EYIC

A350 – ATA 32 Landing Gear

Presented by
Brian Endersby / Manager Systems

AIRBUS

Technical Brochure Contents

Technical Brochure Contents

Landing Gear Function

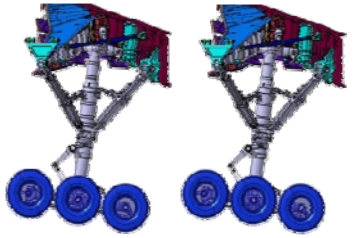
- Transmission of loads to the aircraft structure during:
  - landing
  - take-off
  - taxi
- Distribute aircraft loads on the pavement
- Manoeuvre the aircraft when on ground
- Decelerate aircraft or maintain stationary
- Minimize aerodynamic drag in flight
- Ensure passenger comfort

Design Weights

A350-800 design weight in tons		
MTOW	MLW	MZFW
248	190	178

A350-900 design weight in tons		
MTOW	MLW	MZFW
268	205	192

A350-1000 design weight in tons		
MTOW	MLW	MZFW
308	233	220



Aircraft Pavement Loading

A350 XWB Aircraft Classification Numbers (ACN) *

	Flexible Pavement				Rigid Pavement			
	High	Medium	Low	Very Low	High	Medium	Low	Ultra Low
	A	B	C	D	A	B	C	D
A350-800	63	67	76	104	60	66	77	90
A350-900	66	70	80	110	64	71	83	96
A350-1000	54	60	73	103	55	69	88	108

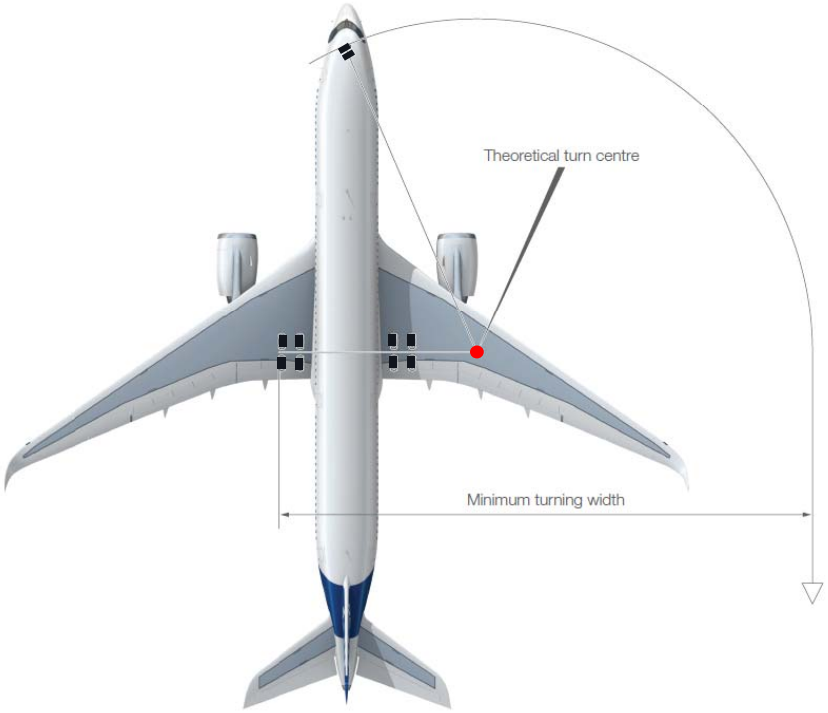
* Values are given foe a specific MTW (Max Taxi Weight), CG (Max aft. CG position) & tire pressure (loaded)

** Flexible pavement ACN's are based on the approval of the ICAO aerodrome panel / December 2006

Assumptions				
		A350-800	A350-900	A350-1000
MRW	[kg]	**259900**	**268900**	**308900**
MTOW	[kg]	**259000**	**268000**	**308000**
Max aft CG	**%**	**35**	**33**	**34**
% Weight on MLG	**@ max aft CG**	92.849	93.683	94.223
Loaded Tyre Pressure	**Kpa**	**1590**	**1660**	**1500**

Minimum Turning Width

	A350-800	A350-900	A350-1000
Minimum turning width	46.0m (150ft 11.0in)	51.0m (167ft 3.9in)	56.0m (183ft 8.7in)



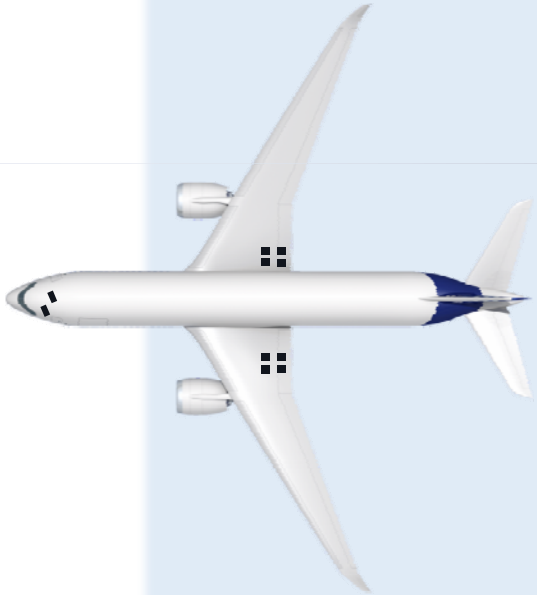
Aircraft conditions:

- Symmetric thrust ,and
- no braking

Minimum turning widths are still under review.

Final values will be published in the Aircraft Characteristics for Airport Planning document

Nose & Main Landing Gears

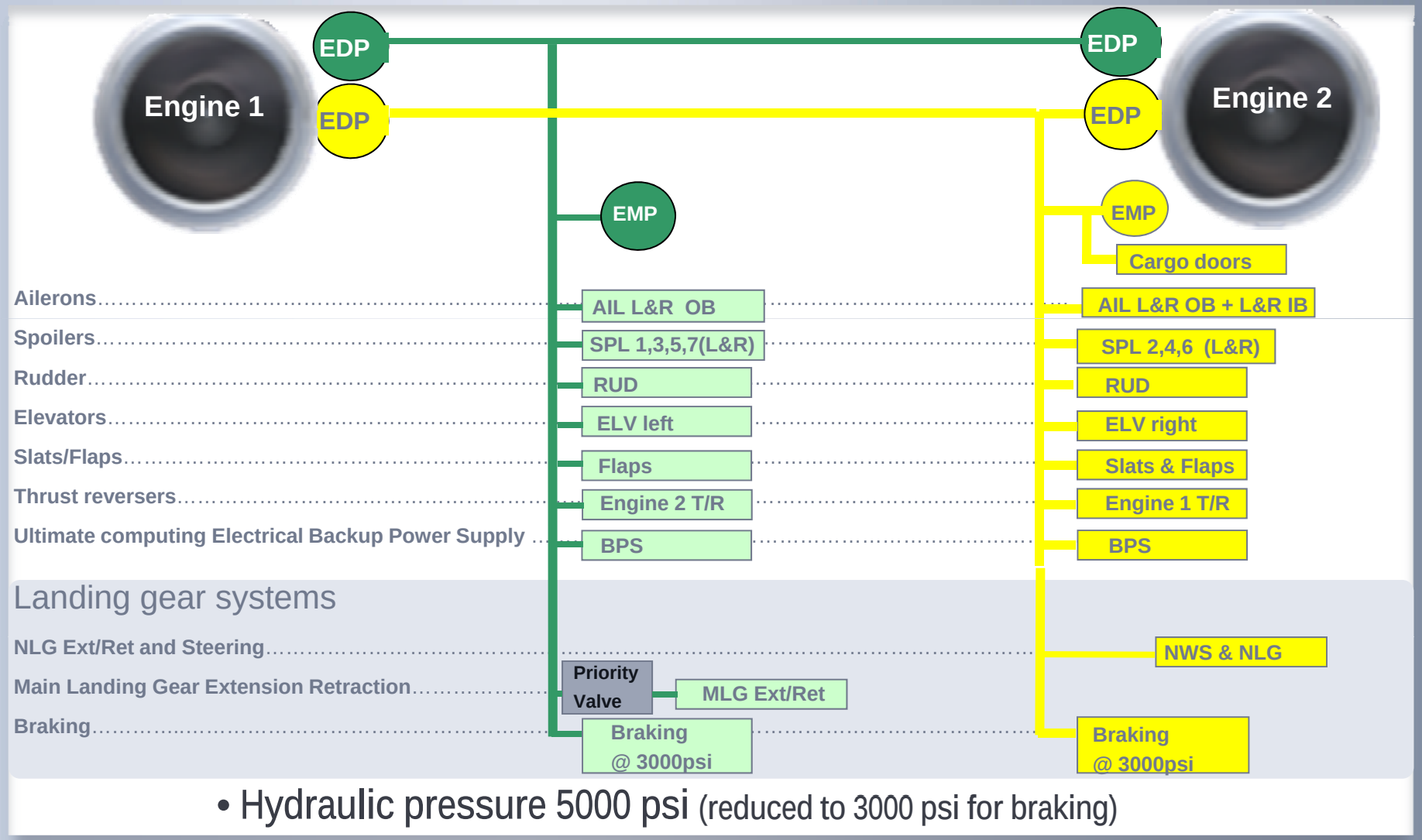


- Nose landing gear plus two main gears (main gears are either 4 or 6 wheel bogies)

Technical Brochure Contents

Technical Brochure Contents

Hydraulic Power

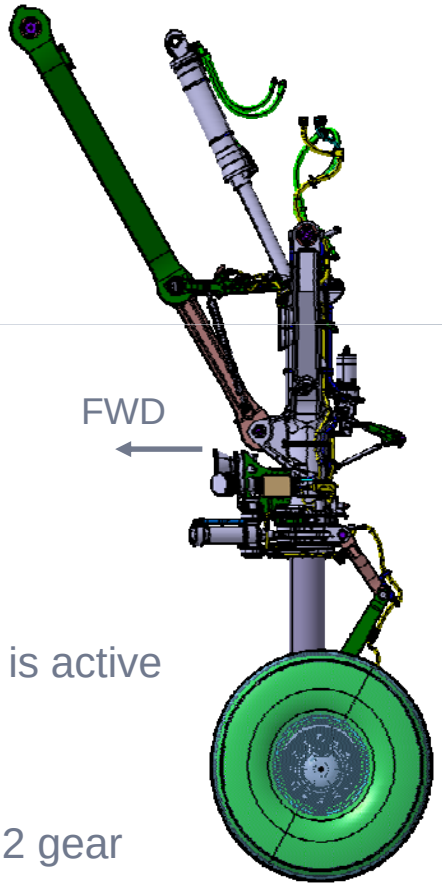


- Hydraulic pressure 5000 psi (reduced to 3000 psi for braking)

Technical Brochure Contents

Nose Landing Gear

- Pull-to-retract actuator
- Push/pull hydraulic steering
- 300M (steel alloy) main fitting
- 300M (steel alloy) single forged sliding tube & axle
- Single stage oleo
- Zero rake angle relative to fuselage datum
- 2 wheels, 1050x395 R16 28PR tires
- Hydraulic unlock actuator
- Hydraulic control unit
  - Enables passive steering
  - Provides shimmy damping
  - Provides protection against towing damage when steering is active
- Forward tow fitting
  - aft fitting offered as option
- 4-door concept with 2 main doors independently actuated and 2 gear driven doors



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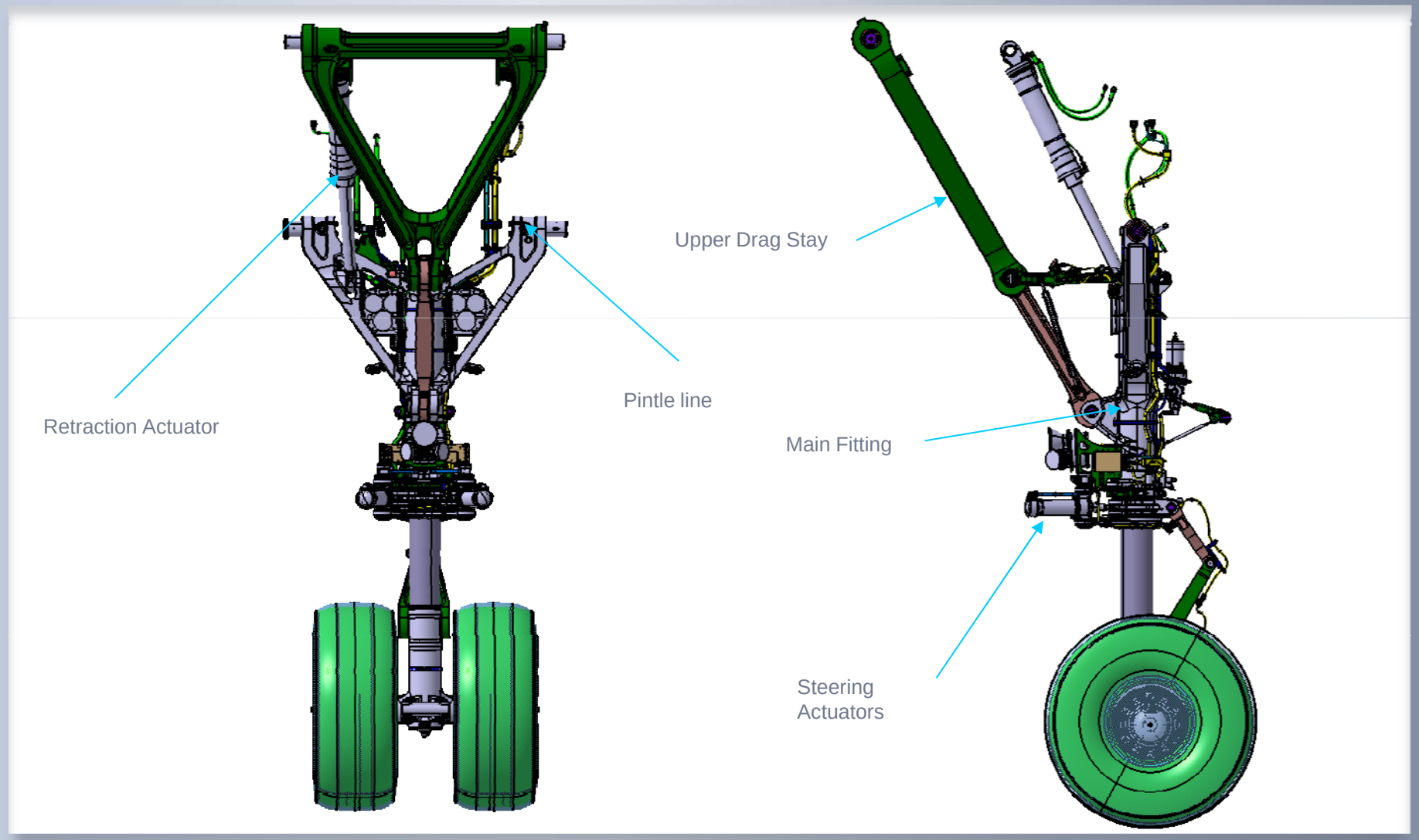
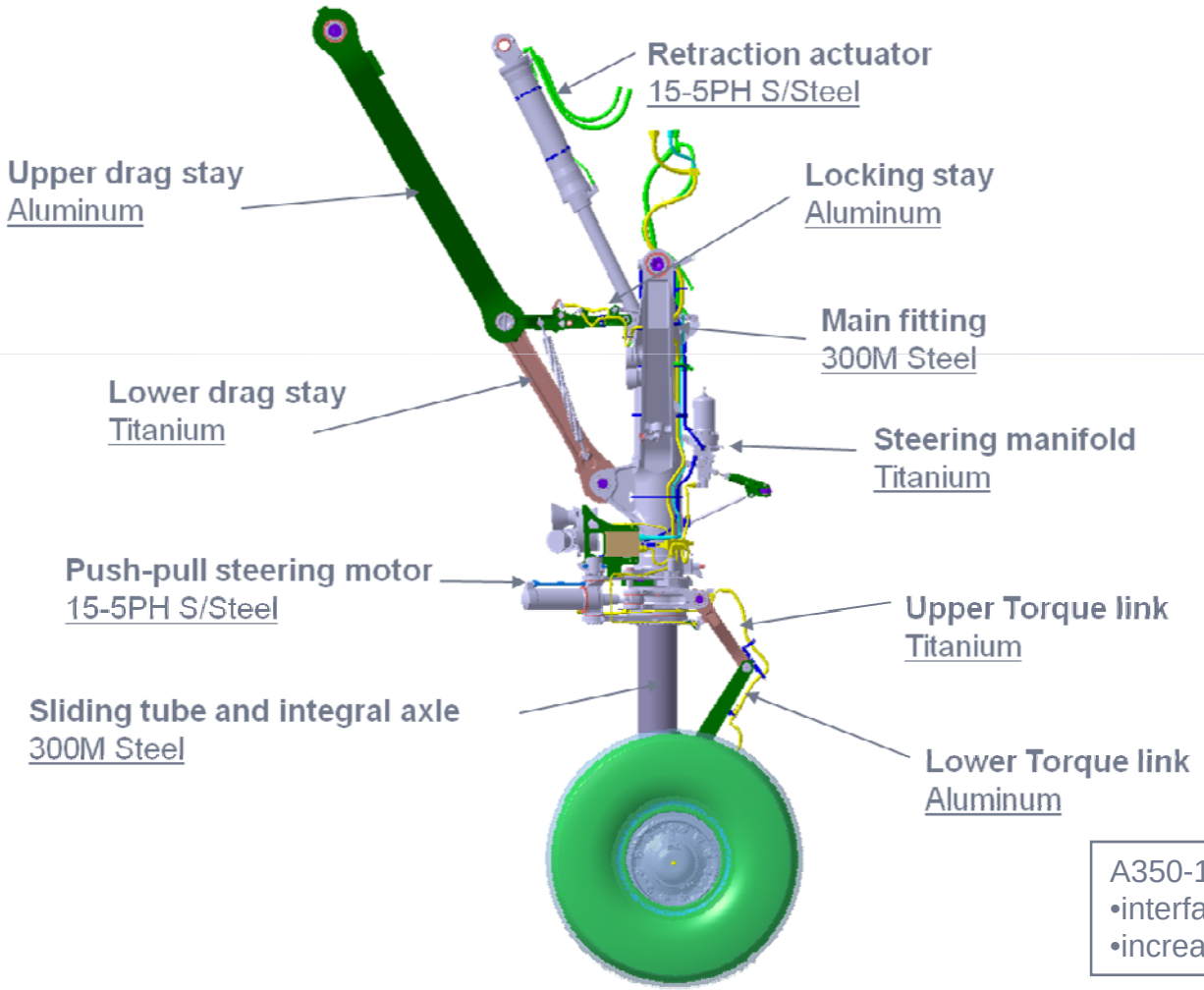
Nose Landing Gear



