INCH-POUND

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PERFORMANCE SPECIFICATION
PACKING MATERIAL, BRAIDED, NON-ASBESTOS

This specification is approved for use by the Naval Sea Systems Command, Department of the Navy, and is available for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification establishes the requirements for braided non-asbestos packing material for rotary, centrifugal, and reciprocating pumps handling various fluids and gases on naval ships.

1.2 Classification. The packing is of the following types and classes as specified (see 6.2).

Type I -- Rotary and centrifugal pump applications

Class A - Class A meets the requirements for all of the following services:
Fresh water (150 pounds per square inch differential (psid)/250 degrees Fahrenheit (ºF)/max. shaft speed 4,000 feet per minute (fpm)).
Seawater (500-625 psid/75 ºF/max. shaft speed 1,700 fpm).
Boiler feedwater (100 psid/300 ºF/max. shaft speed 5,400 fpm).

Type II -- Reciprocating pump applications.

Class A - Saturated L.P. steam (300 psid/420 ºF/max. shaft speed 170 fpm).

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3 and 4 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements documents cited in sections 3 and 4 of this specification, whether or not they are listed.

2.1 Government documents.

2.1.1 Other Government documents, drawings and publications. The following other Government documents, drawings, and publications form a part of this document to the extent specified herein. Unless otherwise specified, the issues are those cited in the solicitation.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, Naval Sea Systems Command, SEA 03R42, 2531 Jefferson Davis Hwy, Arlington, VA 22242-5160 by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A FSC 5330

CODE OF FEDERAL REGULATIONS (CFR)

29 CFR 1910.1000	Subpart Z, Toxic and Hazardous Substances.
29 CFR 1910.1200	Hazard Communication Standard.
29 CFR 1990	Identification, Classification, and Regulation of Potential Occupational Carcinogens.
40 CFR 60 Appendix A	Method 24-Determination of Volatile Matter Content, Water Content, Density, Volume Solids, and Weight Solids of Surface Coatings.
40 CFR 82	Protection of Stratospheric Ozone.
40 CFR 355 Appendixes A and B	The List of Extremely Hazardous Substances and Their Threshold Planning Quantities.
40 CFR 372.65	Specific Toxic Chemical Listings.
49 CFR 171-178	Hazardous Materials Regulations.

(Application for copies of Code of Federal Regulations (CFR) should be addressed to the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402-0001.)

NATIONAL TOXICOLOGY PROGRAM (NTP)

Latest Annual Report On Carcinogens, Summary, National Toxicology Program.

(Application for copies should be addressed to the U.S. Department of Health and Human Services, National Institute of Environmental Health Sciences, Public Information Office, P.O. Box 12233, MD B2-04, Research Triangle Park, NC 27709.)

2.2 Non-Government publications. The following document(s) form a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents which are DoD adopted are those listed in the issue of the DoDISS cited in the solicitation. Unless otherwise specified, the issues of documents not listed in the DoDISS are the issues of the documents cited in the solicitation (see 6.2).

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

D 129	Standard Test Method for Sulphur in Petroleum Products (General Bomb Method). (DoD adopted)
D 512	Standard Test Methods for Chloride Ion in Water. (DoD adopted)
D 1179	Standard Test Methods for Fluoride Ion in Water. (DoD adopted)
D 1246	Standard Test Method for Bromide Ion in Water. (DoD adopted)
D 3850	Standard Test Method for Rapid Thermal Degradation of Solid Electrical Insulating Materials by Thermogravimetric Method.
E 144	Standard Practice for Safe Use of Oxygen Combustion Bombs.
F 152	Standard Test Methods for Tension Testing of Nonmetallic Gasket Materials. (DoD adopted)

(Application for copies should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103-1187.)

INTERNATIONAL AGENCY FOR RESEARCH ON CANCER (IARC)

International Agency for Research on Cancer (IARC) Monographs

(Application for copies should be addressed to the WHO Publication Center, 49 Sheridan Avenue, Albany, NY 12210.)

2.3 Order of precedence. In the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 Qualification. Packing material furnished under this specification shall be products that are authorized by the qualifying activity for listing on the applicable qualified products list before contract award (see 4.3 and 6.3).

3.2 Material.

3.2.1 Composition. The packing material ingredients, shape and construction shall conform to that of the sample submitted for qualification inspection. For braided packing, except for 1/8-inch and 3/16-inch sizes, the material shall be braided to a diagonal interlocking through body-to-surface construction (as opposed to braid-over-braid or square-braid construction) to product a dense packing with good dimensional stability. The 1/8-inch and 3/16-inch braided packings shall be square plait-braided.

3.2.2 Recycled, recovered, or environmentally preferable materials. Recycled, recovered, or environmentally preferable materials should be used to the maximum extent possible provided that the material meets or exceeds the operational and maintenance requirements, and promotes economically advantageous life cycle costs.

3.3 Performance characteristics.

3.3.1 Flexibility. The packing shall be flexible enough to be formed readily into coils to fit a rod with a diameter which is equal to five times the size of the packing. Any sign of voids or separations between the rod and the packing shall be cause for disqualification (see 4.6.1 and 6.7).

3.3.2 Packing and fluid compatibility. To qualify for each specific type and class (see 1.2), the packing material shall be immersed in the fluids specified in table I and shall meet the requirements of 3.3.2.1 through 3.3.2.3.

TABLE I. Immersion fluids for compatibility tests.

Type	Fluid
Type I, Class A	Fresh water and Seawater, and Boiler feedwater
Type II, Class A	Fresh water

3.3.2.1 Flexibility and fluid compatibility. Fluid media effect on flexibility shall be determined after fluid immersion (see 4.6.2.1). Any signs of voids or separations between the rod and the packing shall be cause for disqualification of a material for the class that includes the fluid which caused the change.

3.3.2.2 Dimensional stability and fluid compatibility. Fluid media effect on dimensional stability shall be determined by comparing cross-sectional dimensions of a sample of 1/2-inch square packing after fluid immersion with packing dimensions before immersion (see 4.6.2.2). A 5 percent or greater change from the original dimensions shall be cause for disqualification of a material for use in the fluid which caused the change.

3.3.2.3 Tensile strength and fluid compatibility. Fluid media effect on tensile strength shall be determined by comparing tensile strength measurements before and after fluid immersion (see 4.6.2.3). Post immersion tensile strength measurements shall be no less than 95 percent of pre-immersion tensile strength measurements. A tensile strength which is less than 95 percent of the tensile strength of the reference (pre-immersion) material shall be cause for disqualification of material for use in the fluid which caused the change.

3.3.3 Thermogravimetric analyzer (TGA) analysis. Thermogravimetric analyses shall be conducted to determine weight loss as a function of heat. Material weight loss as a function of heat shall be recorded and compared with original (pre-heating) material measurements. If weight loss exceeds 10 percent at a temperature which is less than the applicable temperature specified in 1.2, the material shall be disqualified (see 4.6.3).

3.4 Detrimental materials.

3.4.1 Halogen concentration. Packing materials, Type I, Class A and Type II, Class A, shall be tested for halogen concentration (that is, the sum of total bromide, total chloride, and total fluoride ions) (see 4.6.4.1). The following limits shall apply:

(a) Either total halogens shall not exceed 250 parts per million (ppm), or

(b) Halogen concentration excluding fluoride shall not exceed 250 ppm and the packing manufacturer shall certify in writing that: "the only intentionally added, fluoride-bearing ingredient is polytetrafluoroethylene," or
(c) The sum of water-leachable halogens shall be less than 250 ppm when tested as specified in 4.6.4.1.1.

3.4.2 Total sulfur concentration. Packing materials, Type I, Class A, and Type II, Class A, shall be tested for total sulfur concentration which shall not exceed 700 ppm unless otherwise approved by NAVSEA when tested as specified in 4.6.4.2.

3.4.3 Mercury. During manufacturing, fabrication, handling and packaging, the pump packing (all types and classes) shall not come into contact with mercury or mercury compounds.

3.4.4 Other detrimental materials. For packing materials, Type I, Class A, and Type II, Class A, the maximum concentrations specified in table II also apply (see 4.6.4.3).

TABLE II. Other detrimental materials.

Material	Max concentration (ppm)
Cadmium	250
Lead	250

3.4.5 Asbestos and polychlorinated biphenyls (PCBs). No asbestos or PCBs shall be used in the packing material (all types and classes) (see 6.3).

3.5 Simulated service testing. Packing materials shall be tested as specified in 4.6.5.

3.5.1 Packing gland leakage rates. Maximum allowable value of the average overall leakage rates during simulated service testing of rotary and reciprocating pump packings shall be as specified in table III (see 4.6.5 and 6.6).

TABLE III. Maximum allowable value of average overall packing gland leakage rates.

Type/class packing	No. packing rings	Shaft speed (fpm.)	Fluid media	Maximum allowable value of average overall leakage rate (max) 1/
Type I, Class A	5	4000	Fresh water	300 mL/min.
	4	2100	Fresh water	60 mL/min.
	4	1700	Seawater	411 mL/min.
	5	5400	Boiler feedwater	945 mL/min.
Type II, Class A	5	170	Sat. L.P. stm.	300 mL/min.

1/ Milliliters per minute (mL/min).

3.5.2 Shaft temperature. During the simulated service testing of Type I, Class A packings (freshwater and boiler feedwater only), the shaft temperature as measured by the resistance temperature device (RTD) shall meet the following criteria:

(a) High speed fresh water (4000 fpm) rotary pump packings.

(1) The shaft temperature shall not exceed 570 ºF.
(2) The shaft temperature shall be not greater than 270 ºF for a continuous period of 5 minutes or more.
(3) The average overall shaft temperature shall not exceed 260 ºF (see 6.6).

(b) Low speed fresh water (2100 fpm) rotary pump packings.

(1) The shaft temperature shall not exceed 570 ºF.
(2) The shaft temperature shall be not greater than 250 ºF for a continuous period of 15 minutes or more.

(3) The shaft temperature shall be not greater than 275 ºF for a continuous period of 2 minutes or more.

(4) The average overall shaft temperature shall not exceed 250 ºF (see 6.6).

(c) Boiler feedwater (5400 fpm) rotary pump packings.

(1) The average overall shaft temperature shall not exceed 300 ºF (see 6.6).

Failure to meet any of these criteria shall be cause for disqualification of the packing (see 4.6.5).

3.5.3 Shaft wear. Any single measurement of test fixture shaft wear which is greater than .015 inch (for Type I, Class A fresh water), .014 inch (for Type I, Class A seawater), .022 inch (for Type I, Class A boiler feedwater**),** or .005 inch (for Type II, Class A) shall be cause for disqualification of the tested packing (see 4.6.5.1).

3.5.4 Fixture cavity residue (all types and classes). Any packing residue found in the test fixture cavity upon completion of the simulated service testing shall be cause for disqualification (see 4.6.5).

3.5.5 Addition of packing rings (Type I, Class A; Type II Class A). When test fixture packing gland takeup reaches its limits, a one-time single additional ring of packing may be installed, provided the allowable packing gland leakage rate has been maintained prior to installation of the additional packing ring (see 4.6.5).

3.5.6 Replacement of packing rings (Type I, Class A; Type II Class A). If it becomes necessary to replace any packing ring because of deterioration or excessive packing gland leakage rate, the packing being tested shall be disqualified (see 4.6.5).

3.6 Size and shape. Packing shall be furnished in the size and shape specified (see 6.2). The shape of the packing shall be either square or trapezoidal. Allowable tolerances of the cross-sectional dimensions shall be as specified in table IV.

TABLE IV. Allowable tolerances of packing.

Packing cross-sectional dimensions (inch)	Allowable tolerance (inch)
up to 1/4	±1/64
1/4 to 1/2	±1/32
1/2 and above	±1/16

3.7 Form. The packing shall be furnished in the form of spools or reels in sizes and lengths as specified by the procuring activity (see 6.2). The packing shall be uniformly coiled on spools or reels according to the following:

Packing size (inches)	Package
1/8 through 5/16	1 or 5 pound spools
3/8 through 3/4	5 or 10 pound spools
3/4 through 1	25, 50, or 100 pound reels
1-1/8 through 2	50 or 100 pound reels

3.8 Workmanship. The workmanship shall be such that the packing material shall be free of major defects which affect its serviceability (see 4.5.1.1).

3.9 Safety. The materials used in the packing, unless specific material maximum levels are cited herein, shall have no known carcinogenic or potentially carcinogenic materials identified by Occupational Safety and Health Administration (OSHA) as regulated carcinogens, or International Agency for Research on Cancer (IARC) latest monographs, or the latest annual report of the National Toxicology Program (NTP); and shall have no extremely hazardous substances (EHS) or toxic chemicals identified in 40 CFR 355 and 372, respectively. The manufacturer is responsible for maintaining carcinogenic free, extremely hazardous substance free, and toxic chemical free materials. The manufacturer shall not, unless specific material maximum levels are cited herein, allow the addition of any of these prohibited materials to the formulation; and when any of these prohibited materials are/may be present, as a result of being present as a trace or impurity in another ingredient(s), the concentration of the prohibited material shall not equal or exceed 0.1 percent by weight of the packing. The rubber gasket material shall have no adverse effect on the health of personnel when used for its intended purpose.

3.10 Ozone-depleting chemicals. The materials used in the packing shall not contain class I or class II ozone-depleting chemicals as defined in 40 CFR 82.

3.11 Label. Manufacturer shall prepare label instructions in accordance with the requirements of 29 CFR 1910. Each container shall be affixed with a hazardous chemical warning label in accordance with the requirements of 29 CFR 1910.1200.

4. VERIFICATION

4.1 Classification of inspections. The inspection requirements specified herein are classified as follows:

(a) Qualification inspection (see 4.3).
(b) Conformance inspection (see 4.4).

4.2 Inspection conditions. Unless otherwise specified (see 6.2), all inspections shall be performed in accordance with the test conditions specified herein.

4.3 Qualification inspection. Qualification inspection shall consist of examinations and tests specified in table V.

TABLE V. Qualification inspection.

Inspection	Requirement	Test method
Flexibility	3.3.1	4.6.1
Fluid compatibility	3.3.2	4.6.2
Flexibility	3.3.2.1	4.6.2.1
Dimensional stability	3.3.2.2	4.6.2.2
Tensile strength	3.3.2.3	4.6.2.3
TGA analysis	3.3.3	4.6.3
Halogen concentration	3.4.1	4.6.4.1
Total sulfur concentration	3.4.2	4.6.4.2
Other detrimental materials	3.4.4	4.6.4.3
Simulated service testing	3.5	4.6.5
Packing gland leakage rates	3.5.1	4.6.5
Shaft temperature	3.5.2	4.6.5
Shaft wear	3.5.3	4.6.5.1
Fixture cavity residue	3.5.4	4.6.5
Replacement of packing rings	3.5.6	4.6.5
Ozone depleting chemicals	3.11	---

4.4 Conformance inspection. Conformance inspection shall consist of the tests specified in table VI (for groups A, B, and C).

TABLE VI. Conformance inspection.

Inspection	Requirement	Test method
Group A		
Workmanship	3.8	4.5.1.1
Dimensions	3.6	4.5.1.1
Group B		
Flexibility	3.3.1	4.6.1
Fluid compatibility	3.3.2	4.6.2
Flexibility	3.3.2.1	4.6.2.1
Dimensional stability	3.3.2.2	4.6.2.2
Tensile strength	3.3.2.3	4.6.2.3
TGA analysis	3.3.3	4.6.3
Halogen concentration	3.4.1	4.6.4.1
Total sulfur concentration	3.4.2	4.6.4.2
Other detrimental materials	3.4.4	4.6.4.3
Group C		
Simulated service testing	3.5	4.6.5
Packing gland leakage rates	3.5.1	4.6.5
Shaft temperature	3.5.2	4.6.5
Shaft wear	3.5.3	4.6.5.1
Fixture cavity residue	3.5.4	4.6.5
Replacement of packing rings	3.5.6	4.6.5

4.4.1 Lot. For purposes of quality conformance and test sampling, a lot is defined as all finished packing of one class, type and size, produced in one facility, using the same production processes and materials, and being offered for delivery at one time.

4.4.2 Sampling.

4.4.2.1 Sampling for visual examination of packing material. At a minimum, the contractor shall randomly select samples from each lot of completed spools or reels of packing as specified in table VII, and inspect them as specified in 4.5.1.1 (see 6.7).

TABLE VII. Sampling for visual examination of packing material.

Lot size	Sample size
2 to 50	5
51 to 90	7
91 to 150	11
151 to 280	13
281 to 500	16
501 to 1,200	19
1,201 to 3,200	23
3,201 to 10,000	29
10,001 to 35,000	35

4.4.2.2 Sampling for tests. At a minimum, the contractor shall randomly select a sample quantity from each lot of completed spools or reels of packing as specified in table VIII, and test them as specified in 4.6.1 through 4.6.5 (see 6.7).

TABLE VIII. Sampling for tests.

Lot size	Sample size
2 to 25	3
26 to 50	5
51 to 90	6
91 to 150	7
151 to 280	10
281 to 500	11
501 to 1,201	15
1,201 to 3,200	18
3,201 to 10,000	22
10,001 to 35,000	29

4.5 Conformance tests.

4.5.1 Group A tests. Group A tests shall be performed for all conformance inspections (see 4.5.1.1).

4.5.1.1 Visual examination and dimensions. Packing material shall be carefully examined by visual inspection to detect defects in workmanship and dimensions (see 3.8). For each spool or reel of packing material, major defects such as a rip, tear, hole, void, crease, crimp, gouge, or extraneous particulate matter on the surface, shall be cause for rejection of that spool or reel. Minor surface defects not affecting the serviceability of the packing material shall not be cause for rejection. Cross-sectional dimensions shall be measured at no less than two-foot intervals along the length of two adjacent sides of the spool or reel, using a metal ruler graduated to 1/64-inch (see 3.6).

4.5.2 Group B tests. Group B tests shall be omitted if both of the following are true:

(a) Within 2 years preceding the date current lot will be delivered by the contractor, the material has been tested and found in conformance with the group B requirements of table VI.
(b) The material offered for delivery is manufactured the same in all respects as the sample submitted that qualified the material.

4.5.3 Group C tests. Group C tests shall be omitted if both the following are true:

(a) Within 3 years preceding the date current lot will be delivered by the contractor, the material has been tested and found in conformance with the group C requirements of table VI.
(b) The material offered for delivery is manufactured the same in all respects as the sample submitted that qualified the material.

4.5.4 Composition or process change. Any changes in composition or process shall be promptly reported to the contracting activity.

4.5.5 Noncompliance. If a sample fails to pass any of the inspections in groups B and C, the contractor shall notify the contracting activity and the cognizant inspection activity of such failure and take corrective action on the materials or processes, or both, as warranted, as well as on all units of product which can be corrected and which are manufactured under essentially the same materials and processes, and which are considered by the qualifying activity to be subject to the same failure. Acceptance and shipment of the product shall be discontinued until corrective action, acceptable to the contracting activity, has been taken. After the corrective action has been taken, all of the inspections in groups B and C shall be repeated on additional sample units (this includes all tests and examinations, or the test which the original sample failed, at the option of the contracting activity). Group A inspections may be performed again, but final acceptance and shipment shall be withheld until group B and C inspections have shown that the corrective action was successful. In the event of failure after reinspection, information concerning the failure shall be furnished to the cognizant inspection activity and to the contracting activity.

