

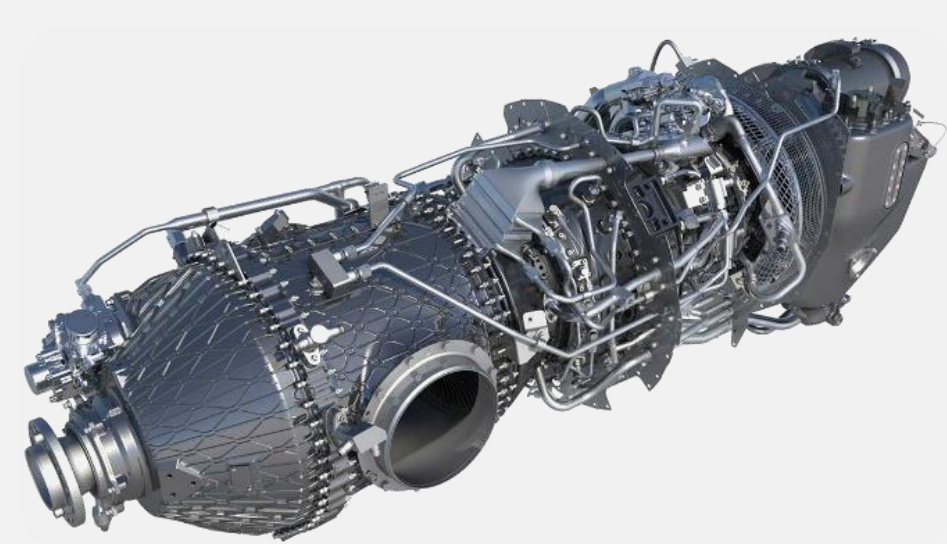
Il motore turboelica Catalyst: — tecnologie innovative e sviluppo tecnologico

— Sergio Salvano, Executive, Engineering Section
Catalyst Product Line
24 oct 2024

Roma, 24 ottobre 2024

La propulsione aeronautica dal 1908 al 2024 – dal motore automobilistico al Catalyst

