MESSERSCHMITT BF.110

GUIDE BY CHUCK

PERFORMANCE SHEET

	(Unit)	SPITFIRE Mk Ia 100 oct	HURRICANE Mk IA Rotol 100oct	BLENHEIM Mk IV	TIGER MOTH DH.82	BF.109 E-4	BF.110 C-7	JU-87B-2 STUKA	JU-88 A-1	HE-111 H-2	G.50 SERIE II	BR.20M
TEMPERATURES												
Water Rad Min Max	Deg C	60 115	60 115	-	-	40 100	60 90	38 95	40 90	38 95	-	-
Oil Rad (OUTBOUND) Min Max	Deg C	40 95	40 95	40 85	-	40 105	40 85	30 95	40 80	35 95	50 90	50 90
Cylinder Head Temp Min Max	Deg C	-	-	100 235	-	-	-	-	-	-	140 240	140 240
ENGINE SETTINGS												
Takeoff RPM	RPM	3000	3000	2600 FINE	2350	2400	2400	2300	2400	2400	2520	2200
Takeoff Manifold Pressure	UK: PSI GER: ATA ITA: mm HG	+6	+6	+9 BCO ON	See RPM Gauge	1.3	1.3	1.35	1.35	1.35	890	820 BCO ON
Climb RPM	RPM	2700	2700	2400 COARSE	2100	2300 30 min MAX	2300 30 min MAX	2300 30 min MAX	2300 30 min MAX	2300 30 min MAX	2400 30 min MAX	2100 30 min MAX
Climb Manifold Pressure	UK: PSI GER: ATA ITA: mm HG	+6	+6	+5	See RPM Gauge	1.23	1.2	1.15	1.15	1.15	700	740
Normal Operation/Cruise RPM	RPM	2700	2600	2400 COARSE	2000	2200	2200	2200	2100	2200	2100	2100
Normal Operation/Cruise Manifold Pressure	UK: PSI GER: ATA ITA: mm HG	+3	+4	+3.5	See RPM Gauge	1.15	1.15	1.1	1.1	1.10	590	670
Combat RPM	RPM	2800	2800	2400 COARSE	2100	2400	2400	2300	2300	2300	2400	2100
Combat Manifold Pressure	UK: PSI GER: ATA ITA: mm HG	+6	+6	+5	See RPM Gauge	1.3 5 min MAX	1.3 5 min MAX	1.15	1.15	1.15	700	740
Emergency Power/ Boost RPM @ km	RPM	2850 5 min MAX	2850 5 min MAX	2600 COARSE 5 min MAX	2350	2500 1 min MAX	2400 5 min MAX	2300 1 min MAX	2400 1 min MAX	2400 1 min MAX	2520 3 min MAX	2200 5 min MAX
Emergency Power / Boost Manifold Pressure @ Sea Level	UK: PSI GER: ATA ITA: mm HG	+12 BCO ON	+12 BCO ON	+9 BCO ON	See RPM Gauge	1.40 1 min MAX	1.3 5 min MAX	1.35 1 min max	1.35 1 min max	1.35 1 min max	890 3 min max	820 BCO ON 5 min MAX
Supercharger Stage 1 Operation Altitude	UK: ft GER: M	-	-	-	-	-	-	0 1500	0 1220	0 1220	-	-
Supercharger Stage 2 Operation Altitude	UK: ft GER: M ITA: M	-	-	-	-	-	-	1500+ (AUTO/MAN MODES)	1220+	1220+	-	-
Landing Approach RPM	RPM	3000	3000	2400	As required	2300	2300	2000	2100	2300	2400	2200
Landing Approach Manifold Pressure	UK: PSI GER: ATA ITA: mm HG	As required	As required	As required	See RPM Gauge	As required	As required	As required	As required	As required	As required	As required
Notes		Use "Rich" mixture for normal operation. Use "Lean" mixture for fuel conservation for RPM under 2600 & boost @ +1 or lower.		Boost Cut-Out Override (BCO) during takeoff often required	**Min Oil Press: 35 psi** **Max Oil Press: 45 psi**			No Abrupt Throttling	Eng. very sensitive to ata/rpm	Eng. very sensitive to ata/rpm		Boost Cut-Out Override (BCO) during takeoff often required
AIRSPEEDS												
Takeoff – Rotation	UK: mph GER/ITA: km/h	120	120	110	55	180	190	170	185	150	170	175
Max Dive Speed		420	390	260	160	750	620	720	675	600	410	600
Optimal Climb Speed		165	175	135	66	240	270	215	250	240	240	210
Landing – Approach		160	160	140	55	200	220	170	200	200	175	175
Landing – Touchdown		90	90	85	50	160	180	150	180	140	160	160

TABLE OF CONTENT – BF.110

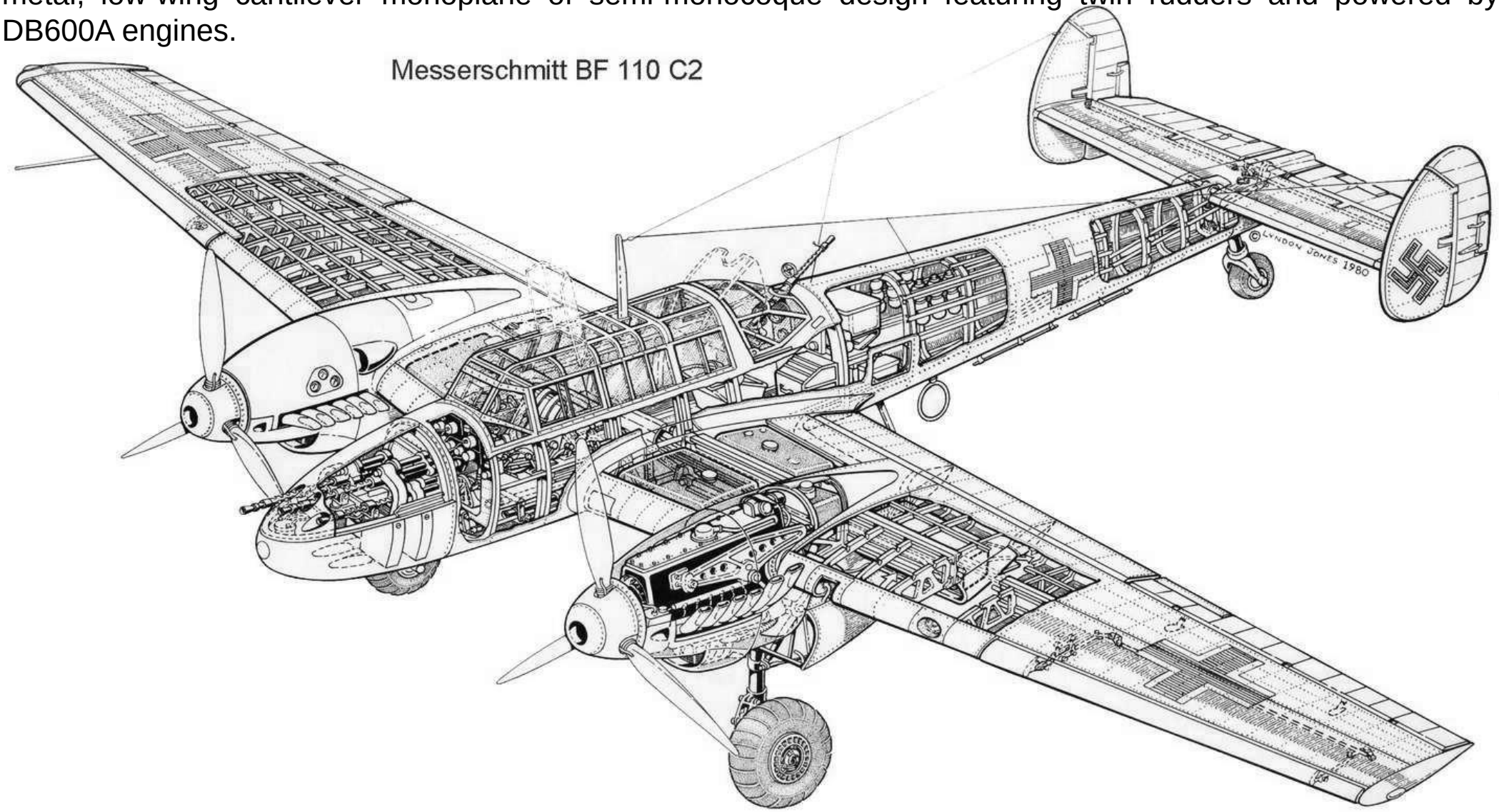
PART 1: AIRCRAFT HISTORY

The **Messerschmitt Bf.110** was a twin-engine heavy fighter (Zerstörer—German for "Destroyer") and fighter-bomber (Jagdbomber or Jabo) developed in Germany in the 1930s and used by the Luftwaffe and others during World War II. Throughout the 1930s, the air forces of the major military powers were engaged in a transition from biplane to monoplane designs. Most concentrated on the single-engine fighter aircraft, but the problem of range arose.

PART 1: AIRCRAFT HISTORY

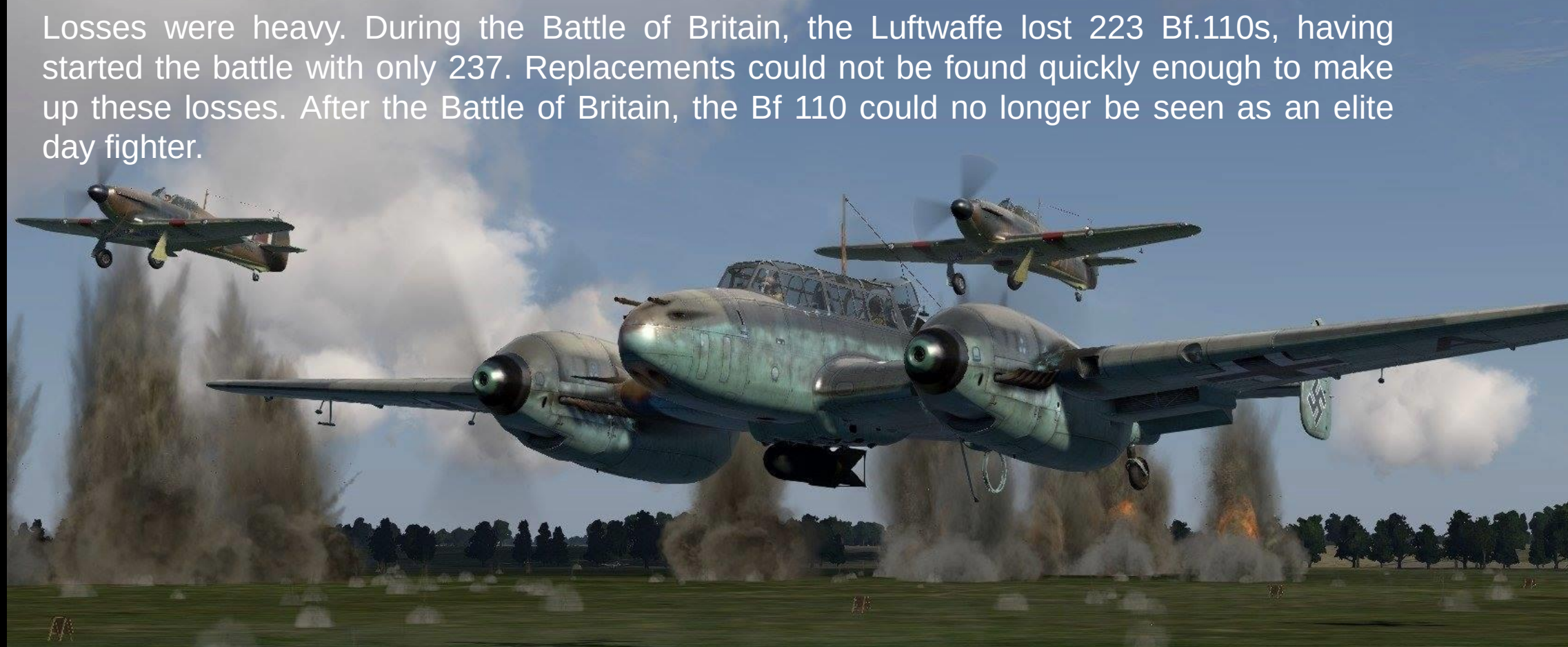
The Reichsluftfahrtministerium (RLM), pushed by Hermann Göring, issued a request for a new multipurpose fighter called the Kampfzerstörer (battle destroyer) with long range and an internal bomb bay. The request called for a twin-engine, three-seat, all-metal monoplane that was armed with cannon as well as a bomb bay. Of the original seven companies, only Bayerische Flugzeugwerke (Messerschmitt), Focke-Wulf and Henschel responded to the request.

Willy Messerschmitt's design prevailed over those of Focke-Wulf, Henschel and Arado. He was given the funds to build several prototype aircraft. Messerschmitt omitted the internal bomb load requirement from the RLM directive to increase the armament element of the RLM specification. The Bf.110 was far superior to its rivals in providing the speed, range and firepower to meet its role requirements. By the end of 1935, the Bf.110 had evolved into an all-metal, low-wing cantilever monoplane of semi-monocoque design featuring twin rudders and powered by two DB600A engines.



PART 1: AIRCRAFT HISTORY

Losses were heavy. During the Battle of Britain, the Luftwaffe lost 223 Bf.110s, having started the battle with only 237. Replacements could not be found quickly enough to make up these losses. After the Battle of Britain, the Bf 110 could no longer be seen as an elite day fighter.



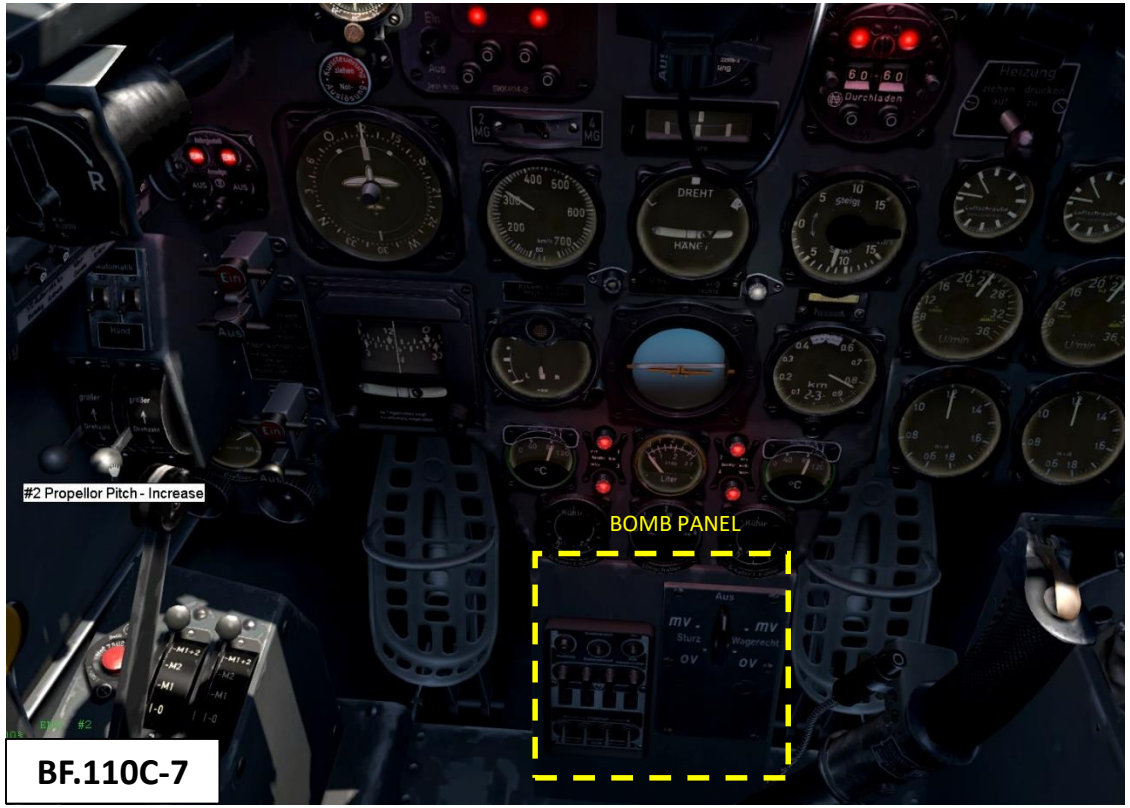
The basic problem faced by the Bf.110 was that it could not perform its job as a bomber escort against modern fighters. In earlier campaigns that weakness had been concealed, either by the lack of such opponents in Poland and Norway, or by the speed of the German advance in France, which disrupted the British and French air effort. It was only over Britain that the Bf 110 came up against a determined enemy equipped with modern fighters, and it simply could not cope. If a Hurricane or Spitfire was unlucky enough to be caught in front of the guns of a Bf 110, then the British fighter would suffer serious damage, but that rarely happened.

PART 2: AIRCRAFT VARIANTS

	(Unit)	Bf.110 C-2	Bf.110 C-4	Bf.110 C-4/N DERATED	Bf.110 C-4/N	Bf.110 C-7	Bf.110 C-7 LATE
TEMPERATURES							
Water Rad Min **Max**	Deg C	60 90	60 90	60 100	60 100	60 90	60 90
Oil Rad (OUTBOUND) Min **Max**	Deg C	40 85	40 85	40 105	40 105	40 85	40 85
ENGINE SETTINGS & PROPERTIES							
Engine & Fuel Grade		DB601 A-1 B-4 – 87 octane	DB601 A-1 B-4 – 87 octane	DB601 N-1 DERATED C-3 – 100 octane	DB601 N-1 C-3 – 100 octane	DB601 A-1 B-4 – 87 octane	DB601 A-1 B-4 – 87 octane
Takeoff RPM	RPM	2400	2400	2600	2600	2400	2400
Takeoff Manifold Pressure	UK: PSI GER: ATA ITA: mm HG	1.3	1.3	1.35	1.35	1.3	1.3
Climb RPM	RPM	2300 30 min MAX	2300 30 min MAX	2400 30 min MAX	2400 30 min MAX	2300 30 min MAX	2300 30 min MAX
Climb Manifold Pressure	UK: PSI GER: ATA ITA: mm HG	1.2	1.2	1.25	1.25	1.2	1.2
Normal Operation/Cruise RPM	RPM	2200	2200	2300	2300	2200	2200
Normal Operation/Cruise Manifold Pressure	UK: PSI GER: ATA ITA: mm HG	1.15	1.15	1.15	1.15	1.15	1.15
Combat RPM	RPM	2400	2400	2600 5 min MAX	2600 5 min MAX	2400	2400
Combat Manifold Pressure	UK: PSI GER: ATA ITA: mm HG	1.3 5 min MAX	1.3 5 min MAX	1.35 5 min MAX	1.35 5 min MAX	1.3 5 min MAX	1.3 5 min MAX
Emergency Power/ Boost RPM @ km	RPM	2400 5 min MAX	2400 5 min MAX	-	2600 1 min MAX	2400 5 min MAX	2400 5 min MAX
Emergency Power / Boost Manifold Pressure @ Sea Level	UK: PSI GER: ATA ITA: mm HG	1.3 5 min MAX	1.3 5 min MAX	-	1.42 1 min MAX	1.3 5 min MAX	1.3 5 min MAX
Landing Approach RPM	GER: ATA ITA: mm HG	2300	2300	2400	2400	2300	2300
Landing Approach Manifold Pressure	UK: MPH GER-ITA: km/h	As required	As required	As required	As required	As required	As required
Top Speed @ Sea Level	UK: MPH GER-ITA: km/h	**420**	**420**	**430**	**440**	**420**	**420**
Notes		MANUAL PITCH 4 x MG17 2 x MG FF NO MINENGSCH.	MANUAL PITCH 4 x MG17 2 x MG FF/M MINENGSCH.	AUTO PITCH 4 x MG17 2 x MG FF/M MINENGSCH. NO WEP	AUTO PITCH 4 x MG17 2 x MG FF/M MINENGSCH.	MANUAL PITCH 4 x MG17 2 x MG FF/M MINENGSCH. BOMB LOAD	AUTO PITCH 4 x MG17 2 x MG FF/M MINENGSCH. BOMB LOAD

PART 2: AIRCRAFT VARIANTS

BF.110C-2
BF.110C-4



BF.110C-7

BF.110 Variant	Characteristic
BF.110C-2	Heavy Fighter / Manual Prop Pitch / MG FF Cannons (no Mineng.)
BF.110C-4	Heavy Fighter / Manual Prop Pitch / MG FF/M Cannons (with Mineng.)
BF.110C-4/N	Heavy Fighter / Automatic Prop Pitch / MG FF/M Cannons (with Mineng.)
BF.110C-4/N DERATED	Heavy Fighter / Automatic Prop Pitch / MG FF/M Cannons (with Mineng.) / No WEP
BF.110C-7	Fighter Bomber / Manual Prop Pitch / MG FF/M Cannons (with Mineng.)
BF.110C-7 LATE	Fighter Bomber / Automatic Prop Pitch / MG FF/M Cannons (with Mineng.)

