

1947

# Proposed specifications for 5,000,000 LB. Universal Testing Machine, 1947 proposed contract requirements for 5,000,000 LB. Universal Testing Machine, 1947

Fritz Lab

Follow this and additional works at: <http://preserve.lehigh.edu/engr-civil-environmental-fritz-lab-reports>

---

## Recommended Citation

Fritz Lab, "Proposed specifications for 5,000,000 LB. Universal Testing Machine, 1947 proposed contract requirements for 5,000,000 LB. Universal Testing Machine, 1947" (1947). *Fritz Laboratory Reports*. Paper 1592.  
<http://preserve.lehigh.edu/engr-civil-environmental-fritz-lab-reports/1592>

This Technical Report is brought to you for free and open access by the Civil and Environmental Engineering at Lehigh Preserve. It has been accepted for inclusion in Fritz Laboratory Reports by an authorized administrator of Lehigh Preserve. For more information, please contact [preserve@lehigh.edu](mailto:preserve@lehigh.edu).

NAVY DEPARTMENT  
BUREAU OF AERONAUTICS

~~PROPOSED~~ SPECIFICATIONS FOR  
5,000,000 LB. UNIVERSAL TESTING  
MACHINE

BY

AERONAUTICAL STRUCTURES LABORATORY  
NAVAL AIR EXPERIMENTAL STATION  
NAVAL AIR MATERIAL CENTER PHILADELPHIA

Authorization . . . . . BuAer ltr. Aer-E-2412-BE - 1/21/46 - N32-3  
11641 of 3 Feb. 46

Reported by . . . . . J. Albert Roy . . . . . Test Engineer  
Aero. Engr., P-5

Approved by . . . . . B. M. Thielen . . . . . Division Supervisor  
Aero. Engr., P-5

Approved by . . . . . J. S. Kean . . . . . Head Engineer  
Aero. Engr., P-7

Approved by . . . . . J. J. Tomemichel . . . . . Superintendent,  
CDR., USN . . . . . Aero. Struc. Lab.

DATE ISSUED 5/6/47

PROPOSED SPECIFICATIONS FOR  
5000,000 LB. UNIVERSAL TESTING  
MACHINE

INDEX

Section A. Foundation Design

Section B. Testing Machine

- Paragraph 1. Type
2. Capacity and Size
  3. General Requirements
  4. Main Columns
  5. Screws
  6. Straining Head
  7. Auxiliary Crosshead
  8. Upper Horizontal Frame Member
  9. Cross Head Jack
  10. Main Table
  11. Control Cabinet
  12. Loading System
  13. Weighing System
  14. Automatic Recording System
  15. Loading Platform
  16. Spherically Seated Tension Rods
  17. Electric Motors
  18. Paints and Finishes

Section C. Tests and Inspections

Section D. Accessories

- Paragraph 1. Bearing Plate
2. Elevator
  3. Tension Grips
  4. Tools

Section E. Operating Manual

Section F. Fifty Point Stress Strain Recorder

| = Items deleted from lab log Spec 2/27

|| = Items to use

PROPOSED SPECIFICATIONS FOR  
5,000,000 LB. UNIVERSAL TESTING  
MACHINE

Section A. Specifications for Foundation design:

(1) Contractor shall submit ~~complete~~ <sup>in outline facilities</sup> outline drawings showing the reinforced-concrete foundation as required to house and support the testing machine, except detail drawings of concrete or reinforcing bars in concrete. Contractor shall supply location and size of "I" beams required to receive the maximum transverse load of 500,000 lbs., data on foundation loadings, sizes and location of anchor bolts and other information needed by the Navy in designing and contracting for the construction of the foundation.

(2) Final foundation drawings shall be submitted within thirty (30) days after award of contract in order that the Government can proceed with construction of the foundations with full confidence that the testing machine will fit the foundations in all respects.

(3) The foundation is to have a "T" cross section with the arms of the "T" extending away from the centerline plane of the testing machine columns a distance of twenty-five (25) feet in both directions. This is to insure that in beam tests all forces shall be integral with the testing machine and its foundation. The foundation, therefore, shall be designed to withstand testing machine loads of five hundred thousand (500,000) pounds for the fifty foot span.

(4) In the "T" extensions of the foundation there shall be included tie down rails similar to those now in use at the NAES. The design details and spacing of these rails will be furnished to the contractor.

(5) The foundation design shall provide that there be sufficient space in pit to permit ready access to all parts of testing machine for all necessary maintenance and repair.

(6) Safety against fire hazards shall be considered, with wall recesses in pit for CO<sub>2</sub> cylinder or provision made for installation of automatic fire protection system.

(7) If feasible, it is desired to conduct hydraulic lines and any other connections from the pump pit to the testing machine pit by passing such hydraulic lines or other connections through an oversize conduit embedded in the floor or walls of the passageway which connects the two pits. Contractor shall indicate the size and location of the oversize conduit. This conduit shall be sufficiently oversize to permit passage of additional electrical, hydraulic and air lines in future.

(8) Foundation pit shall have proper ventilating system with temperature and humidity control.

(9) Entrance to foundation pit shall be by stairway and not by ladder.

(10) Contractor shall indicate the required location of electric power outlets, etc., if any, in the testing machine foundation.

(11) Location and details of anchor bolts and thickness of main table of testing machine shall be indicated.

(12) It is proposed to install in the floor of the testing machine pit a sump and automatic pump to remove seepage waters, should seepage occur. Bidders shall indicate the part of the testing machine pit in which the sump and pump may be installed so as to cause no interference with the testing machine.

(13) The testing machine foundation, foundation nuts and bolts, the sump and sump pump and the pump pit cover, ventilating system, humidity control, stairway, fire protection system and any flooring around the testing machine are not to be supplied under this contract.

SECTION B - SPECIFICATIONS FOR TESTING MACHINE:1. Type:

This machine shall be of the universal, vertical, high capacity floor type suitable for tension, compression, and transverse testing.

2. Capacity and Size:

- (a) The machine shall have a capacity of five million (5,000,000) lbs. in tension and five million (5,000,000) lbs. in compression.
- (b) The machine shall accommodate compression specimens of any height between zero (0) and three hundred and sixty (360) inches, neglecting strain in specimen. The machine shall accommodate tension specimens of any length between one (1) and three hundred and twenty-four (324) inches between grips, including strain in specimen. The maximum tension length applies to visible tension space to which may also be added the 36 inches of ram stroke making a total of 360 inches. The maximum compression length of three hundred and sixty (360) inches shall exist between the top of main table and lower side of bearing plate on loading platform.
- (c) The machine shall accommodate transverse specimens of a length which may be tested on the main table to a maximum load of five million (5,000,000) lbs. or as high as consistent with the design.
- (d) The clear horizontal working space between upright columns shall be not less than one hundred and twenty (120) inches. The clear horizontal space between the screws of the testing machine shall not be less than the clear horizontal space between columns. To provide the maximum clear space about the specimens there shall be only two main column assemblies above the main table.
- (e) The principal center line of the machine is defined as the center line in the plane of the screws and the transverse center line is defined as the center line normal to the plane of the screws.
- (f) The machine shall be erected on the foundations the details of which shall be shown on drawings prescribed under Section A.

3. General Requirements:

- (a) The machine shall consist of three (3) separate units or systems, the loading system, the weighing system and the combined recording system.
- (b) The loading system shall be capable of:
  - (1) Applying loads up to full rated capacity at any desired rate of travel of the straining head from zero (0) inch to three (3) inches per minute.
  - (2) Removing the load rapidly and reversing the motion of the straining head by power at a rate of not less than fifteen (15) inches per minute.

- (c) The weighing system shall indicate the true load by conveniently located twenty-four (24) inch dials of sixty-six (66) inch scale length. There shall be six (6) distinct loading ranges. These ranges shall be as follows:

- (1) 0 to 24,000 lbs. by 20 lb. divisions.
- (2) 0 to 120,000 lbs. by 100 lb. divisions.
- (3) 0 to 240,000 lbs. by 200 lb. divisions.
- (4) 0 to 1,000,000 lbs. by 1000 lb. divisions.
- (5) 0 to 2,000,000 lbs. by 2000 lb. divisions.
- (6) 0 to 5,000,000 lbs. by 5000 lb. divisions.

