



VICTORIA FLYING CLUB

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VICTORIA FLYING CLUB

Flight for Range and Endurance

- Review Straight and Level Flight
- Definition and Motivation
- Flight for **Range**
 - Diagrams, Maximum Range (Experimental)
- Flight for **Endurance**
 - Diagrams, Maximum Endurance (Experimental)
- Summary and Questions
- Pre-Flight Briefing



Review Straight and Level Flight

- *Attitude plus power equals performance!*
- Mentally perform a power reduction from the cruise power setting while maintaining straight and level flight.
- What effect does the power reduction have on the airspeed and the fuel consumption?
- What effect does the power reduction have on the estimated time of arrival?



Definition and Motivation

- Airspeed and fuel flow can be traded off
- **Range** – achievable **distance** per **fuel** unit
(air/ground range): *destinations, alternates*
- **Endurance** – achievable **time** per **fuel** unit:
*holding procedures,
cockpit management / decision making, economy*
- **Maximum range** – best achievable **distance**
- **Maximum endurance** – best achievable **time**



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CRUISE PERFORMANCE

CONDITIONS:

2550 Pounds

Recommended Lean Mixture

Pressure Altitude Feet	RPM	20°C BELOW STANDARD TEMP			STANDARD TEMPERATURE			20°C ABOVE STANDARD TEMP		
		% MCP	KTAS	GPH	% MCP	KTAS	GPH	% MCP	KTAS	GPH
2000	2550	83	117	11.1	77	118	10.5	72	117	9.9
	2500	78	115	10.8	73	115	9.9	68	115	9.4
	2400	69	111	9.8	64	110	9.0	60	109	8.5
	2300	61	105	8.8	57	104	8.1	53	102	7.7
	2200	53	99	7.7	50	97	7.3	47	95	6.9
	2100	47	92	6.9	44	90	6.6	42	89	6.3
4000	2800	83	120	11.1	77	120	10.4	72	119	9.8
	2550	79	118	10.8	73	117	9.9	68	117	9.4
	2500	74	115	10.1	69	115	9.5	64	114	8.9
	2400	65	110	9.1	61	109	8.5	57	107	8.1
	2300	58	104	8.2	54	102	7.7	51	101	7.3
	2200	51	98	7.4	48	96	7.0	45	94	6.7
	2100	45	91	6.6	42	89	6.4	40	87	6.1
6000	2850	83	122	11.1	77	122	10.4	72	121	9.8
	2800	78	120	10.8	73	119	9.9	68	118	9.4
	2500	70	115	9.8	65	114	9.0	60	112	8.5
	2400	62	109	8.8	57	108	8.2	54	106	7.7
	2300	54	103	7.8	51	101	7.4	48	99	7.0
	2200	48	96	7.1	45	94	6.7	43	92	6.4

Cruise Performance POH Section 5

- Consider **conditions**
- Select **pressure altitude**
- Select **temperature**
- Select **power** setting
- Interpolate as required
- Determine **airspeed** and **fuel flow**

