VAISALA

A clearer approach to RVR

Principles and solutions for accuracy and reliability

The importance of Runway Visual Range (RVR)

Few types of data are as important to airports and pilots as Runway Visual Range (RVR). Without accurate and reliable visibility information, airports risk not being able to operate runways safely — and at full capacity — in all weather conditions. For categorized airports, an accurate RVR assessment is the most essential factor for enabling air traffic control (ATC) and pilots to make the correct operational decisions.

ICAO documented the importance of RVR as far back as the 1970s, and today it requires automated RVR assessment at all CAT II and CAT III airports. ICAO also recommends it to CAT I airports, many of which readily adopt it for its operational benefits and safety impact.

An airport's decision about what kind of RVR solution to use is especially important. This solution guide offers context and education that can help — as well as a customizable, all-in-one solution suitable for any airport

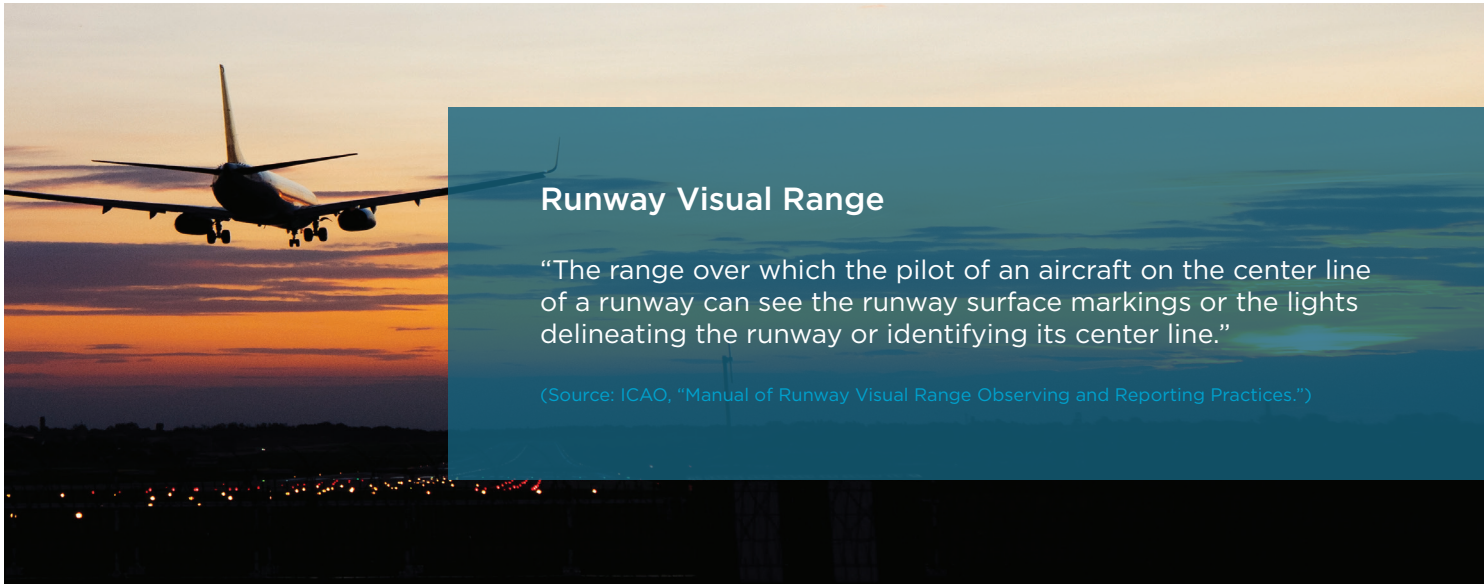
Meets reporting requirements:

ICAO Annex 6, Chapter 1

Categories of precision approach and landing operations				
	CAT IIIB	CAT IIIA	CAT II	CAT I
Runway visual range	≥ 50m	≥ 175m	≥ 350m	≥ 550m

ICAO Annex 3, Attachment A

Operationally desirable accuracy of measurement or observation — RVR	
Runway visual range	± 10m up to 400m
	± 25m between 400m and 800m
	± 10% above 800m