4.6 Test procedures.

4.6.1 Flexibility. The packing shall be coiled by hand around a rod with a diameter which is equal to or less than five times the size of the packing. A visual examination shall then be made to determine whether the packing conforms to the curvature of the rod with no voids or separation between the packing and the rod (see 3.3.1).

4.6.2 Packing and fluid compatibility. Packing shall be immersed in the control fluids specified in table I for the applicable type & class for 1000 hours at ambient temperature (see 3.3.2).

4.6.2.1 Flexibility and fluid compatibility. The flexibility test (see 4.6.1) shall be performed after immersion and the results compared to pre-immersion tests (see 3.3.2.1).

4.6.2.2 Dimensional stability and fluid compatibility. Prior to immersion in the control fluids, cross-sectional measurements shall be taken along a 3-inch length of packing and averaged. Three additional cross-sectional measurements shall be made at 90 degrees to the first measurements and averaged. Following the 1000-hour immersion, the same measurements shall again be made. Pre- and post-immersion averaged cross-sectional measurements shall be compared for swelling or shrinkage (see 3.3.2.2).

4.6.2.3 Tensile strength and fluid compatibility. Tensile strength shall be measured in accordance with method A of ASTM F 152. Tensile strength of the individual packing strands shall be measured rather than the tensile strength of the cross-section of the braided packing material. Packing shall be unbraided, with three 6-inch long strands removed from the braid for each of the control fluids for which the material is to be tested. Three strands shall be used for reference. The tensile strength of the immersed strands shall then be compared to that of the reference strands (average of 3 breaks)(see 3.3.2.3).

4.6.3 Thermogravimetric analyzer (TGA) analysis. Use ASTM D 3850 standard test method (see 3.3.3).

4.6.4 Detrimental materials. Acceptable test methods and procedures are provided as guidance; however, testing methods are not limited to these exact procedures. Any standard test method to determine total concentrations may be used, as long as each element in all forms can be determined to levels below 250 (ppm) (see 3.4).

4.6.4.1 Halogen concentration. Any standard test method may be used (suggested: use oxygen combustion bomb along with ASTM D 129 and ASTM E 144, ignite approximately 0.5 grams of the sample under 30 atmospheres of oxygen pressure and dilute to a final volume of 100 mL with the carbonate/bicarbonate buffer required for analysis by ion chromatography) (see 3.4.1).

4.6.4.1.1 500 ºF leach test.

(a) Cut two specimens from the selected sample, weighing approximately 20 grams, record their exact weight to 0.1 gram, and identify them as specimens A and B. This identification shall be maintained throughout the test.

(b) Each test specimen shall be transferred to a suitable pressure vessel (parr reaction vessel, or equivalent), covered with enough distilled water to obtain a final volume of 500 mL and simmered at 500 ± 10 ºF for a minimum of 6 hours. The leach water shall then be separated by filtration and the filter rinsed. A control filtrate shall be run using similarly cleaned equipment and distilled water from the same source.

(c) Using aliquots from the control filtrate and filtrates A and B, the concentration of bromide, chloride, and fluoride ions in each filtrate shall be determined by an appropriate method of ASTM D 1246, ASTM D 512, and ASTM D 1179, respectively, or by equivalent methods. The concentration of water-leachable halide in the material shall be determined as follows:

Bromide, Chloride, or Fluoride, ug/g (ppm) = C multiplied by 500/M

Where:

C = bromide, chloride, or fluoride concentration of filtrate, in milligrams per liter; and

M = grams of the test specimen, prepared per (a) above.

(d) The total leachable halogen concentration is the sum of leachable bromide, chloride and fluoride concentrations. The halide concentrations for filtrates A and B shall be corrected by the results of the control filtrate.

4.6.4.2 Total sulfur concentration. Any standard test method may be used (see 3.4.2).

4.6.4.3 Other detrimental materials. Any standard test method may be used (suggested: use oxygen combustion bomb digestions for metal analysis; analyze digestates of cadmium and lead by direct aspiration atomic absorption spectroscopy) (see 3.4.4).

4.6.5 Simulated service testing. The rotary and reciprocating pump packing test methods shall be as specified in appendices A, B and C for Type I, Class A, and as specified in Appendix A for Type II, Class A. The test schematics referenced in Appendices A, B and C are included because there are no commercial test equipment which are known to be capable of evaluating packing for simulated performance requirements in paragraph 3.5.

4.6.5.1 Shaft wear. Shaft wear shall be measured using an outside micrometer. Measurements shall be made prior to and upon completion of each simulated service test at not less than 1/4-inch intervals along the shaft in the area where the packing rings are seated. A second set of measurements shall be made along the shaft 90 degrees from the initial measurements (see 3.5.3).

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When actual packaging of materiel is to be performed by DoD personnel, these personnel need to contact the responsible packaging activity to ascertain requisite packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activity within the Military Department or Defense Agency, or within the Military Department's System Command. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use. Packing is primarily intended for general shipboard service in rotating rod, centrifugal, and reciprocating rod pumps handling various fluids and gasses (see 6.7). These packings are military unique because they are subject to stringent composition and performance controls required for pumps used on U.S. Navy surface ships and submarines.

6.2 Acquisition requirements. Acquisition documents must specify the following:

(a) Title, number and date of the specification.
(b) Issue of DoDISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.2).
(c) Type, class, size, and form required (see 1.2, 3.6, and 3.7).
(d) Inspection conditions, if other than as specified (see 4.2.
(e) Packaging requirements (see 5.1).
(f) Is Material Safety Data Sheet required (see 6.4).

6.3 Qualification. With respect to products requiring qualification, awards will be made only for products which are, at the time of award of contract, qualified for inclusion in Qualified Products List QPL No. 24790 whether or not such products have actually been so listed by that date. The attention of the contractors is called to these requirements, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or purchase orders for the products covered by this specification. Information pertaining to qualification of products may be obtained from Naval Sea Systems Command, SEA 03R42, 2531 Jefferson Davis Hwy, Arlington, VA 22242-5160.

6.3.1 Copies of "Provisions Governing Qualification SD-6" may be obtained upon application to Standardization Documents Order Desk, Bldg. 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.

6.4 Material Safety Data Sheets. The packing material covered by this specification contains materials which may be hazardous to personnel and a Material Safety data Sheet (MSDS) is needed for employee safety programs. Contracting officers will identify those activities requiring copies of completed MSDS prepared in accordance with FED-STD-313. In order to obtain MSDS, FAR clause 52.223-3 must be in the contract.

6.5 Packing substitutions. Table IX has been prepared to facilitate substitution of non-asbestos packing materials for asbestos packing materials in pump applications. The asbestos-containing packings are identified by military specifications, designators, and application information.

TABLE IX. Packing substitution table.

Asbestos-containing specification	PUMP PARAMETERS					Non-Asbestos substitute packing
	Max Rod speed (fpm)	Max differ. pressure across packing (psi*d*)	Max system temp (°F)	Medium	Type	
MIL-P-17303						
Class I, Type B or C	4000	150	250	Fresh water	Rotary	Type I, Class A (2/)
Class I, Type D	170	300	420	Sat. L.P. steam	Recip.	Type II, Class A (1/, 2/)
MIL-P-24377	4000	150	250	Fresh water	Rotary	Type I, Class A (2/)
	1700	625	75	Seawater	Rotary	Type I, Class A (2/)
	5400	100	300	Boiler feedwater	Rotary	Type I, Class A (2/)

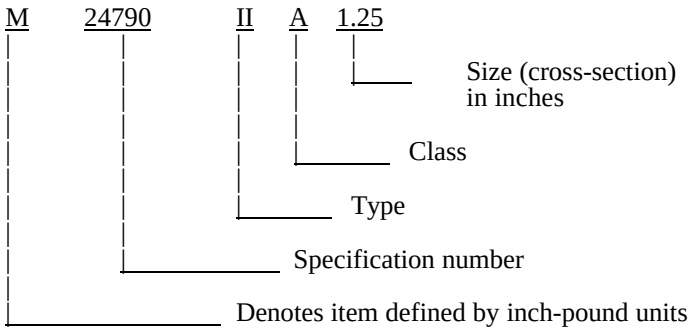
1/ For use in steam applications only.
2/ Not to be used in pumps where the packing runs directly against a shaft or shaft sleeve made of 400 series stainless steel and where the shaft or sleeve is not clad with a different material.

6.6 Definitions.

(a) Average overall shaft temperature. The sum of all temperature readings during the thermal cycle period, divided by the total number of temperature readings during the thermal cycle period.
(b) Average overall leakage rate. The sum of all leakage rate readings divided by the total number of leakage rate readings.
(c) Break-in period. A 30-hour period prior to the start of actual testing, during which leakage rate is gradually decreased from an initial free leakage rate, with the objective of reaching average overall leakage rate by the end of the period.
(d) Normal run. A 480-hour test period for Type I, Class A packings, during which the test fixture is operated at rated temperature and pressure. During the 480-hour run, fixtures are stopped and cooled down from operating temperature to ambient temperature a minimum of four times. The cooling-down periods are separated by intervals of at least 8 hours.
(e) PSID. Pounds per Square Inch Differential. This is the pressure capability of a packing expressed as the maximum differential pressure across the packing.
(f) Sample. A spool or reel of packing selected for qualification or quality conformance testing.
(g) Sample size. The number of spools or reels to be randomly selected from completed lots of spools or reels for qualification or quality conformance testing.
(h) Size of packing. The cross-sectional distance between parallel faces, for square and trapezoidal packings. In the case of rectangular packing, it is the distance between the longest parallel faces; for round or oval packing, it denotes the maximum diameter.
(i) Thermal cycle period. The normal run period, or the period which commences at the end of the break-in, and which extends to the start of the temperature transient period, in the case of low-speed Type I, Class A packing tests. For Type II, Class A packing tests, the thermal cycle is the 336-hour period which follows the break-in, during which the test fixture has alternate hot-run and cool-down times.
(j) Uncontrollable leakage. That condition when continued tightening of the packing gland has no effect on lowering the packing gland leakage rate.

6.*7* Lot rejection. If one or more defects are found in any sample, the entire lot should be rejected. The contractor has the option of screening 100 percent of the lot for the defective characteristic(s) or providing a new lot which should be inspected in accordance with the sampling plan contained herein. The contractor should maintain for a period of three years after contract completion all records of inspections, tests, and any resulting rejections.

6.*8* Part or identifying number (PIN).



6.9 Safety. Questions pertinent to toxic effects (see 3.10) should be referred by the Contracting Activity to the Qualifying Activity. The Qualifying Activity will act as an advisor to the Contracting Activity. The Qualifying Activity should arrange for review of questions by the appropriate departmental medical service.

6.10 Referenced drawings. Full size copies of all drawings specified in the appendices of this document are available from Dayton T. Brown, Inc., Church Street, Bohemia, Long Island, NY 11716.

6.11 Subject term (key word) listing.

Fluid compatibility
Pump, reciprocating rod
Pump, rotating rod

6.12 Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to previous issue due to the extent of the changes.

APPENDIX A

COMPRESSION PACKING MATERIAL DYNAMIC LABORATORY TEST PROCEDURE FOR FRESH WATER ROTARY AND PUMP APPLICATIONS AND SATURATED LOW PRESSURE RECIPROCATING PUMP APPLICATIONS

A.1 SCOPE

A.1.1 Scope. This appendix details the laboratory performance tests (rotary and reciprocating) which are designed to determine if non-asbestos compression packing materials are capable of achieving and maintaining a proper seal in a simulated environment which meets operational safety requirements for naval applications. The tests outlined herein are intended to qualify rotary pump packings (Type I, Class A) for hot water applications, and reciprocating pump packings (Type II, Class A) for saturated low-pressure steam applications. This appendix is a mandatory part of the specification. The information contained herein is intended for compliance.

A.2 APPLICABLE DOCUMENTS

This section is not applicable to this appendix.

A.3 TESTING

A.3.1 Materials. The following tests shall be performed on non-asbestos compression packing materials according to their recommended use and temperature/ pressure limitations. Three-eighths-inch square packing material shall be specified for each test.

A.3.2 Conditioning. No preconditioning of materials shall be performed. It is desirable that the non-asbestos compression material be exposed to existing environmental conditions, as would be expected in supply storage aboard a naval vessel.

A.3.3 Test procedures for Type I, Class A rotary pump packings for fresh water applications. A rotary pump test device is required and shall be in accordance with figure A-1. This device shall have variable shaft speeds up to 4000 fpm. The surface finish and straightness of the test shafting shall be of commercial pump grade.

A recirculating loop is required, preferably with an expansion tank in the loop. A heater and pressurizing device are required to provide temperatures up to 250ºF and differential pressures across the packing of up to 150 psid. The test device shall have the capability of supplying the necessary fluids for exposure to the packing material. It shall have provisions for measuring the test fixture shaft surface temperature in the area of the second ring of packing (counting from the outside ring). The test device shall be configured to permit data acquisition (shaft temperature, pressure and temperature of the fluid) at intervals of 30 seconds or less, and shall have provisions for collecting extruded packing material.

A.3.3.1 Test media, pressures, temperatures, and leakage rates. The following test conditions shall be provided (To qualify, packings shall complete the test successfully under both conditions):

Media	Pressure	Temperature	Shaft speed	No. of packing rings
Water	150 psid	250ºF	4000 fpm	5
Water	150 psid	250ºF	2100 fpm	4

Maximum allowable value of average overall leakage rate shall be as follows:

300 mL per minute @ 4000 fpm.
60 mL per minute @ 2100 fpm.

A.3.3.2 Testing procedure. If the test fixture packing gland requires more than the specified number of packing rings, spacers shall be used.

A.3.3.2.1 Five packing ring configuration.

Step 1: Using a mandrel the same size as the shaft, wrap the packing around the mandrel and cut the rings to the proper size. (Measure after cutting first ring.)

Cut five packing rings using a butt joint cut. Number each packing ring for identification. Measure and record weight and cross-sectional dimensions of each packing ring.

Step 2: Install rings - one ring at a time - making sure each ring is seated properly. Stagger ring joints 90 degrees apart.

Step 3: After all rings are installed in the stuffing box:

A. Tighten packing gland nuts firmly enough to compress packing. Spin shaft by hand to check free rotation.

B. Check alignment of packing gland using 90 degree angle (square) on the back edge of the packing gland. Adjust for equal distance at the following positions (12, 3, 6, and 9 o'clock).

Adjust RTD temperature output to be within plus or minus 5ºF of the measured shaft temperature. Record both the RTD temperature output and the measured shaft temperature. Test fixture shaft temperature can be measured with a standard laboratory thermometer graduated in individual degree increments and held against the shaft as close as practicable to the RTD sensor location.

C. Apply water pressure (50 psid).

D. Start pump and run for 4 hours with free leakage.

E. Increase pressure to 150 psid and run for 4 hours, adjusting packing gland as necessary to reduce leakage rate to a level which can be measured.

F. Run for 20 hours, checking adjustments every hour, or more frequently if necessary. Measure and reduce leakage slowly at a steady rate of decrease, with the objective of reaching the average overall leakage rate value at hour 28. During this 20-hour period, measure and record leakage rate every 2 hours. Take shaft temperature hourly, in accordance with Step 8.

G. Increase temperature to 250ºF and run for 2 hours, adjusting leakage rate as necessary, with the objective of reaching and/or maintaining the maximum value of the average overall leakage rate. Continue to take shaft temperature readings hourly, in accordance with Step 8.

General notes:

1. If, during break-in period, the packing box becomes overheated (that is too hot to hold hands-on), the pump may be secured until cool to touch rather than loosening the gland nuts to permit increased lubrication. There shall be no more than two such cool-downs.

2. Allow time between adjustments for the previous adjustment to take effect. The time needed between adjustments shall be based on past operational experience and on the magnitude of the adjustment made.

Step 4: Upon completion of the 30-hour break-in period, with the test loop at test pressure and temperature, begin the test, unless the leakage rate is uncontrollable, in which case the test is to be terminated. Adjust the leakage rate, if necessary, recording compression of the ring material and gland nut torque.

Step 5: Laboratory simulation conditions shall be at least 150 psid and 250ºF, to be run for a total of 480 hours. During the 480-hour run, fixtures shall be stopped and cooled down from operating temperature to ambient temperature a minimum of four times. These cooling-down periods shall be separated by intervals of at least 8 hours. A typical test sequence is shown in table A-1.

TABLE A-1. Typical test sequence.

Event	Description	Hours
Break-in	Continuous cycle-free and controlled leakage	30
Normal run	20 days x 24 hours	480
	Total run time =	510 hours

Step 6: During the normal run, the following items shall be collected and recorded:

A. All adjustments required, including gland nut torque and percent of material compression.

B. Leakage rate, pressure and both shaft and fluid temperature shall be measured and recorded every 2 hours for the first 8 hours of operation after a shutdown period, and every 8 hours otherwise during the 480-hour normal run period, and immediately after each packing adjustment. The leakage rate, after adjustment, shall not exceed the maximum allowable value of average overall leakage rate. If it does, additional adjustments are to be made until leakage meets the maximum allowable value of average overall rate.

Step 7: Testing of a packing material specimen shall be terminated if uncontrollable leakage occurs. Note: During packing adjustment, some smoke may be visible from the packing. This condition is not sufficient reason to suspend the test.

Step 8: RTD temperature measurement procedure:

A. The temperature measuring equipment shall be configured such that when it is operating, a temperature reading is provided every 30 seconds or less.

B. During break-in:

Once 150 psi***d*** is established, packing adjustments are checked at least hourly. Thus, take shaft temperature readings at least every hour. Details of the data to be taken are dependent on whether or not a packing adjustment is made, and are described in Step 8.C. The shaft temperature readings shall coincide with a packing adjustment if this is possible.

C. During normal-run cycle:

Leakage rate is measured as specified in Step 6. After the leakage rate is determined, either a packing adjustment is made, or the fixture is left as is.

1. If a packing adjustment is to be made:

a. One minute prior to making adjustment, begin taking shaft temperature readings (at least two data points).

b. Make packing adjustment while temperature reading is being taken; record amount each nut is tightened or loosened.

c. Continue taking shaft temperature readings for 4 minutes following completion of the packing adjustment.

2. If no packing adjustment is to be made, take only 2 minutes of temperature readings.

Taking readings in the manner specified above shall provide shaft temperature information during packing adjustments, when peak temperatures are expected, and during steady-state operation.

Step 9: After the test period, secure the heaters and pump, then bleed off system pressure. Remove the packing rings and inspect both packing and pump shaft for any observed wear (any measurable wear shall be recorded). Keep identified packing rings in order of location in the packing gland. Weigh packing.

Inspect housing cavity for extruded packing material. Carefully remove any residue, weigh and retain for tests in Step 9.

Step 10: Place packing rings and cavity residue in separate containers in an oven to air dry at 150ºF for 3 hours. Allow cavity residue and packing rings to cool for 5 hours, then weigh and measure cross-section of each ring and weigh residue. Note any unusual conditions of packing such as cracking, deformation or unusual loss of lubricant or material. Report condition of packing and pump shaft, including wear measurements.

