

FOREWORD

The Flying Training Department was directed to compile a section for the Operators Manual that presented standardized procedures, methods, and guidelines for flight training and proficiency checking. This section is in accord with industry practices, FAA requirements, and airline standards.

The procedures and maneuvers described are mandatory for those pilots undergoing transition training and proficiency checks.

The information in this section is supplemental to the contents of the Aircraft Flight Manual and is not intended as a replacement for that Manual. The resultant proficiency of the individual pilot is dependent upon time allotted to the study of both publications and practice on the line.

This section was compiled with the assistance of the MFD, AMFD, and Instructor Pilots of each base station. From these fine pilots came the many ideas and suggestions that enabled completion; grateful acknowledgment is rendered to their valuable contributions.

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REMOTE COMPASS

1. GENERAL

The remote-reading magnesyn compass system provides a means for locating the magnetic element of the compass remotely from local magnetic disturbances.

The transmitter, or blind compass, is installed in the right outer wing where the magnetic disturbance is reduced to minimum. The indicator, which reproduces movements of the compass element in the transmitter, can be installed in any desired location, since magnetic materials near the indicator will not affect the accuracy of the magnesyn compass system. Such disturbances must be avoided only in the neighborhood of the transmitter. The indicator on Beech Ten-Two is installed on the pilot's instrument panel. The inverter is required to change dc to ac for operation of the system with an output of 26 volts single phase 400 cycles.

The transmission of the magnetic indications of the compass of the indicator is entirely electrical, the only moving parts in the system, in addition to the inverter, being the compass float assembly and the indicator rotor. The compass system will operate at either 400 cycles at 26 volts, or any intermediate point as long as the frequency is from 13 to 17 times the voltage. The power required will not exceed 1.5 volt-amperes per unit (transmitter or indicator).

2. PRINCIPLES OF OPERATION

A. General

- (1) In order to comprehend fully the principles of operation of the remote-reading magnesyn

compass system, the characteristics of a magnet, the magnetic properties of the earth, and the problems of the conventional magnetic compass must be understood.

- (2) Magnet has magnetic "lines of force" which travel from its north pole around to its south pole. These lines of force cause the familiar attraction of one magnet to another. When no other magnetic material is near a magnet, these lines of force will have a certain pattern around the magnet. However, if a piece of soft iron is placed near a magnet, most of the lines of force will pass through the piece of soft iron, because soft iron is a good conductor of magnetic lines of force and offers a path of least resistance.
- (3) The earth is, in reality, a huge magnet with its North Pole situated within the Arctic Circle and its South Pole within the Antarctic Circle. Magnetic lines of flux continuously leave the earth in the region of the South Magnetic Pole and enter in the region of the North Magnetic Pole.
- (4) When a magnetic compass is installed in an airplane, it is subject to deviation error resulting from the ship's magnetism. Deviation error is caused by the magnetism of the steel and soft iron parts of the ship and by electrical conductors carrying direct current. An airplane in flight sets up vibration which allows the earth's field to induce relatively permanent magnetism in

steel parts. The soft iron parts of the plane, on the other hand, readily acquire transient magnetism by induction from the earth's magnetic field. The magnetism thus induced in soft iron varies as the plane changes its direction in flight.

B. Remote-Reading Magnesyn Compass

- (1) The locations at which compass readings are most needed are very often in close proximity to the greatest magnetic disturbances. Because of the remote indicating feature of the magnesyn system, the transmitting unit can be mounted in a position in the airplane where it will be least affected by the magnetic field of the ship itself and, therefore, will be free to a very great extent from the effect of deviation. This feature is particularly advantageous where the magnetic field of the airplane tends to shift from time to time as a result of changes in position or from the use of armament. The indicator units may be placed anywhere without regard to the ship's magnetic field.
- (2) The remote-reading magnesyn compass system operates on the principle of electro-magnetic induction. Electro-magnetic induction is the phenomenon whereby electrical voltage is induced in an electrical conductor when it is cut by magnetic lines of flux. Conversely, an electrical conductor, wound around a material capable of being magnetized, will induce magnetic lines of flux in the material when electric current flows through the conductor.
- (3) In the magnesyn a soft iron ring is placed around a magnet so that most of the magnet's lines of force pass

through the ring. This ring is provided with an electrical winding similar to paper wrapping tape around an automobile tire. When alternating electric current flows through this winding, the soft iron ring will be alternately saturated and unsaturated with magnetic lines of force.

- (4) The remote-reading magnesyn compass system is actually two magnesyns. Each consists of a permanent magnet rotor and a stator which is a toroidally wound coil on a laminated magnetic core. The rotor, magnetized along a line perpendicular to its axis of rotation, is free to revolve in the center of its stator. Since the rotor in the transmitter (compass element) is free to revolve, it aligns itself with the flux lines from the earth's magnetic field. (The indicator rotor is shielded and therefore is not affected by the earth's field). Each stator, supplied with the same 400-cycle alternating current is divided by two taps into three equal sections, and the corresponding taps of each unit are connected together. Since the taps in the transmitter stator are connected to the corresponding taps on the indicator stator, and both coils are supplied from the same ac source, there will be no flow of 400-cycle alternating current between the two units, because the voltages at the taps of each one are at the same fundamental potentials.
- (5) By dividing the electrical winding into three sections the voltages produced in each section will vary with the position of the magnet. As long as the magnet rotor of each unit remains in

the same position in relation to its stator (electrical zero) there will be no flow of current between the transmitter and indicator. However, if one magnet is moved to a new position, the voltages in the three windings of one magnesyn will be no longer the same as the voltages in the second magnesyn. Since the transmitter magnet rotor (compass element) always remains aligned with the earth's field, the instant the aircraft alters its heading in relation to the earth's field, the stator, rigid in its housing, revolves around the rotor. This change in the relative position of the rotor and stator unbalances the voltages between the two magnesyns, and current will now flow between the two stators. In an attempt again to equalize the voltage potentials the indicator rotor, since it is shielded from the earth's field is free to revolve, must follow the transmitter rotor and make the corresponding rotation. Thus the indicator hand, attached to the rotor shaft, follows any alteration in the ship's heading in relation to the earth's field.

- (6) An additional annular core of magnetic material placed around the outside of each stator serves a dual purpose. It provides both a return path for magnetic flux and a shield against extraneous magnetic fields that may be present near the magnesyn.