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Air Refueling for Beginners



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Air refueling for beginners

By experience, air refueling is a demanding procedure. To keep an aircraft smooth, straight and level needs high aircraft control skills and a precise tuned hardware.

Hardware

Therefore, before you begin, you should tune your joystick. The default settings of the roll and pitch axis are linear without any dead zone. This result in overreactions even if you only look at your joystick. So make sure that the curves of the roll and pitch axis look like the picture below. The dead zone is set to one, to ensure a smooth control even for shaking hands.

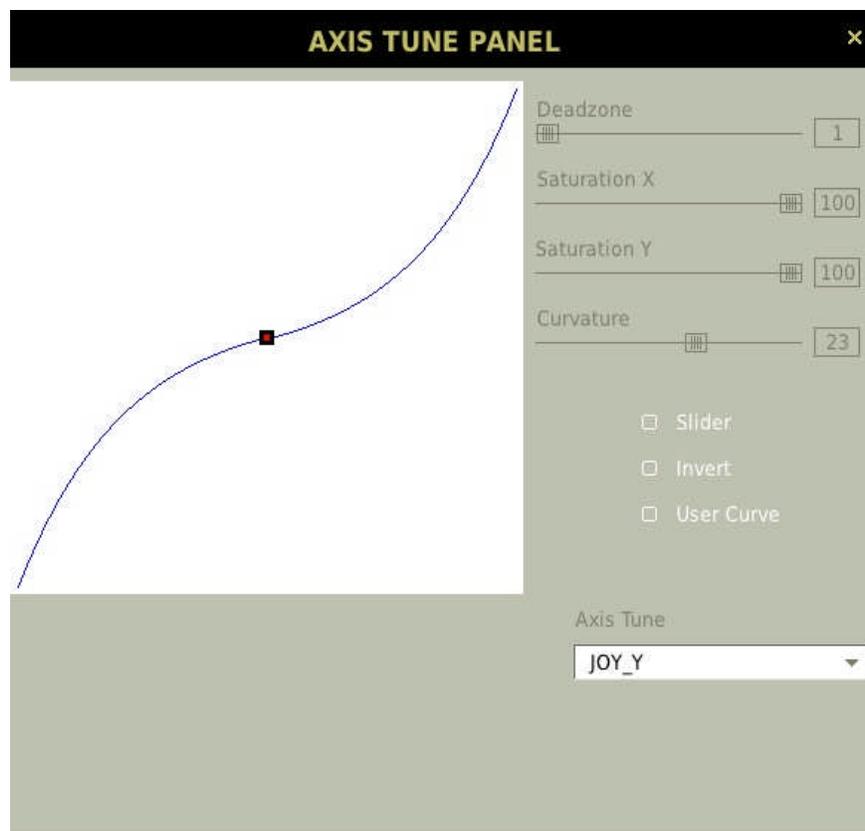


Figure 1 Axis tuning

Training monitor

To get a result from your training, you should measure the time you need for a complete refueling and the number of lost contacts. Write down the date and the time you needed for every training session. Once you are on the level to contact the boom, you will need between 20 and 30 minutes for a complete refueling. The target time should be 6 minutes. The most time lost is experienced when the contact is lost to the boom and you have to reposition the aircraft for the next trial. You will also notice, that the boom is retracted if you need too much time to reposition the aircraft.

Starting refueling

I will not describe here in how to find and approach the tanker aircraft. The focus is set to the refueling procedure its self and avoiding trap doors. The basic idea is to bring the aircraft in a stable contact position. That means to maneuver to and hold a specific position in trail of the tanker. The contact its self is then done by the boom operator. **This means: not chasing the boom.** In the simulation the procedure is a bit different. As soon as the aircraft is close to the contact point, the boom controller starts to move the boom towards the slip door. The boom operator does not wait until the aircraft is stable aligned like in reality. Therefore it is hard to find the ideal position with the first contact. This comes with increasing experience when you know how the boom operator reacts.