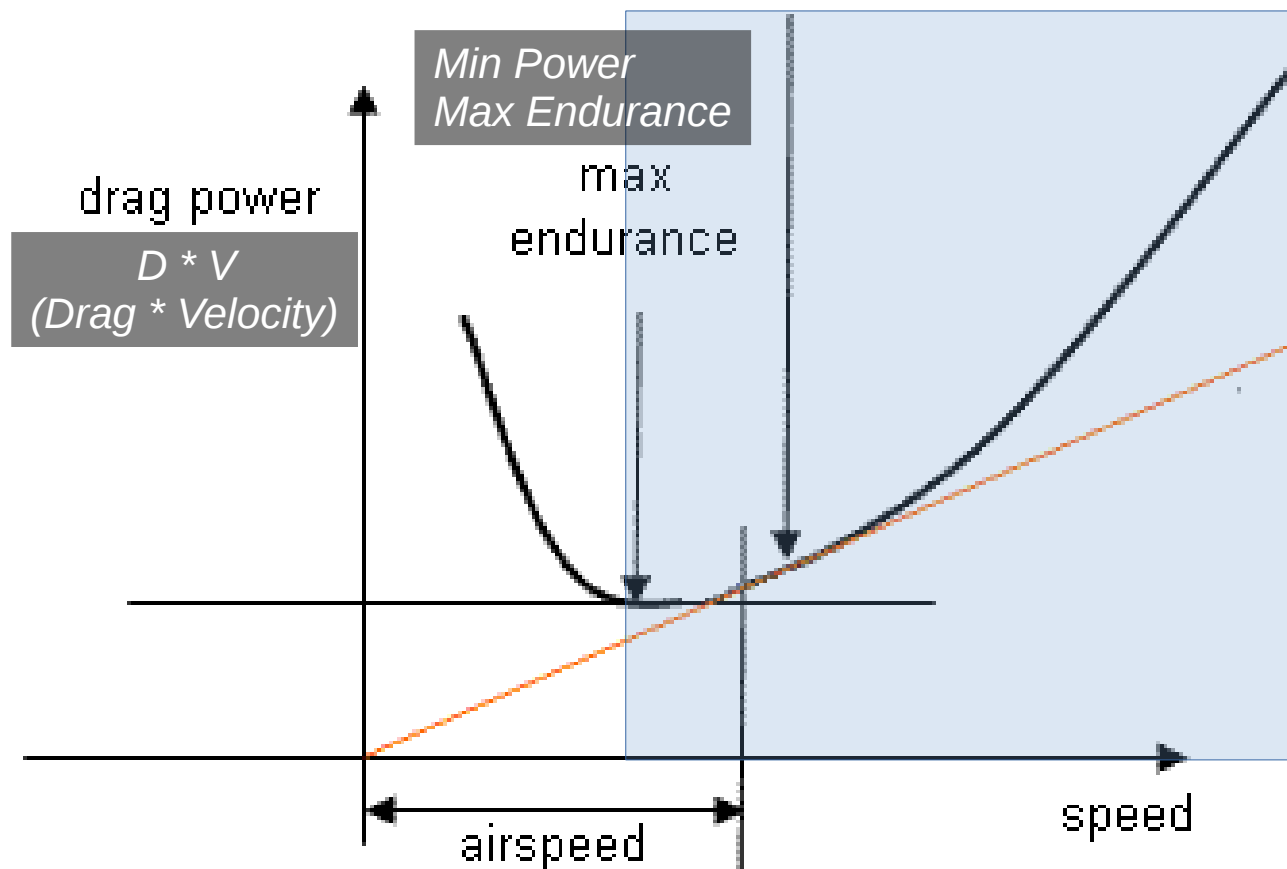


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Flight for Endurance

Power Required

still-air max
range speed

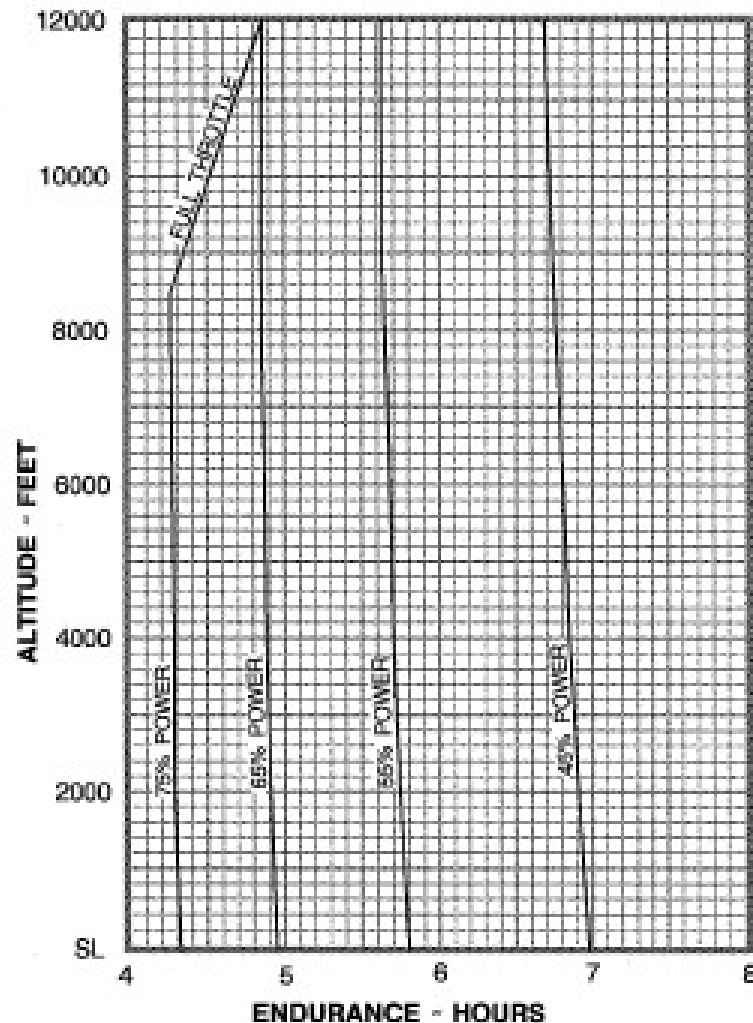




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ENDURANCE PROFILE 45 MINUTES RESERVE 53 GALLONS USABLE FUEL

CONDITIONS:
2550 Pounds
Recommended Lean Mixture for Cruise At All Altitudes
Standard Temperature



NOTE:

1. This chart allows for the fuel used for engine start, taxi, takeoff and climb, and the time during climb.

Endurance Profile POH Section 5

- Consider **conditions**
- Select pressure altitude
- Select **power**
- Determine **endurance**



Flight for Maximum Endurance (Experimental)

- Reduce **power** in *100 RPM* steps maintaining level flight with stable airspeed and **trim**
- *Unstable* decreasing airspeed indicates slow flight range – more power required
- **Reset cruise power** and then **decrease power** to slightly higher stable setting to **compensate** for turbulence and required turns
- **Lean** mixture as recommended
- Notice **reduced control** responses



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Leaning



- Slowly turn **mixture** knob out / *anticlockwise* until a drop in RPM can be observed
- Turn the **mixture** knob back in / *clockwise* until the RPM has increased again (**2-3 turns**)
- Check **fuel flow** and **exhaust gas temperature**



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Endurance - Instruments



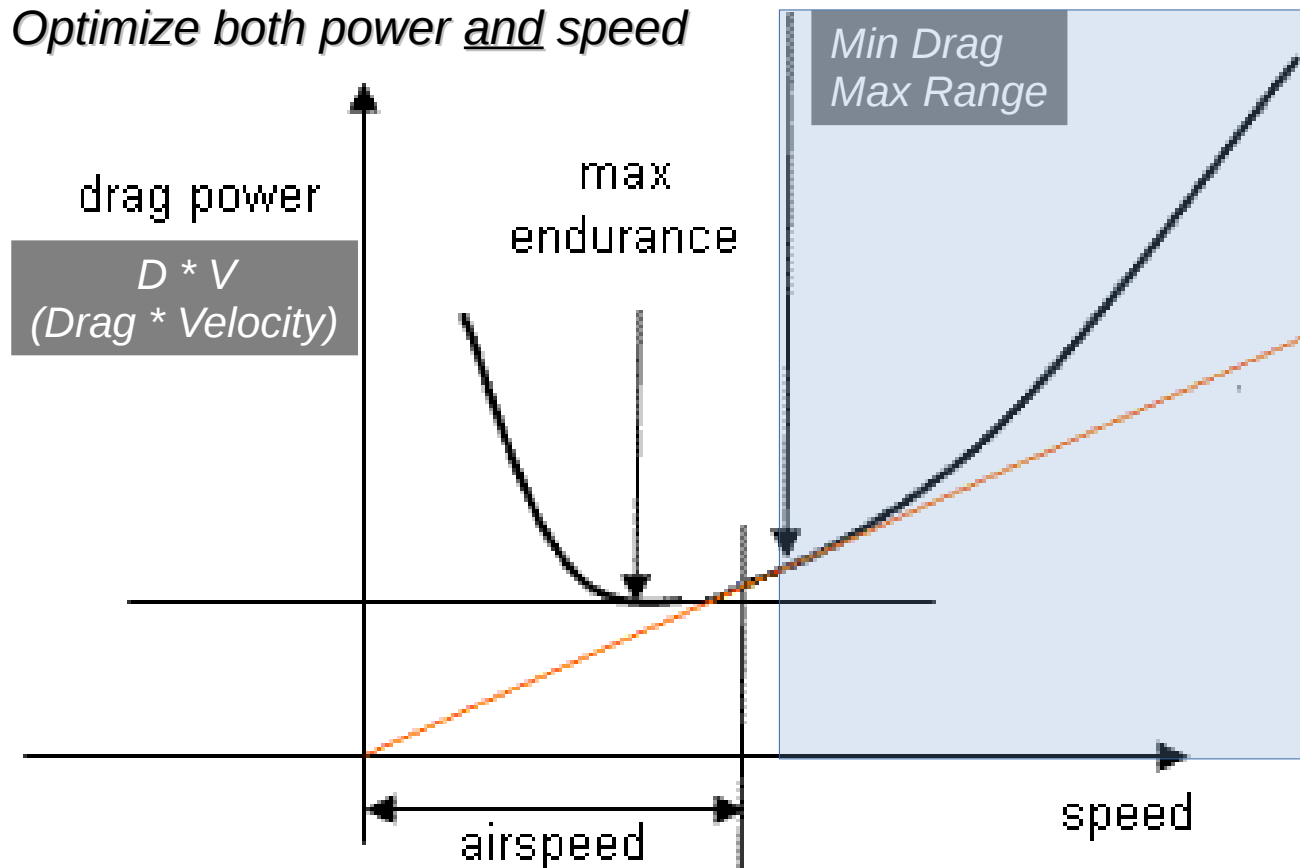
- **Attitude, Power** → Airspeed (about **50-60 KIAS**), Altitude
- **Mixture** → Exhaust Gas Temperature, Fuel Flow



