AEROPLANE HEAVEN

You're virtually there.

LANCASTER

COCKPIT GUIDE & FLYING NOTES

A HIGH DEFINITION SIMULATION OF THE AVRO LANCASTER B MK I FOR MICROSOFT FLIGHT SIMULATOR 2020

Introduction.

The Avro Type 683 Lancaster actually started life in 1937, as a two-engined design - the ill-fated Manchester. Although the Manchester was an advanced aeroplane for the time, early problems with stability saw the addition of a third fin on the rear fuselage.

First flown on July 25, 1939, 200 Manchester Mk.1s were built and delivered to the RAF.

A much revised, four-engined version of the Manchester took to the air in October, 1941. Gone was the middle fin and four improved Rolls Royce engines gave the new design excellent performance. Pilots loved the new machine and a new name - Lancaster was given to the aeroplane to expunge any of the legacy of the flawed Manchester.

The first production aircraft took to the air on October 31, 1941 followed by orders which would lead to a total of 7,734 airframes being built over the life of the type.

The first squadron to receive the new bomber was No 44 (Rhodesia) Squadron who carried out it's first operational mission, mine-laying in the Heligoland Bight on March 3, 1942.

Numerous and famous raids were undertaken by RAF Lancasters throughout the war but perhaps the most notable was 'Operation Chastise', the raid on several dams in Germany's industrial heartland. The 'Dam Busters Raid', as it became known, was only made possible by the development of a cylindrical mine which required the aircraft to fly at just 60 ft and at an exact speed. Once released, the "bouncing bomb" would skip over the surface of the water until striking the dam wall and sinking to its base where the bomb would explode, rupturing the dam. 617 Squadron, led by Wing Commander Guy Gibson carried out the raid with great success, destroying or severely damaging all targets.

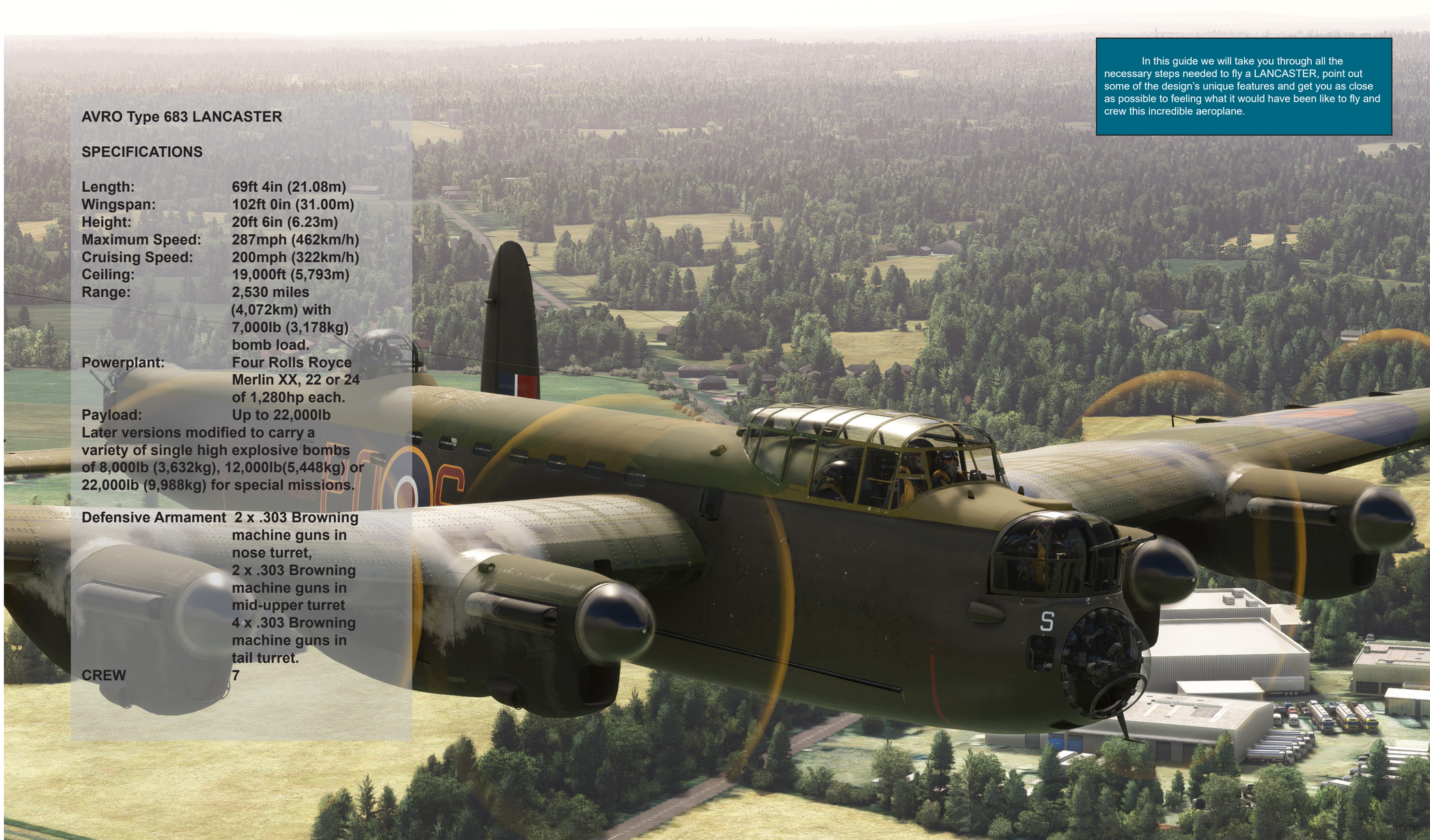
In another raid in November 1944, 617 Squadron was joined by 9 Squadron Lancasters carrying enormous 12,000 lb bombs in specially converted bays. The Lancasters sank the German battleship "Tirpitz" at its moorings.

The Lancaster was capable of carrying and delivering a wide range of powerful ordnance including 8,000lb bombs and incenderies and toward the end of the war, a massive 22,000lb monster dubbed "Grand Slam".
The enormous bomb required a specially converted Lancaster (designated the B. Mk1 Special) and the weapon was used for the first time on March 14, 1945 to destroy the Bielefeld Viaduct.

Right up to the very end of the war in Europe, Lancasters flew raids deep into the heart of Germany and the last sorties recorded were on 25 April 1945 against Hitler's mountaintop retreat at Berchtesgaden. By the time the war ended, Bomber Command had 745 Lancasters with 56 front-line squadrons and a further 296 aircraft with training units. After the war many of these were used to repatriate 75,000 prisoners of war.

