

# MISCELLANEOUS

These charts are for training purposes only  
and not to be use for flight

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**INTRODUCTION TO INDOAVIS  
AERONAUTICAL CHART  
USER'S GUIDE**

English Version

**MISCELLANEOUS**

## MISCELLANEOUS

### INTRODUCTION

In the design of a map or a product, Indoavis has been providing calculate software that is needed in the manufacture of a product. Calculate itself is interpreted as a count to make a deliberate purpose, or design\*. Or a calculation is a deliberate process that transforms one or more inputs into one or more results, with variable change. [sample: count Latitude and Longitude, calculate the True Air Speed, altitude MORA count or calculate Obstacle in an airport.

Indoavis widely Calculate recording needs within the IEDs. IEDs are Indoavis Electronic Data System is an electronic data center that contains a variety of information especially data Aeronautics and topography. The Calculate function consists of <http://www.indoavis.net> or <http://www.indoavis.co.id>

### INDOAVIS ELECTRONICS CALCULATION

1. [Angle](#) - Angle conversions
2. [Great Circle](#) – Latitude and Longitude Calculations
3. [Straight-in Descent](#) - PAN-OPs calculations
4. [HGT to MORA](#) – Shuttle Radar Topography Mission to MEF Calculations
5. [TAS](#) - True Air-Speed calculations
6. [Obstacle](#) - AD Obstacle check

### UNITS MEASURE

*The Indoavis Standards and Recommended Practices*

#### **DISTANCE**

- Distance in nautical miles (except visibility in meters)
- Runway Dimension in meters
- Elevation in feet, Mean Sea Level (MSL)
- Ceilings in feet above elevation
- Radials / bearing / heading / courses are magnetic.
- Horizontal Datum : Unless otherwise noted on the chart, all coordinates are referenced to Indonesia UTM (Universal Transverse Mercator), which for charting purposes is considered equivalent to World Geodetic System 1984 (WGS 84)

Unit	Symbol	Definition (in terms of SI units)	
1 centimeter	Cm	0.3937in	0.032808 ft.
1 foot	ft	0.3048 m	12 in
1 inch	in	25.40 mm	2.540 cm
1 kilometer	Km	3280.8 ft	0.540 nm.
1 meter	m	39.37 in	3.280840 ft
1 nautical mile	Nm	6,080 ft	1.852 km.
1 statute mile	Sm	5,280 ft	1.6093 km 0.8684 nm.

*\* Distance vertical (altitude, elevation, height, vertical speed.)*

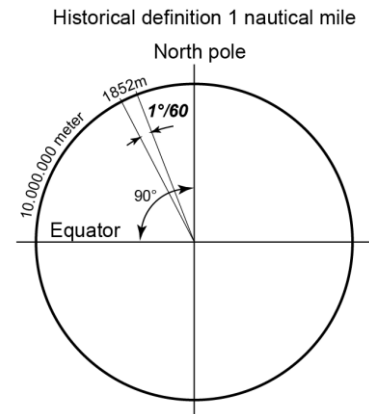
## NAUTICAL MILES

Nautical Miles is a unit of length corresponding approximately to one minute of arc of latitude along any meridian. The nautical mile remains in use by sea and air navigators worldwide because of its convenience when working with charts.

- **1° = 60Nm**
- **1 Nm = 1.852 Km**

Accuracy versus decimal places at the equator

- **1° = 111Km**



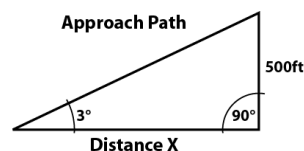
## TANGENT OF THREE (3°) Degrees

Show a practical application of Trigonometry in the aviation environment.

Background: When approaching an airport, pilots must learn to maneuver their aircraft visually, so that a stabilized approach to the runway can be flown at a constant approach angle.