Flight for Range

Power Required still-air max
range speed

Optimize both power and speed



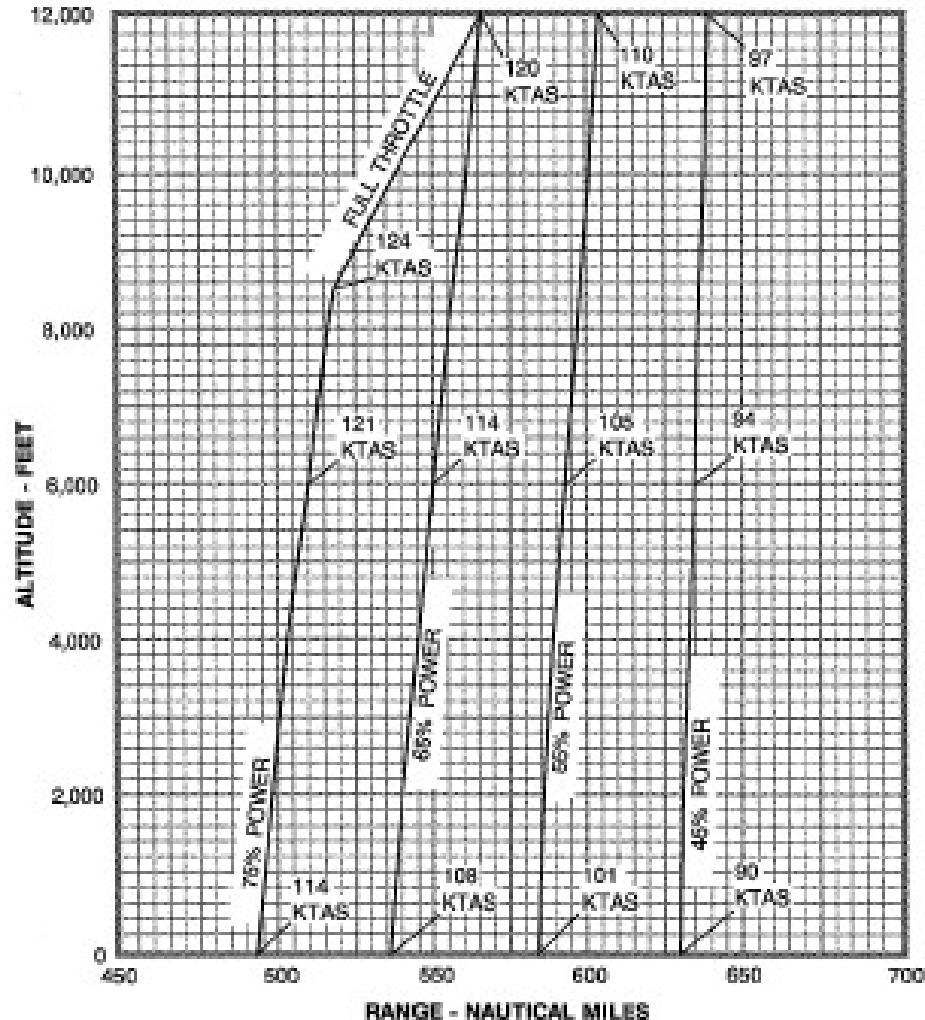


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RANGE PROFILE 45 MINUTES RESERVE 53 GALLONS USABLE FUEL

CONDITIONS:

2550 Pounds
Recommended Lean Mixture for Cruise At All Altitudes
Standard Temperature
Zero Wind



NOTES:

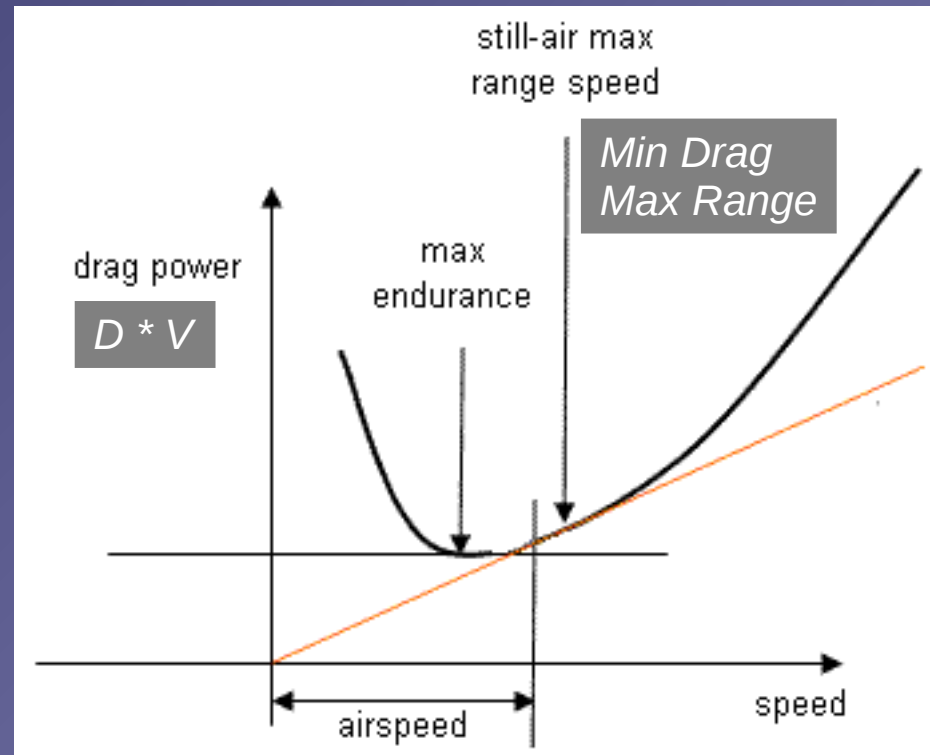
1. This chart allows for the fuel used for engine start, taxi, takeoff and climb, and the distance during climb.