Overload protection devices shall be set to operate at one-hundred and ten (110) percent of dial ranges (1), (2) and (3) above. Throughout these specifications the term "range" or "scale range" shall be understood to apply to the above tabulated values.

- (d) The indicator shall operate on the Null or Zero Method in combination with an external source of energy.
- (e) There shall be no hydraulic connection between the loading system and the weighing system.
- (f) If an hydraulic pressure cell be used in the weighing system, the active unit of that system shall be so mounted upon the straining head (or other part) as to eliminate from the measured loads friction developed in any part of the machine.
- (g) The main table of the machine shall be immovable and at floor level. It shall form no part of the weighing system.
- (h) Depth below floor shall not exceed fifteen (15) feet, with loading ram in its lowest position.
- (i) The net weight of the machine shall be not less than five hundred and fifty thousand (550,000) lbs. This does not include grips, loading platform, compression blocks, etc.
- (j) An adjustable straining head shall be provided, constrained to move vertically in a straight line by suitable guides or columns and sufficiently rigid to resist horizontal forces due to eccentric loading as described in Section C.
- (1) The straining head shall travel in vertical guides or columns for the full length of adjustment with a maximum working clearance in any direction in the horizontal plane of four-thousandths (.004) inch.
  - (2) The straining head shall be provided with a mechanism or mechanisms so constructed that when testing specimens or models in compression, the relative horizontal movement between the straining head and the guide columns and the relative vertical movement between straining head and screws due to working clearances, etc., may be reduced to a negligible amount, as specified in paragraph C-8 "Tests and Inspections".



- (3) The sliding friction due to the motion of the straining head in the guides when so restrained or when eccentric loads are applied as described in paragraphs C-7 and C-8 hereunder, shall introduce no error in the load indication.
- (4) The straining head shall be lowered and raised for adjustment by screws or other gear driven by an electric motor of adequate power with control appliance as specified hereunder at a speed of twenty-four (24) inches per minute.
- (5) The straining head shall be lowered and raised through a power stroke of at least thirty-six (36) inches by means of hydraulic ram.
- (k) The loading power unit and the straining head adjusting (lowering and raising) mechanism shall be driven by separate electric motors of adequate power with a name-plate rating of either four hundred and forty (440) or two hundred and twenty (220) volts, sixty (60) cycles, three (3) phase alternating current. Each motor shall be controlled by an automatic starter having over-load and no-voltage protection with push button and control station located in the cabinet.
- (l) An auxiliary crosshead shall be provided, adjustable in not less than four (4) positions vertically, as described in paragraph B-7(c) and B-7(d) hereunder, to enable the testing of tension specimens of various lengths at a convenient working level above the main table.
- (m) The vertical columns shall be capable of resisting, without exceeding permissible deflection, a thrust component in any direction in a horizontal plane ten (10) feet above floor equal to ten (10) percent of the full rated capacity of the machine, as described in paragraph C-7.
- (n) The dial indicators and electric and hydraulic controllers shall be mounted in a control cabinet which shall be placed convenient to the testing machine proper. Control of the loading power unit, for reversing, varying the speed, etc. shall be by convenient hand wheels or levers mounted in or conveniently near the cabinet. These hand wheels or levers shall not be mounted on the cabinet table but on the front of the cabinet below table height. The hand wheels or levers shall operate in a vertical plane. No apparatus shall be mounted on the end of the cabinet adjacent to the testing machine.
- (o) The word "power" in these specifications shall apply to mechanisms operated from an electric motor through the medium of a liquid under pressure or mechanical gearing. Springs or weights will not be permitted where power operation is required.
- (p) The general arrangement of the machine shall follow Baldwin-Southwork Drawing PP7682.

- (q) Means for adequate lubrication shall be provided for all working parts, together with such guards and covers as may be necessary to keep all bearings and working surfaces clean and in good order.
- (r) Transparent safety screens shall be provided so that the specimen under test shall be fully enclosed. The screens shall be of a folding or collapsible type to facilitate quick access to the specimen.
- (s) Neoprene tubing or its equivalent shall be used to enclose flexible lines to moving parts such as crosshead or movable platform.
- (t) Hydraulic system shall have as few high points as possible to prevent air accumulation in lines. Each high point should have an air bleed valve.
- (u) Main cylinder should have drain plug.
- (v) There shall be provision for an intercommunicating system with stations on the movable platform, in the pit, on the control cabinet and a portable station to be set up near the testing machine for use by test engineer. The intercommunicating system shall be furnished by the NAES but the provisions for its installation are a part of this contract.

#### 4. Main Columns:

- (a) Holes shall be provided through each column, at least four (4) inches in diameter, spaced not more than twenty four (24) inches in a vertical direction, suitable for the insertion of rods or pipes and for erection of temporary scaffolding around the testing machine while special tests are in progress. The corresponding holes in front and back of each column and in the two columns shall be in the same horizontal plane.
- (b) On that column nearest the weighing cabinet there shall be installed a ladder to enable operating personnel to climb to the testing machine movable platform.
- (c) In each column and extending over the full height of the column there shall be two (2) T-slots. The throat of the T-slot shall be such as to receive three-fourths (3/4) inch diameter aircraft bolts with special square heads and the remainder of T-slots shall be a balanced design to exceed the strength of the bolt in order that the three-fourths (3/4) inch bolt will fail before any part of the T-slot fails. There shall be not less than three-fourths (3/4) of one inch of flat face on each side of the T-slot throat. At the top and bottom ends of each T-slot the lips of the T-slot shall be removed for a distance which will permit the insertion of the square head of the three-fourths (3/4) inch bolt.

At each T-slot on that face which is more distant from the principal axis of the testing machine there shall be accurately scribed graduations one (1) inch apart. Every fifth graduation, beginning with zero (0) at the main table, shall be numbered. In each column and screw assembly the screw shall be so located with respect to the face of the T-slots that if a straight-edge is placed horizontally across the two T-slots of a column the screw is within the space bounded by the column and straight-edge at all points in the full height of the column.

- (d) The proportions, weight and strength of these columns shall be such as to provide stability for all possible load conditions well above the limits set by the over load capacity of the loading unit of the testing machine.

#### 5. Screws:

- (a) There must be uniform bearing between all pairs of mating surfaces between nuts at bottom of screws and bottom side of main cylinder bracket through which screws pass.
- (b) Bronze or other bearing material should be used between nuts and main cylinder bracket to prevent "seizing" when screws are rotated.
- (c) Clearances should be adjustable to about four thousandths (.004) inch between nut and bracket to avoid pause in loading.
- (d) Proper lubrication should be provided to main screws where they pass through main table.
- (e) The screws shall be protected by a movable curtain which shall slide up and down in slots in main columns. It shall be attached to straining head and move in conjunction with it so that screws are constantly protected. The window shade principle may be utilized to wind and unwind the curtains as the straining head moves.

#### 6. The Straining Head:

- (a) The straining head shall be adjustable in height by power in either direction, at a speed of not less than twenty-four (24) inches per minute. The straining head shall have a power stroke of at least thirty-six (36) inches.
- (b) The working clearances of the straining head in the guides or columns (total clearance) shall be not more than plus or minus four thousandths (.004) inches.
- (c) The straining head shall be so designed that it will accommodate accessories as specified in paragraph D-3.
- (d) Two lifting lugs, each of five thousand (5,000) pounds capacity, shall be provided on each side of the straining head for lifting models, specimens and appliances.

**7. The Auxiliary Crosshead:**

- (a) The auxiliary crosshead shall be raised or lowered by power by allowing it to rest upon the straining head.
- (b) The working clearances of the auxiliary crosshead in the guides shall be not more than one thirty-secondth ( $1/32$ ) inch.
- (c) The upper position of the auxiliary crosshead shall be at its maximum possible height. The lower position of the auxiliary crosshead shall be above the main table a distance equal to: depth of straining head plus power stroke plus one (1) inch.
- (d) The remaining two or more positions for the auxiliary crosshead shall be spaced at approximately equal distances between the upper and lower positions.
- (e) The auxiliary crosshead shall be designed to accommodate the same tension rods as the straining head. (See paragraph D-3).

