

2015



# Meteorology

## METAR de-coding

Made by: Sebastian Rekdal | Chief of Training Norway

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# Chapter 1. General

## 1.1 Purpose

The main purpose of the *ATC Training Manual Norway FIR* is to provide standardized local and general procedures for controller in Norway FIR. This document is made in respect of all air traffic controllers who needs help to understand meteorology. This document provides standardized meteorology (METAR and de-coding of METAR) within Europe (*source: EuroControl*).

We hope that this document can help you improve your aviation knowledge. Our goal is to make you understand the basics behind a controller unit who is controlling within Europe (more specific: Norway FIR).

On behalf of the crew in VATSIM Scandinavia and the creator of this document, Sebastian Rekdal (Chief of Training Norway), we wish you good luck with your air traffic control (ATC) training on VATSIM, and welcome to VATSIM Scandinavia!

## 1.2 Credits

The *ATC Training Manual Norway FIR* was created by VATSIM Scandinavia. Original appendices published October 10, 2014 was made by Sebastian Rekdal (Chief of Training Norway). Thanks to:

- Sebastian Rekdal | Chief of Training Norway ([accsca23@vatsim-scandinavia.org](mailto:accsca23@vatsim-scandinavia.org))

## 1.3 Feedback and contact information

If you have any questions, comments, suggestions or complains regarding this manual, please do not hesitate to contact us. Please let us know about your concern...

- **Chief of Training Norway** (Sebastian Rekdal): [accsca23@vatsim-scandinavia.org](mailto:accsca23@vatsim-scandinavia.org)
- **Director of Norway FIR** (Daniel Klepp): [accsca4@vatsim-scandinavia.org](mailto:accsca4@vatsim-scandinavia.org)
- **Discussion forum** (need forum-account): <http://www.forum.vatsim-scandinavia.org/>

If you find any errors, outdated procedures or typos in this manual, please do not hesitate to E-mail us: [accsca23@vatsim-scandinavia.org](mailto:accsca23@vatsim-scandinavia.org). Help us keep the documents clean, realistic and updated!

# Chapter 2. Introduction

## 2.1 Meteorology Introduction

Weather knowledge is essential in aviation: Visibility, air pressure, thunderstorms, temperature, clouds, rain and dew point etc.

All affect flying in one way or another. You are most affected by weather when flying VFR, but also when flying IFR, there are restrictions how bad weather can be before plans must be changed. In this section, we'll look into how weather is reported, but not how weather affects flight.

There are many acronyms and concepts in weather reporting, which we will learn throughout the rest of this document. Below we'll cover rather completely the weather report. There are many acronyms and concepts. You need not know them all from the beginning, but you must be able to get the name of the airport, wind and air pressure. Since you as a controller read the weather report to the pilots, you'll soon learn the rest of the acronyms.

# Chapter 3. METAR de-coding

## 3.1 METAR – Aviation Routine Weather Report

*\*As a Student you should have knowledge about what a METAR is and recognize the most essential parts (Where, when, winds and QNH) by heart and know where to find information about the other elements. As a Senior Student you should be able to read out a whole METAR.*

At major airports, weather observations are made every half hour, day and night.  
The weather in the METAR is the weather observed 10 minutes before the report.

The following is part of a METAR:

- Airport (for example ENGM for Oslo airport Gardermoen)
- Observation time (day of the month and time followed by Z)
- Wind at ground level: direction, speed and unit (knots)
- Meteorological visibility (in meters)
- Runway Visual Range (RVR) if visibility is below 1500 m.
- Present weather
- Clouds, amount, type and base
- Air temperature and dew point
- QNH (air pressure), preceded by Q.
- Other information, for example wind change.
- Landing forecast, trend.
- The following is a brief breakdown of some of the basic METAR elements:

**METAR** ENGM 121755Z 21016G24KT 180V240 1500 R19R/0600N +RA BR BKN015 OVC025 06/04 Q1005 BECMG 9999=

<b>ENGM</b>	ICAO IDENTIFICATION	Four letter ICAO Code.
<b>121755Z</b>	DATE and TIME	First two digits are the date, followed by the hour and minutes in UTC time (Z).
<b>21016G24KT</b>	WINDS	Normally a 5-digit grouping (6-digits if speed is over 99 knots). The first 3-digits is the direction, the next two or three is the speed. G indicates gusts with the highest gust report after it.  <b>Note: International stations may use meters per second (MPS) or kilometers per hour (KMH) and code the wind speed accordingly.</b>
<b>180V240</b>	WINDS	V indicates variable wind direction.
<b>VRB04KT</b>	WINDS	VRB indicates variable wind speed 3 knots or less.
<b>1500</b>	VISIBILITY	Prevailing visibility reported in Meters. 2800 represents 2,800 meters and 9999 represents a visibility greater than 10 km.
<b>R19R/0600N</b>	RVR VALUES	"R" indicates the group followed by the runway heading (06) and the visual range in meters. The report might include a "U" for increasing or "D" for decreasing values.
<b>-RA BR</b>	WX PHENOMENA	This example shows light rain with mist. Some main weather codes: SN=Snow, GR=Hail, SH=Showers, FG=Fog, +=Heavy, -=Light
<b>BKN015</b>	SKY CONDITIONS	Shows the amount of sky cover and cloud base height. <i>FEW</i> = less than 1/8 <i>SCT</i> = 1/8 till 3/8 <i>BKN</i> = 4/8 till 7/8 <i>OVC</i> = 8/8  The three digits indicate the cloud base height in hundreds of feet.  The cloud ceiling is lowest height where at least half of the sky is covered, hence the lowest BKN or OVC.
<b>06/04</b>	TEMP / DEW POINT	Reported in two, two-digit groups separated by a slant ("/"), in degrees Celsius. Temperature and dewpoint below zero are prefixed with a "M".
<b>Q1005</b>	ALTIMETER / QNH	QNH reported in a four-digit format in HectoPascals (Hpa) preceded with a "Q". In i.e. USA altimeter reports are in inches of mercury.
<b>BECMG 9999=</b>		How the weather is going to develop in the time the METAR is current (2 hours). You can here find Sky conditions, Visibility, Wind, Weather <i>TEMPO</i> = Temporary change in weather <i>BECMG</i> = Permanent change in weather

### 3.1.1 Wind

Wind is measured 10 m above ground.

The direction is from where the wind is coming. The precision is 10 degrees. In the METAR, the wind velocity is a 10 minute average and given in knots (kt). If there are gusts 10 KT over the average value, this is reported as well. The gusts are reported as G17 and should be read "gusting" or "maximum".

When flying, the wind direction in itself isn't the most important factor, but it's the side-wind component. If the wind direction varies more than 60 degrees and if there's more than 3 kt wind, it is reported as V (variable). If there is less than 3 knots wind and it varies, this is reported as VRB. Calm is reported as 0000KT.

Example:

- VRB02KT – *variable two knots*
- 25020KT – *two five zero degrees two zero knots*
- 15015G25KT – *one five zero degrees one five knots maximum (or gusting) two five knots*
- 24018G35KT 160V290 – *two four zero degrees one eight knots maximum (or gusting) three five knots variable between one six zero and two niner zero degrees*

### 3.1.2 Visibility

Visibility is often of vital importance. There are three ways of obtaining the visibility:

- Flight Visibility is the visibility forward from the cockpit of an aircraft in flight.
- The Ground Visibility, which is given in the ATIS and METAR, is the visibility at an aerodrome, as reported by an accredited observer.
- Ground visibility reading, which is measured automatically.

The two latter is the distance measured to a large unlit object, where the contours of this object can be seen.

Visibility is affected by moisture, ice crystals, salt or dust in the air.

Visibility in darkness is today most often measured with infrared light.