Nose Landing Gear Material A350-800/900

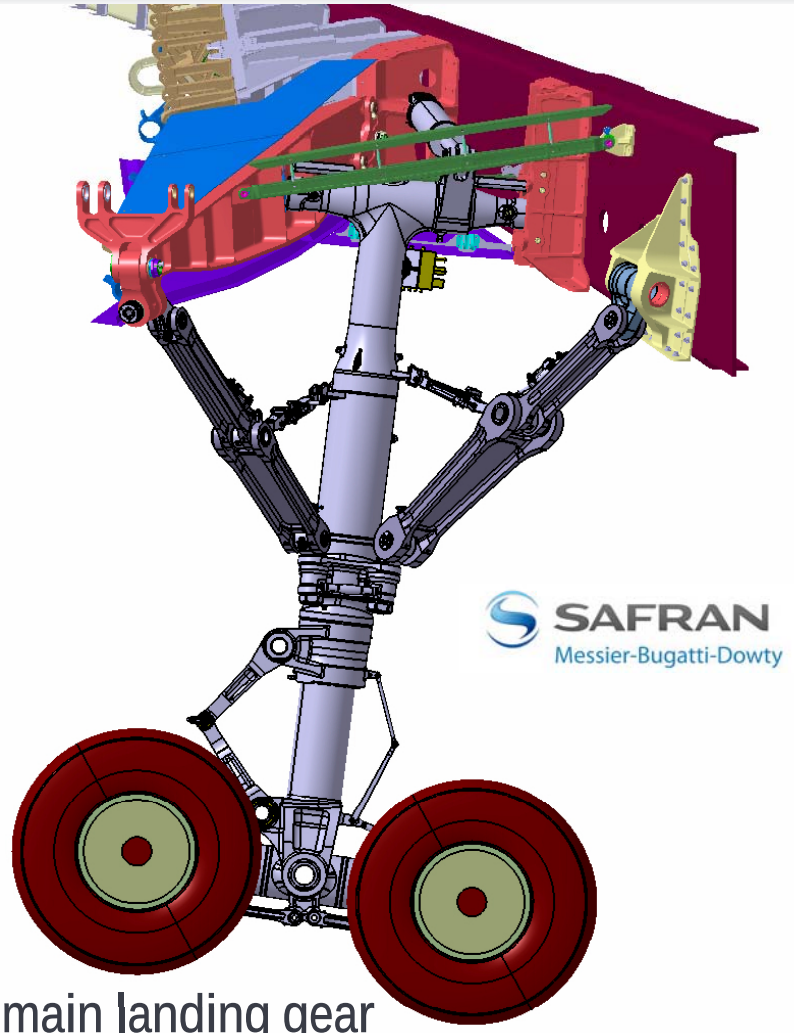


A350-1000
- interfaces will not change
- increased use of titanium

Technical Brochure Contents

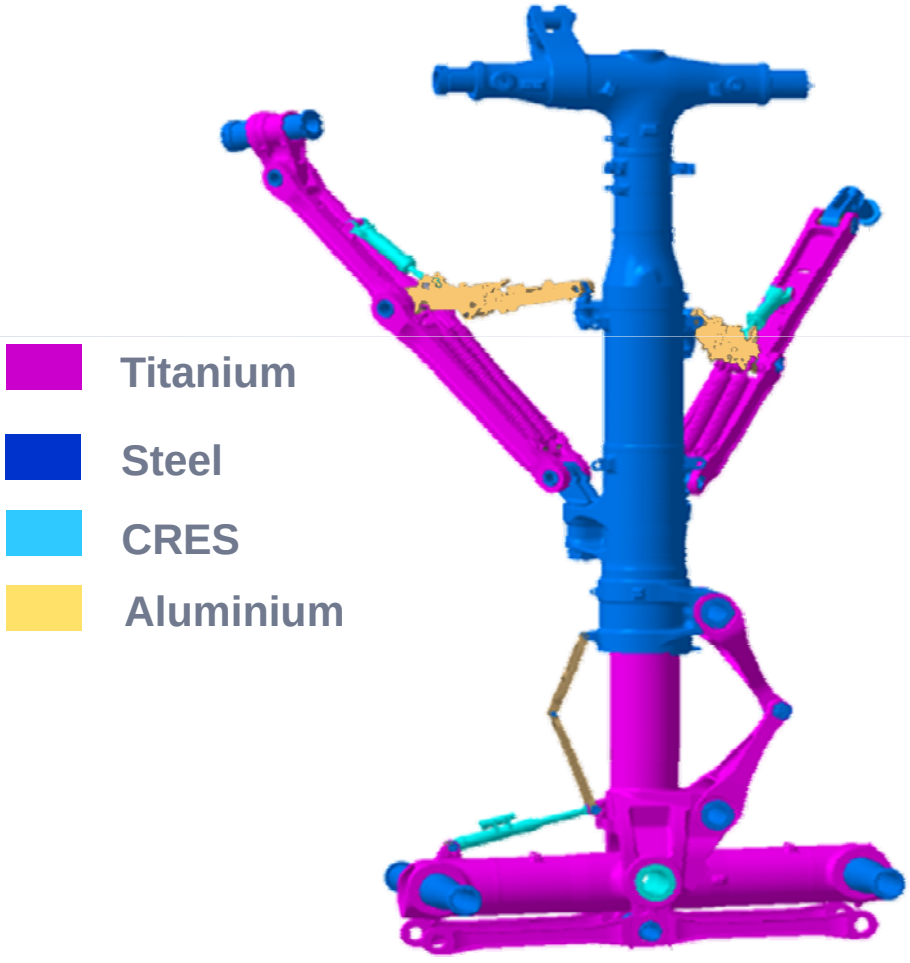
Main Landing Gear - A350-800 & 900

- Double side-stay, with gear beam
- Single stage oleo
  - Unseparated gas and oil
  - Metering pin
- Bogie beam
  - 4 wheels, all braked
  - Brake rods below bogie
  - Hydraulic pitch trimmer (single-acting)
- Hydraulic retraction actuator (double-acting, pull to retract)
- Hydraulic lock stay actuators
- No steering
- No shortening mechanism
- On ground detection via bogie position / rotation
- Weight on wheels detection via shock absorber closure



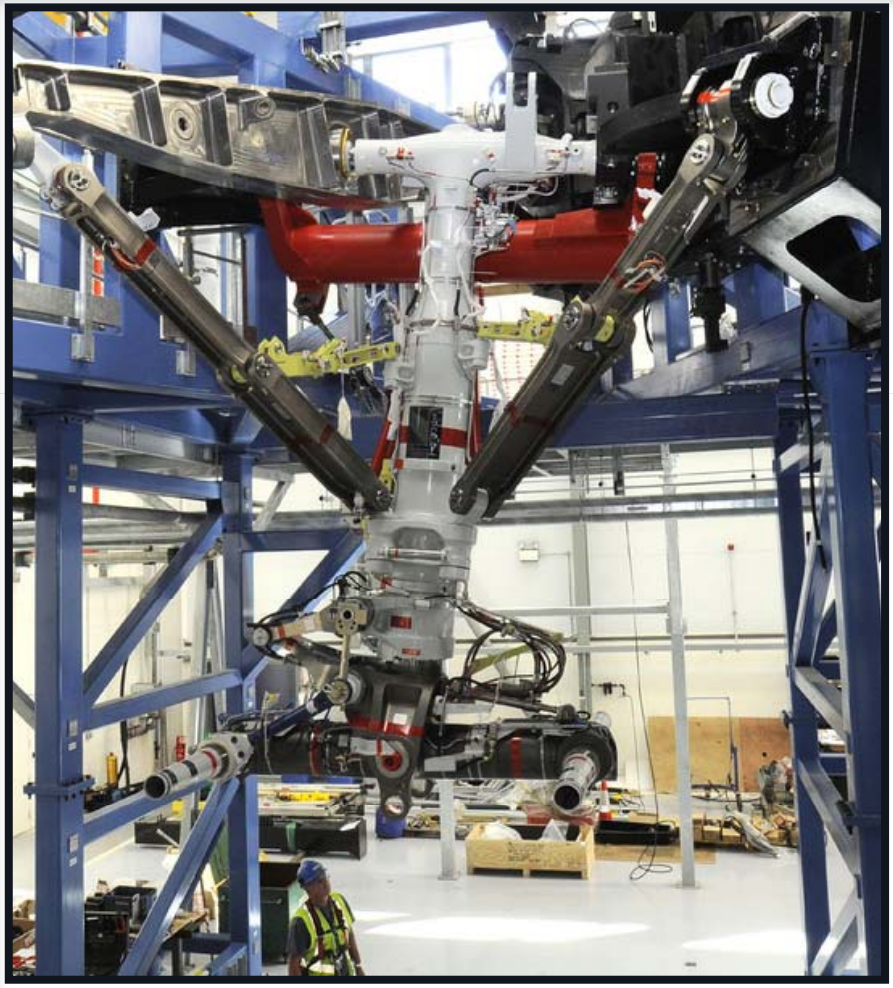
- Double side-stay, 4 wheel main landing gear

Main Landing Gear Materials - A350-800 & 900



- **Titanium**
  - Bogie beam
  - Sliding member
  - Brake rods
  - Torque links
  - Sidestay
- **300M** steel alloy
  - Main fitting
  - all pins & axles, except CRES bogie hinge pin
- **CRES actuators**
- **Aluminium** alloy
  - Lockstay
  - Metering Pin
  - Orifice Tube

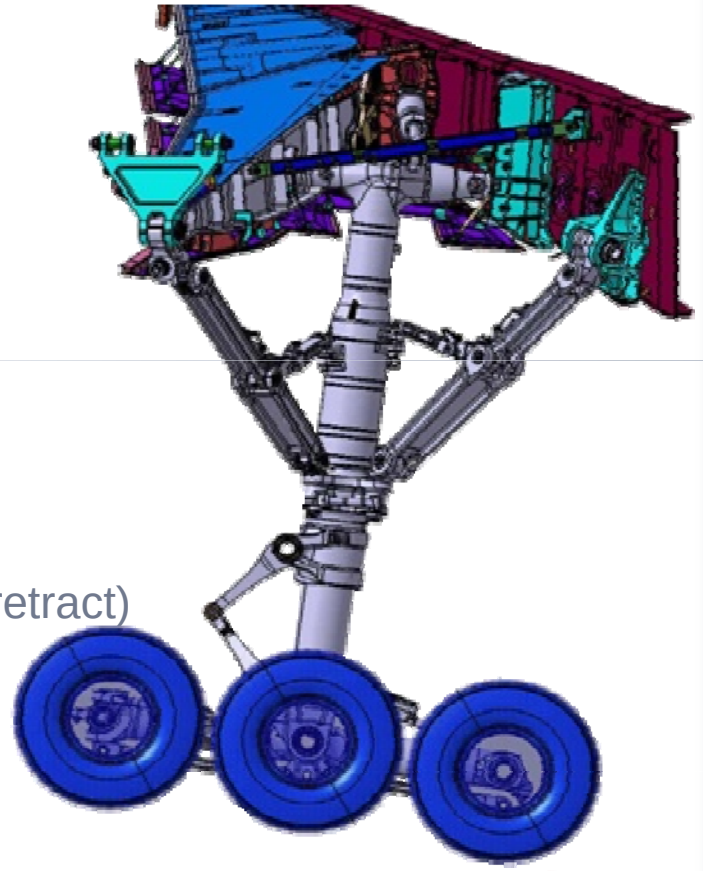
Main Landing Gear - A350-800 & 900



- 4 wheel bogie main landing gear in test rig

Main Landing Gear - A350-1000

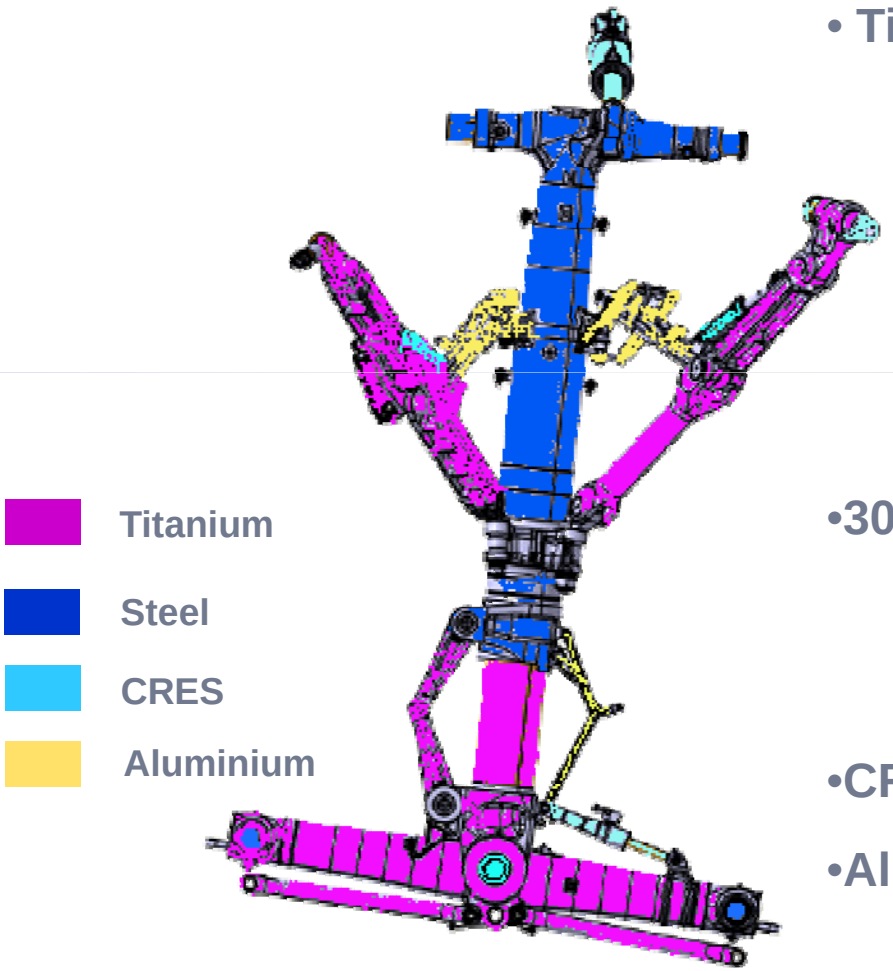
- Double side-stay, with gear beam
- Single stage oleo
    - Unseparated gas and oil
    - metering pin
- Bogie beam
    - 6 wheels, all braked
    - Brake rods below bogie
    - Hydraulic pitch trimmer (single-acting)
- Hydraulic retraction actuator (double- acting, pull to retract)
- Hydraulic unlock actuators
- No steering actuators
- No shortening mechanism



GOODRICH

- Double side-stay, 6 wheel main landing gear

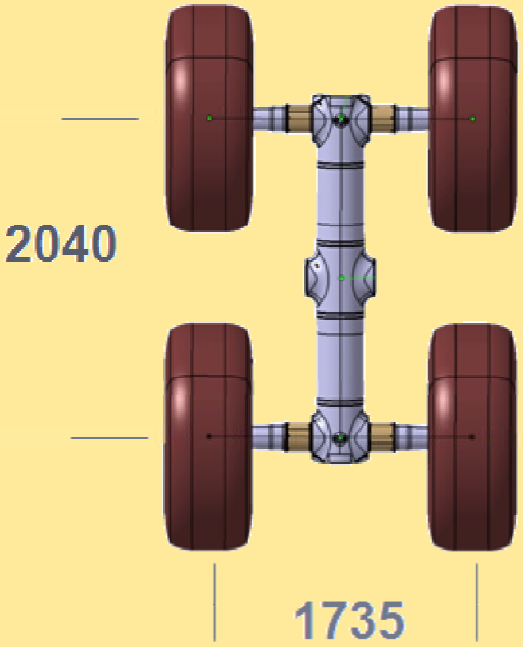
Main Landing Gear - A350-1000



- **Titanium**
  - Bogie beam
  - Sliding member
  - Brake rods
  - Torque links
  - Forward upper & lower stay members
  - Aft upper & lower stay members
  - Fwd stay shackle
- **300M** steel alloy
  - Main Fitting
  - Axles
  - Pins
- **CRES** actuators (15-5PH)
- **Aluminium** alloy
  - Lock links
  - Slave links

