

# ACCELERATED DISTRIBUTION DEMONSTRATION SYSTEM

## REGULATORY INFORMATION DISTRIBUTION SYSTEM (RIDS)

ACCESSION NBR: 8906190084    DOC. DATE: 89/06/05    NOTARIZED: YES    DOCKET # 05000389  
 FACIL: 50-389 St. Lucie Plant, Unit 2, Florida Power & Light Co.  
 AUTH. NAME: KULCHAK, R.D.    AUTHOR AFFILIATION: Morrison-Knudsen Co., Inc.  
 RECIP. NAME: MURLEY, T.    RECIPIENT AFFILIATION: Office of Nuclear Reactor Regulation, Director (Post 870411)

SUBJECT: Part 21 rept re radiator fan shaft bearing failure.

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11/18/89



**MORRISON KNUDSEN CORPORATION**

EXECUTIVE OFFICE  
MORRISON-KNUDSEN PLAZA  
P.O. BOX 73/BOISE, IDAHO U.S.A. 83707  
PHONE: (208) 386-8000

*Handwritten scribbles and marks at the top right of the page.*

8 June 1989

S/N 10CFR21-89-2  
Ref. 10CFR21-0046

Mr. Thomas Murley  
Director - Office of Nuclear Reactor Regulation  
11555 Rockwell Pike  
Rockwell, Maryland 20852

Subject: Potential 10CFR21 Finding  
Radiator Fan Shaft Bearing Failure  
Standby Diesel-Generators

Dear Sir,

I have been advised by our Power Systems Division of a Potential 10CFR21 Finding regarding a radiator fan shaft bearing failure at the Florida Power & Light Company's St. Lucie #2 Nuclear Plant.

We are investigating the problem and will provide additional information as it becomes available.

Very truly yours,

*R. D. Kulchak*

R. D. Kulchak  
Director - Quality Assurance

RDK:ed32

- cc: F. M. Adams
- H. W. Falter
- V. Mitchell
- M. Sharpe

File

8906190084 890608  
PDR ADOCK 05000389  
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U.S.N.R.C.  
NUCLEAR REACTOR  
REGULATION  
JUN 12 AM 11:33 '89

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10CFR21 REPORTING OF  
DEFECTS AND NON COMPLIANCE

COMPONENT - RADIATOR FAN SHAFT BEARING FAILURE

LOCATION - FLORIDA POWER & LIGHT COMPANY  
ST. LUCIE #2 NUCLEAR PLANT  
STANDBY DIESEL-GENERATORS



PREPARED BY Harry W. Falter  
PRINCIPAL ENGINEER

DATE 6-7-89

APPROVED BY M V Mitchell  
QUALITY ASSURANCE MANAGER

DATE 6/7/89

(SEE THE FOLLOWING SHEET - ATTACHMENT 4.2)

REPORTING OF 10CFR PART 21  
POTENTIAL DEFECTS AND NONCOMPLIANCE

ATTACHMENT 4.2  
10CFR PART 21 APPLICABILITY EVALUATION FORM

*Florida Power & Light*  
DETERMINATION OF PART 21 APPLICABILITY

PROCUREMENT DOCUMENT NO 140-6002 St Lucia No 2 Standby Diesel-Generator  
REQUISITION ITEM NOS 645cc Same FL 2993-303 - FPL 002998-056  
DESCRIPTION \_\_\_\_\_

A. Evaluation for Items

1. Is the item "Commercial Grade"  Yes  No If "YES," 10CFR 21 does not apply - go to C. If "NO," go to A2

2. Is the item:

Procured to ASME Section III	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No
Reactor Coolant Pressure Boundary	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No
IEEE Class IE Electrical	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No
Seismic Category I	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No
Welding Material (ASME)	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No
Rx Core or Core-Related	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No

If any "YES" checked above, 10 CFR 21 applies; go to C. If all "NO," go to A3.

3. Is the item being procured the same as a complete component, system, or structure listed in the plant CSSC list?  Yes  No  
If "YES," 10 CFR 21 applies; go to C.  
If "NO," go to A4.