In total, Lancasters had amassed 156,000 sorties. The very last operational sortie by a Lancaster took place on October 15, 1956. At the time of writing, only two examples of the Lancaster remain airworthy. Perhaps the more famous of the two is PA474 flying with the RAF Battle of Britain Memorial Flight and a regular visitor to airshows and memorial events.

The other restored and airworthy Lancaster resides in Canada with the Canadian Warplane Heritage Museum.



AVRO Type 683 LANCASTER

SPECIFICATIONS

Length:	**69ft 4in (21.08m)**
Wingspan:	**102ft 0in (31.00m)**
Height:	**20ft 6in (6.23m)**
Maximum Speed:	**287mph (462km/h)**
Cruising Speed:	**200mph (322km/h)**
Ceiling:	**19,000ft (5,793m)**
Range:	**2,530 miles (4,072km) with 7,000lb (3,178kg) bomb load.**
Powerplant:	**Four Rolls Royce Merlin XX, 22 or 24 of 1,280hp each.**
Payload:	**Up to 22,000lb**

Later versions modified to carry a variety of single high explosive bombs of 8,000lb (3,632kg), 12,000lb(5,448kg) or 22,000lb (9,988kg) for special missions.

Defensive Armament	**2 x .303 Browning machine guns in nose turret, 2 x .303 Browning machine guns in mid-upper turret 4 x .303 Browning machine guns in tail turret.**
CREW	**7**

In this guide we will take you through all the necessary steps needed to fly a LANCASTER, point out some of the design's unique features and get you as close as possible to feeling what it would have been like to fly and crew this incredible aeroplane.

ME649 "AR_J"
This Lancaster was flying with 103 Squadron RAF on a mission over Essen on 12th. December 1944 when it was hit by flak and burst into flames. 5 of the crew successfully baled out except for the pilot, F/O P.M.Picot RAFVR and F/S P.E.G. Yates R.C.A.F, who were killed.

Yates, the tail gunner, accidentally deployed his parachute in the aircraft which rendered it useless. Picot refusing to leave his crew-mate, attempted to regain control of the Lancaster but it broke up in the air and crashed in flames.

R5868 "PO S"
"S for Sugar" completed a remarkable 137 missions during WW2. First serving with 83 Squadron she was later transferred to 467 Squadron RAF. "Sugar" carried home the first British POWs and delivered food to the desperate in Europe. Today she is preserved at RAF Museum, Hendon and is the oldest surviving example of an operational Lancaster in existence.

W4783 "AR_G"
"G for George" completed no less than 90 missions with 460 Squadron RAAF. This machine was returned to Australia and is now preserved at the Australian War Memorial Museum in Canberra.

LM591 "VN B"
Flew with 50 Squadron from RAF Skellingthorpe in 1944.
The tail gunner, Ron Marlow completed 43 missions in LM591 before transferring to 466 Squadron RAAF.
He survived the war - a rare achievement for a Lancaster crew member.

Some facts:

A total of 7,377 Lancasters were built during World War 2.
The type flew a total of 156,000 missions.
3,249 Lancasters were lost.
55,578 crew members lost their lives.
The life expectancy of a Lancaster crew member was 2 weeks.

PA474 / JB607 "AR_L"
PA474 is on of only two airworthy Lancasters left in the world today. She is operated by the RAF Battle of Britain Memorial Flight and is currently carrying the codes and nose art for the original JB607 "Leader" of 460 Squadron RAAF. She flies as a permanent memorial to the crews who flew the Lancaster and lost their lives defending their country.

We have built this simulation in an attempt to honour the memory of these incredible people and to pay tribute to those that survived.

We very much hope that our humble project will at least give you some idea of what it would have been like for these men to operate and fly this remarkable machine.

RF128 "QB V"
"Victorious Virgin" flew with 424 Squadron RAF. On a mission over Hemminstedt, Germany, on March 21, 1945, the crew dropped a "Blockbuster" bomb on an oil refinery. What made this event unusual was that the bomb carried the only known example of nose art painted on its surface. The art depicting a tiger breaking out of an eggshell was titled "An Easter Egg for Hitler".

W4118 "ZN Y"
Flew with 106 Squadron RAF. Wing Commander Guy Gibson VC flew this machine before forming 617 "Dambusters"

ED932 "AJ G"
"Operation Chastise" was an attack on the Ruhr Dams on the night of May16/17, 1943. Known as the "Dambusters" 617 Squadron RAF carried oput the raid using specially prepared Lancasters which carried the now famous "Bouncing Bomb" invented by Barnes Wallis. ED932 was piloted by the leader of 617, W/C Guy Gibson V.C.

Models,texturing and programme code — Aeroplane Heaven
Flight Model — Wells Sullivan
Sounds — Echo 19

Special thanks to Daniel Rive and James Foster for their input on ME649 and LM591.

AEROPLANE HEAVEN

You're virtually there.

The Lancaster was not fitted with an autopilot but did have a set of controls which enabled the pilot and bombardier to make small alterations to the aircraft's course on a bomb run. (38) is the Auto-controls steering lever.

1. Landing Gear Indicator
2. Beam Approach Indicator
3. Clock
4. "Flying Six" Panel
5. Landing Lamps Switches
6. D.F.Indicator
7. D.R. Repeater Compass
8. Master Battery Switch
9. .Gear Indicator Switch
10. Magneto Switches
11. Slow-running Cut Switches (later HS2 version only)
12. Boost Coil Switch
13. Boost Indicators
14 Starters
15. Tachometers
16. I.F.F. Master Switch
17. Jettison Controls
18. Suction (Vacuum)
19. Suction chnage-over Cock
20. Oxygen Sub-panel
21. Radiator Shutter Controls
22. Brake pressure Gauge
23. Signal Lamp Controls
24. Propeller Feather Switches
25. Engine Fire Extinguishers
26. SuperCharger Control
27. Right Engines Fuel Cocks
28. Flaps Position Indicator
29. Throttle and Prop Friction
30. Propeller Controls
31. Throttles
32. Left Engines Fuel Cocks
33. Boost Cut-Out Lever.
34. Recognition Lights Switches
35. D.R.Compass Switches
36. AutoControls Trim Indicator
37. Compass
38. AutoControls Steering
39. Mixture Control

The Lancaster's main instrument panel is laid out in a logical manner for a four-engined aircraft. In front of the pilot is the standard RAF-type "Flying-Six" panel as used in all RAF types of the time. It contains the main instruments essential to flying the aircraft.

The Magnetos are "ganged" with plates which when used will operate the left and right switches together as one.

The Slow-running cut-out switches (11) were fitted to the later Mk1 only. As were the supercharger controls (26)

Pilot Wall

40. Crew Intercom Controls (INOP)
41. Crew Light
42. AutoControls Trim Adjuster
43. Seat adjust (INOP)
44. Bomb Doors Lever
45. AutoControls Master Lever
46. Auto Controls Clutch
47. Windshield De-Ice Control

There a four components to the AutoControls System.

