COOPER NUCLEAR STATION

VENDOR MANUAL

Mfr. BYRON JACKSON PUMP DIVISION

SERVICE WATER PUMPS

Manual No. VM-0180

Mfr. Code: B5800

System Code: SW System Title: SERVICE WATER

CIC(s):

SCANNED MANUAL

VERIFY RELEASE STATUS "INFORMATION OR CONTROLLED" AND CURRENT REVISION OF VENDOR MANUAL IN VENDOR MANUAL DATABASE PRIOR TO USE

PRIOR TO USING VENDOR DRAWINGS IN VENDOR MANUALS CHECK DCP FOR CURRENT REVISIONS, SOME VENDOR DRAWINGS MAY EXIST AT SEVERAL DIFFERENT REVISIONS. PRIOR TO USING ANY VENDOR DRAWINGS, WHETHER IN VENDOR MANUAL ONLY OR DRAWING CONTROL PROGRAM - DCP, VERIFY DRAWING & REVISION APPLICABILITY

CNS Manual Rev. No. 23

VMCF No. 03-0074

VMCF Date 05-07-2003

0180.doc

BB-1

SUMMARY OF CHANGE

DOCUMENT NO.
VM-0180

VENDOR: BYRON JACKSON PUMP DIVISION
TITLE: SERVICE WATER PUMPS

REV.	SUMMARY OF CHANGE	APPROVAL	DATE
13	- Removed VMCF Forms and Inserted Coversheet and Summary Of Change.	KAW	06-03-98
14	- Changed John Crane 810 packing on material list MC-1543, Page 3 to Chesterton ¼ x ¼ 1710 per RCE 97-026.	KAW	08-03-98
15	- This revision adds the record of conversation between Flowserve & CNS Engineering concerning testing the Service Water Pumps. It also reorganized the manual and added a Table of Contents.	MPP	08-16-99
16	- Removed the GE motor Vendor information. This information is relocated to VM 1701.	MPP	09-14-99
17	- Removed reference to lock washers on Page 5-5, Item #2, One Stage 28 KXL Service Water Pumps. - Re-organized manual, improved Table of Contents, added Drawing List, and sent to Scanning. - Updated drawing 2C4747 to current DCP revision.	KAW	05-03-00
18	- This revision incorporated the requirements of EE 97-202, the removal of suction strainers. Affected pages are: 2-1, 5-11, 5-13, 5-15 of Installation, Operation & Maintenance Instruction 681-H-0441/4 and Pages 2 & 5 of B-J Procedure MC-1543 Rev. C.	MPP	08-29-00
19	- Added the Belzona 1311 R-Metal Ceramic Filler data on the Service Water Pump repair.	MPP	07-12-01
20	- Added a note on Page 5-6 of the Installation, Operation & Maintenance Instructions to address RCR 2000-1140, R1.	MPP	03-04-02
21	- Added correspondence, Coupling Thread Engagement. - Added Energy Steel & Supply drawing for Reverse Engineered Coupling, PO-4500021359. - Updated material information for Item 22 on MC-1543, per CED 6008241.	KAW	10-23-02
22	- Replaced correspondence; Coupling Thread Engagement dated 10/4/02 with new correspondence from Vendor dated 10/28/02.	*K. Wright*	11-25-02
23	- Added correspondence correcting torque values on bottom bearing shaft sleeve set screws and updated manual to requirements of CED 6008700.	MPP	05-07-03
	-		

TABLE OF CONTENTS

NOTICE

Pump Internals may be provided by Johnston Pump Co. (See MC-1543, Ref. CED 6008700)

SECTION 1

FLOWSERVE

Flowserve Pump Corporation
Byron Jackson Nuclear Products
Nuclear Products Operations
Nuclear Technical Services

October 28, 2002

Nebraska Public Power District
Cooper Nuclear Station
PO Box 98
Brownville, NE 68321-0098

Attn: Dwight Vorpahl
Senior System Engineer

Subject: Service Water Pump
Pump S/N: 681-H-0441 - 28 KXL 1 Stg

An evaluation was completed to determine the minimum thread engagement for the adjusting plate of the Service Water Pump. The evaluation results indicated a safe minimum thread engagement of 0.850".

Further discussions resulted in the following determination:

- Adjusting Plate: Fully threaded over total thickness (2.00")
- Pump Shaft: From the end of the shaft, threads are 1 9/16" in length
  Top of the shaft where threads begin has a 1/8" chamfer
- Minimum thread engagement is 0.850"

The distance from the top of the adjusting plate to the top of the pump shaft would be 2.00" - .125" - .850" = 1.025" maximum, which would ensure at least 0.850" of thread engagement.

If you have any further comments or concerns, please feel free to contact us.

Regards,

Via E-Mail

Matthew J. Sweeney
Nuclear Specialist

Phone: (323) 587-6171 x4007
Cell: (213) 440-1339

CC: Kinsey, J.
Bartholomew, J.

NEBRASKA PUBLIC POWER DISTRICT
RECORD OF TELEPHONE CONVERSATION

TO: Pat Prom, Senoir Sales Engineer
Flowserve Corporation, Rotating Equipment Division

FROM: Scott McAllister, Service Waster System Engineer

DATE: 4/14/99

SUBJECT: Service Water Pump Testing at Dead Head

TOPICS OF CONVERSATION:

For the purpose of Service Water Pump performance testing, a pump may be operated at dead head (zero flow) conditions to establish the intial point on the pump curve. Per our conversation and the attached e-mail, the maximum time of operation at dead head condition is 60 seconds.

Scott McAllister
Service Water System Engineer

Concurrence

Distribution: Records

McAllister, Scott A.

From: Prom, Pat [PPROM@flowserve.com]
Sent: Wednesday, April 14, 1999 1:32 PM
To: 'samcall@nppd.com'
Subject: Service Water Pump

I spoke with our engineering department in regards to performance testing, and listed below is there response to the limitation of running the service water pumps (S/N 681-H-0441/4) at shutoff.

During acceptance testing we routinely measure head-capacity at shut off on vertical pumps. We limit the time at shutoff to one minute. We have no problem with NPPD testing the pump at shutoff after they are rebuilt, as long as they limit the time to no more than one minute.

Please let me know if you require any information.

Regards,

Pat

FLOWSERVE

Facsimile

Rotating Equipment Division
Byron Jackson Pumps
Durco Process Pumps
Stork Engineered Pumps
United Centrifugal Pumps
Wilson-Snyder Pumps

To: Dwight Vorpal

Date: March 1, 1999

Fax No: 402-825-5179

Page 1 of 1

Phone:

cc: Horst

From: Pat Prom

☐ Urgent

Subject: Bottom Sleeve Bearing

☐ Please Comment/Reply

S/N 681-H-0441/4
28 KXL 1-Stage
Service Water Pump

This fax is being sent as a follow-up to my earlier e-mail transmittal of January 12, 1999 to Wendell Horst regarding torque values for the bottom bearing shaft sleeve set screws.

In a letter dated March 13, 1996, we incorrectly listed the value as 4-4.5 in-lbs. The value should have been listed as 4-4.5 f-lbs. The maximum torque value should be 6 ft-lbs.

Please call me if you have any questions.

Regards,

Pat

Sr. Sales Engineer

BW/IP INTERNATIONAL INC.
A Unit of Flowserve Corporation

800 Roosevelt Road
Building B, Suite 200
Glen Ellyn, IL 60137

Phone 630-545-0290, ext 13
Fax 630-545-0297
www.pprom@flowserve.com

BW/IP International, Inc.

Pump Division | P.O. Box 2017 GMF | Los Angeles California 90051 | Telephone 213 587 8171 Fax 213 589 2060

Memorandum

Date 12 March, 1996

Subject NPPD Service Water Pump, 681-H-0441/4

From J. Bartholomew - Engineering

To P. Prom - Elgin Sales

Ref: NPPD letter, Drasler to Prom dated 8 March, 1996

Pat:

I have reviewed the attachment method for the Bottom Bearing Shaft Sleeve described in referenced letter. This method is adequate on an interim basis and I see no need to remove any pumps employing this method from service prior to their next scheduled refurbishment. However, pumps should be converted to the following arrangement at their next scheduled refurbishment. We are now supplying the shaft sleeves with three 1/4-20 UNC taped holes directly from the factory to simplify the field installation. Set screws are only required at the upper end. This is the preferred arrangement. Each sleeve will require three 1/4-20 UNC X 1/4" long cup point hex socket set screws. Screw material should be 18-8. We do not specify a hardness when ordering fasteners such as these. We specify them to be per ANSI B18.3. The ANSI spec. allows various hardness values according to the material condition the vendor selects. Please note that hardness of a finished fastener of this size is not readily verifiable. Screws should be torqued to 4 ~~in-lbs~~ FT-LBS (per Flowserve letter 3/1/97) and staked in place. Following staking, deburr and remove any raised metal from the staking operation to prevent scratching the bearing. The relief or groove that the set screws fit in was added to the Pump Shaft at the same time as the hardsurfaced area under the Series Case Bearings and no additional modifications are required.

Regards,

cc: F. Costanzo

NEBRASKA PUBLIC POWER DISTRICT
RECORD OF TELEPHONE CONVERSATION

Per VMCF 97-0002

TO: *Patrick W. Prom (BW/IP, phone: 847-741-0400)

FROM: *R.L. Church

DATE: *970106

SUBJECT: *TIR Acceptance Criteria for SW Pump Intermediate Column Shafts

TOPICS OF CONVERSATION:

*Mr. prom had previously sent a fax regarding a BW/IP procedure for the straightening of SW Pump Intermediate Column Shafts. This procedure is intended to be used in the field, by field personnel, on SW Pump Intermediate Column Shafts which failed to meet specified acceptance criteria for shaft total indicated run out (TIR). Conversations with Mr. Prom and CNS Personnel pointed up the fact that a discrepancy exists between the SW Pump Intermediate Column Shaft TIR Acceptance Criteria specified by MP 7.2.15 and the BW/IP shaft straightening procedure. MP 7.2.15, SW Pump Column Maintenance and Bowl Assembly Replacement, specifies a TIR over the entire shaft length of ≤ 0.005" for the intermediate columns. The attached BW/IP procedure specifies a TIR over the entire shaft length of ≤ 0.007" for the intermediate columns. I contacted Mr. Prom to discuss this apparent discrepancy. Mr. Prom indicated that the 0.005" acceptance criteria is the manufacturing tolerance as specified for new shafts, when TIR is measured at the vender facility. The 0.007" acceptance criteria is specified for new or refurbished shafts as measured in the field, by field personnel. Mr. Prom recommended the use of the 0.007" acceptance criteria for our assembly procedures (MP 7.2.15).

R.L. Church 1-16-97

Distribution: Records
D.R. Stahlecker
SW System Engineer, "BW/IP Letters" Notebook

4310034-14

BW/IP International, Inc.

Byron Jackson Pumps
United Centrifugal Pumps
Pump Division

695 Church Road
Elgin Illinois 60123

Telephone 708 741 0400
Fax 708 741 0687

05 August 1994

Per VMCF 94-401

Nebraska Public Power District
General Offices
1414 15th Street
Columbus, NE 68601

Attention: Mr. Ed Togel

Subject: Cooper Nuclear Station
Service Water Pumps
S/N 681-H-0441/4
28 KXL, 1-Stage VCT

Dear Ed:

This letter is in response to our past conversations concerning the minimum gland water flow injection for your Byron Jackson service water pumps at the Cooper Nuclear Station.

The ideal operating range for the gland water injection is 3 to 4 gallons per minute at 25 PSI as clearly delineated on our Outline Drawing, 2C-4747. This flow rate can be increased to 6 gallons per minute without any adverse effect to the pump operation.

BW/IP recommends an absolute minimum gland water flow injection of 1.5 gallons per minute. The pump should be immediately tripped off-line if the injection flow rate is at this 1.5 gallons per minute or less.

If you should have any further questions in regard to the minimum gland water flow injection, please feel free to contact me at your convenience.

Very truly yours,

BW/IP INTERNATIONAL, INC.
PUMP DIVISION

Pat Prom

Patrick W. Prom
Senior Sales Engineer

PWP:db(94\nppd05.aug)

CC: BW/IP INTERNATIONAL, INC.
Jeff Bartholomew - Los Angeles

Byron Jackson Pump Division

Borg-Warner Industrial Products, Inc.
8410 West Bryn Mawr Avenue, Suite 575, Chicago, Illinois 60631
Telephone 312/399-1270

459020055

BORG WAR

27 February 1986

INFORMATION ONLY

Nebraska Public Power District
Cooper Nuclear Station
P.O. Box 98
Brownville, Nebraska 68321

Attention: Mr. Curt Kent
Parts Specialist

Reference: Service Water Pumps
S/N 681-H-0441/4

Dear Curt:

This letter confirms the telephone conversation that we had today. During this conversation you requested the total indicated runout for several shafts for the subject pumps. The total indicated runout that is allowed under Byron Jackson Engineering Standards is .0005 inches per foot of shaft length. This standard is applicable to all vertical pump shafting up to 4 inches in diameter.

I trust that this information will be helpful. If you have any questions, please let me know.

Very truly yours,

BYRON JACKSON PUMP DIVISION
BORG WARNER INDUSTRIAL PRODUCTS, INC.

W. Fred Grondhuis
Sales Engineer

WFG:lc

CED 2000-0015
ATTACHMENT B
PAGE 1 OF 2

FLOWSERVE

Rotating Equipment Division
Byron Jackson Pumps
Durco Pumps
United Centrifugal Pumps
Wilson Snyder Pumps

January 14, 2000

Nebraska Public Power District
Cooper Nuclear Station
PO Box 98
Brownville, NE 68321

Attn: Steve Phillips

Faxed: 2-Pages

Subject: Belzona-Safety Related Application
Belzona 1311 R-Metal

Dear Steve,

This letter is being written in response to our meeting at the Cooper Nuclear Station regarding the use of Belzona filler material on your Service Water Pump outer columns.

Flowserve approved the use of Belzona 1311 R-Metal Ceramic filler for minor restoration of Safety Related Components. An engineering evaluation was prepared by our Nuclear Engineering Department to evaluate the use of this subject filler material under quantified applications. Technical literature as well as field experience was used in the acceptance of this material for safety related use.

The design function for the use of this material was enveloped for the minor build-up of eroded/corroded surfaces and to re-establish close-tolerance locating fits. Minor build-up being defined as less than 20% of the wall thickness at the section needing repair. The filler product will not be used in the evalutions for minimum structural or pressure-retaining calculations for the restored components.

Independent labrotary test data was reviewed regarding the compressive strength and adhesion when tested on carbon steel, the same material as your columns. In both cases the compressive and the tensile shear strength capabilities greatly exceeded the required values for the service water columns.

Experience and testing has also shown that the Belzona 1311 R-metal Ceramic filler will have improved errosion and corrosion resitance over the carbon steel material.

Flowserve Corporation
Rotating Equipment Division
256 Fallbrook Court
East Dundee, IL 60118
Phone 847-836-8984
Facsimile 847-836-8985
Pprom@Flowserve.com

Temperature limits on the 1311 R-metal Ceramic filler is 450F for dry service, which exceeds the temperature that is induced when the filler is machined to size.

Controls were put in place to ensure that the correct Belzona product is being used. Procurement of the product may only be from Belzona Polymerica Ltd. Verification procedures are in place to ensure that the 1311 R-Metal Ceramic filler material is the only product that is used. Application of the material is controlled and applied in accordance with manufactures directions. Specific engineering instruction will be outlined on the component repair route sheets. The route sheets will relate to the proper use instructions and shall be verified by supervision personnel.