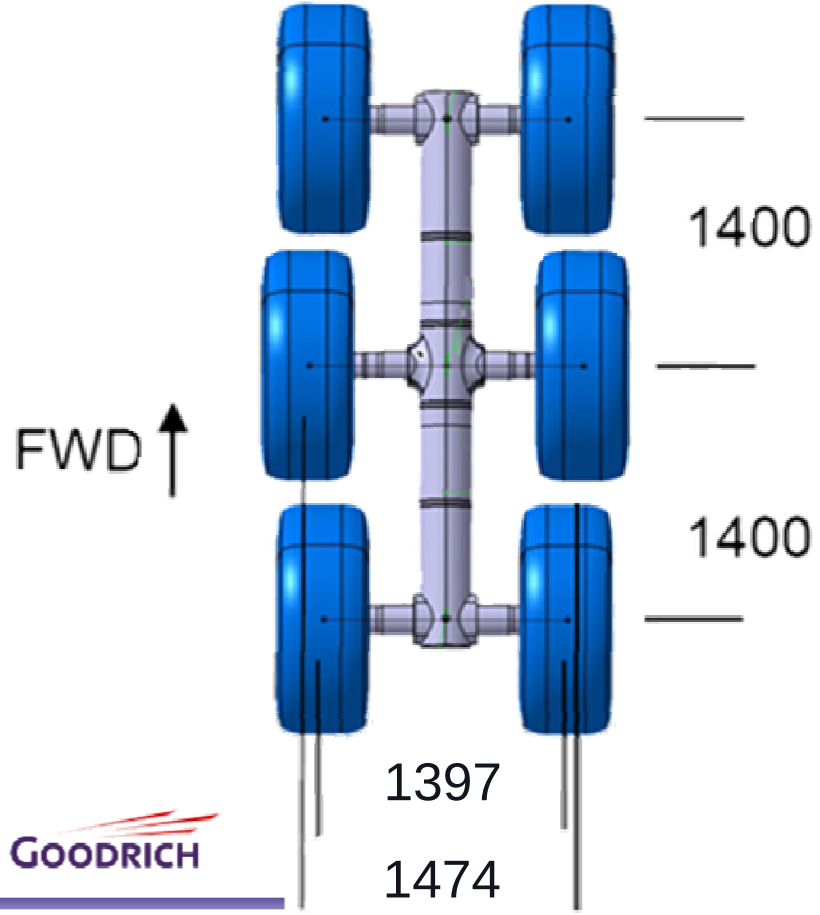
Main Landing Gear

A350-800/900



SAFRAN
Messier-Bugatti-Dowty

A350-1000



GOODRICH

Dimensions in mm

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Technical Brochure Contents

Brake System

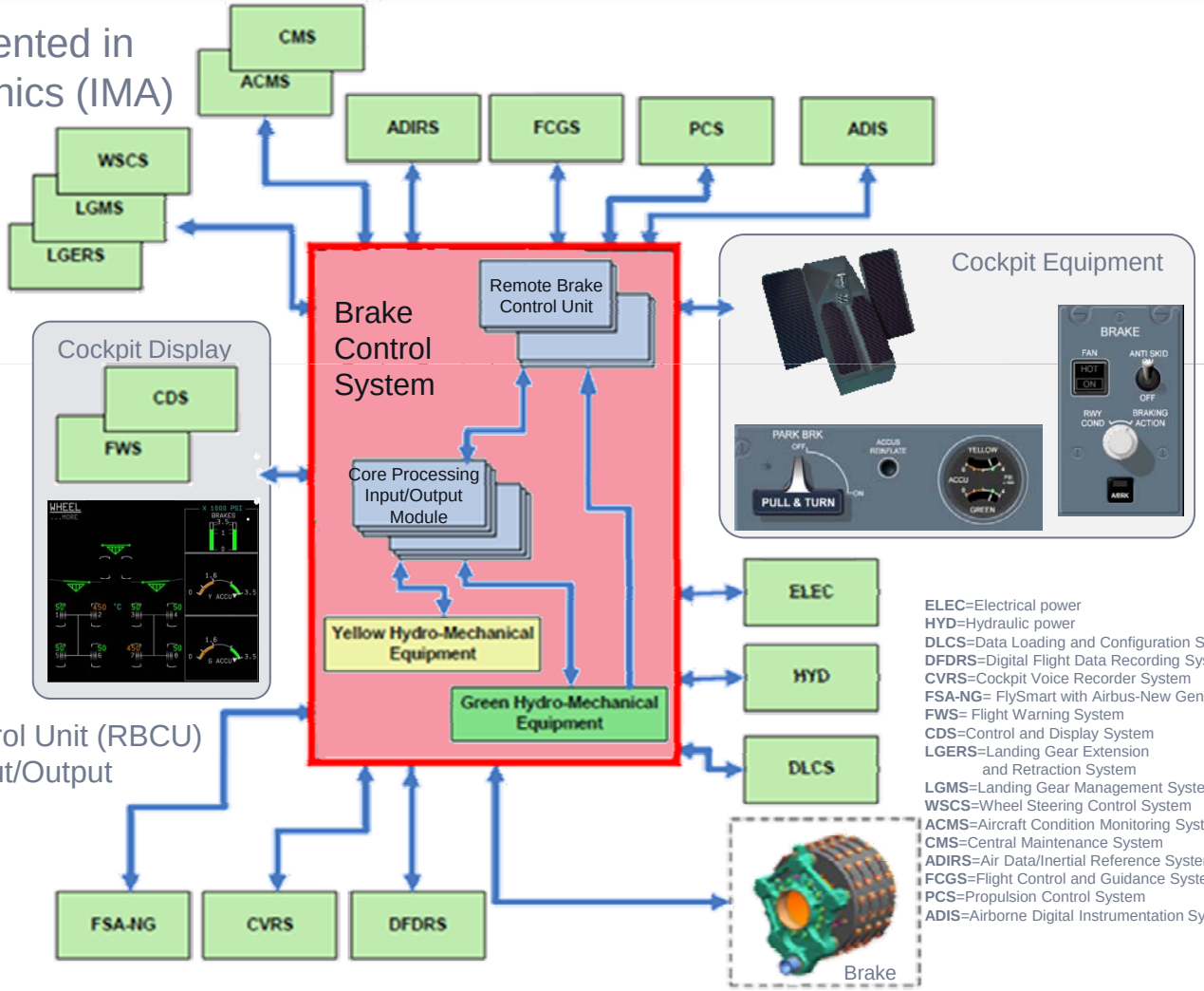
- Single cavity brakes
- Hydraulic supply pressure: 5000psi (regulated to 3000psi)
- No fluid mixing between Green and Yellow hydraulics
- Normal and Alternate braking hydraulic supply segregated down to brake level by use of selector valves
- Wheels individually braked in Normal operational cases
- Antiskid
- Accumulators sized for full antiskid operation to meet ETOPS requirements
- Metal bellow accumulators: low maintenance
- Captain and First Officer pedals mechanically linked

ETOPS = Extended Range Operations

- Brake-by-wire evolved via A320, A330, A380

Brake Control System Achitecture

- Control function implemented in Integrated Modular Avionics (IMA)

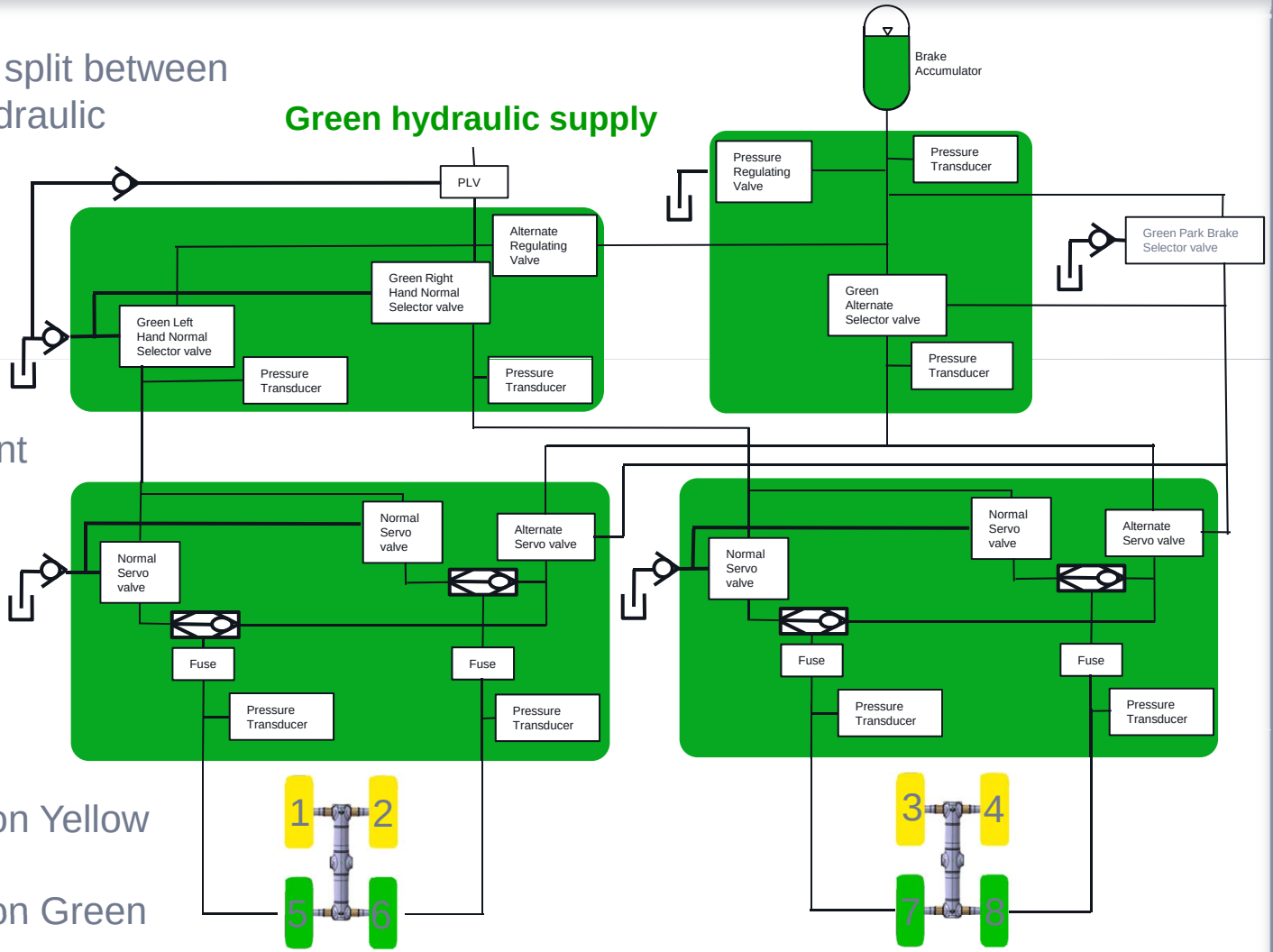


- Dedicated Remote Brake Control Unit (RBCU)
- Standard Core Processing Input/Output Module (CPIOM)

ELEC=Electrical power
HYD=Hydraulic power
DLCS=Data Loading and Configuration System
DFDRS=Digital Flight Data Recording System
CVRS=Cockpit Voice Recorder System
FSA-NG= FlySmart with Airbus-New Generation
FWS= Flight Warning System
CDS=Control and Display System
LGERS=Landing Gear Extension and Retraction System
LGMS=Landing Gear Management System
WSCS=Wheel Steering Control System
ACMS=Aircraft Condition Monitoring System
CMS=Central Maintenance System
ADIRS=Air Data/Inertial Reference System
FCGS=Flight Control and Guidance System
PCS=Propulsion Control System
ADIS=Airborne Digital Instrumentation System

Brake Control System – Hydraulic Circuit (Green)

- Brake architecture split between Green & Yellow hydraulic (only Green shown)
- Common equipment part numbers for each hydraulic system
- Brakes 1, 2, 3 & 4 on Yellow
- Brakes 5 ,6, 7 & 8 on Green

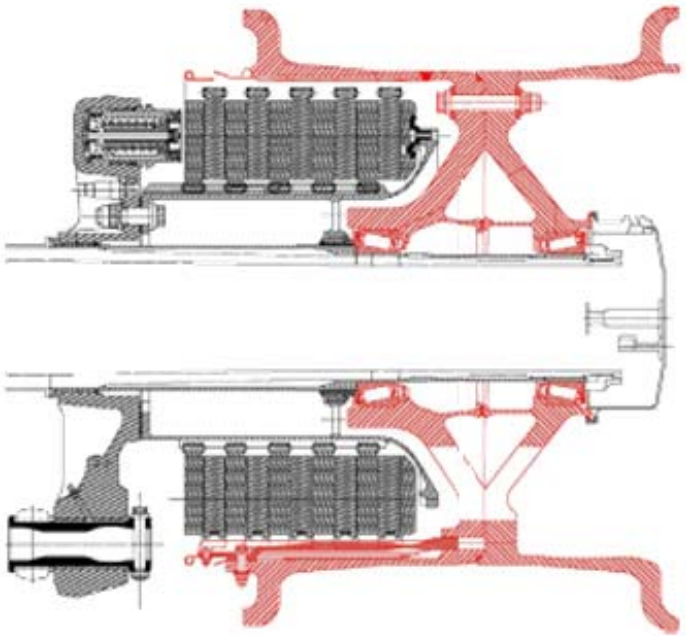


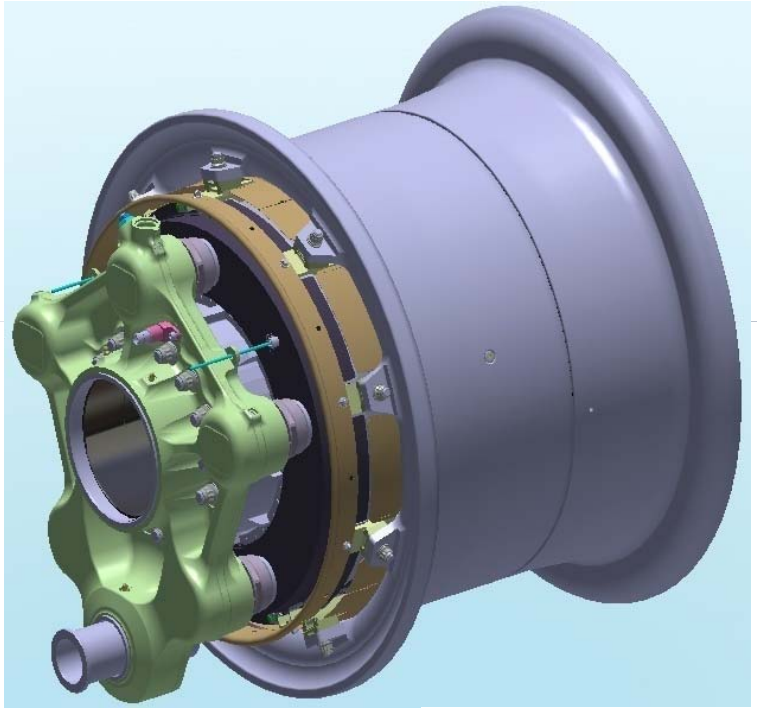
Braking Modes

Braking Modes (A350)	HYD power supply	Cockpit interface	Available functions	Braking performances
NORMAL	GREEN and YELLOW	Pedals, AUTO BRK panel	A/SKID, AUTO BRK, BTV, ADB, differential braking	Normal
ALTERNATE with A/SKID	ACCUs	Pedals, AUTO BRK panel	A/SKID, AUTO BRK, ADB, differential braking	Normal
ALTERNATE without A/SKID	ACCUs	Pedals, AUTO BRK panel	AUTO BRK, ADB, differential braking	Degraded
EMERGENCY	ACCUs	Pedals	ADB, limited brake pressure, differential braking	Degraded
PARKING / ULTIMATE	ACCUs	PRK BRK lever	PRK BRK	N/A

Wheel & Brake

EPAC/TDU 32.40.310/01 & 02





Brakes are designed to achieve 2000 LPO

LPO = Landings per overhaul

SAFRAN Messier-Bugatti-Dowty

GOODRICH

- Mature technology: aluminium wheels and hydraulic brakes

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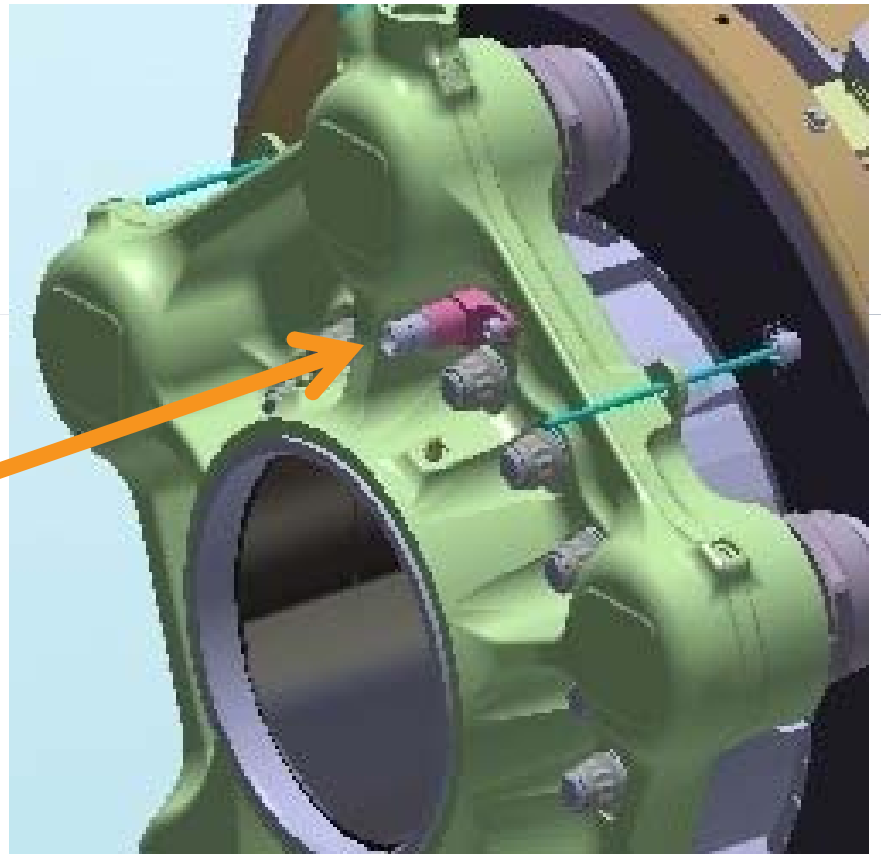
Brake Temperature Monitoring

- Brake temperature is measured by a thermocouple in the brake

- **Ensures Brake thermal capacity prior to take-off**
- **Abnormal braking can be identified**
  - avoid take-off with a hot brake
  - monitor for residual braking due to a dragging brake



- Brake temperatures displayed on system page

Tires

EPAC/TDU 32.41.312/01 & 02

Model	Gear	Wheel size	Tire size	Speed rating	Comments
A350-800/900/1000	NLG	16''	1050x395 R16 Rated 13.1 bar	235mph (-800/900) 245mph (-1000)	Same tire size for all A350 & A330 NLG
A350-800/900	MLG	23''	1400x530R23 42PR Rated 18.1 bar	235mph	
A350-1000	MLG	22''	50x20.0 R22 34PR Rated 16.2 bar	245mph	Same tire size as A380 NLG

Tire Pressure Monitoring System

- Displays individual tire pressure on the ECAM wheel page
- Provides an alert when the pressure in one or more tires is outside defined limits
- Provides an alert when the differential pressure between any two tires on the same axle is outside a defined limit

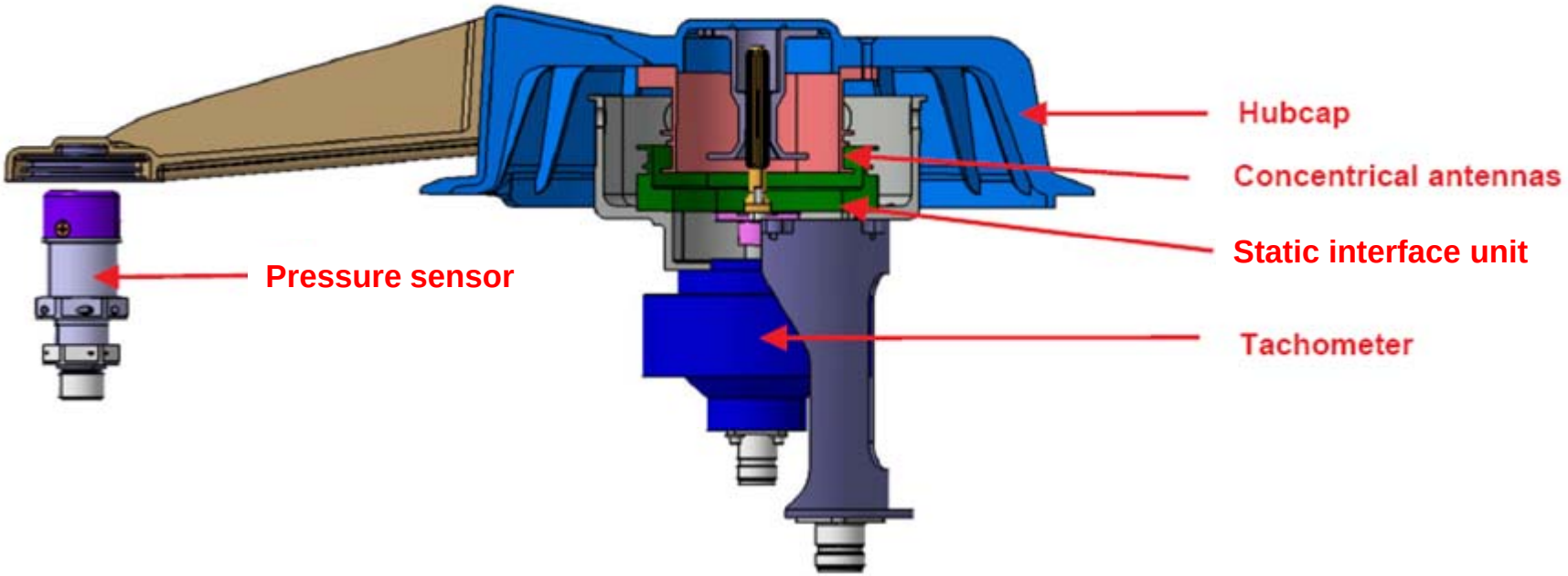
Smart pressure sensor powered through antennas in hubcap and in the axle mounted assembly

Wheel Remote Data Concentrator

- Daily pressure checks may be performed in cockpit

Tire Pressure Monitoring System

- “no-wire” connection from hubcap to pressure sensor
- Improved maintainability and access to the axle



Technical Brochure Contents

Landing Gear Extension Retraction Systems

Landing gear and doors actuation

- Landing gear & door actuation is electrically signalled by the “Landing Gear Control & Interface Function”.
- Landing Gear position is demanded by the landing gear extend retract leaver.
- Position is determined by position sensors on the gears and doors.
- The logic is controlled by two independent systems (System 1 and System 2) implemented using Integrated Modular Avionics each communicating via an independent data bus.

