AGIVIS 2000

Transmissometer IRVR System

Technical Description

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Introduction

Runway Visual Range (RVR) is defined by the International Civil Aviation Organisation (ICAO) as:

"The distance over which the pilot of an aircraft on the centreline of a runway can see the runway surface markings or the lights delineating the runway or identifying its centre line."

Because it is not possible to measure RVR directly, an *assessment* is made, either by a human observer or using an automated system to provide what is called instrumented runway visual range, IRVR. The reliable and accurate assessment of RVR is essential if airport operations are to run as safely and efficiently as possible.

IRVR systems are seen as an improvement over human observations due to the elimination of possible human error and because of lower operating costs. IRVR readings are also available 24 hours a day. The first generation of AGI IRVR systems were developed in co-operation with the UK Met Office and CAA; AGI has now been supplying IRVR systems to international airports for over 20 years.

AGIVIS 2000 is AGI's transmissometer based IRVR system. It complies with all relevant ICAO and WMO standards and regulations and is suitable for any airport up to and including CAT III. The system includes full engineering diagnostics and control, and features extremely robust self-test and monitoring functions.

Systems can be supplied fully installed with comprehensive engineering and operator training, and post-installation support and calibration is available worldwide.

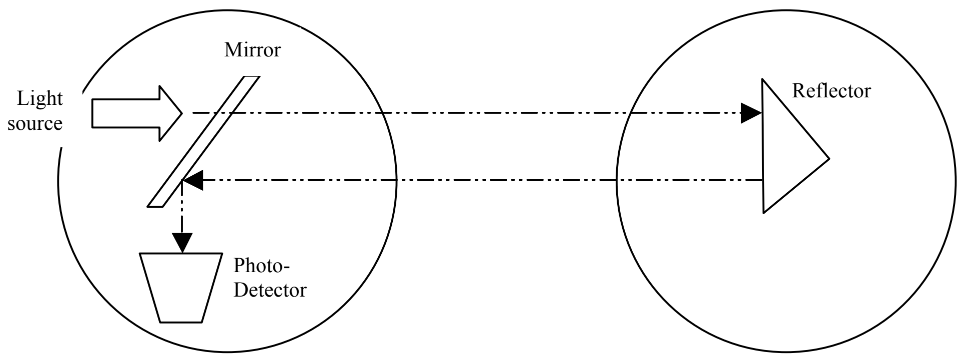
Principle of Operation

The most important factor in assessing RVR is to establish the atmospheric extinction coefficient or the related value for atmospheric transmittance. The extinction coefficient represents the attenuation of light passing through air due to two effects:

- The scattering of light by airborne particles
- The absorption of light by airborne particles

Both forward scatter and transmissometer based IRVR systems can detect extinction due to the scattering of light, but only transmissometers can directly detect extinction due to absorption. Scattering is the dominant effect in fog and snow, whilst absorption plays a larger role for haze, dust and smoke.

Transmissometers measure the extinction coefficient by shining a light of known intensity through a specified distance onto a photo-detector.



Simplified Transmissometer Layout

The AGIVIS 2000 system uses a reflecting transmissometer, which means that the light beam is returned by a reflector back to the initial field site. This serves to double the baseline length along which the measurements are taken, increasing the system accuracy. The AGIVIS 2000 baseline length is 20m.

The system self-corrects to eliminate common causes of inaccuracy including ambient light, internal reflections, light source variation, electrical noise and optical performance. Key system elements are maintained with a positive air pressure to prevent the ingress of dust.

Every 60 seconds the system determines a value for extinction coefficient and uses it to perform calculations according to two different equations:

- **Koschmieder's Law** is a method of assessing visibility based upon the relative luminance of a black body against the luminance of the background it is viewed against. It is principally used to assess IRVR in daylight. When calculated from the extinction coefficient using WMO assumptions the result is known as the Meteorological Optical Range (MOR).
- **Allard's Law** is a method of assessing the visibility of sources of light (such as runway lights). It requires values for extinction coefficient, the luminous intensity of the lights being viewed and the background luminance and is principally used to assess IRVR at night.

The value of background luminance is obtained from a background luminance meter (BLM) mounted on one or more field sites. This is a photo-detector with a photopic response similar to the human eye, to represent what the human observer would see. The BLM is usually oriented so that it faces away from any nearby lighting that could distort readings, and also so that it is never exposed to direct sunlight.