Belzona 1311 R-Metal Ceramic Filler material has been qualified for use in safety related applications by Flowserve Corporation. We will have direct responsibility for complying with the requirements of 10CFR 21 regarding the reporting of defects and non-compliance. The evaluation was completed in accordance with our approved Nuclear Program Quality Manual.

A copy of this Engineering Evaluation (Document EE-1060 Rev.0) can be reviewed at our Vernon, CA facility. It is our company policy not to release these documents outside of our Corporation.

Attached you will find literature from Belzona Polymerics Ltd. The material composition is proprietary, so detailed composition list is not available. An MSDS is being sent to you also.

Per our discussion, we intend to use the Bellzona 1311 R-Metal Ceramic filler to fill in the area between the pads we welded in the locating fit area of the outer columns being repaired under your Purcahse Order 991103, Flowserve Job 99-WE-2541. The filled in areas will reestablish the OEM tolerance in this location. In addition, we have already applied the filler several inches into the interior surface of the coulmns to smooth out the eroded surface in this area. The additional work will be done at no additional cost.

The addition of this 1311 R-Metal Ceramic filler should take minimal time, and the columns will be ready for inspection within 3-days.

We kindly request your approval to proceed with the additional workscope. .

If you have any questions, please call me at your convenience.

Very Truly Yours,

Patrick W. Prom
Sr. Sales Engineer

SECTION 2

Installation, Operation & Maintenance Instructions

One Stage 28 KXL
Service Water Pumps
Serial Numbers 681-H-0441/4

Prepared For

Nebraska Public Power District

Customer Purchase Order

92A-C5

Site

Brownsville, Nebraska

INITIAL RELEASE AND CHANGE RECORD PAGE

This record summarizes the changes in this manual. Replace the previous Initial Release and Change Record Page and affected text pages with the new Initial Release and Change Record Page and new text pages designated by the change number and date at the bottom of the page.

CHG. NO.	DATE	DESCRIPTION OF CHANGE	PAGE
0	4/28/93	Completely revised document per customer contract 92A-C5 and BW/IP International, Inc., Pump Division Order No. 921-C-2070	All
1	9/9/93	Section One - Changed temperature from "34-74°F" to "34°F-95°F".	1-1
		Section One - Changed pump speed from "1160 RPM" to "1180 RPM".	1-1
		Section 2.1, 1st sentence - Changed wording of description from "injected filtered water" to "clean water".	2-1
		Section 2.1.1, 1st para. - Deleted reference to "suction strainer".	2-1
		Section 2.1.1, 2nd para. - Changed wording of description from "two sleeve type bearings" to "a bronze bearing" and "a rubber composition bearing"	2-1
		Section 2.1.2, 2nd para., 2nd sentence - Changed wording of description from "injected filtered water" to "clean water".	2-1
		Section 2.1.3, 3rd and fourth sentences - Added shafting overlay materials "carbide "88% and cobalt 12%".	2-2
		Section 2.2, 1st & 2nd paragraphs - Changed wording of description from "injected filtered water" to "clean water".	2-2
		Section 3.4.1, step 2. - Deleted reference to "suction strainer."	3-6

INITIAL RELEASE AND CHANGE RECORD PAGE (CONT'D)

CHG. NO.	DATE	DESCRIPTION OF CHANGE	PAGE
1	9/9/93	Section 5.6.6 - Steps 2 & 7 performed the same task of removing the head nipple, step 2 was deleted. Steps 8, 9,& 10 performed the same task for removing the top tube bearing, step 8 was deleted. Added new step 8 to remove shaft sleeve (14).	5-5 & 5-6
		Section 5.7 - Added step 7 giving shaft straightness requirements for all pump shafting.	5-12
		Section 5.7.1 - Deleted reference to shaft sleeves, added clearance between hardened shafts and rubber bearings, and corrected clearance between top case wear ring and impeller.	5-12
		Section 6.1 - Added pump shafting and sleeves to recommended spare parts list.	6-1
		Section Seven	7-1
		Revised Sectional Drawing to identify hardened surfaces on the shafts.	Tab A
		Revised Materials of Construction as indicated on cover page of document.	Tab A
2	11/19/93	Section One - Changed impeller lift setting from .021 inch to .056 inch.	1-1
3	2/4/93	Paragraph 5.7, Step 7 - Rewrote step to clarify straightness requirements for the pump shafts.	5-12

SECTION ONE - DESIGN DATA

Pump Type:	28 KXL, One-Stage VCT
Serial Number:	681-H-0441/4
Service:	Service Water Pump
Rotation (viewed from top):	Counter-Clockwise
Fluid Pumped:	Water
Temperature:	34-95°F
Specific Gravity:	1.0
Flow:	8000 GPM
TDH:	125 Feet
Discharge Pressure:	52 PSI
Submergence	
Available:	7-1/2 Feet
Required:	3-1/2 Feet (minimum)
Pump Speed:	1180 RPM
Brake Horsepower:	291 BHP
Efficiency:	87%
Impeller Lift Setting:	.056 Inch

SECTION TWO - PUMP DESCRIPTION

2.1 PUMP

The Vertical Circulator (VCT) pump described in this manual is designed for above foundation discharge with lubrication provided by injected, clean, water. In an emergency river water may be used for a limited a limited period of time but, because of its silt content, bearing and shaft wear will be greatly accelerated.

The major assemblies of the pump are the bowl assembly, the column assemblies, the column shaft assemblies, and the discharge head assembly.

NOTE

Refer to pump sectional drawing, Section Seven, for location of part items parenthized in manual text.

2.1.1 Bowl Assembly

The one-stage bowl assembly consists of the top case (7), the suction bell (8) ~~and strainer 10,~~ the impeller liner (9) and the pump shaft (1) with attached impeller(2).

Lateral support for the pump shaft is provided by two bearings. The grease lubricated suction bell bearing (11) is a bronze bearing protected by the sand cap. The water lubricated top case bearing (12) is of rubber composition type and rides on a hardened area of the pump shaft.

The key driven impeller (2) is positioned on the pump shaft (1) by split ring (4). The split ring is held by thrust collar (3) which is secured to the impeller by means of cap screws. The top case wear ring (6) and the impeller liner (9), both of which are replaceable, provide a close running fit for the open type impeller vanes.

2.1.2 Column Assemblies

The bottom, lower, intermediate and top column assemblies each contain an inner column (or tube), bearings, and column shaft.

The inner columns (or tubes), isolate the shafts and their bearings from the pump discharge. Water injected into the inner columns lubricates the rubber composition bearings.

The sleeve type shaft couplers thread onto the ends of the coupled shafts.

2.1.3 Column Shaft Assemblies

The column shaft assemblies consist of four sections of intermediate column shafts (23), and the top shaft (24). The shafts are connected by threaded couplers (25) and are supported laterally by bearings. The shafting is overlaid with tungsten carbide (88%) and cobalt (12%) in the bearing locations. The inner columns (or tubes) that encase the shafts are coupled by the threaded bearings (26. 27 and 28).

2.1.4 Discharge Head Assembly

The discharge head assembly consists of the discharge head (30), the upper inner column, (or head nipple) (36), the top shaft (24), the stuffing box assembly, and the driver–to-pump coupling assembly.

The discharge head (30) is fastened to the sole plate at the foundation and supports the entire weight of the pump and driver. The discharge head has a right-angle elbow that directs pump discharge from the column assembly to the system piping. The upper inner column and stuffing box assembly are secured to a mounting flange on the discharge elbow, and a large top flange with rabbet fit is provided for mounting the driver. Windows in the outer shell of the discharge head provide access to the driver-to-pump coupling and stuffing box assembly.

The stuffing box assembly controls leakage around the head shaft and includes the packing tension nut (32), split gland (31), packing ring (34), packing (33) and split gland (31).

The pump uses eight rings of packing (33), Chesterton type #1710 1/4" x 1/4" braided and lubricated glass yarn (Per System Engineer, George Krywusha). When correctly adjusted, the packing will minimize but not completely stop leakage around the shaft: some leakage is required to assume adequate lubrication of the packing and the shaft sleeve.

2.1.5 Driver-to-Pump Coupling

The driver-to-pump coupling assembly consists of a drive half coupling (39), an adjusting plate (41), and a pump half coupling (37). The adjusting plate is threaded onto the top of the top shaft (24) to allow setting the position of the rotating element. After the adjusting plate is set, the pump half coupling is connected to the driver half coupling by cap screws which pass through and lock the adjusting plate while lifting the rotating element into its running position. For proper operation, the impellers must be raised by the distance specified in Section One, Design Data.

2.2 LUBRICATION

Except for the suction bell bearing, which is grease-packed, the pump bearings and stuffing box packing are lubricated by injected water to the inner column via the stuffing box.

Prior to starting the pump, it is recommended that injection water to the inner column be initiated to pre-wet the rubber bearings. An alarm is included in the lube piping system to provide warning if injection of filtered water falls below a preset minimum flow.

The grease-packed suction bell bearing should require no attention during operation, but if the pump is disassembled for any reason, it is recommended that the bearing cavity be cleaned and repacked with grease. The recommended grease is Chevron Moly Grease, Grade 2, or equal.

SECTION THREE - INSTALLATION

3.1 GENERAL

The installation sequence consist of installing the pump and driver, connecting the piping and instruments, adjusting the impeller, and installing the stuffing box packing. When installing the pump, refer to the Pump Sectional and Outline Drawings contained in Section Seven.

The unit should be installed only by experienced personnel, with care taken to handle equipment safely and to prevent entry of foreign materials into the working parts of the pump.

3.2 LIFT EQUIPMENT REQUIRED

In addition to common millwright tools used in this type of work, the following should be available at the job site when installing or removing the pump:

A crane or derrick of sufficient strength to lift the entire pump (without driver) safely, and of sufficient height to provide ample clearance for the longest of the pump or column sections.

Spreader bars and shackles (clevis-and-pin type adapters), suitably sized, for attaching lifting line to equipment lifting lugs or lifting clamps.

Lifting eyebolts for handling a section of shaft separately. Shafts have a threaded hole at each end for handling purposes.

Lifting clamps for handling inner columns (or tubes), bearings and couplers.

I-beams or other type of saddle supports for supporting the pump by sections during pump removal.

A set of tools for installing and removing stuffing box packing.

3.3 HANDLING INSTRUCTIONS

NOTE

The approximate weights of the major pump components are listed on the Pump Outline Drawing in Section Seven.

3.3.1 Handling Precautions

- When handling the pump or its components, always work carefully to prevent accidents.
- Be sure lifting devices used are in good repair and are capable of safely handling the weights being lifted.
- Adjust lifting equipment so that the center of lift is directly over the foundation axis or load center of gravity. Watch for overhead obstructions.
- Use care to prevent bumping, pushing or scraping of pump parts, especially the shafts and other machined surfaces and fits.
- Prevent foreign materials or dirt from entering the working parts of the pump or driver.

3.3.2 Lifting Methods

It is important to handle the pump components safely during installation and maintenance. The following procedures are suggested:

Outer Columns - Use lugs provided for supporting and attaching lift lines.

Shafts - Each section of shaft is threaded at each end to receive a lifting eyebolt. When raising shaft from a horizontal position, avoid dragging of shaft lower end.

Tubes (Inner Columns) - Fabricate from plate a clamp to go around the tubes. The clamp should have provisions for installing lifting eyebolts.

Discharge Head - Use lifting lugs provided. Do not lift discharge head with driver attached.

Driver - Handle driver in accordance with the manufacturer's instructions; normally, lifting lugs are provided. Do not lift driver when assembled to pump, as driver lifting points are designed for lifting the driver only.

3.4 PUMP INSTALLATION (See Figures 3-1 through 3-3)

NOTE 1

The following procedures are performed after the pump bowl assembly has been reassembled (paragraph 5.8). Refer to "Bolt Torquing Procedures For Vertical Commercial Pumps" in Reference Section, for applicable nut torquing sequence and values.

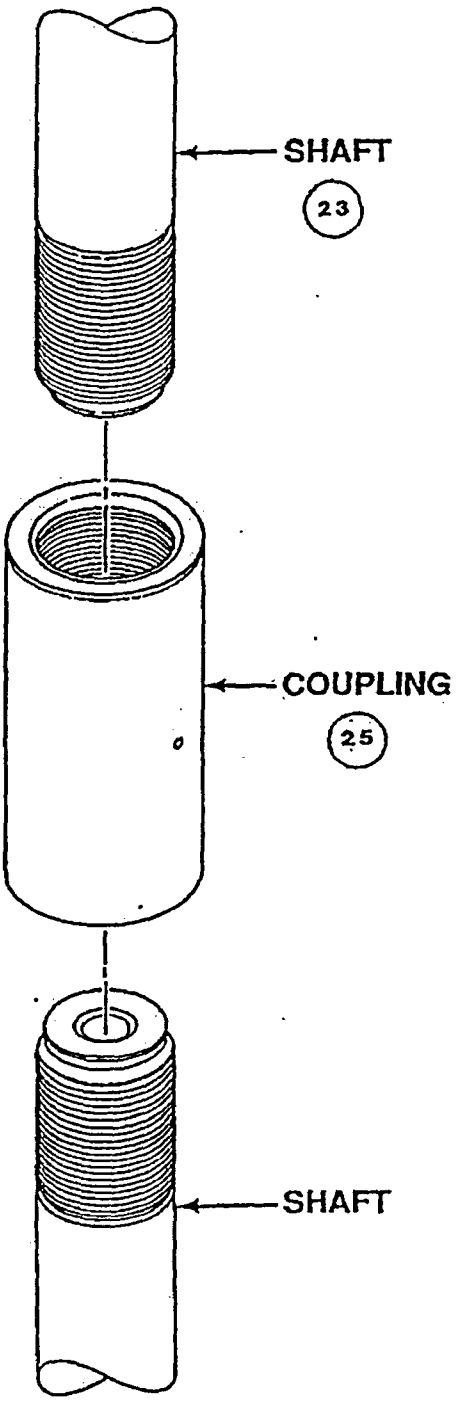


FIGURE 3-1 SHAFT COUPLING ASSEMBLY (TYPICAL)

