CENTRAL FILE

MECHANICAL EQUIPMENT
QUALIFICATION PROGRAM

M-054

Reactor Building Spray System

Centrifugal Pump

No.	DATE	REVISIONS	BY	CH'K	APPR
1	2/2/83	See Revision Control Sheet	MRL	WRK	PDR
0	1/21/83	Issued for use	MRL	WRR	PDR

nutech

JOB NO. CPC-09-17	
SPEC/DES GUIDE No.	REV.
Mechanical M-054	1

REVISION CONTROL SHEET

TITLE: Reactor Building Spray System Centrifugal Pump

REPORT NUMBER: M-054

M. Ross Lee / Consultant — NAME / TITLE — MRL — INITIALS

C. W. Allen / CONSULTANT — NAME / TITLE — CWA — INITIALS

A. R. Kelly / PROJECT ENGINEER — NAME / TITLE — ARK — INITIALS

H. Montella / PROJECT MANAGER — NAME / TITLE — HMF — INITIALS

[illegible] / ENGINEERING MANAGER — NAME / TITLE — BDS — INITIALS

PAGE(S)	REV	PREPARED BY / DATE	ACCURACY CHECK BY / DATE	CRITERIA CHECK BY / DATE	REMARKS
4	1				Revised Note (2)
5	1				Revised temperature and pressure entries to 104°F and ATM respectively
6	1				Revised component designation to shaft seal assembly
					Revised pump packing and pump casing seal function status to "N"
					Revised Mfgr./Model No. Data entries for pump packing and pump casing seal entries to MEEQRF pages 3 and 4 respectively
8/12	1				Revised C/PSS Sheets to non-metallic part description
8	1				Added O-Ring references
9	1				Added bearing oil seal references

REVISION CONTROL SHEET
(CONTINUATION)

TITLE: Reactor Building Spray System Centrifugal Pump REPORT NUMBER: M-054

PAGE(S)	REV	PREPARED BY / DATE	ACCURACY CHECK BY / DATE	CRITERIA CHECK BY / DATE	REMARKS
10	1				Added bearing oil sight references
11	1				Added flexible coupling references
12	1				Added heat exchanger references
13-29	1				Revised MEEQRFs to include additional design and test data
32-34	1				Revised Appendix A, Items 1 and 7 for additional reference material
36	1	MRL 2/1/83	CWA 2/2/83	LRK 2/2/83	Added Reference 18

TABLE OF CONTENTS

Mechanical Equipment File Cover Summary Sheet

Equipment Type: Centrifugal Pump MEQ Prog No.: M-054

Manufacturer/Model No.: Babcock and Wilcox Canada Ltd 6x8x13 SMK

Safety Function:

The Reactor Building Spray Pump provides a continuous supply of water from the Borated Water Storage Tank or the Reactor Building Sump to reduce Reactor Building pressure after a LOCA or MSLB accident.

Operation:

A motor driven centrifugal pump provides sufficient discharge head and flow to supply the Reactor Building spray headers to quench steam and remove airborne radioactive contaminants released to the containment after a LOCA or MSLB accident.

Qualification Status:

The Reactor Building Spray Pump is qualified for a forty (40) year service period and a thirty (30) day post accident condition provided periodic maintenance and surveillance is performed which includes the specific requirements identified in the maintenance and surveillance recommendations in Section G and Appendix A of this document.

MIDLAND UNITS 1 AND 2
EQUIPMENT QUALIFICATION SUMMARY
COMPONENT DATA AND ENVIRONMENT SHEET

EQUIPMENT ID NUMBER 1P-064A

DESCRIPTION: Centrifugal Pump
SERVICE: RB Spray Pump

MANUFACTURER: Babcock and Wilcox
MODEL NO: 6x8x13 SMK
SYSTEM: BKA **PO NO**: M-54 **MEEQS NO**: M-054
ROOM NO: 027 **BLDG**: AX **ELEVATION**: 568
OPERATING CYCLES: 500 **NONSEISMIC VIBR**: N/A
RESPONSE SPECTRUM FIG: Future use
LOCA: Yes **MSLB**: Yes **SAFE SD**: No
HELB OUTSIDE RB: N/A
NOTES:

PARAMETER	NORMAL	LOCA	MSLB	
OPERABILITY PERIOD	40 years	30 Days	30 Days	
SAFETY FUNCTION	RB Spray	RB Spray	RB Spray	
A. TEMPERATURE (F)	50-104	50-104	50-104	
B. PRESSURE	ATM	ATM	ATM	
C. HUMIDITY (PERC RH)	0-100	100	100	
D. RADIATION (RADS)	6.6E06	3.0E06	3.0E06	
E. SPRAY	N/A	N/A	N/A	
F. SUBMERGENCE	N/A	N/A	N/A	
G. ACCURACY	N/A	N/A	N/A	
H. RESPONSE TIME	N/A	72 sec	72 sec	

EQUIPMENT ID NUMBER 1P-064B

DESCRIPTION: Centrifugal Pump
SERVICE: RB Spray Pump

MANUFACTURER: Babcock and Wilcox
MODEL NO: 6x8x13 SMK
SYSTEM: BKA **PO NO**: M-54 **MEEQS NO**: M-054
ROOM NO: 025 **BLDG**: AX **ELEVATION**: 568
OPERATING CYCLES: 500 **NONSEISMIC VIBR**: N/A
RESPONSE SPECTRUM FIG: Future use
LOCA: Yes **MSLB**: Yes **SAFE SD**: No
HELB OUTSIDE RB: N/A
NOTES:

PARAMETER	NORMAL	LOCA	MSLB	
OPERABILITY PERIOD	40 years	30 Days	30 Days	
SAFETY FUNCTION	RB Spray	RB Spray	RB Spray	
A. TEMPERATURE (F)	50-104	50-104	50-104	
B. PRESSURE	ATM	ATM	ATM	
C. HUMIDITY (PERC RH)	0-100	100	100	
D. RADIATION (RADS)	6.6E06	3.0E06	3.0E06	
E. SPRAY	N/A	N/A	N/A	
F. SUBMERGENCE	N/A	N/A	N/A	
G. ACCURACY	N/A	N/A	N/A	
H. RESPONSE TIME	N/A	72 sec	72 sec	

EQUIPMENT ID NUMBER 2P-064A

DESCRIPTION: Centrifugal Pump
SERVICE: RB Spray Pump

MANUFACTURER: Babcock and Wilcox
MODEL NO: 6x8x13 SMK
SYSTEM: BKA **PO NO**: M-54 **MEEQS NO**: M-054
ROOM NO: 028 **BLDG**: AX **ELEVATION**: 568
OPERATING CYCLES: 500 **NONSEISMIC VIBR**: N/A
RESPONSE SPECTRUM FIG: Future use
LOCA: Yes **MSLB**: Yes **SAFE SD**: NO
HELB OUTSIDE RB: N/A
NOTES:

PARAMETER	NORMAL	LOCA	MSLB	
OPERABILITY PERIOD	40 years	30 Days	30 Days	
SAFETY FUNCTION	RB Spray	RB Spray	RB Spray	
A. TEMPERATURE (F)	50-104	50-104	50-104	
B. PRESSURE	ATM	ATM	ATM	
C. HUMIDITY (PERC RH)	0-100	100	100	
D. RADIATION (RADS)	6.6E06	3.0E06	3.0E06	
E. SPRAY	N/A	N/A	N/A	
F. SUBMERGENCE	N/A	N/A	N/A	
G. ACCURACY	N/A	N/A	N/A	
H. RESPONSE TIME	N/A	72 sec	72 sec	

MIDLAND UNITS 1 AND 2
EQUIPMENT QUALIFICATION SUMMARY
COMPONENT DATA AND ENVIRONMENT SHEET

EQUIPMENT ID NUMBER 2P-064B

DESCRIPTION: Centrifugal Pump
SERVICE: RB Spray Pump

MANUFACTURER: Babcock and Wilcox
MODEL NO: 6x8x13 SMK
SYSTEM: BKA PO NO: M-54 MEEQS NO: M-054
ROOM NO: 026 BLDG: AX ELEVATION: 568
OPERATING CYCLES: 500 NONSEISMIC VIBR: N/A
RESPONSE SPECTRUM FIG: Future use
LOCA: Yes MSLB: Yes SAFE SD: No
HELB OUTSIDE RB: N/A
NOTES:

PARAMETER	NORMAL	LOCA	MSLB	
OPERABILITY PERIOD	40 years	30 Days	30 Days	
SAFETY FUNCTION	RB Spray	RB Spray	RB Spray	
A. TEMPERATURE (F)	50-104	50-104	50-104	
B. PRESSURE	ATM	ATM	ATM	
C. HUMIDITY (PERC RH)	0-100	100	100	
D. RADIATION (RADS)	6.6E06	3.0E06	3.0E06	
E. SPRAY	N/A	N/A	N/A	
F. SUBMERGENCE	N/A	N/A	N/A	
G. ACCURACY	N/A	N/A	N/A	
H. RESPONSE TIME	N/A	72 sec	72 sec	

EQUIPMENT ID NUMBER

DESCRIPTION:
SERVICE:

MANUFACTURER:
MODEL NO:
SYSTEM: PO NO: EEQS NO:
ROOM NO: BLDG: ELEVATION:
OPERATING CYCLES: NONSEISMIC VIBR:
RESPONSE SPECTRUM FIG:
LOCA: MSLB: SAFE SD:
HELB OUTSIDE RB:
NOTES:

PARAMETER				
OPERABILITY PERIOD				
SAFETY FUNCTION				
A. TEMPERATURE (F)				
B. PRESSURE				
C. HUMIDITY (PERC RH)				
D. RADIATION (RADS)				
E. SPRAY				
F. SUBMERGENCE				
G. ACCURACY				
H. RESPONSE TIME				

EQUIPMENT ID NUMBER

DESCRIPTION:
SERVICE:

MANUFACTURER:
MODEL NO:
SYSTEM: PO NO: EEQS NO:
ROOM NO: BLDG: ELEVATION:
OPERATING CYCLES: NONSEISMIC VIBR:
RESPONSE SPECTRUM FIG:
LOCA: MSLB: SAFE SD:
HELB OUTSIDE RB:
NOTES:

PARAMETER				
OPERABILITY PERIOD				
SAFETY FUNCTION				
A. TEMPERATURE (F)				
B. PRESSURE				
C. HUMIDITY (PERC RH)				
D. RADIATION (RADS)				
E. SPRAY				
F. SUBMERGENCE				
G. ACCURACY				
H. RESPONSE TIME				

MECHANICAL EQUIPMENT ENVIRONMENTAL QUALIFICATION SHEET (1)

TYPE OF EQUIPMENT: Centrifugal Pump

MANUFACTURER: Babcock and Wilcox PROGRAM NO.: M-054

MODEL NO.: 6x8x13 SMK

EQUIPMENT APPLICABILITY: Model Qualified, Configuration and Interfaces Match Installation	ACCEPTANCE	REF.	PAGE(S)
	Y	Appendix A No. 12	-

EXTERNAL NORMAL OPERATING CONDITIONS

	REQUIRED	QUALIFIED	ACCEPT.	METHOD(1)	REF.	PAGE(S)
QUALIFIED LIFE(2)	40 Years	40 Years	Y	AN	Apdx A No. 10	-
RESPONSE TIME	N/A	N/A	N/A	N/A	N/A	N/A
ACCURACY	N/A	N/A	N/A	N/A	N/A	-
TEMPERATURE, MIN.	50F	50F	Y	AN	Apdx A No. 7	-
TEMPERATURE, MAX.	104F	104F	Y	AN	Apdx A No. 7	-
TEMPERATURE, AVE.	N/A	N/A	N/A	N/A	N/A	N/A
PRESSURE	ATM	ATM	Y	AN	Apdx A No. 6	-
HUMIDITY, MAX.	100%	100%	Y	AN	Apdx A No. 7	-
TID (RADS)	6.6E06	> 2.8E07	Y	TC	Apdx A No. 1,2	-
OPERATING CYCLES	N/A	N/A	N/A	N/A	N/A	N/A

(1) Qualification Method Symbols: TT-Type Test, PT-Partial Type Test, TC-Test of Vital Components, OE-Operating Experience, AN-Analysis

(2) Qualified _____ without exception __X__ with exception (See MEFCSS, page 1)

MECHANICAL EQUIPMENT ENVIRONMENTAL QUALIFICATION SHEET (2)

ACCIDENT ENVIRONMENT:	LOCA X	MSLB X	HELB OUTSIDE RB N/A	PROGRAM NO.: M-054

	REQUIRED	QUALIFIED	ACCEPT-ANCE	METHOD(1)	REF.	PAGE(S)
OPERATING TIME	30 days	30 days	Y	AN	Apdx A No. 10	-
RESPONSE TIME	72 sec	30 sec	Y	PT	Apdx A No. 11	-
ACCURACY	N/A	N/A	N/A	N/A	N/A	N/A
TEMPERATURE	104 F	104F	Y	AN	Apdx A No. 6	-
PRESSURE	ATM	ATM	Y	AN	Apdx A No. 6	-
TID(2) (RADS) γ/β	9.6E06/NA	9.6E06/NA	Y	AN	Apdx A No. 2,4,5	-
SPRAY	N/A	N/A	N/A	N/A	Apdx A No. 6	-
SUBMERGENCE	N/A	N/A	N/A	N/A	Apdx A No. 13	-
LONG TERM FAILURE OF SHORT-TERM USE EQUIP. WAS ADDRESSED	N/A	N/A	N/A	N/A	N/A	N/A

ACCELERATED AGING TIME/TEMPERATURE N/A / N/A

(1) Qualification Method Symbols: TT-Type Test, PT-Partial Type Test, TC- Test of Vital Components, OE-Operating Experience, AN-Analysis

(2) Includes the dose acquired under normal operating conditions over the equipment qualified life.

EQUIPMENT APPLICABILITY EVALUATION SHEET

EQUIPMENT: Reactor Building Spray Pump **PROGRAM NO.:** M-054

SUBSYSTEM	COMPONENT	ESSENTIAL FOR FUNCTION	MFGR./MODEL NO. DATA	C/PSS REF.	REMARKS
Centrifugal Pump	N/A	Y	Babcock & Wilcox 6 x 8 x 13 SMK	N/A	
	Shaft Seal Assembly	Y	John Crane 8B-1	A	
	Pump Packing	N	See MEEQRF, Page 3	N/A	
	Pump Casing Seals	N	See MEEQRF, Page 4	N/A	
	Bearing Oil Seals	Y	See MEEQRF, Page 5	B	
	Bearing Lubricating Oil	Y	See Appendix A No. 4, 5	N/A	
	Bearing Oil Sight	Y	GITS BW-20-04053	C	
	Flexible Coupling	Y	Koppers Model 2½ BS	D	
Pump Cooling	N/A	Y	N/A	N/A	
	Heat Exchanger Shutoff Valve	N	N/A	N/A	
	Separator Outlet Valve No. 1	N	N/A	N/A	

EQUIPMENT APPLICABILITY EVALUATION SHEET

EQUIPMENT: Reactor Building Spray Pump **PROGRAM NO.:** M-054

SUBSYSTEM	COMPONENT	ESSENTIAL FOR FUNCTION	MFGR./MODEL NO. DATA	C/PSS REF.	REMARKS
	Separator Outlet Valve No. 2	N	N/A	N/A	
	Oil Cooler Shut-off Valve	N	N/A	N/A	
	Seal Shut-Off Valve	N	N/A	N/A	
	Cyclone Separator	N	N/A	N/A	
	Heat Exchanger	Y	Crane #2-5	E	
Pump Drive Unit	Motor	Y	Allis-Chambers	N/A	Appendix A No. 9

COMPONENT/PART SUMMARY SHEET A

EQUIPMENT: Reactor Building Spray Pump COMPONENT: Shaft Seal PROGRAM NO.: M-054

NON-METALLIC PART DESCRIPTION	ESSENTIAL FOR FUNCTION	REF. DOC.	MATERIAL	REF. DOC.	REPLACE-MENT INTERVAL	BASIS (1)	REF. DOC.	REQUIRE-MENTS MET	REF. DOC.	REMARKS
O-Ring	Y	8	EPT Rubber	8	10 Years	AN	17	N/A	N/A	Appendix A No. 1
O-Ring	Y	8	EPT Rubber	8	10 Years	AN	17	N/A	N/A	Appendix A No. 1
O-Ring	Y	8	EPT Rubber	8	10 Years	AN	17	N/A	N/A	Appendix A No. 1

(1) Replacement Interval Basis Abbreviations: OE-Operating Experience, AN-Analysis, MR-Manufacturers Recommendation

COMPONENT/PART SUMMARY SHEET B

EQUIPMENT: Reactor Building Spray Pump COMPONENT: Bearing Oil Seals PROGRAM NO.: M-054

NON-METALLIC PART DESCRIPTION	ESSENTIAL FOR FUNCTION	REF. DOC.	MATERIAL	REF. DOC.	REPLACE-MENT INTERVAL	BASIS (1)	REF. DOC.	REQUIRE-MENTS MET	REF. DOC.	REMARKS
Outboard Bearing Shaft Seal	Y	2	Nitrile Rubber	2	40 Years	AN	18	N/A	N/A	Appendix A No. 1
Inboard Bearing Shaft Seal	Y	2	Nitrile Rubber	2	40 Years	AN	18	N/A	N/A	Appendix A No. 1
Outboard Cover Gasket	Y	2	Waxed Paper	2	40 Years	AN	16	N/A	N/A	Appendix A No. 2
Inboard Cover Gasket	Y	2	Waxed Paper	2	40 Years	AN	16	N/A	N/A	Appendix A No. 2
Lubricating Oil	Y	2	Oil	2	10 Years	AN	17	N/A	N/A	Appendix A No. 4,5

(1) Replacement Interval Basis Abbreviations: OE-Operating Experience, AN-Analysis, MR-Manufacturers Recommendation

COMPONENT/PART SUMMARY SHEET C

EQUIPMENT: Reactor Building Spray Pump COMPONENT: Bearing Oil Sight PROGRAM NO.: M-054

NON-METALLIC PART DESCRIPTION	ESSENTIAL FOR FUNCTION	REF. DOC.	MATERIAL	REF. DOC.	REPLACE-MENT INTERVAL	BASIS (1)	REF. DOC.	REQUIRE-MENTS MET	REF. DOC.	REMARKS
O-Ring	Y	9	BUNA-N	9	40 Years	AN	18	N/A	N/A	Appendix A No. 1
O-Ring	Y	9	BUNA-N	9	40 Years	AN	18	N/A	N/A	Appendix A No. 1
Sight Glass	Y	9	Glass	9	as req.	AN	17	N/A	N/A	Appendix A No. 3

(1) Replacement Interval Basis Abbreviations: OE-Operating Experience, AN-Analysis, MR-Manufacturers Recommendation

COMPONENT/PART SUMMARY SHEET D

EQUIPMENT: Reactor Building Spray Pump COMPONENT: Flexible Coupling PROGRAM NO.: M-054

NON-METALLIC PART DESCRIPTION	ESSENTIAL FOR FUNCTION	REF. DOC.	MATERIAL	REF. DOC.	REPLACE-MENT INTERVAL	BASIS (1)	REF. DOC.	REQUIRE-MENTS MET	REF. DOC.	REMARKS
Grease	Y	10	Appendix A No. 7	N/A	10 Years	AN	17	N/A	N/A	Appendix A No. 4,5

(1) Replacement Interval Basis Abbreviations: OE-Operating Experience, AN-Analysis, MR-Manufacturers Recommendation

COMPONENT/PART SUMMARY SHEET E

EQUIPMENT: Reactor Building Spray Pump COMPONENT: Heat Exchanger PROGRAM NO.: M-054

NON-METALLIC PART DESCRIPTION	ESSENTIAL FOR FUNCTION	REF. DOC.	MATERIAL	REF. DOC.	REPLACE-MENT INTERVAL	BASIS (1)	REF. DOC.	REQUIRE-MENTS MET	REF. DOC.	REMARKS
O-Ring	N	11	BUNA-N	11	40 Years	AN	18	N/A	N/A	Appendix A No. 1

(1) Replacement Interval Basis Abbreviations: OE-Operating Experience, AN-Analysis, MR-Manufacturers Recommendation

MECHANICAL EQUIPMENT ENVIRONMENTAL QUALIFICATION REVIEW FORM

COMPONENT: Shaft Seal Assembly	PAGE 1 OF 17
MFGR.: John Crane	PROGRAM NO.: M-054
DWG./DOC. NO.: 71-600-076 (Ref. 2)	MODEL NO.: 8B-1
Item No. 7102, Ref. 2	LOCATION: Aux Bldg. 568FT

SAFETY RELATED: YES X NO ____

DISCUSSION:

The shaft seal prevents gross external leakage from the pump casing along the rotating impeller drive shaft. Failure of the non-metallic parts cause increased shaft leakage, metallic part wear, pump vibration and decreased pump capacity. The safety function of the pump may be impaired. The Reactor Building Spray pumps are not required for continuous service. See surveillance and maintenance recommendations for frequency of seal inspection and maintenance.

PART DESCRIPTION: O-Ring item 2, Ref. 8

FUNCTION: Seal between shaft and rotating seal part

SAFETY RELATED: YES X NO ____

A replacement interval of ten years will assure that the vital rubber components maintain their physical integrity to support their designated safety function.

MFGR.: N/A MODEL NO.: N/A

MATERIAL: EPT Rubber REFERENCE(S): John Crane CFSP-54046-2

DESIGN RATING(S)	REFERENCE(S)	REQUIREMENTS	DEMONSTRATED BY	ACCEPTABLE	REFERENCE(S)
5.0E06 Rads	17	Radiation - gamma	Materials	Y	Ref17
		4.65 E06 Rads	Analysis		Appendix A
		(10 years plus			No. 1
		30 day post			
		accident)			
310°F	1	220°F (maximum	Material Analysis	Y	Ref 1
		temperature of			Appendix A
		recirculating			No. 7
		fluid)			

MEEQRF (CONT.)	PAGE 2 OF 17	PROGRAM NO.: M-054

PART DESCRIPTION: O-Ring, item 4, Ref 8

FUNCTION: Seal between stationary seal part and pump housing

SAFETY RELATED: YES X NO ____ A replacement interval of ten years will assure that the vital rubber components maintain their physical integrity to support their designated safety function.

MFGR.: N/A MODEL NO.: N/A

MATERIAL: EPT Rubber REFERENCE(S): John Crane CFSP-54046-2 (Ref 8)

DESIGN RATING(S)	REFERENCE(S)	REQUIREMENTS	DEMONSTRATED BY	ACCEPTABLE	REFERENCE(S)
5.0E06 Rads	17	Radiation-gamma	Material Analysis	Y	Ref 17
		4.65 E06 Rads (10			Appendix A
		years plus 30 day			No. 1
		post accident)			
310°F	1	220°F (maximum	Material Analysis	Y	Ref 1
		temperature of			Appendix A
		recirculating fluid			No. 17

PART DESCRIPTION: O-Ring, item 15, Ref. 8

FUNCTION: Seal between gland plate and pump housing

SAFETY RELATED: YES ____ NO X

Failure of this seal results in external leakage that does not effect mechanical seal effectiveness.

MFGR.: Not available MODEL NO.: Not available

MATERIAL: EPT Rubber REFERENCE(S): John Crane CFSP-54046-2 (Ref 8)

DESIGN RATING(S)	REFERENCE(S)	REQUIREMENTS	DEMONSTRATED BY	ACCEPTABLE	REFERENCE(S)
5.0E06	17	Radiation-gamma	Material Analysis	Y	Ref 17
		4.65 E06 Rads (10			Appendix A
		years plus 30			No. 1
		day post accident)			
310°F	1	220°F (maximum	Material Analysis	Y	Ref 1
		temperature of			Appendix A
		recirculating			No. 7
		fluid)			

MECHANICAL EQUIPMENT ENVIRONMENTAL QUALIFICATION REVIEW FORM

COMPONENT: Pump Packing	PAGE 3 OF 17
MFGR.: Not available	PROGRAM NO.: M-054
DWG./DOC. NO.: 71-600-076 (Ref 2)	MODEL NO.: N/A
	LOCATION: Aux Bldg 568 FT

SAFETY RELATED: YES ____ NO X

DISCUSSION:

The pump packing normally reduces pump leakage along the shaft. Failure of the pump packing results in increased pump leakage. Because of the construction of the pump, the leakage through the pump packing is expected to be insignificant. Hence, the safety function of the reactor building spray pump is not impaired.

PART DESCRIPTION: N/A - no non-metallic safety related components

FUNCTION:

SAFETY RELATED: YES ____ NO ____

MFGR.: MODEL NO.:

MATERIAL: REFERENCE(S):

DESIGN RATING(S)	REFER-ENCE(S)	REQUIREMENTS	DEMONSTRATED BY	ACCEPT-ABLE	REFER-ENCE(S)

MECHANICAL EQUIPMENT ENVIRONMENTAL QUALIFICATION REVIEW FORM

COMPONENT: Pump Casing Seals	PAGE 4 OF 17
MFGR.: Parker & Various	PROGRAM NO.: M-054
DWG./DOC. NO.: 71-600-076 (Ref 2)	MODEL NO.: #2-454
item 1101, 1103, 1104, 1105, 3102	LOCATION: Aux Bldg. 568FT

SAFETY RELATED: YES ____ NO X

DISCUSSION:

The pump casing seals prevent leakage of the pumped process fluid from occuring between metallic surface of the pump casing assembly. Failure of any of these seals results in external leakage of the process fluid. Because of the construction of the pump, the leakage through the casing seal is expected to be insignificant. Hence, the safety function of the Reactor Building Spray Pump is not impaired.

PART DESCRIPTION: N/A - no non-metallic safety related components

FUNCTION:

SAFETY RELATED: YES ____ NO ____

MFGR.: MODEL NO.:

MATERIAL: REFERENCE(S):

DESIGN RATING(S)	REFERENCE(S)	REQUIREMENTS	DEMONSTRATED BY	ACCEPTABLE	REFERENCE(S)

MECHANICAL EQUIPMENT ENVIRONMENTAL QUALIFICATION REVIEW FORM

COMPONENT: Bearing Oil Seals	PAGE 5 OF 17
MFGR.: unavailable	PROGRAM NO.: M-054
DWG./DOC. NO.: DWG. 71-600-076 (Ref. 2)	MODEL NO.: (See part description)
	LOCATION: Aux Bldg. 568FT

SAFETY RELATED: YES X NO ____

DISCUSSION:

The bearing oil seals retain bearing lubricating oil while the pump is in operation and in standby. Degradation of the bearing seals results in leakage of bearing lubrication. See maintenance and surveillance section for recommendations to avert bearing seal failure.

PART DESCRIPTION: Outboard bearing shaft seal, item 4302, Ref. 2

FUNCTION: Prevents oil leakage from the reservoir along the shaft

SAFETY RELATED: YES X NO ____

Adequate radiation resistance has been demonstrated (Appendix A, No. 1)

MFGR.: not available MODEL NO.: not available

MATERIAL: Nitrile Rubber REFERENCE(S): DWG. 71-600-076 (Ref. 2)

DESIGN RATING(S)	REFERENCE(S)	REQUIREMENTS	DEMONSTRATED BY	ACCEPTABLE	REFERENCE(S)
2.038E08	18	Radiation - gamma	Material analysis	Y	18
		9.6E06 (40 yrs.	and vital compo-		
		plus 30 days	nent test		
		post accident)			
310°F	1	220°F - maximum	Material analysis	Y	1
		temperature of			Appendix A
		recirculating			No. 7
		water			

MEEQRF (CONT.)	PAGE 6 OF 17	PROGRAM NO.: M-054

PART DESCRIPTION: Inboard bearing shaft seal, item 4302, Ref. 2

FUNCTION: Prevents oil leakage from the reservoir along the shaft

SAFETY RELATED: YES X NO ____

Adequate radiation resistance has been demonstrated (Appendix A, No. 1)

MFGR.: Not available MODEL NO.: Not available

MATERIAL: Nitrile Rubber REFERENCE(S): DWG 71-600-076

DESIGN RATING(S)	REFERENCE(S)	REQUIREMENTS	DEMONSTRATED BY	ACCEPTABLE	REFERENCE(S)
2.038E08 Rads	18	Radiation -	Material analysis	Y	18
		9.6E06 (40 years	and vital component		
		plus 30 day post	test		
		accident)			
310°F	1	220°F maximum	Material analysis	Y	1
		temperature of			
		recirculating water			

PART DESCRIPTION: Outboard bearing cover gasket, item 5115, Ref. 2

FUNCTION: The gasket provides a seal between the cover and reservoir

SAFETY RELATED: YES X NO ____

Adequate radiation resistance has been demonstrated (Appendix A, No. 2)

MFGR.: not available MODEL NO.: not available

MATERIAL: Waxed Paper REFERENCE(S): DWG 71-600-076 (Ref 2)

DESIGN RATING(S)	REFERENCE(S)	REQUIREMENTS	DEMONSTRATED BY	ACCEPTABLE	REFERENCE(S)
1.0E08 Rads	16	Radiation-	Material analysis	Y	16
		9.6E06 (40 years	and vital component		
		plus 30 day post	test		
		accident)			
310°F	1	220°F maximum	Material analysis	Y	1
		temperature of			
		recirculating			
		water			

MEEQRF (CONT.)	PAGE 7 OF 17	PROGRAM NO.: M-054

PART DESCRIPTION: Inboard bearing cover gasket item 5215, Ref 2

FUNCTION: The gasket provides a seal between the cover and reservoir

SAFETY RELATED: YES X NO ____

Adequate radiation resistance has been demonstrated (Appendix A, No. 2) for 40 yrs. normal service plus 30 day post accident

MFGR.: not available MODEL NO.: not available

MATERIAL: Waxed Paper REFERENCE(S): not available

DESIGN RATING(S)	REFERENCE(S)	REQUIREMENTS	DEMONSTRATED BY	ACCEPTABLE	REFERENCE(S)
1.0E08 Rads	16	Radiation - 9.6E06 (40 years plus 30 day post accident)	Material analysis and vital component test	Y	16
310°F	1	220° maximum temperature of recirculating water	Material analysis	Y	1

PART DESCRIPTION: Lubricating Oil

FUNCTION: Lubrication

SAFETY RELATED: YES X NO ____

Radiation induced degradation of lubricating oil is insignificant below exposures of 1.0E07 Rads.

MFGR.: See list on page 20, Ref. 1 MODEL NO.: Various

MATERIAL: REFERENCE(S): 1

DESIGN RATING(S)	REFERENCE(S)	REQUIREMENTS	DEMONSTRATED BY	ACCEPTABLE	REFERENCE(S)
1.0E07 Rads	17	Radiation - 9.6E06 (40 years plus 30 day post accident)	Material analysis and vital component test	Y	17
310°F	1	104°F - maximum environmental temperature	Material analysis & design rating	Y	1

MECHANICAL EQUIPMENT ENVIRONMENTAL QUALIFICATION REVIEW FORM

COMPONENT: Bearing Oil Sight	PAGE 8 OF 17
MFGR.: Gits	PROGRAM NO.: M-054
DWG./DOC. NO.: Reference 9	MODEL NO.: BW-20-04053
	LOCATION: Aux Bldg. 568FT

SAFETY RELATED: YES X NO ____

DISCUSSION:

The Gits Oil Sight Gage provides a means of observing bearing reservoir oil level. Failure of the oil sight seals would result in loss of bearing lubricating oil and subsequent bearing failure. Bearing failure may cause pump seizure and loss of the Reactor Building Spray Pump.

PART DESCRIPTION: O-Ring, item [redacted]0, Ref 2

FUNCTION: Glass to sight body seal

SAFETY RELATED: YES X NO ____

Adequate radiation resistance has been demonstrated (Appendix A, No 1)

MFGR.: Parker MODEL NO.: 2-257

MATERIAL: BUNA-N REFERENCE(S): 14

DESIGN RATING(S)	REFERENCE(S)	REQUIREMENTS	DEMONSTRATED BY	ACCEPTABLE	REFERENCE(S)
2.038E08 Rads	18	Radiation-	Material analysis	Y	18
		9.6E06 (40 years	and vital component		
		plus 30 day post	test		
		accident)			
310°F	1	220°F maximum	Material analysis	Y	1
		temperature of			
		recirculating			
		water			

MEEQRF (CONT.)	PAGE 9 OF 17	PROGRAM NO.: M-054

PART DESCRIPTION: O-Ring item 6105, Ref 2

FUNCTION: Sight body to reservoir seal

SAFETY RELATED: YES X NO ____

Adequate radiation resistance has been demonstrated (Appendix A, No. 1)

MFGR.: Parker MODEL NO.: Unavailable

MATERIAL: BUNA-N REFERENCE(S): 14

DESIGN RATING(S)	REFER-ENCE(S)	REQUIREMENTS	DEMONSTRATED BY	ACCEPT-ABLE	REFER-ENCE(S)
2.038E08 Rads	18	Radiation-	Material analysis	Y	18
		9.6E06 (40 years	and vital component		
		plus 30 day post	test		
		accident			
310°F	1	220°F maximum	Material analysis	Y	1
		temperature of			
		recirculating water			

PART DESCRIPTION: Sight Glass, Ref 14

FUNCTION: Visual indication of reservoir oil level

SAFETY RELATED: YES X NO ____ Radiation resistance is in excess of 1.0E08 rads which is higher than TID of 9.6E06. However it shall be replaced if any cracking or discoloration of the glass occurs.