Catalyst engine... the game changer turboprop

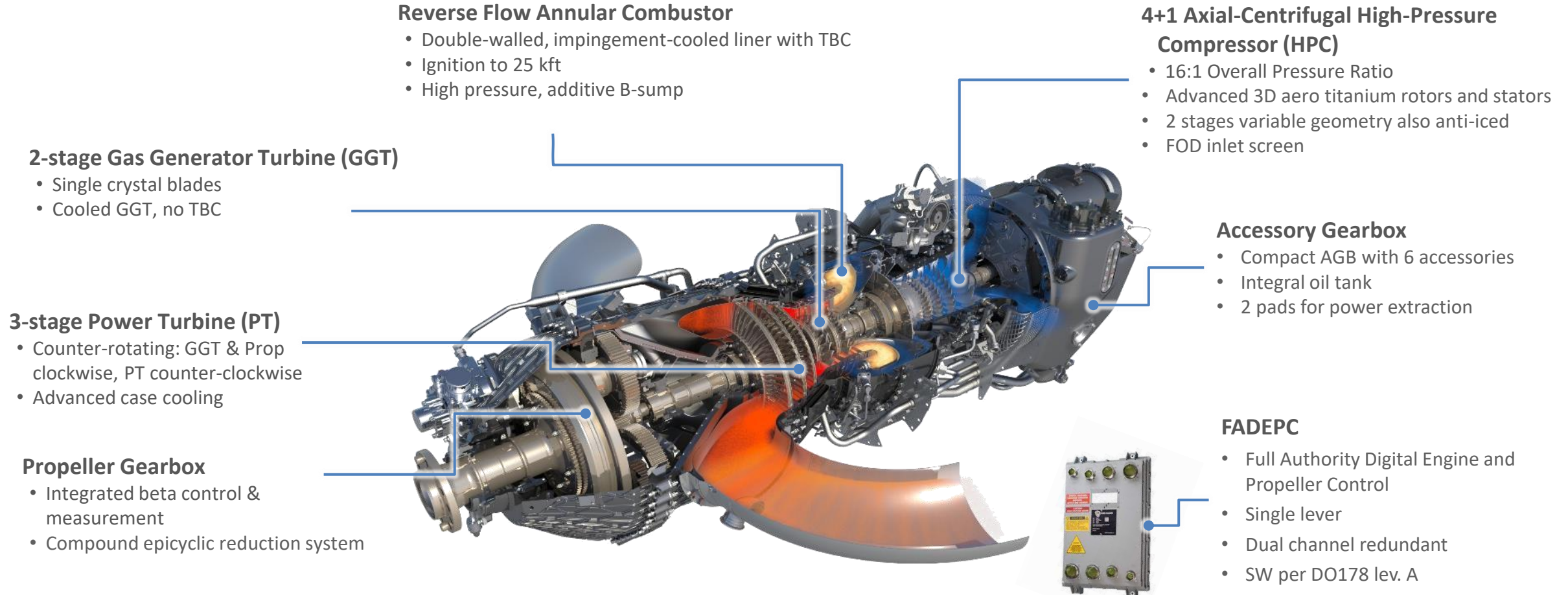


Thermal power ...	2.000 shp
Mechanical power ...	850 – 1.500 shp
Certification ...	Civil per FAA / EASA
Certification date ...	Q4 2024
Country of Origin ...	EU
Launch Customer ...	Beechcraft Denali
Prod./Maintenance ...	EASA POA/MOA

- New engine centerline, native turboprop, first since 50 years
- Differentiating through (proven) technologies
- Highest OPR in class
- FADEPC ... controlling engine and propeller ... enabling continuous digital Health Monitoring System
- Designed for high altitude operations
- Step-change performance in compact architecture
- Ready to run with approved SAF blends
 - Engine test with SAF drop-in blend completed in Feb 2022
 - Engine test with 100% SAF by end of 2025

Taking benefit of the latest technologies...minimizing development risks

Catalyst architecture



Proven technologies and architectural solution to optimize weight, size and performance

Catalyst Engine By The Numbers



7500+
hours of operation



2200+
hours of engine
certification testing



2400+
flight hours achieved



7
flightworthy engines
delivered



5400+
hours of testing with
McCauley propeller



36
test vehicles assembled



88%
cert reports submitted



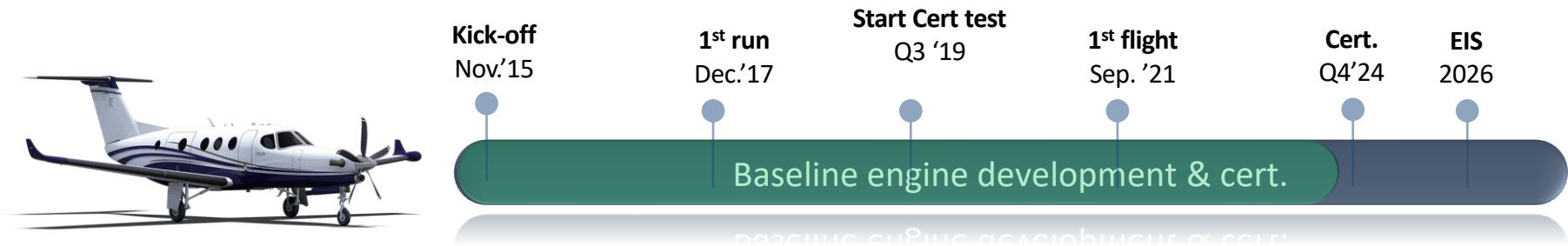
100%
engine certification tests
completed



82%
component certification
tests completed

Catalyst is a best-in-class engine

Catalyst for Denali Timeline



Catalyst Certification Engine Program

Reg.	Test Name	Test Engine	Status
33.83	HPC Rotor System Vibration	148C04/01A	Completed
33.83	GGT Rotor System Vibration	148C02/01A	Completed
33.83	PT Rotor System Vibration	148006/01B	Completed
33.28	Control System Fault Engine	148005/02B	Completed
33.28	PT Loss of Load	148006/01A	Completed
33.63	Engine Vibration	148002/05A	Completed
33.68	Induction System Icing	148009/01A	Completed
33.71	Oil Interruption	148005/02B	Completed
33.76	Small Bird Ingestion	148009/01B	Completed
33.77	Ice Slab Ingestion	148009/01B	Completed
33.78	Rain Ingestion	148009/01B	Completed
33.78	Hail Ingestion by Water	148009/01B	Completed
33.78	Hail Ingestion	148009/01D	Completed
33.88	Overtemperature	148005/02A	Completed
33.73	Power Response	148009/01E	Completed
33.89	Operability	148009/01E	Completed
33.90	IMI	148004/01B	Completed
33.94	Blade Containment	<u>148014/01A</u>	Completed
33.87	Engine Endurance	<u>148003/02B</u>	Completed
33.65	Surge & Stall	148009/01E	Completed
33.95	Engine Propeller System	148005/02B	Completed



All engine certification tests were completed successfully

Key Test Vehicles Experience [engineering]