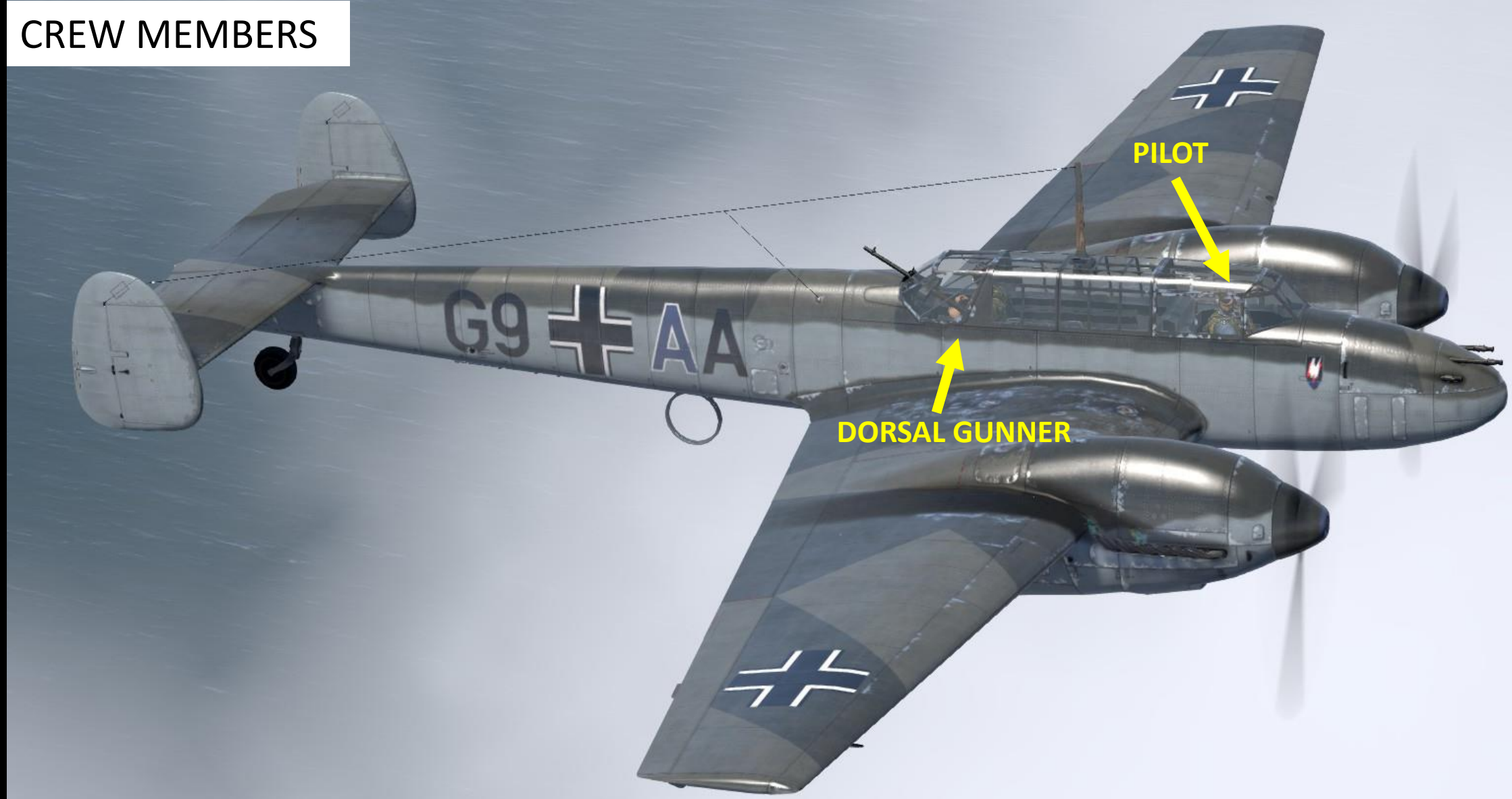
PART 2: AIRCRAFT VARIANTS

BF.110C-2 / BF.110C-4

BF.110C-7

PART 3: AIRCRAFT & COCKPIT FAMILIARIZATION

CREW MEMBERS



PART 3: AIRCRAFT & COCKPIT FAMILIARIZATION

BF.110 C-4

PILOT

PART 3: AIRCRAFT & COCKPIT FAMILIARIZATION

BF.110 C-4

PILOT

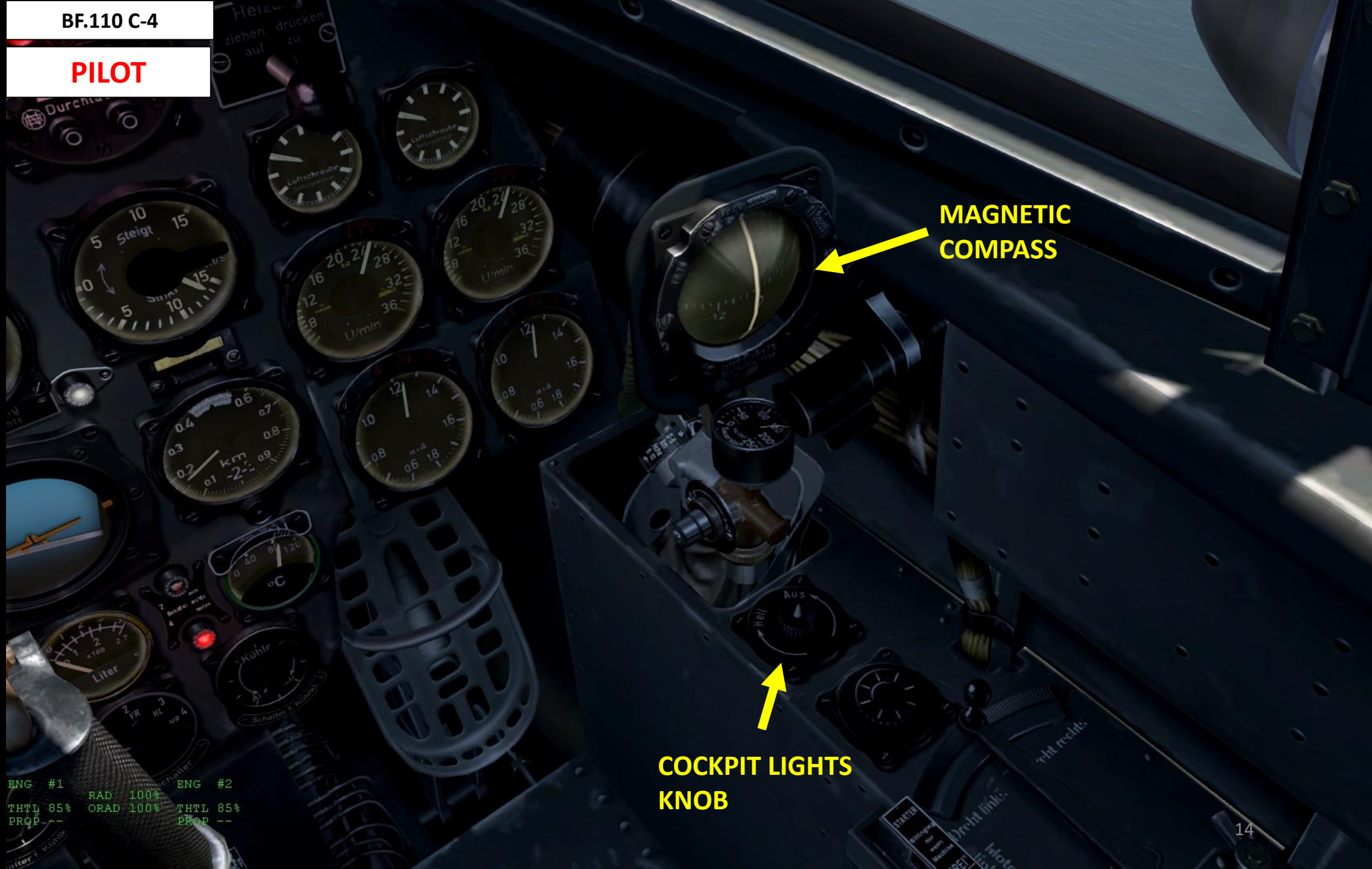
FUEL TRANSFER SYSTEM

(SEE "ENGINE MANAGEMENT SECTION FOR FUEL SYSTEM MANAGEMENT)

PART 3: AIRCRAFT & COCKPIT FAMILIARIZATION

BF.110 C-4

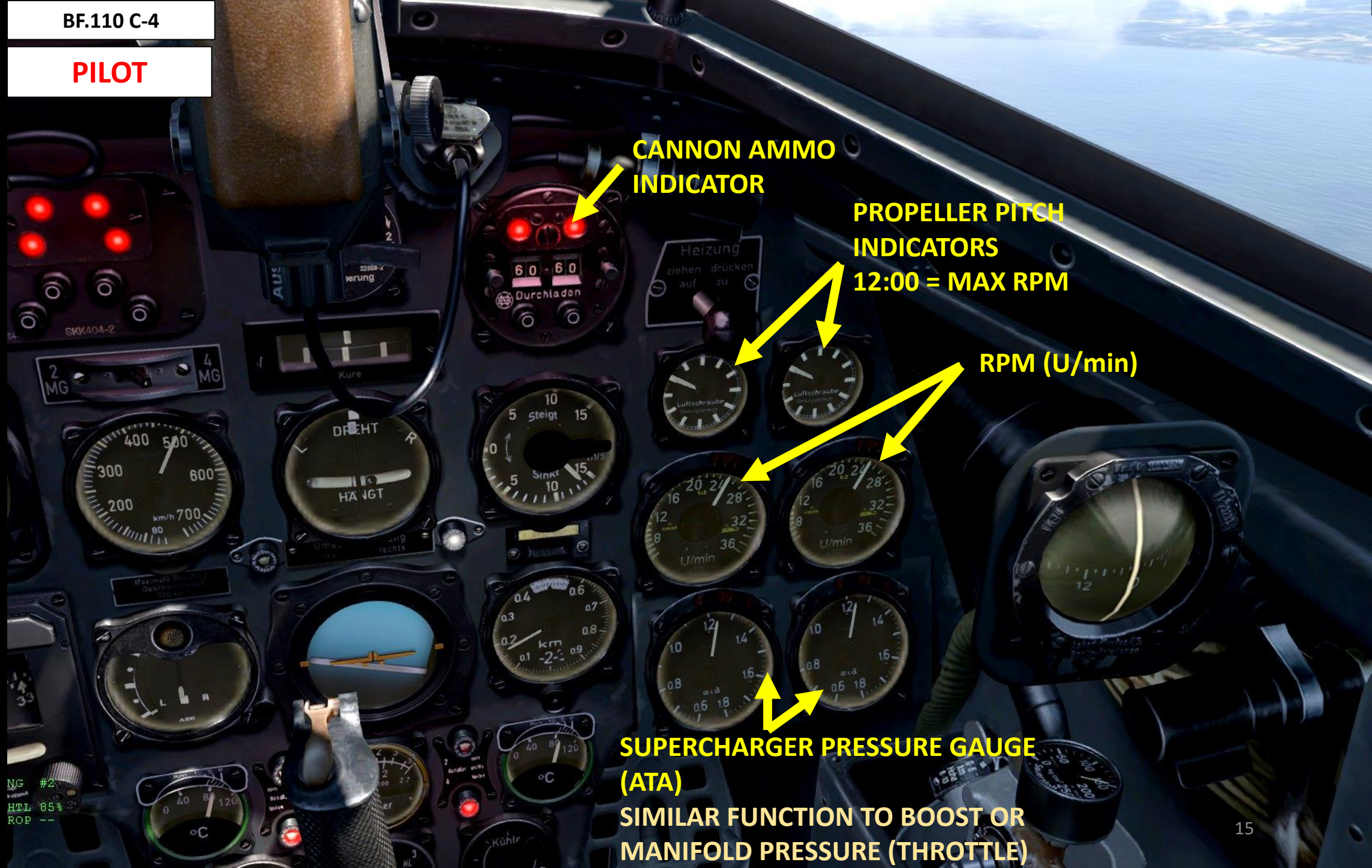
PILOT



PART 3: AIRCRAFT & COCKPIT FAMILIARIZATION

BF.110 C-4

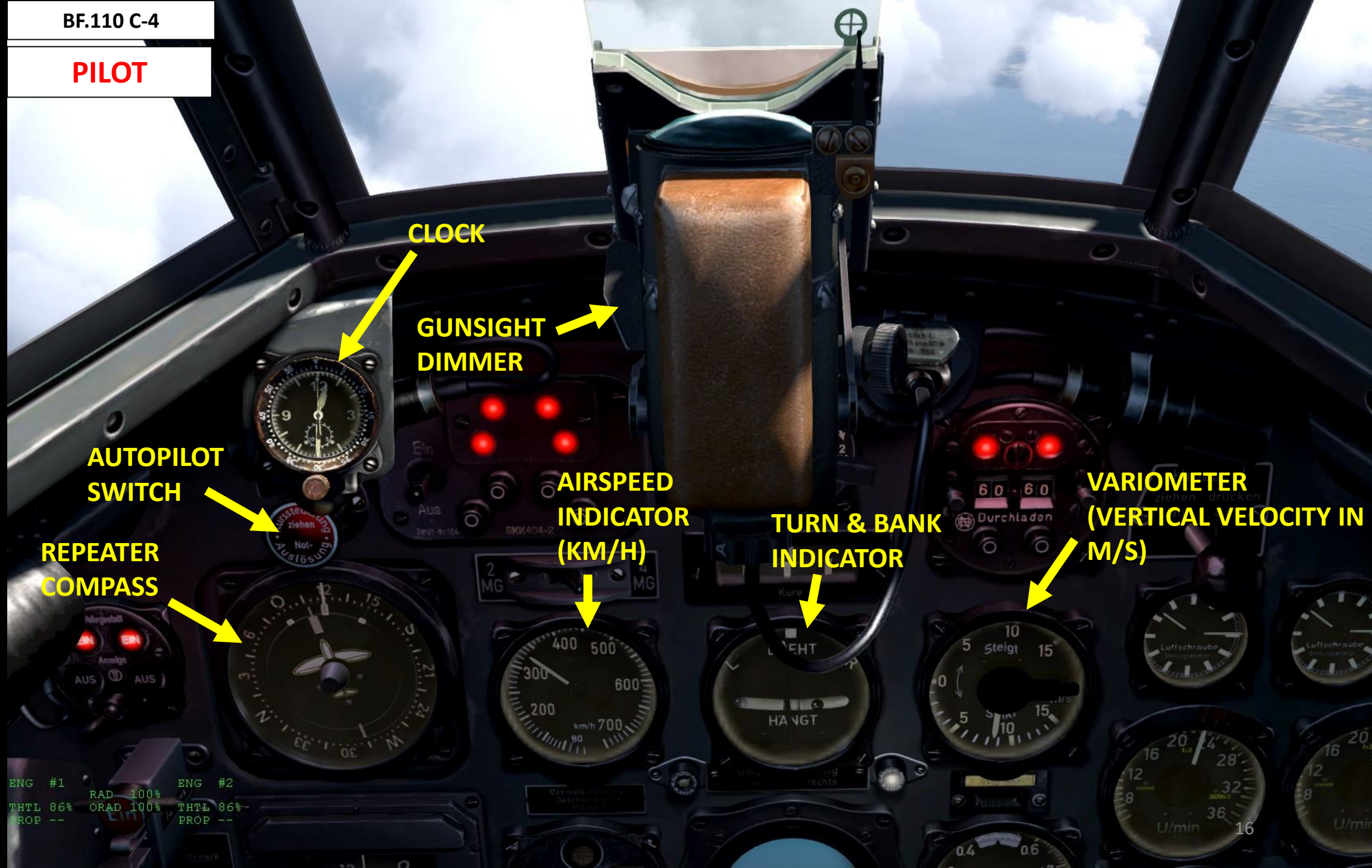
PILOT



PART 3: AIRCRAFT & COCKPIT FAMILIARIZATION

BF.110 C-4

PILOT



PART 3: AIRCRAFT & COCKPIT FAMILIARIZATION

BF.110 C-4

PILOT

PART 3: AIRCRAFT & COCKPIT FAMILIARIZATION

BF.110 C-4

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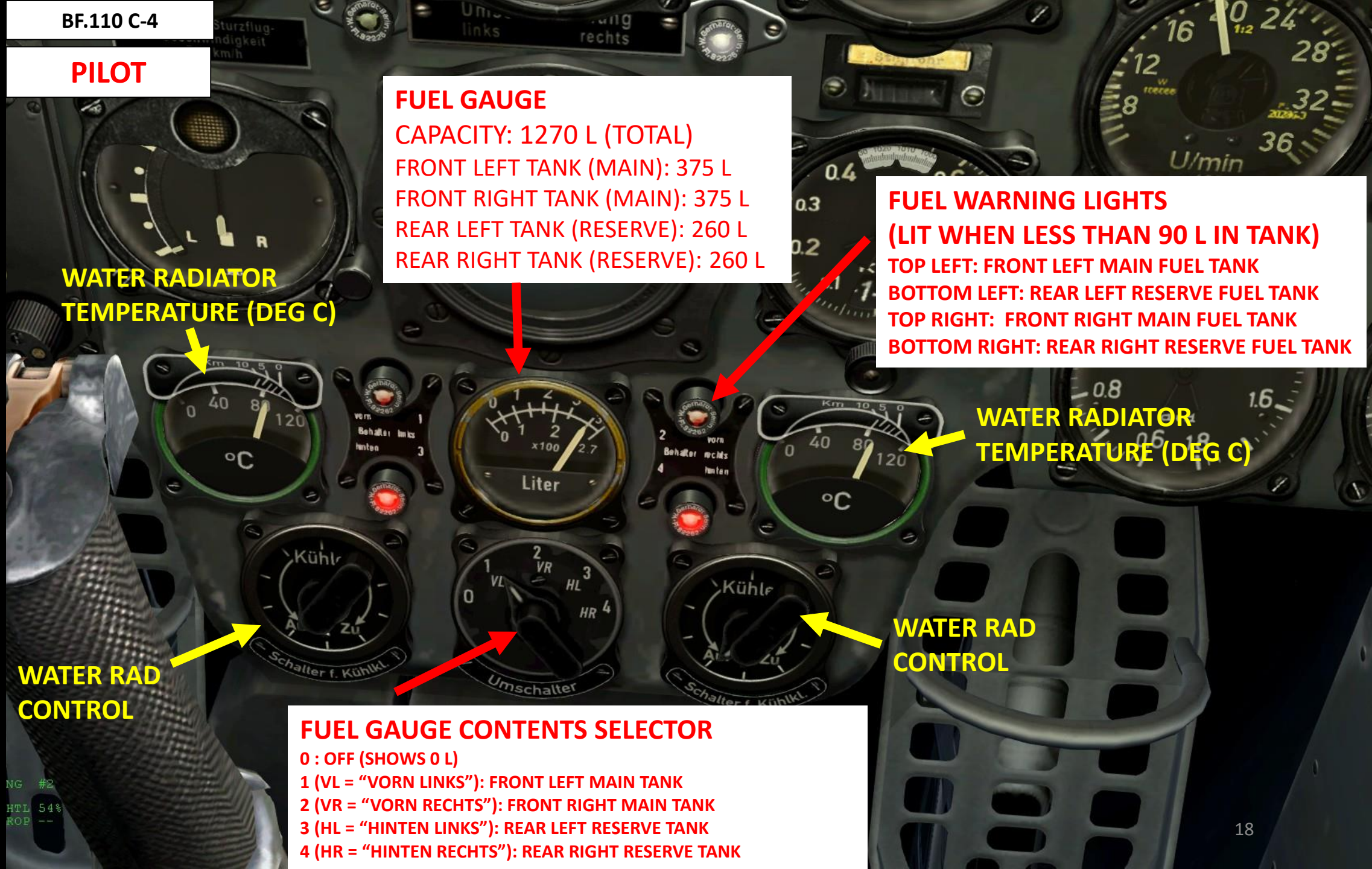
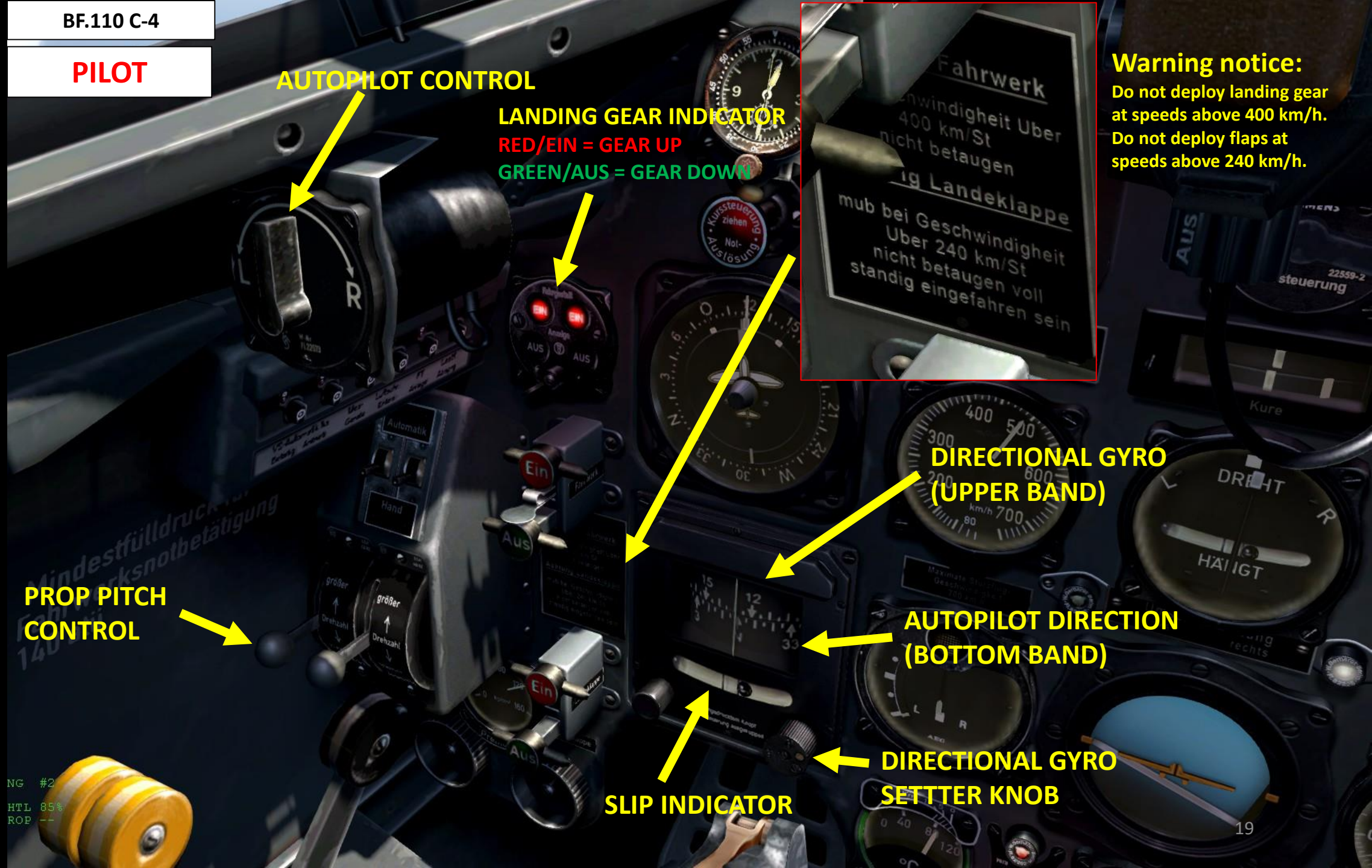


PART 3: AIRCRAFT & COCKPIT FAMILIARIZATION

BF.110 C-4

PILOT



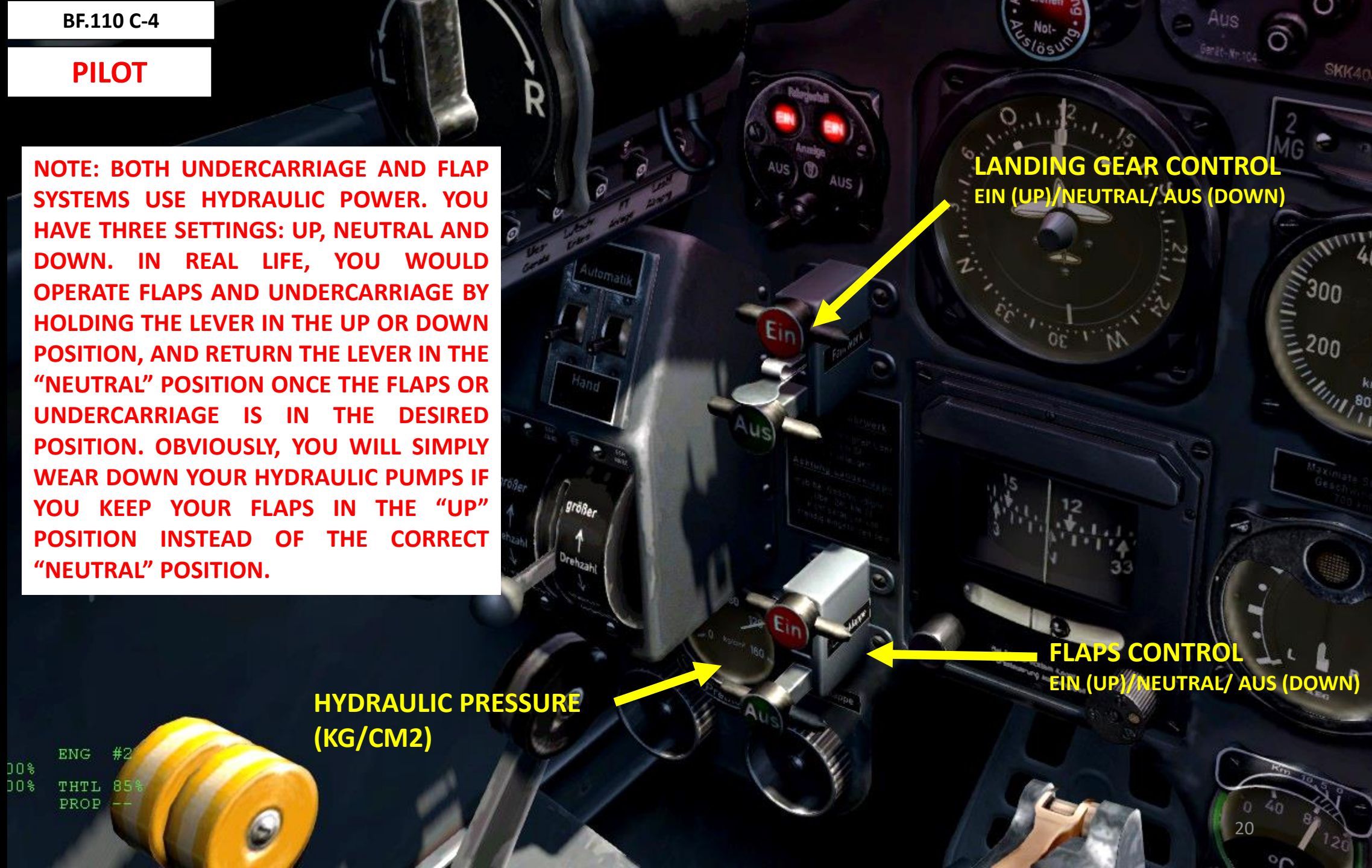
Warning notice:
Do not deploy landing gear at speeds above 400 km/h.
Do not deploy flaps at speeds above 240 km/h.