MFGR.: Unavailable MODEL NO.: Unavailable

MATERIAL: Glass REFERENCE(S): 14

DESIGN RATING(S)	REFER-ENCE(S)	REQUIREMENTS	DEMONSTRATED BY	ACCEPT-ABLE	REFER-ENCE(S)
1.E08 Rads	17	Radiation-	Material analysis	Y	17
		9.6E06 (40 years	and vital component		
		plus 30 day post	test		
		accident)			
310°F	1	220°F maximum	Material analysis	Y	1
		temperature of			
		recirculating			
		water			

MECHANICAL EQUIPMENT ENVIRONMENTAL QUALIFICATION REVIEW FORM

COMPONENT: Flexible Coupling	PAGE 10 OF 17
MFGR.: Koppers	PROGRAM NO.: M-054
DWG./DOC. NO.: Reference 10	MODEL NO.: 2½ BS
	LOCATION: Aux Bldg. 568FT

SAFETY RELATED: YES X NO ____

DISCUSSION:

The flexible coupling is an all metallic component which uses grease to lubricate the driving and driven portion of the flexible coupling. The coupling manufacturer recommends greasing the coupling every six months for those couplings continuously in service. In this application the pump operation during a LOCA or MSLB will not exceed 30 days. Additionally, the coupling is not subjected to the containment environment. Koppers recommends Koppers Coupling Grease KSG which has a polyethylene base. (See Appendix A No. 4, 5).

PART DESCRIPTION: Grease

FUNCTION: The grease lubricates the driving and driven portions of the coupling

SAFETY RELATED: YES X NO ____

See explanation above

MFGR.: See list on page 20, Ref. 1 MODEL NO.: Various

MATERIAL: REFERENCE(S): 1

DESIGN RATING(S)	REFERENCE(S)	REQUIREMENTS	DEMONSTRATED BY	ACCEPTABLE	REFERENCE(S)
1.0E07	17	Radiation -	Material analysis	Y	17
		9.6E06 (40 years	and vital component		
		plus 30 day post	test		
		accident)			
310°F	1	104°F - maximum	Material analysis	Y	1
		environmental			
		temperature			

MECHANICAL EQUIPMENT ENVIRONMENTAL QUALIFICATION REVIEW FORM

COMPONENT: Heat Exchanger Shut-off Valve	PAGE 11 OF 17
MFGR.: N/A	PROGRAM NO.: M-054
DWG./DOC. NO.: N/A	MODEL NO.: N/A
	LOCATION: Aux Bldg. 568FT

SAFETY RELATED: YES ____ NO X

DISCUSSION:

The heat exchanger shut-off valve provides positive isolation of the pump casing heat exchanger. Failure of the valves non-metallic parts results in external leakage of the cooling water. Because of the construction of the shut-off valve the leakage through the non-metallic parts is expected to be insignificant. Hence, the safety function of the reactor building spray pump is not impaired.

PART DESCRIPTION: N/A - no non-metallic safety-related components

FUNCTION:

SAFETY RELATED: YES ____ NO ____

MFGR.: MODEL NO.:

MATERIAL: REFERENCE(S):

DESIGN RATING(S)	REFERENCE(S)	REQUIREMENTS	DEMONSTRATED BY	ACCEPTABLE	REFERENCE(S)

MECHANICAL EQUIPMENT ENVIRONMENTAL QUALIFICATION REVIEW FORM

COMPONENT: Separator Outlet Valve	PAGE 12 OF 17
MFGR.: N/A	PROGRAM NO.: M-054
DWG./DOC. NO.: N/A	MODEL NO.: N/A
	LOCATION: Aux. Bldg. 568FT

SAFETY RELATED: YES ____ NO X

DISCUSSION:

The separator outlet valve provides isolation of water from the cyclone separator and auxiliary water supply. Failure of the non-metallic parts of the valve results in external leakage of water from the pump seal and auxiliary water source. Because of the construction of the valve the leakage through the non-metallic parts is expected to be insignificant. This leakage does not impair the safety function of the pump.

PART DESCRIPTION: N/A - no non-metallic safety-related components

FUNCTION:

SAFETY RELATED: YES ____ NO ____

MFGR.: MODEL NO.:

MATERIAL: REFERENCE(S):

DESIGN RATING(S)	REFER-ENCE(S)	REQUIREMENTS	DEMONSTRATED BY	ACCEPT-ABLE	REFER-ENCE(S)

MECHANICAL EQUIPMENT ENVIRONMENTAL QUALIFICATION REVIEW FORM

COMPONENT: Separator Outlet Valve	PAGE 13 OF 17
MFGR.: N/A	PROGRAM NO.: M-054
DWG./DOC. NO.: N/A	MODEL NO.: N/A
	LOCATION: Aux Bldg. 568FT

SAFETY RELATED: YES ____ NO X

DISCUSSION:

The separator outlet valve provides positive isolation of water from the cyclone separator to the pump suction. Failure of the non-metallic parts of the valve results in external leakage of seal and auxiliary water. Because of the construction of the valve, the leakage through the non-metallic parts is expected to be insignificant. This leakage does not impair the pumps safety function.

PART DESCRIPTION: N/A - no non-metallic safety-related components

FUNCTION:

SAFETY RELATED: YES ____ NO ____

MFGR.: MODEL NO.:

MATERIAL: REFERENCE(S):

DESIGN RATING(S)	REFER-ENCE(S)	REQUIREMENTS	DEMONSTRATED BY	ACCEPT-ABLE	REFER-ENCE(S)

MECHANICAL EQUIPMENT ENVIRONMENTAL QUALIFICATION REVIEW FORM

COMPONENT: Oil Cooler Shut-off Valve	PAGE 14 OF 17
MFGR.: N/A	PROGRAM NO.: M-054
DWG./DOC. NO.: N/A	MODEL NO.: N/A
	LOCATION: Aux Bldg. 568FT

SAFETY RELATED: YES ____ NO X

DISCUSSION:

The oil cooler shut-off valve provides positive isolation of auxiliary cooling water to the oil reservoir cooling jacket. Failure of the non-metallic parts of the valve results in external leakage of auxiliary water. Because of the construction of the valve, the leakage through the non-metallic parts is expected to be insignificant. This leakage does not impair the safety function of the pump.

PART DESCRIPTION: N/A - no non-metallic safety-related components

FUNCTION:

SAFETY RELATED: YES ____ NO ____

MFGR.: MODEL NO.:

MATERIAL: REFERENCE(S):

DESIGN RATING(S)	REFERENCE(S)	REQUIREMENTS	DEMONSTRATED BY	ACCEPTABLE	REFERENCE(S)

MECHANICAL EQUIPMENT ENVIRONMENTAL QUALIFICATION REVIEW FORM

COMPONENT: Seal Shut-off Valve	PAGE 15 OF 17
MFGR.: not available	PROGRAM NO.: M-054
DWG./DOC. NO.: 71-500-007, (Ref 3)	MODEL NO.: N/A
	LOCATION:

SAFETY RELATED: YES ____ NO X

DISCUSSION:

The seal shut-off valve provides positive isolation of auxiliary water to the pump seals. Failure of the valve non-metallic parts results in external leakage of auxiliary water. This leakage does not impair the sealing function of mechanical seals. Hence, the safety function of the pump is not impaired.

PART DESCRIPTION: N/A-no non-metallic safety-related components

FUNCTION:

SAFETY RELATED: YES ____ NO ____

MFGR.: MODEL NO.:

MATERIAL: REFERENCE(S):

DESIGN RATING(S)	REFERENCE(S)	REQUIREMENTS	DEMONSTRATED BY	ACCEPTABLE	REFERENCE(S)

MECHANICAL EQUIPMENT ENVIRONMENTAL QUALIFICATION REVIEW FORM

COMPONENT: Cyclone Separator	PAGE 16 OF 17
MFGR.: N/A	PROGRAM NO.: M-054
DWG./DOC. NO.: DWG. 71-600-076 (Ref 2)	MODEL NO.: N/A
item 7106	LOCATION: Aux Bldg. 568FT

SAFETY RELATED: YES ____ NO X

DISCUSSION:

The cyclone separator removes particles suspended in the water servicing the pump seals. Failure of the non-metallic parts of the cyclone separator results in external leakage of water. Because of the construction of the cyclone separator the leakage through the non-metallic parts is expected to be insignificant. This leakage does not impair the safety function of the pump.

PART DESCRIPTION: N/A-no non-metallic safety-related components

FUNCTION:

SAFETY RELATED: YES ____ NO ____

MFGR.: MODEL NO.:

MATERIAL: REFERENCE(S):

DESIGN RATING(S)	REFERENCE(S)	REQUIREMENTS	DEMONSTRATED BY	ACCEPTABLE	REFERENCE(S)

MECHANICAL EQUIPMENT ENVIRONMENTAL QUALIFICATION REVIEW FORM

COMPONENT: Heat Exchanger	PAGE 17 OF 17
MFGR.: John Crane	PROGRAM NO.: M-054
DWG./DOC. NO.: John Crane TDS D-2200-2,	MODEL NO.: 2-S
Ref 2, item 7110	LOCATION: Aux Bldg 568FT

SAFETY RELATED: YES X NO ____

DISCUSSION:

The heat exchanger provides cooling for the pump seals to prolong seal life. Failure of the heat exchanger's only non-metallic part results in external leakage of auxiliary water. Because of the construction of the heat exchanger, the leakage through non-metallic parts is expected to be insignificant. Hence, the safety function of the pump is not impaired.

PART DESCRIPTION: O-Ring

FUNCTION: Shell to shell cover seal

SAFETY RELATED: YES ____ NO X

Adequate radiation resistance has been demonstrated (Appendix A, No. 2)

MFGR.: not available MODEL NO.: not available

MATERIAL: BUNA-N REFERENCE(S): John Crane TDS D-2200-2

DESIGN RATING(S)	REFERENCE(S)	REQUIREMENTS	DEMONSTRATED BY	ACCEPTABLE	REFERENCE(S)
2.038E08 Rads	18	Radiation-	Material analysis	Y	18
		9.6E06 (40 years	and vital component		
		plus 30 day post	test		
		accident)			
310°F	1	220°F maximum	Material analysis	Y	1
		temperature			
		recirculating			
		water			

Reactor Building Spray Pump
Surveillance and Maintenance Recommendations

M54

Frequency	Requirement	Action
Quarterly	Check proper level of bearing oil reservoir.	Add clean oil as required.
	Check pump packing and oil seals for excessive leakage.	Initiate procedures to repair excessive leakage.
	Check seal injection, bearing cooling and pump cooling water valves full open.	Open valves to insure cooling.
	Run Reactor Building Spray Pumps to check for pump performance and vibration.	Initiate pump repair to correct noted deficiencies.
Yearly	Replace oil seals, renew coupling seals, replace oil sight seals.	Disassemble pump/motor coupling and inspect for wear. Regrease the coupling before assembly.
		Drain bearing oil reservoir, replace oil seals and refill the oil reservoir.

Yearly (cont)	Inspect pump shaft seal.	Replace shaft seal if worn or damaged. Repack pump, adjust packing for proper leakoff.

APPENDIX A

1. Radiation induced degradation of E.P.R. and E.P.T. type rubber is mild to moderate for 5.0E06 Rads (Reference 17, pages 3-24). Nitrile Rubber was exposed to 2.038E08 as a seal O-Ring and still performed its sealing function (Reference 18, Page 70). The projected radiation dose for the Reactor Building Spray Pump for the post LOCA 30 day operability period is 3E06 Rads (Reference 12, Table 1-6). Utilizing 5.0E06 Rads as the maximum tolerable radiation exposure, and from Reference 12 the normal radiation dose for a one (1) year operating period is 1.65E05 Rads, a replacement interval of ten (10) years resulting in a total integrated dose of 4.65E06 Rads will assure that the vital EPT rubber components maintain their physical integrity to support their designated safety function(s). The replacement of the Nitrile Rubber seals is not required over the total anticipated service life of the seals since adequate radiation resistance has been demonstrated (2.038E08 Rads radiation resistance vs 9.6E06 Rads TID).

2. The Reactor Building Spray Pump waxed paper oil seals are subjected to a radiation field of 9.6E06 Rads during forty (40) years normal and thirty (30) days accident conditions. Tests of various waxes subjected to a radiation dose of 7E08 Rads showed some evidence of crumbling. Tests on cellulose, the major constituent of paper subjected to 1E08 Rads, resulted in only a 16% degradation (See Reference 16). Typical radiation damage thresholds are based on 25% degradation. Therefore replacement of the waxed paper seals is not required over the total anticipated service life of the seals since adequate radiation resistance has been demonstrated. However, any maintenance activity that requires access to the inboard bearing covers may require replacement of the waxed paper seals.

3. The oil sight glass shall be replaced if any cracking or discoloration of the glass occurs. Failure of the glass causes loss of lubricating oil and subsequent loss of the Reactor Building Spray Pump safety function. Since the radiation resistance of the glass is in excess of 1E08 Rads (Reference 17, page 4-6), replacement due to accident environments is not required.

4. Babcock and Wilcox and Koppers, manufacturers of the pump and flexible coupling respectively recommend a spectrum of bearing lubricating oils and coupling greases for use in the Reactor Building Spray Pump (See Reference 1, page 20). Radiation induced degradation of the Marfak #1 grease and Regal BR and O manufactured by TEXACO is insignificant below exposures of 1E07 Rads. Regal BR and O oil is now designated R and O 46 (See Reference 14).

5. A Site Restriction Form designating the type of bearing lubricating oil and coupling grease to be used in the Reactor Building Spray Pump has been completed to insure that the manufacturer's lubrication requirements and the radiation resistance requirements are satisfied. Annual replacement of the pump bearing and coupling lubrication further reduces the probability of radiation induced degradation.

6. The Reactor Building Spray Pumps are located in the Auxiliary Building and as a result do not experience any change in temperature and pressure resulting from a LOCA or MSLB. In addition, chemical spray is not applicable to equipment located outside of containment (Reference 12, page 1-26).

7. The components/parts essential to the safety function of the Reactor Building Spray Pump are all totally internal to the pump assembly and are not exposed to a 100% relative humidity environment. If there is any wetted non-metallic materials the

design temperature threshold of those materials, 310°F (Reference 1, page 30), is greater than 220°F which is the maximum temperature of the reactor building sump recirculating water.

8. A comparison of the Reactor Building Spray Pump performance test (Reference 15) and the pump specifications (Reference 1) determined that pump pressure was 110% of normal pressure and pump flow was 70% of normal flow 5 seconds after the start of the pump motor. Pressure and flow stabilized at their nominal values within 30 seconds.

9. The Reactor Building Spray Pump Motor Qualification is discussed in the Electrical Qualification Program number M-054 in Section 2.15 of Reference 12.

10. Since the Reactor Building Spray Pump is located in the Auxiliary Building, radiation is the only environmental parameter that changes as a result of a LOCA or MSLB. The non-metallic constituents of the pump have been evaluated based on their material properties including composition, function and radiation resistance. Based on the margins present in the material properties of the components over the required environmental parameters, the Reactor Building Spray Pump is qualified for a 40 year normal service plus a 30 day accident condition period providing periodic surveillance and maintenance is performed to inspect and renew essential parts, as previously identified.

11. The Reactor Building Spray Pump response time requirement of 72 seconds is based on the most limiting response time characteristics of (1) 58 seconds to fill the Reactor Building Spray Line Piping (assuming the Reactor Building Spray Pump discharge valve is 40% open), (2) a 10 second delay has been assumed for availability of electrical power to the pump motor, and (3) the

shortest Reactor Building pressure excursion to 30 psig resulting from an MSLB or 4 seconds. The demonstrated pump operability from performance testing (Reference 15) is 100% operability at 30 seconds (See Note 8).

12. The Reactor Building Spray Pump subjected to analysis and performance testing as described in this program is identical to the pumps installed at the Midland Plant as noted in References 1, 3, 4, and 15.

13. Because the Reactor Building Spray Pumps are located outside of containment and not required for a HELB, both normal and accidental submergence are not considered for the qualification. Thus this category is not applicable.

REFERENCES AND ADDITIONAL DATA

PAGE 1 OF 2 PROGRAM NO.: M-054

1. B&W, Instruction Manual 7220-M-54-AC for Reactor Building Spray Pump Model 6 x 8 x 13 SMK.

2. B&W Drawing 71-600-076 Cross-Sectional View of Centrifugal Pump 6 x 8 x 13 SMK with parts list.

3. B&W Drawing 71-500-077, Pump, Motor, Baseplate and Auxiliaries.

4. B&W Spec. No. 229995 Specification for Conducting of Performance Test on Centrifugal Pumps for Nuclear Power Plants.

5. Midland Plant Units 1 & 2 FSAR Vol. I Figure 1.2-2 Reactor Building Spray Pump location.

6. Deleted.

7. Midland Plant Units 1 & 2 FSAR Vol. XVI Figure 6.2 M412A, M412B Reactor Building Spray System.

8. John Crane DWG CFSP 54046-2 Mechanical Seal.

9. NUTECH Telecommunication with Gits Manufacturing, dated October 19, 1982.

10. NUTECH Telecommunication with Koppers Manufacturing, dated October 19, 1982.

REFERENCES AND ADDITIONAL DATA

PAGE 2 OF 2 PROGRAM NO.: M-054

11. John Crane Technical Data Sheet D-2200-2 for a Model #2-S Heat Exchanger.

12. Midland Plant, Units 1 & 2 Environmental Qualification Report, Vols. I & II.

13. Deleted

14. NUTECH Telecommunications with Texaco on Greases and Lubricants, dated October 26, 1982.

15. B&W Test Report Contract No. 713-7224 Thermal Transient Test Graphs Flow and Pressure vs Time, Pages 10 and 12, March 1981.

16. Robert O. Bolt and James G. Carrol, "Radiation Effects on Organic Materials", Academic Press 1963, New York.

17. Electric Power Research Institute, "Radiation Effects on Organic Materials in Nuclear Plants", EPRI Report NP-2129, November 1981.

18. Rotork Qualification Test Report 722-M123C-105-1, Wyle Laboratories Test Report No. 43979, Rev. A, October 24, 1978 (Retained in CPCo Equipment Qualification Central File No. M-123CC).

Generic Figures

Generic Figures are not Required to
Support this Qualification Documentation

BABCOCK & WILCOX CANADA LTD.
CAMBRIDGE, ONTARIO

REACTOR BUILDING SPRAY PUMP
PURCHASED BY
BECHTEL POWER CORPORATION
ANN ARBOR, MICHIGAN

FOR

CONSUMERS POWER COMPANY
MIDLAND PLANTS UNIT 1 and 2
MIDLAND, MICHIGAN

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PURCHASE ORDER No. 7220-M-54-AC
B&W LTD. CONTRACT No. 713-7224

PUMP MODEL
6x8x13 SMK

7220-M54-AC-1

TABLE OF CONTENTS

INTRODUCTION:

We welcome you as another of the growing list of customers who have chosen B&W pumps for their specific requirements.

This quality product represents more than fifty years of experience in the R&D and manufacturing of specialized pumps for the electric utility industry.

This Manual is prepared to provide you with detailed instructions about the operation and maintenance of your B&W pump.

Should you have questions regarding this pump or require the service of our experienced service personnel, please contact your nearest B&W pumps representative as listed in this Manual, or contact Head Office at Cambridge, Ontario, Canada.

CONTRACT DATA

Customer	Consumers Power Company
Location	Midland, Michigan
Purchase Order	7220-M-54-AC
Serial No.	72240/72241/72242/72243
Model	6x8x13 SMK
Service	Reactor building spray pump
Material Verification	ASME Class 2
Seismic Class	I
Liquid	Borated water
Temperature	40° F - 310° F
Specific Gracity	1.0
Capacity	1300 USGPM
Total Head	387 ft.
Efficiency	72.5%
B.H.P.	176
Pump RPM	3550

Motor:

Manufacturer	Allis-Chalmers
H.P.	200
Speed	3550 RPM
Volts	460
Phase	3
Cycle	60

7220-M54-AA-1
P2.2

RECEIVING OF EQUIPMENT

Upon receipt of the unit, a careful inspection should be made to determine if any damage has been incurred to the u''t during transit or site handling.

Should there be evidence of damage, then report this immediately to the shipping agent and Babcock & Wilcox Ltd.

CAUTION

ALL PUMP OPENINGS ARE FACTORY SEALED AFTER FINAL ASSEMBLY TO PREVENT CONTAMINATION OF THE INTERNAL COMPONENTS. THESE OPENINGS SHOULD ONLY BE OPENED IMMEDIATELY PRIOR TO PIPING INSTALLATION.

INSTALLATION

Preparation:

Before installing the pump, the surfaces should be cleaned and, using a solvent, remove any protective coating from the pump shaft.

If the pump has been in storage, and prepared for storage in the manner previously outlined, it will be necessary to remove all oil from the bearing housing. The bearings should be flushed and re-lubricated, the proper procedure for this operation is outlined in the lubrication section.

Location:

The pump should be installed as near the suction supply as possible, with the shortest and most direct suction pipe as practical. It should be placed with sufficient accessibility for inspection and maintenance.

Where possible, the pump should be located below the intake pumping water level to facilitate priming and assure a steady flow of liquid. This condition provides a positive suction head on the pump.

When installing the pump, consider the location of it in relation to the system to guarantee sufficient NPSH (net positive suction head) at the pump impeller eye.

The available NPSH must always equal or exceed the required NPSH of the pump.

TR20-M54-P4-1
PG.5

Factory Alignment:

Pumps and drivers that are received from the factory with both machines mounted on a common baseplate were accurately aligned before shipment. All baseplates are flexible to some extent prior to grouting and therefore must not be relied upon to maintain factory alignment. Realignment is necessary after the complete unit has been leveled on the foundation and again after the grouting has set and foundation bolts have been tightened. The alignment must be checked after the unit is piped and rechecked periodically to compensate for pipe strains, settling, etc.

Only the pump is dowelled to the baseplate at the factory. The driver is dowelled after the final alignment has been completed under operating conditions.

Mounting:

Before placing the unit on the foundation, clean the top of the surface, breaking off any loose pieces of concrete. Roughen the top of the foundation with a star chisel and clean it; then thoroughly wet the top to avoid too rapid moisture absorption from the grouting.

Stuff waste around the foundation bolt holes to prevent the grout from flowing into the bushings.

The baseplate should be supported on the foundation on rectangular metal blocks and shims. The blocks and shims should be placed close to the foundation bolts and evenly spaced directly under the loads to give uniform support. A gap of 1" - 1½" should be allowed between the foundation and the baseplate for grouting. Adjust the blocks and shims until the shafts of the pump and driver are level. Check the coupling faces with an indicating gauge placed between the coupling halves. Check with a machinist's spirit level the suction and discharge flanges for horizontal and vertical alignment.

Preliminary angular and parallel misalignment are corrected by adjusting the shims under the baseplate. Final correction is made after the baseplate is properly grouted solid. After each change it is necessary to recheck the alignment of the coupling halves since adjustment in one direction may disturb adjustments previously made in another direction.

7220-M54-74-

INSTALLATION

Preliminary angular and parallel misalignment are corrected by adjusting the wedges or shims under the baseplate. Final correction is made after the baseplate is properly grouted solid. After each change it is necessary to recheck the alignment of the coupling halves since adjustment in one direction may disturb adjustments already made in another direction.

When the unit has been aligned and the foundation bolts have been tightened evenly but not too firmly; the pump may then be grouted to the foundation. A wooden form must be built outside the base to contain the grout.

Stuff waste around the foundation bolt holes to prevent the grout from flowing into the bushings.

The baseplate and the dam should then be filled with grout. It is desirable to grout the shims or wedges in place. The grout(s) holes in the top of the baseplate also serves as a vent to allow air to excape. Grout should be puddled continuously as it is poured to expel the air and completely fill the space under the baseplate to the level of the grout hold. Hollow spots can be detected by tapping on the baseplate with a hammer.

When the grout is hard, check the foundation bolts to assure they are tight, and recheck the coupling halves for alignment.

The coupling supplied will not compensate for misalignment. To maintain bearing life and pump efficiency, the driver must be carefully aligned with the pump as outlined in the coupling manufacturer's instructions. A final alignment check is made after the unit has thoroughly warmed under actual operating conditions. The unit is shut down and the coupling alignment immediately checked. Final corrections are made by adding or removing shims under the driver to yield alignment under operating conditions. Note that adjustment to correct alignment in one direction may alter in another. Always check all directions after making any adjustments. Periodic checks are well worthwhile to ensure trouble-free operation. Foundation or supports may settle in time and upset a careful initial installation.

NOTE

WHEN THE FINAL ALIGNMENT HAS BEEN COMPLETED UNDER OPERATING CONDITIONS, THE DRIVER SHOULD BE DOWELLED TO THE BASEPLATE. SEE MANUFACTURER'S PROCEDURE ON COUPLING ALIGNMENT AND TABLE OF OPERATIONAL LIMITS.

7220-M54-74-1

26.9

OPERATION

Priming:

Before any centrifugal pump is started, the casing and suction pipe must be full of the liquid being pumped. Certain parts within the pump depend upon the pumped liquid for their lubrication, and may seize or otherwise be damaged if the pump is operated dry.

Pumps which have been installed so that the top of the casing is below the level of the liquid being pumped will prime automatically when the following instructions have been completed:

(1) Close the gate valve in the discharge line.

(2) Remove the vent plug.

(3) Slowly open the gate valve in the suction line until the liquid has completely filled the pump casing.

(4) Replace the vent plug.

(5) Open gate valve fully in the suction line.

(6) For pumps that have been in storage see section Servicing and Cleaning.

The pump is now fully primed and ready for pre-starting procedure.

OPERATION

Pre-Starting:

Check List:

(1) Prepare motor as outlined in manufacturer's manual.

(2) Disconnect coupling and jog motor, it must rotate in the same direction as the rotation arrow stamped on the pump.

(3) Rotate pump shaft, make sure there is no binding or rubbing.

(4) Check alignment of pump and motor shafts, and connect coupling.

(5) Check bearing oil lubrication for correct amount.

(6) Check for lubricating fluid in mechanical seal.

(7) Check that pump and suction line are fully primed.

(8) Check suction line gate valve is fully open.

(9) Check lubrication of driver bearings (see manufacturer's instructions).

7220-ACY-P4-1
PS 11

OPERATION

Starting:

(1) Energize motor.

(2) After pump has attained its full operating speed, slowly open the discharge valve.

(3) Be sure pump is running quietly, if there is any abnormal noise or vibtation, shut the pump down and investigate.

(4) Check pump bearing temperature, if bearings should run abnormally hot, shut the unit down immediately and examine.

(5) Check flow of lubricant to the mechanical seals.

(6) Check suction and discharge piping for leaks.

Throttling Pump:

Never throttle suction line. Throttle or partially close discharge valve only.

OPERATION

Stopping Pump:

1. Close discharge valve.
2. Stop motor.
3. Close suction valve.
4. Close lubrication line to mechanical seal if external lubricating water is used.

Indefinite Shut Down:

1. Flush and relubricate pump and motor bearings (see servicing and cleaning).
2. Remove casing plug and drain casing and all piping if there is a possibility of the liquid freezing.
3. Remove mechanical seal and inspect for wear (see manufacturer's instructions for assembly and maintenance).
4. Provide pump and motor with protective covering.

MAINTENANCE

(a) DISMANTLING OF PUMP BASIC COMPONENTS

Refer to sectional arrangement drawing for part name and item number.

Drain oil sump and pump casing.

1. Disconnect all auxiliary piping, oilers and remove spacer coupling according to manufacturer's instructions.
2. Remove casing nuts, Item 1105, and capscrew holding frame support foot (5331) to baseplate.
3. Remove the complete frame and backcover assembly from the pump casing.
4. Remove impeller nut (4201) and impeller lock washer (4203).
5. Remove the impeller (2102).
6. Remove the impeller key (4208).
7. Disengage glandplate capscrews (7229) which holds the glandplate to the backcover, and capscrews (5321) holding backcover.
8. Slide the backcover (6102) off the shaft. (The backcover jacket plate (6104) is removed along with the backcover during this operation).
9. Remove the shaft sleeve (4103) from the shaft. (The mechanical seal assembly which is attached to the sleeve will also be removed during this operation).
10. Remove shaft sleeve gasket (4107) from shaft.
11. Dismantle mechanical seal assembly (refer to appendix for mechanical seal instructions).
12. Remove the inboard bearing V-ring (4302), inboard bearing cover (5204) and capscrews (5226) from shaft.
13. Remove the outboard bearing V-ring (4303) and outboard bearing cover (5104) and capscrews (5142) from shaft.
14. Gently tap the impeller end of the shaft with a wooden block or rubber mallet to loosen the shaft assembly from the frame. To prevent damage to the oil flinger, item 4301, the shaft assembly is withdrawn only enough to permit removal of the outboard thrust bearing assembly item (4304).
15. The shaft assembly must then be moved in the opposite direction, and carefully relocated into the inboard bearing, item (4305). When the bearing removel ring - inboard, makes contact with the inboard bearing, this bearing assembly and shaft is removed by gently tapping the coupling end of shaft.

CAUTION

TO PREVENT DAMAGE TO BEARING SEAT, THE SHAFT MOUNTED OIL FLINGER MUST CAREFULLY PASS THROUGH BEARING FRAME WHEN REMOVING OR INSTALLING SHAFT.

MAINTENANCE - (a) DISASSEMBLY

DISMANTLING OF PUMP SUB-ASSEMBLIES

Impeller and Wear Rings

The impeller is mounted with specially hardened front and back wear rings. To remove wear rings:

1. Remove setscrews (3117) from impellers.

NOTE

"LOCTITE" COMPOUND "A" WAS USED AT THE FACTORY TO SECURELY LOCK THESE ITEMS IN PLACE DURING ASSEMBLY, THEREFORE, LOW HEAT MAY HAVE TO BE APPLIED TO THE PERIPHERY OF THE RINGS AT THESE LOCATIONS TO LOOSEN THE SCREWS AND RING - APPLY "LOCTITE" TO SCREWS DURING ASSEMBLY.

2. Remove wear rings (3104) and (3105) from impeller.

Casing and Wear Ring

1. Remove setscrew (3111) (see note for impeller wear ring for loosening screws).
2. Remove casing wear ring (3102).

Backcover Sub-assembly

1. Remove setscrews (3109) and backcover wear ring (3103) as described for casing wear ring.
2. Remove backcover jacket plate (6104) from backcover.

MAINTENANCE - (a) DISASSEMBLY

Shaft Sleeve and Mechanical Seal Sub-assembly

1. Loosen setscrew holding mechanical seal collar to the shaft sleeve.
2. Carefully remove mechanical seal parts from sleeve.

Shaft Sub-assembly

1. Remove inboard bearing inner race (4305) from shaft be means of a bearing puller using the removal ring (5210).
2. Loosen setscrew (5342) and remove oil flinger (4301) from shaft.

NOTE

WHEN MOUNTING OUTBOARD BEARINGS DURING ASSEMBLY - ENSURE THAT BEARINGS ARE MOUNTED "BACK TO BACK" AND ARE PRESSED RATHER THAN SHRUNK ONTO SHAFT. THE FIRST BEARING IS TO BE PRESSED ON JUST FAR ENOUGH TO ALLOW THE SECOND BEARING TO BE STARTED, THE PAIR ARE THEN TO BE PRESSED INTO POSITION ON THE INNER RACE OF THE OUTER BEARING.

IT IS IMPORTANT THAT THE OUTER FACE IS HARD UP TO SHAFT SHOULDER AND THE INNER FACES ARE TIGHT TOGETHER.

CAUTION

THE SHAFT, WHEN STORED, MUST ALWAYS BE SUPPORTED IN A HORIZONTAL POSITION ON WOODEN BLOCKS OR FRAMEWORK, TO AVOID WARPAGE TO SHAFT.

MAINTENANCE - (b) ASSEMBLY

Installation of O-rings

Before assembly, always lubricate the "O" ring and the metal parts that contact it, with Dow Corning III Compound.

The "O" ring should not be rolled or twisted onto shafts and left in that position because of possible "spiral failure". Small rings should not be over-stretched to reach their piston or rod grooves. If over-stretched, some rings will break through no fault of the producer.

The "O" ring should not be forced over sharp corners, threads, or other sharp edges. Use thimbles or other installation aids.

Installation must not pinch or cut the "O" ring.