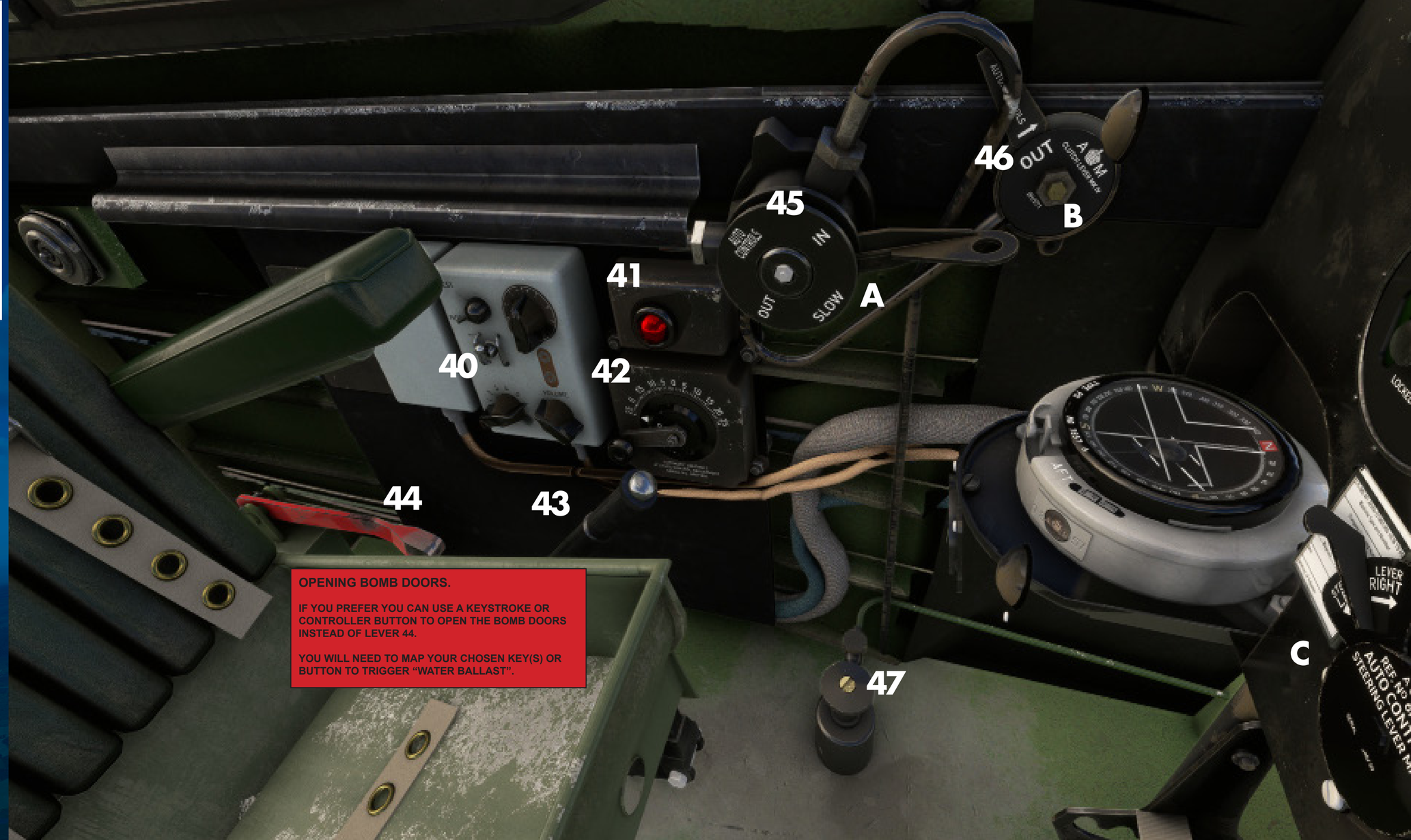
The Master Control Lever (45) A controls the hydraulic flow to the system and acts as an ON-OFF “Switch”.

The Clucth control (46) B engages or disengages the system from the aircraft controls.

The Trim Control (42) adjusts the nose up or down trim when in AutoControls mode. The Trim indicator and pressure gauge (36) gives the pilot an indication of the trim state.

The AutoControls Steering lever (38) C allows small changes to be made to the heading direction when under AutoControls guidance.

The Bombardier also had a steering control mounted on his Bombsight.