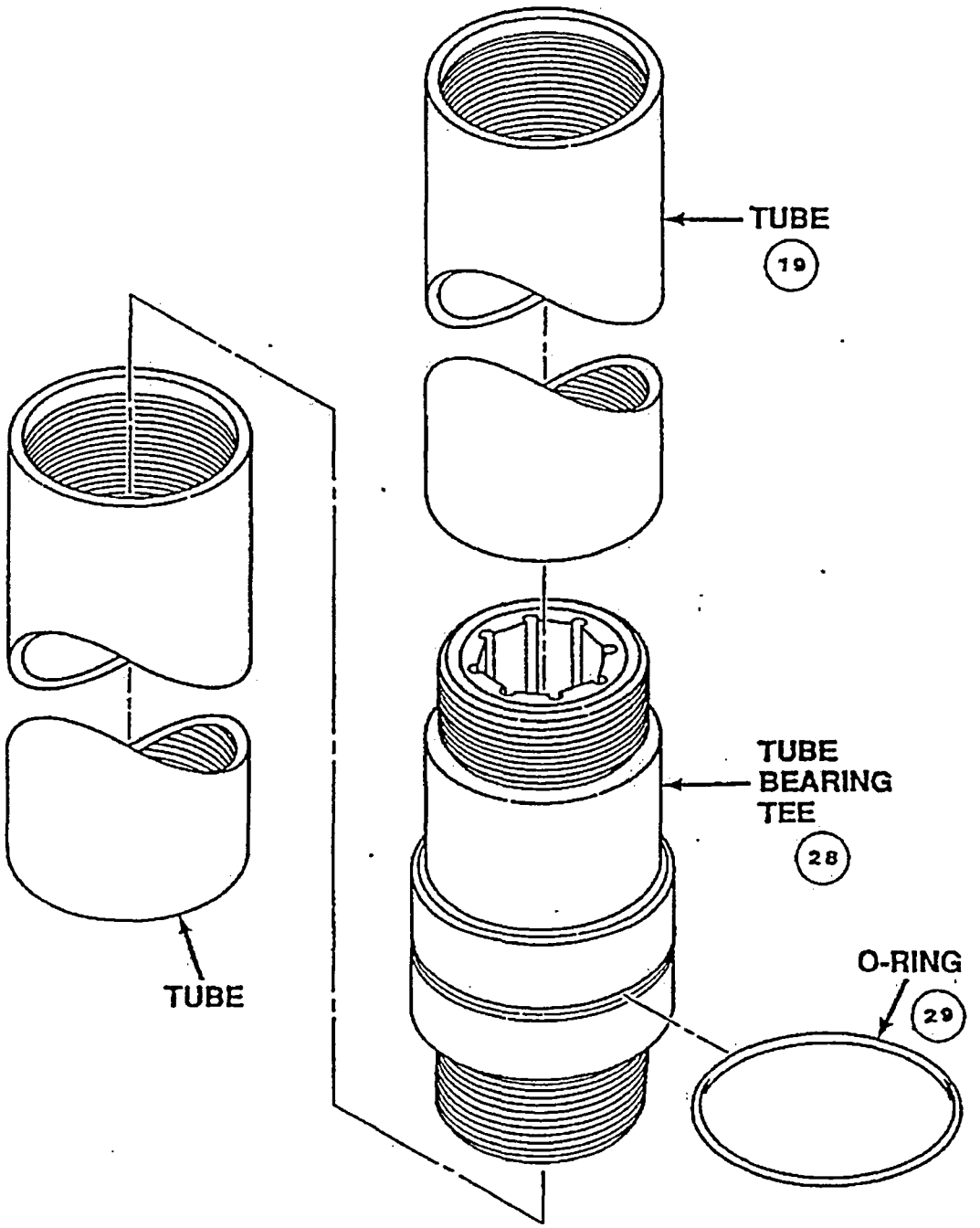


FIGURE 3-2 TUBE (INNER COLUMN) ASSEMBLY (TYPICAL)

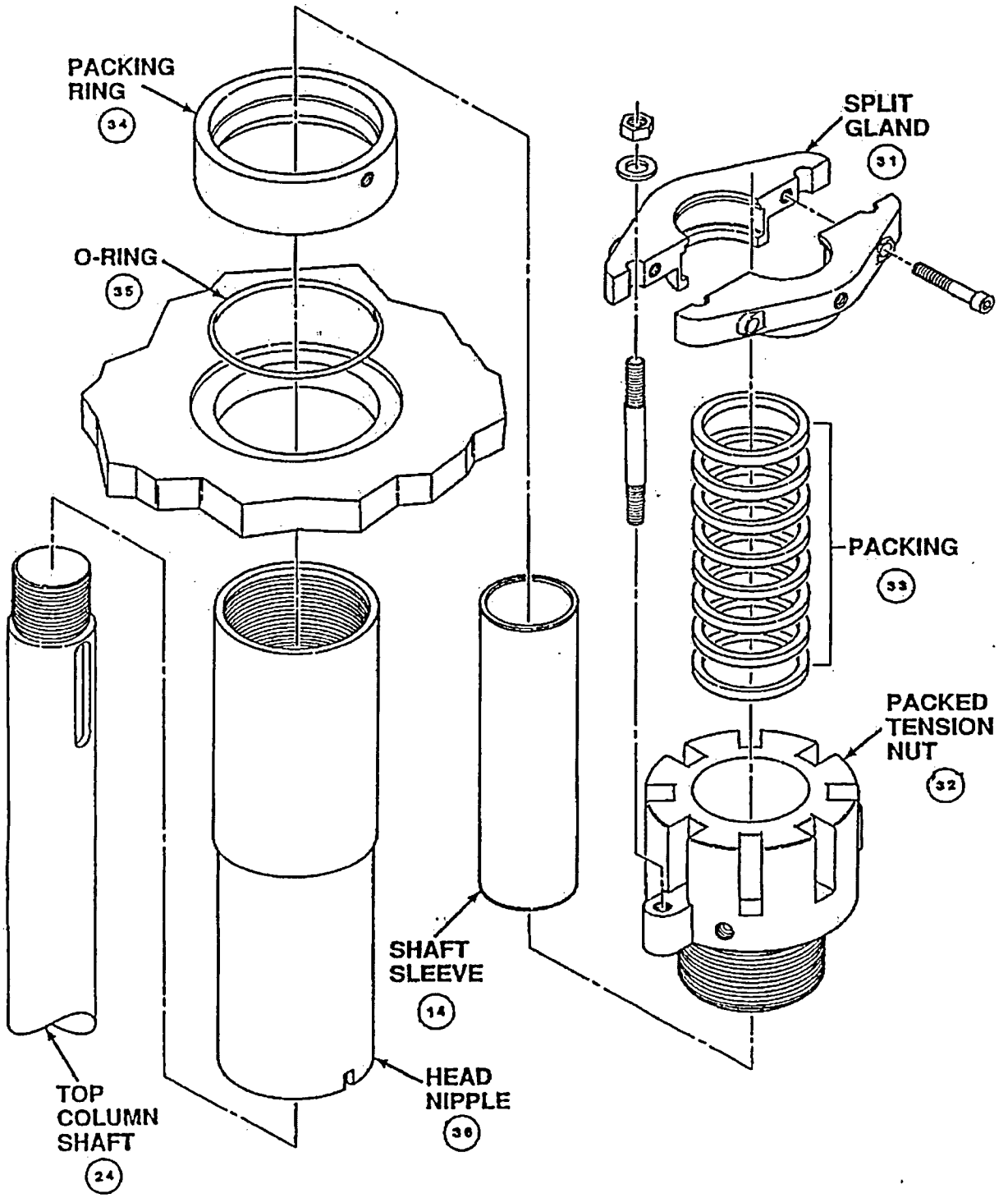


FIGURE 3-3 STUFFING BOX ASSEMBLY

NOTE 2

The hole drilled in the middle of each shaft coupling (25) provides a method of centering the coupling on the shafts. This can be done by visually sighting through the hole or by inserting a rod through the hole and screwing the coupling on the shaft until it touches the rod.

NOTE 3

Designations No. 1, No 2, etc., are made to differentiate components given the same name. The numbers reflect the sequence of the component installation.

3.4.1 Bowl and Bottom Column Installation

1. Place the bowl assembly horizontally on suitable supports.

NOTE

Place I-beams across the foundation hole to support the pump subassemblies as they are installed.

2. Attach a lift line to each of the lifting lugs on bottom column (16). Attach an additional line (sling) around the waist of the suction bell (8). Slowly lift the bottom column/bowl assembly to the vertical position. Place the assembly over the foundation hole and lower it so I-beams can be placed under the restraint on the side of the bottom column. Be sure to secure the I-beams laterally to prevent them from shifting under load. Use plywood under the I-beams to avoid damaging the sole plate. Remove lifting equipment.

3.4.2 Lower Column Assembly and Installation

1. Thread and center coupling (25) on the installed intermediate (No. 1) shaft (23) of the bottom column (16).

2. Attach lift line to an eyebolt installed in one end of intermediate (No. 2) column shaft. Position the shaft over shaft coupling. Use a strap wrench to thread and tighten the shaft to the coupling while restraining the coupling from rotation. Remove lift lines.

3. Fasten a clamp to intermediate (No. 1) tube (20). With lift lines attached to the clamp, position the tube over column shaft. Slowly lower the tube down the shaft and engage its threads with tube bearing tee (28). Tighten the tube with a strap wrench. Remove lift lines.

4. Fasten a clamp to tube bearing (27). With lift lines attached, position the bearing over column shaft. Slowly lower the bearing down the shaft and engage its threads with the intermediate tube. Tighten the bearing with a strap wrench. Remove lift lines.

5. Fasten a clamp to intermediate (No. 2) tube (20). With lift lines attached to the clamp, position the tube over column shaft (23). Slowly lower the tube down the shaft and engage its threads with tube bearing (27). Tighten the tube with a strap wrench. Remove lift lines.

6. Fasten a clamp to next tube bearing (27). With lift lines attached to the clamp, position the bearing over intermediate shaft (23). Slowly lower the bearing down the shaft and engage its threads with intermediate (No. 2) tube (20). Tighten the bearing with a strap wrench. Remove lift lines.

CAUTION

IN THE FOLLOWING STEP, WHEN INSTALLING THE LOWER COLUMN, BE CAREFUL TO ENSURE THAT THE COLUMN SPIDER SLIPS OVER THE TUBE BEARING TEE WITHOUT DAMAGE TO THE TEE OR SPIDER.

7. With lift line attached to eyebolts installed in the top flange of the lower column (15), position the column over intermediate column shaft. Align the column matchmarks and slowly lower the column down the shaft until its flange mates with the flange of bottom column (16). Secure the two columns together by installing the thirty six hex head cap screws and nuts. Torque the hex nuts in sequence and to the value specified.

8. Lift the lower column (15) and remove the I-beams from under the bottom column (16). Lower the assembled columns until the I-beams can be placed under the restraints on the side of the lower column. Be sure to secure the I-beams laterally to prevent them from shifting under load. Use plywood under the I-beams to avoid damaging the sole plate. Remove lifting lines and shackles.

3.4.3 Intermediate Column Assembly and Installation

1. Thread and center coupling (25) on the installed intermediate (No. 2) column shaft (23) for the lower column (15).

2. With lift lines attached to eyebolts installed in one end of an intermediate (No. 3) column shaft, position the shaft over shaft coupling (25). Use a strap wrench to thread and tighten the shaft to the coupling while restraining the coupling from rotation . Remove lift line.

3. Fasten a clamp to intermediate (No. 3) tube (20). With lift attached to the clamp, position the tube over column shaft. Slowly lower the tube down the shaft and engage its threads with tube bearing (27). Tighten the tube with a strap wrench. Remove lift line.

4. Fasten a clamp to next tube bearing (27). With lift line attached to the clamp, position the bearing over column shaft (23). Slowly lower the bearing down the shaft and engage its threads with the intermediate tube (20). Tighten the bearing with a strap wrench. Remove lift line.

5. Fasten a clamp to special (No. 2) tube (21). With lift line attached to the clamp, lift and position the tube over column shaft (23). Slowly lower the tube down the shaft and engage its threads with tube bearing (27). Tighten the tube with a strap wrench. Remove lifting equipment.

6. Fasten a clamp to tube bearing tee (28). With lift line attached to the clamp, position the bearing over column shaft (23). Slowly lower the bearing down the shaft and engage its threads with special tube (21). Tighten the bearing with a strap wrench. Remove lifting equipment.

7. Lubricate O-ring (29) with Dow Corning DC4 or equivalent and install in its groove on tube bearing tee (28).

CAUTION
IN THE FOLLOWING STEP, WHEN INSTALLING THE INTERMEDIATE COLUMN, BE CAREFUL TO ENSURE THAT THE COLUMN SPIDER SLIPS OVER THE TUBE BEARING TEE WITHOUT DAMAGE TO THE TEE OR SPIDER.

8. Attach lift lines to the eyebolts installed in the top flange of the intermediate column (17). Position column over intermediate column shaft (23). Align the column matchmarks and slowly lower the column down the shaft until its flange mates with the flange of lower column (15). Secure the two columns together by installing the thirty six hex head cap screws and nuts. Torque the hex nuts in sequence and to the value specified.

9. Lift the intermediate column (17) and remove the I-beams from under the bottom column (16). Lower the assembled columns until the I-beams can be placed under the restraints on the side of the intermediate column. Be sure to secure the I-beams laterally to prevent them from shifting under load. Use plywood under the I-beams to avoid damaging the sole plate. Remove lifting lines and shackles.

3.4.4 Top Column Assembly and Installation

1. Thread and center coupling (25) on the installed intermediate (No. 3) shaft (25) in the intermediate column (17). Use strap wrench to tighten coupling.

2. Attach lift lines to an eyebolt installed in one end of an intermediate column (No. 4) shaft (23) and position the shaft over shaft coupling (25). Use a strap wrench to thread and tighten the shaft to the coupling while restraining the coupling from rotation . Remove lift line.

3. Fasten a clamp to an intermediate (No. 4) tube (20). With lift line attached to the clamp, position the tube over column shaft (23). Slowly lower the tube down the shaft and engage its threads with tube bearing tee (28). Tighten the tube with a strap wrench. Remove lift line.

4. Fasten a clamp to next tube bearing (27). With lift line attached to the clamp, position the bearing over column shaft (23). Slowly lower the bearing down the shaft and engage its threads with the intermediate tube. Tighten the bearing with a strap wrench. Remove lift line.

5. Fasten a clamp to intermediate (No. 5) tube (20). With lift line attached to the clamp, position the tube over column shaft (23). Slowly lower the tube down the shaft and engage its threads with tube bearing (27). Tighten the tube with a strap wrench. Remove lift line.

6. Fasten a clamp to next tube bearing (27). With lift line attached to the clamp, position the bearing over column shaft (23). Slowly lower the bearing down the shaft and engage its threads with intermediate tube (20). Tighten the bearing with a strap wrench. Remove lift line.

7. Attach lift lines to the eyebolts installed in the top flange of the top column (18) and position column over intermediate column shaft (23). Align the column matchmarks and slowly lower the column down the shaft until its flange mates with the flange of intermediate column (17). Secure the two columns together by installing the thirty six hex head cap screws and nuts. Torque the hex nuts in sequence and to the value specified.

8. Lift the top column (18) and remove the I-beams from under the intermediate column (17). Lower the assembled columns until the I-beams can be placed under the top flange of the top column. Be sure to secure the I-beams laterally to prevent them from shifting under load. Use plywood under the I-beams to avoid damaging the sole plate. Remove lift lines and shackles.

3.4.5 Discharge Head Installation

1. Thread and center coupling (25) on the installed intermediate (No. 4) shaft (25) in the top column (18).

2. Install an eyebolt in one end of top column shaft (24). With lift line attached to the eyebolt, position the shaft over shaft coupling (25). Use a strap wrench to thread and tighten the shaft to the coupling while restraining the coupling from rotation . Remove lift line.

3. Fasten a clamp to top tube (22). With lift line attached to the clamp, lift and position the tube over top column shaft. Slowly lower the tube down the shaft and engage its threads with tube bearing (27). Tighten the tube with a strap wrench. Remove lift line.

4. Fasten a clamp to next tube bearing (27). With lift line attached to the clamp, position the bearing over top column shaft. Slowly lower the bearing down the shaft and engage its threads with top tube. Tighten the bearing with a strap wrench. Remove lift line.

