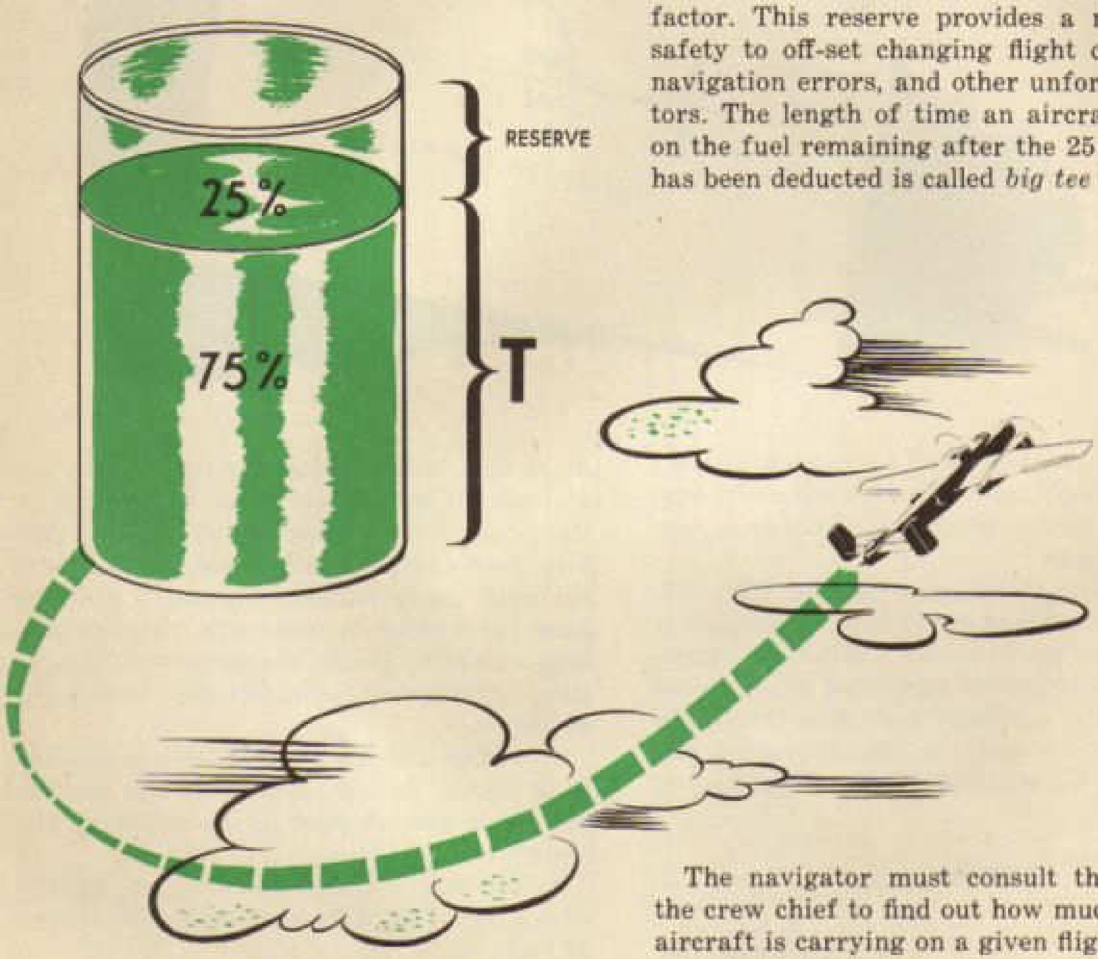
Fuel Consumption Chart

As a general rule, the navigator knows definitely whether he or some other crew member is going to perform any given task. This is not true, however, for the task of keeping up with the fuel consumption. The pilot, co-pilot, or flight engineer usually looks after this detail, but the pilot may assign it to the navigator.