The value of runway light intensity (RLI) is derived from the rated intensity of the runway lights at the airport where the system is installed. The nominal value for maximum intensity is usually reduced by a configurable degradation factor (typically 20%) to allow for loss of runway light performance and any contamination. The RLI value is input to the system based on the electrical current presently being fed to the runway lights, as set by the ATC controllers.

Once calculations for both Koschmieder's and Allard's Laws are complete, the system selects the highest current IRVR value, which is rounded down and reported in bands as per ICAO Doc 9328 (Manual of Runway Visual Range Observing and Reporting Practices).

Transmissometer Installation

IRVR calculations are usually carried out using a rolling 10 minute mean of extinction coefficient. However, the system is capable of recognising what is called a 'marked discontinuity' in visibility. This is defined by the WMO as:

"…an abrupt and sustained change in runway visual range, lasting at least 2 minutes, which reaches or passes through criteria for the issuance of SPECI reports…"

If a marked continuity is detected the system automatically uses only IRVR values occurring after the discontinuity occurred.

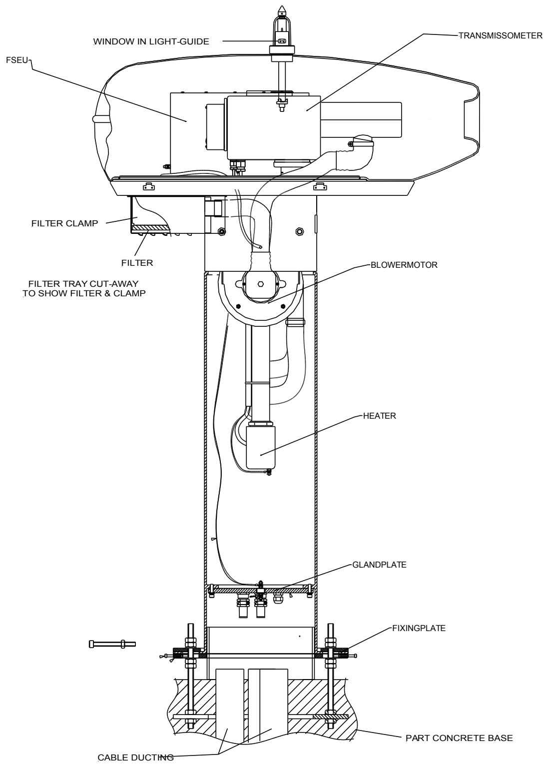
Transmissometer-based IRVR systems are generally acknowledged as being the 'gold standard' of RVR measurement, and offer the highest possible levels of accuracy. AGIVIS 2000 transmissometers provide excellent accuracy in all conditions, including fog, dust, blowing sand, rain and snow.

Field Site Equipment

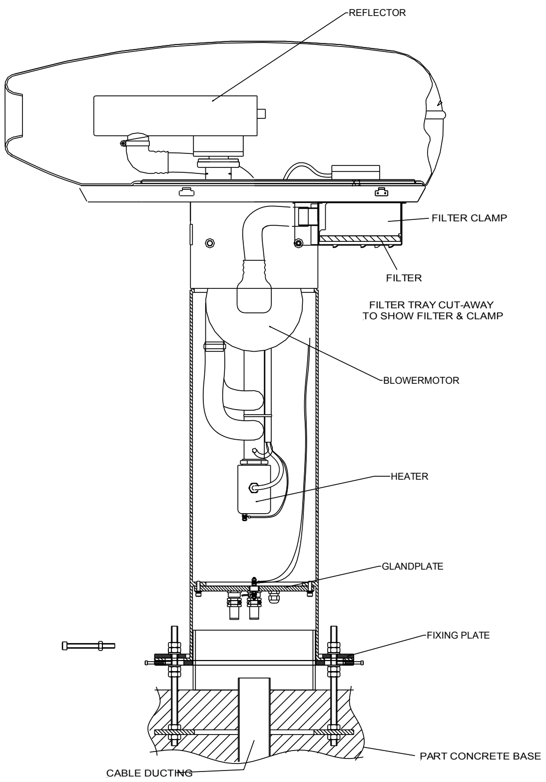
The number of field sites (i.e. pairs of transmitters and reflectors) depends on the requirements and layout of each particular airfield. Usually either two or three field sites are used. Each field site is installed onto a solid concrete base, to ensure stability of alignment of the light source and reflector. Power and communications services are also provided to each field site.

