

INCH-POUND

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MILITARY SPECIFICATION

SERVOMOTORS,  
GENERAL SPECIFICATION FOR

This specification is approved for use by all Departments  
and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers the general requirements for servomotors. It is not complete in itself, but should be used in conjunction with MIL-S-81963 which will form an inherent part of this specification.

1.2 Classification.

1.2.1 Nomenclature. The nomenclature consists of the item name, followed by a type designation which includes a modification letter and a military part number. All servomotors having the same design nomenclature should be physically, mechanically and electrically interchangeable for all military applications. The type designation is made up of a combination of digits and letters as explained in the following paragraphs. The type designation of 26-volt servomotors should be preceded by "26V". The complete nomenclature of a size 15, 400-hertz servomotor is illustrated in Table I. Nomenclature for new servomotor types will be assigned by the Naval Air Systems Command, Department of the Navy.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Systems Engineering and Standardization Department (Code 53), Naval Air Engineering Center, Lakehurst, NJ 08733-5100, by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC - N/A

FSC 6105

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1.2.1.1 Size. The first two digits designate the maximum diameter in tenths of an inch. If the diameter is not exactly a whole number of tenths, the next higher tenth is used.

1.2.1.2 Function. The succeeding group of two letters (SM) indicates the function is that of a servomotor.

**\*NOTE\***

When a servomotor is included in the same frame with a tachometer generator, the nomenclature for the servomotor will be followed by a second two-letter group (separated by a hyphen) indicating the function of the tachometer generator in accordance with the general specification, MIL-S-22820, Servomotor-Tachometer Generator (for example, SM-DG).

1.2.1.3 Supply Frequency. The succeeding digit(s) indicate the frequency of the power source in accordance with the following code:

<u>Supply Frequency</u>	<u>Code</u>
60	6
400	4

1.2.1.4 Design modification. An upper case letter "A" following the frequency digit indicates the original or basic design of a standard servomotor. The first modification that affects the external dimensions or electrical characteristics of the basic type should be indicated by the upper case letter "B". Succeeding design modifications will be indicated by "C", "D", etc., except the use of letters "I", "L", "O" and "Q" is prohibited.

1.2.2 Part identifying number. The part identifying number (PIN) consists of the letter "M", the basic number of the specification sheet (not including the revision letter), an assigned dash number and an upper case suffix letter designating the latest modification letter in the type designation, as shown in Table II.

1.2.3 Illustration. A servomotor classified as 15SM4C (see Table I) indicates the second modification to the original design of a 115-volt, 400-hertz servomotor whose body diameter is greater than 1.40 inches but not greater than 1.50 inches, and the part identifying number specifies that this servomotor has a splined shaft and terminal connections.

**MIL-S-22432A****2. APPLICABLE DOCUMENTS****2.1 Government documents.**

2.1.1 Specifications and standards. The following specifications and standards form a part of this specification to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation (see 6.2).

**SPECIFICATIONS****MILITARY**

MIL-C-13924	Coating, Oxide, Black for Ferrous Metals
MIL-S-22820	Servomotor-Tachometer Generators, AC, General Specification For
MIL-S-81963	Servocomponents, Precision Instrument, Rotating, Common Requirements and Tests
MIL-W-16878/4	Wire, Electrical, Polytetrafluoroethylene (PTFE) Insulated, 200°C, 600 Volts, Extruded Insulation
MIL-S-22432/9E	Servomotor, Type 18SM4C
MIL-S-22432/31D	Servomotor, Type 11SM4C

**STANDARDS****MILITARY**

MS17182	Terminal, Lug, Crimp Style, Copper, Insulated (Servocomponents), Type II, Class I, for 125° Centigrade Total Conductor Temperature
MS17183	Clamp Assembly
MS17186	Washer, Drive
MS17187	Nut, Plain, Hexagon
MS35276	Screw, Machine-Drilled Fillister Head, Slotted, Corrosion-Resisting Steel, Passivated, UNF-2A
MS35338	Washer, Lock-Spring, Helical, Regular (Medium) Series

(Unless otherwise indicated, copies of federal and military specifications, standards and handbooks are available from the Naval Publications and Forms Center, (Attn: Documents Order Desk), Bldg. 4D, 700 Robbins Avenue,

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**2.2 Non-Government publications.** The following documents 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 GEAR MANUFACTURERS ASSOCIATION (AGMA)**

AGMA 207.06	Tooth Proportions for Fine Pitch Involute Spur and Helical Gears
AGMA 2000-A	Gear Classification and Inspection Handbook Tolerances and Measuring Methods for Unassembled Spur and Helical Gears (Including Metric Equivalents)

(Application for copies should be addressed to the American Gear Manufacturers Association, 1500 King Street, Suite 201, Alexandria, VA 22314.)

(Non-Government standards and other publications are normally available from the organizations that prepare or distribute the documents. These documents may also be available in or through libraries or other informational services.)

**2.3 Order of precedence.** In the event of a conflict between the text of this specification and the references cited herein (except for associated detailed specifications, specification sheets, or MS standards), 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 Specification sheets.** The individual item requirements shall be as specified herein, in MIL-S-81963, and in accordance with the applicable specification sheets. In the event of any conflict between the requirements of MIL-S-81963, this specification, and the specification sheet, the latter shall govern.

**3.2 First article.** When specified by the contracting activity (see 6.3), servomotors furnished under this specification shall be subjected to first article inspection (see 4.4).

**3.3 Design and construction.** Servomotors shall be of the design, construction and physical dimensions specified (see 3.1).

**3.3.1 Direction of rotation.** The standard (positive) direction of rotation of the shaft is counterclockwise when the servomotor is viewed from the shaft extension end.

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**3.3.2 Parts, materials and processes.** Parts, materials and processes shall conform to the specifications of MIL-S-81963. Finish of the housing may be black in accordance with MIL-C-13924, if required for a specific purpose.

**3.3.3 Termination identification.** When screw and solder pin terminals are specified, the terminals shall conform to the requirements of MIL-S-81963. When wire leads are used, the wire for size 08, 11 and 15 servomotors shall be Type E-22 in accordance with MIL-W-16878/4, and shall be color coded in compliance with Table III. Wire leads shall be a minimum of 18 inches long and shall be tinned 0.25 inch. Identification of terminal screw, solder pin or wire lead types shall be as specified in Table III and Figure 1 herein. Terminal hardware is listed in Table IV.

**3.3.4 Rated voltages.** The rated voltages of a servomotor are those voltages specified in the specification sheet for the reference and control windings (see 6.4).

**3.3.5 Dimensions.** Outline drawings for the different sizes of servomotors are included as Figures 2 and 3. Lettered dimensions shown on the outline drawings are provided in Table V.

**3.3.6 Storage.** Servomotors shall be capable of storage in ambient temperatures ranging from  $-62^{\circ}\text{C} \pm 2^{\circ}\text{C}$  to  $100^{\circ}\text{C} \pm 2^{\circ}\text{C}$ .

**3.3.7 Spur gear data.** Spur gears shall be designed to meet AGMA 207.06, "Tooth Proportions for Fine Pitch Involute Spur and Helical Gears." Tooth form shall be full depth involute. Spur gears shall be tested to AGMA 2000-A, "Gear Classification and Inspection Handbook Tolerances and Measuring Methods for Unassembled Spur and Helical Gears (Including Metric Equivalents)."

#### **3.4 Performance requirements.**

**3.4.1 Visual and mechanical inspection.** Visual and mechanical inspection shall be performed in accordance with 4.6.1 and shall meet the requirements of 4.9.1 of MIL-S-81963.

**3.4.2 Shaft radial and end play.** Radial play and end play shall not exceed the values specified in the specification sheet when measured with a dial indicator gauge graduated to 0.0001 inch (see 4.6.2).

**3.4.3 Total shaft runout.** When tested in accordance with 4.6.3, the total runout of the smooth portion of the shaft shall not exceed the value specified in the applicable specification sheet.

**3.4.4 Rotor moment of inertia.** The moment of inertia of the rotor shall be no greater than that specified in the applicable specification sheet (see 4.6.4).

**3.4.5 Dielectric withstanding voltage.** When tested in accordance with 4.6.5 and Table VI, the servomotor shall meet the requirements of MIL-S-81963.

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3.4.6 Insulation resistance. When tested in accordance with 4.6.6, insulation resistance measurements shall meet the requirements of MIL-S-81963. Insulation resistance measurements shall be performed in the presence of a relative humidity of 40 to 55 percent.

3.4.7 Electrical breakaway torque (minimum starting voltage). When tested in accordance with 4.6.7, electrical breakaway torque of the servomotor shall be no greater than that voltage specified in the applicable specification sheet.

3.4.8 Current. When tested in accordance with 4.6.8, the current drawn by the servomotor shall be within the limits specified in the applicable specification sheet.

3.4.9 Power. When tested in accordance with 4.6.9, the power consumed by the servomotor shall be within the limits specified in the applicable specification sheet.

3.4.10 Direction of rotation. When tested in accordance with 4.6.10, the direction of rotation shall be positive (CCW) when the voltage at terminal 2 (red) leads the voltage at terminal 1 (yellow) by 90 degrees.

3.4.11 Single phasing. When tested in accordance with 4.6.11, the servomotor shall be considered a failure if the shaft continues to rotate longer than 15 seconds after the removal of the energization voltage to either winding.

3.4.12 No-load speed. When tested in accordance with 4.6.12, the speed of the shaft in either direction shall be no less than the value specified in the applicable specification sheet.

3.4.13 Stall torque. When tested in accordance with 4.6.13, the stall torque, in both senses of control winding energization, shall be no less than the value specified in the specification sheet.

3.4.14 Impedance. When tested in accordance with 4.6.14, the impedance of the servomotor shall be within the limits specified in the applicable specification sheet.

3.4.15 Stall torque linearity. When tested in accordance with 4.6.15, the stall torque linearity of the servomotor shall not deviate from linearity by more than 10 percent.

