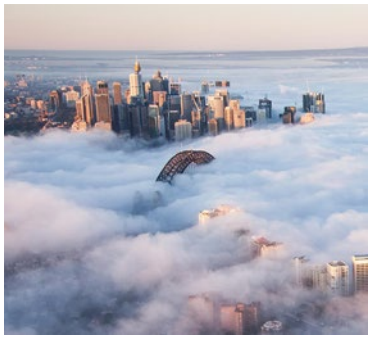
AVIATION WEATHER PRODUCTS

Runway Visual Range



Key requirements for RVR

- Background light level; and
- Intensity of runway lights.

In assessing RVR, no account is taken of the effect on the pilot's vision of such factors as:

- Transmittance of the windscreen;
- Rain on the windscreen;
- Cockpit lighting;
- Pilot exposure to other light sources;
- Physical or psychological state of the pilot;
- Directionality of background luminance; and
- Increase in background luminance from backscatter of aircraft landing lights.

Introduction

Runway Visual Range (RVR) provides pilots, air traffic service (ATS) units and other aeronautical users with information on runway visibility conditions during periods of low visibility. Low visibility is defined by the RVR system as visibilities below 2000m. The most frequent cause of low visibility is due to mist or fog however other common causes include rain, snow, and sandstorms. More specifically, the RVR system assesses whether conditions are above or below a specified operating minima for take-off and landing. In Australia RVR readings from instrumented systems are limited to reduced visibility events due to mist or fog.

Data obtained from the RVR system is one parameter used for assessing the availability of instrument approaches for an aerodrome. RVR is an assessment of the runway visual range and it may not be representative of other areas of the aerodrome such as taxiways. RVR systems are available at some major airports in Australia, such as Sydney and Melbourne, and is planned to be installed at other major airports in the future.

RVR is not an 'observation' or a 'measurement' of a meteorological parameter such as surface wind, temperature or pressure. It is an assessment, based on calculations that take into account various elements including atmospheric, physical/biological and operational factors.

Definitions

Visibility

Visibility for aeronautical purposes is the greater of:

(a) the greatest distance at which a black object of suitable dimensions, situated near the ground, can be seen and recognized when observed against a bright background, which is represented by the meteorological optical range (MOR);

(b) the greatest distance at which lights in the vicinity of 1 000 candelas can be seen and identified against an unlit background, which is represented by RVR or Runway Visibility.

Note: Given the distances are measured using different measurement techniques the two distances may be different.

Runway Visual Range (RVR)

Runway visual range is the range over which the pilot of an aircraft on the centre line of a runway can see the runway surface markings or the lights delineating the runway or identifying its centre line. In Australia RVR is used exclusively in relation to RVR measured by an instrumented system.

View from the cockpit when the aircraft is on the centre of a runway indicating Runway Visual Range or runway visibility.

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Note: RVR applies only for the visual range on the runway. The conditions during approach may be significantly different. Until the pilot is actually on the runway, the view from the cockpit down to the ground represents rather a **slant visual range (SVR)** and as such may be affected by fog densities varying with height.

Runway Visibility (RV)

Runway visibility is the distance along a runway over which a person can see and recognise a visibility marker or runway lights. In Australia the term 'runway visibility' is used by ATC, pilots or ground personnel authorised to report visibility along a runway as determined by a ground observer.

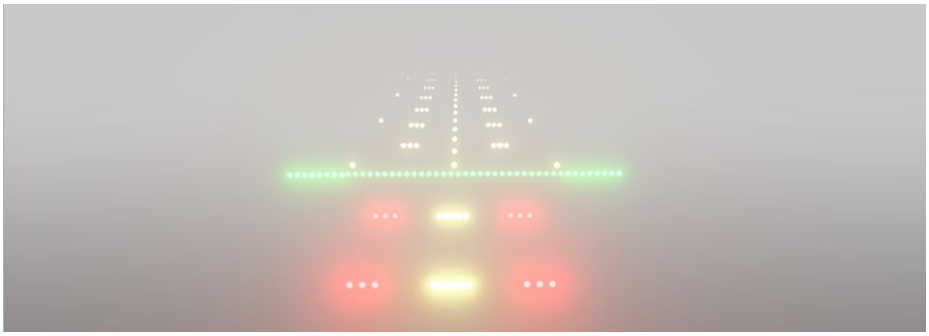
Meteorological Optical Range (MOR)

Meteorological optical range is defined as is the greatest distance at which a black object of suitable dimensions, situated near the ground, can be seen and recognized when observed against a bright background. In Australia MOR is measured by a visibility sensor or observed by a qualified meteorological observer.