Do not use rings that have fallen on the floor or have been wiped with dirty, dusty or oily rags.

(b) Assembly

Before assembly, it is recommended all seals and gaskets be replaced with new ones.

1. Check all parts for wear and damage.
2. Check shaft for straightness and running clearances (see Table of Operational Limits).
3. Re-assemble all sub-assemblies in reverse order as indicated in Dismantling instructions.
4. Install shaft sub-assembly into frame through inboard end of frame.
5. With the shaft extended through the outboard end of the bearing housing, install the back-to-back thrust bearing assembly (Items 5110, 4304, 5106 and 5108) onto the shaft.
6. Lightly tap outer race of outboard bearings (4304) to install into frame.
7. Install the outer race and roller assembly of the inboard bearing, Item (4305) into the frame by gently tapping the outer race.
8. Install the inner V-ring, inboard bearing cover (5204), outer V-ring (4302) and tighten capscrews (5226).
9. Install capscrews (7229) into gland plate (7202) and place over shaft.
10. Install shaft sleeve gasket (4107) onto shaft.
11. Install shaft sleeve and mechanical seal sub-assembly onto shaft.

NOTE

THE SHAFT SLEEVE IS MARKED WITH A SPECIAL SCRIBE MARK FOR LOCATION OF THE MECHANICAL SEAL COLLAR. REFER TO THE SPECIAL MECHANICAL SEAL INSTALLATION INSTRUCTION INCLUDED IN THIS MANUAL.

MAINTENANCE - ASSEMBLY

12. Install backcover sub-assembly to frame by means of capscrews (5321).

13. Install impeller key (4208).

14. Install impeller (2102), impeller lock washer (4203) and impeller nut (4201).

15. Tighten impeller nut (4201) and bend over tabs on lock washer (4203) to lock impeller nut from rotation.

16. Install outboard bearing cover (5104) less gasket and tighten.

17. Measure gap between bearing cover and frame by means of a feeler gauge.

18. Remove bearing cover and add the required number of gaskets to maintain the following gasket thickness:

NOTE

GASKET THICKNESS = FEELER GAUGE THICKNESS (STEP 15) + ASSEMBLY CLEARANCE AS LISTED IN TABLE OF OPERATIONAL LIMITS.

19. Install outboard bearing cover (5104) inner and outer V-rings (4303) and required number of gaskets and tighten.

20. Slowly slide backcover and frame assembly into the casing. Install casing nuts (1105) and torque down as specified in Table of Operational Limits.

NOTE

ALL TORQUING OF NUTS SHOULD BE DONE BY ALTERNATING FROM ONE SIDE TO THE OTHER.

7220. M54.34.1
P513

Bearing Lubrication for Initial Operation

Prior to any operation the bearings of a brand new pump should first be drained and flushed with a thin oil. If possible, after refilling to the correct level with the oil selected for continuous operation, the pump should be run for one hour at light load after which time the bearings should be drained, flushed and again refilled to the correct level.

This procedure is particularly important when the pumps have been kept in storage or allowed to stand for any length of time.

After the first 100 hours of operation bearing abrasion may have changed the colour of the oil, at which time it should be drained out and flushed with a light oil, preferably at 180 - 200°F before adding fresh oil. For bearings operating continuously, it is recommended that this operation be carried out at least every 6 months.

Oils Used for Flushing

Light transformer oils, spindle oils, or automotive type flushing oils are suitable for cleaning and flushing the bearings and frame. Oils heavier than SAE 10 (150 - 200 ssu at 100°F) are not recommended.

Bearing Inspection and Cleaning

Bearings should be inspected whenever there is a major component dismantling. As part of the maintenance replacement procedures with anti-friction bearings, there are two general guidelines:

Inspect bearings for re-use according to established procedures and not haphazardly, and never re-use a bearing that is even suspected of being in poor condition. It is much cheaper to throw away a good bearing than to replace a shaft, a damaged bearing has ruined.

For inspection and cleaning wash the shaft and bearing assembly in chloride free naphtha.

Inspect the bearings to see that they roll freely and are free from cracked, pitted, or worn balls, rollers, and races. Make certain that the shields and retainers are in good condition and not dented or damaged.

MAINTENANCE - (c) - LUBRICATION

Badly worn ball bearings can be detected by excessive end play between the outer and inner races. This condition can be checked manually be holding the shaft and inner race steady and moving the outer race endwise, comparing the difference in movement between the used bearing and a new bearing. As a rule there are no allowable end play specifications so any difference in end play between a used and a new bearing should be considered and replaced if necessary.

After the bearings have been cleaned and inspected, they should be lubricated with a light grade oil and wrapped in water proof paper, until ready for use.

Bearing Lubrication for Normal Operation

The pump frame accommodates a single row of bearings installed in the inboard end, while the outboard bearing is of the double row single race type.

Both bearings are lubricated by a flooded oil system. It is essential that the correct oil level be maintained and for this purpose oil level indicators are provided. The level indicated is the operating level and will rise after the pump has stopped and the oil drains back to the reservoir.

To ensure satisfactory operation, the proper lubricants must be used. A good grade of filtered mineral oil (SAE 20) is satisfactory. When selecting an oil, the features listed below are considered desirable:

(A) The viscosity should be between 150 and 300 ssu at 100°F.

(B) The oil should have an ASPM oxidation life of 1,000 hours or more.

(C) The oil should contain, if possible, rust and oxidation inhibitors and, particularly in high speed applications, an antifoam additive.

(D) Different makes and grades of oil should not be mixed, it is therefore recommended that, if possible, the same make and grade of oil be used for the pump as for any other existing equipment requiring oil lubrication.

The following is a list of recommended lubricants which incorporates one or more of the following features:

Imperial Oil Limited	-	Esstic #48 or Teresso $47
Shell Oil Limited	-	Tellus #29 or Tellus #33
Texaco Canada Limited	-	Regal BR and O
Sun Oil Company Limited	-	Sunvis #916
Gulf Oil Company Limited	-	Harmony #47

These lubricants are not recommended to the exclusion of all others. If in doubt, consult any oil company representative.

ITEM	LOCATION	LIMITS
RUNNING CLEARANCE (DIAMETRAL)	IMPELLER WEAR RING TO CASING WEAR RING	.027 to .029
	IMPELLER WEAR RING TO BACKCOVER WEAR RING	.027 to .029
	IMPELLER TO STUFFING BOX BUSHING	.031 to .033
ASSEMBLY CLEARANCE	BETWEEN OUTBOARD BEARING COVER AND OUTBOARD BEARING	.003 to .008
SHAFT RUNOUT	TOTAL RUNOUT	.003 T.I.R.
TORQUING REQUIREMENTS	CASING NUT (1105)	52 FT./LBS.
	GLAND PLATE CAPSCREWS (7229)	15 FT./LBS.
	IMPELLER NUT (4201)	40 FT./LBS.
VIBRATION		1.0 MILS
BEARING TEMPERATURE	INBOARD BEARING (4305)	180°F. MAX.
	OUTBOARD BEARING (4304)	180°F. MAX.
COUPLING	PARALLELISM (SHAFT TO SHAFT)	.002 T.I.R.
	MISALIGNMENT (FACE TO FACE)	.005 MAX.

TROUBLE SHOOTING:

1. Failure to deliver liquid
   (a) Pump not primed.
   (b) Insufficient speed.
   (c) Discharge head too high.
   (d) Wrong direction of rotation.

2. Insufficient Capacity
   (a) Air leaks in suction line.
   (b) Speed too low.
   (c) Total dynamic head is higher than pump is designed for.
   (d) Mechanical defects - damaged impeller, defective mechanical seal.
   (e) Suction pipe too small or restricted by trash, etc.

3. Insufficient Pressure
   (a) Speed too low.
   (b) Air in water.
   (c) Mechanical defects - damaged impeller, defective mechanical seal.

4. Pump Overloading Driver
   (a) Speed too high.
   (b) Total dynamic head lower than rated, therefore, pumping too much liquid.
   (c) Liquid pumped at different specific gravity and viscosity than pumped rating.
   (d) Mechanical defects.

5. Pump Vibrates

(a) Misalignment.
(b) Foundation not sufficiently rigid.
(c) Impeller partially clogged causing unbalance.
(d) Mechanical defects - bent shaft, worn bearings, rotating element binds.

6. Bearing's Running Hot

(a) Misalignment.
(b) Worn or defective bearings.
(c) Bent shaft.
(d) Excessive lubricant or insufficient lubricant.
(e) Wrong type of lubricant.
(f) Rotating element binds.

B&W pumps

Babcock & Wilcox Canada Ltd.

RECOMMENDED SPARE PARTS

Date

Customer	Equipment Description	Vendor
CONSUMERS POWER COMPANY	REACTOR BUILDING SPRAY PUMPS	
Customer Ref. 7220-M-54-AC	**Model** 6 x 8 x 13 SMK	**Vendor Ref.**

	Part Description	Item/Part Number	Part/Assembly Dwg. Number	Equipment Serial #	Qty. Per Unit	Price Each $	Recommended Qty.	Estimated Delivery
1	Impeller	2102	71-600-076	72240 to 72243	1		1	
2	Shaft	4102	71-600-076	72240 to 72243	1		1	
3	Impeller wear ring	3104	71-600-076	72240 to 72243	1		1	
4	Impeller wear ring	3105	71-600-076	72240 to 72243	1		1	
5	Casing wear ring	3102	71-600-076	72240 to 72243	1		1	
6	Back cover wear ring	3103	71-600-076	72240 to 72243	1		1	
7	Inboard brg.	4304	71-600-076	72240 to 72243	1		2	
8	Outboard brg.	4305	71-600-076	72240 to 72243	2		4	
9	Inboard brg. * V-ring	4302	71-600-076	72240 to 72243	2		4	
10	Outboard brg. * V-ring	4303	71-600-076	72240 to 72243	2		4	
11	Shaft Sleeve	4103	71-600-076	72240 to 72243	1		1	
12	Shaft sleeve * gasket	4107	71-600-076	72240 to 72243	1		2	
13	O-Rings *	1103, 6110, 6105	71-600-076	72240 to 72243	3		6	
14	Impeller nut	4201	71-600-076	72240 to 72243	1		1	
15	Impeller lock washer	4203	71-600-076	72240 to 72243	1		2	

Prices Valid for _____ days from Quotation Date

Terms & Conditions _____

B&W pumps

Babcock & Wilcox Canada Ltd.

RECOMMENDED SPARE PARTS

Date

Customer	Equipment Description	Vendor
CONSUMERS POWER COMPANY	REACTOR BUILDING SPRAY PUMPS	ALLIS-CHALMERS
Customer Ref. 7220-11-54-AC	**Model**	**Vendor Ref.**

	Part Description	Item/Part Number	Part/Assembly Dwg. Number	Equipment Serial #	Qty. Per Unit	Price Each $	Recommended Qty.	Estimated Delivery
1	STATOR & YOKE	---	---	72240 to 72243	1		1	
2	SHAFT END BEARING			72240 to 72243	1		2	
3	OPPOSITE END BEARING			72240 to 72243	1		2	
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								

Prices Valid for _____ days from Quotation Date

Terms & Conditions _____

Storage Recommendations

1.0 STORAGE RECOMMENDATIONS - PUMPS

(a) Indoor Storage (controlled)

- Wholly controlled atmosphere uniform temperature at least 10° F above dew point. Relative humidity - 50% or less.
- Fill bearing housing with good grade rust inhibiting lubricating turbine oil to approximately ½" above operating level.
- Fill bearing frame and backcover water jackets with good quality rust inhibitor.
- Remove mechanical seal assembly and store separately.
- Coat shaft sleeve and exposed portions of shaft with easily removable rust preventative such as Cectyle 502-C or equivalent. This material shall be re-coated every two years or as recommended by supplier.
- Pump shaft must be rotated several turns every three months to re-coat bearings with lubricant.
- Silica-gel bags should be placed in pump volute when originally sealed and replaced every two years. The flange covers should indicate the amount of silica-gel enclosed.
- Prior to placing unit in operation, the pump should be dis-assembled and completely checked out for possible deterioration.

(b) Indoor Storage (uncontrolled)

- Recommendations as above with the addition -- that the unit should be encased in polyethelene sheeting, with all seams welded with heating iron or alternately a "zipper bag" which provides an air tight seal could be used. The purpose of the polyethelene sheeting is to provide a vapor tight barrier. Any means of accomplishing this would be acceptable.
- Silica-gel bags should be placed prominently inside this enclosure and be replaced periodically. The term of effectiveness could possibly be determined by placing a moisture indicator (which would change color in the presence of moisture) along side the dissicant.

(c) Outdoor Storage

- Outdoor storage is not recommended.

2.0 STORAGE RECOMMENDATIONS -- MOTOR

- Refer to motor manual for details.

7120-M54-74-1

26.26

B&W PUMPS REPRESENTATIVES

CANADA

Montreal:
Babcock & Wilcox Canada Ltd.,
Room 430,
Canada Cement Building,
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Montreal 2, Quebec.

Toronto:
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2 St. Clair Avenue, West,
Toronto 7, Ontario.

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Suite 320,
Calgary, Alberta.

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Babcock & Wilcox Canada Ltd.,
1055 Hastings Street, W.,
Vancouver 1, B.C.

B&W PUMPS REPRESENTATIVES

U. S. A.

Eastern Area	Babcock & Wilcox Canada Ltd. 1500 North Kings Highway, Cherry Hill, New Jersey 08034
South East Area	E.D. Green Corporation P.O. Box 39, Forest Park, Georgia 30050
Mid-West Area	Midwestern Equipment Co. Inc. P.O. Box 5583, Lenexa, Kansas 66215
South West Area	Kinetic Engineering Corporation 2300 West Loop South, Suite 280, Houston, Texas 77027
Western Area	Babcock & Wilcox Canada Ltd. One California Street, San Francisco, California 94111

APPENDIX

1. Pump Data Sheet.
2. Performance Curves: 7132-5090, 7132-5085, 7132-5086, 7132-5087.
3. Pump Installation and Performance Record.
4. Inspection and Repair Record.
5. Coupling Instructions.
6. Mechanical Seal Instructions and Drawing #CF-SP-54046-2.
7. Heat Exchanger Drawing #D-2200-2.
8. Cyclone Separator Drawing #AS-0100-00CAN.
9. Motor Outline Drawing #51-808-925.
10. Motor Instructions - #51x3453.
11. Outline Drawing #71-500-077.
12. Sectional Arrangement Drawing #71-600-076.

7220-MS4-74-1

B&W pumps

Babcock & Wilcox Canada Ltd.

SECTION:

Page:
Date:
Supersedes:
Dwg. No.:

PUMP DATA SHEET

SERIAL No. 72240, 72241, 72242, 72243

SIZE AND MODEL 6 x 8 x 13 SMK

PURCHASE ORDER No. 7220-M-54-AC

DATE INSTALLED

CAPACITY	1300 USGPM
TOTAL HEAD	387 FT.
SPEED	3550 RPM
LIQUID	BORATED WATER
TEMPERATURE	40°F - 310°F
SPECIFIC GRAVITY	1.0
EFFICIENCY	72.5
B.H.P.	176
IMPELLER DIAMETER	(SEE PERFORMANCE CURVE)
ROTATION	CLOCKWISE FROM DRIVEN END.
COUPLING	FAST 2-1/2 BS (6-7/8" SPACER)
MECHANICAL SEAL	CRANE
NPSH REQUIRED	13.5 FT. MIN.
SERVICE WATER FLOW	6.0 USGPM MIN.
SERVICE WATER PRESSURE	200 PSIG DESIGN
SERVICE WATER TEMPERATURE	120°F MAX.
THERMOCOUPLES	SIGMA
BEARING LUBRICATION	OIL SPLASH
INBOARD BEARING TYPE	SKF #NU-312
OUTBOARD BEARING TYPE	SKF #7311BG
MOTOR WEIGHT	1300 LBS.
REMOVABLE ELEMENT WEIGHT	250 LBS.
TOTAL WEIGHT	3300 LBS. DRY

7220-M54-74-1

0430

Form No. 1005

B&W pumps

Babcock & Wilcox Canada Ltd.

PUMP PERFORMANCE CHART

CURVES SHOW APPROXIMATE CHARACTERISTICS
WHEN PUMPING CLEAR, COLD WATER
UNLESS OTHERWISE SPECIFIED

PUMP 6x8x13 SMK

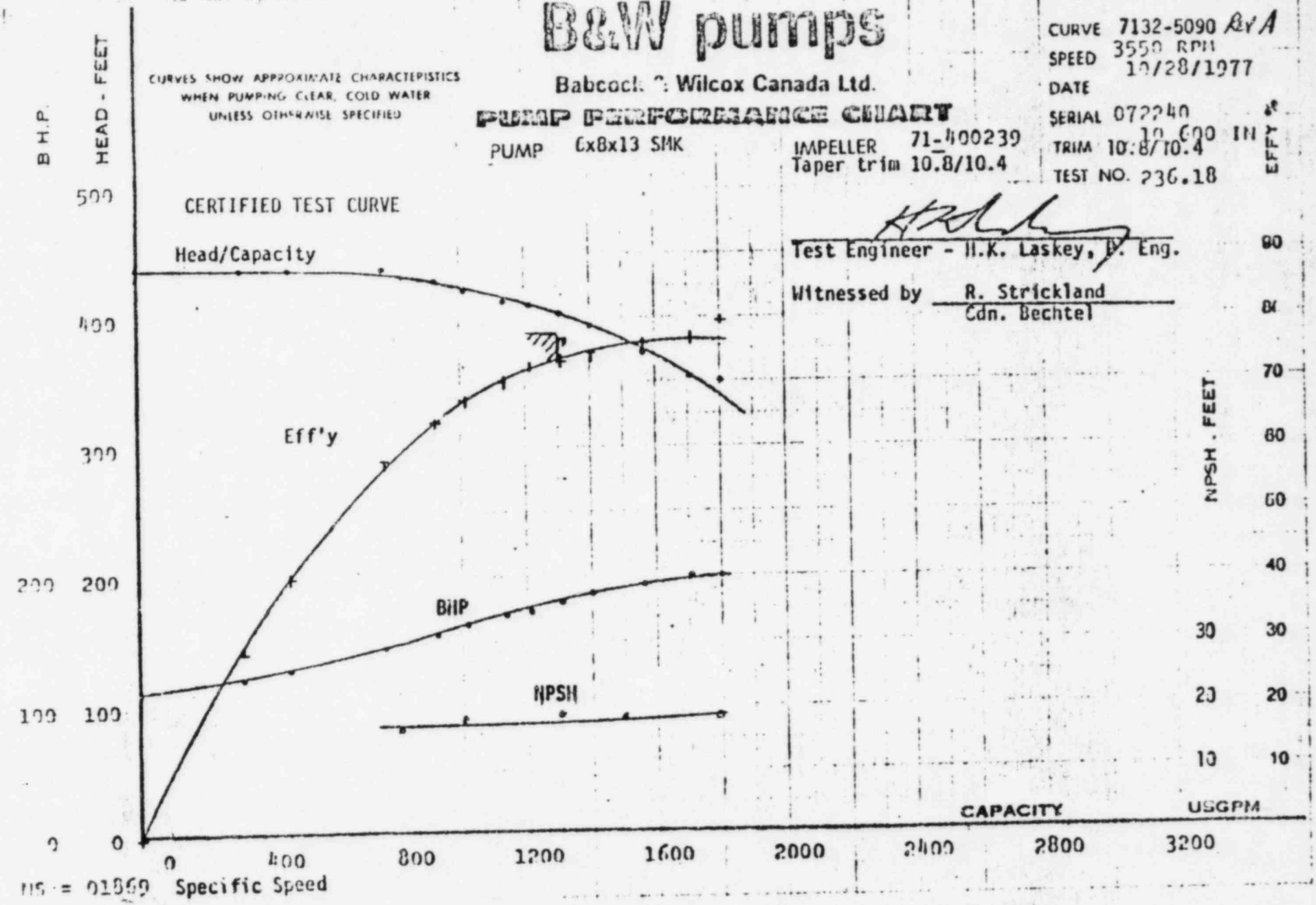
IMPELLER 71-400239
Taper trim 10.8/10.4

CURVE 7132-5090 Rev A
SPEED 3550 RPM
DATE 10/28/1977
SERIAL 072240
TRIM 10.8/10.4 10.600 IN
TEST NO. 236.18

CERTIFIED TEST CURVE

Test Engineer - H.K. Laskey, P. Eng.

Witnessed by R. Strickland
Cdn. Bechtel



NS = 01869 Specific Speed

B&W pumps

Babcock & Wilcox Canada Ltd.

PUMP PERFORMANCE CHART

CURVES SHOW APPROXIMATE CHARACTERISTICS WHEN PUMPING CLEAR, COLD WATER UNLESS OTHERWISE SPECIFIED

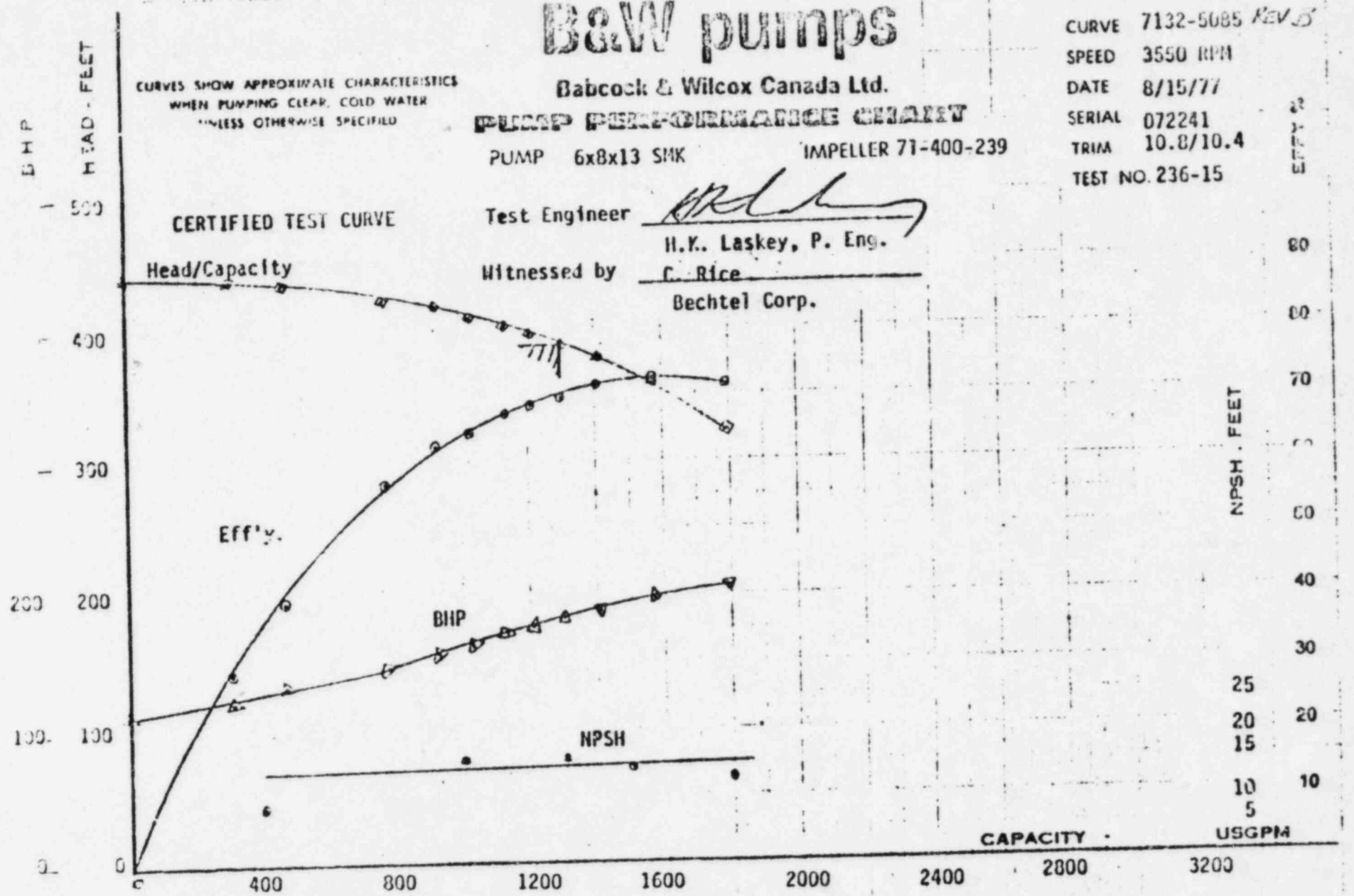
CURVE 7132-5085 REV 5
SPEED 3550 RPM
DATE 8/15/77
SERIAL 072241
TRIM 10.8/10.4
TEST NO. 236-15

PUMP 6x8x13 SMK IMPELLER 71-400-239

CERTIFIED TEST CURVE

Test Engineer H.K. Laskey, P. Eng.

Witnessed by C. Rice
Bechtel Corp.



46 1323

B&W pumps

Babcock & Wilcox Canada Ltd.

PUMP PERFORMANCE CHART

CURVES SHOW APPROXIMATE CHARACTERISTICS
WHEN PUMPING CLEAR, COLD WATER
UNLESS OTHERWISE SPECIFIED

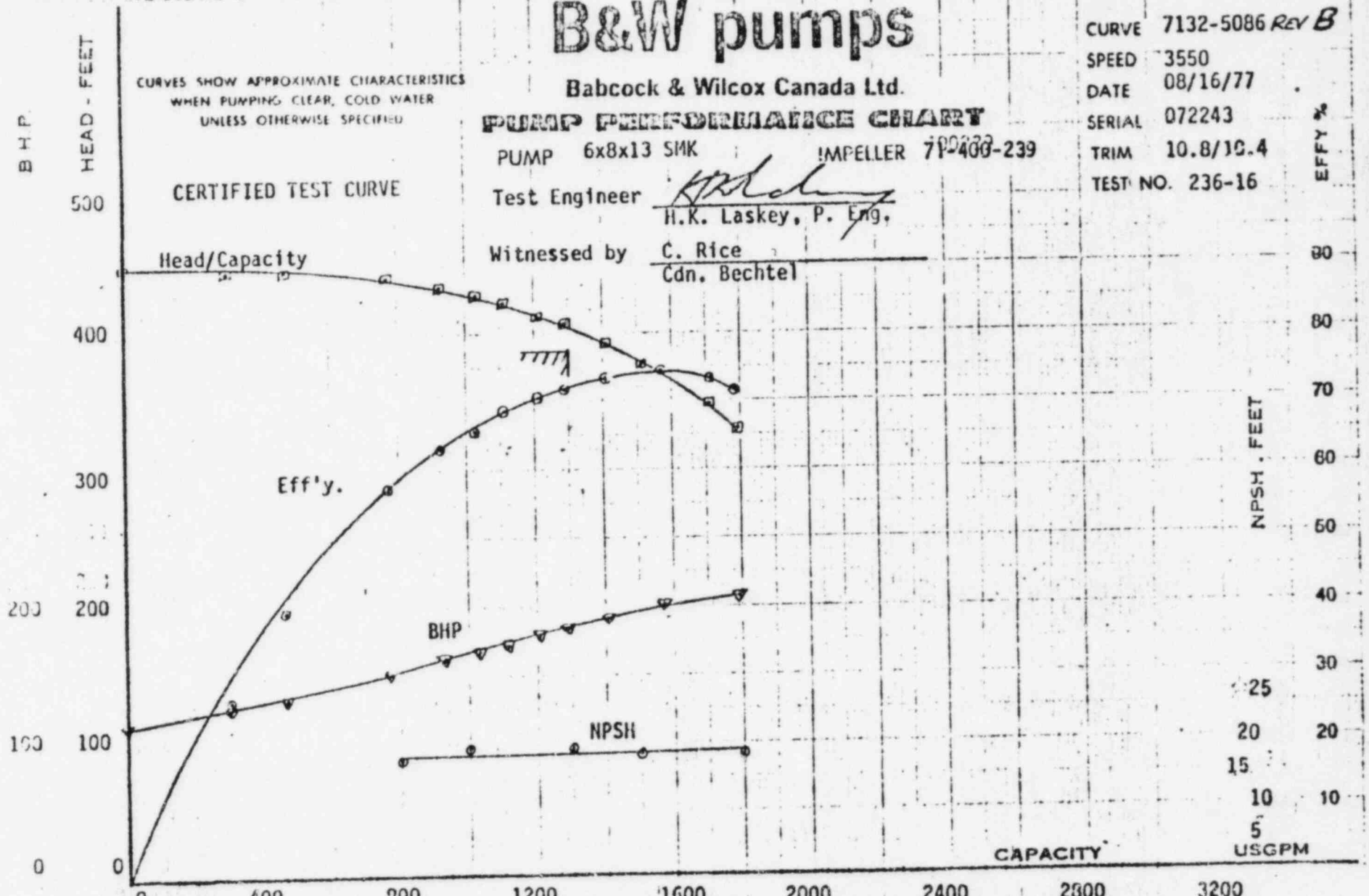
CERTIFIED TEST CURVE

PUMP 6x8x13 SMK IMPELLER 71-400-239

Test Engineer H.K. Laskey, P. Eng.

Witnessed by C. Rice
Cdn. Bechtel

CURVE 7132-5086 REV B
SPEED 3550
DATE 08/16/77
SERIAL 072243
TRIM 10.8/10.4
TEST NO. 236-16



Pg. 33

7220-MSA-742-1

46 1323

B&W pumps

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PUMP PERFORMANCE CHART

CURVES SHOW APPROXIMATE CHARACTERISTICS
WHEN PUMPING CLEAR, COLD WATER
UNLESS OTHERWISE SPECIFIED

CERTIFIED TEST CURVE

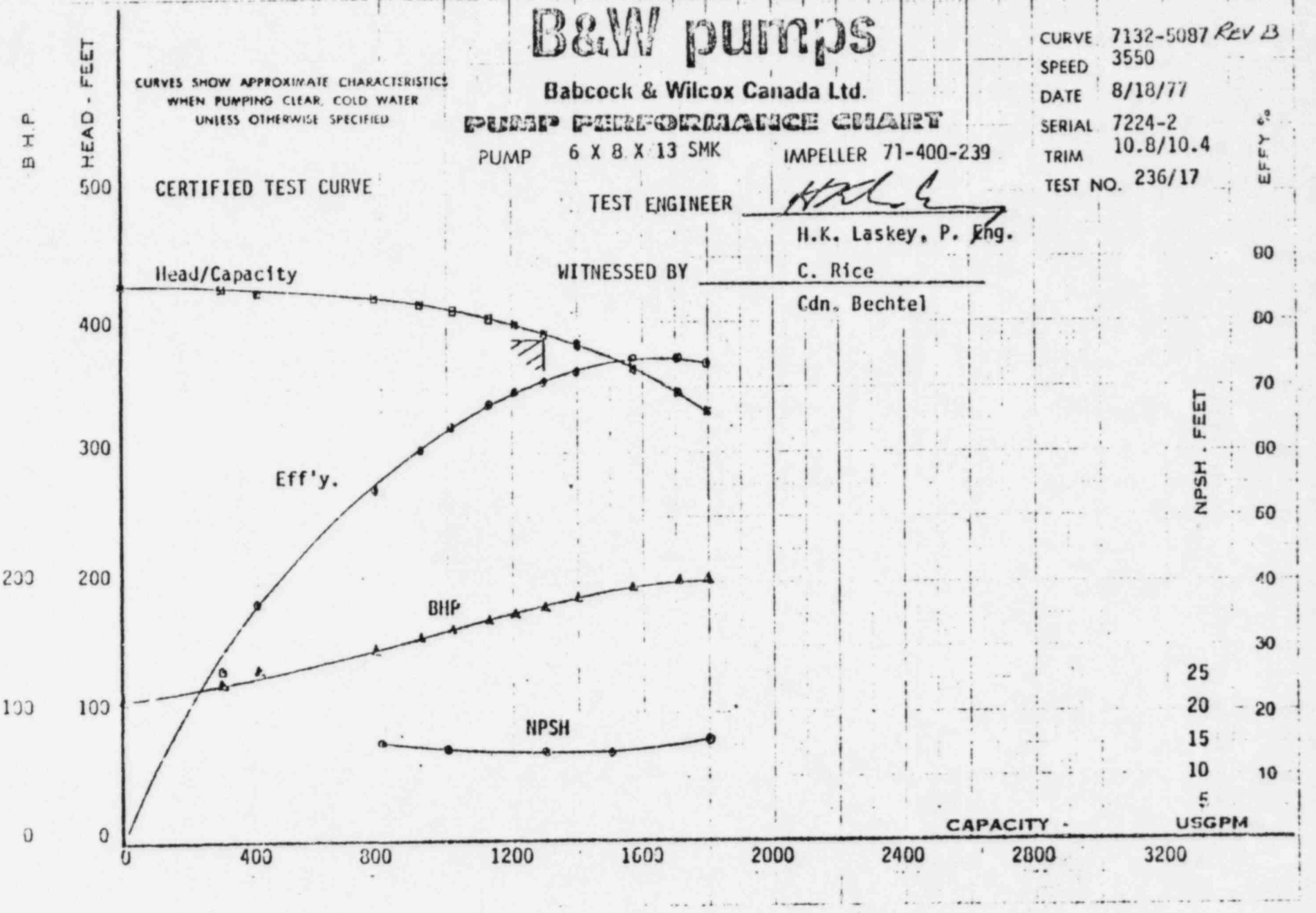
PUMP 6 X 8 X 13 SMK

IMPELLER 71-400-239

TEST ENGINEER H.K. Laskey, P. Eng.

