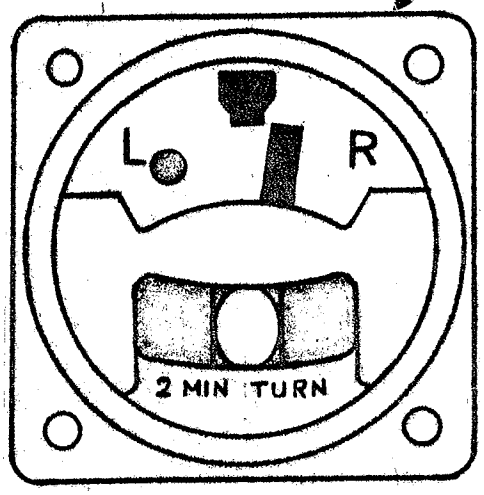
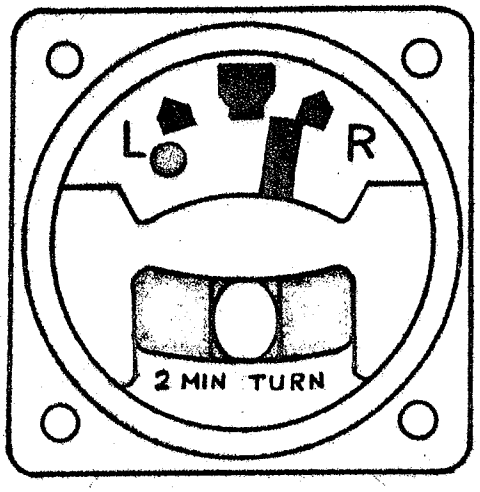
CASE PER MS 33638, 2 INCH TYPE

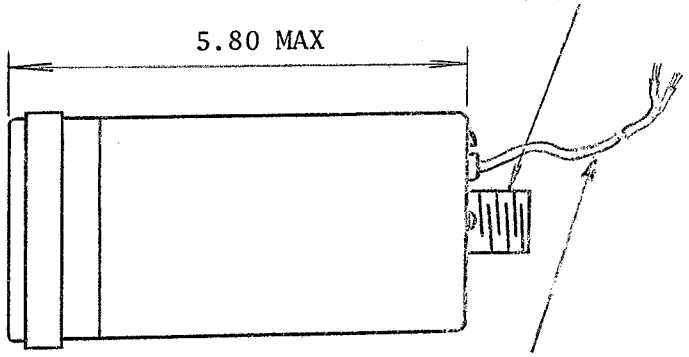


P/N 9550

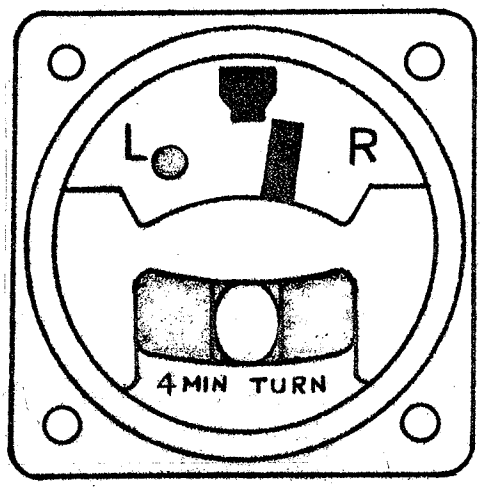


P/N 9551

MS3102A-10SL-3P



TWO 24 INCH LONG WIRES FOR P/N's 9550A, 9551A AND 9552A ONLY. REFER TO INTERNAL LIGHTING/CONNECTION ON PAGE 2.



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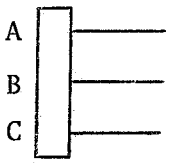

A — 27.5 V.D.C.

B — COMMON

C — OPEN, EXCEPT FOR P/N's 9550B, 9551B and 9552B. REFER TO INTERNAL LIGHTING/CONNECTION ON PAGE 2.

WIRING DIAGRAM

This United Instrument's specification supersedes UI specifications 9550 and 9560.

REV.	DATE		CHK.	REV.	DATE		CHK.		NAME	DATE
								PREP. BY	T. K.	10-27-80
								APPR. BY	T. Kawaguchi	10-27-80
				A	11-7-80	CORRECTED P/N's (PG 1)	T.K.	CHECKER	T. K.	