4. Would the failure of the item being procured cause a basic component not to perform its required safety functions?  Yes  No  
If "YES," 10 CFR 21 applies; go to C. If "NO," 10 CFR 21 does not apply; go to C.

B. Evaluation of Services

1. If this is a repair service, would the item being repaired be procured as a "Commercial Grade" item?  Yes  No If "YES," 10 CFR 21 does not apply, go to C. If "NO," go to B2.

2. Could the service being procured cause a defect in a basic component or are the services connected with the design, inspection, testing, or consulting services important to the safety that are associated with a basic component.  Yes  No If "YES," 10 CFR 21 applies. If "NO," 10 CFR 21 does not apply; go to C.

C. 10 CFR 21 Does  Does Not  apply.

Evaluated by *[Signature]* Concurrency *[Signature]*  
Originator Quality Assurance  
 Date 6-7-89 Date 6/7/89

The standby diesel-generators at the St. Lucie #2 Nuclear Plant are radiator cooled. The fans that push air through the radiator are engine driven by a shaft drive including sheaves and belts. The fan is mounted on a support that is part of the radiator structure. The fan is mounted on a shaft supported by two bearings. (Drawings 10179 Sheet 3 of 7). A sheave is mounted on the opposite end and is driven by belts off the engine drive line.

On June 5, 1989, I had a call from Mr. Phil Barnes of the St. Lucie #2 Nuclear Plant (407-468-4236). He explained that they lost a bearing on the radiator shaft. The Florida Power and Light analysis concluded that the bearing failed because the fit on the shaft was too loose. The component was designed and furnished by the O & M Manufacturing Company of Houston, Texas as part of the radiator assembly.

The radiator fan shaft was 3" round stock. I discussed this with Mr. Rich Rouner of the O & M Manufacturing Company who believed it was round stock (Turned). I found that 3" round stock (Turned) had a tolerance of +000/-004. The bearings used are Link-Belt Pillow Block P/N PE-B22448H. The shaft tolerance required for a 3" shaft is +.000/-.001. To meet this tolerance, 3-1/8" diameter round stock is required for machining to the proper tolerance. I have developed a sketch of the replacement shaft 6002SK-1.

