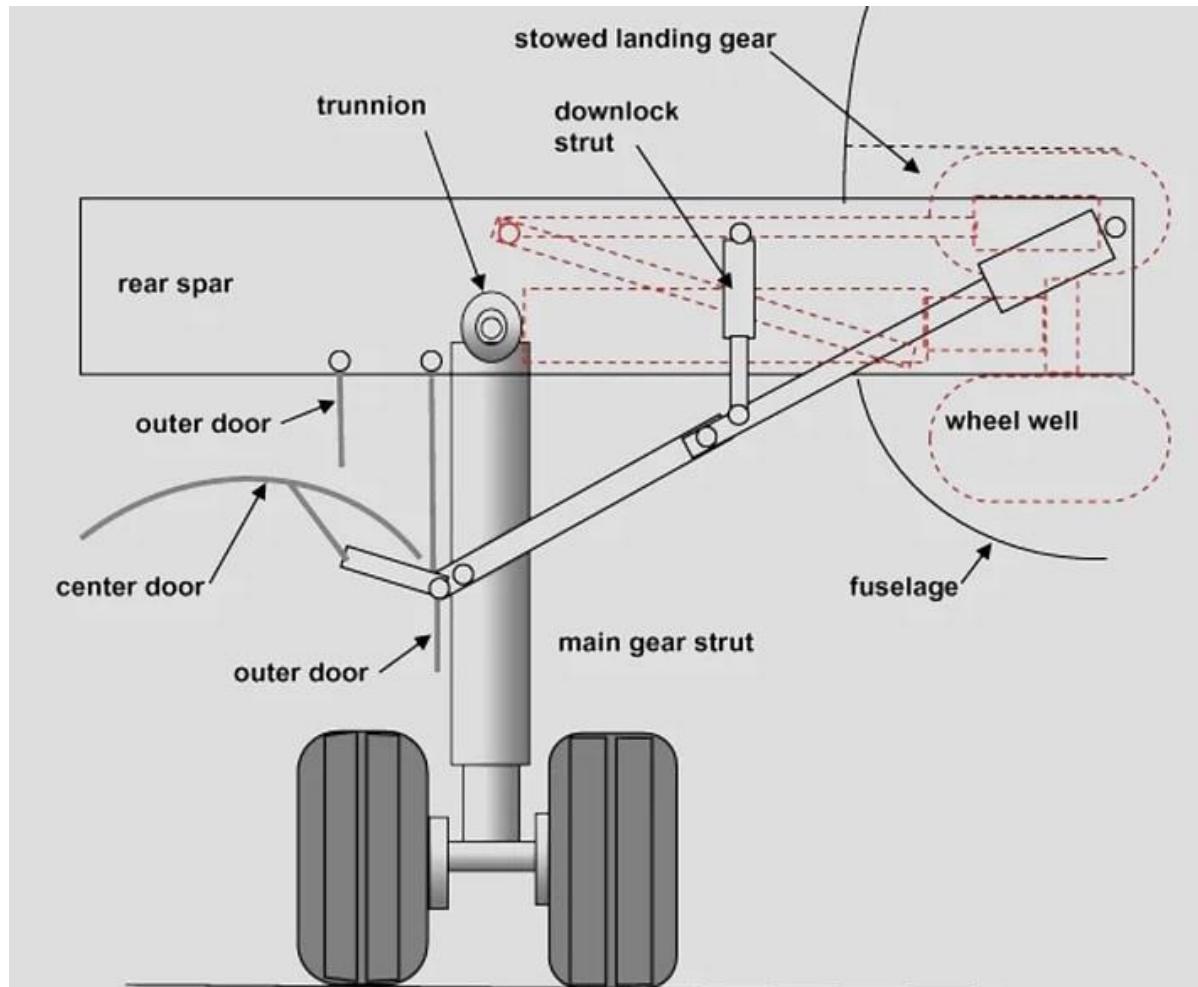


Differences Training:

Vol 2: Retractable Landing Gear



A Study Guide by Steve Pells

Optimised for iPad

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This document is, in no way, a substitute for good instruction from a qualified instructor.