Situation

Aircraft's position is 1 NM, 500 ft below in trail of the tanker. You are the only aircraft for refueling . If there would be more aircraft, a specific choreography have to be followed which is not explained here in.

Action

- Activate the autopilot to hold heading and altitude. This makes it easier to prepare all switches for the refueling procedure.
- Because of precise speed control you will need to spend attention to the speed indication in the HUD. The tanker speed is normally given as true air speed. So change the speed indication in the HUD to true air speed indication. The often practiced use of ground speed has a trap door. Ground speed may change because of winds while true air speed remains almost stable all the time. The only reason for using ground speed is the different indications with different aircraft types. 250 KIAS indicated from a mechanical gauge in a A10 may differ from 250 KIAS in KC35. This is caused by the different constructions. Ground speed is calculated by the flight management system (FMS) software and is precisely the same for all aircraft using a FMS. But this difference is not simulated in DCS.
- If the TAS of the tanker is known from the briefing, you should find out the power setting to hold the speed. Keep the N2 indication in mind. It will be used later.
- For beginners using TrackIR: it is a help if you freeze the TrackIR and setup your view so as to have the best view to all important HUD items.
- Set all weapons to 'safe' or 'off'.
- Set IFF and CMSP to standby.
- if not already done, tune in the tanker frequency .
- Select the corresponding radio box. The communication menu appears. Press the keys: F6 followed by F1. Your simulation voice will ask: "TEXACO, UZI11 request rejoin." The tanker will answer:"UZI11, TEXACO, proceed to pre contact at 9000".
If the tanker does not answer, check the selected frequency and radio box.
If the tanker has responded you will see the boom coming down and the position lights of the tanker will be switched on.

- Open the refueling door. You will notice, that the autopilot will be disengaged automatically. The aircrafts aerodynamic is different with a open refueling door. It tends to lift the nose. So immediate nose down trim is necessary.