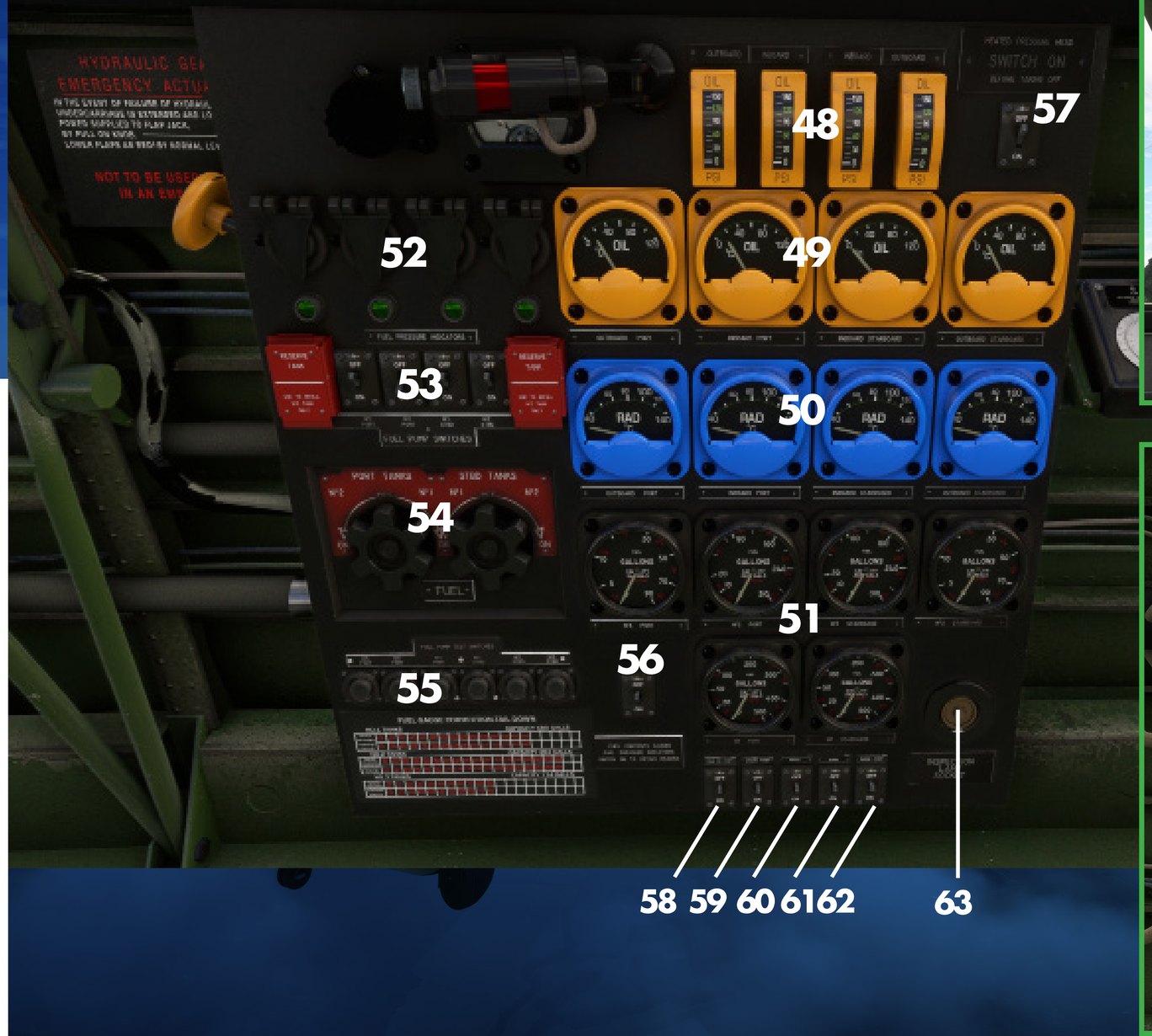
Right Wall

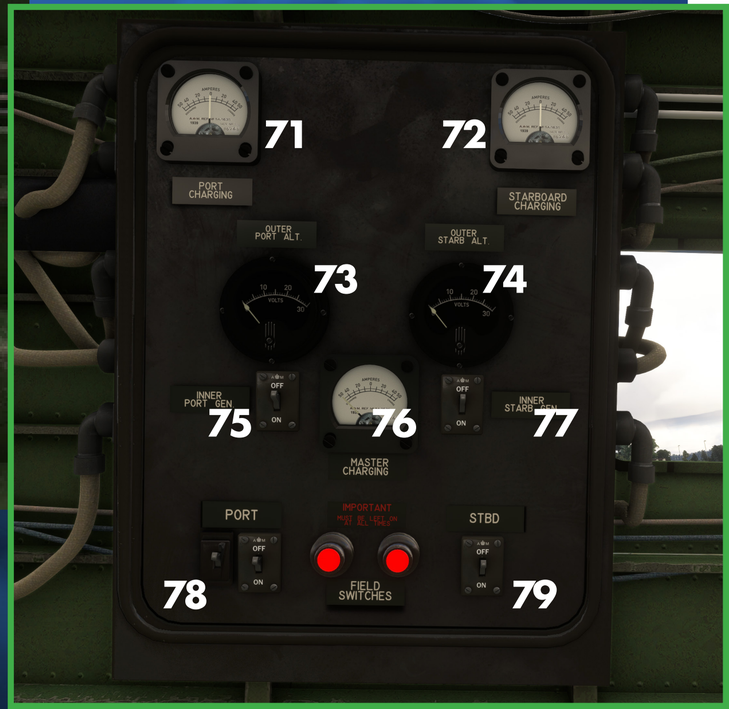
There are a number of panels attached to the right wall of the fuselage.

These include The Engineer's Panel to the left of the main cockpit, Auxilliary Fuel Panel opposite the Navigator's station and the Generator/Electrical panel further down, opposite to the Radio Operator's Station.

Engineer's Panel

48. Oil Pressure Indicators
49. Oil Temperature Indicators
50. Coolant Temperature Indicators
51. Fuel Contents Gauges
52. Oil Dilution Switches
53. Fuel Pump Switches
54. Fuel Tank Selectors
55. Fuel Pump Test Switches
56. Fuel Gauges Power Switch
57. Pitot Heat Switch
58. Cold/Dark Switch
59. Battery cart switch
60. Re-Fuelling Switch
61. Re-Arming Switch
62. Engine Cover Switch
63. Exterior Crew Switch





