D3.8 Flight Test Programme – Flight Test Phase #3, Julius Bartasevicius (TUM)

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CO	Confidential, only for members of the consortium (including the Commission Services)	

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Glossary

AGL	Above Ground Level
ATZ	Aerodrome Traffic Zone
CONOPS	Concept of Operations
EDBC	Magdeburg-Cochstedt Airport
FCC	Flight Control Computer
FTO	Flight Test Operator
GCS	Ground Control Station
GUI	Graphical User Interface
HIL	Hardware in the Loop
IMU	Inertial Measurement Unit
LBA	National Aviation Authority of Germany
LTE	Long Term Evolution
PPM	Pulse-Position Modulation
RC	Remote Controller
SIL	Software in the Loop
SW	Software
TMS	Thrust Measurement Sensor
UAV	Unmanned Aerial Vehicle
VLOS	Visual Line Of Sight

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1 Executive Summary

This deliverable depicts the planned flight test programme 3 for flying the flutter critical -1 wing set with the rebuilt demonstrator aircraft in the last year of the project, 2023. A detailed flight test programme is established defining the test objectives, means of compliance, requirements on specific test procedures to be followed.

Two flight test campaigns are planned for 2023: the first one in March-April and the second one in May. The objectives of these campaigns are to firstly flight test all the systems of the demonstrator which was rebuilt after the crash in August, 2022. After that, test points for aerodynamic modeling have to be done leading to the final part of the flight tests - passing the first two flutter speeds with the help of the designed flutter controllers and validate the model predictions of the the open-loop flutter speed.

Special care has to be taken by flying the demonstrator with the -1 wing as unstable symmetric and asymmetric flutter modes are expected within the flight regime in open-loop. Flying with this configuration is just possible below the flutter speed in open-loop or with a flutter controller switched on. A manually operated flutter stopper system is also used onboard the demonstrator for flight safety risk mitigation, initial test will be conducted with flutter stopper in safe configuration, while the later test will be in the flutter stopper in flutter prone setup.

For security reasons and also to judge the performance of the developed active flutter suppression system an operational modal analysis is performed in real time. It provides information on the actual frequency, damping and mode shapes of the aircraft modes.

The deliverable is divided in three main sections. The first one explains the preparations made to the flight setup for the last two flight test campaigns. The second one presents flight test data processing workflow while the third one - the plan for the first and second test campaigns.

2 Flight Test Set-up

2.1 Flight Test Environment (TUM)

As Mentioned in the D3.2 - Flight Test Report Phase 1, the rules for flying UAVs in Germany and generally in Europe have changed significantly due to new EASA regulations. This required additional effort to submit an application for a flight permit that would be accepted by the Luftbundesamt (LBA). In 2022 a time-limited flight permit was received after the 5th iteration of the application. Another iteration was required to extend it until the end of the year.

For 2023, 4 more iterations were required. This was due to a change in flight geography, change in the calculation of flight and concingency geographies, some configurational changes and also further information demanded by the LBA. The permit was received until end of May, and then an extension until end of June.

Overall, the flight permit application process required significant effort from the TUM team, which was not planned in the project. Additionally, it became impossible to receive a permit for Oberpfaffenhofen (EDMO) for this type of aircraft, which meant higher logistical efforts for the flight tests.

2.1.1 Preparations for flying at Magdeburg-Cochstedt Airport (EDBC)

The consortium is already familiar with the Magdeburg-Cochstedt Airport (EDBC) airport from last year.

The airport belongs to DLR and is located far away from any major air transport hub, which makes it a good candidate for conducting longer flight test campaigns, even though transportation to Cochstedt would take way longer than to Oberpfaffenhofen.

The airspace details can be seen in Figure 1. The airport layout is seen in Figure 2.

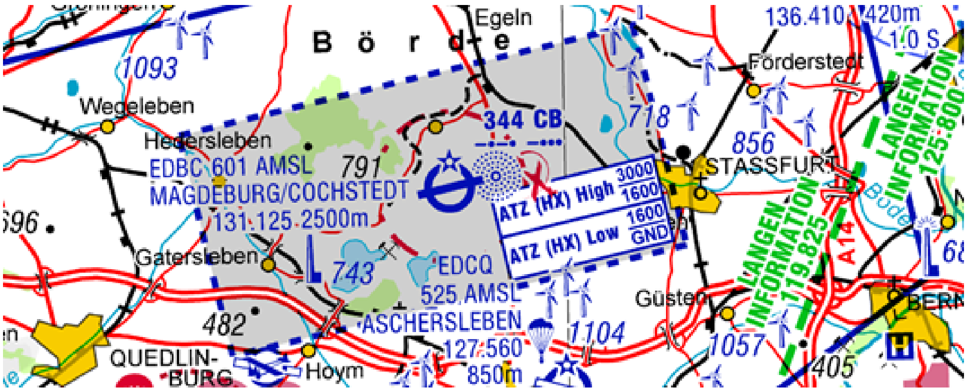


Figure 1: EDBC and the surroundings.

EDBC airport has the possibility to close the airspace above it (ATZ (HX) Low and High). T-FLEX flights will only be done when the airspace is closed exclusively for the UAV. A written agreement is received from the EDBC for this. As the airport is at 601ft altitude, the zone has vertical limit of 1000ft (305m) AGL.

The application is made for two circular geographies. The first one is centred around the taxiway Charlie in the east (EDBC I) and the second is centred around the taxiway Delta in the west (EDBC II).

Ground risk buffer calculations for two flight altitudes were calculated (with contingency altitudes in

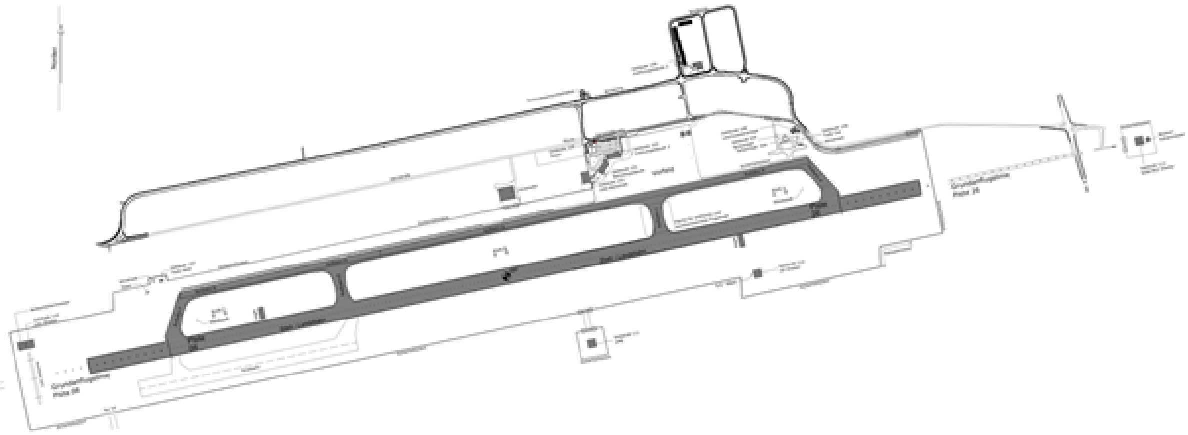


Figure 2: EDBC Airport layout.

brackets): $H_{FG} = 150m$ ($H_{CV} = 308m$) and $H_{FG} = 300m$ ($H_{CV} = 458m$). To estimate the ground risk buffer, a custom software was used . The software was adjusted with the characteristics of the installed parachute. An example of the single simulation can be found in Figure 3.

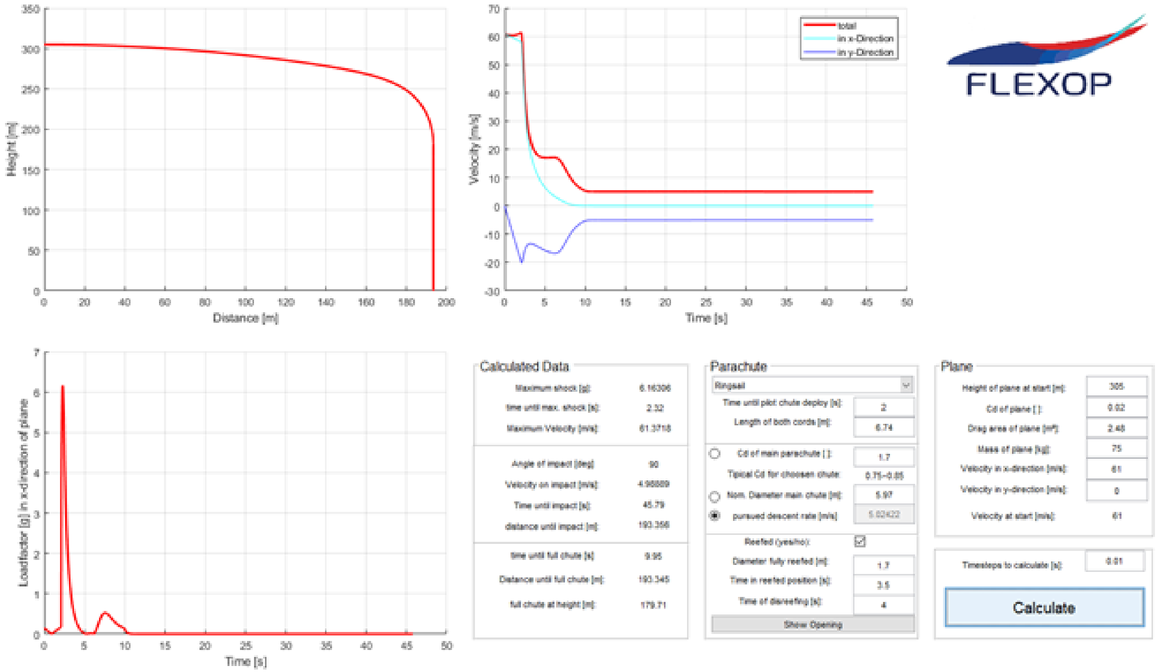
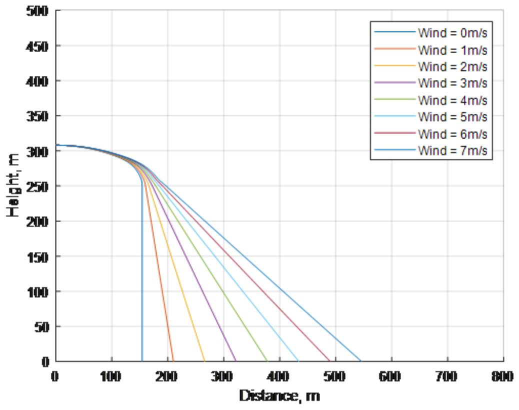


