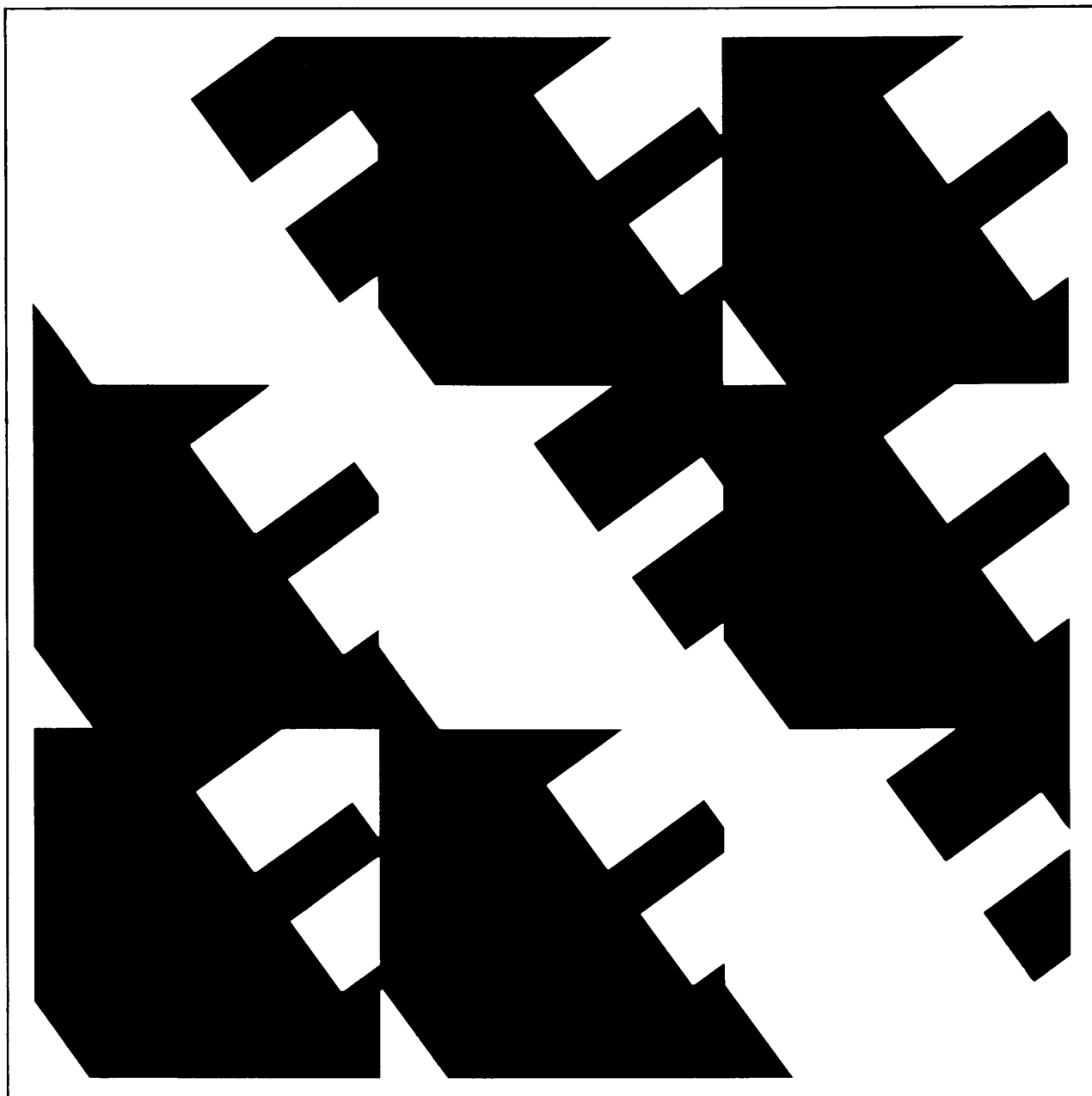


IEEE Test Procedure for Single-Degree-of-Freedom Spring-Restrained Rate Gyros



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This Test Procedure and the Specification Format for Single-Degree-of-Freedom Spring-Restrained Rate Gyros (IEEE Standards Publication No. 292) represent a group effort on a large scale. They were generated as projects of the Gyro and Accelerometer Panel from May of 1962 to November of 1967. The Gyro and Accelerometer Panel (GAP) affiliated with the IEEE in May of 1965 and is now a part of the IEEE Aerospace and Electronic Systems Group. A total of 238 individuals attended 30 GAP meetings while these documents were in preparation. Fifty-one individuals attended six meetings or more and provided 61 percent of the total attendance of 916. These people are listed here.

