NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety

Washington, D.C. 20594

April 27, 2015

STRUCTURES STUDY
11 imbedded photographs

John Clark

ACCIDENT

Location:	Norfolk, VA
Date:	March 4, 2015
Time:	0413 EST
Aircraft:	Mooney M20F, N66BB

SUMMARY

On March 4, 2015, about 0413 eastern standard time, a Mooney M20F, N66BB, was substantially damaged when it impacted trees and terrain while conducting an instrument approach to Norfolk International Airport (ORF), Norfolk, Virginia. The private pilot and two passengers were fatally injured. Dark night instrument meteorological conditions prevailed, and an instrument flight rules (IFR) flight plan was filed and active for the flight, which originated from Palatka Municipal Airport (28J), Palatka, Florida, about 2357 on the preceding day. The personal flight was conducted under the provisions of 14 Code of Federal Regulations Part 91.

DETAIL OF EXAMINATION

A directional gyro was removed from the airplane and examined on April 22, 2015 at Sigma Tek, Inc., Augusta, KS. John Clark (NTSB) and Clifford Pfortmiller (Sigma Tek) conducted the exam.

The directional gyro was manufactured by Edo-Aire[1], Wichita, KS.
Model Number: 4000E
Part Number: 1U262-006-28
SN:49800F
Date of Mfg: March 10, 1977

[1] Sigma Tek acquired Edo-Aire in 1983.

Kelly Instruments - Wichita, KS overhauled the instrument with a date stamp of June 14, 2014.

External observations: The instrument compass card was free to rotate, indicating that the caging mechanism was not engaged. The cage knob was bent upward. The bug setting knob was bent upward with the bug set at 232 degrees. The aftermarket bezel light fixture was broken, with half remaining attached to the instrument. Damage from a shallow dent and scrap partially obscured the data plate located on top of the instrument. The vacuum pressure switch attached to the back of the instrument was broken free.

Initial test: The damaged vacuum pressure switch remnant was removed and replaced with a plug. A vacuum source was attached to the "VAC" port and adjusted to 5 inches of mercury (In. Hg.). Upon application of vacuum pressure, the gyro spin rate increased and sounded normal. The compass card would not rotate when the instrument was slowly rotated about the vertical axis.

Internal examination: The instrument case was removed. The spur gear[2] was not engaged with the dial gear[3]. Each gear rotated freely, independent of the other. The spur gear was displaced downward to disengage from the dial gear.

The upper portion of the instrument frame was deformed very slightly in a downward direction. The lower portion of the instrument frame was bent downward in the center, in the area of the lower pivot bearing. The lower pivot bearing would carry the vertical loads imposed by the gyro. The pivot bearing left an imprint on the inner surface of the bottom side of the instrument case.

Second test: A second test was accomplished by applying 5 In. Hg. pressure to the "AIR INLET" port of the instrument[4]. The gyro spin rate appeared normal and motion about the vertical axis was stable. Index marks were place on a spur gear tooth and nearby frame. There was no observable movement between the index marks for 11 minutes[5]. The case was rotated slightly clockwise. Observation and relative change of the index marks showed that the gyro remained stationary as the case was rotated about the vertical axis. The case was rotated to the original position and the index marks were again in alignment.

Service representative comments: Gyro precession is typically a progressive failure. As the bearings wear or accumulate fine particles of dust, the precession rate gradually increases.

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[2] The spur gear is attached to the gyro cage. It sets at the bottom of the gyro and rotates about the vertical axis, relative to the instrument. The spur gear has 156 teeth.

[3] The dial gear is attached to the compass card. It interfaces at right angles to the spur gear. It rotates about the longitudinal axis.

[4] The instrument case is sealed. A vacuum test could not be performed after removal of the instrument case.