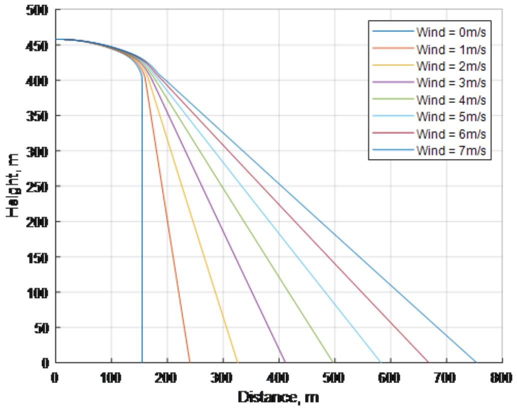
Figure 3: Parachute trajectory when released from 305m AGL, 0m/s wind case.

The simulations were performed for various horizontal wind conditions from 0 to 7m/s. The resulting trajectories are presented in Figure 4 and tabulated in Table 1.

Due to the big ground risk buffers, different maximum wind speeds had to be selected for the two flight geographies. The first flight geography considers the pilots located at the taxiway Charlie and, taking



(a) $H_{CV} = 308m$.



(b) $H_{CV} = 458m$.

Figure 4: Horizontal distance travelled with various wind conditions

Table 1: Distances travelled after parachute release from two different heights

Wind speed, m/s	$H_{CV} = 308m$	$H_{CV} = 458m$
0	155m	155m
1	210m	241m
2	267m	326m
3	323m	412m
4	378m	497m
5	435m	583m
6	491m	669m
7	546m	754m

the surrounding towns into account, allowed for the maximum of 7m/s wind.

The second flight geography considers the pilots located at the taxiway Delta. In this case, due to the proximity of the villages of Neu Königsaue and Cochstedt the available distance in between the pilots and the buildings is reduced to 2040m. Therefore, it was required to also reduce the maximum wind condition to 5m/s (the required ground risk buffer is 583m, Table 1) and also the radius of the flight geography from 1300m to 1260m.

The flight geometries were built in the following manner:

- The pilot position was marked on the map.
- A required flight geography circle was drawn around it (either 1260m or 1300m, which is within the VLOS boundary of 1500m).
- Contingency zone of $S_{CV} = 197m$ was added.
- Maximum operating altitude of $H_{FG} = 300m$ ($H_{CV} = 458m$) was chosen.
- Ground risk buffer zone for the maximum wind condition of either 5m/s or 7m/s at $H_{CV} = 458m$ ($S_{GRB} = 583m$ for 5m/s wind and $S_{GRB} = 754m$ for 7m/s wind) was added.

The resulting maps are shown in Figures 5 and 6.

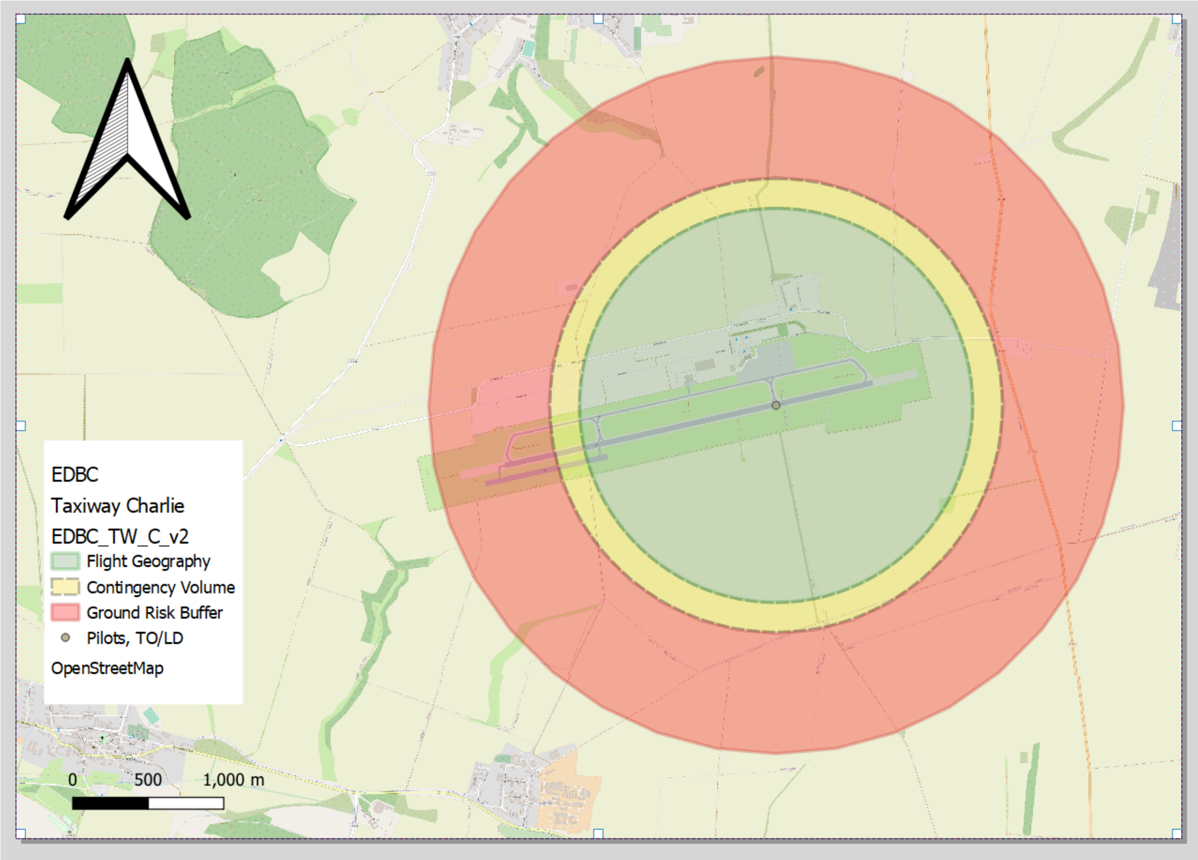


Figure 5: Flight Geography for Taxiway Charlie.

2.2 Flight Test Crew

The Flight Test Crew will be made up from members of TUM, as before. Care was taken to have replacement members available for each of the flight crew roles. Due to some of the members leaving TUM permanently, new members were trained.

The training program consists of the following phases:

- Read (and watch) the prepared training material. This includes some background and educational videos based on the previous flight test experience, as well as familiarization with CONOPS and checklists.
- Attend a tour where we go through the aircraft in person and explain all the systems it has.
- Training day in the simulator where we will test the abilities of communication during flight and assign the roles.
- After that, training for specific roles will be done by the long-time members of the flight test crew.
- We will then do a practise run of the full ground control and aircraft setup, including everything apart from the engine start.

Figure 6: Flight Geography for Taxiway Delta.

- Time permitting, we might also do a training session for Operator and Manager roles with a real UAV.

Therefore, for the flight season 2023 the flight crew personnel pool consisted of a total of 9 people that were available for different roles. 3 Members could take the role of a pilot, 2 of the flight test manager, 4 of the flight test engineer and 3 of the flight test operator (some members were available for different roles within the team). This provided greater flexibility for planning the campaigns.

2.3 Documentation

The flight test documentation takes place in three mediums: logged data, video data and written notes.

As before, the flight tests will be logged on the FCC. Additionally, thrust measurement data and operational modal analysis data will be logged on the OBC-II platform. Additionally, the transmitter logs will be added to the main logs. The aircraft configuration parameters will be noted in the acdata.txt file for each flight. Mission Planner log will be available as well.

Videos will be recorded on the two tail-mounted cameras. A 360 degree camera mounted above the fuselage will provide the better overview of the aircraft in-flight. An example of the panoramic view from the camera is shown in Figure 7.