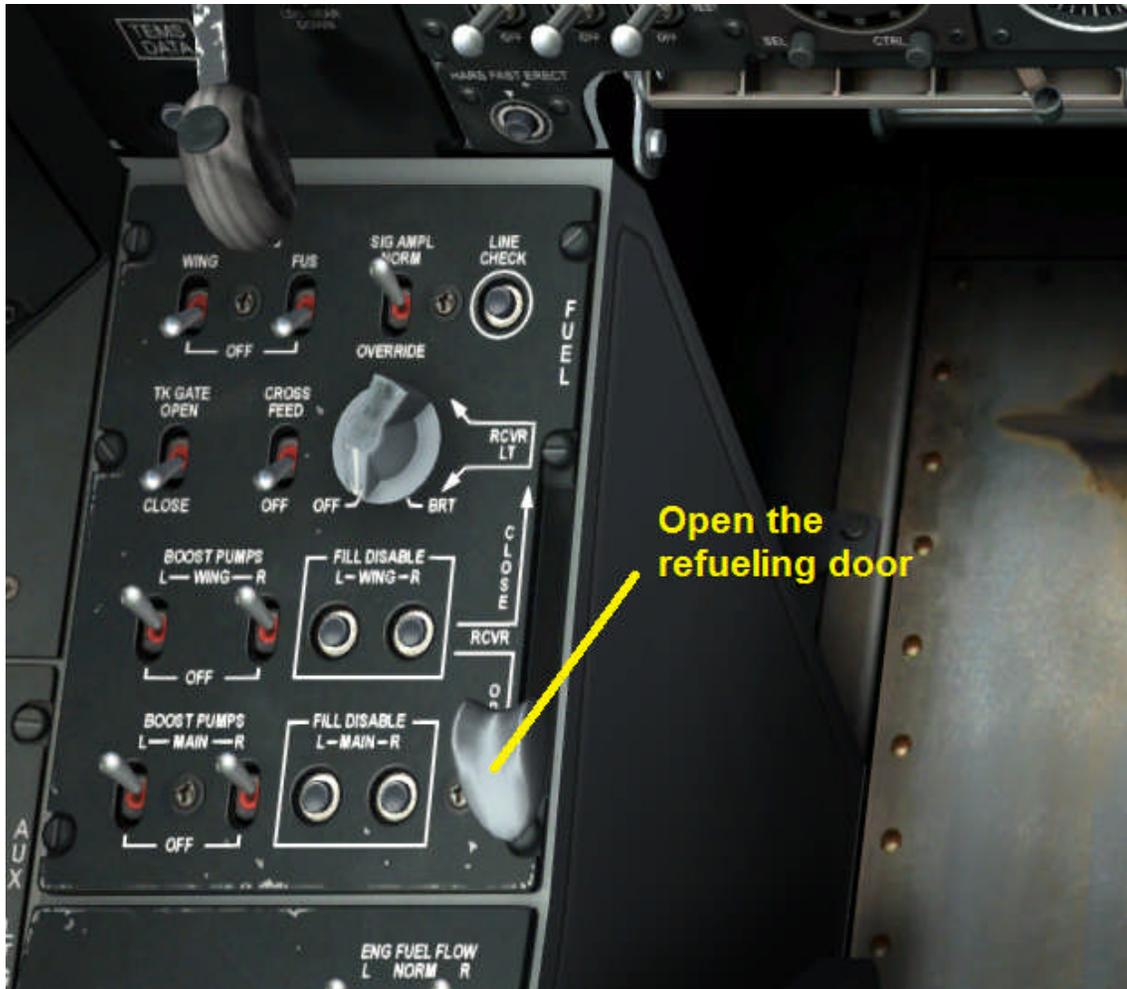


Figure 2 Open the refueling door

- Take your feet from the rudder pedals. It often happens that you move the rudder unintentionally while relaxing on the pedals.
- **Trim your aircraft as precise as possible.** When you start the trim process, you should fly the same speed as the tanker does. The result should be, that the aircraft shows no movement anymore around the roll axis and holds the altitude even if you leave the stick untouched.
- When on tanker speed, have a look to the N2 gauges and keep this setting in mind. It will be used later during the approach.

Approaching the boom

- Now start to bring the hog into the pre contact position. As stated before, you should have the power setting in mind to hold the tanker speed. This will be important for the next step. To move forward to the tanker use a power setting of 90% N2 and observe the acceleration. You see the tanker coming closer and closer. If the speed is about 20 kts higher than the tanker speed, throttle back to the setting you would use to hold the tanker speed. Let the aircraft fly. It will slowly decelerate. If you are close to the tanker use full airbrakes until the hog has the same speed as the tanker. Then retract the airbrakes immediately. If all was done right, you should be in a stable position behind the tanker.



Figure 3 Approaching the Boom

- Out of the above shown position fly towards the tanker with about 20 kts more than the tanker speed.
- You head always towards the tanker centerline, **never towards the boom**.
- As it can be seen in figure 8, the altitude is stable and should not be changed anymore. The boom is in the most down position
- The pipper is aiming to the mid of the colored boom . The idea is, that the boom controller will lift the boom if you come closer. This gives space for the boom to move a bit up and down for adjustments.

- The pre contact position is a box of defined dimensions (which I do not know exactly). You have to be in the box for the next step.