PART 3: AIRCRAFT & COCKPIT FAMILIARIZATION

BF.110 C-4

PILOT

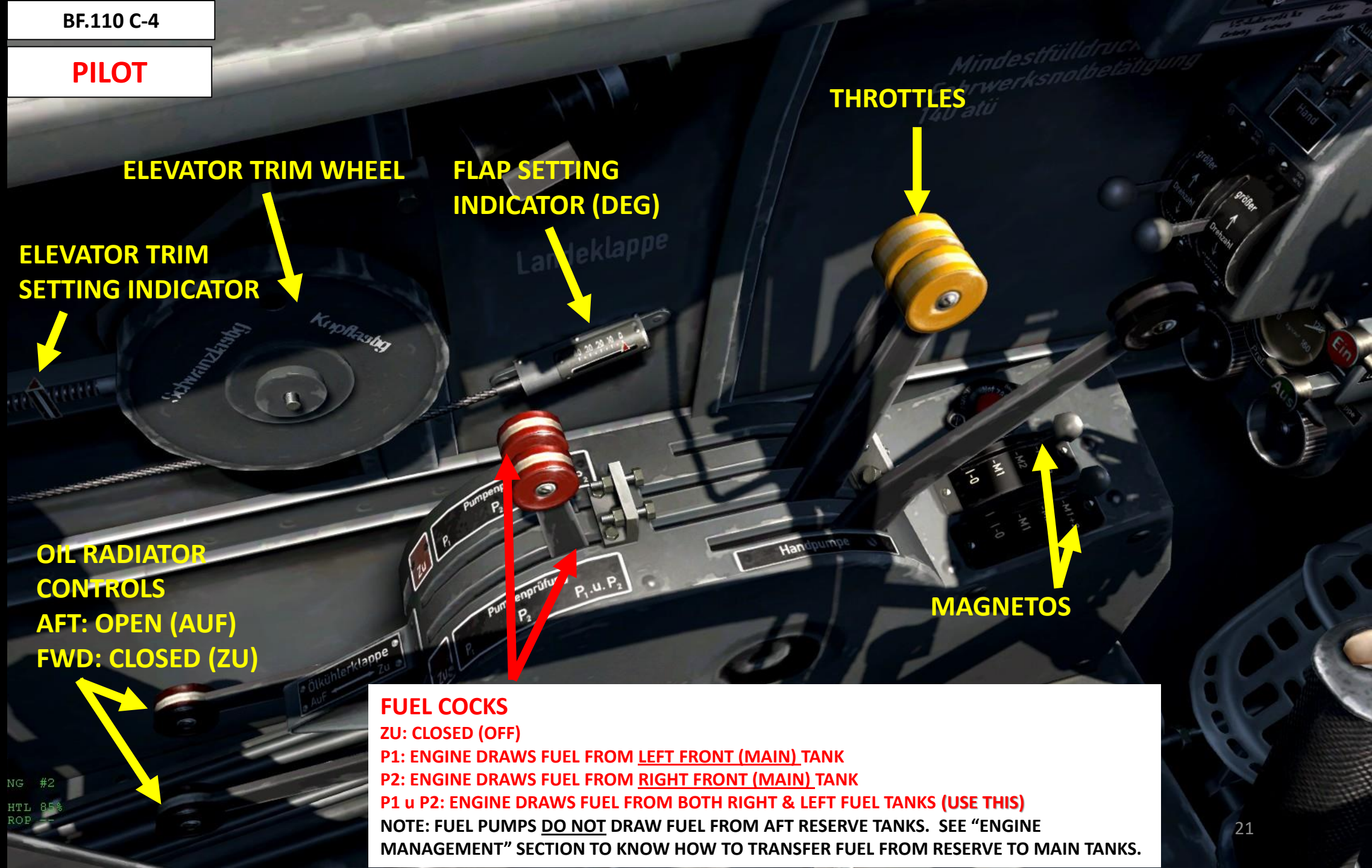
NOTE: BOTH UNDERCARRIAGE AND FLAP SYSTEMS USE HYDRAULIC POWER. YOU HAVE THREE SETTINGS: UP, NEUTRAL AND DOWN. IN REAL LIFE, YOU WOULD OPERATE FLAPS AND UNDERCARRIAGE BY HOLDING THE LEVER IN THE UP OR DOWN POSITION, AND RETURN THE LEVER IN THE "NEUTRAL" POSITION ONCE THE FLAPS OR UNDERCARRIAGE IS IN THE DESIRED POSITION. OBVIOUSLY, YOU WILL SIMPLY WEAR DOWN YOUR HYDRAULIC PUMPS IF YOU KEEP YOUR FLAPS IN THE "UP" POSITION INSTEAD OF THE CORRECT "NEUTRAL" POSITION.



PART 3: AIRCRAFT & COCKPIT FAMILIARIZATION

BF.110 C-4

PILOT



FUEL COCKS

ZU: CLOSED (OFF)

P1: ENGINE DRAWS FUEL FROM LEFT FRONT (MAIN) TANK

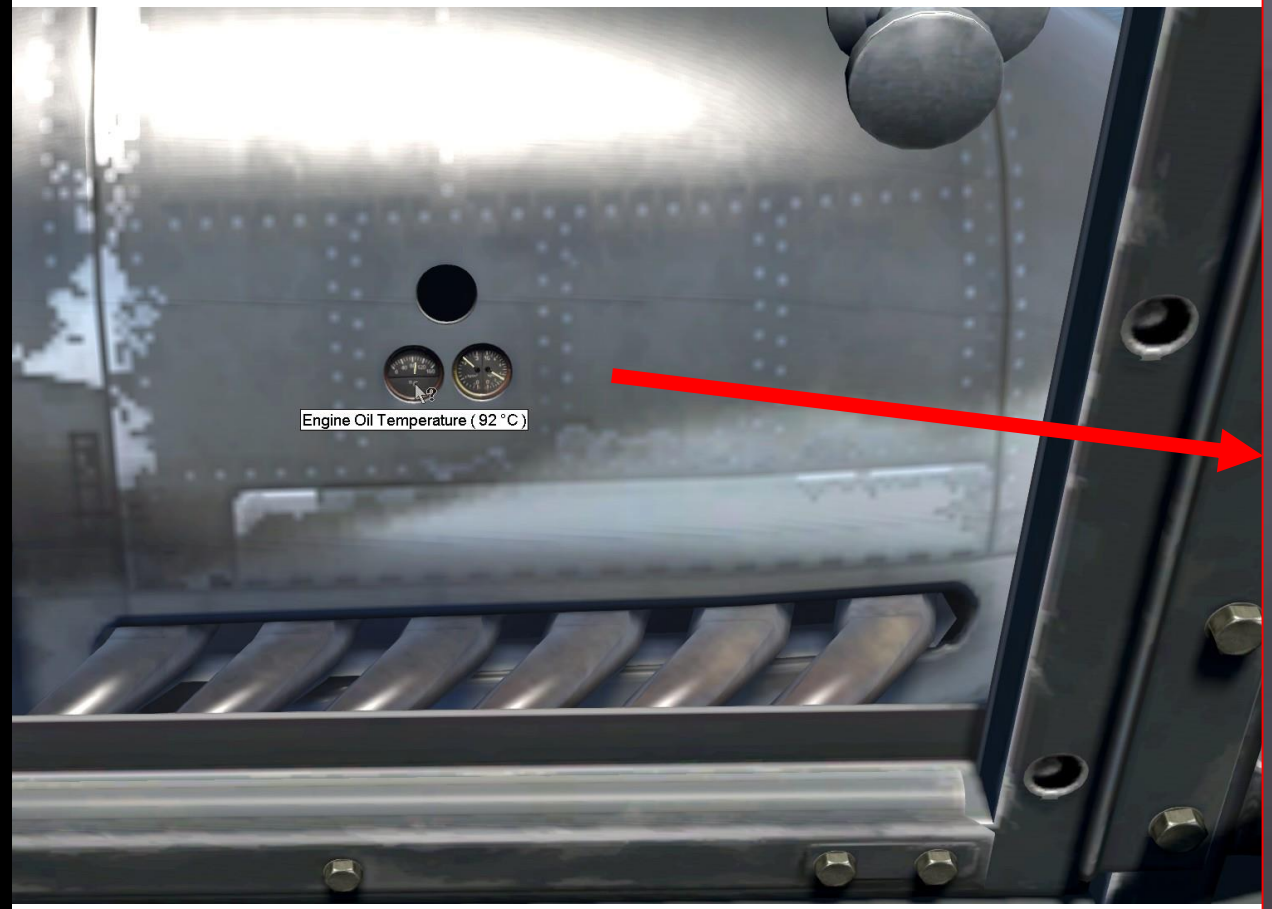
P2: ENGINE DRAWS FUEL FROM RIGHT FRONT (MAIN) TANK

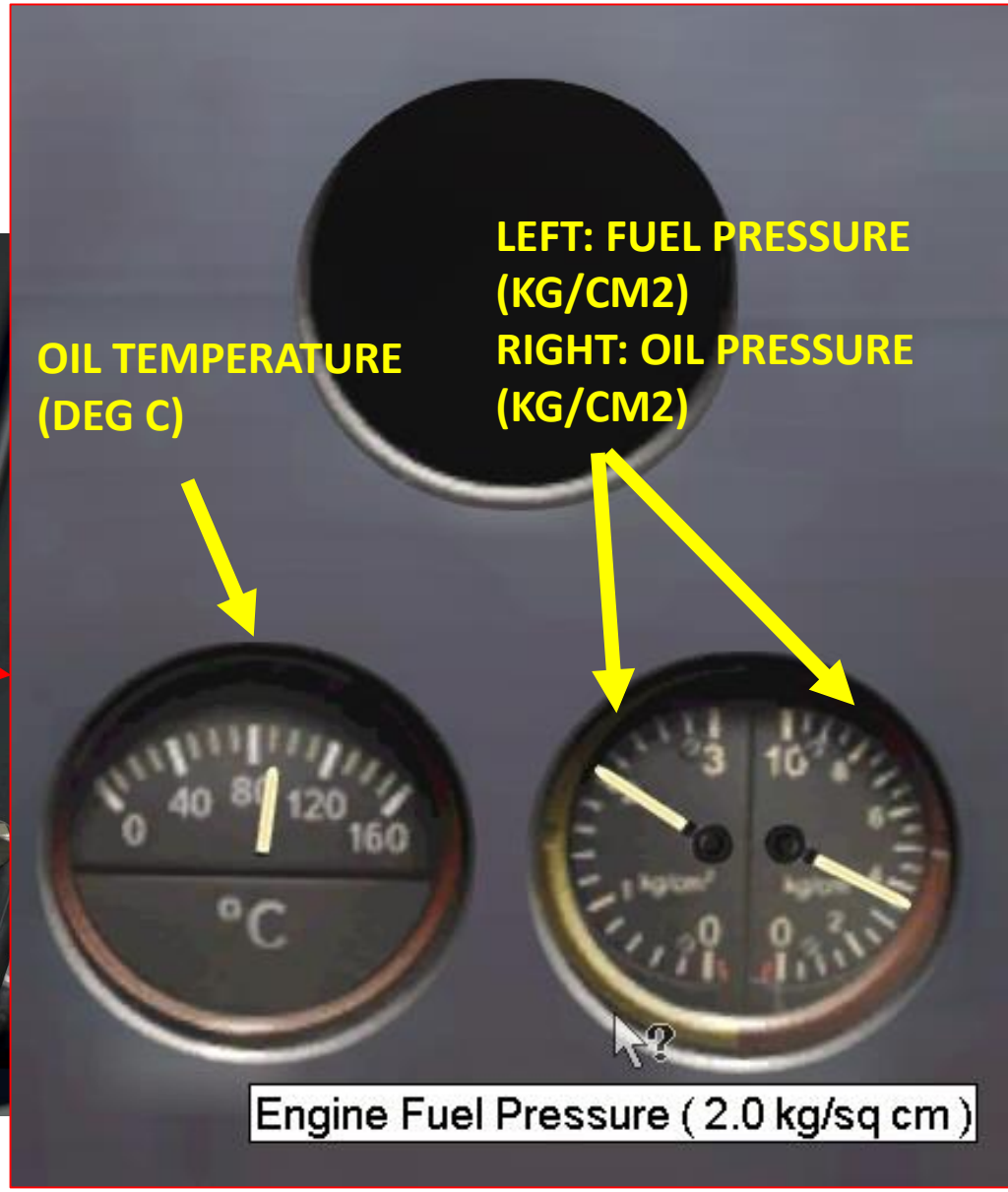
P1 u P2: ENGINE DRAWS FUEL FROM BOTH RIGHT & LEFT FUEL TANKS (USE THIS)

NOTE: FUEL PUMPS DO NOT DRAW FUEL FROM AFT RESERVE TANKS. SEE "ENGINE MANAGEMENT" SECTION TO KNOW HOW TO TRANSFER FUEL FROM RESERVE TO MAIN TANKS.

BF.110 C-4

PILOT

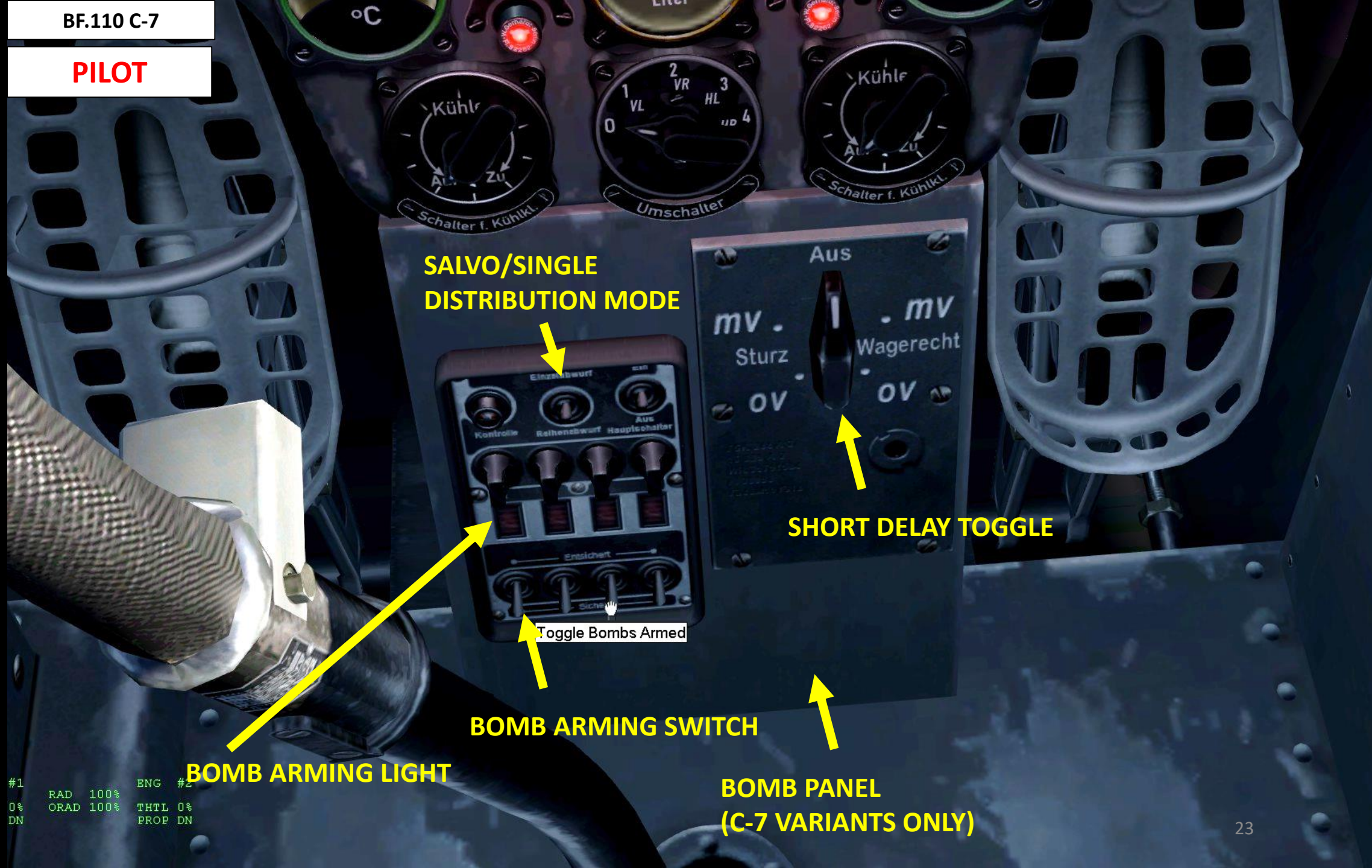




PART 3: AIRCRAFT & COCKPIT FAMILIARIZATION

BF.110 C-7

PILOT



TURRET IN "CRUISE" POSITION

TURRET IN "FIRING" POSITION

NOTES

- Your gunner can call out fighters if you have your in-game chat info window enabled. However, if you switcher to your gunner position and switched back to your pilot seat, it is possible that the AI gunner will not take control of the gun. In other words, your gunner will not fire unless the AI takes control of it. To give back the AI control of your turret, you should use the "L_ALT+F2".
- Your turret has 2 positions: CRUISE and FIRING. During aircraft cold start, you start in "CRUISE/PARKED" position. In this mode, the gunner cannot fire his gun nor move his turret. This mode is primarily used to generate less drag. "FIRING" position, on the other hand, allows you to use your gun and rotate your turret to get a better view angle. It is useful to track targets or examine damage on the wings or upper forward fuselage. Your gunner will only fire when the turret is in "FIRING" position.
- Any turret or other air crew position (like the bombardier) can be manned by other players in multiplayer. They just need to **double-click on the available slot in multiplayer** once they clicked on the "flag".

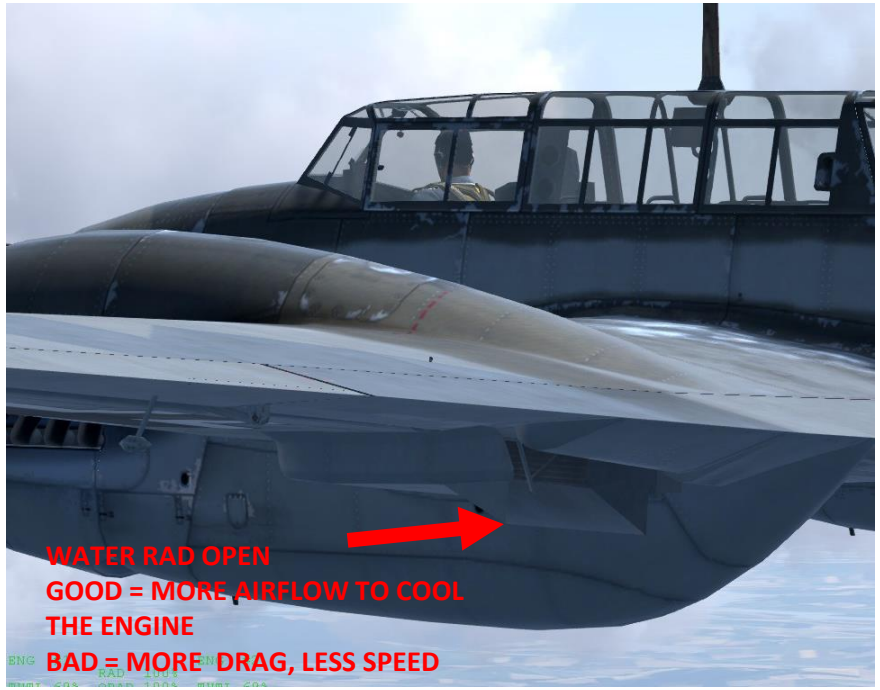
PART 3: AIRCRAFT & COCKPIT FAMILIARIZATION

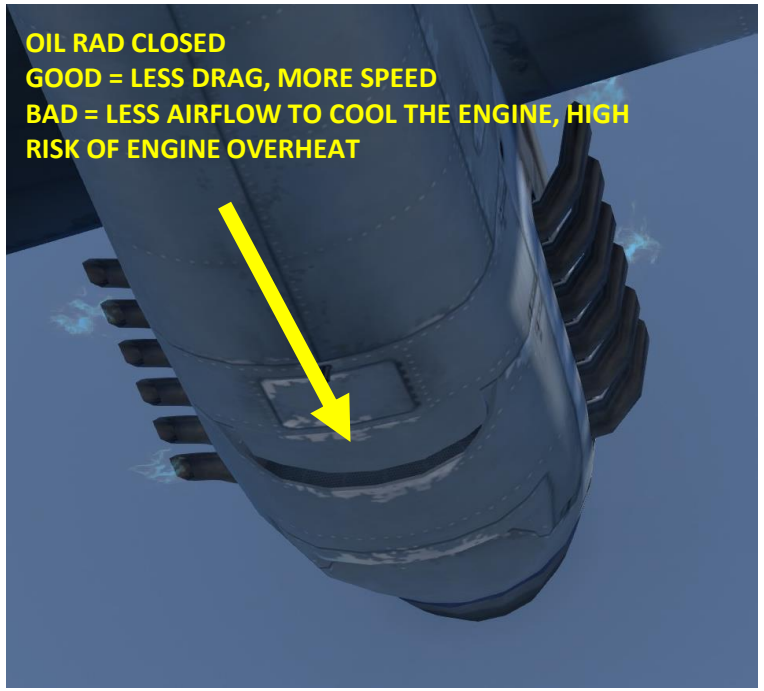
DORSAL GUNNER

DORSAL GUNNER CONTROLS

--CRUISE POSITION: **O**
-FIRING POSITION: **CUSTOM KEY**
-LEAN TO GUNSIGHT: **CUSTOM KEY**
-FIRE WEAPON: **LEFT MOUSE BUTTON**
-SWITCH GUNNER/BOMBARDIER POSITION: **C**
-CHANGE MANNED POSITION: **L_SHIFT_C**
-GIVE GUNNER CONTROL TO AI: **L_ALT+F2**
-TAKE CONTROL OF GUN (TOGGLE INDEPENDENT MODE): **F10**

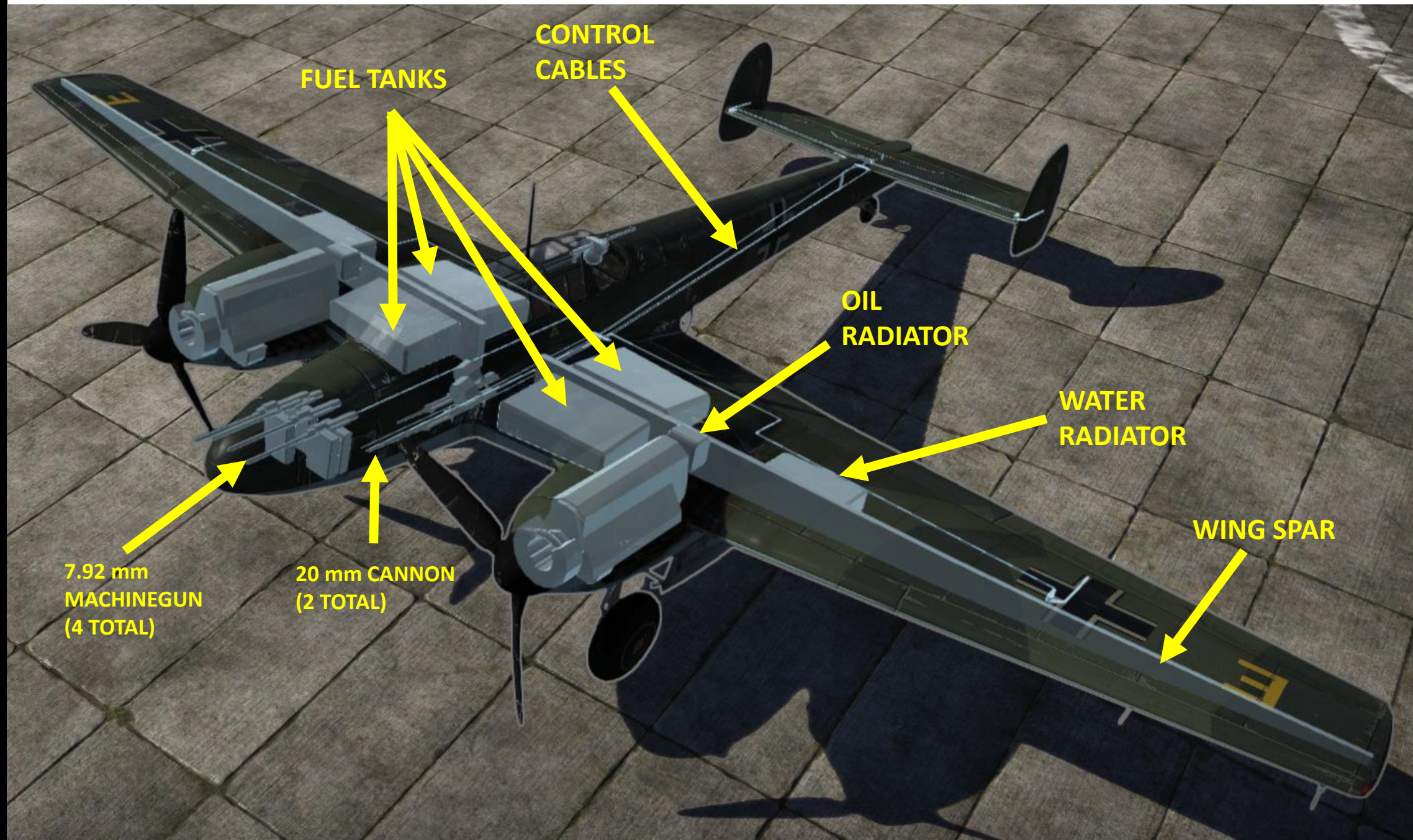
CHECK THE "ENGINE MANAGEMENT" SECTION FOR RECOMMENDED RADIATOR SETTINGS.





