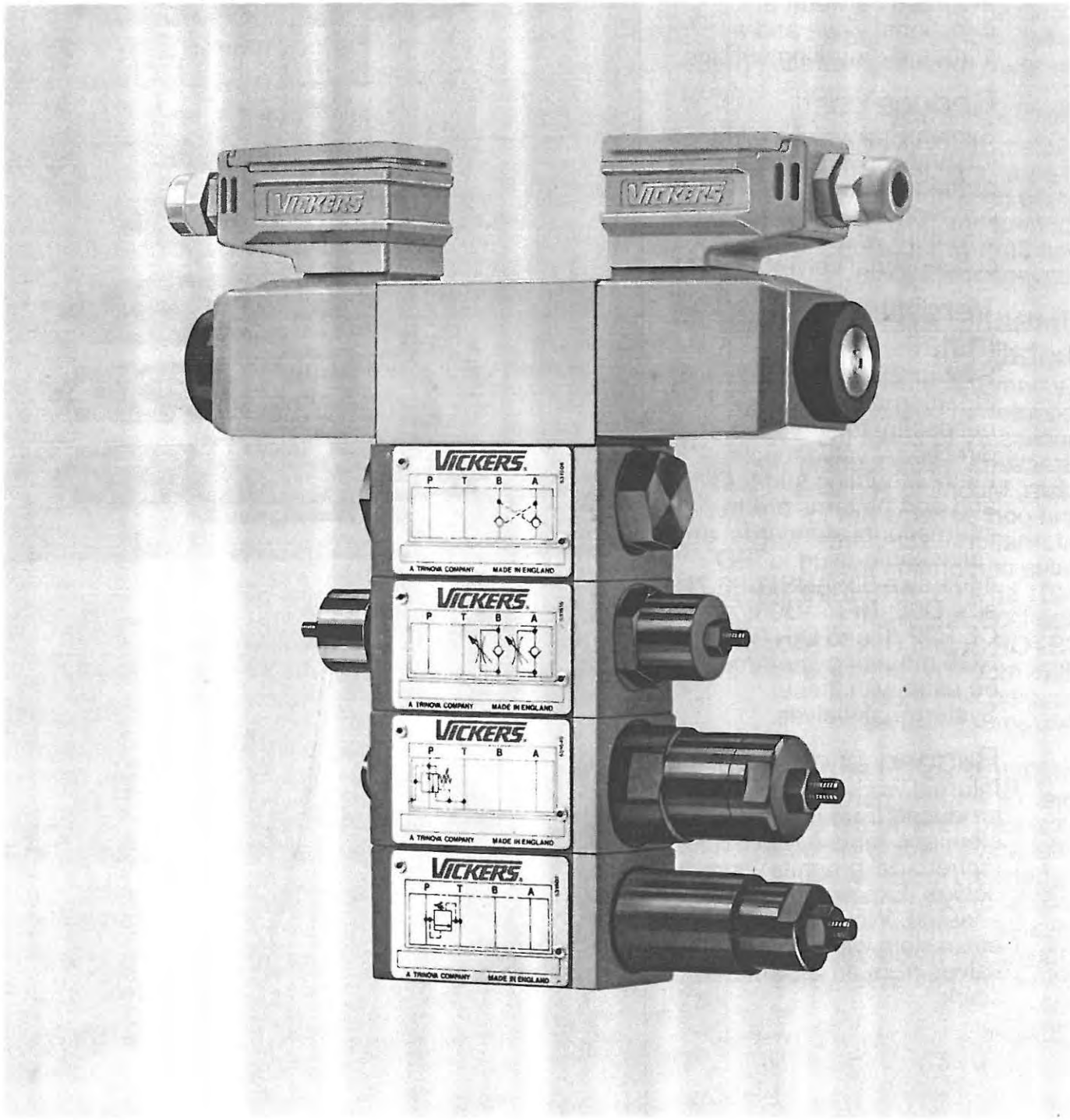
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Printed in U.S.A.

VICKERS

System Stak™ valves

ISO 4401-03 size; NFPA-D03
315 bar (4500 psi)
60 l/min (15.7 USgpm)



December 1991

GB-C-2027

Build a compact, cost effective, reliable hydraulic system with Vickers SystemStak™ valves

Reduces system space requirements

SystemStak valves make compact hydraulic systems in which specific function valves are "sandwich" mounted between a directional valve and a standard mounting surface.

Reduce cost

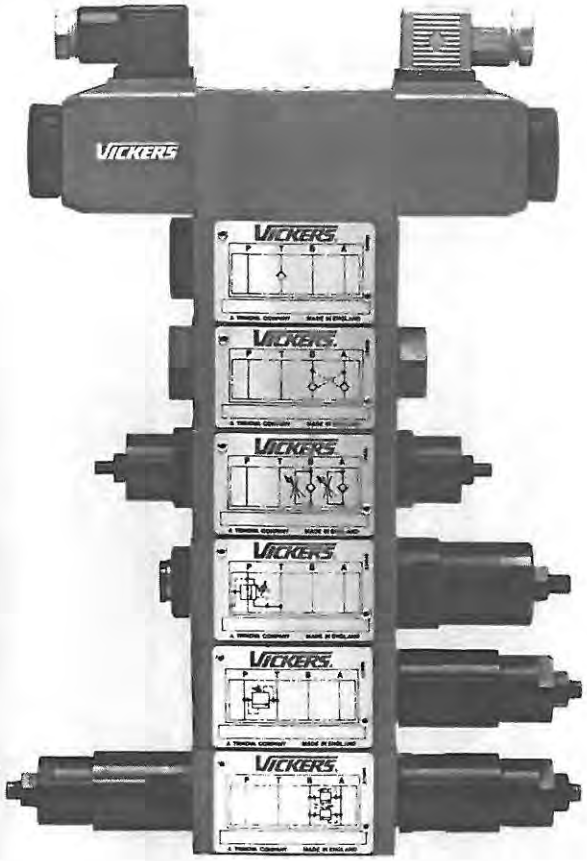
SystemStak valves eliminate intervalve piping and leak-prone tube and pipe connections. Installed cost is less than when using conventional valves.

Versatile and easy to install

SystemStak valves have all the internal passages necessary to serve the directional valve topping them. Mounting surfaces and port patterns are to international standards: any valve conforming to ISO 4401 size 03; ANSI/B93.7M size D03; NFPA-D03; CETOP 3; and DIN 24340, NG6 mounting interface can be used with these SystemStak valves.

Rugged and reliable

Internal working parts are produced from hardened steel and mounted in ductile (spheroidal graphite) iron bodies. Excellent reliability is ensured. Working parts are accessible without removing valves from an assembled stack.



Vickers, Incorporated 1992
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SystemStak systems...easy to understand, easy to design

SystemStak circuitry is best shown using slightly different symbols than those for traditional valve configurations. Each SystemStak symbol has the same basic form and size as shown in fig.1.

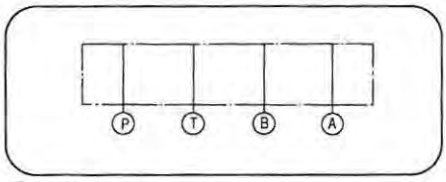


Figure 1

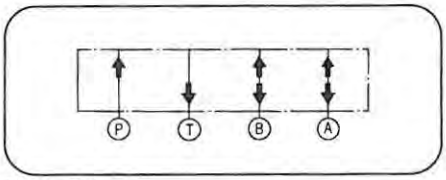


Figure 2

For ease of understanding, remember the directions of flow for each line, and that all four flow paths pass through each valve (see fig.2). For clarity, directional valves are drawn vertically in SystemStak circuit diagrams (see fig.3).

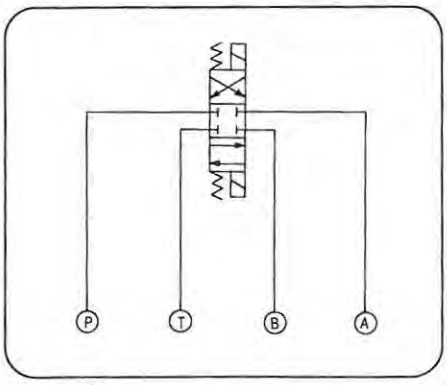


Figure 3

Each station (valve stack) is a combination of functions. When designing and assembling SystemStak valves, care must be taken to ensure that they interact as required by stacking the functions in the correct sequence (fig. 4 is an example). Relief valves should normally be positioned next to the

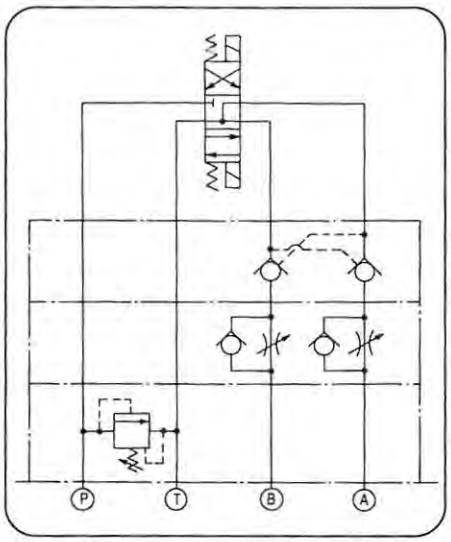


Figure 4

mounting surface (i.e. at the bottom of the stack). When both a flow control and a pilot operated check valve are required, it is recommended that the flow control valve be between the check valve and the actuator to prevent check valve chatter.

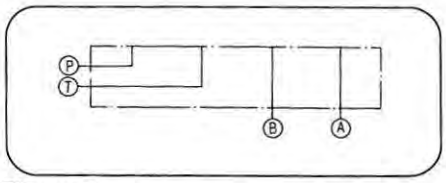


Figure 5

A combination of directional valve, SystemStak valve(s) and subplate/manifold block (fig.5: single station subplate and fig.6: multi-station manifold) completes the assembly.

Fig.7 represents a complete SystemStak system, showing typical use of functions available from this range. The circuit diagram also shows the use of a tapping plate for accessing line pressure readings, and a blanking plate to close off an unused station of a multi-station manifold.

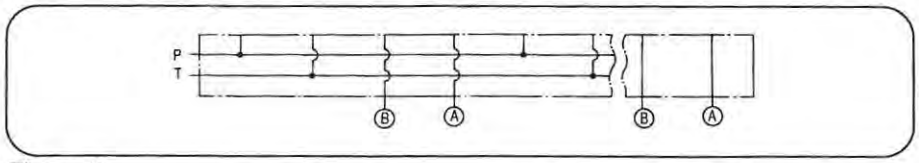


Figure 6

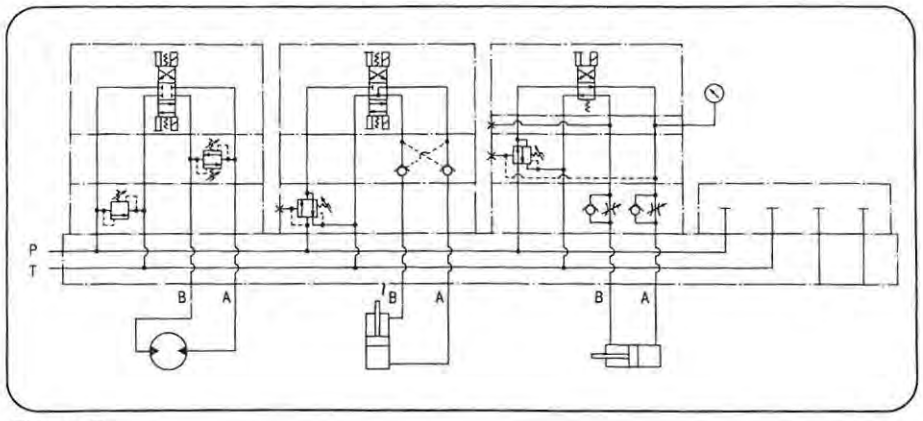
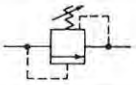
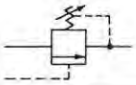
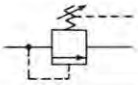
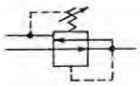
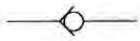
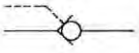
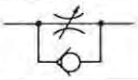


Figure 7

Contents

Function	Basic symbol	Basic model	Features	Page
Relief		DGMC	Single, dual and crossport models	5
Counterbalance		DGMR	Control in port T	9
Sequence		DGMR1	Single port P sequence	9
Reducing/relieving		DGMX2	Piloted from (and reduced pressure in) port P, A or B	9
Direct check		DGMDC	Single check in any port; dual check in ports A and B only	13
Pilot operated check		DGMPC	Single in port A or B; dual in ports A and B	
Flow restrictor		DGMFN	Single or dual port, meter-in or meter-out	19

Further information:

Mounting bolts, subplates and manifold blocks	22
Hydraulic fluids, filtration requirements and temperature limits	22
Warranty and repair	23
Ordering procedure	23

Relief valves

DGMC-3, 40 series
DGMC2-3, 40 series

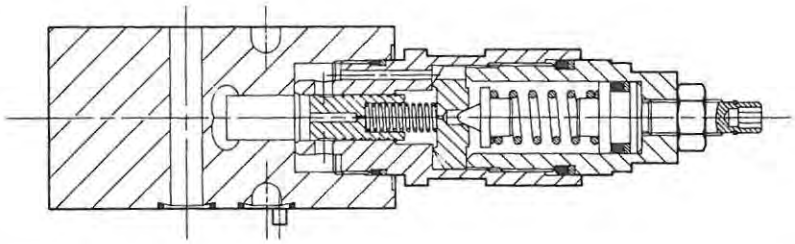
1. General description

These two-stage adjustable pressure relief valves limit the maximum pressure in the line(s) controlled by the integral relief valve elements.

Pressure adjustment options of control knob (with or without keylock) or screw/locknut design are available. The two-stage operation is basically identical to long-established balanced piston valves, described in detail in Vickers Industrial hydraulics manual.



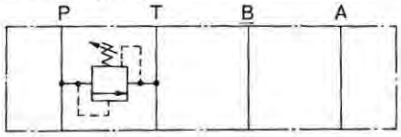
Typical section



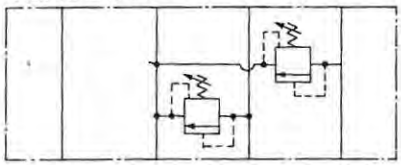
2. Functional symbols

For simplicity these two-stage valves are represented as single-stage models

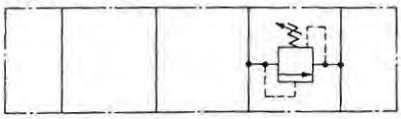
DGMC-3-PT-**



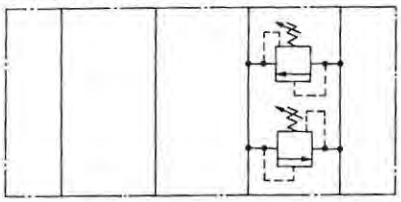
DGMC2-3-AT-**-BT-**



DGMC-3-BA-**



DGMC2-3-AB-**-BA-**



3. Model code for relief valves

DGMC(2) - 3 - * *- * * (- B * - * *) - * - 40

[1] [2] [3][4] [5] [6][7] [8] [9]

[1] Type

2 = Dual relief function
Omit for single relief function

[2] First function

Single relief, or first line of dual models

Code	Pressure limited in	Discharge into	Usage
PT	P	T	Single only
AB	A	B	Single, or dual with BA
BA	B	A	Single only
AT	A	T	Single, or dual with BT
BT	B	T	Single only

[3] Pressure adjustment range, first function

A = 3-50 bar (43.5-725 psi)
B = 3-100 bar (43.5-1450 psi)
C = 10-200 bar (145-2900 psi)
G = 50-315 bar (725-4500 psi)

[4] Pressure adjustment/ locking method, first function

H = Handknob
K = Micrometer with keylock
W = Screw and locknut

[5] Second function
Second line of dual models

Code	Pressure limited in	Discharge into	Usage
BA	B	A	Dual with AB
BT	B	T	Dual with AT

Omit for single line models

[6] Pressure adjustment range, second function
Options as in [3]

[7] Pressure adjustment/ locking method, second function
Options as in [4]

[8] Gage port: option on AT and PT single models only
B = G1/4" (1/4 BSPF)
S = SAE 4 (7/16"-20 UNF-2B)
Blank = No gage port

[9] Design number, 40 series
Subject to change. Installation dimensions unchanged for design numbers 40 to 49 inclusive.

Preferred model selection
The preferred products listed represent those models which are in regular volume production and are therefore most readily available at competitive prices. Other models constructed from the model code may be made available subject to the quantity requested. Please check price and availability before ordering.

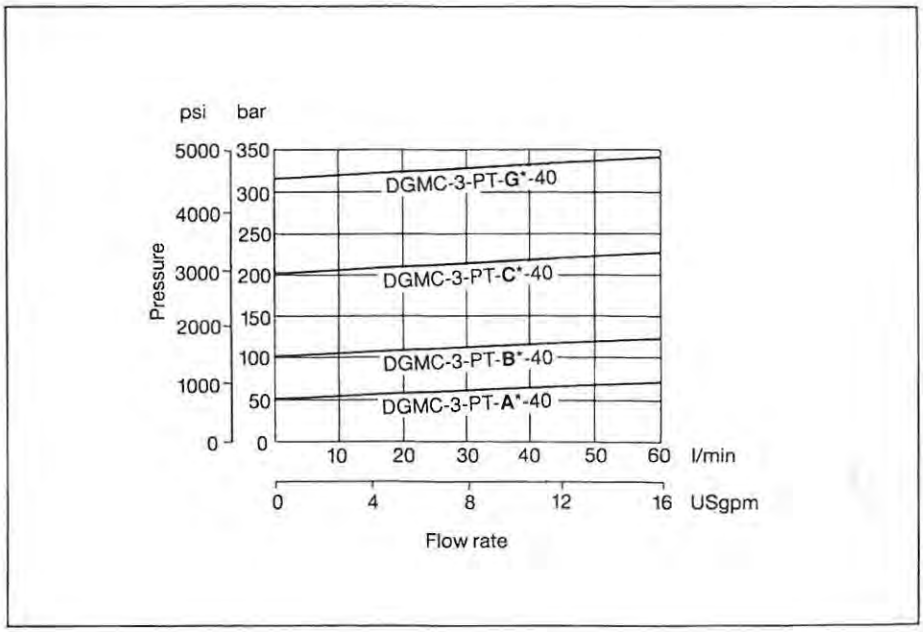
DGMC-3-BA-GW-40
DGMC-3-PT-BW-40
DGMC-3-PT-CW-40
DGMC-3-PT-GW-40
DGMC2-3-AB-BW-BA-BW-40
DGMC2-3-AB-CW-BA-CW-40
DGMC2-3-AB-GW-BA-GW-40
DGMC2-3-AT-BW-BT-BW-40
DGMC2-3-AT-CW-BT-CW-40

4. Operating data

Maximum flow rate	60 l/min (16 USgpm)
Maximum operating pressure	315 bar (4500 psi)
Pressure override	See graph below
Hydraulic fluids	See "Further information", item 2
Filtration requirements	See "Further information", item 3
Temperature limits	See "Further information", item 4
Installation dimensions	See next page
Mass, approximate: DGMC DGMC2	1,3 kg (2.9 lb) 2,5 kg (5.5 lb)
Installation data: Mounting bolts Manifold blocks and subplates Mounting position	 See "Further information", item 1.1 See "Further information", item 1 Optional

5. Performance characteristics

Pressure override
Typical performance for PT models at max. pressure settings with mineral oil at 21 cSt (102 SUS) and at 50°C (122°F).



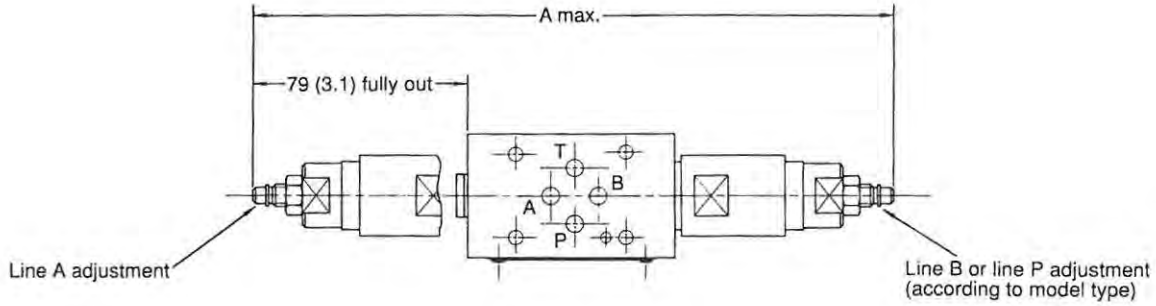
6. Installation dimensions in mm (inches)

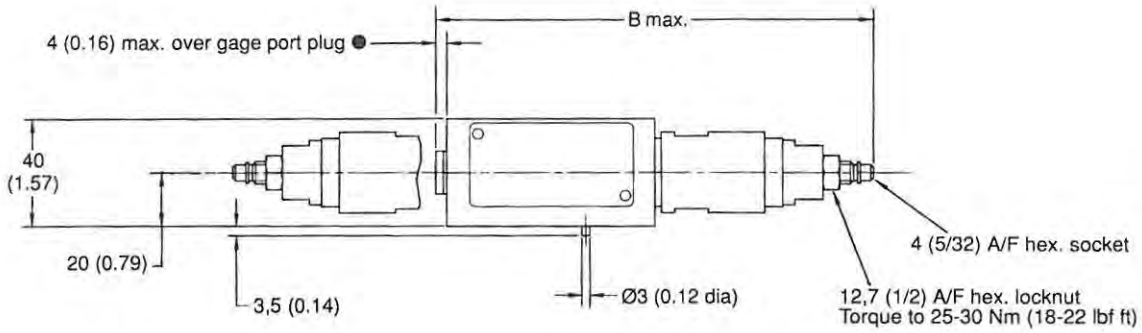
DGMC(2)-3-**-**(-B*-**)-40

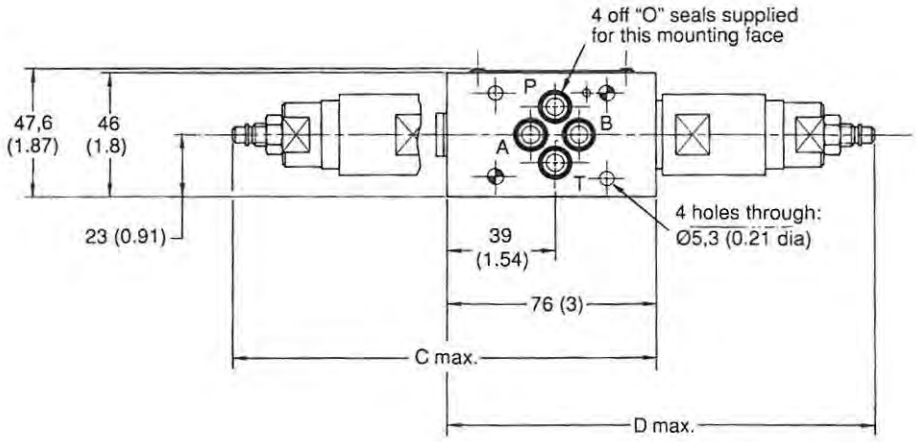
3rd angle projection

Models with type W adjuster

To adjust valve setting slacken off locknut and turn adjuster screw ■. Re-tighten locknut after completing adjustment.



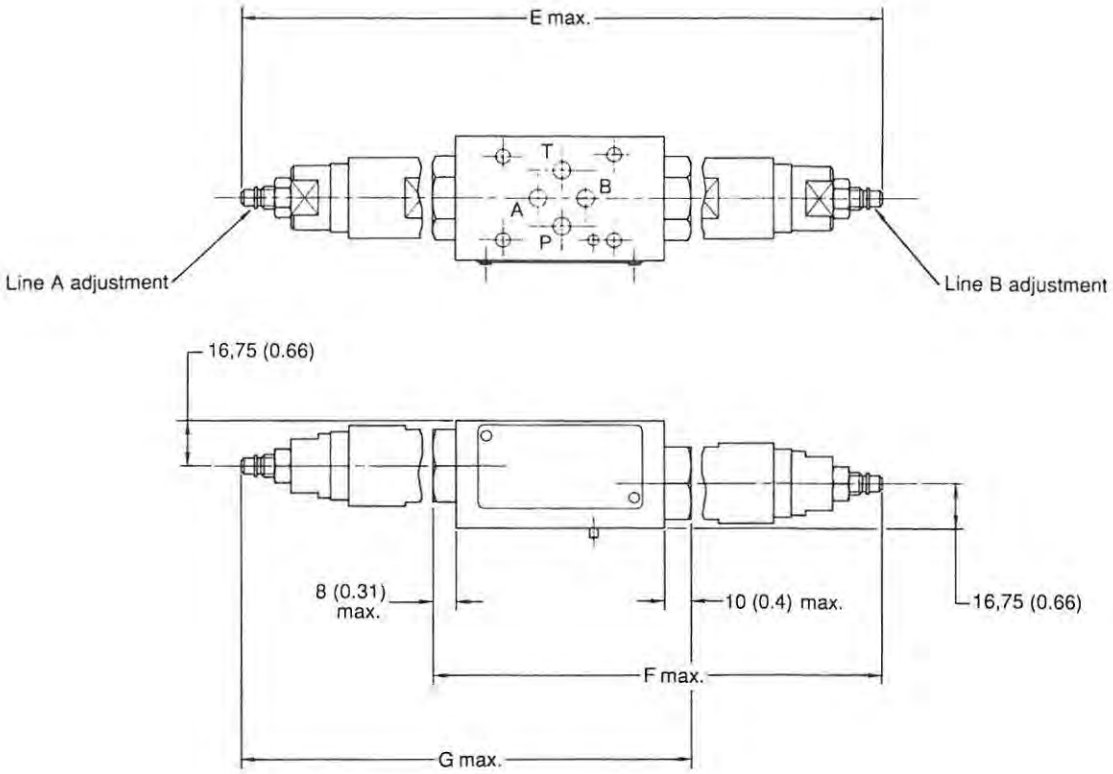




Model	A	B	C	D
DGMC-3-AT-*W-40	–	–	154(6.1)	–
DGMC-3-BT-*W-40	–	–	–	156 (6.2)
DGMC-3-BT-*W-*-40	–	160 (6.3)	–	–
DGMC-3-PT-*W-40	–	–	–	156 (6.2)
DGMC-3-PT-*W-*-40	–	160(6.3)	–	–
DGMC2-3-AT-*W-BT-*W-40	234 (9.2)	–	–	–

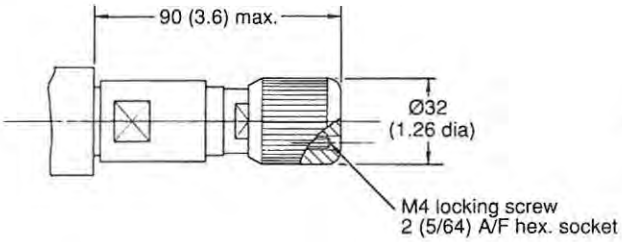
■ *Turn clockwise to increase pressure; counter-clockwise to decrease pressure*

● *For gage port thread options see model code* [8]



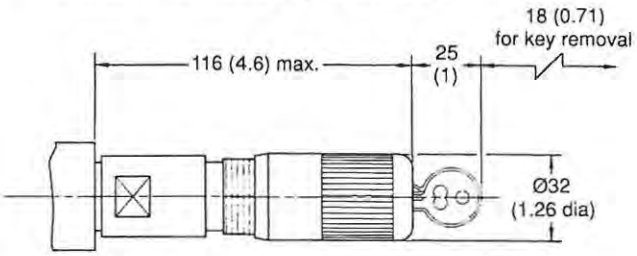
Type H adjuster

To adjust valve setting slacken M4 locking screw and rotate knob ■. Re-tighten locking screw after completing adjustment.



Type K adjuster

Key must be inserted and turned to allow valve setting to be adjusted ■. When key is removed adjustment mechanism can be freely turned without changing valve setting.



Model	E	F	G
DGMC-3-AB-*W-40	–	–	164 (6.5)
DGMC-3-BA-*W-40	–	164 (6.5)	–
DGMC2-3-AB-*W-BA-*W-40	234 (9.2)	–	–

■ *Turn clockwise to increase pressure; counter-clockwise to decrease pressure*

7. Spare parts

Valves are sold complete with all seals.
Spare seal kits available are:
For DCMC-3-40 models.....kit no. 870738
For DGMC2-3-40 models.....kit no. 870737

Note: seal kits cover various model options for the respective type; redundant seals will be found for some models.

8. Ordering procedure

See "Further information", item 7.

Pressure controls: counterbalance, sequence and pressure reducing valves

DGMR(1)-3, 40 series
DGMX2-3, 40 series

1. General description

These single-stage valves operate by the application of pressure on the end of the valve spool, acting against a spring which is loaded by means of the adjustment mechanism.

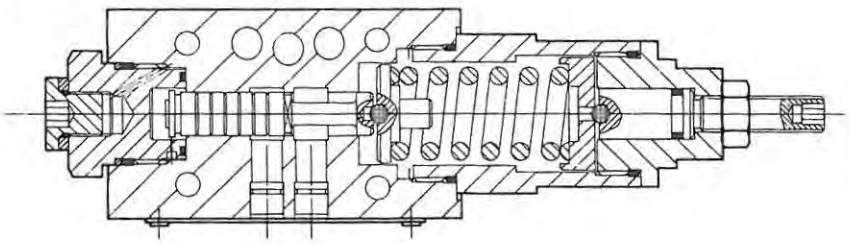
In the counterbalance and sequence valves the spool is offset by the spring such that flow cannot pass through the valve. When the force exerted by the pilot pressure on the spool end exceeds the force of the main spring, the spool is moved to allow flow through the valve.

In the pressure reducing valve the flow path is normally open and is closed as the pilot pressure exceeds the setting of the valve. Excessive pressure in the reduced-pressure line is prevented by a pressure relieving function.

Pressure adjustment options of control knob (with or without keylock) or screw/locknut design are available.

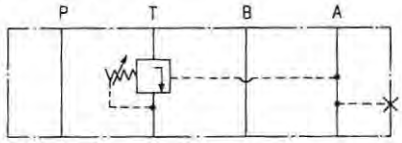


Typical section

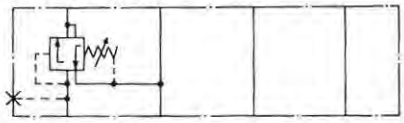


2. Functional symbols

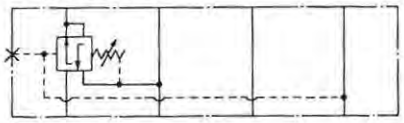
DGMR-3-TA



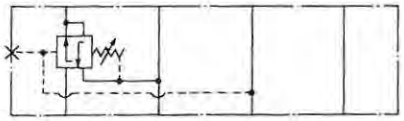
DGMR1-3-PP



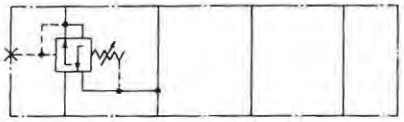
DGMX2-3-PA



DGMX2-3-PB



DGMX2-3-PP



3. Model code for counterbalance, sequence and pressure reducing valves

DGM * (*) - 3 - * * (*) - * * - * - 40

[1] [2] [3] [4] [5] [6] [7]

[1] Type

R = Counterbalance function
R1 = Sequence function
X2 = Pressure reducing function

[2] Function ports

For DGMR only:
TA = Counterbalance control function in "T" port, controlled by pressure in "A" port
For DGMR1 only:
PP = Sequence control in "P" port, controlled by pressure in "P" port
For DGMX2 only:
PA = Pressure reducing function in line P, piloted from A
PB = Pressure reducing function in line P, piloted from B
PP = Pressure reducing function in line P, piloted from P

[3] Adjuster location

Option on DGMX2 only
L = Adjuster at "A"-port end of valve
Blank = Adjuster at "B"-port end of valve

[4] Pressure adjustment range

A = 3-30 bar (43.5-435 psi)
B = 3,5-70 bar (51-1000 psi)
C = 10-140 bar (145-2000 psi)
F = 20-250 bar (290-3625 psi)

[5] Pressure adjustment/ locking method

H = Handknob
K = Micrometer with keylock
W = Screw and locknut

[6] Gage port

B = G1/8" (1/8 BSPF)
S = SAE 4 (7/16"-20 UNF-2B)

[7] Design number, 40 series

Subject to change. Installation dimensions unchanged for design numbers 40 to 49 inclusive.

Preferred model selection

The preferred products listed represent those models which are in regular volume production and are therefore most readily available at competitive prices. Other models constructed from the model code may be made available subject to the quantity requested. Please check price and availability before ordering.

With SAE gage port thread	With BSPF gage port thread
DGMR1-3-PP-CW-S-40	DGMR1-3-PP-CW-B-40
DGMX2-3-PA-AW-S-40	DGMX2-3-PA-AW-B-40
DGMX2-3-PA-BW-S-40	DGMX2-3-PA-BW-B-40
DGMX2-3-PB-AW-S-40	DGMX2-3-PB-AW-B-40
DGMX2-3-PB-BW-S-40	DGMX2-3-PB-BW-B-40
DGMX2-3-PB-CW-S-40	DGMX2-3-PB-CW-B-40
DGMX2-3-PP-AW-S-40	DGMX2-3-PP-AW-B-40
DGMX2-3-PP-BW-S-40	DGMX2-3-PP-BW-B-40
DGMX2-3-PP-CW-S-40	DGMX2-3-PP-CW-B-40

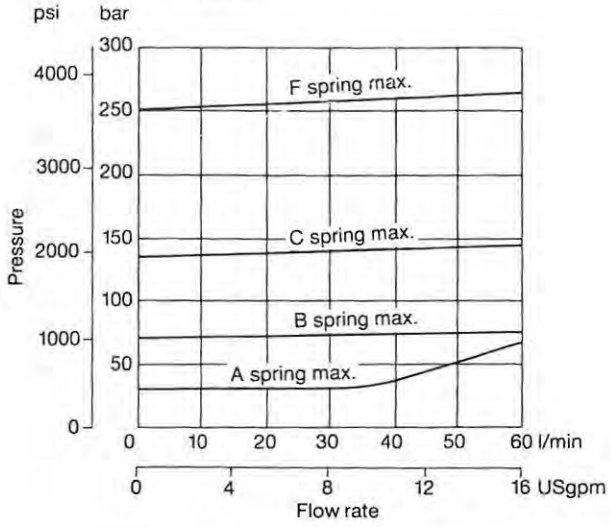
4. Operating data

Maximum flow	60 l/min (16 USgpm)
Maximum operating pressure	315 bar (4500 psi)
Pressure/flow characteristics	See graphs on next page
Low pressure performance limits: DGMX2	See graph on next page
"Dead head" leakage: DGMX2	See graph on next page
Hydraulic fluids	See "Further information", item 2
Filtration requirements	See "Further information", item 3
Temperature limits	See "Further information", item 4
Installation dimensions	See two pages on
Mass, approximate, all models	1,3 kg (2.9 lb)
Installation data: Mounting bolts Manifold blocks and subplates Mounting position	 See "Further information", item 1.1 See "Further information", item 1.2 Optional

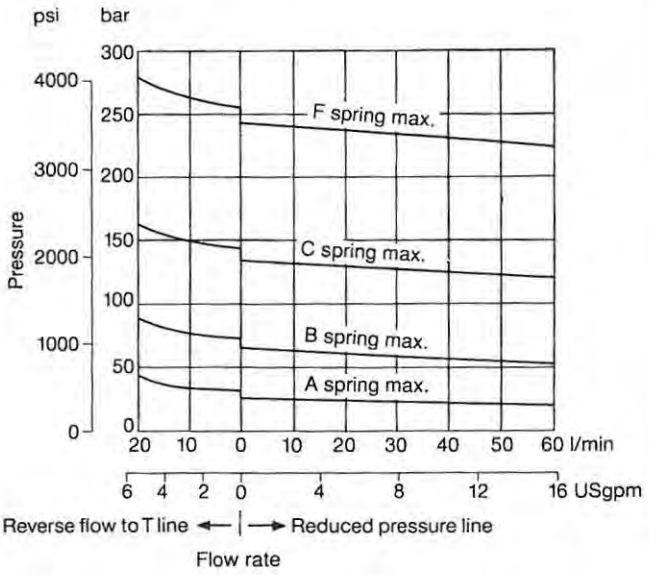
5. Performance characteristics

Typical performance with mineral oil at 21 cSt (102 SUS) and at 50°C (122°F).

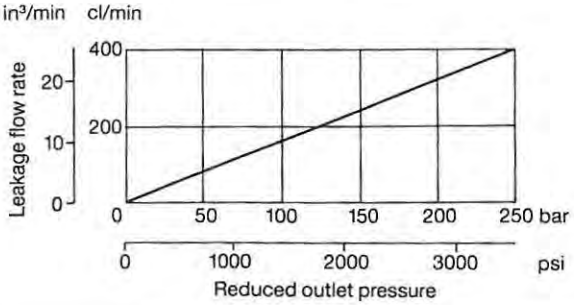
DGMR1-3-PP models



DGMX2-3-P* models

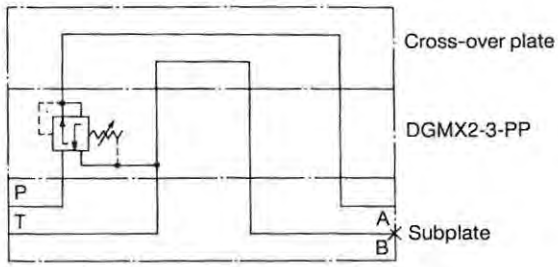


Typical leakage flow from reduced pressure line into line T at "dead head" condition (i.e. no flow required at reduced pressure outlet). This leakage flow must be provided at the inlet line P in order to maintain the reduced outlet pressure.

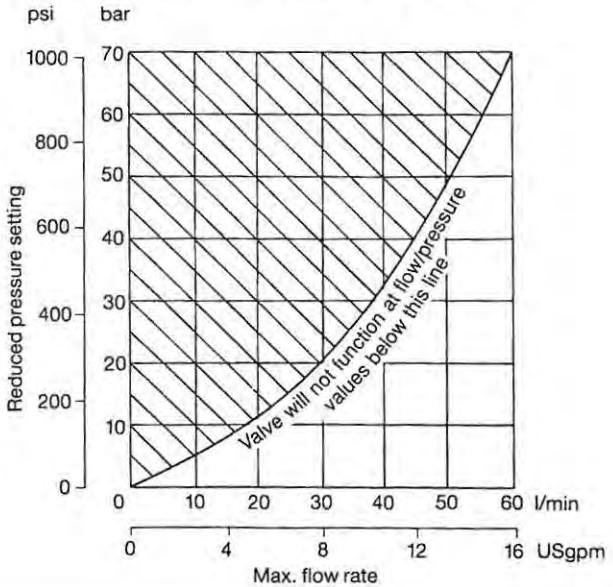


Note that the effective reduced pressure is the sum of the valve adjustment and any back-pressure in line T. The effect is illustrated below.

Typical installation



Low pressure/flow rate performance limits



6. Installation dimensions in mm (inches)

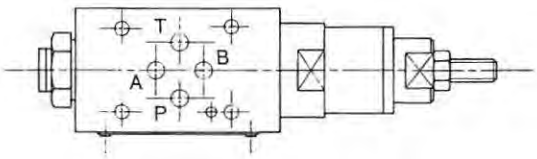
DGMR-3-TA-**-*-40
DGMR1-3-PP-**-*-40
DGMX 2-3-P*(L)-**-*-40

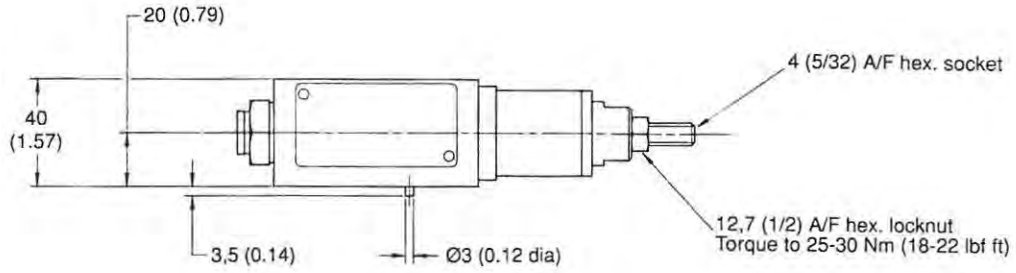
3rd angle projection

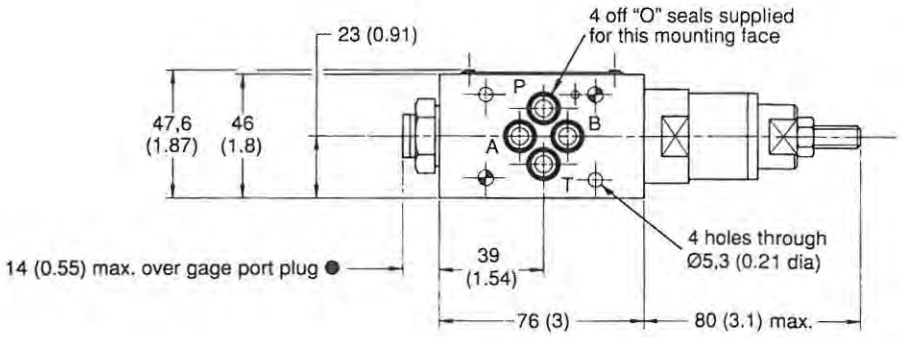
Models with type W adjuster

To adjust valve setting slacken off locknut and turn adjuster screw ■ Re-tighten locknut after completing adjustment.

DGMX2-3-**L models have adjuster and end cap/gage port locations interchanged from positions shown.

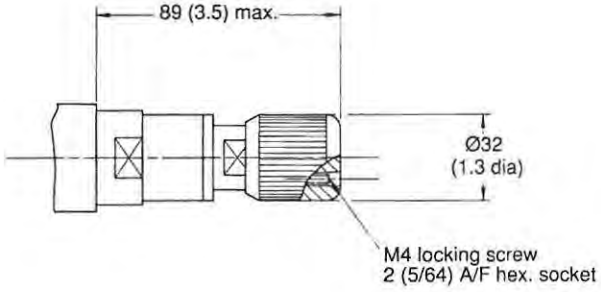






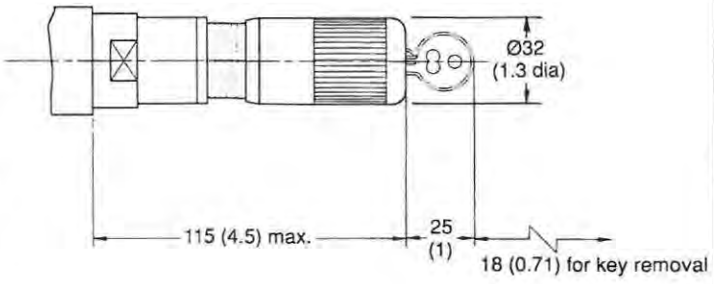
Type H adjuster

To adjust valve setting slacken M4 locking screw and rotate knob ■. Re-tighten locking screw after completing adjustment.



Type K adjuster

Key must be inserted and turned to allow valve to be adjusted ■. When key is removed, adjustment mechanism can be freely turned without changing valve setting.



■ *Turn clockwise to increase pressure; counter-clockwise to decrease pressure.*

● *For gage port thread options see model code* [6] *,(pressure plug fitted).*

7. Spare parts

Valves are sold complete with all seals. Spare seal kit no. 870739 is available for models DGMR-3-40, DGMR1-3-40 and DGMX2-3-40.

8. Ordering procedure

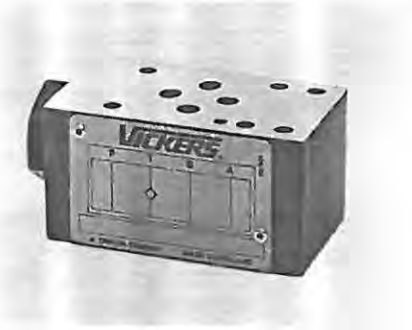
See "Further information", item 7.

Direct check valves

DGMDC-3, 40 series

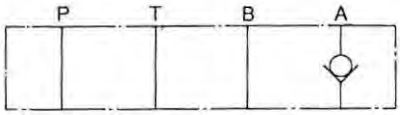
1. General description

These valves allow free flow in one direction in the line in which the check valve element(s) is (are) located; flow in the opposite direction is not possible.



2. Functional symbols

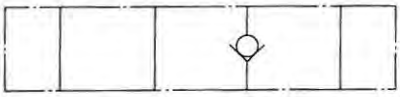
DGMDC-3-X-A*



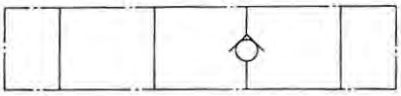
DGMDC-3-Y-A*



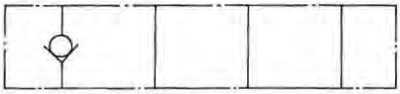
DGMDC-3-X-B*



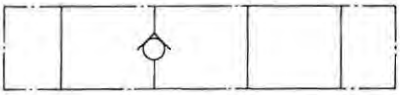
DGMDC-3-Y-B*



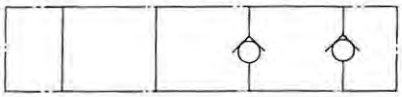
DGMDC-3-Y-P*



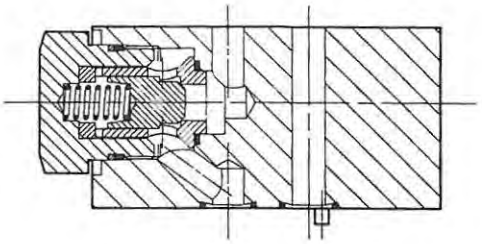
DGMDC-3-X-T*



DGMDC-3-Y-A*-B*



Typical section



3. Model code for direct check valves

DGMDC - 3 - * - * * (- * *) - 40

1 2 3 4 5 6

1 Direction of flow

X = Free flow away from actuator
Y = Free flow towards actuator

2 Check location

A = A line
B = B line
P = P line; with Y in 1
T = T line; with X in 1

3 Check valve opening/ cracking pressure

K = 1 bar (14.5 psi)
M = 2,5 bar (36 psi)
N = 5 bar (72 psi)

4 Check location (second element of dual model)

Only available as model type DGMDC-3-**Y**-**A***-**B***-40
B = B line

5 Check valve opening/ cracking pressure (second function of dual model)

Options as in 3

6 Design number, 40 series

Subject to change. Installation dimensions unchanged for design numbers 40 to 49 inclusive.

Preferred model selection

The preferred products listed represent those models which are in regular volume production and are therefore most readily available at competitive prices. Other models constructed from the model code may be made available subject to the quantity requested. Please check price and availability before ordering.

DGMDC-3-X-TK-40
DGMDC-3-Y-AK-40
DGMDC-3-Y-PK-40

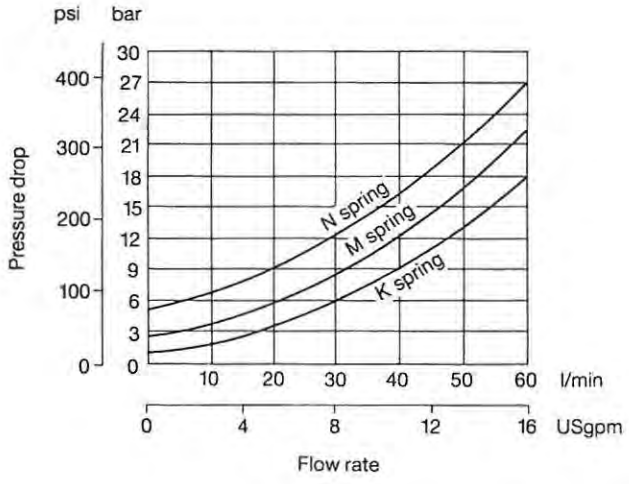
4. Operating data

Maximum flow rate	60 l/min (16 USgpm)
Maximum pressure	315 bar (4500 psi)
Pressure drop	See graph below
Hydraulic fluids	See "Further information", item 2
Filtration requirements	See "Further information", item 3
Temperature limits	See "Further information", item 4
Installation dimensions	See next page
Mass, approximate: DGMDC	1 kg (2.2 lb)
Installation data: Mounting bolts Manifold blocks and subplates Mounting position	 See "Further information", item 1.1 See "Further information", item 1.2 Optional

5. Performance characteristics

Typical performance with mineral oil at 21 cSt (102 SUS) and at 50°C (122°F) ●

Pressure drop: free flow through check valve



● *For other viscosities, see "Further information", item 5.*

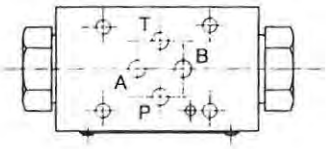
Internal leakage across closed check valve

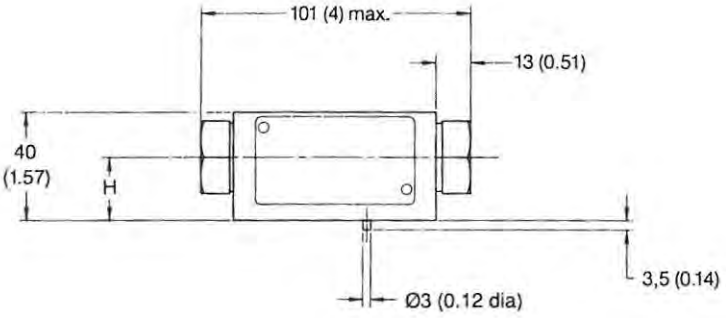
Less than 0,25 ml/min (0.015 in^3/min) at 250 bar (3625 psi)

6. Installation dimensions in mm (inches)

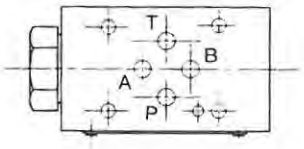
3rd angle projection

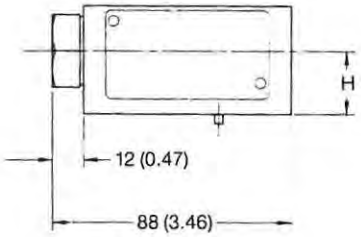
DGMDC-3-Y-A*-B*-40

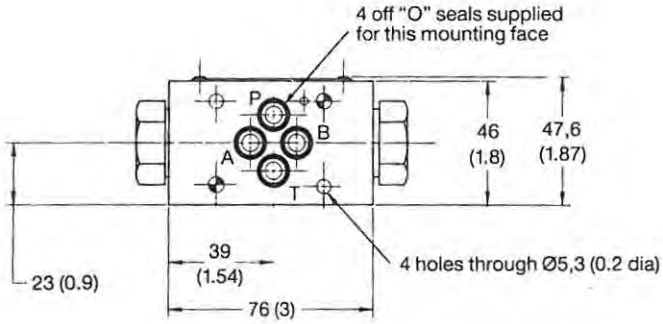




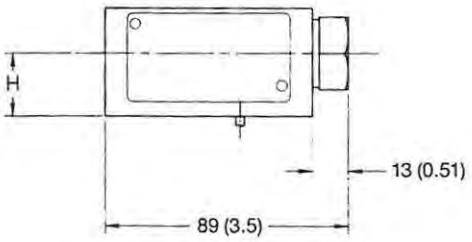
DGMDC-3-X-A*-40
DGMDC-3-X-T*-40
DGMDC-3-Y-A*-40
DGMDC-3-Y-P*-40







DGMDC-3-X-B*-40
DGMDC-3-Y-B*-40



Model type	H
DGMDC-3-X-A*-40 DGMDC-3-X-B*-40 DGMDC-3-Y-P*-40	16,75 (0.66)
DGMDC-3-X-T*-40 DGMDC-3-Y-A*-40 DGMDC-3-Y-B*-40 DGMDC-3-Y-A*-B*-40	23,25 (0.92)

7. Spare parts

Valves are sold complete with all seals.Spare seal kit no. 870708 is available for all DGMDC-3-40 models.

Note: this kit covers all types of DGMDC-3-40. Redundant seals will be found for all single line models.

8. Ordering procedure

See "Further information", item 7.

Pilot operated check valves

DGMPC-3, 40 series

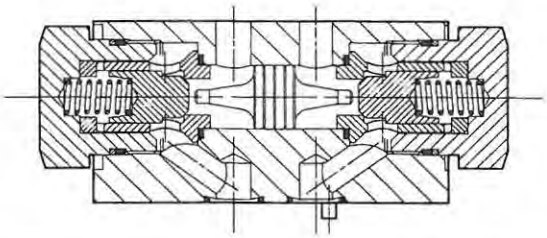
1. General description

These valves provide pilot operated check functions in one or both service lines (A or B), the operating pilot supply coming from the opposite service line. Thus with pressure in one service line the check valve in the other service line will be open (subject to system/actuator pressures being correct for the valve area ratios).

A 3:1 area ratio of pilot piston to check valve seat is supplemented by an optional 10:1 decompression feature.

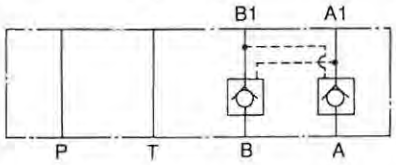


Typical section

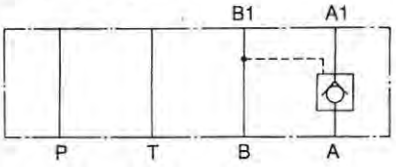


2. Functional symbols

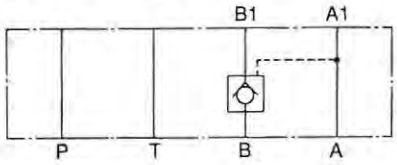
DGMPC-3-(D)AB*-(D)BA*



DGMPC-3-(D)AB*



DGMPC-3-(D)BA*



3. Model code for pilot operated check valves

DGMPC -3 -(D) ** * [-(D) ** *] - 40

1 2 3 4 5 6 7

1 Decompression feature
D = 10:1 decompression ratio
Omit if not required

2 Function
AB = Check in line A, pilot operated from line B
BA = Check in line B, pilot operated from line A (single check model only)

3 Check valve opening/ cracking pressure
K = 1 bar (14.5 psi)
M = 2,5 bar (36 psi)
N = 5 bar (72 psi)

4 Decompression feature (second function of dual models)
As in 1
Omit for single line models, and if not required for dual models
Note: "D" must be specified here, for dual models, if called for in 1

5 Second function of dual models
BA = Check in line B, pilot operated from line A
Omit for single line models

6 Check valve opening/ cracking pressure (second function of dual models)
Options as in 3
Omit for single line models

7 Design number, 40 series
Subject to change. Installation dimensions unchanged for design numbers 40 to 49 inclusive.

Preferred model selection

The preferred products listed represent those models which are in regular volume production and are therefore most readily available at competitive prices. Other models constructed from the model code may be made available subject to the quantity requested. Please check price and availability before ordering.

DGMPC-3-ABK-40
DGMPC-3-ABK-BAK-40
DGMPC-3-BAK-40

4. Operating data

Maximum flow rate	60 l/min (16 USgpm)
Maximum operating pressure	315 bar (4500 psi)
Pressure drop	See graphs below
Pilot pressure	See below
Hydraulic fluids	See "Further information", item 2
Filtration requirements	See "Further information", item 3
Temperature limits	See "Further information", item 4
Installation dimensions	See next page
Mass, approximate: DGMPC	0,8 kg (1.8 lb)
Installation data: Mounting bolts Manifold blocks and subplates Mounting position	 See "Further information", item 1.1 See "Further information", item 1.2 Optional

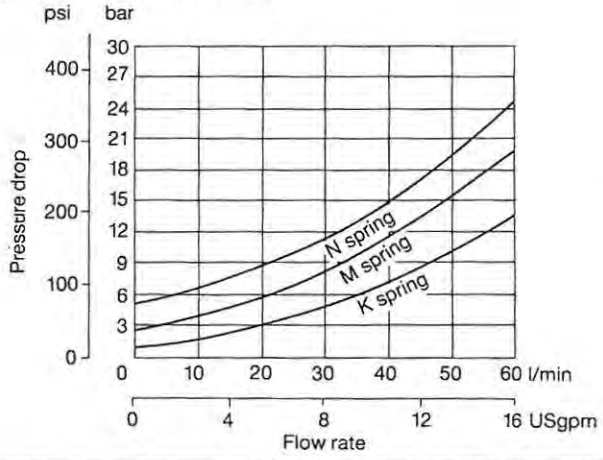
5. Performance characteristics

Pressure drop data

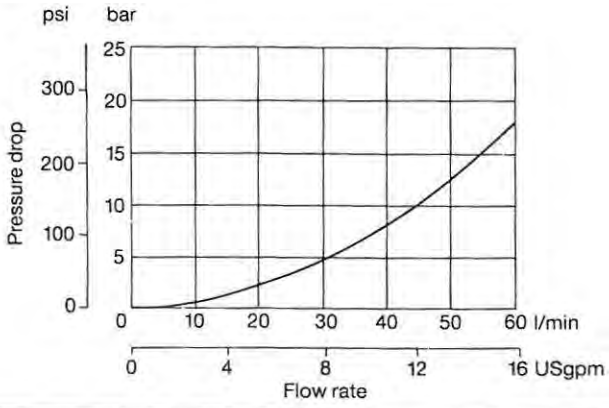
Typical performance with mineral oil at 21 cSt (102 SUS) and at 50°C (122°F) ●

● *For other viscosities see "Further information", item 5.*

Pressure drop: through check valve; flow path A1 to A or B1 to B (no pilot-pressure operation)



Pressure drop: flow path A to A1, or B to B1 with check valve pilot-operated fully open



Pilot pressures

Pilot area ratios:
Main check valve 3:1
Decompression poppet.....10:1
Use applicable ratio and opening/cracking pressure to calculate pilot pressure to open valve element, applied to the following formulae:

To open valve or decompression poppet in line A:

$$\text{Pressure at B1} = \frac{p_A + p_C - p_{A1}}{\text{Area ratio factor}} + p_{A1}$$

To open valve or decompression poppet in line B:

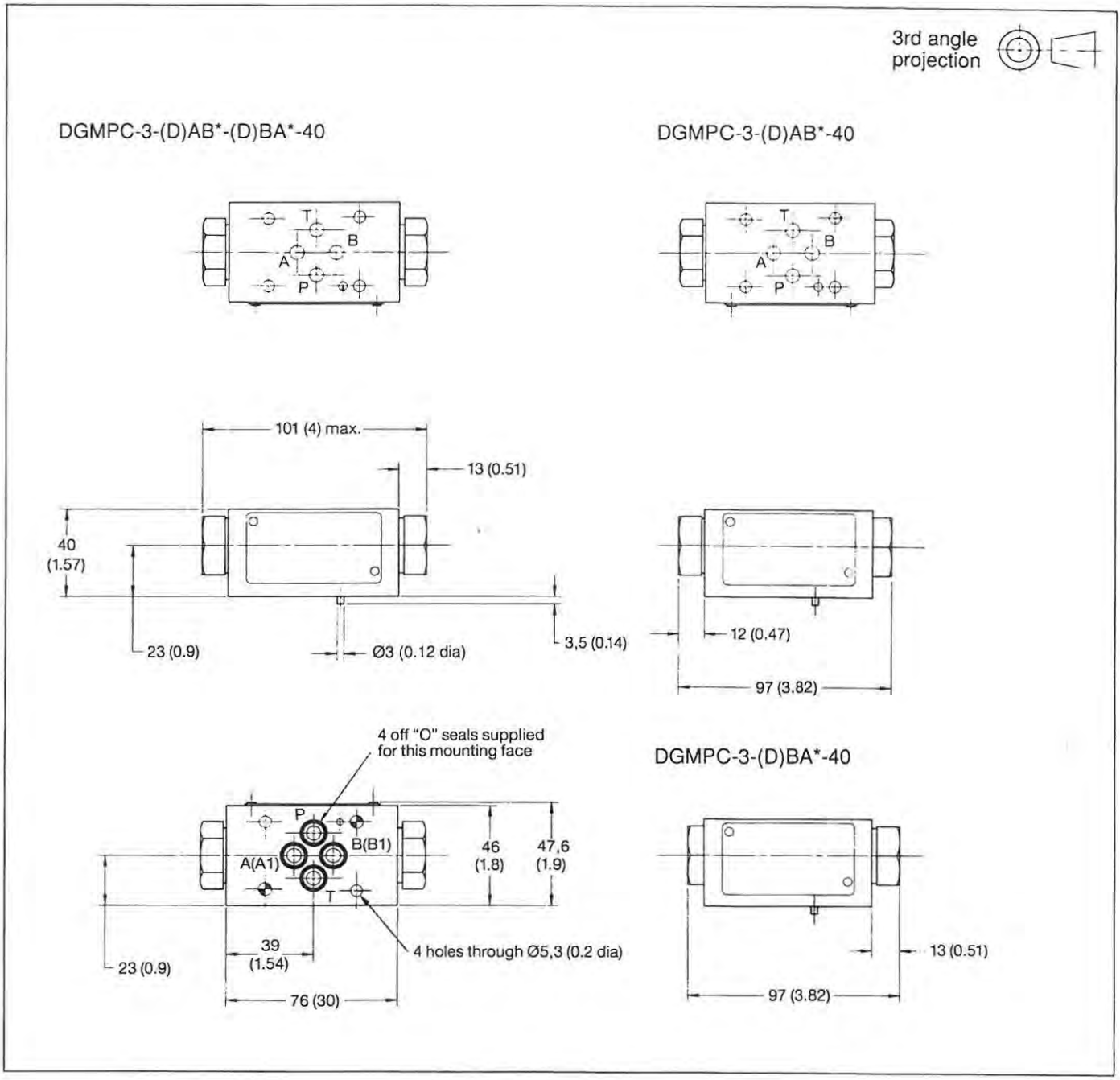
$$\text{Pressure at A1} = \frac{p_B + p_C - p_{B1}}{\text{Area ratio factor}} + p_{B1}$$

Where:
p_A = Pressure at A
p_C = Cracking/opening pressure
p_{A1} = Pressure at A1
p_B = Pressure at B
p_{B1} = Pressure at B1
A =, B =, A1 =, B1 = } Service line location; see functional symbols on previous page

Leakage

Less than 0,25 ml/min (0.015 in³/min) at 250 bar (3625 psi).

6. Installation dimensions in mm (inches)



7. Spare parts

Valves are sold complete with all seals. Spare seal kit no. 870708 is available for all DGMPC-3-40 models.

Note: this seal kit covers all DGMPC-3-40 model types. Redundant seals will be found for some models.

8. Ordering procedure

See "Further information", item 7.

Flow restrictor valves

DGMFN-3, 40 series

1. General description

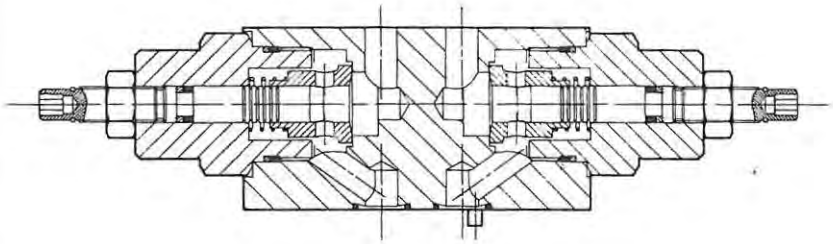
These valves regulate flow by means of an adjustable orifice which is not pressure compensated, and flow through the valve is entirely dependent upon pressure drop at any particular setting of the orifice.
Dual service-line models with an integral non-return valve around each control orifice provide for meter-in or meter-out control; single line versions of these are available.

For flow restriction in P or T lines (where reverse free flow is not required) models without check valves are available.

Adjustment options are either screw/locknut or handknob.

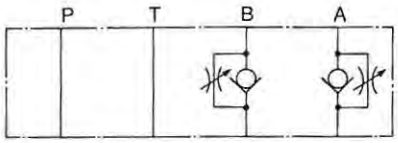


Typical section

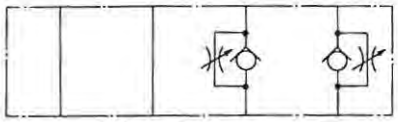


2. Functional symbols

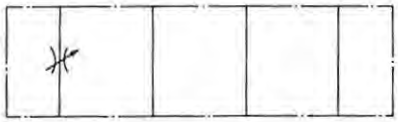
DGMFN-3-X-A**-B**



DGMFN-3-Y-A**-B**



DGMFN-3-Z-P**



DGMFN-3-Z-T**



3. Model code for flow restrictor valves

DGMFN - 3 - * - * * * (- * * *) - 40
[1] [2] [3] [4] [5] [6] [7] [8]

[1] Direction of flow control (with respect to machine actuator)

X = Meter-in control, applicable to lines A and B
Y = Meter-out control, applicable to lines A and B
Z = Meter-in control, line P only and meter-out control, line T only.