RETRACTABLE UNDERCARRIAGE (LANDING GEAR)

The purpose of this document is to provide guidance and background information for pilots who already hold as SEP (Land) rating, and wish to undertake differences training to allow them to fly aircraft with the following characteristics:

- Variable Pitch Propeller
- **Retractable Undercarriage**
- Turbo or Supercharged Engine
- Electronic Flight Instrument System (EFIS)
- Single Lever Power Control (SPLC)
- Tail Wheel

1: Rules & Regulations:

Differences Training should be conducted by the holder of an appropriate instructor rating who meets the following requirements:

- (a) Hold a valid Flight Instructor or Class Rating Instructor qualification (SPA) for the aircraft on which the training is to be carried out.*
- (b) Hold a valid Type/Class Rating applicable to the particular aircraft to be flown.*
- (c) Have completed their own Differences Training to fly the particular aircraft on their own licence.*

Upon completion of Differences Training, and when the instructor is satisfied that an acceptable level of competency has been achieved, the pilot's logbook or equivalent document should be annotated to show successful completion and be signed by the instructor who conducted the training.

The Differences Training certification is recommended to take the following format and should include the Type or Class Rating designation of the Aeroplane;

Date	Certified Differences Training In:	Signed	CAA Reference Number														
	Example:- Single Power Lever Controls SE Piston (Land) Name	<table><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td colspan="7"></td></tr></table>														

Date	Certified Differences Training In:	Signed	CAA Reference Number														
	Example:- Manual Engine Controls Turbocharged Engines ME Piston (Land) Name	<table><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td colspan="7"></td></tr></table>														

There is no test, as such, and for single-engine aeroplanes, this is a one-time sign-off that never expires. It is valid for 2 years on multi-engined aeroplanes.

If it has been a while since your last flight in such an aircraft, a review of procedures, or a flight with an instructor is recommended.

PART-FCL: Differences Notes & Syllabus for Retractable Undercarriage:

NOTE: Differences Training completed, for this section (retractable undercarriage), on an SEP aeroplane, does provide equivalent qualification on MEP aeroplanes and vice versa.

Theoretical Knowledge Topics:

All Aeroplanes:

Principles and effect on performance;

System construction and function;

Limitations – raising, lowering and extended.

Operation including pre-flight checks and normal handling:

After take-off & On approach/go-around and landing.

In-flight system failures and emergency lowering.

Operation of undercarriage during: Engine failure after take-off/go-around (Emergency raising – as applicable to type) & Engine failure during other phases of flight, including approach and landing.

Effect on glide performance.

Considerations for MEP Aeroplanes:

Effect on performance – one or more engines inoperative.

Handling during approach and landing/go-around with one or more engines inoperative.

Effect on engine out allowance and landing committal height.



2: Introduction:

Throughout this section, reference will be made to the undercarriage system and speed limits that apply to Piper PA28R-201 Arrow III, such as G-CBZR and G-OARU, but the principles for other aircraft are similar.

In order to reduce drag and allow the aircraft to cruise faster and burn less fuel, some aircraft are equipped with retractable landing gear. The operation of the undercarriage system is rarely complicated, but the consequences of getting it wrong cannot be overstated.



Although gear-up landings are rarely fatal in light aircraft, they are always expensive and highly embarrassing for the pilot.

To be honest, there is really only one rule when it comes to flying aircraft with retractable landing gear:

Make Sure the Gear is DOWN for Landing!!!

It sounds obvious, but it continues to happen on a regular basis worldwide.

Not only this, but sometimes the gear is retracted on the ground by accident. Usually, there is some kind of a guard on the switch to prevent inadvertent retraction, and usually a 'weight on wheels' sensor prevents operation of the gear on the ground. But these systems do fail. The best practice is to be very careful when getting in and out of the aircraft, so that you do not accidentally knock the gear lever. Also, never touch it on the ground. Some people check the gear lever is down, and then touch the lever to verify its position. Best practice suggests just looking at it and only touching it in the air when the time comes to retract it.

3. Landing Gear Retraction:



Placard speeds for an Arrow III

Usually there are airspeed limits for the retraction and lowering of the gear, and these 2 limits are often different. Sometimes there is a third limit, a maximum airspeed with the gear lowered. These limits are often placarded next to the gear lever.