FETT



- ✓ Full power to xx shp
- ✓ Max rate transients
- ✓ Aero mech VG sweeps
- ✓ Broken pipe test
- ✓ Part/full power operability/stalls
- ✓ Flameout and relight
- ✓ IR camera
- ✓ Smoke test
- ✓ Dirty layout

Altitude



- ✓ Envelope steady state points
- ✓ Transient performance
- ✓ Operability pinch points
- ✓ Altitude relight tests
- ✓ Cold soak starts
- ✓ Conditions tested up to xx k ft

Engine Vibe Practice



- ✓ First test with Prop
- ✓ Propeller control system verification
- ✓ Fast manouvers & Reverse
- ✓ Max Field imbalance on all rotors
- ✓ Vibe surveys
- ✓ Stair-step & dwell test
- ✓ Dirty layout

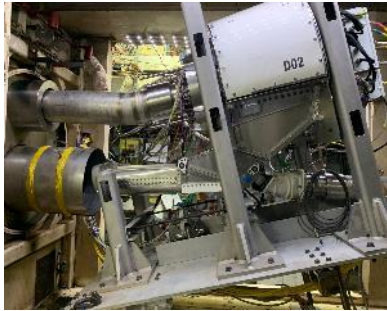
Practice Small bird Ingestion



- ✓ Small bird practice test
- ✓ No operability or dynamics issues post the event

Key Test Vehicles Experience [engineering]

Ice Crystal Ingestion



- ✓ Full Customer envelope screening in ice crystal conditions
- ✓ Sensitivities on inlet separation efficiency impact
- ✓ Data for Aero validation and particles tracking

Blade Out Practice



- ✓ HP R1 blade release w/same requirements as cert test;
- ✓ Blade release exceeded redline speed

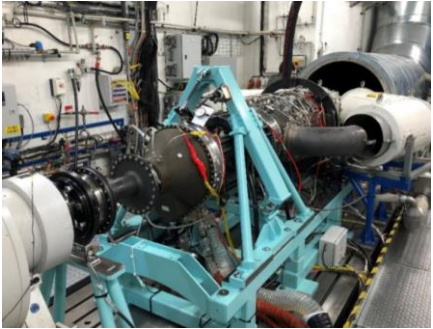
SoF & Practice Endurance



- ✓ PGB vibe surveys & dwell
- ✓ High power feather
- ✓ FADEC power loose
- ✓ Oil interruption
- ✓ Endurance test

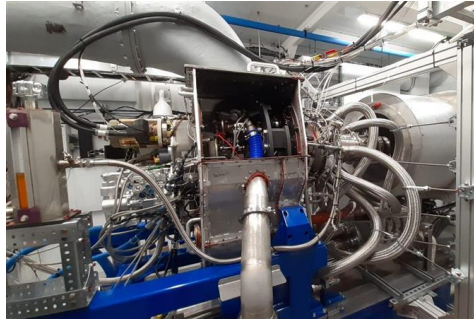
Key Test Vehicles Experience [certification]

PT Loss of Load



- ✓ 1ST Certification test run
- ✓ 4 PT shafts cuts executed
- ✓ PT overshoot up to xx RPM
Max achieved Power: xx SHP
- ✓ Control system response for PT O/S event as expected

Core GGT Aeromechanics



- ✓ Rotating strain gages on GGT blades and rotors
- ✓ Aeromech sweep with Low op/line run up to 105% NG RL speed
- ✓ Aeromech sweep with Nominal op/line run up to NG RL speed
- ✓ Post test GGT nozzles BSI completed
- ✓ HPC Thermal surveys (engineering test)

Icing Certification



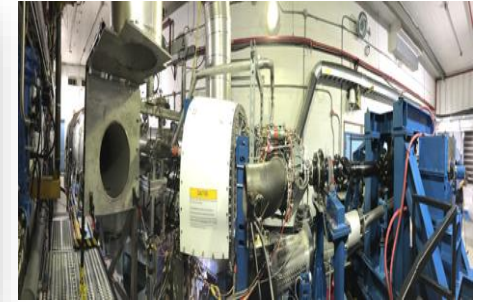
- ✓ 11 certification icing points executed
- ✓ Minimum temperature reached
- ✓ 8 engineering icing points executed
- ✓ Engineering tests performed: Impeller dwell, bow rotor, high power stalls

Ice slab ingestion



- ✓ Foreign object ingestion (Ice) – 33.77
- ✓ No detrimental effects occurred during the ice slab ingestion and no engine deterioration noted after the event (Pcal)

Small Bird Ingestion



- ✓ Small Bird ingestion – 33.76
- ✓ No detrimental effects occurred during the small bird ingestion and no engine deterioration noted after the event (Pcal)

Key Test Vehicles Experience [certification]

Engine Vibration Test



- ✓ Vibe Sweep up to Ng and Np red line
- ✓ Stair Step and dwell for 33.63
- ✓ PGB certification for 33.83

Endurance Test



- ✓ Triple Red Line conditions
- ✓ 25 x 6 hours endurance cycles
- ✓ Test run in the same facility as a practice test
- ✓ Engine teardown completed.