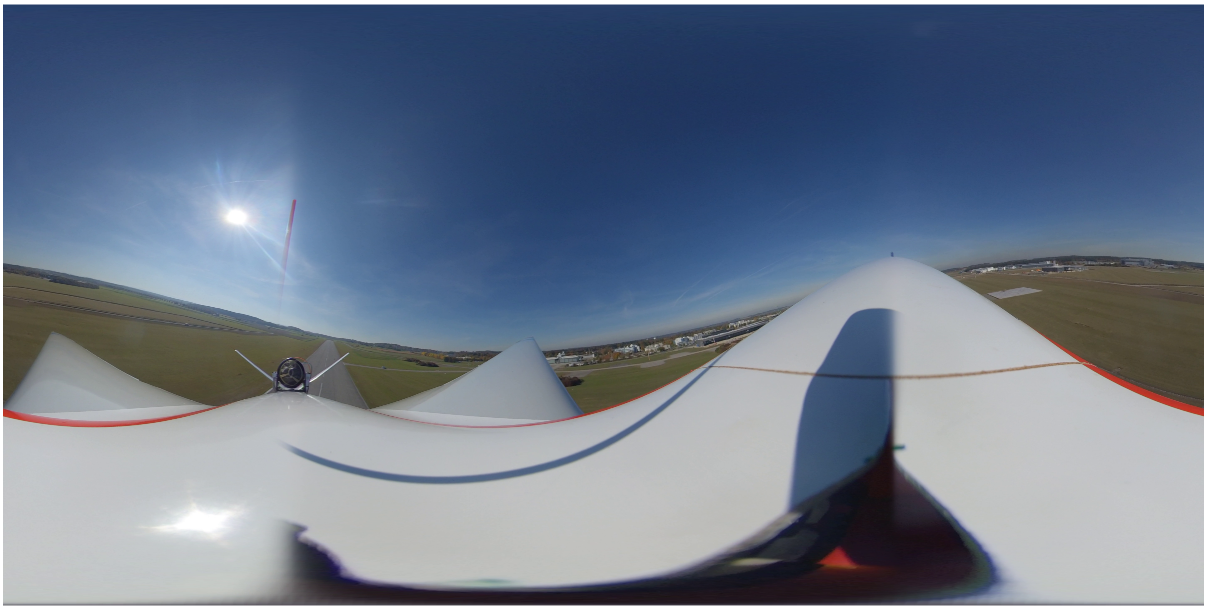


Figure 7: Panoramic view from the 360 degree camera mounted above the fuselage. Visible is (from left to right): left wing, engine and tail, right wing, front-top part of the fuselage.

Finally, an external camera tracker will be used, which automatically follows the aircraft during flight.

In 2022 the paper test cards were substituted for their digital versions. The test cards were rewritten in OneNote and are filled out by the Flight Test Manager during flight. This has already proved to be a very convenient change. This allowed to be able to adapt the test cards minutes before the flight, share them with the team online. It also facilitates more efficient pre-flight and post-flight briefing with the team.

04 System start-up

Dienstag, 10. Mai 2022 15:56

	System start-up		
ALL	Perform an intercom check	✓	
	Confirm the antenna position is correct.	✓	
OPERATOR	Start the Mission Planner	✓	
OPERATOR	Start the Engineering Data Link	✓	
ENGINEER	Plug in the 6S battery	✓	FLIGHT-HAT and the Raspberry-Pi are booting up and the sensors are getting ready
FLEXOP 1	Start the 360 camera	✓	
ENGINEER	Confirm the flightHAT has a red LED constantly ON	✓	
FLEXOP 1, FLEXOP 2	Confirm that phones are away	✓	
FLEXOP 1, FLEXOP 2	Both transmitters ON	✓	
FLEXOP 1, FLEXOP 2	Transmitter model FLEXOP 1	✓	

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Figure 8: An example of the test cards used.

3 Flight Test Programme

Two flight test campaigns are planned for 2023, which follow the tight schedule of rebuilding the demonstrator and the required ground tests. Based on this schedule, the first flight test campaign falls in March and the second one in May. These timings were selected so that there is some buffer left in June in case any final individual flights will be required.

The two campaigns are presented in the following subsections.

An important thing to note is the change in flutter testing sequence. Previously it was envisioned that flutter would be tested in a horse-race pattern, where there is an acceleration window, a measurement window (up to 2-4 seconds) and a decceleration window before turning around. After discussing this further it was decided that such a trajectory is not really valuable as the high speed points are only reached for a very short amount of time. Therefore, it was decided to change the horse-race pattern into a steady coordinated turn flight with large radius. It was confirmed that the additional load factor (of up to 1.1G) does not influence significantly the flutter behaviour of the aircraft, and operationally such flight would be way simpler. As a result, the measurement legs are only limited by drift of the trajectory due to wind, which can also be corrected for. Therefore, testing such a trajectory will be one of the goals of the first campaign.

3.1 March-April Flight Test Campaign

The March-April campaign is planned for two weeks on 27.03 - 06.04.

The goals for the flight test campaign were split into primary for the flight dynamics, primary for the autopilot system, and secondary objectives.

The primary flight dynamics goals for the first flight test campaign are (responsible partners are noted down in the brackets):

- Perform the maiden flight with the new demonstrator. (TUM, SZTAKI)
- Confirm take-off and landing performance for the new demonstrator. (TUM)
- Confirm fuel system performance (main and auxiliary), and evaluate the increase in flight time and c.g. shift due to fuel transfer (TUM)
- Confirm the sensor network works as required. (SZTAKI)
- Get new trim values for all flight states (take-off, cruise, landing). (TUM)
- Familiarize with handling qualities of the new demonstrator. (TUM)
- Direct drive modelling in-flight (frequency sweeps at different loads/airspeeds). (SZTAKI)
- Perform manoeuvres for baseline performance evaluation (lift, drag polars). (TUM)
- Perform manoeuvres for rigid and elastic model identification and update. (TUM, DLR-SR)
- Test the flutter stopper function in-flight (for this we would need to fly flutter configuration, not flutter-free). (TUM, DLR-SR, DLR-G, SZTAKI)
- Test the data processing and evaluation toolchain in-flight (telemetry links, online data retrieval, model updating). (TUM, DLR-SR, DLR-G, SZTAKI)

The primary autopilot system goals are:

- Tune the augmented mode for the new demonstrator. (SZTAKI)
- Confirm that the altitude hold mode can track the required pressure altitude. (SZTAKI)
- Adjust the flight control surface lookup tables and confirm their behavior (SZTAKI, TUM)
- Confirm that the autothrottle mode can follow different airspeeds all the way up to the second flutter speed. (SZTAKI)
- Confirm that the autopilot can guide the aircraft in circles (getting into the circle, following the circle, aborting the circle). (SZTAKI)
- Confirm that all three modes can work together (increase the airspeed while flying in a circle). (SZTAKI)
- Test and refine the telemetry and EDL system (SZTAKI, TUM)

Finally, some secondary goals were noted down:

- Investigate the engine wake effects on the V-Tail. (TUM)
- Investigate the effects of asymmetry of the wings and the possible associated free-play (TUM, DLR-G).

These goals were transferred into three separate flights. It is envisioned that these flights are just preliminary plans and can be changed/adapted during the test campaign or even the flight. For example, if one test block is finished and there is still time remaining, the test block from the next flight can be started. This is especially important due to installing new fuel system onboard the aircraft, allowing longer flight time.

The test cards from the first campaign are presented in the following pages.

Maiden Flight 1

Thursday, March 23, 2023   8:47

Flight Goal:
Test the new aircraft. Get familiar with the aircraft handling. Trim the aircraft. Cehck the TX airspeed probes. Test the autopilot modes.

ENGINEER	CONFIRM **AUGMENTED** SELECTED ON AP1 AND AP2		
ENGINEER	CONFIRM **OLD** LUT SELECTED		
ENGINEER	CONFIRM **AUTOTHROTTLE FILTER** SELECTED		
ENGINEER	CONFIRM THE PARACHUTE IS ATTACHED TO THE TAIL CONE		
	Take-off		
MANAGER	REPORT TO ATC READY FOR TAKE-OFF		
FLEXOP 1, FLEXOP 2	Engine **ON**	*	
FLEXOP 1	CHECK CONTROLS, FULL DEFLECTIONS		
FLEXOP 1, FLEXOP 2	JETI WARNINGS **ON** **Volume 100%**		
OPERATOR	STANDBY TO ANNOUNCE TAKE-OFF AT 18m/s		
FLEXOP 1	CLEARED FOR TAKE-OFF		T-0
FLEXOP 1	THROTTLE 70%, CLIMB 200		At 30m AGL, stay in TO config
	Trim setting check		
FLEXOP 2	TURN THE FUEL TRANSFER ON		This starts pumping the fuel from AUX to MAIN tank.
FLEXOP 1	TRIM 35m/s		
FLEXOP 1	FLIGHT STATE LANDING		
FLEXOP 1	TRIM 35m/s		
FLEXOP 1	FLIGHT STATE CRUISE		
FLEXOP 1	TRIM 35m/s		
	Airspeed probe check		
FLEXOP 2	REPORT MAIN TX AIRSPEED		Main TX airspeed: GCS Airspeed:
FLEXOP 2	REPORT SECONDARY TX AIRSPEED		Secondary TX airspeed: GCS Airspeed:
OPERATOR	MUTE THE ANNOUNCER SCRIPT, RELAUNCH ONLY FOR WARNINGS		If both airspeeds are similar to the main system
FLEXOP 1	TURN ON SPEED ANNOUNCEMENTS		
	Pilot Training		
FLEXOP 1	PREPARE FOR LANDING IMITATION	*	Around 20m AGL
FLEXOP 1	SWITCH MANUAL		
FLEXOP 1	FLIGHT STATE LANDING		
OPERATOR	GUIDE FOR LANDING, ANNOUNCER SCRIPT OFF, REPORT SPEED		