Auxilliary Fuel Panel

64 Forward Tank Contents

65. Fuel Gauges Power Switch

66. Aft Tank Contents

67. Forward Fuel Pump Switch

68. Forward Tank Transfer

69. Aft Tank Transfer

70 Aft Fuel Pump Switch

Electrical Panel

71. Port Alternator Charging Ammeter

72. Starboard Alternator Charging Ammeter

73. Port Generator Volts

74. Starboard Generator Volts

75. Port Generator Switch

76. Master Charging Ammeter

77. Starboard Generator Switch

78. Port Field Switch

79. Starboard Field Switch

Trim Console

80. Flaps lever

81. Aileron Trim Wheel

82. Aileron Trim Indicator

83. ElevatorTrim Indicator

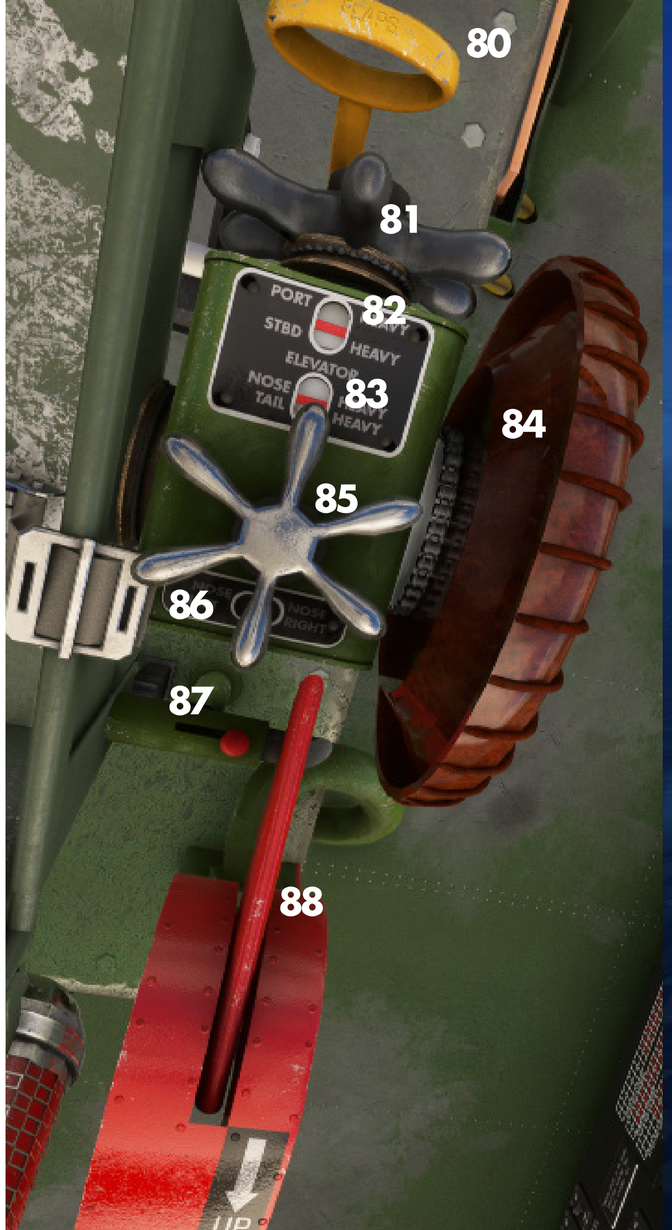
84. ElevatorTrim Wheel

85. RudderTrim Wheel

86. RudderTrim Indicator

87. Landing Gear Lock Latch

88. Landing Gear lever



Using the P11 compass.

The Lancaster is fitted with a P11 Maritime Compass. You will find it mounted in its own tray in the left-hand corner of the instrument panel.

This type of compass is designed to give the pilot a rapid indication of the current heading and a desired course which can be set, using the bezel.
The compass has a lubber line and has a lock lever which locks the bezel on the set course.

The compass needle has a white cross which is indicating the current course. In the main illustration, this would appear to be 110^0 (at the top of the lubber line) . Later we wish to turn to a course of 220^0 . So, by turning the bezel of the compass so that the 220^0 mark is opposite the lubber line, we can lock the bezel there. By using the lock, you can be sure your desired course will not move until you are ready to turn. Then, when the time comes for the course change we simply turn our aircraft until the needle is nestling in between the course marks etched into the bezel glass. We will then be on an 220^0 course.

Just by turning the bezel and then turning the aircraft, the pilot can change course with a high degree of accuracy and yet just glance at the compass.Simple but highly effective.

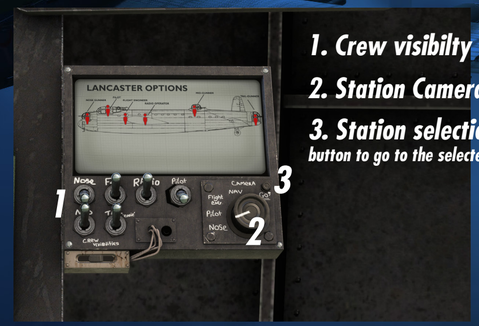
Crew Stations

In addition to the Pilot, there are four other main crew stations in the Lancaster fuselage - the Engineer/Observer, the Navigator, Radio Operator and three Gunner Stations - Nose Gunner/Bombardier, Upper Mid Turret Gunner and the Tail Gunner.

In this simulation we have made each indiviual crew member selectable, to hide or show.

You can do this via special configuration panels at each crew station.

Switch ON the switch marked “OPTIONS” at each station.



1. Crew visibilty switches
2. Station Camera selection
3. Station selection (click this button to go to the selected station)


Engineer Station
OPTIONS
SWITCH
OIL
OUTBOARD
PSI
LANCASTER OPTIONS


Radio/Nav Station
OPTIONS
SWITCH
LANCASTER OPTIONS


Nav Station Camera


Nose/Bombardier Station
OPTIONS
SWITCH
LANCASTER OPTIONS


Engineer Station Camera


Radio Station Camera


Nose/Bombardier Camera

Engineer

The Engineer is in charge of the Engineer's Panel. Here he will select the fuel tanks to use, monitor engine health and keep an eye on fuel contents.

He will also monitor the Auxilliary Fuel Panel when extra long-distance mission fuel is being carried.

When he is not at his panel he will act as Observer using the special bubble windows in the port and starboard side glazing.

He can also act as a "CoPilot" . Although he has no access to flying controls he can operate things like throttles and prop levers, fuel cocks and other panel-mounted equipment.

To move him to this position, click the fold-away Engineer's Seat mounted on the right cockpit wall.

Navigator

Immediately behind the Pilot, on the port side of the fuselage is the Navigator Station.

The Navigator will compute course and direction to a target and a safe passage back.

He is constantly updating the Pilot via the intercom radio on position and distance to target and any change of course necessary if enemy action prevents them from adopting the planned routes.

Just aft of his position, in the roof over the Radio Station there is a glazed dome which houses a Sextant which the Navigator can use for star-sightings and night navigation if needed.

In addition to repeater gauges for altitude, airspeed and D.F. Compass, there are other specialised devices and pieces of equipment such as wind speed and direction computer, course computer and H2S radar displays.

Mounted in the roof above is the control for the D.F. (Direction Finding) Aerial which is mounted on the roof panel under the canopy.

Radio Operator

The Radio Operator maintains contact with the ground and other aircraft flying in formation. He also operates the “FishPond” early warning display which can pinpoint any enemy aircraft in the vicinity.

Other controls and instruments at this station include controls for the trailing wire aeriel and various repeaters of the cockpit gauges like the D.F. Indicator.

The radios used in a Lancaster are the T1154 Transmitter and R1155 Receiver units and the operator is also equipped with a morse signal key.

USING THE RADIOS

For this simulation we have adapted the replica radios to use the familair simulation radio sets.

In the centre of the top T1154 transmitter is an ADF radio. The four knobs are used to tune the frequency which will appear in the small window.

The lower R1155 Receiver is adpted to a NAV radio operated by the centre knobs for Standby and Active frequencies which show in the left pair of frequency windows.

The right hand knob set operates the Standby and Active frequencies for COM1. These show in the right pair of frequency windows.

Bombardier

The Bombardier doubles as a Front Turret Gunner when not on a bomb run.
He can access the turret from here by climbing up and perching on the seat.

The large glazed dome dominates the noseroom and the Bombardier has a commanding view ahead and down.
A special optically flat glass is framed into the dome for the Mk XIV bombsight.

To the right of the bombsight are Type F Bomb Selector switch box, a Type 7 Bomb Distributor Unit, bomb timing unit and the all important bomb release trigger.

To the left are the bombsight controls and a large Type T1 109/126 bombing system “computer”.

Immediately aft of the T1 is the F24 Camera to record target inforamation and mission results.

On the opposite wall is the Type 3 Remote Contactor. This device was used to send a brief position signal to ground receivers at set timed intervals so as not to attract enemy interest.

If you are touring the interior of your Lancaster with the Showcase Camera. you can access the Bombardier’s Station via the passage way and steps to the right of the Pilot Station. Mind your head as you go down the steps!