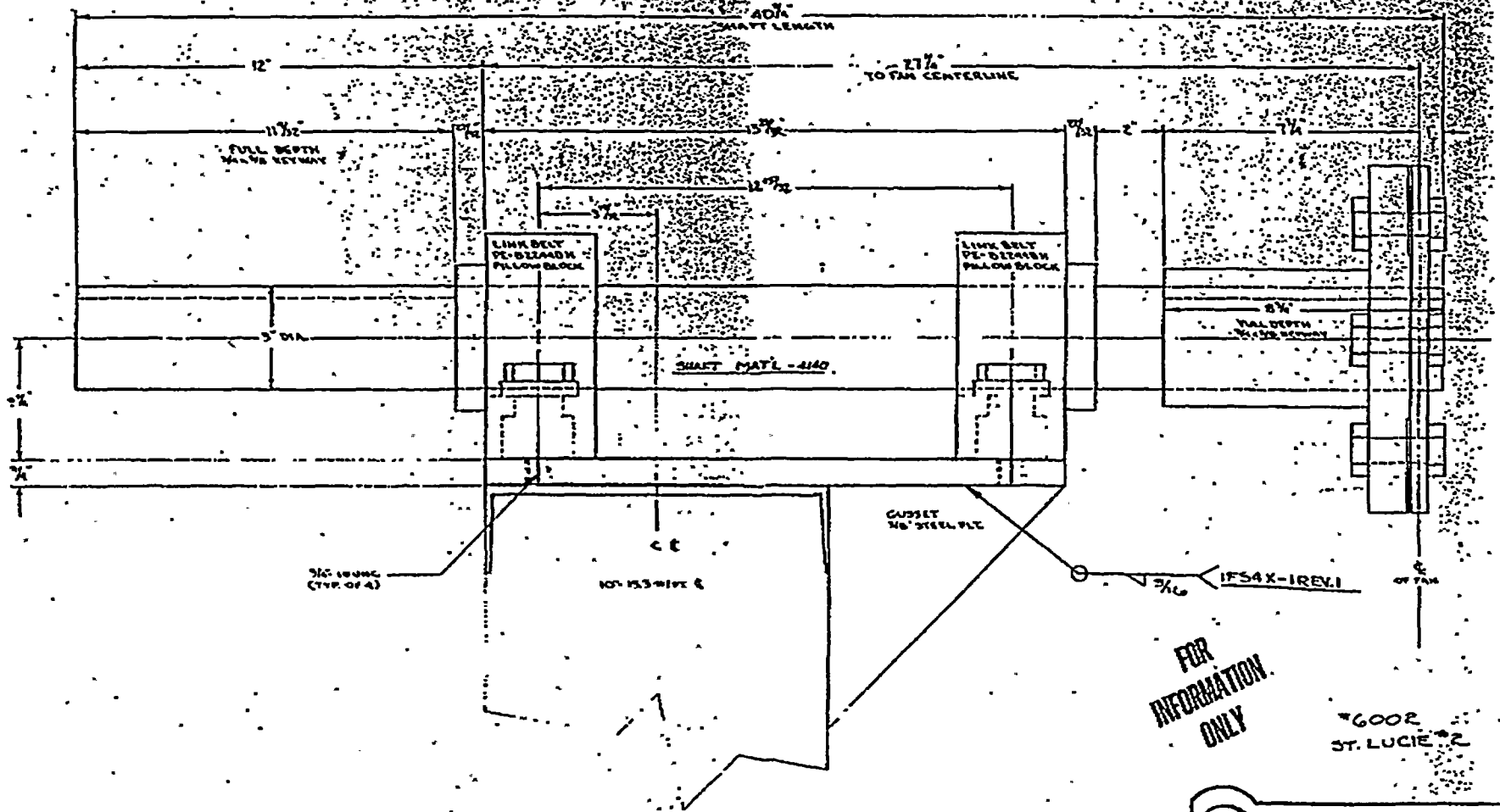
I discussed this further with Phil Barnes in the late afternoon of June 6, 1989. Florida Power and Light has taken corrective action and replaced the fan shaft with one of the proper tolerance.

I told Mr. Phil Barnes that by definition, this defect is reportable in accordance with 10CFR21 because the failure of the radiator to cool could cause the diesel-generator to fail to perform its safety function. I asked if Florida Power and Light would file the report. He was waiting for my input and felt that Florida Power and Light would file. I asked him to confirm this to me in writing.

We have no other radiator drives in this type of construction in Nuclear Plants. The EMD 999 type units have some that are radiator cooled, but their design also is very different. To my knowledge, this defect is limited to the St. Lucie Plant.

Attachments -- Drawing 10179  
Sketch 6002 SKI  
Link-Belt Cat pg 1-100  
Link-Belt "shaft fits & tolerances"  
Letter to O&M Manufacturing Co. June 6, 1989






REV	DATE	BY	DESCRIPTION
1E	2-27-83	AS	ADD WELDING SPEC

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DATE: 10/19/83  
 OR THE SCALE