Usually the gear retraction limit is the lowest, for example in the PA28R-201 Arrow III the maximum gear retraction speed is 107 KIAS. Above this speed the gear must not be retracted. Should this situation occur, simply raise the nose to reduce airspeed below the limit and then retract.

The maximum speed for gear lowering in this aircraft is 129 KIAS.

The maximum speed with the gear down is also 129 KIAS.

The next question is when do we retract the gear? The best answer is 'when we no longer require it'.

Do not be in a hurry to retract the gear after take-off. Should sink be encountered, or an engine failure occur immediately after rotation, you will be glad to have the gear down. Once there is no longer sufficient runway remaining to land back on in case of need, then we can retract the gear.

Usually, before retracting the gear, it is good practice to apply the brakes first, to stop the main wheels from spinning.

To retract the gear, there is usually some kind of latch to be moved to allow the lever to move. On the Arrow, you pull the lever towards you and then move it to UP. On aircraft such as the Bonanza, there is a sliding latch under the switch that need to be moved.

On the Arrow, there is a red gear unsafe light above the AI/Horizon, and a loud horn that operate together while the gear is retracting. Once retraction is complete, the light goes out and the horn silences. The 3 green lights go out.

On the Mooney, there is only one light for gear down, and another for gear up. These is also a floor mounted sight window which displays the word UP or DN.



A special note about the Piper Arrow:

The design of the aircraft includes an automatic dimming of the 3 green gear position lights. Whenever the NAV lights are turned on, the 3 green lights dim. This makes them perfectly visible at night, but during the day, you would swear that they are not illuminated. This has caused numerous Arrow pilots to declare emergencies, thinking that the gear has failed to extend. If you ever find a situation in such an aircraft when all 3 green lights appear to be out, check the NAV light switch first!

Also, in the Arrow, and some other Piper aircraft too, the 3 square green gear position lights can be swapped over. This is to allow you to check that the gear is down when a bulb has failed. Let's say that when you lower the gear you only get 2 out of the 3 lights. Simply pull out the unilluminated green square and one of the others that was working. Then put them back in the other way round. If the same light fails to illuminate, then you may have a problem.



4: Landing Gear Warnings:

Most aircraft are equipped with a system to warn the pilot in case (s)he forgets to lower the gear. These are not failsafe and should never be relied upon. As well as providing useful warnings, they frequently occur as nuisance warnings as well. For example, in the Arrow:

a: Low power: If the power is reduced to idle, with the gear up, regardless of flap position, the gear unsafe light and horn will sound continuously. This means that in a descent, in order to get rid of the noise, you will have to add a little power (or lower the gear)

b: Landing Flaps: If more than Flap 10 is selected (i.e. 2 or 3 notches of flap) with the gear up, the warnings occur again. This can be a nuisance when taking off from a grass field with flap 25. Once airborne, you retract the gear. The warning will then sound continuously until the flap is retracted to 10 or less.

c: Gear Selector UP on the ground with the throttle at idle.

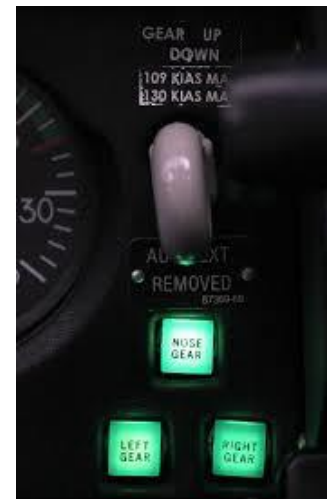
NOTE: These warnings usually require the Battery Master Switch to be in the **ON** position.

Auto Extension Feature:

As a result of several gear-up landings in the early days, some aircraft manufacturers, in an attempt to reduce mishaps, added a Gear Auto Extension Feature.

This was common on many Piper Arrow aircraft. Basically, once the aircraft reduced speed below a set limit, the gear would automatically extend, thus eliminating accidents. However, this made life very difficult for training. Every time you practiced slow flight, or stalling, the gear would fall out. So, many operators have inhibited this feature.

No aircraft in the Blackbushe Flying Group currently has this feature enabled.