PART 3: AIRCRAFT & COCKPIT FAMILIARIZATION

CRITICAL COMPONENTS



HOW TO RECOGNIZE A TAIL NUMBER

LUFTWAFFE

The tactical markings system for the Luftwaffe in WWII must have been designed by a mad genius. Comparative simplicity of the systems used by Italy and the British is a further testament to the fact.

The system will seem extremely convoluted to most everyone who reads this guide; imagine programming all that into the sim!

Serial Number or Werknummer: usually a four-digit number.

Some Examples (symbols in **bold** can be set by the player, symbols in *italics* are automatically set by Cliffs of Dover)

Plane	Squadron	Tactical #	Serial #
Bf-109E-3	II./JG26	<<+-	**1542**
Bf-109E-3	7./JG26	**7**+|	**1195**
Bf-110	5./ZG1	*G9*+**I***N*	**4277**
Bf-110	Stab II./ZG76	*M8*+**K***C*	**3863**
He-111	Stab./KG55	*G1*+**F***A*	**1582**
Ju-87	III./StG51	*6G*+**A***D*	**5338**

Tail Number. Two completely different systems were used for bomber and fighter aircraft.

Fighters: Squadron designated by squadron badge. Tactical number either consists of a one- or two-digit number, or a special symbol such as double chevron for a group commander. See below for all symbols supported by Cliffs of Dover.

Colour of the tactical number determines the Staffel within the squadron the aircraft belongs to. Some Gruppen are also marked with another special symbol aft of the fuselage cross, such as a horizontal line for II. Gruppe or a curvy line for the III. Gruppe.

Bombers: a four character string, in which the first two symbols are the squadron code, usually a number and a letter. The next symbol is the individual aircraft letter, and the final is the letter that identifies which Gruppe and Staffel the aircraft belongs to. The final letter also determines the colour of the individual aircraft letter.

Luftwaffe Fighter Symbols

Note that there are multiple variants for some positions, which give similar but distinct markings. For example both <|- and <I mean Geschwader Adjutant, but display different graphics on the aircraft. These variations were generally created and used by individual squadrons.

Symbol	Deciphered	Meaning
<|-	[less than] [vert line] [dash]	Geschwader Adjutant
<|	[less than] [vert line]	Geschwader Adjutant
<I	[less than] [capital I]	Geschwader Adjutant
--	[dash] [dash]	Geschwader Adjutant
-o	[dash] [lower case o]	Geschwader Adjutant
<--	[less than] [dash] [dash]	Geschwader Commodore
<_1	[less than] [underscore] [number 1]	Geschwader Commodore
<-	[less than] [dash]	Geschwader Commodore
<.-	[less than] [period] [dash]	Geschwader Commodore
<<-	[less than] [less than] [dash]	Geschwader Commodore
<<<4	[less than] [less than] [less than]	Geschwader Commodore
K<<	[less than] [less than]	Geschwader Commodore Kuban
<||	[less than] [vert line] [vert line]	Geschwader Major Beim Stab
<o-	[less than] [lower case o] [dash]	Geschwader Technical Officer
<O-	[less than] [capital O] [dash]	Geschwader Technical Officer
<|o	[less than] [vert line] [lower case o]	Geschwader Technical Officer
<Io	[less than] [capital I] [lower case o]	Geschwader Technical Officer
<|O	[less than] [vert line] [capital O]	Geschwader Technical Officer
<IO	[less than] [capital I] [capital O]	Geschwader Technical Officer
<	[less than]	Gruppen Adjutant
_<	[underscore] [less than]	Gruppen Adjutant
<1	[less than] [one]	Gruppen Beim Stab
<.	[less than] [period]	Gruppen Kommandeur
_<.	[underscore] [less than] [period]	Gruppen Kommandeur
<<	[less than] [less than]	Gruppen Kommandeur
I<<	[capital I] [less than] [less than]	Gruppen Kommandeur
<o	[less than] [lower case o]	Gruppen Technical Officer
<O	[less than] [capital O]	Gruppen Technical Officer
T	[capital T]	Gruppen Technical Officer
<*	[less than] [asterisk]	Gruppen Technical Officer
<t	[less than] [lower case T]	Kommodore
<0	[less than] [zero]	Kuban
-A-	[dash] [capital A] [dash]	Stab.
I_	[capital I] [underscore]	Stab.

NOTE: Many of these symbols were historically meant for Stab aircraft only; however you can still assign them to other Staffeln, which may colour these symbols in non-historical Staffel colours.

PART 4: CONTROLS

MESSERSCHMITT BF.110 (ALL VARIANTS)		
DESCRIPTION	MAPPED TO	ESSENTIAL / NON-ESSENTIAL
Wheel Chocks		ESSENTIAL
toggle primary cockpit illumination		CLICKABLE IN COCKPIT
fire machine guns	Joystick Gun Trigger	ESSENTIAL
fire cannons	Joystick Cannon Trigger	ESSENTIAL
toggle prop pitch automation (C-7 LATE MODEL ONLY)		ESSENTIAL
toggle gunsight illumination		ESSENTIAL
Drop ordnance (bombs)	B	ESSENTIAL
Fuel Cock Toggle #1 #2 #3 #4		CLICKABLE IN COCKPIT
toggle selected engine (ignition)	“I” by default	ESSENTIAL
directional controls (ailerons, elevators, and rudder)	Joystick & Rudder Pedal axes	ESSENTIAL
Trim controls (elevator/rudder)	Joystick hat switch	ESSENTIAL
Field of View + (allows you to zoom out)		ESSENTIAL
Field of View – (allows you to zoom in)		ESSENTIAL
engine #1 select	L_SHIFT+1	ESSENTIAL
engine #2 select	L_SHIFT+2	ESSENTIAL
all engines select	L_SHIFT+3 (CUSTOM)	ESSENTIAL

PART 4: CONTROLS

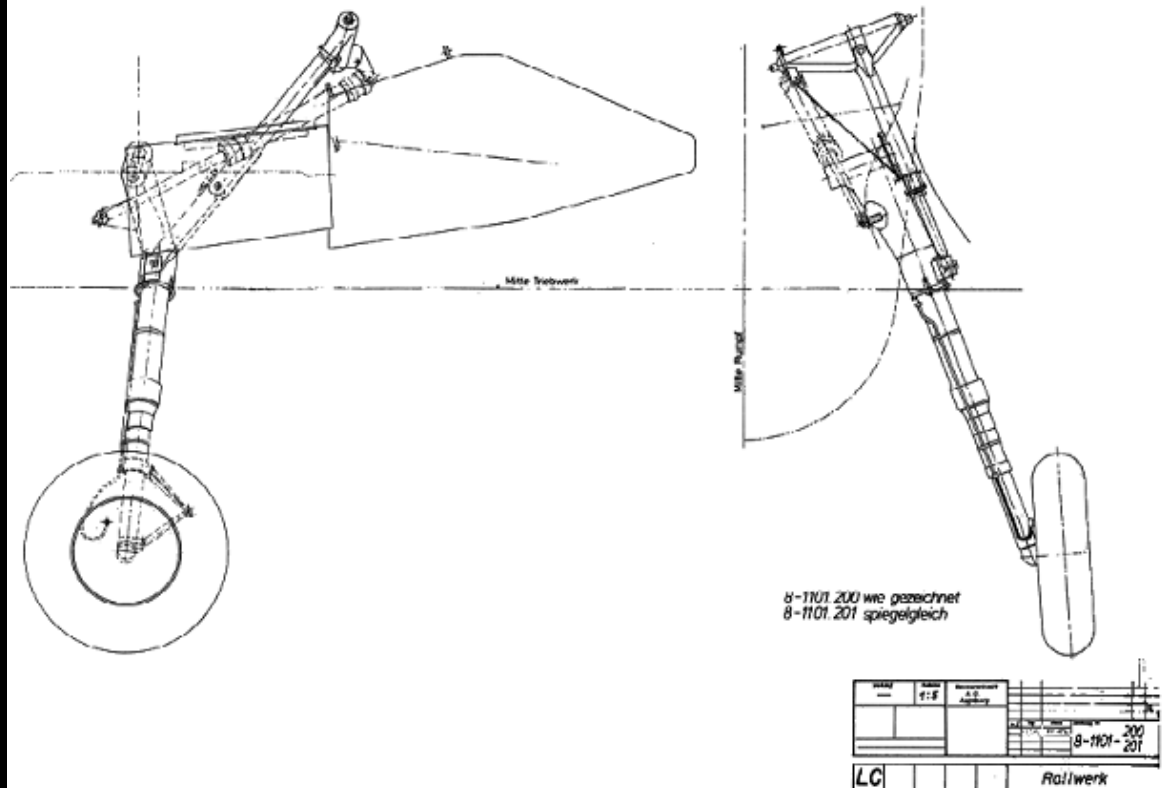
MESSERSCHMITT BF.110 (ALL VARIANTS)		
DESCRIPTION	MAPPED TO	ESSENTIAL / NON-ESSENTIAL
lean to gunsight		NOT ESSENTIAL
throttle	Throttle axis	ESSENTIAL
War Emergency Power		ESSENTIAL
toggle canopy/hatch		ESSENTIAL
Jettison canopy		ESSENTIAL
Open oil radiator	Right Arrow keyboard	ESSENTIAL
close oil radiator	Left Arrow keyboard	ESSENTIAL
open radiator	Up Arrow keyboard	ESSENTIAL
close radiator	Down Arrow keyboard	ESSENTIAL
increase propeller pitch	**CUSTOM. DO NOT MAP TO AXIS LIKE FOR THE RAF A/C. MAP TO KEYS INSTEAD.**	ESSENTIAL
decrease propeller pitch		ESSENTIAL
Toggle undercarriage (landing gear)		ESSENTIAL
Left / Right Wheel brake	Map in AXES if pedals	ESSENTIAL
bail out		ESSENTIAL
Toggle Independent Mode (allows you to use/hide mouse cursor)	F10	ESSENTIAL

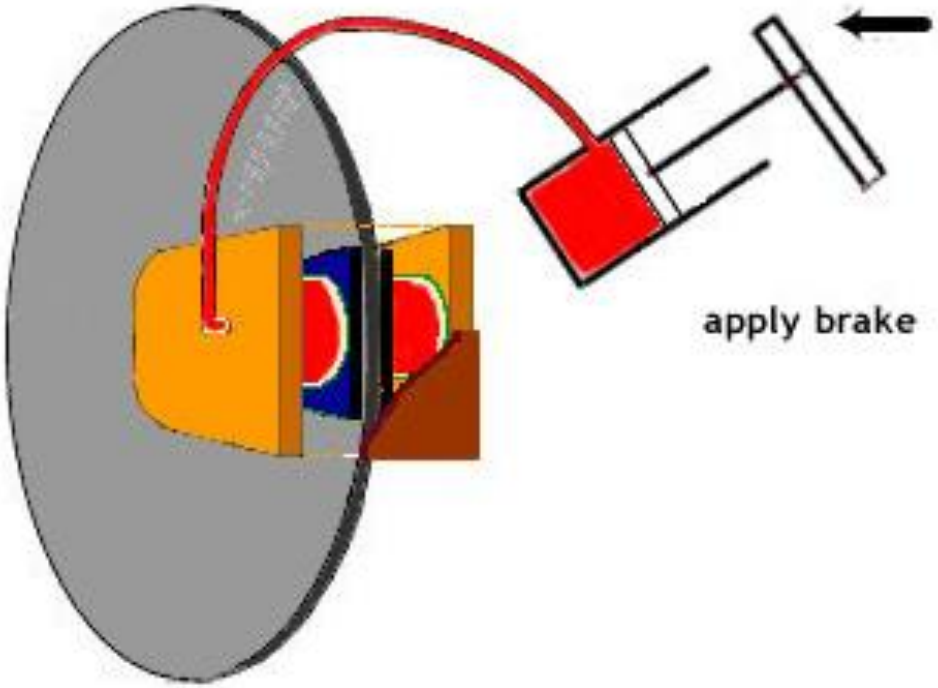
PART 4: CONTROLS

MESSERSCHMITT BF.110 (ALL VARIANTS)		
DESCRIPTION	MAPPED TO	ESSENTIAL / NON-ESSENTIAL
Turret – Cruise Position	O	ESSENTIAL
Turret – Firing Position	L_SHIFT+O (CUSTOM)	ESSENTIAL
External View (Give Turret Gunner Control to AI)	L_ALT+F2	ESSENTIAL
View-Position #1 (pilot)	L_ALT+1	ESSENTIAL
View-position #2 (dorsal gunner)	L_ALT+2	ESSENTIAL
Next Manned Position (Cycles through air crew)	C	ESSENTIAL
Course autopilot – Previous Mode (Course or OFF)	A	ESSENTIAL
Course autopilot – Next Mode (Course mode or OFF)	S	ESSENTIAL
course setter – increase	NUMPAD + (CUSTOM)	ESSENTIAL
course setter – decrease	NUMPAD - (CUSTOM)	ESSENTIAL
directional gyro – increase	NUMPAD / (CUSTOM)	ESSENTIAL
directional gyro – decrease	NUMPAD * (CUSTOM)	ESSENTIAL
Autopilot left (aircraft turns left while in autopilot)	L_CTRL + A (CUSTOM)	ESSENTIAL
Autopilot right (aircraft turns right while in autopilot)	L_CTRL + S (CUSTOM)	ESSENTIAL
bomb mode selector – next / previous (salvo/single)	SEE BOMBER NUMPAD	ESSENTIAL
toggle bombs armed	SEE BOMBER NUMPAD	ESSENTIAL
toggle bomb short delay	SEE BOMBER NUMPAD	ESSENTIAL

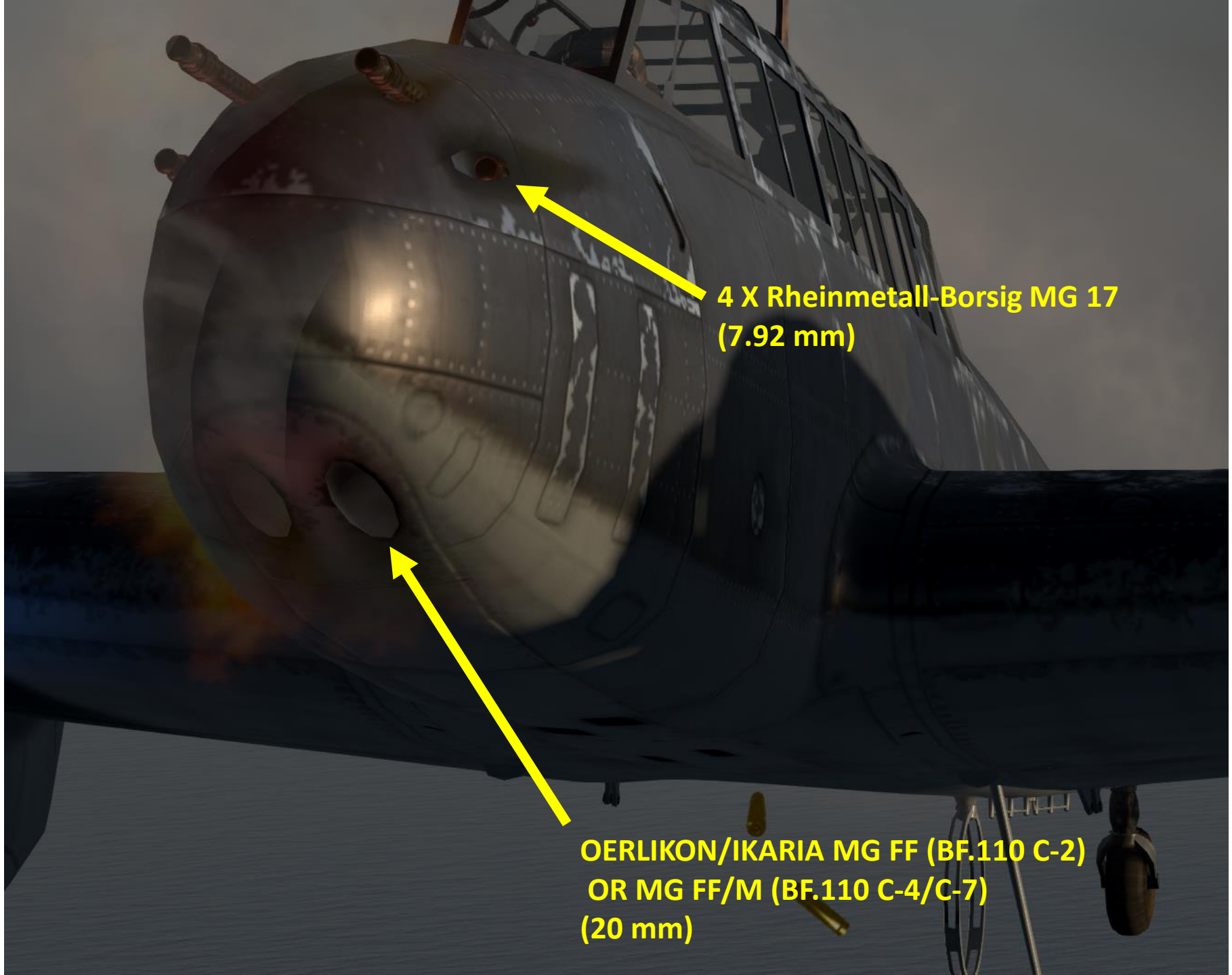
PART 4: CONTROLS

- Most german aircraft, unlike the majority of British and Russian planes, has a “toe brake” or “heel brake” system, which is linked to each individual wheel of your landing gear.
- In order to brake, you need to hold either your left or right wheel toe brake key to steer your aircraft. Applying rudder will also help you turn tighter.
- The main landing wheel brake system employs hydraulically actuated disc-type brakes. Each brake is operated by individual master brake cylinders located directly forward of the instrument panel. The brakes are selectively controlled by means of toe pedals incorporated into the rudder pedal assembly.
- Be careful: your “wheel brake” command used for Differential braking aircraft will lock both your brakes in a german plane. You can map “left/right wheel brake” axes if you have rudder pedals.



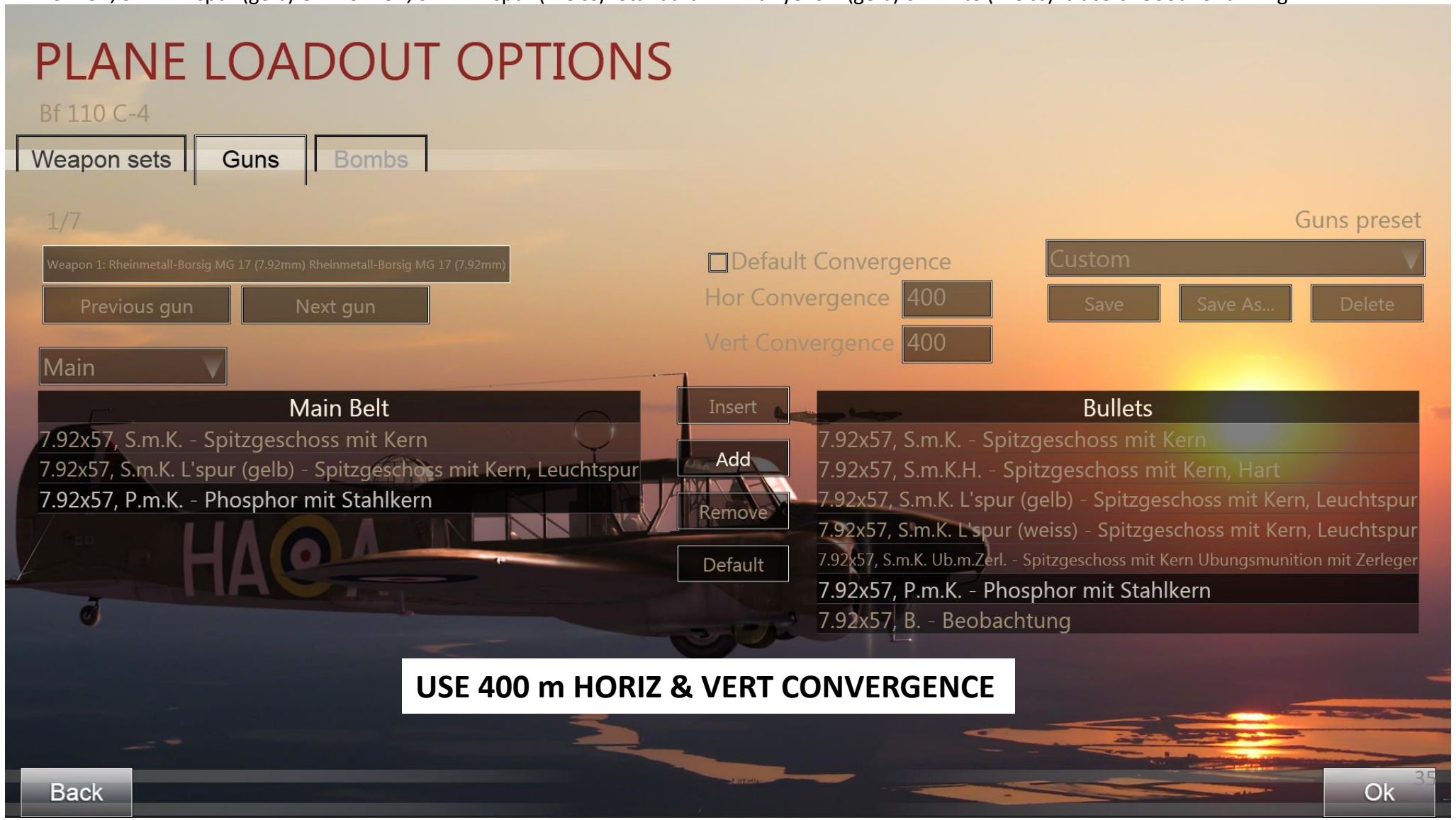


PART 5: WEAPONS AND ARMAMENT



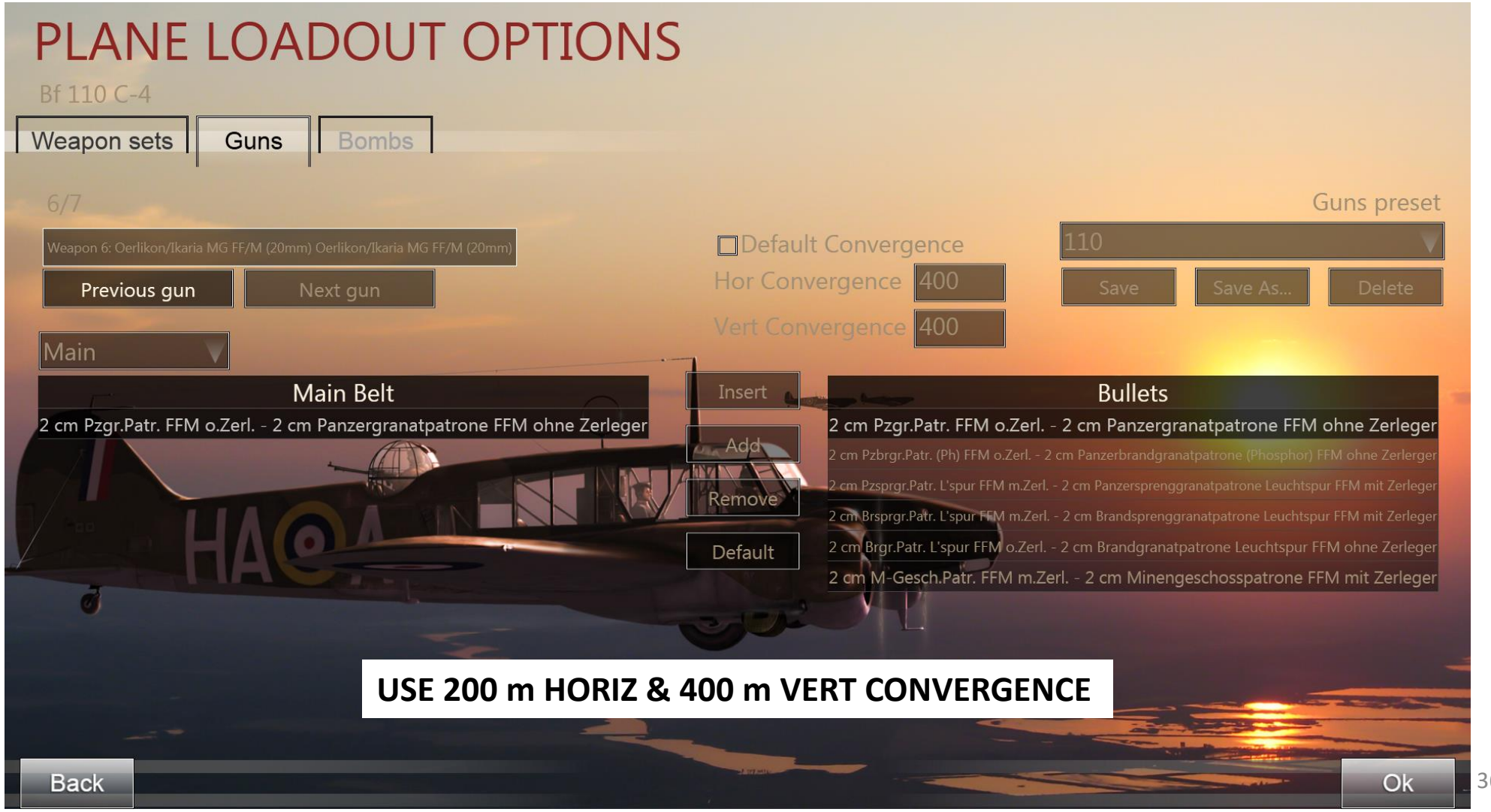
Recommended Machine-Gun Belt Loadout – **Rheinmetall-Borsig MG 17 (7.92 mm)**

1. 7.92×57, S.m.K.H. - Spitzgeschoss mit Kern, Hart- Improved AP round with tungsten core. Highly recommended if you want a straight AP. However, the S.m.K.H. **in-game is in fact a duplicate of the S.m.K**., because the S.m.K.H. was never used on a fighter aircraft. Tungsten is a precious and expensive metal that was much needed elsewhere for the german war effort.
2. 7.92×57, P.m.K. - Phosphor mit Stahlkern- Standard AP with an incendiary composition. A great round, can still pierce armor and set fires
3. 7.92×57, S.m.K. L'spur (gelb) OR 7.92×57, S.m.K. L'spur (Weiss)- Standard AP with yellow (gelb) or white (Weiss) tracers. Good for aiming.