[2] Location of control function (single model or first line of dual model)

P = Line P (single model only)
T = Line T (single model only)
A = Line A (single model or first line of dual model)
B = Line B (single model only)

[3] Type of control needle/ orifice (single model or first line of dual model)

1 = Fine control
2 = Standard control

[4] Adjuster type (single model or first line of dual model)

H = Handknob
W = Screw/locknut

[5] Control in second line

B = Line B (use for dual models with "A" specified at [2])
Omit for single models

[6] Type of control needle/ orifice (second line of dual models)

Options as in [3]
Omit for single models

[7] Adjuster type (second line of dual models)

Options as in [4]
Omit for single models

[8] Design number, 40 series

Subject to change. Installation dimensions unaltered for design numbers 40 to 49 inclusive.

Preferred model selection

The preferred products listed represent those models which are in regular volume production and are therefore most readily available at competitive prices. Other models constructed from the model code may be made available subject to the quantity requested. Please check price and availability before ordering.

DGMFN-3-X-A1W-B1W-40
DGMFN-3-X-A2W-B2W-40
DGMFN-3-X-B2W-40
DGMFN-3-Y-A1W-B1W-40
DGMFN-3-Y-A2W-B2W-40
DGMFN-3-Y-A2W-40
DGMFN-3-Z-P2W-40
DGMFN-3-Z-T2W-40

4. Operating data

Maximum flow rate	60 l/min (16 USgpm)
Maximum operating pressure	315 bar (4500 psi)
Pressure drop	See graphs below
Hydraulic fluids	See "Further information", item 2
Filtration requirements	See "Further information", item 3
Temperature limits	See "Further information", item 4
Installation dimensions	See next page
Mass, approximate: DGMFN	1,1 kg (2.2 lb)
Installation data: Mounting bolts Manifold blocks and subplates Mounting position	 See "Further information", item 1.1 See "Further information", item 1.2 Optional

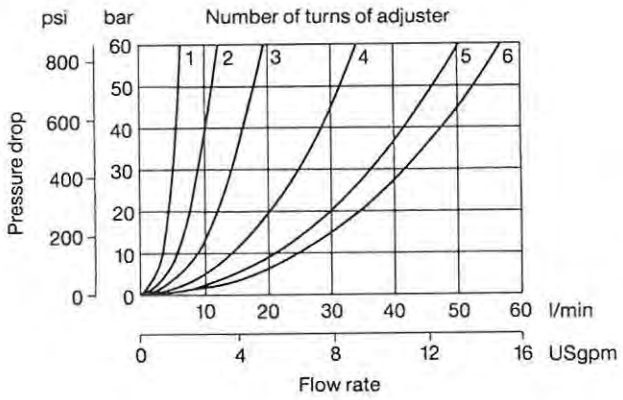
5. Performance characteristics

Pressure drop

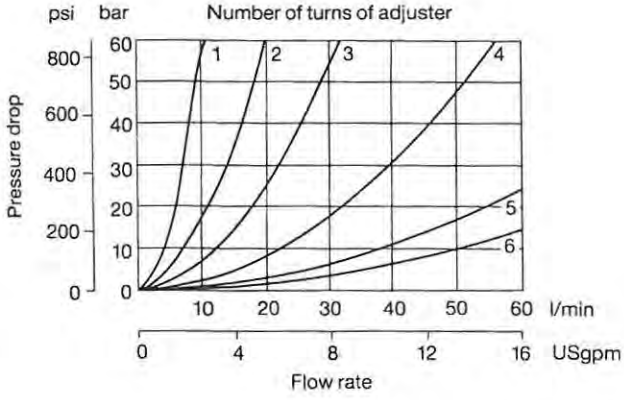
Typical performance with mineral oil at 21 cSt (102 SUS) and at 50°C (122°F) ●

● *For other viscosities see "Further information", item 5.*

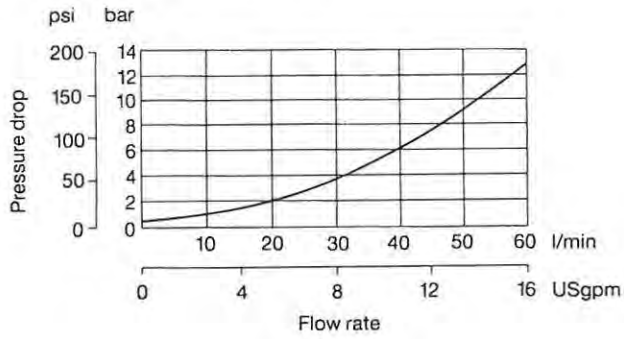
Type "1" needle (see model codes 3 and 6)



Type "2" needle (see model codes 3 and 6)



Free flow through check valve



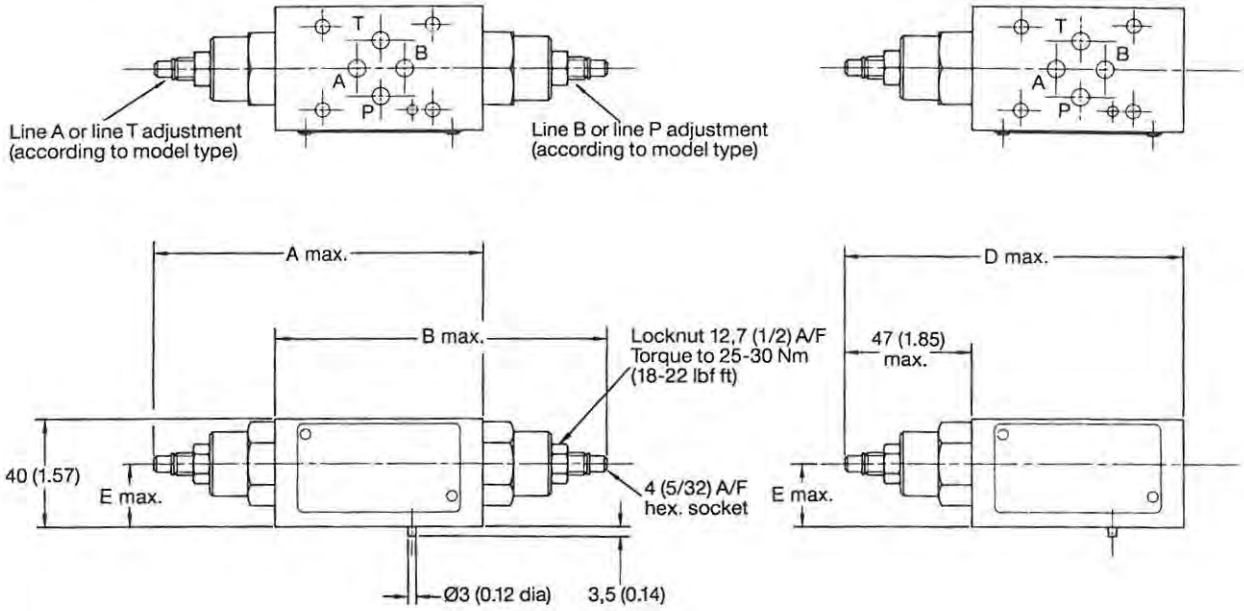
6. Installation dimensions in mm (inches)

DGMFN-3-X-***(-***)-40
DGMFN-3-Y-***(-***)-40
DGMFN-3-Z-***-40

3rd angle projection

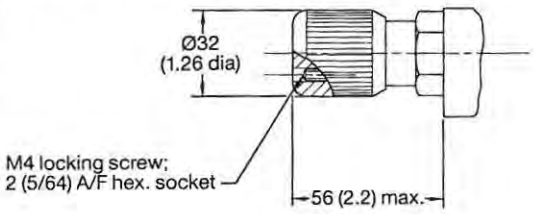
Models with type W adjuster

To adjust valve setting, slacken off locknut and turn screw ■. Re-tighten locknut after completing adjustment.



Type H adjuster

To adjust valve setting, slacken M4 locking screw and rotate knob ■. Re-tighten locking screw after completing adjustment.



■ *Turn clockwise to decrease flow (increase restriction); counter-clockwise to increase flow (reduce restriction).*

Model	A	B	C	D	E
DGMFN-3-X-A*W-40	121 (4.76)	–	–	–	16,75 (0.7)
DGMFN-3-X-A*W-B*W-40	–	–	167 (6.6)	–	16,75 (0.7)
DGMFN-3-X-B*W-40	–	122 (4.8)	–	–	16,75 (0.7)
DGMFN-3-Y-A*W-40	121 (4.76)	–	–	–	23,25 (0.9)
DGMFN-3-Y-A*W-B*W-40	–	–	167 (6.6)	–	23,25 (0.9)
DGMFN-3-Y-B*W-40	–	122 (4.8)	–	–	23,25 (0.9)
DGMFN-3-Z-P*W-40	–	–	–	123 (4.8)	16,75 (0.7)
DGMFN-3-Z-T*W-40	–	–	–	123 (4.8)	23,25 (0.9)

7. Spare parts

Valves are sold complete with all seals. Spare seal kit no. 870707 is available for all DGMFN-3-40 models.

Note: this kit contains seals for all model types. Redundant seals will be found for some models, e.g. single line models.

8. Ordering procedure

See "Further information", item 7.

Further information

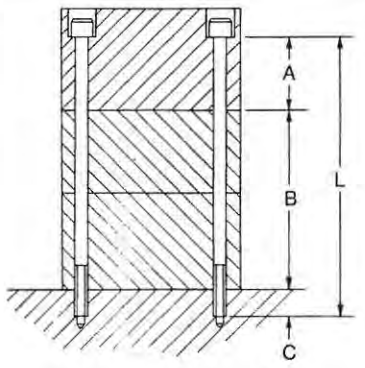
1. Mounting bolts, subplates and manifold blocks

1.1 Mounting bolts

The length of mounting bolt used to install a SystemStak assembly is dependent on the number of valves being used, plus the length needed for mounting other valves in the assembly, such as:

- solenoid operated, or other type of directional valve
- tapping plate
- blanking or crossover plate.

Vickers offers a large selection of bolt kits (one bolt kit for these SystemStak valves comprises 4 bolts) in metric and inch sizes as listed. To determine your needs, use the following guide for bolt length calculation.



A = Bolt clamp length in directional valve, blanking plate, crossover plate, etc.
B = Height of intermediate valve stack, comprising Vickers SystemStak valve(s) plus tapping plates, etc.
C = Depth of thread engagement in subplate/manifold block:
8/10 mm (0.3/0.4"), valid for:
315 bar (4500 psi) when using cast iron or steel subplates/manifold blocks, or 210 bar (3045 psi) when using Vickers aluminium alloy manifold blocks.
L = Required bolt length; select from the table.

Notes

1. *Bolts should be torqued to 7–9 Nm (63–80 lbf in) with threads lubricated.*
2. *If not using Vickers bolt kits, bolts must be to Grade 12.9 (ISO 898) or better.*

Bolt kit selection

Metric: M5–6g		Inch: 10–24 UNC-3A	
Length (mm)	Vickers bolt kit number	Length (in)	Vickers bolt kit number
50	BK466835M	2.0	BK255698
60	BK466836M	2.375	BK466849
70	BK464125M	2.75	BK870017
80	BK466837M	3.125	BK466850
90	BK466838M	3.5	BK466851
100	BK466839M	3.937	BK466852
110	BK466840M	4.312	BK466853
120	BK466841M	4.75	BK466854
130	BK466842M	5.125	BK466855
140	BK466843M	5.5	BK466856
150	BK466844M	5.937	BK466857
160	BK466845M	6.312	BK466858
170	BK466846M	6.687	BK466859

1.2 Subplates and manifold blocks

For BSPF port threads and metric mounting bolt types, refer to data sheet V-1310 (see section "J" of catalog C-2005).

For SAE straight port threads and UNC (or metric) mounting bolt types, refer to data sheet I-517355 (see section "I" of catalog #400).

2. Hydraulic fluids

Materials and seals used in these valves are compatible with anti-wear hydraulic oils, water-in-oil emulsions, water glycols and non-alkyl-based phosphate esters. The extreme operating viscosity range is from 500 to 13 cSt (2270 to 70 SUS) but the recommended operating range is 54 to 13 cSt (245 to 70 SUS). For further information about fluids see "Technical information" leaflet B-920 or I-286S.

3. Filtration requirements

Up to 200 bar (3000 psi): ISO 4406 20/16
Above 200 bar (3000 psi): ISO 4406 18/14

4. Temperature limits

Ambient range.....–20°C to +80°C
(–4°F to +176°F)

Fluid temperatures

	Petroleum oil	Water-containing
Min.	–20°C (–4°F)	+10°C (+50°F)
Max.*	+80°C (+176°F)	+54°C (+129°F)

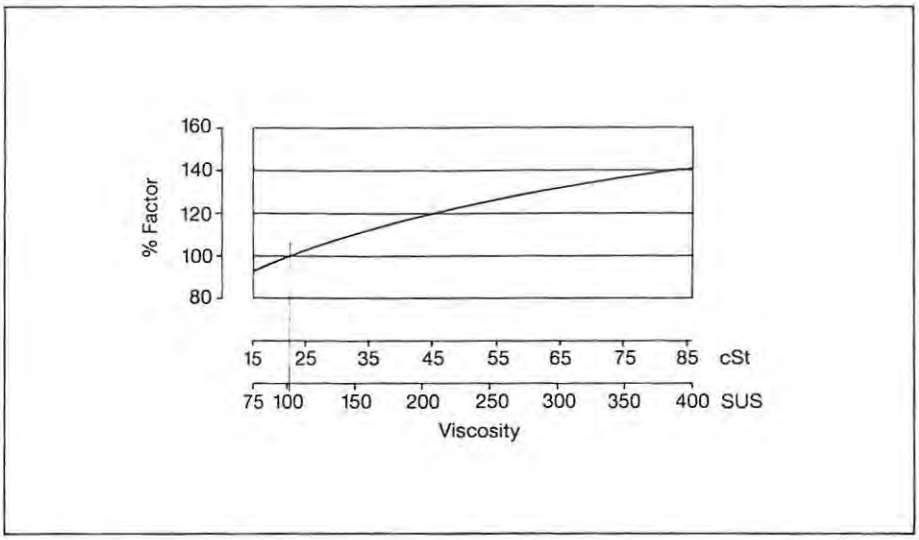
* *To obtain optimum service life from both fluid and hydraulic system, 65°C (150°F) is the recommended maximum fluid temperature, except for water-containing fluids.*

For synthetic fluids consult fluid manufacturer or Vickers representative where limits are outside those for petroleum oil.

Whatever the actual temperature range, ensure that fluid viscosities stay within the limits specified in item 2, "Hydraulic fluids".

5. Pressure drop at other viscosities

Published pressure drop data is valid for a fluid viscosity of 21 cSt (102 SUS). The graph shows the approximate percentage change in pressure drop for a range of other viscosities. To determine the approximate pressure drop for any given fluid viscosity, multiply the published data by the % factor for the required viscosity.



6. Warranty and repair

Units to be returned under warranty should be sent, with a description of the fault, to the Vickers representative in your area.

Repair of these size 03 valves is not generally economically viable. Contact your nearest Vickers representative before returning any unit for repair.

7. Ordering procedure

Specify requirements by valve model code, and by seal kit number. To ensure best availability refer to "Preferred model selection" list (for each model type) when designing your SystemStak system.

Hydraulics, electro-hydraulics, electronics: high performance products with quality standards second to none – for enhanced productivity and economy.

Vickers components and systems are used extensively for in-plant machinery, mobile vehicles, automotive equipment, aerospace and marine applications.

Berendsen Fluid Power

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FAX: (805) 392-1468

Sacramento
(916) 372-0550
FAX: (916) 372-3817

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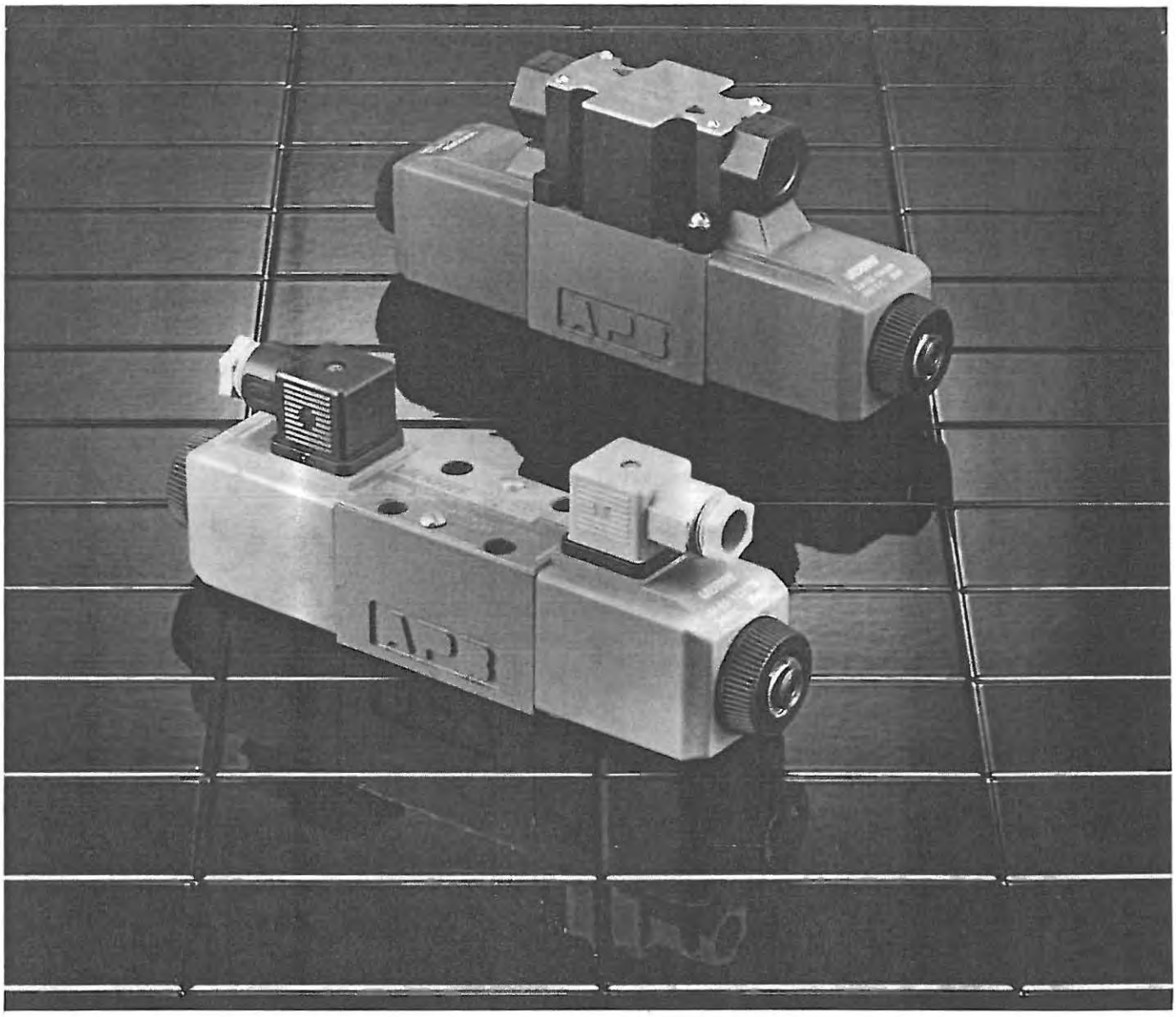
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CETOP 3 Size Soft Shift Directional Control Valves

DG4V-3(S)-60 Design



Introduction

General Description

Basically, these solenoid operated directional control valves are for directing and stopping flow at any point in a hydraulic system.

The soft shift feature is designed to provide smoother control of actuator acceleration and deceleration than is possible with conventional solenoid valves. The result is minimum hydraulic shock, more reliable systems with longer component life and less downtime.

Features & Benefits

- Milled metering notches on the spool enable precise control of flow rate change as the spool is shifted.
- Easily interchangeable orifice plugs allow for fine tuning of valve shift time to each application.
- Standard and high performance solenoids offer designers a choice of flow and tank pressure ratings to match system requirements.
- A "P12L" model offers a junction box with rectifier, lights and plug-in coils for quick and easy solenoid changing without removing the valve from the machine.
- Installed cost and space savings from higher power/weight–and–size ratios.
- Reduced internal leakage reduces power losses, increases system efficiency: the result of improved manufacture of spool and bores.
- Installation flexibility resulting from a choice of numerous combinations of solenoid connectors and locations.
- Multi–fluid capability without need to change seals.
- Higher sustained machine productivity and higher uptime because of proven fatigue life and endurance, tested over 20 million cycles.
- Solenoid coils can be changed quickly and easily without leakage from hydraulic system.
- Compact, cost effective system design when used with Vickers SystemStak™ valves and multi–port subplates.

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DG4V-3(S) Soft Shift Model Series

Model Code

DG4V - 3(S)- **(L) 2 ** - (P2) - (V) M - * * * * (L) - **H* - 60 - (P*-A*-B*-T)

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

1 Valve Type

D – Directional control valve
G – Subplate mounted
4 – Solenoid operated
V – Rated pressure (350 bar)

2 Interface

3 – ISO 4401-03, CETOP 3 (NFPA D03)

3 Valve Performance

S - Standard performance
Blank - High performance

4 Spool Types

0 – Open center
2 – Closed center (all ports)
3 – P & B closed, A to T
6 – Closed center (P only)
8 – Tandem center (open crossover)
31 – P & A closed, B to T
33 – Closed center (bleed A & B)

5 Spool/Spring Arrangement

A – Spring offset, single solenoid
AL – Spring offset, single solenoid (left hand build)
B – Spring centered, single solenoid
BL – Spring centered, single solenoid (left hand build)
C – Spring centered

6 Soft Shift Valve

7 Soft Shift Orifice Size

00 – No orifice
07 – 0.7 mm dia.
08 – 0.8 mm dia.
09 – 0.9 mm dia.
20 – 2.0 mm dia*

* Minimum orifice size recommended for high performance type "8C" spool.

8 Manual Override

Blank – Override in solenoid end only
P2 – Manual override in end cap and solenoid, A & B models only.

9 Solenoid Energization identity

Blank – ANSI B93 energize solenoid A to give flow P to A
V – Solenoid identification determined by position of solenoid (i.e. solenoid A is at port A end of valve, solenoid B is at port B end of valve.)

10 Flag Symbol

(Introduces electrical features and options)

11 Coil Types

F – Flying lead type coils
U – DIN 43650 coils
SP1 – Single $^1/_4$" male spade
SP2 – Dual $^1/_4$" male spade
P12L – Plug-in coils w/rectifier in junction box, lights included.
KU – Top exit flying leads

12 Coil Connectors

("U" type coils only, omit if not required)
1 – Connector fitted
6 – Connector with light fitted
11 – Rectifier with lights fitted
12 – Rectifier fitted

13 Electrical Connections

("F" type coils only, omit if not required)

PA – Insta-plug male recpt. only
PA3 – 3-pin receptacle
PA5 – 5-pin receptacle
PB – Insta-plug male & female recpt.
T – Terminal block

14 Wiring Housing Thread

("F" type coils only, omit if not required)

W – $^1/_2$" NPT
J – M20 x 1.5 - 6H
G – G$^1/_2$

15 Solenoid Indicator Lights

(Not available on PA, U, SP1, SP2. Omit if not required.)

16 Coil Identification Letter

GH – 12V DC
DTH– 18V DC
HH – 24V DC
DJH – 98V DC (req'd. for P12L models)
PH – 110V DC
SH – 220V DC

17 Tank Pressure Rating

2 – 10 bar (145 psi)
5 – 100 bar (1450 psi) for DG4V-3S
7 – 207 bar (3000 psi) for DG4V-3

18 Design Number

19 Port Orfices

Blank – 00
03 - 0.3 mm dia.
06 - 0.6 mm dia.
08 - 0.8 mm dia.
10 - 1.0 mm dia.
13 - 1.3 mm dia
15 - 1.5 mm dia.
20 - 2.0 mm dia.
23 - 2.3 mm dia.
(Example: "P03" = 0.3 mm dia. orifice in P port of valve. Omit if not required

DG4V-3S-60 Operating Data

Basic Characteristics

Max. pressure ports P, A & B:
. . . . . 350 bar (5075 psi)
Max. pressure port T:
3S . . . . . 100 bar (1450 psi)
3 . . . . . 207 bar (3000 psi)

Max. flow: 3S . . up to 40 l/min
. . . . (10.5 USgpm)
3 . . . up to 76 l/min
. (20 USgpm)

Mounting Interface

ISO 4401-03
CETOP 3
NFPA D03

Seals & Fluid Cleanliness

Fluorocarbon seals are standard and are suitable for use with phosphate ester type fluids or its blends, water glycol, water–in–oil emulsion fluids and petroleum oil. Refer to data sheet I–286–S for hydraulic fluid and temperature recommendations.

Proper fluid condition is essential for long and satisfactory life of hydraulic components and systems. Hydraulic fluid must have the correct balance of cleanliness, materials and additives for protection against wear of components, elevated viscosity and inclusion of air.

Essential information on the correct methods for treating hydraulic fluid is included in Vickers publication 561; "Vickers Guide to Systemic Contamination control," available from your local Vickers distributor or by contacting Vickers, Incorporated.

Recommendation of filtration and the selection of products to control fluid condition are included in 561.

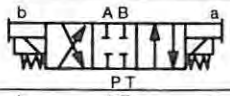
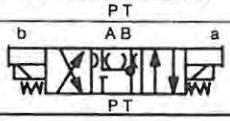
Recommended cleanliness levels using petroleum oil under common conditions is based on the highest fluid pressure levels in the system.

Directional controls, regardless of manufacturer, will operate with fluids showing a higher cleanliness code. The operating life of the control, and other components in the system, will be less however. For maximum life and best system performance, cleanliness codes as defined below should be achieved.

Fluids other than petroleum, severe service cycles or temperature extremes are cause for adjustment of these cleanliness codes. See Vickers Publication 561 for exact details.

	System Pressure		
	1000 psi	2000 psi	3000+ psi
Valves	20/18/15	20/18/15	19/17/14

Functional Symbols

Standard Spool Types	Graphic Symbol Center Condition	Spring Offset	Spring Centered
0			
3			
2			
6			
8			
31			
33			

Solenoid Energizing

Spring centered and spring offset valves will be spring positioned unless the solenoid is energized continuously.

NOTE

Any sliding spool valve, if held shifted under pressure for long periods, may stick and not spring return, due to silting. Therefore, it is recommended that the valve be cycled periodically to prevent this from occurring.

Only DC coil voltages are available. For applications where the junction box is required, valves with F (flying lead) type coils must be driven by a DC electrical signal. The P12L models must be driven by a 110-120, 50-60 Hz AC signal. For other applications, rectified DIN connectors ('11' or '12' in model code) can be used to convert AC input voltage to the DC voltage necessary to power the valve.

NOTE

The P12L designated coil is rectified.

Bleeding Procedure

Apply a minimum of 3.4 bar (50 psi) tank pressure. Shift either solenoid "a" or "b". Loosen manual actuators in solenoid ends until air is evacuated. Retighten manual actuators. No further bleeding should be required.

Initial start ups thereafter will require 6-8 shifts to refill solenoid tubes. Addition of a back pressure check valve may be required to prevent bleed down.

Drain

The tank line must be plumbed above the level of the core tube (and valve body). This will insure that the tank port is always flooded with oil. By doing this, the core tube will remain flooded with oil and the soft shift operate as designed.

Specifications

Maximum flow . See curves on page 6
Maximum operating
pressure ..... 350 bar (5000 psi)
Rated fatigue pressure ports
A, B and P ..... 350 bar (5000 psi)
Maximum tank
line pressure 3S 100 bar (1450 psi)
..... 3 207 bar (3000 psi)
Mounting interface
..... ISO 4401–3, CETOP 3
Weights
Double solenoid
models ..... 2.1 kg (4.6 lbs)
Single solenoid
models ..... 1.7 kg (3.7 lbs)

Solenoids

Solenoid Voltage DC	Solenoid ID	Amps	Watts	Ohms
12	GH	3.1	39	3.8
24	HH	1.5	36	15.9
98	DJH	.38	35	275
110	PH	.34	37	328
18	DTH	2.1	39	8.4
220	SH	.17	37	1280

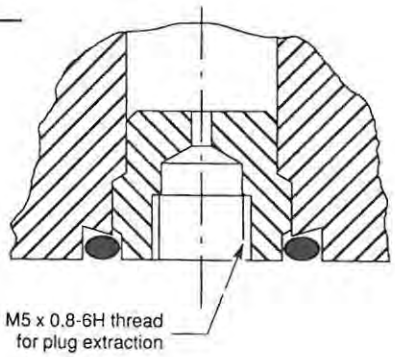
Valve Port Restrictor Plugs

Restrictor plugs are available for use in ports P, T, A, or B. These can be used for restricting flow or for circuit dampening. Restrictor plugs are not recommended for use above 210 bar (3000 psi) system pressure.

Part Number†	Orifice ∅	Model Code
694353	Blank	*00
694341	0,30 (0.012)	*03
694342	0,60 (0.024)	*06
694343	0,80 (0.030)	*08
694344	1,00 (0.040)	*10
694345	1,30 (0.050)	*13
694346	1,50 (0.060)	*15
694347	2,00 (0.080)	*20
694348	2,30 (0.090)	*23

† – Available in multiples of 25 per part number

* – P, T, A, or B as required



Response Time

Response times are increased over that of a standard solenoid. These times are influenced by flow, pressure, applied solenoid voltage, oil viscosity and ambient temperatures.

Response times can be fine tuned to the application by orifices that are interchangeable via the manual actuator in the solenoid end. See model code for available orifices.

Response times shown are for a type "2C" spool at a system pressure of 207 bar (3000 psi), flow at 19 L/min (5 USgpm), solenoid voltage at 100% of rating and 38° C (100° F) oil temperature. Times are determined from the instant of power on/off to the point of maximum cylinder velocity (shift) or the end of cylinder movement (spring return). All times are without arc suppression diodes. Spring return times can be expected to increase with diodes in place.

Response times greater than 700 msec are not recommended.

NOTE

For the high performance type "8C" model, core tube orifice sizes smaller than 2.0 mm diameter are not recommended.

Orifice Diameter mm	Response Times		Color Code
	Shift (ms)	Spring Return (ms)	
0,7	625	550	Green
0,8	400	375	Blue
0,9	250	250	Purple

Response times for spools other than the 2C spool are similar and are system dependent.

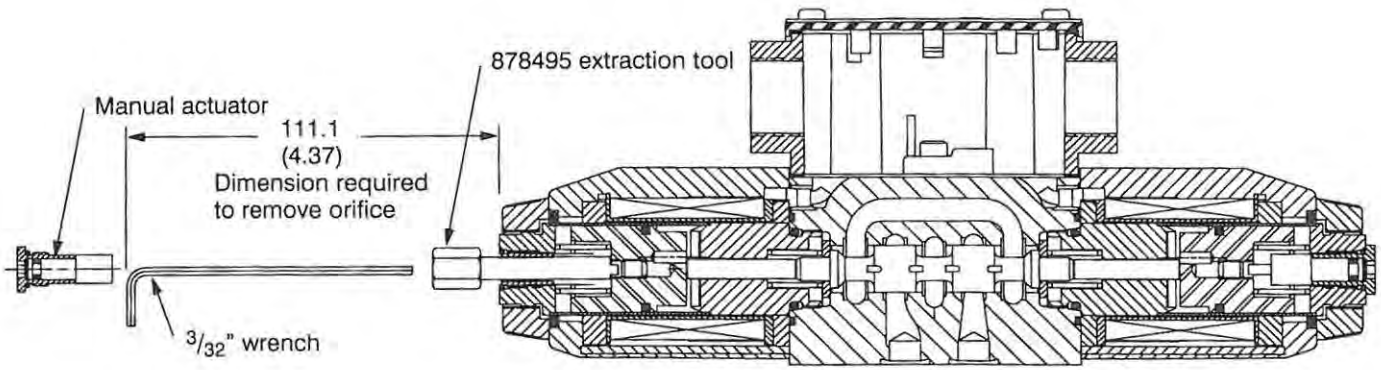
Orifice Changing Procedure

WARNING

1. Before breaking a circuit connection make certain that power is off and system pressure has been released. Lower all vertical cylinders, discharge accumulators and block any load whose movement could generate pressure. Plug all removed units and cap all lines to prevent entry of dirt into the system.
2. Using a $^{5}/_{32}$" hex key, remove manual actuator plug and spring from the end of solenoid (Tightening torque 6.2–7.3 N.m 55–65 lbf.in.)
3. Insert extraction tool (878495) into solenoid via the manual actuator opening. Rotate tool until aligned and push pin into slot in armature.
4. Using $^{1}/_{2}$" wrench and tool to prevent the armature from rotating, insert $^{3}/_{32}$" hex key down the center of tool and remove orifice plug.
5. Replace by the same method, tightening orifice snug to ensure bottoming of threads. Smaller orifices increase response times, larger orifices decrease response time.

Orifice & Tool Kit 02-140211

For fine tuning shift performance, orifices
must be ordered separately. The kit includes (2) each of .7, .8 & .9 mm dia. orifices, (1) installation tool, (1) $^{5}/_{32}$" hex key and (1) $^{3}/_{32}$" hex key.



Performance Data

Pressure Drops

The pressure drop values shown are typical. Actual pressure drops will vary ±10%.

The pressure drop curves give approximate pressure drop (ΔP) when passing 21 cSt (100 SUS) fluid having .865 specific gravity through the indicated flow path.

For any other viscosity, the pressure drop (ΔP) will change as follows:

Viscosity(s) cSt (SUS)	14 (75)	32 (150)	43 (200)	54 (250)	65 (300)	76 (350)	87 (400)
% of ΔP (Approximate)	93	111	119	126	132	137	141

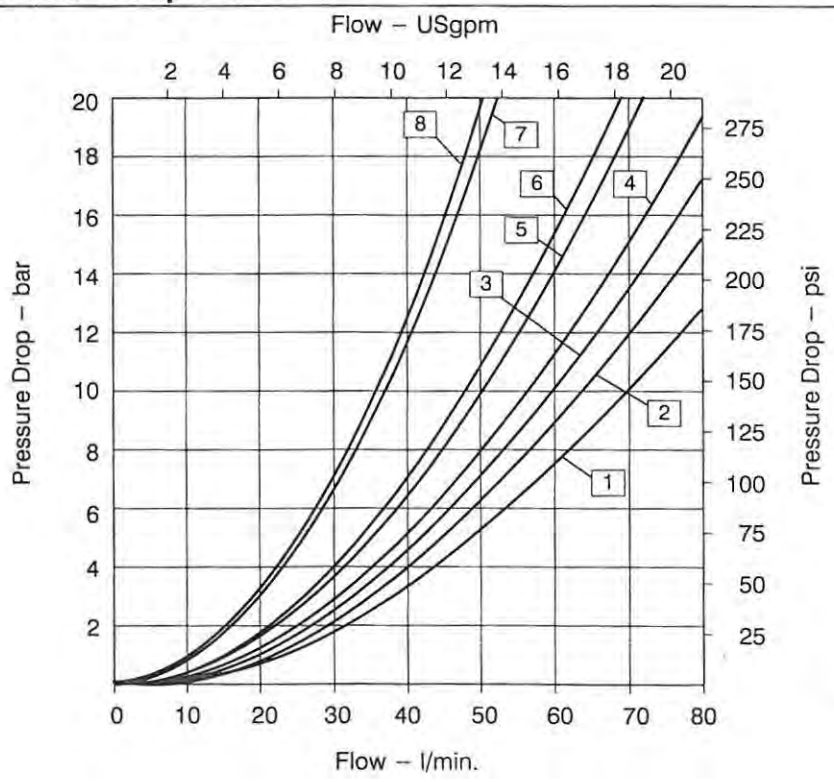
Spool Type	Pressure Drop Curve Reference Chart			
Spring Centered	P–A	B–T	P–B	A–T
A B "0C" + P T	5	1	5	1
A B "2C" P T	5	4	5	4
A B "6C" P T	6	1	6	1
A B "8C" + P T	5	3	5	3
A B "3C" P T	5	4	5	1
A B "31C" * P T	5	1	5	4
A B "33C" * P T	6	2	6	3

Spring Offset	P–A	B–T	P–B	A–T
A B "2A" P T	7	5	8	5

* NOTE: Type "33" spool at center will pass 650 ml/min (40 in^3/min) to 15 L/min (4.0 USgpm) at 103 bar (1500 psi) tank pressure to both "A" and "B" ports.

"+" type "0C" and "8C" centered pressure P to T represented by curve number "5". Cylinder ports blocked for type "0C".

Pressure Drop Curves



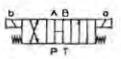
Maximum Flow Data

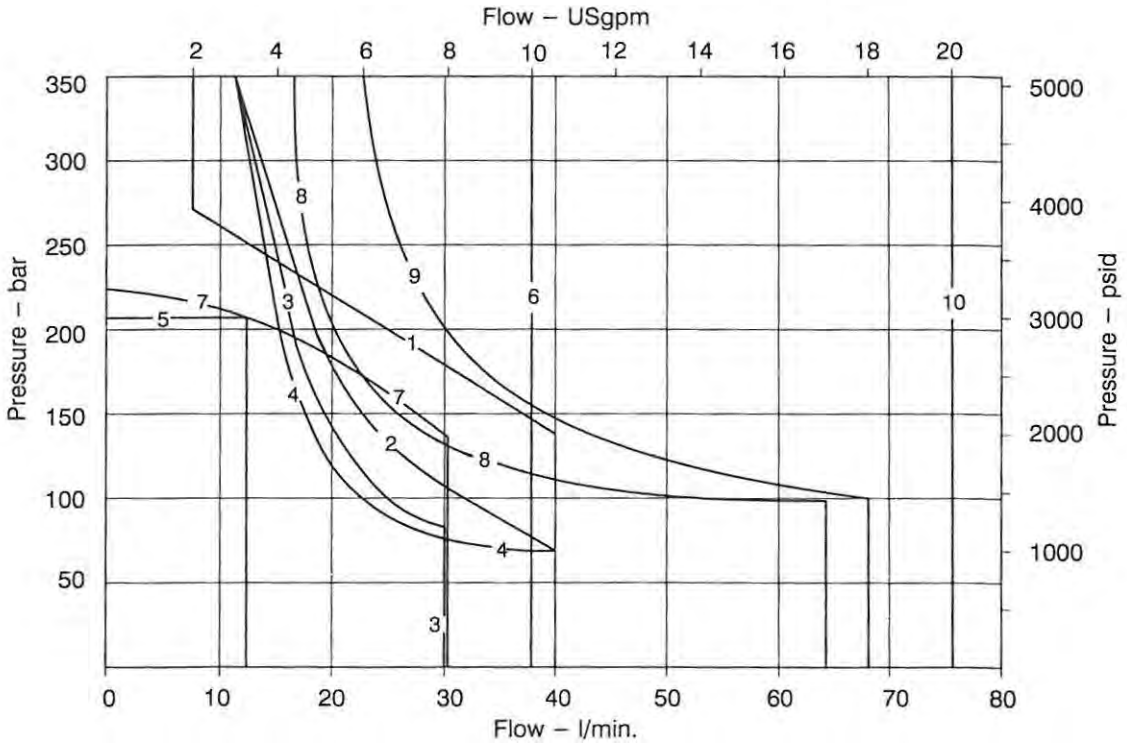
Maximum recommended flow data is for 90% nominal voltage in a 4–way circuit with cylinder ports either looped or blocked and containing 2,5 liters (.66 USgal) compressed volume. Reduced performance may result when certain spools are used in 3–way circuits.

Flow rates are based on warm solenoids operating at minimum rated voltage (i.e. 90% of rating), standard 0.8 mm orifice and 38C° (100° F) oil temperature.

NOTE

2.0 mm diameter orifice for the high performance type "8C".

Spool Type	Curve Number	
	"3S"	"3"
 0C	6	10
 2C	1	10
 6C	2	8
 3C	2	9
 8C	5	7
 31C	2	9
 33C	3	9
 2A	4	8

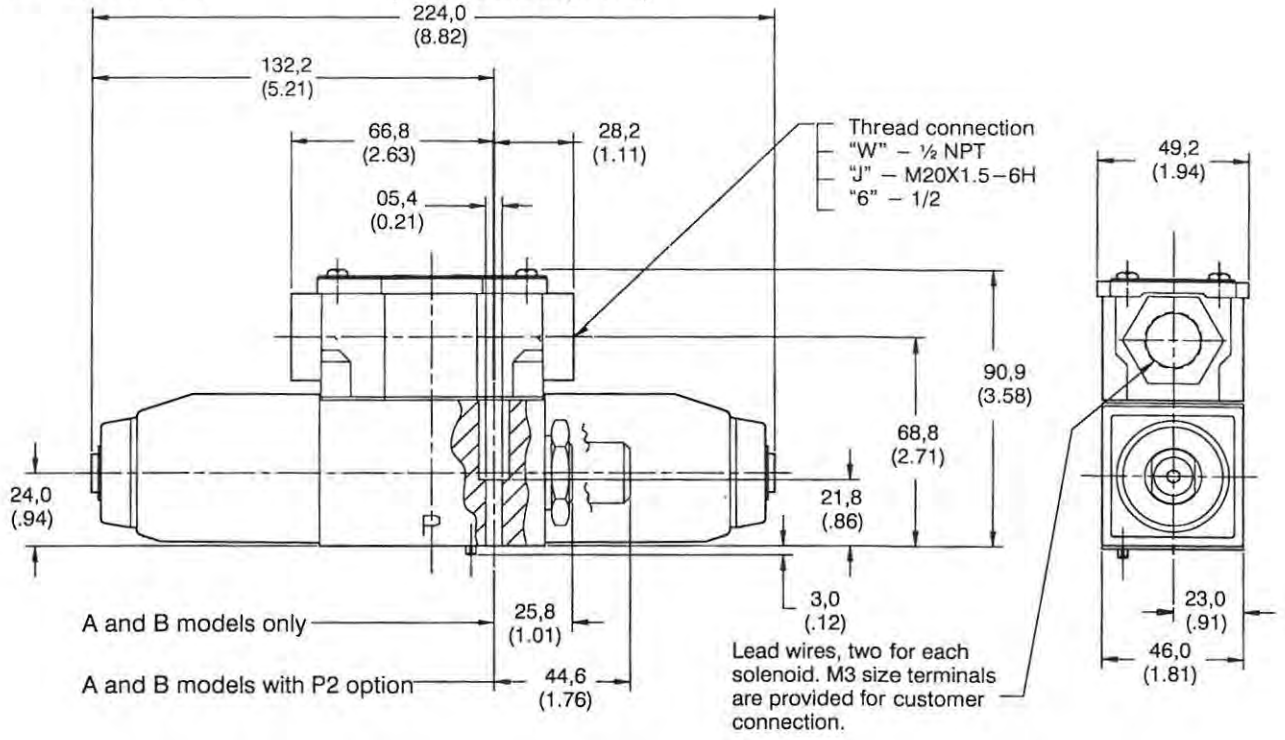


Installation Dimensions

DG4V-3(S)-**2**-(V) M-F**** (L)-*H5-60
Flying Lead Model

Flying lead models
(All options except "PB")

Millimeters (inches)

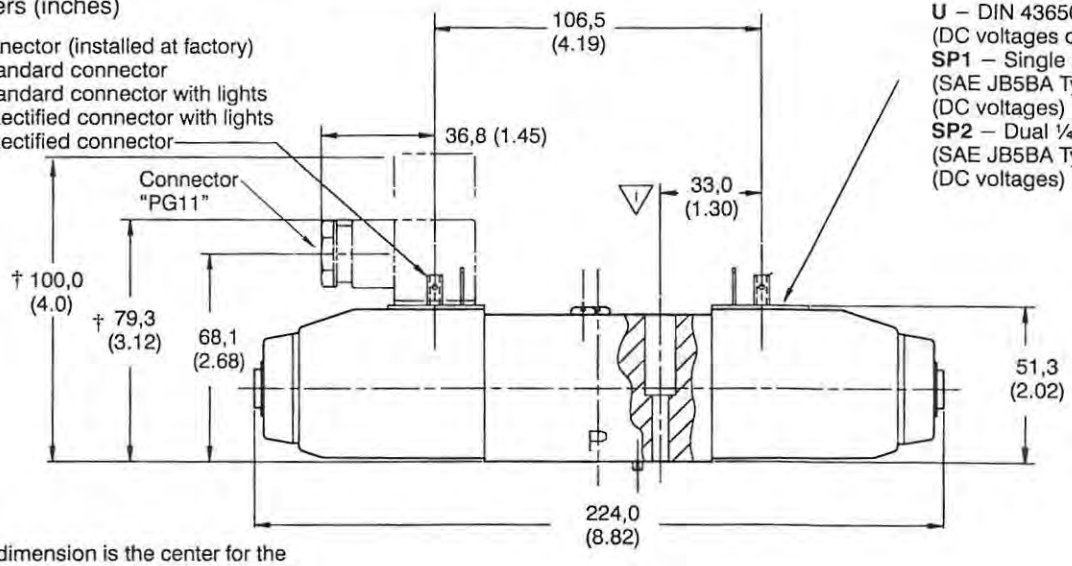


DG4V-3(S)-**2**-(V) M-U/SP1/SP2-*H5-60
DIN Connector

Coil Types
U – DIN 43650 coils (shown)
(DC voltages only)
SP1 – Single ¼" male spade
(SAE JB5BA Type 1A)
(DC voltages)
SP2 – Dual ¼" male spades
(SAE JB5BA Type 1A)
(DC voltages)

Millimeters (inches)

Coil Connector (installed at factory)
"1" – Standard connector
"6" – Standard connector with lights
"11" – Rectified connector with lights
"12" – Rectified connector



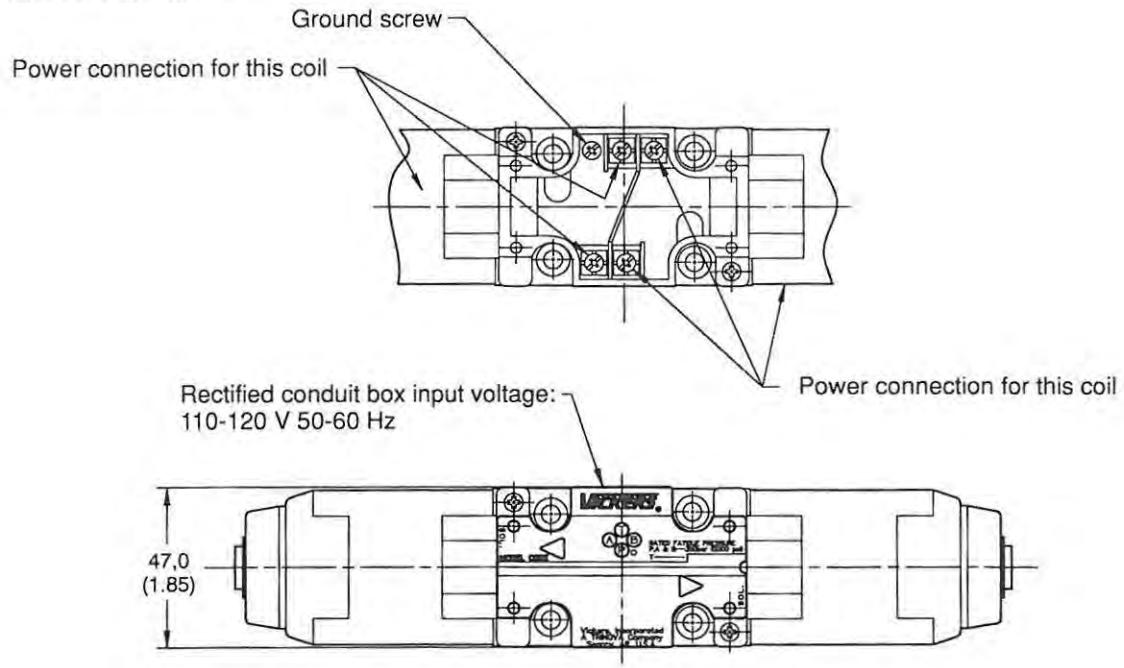
▽ This dimension is the center for the female connector and applies to "U", "SP1" and "SP2" coil type units.

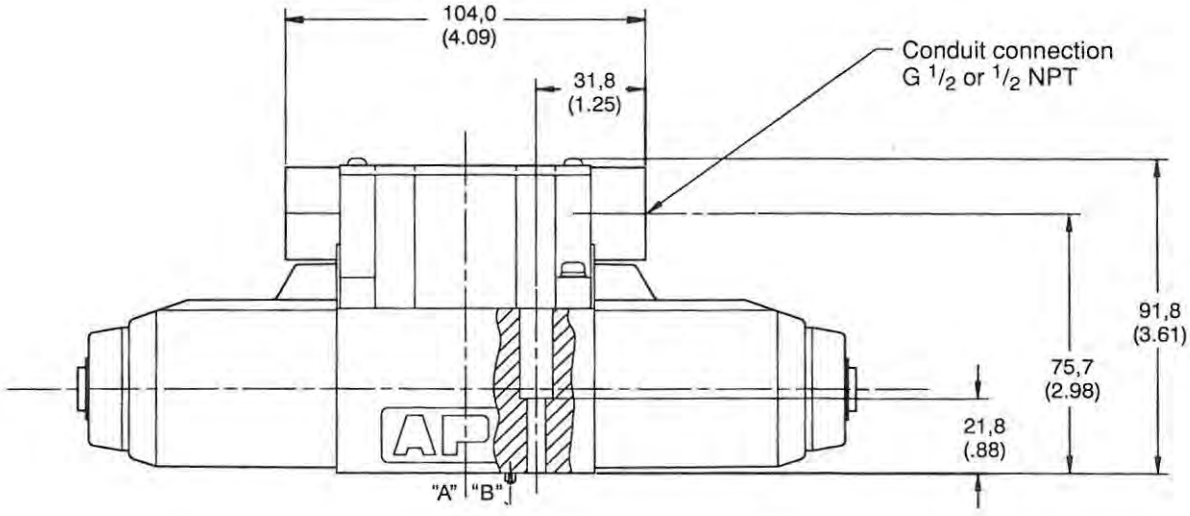
† This dimension can vary depending on source of plug.

Installation Dimensions

DG4V-3(S) - **2**-M-P12L-DJH5-60
Plug-in Coil

Millimeters (inches)

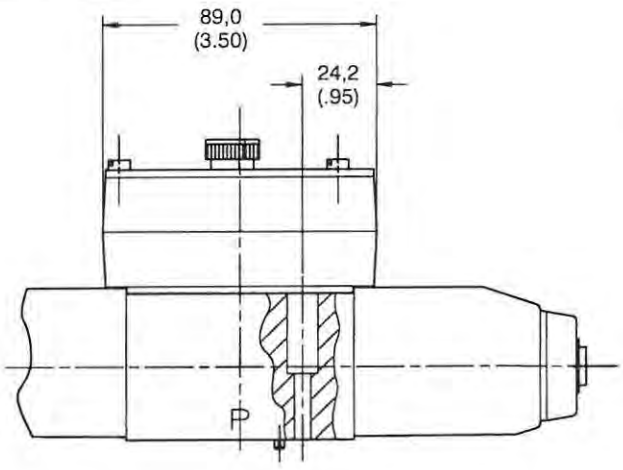


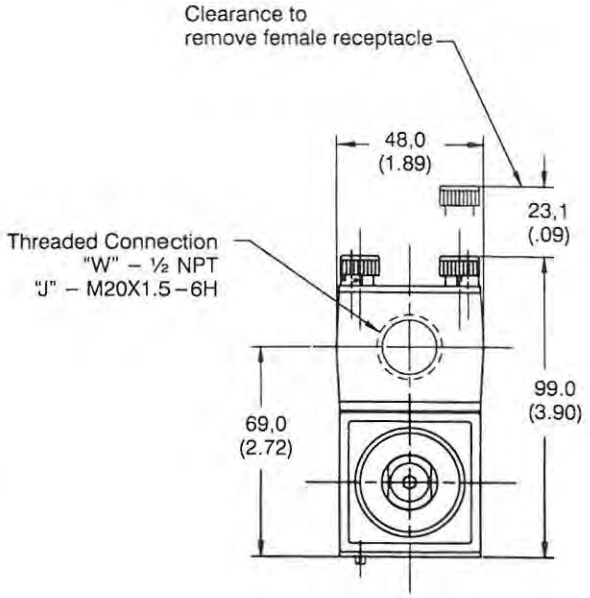


Electrical Connectors

DG4V-3(S)-**2**-M-FPB Insta-plug Option

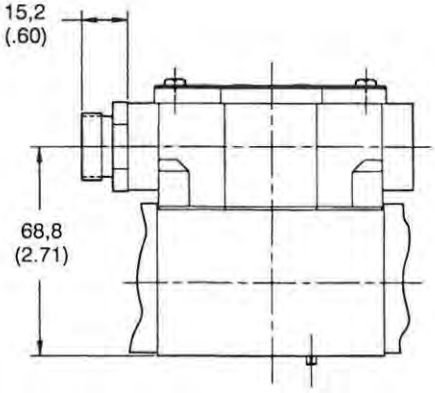
Millimeters (inches)



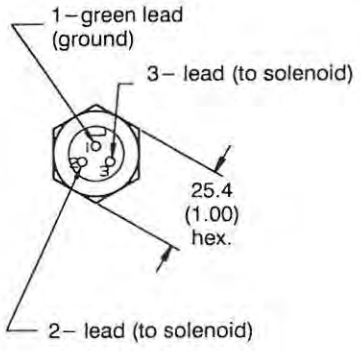


NFPA Electrical Connector

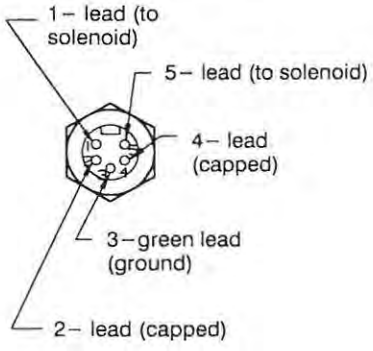
The receptacle is a standard three or five pole electrical connector with shortened leads and terminals added. The connector is assembled over the solenoid "B" on dual solenoid models and over the solenoid "A" for single solenoid models.



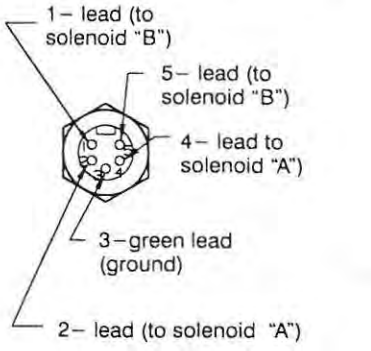
MODEL:
DG4V–3(S)–*A/B2**–M–FPA3



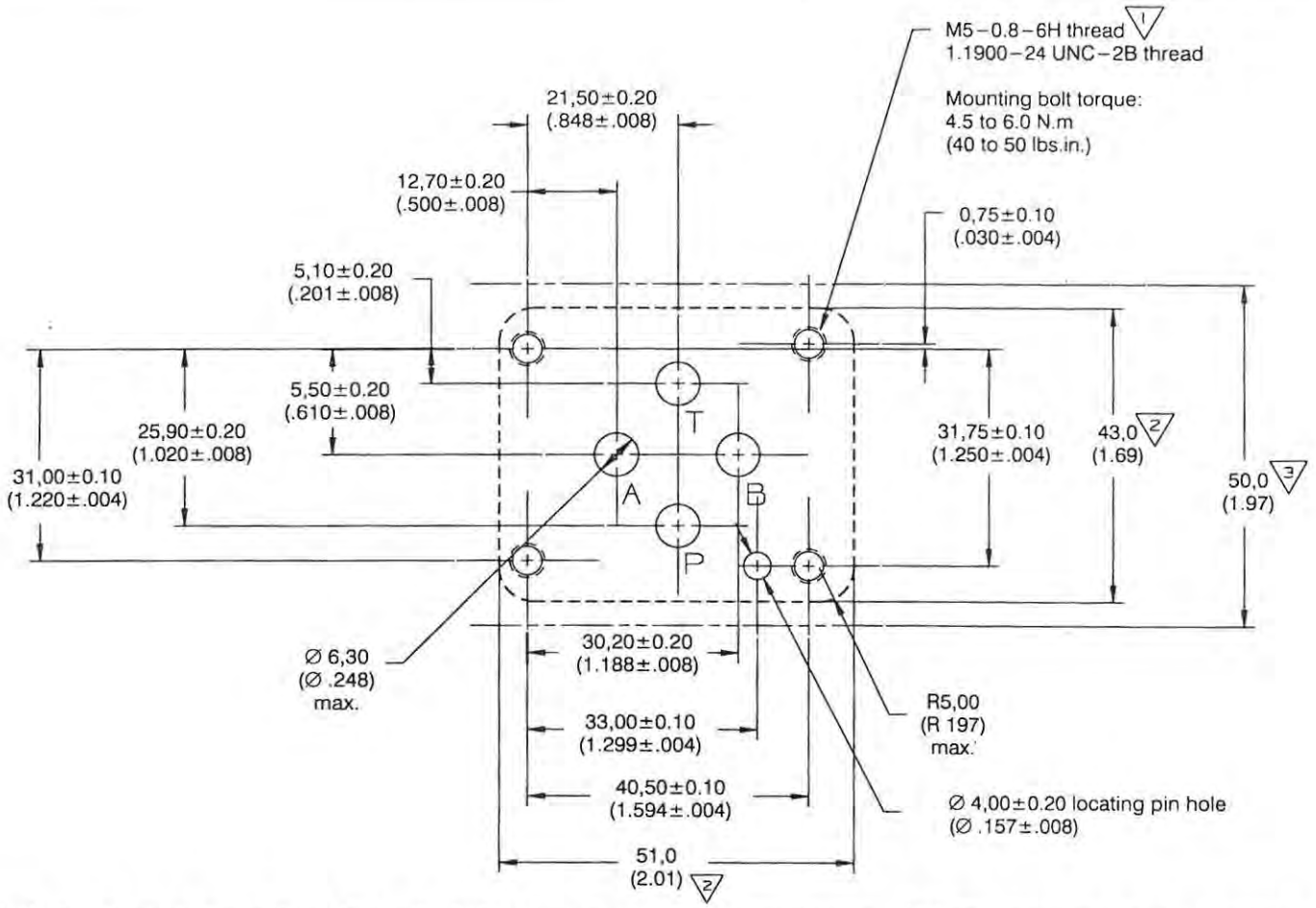
MODEL:
DG4V–3(S)–*A/B2**–M–FPA5



MODEL:
DG4V–3(S)–*C2**–M–FPA5



Mounting Interface



(1) The minimum thread depth is 1.5 of bolt diameter. The recommended full thread depth is 2xD+6mm to aid in the interchangeability of valves and to reduce the number of fixing bolt lengths. The recommended engagement of fixing bolt thread for ferrous mountings is 1.25 D.

(2) The dimensions specifying the area within the dotted lines are the minimum dimensions for the mounting surface. The corners of the rectangle may be radiused as shown.

(3) This dimension gives the minimum spacing distance between the valves and adjacent obstructions. For example, another valve or a wall. This dimension is therefore, the minimum distance from centerline to centerline of two similar mounting surfaces placed on a manifold block. The fixing holes are at equal distances to this dimension.

The mounting surface must be flat within 0.013 mm (.0005 inch) and smooth within 1.1 micrometer (0.045 microinch). Mounting bolts should be grade 12.9 (SAE grade 7) or better.

Subplate & Bolt Kits

Valve subplates and mounting bolts must be ordered separately.
Example:

(1) DG4V–3S–2C208–M–FW–6H5–60 valve
(1) DGVM–3–10–S subplate
(1) BK590716 inch mounting bolt
(1) BK616452M metric mounting bolt kit

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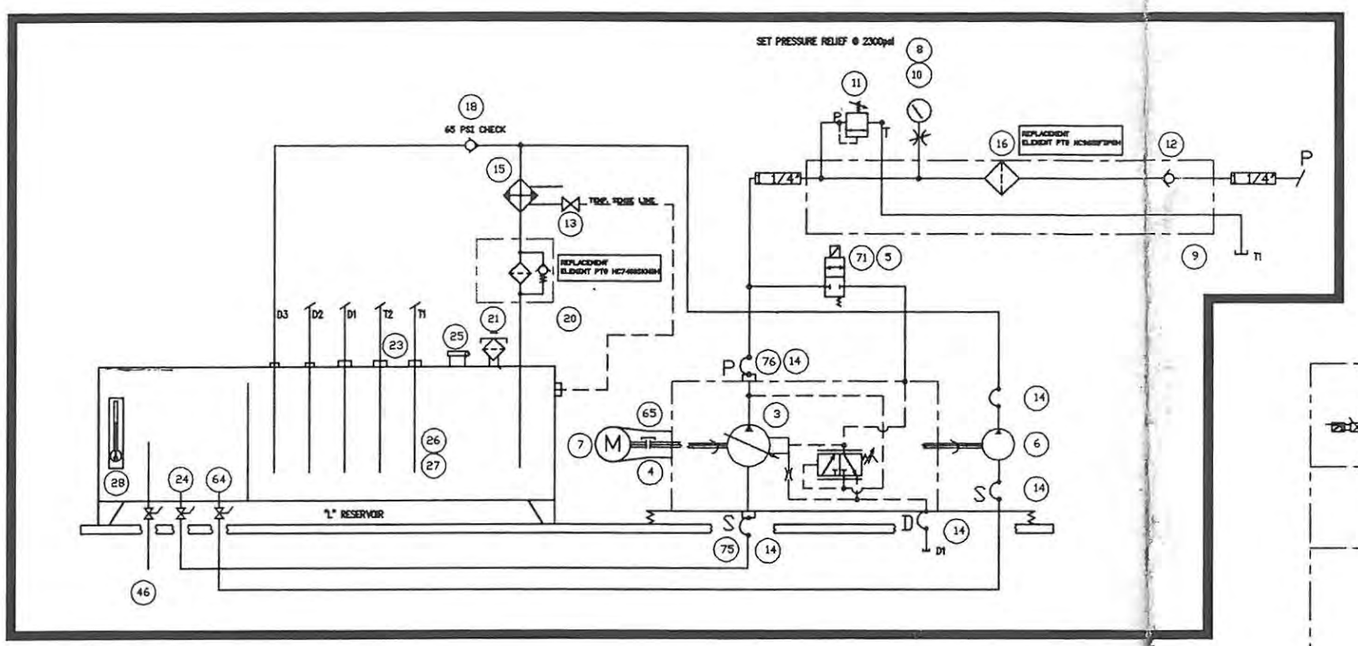
Salt Lake City
(801) 977-0123
FAX: (801) 977-0167

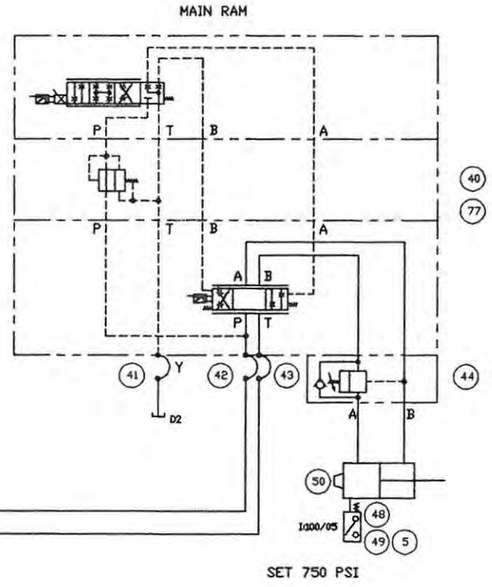
VICKERS
A TRINOVA Company

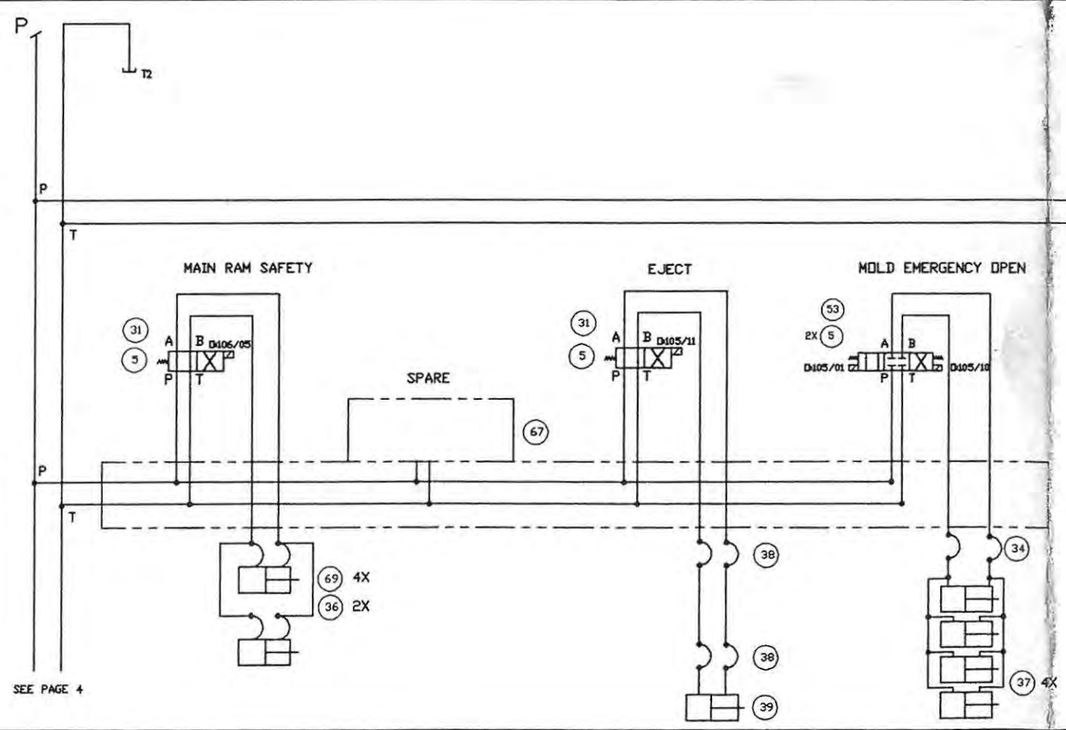
Vickers, Incorporated
5445 Corporate Drive
P.O. Box 302
Troy, Michigan 48007–0302
Phone: 810-641-4500
Fax: 810-641-4948

Rev. 6/93 HH

Printed in U.S.A.