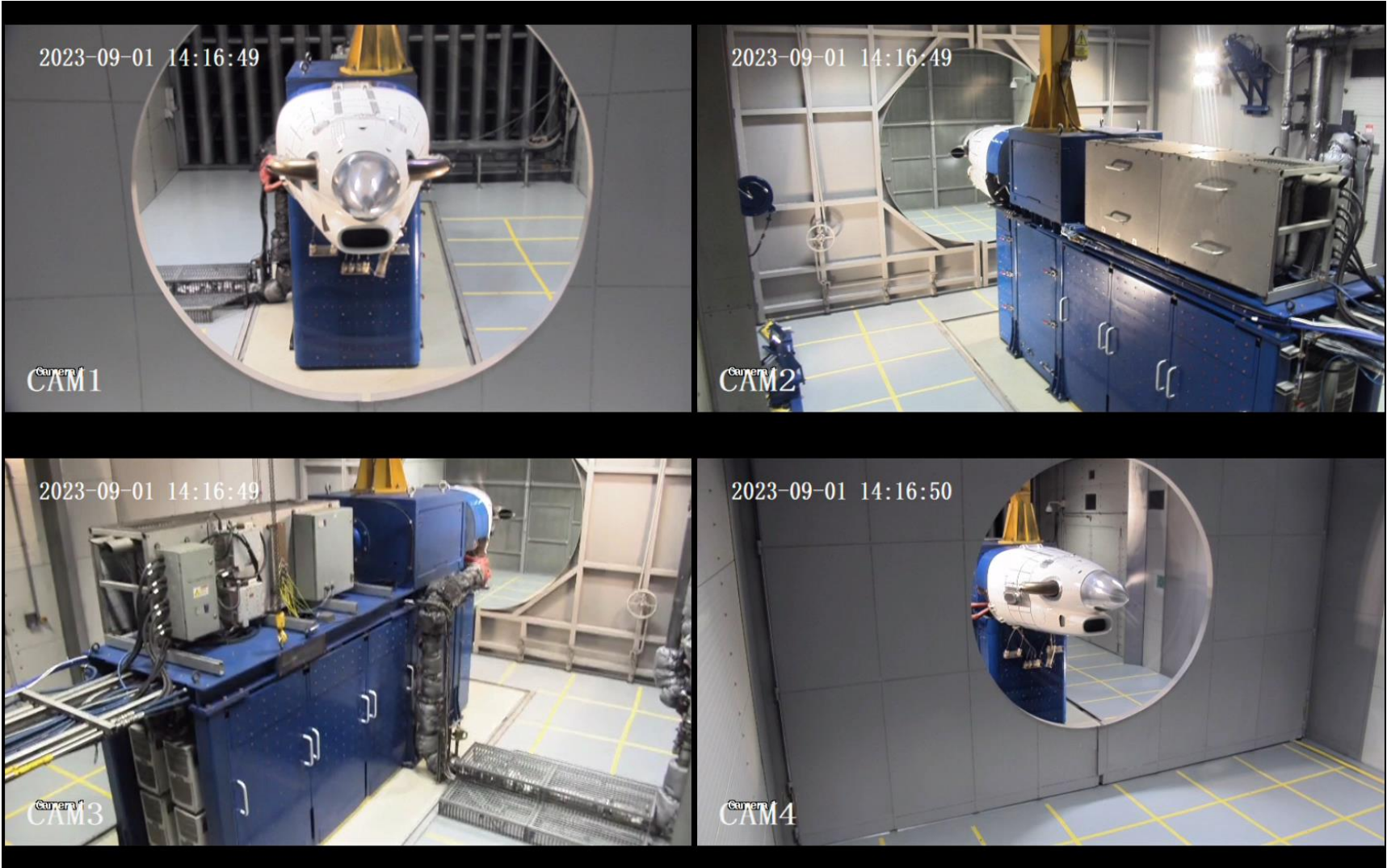
Blade Out Test



- ✓ HP R1 blade released above Ng redline speed as intended
- ✓ Blade contained, no fire, no damage to mounts

All Part 33 engine certification tests have been completed successfully.