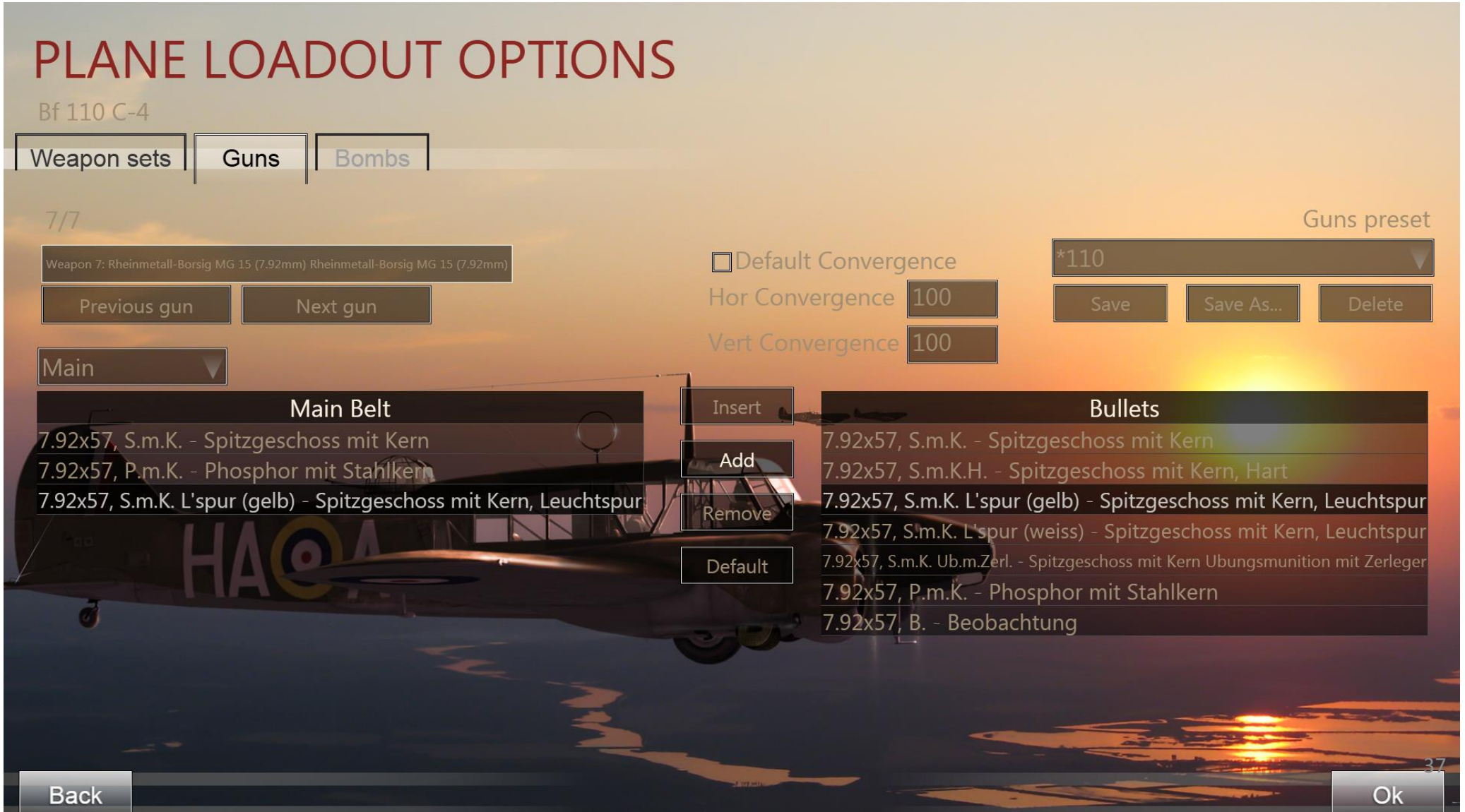
Recommended CANNON Belt Loadout – **OERLIKON/IKARIA MG FF OR MG FF/M (20 mm)**

1. ***For Bf.110C-2 Variants (MG FF):*** Sprenggranate L'spur m.Zerl (134g AP round with small HE payload, with tracer and self destruction) A very effective round, has the potential to do major structual damage while still piercing armor.
2. ***For Bf.109C-4 or C-7 Variants (MG FF/M)****:* M-Geschoss m.Zerl (92g HE with self destruction) Thin walled HE round. Has immense potential for destruction, containing 3 times the amount of HE payload than that of a normal HE round. Arguably the best round for the MG FF/M. However, it does not contain a tracer composition



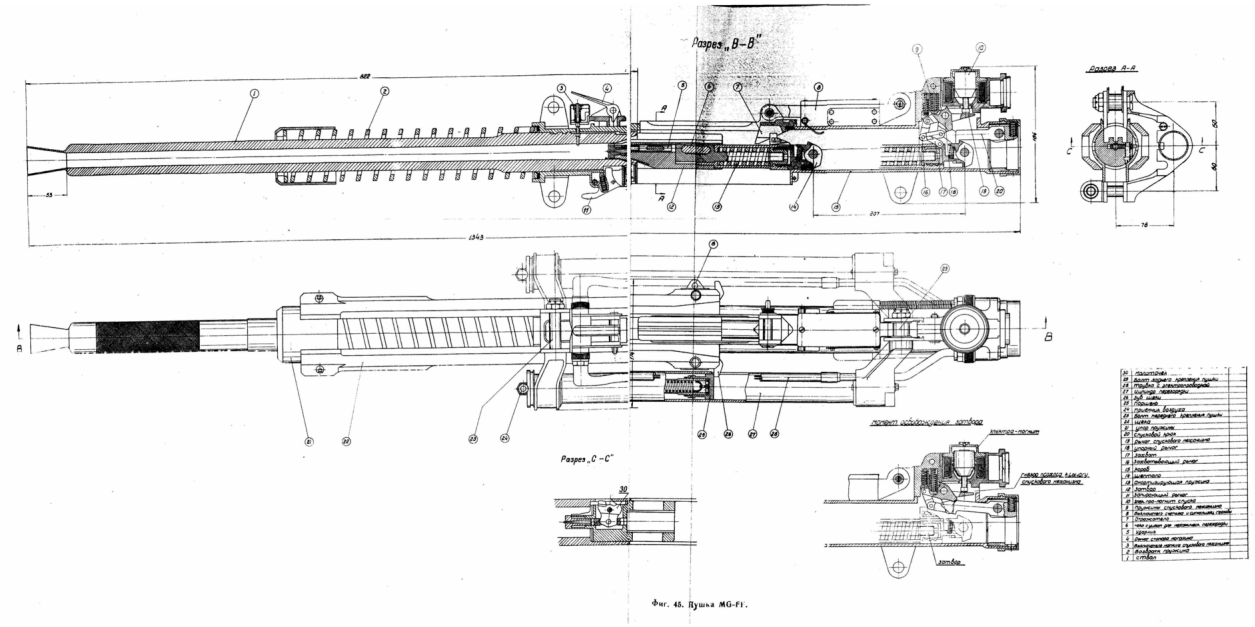
Recommended Dorsal Gunner Machine-Gun Belt Loadout – **Rheinmetall-Borsig MG 15 (7.92 mm)**

1. 7.92×57, S.m.K.H. - Spitzgeschoss mit Kern, Hart- Improved AP round with tungsten core. Highly recommended if you want a straight AP. However, the S.m.K.H. **in-game is in fact a duplicate of the S.m.K**., because the S.m.K.H. was never used on a fighter aircraft. Tungsten is a precious and expensive metal that was much needed elsewhere for the german war effort.
2. 7.92×57, P.m.K. - Phosphor mit Stahlkern- Standard AP with an incendiary composition. A great round, can still pierce armor and set fires
3. 7.92×57, S.m.K. L'spur (gelb) OR 7.92×57, S.m.K. L'spur (Weiss)- Standard AP with yellow (gelb) or white (Weiss) tracers. Good for aiming.

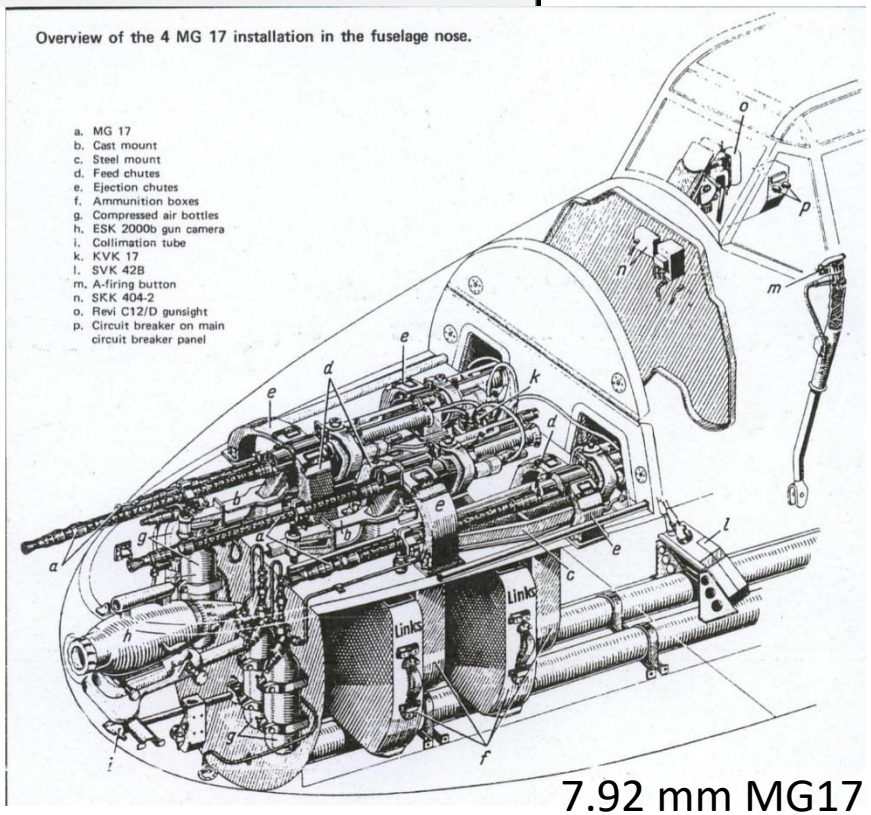


PART 5: WEAPONS AND ARMAMENT

ONE	LUFTWAFFE SIGHT DATA					ONE
Royal Air Force Aircraft	Wingspan			REVI C12 SIGHT (100 mils)		
	Meters	Yards	Feet	Range (m)	Range (yds)	Range (ft)
Tiger Moth	8.94	9.78	29.3	89	98	293
Gladiator Mk.I	9.80	10.72	32.2	98	107	322
Spitfire MK.I	11.23	12.28	36.8	112	123	368
Defiant MkI	11.99	13.11	39.3	120	131	393
Hurricane Mk.I	12.19	13.33	40.0	122	133	400
Walrus MkI	14.00	15.31	45.9	140	153	459
Blenheim MkI	17.17	18.78	56.3	172	188	563
Anson MkI	17.22	18.83	56.5	172	188	565
Beaufighter MkIF	17.65	19.30	57.9	177	193	579
Wellington MkIc	26.27	28.73	86.2	263	287	862
Sunderland MkI	34.39	37.61	112.8	344	376	1128

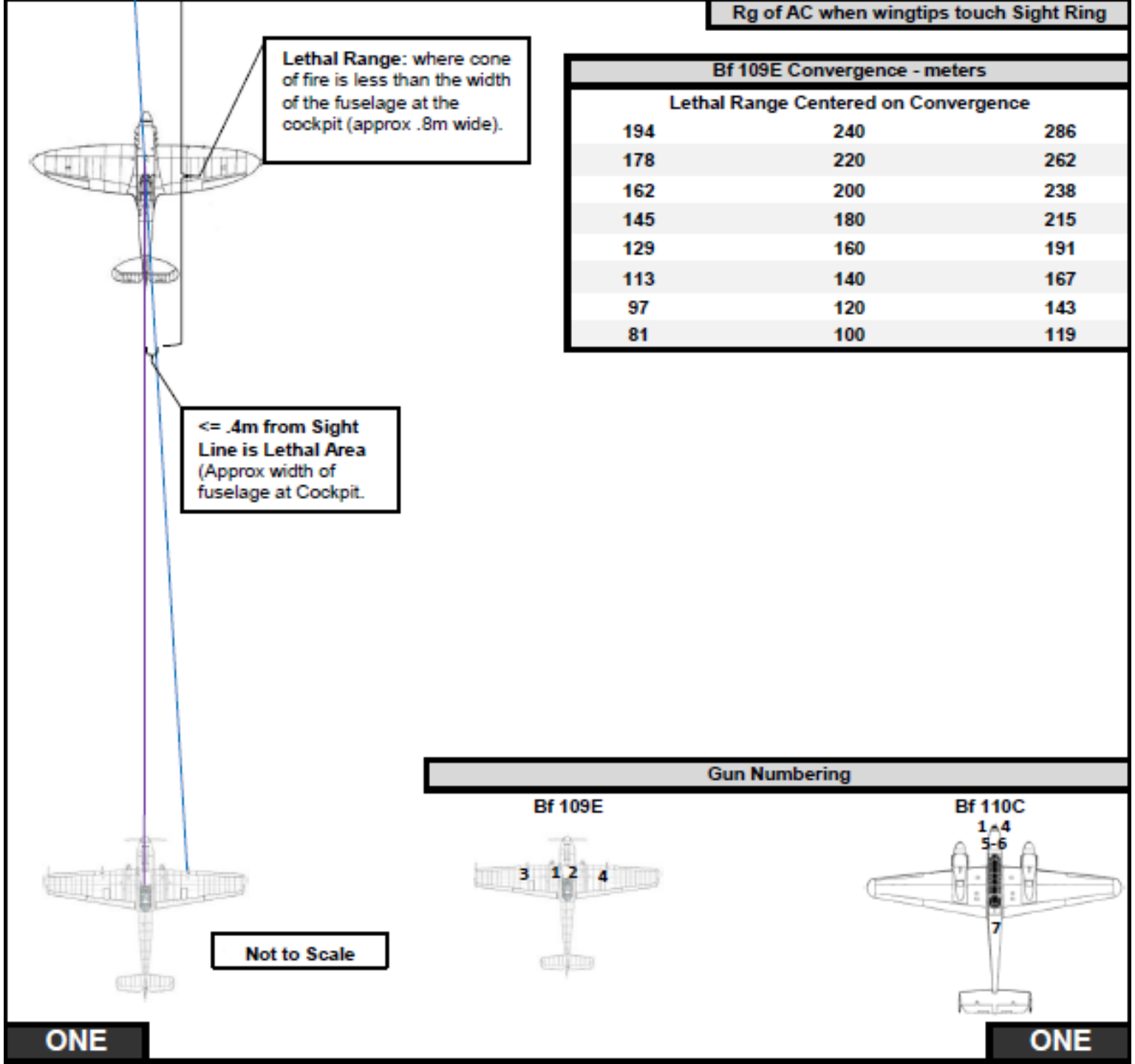


20 mm MG/FF



7.92 mm MG17

PART 5: WEAPONS AND ARMAMENT



Bf 109E Convergence - meters		
Lethal Range Centered on Convergence		
194	240	286
178	220	262
162	200	238
145	180	215
129	160	191
113	140	167
97	120	143
81	100	119

PART 5: WEAPONS AND ARMAMENT

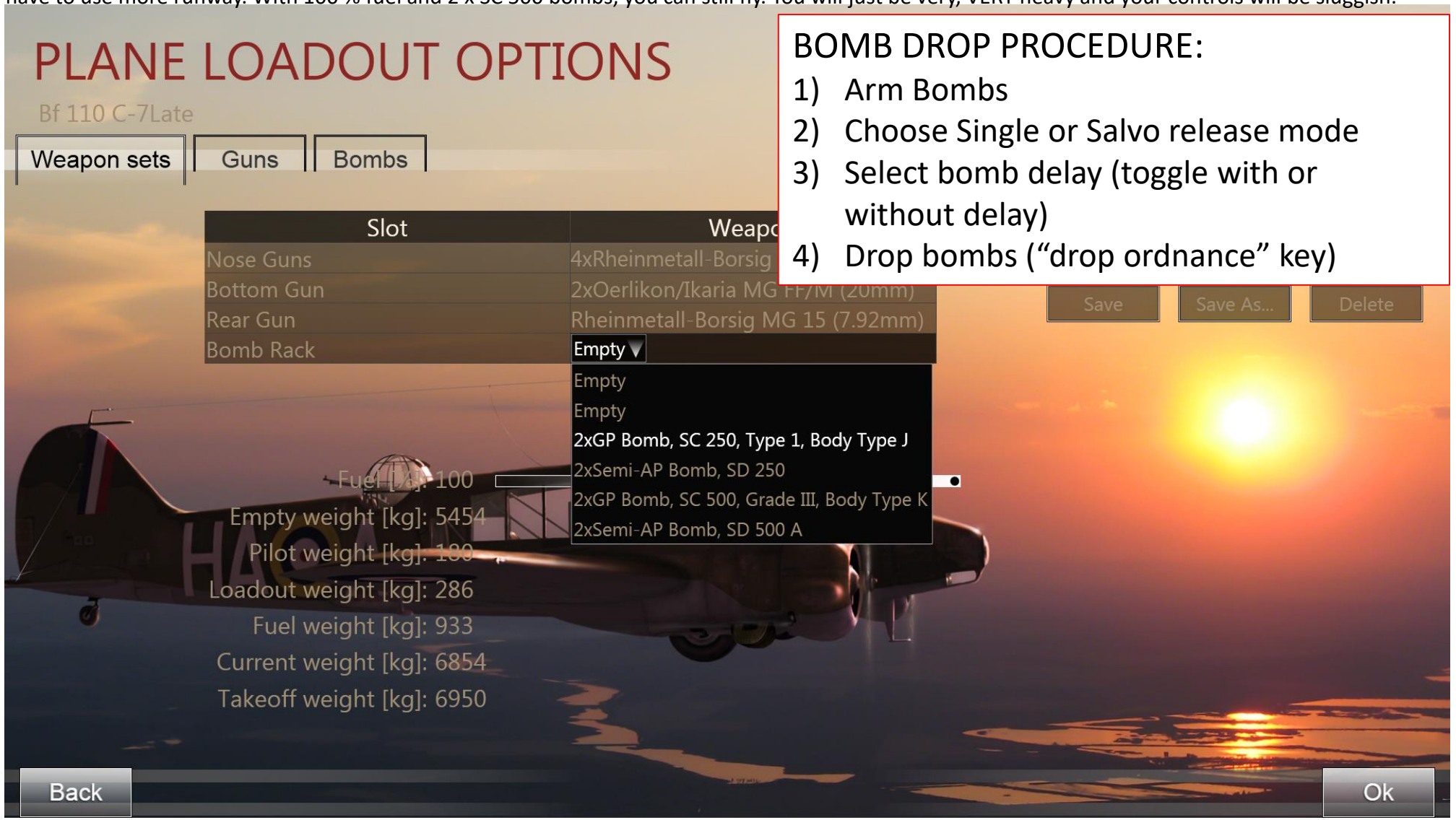
TWO	LUFTWAFFE WEAPON DATA						TWO
Luftwaffe Machinegun and Cannon Ammunition							
Weapon	**Nomen**	**Type**	**Fill**	**Burnout**	**Tracer Color**	**Smoke Trail**	**Notes**
MG 17 7.92mm	SmK v	AP					Steel Core
	SmK (H) v	AP (Super)					WC Core
	SmK L'Spur v	AP-T		900 m	Yellow		
	SmK L'Spur v	AP-T		900 m	White		
	SmK Ub m Zer	SAPHE w SD					Flash
	PmK v	API	Ph			Yes	Burns
	B Patr v	HEI	Ba				Flash
MG FF 20mm	Brsprgr L'Spur	HEI-T / SD	PETN, Mg/Thm	1100 m			750m SD
	Brgr L'Spur	Incend -T / SD		1100 m		Yes	750m SD, Burns
	Pzbrgr	API / SD					750m SD
	PzBrgr (Elek)	API / SD	Mg				750m SD
	Pzbrgr (Phos)	API / SD	Ph				750m SD
MG FFM	M'gesch.	HE	RDX / Al				750m SD
German Ammunition Types	**SmK - Spitzgeschoss mit Stahlkern** = Pointed bullet with Steel Core						
	v - Verbesserte = Improved - increased propellant for increased muzzle velocity. Aircraft use only						
	L'Spur - Leuchtspur = Tracer						
	Ub. - Ubung = Training Ammo containing a small bursting charge						
	m. Zerl - mit Zerleger = with Burster = SD = Self Destruct Mechanism						
	PmK - Phospor mit Stahlkern = Phosphorus with Steel Core						
	B Patr - Beobachtung Patrone = Observation Cartridge						
	Brsprgr - Brandsprenggranate = Incendiary Explosive Grenade						
	Brgr - Brandgranate = Incendiary Grenade						
	Pzbrgr - Panzerbrandgranate = Armor peircing Incendiary Grenade						
	M'gesch. - Minengeschoß = Mine Projectile - High Capacity HE						
Notes	**Fill**: Ph (Phosph.), Mg (Magnes.), Al (Alum.), Ba (Barium), WC (Tunsten Carbide), Thm (Thermite)						
	Burns = Incendiary Composition (usually Phosphorus) is ignited on firing and burns during flight						
	Flash = Incendiary Ignition or small HE Burst on impact with target						
	Slow Tracer = Delayed tracer ignition for Night use						

PART 5: WEAPONS AND ARMAMENT

Recommended Bomb Loadout

1. **For ship or low-level bombing:** 2 X SC 250 GP BOMB, Low Level Fuse, 14 sec delay (50 % fuel)
2. **For high altitude dive bombing:** 2 X SC 500 GP BOMB, High Altitude Fuse, 0 sec delay (50 % fuel)

NOTE: 2 x SC 250 bombs weighs 782 kg, while 2 x SC 500 bombs weighs 1286 kg. With around 55 % fuel, you will reach your max takeoff weight for SC 250 bombs. However, if you load SC 500 bombs, you are overweight even with no fuel at all. It doesn't mean that you can't takeoff if you are overweight: it just means that you will have to use more runway. With 100 % fuel and 2 x SC 500 bombs, you can still fly. You will just be very, VERY heavy and your controls will be sluggish.



