FORM E 1081

WILLAMETTE IRON AND STEEL COMPANY

A-3421

SHEET 1 OF REV. A

July 7, 1959

JOB NO. 5233 JOB NAME 18' Butterfly Valves Fort Peck Dam and Reservoir DATE June 1, 1959

DESCRIPTION Repair Procedure for Valve Bodies (Welding)

DESIGN BY CHECKED BY APPROVED

18' BUTTERFLY VALVES FOR SECOND POWER PLANT, FORT PECK DAM AND RESERVOIR, FORT PECK, MONTANA

APPROVED

U. S. Army Engineer District
Garrison Corps of Engineers
Riverdale, North Dakota

U. S. ARMY ENGINEER DISTRICT, GARRISON CORPS OF ENGINEERS
JUL 17 1959
JUL 20 1959 DATE

Specification No. CIVENG-32-015-58-58
Contract No. DA-32-015-CIVENG-59-113

Repair Procedure for Nos. 1 and 2 Lower and Nos. 1 and 2 Upper Butterfly Valve Bodies.

1. Arc-air gauge remainder of stainless steel overlay from the valve bodies.
2. Cleanup and magnetic particle inspect parent metal.
   a. Proof etch to insure absence of stainless steel before magnetic particle inspection
   b. Arc-air gauge out any defects revealed by magnetic particle inspection.
3. Stress relieve valve bodies that have not been previously stress relieved.
4. Weld build-up of base metal, including existing groove, sufficiently to rough machine flush with finished surface. (See attached sketch Fig. 1)
   a. Use L. H. electrode E7016 or equal and approved WISCO Procedure A3387.
   b. Magnetic particle inspect each 3/8-inch layer of deposited weld metal.
   c. Stress relieve valve body when deposited weld metal has reached a depth of 3/4-inch.
   d. Stress relieve valve bodies after build-up of base metal has been completed.
5. Rough machine the center of the valve bodies approximately 3-inches wide to contour as shown on attached sketch Fig. 1 for receiving stainless steel.
   a. Magnetic particle inspect entire inner 1/4-inch width of the 3-inch parent metal.
6. Build up of Stainless Steel.
   a. Deposit one layer of "E-309" over the surface of the carbon steel to be covered with stainless steel.
      Note: The E-309 layer shall be followed or overlayed with subsequent passes as soon as possible. This is done to temper hard structures in the fusion line and heat-affected zone before

JUL 9 1959

maximum reaction stresses develop in weld cool-down. This is particularly important for the outboard surface passes, which in addition, should blend smoothly into the base metal by grinding, if necessary.

b. Finish depositing stainless steel to desired contour using E308-16 electrode. (See attached sketch Fig. 2)

c. Do not stress relieve after stainless overlay is deposited.

7. Machine to finish dimensions as shown on attached sketch Fig. 3.

a. Dye check stainless steel and adjacent parent metal.

A-3421
REV. A
SHT 3 OF 3

SECTION THRU OVERLAY

APPROVED
U. S. ARMY ENGINEER DISTRICT, GARRISON
CORPS OF ENGINEERS
JUL 17 1959
JUL 20 1959 DATE

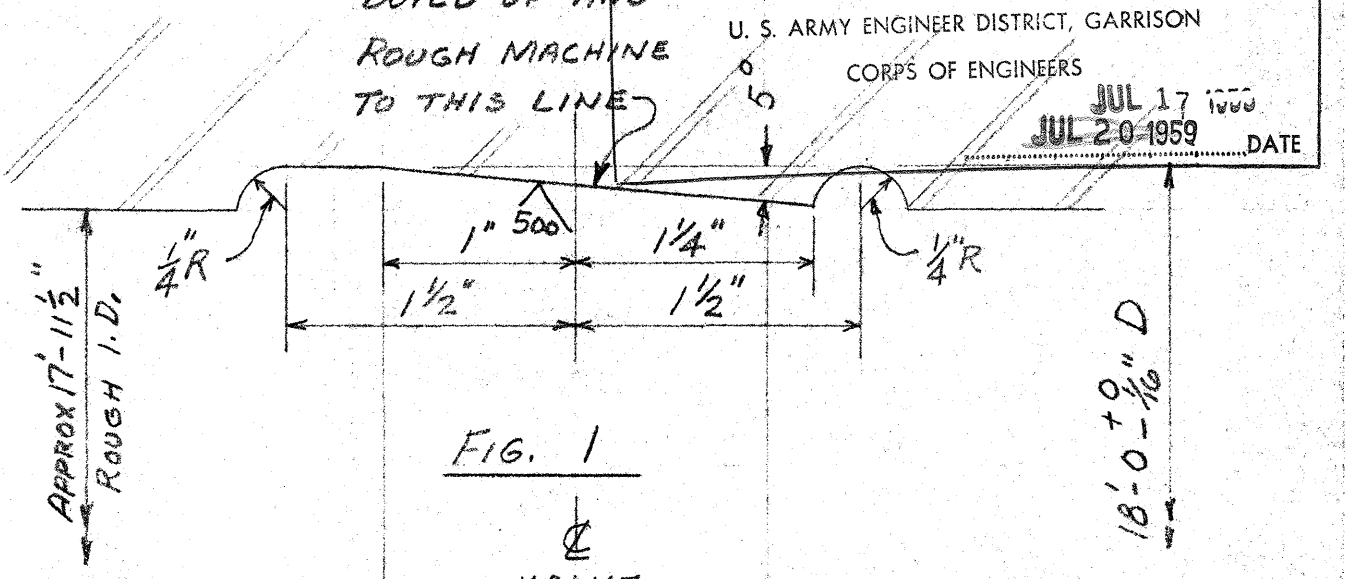


FIG. 1

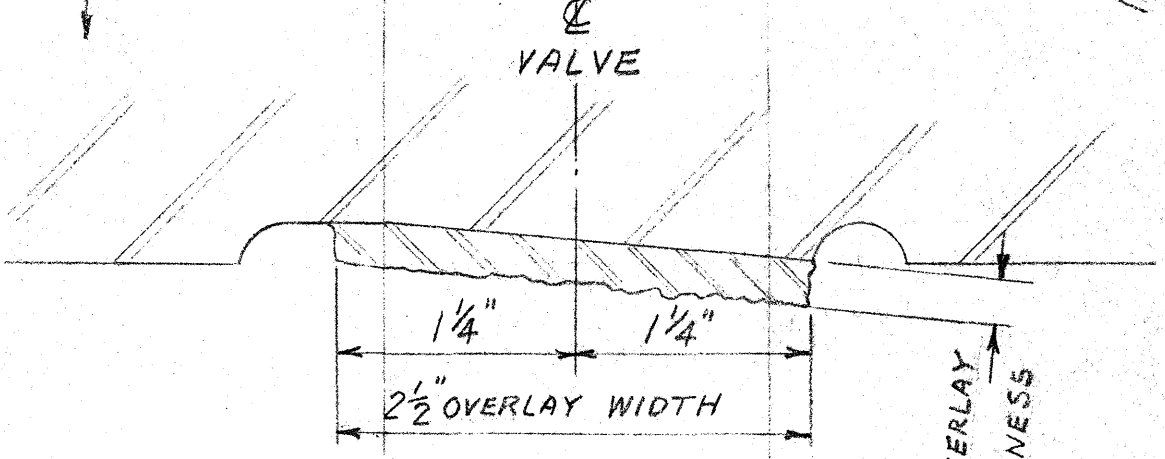


FIG. 2

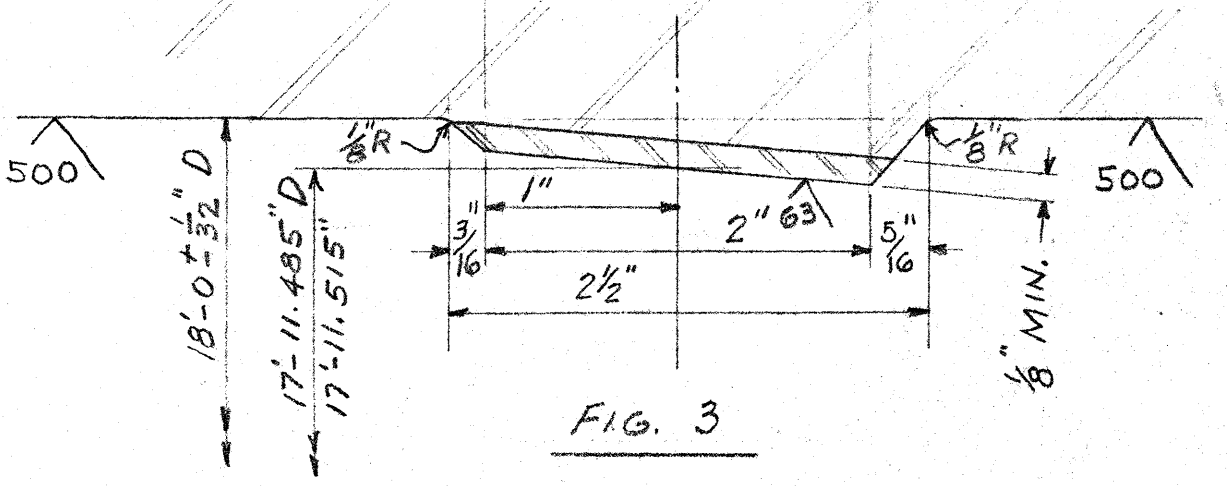


FIG. 3

A-3421
REV. A
SHT 3 OF 3

SECTION THRU OVERLAY

APPROVED
U. S. ARMY ENGINEER DISTRICT, GARRISON
CORPS OF ENGINEERS
JUL 17 1959
JUL 20 1959 DATE

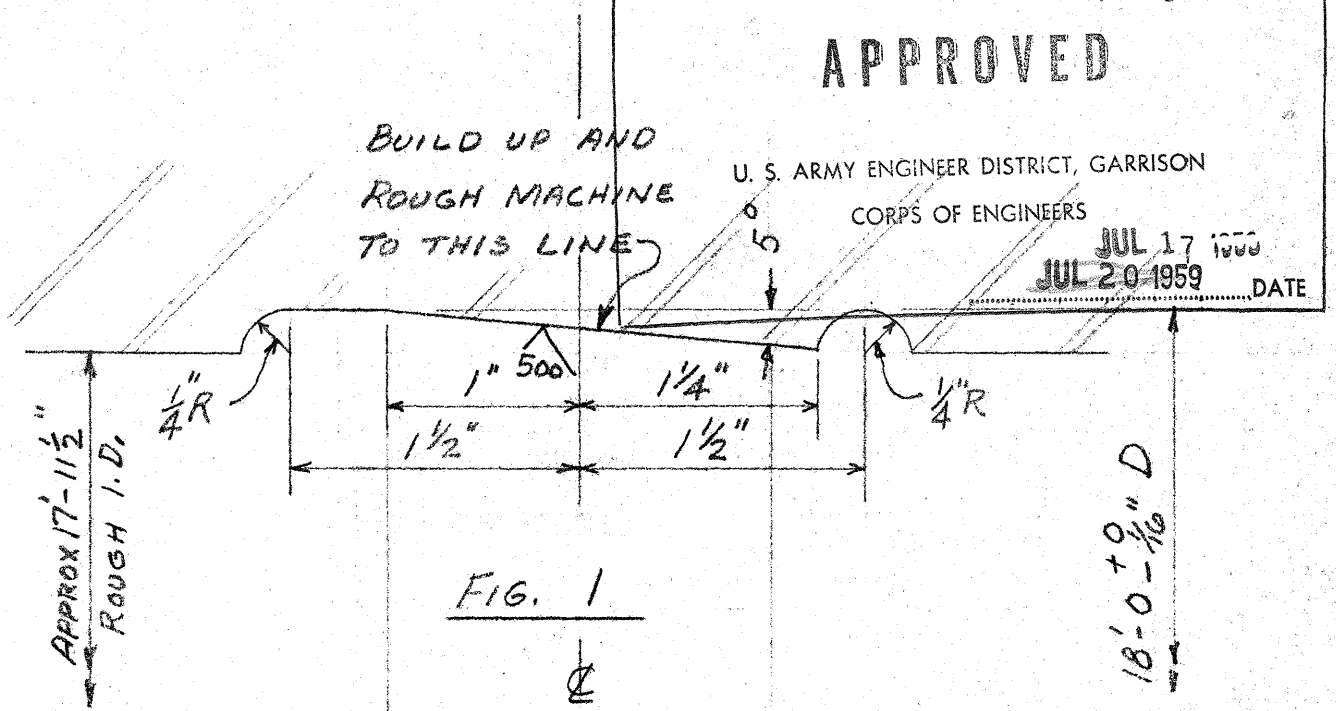


FIG. 1

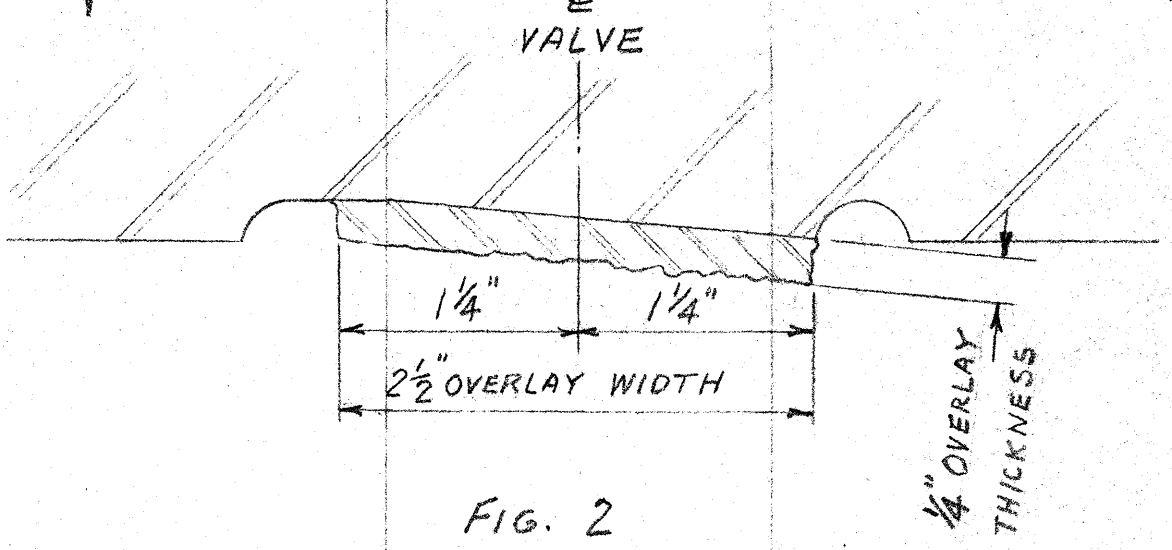


FIG. 2

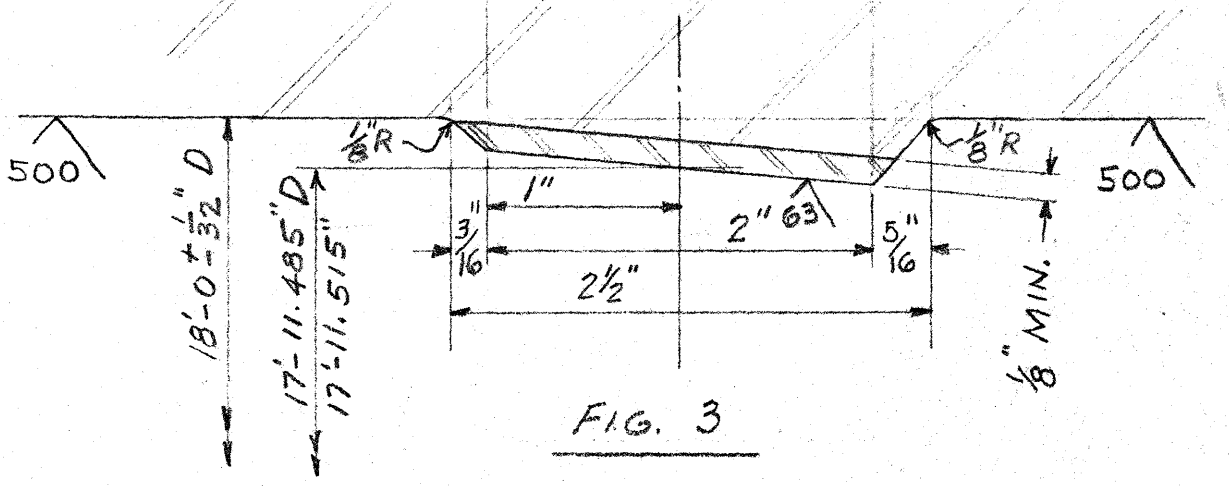


FIG. 3

A-3389

APPROVED
EXCEPT AS NOTED
U. S. ARMY ENGINEER DISTRICT, GARRISON
CORPS OF ENGINEERS
JAN 20 1959 DATE

FORT PECK DAM
18 FT. BUTTERFLY VALVE
FABRICATION PROCEDURE
DISC WELDMENT

STEP I

1. Cut all parts to size and rough machine trunnion castings.

STEP II

1. Fit-up and weld horizontal ribs, mark AC, to trunnion castings.
2. Fit-up and weld center vertical stiffeners, mark AD and AE, to trunnion casting/horizontal rib weldment.
3. Fit-up and weld vertical ribs, mark AF, AG, and AA, to trunnion casting/horizontal rib weldment.
4. Inspect for alignment and straighten as necessary.

STEP III

1. Fit-up weldment manufactured under step II, to head, mark AB.
2. Mark all ribs to fit contour of head.
3. Burn ribs to head contour.
4. Fit-up and weld rib and trunnion weldment to head, mark AB.

STEP IV

1. Fit-up head, mark AA, to weldment manufactured under step III.
2. Mark ribs to fit head, mark AA.
3. Remove head, mark AA, and burn ribs to fit contour of head mark AA.
4. Fit-up and plug weld head, mark AA, to complete the leaf assembly.

STEP V

1. Weld heads, mark AA and AB together at periphery.
2. Stress-relieve completed weldment.
3. Inspect completed weldment.

The contractor should indicate locations and amounts of preheat he intends to use.

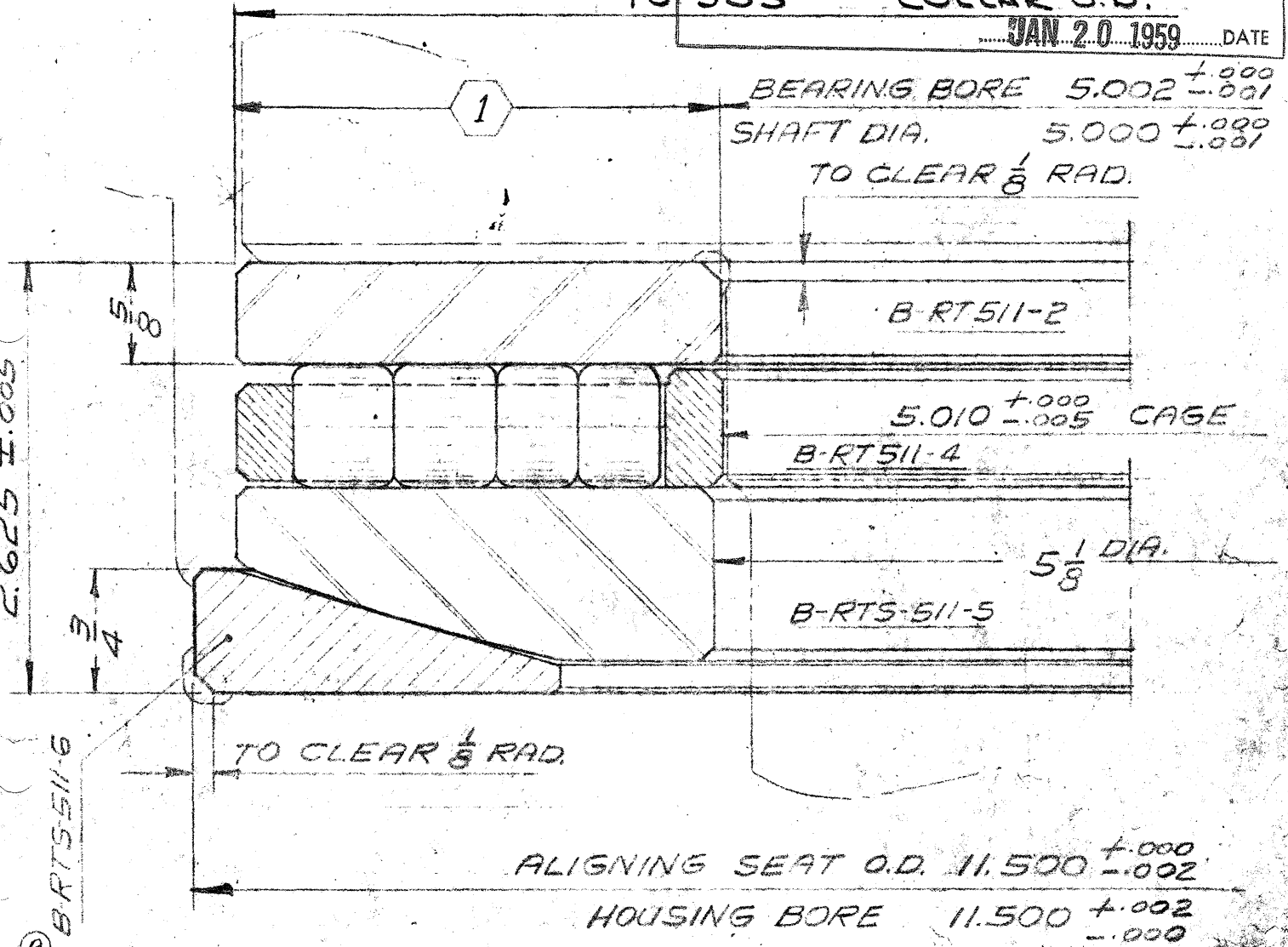
A-RTS-511

UNLESS OTHERWISE SPECIFIED —
1 - DO NOT SCALE DRAWINGS
2 - REMOVE ALL BURRS AND SHARP CORNERS
3 - ALLOW ± .010 ON FINISHED FRACTIONAL DIMENSIONS

16 RAD.

17 ROLLER POCKETS
34 ROLLERS $\frac{3}{4}$ DIA. x $\frac{1}{2}$ LONG — RT- $\frac{3}{4} \times \frac{1}{2}$
34 ROLLERS $\frac{3}{4}$ DIA. x $\frac{5}{8}$ LONG — RT- $\frac{3}{4} \times \frac{5}{8}$
111,600# CAP. @ 100 R.P.M.
(C) STATIC CAP. - 547,000#

APPROVED
U. S. ARMY ENGINEER DISTRICT, GARRISON
(B) CORPS OF ENGINEERS
10 985 ±.005 COLLAR O.D.
JAN 20 1959 DATE



(A) * (1) .015 MAX. VARIATION IN WALL THICKNESS

DEC 26 1958

SYM.	CHANGES	DATE	CHK.
C	ADDED	12-30-58	OGB
B	WAS 10.968 ±.005	12-30-58	OGB
A	NOTE ADDED	11-7-58	OGB

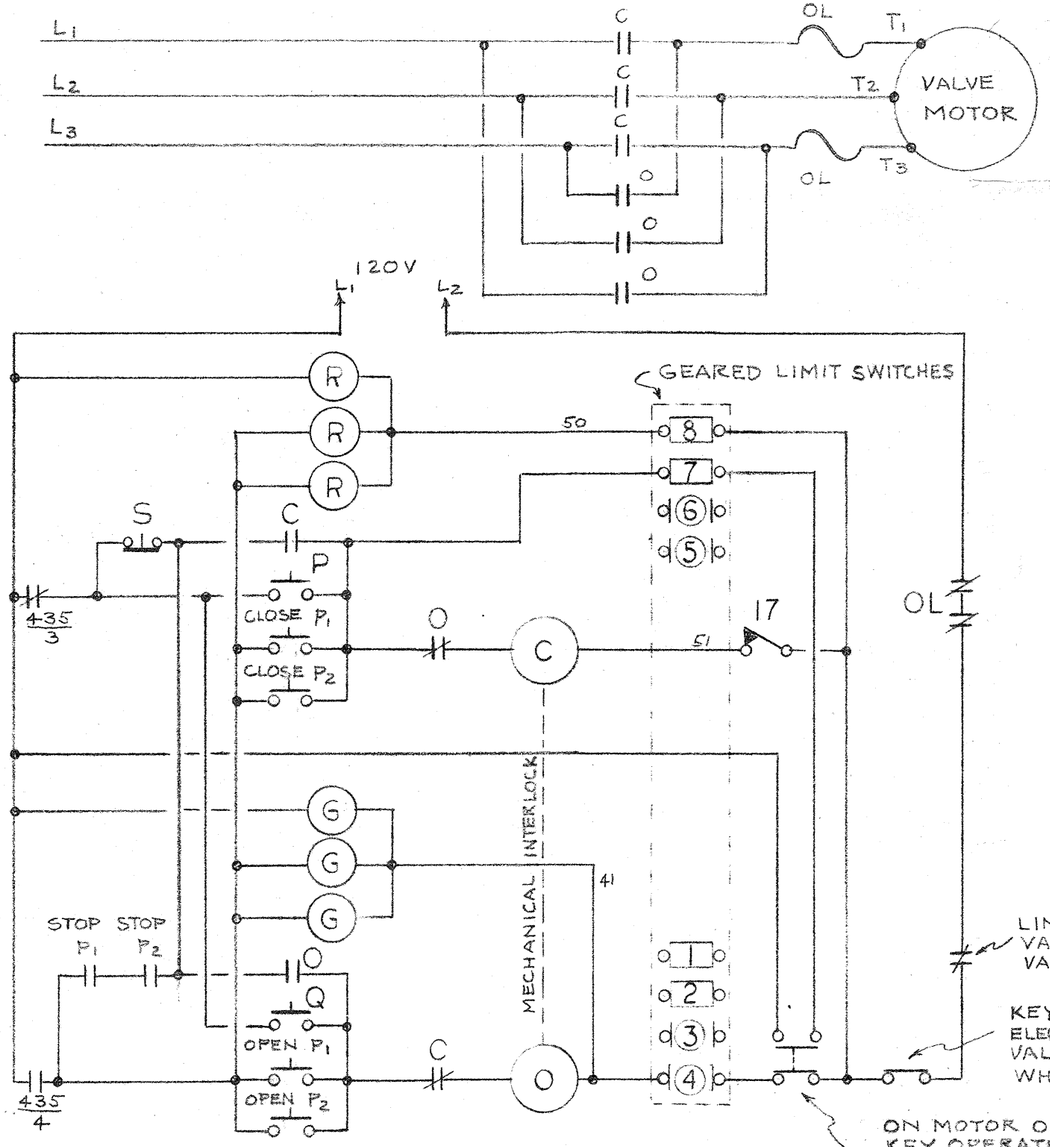
THE KAYDON ENGINEERING CORP.
MUSKEGON, MICHIGAN

PART NAME SELF ALIGNING R.T. BEARING
MACHINE | MODEL
MATERIAL | SCALE 2" = 1"

DR. E.J.	CK. L.P.J.JR.	APVD.
DATE 11-1-45	DATE 11-5-45	DATE

A-RTS-511

CHARLES BRUNING CO., INC.



— VALVE SHOWN IN FULL OPEN POSTION —

C CLOSING CONTACT & CONTACTOR
O OPENING CONTACT & CONTACTOR
◎ CLOSING COIL
◎ OPENING COIL
G GREEN INDICATOR LIGHT
R RED INDICATOR LIGHT
P CLOSE PUSH BUTTON
Q OPEN PUSH BUTTON
S STOP PUSH BUTTON
OL OVERLOAD RELAY

NOTE
VALVE SELECTOR SWITCH (435) SHOWN IN "VALVE ROOM" POSITION.

LIMIT SWITCH CONTACT DEVELOPMENT

CONTACT	VALVE FULL OPEN	INTERMEDIATE VALVE POSITION	VALVE FULL CLOSED	CONTACT FUNCTION
1	CLOSED	OPEN	OPEN	SPARE
2	CLOSED	OPEN	OPEN	"
3	OPEN	CLOSED	CLOSED	"
4	OPEN	CLOSED	CLOSED	OPEN LIMIT
5	OPEN	OPEN	CLOSED	SPARE
6	OPEN	OPEN	CLOSED	"
7	CLOSED	CLOSED	OPEN	AUTO. CLOSE
8	CLOSED	CLOSED	OPEN	IND. LIGHT

17 CLOSING TORQUE SWITCH INTERRUPTS CONTROL CIRCUIT IF MECHANICAL OVERLOAD OCCURS DURING CLOSING CYCLE OR FULL CLOSED VALVE.

APPROVED

U. S. ARMY ENGINEER DISTRICT, GARRISON
CORPS OF ENGINEERS
JAN 14 1959 DATE

PLAN DEVELOPED FROM PHILADELPHIA GEAR CORPORATION PLAN NO. B-68205

S.O. 5233

FOR CONTRACT

TITLE
PROPOSED WIRING DIAGRAM FOR BYPASS & DRAIN VALVE INTERLOCK

WILLAMETTE IRON & STEEL COMPANY
2800 N. W. FRONT AVENUE
PORTLAND 10, OREGON

DR. EJS SCALE NONE 1 FT. DATE ISSUED DEC 22 1958
TR. DATE 12-22 1958 FILE NO. B-5491
CH. FEW APPVD.

SALES ORDER NO. SO- | COMPONENT NO. | REV.

REFERENCE DRAWING No.	MARK	REVISIONS	BY	DATE	APPV.

RECORD OF MANUFACTURER'S PRINTS

* Received Tracing 1/6/60 - Sent to Engrg 1/7/60
** Received Four Final Prints - Sent to Engrg 1/13/60
Engrg Rtnd 3 sets 1/15/60 - Sent 2 sets to Ft. Peck.

MANUFACTURER: Willamette Iron & Steel Company
SUBJECT OF CONTRACT: Butterfly Valve & Appurtenances
DATE OF AWARD: 12 Sept. 1958 DAYS ALLOWED FOR SUBMISSION OF DWG.: 30 days

U.S.E.D. CONTRACT NO.: 59-113
MFR. CONTRACT NO.:

Page 1

MFGS. Dwg. No.	U.S.E.D. File No.	TITLE	FIRST APPROVAL REC'D No.	Date	CHECKED By	Date	ACTION ACN	RETURN Date	SECOND APPROVAL REC'D No.	Date	CHECKED By	Date	ACT ACN	RET Date	THIRD APPROVAL REC'D No.	Date	CHECKED By	Date	ACT ACN	RET Date	FOURTH APPROVAL REC'D No.	Date	CHECKED By	Date	ACT ACN	RET Date	FIFTH APPROVAL REC'D No.	Date	CHECKED By	Date	ACT ACN	RET Date	REMARKS
5233-0100	Rev 00	18" Butterfly Valve Gen Arrangement	10	10/3/58	To Engrg 10/6/58 No action - See reentry				Bottom of Page																								* **
5233-1000	Rev. 00	Sectional Valve Assembly	10	10/3/58	"	"		" "	Page 2 Line 2																								
5233-1100	Rev. 00	Half Section & end View Assembly	10	10/3/58	"	"		" "	Page 2 Line 3																								
1454-1		Fort Peck B.F. Hydraulic Control	11 9	11/3/58	To Engrg 11/5/58	12/2/58	RFC	12/4/58	11	1/15/59	To Engrg 1/19/59	2/9/59	RFC	2/13/59	02 11	3/23/59	To Engr 3/26/59	4/9/59	RFC	4/16/59	11	6/2/59		6/17/59	A	6/18/59	06 10	9 Oct 59	To Engr on 12 Oct 59	Destroy			4 3-21-60
Sec 4. Page 812		A.O. Smith Electric Motor	11 9	11/3/58		12/2/58	A	12/4/58																									
EM-157-C		A.O. Smith Electric Motor	11 9	11/3/58		12/2/58	RFC	12/4/58																									
Page 11-19		A.O. Smith Engineering Data	11	11/3/58		12/2/58	RFC	12/4/58																									
		Specifications A.O. Smith Electric Motor	11	11/3/58		12/2/58	AEAN	12/4/58																									
Form C-1-58		Fabco Flexible Coupling	11	11/3/58		12/2/58	A	12/4/58																									
		Section 6 Marsh Industrial Gauges	11	11/3/58		12/2/58	A	12/4/58																									
Bulletin No. 102		Electrical Hand Pumps	11	11/3/58		12/2/58	A	12/4/58																									
		Series 2010H3B1 Hydreco Pumps	11	11/3/58		12/2/58	RFC	12/4/58																									
		I.132395 Vickers Press Control Valve	11	11/3/58		12/2/58	RFC	12/4/58																									
		I 113720 Vickers Check Valves	11	11/3/58		12/2/58	A	12/4/58																									
		I.131952 Vickers Balanced Piston Type Relief Valve	11	11/3/58		12/2/58	A	12/4/58																									
		I & M292-S Vickers Oil Strainer	11	11/3/58		12/2/58	A	12/4/58																									
		I-113929 Vicker Pressure Switch	8	11/3/58		12/2/58	A	12/4/58																									
		R-5567 Vicker Right Angle Check Valve	11	11/3/58		12/2/58	A	12/4/58																									
		I 182413 Vicker Pilot Operated 4 Way Valve	11	11/3/58		12/2/58	RFC	12/4/58																									
5233-0100 Rev. 01		General Arrangement	11	10/31/58	To Engrg 11/6/58	12/2/58	RFC	12/4/58	02 11	2/3/59	To Engrg 2/6/59	3/2/59	AFC	3/6/59	03 10	9 Oct 59	To Engr on 12 Oct 59	Destroy			04 10	10/29/59		11/17/59	AFC	11/18/59							* **
5233 0200 Rev. 00		Operating & Wiring Diagrams and Instructions	11	10/30/58		12/2/58	RFC	12/4/58	01 11	12/29/58		1/14/59	AEAN	1/19/59	02 11	2/3/59	To Engrg 2/6/59	3/2/59	AFC	3/6/59	03 11	3/23/59	To Engr	4/9/59	3/26/59 AEAN	4/16/59	04 10	5/28/59	To Engr	6/1/59 6/16/59	AFC	6/22/59	* ** See Line 18, Page 6

All dwgs complete per Omaha radio MRHGD 174 26 Apr 61

MRG FORM 222 17 FEB 55 (Tentative)

RECORD OF MANUFACTURER'S PRINTS

MANUFACTURER Willamette Iron & Steel Company

SUBJECT OF CONTRACT Butterfly Valves & Appurtenances

DATE OF AWARD _____ DAYS ALLOWED FOR SUBMISSION OF DWG. 30 days.