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G. A. Glaubitz	R. H. Marcus	W. M. Weil
J. M. Golden	F. B. Mikoleit	A. E. Willis

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IEEE Test Procedure for SINGLE-DEGREE-OF-FREEDOM SPRING-RESTRAINED RATE GYROS

1. INTRODUCTION

This Test Procedure is a compilation of recommended rate gyro test procedures derived from those currently in use, including test conditions to be considered. In some cases alternate methods for measuring a performance characteristic have been included. In selecting among the alternates, attention should be paid to the intended application of the gyro, available test facilities, and the standard methods in use by the test facility. This document is intended to be a guide in the preparation of Section 4 of a specification that follows the format of IEEE Standards Publication No. 292, Specification Format for Single-Degree-of-Freedom Spring-Restrained Rate Gyros. The intent is for the specification writer to extract the applicable test conditions and equipment from Section 3 of this document for inclusion in the paragraphs concerning test conditions and equipment corresponding to paragraph 4.5 of the Specification Format. Similarly, it is intended that the writer extract the applicable test procedures from Section 4 of this Procedure for inclusion in the paragraphs concerning test procedures, corresponding to the paragraphs listed under paragraph 4.6 of the Specification Format. This Test Procedure can also be used as a guide in the preparation of a rate gyro test specification, but would require reorganization into the proper Specification Format.

Blanks have been used in this document for two distinct purposes. One purpose is to provide for selection of specific values of test parameters and their tolerances. Other blanks are to be filled in with the number of the applicable paragraph from Requirements Section 3 of the specification being written.

Aerospace Industries Association EETC Report No. 5 (Revision A), "Standard Gyro Terminology"* has been utilized in the preparation of this Test Procedure. Although this Procedure is limited to electrically energized single-degree-of-freedom spring-restrained rate gyros, it can be used as a guide in the preparation of Test Procedures for other types of rate gyros.

2. FUNCTION AND APPLICATION OF THE RATE GYRO

The rate gyro considered in this document is a single-degree-of-freedom gyro with an elastic restraint about the output axis. An angular rate about the input axis produces a gyroscopic torque about the output axis that is opposed by a restoring torque exerted by the elastic

restraint element. Static equilibrium is reached when the gyroscopic torque about the output axis is exactly balanced by the elastic restraint. The resultant angular rotation of the gimbal relative to the case produces an output signal proportional to the angular rate about the input axis. Output axis damping is generally employed.

The rate gyro is normally used as a sensing element to provide electric angular-rate signals in control or indicating systems.

The dynamics of the gyro are expressed by an equation given in paragraph 6.3, IEEE Standards Publication No. 292, Specification Format for Single-Degree-of-Freedom Spring-Restrained Rate Gyros.

3. TEST CONDITIONS AND TEST EQUIPMENT

3.1 Standard Test Conditions

Unless otherwise stated the following conditions apply.

3.1.1 Ambient Environment

3.1.1.1 Atmospheric Conditions

Pressure _____ $\pm$ _____ inHg (N/m²).

Ambient temperature _____ $\pm$ _____ °C.

Relative humidity _____ percent to _____ percent.

3.1.1.2 Magnetic Field

Horizontal component _____ gauss (milliteslas) max.

Vertical component _____ gauss (milliteslas) max.

Method of measurement shall be as specified in _____.

3.1.1.3 Radiation. All tests are to be performed under radiation conditions as specified in _____.

(List type of radiation and applicable intensity limits.)

3.1.1.4 Vibration

Acceleration _____ g max.

Frequency range _____ hertz to _____ hertz.

(Above limits apply to each of the three axes of a coordinate system.)

3.1.2 Installation Requirements. The mounting fixture should be designed to simulate the application conditions.

3.1.2.1 Thermal Conditions. All tests shall be performed with the unit at thermal equilibrium as evidenced by _____. The unit operating temperature shall be _____ $\pm$ _____ °C. Determination of the temperature shall be as specified in _____.

