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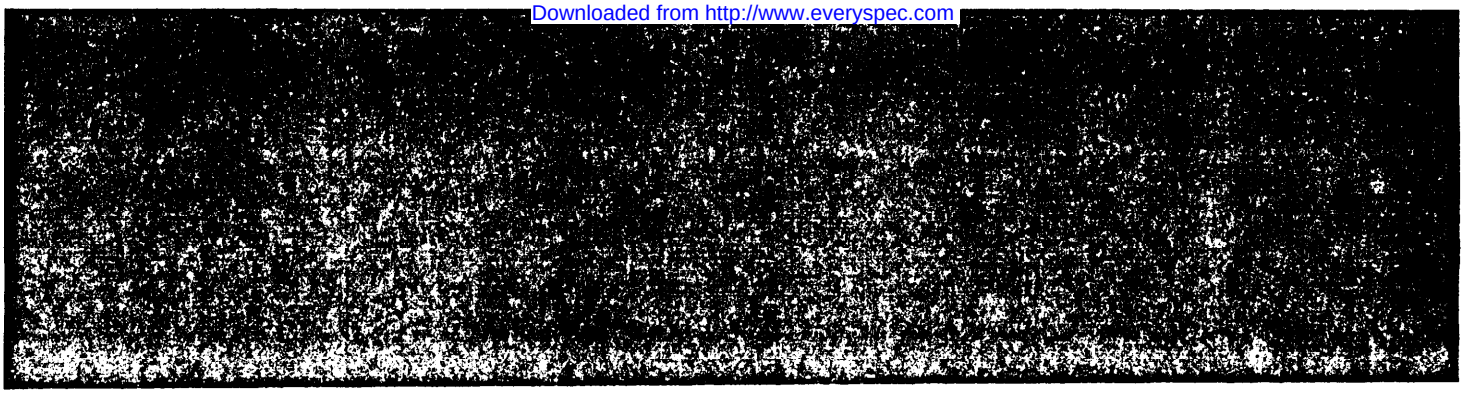
MILITARY STANDARD

MOTORS, ELECTRIC; FOR AIR CONDITIONER APPLICATIONS

METHODS OF TESTS AND INSTRUCTIONS

AMSC N/A FSC 6105



DEPARTMENT OF DEFENSE
Washington, D.C. 20301

Motors, Electric; for Air Conditioner Applications
Methods of Test and Instructions

MIL-STD-1412(ME)

1. This Military Standard is approved for use by USA Belvoir Research, Development, and Engineering Center, Department of the Army, and is available for use by all Departments and Agencies of the Department of Defense.

2. Recommended corrections, additions, or deletions should be addressed to the USA Belvoir Research, Development, and Engineering Center, ATTN: STRBE-TSE, Fort Belvoir, VA 22060-5606.

FORWARD

This standard is intended to define specific methods for measurements associated with the evaluation of electric motors used for military air conditioner applications. These methods are described herein, and referenced for terminology, instrumentation, general methods of measurements and background electrical technology to NEMA and other industry standards. Each method described in this standard contains a results section which establishes failure criteria.

CONTENTS

1. SCOPE

1.1 Coverage. This standard covers a series of specific test method testing and determining the characteristics of electric motors. It est methods of test and failure criteria for determining characteristics de the Military Departments to ensure that electric motors are adequate fo military requirements.

1.2 Numbering system. The methods are designated by numbers assigne accordance with the following system.

1.2.1 Method numbers. The methods included in this standard are numb the 300-600 series.

1.2.2 Decimal system. The decimal system is used to list similar or associated methods in numerical sequence and to provide means for readi identifying main and subparagraphs for purpose of reference.

1.3 Method of reference. Methods of test contained in this standard referenced, when applicable in the individual procurement documents by specifying this standard and the method number.

2. REFERENCED DOCUMENTS

2.1 Issues of documents. The following document of the issue in effe date of invitation for bids or request for proposal, forms a part of thi standard to the extent specified herein.

STANDARD

MIL-STD-810 - Environmental Test Methods.

2.2 Other publications. The following documents form a part of this specification to the extent specified herein. Unless otherwise indicate issue in effect on date of invitation for bids or request for proposal s apply.

ANTI-FRICTION BEARING MANUFACTURERS ASSOCIATION

AFBMA-STD 9 - Load Ratings and Fatigue Life for Ball Bearings.
AFBMA Manual 100 - Anti-Friction Bearing Maintenance.

(Application for copies should be addressed to the Anti-Friction Bea Manufacturers Association, Inc, 1235 Jefferson Davis Highway, Arlington, 22202).

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS, INC. (IEEE)

IEEE STD 43 - Testing Insulation Resistance for Rotating Machinery.
IEEE STD 112 - Test Procedure for Polyphase Induction Motors and Generators.
IEEE STD 114 - Test Procedure for Single-Phase Induction Motors.

(Application for copies should be addressed to The Institute of Electrical and Electronics Engineers, Inc., 345 East 47th Street, New York, New York 10017).

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG1 - Motors and Generators.

(Application for copies should be addressed to The National Electrical Manufacturers Association, 2101 L Street, NW, Suite 300, Washington, DC 20037).

(Industry association specifications and standards are generally available for reference from libraries. They are also distributed among technical groups and using Federal agencies.)

Custodians:
Army - ME

Preparing activity:
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Project 6105-A141

METHOD 301

INSULATION RESISTANCE TEST

CAUTION: OBSERVE SAFETY REGULATIONS. The voltages used in this method dangerous to human life. Contact with the leads or the windings under t cause severe, and possible fatal shock. Arrange and guard the high volt leads so that they are not in a position to be accidentally touched. Ke of all energized parts. Always reduce the test voltage to zero and grou winding under test before making any mechanical or electrical adjustment motor. When grounding windings which have been tested, always connect t connection wire to ground first and then to the winding. Never perform test without at least one other person assisting. The motor frame shall securely grounded.

301.1 General. To assure that the current leakage is kept to a minir insulation resistance must be as high as practicable.

301.2 Apparatus. Direct measurement of insulation may be made with t following instruments:

(1) Direct-indicating ohmmeter with self contained hand or power- generator.
(2) Direct-indicating ohmmeter with self contained battery.
(3) Direct-indicating ohmmeter with self contained rectifier usir external alternating current supply.
(4) Resistance bridge with self-contained galvanometer and batter

301.3 Test procedure. The ground connection of the motor shall be disconnected and the insulation resistance of each coil measured by appl volts direct current (power source should be such as to limit maximum cu 5 milliamperes) between each lead and motor frame. While insulation res can be expected to vary inversely with the size of the machine, for most small motors insulation resistance of at least 100 megohms is to be expe Voltage should be applied for sufficient time to obtain a steady reading measuring resistance in order to allow the winding to become completely

301.4 Results. The insulation resistance shall measure a minimum of megohms. Following the dry out period of the humidity and salt fog test insulation resistance shall comply with the following equation:

$$Rm = Kv + 1$$

where: Rm = Minimum insulation resistance in megohms at 40° C of entire winding.
Kv = Rated machine potential in kilovolts.

Rm at 40° C is in effect one megohm per 1000 volts plus one megohm. Temperature corrections must be made if the motor winding is not at 40° accordance with the following equation:

$$Rm = Rt \times Kt40^\circ C$$

where: Rt = Measure insulation resistance at some temperature other than 40° C.
Kt40° C = Temperature coefficient taken from the IEEE STD 43 figure 1.