U.S.E.D. CONTRACT NO. 59-113

MFR. CONTRACT NO. _____

MFGS. Dwg. No.	U.S.E.D. File No.	TITLE	FIRST APPROVAL REC'D No.	FIRST APPROVAL REC'D Date	FIRST APPROVAL CHECKED By	FIRST APPROVAL CHECKED Date	FIRST APPROVAL ACTION ACN	FIRST APPROVAL RETURN Date	SECOND APPROVAL REC'D No.	SECOND APPROVAL REC'D Date	SECOND APPROVAL CHECKED By	SECOND APPROVAL CHECKED Date	SECOND APPROVAL ACT ACN	SECOND APPROVAL RET Date	THIRD APPROVAL REC'D No.	THIRD APPROVAL REC'D Date	THIRD APPROVAL CHECKED By	THIRD APPROVAL CHECKED Date	THIRD APPROVAL ACT ACN	THIRD APPROVAL RET Date	FOURTH APPROVAL REC'D No.	FOURTH APPROVAL REC'D Date	FOURTH APPROVAL CHECKED By	FOURTH APPROVAL CHECKED Date	FOURTH APPROVAL ACT ACN	FOURTH APPROVAL RET Date	FIFTH APPROVAL REC'D No.	FIFTH APPROVAL REC'D Date	FIFTH APPROVAL CHECKED By	FIFTH APPROVAL CHECKED Date	FIFTH APPROVAL ACT ACN	FIFTH APPROVAL RET Date	REMARKS
5233 0300 Rev. 00		Erection Instructions	11	10/30/58		To Engrg 11/6/58 No action		12/11/58	10	12/9/59		To Engrg 12/14/59 12/17/59	A	To Engrg 12/15/59 12/21/59																				* XX
1000 Rev. 01		Sectional Valve Assembly	11	10/30/58		12/2/58	AEAN	12/4/59	02 11	12/29/58		1/14/59	AFC	1/19/59	03 10	7/15/59		7/23/59	AEAN	7/27/59	04 10	8/1/59		8/12/59	AFC	8/13/59								* XX
1100 Rev. 01		Half Section & End Valve View Assembly	11	10/30/58		12/2/58	AEAN	12/4/59	02 11	12/29/58		1/14/59	AEAN	1/19/59	03 11	2/3/59		3/2/59	AFC	3/6/59	04 10	5/28/59		To Engrg 6/1/59 6/16/59	AFC	6/22/59	07 10	10/30/59		11/17/59	AFC	11/18/59	* XX
2100 Rev. 00		Upper Half Body Weldment	11	10/30/58		12/2/58	RFC	12/4/58	01 11	12/29/58		1/14/59	AEAN	1/19/59	02 11	2/3/59		3/2/59	AEAN	3/6/59	02 11	3/30/59		4/13/59	AFC	4/16/59	03 10	5/28/59		To Engrg 6/1/59 6/16/59	AEAN	6/22/59	* XX Cont. on Page 6 (Bottom)
2200 Rev. 00		Lower Half Body Weldment	11	10/30/58		12/2/58	RFC	12/4/58	01 11	12/29/58		1/14/59	AEAN	1/19/59	02 11	2/3/59		3/6/59	AEAN	3/6/59	02 11	3/30/59		4/13/59	AFC	4/16/59	03 10	5/28/59		To Engrg 6/1/59 6/16/59	AEAN	6/22/59	* XX Cont. on Page 6
2300 Rev. 00		Thrust Bearing Details	11	10/30/58		12/2/58	AEAN	12/4/58	01 11	12/29/58		1/14/59	AEAN	1/19/59	02 11	2/3/59		3/2/59	AEAN	3/6/59	03 11	3/30/59		4/13/59	AFC	4/16/59	04 10	8/25/59		9/8/59	AFC	9/14/59	* XX See Line 6, page 7
2400 Rev. 00		Valve Details	11	10/30/58		12/2/58	AEAN	12/4/58	01 11	12/29/58		1/14/59	AFC	1/19/59	02 10	5/28/59		To Engrg 6/1/59 6/16/59	AFC	6/22/59	03 10	7/17/59		To Engrg 7/20/59 7/23/59	AFC	7/27/59							* XX
2500 Rev. 00		Miscellaneous Body Details	11	10/30/58		12/2/58	RFC	12/4/58	01 11	12/29/58		1/14/59	AFC	1/19/59																				* XX
3000 Rev. 00		Disc Assembly	11	10/30/58		12/2/58	AEAN	12/4/58	01 11	12/29/58		1/14/59	AFC	1/19/59	3 10	8/1/59		8/26/59	AFC	8/28/59														* XX
3100 Rev. 00		Disc Weldment Details	11	10/30/58		12/2/58	RFC	12/4/58	11	1/2/59		1/20/59	AFC	1/23/59	02 11	2/3/59		3/2/59	AEAN	3/6/59	03 11	3/30/59		4/13/59	AEAN	4/16/59	05 10	5/28/59		To Engrg 6/1/59 6/16/59	AFC	6/22/59	* XX See Line 17 Page 6
3200 Rev. 00		Disc Details	11	10/30/58		12/2/58	AEAN	12/4/58	01 11	12/29/58		1/14/59	AFC	1/19/59	07 10	7/17/59		To Engrg 7/20/59 7/23/59	AFC	7/27/59														* XX
3300 Rev. 00		Disc Details	11	10/30/58		12/2/58	AFC	12/4/58	11	1/2/59		1/20/59	AEAN	1/23/59	02 10	5/28/59		To Engrg 6/1/59 6/16/59	AFC	6/22/59	03 10	8/17/59		8/26/59	AFC	8/28/59							* XX
4000 Rev. 00		Operator Assembly	11	10/30/58		12/2/58	RFC	12/4/58	01 11	12/29/58		1/14/59	AEAN	1/19/59	02 11	2/3/59		3/2/59	AFC	3/6/59	03 10	5/18/59		5/14/59	AFC	5/14/59	04 10	10/29/59		11/17/59	AFC	11/18/59	* XX
4100 Rev. 00		Operator Cover, Housing Details	11	10/30/58		12/2/58	AEAN	12/4/58	01 11	12/29/58		1/14/59	AEAN	1/19/59	02 11	2/3/59		3/2/59	AFC	3/6/59	03 10	10/29/59		11/17/59	AFC	11/18/59								* XX
4200 Rev. 00		Operator Housing Details	11	10/30/58		12/2/68	AEAN	12/4/58	01 11	12/29/58		1/14/59	AEAN	1/19/59	02 11	2/3/59		3/2/59	AFC	3/6/59														* XX
4300 Rev. 00		Operator Cylinder Details	11	10/30/58		12/2/58	AEAN	12/4/58	11	12/29/58		1/14/59	AFC	1/19/59	01 10	5/18/59		5/14/59	AFC	5/18/59														* XX
4400 Rev. 00		Operator Cylinder Details	11	10/30/58		12/2/58	AFC	12/4/58	01 11	12/29/58		1/14/59	AFC	1/19/59	02 10	5/18/59		5/14/59	AFC	5/18/59														* XX
4500 Rev. 00		Operator Details	11	10/30/58		12/2/58	AEAN	12/4/58	11	12/29/58		1/14/59	AEAN	1/19/59	01 11	2/3/59		3/2/59	AEAN	3/6/59	02 11	3/30/59		4/13/59	AFC	4/16/59	03 10	10/29/59		11/17/59	AFC	11/18/59	* XX
4600 Rev. 00		Operator Miscellaneous Details	11	10/30/58		12/2/58	RFC	12/4/58	01 11	1/15/59		To Engrg 1/19/59 2/9/59	AFC	2/13/59	02 10	10/29/59		11/17/59	AFC	11/18/59														* XX
4700 Rev. 00		Operator Miscellaneous Details	11	10/30/58		12/2/58	AFC	12/4/58	01 11	12/29/58		1/14/59	AFC	1/19/59																				* XX
5000 Rev. 00		Transitions Details & Piping	11	10/30/58		12/2/58	RFC	12/4/58	01 11	12/29/58		1/14/59	RFC	1/19/59	02 11	2/3/59		3/2/59	AEAN	3/6/59	02 11	3/30/59		4/13/59	AFC	4/16/59								* XX

RECORD OF MANUFACTURER'S PRINTS

MANUFACTURER Willamette Iron & Steel Company

U.S.E.D. CONTRACT NO. 59-113

SUBJECT OF CONTRACT Butterfly Valves & Appurtenances

MFR. CONTRACT NO.

DATE OF AWARD ______ DAYS ALLOWED FOR SUBMISSION OF DWG. 30 days

Page 3

MFGS. Dwg. No.	U.S.E.D. File No.	TITLE	FIRST APPROVAL REC'D No.	Date	CHECKED By	Date	ACTION ACN	RETURN Date	SECOND APPROVAL REC'D No.	Date	CHECKED By	Date	ACT ACN	RET Date	THIRD APPROVAL REC'D No.	Date	CHECKED By	Date	ACT ACN	RET Date	FOURTH APPROVAL REC'D No.	Date	CHECKED By	Date	ACT ACN	RET Date	FIFTH APPROVAL REC'D No.	Date	CHECKED By	Date	ACT ACN	RET Date	REMARKS
5233 6000 Rev. 00		Hydraulic Piping Details	11	10/30/58		12/2/58	RFC	12/4/58	01 11	12/29/58		1/14/59	RFC	1/19/59	02 11	2/3/59		3/2/59	AFC	3/6/59	03 11	3/20/59		4/13/59	AFC	4/16/59	04 10	10/29/59		11/17/59	AFC	11/18/59	* XX
7000 Rev. 00		Lubrication System Details	11	10/30/58		12/2/58	RFC	12/4/58	01 11	12/29/58		1/14/59	AFC	1/19/59	03 10	10/29/59		11/17/59	AFC	11/17/59													* XX
8000 Rev. 00		Anchor Bolt Detail & Installation	11	10/30/58		12/2/58	RFC	12/4/58	01 11	12/29/58		1/14/59	RFC	1/19/59	02 11	2/3/59		3/2/59	AFC	3/6/59	03 10	9 Oct 59	To Engr on 12 Oct 59 DESTROY				04 10	10/29/59		11/17/59	AFC	11/18/59	* XX
9000 Rev. 00		Handling - Seal Adjustment - Valve Assembly Procedure	11	10/30/58		12/2/58	AEAN	12/4/58	01 10	5/28/59	Destroyed by Engrg.	To Engr 6/1/59			2 10	7/15/59		7/23/59	AFC	7/27/59	3 10	12/9/59	20 Engrg 12/14/59	12/17/59	as marked A	12/21/59 Engrg 12/15/59							* XX
9100 Rev. 00		Special Tools & Lifting Devices	11	10/30/58		12/2/58	AFC	12/4/58																									* XX
A-3385		Welding Specifications	11	10/30/58		12/2/58	AEAN	12/4/58	11	12/29/58		1/14/59	A	1/19/59	10	9/25/59	To Engrg 9/30/59	10/20/59	A	10/22/59													
4160.2-4507		1" Plug Valve	11	10/30/58		12/2/58	A	12/4/58																									
A-RTS-511		Self Aligning RT. Bearing	11	10/30/58		12/2/58	RFC	12/4/58	11	1/2/59		1/20/59	A	1/23/59																			
R-23476		Step Seal Ring	11	10/30/58		12/2/58	A	12/4/58																									
Form B-3		Water Pressure Switch	11	10/30/58		12/2/58	RFC	12/4/58																									
2/4935		Air Release & Vacuum Valve	11	10/30/58		12/2/58	RFC	12/4/58																									
B2E-2RN		Switch - Enclosed	11	10/30/58		12/2/58	A	12/4/58																									
No K-679-B		Wedge Gate Valve - Rising Stem	11	10/30/58		12/2/58	A	12/4/58																									
B-68205		Wiring Diagram - By-Pass Valve	11	10/30/58		12/2/58	RFC	12/4/58																									Superseded by Dwg No. B-68302
C-79184		Limitorque Valve Control	11	10/30/58		12/2/58	RFC	12/4/58	11	1/15/59	To Engrg 1/19/59	2/9/59	RFC	2/13/59																			
LD-6568		Lubricating System - Layout	11	10/30/58	No action			12/4/58																									
Sheet 47.06		Dualine Valves	11	10/30/58		12/2/58	A	12/4/58																									
Sheet 47.03		Manual Compressor	11	10/30/58		12/2/58	A	12/4/58	4	4-18-60																							
Sheet 87.71		Barrel Transfer Pump	10	10/30/58		12/2/58	A	12/4/58	4	3-21-60																							
A-3126		Field Welding Procedure	11	10/30/58		12/2/58	AEAN	12/4/58	11	12/29/58		1/14/59	A	1/19/59																			
Form B1G		Welder Qualifications	11	10/30/58	Info Only			12/4/58																									

RECORD OF MANUFACTURER'S PRINTS

MANUFACTURER Willamette Iron & Steel Company

SUBJECT OF CONTRACT Ford Peck Butterfly Valves & Appurtenances

DATE OF AWARD _____ DAYS ALLOWED FOR SUBMISSION OF DWG. 30

U.S.E.D. CONTRACT NO. 59-113

MFR. CONTRACT NO. _____

Sheet #4

MFGS. Dwg. No.	U.S.E.D. File No.	TITLE	FIRST APPROVAL REC'D No.	FIRST APPROVAL REC'D Date	FIRST APPROVAL CHECKED By	FIRST APPROVAL CHECKED Date	FIRST APPROVAL ACTION ACN	FIRST APPROVAL RETURN Date	SECOND APPROVAL REC'D No.	SECOND APPROVAL REC'D Date	SECOND APPROVAL CHECKED By	SECOND APPROVAL CHECKED Date	SECOND APPROVAL ACT ACN	SECOND APPROVAL RET Date	THIRD APPROVAL REC'D No.	THIRD APPROVAL REC'D Date	THIRD APPROVAL CHECKED By	THIRD APPROVAL CHECKED Date	THIRD APPROVAL ACT ACN	THIRD APPROVAL RET Date	FOURTH APPROVAL REC'D No.	FOURTH APPROVAL REC'D Date	FOURTH APPROVAL CHECKED By	FOURTH APPROVAL CHECKED Date	FOURTH APPROVAL ACT ACN	FOURTH APPROVAL RET Date	FIFTH APPROVAL REC'D No.	FIFTH APPROVAL REC'D Date	FIFTH APPROVAL CHECKED By	FIFTH APPROVAL CHECKED Date	FIFTH APPROVAL ACT ACN	FIFTH APPROVAL RET Date	REMARKS
Form D-1		Procedure Qualifications	11	12/30/58		Info Only		12/11/58	11	3/20/59		4/13/59	A	4/16/59																			
A-3268		Revision B - Welding Procedure	10	12/2/58		12/9/58	A	12/11/58																									
Form 5781		Weld Flux Sealer	10	12/2/58		12/9/58	A	12/11/58																									
B-5491		Wiring Diag. for Bypass & Drain Valve Interlock	11	12/29/58		1/14/59	A	1/19/59																									
A-3387		Welding Process Spec.	11	12/29/58		1/14/59	AEAN	1/19/59	11	3/20/59		4/13/59	A	4/16/59	10	9/25/59		2o Engrg 9/30/59 10/20/59	AEAN	10/22/59	8	10/20/59		2o Engrg 10/22/59 11/9/59	A	11/10/59							
Sheet 1 and 2		Lockpin Calculation	11	12/29/58		1/14/59	Correction Required																										
AD-115-15	M-11-57	Garlock Chevron Packing	11	12/29/58		1/14/59	A	1/19/59																									
Garlock	260	Sepec. Hydraulic Packing	11	12/29/58		1/14/59	A	1/19/59																									
Model 51		Klozures	11	12/29/58		1/14/59	A	1/19/59																									
Cat. No. 203 A		National O Rings	11	12/29/58		1/14/59	A	1/19/59																									
Cat No. 858		Mercoid Controls	11	12/29/58		1/14/59	A	1/19/59																									
2/4935		Air Release & Vacuum Valve	11	12/29/58		1/14/59	A	1/19/59																									
Bul. No. 1202		Vacuum Valve	11	12/29/58		1/14/59	A	1/19/59																									
Bul No. 1206		Air Release	11	12/29/58		1/14/59	A	1/19/59																									
Add. to Bull. 41		Engineering Data	11	12/29/58		1/14/59	A	1/19/59																									
Garlock Letter dtd. 12/11/58			11	12/29/58		1/14/59	A	1/19/59																									
Bull. No. 41		Lubrite	1	12/29/58		1/14/59																											
A-3389		Disc Fabrication Procedure	11	1/2/59		1/20/59	AEAN	1/23/59																									
5233-4800-0		Indicator Assy & Misc. Details	11	1/5/59	2o Engrg	1/19/59 2/9/59	RFC	2/13/59	dt 11	3/20/59		4/13/59	AFC	4/16/59																			*
B-68302		Wiring Diagram	11	1/5/59	2o Engrg	1/19/59 2/9/59	RFC	2/13/59	11	3/20/59		4/13/59	A	4/16/59																			
I-89298		Oil Filler Cap & Air Filter Unit	11	1/5/59	2o Engrg	1/19/59 2/9/59	A	2/13/59																									

MRG FORM 222 17 FEB 55 (Tentative)

RECORD OF MANUFACTURER'S PRINTS

MANUFACTURER Willamette Iron & Steel Company

SUBJECT OF CONTRACT Fort Peck Butterfly Valves & Appurtenances

DATE OF AWARD _____ DAYS ALLOWED FOR SUBMISSION OF DWG. 30

U.S.E.D. CONTRACT NO. 59-113

MFR. CONTRACT NO. _____

MFGS. Dwg. No.	U.S.E.D. File No.	TITLE	FIRST APPROVAL REC'D No.	REC'D Date	CHECKED By	CHECKED Date	ACTION ACN	RETURN Date	SECOND APPROVAL REC'D No.	REC'D Date	CHECKED By	CHECKED Date	ACT ACN	RET Date	THIRD APPROVAL REC'D No.	REC'D Date	CHECKED By	CHECKED Date	ACT ACN	RET Date	FOURTH APPROVAL REC'D No.	REC'D Date	CHECKED By	CHECKED Date	ACT ACN	RET Date	FIFTH APPROVAL REC'D No.	REC'D Date	CHECKED By	CHECKED Date	ACT ACN	RET Date	REMARKS
					To Engr	1/19/59																										
C-22576		Oil Level Gauge	11	1/15/59		2/9/59	A	2/13/59																								
Sheet 20		Sequence Valve	11	1/15/59		2/9/59	A	2/13/59																								
Sheet 21		" "	11	1/15/59		2/9/59	A	2/13/59																								
Sheet 38		4-Way Valve	11	1/15/59		2/9/59	A	2/13/59																								
Sheet 39		" " "	11	1/15/59		2/9/59	A	2/13/59																								
Bulletin 1-57		Limitorque Valve Controls	11	1/15/59		2/9/59	A	2/13/59	4	3-21-60																						
Form Sheet		Lovejoy Coupling	11	1/15/59		2/9/59	A	2/13/59																								
Page 84		Composition of Oilite Bronze Bearing	11	1/15/59		Information Only																										
Page 66		Bearing AB-820	11	1/15/59		2/9/59	A	2/13/59																								
Page 116		Bearing F-842-Z	11	1/15/59		2/9/59	A	2/13/59																								
5233-5100	Rev. 00	By-Pass Valve Operator & Drain Valve Bracket	11	2/3/59		2/6/59	AEAN	3/6/59	01 11	3/30/59		4/13/59	AEAN	4/16/59	02 10	5/28/59		To Engr 6/16/59	6/1/59 AFC	6/22/59												* **
8100	Rev. 00	Inspection Platform & Ladder	11	2/6/59		2/6/59	AFC	3/6/59																								* **
A-3389	Rev. A	Disc Fabrication Procedure	11	2/3/59		2/6/59	A	3/6/59																								
Bulletin No. EM-157-C		A.O. Smith Electric Motor	11	2/3/59		2/2/59	A	3/6/59																								
Pages 11-19		A.O. Smith Engineering Data	11	2/3/59		2/2/59	A	3/6/59																								
Series 2010A381		Hydreco Pump	11	2/3/59		2/2/59	A	3/6/59	4	3-21-60																						
I.132395		Vickers Sequence Valve	11	2/3/59		2/2/59	A	3/6/59																								
I.182413		Vickers 4-way valve	11	2/3/59		2/2/59	A	3/6/59																								
Page 11-2		A.O. Smith Engineering Data	11	2/3/59		2/2/59	A	3/6/59																								
Page 11		Type FS Kirk Interlocks	11	2/3/59		2/2/59	A	3/6/59																								
Page 5		Kirk Interlocks	11	2/3/59		2/2/59	A	3/6/59																								

RECORD OF MANUFACTURER'S PRINTS

MANUFACTURER Willamette Iron & Steel Company

SUBJECT OF CONTRACT ~~Foot Deck~~ Butterfly Valve & Appurtenances

DATE OF AWARD _____ DAYS ALLOWED FOR SUBMISSION OF DWG. 32

U.S.E.D. CONTRACT NO. 59-113

MFR. CONTRACT NO. _____

Sheet No. 6

	MFGS. Dwg. No.	U.S.E.D. File No.	TITLE	FIRST APPROVAL REC'D No.	FIRST APPROVAL REC'D Date	FIRST APPROVAL CHECKED By	FIRST APPROVAL CHECKED Date	FIRST APPROVAL ACTION	FIRST APPROVAL RETURN Date	SECOND APPROVAL REC'D No.	SECOND APPROVAL REC'D Date	SECOND APPROVAL CHECKED By	SECOND APPROVAL CHECKED Date	SECOND APPROVAL ACT	SECOND APPROVAL RET	THIRD APPROVAL REC'D No.	THIRD APPROVAL REC'D Date	THIRD APPROVAL CHECKED By	THIRD APPROVAL CHECKED Date	THIRD APPROVAL ACT	THIRD APPROVAL RET	FOURTH APPROVAL REC'D No.	FOURTH APPROVAL REC'D Date	FOURTH APPROVAL CHECKED By	FOURTH APPROVAL CHECKED Date	FOURTH APPROVAL ACT	FOURTH APPROVAL RET	FIFTH APPROVAL REC'D No.	FIFTH APPROVAL REC'D Date	FIFTH APPROVAL CHECKED By	FIFTH APPROVAL CHECKED Date	FIFTH APPROVAL ACT	FIFTH APPROVAL RET	REMARKS
1	Page 9		Type F Micro-Switch	11	2/3/59		3/6/59	A	3/6/59																									
2	B-91560		14"-125# Iron Body Gate Valve Assembly	11	3/20/59		4/13/59	AEAN	4/16/59																									
3	B-158602		~~Iron~~ Nut	11	3/20/59		4/13/59	A	4/16/59																									
4	C 79184		Limitorque Valve Control	11	3/20/59		4/13/59	A	4/16/59																									
5	X-1832		Peerless Motor Data Curve	11	3/20/59		4/13/59	A	4/16/59																									
6	Type K		Kirk Interlock Switch	11	3/20/59		4/13/59	A	4/16/59																									
7	Type F		Kirk Interlock Housing	11	3/20/59		4/13/59	A	4/16/59																									
8	Sheet 42	~~Series 200~~	Advance Relays - ~~Magnetic~~ Power ~~Starters and Push~~ Control Relays	11	3/23/59		To Engr 4/9/59	3/26/59 A	4/16/59																									
9	200-300	Series	Terminal Blocks - Marathon	11	3/23/59		To Engr 4/9/59	3/26/59 A	11/12/59																									
10	1300 Series		Stayfoam - American Latex Products Corp	11	5/28/59		To Engr	6/1/59	For Information Only																									
11	D-3700	(For Info. only)	Bolt - Prestressing Set-up	4	5/28/59		To Engr	6/1/59	For Information Only																									
12	19749	(For Info. only)	Certified data on pre-stress determination of Body studs	4	5/28/59		To Engr	6/1/59	For Information Only																									
13	A-3421		Repair Procedure for Valve Bodies	10	6/1/59		6/3/59	~~6/3/59~~ A	6/4/59		7/9/59								To Engr on 13 July 59															
14	5233-2100		Upper Half Body Weldment	4/10	6/9/59		6/25/59	AFC	6/30/59	5/10	7/15/59		7/23/59	AFC	7/27/59	6/10	8/17/59		8/26/59	AFC	8/28/59												* ~~XX~~
15	5233 2200		Lower Half Body Weldment	4/10	6/9/59		6/25/59	AFC	6/30/59	5/10	7/15/59		7/23/59	AFC	7/27/59	6/10	8/17/59		8/26/59	AFC	8/28/59	7/10	9 Oct 59		To Engr on DESTROY	12 Oct 59		8/10	10/29/59		11/17/59	AFC	11/18/59	* ~~XX~~
16	5233 0400	Rev: 0	Joint Detail & Procedure	10	7/15/59		7/23/59 To Engrg 7/20/59	AFC	7/27/59																								* ~~XX~~
17	5233-3100		Disc Weldment Details	06/10	7/17/59		7/23/59	AFC	7/27/57																								* ~~XX~~
18	5233 0200			5/10	8/5/59		8/12/59	AFC	8/13/59	4	3-21-60																					* ~~XX~~
19	~~5233-0400 A3385~~		Joint Detail & Procedure	10	9/25/59		To Engrg 9/25/59 10/20/59	A	10/22/59																									
20	DBH 2385C		Machine Tool Relays	8	8/23/59		10/26/59 To Engrg 10/30/59	A	10/26/59																									
21	~~19717-57~~		~~Tachometer Indicator Spec~~	~~8~~	~~10/26/59~~																													

MRG FORM 222 17 FEB 55 (Tentative)

RECORD OF MANUFACTURER'S PRINTS

MANUFACTURER Willamette Iron & Steel Company

SUBJECT OF CONTRACT Butterfly Valve & Appurtenances

DATE OF AWARD _____ DAYS ALLOWED FOR SUBMISSION OF DWG. 30 days

U.S.E.D. CONTRACT NO. 59-113

MFR. CONTRACT NO. _____

Sheet No. 7

MFGS. Dwg. No.	U.S.E.D. File No.	TITLE	FIRST APPROVAL REC'D No.	REC'D Date	CHECKED By	CHECKED Date	ACTION ACN	RETURN Date	SECOND APPROVAL REC'D No.	REC'D Date	CHECKED By	CHECKED Date	ACT ACN	RET Date	THIRD APPROVAL REC'D No.	REC'D Date	CHECKED By	CHECKED Date	ACT ACN	RET Date	FOURTH APPROVAL REC'D No.	REC'D Date	CHECKED By	CHECKED Date	ACT ACN	RET Date	FIFTH APPROVAL REC'D No.	REC'D Date	CHECKED By	CHECKED Date	ACT ACN	RET Date	REMARKS
5233-2300		Thrust Bearing Details	05 10	12/29/59		1/1/59	AFC	1/1/59																								* XX
5233-0500		Disc & Body Measurements	0 10	12/9/59		12/1/59	For Info	12/21/59																								
5233-0600		As-Built Dimensions and Match Marking	0 10	12/9/59		12/17/59	For Info	12/21/59																								
5233-0700		Disc and Body Measurement	10	1/8/60		Submitted for Info Only																										
5233-0800		As Built Dimensions & Match Marks	10	1/8/60		Submitted for Info Only																										
		Operating Manuals	4	1/18/60		1/21/60 A	2 cys to																									
Sh 87.12		Barrell transfer Pump Parts List	4	3-21-60																												
Model 2010 2000 H3B1		Hydreco - Section + Parts List	4	3-21-60																												
Sh 47.02		Operating Principles	4	4-18-60																												
Sh 47.04A		Compressor Sectional View	4	4-18-60																												

MRG FORM 222 17 FEB 55 (Tentative)

Williamette Iron and Steel Company

WELDING PROCEDURE & OPERATOR CERTIFICATION

A Procedure No. A-3126 REV. A

Code or Spec. AWS STD. & ASME SEC IX 50

SHEET 1

Base Material ASTM 285-C

Range of Thickness 3/16 TO 2

Process MANUAL METAL ARC

Position VERTICAL (OR REQ'D POSITION)

A1 Filler Metal ~~E-6010~~ - E-7016

Pre-Heat NONE

Flames —

Speed, In./Min. —

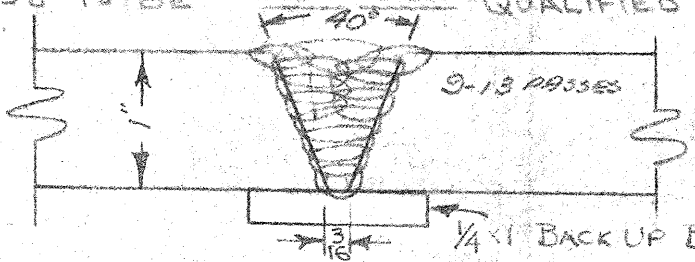
A2 Current DC.-REVERSE POLARITY OR A.C., 60 CYCLE

Welding REMOVE BACK UP BY BURNING, GRINDING, OR CHIPPING

Post Heat Treatment NONE

Date Qualified 8-16-54 FOR E-6010/RE-CERTIFIED FOR E-7016 (7-5-5

A3 OPERATORS QUALIFIED BETWEEN 8/16/54 AND 1/31/58 ARE QUALIFIED FOR WELDING WITH E-6010 ELECTRODES ONLY. OPERATORS QUALIFIE AFTER 1/31/58 TO BE ~~WORK DONE~~ QUALIFIED USING E-7016



OPERATORS QUALIFIED IN THIS PROCEDURE

CERTIFIED VERTICAL UNLESS NOTED.

Name	No.	Date
GAMELL, ROGER	1614	8-16-54
BENTHIN, GUSTAVE	656	"
STORM, WILLIAM	1627	"
SALLIS, JOSEPH	674	"
HARRINGTON, CHARLES	503	"
FREIDEL, RUSSELL	516	"
KLEBAUM, ARTHUR	607	"
LORENTZEN, CLAUS	710	"
CAMPAU, JOSEPH	718	"
QUINCER, JOHN	755	"
MARSTON, GILBERT	771	"
KOZACHENKO, HARRY	1406	"
GOBLE, WILLIAM	1413	"
ROOZING, STANLEY	1432	"
BUCKLEY, GEORGE	1450	"
DAVIS, JOHN	1514	"
GARRISON, GLENN	1547	"
TORANGO, ARTHUR	1560	"
BUNNELL, DONALD	528	"
DRIESEL, ELDON	561	11-23-54

Name	No.	Date
ZASKY, STANLEY	584	11-17-54
WIGGINS, RAYMOND	602	"
FRANK, EDGAR	706	"
WILSON, RAYMOND	715	"
SWANSON, ROBERT	724	"
LAURENT, FRANK	732	"
RYAN, NOBLES	769	"
LOUY, RALPH	781	"
LARSON, LOUIS	782	"
BUBALO, RICHARD	1437	"
WILLIAMS, IRA	1533	"
RUNYAN, GEORGE	1575	"
FRIEMACK, FRED	1585	"
LOHNING, THOMAS	506	1-19-55
LLANES, BENJAMIN	533	"
OLSEN, THOMAS	539	"
HERMANSON, ELMO	559	"
MOORE, DONALD	576	"
LAUNER, EDWARD	579	"
ENDLEY, LOGAN	632	"

A4 — RE-CERTIFIED UNDER 1956 ASME CODE USING E-7016

RECEIVED
DEC 24 1958
CONSTRUCTION DIVISION
RIVERDALE, NORTH DAKOTA

DEC 22 1958

FORM A-3195

Willamette Iron and Steel Company

WELDING PROCEDURE & OPERATOR CERTIFICATION

Procedure No. A-3126 REV. A

A1 Code or Spec. AWS STD ASME ~~-52~~ 56

SHEET 2

Base Material _____

Range of Thickness _____

Process _____

Position _____

Filler Metals _____

Pre-Heat _____

Flame _____

Speed, In./Min. _____

Current _____

Processing _____

Heat Treatment _____

Date Certified _____

JOINT DESIGN

A2 ALL OPERATORS QUALIFIED PRIOR TO 1-31-58 ARE QUALIFIED FOR WELDING WITH E-6010 ELECTRODES ONLY.