[5] The spur gear has 156 teeth. Relative movement equivalent to one tooth would be 2.3 degrees

PHOTOS OF EXAMINATION

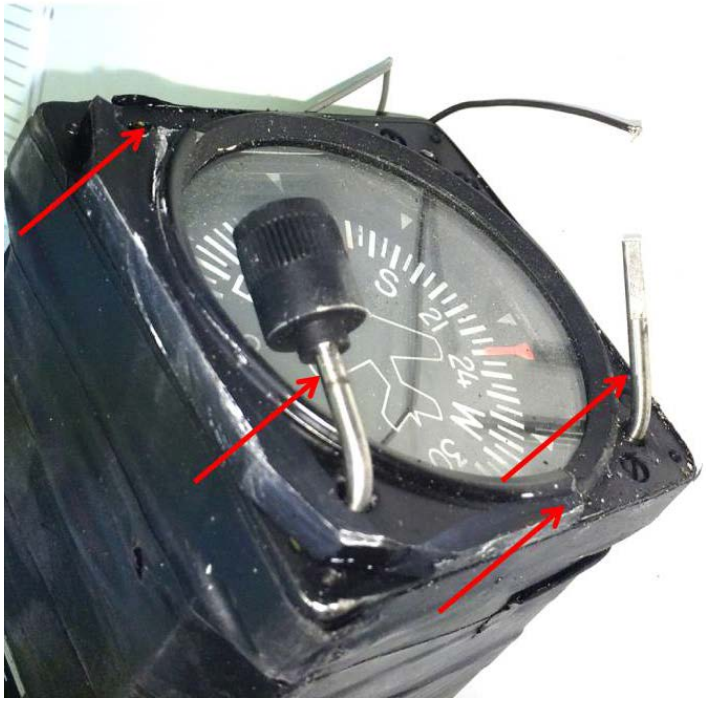

Photo 1 – The arrows point to the damage to the knobs and aftermarket lighted bezel.

Photo 2 – Instrument data plate and repair sticker.

Photo 3 - Broken vacuum switch

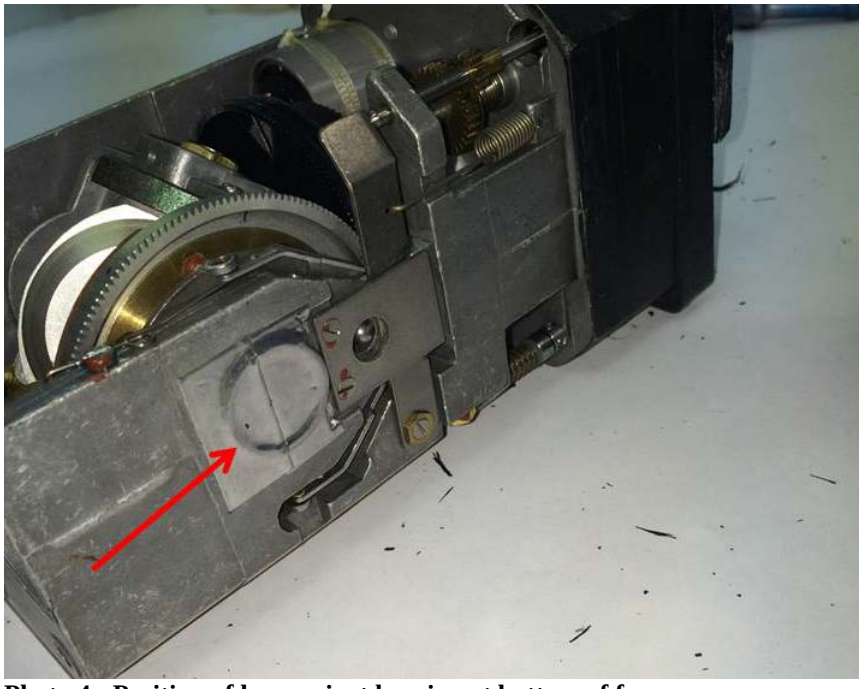

Photo 4 - Position of lower pivot bearing at bottom of frame.

Photo 5 - Imprint left by lower pivot bearing on bottom of the case.

