LIFELINES
Inspiring young people through everyday heroes

HAMPSHIRE AND ISLE OF WIGHT AIR AMBULANCE

Mission Planning Project

By Captain Dave Nicholls, Pilot.

Helimed 56 is the radio call sign for Hampshire and Isle of Wight Air Ambulance. When we hear this call from the Ambulance Service Emergency Operations Centre, we know that it's time to get going on a mission. Within the next 4 minutes the team will coordinate a well-oiled routine to get us airborne and on our way to the incident.

"Helimed 56, we have a job for you".

Planning and Preparation

At the start of each day it is my job, as pilot, to make sure that the helicopter systems are tested and set and that the aircraft is correctly configured. Part of this task includes ensuring that the helicopter is operated within the limitations for mass and that the mass is distributed correctly (centre of gravity or CofG). These calculations need to be done everyday as the mass changes depending on which team members are flying.

Today the Critical Care Team on shift are:

Nicola Hawkes
Paramedic

Mike Funge
Paramedic

David Sutton
Doctor

Dave Nicholls
Pilot

Task 1: Aircraft Calculations

Task 1A: The Centre of Gravity (CofG) Graph

You will need to draw a graph and plot the limits laid down for mass and CofG. You should choose a suitable scale. The Y axis will be used to show mass and needs to cover the range from 1400 kg to 3000 kg. The X axis will be used to show distance (in millimetres) from the datum point and needs to cover the range from 4100 mm to 4600 mm. The distance from the datum is called the arm.

REMEMBER

Mass = the amount of matter (stuff) in an object.

Weight = the force exerted on an object due to gravity.

NOTE: The datum point is an imaginary point just in front of the helicopter. It is used as a reference point so that we can measure how far along the aircraft body (fuselage) each item is placed when loading.

Plotting CofG Limits

Now you have the graph prepared, you will need to plot the corners of our CofG limits. Plot the points shown in the table below and then use straight lines to join points A to B to C to D to A. The area inside the box is called the CofG envelope. We cannot fly if, when plotted, the mass and CofG fall outside this envelope.

Once we have calculated our mass and CofG, this graph will be used to make sure the helicopter stays within the limitations.

Point	Arm (mm)	Mass (kg)
A	4201	2980
B	4369	2980
C	4555	1600
D	4152	2039

Task 1B: Zero Fuel Figures

Before we can start to add fuel or patients to our helicopter, we must work out the mass and CofG point of the helicopter. Complete the following tasks to obtain these figures.

1. The formula used when calculating our **MASS** and **CofG** is: **MOMENT = MASS (kg) x ARM (mm)**

This formula can be rearranged in the same way all formulae can. Use it to help you fill in the spaces in the table below for Aircraft Prepared State (APS), crew mass, arm and moment.

2. Add up the **MASS** and **MOMENT** columns and enter the results in the zero fuel totals row.

3. Divide the **Zero Fuel Moment** by the **Zero Fuel Mass** to obtain the centre of gravity for the aircraft.

NOTE: APS is the Aircraft Prepared State. This is the mass and CofG data for the helicopter with all the medical equipment and any aviation equipment required. It does not include any crew members or fuel.

	Mass (kg)	Arm (mm)	Moment
APS (see note)	2143	4502	9647786
Pilot – Dave Nicholls	85	2428	
Paramedic – Nicola Hawkes	75		200400
Paramedic – Mike Funge		4323	449592
Doctor – David Sutton	99	3465	
Zero Fuel Totals (add each column)			
Centre of gravity = $\frac{\text{Total moment}}{\text{Total mass}}$ =			

Task 1C: Payload

Well done! We now know the mass and CofG for our helicopter. However, what the pilot needs to know is how much mass can be carried while staying within the required limits. This spare mass is called the Payload. Once this has been worked out, we are ready to fly.

Now subtract the **Zero Fuel Mass** from the **Maximum Mass** of the helicopter to calculate the **Payload** (spare mass).