Range Profile POH Section 5

- Consider conditions
- Select pressure altitude
- Select power setting
- Determine range



Flight for Maximum Range



- Increase **power** in **100 RPM** steps until a **non-linear** increase in **airspeed** can be observed
- Maintain **level** flight, **trim** and **lean** mixture as recommended (rich of peak)



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Range – Instruments



- **Attitude, Power** → Airspeed (about **70-80 KIAS**), Altitude
- **Mixture** → Exhaust Gas Temperature, Fuel Flow



Factors Affecting Range and Endurance

- *Endurance*: power setting, **fuel** available, flap setting, angle of attack, airspeed, weight, center of gravity, **altitude**, **mixture**, **turbulence**
- *Range*: power setting, **fuel** available, flap setting, angle of attack, airspeed, weight, center of gravity, **altitude**, **mixture**, **wind**



Summary / Quiz

- Define range, maximum range, endurance and maximum endurance.
- Give examples for when flight for range or endurance is preferable.
- What are the main factors that influence range and endurance and how do they affect them?
- Mentally configure the airplane for best range and endurance and state all required actions, respectively.



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Pre-Flight Briefing

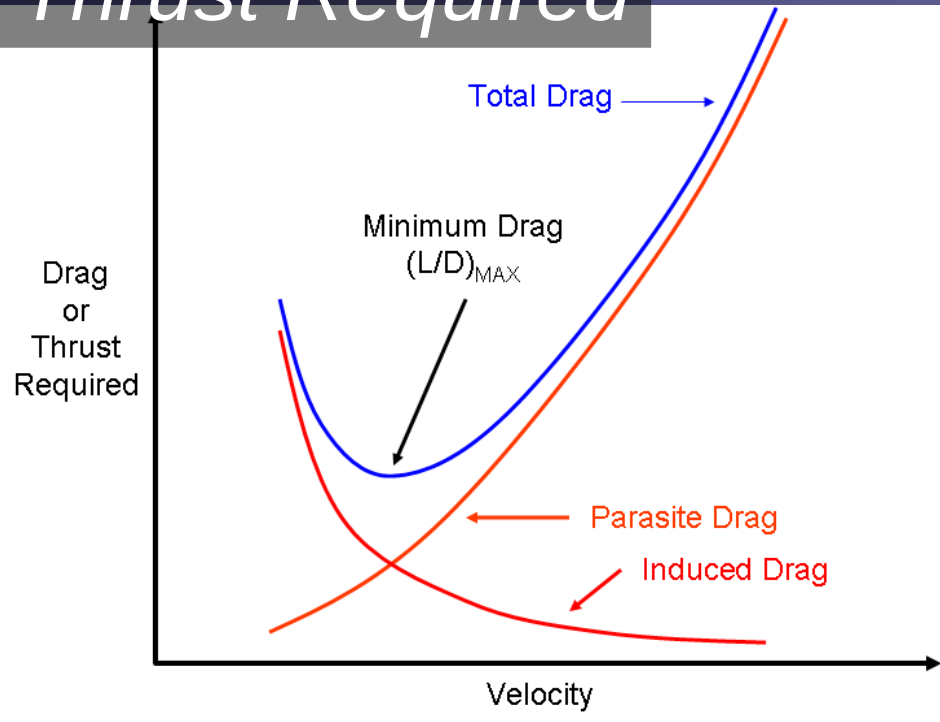
- Exercise
- Training Area
- Departure and Arrival Procedures
- Weather Briefing / NOTAMs
- Aircraft and Documents
- Time and Fuel Requirements
- Safety Considerations and Responsibilities



