



# AEROSPACE TESTING 2005

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## AERMACCHI M346



### INTEGRATED APPROACH FOR FIRST PROTOTYPE TESTING

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# AEROSPACE TESTING 2005

## AERMACCHI TODAY

Established in 1913

Now part of **FINMECCANICA**

### FACILITIES AND WORKFORCE

- Located in Venegono (Varese - IT)
- Total area: 274,000 m<sup>2</sup>
- Total covered area: 112,000 m<sup>2</sup>
- Total workforce: 1,800
- Runway: 1,540 x 60 m



### DIVERSIFIED AEROSPACE ACTIVITIES

TRAINERS



CIVIL COLLABORATION



MILITARY COLLABORATION



PRODUCT SUPPORT





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### M346 - AIRCRAFT

- 2 TURBOFAN engines
- Thrust 2 x 2,835 kg
- TO Weight 6,700 kg
- Max TO Weight 9,500 kg
- Limit Mach number 1.2
- Max level speed 590 KTAS
- Climb speed 20,000 ft/min
- Load factors + 8 / - 3 g

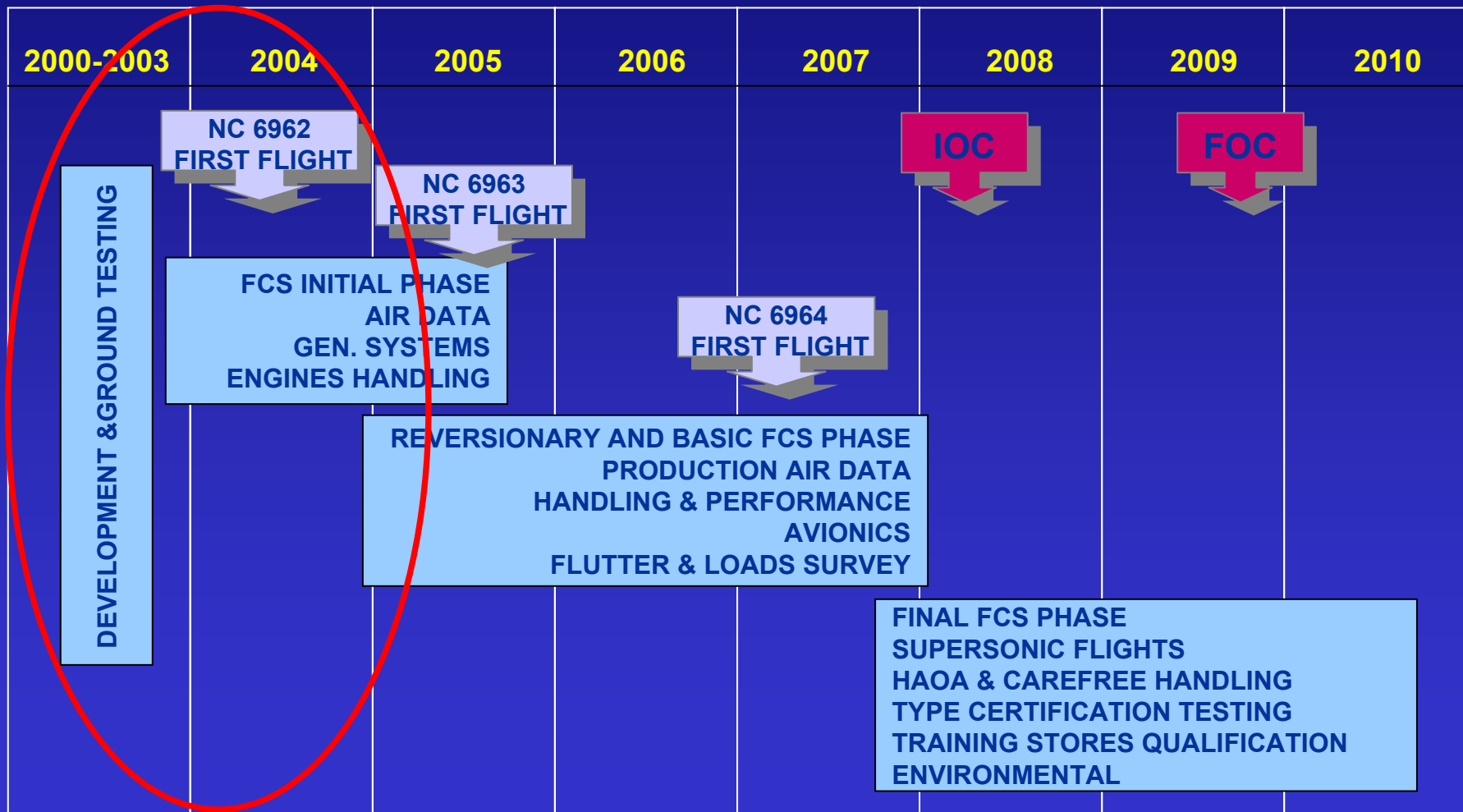


- Reconfigurable FBW Digital Flight Control System
- Full Digital Cockpit - HUD / MFD / HOTAS / HMD - In-flight Refueling Probe
- Nine Stores Stations with Ventral Cannon-Pod
- Max external load: 3,000 kg



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## M346 - PROGRAM