WITNESSED BY C. Rice
Cdn. Bechtel

CURVE 7132-5087 Rev B
SPEED 3550
DATE 8/18/77
SERIAL 7224-2
TRIM 10.8/10.4
TEST NO. 236/17



B&W pumps

Babcock & Wilcox Canada Ltd.

Page:
Date:
Supersedes:
Dwg. No.:

INSTALLATION AND PERFORMANCE RECORD

Serial No. _____ Size and Type 6 x 8 x 13 SMK

Model No. _____ Date Installed: _____

Date	RPM	Suction Pressure	Discharge Pressure	Suction Temperature

7220-M54-74-1
FIG. 35

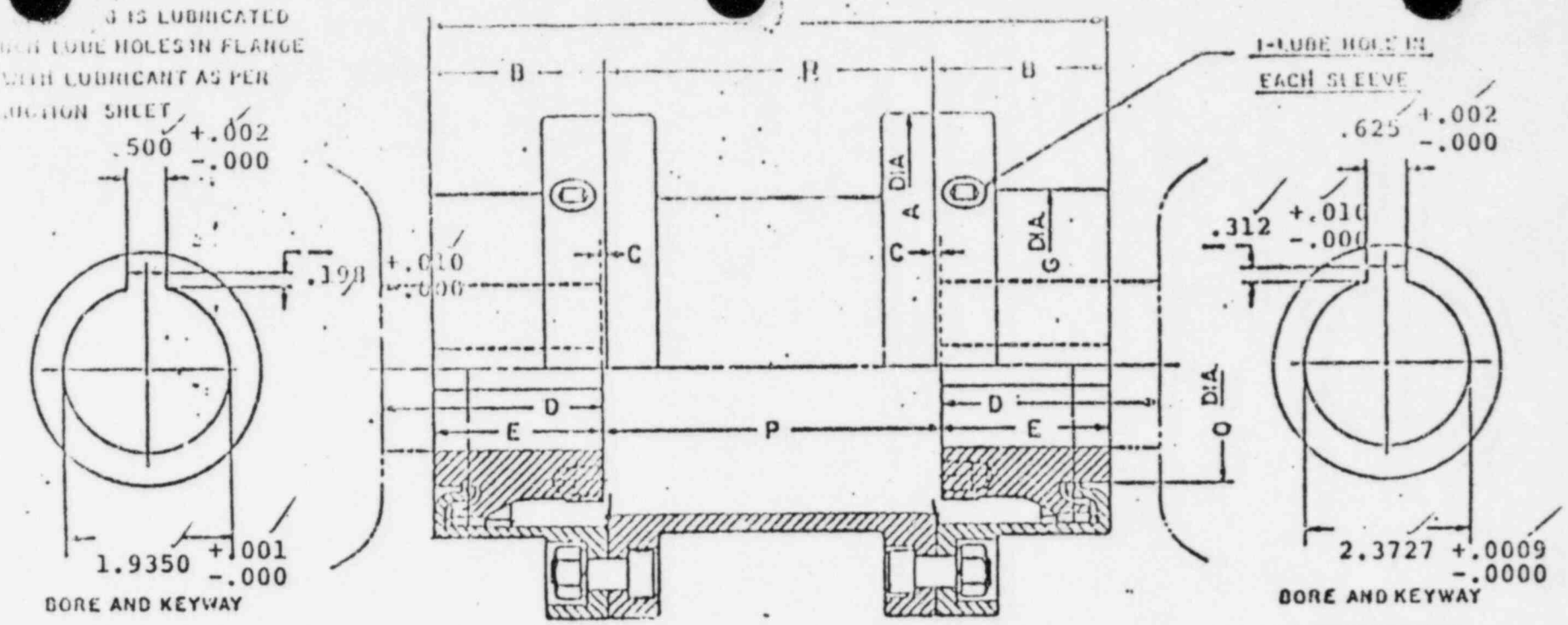
Installation

Inspection and Repair Record

Inspected Date	By	Out of Service	Back in Service	Repairs	Remarks

7220-1055-74-
A.E.C.

...MOISTURE PROOF
...S LUBRICATED
...LUBE HOLES IN FLANGE
...WITH LUBRICANT AS PER
...STRUCTION SHEET



Size #2 1/2 MODEL "B"

FAST'S SELF-ALIGNING SPACER COUPLING

HP at RPM.

	CAPACITY HP/COORPM	A	B	C	D	E	F	G	P	O	R
1	35	4	1 5/16	1/16	1 9/16	1 1/4		2 23/32		1 9/16	
1 1/2	7	5	1 3/4	1/16	2 1/16	1 11/16		3 5/16		2 3/16	
2	15	6	2 5/32	1/16	2 1/2	2 3/32		4 1/8		2 7/8	1
2 1/2	27.5	7	2 3/8	1/16	3 1/16	2 9/16	12 1/8	5 1/8	7"	3 11/16	1 7/8
3	50	8 3/8	3 1/4	3/32	3 7/8	3 5/32		6 1/8		4 1/4	
3 1/2	80	9 7/16	3 7/8	3/32	4 9/16	3 25/32		7 3/16		5	

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Jan 9/76
CONTRACT 713-7224

CUSTOMER: BABCOCK & WILCOX CANADA LIMITED
CUST. ORDER NO. 52858-7224
OUR ORDER NO CPT 21814
NO. REQ'D 4
DATE Aug. 25/75 CERTIFIED BY S. Warren

KOPPERS COMPANY, INC.
METAL PRODUCTS DIVISION
COUPLING DEPARTMENT
BALTIMORE, MARYLAND

Fast's Self-Aligning Couplings

Instructions

SHEET 1900C

Koppers Products, Ltd.
19 Meteor Drive
Rexdale, Ontario M9W 1A3
Tel.: 416-677-8044, Telex: 06-968730

Installation and Maintenance Instructions

These instructions apply specifically to the following couplings: Forged Steel, Mill Motor, Double Mill Motor, Model B, Model B Mill Motor, Model B Double Mill Motor, Cast Steel, and Flex-Rigid, Floating Shaft Arrangements and Spacer couplings of the preceding types. For other couplings these instructions are supplemented by Special Instructions supplied with each coupling.

LUBRICATION INTERVAL

Lubricant should be checked to see that proper level is maintained and that lubricant is free of contaminants. Grease is recommended if operating periods exceed six months. If oil is used, the coupling should be filled at six month intervals for the average industrial application. Other conditions, such as very slow speed operation, reversing drives, high temperatures and severe environments may require shorter lubrication periods.

APPROVED LUBRICANTS

For applications with ambient temperatures below 150°F, use a grease or oil as recommended below. For higher ambient temperatures contact Koppers Products, Ltd. for specific recommendations. Greases listed below are in response to requests for specific recommendations. This list is not complete and is not intended to restrict the use of equivalent lubricants manufactured by companies not listed, nor is it intended to exclude improved lubricants developed since publication of this list. If coupling is mounted on a reciprocating machine or if recurrent reverse loading is experienced a heavy viscous lubricant, similar to Texas Crater Compound #1, is suggested. For specific information refer to Special Instructions Form 1900-11.

OILS

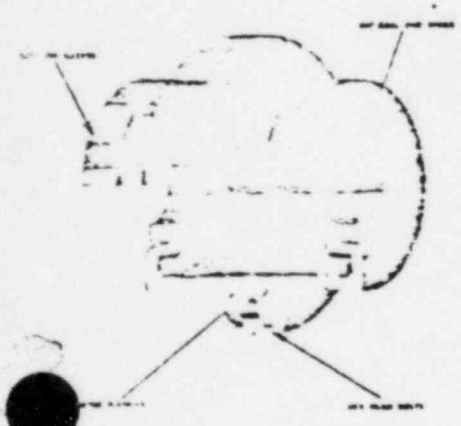
Use a mineral base oil having a viscosity no lighter than 150 SSU (Saybolt Seconds Universal) and no heavier than 1000 SSU at 210°F. Do not use oil in Model B Couplings. For example: Gear oil SAE 140, #8 AGMA, etc. or heavier oils.

GREASES

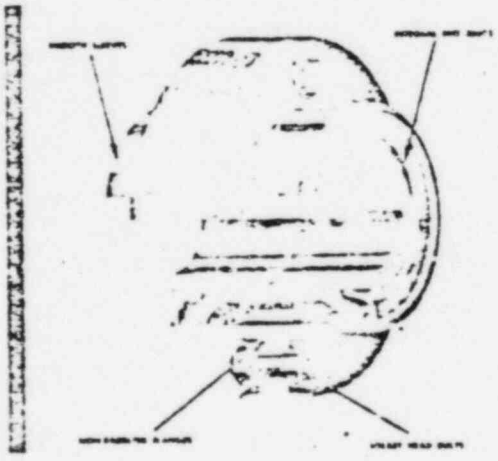
B.P. Canada Ltd.	Energrease LG EP1
Brooks Oil Co.	Lifeguard 375 Light
	Kingfast 370
Gulf Canada Ltd.	Gulfcrown EP2
Imperial Oil Ltd.	Nebula EP1
	Unirex EP1
	Argon EP1
Kendall Refining Co.	Kentube L-426
Keystone Lubricating Co.	Zenpure #2
Shell Canada Ltd.	Shell Alvania Grease #2
	Alvania EPRO
Sun Oil Co. Ltd.	Prestige 741 EP
Texaco Canada Ltd.	Marfak #1

IDENTIFYING FEATURES

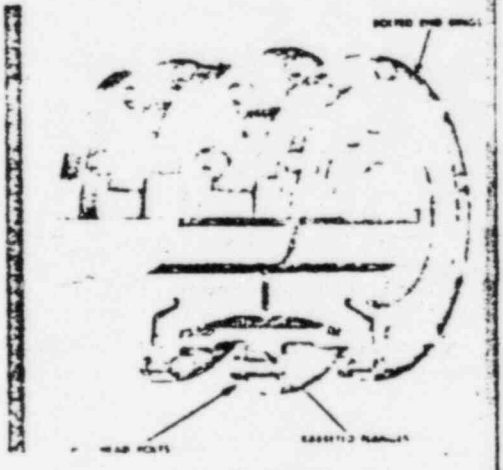
Forged Steel #1 1/2 to #7



Model B #1 to #3 1/2



Cast Steel #5 1/2 to #30

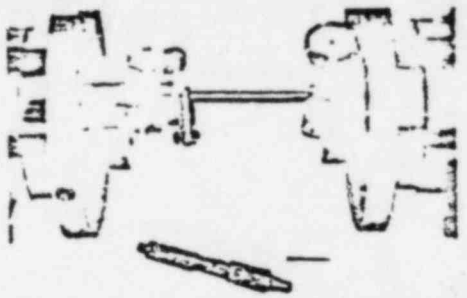


7220-M54-74-1

CHECK OFFSET ALIGNMENT — INSTRUMENT METHOD (Greater Hub Separation)

For greater hub separation (such as spacers and floating shaft arrangements), use dial indicator as shown, (or other suitable alignment fixture) and proceed as in Instruction 5. Recheck angular alignment as in Instruction 3.

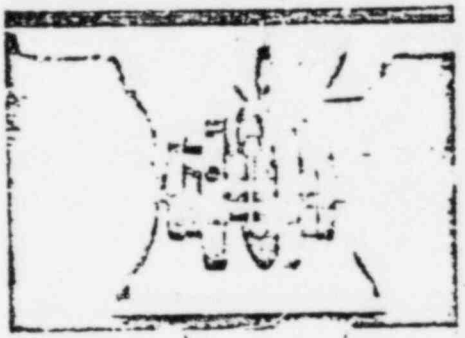
6



INSERT GASKET

Inspect to insure gasket (or neoprene O-ring when supplied) is not torn, cracked or damaged. Clean coupling flanges thoroughly, and insert gasket between flanges. (Position O-ring in grooves). For spacers or floating shaft arrangements, gaskets must be inserted between each set of flanges.

7



ASSEMBLE COUPLING

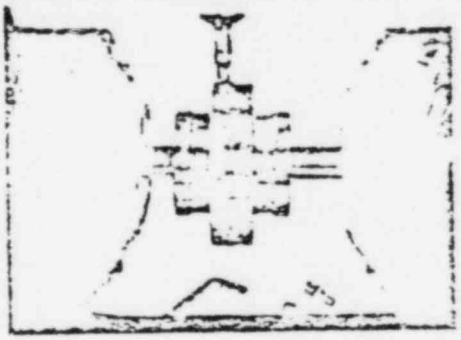
Draw flanges together, positioning lube holes 180° apart on Model B and 90° apart on Forged Steel couplings. Cast Steel couplings have two lube plugs in the male sleeve only. Keep gasket bolt holes in line with flange bolt holes. Insert and tighten bolts, lockwashers and nuts provided.

8

LUBRICATE AND TIGHTEN PLUGS

Remove two lube plugs 180° apart. Position coupling so that one hole is 45° above horizontal. Apply lubricant in this hole until excess starts out of lower opening. Sufficient lubricant has now been added. Specific lubricant capacities are listed on the last page of these instructions. For spacers with limited end float thrust plates and for floating shaft arrangements, each end must be separately lubricated. (As only one lube hole is provided in each Model B flexible half, hand packing of grease is recommended in these applications.) Before replacing lube plugs, make sure that copper ring gaskets (where supplied) are in position and undamaged. Tighten plugs.

9



a. Recheck alignment after all foundation bolts and mechanical connections are tightened.

b. For dynamically balanced couplings, refer to the special instructions included in the shipment.

c. Installation illustrated is that of a typical Forged Steel coupling, but is also applicable for other couplings as stated on first page.

d. Mounting of Taper Bored Hubs. — Mount the cold hub hand tight on the shaft and rap lightly with a soft mallet to establish initial line-to-line fit. Draw hub up an additional distance to obtain the desired interference fit for the connection. (The required amount of axial movement is dependent upon the bore diameter and taper angle.)

NOTE. Interference fit requirements in excess of .0005 inch per inch of bore diameter should be referred to Koppers for approval. For most applications, the hub face will project beyond the shaft end of the shaft taper after pull-up of the hub.

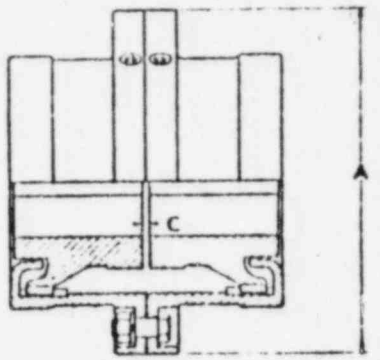
Install the hub retention means (locknut or retaining plate and capscrews) provided with the shaft and securely lock the nut or cap-screws.

06 40

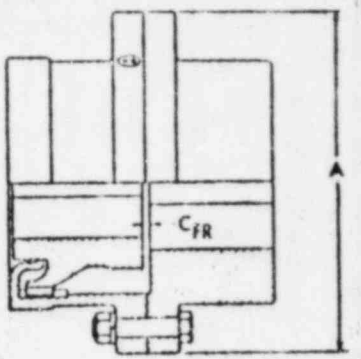
FAST'S COUPLINGS

FORGED STEEL and MILL MOTOR

COUPLING SIZE		1½	2	2½	3	3½	4	4½	5	5½	6	7
GREASE CAPACITY (U.S. PINTS)	FULL FLEX	⅛	⅛	¼	⅓	⅔	⅔	⅔	1	1⅓	2⅓	3⅓
	FLEX-RIGID	⅛	⅛	⅛	⅛	⅓	⅓	⅓	⅔	⅔	1⅓	1⅔
	SPACER ONLY (per in. of length)	.03	.04	.05	.07	.08	.12	.15	.18	.22	.25	.35
OIL CAPACITY (U.S. PINTS)	FULL FLEX	⅛	⅛	⅛	⅛	⅛	⅛	⅛	⅛	⅛	⅛	⅛
	FLEX-RIGID	⅛	⅛	⅛	⅛	⅛	⅛	⅛	⅛	⅛	⅛	⅛
	SPACER ONLY (per in. of length)	.02	.04	.05	.07	.08	.12	.15	.18	.22	.25	.35
HUB SEPARATION— "C" (inches)		⅛	⅛	⅛	⅛	¼	⅛	⅛	⅛	⅛	⅛	⅜
HUB SEPARATION— "C$_{FR}$" (inches)		⅛	⅛	⅛	⅛	⅛	⅛	⅛	⅛	⅛	⅛	⅛
FLANGE O.D. — A" (inches)		6	7	8⅛	9⅛	11	12⅛	13⅛	15⅛	16⅝	18	20⅛



FORGED STEEL COUPLING



FLEX-RIGID COUPLING

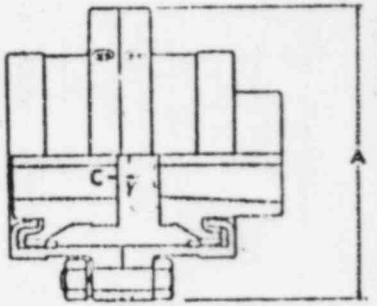
MODEL B and MODEL B MILL MOTOR

COUPLING SIZE		1	1½	2	2½	3	3½
GREASE CAPACITY (U.S. PINTS)	FULL FLEX	1/32	3/64	1/16	1/16	1/16	1/16
	FLEX-RIGID	1/64	1/32	1/16	1/16	1/16	1/16
	SPACER ONLY (per in. of length)	.03	.08	.10	.15	.20	.25
HUB SEPARATION— "C" & "C$_{FR}$" (inches)		0	1/16	1/16	1/16	1/16	1/16
FLANGE O.D. — A" (inches)		4	5	6	7	8⅛	9⅛

DO NOT USE OIL WITH MODEL B

When a spacer is used (to increase shaft separation), additional lubricant is necessary. To the amount required for the FULL FLEX coupling, add the amount required for SPACER ONLY multiplied by the length of spacer in inches. For spacers with limited end float thrust plates and for floating shaft arrangements, each end must be separately lubricated. The capacity at each end is the same as the capacity for a flex-rigid coupling.

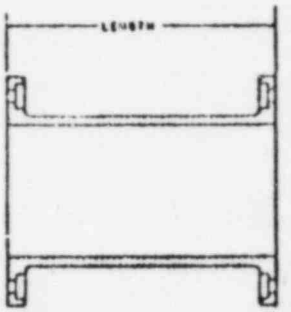
MILL MOTOR COUPLING



CAST STEEL

COUPLING SIZE		5½	6	7	8	9	10	11	12	13	14	15	16	18	20	22	24	26	28	30
GREASE CAPACITY (U.S. PINTS)	FULL FLEX	⅝	1	1¼	1⅝	3⅛	3¼	5	5⅝	6½	7⅛	9¼	10	12	16½	20	23½	26	28	30
	FLEX-RIGID	¼	⅓	⅜	1 1/16	1 5/16	1⅝	2½	2 13/16	3¼	3 13/16	4⅛	5	6	8¼	10	11⅞	13	14	15
	SPACER ONLY	SPACER CAPACITIES DEPENDENT ON INDIVIDUAL DESIGN																		
OIL CAPACITY (U.S. PINTS)	FULL FLEX	⅛	⅜	½	⅝	1¼	1½	2	2¼	2¼	3¼	4½	5½	6	9½	11¼	13½	15	16½	19
	FLEX-RIGID	⅛	3/16	¼	⅜	⅜	¾	1	1⅛	1⅜	1⅜	2¼	2¾	3	4⅜	5⅜	6⅜	7½	8¼	9½
	SPACER ONLY	SPACER CAPACITIES DEPENDENT ON INDIVIDUAL DESIGN																		
HUB SEPARATION— "C" (inches)		1/16	1/16	⅜	⅜	½	½	½	½	¾	¾	¾	1	1	1	1	1	1	1	1
HUB SEPARATION— C$_{FR}$ (inches)		1/16	1/16	½	½	¾	⅝	⅝	⅝	¾	¾	¾	1	1	1	1⅛	1⅛	1⅛	1⅛	1⅛
FLANGE O.D. — A" (inches)		15¾	18	20¾	23¼	26	28	30½	33	35¼	38	40½	43	47½	53½	59	64½	68½	73¼	78

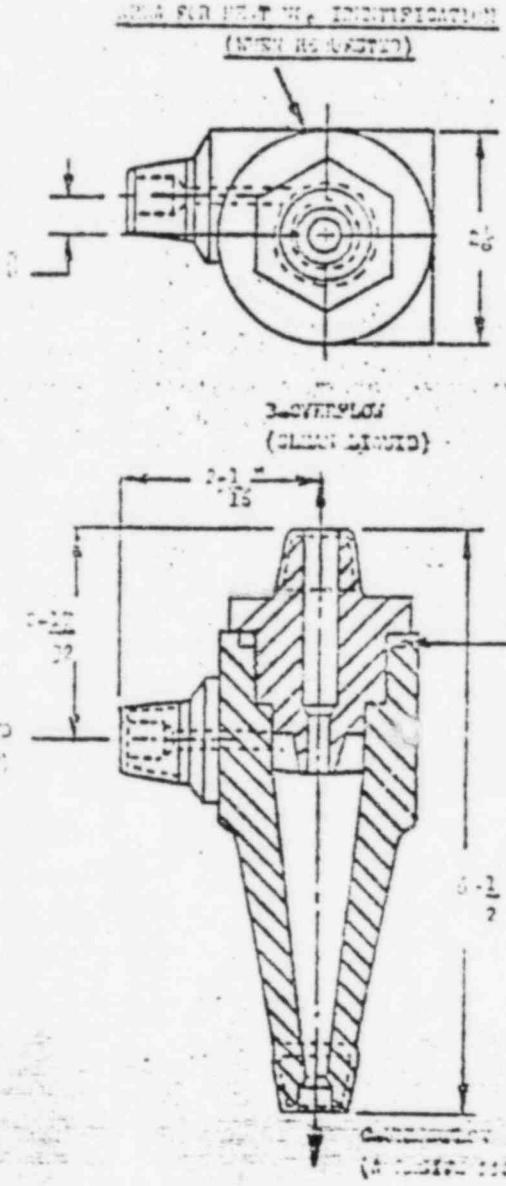
SPACER



SPACER LENGTH + C = HUB SEPARATION

Use of excessive amounts of lubricant will not impair operation of the coupling. The excess lubricant will be thrown from the coupling during operation.

Maximum Allowable Working Pressure	2000 psig
Minimum Pressure Differential	20 psig
Maximum Fluid Temperature	500° F.



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DOCUMENT ON 35mm FILM

☐ CHRONOLOGICAL FILE

Document Control Number: _____

Title: _____

☐ SPECIFICATION/MATERIAL REQUISITION

Specification/Material Requisition No. and Rev.: _____

Title of Portion on 35mm: _____

☐ CALCULATION

Calculation Identification: _____

Title of Portion on 35mm: _____

☑ OTHER

Document Identification: VENDOR

Title of Portion on 35mm: A154-74-1 / 51-503-425

☑ 35mm APERTURE CARD FILM NUMBER(S): 1

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P4

ALLIS-CHALMERS

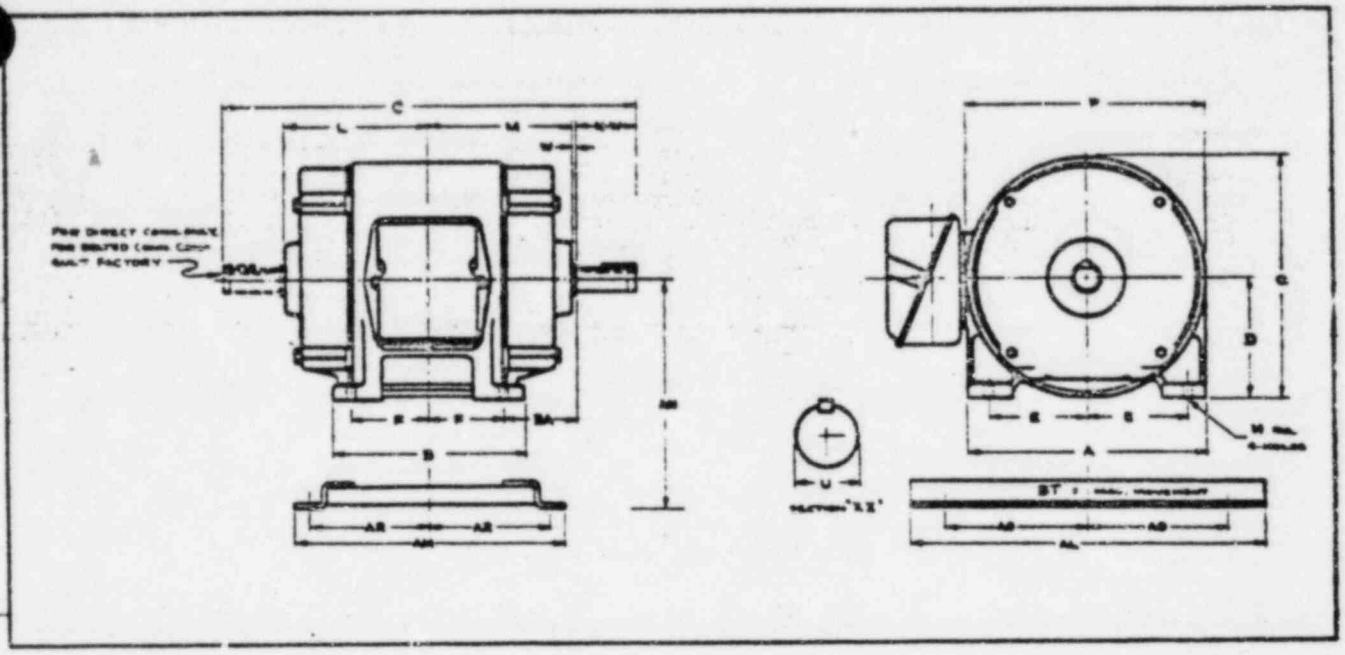
INSTRUCTIONS

Operation
Maintenance

7220-MS4-74-1

51X3453-01

TYPE RG/RGS



Frame	Key Width	Key Length	A	B	C	D	E	F	H	L M	N-W	O P	U	W	BA	AL	AM	AN	AO	AR
143T	3/16	1-3/8	7	5	10-5/8	3-1/2	2-3/4	2	11/22	4-1/8	2-1/4	7	6750		2-1/4	10-1/2	7-1/2	5	3-3/4	3-3/8
145T				6	11-5/8			2-1/2		4-5/8							8-1/2			3-7/8
182T	1/4	1-3/4	9	6-1/4	12-5/8	4-1/2	3-3/4	2-1/4	13/32	4-7/8	2-3/4	9	1.1250	1/8	3-3/4	12-3/4	9-1/2	6	4-1/2	4-1/4
184T				7-1/4	13-5/8			2-3/4		5-3/8							10-1/2			4-3/4
213T	5/16	2-3/8	10-1/2	7	15-3/4	5-1/4	4-1/4	2-3/4		6-1/8	2-3/8	10-1/2	1.3750		3-1/2	15	11	7	5-1/4	4-3/4
215T				8-1/2	17-1/4			3-1/2		6-7/8							12-1/2			5-1/2
254T	3/8	2-7/8	12-1/2	10-1/4	20-9/16	6-1/4	5	4-1/8		8-3/16	4	12-1/2	1.625		4-1/4	17-3/4	15-1/8	8-1/4	6-1/4	6-5/8
256T				12	22-5/16			5		9-1/16							16-7/8			7-1/2
284T	1/2	3-1/4	14	12	23-7/16	7	5-1/2	4-3/4	17/32	9-5/16	4-5/8	14	1.875		4-3/4	19-3/4	16-7/8	9	7	7-1/2
286T				13-1/2	24-15/16			5-1/2		10-1/16							18-3/8			8-1/4
284TS	3/8	1-7/8		12	22-1/16			4-3/4		9-5/16	3-1/4		1.625			--	--	--	--	--
286TS				13-1/2	23-9/16			5-1/2		10-1/16						--	--	--	--	--
324T	1/2	3-7/8	16	12-3/4	26-1/16	8	6-1/4	7-1/4	21/32	10-5/16	5-1/4	16	2.125		5-1/4	22-3/4	19-1/4	10-1/2	8	8-1/2
326T				14-1/4	27-9/16			1		11-1/16							20-3/4			9-1/4
324TS	1/2	2		12-3/4	24-9/16			7-1/4		10-5/16	3-3/4		1.675			--	--	--	--	--
326TS				14-1/4	28-1/16			8		11-1/16						--	--	--	--	--
364T	3/8	4-1/4	18	13-1/2	28-11/16	9	7	5-5/8	21/32	11-5/16	5-7/8	18	2.375	3/16	5-7/8	25-1/2	20-1/2	11-1/2	9	9-1/8
365T				14-1/2	29-11/16			6-1/8		11-13/16							21-1/2			9-5/8
364TS	1/2	2		13-1/2	26-9/16			5-5/8		11-5/16	5-3/4		1.875			--	--	--	--	--
365TS				14-1/2	27-9/16			6-1/8		11-13/16						--	--	--	--	--
404T	3/4	5-5/8	20	15-1/4	32-9/16	10	8	6-1/8	13/16	12-9/16	7-1/4	20	2.875		6-5/8	28-3/4	22-3/8	13	10	9-7/8
405T				16-3/4	34-1/16			6-7/8		13-5/16							23-7/8			10-5/8
404TS	1/2	2-3/4		15-1/4	29-9/16			6-1/8		12-9/16	4-1/4		2.125			--	--	--	--	--
405TS				15-3/4	31-1/16			6-7/8		13-5/16						--	--	--	--	--
444T	7/8	6-7/8	22	17-1/2	37-13/16	11	9	7-1/4		14-9/16	8-1/2	22	3.375		7-1/2	31-1/4	24-5/8	14	11	11
445T				19-1/2	39-13/16			8-1/4		15-9/16							26-5/8			12
444TS	5/8	3		17-1/2	34-1/16			7-1/4		14-9/16	4-3/4		2.375			--	--	--	--	--
445TS				19-1/2	36-1/16			8-1/4		15-9/16						--	--	--	--	--

TEES-MS4.74-1

INDOORS	ATMOSPHERE	
	Controlled	Partially Controlled
	Required: Even temperature, 10°F or more above dew point; relative humidity 50 % or less; little dust, no harmful fumes.	Desired: Clean and dry as possible.
1. STORAGE PREPARATION		
a. Bearings	a. No activity required: ball bearings grease-packed at factory.	
b. Shaft, flange surfaces	b. Coat with easily removable rust-preventive Tectyl No. 502-C mfd. by Ashland Oil & Refining Co., Ashland, Kentucky, or equal.	
c. Rodents	c. Prevent rodents, other small animals from nesting inside motor.	
d. Long Storage (over 6 months)	d. Nothing else required.	d. 1) Disassemble main parts and clean thoroughly 2) For open motors (except Super Seal) coat rotor machined surfaces with removable rust-preventive film (Tectyl No. 502-C). 3) Repaint previously painted surfaces before reassembly. 4) Remove condensation drain plugs (if present), insert silica-gel (dessicant) plugs in openings. 5) For drip-proof motors, install 1 2-pound bags of silica-gel in air inlets and outlets. Bags must be visible to insure removal before operation. 6) Cover completely to exclude dirt, dust, moisture, and other foreign materials. If possible, insert motor in strong, transparent plastic bag. Attach moisture indicator to side of motor, place several bags of silica-gel inside, then seal plastic bag. 7) If motor cannot be moved from base, cover all openings with adhesive plastic cloth and spray completely with peelable plastic. As a bare minimum, cover with heavy water-proof paper bag and tie securely around bottom. 8) If motor cannot be sealed in bag and relative humidity exceeds 50 %, use space heaters (installed inside motor when possible) to keep it at least 10°F above ambient air.
2. STORAGE MAINTENANCE		
a. Bearings	a. Rotate shaft several revolutions every month. Relubricate ball bearings after each year of storage.	
b. Shaft, flange surfaces	b. Check condition of rust preventive periodically, recoat as recommended by manufacturer. Tectyl No. 502-C may last 2 years.	
c. Long storage	c. Nothing else required.	c. 1) Check silica-gel bags and plugs monthly; check weekly if subject to wide temperature variations. 2) When moisture indicator changes color, open plastic bag, remove used silica-gel, and install fresh bags. Reseal plastic bag. 3) Check operation and setting of space heaters. It is important they function properly.
3. SERVICE PREPARATION		
a. Cleaning	a. Remove any spilled oil, water, dust, and dirt from interior and exterior. Wipe exterior. Blow out interior with low pressure air or hand bellows. Remove magnetic dust and particles with permanent magnet.	1) Remove all covers, plugs and dessicant bags. Remove rust preventive with petroleum solvent (Stoddard solvent). Replace pipe plugs.
b. Bearings	b. **RELUBRICATE BEARINGS.** Make sure bearings and lubricant cavities are free from dirt and dust.	
c. Insulation Resistance	c. Measure insulation resistance of windings by meggering. Refer to Section 4, Maintenance.	