A.3.3.2.2 Four packing ring configuration.

Step 1: Using a mandrel the same size as the shaft, wrap the packing around the mandrel and cut the rings to the proper size. (Measure after cutting first ring.)

Cut four packing rings using a butt joint cut. Number each packing ring for identification. Measure and record weight and cross-sectional dimensions of each packing ring.

Step 2: Install rings - one ring at a time - making sure each ring is seated properly. Stagger ring joints 90 degrees apart.

Step 3: After all rings are installed in the stuffing box:

A. Tighten packing gland nuts firmly enough to compress packing. Spin shaft by hand to check free rotation.

B. Check alignment of packing gland using 90 degree angle (square) on the back edge of the packing gland. Adjust for equal distance at the following positions (12, 3, 6, and 9 o'clock).

Adjust RTD temperature output to be within plus or minus 5ºF of the measured shaft temperature. Record both the RTD temperature output and the measured shaft temperature. Test fixture shaft temperature can be measured with a standard laboratory thermometer graduated in individual degree increments and held against the shaft as close as practicable to the RTD sensor location.

C. Apply water pressure (50 psid).

D. Start pump and run for 4 hours with free leakage.

E. Increase pressure to 150 psid and run for 4 hours, adjusting packing gland as necessary to reduce leakage rate to a level which can be measured.

F. Run for 20 hours, checking adjustments every hour, or more frequently if necessary. Measure and reduce leakage slowly at a steady rate of decrease with the objective of reaching the maximum allowable value of the average overall leakage rate at hour 28. During this 20-hour period, measure and record leakage rate every 2 hours. Take shaft temperature hourly in accordance with Step 8.

G. Increase temperature to 250ºF and run for 2 hours, adjusting leakage rate as necessary, with the objective of reaching and/or maintaining the maximum allowable value of the average overall leakage rate. Continue to take shaft temperature readings hourly in accordance with Step 8.

General notes:

1. If, during break-in period, the packing box becomes overheated (that is too hot to hold hands-on), the pump may be secured until cool to touch rather than loosening the gland nuts to allow for more lubrication. There shall be no more than two such cool-downs.

2. Allow time between adjustments for the adjustment to take effect. The time needed between adjustments shall be based on past operational experience and the magnitude of the adjustment made.

Step 4: Upon completion of the 30-hour break-in period, with the test loop at test pressure and temperature, begin the test (normal run), unless the leakage rate is uncontrollable, in which case the test is to be terminated. Adjust the leakage rate, if necessary, recording compression of the ring material and gland nut torque.

Step 5: Laboratory simulation conditions shall be at least 150 psid and 250ºF, to be run a total of 480 hours. During the 480-hour run, fixtures shall be stopped and cooled down from operating temperature to ambient temperature a minimum of four times. These cooling-down periods shall be separated by intervals of at least 8 hours. A typical test sequence is shown in table A-2.

TABLE A-2. Typical test sequence.

Event	Description	Hours
Break-in	Continuous cycle-free and controlled leakage	30
Normal run	20 days x 24 hours	480
Temperature transient	2 days x 24 hours	48
	Total run time =	558 hours

Step 6: During the test period, the following items shall be collected and recorded:

A. All adjustments required, including gland nut torque and percent of material compression.

B. Leakage rate, pressure and both shaft and fluid temperature shall be measured and recorded every 2 hours for the first 8 hours of operation after a shutdown period, and every 8 hours otherwise during the 480-hour normal run, and immediately after each packing adjustment. The leakage rate, after adjustment, shall not exceed the maximum allowable value of the average overall leakage rate. If it does, additional adjustments are to be made until leakage meets the maximum allowable value of the average overall rate.

C. Shaft temperature at the second packing ring position (RTD output) shall be measured and recorded every 2 hours for the first 8 hours of operation after a shutdown period, and every 8 hours during the 480-hour normal run period and immediately after each packing adjustment (see Step 8).

Step 7: Testing of a packing material specimen shall be terminated if uncontrollable leakage occurs. Note: During packing adjustment, some smoking may be visible from the packing. This condition is not sufficient reason to suspend the test.

Step 8: RTD temperature measurement procedure:

A. The temperature measuring equipment shall have the capability of providing a temperature reading every 30 seconds or less.

B. During break-in:

Once 150 psid is established, packing adjustments are checked at least hourly. Thus, take shaft temperature readings at least every hour. Details of the readings to be taken are dependent on whether or not a packing adjustment is made and are described in Step 8.C. The shaft temperature readings shall coincide with a packing adjustment if this is possible.

C. During normal-run cycle:

Leakage rate is measured as specified in Step 6. After the leakage rate is determined, either a packing adjustment is made, or the fixture is left as is.

1. If a packing adjustment is to be made:

a. One minute prior to making adjustment, begin taking shaft temperature readings (at least two data points).

b. Make packing adjustment while temperature reading is being taken; record amount each nut is tightened or loosened.

c. Continue taking shaft temperature readings for 4 minutes.

2. If no packing adjustment is to be made, take only 2 minutes of temperature readings.

Taking readings in the manner specified above shall provide shaft temperature information during packing adjustments, when peak temperatures are expected, and during steady-state operation.

Step 9: Temperature transient (see figure A-2):

Thermal cycling shall begin at the end of the 480-hour normal run cycle, with the test fluid hot (250ºF). The test-rig shaft shall remain operating throughout the thermal cycling, which is described by the steps listed below. During the temperature transient period, "hot" test fluid is fluid heated to 250ºF; "cold" test fluid is at ambient temperature.

Step I.

A. Initiate transition to cold test fluid. During the temperature transition, and when finally cold, make packing adjustments as needed with the objective of achieving a leakage rate of less than 60 mL but as close to 60 mL as feasible. Once the test fluid has been cold for 30 minutes and the leakage

rate is as close to 60 mL as is feasible, do not adjust packing again, even during temperature transition, until called for in Step I.E.2. below. Continue with Step I.B.

B. Take shaft temperature readings for 2 minutes. Initiate transition to hot test fluid. Take shaft temperature readings for an additional 2 minutes and then for 1 minute of each 15 minutes that expires until the temperature transition is complete. Once hot, take 2 minutes of shaft temperature readings.

C. Maintain hot condition for 2 hours, recording the following:

1. Leakage rate at 30 minutes.

2. Shaft temperature readings for 2 minutes every 30 minutes.

D. Initiate transition to cold test fluid. Take shaft temperature readings for 2 minutes and then for 1 minute of each 15 minutes that expires until the temperature transition is complete. Once cold, take 2 minutes of shaft temperature readings.

E. Maintain cold condition for at least 4 hours.

1. First 4 hours during cold condition:

a. Record 2 minutes of shaft temperature readings every 30 minutes.

b. Record leakage rate at first 30-minute interval; for the remainder of the 4 hours, make packing gland adjustments and take leakage rate measurements as necessary, with the objective of achieving a leakage rate of less than 60 mL, but as close to 60 mL as is feasible.

c. Record leakage rate at the end of the 4-hour period.

2. Remaining hours in cold condition (if applicable):

a. Following the 4-hour period described above (Step I.E.1), continue running cold. During this interval, measure and record leakage rate every 8 hours, if applicable, and just before continuing with Step II below.

Step II.

A. Initiate transition to hot test fluid. During the temperature transition, and when finally hot, make packing adjustments as needed with the objective of achieving a leakage rate of less than 60 mL, but as close to 60 mL as is feasible. Once the test fluid has been hot for 30 minutes and the leakage rate is as close to 60 mL as is feasible, do not adjust packing again, even during temperature transition, until called for in Step II.E.2. below. Continue with Step II.B.

B. Take shaft temperature readings for 2 minutes. Initiate transition to cold test fluid. Take shaft temperature readings for an additional 2 minutes and then for 1 minute of each 15 minutes that expires until the temperature transition is complete. Once cold, take 2 minutes of shaft temperature readings.

C. Maintain cold condition for 2 hours recording the following:

1. Leakage rate at 30 minutes.

2. Two minutes of shaft temperature readings every 30 minutes.

D. Initiate transition to hot test fluid. Take shaft temperature readings for 2 minutes and then for 1 minute of each 15 minutes that expires until the temperature transition is complete. Once hot, take 2 minutes of shaft temperature readings.

E. Maintain hot condition for at least 4 hours:

1. First 4 hours during hot condition:

a. Record 2 minutes of shaft temperature readings every 30 minutes.

b. Record leakage rate at first 30-minute interval; for the remainder of the 4 hours, make packing gland adjustments and take leakage rate measurements as necessary, with the objective of achieving a leakage rate of less than 60 mL, but as close to 60 mL as is feasible.

c. Record leakage rate at the end of the 4-hour period.

2. Terminate test.

Step 10: After the test period, secure the heaters and pump, then bleed off system pressure. Remove the packing rings and inspect both packing and pump shaft for any observed wear (any measurable wear shall be recorded). Keep identified packing rings in order of location in the packing gland. Weigh packing.

Inspect housing cavity for extruded packing material. Carefully remove any residue, weigh and retain for tests in Step 11.

Step 11: Place packing rings and cavity residue in separate containers in an oven to air dry at 150ºF for 3 hours. Allow cavity residue and packing rings to cool for 5 hours, then weigh and measure cross-section of each ring and weigh residue. Note any unusual conditions of packing such as cracking, deformation or unusual loss of lubricant or material. Report condition of packing and pump shaft, including wear measurements.

A.3.4 Reciprocating pump packing test for low pressure steam (Type II, Class A). A reciprocating pump test device is required and shall be in accordance with figure A-3. This device shall have variable shaft speeds up to 170 fpm. A recirculating loop is required, preferably with an expansion tank in the loop. A heater and pressurizing device are required to provide temperatures up to 450ºF and pressures up to 300 psid.

Media	Pressure	Temperature	Shaft
Sat. L.P. steam	300 psid	420ºF	170 fpm

Maximum allowable value of the average overall leakage rate shall be 300 mL per minute at 170 fpm

A.3.4.1 Testing procedure. A maximum of five packing rings shall be installed in the pump packing gland. If the existing pump gland requires more than five packing rings, spacers shall be used.

Leakage rates shall be tested for the following configuration:

Five packing rings, 170 fpm shaft speed with a maximum allowable value of the average overall leakage rate of 300 mL per minute.

A.3.4.2 Five packing ring configuration.

Step 1: Using a mandrel the same size as the shaft, wrap the packing around the mandrel and cut the rings to the proper size. (Measure after cutting first ring.)

Cut five packing rings using a butt joint cut. Number each packing ring for identification. Measure and record weight and cross-sectional dimensions of each packing ring.

Step 2: Install rings - one ring at a time - making sure each ring is seated properly. Stagger ring joints 90 degrees apart.

Step 3: After all rings are installed in the stuffing box:

A. Tighten packing gland nuts firmly enough to compress packing. Spin shaft by hand to check free rotation.

B. Check alignment of packing gland using 90 degree angle (square) on the back edge of the packing gland. Adjust for equal distance at the following positions (12, 3, 6, and 9 o'clock).

C. Apply water pressure (50 psid).

D. Start pump and run for 4 hours with free leakage.

E. Increase pressure to 150 psid and run for 4 hours, adjusting packing gland as necessary to achieve a measurable leakage rate.

F. Run for 20 hours, checking adjustments every hour, or more frequently if necessary. Measure and reduce leakage slowly at a steady rate of decrease, with the objective of reaching the maximum allowable value of the average overall leakage rate or less at hour 28.

G. Increase temperature to 420ºF and run for 2 hours, adjusting leakage rate as necessary to maintain maximum allowable value of the average overall leakage or less.

General notes:

1. If, during break-in period, the packing box becomes overheated (that is too hot to hold hands-on), the pump may be secured until cool to touch rather than loosening the gland nuts to permit increased lubrication. There shall be no more than two such cool-downs.

2. Allow at least 30 minutes of operation between each adjustment because leak rate may change slowly.

Step 4: Upon completion of the 30-hour break-in period, with the test loop at test pressure and temperature, begin the thermal cycle, unless the leakage rate is uncontrollable, in which case the test is to be terminated. Adjust the leakage rate if necessary, recording compression of the ring material and gland nut torque.

Step 5: Laboratory simulation conditions shall be at least 150 psid and 250ºF for the continuous run, a total of 168 hours as follows:

	Time	Function
Continuous run	2 Hours	Adjust torque & leakage
	14 Hours	Hot run time

8 Hours Cool down

NOTE: Continuous cycle: 24 hours x 7 days = 168 hours. A typical test sequence is shown in table A-3.

TABLE A-3. Typical test sequence.

Event	Description	Hours
Thermal cycle	24 days x 14 hours (run time)	336
Continuous-run cycle	1 day (24 hours) x 7 days	168
	Total run time =	504 hours

Step 6: During the test period, the following items shall be collected and recorded:

A. All adjustments required, including gland nut torque and percent of material compression.

B. Leakage rate, pressure and temperature shall be measured and recorded daily and immediately before and after each packing adjustment. The leakage rate, after adjustment, shall not exceed the maximum allowable value of the average overall leakage rate.

Step 7: Testing of a packing material specimen shall be terminated if either uncontrollable leakage occurs, or gland nut torque settings to control leakage result in an overheated packing.

Step 8: After the test period, secure the heaters and pump, then bleed off system pressure. Remove the packing rings and inspect both packing and pump shaft for any observed wear (any measurable wear shall be recorded). Keep identified packing rings in order of location in the packing gland. Weigh packing.

Step 9: Place packing rings in a container and place in an oven to air dry at 150ºF for 3 hours. Allow packing to cool for 5 hours, then weigh and measure cross-section of each ring. Note any unusual conditions of packing such as cracking, deformation or unusual loss of lubricant or material. Report condition of packing and pump shaft, including wear measurements.

NOTES:

1.0 INTERPRET THIS DRAWING PER DOD-STD-100.

2.0 ASSEMBLY REQUIREMENTS:

2.1 ASSEMBLE MECHANICAL COMPONENTS AS SHOWN PER DRAWING.

3.0 INSTALLATION REQUIREMENTS FOR RTD ELEMENTS (ITEM NO.25):

3.1 ROUTE RTD EXTENSION WIRING (ITEM NO.25) THROUGH SHAFT CENTERLINE BORE AND RADIAL EXIT HOLES.

3.2 INSTALL SHRINK TUBING (ITEM NO.28) ONTO EACH RTD LEAD AND SOLDER TWO EXTENSION WIRES ONTO EACH RTD LEAD. APPLY SHRINK TUBING OVER SOLDER JOINT.

3.3 POSITION RTD ELEMENT (ITEM NO.25) AS REQUIRED (3.56" FROM SLEEVE MIDPOINT TO POSITION UNDER SECOND PACKING RING) AND APPLY OMEGABOND EPOXY (ITEM NO.24) INTO GROOVE.

3.4 PUSH RTD ELEMENT AND WIRING INTO EPOXY. RTD ELEMENT SHOULD BE NO GREATER THAN 1/8" BELOW SHAFT SURFACE.

3.5 CURE EPOXY FOR 8 HOURS AT 250°F.

3.6 CAREFULLY INSTALL SHAFT SLEEVE ONTO SHAFT.

QTY REQR.	QTY REQD.	FSCM	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MATERIAL SPECIFICATION	ITEM NO.
4	4		.125-28 X 1.25	CAP SCREW, HEX HD	STEEL-ZINC PLATED	28
AR	AR			SHRINK TUBING		27
2	2		PTO6E (SR)	CONNECTOR	BENDIX	26
2	2		[illegible]	RTD ELEMENTS	OMEGA ENGINEERING CORP	25
AR	AR		OB-200	OMEGA BOND EPOXY	OMEGA ENGINEERING CORP	24
AR	AR		EXGG-2CU-24	[illegible] EXT WIRE	OMEGA ENGINEERING CORP	23
1	1		EC-FR-LB-10	SLIP RING ASSY	EC CORP	22
1	1		.125 SQ X 1.0 LG	KEY	311 CRES	21
8	8		.50	NUT	311 CRES	20
1	1		.125 SQ X 4.0 LG	KEY	311 CRES	19
1	1		.50-20UNF X .356	BOLT	311 CRES	18
16	16		.50	WASHER, FLAT	311 CRES	17
12	12		.75	WASHER, FLAT	311 CRES	16
18	18		.50	WASHER, LOCK	311 CRES	15
12	12		.75	WASHER, LOCK	311 CRES	14
16	16		.50-13UNC X 1.75	CAP SCREW, HEX HD	311 CRES	13
12	12		.75-10UNC X 2.75	CAP SCREW, HEX HD	FULL THREAD GR 8, STEEL	12
6	6		.375 X 1 LG	PIN, SPRING	STEEL-LOW CARBON	11
2	2		SAF 1509	PILLOW BLOCK		10
1	1		L9545-5-004-5	COUPLING		9
1	1		L9545-5-004-3	SLEEVE		8
1	1		L9540-5-004-1	SHAFT		7
1	1		L9527-2-007-3	MOUNTING PLATE		6
2	2		L9527-2-006-3	BLOCK		5
2			L9527-2-005-7	PACKING GLAND		4
	2		L9527-3-005-5	PACKING GLAND		3
1			L9527-2-004-30	HOUSING ASSY		2
	1		L9527-2-004-10	HOUSING ASSY		1
–			-3D	ROTARY PACKING TEST ROUTE		
	–		-1D	ROTARY PACKING TEST ROUTE		

LIST OF MATERIALS

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE

DO NOT SCALE DRAWING

ROTARY PACKING TEST FIXTURE (HIGH PRESSURE)

DWG. NO. L9527-2-002

SHEET 1 OF 3

FIGURE A-1. Rotary pump test device. (Sheet 1 of 9)