OPERATORS QUALIFIED IN THIS PROCEDURE

Name	No.	Date
ROLLING, CHARLES	682	1-19-55
GLTSCH, FRANK	742	"
ANDERSON, EVERETT	765	"
TROEN, EINAR	768	"
HOLLOWAY, LAWRENCE	1440	"
LAPRATH, LEO	1443	"
REED, HARVEY	1494	"
LESSARD, ROBERT	1454	"
JENNINGS, DORRE	1457	"
SPRAGUE, JOSEPH	1459	"
GOULD, LEE	1462	"
HOLLEY, LLOYD	1492	"
CARTWRIGHT, LESTER	1536	"
JANSEN, FRED	1564	"
RATLIFF, ELBERT	1639	"
HOLT, WILLIAM	514	12-20-54
FREY, MARCUS	589	"
RAY, GORDON	645	"
MARONEY, RALPH	1479	"
HOLBROOK, MELVIN	1502	"

Name	No.	Date
IMEL, LUTHER	1615	12-20-54
OLSEN, WALTER	704	3-22-55
WOOD, WILLIAM	1555	"
MOODY, JAMES	1565	"
BASHAM, OVAL	1567	"
OLSEN, WILLIAM	1518	"
BUTLER, LOYD	517	"
KAY, RAYMOND	1442	"
BACKET, JOHN	1451	"
HAMBERG, NEWMAN	545	7-19-55
MCGUIRE, MELVIN	601	" "
DUNAKIN, HOMER	725	" "
RONALD, JAMES	737	" "
YOUNG, JERRY	1461	" "
LEER, GARVIN	1529	" "
MCNATOR, WILLIS	1570	" "
DILLEY, J.L	759	5-12-55
BLANKENFELD, R.B	774	" "
ADAMS, J.G.	786	" "
FINE, G.L	1404	" "

A2- RE-CERTIFIED UNDER 1956 ASME CODE, DATE: 9-5-58 SEE PAGE 1.

FORM A-3195

Willamette Iron and Steel Company

WELDING PROCEDURE & OPERATOR CERTIFICATION

Procedure No. A-3126 REV. A.

(A1) Code or Spec. AWS STD. ASME ~~52~~ 56

SHEET 3

Base Material _____

Range of Thickness _____

Process _____

Position _____

Filler Metals _____

Pre-Heat _____

Fluxes _____

Speed, In./Min. _____

Current _____

Beveling _____

Heat Treatment _____

Date Certified _____

JOINT DESIGN

(A2) ALL OPERATORS QUALIFIED PRIOR TO 1-31-58 ARE QUALIFIED FOR WELDING WITH E-6010 ELECTRODES ONLY.

OPERATORS CERTIFIED IN THIS PROCEDURE

	Name	No.	Date
	BROOKS, R.E	712	5-12-55
RE-QUALIFICATION	HALEY, M.T.	716	" "
	SPAIN, H.P.	762	" "
	RILEY, H.T	1482	" "
	MERRIMAN, C.E	1515	" "
	DWYRE, J.E.	1528	" "
	FARIS, F.L.	1541	" "
	HUDDLE, G.W.	1608	" "
	SANDS, GEORGE	1622	1-9-57
	CARNAHAN, C.	1519	" "
	HALEY, M.T	716	" "
	SMITH, C.	713	" "
	ALEXANDER, F.	542	" "
	GILBERT, ERNEST	747	" "
	HINKLE, L.	603	" "
	GLASSCOCK, H.	1511	" "
	MC HENRY, D.G.	1549	" "
	WENDTE, VICTOR	1513	" "
	ZIMRICK, A.	1630	8-16-54
	L.G. HOLLOWAY	1441	9-19-57

Name	No.	Date
D.K. EVANDER	1430	9-19-57
V.L. KNOX	1423	" "
W.J. MCKINNON		" "
JACK SHAW	694	" "
G.L. CARRELL	1464	" "
LUTHER IMEL	1504	" "
P.S. FLETCHER	1488	" "
C. LORENTZEN	521	" "
R.E. BECKMAN	527	" "
A. SALAZAR	617	10-25-57
H. SCHULTZ	1490	" "
A. RIKERT	719	" "
R. MC MAHON	529	" "
J. LORENTZEN	1469	" "
L. BARNETT	1503	" "
B. WEATHERBY	1469	" "
E. DAVIS	1540	" "
R.L. MELLOTT	1596	" "
GENE HALL	587	10-25-57

(A2) - RE-CERTIFIED UNDER 1956 ASME CODE, DATE: 9-5-58 SEE PAGE 1.

Willamette Iron and Steel Company

WELDING PROCEDURE & OPERATOR CERTIFICATION

Procedure No. A-3126 REV. A.

A1 Code or Spec. AWS STD. ASME ~~52~~ 56

SHEET 4

Base Material _____

Range of Thickness _____

Process _____

Position _____

Filler Metals _____

Pre-Heat _____

Flame _____

Speed, In./Min. _____

Current _____

Preparation _____

Heat Treatment _____

Date Certified _____

JOINT DESIGN

OPERATORS CERTIFIED IN THIS PROCEDURE

Name	No.	Date
L.A. MOODY	1097	10-15-57
J.T. HESS	1045	" "
A.C. MELHOF	1026	" "
H. SCOGGINS	1071	" "
R.W. WILLIAMS	1068	10-15-57
C. SMITH	713	6-19-57
MURLE DOMKE	524	6-19-57
F.L. FARIS	1578	3-21-57
R. MUIR	1577	3-21-57
G. SANDFORD	757	12-13-57
R. SUNDSTROM	1421	12-13-57
W. GRIMMETT	1462	12-13-57
R.L. LEONARD	1478	12-13-57
A. LEAF	1496	12-13-57
R. A. LESSARD	1475	12-13-57
O.M. ACHEN	1515	12-13-57
R. FYOCK	1189	1-2-58
E. DAY	1188	1-2-58
R WESTENFELDER	1191	1-2-58

Name	No.	Date
F. MARINI	1129	1-20-58
L. WALQUIST	1136	1-21-58
J. D'ARCY	1200	1-31-58
G.L. GALE	1201	1-31-58
OPERATORS QUALIFIED PRIOR		
TO 1-31-58 ARE QUALIFIED		
FOR WELDING WITH E-6010		
ELECTRODES ONLY. ALL OPERATORS		
QUALIFIED AFTER 1-31-58 TO		
BE QUALIFIED USING E-7016		
ELECTRODES.		

A2

A2 - RE-CERTIFIED UNDER 1956 ASME CODE, DATE: 9-5-58

SEE PAGE 1.

FORM A-3195

Willamette Iron and Steel Company

WELDING PROCEDURE & OPERATOR CERTIFICATION

Procedure No. A-3126 REV. A

(A1) Code or Spec. AWS & ASME - ~~52~~ 56

Base Material _____

Range of Thickness _____

Process _____

Position _____

Filler Metals _____

Pre-Heat _____

Fluxes _____

Speed, In./Min. _____

Current _____

Deseaming _____

Heat Treatment _____

Date Certified _____

(1.) NORTH FORK DAM - GFA CO. (QUALIFIED USING E-6010 ELECTRODES ONLY.)

JOINT DESIGN

OPERATORS CERTIFIED IN THIS PROCEDURE

	Name	No.	Date
(1.)	G. PULLEN	X	3-14-58
	QUALIFIED FOR WELDING USING		
	E-6010 ELECTRODE ONLY.		
	ALL FUTURE QUALIFICATIONS		
	TO BE QUALIFIED WITH E-7016		
	ELECTRODES.		
RE-QUALIFIED PROCEDURE	F. THOMAS	1022	9-5-58
	F.H. LAURENT	1079	9-22-58
	H.G. HARKEMA	1092	" " "
	K.N. RIFFLE	1061	" " "
	D.W. BUNNELL	1015	" " "
	L. LARSON	1099	" " "
	D. BRITTAIN	1008	" " "
	H. EGGER	1206	" " "
	R. McFERRAN	1051	" " "
	K. BURKE	1005	" " "
	D. McHENRY	1159	" " "
	V. KNOX	1116	" " "
	G.M. MARSTON	1096	10-24-58

Name	No.	Date
E.F. HURNER	1070	10-24-58
G.W. LAVERTY	1062	" " "
J.A. CARLSON	1041	11-5-58
K. HOPMAN	1030	11-10-58
A.K. HINKLE	1175	11-5-58
V. AHLSON	1164	11-25-58
B.E. PHELPS	1027	11-25-58

(A1) 1- RE-CERTIFIED UNDER 1956 ASME CODE DATE: 9-5-58
SEE PAGE 1.

FORM A-3195

FORM E 1051

WILLAMETTE IRON AND STEEL COMPANY

A-3126 REV. A

SHEET 1 OF

JOB NO. JOB NAME DATE

DESCRIPTION

DESIGN BY CHECKED BY APPROVED

A1 PROCEDURE SPECIFICATION FOR MANUAL METAL ARC WELDING OF STRUCTURAL STEEL (Ref. A.W.S. Bridge Specs., ~~1947~~ Ed.) & UNFIRED PRESSURE VESSELS, ~~1952~~ 1956 Code

Specification No. A-3126

Date: July 9, 1954
REV. A: JUNE 10, 1958

Process: Manual Metal Arc

Base Metal: A.S.T.M. 285-C

A2 Filler Metal: A.W.S. ~~E-6010~~ E-7016

Position: Vertical OR AS REQUIRED.

Preparation of Base Material: All excess scale, rust, or grease shall be removed from edges of plates before any welding is done. Joint design shall be per Sketch A-3126.

A3 Welding Current: Direct, Reverse Polarity OR A.C., 60 CYCLE.

Welding Details: Technique, Electrode Sizes, Mean Voltages and Currents shall be substantially as shown on attached Sketch A-3126.

Appearance of Welding Layers: Layers of welding shall be deposited with practically no undercutting on side walls of groove. Any undercutting shall be chipped out before depositing succeeding layer.

Cleaning: All slag or flux shall be removed from any bead of welding before depositing succeeding pass.

Defects: All cracks, blow-holes, and areas of lack of fusion shall be removed from each bead of welding by chipping, grinding or flame gouging before depositing next succeeding layer of weld.

* Peening: No Peening shall be done. ~~between passes when necessary to remove weld slag or scale.~~

Treatment of Underside of Welding Groove: After groove is completely filled, back-up strip shall be removed by grinding, chipping, flame gouging or machining.

Preheating: None required except when necessary to remove excessive moisture from welding groove.

Heat Treatment: None required.

WILLAMETTE IRON & STEEL COMPANY

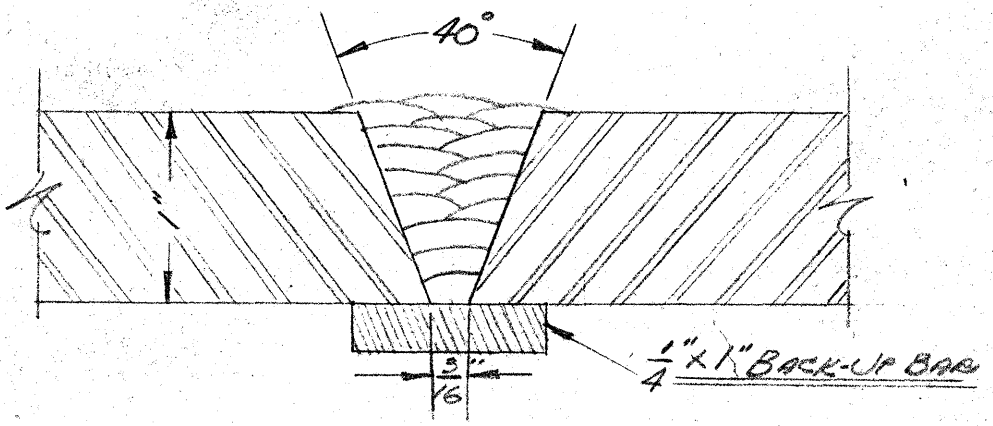
Approved:

George A. Conner

George A. Conner

A3 — RE-CERTIFIED UNDER 1956 ASME CODE, DATE: 9-5-58
FOR E-7016 ELECTRODES.

* THIS CHANGE DOES NOT REQUIRE RE-QUALIFICATION



(A)

NO. PASSES - 9-13

TYPE ELECTRODE - ~~E 6010~~ E-7016

TYPE CURRENT - D.C. REV. POL. OR A.C., 60 CYCLE

SIZE ELECTRODE - 5/32" & 3/16" & 1/4"

AMPS. - ~~125-160~~ 5/32" — 140-190 A., 3/16" — 190-240 A., 1/4" — 250-350 A.

VOLTS - ~~24-28~~ 5/32" — 24-30 V., 3/16" — 26-30 V., 1/4" — 23-30 V.

POSITION - VERTICAL OR AS REQUIRED.

REV. (A) 6-10-58 PROCEDURE RE-CERTIFIED UNDER 1956 ASME CODE FOR E-7016 ELECTRODES, DATE: 9-5-58

(A) WELDING PROCEDURE - A.W.S. STD.
REF. A.W.S. BRIDGE SPECS. - ~~1949~~ 1956 ED. &
A.S.M.E. ~~1952 CODE~~ 1956 CODE, SECTION 9
(APPLICABLE FOR C/E WELDING)

DR. G.A.C SCALE 12" = 1 FT.
TR. _____ DATE 7/9 19~~57~~
CH. _____ APPVD. _____

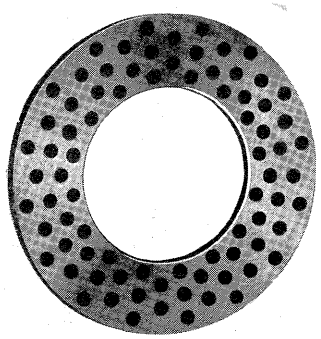
WILLAMETTE IRON AND STEEL COMPANY
2860 N. W. FRONT AVENUE
PORTLAND 10, OREGON

A-~~8~~126
REV. A

Lubrite

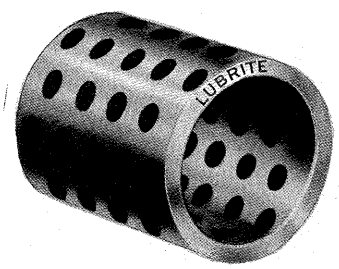
Self Lubricating

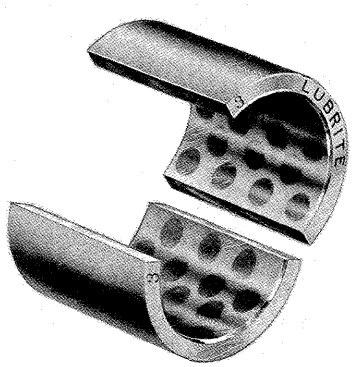
BEARINGS



Engineering Data

ADDENDUM TO
BULLETIN NO. 41





Page

MERRIMAN BROTHERS, Inc.
185 AMORY ST., JAMAICA PLAIN, BOSTON 30, MASS.

DIMENSION DATA

Lubrite Bushings and Bearings are made to suit individual requirements or practice. Lubrite products are finished to size and are ready for assembly without further machine work. Reaming for clearance or alignment will reduce their efficiency and operating life.

The following proportions are recommended:

DIAMETER Bushings of least diameter consistent with shaft strength and stiffness give the highest mechanical efficiency. Where pressures require that bearing area be increased, change the length rather than diameter for a minimum loss of power by friction.

LENGTH If possible, the length of the bushing should not be less than one and one-half times shaft diameter. Although a greater ratio of length to diameter is desirable, in certain applications such as hoisting sheaves, it is impossible to obtain this ratio. Lubrite bushings are in successful operation in many such places.

THICKNESS In general, the thickness of the wall should be at least 10% of the inside diameter. In diameters under two inches, however, it is necessary to use relatively thicker walls in order to have sufficient metal to provide suitable lubricating recesses economically. We recommend the following minimum wall thicknesses for either one-piece or two-piece bushings.

STANDARD WALL THICKNESSES

I.D. OF BUSHING	WALL THICKNESS
under 1/2"	1/8"
1/2"—13/16"	5/32"
7/8"—1-1/4"	3/16"
1-5/16"—1-5/8"	7/32"
1-11/16"—2"	1/4"
2-1/16"—2-5/8"	9/32"
2-11/16"—3"	5/16"

Over 1-1/4" I.D. the wall thickness can be figured by:

$$\frac{\text{I.D.}}{16} + 1/8\text{" (to nearest } 1/32\text{")}$$

or

$$\text{O.D.} = 1\text{-}1/8 \times \text{I.D.} + 1/4\text{" (to nearest } 1/16\text{")}$$

These proportions provide ample strength and proper quantity of lubricant for satisfactory results. Naturally, other wall thicknesses can be provided. However, an extremely thin wall for the size of bushing is not recommended.

In FLANGED BUSHINGS, the thickness of the flange is ordinarily the same as the thickness of the wall of the bushing.

THRUST WASHER thickness should run from a minimum of 1/8" for small diameters up to 1/2" or more for large diameters. A rough formula is:

$$\text{THICKNESS} = \frac{\text{O.D.}}{16}$$

For washers up to 18" outside diameter a thickness of 1/2" will usually be sufficient.

SPEEDS AND LOADS

Lubrite Bushings are designed primarily for medium and heavy loads and slow and medium speeds. They are not recommended for shaft surface speeds over 500 feet per minute, at conservative loads.

For ordinary service, bearing pressures equal to those customarily used for oil bushings are well within the capacity of Lubrite. For bushings requiring the greater load carrying capacity of Lubrite, the following factors are suggested and are well within the limits of successful Lubrite operation.

PV

	Class of Service	P Maximum Load (p.s.i.)	V Maximum Speed (f.p.m.)	PV Average Factor
Continuous	Conservative	1,000	500	15,000
	General	2,000	300	30,000
Intermittent	Bridge-Hydraulic Power Devices, Large Movable Structures	3,000	100	50,000
	Bridge Bearings Severe Loads, Hoists, Sheaves, etc.	3,500	100	70,000
Slow-Moving & Static	Special	7,000	10	70,000
		15,000	—	Consult our Engineers

P = Bearing Pressure in pounds per square inch of Projected Bearing Area.

$$P = \frac{\text{Total Load on Bearing (pounds)}}{\text{Bearing Length (inches) x Shaft Diameter (inches)}}$$

V = Shaft Surface Speed in Feet per Minute

$$V = 0.262 \times \text{r.p.m.} \times \text{Shaft Diameter (inches)}$$

PV = The product of Actual Speed (V) x Unit Loading (P) should not exceed Average Factor

$$P \times V = PV \text{ (maximum)}$$

Bearings should not be shortened in design simply because the resulting area will bring the product of load and speed within a particular factor, for the lower the pressure, the longer the service life.
The choice of an actual factor to be used in design work is a matter of judgment and experience. Three representative groups are suggested. They do not represent ultimate limits, but are intended as a guide to bearing proportions which will give long, efficient service. Where conditions necessitate a factor greater than 70,000, speeds exceeding 500 feet per minute, pressures greater than 3,500 pounds per projected square inch, or other considerations that may affect the operation of the bearings — consult our engineers. Their experience is at your disposal and their recommendations place you under no obligation.

See Page 3 for proper material selection to suit unit bearing pressure for your application.

MATERIALS AND BEARING VALUES

Lubrite Bushings and Washers may be made with practically any bearing metal to meet the conditions of the application. However, continued tests, experiments, and actual reports from Lubrite installations have enabled us to determine that of all the bearing metals tested, the following have proven the most successful with Lubrite lubrication and will meet the requirements of most applications.

GENERAL DUTY— for unit loadings up to approximately 1200 psi.*

STANDARD LUBRITE BRONZE ALLOY
ONE AND TWO PIECE BUSHINGS

We highly recommend for most applications, our Standard Lubrite Bronze Alloy which was developed in our own Laboratory and Foundry. You will find that this is the most economical high-grade bearing metal for Lubrite lubrication.

The approximate physical and chemical properties are as follows:

CHEMICAL	PHYSICAL		
86% Copper	Ult. Tensile Strength	— 38,000 psi.	min.
9% Tin	Yield Point	— 16,000 psi.	min.
3% Zinc	Elong. in 2 inches	— 25%	min.
2% Lead	Reduction in Area	— 15%	min.

HEAVY DUTY

Medium Speeds —— up to 2000 psi.
Slow Speeds —— up to 3500 psi and higher.**
Static Loads —— up to 7000 psi and higher.**

CAST BRIDGE BEARING BRONZE ALLOY

This material may be ordered under any of the following Specifications:

	ONE PIECE BUSHINGS	TWO PIECE BUSHINGS†
	A. S. T. M. B147-49 Alloy 8c Mil-B-16522 Class 1 S. A. E. 430 Grade B QQ—B—726c Grade C A. S. T. M. B22-51 Grade E	A. S. T. M. B147-49 Alloy 8b Mil-B-16522 Class 2 S. A. E. 430 Grade A QQ—B—726c Grade B
PHYSICAL PROPERTIES	ONE PIECE BUSHINGS	TWO PIECE BUSHINGS†
Ult. Tensile Strength	110,000 psi. min.	90,000 psi. min.
Yield Point	60,000 psi. min.	45,000 psi. min.
Elongation in 2 inches	12% min.	18% min.
Brinell Hardness	210-240	175

Our foundry is completely equipped to produce quality castings for Lubrite Bushings to practically any Bronze Alloy Specification, upon request. However, the above alloys have proven to be very successful and will meet the conditions of most applications.

For unusual applications, Lubrite Bushings have been made from Monel metal, cast iron, stainless steel, Meehanite, Ductile Ni-Resist Cast Iron and Others.

**This loading is conservative and provides ample factor of safety for long service. It is used with equal success up to 2000 psi for slow-moving and static loads.*

***For extremely heavy unit loads, beyond the capacity of other bearings, we suggest our One Piece Bridge Bearing Bronze Lubrite Bushings with internal drilling and Lubriting. These bushings provide extremely high load-carrying capacity and provide high factor of safety for applications where extra long life is a must. Please present your application to our Engineers for their advice regarding higher loadings. No obligation, of course.*

†The change of grade of alloy is necessary for two-piece bushings in order to properly manufacture.

CLEARANCES AND TOLERANCES

The Lubrite lubricating film is considerably thicker than an oil or grease film, therefore, for a running fit, greater clearance is required between bushing and shaft than for oiled bushings. In order to receive maximum life and service Lubrite self-lubricating bushings should not be reamed on assembly.

STANDARD CLEARANCES
(Running Fit)

Shaft Sizes	Clearance (Over Nominal Shaft Size)*
3/8" — 1"	.004-.005"
1-1/16" — 1-3/8"	.005-.006"
1-7/16" — 1-15/16"	.006-.007"
2" — 2-1/2"	.007-.008"
2-9/16" — 2-15/16"	.008-.009"
3" — 4"	.009-.010"
4" — 5"	.010-.012"
5" — Up	.012-.015"

SPECIAL CLEARANCES

Special applications require larger running clearances because of the nature of the operation. A **Coarse Running Fit** should be used for high temperature applications, for sheave bushings, hydro-electric gate rollers and other similar operating conditions. The table on the right will guide you in specifying for this class of duty.

Nominal Shaft Diameter	Coarse Running Fit Allowance in Bore	Press Fit Allowed on Outside Diameter
1-1/8 to 1-9/16	.007 to .013	+ .002 to .003
1-5/8 to 2-1/16	.008 to .015	" "
2-1/8 to 2-15/16	.009 to .017	" "
3 to 3-5/16	.010 to .020	" "
3-3/8 to 3-15/16	.012 to .022	+ .003 to .004
4 to 4-15/16	.013 to .023	" "
5 to 5-15/16	.014 to .025	" "
6 to 6-15/16	.014 to .026	" "
7 to 7-15/16	.016 to .028	" "
8 to 10	.017 to .032	" "
10-1/16 to 12	.019 to .034	" "
12-1/16 to 16	.022 to .039	" "

STANDARD PRESS FIT

up to 4" O.D.....002-.003 inch
over 4" O.D.....003-.004 inch

STANDARD PRACTICES

It is customary that the shaft size be made to the nominal fractional dimension, i.e.; for a 1-1/2" D shaft, the decimal dimension of the shaft is assumed to be: $1.500\ ^{+.000}_{-.001}$ (.001 beyond, either way). If a 1-1/2" I. D. bushing is ordered, we automatically provide the bushing with the proper clearance, i. e., $1.506\ ^{+.001}_{-.000}$ I.D. as obtained from the table of standard clearances.

The above listed clearances are our standard. If other clearances are necessary or the shaft is not to the nominal fractional size, we have a wide range of completed tooling to take care of the majority of possibilities.

The press fit is also assumed to be to the nominal fractional dimension, i. e., for a 1-15/16" O. D. bushing we assume the housing bore is to the nominal size, i. e., $1.937\ ^{+.001}_{-.000}$. The bushing would be supplied with the O. D. $1.940\ ^{+.000}_{-.001}$.

The aforegoing information is provided as a basic guide to assist the designer as to the best and most economical practices for Lubrite. Should the design or application require deviation from the above, our complete facilities make it possible to meet the most exacting requirements.

**"Close-in" due to press fit considered.*

LUBRITE LUBRICANTS

Lubrite products are unlike many other so-called "oilless", "graphite" or "self-lubricating" items in that Lubrite lubricants are completely self-lubricating and **do not** require supplementary lubrication at varying intervals of time. Other "similar-appearing" graphite type bushings have not been able to duplicate the low coefficient of friction and performance of Lubrite.

The Lubrite lubricating film does not break down under severe static or slow moving loads as an oil or grease film tends to do.

Lubrite lubricants have been developed to meet nearly all possible conditions of operation. Specific Lubrite lubricant formulae have been developed to operate best under specific operating conditions.

STANDARD LUBRITE LUBE

This lubricant will meet the great majority of requirements of operation and is supplied on all orders unless the operating conditions warrant our providing a more practicable grade of Lubrite lubricant for the application. Typical uses are as follows:

GENERAL DUTY	TEMPERATURE RANGES UP TO 250°F
UNDER WATER	SUB-ZERO TEMPERATURES
IN STEAM (not super-heated)	EXPOSED TO THE ELEMENTS

If your conditions are other than standard, we should be advised details of your operating conditions to insure our selection of the proper lubricant, i. e., temperature range, and/or, in presence of oil or grease (intermittent oiling or oil bath), and/or, presence of acids or corrosive gasses, and/or must operate in solvent solution, etc.

Since the proper lubricant for the application is the key to Lubrite success, it is important that you obtain the recommendation of our Engineers for your specific conditions.

FINISHES

It is not necessary to provide a ground or polished surface on the pin or shaft. A plain machined finish, approximately 125 microinch rms is all that is desirable. The Lubrite bushing is also supplied with the same finish. This class of finish has proven most satisfactory in conjunction with Lubrite lubrication.

COEFFICIENT OF FRICTION

Lubrite Bushings will run at a coefficient of friction from 0.035 to 0.07 for medium and heavy loads, and, approximately 0.09 for light loads. The coefficient, being a function of the speed and the load, varies with the operating conditions.

FOR DESIGN, it is suggested that a coefficient of friction of ten (10) percent be used. For high temperature and extremely light load applications, it is suggested that a value of fifteen (15) percent be used.

The following information will prove helpful to us and assure your obtaining the proper Lubrite product for the application involved. We vary the bearing metal and the Lubrite lubricant formulae to give best performance for your conditions of operation.

BEARINGS LUBRITE BUSHINGS

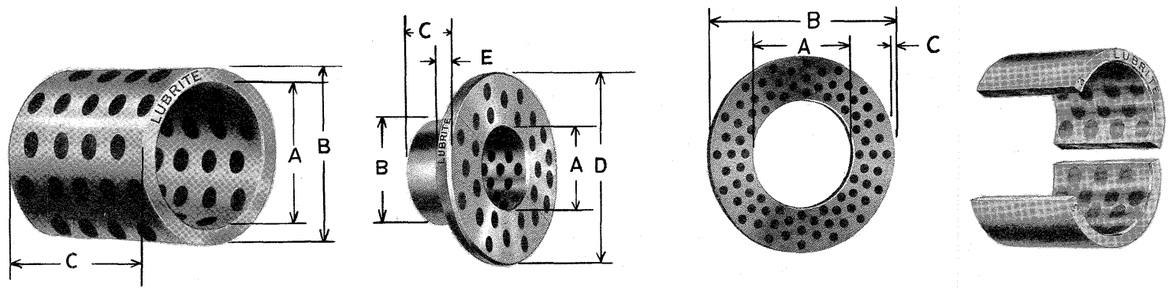
INQUIRY ☐ **ORDER** ☐ **ORDER No.**_____

NAME.....DATE.....

ADDRESS.....B/P OR DWG. NO.....

1. Unit or Machine.....
2. Quantity Required.....
3. One-Piece (Solid).....Two-Piece (Split).....Thrust Washer.....
4. Shaft Diameter, for Bore (A).....
5. Housing Bore, for Outside Dia. (B).....
6. Overall Length (C).....
7. Has Bearing a Flange?.....Diameter? (D).....Thickness? (E).....
   Is Flange Plain or to be Lubrited?.....
8. Load (approx.), in lbs. per sq. in. of Projected Bearing Area.....
9. Speed, in R. P. M.....Motion: Full Revolution.....
   Oscillating.....
   Min. Degrees.....
   Sliding.....
10. If Load or Motion is Intermittent, describe conditions.....
    .....
11. Describe Conditions of Temperature, Moisture, Chemical Vapor, Dust, etc.

Unless you advise to the contrary, it will be assumed that you require a running fit on the bore and a press fit on the outside diameter. (See Page 4 of Engineering Data Manual)



COPIES OF THE ABOVE ORDER FORM ARE AVAILABLE ON REQUEST

FORM E 1081

WILLAMETTE IRON AND STEEL COMPANY A-3385

SHEET 1 OF 2 REV.-A

JOB NO SO 5233 JOB NAME 18' BUTTERFLY VALVE -- C/E DATE 10/30/58

12/16/58 - REV.-A

DESCRIPTION WELDING SPECIFICATION -- FORT PECK BUTTERFLY VALVE

DESIGN BY R.A. RAMONSON CHECKED BY APPROVED R.A. Raymond

APPROVED
U. S. ARMY ENGINEER DISTRICT, GARRISON
CORPS OF ENGINEERS
DATE JAN 14 1959

I. GENERAL:

This specification covers both shop and field welding of the valve body, valve disc, transitions and operator.

II. PROCESS:

A. Shop Welding:

Shop welding shall be performed by the manual shielded metal arc welding process, the submerged melt automatic welding process or a combination of these processes. All welding shall be in accordance with established procedures.
All manual welding electrodes shall be of the low hydrogen type, and shall be suitable for all-position welding. In welding, arcs shall not be struck in other than weld locations.

All shop welding shall be in accordance with the requirements shown on the shop drawings, and shall conform to the requirements of the ASME Boiler and Pressure Vessel Code, applicable to the work, except that stamping with the code symbol and reports will not be required and thermal stress relief shall be as shown on the shop drawings.

B. Field Welding:

A Field welding shall be performed by the manual metal arc welding process, and shall be in accordance with Willamette Iron And Steel Company welding specification No. A-3387 attached.

1. The valve body and transitions shall be field erected in accordance Willamette Iron And Steel Company Drawing Numbers 5233-2100, 5233-2200, and 5233-5000.

2. Field welding shall be in accordance with Willamette Iron And Steel Company Drawing No. 5233-1000.

III. QUALIFICATION OF WELDERS:

All welding both shop and field, on the valve body, valve disc, and transitions shall be done only by welders qualified in accordance with the applicable provisions of the ASME Code, Section IX "Welding Qualifications" 1956 edition, by passing all the necessary tests at the job site irrespective of any previous qualification.

IV. WELDING TECHNIQUE:

1. Preparation for Welding. Members to be joined by welding shall be cut accurately to size and, where required, shall be rolled or pressed to the proper curvature in accordance with dimensions shown on the drawings. The edges of the members shall be sheared, flame-cut, or machined to suit the required type of welding and to allow thorough penetration. The cut surfaces shall expose sound metal free from

A CHANGED WELDING (FIELD) SPEC; WAS A-3126 REV. A

DEC 22 1958

JOB NO SO 5233 JOB NAME 18" BUTTERFLY VALVE -- C/E DATE 10/30/58 12/16/58-REV.-A

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DESIGN BY CHECKED BY APPROVED

(IV. 1 Continued)

laminations, surface defects caused by shearing or flame-cutting operations, or other injurious defects. The surfaces of plates to be welded shall be free from rust, grease, and other foreign matter for a distance of at least 1/2" inch back from the edge of the weld.