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	Repeat above block as needed		Repeated:
FLEXOP 2	REPORT FUEL USED		
	Augmented mode check		
FLEXOP 1	FLIGHT STATE CRUISE		
FLEXOP 1	SWITCH AUTOPILOT 1		
FLEXOP 1	FREE FLIGHT		If needed to be familiar with the aircraft
FLEXOP 1	SWITCH MANUAL		
	Landing		**When either:** **6.2kg used (MAIN)** **8.8kg used (MAIN and AUX)**
FLEXOP 1	PREPARE FOR LANDING	*	
FLEXOP 1	FLIGHT STATE LANDING		If GO AROUND: Throttle 70%, FS LANDING until safe
FLEXOP 2	TURN THE FUEL TRANSFER OFF		
FLEXOP 1	ONE TRAFFIC PATTERN FOR TRIM CHECK		
OPERATOR	GUIDE FOR LANDING, REPORT AIRSPEED		
FLEXOP 1	DUAL RATE FULL		
FLEXOP 1	AFTER TOUCHDOWN ELEVATOR UP		
FLEXOP 1	CHECK CONTROLS, FULL DEFLECTIONS		
FLEXOP 1	ENGINE OFF	*	

	PLAN B		

Nr	U, m/s	MAN ID	Amplitude	OK	Notes
		Acceleration-deceleration			30-50-30
		Acceleration-deceleration			30-50-30
		Acceleration-deceleration			30-50-30
		Asymmetric chirp	2		36
		Asymmetric chirp	2		36
		Symmetric chirp	2		36
		Symmetric chirp	2		36
		Symmetric chirp	2		46
		Symmetric chirp	2		46
		Asymmetric chirp	2		36
		Asymmetric chirp	2		36
		Multisine rudder	5		36
		Multisine rudder	5		36
		Multisine rudder	4		46
		Multisine rudder	4		46

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Baseline Controller Check 1

Sunday, March 26, 2023 16:12

Flight Goal:
Test all the autopilot functions required for the flutter supression tests.

ENGINEER	CONFIRM **AUGMENTED** SELECTED ON AP1 AND AP2		
ENGINEER	CONFIRM **OLD** LUT SELECTED		
ENGINEER	CONFIRM **ALTITUDE HOLD** SELECTED ON AP2		Pitch command is limited to 20deg
ENGINEER	CONFIRM **ROBUST** SELECTED		Under Autothrottle Params window
ENGINEER	CONFIRM **AUTOTHROTTLE FILTER** SELECTED		
ENGINEER	INPUT **38m/s**		As velocity parameter
	Take-off		
MANAGER	REPORT TO ATC READY FOR TAKE-OFF		
FLEXOP 1, FLEXOP 2	Engine **ON**	*	
FLEXOP 1	CHECK CONTROLS, FULL DEFLECTIONS		
FLEXOP 1, FLEXOP 2	JETI WARNINGS **ON** **Volume 100%**		
OPERATOR	STANDBY TO ANNOUNCE TAKE-OFF AT 18m/s		
FLEXOP 1	CLEARED FOR TAKE-OFF		T-0
FLEXOP 1	THROTTLE 70%, CLIMB 200		At 30m AGL, stay in TO config
FLEXOP 1,2	FLIGHTSTATE CRUISE		
	Augmented mode check		
FLEXOP 1	SWITCH AUTOPILOT 1		
FLEXOP 1	DO CONTROL INPUTS TO CHECK BEHAVIOUR		The control inputs should be at 0.5-1Hz range.
FLEXOP 1	CIRCLE IN POSITION		
FLEXOP 1	REPORT BEHAVIOUR		
ENGINEER	CHECK AP SETTINGS AS ABOVE		
	Altitude hold check		
ENGINEER	CONFIRM **CURRENT ALTITUDE** SELECTED		Under Altitude (AMSL) window. The altitude hold target will be selected when the pilot switches to AP2.
FLEXOP 1	CLIMB 200		

FLEXOP 1	SWITCH AUTOPILOT 2		The altitude hold target is selected.
FLEXOP 1	CIRCLE, TAKE CARE FOR SPEED		
FLEXOP 1	THROTTLE INPUT		To check if the altitude hold functions correctly.
ENGINEER	SELECT -25m		
ENGINEER	SELECT **CURRENT ALTITUDE**		See if the right altitude is reached.
FLEXOP 1	SWITCH AUTOPILOT 1		
FLEXOP 2	REPORT FUEL		
	Autothrottle check 1 - Robust mode		
ENGINEER	CONFIRM **AUTOTHROTTLE** SELECTED ON AP2		
ENGINEER	CONFIRM **ROBUST** SELECTED		Under Autothrottle Params window
ENGINEER	SELECT **38m/s**		Under Velocity window
FLEXOP 1	SWITCH AUTOPILOT 2		
FLEXOP 1	CIRCLE		To check the autothrottle functionality. If works, continue. If not, switch to AP1 and go to plan B.
ENGINEER	SELECT **42m/s**		Under Velocity window
ENGINEER	SELECT **38m/s**		Under Velocity window
FLEXOP 1	SWITCH AUTOPILOT 1		
	Autothrottle check 2 - Performance mode		
ENGINEER	CONFIRM **PERFORMANCE** SELECTED		Under Autothrottle Params window
FLEXOP 1	SWITCH AUTOPILOT 2		
FLEXOP 1	CIRCLE		To check the autothrottle functionality. If works, continue. If not, switch to AP1 and go to plan B.
ENGINEER	SELECT **42m/s**		Under Velocity window
ENGINEER	SELECT **38m/s**		Under Velocity window
FLEXOP 1	SWITCH AUTOPILOT 1		
	Autothrottle check 3 - TECS Mode		
ENGINEER	CONFIRM **TECS** SELECTED		Under Autothrottle Params window
FLEXOP 1	SWITCH AUTOPILOT 2		
FLEXOP 1	CIRCLE		To check the autothrottle functionality. If works, continue. If not, switch to AP1 and go to plan B.
ENGINEER	SELECT **42m/s**		Under Velocity window
FLEXOP 1	CIRCLE		To check the autothrottle functionality. If works, continue. If not, switch to AP1 and go to plan B.
ENGINEER	SELECT **+25m**		Under Altitude (AMSL) window
ENGINEER	SELECT **38m/s**		Under Velocity window
ENGINEER	SELECT **CURRENT ALTITUDE**		Under Altitude (AMSL) window

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ENGINEER	CONFIRM **ALTITUDE HOLD** SELECTED ON AP1		If good, move it to AP1 as well
ENGINEER	CONFIRM **AUTOTHROTTLE** SELECTED ON AP1		
ENGINEER	CONFIRM **PERFORMANCE** SELECTED		Under Autothrottle Params window?
FLEXOP 1	SWITCH AUTOPILOT 1		
ENGINEER	SELECT **34m/s**		If everything works
	Course angle		
ENGINEER	CONFIRM **COURSE ANGLE** SELECTED ON AP2		
ENGINEER	CONFIRM **EAST** SELECTED		Depending on intended flight direction
ENGINEER	CONFIRM **400m** and **CLOCKWISE** SELECTED		
FLEXOP 1	FLY EAST WITH COURSE OFFSET		Within 30deg
FLEXOP 1	SWITCH AUTOPILOT 2		The heading should change to the intended direction
ENGINEER	SELECT **COORDINATED TURN**		AC should start a turn with 400m radius.
ENGINEER	SELECT **42m/s**		Under Velocity window
ENGINEER	SELECT **900m**		
FLEXOP 1	SWITCH AUTOPILOT 1		Or continue with increasing airspeed and skip these three points?
	Autothrottle full envelope check		
FLEXOP 1	SWITCH AUTOPILOT 2		
ENGINEER	SELECT **COORDINATED TURN**		AC should start a turn with 400m radius.
ENGINEER	SELECT **42m/s**		R = 386m
ENGINEER	SELECT **46m/s**		R = 463m
ENGINEER	SELECT **50m/s**		R = 547m
	Landing		**When either:** **6.2kg used (MAIN)** **8.8kg used (MAIN and AUX)**
FLEXOP 1	PREPARE FOR LANDING	*	
FLEXOP 1	FLIGHT STATE LANDING		If GO AROUND: Throttle 70%, FS LANDING until safe
OPERATOR	GUIDE FOR LANDING, REPORT SPEED		
FLEXOP 1	DUAL RATE FULL		
FLEXOP 1	AFTER TOUCHDOWN ELEVATOR UP		
FLEXOP 1	CHECK CONTROLS, FULL DEFLECTIONS		
FLEXOP 1	ENGINE OFF	*	

Identification

Sunday, March 26, 2023 17:30

Flight Goal:
Do all the required manoeuvre injections.