5. Fasten a clamp to head nipple (36). With lift lines attached to the clamp, position the tube over the top column shaft. Slowly lower the tube down the shaft and engage its threads with tube bearing. Tighten the tube with a strap wrench. Remove lift line.

6. Attach lift lines attached to eyebolts installed in the top flange of the discharge head (30). Position the discharge head over top column shaft (24). Align the discharge head so that the discharge elbow faces facility piping. Slowly lower the column down the shaft until its flange mates with the flange of top column (18). Secure the head to the column by installing the thirty six hex head cap screws and nuts. Torque the hex nuts in the sequence and to the value specified.

7. Lift the discharge head to remove the I-beams from under the top flange of the top column (17). Align the discharge head mounting holes with the holes of the sole plate and lower the discharge head onto the sole plate. Fasten the discharge head to the sole plate by installing the eight studs and hex nuts. Torque the hex nuts in sequence and to the value specified.

3.4.6 Tension Nut Installation

1. Lubricate O-ring (35) with Dow Corning DC4 or equivalent and slide it down top column shaft (24) until it rests on floor of discharge head (30).

2. Orient packing ring (34) so that the beveled I.D. faces O-ring (35) and slide packing ring (34) down top column shaft (24) until it rests on floor of discharge head (30).

3. Lower packed tension nut (32) down top column shaft (24) and engage its threads with threads of head nipple (36). Tighten packing ring (34) on head nipple.

3.4.7 Pump Half-Coupling Installation

1. Place pump-half coupling key (38) in it keyway on top column shaft (24).

2. Slide pump-half coupling (37) down top column shaft (24) and allow it to rest on packed tension nut (32).

3. Thread adjusting plate (41) all the way down on top column shaft (24).

3.4.8 Driver Installation

When installing the driver (motor) on the pump, certain alignment checks should be made to ensure successful operation. Proceed as follows:

1. Before mounting the driver, check its mounting flange dimensions to be certain it will fit the mounting surface on the discharge head.

2. Support the driver vertically, shaft facing down, and thoroughly clean the shaft and mounting surfaces in preparation for checking alignment.

3. Check trueness of driver mounting face by attaching a dial indicator to the shaft, on an extension perpendicular to the shaft centerline and setting the dial indicator to contact with the mounting face of the driver. While rotating the shaft and taking readings, check:

   (a) Concentricity of the rabbet fit; must be within .001" total indicated runout (T.I.R.) per foot of rabbet diameter.

   (b) Squareness of the mounting face; must be perpendicular to the shaft within .001" T.I.R. per foot of bolt circle diameter.

4. Check trueness of driver shaft by mounting the dial indicator to its housing and setting the dial indicator to contact the shaft. While rotating the shaft to take readings, check:

   (a) Runout of shaft circumference; must not exceed .003" (.002") T.I.R. or .001" T.I.R. per inch of shaft diameter, whichever is greater.

(b) Squareness of shaft split ring groove; must be parallel to the motor mounting face within .001" T.I.R.

5. If driver half-coupling (39) is not installed, install its key in driver shaft keyway. Heat up the coupling, which is a slight press fit on the shaft, to approximately 250°F and slide the coupling up the shaft past the groove for inserting split ring halves (40). Insert the split ring halves (40) and pull the coupling down to seat firmly against the split ring halves.

6. Install driver on pump discharge head (30). Temporarily secure the driver to the discharge head by installing and tightening the seven hex head cap screws.

7. With a dial indicator mounted on the driver half-coupling (39), rotate the driver shaft to take readings from its mounting flange. Adjust the unit's mounting position as necessary to center its shaft within .006" total indicator runout. Tighten driver mounting fasteners.

8. Refer to driver manufacturer's manual for instructions regarding its operation. Check the unit for proper lubrication, connect its leads to power source, and "bump" it to check the shaft for correct rotation. Viewed from the top, shaft rotates correctly COUNTER-CLOCKWISE. If shaft rotates incorrectly, interchange two leads to establish correct rotation. When correct rotation is established, disconnect driver leads at power source, and tag the leads with correct terminal identification.

3.4.9. Impeller Lift Adjustment

1. Insert a steel rod into hole provided in coupling adjusting plate (41). Rotate adjusting plate until gap between faces of adjusting plate and driver half-coupling (39) is slightly higher than .056". Use feeler gages.

2. Slide the pump half coupling (37) up the top column shaft (24) against adjusting plate (41). Turn the adjusting plate bolt holes line up with the nearest holes in the pump half coupling, then rotate the driver shaft to align bolt holes of the driver half coupling (39) with those of the adjusting plate.

3. Insert the coupling socket head cap screws and tighten progressively until secure, thereby closing the gap above the adjusting plate (41) and raising the impeller to its running position.

4. Check for free rotation of driver and pump shafts, with no binding as shafts are rotated using a strap wrench.

5. With dial indicator mounted to pump housing, check that top column shaft (24) runout below coupling does not exceed .001" per inch of shaft diameter. Re-adjust driver if necessary, tighten its mounting hex head cap screws, and recheck for free shaft rotation.

3.4.10 Packing Installation

1. Refer to paragraph 2.1.4 for type, size and number of packing rings required. Be certain that type of packing used is compatible with the product being pumped. Install new packing rings only.

2. Determine that packed tension nut (34), and sleeve (14) are clean and free of damage.

NOTE

When installing packing rings, stagger the joints 90° from each other as shown in Figure 3-4-A.

3. (See Figure 3-4-B). Insert one ring of packing, pressing by hand to point of maximum entrance.

4. (See Figure 3-4-C). Insert spacer ring, with packing tool attached, and press on the packing tool handles to guide and tamp the packing ring solidly and squarely into position.

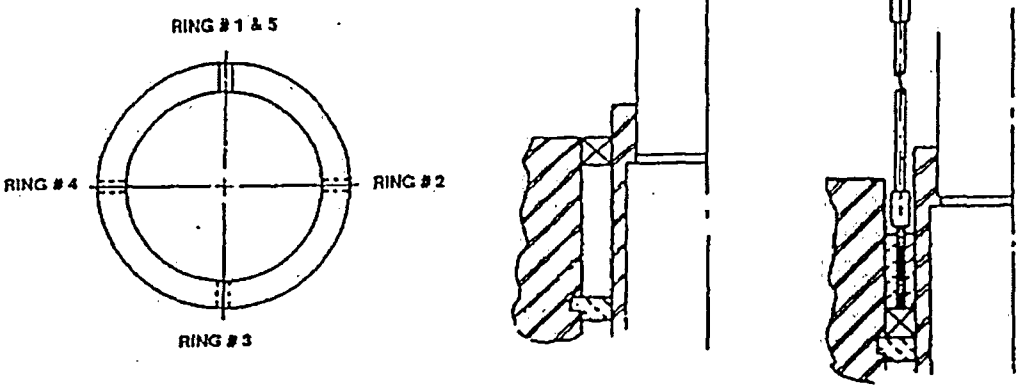


FIGURE 3-4 PACKING INSTALLATION

5. Retract the packing tool and insert sufficient spacer rings to fill the stuffing box.

6. Install and pull in the split gland (31), tightening stud nuts evenly and firmly, so that gland does not cock on the shaft. Remove gland and spacer rings.

7. Repeat Steps 3 through 6 to install each remaining ring of packing.

8. When all rings of packing are installed, loosen the gland stud nuts, then secure stud nuts finger tight.

3.4.11 Packing Adjustment

When a pump is first operated with new packing, the packing should be adjusted loosely to allow a continuous stream of water (approximately 1/4" in diameter) to flow from the split gland. While leakage may seem excessive during the initial period of operation, this leakage will decrease as pump and packing approach operating temperature. Therefore, do not operate unit with new packing too tightly adjusted, and do not make final adjustment of gland until pump has been in operation at least four (4) to eight (8) hours.

When pump has been in operation four (4) to eight (8) hours at operating temperature and pressure conditions, employ an open end wrench to tighten the gland stud nuts evenly and progressively, one flat at a time until recommended stuffing box leakage is obtained. Do not operate the packing at less than the specified rate of leakage, as this will adversely affect its life.

3.5 MAIN PIPING CONNECTION

With the pump grouted and firmly bolted to the foundation, the main piping should then be connected to the pump discharge flange. When installing piping, note the following:

1. Use pipe of ample size for the length of line and the pressure involved. Allow absolute minimum of bends and fittings.

2. Install check valve, followed by gate valve, in discharge line. Check valve prevents back flow in event of power failure, and protects pump from system back pressure. Reducer, if used in discharge line, should be fitted to discharge flange preceding check valve and gate valve.

3. Permit no excessive strain on pump discharge flange. Pipe strains on the pump are a definite source of trouble, resulting in misalignment, overheated bearings, excessive wear, vibration, and even broken shafts. Pipe-to-pump flange faces must mate flush and parallel with bolt holes in alignment, and any tendency to

push toward or pull away from the pump must be eliminated. Never force piping into position with flange bolts or use drifts to force alignment of bolt holes.

4. All piping must be properly supported independently of the pump. Not only must the weight be carried, but also thrust loads produced from the pump discharge pressure or possible thermal effects. Provide hot lines either with loops or expansion joints to prevent strains on the pump caused by pipe expansion. Place piping supports close to the pump output flange, to avoid vibration and strain on pump casing.

5. A short section of pipe should be provided for final make up when aligning piping to the pump. This piece should be placed several feet away from the pump pipe flange.

6. Be certain that piping is thoroughly clean before connecting pump to piping. It is important to prevent welding slag, pipe scale and other foreign material from entering the pump and causing damage to the pump or the valves and equipment which follow. Provide strainers or screens when required to prevent foreign materials from being drawn into the pump suction inlet.

3.6 PRESSURE GAGES INSTALLATION

Pressure gages are the most effective direct check on the operation of a centrifugal pump; their use is highly recommended. It is preferable that the discharge gage be placed at least five pipe diameters away from the pump or other fittings such as elbows or valves.

3.7 AUXILIARY INSTRUMENTS, PIPING AND WIRING INSTALLATION

Install and connect any auxiliary instruments, piping and wiring as indicated on the Pump Outline Drawing in Section Seven.

3.8 STORAGE OR RESHIPMENT PREPARATION

Unit should be stored or shipped in original as-shipped condition, protected against moisture, dirt and physical damage. Prepare the pump for shipping or storage as follows:

1. Remove auxiliary instruments such as gages and place in a separate container with other loose parts. This container may be stored inside pump if desired.

2. Block the shaft or shafts as necessary to eliminate shaft end float.

3. Coat exposed machined surfaces that are vulnerable to moisture with a suitable protective compound.

4. Ensure pump is thoroughly dry, place desiccant inside unit, install suitable flange covers and plug any smaller openings.

5. Install protective wrapping and crate the unit or mount on skids as appropriate.

6. Store equipment in a dry and protected location, keeping pump free of dirt and grit both internally and externally.

7. During storage, periodically inspect desiccant and other protective materials and renew as necessary.

SECTION FOUR - OPERATION

4.1 OPERATING PRECAUTIONS

- Operate the pump only within the design parameters specified in Section One, Design Data.
- Do not operate the pump for any extended period of time with discharge valve closed or near closed, as insufficient flow will lead to pump overheating and greatly reduced pump life. If pump is installed in a parallel system, operate only a sufficient number of pumps (at or near their full capacity) to maintain the desired total flow.
- Do not allow pump to run dry or break suction, as possible damage to the unit may occur.
- Pumped liquid must be free of excessive air or gas. The presence of excessive air or gas in the liquid will result in a reduction in capacity and head which cannot be predicted with accuracy, and may lead to excessive wear or damage of the unit.
- BW/IP International, Inc., Pump Division makes no guarantees against the erosive action of sand or other abrasive material in pumped liquid. Small amounts of abrasives will pass through the unit with slight immediate effect, but it is only a question of time until continued operation under this condition will damage the working parts of the pump.
- Perform the preliminary check of paragraph 4.2 before initiating pump operation.

4.2 PRELIMINARY CHECK

1. Before starting the pumping operation, check the security of all bolting, piping and wiring.
2. Check all gages, valves and instruments for proper working order.
3. Verify proper flow of any injection liquids required. (Refer to the Pump Outline Drawing in Section Seven for injection requirements.)
4. Check the driver for proper lubrication. Refer to the driver instruction manual for instructions regarding starting of the driver.

4.3. STARTING

1. Open discharge valve.

2. Determine that pit or sump is full of liquid.

3. Start driver and bring pump up to speed as quickly as possible.

4.4 OPERATING CHECK

As soon as possible after pumping operation begins, repeat the applicable portions of the checking procedure of paragraph 4.2. Other than monitoring of flows, pressures, packing leakage, temperatures, driver lubrication and any pump lubrication specified, the pump should require no attention during operation. In the event symptoms of trouble occur, stop the pump and refer to the Troubleshooting Chart, paragraph 5.3. Refer to paragraph 3.4.11 for normal packing leakage and adjustments.

4.5 STOPPING

Close discharge valve and immediately deenergize the driver. It is recommended that the flow of any required injection liquids be continued when pump is idle.

SECTION FIVE - MAINTENANCE

5.1 GENERAL

Routine performance of preventative maintenance will enable early detection of most problems that may arise. Periodic dismantling of the pump for inspection is not necessary unless there is reason to suspect excessive wear or other internal damage. If a pump malfunction is suspected, refer to Troubleshooting, paragraph 5.3. When major maintenance is undertaken, refer to paragraph 5.6 for pump disassembly procedures and paragraph 5.8 for pump reassembly procedures.

5.2 PREVENTATIVE MAINTENANCE

Monitoring of pump performance is recommended to establish the maintenance requirements for the pump. The following maintenance checks should be performed as defined below:

1. After first start-up, check tightness of the pump and driver mounting fasteners and tighten as necessary. Further checking of the fasteners should not be required unless excessive pump vibrations are encountered.

2. After first start-up, inspect all piping for evidence of leakage, loosening or other damage and repair as necessary. Further checking of the piping should not be required unless excessive pump vibrations are encountered.

3. After first operational adjustment of the stuffing box gland leakage (paragraph 3.4.11), check leakage every hour, adjusting as necessary until leakage remains within recommended limits. Then inspect daily, weekly or monthly to establish a pattern as to when inspection is required. Excessive leakage will not adversely affect packing life but too little or no flow (over tightened split gland nuts) will cause the packing to run dry, adversely affecting packing life.

4. Refer to manufacturers instructions for driver and other auxiliary equipment lubrication, periodic inspection and any other scheduled maintenance.

5.3 TROUBLESHOOTING CHART

The following chart lists most of the troubles that can be encountered during pump operation, their possible causes, and recommended remedies:

TROUBLE	PROBABLE CAUSE	REMEDY
No discharge	Speed too low	Increase driver speed
	Wrong rotation direction	Check driver rotation
	Liquid level too low (insufficient submergence)	Check submergence level
	Completely plugged impeller	Clean out impeller
Insufficient discharge	Speed too low	Increase driver speed
	Wrong impeller lift setting	Correct setting (see Sect. One, Design Data)
	Partially plugged impeller	Clean out impeller
	Worn wear ring	Replace wear ring
	Damaged part	Replace part
Excessive power consumption, noise or vibration excessive	Speed too high	Reduce driver speed
	Suction head insufficient	Check pump submergence
	Pump or driver mounting fasteners loose	Tighten fasteners
	Wrong impeller lift setting	Correct setting (see Sect. One, Design Data)
	Stuffing box packing too tight; excessive clearances; rotating element binding; bent shaft	Replace defective part

5.4 LIFT EQUIPMENT REQUIRED

In addition to common hand tools used in this type work, the following should be available at the job site when installing or removing the pump subassemblies:

A crane or derrick of sufficient strength to lift the entire pump (without driver) safely, and of sufficient height to provide ample clearance for the longest of the pump or column sections.