The payload figure will be used throughout the day to ensure we do not exceed the maximum mass of the aircraft. This will involve juggling figures because:

a. We could use the entire payload for fuel. This means we could fly further, but we would have no spare mass to carry a patient.

b. We could use the entire payload to carry patients but we would have no fuel to fly them anywhere.

c. A good trade-off between carrying the most fuel but leaving enough mass for a patient is what we need.

	Mass (kg)
Maximum Mass	2980
Zero Fuel Mass	
Payload	

Task 1D: Centre of Gravity at Take-off

Our payload will usually allow us to carry 420 kg fuel. Before we can add this fuel, we need to make sure that it will keep us inside our CofG limits. Complete the table below using the **Zero Fuel Totals** you calculated earlier. As before, divide the total **MOMENT** by the total **MASS** to get the CofG.

	Mass (kg)	Arm (mm)	Moment
Zero fuel totals			
420 kg of fuel	420	4181	
Totals			
Centre of gravity = $\frac{\text{Total moment}}{\text{Total mass}}$ =			

Now plot the CofG figure and MASS on the graph you made. Does this point fall inside our CofG envelope? If it does, we are ready to fly.

Task 2: The Mission

A call has come in. The Ambulance Service Emergency Operations Centre has given us the following details:

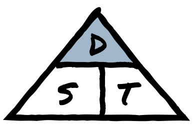
- RTC (Road Traffic Collision)
- Pedestrian vs Car
- Bishops Waltham

THERE IS A REPORT THAT A PEDESTRIAN HAS BEEN HIT BY A CAR AND HAS BEEN BADLY INJURED. NO FURTHER DETAILS ARE AVAILABLE YET BUT WE CAN FIND OUT MORE IN FLIGHT. THE IMPORTANT THING IS TO PLAN OUR ROUTE AND GET AIRBORNE AS QUICKLY AS POSSIBLE.

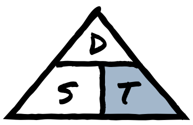
Task 2A: It's time to plan our mission!

1. On your map, draw a straight line from Thruxton (our base) to the incident at Bishops Waltham. Use a protractor to work out the bearing to our destination by placing the centre of your protractor on the line you have drawn. Make sure it is lined up with the closest north/south line to Thruxton. Read off the bearing and write the number in the box on the right.
2. Cut out the printed aviation ruler and stick together, matching the numbers. Measure the line with the aviation ruler and write the distance in the box on the right. Make sure you use the correct scale (1:250,000).
3. Work out how long it will take us to get to our destination; Bishops Waltham. Use the speed/distance/time triangle to help

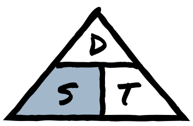
Thruxton – Bishops Waltham	
Bearing	
Distance	
Speed	120 mph (2 miles per minute)
Time (How long will it take)	