Figure 1. Motor Storage Procedures (Indoors)

OUTDOORS	INLAND		Salty or Industrial Atmosphere
	Dry	Humid	
	Usual Conditions		
	Dust, sand, sunheat, occasional rain and snow	Dust, sand, sunheat, rain, snow, organic (fungus) growth	Salt (other chemicals)-laden moisture and dust, sand, sun heat, rain, snow, fungus growth, fumes, coal chemical dust, soot
4. STORAGE PREPARATION			
a. Bearings	a. Nothing required; ball bearings grease-packed at factory.		
b. Shaft, flange surfaces	b. Same as for indoor storage.		
c. Rodents	c. Same as for indoor storage.		
d. Long storage	d. Over six months — Consult Service Shop or Plant for specification of protective coating for internal parts. Otherwise, take following precautions:	Over one month	
	1) Same as indoor storage, refer to 1. d 1), 2), 3).		
		2) Spray all internal surfaces of open motors with one coat anti-fungus varnish (P. D. George No. 11137 protective sealer, or equal).	
	3) If motor can be moved, seal as for indoor storage, refer to 1. d 4) thru 8).		
	4) Provide roof or shed to protect from direct rain, snow, sunheat, sand storms.		
	5) If space heaters are not used, install desiccant plugs and bags in all motors.		
5. STORAGE MAINTENANCE			
a. Bearings	a. Rotate shaft several revolutions at one month intervals. Relubricate ball bearings after each year of storage. Refer to Section 4, Maintenance.		
b. Shaft, flange surfaces	b. Same as indoor storage, refer to 2. b. Outdoor life of Tectyl No. 502-C is approximately one (1) year.		1) Life of rust-preventive decreases in salt, acid, or alkali atmosphere
c. Long storage	Same as indoor storage, refer to 2. c. 1) thru 3). Check dessicant weekly.		
6. SERVICE PREPARATION	Same as for indoor storage, refer to 3. a, b, c. Remove anti-fungus varnish in accordance with manufacturer's recommendations.		

A motor is in storage when:

A. It has been delivered to the job site and is awaiting installation.
B. It has been installed, but regular operation is delayed pending completion of plant construction.
C. There are long, idle periods between operating cycles.
D. The plant or department is shut down.

Figure 2. Motor Storage Procedures: Outdoors.

NOTE: The information contained in this book is intended to assist operating personnel by providing information about the general characteristics of the purchased equipment; it does not relieve the user of the responsibility of using accepted engineering practices during the installation, operation, or maintenance of this equipment. This book does not cover all design details. When information cannot be found herein, contact the nearest Allis-Chalmers office. (See Directory 25X8109.)

7220-M54-24-1

SECTION 2 INSTALLATION

LOCATION. Select a location for the motor and driven unit that will:

a. Be clean, dry, well ventilated, properly drained, and provide accessibility for inspection, lubrication, and maintenance (see dimensions). Out-door installations may require protection from the elements.

b. Provide adequate space for motor removal without shifting the driven unit.

c. Permit the motor to safely deliver adequate power. Temperature rise of a standard motor is based on operation at an altitude not higher than 3,300 feet above sea level.

FOUNDATION. Concrete (reinforced as necessary or required) makes the best foundation, particularly for large motors and driven units. In sufficient mass it provides rigid support that minimizes deflection and vibration. It may be located on soil, structural steel, or building floors, provided the total weight (motor, driven unit, foundation) does not exceed the allowable bearing load of the support. Allowable bearing loads of structural steel and floors can be obtained from Engineering Handbooks; building codes of local communities give the recommended allowable bearing loads for different types of soil.

Before pouring, locate foundation bolts by use of a template frame and provide secure anchorage (not rigid). It is recommended that a fabricated steel base be used between motor feet and foundation. See certified drawings of motor, base, and driven unit, for exact location of foundation bolts. Allow for grouting base when pouring. Cast the base foot pads level and in the same plane.

If vibration or noise will be objectionable (as in office buildings), it may be advisable to use vibration dampeners between the motor, driven unit, and foundation.

MOUNTING. Motors listed in these instructions may be floor-, wall-, or ceiling-mounted. When wall-mounted the shaft may be at any angle, provided external thrust is not transmitted to, nor absorbed by the motor bearings.

Mount the motor base (if used) on foundation or other support. Shim as required to level (vertical if wall-mounted). Use spirit level (check two directions at 90°) to insure motor feet will be in one plane (base not warped) when base bolts are tightened. Set motor on the base, install nuts and snug - DO NOT TIGHTEN

NOTE: *Base mounted assemblies of motor and driven unit are aligned at the factory. However, experience has shown that bases, no matter how rugged or deep in section, will twist during shipment. Therefore, the alignment must be checked after mounting.*

ALIGNMENT. Reliable, trouble-free, and efficient operation of a motor-driven unit depends on the correct alignment of motor and driven shafts. Misalignment may be the cause of:

a. Noisy operation
b. Vibration
c. Premature bearing failure
d. Excessive coupling wear

Factors that may change the alignment of the unit are:

a. Settling of the foundation
b. Distortion of the base
c. Settling of the building
d. Shift of motor or driven unit on the foundation
e. Temperature differences causing difference in shaft heights.

The following checking procedure applies to a ball bearing unit, consisting of motor, flexible coupling, and a driven component mounted on a common base. Although applicable to all types of flexible couplings, it is primarily intended for the pin and rubber bushing type. For other types, where the procedures differ, refer to the coupling manufacturer's Installation and Maintenance Instructions.

Check alignment as follows:

NOTE: *This procedure is for motors not requiring an offset height to allow for temperature rise of the driver. In such cases, see Extreme Service.*

a. Disconnect the coupling halves.

b Test for parallel and angular alignment one plane at a time (horizontal and vertical) with a dial indicator as shown in Figure 3.

Proceed as follows:

(1) Scribe index lines on the coupling halves (as shown) or mark where the indicator point rests.

(2) Set indicator dial to zero at starting point.

(3) Slowly turn BOTH coupling halves so that indicator point remains on the mark.

(4) Observe dial reading 180° from start.

(5) Acceptable parallel alignment occurs when the total indicator reading does not exceed 0.004 in.

Acceptable angular alignment occurs when the total indicator reading does not exceed 0.004 in. ft. (radius to dial indicator = one foot).

Correct excessive parallel and angular misalignment by inserting shims under motor feet and or driven unit feet. Retest alignment after each change. For additional alignment information, see factory instructions 51X1175.

DRIVE SYSTEMS. Successful motor operation depends on proper selection of the drive. The accompanying NEMA Standard table lists the minimum requirements for the various drives. This table assumes that the total belt pull does not exceed one and one-half times the net belt pull. Further, the service

T222-M24-T--

FG 52

factor is taken as one. Finally, all calculations have been based on the use of standard, high-capacity belts. For long bearing life, the minimum pitch diameters should be avoided, particularly when the load is not smooth and steady. It is important that shaft axes be parallel, particularly for belt or gear drives.

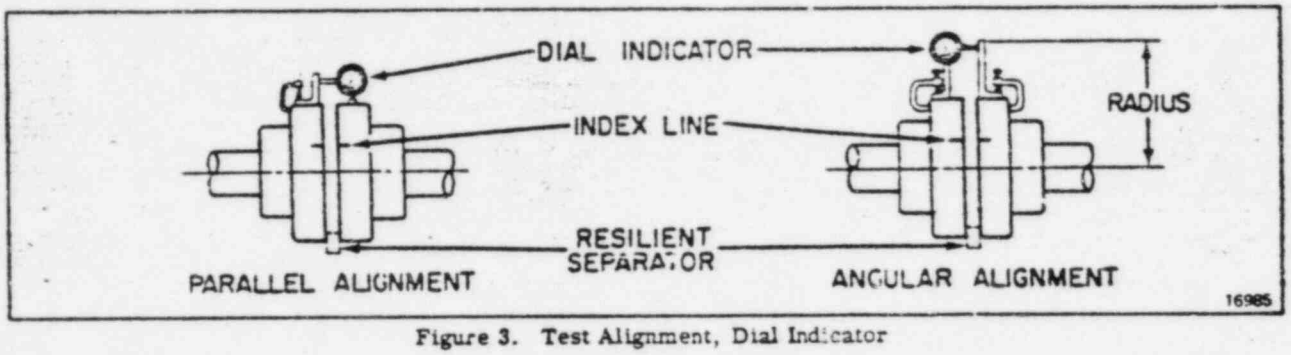


Figure 3. Test Alignment, Dial Indicator

NEMA STANDARD MINIMUM DRIVES

Frame Number	Horsepower at Synchronous Speed, Rpm				V-belt Sheave			
					Conventional		Narrow	
					A, B, C, D and E (See Note I)		3V, 5V and 8V (See Note II)	
	3600	1800	1200	900	Minimum Pitch Diameter, Inches	Maximum Width	Minimum Outside Diameter, Inches	Maximum Width
142T	1½	1	¾	½	2.2		2.2	
145T	2-3	1½-2	1	¾	2.4		2.4	
182T	3	3	1½	1	2.4		2.4	
182T	5				2.6		2.4	
184T			2	1½	2.4		2.4	
184T	5				2.6		2.4	
184T	7½	5			3.0		3.0	
213T	7½-10	7½	3	2	3.0		3.6	
215T	10		5	3	3.0		3.0	
215T	15	10			3.8		3.8	
254T	15		7½	5	3.8		3.8	
254T	20	15			4.4		4.4	
256T	20-25		10	7½	4.4		4.4	
256T		20			4.6		4.6	
284T			15	10	4.6		4.6	
284T		25			5.0		4.6	
286T		30	20	15	5.4	See Note III	5.2	See Note IV
324T		40	25	20	6.0		6.0	
326T		50	30	25	6.8		6.8	
364T			40	30	6.8		6.8	
364T		60			7.4		7.4	
365T			50	40	8.2		8.2	
365T		75			9.0		8.6	
404T			60		9.0		8.0	
404T				50	9.0		8.4	
404T		100			10.0		8.6	
405T			75	60	10.0		10.0	
405T		125			11.5		10.5	
444T			100		11.0		10.0	
444T				75	10.5		9.5	
444T		125			11.0		9.5	
444T		150					10.5	
445T			125		12.5		12.0	
445T				100	12.5		12.0	
445T		150					10.5	

NOTE I - As covered by Engineering Standards - Specifications for Drives Using Multiple V-Belts (A, B, C, D and E Cross-sections)*, dated January 1964.

NOTE II - As covered by Standard Specifications for Drives Using Narrow V-Belts (3V, 5V and 8V Cross-Sections)*, dated July 1964.

NOTE III - The width of the sheave shall be not greater than that required to transmit the indicated horsepower but in no case shall it be wider than 2 (N-W) + 1/4.

NOTE IV - The width of the sheave shall be not greater than that required to transmit the indicated horsepower but in no case shall it be wider than 2 (N-W).

NOTE V - For the assignment of horsepower and speed ratings to frames, see MG 1-13.02.a and MG 1-13.06.a.

Flexible Coupling. Separate the coupling and mount a dial indicator as shown in Figure 3. (Check alignment as previously discussed.)

Chain. Avoid use with vertical shafts. Install so that top (upper side) of chain is driving side. Make certain that sprockets or gears are in same plane. Use straight edge of sufficient length and check across side faces, both sides of shafts. Observe that chain leaves and enters sprockets straight; there must be no twist or wrack. Observe NEMA limits on pitch diameter and follow recommendations of chain manufacturer.

Gear. Accurate alignment and rigid mounting are essential for a satisfactory gear drive. Pitch diameter and width should not be outside recommended NEMA limits. Check the factory for bearing thrust capacity before installing helical gears. In all cases, gear teeth must be centered with each other, correct

(2) Through opposite motor feet drill through and into the base, holes of a diameter 1/64 inch less than dowel pin. Clean out the chips.

(3) Ream the holes in the feet and base to the proper diameter for the pins (light push fit). Clean out the chips.

(4) Insert pins to be approximately flush with motor feet.

NOTE: It is recommended that driven unit be doweled. Refer to the manufacturer's installation instructions for the procedure to follow.

EXTERNAL WIRING. Starting and over-load control devices must be matched to motor rating. For safety or convenience they may need to be installed some distance from the motor. Follow the control manufacturer's instructions to make proper installation and connections.

Observe the following:

a. Connect electrical power supply to conform with National Electrical Code and any local regulations. Line voltage and wire capacity must match motor rating stamped on the nameplate.

b. Only when the drive is disconnected, momentarily energize the motor to check that rotation is in the proper direction.

c. If motor is three-phase type, reverse rotation (if required) by inter-changing any two of the three power leads.

If two-phase, inter-change stator leads of either phase, being careful not to interchange leads from one phase to the other.

EXTREME SERVICE. If motor application is abnormal (high temperature, extreme vibration, etc.), consult Norwood Plant for special instructions for installation. In all cases where a foot-mounted motor is direct coupled, check vertical alignment (parallelism) of coupled drive as follows:

a. Operate unit until normal temperature is reached (may require 1 to 2 hours).

b. Shut down motor and lock out switch.

c. Mount dial indicator as in Figure 4.

d. Rotate shafts, noting readings at 0° and 180° (top and bottom). If within 0.004 inch total indicator reading, or other limit specified by Norwood Plant, unit is satisfactory for operation.

e. If not within limits, add or remove shims as required to raise or lower motor.

f. If shims are changed for high temperature operation, repeat parallel and angular alignment procedures.

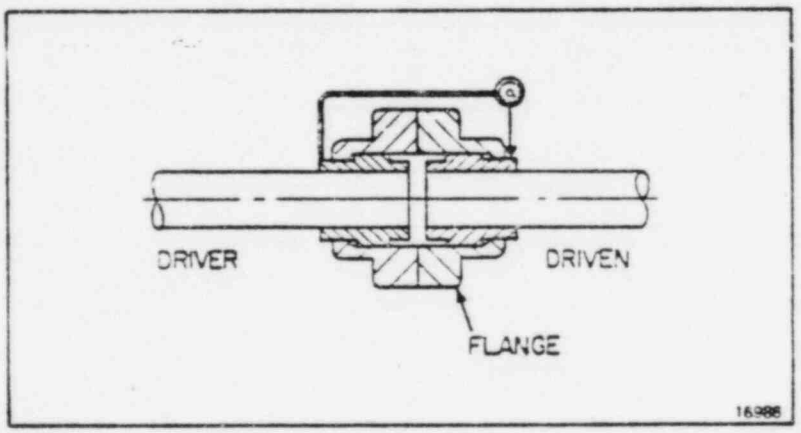


Figure 4. Check of Vertical Alignment

7220-M54-74-1

pg. 55

INITIAL START. After installation is completed, but before motor is put in regular service, make an initial start as follows:

1. Motor starting, and control device connections must agree with wiring diagrams.

2. Voltage, phase, and frequency of line circuit (power supply) must agree with motor nameplate.

3. If motor has been in storage, either before or after installation, refer to Section I for instructions to prepare for service.

4. Check motor service record and tags accompanying motor to be certain bearings have been properly lubricated.

   When shipped from the factory, ball bearings have been lubricated to give six months satisfactory service.

5. If possible, remove external load (disconnect drive) and turn shaft by hand to insure free rotation. This may have been done during installation procedure; if so, and conditions have not changed since, this check may not be necessary.

   a. If drive is disconnected, run motor at no load long enough to be certain that no unusual condition develops. Listen and feel for excessive noise, vibration, clicking, or pounding. If present, stop motor immediately. Investigate the cause and correct before putting motor in service.

   b. If drive is not disconnected, interrupt the starting cycle after motor has accelerated to low speed. Carefully observe for unusual conditions as motor coasts to a stop. Repeat several times if necessary.

CAUTION

Repeated trial starts can overheat the motor (particularly for across-the-line starting). If repeated trial starts are made, allow sufficient time between trials to permit heat to dissipate from windings or rotor to prevent overheating. Starting currents are several times running currents, and heating varies as the SQUARE of the current.

6. When checks are satisfactory, operate at minimum load and look for any unusual condition. Increase load slowly to maximum; check unit for satisfactory operation.

NORMAL OPERATION. Start the motor in accordance with standard instructions for the starting equipment used. Some loads should be reduced to the minimum, particularly reduced voltage starts, and or high inertia connected loads.

a. Run high temperature motors (Class H insulation) at reduced load until bearings reach operating temperature.

VOLTAGE REGULATION. Motors will operate successfully under the following conditions of voltage and frequency variation, but not necessarily in accordance with the standards established for operating under rated conditions:

a. When the variation in voltage does not exceed 10% above or below normal, with all phases balanced.

b. When the variation in frequency does not exceed 5% above or below normal.

c. When the sum of the voltage and frequency variations does not exceed 10% above or below normal (provided the frequency variation does not exceed 5%).

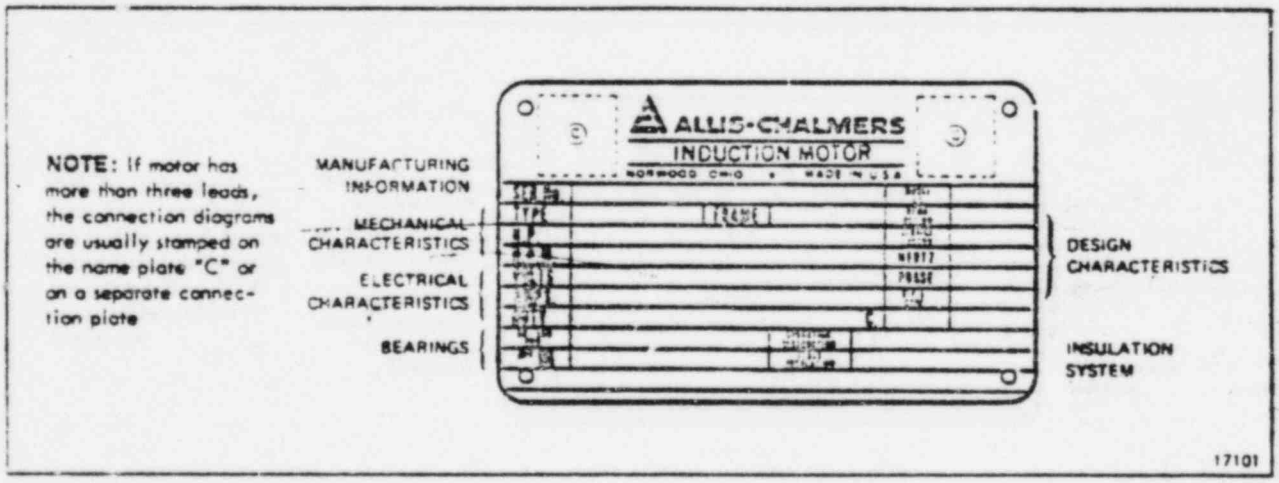


Figure 5. Rating Plate.

7220-M54-74-1

PG. 56

TROUBLE SHOOTING. Between regular maintenance inspections, be alert for signs of motor trouble. Common symptoms are listed in the following table. Correct any trouble immediately and AVOID COSTLY REPAIR AND SHUT DOWN.

SYMPTOM	POSSIBLE CAUSES	CURE
1. Fine dust under coupling employing rubber buffers or pins.	Misalignment.	Realign set.
2. Motor won't start.	Usually line trouble - single-phasing at starter.	Correct. Check source of power supply. DON'T check with motor energized. Check overloads, controls and fuses. Check voltage, compare with rating plate data.
	Improper connection.	Check connections with diagram.
	Load too heavy. Disconnect motor to see if it starts without load.	Reduce load - or replace motor with unit of greater capacity.
3. Excessive hum.	High voltage.	Check input voltage and for proper connections.
	Unbalanced rotor.	Balance with washers on die cast balance lugs.
4. Regular clicking.	Foreign matter in air gap.	Take out rotor; remove m.. 'er.
5. Rapid knocking.	Bad bearing; dirt in grease.	Replace bearing; renew gre..
6. Vibration.	Misalignment.	Realign set.
	Vibration in driven machine. Run motor disconnected for check.	Eliminate source in machine, if possible. Or change to a flexible belt drive may be in order.
7. Vibration - following motor repair.	Rotor out of balance, due to holes drilled or weights shifted . . . new rotor.	Balance rotor.
8. Motor over-heating. (Check with thermometer - don't depend on hand).	Overload. Measure load; compare with nameplate rating.	Check for excessive friction in motor, drive or machine. Reduce load, or replace motor with unit of greater capacity.
	Single phase.	Check current, all phases.
	Dirt in motor. Check flow of ventilating air.	Blow out motor. Use solvent on wound section if necessary.
	Unbalanced voltage.	Check voltage, all phases.
	Rotor rubbing on stator.	Replace bearings.
	Open stator windings.	Disconnect motor from load to see idle amps balance in all three phases. Check stator resistance in all three phases for balance.
	Over voltage.	Check voltage.
	Ground.	Locate with test lamp or megger and repair.
	Improper connections.	Recheck connections.
9. Bearing over-heating.	Misalignment.	Realign set.
	Too much tension in chain or belt drive.	Reduce tension to point of adequacy.
	Excessive end thrust.	Reduce thrust from drive or machine.
	Too much grease (ball or roller bearing).	Relieve supply to point set by manufacturer.
	Insufficient lubricant.	Add - up to point set by manufacturer.

7220-MS4-74-1

P457

SECTION 4 MAINTENANCE

GENERAL. Routine, regular maintenance is the best assurance of trouble-free, long-life motor operation. It prevents costly shutdown and repairs. Major elements of a controlled maintenance program are:

a. Trained personnel who KNOW the work.

b. Systematic records, which contain at least the following:

(1) Complete nameplate data (Motor Service Record).

(2) Prints (Wiring diagrams, certified outline, sectional view).

(3) Parts list (see rear of this section).

(4) Stock of essential parts.

(5) List of spare motors in storage.

(6) Alignment data (departures from perfect alignment, allowance for high temperature).

(7) Results of regular inspection (Motor Service Record).

(8) Repairs (Motor Service Record).

(9) Lubrication data:

a) Method of application.

b) Types of grease for wet, dry, hot, or adverse locations.

c) Stock of lubricants.

d) Maintenance cycle by locations (Some require more frequent lubrication).

e) Record for each motor (Motor Service Record).

REGULAR MAINTENANCE. Several of the more important items of good maintenance are discussed in the following paragraphs. Others should be added when adverse or unusual conditions exist.

Inspection. Each motor should be inspected at regular intervals. The frequency and thoroughness will depend on the amount of operation, nature of service, and the environment.

Cleanliness. The motor exterior should be kept free of oil, dust, dirt, water, and chemicals. For fan-cooled motors, it is particularly important to keep the air intake opening free of foreign material. Do not block air outlet.

Protection Motors operating intermittently in very damp locations should be protected by space heaters. To retard corrosion, grease all machined fits when the motor is reassembled after a maintenance check. Refer to Section I, Storage.

Loading. Guard against overloading. Overloading causes overheating and overheating means shortened insulation life. A motor subjected to a 10° temperature rise above the maximum limit for the insulation will have its insulation life reduced.

While somewhat less serious, underloading a motor is improper. It does lower the power factor, which results in higher power cost. Any motor consistently underloaded should be replaced by one of lower power rating. The amount of work a motor can safely produce is not easy to measure. A rule of thumb for most cases would be: If the input terminal voltage agrees with the rating plate, the amps are equal to, or less than, the rating plate value; and the speed (R. P. M.) is equal to, or more than rating plate specification, then the motor is not overloaded and is probably developing its rated horsepower.

Duty is also part of the H.P. relationship. Motors have a time requirement, which is specified as duty at a given ambient temperature and. horsepower being work, produces heat. This "work-heat" added to the ambient heat, then becomes the environment temperature of the motor. Duty is therefore expressed in time at a given starting temperature.

> **Note:** Duty and the ambient temperature cannot be exceeded without exposing the motor to the hazards of overheating. If the starting temperature (ambient) is greater than the rating plate specification the motor output H.P. should be reduced to compensate; refer to the factory for instructions if this problem occurs.

Temperature. An induction motor operating under normal conditions becomes quite warm. Although some places may feel hot to the touch, the unit will be within guaranteed limits if the unit is operated within the rating plate limits and ventilation is not restricted.

The Total Temperature, not the temperature rise, is the measure of safe operation. Operating conditions should be investigated if the total temperature measured *exceeds: Class B - insulation - 110°C (230°F): Class F - 135°C (275°F); Class H - 150°C (302°F).

*(See "Temperature Measurement Devices" IEEE No. 119)

Insulation. Check insulation resistance periodically. Any approved method of measuring insulation resistance may be used, provided the voltage across the insulation is at a safe value for the type and condition of the insulation. A hand cranked megger of not over 500 volts is the most convenient and safest method. Standards of the Institute of Electrical and Electronics Engineers, Inc., recommend that the insulation resistance of stator windings at 75° C, measured at 500 volts dc, after one minute should not be less than:

$$\frac{\text{Rated Voltage of Machine} + 1000}{1000} = \text{Insulation Resistance in Megohms}$$

This formula is satisfactory for most checks. For more information, see IEEE Standard No. 43, "Recommended Practice for Insulation Resistance Testing of AC Rotating Machinery."

7220-M54-74-1

P6.55

If the insulation fails to meet this standard, the motor may be dried out by heat from a warm air oven, electric strip heaters, heat lamps, or by passing current through the windings. The temperature should not exceed 167°F (75°C). Remove the bearing housings and direct a fan on the motor to carry the moisture away.

For oven drying, a forced circulation type oven rather than a radiant type is recommended. In radiant type ovens, some motor parts would be scorched or even burned before the more remote parts reach a desirable drying temperature.

When the motor is dried by passing alternating current through the windings with the bearing housings removed, the rotor must be centered in the stator core. Make certain that the air gap is uniform by wedging fiber strips in the lower portion of the gap. A controlled current of the same number of phases and the same or lower frequency is applied to the terminals. Voltage should not exceed 10% of normal, and it should not cause more than 60% of normal full-load current to pass through the windings. A voltage 15% of normal may be applied after the insulation resistance has reached one-half of the minimum value determined by the formula. The recommended drying out temperature of 167°F (75°C) should not be exceeded.

CLEANING. Clean the motor, inside and outside, regularly. Frequency depends upon actual conditions existing around the motor. Use the following procedures, as they apply:

a. Wipe off dirt, dust, oil, water, other liquids from external surfaces of motor. These materials can work into, or be carried into, the motor windings and may cause overheating or insulation breakdown.

b. Remove dirt, dust, other debris from ventilating air inlet. Do not permit such matter to accumulate near the inlet. Do not operate motor with air outlet blocked.

c. Clean open motors internally by blowing with clean, dry compressed air at 40 to 60 psi. If the conditions warrant, use a vacuum cleaner.

d. When dirt and dust are solidly packed windings are coated with oil or greasy g disassemble the motor and clean with vent. Use only high-flash naphtha, m spirits, or Stoddard solvent. Wipe wit vent dampened cloth, or use a bristle brush. DO NOT SOAK (150° F) solvent-cleaned winding before reassembly.

e. Windings of SUPER-SEAL (enca, tor) motors may be rinsed or sp. solvent, and immediately wiped dr, cloth. These windings may be clean. water and a fugitive detergent (ammo. oleate), or common household detergen. Rinse with clean, clear water to remove all detergent. Hot water or low-pressure steam may be used. Wipe excess water from metal surfaces and oven dry at 200°F.

f. After cleaning and drying windings, check the insulation resistance.

BEARINGS. Long life of bearings is assured only by maintaining proper alignment, proper belt or chain tension, and good lubrication at all times. Incorrect alignment of solid couplings can cause excessive load on bearings, and excessive vibration. Incorrect alignment of flexible couplings can produce vibration and thrust. Misalignment of belt or chain drives can cause thrust or harmful shaft oscillation. Improper alignment of gear drives will produce shock loads and probably bend the shaft.

Too much belt or chain tension often causes overheating of bearings. Also, bearings tend to overheat when pulley centers are too close, pulley diameters are too small, or belt speed is too high.

A serious mistake is daily lubrication of bearings. It is a dangerous practice, particularly when grease is added without removing the drain plug. The excess grease can cause hot bearings and is usually forced into and through the inner bearing cap, to be thrown into the windings. Proper lubrication is desired, but some under-lubrication is less dangerous than over-lubrication.

Lubrication. Prior to shipment, motor bearings are lubricated with the proper amount and grade of grease to provide six months of satisfactory service under normal operation and conditions. It is good practice, however, to visually check bearing grease of newly installed motors for proper lubrication after approximately three months operation.

Grease For best results, grease should be compounded from a lithium soap base and a good grade of petroleum oil. It should be of No. 2 consistency and stabilized against oxidation. Operating temperature range should be from -15° F to +250° F for Class B insulation, and to +300° F for Class "F" and "H". Most leading oil companies have special bearing greases that are satisfactory.

Relubricate bearings each six months (oftener tions require), as follows:

TOR .P.M.)	*RELUBRICATING FREQUENCY
	6 MONTHS (4,000 HOURS)
S	12 MONTHS (8,000 HOURS)

nment may dictate more frequent lubrication.

he motor. Lock out the switch, particu- if end shield is to be withdrawn.

horoughly clean off and remove pipe plugs from earing housing.

3. Remove hardened grease from drains with stiff wire or rod.

PC 59

4. Add grease to inlet with hand gun until small amount of new grease is forced out drain. Catch used grease in suitable container.

Note: For vertical shaft motors, it is wise to check the inner cap of the top bearing for grease slumping through the bearing and filling the inner cap grease reservoir. Since it is necessary to remove the housing, this check is best done during periodic shut down inspections. (Bottom bearing inner cap should be 2/3 full.)

5. Remove excess grease from ports, replace inlet plugs, and run motor 1/2 hour before replacing drain plug.

6. Put motor back in operation.

Replacement. Replacement bearings may be of a manufacture different from that used in the motor. When ordering, specify:

a. Identifying numerals stamped on bearing (also manufacturer, if different),

b. Tolerance Class ABEC-1,

c. Electric motor quality,

d. Internal radial clearance AFBMA-3 is standard, for all Norwood motors.

CAUTION

Never use A.F.B.M.A.-0 Bearings on enclosed motors with Class "F" or "H" insulation.

Replace bearings as follows:

1. Remove end shields (bearing housings). Be sure to take out bolts holding inner caps before pulling shields from shaft.

2. Use bearing puller and exert force only on inner race to remove bearing from shaft.

3. Heat new bearing in an oven to 200° F. While hot, slide bearing on shaft, make certain inner race makes firm, even contact with shaft shoulder.

CAUTION

Do not subject bearing to impact.

4. Let bearing cool. Pack bearing caps and assemble end shields. Be sure inner caps are clean and secured.

Operating Position (Shaft)	Grease Quantity			
	Front or Top		Rear or Bottom	
	Outer	Inner	Inner	Outer
Horizontal	Full	*None	*None	Full
Vertical	Full	None	2/3 Full	Full

* Except for a thin cylinder (line) of grease around shaft at cap clearance.

Parts Identification

The drawings in this book are of the standard design. Most of the parts should be easy to identify, if however, there is some deviation from your machine, consult the factory or the drawings supplied with your unit.

Order these and other parts, as required, from Allis-Chalmers Manufacturing Company, 4620 Forest Ave., Norwood, Ohio 45212, or through the nearest sales office. Give the following information:

a. Motor serial number,

b. Other data stamped on nameplate,

c. Name and number of part (see cross section and parts list),

d. Quantity required.

RECOMMENDED SQUIRREL-CAGE INDUCTION AND SYNDUCTION® MOTOR PARTS

ITEM	DESCRIPTION OF PART	RECOMMENDED MINIMUM STOCK NUMBER OF UNITS IN OPERATION			
		1 to 4	5 to 9	10 to 20[1]	10 to 20
1	Motor Complete	0	0	0	1
2	Stator Coils with Winding Supplies[2]	1 Set	1 Set	2 Sets	1 Set
3	Bearings	1 Set	2 Sets	2 Sets	1 Set

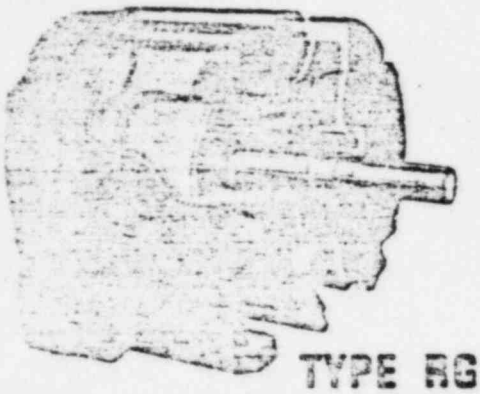
SYNDUCTION®, SUPER-SEAL® and POXEAL® are Allis-Chalmers trademarks.