3.1.2.2 Mechanical Conditions. The test unit shall be mounted in such a way that the alignment of its three reference axes with respect to the test fixture is maintained

* Available from National Standards Association, Inc., 1321 Fourteenth St. N.W., Washington, D. C. 20005.

within $\pm$ _____ degrees under all specified test conditions. The three reference axes of the test unit are those defined by the external case markings and/or mounting surfaces.

3.1.3 Electrical Requirements

3.1.3.1 Spin Motor

Frequency _____ $\pm$ _____ hertz.
Type of connection _____ (e.g., 3 phase, 3 wire delta).
Line-to-line voltage _____ $\pm$ _____ volts.
Phase angle _____ $\pm$ _____ degrees.
Wave characteristic shall be _____.
Source impedance _____ $\pm$ _____ ohms.

3.1.3.2 Pickoff

Frequency _____ $\pm$ _____ hertz.
Voltage (current) _____ $\pm$ _____ volts (mA).
Maximum voltage (current) waveform distortion _____.
Source impedance _____ $\pm$ _____ ohms (e.g., series choke).
Load impedance _____ $\pm$ _____ ohms (e.g., phase shift network).

3.1.3.3 Self-Test Torquer

Frequency _____ $\pm$ _____ hertz.
Pattern current _____ $\pm$ _____ mA.
Maximum pattern current waveform distortion _____.
Pattern source impedance _____ $\pm$ _____ ohms.
Control source impedance _____ $\pm$ _____ ohms.

3.1.3.4 Rotor Rotation Detector

Frequency _____ $\pm$ _____ hertz.
Voltage (current) _____ $\pm$ _____ volts (mA).
Source impedance _____ $\pm$ _____ ohms.
Load impedance _____ $\pm$ _____ ohms.

3.1.3.5 Warm-Up Heater

Frequency _____ $\pm$ _____ hertz.
Voltage _____ $\pm$ _____ volts.

3.1.3.6 Maintenance Heater

Frequency _____ $\pm$ _____ hertz.
Voltage _____ $\pm$ _____ volts.
Type of control _____.

3.1.3.7 Temperature Sensor

Frequency _____ $\pm$ _____ hertz.
Voltage _____ $\pm$ _____ volts.

3.1.3.8 Phasing and Interconnection. Interconnection and grounding shall be as specified on schematic diagram _____.

3.1.4 Starting Procedure

3.1.4.1 Warm-Up Time. Unless otherwise specified, a warm-up time of _____ seconds is allowed before starting the tests of Section 4.

3.1.4.2 Starting Sequence. The sequence of operations required to bring the gyro and the test equipment to operating conditions shall be _____.

3.2 Test Equipment

3.2.1 General Requirements. The selection of the test equipment shall be based on accuracy requirements compatible with the performance specifications. Similarly, the bandpass of the measuring devices used shall be chosen so as to provide information only within the frequency spectrum of interest for the tests.

3.2.2 Description of the Test Equipment. All special-purpose or commercial test equipment shall be listed by name, manufacturer, model, part number, or performance requirement.

4. TEST PROCEDURES

4.1 Examination of the Product

The gyro shall be inspected visually and dimensionally for proper identification, surface finish, and for defects in workmanship to determine that it conforms to paragraph _____.

4.2 Impedance Test

4.2.1 Purpose. The purpose of this test is to measure the alternating-current impedance of electrocapacitive and electroinductive circuits and the direct-current resistance of resistors and conductors.

4.2.2 Test Equipment. The following test equipment from paragraph 3.2 is required for this test:

Impedance bridge with frequency generator adjustable to the nominal operating signal frequency,
Direct-current resistance bridge or other suitable current measuring system.

4.2.3 Test Setup and Procedure. The gyro shall be allowed to reach thermal equilibrium at the temperature specified in paragraph _____ so that the final value will not be affected by changing temperature. Measure all gyro impedances specified in paragraph _____. The test current through the circuit shall be as small as practical considering the sensitivity of the measuring instruments. The test current shall be applied uninterrupted for _____ $\pm$ _____ seconds.

4.2.4 Test Results. The impedance quantities measured shall be recorded and shall conform to the requirements of paragraphs _____.

4.3 Dielectric Test

4.3.1 Purpose. The purpose of this test is to ascertain that a circuit element or component part of the gyro can operate safely at its rated voltage and withstand momentary overpotentials due to switching, surges, etc., by measuring the leakage current between isolated circuits and between the gyro case and the circuits isolated from the gyro case.

