flight loads

1
00:00:00,003 --> 00:00:03,440
>>Flashing across California desert skies, the airplanes you see

2
00:00:03,440 --> 00:00:07,544
here are writing new chapters in the story
of man made flight....there she goes!

3
00:00:07,544 --> 00:00:12,082
>>This is my first opportunity
to greet you as deputy administrator

4
00:00:12,082 --> 00:00:15,752
of the National Aeronautics
and Space Administration.

5
00:00:16,086 --> 00:00:18,722
>>Together, you and I must make our new agency

6
00:00:18,722 --> 00:00:20,056
>>A most unusual place

7
00:00:20,090 --> 00:00:22,926
>>An organization that can challenge
conventional wisdom.

8
00:00:22,926 --> 00:00:26,530
>>We can engineer anything we can write the requirements for.

9
00:00:26,530 --> 00:00:27,931
>>We're going to make your idea work.

10
00:00:27,931 --> 00:00:30,500
This particular idea is quite disruptive.

11
00:00:31,168 --> 00:00:35,439
>>A typical flight, of course, starts
under the wing of the B-52 mothership.

12

00:00:35,605 --> 00:00:41,044
>>This sleek, high speed machine
would have made Rube Goldberg proud.

13
00:00:41,178 --> 00:00:44,047
>>The manner in which we fly
reentry from space,

14
00:00:44,047 --> 00:00:48,051
on the space shuttle was
pioneered on the X-15.

15
00:00:48,051 --> 00:00:53,657
>>The X-31 pretty much wrote the book on thurst vectoring, along with its sister program, the F-18 HARV.

16
00:00:53,657 --> 00:00:55,826
>>An observation of an occulation is

17
00:00:55,826 --> 00:00:58,795
one of the more challenging
missions that SOFIA can do.

18
00:00:59,596 --> 00:01:18,782
[Music/Background sound]

19
00:01:19,616 --> 00:01:23,987
>>Right now, we are looking
at the dawn of a new era of aviation.

20
00:01:27,023 --> 00:01:31,361
[Music/Background sound]

21
00:01:37,931 --> 00:01:39,899
[Music]

22
00:01:40,300 --> 00:01:42,902
>>Flight loads is a crucial discipiline.

23
00:01:43,436 --> 00:01:48,608

It is one of the areas that requires a
good combination of both science and art.

24
00:01:48,942 --> 00:01:52,979
We often say that every airplane that
we have ultimately goes through the Loads Lab.

25
00:01:53,446 --> 00:01:58,585
>>In 1964, a new building was rising
from the desert shore of Rogers Dry Lake.

26
00:01:58,685 --> 00:02:01,588
The tests this laboratory has conducted
over the past 50 years have

27
00:02:01,688 --> 00:02:05,325
supported almost every type of vehicle
the aerospace industry has to offer.

28
00:02:06,159 --> 00:02:09,229
>>We do a lot of testing in the laboratories
to make sure

29
00:02:09,229 --> 00:02:12,365
that components are going to withstand
the environments that they will see.

30
00:02:12,432 --> 00:02:15,568
>>Every time we go away
from a standard configuration on a vehicle

31
00:02:15,568 --> 00:02:17,670
that changes the loads
and we've got to understand

32
00:02:17,670 --> 00:02:21,975
how that affects the forces, stresses
and things going on in the airplane.

33
00:02:22,742 --> 00:02:25,178

>>We in the Flight Loads
Lab have been interested in thermal

34
00:02:25,178 --> 00:02:26,646
testing for many years.

35
00:02:26,646 --> 00:02:28,348
>>These specimens are being exposed

36
00:02:28,348 --> 00:02:32,218
to temperatures from 400 degrees
to 1000 degrees Fahrenheit...

37
00:02:32,352 --> 00:02:35,488
>>...in order to precisely calibrate
the thermal effects on the strain

38
00:02:35,488 --> 00:02:38,725
gauges ground heating tests were conducted.

39
00:02:58,745 --> 00:03:00,046
>>Also, over the years, there's

40
00:03:00,046 --> 00:03:03,550
been low temperature testing
using cryogenic cooling capability.

41
00:03:04,017 --> 00:03:06,686
>>A cooling system was used to lower
the glove temperature

42
00:03:06,686 --> 00:03:09,689
to the -30 degree Fahrenheit
pre-launch condition.

43
00:03:09,989 --> 00:03:13,226
The heating and cooling systems
worked together to bring the entire glove

44

00:03:13,226 --> 00:03:15,628
to cold soak condition...

45
00:03:18,231 --> 00:03:21,334
>>The type of loads that a wing
will experience in flight,

46
00:03:21,334 --> 00:03:24,837
are bending loads,
torsion loads and shear loads.