Key Test Vehicles Experience [Certification] - Blade Out



Key Test Vehicles Experience [certification]

IMI



IMI:

- ✓ 33.90 – Total 2000+ c-cycles
- ✓ Teardown/layout complete

PT Vibration test



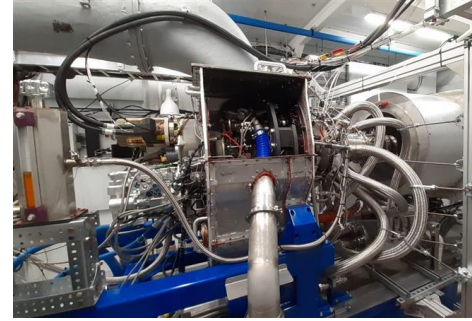
- ✓ Rotating strain gages on PT blades and rotors
- ✓ Aeromech sweep with run above RL speed
- ✓ Mapping of power of PT operating range speed vs torque (engineering test)
- ✓ PT Thermal surveys (engineering test)

Op/power response/oil inter./ fault ing, overtemp



- ✓ 33.65 Surge & stall
- ✓ 33.73 Power response
- ✓ 33.89 Operations
- ✓ 33.71 Oil interruption
- ✓ 33.28 Engine fault ingestion
- ✓ 33.95 Engine-Propeller Systems Tests
- ✓ 33.88 - overtemperature
- ✓ Engineering operability test

Core HPC Aeromechanics



- ✓ Certification mission for Aeromech (33.83), including sweeps up to 105% NG/NRG redline
- ✓ Rotating strain gages on HPC blades and impeller
- ✓ Additional engineering testing for aeromech, TSD and operability teams

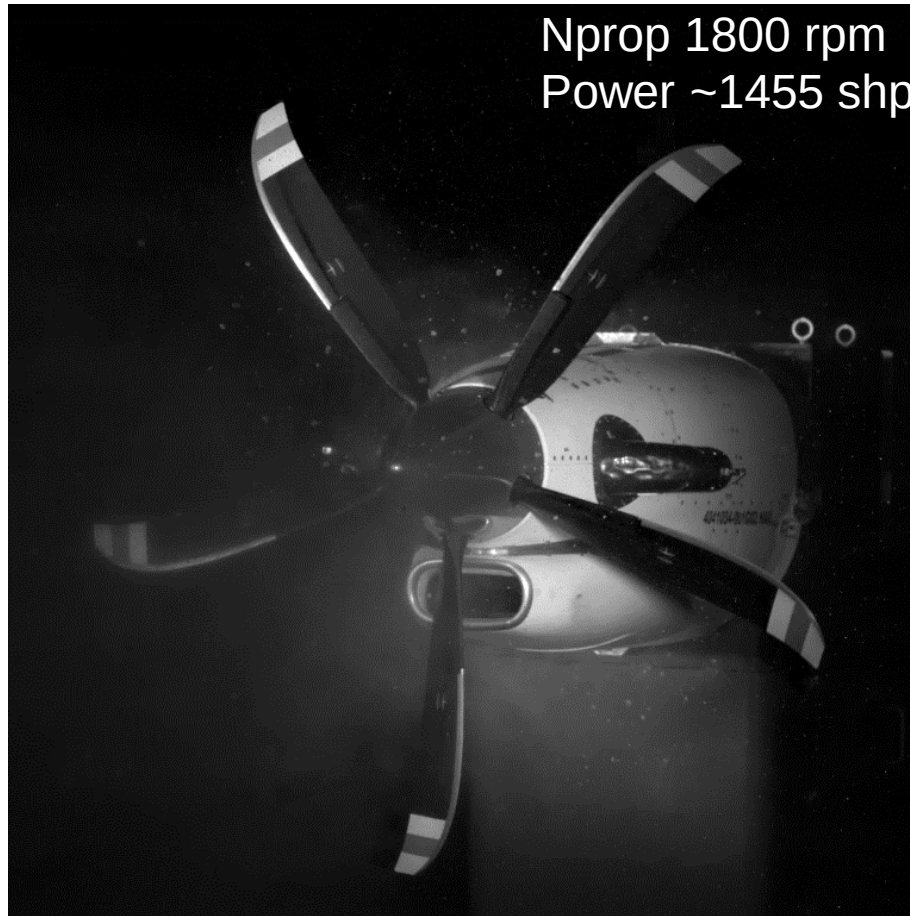
Hailstorm Ingestion



- ✓ Hailstorm mechanical damage – 33.78

Key Test Vehicles Experience [certification] - Hail by Hail

Front view



Side view



High speed cameras recording high fps ~ 46 seconds of record time.
Video and sampling rate downsized for presentation.
Individual hailstones can be tracked.



Eurodrone

AIRBUS
DEFENCE AND SPACE