ENGINEER	CONFIRM **AUGMENTED** SELECTED ON AP1 AND AP2		
ENGINEER	CONFIRM **NEW** LUT SELECTED		
ENGINEER	CONFIRM **HIGH** GAIN SELECTED		
ENGINEER	CONFIRM **ALTITUDE HOLD** SELECTED ON AP1		Pitch command is limited to 20deg
ENGINEER	CONFIRM **PERFORMANCE** SELECTED		Under Autothrottle Params window
ENGINEER	INPUT **34m/s**		As velocity parameter
ENGINEER	CONFIRM **AUTOTHROTTLE** SELECTED ON AP1		
	Take-off		
MANAGER	REPORT TO ATC READY FOR TAKE-OFF		
FLEXOP 1, FLEXOP 2	Engine **ON**	*	
FLEXOP 1	CHECK CONTROLS, FULL DEFLECTIONS		
FLEXOP 1	JETI WARNINGS **ON**		
OPERATOR	STANDBY TO ANNOUNCE TAKE-OFF AT 18m/s		
FLEXOP 1	CLEARED FOR TAKE-OFF		T-0
FLEXOP 1	THROTTLE 70%, CLIMB 200		At 30m AGL, stay in TO config
	AP preparation		
ENGINEER	AT 200m CONFIRM **CURRENT ALTITUDE** SELECTED		Under Altitude (AMSL) window. The altitude hold target is selected at this point.
FLEXOP 1	SWITCH AUTOPILOT 1		Altitude hold and augmented and autothrottle is live now.
	Manoeuvre injections		
	See the table below		
	Landing		**When either:** **6.2kg used (MAIN)** **8.8kg used (MAIN and AUX)**
FLEXOP 1	PREPARE FOR LANDING	*	
FLEXOP 1	FLIGHT STATE LANDING		If GO AROUND: Throttle 70%, FS LANDING until safe
OPERATOR	GUIDE FOR LANDING, REPORT SPEED		
FLEXOP 1	DUAL RATE FULL		
FLEXOP 1	AFTER TOUCHDOWN ELEVATOR UP		
FLEXOP 1	CHECK CONTROLS, FULL DEFLECTIONS		
FLEXOP 1	ENGINE OFF	*	

Nr	U, m/s	MAN ID	Amplitude	OK	Targets

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		MANUAL			
		Acceleration-deceleration			30-50-30
		Acceleration-deceleration			30-50-30
		Acceleration-deceleration			30-50-30
		Banked manual doublet			36m/s, +40deg bank, 10deg/s
		Banked manual doublet			36m/s, +40deg bank, 10deg/s
		Banked manual doublet			36m/s, -40deg bank, 10deg/s
		Banked manual doublet			36m/s, -40deg bank, 10deg/s
		REDUCE dual rate for these			
		Pushover-pullup			36m/s, 0-2G, 10deg/s, 20deg pitch
		Pushover-pullup			36m/s, 0-2G, 10deg/s, 20deg pitch
		Pushover-pullup			36m/s, 0-2G, 10deg/s, 20deg pitch
		Pushover-pullup			46m/s, 0-2G, 10deg/s, 20deg pitch
		Pushover-pullup			46m/s, 0-2G, 10deg/s, 20deg pitch
		Pushover-pullup			46m/s, 0-2G, 10deg/s, 20deg pitch
		AP INJECTIONS			
		Multisine elevator	5		36m/s
		Multisine elevator	5		36m/s
		Flap 2-3-4 multisine	2		36m/s
		Flap 2-3-4 multisine	2		36m/s
		Multisine rudder	5		36m/s
		Multisine rudder	5		36m/s
		Multisine aileron	2		36m/s
		Multisine aileron	2		36m/s
		Multisine elevator	4		46m/s
		Multisine elevator	4		46m/s
		Flap 2-3-4 multisine	2		46m/s
		Flap 2-3-4 multisine	2		46m/s
		Multisine rudder	4		46m/s
		Multisine rudder	4		46m/s
		Multisine aileron	2		46m/s
		Multisine aileron	2		46m/s
		Asymmetric chirp	2		36m/s
		Asymmetric chirp	2		36m/s
		Symmetric chirp	2		36m/s
		Symmetric chirp	2		36m/s
		Symmetric Aileron doublet 1	3		36m/s
		Symmetric Aileron doublet 1	3		36m/s

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		Asymmetric Aileron doublet 1	3		36m/s
		Asymmetric Aileron doublet 1	3		36m/s
		Symmetric Aileron doublet 2	3		36m/s
		Symmetric Aileron doublet 2	3		36m/s
		Asymmetric Aileron doublet 2	3		36m/s
		Asymmetric Aileron doublet 2	3		36m/s
		Symmetric chirp	2		46m/s
		Symmetric chirp	2		46m/s
		Asymmetric chirp	2		36m/s
		Asymmetric chirp	2		36m/s

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3.2 May Flight Test Campaign

To allow more time for data processing and analysis during the second campaign, a one-week break was planned between the first and second flight week of the second campaign. But it was also taken into account that if anything goes wrong during the first week, the second week would be used for additional tests or repairs. This meant that the first week of the second campaign would take place on 08-12.05 and the second week (data analysis/additional tests/repair week) would be on 15-19.05. The final flight test week of the project would take place on 22-26.05.

The goals of the campaign are following the outcomes of the first one. Assuming that many goals connected to system checks of the demonstrator are already achieved during the first week, the primary flight dynamics goals for the second flight test campaign are (responsible partners are noted down in the brackets):

- Direct drive modelling in-flight (frequency sweeps at different loads/airspeeds). (SZTAKI)
- Perform manoeuvres for baseline performance evaluation (lift, drag polars). (TUM)
- Perform manoeuvres for rigid and elastic model identification and update. (TUM, DLR-SR)
- Test the flutter stopper function in-flight (for this we would need to fly flutter configuration, not flutter-free). (TUM, DLR-SR, DLR-G, SZTAKI)
- Test the data processing and evaluation toolchain in-flight (telemetry links, online data retrieval, model updating). (TUM, DLR-SR, DLR-G, SZTAKI)

The primary autopilot system goals are:

- Confirm that the autothrottle mode can follow different airspeeds all the way up to the second flutter speed. (SZTAKI)
- Confirm that the autopilot can guide the aircraft in circles (getting into the circle, following the circle, aborting the circle). (SZTAKI)
- Confirm that all three modes can work together (increase the airspeed while flying in a circle while holding the altitude). (SZTAKI)

The primary flutter control goals are:

- Confirm the DLR flutter controller increases wing damping in the subcritical region (under 42m/s). (DLR, SZTAKI)
- Confirm the SZTAKI flutter controller increases wing damping in the subcritical region (under 42m/s). (SZTAKI)
- Confirm the DLR flutter controller increases wing damping in flutter region (above 50m/s). (DLR)
- Confirm the SZTAKI flutter controller increases wing damping in flutter region (above 50m/s). (SZTAKI)
- Validate open-loop flutter speed prediction of the models. (ONERA, DLR)

Finally, some secondary goals were noted down:

- Investigate the engine wake effects on the V-Tail. (TUM)
- Investigate the effects of asymmetry of the wings and the possible associated freeplay. (DLR, ONERA)
- Induced drag reduction with active load shape control. (DLR, SZTAKI)

These goals were further divided among the flights:

Scheduled flights (1st week):

- FT26 (flutter safe configuration). Autothrottle tests, coordinated turn. Going through the manoeuvre list (block 1).
- FT27 (flutter safe configuration). Flutter controller test point (check for operation, reception, visibility). Going through the manoeuvre list (block 2).
- FT28 (flutter safe configuration). Going through the manoeuvre list (block 3).
- FT29 (flutter configuration). Flutter controller tests in subcritical region. Selected manoeuvres at low speed (block 4). Flutter stopper test.

Scheduled flights (3rd week):

- FT30 (flutter configuration). Flutter controller tests in subcritical region.
- FT31 (flutter configuration). Flutter controller tests in critical region.
- FT32 (flutter configuration). Flutter controller tests in critical region.
- FT33 (flutter configuration). Flutter controller tests in critical region.

The test cards for the first four prepared flights are included below. Note that any further flights will have to be planned on the spot, building on the results of the previous flights.

FT26 Baseline Controller and Manoeuvres

Tuesday, April 18, 2023 11:51

Flight Goal:
Do further checks on the autothrottle controller and the performance of that together with the coordinated turn. Do the manoeuvres from block 1.

Emergency checklists:

LAND TERMINATE FLAMEOUT

ENGINEER	CONFIRM **AUGMENTED** SELECTED ON AP1 AND AP2		
ENGINEER	CONFIRM **ALTITUDE HOLD** SELECTED ON AP2		Pitch command is limited to 20deg
ENGINEER	CONFIRM **ROBUST 1** SELECTED		Under Autothrottle Params window
ENGINEER	CONFIRM **AUTOTHROTTLE FILTER** SELECTED		
ENGINEER	INPUT **38m/s**		As velocity parameter
	Take-off		
MANAGER	REPORT TO ATC READY FOR TAKE-OFF		
FLEXOP 1, FLEXOP 2	Engine **ON**, pay attention to the turbine	*	Confirm the starter has spooled up
FLEXOP 2	After engine is running: TURN THE FUEL TRANSFER ON		This starts pumping the fuel from AUX to MAIN tank.
FLEXOP 1	CHECK CONTROLS, FULL DEFLECTIONS		
FLEXOP 1	JETI WARNINGS **ON**		
OPERATOR	STANDBY TO ANNOUNCE TAKE-OFF AT 18m/s		
FLEXOP 1	CLEARED FOR TAKE-OFF		T-0
FLEXOP 1	THROTTLE 70%, CLIMB 200		At 30m AGL
	FS CRUISE		
	Augmented mode check		
FLEXOP 1	SWITCH AUTOPILOT 1		
FLEXOP 1	DO CONTROL INPUTS TO CHECK BEHAVIOUR		The control inputs should be at 0.5-1Hz range.
FLEXOP 1	REPORT BEHAVIOUR		
	Altitude hold check		
ENGINEER	CONFIRM **CURRENT ALTITUDE** SELECTED		Under Altitude (AMSL) window. The altitude hold target will be selected when the pilot switches to AP2.
FLEXOP 1	CLIMB 200		
FLEXOP 1	SWITCH AUTOPILOT 2		The altitude hold target is selected.