2. Cleaning: After being deposited, welds shall be cleaned with a pneumatic slagging gun and grinding, if required, to remove slag and weld spatter.

3. Interpass defects shall be removed by chipping and/or grinding to sound metal.

4. Completed welds shall show uniform cross sections with smooth contour and absence of undercut and overlap. Visual inspection shall show good fusion with the base metal.

V. INSPECTION OF WELDS:

A. Welds shall be inspected by the use of X-Ray or magnaflux as follows:

1. Hydraulic Operator Cylinder:

X-Ray all main welded joints in accordance with ASME Code Section VIII unfired pressure vessels, 1956 edition, Paragraph UW-51.

2. Valve Body And Transition:

Butt X-Ray all full penetration welds magnaflux all other welds.

3. Valve Disc:

Magnaflux all welds.

B. Magnaflux weld inspection shall be done as follows:

Full Penetration Welds:

Magnaflux root pass and each 3/8" thickness of deposited metal including the finish pass.

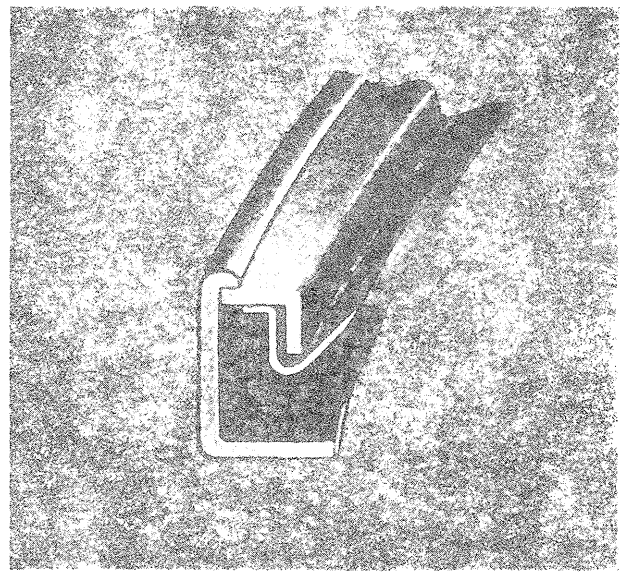
Fillet Welds:

Magnaflux finish pass only.

VI. REPAIR OF DEFECTS:

Defects disclosed by inspection shall be removed by chipping, gouging, or grinding to sound metal and rewelded. Repairs shall be re-examined by the applicable inspection method.

MODEL 51 KLOZURES



The Model 51 Klozure is a general-purpose oil seal consisting of a synthetic rubber sealing member, a metal adapter and a serrated, finger-type spring, all enclosed in a metal case.

The synthetic sealing member is molded to accurate size and has a cross-sectional shape resembling a modified "V." The exclusive Garlock compound from which this ring is made is resilient; oil-resistant; heat-resistant; impervious to water, mild acids and alkalies; tough and durable; and nonabrasive. It is a sturdy ring of relatively heavy section.

The finger-type spring supplements the inherent resiliency of the sealing member. This spring is an exclusive Garlock design, formed in precision dies and properly heat-treated to predetermined exacting standards. It is a flexible unit with each finger delivering independently its required light pressure to the lip of the sealing member. Normal temperatures encountered in oil seal service do not affect the flexibility of the spring; and hard greases, dirt or foreign material, which frequently are encountered in oil seal applications and which may impede or destroy the action of springs of other types, cannot interfere with or hinder the action of this spring.

The metal adapter and metal case are made from sheet metal carefully selected and sorted to close thickness tolerances. Dies of the most modern type produce the case to such a high degree of precision that the surface of the outside diameter has a finish comparable to a polished finish and no grinding is required. As a result of this precision, the metal in the case is uniform throughout in thickness and does not have the thick and thin areas in its periphery which result when a grinding operation is necessary. Also, the danger of trapping abrasives, metal particles or dust in the case, which result from grinding, is eliminated.

The metal case and adapter are made of steel unless otherwise specified. When service conditions require, however, these parts may be made of cadmium-plated, tin-plated or zinc-plated steel or of stainless steel or brass.

Steel springs are supplied with standard steel cases and tempered beryllium copper springs with plated steel, stainless steel or brass cases.

Model 51 Klozures are recommended for low- or medium-speed rotary service and may also be used where an oil seal is required on a reciprocating rod or against pressures up to 35 p.s.i. of lubricating media subject to limitations on shaft sizes and shaft speeds. The sealing lip in this model is less flexible and sensitive than in Models 53 and 63 and, therefore, is not suitable for shaft speeds in excess of 1000 feet per minute or on shafts with high runout or eccentricity. Suitable for operating temperatures up to 300° F.

This model is available in sizes ranging from the smallest size up to and including 3″ shaft x 4.003″ bore and in a limited number of large sizes as shown in the table of sizes on pages 44 to 59 and 64 to 71.

KLOZURE SIZES and PART NUMBERS

Shaft Diameter	Bore Diameter	Klozure Dimensions		Klozure Part No.		
		O.D. ±.002	Width ±1/64			
A (Inches)	B (Inches)	C (Inches)	D (Inches)	Model 51	Model 53	Model 64
11-1/8 (11.125)	12.625	12.635	3/4	51X4042		
	12.750	12.760	3/4	51X4043		
	12.875	12.885	3/4	51X4044		
	13.000	13.010	3/4	51X4045		
11-1/4 (11.250)	12.750	12.760	11/16			64X4527
			3/4	51X4046	53X4046	
	13.250	13.260	13/16			64X4047
			1		53X3703	
	13.500	13.510	1	51X4048		
11-5/16 (11.312)	13.375	13.385	1	51X4049		
11-3/8 (11.375)	12.875	12.885	3/4	51X4050		
	13.000	13.010	3/4	51X4051		
	13.375	13.385	13/16			64X4052
			1		53X4053	
	13.500	13.510	1		53X3704	
11-7/16 (11.437)	13.000	13.010	11/16			64X4054
			3/4		53X4055	
			1		53X4056	
11-1/2 (11.500)	13.000	13.010	11/16			64X4057
			3/4		53X4058	
			1		53X4059	
	13.250	13.260	3/4		53X4060	
	13.375	13.385	3/4		53X4061	
	13.500	13.510	3/4		53X4062	
			13/16			64X4063
			1		53X3705	
11-3/4 (11.750)	13.250	13.260	11/16			64X4064
			3/4		53X4065	
			13/16			64X4528
	13.750	13.760	1	51X3706	53X3706	
	13.875	13.885	1	51X4066		
	14.000	14.010	1	51X3707		
11-13/16 (11.812)	14.000	14.010	1	51X3708		
12 (12.000)	13.500	13.510	3/4	51X4067		
	13.625	13.635	3/4	51X4068		
	13.750	13.760	3/4	51X4069		
	13.875	13.885	3/4	51X4070		
	14.000	14.010	3/4	51X4071		
			13/16			64X4072
			1		53X3709	
	14.250	14.260	1	51X3710		
	14.500	14.510	1	51X3711		
	14.750	14.760	1	51X3712		
12-1/8 (12.125)	14.000	14.010	1	51X4073		
12-1/4 (12.250)	13.750	13.760	3/4	51X4074		
	14.250	14.260	13/16			64X4075
			1	51X3713	53X3713	
12-3/8 (12.375)	13.875	13.885	11/16			64X4076
			3/4		53X4077	
	14.500	14.510	1	51X4078		
12-1/2 (12.500)	14.000	14.010	11/16			64X4079
			3/4	51X4080		
	14.250	14.260	3/4	51X4081		
	14.500	14.510	3/4	51X4082		
			13/16			64X4083
			1	51X3714	53X3714	
	14.625	14.635	1	51X4084		
	14.750	14.760	1	51X4085		

Shaft Diameter	Bore Diameter	Klozure Dimensions		Klozure Part No.		
		O.D. ±.002	Width ±1/64			
A (Inches)	B (Inches)	C (Inches)	D (Inches)	Model 51	Model 53	Model 64
12-5/8 (12.625)	14.125	14.135	3/4	51X4086		
	14.250	14.260	3/4	51X4087		
	14.500	14.510	3/4	51X4088		
	14.625	14.635	1	51X3715		
	14.750	14.760	1	51X3716		
12-11/16 (12.687)	14.750	14.760	1		53X3717	
12-3/4 (12.750)	14.250	14.260	11/16			64X4089
	14.750	14.760	1	51X4090		
	14.875	14.885	1	51X4091		
	15.000	15.010	1	51X4092		
12-7/8 (12.875)	14.750	14.760	1	51X3718		
13 (13.000)	14.500	14.510	11/16			64X4093
			3/4	51X4094	53X4094	
	14.625	14.635	3/4		53X4095	
	14.750	14.760	3/4		53X4096	
	14.875	14.885	3/4		53X4097	
	15.000	15.010	3/4		53X4098	
			13/16			64X4099
			1	51X3719	53X3719	
13-1/8 (13.125)	15.125	15.135	1	51X4100		
13-1/4 (13.250)	14.750	14.760	11/16			64X4101
			3/4	51X4102	53X4102	
	14.875	14.885	3/4	51X4103	53X4103	
	15.000	15.010	3/4	51X4104		
	15.125	15.135	3/4	51X4105		
	15.250	15.260	3/4	51X4106		
			1	51X4107		
	15.375	15.385	3/4	51X4108		
			1	51X4109		
	15.437	15.447	3/4	51X4110		
			1	51X4111		
	15.500	15.510	3/4	51X4112		
			1	51X4113		
	15.562	15.572	3/4	51X4114		
			1	51X4115		
	15.750	15.760	3/4	51X4116		
	16.000	16.010	3/4	51X4117		
13-5/16 (13.312)	15.375	15.385	1	51X4118		
	15.437	15.447	1	51X4119		
	15.500	15.510	1	51X3720		
13-3/8 (13.375)	15.375	15.385	1	51X4120		
13-1/2 (13.500)	15.000	15.010	11/16			64X4121
			3/4	51X4122	53X4122	
	15.125	15.135	3/4	51X4123		
	15.250	15.260	3/4	51X4124		
	15.375	15.385	3/4	51X4125		
	15.437	15.447	3/4	51X4126		
	15.500	15.510	3/4	51X4127		
			13/16			64X4128
			1	51X3721	53X3721	
13-3/4 (13.750)	15.250	15.260	11/16			64X4529
			3/4		53X4530	
	15.500	15.510	3/4		53X4531	
	15.750	15.760	3/4		53X4532	
			13/16			64X4129
			1	51X3722	53X3722	
	16.000	16.010	1	51X3723		
13-15/16 (13.937)	15.437	15.447	11/16			64X4130
	15.750	15.760	1	51X3724		

28

Special Hydraulic Packing

FOR...

Hot or cold water.

ON...

Pistons or plungers of inside packed pumps.

Also used as anti-extrusion end rings in combination with other packings on rod packing installations.

Construction Garlock Special Hydraulic Packing is constructed of plies of fine, cotton fabric treated with a special Garlock rubber compound and finished with muslin top and bottom covers. The material is unlubricated and ungraphited.

Regular cure, which is suitable for most applications is supplied unless otherwise specified. For some hot water services, however, rock-hard cure is desirable and will be furnished if specified.

Forms Garlock 261 Rings are furnished in specified inside and outside diameters and are regularly supplied with step-cut joint but are also available with bevel-cut or butt joint. If solid rings are required specify Garlock 260.

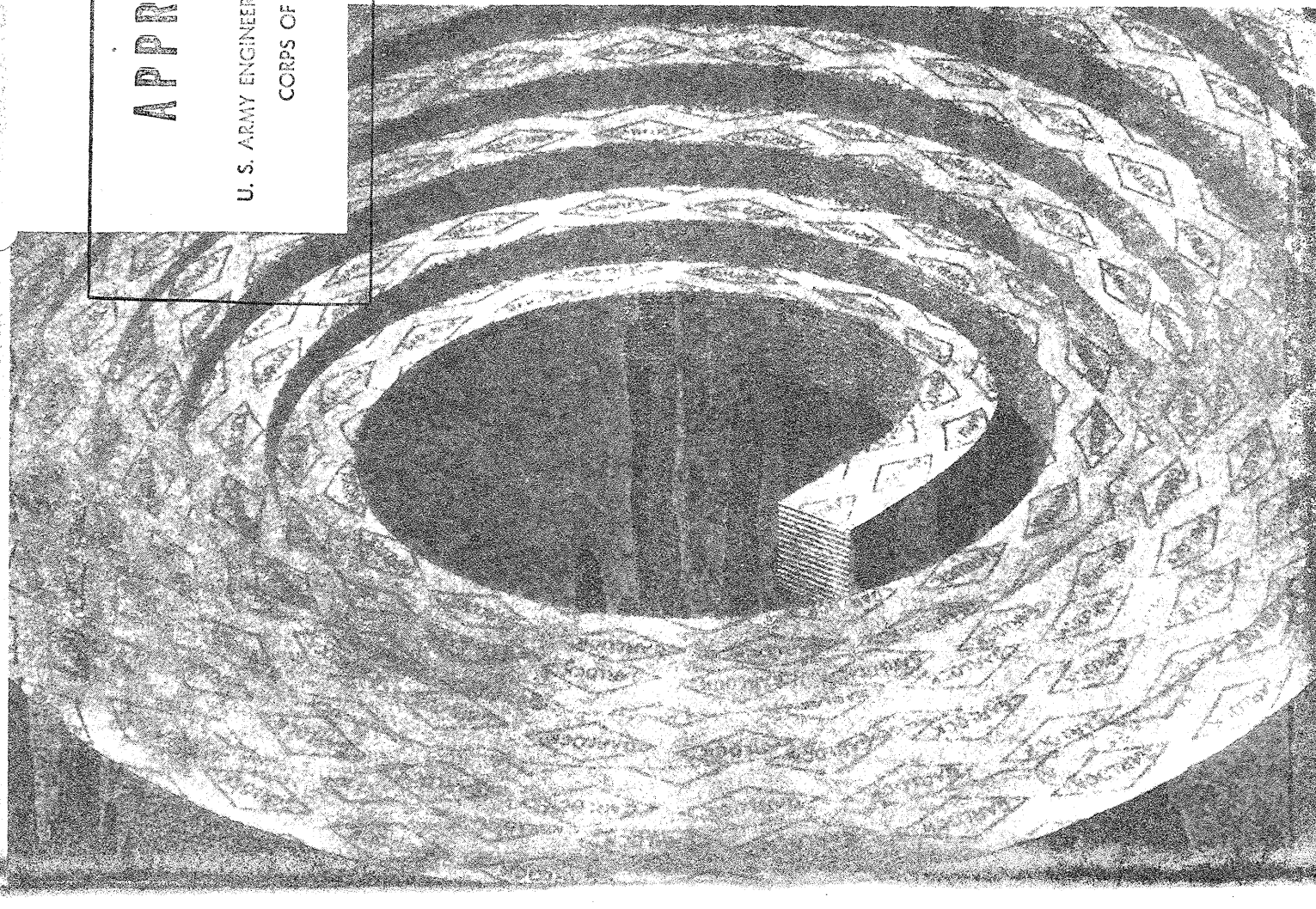
Garlock 262 Coil is furnished in standard 15-foot lengths, square or rectangular in cross section. Regular thicknesses are from $\frac{1}{4}$" to $1\frac{1}{4}$" advancing by eighths. Standard packing sizes are from $\frac{1}{8}$" to $1\frac{1}{4}$" advancing by sixteenths. Packaging data for sizes up to 1" are shown below.

GARLOCK 262 Coil

Packing Size	1/8	5/32	3/16	7/32	1/4	9/32	5/16	11/32	3/8	13/32	7/16	15/32	1"
Coils per box	8	4	4	3	3	2	2	2	2	2	1	1	1	1
Feet per box—approx.	120	60	60	45	45	30	30	30	30	30	15	15	15	15
Pounds per box—approx.	$2\frac{1}{2}$	2	$2\frac{3}{4}$	$3\frac{1}{8}$	$3\frac{1}{2}$	$4\frac{5}{8}$	$5\frac{3}{4}$	$7\frac{1}{2}$	$8\frac{1}{4}$	$11\frac{1}{4}$	12	$7\frac{1}{4}$	8	$9\frac{3}{4}$	$10\frac{1}{2}$

GARLOCK 260 RING (Solid) GARLOCK 261 RING

GARLOCK 262 COIL (Illustrated)



CHEVRON

AUTOMATIC

CHEVRON
Reg. U. S. Pat. Off.

THE CHEVRON TRADE-MARK

GENUINE CHEVRON PACKING is manufactured only by The Garlock Packing Company. It can always be identified by the registered trade-mark above which appears on a tag attached to every set of Garlock CHEVRON Packing.

GARLOCK CHEVRON* PACKING

for rams, plungers and reciprocating rods

1. Assures a low friction, positive seal.
2. Lasts much longer, needs less maintenance than ordinary V-type packing.
3. Works efficiently in a shallow stuffing box.

*CHEVRON is a registered trade-mark of The Garlock Packing Company

1

Garlock CHEVRON packing is entirely different from ordinary V-type packings. CHEVRON packing has an exclusive hinge-like construction. This permits free operation with minimum friction at all pressures.

With increasing pressures CHEVRON packing rings tighten to prevent leakage. As pressures decline, the rings instantly ease off and permit free operation of the rod, ram or piston without leakage.

On a machine with hydraulically operated clutches—¾″ cylinder, maximum pressure 500 p.s.i., service intermittent, maximum travel ¾″—customer used cups, then O-rings, neither of which worked well. Now packed with Garlock 431 CHEVRON ⅜″ x ¾″ x 17/32″ deep and do a smooth, positive sealing job.

2

The low-friction properties plus the variety of materials in which CHEVRON packing is furnished, assure long life. Also, with proper initial adjustment of the gland, no later adjustments are necessary to compensate for variations in pressures.

On hydraulic press—40″ ram, 6000 p.s.i., ram honed and chrome plated, gland machined to give clearance of .006″ between gland and ram, Garlock CHEVRON packing size 40″ x 41½″ x only 2″ deep gave 14 years service.

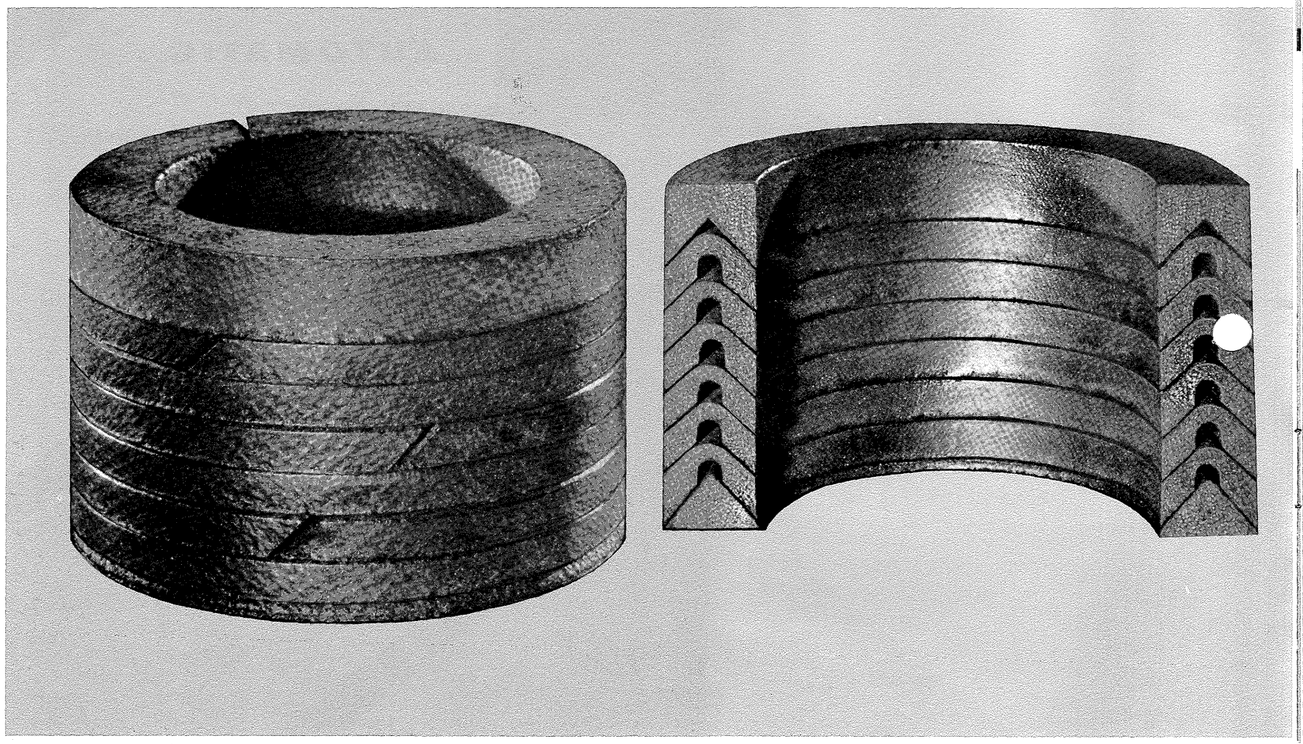
3

The design of Garlock CHEVRON packing permits the use of a greater number of rings in a shallower stuffing box depth than is the case with ordinary packing. For further information see the depth tables on pages 4, 5 and 7.

TO ORDER CHEVRON PACKING

Specify:

1. Diameter of rod or plunger
2. Diameter of stuffing box
3. Depth of stuffing box
4. Extreme gland entrance into stuffing box
5. Bevel of gland
6. Bevel of bottom of stuffing box
7. Type of fluid
8. Pressure
9. Temperature
10. Number of sets required



IF IT ISN'T GARLOCK IT ISN'T CHEVRON PACKING

POPULAR GARLOCK CHEVRON STYLES

Style No.	Materials of Construction	Generally Recommended For Use Against
430	Cotton duck and rubber compound	Hot or cold water up to 300° F. Max.
431	Cotton duck and oil-resistant neoprene	Cold oils and other rubber solvents up to 300° F. Max.
432	Cotton duck and nitrile rubber	Oils at low and medium temperatures. Non-corrosive during protracted periods of idleness up to 300° F. Max.
433	Cotton duck and butyl rubber	Phosphate ester base hydraulic fluid—(not suitable for petroleum oils). Fire resistant types up to 225° F. Max.
530	Asbestos cloth and rubber	Steam, air or gas at temperatures up to 600° F.
531	Asbestos cloth and neoprene	Oils and other rubber solvents at temperatures up to 300° F.
7262	Asbestos and rubber—molded rockhard	Steam, air, oil,—up to 600° F. Max.
7815	Special rubber compound containing asbestos fibre (homogeneous)	Water-base non-flammable hydraulic fluids and warm or cold oils up to 225° F. Max.
7857	Cotton duck and rubber—molded rockhard	Water or oil in very heavy hydraulic service and non-flammable hydraulic fluids of the phosphate ester type. Also for high temperature up to 300° F. Max.
8051	Cotton duck and white rubber	Equipment in dairy and food industries where white packing material is desired.
8452	Buna-N rubber (homogeneous)	Cold and warm oils up to 225° F. Max.
8764	Teflon*	All services except molten alkali metals and fluorine at elevated temperature—from −110° F. to + 500° F. Max.
9291	Kel-F**	Chemicals, caustics, alcohols, mineral oils and aliphatic hydrocarbons—from −120° F. to +325° F. Max.

*Teflon—duPont's trade-mark for its tetrafluoroethylene resin.

**Kel-F—Registered trade-mark of Minnesota Mining & Mfg. Co. for its fluorocarbon plastic.

FURNISHED IN RINGS

Garlock CHEVRON packing is furnished in ring form only. It is usually supplied in complete sets, consisting of a top and bottom adapter ring conforming, respectively, to the bevel of the gland and stuffing box, and a sufficient number of CHEVRON rings to make up the required depth.
For depth tables see page 4, 5, and 7.

ADAPTER RINGS

Top and bottom adapter rings are usually made of the same material as the CHEVRON packing rings. However, for pressures above 3000 p.s.i., the use of filler rings and/or rockhard or metal adapter rings (see page 6) is suggested.

The table below is for general guidance. Many satisfactory CHEVRON packing installations can be made with packings smaller or larger than the sizes indicated and with a lesser or greater number of rings than shown.

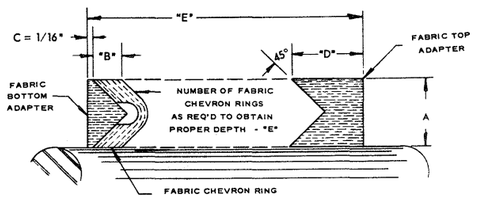
General Recommendations for Chevron Packings Against Various Pressures

		Diameter of Rod or Ram				
		1″ to 3″	3″ to 8″	8″ to 14″	14″ to 24″	24″ and up
Pressures Up to 1000 Lbs.	Packing Space	3/8″	1/2″	5/8″	3/4″	7/8″
	Number of Chevron Rings	3	3	3	3	3
	Nominal Depth of Set	1″	1 19/64″	1 9/16″	1 53/64″	2 1/8″
Pressures From 1000 to 2000 Lbs.	Packing Space	3/8″	1/2″	5/8″	3/4″	7/8″
	Number of Chevron Rings	4	4	4	4	4
	Nominal Depth of Set	1 3/16″	1 17/32″	1 27/32″	2 5/32″	2 1/2″
Pressures From 2000 to 4000 Lbs.	Packing Space	1/2″	5/8″	3/4″	3/4″	7/8″
	Number of Chevron Rings	5	5	5	5	5
	Nominal Depth of Set	1 49/64″	2 1/8″	2 31/64″	2 31/64″	2 7/8″
Pressures From 4000 to 6000 Lbs.	Packing Space	1/2″	5/8″	3/4″	3/4″	7/8″
	Number of Chevron Rings	6	6	6	6	6
	Nominal Depth of Set	2″	2 13/32″	2 13/16″	2 13/16″	3 1/4″

SPECIAL NOTES

For ease in determining the approximate depth of CHEVRON packings containing fabric, the table on page 5 is published:

1. Depths are approximate.
2. Schedule does not apply to sets with metal adapters.



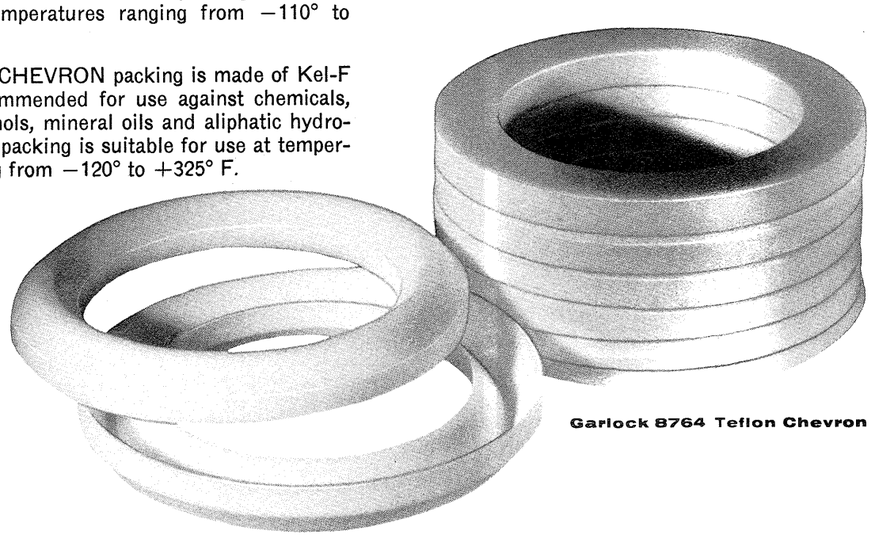
GARLOCK CHEVRON PACKING MADE OF TEFLON AND KEL-F

FOR EXTREMELY CORROSIVE LIQUIDS AND GASES

Low Coefficient of Friction... Non-Adhesive

Garlock 8764 CHEVRON PACKING is made of Teflon which is chemically inert to all materials except molten alkali metals. This packing is suitable for use at temperatures ranging from −110° to +500° F.

Garlock 9291 CHEVRON packing is made of Kel-F which is recommended for use against chemicals, caustics, alcohols, mineral oils and aliphatic hydrocarbons. This packing is suitable for use at temperatures ranging from −120° to +325° F.



Garlock 8764 Teflon Chevron Packing

Approximate Depths for Chevron Packings Containing Fabric

Nominal Packing Space "A"	Stack Ht. of One CHEVRON Ring "B"	Height of Adapter Rings "C" + "D"	Total Depth "E" (Which Includes "C" Plus "D" Plus Number of CHEVRON Rings as Indicated)								
			1 Ring	2 Rings	3 Rings	4 Rings	5 Rings	6 Rings	7 Rings	8 Rings	9 Rings	10 Rings
3/16″	7/64″	5/16″	2 7/64″	1 7/32″	4 1/64″	3/4″	5 5/64″	3 1/32″	1 5/64″	1 3/16″	1 19/64″	1 13/32″
7/32″	7/64″	5/16″	2 7/64″	1 7/32″	4 1/64″	3/4″	5 5/64″	3 1/32″	1 5/64″	1 3/16″	1 19/64″	1 13/32″
1/4″	7/64″	5/16″	2 7/64″	1 7/32″	4 1/64″	3/4″	5 5/64″	3 1/32″	1 5/64″	1 3/16″	1 19/64″	1 13/32″
9/32″	5/32″	1 1/32″	1/2″	2 1/32″	1 3/16″	3 1/32″	1 1/8″	1 9/32″	1 7/16″	1 11/32″	1 3/4″	1 29/32″
5/16″	1 1/64″	3/8″	3 5/64″	2 3/32″	5 7/64″	1 1/16″	1 15/64″	1 13/32″	1 37/64″	1 3/4″	1 59/64″	2 3/32″
1 1/32″	3/16″	13/32″	1 9/32″	2 5/32″	3 1/32″	1 5/32″	1 11/32″	1 17/32″	1 23/32″	1 29/32″	2 3/32″	2 9/32″
3/8″	3/16″	7/16″	5/8″	1 3/16″	1″	1 3/16″	1 3/8″	1 9/16″	1 3/4″	1 15/16″	2 1/8″	2 5/16″
13/32″	3/16″	1 5/32″	2 1/32″	2 7/32″	1 1/32″	1 7/32″	1 13/32″	1 19/32″	1 25/32″	1 31/32″	2 5/32″	2 11/32″
7/16″	1 5/64″	1/2″	4 7/64″	3 1/32″	1 13/64″	1 7/16″	1 43/64″	1 29/32″	2 9/64″	2 3/8″	2 39/64″	2 27/32″
1 5/32″	1 5/64″	9/16″	5 1/64″	1 1/32″	1 17/64″	1 1/2″	1 47/64″	1 31/32″	2 13/64″	2 7/16″	2 43/64″	2 29/32″
1/2″	1 5/64″	1 9/32″	5 3/64″	1 1/16″	1 19/64″	1 17/32″	1 49/64″	2″	2 15/64″	2 15/32″	2 45/64″	2 15/16″
1 7/32″	1 5/64″	5/8″	5 5/64″	1 3/32″	1 21/64″	1 9/16″	1 51/64″	2 1/32″	2 17/64″	2 1/2″	2 47/64″	2 31/32″
9/16″	1 5/64″	2 1/32″	5 7/64″	1 1/8″	1 23/64″	1 19/32″	1 53/64″	2 1/16″	2 19/64″	2 17/32″	2 49/64″	3″
5/8″	9/32″	2 3/32″	1″	1 9/32″	1 9/16″	1 27/32″	2 1/8″	2 13/32″	2 1 1/16″	2 31/32″	3 1/4″	3 17/32″
1 1/16″	9/32″	2 5/32″	1 1/16″	1 11/32″	1 5/8″	1 29/32″	2 3/16″	2 1 5/32″	2 3/4″	3 1/32″	3 5/16″	3 19/32″
3/4″	2 1/64″	2 7/32″	1 11/64″	1 1/2″	1 53/64″	2 5/32″	2 31/64″	2 13/16″	3 5/64″	3 1/32″	3 51/64″	4 1/8″
13/16″	2 1/64″	2 9/32″	1 15/64″	1 9/16″	1 57/64″	2 7/32″	2 35/64″	2 7/8″	3 13/64″	3 17/32″	3 55/64″	4 3/16″
7/8″	3/8″	1″	1 3/8″	1 3/4″	2 1/8″	2 1/2″	2 7/8″	3 1/4″	3 5/8″	4″	4 3/8″	4 3/4″
1 5/16″	3/8″	1 1/16″	1 7/16″	1 13/16″	2 3/16″	2 9/16″	2 15/16″	3 5/16″	3 1 1/16″	4 1/16″	4 7/16″	4 13/16″
1″	13/32″	1 1/8″	1 17/32″	1 15/16″	2 11/32″	2 3/4″	3 5/32″	3 9/16″	3 31/32″	4 3/8″	4 25/32″	5 3/16″
1 1/16″	13/32″	1 3/16″	1 19/32″	2″	2 13/32″	2 13/16″	3 7/32″	3 5/8″	4 1/32″	4 7/16″	4 27/32″	5 1/4″
1 1/8″	29/64″	1 1/4″	1 45/64″	2 5/32″	2 39/64″	3 1/16″	3 33/64″	3 31/32″	4 27/64″	4 7/8″	5 21/64″	5 25/32″
1 3/16″	1/2″	1 5/16″	1 13/16″	2 5/16″	2 13/16″	3 5/16″	3 13/16″	4 5/16″	4 13/16″	5 5/16″	5 13/16″	6 5/16″
1 1/4″	1/2″	1 3/8″	1 7/8″	2 3/8″	2 7/8″	3 3/8″	3 7/8″	4 3/8″	4 7/8″	5 3/8″	5 7/8″	6 3/8″
1 5/16″	35/64″	1 7/16″	1 63/64″	2 17/32″	3 5/64″	3 5/8″	4 11/64″	4 23/32″	5 17/64″	5 13/16″	6 23/64″	6 29/32″
1 3/8″	35/64″	1 1/2″	2 3/64″	2 19/32″	3 9/64″	3 11/16″	4 15/64″	4 25/32″	5 21/64″	5 7/8″	6 27/64″	6 31/32″
1 7/16″	19/32″	1 9/16″	2 5/32″	2 3/4″	3 11/32″	3 15/16″	4 17/32″	5 1/4″	5 23/32″	6 5/16″	6 29/32″	7 1/2″
1 1/2″	41/64″	1 5/8″	2 17/64″	2 29/32″	3 35/64″	4 3/16″	4 53/64″	5 35/64″	6 7/64″	6 3/4″	7 25/64″	8 1/32″

Approximate Depths for Chevron Packings Made of TEFLON and KEL-F

Nominal Packing Space	Stack Height of One CHEVRON Ring	Height of Adapter Rings	Total Depth Which Includes Adapters Plus Number of CHEVRON Rings Indicated							
			1 Ring	2 Rings	3 Rings	4 Rings	5 Rings	6 Rings	7 Rings	8 Rings
3/16″	.083″	.218″	.301″	.384″	.467″	.550″	.633″	.716″	.799″	.882″
7/32″	.083″	.218″	.301″	.384″	.467″	.550″	.633″	.716″	.799″	.882″
1/4″	.083″	.234″	.317″	.400″	.483″	.566″	.649″	.732″	.815″	.898″
9/32″	.123″	.234″	.357″	.480″	.603″	.726″	.849″	.972″	1.095″	1.218″
5/16″	.140″	.265″	.405″	.545″	.685″	.825″	.965″	1.105″	1.245″	1.385″
11/32″	.156″	.265″	.421″	.577″	.733″	.889″	1.045″	1.201″	1.357″	1.513″
3/8″	.156″	.296″	.452″	.608″	.764″	.920″	1.076″	1.232″	1.388″	1.544″
13/32″	.156″	.296″	.452″	.608″	.764″	.920″	1.076″	1.232″	1.388″	1.544″
7/16″	.197″	.321″	.518″	.715″	.912″	1.109″	1.306″	1.503″	1.700″	1.897″
15/32″	.197″	.321″	.518″	.715″	.912″	1.109″	1.306″	1.503″	1.700″	1.897″
1/2″	.197″	.359″	.556″	.753″	.950″	1.147″	1.344″	1.541″	1.738″	1.935″
9/16″	.197″	.398″	.595″	.792″	.989″	1.186″	1.383″	1.580″	1.777″	1.974″
5/8″	.250″	.421″	.671″	.921″	1.171″	1.421″	1.671″	1.921″	2.171″	2.421″

Note: Garlock 8764 and 9291 CHEVRON packings can be furnished in nominal packing space sizes from 3/16″ to 1″ in 1/64″ increments.

