Calculation of approx fuel burn off.

Abbreviations/terms used:

- BR ... Brake release. The point at which the takeoff begins.
- BRW ... Brake Release Weight. The aircraft gross weight at takeoff position.
- EMZW ... Estimated Mid Zone Weight. The estimated aircraft gross weight at the mid point of a cruise zone. It is used as a reference to find the average fuel flow for the zone.
- EZW ... The gross weight at the end of the cruise zone.
- Flight Fuel ... The fuel used from brake release at departure airport, to landing at destination airport.
- GW ... Gross weight of aircraft. (ie: Basic Op GW + fuel on board + payload).
- HWC ... Head wind component.
- LRC ... Long Range Cruise speed schedule (variable Mach number dependant on aircraft GW).
- LW ... Landing Weight. Aircraft weight at touch down.
- SAR ... Specific Air Range. Found by dividing the fuel flow/hr by the aircraft TAS.
- SGR ... Specific Ground Range. Found by dividing the fuel flow/hr by the aircraft ground speed.
- TWC ... Tail wind component.
- Sector distance ... The total distance from departure airport to arrival airport.

General

These approximations are required to find the approx LW, and from that we can also find the descent distance. They are helpful as a "gross error check" to confirm the accurate flight fuel, and are also used to find the estimated mid zone weight (EMZW) which is required to accurately find the fuel flow for a given cruise zone, and ultimately the accurate cruise zone fuel burn off (FBO).

How the rough SAR's are calculated

Simply by dividing the B727 fuel flow at a typical cruise estimated mid zone weight of 75, 000 kg at a typical cruise flight level, by the cruise TAS for the cruise Mach number.

Example: Cruise schedule is Mach 0.80/FL330. EMZW 75, 000 kg. ISA conditions.

Find SAR ?

Working:

1. By the navigation computer find the TAS at ISA/FL330 of 465 kt.

2. Refer to B727 planning manual page 3-93 to find the ISA fuel flow at EMZW 75, 000 kg is 4, 371 kg/hr.

3. The SAR is the 3 engine fuel flow of 4, 371 kg/hr, divided by the TAS of 465 kt.
   This gives a SAR of 9.41 kg/air nm (anm).

A summary of the various Mach cruise schedule SAR's calculated using the above method is reproduced on the next page, and also on your flight planning "cheat sheet" !

Normal operations approx SAR's

Mach schedule	Approx SAR
LRC	9.2 kg/anm
M 0.79/0.80	9.5 kg/anm
M 0.82	10.0 kg/anm
M 0.84	10.3 kg/anm

Abnormal operations approx SAR's

Operation type	Approx SAR
LRC 1 Engine inop	10.7 kg/anm
Depressurised	12.5 kg/anm
Yaw damper inop	9.2 kg/anm
Gear down LRC	20.0 kg/anm
Tail skid extended	10.0 kg/gnm

Points:

- There is no need to correct the approx SAR's for temperature deviation from ISA.
- Corrections for wind are required to find the specific ground range (SGR). To be discussed soon.
- Approx SAR's can be found for any aircraft type from a C152 to a B747 by using this method (ie: fuel flow divided by TAS. Knowledge of such SAR figures will assist you in your airline career by allowing you to quickly check that the fuel on board (FOB) is sufficient for the flight.

Corrections for wind

Flying into a head wind will increase the fuel burnt in any given zone length as we will effectively be in that zone for a longer time than we would in nil wind conditions. The reverse is true if you are flying in a tailwind.

To allow for head wind conditions, the SAR must be INCREASED by some value.

To allow for tail wind conditions, the SAR must be REDUCED by some value.

In correcting for wind we will find the amount of fuel that is consumed per ground nm (gnm). This is referred to as the "Specific Ground Range" (SGR), and it is a figure we need to find for flight planning purposes.

SAR is the fuel burnt per air nm (anm), and is the fuel flow/hr divided by TAS.

SGR is the fuel burnt per ground nm (gnm), It is fuel flow/hr divided by groundspeed.

For commercial jet aircraft cruising in the the Mach 0.70 to Mach 0.85 speed range, the following wind corrections are valid to roughly convert a SAR to a SGR value.

Multiply the HWC/TWC by 0.02 to obtain wind effect correction value, then...

For HWC ADD the wind correction to the approx SAR to get approx SGR.

For TWC SUBTRACT the wind component from the approx SAR to get approx SGR.