FLEXOP 1	REPORT BEHAVIOUR		About the altitude hold.
FLEXOP 1	SWITCH AUTOPILOT 1		
	Autothrottle check 1 - Robust 1 mode		
ENGINEER	CONFIRM **AUTOTHROTTLE** SELECTED ON AP2		
ENGINEER	CONFIRM **ROBUST** SELECTED		Under Autothrottle Params window
ENGINEER	SELECT **38m/s**		Under Velocity window
FLEXOP 1	SWITCH AUTOPILOT 2		
FLEXOP 1	CIRCLE		To check the autothrottle functionality. If works, continue. If not, switch to AP1 and go to plan B.
ENGINEER	SELECT **42m/s**		Under Velocity window
ENGINEER	SELECT **34m/s**		Under Velocity window
ENGINEER	SELECT **50m/s**		Under Velocity window (in a straight)
ENGINEER	SELECT **34m/s**		Under Velocity window
ENGINEER	SELECT **38m/s**		Under Velocity window
FLEXOP 1	SWITCH AUTOPILOT 1		
	Autothrottle check 2 - Performance mode		
ENGINEER	CONFIRM **PERFORMANCE** SELECTED		Under Autothrottle Params window
FLEXOP 1	SWITCH AUTOPILOT 2		
FLEXOP 1	CIRCLE		To check the autothrottle functionality. If works, continue. If not, switch to AP1 and go to plan B.
ENGINEER	SELECT **42m/s**		Under Velocity window
ENGINEER	SELECT **34m/s**		Under Velocity window
ENGINEER	SELECT **50m/s**		Under Velocity window (in a straight)
ENGINEER	SELECT **34m/s**		Under Velocity window
ENGINEER	SELECT **38m/s**		Under Velocity window
FLEXOP 1	SWITCH AUTOPILOT 1		
	Autothrottle check 1 - Robust 2 mode		
ENGINEER	CONFIRM **TECS** SELECTED		Under Autothrottle Params window
FLEXOP 1	SWITCH AUTOPILOT 2		
FLEXOP 1	CIRCLE		To check the autothrottle functionality. If works, continue. If not, switch to AP1 and go to plan B.
ENGINEER	SELECT **42m/s**		Under Velocity window
ENGINEER	SELECT **34m/s**		Under Velocity window
ENGINEER	SELECT **50m/s**		Under Velocity window (in a straight)
ENGINEER	SELECT **34m/s**		Under Velocity window
ENGINEER	SELECT **38m/s**		Under Velocity window
FLEXOP 1	SWITCH AUTOPILOT 1		

	Course angle		
ENGINEER	CONFIRM **COURSE ANGLE** SELECTED ON AP2		
ENGINEER	CONFIRM **EAST** SELECTED		Depending on intended flight direction
FLEXOP 1	FLY EAST WITH COURSE OFFSET		Within 30deg
FLEXOP 1	SWITCH AUTOPILOT 2		The heading should change to the intended direction
FLEXOP 1	SWITCH AUTOPILOT 1		
ENGINEER	CONFIRM **400m** and **CLOCKWISE** SELECTED		
FLEXOP 1	FLY EAST WITH COURSE OFFSET		Within 30deg
FLEXOP 1	SWITCH AUTOPILOT 2		The heading should change to the intended direction
ENGINEER	SELECT **COORDINATED TURN**		AC should start a turn with 400m radius.
FLEXOP 1	REPORT BEHAVIOUR		
ENGINEER	REPORT TELEMETRY		**If good, stay with 900m. Otherwise go down to 400m.**
FLEXOP 1	SWITCH AUTOPILOT 1		
ENGINEER	SELECT **900m**		After a full lap. The radius will increase at the moment.
FLEXOP 1	SWITCH AUTOPILOT 2		The heading should change to the intended direction
	REPORT IF SWITCHING TO COORDINATED TURN WORKS		
FLEXOP 1	SWITCH AUTOPILOT 1		
	ALIGN FOR 900M CIRCLE		
FLEXOP 1	SWITCH AUTOPILOT 2		The heading should change to the intended direction
FLEXOP 1	REPORT BEHAVIOUR		
ENGINEER	REPORT TELEMETRY		
FLEXOP 1	SWITCH AUTOPILOT 1		
	Manoeuvre injections		
FLEXOP 1	SWITCH MANUAL		Altitude hold and augmented and autothrottle is live now.
FLEXOP 1	Control doublet injections		Elevator, rudder, ailerons, 1Hz
FLEXOP 1	Control doublet injections		Elevator, rudder, ailerons, 1Hz
FLEXOP 1	Reduce dual rate		Preparation for Pushover-pullups.
FLEXOP 1	PREPARE TRANSMITTER MENU FOR PUSHOVER-PULLUPS		
	See MANUAL Manoeuvres below		
FLEXOP 1	FULL DUAL RATE		
FLEXOP 1	SWITCH AUTOPILOT 1		

Nr	Block	U, m/s	MAN ID	Amplitude	OK	Targets
			MANUAL			
	1		Pushover-pullup			36m/s, 0-2G, 10deg/s, 20deg pitch,

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						reduced dual rate
	1		Pushover-pullup			36m/s, 0-2G, 10deg/s, 20deg pitch, reduced dual rate
	1		Pushover-pullup			36m/s, 0-2G, 10deg/s, 20deg pitch, reduced dual rate (REPORT 15DEG PITCH DOWN AND 34MS DURING PULLUP)
			AP INJECTIONS			
	1		Multisine elevator	5		36m/s
	1		Multisine elevator	5		36m/s
	1		Flap 2-3-4 multisine	3		36m/s
	1		Flap 2-3-4 multisine	3		36m/s
	1		Multisine rudder	5		36m/s
	1		Multisine rudder	5		36m/s
	1		Multisine aileron	3		36m/s
	1		Multisine aileron	3		36m/s
	1		Asymmetric chirp	4		36m/s
	1		Asymmetric chirp	4		36m/s
	1		Symmetric chirp	4		36m/s
	1		Symmetric chirp	4		36m/s

	Landing		**When either:** **6.2kg used (MAIN)** **9.0kg used (MAIN and AUX)**
FLEXOP 1	PREPARE FOR LANDING	*	
FLEXOP 1	FLIGHT STATE LANDING		If GO AROUND: Throttle 70%, FS LANDING until safe
OPERATOR	GUIDE FOR LANDING, REPORT SPEED		
FLEXOP 1	DUAL RATE FULL		
FLEXOP 1	AFTER TOUCHDOWN ELEVATOR UP		
FLEXOP 1	CHECK CONTROLS, FULL DEFLECTIONS		
FLEXOP 1	ENGINE OFF	*	

Debriefing:

Engine start/stop time	
Fuel used, kg	
Aircraft status	
Discussion of the test conduct	1. Were tests acceptably performed? 2. Were any limits approached or exceeded? 3. Was the required data gathered? 4. Was risk level accurate? 5. Any unusual events? 6. Ground observations.

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Discussion of the results	1. Data analysis observations. 2. Any repeats necessary?
Reports Required	(Accident/incident)
Lessons learned	
Plan for next flight	

Notes:

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FT27 Coordinated turns and Manoeuvres

Sunday, May 7, 2023 15:19

Flight Goal:
Check the course angle hold again. Do autothrottle check through the full envelope. Do the manoeuvres from block 1 and 2.

Emergency checklists:

LAND TERMINATE FLAMEOUT

ENGINEER	CONFIRM **AUGMENTED** SELECTED ON AP1 AND AP2		
ENGINEER	CONFIRM **ALTITUDE HOLD** SELECTED ON AP1 AND AP2		Pitch command is limited to 20deg
ENGINEER	CONFIRM **CURRENT ALTITUDE** SELECTED		Under Altitude (AMSL) window. The altitude hold target will be selected when the pilot switches to AP2.
ENGINEER	CONFIRM **AUTOTHROTTLE** SELECTED ON AP1 AND AP2		
ENGINEER	CONFIRM **PERFORMANCE** SELECTED		Under Autothrottle Params window
ENGINEER	CONFIRM **AUTOTHROTTLE FILTER** SELECTED		
ENGINEER	CONFIRM **COURSE ANGLE** SELECTED ON AP2		
ENGINEER	CONFIRM **COORDINATED TURN** SELECTED		Depending on intended flight direction
ENGINEER	CONFIRM **400m** and **CLOCKWISE** SELECTED		
ENGINEER	INPUT **34m/s**		As velocity parameter
	Take-off		
MANAGER	REPORT TO ATC READY FOR TAKE-OFF		
FLEXOP 1, FLEXOP 2	Engine **ON**, pay attention to the turbine	*	Confirm the starter has spooled up
FLEXOP 2	Confirm engine **ON**		
FLEXOP 2	After engine is running: TURN THE FUEL TRANSFER ON		This starts pumping the fuel from AUX to MAIN tank.
FLEXOP 1	CHECK CONTROLS, FULL DEFLECTIONS		
FLEXOP 1	JETI WARNINGS **ON**		
OPERATOR	STANDBY TO ANNOUNCE TAKE-OFF AT 18m/s		
FLEXOP 1	CLEARED FOR TAKE-OFF		T-0
FLEXOP 1	THROTTLE 70%, CLIMB 280		At 30m AGL