3.4.16 Speed at one-half measured stall torque. Unless otherwise specified in the applicable specification sheet, the speed in rpm when the servomotor develops one-half of the measured stall torque (see 3.4.13) shall not be greater than 75 percent of the minimum no-load speed requirement. The servomotor shall be tested in accordance with 4.6.16.

3.4.17 Temperature rise. When measured in accordance with 4.6.17, the temperature rise of the servomotor shall be no greater than that value specified in the applicable specification sheet.

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3.4.18 Voltage sensitivity. When tested in accordance with 4.6.18, the servomotor shall not single phase when the reference winding voltage is changed  $\pm 10$  percent from the rated standard voltage.

3.4.19 Frequency sensitivity. When tested in accordance with 4.6.19, the servomotor shall not single phase when the frequency is changed  $\pm 5$  percent from the rated value.

3.4.20 Coupling in split or center-tapped control windings. When tested in accordance with 4.6.20, the voltage of mutual inductance shall be at least that value, expressed as a fraction of the input voltage, specified in the applicable specification sheet.

3.4.21 Security of terminals or wire leads. The security of each screw type or solder pin type of terminal or of each wire lead, as applicable to the particular type of servomotor, shall be tested in accordance with 4.6.21 and shall meet the requirements of MIL-S-81963.

3.5 Environmental.

3.5.1 Vibration. When tested in accordance with 4.7.1, the servomotor shall meet the requirements of MIL-S-81963 and Table VII herein.

3.5.2 Shock.

3.5.2.1 Shock, low impact. When tested in accordance with 4.7.2.1, the servomotor shall meet the requirements of MIL-S-81963 and Table VII herein.

3.5.2.2 Shock, high impact. When tested in accordance with 4.7.2.2, the servomotor shall meet the requirements of MIL-S-81963 and Table VII herein.

3.5.3 Altitude. During altitude testing, servomotors shall be capable of operation from sea level to 100,000 feet in combination with any ambient temperature from  $-55^{\circ}\text{C}$  to that high ambient temperature specified in the applicable specification sheet.

3.5.3.1 Altitude, low temperature. When tested in accordance with 4.7.3.1, the servomotor shall meet the requirements of MIL-S-81963 and Table VII herein.

3.5.3.2 Altitude, high temperature. When tested in accordance with 4.7.3.2, the servomotor shall meet the requirements of MIL-S-81963 and Table VII herein.

3.5.4 Ambient temperature.

3.5.4.1 Ambient low temperature. When tested in accordance with 4.7.4.1, the servomotor shall meet the requirements of MIL-S-81963 and Table VII herein.

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3.5.4.2 Ambient high temperature. When tested in accordance with 4.7.4.2, the servomotor shall meet the requirements of MIL-S-81963 and Table VII herein.

3.5.5 Moisture resistance. When tested in accordance with 4.7.5, the servomotor shall meet the requirements of MIL-S-81963 and Table VII herein.

3.5.6 Endurance. When tested in accordance with 4.7.6, the servomotor shall meet the requirements of MIL-S-81963 and Table VII herein.

3.5.7 Audible noise structureborne. When required by the applicable specification sheet, structureborne noise shall be tested in accordance with 4.7.7 and shall meet the requirements of MIL-S-81963.

3.5.8 Salt atmosphere. When required by the applicable specification sheet, the servomotor shall be tested in accordance with 4.7.8 and shall meet the requirements of MIL-S-81963.

3.5.9 Explosion resistance. When required by the applicable specification sheet, the servomotor shall be tested in accordance with 4.7.9 and shall meet the requirements of MIL-S-81963.

3.6 Identification markings. Identification markings shall be as specified in MIL-S-81963.

3.7 Workmanship. Workmanship of the servomotor shall conform to the requirements of MIL-S-81963.

#### 4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. The responsibility for performance of all inspection requirements shall be in accordance with MIL-S-81963.

4.1.1 Responsibility for compliance. The responsibility for compliance with all requirements of sections 3 and 5 shall be in accordance with MIL-S-81963.

4.1.2 Test equipment and inspection facilities. The accuracy of test equipment and inspection facilities shall conform to MIL-S-81963.

4.1.3 Alternate test methods. Alternate test methods shall conform to MIL-S-81963.

#### 4.2 Test conditions.

4.2.1 Standard test conditions. Unless otherwise specified, the standard test conditions shall conform to MIL-S-81963, and each test shall be carried out with the servomotor in the applicable mounting fixture of Figures 4 and 5.

4.2.2 Ambient test conditions. Unless otherwise specified herein, all measurements and tests shall be made within the temperature, atmospheric pressure, and relative humidity limits below:

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Temperature	23° ± 2°C
Pressure	28 to 32 inches Hg
Humidity	No greater than 55 percent

4.2.3 Temperature, stabilized non-operating. The stabilized non-operating temperature of the servomotor shall be as specified in MIL-S-81963. Both windings shall be energized with the rated standard test voltages of 4.2.5. The control winding shall be used for the periodic DC resistance measurements.

4.2.4 Temperature, stabilized operating. The stabilized operating temperature of the servomotor shall be as specified in MIL-S-81963 after the applicable rated standard test voltage has been applied to the reference winding for a period of one hour. The control winding shall be used for the periodic DC resistance measurements.

4.2.5 Standard test voltages. Unless otherwise specified, the standard test voltage sources shall possess the following characteristics:

a. The amplitude and frequency of the standard test voltages shall be maintained within a tolerance of ± 1 percent of the rated or specified values given on the applicable specification sheet.

b. The total harmonic content of the standard test voltages shall not exceed 3 percent of the voltages of fundamental frequency. In addition, no single excursion or "spike" shall exceed 1 percent of the voltages of fundamental frequency.

c. The time phase angle between the two standard test voltages shall be 90° ± 3°.

4.3 Classification of tests. The methods of sampling, inspection, and tests conducted on servomotors shall be classified as follows:

a. First Article (4.4)

b. Quality Conformance (4.5)

4.3.1 Degradation of performance. The following minor relaxations may be allowed at the discretion of the qualifying activity.

4.3.1.1 Quality conformance tests. All the specified performance requirements must be attained.

4.3.1.2 Environmental tests. As appropriate during or following each of the environmental tests, the following minor relaxations in specified requirements may be permitted. It should be noted that the relaxations are not cumulative; for example, if the no-load speed is accepted at 98 percent of the specified minimum value following vibration, it must still not be less than 98 percent of the specified minimum value following low impact shock.

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4.3.1.2.1 Shaft radial play. The maximum permissible radial play is 1.5 times the maximum value specified in the specification sheet. Following high impact shock, radial play shall not exceed 2.25 times the maximum value specified on the specification sheet.

4.3.1.2.2 Shaft end play. Irrespective of the limits specified in the specification sheet, a minimum end play of 0.0002 inch is required. The maximum permissible end play is 1.66 times the maximum value specified in the specification sheet. Following high impact shock, end play shall not exceed 2.5 times the maximum value specified on the specification sheet.

4.3.1.2.3 Dielectric withstanding voltage. Following high impact shock, the winding leakage current shall not exceed 1.5 mA peak maximum with 80 percent of the initial test voltage applied.

4.3.1.2.4 Insulation resistance. Following high impact shock and having been immediately preceded by dielectric withstanding voltage, a reduction to 25 megohms insulation resistance is permissible.

4.3.1.2.5 Electrical breakaway torque (starting voltage). An increase of 10 percent of the specified value on the specification sheet is permitted. Following high impact shock, a minimum starting voltage not exceeding 1.5 times the voltage specified on the specification sheet is permissible.

4.3.1.2.6 No-load speed. A reduction of 2 percent of the minimum value specified on the specification sheet is permitted. Following high impact shock, the no-load speed in either shaft direction shall be no less than 95 percent of the value specified on the specification sheet.

4.3.1.2.7 Stall torque. A reduction of 2 percent of the minimum value specified on the specification sheet is permissible.

4.3.1.2.8 Major failures during or following environmental tests. Allowances having been made for the relaxations quoted above, failures experienced during or following environmental tests shall be cause for refusal to grant first article approval.

4.4 First article sample inspection. First article testing shall be as specified in MIL-S-81963.

4.4.1 First article sample failure. Action following first article sample failure shall be as specified in MIL-S-81963.

4.5 Quality conformance inspection. Quality conformance inspection shall be as specified in MIL-S-81963 and Table VII herein.

4.5.1 Quality conformance inspection sampling. Statistical sampling and inspection shall be as specified in MIL-S-81963. When MIL-STD-105 specifies an action by the Government, it shall, at the option of the Government, be performed either by the Government or by the contractor under the supervision of the Government.

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4.5.2 Quality conformance inspection routine. The minimum of inspection to be verified by the Government Inspector shall be the requirements of MIL-S-81963 and Table VII herein. The Government Inspector may substitute 100 percent inspection for all or part of the sampling procedure.

4.5.3 Quality conformance sample failure. Action following quality conformance sample failure shall be as specified in MIL-S-81963.

4.6 Test methods and examinations.

4.6.1 Visual and mechanical examination. The servomotor shall be examined in accordance with MIL-S-81963 and shall meet the requirements of 3.4.1 herein.

4.6.2 Shaft radial and end play. Shaft radial and end play shall be tested in accordance with MIL-S-81963 and shall meet the requirements of 3.4.2 herein.

4.6.3 Total shaft runout. Total shaft runout of the smooth portion of the shaft shall be performed in accordance with MIL-S-81963 and shall not exceed the requirements of 3.4.3.

4.6.4 Rotor moment of inertia. The rotor moment of inertia shall be measured in accordance with MIL-S-81963 and shall meet the requirements of 3.4.4 herein.

4.6.5 Dielectric withstanding voltage. The dielectric withstanding voltage test shall be conducted as specified in MIL-S-81963 and Table VI herein and shall meet the requirements of 3.4.5. Quality conformance tests shall be performed at the standard ambient temperature of 4.2.2 and MIL-S-81963.