Distance = **S**peed x **T**ime

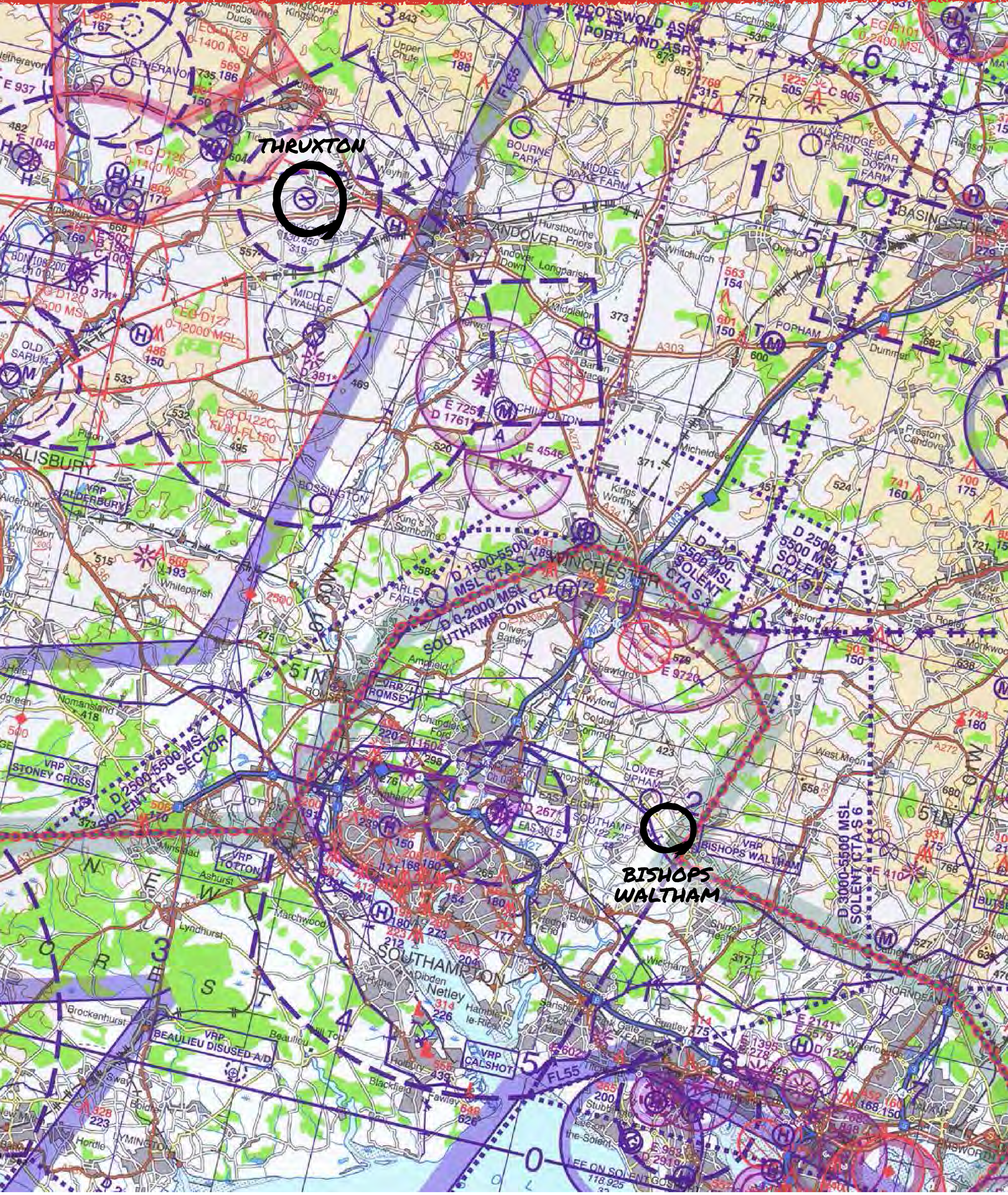


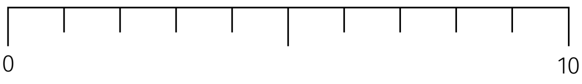
Time = **D**istance / **S**peed



Speed = **D**istance / **T**ime

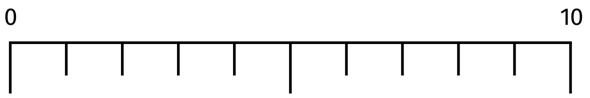
NOTE: LINE UP THE PROTRACTOR WITH THE CLOSEST NORTH / SOUTH LINE TO THRUXTON. N/S LINES ON AN AVIATION MAP DO NOT RUN PARALLEL TO THE EDGES OF THE MAP. REMEMBER, IF YOU WANT TO WORK OUT THE TIME IN MINUTES, YOU WILL NEED TO USE THE SPEED IN MILES PER MINUTE. THE UNITS MUST MATCH.





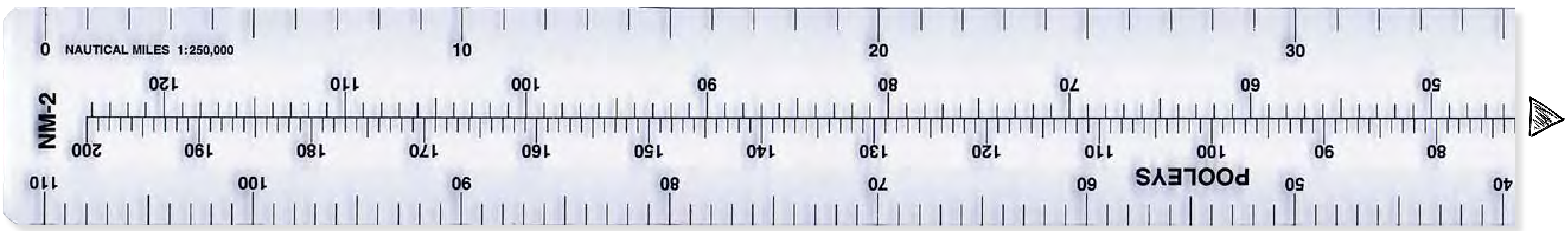
Make sure the 1:25 scale on your aviation ruler measures the same as this.