Command of a sequence

- Commands are controlled by System 1 or System 2 during a retraction / extension cycle.
- For each new cycle (determined by the operation of the landing gear lever in the cockpit) a switch-over is effected between the two Systems.
- When a System detects a fault in its own system, it transfers control of the landing gear to the other system automatically.

Normal operation

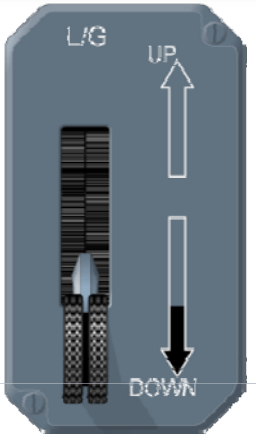
- Nose gears and doors are hydraulically actuated by the Yellow hydraulic system.
- Main gears and doors are hydraulically actuated by the Green hydraulic system.
- Hydraulic supplies are automatically cut off by a safety valve above specified aircraft speed.

Abnormal operation

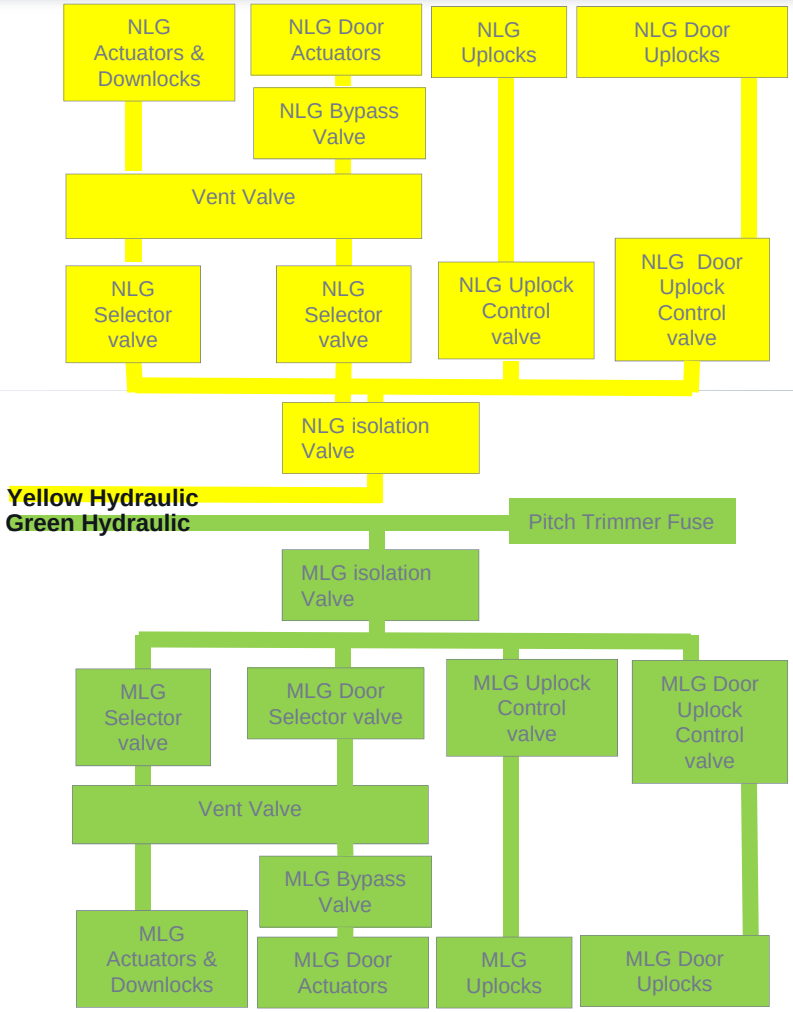
- In an abnormal situation, a switch in the cockpit allows disengagement of door and gear uplocks, which permits all the landing gears to deploy by free-fall and to lock down automatically.

Display status

- Landing gear and door position status is displayed on the system wheel page
- There is a third independent downlock status provided on Primary Flight Display.