BOMB DROP PROCEDURE:

1) Arm Bombs
2) Choose Single or Salvo release mode
3) Select bomb delay (toggle with or without delay)
4) Drop bombs ("drop ordnance" key)

PART 5: WEAPONS AND ARMAMENT

Bombs					
Country	**Nomen**	**Type**	**WT (lbs/kg)**	**Fuze**	**Aircraft**
Luftwaffe	SC 50	GP	110 / 50	5, 25B	Ju87B, Ju88, Me109, He111
	SC 250	GP	551 / 250	5, 15, 25B	Ju87B, Ju88, Me109, Me110, He111
	SD 250	Semi-AP Frag	551 / 250	5	Ju87B, Ju88, Me110, He111
	SC 500	GP	1102 / 500	25B	Ju87B, Ju88
	SD 500	Semi-AP Frag	1102 / 500	5	Ju87B, Ju88
Notes	**SC - Sprengcylindrische** = Cylindrical Explosive: GP - General Pupose HE				
	SD - Spreng Dickenwand = Thick wall Explosive: Semi AP Frag - Thick walled case HE				

Pistols					
Weapon	**Nomen**	**Type**		**Settings (oV, mV, Vz)**	**Bomb Type**
Luftwaffe Fuzes	5	High Alt		0, .8sD	SC50, SC250, SD500
	15	Dive		0, .05sD, 8sD	SC250
	25B	Low Alt		0, .8sD, 14sD	SC50, SC250, SC500
Notes	**Settings:** 0 = Instantaneous; 8sD = 8 second Delay; etc				
	LW High Alt = High Altitude Release - Greater Than 1km				
	LW Low Alt = Low Altitude Release - Less Than 1km				
	LW Dive = Automatic Delay in Dive Release of 14 seconds				
TWO					**TWO**

PART 5: WEAPONS AND ARMAMENT

THREE **LW WEAPON SYSTEMS OPERATION** THREE

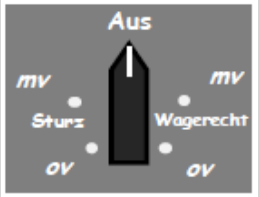
Operating instructions for the ZSK 244 /244 A2 and the ASK-R for the Me 109E-3/B,Me 109E-4/B, and Me 110C-7.

NOTE: The in game operation of the Zünderschaltkasten (ZSK) and Abwurfschaltkasten (ASK) differ from the historical modes of operation for the devices. These operating instructions reflect "In Game" use.

Schaltkasten (Control Box) Diagrams

Zünderschaltkasten (Fuze Control Box)

Aus (Off)



Sturz (Dive)
Wagerecht (Level)
mv (with Delay)
ov (without Delay)

Abwurfschaltkasten (Weapons Release Control Box)

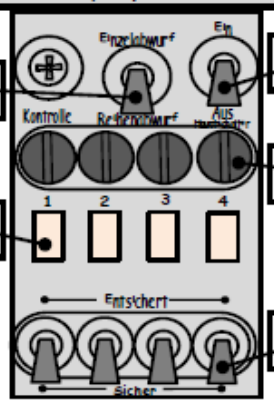
Einzelabwurf (Single Release)

Wahlschalter (Selector Switch)

Reihenabwurf (Salvo Release)

Schauzeichen (Weapon Indicators)

Lit when selected and armed



Ein (On)

Hauptschalter (Main Switch)

Aus (Off)

Bomb Rack Selectors (non-historical)

Entsichert (Armed)

Sicherungsschalter (Arming Switches)

Sicher (Safe)

In Game Commands to ASK and ZSK Mapping

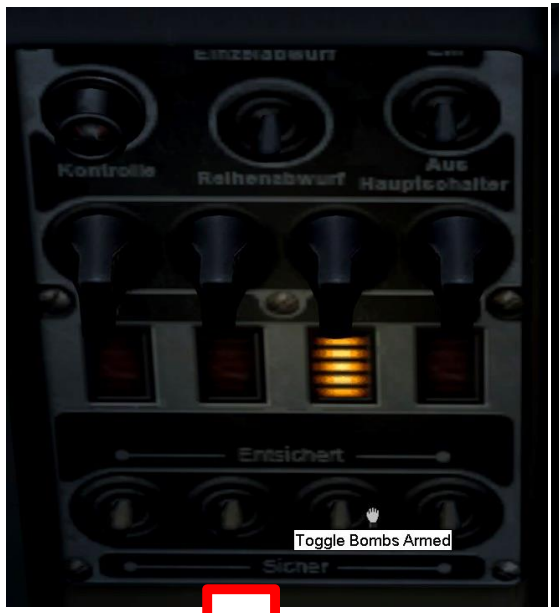
Game Command	Device	Device Function
Toggle Bombs Arm ON	ASK	Sicherungsschalter Entsichert
Toggle Bombs Arm OFF	ASK	Sicherungsschalter Sicher
Toggle Distributer Short Delay ON	ZSK	Sturz mV
Toggle Distributer Short Delay OFF	ZSK	Waagerecht mV
Select Bomb Rack Previous	ASK	Bomb Rack Button (non-historical)
Select Bomb Rack Next	ASK	Bomb Rack Button (non-historical)
Distributer Mode Previous	ASK	Wahlschalter Einzelabwurf
Distributer Mode Next	ASK	Wahlschalter Reihenabwurf
Salvo Quantity Decrease	NA	Not Available for the ZSK 244 /244 A2 and the ASK-R
Salvo Quantity Increase	NA	Not Available for the ZSK 244 /244 A2 and the ASK-R
Distributer Delay Decrease	NA	Not Available for the ZSK 244 /244 A2 and the ASK-R
Distributer Delay Increase	NA	Not Available for the ZSK 244 /244 A2 and the ASK-R

Abwurfschaltkasten Operation

Einzelaburf (Single Release)	1. All Safety Switches to -- SICHER (SAFE) 2. Hauptschalter to -- EIN (ON); Check for Kontrolle and Weapon Station Indicator Light(s) 3. Wahlschalter to -- EINZELABWURF (SINGLE RELEASE) 4. Weapon Safety Switches to -- ENTSICHERT (ARM) 5. Press Weapon Release Button on Control Stick to release first selected weapon. Each subsequent press will release the next weapon selected.
Reihenabwurf (Salvo Release)	1. All Safety Switches to -- SICHER (SAFE) 2. Hauptschalter to -- EIN (ON); Check for Kontrolle Light ON 3. Wahlschalter to -- EINZELABWURF (SINGLE RELEASE) 4. All Weapon Station Safety Switches to -- ENTSICHERT (ARM) 5. Press Weapon Release Button on Control Stick to release ALL weapons simultaneously. Check for Weapon Station Indicators to turn OFF

Reference: L.Dv.208 Beschreibung, Bedienungs und Wartungsvorschrift des Abwurfschaltkasten ASK-R, 1939

THREE THREE



BOMB DROP PROCEDURE:

1) Arm Bombs
2) Choose Single or Salvo bomb release mode
3) Select bomb delay (toggle with or without delay)
4) Drop bombs (“drop ordnance” key)

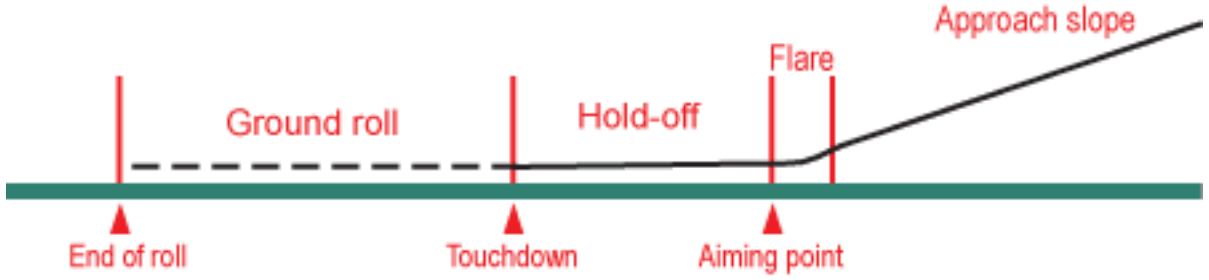
PART 6: TAKEOFF

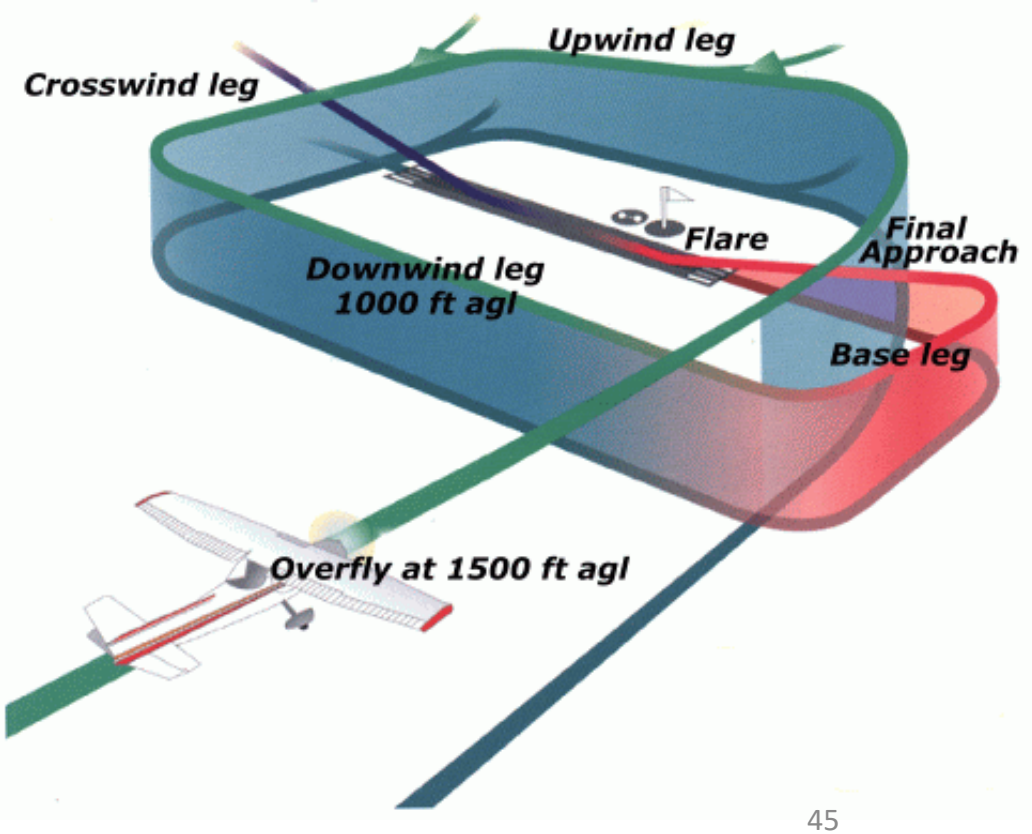
NOTE: This procedure is NOT the real-life start-up procedure, it has been simplified in the sim.

1. Fuel cocks for both engines (throttle quadrant) set to P1 U P2 (engine will pump fuel from both front main tanks). Make sure that your engine fuel tanks are filled by selecting front fuel tanks with the Fuel Contents Gauge Selector (1 – VL for front left main fuel tank).
2. Select Engine # 1 (L_Shift + 1).
3. Oil rad and water rad fully open (100 %)
4. If flying a Bf.110C-7 Late, disengage Automatic Prop Pitch
5. Prop pitch full fine (12:00 position)
6. Deploy flaps at roughly 10 degrees
7. Crack throttle about an inch
8. Switch Magnetos to M1+M2
9. Make sure your propeller is clear (“Clear prop!”)
10. Engine ignition! (press “I” by default)
11. Select Engine # 2 (L_Shift + 2) and repeat steps 2 to 10.
12. Select both engines (L_Shift + 3).
13. Wait for oil temperature to reach at least 40 deg C and water rad temperature to reach at least 60 deg C.
14. Taxi to the runway.
15. Make sure you are facing yellow panels on the runway. This means you are facing the right direction for takeoff.
16. Perform last takeoff checks: Canopy Closed, Water & Oil Rads fully open, Full Fine prop pitch (12:00), good oil & water rad temperatures.
17. Gradually throttle up. Compensate for engine torque and wind using rudder pedals and small brake input to keep the aircraft straight. Slightly push the control column forward to lift the tail.
18. Rotation is at 190 km/h.
19. Raise landing gear and flaps and throttle back to approx. 1.2 ATA. Lower prop pitch until engine is operating at 2300 RPM while you are beginning your climb.

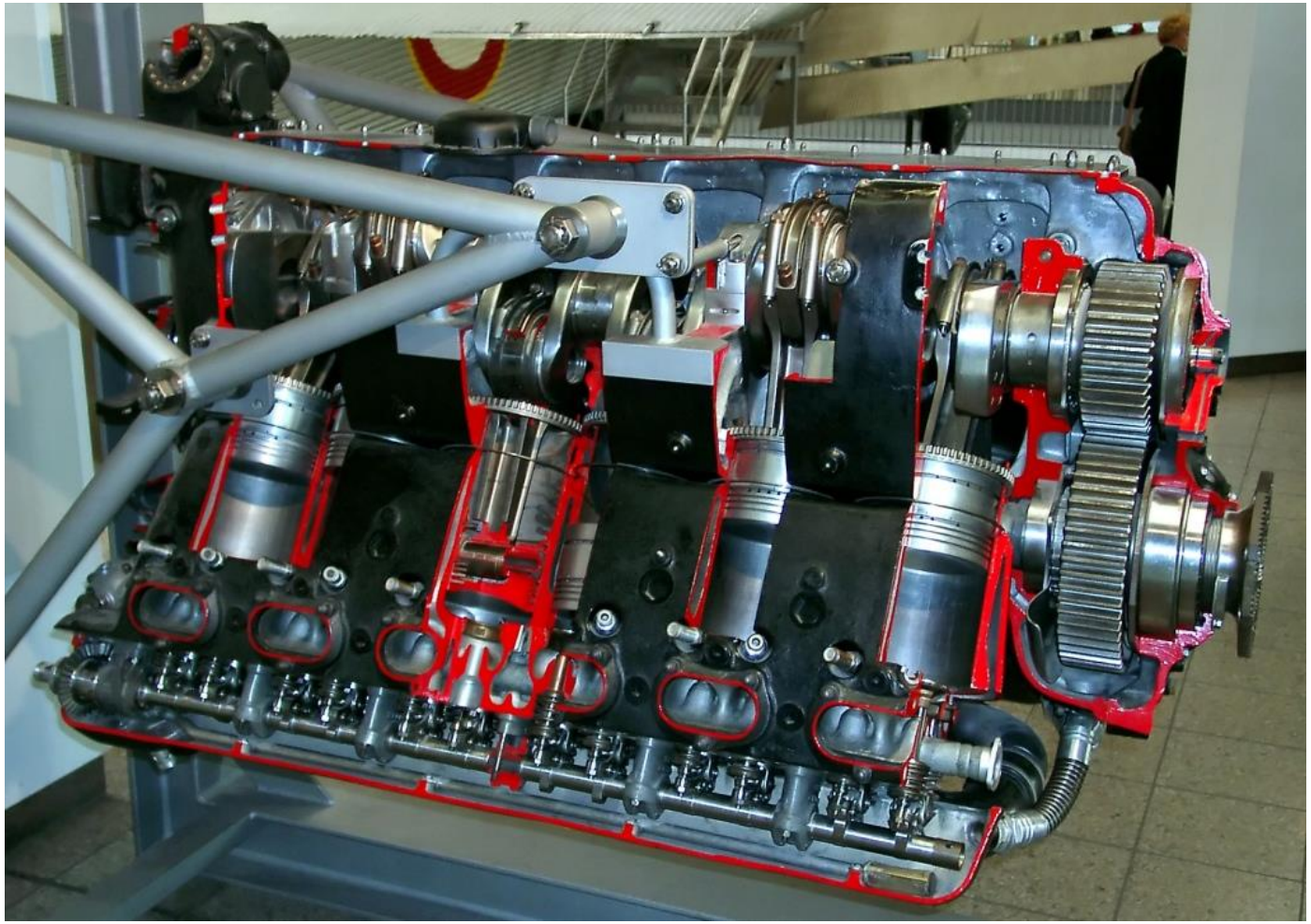
PART 7: LANDING

1. Start your approach at 220 km/h @ approx. 800 m (1500 ft AGL).
2. Water and oil rads fully open (100 %) and set prop pitch to full fine (12:00).
3. Deploy flaps (fully down) and landing gear.
4. Cut throttle and try to keep your nose pointed to the end of the runway.
5. Touchdown at 180 km/h in a 3-point landing.
6. Stick fully back.
7. Tap your brakes until you come to a full stop. Be careful not to overheat your brakes or force your aircraft to nose over into a prop strike.





PART 8: ENGINE MANAGEMENT



The earlier Mercedes-Benz DB 600 was rated at 1,050 hp at 2,400 rpm for take-off and also developed this power at an altitude of 13,100 ft. It was equipped with a pressure carburetor between the supercharger and the intake manifolds and an automatic timing device which permitted a 10 percent overload for a period of one minute. Using 87-Octane gasoline, four of these engines installed in a Junkers Ju 90 airliner established a World's Record by carrying a payload of 10,000 kg. (22,050 lb.) to an altitude of 7,242 m. (23,750 ft.) on June 8, 1938 in Germany.

DB 601A

The **Daimler-Benz DB 601** was a German aircraft engine built during World War II. It was a liquid-cooled inverted V12, and powered the Messerschmitt Bf 109, among others. The DB 601 was basically an improved DB 600 with direct fuel injection. Direct fuel injection gave the Luftwaffe an edge over the RAF during the Battle of Britain since the DB 601 was unaffected by negative g's… unlike the early Merlin models. The engine used dry cylinder liners, had roller bearing connector rods and had a unique system of attaching the cylinders to the crankcase. It was used in several aircraft such as the Heinkel He-111 and Messerschmitt Bf 110 as well. By 1944, Daimler-Benz engines were so important to the Luftwaffe that it ran 8 major factories with 6 more being run by other organizations.

PART 8: ENGINE MANAGEMENT

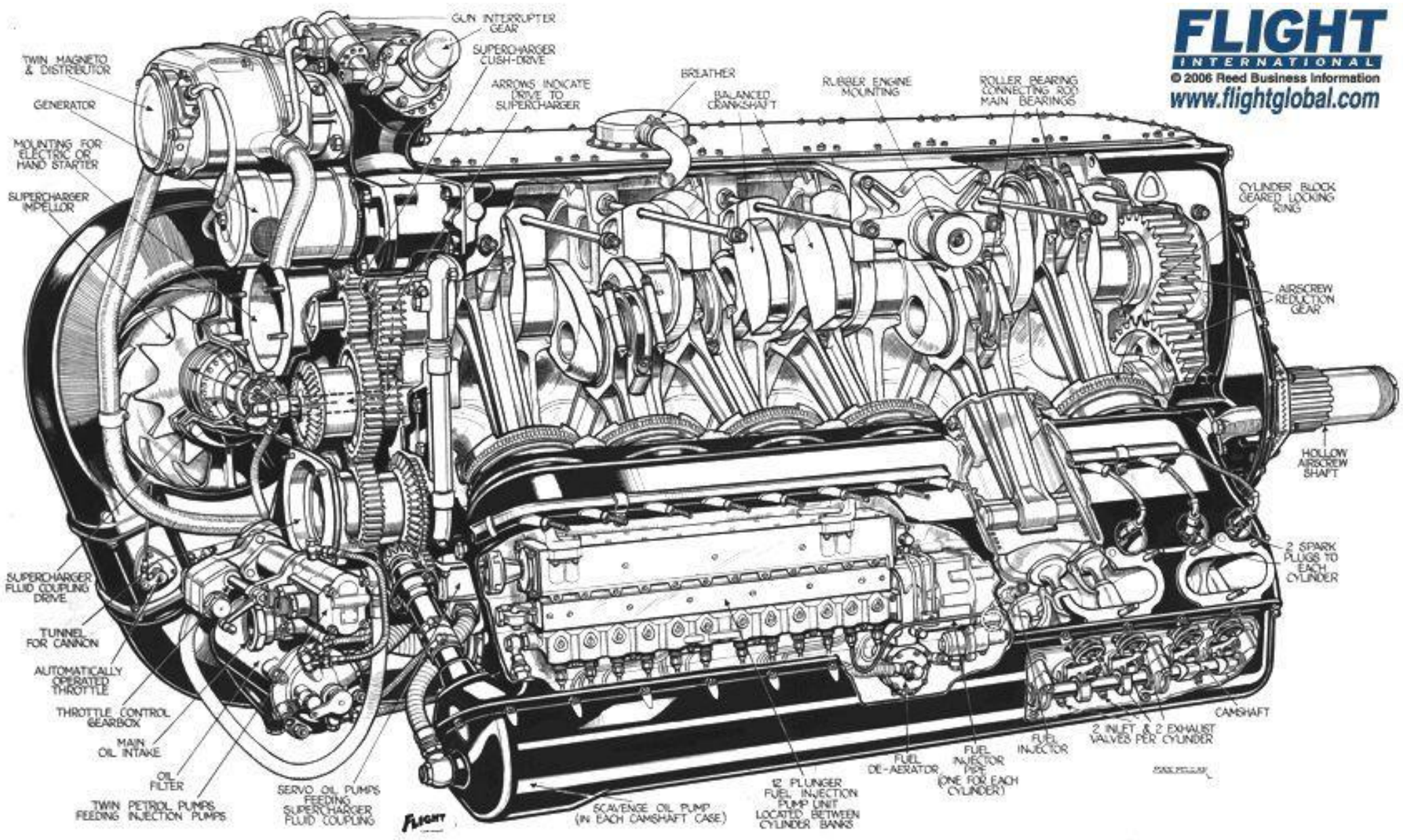
COMPARISON WITH BRITISH ENGINES

A cardinal fault of the Bf.109E (which had the same engine installed as the Bf.110 at that time) - one which was corrected in the F and G models - was the design of the supercharger air intake. The unit on the Emil was close to the fuselage and ingested the "dirty" boundary layer air which scrubbed along the cowling surface. As a result, the supercharger ram recovery was 37.5% compared with the Spitfire's 50%. The lower ram recovery meant that the critical altitude was reached at a lower altitude. Had the later design been used on the Bf.109E, as much as 1000 ft may have been gained in ceiling and in best combat altitude. This would have nullified much of the Spitfire's performance advantage at height.

Another important difference between the DB engines and the early Merlin engines lay in the supercharger design. The early Merlin engines were equipped with gear-driven single-speed, single-stage units. The supercharger had to be throttles back at low altitude to avoid over-boosting the engine. As altitude increased, more and more of the supercharger capability was used and engine horsepower continued to increase until critical altitude was reached, after which power fell off rapidly.

The DB601A engine, on the other hand, was equipped with a single-stage supercharger with a hydraulic or fluid clutch. While heavier and more complex than the gear-driven clutch, this unit had the capability of operating at an infinite number of speed ratios. This meant that the supercharger could be slowed down without choking it and far more power was delivered at lower altitudes. As the Bf.110 flew higher, an aneroid control caused the supercharger to run faster to compensate for the decreased density of the air. The variable speed characteristics of this supercharger are obtained through slippage, so it was necessary for the Bf.110 cooling system to contain more oil for cooling.

PART 8: ENGINE MANAGEMENT



DB 601 N-1

PART 8: ENGINE MANAGEMENT

A de-rated engine is allowed to operate at maximum power pretty much infinitely. In modern industrial facilities, many gas turbines (which are derived from aero engines) are often requested to be “de-rated” by the customer using them as a power plant. Why? Because industrial engines need to be working 24/7 at high regimes while maintaining a certain security factor (you don’t want to have the engine blow up in your face, eh?).

'De-rated' is a term the British used to denote an aircraft engine which had its intended maximum power level reduced (by the manufacturer) to a lower level to reduce the chance of mechanical failure. An engine would be “derated” if it was not deemed to be reliable enough at the higher power settings.

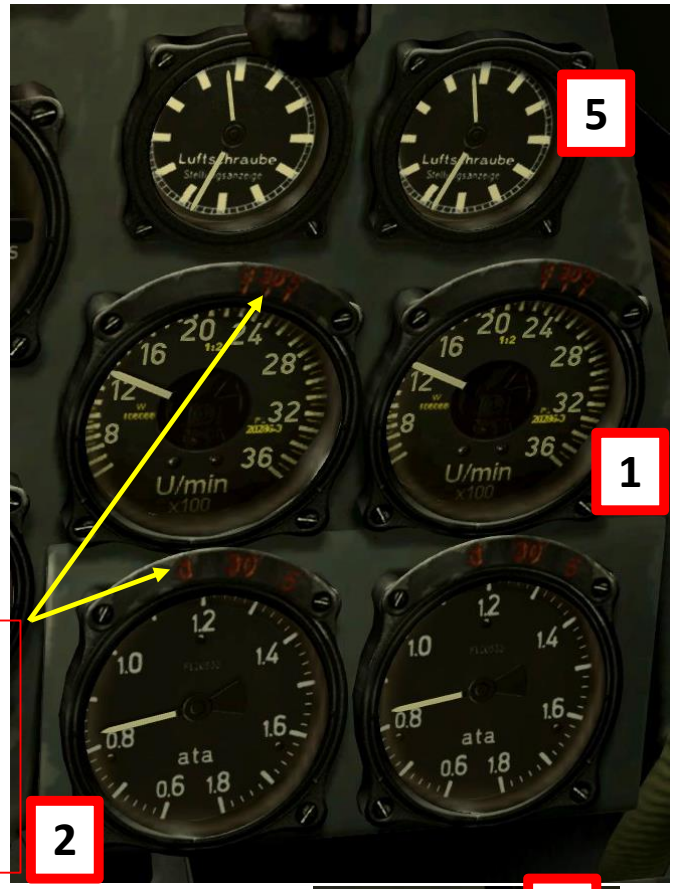
The **DB 601 N-1** engine on the Bf.110C-4/N could reach a max manifold pressure of 1.42 ATA for about 5 minutes before engine failure or damage. With the Bf.110C-4/N de-rated variant, you can reach a max manifold pressure of 1.35 ATA for as long as you like.