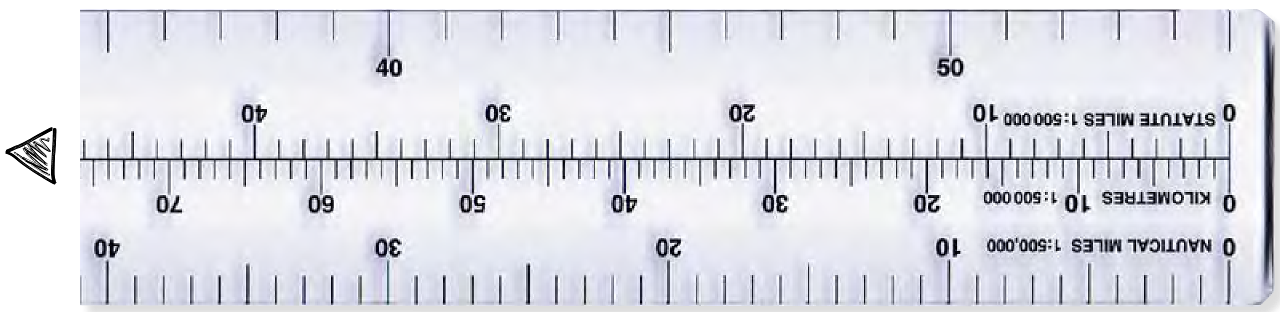
Aviation ruler – Scale 1:25



1. Cut out both sides of the ruler
2. Join the two halves together

Make sure you use the 1:25 scale





Task 2B: Arriving at our destination

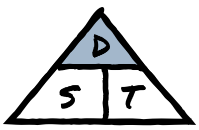
By the time we arrive at the destination, we will have burned approximately 30kg of fuel. We also need to fly the patient, who weighs 80kg. We cannot take off until we are satisfied that this new loading will stay within our CofG envelope. Complete the table below and then plot the results on your CofG graph to see whether it is safe to fly.

	Mass (kg)	Arm (mm)	Moment
Zero fuel totals			
390kg of fuel	390	4193	
Patient	80	4383	
Totals			
Centre of gravity = $\frac{\text{Total moment}}{\text{Total mass}}$ =			

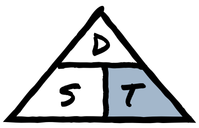
Task 2C: Flying to the Hospital

We now need to fly the patient to University Hospital Southampton. Plan our journey to the hospital by completing the table below. If it took us 4 minutes to reach the helipad at the hospital, what would our speed be? Use the speed/distance/time triangle again.

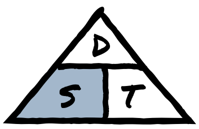
Bishops Waltham – University Hospital Southampton	
Bearing	
Distance	
Speed	
Time	4 minutes



Distance = Speed x Time



Time = $\frac{\text{Distance}}{\text{Speed}}$



Speed = $\frac{\text{Distance}}{\text{Time}}$

We made it!

We have used mathematics today (along with a big dose of science, technology and engineering) to make a real difference to somebody's life by delivering them safely to hospital. With a little practice you can increase the speed of your calculations. Remember, we need to get airborne in four minutes!

Pilot Test

Test your mission planning knowledge and see if you can explain the following terminology.

Wording	What does it mean?
Helimed 56	
Critical Care Team	
HIOWAA	
HEMS	
Centre of Gravity	
The Arm of the Helicopter	
Datum Point	
APS	
Payload	
Zero Fuel Weight	