The rate of fuel consumption is the number of gallons of fuel that the aircraft burns per hour. This rate varies with the type engine, RPM's, altitude, grade of fuel, and other factors. Because the time, and hence the distance, an aircraft can fly is limited by the amount of fuel carried, the navigator must check carefully the rate of fuel consumption in flight.

The navigator must not figure on using all of the fuel the aircraft carries, but must reserve 25% of the total capacity as a safety factor. This reserve provides a margin of safety to off-set changing flight conditions, navigation errors, and other unforeseen factors. The length of time an aircraft can fly on the fuel remaining after the 25% reserve has been deducted is called *big tee* (T).



The navigator must consult the pilot or the crew chief to find out how much fuel the aircraft is carrying on a given flight. He can consult the technical order on the aircraft, or a graph or table in the aircraft, to find the fuel consumption rate under given conditions. Bombers and other tactical aircraft carry standard tables and graphs; training craft, a Form No. 41, which give fuel consumption data. From this data the navigator can compute T for the conditions anticipated for a given flight. During flight, then, he must check carefully to see if the anticipated conditions actually are present.

In addition to the fuel consumption rate and T for the flight, the navigator must know, at any time during the flight, (1) the distance flown and the distance remaining to be flown, (2) the amount of fuel consumed and the amount remaining in the tanks, both with and without the reserve, and (3) whether or not it is possible to fly back to departure point. To enable him to know these facts, the navigator constructs a fuel consumption chart and works with it during the flight.

The navigator does the greater part of the work on a fuel consumption chart on the ground before the flight begins. There is little left for him to do on it in the air. Before beginning work on the chart, he must know, in addition to the usual facts about the flight, the metro winds en route. Using these winds, he divides the route into wind zones, terminating each zone as nearly as possible at each predicted wind shift. Two or three such zones usually cover an entire route.

The navigator works the following problem in the steps indicated:

Given:

1. TC: 186, TAS: 160, Total distance: 1,200 NM
2. Total fuel: 600 gallons; Fuel consumption: 50 gph
3. Zone I: W/v, 320/18 K; distance, 300 NM
4. Zone II: W/v, 086/12 K; distance, 550 NM
5. Zone III: W/v, 286/16 K; distance 350 NM

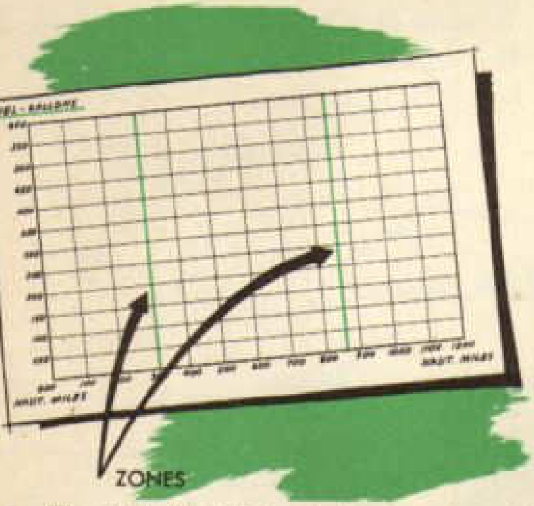
ZONE ROUTE ACCORDING TO METRO WINDS

Procedure:

1. The fuel scale is set up along the left side of the graph from zero gallons at the bottom of the graph to the aircraft's fuel capacity at the top.

2. The distance scale is marked off along the bottom of the graph from zero nautical miles at the left to destination, which is 1200 NM. The destination line is drawn on right side of graph parallel to the fuel scale line.