Runway Visual Range

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

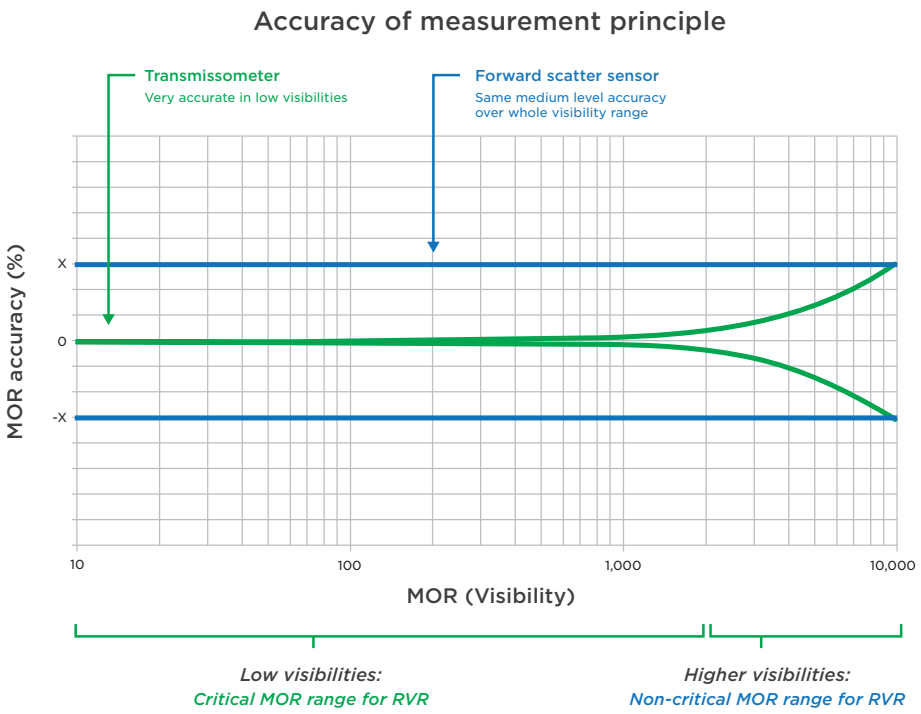
(Source: ICAO, "Manual of Runway Visual Range Observing and Reporting Practices.")

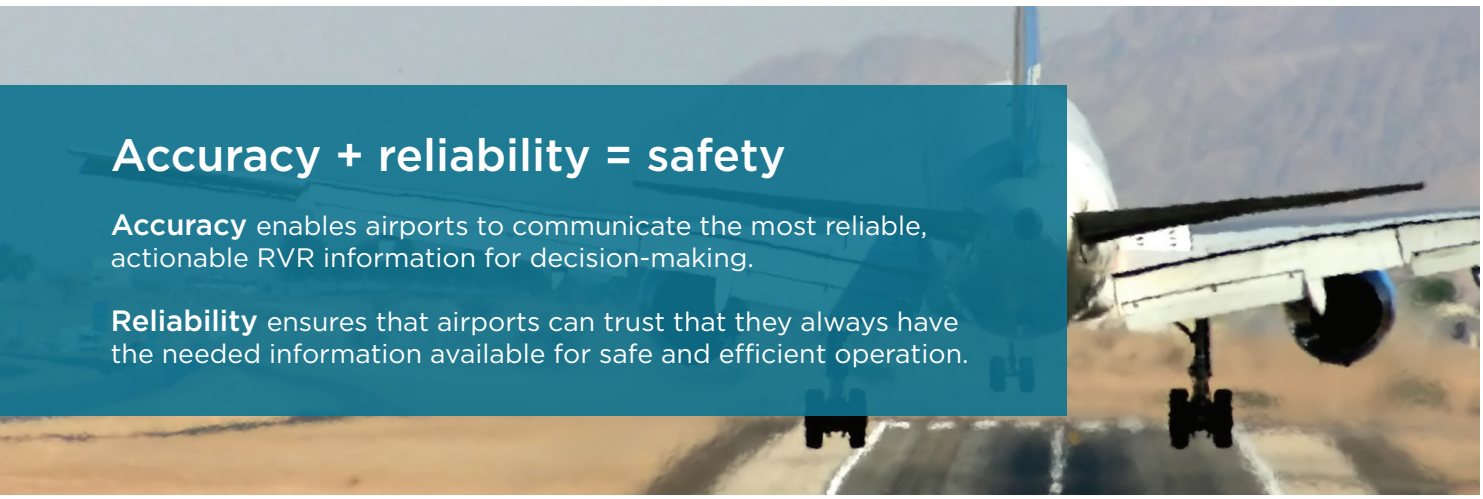
Visibility measurement methods for RVR: Transmissometers and forward scatter sensors