HOMOGENEOUS
GARLOCK CHEVRON PACKINGS TO J.I.C. STANDARDS

The Joint Industry Conference has established a set of recommended practices covering the dimensional design of hydraulic equipment. Included is a suggested size table and stacking height for ordinary V-type packings. This table is similar to Aeronautical Standard drawing AN-6225.

The following Garlock CHEVRON packings meet the J.I.C. standards of dimensional design:

GARLOCK 7815 — made of a special rubber compound containing asbestos fibre and generally used against warm or cold oils and water-base non-flammable hydraulic fluids.

GARLOCK 8452 no-hinge — made of Buna-N rubber and generally used against warm or cold oils

Garlock 7815

Garlock 8452 No-Hinge

THE GARLOCK WARRANTY

The Garlock Packing Company guarantees that any product of its manufacture, which upon examination is found by a Garlock representative to be defective either in workmanship or material whereby it is not suitable under proper usage and service for the purpose for which designed, will be replaced free of charge including transportation charges but not cost of installation. This shall be Garlock's maximum liability. The sale of Garlock products under any other warranty or guarantee, expressed or implied, is not authorized by Garlock.

J.I.C. Suggested Sizes for Homogeneous V Packings for Hydraulic Equipment

Nominal Packing Space	¼	¼	¼	¼	¼	¼	¼	¼	¼	5/16	5/16	5/16	5/16	5/16	5/16	5/16	5/16	5/16	3/8	3/8	3/8	3/8	3/8
Nominal Inside Diameter	¼	3/8	½	5/8	¾	7/8	1	1⅛	1¼	1¼	1⅜	1½	1⅝	1¾	1⅞	2	2⅛	2¼	2⅜	2½	2½	2¾	3	3¼	3½
Nominal Outside Diameter	¾	⅞	1	1⅛	1¼	1⅜	1½	1⅝	1¾	1⅞	2	2⅛	2¼	2⅜	2½	2⅝	2¾	2⅞	3	3⅛	3¼	3½	3¾	4	4¼
Stacking Height per Ring ±.010″	.083	.083	.083	.083	.083	.083	.083	.083	.083	.140	.140	.140	.140	.140	.140	.140	.140	.140	.140	.140	.156	.156	.156	.156	.156

Nominal Packing Space	3/8	7/16	7/16	7/16	7/16	7/16	7/16	7/16	½	½	½	½	½	½	½	½	½	½	½	½	½	½	½	½	
Nominal Inside Diameter	3¾	4	4¼	4½	4¾	5	5¼	5½	5½	6	6½	7	7½	8	8½	9	9½	10	10½	11	12	13	14	15	
Nominal Outside Diameter	4½	4⅞	5⅛	5⅜	5⅝	5⅞	6⅛	6⅜	6½	7	7½	8	8½	9	9½	10	10½	11	11½	12	13	14	15	16	
Stacking Height per Ring ±.010″	.156	.197	.197	.197	.197	.197	.197	.197	.197	.197	.197	.197	.197	.197	.197	.197	.197	.197	.197	.197	.197	.197	.197	.197	

GARLOCK CHEVRON PACKINGS FOR EXTREME PRESSURES

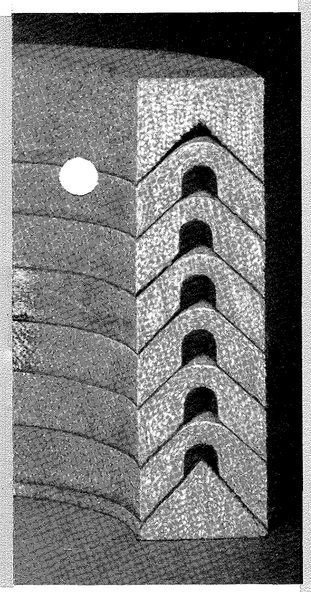
Garlock CHEVRON packing is suitable for use against the highest pressures but when pressures are in excess of 3000 pounds per square inch it frequently is desirable to provide means for reinforcing the packing to prevent undue distortion from the extreme pressure. This can be done in several ways, i.e.,

1 By using metal top and bottom adapters in place of the usual adapters. The metal adapters have a greater over-all stacking height than regular adapters.

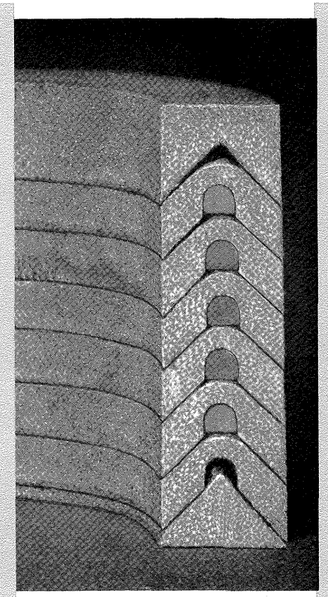
2 By installing metal separator rings between the CHEVRON packing rings. Lead separator rings, $\frac{1}{16}$″ thick, are generally used.

3 By applying "D" shaped molded filler rings in the hinge of the CHEVRON rings. This prevents distortion of the packing without interfering with the automatic hinge-like action of the CHEVRON.

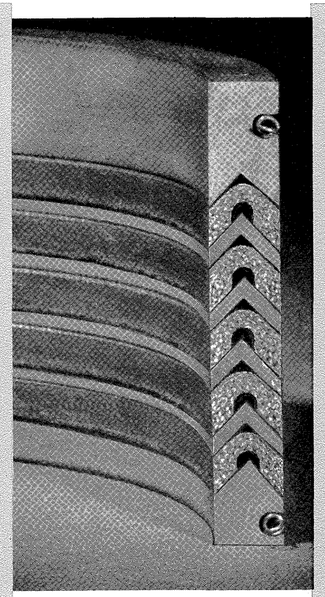
4 By using Garlock 260 (solid) or 261 (cut open) rockhard adapters. These are made of plies of cotton fabric treated with rubber and given a rockhard cure. These adapters are regularly furnished in the same height as shown in the table on page 5 but can be furnished in greater height when desired.



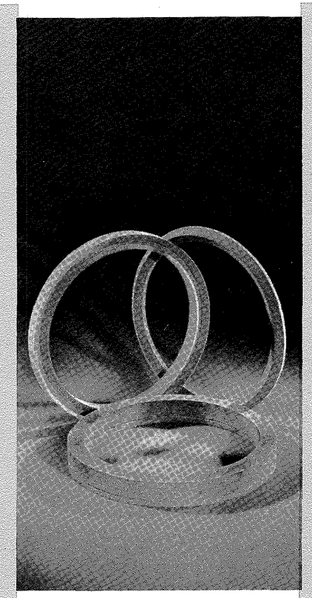
Standard set of Garlock CHEVRON Packing



Garlock CHEVRON Packing With "D" shaped Filler Rings



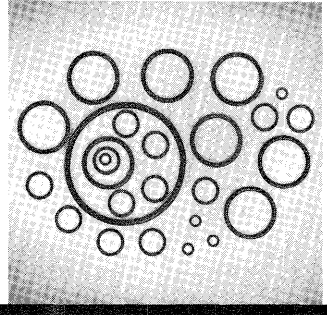
Garlock CHEVRON Packing With Metal Separators and Metal End Rings



Garlock 261 Rockhard Adapters for CHEVRON Packing

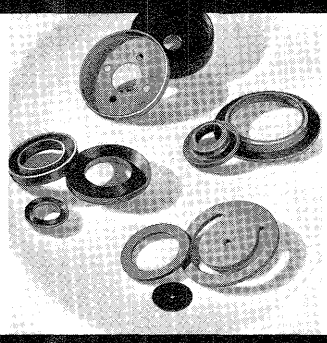
MORE OF "THE GARLOCK 2,000"

Two thousand different styles of packings, gaskets and seals to meet all your needs. The only complete line available. Get unbiased recommendations from your Garlock representative.



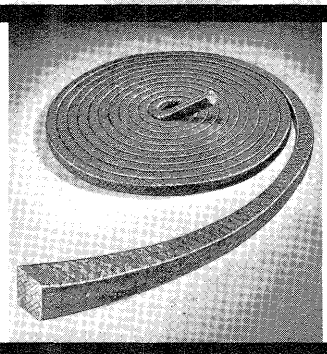
O-Rings and back-up rings (Teflon and rubber) for dynamic sealing and static gasketing.

Ask for catalog AD-148



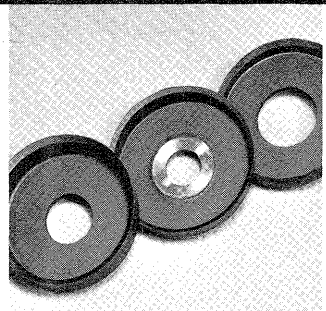
BITAN* Leather Packings: cups, V-packings, flange or hat packings, U packings, washers, gaskets, discs.

Ask for catalog AD-121



LATTICE BRAID* flax packings for hydraulic service.

Ask for catalog AD-131



Molded cups for pump pistons, hydraulic service and pneumatic equipment.

Ask for catalog AD-145

Teflon V rings, piston rings, cups, U-packings, etc.

Ask for catalog AD-155

*Registered trade-mark

The Garlock Packing Co.
Palmyra, New York

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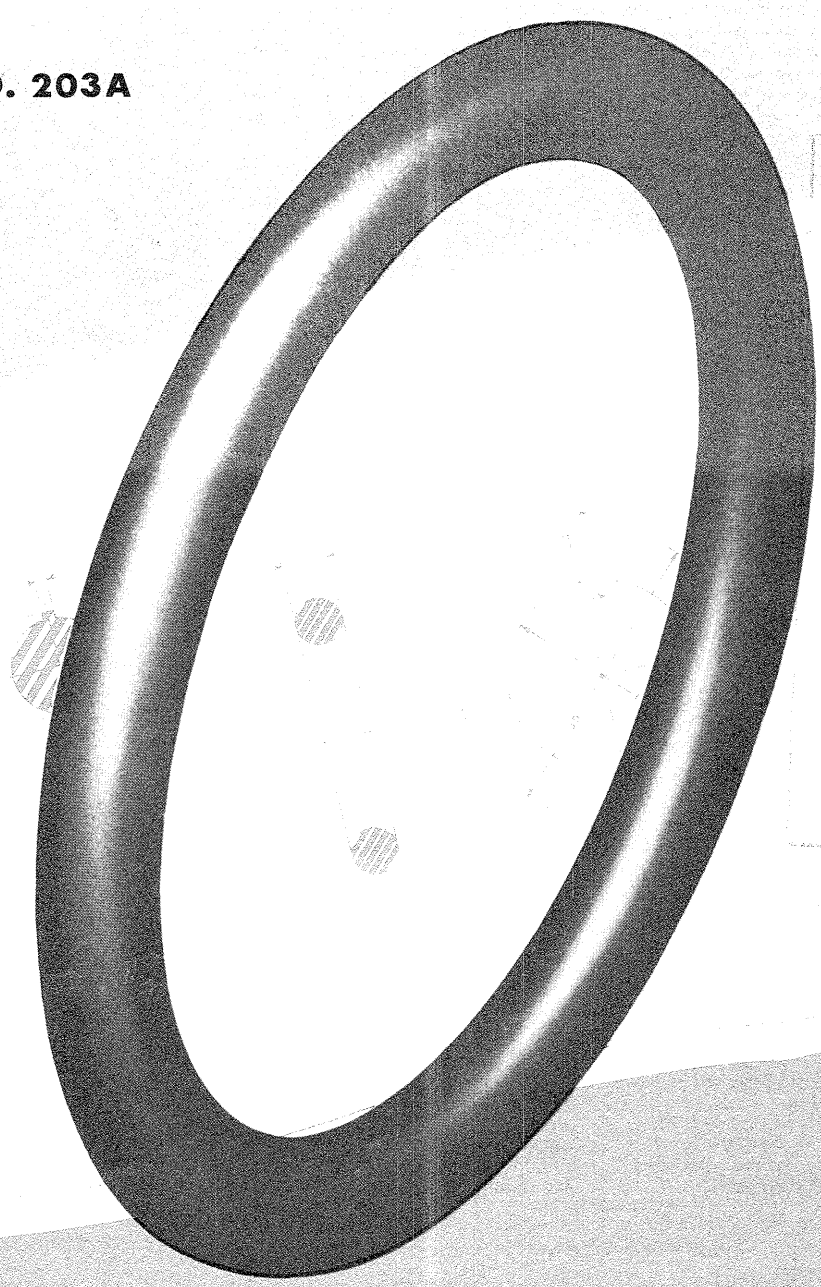


NATIONAL

O-RINGS

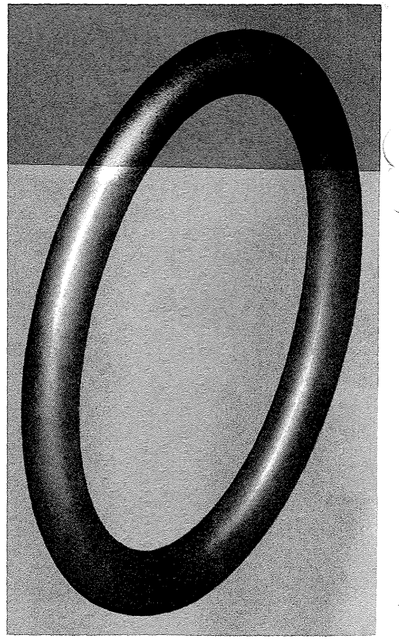
FEDERAL-MOGUL SERVICE

Div. of FEDERAL-MOGUL-BOWER BEARINGS, INC.

DETROIT 13, MICHIGAN, U.S.A.

NATIONAL
OIL SEALS O-RINGS

The urgent military need for better, more efficient, and more practical packing and sealing in aircraft hydraulic equipment led to development of the synthetic rubber O-ring. National Seal Division entered the field in the early stages of development and today National O-rings are used not only in aircraft and vehicle applications, but for almost unlimited applications throughout industry. No other pressure sealing device offers all the advantages O-rings can give.



O-RINGS ADVANTAGES

EFFICIENT AND ECONOMICAL

O-rings are effective in limited spaces. They withstand wide temperature ranges and variable pressures. They seal pressure flow in both directions, and running friction is held to a minimum. Their use eliminates the need for adjustment devices.

SIMPLIFY DESIGN

O-rings eliminate difficult design restrictions and make possible a high power, low bulk assembly with improved performance and lower costs.

PRECISE DIMENSIONS

O-rings, to be efficient, must be held to very close dimensional limitations. National's precision manufacturing techniques and controlled compounds produce an O-ring which meets every requirement.

SURFACE QUALITIES

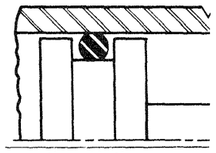
National O-rings have a smooth, flawless, non-porous surface which provides minimum absorption, is non-corrosive, and resists abrasion exceptionally well.

FLASH POINTS

National O-rings are produced with a minimum paper-thin flash which is removed. Flash-point removal is limited to a minute surface area.

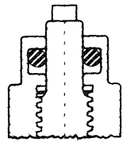
TYPICAL APPLICATIONS

DYNAMIC



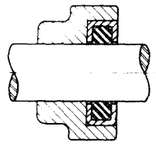
Reciprocating Motion

Extensively used in hydraulic and pneumatic cylinders, valves, boosters, actuators and similar devices.



Oscillating Movement

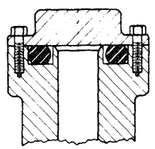
Simplifies construction of mechanism by eliminating gland adjustment devices and multiple packings.



Rotating Motion

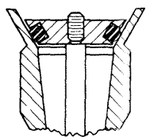
For low rubbing speeds, continuous or intermittent, where the heat is dissipated. A device is required to control diametral squeeze.

STATIC



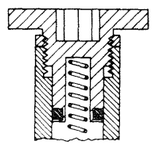
Gasket or Seal

Unlimited use for seals for pressure chambers, end caps, end plates, covers, plugs, unions, couplings, flanges, and many others.



Intermittent Seal

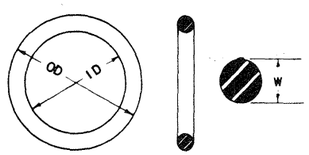
Very efficient under periodic compression, as in valve seats. Offers exceptional resistance to mechanical fatigue.



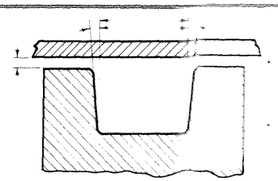
Adjustment Screw Seal

Permits adjustment and provides sealing in a limited space. The low compression set assures constant sealing.

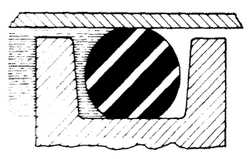
IMPORTANT BASIC APPLICATION PRINCIPLES



Select O-ring to meet required size. It must be consistently uniform and free of surface imperfections to assure good performance under controlled conditions.



Provide a groove which will permit the O-ring to function properly. Size, shape, and finish of this groove are factors which influence the efficiency of an O-ring.



Compound used must be compatible with working conditions. When installed the O-ring must retain essential chemical and physical properties under variable conditions.

INDUSTRIAL O-RINGS

The National Industrial O-ring, because of the inherent stability of its Buna N base, has excellent resistance to most of the commonly used fluids. Its chemical and physical properties make it suitable for effective sealing under a wide range of operating conditions some of which are shown below (Table 1.) For extreme or special service, Special Service O-rings are available to meet practically any assignment. The list of Special Service Compounds (Table 2) shows those in most common use.

WORKING QUALITIES

TEMPERATURE—Industrial O-rings applied under recommended working conditions retain much of their original flexibility and resiliency from —40°F to 300°F, in either dynamic or static applications. Special compounds are available for temperatures from —100°F to 500°F.

PRESSURE—In dynamic applications the O-ring will withstand constant, pulsating, or intermittent loads up to 1500 PSI in either direction of flow without extruding into the clearance gap. Back-up rings which bridge the gap will raise pressure limits to 3000 PSI. In static applications used as gaskets, where metal-to-metal contact can be maintained, they will withstand unlimited pressures.

FRICTION—Friction is not usually a major design problem. Standard sizes for dynamic applications when applied to the recommended groove design, metal finishes and lubricating conditions, provide minimum friction and long wear. Low friction compounds for special applications are available.

TABLE 1—INDUSTRIAL B-46A COMPOUND

SERVICE	RECOMMENDATIONS	TEMP. RANGE
Lubricating oils and greases	All dynamic and static applications. Excellent for automotive engine oils and lubricants, also other petroleum base oils having a minimum aniline point of 150° F.	—40° to +300° F
Hydraulic fluids (mineral base)	All dynamic and static applications used in hydraulic systems. The mineral base oil is used in all industries, including Aircraft, Tractor, Agricultural and Industrial equipment; also Automotive except brake systems which use compound L1. (Table 2)	—40° to +300° F
Coolants, anti-freeze solutions and alcohols	All dynamic and static applications related to coolant service. Commonly used fluids are ethylene glycol, soluble oil and water with or w/out anti-freezes.	—40° to +300° F
Air and inert gases	All pneumatic and pressure applications both dynamic and static related to air services also inert gases such as oxygen, acetelene, carbon dioxide, etc. Means for lubricating the O-ring must be provided.	—40° to +225° F
Gases used as fuel	All static applications related to natural gases, such as butane and propane or coal gases. Also dynamic applications except where a constant minimum friction is required in sensitive devices such as regulators, meters, etc. For low swell applications, use B1. Table 2)	—40° to +225° F
Water	Very adaptable to water service in both dynamic and static applications.	—40° to +212° F
Gasoline—Kerosene (automotive) (aviation non-aromatic)	All dynamic and static applications. For aromatic gasoline use compound B1. (Table 2)	—40° to +160° F
Fuel and Diesel oils	Excellent for static applications related to diesel oils. Also for most dynamic uses except where a constant friction O-ring is needed for sensitive devices such as regulators, meters, etc. For such applications use low swell B1. (Table 2)	—40° to +300° F

PHYSICAL PROPERTIES

	Tensile Maximum psi	Elongation Ultimate %	Hardness Shore A ±5
Original properties obtained	2350	285	70

CHARACTERISTICS AND CHANGES UNDER TEST CONDITIONS SHOW STABILITY AND PERFORMANCE RANGE WELL WITHIN LIMITS

TENSILE—An increase in tensile strength is gained when subjected to oven test at 250°F. or oil immersion at 300°F for a period of 70 hours. Results in tensile strength loss due to the adverse reaction of some fluids is sufficiently light to be neglible.

ELONGATION—Ample flexibility for stretching over protrusions permits easy installation. Test conditions show that changes in the original elongation of 285% is well within required limitations for general applications.

HARDNESS—A high degree of stability is maintained at both extremes of the recommended limits. The original Durometer-A hardness of 70 points gains 9 points when oven tested for 70 hours at 212°F and slight losses or gains are evident when oil tested, depending on fluid specifications.

VOLUME CHANGE—This is an important characteristic to be considered because shrinkage and swell caused by certain fluids and working conditions affect the design and tolerances of metal parts. All volume changes for the recommended fluids and conditions are well within limits compatible with standard groove design.

CORROSION—Does not have any corrosive action against any metals or alloys employed in machinery and will not destroy any fine finishes due to contact.

ABRASION RESISTANCE—This is one of the prime qualities sought after in O-ring sealing for dynamic applications. This has been accomplished to a high degree without sacrificing other required qualities.

COMPRESSION SET—This is another quality which must meet severe tests for O-ring sealing. The National Industrial O-ring will not lose its effectiveness due to compression set. Under average working conditions the compression set is a very slight factor.

ADHESION—This compound material will not adhere to any metals, alloys or other materials used in machinery. Break-out friction curves are not influenced by adhesion.

SPECIAL SERVICE COMPOUNDS

The only necessary departure from the Industrial O-ring is when it does not meet the required chemical resistance or it is necessary to meet an extreme operating condition.

National has a large selection of special compounds for specific purposes and is in a position to meet any difficult assignment. A partial list of special service compounds is shown below (Table 2).

DEVIATIONS from recommended working conditions, services, or physical characteristics can be accomplished. O-ring Data Sheets are available from National to make it easy to submit required information on the liquid or gas to be sealed, temperature ranges, operating pressures, type of application and a drawing of the application, showing tolerances, finishes, etc.

TABLE 2—SPECIAL SERVICE COMPOUNDS

SERVICE	RECOMMENDATIONS	COMPOUND NO.	TEMPERATURE RANGE	DUROMETER HARDNESS
Lubricating Oils	Applicable to extreme low temperature	B3	−65 to +250	70
	Especially compounded for non shrinkage in oils of high aniline point	B14	−40 to +250	70
	For applications requiring high temperature resistance in oil	L3 L13	0 to +350 0 to +350	70 80
	For general purpose usage where a deviation is required in the standard durometer hardness as used in the industrial compound B-46A (Table 1)	B5 B50 B8 B38 B33 B35	−40 to +250 −40 to +250 −40 to +250 −40 to +250 −40 to +250 −40 to +250	90 85 80 60 50 40
Hydraulic Fluids	For use in applications related to hydraulic systems using vegetable base hydraulic oil. For mineral base oil use industrial compound B-46A (Table 1)	L1 L2	−65 to +160 −65 to +160	60 70
	Recommended for Skydraul, Lindol and Pydraul	L14	−65 to +250	60
Fuel	Used in connection with automotive and aromatic gasolene, kerosene and fuel oil where a low swell compound is required to obtain minimum friction in such devices as regulator mechanisms. For general purpose applications use industrial compound B-46A (Table 1)	B7 B25	−20 to +160 −65 to +160	70 60
Gases (inert) and Hot Air	Recommended for use with Butane, Propane and other hydro-carbon gases. May also be used with inert gases. This is a low swell compound for uses where minimum friction is required.	B1	−20 to +160	70
	For use in applications related to high temperature ranges.	S17 S30 S39 L3 L13	−65 to +500 −65 to +500 −65 to +500 0 to +350 0 to +350	50 60 70 70 80
	For use in extreme low and high temperatures	S32	−125 to +500	70
	Recommended for most gases and extreme pressures at normal temperature range.	L14	−65 to +250	60
	Compounded specifically to provide a low compression set at high temperature.	S30	−65 to +500	60
Food and Beverages	Where a tasteless and odorless compound is required for use with foods, CO_2, water, beverages, etc. this compound will meet all such needs.	N1	−40 to +220	70
Refrigerants	Especially suited for use with Freon 12, 22 and 31, also ammonia. When oil of low aniline point is present in applications of Freon 11, 12, 112 and amonia, it is recommended that the industrial compound B-46A be used (Table 1)	N2	−40 to +250	70
Water	Furnished for use where conditions of small dimensional changes in water or low pressure steam is desired.	B37	−40 to +300	70

SPECIFICATION COMPOUNDS

National has developed and can furnish many compounds to customers' specifications. Shown below are some of the popular AMS and MIL specifications. Many other compounds are available including ASTM-SAE No. D735-51T, JIC and Military Specifications MIL, NAVY, AAF and USAF.

TABLE 3—SPECIFICATION COMPOUNDS

SPECIFICATION NO.	APPLICATION	COMPOUND NO.	TEMPERATURE RANGE	DUROMETER HARDNESS
AMS 3200	Petroleum base hydraulic fluids such as ANVO 366B and Mil-o-5606.	B55	−40 to +250	60
AMS 3201	Dry heat	B62	−40 to +275	40
AMS 3202	Dry heat	B54	−40 to +275	60
AMS 3207	Weather	N8	−40 to +250	30
AMS 3208	Weather, sunlight and oils of high aniline point	N10	−40 to +250	50
AMS 3209	Weather	N2	−40 to +250	70
AMS 3212	Aromatic fuel	B4	−40 to +160	60
AMS 3215	Aromatic fuel	B70	−40 to +160	70
AMS 3220	Moderate resistance to fuel lubricant oils and coolants.	N5	−40 to +250	60
AMS 3221	Rapid fuel swelling	N9	−40 to +250	50
AMS 3226	Hot oil and coolant	B13	−40 to +250	50
AMS 3227	Hot oil and coolant	B31	−40 to +250	60
AMS 3228	Hot oil and coolant	B20	−40 to +250	70
AMS 3240	Weather, sunlight and oils of high aniline point	N15	−40 to +250	40
AMS 3242	Weather, sunlight and oils of high aniline point	N14	−40 to +250	80
AMS 7270	Fuel	B17	−40 to +160	70
AMS 7274	Oil	B14	−40 to +160	70
AMS 3301	General purpose silicone rubber	S19	−100 to +500	40
AMS 3302	General purpose silicone rubber	S1	−100 to +500	50
AMS 3303	General purpose silicone rubber	S21	−65 to +500	60
AMS 3304	Low compression set silicone rubber	S26	−65 to +500	70
AMS 3305	Low compression set silicone rubber	S12	−100 to +500	80
MIL-R-6855 Class I-60	Fuel resistant for aircraft application	B34	−65 to +160	60
MIL-R-6855 Class II-40	Oil resistant for aircraft application	N3	−65 to +160	40
MIL-R-6855 Class III-60	Oil resistant for aircraft application	N4	−65 to +160	60

COMPOUND BASES

Certain natural and synthetic rubbers may be specially compounded for either moderately high or low temperature use. Greater stability at one extreme is obtained at the expense of stability at the opposite extreme or other characteristic, therefore, formulating special compounds require careful analysis of working conditions.

Comparative Properties of Compound Bases

PROPERTY	Buna N	Neoprene	Thiokol	Buna S	Butyl	Natural Rubber	Silicone
Typical Tensile Strength: Lbs. per sq. in.	2,500	2,500	1,500	2,000	2,500	3,800	700
Elongation	Good	Excellent	Poor	Good	Excellent	Excellent	Good
Durometer-Hardness	10-100	20-90	20-80	25-100	20-85	10-100	45-85
Stability in Heat	Very Good	Very Good	Poor	Good	Good	Good	Excellent
Stability in Cold	Very Good	Very Good	Good	Good	Good	Excellent	Excellent
Resistance to Abrasion	Excellent	Excellent	Poor	Good	Fair	Excellent	Poor
Resistance to Oil	Excellent	Good	Excellent	Poor	Poor	Poor	Good
Resistance to Petroleum Products	Excellent	Good	Excellent	Poor	Poor	Poor	Good

GLOSSARY OF O-RING TERMS

ADHESION—To bond or adhere to a contact surface.

ANILINE NO. OF OIL—Temperature at which a given amount of aniline reacts with a particular oil. The aniline point generally affects the swell.

BLOOM—Cloudy or white discoloration that sometimes appears on the surface of the O-ring after storage; does not impair the quality of the O-ring.

CROSS SECTION—Area across the O-ring width.

CURING DATE—O-ring molding date.

DYNAMIC—O-ring application in which the O-ring is subject to movement.

ELONGATION—Percent of stretch before breaking.

EXTRUSION—Distortion of part of O-ring into clearance gap.

FLASH—Excess rubber left around O-ring at parting line of mold. Flash is subsequently removed.

FRICTION, BREAK-OUT—Initial friction developed when employed as a dynamic seal.

FRICTION, RUNNING—Constant friction developed during operation of a dynamic O-ring.

FUEL, AROMATIC—Fuel which contains benzene or aromatic hydrocarbons.

FUEL, NON-AROMATIC—Fuel which is composed of straight chain hydrocarbons.

GLAND—Complete assembly, including O-ring, groove and contacting surfaces.

GROOVE—Cavity machined in the metal part to contain the O-ring.

HARDNESS SHORE A—Durometer reading in degrees of the hardness of the rubber. (Shore A hardness of 35 is soft; 90 is hard.)

IDENTIFICATION—Colored dots or stripes on O-rings for identification purposes.