## AEROSPACE TESTING 2005

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### M346 – FLIGHT CLEARANCE TESTS APPROACH

- INTEGRATED TEST TEAM (DESIGN, LABORATORY, MANUFACTURING, QUALITY)
  - DIRECT INVOLVMENT OF RISK SHARING PARTNERS AND MAJOR SUPPLIERS
  - EXTENSIVE USE OF SYSTEM RIGS
  - INTEGRATED GROUND (Rigs, Iron Bird, Simulator) AND FLIGHT(A/C ground and flight test) MEASUREMENT SYSTEM
  - RIGOROUS EXPERIMENTAL PROCESS FOR ALL ASPECTS THAT MIGHT HAVE IMPACTS ON FLIGHT SAFETY
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### M346 – FLIGHT CLEARANCE STRUCTURAL TESTS

- **DESIGN DEVELOPMENT TEST FOR PROOF OF CONCEPT:** performed very early in the development phase with contribution of university laboratories.
  - **SUB COMPONENT STRUCTURAL TEST:** performed on the full scale components that was more efficient to test alone and not on the full scale test.
  - **FUNCTIONAL TEST:** all movable surfaces have been tested to assess their operability under deflection associated to applicable limit load conditions.
  - **FULL SCALE STATIC TESTS :** tests performed on second prototype structure up to limit load (including cockpit and fuel tanks pressurization).
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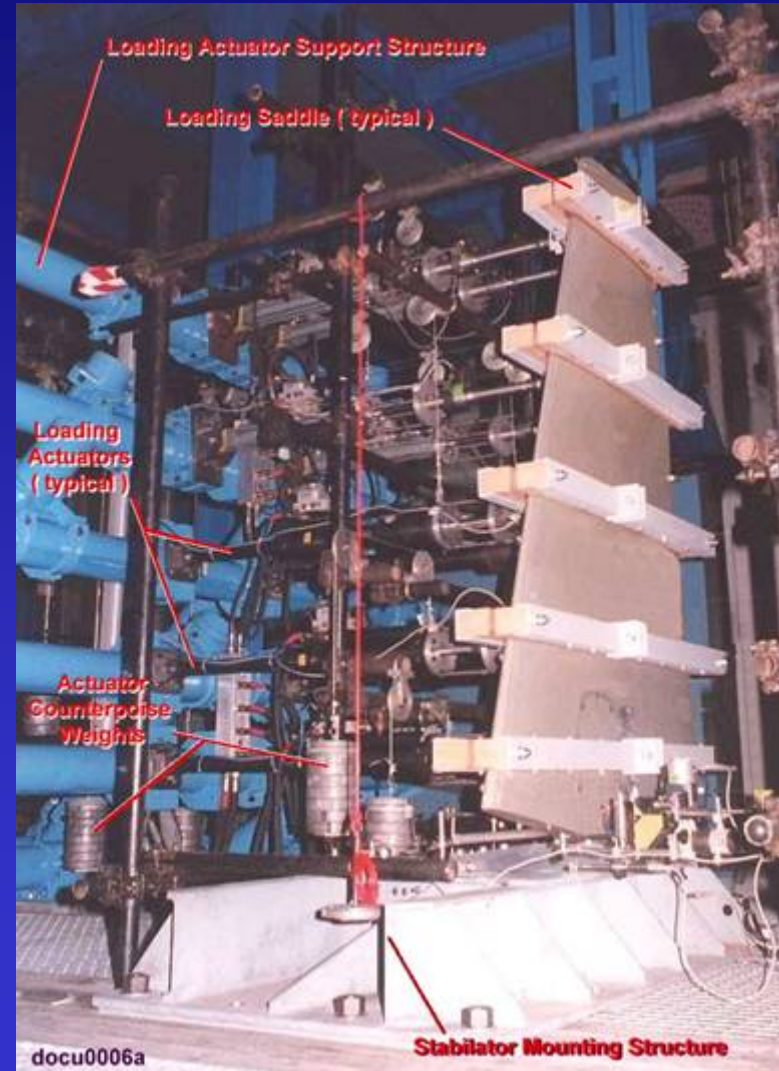
# AEROSPACE TESTING 2005