View of an airport indicating the prevailing visibility.

Slant Visual Range (SVR)

The visual range of a specified object or light along a line of sight which differs significantly from the horizontal; for example, the visual range of ground objects or lights as seen from an aircraft on the approach.



Slant visual range of the runway as seen from an aircraft on the approach.

Measurement or observing practices

There are currently two main observing techniques in use for the assessment of visibility along a runway; RVR, the instrument technique and RV, the human observer technique.

Instrumented technique

Transmissometers are instruments used to measure the light transmittance of the atmosphere. RVR is then calculated taking into account the measured quantity (i.e. transmittance), runway light levels and the expected detection sensitivity of the pilot's eye under the prevailing conditions of background luminance.

Transmissometer at Perth Airport.

Human observer technique

The human observer technique to measure runway visibility relies upon a trained observer at the aerodrome to count the number of runway lights or markers visible from a specified observing position near the runway in accordance with CASA Manual of Standards Part 139. This number is converted to a runway visibility, making due allowance for the differences in light intensity and background luminance from the different viewing positions of the observer and the pilot. Sometimes, where it is difficult to count runway lights, observations are made on a special row of runway or other lights set up near the runway.

Limitations of using RVR data

RVR use has practical limitations as follows:

- RVR is a value which typically only has meaning for the portions of the runway associated with the RVR report (TDZ, MID, or END).
- RVR may vary with runway light step settings.
- RVR may not be representative of actual visibility along portions of the runway due to the location of the transmissometer or due to variable weather conditions (e.g. patchy fog). RVR is an instrumentally derived value that has operationally significant limitations and can be greater than or less than the actual visibility available to a pilot at typical flight deck eye height (ground level) at the runway. This is particularly true at night, if runway lights are not at settings standard for the prevailing conditions, or if unusual daylight conditions are experienced such as when a runway is aligned with a sunrise or sunset condition, in shallow or patchy fog.

Due to its inherent weaknesses, the human observer method is typically only used under the following circumstances:

(a) at an aerodrome with low frequency of occurrence of fog, or any other weather phenomena reducing RVR below 1 500 m (not recommended for Categories II & III);

(b) for non-precision approach runways; and

(c) as a back-up in case of failure of the instrumented system (not recommended for Categories II and III).

Instrumented Approach and landing

Category	Height	Visibility	RVR
I	≥ 200ft (60m)	≥ 800m	≥ 550m
II	≥ 100ft (30m) but < 200ft (60m)	Not applicable	≥ 300m
IIIa	< 100ft (30m) or no decision height (i.e. 0ft)	Not applicable	≥ 175m
IIIb	< 50ft (15m) or no decision height (i.e. 0ft)	Not applicable	≥ 50m but < 175m
IIIc	No decision height (i.e. 0ft)	Not applicable	No RVR limits (i.e. 0m)

Content from ICAO Annex 6 and Annex 14.

Reporting procedures

RVR information is included in METAR/SPECI whenever either the prevailing visibility or RVR is less than 1 500 m.

The RVR at a runway's threshold in the METAR/SPECI is given by **RDD[r]/[n] V1V1V1V1 [V[n]V2V2V2V2][i]**

RVR is reported in steps of:

(a) 25 metres when the RVR is less than 400 metres;

(b) 50 metres when the RVR is 400 metres or more, but less than 800 metres; and

(c) 100 metres when the RVR is 800 metres or more.

Any observed value which does not fit the reporting scale is rounded down to the nearest resolution value. RVR can be assessed from more than one location along the runway, i.e., the value representative at touchdown zone (TDZ), mid-point (MID) and roll - out portion (END). However, in METAR/SPECI only the value representative of the touchdown zone is given, and no indication of location on the runway is included.