Spreader bars and shackles (clevis-and-pin type adapters), suitable sized, for attaching lifting line to equipment lifting lugs or lifting clamps.

Lifting eyebolts for handling a column or section of shaft separately. Shafts have a threaded hole at each end for handling purposes.

Lifting clamps for handling inner columns (or tubes), bearings and couplers.

I-beams or other type of saddle supports for supporting the pump by sections during pump removal.

A set of tools for installing and removing stuffing box packing.

5.5 HANDLING INSTRUCTIONS

NOTE

The approximate weights of the assembled pump and driver are listed on the Pump Outline Drawing in Section Seven, Reference Materials.

5.5.1 Handling Precautions

WARNING

DO NOT WORK OR STAND UNDER A HEAVY SUSPENDED OBJECT UNLESS THERE IS A POSITIVE SUPPORT UNDER IT TO PROTECT PERSONNEL SHOULD A HOIST OR SLING FAIL.

- Be sure lifting devices used are in good repair and are capable of safely handling the weights being lifted.
- When handling the pump or its components, always work carefully to prevent accidents.

- Adjust lifting equipment so that the center of lift is directly over the foundation axis. Watch for overhead obstructions.

- Use care to prevent bumping, pushing or scraping of pump parts, especially the shafts and other machined surfaces and fits.

- Prevent foreign materials or dirt from entering the working parts of the pump.

5.5.2 Lifting Methods

It is important to handle the pump subassemblies safely during installation and maintenance. The following procedures are suggested:

Outer Columns - Use lugs provided for supporting and attaching lift lines.

Shafts - Each section of shaft is threaded at each end to receive a lifting eyebolt. When raising shaft from a horizontal position, avoid dragging of shaft lower end.

Tubes (Inner Columns) - Fabricate from plate a clamp to go around the tubes. The clamp should have provisions for installing lifting eyebolts.

Discharge Head - Use lifting lugs provided. Do not lift discharge head with driver attached.

Driver - Handle driver in accordance with the manufacturer's instructions; normally, lifting lugs are provided. Do not lift driver when assembled to pump, as driver lifting points are designed for lifting the driver only.

5.6 PUMP DISASSEMBLY (See Figures 3-1 through 3-3.)

NOTE

Designations No. 1, No 2, etc., are made to differentiate components given the same name. The numbers reflect the sequence of the component installation.

5.6.1 Preparation For Disassembly

1. Follow stopping procedure paragraph 4.5, and disconnect driver leads from power source.

2. Disconnect any auxiliary instruments, piping and wiring that could interfere with disassembly.

3. Remove the attaching hardware securing the main piping to the discharge head.

5.6.2 Driver Half-Coupling Removal

Remove all but two opposing hex head cap screws securing pump half coupling (37) to the driver half coupling (39). Unscrew the two screws simultaneously until impeller (2) is resting on suction bell (8). Remove the two screws and allow the pump half coupling to rest on split gland (31).

5.6.3 Driver Removal

Following the motor manufacturers instructions for handling the driver, attach lifting equipment to the driver and remove the eight hex head cap screws securing it to discharge head (30). Remove driver and place vertically on suitable supports.

5.6.4 Pump Half-Coupling Removal

1. Unscrew adjusting plate (41) from top column shaft (24).

2. Install lifting eyebolts with washers and nuts in opposite through holes in pump half coupling (37). Attach lifting equipment to the eyebolts and remove coupling from top column shaft.

5.6.5 Stuffing Box Removal

1. Remove the two cap screws and lock washers securing the split gland (31) to the packed tension nut (32) and with a hooked puller, remove the eight rings of packing (33).

2. Unscrew the packed tension nut (32) from head nipple (36). Remove packing ring (34) and O-ring (35). Discard O-ring.

5.6.6 Discharge Head Removal

1. Disconnect the main discharge piping from the discharge head (30) output flange.

2. Remove the eight hex nuts securing the discharge head to the sole plate.

3. With lift lines attached to lifting lugs on the discharge head (30), lift the pump and place I-beams under the pads of the top column (18).

4. Remove thirty-two nuts, lock washers and cap head screws securing the discharge head (30) to the top column (18).

5. Slowly lift the discharge head (30) until it clears top column shaft (24) and place it on suitable supports. Remove lift lines.

6. Fasten a clamp to head nipple (36) and attach lift lines to the clamp. With a strap wrench, unscrew tube from top shaft tube bearing (27) and remove nipple.

7. With clamp and lift line attached, use strap wrench to unscrew top shaft tube bearing from top tube (22) and remove bearing.

8. Loosen the six set screws securing shaft (packing) sleeve (14) to pump shaft and remove sleeve.

9. With a strap wrench, unscrew bearing from top tube (22) and remove bearing.

10. Fasten a clamp to the top tube (22) and attach lift lines to the clamp.

11. Using a strap wrench unscrew top tube from the No. 5 intermediate tube bearing (27). Carefully lift and remove top tube.

12. Install an eyebolt in the end of the top column shaft (24) and attach lift line to eyebolt.

13. While restraining the top shaft coupling (25), unscrew the shaft from the shaft coupling using a strap wrench. Remove shaft.

14. Unscrew shaft coupling (25) from No.3 intermediate shaft (23) and remove.

15. Fasten a clamp to tube bearing (27) and attach lift lines to the clamp.

16. With a strap wrench, unscrew bearing from top intermediate (No. 5) tube (20) and remove bearing.

5.6.7 Top Column Removal

Column Removal

1. Install lifting lines the lifting lugs on top column (18) and lift pump up until I-beam supports can be placed under the pads of the intermediate column (17).

2. Remove thirty-two hex head cap screws, lock washers and nuts securing top column to the intermediate column.

3. Slowly lift the top column clear of the intermediate column shaft.

No's. 5 and 4 Intermediate Tubes and No. 4 Intermediate Shaft Removal

4. Fasten a clamp to No. 5 intermediate tube (20) and attach lift lines to the clamp to support tube.

5. Using a strap wrench, unscrew tube from tube bearing (27). Carefully lift and remove tube.

6. Fasten a clamp to tube bearing (27) and attach lift lines to the clamp.

7. Using a strap wrench, unscrew tube bearing from No.4 intermediate tube. Carefully lift and remove bearing.

8. Fasten a clamp to No.4 intermediate tube and attach lift lines to the clamp to support tube. Using a strap wrench, unscrew intermediate tube from tube bearing tee (28). Carefully lift and remove tube.

9. Install an eyebolt in the end of the No. 4 intermediate column shaft (23) and attach lift line to eyebolt.

10. While restraining the shaft coupling (25), unscrew the shaft from the coupling with a strap wrench. Remove shaft

11. Unscrew shaft coupling (25) from the middle intermediate shaft and remove.

12. Fasten a clamp to the tube bearing tee (28) and with lift line attached, remove tee. Discard O-ring.

5.6.8 Intermediate Column Removal

Column Removal

1. Install lift lines in the lifting lugs of intermediate column (17) and lift pump until I-beam supports can be placed under the pads of the lower column (15).

2. Remove thirty-two nuts and lock washers securing intermediate column to the lower column (15).

3. Slowly lift the intermediate column clear of the lower column shaft. Place on adequate supports.

No. 3 Special and No. 2 Intermediate Tubes, and No. 3 Intermediate Shaft Removal

4. Fasten a clamp to the special tube (21) and attach lift lines to the clamp to support tube.

5. Using a strap wrench, unscrew tube from tube bearing (27). Carefully lift and remove tube.

6. Fasten a clamp to tube bearing (27) and attach lift lines to the clamp.

7. With a strap wrench, unscrew bearing (27) from No.3 intermediate tube (20) and remove bearing.

8. Repeat above steps to remove No. 3 intermediate tube (20) from tube bearings (27).

9. Install an eyebolt in the end of the No. 3 intermediate shaft (23) and attach lift lines.

10. While restraining shaft coupling (25), unscrew the shaft from the coupling, with a strap wrench. Remove shaft.

11. Unscrew shaft coupling (25) from No. 2 intermediate shaft (23) and remove coupling with a strap wrench.

12. Fasten a clamp to the tube bearing (27) and with lift line attached, remove bearing with strap wrench.

5.6.9 Lower Column Removal

Column Removal

1. Install lift lines in lifting lugs on the lower column (15). Lift column until I-beam supports can be placed under the pads of the bottom column (16).

2. Remove thirty-two hex head cap screws, lock washers and nuts securing lower column to bottom column (16).

3. Slowly lift the lower column clear of the second intermediate column shaft (20).

No's. 2 and 1 Intermediate Tubes, and No. 2 Intermediate Shaft Removal

4. Fasten a clamp to No. 2 intermediate tube (20) and attach lift lines to the clamp to support the tube.

5. Using a strap wrench, unscrew tube from tube bearing (27). Carefully lift and remove tube.

6. Fasten a clamp to the tube bearing (27) and with lift line attached, remove bearing.

5.6.10 Bottom Column Removal

Column Removal

1. Attach lift lines to lifting lugs on side of the bottom column (16) and carefully lift column and bowl assembly from foundation hole.

2. With a support sling around the waist of the suction bell (8), place column and bowl assembly in a horizontal position on suitable supports placed under each component.

NOTE

Prior to removing the attaching hardware in the following step, support each half restraint ring with a clamp and lift line.

3. With lift lines attached to lifting lugs and a sling placed around the bottom column (16) near the restraint ring, remove the twenty four hex head cap screws lock washers and nuts securing restraint ring, bottom column and bowl assembly together.

4. Slowly remove the bottom column (16) and place on suitable supports.

No. 1 Special and Bottom Tube, and Bottom Shaft Removal

5. With a sling supporting bearing tee (29), unscrew and remove it from special tube (21). Discard O-ring (29).

6. With slings supporting special tube (21), use a strap wrench to unscrew it from jump bearing (26). Remove and place tube on suitable supports.

7. With a sling supporting jump bearing, (26) use a strap wrench to unscrew it from bottom tube (19). Remove and place bearing on a suitable support.

8. With slings supporting bottom tube (19), use a strap wrench to unscrew it from top case bearing (12). Remove and place tube on suitable supports.

9. With slings supporting bottom intermediate (No. 1) column shaft (23), use a strap wrench to unscrew it from coupling (25). Remove and place shaft on suitable supports.

10. With a sling supporting coupling (25), use a strap wrench to unscrew it from pump shaft (1). Place coupling on a suitable support.

5.6.11 Bowl Disassembly

Top Case and Bearing Removal

1. With a sling supporting it, unscrew and remove top case bearing (12) from top case (7).

2. Remove the twenty-four nuts and lock washers securing top case (7) to suction bell (8).

3. With a sling supporting it, carefully remove top case from suction bell.

Impeller and Pump Shaft Removal

4. Install a lifting eyebolt in the end of pump shaft (1). Attach a liftline to the eyebolt and place a sling around the shaft at the impeller end.

5. Slowly withdraw the pump shaft (1) with attached impeller (2) from suction bell (8) and slowly transpose the shaft from the horizontal to the vertical position.

6. Loosen set screw and slide sand cap (13) off pump shaft.

7. Slowly lower the shaft (1) with attached impeller (2) on wooden blocks for support.

8. With lift line attached to pump shaft (1) for support, remove the four socket head cap screws and lock washers securing thrust collar (3) to impeller (2).

9. Slide thrust collar (3) up pump shaft to expose split ring halves (4). Remove split ring halves.

10. Withdraw pump shaft (1) from bore of impeller (2) and place shaft on suitable horizontal supports. Remove lift line from shaft and remove impeller key (5) from pump shaft keyway.

Impeller Suction Strainer and Liner Removal

~~11. Remove the eight hex head cap screws and lock washers securing suction strainer (10) to suction bell (8). Place the suction strainer out of the way so that it will not be damaged or interfere with disassembly of the pump.~~

08/24/00

12. Use a sling and place the suction bell (8) on wooden blocks so that its bottom flange faces the floor. Remove hex nuts and lock washers securing impeller liner (9) to suction bell (8). Remove and place the liner on a suitable support.

Wear Ring Removal and Replacement

NOTE

The case wear ring is retained by three set screws that are staked in place. It will be necessary to grind away the metal from the stake to remove the set screws.

13. Remove the three socket set screws used to secure case wear ring (6) to top case (7).

14. Use a puller and remove the wear ring (6). If a puller is not available, the ring may be removed by using a soft hammer to drive it into the case (7) where it may be segmented and the pieces removed.

15. Remove any burrs from the wear ring area.

16. Use a soft hammer and tap the replacement wear ring (5) into place.

17. Use an "F" drill and drill three new holes to a depth of 3/8 to 1/2 inch. Drill holes approximately 1-inch away from previously drilled holes.

18. Thread the holes with a 5/16-18NC tap.

19. Secure wear ring with socket set screws coated with Locktite Sealant, Grade AV, Color Red. Stake set screws.

5.7 CLEANING AND INSPECTION

1. Discard all O-rings removed during disassembly.

2. Discard all used rings of packing.

3. Solvent or detergent wash all parts and dry using compressed air or clean cloths.

4. When parts are dry, inspect each part for wear, erosion, or corrosion. Discard and provide replacements for any parts damaged sufficiently to impair pump operation.

5. Repeat the cleaning and drying procedure of step 3 for all original and replacement parts to be reassembled.

6. Check pump diametrical running clearances of parts listed below. The clearances shown are factory tolerances for a new or rebuilt pump. It is recommended that components be replaced when pump running clearances exceed 50% more than the maximum values given.

7. Check that the the pump shaft and the top column shaft are straight within .002" total with no more than .001" in any one foot section. The intermediate column shafts shall be straight within .005" total with no more than .001" in any one foot section.

5.7.1 Diametral Running Clearances

FROM	TO	CLEARANCE
Pump Shaft Sleeve (42)	Bottom Bearing (11)	.012"-.015"
Hardened Shafts	Rubber Bearings (12, 26, 27, 28)	.010"-.018"
Top Case Wear Ring (6)	Impeller (2)	.020"-.024"

5.8 PUMP REASSEMBLY

5.8.1 Bowl Reassembly

Assemble the pump bowl according to the following paragraphs. For parts identification and location, refer to the Pump sectional Drawing in Section Seven. Torque all nuts and bolts per Torquing Instructions (GS-1507) in Section Seven. Replace any bearings or wear rings that may have been removed, and check that all retaining screws are securely tightened.

Impeller Liner-to-Suction Bell Installation

1. With the suction bell (8) placed on wooden blocks so that its bottom flange faces the floor, install and secure the impeller liner (9) with its eight studs, lock washers and nuts. Torque nuts to the value specified.

2. With a lift sling, place suction bell (8) on wood blocks in a horizontal position.

Pump Shaft-to-Impeller Installation (See Figure 5-1.)

1 To allow adequate clearance for installing pump shaft (1), place impeller (2) on wooden blocks so that it is approximately 16" off the floor. Place it so that its eye side is facing down.

2. Install a lifting eyebolt in the end of the pump shaft. Attach a lift line to the eyebolt.

3. Position the pump shaft (1) over the bore of impeller (2). Slide thrust collar (3) up shaft until it is above groove for installing split ring halves (4). Install split ring halves, then lower thrust collar over split ring halves. Lower the pump shaft until split ring halves are resting on top face of impeller hub. Secure the thrust ring to impeller hub with its four socket head cap screws and lock washers.