NOTE: -Pressure line from pump to be 1 1/4"
-Pressure line to tank to be 1 1/2"

REV	DESCRIPTION	DATE	BY
–	ENGINEERING RELEASE	14DEC06	

REVISIONS

APPROVALS	DATE
DRAWN BY: J. WATERS	12/14/06
CHECKED BY: J. WATERS	
APPROVED BY:	
ENGINEERING	
MANUFACTURING	
CUSTOMER: AAP St. Marys	
DO NOT SCALE DRAWING	

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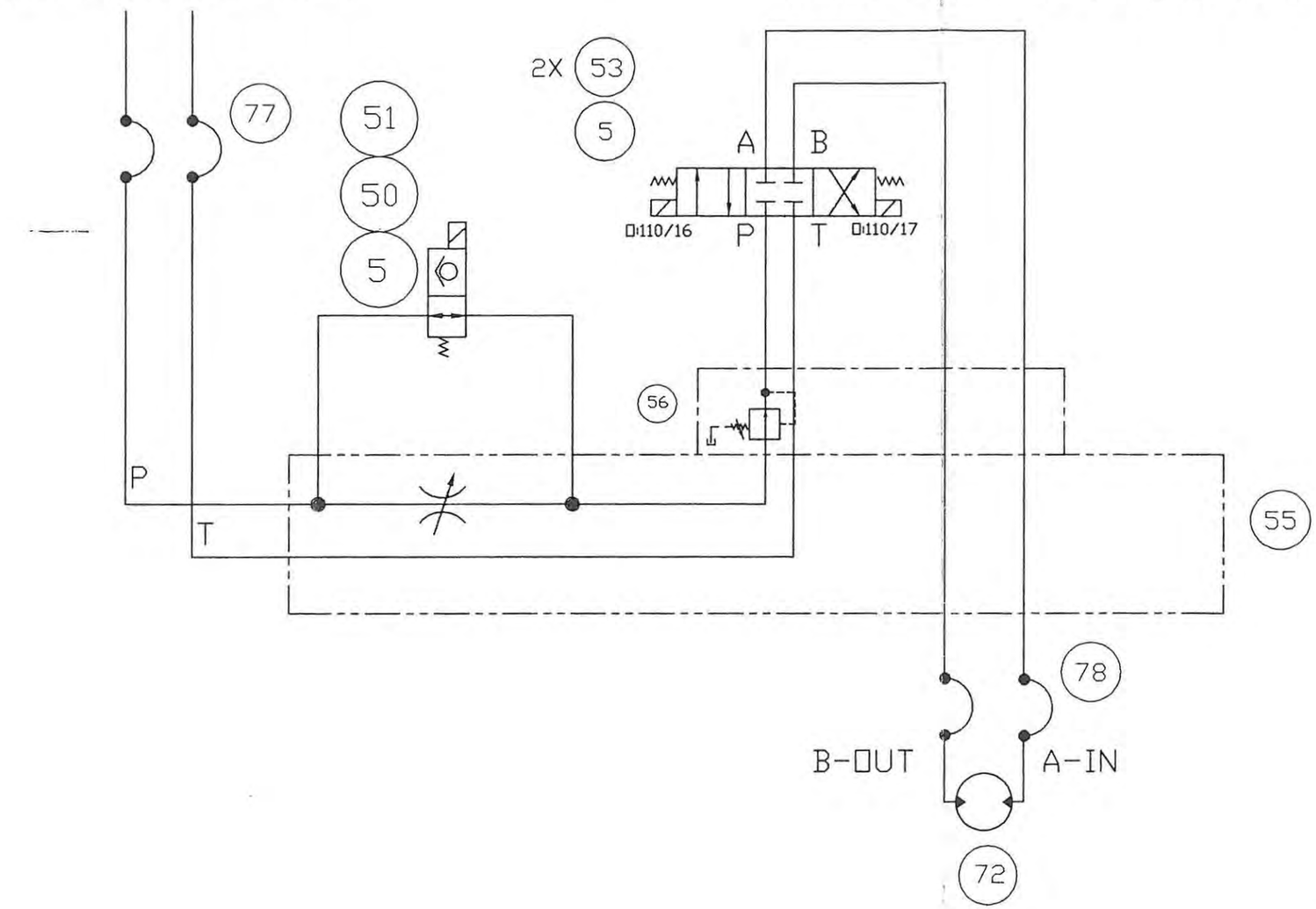
HYDRAULIC SYSTEMS SCHEMATIC

EMPIRE WORK ORDER NO.	EMPIRE DRAWING NO.
AAPM01	1700103
NEXT ASSEMBLY NO. 1700104	CUSTOMER PART NO.
QTY: 1	SCALE: TO FIT
REV –	SHEET 8 OF 8

CONTINUED FROM PAGE 4

RETRIEVER

NOTE: SOFT SHUTTLE VALVE - DC



REV	DESCRIPTION	DATE	APP'D
A	REMOVE (1) FLOW CONTROL MODULE	24JAN97	RAP
–	ENGINEERING RELEASE	14DEC96	

REVISIONS

APPROVALS	DATE
DRAWN BY: J. WAYERS	12/14/96
CHECKED BY: J. WAYERS	
APPROVED BY:	
ENGINEERING	
MANUFACTURING	
CUSTOMER: AAP St. Marys	
DO NOT SCALE DRAWING	

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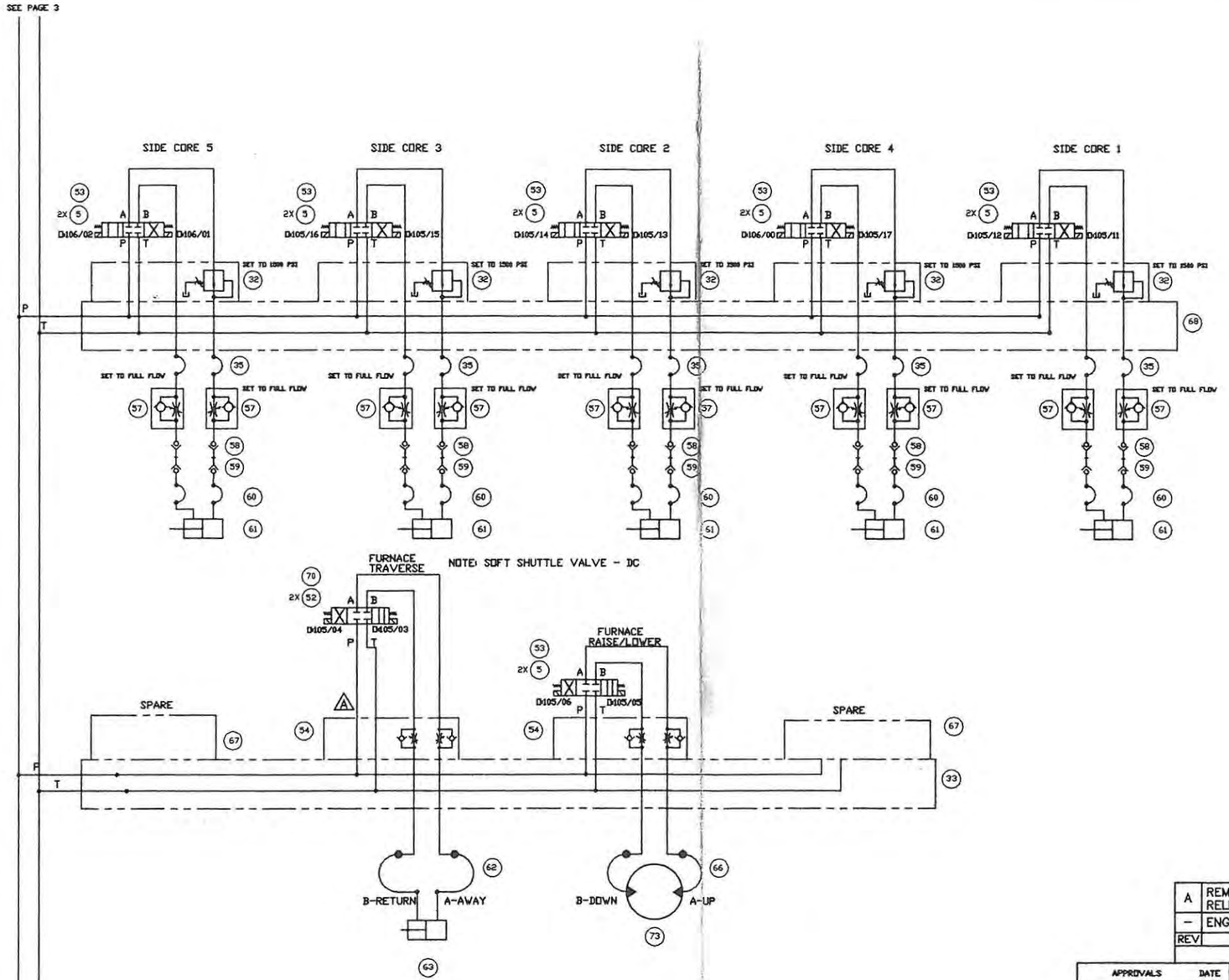
HYDRAULIC SYSTEMS SCHEMATIC

EMPIRE WORK ORDER NO. AAPM01	EMPIRE DRAWING NO. 1700105
NEXT ASSEMBLY NO.	CUSTOMER PART NO. REV A
QTY: 1	SCALE: TO FIT
	SHEET 5 OF 6

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SEE PAGE 3



SEE PAGE 5

REV	DESCRIPTION	DATE	APP'D
A	REMOVE (1) PRESSURE RELIEF MODULE	24JAN97	RAP
–	ENGINEERING RELEASE	14DEC88	

REVISIONS

APPROVALS	DATE
DRAWN BY: J. WATERS	12/14/88
APPROVED BY: J. WATERS	
ENGINEERING	
MANUFACTURING	
CUSTOMER: AAP St. Marys	
DO NOT SCALE DRAWING	

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HYDRAULIC SYSTEMS SCHEMATIC

EMPIRE WORK ORDER NO.	EMPIRE DRAWING NO.	
AAPM01	1700104	
NEXT ASSEMBLY NO. 1700105	CUSTOMER PART NO.	REV A
QTY: 1	SCALE: TO FIT	SHEET 4 OF 5

OPERATING AND MAINTENANCE

MANUAL

FOR

34 GPM HYDRAULIC POWER UNIT

DECEMBER 1996

EMPIRE CASTINGS

B & T HYDRAULICS AND PNEUMATICS

B&T JOB 96255

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OPERATING AND MAINTENANCE

MANUAL FOR 34 GPM HYDRAULIC POWER UNIT

JOB 96255

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5.0	BILL OF MATERIAL
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AVERY® READY INDEX™ INDEXING SYSTEM

OPERATING AND MAINTENANCE

MANUAL FOR 34 GPM HYDRAULIC POWER UNIT

JOB 96255

SECTION 1.0

1.0 SAFETY PRECAUTIONS

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1.0 SAFETY PRECAUTIONS:

1.1 THE SAFETY OF PERSONNEL AND EQUIPMENT IS OF PRIME CONCERN DURING INSTALLATION, FINAL COMMISSIONING AND FINAL USE OR MAINTENANCE OF THE EQUIPMENT. NOTWITHSTANDING FURTHER OR EXPANDED SAFETY REQUIREMENTS AT THE FACILITY, THE FOLLOWING SPECIFIC SAFETY RULES SHALL BE FOLLOWED:

CAUTION

1.1.1 **HYDRAULIC PRESSURE IN EXCESS OF 1800 PSIG WILL BE ACTING ON MOVABLE SURFACES DURING OPERATION. VERY LARGE FORCES MAY BE GENERATED WHICH IS A POTENTIAL HAZARD TO OPERATING PERSONNEL. WHILE OPERATING THE MACHINERY, EXTREME CARE SHOULD BE TAKEN TO MONITOR THE PRESSURE AND RESULTING MOTION OF THE HYDRAULIC ASSEMBLY TO PREVENT ANY INJURIES.**

OBSERVE GOOD SHOP PRACTICES. IMMEDIATELY CLEAN-UP ANY SPILLED FLUIDS TO AVOID INJURIES. HYDRAULIC FLUID CAN BE IRRITATING TO THE SKIN AND EYES. IMMEDIATELY FLUSH ANY PART OF THE BODY THAT COMES ONTO CONTACT WITH THE FLUID.

NO PERSON SHALL RIDE, SIT OR OTHERWISE PLACE THEMSELVES IN, UNDER, ON OR ACROSS ANY OF THE EQUIPMENT UNLESS IN A CONTROLLED TEST PLAN ENVIRONMENT. DEATH OR SERIOUS INJURY MAY RESULT IF THIS SAFETY RULE IS NOT STRICTLY OBSERVED.

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1.2 THE FOLLOWING **GENERAL SAFETY RULES** ALSO APPLY:

1.2.1 EACH PERSON INVOLVED WITH THE OPERATION OF THE EQUIPMENT INSTALLATION OR OPERATION SHOULD ATTEND BRIEFING INSTRUCTIONS BY THE JOB SITE SAFETY PERSONNEL TO LEARN OF SPECIFIC SAFETY RULES APPLYING TO USE AND MOVEMENT OF THE EQUIPMENT.

1.2.2 EACH PERSON SHALL COORDINATE HIS OR HER TASK WITH THE JOB SITE SUPERVISOR BEFORE DURING AND AFTER THE EQUIPMENT INSTALLATION OR OPERATION EVEN IF THE EQUIPMENT WILL NOT BE USED, i.e. IF ONLY TESTS ARE BEING PERFORMED.

1.2.3 NO ONE SHOULD ENTER ANY PART OF THE EQUIPMENT AT A TIME WHEN THE POWER SYSTEM (**HPU**(S)) ARE ACTIVE AND AVAILABLE TO START OPERATION. IF ENTRY IS REQUIRED, PROPER LOCKOUT OF THE MOTOR STARTERS IS A PREREQUISITE TO ENTRY INTO ANY PART OF THE EQUIPMENT.

1.2.4 A MINIMUM OF TWO PEOPLE SHOULD ATTEND REMOTE LOCATIONS DURING EQUIPMENT OPERATION.

1.2.5 SAFETY TYPE, STEEL-TOE, NO-SKID SHOES MUST BE WORN WHEN WORKING ON OR AROUND THE EQUIPMENT.

1.2.6 NO SMOKING IS PERMITTED NEAR THE EQUIPMENT OR NEAR THE WORK AREA.

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1.2.7 CARE SHOULD BE EXERCISED WHEN USING ANY TOOL OR POTENTIAL SPARKING DEVICE NEAR THE EQUIPMENT. ALTHOUGH THESE TOOLS WILL NOT NECESSARILY HARM THE EQUIPMENT, THE EQUIPMENT AREA IS RISK DUE TO SPARKS OR INCENDIARY DEVICES.

NOTE AND CAUTION:
...THIS MAY BE AN EXPLOSION PRONE AREA...

1.2.8 SAFETY GLASSES AND HELMETS ARE REQUIRED AT ALL TIMES.

1.2.9 SAFETY CLOTHING MAY BE REQUIRED, IF SPECIFIED AT THE INSTALLATION SITE. CAUTION MUST BE TAKEN TO ASSURE THAT LOOSE CLOTHING SUCH AS COATS, SHIRT SLEEVES AND SIMILAR ARTICLES ARE NOT PLACED NEAR ROTATING EQUIPMENT. GLOVES SHOULD BE WORN WHEN HANDLING THE EQUIPMENT HYDRAULIC FLUID.

1.2.10 THE PIPING AND EQUIPMENT NORMALLY WILL BE AT TEMPERATURES AT OR BELOW A LEVEL THAT WILL CAUSE DISCOMFORT IF TOUCHED WITHOUT GLOVES. HOWEVER, SOME OPERATING CONDITIONS MAY RESULT IN FLUID AND PIPING TEMPERATURES TO 138° F. THIS LEVEL OF TEMPERATURE MAY CAUSE DAMAGE TO UNPROTECTED HUMAN TISSUE.

NOTE AND CAUTION

....DO NOT HANDLE OR TOUCH PIPING OR THE EQUIPMENT AT ELEVATED TEMPERATURES....

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1.2.11 DO NOT OPEN ANY ELECTRICAL ENCLOSURES ON THE EQUIPMENT WITHOUT PROPER PRECAUTIONS TO ASSURE THAT THE AREA IS GAS FREE. THIS INCLUDES ALL SUPPLIED EQUIPMENT AND ALL SITE SUPPLIED JUNCTION BOXES AT THE EQUIPMENT.

NOTE AND CAUTION:

....EXPLOSIONS MAY RESULT IF ELECTRICAL EQUIPMENT IS OPENED WITHOUT FREEING THE AREA OF GAS CONTAMINATION/VAPORS....

1.2.12 DO NOT PLACE ANY CONTAINERS, ARTICLES OR LIQUIDS ON TOP OF ANY SURFACE OF THE EQUIPMENT.

1.2.13 IN ADDITION TO THE CAUTIONS IN 1.2.11, ASSURE THAT ALL PROPER LOCKOUT PROCEDURES, PRESCRIBED BY THE JOB SITE SAFETY PERSONNEL, ARE USED BEFORE OPENING ANY ELECTRICAL ENCLOSURES THAT ARE POTENTIALLY ALIVE WITH POWER.

1.2.14 ASSURE THAT ALL PROPER LOCKOUT PROCEDURES, PRESCRIBED BY THE JOB SITE SAFETY PERSONNEL, ARE USED BEFORE OPENING ANY HYDRAULIC PIPING THAT ARE POTENTIALLY ALIVE WITH POWER.

NOTE AND CAUTION:

....ASSURE THAT ALL HYDRAULIC LINES ARE AT ATMOSPHERIC PRESSURE AND PREFERABLY DRAINED BEFORE OPENING ANY PIPING....

1.2.15 KEEP A CO^2 FIRE EXTINGUISHER NEARBY.

1.2.16 ASSURE THAT A FIRST AID KIT IS NEARBY AND CONTAINS THE MINIMUM CONTENTS AS REQUIRED BY THE JOB SITE SAFETY PERSONNEL.

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1.2.17 **WORK SAFELY.** DO NOT TAKE UNDUE RISKS WITH THE EQUIPMENT THAT WILL CAUSE ANY DAMAGE OR INJURY TO THE PERSONNEL OR NEARBY EQUIPMENT.

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OPERATING AND MAINTENANCE

MANUAL FOR 34 GPM HYDRAULIC POWER UNIT

JOB 96255

SECTION 2.0

2.0 START-UP, OPERATION AND SHUT-DOWN

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2.1 INITIAL START-UP, START-UP AFTER SERVICE OR START-UP AFTER LONG PERIODS ON NON-OPERATION.

2.1.1 FILL RESERVOIR WITH A HIGH QUALITY, FILTERED HYDRAULIC OIL.

2.1.2 FILL THE CASE OF THE PUMP WITH THE ABOVE FLUID.

2.1.2.1 ENSURE THE MAIN PUMP SUCTION VALVE IS OPEN

2.1.2.2 ENSURE THE MAIN PUMP CASE DRAIN VALVE IS OPEN

2.1.2.3 ENSURE THE CIRCULATION PUMP SUCTION VALVE IS OPEN.

FAILURE TO FILL THE CASE OF THE PUMP WITH OIL WILL DESTROY THE PUMP UPON STARTING

2.1.3 JOG THE MOTOR TO CHECK FOR CORRECT ROTATION.

2.1.4 JOG THE MOTOR TO PRIME THE PUMP.

2.1.5 START THE PUMP.

2.1.6 MONITOR OIL LEVEL DURING START-UP AFTER FILLING ALL PIPING, CYLINDERS, ETC.

2.1.7 MONITOR PIPING AND HOSE ASSEMBLIES FOR LEAKS.

2.1.8 ADD OIL TO RESERVOIR AS NEEDED.

2.1.8.1 IF THE SYSTEM CONTAINS ACCUMULATORS, DO NOT TOP-OFF THE RESERVOIR WHILE THE SYSTEM IS IN OPERATION. TOP-OFF THE RESERVOIR ONLY AFTER THE ACCUMULATORS ARE COMPLETELY DISCHARGED.

FAILURE TO DO THIS MAY CAUSE THE RESERVOIR TO OVERFLOW UPON SYSTEM SHUT-DOWN

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2.1.9 MONITOR FILTER INDICATORS FOR DIRTY FILTERS WHILE STARTING THE SYSTEM.

2.1.10 MONITOR OIL TEMPERATURE DURING OPERATION. SHUT-DOWN SYSTEM IF OIL TEMPERATURE IS EXCESSIVE.

2.2 NORMAL START-UP AND OPERATION

2.2.1 CHECK OIL LEVEL IN THE RESERVOIR, ADD OIL IF NEEDED.

2.2.2 START THE PUMP.

2.2.3 MONITOR OIL LEVEL AFTER ALL CYLINDERS, LINES, ETC. HAS BEEN FILLED.

2.2.4 ADD OIL AS NEEDED.

2.2.4.1 IF THE SYSTEM CONTAINS ACCUMULATORS, DO NOT TOP-OFF THE RESERVOIR WHILE THE SYSTEM IS IN OPERATION. TOP-OFF THE RESERVOIR ONLY AFTER THE ACCUMULATORS ARE COMPLETELY DISCHARGED.

FAILURE TO DO THIS MAY CAUSE THE RESERVOIR TO OVERFLOW UPON SYSTEM SHUT-DOWN

2.2.5 MONITOR PIPING AND HOSE ASSEMBLIES FOR LEAKS.

2.2.7 MONITOR FILTER INDICATORS FOR DIRTY FILTERS DURING NORMAL OPERATION.

2.2.8 MONITOR OIL TEMPERATURE DURING OPERATION. SHUT-DOWN SYSTEM IF OIL TEMPERATURE IS EXCESSIVE.

2.3 SHUT-DOWN

2.3.1 SHUT OFF POWER TO THE ELECTRIC MOTOR.

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SECTION 3.0

3.0 MAINTENANCE, SPARES LIST AND TROUBLESHOOTING

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3.1 MAINTENANCE

3.1.1 REPLACE FILTERS UPON INDICATION.

3.1.2 REPLACE ALL SOFT PARTS EVERY 5 YEARS.

3.1.3 REPAIR LEAKS IMMEDIATELY.

3.1.4 REPAIR OR REPLACE COMPONENTS AS PERFORMANCE DEGRADES.

3.2 SPARES LIST

3.2.1 CIRCULATION FILTER ELEMENT: PALL HC7400SKN8H

3.2.2 PRESSURE FILTER ELEMENT: PALL HC9650FDP8H

3.3 TROUBLESHOOTING

3.3.1 THE SYSTEMS DESCRIBED IN THIS MANUAL ARE SIMPLE IN THEORY, YET TROUBLESHOOTING MAY BE DIFFICULT FOR THOSE PEOPLE WHO ARE NOT FAMILIAR WITH THE TOTAL DESIGN.

3.3.2 BEFORE MAKING ANY CHANGES TO THE SYSTEM, VERIFY THAT THE SUSPECTED OPERATIONAL SYMPTOM IS TRULY AN ABNORMAL OCCURRENCE. THE BEST SOURCE OF SUCH INFORMATION IS THIS MANUAL.

3.3.3 BEFORE ATTEMPTING ANY CHANGES, MAKE A WRITTEN LIST OF STEPS THAT WILL BE ATTEMPTED AND THE ANTICIPATED RESULTS IF THE CHANGES ARE MADE.

3.3.4 BE SURE TO LEAVE A PATH FOR BACKTRACKING ON CHANGES. SOME CHANGES YOU MAKE MAY REQUIRE SIGNIFICANT CHANGES THAT MAY HAVE TO BE RECOVERED.

3.3.5 NEVER CHANGE SETTINGS OR REMOVE MORE THAN ONE (1) COMPONENT OR ITEM AT A TIME. CHANGE OR VERIFY OPERATION WITH ONLY ONE (1) CHANGE PER SYMPTOM.

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3.3.6 WORK SAFELY; DO NOT MAKE CHANGES THAT WILL ENDANGER YOURSELF, COWORKERS OR THE EQUIPMENT.

3.3.7 SHARE YOUR IDEAS WITH ANOTHER PERSON WHO HAS KNOWLEDGE OF THE SYSTEMS. QUITE OFTEN, IDEAS WILL DEVELOP AS A RESULT OF DISCUSSIONS.

3.3.8 USE THE DRAWINGS, BOM AND EQUIPMENT LISTS. VERIFY COMPONENTS ARE AS NOTED ON THE DRAWINGS.

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3.3.9 FAULT ISOLATION AND REMEDIES:

SYMPTOM	FAILURE	REMEDY
ELECTRIC MOTOR WILL NOT START	CIRCUIT BREAKER or MAIN SWITCH OPEN	CLOSE BREAKER
	FUSE(S) OPEN	REPLACE FUSE(S)
	POWER IS OFF	RESTORE POWER
	WIRING NOT ATTACHED TO MOTOR LEADS	CONNECT WIRING
	HEATERS ARE TRIPPED	RESET HEATERS
	CONTROL POWER NOT CONNECTED	RESTORE CONTROL POWER
	STARTER RELAY IS FAULTY	REPAIR RELAY
	PUSH-BUTTON FAULTY	REPLACE PUSH-BUTTON
	MOTOR WINDINGS FAULTY	REPAIR MOTOR
ELECTRIC MOTOR STARTS, BUT WILL NOT CONTINUE TO RUN	STARTER COIL HOLDING CONTACT FAULTY	REPLACE RELAY CONTACTS OR RELAY
	HEATER CONTACT TRIPPING ON START OVERLOAD	CHECK HEATER SETTING
	SYSTEM INTERLOCKS, IF USED, ARE NOT MADE	CHECK ELECTRICAL DIAGRAM FOR INTERLOCKS, ASSURE THEY ARE SATISFIED
ELECTRIC MOTOR STARTS, BUT WILL NOT DEVELOP POWER	POWER IS LOST IN ON OR MORE LEADS OF INCOMING LINES	RESTORE POWER

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SYMPTOM	FAILURE	REMEDY
	MOTOR WINDINGS SHORTED	REPLACE ELECTRIC MOTOR
ELECTRIC MOTOR IS NOISY WHEN ROTATING OR VIBRATES	BEARINGS WORN	REPLACE BEARINGS
	FAN IS LOOSE	TIGHTEN FAN
	PUMP COUPLING IS LOOSE	TIGHTEN COUPLING
	PUMP MIS-ALIGNED	CHECK ALIGNMENT
	HOLD DOWN BOLTS LOOSE	TIGHTEN BOLTS
PUMP VIBRATES WHILE TURNING	COUPLING LOOSE	TIGHTEN COUPLING
	SUCTION VALVE CLOSED	OPEN SUCTION
	PUMP INTERNALS WORN	REPLACE PUMP
	PUMP MIS-ALIGNED	CHECK ALIGNMENT
PUMP HAS A LOUD NOISE WHILE TURNING	NO FLUID IN RESERVOIR	TOP UP FLUID
	FLUID TOO COLD	WARM FLUID TO OPERATING TEMPERATURE
	PUMP ROTATING BACKWARDS	CHECK ROTATION
	SUCTION LINE OPEN TO ATMOSPHERE	SECURE SUCTION LINE
PUMP WILL NOT DELIVER FLOW	COUPLING DISCONNECTED	RESTORE COUPLING
	PUMP INTERNALS WORN	REPLACE PUMP

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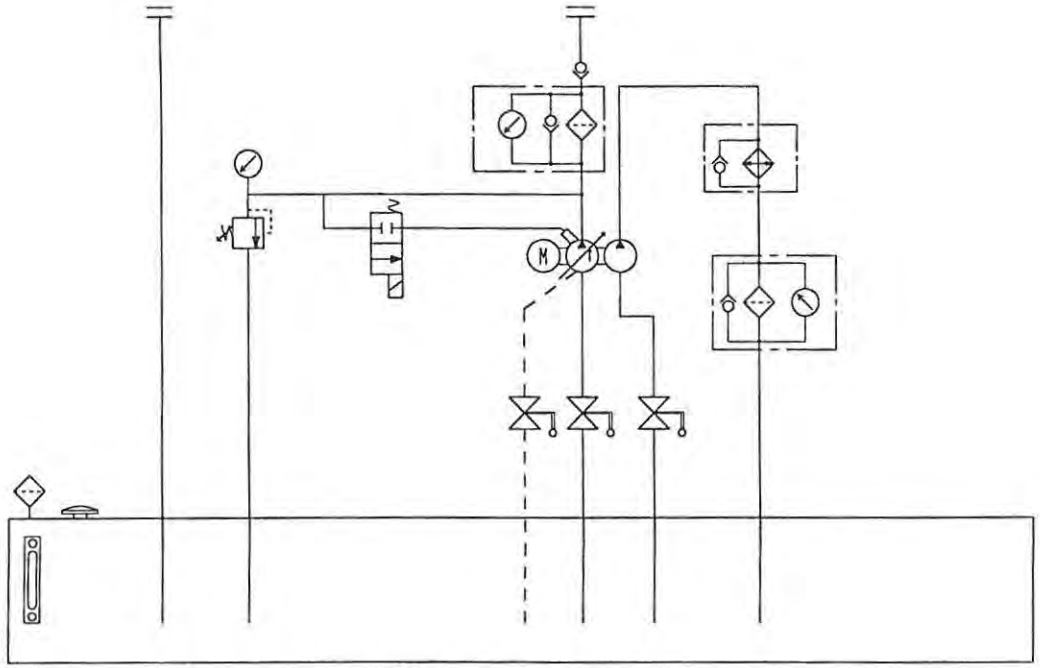
SYMPTOM	FAILURE	REMEDY
	NO FLUID IN RESERVOIR	TOP UP FLUID
	PUMP ROTATING BACKWARDS	CHECK ROTATION
	SUCTION LINE OPEN TO ATMOSPHERE	SECURE SUCTION LINE
PUMP PRODUCES FLOW BUT WILL NOT DEVELOP PRESSURE	SYSTEM BYPASS OPEN	CLOSE BYPASS
	GAUGE FAULTY	REPLACE GAUGE
	GAUGE SHUTOFF VALVE CLOSED	OPEN VALVE
	PUMP IS WORN	SEE PUMP SECTION
FILTERS CLOG OFTEN	FLUID IS CONTAMINATED	CHANGE FLUID AND FILTER ELEMENTS
	CONTAMINATION IS INTRODUCED IN PIPELINES	LIMIT CONTAMINATION INPUT FROM PIPELINES
PRESSURE GAUGES DO NOT REGISTER PROPERLY	GAUGE FAULTY	REPLACE GAUGE
	GAUGE SHUTOFF CLOSED	OPEN VALVE

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SECTION 4.0

4.0 SCHEMATICS

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DIMENSIONS ARE IN INCHES
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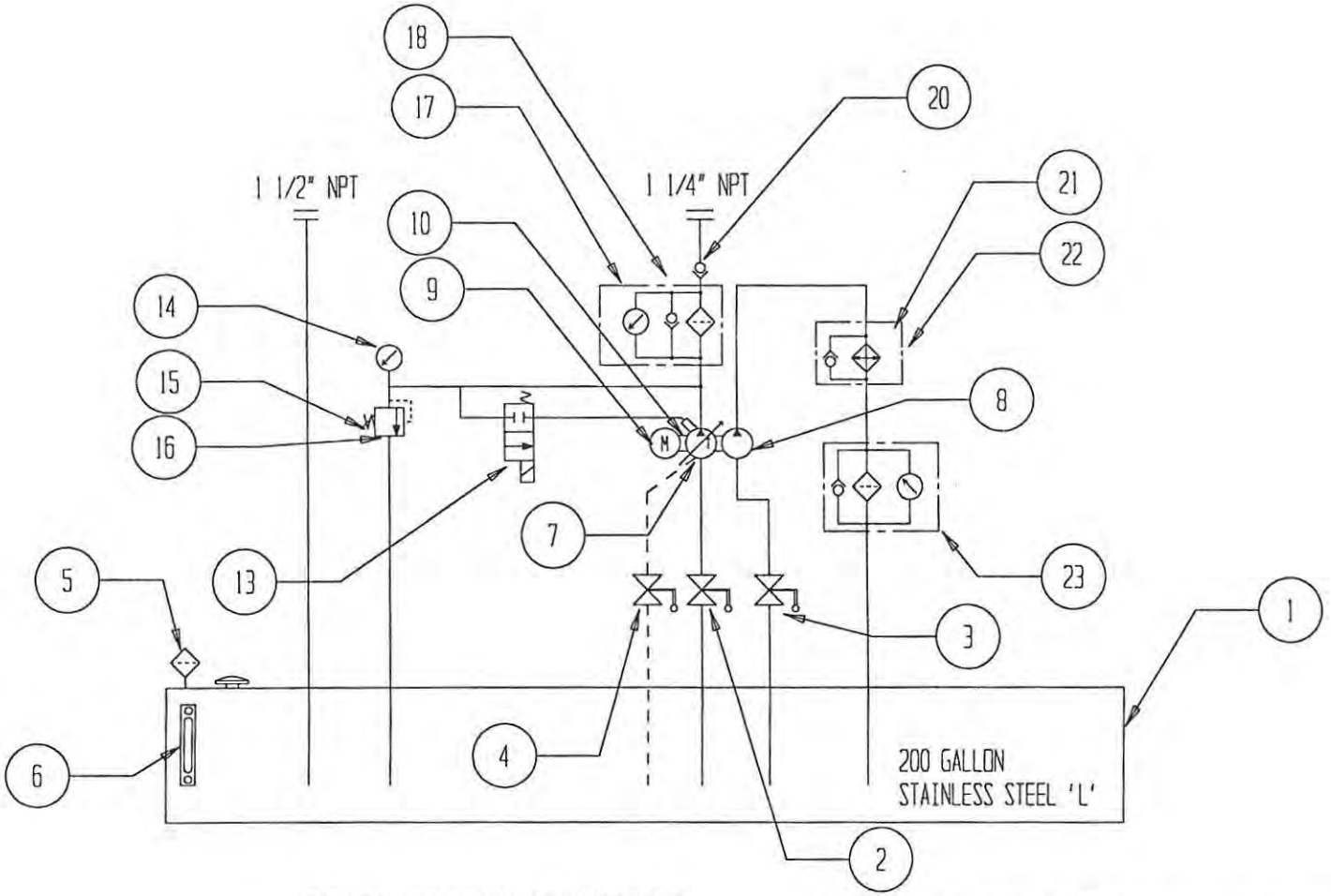
USED IN ASSEMBLY: POWER UNIT

DRAWN BY	DATE	SCALE	
KSC	01/21/97	N/A	
CHECKED BY	DATE	Q.A.	DATE
JRW	01/21/97	SEJ	01/21/97
APPROVED BY		JOB NO.	
SEJ	01/21/97	96255	

B&T HYDRAULICS & PNEUMATICS
2324 DEL MONTE STREET
WEST SACRAMENTO , CA 95691

POWER UNIT
25 HP
34 GPM, 1800 PSI

CUSTOMER	WEIGHT	REV.	DRAWING NUMBER	SHEET NUMBER
EMPIRE CASTING	N/A	0	C 96255	1 OF 1



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DIMENSIONS ARE IN INCHES
DIMENSIONAL TOLERANCE
.X ±.10 .XXX ±.005 ANG ±2AC.
±.030 ±.015 ±.005 ±1/2° ±1/8
DIA'S ABOUT COMMON Ⓒ Ø .005
FINISH 250

USED IN ASSEMBLY: POWER UNIT

	DRAWN BY	DATE	SCALE
	KSC	01/21/97	N/A
CHECKED BY	DATE	D.A.	DATE
JRW	01/21/97	SEJ	01/21/97
APPROVED BY		JOB NO.	
SEJ	01/21/97	96255	

B&T HYDRAULICS & PNEUMATICS
2324 DEL MONTE STREET
WEST SACRAMENTO, CA 95691

POWER UNIT
25 HP
34 GPM, 1800 PSI

CUSTOMER	WEIGHT	REV.	DRAWING NUMBER	SHEET NUMBER
EMPIRE CASTING	N/A	0	C 96255	1 OF 1

SECTION 5.0

5.0 BILL OF MATERIALS

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BILL OF MATERIAL BM-96255

ITEM	QTY	DESCRIPTION		MFG	MFG P/N
1	1	200 GALLON STAINLESS TANK L' SHAPED STEEL		B&T	CUSTOM
2	1	2" GATE VALVE PUMP SUCTION		WATTS	GV-2"
3	1	3/4" GATE VALVE CIRCULATION PUMP		WATTS	GV-3/4"
4	1	1/2" BALL VALVE PVWW CASE DRAIN		WATTS	B6000 1/2"
5	1	SIDE MOUNT VENTED FILLER/BREATHER		LENZ	SM537-W
6	1	5" LIQUID LEVEL W/ DIAL THERMOMETER		VESCOR	FMALG-5DT
7	1	PRESSURE COMPENSATED PUMP W/ SAE' A REAR PAD & MAX VOLUME STOP		OILGEAR	PVWW34-LDFY-CNNNTK
8	1	SAE A MOUNT FIXED DISPLACEMENT GEAR PUMP		VICKERS	V10-1P-7P-1C-A20
9	1	25HP 284TSC TEFC 230/460 50/60 ELECTRIC MOTOR		LINCOLN	LMO1798
10	1	PUMP ADAPTER, 284TSC TO SAE C 2 BOLT		MACMILLIN	F3-C

Used on: Empire Casting Power Unit	Drawn: K. Sean Cowan	Date: 01/20/97
Contract: PO #	Check: Steve Jacobs	Date: 01/20/97
Customer: Empire Casting	Engineer: K. Sean Cowan	Date: 01/20/97
Job No: 96255	Approval: Steve Jacobs	Date: 01/20/97

B&T HYDRAULICS & PNEUMATICS
2324 Del Monte Street
West Sacramento, CA 95601

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Revision No.

BILL OF MATERIAL BM-96255

ITEM	QTY	DESCRIPTION		MFG	MFG P/N
11	1	PUMP ADAPTER COVER		MACMILLIN	MC-14R
12	1	COUPLING 1 5/8" X 1 1/4"		MAUREY	FC-190 1 5/8 X 1 1/4 COMPLETE
13	1	NORMALLY CLOSED 2 WAY SOLENOID #8 SAE PORTED VALVE 110 VAC COIL		HYDRAFORCE	SV08-24-8T-N-115-AG
14	1	PRESSURE GAUGE 0-3000 PSI		PDI	CF-1P-210A
15	1	SPIKE RELIEF CARTRIDGE		VICKERS	RV5-10-S-0-50
16	1	1/2" NPT BODY FOR ITEM 15		CCI	220124
17	1	PRESSURE FILTER HOUSING		PALL	HH9651A20**SW1T
18	1	PRESSURE FILTER, β_6=200 RATED		PALL	HC9651FDP8H
19	1	ELECTRICAL INDICATOR, 35 PSID		PALL	RC861CZ097H
20	1	INLINE CHECK VALVE, 1 1/4" FEMALE NPT		PARKER	C2000-S

Used on: Empire Casting Power Unit	Drawn: K. Sean Cowan	Date: 01/20/97
Contract: PO #	Check: Steve Jacobs	Date: 01/20/97
Customer: Empire Casting	Engineer: K. Sean Cowan	Date: 01/20/97
Job No: 96255	Approval: Steve Jacobs	Date: 01/20/97

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Revision No.

ITEM	QTY	DESCRIPTION		MFG	MFG P/N
21	1	WATER EXCHANGER WITH 50 PSID BYPASS VALVE		T/T	EK-712-T-R
22	1	WATER MODULATING VALVE, 115°F TO 180°F		T/T	65293
23	1	LINE MOUNT CIRCULATION FILTER, β_6=200 RATED WITH VISUAL INDICATOR		PALL	HH7400B12KNSBPL

Used on: Empire Casting Power Unit	Drawn: K. Sean Cowan	Date: 01/20/97
Contract: PO #	Check: Steve Jacobs	Date: 01/20/97
Customer: Empire Casting	Engineer: K. Sean Cowan	Date: 01/20/97
Job No: 96255	Approval: Steve Jacobs	Date: 01/20/97

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Revision No.

SECTION 6.0

6.0 CUT SHEETS

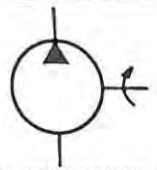
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VANE PUMPS

MODEL SERIES V10

FIXED DISPLACEMENT
SINGLE PUMP



STANDARD GRAPHICAL SYMBOL FOR FLUID POWER DIAGRAMS

GENERAL DATA

Series V10 pumps are of Vickers "balanced vane type" construction. These high performance intra-vane single pumps have a fixed displacement, a rated capacity of 1 to 5 GPM, and a 2-bolt flange or foot mounting. They are designed for use with oil or synthetic fire resistant fluids.

APPLICATION GUIDANCE

Shaft Rotation

Pumps are normally assembled for right hand or clockwise rotation as viewed from the shaft end.

If left hand or counterclockwise rotation is required, specify by adding suffix "L" to the model number.

Example: V10-1P5S-1C10-L

Inlet and outlet ports remain the same regardless of direction of shaft rotation. Change of assembly of internal parts is necessary when change of shaft rotation is required.

Pump Drive

Pump is recommended for direct coaxial drive. If drives imposing radial shaft loads are considered, consult your local Vickers representative.

RATINGS

Input Drive Speed (when used with the following fluids):
- Maximum (All Fluids) ..... 1800 RPM
- Minimum ..... 600 RPM

Maximum Pressure (when used with the following fluids):
- Petroleum Oil ..... 2250 PSI
- Synthetic ..... 2000 PSI
- Water-Glycol ..... 1800 PSI
- Water-in-oil Emulsion ..... 1500 PSI

Maximum Inlet Pressure ..... 20 PSI

Rated Capacity ..... See chart.

Maximum Speed Rating

Specific gravity, viscosity, pump suction and speed should be related so that vacuum at pump inlet does not exceed 5" of mercury for petroleum oil, water-in-oil emulsions and water glycol, and 3" for synthetic fire-resistant fluids.

INSTALLATION DATA

Air Bleed

At time of first starting, if the pump does not immediately prime, air should be bled from pump delivery line. This may be accomplished by loosening a connection in the delivery line close to the pump until oil flows, indicating pump has primed. An airbleed valve is available for this purpose. See drawing 521601.

ACCESSORIES

Electric Motor Pumps

Many motor manufacturers are prepared to supply drip proof or totally enclosed motors with end bells on which this pump can be mounted. Submit installation drawing to motor manufacturer.

FILTRATION

For satisfactory service life of these components in industrial applications, use full flow filtration to provide fluid which meets ISO cleanliness code 18/15 or cleaner. Selections from Vickers OFP, OFR and OFRS series are recommended. Refer to Section "P"-"Filters" and section "S"-"Technical Information" of Vickers Catalog 400 or contact your Vickers representative for further filtration advice.

MODEL CODE

F3 - V 10 - 1 P 5 S - 1 C 20 - L

[1] [2] [3] [4] [5] [6] [7] [8] [9] [10] [11]

[1] Special Prefix
Omit if not required. See "Fluids" note.

[2] Vane Pump

[3] Series Designation

[4] Mounting Type
1 - 2-bolt flange.
2 - Foot (For separate "Foot Bracket Kit", order model FB-A-10.)

[5] Inlet Port
P - 1" NPTF
S - 1.3125-12 UN-2B straight thread.

[6] Ring Size - Pump Delivery
(1200 RPM, 100 PSI)
1 - 1 GPM (3.8 l/min.)
2 - 2 GPM (7.5 l/min.)
3 - 3 GPM (11.3 l/min.)
4 - 4 GPM (15.1 l/min.)
5 - 5 GPM (18.9 l/min.)

[7] Outlet Port
P - 1/2" NPTF
S - .760-16 UNF 2B straight thread.

[8] Shaft Type
1 - Straight keyed (standard)
11 - SAE "A" splined
(See catalog 479 for shaft end description)

[9] Outlet Position
(viewed from cover end)
A - Opposite inlet.
B - 90° CCW from inlet.
C - Inline with inlet.
D - 90° CW from inlet.

[10] Design Number
Subject to change. Installation dimensions remain as shown for designs 20 through 29.

[11] Rotation
(viewed from shaft end)
L - Left hand rotation.
Omit for right hand rotation.

FLUIDS AND TEMPERATURE DATA

Petroleum Oils

Use antiwear type hydraulic oils or SAE 10W oils meeting A.P.I. service classification "MS". For details, refer to Vickers data sheet I-286-S, "Hydraulic Fluid and Temperature Recommendations for Industrial Machinery" (included in the Technical Information section of Vickers Catalog 400). Viscosity of oil at 100°F should be 150-225 SUS. Maximum oil temperature of 150°F is recommended.

Water Containing Fluids
Water glycols and water-in-oil emulsions, as produced by responsible sources for ratings given herein, are recommended. Select fluids with a viscosity as close as possible to that of petroleum oil described above. It is recommended that temperatures for water base fluids be limited to a maximum of 130°F.

Synthetic Fire Resistant Fluids
Phosphate esters, chlorinated hydrocarbons, and blends as produced by responsible sources for ratings given herein are recommended. Select fluids with viscosity as close as possible to that for petroleum oil described above. Maximum specific gravity of 1.3 is suggested. The fluid must be compatible with pump seals of fluorocarbon elastomers (i.e., Viton, etc.).

To obtain pumps equipped for operation with synthetic fire resistant fluids, add the prefix "F3" to the model number.

Example: F3-V10-1P5S-1C10

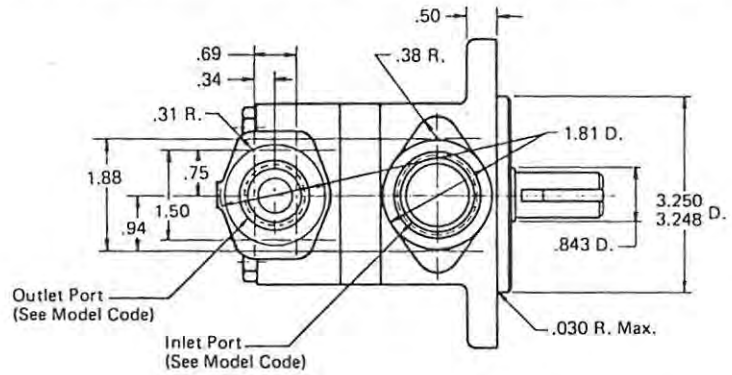
WEIGHT
Flange Mounting ..... 8 lbs.
Foot Mounting ..... 13 lbs.

SERVICE INFORMATION
Refer to specific Vickers part drawing or overhaul manual for service information. A complete "Index to Industrial Products Service Information" is included in the Technical Information section of Vickers Catalog 400.

ORDERING PROCEDURE
Select pumps according to the typical model code shown. Available standard options are listed in this code.

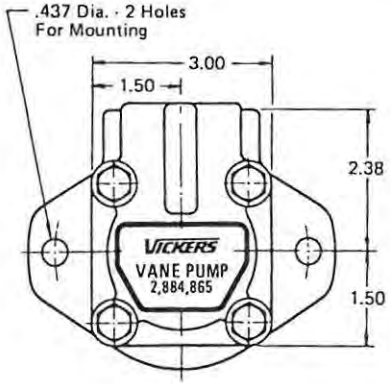
RATED CAPACITY (GPM)

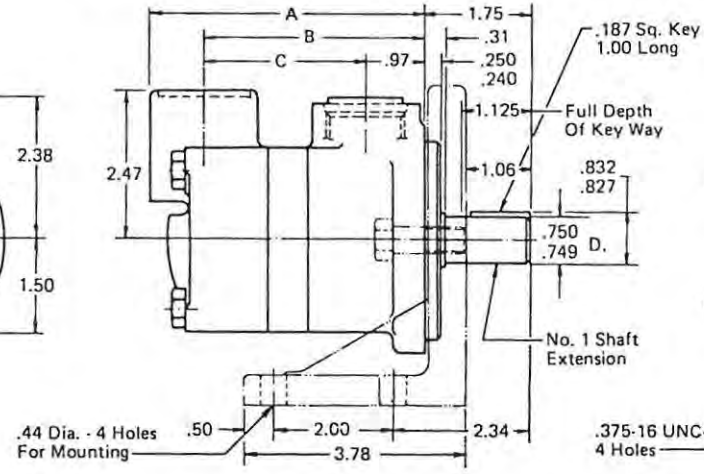
Model Numbers Use as Listed for Petroleum and Water Containing Fluids. For Synthetic Fluids, See Synthetic Fluids Paragraph.		Typical Operating Characteristics At 1200 RPM. Data Based on Performance at Oil Temperature of 120°F Viscosity 150 SSU At 100°F.						
Mounting		Ring Size	100 PSI		1000 PSI		2250 PSI	
Flange	Foot		USGPM	Input HP	USGPM	Input HP	USGPM	Input HP
V10-1P1*-1C10	V10-2P1*-1C10	1	1	.3	.7	.8	.6	1.6
V10-1P2*-1C10	V10-2P2*-1C10	2	2	.3	1.8	1.75	1.6	3.8
V10-1P3*-1C10	V10-2P3*-1C10	3	3	.4	2.8	2.2	2.6	5.0
V10-1P4*-1C10	V10-2P4*-1C10	4	4	.4	3.7	3.0	3.5	6.5
V10-1P5*-1C10	V10-2P5*-1C10	5	5	.6	4.8	3.6	4.5	7.8

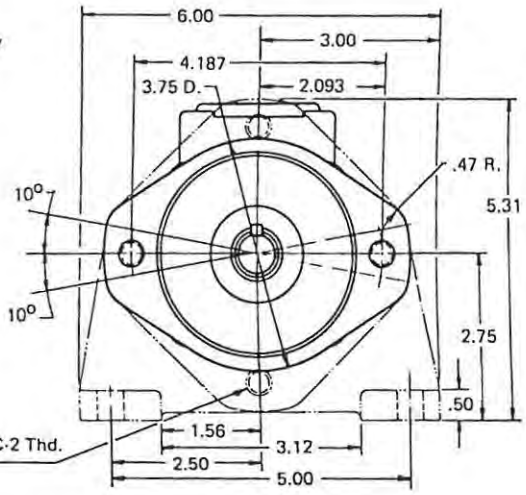


Dimensions A, B & C vary with ring size as tabulated:

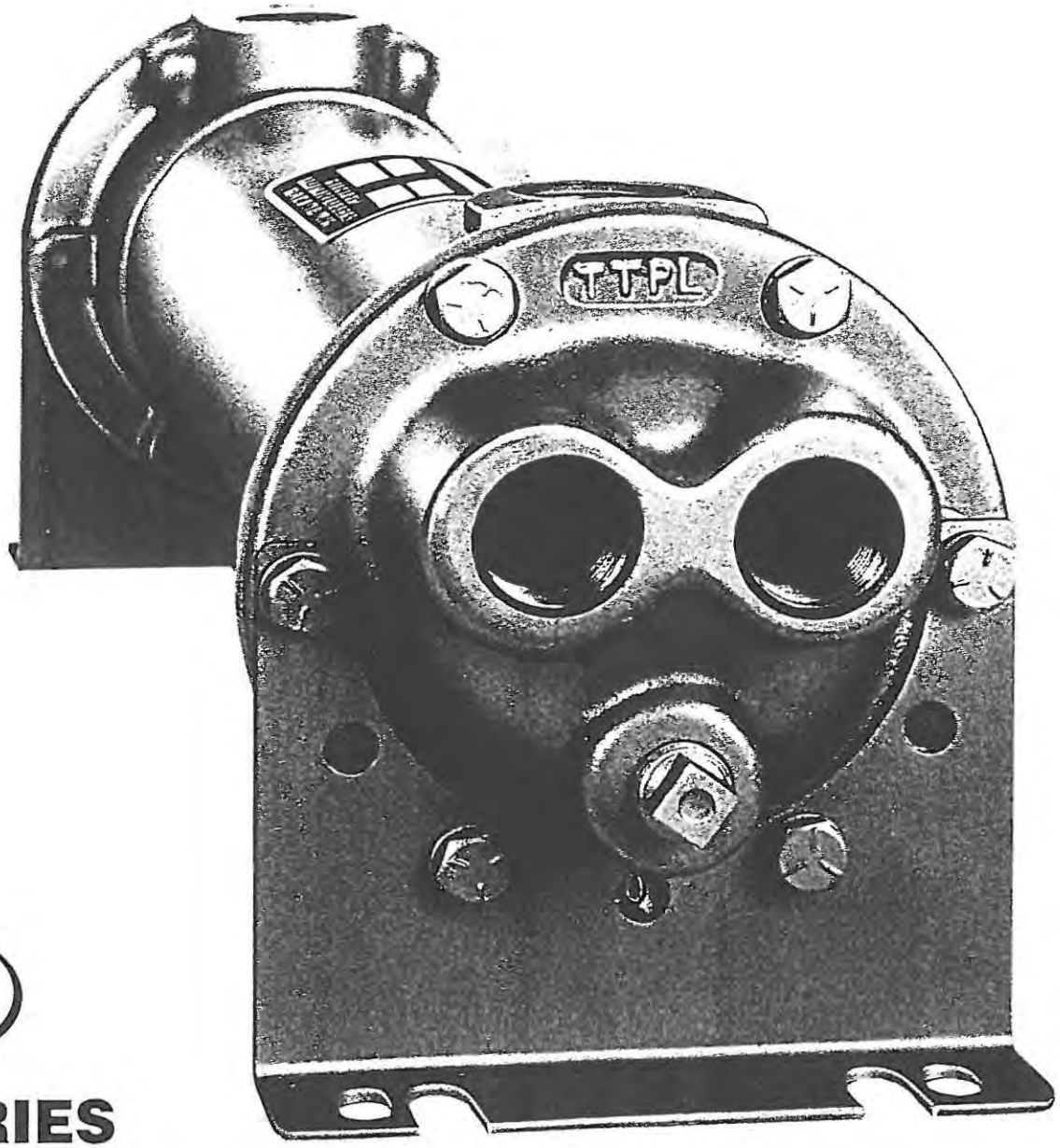
Ring Size GPM	Dimension		
	A	B	C
1	4.55	3.62	2.65
2			
3			
4	4.80	3.87	2.90
5			







Note:
Pump may be assembled on foot mounting in any one of four positions.



THERMAL TRANSFER PRODUCTS LTD

"B" SERIES

HEAT EXCHANGERS

FIXED BUNDLE / WATER COOLED

SPECIFICATIONS

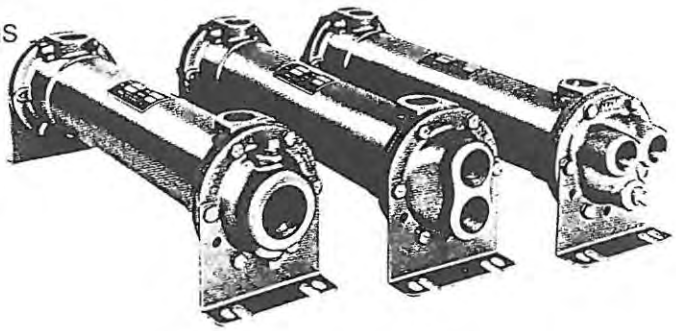
MATERIALS
Tubes—Copper
Headers—Brass, Steel B-2000 Series
Shell—Brass, Steel B-2000 Series
End Hubs—Brass
End Bonnets—Cast Iron
Baffles—Brass
Mounting Brackets—Steel
Gaskets—Non-asbestos nitrile rubber/cellulose fiber
Nameplate—Aluminum Foil

PRESSURE & TEMPERATURE RATINGS

B-400 THRU B-1600 SERIES
Operating Pressure
Tubes—150 psi
Shell—250 psi

B-2000 SERIES
Tubes—150 psi
Shell—150 psi

ALL SERIES
Test Pressure
Tubes—225 psi
Shell—300 psi
Operating Temp. 350°F



BULLETIN 6.01

INSTALLATION

The satisfactory use of this heat exchange equipment is dependent upon certain precautions which must be taken at the time of installation.

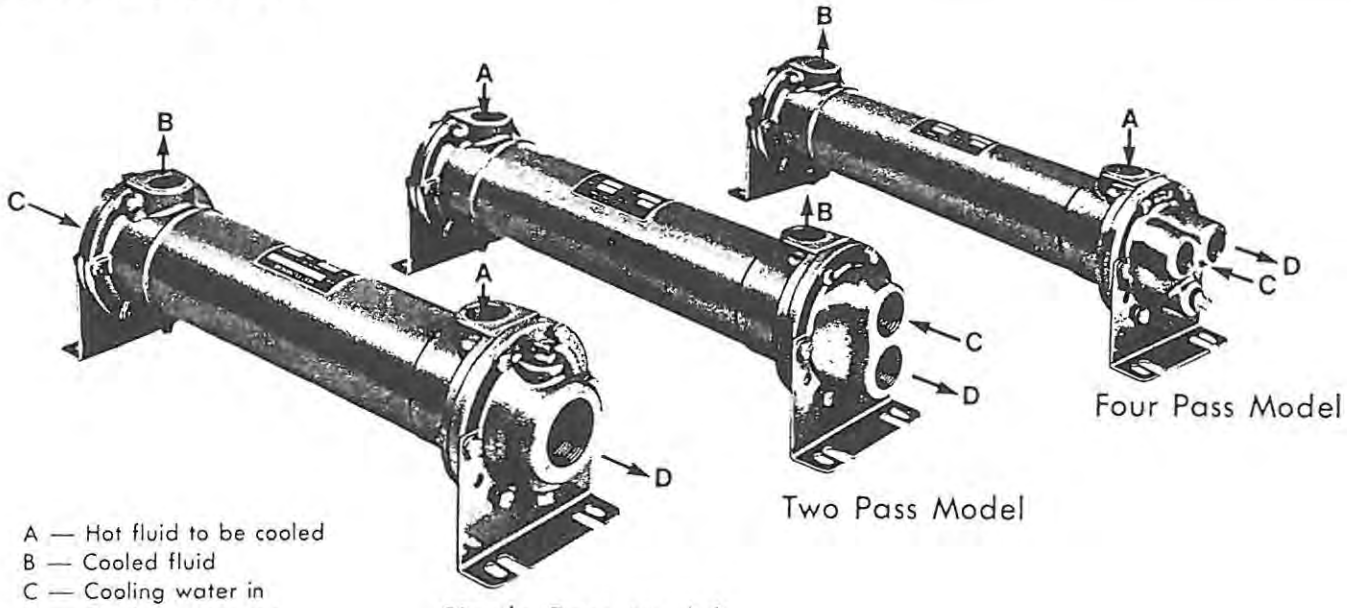
1. Connect the hot fluid (and most viscous fluid) lines and the cooling water lines in accordance with the piping instructions below.
2. If an automatic water regulating valve is used, place it on the **inlet** end of the cooler. Arrange the water outlet piping so that the exchanger remains flooded with water, but at little or no pressure. If this is not done, and a leak develops internally, water can be forced into the oil chamber because of the difference in fluid pressures. The temperature probe is placed in the hydraulic reservoir to sense a system temperature rise. Consult the factory for water regulating valve recommendations.
3. There are normally no restrictions as to how a cooler may be mounted. The only limitation regarding the mounting of this equipment is the possibility of having to drain either the water or the oil chambers after the cooler has been installed.The bottom drain plugs should then be located to accomplish the draining of these fluids. Drains on all models except 400 series.
4. It is possible to protect your cooler from high flow and pressure surges of hot fluid by installing a fast acting relief valve or a bypass check valve in the **inlet** line to the cooler.
5. It is recommended that water strainers be installed ahead of this cooler when the source of cooling water is from other than a municipal water supply. Dirt and debris can plug the water passages very quickly rendering the cooler ineffective. Consult the factory for water strainer recommendations.
6. Caution: Incorrect installation can cause this product to fail prematurely, causing the shell-side and tube-side fluids to intermix. Maximum allowable flow rates are printed and included with each heat exchanger. If this information is not available, contact the factory before installation. For liquid to liquid applications, maximum shell velocity 8 feet per second; maximum tube velocity 7.5 feet per second. Maximum nozzle velocity 11 feet per second.
7. The differential temperature between the entering shell side fluid and the entering tube side fluid should not exceed 150°F. For applications that exceed these limits, heat exchangers with floating tube bundles must be used. Consult factory for assistance.