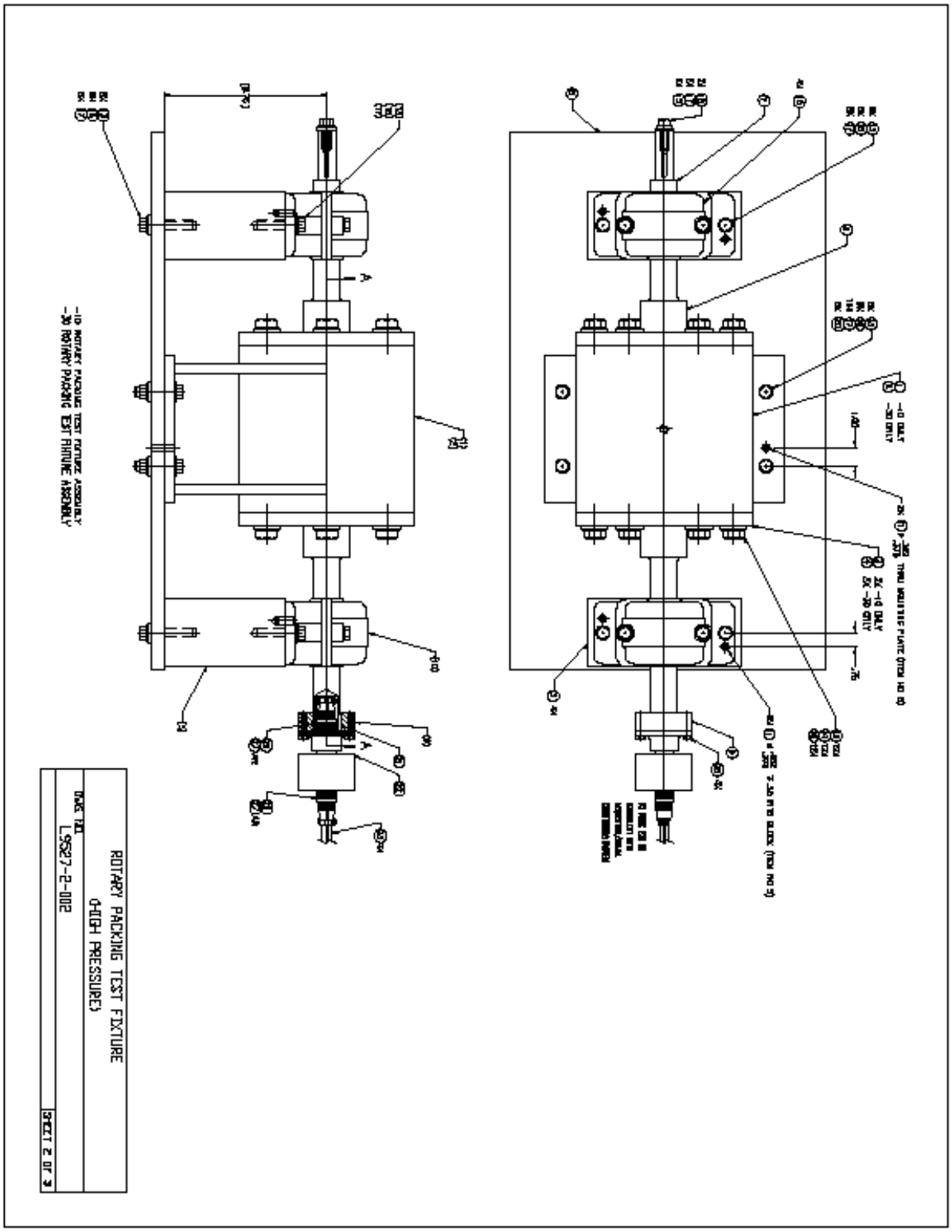


FIGURE A-1. Rotary pump test device. (Sheet 2 of 9)

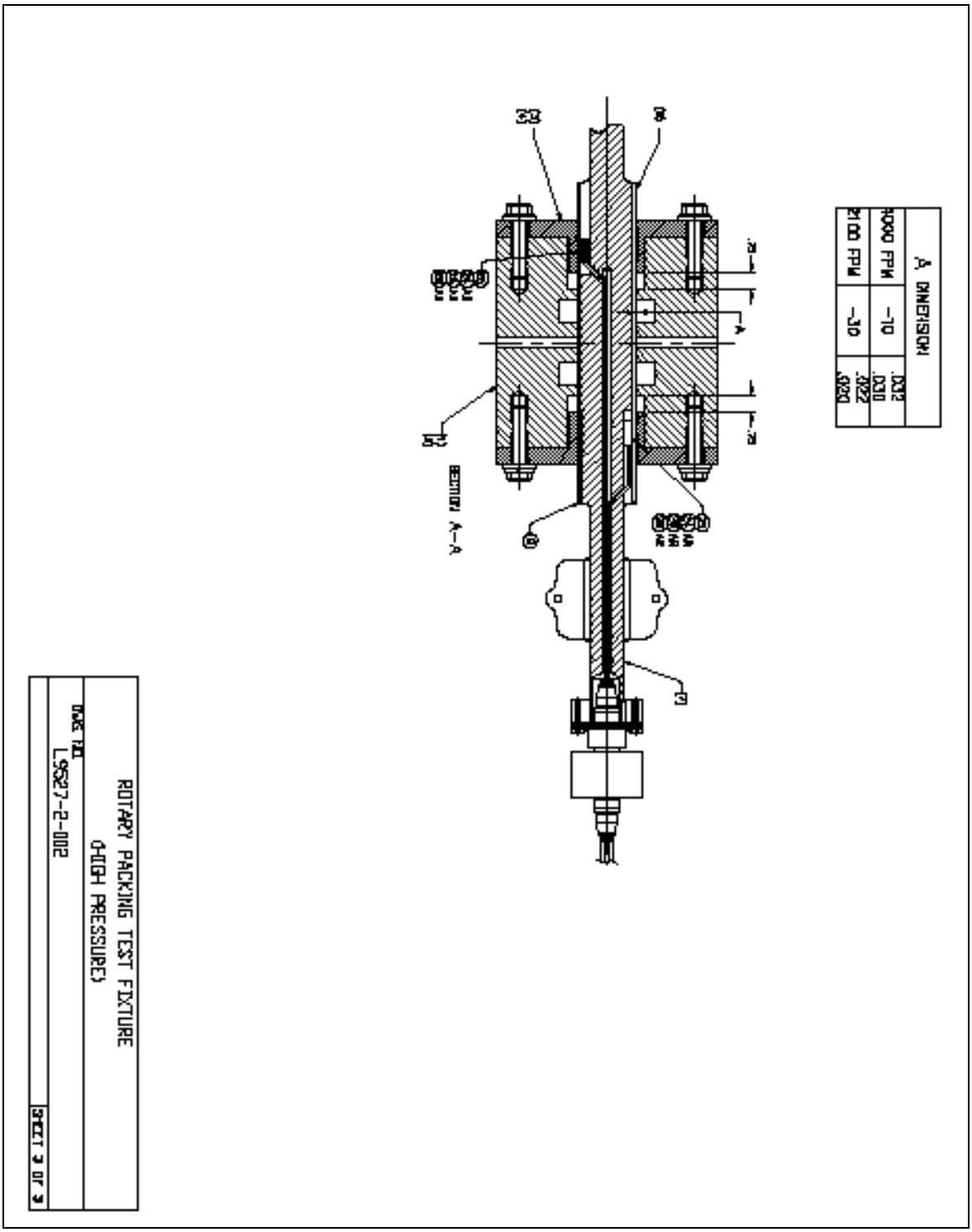


FIGURE A-1. Rotary pump test device. (Sheet 3 of 9)

APPENDIX A

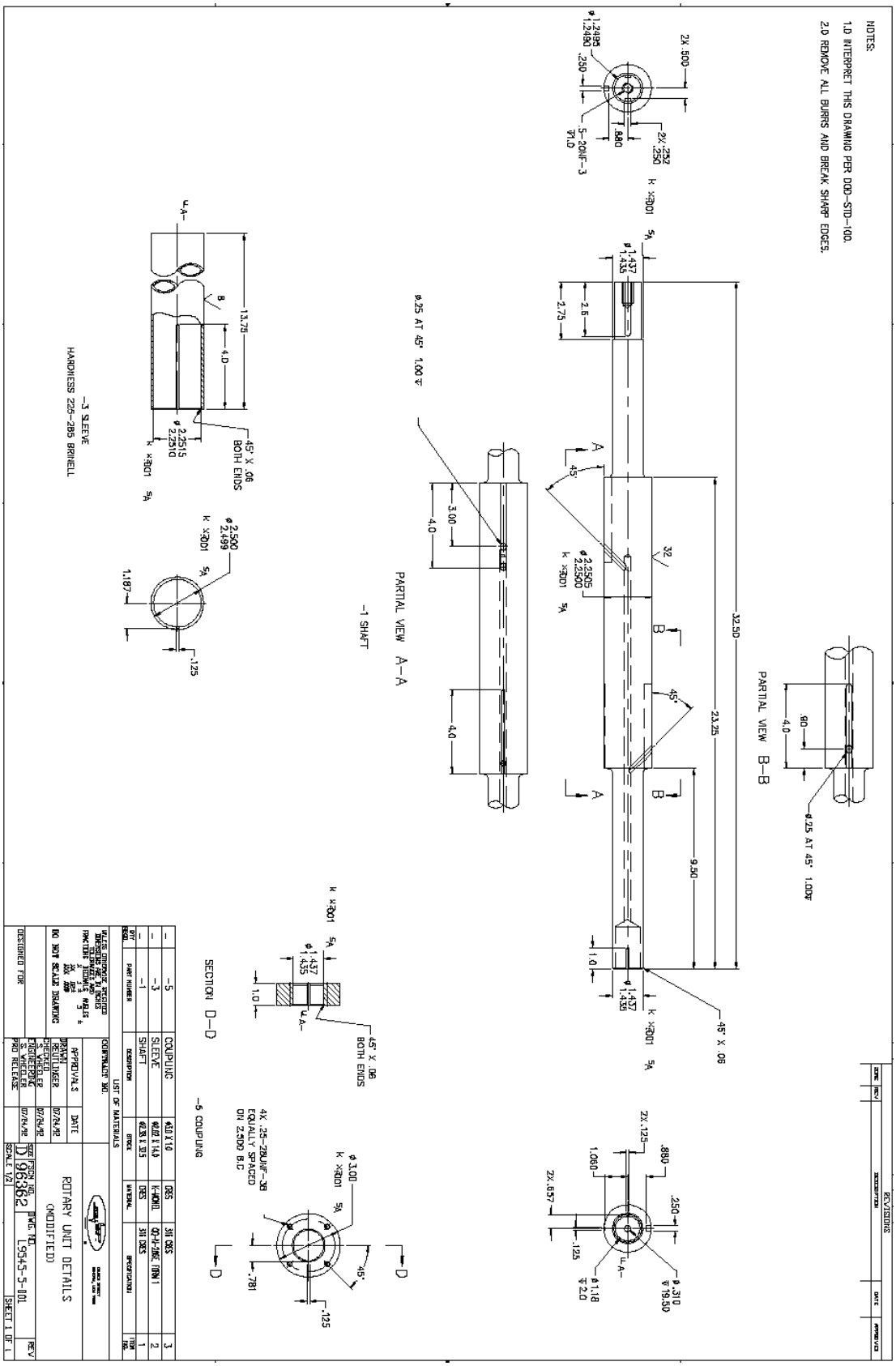


FIGURE A-1. Rotary pump test device. (Sheet 4 of 9)

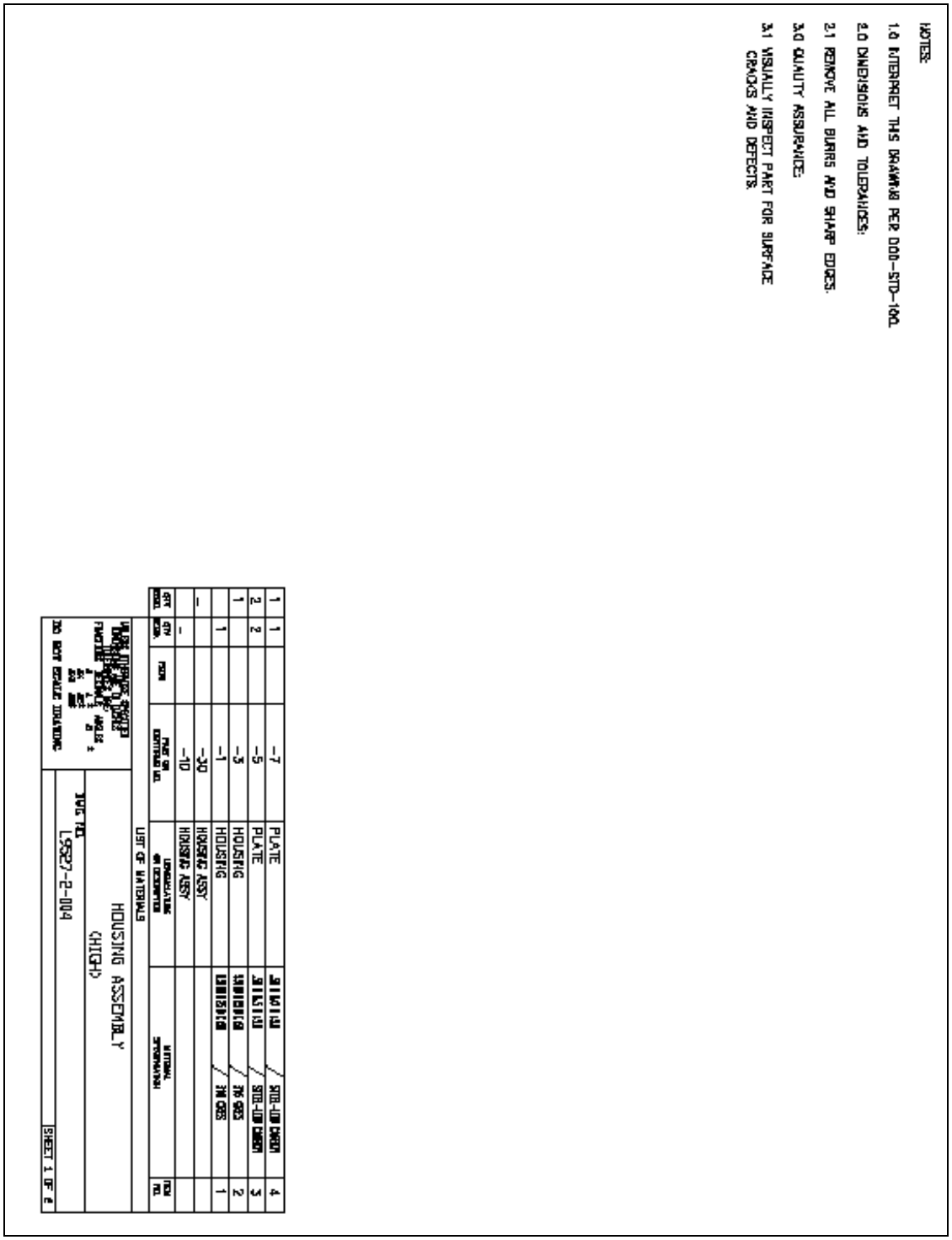


FIGURE A-1. Rotary pump test device. (Sheet 5 of 9)

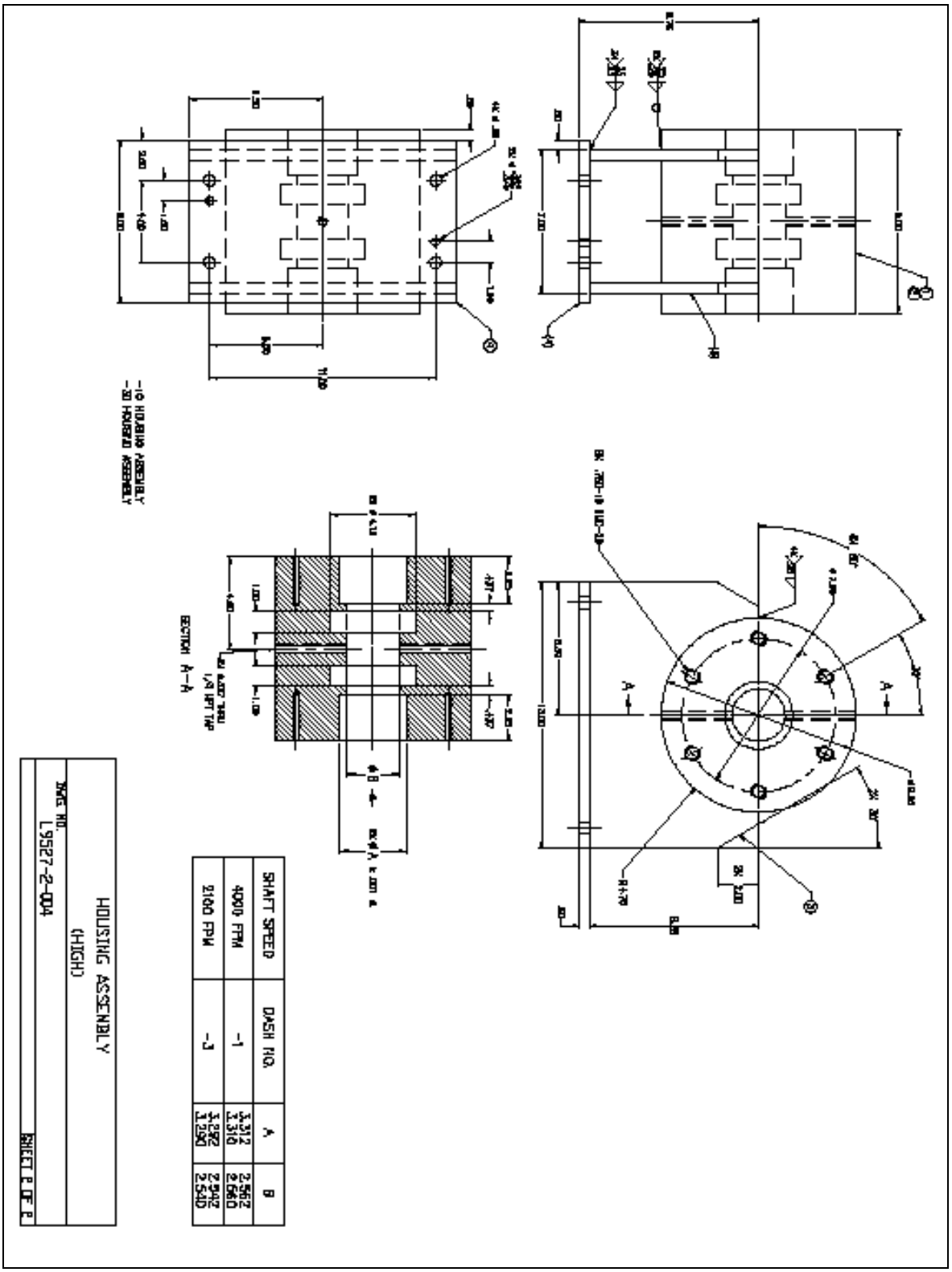


FIGURE A-1. Rotary pump test device. (Sheet 6 of 9)