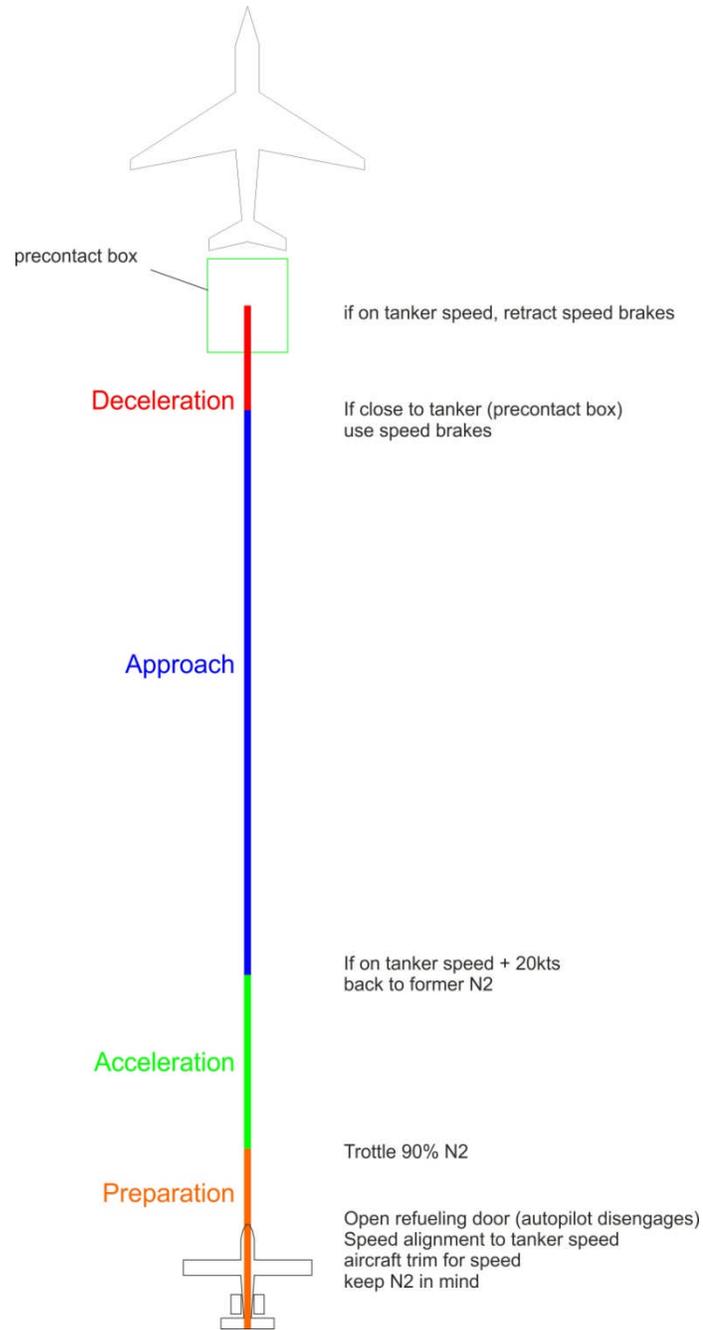


Figure 4 Tanker Approach Phases

- In the pre contact position, check the control light right of the HUD, it should show 'ready' to indicate that the hog is ready to suck fuel. If it does not, for whatever reason, check, if the

refueling door is open and press the nose wheel steering button to reset the refueling system of the hog.



Figure 5 Refueling system ready

- Select the radio box again and press F1 to report "ready pre contact". Listen to the radio answer. It should say "will contact". If you receive "return pre contact", the boom controller will not work. In this case it is most likely, that you are too far away from the boom or the position in regard to the boom is not suitable for the boom controller.
- Now the tanker will acknowledge and extend the boom.