4.3.2 Test Equipment. The following test equipment from paragraph 3.2 is required for this test:

High-voltage source, either alternating current or direct current, equipped with a voltage-measuring or current-measuring device.

4.3.3 Test Setup and Procedure. Apply _____ $\pm$ _____ volts root mean square at _____ hertz or direct current between the insulated portion and the case ground. The test voltage shall be raised from zero to the specified value as uniformly as possible, at a rate of approximately 500 volts root mean square or direct current per second. The test voltage shall be maintained for a period of _____ seconds. At this time, the voltage shall be gradually reduced to avoid surges. During each test the fault indicator shall be monitored for the leakage current.

4.3.4 Test Results. The results shall conform to the requirement of paragraph _____.

4.4 Insulation Resistance Test

4.4.1 Purpose. The purpose of this test is to measure the insulation resistance between the isolated electric circuits and between the gyro case and the circuits isolated from the gyro case.

4.4.2 Test Equipment. The following test equipment from paragraph 3.2 is required for this test:

Megohmmeter.

4.4.3 Test Setup and Procedure. Apply _____ $\pm$ _____ volts direct current for a period of _____ $\pm$ _____ minutes between the indicated circuits and between the circuits and the gyro case. Record the final resistance reading.

4.4.4 Test Results. The results shall conform to the requirement of paragraph _____.

4.5 Leak Test

4.5.1 Purpose. The purpose of this test is to determine whether external leakage is occurring.

4.5.2 Test Equipment. The following test equipment from paragraph 3.2 is required for this test:

4.5.2.1 Fluid-Filled Gyro

Binocular microscope,
Vacuum enclosure.

4.5.2.2 Gas-Filled Gyro

Helium leak detector or immersion fluid (specify),
Vacuum enclosure.

4.5.3 Test Setup and Procedure

4.5.3.1 Fluid-Filled Gyro. The gyro shall be cleaned of all dirt and grease and placed in a vacuum enclosure at _____ $\pm$ _____ torr (N/m²) and at a gyro temperature of _____ $\pm$ _____ °C for a minimum period of _____ hours. The gyro shall then be removed and visually examined at a magnification of _____.

4.5.3.2 Gas-Filled Gyro

- (a) The gyro shall be cleaned of all dirt and grease and placed in a vacuum enclosure at _____ $\pm$ _____ torr (N/m²) and stabilized at _____ $\pm$ _____ °C gyro temperature. External gas leakage shall then be measured using a helium gas detector. or
- (b) The gyro shall be cleaned of all dirt and grease and submerged in fluid and placed in a vacuum enclosure at _____ $\pm$ _____ torr (N/m²) and _____ $\pm$ _____ °C temperature for a period of _____ minutes. The presence or absence of a continuous flow of bubbles shall be noted.

4.5.4 Test Results

4.5.4.1 Fluid-Filled Gyro. There shall be no evidence of external fluid leakage.

4.5.4.2 Gas-Filled Gyro

- (a) The measured gas leakage rate shall not exceed _____ cm³/s. or
- (b) There shall be no evidence of a steady stream of bubbles after _____ minutes.

4.6 Polarity Test

4.6.1 Purpose. The purpose of this test is to determine the gyro polarity from the input-output relationship with reference to the coordinate polarities, the gyro motor polarity, the pickoff polarity, and the torquer polarity.

4.6.2 Test Equipment. The following test equipment from paragraph 3.2 is required for this test:

Single-axis rate table,

Means of measuring the polarity and magnitude of the gyro output.

4.6.3 Test Setup and Procedure

4.6.3.1 Motor. Mount the gyro with the spin reference axis (SRA) parallel to the table axis and nominally vertical. Connect the gyro to the output measuring equipment. Operate the gyro in accordance with the standard test conditions of paragraph 3.1. Rotate the table at _____ °/s with the input vector in the same direction as the positive spin reference axis. Record the gyro output.

4.6.3.2 Pickoff. Mount the gyro with the input reference axis (IRA) parallel to the table axis and nominally vertical. Connect the gyro to the output measuring equipment. Operate the gyro in accordance with the standard test conditions of paragraph 3.1. Rotate the table at _____ °/s to apply a positive input to the gyro. Record the polarity of the gyro output with respect to the pickoff excitation.

4.6.3.3 Torquer. Connect the gyro to the output measuring equipment. Operate the gyro in accordance with the standard test conditions of paragraph 3.1. Apply a positive input of _____ mA to the torquer. Record