**8. Upper Horizontal Frame Member:**

- (a) The upper horizontal frame member of the testing machine which connects the two columns shall be so constructed as to permit raising the auxiliary crosshead to the greatest possible height with the headroom available. For this purpose the horizontal member shall be made in the form of a hollow yoke, partially surrounding the auxiliary crosshead in its highest position.
- (b) The upper horizontal frame member shall be designed to accommodate the installation of a m.p.\* as described in paragraph D-2.
- (c) A central hole shall be provided for removing or adjusting tension rods in the auxiliary crosshead when in its highest position.
- (d) Two lifting lugs, each of five thousand (5,000) pounds capacity, shall be provided on each side of the upper horizontal frame member of the testing machine for the attachment of blocks to lift models, specimens, and appliances.
- (e) The attachment of this frame member to main columns shall be as rigid as possible. Several bolts shall be used for this purpose. Rigidity should be obtained in both the vertical plane of the main columns and also in the horizontal plane of the frame member itself.
- (f) If possible the openings in the frame member above the main screws should be large enough to permit passage of the straining head retainer nuts.

\* movable platform

9. Cross-Head Jack:

- (a) A cross-head jack shall be installed on the machine to lift the main cross-head through the backlash distance. This apparatus prevents the load-applying cross-head from changing its attitude in space when the applied load begins to exceed the dead weight of the cross-head, and it thereby assures that uniform bearing of the loading platform on the specimen is maintained.

10. Main Table:

- (a) There shall be accurately scribed lines in the main table parallel to the principal and transverse center lines of the testing machine.
- (b) These lines shall be spaced at six (6) inch intervals so that the surface of the main table is marked off in six (6) inch squares.
- (c) The lines shall be so located that the center of a six (6) inch square coincides with the intersection of the principal and transverse center lines of the testing machine.

NOTE: Lines coinciding with the principal and transverse center lines of the testing machine are not to be scribed on the main table.

- (d) The two lines most distant from and parallel to the principal center line shall each be fifty-seven (57) inches distant from the principal center line.
- (e) The two lines most distant from and parallel to the transverse center line shall each be fifty-seven (57) inches distant from the transverse centerline.
- (f) Lines shall be approximately same as markings on Lufkin Co. steel scale No. 2404 Heavy.
- (g) Figures or numbers on scribed lines for identification are not required.
- (h) Holes for one and one-half ( $1\frac{1}{2}$ ) inch NF 12-3 bolts shall be drilled and tapped in the main table at the following locations: on the forty-five (45) degree diagonals at distances perpendicular to the center lines of fifteen (15), twenty-seven (27), thirty-three (33) and fifty-four (54) inches; also on the two lines parallel to the transverse center line at distances of twenty-seven (27), thirty-three (33) and fifty-four inches from the principal center line in both directions. These holes shall be tapped to a depth of at least two (2) inches. For these holes there shall be supplied plugs, whose top faces shall be machined flat with surface of main table and shall contain screw driver slots.

- (1) The main table shall be sufficiently deep where main columns are bolted down to permit bolt holes to be threaded to a depth of at least one and one-half ( $1\frac{1}{2}$ ) times bolt diameter.

#### 11. Control Cabinet:

##### (a) Dial Indicators:

- (1) Shall be mounted at a convenient height on a suitable instrument board on the control cabinet.
- (2) Shall each be provided with a sensitive maximum hand and a convenient means of obtaining zero adjustment.
- (3) Shall have scale divisions not less than fifty-five thousandths (0.055) inch (center to center of graduations) with the width of each graduation not more than one-fifth ( $1/5$ ) of this value.
- (4) Shall have pointers whose widths, abreast the scale, are not more than one-fifth ( $1/5$ ) of a scale division.
- (b) The back of this cabinet shall be hinged for ready access to valves and mechanism for maintenance and repair purposes.
- (c) A load rate pacing disk, a strain rate pacing disk (Selsyn motor type), a straining head motion indicator (Selsyn motor type) and a load maintaining indicator are all to be provided on the control cabinet.
- (d) If possible cabinet should be "knee hole" type permitting operator to manipulate controls while seated.
- (e) Warning lights indicating that electrical circuits are turned on, pit is occupied etc. should be on control cabinet in plain view of operator.
- (f) Location of control cabinet with respect to the testing machine shall be such as to provide safety for operator from flying fragments when specimens are broken in the testing machine to the extent practicable and consistent with efficient operation of the machine.
- (g) Intercommunication system shall have station at control cabinet.

#### 12. The Loading System:

- (a) The screws which transmit load to the straining head will not be permitted to rotate during the application of the power stroke by the loading system.
- (b) If an hydraulic pump be used for the loading system, the pump impulses shall so overlap that there is no perceptible or measurable pulsation during application of the load.

- (c) Suitable springs or other appliances shall be built into the loading system, capable of absorbing the shock when specimens are broken at full load capacity on the machine, as described in paragraphs C(b) and C(c).
- (d) The testing machine shall be provided with automatic limit switches to prevent over travel of the straining head and of the moving parts of the loading system. The loading power unit shall be provided with automatic release valves to prevent building up excessive pressure.
- ✓ (e) The loading system shall be capable of applying one hundred and ten (110) percent of capacity load.

13. The Weighing System:

- (a) The following accuracies must be guaranteed for the machine:

<u>Range</u>	<u>Accuracy</u>
5,000,000 lbs.	} .5% of reading or .10% of dial range
2,000,000 lbs.	
1,000,000 lbs.	
240,000 lbs.	
120,000 lbs.	.75% of reading or .15% of dial range
24,000 lbs.	1% of reading or .20% of dial range

- (b) It shall be possible to bring the scales of any or all of the dial indicators to zero adjustment when special fixtures or other devices, not required under this specification, weighing up to two thousand (2,000) lbs. are attached to the straining head. The accuracy of the readings of these dial indicators under these conditions shall be within the limits given in paragraph (a).
- (c) Hysteresis: The load indication shall be as free from hysteresis lag as possible. During the loading and unloading cycle, the hysteresis at mid-point of the cycle shall not exceed the conditions defined in paragraph C-10 "Tests and Inspections".
- (d) Creep: The dial load indicators shall be designed so that they are practically free from creep due to the constant application of heavy loads and so that they will continue to give accurate load indication regardless of the length of time for which the load is applied. They shall meet the requirements in paragraph C-11 "Tests and Inspections".

14. The Automatic Recording System:

- (a) Autographic recording apparatus shall be a self-contained unit of the electric type, for making load-elongation records on suitable charts.
- (b) The load record, or ordinate, shall be obtained by a pen which moves over a coordinate paper on a revolving drum or other suitable method. The elongation record shall be obtained by suitable strain measuring gages attached to test specimen.

- (c) The necessary strain gages for performing the tests on this system as specified in paragraph C-13 shall be supplied by Contractor.
- (d) The load record shall be adjustable approximately to full scale (full ordinate) for each of the following nine (9) values:
- |                |              |
|----------------|--------------|
| 5,000,000 lbs. | 120,000 lbs. |
| 2,500,000 lbs. | 60,000 lbs.  |
| 1,000,000 lbs. | 24,000 lbs.  |
| 500,000 lbs.   | 12,000 lbs.  |
| 240,000 lbs.   |              |
- (e) The recording mechanism shall operate on one hundred and twenty (120) volts, sixty (60) cycles alternating current.
- (f) Magnification of the elongation shall be adjustable to one thousand (1,000), five hundred (500), two hundred and fifty (250), two hundred (200), one hundred (100), and fifty (50). The selection of the latter three magnifications shall meet with the approval of the Naval Air Experimental Station.
- (g) The accuracy of the recorder in load shall be within plus or minus three-fourths ( $3/4$ ) of one (1) percent of the applied load on each of the scale ranges above thirty (30) percent of full-scale range, and within two-tenths (0.20) of one percent of full-scale range below thirty (30) percent of full-scale range.
- (h) The sensitivity of the apparatus in elongation shall be within plus or minus two hundred-thousandths (0.00002) inch and the accuracy within plus or minus five hundred thousandths (.00005) of an inch, or within plus or minus one-half ( $1/2$ ) of one (1) percent of the recorder strain whichever is greater.
- (i) The accuracy of the load and the elongation recording mechanism shall not be affected by voltage changes.
- (j) There shall be an addition to standard recorder for automatic indication of yield strength, etc with varying offset and complete usable chart direct from recorder.
- (k) There shall be an addition to standard recorder for printing attachment to recorder with accuracy of printing one (1) percent of reading. This does not effect accuracy of recorder.
- (l) There shall be an addition to standard recorder for automatic change of loading rate of main ram.