UNIT CODING

MODEL B - 702 - A 4 - T (Example)

- Standard Construction
- Shell Diameter
- Effective Tube Length
- Baffle Spacing
- Cooling Tube Diameter
- Tube Side Passes

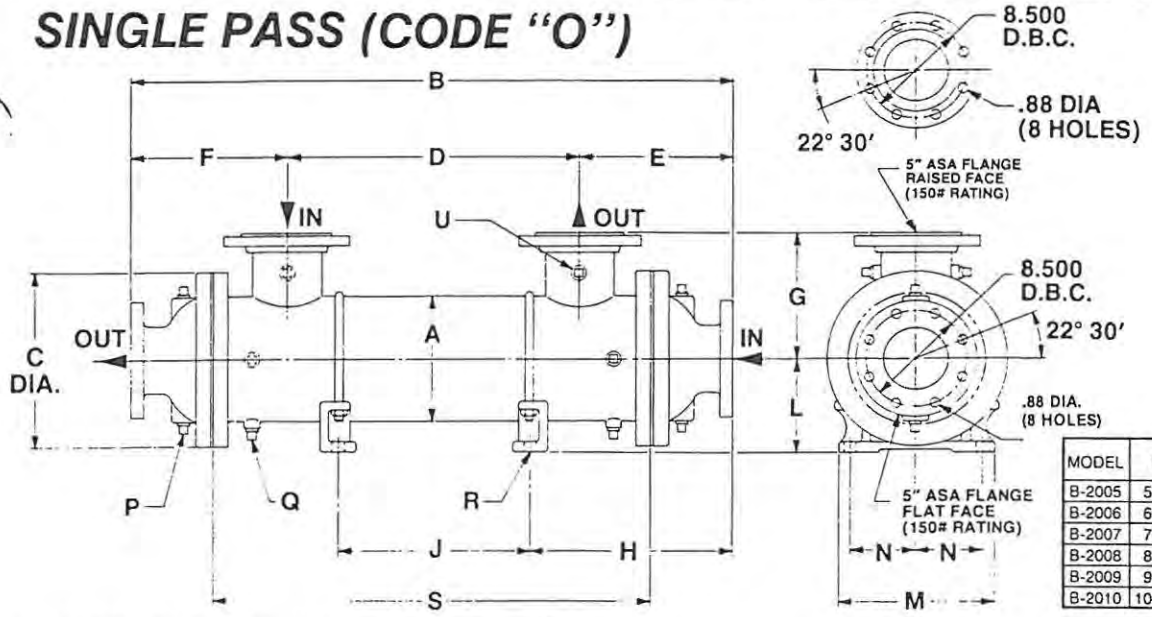
PIPING HOOK UP



A — Hot fluid to be cooled
B — Cooled fluid
C — Cooling water in
D — Cooling water out

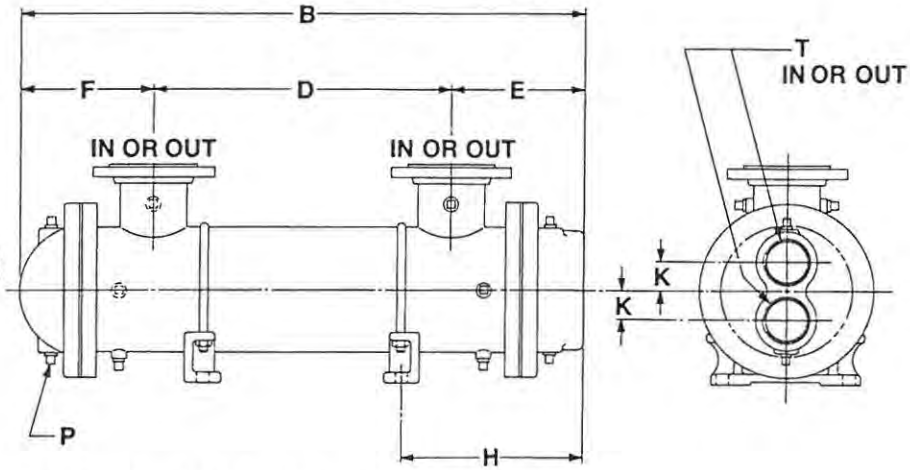
DIMENSIONAL DATA B-2000 SERIES

SINGLE PASS (CODE "O")



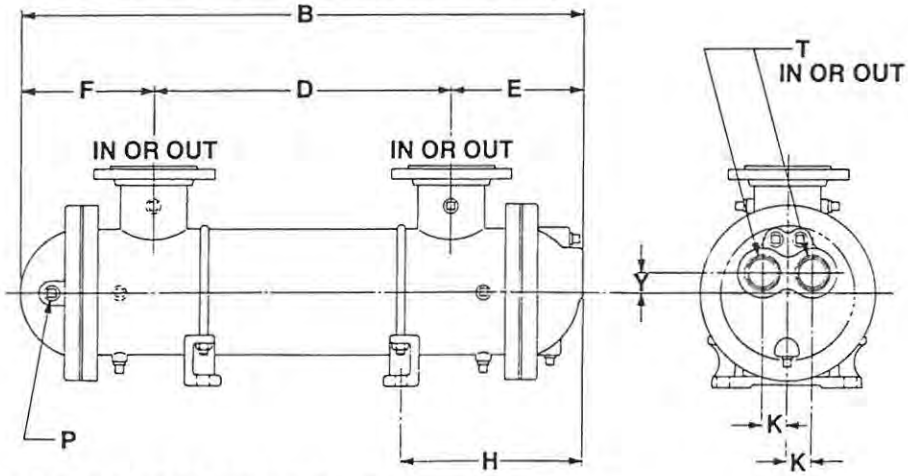
MODEL	B	E	F	H	P N.P.T.
B-2005	59.88	12.88	12.88	17.44	(4) .50
B-2006	68.88				
B-2007	77.88				
B-2008	86.88				
B-2009	95.88				
B-2010	104.88				

TWO PASS (CODE "T")



MODEL	B	E	F	H	K	P N.P.T.	T N.P.T.
B-2005	55.63	10.88	10.63	15.38	2.50	(4) .50	3.00
B-2006	64.63						
B-2007	73.63						
B-2008	82.63						
B-2009	91.63						
B-2010	100.63						

FOUR PASS (CODE "F")



MODEL	B	E	F	H	K	P N.P.T.	Y	T N.P.T.
B-2005	55.63	10.88	10.63	15.38	2.00	(5) .50	1.75	2.50
B-2006	64.63							
B-2007	73.63							
B-2008	82.63							
B-2009	91.63							
B-2010	100.63							

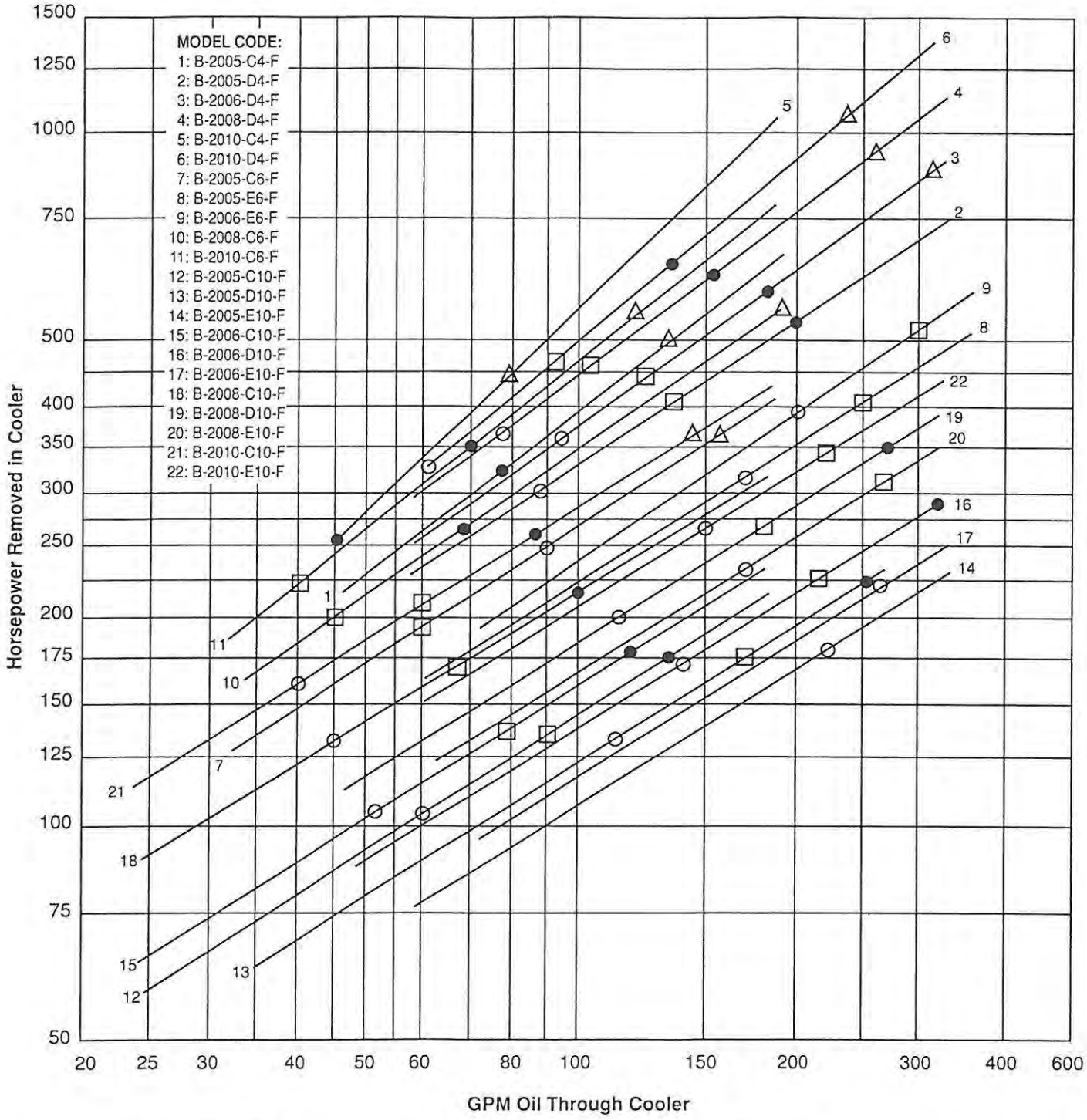
COMMON DIMENSIONS

MODEL	A	C	D	G	J	L	M	N	Q N.P.T.	R	S	U N.P.T.	NET WEIGHT LBS	MODEL
B-2005	10.50	14.88	34.12	10.75	25.00	8.00	12.25	5.00	(4) .50	(4) .750 DIA.	46.12	(2) .38	670	B-2005
B-2006			43.12		34.00						55.12		720	B-2006
B-2007			52.12		43.00						64.12		770	B-2007
B-2008			61.12		52.00						73.12		820	B-2008
B-2009			70.12		61.00						82.12		870	B-2009
B-2010			79.12		70.00						91.12		920	B-2010

All dimensions in inches. Zinc anodes optional.

NOTE: We reserve the right to make reasonable design changes without notice.

PERFORMANCE DATA B-2000 SERIES



1) Above curves based on 40°F approach temperature. Example: oil leaving cooler at 125°F using 85°F cooling water (125 - 85 = 40).

2) The oil to water ratio of 2:1 means that for every gallon of oil circulated, a minimum of 1/2 gallon of 85°F water must be circulated to obtain the curve results.

3) Curve performance based on oil with an average viscosity of 100 SSU.

4) Oil pressure drop coding: ○ = 5 psi; □ = 10 psi; ● = 20 psi; △ = 50 psi. Curves having no pressure drop code symbol means that the oil pressure drop is less than 5 psi to the maximum recommended flow rate for that model cooler. Multiply oil pressure drop x B.

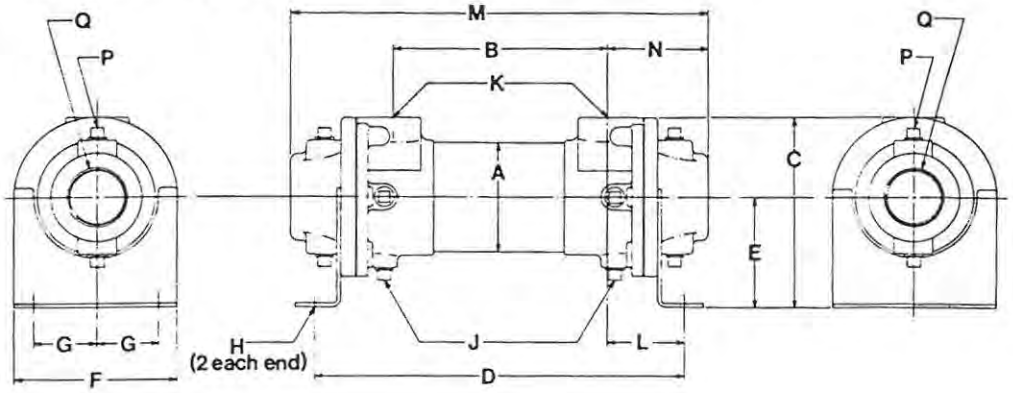
5) Corrections for approach temperature and oil viscosity:

$$\text{H.P. Removed in Cooler} = \text{H.P. actual heat load} \times \left(\frac{40}{\text{Actual Approach}}\right) \times A$$

VISCOSITY CORRECTIONS		
Avg. Oil SUS	A	B
50	.84	.83
100	1.0	1.0
200	1.14	1.3
300	1.24	1.7
400	1.31	2.1
500	1.37	2.5
600	1.42	2.8
700	1.46	3.2
800	1.50	3 6
900	1.53	4.0
1000	1.56	4.4

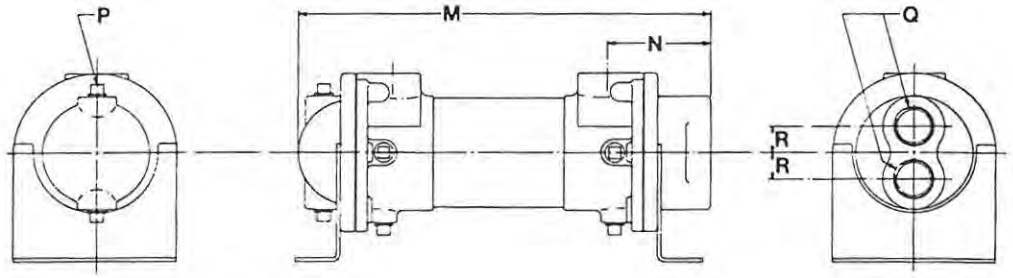
DIMENSIONAL DATA B-400 THROUGH B-1600 SERIES

SINGLE PASS (Code "O")



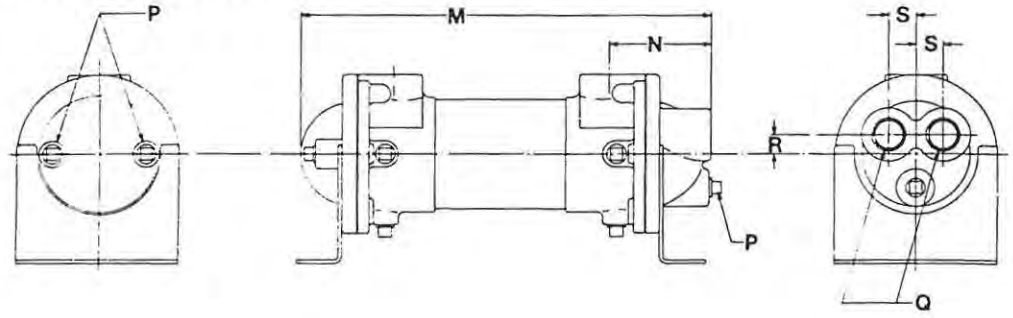
MODEL	M	N	P NPT	Q NPT
B-401	11.24			
B-402	20.24	1.81	—	1.00
B-701	13.47		(4)	
B-702	22.47	3.24	.38	1.50
B-703	31.47			
B-1002	23.60		(4)	
B-1003	32.60	4.05	.38	2.00
B-1004	41.60			
B-1202	24.38			
B-1203	33.25			
B-1204	42.12		(4)	
B-1205	51.12	4.88	.50	3.00
B-1206	60.25			
B-1207	69.25			
B-1208	78.12			
B-1602	26.62			
B-1603	35.62			
B-1604	44.62			
B-1605	53.62		(4)	
B-1606	62.62	6.52	.50	4.00
B-1607	71.62			
B-1608	80.62			
B-1609	89.62			
B-1610	98.62			

TWO PASS (Code "T")



MODEL	M	N	P NPT	Q NPT	R
B-401	—	—	—	—	—
B-402	—	—	—	—	—
B-701	13.28		(2)		
B-702	22.28	3.30	.38	1.00	.88
B-703	31.28				
B-1002	23.29		(2)		
B-1003	32.29	3.80	.38	1.50	1.19
B-1004	41.29				
B-1202	23.94				
B-1203	32.81				
B-1204	41.69		(2)		
B-1205	50.69	4.56	.50	2.00	1.44
B-1206	59.81				
B-1207	68.81				
B-1208	77.69				
B-1602	25.10				
B-1603	34.10				
B-1604	43.10				
B-1605	52.10		(2)		
B-1606	61.10	6.08	.50	2.50	1.88
B-1607	70.10				
B-1608	79.10				
B-1609	88.10				
B-1610	97.10				

FOUR PASS (Code "F")



MODEL	M	N	P NPT	Q NPT	R	S
B-401	—	—	—	—	—	—
B-402	—	—	—	—	—	—
B-701	13.42		(3)			
B-702	22.42	3.24	.38	.75	.62	.88
B-703	31.42					
B-1002	23.55		(3)			
B-1003	32.55	4.06	.38	1.00	.75	1.34
B-1004	41.55					
B-1202	24.44					
B-1203	33.31		(2)			
B-1204	42.19		.38			
B-1205	51.19	4.90		1.50	1.06	1.40
B-1206	60.31		(1)			
B-1207	69.31		.50			
B-1208	78.19					
B-1602	26.72					
B-1603	35.72					
B-1604	44.72					
B-1605	53.72		(3)			
B-1606	62.72	6.48	.50	2.00	1.38	1.88
B-1607	71.72					
B-1608	80.72					
B-1609	89.72					
B-1610	98.72					

COMMON DIMENSIONS

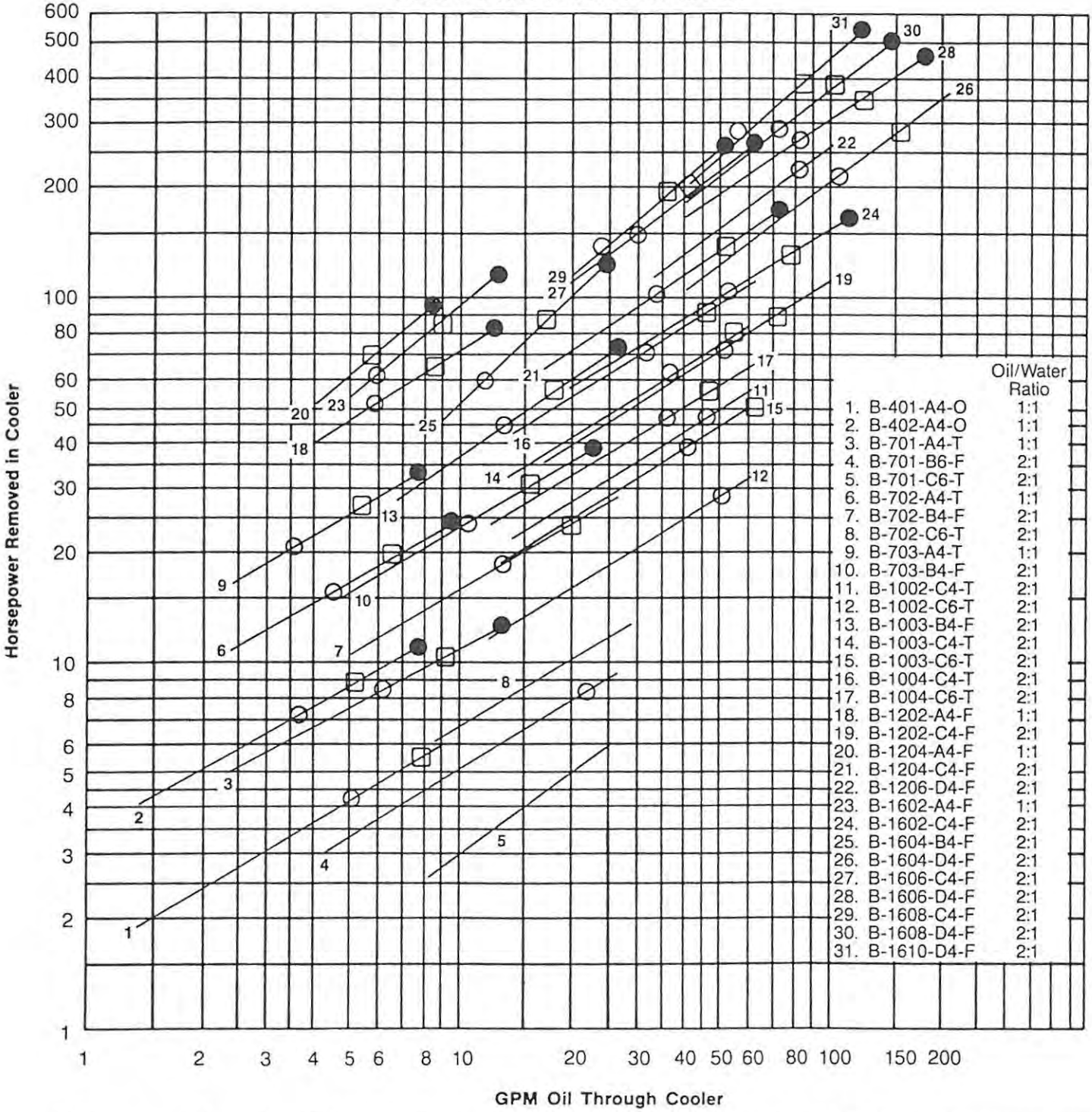
MODEL	A	B	C	D	E	F	G	H	J NPT	K NPT	L	NET WEIGHT (LBS)	MODEL
B-401		7.62		10.91								7	B-401
B-402	2.125	16.62	3.50	19.91	1.94	2.62	.88	.41 Dia.	—	.50	1.72	10	B-402
B-701		7.00		12.38								23	B-701
B-702	3.656	16.00	6.25	21.38	3.62	5.25	1.50	.44x1.00	(2) .38	1.00	2.69	28	B-702
B-703		25.00		30.38								35	B-703
B-1002		15.50		21.62								49	B-1002
B-1003	5.125	24.50	7.38	30.62	4.00	6.75	2.00	.44x1.00	(6) .38	1.50	3.06	65	B-1003
B-1004		33.50		39.62								72	B-1004
B-1202		14.62		21.50								72	B-1202
B-1203		23.50		30.38								90	B-1203
B-1204		32.38		39.25								110	B-1204
B-1205	6.125	41.38	8.81	48.25	4.75	7.50	2.50	.44x.88	(6) .38	2.00	3.44	135	B-1205
B-1206		50.50		57.38								160	B-1206
B-1207		59.50		66.38								185	B-1207
B-1208		68.38		75.25								200	B-1208
B-1602		13.60		22.38								145	B-1602
B-1603		22.60		31.38								170	B-1603
B-1604		31.60		40.38								195	B-1604
B-1605		40.60		49.38								245	B-1605
B-1606	8.00	49.60	12.13	58.38	6.50	8.62	3.50	.44x1.00	(6) .38	3.00	4.39	259	B-1606
B-1607		58.60		67.38								270	B-1607
B-1608		67.60		76.38								310	B-1608
B-1609		76.60		85.38								350	B-1609
B-1610		85.60		94.38								400	B-1610

All dimensions in inches. Zinc anodes optional.

NOTE: We reserve the right to make reasonable design changes without notice.

PERFORMANCE DATA B-400 THROUGH B-1600 SERIES

BASIC STOCK MODELS
HEAT ENERGY DISSIPATION RATES



1) Above curves based on 40°F approach temperature. Example: oil leaving cooler at 125°F using 85°F cooling water (125 - 85 = 40).

2) The oil to water ratio of 1:1 or 2:1 means that for every gallon of oil circulated, a minimum of 1 or 1/2 gallon (respectively) of 85°F water must be circulated to obtain the curve results.

3) Curve performance based on oil with an average viscosity of 100 SSU.

4) Oil pressure drop coding: ○ = 5 psi; □ = 10 psi; ● = 20 psi. Curves having no pressure drop code symbol means that the oil pressure drop is less than 5 psi to the maximum recommended flow rate for that model cooler. Multiply oil pressure drop x B.

5) Corrections for approach temperature and oil viscosity:

$$\text{H.P. Removed in Cooler} = \text{H.P. actual heat load} \times \left(\frac{40}{\text{Actual Approach}}\right) \times A$$

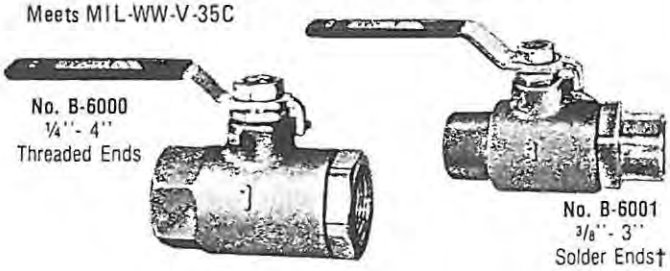
VISCOSITY CORRECTIONS		
Avg. Oil SUS	A	B
50	.84	.83
100	1.0	1.0
200	1.14	1.3
300	1.24	1.7
400	1.31	2.1
500	1.37	2.5
600	1.42	2.8
700	1.46	3.2
800	1.50	3.6
900	1.53	4.0
1000	1.56	4.4

bronze and brass ball valves

Series B-6000, B-6001

2-Piece Bronze, Standard Port
For Residential, Commercial and Industrial Use

Meets MIL-WW-V-35C



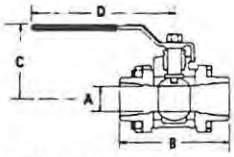
No. B-6000
¼"- 4"
Threaded Ends

No. B-6001
⅜"- 3"
Solder Ends†

- Glass reinforced Durafill seats standard
- Hard chrome plated brass ball
- Sizes ¼"- 2" pressure rated at 600 psi WOG , 2½"- 4" 400 psi WOG (non-shock) and 150 psi saturated steam
- Adjustable stem packing gland
- Suitable for temperatures from -55°F to +450°F

OPTIONS - Add Suffix:
*GS - Ground washer
*TH - Tee handle
*RH - Round handle - sizes ¼"-2"
*SS - Stainless steel ball and stem
*SH - Stainless steel handle and nut
*XH - Extended handle
*CL - Chain lever kit - sizes ¾"-1"
*BS - Balancing stop
SC - Rough chrome - sizes ¼"- 2"
*04 - Mineral filled TFE seats and seals (available in all 316SS ball and stem option valves)
*Z15 - Less lever and nut

ODELS: B-6000UL
..L. - Flammable Liquids (YRBX)
U.L. - Compressed Gas (YQNZ)
U.L. - Fire Protection (HNFX)
U.L. - LP Gas (YSDT)
U.L. - Natural/Manufactured Gas (YRPV)
U.L. - for #1/#2 Fuel Oils (MHKZ)



B-6004 - Size ½"- 1" single hose connection. Ideal for applications where flexible hose will be used downstream of valve

DIMENSIONS (Inches) B-6000

Size	A Ball Orifice	B End to End	C Center to Handle	D Radius of Handle	Weight (Lbs.)
1/4"	3/8	2 1/16	1 3/4	3 1/16	.58
3/8"	3/8	2 1/16	1 3/4	3 1/16	.60
1/2"	1/2	2 3/16	1 3/4	3 3/4	.63
3/4"	11/16	2 13/16	2	3 3/4	1.19
1"	7/8	3 7/16	2 5/16	4 1/2	2.13
1 1/4"	1	3 7/8	2 15/16	5 1/2	3.25
1 1/2"	1 1/4	4 1/4	2 15/16	5 1/2	4.13
2"	1 1/2	4 13/16	3 5/8	8 1/8	6.38
2 1/2"	2	4 1/4	6 1/2	8 1/8	12.75
3"	2 1/2	6 13/16	4 1/2	8 1/8	17.75
4"	3	7 11/16	5	11	24.94
		†B-6001			
3/8", 1/2"	1/2	2 3/8	1 3/4	3 3/4	.63
3/4"	11/16	3 5/16	2	3 3/4	1.13
1"	7/8	3 13/16	2 5/16	4 1/2	1.81
1 1/4"	1	4 1/2	2 15/16	5 1/2	2.88
1 1/2"	1 1/4	5	2 15/16	5 1/2	4.25
2"	1 1/2	6 1/4	3 5/8	8 1/8	6.81
2½"	2	7 5/8	4 1/2	8 1/8	13.00
3"	2 1/2	8 3/16	4 1/2	8 1/8	18.00

†Designed to be soft soldered without disassembly, using a low temperature solder; 50/50 tin lead (420°F). Other solders, 95/5 tin antimony (460°F) or 96/4 tin silver (430°F) can be used, however, extreme caution must be used to prevent seat damage. Higher temperature solders will damage the seat material. ANSI B.16.18 stated that the maximum operating pressure of 50/50 solder sweat connections is 200 PSI at 100°F and decreases with higher temperatures.

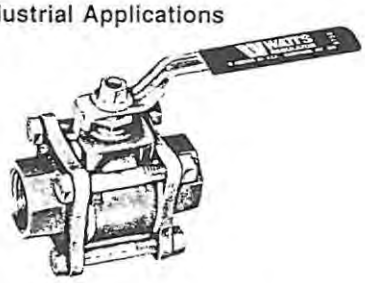
For Additional Information, send for F-B6000.

Series B-6800

3-Piece Brass, Full Port
For Commercial and Industrial Applications

No. B-6800
¼"- 2"
Threaded Ends

No. B-6801
½"- 2"
Solder Ends†



- Three-piece lift-out design is ideal where maintenance is a must.
- High cycle life reinforced TFE stem packing seal and thrust washer.
- Excellent for throttling and balancing applications.
- Individually tested, air under water, opened & closed position
- Sizes ¼"- 1" pressure rated at 600 psi WOG, 1¼"- 2" at 400 psi WOG (non-shock) and 150 psi saturated steam
- Suitable for temperatures from -55°F to +450°F at 50 psi
- Other features same as B-6000

OPTIONS (See * on B-6000 plus LL - Latch-Lok, SE - Safety exhaust)

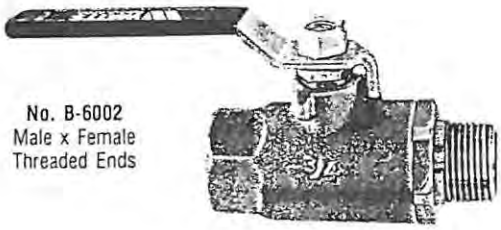
DIMENSIONS (Inches) B-6800

Size	A Ball Orifice	B End to End	C Center to Handle	D Radius of Handle	Weight (Lbs.)
1/4", 3/8", 1/2"	1/2	2 3/8	1 3/4	3 7/8	1.12
3/4"	3/4	3 1/4	2 1/4	4 1/2	2.50
1"	1	3 7/8	2 3/4	5 1/2	4.12
1 1/4"	1 1/4	4 1/2	3	5 1/2	6.25
1 1/2"	1 1/2	5	3 1/2	8 1/8	9.25
2"	2	5 5/8	3 7/8	8 1/8	13.75

For Additional Information, send for ES-B6800.

Series B-6002

Male x Female Bronze, Standard Port
For Industrial Applications



No. B-6002
Male x Female
Threaded Ends

- Same features as B-6000.

OPTIONS: Same as B-6000 except SC, U.L. and OC.

DIMENSIONS (Inches)

Size	A Ball Orifice	B End to End	C Center to Handle	D Radius of Handle	Weight (lbs.)
1/4", 3/8"	3/8	2 1/2	1 3/4	3 1/16	.56
1/2"	1/2	2 7/8	1 3/4	3 13/16	.69
3/4"	11/16	3 7/16	2 1/16	3 13/16	1.25
1"	7/8	4 1/8	2 3/8	4 9/16	2.12

For Additional Information, send for ES-B6002.

bronze and brass gate valves

Complies with Federal Specification WW-V-54,
Type I, Class A, 85-5-5-5 construction

Series FGV-1

Federal Specification MSS SP-80
Inside screw bonnet, NRS, solid disc

(I)



Designed for continuous service on steam, water, oil and gas in either the open or fully-closed position. They are ideally suited for areas where space is a premium. Virgin PTFE packing and a gland follower. ASTM B62 body, stem and disc. Threaded IPS connections.

Pressure rating: 200 WOG
Steam rating: 125 W.S.P.

No.	Size	Dimensions (Inches) A	B	C	Master Carton Qty.	Weight (lbs.)
FGV-1, FGVS-1*	1/4"	1.66	3.05	1.88	120	60
FGV-1, FGVS-1*	3/8"	1.66	3.05	1.88	120	60
FGV-1, FGVS-1*	1/2"	1.96	3.29	2.44	96	74
FGV-1, FGVS-1*	3/4"	2.05	3.92	2.75	48	62
FGV-1, FGVS-1*	1"	2.48	4.46	2.75	42	74
FGV-1, FGVS-1*	1 1/4"	2.60	5.24	3.35	24	64
FGV-1, FGVS-1*	1 1/2"	2.77	5.59	3.74	15	46
FGV-1, FGVS-1*	2"	2.96	6.38	4.13	10	45

*FGVS-1 solder end connections

For Additional Information, send for F-BBV, GV, CV

Series FGV-UB

Federal Specification MSS SP-80
Union bonnet, rising stem, solid disc

(I)



Designed for continuous service on steam, water, oil and gas in either the open or fully-closed position. They afford free flow with minimum pressure drop. The union bonnet provides for quick valve disassembly for inspection and repair plus it reinforces the body to protect against vibration and pipeline strain. Virgin PTFE packing and a gland follower.

Pressure rating: 300 WOG
Steam rating: 150 W.S.P.

No.	Size	Dimensions (Inches) A	B	C	Master Carton Qty.	Weight (lbs.)
Threaded IPS connections						
FGV-UB	1/4"	1.75	4.13	1.88	120	60
FGV-UB	3/8"	1.75	4.13	1.88	120	60
FGV-UB	1/2"	2.13	5.00	2.44	96	74
FGV-UB	3/4"	2.24	6.10	2.75	48	62
FGV-UB	1"	2.62	7.56	2.75	42	74
FGV-UB	1 1/4"	2.87	8.62	3.35	24	64
FGV-UB	1 1/2"	3.13	10.04	3.74	15	46
FGV-UB	2"	3.52	12.13	4.13	10	45

For Additional Information, send for F-BBV, GV, CV

Series GV, GVS

Bronze Gate Valves
For Water and Steam Service



(I)

Full rating for broad application.
125 WSP, 200 psi WOG.

Series GV have IPS threaded connections in sizes 1/4"- 4".

Series GVS have CxC sweat connections in sizes 3/8"- 3".

- Screw-in bonnet
- 85-5-5-5 bronze body

Size	DIMENSIONS (Inches) A GV	A GVS	B GV	B GVS	C GV	C GVS	Weight (lbs.) GV	Weight (lbs.) GVS
1/4"	15/8	–	3	–	1 15/16	–	0.62	–
3/8"	15/8	1 3/4	3 3/16	3 3/8	1 15/16	2 1/8	0.62	0.62
1/2"	1 3/4	1 3/4	3 3/8	3 3/8	2 3/16	2 1/8	0.71	0.62
3/4"	1 15/16	2 3/8	3 5/8	3 5/8	2 3/8	2 3/8	0.93	0.88
1"	2 1/8	2 13/16	4 7/16	4 7/16	2 9/16	2 9/16	1.2	1.15
1 1/4"	2 3/8	3	5	5	2 3/4	2 3/4	2.0	1.72
1 1/2"	2 1/2	3 3/8	5 3/8	5 7/16	3 1/8	3 1/8	2.7	1.85
2"	2 7/8	4	6 1/2	6 1/2	3 9/16	3 1/2	3.4	3.53
2 1/2"	3 1/2	4 1/2	8	8 5/16	4 5/16	4 3/8	6.4	5.95
3"	3 15/16	5 3/16	9 3/16	9 3/16	4 15/16	4 15/16	9.3	8.82
4"	4 3/4	–	10 3/4	–	5 3/4	–	18.0	–

For Additional Information, send for F-BBV/GV/CV.

Series WGV, WGVS

Brass Gate Valves



(I)

Rating: 125 psi WOG

Series WGV have IPS threaded connections in sizes 1/2"- 4".

Series WGVS have CxC sweat connections in sizes 1/2"- 2".

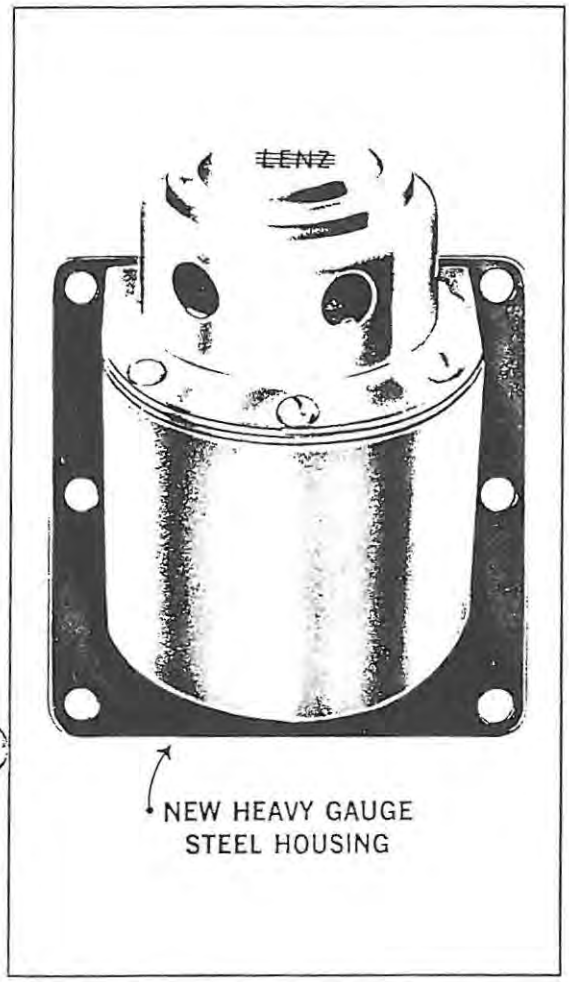
Size (Inches)	DIMENSIONS (Inches) A WGV	A WGVS	B WGV	B WGVS	C WGV	C WGVS	Weight (lbs.) WGV	Weight (lbs.) WGVS
1/2	1 3/4	1 15/16	3	3	2 1/8	2 1/8	.60	.58
3/4	1 15/16	2 1/2	3 1/2	3 1/2	2 1/8	2 1/8	.82	.80
1	2 1/8	2 3/4	4 1/8	4	2 3/8	2 3/8	1.1	1.
1 1/4	2 3/8	3	4 1/2	4 1/2	2 1/2	2 3/4	1.37	1.33
1 1/2	2 3/8	3 1/2	5 3/8	5 1/8	2 3/4	2 3/4	2	2
2	2 13/16	4 1/4	6	6	3 1/4	3 1/4	3	3
2 1/2	3 1/2	—	7 3/4	—	4	—	6.25	—
3	3 7/8	—	8 7/8	—	4 7/16	—	7.75	—
4	4 3/4	—	10 1/2	—	5 1/8	—	13.50	—

For Additional Information, send for S-WGV.

(I) International Product

FILLER CAP ASSEMBLIES

side mount



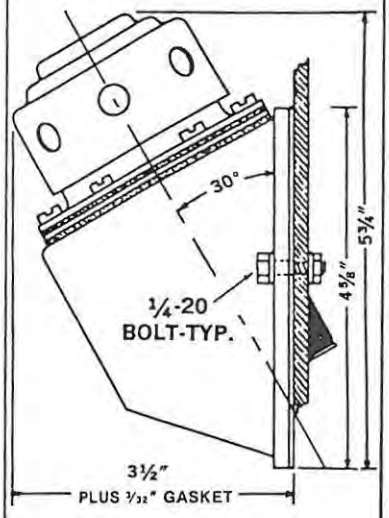
FILTER • STRAINER BREATHER

MODEL SM

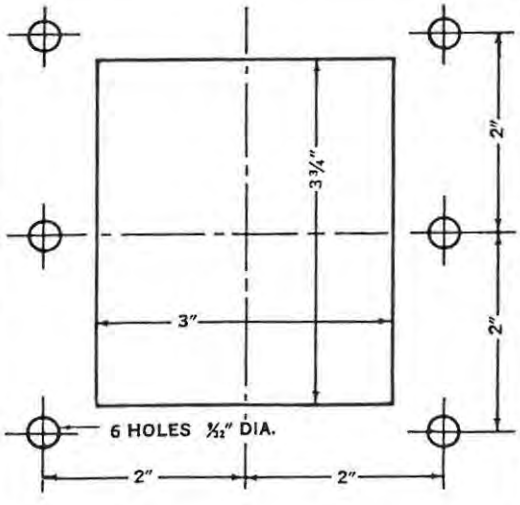
Filters, Breathes and Strains - Makes fuel tank customizing easier. Designed for use on tanks that require filling from the end or side. Choice of standard or weather-proof cap (same as Model FCS) at no extra charge. The Super 3" cap used on Model 57-XL is available as an extra-cost option on these units. Fully assembled and ready to mount. Includes instructions and template. May also be welded directly to side of reservoir.

Lenz Quality Standards - Newly designed, heavy-duty, one-piece housing is of zinc-plated steel. Six bolts with nuts and seals and mounting gasket are included. All other components and specifications are identical to those for Lenz Standard FCS Model or 57XL (Page 2). Nickel-chrome or black oxide finish optional at additional cost. Separate housings, unplated, are also available.

DIMENSIONS



Optional Perforated Inner Guards Are Available At Extra Cost



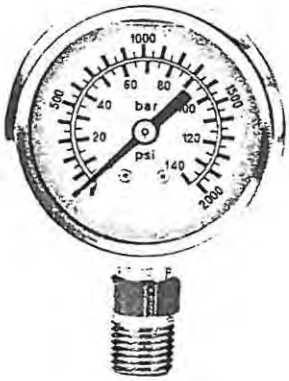
MOUNTING DIMENSIONS

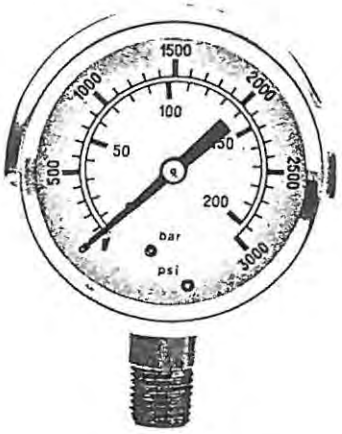
MODEL NUMBER	DESCRIPTION
SM-537	Standard Cap Assembly With Chain
SM-547	Standard Cap Assembly Without Chain
SM-537W	Weatherproof Cap Assembly With Chain
SM-547W	Weatherproof Cap Assembly Without Chain
SM-557	Non-Vented Cap Assembly With Chain
SM-57-XL-40	High Capacity Cap Assembly With Chain (40 Micron)
SM-57-XL-15	High Capacity Cap Assembly With Chain (15 Micron)

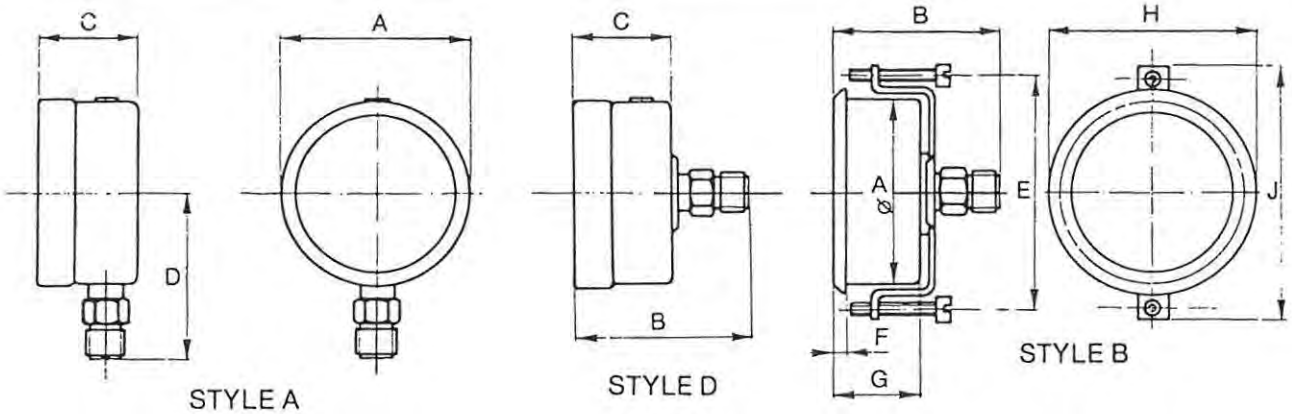
Note: SM Models Use 3" Screens Only

CF Series
SILICONE FILLED 2 AND 2½ INCH

- Stainless Steel Case and Bezel
- Spiral Bourdon Tube Over 600 PSI
- Built in Relief Valve
- Optional Glycerine Filled
- Pressure range to 15,000 PSI
- Dual Scale
- Accuracy ± 1.6% Full Scale Deflection Center 40% of Scale otherwise 2% FSD
- New 1-1/2" Diameter Size Available



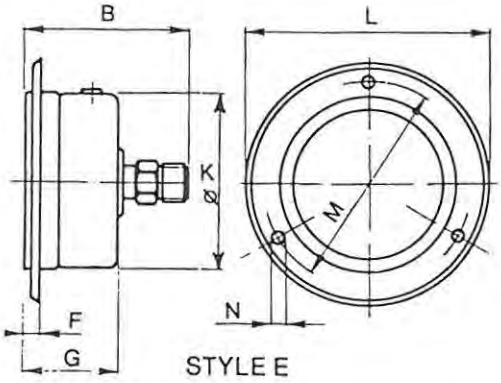




NOW AVAILABLE - Rubber Housing for the 2-l/2" gage
Order by No. GP 40N.

Size	A	B	C	D	E	F	G	H	J	K	L	M	N	
2 in.	2.09	2.24	1.22	1.97	2.33	.28	1.18	2.24	2.68	2.13	2.76	2.44	.14	in.
	53	57	31	50	59	7	30	57	68	54	70	62	3.5	mm
2½ in.	2.5	2.36	1.34	2.16	3.00	.20	1.30	2.68	3.31	2.52	3.46	2.95	.14	in.
	63	60	34	55	76	5	33	68	84	64	88	75	3.5	mm

Standard Stem is ¼ NPT — Special on Request — $^{7}/_{16}$ - 20 SAE Swivel



Ordering Example: CF - 1P - 004 - B - SAE

*2" dia. gage has 2 mtg. holes on M dia.

PDI Designation for Silicone Filled Gages

Size
1 — 2½" (63 mm)
5 — 2" (53 mm)

Specify if glycerine filled gage required.

Type
C — Compound
V — Vacuum
P — Pressure

Range
002 — −30" Hg — 30 psi
000 — −30" Hg — 0 psi
001 — 0-15 psi
002 — 0-30 psi
004 — 0-60 psi
007 — 0-100 psi
010 — 0-160 psi
015 — 0-200 psi
020 — 0-300 psi
035 — 0-500 psi
040 — 0-600 psi
055 — 0-800 psi
070 — 0-1000 psi
100 — 0-1500 psi
140 — 0-2000 psi
210 — 0-3000 psi
280 — 0-4000 psi
350 — 0-5000 psi
420 — 0-6000 psi
700 — 0-10,000 psi
800 — 0-15,000 psi

Style
A - Stem
B - Panel clamp
D - Center
E - Panel flange

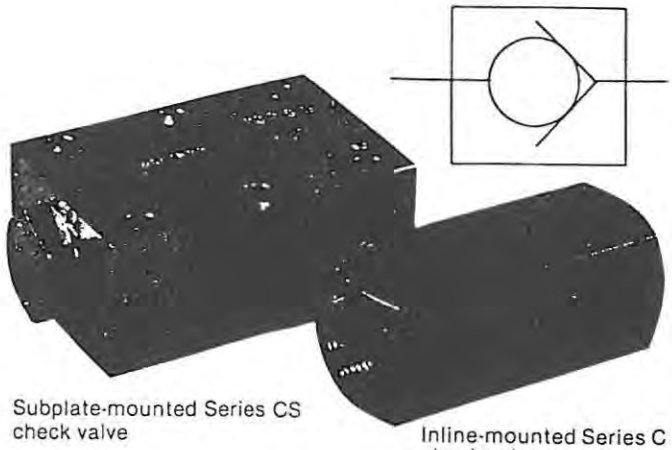
Connection
Omit if NPT add SAE or BSP for these threads 2½ in. only

* Consult PDI for New 1-1/2 dia. glycerine filled model. Available Sept. 88.

6

Check Valves
Series C and CS

Manatrol Series C and CS Check Valves permit free flow in one direction, and shutoff automatically in the reverse direction. These valves are ideal for both hydraulic and pneumatic systems.
Stainless steel poppets, not balls, are standard on all Series C and CS Check Valves. Poppets eliminate chatter and, minimize wear. Triangular retainers developed by Manatrol guide the poppets, hold the spring firmly in place even under high velocity and shock load.



Subplate-mounted Series CS check valve

Inline-mounted Series C check valve

Operating pressures:
Series CS (subplate-mounted):
3000 PSI (210 Bar) max.
Series C (inline-mounted):
Brass: 200-1200 Series: 2000 PSI (140 Bar)
1600 Series: 500 PSI (34 Bar)
Steel: 200-1220 Series: 5000 PSI (340 Bar)
1600-3220 Series: 3000 PSI (210 Bar)

Cracking Pressures, nominal: 5 PSI (0.3 Bar)
Standard Options: 20 PSI (1.3 Bar)
65 PSI (4.5 Bar)
(Other cracking pressures may be available on request)

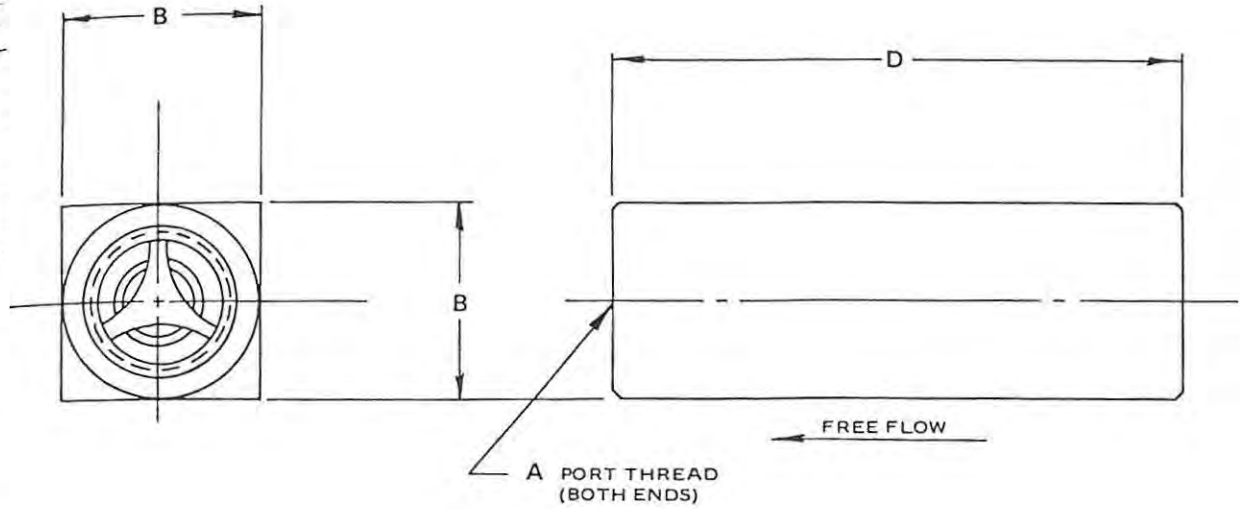
Poppet Style:
Soft seal poppet: Inline-mounted only:
200 thru 1020
Note-Only available on valves with less than 20 PSI springs (cracking pressure)
Solid metal poppet: Inline-mounted only:
1200 thru 3220
Manifold-mounted only: 400 thru 1600

Quick Reference Data Chart

Model Number	Port Size, Inches	Free Flow Rate GPM (L/M)	C_V GPM	Orifice area, in²	ΔP at Max. flow PSI (Bar)
C200 *	1/8-27 NPTF	3 (15)	0.53	0.023	27 (1.9)
C400 * CS400	1/4-18 NPTF 1/4	5 (23)	1.56	0.068	9 (0.6)
C620 *	9/16-18 UNF 2B (SAE 6)	5 (23)	1.56	0.068	9 (0.6)
C600 * CS600	3/8-18 NPTF 3/8	8 (30)	2.27	0.099	11 (0.8)
C820 *	3/4-16 UNF 2B (SAE 8)	8 (30)	2.27	0.099	11 (0.8)
C800 * CS800	1/2-14 NPTF 1/2	15 (45)	5.11	0.224	8 (0.6)
C1020 *	7/8-14 UNF 2B (SAE 10)	15 (45)	5.11	0.224	8 (0.6)
C1200 * CS1200	3/4-14 NPTF 3/4	25 (100)	7.95	0.348	13 (0.9)
C1220 *	1-1/16-12 UN 2B (SAE 12)	25 (100)	7.95	0.348	13 (0.9)
C1600 * C1620 CS1600	1-11-1/2 NPTF 1-5/6-12 UN (SAE 16) 1	40 (150)	10.35	0.453	13 (0.9)
C2000 C2020	1-1/4-11-1/2 NPTF 1-5/8-12 UN (SAE 20)	70 (284)	19.52	0.855	12 (0.8)
C2400 C2420	1-1/2-11-1/2 NPTF 1-7/8-12 UN (SAE 24)	100 (378)	21.82	0.955	18 (1.2)
C3200 C3220	2-11-1/2 NPTF 2-1/2-12 UN (SAE 32)	150 (605)	23.90	1.046	33 (2.3)

*Coast Guard Acceptance-Steel.

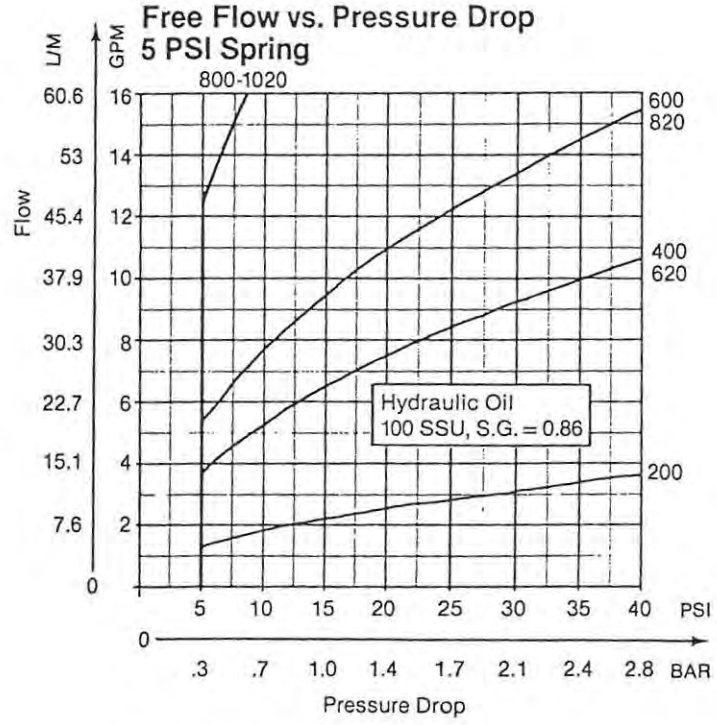
Dimensions
Check Valve, Inline-mounted
Models C200 through C3220



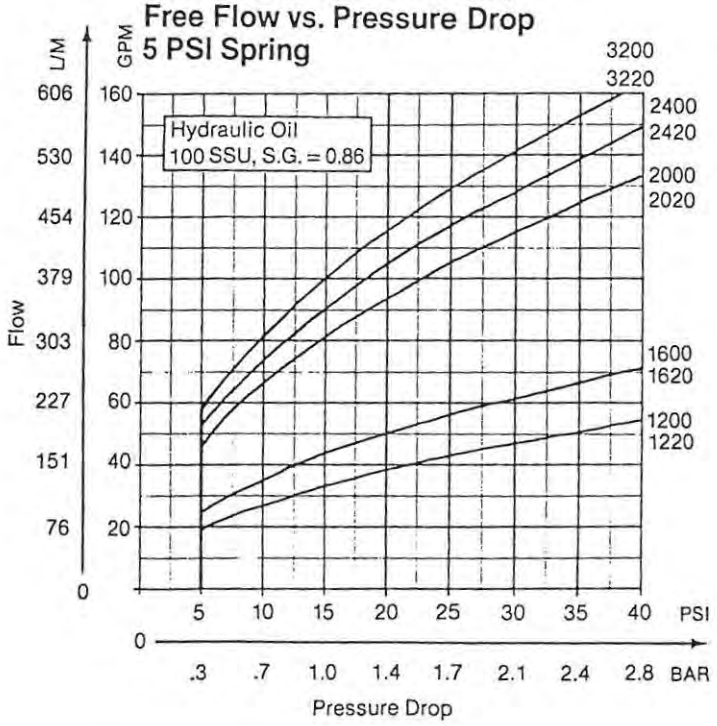
Model Number	Port Size, Inches A	Dimensions, Inch (mm) B	D	Weight Lb. (Kg)
C200	1/8-27 NPTF	0.62 (15.7)	2.00 (50.8)	0.1 (0.05)
C400	1/4-18 NPTF	0.81 (20.6)	2.62 (66.5)	0.4 (0.2)
C620	9/16-18 UNF 2B (SAE 6)	0.88 (22.3)	3.12 (79.2)	0.5 (0.2)
C600	3/8-18 NPTF	1.00 (25.4)	2.75 (69.9)	0.5 (0.2)
C820	3/4-16 UNF 2B (SAE 8)	1.12 (28.4)	3.50 (88.9)	1.3 (0.6)
C800	1/2-14 NPTF	1.25 (31.8)	3.44 (87.4)	1.3 (0.6)
C1020	7/8-14 UNF 2B (SAE 10)	1.25 (31.8)	4.00 (101.6)	2.0 (0.9)
C1200	3/4-14 NPTF	1.50 (38.1)	3.88 (98.6)	2.0 (0.9)
C1220	1-1/16-12 UNF 2B (SAE 12)	1.50 (38.1)	4.62 (117.3)	2.0 (0.9)
C1600	1-11-1/2 NPTF	1.75 (44.5)	5.00 (127.0)	3.3 (1.5)
C1620	1-5/16-12 UN (SAE 16)	2.25 (57.2)	5.62 (142.7)	3.3 (1.5)
C2000	1-1/4-11-1/2 NPTF	2.25 (57.2)	5.62 (142.7)	6.2 (2.9)
C2020	1-5/8-12 UN (SAE 20)	2.75 (69.9)	6.50 (165.1)	6.2 (2.9)
C2400	1-1/2-11-12 NPTF	2.75 (69.9)	5.62 (142.7)	8.4 (3.9)
C2420	1-7/8-12 UN (SAE 24)	3.00 (76.2)	7.25 (184.2)	8.4 (3.9)
C3200	2-11-1/2 NPTF	3.50 (83.7)	6.50 (165.1)	15.4 (7.1)
C3220	2-1/2-12 UN (SAE 32)	4.00 (101.6)	9.00 (228.6)	15.4 (7.1)

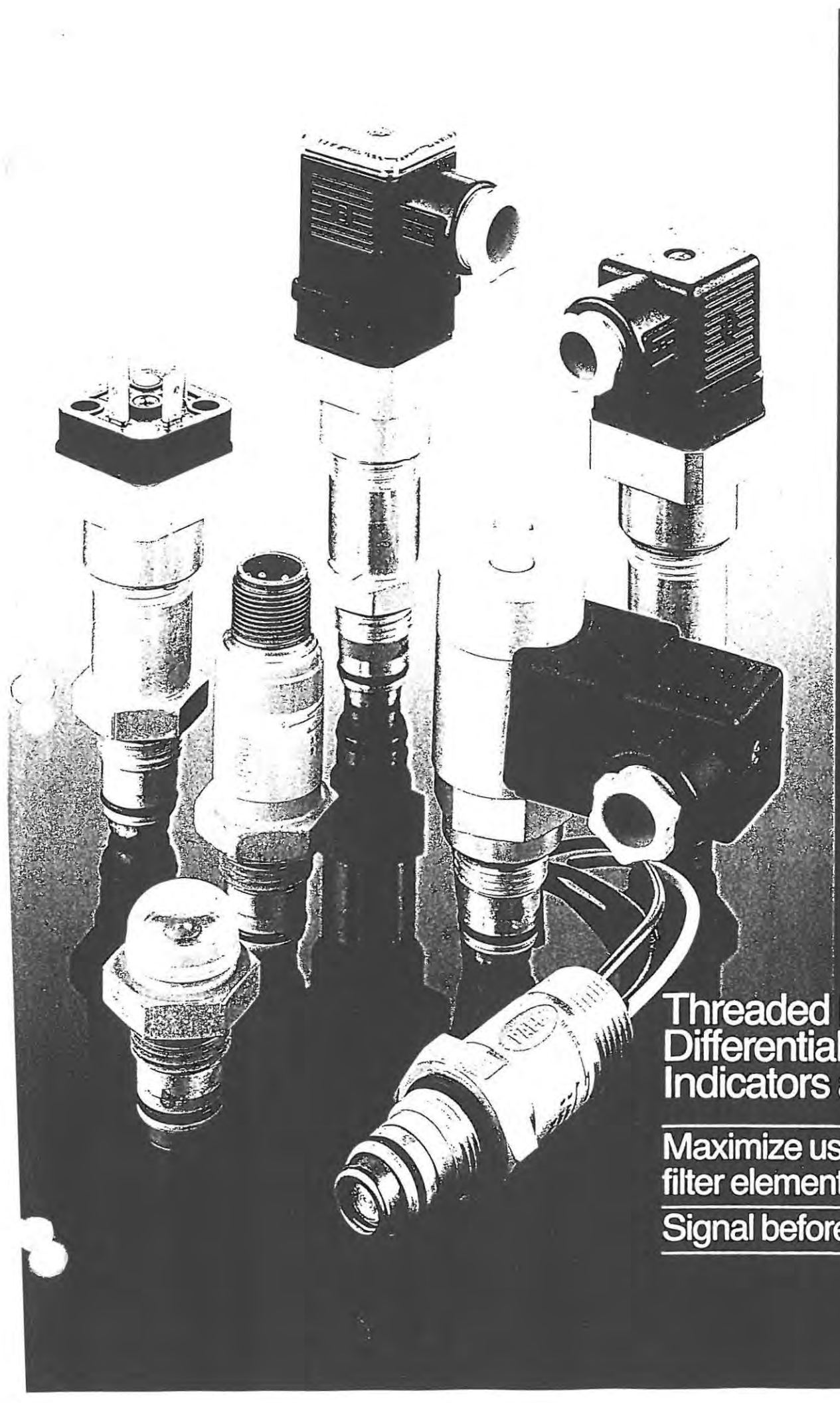
Performance

C Series 200 thru 1020
CS Series 400 thru 800
Free Flow vs. Pressure Drop
5 PSI Spring



"C" Series 1200 thru 3220
"CS" Series 1200 thru 1600
Free Flow vs. Pressure Drop
5 PSI Spring





ΔP DEVICES

Threaded Deltadyne® Differential Pressure Indicators and Switches

Maximize useful life of filter elements

Signal before fluid bypass

PALL

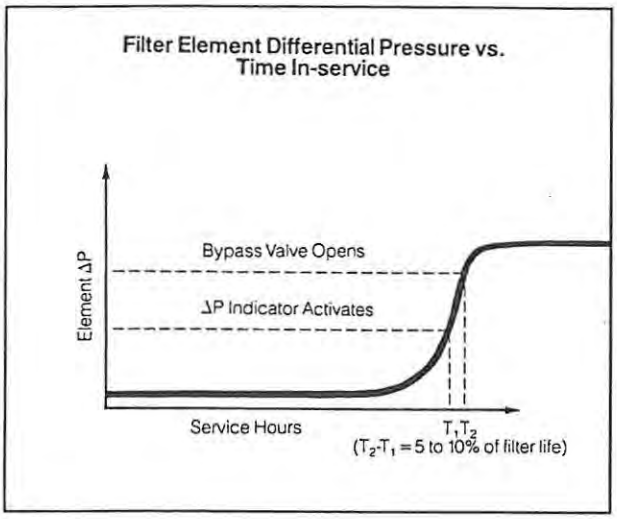
ΔP Device Performance

- Signal before fluid bypass
- Operating pressure to 6000 psi (414 bar)
- Indicators have memory and optional thermal lockout
- Switches serve as warm-up indicators
- Several differential pressure settings available
- Magnetic coupling eliminates potential leak path

Deltadyne® indicators and switches maximize useful life of filter elements

As dirt is trapped by the filter, pressure drop across the filter element increases. A differential pressure (ΔP) indicator or switch is used to signal the need for element change *before* the bypass relief valve opens. The bypass valve protects the system from excessive differential pressure and/or element collapse.

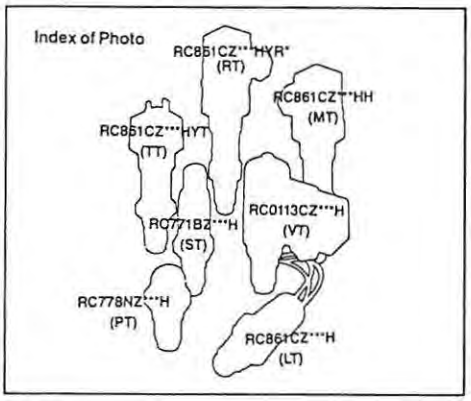
The use of ΔP devices to monitor filter condition prevents component damage caused by contaminated fluid bypassing a plugged filter or the unnecessary expense of premature replacement of partially used filter elements.



Operation

Deltadyne differential pressure devices operate by sensing the differential pressure between ports upstream and downstream of the filter element. The differential pressure acts on a piston/magnet assembly that is contained in the Deltadyne device. When the differential pressure across the internal piston/magnet assembly reaches a preset value, determined by the range spring, the piston assembly moves downward sufficiently to reduce the attractive force between the magnet and indicator button or switch actuator lever. The indicator or switch spring then overcomes the reduced magnetic force to release the button or actuate the switch to signal the need for element change.

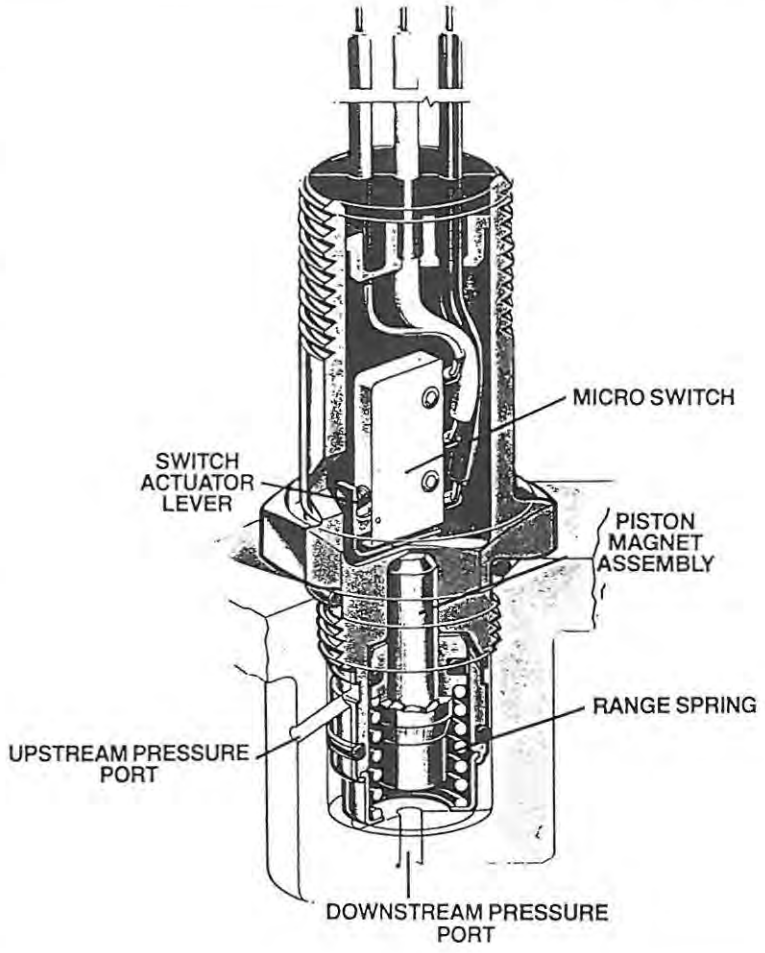
Magnet coupling isolates the pressurized fluid from the electrical or mechanical actuator. This eliminates dynamic seals and exposed cams, thus avoiding a leakage point common to other types of warning devices, particularly those which are connected to the bypass valve. Deltadyne devices respond only to differential pressures; they can withstand system pressures up to the design limit of 6000 psi (414 bar).