MODULUS—Stress at 100% elongation.

SET, COMPRESSION—Permanent distortion of rubber after compression.

SET, PERMANENT—Permanent distortion of rubber after elongation.

SERVICE—Operating conditions to be met.

SHRINKAGE—Decreased volume.

SIZE, ACTUAL—Actual dimensions of the O-ring, including tolerance limits.

SIZE, NOMINAL—Approximate size of O-ring in fractional dimensions.

SQUEEZE—Cross section compression on the application.

STATIC—Stationary application such as a gasket.

SWELL—Increased volume.

TEMPERATURE RANGE—Lowest temperature at which rubber remains flexible and highest temperature at which it will function.

TENSILE—Pulling strength before breaking, measured in pounds per square inch (PSI).

TORSIONAL STRENGTH—Ability of rubber to withstand torque.

ABBREVIATIONS

AF	Air Force
AMS	Aeronautical Material Specification
AN	Air Force—Navy
AND	Air Force—Navy Design
ASTM	American Society for Testing Materials
JIC	Joint Industry Conference on Hydraulic standards for Industrial Equipment
MIL	Military
MS	Military Standard
PSI	Pounds Per Square Inch
SAE	Society of Automotive Engineers
USAF	United States Air Force

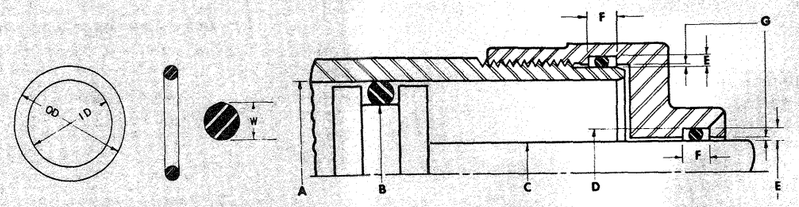
CHECK LIST OF O-RING FAILURES

O-ring failure can be caused by many conditions not related to its manufacture. To assist in detecting a condition of this nature, we are listing below some of the causes which have been experienced.

- ☐ O-ring *pinched* during installation.
- ☐ O-ring *damaged* during installation by sharp edges, threads or burr.
- ☐ *Temperature* rise beyond limitations.
- ☐ *Pressure* surge beyond limitations.
- ☐ *Corrosive agent* added to fluid.
- ☐ *Scratched* running surface prior to assembly.
- ☐ *Dust excluder* not replaced when worn out.
- ☐ *Metal parts* out of tolerance.
- ☐ *Finish* of metal parts not up to specifications.
- ☐ *Running dry* due to lubricant starvation.
- ☐ Foreign *abrasive material* in the lubricant.
- ☐ Application *not protected* when spray painted.
- ☐ *Lubricating value* of fluid lowered when changed and no provision made for the O-ring installation.
- ☐ *Groove design* change needed.

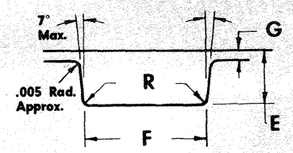
NATIONAL OIL SEALS O-RINGS

STOCK SIZES



622700 SERIES – FOR DYNAMIC AND STATIC APPLICATIONS

PART NUMBER	NOMINAL SIZE			ACTUAL SIZE		ID GROOVE		OD GROOVE	
	W	ID	OD	W	ID	A	B	C	D
						±.001	+.002 −.000	±.001	+.000 −.002
622701	1/16	1/8	1/4	.070 ± .003	.114 ± .005	.250	.137	.123	.236
622702	1/16	5/32	9/32	.070 ± .003	.145 ± .005	.281	.168	.154	.267
622703	1/16	3/16	5/16	.070 ± .003	.176 ± .005	.312	.199	.185	.298
622704	1/16	7/32	11/32	.070 ± .003	.208 ± .005	.344	.231	.217	.330
622705	1/16	1/4	3/8	.070 ± .003	.239 ± .005	.375	.262	.248	.361
622706	1/16	5/16	7/16	.070 ± .003	.301 ± .005	.4375	.3245	.310	.423
632707	1/16	3/8	1/2	.070 ± .003	.364 ± .005	.500	.387	.373	.486
622708	3/32	3/8	9/16	.103 ± .003	.362 ± .005	.5625	.3835	.373	.552
622709	3/32	7/16	5/8	.103 ± .003	.424 ± .005	.625	.446	.435	.614
622710	3/32	1/2	11/16	.103 ± .003	.487 ± .005	.6875	.5085	.498	.677
622711	3/32	9/16	3/4	.103 ± .003	.549 ± .005	.750	.571	.560	.739
622712	3/32	5/8	13/16	.103 ± .003	.612 ± .005	.8125	.6335	.623	.802
622713	3/32	11/16	7/8	.103 ± .003	.674 ± .005	.875	.696	.685	.864
622714	3/32	3/4	15/16	.103 ± .003	.737 ± .005	.9375	.7585	.748	.927
622715	1/8	3/4	1	.139 ± .004	.734 ± .006	1.001	.756	.747	.992
622716	1/8	13/16	1 1/16	.139 ± .004	.796 ± .006	1.063	.818	.809	1.054
622717	1/8	7/8	1 1/8	.139 ± .004	.859 ± .006	1.126	.881	.872	1.117
622718	1/8	15/16	1 3/16	.139 ± .004	.921 ± .006	1.188	.943	.934	1.179
622719	1/8	1	1 1/4	.139 ± .004	.984 ± .006	1.251	1.006	.997	1.242
622720	1/8	1 1/16	1 5/16	.139 ± .004	1.046 ± .006	1.313	1.068	1.059	1.304
622721	1/8	1 1/8	1 3/8	.139 ± .004	1.109 ± .006	1.376	1.131	1.122	1.367
622722	1/8	1 3/16	1 7/16	.139 ± .004	1.171 ± .006	1.438	1.193	1.184	1.429
622723	1/8	1 1/4	1 1/2	.139 ± .004	1.234 ± .006	1.501	1.256	1.247	1.492
622724	1/8	1 5/16	1 9/16	.139 ± .004	1.296 ± .006	1.563	1.318	1.309	1.554
622725	1/8	1 3/8	1 5/8	.139 ± .004	1.359 ± .006	1.626	1.381	1.372	1.617
622726	1/8	1 7/16	1 11/16	.139 ± .004	1.421 ± .006	1.688	1.443	1.434	1.679
622727	1/8	1 1/2	1 3/4	.139 ± .004	1.484 ± .006	1.751	1.506	1.497	1.742
622728	3/16	1 1/2	1 7/8	.210 ± .005	1.475 ± .010	1.876	1.502	1.497	1.871
622729	3/16	1 5/8	2	.210 ± .005	1.600 ± .010	2.001	1.627	1.622	1.996
622730	3/16	1 3/4	2 1/8	.210 ± .005	1.725 ± .010	2.126	1.752	1.747	2.121
622731	3/16	1 7/8	2 1/4	.210 ± .005	1.850 ± .010	2.251	1.877	1.872	2.246
622732	3/16	2	2 3/8	.210 ± .005	1.975 ± .010	2.376	2.002	1.997	2.371
622733	3/16	2 1/8	2 1/2	.210 ± .005	2.100 ± .010	2.501	2.127	2.122	2.496
622734	3/16	2 1/4	2 5/8	.210 ± .005	2.225 ± .010	2.626	2.252	2.247	2.621
622735	3/16	2 3/8	2 3/4	.210 ± .005	2.350 ± .010	2.751	2.377	2.372	2.746
622736	3/16	2 1/2	2 7/8	.210 ± .005	2.475 ± .010	2.876	2.502	2.497	2.871
622737	3/16	2 5/8	3	.210 ± .005	2.600 ± .010	3.001	2.627	2.622	2.996
622738	3/16	2 3/4	3 1/8	.210 ± .005	2.725 ± .015	3.126	2.752	2.747	3.121
622739	3/16	2 7/8	3 1/4	.210 ± .005	2.850 ± .015	3.251	2.877	2.872	3.246
622740	3/16	3	3 3/8	.210 ± .005	2.975 ± .015	3.377	3.003	2.996	3.370
622741	3/16	3 1/8	3 1/2	.210 ± .005	3.100 ± .015	3.502	3.128	3.121	3.495
622742	3/16	3 1/4	3 5/8	.210 ± .005	3.225 ± .015	3.627	3.253	3.246	3.620
622743	3/16	3 3/8	3 3/4	.210 ± .005	3.350 ± .015	3.752	3.378	3.371	3.745
622744	3/16	3 1/2	3 7/8	.210 ± .005	3.475 ± .015	3.877	3.503	3.496	3.870

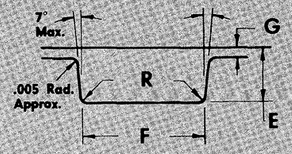


O-ring Width W	Groove Width E	Groove Length F	Radius R	Diametral Clearance G
(NOMINAL)	(MAX)	+.005 −.000	(APPROX)	(MAX)
1/16	.057	3/32	1/32	.005
3/32	.090	5/64	1/32	.005
1/8	.123	3/16	1/32	.006
3/16	.188	5/32	1/32	.007
1/4	.240	3/8	1/32	.008

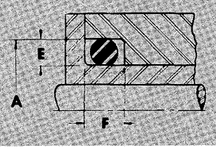
622700 SERIES (CONTINUED)

PART NUMBER	NOMINAL SIZE			ACTUAL SIZE		ID GROOVE		OD GROOVE	
	W	ID	OD	W	ID	A	B	C	D
						±.001	+.002 −.000	±.001	+.000 −.002
622745	3/16	3 5/8	4	.210 ± .005	3.600 ± .015	4.002	3.628	3.621	3.995
622746	3/16	3 3/4	4 1/8	.210 ± .005	3.725 ± .015	4.127	3.753	3.746	4.120
622747	3/16	3 7/8	4 1/4	.210 ± .005	3.850 ± .015	4.252	3.878	3.871	4.245
622748	3/16	4	4 3/8	.210 ± .005	3.975 ± .015	4.377	4.003	3.996	4.370
622749	3/16	4 1/8	4 1/2	.210 ± .005	4.100 ± .015	4.502	4.128	4.121	4.495
622750	3/16	4 1/4	4 5/8	.210 ± .005	4.225 ± .015	4.627	4.253	4.246	4.620
622751	3/16	4 3/8	4 3/4	.210 ± .005	4.350 ± .015	4.752	4.378	4.371	4.745
622752	3/16	4 1/2	4 7/8	.210 ± .005	4.475 ± .015	4.877	4.503	4.496	4.870
622753	1/4	4 5/8	5 1/8	.275 ± .006	4.600 ± .015	5.128	4.649	4.621	5.100
622754	1/4	4 3/4	5 1/4	.275 ± .006	4.725 ± .015	5.253	4.774	4.746	5.225
622755	1/4	4 7/8	5 3/8	.275 ± .006	4.850 ± .015	5.378	4.899	4.871	5.350
622756	1/4	5	5 1/2	.275 ± .006	4.975 ± .015	5.503	5.024	4.996	5.475
622757	1/4	5 1/8	5 5/8	.275 ± .006	5.100 ± .023	5.628	5.149	5.121	5.600
622758	1/4	5 1/4	5 3/4	.275 ± .006	5.225 ± .023	5.753	5.274	5.246	5.725
622759	1/4	5 3/8	5 7/8	.275 ± .006	5.350 ± .023	5.878	5.399	5.371	5.850
622760	1/4	5 1/2	6	.275 ± .006	5.475 ± .023	6.003	5.524	5.496	5.975
622761	1/4	5 5/8	6 1/8	.275 ± .006	5.600 ± .023	6.128	5.649	5.621	6.100
622762	1/4	5 3/4	6 1/4	.275 ± .006	5.725 ± .023	6.253	5.774	5.746	6.225
622763	1/4	5 7/8	6 3/8	.275 ± .006	5.850 ± .023	6.378	5.899	5.871	6.350
622764	1/4	6	6 1/2	.275 ± .006	5.975 ± .023	6.503	6.024	5.996	6.475
622765	1/4	6 1/4	6 3/4	.275 ± .006	6.225 ± .023	6.753	6.274	6.246	6.725
622766	1/4	6 1/2	7	.275 ± .006	6.475 ± .023	7.003	6.524	6.496	6.975
622767	1/4	6 3/4	7 1/4	.275 ± .006	6.725 ± .023	7.253	6.774	6.746	7.225
622768	1/4	7	7 1/2	.275 ± .006	6.975 ± .023	7.503	7.024	6.996	7.475
622769	1/4	7 1/4	7 3/4	.275 ± .006	7.225 ± .030	7.753	7.274	7.246	7.725
622770	1/4	7 1/2	8	.275 ± .006	7.475 ± .030	8.003	7.524	7.496	7.975
622771	1/4	7 3/4	8 1/4	.275 ± .006	7.725 ± .030	8.253	7.774	7.746	8.225
622772	1/4	8	8 1/2	.275 ± .006	7.975 ± .030	8.503	8.024	7.996	8.475
622773	1/4	8 1/2	9	.275 ± .006	8.475 ± .030	9.003	8.524	8.496	8.975
622774	1/4	9	9 1/2	.275 ± .006	8.975 ± .030	9.503	9.024	8.996	9.475
622775	1/4	9 1/2	10	.275 ± .006	9.475 ± .030	10.003	9.524	9.496	9.975
622776	1/4	10	10 1/2	.275 ± .006	9.975 ± .030	10.503	10.024	9.996	10.475
622777	1/4	10 1/2	11	.275 ± .006	10.475 ± .030	11.003	10.524	10.496	10.975
622778	1/4	11	11 1/2	.275 ± .006	10.975 ± .030	11.503	11.024	10.996	11.475
622779	1/4	11 1/2	12	.275 ± .006	11.475 ± .030	12.003	11.524	11.496	11.975
622780	1/4	12	12 1/2	.275 ± .006	11.975 ± .030	12.503	12.024	11.996	12.475
622781	1/4	12 1/2	13	.275 ± .006	12.475 ± .030	13.003	12.524	12.496	12.975
622782	1/4	13	13 1/2	.275 ± .006	12.975 ± .030	13.503	13.024	12.996	13.475
622783	1/4	13 1/2	14	.275 ± .006	13.475 ± .030	14.003	13.524	13.496	13.975
622784	1/4	14	14 1/2	.275 ± .006	13.975 ± .030	14.503	14.024	13.996	14.475
622785	1/4	14 1/2	15	.275 ± .006	14.475 ± .030	15.003	14.524	14.496	14.975
622786	1/4	15	15 1/2	.275 ± .006	14.975 ± .030	15.503	15.024	14.996	15.475
622787	1/4	15 1/2	16	.275 ± .006	15.475 ± .030	16.003	15.524	15.496	15.975
622788	1/4	4 1/2	5	.275 ± .006	4.475 ± .015	5.003	4.524	4.496	4.975

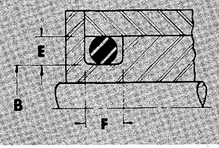
623000 SERIES – FOR STATIC APPLICATIONS



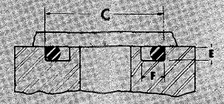
O-RING WIDTH	GROOVE WIDTH	GROOVE LENGTH	RADIUS	DIAMETRAL CLEARANCE
W	E	F	R	G
(Nominal)	(Max.)	+.005 −.000	(Approx.)	(Max.)
1/8	.123	3/16	1/32	.004



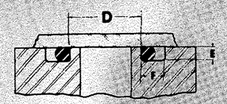
OD Groove with diametral squeeze applied on the OD diameter



ID Groove with diametral squeeze applied on the OD diameter



OD Groove to seal internal pressure with diametral squeeze applied to the lateral cross-section width



ID Groove to seal external pressure with diametral squeeze applied to the lateral cross-section width

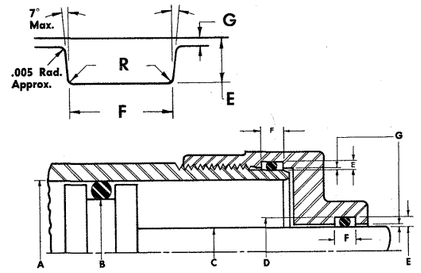
PART NUMBER	NOMINAL SIZE			ACTUAL SIZE		GROOVE +.000 −.005	GROOVE +.005 −.000	GROOVE +.000 −.005	GROOVE +.005 −.000
	W	ID	OD	W	ID	A	B	C	D
623001	1/8	1 5/8	1 7/8	.139 ± .004	1.609 ± .010	1.871	1.629	1.875	1.625
623002	1/8	1 3/4	2	.139 ± .004	1.734 ± .010	1.996	1.754	2.000	1.750
623003	1/8	1 7/8	2 1/8	.139 ± .004	1.859 ± .010	2.121	1.879	2.125	1.875
623004	1/8	2	2 1/4	.139 ± .004	1.984 ± .010	2.246	2.004	2.250	2.000
623005	1/8	2 1/8	2 3/8	.139 ± .004	2.109 ± .010	2.371	2.129	2.375	2.125
623006	1/8	2 1/4	2 1/2	.139 ± .004	2.234 ± .010	2.496	2.254	2.500	2.250
623007	1/8	2 3/8	2 5/8	.139 ± .004	2.359 ± .010	2.621	2.379	2.625	2.375
623008	1/8	2 1/2	2 3/4	.139 ± .004	2.484 ± .010	2.746	2.504	2.750	2.500
623009	1/8	2 5/8	2 7/8	.139 ± .004	2.609 ± .010	2.871	2.629	2.875	2.625
623010	1/8	2 3/4	3	.139 ± .004	2.734 ± .015	2.996	2.754	3.000	2.750
623011	1/8	2 7/8	3 1/8	.139 ± .004	2.859 ± .015	3.121	2.879	3.125	2.875
623012	1/8	3	3 1/4	.139 ± .004	2.984 ± .015	3.246	3.004	3.250	3.000
623013	1/8	3 1/8	3 3/8	.139 ± .004	3.109 ± .015	3.371	3.129	3.375	3.125
623014	1/8	3 1/4	3 1/2	.139 ± .004	3.234 ± .015	3.496	3.254	3.500	3.250
623015	1/8	3 3/8	3 5/8	.139 ± .004	3.359 ± .015	3.621	3.379	3.625	3.375
623016	1/8	3 1/2	3 3/4	.139 ± .004	3.484 ± .015	3.746	3.504	3.750	3.500
623017	1/8	3 5/8	3 7/8	.139 ± .004	3.609 ± .015	3.871	3.629	3.875	3.625
623018	1/8	3 3/4	4	.139 ± .004	3.734 ± .015	3.996	3.754	4.000	3.750
623019	1/8	3 7/8	4 1/8	.139 ± .004	3.855 ± .015	4.121	3.879	4.125	3.875
623020	1/8	4	4 1/4	.139 ± .004	3.984 ± .015	4.246	4.004	4.250	4.000
623021	1/8	4 1/8	4 3/8	.139 ± .004	4.109 ± .015	4.371	4.129	4.375	4.125
623022	1/8	4 1/4	4 1/2	.139 ± .004	4.234 ± .015	4.496	4.254	4.500	4.250
623023	1/8	4 3/8	4 5/8	.139 ± .004	4.359 ± .015	4.621	4.379	4.625	4.375
623024	1/8	4 1/2	4 3/4	.139 ± .004	4.484 ± .015	4.746	4.504	4.750	4.500
623025	1/8	4 5/8	4 7/8	.139 ± .004	4.609 ± .015	4.871	4.629	4.875	4.625
623026	1/8	4 3/4	5	.139 ± .004	4.734 ± .015	4.996	4.754	5.000	4.750
623027	1/8	4 7/8	5 1/8	.139 ± .004	4.859 ± .015	5.121	4.879	5.125	4.875
623028	1/8	5	5 1/4	.139 ± .004	4.984 ± .015	5.246	5.004	5.250	5.000
623029	1/8	5 1/8	5 3/8	.139 ± .004	5.109 ± .023	5.371	5.129	5.375	5.125
623030	1/8	5 1/4	5 1/2	.139 ± .004	5.234 ± .023	5.496	5.254	5.500	5.250
623031	1/8	5 3/8	5 5/8	.139 ± .004	5.359 ± .023	5.621	5.379	5.625	5.375
623032	1/8	5 1/2	5 3/4	.139 ± .004	5.484 ± .023	5.746	5.504	5.750	5.500
623033	1/8	5 5/8	5 7/8	.139 ± .004	5.609 ± .023	5.871	5.629	5.875	5.625
623034	1/8	5 3/4	6	.139 ± .004	5.734 ± .023	5.996	5.754	6.000	5.750
623035	1/8	5 7/8	6 1/8	.139 ± .004	5.859 ± .023	6.121	5.879	6.125	5.875
623036	1/8	6	6 1/4	.139 ± .004	5.984 ± .023	6.246	6.004	6.250	6.000
623037	1/8	6 1/4	6 1/2	.139 ± .004	6.234 ± .023	6.496	6.254	6.500	6.250
623038	1/8	6 1/2	6 3/4	.139 ± .004	6.484 ± .023	6.746	6.504	6.750	6.500
623039	1/8	6 3/4	7	.139 ± .004	6.734 ± .023	6.996	6.754	7.000	6.750
623040	1/8	7	7 1/4	.139 ± .004	6.984 ± .023	7.246	7.004	7.250	7.000
623041	1/8	7 1/4	7 1/2	.139 ± .004	7.234 ± .030	7.496	7.254	7.500	7.250
623042	1/8	7 1/2	7 3/4	.139 ± .004	7.484 ± .030	7.746	7.504	7.750	7.500
623043	1/8	7 3/4	8	.139 ± .004	7.734 ± .030	7.996	7.754	8.000	7.750
623044	1/8	8	8 1/4	.139 ± .004	7.984 ± .030	8.246	8.004	8.250	8.000
623045	1/8	8 1/4	8 1/2	.139 ± .004	8.234 ± .030	8.496	8.254	8.500	8.250
623046	1/8	8 1/2	8 3/4	.139 ± .004	8.484 ± .030	8.746	8.504	8.750	8.500
623047	1/8	8 3/4	9	.139 ± .004	9.734 ± .030	8.996	8.754	9.000	8.750
623048	1/8	9	9 1/4	.139 ± .004	8.984 ± .030	9.246	9.004	9.250	9.000
623049	1/8	9 1/4	9 1/2	.139 ± .004	9.234 ± .030	9.496	9.254	9.500	9.250
623050	1/8	9 1/2	9 3/4	.139 ± .004	9.484 ± .030	9.746	9.504	9.750	9.500
623051	1/8	9 3/4	10	.139 ± .004	9.734 ± .030	9.996	9.754	10.000	9.750
623052	1/8	10	10 1/4	.139 ± .004	9.984 ± .030	10.246	10.004	10.250	10.000

AMS SERIES

AMS7270 For Fuel	AMS7274 For Oil	NOMINAL SIZE Width	NOMINAL SIZE ID	NOMINAL SIZE OD	ACTUAL SIZE Width +	ACTUAL SIZE ID	ACTUAL SIZE +
AN123956	AN123856	1/16	1/8	1/4	.070	.003	.114	.005
AN123957	AN123857	1/16	5/32	9/32	.070	.003	.145	.005
AN123958	AN123858	1/16	3/16	5/16	.070	.003	.176	.005
AN123959	AN123859	1/16	7/32	11/32	.070	.003	.208	.005
AN123960	AN123860	1/16	1/4	3/8	.070	.003	.239	.005
AN123961	AN123861	1/16	5/16	7/16	.070	.003	.301	.005
AN123962	AN123862	1/16	3/8	1/2	.070	.003	.364	.005
AN123963	AN123863	3/32	3/8	9/16	.103	.003	.362	.005
AN123964	AN123864	3/32	7/16	5/8	.103	.003	.424	.005
AN123965	AN123865	3/32	1/2	11/16	.103	.003	.487	.005
AN123966	AN123866	3/32	9/16	3/4	.103	.003	.549	.005
AN123967	AN123867	3/32	5/8	13/16	.103	.003	.612	.005
AN123968	AN123868	3/32	11/16	7/8	.103	.003	.674	.005
AN123969	AN123869	3/32	3/4	15/16	.103	.003	.737	.005
AN123970	AN123870	1/8	3/4	1	.139	.004	.734	.006
AN123971	AN123871	1/8	13/16	1 1/16	.139	.004	.796	.006
AN123972	AN123872	1/8	7/8	1 1/8	.139	.004	.859	.006
AN123973	AN123873	1/8	15/16	1 3/16	.139	.004	.921	.006
AN123974	AN123874	1/8	1	1 1/4	.139	.004	.984	.006
AN123975	AN123875	1/8	1 1/16	1 5/16	.139	.004	1.046	.006
AN123976	AN123876	1/8	1 1/8	1 3/8	.139	.004	1.109	.006
AN123977	AN123877	1/8	1 3/16	1 7/16	.139	.004	1.171	.006
AN123978	AN123878	1/8	1 1/4	1 1/2	.139	.004	1.234	.006
AN123979	AN123879	1/8	1 5/16	1 9/16	.139	.004	1.296	.006
AN123980	AN123880	1/8	1 3/8	1 5/8	.139	.004	1.359	.006
AN123981	AN123881	1/8	1 7/16	1 11/16	.139	.004	1.421	.006
AN123982	AN123882	1/8	1 1/2	1 3/4	.139	.004	1.484	.006
AN123983	AN123883	1/8	1 5/8	1 7/8	.139	.004	1.609	.010
AN123984	AN123884	1/8	1 3/4	2	.139	.004	1.734	.010
AN123985	AN123885	1/8	1 7/8	2 1/8	.139	.004	1.859	.010
AN123986	AN123886	1/8	2	2 1/4	.139	.004	1.984	.010
AN123987	AN123887	1/8	2 1/8	2 3/8	.139	.004	2.109	.010
AN123988	AN123888	1/8	2 1/4	2 1/2	.139	.004	2.234	.010
AN123989	AN123889	1/8	2 3/8	2 5/8	.139	.004	2.359	.010
AN123990	AN123890	1/8	2 1/2	2 3/4	.139	.004	2.484	.010
AN123991	AN123891	1/8	2 5/8	2 7/8	.139	.004	2.609	.010
AN123992	AN123892	1/8	2 3/4	3	.139	.004	2.734	.015
AN123993	AN123893	1/8	2 7/8	3 1/8	.139	.004	2.859	.015
AN123994	AN123894	1/8	3	3 1/4	.139	.004	2.984	.015
AN123995	AN123895	1/8	3 1/8	3 3/8	.139	.004	3.109	.015
AN123996	AN123896	1/8	3 1/4	3 1/2	.139	.004	3.234	.015
AN123997	AN123897	1/8	3 3/8	3 5/8	.139	.004	3.359	.015
AN123998	AN123898	1/8	3 1/2	3 3/4	.139	.004	3.484	.015
AN123999	AN123899	1/8	3 5/8	3 7/8	.139	.004	3.609	.015
AN124000	AN123900	1/8	3 3/4	4	.139	.004	3.734	.015
AN124001	AN123901	1/8	3 7/8	4 1/8	.139	.004	3.859	.015
AN124002	AN123902	1/8	4	4 1/4	.139	.004	3.984	.015
AN124003	AN123903	1/8	4 1/8	4 3/8	.139	.004	4.109	.015
AN124004	AN123904	1/8	4 1/4	4 1/2	.139	.004	4.234	.015
AN124005	AN123905	1/8	4 3/8	4 5/8	.139	.004	4.359	.015
AN124006	AN123906	1/8	4 1/2	4 3/4	.139	.004	4.484	.015
AN124007	AN123907	1/8	4 5/8	4 7/8	.139	.004	4.609	.015
AN124008	AN123908	1/8	4 3/4	5	.139	.004	4.734	.015
AN124009	AN123909	1/8	4 7/8	5 1/8	.139	.004	4.859	.015
AN124010	AN123910	1/8	5	5 1/4	.139	.004	4.984	.015
AN124011	AN123911	1/8	5 1/8	5 3/8	.139	.004	5.109	.023
AN124012	AN123912	1/8	5 1/4	5 1/2	.139	.004	5.234	.023
AN124013	AN123913	1/8	5 3/8	5 5/8	.139	.004	5.359	.023
AN124014	AN123914	1/8	5 1/2	5 3/4	.139	.004	5.484	.023
AN124015	AN123915	1/8	5 5/8	5 7/8	.139	.004	5.609	.023
AN124016	AN123916	1/8	5 3/4	6	.139	.004	5.734	.023
AN124017	AN123917	1/8	5 7/8	6 1/8	.139	.004	5.859	.023
AN124018	AN123918	1/8	6	6 1/4	.139	.004	5.984	.023
AN124019	AN123919	1/8	6 1/4	6 1/2	.139	.004	6.234	.023
AN124020	AN123920	1/8	6 1/2	6 3/4	.139	.004	6.484	.023
AN124021	AN123921	1/8	6 3/4	7	.139	.004	6.734	.023
AN124022	AN123922	1/8	7	7 1/4	.139	.004	6.984	.023
AN124023	AN123923	1/8	7 1/4	7 1/2	.139	.004	7.234	.030
AN124024	AN123924	1/8	7 1/2	7 3/4	.139	.004	7.484	.030
AN124025	AN123925	1/8	7 3/4	8	.139	.004	7.734	.030
AN124026	AN123926	1/8	8	8 1/4	.139	.004	7.984	.030
AN124027	AN123927	1/8	8 1/4	8 1/2	.139	.004	8.234	.300
AN124028	AN123928	1/8	8 1/2	8 3/4	.139	.004	8.484	.030
AN124029	AN123929	1/8	8 3/4	9	.139	.004	8.734	.030
AN124030	AN123930	1/8	9	9 1/4	.139	.004	8.984	.030
AN124031	AN123931	1/8	9 1/4	9 1/2	.139	.004	9.234	.030
AN124032	AN123932	1/8	9 1/2	9 3/4	.139	.004	9.484	.030
AN124033	AN123933	1/8	9 3/4	10	.139	.004	9.734	.030
AN124034	AN123934	1/8	10	10 1/4	.139	.004	9.984	.030

RECOMMENDED GROOVE DETAIL

One of the basic principles of prime consideration is to provide a groove which will permit the O-ring to function efficiently. National O-rings have ample dimensional stability to allow the use of standard specifications consistent with good design within its temperature range.

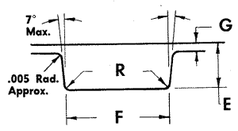


O-ring Width	Width E	Diametral Squeeze	Groove Length F. +.005 −.000			Radius R	Diametral Clearance	Eccentricity
			Back-up Rings					
Nominal	Max.	Min.	none	one	two	Approx.	Max.	Min.
DYNAMIC APPLICATIONS								
1/16	.057	.010	3/32	.138	.205	1/32	.005	.002
3/32	.090	.010	9/64	.171	.238	1/32	.005	.002
1/8	.123	.012	3/16	.208	.275	1/32	.006	.003
3/16	.188	.017	9/32	.311	.410	1/32	.007	.004
1/4	.240	.029	3/8	.408	.538	1/32	.008	.005
STATIC APPLICATIONS								
1/8	.123	.012	3/16	.208	.275	1/32	.004	.003

*Total Indicated For Reading

Groove Shape

The rectangular groove is recommended for all applications and is mandatory for moving seals.



Slope—For all normal uses the sides may have a slight degree of slope to facilitate machining, not to exceed 7°.

Radius—The recommended radius at the bottom corners of the groove should be followed to prevent localizing the stress at the clearance gap. See details in size section.

Length—The groove length is a controlled factor on all dynamic installations, according to the cross-section width of the O-ring. The established standards as shown in the design table have been calculated to provide adequate volumetric swell due to fluid contact and deformation due to diametral squeeze. Also provision is made to allow the O-ring to roll slightly at the beginning of each stroke so that the fluid will lubricate the running surface. Ease of installation and replacement is another consideration.

It may be necessary to use other groove shapes in exceptional cases where space limitations, construction or installation features require them. Other shapes in use are as follows:

The semi-rectangular groove is suitable for applications where the pressure flow is in one direction. This type groove is used when necessary to facilitate installation.

The Vee groove should be used only for static applications. Its use for dynamic installations is not recommended because the O-rings create considerable friction and extrude more readily at relatively low pressures.

Clearance

The life and pressure range of an O-ring seal can be affected by the amount of clearance between the mating metal parts. The clearance should be held to an absolute minimum consistent with thermal expansion within the working temperature range.

If excessive, the extrusion into the clearance gap at relatively low pressures will cause failure.

Diametral Squeeze

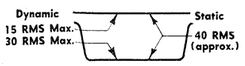
The important feature is to establish and maintain diametral squeeze, or interference, under variable working conditions taking into consideration all factors such as tolerances and clearances. Dimensional tables are provided which establish the correct amount according to the cross-section width for all normal operations.

Insufficient diametral squeeze will not provide positive sealing under zero or low pressures.

Excessive diametral squeeze increases friction, shortens life and causes assembly problems.