## SUB COMPONENT STRUCTURAL TEST

### HORIZONTAL TAIL

Extensively tested due to its new manufacturing technology

- DYNAMIC RESPONSE
- STATIC UP TO LL (including operability)
- LCF
- HCF
- STATIC UP TO RUPTURE
- IMPACT





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## SUB COMPONENT STRUCTURAL TEST

**AIRBRAKE**



**FLAP**



**AILERON**





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### M346 WING CONTROL SURFACES FUNCTIONAL TEST UP TO LL AND LEADING EDGE FLAP LIMIT LOAD STATIC TEST

- 14 HYDRAULIC JIGS
- 2 ELECTRICAL MOTORS FOR SURFACES ACTUATION
- 320 STRAIN GAUGES BRIDGES
- 53 LVDT/RVDT
- 9 LOAD CONDITION WITH AILERON AND LEF ACTUATED UP TO LL

TOTAL TEST TIME:  
19 DAYS





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## FULL SCALE STATIC TESTS

TEST PERFORMED ON SECOND PROTOTYPE STRUCTURE



60 HYDRAULIC JIGS

66 LOAD CELLS

80 LVDT / RVDT

783 STRAIN GAUGES  
BRIDGES

14 LOAD CONDITIONS  
UP TO LL

5 HT AND RUDDER  
FUNCTIONAL TEST

TOTAL TEST TIME:  
12 WEEKS

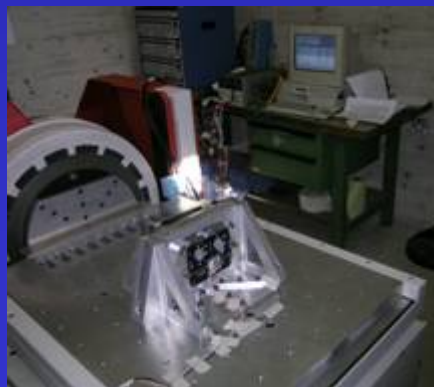


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### M346 – FLIGHT CLEARANCE DYNAMIC & ENVIRONMENTAL TESTS

#### GROUND VIBRATION & STRUCTURAL COUPLING TEST

- NORMAL MODE TESTING
- A/C ON PNEUMATIC SUSPENSION SYSTEM
- 155 ACCELER. – 8 SHACKERS
- 95 VIBRATION MODES MEASURED
- TOTAL TEST TIME: 14 DAYS



