061 General Navigation

061-01 Basics of Navigation

061-01-01 The Solar System

23.5°N – Tropic of Cancer, 23.5°S – Tropic of Capricorn, 66.5°N/S – Polar Circle

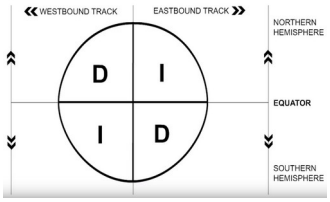
perihelion (closest to sun)	04JAN	fastest orbital speed
spring equinox	20MAR	length of day/night and declination of sun changes rapidly
summer solstice	21JUN	sun at highest angle from celestial equator
aphelion (furthest from sun)	03JUL	slowest orbital speed
autumn equinox	23SEP	length of day/night and declination of sun changes rapidly
winter solstice	21DEC	sun at lowest angle from celestial equator

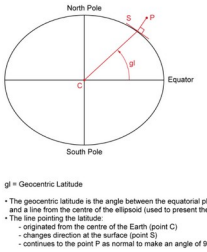
061-01-02 The Earth

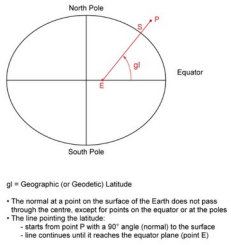
$$convergency = chlong \times \sin(lat)$$

$$departure_{nm} = chlong_{min} \times \cos(lat)$$

$$\frac{departure_{latA}}{departure_{latB}} = \frac{\cos(latA)}{\cos(latB)}$$







vertex point: highest latitude, true course either 090 or 270

061-01-03 Time and Time Conversions

NM * TAS = NAM * GS

061-01-04 Directions

grivation – grid variation

$$dip = \cos^{-1}\left(\frac{H}{T}\right)$$

TT	Drift	TH	VAR	MH	DEV	CH

GRID	CONV	TRUE

061-01-05 Distance

061-02 Magnetism and Compasses

061-02-01 Knowledge of the Principles of Direct Reading (standby) Compass

standby compass instrument accuracy: 10°, pre-flight check: compare to runway or main compass indication

swing compass when:

- after lightning storm or lightning strike
- after on ground stationary for > 1 year
- after permanent significant change of magnetic latitude

061-03 Charts

061-03-01 General Properties of Miscellaneous Types of Projections

large scale → less area, **more detail**, e.g. 1:25000 vs. **small scale** → more area, **less detail**, e.g. 1:500000

lambert constant of cone = sin(mid-latitude)

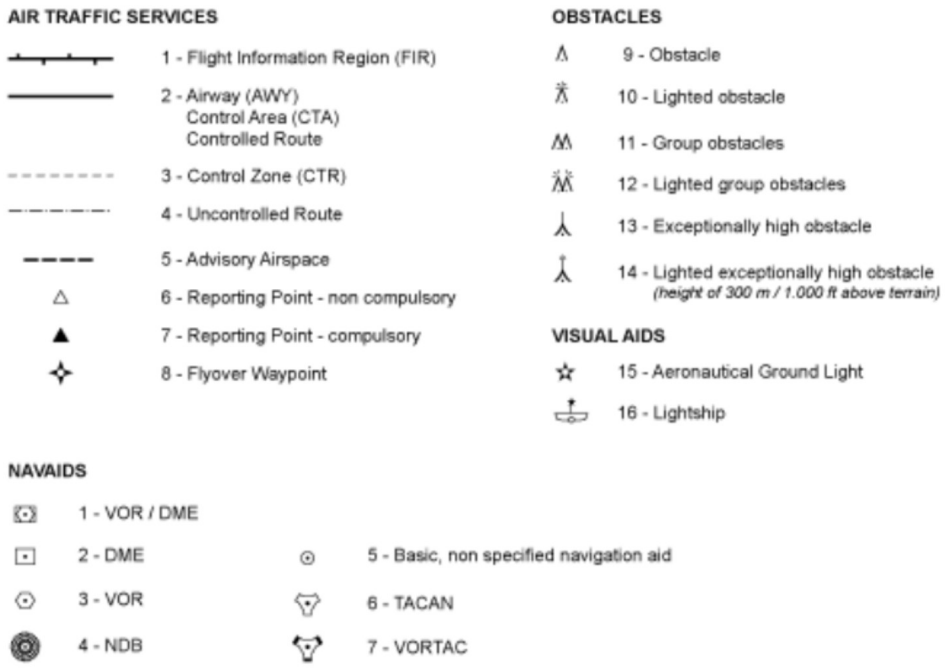
Mercator Scale Change

$$\frac{Denominator_A}{Denominator_B} = \frac{\cos A}{\cos B}$$

061-03-02 The Representation of Meridians, Parallels, Great Circles and Rhumb Lines

	mercator	lambert	polar
rhumb	straight	concave to pole	
straight			
great circle	concave to equator	concave to origin	concave to pole

061-03-03 The use of Aeronautical Charts



$$Distance = \sqrt{chlat_{min}^2 + \left(chlong_{min} \times \cos\left(meanlat\right)\right)^2}$$

061-04 Dead Reckoning Navigation (DR)

061-04-01 Basis of dead reckoning

061-04-02 Use of the navigational computer

061-04-03 The triangle of velocities problems

> TH/TAS >> TT/GS >>> W/V

$$Headwind = \cos(wind\ angle) \times wind\ speed$$
$$Crosswind = \sin(wind\ angle) \times wind\ speed$$

$$ETAS = TAS \times \cos(WCA \text{ or } DA)$$
$$GS = ETAS + TWC$$

061-04-04 Determination of DR position

$$NAM = NGM \times \frac{TAS}{GS}$$

061-04-05 Measurement of DR elements

061-05 In-flight Navigation

061-05-01 Use of visual observations and application to in-flight navigation

061-05-02 Navigation in climb and descent

$$Gradient(\%) = \frac{altdiff\ (ft)}{grounddiff\ (ft)}$$

$$ROC(ft/min) = gradient(\%) \times GS(kt)$$

$$Gradient(°) = arctg\left(\frac{altdiff\ (ft)}{grounddiff\ (ft)}\right)$$

$$Angle(°) = \frac{Height \times 60}{Distance}$$

$$ROC/D(ft/min) = GS(kts) \times \frac{Gradient\ (ft/nm)}{60}$$

climb: 2/3 of alt (wind), descend: ½ of alt (wind)

061-05-03 Navigation in cruising flight, use of fixes to revise navigation data

$$TKE = \frac{Distance\ off track \times 60}{Distance\ Flown\ Along\ Track}$$

061-05-04 Flight Log