- Precise approach planning insures a smooth transition to a landing within the Touchdown Zone of the runway.
- Pilots must sometimes execute visual approaches that are varied in size, shape, and angle based upon a variety of factors such as: other aircraft, obstructions, noise abatement, or prevailing weather conditions. The standard approach angle however, is 3°. This 3° angle is the standard approach angle integrated into Instrument Landing Systems (ILS)
- Visual Approach Slope Indicators (VASI)
- installed at many airports. When flying a normal traffic pattern, the aircraft is maneuvered so that the final approach is intercepted at an altitude of 500 feet above the elevation of the airport (AFE).

In order to fly the standard 3° approach, how long should the final approach segment be if the pilot plans to turn final at 500 feet AFE?



$$500 \text{ feet} / \tan 3 = 9,540.56683$$

$$6076.1 \text{ feet} = 1 \text{ Nm}$$

$$9,540.5683 \text{ feet} / 6076.1 = 1.57 \text{ nm}$$

If we begin our final approach 500 feet AFE, we can compute the length of our final approach (Distance X) by dividing our altitude (500 feet AFE) by the tangent of 3°. So,  $500 \text{ feet} / \tan 3 = 9,541 \text{ feet}$ .

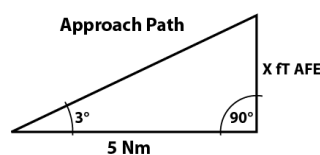
### A Conversion for Convention:

Pilots are accustomed to judging distance in miles, more precisely Nautical Miles (nm).

To convert 9,540.5683 feet to nautical miles, we use the factor 6076.1 feet per nm.

$9,540.5683 \text{ feet} / 6076.1 = 1.57 \text{ nm}$ , or a final approach segment approximately 1.6nm in length.

If the pilot planned the approach to begin 5nm (a typical distance for an ILS) from the end of the runway, at what altitude (AFE) should the aircraft be when intercepting the final approach?

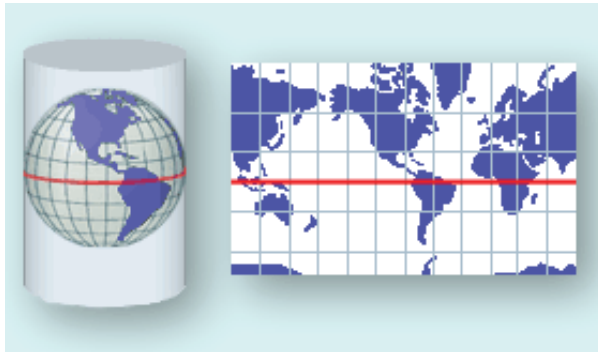


$$1 \text{ nm} = 6,076.1 \text{ feet}$$

$$5 \text{ nm} = 6076.1 \times 5 = 30,380.5 \text{ feet}$$

$$30,380.5 \times \tan 3 = 1,592 \text{ feet AFE}$$

## MERCATOR PROJECTION



**DESCRIPTION:** Originally created to display accurate compass bearings for sea travel. An additional feature of this projection is that all local shapes are accurate and clearly defined.

**PROJECTION METHOD:** Cylindrical projection. Meridians are parallel to each other and equally spaced. The lines of latitude are also parallel but become farther apart toward the poles. The poles cannot be shown.

**LINES OF CONTACT:** The equator or two latitudes symmetrical around the equator.

**LINEAR GRATICULES:** All meridians and all parallels.

**PROPERTIES;** Shape conformal Small shapes are well represented because this projection maintains the local angular relationships.

**AREA:** Increasingly distorted toward the polar regions. For example, in the Mercator projection, although Greenland is only one-eighth the size of South America, Greenland appears to be larger.

**Direction:** Any straight line drawn on this projection represents an actual compass bearing. These true direction lines are thumb lines and generally do not describe the shortest distance between points.