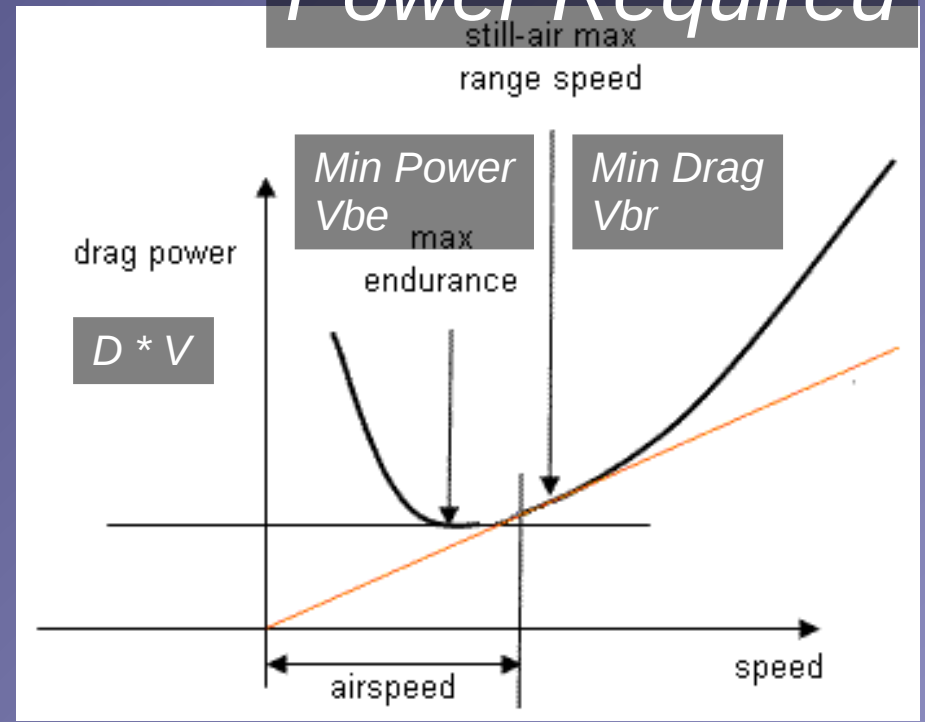
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Flight for Endurance

Thrust Required



Power Required



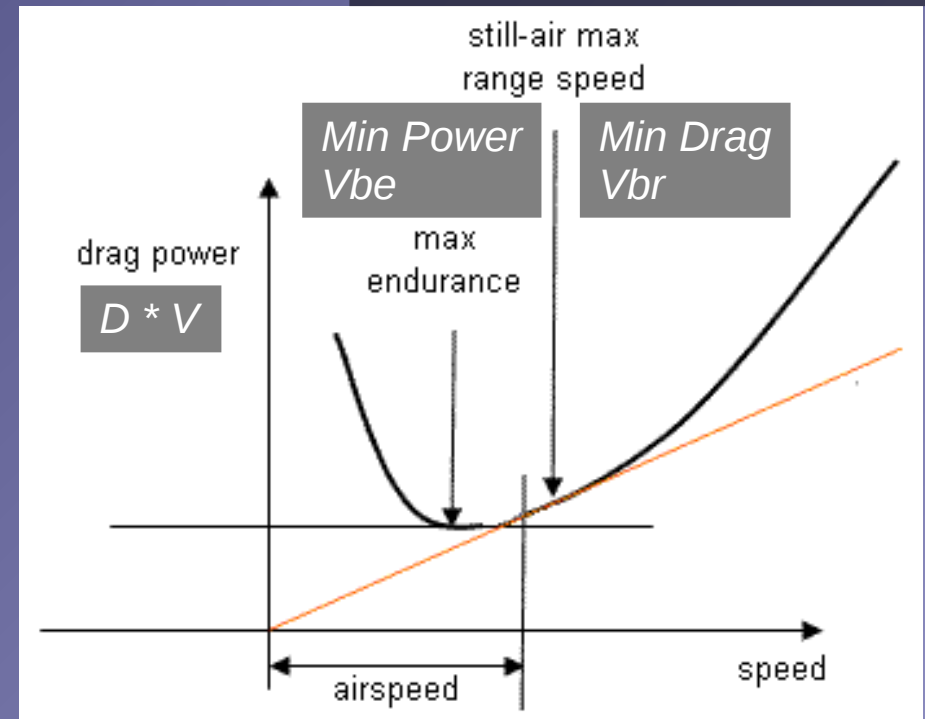
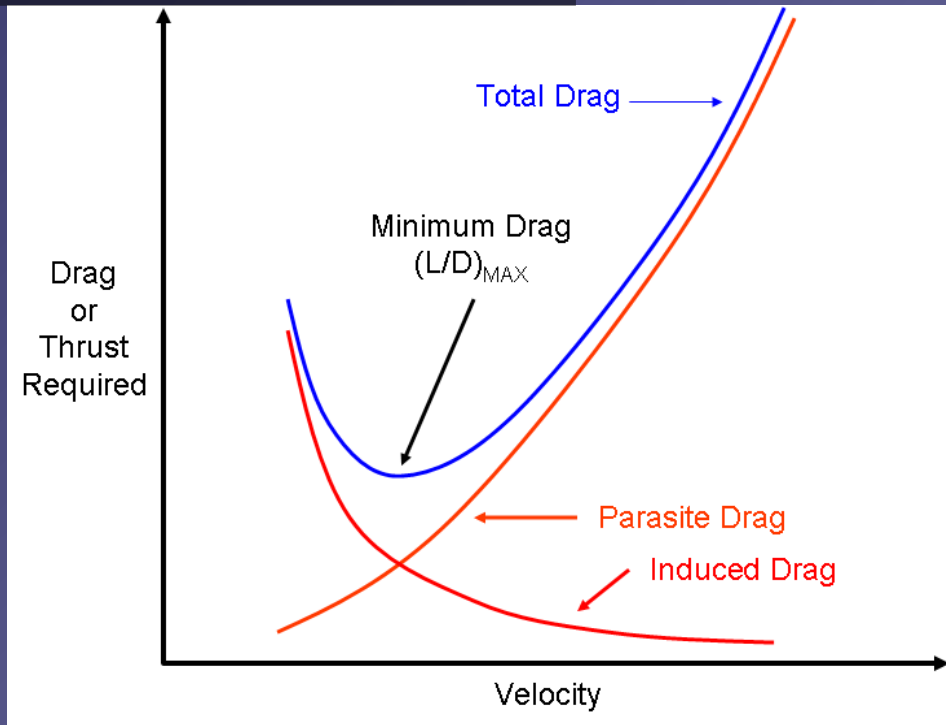