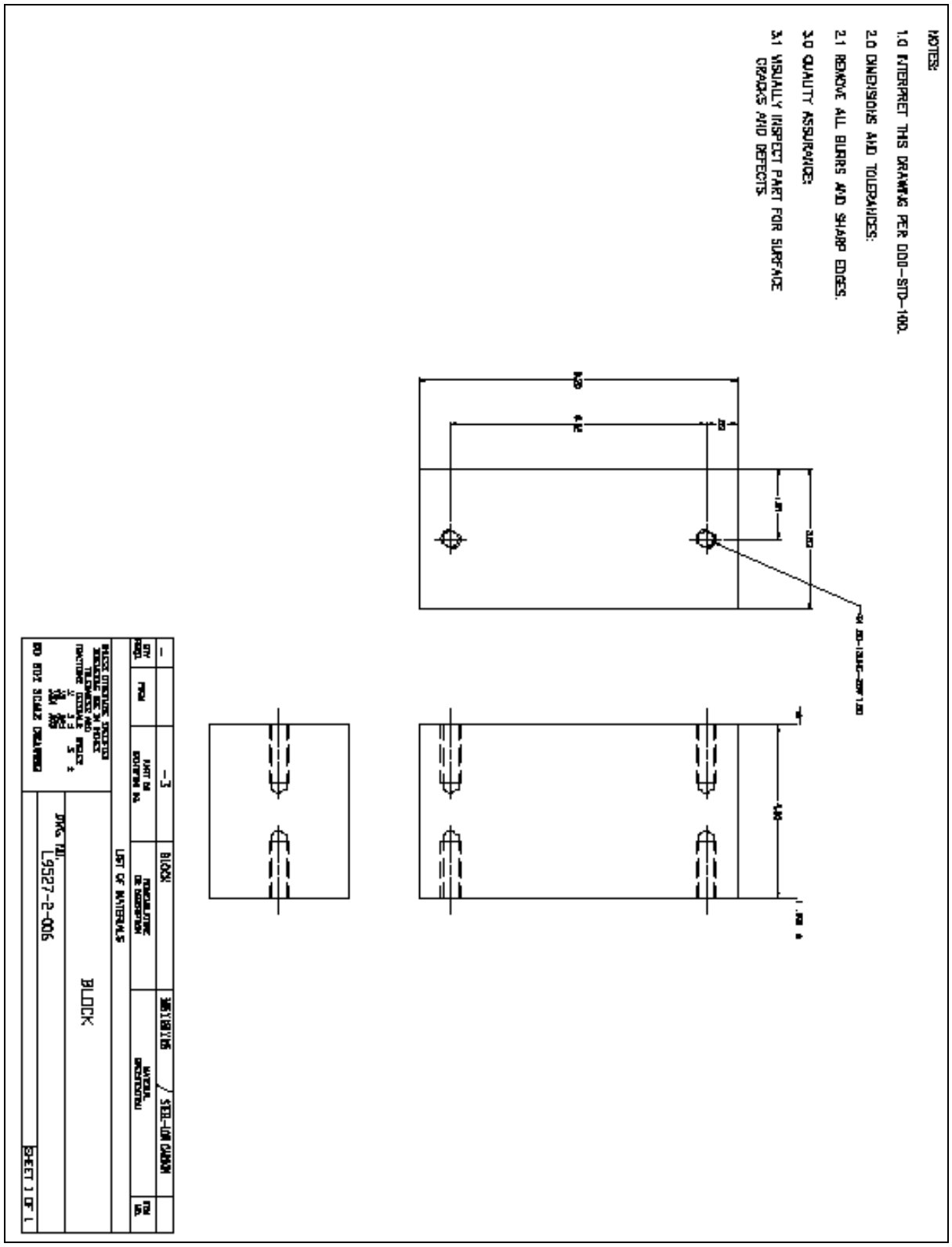


FIGURE A-1. Rotary pump test device. (Sheet 7 of 9)

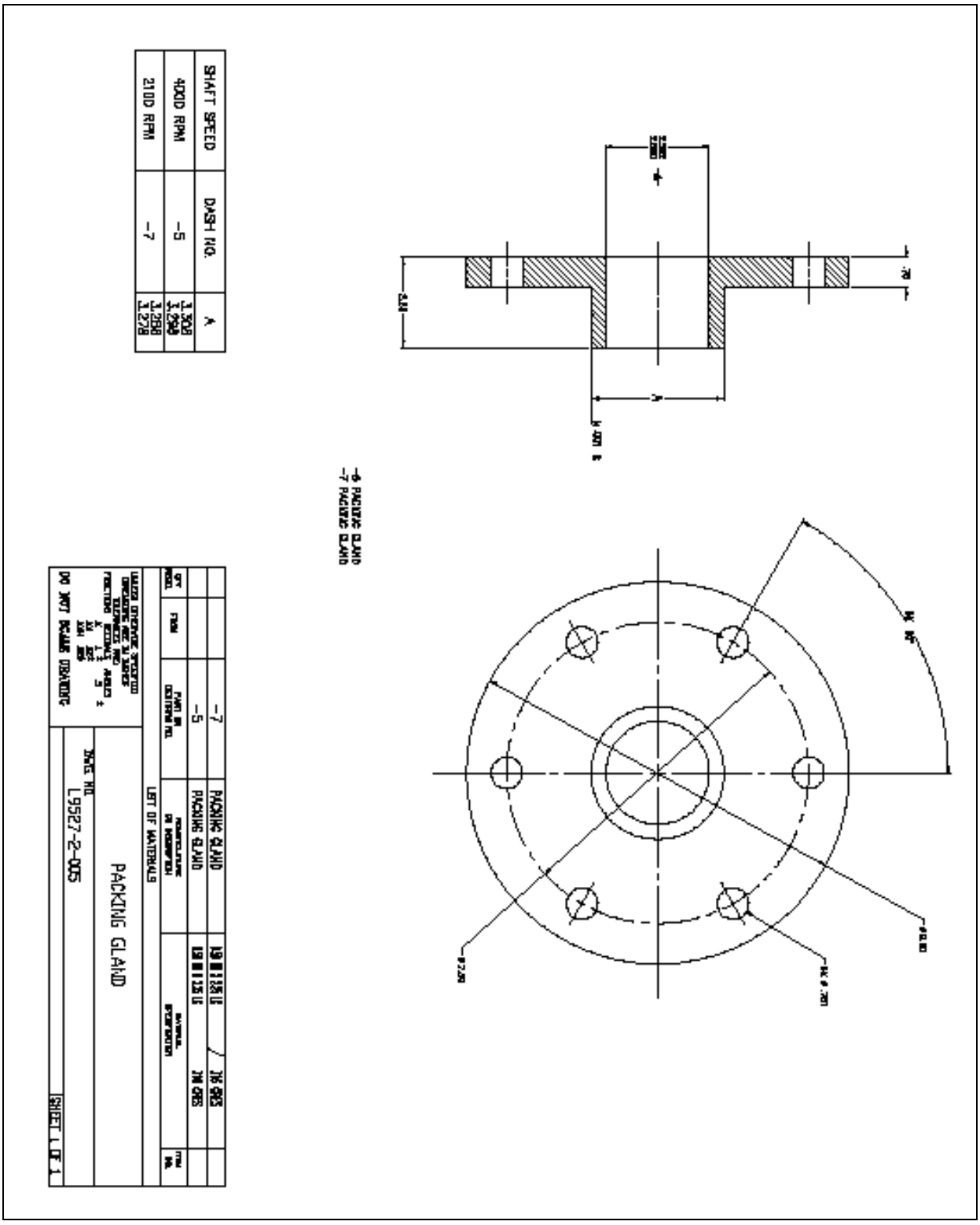


FIGURE A-1. Rotary pump test device. (Sheet 8 of 9)

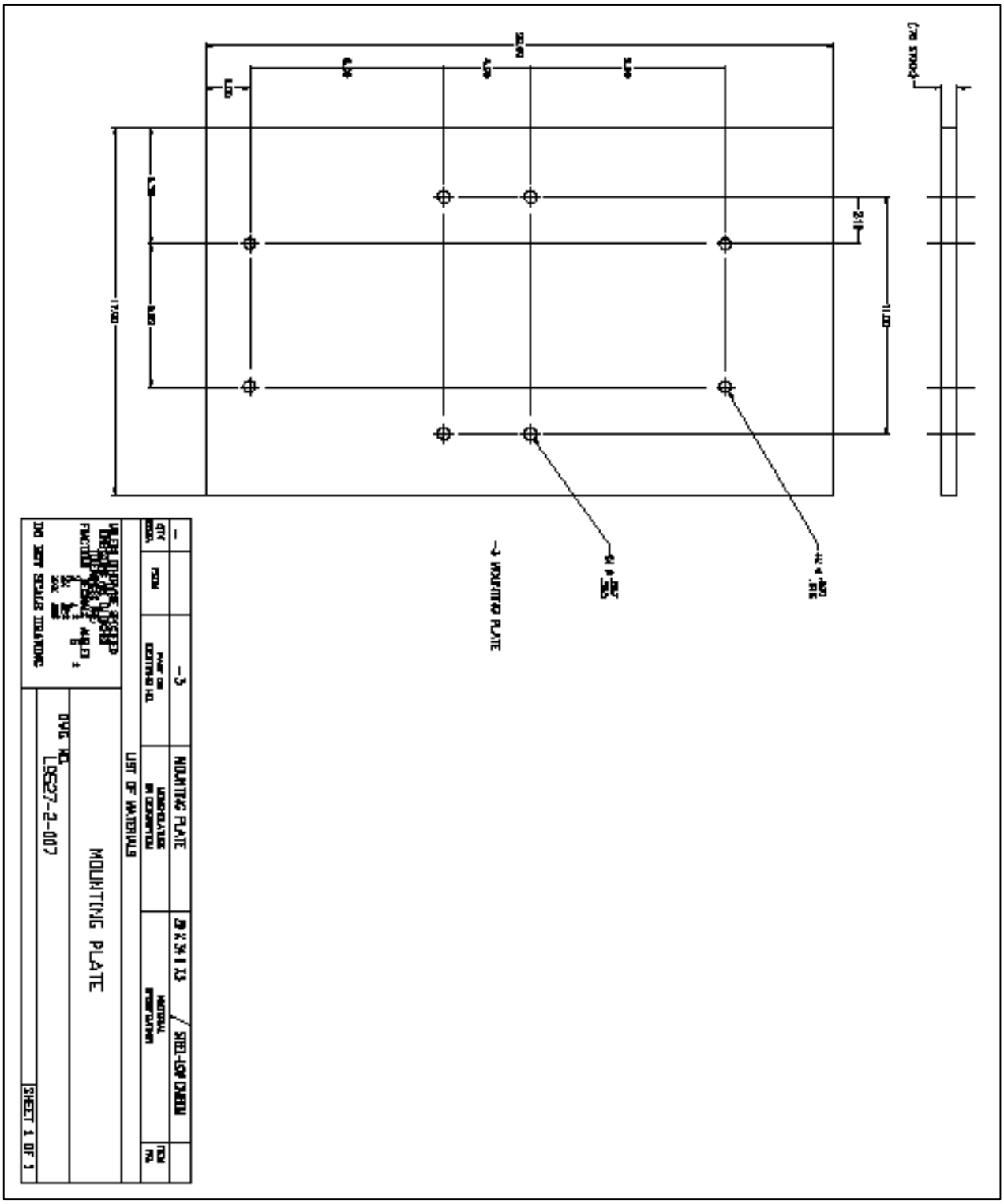


FIGURE A-1. Rotary pump test device. (Sheet 9 of 9)

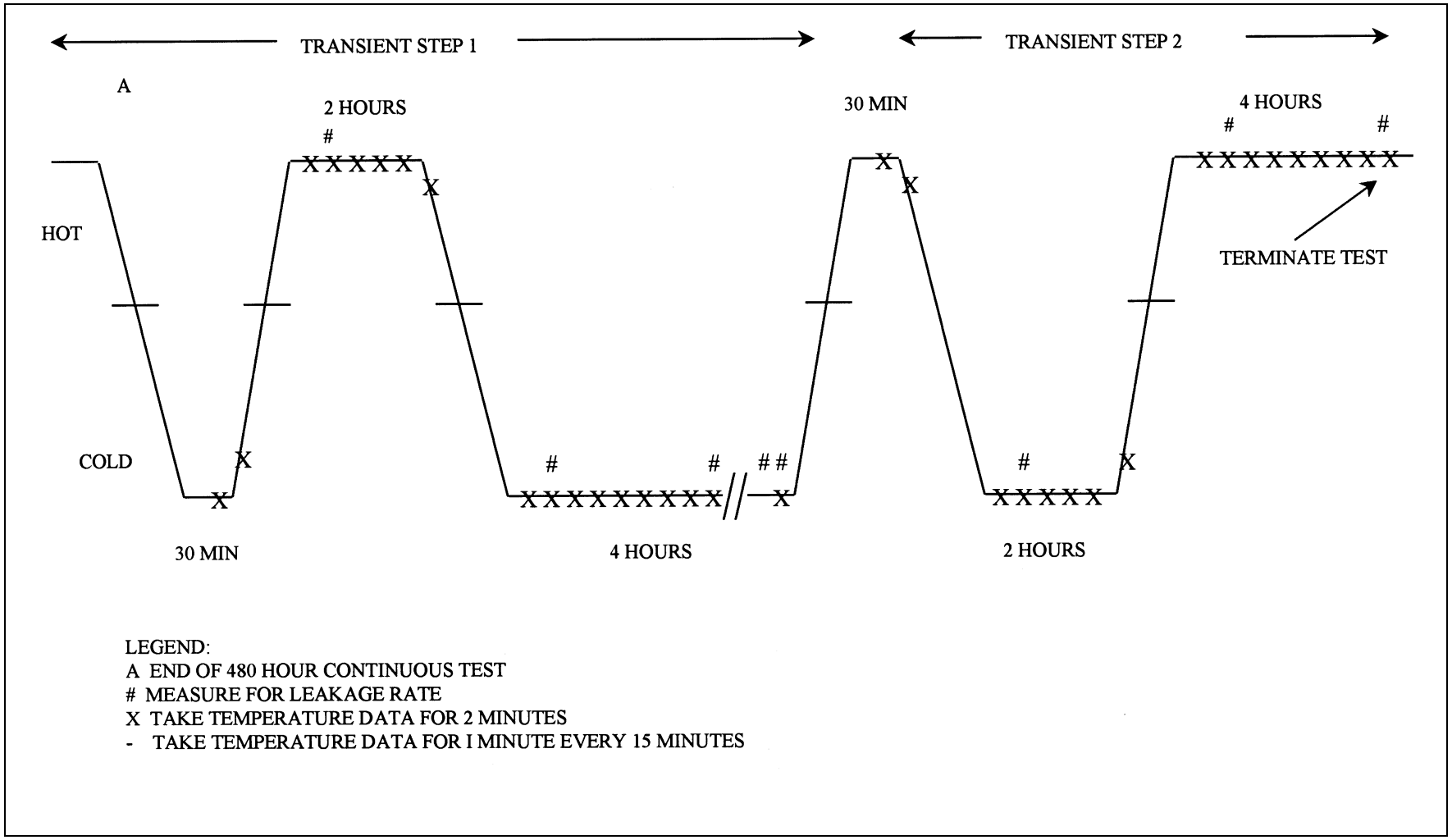


FIGURE A-2. Temperature transient.

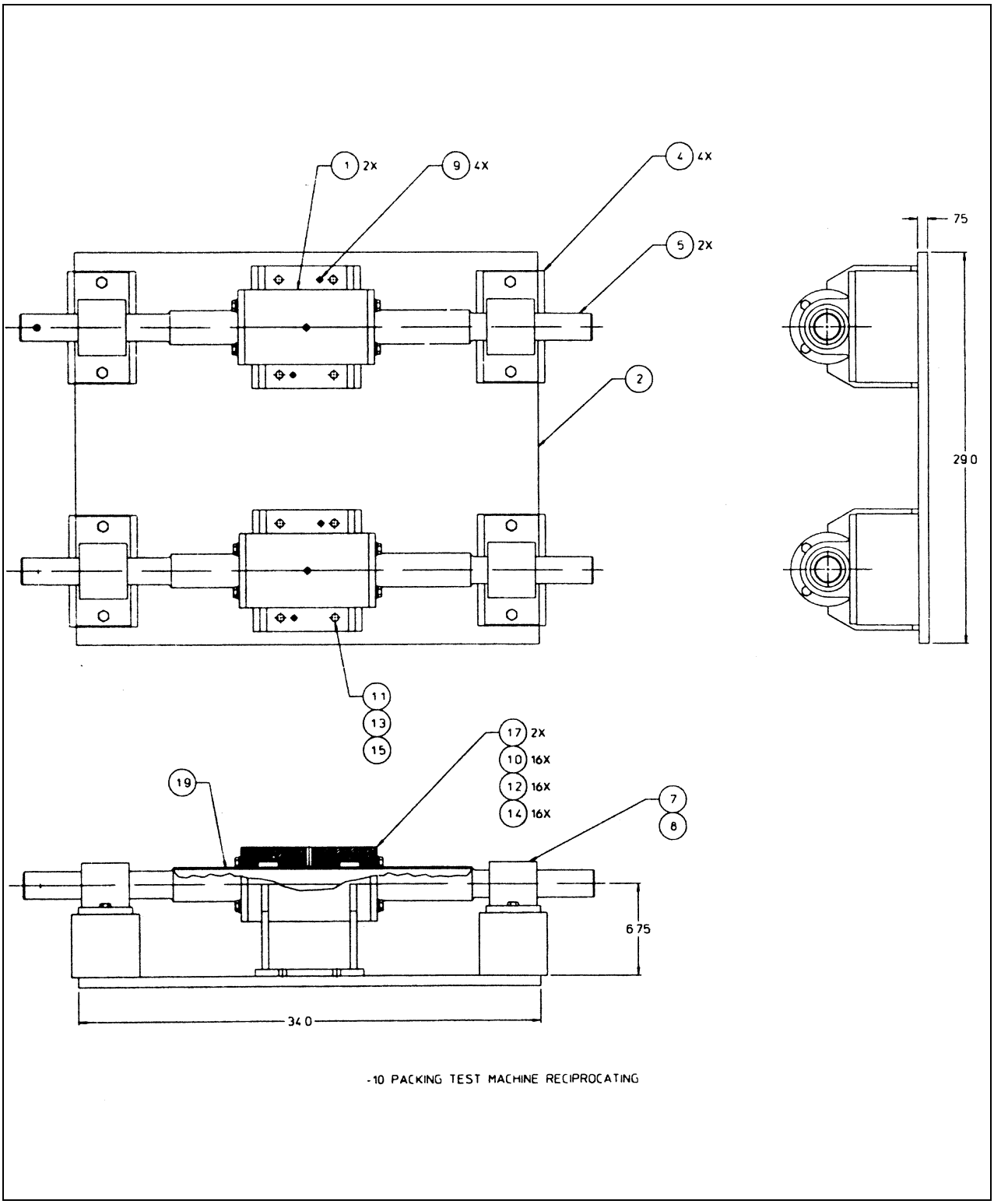


FIGURE A-3. Reciprocating pump test device. (Sheet 1 of 3)