UNITED INSTRUMENTS, INC. 3625 Comotara Ave. Wichita, KS 67226	TITLE: INDICATOR, TURN AND SLIP 2 INCH, 28 V.D.C.	SPEC. NO: UI9550-N501	ISSUE A
		PAGE 1 OF 9 PAGES	

UNITED INSTRUMENTS PART NO.	CODE NO.	TURN RATE (MINUTE)	POINTER DEFLECTION	INTERNAL LIGHTING / CONNECTION
9550	N.501	2	SINGLE	NO LIGHTING
9550A	N.503	2	SINGLE	LIGHTED, 5 VDC / LEAD WIRES
9550A	N.505	2	SINGLE	LIGHTED, 28 VDC / LEAD WIRES
9550B	N.537	2	SINGLE	LIGHTED, 5 VDC / CONNECTOR
9550B	N.540	2	SINGLE	LIGHTED, 28 VDC / CONNECTOR
9551	N.506	2	DOUBLE	NO LIGHTING
9551A	N.508	2	DOUBLE	LIGHTED, 5 VDC / LEAD WIRES
9551A	N.510	2	DOUBLE	LIGHTED, 28 VDC / LEAD WIRES
9551B	N.538	2	DOUBLE	LIGHTED, 5 VDC / CONNECTOR
9551B	N.541	2	DOUBLE	LIGHTED, 28 VDC / CONNECTOR
9552	N.511	4	SINGLE	NO LIGHTING
9552A	N.513	4	SINGLE	LIGHTED, 5 VDC / LEAD WIRES
9552A	N.515	4	SINGLE	LIGHTED, 28 VDC / LEAD WIRES
9552B	N.539	4	SINGLE	LIGHTED, 5 VDC / CONNECTOR
9552B	N.542	4	SINGLE	LIGHTED, 28 VDC / CONNECTOR

1 GENERAL

1.1 PURPOSE: The purpose of this specification is to provide minimum performance standard and test procedures for turn and slip indicator.

1.2 SCOPE: This specification covers the following type(s) of turn and slip indicator(s).

Type 9550: 2 Minute Turn, Single Pointer Deflection, 28 V.D.C.
9551: 2 Minute Turn, Double Pointer Deflection, 28 V.D.C.
9552: 4 Minute Turn, Single Pointer Deflection, 28 V.D.C.

2 STRUCTURE, DESIGN, AND MATERIAL

2.1 INDICATING METHOD: Rate-of-turn shall be indicated by means of a pointer, deflecting in the direction of turn. Slips shall be indicated by means of a ball, free to move in a curved transparent tube.

2.2 VISIBILITY OF DIAL: Both slip and turn indications shall be visible from any point within the frustum of a cone, the side of which makes an angle of at least 30 degrees with the perpendicular to the dial, and the small diameter of which is the aperture of the instrument case. The distance between the dial and the cover glass shall be a practical minimum.

2.2.1 SLIP INDICATOR VISIBILITY: With the ball in the extreme position at each end of the tube, at least one-half of it shall be visible from a point 12 inches (305 m.m.) directly in front of the zero mark.

2.2.2 SLIP INDICATOR FILLING: The instrument shall be rotated so that all the air in the tube is trapped in the expansion chamber. Then, with the plane of the dial vertical, the instrument shall be rotated to an angle of roll of 45 degrees. With the expansion chamber end of the tube low, no part of the air bubble shall be visible from a point 12 inches (305 m.m.) directly in front of the bank indicator zero position.

2.3 DIAL MARKINGS

2.3.1 FINISH: Unless otherwise specified by the user, matte white material shall be applied to major graduations, numerals, and pointers. Non-functional surfaces shall be a durable dull black. Ball shall be black for non-lighted unit, and white ball for lighted unit, unless otherwise specified.

2.3.2 INSTRUMENT NAME: Instrument name or function it measures may be legibly indicated in the same finish as applied to the major graduations and numerals.

2.4 ENVIRONMENTAL CONDITIONS: The following conditions have been established as design requirements only. Tests shall be conducted as specified in paragraph 3.4.

2.4.1 TEMPERATURE: When installed in accordance with instrument manufacturer's instructions, the instrument shall function over the range of ambient temperature of -30° and 50°C, and shall not be adversely affected by exposure to temperatures of -65°C to 70°C.

2.4.2 HUMIDITY: The instrument shall function and shall not be adversely affected when exposed to any relative humidity in the range 0 to 95% at a temperature of approximately 70°C.