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Flight for Range

Thrust Required

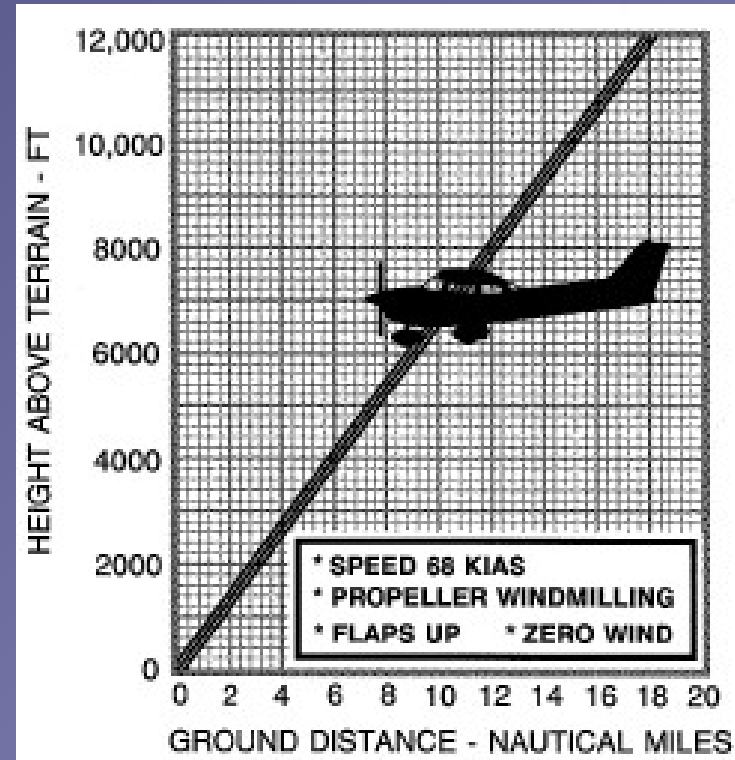
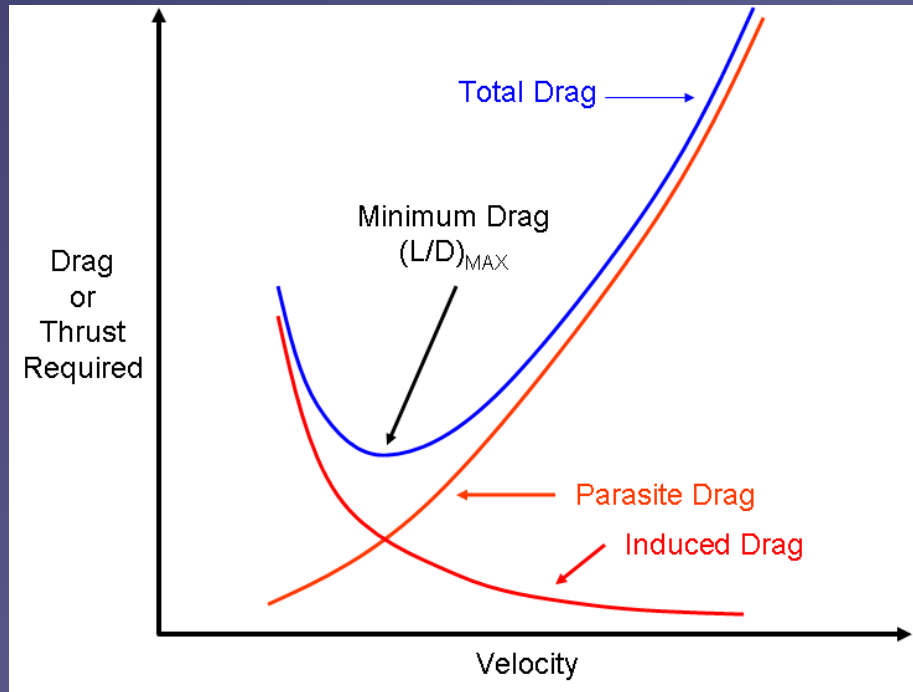
Power Required