**O & M** BEST QUALITY PRODUCTS  
 MANUFACTURING COMPANY  
 HOUSTON, TEXAS

FAN BEARING DETAIL  
 Scale as 10180

REV	DATE	BY	DESCRIPTION
1E	10/19/83	AS	10179

3 - 07



PSD

COMP #2

CONTRACT NO. W06002

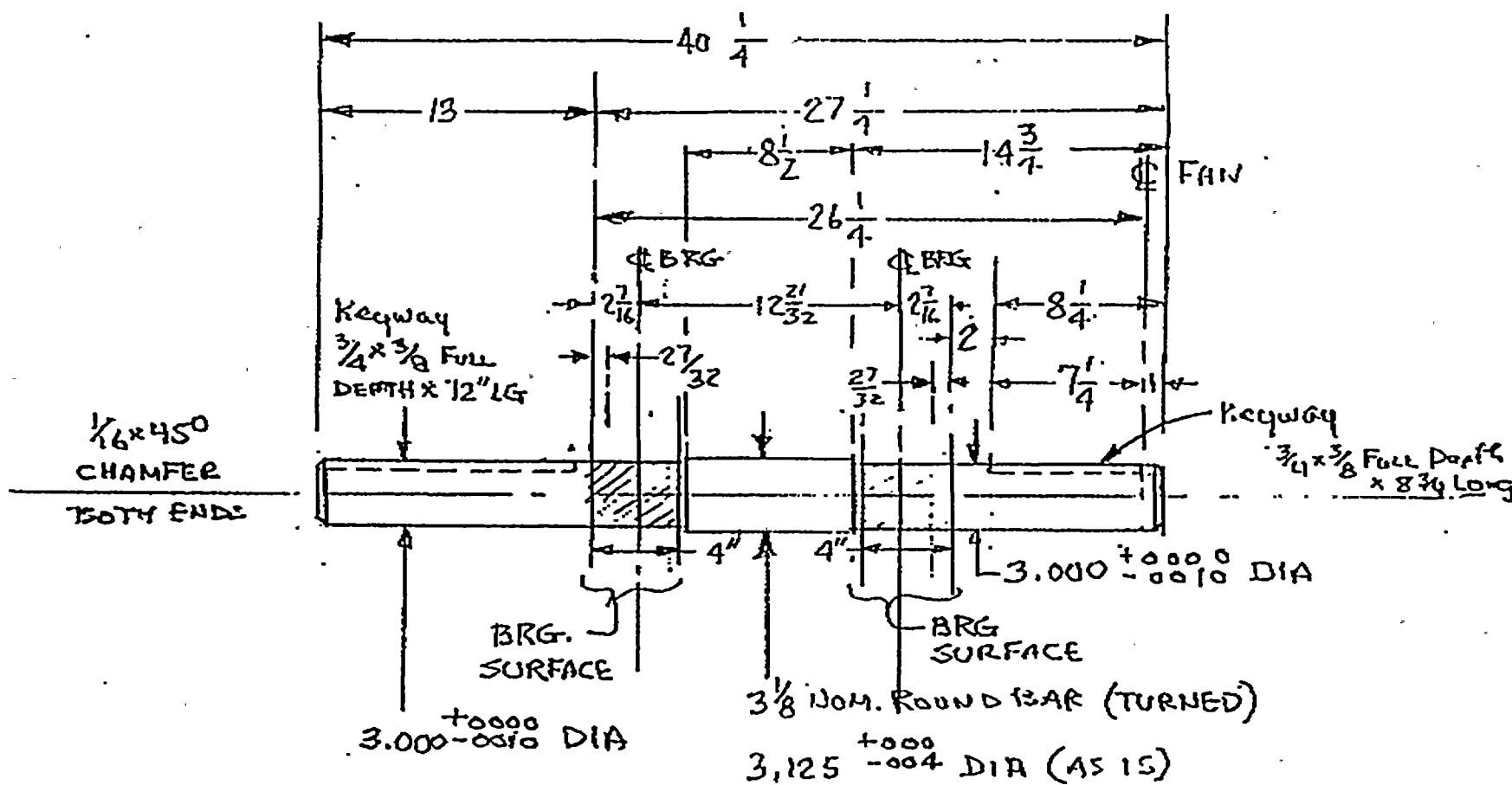
JOB TITLE: St Lucie #2 Radiator Fan Shaft

DESCRIPTION: OEM DWG 10179 SH3 & 10180 SH3 SHEET NO. 6002 SK-1

MADE BY: [Signature]

CHECKED BY:

DATE: 6-6-89



RADIATOR FAN SHAFT  
ST Lucie 6002

MATERIAL  $3 \frac{1}{8}$  DIA ROUND  
BAR-TURNED  
COLD ROLLED  
SAE 4140

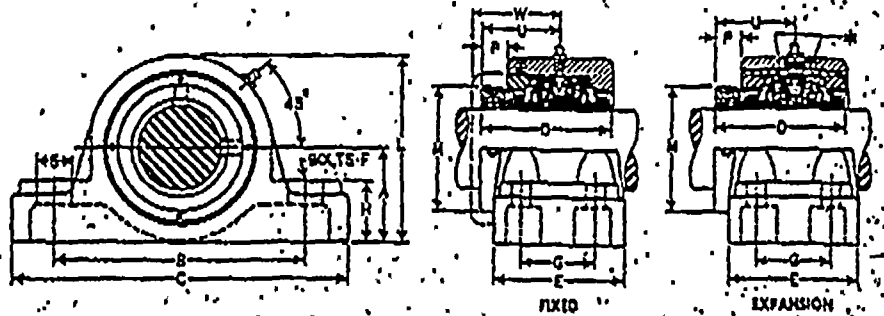
REF OEM DWGS  
10179 SH3 & 10180 SH3

# Spherical Roller Bearing Pillow Blocks P-B22400FH, PE-B22400FH

- Cast Iron Housing
- 4-bolt Base
- Fixed or Expansion
- Self-aligning
- Spring Locking Collar
- Factory Adjusted and Sealed

*Brq Tech Manual*  
*LINE BECT*

*FMC*



## Dimensions (Inches/mm)

Shaft dia.		Pillow block number		A	B	C	D	E	F	G	H	L	M	P	S	U	W
mm	inches	Fixed	Expansion						Bolts								
45	1 1/8	P-B22431FH	PE-B22431FH	2 1/4	6 1/4	8 3/4	3 1/4	3 1/8	1/2	1 1/2	1 1/2	4 1/8	2 1/4	1 1/2	1 1/8	1 1/2	2 1/2
	2	P-B22432FH	PE-B22432FH														
	50	P-B224M45FH	PE-B224M45FH														
55	2 1/8	P-B22435FH	PE-B22435FH	2 1/2	8 3/4	8 3/4	3 1/8	3 3/4	1/2	1 1/4	1 1/4	5	3 3/4	1 1/2	1 1/8	2 1/8	2 1/8
	2 1/4	P-B22436FH	PE-B22436FH														
	60	P-B224M55FH	PE-B224M55FH														
60	2 1/8	P-B22439FH	PE-B22439FH	2 3/4	7 1/4	8 1/4	3 1/4	3 3/8	1/2	1 1/4	1 3/4	5 1/2	3 3/4	1 1/2	1 1/8	2 1/8	2 1/8
	2 1/4	P-B22440FH	PE-B22440FH														
	65	P-B224M60FH	PE-B224M60FH														
65	2 1/8	P-B22443FH	PE-B22443FH	3 1/4	8 1/4	10 1/8	4	3 3/4	3/4	1 1/4	2 1/4	6 1/8	4 1/8	1 1/2	1 1/8	2 1/8	2 1/2
	2 1/4	P-B22444FH	PE-B22444FH														
	70	P-B224M65FH	PE-B224M65FH														
70	2 1/4	P-B22447FH	PE-B22447FH	3 1/4	8 1/4	10 1/8	4	3 3/4	3/4	1 1/4	2 1/4	6 1/8	4 1/8	1 1/2	1 1/8	2 1/8	2 1/2
	2 1/2	P-B22448FH	PE-B22448FH														
	75	P-B224M70FH	PE-B224M70FH														
80	3 1/8	P-B22451FH	PE-B22451FH	3 3/4	10	13	4 3/4	4 1/4	3/4	2	2 1/4	7 1/2	5	1 1/8	1 1/2	2 1/2	3
	3 1/4	P-B22455FH	PE-B22455FH														
	85	P-B224M80FH	PE-B224M80FH														
90	3 1/8	P-B22459FH	PE-B22459FH	4 1/4	12 1/2	15 1/4	5 1/8	4 1/2	3/4	2 1/4	2 3/4	8 1/2	5 1/2	1 1/8	1 1/4	3 1/8	3 1/4
	3 1/4	P-B22463FH	PE-B22463FH														
	100	P-B224M90FH	PE-B224M90FH														
110	4 1/8	P-B22567FH <sup>o</sup>	PE-B22567FH <sup>o</sup>	4 3/4	13 1/4	16 1/4	6 3/4	4 3/4	3/4	2 1/4	2 3/4	9 3/4	6 3/4	1 1/4	1 3/4	3 3/4	3 3/4
	4 1/2	P-B22571FH <sup>o</sup>	PE-B22571FH <sup>o</sup>														
	115	P-B225M110FH <sup>o</sup>	PE-B225M110FH <sup>o</sup>														
125	4 1/2	P-B22572FH <sup>o</sup>	PE-B22572FH <sup>o</sup>	5 1/4	15 1/4	18 1/4	7 1/4	5 1/4	3/4	2 3/4	3	10 3/4	6 3/4	1 1/2	1 1/2	3 3/4	4
	4 3/4	P-B22579FH <sup>o</sup>	PE-B22579FH <sup>o</sup>														
	125	P-B225M115FH <sup>o</sup>	PE-B225M115FH <sup>o</sup>														
125	4 3/4	P-B22580FH <sup>o</sup>	PE-B22580FH <sup>o</sup>	5 1/4	15 1/4	18 1/4	7 1/4	5 1/4	3/4	2 3/4	3	10 3/4	6 3/4	1 1/2	1 1/2	3 3/4	4
	4 3/4	P-B22572FH <sup>o</sup>	PE-B22572FH <sup>o</sup>														
	125	P-B225M125FH <sup>o</sup>	PE-B225M125FH <sup>o</sup>														