Visibility, technically defined as Meteorological Optical Range (MOR), is a seemingly simple observation that is nevertheless prone to error, and has a direct impact on the given RVR value. Only proven, high-end RVR systems with state-of-the-art sensors can ensure accurate visibility data so airports can operate safely at full capacity, in all weather conditions. Each airport faces a decision about which type of sensor to deploy, since two approaches are widely used.

ICAO has defined transmissometers and forward scatter sensors as the suitable MOR measurement options for RVR assessment at airports. Both technologies satisfy RVR needs and are reliable over long service lives, but they work quite differently and have different characteristics.

Transmissometers provide the best accuracy, especially in the most critical, low-visibility situations. This graph shows MOR accuracy behavior for transmissometers and forward scatter sensors.





Accuracy + reliability = safety

Accuracy enables airports to communicate the most reliable, actionable RVR information for decision-making.

Reliability ensures that airports can trust that they always have the needed information available for safe and efficient operation.

Transmissometer operating principles

A transmissometer sends light between two points to directly measure visibility degradation due to light scattering and absorption effects. This principle is called light attenuation, and it is advantageous because it closely resembles how the human eye works. It allows for very high accuracy, particularly in low-visibility conditions, and it is the best method to measure RVR range from 0 to 2,000m.

Transmissometer technology is suitable for all conditions and air impurity types, including weather phenomena like rain and snow, as well as sand, dust, pollen, and smoke. It also provides very high sample volume, which enhances accuracy. Because of their accuracy, transmissometers are used as the reference sensors for forward scatter sensors.

Transmissometers are also considered fail-safe technologies, meaning that a measurement disturbance will always cause the device to report lower-than-actual visibility. This is a much safer situation than visibility overestimation, which might cause airports and pilots to proceed with dangerous landing approaches.

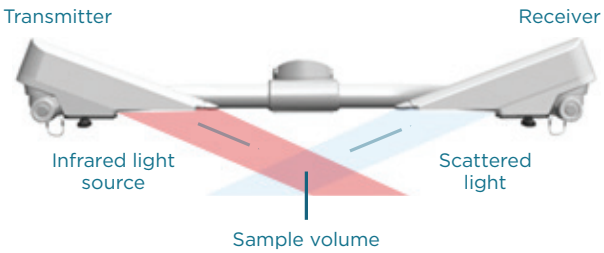
Transmissometer

Direct measurement of the attenuation of light

Forward scatter sensor operating principles

Forward scatter sensors measure the scattering of light between a transmitter and receiver located on the same pole, extrapolating this observation into a broader visibility assessment of the runway area.
This scatter-only measurement is sufficient for many locations because many of the most common visibility-changing phenomena, such as fog and snow, act primarily through scattering rather than absorption.

As noted by ICAO, airports with forward-scatter sensors that are sufficient must still select the best available solution for accuracy and reliability. These devices' error-avoidance features are important, as measurement disturbances can cause forward scatter sensors to report better-than-actual visibility.