Visibility is measured in steps up to 10 km.

Visibility below 50 m is written as 0000 and 10 km or more as 9999.

Visibility below 5000 m is given in m, and above in km.

Example:

- 450 – *visibility four five zero meters*
- 1500 – *visibility one five zero zero (or one thousand five hundred) meters*
- 9999 – *visibility more than ten kilometers*
- Special case: 1800N 7000S – *visibility to north one eight zero zero meters, to south seven kilometres.*

### 3.1.3 Runway Visual Range (RVR)

Runway visual range is only given if the visibility and/or the RVR (Runway Visibility Range) is less than 1500 meters. The RVR is prefixed by the letter R followed by runway designator, then a slash (/) followed by the RVR in meters. The lowest value for RVR that may be stated is 50 meters, or the lowest limit for the system, if RVR is lower than that, the letter M will be used after the slash, as in this example: R36/M0050, meaning that for RWY36 the RVR is less than 50 meters.

If the RVR is more than 1500 meters, or more than the upper limit for the system used for measuring, the letter P will be used to prefix the RVR value. (Example R19/P2000, R19/P1500)

If the RVR is measured by instruments, it is usually the mean RVR over ten minutes that is given. If the RVR varies during these 10 minutes, this is indicated by giving minimum and maximum values, separated by an indicator:

*Example: R36/0300V750D: Runway 36 has an RVR of minimum 300 meters, maximum 750 meters, but the RVR is going down (D).*

If the RVR has a tendency either up or down, or no tendency, this is notified by the use of the letters U (up), D (down) or N (no change).

*Example: R01/0900U: Mean RVR of 900 meters and the RVR is improving.*

Other RVR codes:

- M: *visibility is below what can be measured, or below 50m*
- P: *RVR is more than 1500 m*
- V: *RVR varies*
- U: *RVR is going Up*
- D: *RVR is going Down*

Examples:

- R29L/0700 – *R-V-R two niner left seven zero zero meters*
- R19R/M0150D – *R-V-R one niner right below one five zero meters going down*
- R26/0350V0600U – *R-V-R two six variable between three five zero and six zero zero meters going up*

### 3.1.4 Weather Phenomena

Current weather is included in the METAR. It is abbreviated with two letters. If this isn't enough, the abbreviations can be combined. The abbreviations are listed at the end of this chapter. Some abbreviations can be preceded with a "+" (plus) or "-" (minus), this lists the intensity. VC means Vicinity, which means within 8 km from the airport. Exception: thunder and cumulonimbus clouds. Sometimes the recent weather is also reported, in this case "RE" precedes the weather condition.

Examples:

- SN BLSN – *Snow and blowing snow*
- +FZDZ FG – *Heavy freezing drizzle with fog*
- RESN – *Recent snow*

### 3.1.5 Clouds

There are a number of reported clouds types, but only two are important to differentiate: Cumulonimbus (CB) and Towering Cumulus (TCU). Otherwise, only the fraction of sky covered by clouds is measured. This was previously reported in 1/8's, but nowadays this is described in words:

- 0/8: Sky clear (*SKC*)
- 1-2/8: Few (*FEW*)
- 3-4/8: Scattered (*SCT*)
- 5-7/8: Broken (*BKN*)
- 8/8: Overcast (*OVC*)

The cloud base above the airport's reference height AGL (Above Ground Level) is measured in hundreds of feet. 001 means 100 ft, 012 = 1200 ft and 120 = 12000 ft. Vertical visibility is reported as VV, and if this is not measured VV///.

Examples:

- BKN002 – *Broken two hundred feet*
- SCT013 BKN120 – *Scattered one thousand three hundred feet broken one two thousand feet.*
- SCT035TCU – *Scattered three thousand five hundred feet, towering cumulus.*

### 3.1.6 CAVOK

CAVOK, or *Ceiling and visibility OK*, replaces visibility, weather and clouds if: visibility  $\geq 10\text{km}$ ; no cloud below 5000 ft (1500m) or below the highest minimum sector altitude, whichever is greater and no CB or TCU (Cumulonimbus); and no precipitation, TS, DS, SS, MIFG, DRDU, DRSA, or DRSN.