4. Slide sand cap (13) up pump shaft until it is against impeller (2). Temporarily secure cap with its set screw.

Pump Shaft Installation

5. Place a sling around the pump shaft near the impeller (2) and slowly transpose the shaft from the vertical to the horizontal position.

6. Slowly insert the bottom end of the pump shaft (1) into the suction bell bearing (11) until the impeller touches bottom of suction bell (8).

7. Loosen set screw on sand cap (13) and slide sand cap against bottom bearing (11). Tighten set screw.

Top Case and Bearing Installation

8. With sling support, guide top case (7) along pump shaft (1) until its bottom flange mates with top flange of suction bell (8). Secure the two together with their twenty-four studs, lock washers, and nuts.

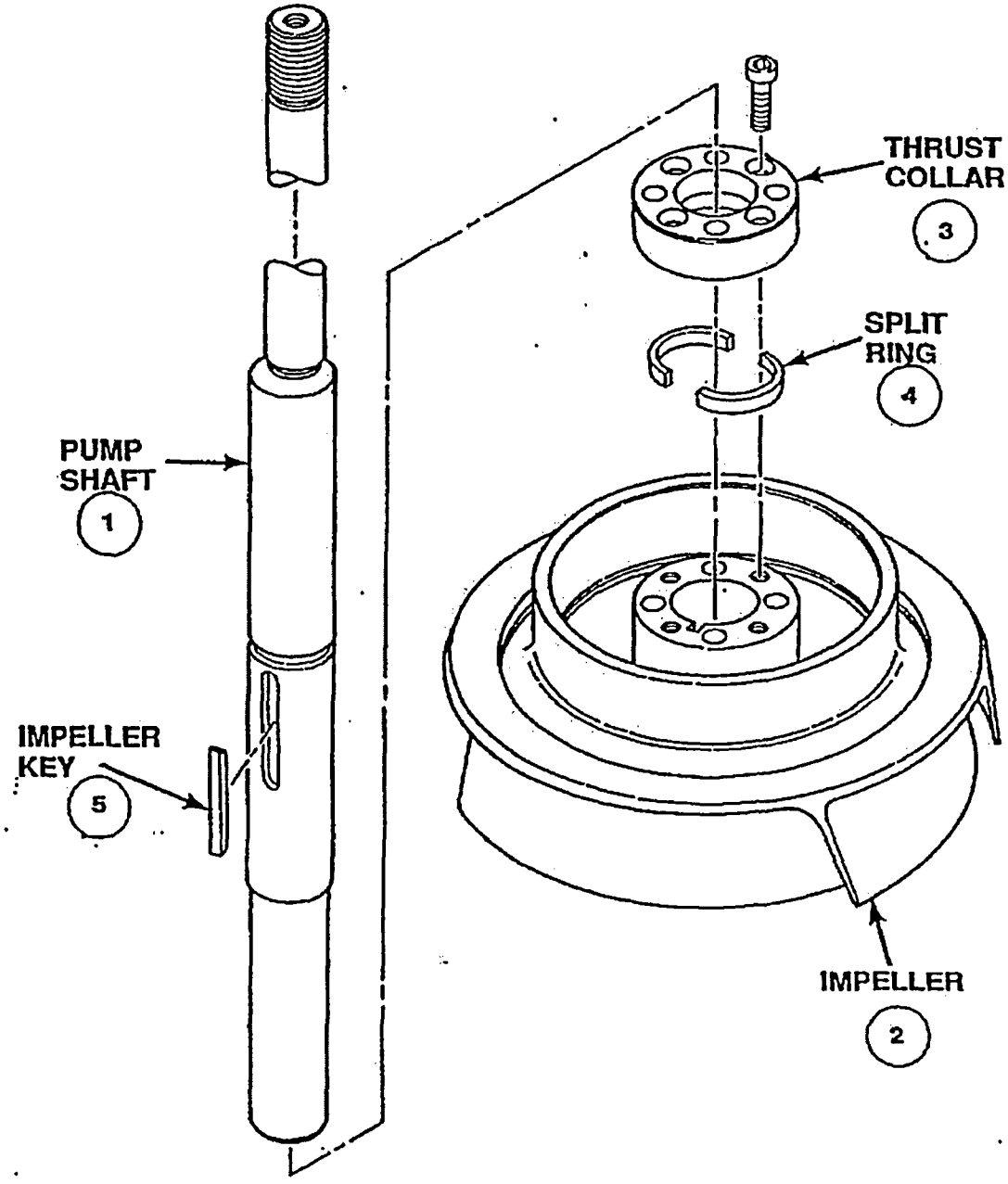


FIGURE 5-1 IMPELLER INSTALLATION

9. Slide top case bearing (12) along pump shaft and thread into top case (7) with strap wrench.

10. With a sling supporting coupling (25), thread and center coupling on pump shaft (1).

11. With lift sling support, align bottom intermediate (No. 1) column shaft (23) with pump shaft coupling (25). With strap wrench, thread bottom shaft onto coupling while restraining coupling from turning. Place suitable support under end of shaft.

12. With lift sling support, slide bottom tube (19) on shaft and thread into bottom bearing (12) with strap wrench.

13. With lift sling support and strap wrench, thread and tighten jump bearing (26) onto bottom tube (19) and special tube No. 1 (21) onto jump bearing (26).

14. Lubricate O-ring (29) with Dow Corning DC4 or equivalent and install in its groove on tube bearing tee (28).

15. Install and thread tube bearing tee onto special tube (21) and tighten with strap wrench.

CAUTION
WHEN INSTALLING THE BOTTOM COLUMN IN THE FOLLOWING STEP, MAKE SURE THAT THE COLUMN SPIDER SLIPS PROPERLY OVER THE TUBE BEARING TEE.

16. With lift sling support, align the matchmarks on the bottom column (16). Slowly guide the bottom column over the installed tubes (19 and 21) until the flanges of the column and case meet. Install each half restraint ring 221119 (see pump outline drawing, Section Seven) by attaching a clamp and a lifting line. Lift and position the half restraint against the flange of the bottom column. Install the twelve hex head cap screws, lock washers, and hex nuts securing the half restraint, bottom column, and top case together. Secure respective flanges together. Torque the fasteners in sequence and to the value specified.

~~17. Lift, position and secure suction strainer (10) to the bottom of the suction bell (8) by installing its eight hex head cap screws. Torque the hex nuts in sequence and to the value specified.~~

8/29/00

18. With slings supporting No. 1 intermediate (or bottom) shaft (23), use a strap wrench to thread it into coupling (25). Restrain coupling from rotating.

19. With slings supporting bottom tube (19), use a strap wrench thread it on top case bearing (12).

20. With a sling supporting jump bearing (26), use a strap wrench to thread it to jump bearing (26).

21. With slings supporting special tube (21), use a strap wrench to thread it to jump bearing (26).

22. Lubricate O-ring with an approved site lubricant and install it in it groove on bearing tee (29).

23. With a sling supporting bearing tee (29), use a strap wrench to thread it to special tube (21).

Lubrication of Suction Bell Bearing

24. Remove the pipe plug from the side of the suction bell bearing cavity. Install a grease fitting and slowly fill the cavity with Chevron Moly Grease, Grade 2, or equal until the grease flows from between the bearing cavity and the sand cap. Remove the grease fitting and reinstall the pipe plug.

NOTE

This completes the pump bowl reassembly operations. If the pump is to be placed into service, assemble and install in its foundation following the instructions given in paragraph 3.4. If the pump is to be place in storage, follow the instructions of paragraph 3.8.

SECTION SIX - SPARE PARTS

6.1 RECOMMENDED SPARE PARTS

REF. NO.	NAME OF PART	QTY/PUMP
410	Pump Shaft	1
424	Case Wear Ring	1
461	Bottom Bearing	1
463	Top Case Bearing	1
490	Shaft Sleeve (stuffing box)	1
490-1	Shaft Sleeve (bottom bearing)	1
523	Intermediate column shaft	5
524	Top column shaft	1
531	Jump Bearing	1
532	Tube Bearing	6
536	Tube Bearing Tee	2
536-H-62	Bearing O-ring	2
572-H-63	Rings of Packing	8
577-H-62	O-Ring - Packing Ring	1

6.2 ORDERING SPARE PARTS

1. Standard Parts: When ordering standard replacement parts, be certain to state:

   a. Parts for pump of type, service and serial number shown on nameplate.

   b. Correct part and reference numbers as shown on the Materials of Construction, Section Seven.

2. Parts for pumps on which operating conditions have been changed:

   If operating conditions have been changed since pump was purchased, add full particulars of new operating conditions. This is especially important in selection of a replacement impeller.

   NOTE

   Should a change in operating conditions be considered, consult nearest Pump Division representative or the dealer from whom the unit was purchased to determine whether such a change is feasible.

3. Oversized or Undersized Parts: If oversized or undersized parts are required add:

   a. Dimensions (with sketch of part, if possible).

b. "Pump Division to finish" or "leave rough - customer to finish".

NOTE

Customer finishes parts at customer's own risk.

4. Field Alterations: BW/IP International, Inc., Pump Division, accepts no responsibility for incorrect replacement of original parts or for parts which have been altered in the field.

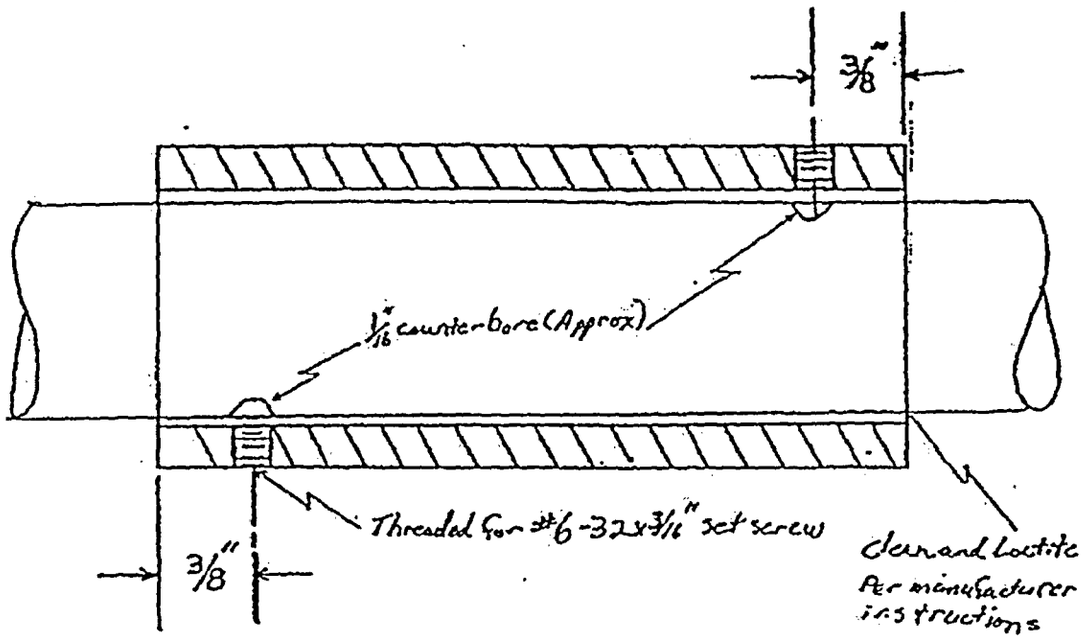
6.3 STORAGE OF SPARE PARTS

In general, spare metal parts can be stored indefinitely if adequately protected from moisture and physical damage. Rubber parts such as spare o-rings have a shelf life of up to 3 years if stored in original heat sealed packaging and are adequately protected from air, light, ozone, radiation, excessive temperature (102°F), contamination and physical damage.

SECTION SEVEN - REFERENCE MATERIALS

MATERIAL	NUMBER	TAB
Pump Sectional Drawing	IF-6921	A
Materials of Construction	MC-1543	A
Pump Outline Drawing	2c-4747	B
Torquing Instructions	GS-1507	C

SHAFT SLEEVE INSTALLATION



- 3 set screws 6-32x3/16 to be spaced equally around the circumference
- ℄ of set screws to be located 3/8" in from the end of the sleeve.
- use Cup Point Set Screw (18-8).
- Loctite Set Screw In Place

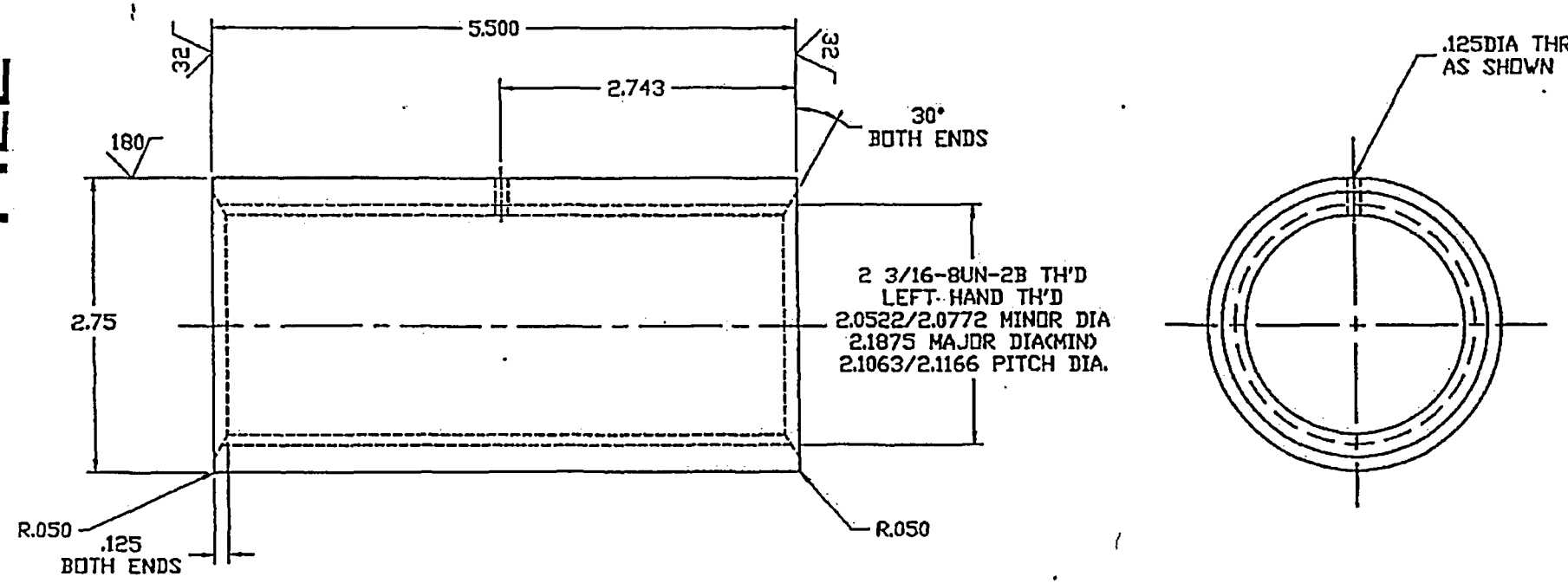
NPPD DRAWING

SKE-1

E Cust. NPPD
S P.O. 4500021359
& Item 10
S Reviewed & Approved
C By [signature] Date 4/18/02

QADEPT

FILE



NOTES.
1. MATERIAL. ASTM A479 TYPE410 CL.2 , EDITION 1989.
2. ALL DIMENSIONS SHOWN ARE ACTUAL .
3. ALL DIMENSIONS SHOWN ARE IN INCHES.
4. THREAD TOLERANCES PER ANSI B1.1 .