Forward scatter sensor

Indirect measurement of scattered light away from focused beam of light

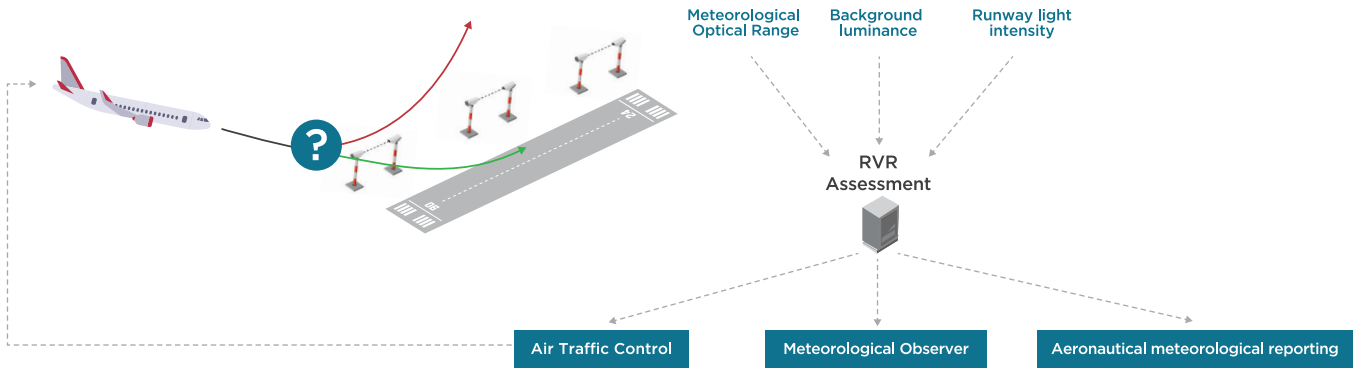
Vaisala AviMet ICAO Compliant Runway Visual Range System

The AviMet ICAO Compliant Runway Visual Range System is a fully automated RVR assessment system that gives airports a single, scalable solution. It can easily be integrated with, or expanded into, a full Vaisala AviMet Automated Weather Observing System (AWOS).

The AviMet RVR system fulfills ICAO requirements, is suitable for any airport, and makes visibility data available to ATC, pilots, and others using the ideal formats and alerting methods. This way, all stakeholders are able to put RVR information to use immediately and effectively — ensuring safe airport operations and full capacity in all weather conditions.

The system works by collecting, processing, storing, and distributing data from various sensors. The central data unit (CDU) takes in data frequently in order to provide 1-minute and 10-minute RVR values as defined by ICAO. Importantly, AviMet can easily integrate duplicate sensors or other system elements for redundancy. With system redundancy, airports can risk losing RVR measurement, invalidating their ICAO compliance, and having to shut down the runway(s).

Vaisala AviMet® ICAO Compliant Runway Visual Range System



Key benefits:

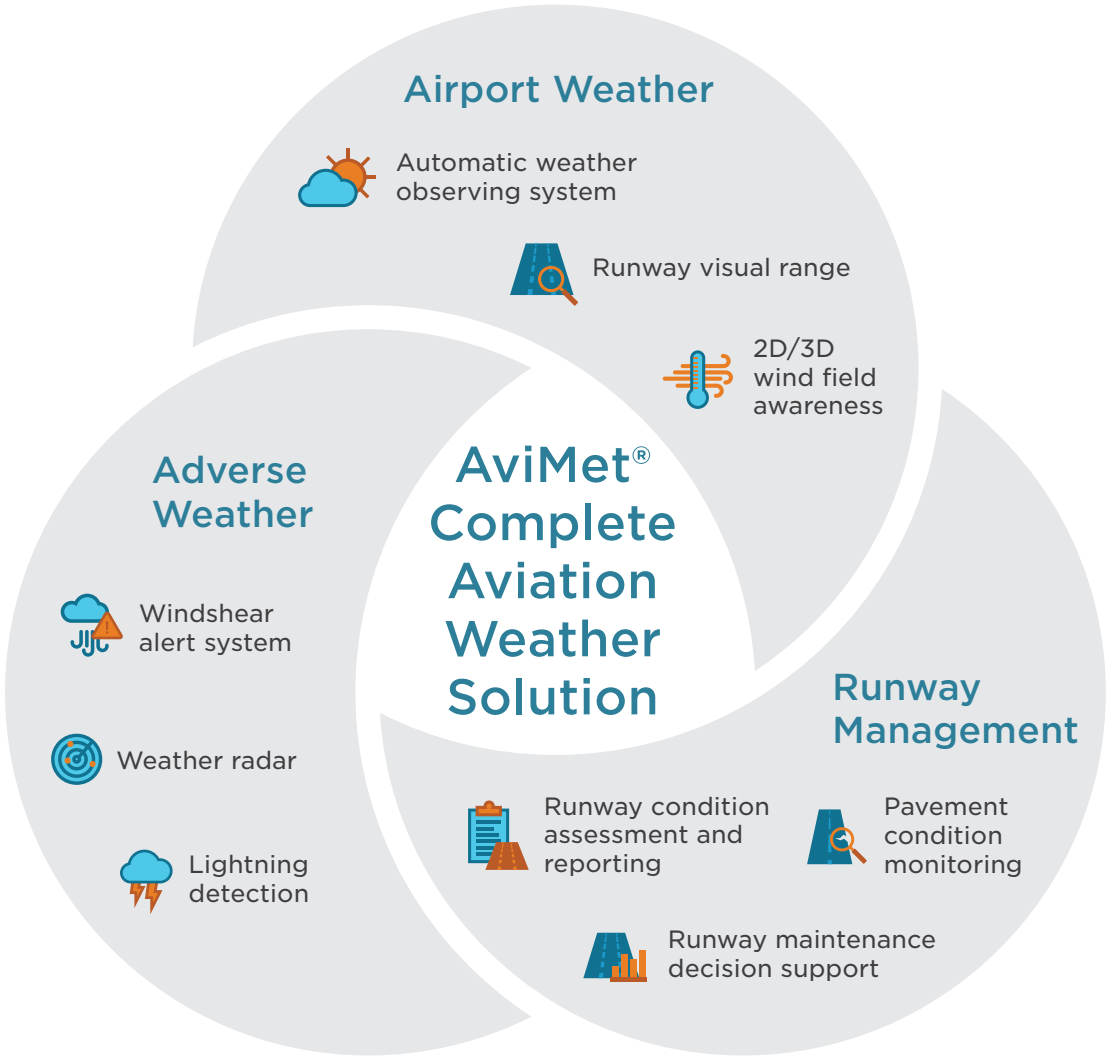
- Fully automated RVR assessment system
- Best-in-class, cost-efficient sensor technology proven over long service lives
- Superior data accuracy and consistency in all weather conditions
- Can be used either as a standalone system or integrated as part of larger Vaisala AviMet AWOS
- Flexible and configurable to meet any airport's needs

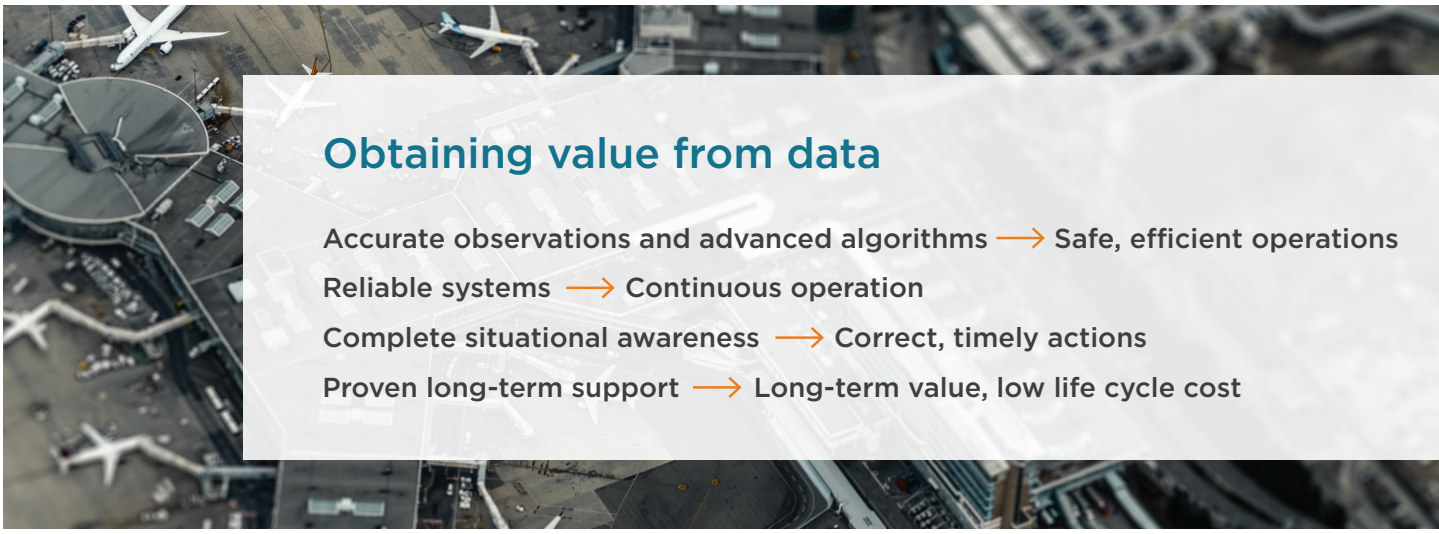
System components:

- Visibility sensor (Transmissometer LT31 or Forward Scatter Sensor FD70)
- Background luminance sensor
- Runway light setting interface
- Central computing unit with AviMet software for RVR calculation
- Workstations for data displays and RVR reporting

Part of the larger AviMet ecosystem

AviMet is the industry's most comprehensive, integrated aviation weather solution. It includes, but is not limited to, RVR. Each of the capabilities in the chart below are addressed with specific Vaisala sensors and systems, which are chosen and easily integrated based on an airport's needs.





Obtaining value from data

Accurate observations and advanced algorithms → Safe, efficient operations

Reliable systems → Continuous operation

Complete situational awareness → Correct, timely actions

Proven long-term support → Long-term value, low life cycle cost

Vaisala visibility sensors: The core technologies for AviMet RVR

Vaisala Transmissometer LT31

The Vaisala Transmissometer LT31 is the most accurate and trusted solution available for automatic measurement of RVR. It is the best choice for airports where accuracy and reliability in critical, low-visibility situations is required. Because of its outstanding technology and performance, the LT31 is the most-installed RVR transmissometer in the world.

LT31 at a glance:

- The highest level of precision possible for RVR sensors in all types of weather
- Exceeds ICAO Annex 3 definition of RVR accuracy
- Advanced features that lower maintenance needs
- Automated to provide maximum uptime with minimal need for skilled technicians or ideal weather conditions
- Provides fail-safe operation by reporting lower-than-actual visibility when the sensor is disturbed

Forward Scatter Sensor FD70 Series

As noted by ICAO, airports where forward-scatter technology is sufficient still must select the best available solution for accuracy and reliability. The Vaisala Forward Scatter FD70 is that solution, and the next-best alternative to transmissometers for accurate and reliable RVR data.

FD70 at a glance:

- Provides industry-leading data accuracy and performance among forward scatter sensors
- Has low maintenance needs and fast repair times courtesy of its modular, rugged design
- Optimized to avoid traditional sources of error, degradations from contaminants and wind, and insect disturbances
- Forward scatter sensors are often used as backup for transmissometer-based RVR systems

The importance of background luminance and runway light intensity

RVR assessment requires reliable and accurate background luminance and runway light intensity information.

Vaisala's LM21 is a precision photometer with a verified photopic spectral response resembling the human eye. It measures the total incoming light, sending this data to the interface unit of a Vaisala transmissometer or forward scatter sensor, after which it is relayed to the AviMet CDU.

For runway light intensity, Vaisala offers the RSI50/51 interface unit, which collects light intensity information from a switch or relay normally located at the ATC tower, converting this data into a message for the CDU.

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www.vaisala.com

Adaptable for any airport, ready to serve you now

The Vaisala AviMet ICAO Compliant Runway Visual Range System provides exceptional reliability, low lifecycle costs, and the assurance of a one-stop, globally trusted vendor. Vaisala's decades of experience and unmatched scientific leadership ensure that as airport needs evolve, so does our ability to immediately and effectively meet those needs.

We know that building an RVR solution goes beyond the technology. It also takes a spirit of partnership and helpful guidance. Whatever your airport size, geography, or climate, Vaisala is ready to assist.

- **45+ years of aviation experience**
- **100+ AviMet system and project deliveries each year**
- **160+ countries served**
- **1,000+ AviMet installed base**

Learn more at vaisala.com/airports.

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