#### ENVIRONMENTAL TESTS

SHOCK & VIBRATION ENVIRONMENTAL QUALIF. TESTS PERFORMED ON SEVERAL MECHANICAL AND ELECTRONIC EQUIPMENT

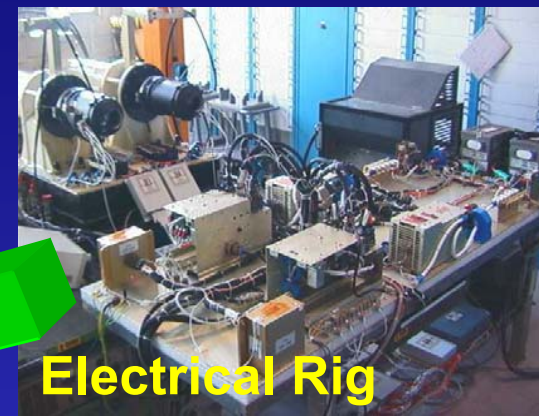


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## M346 – FLIGHT CLEARANCE SYSTEMS TESTS



Iron Bird



Electrical Rig



FLIGHT TEST  
ANALYSIS ENVIRONMENT



Fuel Rig



Avionic Rig



## AEROSPACE TESTING 2005

### M346 – FLIGHT CLEARANCE HIRF & EMC TESTS



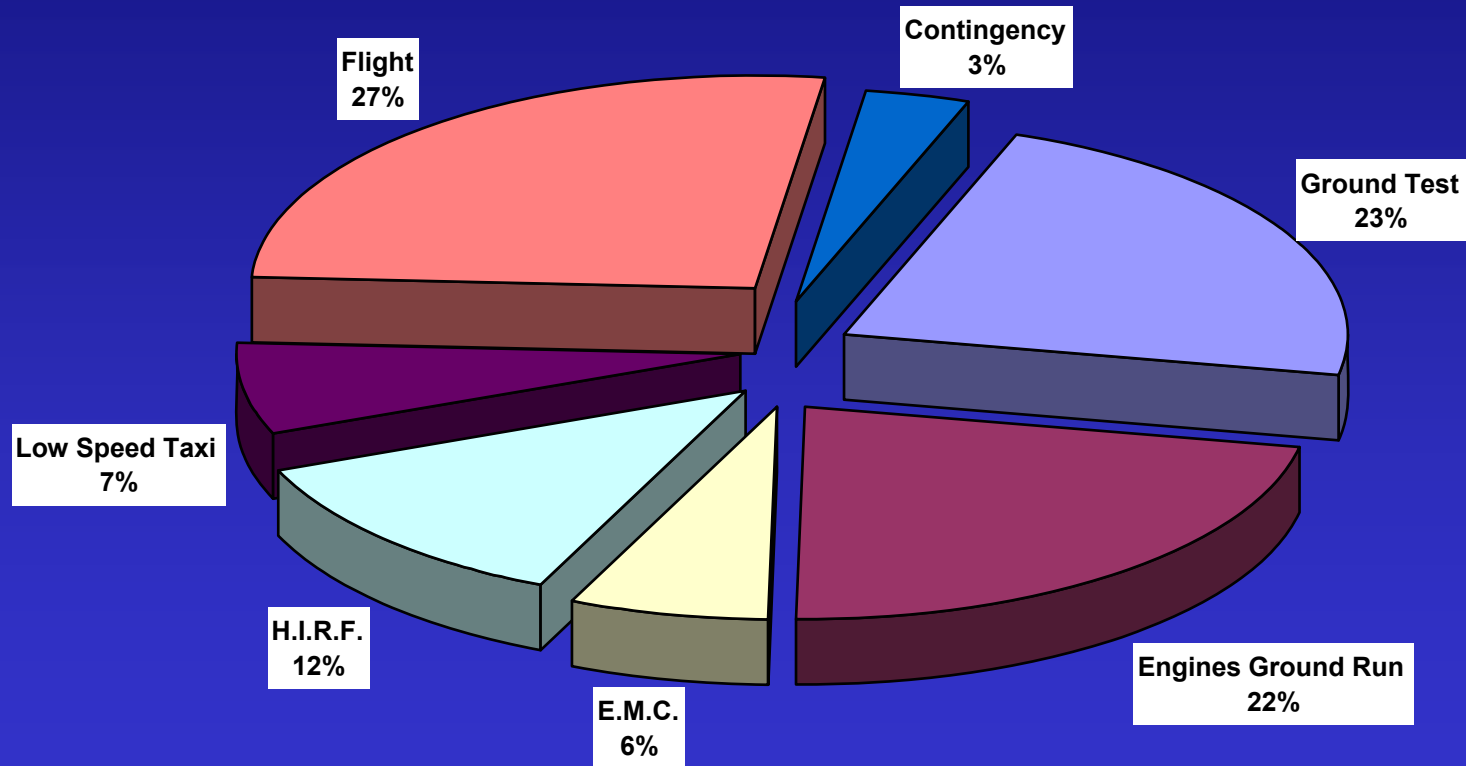
- TEST PERFORMED WITH AND WITHOUT ENGINES RUNNING
- TEST FOR EXTERNAL FIELD, EXTERNAL PEAK FIELD AND MICROWAVES UP TO 6 GHz.
- TOTAL TEST TIME: 5 DAYS