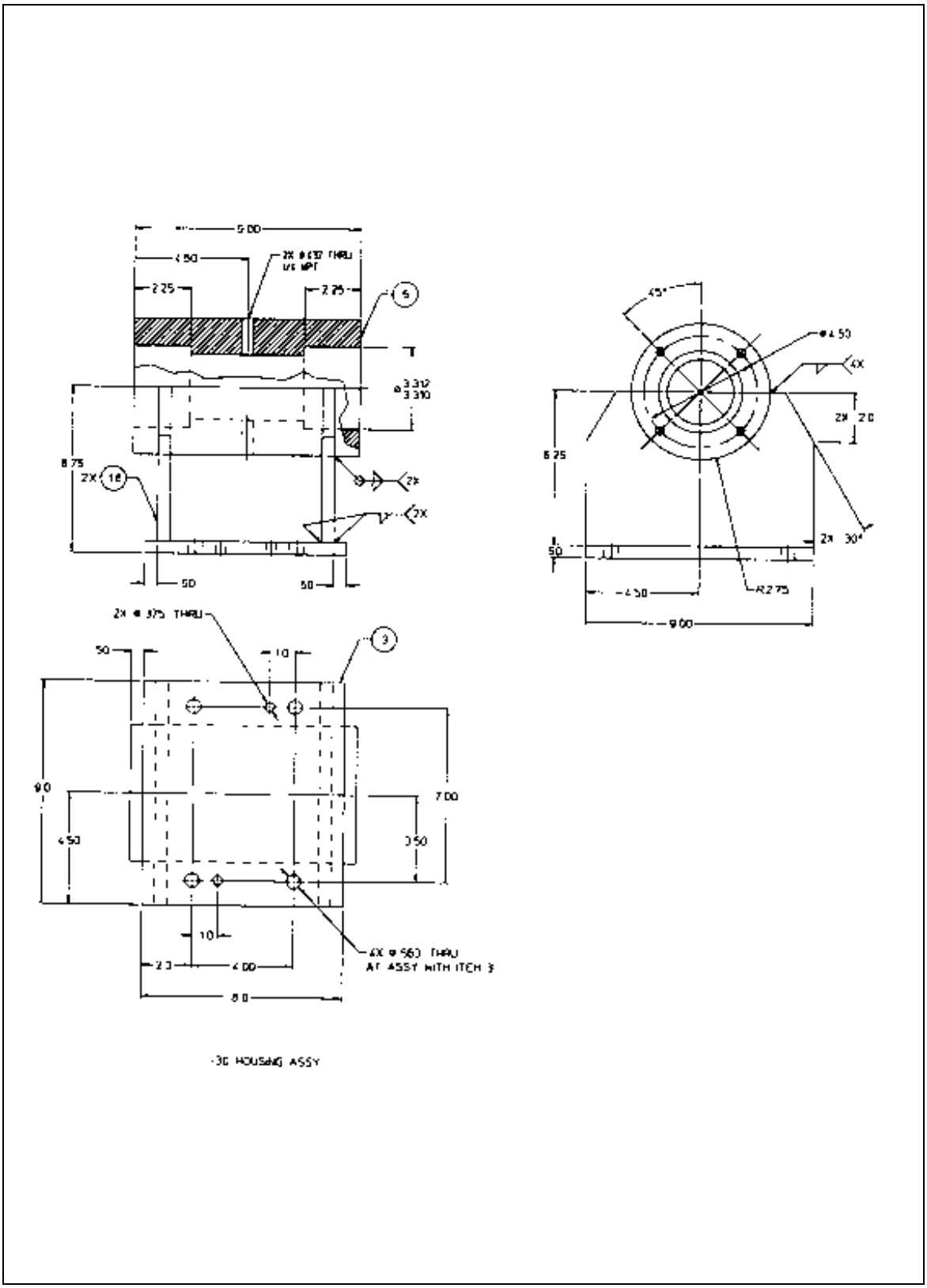


FIGURE A-3. Reciprocating pump test device. (Sheet 2 of 3)

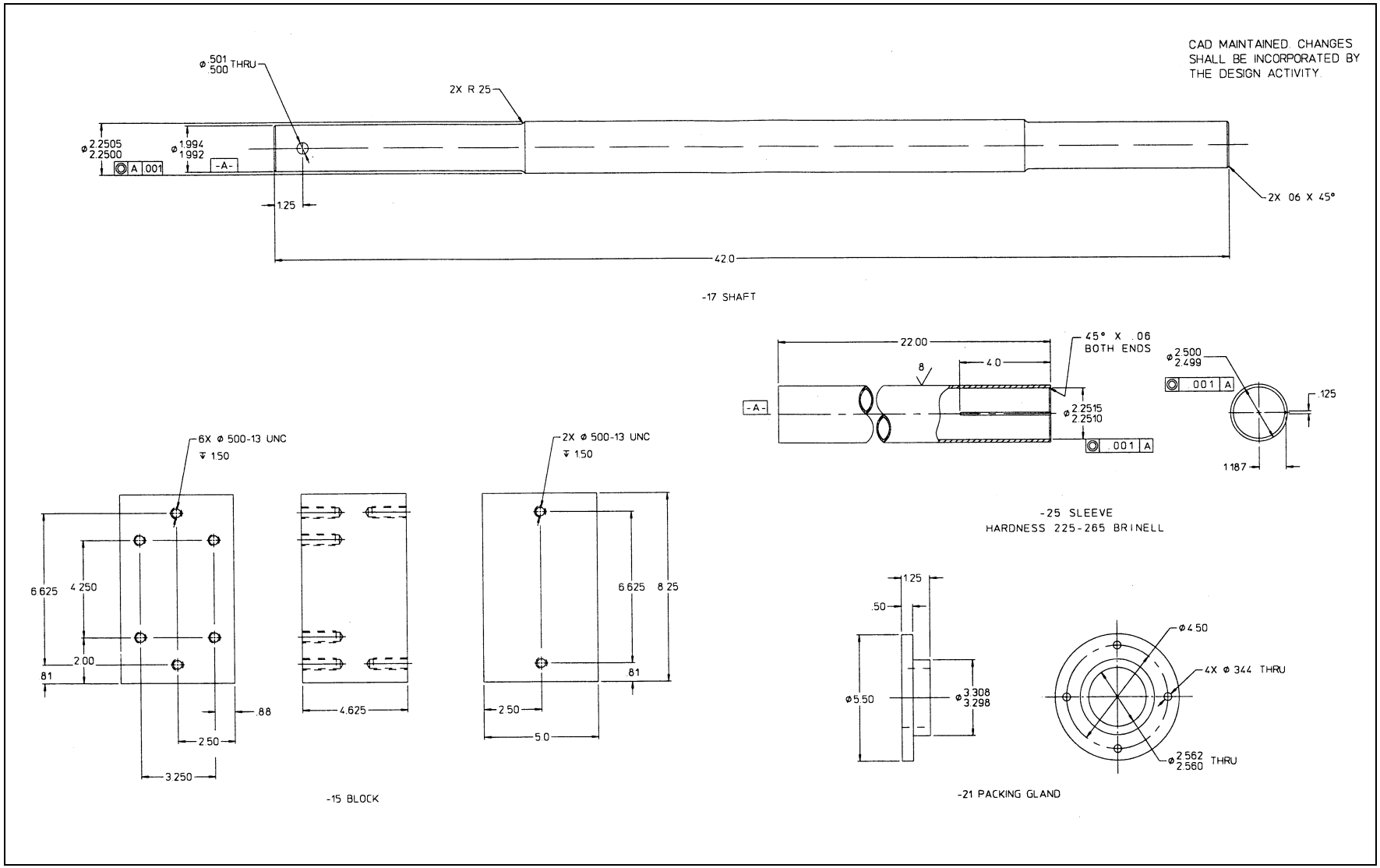


FIGURE A-3. Reciprocating pump test device. (Sheet 3 of 3)

APPENDIX B

COMPRESSION PACKING MATERIAL DYNAMIC LABORATORY TEST PROCEDURE FOR SEAWATER ROTARY PUMP APPLICATIONS

B.1 SCOPE

B.1.1 Scope. This appendix details the laboratory performance tests which are designed to determine if non-asbestos compression packing materials are capable of achieving and maintaining a proper seal in a simulated environment which meets operational safety requirements for naval applications. The tests outlined herein are intended to qualify rotary pump packings for seawater applications (Type I, Class A). This appendix is a mandatory part of the specification. The information contained herein is intended for compliance.

B.2 APPLICABLE DOCUMENTS

This section is not applicable to this appendix.

B.3 TESTING

B.3.1 Materials. The following tests shall be performed on non-asbestos compression packing materials according to their recommended use and temperature/pressure limitations. Three-eighths-inch square packing material shall be specified for each test.

B.3.2 Conditioning. No preconditioning of materials shall be performed. It is desirable that the non-asbestos compression material be exposed to existing environmental conditions, as would be expected in supply storage aboard a naval vessel.

B.3.3 Test procedures for Type I, Class A rotary pump packings for seawater applications. A high pressure rotary pump test device is required and shall be in accordance with figure A-1. This device shall have variable shaft speeds up to 1700 fpm. The surface finish and straightness of the test shafting shall be of commercial pump grade.

A recirculating loop is required, preferably with an expansion tank in the loop. A heater and pressurizing device are required to provide temperatures up to 75ºF and differential pressures across the packing of up to 625 psid. The test device shall have the capability of supplying the necessary fluids for exposure to the packing material. It shall have provisions for measuring the test fixture shaft surface temperature in the area of the second ring of packing (counting from the outside ring). The test device shall be configured to permit data acquisition (shaft temperature, pressure and temperature of the fluid) at intervals of 30 seconds or less, and shall have provisions for collecting extruded packing material.

B.3.3.1 Test media, pressures, temperatures, and leakage rates. The following test conditions shall be provided:

Media	Pressure	Temperature	Shaft speed	No. of packing rings
Seawater	500-625 psid	75ºF	1700 fpm	4

Maximum allowable value of the average overall leakage rate shall be 411 mL per minute at 1700 fpm.

B.3.3.2 Testing procedure. If the test fixture packing gland requires more than the specified number of packing rings, spacers shall be used.

B.3.3.2.1 Four packing ring configuration.

Step 1: Using a mandrel the same size as the shaft, wrap the packing around the mandrel and cut the rings to the proper size. (Measure after cutting first ring.)

Cut five packing rings using a butt joint cut. Number each packing ring for identification. Measure and record weight and cross-sectional dimensions of each packing ring.

Step 2: Install rings - one ring at a time - making sure each ring is seated properly. Stagger ring joints 90 degrees apart.

Step 3: After all rings are installed in the stuffing box:

A. Tighten packing gland nuts firmly enough to compress packing. Spin shaft by hand to check free rotation.

B. Check alignment of packing gland using 90 degree angle (square) on the back edge of the packing gland. Adjust for equal distance at the following positions (12, 3, 6, and 9 o'clock).

C. Apply water pressure (250 psid).

D. Start pump and run for 4 hours with free leakage.

E. Increase pressure to 350 psid and run for 4 hours, adjusting packing gland as necessary to achieve a measurable leakage rate.

F. Run for 20 hours, checking adjustments every hour, or more frequently if necessary. Measure and reduce leakage slowly at a steady rate of decrease, with the objective of reaching the maximum allowable value of the average overall leakage rate or less at hour 28.

G. Run for 2 hours, adjusting leakage rate as necessary to maintain maximum allowable value of the average overall leakage or less.

General notes:

1. If, during break-in period, the packing box becomes overheated (that is too hot to hold hands-on), the pump may be secured until cool to touch rather than loosening the gland nuts to permit increased lubrication. There shall be no more than two such cool-downs.

2. Allow at least 30 minutes of operation between each adjustment because leak rate may change slowly.

Step 4: Upon completion of the 30-hour break-in period, with the test loop at test pressure and temperature, begin the test, unless the leakage rate is uncontrollable, in which case the test is to be terminated. Adjust the leakage rate if necessary, recording compression of the ring material and gland nut torque.

Step 5: Laboratory simulation conditions shall be at least 500 psid and 75ºF for the first 100 hours, and at least 625 psid and 75ºF for the final 10 hours. A typical test sequence is shown in table B-1.

APPENDIX B

TABLE B-1. Typical test sequence.

Event	Description	Hours
Break-in	Continuous cycle-free and controlled leakage	30
Normal run	500 psid and 75ºF 625 psid and 75ºF	100 10
	Total run time =	140 hours

Step 6: During the test period, the following items shall be collected and recorded:

A. All adjustments required, including gland nut torque and percent of material compression.

B. Leakage rate, pressure and temperature shall be measured and recorded hourly. The leakage rate, after adjustment, shall not exceed the maximum allowable value of the average overall leakage rate.

Step 7: Testing of a packing material specimen shall be terminated if either uncontrollable leakage occurs, or gland nut torque settings to control leakage result in an overheated packing.

Step 8: After the test period, secure the heaters and pump, then bleed off system pressure. Remove the packing rings and inspect both packing and pump shaft for any observed wear (any measurable wear shall be recorded). Keep identified packing rings in order of location in the packing gland. Weigh packing.

Step 9: Weigh and measure cross-section of each ring. Note any unusual conditions of packing such as cracking, deformation or unusual loss of lubricant or material. Report condition of packing and pump shaft, including wear measurements.

APPENDIX C

COMPRESSION PACKING MATERIAL DYNAMIC LABORATORY TEST PROCEDURE FOR BOILER FEEDWATER ROTARY PUMP APPLICATIONS

C.1 SCOPE

C.1.1 Scope. This appendix details the laboratory performance tests which are designed to determine if non-asbestos compression packing materials are capable of achieving and maintaining a proper seal in a simulated environment which meets operational safety requirements for naval applications. The tests outlined herein are intended to qualify rotary pump packings for boiler feedwater applications (Type I, Class A). This appendix is a mandatory part of the specification. The information contained herein is intended for compliance.

C.2 APPLICABLE DOCUMENTS

This section is not applicable to this appendix.

C.3 TESTING

C.3.1 Materials. The following tests shall be performed on non-asbestos compression packing materials according to their recommended use and temperature/pressure limitations. Three-eighths-inch square packing material shall be specified for each test.

C.3.2 Conditioning. No preconditioning of materials shall be performed. It is desirable that the non-asbestos compression material be exposed to existing environmental conditions, as would be expected in supply storage aboard a naval vessel.

C.3.3 Test procedures for Type I, Class A rotary pump packings for boiler feedwater applications. A high speed rotary pump test device is required and shall be in accordance with figure C-1. This device shall have variable shaft speeds up to 5400 fpm and shaft hardness shall be 225 ±25 Bhn. The surface finish and straightness of the test shafting shall be of commercial pump grade.

A recirculating loop is required, preferably with an expansion tank in the loop. A heater and pressurizing device are required to provide temperatures up to 300ºF and pressures up to 100 psid. The test device shall have the capability of supplying the necessary fluids for exposure to the packing material.

C.3.3.1 Test media, pressures, temperatures, and leakage rates. The following test conditions shall be provided for rotary pump packing tests:

Media	Pressure	Temperature	Shaft speed	No. of packing rings
Boiler feedwater	100 psid	300ºF	5400 fpm	5

Maximum allowable value of the average overall leakage rate shall be 945 mL per minute at 5400 fpm.

C.3.3.2 Testing procedure. A maximum of five to eight packing rings shall be installed in the pump packing gland. The first run at 5400 fpm shall use five packing rings with spacers; an additional run with eight packing rings is optional except when a 5 packing ring run fails. In this case, an 8 packing ring run shall be required.

Leakage rates shall be tested for the following configurations:

Five or eight packing rings, 5400 fpm shaft speed with a maximum leakage rate of 4 oz/min-32 oz/min (max).

C.3.3.2.1 Five packing ring configuration.

Step 1: Using a mandrel the same size as the shaft, wrap the packing around the mandrel and cut the rings to the proper size. (Measure after cutting first ring.)

Cut five packing rings using a butt joint cut. Number each packing ring for identification. Measure and record weight and cross-sectional dimensions of each packing ring.

Step 2: Install rings - one ring at a time - making sure each ring is seated properly. Stagger ring joints 90 degrees apart.

Step 3: After all rings are installed in the stuffing box:

A. Tighten packing gland nuts firm enough to compress packing and spin shaft by hand to check free rotation.

B. Check alignment of packing gland using 90 degree angle (square) on the back edge of the packing gland. Adjust for equal distance at the following positions (12, 3, 6, and 9 o'clock).

Adjust RTD temperature output to be within plus or minus 5°F of the measured shat temperature. Record both the RTD temperature output and the measured shaft temperature. Test fixture shaft temperature can be measured with a standard laboratory thermometer graduated in individual degree increments and held against the shaft as close as practicable to the RTD sensor location.

C. Apply test fluid pressure (50 psid).

D. Start pump and run for 4 hours with free leakage.

E. Increase pressure to 100 psi***d*** and run for 4 hours, adjusting packing gland as necessary to achieve a measurable leakage rate.

F. Run for 20 hours, checking adjustments every hour, or more frequently if necessary. Measure and reduce leakage slowly at a steady rate of decrease with the objective of achieving the specified leakage rate at hour 28. During this 20-hour period, measure and record leakage rate every two hours. Take shaft temperature hourly, in accordance with Step 8.

G. Increase temperature to 300ºF and run for 2 hours, adjusting leakage rate as necessary to maintain specified leakage. Continue to take shaft temperature readings hourly, in accordance with Step 8.

General notes:

1. During run-in period, if the packing box becomes overheated (i.e. too hot to hold hands-on), the pump may be secured until cool to touch rather than loosen the gland nuts to allow for more lubrication. There shall be no more than two such cool-downs.

2. Allow time between adjustments for the adjustment to take effect. The time needed between adjustments shall be based on past operational experience and the magnitude of the adjustment made.

Step 4: Upon completion of the run-in period, with the test loop at test pressure and temperature, begin the test. Adjust the leakage rate if necessary, recording compression of the ring material and gland nut torque.

Step 5: Laboratory simulation conditions shall be at least 100 psid and 300ºF, to be run for a total of 480 hours.

APPENDIX C

NOTE: Cycles normally shall be run for five consecutive days for 24 hours/day. Cool down cycles shall be scheduled during weekends and holidays. A typical test sequence is shown in table C-1.

TABLE C-1. Typical test sequence.

Event	Description	Hours
Break-in	Continuous cycle-free and controlled leakage	30
Normal run	20 days x 24 hours	480
	Total run time =	510 hours

Step 6: During the test period the following items shall be recorded:

A. All adjustments required, including gland nut torque and percent of material compression.

B. Leakage rate, pressure and temperature shall be measured and recorded every two hours for the first eight hours of operation after a shutdown period and every eight hours otherwise during the 480-hour continuous-run period and immediately after each packing adjustment. The leak rate, after adjustment, shall not exceed the specified leakage rate. If it does, additional adjustments are to be made until leakage is within the specified limit.

Step 7: Testing of a packing material specimen shall be terminated if uncontrollable leakage occurs. Note: During packing adjustment, some smoke may be visible from the packing. This condition is not sufficient reason to suspend the test.

Step 8: RTD temperature measurement procedure:

A. The temperature measuring equipment shall be configured such that when it is operating, a temperature reading is provided every 30 seconds or less.

B. During break-in:

Once 100 psid is established, packing adjustments are checked at least hourly. Thus, take shaft temperature readings at least every hour. Details of the data to be taken are dependent on whether or not a packing adjustment is made, and are described in Step 8.C. the shaft temperature readings shall coincide with a packing adjustment if this is possible.

C. During normal-run cycle:

Leakage rate is measured as specified in Step 6. After the leakage rate is determined, either a packing adjustment is made, or the fixture is left as is.

1. If a packing adjustment is to be made:

a. One minute prior to making adjustment, begin taking shaft temperature readings (at least two data points).

b. Make packing adjustment while temperature reading is being taken; record amount each nut is tightened or loosened.

c. Continue taking shaft temperature readings for 4 minutes following completion of the packing adjustment.

2. If no packing adjustment is to be made, take only 2 minutes of temperature readings.

Taking readings in the manner specified above shall provide shaft temperature information during packing adjustments, when peak temperatures are expected, and during steady-state operation.

Step 9: Following the test period, secure the heaters and pump, then bleed off system pressure. Remove the packing rings and inspect both packing and pump shaft for corrosion, discoloration of packing or pump shaft and any observed wear (any measurable wear shall be recorded). Keep identified packing rings in order of location in the packing gland.

Inspect housing cavity for extruded packing material. Carefully remove any residue, weigh and retain for tests in Step 9.

