# CEILING AND VISIBILITY INSTRUMENTATION WITHIN GOVERNMENT AGENCIES

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## Ceilometers

Key system requirements. The key requirements for ceilometer systems are as follows:

1. Range must be 10,000 ft.
2. Laser emission must conform to the Bureau of Radiological Health Class I performance.
3. System must detect two lowest cloud layers.
4. Display must be in either English or metric units.
5. System must be capable of self-monitoring and testing performance.

Based upon the above requirements, Hughes Aircraft Corporation and Sanders Associates have been awarded contracts to build competitive prototype Cloud Height Indicator (CHI) systems. Witness evaluation tests will be conducted on them at their respective manufacturers' facilities in March, 1980. An evaluation report will be written in April, and a contract award for the initial production of a few units for operational testing will occur in late FY80.

*Hughes system*. The Hughes system consists of a transceiver unit which is located on the airfield, a maintenance unit which is remotely located from the transceiver, and remote readout units.

The transceiver has the following characteristics:

1. Is contained in a cylindrical enclosure.
2. Has built-in test capability to monitor operation of its major subsystems.
3. Has environmental control for subsystems and window heaters.
4. Uses a 1.54 μm laser transmitter.
5. Uses a germanium photo detector.
6. Uses laser rangefinder principle to find cloud height, i.e., time of travel for light pulse to and from the target.

The maintenance unit has the following characteristics:

1. Contains microprocessor-based command and control for the transceiver.
2. Controls timing of cloud height measurements and built-in test data from transceiver.
3. Commands initiation of test sequences.

The maintenance unit commands the transceiver to perform a series of cloud height measurements in a one-minute period. These measurements are stored in memory and are correlated to reduce false alarms. The transceiver then performs the built-in test sequence upon command from the maintenance unit. Cloud height and built-in test data for the last series of measurements are then transmitted to the maintenance unit. The maintenance unit subsequently delivers the cloud height data to the readout units. When this sequence is complete, the transceiver is ready to repeat the cycle upon command from the maintenance unit.

Status and malfunction indicators are provided in the maintenance unit for quick response on maintenance.

*Sanders Associates system.* The Sanders Associates system consists of basically the same units as the Hughes system, namely, a transceiver, a maintenance unit and a remote readout unit.

The transceiver unit has the following characteristics:

1. Is contained in a large weather-proof enclosure similar in appearance to a house with a peaked roof.
2. Uses the roof of the enclosure to serve as windows for the transmitter and receiver.
3. Has 16-inch cassegrain telescopes for transmitter and receiver optics.
4. Has a 1.73 μm Q-switched laser.
5. Has a germanium photodetector receiver.
6. Contains a microprocessor which controls cloud height measurement sequence timing, processes first two cloud-base returns to eliminate false data, and converts the measurements to either feet or meters.

The maintenance unit has the following characteristics:

1. Is rack mountable.
2. Provides remote control and monitoring of the transceiver unit.
3. Provides interface between transceiver and display units.
4. Has built-in self- and line-monitoring capability.
5. Has functional monitoring with a microprocessor which provides error correction techniques, less system downtime, and ease of maintenance.

The display unit controls will indicate intensity and cloud height (in feet or meters). They will also activate or deactivate the display unit power.

This system operates in basically the same manner as the Hughes unit, with the exception that all of the timing control, self-check functions, and data processing are accomplished in the transceiver unit. The maintenance unit acts only as an interface to the display units and as an error corrector and fault indicator.

Government programs.

*National Weather Service.* Mr. Tom Gifft of Gifft Company, California, has left with the National Weather Service (NWS) a prototype laser ceilometer for testing. Features include two ranges (10,000 and 20,000 ft), 10-inch optics for transmitter and receiver, digital and analog output, remote readout, GaAs laser transmitter, receiver, and associated optics which are fitted into a machined aluminum block. The whole unit is housed in a 2 ft x 2.5 ft x 1 ft box and is estimated to cost about $4,000. Initial test results are favorable.