Example 1. Crz Sched M 0.80 Cruise zone length 1, 000 gnm. TWC 50 kt.

Calculate:
a. The approx SGR for the zone ?____________ kg/gnm.

b. The approx zone fuel burn off (FBO) ?____________kg.

Working:

Step 1. Calculate approx SGR.

Approx SAR M 0.80	9.5 kg/anm
Minus wind allowance (50 kt TWC x 0.02)	-1.0 kg gnm
Approx SGR	**8.5 kg/gnm**

Step 2. Calculate approx zone FBO.

1, 000 gnm x 8.5 kg/gnm = **8, 500 kg.**

Example 2. Crz Sched M 0.80 Cruise zone length 1, 000 gnm. HWC 50 kt.

Working:

Step 1. Calculate approx SGR.

Approx SAR M 0.80	9.5 kg/anm
Plus wind allowance (50 kt HWC x 0.02)	+1.0 kg gnm
Approx SGR	**10.5 kg/gnm**

Step 2. Calculate approx zone FBO.

1, 000 gnm x 10.5 kg/gnm = **10, 500 kg.**

Note: Zone FBO is considerably higher in a head wind, than it is with the same tail wind component.

Wind makes a large difference to zone FBO.
ISA deviation has much less effect (almost negligible).

Example 3. Crz Sched M 0.82 Cruise zone length 500 gnm. TWC 80 kt.

Calculate:
a. The approx SGR for the zone ?____________ kg/gnm.

b. The approx zone fuel burn off (FBO) ?____________kg.

Working:

Step 1. Calculate approx SGR.

Approx SAR M 0.82	10.0 kg/anm
Minus wind allowance (80 kt TWC x 0.02)	-1.6 kg gnm
Approx SGR	**8.4 kg/gnm**

Step 2. Calculate approx zone FBO.

500 gnm x 8.4 kg/gnm = 4**, 200 kg.**

Example 4. Crz Sched M 0.82 Cruise zone length 500 gnm. HWC 80 kt.

Calculate:
a. The approx SGR for the zone ?____________ kg/gnm.

b. The approx zone fuel burn off (FBO) ?____________kg.

Working:

Step 1. Calculate approx SGR.

Approx SAR M 0.82	10.0 kg/anm
Plus wind allowance (80 kt HWC x 0.02)	+1.6 kg gnm
Approx SGR	**11.6 kg/gnm**

Step 2. Calculate approx zone FBO.

500 gnm x 11.6 kg/gnm = **5, 800 kg.**

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Example 5. A B727 aircraft is cruising with 1 of the 3 engines inoperative.
Crz Sched LRC 1 Engine Inop   Cruise zone length 300 gnm.   TWC 40 kt.

Calculate:
a. The approx SGR for the zone ?____________ kg/gnm.

b. The approx zone fuel burn off (FBO) ?____________kg.

Working:

Step 1. Calculate approx SGR.

Approx SAR 1 eng inop	10.7 kg/anm
Minus wind allowance (40 kt TWC x 0.02)	-0.8 kg gnm
Approx SGR	**9.9 kg/gnm**

Step 2. Calculate approx zone FBO.

300 gnm x 9.9 kg/gnm = **2, 970 kg.**

Note: If in the above example the wind component was a 40 kt head wind, the approx SGR would have been 11.5 kg/gnm, and the zone FBO approximately 3, 450 kg (ie: 300 gnm x 11.5 kg/gnm).

Example 6. Aircraft cruising depressurised at 310 KIAS/FL130.   Zone length 400 gnm.   HWC 45 kt.

Calculate:
a. The approx SGR for the zone ?____________ kg/gnm.

b. The approx zone fuel burn off (FBO) ?____________kg.

Working:

Step 1. Calculate approx SGR.

Approx SAR Dep	12.5 kg/anm
Plus wind allowance (45 kt HWC x 0.02)	+0.9 kg gnm
Approx SGR	**13.4 kg/gnm**

Step 2. Calculate approx zone FBO.

400 gnm x 13.4 kg/gnm = **5, 360 kg.**

Note: If in the above example the wind component was a 45 kt tail wind, the approx SGR would have been 11.6 kg/gnm, and the zone FBO approximately 4, 640 kg (ie: 400 gnm x 11.6 kg/gnm).

Now attempt assignment “Estimated FBO 1”.

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