Podcast 012 – Landing Gear

Hello everyone and welcome to this week's edition of the 737 Talk where we will once again be getting technical. Today we will be discussing the landing gear system and its operation which will include a look through the various braking options the 737 provides us with. So, without further ado let's get into it for some knowledge refreshment and hopefully maybe even a little expansion.

We hope you are enjoying listening to the podcasts as much as we're enjoying producing them. We're certainly doing plenty of learning along the way so hopefully a little will be rubbing off on you too.

Anyway, back to that Landing Gear. The 737 has two main landing gear and a single nose gear. Each gear has a conventional 2-wheel gear unit giving us 6 tires total, with the nosewheel gear being steerable.

Hydraulic power for extraction, extension and nose wheel steering is normally supplied by the A system. A manual gear extension and an alternate source for NWS are also provided.

The normal brake system is powered by the B for Brakes hydraulic system with the A for "Alternate" brakes using the A Hydraulics. Antiskid is provided on both brake systems, with a slight difference we'll cover later, but the autobrake is only available with the normal brakes system.

We normally control the landing gear operation through the Landing gear lever. When we are on the ground, a landing gear lever lock prevents inadvertent raising of the gear. An override lever may be used to bypass this lock but when inflight the air/ground logic energises a solenoid which opens the lever lock.

Let's talk about the retraction process. When you move that gear handle to up it operates a landing gear selector valve by cable assembly. This valve is commanded to DOWN, UP or OFF dependant on gear lever selection. This will pressurise the extend or retract lines or depressurise the gear system. On UP selection the brakes then automatically stop rotation of the main gear wheels. After retraction, by Hydraulic system A pressure, the main gear is held in place by mechanical uplocks. Rubber seals and oversized hubcaps complete the fairing of the outboard wheels.

The nose wheel retracts forward into the wheel well where rotation is stopped by snubbers. The nose gear is held in place by an overcentre lock and enclosed by doors which are mechanically linked to the gear. A couple of limitations to mention here are that Max tire speed is 195kts and max retraction speed 235kts.

If a main tire is damaged during take-off, it is possible that braking during retraction may be affected. The spinning tire with loose tread is stopped prior to entering the wheel well by a frangible fitting on the outboard side of both wheel well rings. On impact with this fitting up pressure is removed from the main landing gear actuator and that wheel free falls down to prevent wheel well damage. The affected gear cannot be retracted until the fitting is replaced.

Another system that can aid in gear retraction is the landing gear transfer unit or the LGTU. This is a backup where Hydraulic system B pressure is used. System B provides the volume of fluid required to raise the gear at the normal rate on loss of the system A engine driven pump. We would all have experienced this for example on a number 1 engine failure on take off in the simulator, some of us perhaps for real. For the LGTU to take over the following conditions are required. The air/ground sensors sense airborne, No1 engine RPM drops below 50%, the gear lever is positioned up and either main gear is not up and locked.

As we're talking about the LGTU system we'll also mention the Alternate nosewheel steering here. When the airplane is on the ground the LGTU system supplies Hydraulic B pressure to the NWS when the NWS switch is placed in Alternate as long as you have at least 21% Hydraulic B quantity.

So that's retraction, how about extension. Well, normal extension is achieved by moving that gear lever to the down position and hydraulic A pressure is then used to release the uplocks. Extension is then achieved through hydraulic pressure, gravity and air loads. Overcentre mechanical and hydraulic locks hold the gear at full extension with the nose wheel doors remaining open when the gear is down.

The other way we have to lower the gear is through Manual extension in case of the loss of System A. Manual gear releases in the flight deck are used to release the uplocks and allow the gear to free-fall to the down and locked position using gravity and air loads. These 3 releases, one for each gear which are to be pulled to their limits of 61cm, are located on the floor behind the central pedestal on the FO's side.

With the manual extension access door open manual extension is possible with the gear lever in any position. You can still drop the gear if system A is serviceable using the normal means with this door open, however you cannot retract the gear. So' if after getting airborne you can't retract the gear it is always worth checking the access door position.

Following a manual extension, it is still possible to retract the gear but only if system A pressure is available. You would need to close the access door, put the gear lever to the down position and then position the lever to UP.

Your landing gear lights indicate a few things to you. Red lights could mean either the gear is not down and locked below 800ft AGL or the gear is in disagreement with the gear lever, or they indicate transit or an unsafe condition.

The green lights, of which you have two sets, 1 on the aft overhead and one on the centre panel, indicate the gear is down and locked. If one landing gear does not illuminate on one panel but shows green on the other the gear is down and locked.

Before we get into the brake system lets sweep up on something I mentioned earlier, NWS. We talked about the alternate system so let's talk about the main. It is powered by Hyd A as

I'm sure you'll remember from our hydraulics podcast, if not why, not give episode 6 another listen! NWS is available when the gear is down and compressed by airplane weight. Positioning the gear lever down makes system A pressure available to the steering metering valve.

Steering input from the tiller always overrides rudder pedal inputs. The tiller provides 78° of steering compared to the rudder pedals 7° and this pedal steering is deactivated as the nose gear strut extends. When towing the NWS system is deenergised by a lock out pin installed in the towing lever, keeping it in the tow position which allows for pushback without deenergising the hydraulic systems.