One of the main reasons why the Bf.110C-4 received few DB 601 N-1 engines was because at the height of the Battle of Britain, the first Bf.109F models started rolling off the assembly line and were given a much higher priority in terms of engine distribution, together with the Bf.110 D and E series. With the Friedrich coming into service, it did not make sense to retrofit the obsolete E series to the new engine configuration. The Bf.110 itself had proven its obsolescence during the Battle of Britain and was about to be discontinued in favour of the more modern Me 210 and Me 410 models. The first examples of the Me 210 were ready in 1939, but they proved to have unacceptably poor flight characteristics from serious, unanticipated design flaws. A large-scale operational testing program throughout 1941 and early 1942 did not cure the aircraft's problems. The design eventually entered limited service in 1943, but was almost immediately replaced by its successor, the Me 410, which was a further development of the Me 210, renamed so as to avoid the 210's notoriety. The failure of the Me 210's development program meant that the *Luftwaffe* was forced to continue fielding the outdated Bf 110, despite mounting losses.

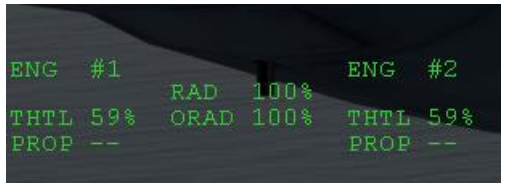
PART 8: ENGINE MANAGEMENT

During a mission, the flight lead usually calls out his engine settings once in a while for the pilots to know what settings they should use. You can read your engine settings from the gauges in the cockpit or from an info window.

- The RPM indicator (1) shows 1200 RPM. The manifold pressure (2) reads 0.83 ATA. The oil (3) and water (4) radiators can be approximated from the crank position or read from the info window in %. Note: 100 % = fully open
- The resulting RPM is affected by both manifold pressure and prop pitch (5). 12:00 Pitch is fully fine, and generates maximum RPM.
- Radiator settings:
  - 65-75 % WATER / 50-60 % OIL during **normal level flight** (1.2 ATA)
  - 75-100 % WATER / 60 % OIL during **shallow climb** (1.2 ATA)
  - 85-100 % WATER / 85 % OIL during **steep climb** (Full power)
  - 50-100 % WATER / 40 % OIL for **WEP level flight** (when extending or pursued)
  - 65-75 % WATER / 50 % OIL for **full throttle no WEP** (extending or pursued)
  - 100 % WATER / 100 % OIL during **takeoff & landing**



Red notches indicate "d" (infinite), "30 min" and "5 min" engine settings.



GAUGE IS ON THE ENGINE ITSELF!

	(Unit)	Bf.110 C-2	Bf.110 C-4	Bf.110 C-4/N DERATED	Bf.110 C-4/N	Bf.110 C-7	Bf.110 C-7 LATE
TEMPERATURES							
Water Rad Min	Deg C	60	60	60	60	60	60
Max		90	90	100	100	90	90
Oil Rad (OUTBOUND) Min	Deg C	40	40	40	40	40	40
Max		85	85	105	105	85	85

PART 8: ENGINE MANAGEMENT

- I must stress the importance of understanding how “manual prop pitch” works. Many new pilots take the C-7 Late variant of the Bf.110 in the hopes that the “automatic propeller pitch control” will reduce their work load. Does it? Yes and no.
- Automatic prop pitch at this stage of development was not as good as the governor systems installed on later 109 versions like the F, the G or the K variants. Auto prop pitch controls your pitch for you, but it does it in a way that preserves the engine to a point where you have a significant decrease in aircraft performance for no gain at all. Imagine your car limiting your engine regime so you don’t go over 80 km/h while on the Autobahn… wouldn’t that be frustrating? In a game where speed is life, you cannot afford to lose speed in critical phases of your mission.
- But why are you telling me this, Chuck? This all seems a little overly dramatic, don’t you think?
- Not in the slightest. **Learn how to use the manual prop pitch from the beginning**. Engine RPM is slower to respond to propeller pitch variation than, say, the RPM control in the Spitfire or the Hurricane.
- While the Bf.109 is a superb climber, the Bf.110 is not because it is much heavier. In order to survive against anything (the Bf.110 is at a serious disadvantage against any british fighter) for that you need to use your prop pitch intelligently so you milk every meter of altitude you can get in order to get as high as possible as quickly as possible. The Bf.110 was best used as a bomber-killer.
- You do not have to check your prop pitch gauge. You can simply consult your RPM. Maintain it between 2200 and 2400 max. RPM is too low? Get your prop pitch finer and your RPM will go up. RPM is too high? Reduce RPM by getting your prop pitch coarser.
- Experienced pilots can guess their RPM just by listening to the sound of their engine. Yep, they do it by ear. With enough practice, you can do it to.

PART 8: ENGINE MANAGEMENT

Propeller Pitch Terminology				
				
RAF	Fine	Coarse	Feathered	RAF
USAAC	Flat / Low	High	Feathered	USAAC
Luftwaffe	Startstellung (Start Position)	Reisestellung (Cruise Position)	Segelstellung (Sail Position)	Luftwaffe

Propeller Types		
Propeller Types	**Definition**	**Example**
Luftschauben Verstellautomatik (LV)	Propeller with an automatic pitch changing device that prevents overrevs. Additionally, every throttle position has a corresponding RPM that is maintained within narrow limits by the automatic device. May be switched off.	**Bf 109E-4, 109E-4/B**

Propeller Operations	
Propeller	**Operation**
VDM (Luftwaffe) VP (electric)	The VDM propeller functions as a fully adjustable variable pitch prop. The "schalter für verstellschraube drehzahl" (switch for adjusting RPM) adjusts the pitch angle (from Startstellung to Reisestellung) of the airscrew. Adjusting the switch "größer" will increase RPMs by decreasing the pitch angle. Adjusting the lever "kleiner" will decrease RPMs by increasing the pitch angle. Placing the switch in the "segelstllg" position will feather the airscrew.
VDM Automatik (Luftwaffe) LV (electric)	The LV propeller electrically provides a pitch setting for every throttle position to maintain a given RPM thus coupling throttle and pitch (boost and RPM) to provide optimum performance.
Luftschraube Stellungsanzeige	The Propeller Position Indicator is a clock mechanism used to indicate the pitch of the propeller. 12:00 = Startstellung; 8:30 = Reisestellung
Note for Cliffs of Dover: For RAF Aircraft, commanding Pitch Increase or Pitch Decrease actually Increases or Decreases RPM. For Luftwaffe Aircraft, commanding Pitch Increase or Pitch Decrease actually increases or decreases pitch. Pitch 10, Pitch 20, etc will only work for RAF Aircraft with a moveable lever. Pitch 10, Pitch 20, etc will not work for Luftwaffe Aircraft with Electrical Pitch Adjustment Switches.	

PART 8: ENGINE MANAGEMENT

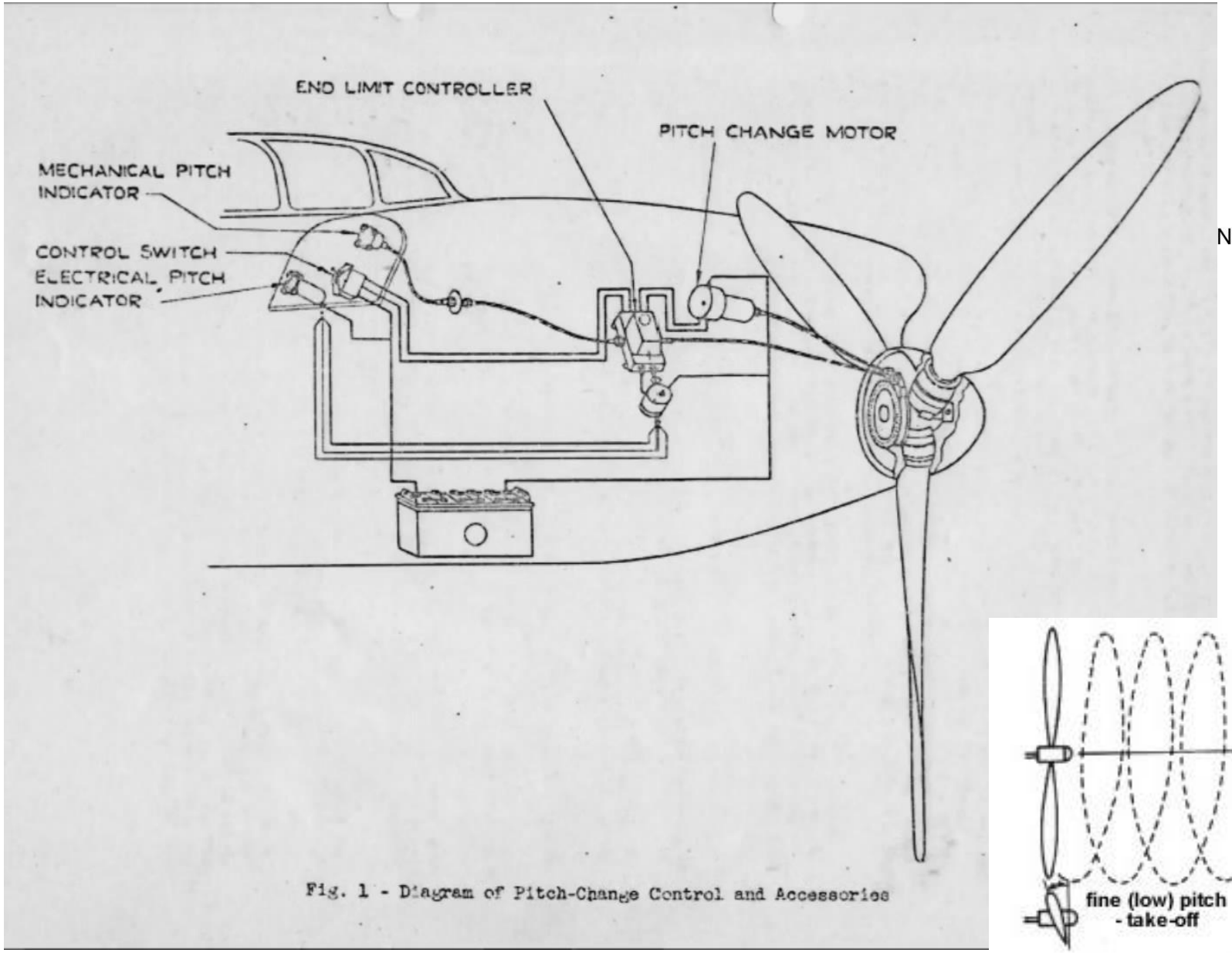
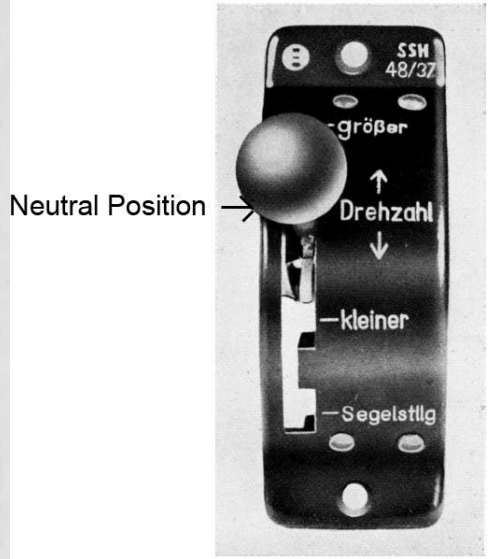
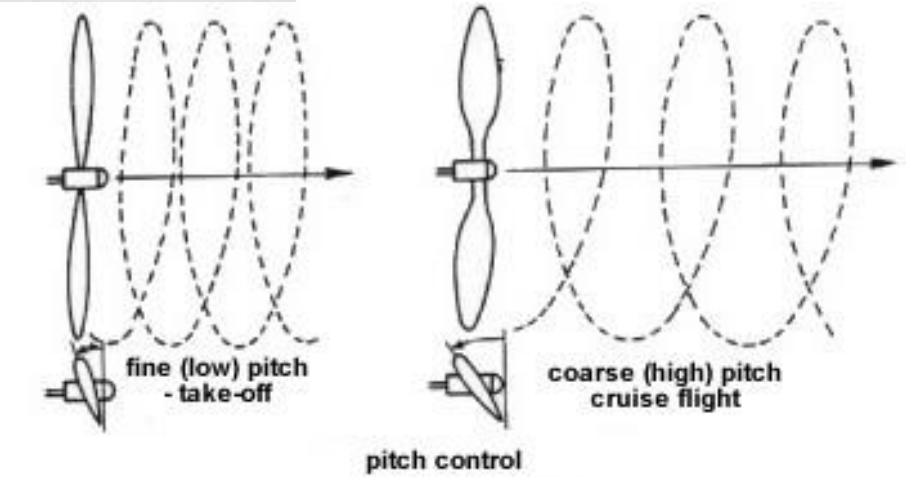


Fig. 1 - Diagram of Pitch-Change Control and Accessories





An excellent video tutorial to understand prop pitch: https://www.youtube.com/watch?v=qIpZAu61OM8

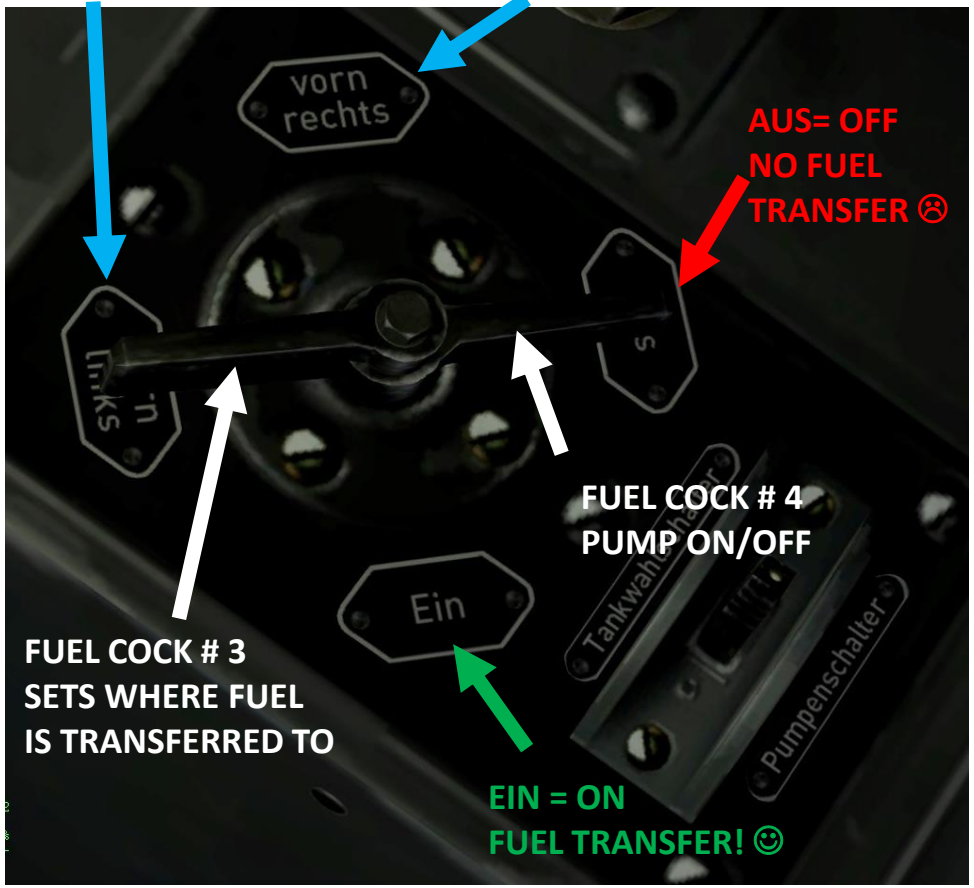
PART 8: ENGINE MANAGEMENT

FUEL MANAGEMENT DURING NORMAL OPERATION

- One of the peculiarities of the Bf.110 is that the fuel pumps take fuel from the main front tanks only, NOT from the rear reserve tanks.
- When your front tanks run out of fuel (which is indicated by the fuel warning lights next to your fuel gauge), you need to use auxiliary fuel transfer pumps to get fuel from the reserve tanks to the front tanks.
- Transfer pumps take fuel from BOTH rear reserve tanks.

VORN LINKS (FRONT LEFT)
FUEL IS BEING TRANSFERRED TO THE FRONT RIGHT MAIN TANK

VORN RECHTS (FRONT RIGHT)
FUEL IS BEING TRANSFERRED TO THE FRONT RIGHT MAIN TANK



AUS= OFF NO FUEL TRANSFER ☹

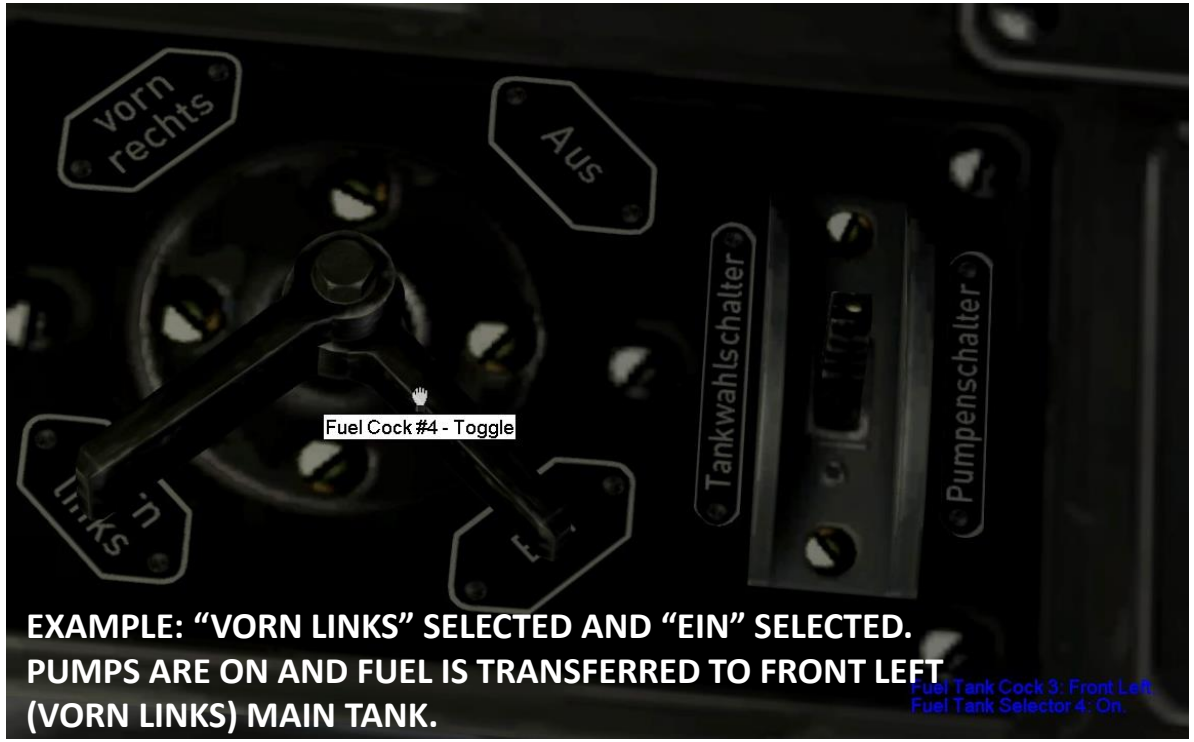
FUEL COCK # 4 PUMP ON/OFF

FUEL COCK # 3 SETS WHERE FUEL IS TRANSFERRED TO

EIN = ON FUEL TRANSFER! ☺

PROCEDURE:

1) Select right or left front tank with Fuel Cock #3
2) Select “EIN” (ON) to turn on the fuel transfer pump. Monitor fuel level in desired front tank to know when it is full.
3) When desired front tank is full, you can select the opposite tank as well and fill it up too.
4) Select “AUS” (OFF) to turn off the fuel transfer pump.



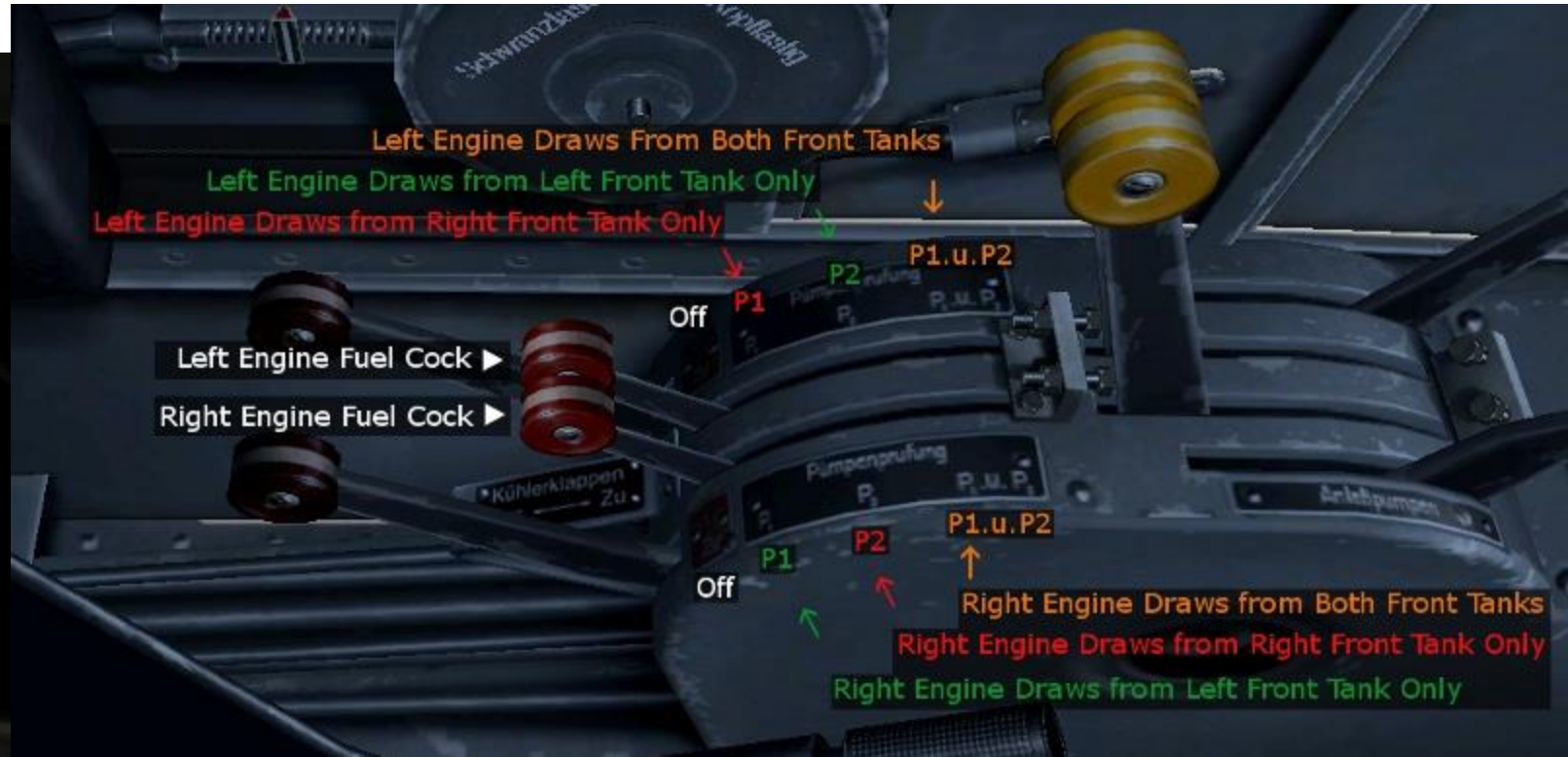
EXAMPLE: “VORN LINKS” SELECTED AND “EIN” SELECTED. PUMPS ARE ON AND FUEL IS TRANSFERRED TO FRONT LEFT (VORN LINKS) MAIN TANK.