**DISTANCE:** Scale is true along the equator or along the secant latitudes.

**LIMITATIONS:** The poles cannot be represented on the Mercator projection. All meridians can be projected, but the upper and lower limits of latitude are approximately 80° N and S. Large area distortion makes the Mercator projection unsuitable for general geographic world maps.

**USES AND APPLICATIONS:** Standard sea navigation charts (direction). Other directional uses: air travel, wind direction, ocean currents.

**Conformal world maps** The best use of this projection's conformal properties applies to regions near the equator such as Indonesia and parts of the Pacific Ocean.

### **PROJECTION PARAMETERS**

ArcInfo: ARC, ARCPLOT, ARCEDIT, ArcToolbox;  
PC ARC/INFO: ArcCAD  
:PROJECTION MERCATOR  
:PARAMETERS  
Longitude of central meridian:  
Latitude of true scale:  
False easting (meters):  
False northing (meters):  
Projection Engine: ArcMap, ArcCatalog, ArcSDE,  
MapObjects 2.x, ArcView Projection Utility  
Central Meridian - Standard Parallel 1  
False Easting -False Northing  
ArcView GIS  
Central Meridian:  
Latitude of True Scale:  
False Easting - False Northing

## SYMBOLS FOR DEGREES, MINUTES, SECONDS

Symbols	The three common formats	
° (Degrees)	DDD° MM' SS.S"	Degrees, Minutes and Seconds
' (Minutes)	DDD° MM.MMM'	Degrees and Decimal Minutes
" (Seconds)	DDD.DDDDD°	Decimal Degrees

### **Degrees, Minutes and Seconds**

#### **DDD° MM' SS.S"**

**32° 18' 23.1" N 122° 36' 52.5" W**

This is the most common format used to mark maps. It's also the most cumbersome to work with. It's a lot like telling time.

*There are sixty seconds in a minute (60" = 1') and*

*There are sixty minutes in a degree (60' = 1°).*

Keeping in mind a few easy conversions between seconds and decimal minutes will help when working with maps that use degrees, minutes and seconds.

*15 seconds is one quarter of a minute or 0.25 minutes  
30 seconds is one half of a minute or 0.5 minutes  
45 seconds is three quarters of a minute or 0.75 minutes*



**Degrees and Decimal Minutes**

**DDD° MM.MMM'**

**32° 18.385' N 122° 36.875' W**

This is the format most commonly used when working with electronic navigation equipment.

**Decimal Degrees**

**DDD.DDDDD°**

**32.30642° N 122.61458° W**

**or +32.30642, -122.61458**

This is the format you'll find most computer based mapping systems displaying. The coordinates are stored internally in a floating point data type, and no additional work is required to print them as a floating point number. Often the N-S and E-W designators are omitted. Positive values of latitude are north of the equator, negative values to the south. Watch the sign on the longitude, most programs use negative values for west longitude, but a few are opposite. This saves a lazy western hemisphere programmer from having to type in a minus sign before most of their longitude values.

**Which format should you use?**

You can set your GPS to display any one of these three formats. Locations can be entered into the GPS with the selected format, and then by switching the display format setting, viewed in a different format.

to use the Degrees and Decimal Minutes format, even though the INDOAVIS maps using are marked in Degrees, Minutes and Seconds. The markings on the map are all at either 0, 15, 30, or 45 seconds. By remembering the "quarter minute conversions" of 0.00, 0.25, 0.50, and 0.75, I can quickly do the conversions.

**Decimal Degrees**

**Decimal degrees (DD)** express latitude and longitude geographic coordinates as decimal fractions and are used in many geographic information systems (GIS), web mapping applications such as Google Maps, and GPS devices. Decimal degrees are an alternative to using degrees, minutes, and seconds

(DMS). As with latitude and longitude, the values are bounded by ±90° and ±180° respectively.

Positive latitudes are north of the equator, negative latitudes are south of the equator. Positive longitudes are east of Prime Meridian, negative longitudes are west of the Prime Meridian. Latitude and longitude are usually expressed in that sequence, latitude before longitude.