Each transmitter or reflector is contained in a weatherproof housing that incorporates heaters to prevent icing and filtered blown-air systems to prevent contamination of the optics.

The transmitter field site contains the transmissometer light source/detector unit, a BLM (if specified for that field site) and the Field Site Electronics Unit, where processing of IRVR data takes place. It also contains the modem for communication to the rack equipment.



Transmitter Field Site



Reflector Field Site

Rack Equipment

IRVR data from each field site is reported to other system equipment, usually mounted in a 19" rack positioned in the ATC tower. The necessary data links can be wired, fibre optic or wireless. The receiving modems and other system inputs are all mounted on the same rack.

Field site IRVR data is fed to the disseminator, which acts as an internal communication node for the system. The disseminator synchronises to the ATC system clock and also has an internal clock as a back-up. There is a lockable key-switch to change between operating and maintenance modes, and LEDs that indicate comms status. There is also a master alarm light. The disseminator also creates alarm outputs that can be sent to remote stations such as ATC positions.

Disseminator Front Panel

Also mounted in the rack is the Control and Recording Unit (CRU). This provides the interface to the system via a command console. Through this console raw IRVR data may be viewed, as well as the health and status of the system. It is also used to configure the system. The CRU also has an IRVR display with a similar layout as that provided to ATC personnel. It also stores data records internally, as well as to an external back-up.

The rack can include a printer, if written system records are required, or an IRVR display, identical to those described below.

The rack also receives inputs RLI and runway direction settings from the ATC position. This can either be a manual or automatic function.

IRVR, alarm and system status information can all be supplied for integration to AWOS or other Met and ATC systems.

IRVR Displays

Multiple IRVR displays can be driven by the disseminator. These are typically 6.5” panel mounted TFT touch screens, which include self-test and data validation routines. IRVR data is displayed in bands (as per ICAO Doc 9328), colour coded and with trends and the selected runway clearly marked. As an option, ILS status can also be indicated.

IRVR Display Layout

The displays can trigger visual and audible alarms when fog/LVP thresholds are crossed.

Standards

AGIVIS 2000 complies with all relevant international standards, including:

- ICAO Annex 3 (Meteorological Service for International Air Navigation)
- ICAO Manual on Automatic Meteorological Observing Systems at Aerodromes (Doc 9837)
- ICAO Manual of Aeronautical Meteorological Practice (Doc 8896)
- ICAO Manual of Runway Visual Range Observing and Reporting Practices (Doc 9328)
- WMO CIMO Guide

The system also complies with a number of national standards issued locally by countries worldwide, including:

- UK CAA CAP 746 (Meteorological Observations at Aerodromes)
- UK CAA CAP 670 (Air Traffic Services Safety Requirements)

Installation and Support

AGI offers a full installation service, which includes comprehensive site acceptance testing to demonstrate full functionality of the system. Factory-based and on-site training is available for both engineers and system users, and post-installation support and calibration can be provided worldwide. We can also offer a spares package tailored to the needs of each system.

All AGIVIS 2000 systems are covered by a full 2 year warranty.

Specifications

AGIVIS 2000 System	
Accuracy: 50m – 400m	±10m
Accuracy: 400m – 800m	±25m
Accuracy: Above 800m	±10%
Measurement Baseline	20m
Light Source	Halogen Filament
EMC: Emissions	EN 50081-1 Part 1
EMC: Immunity	EN 50082-2 Part 2

Field Sites	
Operating Temperature	-30°C to +35°C
Relative Humidity	100%
Power Requirements	230V ±34.5V, 44Hz to 60Hz

Rack Equipment	
Operating Temperature	0°C to +30°C
Relative Humidity	95% non-condensing
Power Requirements	230V ±34.5V, 44Hz to 60Hz

IRVR Displays	
Operating Temperature	-10°C to +40°C
Relative Humidity	95% non-condensing
Power Requirements	12V DC (an in-line 90V to 264V, 50Hz to 60Hz AC PSU can be supplied)
Resolution	640 x 480
Brightness	800 cd/m^2
Contrast Ratio	600:1
EMC: Emissions	EN 55022 and EN 61000
EMC: Immunity	IEC 61000

AGI is dedicated to the continuous improvement of its products. If specific requirements exist that are not covered by this Technical Description, we are always happy to discuss developments that would allow them to be fulfilled.