DO NOT SCALE.

TOLERANCE ±
1. FRACTIONAL
2. DECIMAL .XX .XXX .XXXX
3. ANGLES
4. SURFACE FINISH
5. BREAK SHARP EDGES
6. FILLET RADII

	INITIAL	DATE
DRAWN BY	D.P.	2/27/02
CHECKED BY		
QA REVIEW BY		

Home of the "Duke of Mule"

ENERGY STEEL & SUPPLY CO.

DESCRIPTION: COUPLING
REF. DRAWING No.: REVERSE ENGINEERING
ESC DRAWING No.: 18748
ESC PART No.: SMAC18748101
DRAWING No.: 1273
REV: 0
DATE: 2/27/02
SHEET: 1

Comparison of Byron Jackson to Johnston Pump Component Part Numbers

(Result of the changes made by CED6008700)

Description	Byron Jackson	Johnston
Bowl Assembly	N/A	71756-D
Bottom Bearing	461	71716-A
Bottom Shaft Sleeve	490-1	71715-A
Sand Cap	482	71720-A
Impeller Liner	443	71713-B
Impeller	411	71712-B
Case Wear Ring	424	71717-A
Impeller Key	411-H-57	80016-AN
Split Ring	411-H-56	71719-A
Thrust Collar	411-H-55	71718-A
Top Case	433	71710-B
Top Case Bearing	463	71721-A
Bottom Pump Shaft	410	71714-B
Suction Bell	441	71711-B
Tube Bearing	532	71722-A
Tube Tee Bearing	536	71723-A
Jump Bearing	531	71724-A
Shaft Coupling	525	71725-A
Top Shaft	524	71726-A
Column Shaft (Intermediate)	523	71727-A
Tension Nut	572	71728-B
Top Shaft Sleeve	490	71729-A

Reference Byron Jackson Drawing IF-6921 and Johnston Pump Drawings 71728-D & 71756-D for applicable components.

4590062305

BW/IP International, Inc. Pump Division Los Angeles Operations

Per VMCF 93-350

Byron Jackson® Products

PROCEDURE NUMBER MC-1543 REV. C

SERVICE WATER PUMPS
NEBRASKA PUBLIC POWER DISTRICT
COOPER NUCLEAR STATION
CONTRACT E68-46 (91-36)
681-H-0441/44

PREPARED BY Raul L Castillo DATE 8-30-93

MANUFACTURING APPROVAL BY — — — DATE — — —

METALLURGY APPROVAL BY R. L. Shaw DATE 30 AUGUST 1993

QUALITY ASSURANCE APPROVAL BY — — — DATE — — —

ENGINEERING APPROVAL BY J A Bartholomew DATE 30 AUG 93

REVISION DESCRIPTION

PARAGRAPH	CONTENT
Item 1	Added, Note 1
Item 2,6,9	Added or CF-3M
Item 13	Was B-144 Alloy 3B
Item 14	Was A-276, Type 416
Item 15-18,30	Added or 70
Item 23,24	Added, Note 1
Item 31	Was B-145 GR 4A
Item 32	Was B-147 GR 8A
Item 40	Was A-107, GR 1018
Item 35	Was Neoprene
Item 38	Specified Condition T
Item 42	Was A-276, Type 416

MATERIALS OF CONSTRUCTION
SERVICE WATER PUMPS
NEBRASKA PUBLIC POWER DISTRICT
COOPER NUCLEAR STATION
CONTRACT E68-46

REF: BW/IP INTERNATIONAL, PUMP DRAWING NO.: 1F-6921-B
PUMP SERIAL NUMBERS: 681-H-0441 THRU 681-H-0444
PUMP MODEL: 28KXL 1-STAGE

ITEM NO.	REF. NO.	QTY.	DESCRIPTION	MATERIAL
1	410	1	Pump Shaft	A-479 TP. 410 CL.2 Note 1
2	411	1	Impeller	A-351, GR.CF-8M or CF-3M
3	411-H-55	1	Thrust Collar	B584 UNS C90300
4	411-H-56	1	Split Ring	A-479 TP. 410 CL.2
5	411-H-57	1	Key.- Impeller	A-582 TP. 416 Cond.T
6	424	1	Case Wear Ring	~~A-351, GR. CF-8M or CF-3M~~
7	433	1	Top Case	~~A-48, CL. 30B~~ A216 WCB
8	441	1	Suction Bell	~~A-48, CL. 30B~~
9	443	1	Impeller Liner	A-351, GR. CF-8M or CF-3M
~~10~~	~~449~~	~~1~~	~~Suction Strainer~~	~~Type 316 Fabrication~~
11	461	1	Bottom Bearing	B271, B505 & B584 UNS C93200 or CDA 93600
12	463	1	Top Case Bearing	Nitrile Rubber/A-743 GR. CA15 Shell
13	482	1	Sand Cap	B-584 UNS C93200
14	490	1	Shaft Sleeve	A-582 Condition H
15	510	1	Column - Lower	A-515, GR. 60 or 70
16	511	1	Column - Bottom	A-515, GR. 60 or 70
17	512	1	Column - Interm.	A-515, GR. 60 or 70
18	513	1	Column - Top	A-515, GR. 60 or 70
19	518	1	Tube - Bottom	A-106 GR. B
20	519	5	Tube - Interm.	A-106 GR. B
21	519-01	2	Tube - Special	A-106 GR. B
22	521	1	Tube - Top	A-120 GR. B
23	523	4	Column Shaft - Interm.	A-479 TP. 410 CL.2 Note 1
24	524	1	Column Shaft - Top	A-479 TP. 410 CL.2 Note 1
25	525	5	Shaft Coupling	A-479 TP. 410 CL.2

DJ 02/29/00

LAO ENGRG.

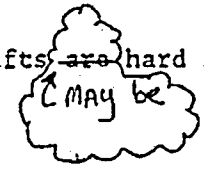
Per VMCF 93-350

ITEM NO.	REF. NO.	QTY.	DESCRIPTION	MATERIAL
26	531	1	Jump Bearing	Nitrile Rubber/A-743 GR. CA15 Shell
27	532	6	Tube Bearing	Nitrile Rubber/A-743 GR. CA15 Shell
28	536	2	Tube Bearing - Tee	Nitrile Rubber/A-743 GR. CA15 Shell
29	536-H-62	2	"O" Ring - Bearing	Nitrile
30	551	1	Discharge Head	A-515, GR. 60 or 70
31	562	1	Split Gland	B-584 UNS C83600/C90300/C90500
32	572	1	Packed Tension Nut	B-505/271/584 UNS C86500 or UNS C95200
33	572-H-63	8	Rings of Packing	Chesterton ¼ x ¼ style 1710
34	577	1	Packing Ring	A-108/A-575/A-576 GR. 1010 thru GR. 1025
35	577-H-62	1	"O" Ring - Packing Ring	Nitrile
36	578	1	Head Nipple	A-106 GR. B
37	581	1	Pump Half Coupling	A-108/A-575/A-576 GR. 1010 thru GR. 1025 Phosphate Coat
38	581-H-57	1	Key	A-582, TP. 416 Condition T
39	582	1	Drive Half Coupling	A-108/A-575/A-576 GR. 1010 thru GR. 1025 Phosphate Coat
40	582-H-56	1	Split Ring	A-108/A-575/A-576 GR. 1010 thru GR. 1025 Phosphate Coat
41	584	1	Adjusting Plate	A-108/A-575/A-576 GR. 1010 thru GR. 1025 Phosphate Coat
42	490-1	1	Shaft Sleeve	A-582 Condition H
BOLTING				
			Suction Bell To Series Case	
43	-	24	Studs .750-10NC x 3.500 Lg.	Carbon Steel
44	-	24	Hex Nuts .750 - 10NC	Carbon Steel
			Top Case to Column	
45	-	24	Hex Hd. Cap Screw .750-10UNC x 4.00 Lg.	SAE GR.5
46	-	24	Hex Nuts .750 - 10UNC	Carbon Steel

ITEM NO.	REF. NO.	QTY.	DESCRIPTION	MATERIAL
			Column To Column	
47		32	Studs 1.00-8UNC x 4.50 Lg.	4140 HT. GR.B7
48	-	96	Hex Head Cap Screws 1.00-8UNC x 4.500 Lg.	SAE GR. 5
49	-	128	Hex Nuts 1.00-8UNC	Carbon Steel
			Impeller Liner	
50	-	8	Studs .500-13NC x 2.50 Lg.	Carbon Steel
51	-	8	Hex Nuts .500-13NC	Carbon Steel
			Discharge Head To Sole Plate	
52	-	8	Studs	Carbon Steel
53	-	8	Hex Nuts	Carbon Steel
			Drive Coupling	
54	-	6	Hex Head Capscrews	Carbon Steel

NOTES:

1. Shafts ~~are~~ hard surfaced with Tungsten Carbide (88°b) and Cobalt (12%) under rubber bearings.



Per VMCF 93-35 Q

MATERIALS OF CONSTRUCTION (CONTINUED)

ITEM NO.	REF. NO.	QTY.	DESCRIPTION	MATERIAL
			Thrust Collar To Impeller	
NA		4	Hex Soc. Head Capscrews	300 Series S/S
			Wear Rings	
NA		3	Hex Soc. Head Set Screw	300 Series S/S
			Bottom Bearing and Sand Cap	
NA		2	Soc. Head Set Screw 1/2 Dog	300 Series S/S
	08/29/00		~~Suction Bell To Strainer~~	
~~NA~~		~~8~~	~~Hex Hd. Cap Screw~~	~~Carbon Steel~~
			Gland To Stuffing Box	
NA		2	Studs	300 Series S/S
NA		2	Hex Nut	300 Series S/S
			Split Gland	
NA		2	Hex Head Cap Screws	300 Series S/S
			Motor To Pump	
NA		8	Hex Head Cap Screw	SAE GR. 5

Per VMCF 93-350

45400 0203

BW/IP International, Inc. Pump Division Los Angeles Operations

Byron Jackson® Products

PROCEDURE NO. GS-1507, REV. D

BOLT TORQUING PROCEDURE FOR VERTICAL COMMERCIAL PUMPS

PREPARED BY Joe Waugh DATE 5/4/93

MANUFACTURING APPROVAL BY N/A DATE

METALLURGY APPROVAL BY N/A DATE

QUALITY ASSURANCE APPROVAL BY N/A DATE

ENGINEERING APPROVAL BY N/A DATE

REVISION DESCRIPTION

PARAGRAPH	CONTENT
5.2	Added Bill of Materials

BOLT TORQUING PROCEDURE FOR VERTICAL COMMERCIAL PUMPS

1.0 SCOPE

This procedure specifies the bolt torquing method and torque values to be used for pump assembly.

2.0 APPLICATION

2.1 In general this procedure applies to bolting at the following joints: case to case, case to column, column to column, column to discharge head, head to barrel, head to sole plate, foundation bolts, seal flange, stuffing box, drive coupling and any other major bolting.

2.2 All external bolting on sub-assemblies or pumps shipped assembled, must be retorqued to specified values before installation.

3.0 THREAD LUBRICANT

Thread lubricant shall be Nickel Never-Seeze or equal.

WARNING: Specified torque values in this procedure are dependent upon strict adherence to lubrication and cleaning procedures specified herein.

4.0 INSPECTION, CLEANING AND LUBRICATION

4.1 All threads shall be examined to insure that there are no incompletely cut threads, burrs, nicks or metallic slivers. Discard or upgrade any bolting which does not pass visual inspection.

4.2 Solvent shall be used to clean all mating surfaces of the fasteners to insure foreign matter, grease, corrosion, rust, and previous lubricant is removed.

4.3 Mix or agitate thread lubricant well before using. Apply a uniform layer of lubricant to all surfaces which experience relative motion including threads, nuts, washers, and flange.

5.0 BOLT TORQUING

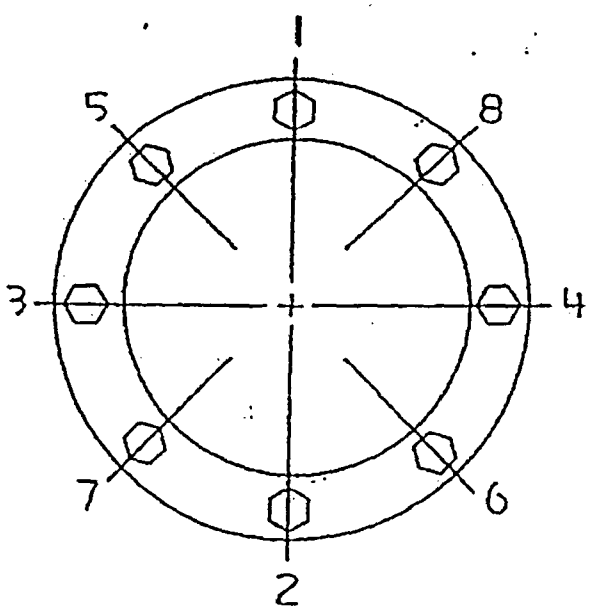
5.1 Flange mating surfaces shall be thoroughly cleaned. Assemble joint and hand tighten all fasteners to insure uniform metal-to-metal contact of the flange mating surfaces.

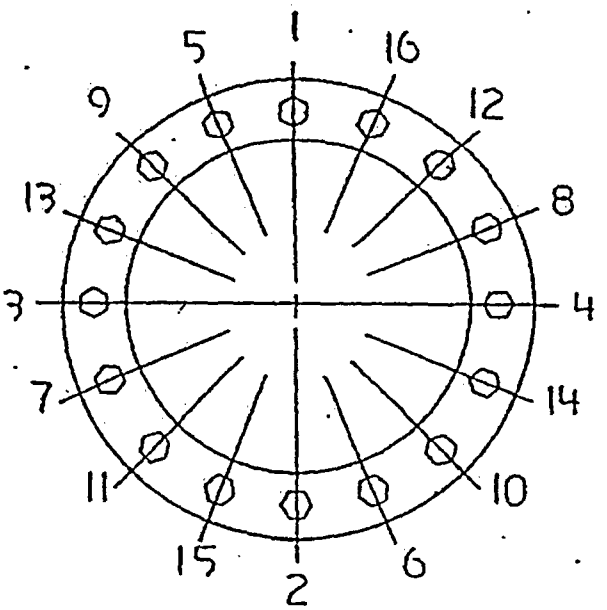
5.2 Refer to Sectional Drawing or Bill of Materials for information regarding the category (metallurgical class), and select torque value from chart on Page 4 of 5.

5.3 Using the proper size torque wrench (work in 1/4 to 3/4 of wrench scale), pretorque fasteners with an even steady pull to approximately 1/3 of the torque value in the sequence specified in Paragraph 5.3. Repeat sequence increasing torque to approximately 2/3 of the specified value. Finally repeat sequence for the specified torque.

NOTE: Do not use pneumatic impact wrenches.

Start with any bolt and identify as (1) and location designated as 0°. Bolt (2) will be at 180°; bolt(3) at 270°; and bolt (4) at 90°. Using counterclockwise rotation, tighten bolt (5), (see examples below) and continue rotation until all bolts have been tightened.