**Accuracy**

The radius of the semi-major axis of the Earth at the equator is 6,378,160.0 meters<sup>[1]</sup> resulting in a circumference of 40,075,161.2 meters. The equator is divided into 360 degrees of longitude, so each degree at the equator represents 111,319.9 meters or approximately 111 km. As one moves away from the equator towards a pole, however, one degree of longitude represents a diminishing number of meters, approaching zero at the pole. The number of decimal places required for a particular accuracy at the equator is:

**Accuracy versus decimal places at the equator**

Decimal	Degree	Distance
0	1.0	111 Km
1	0.1	11.1 Km
2	0.01	1.11 Km
3	0.001	111 m

A value in decimal degrees to an accuracy of 4 decimal places is accurate to 11.1 meters (± 5.55 m) at the equator. A value in decimal degrees to 5 decimal places is accurate to 1.11 meter at the equator. Because the earth is not flat, the accuracy of the longitude part of the coordinates increases the further from the equator you get. The accuracy of the latitude part does not increase so much, more strictly however, a meridian arc length per 1 second depends on latitude at point concerned. The discrepancy of 1 second meridian arc length between equator and pole is about 0.3 meters because the earth is an oblate spheroid.

The decimal degree representation of the location of the **Halim Perdana Kusuma Airport**

- 6.264966°	106.895084°	Decimal Degree
S07°44'6.13"	E106°53'42.302"	Degrees, Minutes and Seconds
S07°44.102'	E106°53.705'	Degrees and Decimal Minutes

A D, M, S value is converted to decimal degrees using the formula:

$DD = D + \frac{M}{60} + \frac{S}{3600}$	DD : Decimal Degree D : Degree M : Minute S : Second
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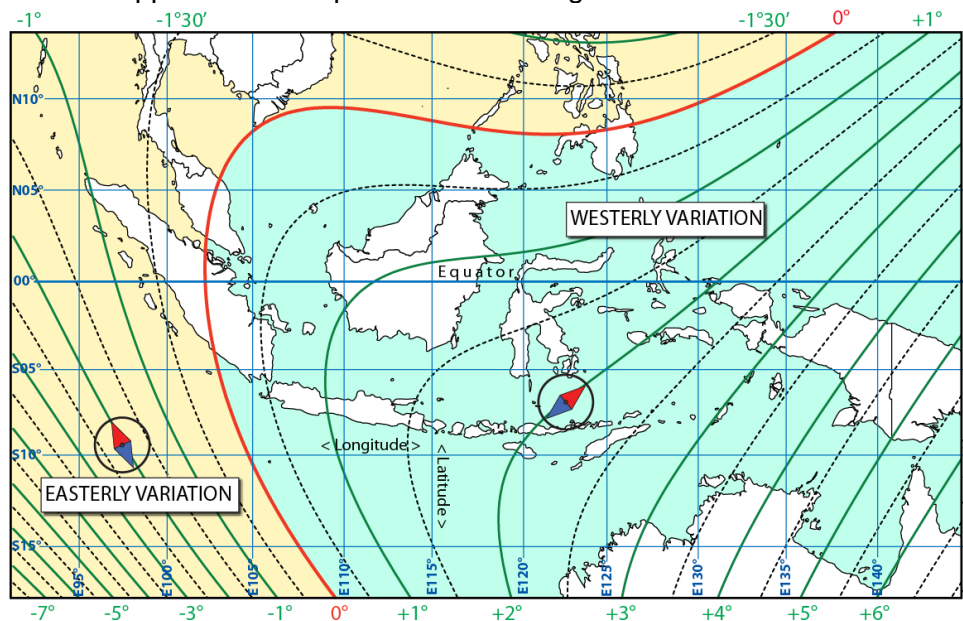
**Converting Degrees, Minutes, Seconds to Degrees & Decimals**