After landing, never be in a hurry to retract flaps, or switch off other items such as pitot heat. You could inadvertently retract the gear by mistake. Never do any of these actions while still on the runway. Vacate the runway and stop before moving any critical switches.

6: Normal Gear Extension:

When it's time to land, obviously we need to lower the landing gear. But when is the best time to do this?

If the circuit is busy with slower aircraft, it can sometimes be useful to lower the gear early. The gear produces quite a bit of drag, and can be useful in slowing you down, or getting you down if you are a little high.

However, the most usual place to take the gear is downwind. I suggest starting your pre-landing checks by lowering the gear. Always remember the gear lowering speed limit! I always wait until I have the correct gear down indication before moving on to other checklist items, because the check that it's down and locked can be missed otherwise.

A real danger occurs when you don't have a downwind position to trigger the lowering of the gear, for example if you join on base or on a long final. That is why, once established on short finals, we should always do our **Red, Blue, Green Checks**:

- REDS Mixture(s) Fully Rich
- BLUES Propeller(s) Max RPM
- GREENS Gear Down, 3 Greens



The landing gear switch and landing gear indication system in a Beechcraft Duchess Be-76 aircraft. Note the 'Gear in Transit' light.



5: Emergency Landing Gear Extension:

Most light aircraft have gear that is controlled by a system of electrical signalling and hydraulic actuation. Should any of these systems fail, there is usually an emergency gear extension system which allows the gear to drop by gravity. Usually once lowered by such a system, the gear cannot be retracted again.

In the Arrow, there is a small lever below and at the front of the flap lever quadrant.

Emergency Landing Gear Extension

- Auto extension lockout pin must be pulled out to allow automatic or manual emergency gear extension to work
- Gear will automatic extend when speed is 87 KIAS or below
- To manual lower gear if normal system is not working, push and hold the emergency gear lever switch down towards the floor
- Extension is accomplished by manually releasing hydraulic pressure; gear free-falls; nose gear is assisted in free-fall/lock by a spring
- If gear does not indicate down and locked, yaw the airplane side to side



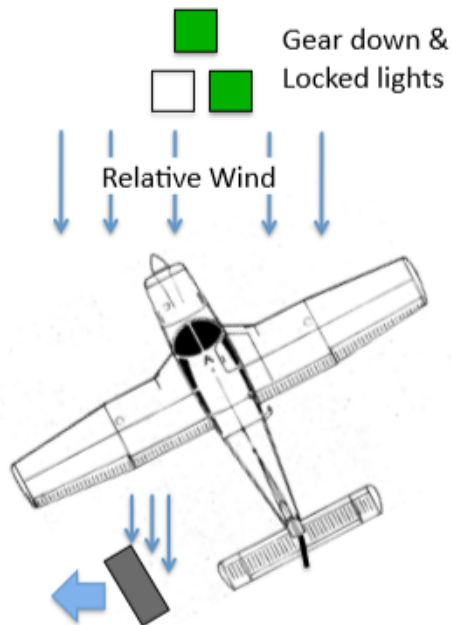
Auto Extension
Lockout Pin

Emergency Gear
Lever

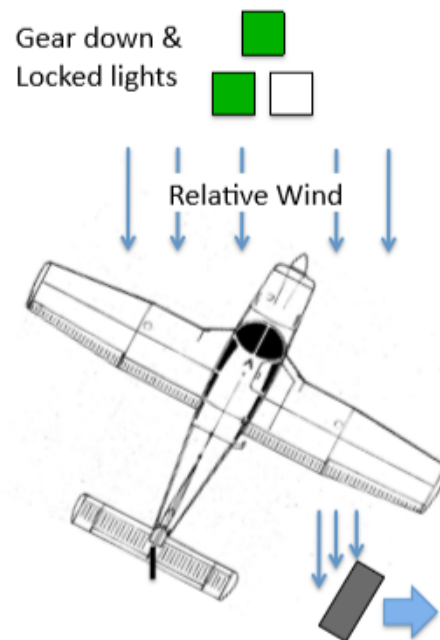
If the emergency lowering is required, don't try to remember the checklist. Get the checklist out and go through it carefully. It's not a time critical situation.

Part of the Emergency checklist suggests yawing the aircraft with rudder if necessary, to help lower the gear.