- Lubrication fitting tap size, 1/8" PT.
- All units available with type E lip seals.
- † Tolerance, ±.005" (±0.13 mm).
- Expansion unit allows axial movement of 1/16" (4.8 mm) in either direction from centered position shown.
- Series P-B22500FH pillow blocks have two spring locking collars (bearing dimensions, page I-120; load ratings, pages I-115, I-116).
- Width dimension for closed end unit.

Load ratings, pages I-97, I-98.  
Additional information, page I-121.

# Additional Information Series B22400 and B22500

## Additional Features:

All fixed type B22400 and B22500 mounted units (except CS units) can be purchased with formed steel closed end caps on the collar side which covers all rotating elements. Two housing seals are provided to protect the bearing during mounting or in case of accidental cap removal. Closed end units have a special extended threaded cover for mounting the end cap. They are designated with the suffix HHC or EEC (i.e. P-B22431HHC). Shafting should not extend beyond the end of the bearing inner ring more than  $\frac{1}{8}$ " (3.2 mm) when end caps are to be used.

Series B22400 and B22500 mounted units have drilled or cored mounting bolt holes suitable for the inch or metric bolts listed. Drilled holes will be  $\frac{1}{16}$ " (0.8 mm) larger than the largest inch or metric bolt shown.

Bearings and seals can be replaced in Series B22400 and B22500 mounted units (except CS and CSE units). Service instructions for mounting are included with

each replacement bearing and should be closely followed. Replacement bearings are not prelubricated but are coated with a mineral base preservative and should be further protected from moisture and dirt, especially during installation:

## Operation:

Series B22400 and B22500 mounted units are prelubricated with a good quality petroleum grease of No. 2 consistency which has been tested for operational characteristics and stability for long shelf life. The service instructions packed with each unit provide guidelines for relubrication intervals and recommended greases. The lubricant furnished is generally limited to an operating temperature range of  $-20^{\circ}\text{F}$  to  $+200^{\circ}\text{F}$  ( $-29^{\circ}$  to  $93^{\circ}\text{C}$ ). The lip seal E should be limited to a temperature less than  $225^{\circ}\text{F}$  ( $107^{\circ}\text{C}$ ).

Where significant thrust loads are applied to B22400 or B22500 mounted units, thrust collars, spacers, shaft shoulders etc. should be utilized to support the thrust

so that it is not transmitted through the locking collars and set screws.

These units have a misalignment capability of  $\pm 2^{\circ}$ . They are factory adjusted with sufficient clearance for operation within stated speed limits.