1 This column to be used when complete machine is not stocked.
2 This does not apply for motors with Poxeal encapsulated-stator, in which case one complete stator is recommended.

7220-M54-74-1

PG 60

PARTS LIST



TYPE RG

TYPE RGS

KEY NO.	CATALOG NO.	PART NAME
1	71000	Stator Assembly
2	70520	Rotor Core
3	70510	Shaft, Rotor
4	70660	Key, Square
5	72014	Cap, End - Rear (Stationary)
6	72320	Deflector, Air
7	72014	Cap, End - Rear (Rotating)
8	72054	Bearing - Rear
9	72004	Housing, Bearing - Rear
10	72330	Seal, Shaft
11	72220	Bolt, Hex Head (Rear Bearing Housing)
12	72220	Bolt, Hex Head (Rear Bearing Cap)
13	72270	Plug, Pipe
14	72040	Plug, End Cap
15	72090	Bowl, Fan and Grid**
16	72080	Fan*
17	72003	Housing, Bearing - Front
18	72053	Bearing - Front
19	72013	Cap, End - Front (Rotating)
20	72013	Cap, End - Front (Stationary)
21	72220	Bolt, Hex Head (Front Air Deflector)
22	71010	Yoke Stator
23	72210	Eyebolt, Lifting
24	72340	Plate, Rating
25	72220	Pin, Escutcheon
26	72220	Bolt, Hex Head (Air Deflector - Rear)
27	70930	Gasket (Conduit Box to Yoke)
28	70900	Box Conduit
29	70960	Plug - Conduit Box
30	72270	Plug, Pipe Conduit Box*
31	70910	Cover, Conduit Box
32	72220	Bolt, Hex Head (Conduit Box Cover)
33	72220	Bolt, Hex Head (Conduit Box)
34	72220	Bolt, Hex Head (Front Bearing Housing)
35	72220	Bolt, Hex Head (Front Bearing Cap)
36	72220	Bolt, Hex Head (Fan Bowl)*
37	72260	Coupling Pipe*
38	72250	Nipple Pipe*
39	70930	Gasket, Cond. Box Parting

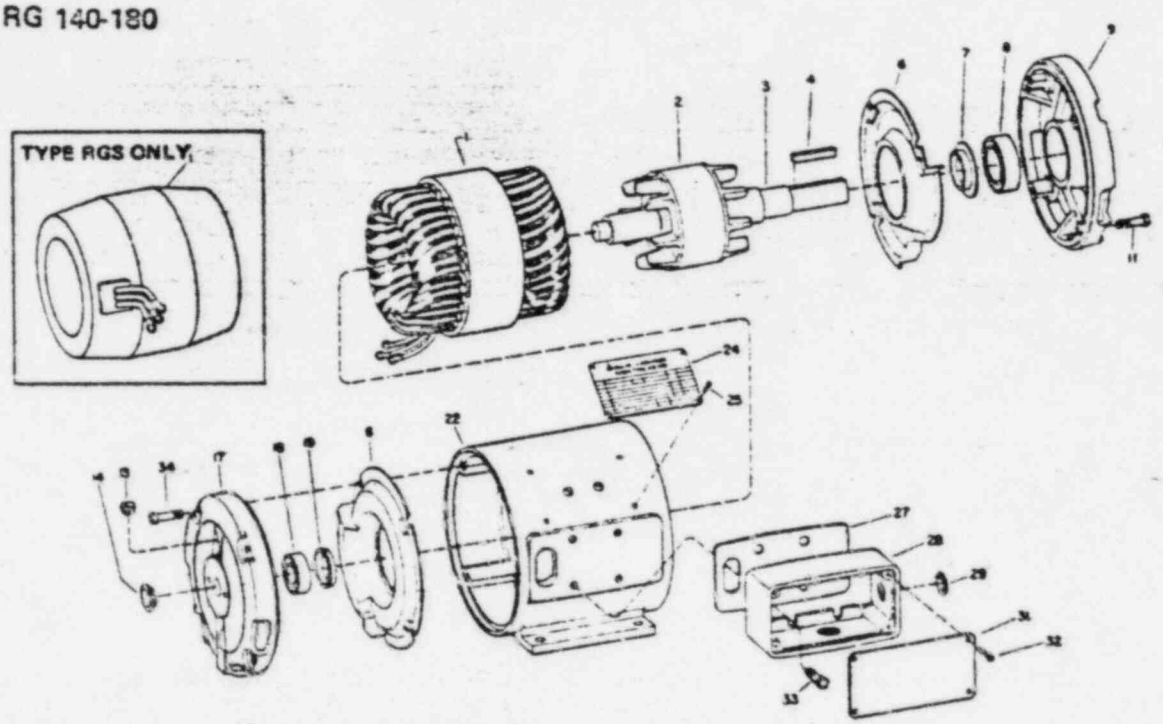
*Parts not required.

72RC. RGS-4.74-1

RG 61

TYPE RG/RGS

RG 140-180



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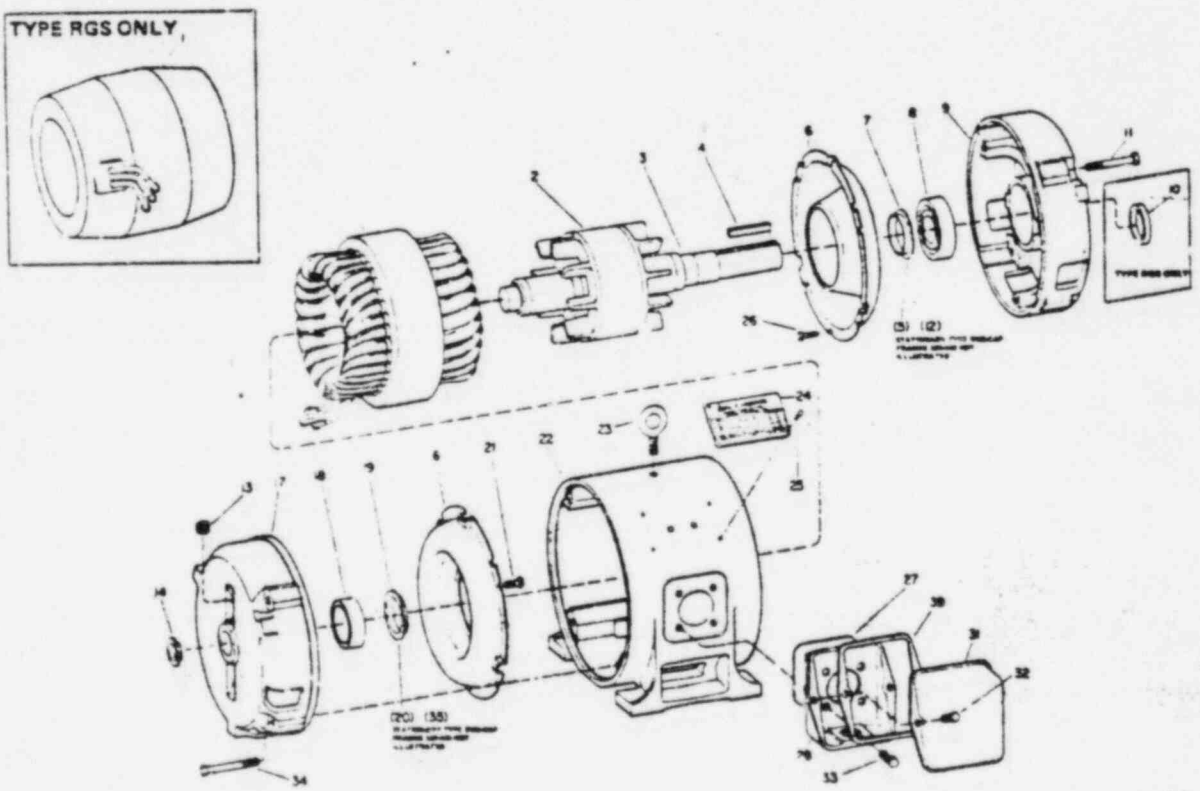
RG 210-440



17106

7220.M54.74-1

P.62

MOTOR SERVICE RECORD

Horsepower _____ Type _____

Volts _____ Amperes _____ Phase _____ Cycles _____

Temperature Rise _____ °C Frame Size _____

Stator _____

Item No. _____ Date Purchased _____

MACHINE TYPE	BEARINGS	SHAFT EXTENSION
Horizontal Vertical Moisture-Resistant Open Drip-Proof Super-Seal Totally-Enclosed Explosion Proof	☐ Ball ☐ Roller ☐ Sleeve Size: Front _____ Rear _____ Lubrication _____	Length _____ Diameter _____ Internal Thread _____ External Thread _____ Keyway _____

Date Installed	Location	Application

Date Repaired or Replaced	Repairs or Parts Replaced(1)	Fault	Repaired by	Total Cost

(1) Name of Part	No. Per Machine	Manufacturer's No.	Date	Quan. Repl.	Cost	Date	Quan. Repl.	Cost	Date	Quan. Repl.	Cost
Rotor											
Stator Coils											
Bearing, Front											
Rear											
Other											
.....											

INSPECTION

Date Checked																							
Bearings																							
Lubrication																							
Excess Heat																							
Excess Noise																							
Speed																							
Voltage																							
Amps																							
Insulation																							
Clean																							
Alignment																							
Vibration																							
Temperature																							

7220-454-74-1

Litho in U.S.A.

ALLIS-CHALMERS
NORWOOD, OHIO 45212

DOCUMENT ON 35mm FILM

☐ CHRONOLOGICAL FILE

Document Control Number: _____

Title: _____

☐ SPE ATION/MATERIAL REQUISITION

Specification/Material Requisition No. and Rev.: _____

Title of Portion on 35mm: _____

☐ CALCULATION

Calculation Identification: _____

Title of Portion on 35mm: _____

☑ OTHER

Document Identification: Vendor

Title of Portion on 35mm: RI 541-74-1 / 71-560-077

☑ 35mm APERTURE CARD FILM NUMBER(S): 2

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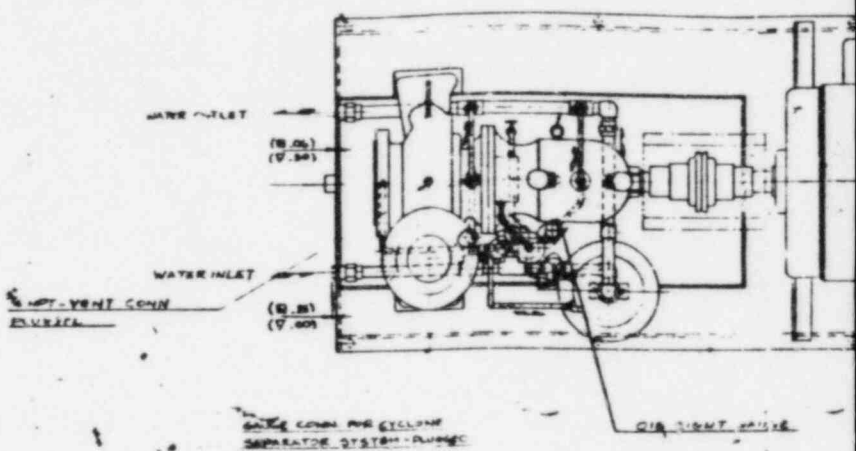
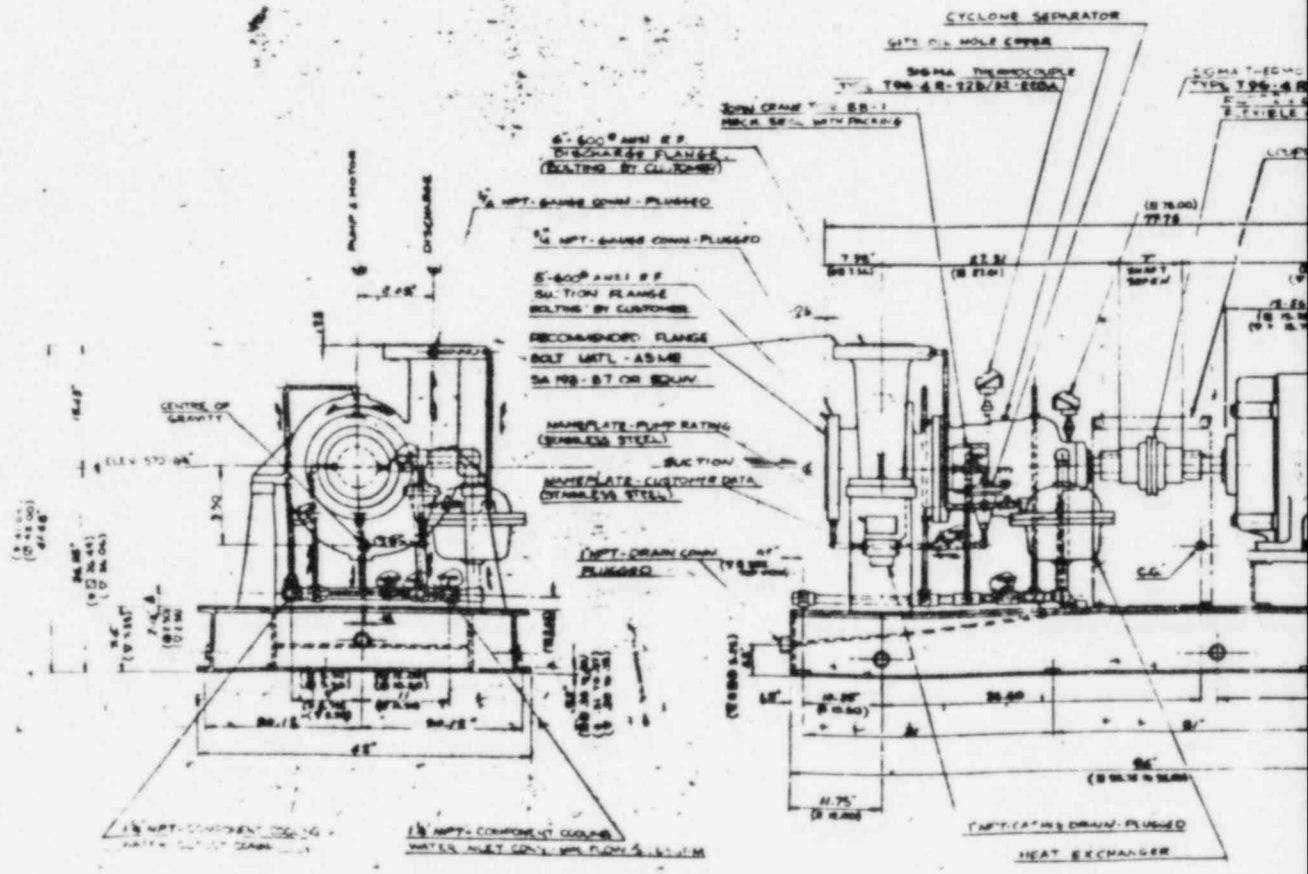

WATER OUTLET
WATER INLET
GAUGE CONN FOR CYCLONE SEPARATOR SYSTEM - PLUGGED
OIL LIGHT HOUSE


CYCLONE SEPARATOR
DISCHARGE FLANGE
SUCTION FLANGE
RECOMMENDED FLANGE
NAMEPLATE - PUMP RATING
NAMEPLATE - CUSTOMER DATA
SUCTION
DRAIN CONN
CENTRE OF GRAVITY
HEAT EXCHANGER

PUMP DATA

CUSTOMER: BRUCE POWER CORP. FOR CONSTRUCTION PURPOSES

CUSTOMER P.O.# 7220-M-54-AC

PUMP TYPE: 6 x 8 x 13 SMK

SERIAL NOS: (SEE TABLE)

SERVICE: REACTOR BUILDING SPRAY PUMPS

LIQUID: BORATED WATER CAPACITY 1800 IGPM (RATED)

HEAD (SHUT OFF) 450 FT HEAD (RATED) 387 FT EFFCY 72.5 %

P.W.R.S.P.I.I. 3550 NPSH (RATED) 13.5 FT NPSH (AVAILABLE) 25 FT

TEMP 40°F (MIN) 310°F (MAX) DESIGN PRESS 380 PSIG

HYDROSTATIC PRESS 690 PSIG SEISMIC DESIGN CLASS I

BHP (RATED) 176 PWR (SHUT OFF) 100 ASME I - III CLASS 2

SUMMER 1973 ADD

SERIAL NOS	CUSTOMERS TAG NOS
72240	1P-64A
72241	2P-64A
72242	1P-64B
72243	2P-64B

MOTOR DATA

DRIVE: ALLIS CHALMERS AC MOTOR 200 HP 3600 RPM

(DRIP PROOF) 3 PHASE 60 CYCLES 4160 VOLTS

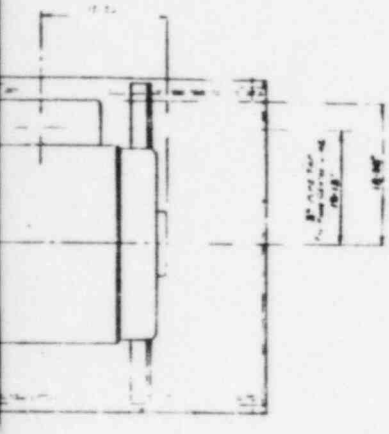
FRAME 445TZ

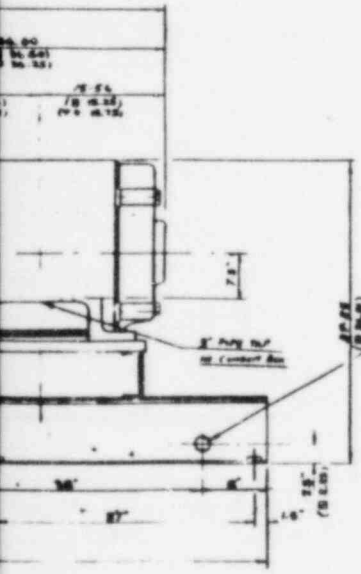
INSTALLATION

MIDLAND UNITS 1 AND 2

WEIGHTS

PUMP	600#
BASE	1400#
MOTOR	1300#
TOTAL	3300# ea
TOTAL	3100# wet





A AS BUILT DIMENSIONS

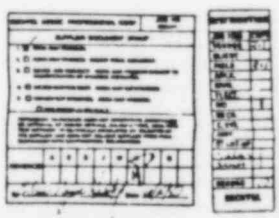
DRAWING DIMENSIONS THAT DEVIATE FROM TOLERANCE STATED ARE MARKED AS FOLLOWS

PUMP SER NO. 72240 E

PUMP SER NO. 72241 F

PUMP SER NO. 72242 F

PUMP SER NO. 72243 E



30X

7220-M54-B-7

3	DESIGNED PUMP CONSTRUCTION
2	ROTATION SUCTION, HOUSE PUMP CASING AND BASE
1	TOLERANCE ON DIMENSIONS, MATL. JACKET SHROUD

NOTES

Babcock & Wilcox Canada Ltd.

7224

71-500-077

7290-54-9-3

B&W pumps

Babcock & Wilcox Canada Ltd.
ENGINEERING STANDARDS

SECTION: 2.3.7/3-3
Page 0
Date November 19/71
Supersedes Sept 21/71
Dwg No.:

SPECIFICATION FOR

CONDUCTING OF PERFORMANCE TEST

ON

CENTRIFUGAL PUMPS

FOR

NUCLEAR POWER PLANTS

BABCOCK & WILCOX CANADA LTD

PUMP DEPARTMENT

GALT, ONTARIO, CANADA

Specification No. 229995

Standard Issued by	Approved by:

B&W pumps

Babcock & Wilcox Canada Ltd.
ENGINEERING STANDARDS

SECTION: 2.3.7/3-3
Page 00
Date November 19/71
Supersedes Sept 21/71
Dwg No.:

PERFORMANCE TEST - NUCLEAR PUMPS

TABLE OF CONTENTS

Note: Appendix I & II will vary depending upon customer requirements and pump design duty.

Standard Issued by	Approved by:
T. Gardner	D.W. Chalmers

B&W pumps

Babcock & Wilcox Canada Ltd. - Cambridge, Ontario, Canada

DOCUMENT IDENTIFICATION COVER FORM

Customer: BECHTEL POWER CORP.

Project: CONSUMERS POWER CO.
MIDLAND UNITS 1&2, MICHIGAN

Customer P.O. No.: 7220-M-54-AC Mark No.:

Unit:

Service: REACTOR BUILDING SPRAY PUMPS

B&W Canada Ltd. Contract No.: 713-7224

B&W Canada Ltd. P.O. No.:

RECORD PRINT

NOTE

The attached document No. 2.3.7/3-3 revision 10
dated 4-3-74 has been reviewed by Babcock & Wilcox Canada Ltd., for compliance to contract specifications, and has been assigned the following status:

☑ Approved
☐ Approved As Noted Per Attached Comments

Signed [signature] Date 8-16-74

CUSTOMER CONCURRENCE/STAMP

BECHTEL CO. — DISTRIBUTION

MIDLAND PLANT UNITS 1 & 2
CONSUMERS POWER CO.
PLEASE RESUBMIT CORRECTIONS WITHIN ___ WEEKS

VENDORS DRAWING REVIEW

7220

AUG 23 1974

7220-M54-9-3

B&W pumps

Babcock & Wilcox Canada Ltd.
ENGINEERING STANDARDS

SECTION: 2.3.7/3-3
Page: 0
Date: November 19/71
Supersedes: Sept 21/71
Dwg No.:

B&W pumps

Babcock & Wilcox Canada Ltd.
ENGINEERING STANDARDS

SECTION: 2.3.7/3-3
Page: 0
Date: April 3, 1974
Supersedes: March 6/74
Dwg No.:

PERFORMANCE TEST - NUCLEAR PUMPS - ISSUE & REVISIONS

ISSUE	PAGES REVISED	SUPERSEDES	ISSUED BY	APPROVED BY	DATE
01	Initial Issue		T.J.G.	D.W.C.	3/31/70
02	General Revision	3/31/70	T.J.G.	D.W.C.	4/9/70
03	4.2 added 7.1.2 to 7.3.3	4/9/70	OK/TJG	D.W.C.	8/24/70
04	General Revision	8/24/70	OK/TJG	D.W.C.	9/21/71
05	Appendix I Pages 1-2	9/21/71	O.K.	PAD/DWC	10/14/71
06	Pages 1-6 Figures 1(A) & (B)	10/14/71	O.K.	P.A.D.	11/19/71
07	Appendix II	11/19/71	O.K.	P.A.D.	3/6/72
08	Page 8	3/6/72	O.K.	P.A.D.	4/26/72
09	Appendix I-Pg. 1	4/26/72	P.S.	O.K.	3/6/74
10	Appendix I-Pg. 1	3/6/74	P.S.	OK.	4/3/74

Distribution A R C D E R G H

Standard Issued by: Paul Stevens

Approved by: [signature] 2

B&W pumps

Babcock & Wilcox Canada Ltd.
ENGINEERING STANDARDS

SECTION: 2.3.7/3-3
Page: 00
Date: November 19/71
Supersedes: Sept 21/71
Dwg No.:

PERFORMANCE TEST - NUCLEAR PUMPS

TABLE OF CONTENTS

3.2 Starting the Unit

3.2.1 The unit will be started with the discharge valve adjusted to an intermediate position. When full load speed is acheived the discharge valve will be opened to pass approximately duty flow.

3.2.2 A run of at least 15-30 minutes at design flow conditions, will be allowed to enable bearings and mechanical seals to run-in. During this period all instruments will be checked to ensure proper operation, and the loop temperature will be controlled at the value, upon which it has been agreed that the test will be conducted.

3.3 Performance Test

3.3.1 Upon steady conditions being acheived and maintained the test will be started.

3.3.2 The total head/flow characteristic will be determined by recording sufficient points (at least 10) to unable the curve to be drawn; two or more will bracket the design point. The maximum sum shall be established for one pump of each type on each contract.

3.3.3 At, no-flow, rated design flow and run-out flow the true developed head (T.D.H.), B.H.P. and efficiency will be accurately determined.

3.3.4 Sufficient time will be allowed before taking gauge readings, after changing the flow, to allow the system to stabilize.

3.3.5 During the test record of bearing temperature and mechanical seal leakage will be made. Motor Temperatures will be taken where applicable.

3.3.6 The start and stop time will be recorded. The recommended motor cooling period will be observed prior to subsequent starts.

4.0 Suction Performance Test Procedure

4.0.1 If these tests are not conducted immediately after the hydraulic performance test, the procedures outlined in paragraphs 3.1.1 to 3.2.2 inclusive, will be observed. This test will be performed using either method 1 or 2 as outlined in section 4.1 and 4.2.

4.1 Suction Performance Test (Method 1)

4.1.1 The suction performance of the pump will be determined at constant temperature (±5°F), unless specifically requested otherwise, by running the pump out its characteristic curve at various values of N.P.S.H.

4.1.2 In the first instance the N.P.S.H. to give cavitation free operation will be determined.

4.1.3 During each run-out of the characteristic curve, the loop suction pressure will be maintained constant. For the purpose of determining the N.P.S.H. it will be assumed that the velocity at the suction branch is uniform, and the fluid Kinetic head (ft) will be calculated on the basis of the mean velocity at that section.

4.1.4 At each successive run the loop suction pressure will be reduced and then maintained constant. The run will be terminated when no appreciable increase in flow occurs for a considerable fall off in head.

4.1.5 The procedure will be repeated until at least 5 cavitation curves are obtained. In each case sufficient time will be allowed for steady conditions to be maintained. One cavitation curve shall be obtained at rated condition, and one civitation curve shall be obtained at run-out condition.

1.0 Scope

1.1 This specification provides standard directions for the conducting and reporting of tests on centrifugal pumps. These tests will establish:

(a) Total head produced by the pump.

(b) The capacity or flow rate.

(c) Power input to the pump.

(d) Efficiency

(e) Suction requirements of the pump.

(f) Mechanical reliability of the pump.

1.2 Amendments

Contract requirements which modify the application of the standard will be recorded in Appendix II and will supercede the appropriate paragraph of this standard, for the particular contract. The Appendix II data sheet will be issued as a drawing and referenced in the Bill of Material.

Modification to the technical content will be cause for revision of the standard or issuance of a new standard.

2.0 Codes

The following codes apply:

(a) A.S.M.E. Power Test Code 8.2 1965.

(b) Flow measurement by means of thin plate orifices, flow nozzles, and Venturi tubes. Power Test Code 19.5, 4-1959.

3.0 Hydraulic Performance Test Procedures

3.0.1 The test will be conducted by qualified and experienced personnel. The procedure to be followed, before, during and after the test will be as generally given below.

3.0.2 All performance tests will be run using water as the pumped fluid. Each unit will be run at rated speed and if available, will use its own motor, with the supply voltage and frequency as close to the design conditions as possible.

3.1 Preliminary Procedure

3.1.1 The atmospheric conditions of pressure and temperature in the vicinity of the test loop will be recorded.

3.1.2 Before the unit is started a careful inspection shall be made, this will include the following:

3.1.3 A check of alignment

3.1.4 That the system is properly primed and leak free

3.1.5 That all bearings are adequately lubricated and if a forced feed system is incorporated, this will be started and observed to be operating satisfactorily.

3.1.6 The electrical connection of the driving motor will be checked at the terminals to ensure correct rotational direction of the unit. If considered necessary a stop/start will be performed to allow visual observation of rotation direction.

3.1.7 Suction pressure will be set to give the operating N.P.S.H. of the pump, and suction valve checked to ensure that it is open.

3.2 Starting the Unit

4.0 Suction Performance Test Procedure

B&W pumps

Babcock & Wilcox Canada Ltd.
ENGINEERING STANDARDS

SECTION 2.3.7/3-3
Page 0
Date November 19/71
Supersedes Sept 21/71
Dwg. No.:

SPECIFICATION FOR

CONDUCTING OF PERFORMANCE TEST

ON

CENTRIFUGAL PUMPS

FOR

NUCLEAR POWER PLANTS

BABCOCK & WILCOX CANADA LTD

PUMP DEPARTMENT

GALT, ONTARIO, CANADA

Specification No. 229995

Standard Issued by	Approved by:

B&W pumps

Babcock & Wilcox Canada Ltd.
ENGINEERING STANDARDS

SECTION: 2.3.7/3-3
Page 00
Date November 19/71
Supersedes Sept 21/71
Dwg. No.:

TABLE OF CONTENTS

Note: Appendix I & II will vary depending upon customer requirements and pump design duty.

Standard Issued by	Approved by:
T. Gardner	D.W. Chalmers

4

B&W pumps

Babcock & Wilcox Canada Ltd. - Cambridge, Ontario, Canada

DOCUMENT IDENTIFICATION COVER FORM

Customer: BECHTEL POWER CORP.

Project: CONSUMERS POWER CO.
MIDLAND UNITS 1&2, MICHIGAN

Customer P.O. No.: 7220-M-54-AC Mark No.:

Unit:

Service: REACTOR BUILDING SPRAY PUMPS

B&W Canada Ltd. Contract No.: 713-7224

B&W Canada Ltd. P.O. No.:

RECORD PRINT

NOTE

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dated 4-3-74 has been reviewed by Babcock & Wilcox Canada Ltd., for compliance to contract specifications, and has been assigned the following status:

☑ Approved
☐ Approved As Noted Per Attached Comments

Signed [signature] Date 8-16-74

RJ 1-18

CUSTOMER COMMENTS/STAMP

BECHTEL CO. DISTRIBUTION

MIDLAND PLANT UNITS 1 & 2
CONSUMERS POWER CO.
PLEASE RESUBMIT
CORRECTIONS WITHIN
WEEKS.