The above equations as taken from IEEE STD 43 are for integral horsepower motors. The same equations for determining the insulation failure criteria for fractional horsepower motors is considered adequate.

METHOD 302

HIGH POTENTIAL TEST

CAUTION: OBSERVE SAFETY REGULATIONS: The voltages used in this test are dangerous to human life. Contact with the leads or the windings under test may cause severe and possibly fatal shock. Arrange and guard the high voltage leads so that they are not in a position to be accidentally touched. Keep clear of all energized parts. Always reduce the test voltage to zero and ground the winding under test before making any mechanical or electrical adjustments on the equipment. When grounding windings which have been tested, always connect the connection wire to ground first, and then to the winding. Never perform this test without at least one other person assisting. The motor frame shall be securely grounded.

302.1 General. Dielectric testing is intended to determine the suitability of the insulation system for the use intended and to determine the adequacy of clearance distances. This test is to be conducted upon new motors only since the accumulation of dirt and moisture which accompanies motor use will decrease the dielectric properties.

302.2 Apparatus:

a. High potential breakdown tester capable of producing a (root-mean-square) potential of 1,500 volts. The voltage produced by this tester should be of commercial frequency with substantially a sine wave form (amplitude factor of approximately 1.414) and the application of the voltage to the winding should produce no appreciable transient voltages.
b. Suitable leads and prods.

302.3 Test procedure. This procedure is intended as a "first time" test on new motors. Any additional tests will be conducted at 85 percent of the voltage values shown. The following test voltage shall be applied between windings and the motor frame.

a. Motors rated 1/2 horsepower and larger. The high potential test for motors rated 1/2 horsepower (or 373 watts) and larger shall be made by applying 1000 volts plus twice the rated voltage of the motor.
b. Motors rated less than 1/2 horsepower. The high potential test for motors rated less than 1/2 horsepower (or 373 watts) for operation upon circuits not exceeding 250 volts shall be made by applying 1000 volts.

The specified high-potential test voltage shall be applied for 1 minute. Test may be performed with the winding at room temperature or at any higher temperature attained during process of testing up to rated load of operating temperature.

302.4 Results. Motor shall maintain required test potential for the duration of one minute.

METHOD 303

WINDING RESISTANCE MEASUREMENTS

303.1 General: Winding resistance measurements are made to determine if coils are made up of the correct number of turns and correct wire size and to form a basis for calculating copper (I^2R) losses and for determining average winding temperatures.

303.2 Apparatus: Wheatstone Bridge, Kelvin Double Bridge or a comparably accurate electronic meter.

303.3 Test procedure:

a. Isolate the winding whose resistance is to be measured by disconnecting one end from all other circuits.
b. Winding resistance measurements shall be made by one of the following approved methods: Wheatstone bridge; Kelvin bridge.
c. Connect the measuring apparatus across the winding in accordance with the apparatus manufacturer's instructions.
d. Cold resistance measurements shall be made with the motor set at the surrounding ambient temperature; that is the measurements shall be taken after the motor has been inoperative for a sufficient time (approximately 12 hours) to bring the major motor mass temperatures, as measured by a thermocouple to within 5° F of the ambient temperature.

303.4 Results. The values determined by these measurements shall be compared with procurement document or design requirements, or shall be used in other computations.

METHOD 304

LOCKED-ROTOR TEST

CAUTION: It should be recognized that the testing of induction motors under locked-rotor conditions with polyphase and single phase power involves high mechanical stresses and high rates of heating. Therefore it is necessary that:

(1) The mechanical means of locking the rotor be of adequate strength and guarded to prevent possible injury to personnel or damage to equipment.
(2) The direction of rotation be established prior to this test.

304.1 General. Locked-rotor test is conducted to determine the adequacy of the thermal protector to prevent the motor windings from attaining a temperature more than appropriate for the class insulation provided.

304.2 Apparatus:

a. Test fixture designed for mounting motors and holding shaft when motor is energized.
b. Amp meter.
c. Volt meter.
d. Watt meter.
e. Wheatstone Bridge, Kelvin Double Bridge or a comparable accurate electronic meter.
f. Stopwatch.
g. Thermocouple and potentiometer.

304.3 Test Procedure:

a. Test shall be conducted at room ambient and rated voltage and frequency. Lock the motor shaft to prevent rotation. Measure the insulation resistance (see Method 301) and the motor winding resistance (see Method 303). Connect the thermal cut-out device so that over temperatures will cause the input voltage to be removed from the motor. Energize the motor and allow the automatic thermal protector to cycle the motor "off" and "on". Measure and record the locked rotor current and winding temperature at the start of the test and at end of each hour for a total of five hours. Measure temperature of windings after the first and last cycle. Temperature shall be measured in accordance with applied thermocouple method of IEEE STD 114.
b. At the completion of the test de-energize the motor and measure the insulation resistance and winding resistance of the motor. Remove the shaft locking device, operate the motor for one hour at no load conditions and record the input voltage, current, power, power factor and frequency.

304.4 Results. Motor temperature as measured by the thermocouple shall not exceed 155° C (for class H insulation). The 155° C temperature takes into account a 10° C allowance for a service factor and a 15° C allowance for hot spots. Motor shall operate continuously, unloaded, for a period of one hour.

METHOD 401

PERFORMANCE TEST

401.1 General. Performance test is intended to determine compliance of the motor to the torque and speed requirements of the applicable motor drawing and determine the efficiency of the motor.

401.2 Test equipment. Test equipment for single phase motor shall be as required by IEEE Test Procedure for Single-Phase Induction Motors STD 114 and test equipment for polyphase motor shall be in accordance with IEEE Test Procedure for Polyphase Induction Motors and Generator IEEE STD 112, or comparably accurate test devices.

401.3 Procedure. Test shall be conducted in accordance with procedures specified in IEEE Test Procedure for Single-Phase Induction Motor STD 114 and IEEE Test Procedure for Polyphase Induction Motors and Generators IEEE STD 112 as applicable to the type motor. The test shall be conducted at 80° ±10° F ambient temperature.

401.4 Results. Compare data with requirements of the applicable procurement document.

METHOD 402

VOLTAGE AND FREQUENCY VARIATION

402.1 General. Voltage and frequency variation testing is intended to determine the effect upon performance of extreme power supply conditions.

402.2 Apparatus. Equipment required by procedure 401.

402.3 Test procedure. The test methods of procedure 401 shall be repeated. The motor shall be operated at rated electrical characteristics at 75° ±15° F before and after conducting the voltage and frequency variation test. Record input voltage, amperage, watts, frequency, motor winding and ambient temperatures. No degradation in performance or operation should be observed in the before and after operation. The voltage and frequency variation test shall be conducted at +5 percent of the specified voltage and -5 percent of the minimum specified frequency as shown in table I. The motor shall start and operate for one half hour as follows:

a. At -50° +0°/-5° F after soaking for four hours at -50° +0°/-5° F ambient temperature.

b. At +160° +5°/-0° F after soaking for four hours at +160° +5°/-0° F ambient temperature.

Table I. Test variations.

Specified Condition		Test Condition	
Volts	Hz	Volts	Hz
115	50/60	120.8	47.5
230	50/60	241.5	47.5
208	50/60	218.4	47.5
208	400	218.4	380

402.4 Results. Motor shall operate continuously for 30 minutes at the above specified power conditions and at the specified ambient temperatures.