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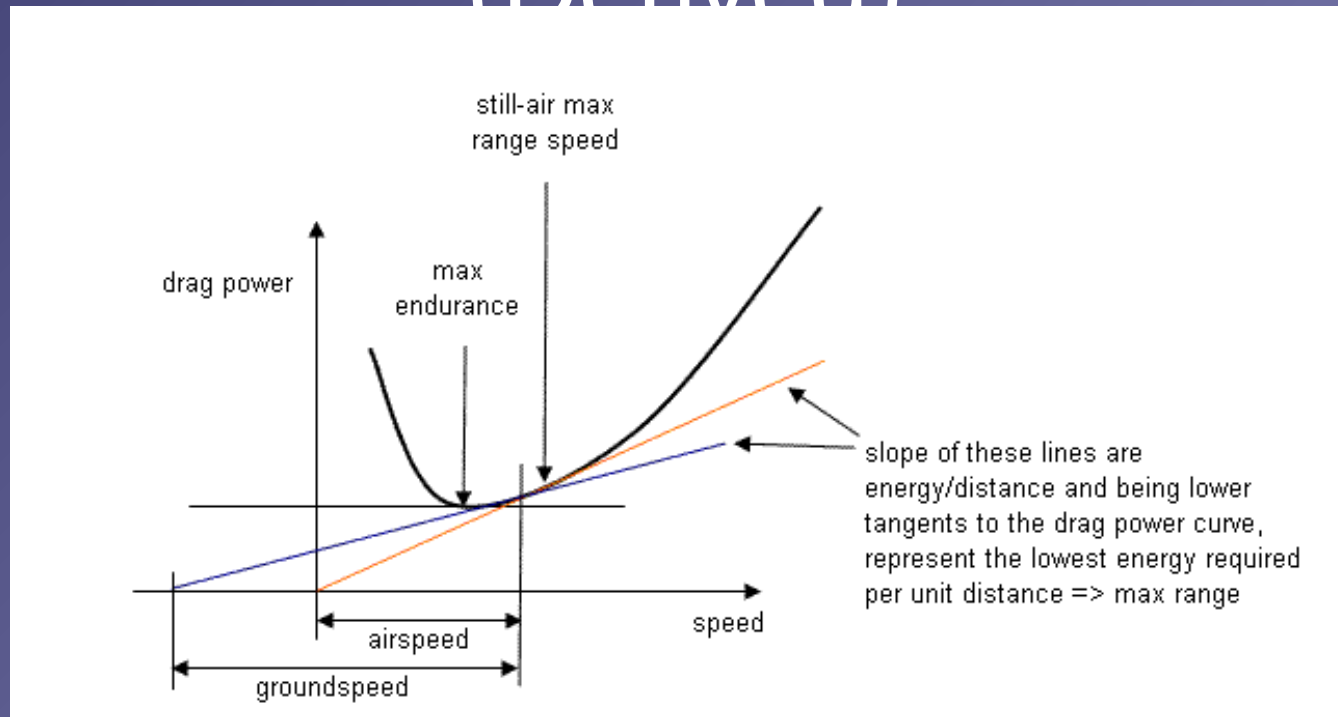
Flight for Maximum Range (Derived)



- Reduce **power** to establish **best glide** airspeed
- Maintain **level** flight and **trim** accordingly
- **Lean** mixture as recommended (rich of peak)



Flight for Maximum Endurance (Derived)



- Reduce **power** to lowest setting (above slow flight) to maintain altitude (about *best glide / 1.3 = 52 KIAS*)
- Maintain **level** flight and **trim** accordingly
- **Lean** mixture as recommended (rich of peak)



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Familiarization Demonstration

- Employ an obvious and dramatic example
- Slow Flight: 2000 RPM, increase nose-up attitude, demonstrate slower airspeed while maintaining straight-and-level