Finishes

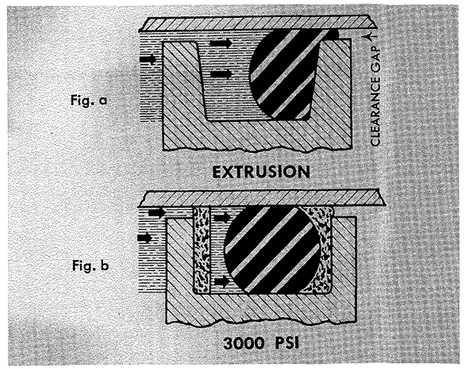
The efficiency of a moving seal is dependent on the smoothness of the contact surface over which the ring must slide. A micro-inch finish of 15 RMS max. is recommended. The groove surface should have a maximum of 30 RMS, free from nicks, burrs, scratches or tool marks. Static seal surfaces should be held to 40 RMS max.



BACK-UP RINGS

APPLICATION

There are three primary functions for installation of Back-up Rings in any application where the O-ring is required to seal across a clearance gap under pressure.



1. To eliminate extrusion at pressures in excess of 1500 PSI as it then becomes a critical factor under recommended working conditions. (Fig. a) The 1500 PSI limitation can be exceeded up to 3000 PSI by employing leather back-up rings which bridge the gap and prevent extrusion. (Fig. b)

2. To permit the use of wider tolerances. Back-up rings are mandatory when the clearance gap is increased beyond recommended limitations. (Fig. a)

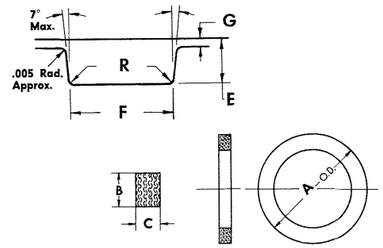
3. To extend O-ring life in any pressure range by giving added protection as a dirt wiper and aid to lubrication.

MATERIALS

Leather was originally established and adopted by industry as the most suitable material particularly because it absorbs the fluid and aids lubrication.

Other materials are being developed and are under test which may prove more advantageous than leather such as Kel-F, Teflon and Nylon.

SIZE AND GROOVE DATA



Size—For each standard size O-ring a corresponding Back-up Ring is provided having the same Nominal ID and OD dimensions.

The Back-up Ring dash numbers are the same as the last digits of the O-ring numbers.

Groove—When using Back-up Rings all dimensions and tolerances of the groove remain the same except the length. The size table shows groove length for one or two Back-up Ring installations.

FOR USE WITH 622700 SERIES O-RINGS
Outside Dia. A equivalent to O-ring OD

DASH NUMBERS	ACTUAL SIZE			GROOVE LENGTH	
	OUTSIDE DIAMETER A	WIDTH B	THICKNESS C	FOR ONE RING F	FOR TWO RINGS F
6246 Series	±1/64	+.010 −.005	±.010	+.005 −.000	+.005 −.000
1—7	1/4″— 1/2″	.057	.062	.138	.205
8—14	9/16″— 1 5/16″	.090	.062	.171	.238
15—27	1″ —1 3/4″	.123	.062	.208	.275
28—52	1 7/8″—4 7/8″	.188	.094	.311	.410
53—88	5″ —16″	.240	.125	.408	.538

6244 Series — **FOR USE WITH 623000 SERIES O-RINGS**
Outside Dia. A equivalent to O-ring OD

1—52	1 7/8″—10 1/4″	.125	.062	.208	.275

INSTALLATION

In the smaller sizes it may be difficult to stretch them sufficiently to install them in a one-piece groove. This can be accomplished by soaking in oil for 30 minutes at room temperature prior to installation. They should then be air-dried at approximately 200°F which will shrink them to groove size. Whenever practicable a two-piece groove should be provided.

A precaution to be observed is to assemble the flesh side adjacent to the O-ring. Also splitting the Back-up Ring should never be permitted. It will not function efficiently unless it is assembled in one continuous ring.

NATIONAL OIL SEALS O-RINGS

SIZE CONVERSION CHART

O-RING SIZE								NATIONAL O-RINGS	MIL-R-7362	MIL-P-5315
ACTUAL					NOMINAL					
I.D.	±	Mean OD	W.	±	I.D.	O.D.	W.	6227— Series	MS29561— Dash No.	MS29513— Dash No.
.114	.005	.254	.070	.003	1/8	1/4	1/16	622701	−6	−6
.145	.005	.285	.070	.003	5/32	9/32	1/16	622702	−7	−7
.176	.005	.316	.070	.003	3/16	5/16	1/16	622703	−8	−8
.208	.005	.348	.070	.003	7/32	11/32	1/16	622704	−9	−9
.239	.005	.379	.070	.003	1/4	3/8	1/16	622705	−10	−10
.301	.005	.441	.070	.003	5/16	7/16	1/16	622706	−11	−11
.364	.005	.504	.070	.003	3/8	1/2	1/16	622707	−12	−12
.362	.005	.568	.103	.003	3/8	9/16	3/32	622708	−110	−110
.424	.005	.630	.103	.003	7/16	5/8	3/32	622709	−111	−111
.487	.005	.693	.103	.003	1/2	11/16	3/32	622710	−112	−112
.549	.005	.755	.103	.003	9/16	3/4	3/32	622711	−113	−113
.612	.005	.818	.103	.003	5/8	13/16	3/32	622712	−114	−114
.674	.005	.880	.103	.003	11/16	7/8	3/32	622713	−115	−115
.737	.005	.943	.103	.003	3/4	15/16	3/32	622714	−116	−116
.734	.006	1.012	.139	.004	3/4	1	1/8	622715	−210	−210
.796	.006	1.074	.139	.004	13/16	1 1/16	1/8	622716	−211	−211
.859	.006	1.137	.139	.004	7/8	1 1/8	1/8	622717	−212	−212
.921	.006	1.199	.139	.004	15/16	1 3/16	1/8	622718	−213	−213
.984	.006	1.262	.139	.004	1	1 1/4	1/8	622719	−214	−214
1.046	.006	1.324	.139	.004	1 1/16	1 5/16	1/8	622720	−215	−215
1.109	.006	1.387	.139	.004	1 1/8	1 3/8	1/8	622721	−216	−216
1.171	.006	1.449	.139	.004	1 3/16	1 7/16	1/8	622722	−217	−217
1.234	.006	1.512	.139	.004	1 1/4	1 1/2	1/8	622723	−218	−218
1.296	.006	1.574	.139	.004	1 5/16	1 9/16	1/8	622724	−219	−219
1.359	.006	1.637	.139	.004	1 3/8	1 5/8	1/8	622725	−220	−220
1.421	.006	1.699	.139	.004	1 7/16	1 11/16	1/8	622726	−221	−221
1.484	.006	1.762	.139	.004	1 1/2	1 3/4	1/8	622727	−222	−222
1.475	.010	1.895	.210	.005	1 1/2	1 7/8	3/16	622728	−325	−325
1.600	.010	2.020	.210	.005	1 5/8	2	3/16	622729	−326	−326
1.725	.010	2.145	.210	.005	1 3/4	2 1/8	3/16	622730	−327	−327
1.850	.010	2.270	.210	.005	1 7/8	2 1/4	3/16	622731	−328	−328
1.975	.010	2.395	.210	.005	2	2 3/8	3/16	622732	−329	−329
2.100	.010	2.520	.210	.005	2 1/8	2 1/2	3/16	622733	−330	−330
2.225	.010	2.645	.210	.005	2 1/4	2 5/8	3/16	622734	−331	−331
2.350	.010	2.770	.210	.005	2 3/8	2 3/4	3/16	622735	−332	−332
2.475	.010	2.895	.210	.005	2 1/2	2 7/8	3/16	622736	−333	−333
2.600	.010	3.020	.210	.005	2 5/8	3	3/16	622737	−334	−334
2.725	.015	3.145	.210	.005	2 3/4	3 1/8	3/16	622738	−335	−335
2.850	.015	3.270	.210	.005	2 7/8	3 1/4	3/16	622739	−336	−336
2.975	.015	3.395	.210	.005	3	3 3/8	3/16	622740	−337	−337
3.100	.015	3.520	.210	.005	3 1/8	3 1/2	3/16	622741	−338	−338
3.225	.015	3.645	.210	.005	3 1/4	3 5/8	3/16	622742	−339	−339
3.350	.015	3.770	.210	.005	3 3/8	3 3/4	3/16	622743	−340	−340
3.475	.015	3.895	.210	.005	3 1/2	3 7/8	3/16	622744	−341	−341
3.600	.015	4.020	.210	.005	3 5/8	4	3/16	622745	−342	−342
3.725	.015	4.145	.210	.005	3 3/4	4 1/8	3/16	622746	−343	−343
3.850	.015	4.270	.210	.005	3 7/8	4 1/4	3/16	622747	−344	−344
3.975	.015	4.395	.210	.005	4	4 3/8	3/16	622748	−345	−345
4.100	.015	4.520	.210	.005	4 1/8	4 1/2	3/16	622749	−346	−346
4.225	.015	4.645	.210	.005	4 1/4	4 5/8	3/16	622750	−347	−347
4.350	.015	4.770	.210	.005	4 3/8	4 3/4	3/16	622751	−348	−348
4.475	.015	4.895	.210	.005	4 1/2	4 7/8	3/16	622752	−349	−349
4.475	.015	5.025	.275	.006	4 1/2	5	1/4	622788	−425	−425
4.600	.015	5.150	.275	.006	4 5/8	5 1/8	1/4	622753	−426	−426
4.725	.015	5.275	.275	.006	4 3/4	5 1/4	1/4	622754	−427	−427
4.850	.015	5.400	.275	.006	4 7/8	5 3/8	1/4	622755	−428	−428
4.975	.015	5.525	.275	.006	5	5 1/2	1/4	622756	−429	−429
5.100	.023	5.650	.275	.006	5 1/8	5 5/8	1/4	622757	−430	−430
5.225	.023	5.775	.275	.006	5 1/4	5 3/4	1/4	622758	−431	−431
5.350	.023	5.900	.275	.006	5 3/8	5 7/8	1/4	622759	−332	−432
5.475	.023	6.025	.275	.006	5 1/2	6	1/4	622760	−433	−433
5.600	.023	6.150	.275	.006	5 5/8	6 1/8	1/4	622761	−434	−434
5.725	.023	6.275	.275	.006	5 3/4	6 1/4	1/4	622762	−435	−435
5.850	.023	6.400	.275	.006	5 7/8	6 3/8	1/4	622763	−436	−436
5.975	.023	6.525	.275	.006	6	6 1/2	1/4	622764	−437	−437
6.225	.023	6.775	.275	.006	6 1/4	6 3/4	1/4	622765	−438	−438
6.475	.023	7.025	.275	.006	6 1/2	7	1/4	622766	−439	−439
6.725	.023	7.275	.275	.006	6 3/4	7 1/4	1/4	622767	−440	−440
6.975	.023	7.525	.275	.006	7	7 1/2	1/4	622768	−441	−441
7.225	.030	7.775	.265	.006	7 1/4	7 3/4	1/4	622769	−442	−442
7.475	.030	8.025	.275	.006	7 1/2	8	1/4	622770	−443	−443
7.725	.030	8.275	.275	.006	7 3/4	8 1/4	1/4	622771	−444	−444
7.975	.030	8.525	.275	.006	8	8 1/2	1/4	622772	−445	−445
8.475	.030	9.025	.275	.006	8 1/2	9	1/4	622773	−446	−446
8.975	.030	9.525	.275	.006	9	9 1/2	1/4	622774	−447	−447

MIL-P-5315	MIL-P-5516A Class B	MIL-P-5516A Class A		MIL-P-18017 MS28784- & MIL-P-25732 MS28775	AMS7271	AMS7270	AMS7274
		Ordnance					
Old AF934 Dash No.	AN6227B Part No.	CKC-X-2 Part No.	CKC-X-3 Part No.	Dash Nos.	MS9021- Dash No.	AN12XXX Part No.	AN123XXX Part No.
−1	AN6227B-1	501214	546920	−6	−006	AN123956	AN123856
−2	AN6227B-2	501215	546921	−7	−007	AN123957	AN123857
−3	AN6227B-3	501216	546922	−8	−008	AN123958	AN123858
−4	AN6227B-4	501217	546923	−9	−009	AN123959	AN123859
−5	AN6227B-5	501218	546924	−10	−010	AN123960	AN123860
−6	AN6227B-6	501219	546925	−11	−011	AN123961	AN123861
−7	AN6227B-7	501220	546926	−12	−012	AN123962	AN123862
−8	AN6227B-8	501211	546927	−110	−110	AN123963	AN123863
−9	AN6227B-9	501221	546928	−111	−111	AN123964	AN123864
−10	AN6227B-10	501460	546929	−112	−112	AN123965	AN123865
−11	AN6227B-11	501223	546930	−113	−113	AN123966	AN123866
−12	AN6227B-12	501212	546931	−114	−114	AN123967	AN123867
−13	AN6227B-13	501224	546932	−115	−115	AN123968	AN123868
−14	AN6227B-14	501225	546933	−116	−116	AN123969	AN123869
−15	AN6227B-15	501461	546934	−210	−210	AN123970	AN123870
−16	AN6227B-16	501227	546935	−211	−211	AN123971	AN123871
−17	AN6227B-17	501228	546936	−212	−212	AN123972	AN123872
−18	AN6227B-18	501213	546937	−213	−213	AN123973	AN123873
−19	AN6227B-19	501462	546938	−214	−214	AN123974	AN123874
−20	AN6227B-20	501230	546939	−215	−215	AN123975	AN123875
−21	AN6227B-21	501210	546940	−216	−216	AN123976	AN123876
−22	AN6227B-22	501231	546941	−217	−217	AN123977	AN123877
−23	AN6227B-23	501232	546942	−218	−218	AN123978	AN123878
−24	AN6227B-24	501233	546943	−219	−219	AN123979	AN123879
−25	AN6227B-25	501234	546944	−220	−220	AN123980	AN123880
−26	AN6227B-26	501463	546945	−221	−221	AN123981	AN123881
−27	AN6227B-27	501236	546946	−222	−222	AN123982	AN123882
−28	AN6227B-28	501237	546999	−325	−325		
−29	AN6227B-29	501238	547000	−326	−326		
−30	AN6227B-30	501239	570201	−327	−327		
−31	AN6227B-31	546801	570202	−328	−328		
−32	AN6227B-32	546802	570203	−329	−329		
−33	AN6227B-33	546803	570204	−330	−330		
−34	AN6227B-34	546804	570205	−331	−331		
−35	AN6227B-35	546805	570206	−332	−332		
−36	AN6227B-36	546806	570207	−333	−333		
−37	AN6227B-37	546807	570208	−334	−334		
−38	AN6227B-38	546808	570209	−335	−335		
−39	AN6227B-39	546809	570210	−336	−336		
−40	AN6227B-40	546810	570211	−337	−337		
−41	AN6227B-41	546811	570212	−338	−338		
−42	AN6227B-42	546812	570213	−339	−339		
−43	AN6227B-43	546813	570214	−340	−340		
−44	AN6227B-44	546814	570215	−341	−341		
−45	AN6227B-45	546815	570216	−342	−342		
−46	AN6227B-46	546816	570217	−343	−343		
−47	AN6227B-47	546817	570218	−344	−344		
−48	AN6227B-48	546818	570219	−345	−345		
−49	AN6227B-49	546819	570220	−346	−346		
−50	AN6227B-50	546820	570221	−347	−347		
−51	AN6227B-51	546821	570222	−348	−348		
−52	AN6227B-52	546822	570223	−349	−349		
−53	AN6227B-88	546858	570224	−425	−425		
−54	AN6227B-53	546823	570225	−426	−426		
−55	AN6227B-54	546824	570226	−427	−427		
−56	AN6227B-55	546825	570227	−428	−428		
−57	AN6227B-56	546826	570228	−429	−429		
−58	AN6227B-57	546827	570229	−430	−430		
−59	AN6227B-58	546828	570230	−431	−431		
−60	AN6227B-59	546829	570231	−432	−432		
−61	AN6227B-60	546830	570232	−433	−433		
−62	AN6227B-61	546831	570233	−434	−434		
−63	AN6227B-62	546832	570234	−435	−435		
−64	AN6227B-63	546833	570235	−436	−436		
−65	AN6227B-64	546834	570236	−437	−437		
−66	AN6227B-65	546835	570237	−438	−438		
−67	AN6227B-66	546836	570238	−439	−439		
−68	AN6227B-67	546837	570239	−440	−440		
−69	AN6227B-68	546838	570240	−441	−441		
−70	AN6227B-69	546839	570241	−442	−442		
−71	AN6227B-70	546840	570242	−443	−443		
−72	AN6227B-71	546841	570243	−444	−444		
−73	AN6227B-72	546842	570244	−445	−445		
−74	AN6227B-73	546843	570245	−446	−446		
−75	AN6227B-74	546844	570246	−447	−447		

(Continued)

ESTABLISHED 1887 INCORPORATED 1905

THE GARLOCK PACKING COMPANY

SOLE MANUFACTURERS OF

RUBBER ASBESTOS GARLOCK PACKINGS METAL FIBROUS

GENERAL OFFICES AND FACTORIES, PALMYRA, NEW YORK

CABLE ADDRESS
GARLOCK-SAN FRANCISCO
CODE
A. B. C. FIFTH EDITION - BENTLEY'S - ACME

PACIFIC COAST FACTORY, SAN FRANCISCO

REPLY TO
750 18TH STREET, SAN FRANCISCO 7, CALIF.
TELEPHONE HEMLOCK 1-0370
WESTERN UNION WUX

December 17, 1958

Willamette Iron and Steel Company,
2800 N. W. Front Avenue
Portland 10, Oregon

Attention - Mr. Syd Hendy, Purchasing Agent

Gentlemen:

This letter will answer your request to our Portland office for material specifications and recommended applications for Garlock Style #7392.

MATERIAL: Cotton drill frictioned with Neoprene, plied to slab thickness with bare surface cotton sheeting covers on the basis of 80 fabric plies per inch of thickness. No treatment.

APPLICATIONS: For use against Hydrocarbons on pistons or plungers on inside packed pumps. Also used as anti-extrusion end rings in combination with other packings on rod packing installations. There may be and undoubtedly are many other applications where a packing of this construction can be and is used.

We believe the above information is what you require, however if there is a particular application or service on which you would like us to comment, we would be glad to do so.

Yours very truly,

THE GARLOCK PACKING COMPANY

W. V. Wilkes

W. V. Wilkes
Office Manager

WVW:L

FORM E 1081

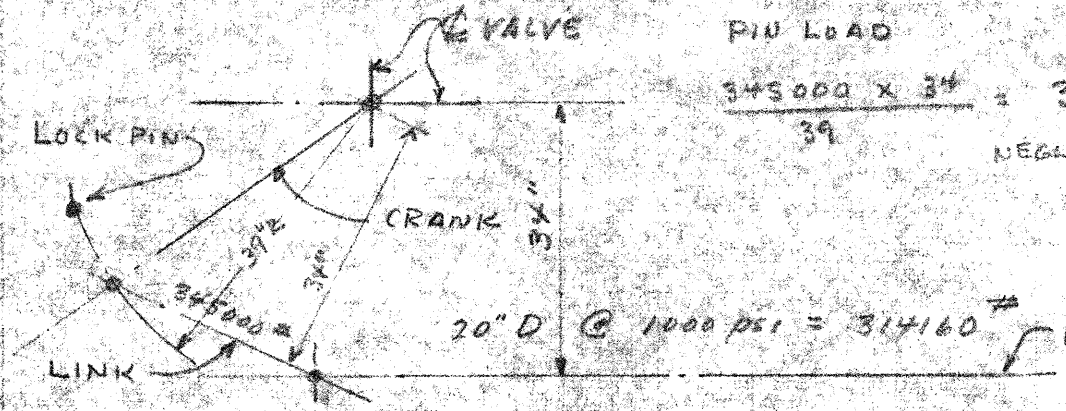
WILLAMETTE IRON AND STEEL COMPANY

SHEET 1 OF 2

JOB NO. 5233 JOB NAME 18 FT BUTTERFLY VALVE DATE 12/16/58

DESCRIPTION MECHANICAL LOCK PIN

DESIGN BY FEW CHECKED BY APPROVED

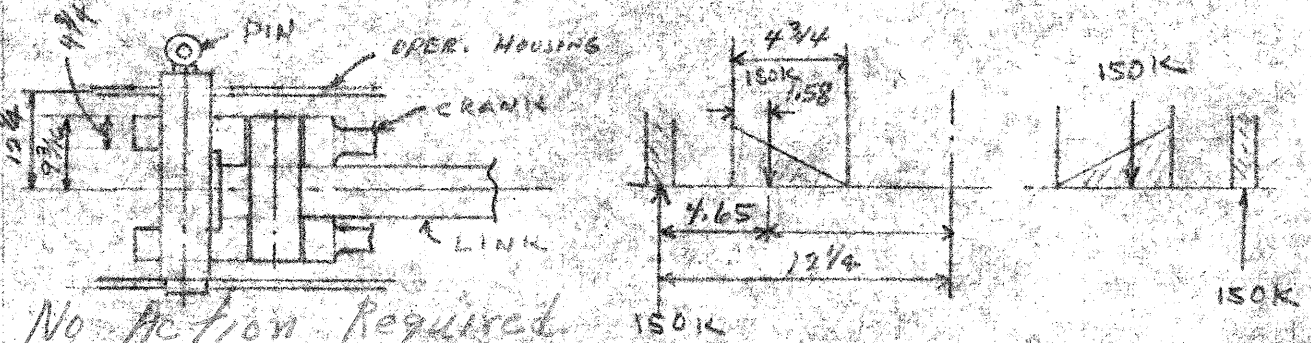


PIN LOAD

$\frac{345000 \times 34}{39} = 300{,}000$ #

NEGLECTING FRICTION

MAX LOAD AT LOCK PIN = 300,000 #



No Action Required

MAX MOMENT ON PIN

150,000 x 4.65 = 697 000 IN #

USING ASTM. A237 CL E 105,000 ULT 80,000 Y.P.

DESIGN STRESS = $\frac{105{,}000}{5}$ = 21000 PSI

$Z = \frac{697000}{21000} = 33.2$ IN^3

$d^3 = \frac{33.2}{.098} = 339$

$d = 6.96$" SAY 7" DIA

SHEAR IN PIN

DEC 22 1958

DESIGN SHEAR STRESS 21000 x .6 = 12600 PSI

$\frac{150{,}000}{12600} = 11.9$ IN^2 $d = \sqrt{\frac{11.9}{.785}} = 3.9$ SAY 4" DIA MIN

FORM E 1081

WILLAMETTE IRON AND STEEL COMPANY

SHEET 2 OF 2

JOB NO. 5233 JOB NAME DATE 12/16/58

DESCRIPTION

DESIGN BY FEW CHECKED BY APPROVED

IF STRESS IS BASED ON 75% Y.P.

$80{,}000 \times .75 = 60{,}000$ PSI

$$Z = \frac{697{,}000}{60{,}000} = 11.62 \text{ IN}^3$$

$$d^3 = \frac{11.62}{.098} = 118.6 \text{ IN}^3$$

$d = 4.92$ SAY 5" DIA MIN

WT OF LOCK PINS

7"D x 28" = 305 #

5"D x 28 = 187 #

JOB NO S.O. 5233 JOB NAME 18" Butterfly Valve - Corps of Engineers December 12, 1958

DESCRIPTION Process Spec. for Manual Shielded Metal-Arc Welding of ASME P-No. 1, Carbon-Silicon Steel

DESIGN BY WES CHECKED BY APPROVED

PROCESS INDEX: SMAW/MA - 01-21-2-04

WELDING PROCESS SPECIFICATION NO. A-3387

I. GENERAL:

This specification covers the manual shielded metal-arc welding of ASME P-Number 1, Carbon-Silicon steel under the provisions of the ASME Boiler and Pressure Vessel Code, Sections VIII and IX, 1956 Edition and addenda.

II. PROCESS:

All welding shall be done by the Manual Shielded Metal-Arc process.

III. BASE MATERIAL SPECIFICATION:

A. The base material shall conform to the requirements of the specifications for ASME P-Number 1, Carbon-Silicon Steel.

B. The base material used for test specimens for the qualification of this specification shall be, in specific, SA-201 Grade B.

IV. MATERIAL THICKNESS:

A. The procedure and welder qualification tests shall be made using 1" plate.

B. This specification qualifies the welding of thicknesses from 3/16" to 2".

V. FILLER METAL:

Manual shielded metal-arc electrodes shall conform to the requirements of the specifications for ASME SA-316, High Tensile and Low Alloy Steel Covered ARC-Welding Electrodes and they shall be of the low hydrogen potassium (E-XX16) type coating. Electrodes shall be of the ASME Group Designation F-Number 4 and of the ASME Weld Metal Analysis Designation A-Number 2.

VI. PREHEAT:

The base material shall be pre-heated to a temperature of 150° F. minimum, prior to any welding.

APPROVED
EXCEPT AS NOTED
(See letter)
U. S. ARMY ENGINEER DISTRICT, GARRISON
CORPS OF ENGINEERS
DEC 22 1958
JAN 14 1959
DATE

JOB NO S.O. 5233 JOB NAME 18" Butterfly Valve - C/E DATE December 12, 1958

DESCRIPTION Process Spec. for Manual Shielded Metal-Arc Welding of ASME P-Number 1, Carbon-Silicon Steel

DESIGN BY WES CHECKED BY APPROVED

VII. WELDING TECHNIQUE:

A. The edges and surfaces of the parts to be joined by welding shall be prepared by shearing, machining, grinding, sawing or flame cutting, or by any combination of these methods in conformance with the pertinent joint design. The joint geometry to be used in preparing the test joint(s) for qualification of this specification and for welder performance qualification is shown in the attached sketch.

B. All surfaces to be welded shall be free of all oil, grease cutting fluids, paint, oxides, mill scale and any other foreign matter.

C. Assembly shall be such as to secure proper root gaps for butt welds. Particular care shall be taken in aligning and separating the edges to be butt welded in order that complete penetration of the joint will be assured.

D. All tacking shall be done with the electrodes (filler metal) specified in Paragraph V.

E. All welding shall be done using alternating current (60 cycle) or direct current, reverse polarity; i.e., the work shall be connected to the negative side of the current source.

F. Multiple pass welding shall be used.

G. Test welds for qualification of this specification and for performance qualification of all welders under this specification shall be done in the horizontal, vertical, and overhead positions. Qualification in any of these positions automatically qualifies this specification, and welders qualified under it for welding in the flat position.

H. The electrode size for each pass, and the welding current and arc voltage for the electrode size and pass number shall conform with the sizes and values specified in the attached table.

I. Weld metal shall be deposited using a stringer bead technique. No bead shall be wider than 2-1/2 times the electrode diameter, except that vertical welds may be made with a weave technique.

J. All weld craters shall be visually examined and any defects so detected shall be removed before the weld bead is covered by the next pass.

K. All slag and spatter shall be thoroughly removed from each pass before depositing the next successive pass of weld metal.

L. The manner of depositing the weld metal shall be such that undercutting of a groove face or the base metal at the toe of a weld shall be held to a minimum.

M. Peening shall not be employed at any stage of welding except as may be directed by the Project Welding Engineer.

N. The root of the "Second Side" shall be deseamed to sound metal before depositing any weld metal from that side.

VIII. POST-HEAT TREATMENT:

No post-heat treatment shall be required.

FORM E 1381

WILLAMETTE IRON AND STEEL COMPANY

A-3387

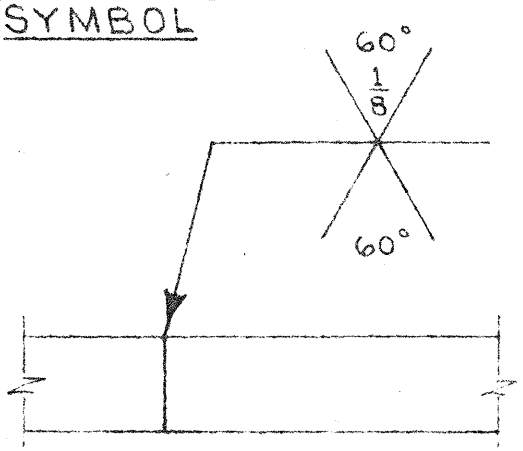
WELDING PROCESS SPECIFICATION NO. A-3387 SHEET 4 OF 5

JOB NO S.O. 5233 JOB NAME 18' Butterfly Valve - C/E DATE December 12, 1958

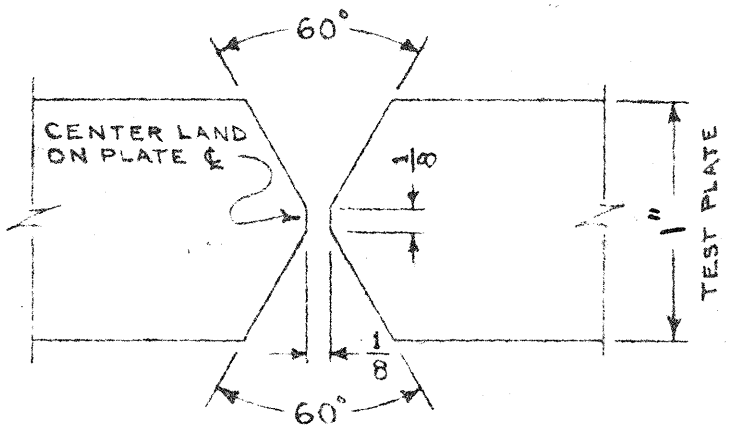
DESCRIPTION DOUBLE VEE BUTT JOINT, WELDED BOTH SIDES (MANUAL SHIELDED METAL ARC)

DESIGN BY WES CHECKED BY APPROVED

SYMBOL



JOINT GEOMETRY



JOINT WELDING PROCEDURE FOR VERTICAL POSITION

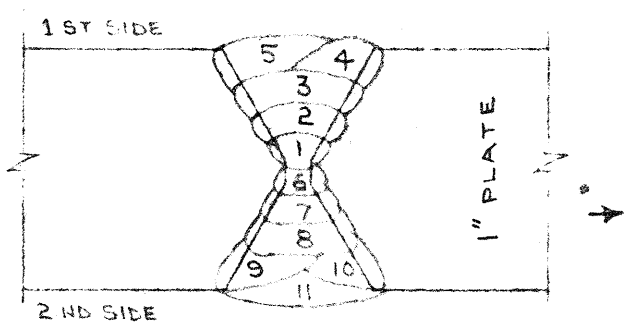


PLATE THICKNESS	NO. OF PASSES 1 ST SIDE *	NO. OF PASSES 2 ND SIDE *
1/4	1	1
1/2	2	2
3/4	3	3
1	5	6
1 1/4	8	9
1 1/2	12	13
1 3/4	16	17
2	20	21

* - AVERAGE (FLAT POSITION)

PASS NO.	MAXIMUM SIZE ELECTRODE	CURRENT AMPS. ±10%	ARC VOLTAGE VOLTS ±10%	REMARKS
1	1/8	170	25	
2	5/32	185	27	
3-4-5	3/16	200	28	FOR THICKER PLATE USE 3/16 ELEC. FOR BALANCE.
6	1/8	170	25	
7-8	5/32	185	27	
9-10-11	3/16	200	28	FOR THICKER PLATE USE 3/16 ELEC., FOR BALANCE.

JOB NO S.O. 5233 JOB NAME 18' Butterfly Valve - C/E DATE December 12, 1958

DESCRIPTION Process Specification for Manual Shielded Metal-Arc Welding of ASME P-Number 1 Carbon Silicon Steel

DESIGN BY CHECKED BY APPROVED

IV. INSPECTION:

A. All welds shall be visually examined for defects. All evidences of cracking, porosity and slag-filled voids detected shall be removed by machining, chipping, grinding or gouging, or by any combination of these methods. The defective areas shall be rewelded and the repair weld examined before resumption of production joint welding.

B. Welded joints shall be completely examined by radiography upon completion of welding in accordance with Paragraph UW-51, and/ Section VIII of the 1956 ASME Boiler and Pressure Vessel Code.