PROCESSED FOR WING REVIEW

AUG 23 1974

7220-M54-9-3

B&W pumps

Babcock & Wilcox Canada Ltd.
ENGINEERING STANDARDS

SECTION: 2.3.7/3-3
Page: 0
Date: November 19/71
Supersedes: Sept 21/71
Dwg No.:

B&W pumps

Babcock & Wilcox Canada Ltd.
ENGINEERING STANDARDS

SECTION 2.3.7/3-3
Page 0
Date April 3, 1
Supersedes March 6/7
Dwg No.:

PERFORMANCE TEST - NUCLEAR PUMPS - ISSUE & REVISIONS

ISSUE	PAGES REVISED	SUPERSEDES	ISSUED BY	APPROVED BY	DATE
01	Initial Issue		T.J.G.	D.W.C.	3/31/70
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03	4.2 added 7.1.2 to 7.3.3	4/9/70	OK/TJG	D.W.C.	8/24/70
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07	Appendix II	11/19/71	O.K.	P.A.D.	3/6/72
08	Page 6	3/6/72	O.K.	P.A.D.	4/26/72
09	Appendix I-Pg. 1	4/26/72	P.S.	O.K.	3/6/74
10	Appendix I-Pg. 1	3/6/74	P.S.	O.K.	4/3/74

Distribution A R C D E K G

Standard issued by: Paul Steiner

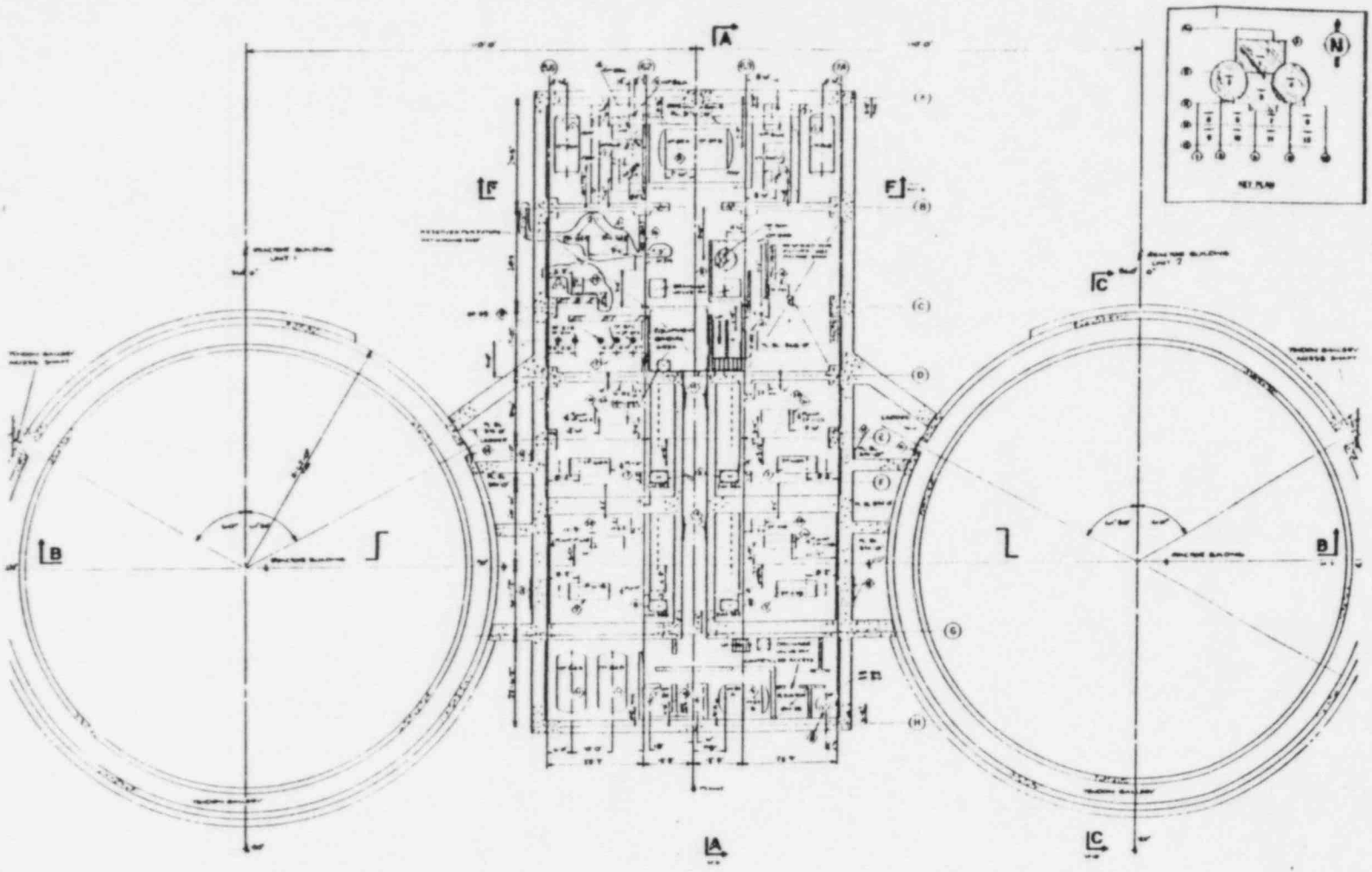
Approved by: [signature]

B&W pumps

Babcock & Wilcox Canada Ltd.
ENGINEERING STANDARDS

SECTION 2.3.7/3-3
Page 00
Date November 1
Supersedes Sept 21/
Dwg No.:

PERFORMANCE TEST - NUCLEAR PUMPS

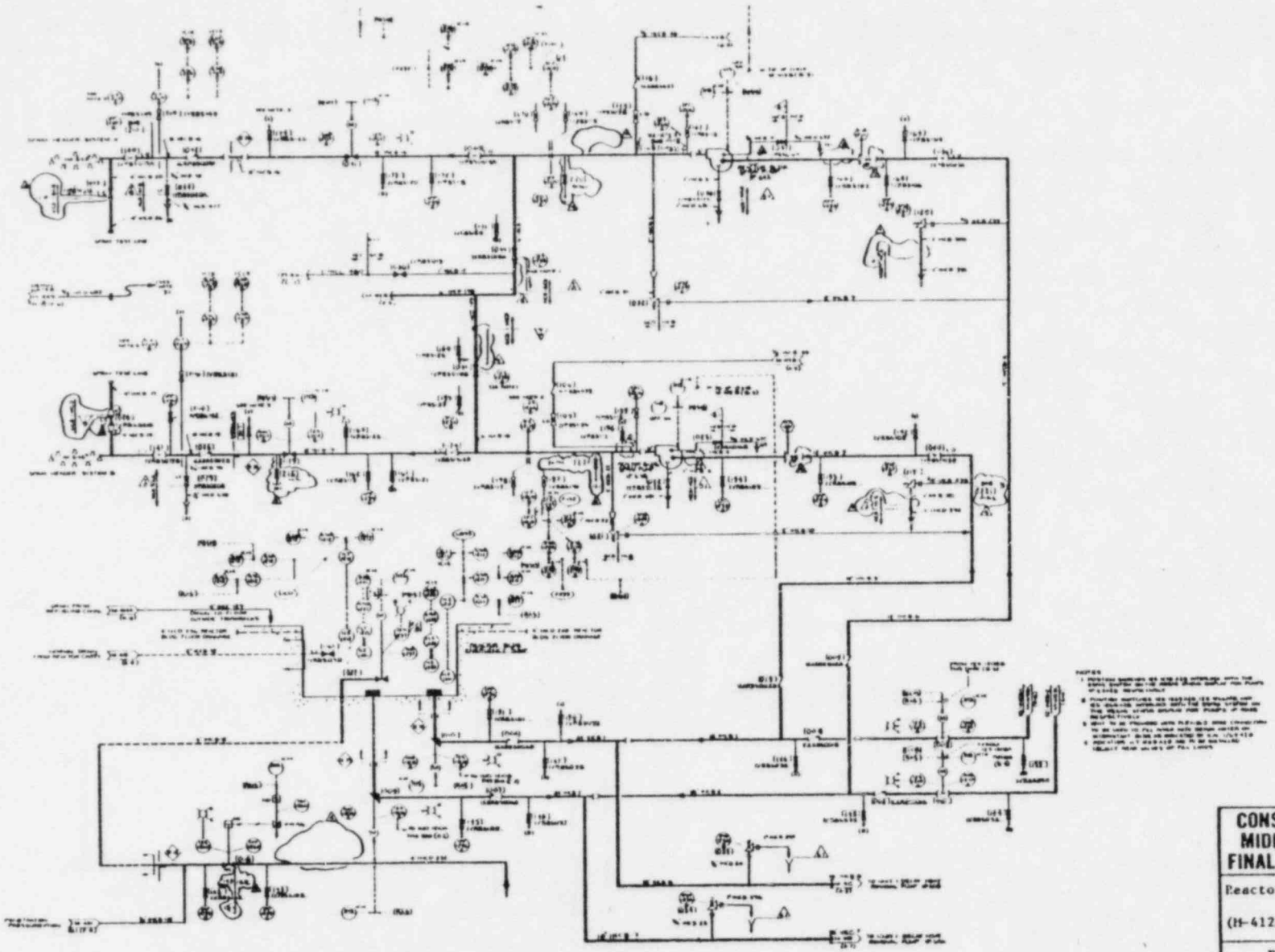


CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Equipment Location - Reactor and Auxiliary Bldgs Plan at El. 568'-0"
(M-1, Rev 15)

FSAR Figure 1.2-2

Reference 6 is deleted

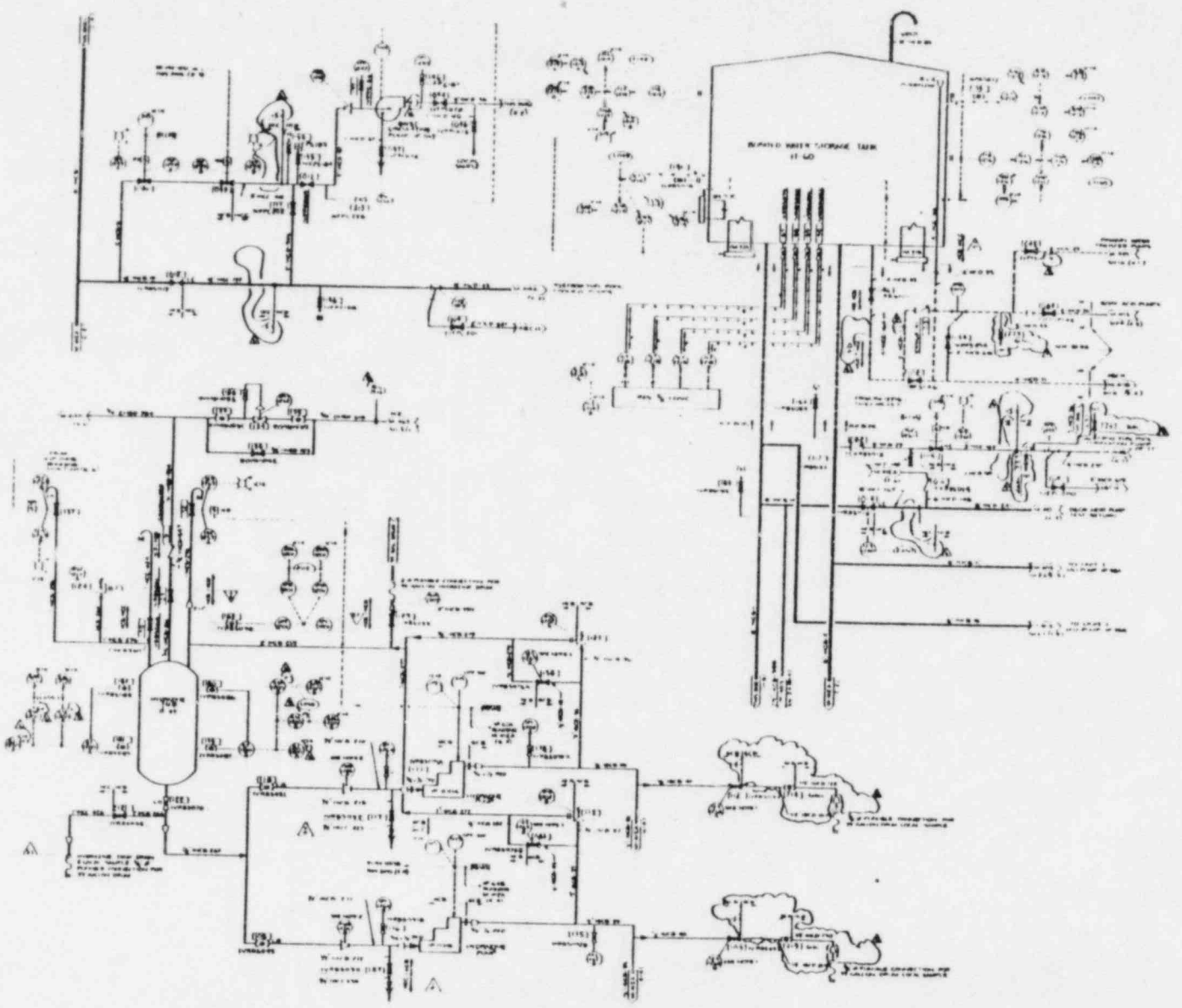


CONSUMERS POWER COMPANY
MIDLAND PLANT UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

Reactor Building Spray Unit 1

(M-412A, Rev 4)

FSAR Figure 6.2-51, sh. 1



CONSUMERS POWER COMPANY MIDLAND PLANT UNITS 1 & 2 FINAL SAFETY ANALYSIS REPORT
Reactor Building Spray Unit 1 (M-412B, Rev 6)
FSAR Figure 6.2-51, sh. 2

INSTALLATION INSTRUCTIONS FOR JOHN CRANE TYPE 8B-1 SEAL

GENERAL INSTRUCTIONS

1. BE SURE TO READ ALL INSTRUCTIONS CAREFULLY BEFORE INSTALLING SEAL.

2. A seal installation drawing containing specific dimensional data and notes is packaged with each seal. It is important that this information be read and followed closely for best operating results.

3. The "JOHN CRANE" Type 8B-1 seal is a precision product. To assure satisfactory operation handle it with care. Take particular caution to see that the lapped sealing faces are not scratched or marred.

4. Packaged shaft seals are shipped as a completely assembled unit for easy installation (See Figure 2).

PREPARING THE EQUIPMENT

1. Check concentricity between the bore of the stuffing box and the shaft. This should not exceed .010" TIR.

2. Check to see that the face of the stuffing box is square with shaft to within .005" TIR. This face must also be smooth enough to form a good sealing surface for a gasket or "O" ring. (On field conversions a portable facing tool can be furnished by Crane Packing Company.)

3. After dismantling pump, check to see that shaft or sleeve is completely free of pits, burrs, or sharp edges to prevent cutting or improper sealing of "O" ring. Surface finish of shaft or sleeve must be highly polished to dimensions and tolerances indicated on seal installation drawing.

4. Check to see that end of shaft or sleeve has a proper 1/16" R.

5. Check shaft or sleeve diameter and stuffing box bore dimensions to see that they agree with those shown on layout drawing.

6. Check pump at coupling for proper alignment of the driver. (Spool type coupling are recommended and when used on split case pump permits replacement of inboard seal without removing top half of casing. This type coupling is especially recommended for vertical type pumps where final adjustment of shaft is required.)

BEFORE STARTING UNIT

1. Check to make certain that the by-pass line is open and free of any obstruction which might interfere with circulation or cooling liquid for seal.

2. Before start up bleed all vapor from seal cavity. It is necessary to insure a liquid environment for effective seal operation. A gaseous entrapment within the seal cavity will cause dry running and diminished seal life.

OVER

7220. M54-74-1

Crane Packing Company Limited
GENERAL OFFICE AND FACTORY: 6400 OAKDALE AVE. NORTH

INSTALLING THE SEAL ASSEMBLY IN UNIT

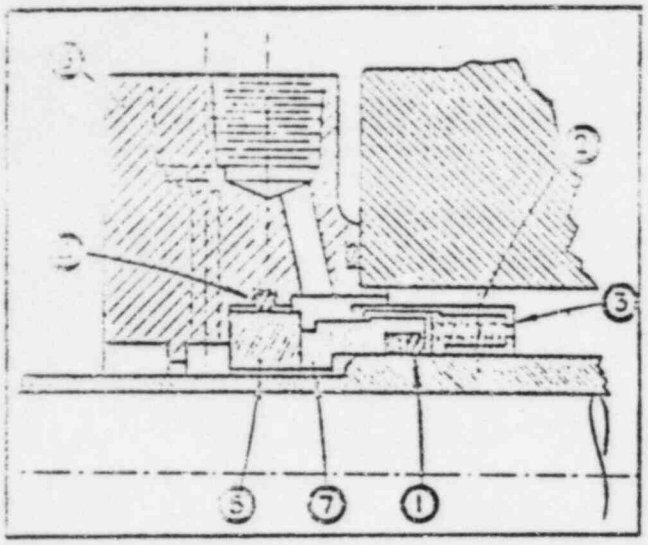


FIGURE 1

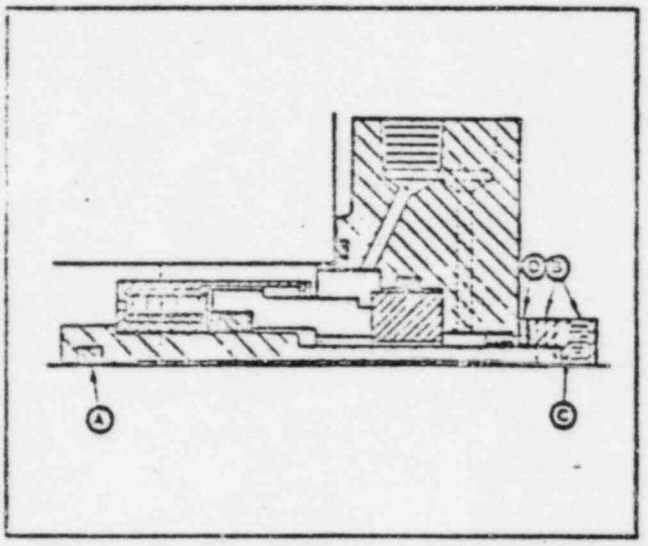


FIGURE 2

1. Before installing seal, lubricate ID of seal "O" ring (2). Also coat shaft or sleeve, over which seal will pass, with a film of lubricant. Required lubricant for all "O" ring materials except Cranelast* is to be SAE #10 or #20 lube oils. When Cranelast material is used for "O" rings, no oil may be used. Oil is harmful to Cranelast Elastomer. It is recommended that a 3% detergent solution be used or other types of mild soap solutions for installation purposes.

2. Lock Pump Bearings in place.

3. Install seal on shaft or sleeve to dimensions noted on seal installation drawing, tighten set screws (2) in retainer (3). We suggest locking set screws with a punch to prevent loosening. (Bear in mind that at some future date the set screws will have to be removed.)

4. Before installing seat, lubricate seat "O" ring (4). (For proper lubricant to be used see note #1.) Insert seat (5) into end plate (6) using finger pressure only.

5. Thoroughly clean both lapped faces of seat (5) and washer (7) with a clean, but lint-free, cloth or lens wiper. Lubricate both seat and washer faces with a light film of clean SAE #10 oil. If Cranelast materials are being used lubricate the seal faces with same lubricants indicated in paragraph 1.

6. Bring up end plate (6) against face of stuffing box and draw bolts up evenly. Use special care in assembling to avoid damaging rotating washer and stationary seat.

7. Important Note: Tighten end plate until metal to metal contact between plate and housing is realized. Do not over-stress due to hazards of distorting seal seat.

1. This seal is shipped as a completely assembled "PACKAGED" unit. It is not necessary to do any dismanteling as the seal is assembled at our factory for easy installation.

2. Lubricate sleeve "O" ring (A) and shaft thoroughly with lubricant and slip complete assembly on shaft. Required lubricant for all "O" ring materials except Cranelast is to be SAE #10 or #20 lube oils. When Cranelast material is used for "O" rings, no oil may be used. Oil is harmful to Cranelast Elastomer. It is recommended that a 3% detergent solution be used or other types of mild soap solutions for installation purposes.

3. Bolt end plate to face of the pump.

4. Tighten end plate until metal to metal contact between plate and housing is realized. Do not overstress due to hazards of distorting seal seat.

5. Lock pump bearings in place.

6. Securely tighten all set screws (B) in the set screw collar (C). (On vertical pump this operation is done after coupling is made up.)

7. Remove the split spacer gasket (D) from between the end plate and set screw collar.

*Cranelast is a Crane Packing Company trade name for a special elastomeric compound.

ITEM	PART NUMBER	MATL CODE	PART NAME	QUAN TITY	MATERIAL
1	D 2049 250		SEAT	1	CERAMIC PS
2	- 137		SEAT RING	1	SPEC. E.P.T. ✓
3	A8 2075 17		WASHER	1	PS CARBON
4	- 188		~~[illegible]~~ RING ~~[illegible]~~	1	SPEC E.P.T. ✓
5	A9 2075 8		RETAINER	1	316 S S
6	P 672		SPRING	12	" "
7	A9 2075 14		DISC ~~[illegible]~~	1	" "
8	A9 2075 43		~~[illegible]~~ SNAP RING		" "
9			SPRING HOLDER		
10	BY CUST		SLEEVE		
11			O RING ASSY		
12			DRIVE COLLAR		
13	$\frac{1}{4}$-20 x $\frac{1}{2}$ LG		SET SCREW	3	316 SS
14	A- 10087		GLAND PLATE ~~[illegible]~~	1	ASME SA 182 F 316
15	- 293		~~[illegible]~~ O RING	1	SPEC. E.P.T. ✓
16	A- 10088		GLAND	1	ASME SA 182 F316
17	$\frac{3}{8}$-16 x $\frac{3}{4}$ LG		CAP SCREW [illegible]	2	ASME SA-193-B6
18			SPACER		
19	$2\frac{5}{8}$ x $3\frac{1}{8}$ x $\frac{1}{4}$ SQ		~~[illegible]~~ PACKING	3	GRAPH.
20	A-6515 - 39		BACK UP RING	1	CARBON
21	.092 x [illegible] LG		ROLL PIN	1	316 SS
22	A- 19962		LANTERN	1	" "
23					

SEAL ASSY NO
SEAT ASSY NO
SPEC NO

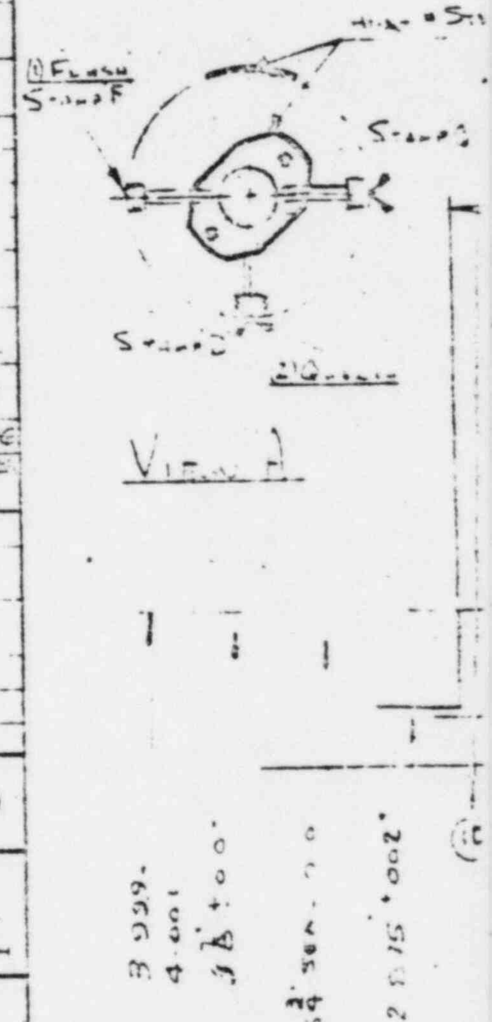
- SPECIAL PART
C40 PS D1 (316SS)
CODE

OPERATING CONDITIONS
LIQUID BORATED WATER PH 4.5 10.5
SPEED 3600 R.P.M. TEMP 40°-310°F PRESS 55 PSIG @ 310°F SUCT / 55 PSIG @ 310°F DISCH

UNIT REF B W 6 x 8 x 3 [illegible] PUMP
#/713-7224

S P REF
C EXP. 50032 / EXP. 31 5 / # SP 2 660
CONTRACT #7224 P.O.# 50913-7224 S.O.# 5557'S D

NOTE ① DO NOT USE [illegible]
USE ② DETERGENT
[illegible] USE WATER
DO NOT USE [illegible]



REVISIONS ② S.O. # A000 4-2-76 RWS

7220-M54-74-1

"John Crane"
REG. CANADIAN PAT. OFF.
CRANE PACKING COMPANY, LTD.

"JOHN CRANE" TYPE 8B-1
$2\frac{7}{8}$ SHAFT SEAL
BABCOCK & WILCOX CANADA LTD
[illegible]
B-117-7[illegible]

... SOLUTION, GLYCERINE OR ...
... ASSEMBLY SEAL FACES DRY
... ON SEAL FACES

FLUSH ...

DRAIN (1) 3/8 NPT STAMP D
AT BOTTOM IN VERT...

QUENCH (1) 3/8 NPT STAMP Q

GLAND LOCATION

NOTE 9 COOLING TO 160°F OR LESS IS RECOMMENDED TO ... SEAL LIFE

NOTE 8 MAXIMUM RADIATION LEVEL OF SEAL 2 x 10⁷ RADS RATED AGAINST EPT ...

CONSUMERS POWER CO MIDLAND MICH.

IMPORTANT NOTES

1. LUBE PARTS ... (AS NOTED) IN SEAL ASSY BEFORE INSTALLING IN UNIT
2. SLEEVE MUST BE CORROSION RESISTANT MATERIAL ... TO DIM AND TOL INDICATED
3. BEFORE COMPLETING THE SEAL INSTALLATION WIPE THE LAPPED SEALING FACES OF THE SEAT AND WASHER PERFECTLY CLEAN ... SURFACE OVER IN WHICH SEAL IS INSTALLED MUST BE SMOOTH ... POLISHED
4. GLAND PLATE PIPE TAPS ARE MARKED AS FOLLOWS: F INDICATES FLUSH OVER SEAL FACES OR INJECTION HOLE ... Q INDICATES QUENCH LIQUID OR ... VENT AND DRAIN
... ABSOLUTELY NECESSARY TO ... PROPER COOLANT AND LUBRICATION FOR SEAL FACES OTHERWISE SEAL MAY RUN DRY AND FAIL ...
... PSI MIN. ABOVE VAPOR PRESS ...

NUTECH COMMUNICATION RECORD

Persons Involved: Mr. Walker	Date/Time: 2:41pm 10/19/82
Company: Gits Brothers Mfg. Co.	Recorded By: D. S. Rosenberg
☐ Telecon/Ph.No. 312-496-7800	Copy To: File
☐ Meeting/Location	Route To:
File: CPC-09-T07	Page 1 of 1

SUBJECT: Gits BW-20-04053 Oil Sight Gage

Mr. Walker of Gits Manufacturing provides the following information regarding Gits Model BW-20-04053 Oil Sight Gage.

1. Seals (2) are BUNA-N Material.

2. Sight is glass.

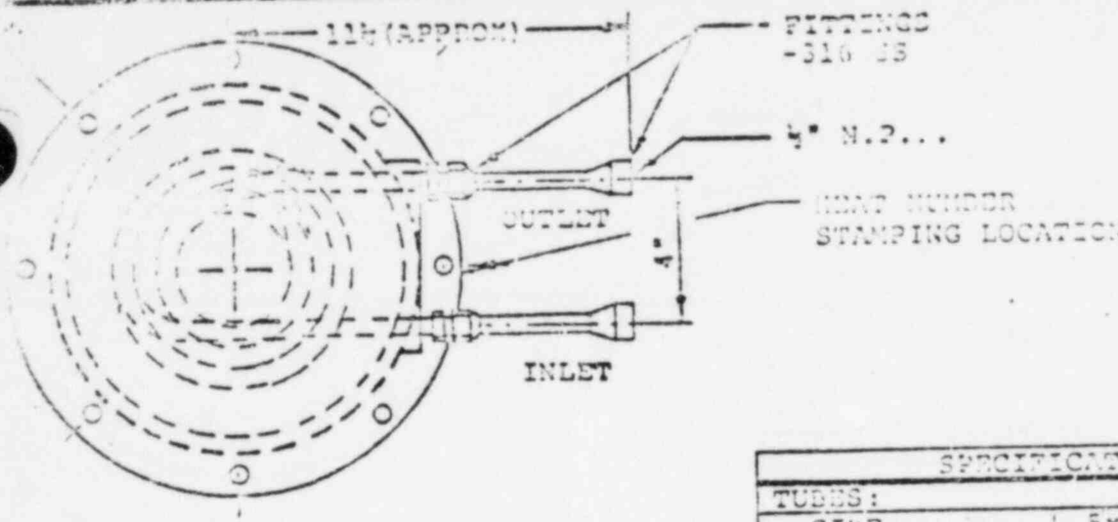
3. Sight Body is made of brass.

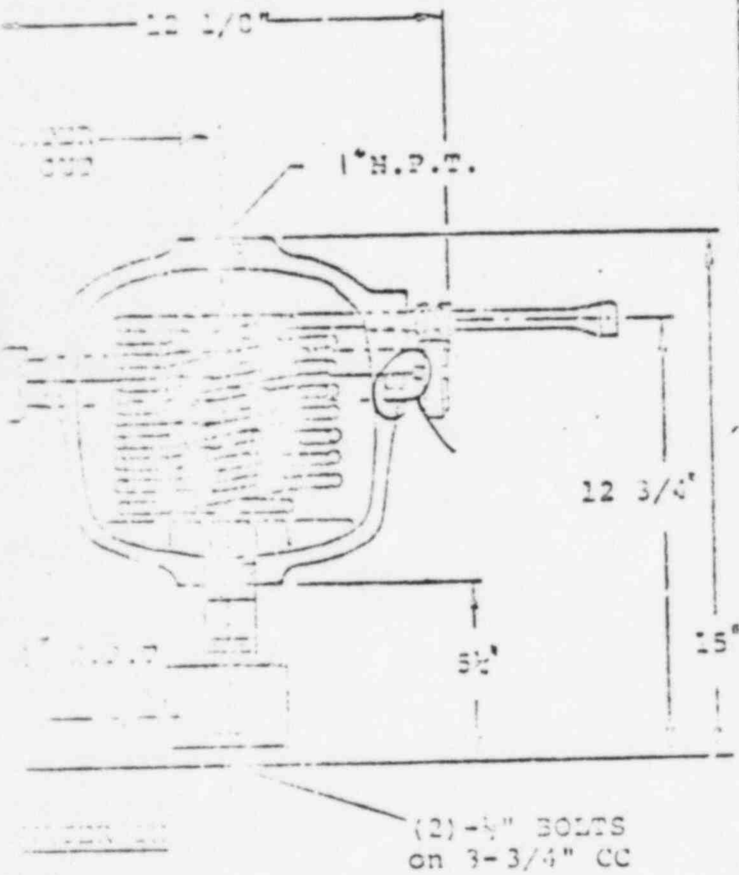
NUTECH COMMUNICATION RECORD

Persons Involved: Jack Hollis	Date/Time: 10/19/82
Company: Koppers Metal Fabrication Dept	Recorded By: D.S. Rosenberg
☐ Telecon/Ph.No. 301-768-2000	Copy To: File
☐ Meeting/Location	Route To:
File: CPC-09-T08	Page 1 of 1

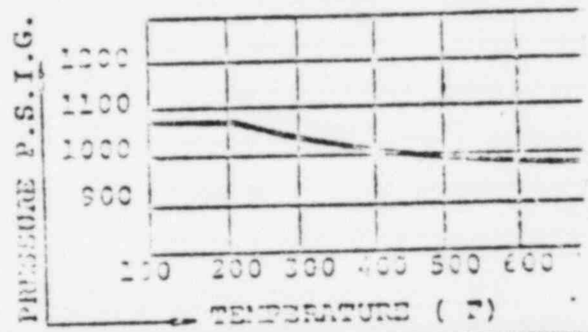
SUBJECT: Koppers Flexible Coupling Model Fast 2½ BS

	The following information was provided by Mr. Hollis of Koppers, Metal Products Division.
1.	Fast Coupling 2½ BS is an all metal coupling, no gaskets or o-rings are employed.
2.	Koppers recommends Kopper's Coupling Grease KSG (polyethylene based).
3.	Recommended regreasing interval is six months for pumps in continuous use.
4.	Service life of Koppers Coupling is in excess of 20 years for continuous service and well maintained couplings.
5.	Catalog and technical data will be supplied by Koppers.
6.	Other greases of equivalent composition may be substituted in place of Koppers KSG.





SPECIFICATIONS	
TUBES:	
-SIZE	.5x.035 WALL
-AREA	4.4 sq. ft.
-MATERIAL	SA-213-316 SS
-TEST PRESSURE	1000 PSIG @ R.T.
-PART NUMBER	D-2400
TUBE PRESSURE LIMITATION	



SHELL:	
-MATERIAL	ASTM-216-74C Grade WCB
-TEST PRESSURE	300 PSIG @ R.T.
-PART NUMBER	D-2673/4 SPEC
O-RING:	
-SIZE	[illegible]
-MATERIAL	BUNA-N

COMPANY, LTD.

JOHN CRANE

HEAT EXCHANGER

MODEL 12-S

D-2204-2

Reference 12

Midland Plant, Units 1&2 Environmental Qualification Report, Vols. I & II.

Reference 13 is deleted

NUTECH COMMUNICATION RECORD

Persons Involved: George Wall	Date/Time: 10/26/82 9:30
Company: Texaco	Recorded By: D. S. Rosenberg
☐ Telecon/Ph.No. 703-425-6800	Copy To:
☐ Meeting/Location	Route To:
File: CPC-09-T09	Page 1 of 1

SUBJECT: Texaco Lubricants

1	Texaco Marfak #1 grease showed no significant degradation in lubricating properties when subjected to a radiation exposure of 2.8E07 Rads.
2	Texaco Oil BR and O is now disignated R + 0 46.
3	R + 0 46 was exposed to 2.8E07 Rads. No change in color or odor were noted. A 2.7% increase in viscosity and a decrease in oxidation from 327 to 64 minutes was experienced.

RECORD PRINT

PLEASE RESUBMIT CORRECTED DOCUMENT IN ITS ENTIRETY WITHIN 2 WEEKS

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By WB Date 4-12-78

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START-UP	
RECORD	1

BECHTEL

APR 10 1978

CONTENTS:
THERMAL TRANSIENT
TEST REPORT IP-64B
S/N 72242

7220-M54-76-1
pg. 1 of 28

Babcock & Wilcox Canada Ltd.

B&W pumps

Babcock & Wilcox Canada Ltd. - Cambridge, Ontario, Canada

DOCUMENT IDENTIFICATION COVER FORM

Customer: BECHTEL POWER CORPORATION

Project: CONSUMERS POWER COMPANY
MIDLAND UNITS 1 & 2, MICHIGAN

Customer P.O. No.: 7220-M-54-AC Mark No.: IP-64B

Unit:

Service: REACTOR BUILDING SPRAY PUMPS

B&W Canada Ltd. Contract No.: 713-7224

B&W Canada Ltd. P.O. No.:

NOTE

The attached document S/N 72242 THERMAL TRANSIENT TEST REPORT. has been reviewed by Babcock & Wilcox Canada Ltd., for compliance to contract specifications, and has been assigned the following status:

☒ Approved
☐ Approved As Noted Per Attached Comments

Signed H Hilstrom Date Mar 31/78

CUSTOMER CONCURRENCE/STAMP

B & W PUMPS
Babcock & Wilcox Canada Ltd.
FOR APPROVAL

7220-M54-76-1
pg. 2

Babcock & Wilcox Canada Ltd.