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FLEXOP 1	FLIGHT STATE CRUISE		

	Course angle		
FLEXOP 1	SWITCH AUTOPILOT 1		
FLEXOP 1	PREPARE FOR COORDINATED TURN		
FLEXOP 1	SWITCH AUTOPILOT 2		The circle will start with 400m
FLEXOP 1	REPORT BEHAVIOUR		
ENGINEER	REPORT TELEMETRY		**If bad, stay with 400m. Otherwise go up to 900m.**
FLEXOP 1	SWITCH AUTOPILOT 1		
ENGINEER	SELECT **900m**		After a full lap. The radius will increase at the moment.
FLEXOP 1	ALIGN FOR 900M CIRCLE		
FLEXOP 1	SWITCH AUTOPILOT 2		The heading should change to the intended direction
FLEXOP 1	REPORT BEHAVIOUR		
ENGINEER	REPORT TELEMETRY		
	Autothrottle stepwise envelope check during coordinated turn		
MANAGER	CONTINUE AFTER TURNING WITH 34m/s FOR 90s		
ENGINEER	SELECT **42m/s**		Under Velocity window. 90s
ENGINEER	SELECT **50m/s**		Under Velocity window. 90s
ENGINEER	SELECT **52m/s**		Under Velocity window. 90s
ENGINEER	SELECT **34m/s**		
FLEXOP 1	SWITCH AUTOPILOT 1		
	Manoeuvre injections		
FLEXOP 1	SWITCH MANUAL		
FLEXOP 1	TRIM 36m/s		
ENGINEER	CONFIRM **ONLY AUGMENTED** SELECTED ON AP1 AND AP2		
FLEXOP 1	Reduce dual rate		Preparation for Pushover-pullups.
FLEXOP 1	Prepare transmitter menu for pushover-pullups		
MANAGER	See MANUAL manoeuvres below		
FLEXOP 1	After Manual manoeuvres done: FULL DUAL RATE		
FLEXOP 1	SWITCH AUTOPILOT 1		Only augmented mode is active

Nr	Block	U, m/s	MAN ID	Amplitude	OK	Targets
			MANUAL			
	1		Pushover-pullup			36m/s, 0-2G, 10deg/s, 20deg pitch, reduced dual rate
	1		Pushover-pullup			36m/s, 0-2G, 10deg/s, 20deg pitch, reduced dual rate

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	1		Pushover-pullup			36m/s, 0-2G, 10deg/s, 20deg pitch, reduced dual rate (Operator report 15deg pitch down and 34m/s during pull-up)
			AP INJECTIONS - BLOCK 1			
	1		Multisine elevator	5		36m/s
	1		Multisine elevator	5		36m/s
	1		Multisine rudder	5		36m/s
	1		Multisine rudder	5		36m/s
	1		Flap 2-3-4 multisine	3		36m/s
	1		Flap 2-3-4 multisine	3		36m/s
	1		Multisine aileron	3		36m/s
	1		Multisine aileron	3		36m/s
	1		Asymmetric chirp	4		36m/s
	1		Asymmetric chirp	4		36m/s
	1		Symmetric chirp	4		36m/s
	1		Symmetric chirp	4		36m/s
			AP INJECTIONS - BLOCK 2			
	2		Symmetric Aileron doublet 1	5		36m/s
	2		Symmetric Aileron doublet 1	5		36m/s
	2		Asymmetric Aileron doublet 1	5		36m/s
	2		Asymmetric Aileron doublet 1	5		36m/s
	2		Symmetric Aileron doublet 2	5		36m/s
	2		Symmetric Aileron doublet 2	5		36m/s
	2		Asymmetric Aileron doublet 2	5		36m/s
	2		Asymmetric Aileron doublet 2	5		36m/s
	2		Multisine elevator	4		46m/s
	2		Multisine elevator	4		46m/s
	2		Multisine rudder	4		46m/s
	2		Multisine rudder	4		46m/s
	2		Flap 2-3-4 multisine	3		46m/s
	2		Flap 2-3-4 multisine	3		46m/s
	2		Multisine aileron	3		46m/s
	2		Multisine aileron	3		46m/s

	Landing		**When either:** **6.2kg used (MAIN)** **9.0kg used (MAIN and AUX)**
FLEXOP 1	PREPARE FOR LANDING	*	
FLEXOP 1	Switch MANUAL		

FLEXOP 1	FLIGHT STATE LANDING		If GO AROUND: Throttle 70%, FS LANDING until safe
OPERATOR	GUIDE FOR LANDING, REPORT SPEED		
FLEXOP 1	DUAL RATE FULL		
FLEXOP 1	AFTER TOUCHDOWN ELEVATOR UP		
FLEXOP 1	CHECK CONTROLS, FULL DEFLECTIONS		
FLEXOP 1	ENGINE OFF	*	

Debriefing:

Engine start/stop time	
Fuel used, kg	
Aircraft status	
Discussion of the test conduct	1. Were tests acceptably performed? 2. Were any limits approached or exceeded? 3. Was the required data gathered? 4. Was risk level accurate? 5. Any unusual events? 6. Ground observations.
Discussion of the results	1. Data analysis observations. 2. Any repeats necessary?
Reports Required	(Accident/incident)
Lessons learned	
Plan for next flight	

Notes:

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FT28 Manoeuvres

Thursday, May 11, 2023 10:41

Flight Goal:
Do the manoeuvres from block 1 and 2 and 3.

Emergency checklists:

LAND TERMINATE FLAMEOUT

ENGINEER	CONFIRM **AUGMENTED** SELECTED ON AP1 AND AP2		
	Take-off		
MANAGER	REPORT TO ATC READY FOR TAKE-OFF		
FLEXOP 1, FLEXOP 2	Engine **ON**, pay attention to the turbine	*	Confirm the starter has spooled up
FLEXOP 2	Confirm engine **ON**		
FLEXOP 2	After engine is running: TURN THE FUEL TRANSFER ON		This starts pumping the fuel from AUX to MAIN tank.
FLEXOP 1	CHECK CONTROLS, FULL DEFLECTIONS		
FLEXOP 1	JETI WARNINGS **ON**		
OPERATOR	STANDBY TO ANNOUNCE TAKE-OFF AT 18m/s		
FLEXOP 1	CLEARED FOR TAKE-OFF		T-0
FLEXOP 1	THROTTLE 70%, CLIMB 280		At 30m AGL
FLEXOP 1	FLIGHT STATE CRUISE		

	Manoeuvre injections		
FLEXOP 1	SWITCH MANUAL		
FLEXOP 1	TRIM 36m/s		
ENGINEER	CONFIRM **ONLY AUGMENTED** SELECTED ON AP1 AND AP2		
FLEXOP 1	Reduce dual rate		Preparation for Pushover-pullups.
FLEXOP 1	Prepare transmitter menu for pushover-pullups		
MANAGER	See MANUAL manoeuvres below		
FLEXOP 1	After Manual manoeuvres done: FULL DUAL RATE		
FLEXOP 1	SWITCH AUTOPILOT 1		Only augmented mode is active

Nr	Block	U, m/s	MAN ID	Initial Amplitude	Desired Amplitude	Amplifier	OK	Targets
			MANUAL					
	3		Pushover-pullup					40m/s, 0-2G, 10deg/s, 20deg pitch, reduced dual rate
	3		Pushover-pullup					40m/s, 0-2G, 10deg/s, 20deg pitch, reduced dual rate
	3		Pushover-pullup					40m/s, 0-2G, 10deg/s,

								20deg pitch, reduced dual rate (Operator report 15deg pitch down and 34m/s during pull-up)
			Banked manual doublet					36m/s, +40deg bank, 10deg/s
			Banked manual doublet					36m/s, 40deg bank, 10deg/s
			Banked manual doublet					36m/s, -40deg bank, 10deg/s
			Banked manual doublet					36m/s, -40deg bank, 10deg/s
			AP INJECTIONS - BLOCK 1					
	1		Symmetric chirp	1	4	4		36m/s
	1		Symmetric chirp	1	4	4		36m/s
			AP INJECTIONS - BLOCK 2					
	2		Symmetric Aileron doublet 1	2	5	2.5		36m/s
	2		Symmetric Aileron doublet 1	2	5	3		36m/s
	2		Symmetric Aileron doublet 1	2	5	3		36m/s
	2		Asymmetric Aileron doublet 1	2	5	3		36m/s
	2		Asymmetric Aileron doublet 1	2	5	3		36m/s
	2		Symmetric Aileron doublet 2	2	5	3		36m/s
	2		Symmetric Aileron doublet 2	2	5	3		36m/s
	2		Symmetric Aileron doublet 2	2	5	4		36m/s
	2		Symmetric Aileron doublet 2	2	5	4		36m/s
	2		Asymmetric Aileron doublet 2	2	5	4		36m/s
	2		Asymmetric Aileron doublet 2	2	5	4		36m/s
	3		Asymmetric chirp	3	4	4		46m/s
	3		Asymmetric chirp	3	4	4		46m/s
	3		Symmetric chirp	3	4	4		46m/s; Banked too much
	3		Symmetric chirp	3	4	4		46m/s
	2		Multisine elevator	5	4	1		46m/s; 7.3kg fuel used
	2		Multisine elevator	5	4	1		46m/s
	2		Multisine rudder	5	4	1		46m/s
	2		Multisine rudder	5	4	1		46m/s; 8.1kg fuel used
	2		Flap 2-3-4 multisine	2	3	1.5		46m/s
	2		Flap 2-3-4 multisine	2	3	1		46m/s
	2		Multisine aileron	2	3	2		46m/s
	2		Multisine aileron	2	3	2		46m/s