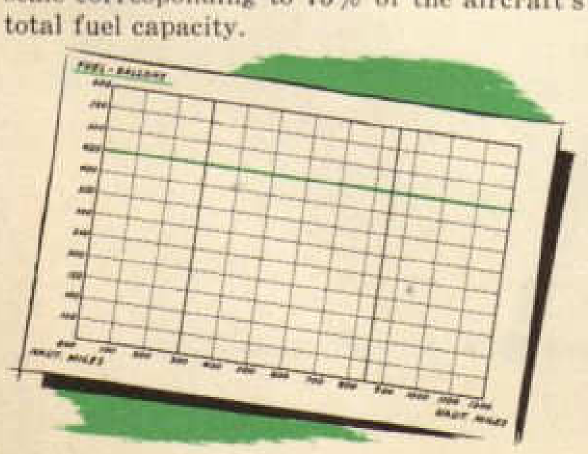
3. Lines are drawn perpendicular to the distance scale at proper intervals to separate the wind zones. Each wind zone is labeled along the bottom of the graph.



4. The Full Tank Line is labeled along the bottom of the chart.

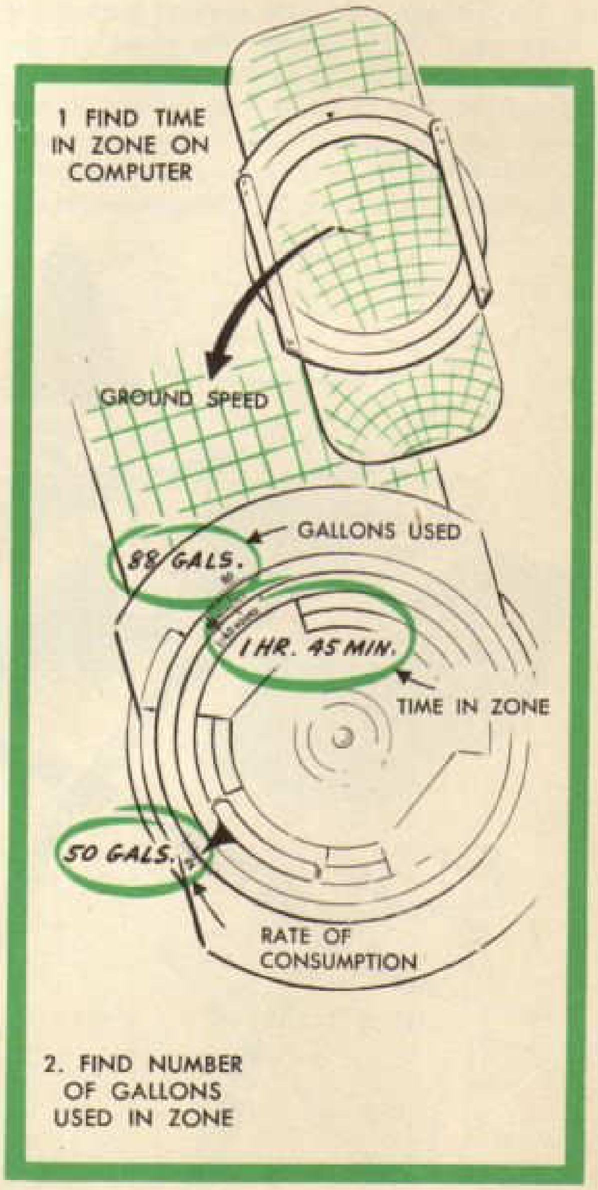
5. Draw the Dry Tank Line parallel to the Full Tank Line at a point on the fuel scale equal to the aircraft's total fuel capacity.

6. Below the Dry Tank Line draw a parallel *Reserve Fuel* Line at a point on the fuel scale corresponding to 75% of the aircraft's total fuel capacity.