8000 lb/min 3.5 PSI

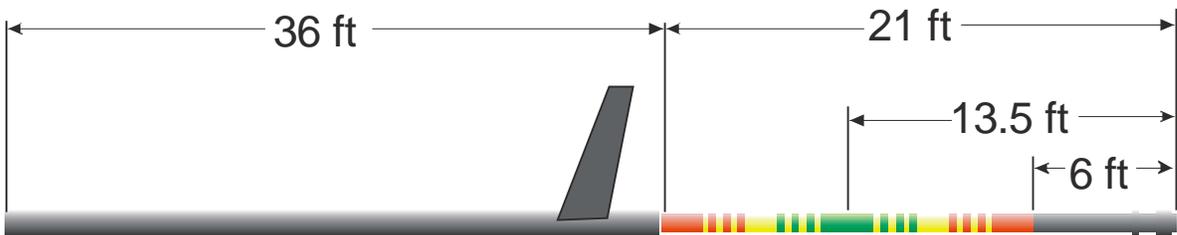


Figure 6 Boom dimensions

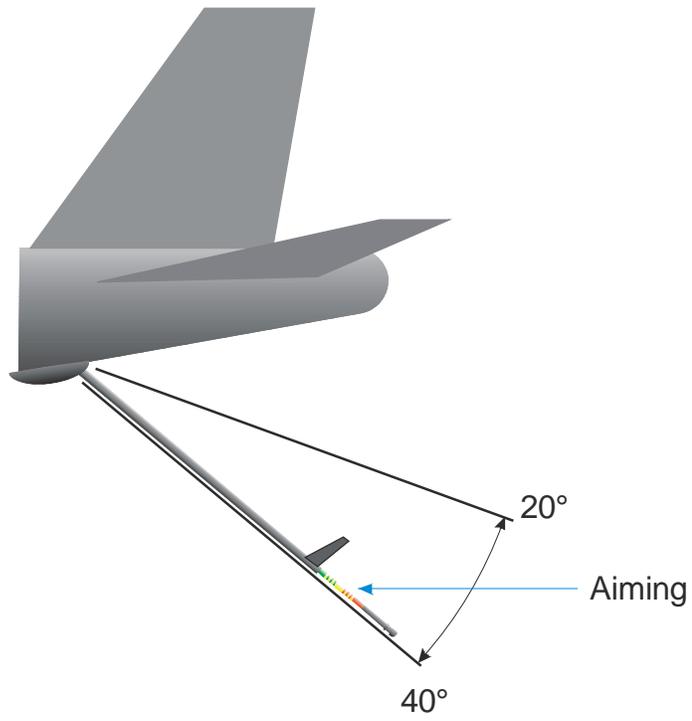


Figure 7 Boom most down

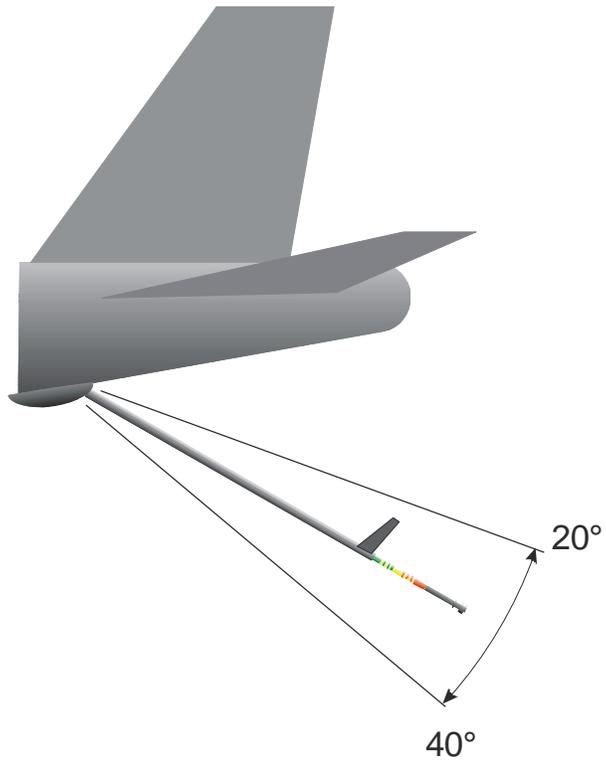


Figure 8 Boom lifted position



Figure 9 Pre contact position

- If you are in the position shown in the picture above, you are in the pre contact position. Your speed should be exactly the tanker speed. Listen to the engine sound. The current melody is your zero orientation to hold the tanker speed.
- If you press F1 now and the tanker acknowledges with "will contact", move slowly forward.
- At the moment, the boom is lifted, reduce to tanker speed +2 kts.



Figure 10 Boom lifted

- You will slowly drift towards the boom. Do not change the altitude. The heading is adjusted so as to remain on the tanker centerline. The rest is done by the boom controller. He will do the contact.



