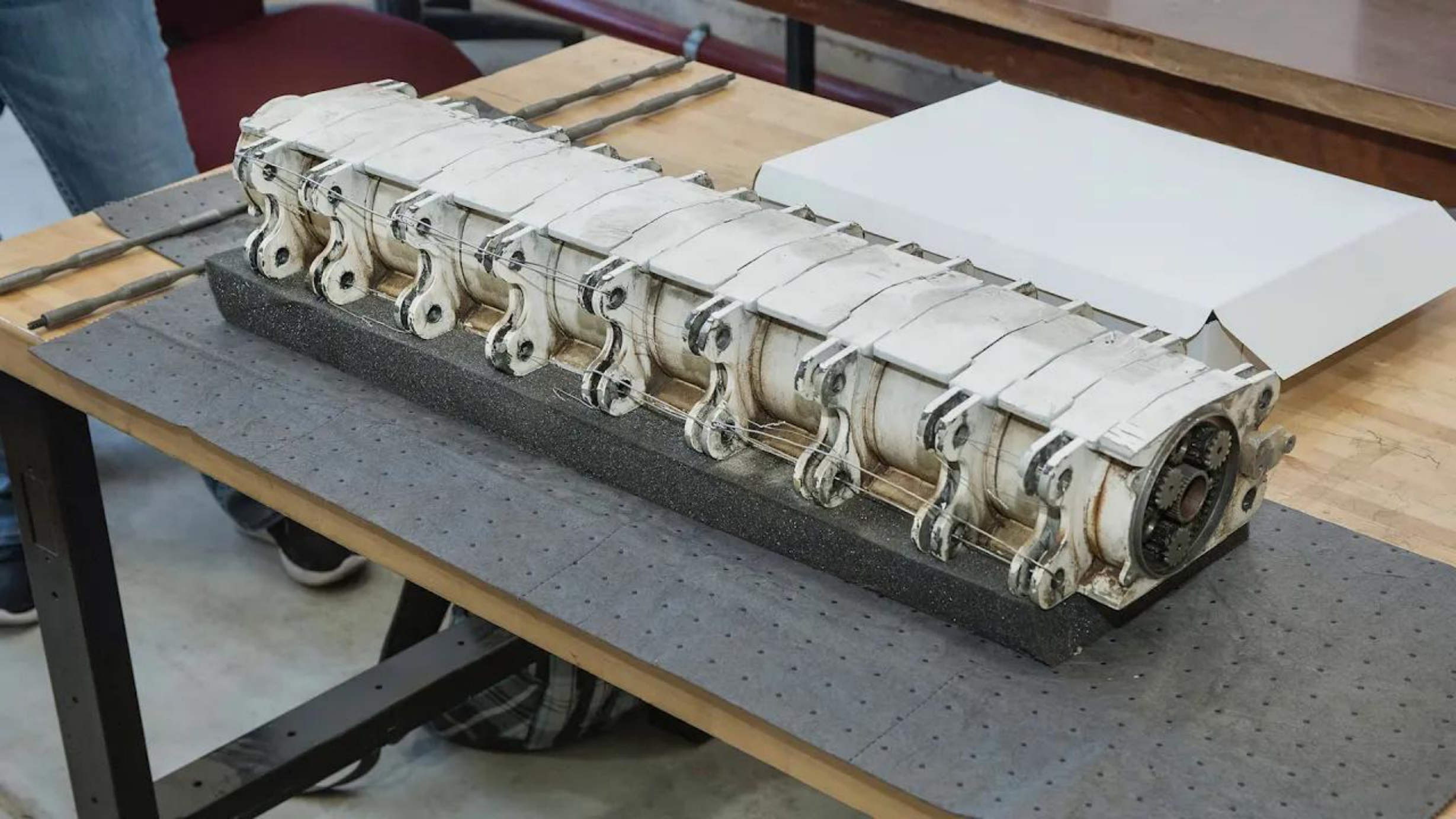

1
00:00:00,496 --> 00:00:03,616
>> Spanwise adaptive wing is
about moving wing sections

2
00:00:03,616 --> 00:00:06,356
in flights to improve
aircraft efficiency.

3
00:00:06,356 --> 00:00:07,966
Whether it's a drag reduction

4
00:00:08,546 --> 00:00:10,526
or control authority
or better stability.

5
00:00:11,206 --> 00:00:13,096
We are not the first
ones that's doing this.

6
00:00:13,096 --> 00:00:15,426
In fact, this dates
back to the early 60s.

7
00:00:15,426 --> 00:00:17,116
Like the example of the XB-70.