#### 15. Loading Platform

- (a) The straining head shall be fitted with a loading platform which shall consist of three principal parts: two leveling disks and one bearing plate. In addition, there are minor parts such as one center pin, a number of supporting springs, two adjusting bars for the leveling disks, etc. Center pin must support bearing plate to prevent sag at center of plate.



- (b) To accommodate the loading platform the yoke shall be constructed with the bottom face of the same area as the bearing plate of the loading platform.
- (c) The lower plate of the yoke which bears against the leveling disks shall be designated as the yoke plate. The yoke plate shall be integral with the yoke. It shall be seventy-two (72) inches square and not less than six (6) inches thick at any point. In addition it shall be adequately stiffened with ribs which extend from the yoke plate to the yoke proper. That face of the yoke plate which bears against the top leveling disk shall be finished flat to a tolerance of plus or minus two thousandths ( $\pm 0.002$ ) inch.
- (d) The edge of each disk shall be graduated from 0 to 100 in quadrants according to practice already established with the NACA 1,000,000 lb. testing machine.
- (e) Each disk shall vary linearly in thickness from one and one-quarter ( $1\frac{1}{4}$ ) inches at one edge to one and one-eighth ( $1\frac{1}{8}$ ) inches at the edge diametrically opposite or heavier dimensions may be used if the design is improved thereby. This will give a total adjustment of one fourth ( $\frac{1}{4}$ ) inch when the leveling disks are turned one hundred eighty degrees with respect to each other. Each face of each leveling disk shall be finished flat to a tolerance of plus or minus two thousandth ( $\pm 0.002$ ) inch.
- (f) The disks shall be rotated <sup>under no load</sup> by electric motors with push button control.
- (g) The bearing plate of the loading platform shall be seventy-two (72) inches square and not less than four (4) inches thick. The plate shall have its two faces parallel within two thousandths (0.002) inch and each face shall be finished flat to a tolerance of plus or minus two thousandths ( $\pm 0.002$ ) inch. The tolerance on parallelism includes the tolerance on flatness. The bearing plate shall be supported from the yoke plate on springs and a pin at center. The number of springs shall be the minimum necessary and their location shall be such as to cause a minimum of interference with the operation of rotating the leveling disks and reading of the graduation. The springs shall be capable of holding the bearing plate and the two leveling disks snugly against the yoke plate over the entire area at all times with such pressure that the leveling disks can be adjusted by a single force of not more than fifty (50) pounds at a distance of forty-eight (48) inches from the center of the disks without adjustment of the spring tension. These springs shall pass through the yoke plate and be supported by a nut or other mechanism above the yoke plate which permits varying the tension on the support springs. The springs shall be capable of holding the bearing plate and leveling disks against the yoke plate with a force equal to one hundred forty (140) percent of the dead weight of those parts.

The nut or tension adjusting mechanism on the support springs shall have such travel that the bearing plate and leveling disks can be lowered such a distance that there is one-half ( $\frac{1}{2}$ ) inch clear space between the yoke plate and top leveling disk. The bearing plate shall be prevented from rotating with respect to the yoke plate by blocks. There shall be provided on the end faces of the bearing plate tapped holes of the same kind and spacing as described for the main table bearing block in paragraph D-1(d). A flush plug and an eyebolt or bolt shall be provided for each tapped hole. That face of the bearing plate which bears against the specimen shall contain accurately scribed lines parallel to the plate edges. The lines shall divide the face of the plate into six (6) inch squares with the center of a six (6) inch square at the center of the plate. The geometric center of the bearing plate shall be plumb over the geometric center of the main table.

- (h) The finish of the flat faces of the yoke plate, leveling disks, and bearing plate shall be of the highest quality as regards flatness and smoothness. A ground or highly polished finish is preferred but where it is proposed to furnish plates with surfaces not ground it shall be so indicated and the surface to be furnished shall be described. The end faces (those faces one of whose dimensions is the plate thickness) shall have a high grade machine finish. On the yoke plate and bearing plate a one-sixteenth ( $1/16$ ) chamfer or radius shall be machined on each edge.

#### 16. Spherically Seated Tension Rods:

- (a) There shall be provided with the testing machine two (2) spherically seated tension rods. One of these rods shall be installed in the fixed crosshead and the other shall be installed in the tension side of the straining head. Each tension rod shall be designed to transmit one hundred and ten (110) percent of the testing machine capacity (5,500,000 lbs.) in direct tension.
- (b) Each tension rod shall consist of three principal parts:
- A. Tension rod bolt, which is a large bolt one end of which is threaded and the other end is headed with the spherical seat head.
  - B. A clevis type nut, one end of which is a socket threaded to fit the tension rod bolt and the other end is a fork. The fork arms are drilled to receive a pin.
  - C. Pin. The tension rod pin shall have a circular cross-section, shall be a medium fit in the fork, and shall be provided with a locking device such as pin, snap ring, etc. to prevent the pin slipping out of fork.
- (c) The quality and appearance of the machine work on the tension rod shall be consistent with the highest standards of machining practice.
- (d) Final design working drawings of the tension rod shall be submitted to the Naval Air Exp. Sta. for approval before construction of the tension rod begins.

17. Electrical Motors:

- (a) All motors one-half (1/2) horsepower and larger shall have a name-plate rating of both two hundred and twenty (220) and four hundred and forty (440) volts, sixty (60) cycles, three (3) phase. Motors smaller than one-half (1/2) horsepower shall operate on one hundred and ten (110) volts, sixty (60) cycles, single phase.
- (b) All motors shall have inverse time, thermal overload protection.
- (c) All motor and control wiring shall be enclosed in rigid conduit or flexible Neoprene tubing with suitable terminal enclosing boxes at equipment.
- (d) The straining head adjusting motor shall be wound rotor type with sufficient steps of resistor to insure starting and switching surges not exceeding one hundred and fifty (150) percent of full load motor current. Primary control shall be push-button operated reversing type suitably interlocked with the secondary control to insure starting with maximum secondary resistance in circuit.
- (e) Secondary control shall have six (6) or more control points in either direction of operation.
- (f) Straining head shall be provided with limit switches to shut off the straining head adjusting motor when safe limit of travel is reached in either direction.
- (g) The straining head adjusting motor and the hydraulic pump motor shall have ball bearings.
- (h) The bearing plate shall be provided with a removable and adjustable specimen alignment bar. The bar shall be of rectangular cross section six (6) inches wide by two (2) inches thick. It shall be moved by electric motors in such a manner as to keep the face against which the specimen will bear parallel to the same face of a similar bar mounted on the lower bearing plate as specified in paragraph D-1(e). A convenient method of aligning these two bars in the same vertical plane should be incorporated as part of the testing machine.

A second alignment bar shall be included for clamping of specimens until application of sufficient load to hold specimens in place.

18. Paints and Finishes

- (a) All external parts of the testing machine, except lubricated surfaces bearing surfaces of main table, etc., and other parts where a paint coat is not desirable shall be given one coat of basic lead chromate primer and two coats of gray paint similar to that used on testing machine at the Aluminum Company of America.

Section C. Tests and Inspections:

After installation, adjustment and calibration, the testing machine shall be subjected to the following tests, in the order given:

(1) Operation Tests:

(a) All special attachments, tension rods, etc. as listed in paragraphs B-16, D-1, and D-3 herein shall be tried in place, with specimens, supplied by the contractor, to demonstrate the satisfactory construction and operation of these parts.

(b) The straining head shall be raised and lowered (adjusted) by power throughout its full limit of travel at a rate not less than twenty-four (24) inches per minute.

(c) The straining head shall be used to raise the auxiliary crosshead, which shall in turn be mounted and secured in each of its four positions.

(d) The straining head shall be raised and lowered for a vertical distance of at least thirty-six (36) inches by the power loading system. This test shall be carried out at any point in its travel as selected by the Naval Air Experimental Station.

(e) The loading system shall demonstrate its ability to apply full capacity loads at a rate of movement of the straining head of three (3) inches per minute. The movement of the straining head during this test shall be at least one-half (0.5) inch. The indicated load during this test shall not fall below seventy-five (75) percent of full rated capacity (four million) (4,000,000 lbs.).

(f) The movable platform shall be operated over its full range.