The full readout of CAVOK is "Ceiling and Visibility OK". The most common is the latter, but the most correct ought to be the first. This is because 'ceiling' means BKN or OVC when it comes to clouds and the definition of CAVOK is that NO clouds should be present below 5000ft.

### 3.1.7 Temperature and dew point

The air temperature is measured in degrees Celsius. If below 0, it is preceded by an M. The dew point is defined as the temperature the air must be cooled to, to get saturation, i.e. relative humidity 100%. If below 0, it is preceded by an M.

Dew point is important to the pilot since this value gives information about visibility, clouds and together with the temperature indicates the risk of ice-formation. The closer the temperature and dew point are, the more humidity is in the air and the worse is the visibility.

The difference between temperature and dew point is called spread. If you calculate SPREAD x 400ft you will get the lowest cloud base.

Example:

- 02/M04 – *Temperature two dew point minus four*

### 3.1.8 Air Pressure - QNH

As described in other sections in this manual, the air pressure is vital to know, since it affects the altitude measuring system. Air pressure can be measured in different ways, and relative different levels. QNH is air pressure at sea level (or reduced to sea level in standard atmosphere if it's measured at another point).

QFE is air pressure at the airport. A high value means high air pressure and vice versa. Standard pressure is 1013.25 hPa or 29.92 inch Hg.

In the METAR, the value is preceded by a Q if the unit is hPa and A if it's inch Hg. Q is used in Europe.

Example:

- Q0987 – *Q-N-H niner eight seven*

### 3.1.9 Trend

The trend prognosis should indicate expected changes within next two hours.

There are three MAIN concepts used in Trend:

- Becoming (BECMG)
- Temporary (TEMPO)
- No Significant Change (stable) (NOSIG)
- The first two can be given with a time reference.

Examples:

- BECMG FM1250 TL1340 – *Becoming from 1250 till 1340 (the change will take place between 12:50 to 13:40)*
- BECMG AT 1400 – *Becoming at 1400 (will change at 14:00)*
- TEMPO FM 1400 – *Tempo from 1400 (One or more changes shorter than one hour, from 14:00 to two hours after the METAR was reported.)*

Additional Trend prognosis can be From, To and At.



### 3.1.10 Runway Conditions

Runway Condition is not always included in a METAR. It is only when the conditions on the runway might affect aircrafts landing and departing. First the runway number is indicated. This is done with the runway two digit numbers. If the report covers all runways at the airport, "88" is reported. Repeats of earlier given information is indicated with "99".

The runway report is given as AABCDDEE as follows:

#### AA: Runway

01 – 36 Runway (Left if parallel)  
51 – 86 Right runway (if two parallel)  
88 All runways at airport

#### B: TYPE OF DEPOSIT

0= CLEAR and DRY  
1= DAMP  
2= WET or Water Patches  
3= RIME or FROST (<1mm)  
4= DRY SNOW  
5= WET SNOW  
6= SLUSH  
7= ICE  
8= COMPACTED or ROLLED SNOW  
9= FROZEN RUTS or RIDGES  
/= TYPE of DEPOSIT NOT REPORTED, e.g due to RWY clearance/de-icing in progress

#### C: EXTENT OF CONTAMINATION

1=10% or less of RWY covered  
2=11-25% of RWY covered  
5=26-50% of RWY covered  
9=51-100% of RWY covered  
/= NOT REPORTED e.g due to RWY clearance or de-icing in progress.

#### DD: DEPTH OF DEPOSIT

00= less than 1mm  
01 to 90= depth in mm, e.g 23=23mm  
92= 10cm  
93= 15cm  
94= 20cm  
95= 25cm  
96= 30cm  
97= 35cm  
98= 40cm  
99= RWY not operational due to snow, slush, ice, large drifts or RWY clearance. Depth not reported.  
//= Depth operationally not significant e.g with ice or rolled snow, or not measurable e.g RWY wet.