1. **First:** Convert the seconds to a fraction.  
Since there are 60 seconds in each minute,  $07^{\circ} 44' 6.13''$  can be expressed as  **$07^{\circ} 44' \frac{6.13}{60}$ . Convert to  $07^{\circ} 44.102'$ .**
2. **Second:** Convert the minutes to a fraction.  
Since there are 60 minutes in each degree,  $07^{\circ} 44.102'$  can be expressed as  **$07 \frac{44.102}{60}$ . Convert to  $06.264966^{\circ}$ .**

## ISOGONIC LINES

Isogonic lines, an imaginary line connecting points on the Earth's surface where the magnetic declination is the same.

**Indonesia Isogonic lines** - Lines drawn across aeronautical charts to connect points having the same magnetic declination. Anywhere along this line the two poles are aligned, and there is no variation. East of this line, the magnetic pole is to the west of the geographic pole and a correction must be applied to a compass indication to get a true direction.



**Magnetic declination** has a very important influence on air navigation, since the most simple aircraft navigation instruments are designed to determine headings by locating magnetic north through the use of a compass or similar magnetic device.

Aviation sectionals (maps / charts) and databases used for air navigation are based on True north rather than magnetic north, and the constant and significant slight changes in the actual location of magnetic north and local irregularities in the planet's magnetic field require that charts and databases be updated at least 2 times per year to reflect the current magnetic variation correction from True north. For example, as of March 2010, near San

Francisco the magnetic north is about 14.3 degrees east of True north, with the difference decreasing by about 6 minutes of arc per year.<sup>[4]</sup>

When plotting a course, a pilot in most small planes will plot a trip using true north on a sectional (map), then, convert the true north bearings to magnetic north for in-plane navigation using the magnetic compass. During flight, the correct compass course is obtained by a deviation correction card, which is usually located in the proximity of the compass.

Radio navigation aids located on the ground, such as VORs, are also checked and updated to keep them aligned with magnetic north to

allow pilots to use their magnetic compasses for accurate and reliable in-plane navigation.

Runways are named by a number between 01 and 36, which is generally one tenth of the magnetic azimuth of the runway's heading: a runway numbered 09 points east (90°), runway 18 is south (180°), runway 27 points west (270°) and runway 36 points to the north (360° rather than 0°).<sup>[6]</sup> However, due to magnetic declination, changes in runway names have to occur at times to keep their name in line with the runway's magnetic heading. An exception is made for runways which lie within the Northern Domestic Airspace of Canada; these are numbered relative to true north

because proximity to the magnetic North Pole makes the magnetic declination large.

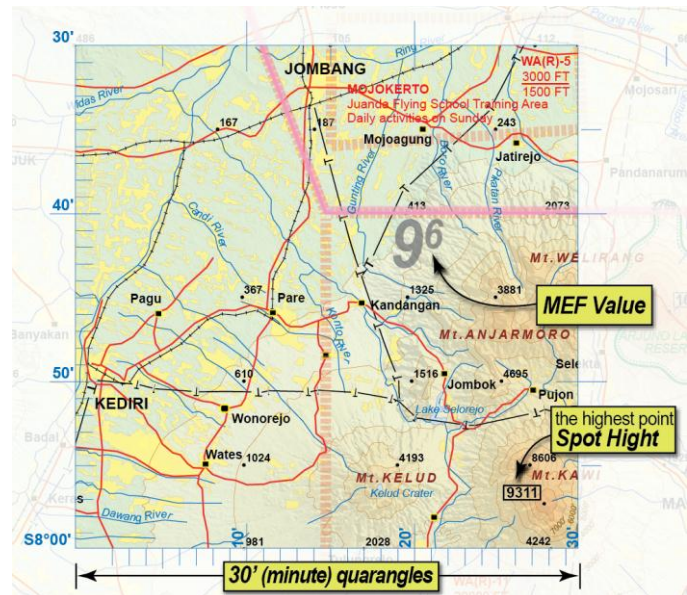
GPS systems used for air navigation can use magnetic north or true north. In order to make them more compatible with systems that depend on magnetic north, magnetic north is often chosen, at the pilot's preference. The GPS receiver natively reads in true north, but can elegantly calculate magnetic north based on its true position and data tables calculate the current location and direction of the north magnetic pole and (potentially) any local variations, if the GPS is set to use magnetic compass readings.