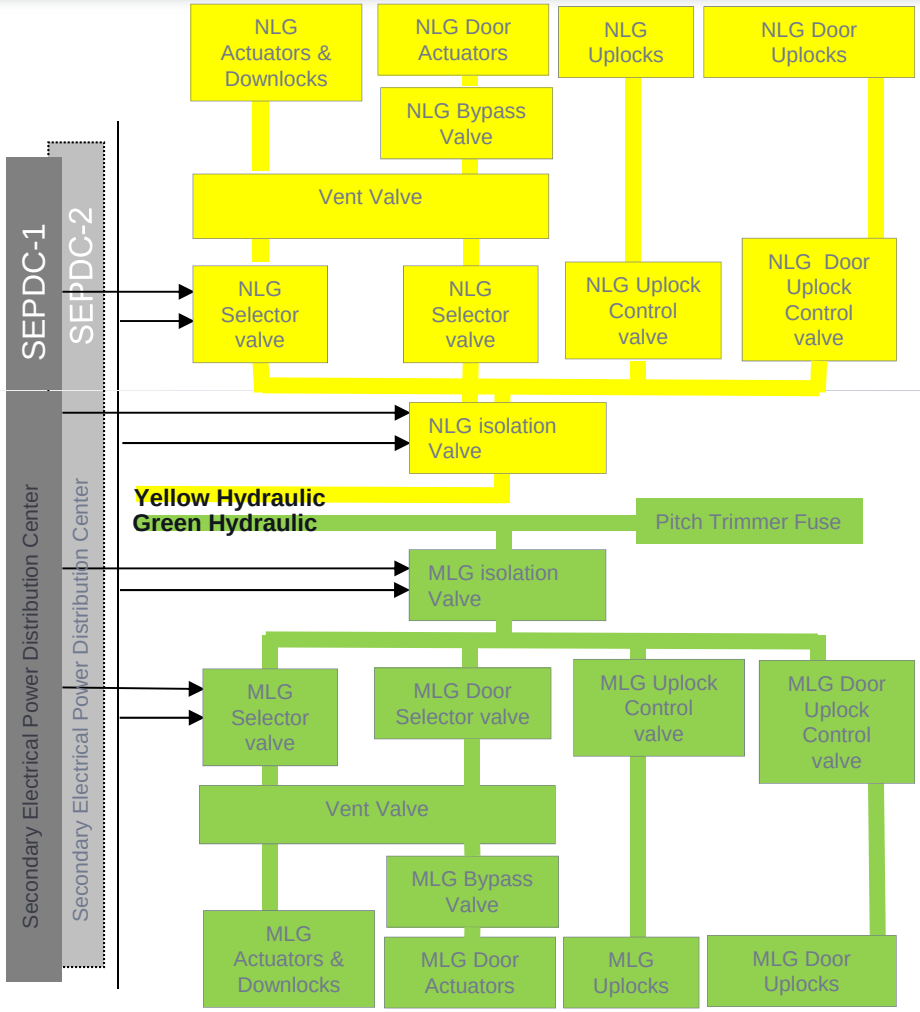


Landing Gear Extension Retraction Systems



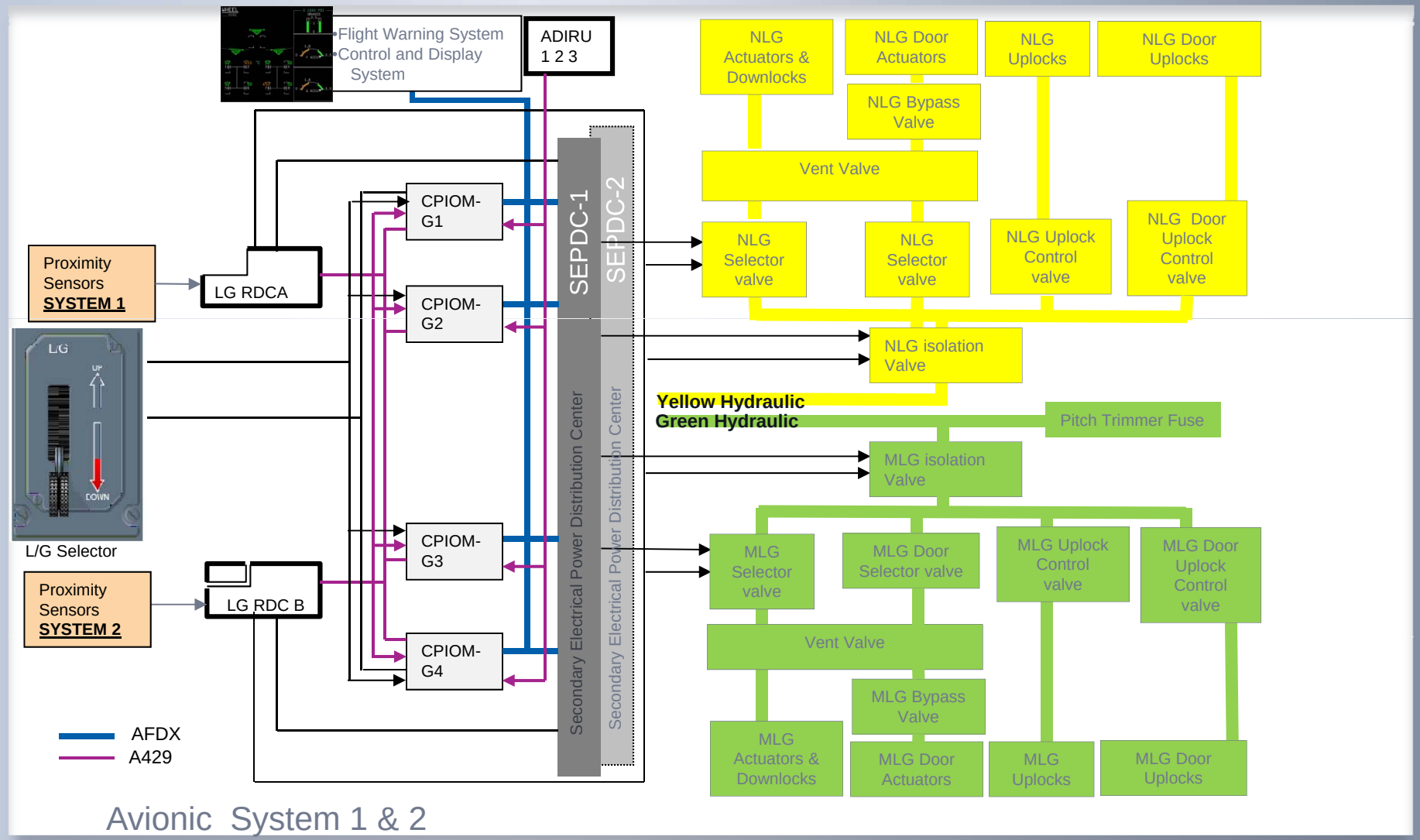
Yellow & Green Hydraulic Systems

Landing Gear Extension Retraction Systems

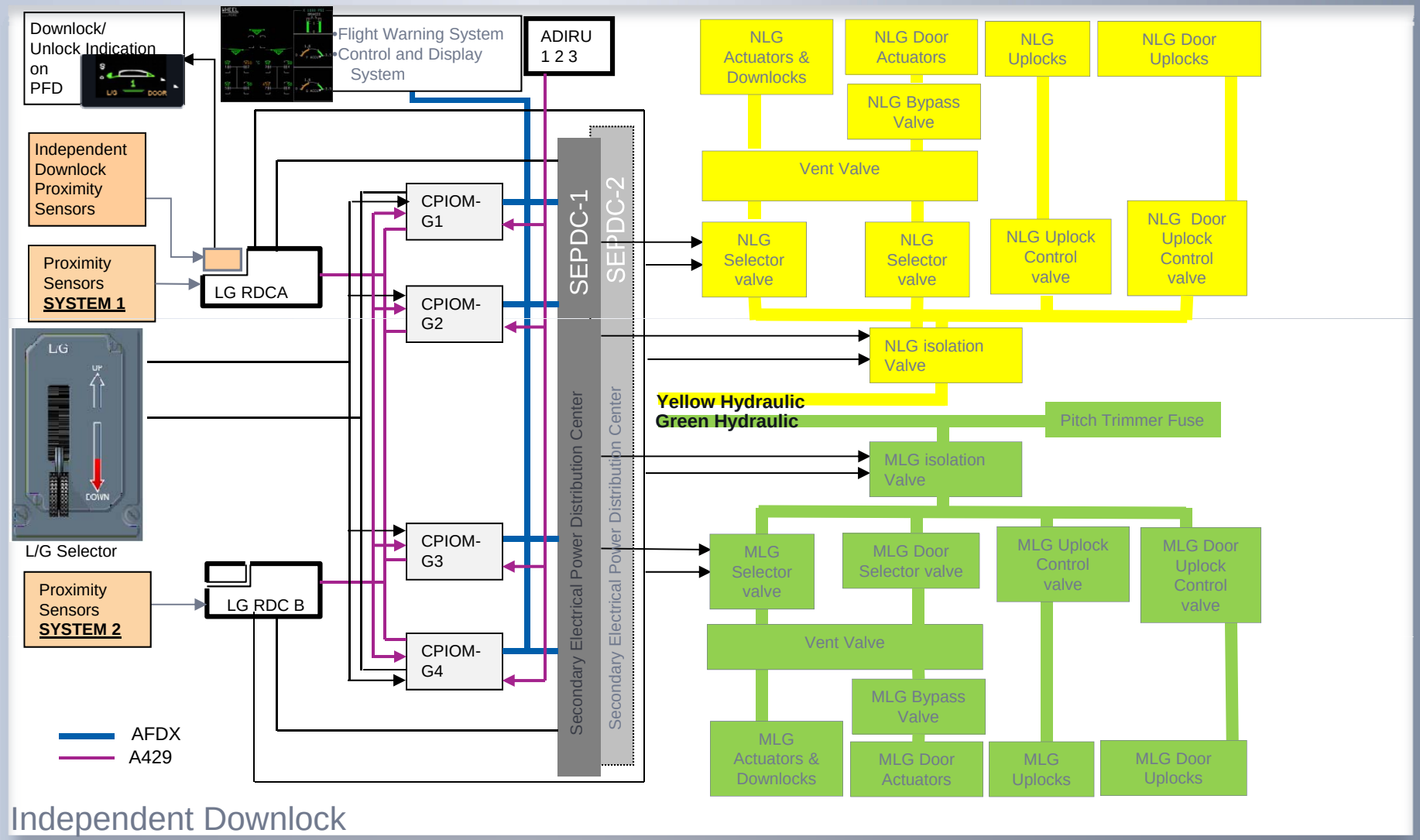


Electrical Power System 1 & 2

Landing Gear Extension Retraction Systems

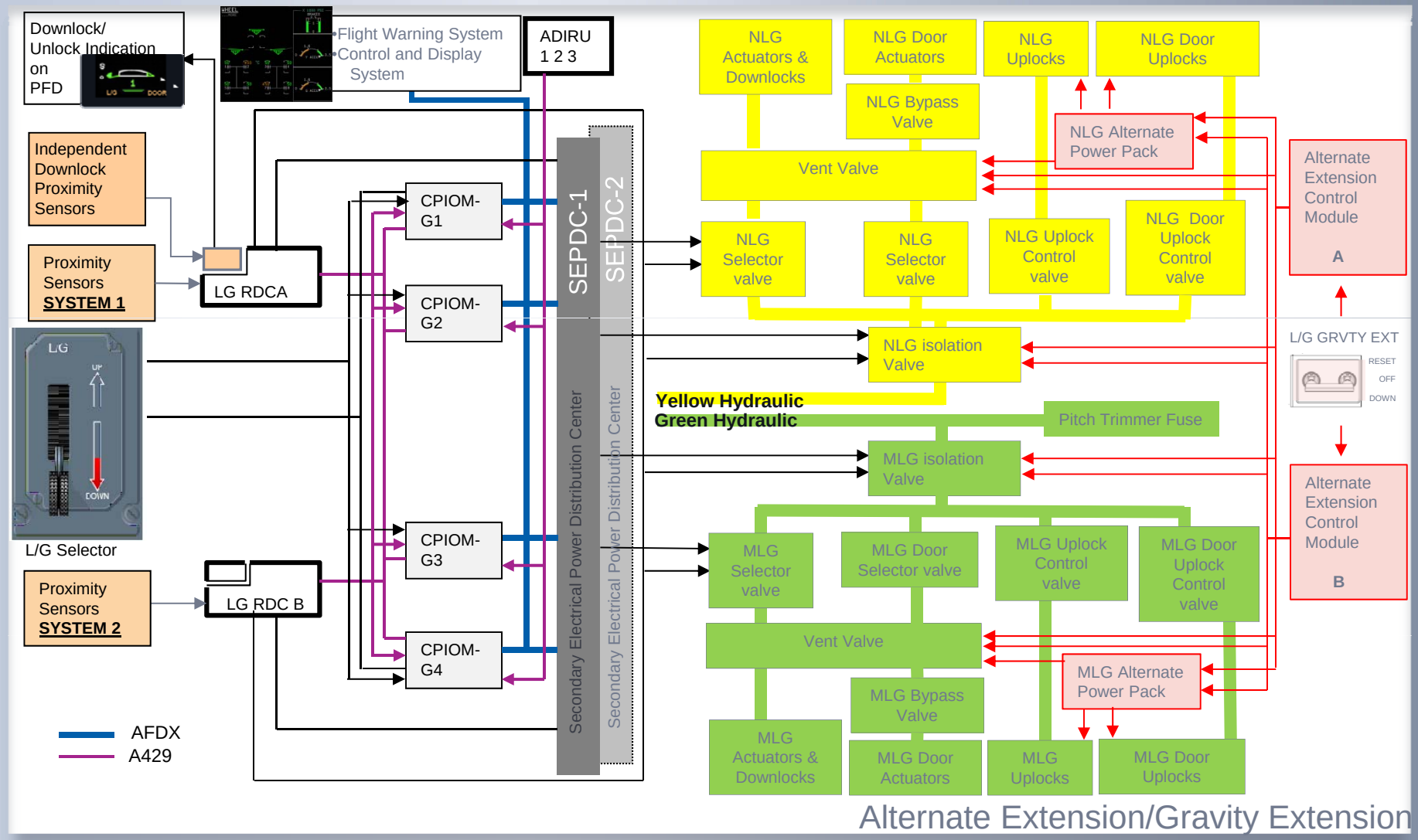


Landing Gear Extension Retraction Systems



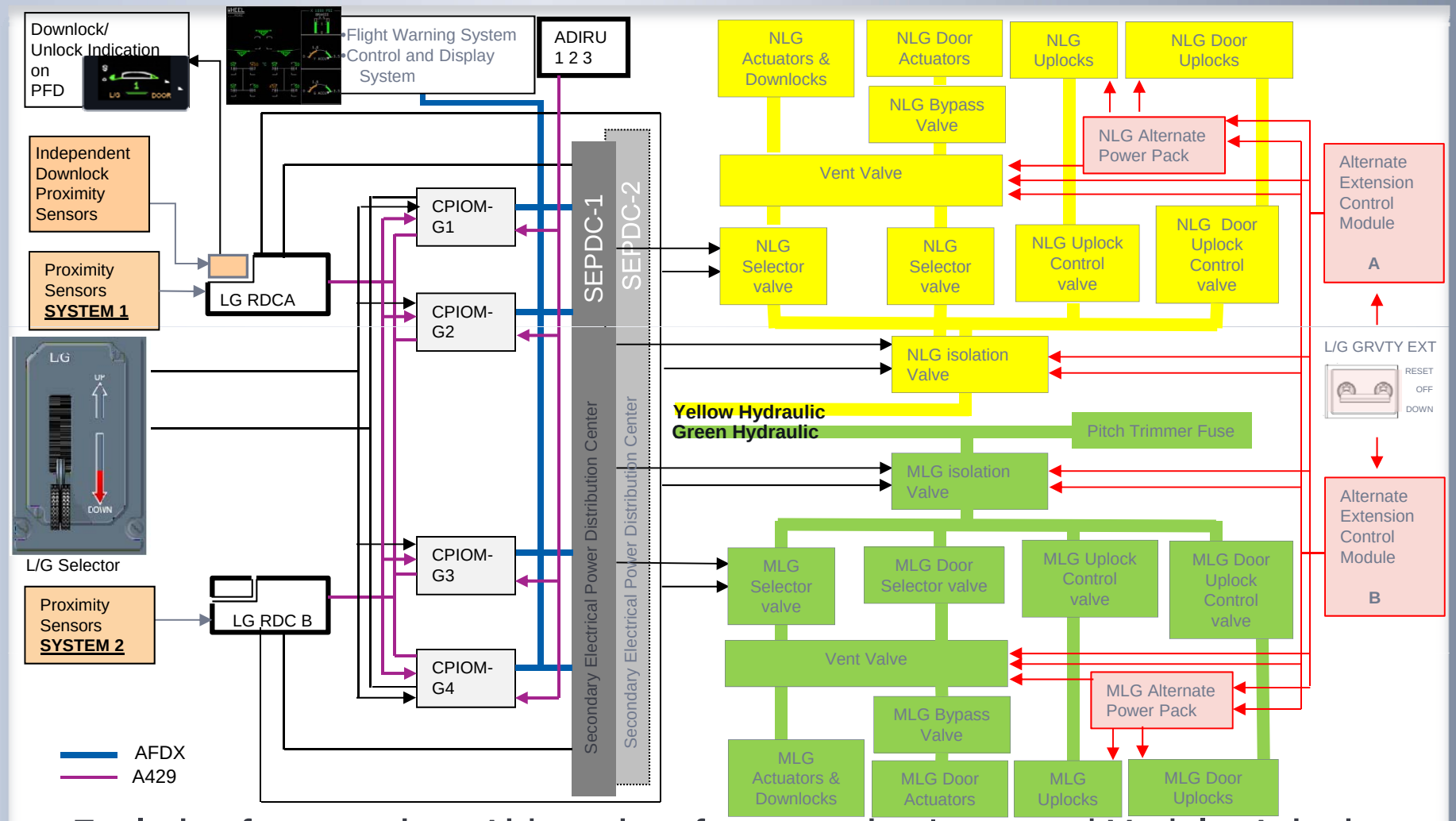
Independent Downlock

Landing Gear Extension Retraction Systems



Alternate Extension/Gravity Extension

Landing Gear Extension Retraction Systems



- Evolution from previous Airbus aircraft types using Integrated Modular Avionics

Technical Brochure Contents

Steering

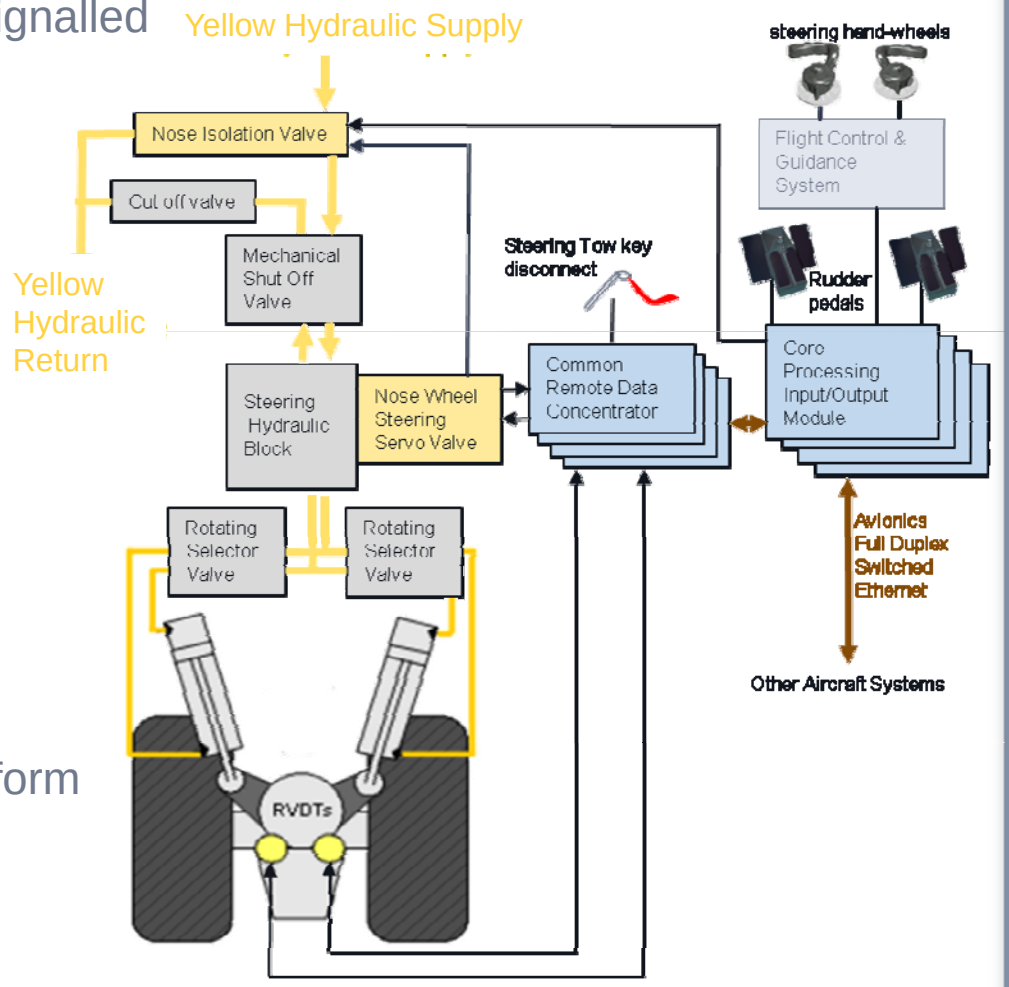
- Normal steering via nose wheel
- Backup steering:
  - automatic differential braking in the event of Yellow hydraulic failure via main landing gear
- Heading control function
- Pre-land test, monitoring & BITE
- Avionics architecture implemented using IMA and AFDX

IMA = Integrated Modular Avionics
AFDX = Avionics Full Duplex Switched Ethernet

- Improved functionality:
  - Automatic differential braking (main gear)
  - Heading control function

Nose Wheel Steering

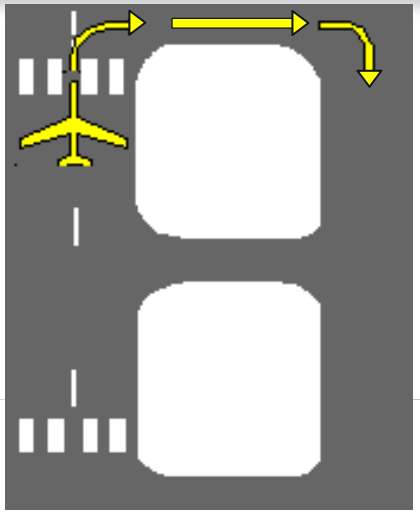
- Hydraulically actuated, electrically signalled
- Hydraulic supply pressure: 5000 psi
- Normal steering (Yellow)
- Push-Pull Steering Motor
- Towing and push-back
- Wheel centring and free castoring
- Pre-land testing
- Avionics architecture using IMA platform (CPIOM and CRDC)

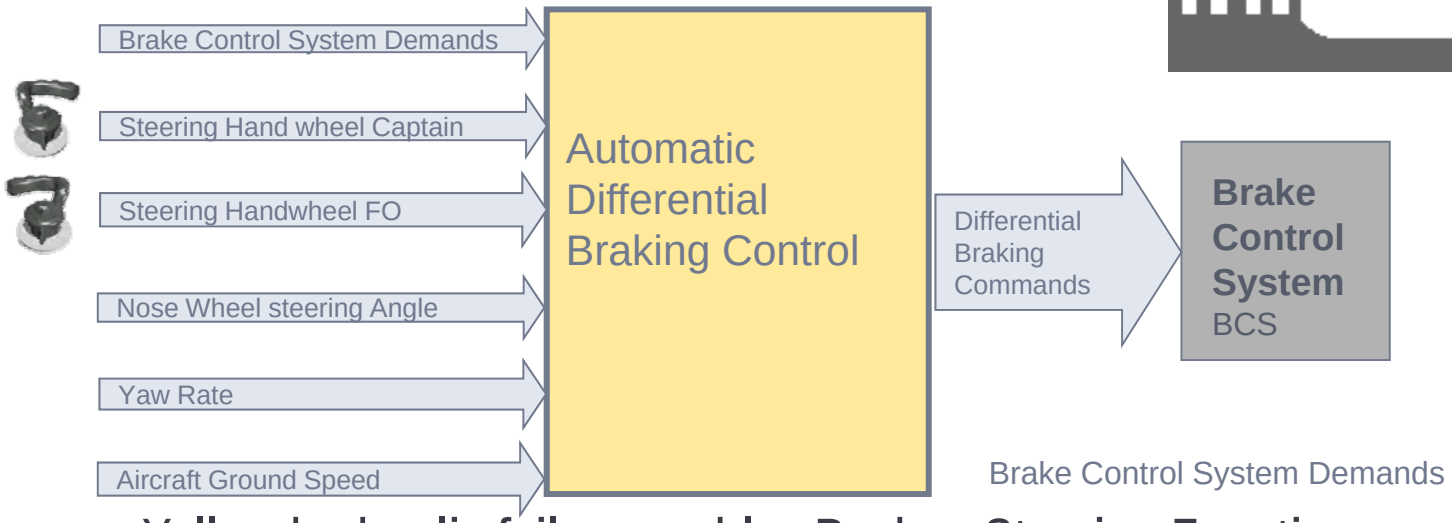


CPIOM = Core Processing Input/Output Module
CRDC = Common Remote Data Concentrator

Backup Steering

- Allows steered runway exit in the event of Yellow hydraulics failure
- Automatic differential braking relies on software control of the brakes, via a **Steering Handwheel**, to produce an equivalent steering response.
- Manual control of engine thrust is required to compensate for the speed loss caused by the braking.





- Yellow hydraulic failure enables Backup Steering Function by Steering Handwheel input

Heading Control

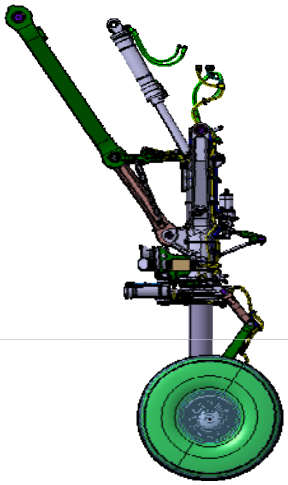
Steering Handwheels →

Rudder Pedals →

Auto Pilot →

A/C Ground Speed →

A/C true Heading →

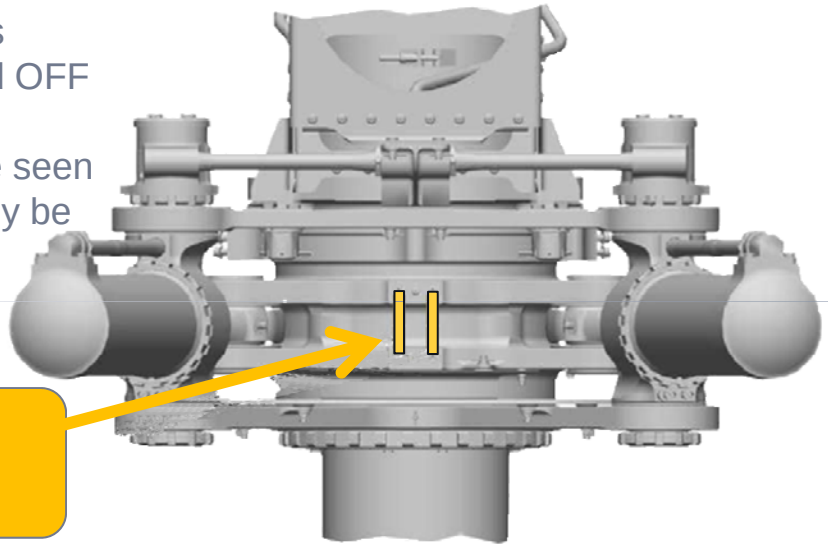


- When on-ground and lined up on the runway or taxiway, aircraft will maintain heading without Steering Handwheel or rudder pedal inputs from the pilot.
- This function compensates for minor mechanical offset and crosswind during taxi.

- Heading function already certified on A380

Oversteer Protection

The **Wheel Steering Control System** (WSCS) monitors the nose wheel steering angle and transmits an over steer indication signal to the Steering Disconnect Panel; this results in the "Oversteer Warning" light to flash ON and OFF (with a frequency of 1Hz) when the NWS angle has exceeded **±75°** The Steering Disconnect Panel can be seen by the tow-truck drive. The over steer indication will only be available if A/C power is provided to the WSCS IMA (CPIOMs and CRDCs).

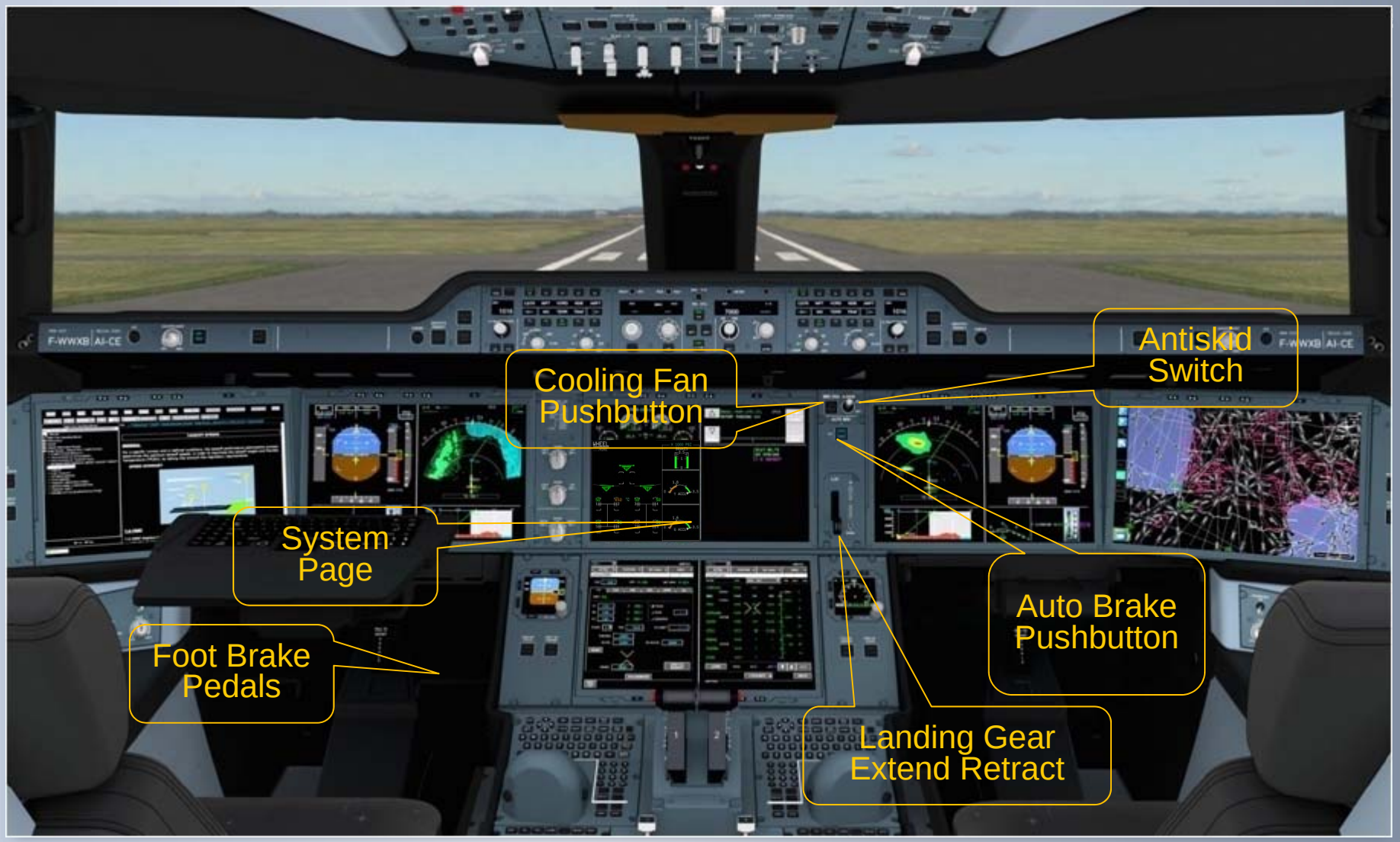


The NLG provides brackets that deform above **±78°** indicating an over steer event has occurred. These devices will record an oversteer with A/C power off.