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## M346 – FLIGHT CLEARANCE PROTOTYPE TESTS

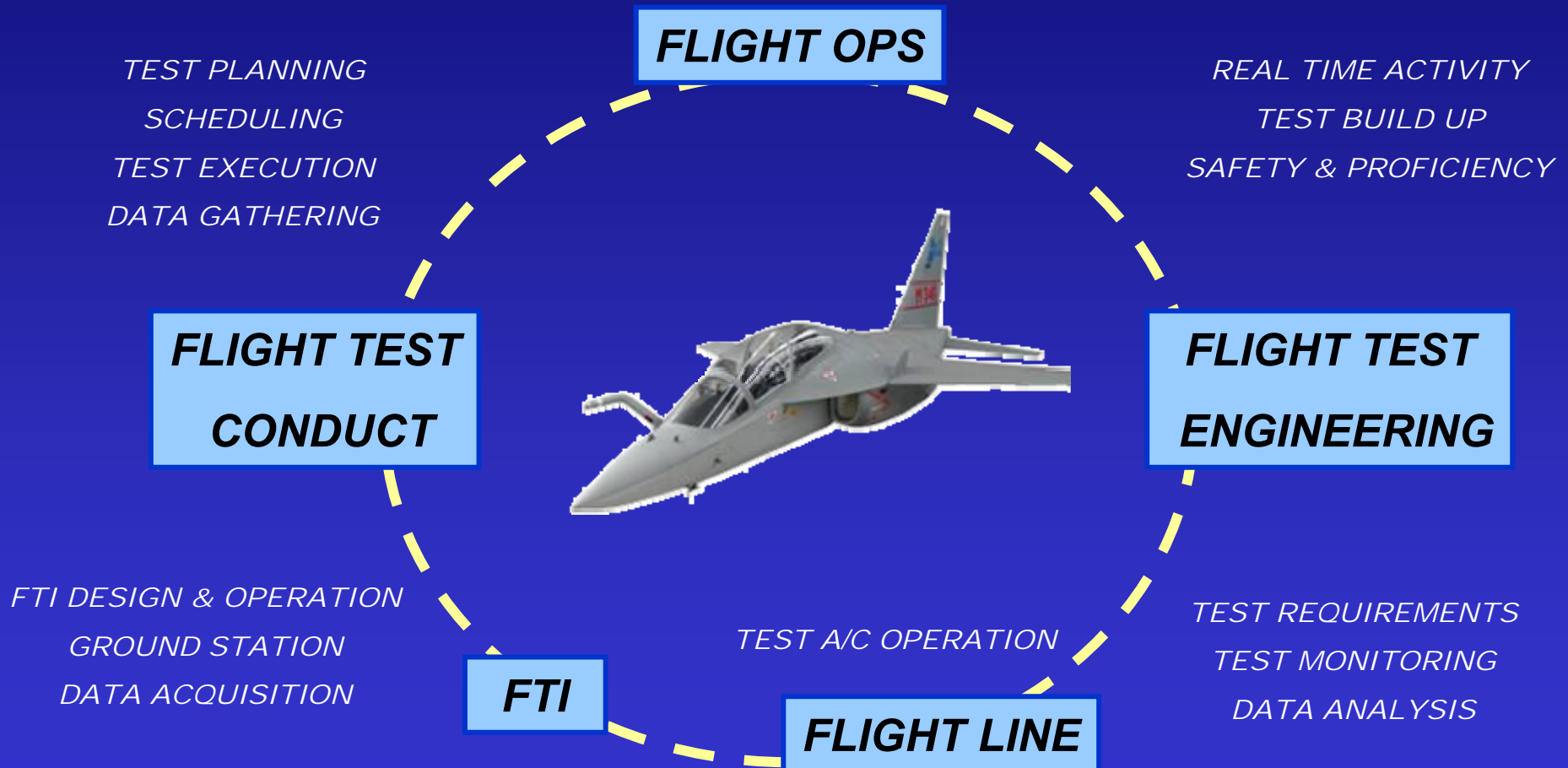
### 2004 FIRST PROTOTYPE TEST ACTIVITY





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## M346 – INTEGRATED FLIGHT TEST TEAM APPROACH





## AEROSPACE TESTING 2005

### M346 – FLIGHT TEST INSTRUMENTATION



#### Capabilities:

- > 5000 acquired measurements (> 1000 analog parameters)
- 4 video digital channels
- 20 Mbits/s recording capability
- 10 Mbits/s dual L-Band telemetry transmission rate

Miniature CAIS Data Acquisition Units  
Distributed, miniaturized, international standard, last generation PCM system.





## AEROSPACE TESTING 2005

### M346 – TELEMETRY & GROUND STATION

- Maximum use of real time analysis with direct involvement of specialist
- Enhanced Data Gathering for post-test data processing
- Flight test data analysis by standard COTS SW Tools
- Distributed real time data analysis system under implementation



- Decommuration, calibration, derived parameters processing, output to external WS (Unix, Windows) with fiber optical I/F (ScramNet, 1 Million S/S).



# AEROSPACE TESTING 2005

## M346 – INITIAL FLIGHT TESTING

Full Envelope Expansion Phase 1 CLM  
FCS:

- ✓ 325kts (0.65M)
- ✓ 35.000 ft
- ✓ -4° to +20° AoA
- ✓ Load Factor ( $N_z$ ) -1 to +5g

All Control Surfaces Configurations  
Cleared

Inflight Phase 1 & Phase 2 Engine Restart  
(Autorelight, Windmill and assisted)