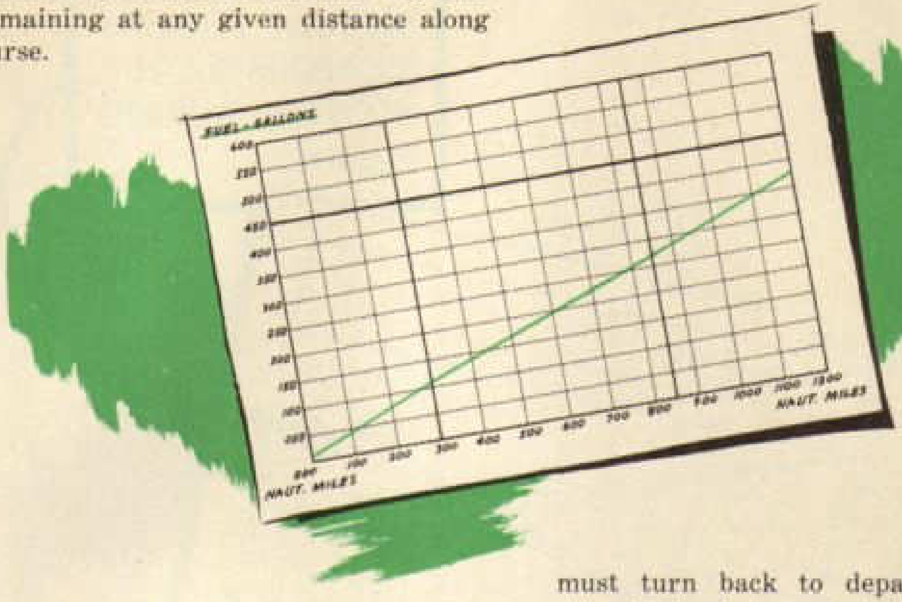
7. The TAS, TC, and wind are placed on the computer and the GS for each zone is calculated. GS and distance are placed on the computer to find the time to run in each zone.

8. The total gallons of fuel consumed is calculated for each zone. This is done by placing the fuel rate on the outside scale of the computer, opposite the black arrow of the inner scale. Read total gallons consumed on the outside scale, above the time.



9. The amount of fuel consumption is plotted against distance for each zone, upward from the full tank line.

10. Then, with the full mark as an origin, a solid line is drawn connecting the plotted points. This is the *Ahead Line*, which shows the fuel already consumed and also the total fuel remaining at any given distance along the course.

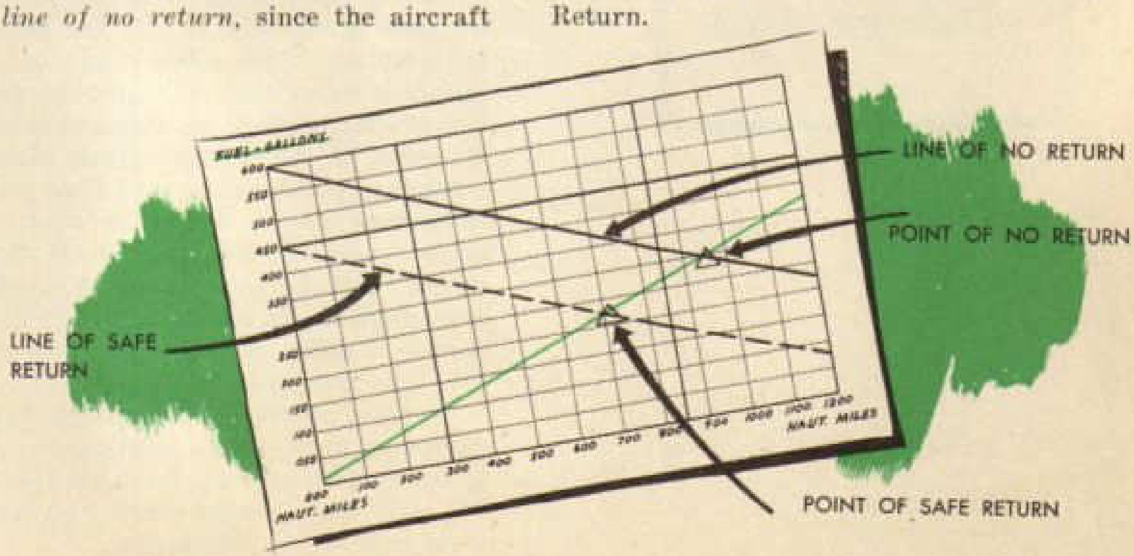


11. The amounts of fuel consumed for each zone of the return trip are calculated, using the same winds and the reverse course for each zone.