- During normal towing operations (A/C power and WSCS available) the WSCS provides a *Flight Warning System* alert and *System Display Page* indication; when the NWS angle has exceeded WSCS threshold.
- The alert and/or indication trigger an inspection of the NLG oversteer indication deformable brackets.
- If no deformation is detected, the oversteer event has not reached the NLG bottoming angle. No further inspections or operations are required and the A/C can return to normal service.
- If deformation is detected, further detailed inspection of the NLG is required to determine the implications of the NLG oversteer event, before the A/C can be dispatched.

Technical Brochure Contents

Cockpit



Pedestal Controls

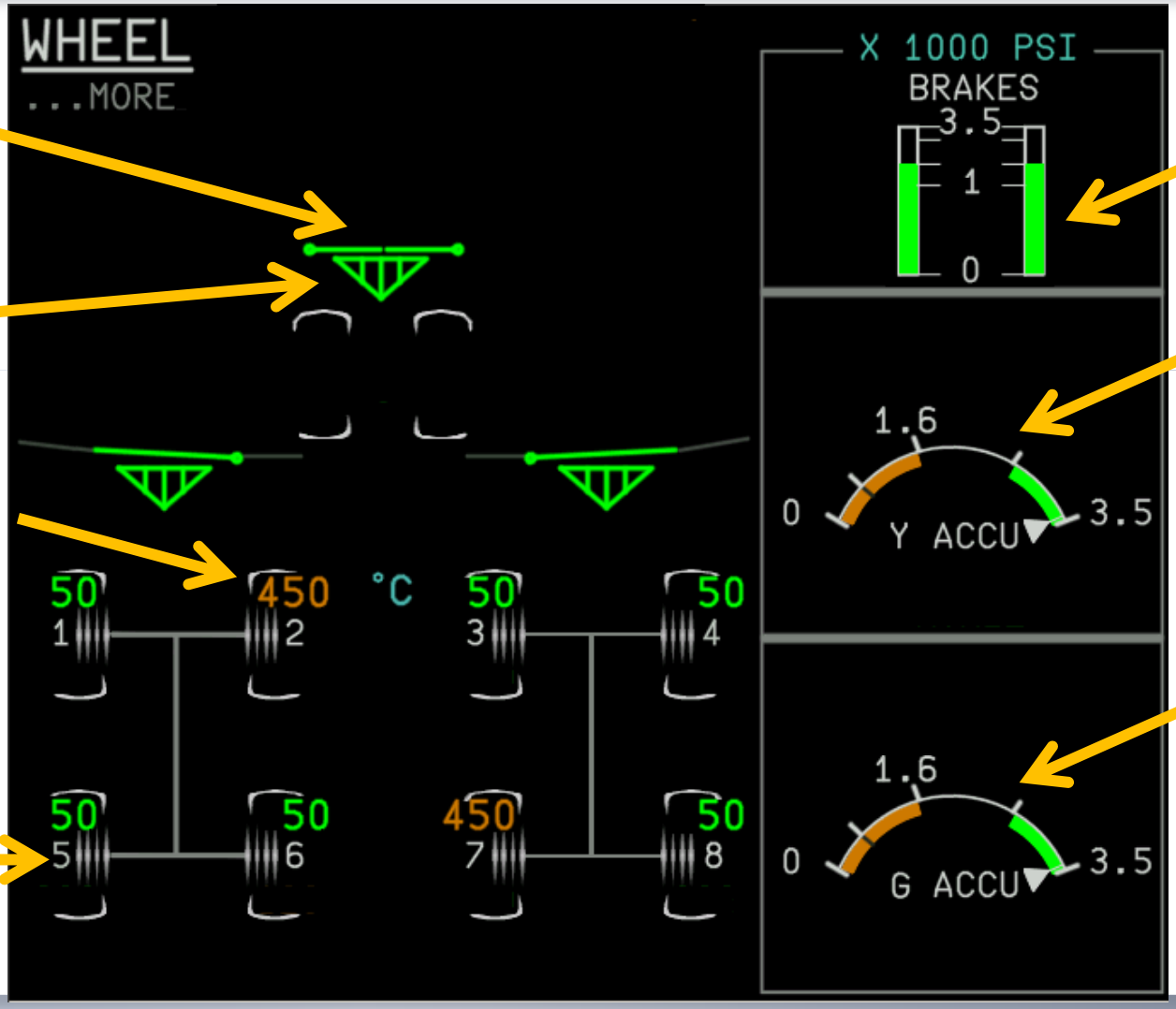
Park brake

Landing gear Gravity Extension

Yellow and Green brake accumulator pressure

Brake accumulator re-inflate enables the flight crew to re-inflate the ACCUs using the electrical motor pumps

Wheel System Page



Doors

Downlocks

Brake Temperature Indicating Fault

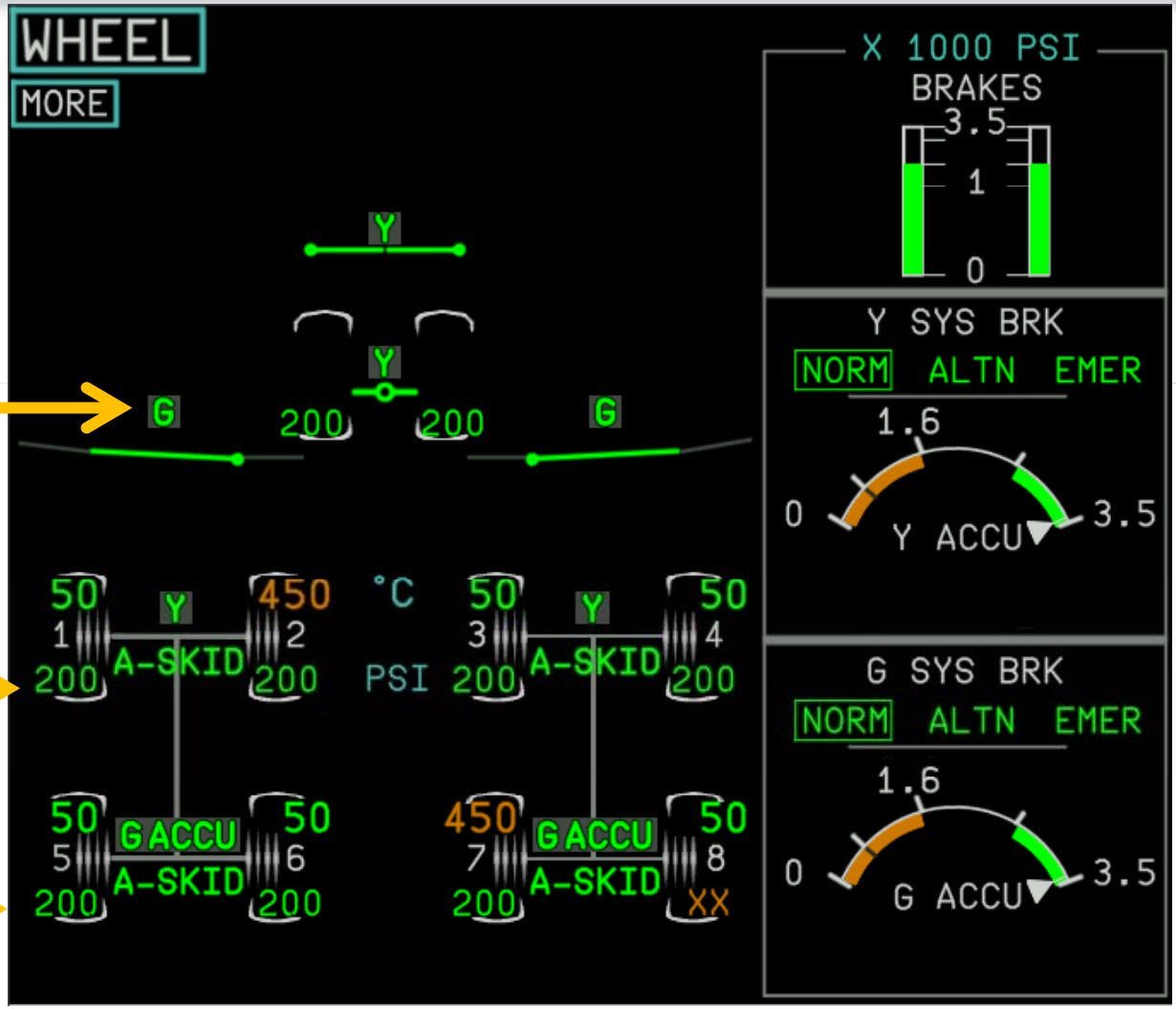
Wheel Number

Pressure measured at brake Left & Right

Yellow Brake Accumulator Pressure

Green Brake Accumulator Pressure

Wheel System More Page



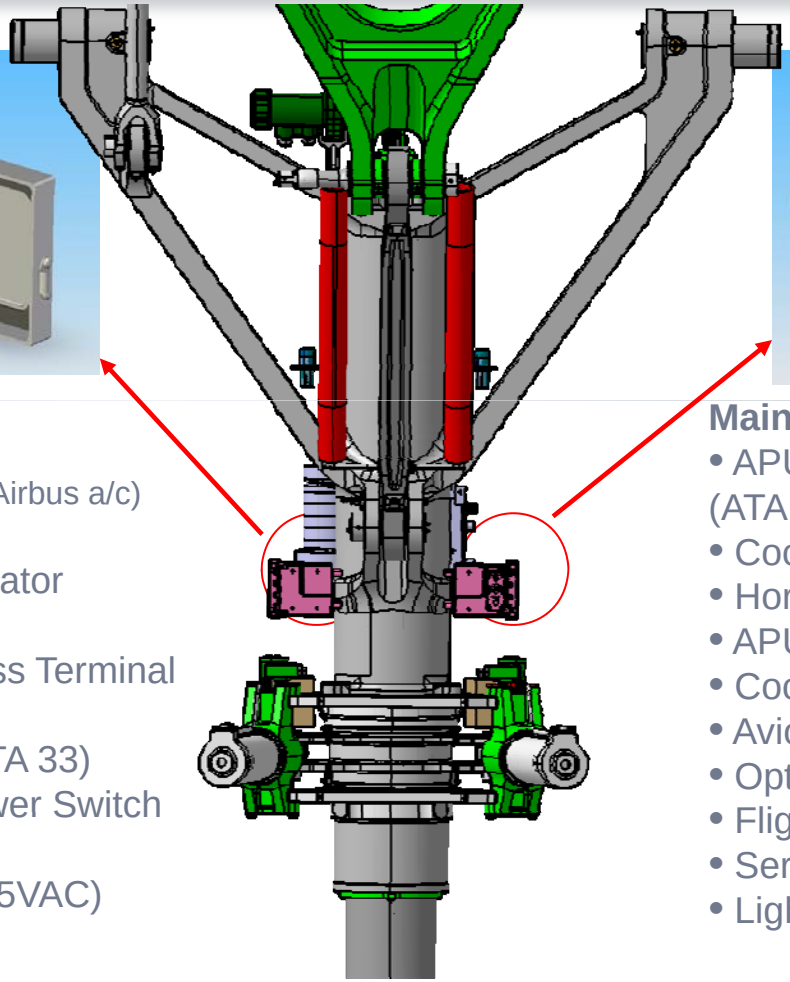
Hydraulic Power Source (Green)

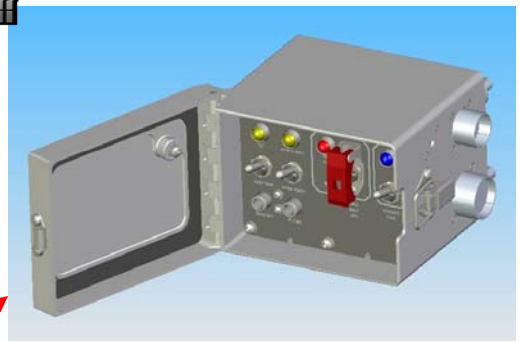
Tire Pressure

Tire Pressure

Brake Mode

Nose Landing Gear – Operational Function Access





Steering Disconnect Panel

- NWS Disconnect Switch
  (common disconnect pin with all Airbus a/c)
- Park Brake On Indicator
- NWS Disconnect Fault Indicator
- Oversteer Warning Indicator
- Portable Maintenance Access Terminal (PMAT) connector (ATA 46)
- NLG Wheel Light Switch (ATA 33)
- Ground Servicing Mode Power Switch (ATA24)
- Two 5A Fuses (28VDC & 115VAC)
- Light Test Switch
- Tow Truck Power Connector
  (Navigation & Obstacle Lights for towing)

Maintainability Panel

- APU Emergency Stop Switch (ATA 49)
- Cockpit Call Switch (ATA 23)
- Horn Reset Switch (ATA 23)
- APU Fire Indicator (ATA 26)
- Cockpit Call Indicator (ATA 23)
- Avionics Vent Indicator (ATA 21)
- Optional ELT Indicator (ATA 25)
- Flight Interphone Jack (ATA 23)
- Service Interphone Jack (ATA 44)
- Light Test Switch

- Easy access

Brake Control System Modes

- Normal braking
  - Alternate braking (accommodates system failures)
- Park braking
- Emergency braking (via PARK BRK; when A/C in motion)

- In-flight wheel braking
- Automatic braking (selected by new AUTO BRK pushbutton)
  - BRK RTO Rejected take-off (when A/C is on ground)
  - BRK BTV Brake-To-Vacate (when in-flight and runway/taxiway selected)
  - AUTO BRK default (equivalent to a MED level on Single Aisle)

- Brake-to-vacate is proposed as the preferred operational mode at landing

Brake Control System Modes - Automatic Braking Display

Information about mode selected is displayed on Primary Flight Display Flight Mode Annunciator

BRK RTO or
BRK BTV or
AUTO BRK

Brake-To-Vacate

Brake To Vacate (BTV) is a unique Airbus automated braking function:

It enables optimised braking performance based on the pre-selection of a landing runway and exit, using known airport data and computation of realistic operational landing performance.

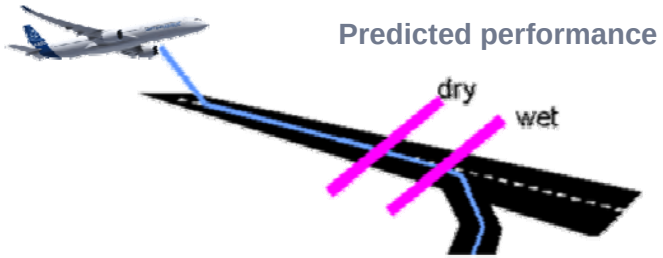
The pilot is informed before landing if a Runway Overrun is predicted.

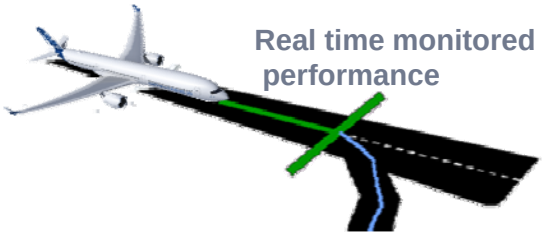
Visual and aural alerts are provided to the flight crew and ultimately automatic full auto brake is activated if there is a risk of runway overrun.

Maximum aerodynamic braking is used, avoiding normal human reaction to use excessive wheel braking to meet the target runway exit.

Benefit

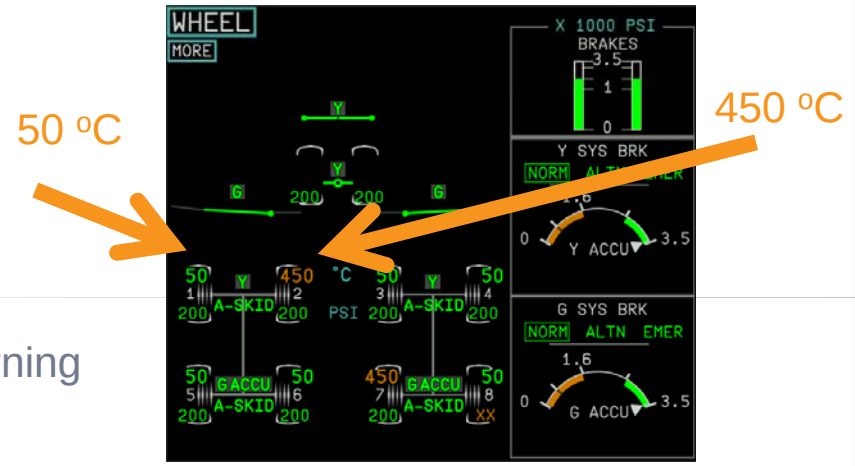
- Safety improvement: Runway Overrun prevention
  - Mitigates Runway Overrun risk at landing
  - May be used to negotiate lower aircraft insurance
- Full auto brake activated when risk of Runway Overrun
- Repeatable landing braking profile
- Continuous optimum brake application
- Reduced runway occupancy time
- Less stored brake energy per landing
  - Less brake cooling required at turn around
- No missed runway exits (no extra time or fuel burn)
- Use of idle thrust reverse use on dry runway(fuel, noise, maintenance)
- Customer comfort due to smooth braking





- Mature A380 technology

Brake Temperature Monitoring



Brake temperature is monitored and displayed to pilots on the WHEEL System Page.
Identified failures appear on the “Engine and Warning Display”

Pilots can monitor:
- brake temperature is below 300 °C before take-off
- uneven braking due to a brake fault
- abnormal brake temperatures

- Brake temperatures displayed on System page

Pilot Flight Display - Downlock Indication

The independent gear downlock status is shown on the **P**rimary **F**light **D**isplay. A single symbol is displayed in the left hand bottom corner under the Slat/Flap status. The possible symbols and meanings are shown.