#### EE: BRAKING CONDITIONS

##### FRICITION COEFFICIENT

Reported figures from 01 to 90 represent FC, e.g 05=FC 0.05, 28=FC 0.28

##### BRAKING ACTION

91= POOR  
92= MEDIUM/POOR  
93= MEDIUM  
94= MEDIUM/GOOD  
95= GOOD

### 3.2 VMC - Visual Meteorological Conditions

Please note that the VMC minima differ between countries and you have to refer to your local vACC to get the minimums for your country. If no such values are available you can use the ones below.

During a VFR-flight certain VMC-minima, i.e. certain limits for visibility and cloud base has to be fulfilled. These limits depend on what altitude and in what airspace the flight is conducted. A pilot may not fly VFR if the weather is below these minima.

Clearance to fly below the minima as special-VFR can be obtained by ATC, but such a clearance can only be given for flights within a CTR and is only valid for an approach or departure to or from the airport when the weather is above minima outside the CTR.

The opposite of VMC is instrument metrological conditions (IMC), which is considered to prevail whenever VMC minima aren't be met.

In our virtual world ATC and pilots may have different weather on the same spot and time because of software and updates from servers. It is therefore good practice to leave the decision if a flight shall be cancelled or postponed due to VMC to the pilot.

#### 3.2.1 VMC Minimums

	Class B	Class C, D & E
<b>Visibility</b>	At or above FL100: 8 km Below FL 100: 5 km	At or above FL100: 8 km Below FL100: 5 km
<b>Clouds</b>	Clear of clouds	Horizontal distance minimum 1500m Vertical distance minimum 300m
	Class F	Class G
	Above 3000ft MSL or 1000ft AGL whichever is higher	At or below 3000ft MSL or 1000ft AGL whichever is higher
<b>Visibility</b>	5 km	3 km
<b>Clouds</b>	Horizontal distance minimum: 1500m Vertical distance minimum 300m	Clear of clouds and ground in sight

### 3.3 Figure METAR Reference

-	Light (intensity)	<b>TCU</b>	Towering cumulus
+	Heavy (intensity)	<b>TL</b>	To (time)
<b>AT</b>	At (time)	<b>TS</b>	Thunderstorm
<b>BC</b>	Patches	<b>V</b>	Variable wind
<b>BECMG</b>	Becoming	<b>VC</b>	In vicinity
<b>BKN</b>	Broken	<b>VV</b>	Vertical Visibility
<b>BL</b>	Blowing	<b>WS</b>	Windshear
<b>BR</b>	Mist		
<b>CAVOK</b>	Ceiling And Visibility OK		
<b>CB</b>	Cumulonimbus		
<b>DR</b>	Low drifting		
<b>DZ</b>	Drizzle		
<b>FEW</b>	Few		
<b>FG</b>	Fog		
<b>FM</b>	From (time)		
<b>FU</b>	Smoke		
<b>FZ</b>	Freezing		
<b>G</b>	Wind Gusts / Maximum		
<b>GR</b>	Hail		
<b>GS</b>	Snow grain		
<b>HZ</b>	Haze		
<b>IC</b>	Diamond dust		
<b>KT</b>	Knots		
<b>MI</b>	Shallow		
<b>NOSIG</b>	Nil significant change		
<b>NSW</b>	Nil significant weather		
<b>OVC</b>	Overcast		
<b>PL</b>	Ice pellets		
<b>PR</b>	Partial		
<b>Q</b>	QNH		
<b>RA</b>	Rain		
<b>RE</b>	Recent		
<b>SCT</b>	Scattered		
<b>SG</b>	Snowgrains		
<b>SH</b>	Showers		
<b>SKC</b>	Sky clear		
<b>SN</b>	Snow		