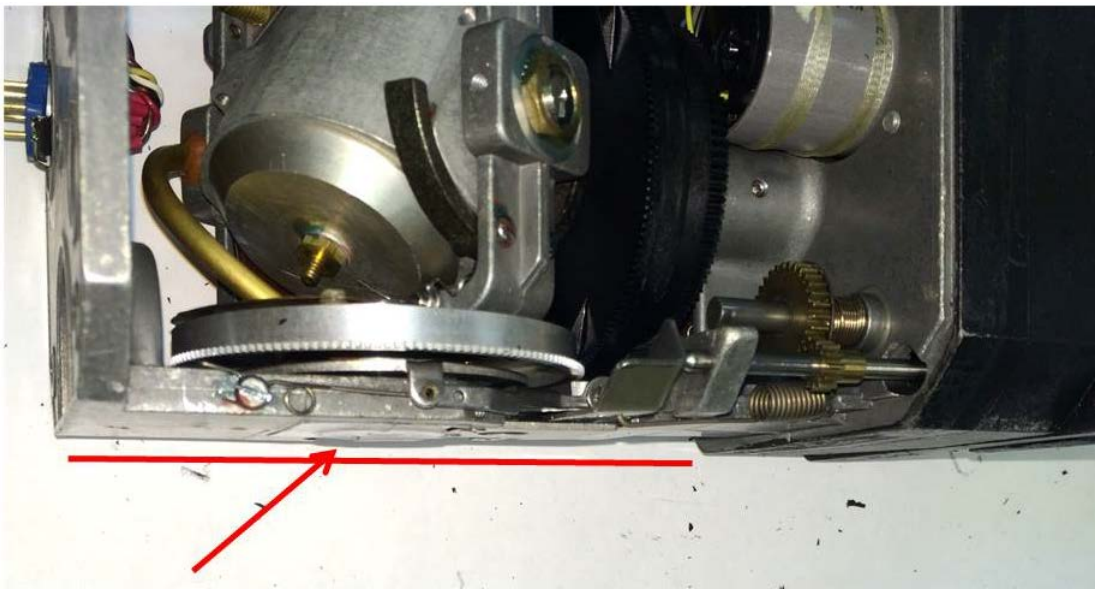

Photo 6 - Downward bending of bottom case structure.

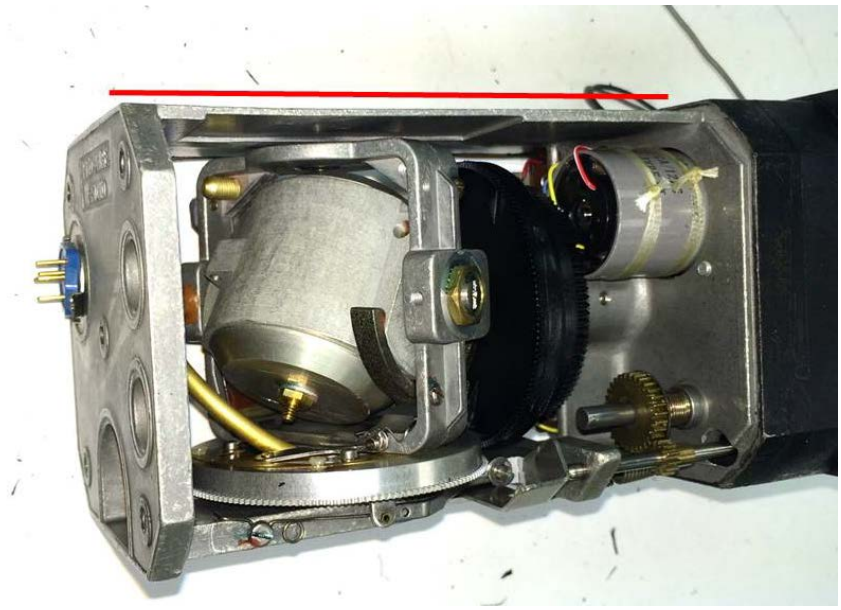

Photo 7 - Very slight downward bending of upper case structure.