2.4.3 VIBRATION: When installed in accordance with the instrument manufacturer's instructions, the instrument shall function and shall not be adversely affected when subjected to vibration of the following characteristics.

Instrument Location in Air Frame	Cycles Per Sec	Max Double Amplitude(in.)	Max Acceleration (g)
Instrument panel or vibration isolated mount.	5 - 50	0.020	1.5

2.4.4 ALTITUDE: The instrument shall function and shall not be adversely affected when subjected to a pressure and temperature range equivalent to -1,000 to 40,000 feet standard altitude, per NACA Report Number 1235, except as limited by the application subparagraph of 2.4.1. The instrument shall not be adversely affected when subjected to an ambient pressure of 50 and 3 in.Hg absolute.

2.5 FIRE HAZARD: The instrument shall be so designed to safeguard against hazards to the aircraft in the event of malfunction or failure. Under normal conditions, the maximum operating temperature of external surfaces of the instrument must not exceed 200°C due to self-heating.

2.6 RADIO INTERFERENCE: The instrument shall not be the source of objectionable interference, under operating conditions at any frequencies used on aircraft either by radiation feed-back, in electronic equipment installed in the same aircraft as the instrument.

2.7 MAGNETIC EFFECT: The magnetic effect of the instruments shall not adversely affect the performance of other instruments installed in the same aircraft.

2.8 POWER VARIATION: The instrument shall properly function with variations of ± 15% of rated direct current voltage.

2.9 POWER MALFUNCTION INDICATION: Means shall be incorporated in the instrument to indicate when adequate power is not being made available to all phases required for the proper operation of the instrument. The indicating means shall indicate a failure or a malfunction in a positive manner.

2.10 MATERIALS AND WORKMANSHIP

2.10.1 MATERIALS: Materials shall be of a quality which experience and/or tests have demonstrated to be suitable and dependable for use in aircraft instruments. Metals used shall be anticorrosive under normal operating conditions or be protected appropriately against corrosion. Contact of dissimilar metals shall be avoided. The use of such a material that may stimulate the generation or growth of fungus shall be avoided. In case such a material, as stated above is to be used, the materials shall be treated with a germicide.

2.10.2 WORKMANSHIP: Workmanship shall be consistent with high grade aircraft instrument manufacturing practices.

3 TESTS

3.1 TEST CONDITIONS

3.1.1 ATMOSPHERIC CONDITIONS: Unless otherwise specified, all tests required by this specification shall be made at an atmospheric pressure of approximately 29.92 in.Hg and at an ambient temperature of approximately 25°C and at a relative humidity of not greater than 85%. When tests are conducted with the atmospheric pressure or temperature substantially different from these values, allowance shall be made for the variation from the specified conditions.

3.1.2 VIBRATION (TO MINIMIZE FRICTION): Unless otherwise specified, all tests for performance may be conducted with the instrument subjected to a vibration of 0.002 to 0.005 inches (0.05 to 0.12 m.m.) double amplitude as used herein, indicates to total displacement from positive maximum to negative maximum.

3.1.3 VIBRATION EQUIPMENT: Vibration equipment shall be used, which will provide frequencies and amplitudes consistent with the requirements of subparagraph 3.4.12.

3.1.4 CIRCULAR MOTION VIBRATION:, Vibration equipment shall be such that a point on the instrument case will describe a circle in a plane inclined 45 degrees to the horizontal plane, the diameter of which is equal to the double amplitude specified.

3.1.5 TURNTABLE: A turntable which can be operated smoothly through the ranges specified herein shall be used for making calibration tests.

3.1.6 POWER CONDITIONS: Unless otherwise specified, all tests shall be conducted at the rated power ± 5%.

3.1.7 NORMAL OPERATION: Unless otherwise specified, all instruments shall be operated at normal power for at least 5 minutes prior to conducting any test.

3.2 QUALIFICATION TESTS: Qualification Tests consist of all the tests, subparagraphs 3.4.1 through 3.4.16 performed on two sample instruments submitted for approval as a qualified product.

3.3 INDIVIDUAL TESTS: Each instrument submitted for acceptance shall be subjected to the tests, subparagraphs 3.4.1 through 3.4.9 to determine compliance with the requirements of material, workmanship, and operational adequacy.