Step 10: Place packing rings and cavity residue in separate containers in an oven to air dry at 150ºF for 3 hours. Allow cavity residue and packing rings to cool for 5 hours, then weigh and measure cross-section of each ring and weigh residue. Note any unusual conditions of packing such as cracking, deformation or unusual loss of lubricant or material. Report condition of packing and pump shaft, including wear measurements.

C.3.3.2.2 Eight packing ring configuration

Step 1: Using a mandrel the same size as the shaft, wrap the packing around the mandrel and cut the rings to the proper size. (Measure after cutting first ring.)

Cut eight packing rings using a butt joint cut. Number each packing ring for identification. Measure and record weight and cross-sectional dimensions of each packing ring.

Step 2: Install rings - one ring at a time - making sure each ring is seated properly. Stagger ring joints 90 degrees apart.

Step 3: After all rings are installed in the stuffing box:

A. Tighten packing gland nuts firm enough to compress packing and spin shaft by hand to check free rotation.

B. Check alignment of packing gland using 90 degree angle (square) on the back edge of the packing gland. Adjust for equal distance at the following positions (12, 3, 6, and 9 o'clock).

Adjust RTD temperature output to be within plus or minus 5°F of the measured shat temperature. Record both the RTD temperature output and the measured shaft temperature. Test fixture shaft temperature can be measured with a standard laboratory thermometer graduated in individual degree increments and held against the shaft as close as practicable to the RTD sensor location.

C. Apply test fluid pressure (50 psid).

D. Start pump and run for 4 hours with free leakage.

E. Increase pressure to 100 psid and run for 4 hours, adjusting packing gland as necessary to achieve a measurable leakage rate.

F. Run for 20 hours, checking adjustments every hour, or more frequently if necessary. Measure and reduce leakage slowly at a steady rate of decrease with the objective of achieving the specified leakage rate at hour 28. During this 20-hour period, measure and record leakage rate every two hours. Take shaft temperature hourly, in accordance with Step 8.

G. Increase temperature to 300ºF and run for 2 hours, adjusting leakage rate as necessary to maintain specified leakage. Continue to take shaft temperature readings hourly, in accordance with Step 8.

General notes:

1. During run-in period, if the packing box becomes overheated (i.e. too hot to hold hands-on), the pump may be secured until cool to touch rather than loosen the gland nuts to allow for more lubrication. There shall be no more than two such cool-downs.

2. Allow time between adjustments for the adjustment to take effect. The time needed between adjustments shall be based on past operational experience and the magnitude of the adjustment made.

Step 4: Upon completion of the run-in period, with the test loop at test pressure and temperature, begin the test. Adjust the leakage rate if necessary, recording compression of the ring material and gland nut torque.

Step 5: Laboratory simulation conditions shall be at least 100 psid and 300ºF, to be run for a total of 480 hours. A typical test sequence is shown in table C-1.

NOTE: Cycles normally shall be run for five consecutive days for 24 hours/day. Cool down cycles shall be scheduled during weekends and holidays.

Step 6: During the test period the following items shall be recorded:

A. All adjustments required, including gland nut torque and percent of material compression.

B. Leakage rate, pressure and temperature shall be measured and recorded every two hours for the first eight hours of operation after a shutdown period and every eight hours otherwise during the 480-hour continuous-run period and immediately after each packing adjustment. The leak rate, after adjustment, shall not exceed the specified leakage rate. If it does, additional adjustments are to be made until leakage is within the specified limit.

Step 7: Testing of a packing material specimen shall be terminated if uncontrollable leakage occurs. Note: During packing adjustment, some smoke may be visible from the packing. This condition is not sufficient reason to suspend the test.

Step 8: RTD temperature measurement procedure:

A. The temperature measuring equipment shall be configured such that when it is operating, a temperature reading is provided every 30 seconds or less.

B. During break-in:

Once 100 psid is established, packing adjustments are checked at least hourly. Thus, take shaft temperature readings at least every hour. Details of the data to be taken are dependent on whether or not a packing adjustment is made, and are described in Step 8.C. the shaft temperature readings shall coincide with a packing adjustment if this is possible.

C. During normal-run cycle:

Leakage rate is measured as specified in Step 6. After the leakage rate is determined, either a packing adjustment is made, or the fixture is left as is.

1. If a packing adjustment is to be made:

a. One minute prior to making adjustment, begin taking shaft temperature readings (at least two data points).

b. Make packing adjustment while temperature reading is being taken; record amount each nut is tightened or loosened.

c. Continue taking shaft temperature readings for 4 minutes following completion of the packing adjustment.

2. If no packing adjustment is to be made, take only 2 minutes of temperature readings.

Taking readings in the manner specified above shall provide shaft temperature information during packing adjustments, when peak temperatures are expected, and during steady-state operation.

Step 9: Following the test period, secure the heaters and pump, then bleed off system pressure. Remove the packing rings and inspect both packing and pump shaft for corrosion, discoloration of packing or pump shaft and any observed wear (any measurable wear shall be recorded). Keep identified packing rings in order of location in the packing gland.

Inspect housing cavity for extruded packing material. Carefully remove any residue, weigh and retain for tests in Step 9.

Step 10: Place packing rings and cavity residue in separate containers in an oven to air dry at 150ºF for 3 hours. Allow cavity residue and packing rings to cool for 5 hours, then weigh and measure cross-section of each ring and weigh residue. Note any unusual conditions of packing such as cracking, deformation or unusual loss of lubricant or material. Report condition of packing and pump shaft, including wear measurements.

APPENDIX C

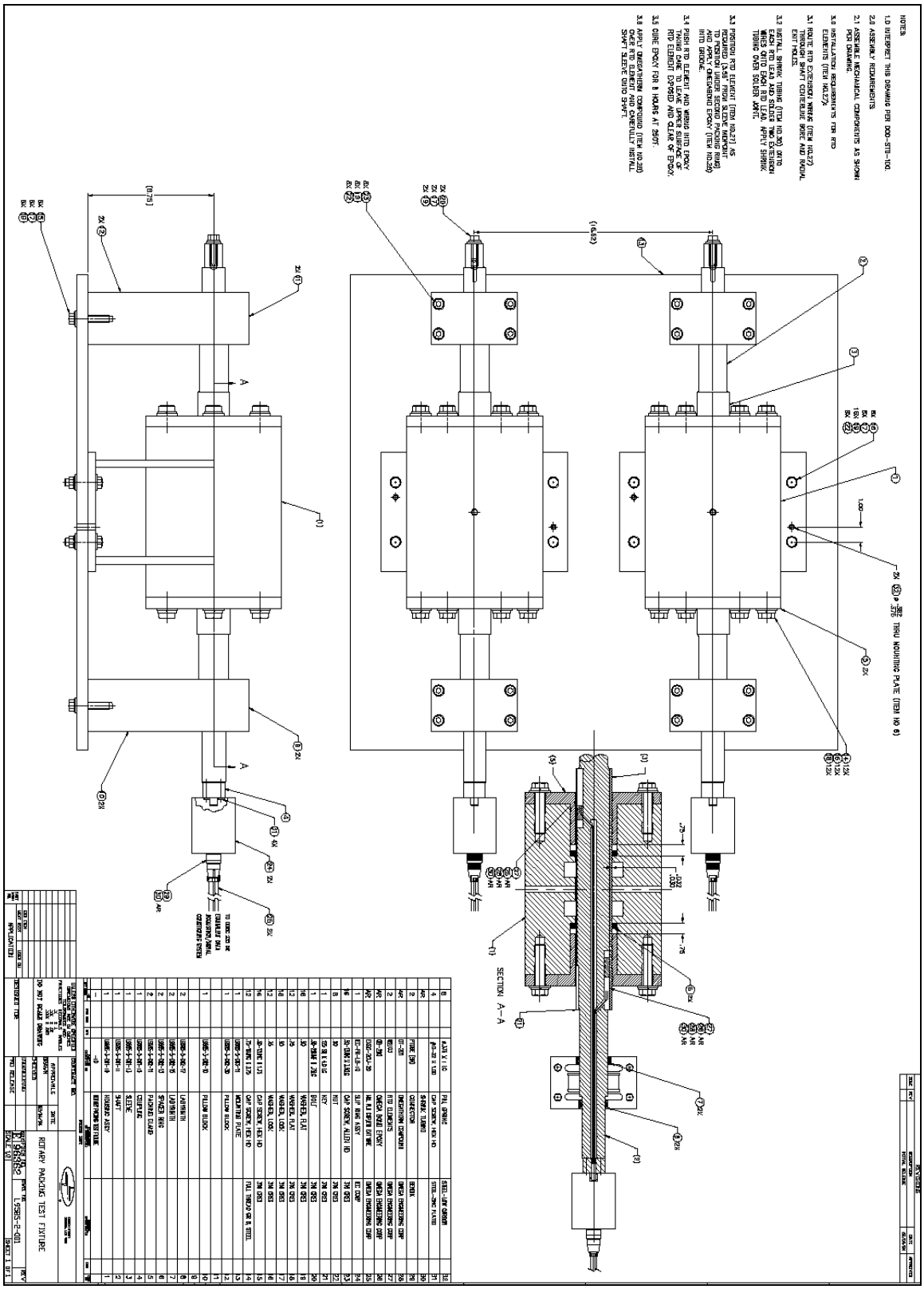


FIGURE C-1. BFW rotary pump test device. (Sheet 1 of 8)

APPENDIX C

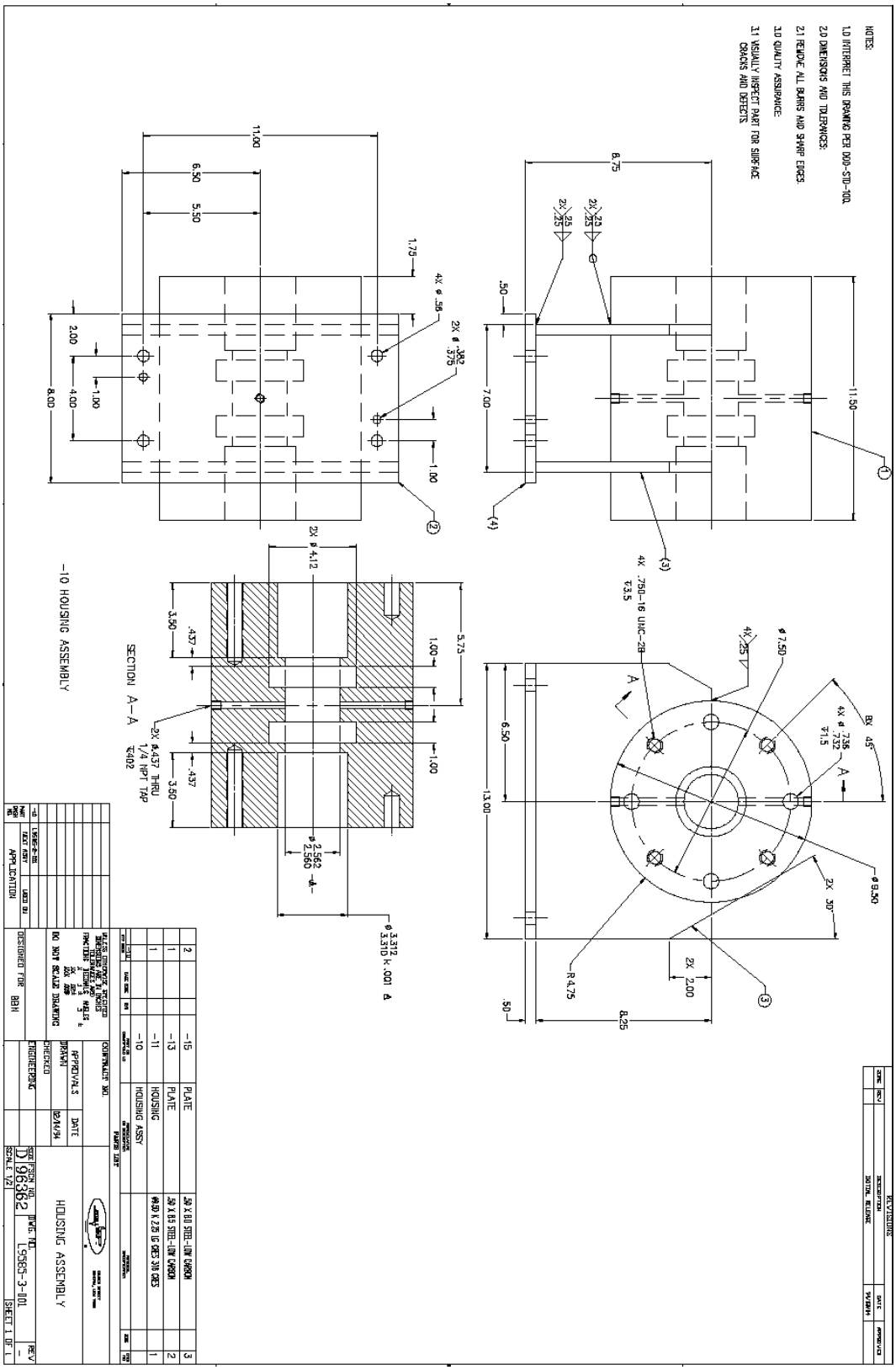


FIGURE C-1. BFW rotary pump test device. (Sheet 2 of 8)

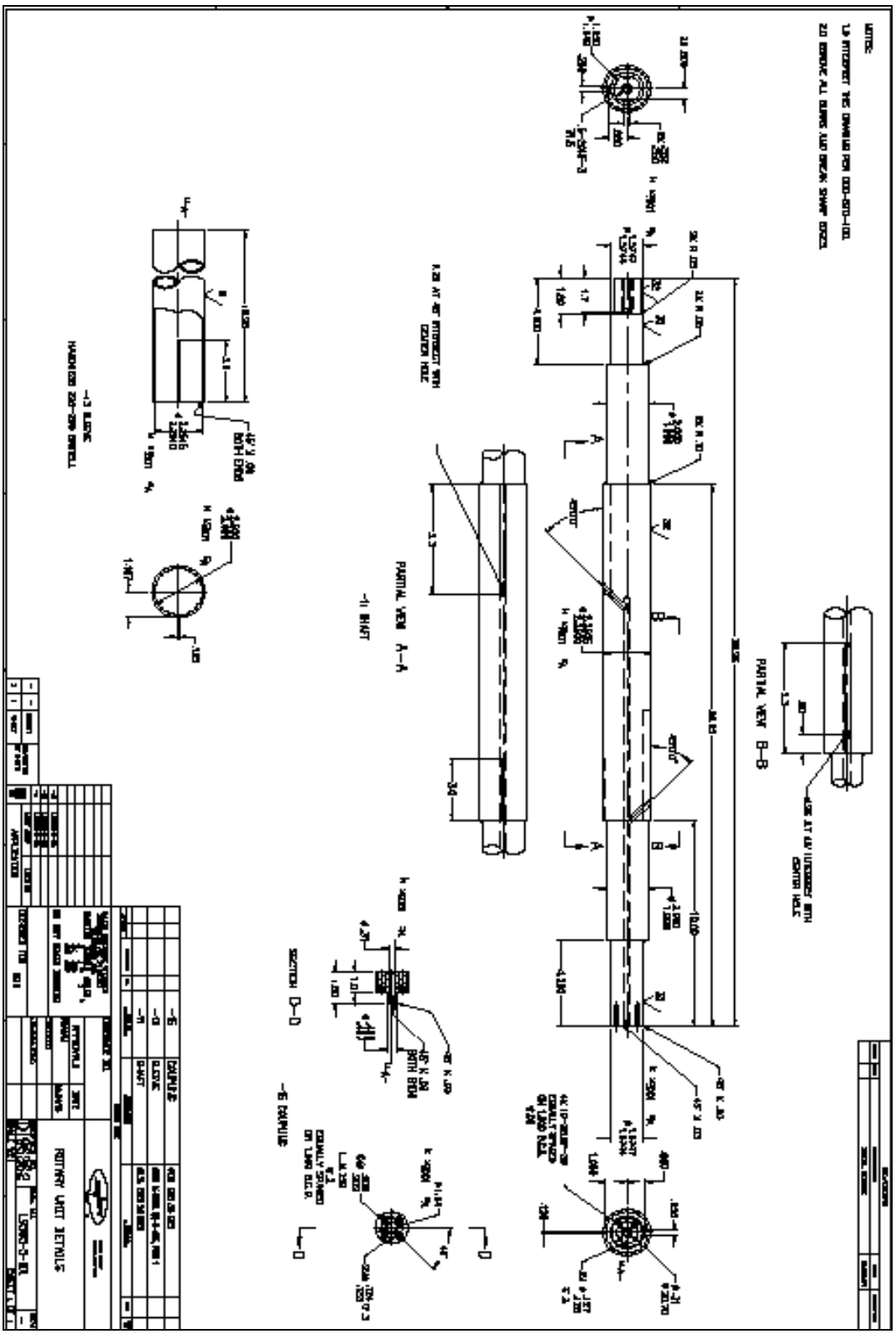


FIGURE C-1. BFW rotary pump test device. (Sheet 3 of 8)

APPENDIX C

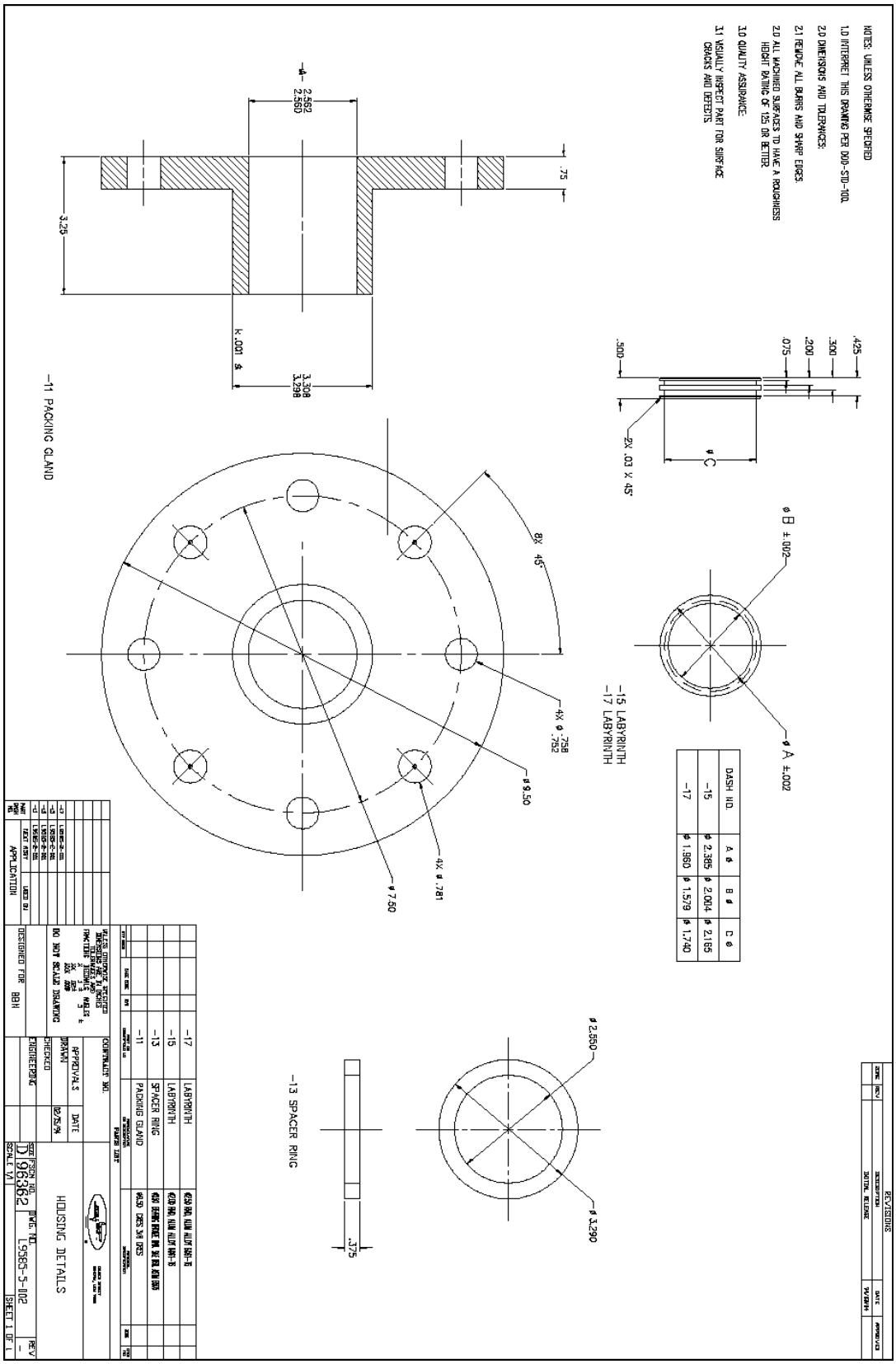


FIGURE C-1. BFW rotary pump test device. (Sheet 4 of 8)