### **MAXIMUM ELEVATION FIGURE (MEF)**

Maximum elevation figure or MEF is the a type of VFR altitude which indicates the height of the highest feature within a quadrangle area. It is of interest to pilots, who want to be aware of the highest mountain peaks and tall towers nearby, so they can fly above them to avoid controlled flight into terrain. ("Features" includes terrain, trees, towers, and other obstacles). In a VFR context, this altitude is commonly referred to as a "quadrantal altitude"

Maximum Elevation Figures (MEF) depicted on a sectional chart (SAC 1:500.000) Quadrant for every 30' (minute) and Operational Navigation Chart (ONC 1:1.000.000) Quadrant for every 1° (Degree) show the highest terrain and/or obstacles within a quadrant.

For man-made obstacles taller than 200 feet, the MEF is calculated by determining the elevation of the top of the obstacle above mean sea level (msl). Then, additional height is added according to a cartography formula to cover a possible vertical error. Finally, the figure is rounded up to the next highest 100-foot increment. For example, if the highest man-made obstacle within a sector is 2,424 feet msl, 100 feet would be added to cover a possible vertical error (2,524 feet). This figure would then be rounded up to the nearest 100 feet and be charted as a 2,624 feet MEF for that sector. A similar process is used for

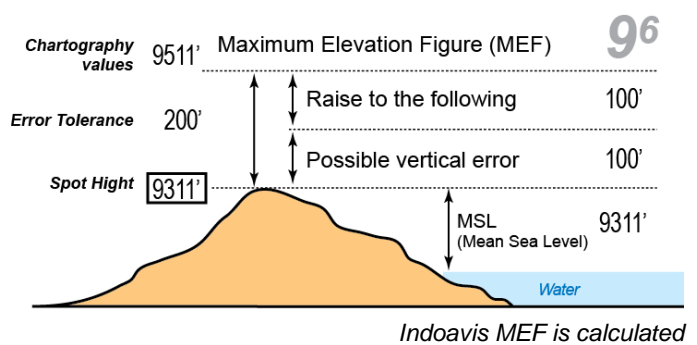


Example **9311** feet **96**

Show the highest terrain and/or obstacles within a quadrant 30 Minute latitude and Longitude Sectional Chart. 1:500.000. .



calculating the MEF for terrain or natural obstacles, except that an additional 200 feet is added just in case there is a man-made obstacle on that terrain that wasn't charted because it is less than 200 feet tall.



## **DOCUMENT REFERENCE**

### **ICAO (International Civil Aviation Organization)**

- ICAO Annex 4 Rules of the Air
- ICAO Annex 4 Aeronautical Chart
- ICAO Annex 5 Units of Measurement to be Used in Air and Ground Operations
- ICAO Annex 14 Aerodromes
- ICAO DOC. 8168 Aircraft Operations Vol-1,2
- ICAO DOC. 8697 Aeronautical Chart Manual
- ICAO DOC. 8400 (Procedure for Air Navigation Services)
- ICAO DOC. 9674 (World Geodetic System -1984 (WGS 84) Manual

### **FAA (Federal Aviation Administration)**

- TERMINAL PROCEDURES PUBLICATION EXPLANATION OF TPP TERMS AND SYMBOLS
- IFR AERONAUTICAL CHARTS EXPLANATION OF IFR ENROUTE TERMS AND SYMBOLS
- VFR AERONAUTICAL CHARTS EXPLANATION OF VFR TERMS AND SYMBOLS