## Takeups:

The mounting of B22400 and B22500 pillow blocks on universal ball takeup frames is illustrated on page I-111. Small pillow blocks can be mounted on LC frames, see page I-27.

## Fixed and Expansion Units:

Fixed and expansion type units are available in series B22400 and B22500 pillow blocks and flanged units. As these units are designed for slip fitted shafts, collar mounted, two fixed units can usually be applied to a shaft. Expansion units are recommended for use on one end of longer shafts, where supports are not steel or where significant temperature differentials are expected between shaft and mounting structures.

## Shaft Fits and Tolerances:

Bearings should have proper fits on the shafts to minimize fret wear. Shafting should be round, straight, free of burrs and nicks, and of correct size. For the average application with moderate loads and speeds the following shaft tolerances are recommended:

Shaft Diameter	Recommended Tolerance
$\frac{3}{4}$ "-2"	Nominal to $-.0005$ "
2 $\frac{1}{4}$ "-5"	Nominal to $-.0010$ "
25 mm-50 mm	Nominal to $-0.013$ mm
55 mm-125 mm	Nominal to $-0.025$ mm

For more severe conditions, or where dynamic balance is important, a light press fit may be required. Consult FMC Corporation, Bearing Division.

## Warning:

The correct selection of bearings or mounted units requires that the magnitude and nature of all loads, speeds, alignment, mounting, operating requirements, and maintenance be adequately considered. The selection of materials for and design of housings, shafting, fasteners, seals, and accessories, as well as provisions for installation and maintenance, must follow good engineering principles.

Housings must be selected and installed with regard to the degree and direction of the forces that will occur. Housings should not be used under tension loads except

with adequate safety factors. For this reason pillow blocks are best suited to withstand radial loads passing through the base. When heavy loads or shock loads are possible, it is most important to mount a unit so that the unit is directly and substantially supported other than through its mounting bolts. Where the line of force falls outside the base, such as with horizontal or uplilt loads on pillow blocks, serious housing and fastener deflection or failure may occur. These conditions may require designs using different materials, fasteners, mounting design, stop bars,

etc., together with proper safety factors. When these conditions are unavoidable FMC Corporation, Bearing Division should be consulted.

Service instructions are provided with shipments of bearings and are available on request. These instructions provide detailed information to aid in the proper installation, operation, and maintenance and should be carefully read and followed. Failure to do so may result in unsatisfactory service as well as serious personal injury or property damage.

**MORRISON-KNUDSEN COMPANY, INC.**  
POWER SYSTEMS DIVISION

POST OFFICE BOX 1928  
ROCKY MOUNT, NORTH CAROLINA 27802-1928  
PHONE: (919) 977-2720 / TWX: (510) 929-0725  
FAX: (919) 448-3830



June 6, 1989  
*FOR REF ONLY*

Mr. Rich Rouser  
O & M Manufacturing Company  
Post Office Box 24098  
Houston, TX 77229

REF - St. Lucie #2 - Florida Power & Light Company  
Radiator Shaft (Dwg. 10179 & 10180)

Dear Mr. Rouser:

The radiator shaft bearings failed. Florida Power & Light Company analysis of the failure attributed the failure to loose bearing fit. A crack developed under the locking collar in the set screw area.

I believed the 3" diameter shaft was cold rolled turned stock with a tolerance of +.000 to -.004. If it was ground stock, the tolerance was +.000 -.002. The bearing PE-B22448 (3") requires a shaft tolerance of 3" +.000 to -.001. To get this a 3-1/8 round bar would have to be used then machined to 3.000+.000/-.001 diameter.

I note that the 27 1/4" dimension on drawings 10179 and 10180 should be 26 1/4" to the centerline of the fan. The 12" end dimension should be 13".

Since FP&L plans to order replacement shafts, we require verification of our findings or corrections you determine are correct. Attached is a sketch of the shaft as we see it.

Thanks for your cooperation.

Very truly yours,

Harry W. Falter  
Principal Engineer

Attachment

cc: Gene Schoeck  
Don Galeazzi



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