(2) and (3) Tensile or Compressive Test:

The machine shall be used to rupture either a tensile or compression specimen which is designed to break at a load between seventy-five (75) percent and full capacity of the machine. As a result of this test there shall be no derangement or damage whatsoever to the machine, including the weighing, indicating and recording system.

(4) Loading Cycle Test:

None required.

(5) Transverse Tests:

None required.

(6) Overload Tests:

(a) The machine shall put a tensile specimen to at least one hundred ten (110) percent of full-load capacity (5,500,000 lbs.).

(b) The machine shall compress a block specimen to at least one hundred ten (110) percent of full-load capacity (5,500,000 lbs.).

(c) It is not required that the specimens be broken in tests (a) and (b) above.

(7) Eccentric Load Test:

The machine shall be tested for its ability to withstand eccentric loads by compressing a column (supplied by the contractor) ten (10) feet long so inclined that a horizontal component of ten (10) percent of the end load will be applied to the straining head. Under capacity load (5,000,000 lbs.) the guide columns, screws, and other parts shall not deflect from their initial position (zero load) more than three-fourths ( $3/4$ ) of one inch as indicated on the main table by the movement of at least two plumb bobs suspended from the tops of the main column members. This test shall be conducted:

(a) Horizontal thrust in plane of columns.

(b) Horizontal thrust normal to plane of columns.

(8) Rigidity Test:

(a) It shall be demonstrated that the mechanism employed to prevent relative horizontal motion between straining head and guide columns restricts such motion to not more than plus or minus four-thousandths ( $\pm 0.004$ ) inch under a horizontal load of one hundred thousand (100,000) pounds. This test may be conducted simultaneously with that in (7), preceding.

(b) Also suitable tests shall be made to demonstrate that the mechanism to prevent relative vertical motion between the straining head and screws restricts such motion to less than four thousandths (0.004) inch under capacity load.

(9) Proving Rings:

(a) The contractor shall supply for these tests the necessary proving rings for testing up to loads of 2,500,000 lbs. Each proving ring shall conform to specifications of letter circular L. C. 657 of August 5, 1941 of the U. S. Bureau of Standards and shall have been primarily calibrated by the Bureau of Standards within twelve (12) months prior to test of the machine described herein. A certificate of such calibration from the Bureau of Standards shall be submitted for examination at the time of test. For tests at loads between 2,500,000 and 5,000,000 lbs. the contractor shall provide a gage tester which shall be guaranteed by the contractor to be accurate within three tenths (0.3) of one (1) percent.

(b) Proving rings shall be read only on increasing loads.

(10) Hysteresis Test:

The following hysteresis test shall be performed on the 1,000,000 lb. dial:

(a) The purpose of this test is to ascertain the accuracy with which a dial indicator will repeat its readings under the following loading cycle:

1. Compression load to one-half full capacity.
2. Compression load increased to within five (5) percent of full capacity.
3. Compression load maintained at a given figure within five (5) percent of full capacity for approximately one (1) hour.
4. Compression load decreased to one-half full capacity.
5. Hysteresis readings on the dial indicator will be taken between 1 and 4.

(b) This test shall be conducted by using for the half-load indication a group of proving rings, not less than 2, whose combined capacity is greater than one million (1,000,000) pounds but not more than two million five hundred thousand (2,500,000) pounds.

(c) The full compression load shall be exerted by a hydraulic jack of about three million (3,000,000) pound capacity, placed on the main table at its center, with the proving rings spaced concentrically about it. The manner of conducting the test shall be as follows:

(d) Compression load will be applied to the proving rings, with the ram of the jack clear of the compression plate, until a load of five hundred thousand (500,000) pounds (plus or minus one (1) percent) is reached. The dial indicator scale will be adjusted so that the pointer reads five hundred thousand (500,000) pounds (or the sum of the loads on all the rings).

(e) The hydraulic jack will then be pumped up until the dial indicator reads between nine hundred fifty thousand (950,000) and one million and fifty thousand (1,050,000) pounds, relieving the proving rings of some of their load. The apparatus will be held in this position for a period of thirty minutes. The combined load of the proving rings shall be recorded during this interval.

(f) The jack will then be slowly lowered until the proving rings have again taken the entire compression load and the ram of the jack is clear of the compression plate.

(g) The proving rings and the dial indicator shall again be read. The difference between the two readings shall be less than two scale divisions on the indicator (2,000 lbs.), plus or minus.

(h) If the Naval Air Experimental Station requests, a test similar to that described in (e) to (g) above shall be repeated on one other dial indicator selected at time of test.

(i) Necessary manipulation of load applying mechanism will be permitted during this test, except that the indicated load shall not be increased at any time during the operation described in (f) until after the final reading of the proving rings in (g).

(j) The contractor shall supply the three million (3,000,000) pound (or other) hydraulic jack for the test, but it and the proving rings and other special test equipment shall remain the property of the contractor.

(11) Creep Test:

(a) A compression load shall be applied to the machine through proving rings, of not less than ninety (90) percent of full rated capacity of any one dial indicator which the NAES may select at the time of the test except for the 5,000,000 lb. dial. The proving rings shall be read and the dial indicator set to the combined load.

(b) This load shall then be held as nearly constant as possible (variations shall be recorded) for a period of six (6) hours, at which time the proving rings and dial indicator shall again be read.

(c) The difference between the latter two readings shall not exceed six tenths (0.6) of one percent of dial reading.

(12) Accuracy Tests:

(a) The accuracy of the testing machine throughout each of the six (6) ranges shall be demonstrated after all the above tests have been successfully completed by tests with proving rings conforming to specifications of letter circular L. C. 657 of August 5, 1941, of the U.S. Bureau of Standards.

(b) The proving rings shall be selected for test in such manner that the capacity of any proving ring (or the combined capacity of any group of rings) shall not exceed two (2) times the maximum load capacity of the particular dial indicator being tested. The proving rings shall not be used below one tenth (1/10) of their rated capacity.

(c) The machine shall meet the accuracy requirements with and/or without the special fixtures mentioned in paragraphs D-1 and D-3.

(d) Tapping of the dial indicators or any other parts of the weighing mechanism will not be permitted during any of the tests, except by special permission of the NAES, except for the 5,000,000 lb. dial.

(e) Failure of the machine to meet the accuracy requirements of paragraph B-13(a) shall be sufficient cause for rejection of the machine.

(13) Automatic Recorder Tests:(a) Automatic Load Record:

1. A test specimen having an ultimate strength of at least one million five hundred thousand (1,500,000) lb. shall be inserted in the testing machine. The extensometer need not be attached. The recorder shall be adjusted to full-scale load ordinate for a load of one million (1,000,000) lb. A zero load line shall be drawn. The load shall then be increased from zero (0) to one million (1,000,000) lbs. at a rate of about three hundred thousand (300,000) lbs. per minute.

2. With the load held at one million two hundred thousand (1,200,000) pounds, the recorder shall be manipulated to cause a short elongation line to be drawn at constant load. This test shall be repeated five (5) times bringing the indicated load back to zero each time. The pen or stylus shall be moved transversely between load applications so as to draw five separate but closely spaced ordinates.

3. No full load ordinate shall vary by more than three-fourths ( $3/4$ ) of one percent of its total length from the average length of the five ordinates measured from the zero load line.

4. From these tests, or from data supplied by the manufacturer, the position of the zero and full-scale ordinates representing zero and one million two hundred thousand (1,200,000) pound loads, respectively, shall be determined and transferred to four (4) other sheets of record paper. Each sheet shall be placed on the drum of the recorder and the load increased from zero (0) to three hundred thousand (300,000) pounds. With the load held at this value, the elongation recording mechanism shall then be manipulated to draw a short line. The load shall then be increased to six hundred thousand (600,000) pounds and held while a similar line is drawn. This process shall be repeated at nine hundred thousand (900,000) pounds and one million two hundred (1,200,000) pound loads.

5. This test shall be conducted at a representative number of loading rates to be selected by the NAES.

6. The linear distance between the zero and one million two hundred thousand (1,200,000) pound ordinates shall be divided into four (4) equal parts and corresponding load ordinates of three hundred thousand (300,000), six hundred thousand (600,000), and nine hundred thousand (900,000) pounds drawn on each sheet. The maximum distance between these load ordinates on any of the four (4) sheets, and any part of the elongation line at these constant loads shall not exceed three-fourths ( $3/4$ ) of one percent of the total distance from the zero load ordinate.