4.6.6 Insulation resistance. The DC resistance between the terminal locations specified in Table VI shall be measured as specified in MIL-S-81963 and shall meet the requirements of 3.4.7 herein. A minimum of 500 volts DC shall be applied between all specified points. Quality conformance tests shall be performed at the standard ambient temperature of 4.2.2.

4.6.7 Electrical breakaway torque (starting voltage). The servomotor shall be mounted in the standard test fixture and brought to the stabilized operating temperature of 4.2.4. The electrical breakaway torque shall be conducted as specified in MIL-S-81963 and shall meet the requirements of 3.4.7.

4.6.8 Current. The servomotor shall be mounted in the standard test fixture and brought to the stabilized operating temperature of 4.2.4. The current drawn by the reference winding shall be measured with the control winding open-circuited, and the servomotor energized in accordance with 4.2.5. The reference winding shall then be disconnected; the rated voltage shall be applied to the control winding and the current consumed by the control winding shall be measured. The power consumed shall meet the

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4.6.9 Power. The servomotor shall be mounted in the standard test fixture and brought to the stabilized operating temperature of 4.2.4. The power consumed by the reference winding shall be measured with the control winding open-circuited, and the servomotor energized in accordance with 4.2.5. The reference winding shall then be disconnected; the rated voltage applied to the control winding and the power consumed by the control winding shall be measured and shall conform to the requirements of 3.4.9.

4.6.10 Direction of rotation. With the servomotor mounted on the standard test fixture and energized in accordance with 4.2.5 and Figure 1, direction of rotation of the shaft shall be observed and recorded and shall meet the requirements of 3.4.10.

4.6.11 Single phasing. Unless otherwise specified, the servomotor shall be mounted on the standard test fixture and allowed to obtain the stabilized non-operating temperature of 4.2.3. Both windings shall then be energized with the rated standard test voltage of 4.2.5. While operating at the resultant free speed, the control voltage shall be disconnected and the motor observed for evidence of single phasing. This test shall be performed in both directions of rotation. The test sequence shall then be repeated with the reference winding disconnected instead of the control winding. The motor shall meet the requirements of 3.4.11.

4.6.12 No-load speed. The servomotor shall be mounted in the standard test fixture and brought to the stabilized operating temperature of 4.2.4. The standard rated test voltage of 4.2.5 shall then be applied to the control winding and the speed of the motor determined. This test shall be performed in both directions of shaft rotation and shall meet the requirements of 3.4.12.

4.6.13 Stall torque. The servomotor shall be brought to the stabilized operating temperature of 4.2.4 and the shaft of the motor rigidly coupled to a fixture consisting of a suitable lever-arm and weight assembly which is entirely free to rotate to 90 degrees from its free hanging vertical position. A combination of weights and lever-arm lengths shall be chosen which effect angular deflections of at least 40 degrees. The control winding shall then be energized with the rated standard test voltage. The stall torque in ounce-inches shall be determined from the resultant angular deflection of the lever-arm and weight assembly. The stall torque shall be measured in both directions of shaft rotation and shall meet the requirements of 3.4.13.

4.6.14 Impedance. The servomotor shall be mounted in the standard test fixture and brought to the stabilized operating temperature of 4.2.4. The impedance of each winding shall be measured in accordance with MIL-S-81963 when energized with the applicable rated standard voltage of 4.2.5 and with the remaining winding open. Impedance shall meet the requirements of 3.4.14.

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4.6.15 Stall torque linearity. The servomotor shall be mounted on the standard test fixture and brought to the stabilized operating condition of 4.2.4. At this stabilized condition, the stall torque in ounce-inches shall be determined and shall be referred to either as the stall torque at 100 percent, or as the rated control voltage. The control voltage shall then be reduced to 20 percent of the rated control voltage and the stall torque measured. The stabilization cycle shall be repeated with successive control voltages of 40%, 60%, 80% and 110% of the rated control voltage applied and the corresponding stall torque measured. The stall torque linearity is a function of the deviation between the actual measured stall torque readings at 20, 40, 60, 80 and 110 percent of the rated control voltage and the reading at 100 percent. Stall torque linearity shall meet the requirements of 3.4.15. The expression as a percent linearity error would be:

$$\frac{T_s}{T_{100}} - A \times 100\%$$

where

$T_s$  = stall torque at 20, 40, 60, 80 and 110 percent of rated control voltage

$T_{100}$  = measured stall torque at 100 percent or rated control voltage

A = 20%, 40%, 60%, 80% and 110% expressed as a decimal; e.g., 0.20, 0.40, 0.60, etc.

4.6.16 Speed at one-half measured stall torque. The servomotor shall be mounted on the standard test fixture and brought to the stabilized operating temperature of 4.2.4. The shaft shall then be coupled to a suitable dynamometer and the control winding energized with the rated standard test voltage of 4.2.5. A load equivalent to one-half the measured stall torque shall be applied; the speed shall be measured (in rpm) and shall meet the requirements of 3.4.16.

4.6.17 Temperature rise. Temperature rise shall be conducted in accordance with MIL-S-81963 and shall meet the requirements of 3.4.17, using the control winding for DC resistance measurements. Both the reference and control windings shall be energized as specified in 4.2.5 and the rotor stalled.

4.6.18 Voltage sensitivity. The servomotor shall be mounted on the standard test fixture and brought to the stabilized operating temperature of 4.2.4. The reference winding voltage shall then be adjusted to 110 percent of the rated standard test voltage of 4.2.5, and the control winding shall be energized at the rated voltage. After the shaft has reached the final no-load speed at this condition, the control winding voltage shall be disconnected, and the shaft observed for single-phasing. The test shall be repeated with the reference winding voltage reduced to 90 percent of the rated standard voltage. Both tests shall be performed for each direction of shaft rotation. The reference winding voltage shall then be returned to the

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rated standard voltage. The test sequence shall be repeated with the control winding adjusted to 110 and 90 percent of the rated voltage and the reference winding being removed. The servomotor shall be considered a failure if the shaft continues to rotate longer than 15 seconds after either winding has been disconnected.

**4.6.19 Frequency sensitivity.** The servomotor shall be mounted on the standard test fixture and brought to the stabilized operating temperature of 4.2.4. The frequency of the standard test voltages shall then be adjusted to 105 percent of the rated value and the control winding energized with a voltage equal in amplitude to the rated standard test voltage. When the shaft has reached its final no-load speed under these conditions, the control winding shall be disconnected and the shaft observed for single phasing. The frequency of the test voltages shall then be adjusted to 95 percent of the rated value and the above test repeated. Both tests shall be performed for each direction of shaft rotation. The reference winding voltage shall then be returned to the rated standard voltage. The same test sequence shall be repeated with the control winding adjusted to 110 and 90 percent of the rated voltage and the reference winding being removed. The servomotor shall be considered a failure if the shaft continues to rotate for more than 15 seconds after either winding has been disconnected.

**4.6.20 Coupling in split or center-tapped control windings.** The servomotor shall be brought to the stabilized operating condition of 4.2.4. The reference winding shall then be disconnected and a voltage equal in amplitude to one-half the rated control winding voltage shall be applied to one-half of the split or center-tapped control winding. A voltmeter and network having a combined impedance equivalent to a 100K ohm resistor in parallel with a capacitance of 30 microfarads shall be connected across the remaining half of the control winding. The ratio of the resultant voltmeter reading to one-half the rated control winding voltage, expressed as a fraction, shall meet the requirements of 3.4.20.

**4.6.21 Security of terminals or lead wires.** The security of each screw type or solder pin type of terminal or of each lead wire shall be tested in accordance with MIL-S-81963 and shall meet the requirements of 3.4.22.

**4.7 Environmental.**

**4.7.1 Vibration.** All servomotors shall be tested in accordance with MIL-S-81963. During this test, one half of the total quantity of servomotors shall be energized in accordance with 4.2.5. The remaining half shall not be energized. Immediately after the test, each servomotor shall be examined for loose or damaged parts and shall meet the requirements of 3.5.1. The servomotors shall then be subjected to shock testing of 4.7.2.

**4.7.2 Shock.**

**4.7.2.1 Low impact shock.** All servomotors shall be tested in accordance with MIL-S-81963. During the test, the motors shall be unenergized and the rotors mechanically free to rotate. Following the test, the servomotors shall meet the requirements of 3.5.2.1.

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4.7.2.2 High impact shock. All servomotors shall be tested in accordance with MIL-S-81963. During the test, the motors shall be unenergized and the rotors mechanically free to rotate. Following the test, the servomotors shall meet the requirements of 3.5.2.2.

4.7.3 Altitude.

4.7.3.1 Altitude low temperature. Servomotors shall be tested in accordance with MIL-S-81963 and the reference winding shall be energized in accordance with 4.2.5. The servomotors shall then meet the requirements of 3.5.3.1.

4.7.3.2 Altitude high temperature. Servomotors shall be tested in accordance with MIL-S-81963 and the reference winding shall be energized in accordance with 4.2.5. The servomotors shall then meet the requirements of 3.5.3.2.

4.7.4 Ambient temperature.

4.7.4.1 Ambient low temperature. The servomotor shall be tested in accordance with MIL-S-81963 and allowed to attain the stabilized non-operating temperature condition of 4.2.3. The servomotor shall then be subjected to the dielectric withstanding test of 4.6.5. After successfully withstanding the Table VI test potentials, the reference winding shall be energized with the rated standard test voltage and, at the same time, the control winding shall be energized with a test voltage equal in amplitude to two times the minimum starting voltage requirement specified in the specification sheet. The shaft shall rotate and continue to rotate, or the motor is considered a failure. Following the determination of shaft rotation, both test voltages shall be removed. The rated standard test voltage shall then be applied to both windings and the shaft allowed to attain its final speed. Disconnect the voltage from the control winding and observe the shaft for evidence of single phasing. This test shall be performed for both directions of rotation. The test sequence shall be repeated with the reference winding being removed. If the shaft continues to rotate longer than 15 seconds after removal of either voltage, the motor is considered a failure. The servomotor shall then be energized to attain the stabilized operating temperature of 4.2.4. While in this low-temperature environment, the motor shall be tested to the requirements of 3.5.4.1.