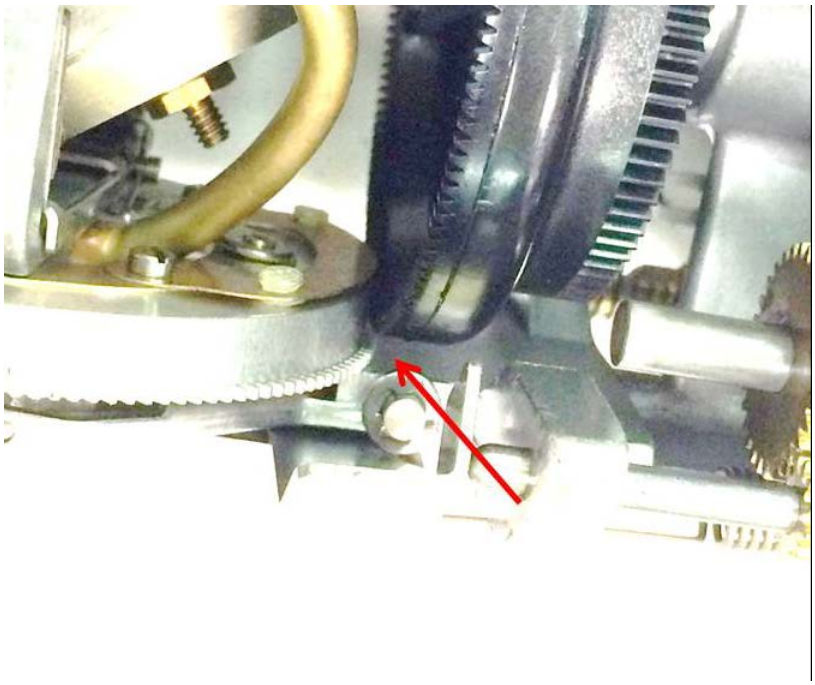

Photo 8 - Separation of spur gear (horizontal gear) from dial gear (vertical gear).

Photo 9 - Initial alignment of spur gear and case index marks.

Photo 10 - Final alignment of spur gear and case index marks after the 11-minute test.

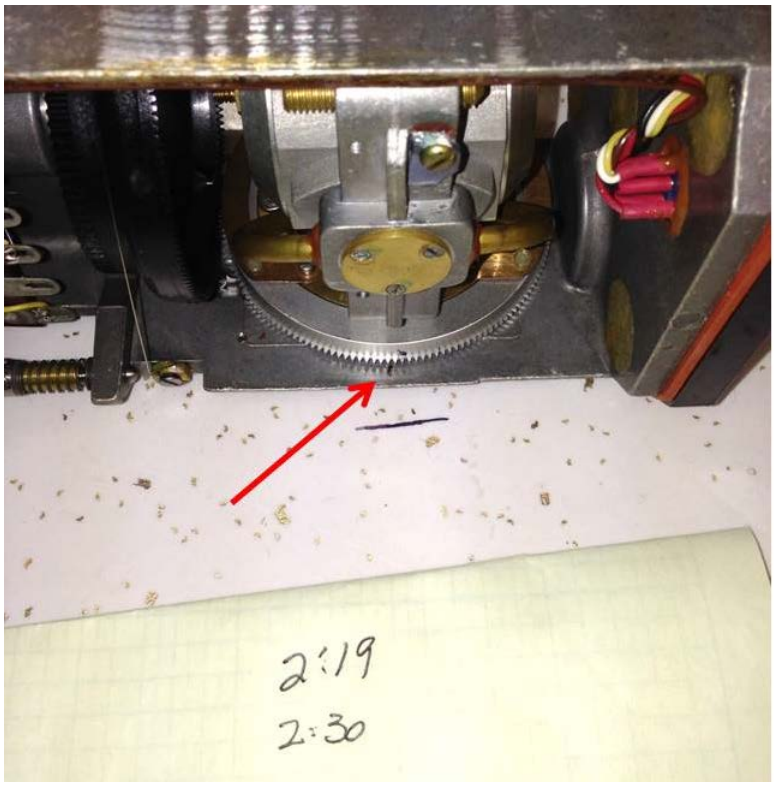

Photo 11 - Alignment of index marks after case was rotated slightly clockwise about the vertical axis.

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