Figure 11 Close to the boom

Don't worry if the boom does not engage on the first trial or if it probably hits the aircraft's nose. You are not alone on this world with that problem. As you can see in the picture below, even real hog pilots were kissed by the boom.



Figure 12 Boom lips gloss

Staying in contact

Once contact is established, the tanker reports 'Contact, you are taking fuel'. This is the first success for a beginner. You will notice, staying in contact is a different procedure.

- The best success is granted with a optimal prepared trim
- You should maintain an altitude at which the boom can be held in a mid position of its vertical operation range. If you are too high or too low, you have a 50% chance to disconnect in the next view seconds. As explained before, you find the correct altitude if you aim to the mid of the colored part of the boom during approach. Maintain this altitude even if the boom is moved upwards suddenly. It comes back if you are close enough.

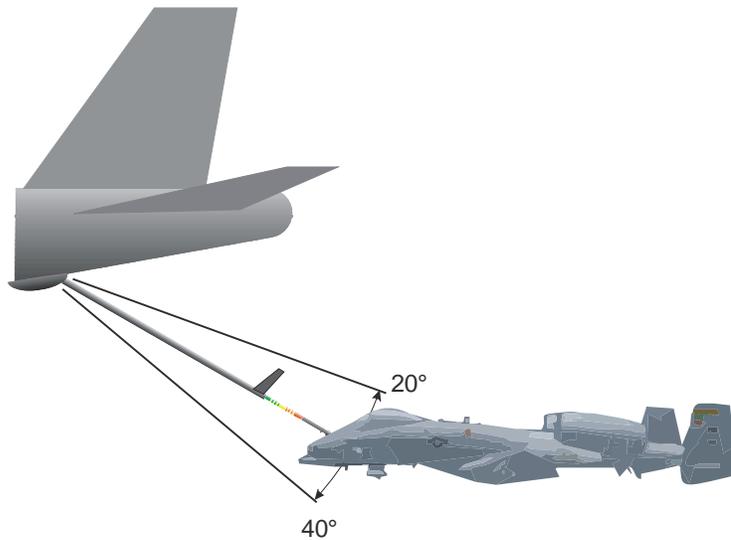


Figure 13 Best vertical position

- A beginner should periodically relax the stomach muscles. This avoids cramping even in arms and hands.
- Start to learn peripheral looking. Your eyes should be focused on the piper to compensate flight path movements. In the periphery of your field of view, you should observe the tanker centerline and the color markings of the boom barber pole. The green marks shall remain at the border to the upper gray part of the boom.
- Changes of the color marks are caused by speed fluctuations. If you are forced to adjust the speed, listen to the engines melody and look to the speed indication in the HUD. Give a short micro push forward or back with the throttle and change back to normal melody. Be patient the reaction comes not immediately.
- A color change is even caused by small altitude changes. So ensure, that you are vertically stable in relation to the boom. Being too high, even if you are in the green zone, may cause a disconnect. The best position is, if you have the lower end of the grey tube almost at the upper end of the windshield.
- If you need the throttle to adjust the speed or the stick to control the attitude, remember, only small and smooth inputs shall be made. Be patient, give the aircraft time to react on the input. The reaction of a throttle input takes a couple of seconds.
- There are two situations which cause the boom controller to shout 'Break away! Break away!'. One is your speed delta. You are too fast moving towards the boom. The other is, is you are about to leave the field of operations for the boom. If you are sure, that you can handle the situation, you may ignore the command.
- The most experienced mistakes are unnoticed drifts vertically and horizontally. While horizontal movements are easy to recognize, vertical movements upwards are noticed mainly short before you reach the upper or lower limit. So it is essential to keep an eye to the color coding of the boom. Avoid abrupt movements to solve the situation. Only small and smooth controls are necessary.