APPENDIX C

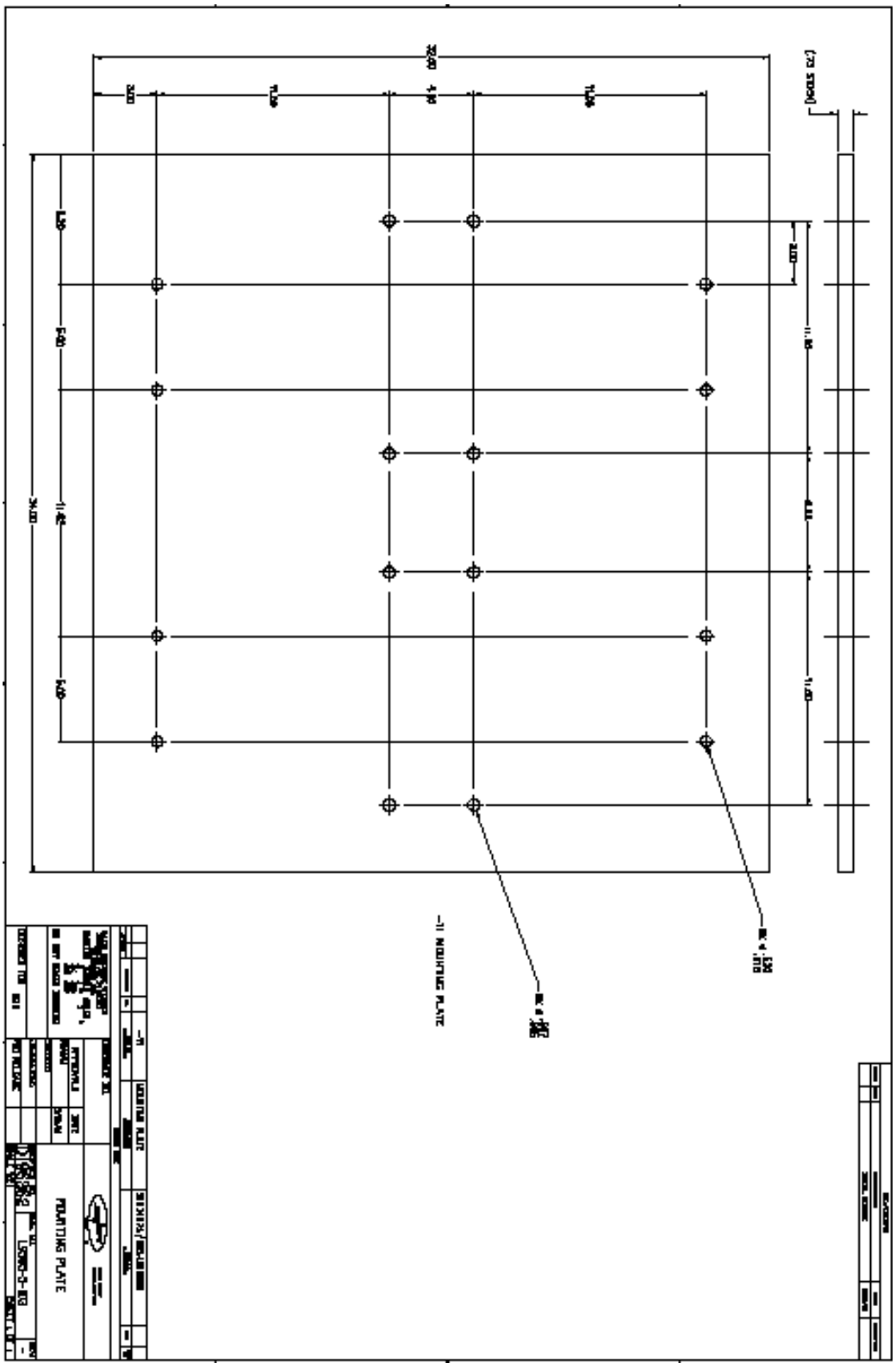


FIGURE C-1. BFW rotary pump test device. (Sheet 5 of 8)

APPENDIX C

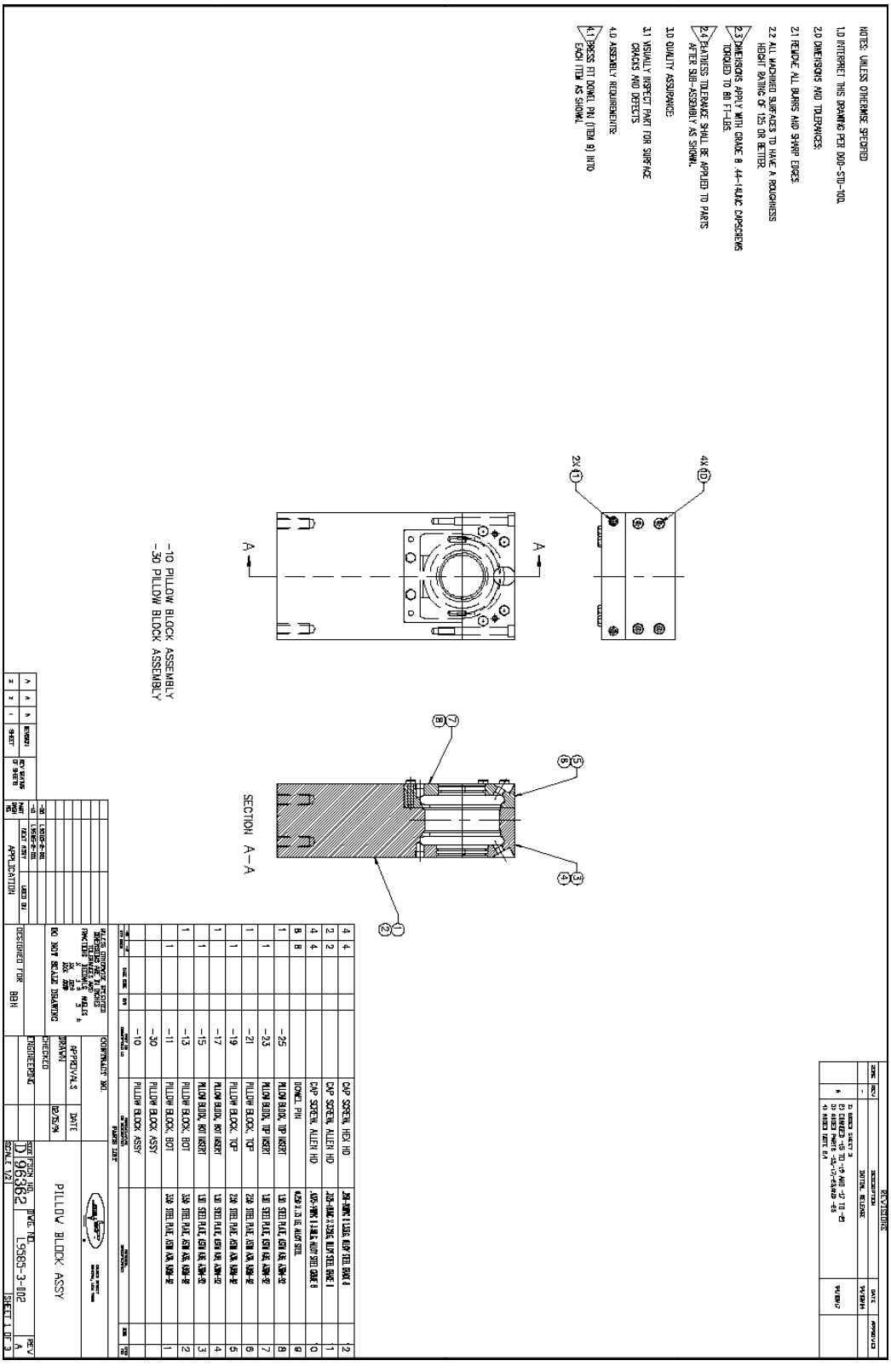


FIGURE C-1. BFW rotary pump test device. (Sheet 6 of 8)

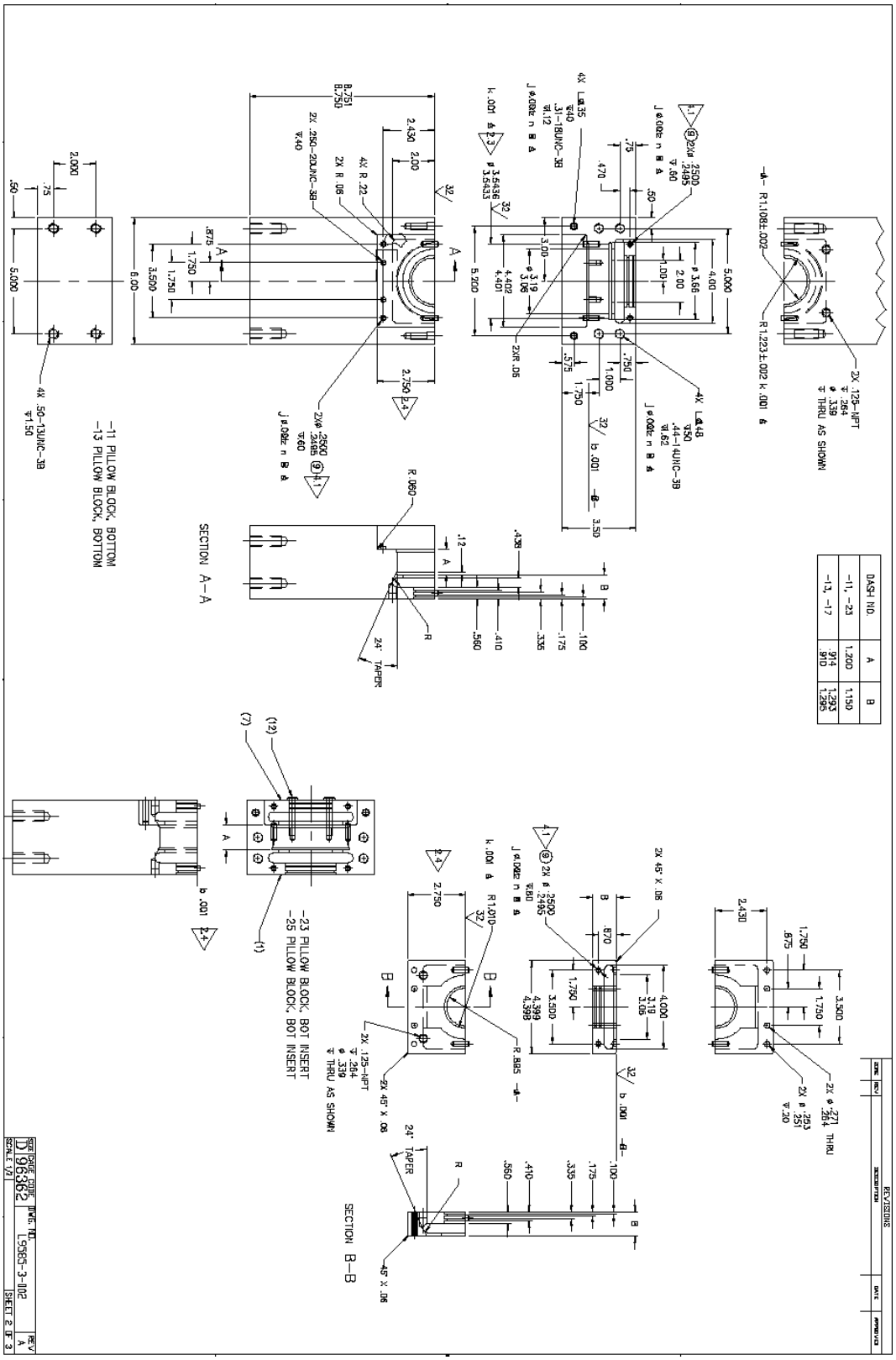


FIGURE C-1. BFW rotary pump test device. (Sheet 7 of 8)

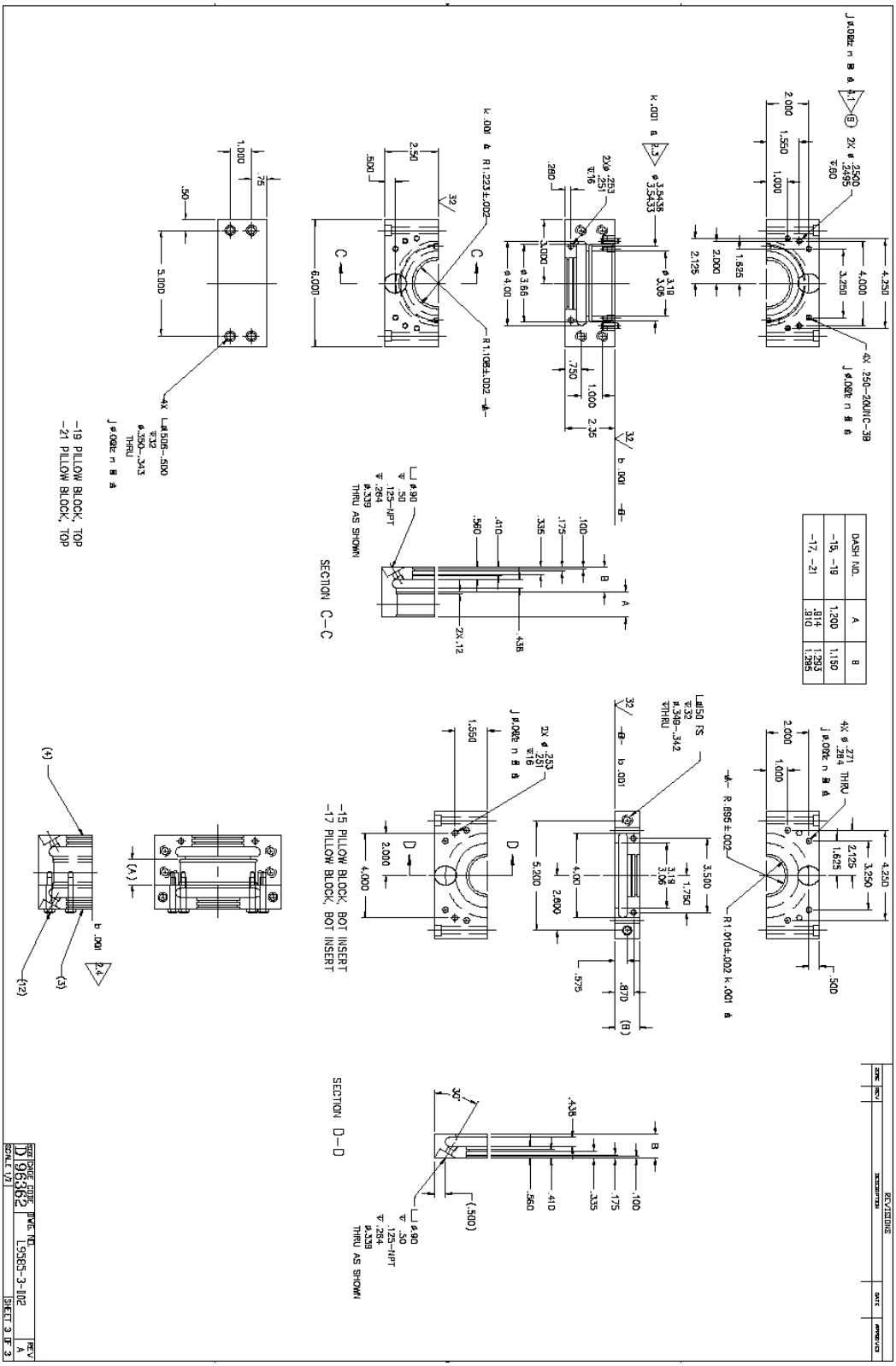


FIGURE C-1. BFW rotary pump test device. (Sheet 8 of 8)

CONCLUDING MATERIAL

Preparing activity:
Navy - SH
(Project 5330-N165)

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

INSTRUCTIONS

1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revision letter should be given.
2. The submitter of this form must complete blocks 4,5,6, and 7.
3. The preparing activity must provide a reply within 30 days from receipt of this form.

NOTE: This form may not be used to request copies of documents, nor to request waivers, or clarification of requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements.

I RECOMMEND A CHANGE:	1. DOCUMENT NUMBER MIL-PRF-24790	2. DOCUMENT DATE *(YYMMDD)* 980923

3. DOCUMENT TITLE
PERFORMANCE SPECIFICATION PACKING MATERIAL, BRAIDED, NON-ASBESTOS

4. NATURE OF CHANGE *(Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed)*

5. REASON FOR RECOMMENDATION

6. SUBMITTER

a. NAME *(Last, First, Middle Initial)*	b. ORGANIZATION	
c. ADDRESS *(Include Zip Code)*	d. TELEPHONE *(Include Area Code)* (1) Commercial (2) AUTOVON *(if applicable)*	7. DATE SUBMITTED *(YYMMDD)*

8. PREPARING ACTIVITY

a. NAME Technical Point Of Contact (TPOC) Richard L. Dempsey	b. TELEPHONE *(Include Area Code)* (1) Commercial (703) 602-0147 X223 (2) AUTOVON
c. ADDRESS *(Include Zip Code)* Commander, Naval Sea Systems Command ATTN: SEA 03Q, 2531 Jefferson Davis Hwy Arlington, VA 22242-5160	IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT: Defense Quality and Standardization Office 5203 Leesburg Pike, Suite 1403, Falls Church, VA 22041-3466 Telephone (703) 756-2340 AUTOVON 289-2340