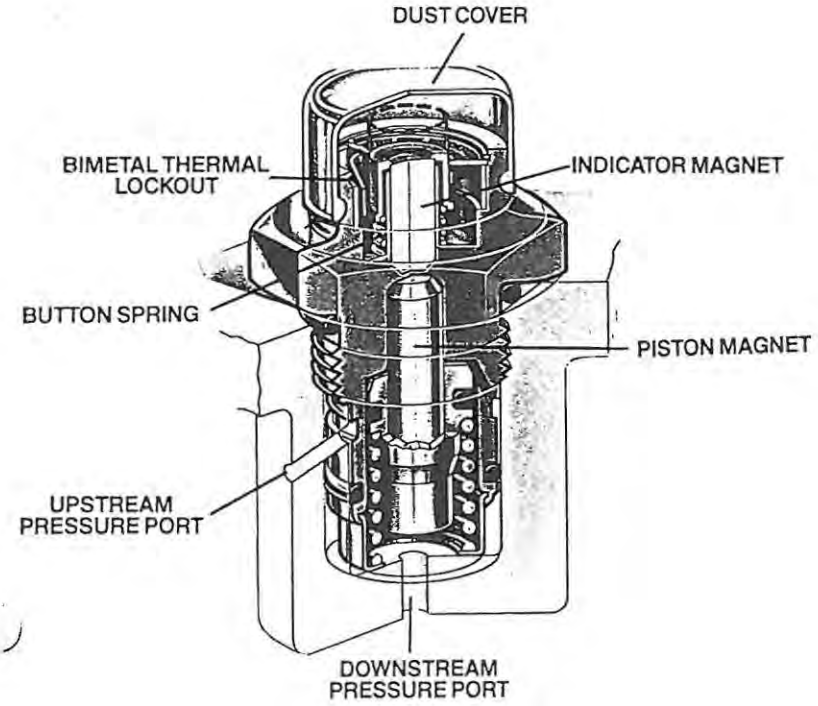


Electrical switches

Deltadyne electrical switches have an automatic reset function that allows them to be used as system warm-up monitors. High fluid viscosity associated with low temperature start-ups will cause a higher pressure drop across the filter element. Deltadyne switches will signal high differential pressure until the system reaches operating temperature. As the system warms up, the differential pressure is reduced, and the range spring returns the piston assembly to its normal position, thus restoring the magnetic force between the magnet and the actuator lever. The restored magnetic force is sufficient to overcome the switch spring force, allowing the single pole double throw switch (SPDT) to signal a differential pressure below the switch setting.

Single Pole Double Throw Switch: The SPDT switch allows this device to be used in a typical green-red light circuit. When the green light signals pressure drop below the actuation pressure, there is element life remaining. The red light signals pressure drop above the preset value...either a cold start or the need for an element change. The two-light circuit also serves as a continuity check; one of the two lights should always be on.





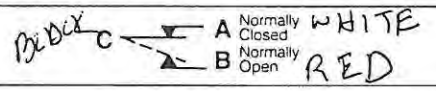
Visual indicators

Memory: All Deltadyne visual indicators show whether a preset differential pressure has been exceeded at any time—even after the system is shut down. When the factory-set differential pressure is exceeded, the red button pops up and stays up until it is manually reset. When the differential pressure is reduced, the range spring returns the piston assembly to its normal position; however, the gap between the magnet and the now extended indicator button is too great for magnetic force to overcome the button spring force. The button, therefore, remains in the extended position until differential pressure is reduced *and* the button is manually reset.

Thermal lockout: An optional bimetallic thermal lockout prevents actuation below 32°F and allows actuation above 80°F system temperature. Between 32°F and 80°F the thermal lockout device is in transition. Above 80°F the indicator will actuate when the element is plugged and the differential pressure exceeds the pre-set limit.

Specifications and Ordering Information

DELTADYNE SWITCH AND INDICATOR SPECIFICATIONS

Maximum System Pressure:	6000 psi (414 bar)
Temperature Range:	– 45°F to 275°F (– 43°C to 135°C)
Rated Fatigue Pressure: 10^7 cycles per NFPAT.2.6.1-1974:	3000 psi (207 bar)
Seals:	Internal: Fluorocarbon External: Nitrile or Fluorocarbon
Housing Material:	Aluminum (Stainless Steel or Other Materials Available)
Electrical Switch Ratings:	4 amp @ 110 VAC, 28 VDC (resistive) 2 amp @ 110 VAC, 28 VDC (inductive) SPDT, automatic reset
Electrical Switch Circuit:	
Installation:	Deltadyne switches and indicators fit Pall housings that have a threaded differential pressure port. A mounting block is available for remote installation.

ORDERING INFORMATION

RC [ ] [ ] [ ] [ ]

TABLE 1 CODE A | TABLE 2 | TABLE 3 | TABLE 1 CODE B

TABLE 1

CODE A	CODE B	ΔP DEVICE OPTION	FILTER ASSEMBLY PART NUMBER CODE
778NZ	Omit	Visual indicator with thermal lockout. No signal below 32° F, signal above 80°F. Red button rises 3/16" on actuation, remains up until manually reset. Includes clear plastic cover.	PT
860MZ	Omit	Visual indicator without thermal lockout. As above with no thermal lockout.	DT
861CZ	Omit	Electrical switch—wire leads. ½" male conduit threads, three color coded 6" flying leads, potted.	LT
771BZ	Omit	Electrical switch—MS connector. Three pin receptacle per MS3102R 10SL-3P.	ST
861CZ	H	Electrical switch—DIN connector. Four pin connector with matching connector cap.	MT
861CZ	YT	Electrical switch—DIN connector. Four pin connector.	TT
0113CZ	Omit	Dual electrical and visual. Visual indicator with memory and electrical switch with DIN connector and cap, manual reset.	VT
861CZ	YR110AC YR220AC YR24DC	Electrical switch with built-in signal light. Four pin DIN connector with matching connector cap and indicator light per voltage specified in Code B of part number.	RT

TABLE 2

CODE	DIFFERENTIAL PRESSURE SETTING	BYPASS VALVE SETTING
084	16± 3 psid (1.1 ±0.2 bar)	22 or 25 psid (1.5 or 1.7 bar)
090	35± 5 psid (2.5 ±0.3 bar)	50 psid (3.5 bar)
097	100±15 psid (7±1 bar)	Non-bypass

TABLE 3

CODE	EXTERNAL SEAL	FLUID SERVICE
H	Nitrile	Petroleum, Water Oil Emulsions, Water Glycol, HWCF
Z	Fluorocarbon	Specified Synthetics

PALL

Pall Industrial Hydraulics Company
A Division of Pall Aeropower Corporation
2200 Northern Boulevard
East Hills, NY 11548-1289
(516) 484-5400 • 1(800) 645-6532
Telex: 968855 Fax: (516) 625-0005

Distributed by:

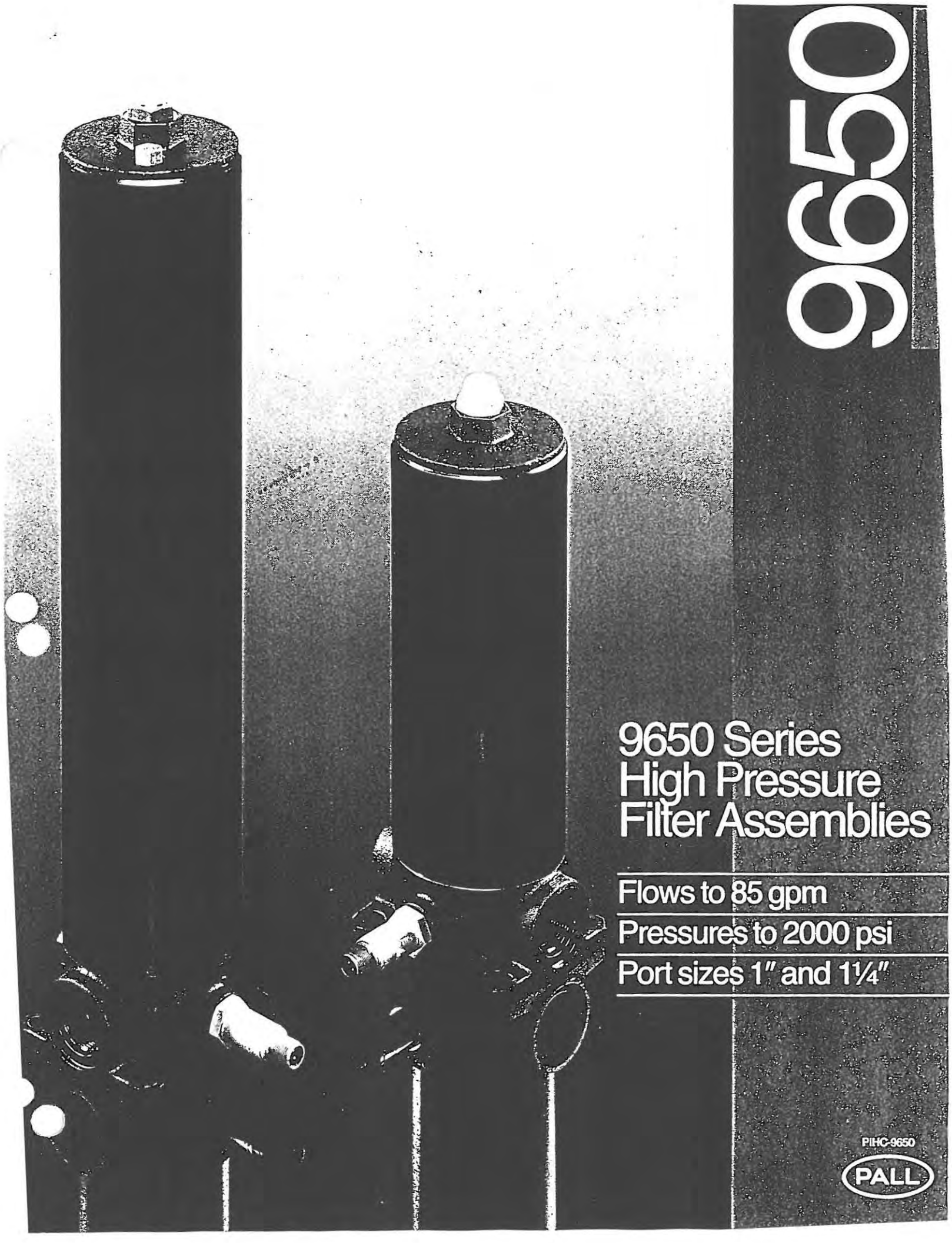
Absolute Performance

International Offices and Plants: Austria, Pall Filter Ges.m.b.H., Vienna; Brazil, Pall Industrial do Brasil, Ltda., São Paulo; Canada, Pall (Canada) Ltd., Mississauga, Ontario; England, Pall Europe, Ltd., Portsmouth; France, Pall Industrie S.A., Paris; Germany, Pall Filtrationstechnik GmbH, Frankfurt; Italy, Pall Italia, S.R.L., Milan; Japan, Nihon Pall, Ltd., Tokyo; Korea, Pall Korea Ltd., Seoul; Singapore, Pall Fluid Clarification Import-Export Pte. Ltd., Singapore; Spain, Pall España S.A., Madrid; Switzerland, Pall (Schweiz) AG, Muttenz; USA, Pall Corporation, East Hills, New York. Distributors in all major industrial areas of the world.

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QCP12936M

Printed in U.S.A.
PIHC-IND



9650

9650 Series High Pressure Filter Assemblies

Flows to 85 gpm

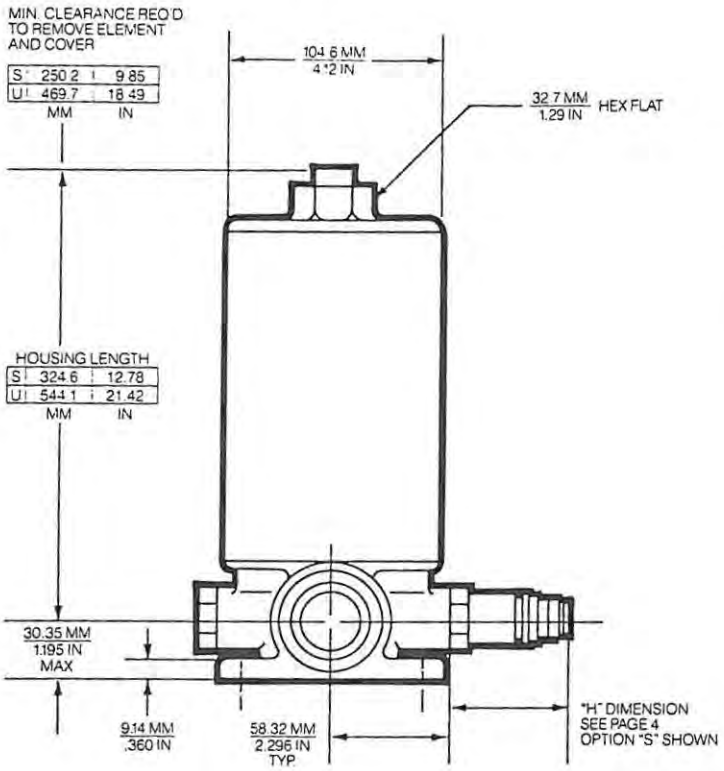
Pressures to 2000 psi

Port sizes 1″ and 1¼″

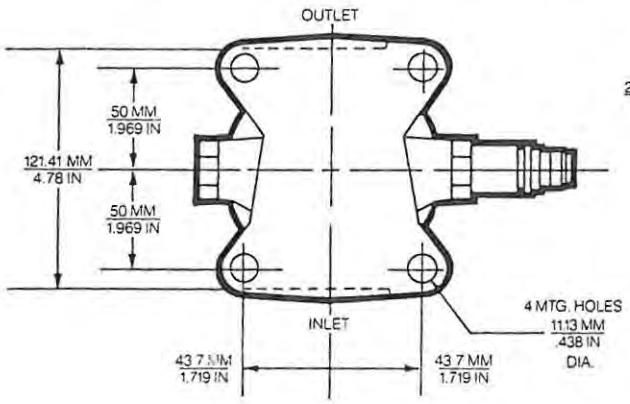
PIHC-9650

PALL

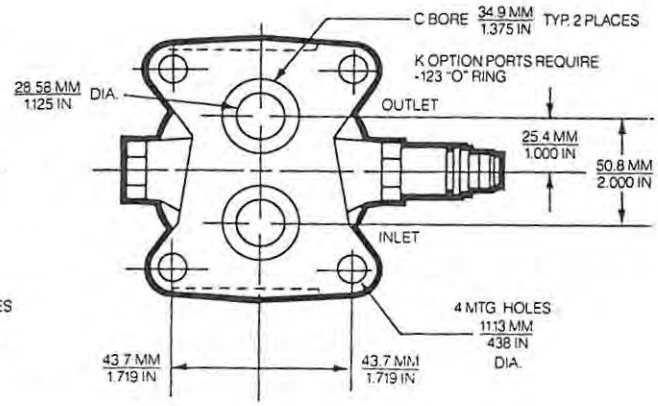
Dimensional Information



"H" DIMENSION	
PT	.90" 23mm
DT	.90" 23mm
LT	1.72" 44mm
ST	2.25" 57mm
TT	3.06" 78mm
MT	3.75" 95mm
BT	.25" 6.4mm



A and B Ports



K20 Ports

Pressure Drop Information

Filter Assembly Clean Pressure Drop = ΔP housing + ΔP element.

Figure 1. Housing Pressure Drop using fluid with 0.9 S.G.
Housing pressure drop is directly proportional to specific gravity.

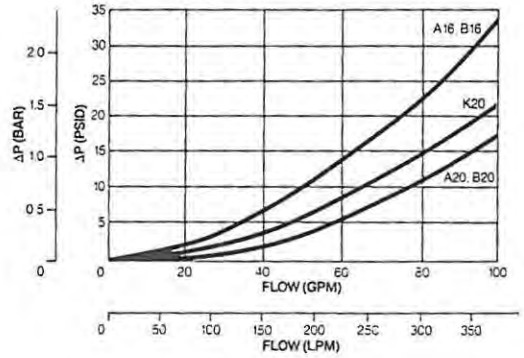


Figure 2. S Length Element Pressure Drop at 150 SUS (32cSt).
Element pressure drop is directly proportioned to absolute viscosity.*

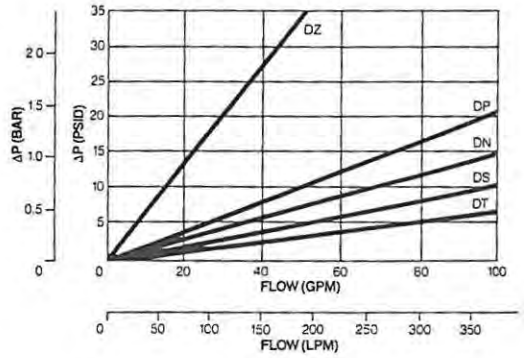


Figure 3. U Length Element Pressure Drop at 150 SUS (32cSt).
Element pressure drop is directly proportioned to absolute viscosity.*

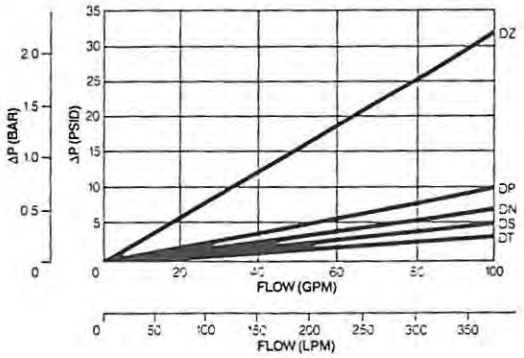


Figure 4. Dirt Fuse® S Length Element Pressure Drop at 150 SUS (32cSt).
3000 psid (210 bar) collapse rated elements for use in housings without bypass valves. Element pressure drop is directly proportional to absolute viscosity.*

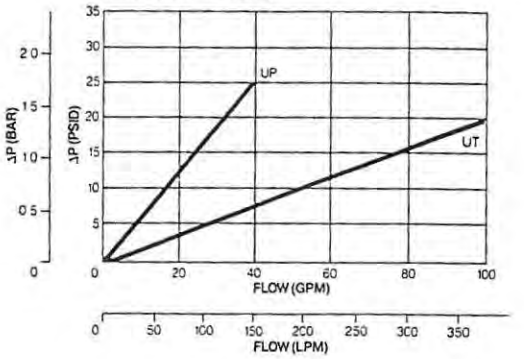


Figure 5. Dirt Fuse® U Length Element Pressure Drop at 150 SUS (32cSt.).
3000 psid (210 bar) collapse rated elements for use in housings without bypass valves. Element pressure drop is directly proportional to absolute viscosity.*

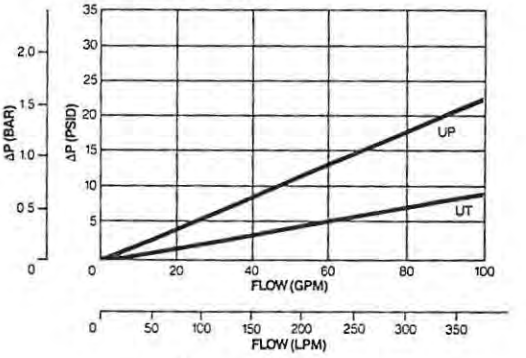
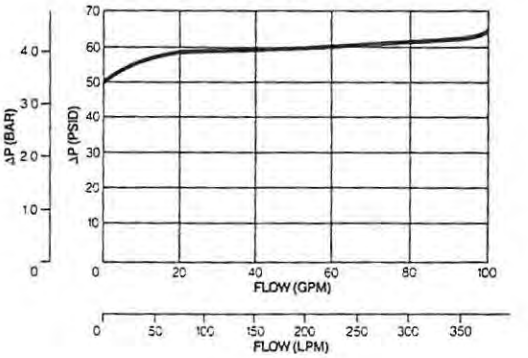


Figure 6. Bypass Valve Pressure Drop using fluid with 0.9 S.G.
Bypass valve pressure drop is directly proportional to specific gravity.



Sample ΔP Calculation

Assume DN filter medium with 9650 S length element and A20 port. Flow is 40 gpm using a hydraulic fluid at 200 SUS and 0.9 specific gravity (S.G.).

ΔP = 2.0 × 0.9 = 1.8 psid (housing) + 6.2 × 200/150 × 0.9
= 2.2 psid (housing) + 8.9 psid (Element)
= 11.1 psid clean assembly pressure drop

*Absolute viscosity is measured in units of centipoise (cP) which equals kinematic viscosity in centistokes (cSt) x specific gravity (S.G.). Therefore, element ΔP from curve should be corrected by multiplying by

New viscosity in cP 29
or new viscosity in cSt 32 x new Specific Gravity 0.9
or new viscosity in SUS 150 x new Specific Gravity 0.9

ASSEMBLY PART NO.: H [ ] 965 [ ][ ][ ][ ][ ][ ][ ]

TABLE 1 — TABLE 2 TABLE 3 TABLE 4 TABLE 5 TABLE 6 TABLE 7 TABLE 8

REPLACEMENT ELEMENT PART NO.: HC 965 [ ] F [ ][ ][ ]

TABLE 2 — TABLE 5 TABLE 6 TABLE 1

TABLE 1

SEAL OPTIONS		
CODE	SEAL MATERIAL	FLUID SERVICE
H	BUNA 'N' (Nitrile)	Petroleum, Water-oil emulsions, Water-glycol
Z	Fluorocarbon	Specified synthetics

TABLE 2

ELEMENT COLLAPSE RATING	
CODE	RATING
0	150 psid (10.3 bar) For housings with bypass valves
1	3000 psid (207 bar) For housings without bypass valves *DIRT-FUSE® option*

TABLE 3

PORT STYLE OPTIONS	
CODE	PORT STYLE
A	Straight Thread O-Ring Boss per SAE J514H
B	NPT Tapered Pipe Thread
K*	Manifold Mount

*Available only with 1¼" inlet port (Code 20)

TABLE 4

INLET PORT SIZE OPTIONS	
CODE	PORT SIZE
16	1" Nominal Size
20	1¼" Nominal Size

TABLE 5

FILTER ELEMENT OPTIONS			
CODE	REMOVAL RATING Micron Size at Which $\beta_x = 200$	SILT CONTROL RATING ß Ratio at 2/10/20 Microns	AVAILABLE FOR
DZ	1	650 >3000 >3000	9650 ONLY
DP	3	60 >3000 >3000	
DN	6	12 >3000 >3000	
DS	12	2 80 >3000	
DT	25	NA 2 44	
UP	2*	75 >3000 >3000	9651 ONLY
UT	15*	— 11 500	

*For UP, UT, $\beta_x = 75$

TABLE 6

LENGTH OPTIONS		
ASSEMBLY CODE	ELEMENT CODE	DRY WEIGHT (LBS.)
S	8	24.0
U	16	34.8

TABLE 7

VALVE OPTIONS		
CODE	VALVE OPTIONS	AVAILABLE FOR
B	50 ± 5 psid Bypass	9650 ONLY
W	Non-bypass	9651 ONLY

TABLE 8

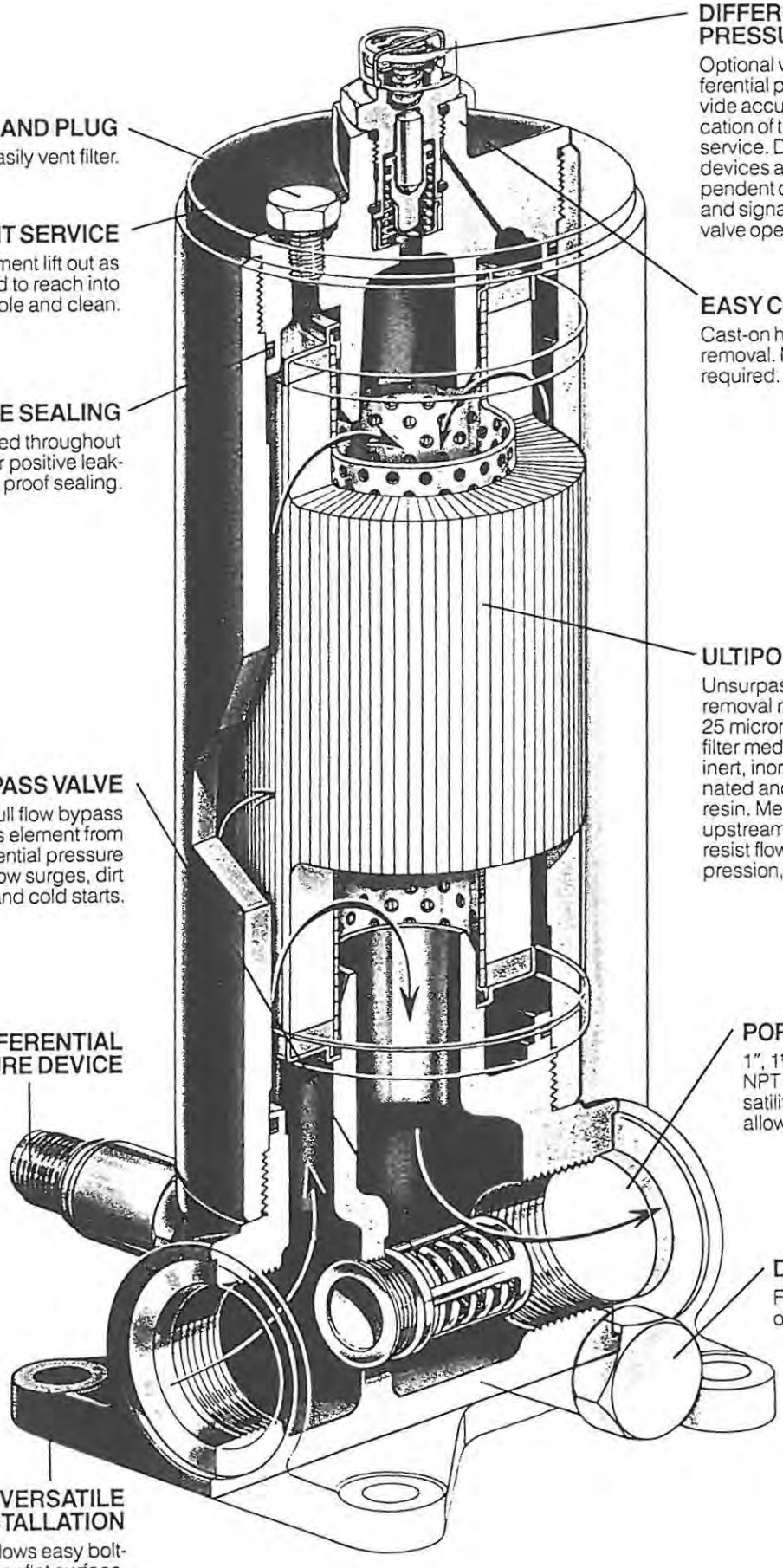
DIFFERENTIAL PRESSURE PORT Δ DEVICE OPTIONS		
CODE	ΔP DEVICE OPTIONS	LOCATION
BT	Plug in place of ΔP devices.	Both
PT	Visual Indicator: Thermal Lockout & Manual Reset. No signal below 32°F, signal above 80°F	Cover
DT	'PT' type with no thermal lockout	
LT	Electrical Switch (SPDT) with 3 color coded 6" potted leads. ½" male conduit. Auto reset.	Head
ST	Electrical Switch (SPDT) with 3 pin receptacle. Auto reset.	
TT	'LT' Type Electrical Switch with DIN connector.	
MT	'TT' Type Electrical Switch with wiring cap.	
2T	PT and LT	PT in Cover
3T	PT and ST	
Settings: 9650 Series—35±5 psid 9651 Series—100±15 psid		

EXAMPLE: Filter Assembly Part No. HZ9650A20DNSBPT

Equipped with:
–Fluorocarbon seals
–SAE J514H 1¼" straight thread O-ring boss port style
–6µm ($\beta_6 = 200$) Ultipor II filter element
–S length element and bowl
–50 psid bypass valve
–35 psid visual indicator

EXAMPLE: Replacement Element Part No. HC9650FDN8Z

Equipped with:
–6µm ($\beta_6 = 200$) Ultipor II filter medium
–150 psid element collapse rating
–8" long (for S length code)
–Fluorocarbon seals



DIFFERENTIAL PRESSURE DEVICES
Optional visual or electrical differential pressure devices provide accurate and reliable indication of the need for element service. Differential pressure devices are mechanically independent of the bypass valve and signal before the bypass valve opens.

BLEED PORT AND PLUG
To easily vent filter.

ELEMENT SERVICE
Cover and element lift out as one unit. No need to reach into housing. Simple and clean.

EASY COVER REMOVAL
Cast-on hex for easy cover removal. No special tools required.

POSITIVE SEALING
O-Ring seals used throughout assembly for positive leak-proof sealing.

ULTIPOR II® ELEMENT
Unsurpassed service life at removal ratings of 3, 6, 12, and 25 microns ($\beta_x = 200$). Ultipor II filter medium is composed of inert, inorganic fibers, impregnated and bonded with epoxy resin. Medium is supported upstream and downstream to resist flow fatigue, pleat compression, and cold starts.

BYPASS VALVE
Fast response, full flow bypass valve protects element from excessive differential pressure caused by flow surges, dirt loading, and cold starts.

DIFFERENTIAL PRESSURE DEVICE

PORT OPTIONS
1", 1¼" SAE Straight thread and NPT ports allow for piping versatility; manifold mount option allows for compact installation.

DRAIN PORT AND PLUG
Filter readily drained for ease of filter element replacement.

VERSATILE INSTALLATION
Mounting pad allows easy bolting to any flat surface.

HOUSING DATA

Temperature Range:	Nitrile Seals −45°F (−43°C) to +225°F (+107°C). Fluorocarbon Seals −20°F (−29°C) to +275°F (+135°C).
Materials:	Head—Gray cast iron, corrosion resistant finish. Bypass Valve—corrosion resistant steel. Tube—Carbon steel; corrosion resistant finish. Cover—Gray cast iron, corrosion resistant finish.
Pressure Ratings:	Rated static pressure 6500 psi (448 bar) 'A' and 'B' Ports; 6000 psi (414 bar) 'K' Port Rated fatigue pressure 2000 psi (138 bar) 'A' and 'B' Ports; 1500 psi (103 bar); K Port (10^7 cycles per NFPA T2.6.1-1974).
Bypass Valve Setting:	9650 Series—50±5 psid cracking. See flow curve Page 3 (with blocked element). 9651 Series—none. *Dirt-Fuse® filter option.*

ELEMENT DATA

Filter Element Hardware:	Corrosion-protected carbon steel end caps and core.
Filter Medium (Ultipor II®):	Inert inorganic fibers, impregnated and bonded with epoxy resin.
Fluid Compatibility Per ANSI/B93.23-1972 (ISO 2943):	Compatible with petroleum oils, water-glycols, water-oil emulsions, and HWCF. Fluorocarbon seals are required for industrial phosphate esters, diesters, and specified synthetics. Do not bubble-point test in alcohol. Freon™ TF is a suitable alternative.
Element Collapse Pressure Ratings (ANSI/B93.25-1972 and ISO 2941):	9650 Series—150 psid minimum (10 bar). 9651 Series—3000 psid minimum (210 bar).

Multi-Pass Filtration Ratings Per ANSI B93.31—& ISO4572 (Modified for Silt Control)

Filter Medium	Micrometre Size x Where β_x=2/20/75/200(*<2μm)	Filtration Ratio			Terminal ΔP psid
		β_2	β_{10}	β_{20}	
DZ	*/*/*/1.0	650	>3000	>3000	60
DP	*/*/2.2/3.0	60	>3000	>3000	60
DN	*/2.5/4.5/6.0	12	>3000	>3000	60
DS	2.0/7.0/9.9/12.0	2	80	>3000	60
DT	10/17.5/22/25	NA	2	44	60
UP	*/*/2/3	75	>3000	>3000	235
UT	5.5/12/15	NA	11	500	235

™ E.I. duPont Co.

DIFFERENTIAL PRESSURE DEVICES

ΔP Switch and Indicator Setting:	9650 Series—35 ± 5 psid (with "B" bypass). 9651 Series—100 ± 15 psid (with "W" bypass).
Electrical Switch Ratings:	4 amp @ 110 VAC, 28 VDC (resistive). 2 amp @ 110 VAC, 28 VDC (inductive).

PALL®
Pall Industrial Hydraulics Corporation
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FAX: 516-484-6007

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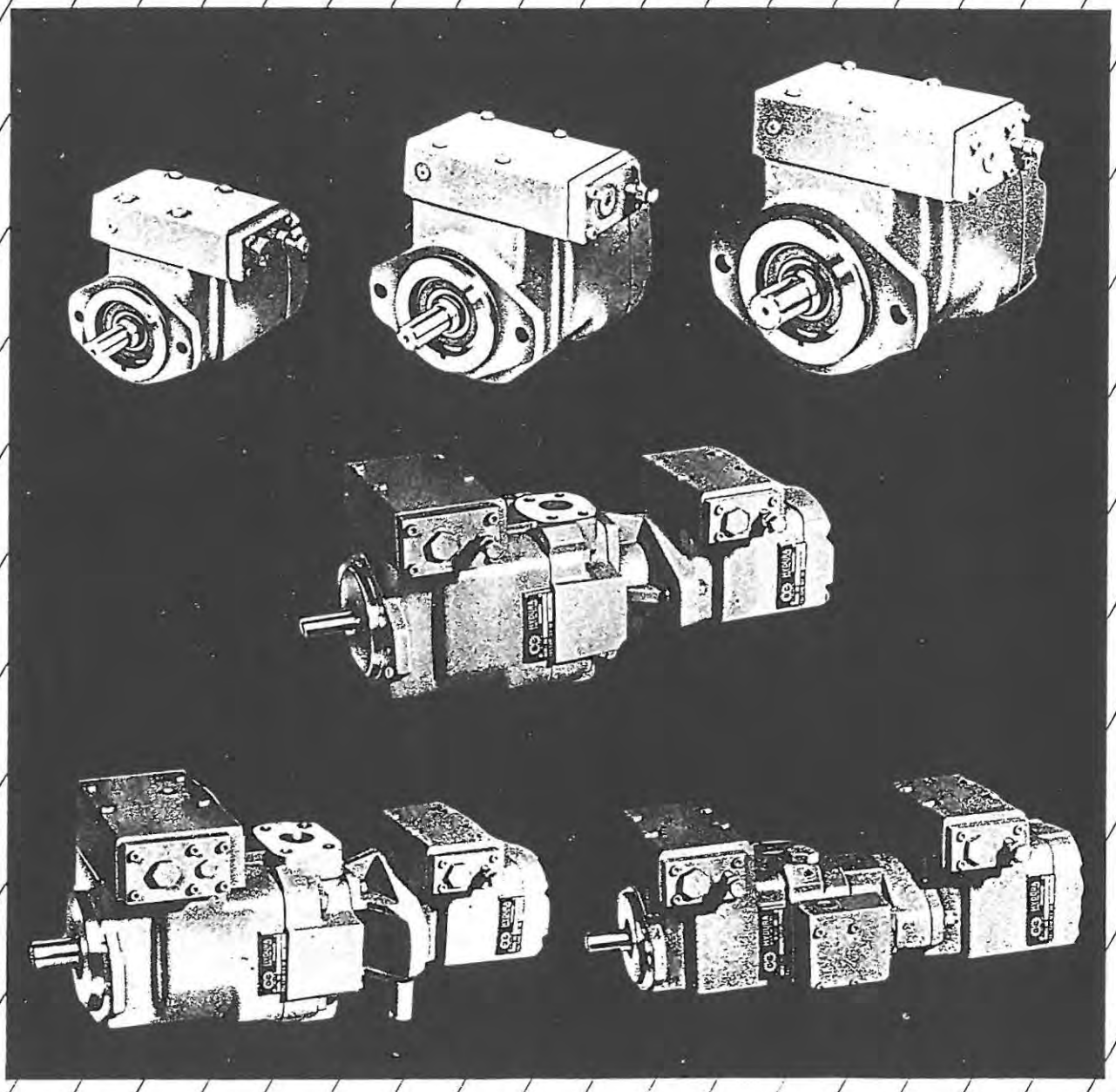
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Oilgear

PVWW
OPEN LOOP PUMPS FOR FLUIDS CONTAINING WATER



BULLETIN 47013

PERFORMANCE ASSURANCE IS STANDARD WITH EVERY OILGEAR COMPONENT

Every Oilgear pump manufactured is shipped with a corporate commitment to stay with the installation until it performs as specified.

This total dedication to performance is based upon experience gained since 1921 in matching fluid power system to a tremendous range of machines and applications.

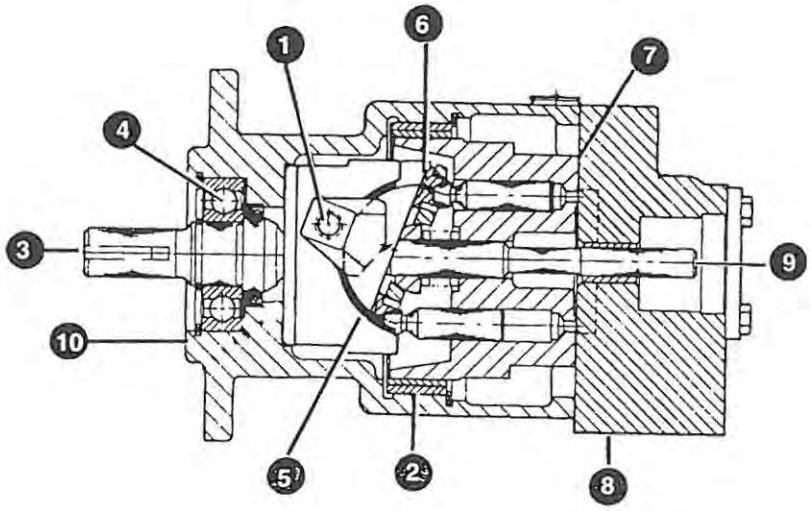
Oilgear's Performance Assurance is made possible because of the many hydraulic techniques learned over the years in supplying machinery builders and users with unique solutions to hundreds of unusual fluid power problems.

Historically, Oilgear has concentrated its energies on hydraulic equipment and systems. Every Oilgear facility is staffed with factory trained and field experienced application engineers. These men are backed by a headquarters engineering staff who has access to the records and knowledge generated from these historically successful solutions.

Performance Assurance doesn't stop with the design of the system or the sale of the component. It guarantees that Oilgear engineers will be there— when they are needed— supplying the education, field service, parts and repairs, to make sure each runs smoothly— and keeps on running.

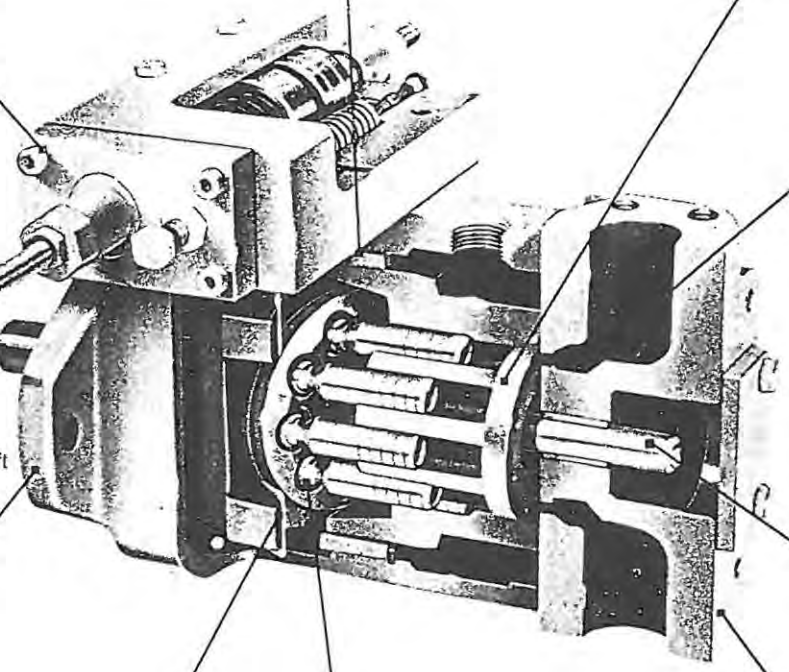
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PVWW
OPEN LOOP PUMP



Cylinder mounted polymerous journal bearings
- Allows operation with water base, low viscosity or other special fluids
- Provides infinite bearing life
- Provides compact design

Large control selection
- 11 different types
- Field interchangeability without disconnecting from drive or system piping

Hardened cylinder surface running on hardened valve plate ("hard-on-hard")
- Provides greater resistance to contamination
- Provides longer life
- Allows operation with water base, low viscosity or other special fluids

Valve plate selections
- Rear or side port connections available

SAE keyed or SAE splined shaft
- Heavy duty belt drive shafts available

Thru-shaft availability
- Allows for multiple pump installation from a single drive shaft
- Allows pumps to drive auxiliary devices

Sealed front shaft bearings
- Allows operation with water base, low viscosity or other special fluids
- Allows side loading

Three frame sizes with seven capacity ranges allowing greater flexibility to selectively match pressure and capacity.
- Low flow/high pressure to low pressure/high flow from the same frame sizes.

Swashblock and saddle with special polymerous bearings
- Allows running on water base, low viscosity or other special fluids
- Permits consistent control reaction
- Eliminates troublesome yoke bearings
- Provides long life

Steel shoes with specially treated faces for increased fluid retention, running on hardened swashblock surface.
- Allows a higher degree of contaminate resistance
- Allows higher pressure operation with long life
- Allows operation with water base, viscosity or other special fluids
- Provides longer life

SPECIFICATIONS

27—30 SSU VISCOSITY FLUID

FRAME SIZE	UNIT SIZE	MAXIMUM DISPLACEMENT		RATED CONTINUOUS PRESSURE		MAXIMUM PRESSURE		FLOW RATE at 1800 rpm, rated continuous pressure & 14,7 psia ($1\ bar_{abs}$) inlet condition		MAXIMUM SPEED at 1800 rpm and 14,7 psia inlet condition	POWER INPUT at rated continuous pressure and 1800 rpm	
		in^3/rev	ml/rev	psi	bar	psi	bar	gpm	l/min	rpm	hp	kw
A	06	0.86	14,1	3000	206,9	3500	241,4	5.5	20,8	1800	12.9	9,6
	10	1.35	22,1	2000	137,9	2500	172,5	9.0	34,1	1800	13.3	9,9
B	15	2.06	33,8	3000	206,9	3500	241,4	12.7	48,1	1800	30.4	22,7
	20	2.83	46,4	2000	137,9	2500	172,5	20.3	76,9	1800	27.8	20,7
C	34	4.67	76,5	3000	206,9	3500	241,4	32.6	123,6	1800	68.4	51,0
	45	6.00	98,3	2000	137,9	2500	172,5	42.8	162,2	1800	59.7	44,5
	60	7.94	130,2	1200	82,8	1500	103,4	56.5	214,2	1800	51.1	38,1

*Higher pressure available— consult factory.

Note: Minimum speed 600 rpm.

For units to be run with conventional (oil) hydraulic fluids, please see Oilgear Bulletin 47014 (PVW Pumps) or Bulletin 47015 (PVWH Pumps).

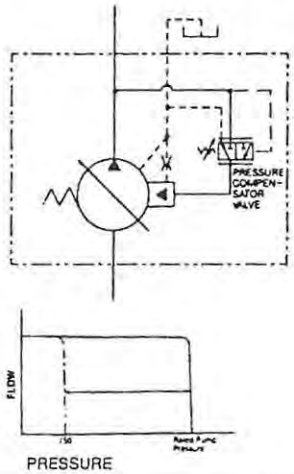
PUMP CONTROLS
PRESSURE*

Pressure Compensator "CN"

Ensures maximum pump flow until unit reaches preset control pressure setting then regulates output flow to match the requirements of the system while maintaining preset output pressure.

Can be adjusted from 750 psi working pressure up to the maximum pressure rating of applicable pump.

A remote control module "VSR" can be used to adjust the "CN" Control.

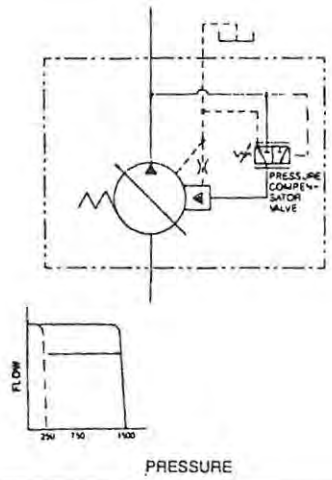


509820

Low Pressure Compensator "CL"

Works the same as the "CN" Control except it provides a lower minimum pressure. Can be adjusted from 250 psi working pressure up to a maximum of 1500 psi.

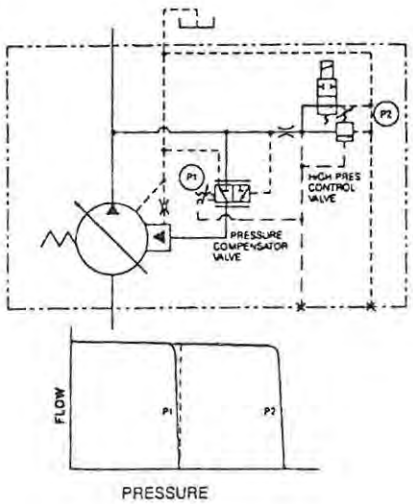
A remote control module "VSR" can be used to adjust the "CL" Control.



509820

Dual Pressure Compensator "C2"

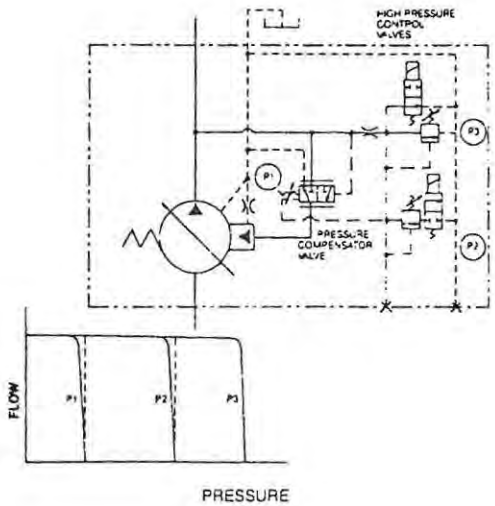
Provides two independently adjustable pressure compensated deliveries as selected by an integral solenoid.



509819

Triple Pressure Compensator "C3"

Provides three independently adjustable pressure compensated deliveries as selected by integral solenoids.



509819

*Be sure system and pumps are protected against overloads with a high pressure relief valve.

PUMP CONTROLS

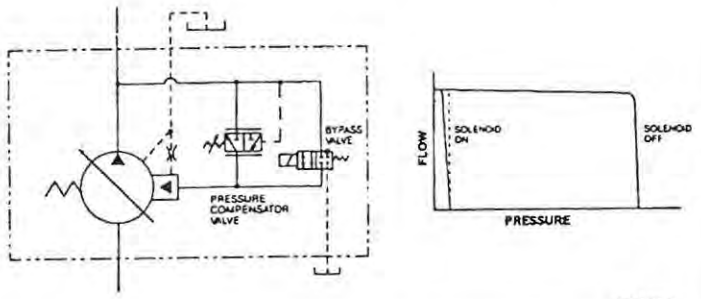
PRESSURE * (Cont'd)

VOLUME/PRESSURE SENSING*

Soft Start Pressure Compensator "CU"

Pump starts "softly" by going quickly at low pressure to a reduced flow setting, thereby reducing start up torque requirements.

While a standard compensator adjustor is supplied, a remote control module "VSR" can also be used to adjust the "CU" control.

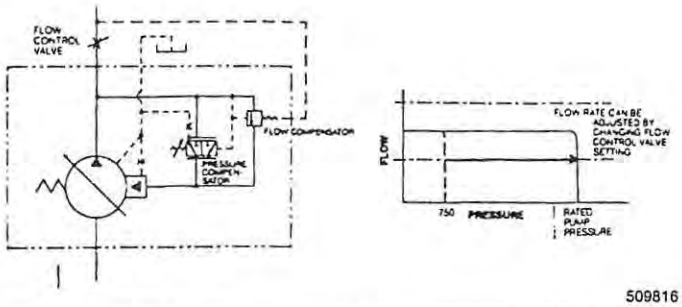


E51316

Load Sensing "CF"

A constant flow output is maintained for a given flow control valve setting regardless of changes in drive speed and/or working pressure.

Remote control module "VSR" can also be used to adjust the pressure compensator action of "CF" controlled pumps.

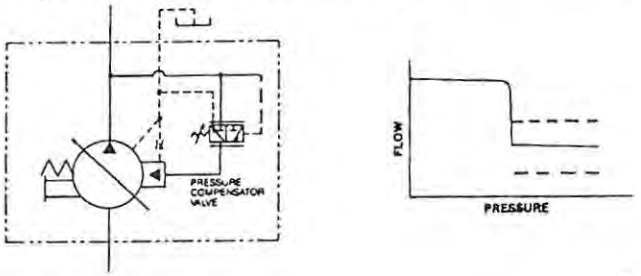


509816

High-Low Pressure Compensator "CH"

Ensures maximum pump flow until unit reaches preset control pressure setting, then partially de-strokes the pump to provide a minimum variable adjustment preset flow rate regardless of system pressure.

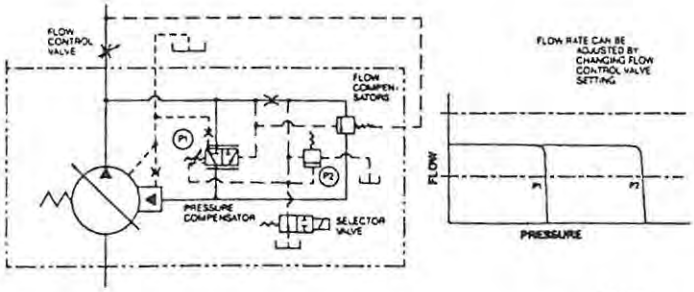
Remote control module "VSR" can also be used to adjust the pressure compensator action of "CH" controlled pumps



E51340

Dual Pressure Compensator with Load Sensing "2F"

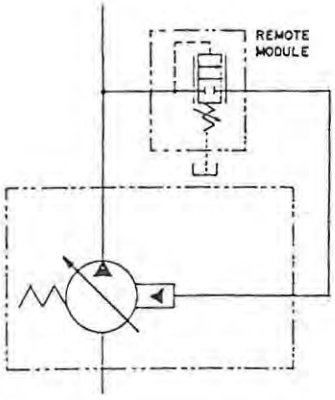
Maintains a constant flow rate at up to either of two independent adjustable pressures as selected by an integral solenoid.



E51215

Remote Operator "VSR"

Remote control module to adjust "CF", "CH", "CL" ,"CN", and "CU" controlled pumps. When system pressure reaches the setting of the remote control module, the control then regulates output to match the requirements of the system while maintaining preset output pressure.

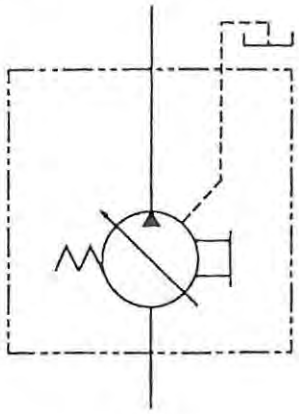


*Be sure system and pumps are protected against overloads with a high pressure relief valve.

VOLUME*

Handwheel "HN"

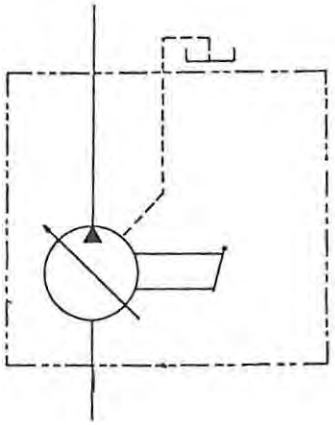
Provides simple manual handwheel adjustment of delivery.



509815

Lever Operated "MN"

Varies displacement proportional to the rotation of a pintle.



509818

Fixed Displacement "NN"

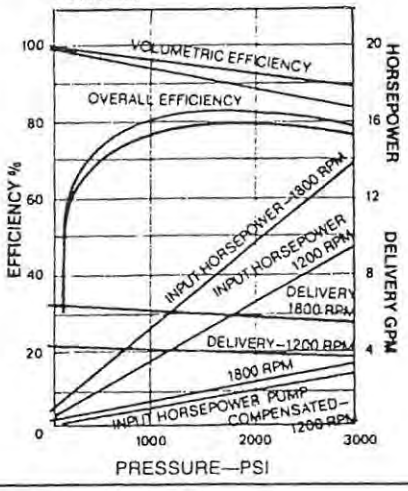


*Be sure system and pumps are protected against overloads with a high pressure relief valve.

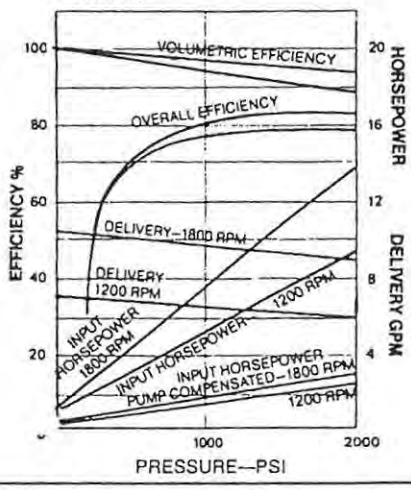
PERFORMANCE CURVES

The following single pump curves are based on a fluid temperature of 95°F (27 SSU) and flooded inlet.

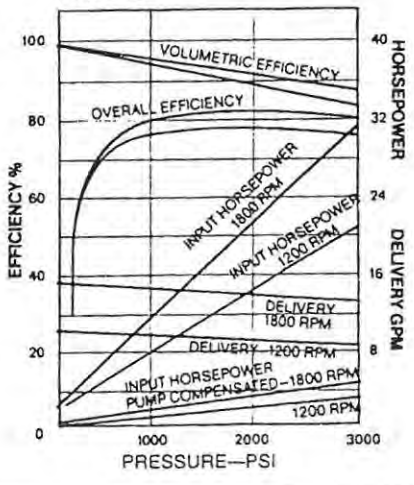
PVWW-06



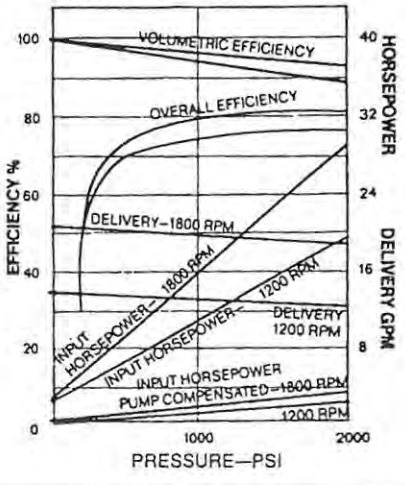
PVWW-10



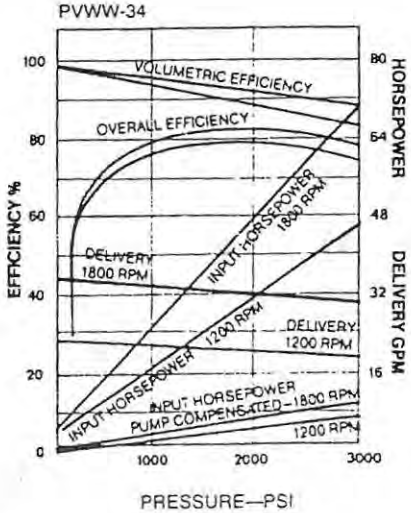
PVWW-15



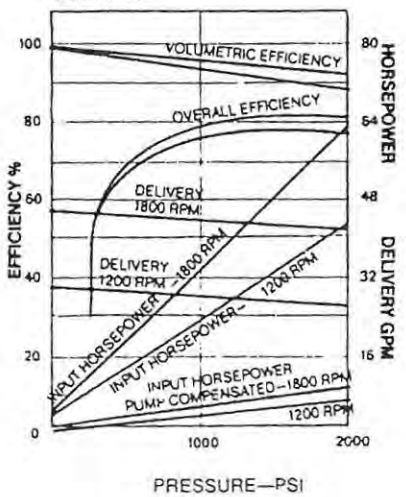
PVWW-20



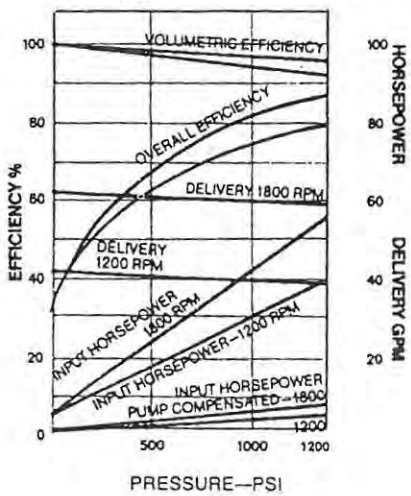
PVWW-34



PVWW-45



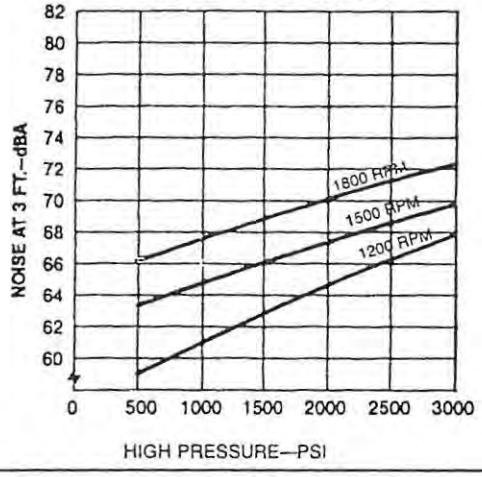
PVWW-60



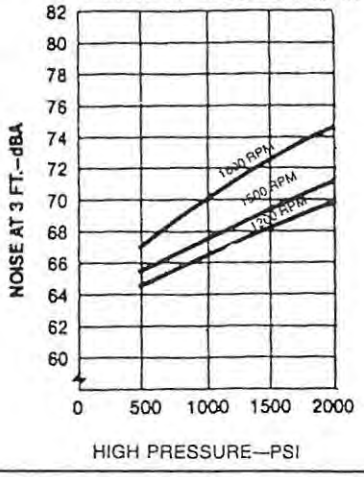
SOUND CURVES

All of the following sound curves are based on pump delivering full volume from port "A". Single microphone noise taken in semi-reverberant room at three feet from pump surface. Tolerance on curves is ±3 dBa.

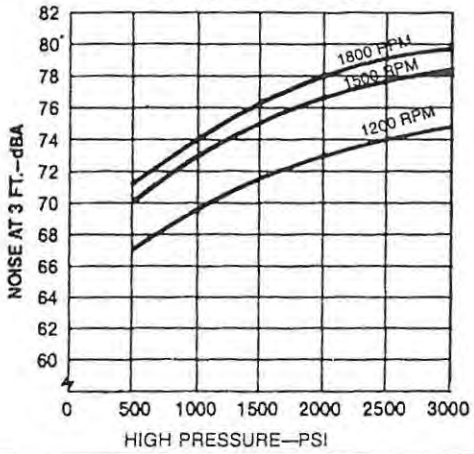
PVWW-06 —FULL STROKE



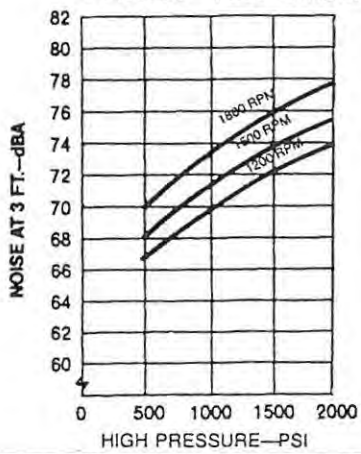
PVWW-10—FULL STROKE



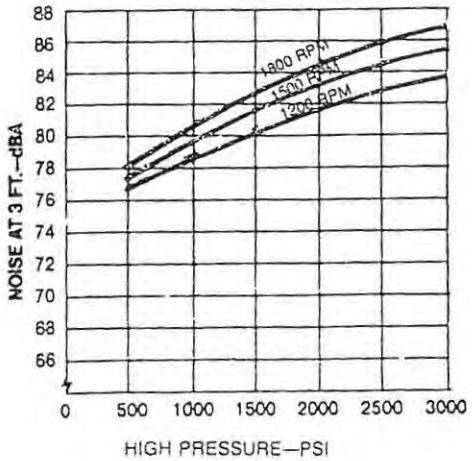
PVWW-15 —FULL STROKE



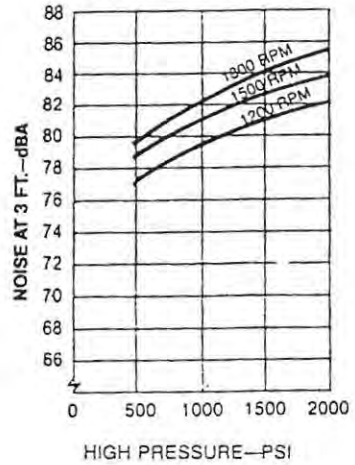
PVWW-20 —FULL STROKE



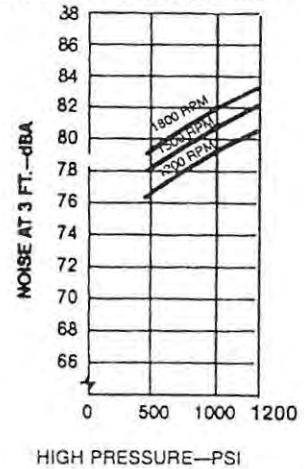
PVWW-34 —FULL STROKE



PVWW-45 —FULL STROKE



PVWW-60 —FULL STROKE

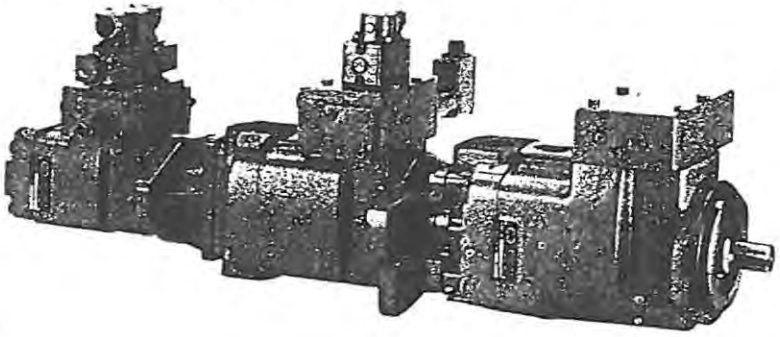


MULTIPLE PUMPS
PUMP COMBINATIONS

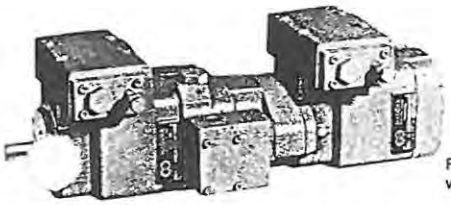
Two or more Oilgear axial piston variable delivery pumps can be integrally coupled together and driven from a single shaft.

Pump deliveries can be combined for large volume circuits or deliveries can be used individually. See page 4 for individual pump ratings.

The front pump can be used at full rated output while the rear pumps are governed by the thru shaft torque listed in the table, on page 11.