3.4 TESTS

3.4.1 APPEARANCES AND OVERALL DIMENSIONS: Appearances and overall dimensions of each instrument shall meet the requirements of Figure 1.

3.4.2 SLIP INDICATOR TESTS

A. ZERO POSITION: With the instrument in normal position with the lower mounting holes on a horizontal line, the position of the ball shall be within 1/32 inch (0.79 m.m.) of the zero position.

B. FRICTION: The ball shall move smoothly and without sticking throughout the full length of the tube.

C. SENSITIVITY: With the dial vertical, the indicator shall be rotated about the longitudinal axis to the right until the ball is just short of its limit. The angle of rotation shall be 10 ± 2 degrees. The test shall be repeated, rotating the instrument to the left. The same tolerance shall apply. The ball shall not stick at the high end of the tube.

3.4.3 TURN INDICATING TESTS

A. STARTING AT RATED POWER: When started by the application of the instrument's rated voltage shown in Table 1, the rated performance of Table 2 must be reached in 3 minutes or less.

Table 1

Rated Voltage (V.D.C.)	Reduced Voltage (V.D.C.)
27.5 ± 4.2	22.0

B. STARTING AT REDUCED POWER: The gyro motor must start to rotate and continue to run on the reduced voltage shown in Table 1. After no more than five minutes' operation at this reduced power, the instrument must be able to provide an adequate indication of aircraft turning motion.

3.4.4 SENSITIVITY AT ROOM TEMPERATURE: Started in normal position and operated under rated power, the instrument shall be rotated about the vertical axis at the rates specified in Table 2. Deflection of the pointer shall be of the magnitudes shown in Table 2. The pointer movement shall be smooth.

Table 2

Rate of Turn in degrees/minute	Pointer Deflection in inches (m.m.)	
	Single Deflection	Double Deflection
0	0 ± 0.015(0 ± 0.38)	0 ± 0.015 (0 ± 0.38)
36	1/32 ± 1/64(0.79 ± 0.40)	1/16 ± 1/64(1.59 ± 0.40)
90	5/64 ± 1/32(1.98 ± 0.79)	5/32 ± 1/32(3.97 ± 0.79)
180	5/32 ± 1/32(3.97 ± 0.79)	5/16 ± 1/16(7.94 ± 1.59)
360	5/16 ± 1/16(7.94 ± 1.59)	9/16 ± 1/8(14.29 ± 3.18)

3.4.5 DAMPENING AT ROOM TEMPERATURE: The instrument operating under rated power in normal position shall be rotated about the vertical axis at a rate which causes full scale pointer deflection. The turn shall be stopped suddenly and the time required for the pointer to return to the zero mark without crossing the zero mark must be at least 2, but not more than 4 seconds.

3.4.6 POWER MALFUNCTION INDICATOR: When the input voltage is zero and/or the gyro motor is at rest, the part of the power malfunction indicator colored in red shall be totally visible. The red mark shall be visible within one minute after no more than 11.0 V.D.C. is applied and/or when the rotor speed is not high enough to give the instruments performance adequately.

No part of the red mark shall be visible within one minute after the reduced voltage to the upper limit of the rated voltage shown in Table 1 is applied, when the rotor speed is sufficiently high so as to give the instruments performance shown in Table 2.

3.4.7 DAMPENING: While operating at room temperature, the time for the slip indicator to move from the zero position of the slip indication to the rest position must not be less than 0.2 seconds following a sudden rotation of the instrument from a position of 12 degrees bank through the vertical to 12 degrees opposite bank.

3.4.8 INSULATION RESISTANCE: The insulation resistance measured at 200 V.D.C. for 5 seconds between all electrical circuits connected together and the metallic frame shall not be less than 5 megohms.

3.4.9 OVERPOTENTIAL TESTS: The instruments shall not be damaged by the application of a test potential between electrical circuits and between electrical circuits and the metallic frame. The test potential shall be a sinusoidal voltage of a commercial frequency with an rms value of five times the maximum circuit voltage. The potential shall start from zero and be increased at a uniform rate to its test value. It shall be maintained at this value for 5 seconds and then reduced at a uniform rate to zero.

3.4.10 LOW TEMPERATURE

A. SLIP INDICATOR DAMPENING: The instrument shall be exposed without operating to a temperature of -30°C, for 3 hours. Then the instrument, while at a temperature of -30°C shall be tested as specified in subparagraph 3.4.7. The time for ball motion from the zero position of the slip indicator to the rest position at the end of the tube shall not exceed 4 seconds.