7. Tests similar to (4), (5), and (6), shall be performed on not less than three (3) additional ranges of the nine (9) loading ranges given in B-14(e), as the purchaser may select.

(b) Automatic Elongation Record:

1. The sensitivity of the recorder in elongation shall be tested as follows: The extensometer shall be clamped to a dummy specimen, so arranged that the distance between the two ends of the extensometer can be increased and the amount of increase read by a standard micrometer screw accurate to within one hundred thousandth (.00001) inch. The contractor shall furnish the necessary dummy specimen and micrometer screw for this test. The recorder shall be connected to the extensometer in the usual manner, as for testing specimens in the testing machine, and the apparatus shall be set to a magnification of two hundred fifty (250) times.



2. The recorder shall be caused to inscribe a straight line parallel to the load axis. At short intervals, the two ends of the extensometer shall be separated by a distance of two hundred thousandths (0.00002) inch as measured by the micrometer screw. This motion shall be plainly indicated by a perceptible offset in the scribed line.

3. The accuracy of the recorder in elongation shall be tested as follows:- The extensometer shall be set up as in the previous test A. The recorder shall be adjusted to draw a straight line parallel to the elongation axis. The two ends of the extensometer shall be slowly separated, until the recorder has traced a line of at least seven and one-half (7-1/2) inches long. The length of this line shall be measured and divided by the magnification factor which was selected for the accuracy test and the result shall check with the reading of the special micrometer screw to the accuracy specified in paragraph B-14(1).

4. A separate test shall be performed for each elongation magnification ratio.

5. All sensitivity and accuracy tests shall be performed at the O. S. Peters Company, Washington, D. C., in the presence of Naval inspectors and NAES personnel. All test equipment shall remain the property of the O. S. Peters Company.

Section D. Accessories(1) Bearing Plate

(a) There shall be provided for the main table a bearing plate seventy-two (72) inches square and six (6) inches thick. The bearing plate shall conform to the requirements for the loading platform bearing plate as regards flatness, parallelism, finish, edge chamfer, and scribed lines.

(b) The bearing plate shall be mounted on a movable steel pedestal so that the top face of the block shall be thirty (30) inches above the main plate. The block shall be fixed to the steel pedestal with slanted bolts. The mobility of the pedestal shall be obtained by having retractable wheels, one at each corner, raised and lowered hydraulically.

(c) The base of the pedestal shall have the same machine surface as the main table on which it will rest, but not the same surface area.

(d) The bearing plate shall contain the following tapped holes in the end faces: On those two opposite end faces which will be nearest the testing machine columns there shall be five (5) tapped holes at twelve (12) inch centers to receive three-quarter ( $3/4$ ) inch bolts. The middle tapped hole shall be on the center line of the plate. On the other two end faces there shall be similar tapped holes except that the outermost holes shall be tapped to receive eye bolts of such capacity that any one eye bolt will lift the plate. Flush plugs shall be provided for all tapped holes, two (2) inch long machined bolts shall be provided for the three-quarter ( $3/4$ ) inch holes and four (4) eye bolts shall be provided for the eye bolt holes.

(e) A specimen alignment bar similar to that of paragraph B-15(f) shall be provided for the bearing plate.

(2) Movable Platform

(a) The testing machine shall be equipped with a movable platform.

(b) The movable platform shall have a rise from floor to five (5) feet below top of testing machine (measured from laboratory floor to working deck of movable platform) at a lifting speed of about twelve (12) feet per minute.

(c) The movable platform shall be able to stop at any position in its rise for indefinite periods.

(d) The movable platform shall be controlled from the movable platform working deck and from the testing machine control cabinet by push button control.

(e) There shall be supplied removable floor planks with the movable platform to vary the size and shape of the space enclosed by the movable platform. The number and size of the planks shall be such that the size of opening enclosed by the movable platform can be reduced from nine (9) feet by nine (9) feet to two (2) feet by two (2) feet.

(f) The movable platform shall have a lifting capacity of not less than two thousand (2,000) pounds in addition to the dead weight of the movable platform.

(g) The movable platform shall have railing on all sides of the working platform. Inside railing opposite the clear space between testing machine columns shall be removable. The railing shall consist of a pipe hand rail at the top and wire screening from there down to six (6) inches above the movable platform floor; within those six (6) inches there shall be a one-eighth (1/8) inch thick steel plate.

(h) The movable platform shall be as light as is consistent with other requirements. It shall be constructed to the same standards of appearance, workmanship and reliability as the testing machine and shall contain all protection and safety devices consistent with the best practice in movable platform installation.

### (3) Tension Grips

(a) The following types of tension grips are to be provided:

(1) Flat grips to accommodate specimens up to twelve (12) inches wide and six (6) inches thick.

(2) Vee grips to accommodate round specimens one and one-half (1-1/2) to three (3) inches in diameter.

(3) Vee grips to accommodate round specimens three (3) to six (6) inches in diameter.

(4) Vee grips to accommodate round specimens five (5) to ten (10) inches in diameter.

(b) All grips shall be remotely operated by air pressure with all conventional equipment built in.

### (4) Tools

A complete set of all wrenches and other small tools necessary for the normal operation and adjustment of the machine shall be furnished. These tools shall be of first quality. They shall be individually marked with the serial number of the testing machine and fitted in racks in a tool compartment which shall be either a part of the machine, attached to the machine, or a portable steel or hardwood case. This compartment shall be fitted with a cylinder lock of good grade.

Section E. Operating Manual

(1) Contractor shall furnish twelve (12) bound copies of an operating manual which shall contain the following drawings and descriptive information.

(a) A set of line drawings showing principal cross sections of machine. These drawings need only be so complete as to acquaint government personnel with the operating principles of the different parts, but need not be so complete that they constitute complete shop drawings.

(b) Complete operating and maintenance instructions for the testing machine proper, and for all pumps and auxiliary appliances.

(c) Complete operating and maintenance instructions for the automatic recorder.

Section F. Stress Strain Recorder

(1) As an additional accessory contractor shall furnish one forty-eight (48) point stress-strain recorder.

(2) A complete set of instructions for operation and maintenance of the recorder shall also be furnished.

(3) This recorder shall be as made by the Connecticut Telephone and Electric Co. and similar to their Bulletin No. M-102, except that the diagram size shall be five (5) by five (5) inches and the recorder shall be capable of making a forty-eight (48) chart record in approximately fifteen (15) seconds.

NAVY DEPARTMENT  
BUREAU OF AERONAUTICS

~~PROPOSED~~ CONTRACT REQUIREMENTS FOR  
5,000,000 LB. UNIVERSAL TESTING  
MACHINE

BY

AERONAUTICAL STRUCTURES LABORATORY  
NAVAL AIR EXPERIMENTAL STATION  
NAVAL AIR MATERIAL CENTER PHILADELPHIA

Authorization . . . . BuAer ltr. Aer-E-2412-BR - 1/21/46 - N32-3  
11641 of 8 Feb. 46

Reported by . . . . J. Albert Roy Test Engineer  
Aero. Engr., P-5

Approved by . . . . B. M. Thigpen Division Supervisor  
Aero. Engr., P-5

Approved by . . . . J. S. Kean Head Engineer  
Aero. Engr., P-7

Approved by . . . . J. J. Pomamichel Superintendent,  
CDR, USN Aero. Struc. Lab.

DATE ISSUED

5/6/47

PROPOSED CONTRACT REQUIREMENTS FOR  
5,000,000 I.B. UNIVERSAL TESTING MACHINE

INDEX

- Section A - Description of Project
- B - Scope
- C - Spirit and Intent
- D - Site
- E - Program of Construction
- F - Acceptance Tests
- G - Inspection and Acceptance
- H - Workmanship
- I - Materials
- J - Defects and Guarantees
- K - Climatic Conditions
- L - Protection and Repair
- M - Traffic Provisions
- N - Superintendence by Contractor
- O - Stop Orders
- P - Removal of Debris, Cleaning, etc.
- Q - Identification Badges
- R - General
- S - Notes for Bidders

PROPOSEDCONTRACT REQUIREMENTSFOR5,000,000 LB. UNIVERSAL TESTING MACHINEA. Description of Project:

(1) The testing machine described in these specifications is to be installed in the Aeronautical Structures Laboratory of the Naval Air Experimental Station, Naval Air Material Center Philadelphia, U. S. Naval Base Station, Philadelphia 12, Pa. The testing machine and the control cabinet will be erected on the foundations prescribed under Section A of the specifications.