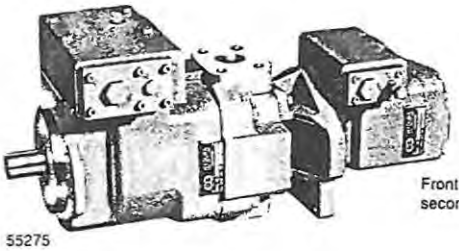


89031



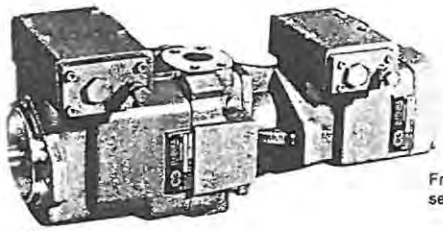
55269

Front pump frame size A with second pump frame size A



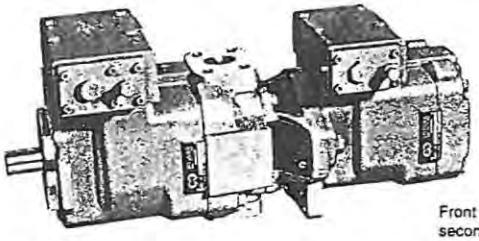
55275

Front pump frame size C with second pump frame size A



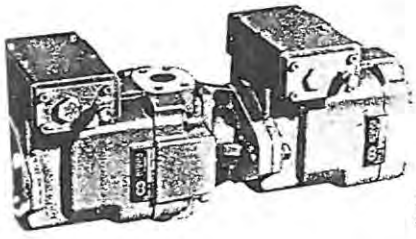
5271

Front pump frame size B with second pump frame size A



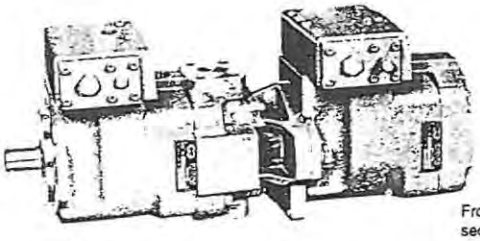
55277

Front pump frame size C with second pump frame size B



73

Front pump frame size B with second pump frame size B



55279

Front pump frame size C with second pump frame size C

THRU SHAFT SIZING/COMPATIBILITY

PISTON PUMP FRAME SIZE	PUMP SIZE	INPUT TORQUE								ALLOWABLE THRU SHAFT TORQUE	
		RATED PRESSURE		INPUT TORQUE (T_R) @ RATED PRESSURE		PEAK PRESSURE		INPUT TORQUE @ PEAK PRESSURE		STANDARD SHAFT	
		psi	bar	in-lb.	Nm.	psi	bar	in-lb.	Nm.	in-lb.	Nm.
A	06	3000	206,9	452	50,9	3500	241,4	527	59,3	200	22,5
	10	2000	137,9	466	52,5	2500	172,5	588	66,2		
B	15	3000	206,9	1063	119,7	3500	241,4	1244	140,0	500	56,3
	20	2000	137,9	973	109,5	2500	172,5	1215	136,8		
C	34	3000	206,9	2395	269,6	3500	241,4	2795	314,7	900	101,4
	45	2000	137,9	2100	236,4	2500	172,5	2600	292,7		
	60	1200	82,8	1722	193,9	1500	103,4	2125	239,2		

ACTUAL INPUT TORQUE CALCULATION

$$T_A = T_R \times \frac{\text{ACTUAL OPERATING PRESSURE}}{\text{RATED PRESSURE}} \times \frac{\text{\% FULL DELIVERY}}{100\%}$$

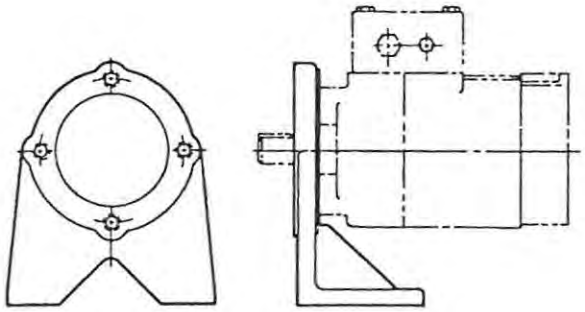
NOTE: When applying a thru shaft driven Oilgear pump or a thru shaft driven pump from other manufacturers, it must be determined that its actual input torque does not exceed the allowable thru shaft torque given in the table above. Use the formula given to determine actual input torque if the pump is applied at other than rated values.

NOTE: If more than one pump is to be thru shaft driven, their combined actual input torques must not exceed the above valves if their highest loads are experienced simultaneously.

MOUNTING BRACKETS FOR PVWW PUMPS

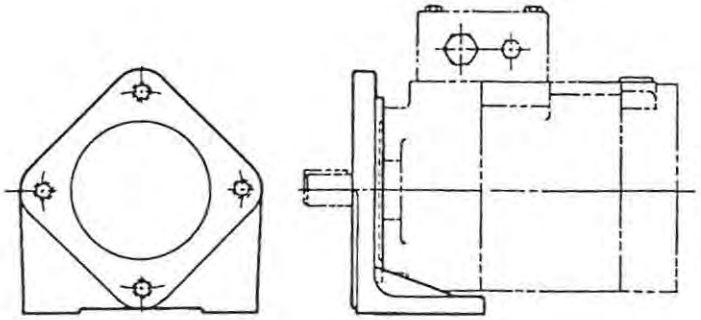
A

06, 10

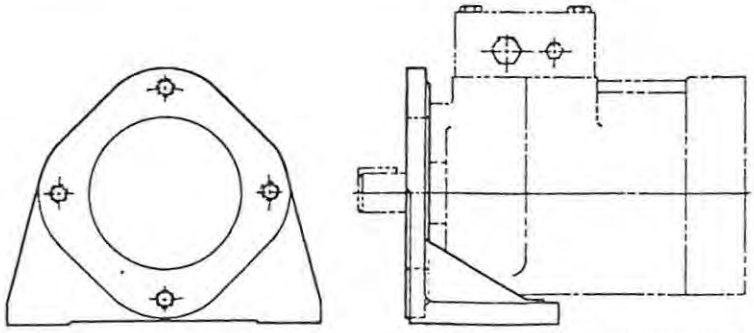


B

15, 20



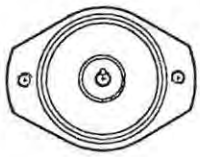
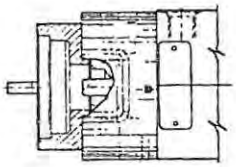
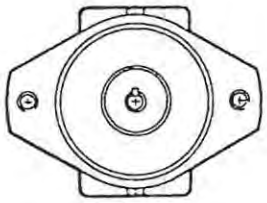
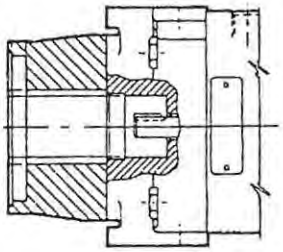
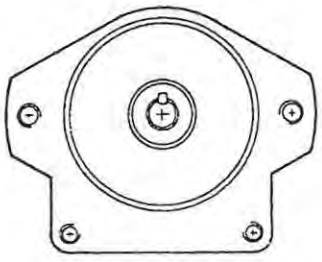
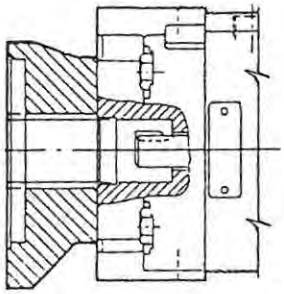
34, 45, 60



Contact your Oilgear Representative for detailed dimensions.

SAE ADAPTERS FOR PVWW PUMPS

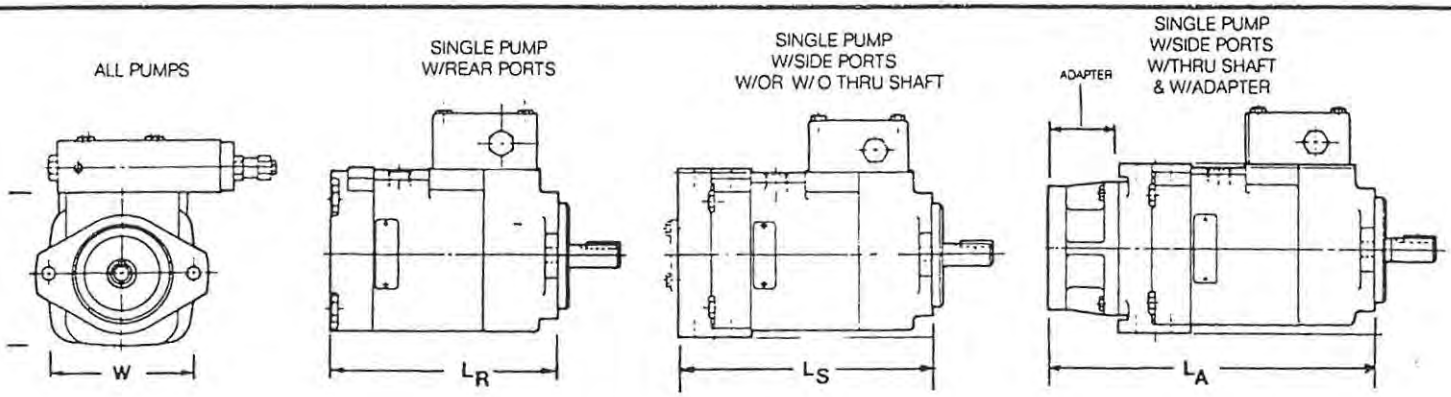
Installation adapters for single pumps with thru shaft and side ports. (E60240)

Piston Pump Frame Size		For Mounting The Following	To Piston Pump Size	Order Code No.
A				
		06, 10 Piston Pump	06, 10	AA
B				
		06, 10 Piston Pump	15, 20	AA
		15, 20 Piston Pump	15, 20	AB
C				
		06, 10 Piston Pump	34, 45, 60	AA
		15, 20 Piston Pump	34, 45, 60	AB
		34, 45, 60 Piston Pump	34, 45, 60	AC

(E60203)

Contact your Oilgear Representative for detailed dimensions.

SIZE AND WEIGHTS
SINGLE PUMPS



DIMENSIONS AND WEIGHTS

FRAME SIZE	PVWW PUMP SIZE	HEIGHT H		WIDTH W		LENGTH L_R		LENGTH L_S		LENGTH L_A W/PISTON PUMPS ADAPTER		WEIGHT SINGLE PUMP W/REAR PORTS	
		inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	lb	kg
A	06 & 10	4.50	114,3	4.32	109,7	7.20	182,9	8.07	205,0	9.39	238,5	32	14,5
B	15 & 20	6.11	155,2	5.80	147,3	8.50	215,9	9.63	244,6	12.36	313,9	68	30,9
C	34, 45 & 60	7.18	182,4	6.76	171,7	10.44	265,2	11.50	292,1	14.00	355,6	103	46,8

All dimensions are approximate, for detailed dimensions contact your Oilgear Representative.

Length Example
SINGLE PUMP
*With rear ports.
PVWW-15-RSAY-CNN
Size 15 (L_R) length = 8.50 inches (215,9 mm)

*With side ports, w/wo thru shaft
PVWW-15-RDFY-CNNNTK
Size 15 (L_S) length = 9.63 inches (244,6 mm)
*With side ports, with thru shaft and adapter
PVWW-15-RDFY-CNNNTK-AG
Size 15 (L_A) length = 12.36 inches (313,9 mm)

CHEM-TREND HYDRAULIC FLUID

HF - 28

Description

Chem-Trend's newest development, HF-28, resulting from over 18 years of extensive research and actual field experience, is unquestionably the premier water-glycol fire-resistant hydraulic fluid. HF-28 was specifically designed for use in modern intra-vane pumps. The extra performance developed into this fluid is equally applicable to all other types of hydraulic pumps, valves and other components. HF-28 is a 200 SUS @ 100°F viscosity fluid.

HF-28 also continues to provide the other expected benefits including protection from rust and corrosion, high viscosity index, excellent low-temperature fluidity, and complete compatibility with commonly used seals, hoses and metals. Excellent tramp oil rejection and foam supression are two more benefits of HF-28. In addition, HF-28 is completely compatible in all proportions with other reputable brands of water-glycol fluids.

Certified Pump Performance Test

Test Parameters: Vickers high-performance intra-vane 35V25A-1C10-282 (12-vane cartridge), 2000 psi, 50 hours, 130°F/54°C, 31.25 gpm, 1500 rpm, steady state, 3 cartridge test.

Test Results:	HF-28	Leading Competitor
Average weight loss, mg, cam ring:	67	343
vane kit:	8.1	7.2

Conclusion: Exceptional results: superior by a 5-fold factor over the nearest leading competitor's fluid in side-by-side tests.

Typical Properties

Viscosity, SUS @ 100°F/38°C	200
pH	9.5
Alkaline reserve	195
Water content (% by wt.)	45
Appearance	Clear, red liquid
Density @ 70°F/21°C (g/cc)	1.07
Flash point	None
Fire point	None
Viscosity index	+150
Foam tendency & stability	Pass
Mineral oil rejection test	Pass

HELPING INDUSTRY PRODUCE Chem-Trend

HF - 28

CHEM-TREND HYDRAULIC FLUID

Application and Use

HF-28 is recommended for use in all types of hydraulic systems requiring a water-glycol fire-resistant hydraulic fluid. If you want to add HF-28 to another water-glycol fluid, call us and we will advise you regarding compatibility. Fluids other than water-glycol should first be thoroughly removed by a flushing procedure which we can recommend. Chem-Trend representatives are trained and experienced in all aspects of conversion assistance. They will check all details of the system for complete suitability of the specific application.

Compatibility

FILTER MEDIA	
Adsorbent (Fuller's) earth	No
Cotton waste	Yes
Paper (cellulosic), Phenolic treated	Yes
Wire or metal (see specific metal)	
METALS	
Aluminum, anodized, 1 mil	Yes
Aluminum, unanodized	No
Brass	Yes
Bronze, less than 20% lead	Yes
Bronze, more than 20% lead	Ltd.
Cadmium	Ltd.
Copper	Yes
Ferrous (iron or steel)	Yes
Galvanized	No
Lead	No
Magnesium	No
Zinc	No
ELASTOMERS	
Buna "N" (butadiene acrylonitrile)	Yes
Buna "S" (butadiene styrene, GRS)	Yes
Butyl	Yes
EPR, EPDM (ethylene-propylene)	Yes
Neoprene (chloroprene)	Yes
Polyurethane	Ltd.
Silicone	Yes
Teflon® (tetrafluoroethylene)	Yes
Viton®, Kel-F® (fluorocarbon)	Yes

OTHER FLUIDS	
Water glycols	Yes
Water/oil emulsions	No
Synthetic (non-aqueous)	No
Petroleum oil	No
PAINTS	
Enamel	No
Epoxy	Yes
Phenolic	Yes
PLASTICS	
Acrylic	Yes
Lucite®, Plexiglas®	Yes
Epoxy	Yes
Nylon	Yes
Phenolic	Yes
Polycarbonate	Yes
Polyvinylchoride (PVC)	Yes
Silicone	Yes
Styrene	Yes
Teflon®	Yes
MISCELLANEOUS	
Pipe joint compounds	
Loctite®	Yes
Teflon® Tape	Yes
Permatex®	Yes
Cork	No
Leather	No

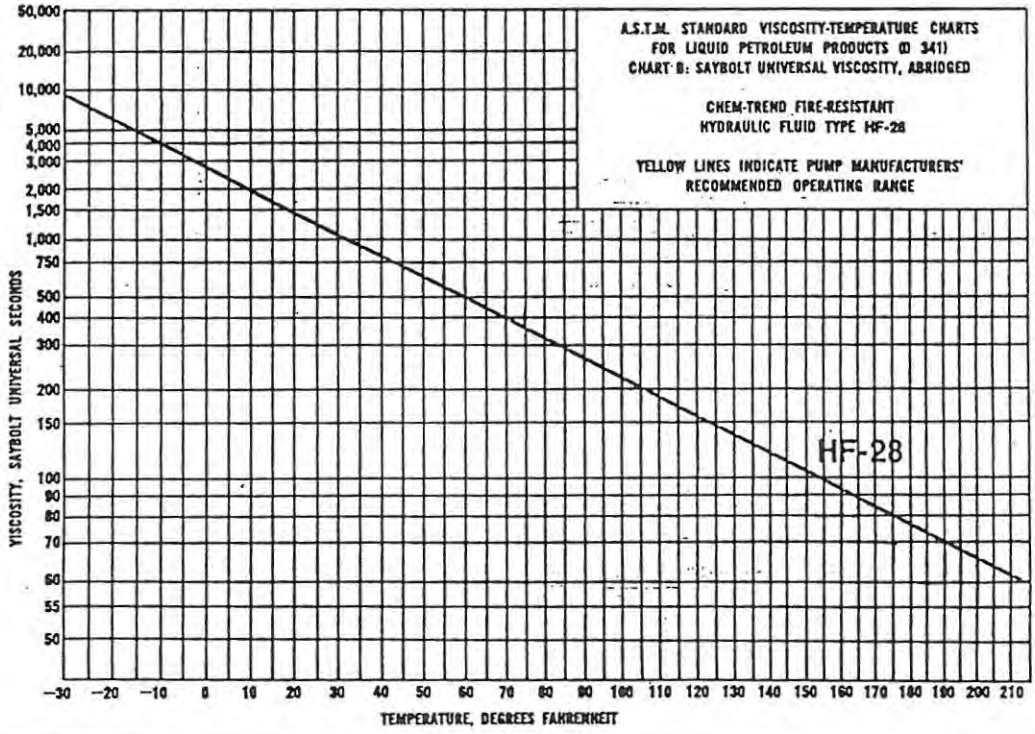
HF - 28

CHEM-TREND HYDRAULIC FLUID

Recommended Temperatures for Hydraulic Applications

Major pump manufacturers recommend that the viscosity of a fluid at start-up not exceed 4000 SUS. The minimum recommended operating limit is 70 SUS.

The viscosity-temperature curve for HF-28 sets the corresponding temperature limits as −10°F/−23°C and 190°F/88°C. To realize maximum performance from HF-28, it is recommended that the reservoir operating temperatures be controlled between 100°F/38°C and 120°F/49°C. Temperatures above 120°F/49°C increase the tendency to evaporate water from the fluid resulting in a gradual increase in viscosity. Continuous temperatures over 150°F/66°C should be avoided. Loss of water can also compromise the fire-resistance properties of the hydraulic fluid. We recommend that operating conditions be maintained at the optimum range for maximum safety and longest component life.

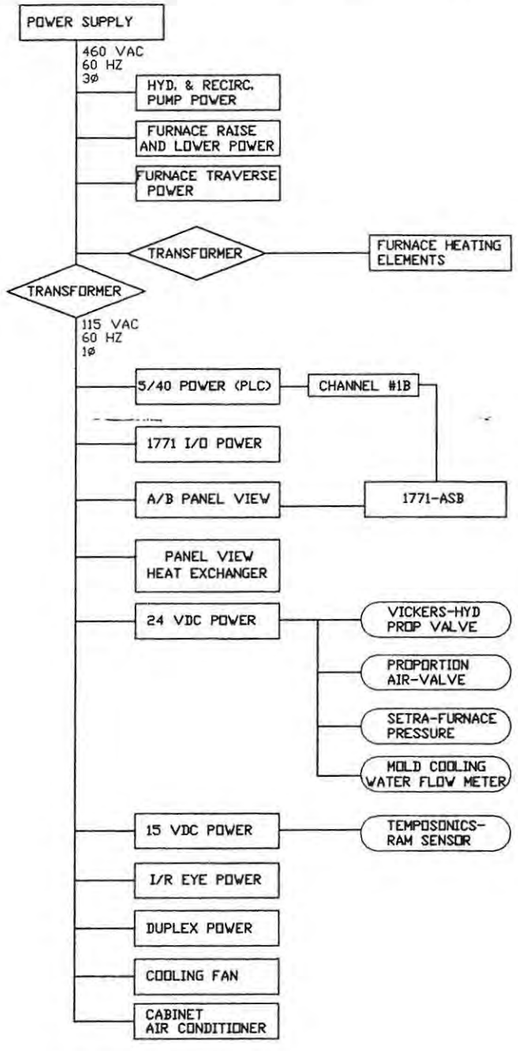


Handling

We believe HF-28 has a low degree of hazard when used as intended. For more complete information, request a copy of Chem-Trend's Material Safety Data Sheet.

Packaging

HF-28 is available in 5-gallon, 55-gallon, 400-gallon and bulk quantities.



ITEM	DESCRIPTION	QTY	ECI P/N	MANUFACTURER P/N	MANUFACTURER	ZONE
28	INDUSTRIAL RELAY	1	X	700-PK400A4	ALLEN BRADLEY	404
27	PANELVIEW ALARM RELAY	1	X	BUILT IN PANELVIEW	ALLEN BRADLEY	SEE PART #11
26	OPTO-TOUCH CYCLE START	2	X	OTBA5	BANNER	1619, 1645, 3052
25	PUSH BUTTON	1	X	800T-A2A	ALLEN BRADLEY	1741 1816
24	PUSH BUTTON	1	X	800T-D2A	ALLEN BRADLEY	1815
23	PUSH BUTTON	3	X	800T-A3A	ALLEN BRADLEY	1741,1744,1745
22	2 POSITION PUSH/PULL E/STOP	1	X	800T-FXD4	ALLEN BRADLEY	717 1414
21	EMERGENCY STOP ENGRAVED CAP	1	X	800T-N209RE1	ALLEN BRADLEY	717
20	SURGE SUPPRESSOR	1	X	700-N24	ALLEN BRADLEY	717
19	ILLUMINATED PUSH BUTTON	1	X	800T-PB16A	ALLEN BRADLEY	717
18	XXXXXXXX	X	X	XXXXXXXXXX	XXXXXXXXXXXXXX	XXXXXX
17	XXXXXX	X	X	XXXXXX	XXXXXX	XXXXXX
16	3 POSITION SELECTOR SWITCH	3	X	800T-J91A	ALLEN BRADLEY	1716 1717 1718 1719 1730 1731
15	4 POSITION SELECTOR SWITCH	1	X	800T-N2KF4B	ALLEN BRADLEY	1732 1734 1733 1735
14	2 POSITIION ON/OFF SWITCH	11	X	800T-H2A	ALLEN BRADLEY	1736 1738 1740 1742 1813 1737 1739 1741 1743
13	SIDE CORE OPEN/CLOSE JOYSTICK	5	X	800T-T2F3DDXX	ALLEN BRADLEY	1706-1714
12	RAM UP AND DOWN JOYSTICK	1	X	800T-T2H3EEXX	ALLEN BRADLEY	1704
11	KEYPAD PANELVIEW WITH COLOR	1	X	2711-KC1/2711-EU1B12C	ALLEN BRADLEY	512
10	REMOTE I/O ADAPTER	1	X	1771-ASB	ALLEN BRADLEY	SHEET 24
9	16 SLOT CHASSIS	2	X	1771-A4B	ALLEN BRADLEY	PLC CABINET
8	POWER SUPPLY PARALLELING CABLE	2	X	1771-CT	ALLEN BRADLEY	SHEET 15 & 23
7	POWER SUPPLY SLOT, 8A, 120VAC	4	X	1771-PS4	ALLEN BRADLEY	SHEET 15 & 23
6	THERMOCOUPLE INPUT	3	X	1771-IXE	ALLEN BRADLEY	SHEET 11 & 12
5	ANALOG OUTPUT	1	X	1771-OFE1	ALLEN BRADLEY	SHEET 13
4	ANALOG INPUT 8 POINT DIFF.	5	X	1771-IFE	ALLEN BRADLEY	SHEET 8,9,10,11
3	16 POINT 120VAC OUTPUT	5	X	1771-OAD	ALLEN BRADLEY	SHEET 18,19,20,21,22
2	16 POINT 120VAC INPUT	5	X	1771-IAD	ALLEN BRADLEY	SHEET 16,17,18
1	PLC 5/40	1	X	1785-L40B	ALLEN BRADLEY	SHEET 24

PARTS LIST

NOTES:

1. (X) ITEM NO.S
2. (XXYY) ZONE LOCATIONS- XX IS SHEET NO. (OR LAST DIGIT IN DRAWING NO.) AND YY IS LINE NO.
3. (X) 3X IS QUANTITY, I.E. QUANTITY IS 3 FOR ITEM NO.
4. THIS SCHEMATIC USED ON AMC005
5. CONTENTS

CONTENTS	SHEET
PARTS LIST	1-3
POWER TO COMPONENTS	4-7
I/O MODULE & P.S.	8-23
PLC TO ASB	24
24 VDC POWER COMPONENTS	25-28
RAM HYD. VALVE & TEMPO.	29
LIGHT CURTAIN MODULES	30
AIR/WATER BOX WIRING	31-32

WIRE COLOR CODE:

BLACK	460 Volts A.C.
GREEN	GROUND
BLUE	24 Volts D.C.
RED	115 Volts A.C.
YELLOW	INTERLOCK or Voltage above MCR

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REV	DESCRIPTION	DATE	APP'D
–	ENGINEERING RELEASE		

REVISIONS

APPROVALS	DATE
DRAWN BY: J. WATERS	8/27/06
DESIGNED BY: G. FEARN	12/08/06
APPROVED BY:	
ENGINEERING: V. HAWLEY	
MANUFACTURING: D. DINKA	
CUSTOMER: AAP	

DO NOT SCALE DRAWING

EMPIRE CASTINGS INC.
3195 REGIONAL PARKWAY SANTA ROSA, CA 95403

ELECTRICAL SCHEMATIC PAGE 1

EMPIRE WORK ORDER NO.	EMPIRE DRAWING NO.	
AAPM01	1800101	
NEXT ASSEMBLY NO. 1800102	CUSTOMER PART NO.	REV B
QTY: 1	SCALE: TO FIT	SHEET 1 OF 88

ITEM	DESCRIPTION	QTY	ECI P/N	MANUFACTURER P/N	MANUFACTURER	ZONE
56						
55	PROPRTIONAL AIR VALVE	1	XXXXX	BB2FEE015/R000B-S160-S19-S91-S92	PROPORTION AIR	2621
54	DUPLEX BOX	1	XXXXX	FS1 & DS100G	CROUSE HINDS	515
53	4-20ma WATER FLOW SENSOR	48	XXXXX	CCB-10-BC	LAKE	SHEET 25-28
52						
51						
50						
49	20 PSI FURNACE PRESSURE SWITCH	1	XXXXX	WS1B20RHR/ADJ 20 PSIR	NASON	1908
48	1 PSI FURNACE PRESSURE SWITCH	1	XXXXX	NSM1B1.5FHR/SET 1.5 PSIF	NASON	1618
47	24 VDC POWER SUPPLY	1	XXXXX	F24-12-A	POWER ONE	519
46	± 12 TO 15 VDC POWER SUPPLY	1	XXXXX	HAA15-0.8A	POWER ONE	521
45	CONTACTOR	1	XXXXX	100-B250ND3	ALLEN BRADLEY	425
44	PHOTOELECTRIC SENSOR (I/R EYE)	3	XXXXX	42GRU-9002	ALLEN BRADLEY	516 517 518 3001 3015 3027
43						
42						
41	CIRCUIT BREAKER 20 AMP	1	XXXXX	1492-CB2G200	ALLEN BRADLEY	502
40	CIRCUIT BREAKER 25 AMP	1	XXXXX	1492-CB1G250	ALLEN BRADLEY	506
39	CIRCUIT BREAKER 2 AMP	4	XXXXX	1492-GH020	ALLEN BRADLEY	616 621 619
38						
37	CIRCUIT BREAKER 7 AMP	4	XXXXX	1492-GH070	ALLEN BRADLEY	519 608 613 606 611
36	CIRCUIT BREAKER 5 AMP	2	XXXXX	1492-GH050	ALLEN BRADLEY	510 704
35	CIRCUIT BREAKER 2.5 AMP	1	XXXXX	1492-GH025	ALLEN BRADLEY	512 515
34	CIRCUIT BREAKER 1 AMP	3	XXXXX	1492-GH010	ALLEN BRADLEY	517 707 521 514
33	RELAY SOCKET	4	XXXXX	700-HN116	ALLEN BRADLEY	710 718 719 720 1837 2038-2045
32	RELAY	4	XXXXX	700-HF32-A1-4	ALLEN BRADLEY	710 718 719 720 1837 2038-2045
31	MALE FEMALE EXTENSION CORD CUSTOMER SUPPLIED	0	XXXXX	40946	BRAD HARRISON	1630-1639
30	MINI CHANGE ELEC. RECEPT. MALE CUSTOMER SUPPLIED	0	XXXXX	40909	BRAD HARRISON	1630-1639
29	MINI CHANGE ELEC. RECEPT. FEMALE	8	XXXXX	40910	BRAD HARRISON	1630-1639

PARTS LIST

ITEM	DESCRIPTION	QTY	ECI P/N	MANUFACTURER P/N	MANUFACTURER	ZONE
84	APX FRAME	2	XXXXX	X-F1888	HOFFMAN	
83	BASE	2	XXXXX	X-B088	HOFFMAN	
82	POGADA TOP	1	XXXXX	X-PT88	HOFFMAN	
81	TOP	1	XXXXX	X-T88	HOFFMAN	
80	BACK	1	XXXXX	X-CS188	HOFFMAN	
79	DISCONNECT DOOR	1	XXXXX	X-DSC188	HOFFMAN	
78	DOOR	2	XXXXX	X-DS188	HOFFMAN	
77	PANEL	3	XXXXX	X-PF188	HOFFMAN	
76	SIDE	3	XXXXX	X-SS188	HOFFMAN	
75	JOINING KIT	1	XXXXX	X-J2F	HOFFMAN	
74	DATA POCKET	1	XXXXX	X-DP2C	HOFFMAN	
73	MASTER DOOR ACTUATOR	1	XXXXX	X-MLMA	HOFFMAN	
72	SLAVE DOOR ACTUATOR	1	XXXXX	X-MLS18	HOFFMAN	
71	CONNECTING ROD	1	XXXXX	X-MLC8	HOFFMAN	
70	POGADA/APX VENT KIT	1	XXXXX	X-PV32	HOFFMAN	
69	FAN KIT	1	XXXXX	A6AXFM	HOFFMAN	
68	COMMUNICATIONS CABLE	100'	XXXXX	9463 250/M	BELDEN	2423
67						
66	FURNACE LOW TEMP. STROBE	1	XXXXX	5947T75	McMASTER CARR	513
65	SILICON CARBIDE HEATING ELEMENTS	3	XXXXX	75X40X2.125X0.620HMS -0% +15%	WIC	423
64	THERMOCOUPLE WIRE 8 PAIRS	50'	XXXXX	8KX20PP	OMEGA	SHEET 11,12,26
63	T/C JACK PANEL	2	XXXXX	SJP-2-12-K	OMEGA	SHEET 26-29
62	THERMOCOUPLE CONNECTION BOX	1	XXXXX	JPCB-5-K-F	OMEGA	SHEET 11-12
61	3-1/2" 0-200 AMP METER	3	XXXXX	1357-03240	SIMPSON	420
60	CURRENT TRANSFORMER 200:5	3	XXXXX	2SFT-201	INSTRUMENT TRNASFORMER	420
59	OPERATING HANDLE	1	XXXXX	1494V-H1	ALLEN BRADLEY	404
58	CONNECTING ROD	1	XXXXX	1494V-RA2	ALLEN BRADLEY	404
57	DISCONNECT SWITCH	1	XXXXX	1494V-DS100	ALLEN BRADLEY	404

PARTS LIST

REV	DESCRIPTION	DATE	APP'D
B	FIELD RELEASE	08DEC95	
A	DELETED #'S 42 & 43	22MAY95	
–	ENGINEERING RELEASE		

REVISIONS

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APPROVALS	DATE
DRAWN BY: J. WATERS	9/27/95
CHECKED BY: G. PEARN	12/05/95
APPROVED BY:	
ENGINEERING: V. HAWLEY	
MANUFACTURING: P. PINNEY	
CUSTOMER: AAP	

DO NOT SCALE DRAWING

EMPIRE CASTINGS INC.
3195 REGIONAL PARKWAY SANTA ROSA, CA 95403

ELECTRICAL SCHEMATIC PAGE 2

EMPIRE WORK ORDER NO.	EMPIRE DRAWING NO.
AAPM01	1800102
NEXT ASSEMBLY NO. 1800103	CUSTOMER PART NO.
QTY: 1	SCALE: TO FIT
REV: B	SHEET 2 OF 32

ITEM	DESCRIPTION	QTY	ECI P/N	MANUFACTURER P/N	MANUFACTURER	ZONE
112	PROXIMITY SWITCH	2	XXXXX	802PR-LABB2	ALLEN BRADLEY	1640 1818 1641 1819
111	ISOLATED T/C TRANSMITTER	1	XXXXX	6TS-K 0-1400° F	M-SYSTEM CO.,LTD.	2634
110	LVDT 48" INCLUSIVE	1	XXXXX	TTSRBU0480AS1B	TEMPOSONICS	2941
109	POWER AMPLIFIER CARD	1	XXXXX	EEA-PAM-561-A-31	VICKERS	2909
108	HYD. FILTER DIRTY SWITCH	2	XXXXX			1607 1608
107	HYD. PRESSURE SWITCH 1100 PSI	1	XXXXX	WS11C750FHRV, ADJ-700-2500	NASON	1610
106	HYD. PRESSURE SWITCH 750 PSI	1	XXXXX	WS11C750FHRV, ADJ-700-2500	NASON	1609
105						
104	PROAIR SIDE MOUNT A/C	1	XXXXX	CR43-0616-002	HOFFMAN	538
103	COMPACT COOLING FAN	1	XXXXX	A-6AXFN	HOFFMAN	707
102	480VAC - 115VAC 3KVA XFRMR	1	XXXXX	TA-2-81220	ACME	503
101	30KVA 3Ø 480VAC TRANSFORMER	1	XXXXX	17571	LC MAGNETICS	415
100	CARD HOLDER, AMPLIFIER	1	XXXXX	SKP48/IF	NORSTADT	2909
99	PROXIMITY SWITCH	8	XXXXX	802PR-LABB2	ALLEN BRADLEY	1611,1612,1615 1616,1617,1642
98	MOLD COOLING AIR VALVE	24	XXXXX	SC8316G64	ASCO	530
97	MOLD COOLING WATER VALVE	24	XXXXX	450075F	BURKERT	
96	xxxxxxxx	0	XXXXX	xxxxxxxxx	xxxxxxxxxx	
95	ENCLOSED MOTOR STARTER	1	XXXXX	112-A45JDC45*	ALLEN BRADLEY	403
94	REFLECTOR	3	XXXXX	92-39	ALLEN BRADLEY	USE WITH ITEM #44
93	RELAY	1	XXXXX	700-P800A1	ALLEN BRADLEY	717
92	25HP 3Ø 1760RPM 284T FRAME	1	XXXXX	LM01798	LINCOLN	405
91	xxxxxxxx	0	XXXXX	xxxxxxxxx	xxxxxxxxxx	
90	60 AMP FUSE	6	XXXXX	LPJ-60SP	BUSS	405 412
89	200 AMP FUSE	3	XXXXX	LPJ-200SP	BUSS	423
88	60 AMP FUSE	3		FRS-R-60	BUSS	
87						
86	FUSE HOLDER - 3 FUSE	1	XXXXX	J60060-3	BUSS	412
85	FUSE HOLDER - 1 FUSE	3	XXXXX	J60200-1CR	BUSS	423

ITEM	DESCRIPTION	QTY	ECI P/N	MANUFACTURER P/N	MANUFACTURER	ZONE
140						
139						
138						
137	T/C PANEL JUNCTION BOX	X	XXXXX	108412SC	CIRCLE AW	
136	MOLD COOLING TERMINAL JUNCTION BOX	X	XXXXX	448-12WT	CIRCLE AW	
135	PARTITION	X	XXXXX	3003224	PHOENIX	
134	BRIDGE	X	XXXXX	0201184	PHOENIX	
133	SINGLE TERMINAL BLOCK	X	XXXXX	3003017	PHOENIX	
132	DOUBLE TERMINAL BLOCK	X	XXXXX	2774017	PHOENIX	
131	TERMINAL GROUND BLOCK	X	XXXXX	0441012	PHOENIX	
130	15 AMP CIRCUIT BREAKER	1	XXXXX	1492-GHA150	ALLEN BRADLEY	
129	RELAY BASE	1	XXXXX	700-HN127	ALLEN BRADLEY	605 1829
128	SINGLE RANGE TIMING RELAY	1	XXXXX	700-HS12AA1	ALLEN BRADLEY	605 1829
127	LUG	2	XXXXX	199-LE1	ALLEN BRADLEY	
126	SURGE SUPPRESSOR	1	XXXXX	599-K04	ALLEN BRADLEY	1830
125	SURGE SUPPRESSOR	1	XXXXX	199-GSMA1	ALLEN BRADLEY	711
124	AIR-TO-AIR HEAT EXCHANGER	1	XXXXX	XR-2016-101	HOFFMAN	514
123	T/C TERMINAL BLOCK		XXXXX	3100062	PHOENIX	
122	HEX INSERT KEY	1	XXXXX	X-KOHM10	HOFFMAN	
121	GRID STRAP	1	XXXXX	XGH6S8	HOFFMAN	
120	CABLE 16AWG 21 CONDUCTOR	150'	XXXXX	19007	OLFLEX	
119			XXXXX			2415
118			XXXXX			2415
117			XXXXX			2415
116						
115	SINGLE PAIR, COMMUNICATION CABLE	80'	XXXXX	8761	BELDEN	2502 2634
114	FIVE PAIR, COMMUNICATION CABLE	150'	XXXXX	8105	BELDEN	2915 2941
113	SCREW CLAMP LUG CONNECTOR	3	XXXXX	1492R-N2	ALLEN BRADLEY	403

REV	DESCRIPTION	DATE	APP'D
-	ENGINEERING RELEASE		

REVISIONS

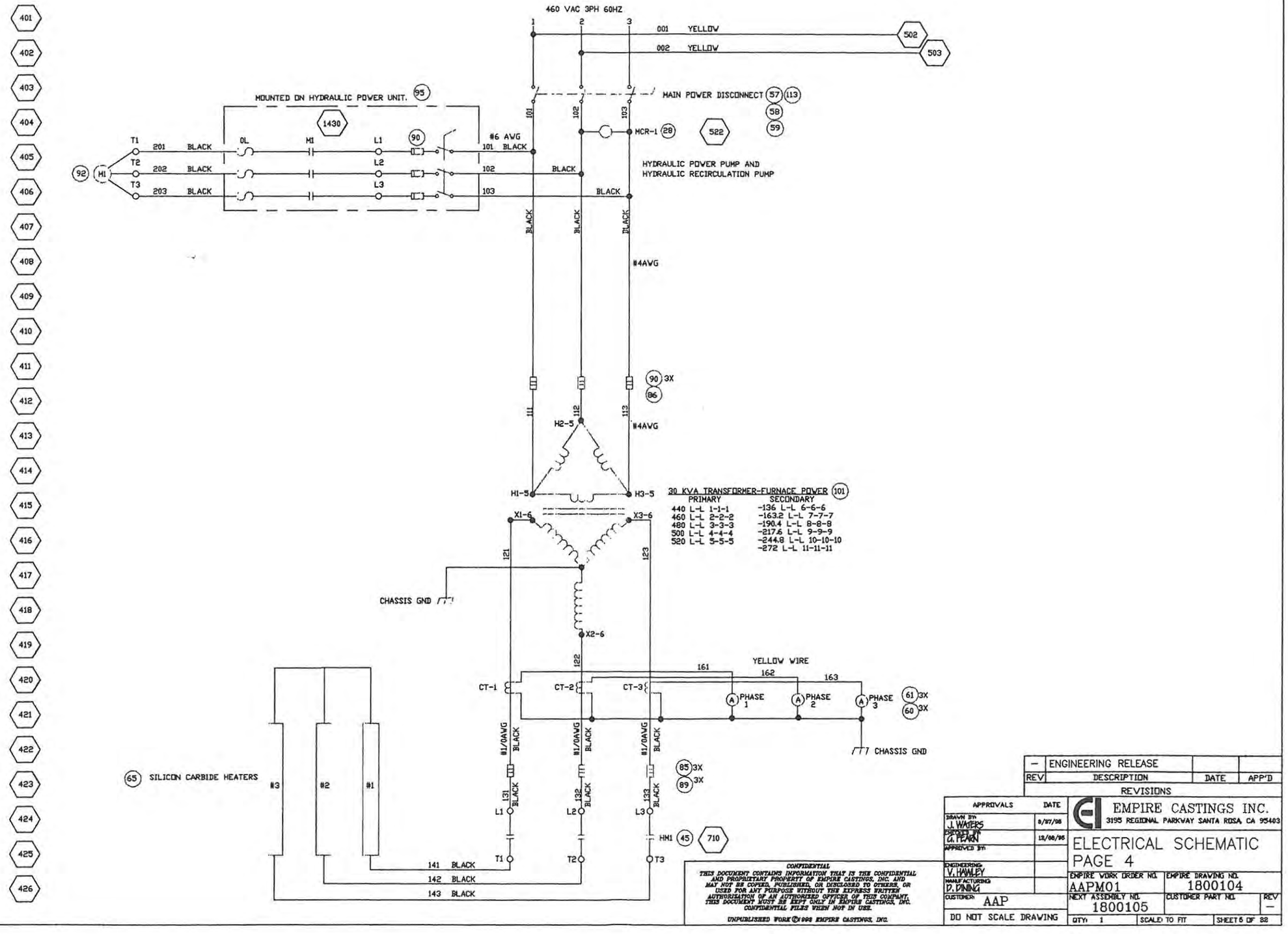
APPROVALS	DATE
DRAWN BY: J. WATERS	8/27/03
CHECKED BY: G. PEARN	12/08/05
APPROVED BY:	
ENGINEERING: V. HAWLEY	
MANUFACTURING: D. DINING	
CUSTOMER: AAP	
DO NOT SCALE DRAWING	

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3195 REGIONAL PARKWAY SANTA ROSA, CA 95403

ELECTRICAL SCHEMATIC
PAGE 3

EMPIRE WORK ORDER NO.	EMPIRE DRAWING NO.	
AAPM01	1800103	
NEXT ASSEMBLY NO. 1800104	CUSTOMER PART NO.	REV D
QTY: 1	SCALE: TO FIT	SHEET 3 OF 32



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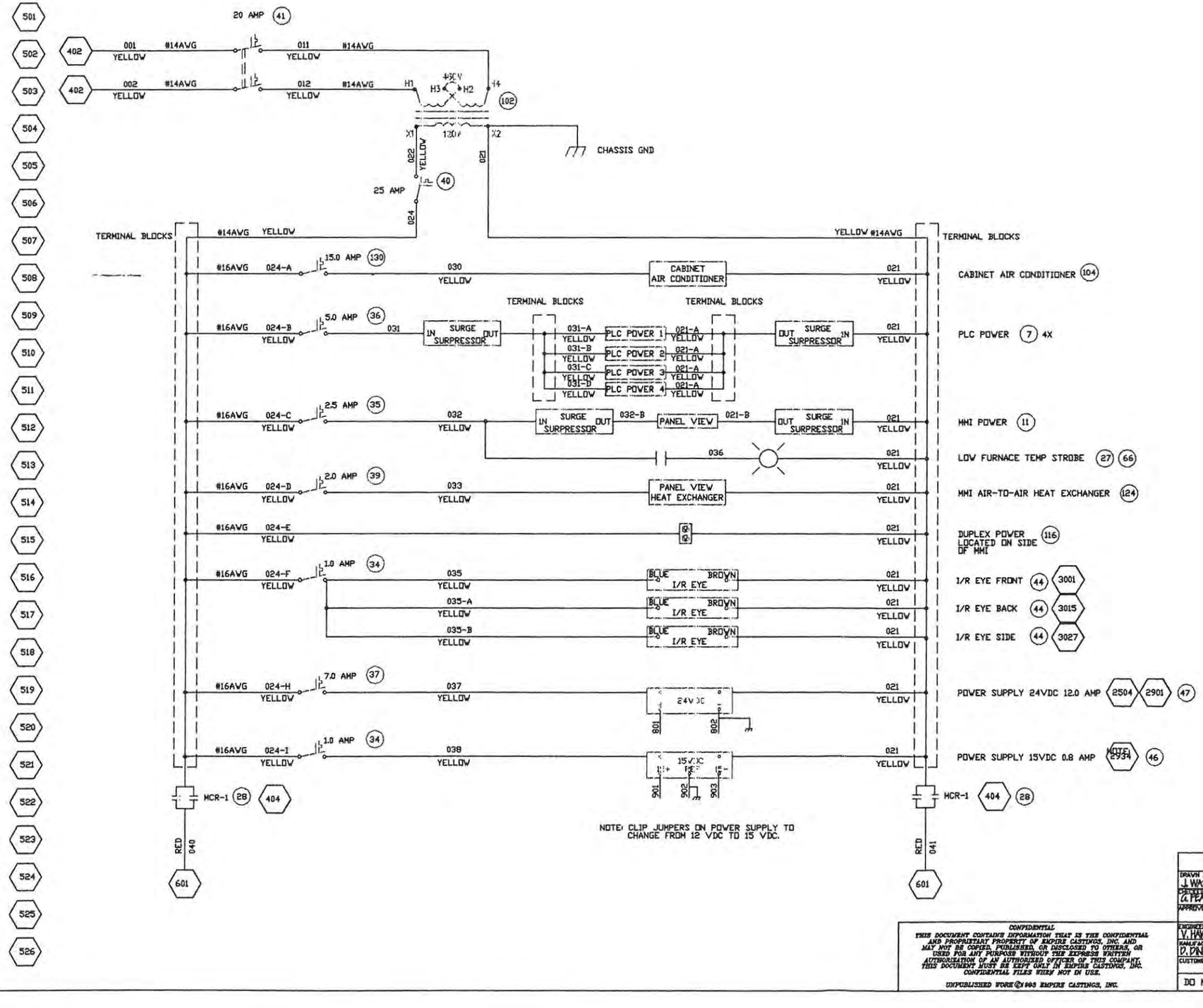
REVISIONS

APPROVALS	DATE
DRAWN BY J. WATERS	8/27/98
CHECKED BY G.A. PEARN	12/08/95
APPROVED BY	
ENGINEERING V. HAWLEY	
MANUFACTURING D. DINING	
CUSTOMER AAP	
DO NOT SCALE DRAWING	

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ELECTRICAL SCHEMATIC PAGE 4

EMPIRE WORK ORDER NO.	EMPIRE DRAWING NO.
AAPM01	1800104
NEXT ASSEMBLY NO. 1800105	CUSTOMER PART NO.
QTY: 1	SCALE: TO FIT
SHEET 5 OF 32	REV –



REV	DESCRIPTION	DATE	APP'D
B	FIELD RELEASE	08DEC95	
A	CHANGED AIR/WATER HEAT EXCHANGER TO AIR CONDITIONER	22MAY95	
–	ENGINEERING RELEASE		

REVISIONS

APPROVALS	DATE
DRAWN BY: J. WATERS	9/27/95
CHECKED BY: G. PEARN	12/08/95
APPROVED BY:	
ENGINEERING: V. HAWLEY	
MANUFACTURING: D. DINING	
CUSTOMER: AAP	

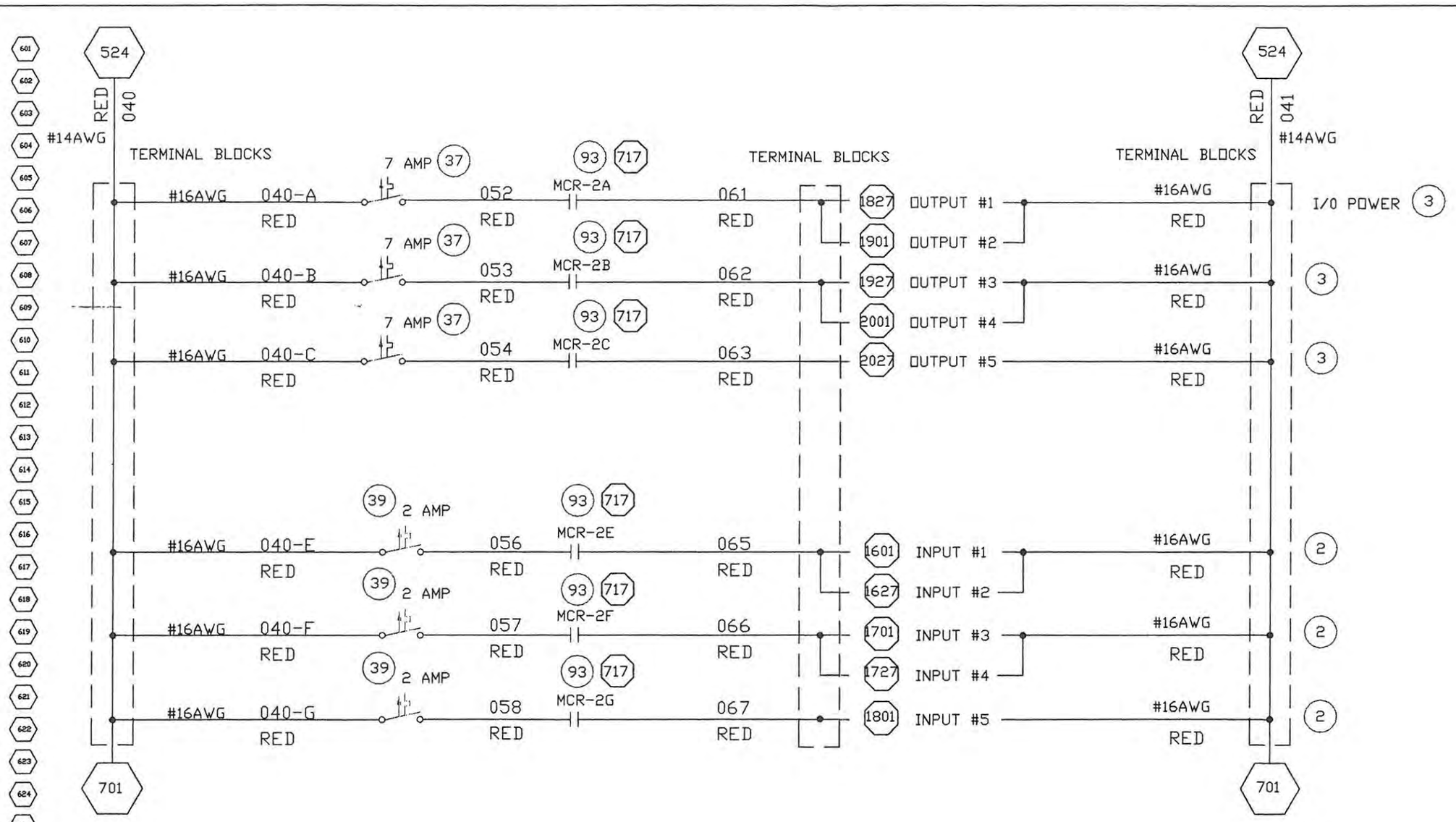
DO NOT SCALE DRAWING

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ELECTRICAL SCHEMATIC PAGE 5

EMPIRE WORK ORDER NO.	EMPIRE DRAWING NO.	
AAPM01	1800105	
NEXT ASSEMBLY NO. 1800106	CUSTOMER PART NO.	REV B
QTY: 1	SCALE: TO FIT	SHEET 6 OF 32

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✳ TO BE USED ON 48 CHANNEL ONLY.

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REV	DESCRIPTION	DATE	APP'D
A	FIELD RELEASE	08DEC95	
–	ENGINEERING RELEASE		

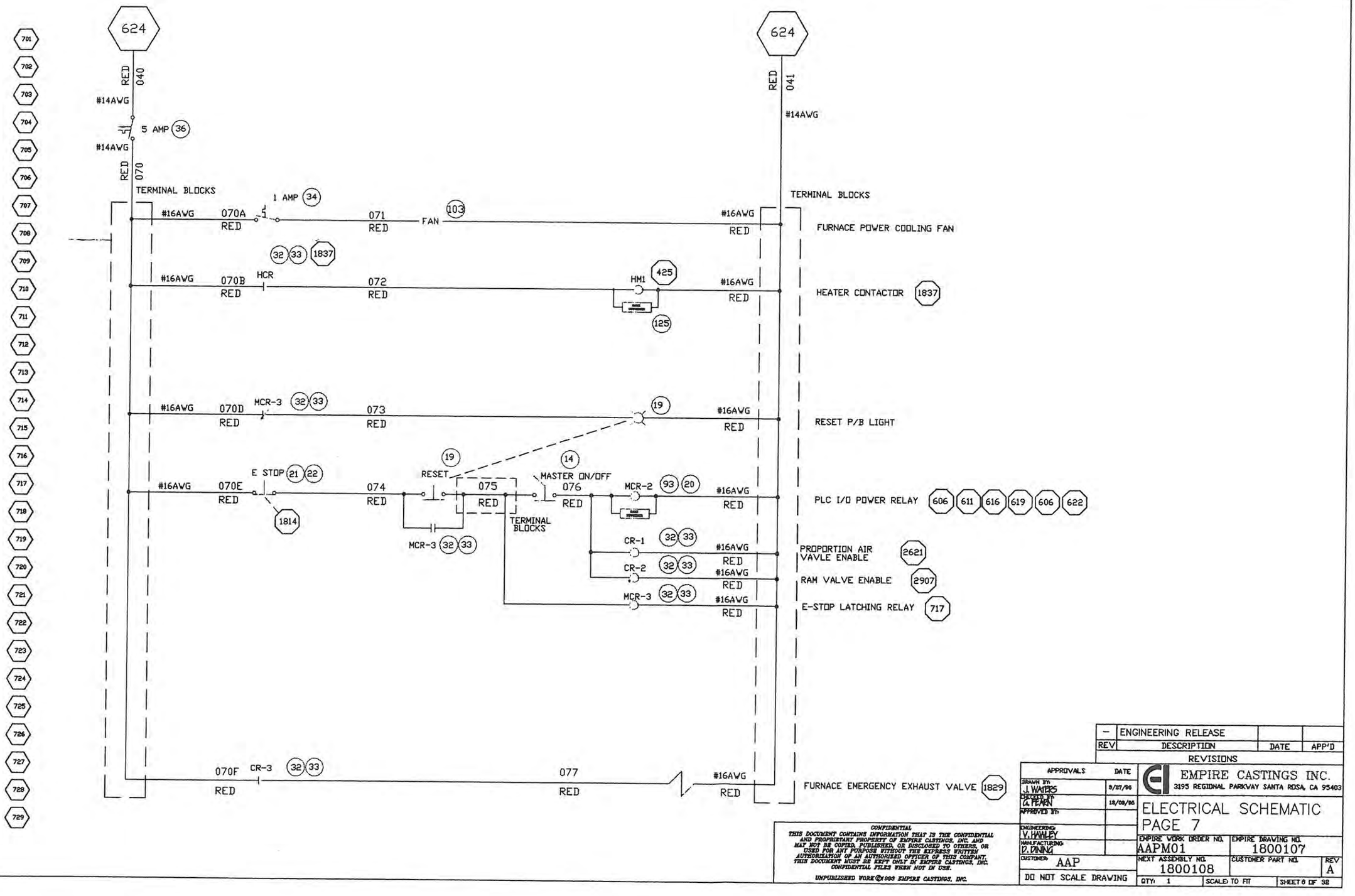
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APPROVALS	DATE
DRAWN BY: J. WATERS	9/27/95
CHECKED BY: G. PFARR	12/08/95
APPROVED BY:	
ENGINEERING: V. HAWLEY	
MANUFACTURING: D. DINING	
CUSTOMER: AAP	
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ELECTRICAL SCHEMATIC PAGE 6

EMPIRE WORK ORDER NO.	EMPIRE DRAWING NO.	
AAPM01	1800106	
NEXT ASSEMBLY NO. 1800107	CUSTOMER PART NO.	REV A
QTY: 1	SCALE: TO FIT	SHEET 6 OF 32



REV	DESCRIPTION	DATE	APP'D
–	ENGINEERING RELEASE		

REVISIONS

APPROVALS	DATE
DRAWN BY: J. WATERS	8/27/96
CHECKED BY: A. PEARN	12/09/96
APPROVED BY:	
ENGINEERING: V. HAWLEY	
MANUFACTURING: D. DINING	
CUSTOMER: AAP	
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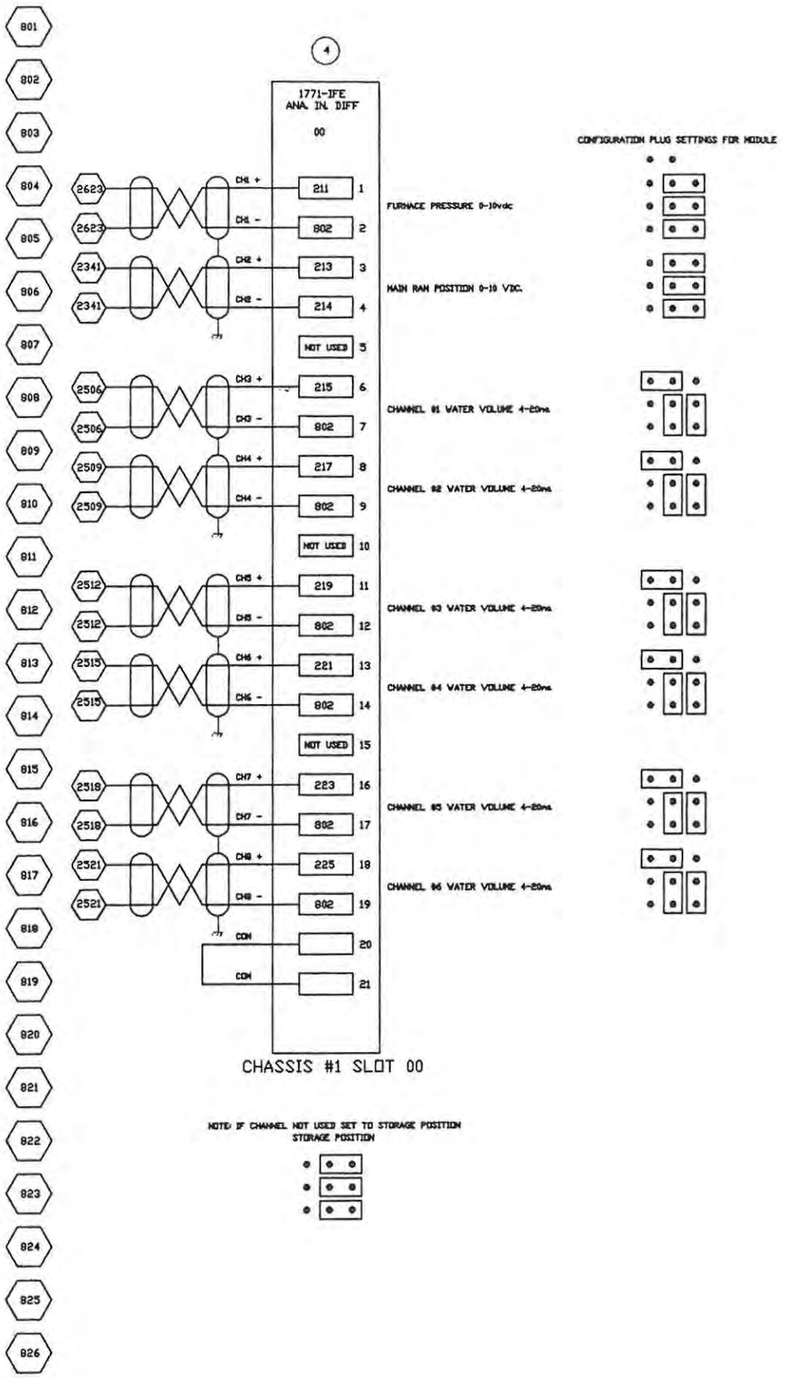
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ELECTRICAL SCHEMATIC PAGE 7

EMPIRE WORK ORDER NO.	EMPIRE DRAWING NO.
AAPM01	1800107
NEXT ASSEMBLY NO. 1800108	CUSTOMER PART NO.
QTY: 1	SCALE: TO FIT
SHEET 8 OF 38	REV A

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DESIGNED BY: G. PEARN	12/06/96
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MANUFACTURING: D. DINNING	
CUSTOMER: AAP	
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ELECTRICAL SCHEMATIC PAGE 8

EMPIRE WORK ORDER NO.	EMPIRE DRAWING NO.	
AAPM01	1800108	
NEXT ASSEMBLY NO. 1800109	CUSTOMER PART NO.	REV A
QTY: 1	SCALE: TO FIT	SHEET 8 OF 32

901
1002
1003
EMPTY SLOT
1004
1005
1006
1007
1008
1009
1010
1011
1012
1013
1014
1015
1016
1017
1018
1019
1020
1021
1022
1023
1024
1025
1026

927
1028
1029
EMPTY SLOT
1030
1031
1032
1033
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1037
1038
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1052

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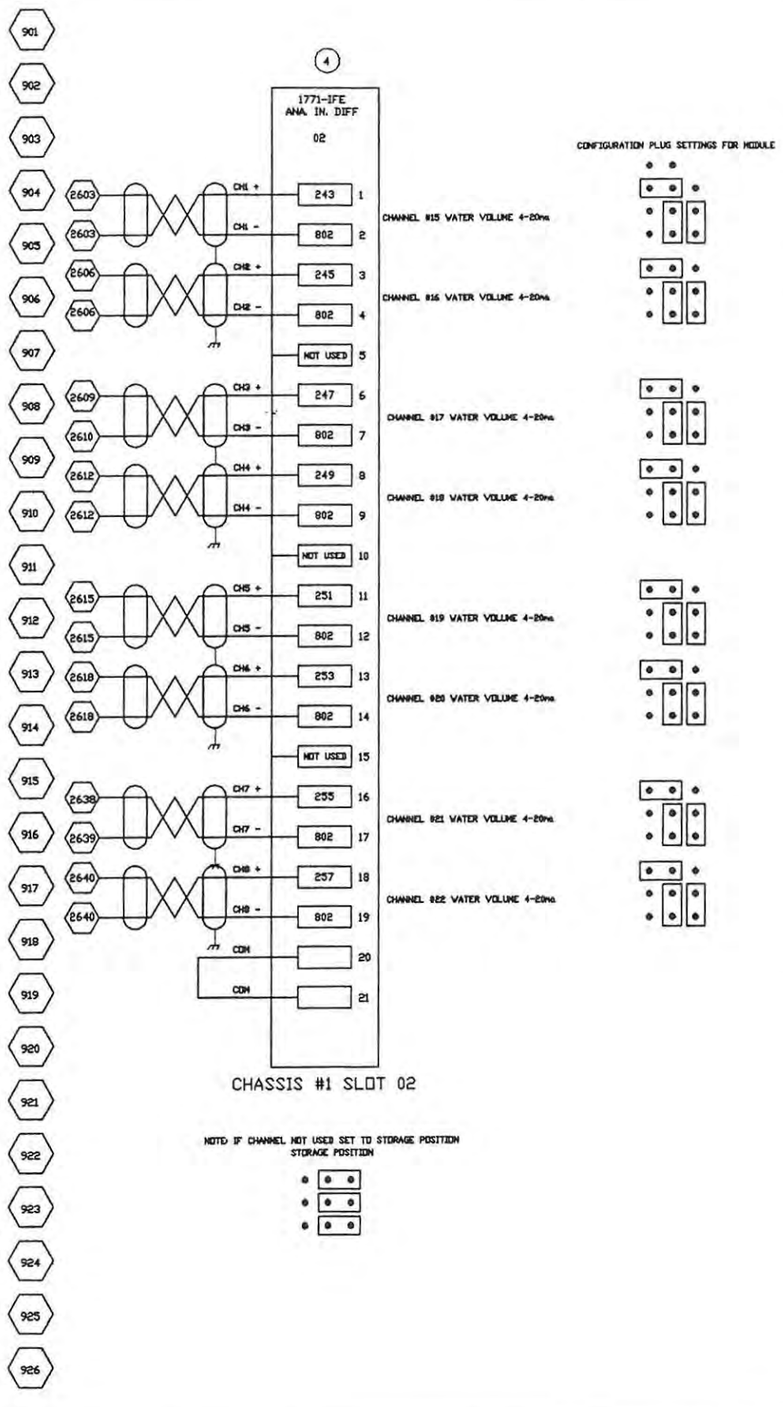
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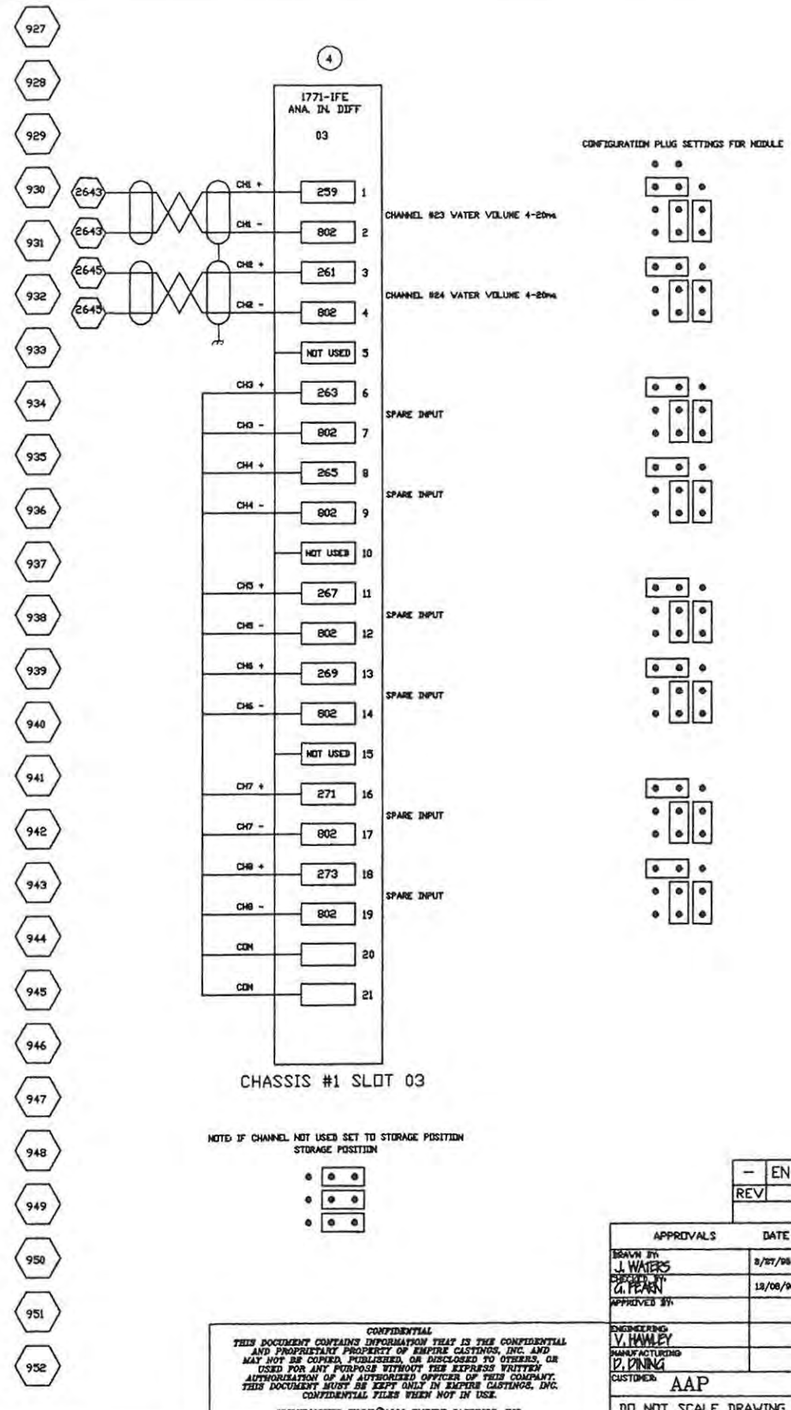
APPROVALS	DATE
DRAWN BY: J. WATERS	3/27/98
DESIGNED BY: A. PEARSON	12/08/98
APPROVED BY:	
ENGINEERING: V. HAWLEY	
MANUFACTURING: D. DINING	
CUSTOMER: AAP	
DO NOT SCALE DRAWING	

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ELECTRICAL SCHEMATIC PAGE 10

EMPIRE WORK ORDER NO.	EMPIRE DRAWING NO.	
AAPM01	1800110	
NEXT ASSEMBLY NO. 1800111	CUSTOMER PART NO.	REV A
QTY: 1	SCALE: TO FIT	SHEET 9 OF 32





REV	DESCRIPTION	DATE	APP'D
–	ENGINEERING RELEASE		

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APPROVALS	DATE
DRAWN BY: J. WATERS	8/27/98
CHECKED BY: G. PEARN	12/08/98
APPROVED BY:	
ENGINEERING: V. HAWLEY	
MANUFACTURING: D. DINING	
CUSTOMER: AAP	
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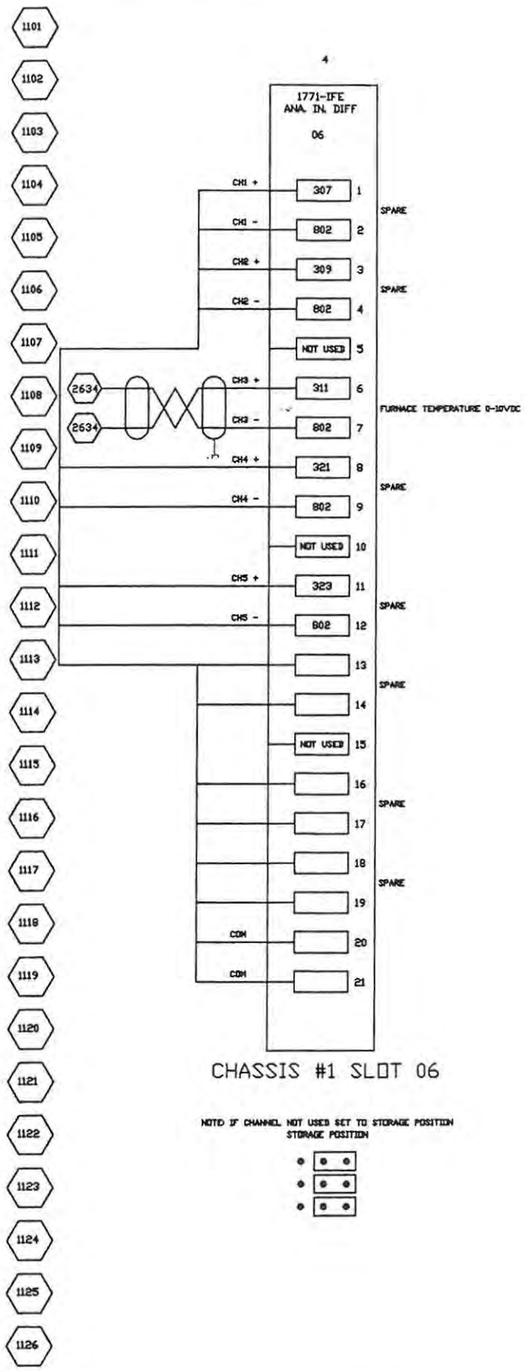
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ELECTRICAL SCHEMATIC
PAGE 9

EMPIRE WORK ORDER NO.	EMPIRE DRAWING NO.
AAPM01	1800109
NEXT ASSEMBLY NO.	CUSTOMER PART NO.
1800110	

QTY: 1 | SCALE: TO FIT | SHEET 9 OF 32 | REV —



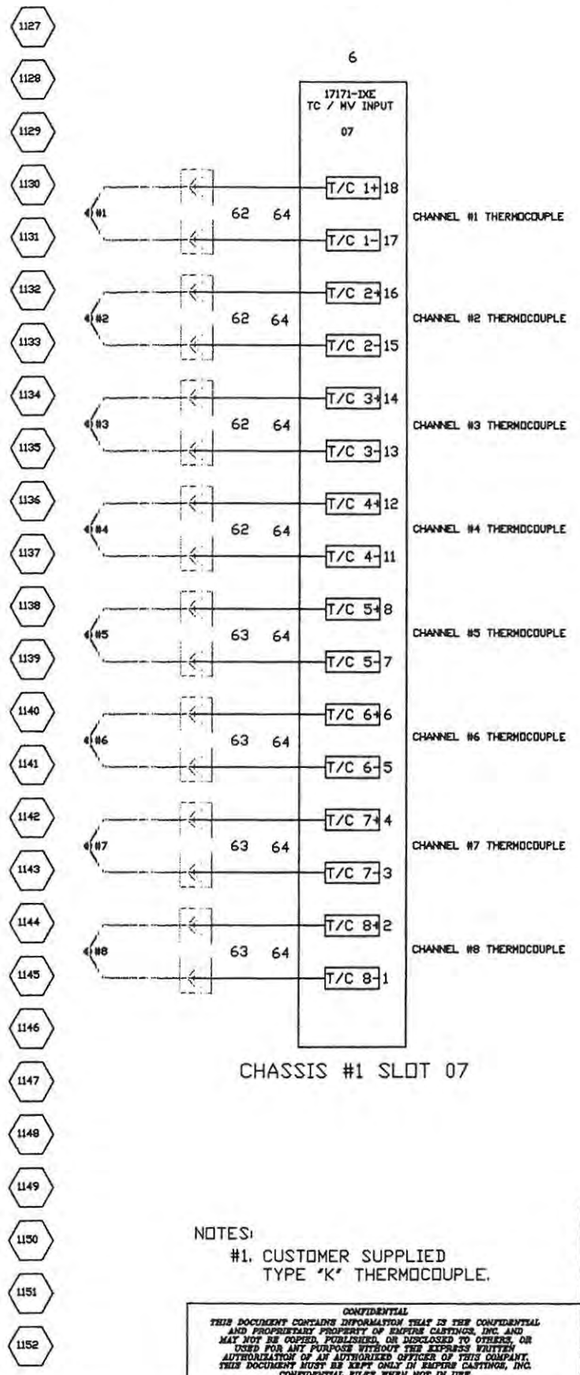
CHASSIS #1 SLOT 06

CONFIGURATION PLUG SETTINGS FOR MODULE



NOTE: IF CHANNEL NOT USED SET TO STORAGE POSITION

STORAGE POSITION



CHASSIS #1 SLOT 07

NOTES:

#1. CUSTOMER SUPPLIED TYPE "K" THERMOCOUPLE.