METHOD 403

ENDURANCE TEST

403.1 General. Endurance testing is intended to determine the life expectancy of the motor.

403.2 Apparatus:

a. Loading device capable of applying rated load.
b. Electrical instrumentation capable of measuring input volts, amps, watts and frequency.
c. Thermocouples and potentiometer.
d. Speed measuring device.

403.3 Test procedure: The motor shall be tested using a fan wheel/scroll assembly or by being installed in an air conditioner to duplicate end item application. The motor shall be operated at rated load specified on the drawings for four thousand hours at 100° +10°/-0° F ambient temperature. The motor shall be cycled "on" for twenty-five minutes and "off" for five minutes each one half hour during the 4000 hour test. The 4000 hours shall include the "off" time during each cycle. Speed, input voltage, frequency, current and power readings should be taken at intervals that will give at least one reading every twenty-four hours during the test to determine any changes in performance that may occur. Upon completion of the duration of the test the motor shall be tested for performance at rated torque.

403.4 Results: The performance test at rated torque after endurance test shall be within 10 percent of the values obtained before life test.

METHOD 404

OPERATING TEMPERATURE TEST

404.1 General. Operating temperature testing is intended to determine if extreme temperature storage and operating conditions will have a detrimental effect on motor operation.

404.2 Apparatus. Equipment required by procedure 401.

404.3 Test procedure. The test methods of procedure 401 shall be repeated. The motor shall be operated at an ambient temperature of 75° ±15° F. Record input voltage, current, power, and frequency, for use as base line data. Upon completion of the base line data run, the motor will be tested as follows:

a. Soak motor for four hours at -50° +0°/-5° F ambient temperature. Start and operate the motor at rated electrical characteristics and load at -50° +0°/-5° F for one half hour.
b. Soak motor for four hours at +160° +5°/-0° F ambient temperature. Start and operate the motor at rated electrical characteristics and load at +160°+5°/-0° F for one half hour.
c. Soak motor at -65° ±5° F ambient temperature twelve hours. Slowly return ambient temperature to 80° ±10° F. Start and operate motor at rated electrical characteristics for one half hour.
d. Perform a no load acceleration run at -50° F, after a four hour soak at -50° +0°/-5° F ambient temperature.

Operate the motor at an ambient temperature of 75° ±15° F. Record input voltage, current, power, and frequency. No degradation in operation or performance should be observed between this run and the base line data run.

404.4 Results. Motor shall operate continuously for 30 minutes for methods 404.3 a, b, and c at rated power and at the specified ambient temperatures. Motor shall accelerate to rated speed within twenty seconds of power application for d.

METHOD 501

SALT FOG TEST

501. General. To assure that the motor is capable of being exposed to salt fog without deterioration in performance.

501.2 Apparatus. Instrumentation and equipment shall be as specified in test method 509.2, procedure I of MIL-STD-810.

501.3 Test procedure. Subject the motor to test method 509.2, procedure I of MIL-STD-810. Do not operate the motor during exposure. Cover electrical terminals on cord or junction box to protect from deposit build-up. Prior to this test and 24 hours after the exposure, conduct insulation resistance test in accordance with method 301 procedure and operate the motor at rated electrical characteristics. Record voltage, amperes, watts and frequency. Following the salt fog test the motor shall be immediately placed in a chamber for 24 hours with the relative humidity controlled between 40 and 50 percent and the ambient temperature controlled at 100° F -01° F +10° F. Insulation resistance shall be measured after the 24 hour drying period.

501.4 Results. Motor shall meet the applicable value of insulation resistance required in accordance with method 301 and shall start and operate for 30 minutes with no degradation in performance.

METHOD 502

HUMIDITY TEST

502.1 General. The humidity test is conducted to determine the resistance of equipment to the effects of exposure to warm, highly humid atmosphere such as encountered in tropical areas.

502.2 Apparatus. Instrumentation and equipment shall be as specified in test method 507.2, procedure III of MIL-STD-810.

502.3 Test procedure. Subject the motor to test method 507.2, procedure III of MIL-STD-810, except that the maximum temperature shall be 155° F. Do not operate the motor during exposure. Cover electrical terminals on cord or junction box to protect from deposit build-up. Prior to this test and 24 hours after exposure conduct insulation resistance test per method 301 and operate motor at rated electrical characteristics. Record voltage, amperes, watts, and frequency. Following the humidity test the motor shall be placed in a chamber for 24 hours with the relative humidity controlled at 50 percent or less and the ambient temperature controlled to 100° F -0° F +10° F. Insulation resistance shall be measured after the 24 hour drying period.

502.4 Results. Motor shall meet the applicable value of insulation resistance required in accordance with method 301 and shall start and operate for 30 minutes with no degradation in performance.

METHOD 503

SELF-INDUCED VIBRATION

503.1 General. Self-induced vibration (dynamic balance) testing is intended to evaluate the amount of mechanical unbalance present in the motor.

503.2 Apparatus:

a. Light-beam type vibrometer capable of measuring amplitudes to 0.005 inch or other instrument which measures total excursion.
b. Elastic mounting support with a natural frequency at least as low as one-quarter of the operating speed of the motor.
c. Voltmeter arranged so as to measure phase voltage.
d. Frequency meter arranged so as to measure phase frequency.

503.3 Test procedure. The motor should be operated at no load, at rated frequency and rated voltage and the amplitude of vibration of the motor measured with the vibrometer.

503.4 Results. Dynamic balance of motor shall be in accordance with NEMA MG1. The NEMA criteria is actually for integral horsepower motors only. Using the same criteria for fractional horsepower motors is considered adequate.

METHOD 504

VIBRATION

504.1 General. The vibration test is performed to determine if motor is constructed to withstand expected dynamic vibrational stresses and to insure that performance degradation or malfunctions will not be produced by the service vibration environment.

504.2 Apparatus: Vibration equipment with required instrumentation.

504.3 Test procedure. The motor shall be operated at rated electrical characteristics at 75° ±15° F prior to vibration for baseline data. Record input voltage, amperage, watts and frequency. The motor shall be installed in a fixture to duplicate normal orientation in an end item and vibration test shall be accomplished as specfied below: See attachment A.

The test time shall be 60 minutes total per plane. The motor shall not be operated during the vibration test. Motor shall be operated for 30 minutes following each plane of vibration. After completion of each vibration plane and after each operation run, the motor shall be disassembled and inspected for damage.

504.4 Results. No evidence of damage should be observed during the visual inspection. No degradation in performance or operation should be observed during each 30 minute run.

Attachment A

Motor shall not be damaged when vibrated in the applicable end item air conditioner. Air conditioner shall be subjected to sinusoidal vibration applied along each of the three mutually perpendicular axes. The vibration acceleration levels and double amplitudes shall be maintained as specified in figure 1. Vibration shall be logarithmically cycled from 5 Hz to 200 Hz and returned to 5 Hz over a 12 minute sweep period. The ascending and descending sweep time shall be equal (6 minutes each). The test time shall be 60 minutes total per plane. The air conditioner base shall remain in a horizontal plane during all vibration testing.