4.7.4.2 Ambient high temperature. The servomotor shall be tested in accordance with MIL-S-81963 and allowed to attain the stabilized non-operating temperature condition of 4.2.3 at the ambient high temperature,  $\pm 2^{\circ}\text{C}$ , specified in the applicable specification sheet. Both windings shall then be energized at the rated voltage, and the servomotor shall be allowed to attain the stabilized operating temperature condition of 4.2.4. After reaching this condition, and while still in the same high temperature environment, the servomotors shall meet the requirements of 3.5.4.2.

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**4.7.5 Moisture resistance test.** Servomotors shall be subjected to the moisture resistance test in accordance with MIL-S-81963. One unit shall be unenergized and one unit shall have the reference winding energized in accordance with the rated standard voltage of 4.2.5. Following completion of step 6 with the humidity controlled at 90 to 98 percent, both motors shall be energized with the standard rated voltage and allowed to attain the no-load speed. The units shall remain at this condition for five minutes. This procedure shall be followed during each of the total 10 cycles. After completion of the final cycle, the motors shall remain unenergized at the standard ambient conditions for 24 hours. The servomotors shall subsequently be subjected to and shall meet the requirements of 3.5.5.

**4.7.6 Endurance.** The servomotor shall be tested to 1000 hours in accordance with the combination of speed conditions, ambient temperatures and shaft positions indicated in Table VIII. For approximately one-half the time at each combination of temperature, speed condition, and attitude delineated, the servomotors shall be energized to cause the opposite shaft rotation. After completion of the 1000 hour test, the motors shall be subjected to and shall meet the requirements of 3.5.6.

**4.7.7 Audible noise structureborne.** When required by the applicable specification sheet, the structureborne noise test shall be conducted in accordance with MIL-S-81963 while mounted in the test fixture of Figure 6. The motor and fixture combination shall be suspended as shown in Figure 7 in such a manner that the shaft axis and the top edge of the mounting plate are horizontal within 5 degrees. After determination of the prevailing ambient noise level for the broad, one-third octave, and narrow bands with the unit unenergized, the reference winding shall be energized with the rated standard voltage in accordance with 4.2.5, and the control winding shall be energized with a standard test voltage equal to one-half the rated value. The required vibration levels shall be recorded and shall meet the requirements of 3.5.7.

**4.7.8 Salt atmosphere.** When required by the applicable specification sheet, servomotors shall be subjected to the salt atmosphere test in accordance with MIL-S-81963 and shall meet the requirements of 3.5.8.

**4.7.9 Explosion resistance.** When required by the applicable specification sheet, servomotors shall be subjected to explosion resistance in accordance with MIL-STD-202, Method 109, while being vibrated according to 4.7.2 and energized as specified in Table VIII. The servomotor shall meet the requirements of 3.5.9. Additional information on explosion resistance is given in 4.10.6 of MIL-S-81963.

**4.8 Inspection of packaging.** The sampling and inspection of the preservation and packaging, packing, and container marking shall be in accordance with the requirements of MIL-S-81963.

## 5. PACKAGING

**5.1 Packaging requirements.** The requirements for packaging shall be in accordance with MIL-S-81963.

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6. NOTES

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

6.1 Intended use. The intended use for servomotors covered by this specification must be in accordance with MIL-S-81963.

6.2 Acquisition requirements. Acquisition documents should contain the information specified in MIL-S-81963, and should also specify if a black finish is required for the housing.

6.3 First article inspection. Information pertaining to first article inspection of servomotors should be obtained as specified in MIL-S-81963.

6.4 Rated voltage and frequency. Normal tolerances for field power supplies are  $\pm 10$  percent on voltage and frequency and  $\pm 5$  percent on harmonic content. Unless otherwise noted in the specification sheet, the characteristics required in the applicable specification sheets for servomotors are based upon tolerances of  $\pm 1$  percent on voltage and frequency and  $\pm 3$  percent on harmonic content (see 4.2.5). Therefore, servomotor performance characteristics may be degraded under normal field power supply tolerances.

6.5 Criteria for establishing the level of preservation and packaging. The following criteria should be used in determining the proper level of preservation or packaging to use:

a. Level A. This level should be used for those items which are to be shipped to indeterminate destinations or stored under indeterminate conditions for redistribution anywhere.

b. Level B. This level should be used for those items which are to be given multiple domestic shipments with indeterminate period of covered storage.

c. Level C. This level should be used for those items which are to be shipped to domestic installations for immediate use at the first receiving station.

6.6 Definitions.

6.6.1 Servomotor. A servomotor is a precision induction motor designed to operate from two independent AC voltages of the same frequency. Variations of amplitude and relative time phase of the two voltages determine the direction, speed and torque of the motor. A high torque-to-rotor inertia ratio is an intended characteristic of a servomotor.

6.6.2 Reference winding. The reference winding (phase 1) of a servomotor is that winding which is energized by a specified fixed voltage and frequency.

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6.6.3 Control winding. The control winding (phase 2) of a servomotor is that winding which is energized by a control voltage with a time-phase difference of 90 electrical degrees from the voltage energizing the reference winding.

6.6.4 Electrical breakaway torque. The electrical breakaway torque or minimum starting voltage of a servomotor is that voltage of the rated frequency which when applied to the control winding causes the shaft to start and continue to rotate from any initial angular position when the reference winding is energized with rated voltage and frequency and the shaft is unloaded.

6.6.5 Single phasing. Single phasing of a servomotor is the tendency of the shaft to start when only one winding is energized, or the tendency to continue rotating when either winding is disconnected from all of its associated energization source impedances after the motor has first attained maximum speed.

6.6.6 Stall torque. The stall torque of a servomotor is the torque developed at zero rotor speed when rated voltages and frequency are applied to both windings.

6.6.7 Direction of rotation. Clockwise and counterclockwise directions of rotation are determined when viewing the motor from the shaft extension associated with the mounting surfaces. The standard positive direction of rotation is counterclockwise.

6.6.8 No-load speed. The no-load speed of a servomotor is the speed of the shaft, mechanically unloaded, when rated voltages and frequency are applied to the reference and control windings.

6.6.9 Synchronous speed. The speed at which the rotor turns when the standard rated voltage is applied to both windings is referred to as the synchronous speed. Synchronous speed in revolutions per minute is equal to the frequency in hertz multiplied by 120, with the result divided by the number of poles, as shown by the following equation:

$$N = \frac{120 f}{P}$$

where:

N = synchronous speed in revolutions per minute

f = frequency in hertz

P = number of poles

6.6.10 Effective resistance. The equivalent pure DC resistance which, when substituted for the winding being checked, will consume the same power. It is equal to the impedance of a circuit consisting of a capacitance in parallel with the winding being checked when the capacitor is adjusted for

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6.6.11 Temperature rise. The temperature rise of a servomotor is the increase of the internal temperature of the servomotor above the ambient temperature due to the dissipation of excitation power.

6.6.12 Damping constant. The damping constant (D) of a servomotor is the slope of the speed-torque curve. The value, the average damping constant, is approximately equal to:

$$D = \frac{T_s}{N_o} \times 6.74 \times 10^5 \text{ dyne-centimeter-seconds per radian}$$

where:

$T_s$  = the stall torque in ounce-inches

$N_o$  = the no-load speed in revolutions per minute (rpm)

6.6.13 Time constant. The time constant (TC) of a servomotor is the time required for the motor to reach 63.2 percent of the no-load speed after both windings have been energized with rated voltages. It is equal to:

$$TC = \frac{J_r}{D} \text{ seconds}$$

where:

$J_r$  = rotor moment of inertia in gram-centimeters<sup>2</sup>

D = damping constant

6.6.14 Reversing time. The reversing time (RT) of a servomotor is the time required for the motor to reach 63.2 percent of the no-load speed upon the phase reversal of the control winding voltage after initially running at the no-load speed in the opposite direction. It is approximately equal to:

$$RT = (TC) \times 1.69 \text{ seconds}$$

6.6.15 Theoretical acceleration at stall. The theoretical acceleration at stall (A) of a servomotor is a ratio that indicates the ability of the motor to accelerate from the stall condition with rated voltage. It is equal to:

$$A = \frac{T_a}{J_r} \times 7.06 \times 10^4 \text{ radians per second}^2$$

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6.6.16 Maximum power output. The power output of a motor is the power measured at the shaft due to the rotation of a torque load. It is equal to:

$$P_o = T \times N \times 7.4 \times 10^{-4} \text{ watts}$$

where:

T = the torque developed in ounce-inches

N = shaft speed for a torque load T in rpm

For a servomotor defined by this document, maximum power output is realized when the reference and control windings are energized with rated voltages, and a torque load necessary to reduce the shaft speed to essentially one-half the measured no-load speed is applied to the shaft.

6.6.17 Coupling in center-tapped and split windings. The coupling is that voltage of mutual induction present across one-half of a split or center-tapped winding when the remaining one-half is energized with one-half rated voltage. The coupling is expressed in percent of energization and is intended to approximate 100 percent for servomotor control windings.

6.6.18 Voltage sensitivity. The voltage sensitivity of a servomotor is the change in the applicable electrical or mechanical characteristic due to prescribed deviations from the rated value of either winding voltages. It may be specified as a percent change per volt.

6.6.19 Frequency sensitivity. The frequency sensitivity of a servomotor is the change in the applicable electrical characteristic due to prescribed deviations of frequency of the energizing voltages. It is sometimes expressed as a percent change per hertz.

6.6.20 Units of measurement. Unless otherwise specified, units of measurement are as follows:

- a. Angles - degrees and minutes
- b. Potential - volts rms
- c. Impedance - ohms
- d. Current - amperes rms
- e. Temperature - degrees Centigrade
- f. Time Phase - degrees
- g. Torque - ounce-inches
- h. Time - seconds
- i. Angular velocity - revolutions per minute (rpm)

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6.7 Subject term (key) word listing.