The RVR is also transmitted to aircraft by ATS units, via data link (i.e. D-ATIS, D-VOLMET) or via aeronautical broadcasts (i.e. ATIS, VOLMET).

When the RVR is to be reported and RVR data is unavailable, it will be reported as **R**DD////

CODE	DESCRIPTION
R	A fixed indicator, denoting that RVR information follows
DD	Designator for the runway for which RVR is being reported
r	Parallel runways will be distinguished by the letter L, C or R indicating the left, centre or right runway, respectively.
/	A fixed separator
n	will only be reported when the RVR is assessed to be one of the following: • greater than 2000 metres, in which case n will be reported as P, and the group will be reported as P2000; • greater than the maximum value which can be assessed by the system, and this maximum value is 2000 metres or less, in which case n will be reported as P, and VVVV will report the maximum value, e.g. P1700; • less than 50 metres, in which case n will be reported as M, and the group will be reported as M0050; • less than the minimum value which can be assessed by the system, and this minimum value is 50 metres or more, in which case n will be reported as M, and VVVV will report the minimum value, e.g. M0100.

Common weather phenomena reducing visibility

Phenomenon	Typical MOR values (m)
Fog	30 – 1000
Mist	1000 – 5000
Haze	1000 – 5000
Drizzle	> 1000
Rain	> 1000

Content from ICAO Doc 9328 – Manual of Runway Visual Range Observing and Reporting Practices.

CODE	DESCRIPTION
V1V1V1V1	Gives the last 10-minute average RVR value, except when the RVR has varied significantly during the 10 minutes in which case it gives the minimum 1-minute average value during this period (and is followed by V[n]V2V2V2V2).
V	A conditional indicator, included only when RVR has varied significantly during the last 10 minutes.
V2V2V2V2	Gives the maximum one-minute average value during the last ten minutes. Only included when RVR has varied significantly during the ten minutes.
i	Gives any distinct RVR tendency over the sampling period – either U (upward), D (downward) or N (nil). Is not reported if tendency not available.

SPECI YMML 221945Z 14004KT 0600 R16/0600D R27/0550N FG ////// 08/08 Q1026 RMK RF000.0/001.8

R16/0600D Runway visual range on runway 16 threshold is 600 metres, and is trending down.

SPECI YMML 221945Z 14004KT 0600 R16/0600D R27/0550N FG ////// 08/08 Q1026 RMK RF000.0/001.8

R16/0600D Runway visual range on runway 16 threshold is 600 metres, and is trending down.

R27/0550N Runway visual range on runway 27 threshold is 550 metres; nil trend.

SPECI YSSY 052000Z 33006KT 0500 R34L/0600N R34R/1200V1800D FG ////// 16/15 Q1006 RF000.0/000.0

R34L/0600N Runway visual range data on runway 34L threshold is 600 metres; nil trend.

R34R/1200V1800D Runway visual range on runway 34R threshold is 1200 metres with variation to 1800 metres during the last 10 minutes and is trending down.

SPECI YSSY 052000Z 33006KT 0500 R34L/0600N R34R/1200V1800D FG ////// 16/15 Q1006 RF000.0/000.0

R34L/0600N Runway visual range data on runway 34L threshold is 600 metres; nil trend.

R34R/1200V1800D Runway visual range on runway 34R threshold is 1200 metres with variation to 1800 metres during the last 10 minutes and is trending down.

SPECI YMML 06182000Z 12005KT 0500 R16///// FG ////// 07/07 Q1022 RMK RF000.0/000.0

R16///// Runway visual range data on runway 16 is not available.

References

ICAO Annex 3 – Meteorological Services for International Air Navigation
ICAO Annex 6 – Operation of Aircraft, Part I, International Commercial Air Transport – Aeroplanes
ICAO Annex 14 – Aerodromes, Volume I, Aerodrome Design and Operations
ICAO Doc. 8896 – Manual of Aeronautical Meteorological Practice
ICAO Doc. 9328 – Manual of Runway Visual Range Observing and Reporting Practices
ICAO Doc. 9365 – Manual of All Weather Operations
ICAO Doc. 9837 – Manual on Automatic Meteorological Observing Systems at Aerodromes
CASA Manual of Standards Part 139 – Aerodromes

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