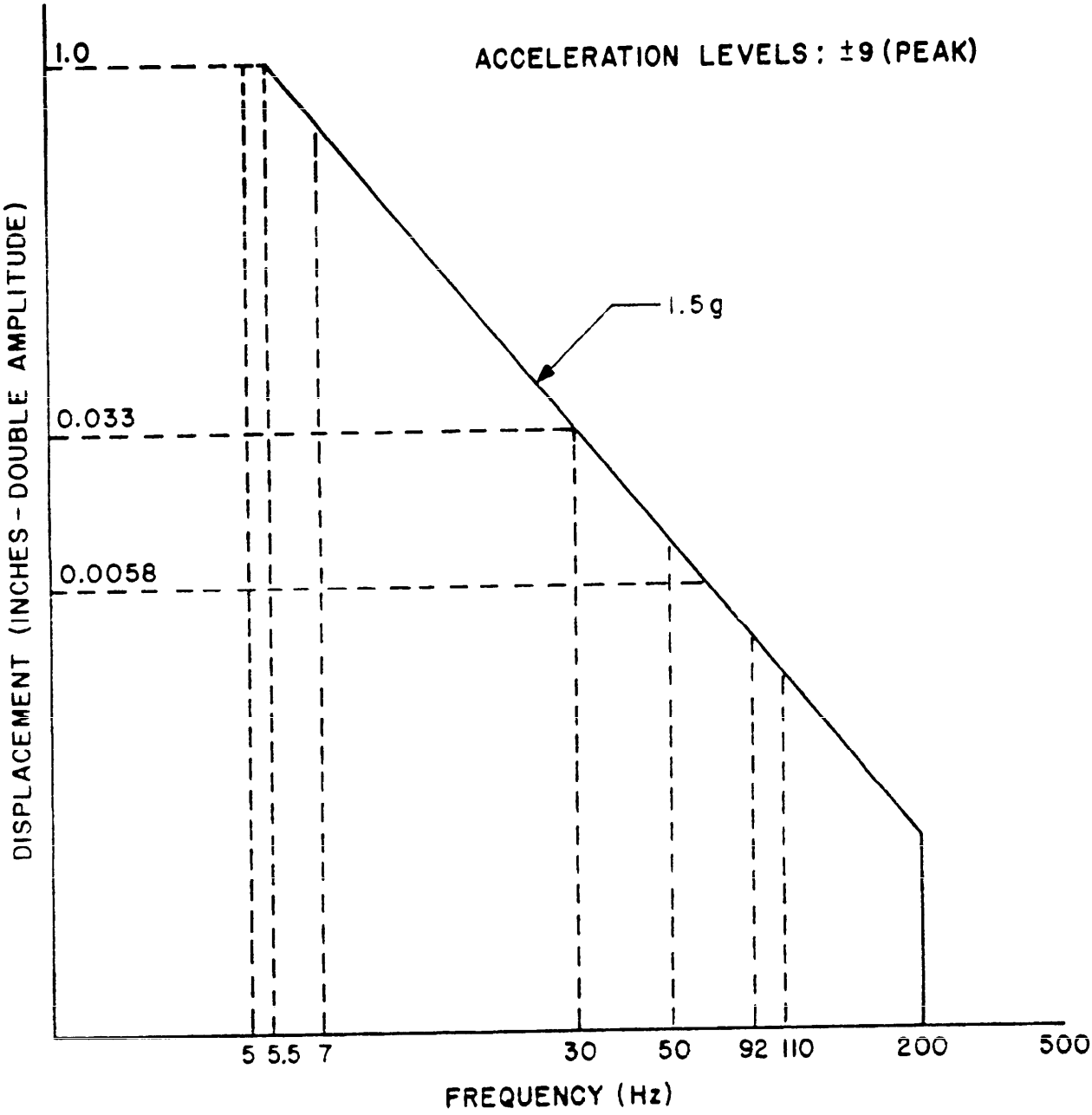

FIGURE 1. Vibration test curve.

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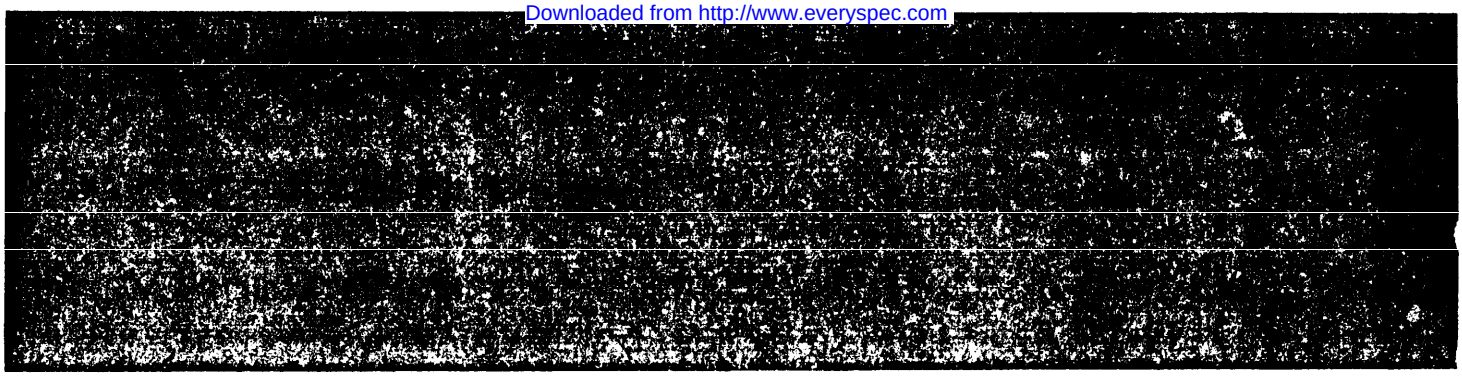


METHOD 601

BEARING INSPECTION

601.1 General. Inspection is intended to determine the adequacy of design and manufacturing methods to ensure that the motor L_1 rating life (99 percent reliability) is in excess of 20000 hours as defined by ANSI/AFBMA Standard 9.

601.2 Apparatus.

a. Internal tri-point micrometer (INTRIMIK), dial bore gage or comptorgage capable of measuring to ±0.0001 inch.
b. Dial indicator capable of indicating to ±0.0001 inch.
c. Micrometer capable of measuring to ±0.0001 inch.
d. Surface plate.
e. Vertical spindle machine with no more than 0.0005 run out.
f. Inspection "V" blocks.

601.3 Measurement procedure.

a. Metrology.

(1) Measurements shall be made in a referenced temperature of 73 ±5° F. Adjustments to the absolute dimensions (excluding tolerances) may be made by use of temperature coefficients of expansion.
(2) The motor shall be carefully disassembled; remove end bells, pull ou rotor, remove shims, bearing spacers, and bearings. The parts shall be laid out on a clean surface in the inspection room. Parts can be wiped clean with a soft lint-free cloth where required. Parts shall be conditioned at room temperature for a period of not less than one hour before measurements are made.

b. End bell insert measurements. The bearing insert internal diameter of the end bell shall be determined at two axial locations along the bore and at two perpendicular radial locations at each axial station. Measurement shall be made with an INTRIMIK. The measurements shall be recorded on inspection report A or B as applicable. The measurement shall be accurate within ±0.0001 inch.
c. Motor frame measurements. Measure the frame to end bell interlace. Measure the frame using an inside micrometer. Measure the end bell using an outside micrometer. Measurements shall be made at two perpend icular radial locations. The measurements shall be recorded on inspection report A or B and C as applicable. These measurements shall be accurate within ±0.0005 inch.
d. Bearing misalignment measurement. Fabricate adapters for each end bell bearing insert in accordance with figure 1a. Press adapters into the bearing inserts and assemble end bells on the frame. Place the right

adapter end with frame in a machine with a vertical spindle (see figure 1b). Rotate spindle by hand and measure runout indicated in inspection report D. Remove from machine and place the left adapter end in the machine; turn frame by rotating spindle by hand and measure runout as indicated in inspection report D.

e. Shaft measurement. Remove the bearings from the armature shaft according to the procedures in AFBMA-100.