Center-tapped winding  
Control winding  
Coupling  
Damping constant  
Dielectric withstanding voltage  
Effective resistance  
Electrical breakaway torque  
First article  
Frequency sensitivity  
Impedance  
Induction motor  
Insulation resistance  
Minimum starting voltage  
No-load speed  
Qualification  
Qualified products list (QPL)  
Quality conformance  
Reference winding  
Reversing time  
Rotor moment of inertia  
Rotating component  
Servocomponent  
Single-phasing  
Split winding  
Stall torque  
Stall torque linearity  
Synchronous speed  
Tachometer generator  
Temperature rise  
Voltage sensitivity

6.8 Changes from previous issue. Asterisks are not used in this revision to identify changes with respect to the previous issue due to the extensiveness of the changes.

6.9 International standardization agreements. Certain provisions of this specification are the subject of international standardization agreements reached by the NATO Working Group on Analogue and Digital Servocomponents (AC/301(SG/A) (WG/5)). When amendment, revision, or cancellation of this specification is proposed which affects or violates the international agreement concerned, the preparing activity will take appropriate reconciliation action through international standardization channels, including departmental standardization offices, to change the agreement or make other appropriate accommodations.

6.10 Applicable international documentation. NATO documents applicable to this specification are Allied Standard Publication (ASTANP)-3, Volume 6105 Chapter 2, NATO Electronic/Electrical Preferred Parts List, Servomotors, Induction, Two-Phase; ASTANP-4, Volume 6105 Chapter 5, NATO Electronic/Electrical Technical Recommendation, Servomotors, Induction, Two-Phase; and ASTANP-5, Volume 6105 Chapter 5, NATO Quality Assessment Recommendation for

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TABLE I. Nomenclature.

Servomotor	15	SM	4	C
(Type Designation)				
Item Name (1.2.1)	Size (1.2.1.1)	Function (1.2.1.2)	Supply Frequency (1.2.1.3)	Design Modification (1.2.1.4)

TABLE II. Example of part identifying number.

M	22432/9	-01	C
Military Designator	Specification Sheet Number	Dash Number	Latest Modification Letter

TABLE III. Termination identification marking.

Terminal No.	Wire Lead Color	Winding
1	Yellow	Reference, start
3	White	Reference, finish
2	Red	Control, start
5	Red-black	Control, mid-point 1/
6	Green	Control, mid-point 1/
4	Black	Control, finish

1/ Mid-point refers to center-tapped winding.

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TABLE IV. Standard dimensions for servomotors.

For location of lettered dimensions, see:

FIGURE	2	3	3	3
SERVOMOTOR SIZE	05-08	11	15	18-23

(Unless otherwise specified, dimensions are in inches)

DIMENSIONS	A	B 1/	C	D	E
SERVOMOTOR SIZE	AS LISTED ON SPECIFICATION SHEET TABLE II	Minimum	AS LISTED ON SPECIFICATION SHEET TABLE II	+0.0000 -0.0005	+0.0000 -0.0005
05		0.250		—	0.3750
08		0.250		—	0.5000
11		0.250		1.0000	0.6250
15		0.312		1.3120	0.8750
18		0.437		1.5620	0.9375
23		0.437		2.0000	0.9375

DIMENSIONS	SPUR GEAR DATA 2/ F			OUTSIDE DIAMETER	G
SERVOMOTOR SIZE	NO. OF TEETH	DIAMETRAL PITCH	PRESSURE ANGLE	+0.0000 -0.0010	AS LISTED ON SPECIFICATION SHEET TABLE II
05	13	120	20°	0.1247	
08	13	120	20°	0.1247	
11	13	120	20°	0.1247	
15	15	96	20°	0.1770	
18 (Pt.# 001)	15	96	20°	0.1765 3/	
18 (Pt.# 002)	21	120	20°	0.1872 3/	
23	22	96	20°	0.2490	

NOTES: 1/ B is full length of tooth.

2/ Spur gear min. length shall be to face of inner race of bearing.

**MIL-S-22432A****TABLE IV. Standard dimensions for servomotors - (Continued).**

DIMENSIONS	H	I	J	K	L	M
SERVOMOTOR SIZE	$\pm 0.005$	Maximum				
05	0.040	—	0.040	0.040	0.437	—
08	0.040	—	0.062	0.062	0.687	—
11	0.062	0.062	0.093	0.062	0.975	1.629
15	0.040	0.132	0.093	0.078	1.312	1.825
18	0.040	0.132	0.093	0.078	1.625	2.000
23	0.062	0.200	0.125	0.100	2.062	—

DIMENSIONS	N	O	P	R 5/	S
SERVOMOTOR SIZE	Maximum	$\pm 0.003$ 4/	Maximum	Reference	Reference
05	—	—	—	—	—
08	—	—	—	—	—
11	1.462	0.812	0.937	0.812	—
15	1.530	1.100	1.440	0.906	0.929
18	—	1.250	1.254	0.906	0.929
23	—	1.500	—	0.906	—

NOTES: 4/ Tolerance not cumulative.

5/ R is applicable to terminal blocks only.

6/ Tolerance is +0.000 and -0.005.

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TABLE V. Terminal hardware.

Hardware	Number Required	Military Standard	Servomotor Size
Machine Screw 1/	6 EA 2/	MS-35276-202	11
		MS-35275-213	15, 18, 23
Lock Washer	6 EA	MS-35338-134	11
		MS-35338-135	15, 18, 23
Drive Washer	1 EA	MS-17187-2 3/	18
		MS-17186-6 3/	18
Terminal Lug	6 EA	MS-17182-1	11
			15, 18, 23

NOTES: 1/ Drilled hole in head of machine screw is optional.

2/ MIL-S-22432/9, Type 18SM4C, requires 8 each machine screws.

3/ MIL-S-22432/9, Type 18SM4C, part identifying number M22432/9-02C, requires one each of MS-17187-2 and MS-17186-6.

MTI-S-22432ATABLE VI. Test voltages and application points.

Rated reference winding voltage	Initial Test Voltages, rms (50 or 60 Hz)		Subsequent Test Voltages rms (50 or 60 Hz)	
	Each winding to housing and primary to secondary windings	Between electrically separate windings in intimate contact	Each winding to housing and primary to secondary windings	Between electrically separate windings in intimate contact
Up to 50	242 to 250	242 to 250	194 to 200	194 to 200
51 to 100	485 to 500	242 to 250	388 to 400	194 to 200
101 to 200	870 to 900	242 to 250	720 to 740	194 to 200

## NOTES:

1. If the servomotor is furnished with a center-tapped or single-ended control winding, the application of the test potentials between lead 2 and the housing, between leads 3 and 2, and leads 5 and 6 are not necessary.
2. See Table II for corresponding color-coded wire lead terminal designation.
3. Subsequent tests shall be performed at 80 percent of the initial test voltage.

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TABLE VII. First article and quality conformance inspection tests.

Test No.	Requirement	Test	Test method for examination	Inspection	
				First article Sample Number	Quality Conformance
1	3.4.1	4.6.1	Visual and mechanical inspection	1, 2, 3, 4	X
2	3.4.2	4.6.2	Shaft radial and end play	1, 2, 3, 4	X
3	3.4.3	4.6.3	Total shaft runout (smooth portion)	1, 2, 3, 4	X
4	3.4.4	4.6.4	Rotor moment of inertia	1, 2, 3, 4	-
5	3.4.5	4.6.5	Dielectric withstand voltage	1, 2, 3, 4	X
6	3.4.6	4.6.6	Insulation resistance	1, 2, 3, 4	X
7	3.4.7	4.6.7	Electrical breakaway torque (starting voltage)	1, 2, 3, 4	X
8	3.4.8	4.6.8	Current	1, 2, 3, 4	X
9	3.4.9	4.6.9	Power	1, 2, 3, 4	X
10	3.4.10	4.6.10	Direction of rotation	1, 2, 3, 4	X
11	3.4.11	4.6.11	Single phasing	1, 2, 3, 4	X
12	3.4.12	4.6.12	No-load speed	1, 2, 3, 4	X
13	3.4.13	4.6.13	Stall torque	1, 2, 3, 4	X
14	3.4.14	4.6.14	Impedance	1, 2, 3, 4	-

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TABLE VII. First article and quality conformance inspection tests - (Continued).

Test No.	Requirement	Test	Test method for examination	Inspection	
				First article Sample Number	Quality Conformance
15	3.4.15	4.6.15	Stall torque linearity	1, 2, 3, 4	-
16	3.4.16	4.6.16	Speed at one-half measured stall torque	1, 2, 3, 4	-
17	3.4.17	4.6.17	Temperature rise	1, 2, 3, 4	-
18	3.4.18	4.6.18	Voltage sensitivity	1, 2, 3, 4	-
19	3.4.19	4.6.19	Frequency sensitivity	1, 2, 3, 4	-
20	3.4.20	4.6.20	Coupling in split or center-tapped control windings	1, 2, 3, 4	-
21	3.4.21	4.6.21	Security of terminals or wire leads	1, 2, 3, 4	-
22	3.5.1	4.7.1	vibration, followed by test no. 1	1, 2, 3, 4	-
23	3.5.2.1	4.7.2.1	Shock, low impact, followed by test nos. 2, 5, 6, 7, 11, 12 and 13	1, 2, 3, 4	-
24	3.5.2.2	4.7.2.2	Shock, high impact, followed by test nos. 5, 6, 7 and 12	1, 2, 3, 4	-
25	3.5.3.1	4.7.3.1	Altitude, low temperature, during test nos. 6 and 7	1, 2	-

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TABLE VII. First article and quality conformance inspection tests - (Continued).