Landing	**When either:**

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			6.2kg used (MAIN) **9.0kg used (MAIN and AUX)**
	Manual doublets (roll, yaw, pitch?)		AP1 in between to stabilize.
FLEXOP 1	PREPARE FOR LANDING		
FLEXOP 1	Switch MANUAL		
FLEXOP 1	FLIGHT STATE LANDING		If GO AROUND: Throttle 70%, FS LANDING until safe
OPERATOR	GUIDE FOR LANDING, REPORT SPEED		
FLEXOP 1	DUAL RATE FULL		
FLEXOP 1	AFTER TOUCHDOWN ELEVATOR UP		9.2kg fuel used.
FLEXOP 1	CHECK CONTROLS, FULL DEFLECTIONS		
FLEXOP 1	ENGINE OFF		

Debriefing:

Engine start/stop time	
Fuel used, kg	
Aircraft status	
Discussion of the test conduct	1. Were tests acceptably performed? 2. Were any limits approached or exceeded? 3. Was the required data gathered? 4. Was risk level accurate? 5. Any unusual events? 6. Ground observations.
Discussion of the results	1. Data analysis observations. 2. Any repeats necessary?
Reports Required	(Accident/incident)
Lessons learned	
Plan for next flight	

Notes:

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FT29 Flutter Configuration Tests

Tuesday, May 9, 2023 12:32

Flight Goal:
Steady circles with flutter configuration. Flexible manoeuvres with flutter configuration. Flutter stopper check. Flutter controller initial check?

Emergency checklists:

LAND TERMINATE FLAMEOUT

ENGINEER	CONFIRM **AUGMENTED** SELECTED ON AP1 AND AP2		
ENGINEER	CONFIRM **ALTITUDE HOLD** SELECTED ON AP1 AND AP2		Pitch command is limited to 20deg
ENGINEER	CONFIRM **CURRENT ALTITUDE** SELECTED		Under Altitude (AMSL) window. The altitude hold target will be selected when the pilot switches to AP2.
ENGINEER	CONFIRM **AUTOTHROTTLE** SELECTED ON AP1 AND AP2		
ENGINEER	CONFIRM **PERFORMANCE** SELECTED		Under Autothrottle Params window
ENGINEER	CONFIRM **AUTOTHROTTLE FILTER** SELECTED		
ENGINEER	CONFIRM **COURSE ANGLE** SELECTED ON AP2		
ENGINEER	CONFIRM **COORDINATED TURN** SELECTED		Depending on intended flight direction
ENGINEER	CONFIRM **700m** and **CLOCKWISE** SELECTED		
ENGINEER	INPUT **34m/s**		As velocity parameter
	Take-off		
MANAGER	REPORT TO ATC READY FOR TAKE-OFF		
FLEXOP 1, FLEXOP 2	Engine **ON**, pay attention to the turbine	*	Confirm the starter has spooled up
FLEXOP 2	Confirm engine **ON**		
FLEXOP 2	After engine is running: TURN THE FUEL TRANSFER ON		This starts pumping the fuel from AUX to MAIN tank.
FLEXOP 1	CHECK CONTROLS, FULL DEFLECTIONS		
FLEXOP 1	JETI WARNINGS **ON,** VOLUME **ON**		
OPERATOR	STANDBY TO ANNOUNCE TAKE-OFF AT 18m/s		
FLEXOP 1	CLEARED FOR TAKE-OFF		T-0
FLEXOP 1	THROTTLE 70%, CLIMB 280		At 30m AGL
FLEXOP 1	FLIGHT STATE CRUISE		

	Autothrottle check 2 - Performance mode		
FLEXOP 1	SWITCH AUTOPILOT 1		
FLEXOP 1	PREPARE FOR COORDINATED TURN		
FLEXOP 1	SWITCH AUTOPILOT 2		The circle will start with **700m**
FLEXOP 1	REPORT BEHAVIOUR		

	Autothrottle stepwise envelope check during coordinated turn		
MANAGER	CONTINUE AFTER TURNING WITH 34m/s FOR 90s		
ENGINEER	SELECT **36m/s**		Under Velocity window. 90s
ENGINEER	SELECT **38m/s**		Under Velocity window. 90s
ENGINEER	SELECT **40m/s**		Under Velocity window. 90s
ENGINEER	SELECT **42m/s**		Under Velocity window. 90s
ENGINEER	SELECT **36m/s**		Under Velocity window.
FLEXOP 1	SWITCH AUTOPILOT 1		
	Flutter controller check		
ENGINEER	DESELECT COURSE ANGLE		
ENGINEER	SELECT FLUTTER CONTROLLER		
ENGINEER	SELECT SZTAKI CONTROLLER		
FLEXOP 1	In good visibility SWITCH AUTOPILOT 2		For 2s
ALL	Observe behaviour		
FLEXOP 1	SWITCH AUTOPILOT 1		
ENGINEER	SELECT DLR CONTROLLER		
FLEXOP 1	In good visibility SWITCH AUTOPILOT 2		For 2s
ALL	Observe behaviour		
FLEXOP 1	SWITCH AUTOPILOT 1		
	Manoeuvre injections		
FLEXOP 1	SWITCH MANUAL		
ENGINEER	CONFIRM **ONLY AUGMENTED** SELECTED ON AP1 AND AP2		
FLEXOP 1	SWITCH AUTOPILOT 1		Only augmented mode is active
FLEXOP 1	TRIM 36m/s		

Nr	Block	U, m/s	MAN ID	Initial Amplitude	Desired Amplitude	Amplifier	OK	Targets
			AP INJECTIONS - BLOCK 4					
	1		Asymmetric chirp	1	4	4		36m/s
	1		Asymmetric chirp	1	4	4		36m/s
	1		Symmetric chirp	1	4	4		36m/s
	1		Symmetric chirp	1	4	4		36m/s
	2		Symmetric Aileron doublet 1	2	5	3		36m/s
	2		Symmetric Aileron doublet 1	2	5	3		36m/s
	2		Asymmetric Aileron doublet 1	2	5	3		36m/s
	2		Asymmetric Aileron doublet 1	2	5	3		36m/s
	2		Symmetric Aileron doublet 2	2	5	3		36m/s
	2		Symmetric Aileron doublet 2	2	5	3		36m/s
	2		Asymmetric Aileron doublet 2	2	5	3		36m/s
	2		Asymmetric Aileron doublet 2	2	5	3		36m/s

	Flutter stopper		
FLEXOP 1	SWITCH AUTOPILOT 1		Only augmented mode is active
FLEXOP 1,	FLUTTER STOPPER ARMED		

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FLEXOP 2			
FLEXOP 2	FLUTTER STOPPER TRIGGERED		
FLEXOP 1	FLUTTER STOPPER TRIGGERED		
FLEXOP 1	SWITCH AUTOPILOT 1		Only augmented mode is active

Nr	Block	U, m/s	MAN ID	Initial Amplitude	Desired Amplitude	Amplifier	OK	Targets
			AP INJECTIONS - BLOCK 4					
	2		Symmetric Aileron doublet 1	2	5	3		36m/s
	2		Symmetric Aileron doublet 1	2	5	3		36m/s
	2		Asymmetric Aileron doublet 1	2	5	3		36m/s
	2		Asymmetric Aileron doublet 1	2	5	3		36m/s

	Landing		**When either:** **6.2kg used (MAIN)** **8.5kg used (MAIN and AUX)**
FLEXOP 1	PREPARE FOR LANDING	*	
FLEXOP 1	Switch MANUAL		
FLEXOP 1	FLIGHT STATE LANDING		If GO AROUND: Throttle 70%, FS LANDING until safe
OPERATOR	GUIDE FOR LANDING, REPORT SPEED		
FLEXOP 1	DUAL RATE FULL		
FLEXOP 1	AFTER TOUCHDOWN ELEVATOR UP		
FLEXOP 1	CHECK CONTROLS, FULL DEFLECTIONS		
FLEXOP 1	ENGINE OFF	*	

Debriefing:

Engine start/stop time	
Fuel used, kg	
Aircraft status	
Discussion of the test conduct	1. Were tests acceptably performed? 2. Were any limits approached or exceeded? 3. Was the required data gathered? 4. Was risk level accurate? 5. Any unusual events? 6. Ground observations.
Discussion of the results	1. Data analysis observations. 2. Any repeats necessary?
Reports Required	(Accident/incident)
Lessons learned	
Plan for next flight	

Notes:

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4 Conclusion

The final flight testing phase within the FLIPASED project has been planned and the corresponding flight permits from aviation authorities and the airport are obtained. The flight tests cover the full test programme for the newly rebuilt demonstrator, starting from system tests, aerodynamic system identification flights and finally - flutter controller tests.

The programme is only planned to an extent of the few initial flights for each test campaign, as the second half of the campaign must always build on the results of the first half (or even previous campaigns). However, care is taken that all the goals of the test campaign are attempted.

The final distribution of flights, their respective test cards and achievements-per-flight will follow in D3.11 Flight Test Report Phase 3.