8
00:00:17,796 --> 00:00:18,866
But what's different here

9
00:00:18,866 --> 00:00:21,286
and what's new is how
do we fold those wings.

10
00:00:22,106 --> 00:00:24,526
At the heart of spanwise
adaptive wing project,

11
00:00:25,036 --> 00:00:27,626
we have this new

multifunctional material known

12
00:00:27,626 --> 00:00:28,966
as shape memory alloys.

13
00:00:29,876 --> 00:00:32,336
Which change shape or
remember different shapes

14
00:00:32,336 --> 00:00:33,766
as you heat them and cool them.

15
00:00:33,766 --> 00:00:36,126
And can be used as actuators.

16
00:00:36,126 --> 00:00:39,366
Recently back in, a few months
back we did a flight test

17
00:00:39,986 --> 00:00:42,806
on a sub-scale aircraft
using these new actuators.

18
00:00:42,866 --> 00:00:46,636
And, in fact, for the first time
we used a new high-temperature

19
00:00:46,706 --> 00:00:49,926
shape memory alloys
developed at NASA Glenn based

20
00:00:49,966 --> 00:00:51,506
on nickel-titanium hafnium.

21
00:00:51,656 --> 00:00:54,336
And this new material had
the right characteristics

22
00:00:54,416 --> 00:00:54,886

for flight.

23
00:00:55,366 --> 00:00:57,246
So now that we've
done this flight test,

24
00:00:57,246 --> 00:01:01,236
we wanted to transition
to a full-scale test.

25
00:01:01,336 --> 00:01:04,596
Being this F18 wing sections
that we're demonstrating on.

26
00:01:05,106 --> 00:01:07,666
And with that we took
the existing hardware

27
00:01:07,666 --> 00:01:08,846
of the folding mechanism.

28
00:01:08,926 --> 00:01:10,516
Which is a motor,
electric motor.

29
00:01:12,046 --> 00:01:13,846
And the transmission,
gear transmission.

30
00:01:14,196 --> 00:01:16,536
And we replaced that
with a 5,000

31
00:01:16,536 --> 00:01:21,186
and then a 20,000-inch pound
torque-rated actuators based

32
00:01:21,186 --> 00:01:26,186
on the shape memory alloys.

33
00:01:26,186 --> 00:01:29,046
The first test condition
is from zero to 90 degrees.

34
00:01:29,046 --> 00:01:30,666
So from horizontal to vertical.

35
00:01:31,226 --> 00:01:33,636
Similar to the way an
F18 aircraft folds wing.

36
00:01:33,996 --> 00:01:36,866
In this case the highest
torque is at zero.

37
00:01:37,326 --> 00:01:39,826
And then reduces as the
wing section moves up.

38
00:01:40,506 --> 00:01:43,506
I should point out that it
is controlled all the way.

39
00:01:43,896 --> 00:01:46,836
And we can dial any angle
in this wing from zero to 90

40
00:01:47,326 --> 00:01:48,526
with very good precision.

41
00:01:51,076 --> 00:01:55,126
This next test condition is
from minus 45 to 45 degrees.

42
00:01:55,256 --> 00:01:58,396
Since our project is not just
about folding on the ground,

43
00:01:58,396 --> 00:02:00,316

but also in flights, we need

44
00:02:00,396 --> 00:02:02,736
to evaluate how folding
the wing down looks like.

45
00:02:03,476 --> 00:02:04,756
Here the torque increases

46
00:02:04,866 --> 00:02:08,236
as we approach zero reference
angle, so horizontal plane.

47
00:02:08,706 --> 00:02:11,746
And then decrease again as
we reach the positive 45.

48
00:02:12,376 --> 00:02:15,946
In a real flight scenario, this
is the kind of loading or kind

49
00:02:16,116 --> 00:02:16,976
of [inaudible] that
you would expect.

50
00:02:17,516 --> 00:02:29,206
[Music]

51
00:02:29,706 --> 00:02:31,376
>> This ground demonstration
is one

52
00:02:31,376 --> 00:02:32,716
of a kind on multiple fronts.

53
00:02:33,486 --> 00:02:36,046
We'll have a new and
improved shape memory alloys.

54

00:02:36,416 --> 00:02:37,606
High torque actuators.

55
00:02:38,026 --> 00:02:38,686
And new mechanisms.

56
00:02:39,426 --> 00:02:41,706
Our next goal is to take
it to the next level.

57
00:02:42,446 --> 00:02:46,216
Learn what we've taken in
ground testing and mature it