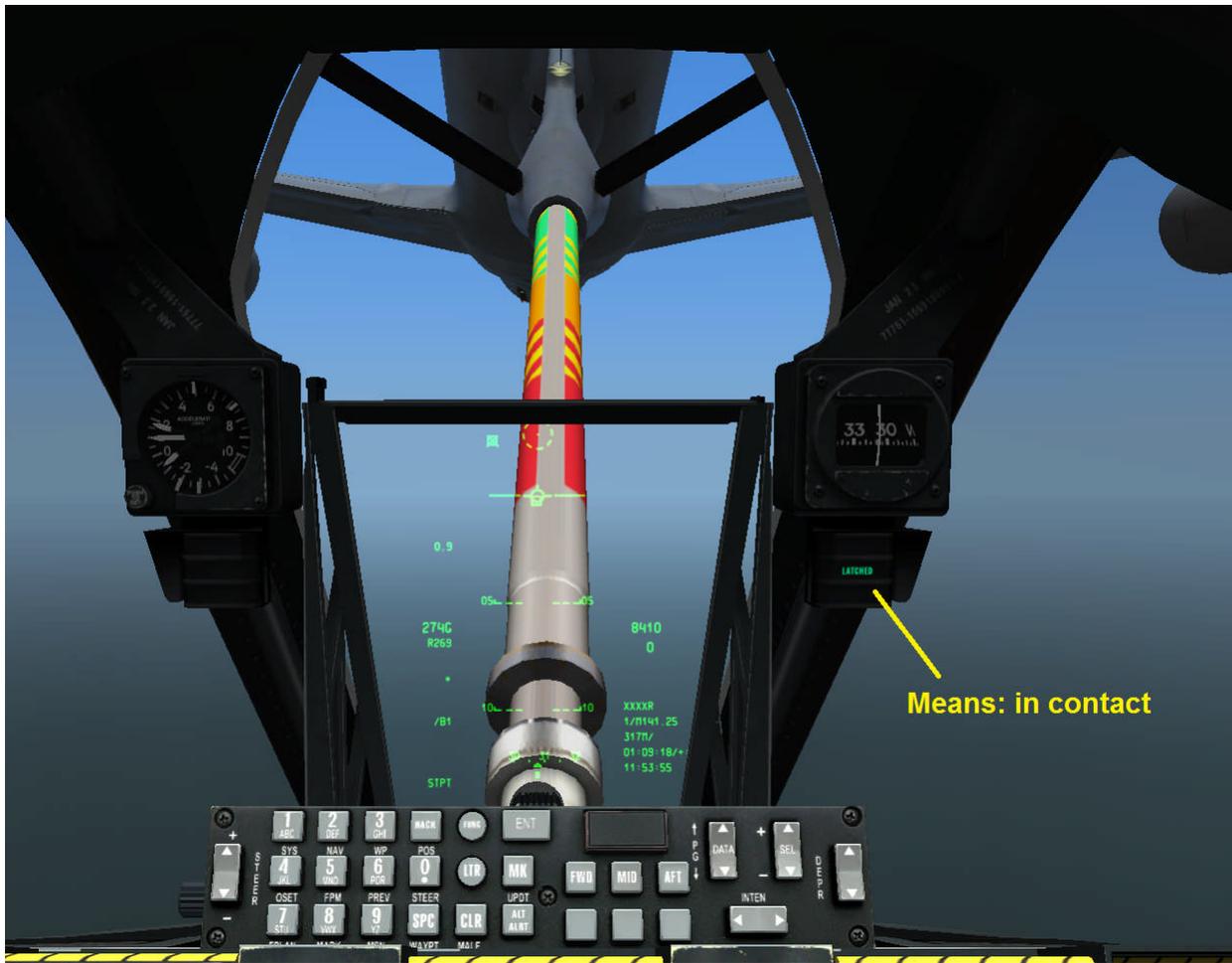


Figure 14 Almost perfect

Horizontal movement compensation

The horizontal movement compensation should be automated. This needs a lot of training and cannot be perfect from the first trial on. As long as the procedure is in training phase you should pay attention to the following rules:

Banking the aircraft should never be more than 5 degrees.