APPROVED:

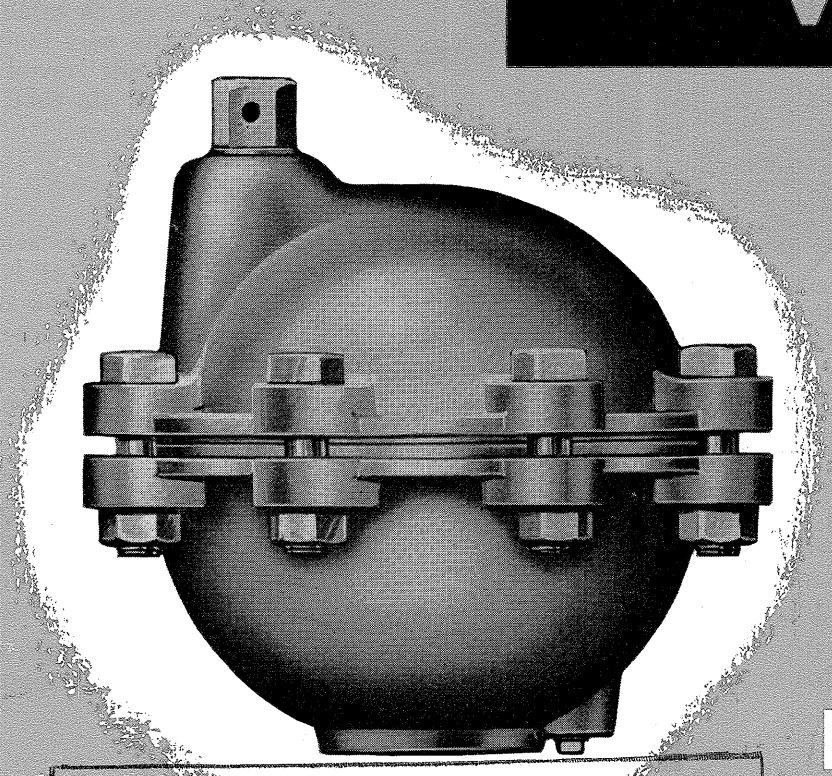
R. A. Royer

WILLAMETTE IRON AND STEEL COMPANY

William E. Sargent for
Peter L. Amonson

SIMPLEX

AIR RELEASE VALVES



FOR WATER,

SEWAGE AND

INDUSTRIAL USE

BULLETIN NO. 1206

SIMPLEX®
VALVE AND METER COMPANY
LANCASTER PENNSYLVANIA

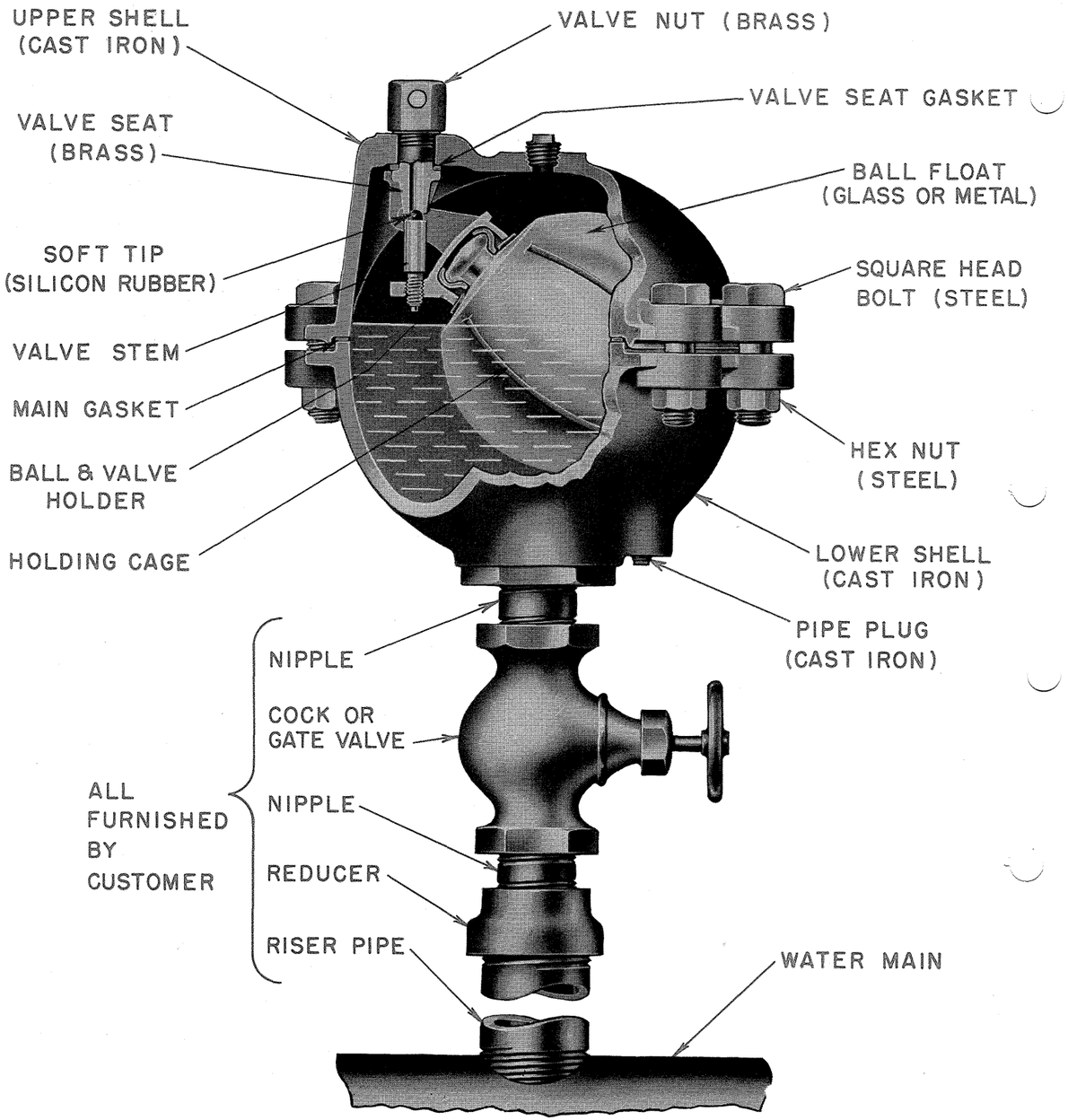


Figure 1—Cross Section of Simplex Automatic Air Release Valve, Type AGFD, Showing Materials of Construction.

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FOREWORD

Designing and operating engineers have experienced difficulties resulting from accumulations of air in pipe lines operated under pressure. Air may be carried in solution in the liquid, may enter through inefficient joints in the pump suctions, or it may be drawn in at any other part of the system which may be continually, or for part of the time, under a vacuum. Air, which is in solutions under high pressure and low temperatures will separate out when the conditions are reversed.

Whatever may be the source, the air which accumulates at peaks in the line reduces the cross sectional area and induces a friction head factor that lowers the pumping capacity for the entire line. This air, in the escaping through apertures too small to show water leaks, tends to remove particles of the jointing compound causing serious leaks. It is also capable of bringing about the more serious effect of water hammer.

Since the ingress of air in the line can never be wholly eliminated the only safe solution is the use of well-designed air release valves with large discharge capacities for its removal. Simplex Air Release Valves with vacuum holding attachments allow the accumulated air to separate while preventing the re-entrance of air into the line through the valve. These valves will provide the greatest possible protection for any installation on which they are used.

ADVANTAGES

Simplex Automatic Air Release Valves are designed to meet the following essential requirements and they have been proved repeatedly by thousands of installations over the past 40 years:

1. Excess power to insure the opening of the valve against a high internal pressure.
2. A valve seat of such form that will be least liable to stick shut or leak water.
3. An operating float that will not corrode, collapse, or become disconnected from its lever.
4. Simplicity of construction of materials that will not corrode; easy bearings and few parts.
5. Designed so that the outlet ports cannot be clogged by deposits of any kind thereby assuring efficiency of the unit.
6. A valve that may be shipped with a minimum of probability of damage and that may be placed in service without necessity for dismantling or assembly in the field.
7. Designed so that ease of access for repairs, replacement of minor parts should they be required.
8. Ability to prove proper action of the valve without dismantling or otherwise affecting the installation.
9. Provision for draining the valve without dismantling it or affecting the installation in the event of enforced idleness of the unit.

OPERATION

The valve is placed on the high portion of the line, wherever there is a possibility of air collecting as shown on cross section of Figure 1.

When the line is empty the ball float is down and the needle valve open. As water is admitted it fills the valve and the float rises, closes the needle valve and prevents leakage.

When air accumulates it will, on account of its lightness, ascend to the highest point in the line.

It passes through the nipple connecting the valve to the line and gradually collects on the top of the valve. Air accumulates to such an extent that eventually the water is forced downwards and out of the valve. When this occurs the float, which has been buoyed up by the water, descends and opens the needle valve, and the entrapped air escapes immediately to the atmosphere. Water then rises to take the place of the escaped air and the float again is forced upward, closing the needle valve.

It is most desirable that a large collection area in the form of a riser pipe be located directly beneath the valve. This riser pipe may be of any reasonable size consistent with diameter of the water main to which it is connected. This is illustrated in Figure 1.

CONSTRUCTION

The Simplex Automatic Air Release Valve, Type AGFD, shown in cross section, Fig. 1, contains but one lever movement which operates a needle valve so designed as to be always tight seating. The valve is operated by a heavy thickness, glass ball float (metal float under special conditions, at additional cost), tested to several times the working pressure to which it may be subjected when in service.

STANDARD VALVES

The Standard Simplex Air Release Valve is designed for operation under working pressures up to 250 psig. It is normally furnished with a 2″ tapped inlet connection, but can be bushed to provide a 1½″ or 1″ connection. This valve is equipped with a standard 9/32″ diameter air discharge port.

In order to meet different operating pressure conditions the AGFD valve may also be furnished with a 7/32″ diameter air port for a maximum working pressure of 300 psig. or a ½″ diameter air port for a maximum working pressure of 65 psig. To provide for conditions where a vacuum might occur in the line after the expulsion of air, and to prevent the breaking of this vacuum, there can be furnished a vacuum holding attachment which can be attached to the valve at the discharge port. Figure 2 shows general outline and dimensions of the standard air release valve, and Figure 3 shows this valve with the vacuum holding attachment.

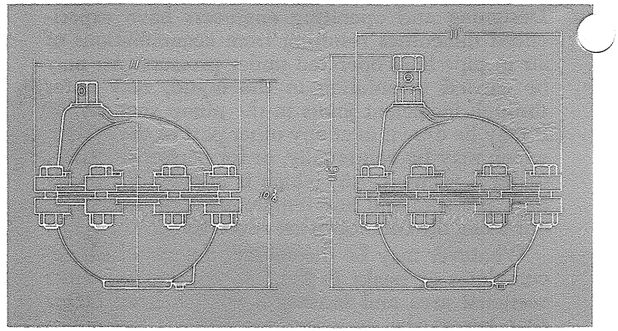


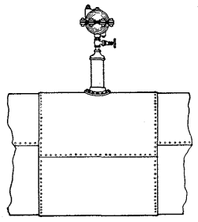
Figure 2—Type AGFD Valve.

Figure 3—Type AGFD Valve with Vacuum Attachment.

TYPE AGFD

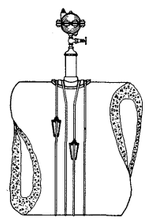
Inlet Diameter	Dimensions		Weight		
	Flange Diam.	Height	Net	Boxed	
				Domestic	Foreign
2″ Can be bushed down to 1½″ or 1″.	11″	10⅜″	31 lbs.	45 lbs.	65 lbs.

METHODS OF INSTALLATION



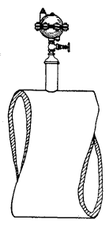
STEEL PIPE

With Simplex Air Release Valve mounted on saddle riveted to pipe.



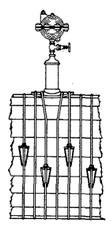
CONCRETE PIPE

With Simplex Air Release Valve mounted on special saddle strapped to pipe.



CAST IRON PIPE

With Simplex Air Release Valve mounted on riser screwed into pipe.



WOODEN PIPE

With Simplex Air Release Valve mounted on special saddle strapped to pipe.

Fig. 4—Forms of Mountings for Different Types of Pipes.

HIGH PRESSURE VALVES

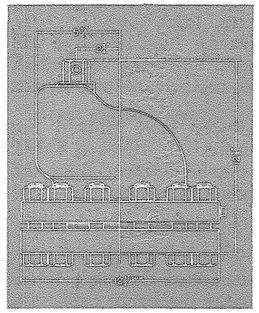


Figure 5—Type ARA Air Release Valve.

TYPE ARA

Inlet Diam.	Dimensions	
	Flange Diam.	Height
2″	12½″	12⅜″

Net	Weight	
	Boxed	
	Domestic	Foreign
135 lbs.	180 lbs.	260 lbs.

In order to provide a correctly designed and efficiently operating air release valve for pressures higher than normally encountered, the Simplex Type ARA unit can be furnished. The Type ARA valve is constructed almost identically in principle as the standard valve, differing only in its materials of construction and general appearance. The shell and flange are of steel and the flanges are heavier and provided with a greater number of holding parts. General appearance of this unit is shown in Fig. 5. The Type ARA valve is designed for working pressures up to 800 pounds per square inch, and is provided with a 2″ tapped inlet connection in the center of the under flange.

A cast steel hemispherical shell houses the lever, needle valve and stainless steel float. The needle valve, lever and wire frame holding the float are constructed of non-rusting material.

The needle and the valve seat are so manufactured that they are air-tight under highest pressures without the necessity for any grinding process.

SPECIAL PURPOSE VALVES

For Sewage

When sewage or sludge is forced through mains under pressure, the problem of obtaining unrestricted flow is further complicated by the fact that there is present not only entrained air but also the gases liberated by decomposing organic matter.

The use of a standard form of valve for this purpose is, of course, impossible, since the collection of sewage solids on the valve float and in the valve body will, in a relatively short time, prevent operation.

The SIMPLEX Type "B" air release valve has been designed to meet especially that condition.

The Simplex Type "B" sewage air release valve, as shown in Fig. 6 is essentially the same as the Type AGFD described previously, with an additional connection in its upper shell, which shell is mounted on side pipe (P), the assembly of which terminates with a 2″ valve (1), which connects to a vertical riser of the sewage force main. The connection at the force main should be at least 2″ in diameter to match the size of the valve assembly, but if feasible the connection at the main itself should be larger so as to provide the greatest possible entrapment for air as it passes along the line.

The trap formed by pipe (P), and the inclined connection from it to pipe (P2) provides a place in which sediment, which may be carried towards the air release valve, may settle out.

The Simplex type sewage valve is provided with a method of flushing to eliminate such sediment. This method includes a special diffuser which directs back flushing water in such a manner as to flush across the air outlet valve seat, flow over the ball float and cut loose adhering matter from the inner surface of the shell.

There is furnished with each valve a Simplex disconnector, consisting of a hose and disconnecting lever for alternative attachment at special seats above Valves (3) and (4) in the back flushing operation.

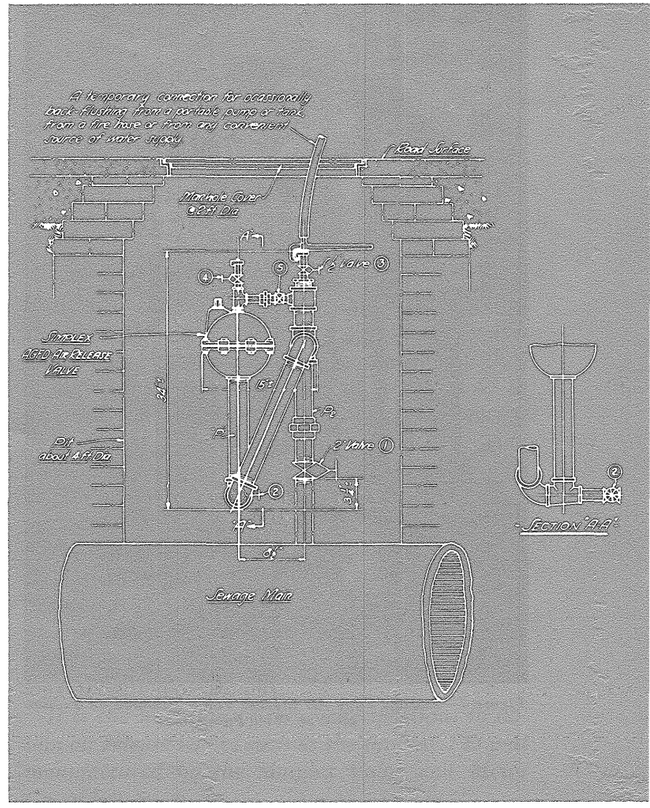


Figure 6—Type B Air Release Valve for Sewage.

This disconnector assembly is provided to comply with all health requirements. Inspection of the valve can be accomplished readily by removing the bolts at the valve center flange and breaking the union in cross connection (5).

Inlet Diam.	Dimensions			Weight		
	Height	Width	Depth	Net	Boxed	
					Domestic	Foreign
2″	34″	15″	15″	85 lbs.	125 lbs.	180 lbs.

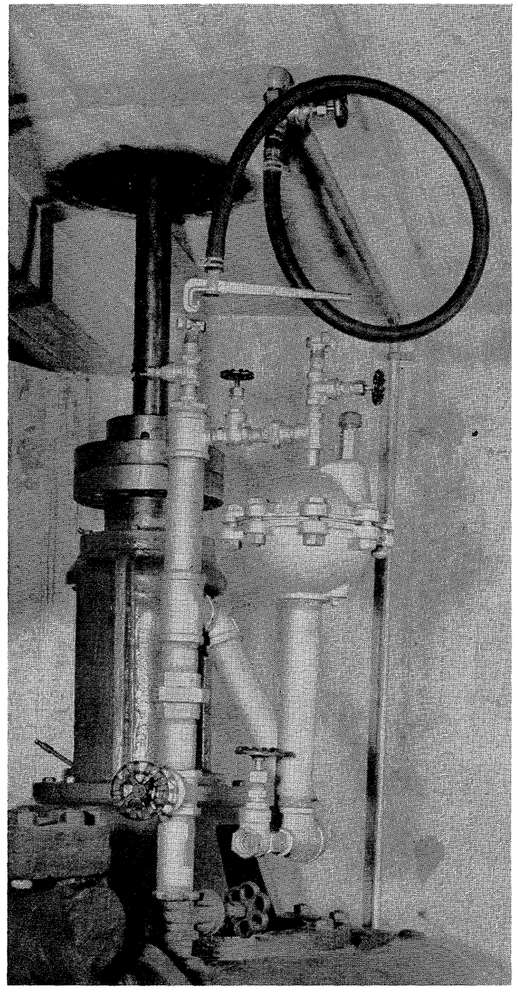


Figure 7—Sewage Type Air Release Valve Mounted on Suction of Wet Well Pump.

Figure 8—Air Release Valve Mounted on Pump Casing.

For Gasoline and Oil Lines

The problem of releasing accumulations of air is also of prime importance in the pumping of oil, gasoline and other liquids in the industrial field.

While the standard Simplex Air Release Valve will operate satisfactorily under most operating conditions, it can be adapted for use with corrosive liquids by the making of but few changes.

Many installations in industry have proven the value of this use of the Simplex Air Release Valve.

Specific recommendations can be obtained upon the receipt of a complete description of the conditions to be encountered.

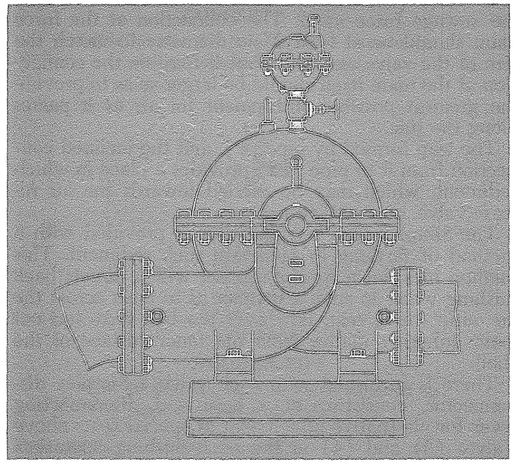
For Pump Casings

In many instances it has been found desirable to install air release valves with large discharge capacities close to the pumping unit or, when conditions permit, on the pump casing itself. This is for the purpose of releasing air from the line which may later give serious trouble at other points in the system.

When installed on pump casings the air release valve may be equipped with a vacuum holding attachment the purpose of which is to prevent the pump from becoming air bound during the period when the pump casing may be under a negative pressure.

When used in connection with sewage type wet well pumps the Type B sewage air release valve complete with the sewage piping arrangement may be mounted directly in the pump casing. In this instance, as shown in Figure 7, a 2-inch connecting pipe riser joins the pump casing and provides a means of supporting the entire valve assembly. When the sewage air valve is equipped with a vacuum holding attachment and the entire assembly mounted on the discharge side of the pump casing such an installation will maintain the discharge efficiency of the pump and prevent loss of priming during shut down periods.

When mounted directly on the pump casing, as shown in Figure 8 the valve should be placed at the topmost point utilizing 2 inch nipples and an intermediate 2 inch gate valve between the air release valve and the pump casing itself.



SUGGESTED SPECIFICATIONS FOR AIR RELEASE VALVES

There shall be furnished at each of the points shown in the line a properly designed air release valve suitable for operating under a working pressure of ——— lbs., per square inch and shop tested at a pressure of ——— lbs., per square inch.

Each valve shall be of the type wherein a spherical float resting on the surface of the water within the valve casing opens or closes, by means of a lever movement, the air discharge vent hole.

The valve casing shall be constructed in two sections of cast iron, both sections being of spherical design and each having an internal cast flange.

The flange sections shall be bolted together with a sufficient number of heavy bolts and nuts to suit the operating and test pressure conditions, thus completing the entire valve casing.

The upper spherical section of the casing shall have integrally cast with it a chamber within which the valve stem and valve seat will be assembled and the discharge opening through this chamber shall not exceed ———″ in diameter.

The spherical float shall be constructed of glass of sufficient strength to withstand the pressures to which it will be subjected, and will be connected by means of a lever movement to the valve stem thereby providing opening and closing of the discharge port subject to the position of the float resting on the liquid within the valve chamber.

The construction of the valve shall be such that there shall be an excess power in the float to insure opening of the valve port under high internal pressure and the design of the unit shall be such that it will not stick shut or leak water under continued long operating conditions.

The valve shall be designed for sewage service and shall have incorporated with it a 2″ pipe trap arrangement designed to act as a settling chamber for solid particles. This pipe trap arrangement shall be complete with a 1/2″ shut off valve and flushing disconnector seat to provide an approved temporary back flushing connection for cleaning the entire valve and pipe trap assembly, all as shown on the plans.

It is the intention of these specifications to obtain air release valves complete with pipe trap assemblies such as the type "B" valve manufactured for sewage service by the Simplex Valve and Meter Co. of Lancaster, Penna.

SUGGESTED SPECIFICATIONS FOR AIR RELEASE VALVES ARRANGED FOR SEWAGE SERVICE

There shall be furnished at each of the points shown in the line a properly designed air release valve suitable for operating under a working pressure of ——— lbs., per square inch and shop tested at a pressure of ——— lbs., per square inch.

Each valve shall be of the type wherein a spherical float resting on the surface of the water within the valve casing opens or closes, by means of a lever movement, the air discharge vent hole.

The valve casing shall be constructed in two sections of cast iron, both sections being of spherical design each having an integral cast flange.

The flange sections shall be bolted together with a sufficient number of heavy bolts and nuts to suit the operating and test pressure conditions, thus completing the entire valve casing. The bottom section shall have a 2″ threaded inlet opening.

The upper spherical section of the casing shall have integrally cast with it a chamber within which the valve stem and valve seat will be assembled and the discharge opening through this chamber shall not exceed ———″ in diameter.

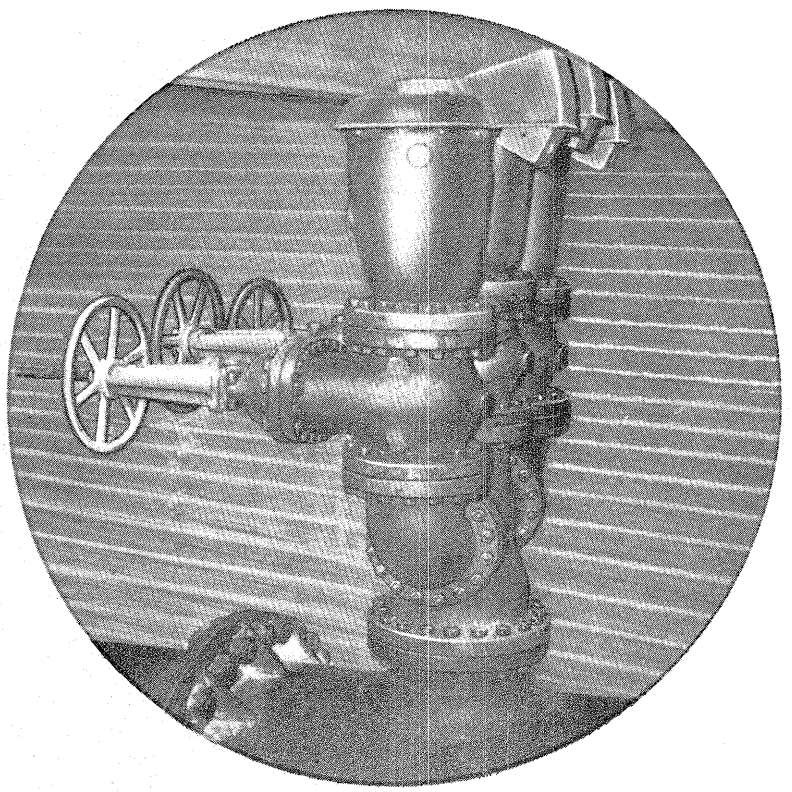
The spherical float shall be constructed of glass of sufficient strength to withstand the pressures to which it will be subjected, and will be connected by means of a lever movement to the valve stem thereby providing opening and closing of the discharge port subject to the position of the float resting on the liquid within the valve chamber.

The construction of the valve shall be such that there shall be an excess power in the float to insure opening of the valve port under high internal pressure and the design of the unit shall be such that it will not stick shut or leak water under continued long operating conditions.

It is the intention of these specifications to obtain air release valves such as the type AGFD unit manufactured by the Simplex Valve and Meter Co. of Lancaster, Pa.

®

AIR INLET (VACUUM BREAKING) VALVES



BULLETIN
1202

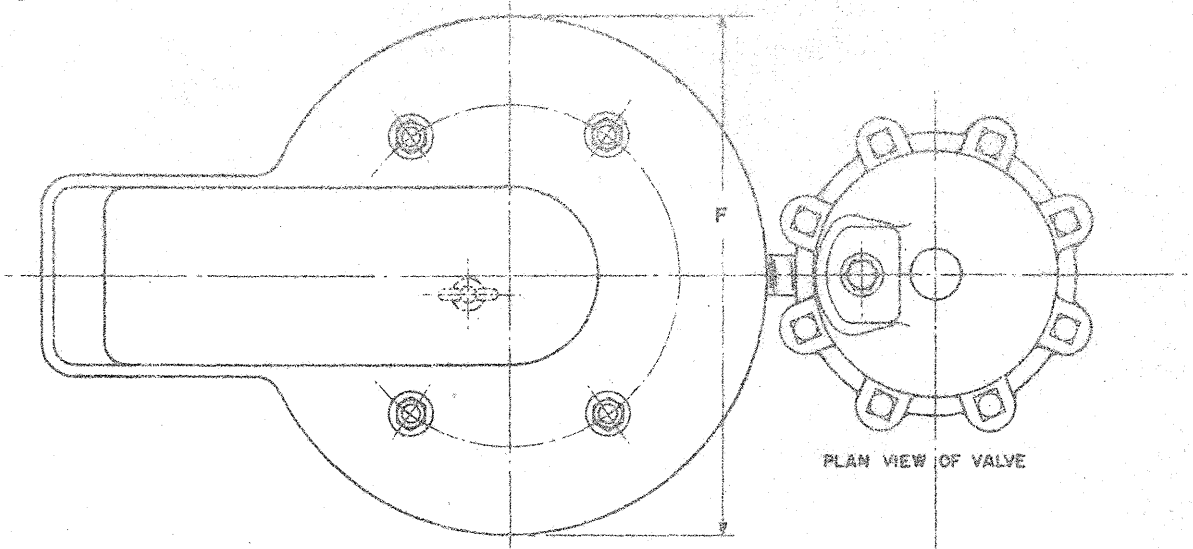
SIMPLEX
MOVES PROPORTIONALLY TO RATE OF FLOW

TRADE MARK
Reg. U.S. Pat. Office

SIMPLEX

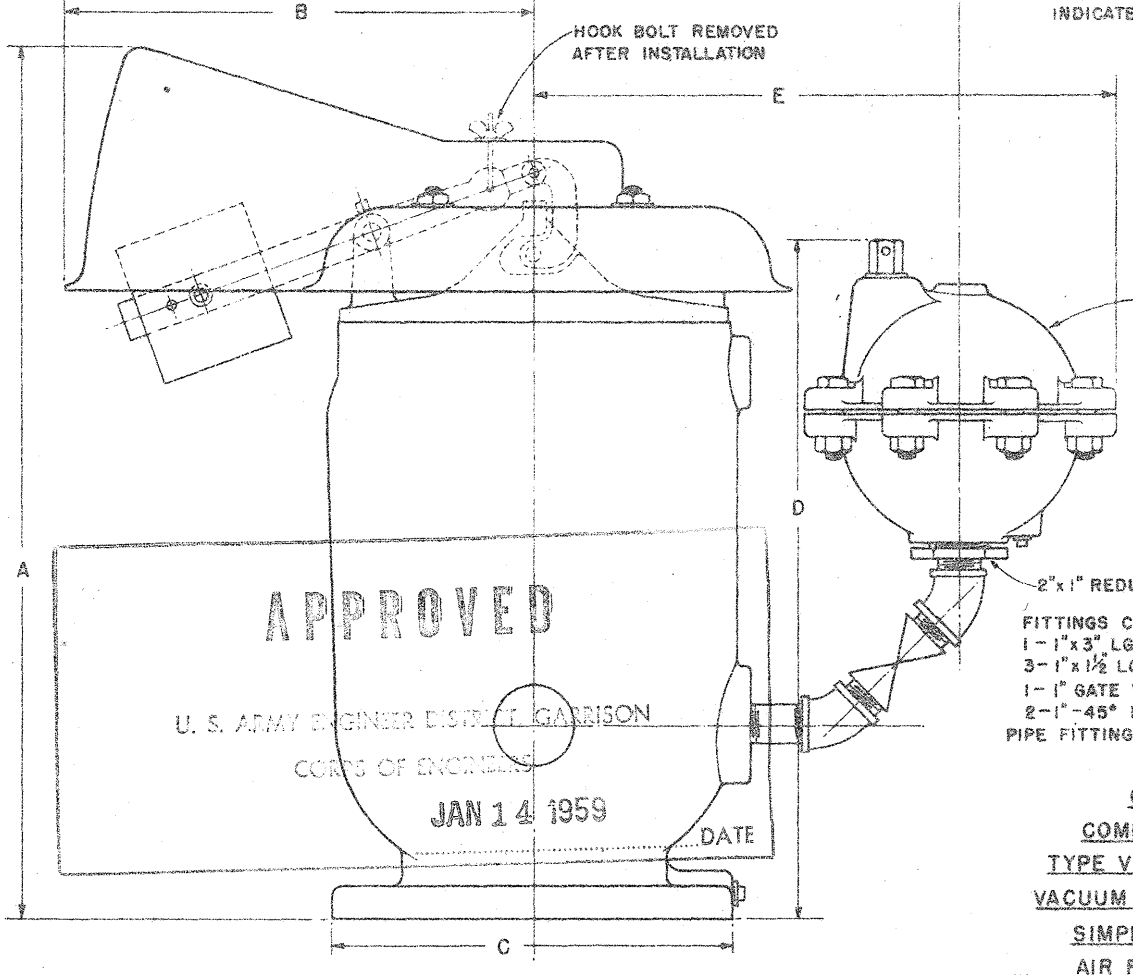
VALVE AND METER COMPANY

68th AND UPLAND STS., PHILADELPHIA 42, PA.



PLAN VIEW OF VALVE

NOTE:-
CLEARANCE DIMENSIONS AS INDICATED ARE MAXIMUM



TYPE AGFD
AIR RELEASE VALVE

INSTALLED IN VERTICAL POSITION ONLY

2"x 1" REDUCING BUSHING

FITTINGS CONSIST OF
1 - 1"x 3" LG. NIPPLE
3 - 1"x 1½ LG. CLOSE NIPPLES
1 - 1" GATE VALVE 2⅝ LG. (BRASS)
2 - 1" - 45° ELBOWS
PIPE FITTINGS GALVANIZED

APPROVED

U. S. ARMY ENGINEER DISTRICT, GARRISON
CORPS OF ENGINEERS

JAN 14 1959
DATE

SIZE OF VALVE INCHES	A		B	C		D		E	F	FLG. THICK.		STD. DRILLING			EX.H. DRILLING		
	STD.	EX. H.		STD.	EX.H.	STD.	EX.H.			STD.	EX.H.	NO.	SIZE	B.C.	NO.	SIZE	B.C.
4	18½	18¾	9¼	9	10	21⅛	21⅜	16⅞	7½	15/16	1¼	8	¾	7½	8	⅞	7⅞
6	22⅞	23¼	11⅝	11	12½	23⅛	23½	18½	10	1	1 7/16	8	⅞	9½	12	⅞	10⅝
8	29⅜	29⅞	15¾	13½	15	22⅞	23⅝	19⅞	17⅝	1⅛	1⅝	8	⅞	11¾	12	1	13
10	31½	32¼	17⅝	16	17½	28¼	29	21⅛	20⅝	1 3/16	1⅞	12	1	14¼	16	1⅛	15¼

OUTLINE OF
COMBINED SIMPLEX
TYPE VAC AIR RELEASE &
VACUUM BREAKING VALVE &
SIMPLEX TYPE AGFD
AIR RELEASE VALVE

SIMPLEX VALVE & METER CO.
PHILA., PA.

2
4935

12-21-48