Technical Brochure Contents

Braking System MMEL

MMEL not yet confirmed, but the following items are expected to be GO-IF:

- Pressure Limiter Valve Jammed Open
- Accumulator Monitoring Device
- 1 Normal Brake Selector Valve Coil
- Normal Brake Selector Valve Pressure Transducer
- 1 Alternate Brake Selector Valve Coil
- Alternate Brake Selector Valve Pressure Transducer
- Park Brake Selector Valve Jammed Closed
- 1 Alternate Selector Valve Coil
- Wheel Pressure Transducer
- 1 CPIOM Side
- 1 Remote Brake Control Unit Channel
- Tachometer

MMEL = Master Minimum Equipment List

Steering System MMEL

MMEL not yet confirmed, items under consideration:

"GO IF" Items examples:

- WSCS IMA Side 1
- WSCS IMA Side 2
- Captain or First Officer Steering Hand Wheel

"NO GO" Items examples:

- NWS Nose Isolation Valve
- NWS Servo Valve
- RVDT

Landing Gear Extension & Retraction System MMEL

MMEL not yet established

Landing Gear Monitoring Systems MMEL

Tire Pressure Indicating System TPIS MMEL:

•*GO: The TPIS MMEL dispatch condition for a loss of tyre pressure data is GO (manual check)*

•*NO-GO: The TPIS MMEL dispatch condition for a tyre pressure warning is NO-GO. The tyre pressure(s) must be checked using a manual gauge to determine the appropriate action (i.e. service/replace tyre(s)).*

Brake Temperature Monitoring System BTMS MMEL:

GO-IF

•A maximum of 4 brake temperature indications may be inoperative provided that:

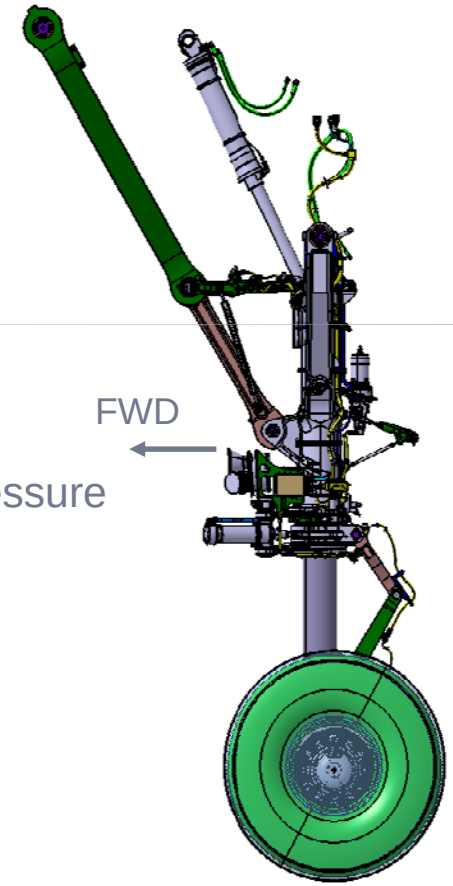
1) At least two brake temperature indications per landing gear are operative, and
2) A ground brake cooling time is applied, and
3) The remaining brake temperature indications are from brakes that are not released.

BCF MMEL:

•*GO-IF: Aircraft dispatch does not directly drive the BCF architecture.*

Nose Landing Gear Scheduled Maintenance

- Nose Landing Gear (NLG) Overhaul
  - **12 Years (144 Months)** at EIS
  - **14 Years** target supported by sampling
- NLG Shock Strut Nitrogen/Oil servicing
  - **36 Months** functional check of NLG shock strut charge pressure
  - **72 Months** service NLG shock strut (weight on wheels)
- NLG Lubrication
  - **5 Months or 500FC** lubrication of NLG (complete)



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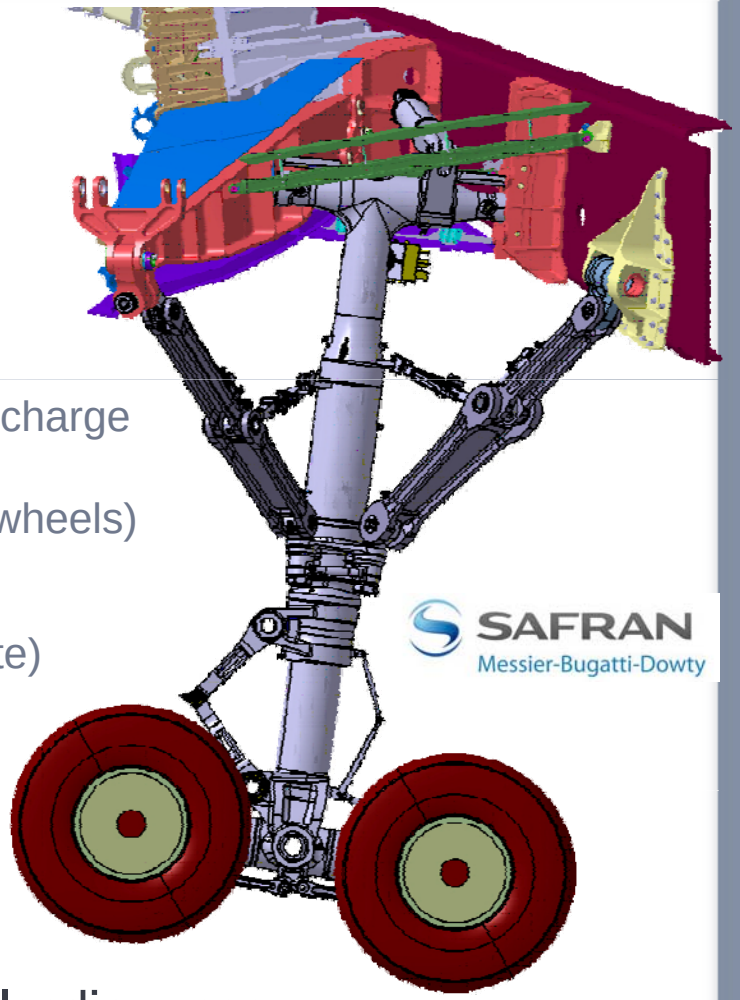
Main Landing Gear Scheduled Maintenance – A350-800 & 900

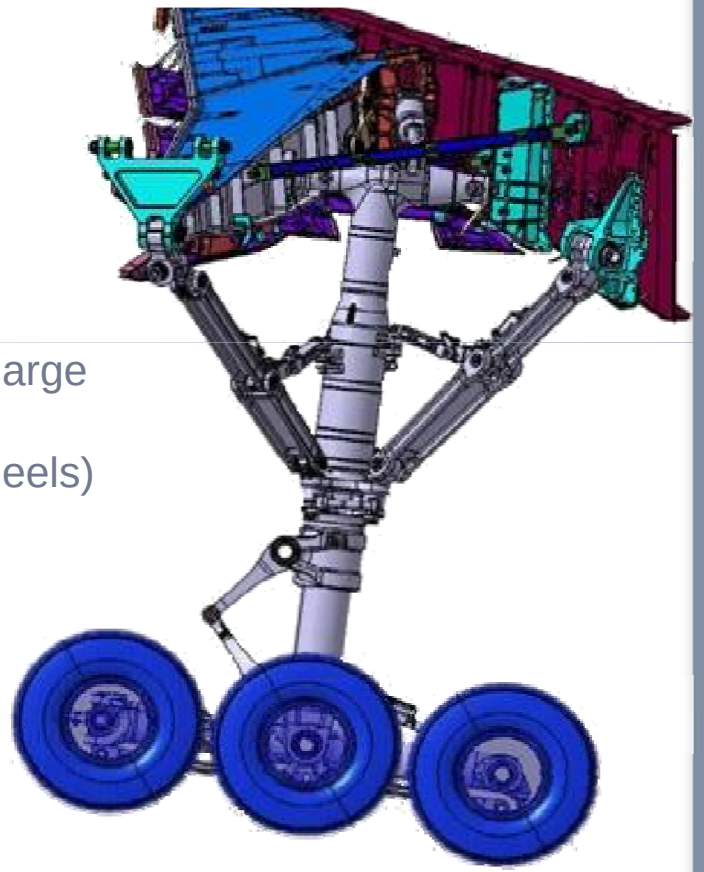
- Main Landing Gear (MLG) Overhaul
  - **12 Years (144 Months)** at EIS
  - **14 Years** target supported by sampling
- MLG Shock Strut Nitrogen/Oil Servicing
  - **36 Months** functional check of MLG shock strut charge pressure
  - **72 Months** service MLG shock strut (weight on wheels)
- MLG Lubrication
  - **5 Months or 500FC** lubrication of MLG (complete)



- Double side-stay, 4 wheel main landing gear

Main Landing Gear Scheduled Maintenance – A350-1000

- Main Landing Gear (MLG) Overhaul
  - **12 Years (144 Months)** at EIS
  - **14 Years** target supported by sampling
- MLG Shock Strut Nitrogen/Oil servicing
  - **36 Months** functional check of MLG shock strut charge pressure
  - **72 Months** service MLG shock strut (weight on wheels)
- MLG Lubrication
  - **5 Months or 500FC** lubrication of MLG (complete)



- Double side-stay, 6 wheel main landing gear

Landing Gear Scheduled Maintenance

- **Tire Pressure Indicating System** (TPIS),
  - **36 hour** functional check of tire pressures
- **Brake Control System** (BCS)
  - **144 month** functional check of brake servo valve manifold hydraulic fuse (off aircraft)
- **Wheels and Steering Control System** (WSCS)
  - **48 month** functional check of nitrogen charge pressure on NWS hydraulic block accumulator
  - **144 months** operational check of NWS mechanical shut-off valve
- **Landing Gear Monitoring System** (LGMS)
  - There are no scheduled maintenance tasks, due to the continuous monitoring of systems during flight.

Landing Gear Scheduled Maintenance

Extension Retraction System (LGERS)

5 month or 500 flight cycle

- Lubrication of:
  - Landing gear uplock rollers/pins,
  - Door actuator attachment joints, door hinges, door uplock rollers/pins

12 month

- General visual inspection of downlock springs

24 month

- Operational check of alternate extension system components.

Landing Gear Scheduled Maintenance

Extension Retraction System (LGERS)

72 month or 6600 flight cycle

- Detailed inspection of
  - Door & gear uplock hooks, door uplock rollers/pins
  - Landing gear uplock rollers/pins
  - MLG uplock spring strut

72 month

- Operational check of landing gear control lever baulk
- Functional check of the alternate extension system

144 month or 16800 flight cycle

- Detailed inspection of door actuator attachment joints and door hinges
- Special detailed inspection (overhaul) of the NLG retraction actuator
- Special detailed inspection (overhaul) of the MLG retraction actuator

Dispatch & Maintenance

- This brochure gives an overview of Dispatch & Maintenance; hence not all detail is given
- Items are under Certification Review: definition is not fixed

Technical Brochure Contents

Customization – Wheel & Brake

LPO = Landings per overhaul

Wheel and brake supplier selection

CP32.40.310

Wheel and brake assembly will be selected from two suppliers mentioned below.
In normal conditions (revenue flights) the brakes perform an average of 2 000 LPO in term of service endurance.

Note: If no choice is made by the customer, wheels and brakes will be selected by Airbus from the proposed suppliers.

Note: Wheel and brake supplier selection availability is subject to supplier certification before aircraft entry into service.

Option	TDU	Model	Weight	Equipment ref	Equipment supplier	Euipment PN	Qty	Sts
Wheel and brake supplier selection-Goodrich	01	A350-800 A350-900	TBD	Brake unit Wheel, main gear Wheel, nose gear	GOODRICH GOODRICH GOODRICH	TBD TBD TBD	8 8 2	SFE SFE SFE
Wheel and brake supplier selection-Messier Bugatti	02	A350-800 A350-900	TBD	Brake unit Wheel, main gear Wheel, nose gear	GOODRICH GOODRICH GOODRICH	TBD TBD TBD	8 8 2	SFE SFE SFE

Customization -Tires

Landing gears - Tire supplier selection

CP32.41.312

Tires will be selected from two suppliers mentioned below.

Note: If no choice is made by the customer, tires will be selected by Airbus from the proposed suppliers.

Note: Tire supplier selection availability is subject to supplier certification before aircraft entry into service.

Option	TDU	Model	Weight (kg) MWE/OWE/APL	Equipment reference	Equipment supplier	Equipment PN	Qty	Sts
Landing gears - Tire supplier selection - Michelin	01	A350-800 A350-900	TBD	Tire, Main Landing Gear (MLG)	MICHELIN	TBD	8	SFE
				Tire, Nose Landing Gear (NLG)	MICHELIN	TBD	2	SFE
Landing gears - Tire supplier selection - Bridgestone	02	A350-800 A350-900	TBD	Tire, Main Landing Gear (MLG)	BRIDGESTONE	TBD	8	SFE
				Tire, Nose Landing Gear (NLG)	BRIDGESTONE	TBD	2	SFE

Customization - Brake Cooling Fan System

BASIC: System provision is made for brake cooling fans on the main landing gear, structural provision is made inside wheel axles, space provision is made for a brake fan push button on the landing gear panel, and a circuit breaker in the avionics compartment.

CUSTOMIZATION: Brake cooling fan system

CP32.48.210

The brake cooling fans provide forced-air cooling in order to allow reduced turnaround times. They are recommended in the case of a network with flights requiring a high-energy landing followed by a short turnaround time, or where several sectors are flown throughout the day where short turnaround times are required.

The brake cooling fans are installed within the axle at each braked wheel position.

They are electrically driven with air being drawn by the impeller from the brake side and vented from the wheel hub. A shroud assembly replaces the wheel's standard hub-cap assembly.

Option	TDU	Model	Weight (kg) MWE/OWE/ APL	Equipment reference	Equipment supplier	Equipment PN	Qty	Sts
Installation of a brake cooling fan	01	A350-800 A350-900	TBD	brake cooling fan	TECHNOFAN	TBD	8	SFE

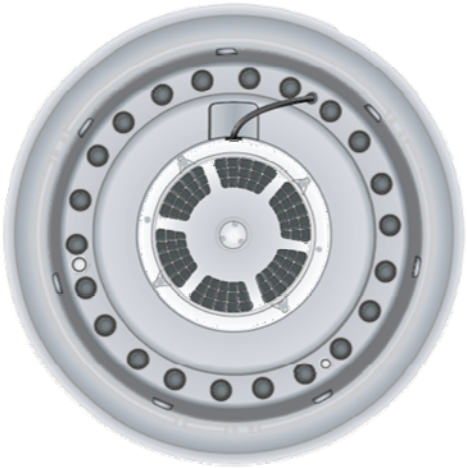
Brake Cooling Fans

Air is drawn by the impeller from the brake side and vented outside. Fans are controlled from a single pushbutton switch on the main instrument panel. When any brake temperature becomes locally higher than 400 C, the "HOT" light illuminates amber associated with an ECAM caution. On the ECAM wheel page, corresponding wheel representation becomes amber. The fans are switched off by the pilots before take-off, however the fans are automatically switched off when the AC current from the engine driven generators reaches 525Hz and/or the weight OFF wheels signal is recieved.

EPAC/TDU32.48.210.01

Main Landing Gear wheel without brake fan

Main Landing Gear wheel with brake fan



- Brake Cooling fan option available for demanding turn-around times

Customization – Tow Bar Fitting Rear Nose Landing Gear

Tow bar fitting on the rear side of the nose landing gear

CP09.10.210

A tow bar fitting is offered as an option at the rear of the nose landing gear in order to provide push-back capability at airports where the available ramp space does not allow push-back operation from the front of the aircraft.

Option	TDU	Model	Weight (kg) MWE/OWE/APL	Equipment reference	Equipment PN	Qty
Installation of a tow bar fitting on the rear side of the nose landing gear	01	A350-800 A350-900 A350-1000	TBD		TBD	1

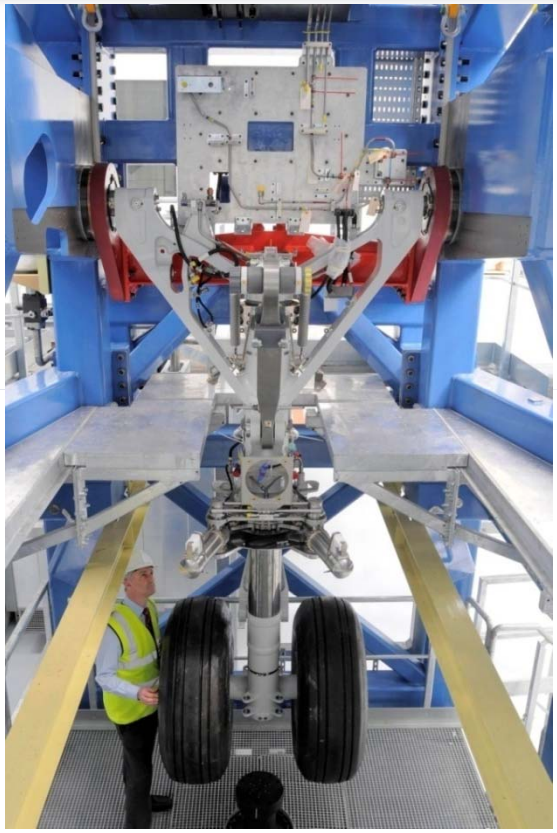
Technical Brochure Contents

A350 Landing Gear

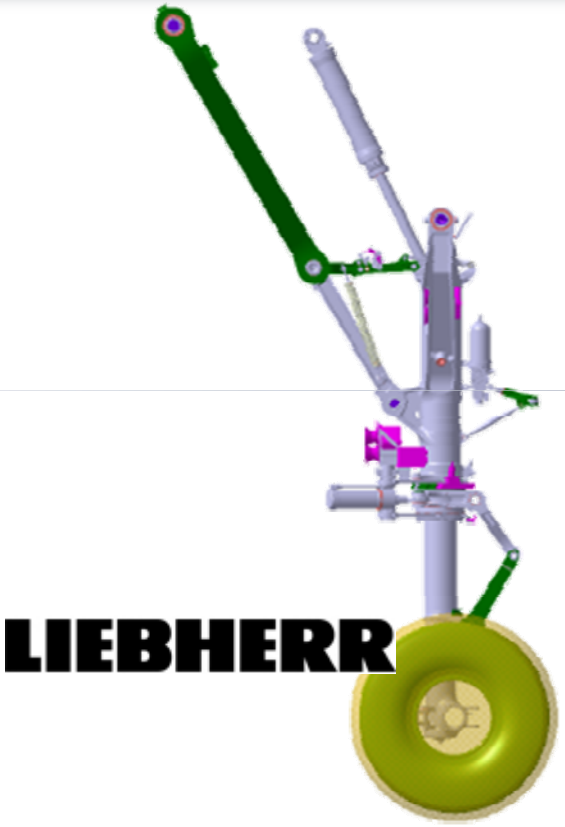
- Landing Gears
  - 14 years between major overhaul requirement
  - use of Titanium components
  - HVOF High Velocity Oxygen Fuel Thermal Process : avoids Chrome plating and gives better finish
  - no shortening mechanisms
  - no steering actuators on Main Gears
- Landing Gear Monitoring
  - Two independent Landing Gear Control Systems that provide 2 system displays, plus 3rd up-lock indicator display
  - Tire monitoring; enables daily checks to be performed from cockpit or maintenance displays
- Braking
  - Brake-by-wire evolution from A320 through A380
  - Brake to Vacate function: safety enhancement *(Mitigate Runway Overruns)*, possible reduced brake wear, improved passenger comfort, reduced brake temperatures
- Avionics
  - use of Integrated Modular Avionics
  - improved Fault isolation
  - reduced Direct Maintenance Cost