Use bank only to cause a lateral movement. As soon as the aircraft moves into the desired direction return to zero bank immediately.

Start a counter bank right in time when you coming close to the intended position.

As soon as the horizontal movement stops, return to zero bank immediately.

Compared to vertical movement compensation, lateral movements are very slow. Therefore you will observe a good training progress over the time for lateral movement compensation. The human system seems to react on slow procedures training better than on fast ones.

Common errors:

- corrective measures initiated too late

- bank angle too high
- maintaining bank during all movements.
- changing altitude during lateral movements.

Vertical movement compensation

The main preparation is a precise neutral trim of the elevator. This avoids unwanted climbs or descends. Keep the focus on the pipper. It tells you if you drift into a vertical move situation. Even here, only small and smooth elevator correction shall be made. Give a little time to the aircraft to react on the elevator input. It may be delayed with small movements.

If you notice, that you drift always upwards unintended, you probably need to trim nose down. Since the trim input is very sensitive, give only a small push like plucking a guitar string. The same procedure applies for a downward tendency.

For the first time, the focus will be permanent on the pipper to maintain the altitude. With training progress over the time you will start to look to the color marking of the boom periodically. The final training progress is, when you control your altitude with the color marking only. Even vertical compensation will be done automated over the time. But it takes more training than horizontal compensation.

Common errors:

- Trim unprecise
- Stick movement too abrupt
- Aircraft oscillating vertically

Speed control

Speed changes with the throttle should be done in millimeter steps. If you see the green disappearing, use a very small throttle back and wait on the result. If the green comes back you need a little push forward to stop the movement, but not that much as you had before. The boom can be controlled even with small pitch changes. Since speed changes are very slow, a small pitch down may solve a situation faster. But keep in mind, you probably leave the ideal vertical position.

Common errors:

- Reaction too late
- Throttle input too strong
- Lack of speed prediction
- Left arm cramps

Speed Brakes

Speed Brakes may increase the effectiveness of speed changes but are not useful during air refueling. You will find, that the aircraft overreacts on throttle changes especially when moving the throttle back. Forward movements are more delayed.

Asynchronous engine setting

Some publications recommend to change only one engines throttle for a precise speed control. But even this has a trap door. Every asynchronous setting causes a momentum around the vertical axis. This results in a unwanted lateral movement.

Lost contact

Boom contact may be lost intentionally by pressing the nose wheel button or due to an unusual maneuver. Only if you are in a stable and save position, you may restart to contact immediately. Otherwise, reposition and stabilize the aircraft for the next trial.

If the contact is lost, **you need to reset the aircraft's refueling system**. This is done with the nose wheel steering button. The visual feedback is the control light right of the HUD. It shall show 'ready' before you start to contact the boom again.



Return pre contact

It even may happen that you leave the pre contact box unintentionally or you need too much time for a positive contact. In this case you will receive the order "return pre contact". Now you have to return to the pr econtact position and to report "ready pre contact" by selecting the radio and pushing the F1 key.

End of refueling

If the aircraft is filled up, the tanker reports 'transfer complete'.

- The boom is pulled out from the slip door by the boom controller.
- Reduce the speed immediately and start a smooth descend.
- close the refueling door
- select the radio and press F2. This signals to the tanker that you will leave and the next aircraft may use the service.
- Take the time used and write it in your training diary.

Conclusion

Air refueling cannot be learned from a book only. It needs a lot of practical training to get use to the aircraft control. With the help of your training diary you can track your success. Once you reach times below 10 minutes you will notice, that you do not cramp your muscles anymore. Your biological control circuit becomes autonomic. You do not think anymore about speed and attitude, you simply react. The goal should be an overall time below 5 minutes, from the time on you reach the pre contact position. From that time on you are ready for air refueling in a formation. But be advised, it is an additional stress to practice refueling in a multiplayer mission. You feel closely observed and fall back into beginner failures.

Another experience is, refueling shown in picture below is more comfortable than at 10000 ft.



Figure 15 Refueling after refueling