1.0 OBJECT

Babcock & Wilcox Canada Ltd.

TEST REPORT

THERMAL TRANSIENT TEST - COLD TO HOT

CONTRACT - 713-7224

PUMP SERIAL NO. 77242

BECHTEL REF. 1P-648

7220. M54. 76-1

Babcock & Wilcox Canada Ltd.

1.0 OBJECT

To demonstrate that the pump will operate through and after a thermal transient in the fluid temperature.

1.1 SCOPE

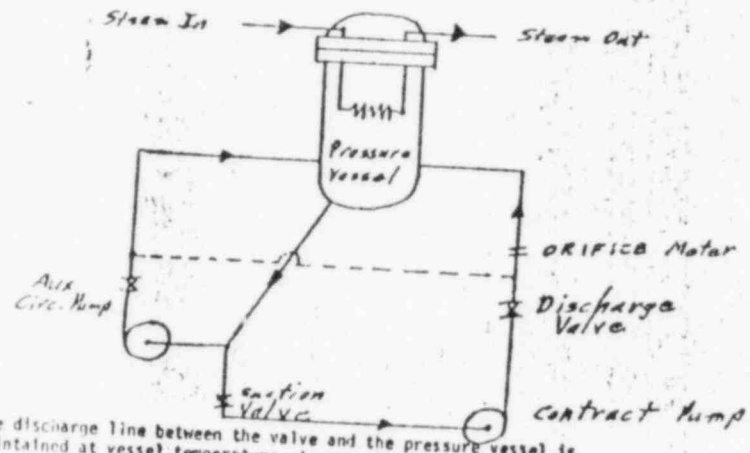
The report will outline the actual equipment and procedure used, and a summary of the results obtained.

7220. M54. 76-1

2.0 TEST EQUIPMENT

2.1 TEST LOOP

The test loop is set up as shown on the schematic below:



The discharge line between the valve and the pressure vessel is maintained at vessel temperature via a small circulation line attached close to the valve.

Flexible pipe connectors are used to absorb thermal expansion piping loads.

The discharge valve is a quick-action butterfly valve to allow the flow to reach the pre-set valve flow before the high temperature water hits the pump.

2.2 INSTRUMENTATION

The following parameters were recorded continuously on a Brush recorder during and after the thermal transient with the instrumentation as indicated:

- Suction temperature - Marlox C/A thermocouple.
- Discharge pressure
- Suction pressure - Bailey pressure transducer 0-1000 psi.
- Motor input power - Westinghouse type VP2-840 Watt transducer.

Pump vibration was recorded continuously using the following equipment:

- Endevco accelerometers Model 2276
- Columbia Model 900 amplifiers
- Lockheed store - 4 FM tape recorder
- Rockland Model 852 filters
- B&K Model 2425 RMS voltmeter
- MB Model M409 dual integrators
- Brush 500 X-Y recorder
- Nicolet Model 206 digital storage oscilloscope

Pump flow was monitored with a Barton 'Δ P' Gauge.

3.0 CONDUCT OF TEST

The pump was installed in the test loop and operated cold to determine the correct discharge valve setting for the required flow during the thermal transient.

The pump was then stopped, and isolated from the pressure vessel. The Auxiliary circulating pump was then operated [illegible]

4.0 RESULTS AND DISCUSSION

Test was conducted by Babcock & Wilcox Research and Development Division at Alliance, Ohio. The following people were present to witness the test:-

1) L. Givens - B&W Canada Ltd.
2) C. Oehlenschlager - Bechtel Corp.

Babcock & Wilcox Canada Ltd.

3.0 CONDUCT OF TEST

The pump was installed in the test loop and operated cold to determine the correct discharge valve setting for the required flow during the thermal transient.

The pump was then stopped, and isolated from the pressure vessel. The Auxiliary circulating pump was then operated while the vessel was brought up to the test temperature.

The Auxiliary pump was then shut off, the suction valve opened and the contract pump started.

The contract pump was allowed to get up to operating speed before the discharge valve was opened.

The pump was then operated through the temperature transient and for one hour at the hot temperature.

Following the test, the pump was dismantled and the impeller and sleeves checked for galling or pickup.

An inspection report is included herein - Reference: Section 4.3.

Babcock & Wilcox Canada Ltd.

4.0 RESULTS AND DISCUSSION

Test was conducted by Babcock & Wilcox Research and Development Division at Alliance, Ohio. The following people were present to witness the test:-

1) L. Givens - B&W Canada Ltd.
2) C. Oehlenschlager - Bechtel Corp.

4.1 HYDRAULIC

Attached is the following reduced data obtained during the thermal transient test on pump 72242 :-

1) Pump flow vs. time.
2) Suction pressure vs. time.
3) Discharge pressure vs. time.
4) Suction temperature vs. time.
5) Motor input horsepower vs. time.

The time "Zero" on the curves corresponds to the time when the fluid temperature in the pump started to increase from Ambient temperature.

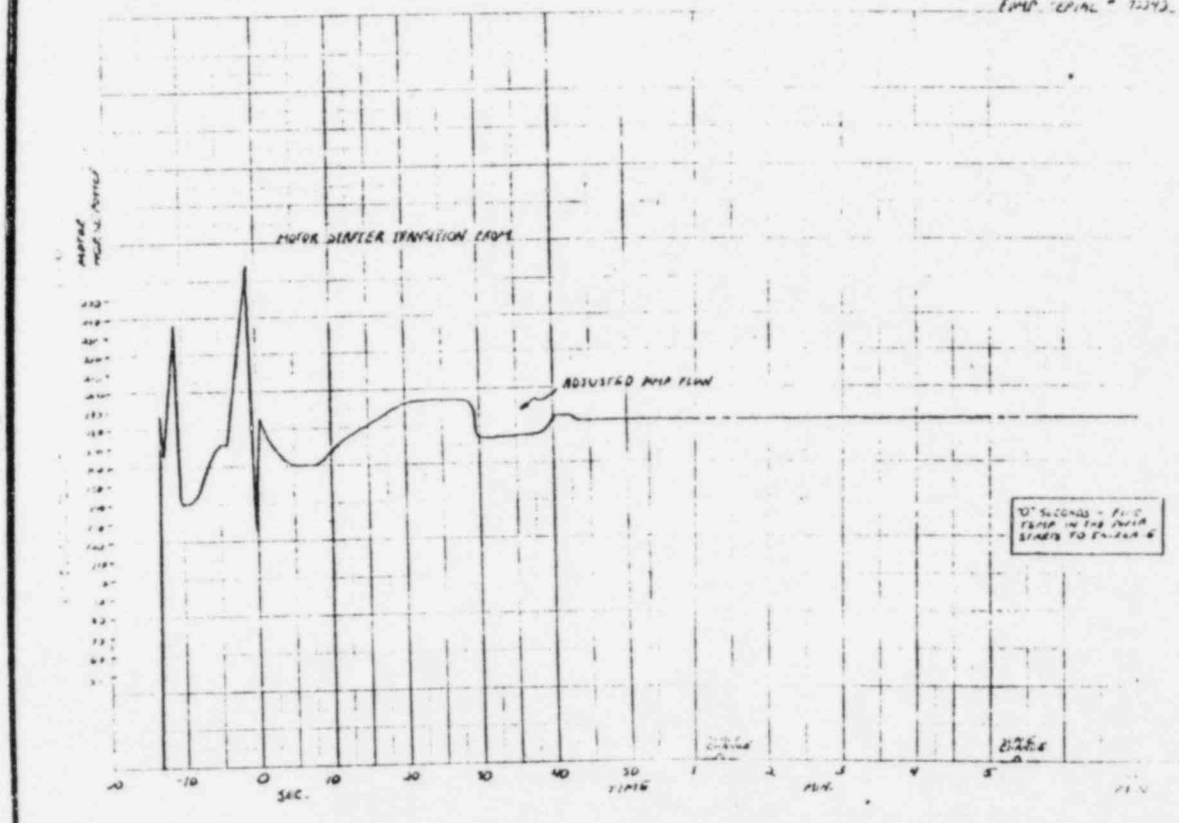
Subsequent to the thermal shock, the suction temperature curve shows a momentary drop. This is due to the Ambient water in the pump and suction line mixing with the high temperature water in the pressure vessel.

No sudden unexplained increase or decrease was evidenced in either of the power/time trace or the discharge pressure/time trace during the thermal transient or the subsequent one hour run.

4.2 MECHANICAL

The purpose of measuring vibration of the pump during and after the temperature transient was to ensure that no undue mechanical degradation had occurred which would manifest itself in large vibration levels.

Three accelerometers were mounted on orthogonal faces of a block to produce a triaxial sensor. This was welded to the pipe plug mounted on the bearing housing of the pump. The accelerometers were Endevco model 2276 high temperature piezoelectric accelerometers. The signals were conditioned with Columbia model 900 charge amplifiers and recorded using a Lockheed Store - 4 FM tape recorder. Recording speed was 3-3/4 inches per second, giving a frequency resporse from DC to over 1kHz.

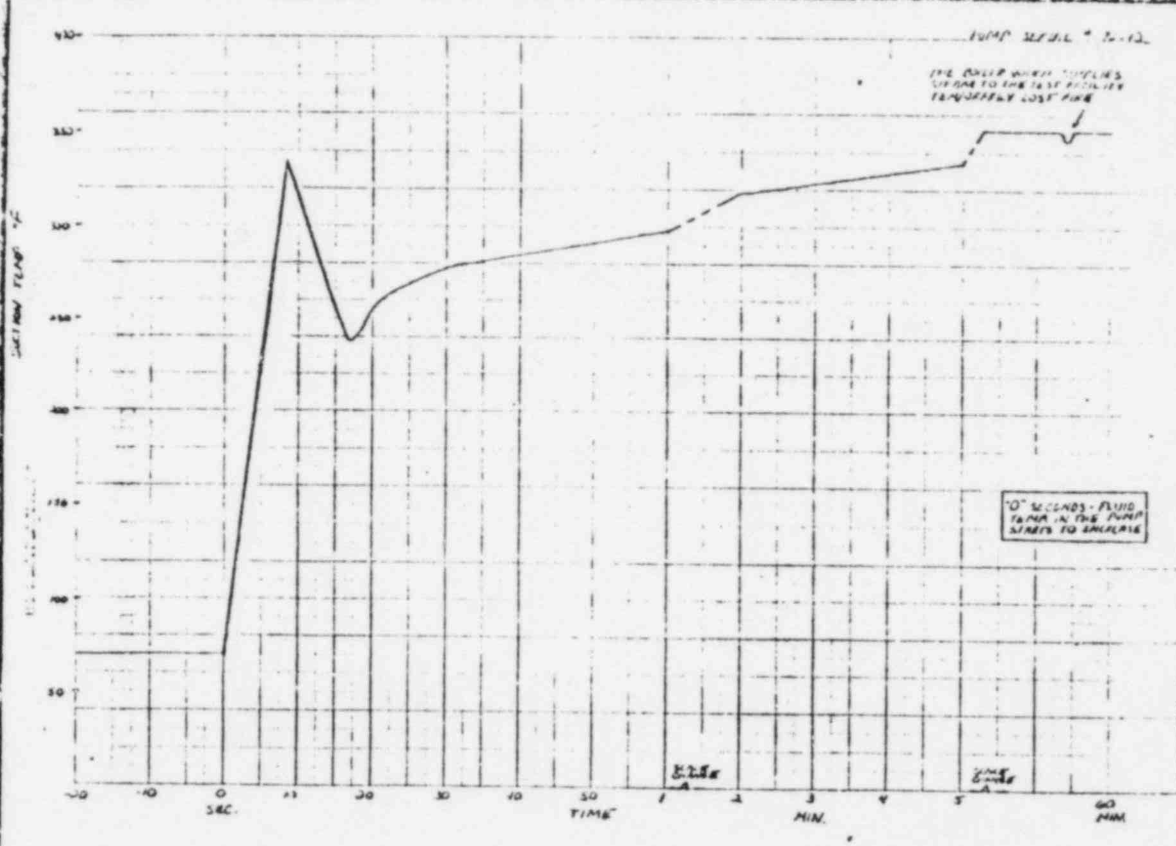


7220. MSV. 76-1

PG. 13

7220. MSV. 76-1

PG. 14



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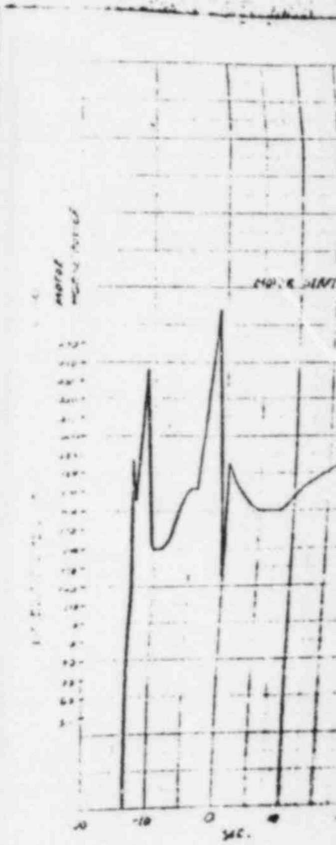
16.13



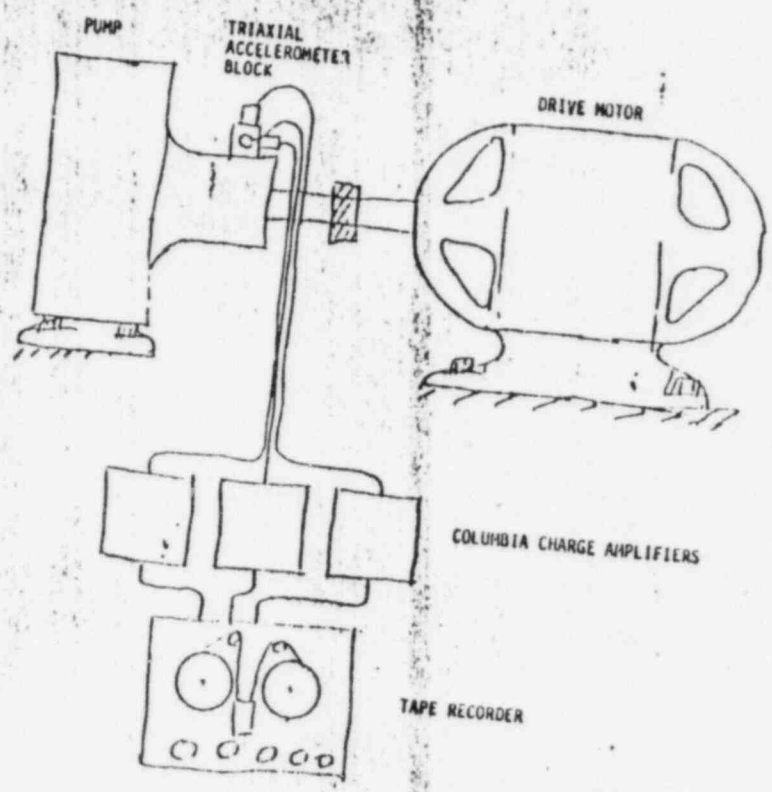


FIGURE 1. DATA ACQUISITION INSTRUMENTATION

7220-A154-76-1

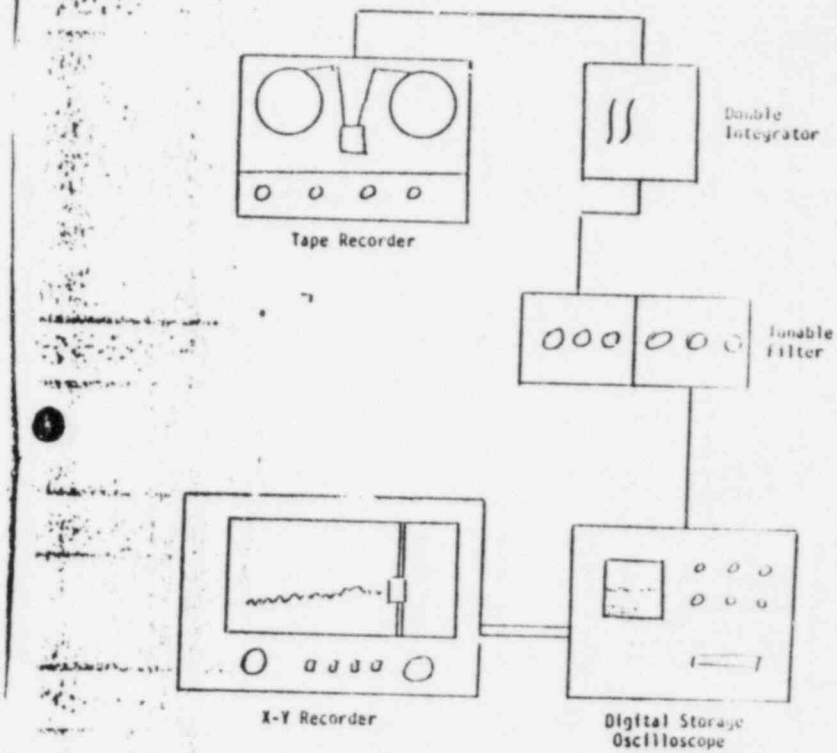


FIGURE 2. Setup for Laboratory Analysis

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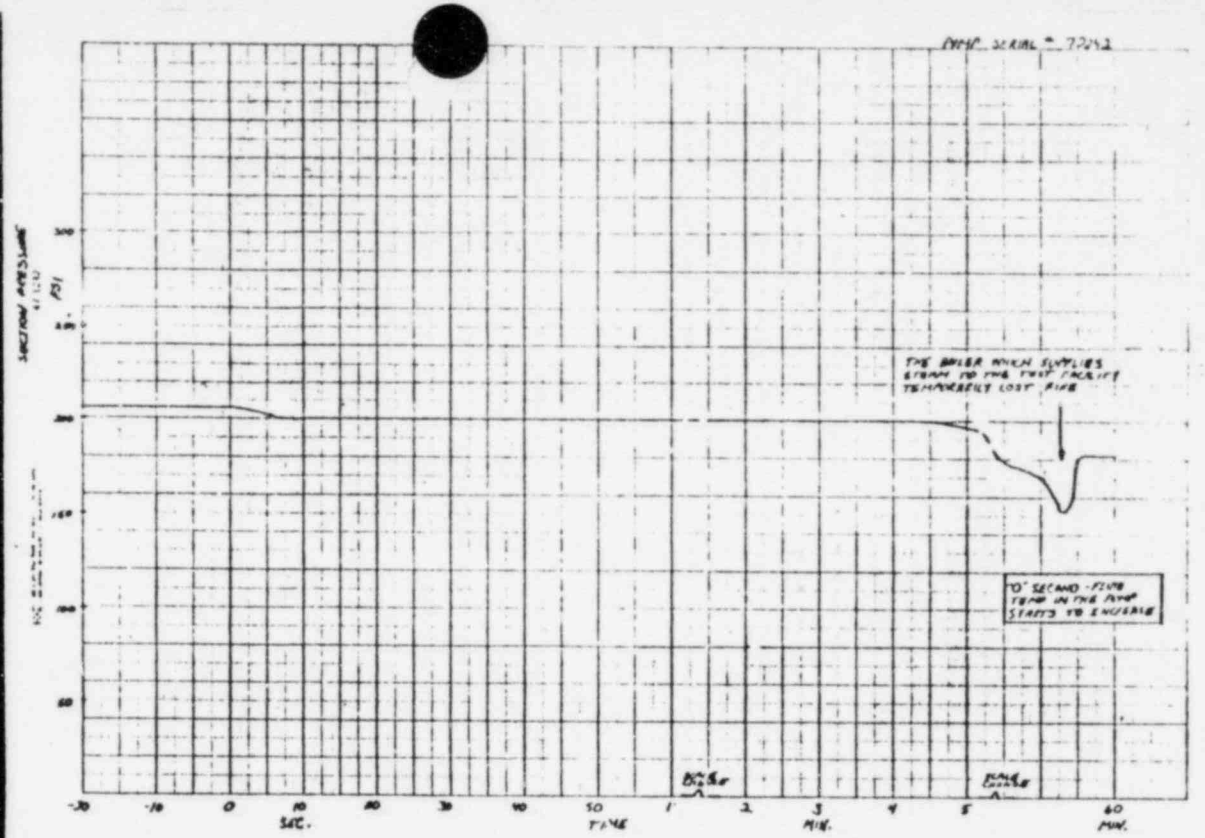

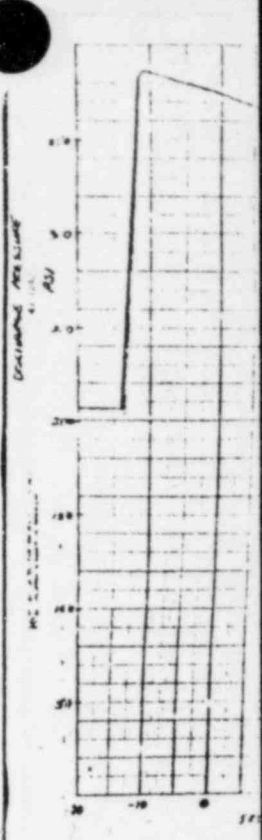

7220.M24.7

P6.11

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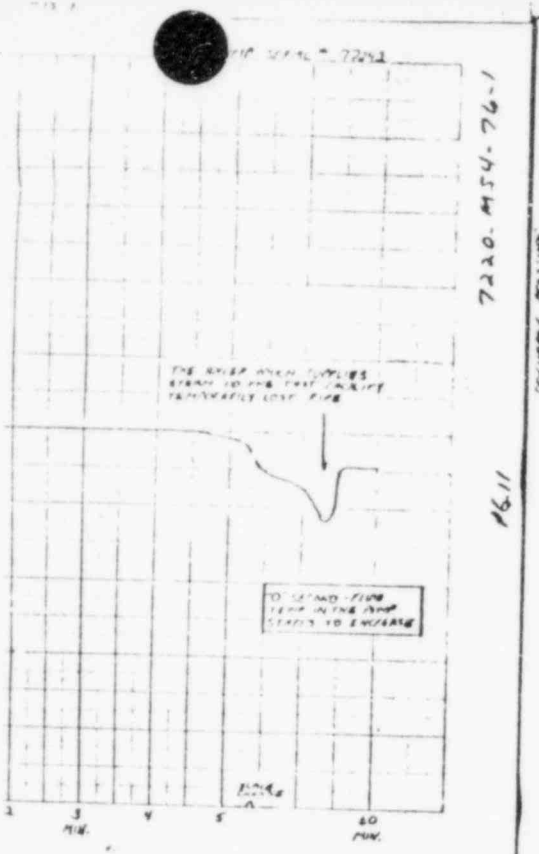
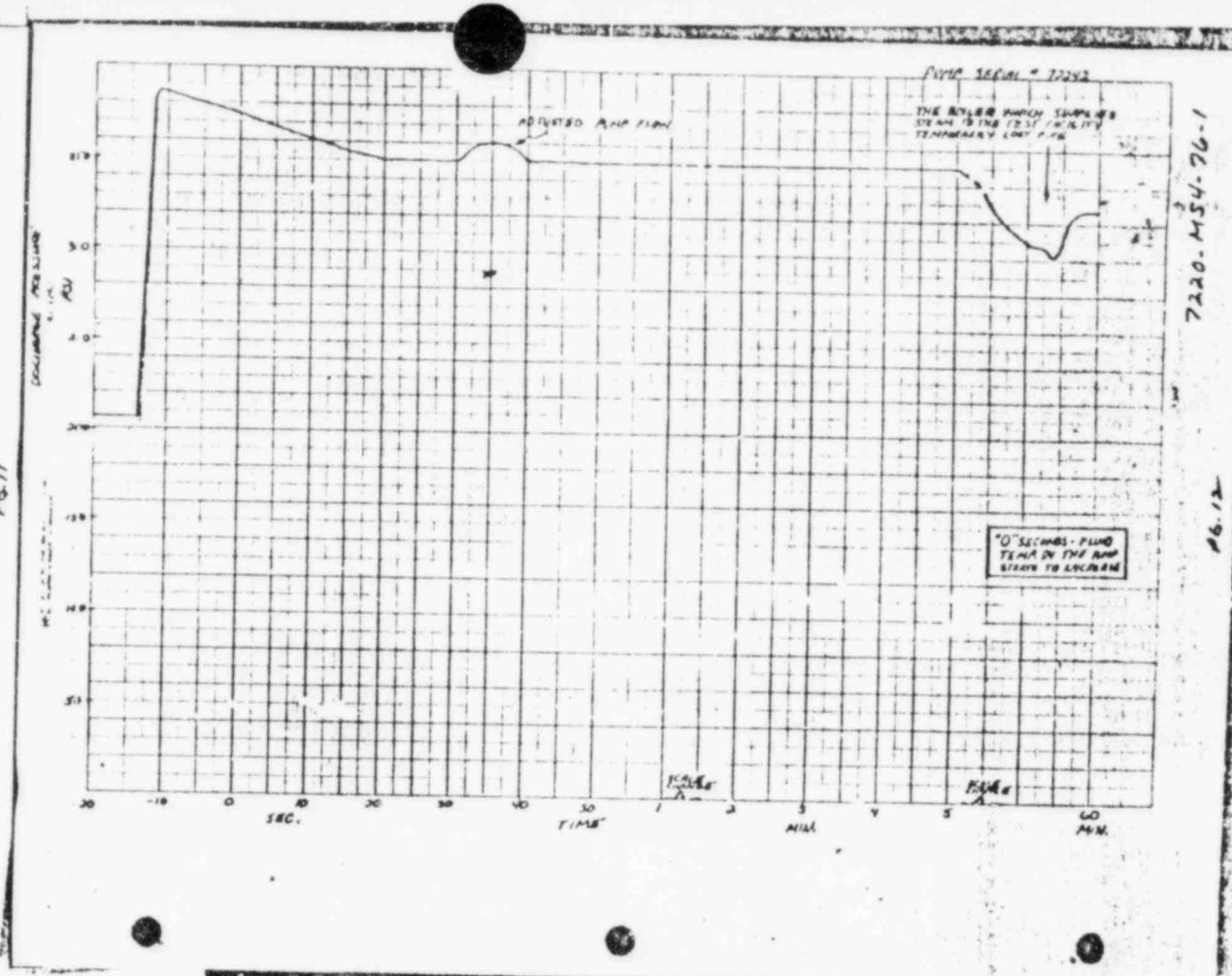




4.2 Mechanical - continued

Laboratory analysis was performed using the tape recorder, Rockland model 852 tunable filters, MB model N409 dual integrators, Nicolet model 206 digital storage oscilloscope, brush 500 XY recorder, and B&W model 2425 RMS voltmeter.

Figure 1 shows the data axquisition set-up.

The apparatus was connected as shown in Figure 2 for laboratory analysis. The effective gain of the integrators was determined experimentally by determining the frequency at which the magnitude of the integrated signal equalled the input signal for a sinusoidal input signal. The accelerometer signals were twice integrated to form displacement signals which were filtered and tabulated.

A typical spectrum of the vibration signal for channel 3 (transverse acceleration) is shown in Figure 3. This was made with the Rockland filter set in high-pass mode at 10 hertz cutoff frequency. Clearly, the motion at low frequency is quite large. This may be due to a mounting resonance or pipe vibration signal at a frequency well below the fundamental rotation frequency of the pump. This would indicate that the vibration is not related to any particular mechanical parts in the pump.

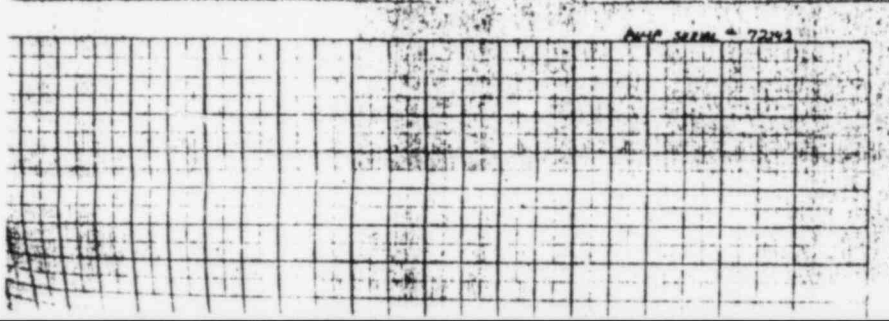
To obtain the most reasonable estimate of the vibration level caused by the mechanical parts of the pump, a 50-hertz rolloff frequency was set on the Rockland filters. RMS displacement levels were sampled at approximately 10 minute intervals through the hot run. The filtered and integrated vibration levels obtained are given in Table 1. Also included in the Table is a comparison vibration level for cold running in the test loop.

The tape was also sampled for maximum peak-to-peak values at approximately 20 minute intervals through the hot run. These values were obtained by measuring the largest single peak-to-peak cycle in a representative four second sample placed in the memory of the Nicolet storage oscilloscope. Maximum values obtained are listed in Table 2 and compared with values taken for cold running.

Figure 4 gives a typical time history in the axial or longitudinal direction for this model pump running in the thermal transient test loop.

7220-M54-76-1

A69



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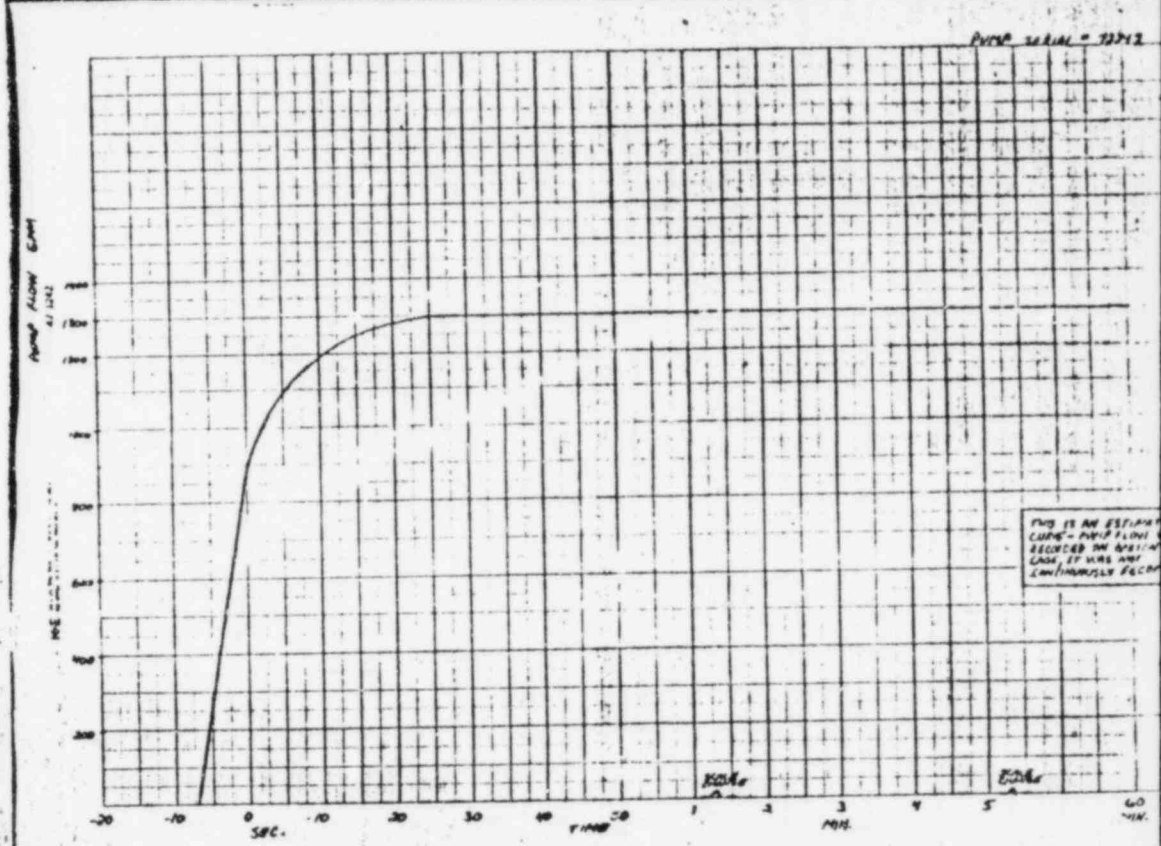

Reference 16

Robert O. Bolt and James G. Carrol, "Radiation Effects on Organic Materials", Academic Press 1963, New York.

Reference 17

Electric Power Research Institute, "Radiation Effects on Organic Materials in Nuclear Plants", EPRI Report EPRI NP-2129, November 1981.

REFERENCE 18

Rotork Qualification Test Report 7220-M123C-105-1, Wyle Laboratories Test Report No. 43979, Rev. A, October 24, 1978.

(Retained in CPCo Equipment Qualification Central File No. M-123CC).