YAW Aircraft to help move gear down to down and locked position



If Left gear not down; Yaw to the left



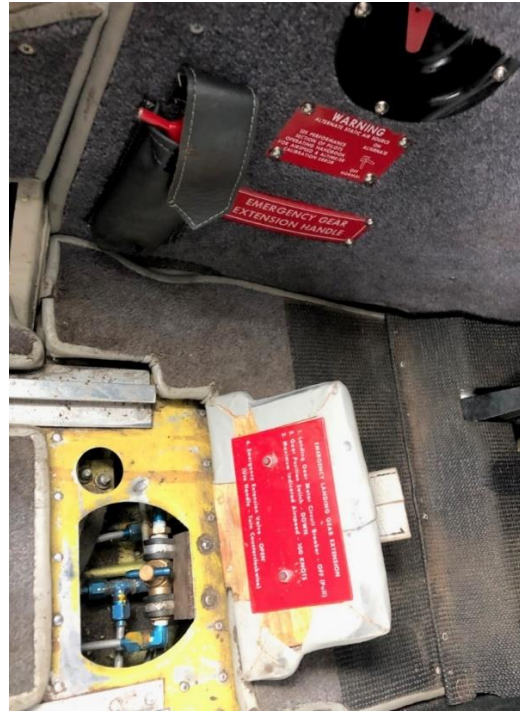
If Right gear not down; Yaw to the right

In the Mooney, a safety latch at floor level at the front of the passenger cabin has to be moved, to allow a handle to be pulled up to 20 times to allow the gear to fall.

On the Beechcraft Duchess Be-76 aircraft, a special tool is used to operate the emergency landing gear extension system, which is located under a flap between the pilot's feet. Obviously, following the pre-flight check should make sure the tool is on board!



Be-76 Gear Tool and its stowage in the cockpit. Access to the operation mechanism is under a flap at floor level. Operating instructions are also provided.



Typical emergency checklist shown below:

PA28R-201 ARROW III: EMERGENCY LANDING GEAR EXTENSION

Prior to emergency Extension Procedure:

1. BATT MASTER/ALT Switch **CHECK ON**
2. Circuit Breakers **MONITOR**
3. NAV Light Switch **OFF (In daytime)**
4. Gear Indication Bulbs **CHECK**
 - If landing gear does not check down and locked:
1. Airspeed **REDUCE BELOW 87 KIAS**
2. Landing Gear Selector Switch **GEAR DOWN POSITION**

- If gear has still failed to lock down, move and hold the emergency lever down to the Emergency Down Position.
- If gear has still failed to lock down, yaw the airplane abruptly from side to side with the rudder.

6: Engine Failure & Forced Landings:

If an engine fails, pilots who already have an SEP (land) class rating, will be familiar with PFLs (Practice Forced Landing). With a retractable geared aircraft, there are a couple of new considerations. First, if the engine fails with the landing gear in the UP position, the Gear Unsafe warning is likely to sound continuously until the gear is lowered. This can be highly distracting, but lowering the gear too early, greatly reduces your gliding range. A decision needs to be made as to when to lower the landing gear (if at all).

The following is from the PoH for the Arrow:

Whether to attempt a landing with gear up or down depends on many factors. If the field chosen is obviously smooth and firm, and long enough to bring the plane to a stop, the gear should be down. If there are stumps or rocks or other large obstacles in the field, the gear in the down position will better protect the occupants of the aircraft. If, however, the field is suspected to be excessively soft or short, or when landing in water of any depth, a wheels-up landing will normally be safer and do less damage to the airplane.

Touchdown should normally be made at the lowest possible airspeed.

7: Suggested Flight Profile for Training

A typical training flight will involve:

- External Checks to include undercarriage bays and services
- Familiarisation of the cockpit controls and indicators.
- Airspeed Limitations for operation
- Take off and gear retraction
- A look at the Gear warnings
- Practice using the Emergency Gear Lowering Procedure alongside the aircraft checklist.
- Practice Forced Landing (PFL) to highlight differences and show glide range
- Return to the airfield for touch and go training.

8: Suggested Circuit Profile for PA28R-201 Arrow 3

Suggested Circuit Profile for PA28R-201 Arrow III