Test No.	Requirement	Test	Test method for examination	Inspection	
				First article Sample Number	Quality Conformance
26	3.5.3.2	4.7.3.2	Altitude, high temperature, during test nos. 6 and 7	1, 2	-
27	3.5.4.1	4.7.4.1	Ambient low temperature, during test nos. 5, 6, 7, 11 and 12	3, 4	-
28	3.5.4.2	4.7.4.2	Ambient high temperature, during test nos. 5, 6, 7, 11, 12 and 13	3, 4	-
29	3.5.5	4.7.5	Moisture resistance, followed by test nos. 2, 5, 6, 7, 11, 12 and 13	3, 4	-
30	3.5.6	4.7.6	Endurance, followed by test nos. 2, 5, 6, 7, 11, 12 and 13	1, 2	-
31	3.5.7	4.7.7	Audible noise structureborne*	1, 2, 3, 4	-
32	3.5.8	4.7.8	Salt atmosphere*	1, 2	-
33	3.5.9	4.7.9	Explosion resistance*	1, 2	-

\*Test Nos. 31, Audible noise structureborne; 32, Salt atmosphere; and 33, Explosion resistance shall be performed only when required by the specification sheet.

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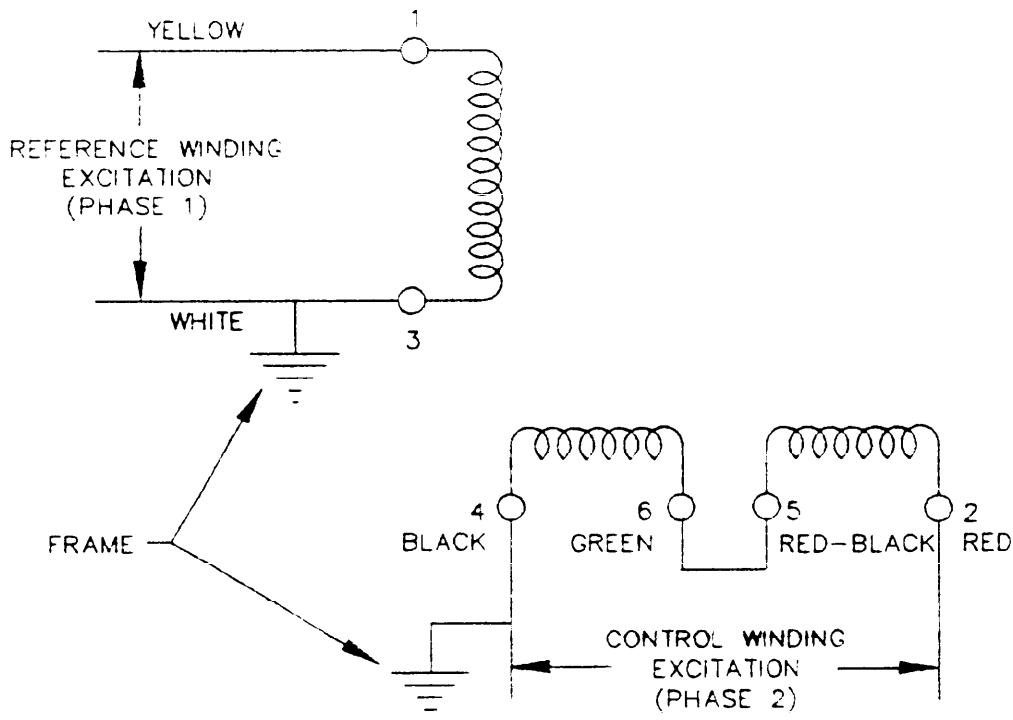
TABLE VIII. Conditions for endurance tests.

Time (hours)	Speed/load condition	Temperature (C°)	Shaft position
64 ± 2	No-load speed	-55°C to +5°C	Horizontal
24 ± 2	No-load speed	Th 1/	Vertical (Up)
24 ± 2	No-load speed	Th 1/	45° (Up)
24 ± 2	No-load speed	Th 1/	45° (Down)
24 ± 2	No-load speed	Th 1/	Vertical (Down)
740 ± 4	No-load speed	Standard (4.2.2)	Horizontal
100 ± 3	Maximum power output 2/	100°C to +5°C	Horizontal

NOTES: 1/ This is the high ambient temperature specified in the detail specification sheet.

2/ Maximum power output is defined in paragraph 6.6.16 of this document.

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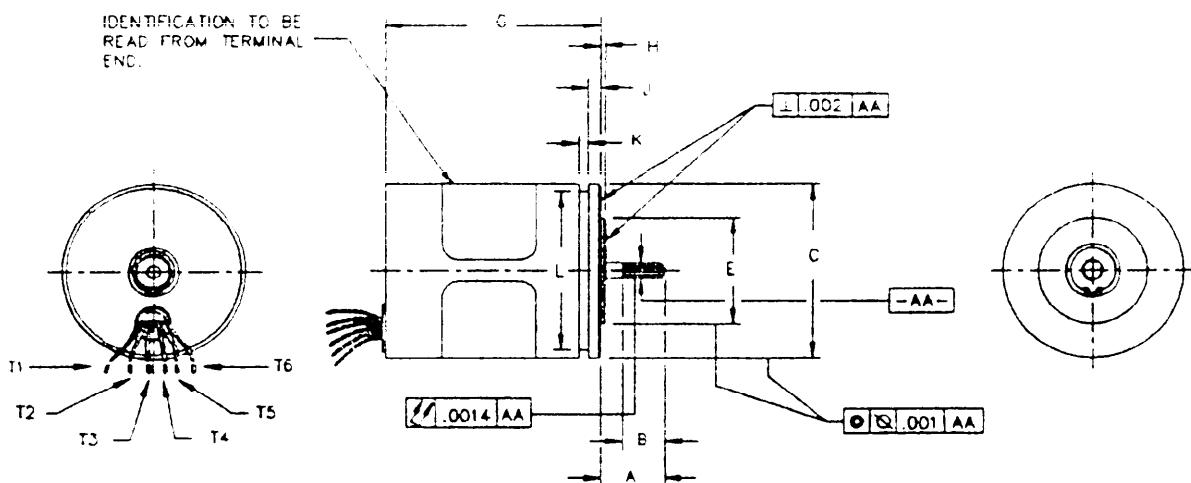


## NOTES:

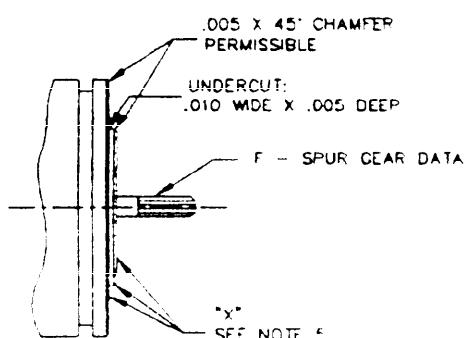
1. Voltage at terminal 2 (Red) must LEAD voltage at terminal 1 (Yellow) by  $90^\circ \pm 3^\circ$  for counterclockwise rotation.
2. When a center-tapped control winding is furnished, a Red-Black wire lead or terminal number 5 shall be used.
3. During testing, terminals 3 and 4 (for CCW rotation), and terminals 3 and 2 (for CW rotation) are strapped and returned to frame.
4. For series operation of control windings, terminals 5 and 6 are strapped and rated series voltage is applied across terminals 2 and 4.
5. For multiple or parallel operation of control windings, terminals 6 and 2 are strapped and terminals 4 and 5 are strapped; then rated parallel voltage is applied across terminals 2 and 4.

FIGURE 1. Standard servomotor schematic and test connection diagram.

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## NOTES:



- PERPENDICULARITY AND CONCENTRICITY SHALL BE MEASURED WITH THE UNIT IN A VERTICAL POSITION SUPPORTED BY THE SHAFT, WHILE ROTATING THE HOUSING.
- TOTAL RUNOUT OF MAJOR DIAMETER OF FEATURE -AA- (SMOOTH PORTION) SHALL NOT EXCEED .0014 IN.
- END PLAY AND RADIAL PLAY SHALL BE MEASURED DURING REVERSAL OF THE FOLLOWING LOADS:  
END PLAY-1 POUND RADIAL PLAY-1/2 POUND
- TERMINAL LEAD WIRES SHALL DEPART THROUGH THE BACK SURFACE OF THE TERMINAL END OF THE SERVOMOTOR IN ANY ACCEPTABLE MANNER.
- SURFACES MARKED "X" SHALL BE CORROSION-RESISTANT STEEL PER MIL-S-819E3
- UNLESS OTHERWISE SPECIFIED, DIMENSIONS ARE IN INCHES. TOLERANCES SHALL BE: FRACTIONS  $\pm 1/64$ , DECIMALS  $\pm .005$ , AND ANGLES  $\pm 2^\circ$ .
- LETTERED DIMENSIONS ARE GIVEN IN TABLE IV

FIGURE 2. Outline drawing for sizes 05 and 08 servomotors.