(1) At the bearing seat, using the micrometer, measure the shaft diameter at two axial locations (see inspection report E) taking two perpendicular readings at each station.

(2) Squareness of the shaft bearing shoulder shall be measured using a dial indicator on the face of the bearing shoulder (see inspection report E).

601.4 Results. The recommended bearing mounting tolerances differ amoung the various bearing manufacturers. Bearing housing and seat tolerances in this standard are based on conversations with bearing manufacturers. The inspection criteria shown below represents a less stringent tolerance than ordinarily recommended by the manufacturers. This loosened tolerance is based on the relatively light service of the military air conditioner blower motors, i.e., light loads, low speeds, ambient operating temperatures and quality of greases used.

a. End bell insert measurements. The end bell insert ID to applicable bearing OD fit shall be .0001 inch tight to .0015 inch loose.

b. Bearing misalignment measurement. The angular bearing misalignment shall not exceed nine minutes of arc. The misalignment shall be calculated by the following formula: (see inspection report D).

$$\text{Arc tan } \frac{(.5)\ (A)}{X}\ 60 = \text{minutes}$$

c. Shaft measurements.

(1) Bearing seat tolerances are shown in table 1. This table represents bearing sizes most commonly used on military air conditioner blower motors.

(2) Shaft shoulders shall be square with the shaft seat.

(3) Shaft runout shall not exceed .002 inch for shaft lengths at six inches and below. Runout shall not exceed .0035 inch for shafts longer than six inches.

d. Motor frame to end bell measurement. This measurement is performed to ensure proper alignment of the bearings will be maintained. The

bearing misalignment measurement actually takes into account two modes of misalignment. These modes are angular and concentric (see figure 2). The motor frame to end bell measurement is basically a back-up check for the misalignment measurement. The major concern on the frame to end bell fit is concentricity. Too loose a fit would allow excessive eccentricity between the bearing housing and the motor frame causing excessive misalignment. This measurement is necessary in addition to the misalignment measurement since loose end bells may be screwed down within the proper concentric tolerance for the misalignment measurement. However, after subsequent removal and retightening of the end bells eccentricity could become excessive.

The following example calculations take into account only concentricity. The tolerance for the measurement depends on the number of end bells on the motor and the distance between adapter measuring points for runout (see inspection report D).

EXAMPLE CALCULATION FOR
ALLOWABLE TOLERANCE BETWEEN
FRAME AND END BELL

Distance between adapter measuring points (approximate)	3.5 inch
No. of end bells	2
Maximum allowable misalignment	9 minutes

Step 1. Find maximum allowable runout.

$$\text{Arc tan } \frac{.5(A)60}{3.5} = 9.0$$

Allowable runout A = .018 inch (Peak to Peak).

Step 2. Find maximum allowable displacement per bearing.
Displacement = 1/2 (runout) = 1/2 (.018) = .009 inch.
Displacement per bearing = 1/2 (.009) = .0045 inch.

Step 3. Maximum concentricity tolerance-use .002 inch runout, .001 inch displacement. This tolerance is based on motor manufacturer's drawings who commonly supply the Government air conditioner blower motors.

Step 4. Find maximum allowable clearance between frame and end bell.

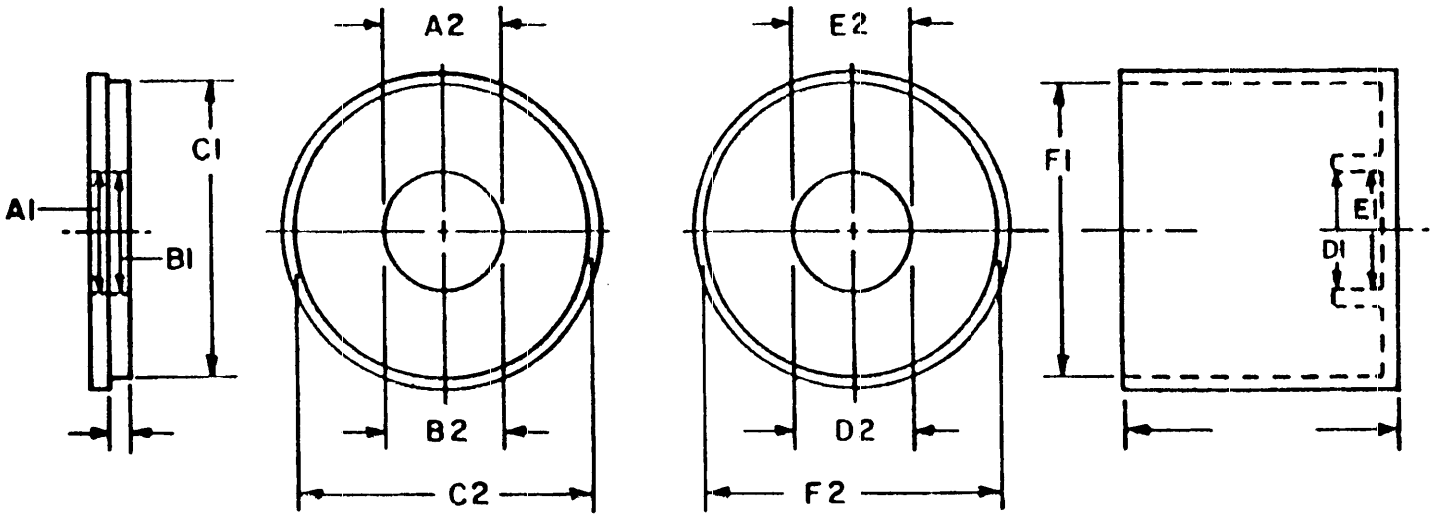
.0045 max. displacement per bearing.
-.001 concentricity tolerance
.003 max. allowable clearance.

Use a maximum allowable interference fit of .002 inch. Greater interference may cause end bell bowing, resulting in misalignment at the bearing. A .002 inch interference fit is not considered excessive.

Allowable fit -.002/+.003

Inspection report A.

End bell and bearing insert measurements.



END BELL DIAMETERS

	A	B	C
1			
2			

HOUSING DIAMETERS

	D	E	F
1			
2			

A/C ELECTRIC MOTOR NO.:

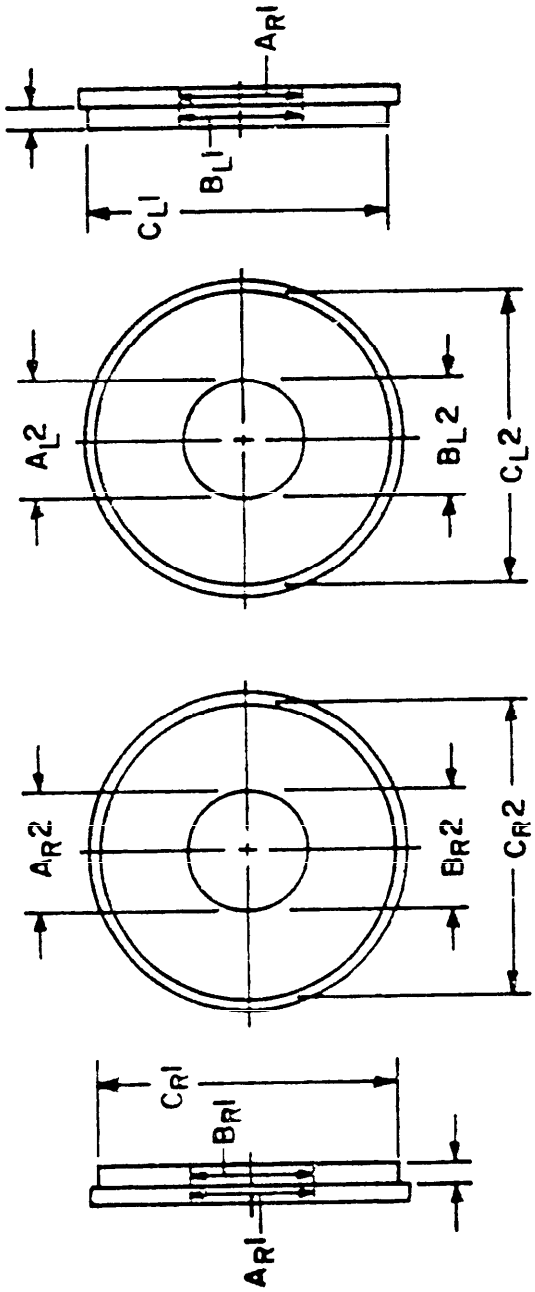
MANUFACTURER:

DATE:

X-4293

Inspection report B.

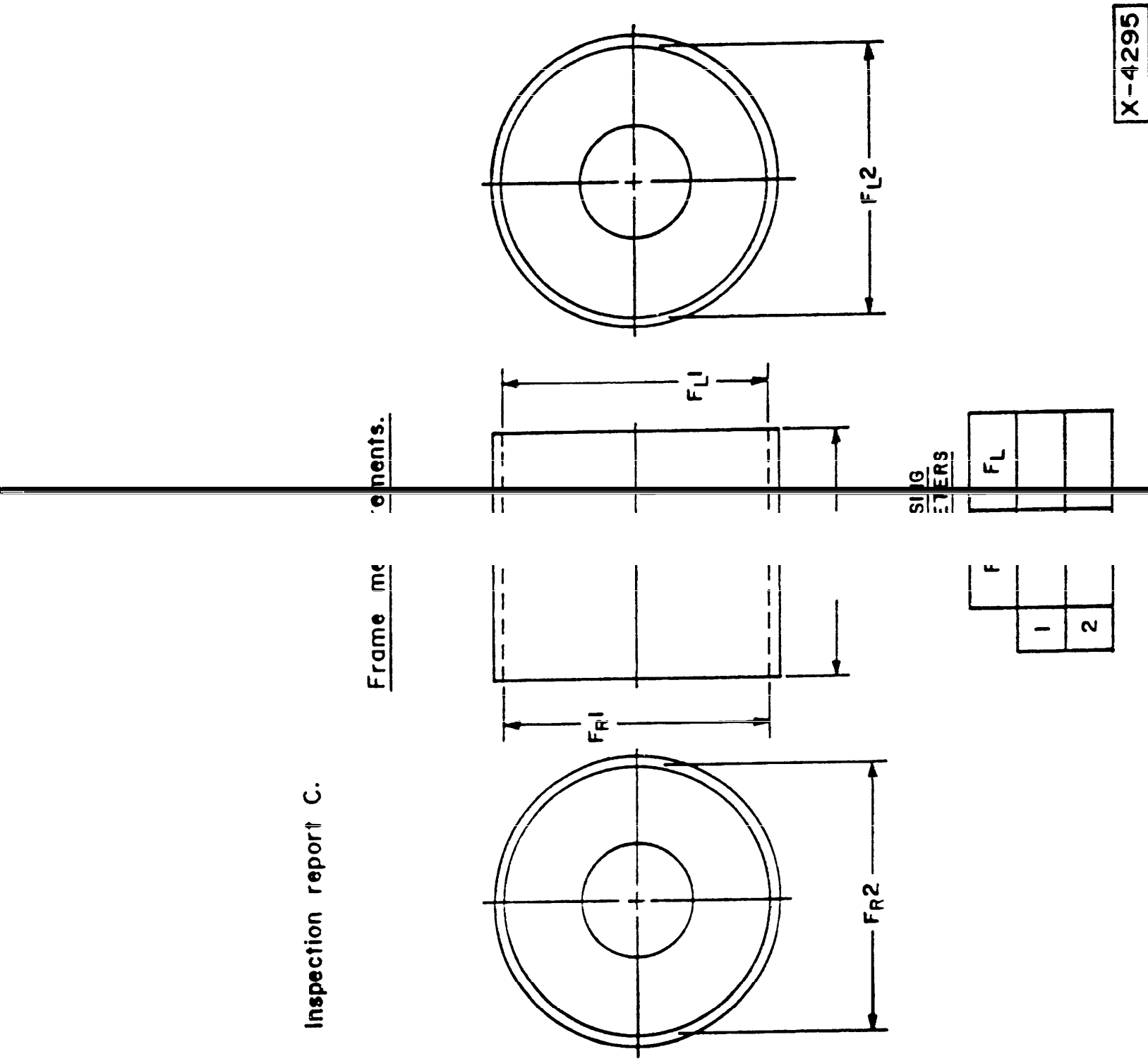
End bell and bearing insert measurements.