The Turrets

The B Mk1 Lancaster carries three turrets. The forward turret is manned by the Bombardier when not on a bomb run. The other two turrets are manned by Air Gunners who form a permant part of the crew.

FORWARD TURRET

This turret is a two-gun, hydraulically operated Fraser Nash type F.5 which rotates in an arc giving a wide range of forward fire. It is fitted with two Browning .303 in. machine guns which can swivel vertically in special cradles.

The gunner can control the turret using control handles, one on each side, which control speed and direction of rotation together with firing triggers to operate the guns.

Mounted centrally on the gun cradle are the electrical services and switches for lighting and gunsight.

MID-UPPER TURRET

This turret is a two-gun, hydraulically operated Fraser Nash type F.N.50.
Its operation is similar to the forward turret but has 360^0 rotation.

The turret is mounted in a collar which sits on top of the fuselage. This collar is shaped so as to deflect the barrels of the Brownings when firing forward or backward to protect the airframe.
An inturruptor mechanism is built into the turret to prevent the guns from firing as they pass the tail structures of the airframe.

MID-UPPER TURRET

FORWARD TURRET

TAIL TURRET

The “sting in the tail” comes from a Fraser Nash Type F.N.20 turret carrying four Browning .303 in. machine guns. Like the front turret it has a partial rotation limited by stops in the mounting ring. Its operation is similar to the other two turrets.

The turret is accessed via the fuselage and two rear armour-plated doors attached to the cupola of the turret.

TAIL TURRET

"Operation Chastise"

On the night of 16th May, 1943, a squadron of heavily modified Lancasters destroyed or badly damaged dams in the Ruhr Valley and on the Eder River. These dams were critical to the German war effort, providing hydro-electric power to the steel industry.

A total of 21 crews were assembled from various squadrons of 5 Group Bomber Cammand into a special squadron called Squadron X which was eventually given the official title of 617 Squadron RAF.

The specially altered Lancasters carried the highly secret "Bouncing Bomb" - called "Upkeep" - invented by Sir Barnes Wallis and designed to skip across the surface of the dams and once at the wall, sink to the base where they would explode.

The bombs were spun in their cradles by a motor and drive belt and released at a critical distance, height and speed over the dam.

This took exceptional skill and the hand-picked crews were trained to fly at no more or less than 60ft and at an exact speed of 243 mph.

Special aiming devices were tried and tested but found lacking. In the end one crew member came up with the idea of a wooden cross with a nail or screw attached at each end of the cross-piece. A string was then stretched between the nails and back to form a triangle. The Bomb-aimer would line up the twin guard -towers at each end of the dam wall with the nails on his aiming device, at exactly the right distance from the target.

The Pilot would keep the Lancaster flying at precisely 243 mph and EXACTLY 60 feet above the water. Two special projector spot lamps angled downward, at either end of the bomb bay had beams set to converge at precisily 60 ft. The Engineer/Observer was able to guide the Pilot by watching the beams through the plexiglass bubble in the side window.

Wing Commander Guy Gibson (later awarded the V.C.) led 617 Squadron into the attack being first to release the first of the spinning bombs over the Mohne Dam. Unfortunately his bomb fell short of the wall.

In an extreme act of bravery, rather than leave the target area, he flew his Lancaster several more times over the Dam to draw the flak away from the other crews as they made their runs.

Eventually the Mohne Dam, Eder and Sorpe Dams along with others were destroyed or badly damaged.

617 Squadron was eventually dubbed "The Dambusters" and went on to carry out more noteworthy and technically demanding missions.

Gibson was awarded the V.C. for his actions on that night.

Sadly, 53 of the 133 crew who participated in "Operation Chastise" lost their lives - a casualty rate for the Squadron of 40%.

The Dambusters.

Here is a unique opportunity for you as a crack Lancaster pilot, to try your hand at re-creating a bomb-run on that fateful night.

There are two switches in the nose-room of the "Upkeep" Lancaster. Switch A will start the bomb spinning in its cradle and B will turn on the special spotlights.

As you descend to to the surface, you will see the beams start to converge until they meet as a single spot. When this happens you are at exactly 60ft.

Now hold that height and fly your Lancaster at EXACTLY 243 mph while you do it.

Now imagine doing all that whilst under constant anti-aircraft fire and bursting flak.

Good luck!

Using the battery cart.

Lancasters are ALWAYS started using an exterior power source. Forerunner of the modern GPU (GroundPowerUnit), the battery cart consisted of a number of lead-cell batteries connected together, mounted in a box and carried on a sturdy wheeled chassis.

A heavy cable runs from the cart to plug into a special recepticle up inside the number 2 engine nacelle.In this simulation, you use the switch **mounted on the Engineer's Panel (59)** to toggle ON the cart and cable. ***Always remember to switch OFF the cart after engine start.***

The Diorama.

Switches have been provided **(59 through 63) mounted on the Engineer's Panel** to allow you to toggle on the exterior Diorama for a more emersive experience. There's an authentic AEC Matador Fuel Truck, a bomb trolley with 1,000lb bombs and a huge 4,000lb "BlockBuster" bomb, battery trolley and crew members assembled at the rear entry door. This would have been a typical sight at any WW2 bomber base prior to a mission.

The Cold-Dark Start.

If you want a thoroughly authentic, immersive experience in your Lancaster, you need to begin your flights with a "Cold-Dark" start.
That is EVERYTHING OFF, in neutral or closed.

A switch has been provided **(58) mounted on the Engineer's Panel .**

Flying the Lancaster.

At the end of this manual you will find a complete set of CHECKLISTS. However, it will be useful to run through a few things about handling and flying the Lancaster.

Just a short note on ground-handling. The Lancaster is what we call a “tail-dragger” that is it has a tailwheel and sits on the ground in a three-point stance, using the tail to steer, unlike modern aircraft that have nosewheels. There is a known issue with Microsoft Flight Simulator where tail-draggers are notoriously difficult to handle properly on the ground, especially in takeoff and landing rolls.

We have spent a lot of time taming the behaviour of our aircraft on the ground to try to overcome some of these shortfalls of the simulator. We believe we now have the handling somewhere close to what a real Lancaster has. However, you will still need a lot of care and attention when operating the Lancaster on the ground. Remember that it is a BIG aircraft and needs room to move around!

So, let’s get started. We are going to assume you are using the “Cold-Dark” start method. That is, all switches OFF, all controls neutral.

Firstly, board the crew. Bring up the **“Nose Station” Camera View** and use the **“Options” Switch** to configure the crew stations. For preparation and engine start procedures you could leave the Engineer toggled OFF or move him to the co-pilot position by clicking on the fold-away seat. This will give a you a clearer view of the Engineer’s Panel.