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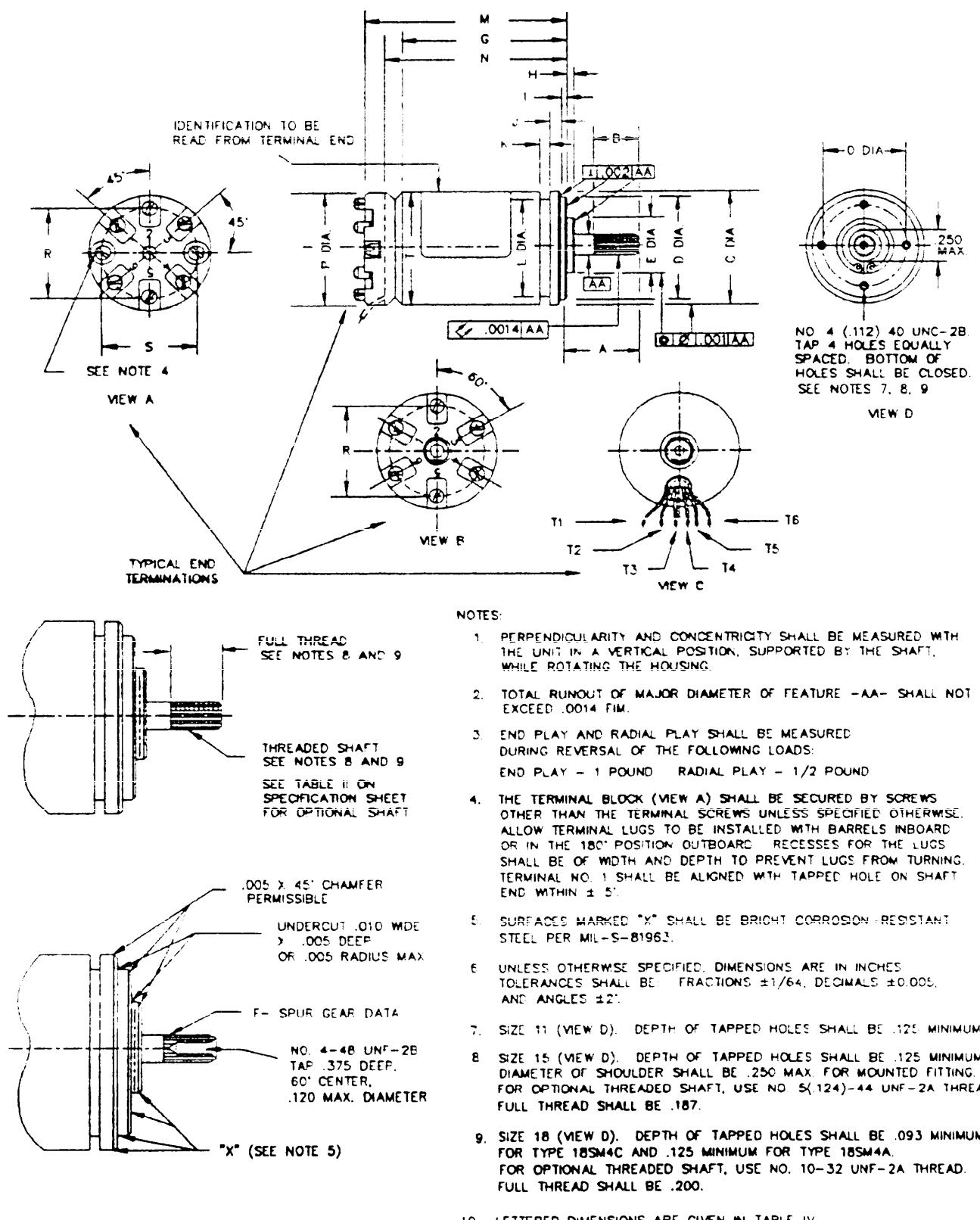
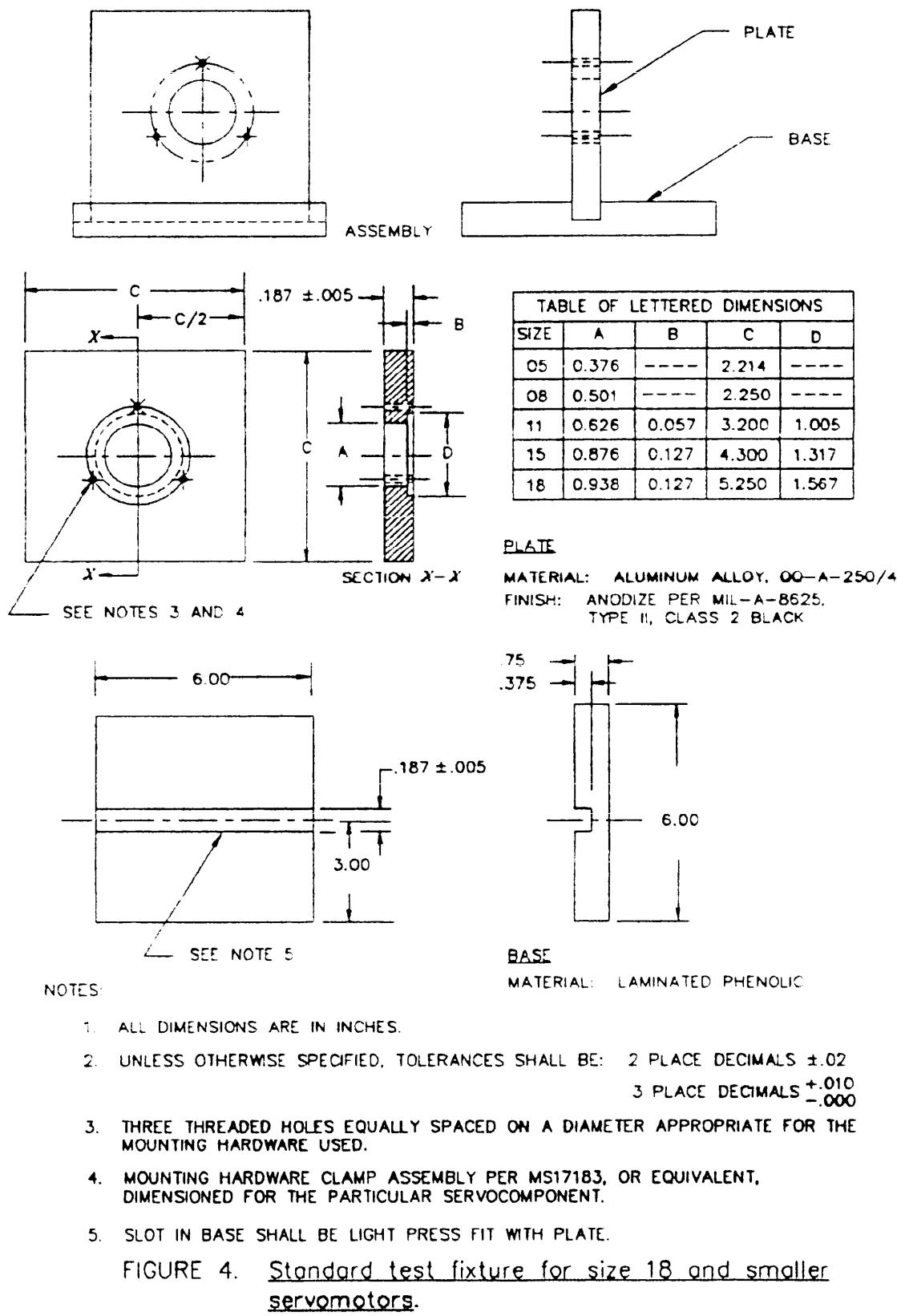


FIGURE 3. Outline drawing for servomotors, sizes 11, 15, 18, and 23.

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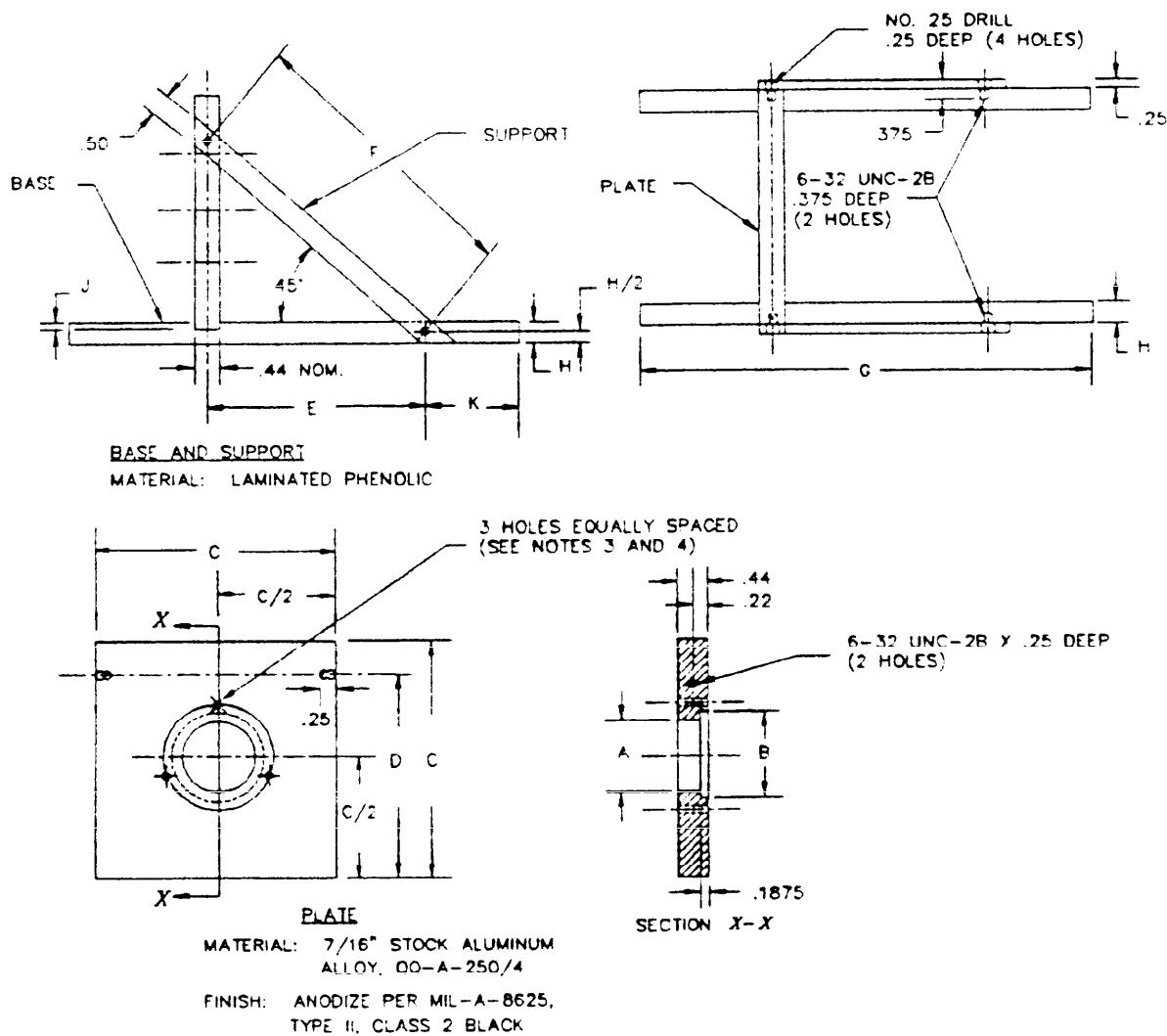


TABLE OF LETTERED DIMENSIONS										
SIZE	A	B	C	D	E	F	G	H	J	K
23	0.938	2.012	5.998	4.75	4.875	6.892	9.00	0.75	0.25	1.00

## NOTES.

1. ALL DIMENSIONS ARE IN INCHES
2. UNLESS OTHERWISE SPECIFIED, TOLERANCES SHALL BE
 

2 PLACE DECIMALS $\pm .02$	3 PLACE DECIMALS $\pm .010$
$-.000$	
3. THREE THREADED HOLES EQUALLY SPACED ON A DIAMETER APPROPRIATE FOR THE MOUNTING HARDWARE USED.
4. MOUNTING HARDWARE CLAMP ASSEMBLY PER MS17183 OR EQUIVALENT, DIMENSIONED FOR THE PARTICULAR SERVOCOMPONENT.