END BELL DIAMETERS

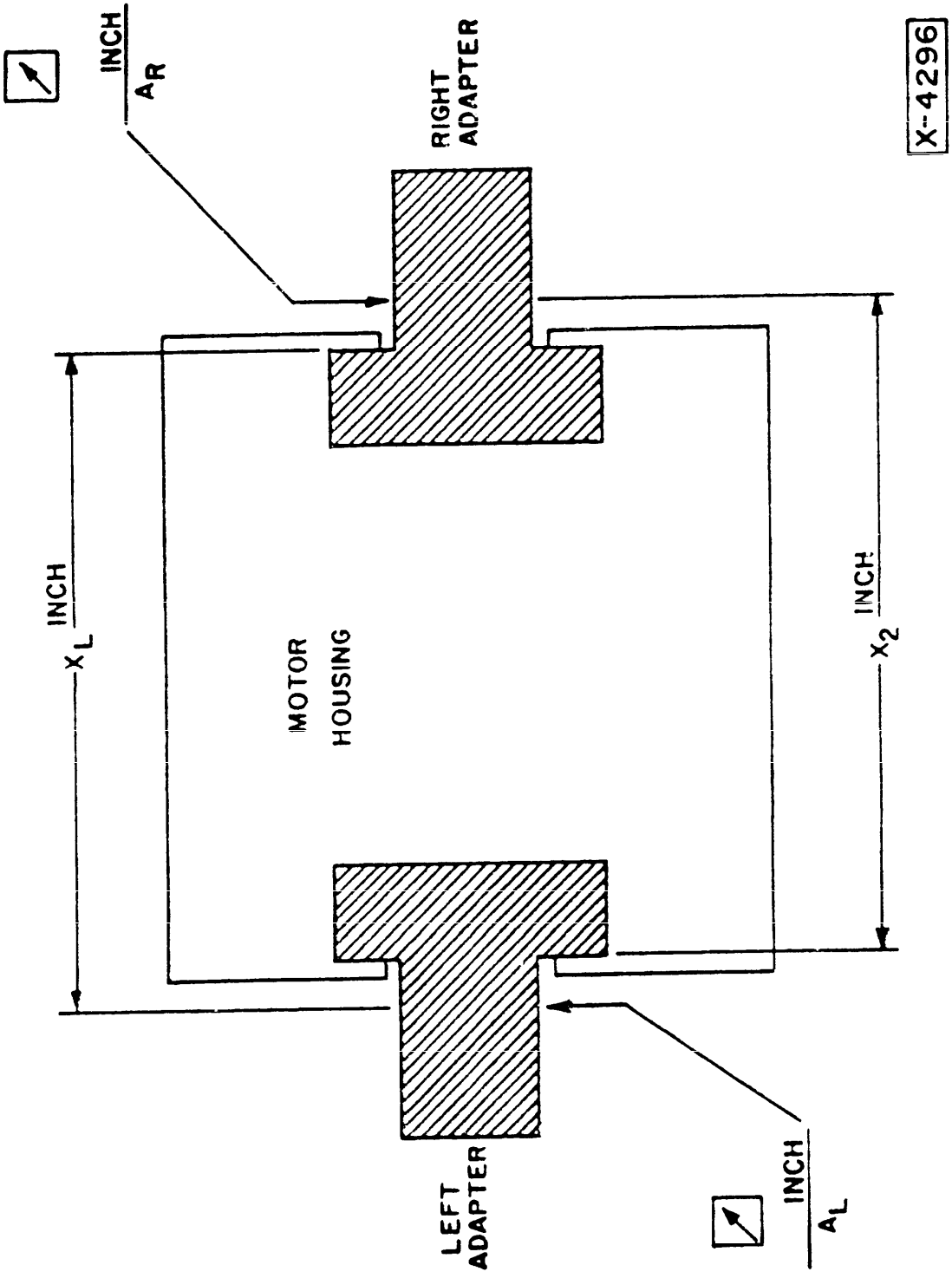
	A_R	B_R	C_R	A_L	B_L	C_L
1						
2						

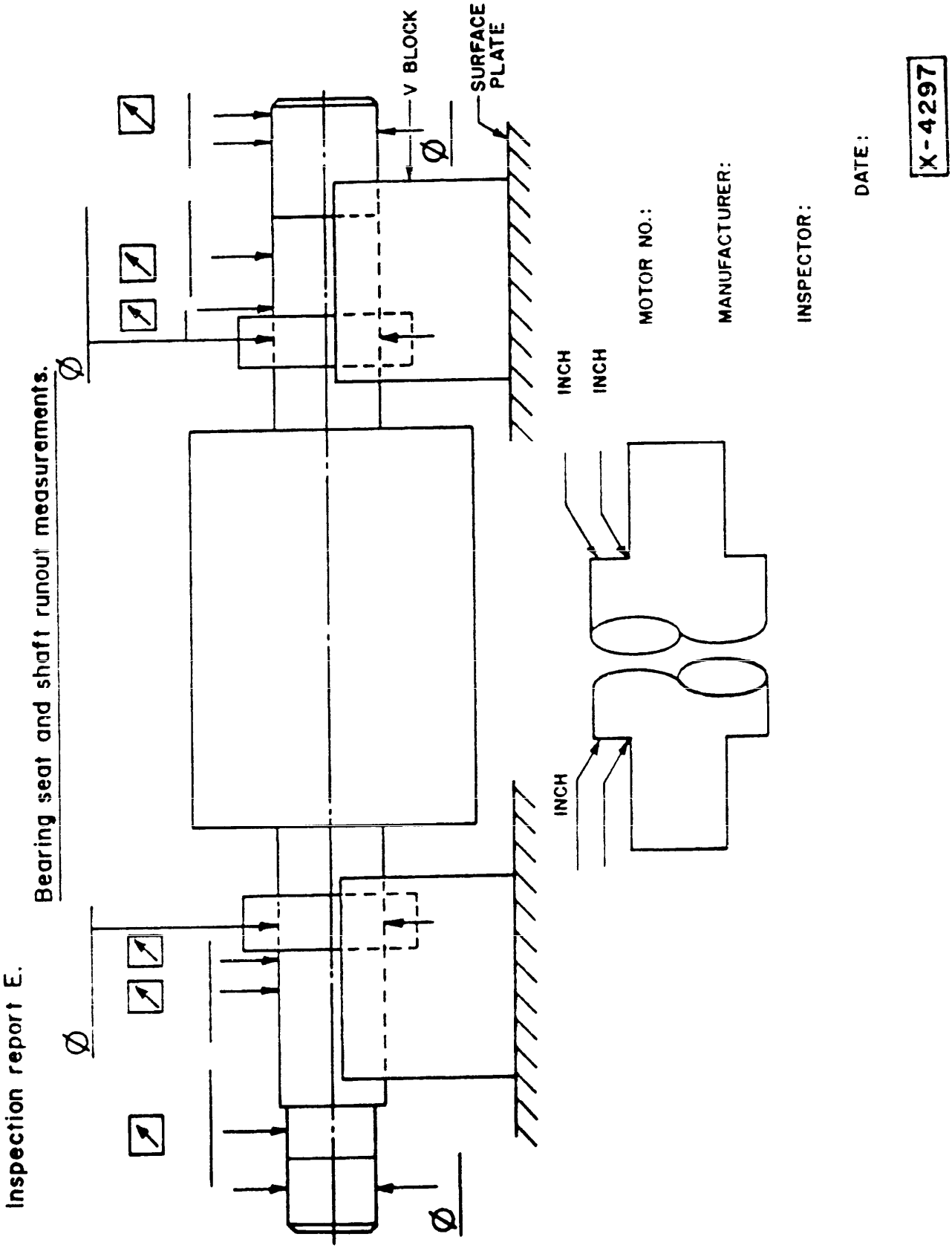
X-4294



Inspection report D.

Bearing alignment measurement.





DIMENSION

A. 1"-2"

B. BEARING INSERT DEPTH

C. SHAFT DIAMETER 1" MAX

D. INSERT DIAMETER - .0001

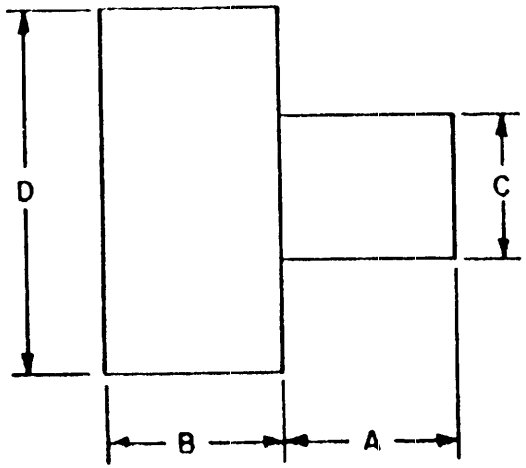


FIGURE 1a. Adaptor configuration.