Aerobatics Maneuvers



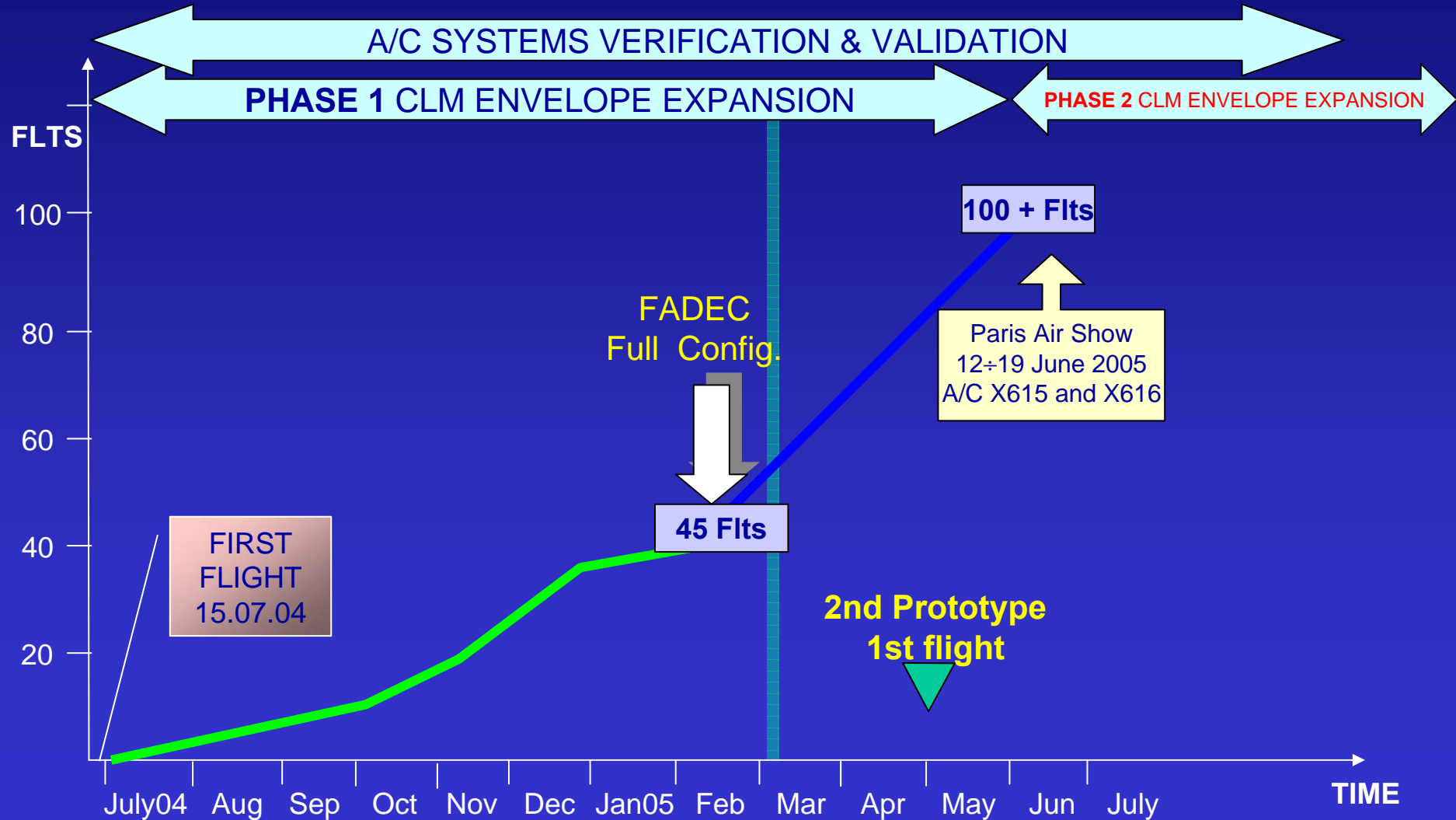
**From July 15<sup>th</sup> 2004 accomplished:**

**N° of FLIGHTS.....48**  
**FLIGHTS HOURS.....53h 45'**  
**FUNCTIONAL TEST**  
(On Ground / In Flight).....**163**  
**ENGINE OPERATING HOURS**  
(25002) LH.....xxx  
(25004) RH.....xxx



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## M346 – FLIGHT TEST PROGRAM





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## CONCLUSION

AN INTEGRATED APPROACH, IN TERMS OF TEST TEAM AND TEST METHODS / FACILITIES, RESULTED IN:

- A COMPLETE EXPERIMENTAL PROCESS, AIMED TO THE FLIGHT CLEARANCE OF THE FIRST PROTOTYPE, IN A SHORT TIME .
  - AN EFFICIENT UTILIZATION OF THE TEST ARTICLES.
  - FULL COMPLIANCE OF ALL THE AIRWORTHINESS REQUIREMENTS.
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