TORQUE (FT.-LBS.)

SIZE	CATEGORY-1 [1][3]		CATEGORY-II [2][3]	
3/8-16UNC	16	(221)	8	(111)
7-16-14UNC	27	(373)	14	(194)
1/2-13UNC	40	(553)	20	(277)
9/16-12UNC	60	(830)	30	(415)
5/8-11UNC	80	(1106)	40	(553)
3/4-10UNC	130	(1798)	65	(899)
7/8-9UNC	210	(2904)	105	(1452)
1-8UNC	330	(4564)	165	(2282)
1-1/8-7UNC	520	(7192)	260	(3596)
1-1/8UN	470	(6500)	240	(3319)
1-1/4-7UNC	730	(10096)	370	(5117)
1-1/4-8UN	670	(9266)	340	(4702)
1-3/8-6UNC	970	(13415)	490	(6777)
1-3/8-8UN	910	(12585)	460	(6362)
1-1/2-6UNC	1170	(16181)	590	(8160)
1-1/2-8UN	1070	(14798)	540	(7468)
1-3/4-5UNC	2070	(28628)	1040	(14383)
1-3/4-8UN	2000	(27660)	1000	(13830)
2-4 1/2UNC	3000	(41490)	1500	(20745)
2-8UN	2930	(40522)	1470	(20330)

NOTES:

[1] Based on approximately 40,000 psi prestress.
[2] Based on approximately 20,000 psi prestress.
[3] See page 5 for typical materials.
( ) Values in Kg-CM

CATEGORY-I:

ASTM NO.	COMMON NAME	APPROXIMATE STRENGTH (KSI) MIN. YIELD	TENSILE
A-193 GR. B7	4140	105	125
A-193 GR. B6	410	85	110
A-193 GR. B16	410	105	125
A-193 GR. B5	501	80	100
A-325 TP. 1	1030	81	105
A-354 GR. BD	Alloy Steel	78	90
A-453 GR. Cl. A	Stainless Steel	70	100

CATEGORY-II:

ASTM NO.	COMMON NAME	APPROXIMATE STRENGTH (KSI) MIN. YIELD	TENSILE
A-576 GR. 1018	1018	32	58
A-193 GR. B8 Cl. 1	304	30	75
A-320 GR. B8 Cl. 1	304	30	75
A-479 GR. 302	302	30	75
A-479 GR. 304	304	30	75
A-479 GR. 316	316	30	75
A-479 GR. 410	410 (Annealed)	40	70
B-98 Alloy C 6610	Sil. Brz. (HO2 Temper)	38	70
B-150 Alloy C 64200	Al. Brz.	45	85
B-164 Alloy N 04400	Monel (Annealed)	25	70

NOTE: Properties from ASTM 1982 and 1983 editions. Properties vary with fastener size and heat treatment

BW/IP International, Inc. Pump Division Los Angeles Operations

Per VMCF 97-0002

Byron Jackson® Products

DOCUMENT NUMBER GS-1680 REV. 0

COLUMN SHAFT STRAIGHTENING PROCEDURE
NEBRASKA PUBLIC POWER DISTRICT
COOPER NUCLEAR STATION

SERVICE WATER PUMPS
28KXL 1 STG VTC S/N 681-H-0441/4

PREPARED BY J A Bartholomew DATE 21 Dec 94

MANUFACTURING APPROVAL BY --- DATE ---

METALLURGY APPROVAL BY J A Bartholomew DATE 21 Dec 94

QUALITY ASSURANCE APPROVAL BY --- DATE ---

ENGINEERING APPROVAL BY [signature] DATE 21 DEC '94

REVISION DESCRIPTION

PARAGRAPH	CONTENT
---	Original Issue

Per VMCF 97-0002

1.0 SCOPE

This procedure is written in response to NPPD Purchase Order Number 388975 and provides instructions for checking, and straightening column shafting for the Cooper Nuclear Station Service Water Pump. All vertical pump shafting is checked for straightness prior to shipment. Handling in transit and in storage can affect straightness and it is recommended that all vertical pump shafting be checked before installation. Since the shafting for this pump has hadrsurfaced areas under the bearing, special precautions are required to prevent damage to these areas during straightening.

2.0 ACCEPTANCE CRITERIA

2.1 Intermediate Column Shafts.

2.1.1 Straight within .007 over the entire length.

2.1.2 Straightness deviation not more than .001 in any one foot length.

2.1.3 The shaft shall have no twists which are defined as a change in the apex of runout condition of more than 45° as the shaft is indicated.

2.2 Top Column and Pump Shaft

2.2.1 Straight within .002 over the entire length.

2.2.2 Straightness Deviation not more than .001 in any one foot length.

2.2.3 The shaft shall have no twists which are defined as a change in the apex of runout condition of more than 45° as the shaft is indicated.

3.0 PROCEDURE

3.1 Temperature

3.1.1 All Checking and straightening operations shall be performed at ambient room temperature.

3.2 Equipment

3.2.1 A dial indicator reading in increments of 0.0001 inch shall be used to measure runout during the checking and straightening sequence.

Per VMCF 97-0002

3.2.2 Straightening shall be performed using a hydraulic press. All blocking and support equipment that is used to hold the shaft during the straightening operation shall be contoured to approximate the diameter of the shaft to prevent damage to the surface of the shaft.

3.3 Sequence.

3.3.1 Prior to the straightening operation, wrap the bearing areas with polyethylene and seal with tape.

3.3.2 Check the runout by using the dial indicator with the shaft supported on rollers, not on centers. Do not place supports under the bearing areas. If the runout meets the acceptance criteria, then verify that the shaft ends are free from burrs or foreign particles which can cause misalignment, and proceed with installation. If the runout is not acceptable, then proceed to paragraph 3.3.3.

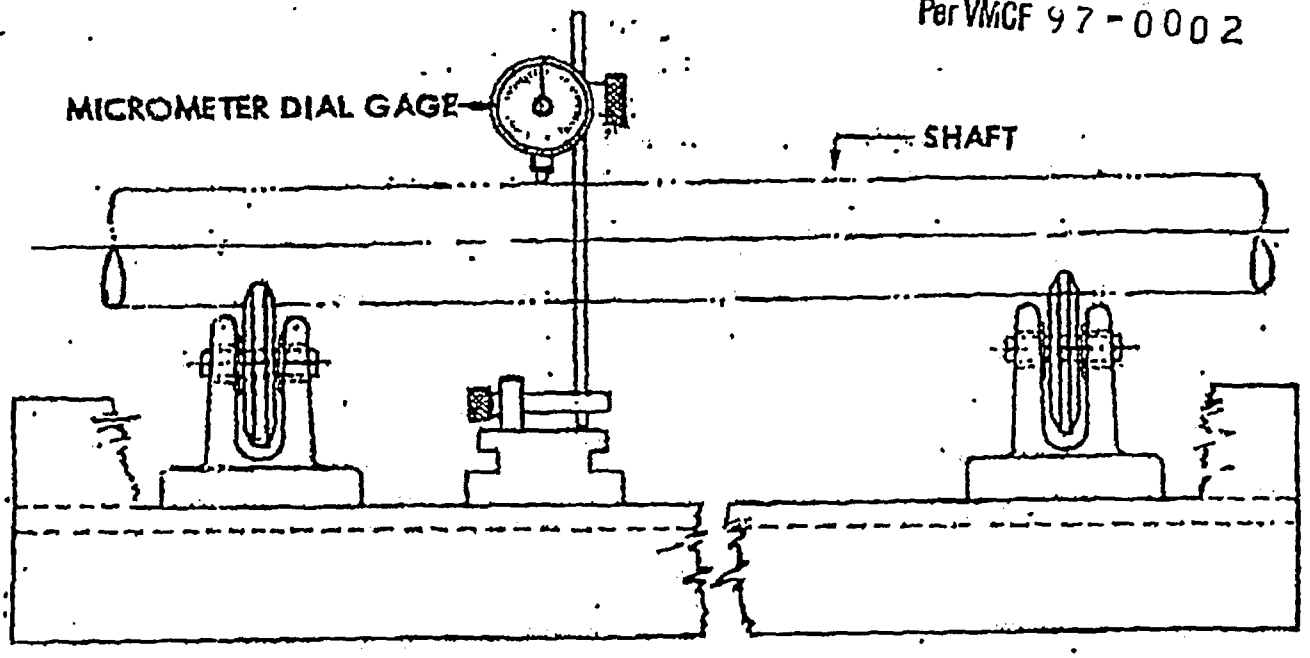
3.3.3 Straighten the shaft by placing contoured saddles at three to four foot intervals and deflecting the shaft with a hydraulic press. Do not apply pressure or support the shaft at the bearing areas. The amount of deflection should be measured and recorded such that the amount of permanent deformation that occurs 180° from the original runout does not exceed 50% of the original runout.

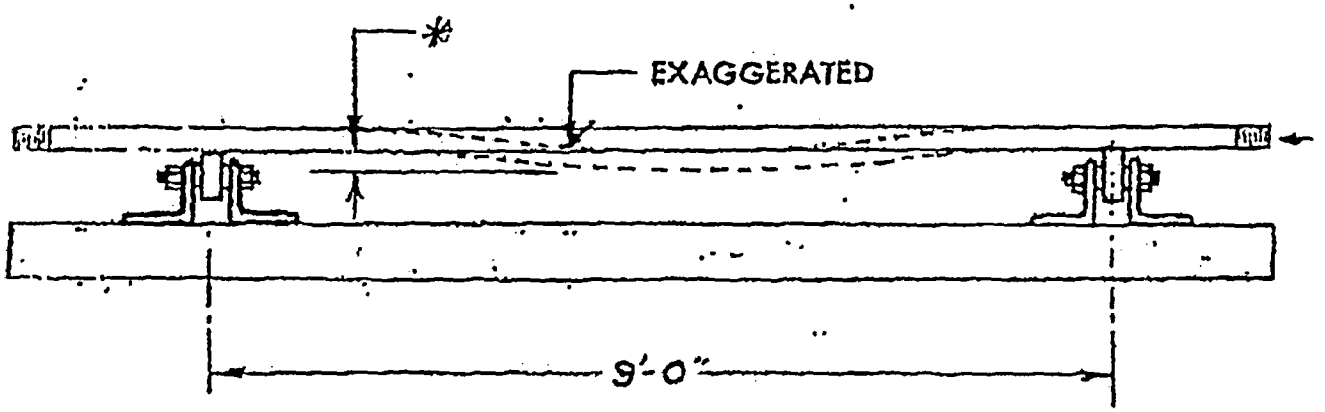
3.3.4 Check the runout. If the runout is unacceptable then repeat the straightening and checking sequence in paragraph 3.3.2 and 3.3.3 until the runout is acceptable.

4.0 POST STRAIGHTENING EXAMINATION.

After straightening, the shaft shall be liquid penetrant or magnetic particle examined. No circumferentially oriented linear indications over 0.0625 inch length are allowed. Do not remove the protective warpping from the bearing area until the liquid penetrant examination is complete.

Per VMCF 97-0002





TO TEST SHAFT TURN IT AROUND ITS AXIS

* EXAMPLE: 10' SHAFT x 0.0005" = 0.005"

CHESTERTON® 1710

Beat Frictional and Environmental Concerns

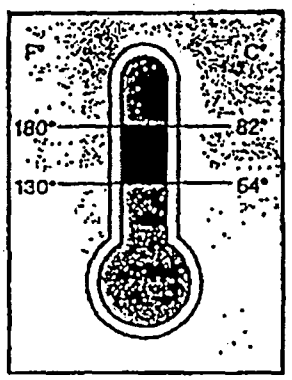
- *Continuous Filament Fiberglass Yarn Smooth as Glass!*
- *Chemical Resistant*
- *Low Friction*
- *Long Life*
- *Triple Lubrication Treated*

CHESTERTON® 1710

CHESTERTON FIBERGLASS PTFE PACKING is manufactured from an exclusive CHESTERTON continuous fiberglass yarn that has a chemical resistance not provided in conventional type E or C glass. Each strand of 1710 glass yarn is treated with PTFE suspensoid then interbraided and once again treated with PTFE. An additional break-in lubricant is also incorporated. The combination of full lubrication and interbraid construction produces a natural square packing having better sealing contact with reduced gland pressure.

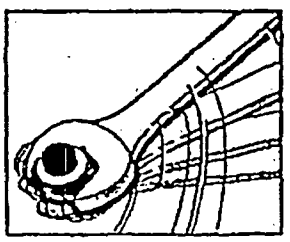
COOLER RUNNING

Fiberglass yarns receive multi-treatment of PTFE suspensoid plus a special break-in lubricant. Reduces temperature rises due to friction by up to 50°F (28°C) as compared to PTFE treated asbestos yarns.



NON-HARDENING FEWER ADJUSTMENTS

Asbestos is inherently a hard fiber. Under heat it can become rock-hard. Unlike many yarns, fiberglass yarns never harden or solidify, control leakage quickly at start-up, require fewer adjustments during their longer life.



VERSATILE

1710 is a packing capable of a wide variety of uses throughout a plant. It may be used on water, steam, solvents, mild acids and alkalies, and slurries in pumps, expansion joints, mixers and agitators to 500°F (260°C). 1710 resists scoring of stainless or plated shafts and, containing no graphite will not cause pitting to rods or shafts.

RUGGED

1710 has proven itself in mild abrasive applications. It is the packing of choice in these severe application services. 1710 reduces shaft wear while giving extended service.

SERVICE CONDITIONS

1710 FIBERGLASS is applicable for most fluids within a pH range of 3–11. 1710 is not recommended for use with strong acids such as Hydrofluoric (HF), Acetic (CH_3COOH), Sulfuric (H_2SO_4), Hydrocholoric (HCl), Nitric (HNO_3), Phosphoric (H_3PO_4) or strong bases such as Sodium Hydroxide (NaOH), Potassium Hydroxide (KOH), Ammonium Hydroxide (NH_4OH). Strict observance of the pH range of 3–11 is recommended.

TEMPERATURE RANGE

To 500°F (260°C)

SPEED

1200 ft./min. (6 m/sec.)

APPROXIMATE DATA

INCH	MM	LBS.	KG.	REORDER NO.	FT/LB	M/KG
3/16	4,8	2	0,908	4082	505,6	154,1
	6,0	2	0,908	4083	328,0	100,4
1/4	6,4	2	0,908	4084	293,7	89,9
		5	2,270	4073		
5/16	8,0	2	0,908	4085	214,8	65,8
		5	2,270	4074		
3/8	9,5	2	0,908	4086	151,2	46,8
		5	2,270	4075		
		10	4,540	4081		
	10,0	2	0,908	4087	136,8	41,9
		5	2,270	4076		
7/16	11,1	5	2,270	4077	107,8	33,2
	12,0	5	2,270	4078	93,1	28,4
		10	4,540	4082		
1/2	12,7	2	0,908	4070	75,6	23,8
		5	2,270	4079		
		10	4,540	4083		
9/16	14,3	5	2,270	4080	64,7	19,2
		10	4,540	4084		
5/8	15,9	10	4,540	4085	52,1	15,9
11/16	17,5	10	4,540	4086	42,9	13,1
3/4	19,1	10	4,540	4087	36,0	11,0
13/16	20,6	10	4,540	4088	30,5	9,3
7/8	22,2	10	4,540	4089	26,1	7,9
15/16	23,8	10	4,540	4083	22,6	6,9
1	25,4	10	4,540	4094	19,5	6,0

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