47
00:03:24,871 --> 00:03:28,474
There are loads that are applied
to the wings as a result of the air loads

48
00:03:28,474 --> 00:03:31,844
that are put onto the airplane
when it's flying or when it's maneuvering.

49
00:03:32,612 --> 00:03:33,780
>>How far can we push it?

50
00:03:33,780 --> 00:03:36,282
Where is it going to fail
and how is it going to fail?

51
00:03:36,482 --> 00:03:40,386
So this work here has really been key
to be able to help us anchor the models

52
00:03:40,386 --> 00:03:43,590
that we're developing to analyze
the performance of these structures

53
00:03:43,590 --> 00:03:47,360
and also to take that next step
and optimize the design of these systems.

54
00:03:48,528 --> 00:03:51,497
[Music]

55
00:03:52,632 --> 00:03:56,035
>>The second HiMAT aircraft underwent
extensive ground vibration

56
00:03:56,035 --> 00:03:59,706
testing after its delivery
to the Hugh L. Dryden flight Research Center.

57
00:04:00,340 --> 00:04:02,442
>>Any aircraft in flight has resonant

58
00:04:02,442 --> 00:04:06,779
modes which occur as its structure
flexes under aerodynamic loads.

59
00:04:07,513 --> 00:04:11,818
These flexures can become rapid and large.
Under extreme conditions,

60
00:04:12,051 --> 00:04:14,487
they may even result in structural
failure.

61
00:04:14,654 --> 00:04:17,590
>>Dryden's flight loads research facility;
mechanical

62
00:04:17,590 --> 00:04:20,627
vibrators are attached to portions
of the aircraft's structure.

63
00:04:20,760 --> 00:04:24,530
>>As the aircraft structure is excited
at known amplitude and frequencies.

64
00:04:24,564 --> 00:04:27,934
Its mechanical responses
are carefully measured and tabulated.

65
00:04:28,101 --> 00:04:31,571
>>We're trying to understand how
the airplane rings, basically like a bell.

66
00:04:31,604 --> 00:04:32,872
>>You actually want to see

67
00:04:32,872 --> 00:04:36,009
the structural characteristics
and how it behaves...once you go and fly,

68
00:04:36,075 --> 00:04:39,112
if you experience any like flutter
or dangerous

69
00:04:39,112 --> 00:04:42,081
vibration motions, then it's practically too late.

70
00:04:42,115 --> 00:04:44,484
>>We can tell if the structure is sound.

71
00:04:44,517 --> 00:04:48,288
>>With all this data, we'll be able
to update our models, which will be used

72
00:04:48,288 --> 00:04:51,491
in our flutter
analysis to validate that we are good

73
00:04:51,524 --> 00:04:53,426
and can give flight
clearance for the vehicle.

74
00:04:54,127 --> 00:04:57,096
[Music/Background Noise]

75
00:04:58,064 --> 00:04:58,931
>>Inertia testing,

76
00:04:58,931 --> 00:05:01,367
understanding
basically how the mass is distributed

77
00:05:01,367 --> 00:05:04,304
around the vehicle,
which gets important for the control laws.

78
00:05:04,637 --> 00:05:05,805
>>The Moment of Inertia

79
00:05:05,805 --> 00:05:09,142
essentially tells us the angular momentum
properties of the vehicle.

80
00:05:09,142 --> 00:05:12,278
We want to understand during flight
when we're trying to control it,

81
00:05:12,278 --> 00:05:13,780
how it pitches up and down,

82
00:05:13,780 --> 00:05:17,650
to understand how much resistance
and inertia happens

83
00:05:17,650 --> 00:05:20,486
during those pitching maneuvers.

84
00:05:20,787 --> 00:05:23,823
>>We need to know for certain
that our sensors are behaving properly

85
00:05:23,823 --> 00:05:26,459
so that when we put them on our structures
or put them on our vehicle,

86
00:05:26,626 --> 00:05:28,661
we actually believe the data

that's coming off.

87
00:05:28,661 --> 00:05:33,433
>>...not only test a large test article,
but to bring in some new test techniques

88
00:05:33,433 --> 00:05:37,370
like the FOSS and really calibrate
that against more traditional

89
00:05:37,370 --> 00:05:40,973
strain measurements
and the finite element modeling.

90
00:05:41,574 --> 00:05:44,877
>>The Flight Loads Lab
here at NASA, Armstrong performs

91
00:05:44,877 --> 00:05:49,315
some of the most sophisticated tests
that I've seen on on vehicles,

92
00:05:49,315 --> 00:05:51,084
flight vehicles,
as well as entry vehicles.