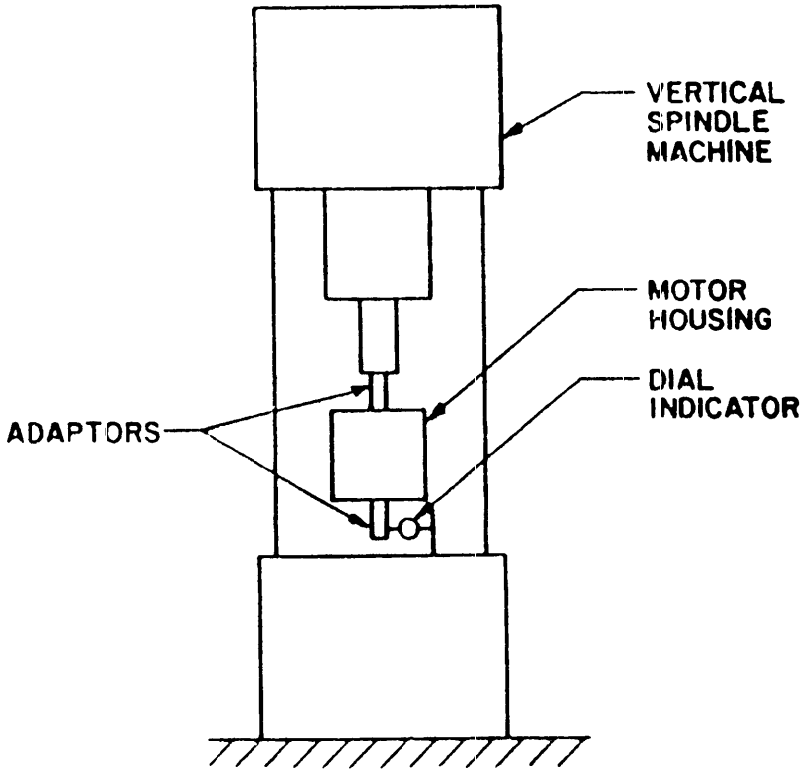


FIGURE 1b. Set-up for bearing alignment measurement.

X-4298

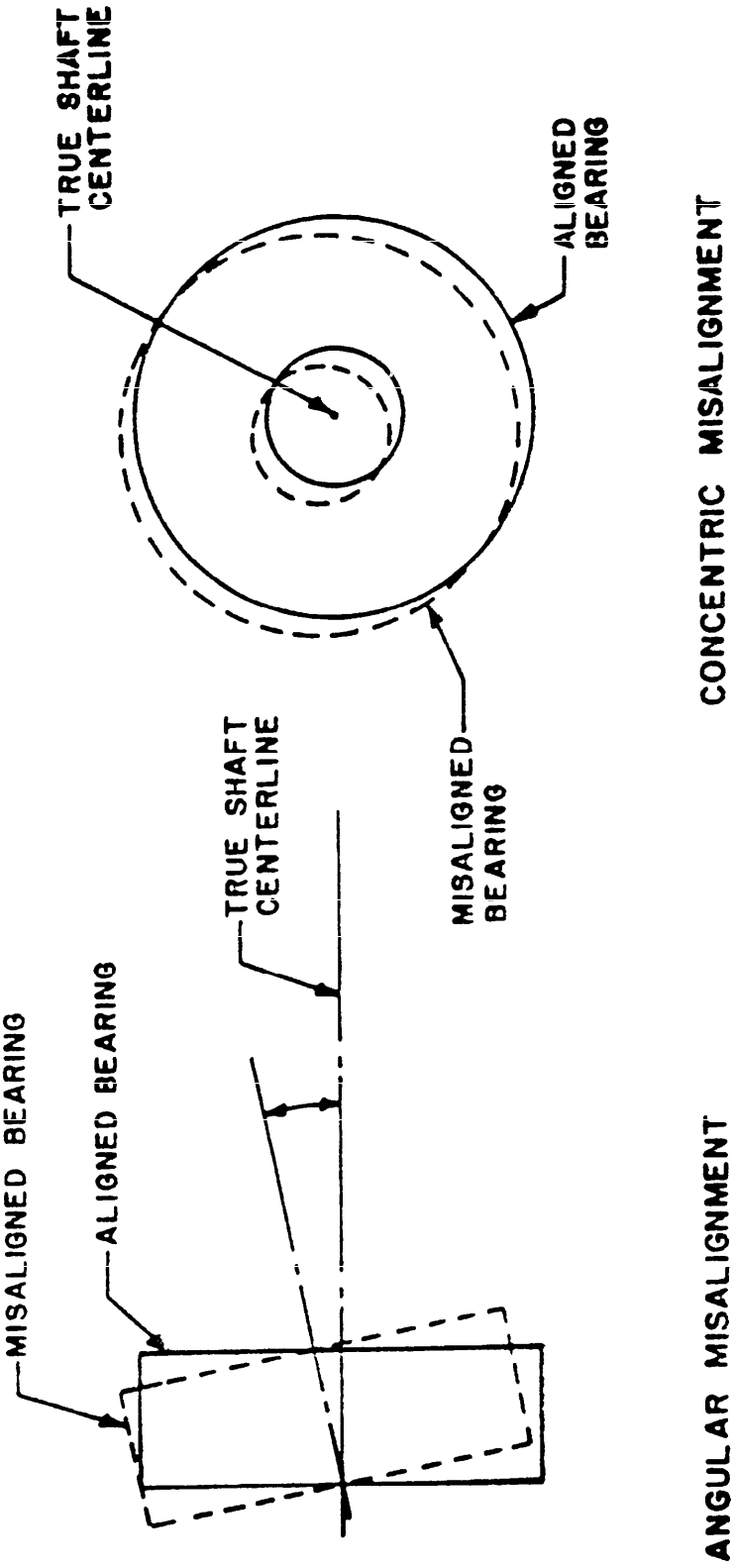


FIGURE 2. Modes of misalignment.

TABLE 1. Allowable shaft diameter tolerances for commonly used bearings (in inches).

Basic bearing No.	103-203-303		104-204-304		105-205-305		106-206-306		107-207-307	
	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
	.6695	.6692	.7879	.7873	.9848	.9842	1.1816	1.1810	1.3785	1.3779

METHOD 602

CYCLE TEST

602.1 General. The cycle test is performed to insure that proper pre provided for the bearings. Preload will reduce the duration of skidding the bearing balls and races. Once started, no deterioration is to be ex during operation unless some damage has occurred to the balls or races d starting. Preload is established on both bearings by means of a preload (wave ring) mounted inside one end bell adjacent to one bearing.

602.2 Apparatus.

a. Counter/timer switch capable of cycling motor and recording the of cycles.
b. Electrical instrumentation capable of measuring input volts and frequency.
c. Thermocouple and potentiometer.
d. Stopwatch.

602.3 Test procedure. Motor shall be allowed to soak at 100° F -0° F for 30 minutes prior to test. Ambient of 100° F -0° F +10° F shall be h throughout entire test. Motor shall be unloaded and energized for three seconds. Motor will then be allowed to coast to a stop. Motor need not brought up to full operating speed. Test shall be repeated at intervals frequency is limited by coast down time and the thermal protector. This operation shall be repeated for a total of 1000 on/off cycles. Bearing temperatures will be monitored by a thermocouple mounted on each bearing A small hole must be drilled through each end bell to accomodate the thermocouples. Data shall be recorded every 30 minutes.

602.4 Results. No distinct increase of bearing temperature shall occu stabilization ±20° F. Coast down time of the motor should be consistent distinct decrease during the test. Test technician should also be aware increase in noise level during the test. Should any of the above occur (temperature rise, decreased coast down time, increased noise level) the b shall be disassembled and visually inspected for damage.

4. ALPHABETICAL INDEX

or specified when such packaging is known to satisfy the

5. NUMERICAL INDEX

Method No.	Method
301	Insulation resistance test.
302	High potential test.
303	Winding resistance test.
304	Lock-rotor test.
401	Performance test.
402	Voltage and frequency variation.
403	Endurance test.
404	Operating Temperature.
501	Salt fog test.
502	Humidity test.
503	Self-induced vibration.
504	Vibration.
601	Bearing inspection.
602	Cycle test.

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