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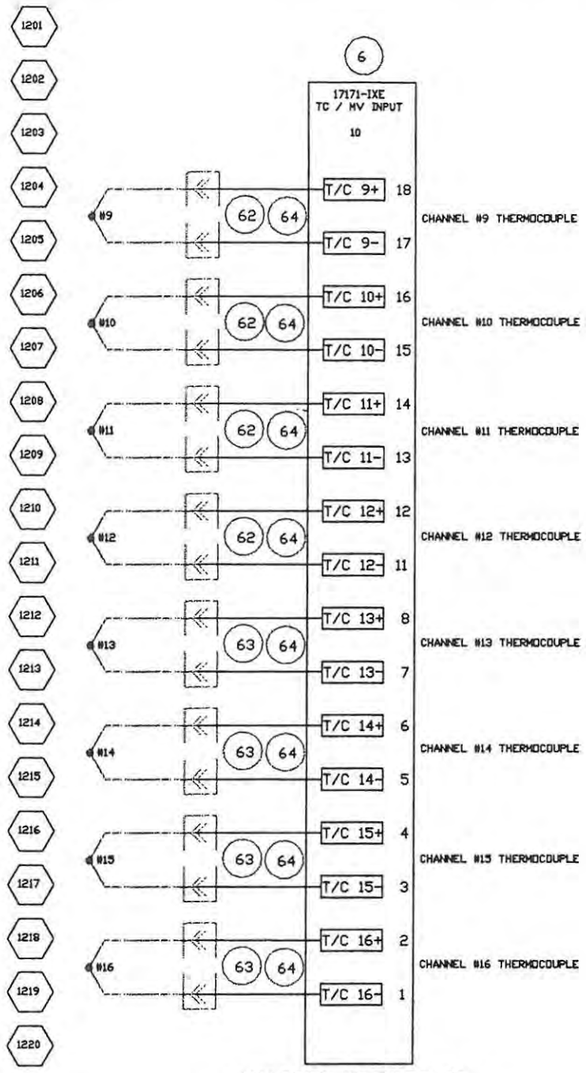
REVISIONS

APPROVALS	DATE
DRAWN BY: J. WATERS	5/27/98
ENGINEER: G. FEARN	06/01/98
APPROVED BY:	
ENGINEERING: V. HAWLEY	
MANUFACTURING: D. DINING	
CUSTOMER: AAP	
DO NOT SCALE DRAWING	

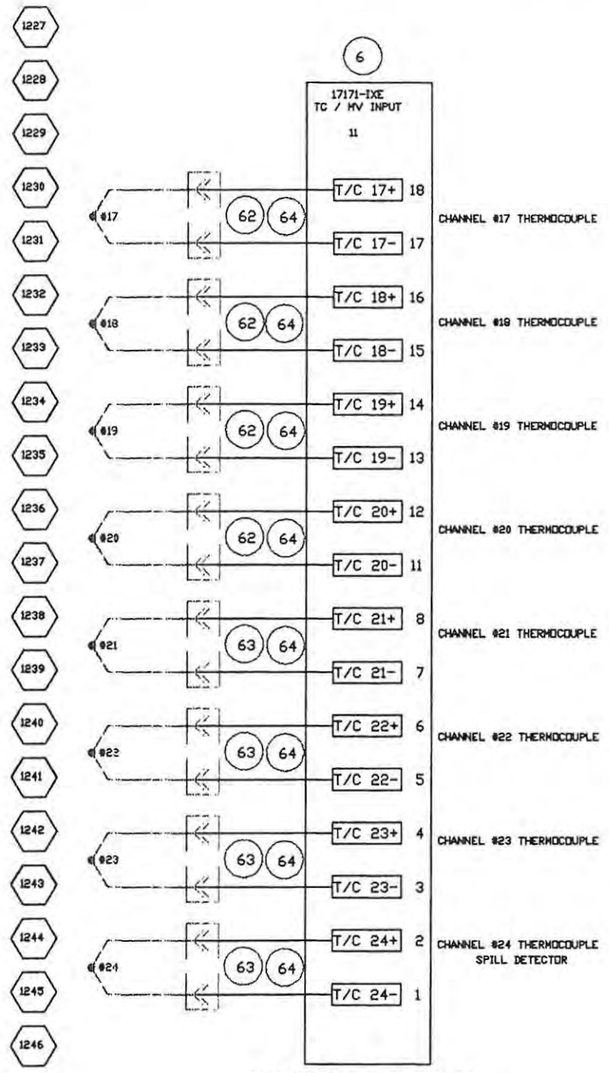
EMPIRE CASTINGS INC.
3195 REGIONAL PARKWAY SANTA ROSA, CA 95403

ELECTRICAL SCHEMATIC PAGE 11

EMPIRE WORK ORDER NO.	EMPIRE DRAWING NO.	
AAPM01	1800111	
NEXT ASSEMBLY NO. 1800112	CUSTOMER PART NO.	REV B
QTY: 1	SCALE: TO FIT	SHEET 11 OF 32



CHASSIS #1 SLOT 08



CHASSIS #1 SLOT 09

NOTES:

#1. CUSTOMER SUPPLIED TYPE "K" THERMOCOUPLE.

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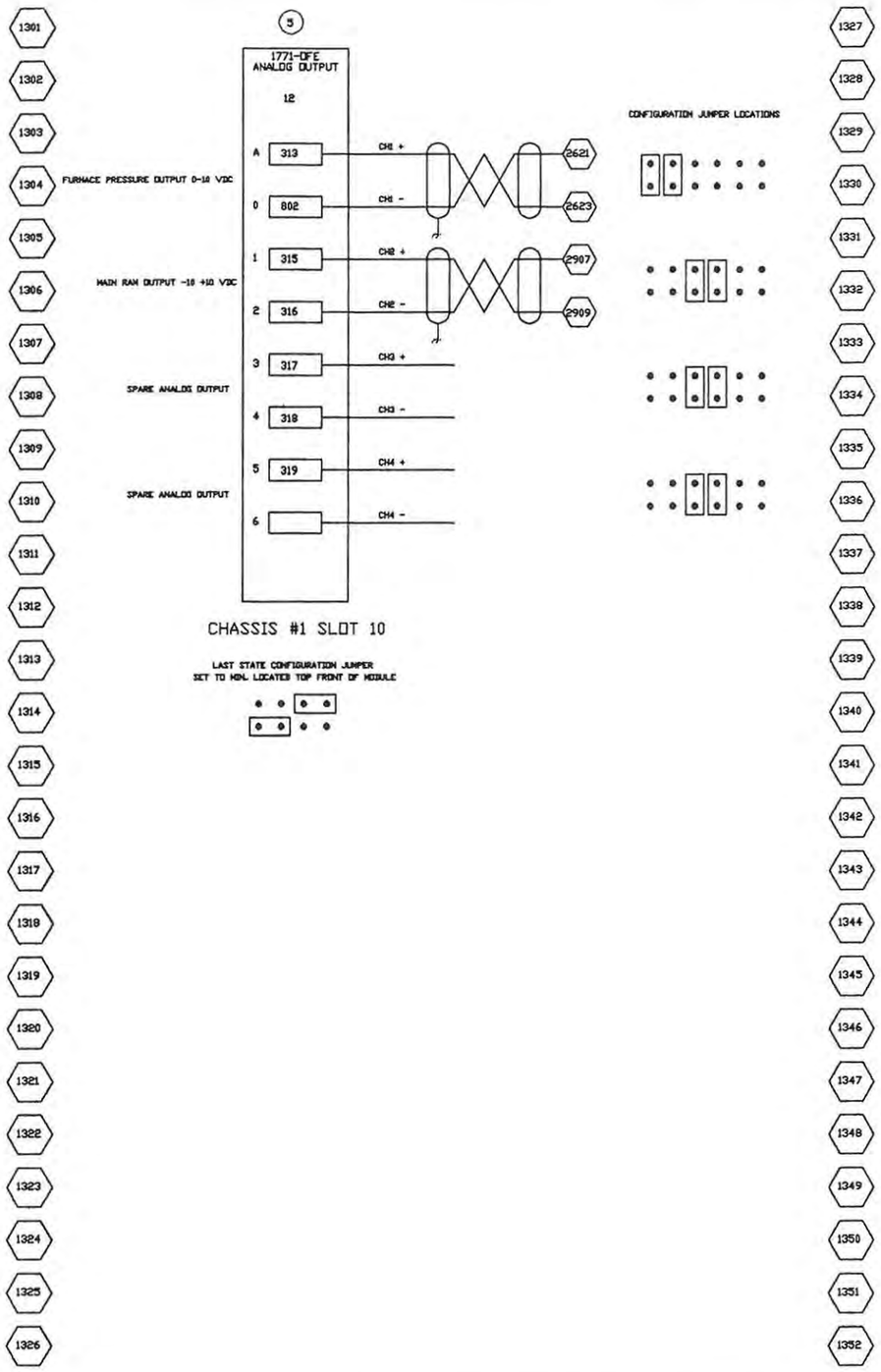
REVISIONS

APPROVALS	DATE
DRAWN BY: J. WATERS	8/27/96
DESIGNED BY: G. PEARN	12/06/96
APPROVED BY:	
ENGINEERING: V. HAWLEY	
MANUFACTURING: D. DINING	
CUSTOMER: AAP	
DO NOT SCALE DRAWING	

EMPIRE CASTINGS INC.
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ELECTRICAL SCHEMATIC PAGE 12

EMPIRE WORK ORDER NO.	EMPIRE DRAWING NO.
AAPM01	1800112
NEXT ASSEMBLY NO. 1800113	CUSTOMER PART NO.
REV A	
QTY: 1	SCALE: TO FIT
SHEET 1 OF 32	



CHASSIS #1 SLOT 10

LAST STATE CONFIGURATION JUMPER
SET TO NML LOCATED TOP FRONT OF MODULE

EMPTY SLOT

REV	DESCRIPTION	DATE	APP'D
–	ENGINEERING RELEASE		

REVISIONS

APPROVALS	DATE
DRAWN BY: J. WATERS	8/27/98
CHECKED BY: G. PEARN	12/08/98
APPROVED BY:	
ENGINEERING: V. HANLEY	
MANUFACTURING: D. DINING	
CUSTOMER: AAP	
DO NOT SCALE DRAWING	

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ELECTRICAL SCHEMATIC
PAGE 13

EMPIRE WORK ORDER NO.	EMPIRE DRAWING NO.	
AAPM01	1800113	
NEXT ASSEMBLY NO. 1800114	CUSTOMER PART NO.	REV A
QTY: 1	SCALE: TO FIT	SHEET 13 OF 38

1401
1402
1403 EMPTY SLOT
1404
1405
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1415
1416
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1424
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1427
1428
1429 EMPTY SLOT
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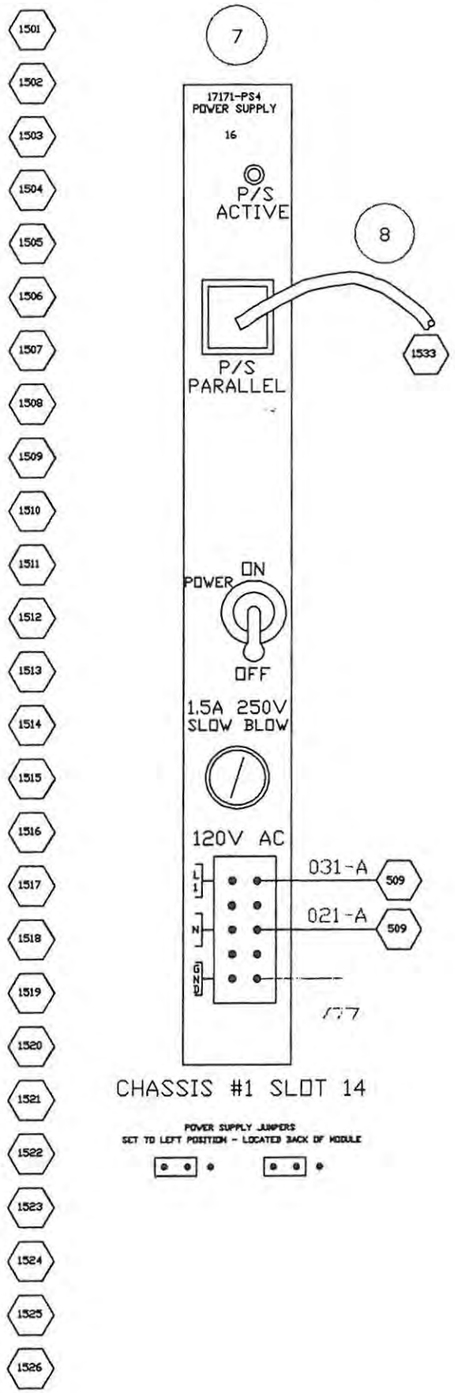
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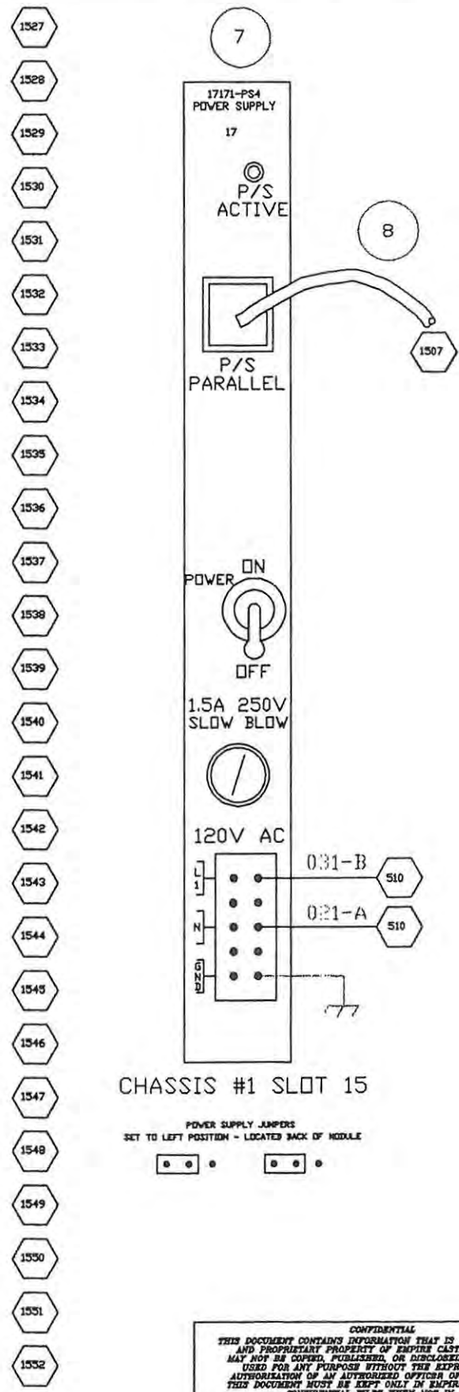
APPROVALS	DATE
DRAWN BY: J. WATERS	9/27/96
DESIGN BY: G. PEARN	12/06/96
APPROVED BY:	
ENGINEERING V. HAWLEY	
MANUFACTURING P. DINNG	
CUSTOMER AAP	
DO NOT SCALE DRAWING	

EMPIRE CASTINGS INC.
3195 REGIONAL PARKWAY SANTA ROSA, CA 95403

ELECTRICAL SCHEMATIC
PAGE 14

EMPIRE WORK ORDER NO.	EMPIRE DRAWING NO.	
AAPM01	1800114	
NEXT ASSEMBLY NO. 1800115	CUSTOMER PART NO.	REV A
QTY: 1	SCALE: TO FIT	SHEET 14 OF 32





REV	DESCRIPTION	DATE	APP'D
–	ENGINEERING RELEASE		

REVISIONS

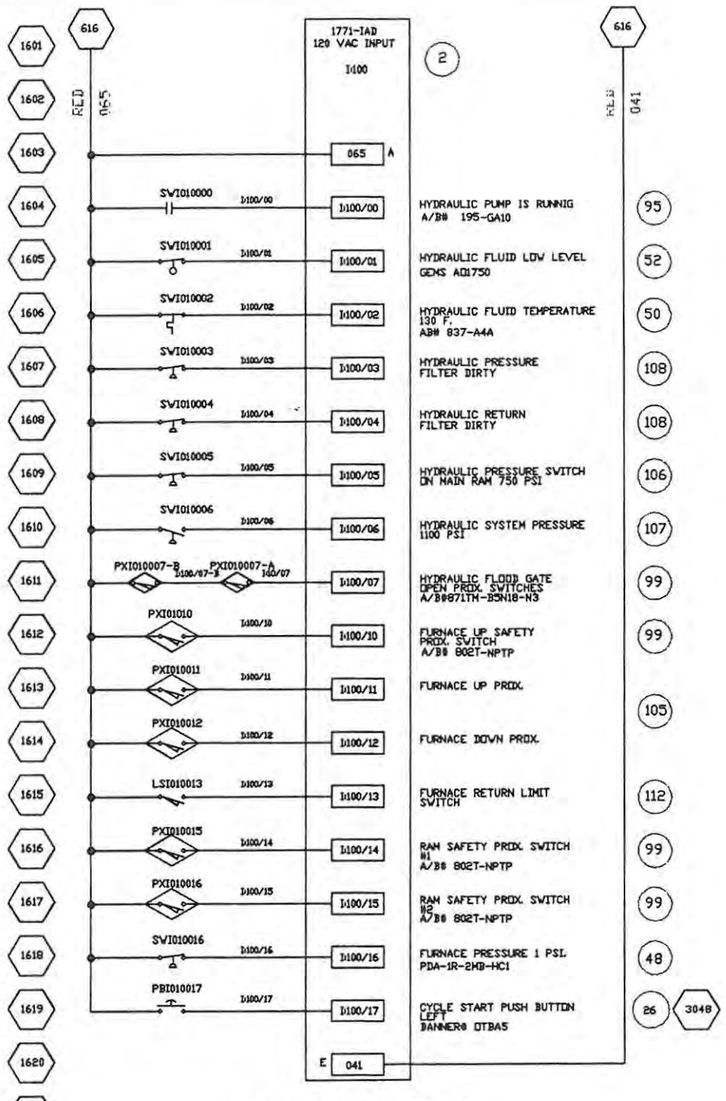
APPROVALS	DATE
DRAWN BY: J. WATERS	3/27/98
CHECKED BY: G. PEARN	12/08/98
APPROVED BY:	
ENGINEERING: V. HAWLEY	
MANUFACTURING: D. DINING	
CUSTOMER: AAP	
DO NOT SCALE DRAWING	

EMPIRE CASTINGS INC.
3195 REGIONAL PARKWAY SANTA ROSA, CA 95403

ELECTRICAL SCHEMATIC
PAGE 15

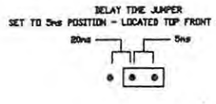
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AAPM01	1800115	
NEXT ASSEMBLY NO. 1800116	CUSTOMER PART NO.	REV A
QTY: 1	SCALE: TO FIT	SHEET 15OF 38

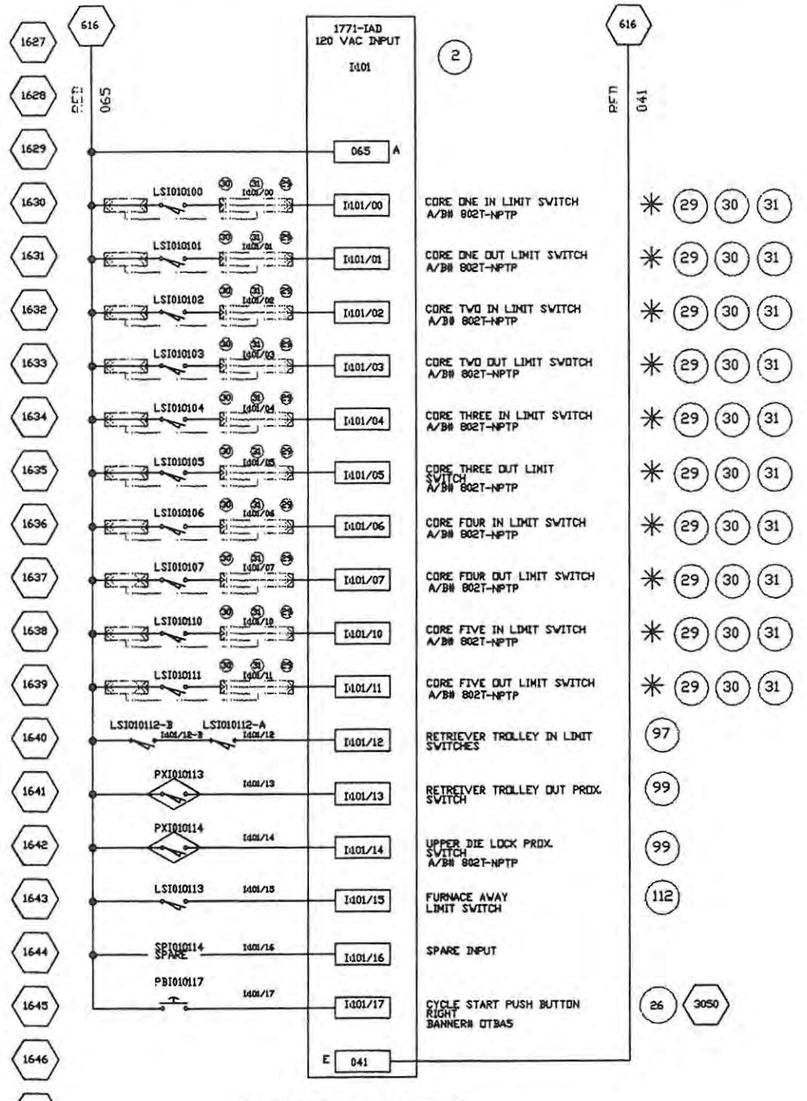
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CHASSIS #2 SLOT 00

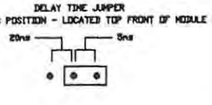
DELAY TIME JUMPER
SET TO 5ms POSITION - LOCATED TOP FRONT OF MODULE





CHASSIS #2 SLOT 01

DELAY TIME JUMPER
SET TO 5ms POSITION - LOCATED TOP FRONT OF MODULE



*CUSTOMER SUPPLIED LIMIT SWITCH

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REV	DESCRIPTION	DATE	APP'D
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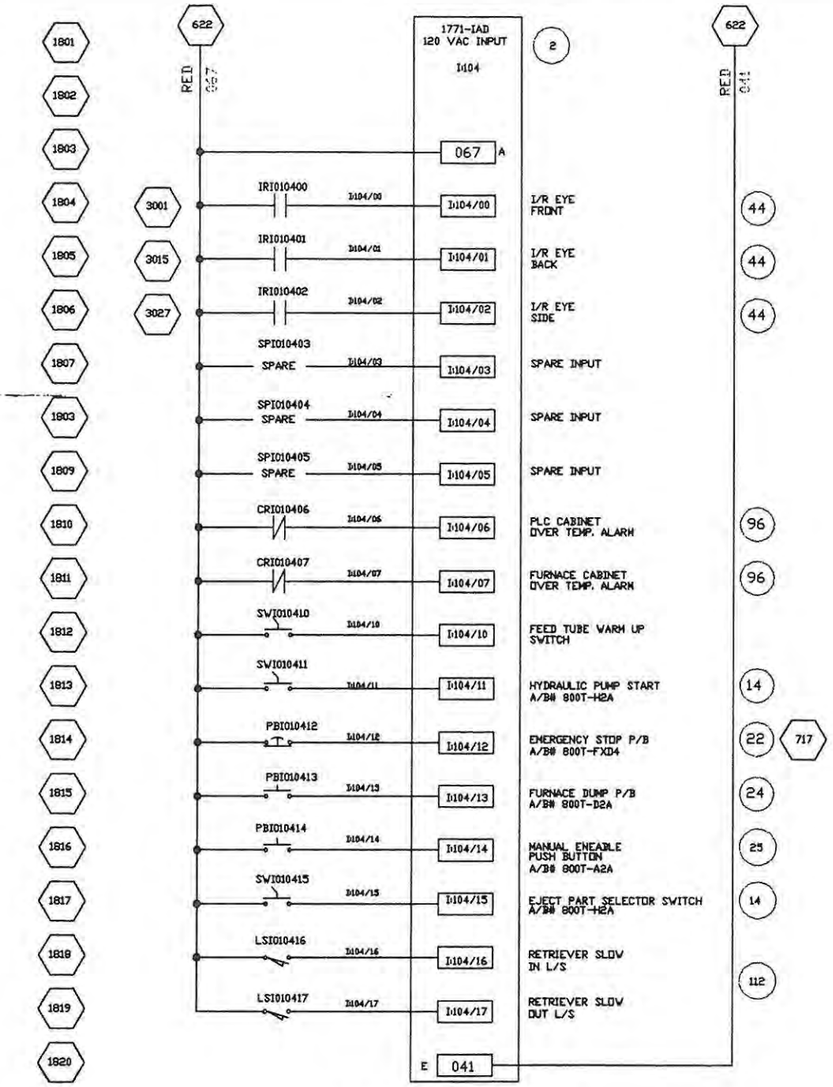
REVISIONS

APPROVALS	DATE
DRAWN BY: J. WATERS	9/27/96
CHECKED BY: G. PEARN	12/05/96
APPROVED BY:	
ENGINEERING: V. HAWLEY	
MANUFACTURING: D. DINING	
CUSTOMER: AAP	
DO NOT SCALE DRAWING	

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3195 REGIONAL PARKWAY SANTA ROSA, CA 95403

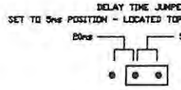
ELECTRICAL SCHEMATIC PAGE 16

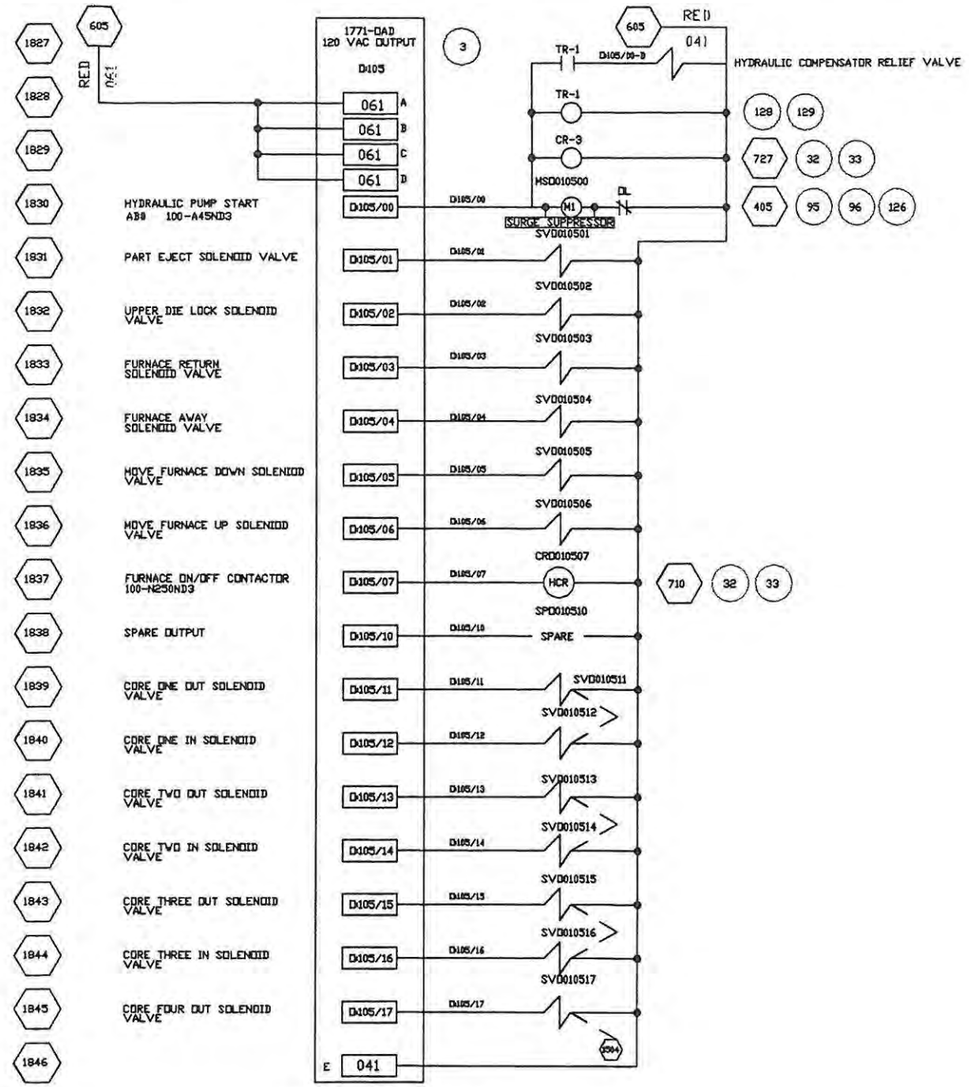
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AAPM01	1800116
NEXT ASSEMBLY NO.	CUSTOMER PART NO. / REV
1800117	B
QTY: 1	SCALE: TO FIT / SHEET 16OF 32



CHASSIS #2 SLOT 04

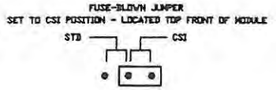
DELAY TIME JUMPER
SET TO 5ms POSITION - LOCATED TOP FRONT OF MODULE





CHASSIS #2 SLOT 05

FUSE-BLOWN JUMPER
SET TO CSI POSITION - LOCATED TOP FRONT OF MODULE



REV	DESCRIPTION	DATE	APP'D
–	ENGINEERING RELEASE		

REVISIONS

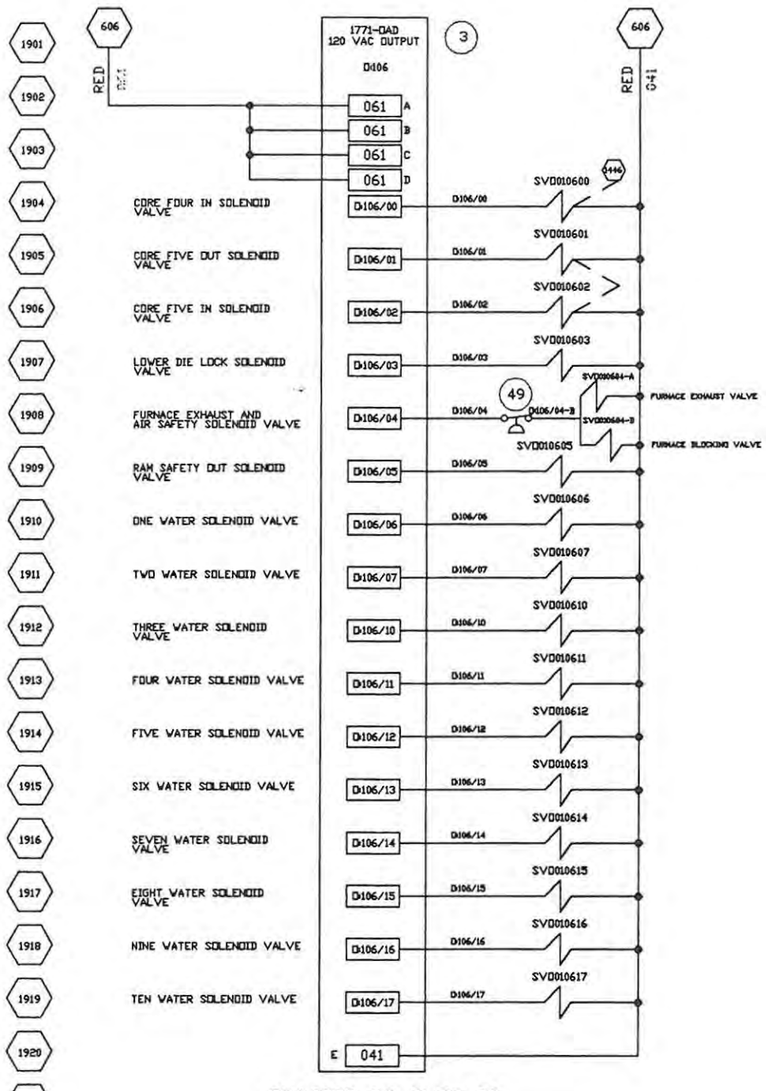
APPROVALS	DATE
DRAWN BY: J. WATERS	8/27/96
ENGINEERING: G. PEARN	12/06/96
APPROVED BY:	
ENGINEERING: V. HAWLEY	
MANUFACTURING: D. DINING	
CUSTOMER: AAP	
DO NOT SCALE DRAWING	

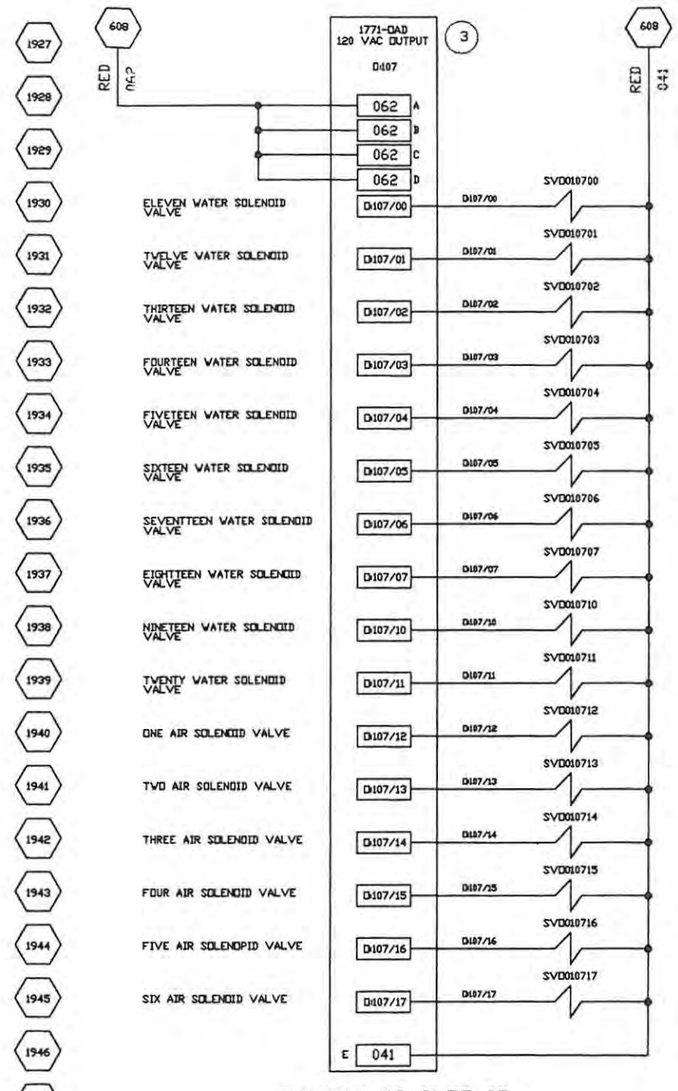
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ELECTRICAL SCHEMATIC PAGE 18

EMPIRE WORK ORDER NO.	EMPIRE DRAWING NO.	
AAPM01	1800118	
NEXT ASSEMBLY NO.	CUSTOMER PART NO.	REV
1800119		A
QTY: 1	SCALE: TO FIT	SHEET 18OF 32





REV	DESCRIPTION	DATE	APP'D
–	ENGINEERING RELEASE		

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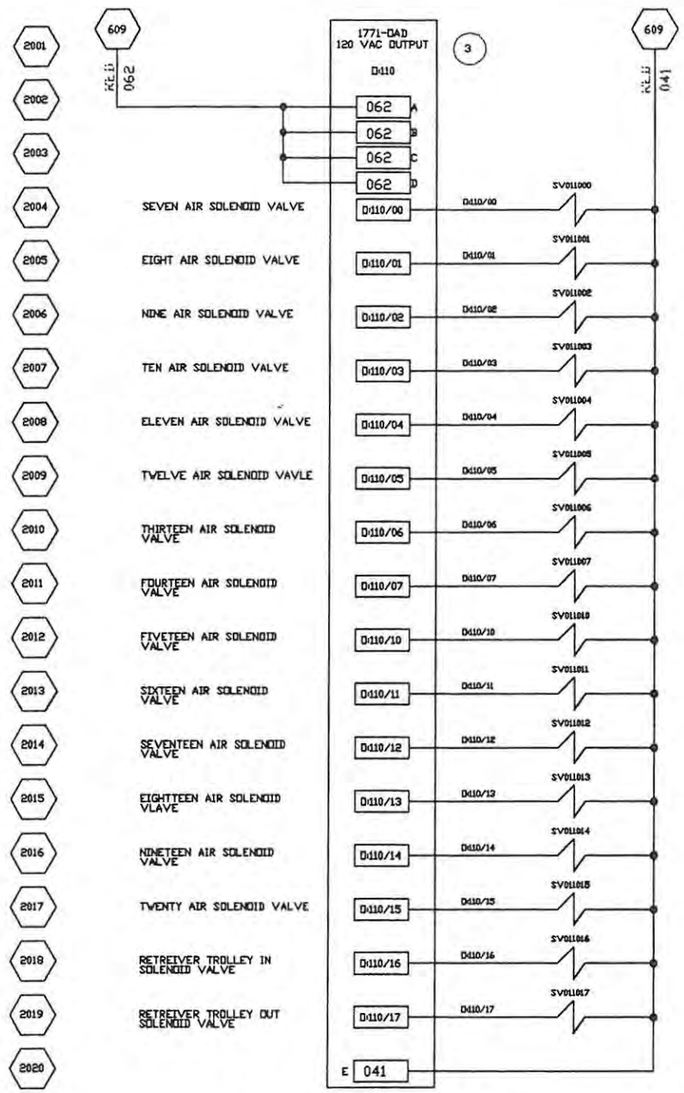
APPROVALS	DATE
DRAWN BY: J. WATERS	8/27/96
DESIGNED BY: G. PEARN	10/08/96
APPROVED BY:	
ENGINEERING: V. HAWLEY	
MANUFACTURING: P. DANG	
CUSTOMER: AAP	
DO NOT SCALE DRAWING	

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3195 REGIONAL PARKWAY SANTA ROSA, CA 95403

ELECTRICAL SCHEMATIC
PAGE 19

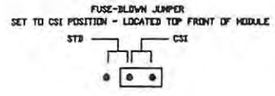
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AAPM01	1800119	
NEXT ASSEMBLY NO. 1800120	CUSTOMER PART NO.	REV A
QTY: 1	SCALE: TO FIT	SHEET 19 OF 32

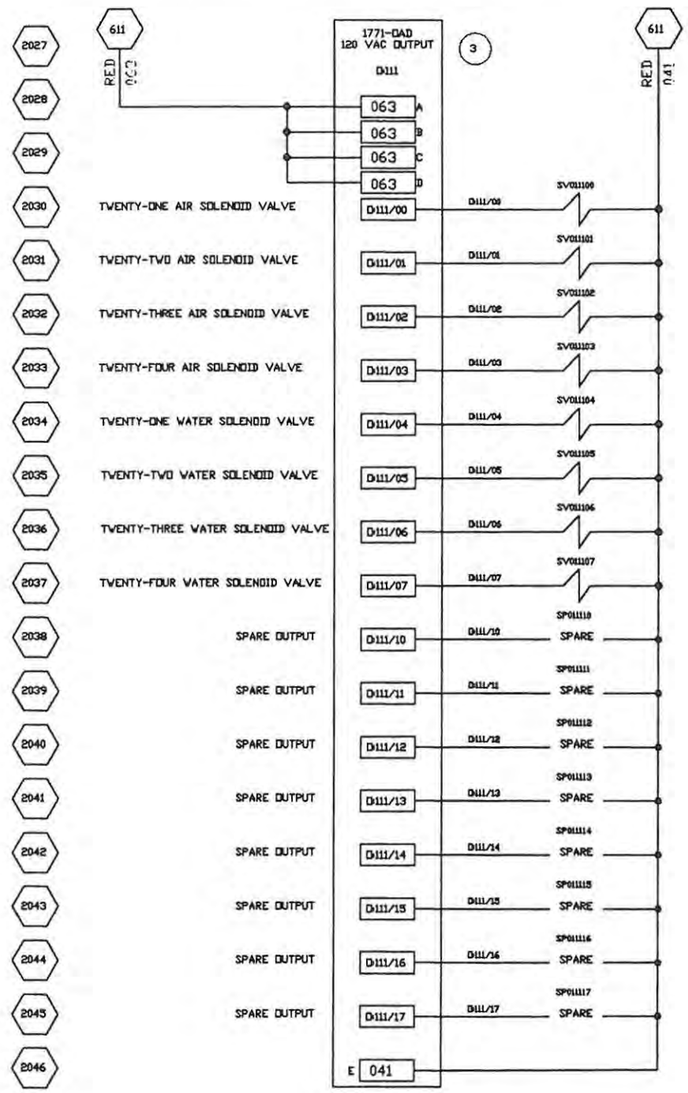
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CHASSIS #2 SLOT 08

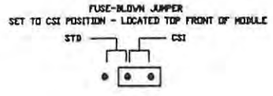
FUSE-BLOWN JUMPER
SET TO CSI POSITION - LOCATED TOP FRONT OF MODULE





CHASSIS #2 SLOT 09

FUSE-BLOWN JUMPER
SET TO CSI POSITION - LOCATED TOP FRONT OF MODULE



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APPROVALS	DATE
DRAWN BY: J. WATERS	9/27/00
CHECKED BY: G. PEARN	10/06/00
APPROVED BY:	
ENGINEERING: V. HAWLEY	
MANUFACTURING: D. DINING	
CUSTOMER: AAP	
DO NOT SCALE DRAWING	

EMPIRE CASTINGS INC.
3195 REGIONAL PARKWAY SANTA ROSA, CA 95403

ELECTRICAL SCHEMATIC PAGE 20

EMPIRE WORK ORDER NO.	EMPIRE DRAWING NO.
AAPM01	1800120
NEXT ASSEMBLY NO. 1800121	CUSTOMER PART NO.
QTY: 1	SCALE: TO FIT
REV A	SHEET 20OF 32

2101
2102
2103 EMPTY SLOT
2104
2105
2106
2107
2108
2109
2110
2111
2112
2113
2114
2115
2116
2117
2118
2119
2120
2121
2122
2123
2124
2125
2126

2127
2128
2129 EMPTY SLOT
2130
2131
2132
2133
2134
2135
2136
2137
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2140
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2152

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REVISIONS

APPROVALS	DATE
DRAWN BY: J. WATERS	5/27/98
CHECKED BY: G. PEARN	12/08/98
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ENGINEERING: V. HAWLEY	
MANUFACTURING: P. DINING	
CUSTOMER: AAP	
DO NOT SCALE DRAWING	

EMPIRE CASTINGS INC.
3195 REGIONAL PARKWAY SANTA ROSA, CA 95403

ELECTRICAL SCHEMATIC
PAGE 21

EMPIRE WORK ORDER NO.	EMPIRE DRAWING NO.	
AAPM01	1800121	
NEXT ASSEMBLY NO. 1800122	CUSTOMER PART NO.	REV A
QTY: 1	SCALE: TO FIT	SHEET 21 OF 32

2201
2202
2203 EMPTY SLOT
2204
2205
2206
2207
2208
2209
2210
2211
2212
2213
2214
2215
2216
2217
2218
2219
2220
2221
2222
2223
2224
2225
2226

2227
2228
2229 EMPTY SLOT
2230
2231
2232
2233
2234
2235
2236
2237
2238
2239
2240
2241
2242
2243
2244
2245
2246
2247
2248
2249
2250
2251
2252

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–	ENGINEERING RELEASE		

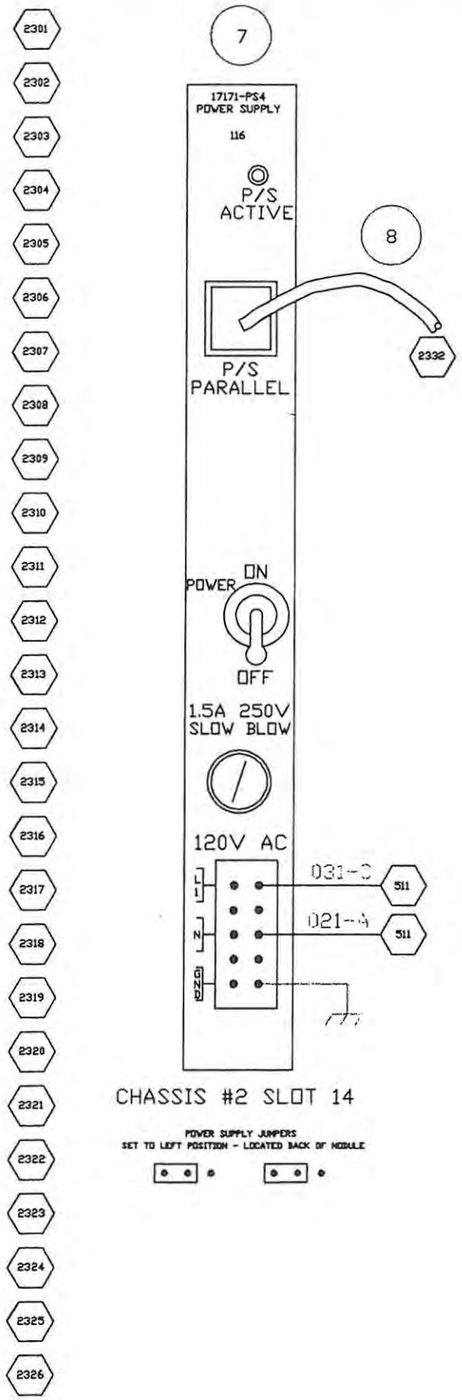
REVISIONS

APPROVALS	DATE
DRAWN BY: J. WATERS	3/27/96
CHECKED BY: A. PEARN	12/05/95
APPROVED BY:	
ENGINEERING: V. HAWLEY	
MANUFACTURING: D. DINING	
CUSTOMER: AAP	
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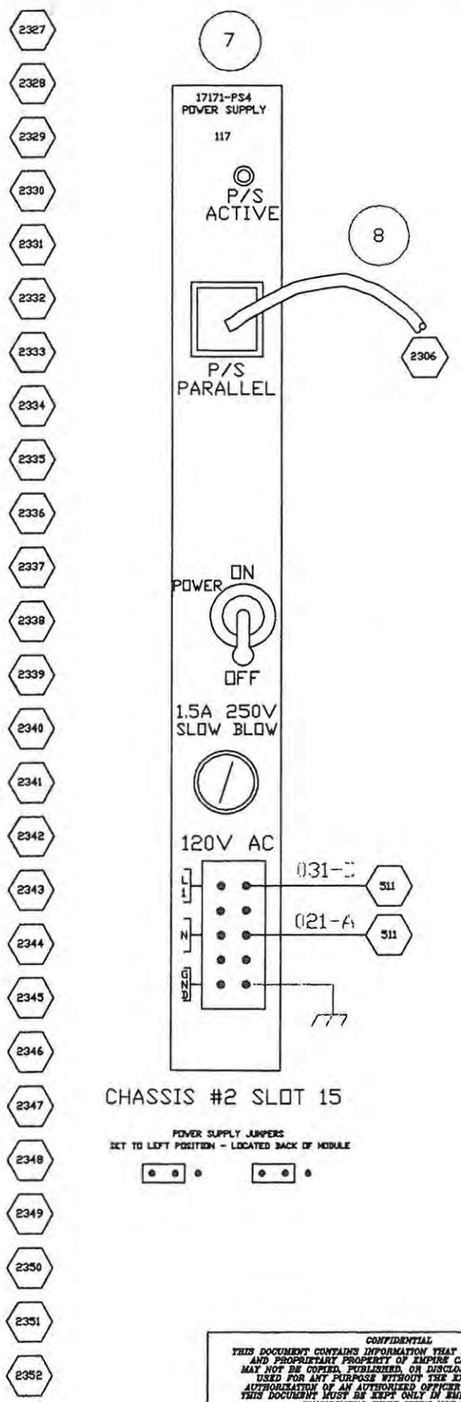
ELECTRICAL SCHEMATIC PAGE 22

EMPIRE WORK ORDER NO. AAPM01	EMPIRE DRAWING NO. 1800122
NEXT ASSEMBLY NO. 1800123	CUSTOMER PART NO. REV A
QTY: 1	SCALE: TO FIT



CHASSIS #2 SLOT 14

POWER SUPPLY JUMPERS
SET TO LEFT POSITION - LOCATED BACK OF MODULE



CHASSIS #2 SLOT 15

POWER SUPPLY JUMPERS
SET TO LEFT POSITION - LOCATED BACK OF MODULE

REV	DESCRIPTION	DATE	APP'D
–	ENGINEERING RELEASE		

REVISIONS

APPROVALS	DATE
DRAWN BY: J. WATERS	9/27/96
CHECKED BY: G. PEARN	10/08/96
APPROVED BY:	
ENGINEERING: V. HAWLEY	
MANUFACTURING: D. DINING	
CUSTOMER: AAP	
DO NOT SCALE DRAWING	

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ELECTRICAL SCHEMATIC
PAGE 23

EMPIRE WORK ORDER NO.	EMPIRE DRAWING NO.	
AAPM01	1800123	
NEXT ASSEMBLY NO.	CUSTOMER PART NO.	REV
1800124		A
QTY: 1	SCALE: TO FIT	SHEET 23 OF 33

PLC BACKPLANE SWITCH

POWER SUPPLY IN CHASSIS
SET TO YES

YES NO

SW1

SW2

1

PLC 5/40

BATT
PROC
FORCE
COMM
PROG
RUN

CH2
CH0
CH1

PLC-5/40
PROGRAMMABLE
CONTROLLER

D M Y

MMI
DATA HIGHWAY PLUG

BLUE
SHIELD
CLEAR

CLEAR
SHIELD
BLUE

BLUE
SHIELD
CLEAR

116

67

68

ASB BACKPLANE SWITCH

67
PANELVIEW

BLUE
SHIELD
CLEAR

10

BLUE
SHIELD
CLEAR
BLUE
SHIELD
CLEAR

1	LINE 1
2	SHIELD
3	LINE 2
4	LINE 1
5	SHIELD
6	LINE 2
7	NO CONNECTION
8	NO CONNECTION
9	NO CONNECTION
10	NO CONNECTION
11	NO CONNECTION
12	NO CONNECTION

1771-ASB

SW1

SW2

LEGEND

OFF ON
Pressed in
at top ON (closed)

OFF ON
Pressed in
at bottom OFF (open)

REV	DESCRIPTION	DATE	APP'D
–	ENGINEERING RELEASE		

REVISIONS

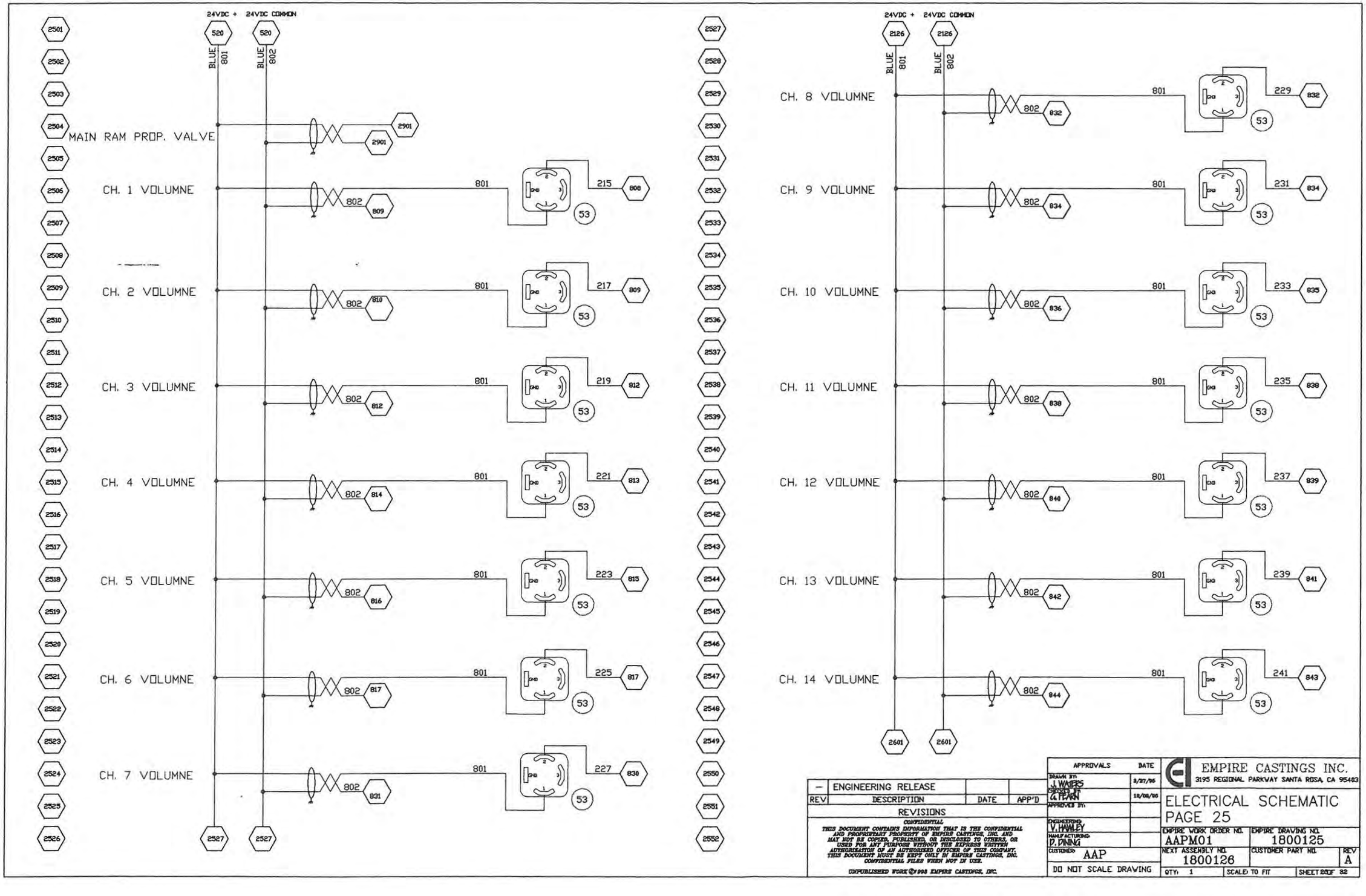
APPROVALS	DATE
DRAWN BY: J. WATERS	5/27/96
DESIGNED BY: G. FEARN	12/08/96
APPROVED BY:	
ENGINEERING: V. HAWLEY	
MANUFACTURING: D. DINING	
CUSTOMER: AAP	
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ELECTRICAL SCHEMATIC
PAGE 24

EMPIRE WORK ORDER NO.	EMPIRE DRAWING NO.
AAPM01	1800124
NEXT ASSEMBLY NO. 1800125	CUSTOMER PART NO.
QTY: 1	SCALE: TO FIT
SHEET 24 OF 32	REV A



REV	DESCRIPTION	DATE	APP'D
–	ENGINEERING RELEASE		

REVISIONS

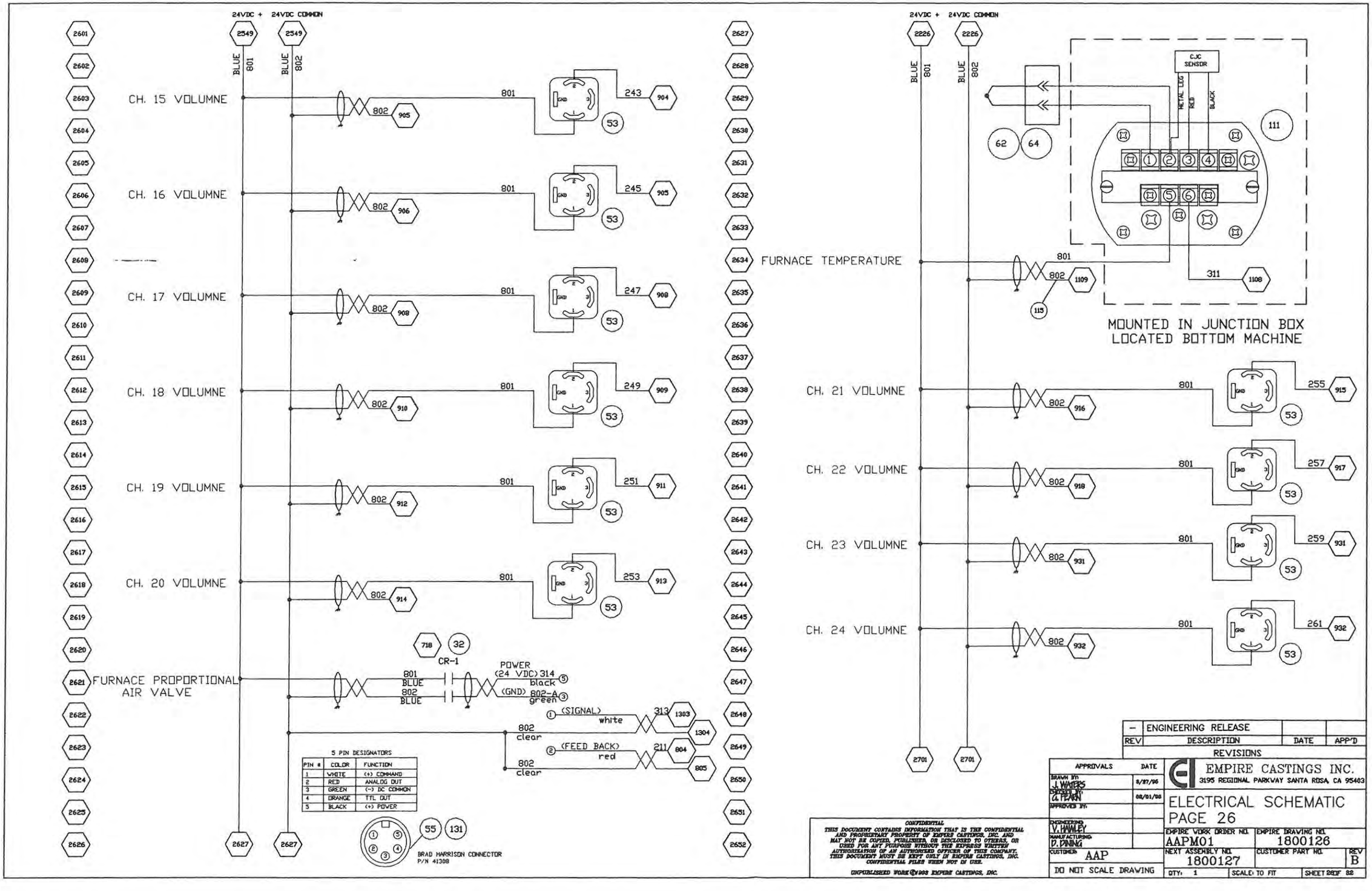
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DRAWN BY: J. WATERS	3/27/96
CHECKED BY: G. FEARN	12/08/96
APPROVED BY:	
ENGINEERING: V. HAWLEY	
MANUFACTURING: D. DINING	
CUSTOMER: AAP	
DO NOT SCALE DRAWING	

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ELECTRICAL SCHEMATIC PAGE 25

EMPIRE WORK ORDER NO.	EMPIRE DRAWING NO.	
AAPM01	1800125	
NEXT ASSEMBLY NO. 1800126	CUSTOMER PART NO.	REV A
QTY: 1	SCALED TO FIT	SHEET 20 OF 32



REV	DESCRIPTION	DATE	APP'D
–	ENGINEERING RELEASE		

REVISIONS

APPROVALS	DATE
DRAWN BY: J. WATERS	8/27/96
ENGINEERING: A. PEARN	08/01/96
APPROVED BY:	
ENGINEERING: V. HAWLEY	
MANUFACTURING: D. DINING	
CUSTOMER: AAP	
DO NOT SCALE DRAWING	

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ELECTRICAL SCHEMATIC
PAGE 26

EMPIRE WORK ORDER NO.	EMPIRE DRAWING NO.
AAPM01	1800126
NEXT ASSEMBLY NO. 1800127	CUSTOMER PART NO. REV B
QTY: 1	SCALE: TO FIT SHEET 26OF 82

2701 2702 2703 2704 2705 2706 2707 2708 2709 2710 2711 2712 2713 2714 2715 2716 2717 2718 2719 2720 2721 2722 2723 2724 2725 2726

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2727 2728 2729 2730 2731 2732 2733 2734 2735 2736 2737 2738 2739 2740 2741 2742 2743 2744 2745 2746 2747 2748 2749 2750 2751 2752

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REV	DESCRIPTION	DATE	APP'D
–	ENGINEERING RELEASE		

REVISIONS

APPROVALS	DATE
DRAWN BY: J. WATERS	8/27/98
CHECKED BY: G. PEARN	10/06/98
APPROVED BY:	
ENGINEERING: V. HAWLEY	
MANUFACTURING: D. DINING	
CUSTOMER: AAP	

DO NOT SCALE DRAWING

EMPIRE CASTINGS INC.
3195 REGIONAL PARKWAY SANTA ROSA, CA 95403

ELECTRICAL SCHEMATIC
PAGE 27

EMPIRE WORK ORDER NO.	EMPIRE DRAWING NO.	
AAPM01	1800127	
NEXT ASSEMBLY NO.	CUSTOMER PART NO.	REV
1800128		A
QTY: 1	SCALE: TO FIT	SHEET 28 OF 32

2801 2802 2803 2804 2805 2806 2807 2808 2809 2810 2811 2812 2813 2814 2815 2816 2817 2818 2819 2820 2821 2822 2823 2824 2825 2826

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–	ENGINEERING RELEASE		

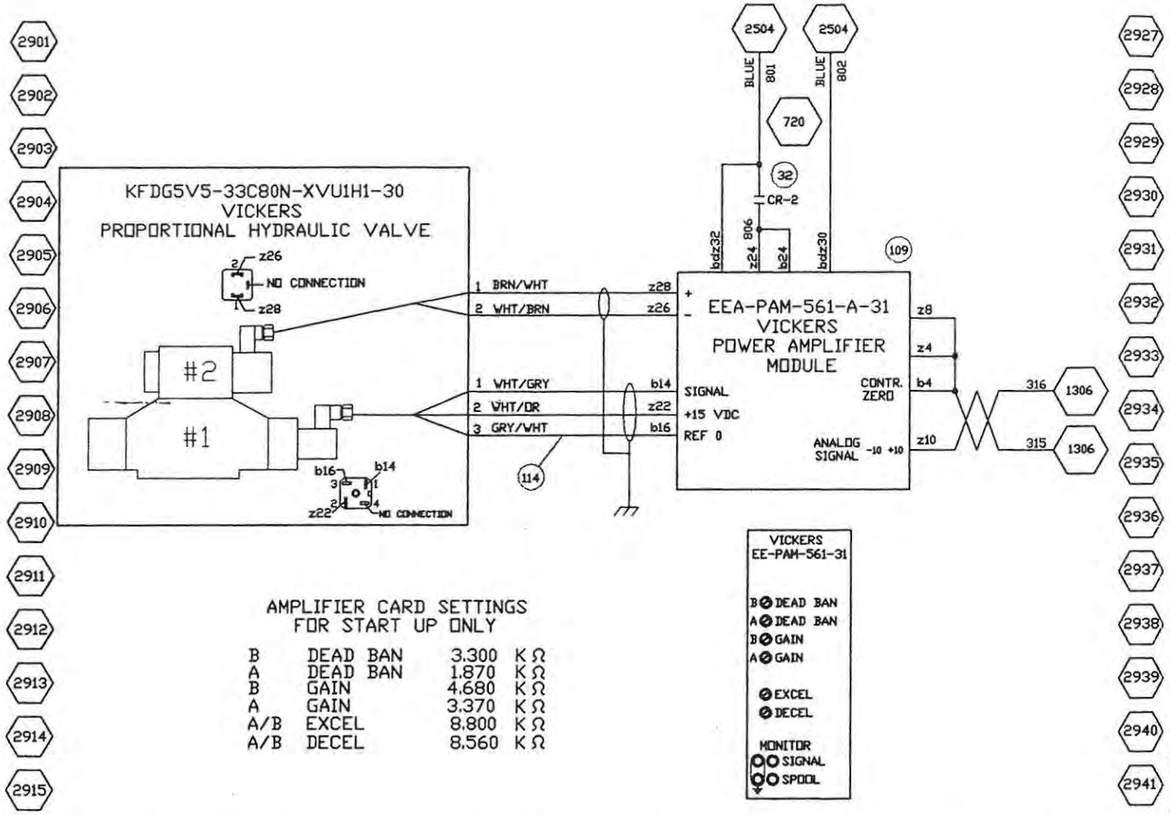
REVISIONS

APPROVALS	DATE
DRAWN BY: J. WATERS	5/27/98
CHECKED BY: G. PEARSON	12/08/95
APPROVED BY:	
ENGINEERING: V. HAWLEY	
MANUFACTURING: P. DINING	
CUSTOMER: AAP	
DO NOT SCALE DRAWING	

EMPIRE CASTINGS INC.
3195 REGIONAL PARKWAY SANTA ROSA, CA 95403

ELECTRICAL SCHEMATIC
PAGE 28

EMPIRE WORK ORDER NO.	EMPIRE DRAWING NO.	
AAPM01	1800128	
NEXT ASSEMBLY NO. 1800129	CUSTOMER PART NO.	REV A
QTY: 1	SCALE: TO FIT	SHEET 28OF 32



AMPLIFIER CARD SETTINGS
FOR START UP ONLY

B	DEAD BAN	3.300	KΩ
A	DEAD BAN	1.870	KΩ
B	GAIN	4.680	KΩ
A	GAIN	3.370	KΩ
A/B	EXCEL	8.800	KΩ
A/B	DECEL	8.560	KΩ

GAIN ADJUSTMENT: Set casting machine to Manual Mode. Use a digital volt meter, set to DC volts, monitor spool position.