B. TURN INDICATOR SENSITIVITY: After exposure to temperature of -30°C for 3 hours, without operating, the instrument while still at -30°C shall meet the requirements of paragraph 3.4.4, except that pointer deflection shall be as indicated in Table 3. The performance shall be checked within ten minutes after power is applied. When turning is stopped, the pointer shall return smoothly to zero within 1/32 inch (0.79 m.m.).

Table 3

Rate of Turn in degrees/minute	Deflection of Pointer in inches (m.m.)	
	Single Deflection	Double Deflection
180	5/32 ± 1/16(3.97 ± 1.59)	5/16 ± 1/8(7.94 ± 3.18)
360	5/16 ± 1/8(7.94 ± 3.18)	9/16 ± 3/16(14.29 ± 4.76)

3.4.11 TURN INDICATOR SENSITIVITY AT HIGH TEMPERATURE: After exposure to temperature of +50°C for 3 hours, while operating, the instrument shall meet the requirements of subparagraph 3.4.4.

3.4.12 VIBRATION

RESONANCE: The instrument, while operating, shall be subjected to a resonant frequency survey of the appropriate range specified in subparagraph 2.4.3 in order to determine if there exist any resonant frequencies of the parts. The amplitude used may be any convenient value that does not exceed the maximum double amplitude and the maximum acceleration specified in subparagraph 2.4.3.

The instrument shall then be subjected to vibration at the appropriate maximum double amplitude or maximum acceleration specified in subparagrpah 2.4.3 at the resonant frequency for a period of 1 hour in each axis or with circular motion vibration, whichever is applicable. When more than one resonant frequency is encountered with vibration applied along any one axis a test period may be accomplished at the

most severe resonance, or the period may be divided among the resonant frequencies, whichever shall be considered most likely to produce failure. The test period shall not be less than ½ hour at any resonant mode. When resonant frequencies are not apparent within the specified frequency range, the instrument shall be vibrated for 2 hours in accordance with the vibration requirements schedule at the maximum double amplitude and the frequency to provide the maximum acceleration.

CYCLING: The instrument, while operating, shall be tested with the frequency cycled between limits specified in subparagraph 2.4.3 in 15 minute cycles for a period of 1 hour in each axis at an applied double amplitude specified in subparagraph 2.4.3 or an acceleration specified in subparagraph 2.4.3, whichever is the limiting value or a total of three hours for circular motion vibration, whichever is applicable.

After completion of this vibration test, no damage shall be evident and the instrument shall meet the requirements of subparagraph 3.4.2 through 3.4.9.

3.4.13 HUMIDITY: The instrument shall be mounted in a chamber maintained at a temperature of 70 + 2 ^{o}C and a relative humidity of 95 + 5% for a period of 6 hours. After this period the heat shall be shut off and the instrument shall be allowed to cool for a period of 18 hours in this atmosphere in which the humidity rises to 100% as the temperature decreases to not more than 38^{o}C. This complete cycle shall be conducted once. Immediately after cycling, there shall be no evidence of damage or corrosion which affects performance following this test, and the instruments shall meet the requirements of subparagraph 3.4.2 through 3.4.9.

3.4.14 ALTITUDE: The instrument shall function and shall not be adversely affected following exposure to a pressure range equivalent to -1,000 to +40,000 ft. standard altitude, per NACA Report 1235. The instrument shall meet the requirements of subparagraphs 3.4.2 through 3.4.9 and shall not be adversely affected following exposure to extremes in ambient pressure of 50 and 3 in.Hg absolute.

3.4.15 RADIO INTERFERENCE: The instrument shall meet the requirements of Aircraft Equipment Interference Control Requirements, MIL-I-6181D.

3.4.16 MAGNETIC EFFECT: The magnetic effect of the indicator shall be determined in terms of the deflection of a free magnet, approximately 1½ inch (38 m.m.) long, in a magnetic field with a horizontal intensity of 0.18 ± 0.01 gauss when the indicator is held invarious positions on an east - west line with its nearest part 12 inches (305 m.m.) from the center of the magnet. An aircraft compass with the compensating magnets removed therefrom may be used as the free magnet for this test. This test shall be made first with the instrument not operating and then shall be repeated with the instrument in normal operation. The maximum deflection of the magnet shall not exceed 5 degrees for any pointer position.