PART 8: ENGINE MANAGEMENT

FUEL MANAGEMENT – HOW TO DEAL WITH A PERFORATED FUEL TANK

- In combat, you can see one of your fuel tanks damaged. Shit happens.
- EXAMPLE: If your **<u>front right</u>** fuel tank is perforated (or even worse, on fire!!!) and you see fuel leaking from it, what would you do? The best solution is to tell your engines to **<u>take fuel from the intact tank, not the damaged one</u>**.
- In our case, the intact fuel tank is the left one.
- Your left engine fuel cock should be set to P2 (Left engine draws from left front tank only).
- Your right engine fuel cock should be set to P1 (Right engine draws from left front tank only).
- TRICK: For each fuel cock/engine, "**P1 U P2**" means "I take my fuel from **BOTH** main tanks". "**P2**" means "I take my fuel from the tank on **MY SIDE** only" and "**P1**" means "I take my fuel from the tank on the **OTHER SIDE** only".
- Since both engines will now drain the same tank (front right), the front left tank will be emptied twice as fast. You might want to send fuel from the reserve tanks. Go to the "Transfer Pump" fuel cocks (as seen in previous slide), select "VORN LINKS" (front left) and "EIN" (ON) and fuel will be transferred from the perforated rear right tank to the intact front left one. Ta-dah!

EXAMPLE: "VORN LINKS" SELECTED AND "EIN" SELECTED. PUMPS ARE ON AND FUEL IS TRANSFERRED TO FRONT LEFT (VORN LINKS) MAIN TANK.



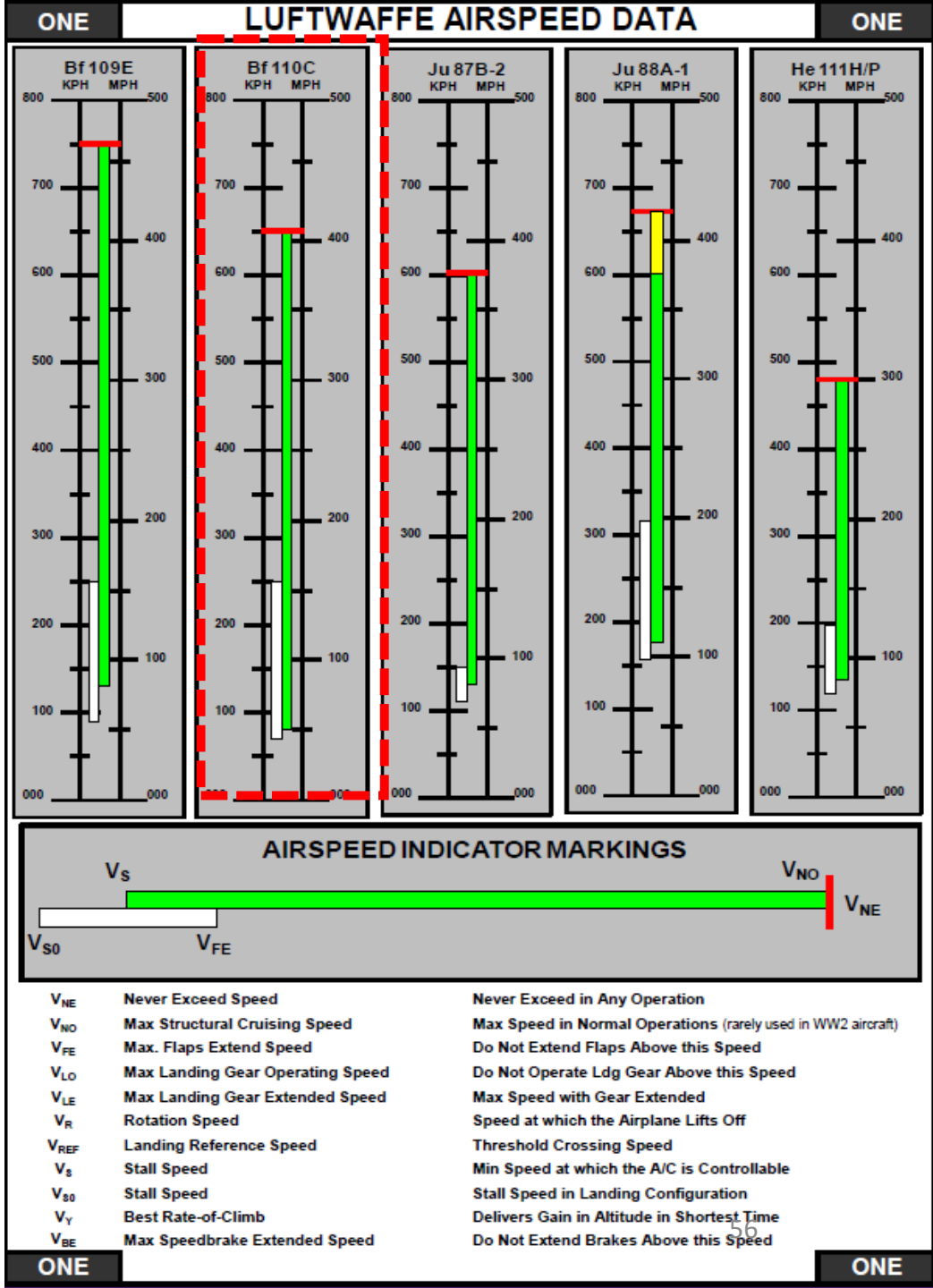
PART 9: AIRCRAFT PERFORMANCE

AIRSPEEDS

Takeoff – Rotation	UK: mph GER/ITA: km/h	190
Max Dive Speed		620
Optimal Climb Speed		270
Landing – Approach		220
Landing – Touchdown		180

- It is interesting to notice that the top speed of the Bf.110 modelled in-game is about 420-440 km/h. This top speed is closer to the recorded top speed of the earlier Jumo 210B-powered Bf.110s (which were severely underpowered due to a shortage of DB 600 engines). In reality, the DB 600-powered Bf.110C variants could reach a top speed of 523 km/h. The flight models are currently being revised by Team Fusion for the upcoming patch.
- For more information on either aircraft or engine performance, consult the **2nd Guards Composite Aviation Regiment** Operations Checklist. It is a fantastic resource (link below).

https://drive.google.com/open?id=0B-uSpZROuEd3NGN4c0JRNHJpYkk&authuser=0



PART 9: AIRCRAFT PERFORMANCE

ONE	Me 110C		ONE
Aircraft Type	**Engine & Prop**	**Fuel**	**Reference**
ME 110C-4 / C-7	DB 601A / VDM VP	87 Oct	

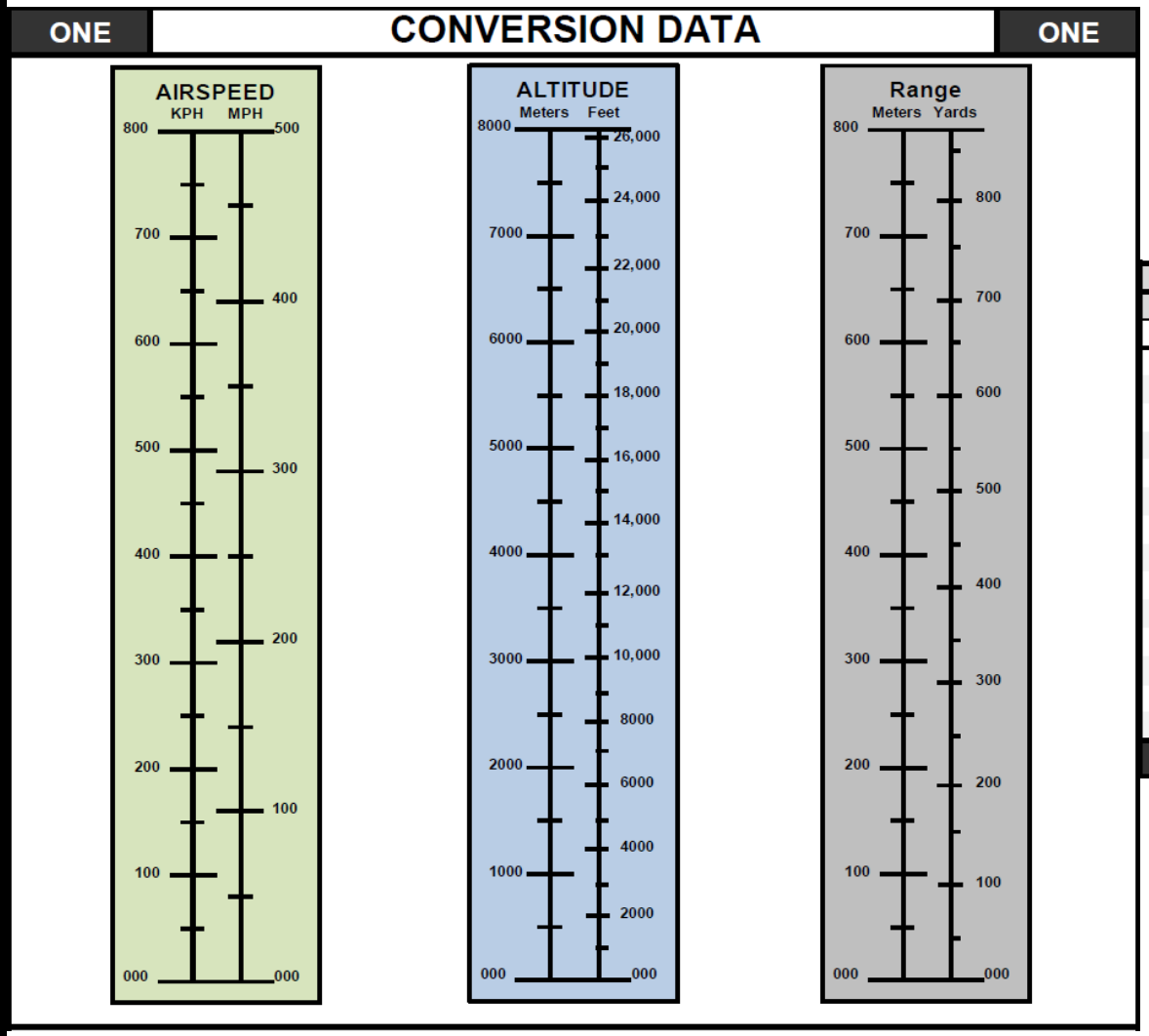
AIRSPEED LIMITATIONS

	Design Speeds	KPH	
V_{NE}	Never Exceed Speed	650	Never Exceed in Any Operation
V_{FE}	Max. Flaps Extend Speed	250	Do Not Extend Flaps Above this Speed
V_{LO}	Max Landing Gear Operating Speed	250	Do Not Operate Ldg Gear Above this Speed
V_{LE}	Max Landing Gear Extended Speed	NA	Max Speed with Gear Extended
V_R	Rotation Speed	NA	Speed at which the Airplane Lifts Off
V_{REF}	Landing Reference Speed	NA	Threshold Crossing Speed
V_S	Stall Speed	79	Min Speed at which the A/C is Controllable
V_{S0}	Stall Speed	71	Stall Speed in Landing Configuration
V_Y	Best Rate-of-Climb	NA	Delivers Gain in Altitude in Shortest Time
V_{BE}	Max Speedbrake Extended Speed	NA	Do Not Extend Brakes Above this Speed

AIRSPEED INDICATOR OPERATING RANGES

ASI MARKING	KPH Range	Description
White Arc	71 - 250 KPH	Full Flap Operating Range. Lower Limit is Max. Weight V_{S0} . Upper Limit Max Speed w/Flaps Extended.
Green Arc	79 - 750 KPH	Normal Operating Range. Lower Limit is Max. Weight V_S . Upper limit Is Max Structural Cruising Speed.
Red Line	750 KPH	Maximum Speed for ALL operations.

PART 9: AIRCRAFT PERFORMANCE



International Civil Aviation Organization International Standard Atmosphere							
Temperature		Altitude Above Sea Level		Atmospheric Pressure			Mach 1
°F	°C	feet	meters	inches Hg	mm Hg	psia	mph
59	15	SL	0	29.92	760	14.70	761
55	13	1000	305	28.86	733	14.17	758
52	11	2000	610	27.82	706	13.67	755
48	9	3000	914	26.82	681	13.17	752
45	7	4000	1219	25.84	656	12.69	750
41	5	5000	1524	24.90	632	12.23	748
38	3	6000	1829	23.98	609	11.78	745
34	1	7000	2134	23.09	586	11.34	742
31	-1	8000	2438	22.22	564	10.92	740
27	-3	9000	2743	21.39	543	10.51	736
23	-5	10000	3048	20.58	523	10.10	734
5	-15	15000	4572	16.89	429	8.29	720
-13	-25	20000	6096	13.75	349	6.75	706
-31	-35	25000	7620	11.10	282	5.45	693
ONE							ONE

PART 9: AIRCRAFT PERFORMANCE

Match-Ups and Relative Performance (from II./KG53 Bomber Schule)

The Bf.110 was best used as a fighter-bomber, a ground attack aircraft or a bomber hunter. Bf.110 squadrons paid a very heavy price when they were sent against fighter squadrons during the Battle of Britain. The losses taken by the 110 forced german high command to revisit their approach to the role of a heavy fighter.

Bf.110C vs Hurricane

This is the only plane where you have a speed advantage. In fact, you can actually outclimb this plane. Assuming that you start with an energy advantage, you can actually take on a Hurricane and win reliably. However, where there are Hurricanes, there are Spitfires. If you stumble upon a Hurricane all by itself, and you have an energy advantage, savor the moment.

Bf.110C vs Spitfire

Death on wings. There is no area where the Spitfire has a disadvantage except firepower. Engage only with caution, and write your will if a Spitfire shows above you and chooses you as his next meal. If you have a shot on one, take it (unless he doesn't know you're there and you can escape first). You won't get another, so blow your ammo supply on him to try to get a few lucky hits. If a couple 20mm land on his wing, he's much less of a threat and may decide to leave. There's a reason this plane has a 3:1 kill/loss ratio on the Bf.110C.

Summary

In the air-to-air role it does not sound too good for the 110 driver. But all is not lost when you have a partner. Good communication and airmanship can overcome the single bandit. On an active server, like ATAG, most of the Red jockeys only know one-speed - flat out! Judicious use of speed, in a Bf.109 or Bf.110, can see you turning the tables on your opponent who is always presuming they have the better turn rate. A barrel roll, with deceleration at the top of the roll, may cause an overshoot. Of course, with the 110 you always have to be aware of its slow acceleration so if you decide to play make sure you have some height

PART 9: AIRCRAFT PERFORMANCE

FOR ADDITIONAL INFORMATION ON THE BF.110, CHECK OUT THESE YOUTUBE CHANNELS. THESE GUYS COMPLETELY UNDERSTAND HOW TO FLY THE BF.110 AND EXPLAIN IT CLEARLY AND EFFORTLESSLY.

APEOFTHEYEAR

Channel:
https://www.youtube.com/user/Apeoftheyear/featured
Tutorials:
https://www.youtube.com/playlist?list=PLUyEbp1iw_PrgHx7nji2ohQyhHqBPluh1
Bf.110 Tutorial:
https://www.youtube.com/watch?v=8DhS9kiTPDw

JG4_KARAYA

Channel:
https://www.youtube.com/user/JG52Karaya
Bf.110 Tutorial:
https://www.youtube.com/watch?v=QsD4bpkgTPs

PART 10: AUTOPILOT

- Unlike German bombers, the Bf.110 does not have a “Mode 22” autopilot mode. It only has a “Course Mode”. In this mode, the auto-pilot takes over rudder control to make your aircraft travel following a given heading. You still have control over ailerons and elevator. Course mode is generally used when climbing or descending. In this mode, climb rate is better controlled through elevator trim rather than pure elevator input.

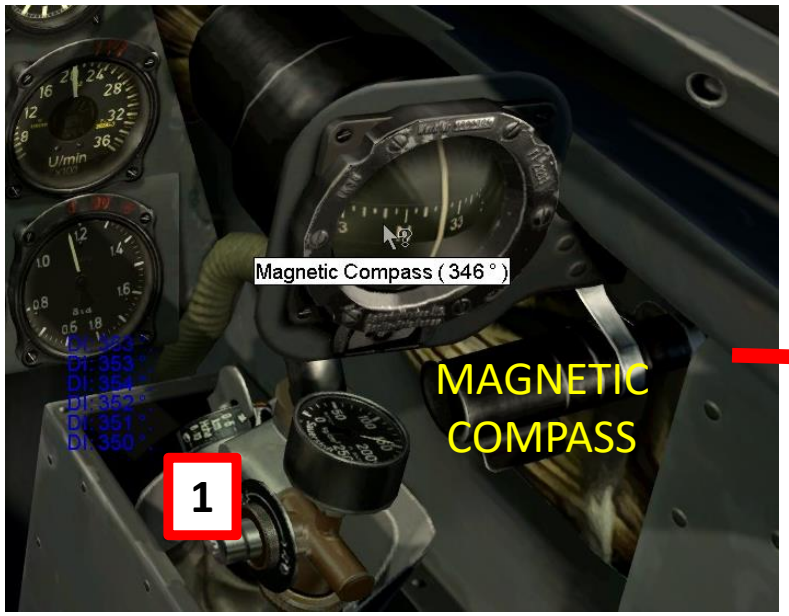
BF.110 AUTOPILOT OPERATION TABLE	
STEP	ACTION
1	SET/SYNCHRONIZE DIRECTIONAL GYRO TO THE SAME HEADING READ ON THE MAGNETIC COMPASS.
2	SET A COURSE TO DESIRED HEADING USING THE COURSE SETTER ON THE REPEATER COMPASS
3	ALIGN AIRCRAFT WITH COURSE SETTER BY CONSULTING THE REPEATER COMPASS (FOLLOW THE WHITE INDICATOR).
4	WHEN AIRCRAFT IS ALIGNED WITH COURSE SETTER, ALIGN AUTOPILOT BAND WITH THE DIRECTIONAL GYRO BAND USING THE “AUTOPILOT RIGHT” OR “AUTOPILOT LEFT” CONTROLS.
5	WHEN AUTOPILOT/GYRO BANDS ARE LINED UP, ENGAGE DESIRED AUTOPILOT MODE (COURSE MODE)
6	WHEN AUTOPILOT IS ENGAGED, STEER AIRCRAFT USING THE “AUTOPILOT RIGHT” OR “AUTOPILOT LEFT” CONTROLS FOR BIG CORRECTIONS. STEER AIRCRAFT USING THE “DIRECTIONAL GYRO INCREASE/DECREASE” CONTROLS FOR SMALL COURSE CORRECTIONS. USING THE DIRECTIONAL GYRO IS USUALLY A BETTER WAY TO USE THE AUTOPILOT AS THE PILOT HAS BETTER CONTROL OVER HIS SHIP.

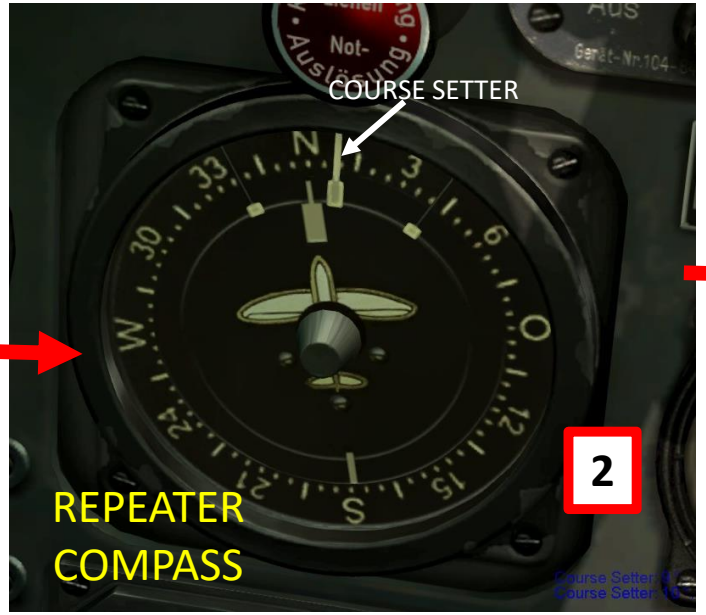
PART 10: AUTOPILOT

EXAMPLE:

- If we want to go to go full north, we will have to follow a magnetic heading of 010 (we add 10 degrees because of magnetic declination).

1. Align Directional Gyro with Magnetic Compass using the DG setter knob.
2. Set your “Course Setter” to 010 on your repeater compass.
3. Navigate towards desired heading (until course setter and repeater compass are aligned).
4. Align Autopilot band with Directional Gyro band using the “Autopilot Left/Right” controls.
5. Once AP and DG bands are aligned, you can now engage course autopilot.





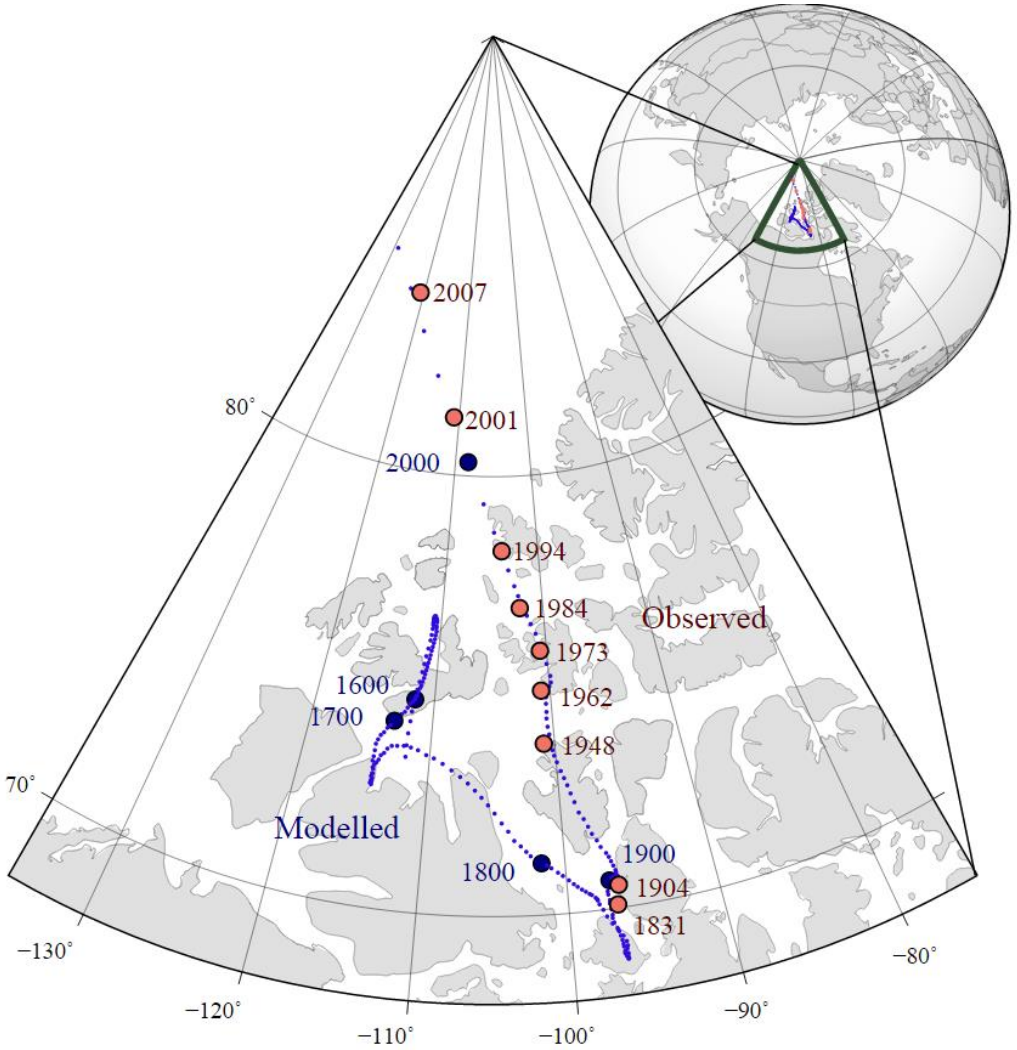
PART 10: AUTOPILOT

About Magnetic Declination

The direction in which a compass needle points is known as magnetic north. In general, this is not exactly the direction of the North Magnetic Pole (or of any other consistent location). Instead, the compass aligns itself to the local geomagnetic field, which varies in a complex manner over the Earth's surface, as well as over time. The local angular difference between magnetic north and true north is called the magnetic declination. Most map coordinate systems are based on true north, and magnetic declination is often shown on map legends so that the direction of true north can be determined from north as indicated by a compass.

This is the reason why in Cliffs of Dover, the magnetic compass needs to be “adjusted” to take into account this magnetic declination of the magnetic North pole (which is actually modelled in the sim, which is pretty neat).

In 1940, the magnetic declination required an adjustment of 10 degrees and 8 minutes. We round that to 10 deg.



The movement of Earth's north magnetic pole across the Canadian arctic, 1831–2007