1. Moving ram at full speed, +100 & −100 output signal, up and down adjust (A & B) gain aprox. +9.5 & −9.5 VDC. + voltage is ram up and − voltage is ram down. (B) gain is for ram down and (A) gain is for ram up.
2. Purpose is to use minumin adjustment to valving for ram maxumin speed up and down.

DEAD BAN AJUSTMENT: Set casting machine to Jog Mode.

1. Moving ram in Jog Mode, +25 & −25 output signal, up and down. Adjust (A) dead ban so that ram speed up is 10 seconds to travel 12 inches. Adjust (B) dead ban so that ram speed down is 15 seconds to travel 12 inches.
2. Purpose is to provide a standard in casting machine slower speeds.

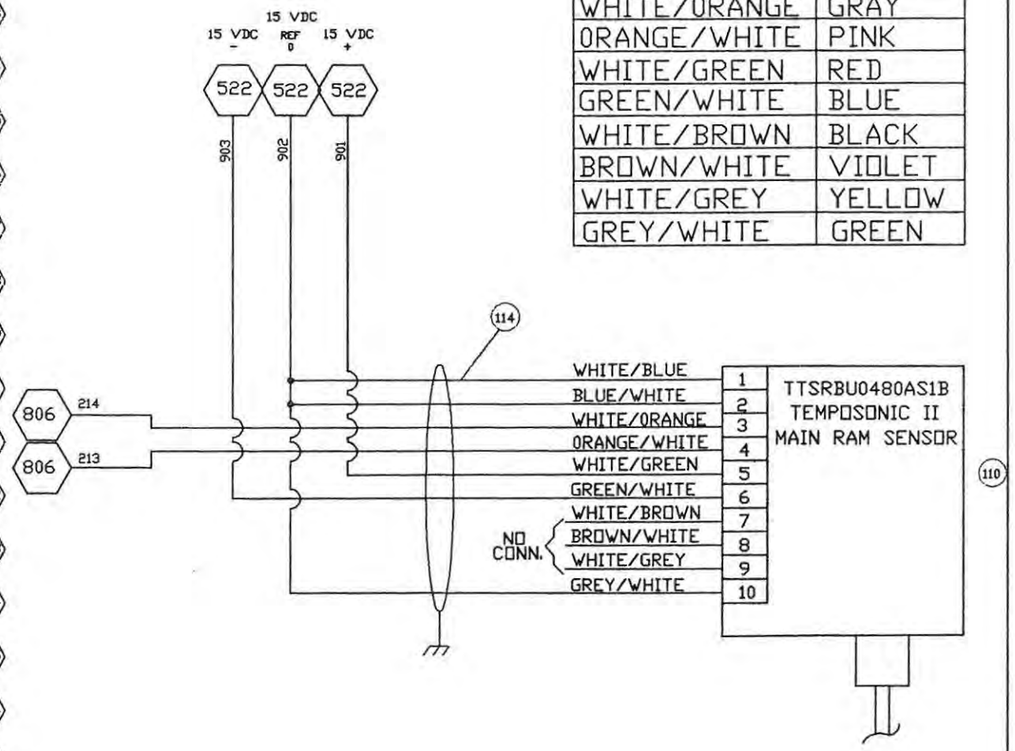
EXCEL ADJUSTMENT: Set casting machine to Manual Mode.

1. Start and stop ram moving up and down. Adjust excel clockwise to soften ram moving up or down when ram starts moving.
2. Purpose is to eliminate jerging movements when ram starts moving.

DECEL ADJUSTMENT: Set casting machine to Manual Mode.

1. Start and stop ram moving up and down. Adjust decel clockwise to soften ram moving up or down when ram stops moving.
2. Purpose is to eliminate jerging movements when ram stops moving.

WIRE COLOR CROSS REFERENCE	
WHITE/BLUE	WHITE
BLUE/WHITE	BROWN
WHITE/ORANGE	GRAY
ORANGE/WHITE	PINK
WHITE/GREEN	RED
GREEN/WHITE	BLUE
WHITE/BROWN	BLACK
BROWN/WHITE	VIOLET
WHITE/GREY	YELLOW
GREY/WHITE	GREEN



REV	DESCRIPTION	DATE	APP'D
–	ENGINEERING RELEASE		

REVISIONS

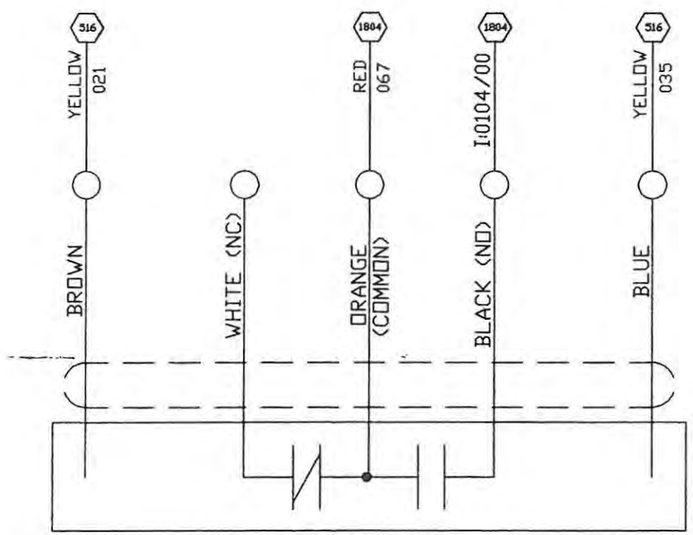
APPROVALS	DATE
DRAWN BY: J. WATERS	8/27/98
CHECKED BY: G. PEARN	08/01/98
APPROVED BY:	
ENGINEERING: V. HAWLEY	
MANUFACTURING: D. DINING	
CUSTOMER: AAP	
DO NOT SCALE DRAWING	

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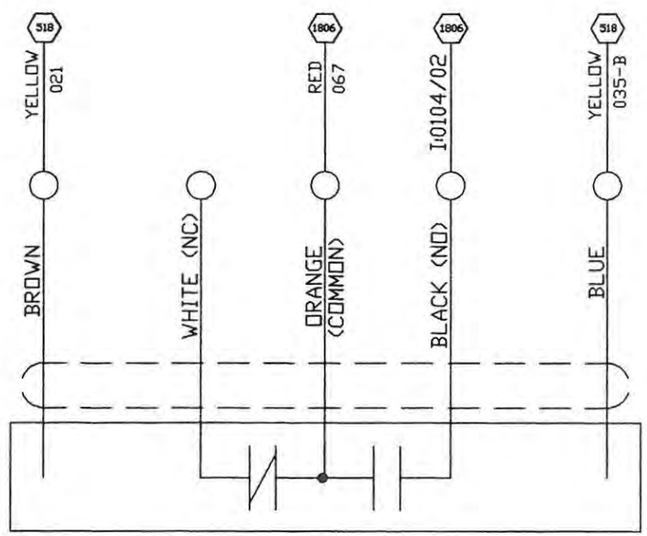
EMPIRE CASTINGS INC.
3195 REGIONAL PARKWAY SANTA ROSA, CA 95403

ELECTRICAL SCHEMATIC
PAGE 29

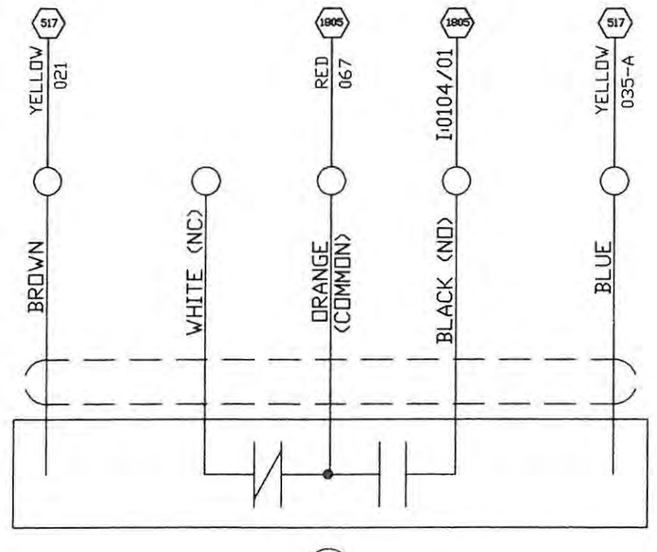
EMPIRE WORK ORDER NO.	EMPIRE DRAWING NO.	
AAPM01	1800129	
NEXT ASSEMBLY NO. 1800129	CUSTOMER PART NO.	REV B
QTY: 1	SCALE: TO FIT	SHEET 29OF 32



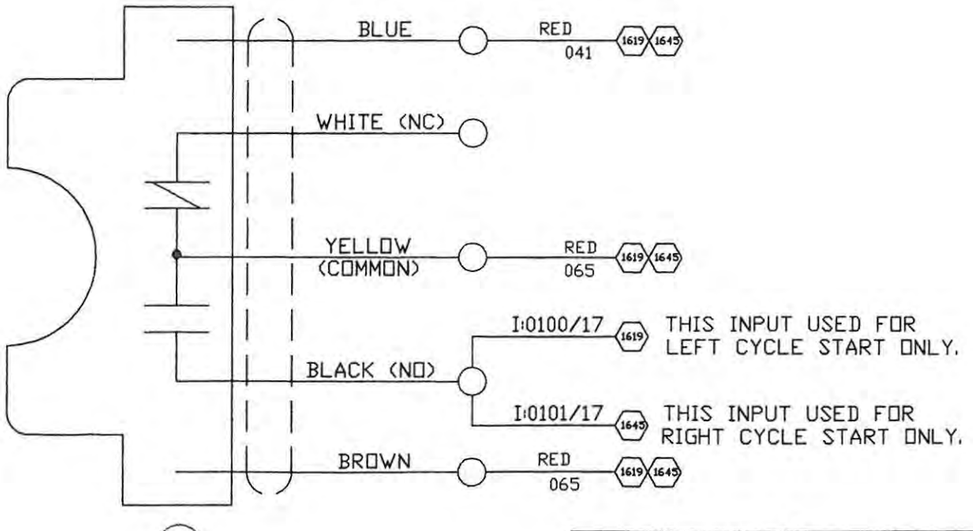
44
I/R EYE FRONT



44
I/R EYE SIDE



44
I/R EYE BACK



26
OPTO-TOUCH CYCLE START

REV	DESCRIPTION	DATE	APP'D
–	ENGINEERING RELEASE		

REVISIONS

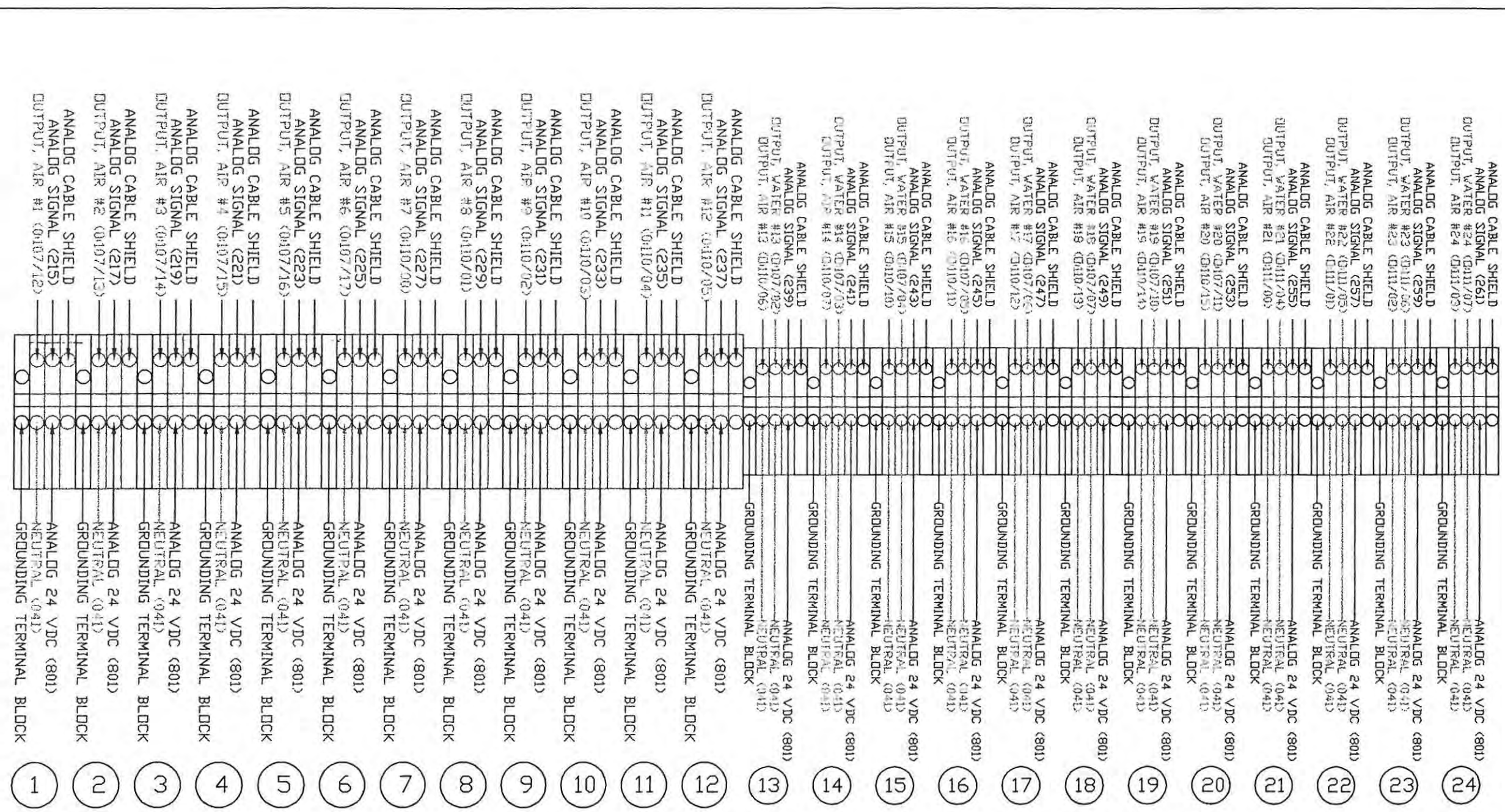
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APPROVALS	DATE
DRAWN BY: J. WATERS	8/27/06
ENGINEERING: C. TEXAN	12/08/06
APPROVED BY:	
ENGINEERING: V. HAWLEY	
MANUFACTURING: D. DINING	
CUSTOMER: AAP	
DO NOT SCALE DRAWING	

EMPIRE CASTINGS INC.
3195 REGIONAL PARKWAY SANTA ROSA, CA 95403

ELECTRICAL SCHEMATIC PAGE 30

EMPIRE WORK ORDER NO.	EMPIRE DRAWING NO.	
AAPM01	1800130	
NEXT ASSEMBLY NO. 1800131	CUSTOMER PART NO.	REV A
QTY: 1	SCALE: TO FIT	SHEET 30 OF 32



NOTE: CENTER IN WIRING BOX

–	ENGINEERING RELEASE		
REV	DESCRIPTION	DATE	APP'D

REVISIONS

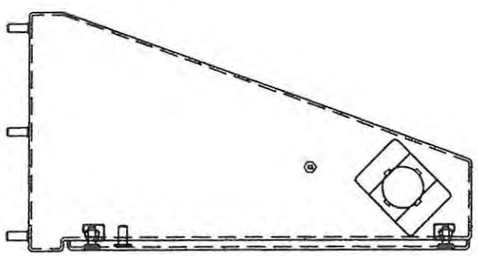
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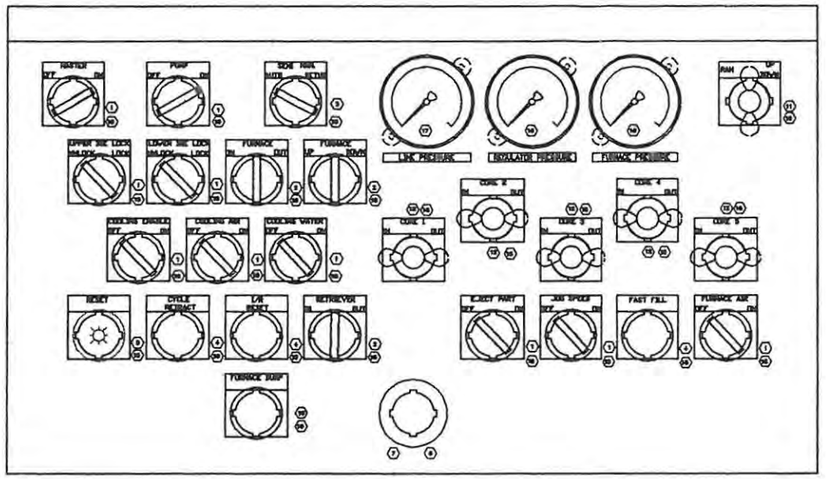
APPROVALS		DATE
DRAWN BY	JIM WATERS	
CHECKED BY	G. PEARN	12/08/95
APPROVED BY		
ENGINEERING	V. HAWLEY	
MANUFACTURING	D. DINING	
CUSTOMER	AAP	
DO NOT SCALE DRAWING		

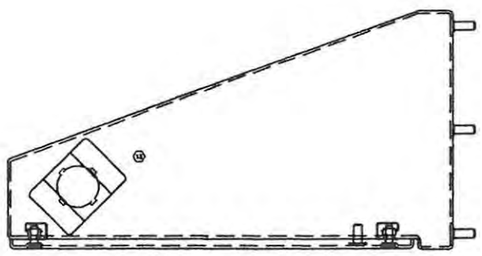
EMPIRE CASTINGS INC.
3195 REGIONAL PARKWAY, SANTA ROSA, CA 95403

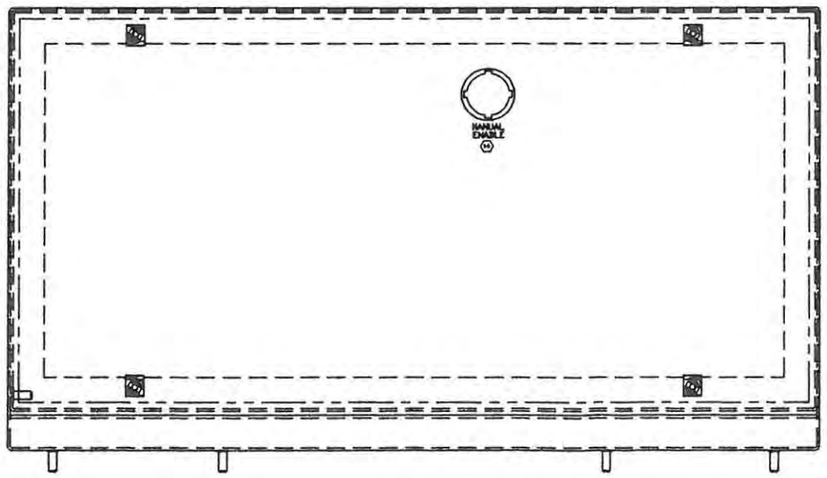
COOLING PANEL
WIRING TOP BOX

EMPIRE WORK ORDER NO.	EMPIRE DRAWING NO.	REV
AAPM01	1800131	A
QTY 1/MACH	SCALE NONE	SHEET 31 of 32









ITEM	DESCRIPTION	QTY.	ECI P/N	MANUFACTURER P/N	MANUFACTURER
18	LEGEND	25	XXXXXXXX	800T-X56a	ALLEN BRADLEY
17	GAUGE 0-150 PSI	1	XXXXXXXX	LHZ-150-2SRC-UC	LENZ
16	GAUGE 0-60 PSI	1	XXXXXXXX	LHZ-60-2SRC-UC	LENZ
15	GAUGE 0-30 PSI	1	XXXXXXXX	LHZ-30-2SRC-UC	LENZ
14	PUSH BUTTON	1	XXXXXXXX	800T-A2A	ALLEN BRADLEY
13	OPTO TOUCH SWITCH	2	XXXXXXXX	OTBA5	BANNER
12	JOYSTICK	5	XXXXXXXX	800T-T2F3DDXX	ALLEN BRADLEY
11	JOYSTICK	1	XXXXXXXX	800T-T2H3EEXX	ALLEN BRADLEY
10	PUSH BUTTON	1	XXXXXXXX	800T-D2A	ALLEN BRADLEY
9	XXXXXXXXXXXXXX	0	XXXXXXXX	XXXXXXXXXXXX	XXXXXXXXXX
8	2 POS. PUSH/PULL	1	XXXXXXXX	800T-FXD4	ALLEN BRADLEY
7	E-STOP CAP	1	XXXXXXXX	800T-N209RE1	ALLEN BRADLEY
6	XXXXXXXXXXXXXX	0	XXXXXXXX	XXXXXXXXXXXX	XXXXXXXXXX
5	ILLUM. PUSH BUTTON	1	XXXXXXXX	800T-PB16A	ALLEN BRADLEY
4	PUSH BUTTON	3	XXXXXXXX	800T-A3A	ALLEN BRADLEY
3	4 POSITION SWITCH	1	XXXXXXXX	800T-K2KF4B	ALLEN BRADLEY
2	3 POSITION SWITCH	3	XXXXXXXX	800T-J91A	ALLEN BRADLEY
1	2 POSITION SWITCH	9	XXXXXXXX	800T-H2A	ALLEN BRADLEY

PARTS LIST

REV	DESCRIPTION	DATE	APP'D
–	ENGINEERING RELEASE		

REVISIONS

APPROVALS	DATE
ISSUED BY: J. WATERS	12/4/98
CHECKED BY: J. WATERS	
APPROVED BY:	
ENGINEERING	
MANUFACTURING: D. DINING	
CUSTOMER: AAP St. Marys	

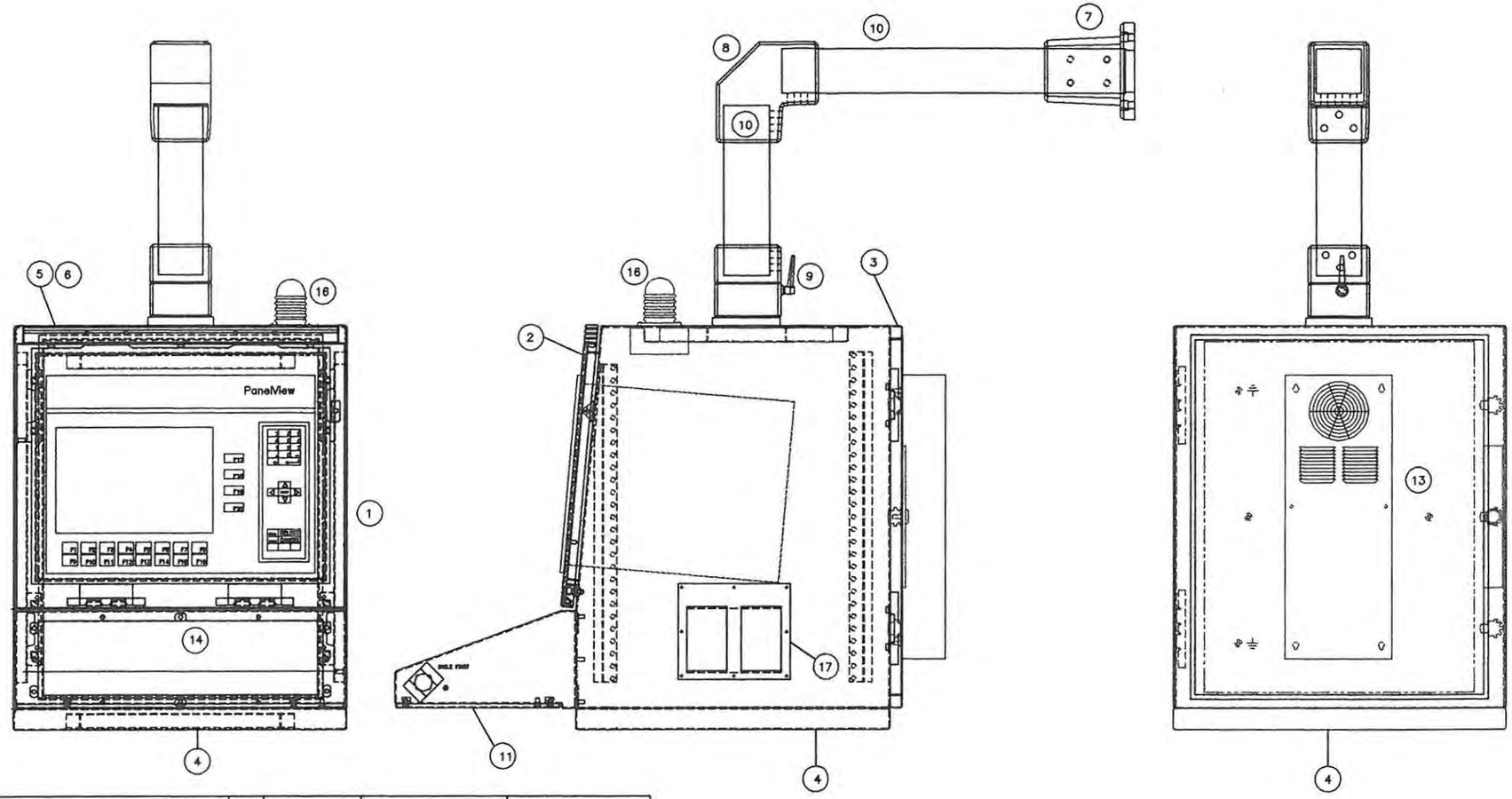
DO NOT SCALE DRAWING

EMPIRE CASTINGS INC.
3195 REGIONAL PARKWAY SANTA ROSA, CA 95403

OPERATOR PANEL
PUSH BUTTON

EMPIRE WORK ORDER NO.	EMPIRE DRAWING NO.	
AAPM01	1800202	
NEXT ASSEMBLY NO. 1800203	CUSTOMER PART NO.	REV –
QTY: 1	SCALED TO FIT	SHEET 8 OF 8

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ITEM	DESCRIPTION	QTY.	ECI P/N	MANUFACTURER P/N	MANUFACTURER
17	DH+/PanelView Connection	1	XXXXXXXX	xxxx	Weco Products
16	STROBELIGHT, RED	1	XXXXXXXX	5899T14	MCMASTER-CARR
15	REMOTE RS-232	1	XXXXXXXX	2711-NC2	ALLEN BRADLEY
14	KEYPAD PANELVIEW	1	XXXXXXXX	2711-KC1	ALLEN BRADLEY
13	HEAT EXCHANGER	1	XXXXXXXX	XR-2016-101	HOFFMAN
12	HANDLE FOR SLOPED TOP	1	XXXXXXXX	X-UHK	HOFFMAN
11	20" CONTROL COMPARTMENT	1	XXXXXXXX	X-C20A6	HOFFMAN
10	TUBE 80X80X200mm 1● 12.00" , 1● 24.00"	1	XXXXXXXX	C-CS8T20	HOFFMAN
9	FLANGE COUPLING	1	XXXXXXXX	C-CS8FC	HOFFMAN
8	ELBOW	1	XXXXXXXX	C-CS8EL	HOFFMAN
7	WALL FLANGE	1	XXXXXXXX	C-CS8WF	HOFFMAN
6	ADAPTER PLATE FOR COMPACT SUSPENSION SYSTEM	1	XXXXXXXX	C-CS8AP	HOFFMAN
5	TOP SUPPORT BRACKET	1	XXXXXXXX	X-TS66	HOFFMAN
4	BASE FOR SLOPED TOP	1	XXXXXXXX	X-BS66	HOFFMAN
3	DOOR FOR REAR OF SLOPED TOP	1	XXXXXXXX	X-DS5A6R	HOFFMAN
2	COVER FOR FRONT OF SLOPED TOP	1	XXXXXXXX	X-CSK56F6	HOFFMAN
1	SLOPED FRONT WITH ACCESSORY FRONT	1	XXXXXXXX	X-ST5A66A	HOFFMAN

PARTS LIST

REV	DESCRIPTION	DATE	APP'D
–	ENGINEERING RELEASE		

REVISIONS

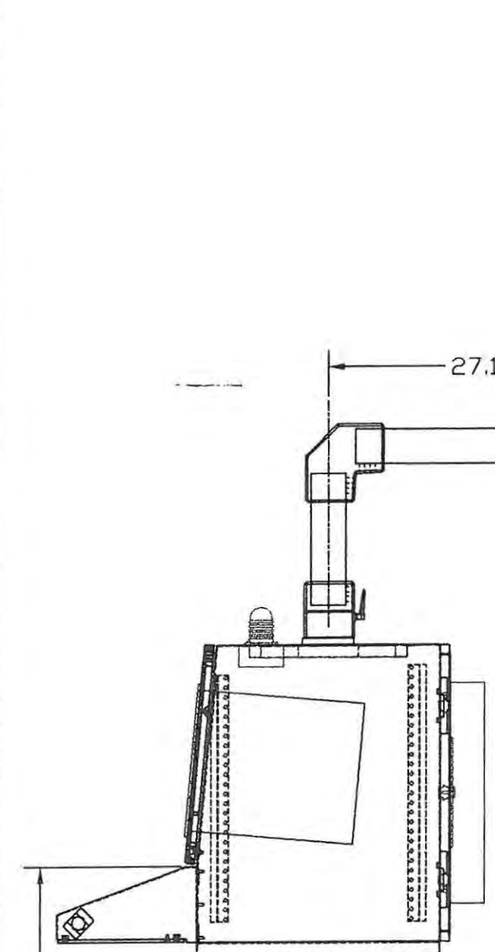
APPROVALS	DATE
DRAWN BY: J. WATERS	12/6/00
CHECKED BY: J. WATERS	
APPROVED BY:	
ENGINEERING	
MANUFACTURING D. DINNG	
CUSTOMER AAP St. Marys	
DO NOT SCALE DRAWING	

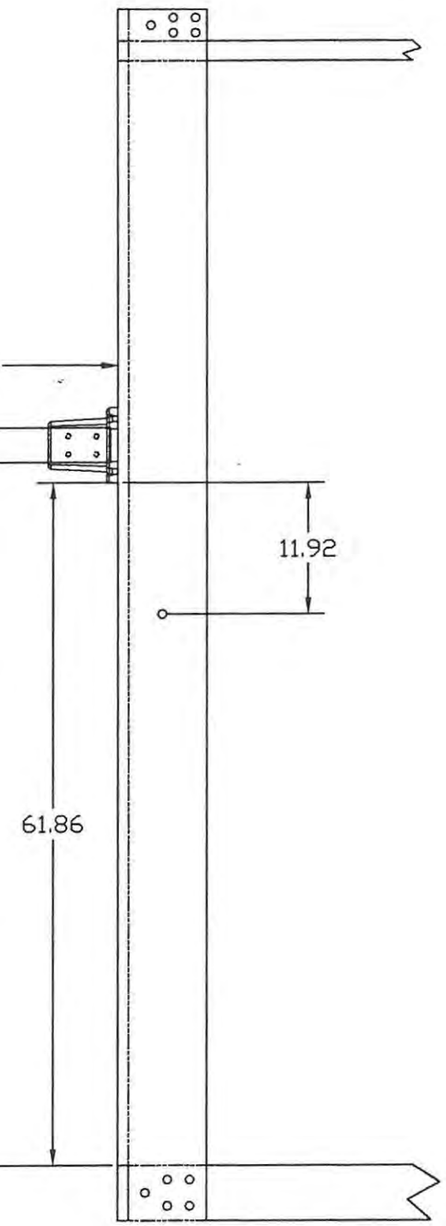
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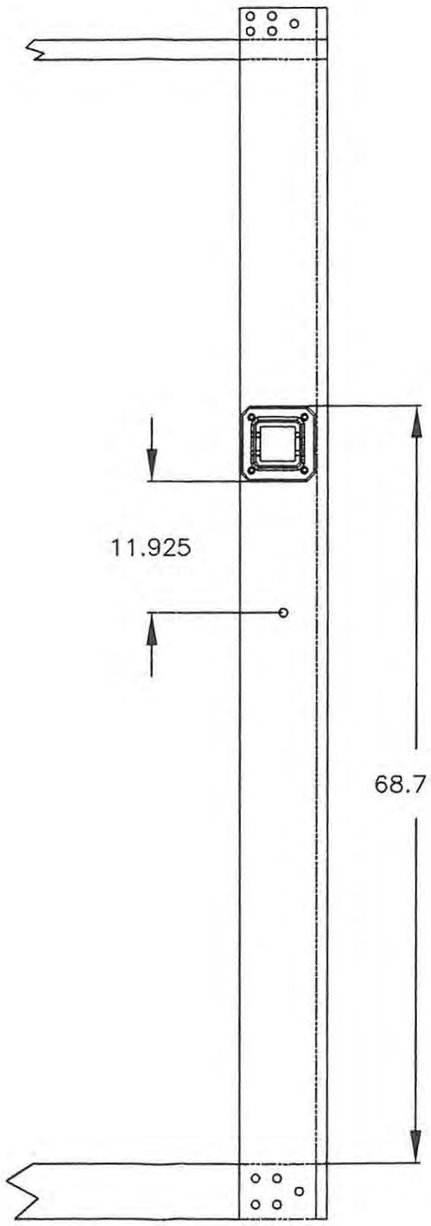
EMPIRE CASTINGS INC.
3195 REGIONAL PARKWAY SANTA ROSA, CA 95403

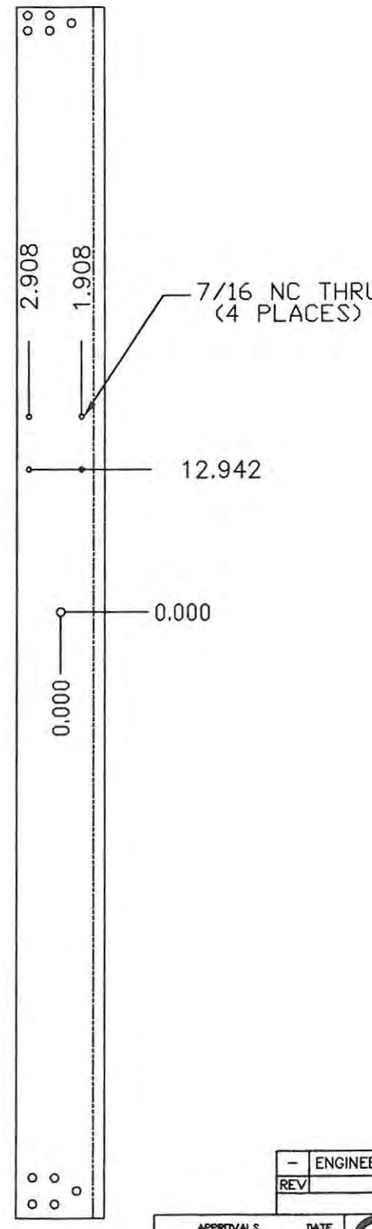
OPERATOR PANEL
PUSH BUTTON

EMPIRE WORK ORDER NO.	EMPIRE DRAWING NO.	
AAPM01	1800201	
NEXT ASSEMBLY NO. 1800202	CUSTOMER PART NO.	REV –
QTY: 1	SCALE: TO FIT	SHEET 1 OF 5









REV	DESCRIPTION	DATE	APP'D
–	ENGINEERING RELEASE		

REVISIONS

APPROVALS	DATE
DRAWN BY: J. WATERS	11/21/08
CHECKED BY: J. WATERS	11/21/08
APPROVED BY:	
ENGINEERING:	
MANUFACTURING: P. DANG	
CUSTOMER: AAP	
DO NOT SCALE DRAWING	

EMPIRE CASTINGS INC.
3195 REGIONAL PARKWAY SANTA ROSA, CA 95403

OPERATOR PANEL
MOUNTING POSITION

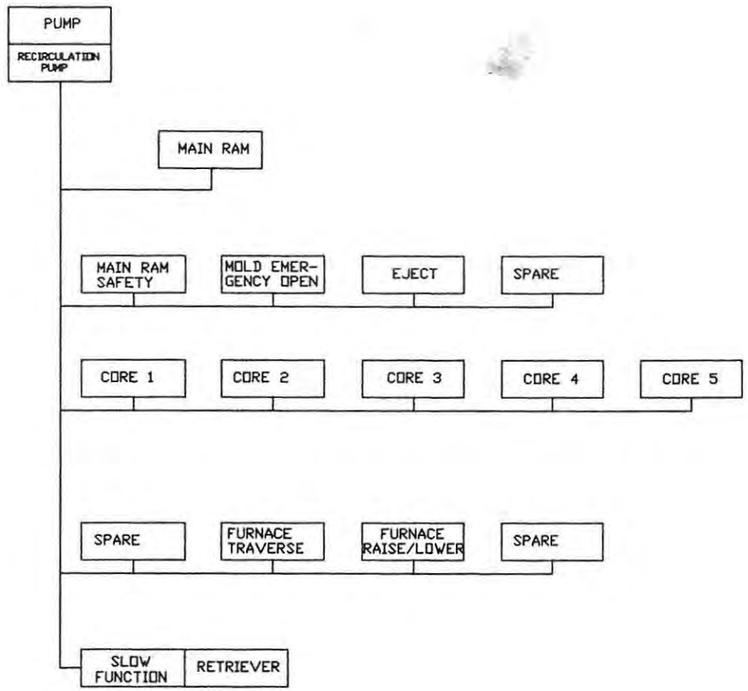
EMPIRE WORK ORDER NO.	EMPIRE DRAWING NO.	
AAPM01	1800206	
NEXT ASSEMBLY NO.	CUSTOMER PART NO.	REV
		–
QTY: 1	SCALE: TO FIT	SHEET 1 OF 1

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ITEM	DESCRIPTION	QTY	PART NO.	MANUFACTURER
29				
28	TEMPERTURE GAUGE	1	B-1560-2	OIL-RITE
27	RESERVOIR-200 GAL	1	XXXXXXXXXX	XXXXXX
26	FLUID-HYD (55 GAL DRUM)	2	HF-28	CHEMTRED
25	NON-VENTED FILL CAP	1	FCS-557-N	LENZ
24	2" BALL VALVE	1	XXXXXXXXXX	UNITED BRASS WORKS
23	FITTING RETURN LINE	1	2501-24	
22				
21	FILTER-BREATHER	1	BF-16	LENZ
20	FILTER-RETURN ASSEMBLEY FILTER-RETURN ELEMENT	1 1	HH7400B12KNSBLL HC7400SN8H	PALL
19		1		
18	AUX. PUMP PRESSURE CHECK - 65psi	1	XXXXXXXXXXX	XXXXXXXXXX
17				
16	FILTER PRESSURE ASSEMBLEY FILTER PRESSURE ELEMENT	1 1	HH9651A20DPSW1T HC9651FDP8H	PALL
15	HEAT EXCHANGER	1	EK-712-T-R	THERMAL TRANS
14	HYDRAULIC PUMP UNIT (MAIN PUMP SUCTION) (MAIN PUMP PRESSURE) (AUX. PUMP SUCTION) (AUX. PUMP PRESSURE) (UNLOADING VALVE) (CASE DRAIN, HYD. PUMP)	1	order 1 of each item (X" x X" LONG) (XX-XXFJX)(XX")(XX-XX FJX) (XX-XX FJX)(XX")(XX-XX FJX) (X-XX FJX)(XX")(X-XX FJX) (X-X FJX)(XX")(X-X FJX) (X-X FJX)(XX")(X-X FJX)	GATES, SANTA ROSA HYD'S
13	WATER VALVE	1	65293	THERMAL TRANS
12	VALVE-SYSTEM PRESSURE CHECK	1	C2020S	PARKER
11	CARTRIDGE RELIEF VALVE	1	RV5-10-S-0-50	VICKERS
10	PRESSURE GAUGE-0-3000 PSI	1	AFC-3M-25	LENZ
9	MANIFOLD-HYDRAULIC UNIT	1	XXXXXXXXXX	XXXXXXXX
8	XXXXXXXX	0	XXXXXX	XXXXXX
7	ELECTRIC MOTOR 25 HP 1765 RPM	1	KM01798	LINCOLN
6	RECIRCULATION PUMP	1	V10-1P7P1C20	VICKERS
5	DIN PLUG	15	51071090000	CANFIELD
4	ROTATING COULPING ROTATING COULPING ROTATING COULPING ROTATING COULPING INSERT	1 1 1 1	XXXXXXXX XXXXXX XXXXX XXXXXX	XXXXXX
3	PUMP 30GPM 2000 PSI	1	PVWW34LDFYCNNNTKAA	OILGEAR
2	XXXXXX	X	XXXXXX	XXXXXX
1				

PARTS LIST



REV	DESCRIPTION	DATE	APP'D
-	ENGINEERING RELEASE	14DEC96	

REVISIONS

APPROVALS		DATE
DRAWN BY	J. WATERS	14DEC96
CHECKED BY	J. WATERS	
APPROVED BY		
ENGINEERING		
MANUFACTURING		
CUSTOMER	AAP St. Marys	
DO NOT SCALE DRAWING		

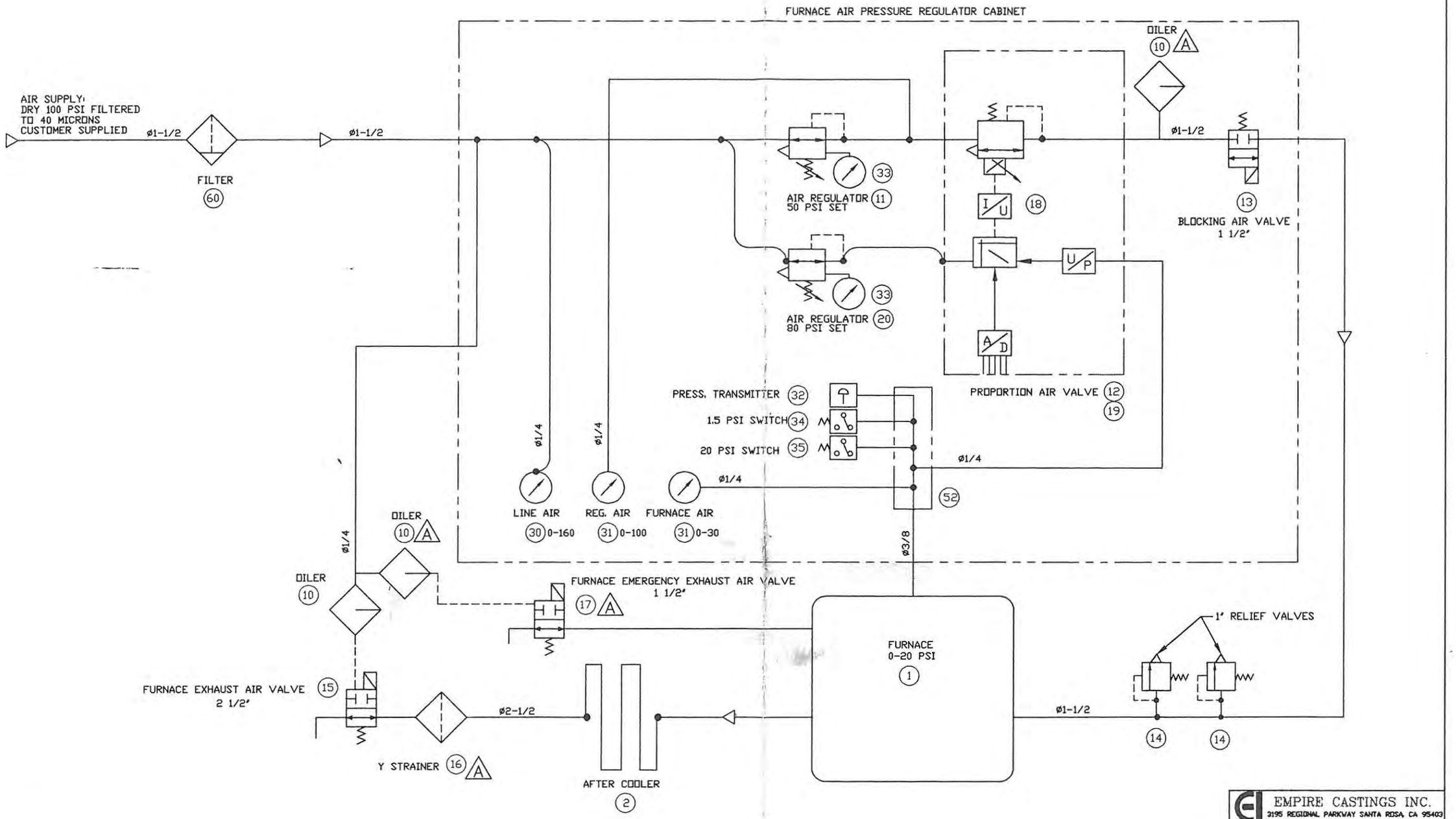
EMPIRE CASTINGS INC.
3195 REGIONAL PARKWAY SANAT ROSA, CA 95403

HYDRAULIC SYSTEM SCHEMATICS

EMPIRE WORK ORDER NO.	EMPIRE DRAWING NO.	
AAPM01	1700101	
NEXT ASSEMBLY NO. 1700102	CUSTOMER PART NO.	REV -
QTY: 1 PER MACH	SCALE: TO FIT	SHEET 1 OF 5

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REV	DESCRIPTION	DATE	APP'D
–	ENGINEERING RELEASE		

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EMPIRE CASTINGS INC.
3195 REGIONAL PARKWAY SANTA ROSA, CA 95403

FURNACE AIR SCHEMATIC

EMPIRE WORK ORDER NO.	EMPIRE DRAWING NO.
AAPM01	1900012
NEXT ASSEMBLY NO.	CUSTOMER PART NO. / REV
	—
QTY: 1 PER MACH	SCALE: TO FIT / SHEET 2

ITEM	DESCRIPTION	QTY	PART NO.	MANUFACTURER
62	HOSE–FURNACE TRANVERSE	2	order 2 of each item (4–6 FJX) (39") (4–6 FJX)	GATES, SANTA ROSA HYD'S
61	CYLINDER–SIDE CORE	5		CUSTOMER SUPPLIED
60	HOSE–QUICK DISCONNECT TO CYLINDER	10		CUSTOMER SUPPLIED
59	QUICK DISCONNECT FEMALE CHECKED	10		
58	QUICK DISCONNECT MALE CHECKED	10		
57	VALVE–INLINE FLOW CONTROL	10	F1020 #10 "O" RING BOSS	PARKER
A 56	MODULE–PRESSURE RELIEF "P"	1	DGMX2–3–PP–BW–S–40	BERENDSEN
55	MANIFOLD–RETRIEVER	1	PFP–3–PMH–105A (SLOW FUNCTION)	VICKERS
A 54	MODULE–FLOW CONTROL	2	DGMFN–3–Y–A2W–B2W–41	BERENDSEN
53	VALVE–DOUBLE SOLENOID DIRECTIONAL	8	DG4V–3–2C–M–U–B6–60	BERENDSEN
52	DIN CONNECTOR/SOLENOID COIL (DC)	2	R5107–1080000	CANFIELD
51	CARTRIDGE–SOLENOID VALVE DIN CONNECTOR/SOLENOID COIL	X	SV3–10–0–00 30588	BERENDSEN
50	CARTRIDGE–NEEDLE VALVE	1	NV–1–10–K–0	BERENDSEN
49	SWITCH–MAIN RAM PRESSURE	1	WS–11C–750F/H/adj	NASON
48	CYLINDER–MAIN RAM	1	TY09LAXAXBA*****	BERENDSEN
47	XXXXXX	X	XXXXXX	XXXXXX
46	FLUID SAMPLE DRAIN VALVE	1	XXXXXXXXXX	XXXXXXXX
45				
44	VALVE–COUNTER BALANCE	1	CBGA–LHN–3000	BERENDSEN
43	HOSE–MAIN RAM 1–1/2"	1	order 1 of each item (24–24 FJX) (96") (24–24 FJX)	GATES, SANTA ROSA HYD'S
42	HOSE–MAIN RAM 1–1/4"	1	order 1 of each item (20–20 FJX) (84") (20–20 FJX90)	GATES, SANTA ROSA HYD'S
41	HOSE–MAIN RAM "Y" DRAIN	1	order 1 of each item (4–6 FJX) (74") (4–6 FJX90)	GATES, SANTA ROSA HYD'S
40	VALVE–PROPORTIONAL CONTROL	1	KFDG5V733C160NXVMU1H112	BERENDSEN
39	CYLINDER–EJECT	1	L5395	BERENDSEN
38	EJECTOR UNIT (EJECTOR HOSE, TRANSFER RACK) (EJECTOR UNIT, MOVING PLATEN)	2 1	order 2 of each item (6–8 FJX) (130") (6–8 FJX90) order 1 of each item (6–8 FJX) (21 1/2") (6–8 FJX) (6–8 FJX) (16 1/2") (6–8 FJX)	GATES, SANTA ROSA HYD'S
37	MOLD EMERGENCY OPEN CYLINDERS	4	3.25 BORE, 2" STROKE, 2" ROD MALE THREAD, PORT POSITION #1	BERENDSEN
36	CYLINDER–RAM SAFETY	2	L6097	BERENDSEN
35	HOSE–SIDE CORES, TRANSFER RACK	5	order 5 of each item (6–8 FJX) (142") (6–8 FJX90) order 5 of each item (6–8 FJX) (143 1/2") (6–8 FJX90)	GATES, SANTA ROSA HYD'S
34	HOSE–MOLD EMERGENCY OPEN TRANSFER RACK	1	order 1 of each item (4–6 FJX) (135") (4–6 FJX) order 1 of each item (4–6 FJX) (131") (4–6 FJX)	GATES, SANTA ROSA HYD'S
33	MANIFOLD–4 POSITION (D03)	2	AD03P042S	BERENDSEN
32	MODULE–PRESSURE REDUCING "A"	4	DGMX2–3–PA–BW–S–40	BERENDSEN
31	VALVE–SINGLE SOLENOID DIRECTIONAL	2	DG4V–3–2A–M–U–B6–60	BERENDSEN
30				

PARTS LIST

ITEM	DESCRIPTION	QTY	PART NO.	MANUFACTURER
79	XXXXXX	X	XXXXXX	XXXXXX
78	RETRIEVER UNIT, TRANSFER RACK A/B	2	order 2 of each item (6–8 FJX)(60")(6–8 FJX)	GATES, SANTA ROSA HYD'S
77	RETRIEVER UNIT, MACH. FRAME P/T	1	order 1 of each item (6–8 FJX)(24")(6–8 FJX90) (6–8 FJX)(28")(6–8 FJX90)	GATES, SANTA ROSA HYD'S
76	PUMP – FLANGE 2"	1	XXXXXXXXX	XXXXXXXXXX
75	PUMP – FLANGE 1"	1	XXXXXXXXX	XXXXXXXXXXX
74				
73	HYD. MOTOR–RAISE AND LOWER	1	101–1033	CHAR–LYNN
72	HYD. MOTOR–RETREIVER	1	109–1106	CHAR–LYNN
71	2–WAY SOLENOID VALVE	1	SV08–24–8T–N–115–AG	HYDRAFORCE
70	VALVE–DOUBLE SOLENOID DIRECTIONAL	1	DG4V–3S–2C207–M–U11–PH5–60	BERENDSEN
69	HOSE–RAM SAFETY	4	order 4 of each item (4–6 FJX) (36") (4–6 FJX90)	GATES, SANTA ROSA HYD'S
68	MANIFOLD–5 POSITION (D03)	1	AD03P052S	BERENDSEN
67	BLOCKING PLATES	2	AD03CPP	BERENDSEN
66	HOSE – FURNACE RAISE/LOWER	2	order 2 of each item (4–6 FJX) (30") (4–6FJX90)	GATES, SANTA ROSA HYD'S
65	PUMP/MOTOR ADAPTER	1	XXXXXXXXX	XXXXXXXXX
64	1" BALL VALVE	1	XXXXXXXXX	XXXXXXXXXX
63	TELESCOPIC DOUBLE–ACTING CYLINDER	1	116–220	BAILEY

PARTS LIST

REV	DESCRIPTION	DATE	BY
A	ITEM 54 QTY. WAS 3, ITEM 56 QTY. WAS 2	24JAN97	RAP
–	ENGINEERING RELEASE	14DEC96	

REVISIONS

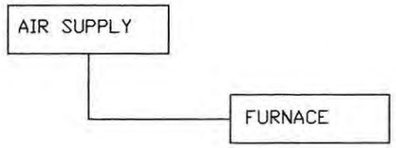
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APPROVALS	DATE
DRAWN BY J. WATERS	12/16/96
CHECKED BY J. WATERS	
APPROVED BY	
ENGINEERING	
MANUFACTURING	
CUSTOMER AAP St. Marys	
DO NOT SCALE DRAWING	

EMPIRE CASTINGS INC.
3195 REGIONAL PARKWAY SANTA ROSA, CA 95403

HYDRAULIC SYSTEMS SCHEMATIC

EMPIRE WORK ORDER NO.	EMPIRE DRAWING NO.
AAPM01	1700102
NEXT ASSEMBLY NO. 1700203	CUSTOMER PART NO.
REV A	
QTY: 1	SCALED TO FIT
SHEET 2 OF 5	



BLOCK DIAGRAM

ITEM	DESCRIPTION	QTY	ECI P/N	MANUFACTURER P/N	MANUFACTURER
62					
61	XXXXXX	X	X	XXXXXX	XXXXXX
60	FILTER–AIR/WATER SEPARATOR 250PSIG	2	X	08F73ACSB–LA8 1–1/2 NPT	SCHRADER BELLOWS
52	MANIFOLD–AIR PRESSURE SWITCH	1	X	5100801	ECI
51					
50					
45					
44					
43					
42					
41					
40					

PARTS LIST

ITEM	DESCRIPTION	QTY	ECI P/N	MANUFACTURER P/N	MANUFACTURER
35	SWITCH–N.C. 20PSI	1	X	WS–18–20R/H/adj	NASON
34	SWITCH–N.C. 1.5 PSI	1	X	NSM–1B–1.5F/H	NASON
33	GUAGE– AIR REGULATOR 0–160psig	2	X	GC 230	DIXON
32	TRANSMITTER–N.C. SW. PRESS. 24VDC	1	X	C206	SETRA
31	GUAGE–REG/FURN. PRESS. 0–30 PSIG	1	X	LNZ–30–25–RC	LENZ
30	GUAGE–LINE AIR PRESS. 0–100PSIG	1	X	LNZ–100–25–RC	LENZ
29	GUAGE–LINE AIR PRESS. 0–160PSIG	1	X	LNZ–160–25–RC	LENZ
20	VALVE–AIR REGULATOR 0–250psig	1	X	06R113ACSB 1/4–NPT	SCHRADER BELLOWS
19	VALVE–PROPORTION AIR	1	X	R000B	PROPORTION AIR
18	FITTING, BULKHEAD	1	X	2705–6–4	SANTA ROSA HYD'S
17	VALVE–EMERG. AIR EXHAUST 1 1/2"	1	X	MB331–202–150–2	AUTOMATION PRODUCTS GRP.
16	"Y" STRAINER 2 1/2"	1	X		
15	VALVE–AIR EXHAUST 2 1/2"	1	X	BB331–201–25 120/60	AUTOMATION PRODUCTS GRP.
14	VALVE–AIR PRESSURE RELIEF 25psi	2	X	FIG. 118C 1"	KINGSTON
13	VALVE–FURN. AIR PRESS. 1 1/2"	1	X	MB331–301–150–2	AUTOMATION PRODUCTS GRP.
12	VALVE–PROPORTIONAL AIR	1	X	BB2ME020S160S19S91S92	PROPORTION–AIR
11	VALVE–AIR REGULATOR 0–250psig	1	X	08R713ABSB	SCHRADER BELLOWS
10	OILER–AIR 250PSIG MAX 175°F	3	X	06L14BCSB	SCHRADER BELLOWS
2	AFTER COOLER	1	X	3000050	ECI
1	FURNACE	1	X	1000001	ECI

PARTS LIST

NOTES:
1. THIS SCHEMATIC IS USED ON AMC 006 MACHINE(S)
2. THE CIRCLED NO.S (#) ARE ITEM NO.S
3. THE "20X" NEXT TO AN ITEM NO., (41) 20X, IS THE QUANITY.
4. REDRAWN FROM AMC006 1900011

REV	DESCRIPTION	DATE	APP'D
–	ENGINEERING RELEASE	19MAY96	

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UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE INCHES TOLERANCES ARE:
FRACTIONS ±1/16 DECIMALS .XX ± .01 .XXX ± .005 ANGLES ±1/2°
MATERIAL:
FINISH:

APPROVALS		DATE
DRAWN BY	RON PERRY	19MAY96
CHECKED BY		
APPROVED BY		
ENGINEERING	J WATERS	19MAY96
MANUFACTURING		
CUSTOMER	AAP	

DO NOT SCALE DRAWING

EMPIRE CASTINGS INC.
3195 REGIONAL PARKWAY SANTA ROSA, CA 95403

FURNACE AIR SYSTEM SCHEMATIC

EMPIRE WORK ORDER NO.	EMPIRE DRAWING NO.	
AAPM01	1900011	
NEXT ASSEMBLY NO.	CUSTOMER PART NO.	REV
		–
QTY: 1 PER MACH	SCALE: TO FIT	SHEET 1 OF 2