- Best use of current mature technology

Nose Landing Gear

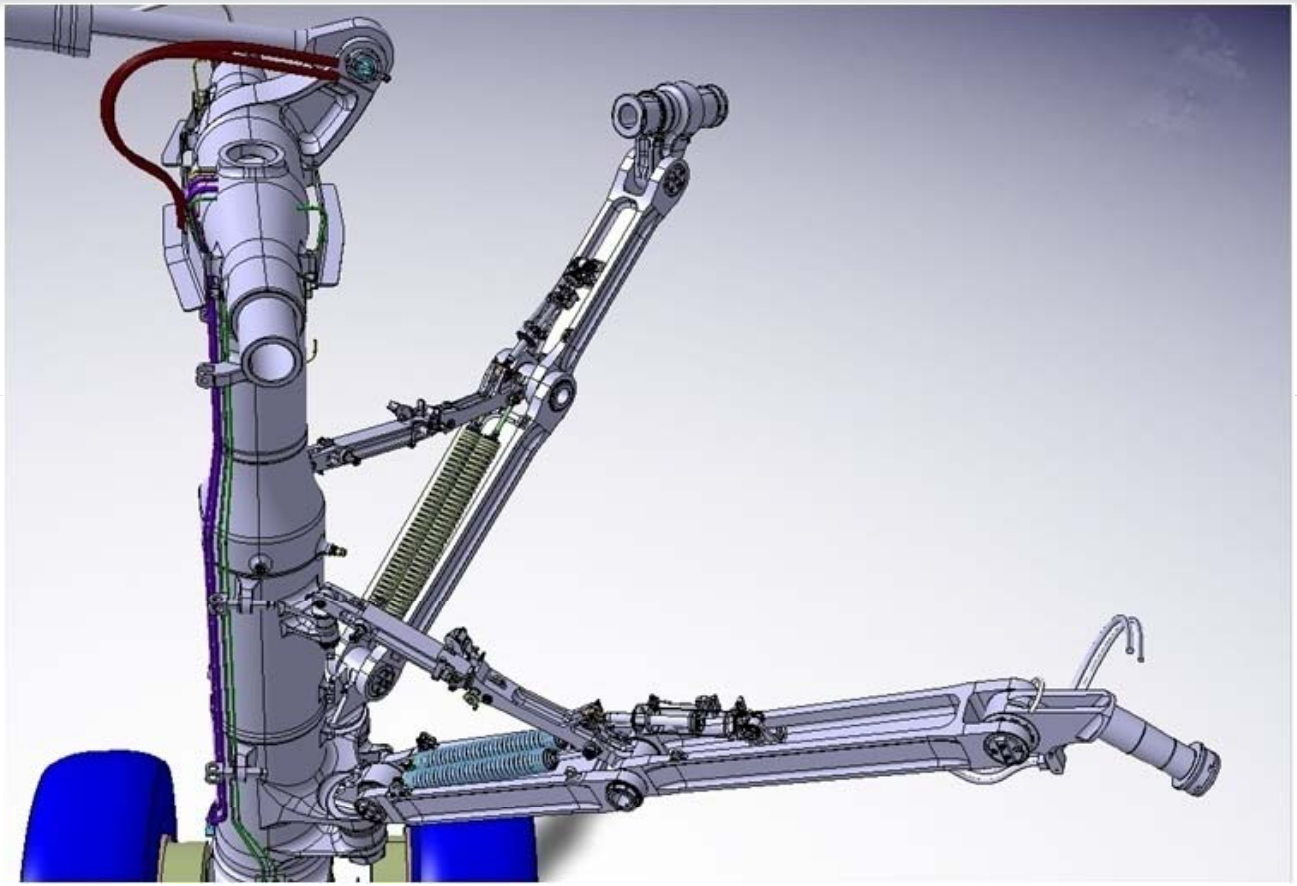


Nose Landing gear in test rig



- Same Nose landing gear design concept for all A350 models:
  strengthened for A350-1000
- Same tire size

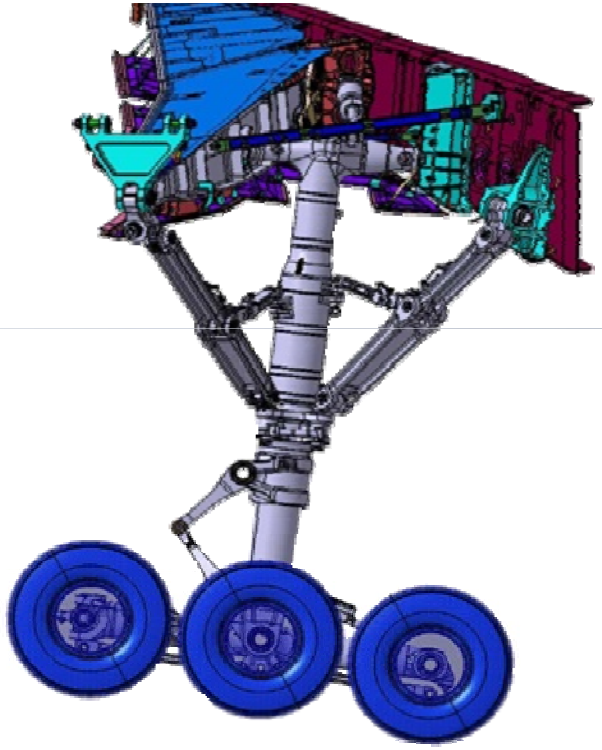
Main Landing Gear - A350-800 & 900



- Double side-stay to distribute loads in CFRP wing structure
  - also applies to A350-1000

Carbon Fiber Reinforced Plastic

Landing Gear - Overhaul

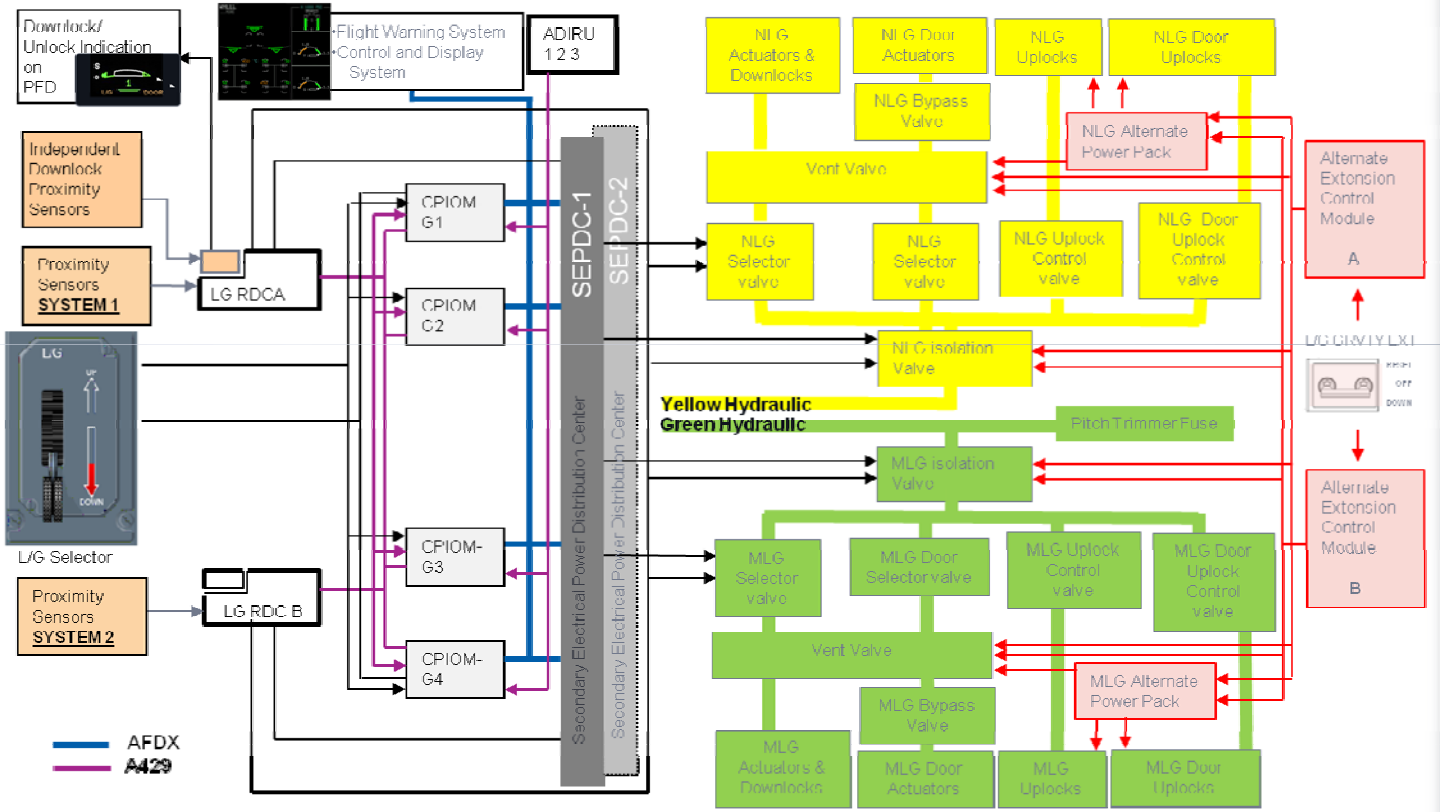


- Landing Gear designed for 14 years between major overhaul
- No shortening mechanism

Landing Gear – Extension Retraction System

AFDX Switch

CPIOM



- Implemented using Integrated Modular Avionics

Automatic Braking

- Automatic braking (selected by new AUTO BRK pushbutton)
  - BRK RTO Rejected take-off (when A/C is on ground) or
  - BRK BTV Brake-To-Vacate (when in-flight and runway/taxiway selected) or
  - AUTO BRK default (equivalent to a MED level on Single Aisle)

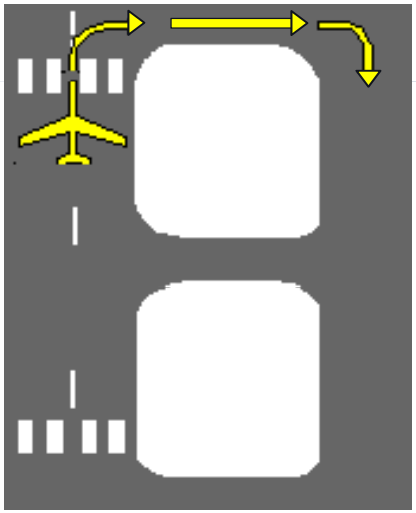
Pilot Flight Display

BRK RTO or
BRK BTV or
AUTO BRK

- Automatic braking when selected:
  responds according to flight phase and function availability

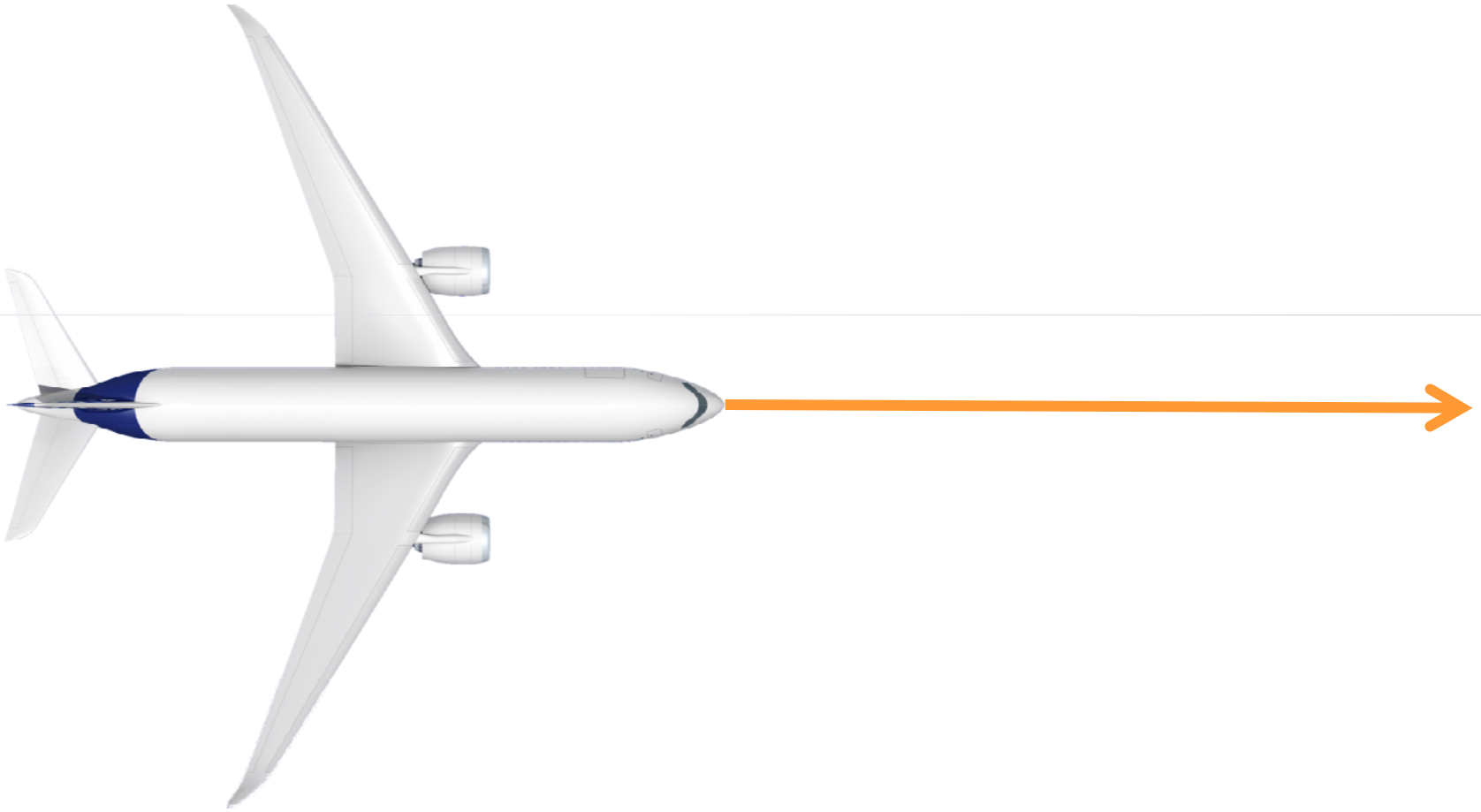
Backup Steering

- Automatic Differential Braking via **Steering Handwheel**, to produce an equivalent steering response in case of Yellow hydraulic failure



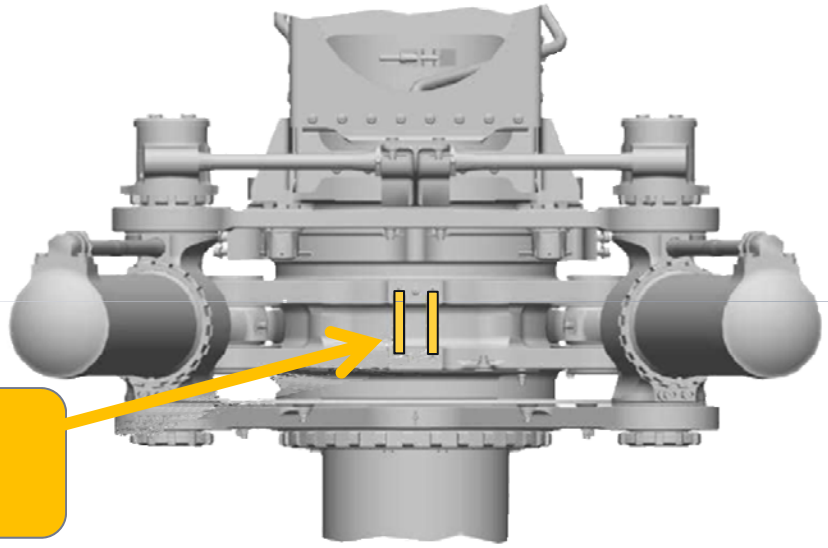
- Backup steering without additional hardware

Heading Control



- Maintain on ground pilot heading demand without need for minor corrections

Oversteer Protection



The NLG provides brackets that deform above ±78° indicating over steer event has occurred. These devices will record an Overseer with A/C power off.

- Nose landing gear oversteer recorded by mechanically deformed brackets

3rd Generation TPIS On A350

1st Generation TPIS on A320, A330, A340 aircraft

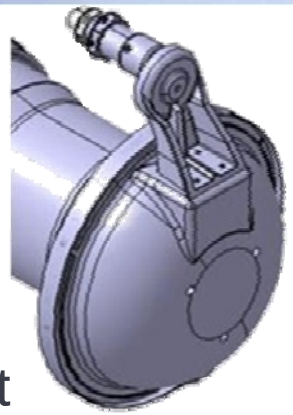
- With wire from pressure sensor to rotating mechanism in axle

2nd Generation TPIS on A380 aircraft

- With wire from pressure sensor to rotating pressure sensing Assembly with concentric antenna in axle mounted assembly

3rd Generation TPIS on A350 aircraft

- Removal of wire from hubcap to pressure sensor
- Smart pressure sensor powered through antennas in hubcap and in axle mounted assembly
- Digital pressure frames decoded by dedicated LRU ensuring robust pressure measurement



• Daily pressure checks may be performed in cockpit

Technical Brochure Contents

Summary

- Common concept Nose Landing Gear A350-800/900/1000
- Common 4 wheel bogie Main Gear for A350-800/900
  - 6 wheel bogie Main gear for A350-1000
- Landing Gear designed for 14 years between major overhaul
- Brake-by-wire control system (Airbus evolution: A320, A330, A340, A380)
  - Brake To Vacate (flying on A380), new Auto brake button function selection
- Steer-by-wire (Airbus evolution: A320, A330, A340, A380)
  - Differential backup steering: Pilot demand by steering hand wheels
- 5000psi hydraulic source
  - (flying on A380)
- Tire pressure monitoring: used for daily tire check
  - (Airbus evolution: A320, A330, A340, A380)
- Brake cooling option available
- Integrated Modular Avionics control system architecture
  - (Airbus evolution: flying on A380)

- Landing Gear Systems implemented using mature technologies

Technical Brochure Contents

Suppliers

	A350-800	A350-900	A350-1000
Nose Gear	Liebherr		
Main Gear	Safran Messier-Bugatti Dowty		Goodrich
Brakes Wheels	Safran Messier-Bugatti Dowty		
Brakes Wheels	Goodrich		
Tires	Michelin		
Tires	Bridgestone		
Brake System	Safran Messier-Bugatti Dowty		
Landing Gear Extension Retraction system	Safran Messier-Bugatti Dowty		
Steering	Safran Messier-Bugatti Dowty		
Tire Pressure	Safran Messier-Bugatti Dowty