Onto brakes then. Each main wheel has a multi-disc hydraulic powered brake, there is no braking on the nosewheel. There are two types of material used for the brakes, steel or carbon with different techniques used on each. Intermittent braking should be avoided on Carbon brakes to prevent excessive wear but this type provides large efficiency savings including weight, high temperature stability and the ability to refurbish the carbon discs. Brake wear indicators pins are provided and show how much wear is remaining for each brake. When the parking brake is set, and the indicator is flush with the brake housing it needs to be replaced.

The foot pedals provide independent control of the left and right brakes providing a manual braking system. The 737 also offers automatic braking through the auto brakes or gear retract system.

The whole system is devised of the normal brake system, the alternate brake system, brake accumulator, antiskid protection, the autobrake system and the parking brake. We'll give a brief run through of them all for you then take a break… sorry.

The normal brake system is powered by the B system, again that should be familiar from podcast 6, with the alternate system run by Hydraulics A. If the B system is low or fails, system A automatically supplies pressure to the alternate brake system.

The brake accumulator is pressurised by system B and if both normal and alternate systems are lost the accumulator provides trapped hydraulic pressure for several braking applications or parking brake application.

In regard to the antiskid system, it is provided for all types of braking, normal, alternate and accumulator. Both the normal and the accumulator system provide anti-skid for each individual wheel with the alternate system providing it for wheel pairs.

When the system detects a skid, the associated anti-skid valve reduces braking pressure until skidding stops. Both normal and alternate brake systems provide skid, locked wheel, touchdown and hydroplane protection. Even with no AC power you will still get anti-skid protection on the inboard main wheels from the battery bus power source. If you get an anti-skid inop light however the system has failed, and you will also lose the autobrakes too. This could be for a number of reasons including a parking brake valve disagree as this is essential for antiskid function.

Right, the autobrake system is next. Here we use hydraulic B pressure to provide maximum deceleration for rejected take off as well as automatic braking at preselected declaration rates after touchdown. We can select 1,2,3, Max or the aforementioned RTO. Autobrakes will start on landing when wheel spin up is sensed and both thrust levers are at idle. You can select them on the landing roll as long as it's done prior to 30kts. The max selection will still be less than max manual braking on dry runways.

RTO mode can only be selected on the ground with the antiskid and autobrake systems operational. When we select RTO, we will get an auto brake disarm light for one or two seconds indicating a successful self test.

If the take off is rejected prior to 90kts autobraking is not initiated and the Autobrake disarm light will not illuminate. If the reject occurs after 90kts max braking is applied automatically when the thrust levers are retarded to idle. If you leave the selector in RTO after getting airborne and land with it still in that position you won't get any automatic braking and the autobrake disarm light will illuminate two seconds after touchdown.

To maintain the selected deceleration rate, autobrake pressure is reduced as other contributors to braking are applied such as reverse thrust and spoilers. You can change the deceleration by rotating the selector. The autobrake system will bring the airplane to a complete stop unless the pilot intervenes by either moving the speedbrake lever to down, advancing the thrust levers except during the first three seconds of landing, or applying manual brakes. All these will illuminate the autobrake disarm light. The other way is rotating the selector to off which will not illuminate the light.

From our list we're now down to the parking brake but we will mention a couple of other things too so bear with us. The parking brake can be set with either A or B hydraulics pressurised. If A and B are not pressurised parking brake pressure is maintained by the accumulator with that pressure being shown on the HYD BRAKE PRESS indicator.

We set the parking brake by depressing both brake pedals fully simultaneously pulling the Parking brake lever up. This mechanically latches the pedals in the depressed position and closes the parking brake valve. Parking brake hold time with a fully charged 3000PSI accumulator is approximately 8 hours.

After an RTO it is advised that unless necessary do not set the parking brake as very hot surfaces may blend together. Talking of hot brakes, each wheel has 4 thermal fuse plugs to prevent tire explosion from expending gases inside the tire. Fuse plugs will melt and deflate the tire completely at high temperatures. It is important to know here that thermal fuse plugs may take up to 40mins after a high energy stop to melt.

As an option a brake temperature monitoring system is available with indications shown on the lower DU system page. The scale is from 0.0 to 9.9 which represents 38°C/100F to 650°C or 1200F. A brake temp light will illuminate over 5 units which is 340C or 645F and the temperature indication will turn amber.

The last couple of things to mention are the air/ground sensors and the landing gear pins. The 737 has an air/ground system comprising of six sensors, two on each landing gear. This system is used to configure the airplane systems to the appropriate air or ground status. Each sensor monitors weight on wheels and sends the signal to the PSEU. If there is a discrepancy between the sensors the PSEU light will illuminate on the ground only.

Finally, to the gear pins. These are used to prevent the downlock mechanism from disengaging on the ground allowing safe maintenance action or airplane towing.

So there it is, we're off for that previously mentioned well-earned break now but if you have the energy left to do so then please head over and continue the Talk at our social media pages. We're over on facebook under 737 Talk. twitter @737Talk and you can also sign up to our newsletter over on the website www.B737Talk.com where you will get a sneak preview at what is coming up and any future competitions we're hoping to run.