NWS is initiating a program to include ceiling and visibility data in the VHF Omni-Directional Range (VOR) at Dulles. The ceilometer to be used is a Gallium Arsenide laser ceilometer built by Impulsphysik.

*United States Air Force.* The United States Air Force (USAF) has an active program to improve hardware and software components to make measurements more reliable and accurate. They are pursuing a program this spring at Otis Air Force Base (AFB) to determine how representative a single point measurement is of the entire cloud base. Two rotating beam ceilometers (RBC's) will be separated by one mile, then comparisons will be made of simultaneous measurements of the base. This is a similar program to the one performed at Wright Patterson AFB a few years ago, but their three RBC's were placed at points of an equilateral triangle five to seven miles on each side. Otis test results will be available in June, 1981.

*United States Army.* The second prototype visioceilometer should be delivered in August, 1980. We are hoping to have another unit delivered by October, 1980. Testing and subsequent demonstrations will commence in the following months.

This is a hand portable system weighing approximately 5 lbs that will use the same laser (1.06 μm) as in the AN/GVS-5 laser rangefinder. The hand-held portion will be approximately the size of a pair of 10 x 50 binoculars. The operator will aim it as nearly vertical as possible and fire the laser; the distance to the cloud base will be displayed in meters in the viewfinder.

## Visibility Sensors

### Government programs.

*Federal Aviation Administration.* The TASCAR 500 system is a dual baseline transmissometer which utilizes a visible light transmitter and two detectors. One detector is located a distance of 40 ft from the transmitter and the other is located 250 ft from the transmitter on the same axis as the 40 ft detector. When the visibility reaches a point between 40 ft and 250 ft, the system automatically changes from one detector to the other.

This system is being tested at the Arcata Airport. The preliminary 250 ft baseline comparisons with the AN/GMQ-10 transmissometer of the same baseline indicate good correlation of 700 ft to 900 ft Runway Visual Range (RVR). However, the 40 ft baseline data have no meaningful transmissometer comparisons since there are no 40 ft baseline transmissometers.

Operational tests will commence at one of the properly equipped CAT III terminals sometime in 1983.

The current AN/GMQ-10 transmissometers seem to be somewhat labor intensive. It is estimated that one man-year of effort is expended for each three transmissometers.

Mr. Eric Mandel, Federal Aviation Administration (FAA) representative, stated at the February, 1980, meeting of the Federal Panel on Automatic Meteorological Observing Systems (PAMOS) that the Artege Company has developed a new visibility system and desires FAA endorsement. However, this creates a dilema since there are no test standards or criteria which could be used in an evaluation of this sort.

Current concensus on the use of the EG&G, Inc., forward scatter meter is that it may possibly be used for both RVR and prevailing visibility measurements.

*National Weather Service.* The NWS at Sterling, Virginia, is doing comparisons of the Videograph, the EG&G forward scatter meter, the AN/GMQ-10 transmissometer, and a telephotometer to determine which one is best suited for automated use. The group at Sterling are also involved in developing algorithms to satisfy automated visibility measurement requirements. There seems to be a need to report the type of visibility measurement in definable terms as input to an automated system. There is also a need for terminology that will differentiate instrument measurements from observer data.

*United States Air Force.* A program to reduce the size and weight of the EG&G forward scatter meter to a device the size of the MRI, Inc., visiometer is underway. The concept for use of this miniaturized system is around tactical airfields. The transmitter and receiver will be remoted from the processing electronics (approximately 15 ft maximum).

*United States Army*. Visibility measurements can also be made with the visioceilometer. A selector switch changes from cloud height measurements to visibility measurements.

## Deficiencies

There are still no effective, eye-safe remote sensors for slant visual range (SVR) measurements.

There is no accurate comparison basis for the 40 ft baseline transmissometer.

There is a need to obtain more statistical test comparison data on laser remote monostatic visibility sensors with standard visibility instruments.