(2) The hydraulic rams, recoil mechanism, <sup>sensitive cross head</sup> ~~straining head~~ adjusting mechanism, pump, and reservoir will be located in pits below the laboratory floor.

(3) The top face of the main table of the testing machine shall be at finished floor level of the laboratory. The specified height of the testing machine is such that overhead traveling cranes will clear the top of the testing machine.

(4) All of the controls of the testing machine shall be mounted in or conveniently near the main control cabinet. The movable platform controls will be on the movable platform, and also on the control cabinet.

B. Scope:

(1) The contractor shall furnish all services and materials necessary to design, build, and deliver the testing machine, its controls, and accessories. The principal parts of the testing machine shall be: main columns, screws, straining head, auxiliary crosshead, upper horizontal frame member, crosshead jack, main table, control cabinet, loading system, weighing system, automatic recording system, loading platform, spherically seated tension rods, bottom bearing plate, auxiliary tension grips and movable platform. ] 2

(2) The contractor shall furnish all services and materials necessary to erect and assemble the testing machine, controls and accessories and place it in a satisfactory operating condition on the site as specified in Section D, except that the Naval Base at Philadelphia will make available to the contractor or his representative complete crane facilities, crane operators and slingers, free of charge, during the complete erection and test periods. Crane is to be at least fifty (50) ton capacity. Further that the Naval Base shall provide suitable power outlets, electrical and air, for the proper functioning of the testing machine to within approxi- T 3

mately five (5) feet of the main pit under the machine. Exact locations are to be shown on the foundation drawing, after the award of the contract.

(3) The contractor shall not furnish the reinforced concrete foundation, the sump and sump pump and the pump pit cover, ventilating system, humidity control, stairway, fire protection system and any flooring around the testing machine.

#### C. Spirit and Intent

It is the spirit and intent of these specifications to provide that the work and all parts thereof shall be fully completed and suitable in every respect for the purposes intended. In general, it is the intent of the specifications to state the type and qualities of materials and workmanship to be furnished, but to permit the contractor to develop such methods of procedure as he may elect, subject to approval by the Naval Air Experimental Station. The contractor shall furnish all equipment, labor, and materials, except such as may be specifically stated herein will be supplied by the Government, and shall do all work which is described or may reasonably be implied to be a part of the contract, regardless of whether or not it is mentioned in the specifications. All work shall be delivered in a complete and undamaged state. The Naval Air Experimental Station will advise and cooperate with the contractor in every way possible to the end that the progress of the work may be expedited and that the work as a whole may be satisfactorily completed; and it is expected that the contractor will facilitate and reciprocate such advice and cooperation. The contractor shall lay out the work and be responsible for the correctness of dimensions and levels. He shall furnish such detail plans as may be required but such plans shall be subject to the approval of the Naval Air Experimental Station.

#### D. Site

The testing machine shall be installed in the Naval Air Experimental Station, Aeronautical Structures Laboratory, at the U. S. Naval Base Station, Philadelphia 12, Pa. The approximate location within the laboratory shall be as shown on a NARS drawing to be supplied to contractor and the exact site shall be indicated by the Naval Air Experimental Station.

#### E. Program of Construction

(1) Except as otherwise specified, the contractor's procedure and methods of construction may be of his own selection, provided that in the judgment of the Naval Air Experimental Station they will secure results which satisfy all the requirements of the specifications and of the supervision. However, the Naval Air Experimental Station shall have the right to control the order in which the various parts of the work are constructed to such an extent as he may deem necessary to protect the interests of the United States.



(2) Immediately after the signing of the contract, the contractor shall outline in writing his program of construction in sufficient detail to enable the Naval Air Experimental Station to anticipate the progress and completion of the work at the site of the installation of the machine.

F. Acceptance Tests:

(1) All acceptance tests specified in Section C of Specifications for Testing Machine, shall be performed in the presence of the Naval Air Experimental Station at the contractor's place of manufacture or at the O. S. Peters Company, Washington, D. C., for the sensitivity and accuracy tests, but only the following tests shall be repeated after installation in the Aeronautical Structures Laboratory at the Philadelphia Naval Base.

- (a) Accuracy Tests, Section C-12 of Specifications.
- (b) Automatic Recorder Tests, Section C-13 of Specifications

No part of the testing machine or its accessories shall be shipped to the Aeronautical Structures Laboratory until the preliminary acceptance tests at the manufacturer's plant are satisfactorily completed and permission to make shipment is received from the Naval Air Experimental Station.

(2) Upon submission by the contractor of invoices therefore, the Government shall make payments on account of the total contract price of the testing machine and equipment on the basis of progress in the manufacture of such machine and equipment as certified by the Naval Inspector; such progress payment invoices shall not be for less than \$25,000. In making payment of these invoices the Government will retain a sum equal to ten (10) percent, of the amount payable, pending final acceptance of the testing machine and equipment, but, in any event, payment of the amount retained shall be made not later than four (4) months after completion of erection at the site.

G. Inspection and Acceptance:

(1) Acceptance of all items under this contract shall be under the cognizance of the Naval Air Experimental Station. All correspondence between the Naval Air Experimental Station and the contractor shall be conducted via the Inspector of Naval Material with copies of letters and enclosures forwarded direct to the Bureau of Aeronautics by the Inspector of Naval Material or the Naval Air Experimental Station.

(2) The contractor must understand that the materials delivered and labor furnished by him at any and all times during the progress of the work and prior to final acceptance and payment for same, shall be subject to the inspection of the Inspector of Naval Material or other authorized agent of the United States, with the full right to accept or reject any part thereof; and that he must, at his own expense, within a reasonable time, remedy any defective or unsatisfactory materials, or work; and that

of his failure to do so after notice, the Inspector of Naval Material shall have the full right to have the same done and to deduct the cost thereof from any money due to the contractor. Contractor must remove at once any materials condemned in final inspection at the Naval Air Experimental Station. 2

(3) Preliminary inspection of materials or parts of the testing machine shall be made at the contractor's place of manufacture but final inspection shall be at the Aeronautical Structures Laboratory at the time of the acceptance tests unless otherwise specifically stated herein.

(4) Upon completion of the work the contractor shall give written notice to the Naval Air Experimental Station and the Inspector of Naval Material of his readiness for inspection and tests specified.

(5) Design engineering and drawings and general design of foundation shall be accepted by the Naval Air Experimental Station within thirty (30) days after receipt in satisfactory form.

(6) The testing machine and associated accessories namely tension grips, automatic recorder, spherically seated tension rods, leveling plates with loading platform, bottom bearing plate and pedestal, movable platform, protective duck curtains for loading screws, protective steel and glass shields at front and rear of machine, 2 load rate pacing discs and drives, 2 load maintainers, 1 head motion pacing disc (motorized), 1 head motion indicator, 1 standard, model T-1 extensometer, and 1 model PD-1 deflectometer shall be accepted by the Naval Air Experimental Station upon satisfactory completion of the preliminary acceptance tests conducted at the contractor's plant.

(7) All other items will be accepted by the Naval Air Experimental Station upon satisfactory completion of the final acceptance tests conducted at the Naval Air Experimental Station.

#### H. Workmanship:

The workmanship throughout on this project shall be of the highest grade trade practice for the types of work involved and must meet with the approval of the Inspector of Naval Material. Except where tolerances are specified in these specifications, the accuracy of dimensions shall be consistent with that found on highest grade work of similar nature.

#### I. Materials:

All materials necessary for the complete fabrication, assembly, erection and tests are to be supplied by the contractor unless otherwise specified in these specifications. All materials used in the execution of this work shall be new, of the best quality for the purpose intended and shall conform, as far as possible, to the applicable Federal Specifications, including revisions and addenda in effect on the date of issue of this specification. Where there is no applicable Federal Specification the materials shall be of the best quality of their respective kind. Where two or more varieties of materials are specified, for any purpose, it shall 2T

be optional with the contractor which is used, but in any instance the same material must be used throughout for that particular purpose and approved by the Inspector of Naval Material. In all cases where an article is mentioned in the specifications in connection with the words "best quality", "Approved quality", or "equal to", the Inspector of Naval Material shall decide what are the best quality and the most suitable articles to use.