FIGURE 5. Standard test fixture for size 23 or larger servomotors.

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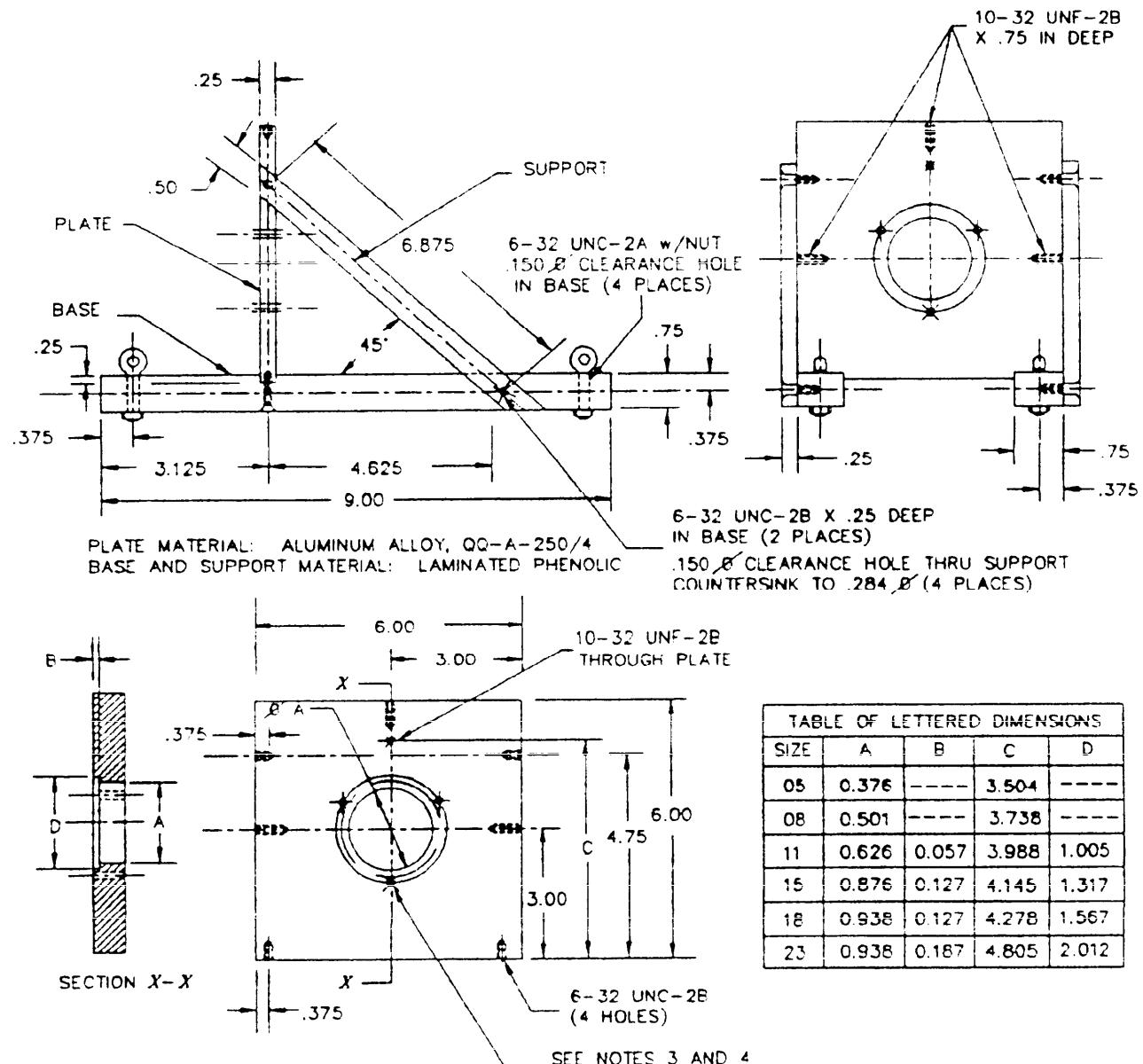


TABLE OF LETTERED DIMENSIONS				
SIZE	A	B	C	D
05	0.376	-----	3.504	-----
08	0.501	-----	3.738	-----
11	0.626	0.057	3.988	1.005
15	0.876	0.127	4.145	1.317
18	0.938	0.127	4.278	1.567
23	0.938	0.187	4.805	2.012

## NOTES:

1. ALL DIMENSIONS ARE IN INCHES.
2. UNLESS OTHERWISE SPECIFIED, TOLERANCES SHALL BE: 2 PLACE DECIMALS  $\pm .02$ , 3 PLACE DECIMALS  $+.010$   $-.000$ .
3. THREE THREADED HOLES EQUALLY SPACED ON A DIAMETER APPROPRIATE FOR THE MOUNTING HARDWARE USED.
4. MOUNTING HARDWARE CLAMP ASSEMBLY PER MS17183, OR EQUIVALENT, DIMENSIONED FOR THE PARTICULAR SERVOCOMPONENT.

FIGURE 6. Servomotor structureborne noise test fixture.

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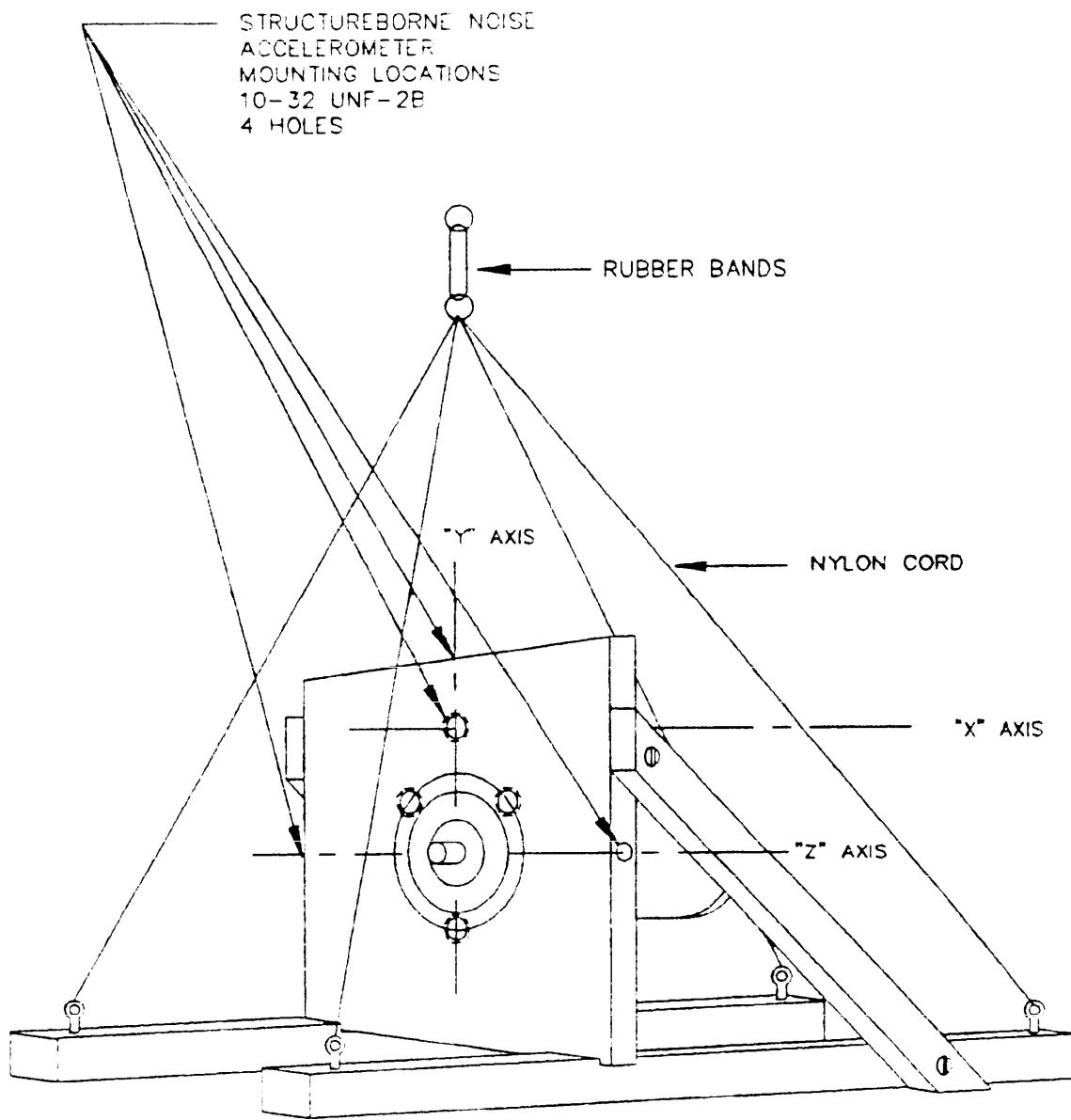


FIGURE 7. Test fixture application for structureborne noise test.

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