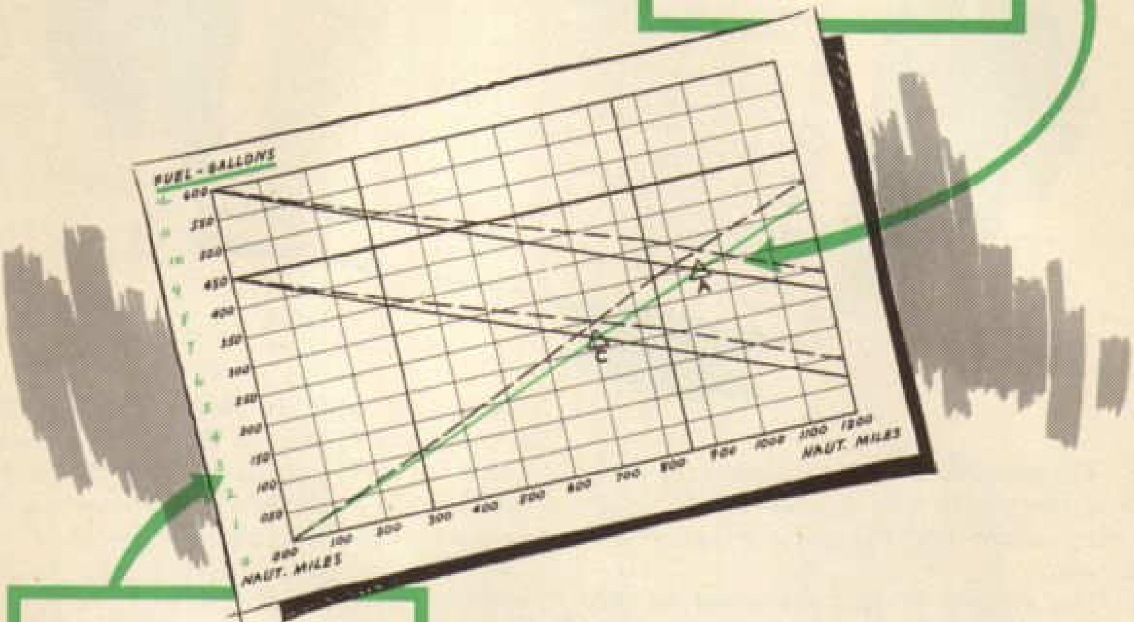
12. The amount of fuel consumed on the return flight is plotted against distance for each zone starting from the Dry Tank Line.

13. Then, with the Dry Tank Line as an origin, the plotted points are connected. This is the *line of no return*, since the aircraft must turn back to departure before the Ahead Line intersects this line, in order to reach the departure point safely. Beyond this intersection point the aircraft must continue to destination or an alternate base.

14. The line of no return is then replotted, using the reserve fuel line as an origin. This becomes the *Line of Safe Return*, since the aircraft can return to base within the safety fuel margin from the Point of Intersection of the Ahead Line and the Line of Safe Return.



15. Add an hour scale to the fuel scale in order to determine the time of arrival at the Line of Safe Return and at destination.



Having constructed the graph, the navigator uses it in flight to plot the actual fuel consumption. If the actual fuel consumption line falls below that estimated for the original graph, the flight is continued as planned. However, if the original graph shows that more fuel is being consumed than predicted, immediate checks should be made to discover reasons for changes. Winds should be checked and compared to metro forecasts. A new graph should be constructed if winds are shown to differ radically from metro data. The new graph can then be used as a basis for judging whether to alter flight plans. The navigator must decide whether to continue to destination or turn back between points (C) and (A). Beyond point (A) the plane must continue to destination.

FUEL CONSUMPTION CHART