Check that the **Landing Gear Lever (88)** is down and **LATCHED (87)**

Using the switch marked **“Battery Cart” (59)** on the **Engineer’s panel**, toggle on the starting trolley. You will now have electrical power in the aeroplane. Turn ON the **Master Battery Switch (8) on the Main Instrument Panel.**

Turn ON the **Landing Gear Indicator Lights Switch (9)**
Turn ON the **Generator Switches (75,77) on the Electrical Panel**
The FIELD SWITCHES on the Electrical Panel MUST be ON for the panel to be powered up. The red warning lights should extinguish.
Turn ON the **Pitot Heater Switch (57) on the Engineer’s Panel**

Fuel system.

The Lancaster has three tanks in each wing which are monitored and controlled on the **Engineer’s Panel** and the ability to load “extended range” tanks which are monitored and controlled by the **Auxilliary Fuel Panel.**
The wing tanks are numbered as **No.1 Port and Starboard** (INBOARD)
and **No.2 Port and Starboard** (INTERMEDIATE)
and **RESERVE** (OUTER)

Ignition system.

On the **Main Instrument Panel** there are **Ignition Magneto Switches (10)** arranged in left and right pairs for each engine. Although each switch can be toggled separately, to assist with rapid starting, each pair of engines are “ganged” with a plate which when raised will turn on all four (Eng.1 & 2) (Eng.3 & 4) switches. A single **Ignition Boost Coil Switch (12)** serves all engines.

Engine Start. (per engine)

Engine start sequence is **No.3 first followed by No.4, No.2 and finally No.1**

It is recommended that INTERMEDIATE tanks (No2) be used first.

Using the tank selectors, select No2 PORT and STARBOARD tanks

Switch ON FUEL PUMPS 2 PORT and STARBOARD

Open the **Engine Fuel Cocks**
Open the **Throttles 1/2 inch**
Propeller Control levers to MAXIMUM
Mixture Lever to FULL RICH (UP)
Switch ON **Ignition Boost Coil Switch**
Switch ON **Ignition Magneto Switches**
Open Starter cover and **PRESS STARTER**

Once the engines are running satisfactorily,
Switch OFF **Ignition Boost Coil Switch** and return throttles to idle

Check all instruments for proper operation and correct readings.

Boost Indicators.

These are the gauges with red bezels, one per engine, above the tachometers (R.P.M.) They indicated the boost level (manifold pressure) of each engine measured in pounds per square inch. The Lancaster’s Merlin XX engines operate in a range of boost from around -5 to +12 lbs. Higher boost levels are possible but only for short periods to avoid engine stress.

At idle they should be reading 0. Merlin engines only produce boost when throttles are opened and pushed forward for takeoff, climb and general flying.

Under normal flying conditions, levels of boost are between +4 and +7 lbs.

Boost Cut-out.

In emergencies and certain combat conditions, a red **Boost Cut-out Lever 33)** can be thrown to increase boost to +18 for very short periods.The two knobs are squeezed together to release the lock and the lever moved sharply downward. This lever must **ONLY BE USED FOR VERY SHORT PERIODS** to avoid engine stress.

Run-up Tests. (per engine)

To check that everything is order, there are several checks to be made whilst warming up the engines, prior to taxying out.

Set throttles to give 1,000 R.P.M. idle.

On the **Engineer’s Panel** check the following:

OIL PRESSURE	**60 P.S.I**
OIL TEMPERATURE	**15^0** (MINIMUM)
COOLANT TEMPERATURE	**60^0**

Check operation of flaps. The **flap lever (80)** can be moved to three positons - UP, DOWN and NEUTRAL. To lower the flaps, push the lever DOWN and hold it there until the flaps are at the desired angle, indicated on the **Flaps Position Indicator (28)** on the Main Instrument Panel. Once you are happy with the flaps angle, move the flaps lever back to NEUTRAL. Raising the flaps is the same process in reverse.

Check operation of Magnetos. (Mag-check)

With brakes set, open up to **0 boost**. This will give around **2,600 R.P.M**.
Switch OFF Mag 1 (left switch of the pair) and check the R.P.M for that engine. You should see **a drop of around 100 R.P.M**. Switch the Mag back on and then switch OFF Mag 2. A similar drop in R.P.M. should be noted. Switch the Mag back on and do this test for all four engines in turn.

Taking off.

Once lined up with the runway, set the bakes.

Set flaps to 25^0 down.
Set Elevator Trim slightly nose down.
Other trims to neutral.
Set Throttles to idle.
Propeller controls fully up.
Mixture control fully up.
Check fuel contents.
Check engine instruments.
Supercharger should be set in MS (do not take off in FS ratio)

Open up to 0 boost against the brakes. Release the brakes and as you begin to roll open the throttles to +4 lbs with the port engines slightly ahead. The Lancaster can have a tendency to swing to port at low speeds on the takeoff roll. This is easily countered with the port throttles and then with rudders as speed increases.

Open throttles smoothly to +12 Boost.
Push the yoke forward slightly to unstick the tail and ease back to take off at around 90 - 100 M.P.H

Raise the undercarriage and check that the red lights extinguish.

Fly straight and level to 125 M.P.H. before commencing climb out.

Raise the flaps at 800 ft. The nose will dip slightly as you raise the flaps so stand by on the trimmer.

Climbing.

Best speed for climbing is 140 m.p.h.
Above 13,000ft. use F.S. ratio on the Supercharger.
For best economy in a climb, recommended speed is 170m.p.h. with Mixture leaned.

General Flying.

Check the fuel gauge contents. Once the **Intermediate Tanks** show 120 gallons of fuel used, **Switch ON the Outboard RESERVE Tanks Fuel Pumps** (Under **RED** safety covers). When the **RESERVE** tanks are empty, **Switch OFF** their pumps.

When the **Intermediate Tanks** show 100 gallons remaining **Change Over to the INBOARD No.1 Tanks.**

Monitor your fuel use regularly and before landing, Change Back Over to the Intermediate No2 Tanks.

N.B. The Lancaster is slightly unstable in the longitudinal plane so will require constant trim changes. Flying controls become heavy above speeds of above 260 m.p.h.

The most economical cruise speed is 170 m.p.h.
Straight, level flight can be maintained at 125 m.p.h. with 25^0 flaps.

AutoControls.

This is the closest ypu will get to an autopilot in the Lancaster.
The AutoControls system enabled the bomb-aimer (and pilot) to make small adjustments to height and heading when lining up on a bomb-run. Refer to the panel guides and:

Set up the aircraft for speed, height and heading. Turn on the AutoControls using the **Master Control Lever 45** and then push the lever another notch to be opposite the **“SLOW”** mark. With this set, the Lancaster will hold the altitude set.