J. Defects and Guarantees:

(1) The contractor shall guarantee all material and equipment supplied by him to be free from defects for a period of one-half (1/2) year from date of acceptance of the work, except where specified for other duration of time, and shall replace f.o.b. Eddystone, Pa., any part or parts found to be defective in material or workmanship by the Naval Air Experimental Station within the period of the guarantee without cost to the Government.

K. Climatic Conditions:

When ordered by the Naval Air Experimental Station the contractor shall suspend any work that may be subject to damage by climatic conditions.

L. Protection and Repair:

(1) The contractor shall provide temporary protection as may be directed. He shall also provide warning lights necessary for the protection of persons and property. Buildings, roadways, walks, and all the existing work damaged by the contractor's operations shall be repaired and left in condition as good as existed before the work was commenced.

(2) The contractor shall be responsible for protecting his equipment from the weather and other construction work which may be in progress until the contract is completed.

M. Traffic Provisions:

(1) The contractor shall so conduct his operations as not to close any thoroughfare, or interfere in any way with traffic on railways, highways, or the river, except with the written permission of the Naval Air Experimental Station.

(2) The contractor shall provide, erect, and maintain, at his own expense, all lights, signals, barriers, passageways, detours, etc., that may be required by the military authorities of the Philadelphia Naval Base or by State or Federal authorities, for the safety of the public and of river traffic and shall observe all regulations of military authorities at the Philadelphia Naval Base, so far as they shall affect his work.

N. Superintendence by Contractor:

The contractor shall give his personal superintendence to the work or have a competent foreman or superintendent satisfactory to the Naval Air Experimental Station on the work at all times during progress with authority to act for him.

O. Stop Orders:

(1) As other contractors (~~and the Government~~) will be engaged in work on other components of the project during the prosecution of the contract, it may be impossible to coordinate the work so that each contractor may proceed without interruption. It may be necessary, therefore to issue stop orders of reasonable duration in order to properly coordinate the work. Personal supervision will be required of the contractor and his superintendent in order that all contractors may fulfill their contracts in accordance with specifications and with the least possible expense and delay to all concerned. This fact should be given consideration in the organization of the contractor's plant and programs of construction. Special attention is invited to the provision of Article 9, "Delays - Damages" of U. S. Standard Form No. 23 (Construction Contract).

(2) The Naval Air Experimental Station will advise and cooperate with the contractor in every way possible to the end that the progress of the work may be expedited and the contractor will be required to reciprocate such advice and cooperation.

(3) The time during which a stop order is in effect will not apply on the contract time.

P. Removal of Debris, Cleaning, Etc.:

During the progress of the work and whenever ordered by the Naval Air Experimental Station, and at the conclusion of the work, the contractor shall remove all debris and deposit same where and in the manner directed by the Naval Air Experimental Station. The contractor shall be responsible at all times that no debris shall be allowed to accumulate in such a manner as to constitute a fire hazard.

Q. Identification Badges:

Contractors and subcontractors shall report to the Naval Air Experimental Station upon their arrival at the site to begin work and shall also report to the Naval Air Experimental Station upon completion of the work at the site. Contractors, subcontractors, their employees and agents shall be required, at all times while on Philadelphia Naval Base grounds or in Philadelphia Naval Base buildings to wear badges which will be issued by the Philadelphia Naval Base and for which the contractor will be held accountable. Immediately after completion of the contract, all badges shall be returned to the Naval Air Experimental Station.

Note: The foregoing items K, L, M, N, O, P, and Q shall be applicable only to work performed by the contractor at the site of the installation of the equipment

R. General:

(1) The contractor shall design, build, deliver, erect, and assemble the testing machine in the Naval Air Experimental Station, Aeronautical Structures Laboratory at Philadelphia Naval Base.

(2) The contractor shall adjust, calibrate, and place the testing machine in operation. The Naval Air Experimental Station shall supply the electric wiring up to the machine but the contractor shall make connections to the Naval Air Experimental Station wiring. Power for the operation of the machine during acceptance tests at the Philadelphia Naval Base shall be supplied by the Naval Air Experimental Station.

S. Notes for Bidders:

(1) Bids shall be submitted for supplying all items described by these specifications.

(2) Bids shall be accompanied by drawings and descriptive information as listed hereunder which shall clearly and definitely show the arrangement and principal dimensions of the machine and the means of performing the functions described in Section C of Specifications.

(a) Outline drawings, with three (3) separate views showing general arrangement and relative position of parts, principal dimensions and space required.

(b) Arrangement of loading system, including longitudinal sections through all hydraulic cylinder assemblies, all screw mechanisms for loading and adjusting the heads, including the arrangement of the mechanical gearing or drives from the motors.

(c) Arrangement of buffers or shock-absorbing appliances and method of attachment to machine.

(d) Arrangement of weighing system, showing sections through hydraulic cells, diaphragm assemblies, lever mechanisms, etc.

(e) Means of supporting hydraulic pressure cell and other parts of weighing system to eliminate friction in indicated loads.

(f) Horizontal section through straining head showing relative positions of columns, guides, bearing surfaces, screws and shape of straining head. This section, or another, should also show the mechanism to be used for restraining the horizontal movement of the straining head.

(g) Horizontal section through auxiliary crosshead showing columns, keys, screws and shape of crosshead.

(h) Elevation and plan view of upper horizontal member.

(i) Horizontal section just above top of main table.

(j) Horizontal section or plan view showing shape and relative position of all parts under the table.

Drawings for Items (a) to (j) inclusive may be combined as desired, provided the separate features listed are clearly and definitely shown.

(k) Outline drawing of control cabinet and instrument board, showing general arrangement and relative position of parts, with principal dimensions of cabinet and dial indicators.

(l) Power, speed and general characteristics of each electric motor.

(m) Type and general characteristics of each hydraulic pump and pump control device.

(n) Dimensioned outline drawings of accessories such as compression blocks, self-adjusting loading platform, etc.

(o) Description of method of operation of dial indicators or gages.

(p) Description of the method of operation of the automatic stress-strain recorder.

Delivery:

(1) Item 1 - Two (2) copies of the design engineering reports and drawings required under this item shall be delivered to the Inspector of Naval Material at least sixty (60) days before date of preliminary inspection tests at contractor's plant; one copy for forwarding to the Naval Air Experimental Station and one copy for forwarding to the Bureau of Aeronautics.

(2) Item 2 - Fourteen (14) copies of the general foundation drawings and specifications required under this item shall be delivered to the Inspector of Naval Material within thirty (30) days after date of contract; twelve (12) copies for forwarding to the Naval Air Experimental Station and two (2) copies for forwarding to the Bureau of Aeronautics.

(3) Item 3 - The testing machine and all auxiliary equipment shall be completed and erected at the contractor's plant, ready for preliminary acceptance tests within nineteen (19) months after date of contract. The preliminary acceptance tests shall be completed as soon as practicable after erection of the testing machine.

(4) Item 4 - The 48 point stress strain recorder shall be delivered f.o.b. Naval Air Experimental Station and installed in time for demonstration as part of the final acceptance tests.

(5) Items 5, 6, 7, and 8 - Delivery of the testing machine and associated equipment and accessories, f.o.b. Naval Air Experimental Station and installation ready for final acceptance tests shall be completed as soon as practicable after satisfactory completion of the preliminary acceptance tests but not later than twenty-one (21) months after date of contract.

(6) ~~Item 9~~ - The hand tools for testing machine, after passing inspection by the Inspector of Naval Material shall be delivered f.o.b. Naval Air Experimental Station not later than the date of completion of final acceptance tests.

(7) ~~Item 10~~ - Final acceptance tests of the testing machine, associated equipment and accessories shall be completed as soon as practicable after erection but not later than sixty (60) days after erection of the testing machine at the Naval Air Experimental Station.

(8) ~~Item 11~~ - Twelve (12) complete sets of the operating manuals and instructions shall be delivered to the Inspector of Naval Material for forwarding to the Naval Air Experimental Station not later than the date of completion of final acceptance tests. One set shall be forwarded by the Naval Air Experimental Station to the Bureau of Aeronautics after acceptance.

I  
2  
3