To make small adjustments to the pitch angle and therefore climb or descend to a new held altitude, use the **Trim Adjuster 42** rotating the lever forward will lower the nose and backward will raise the nose.

Moving the lever on the **AutoControls Clutch 46** forward will engage the heading hold of the system and the Lancaster will maintain the set heading.

The **Steering Lever 38** can then be used to make fine adjustements (only) to the heading.

NOTE: AutoControls is NOT an autopilot and cannot be used as such.For large changes in altitude and heading, the Lancaster **MUST** be flown manually.

Fuel Consumption.

For any mission, correct engine and fuel management are vital.
Here are some offical fuel consumption figures taken from original flight manuals of the time.

Normal Mixture

R.P.M.	BOOST P.S.I	CONSUMPTION Galls/Hr
3,000	+9	410
2,850	+9	390
2,650	+ 7	330
Weak Mixture		
2,650	+4	218
2,300	+2	181
2,000	-1	140

Diving and stalling.

A Lancaster becomes NOSE HEAVY as speed increases. Use of regular trim adjustment using the Elevator Trim Control is adivsed.

Under stall conditions, there is NO tendency for a wing to drop.

Navigation.

OK in the simulator you don't have a Navigator working away with maps and calculator to give you a course or heading. So we have to rely on instruments to do the work.

With this in mind, we have added an **RMI** instrument to provide basic navigation. The **NAV** needle will provide direction to the radial to which or from which you are flying. The **ADF** needle will provide the direction of the **NDB** transmitter, to which you have tuned your ADF radio.

To access this instrument, you switch it with the **D.R. Repeater Compass (7) by clicking the pencil light above the D.F.Indicator.**

The (original equipment) **D.F. indicator (6)** will provide you with a **CDI (Course Deviation Indicator)**. You use this when close to an airfield to keep on track to the runway.

The last navigation aid is the (original equipment) **Beam Approach Indicator (2)** This instrument was carried in all Lancasters and was designed to asssist the pilot in poor visibility conditions when landing. The system basically works like a modern ILS system and uses the Marker Signals of the airfield to guide the pilot to the runway. The original system used morse code signals but we use lights to make life a little easier.

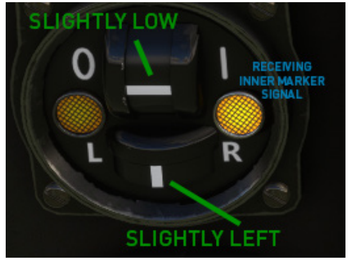
So, with a combination of Radio Frequencies and instrument needles, you will be able to navigate anywhere in the Flight Simulator World.

Sunshade.

A concertina sunshade is fitted to the roof of the Lancaster's canopy. By clicking on the folded shade you can draw the sunshade over and block the sunlight from the cockpit area.

Beam Approach.

Before ILS there was Beam Approach. This was a simple system that was based on marker "beams" set at the Outer and Inner points of the airfield. **The indicator (2)** on the pilot's instrument panel shows the pilot where he is in relation to the field runway. By flying the Lancaster to position the pitch and heading lines he could be sure he was on track.



The small lights either side of the instrument indicate which marker is acquired. In the illustration, we have acquired the Inner Marker.

Approach and Land.

Reduce speed to below 200 m.p.h.
Set flaps to 25^0 down.
Lower Landing gear
Set Elevator Trim slightly nose down.
Other trims to neutral.
Propeller controls fully up.
Mixture control fully up.
Check fuel contents and make sure No.2 Intermediate Tanks are on line.
Check engine instruments.
Supercharger should be set in MS

The correct speed for approach to land is 100.m.p.h.

Lower flaps and balance throttles to give around 90 m.p.h. as you reach the threshold.

Close throttles and touch down at around 80 m.p.h.
Allow the tail to drop and the tailwheel ground before applying brakes.

CHECKLISTS

PRE-START

CREW	ABOARD
ENGINE COVER	ON
DOOR	CLOSED
PARKING BRAKE	ON
BATTERY CART	ATTACHED
MASTER BATTERY	ON
MAGNETOS	OFF
UNDERCARRIAGE	DOWN AND LATCH LOCKED (GREEN LIGHT ON INDICATOR)
FLAPS	UP
LANDING LIGHTS	UP
FUEL CONTENTS	SWITCH ON GAUGES AND CHECK
FUEL	NO. 2 TANKS SELECTED
GENERATOR SWITCHES	ON
PITOT HEAT	ON

START (No.3 First)

THROTTLE	OPEN 1/2 INCH
FUEL COCKS	FULL UP (PER ENGINE)
IGNITION BOOST COIL	ON
MIXTURE	FULL RICH
PROPELLERS	100% MAX REVS (PER ENGINE)
MAGNETOS	ON (BOTH) (PER ENGINE)
STARTER	PUSH (PER ENGINE)

ENGINE WARM AND RUN-UP

IGNITION BOOST COIL	OFF
RADIATOR SHUTTERS	AUTO
FUEL PRESSURE	21/2 - 3 PSI
BRAKE PRESSURES	CHECK
ALTIMETER	SET
COMPASS	FREE AND BEZEL SET AS DESIRED
TEMPERATURES	CHECK

MAG TEST (Per engine)

THROTTLE	+4 BOOST
LEFT MAG	OFF 100 RPM DROP
LEFT MAG	ON
RIGHT MAG	OFF 100 RPM DROP
RIGHT MAG	ON
THROTTLE	IDLE
PROPELLER	100% MAX REVS
NAV LIGHTS	ON

TAXY

PARKING BRAKE	RELEASE
INSTRUMENTS	CHECK
ALTIMETER	SET

PRE-TAKEOFF

ENGINE	CHECK INSTRUMENTS
THROTTLE	0 BOOST
FLAPS	25°
TRIM	NOSE DOWN SMALL AMOUNT (CHECK GAUGE)

TAKEOFF

BRAKES	RELEASE
THROTTLE	+4 BOOST THEN MAX
SUPERCHARGER	M RANGE (LEVER DOWN IN B.MK1)
ROTATION	85 - 100 MPH
GEAR	UP (RED LIGHT ON INDICATOR)
ATTITUDE	LEVEL UNTIL 125 MPH

CLIMB

THROTTLE	AS REQUIRED
SUPERCHARGER	S RANGE ABOVE 13,000 FT.
TRIM	MAINTAIN 750 FPM AT 140 MPH
FLAPS	UP

LANDING

THROTTLE	TO MAINTAIN 120 MPH (APPROACH) THEN 90 MPH (THRESHOLD)
TRIM	AS REQUIRED
GEAR	DOWN (GREEN LIGHT ON INDICATOR)
FLAPS	DOWN (ON FINAL)
THROTTLE	TO GIVE 80 MPH OVER THRESHOLD