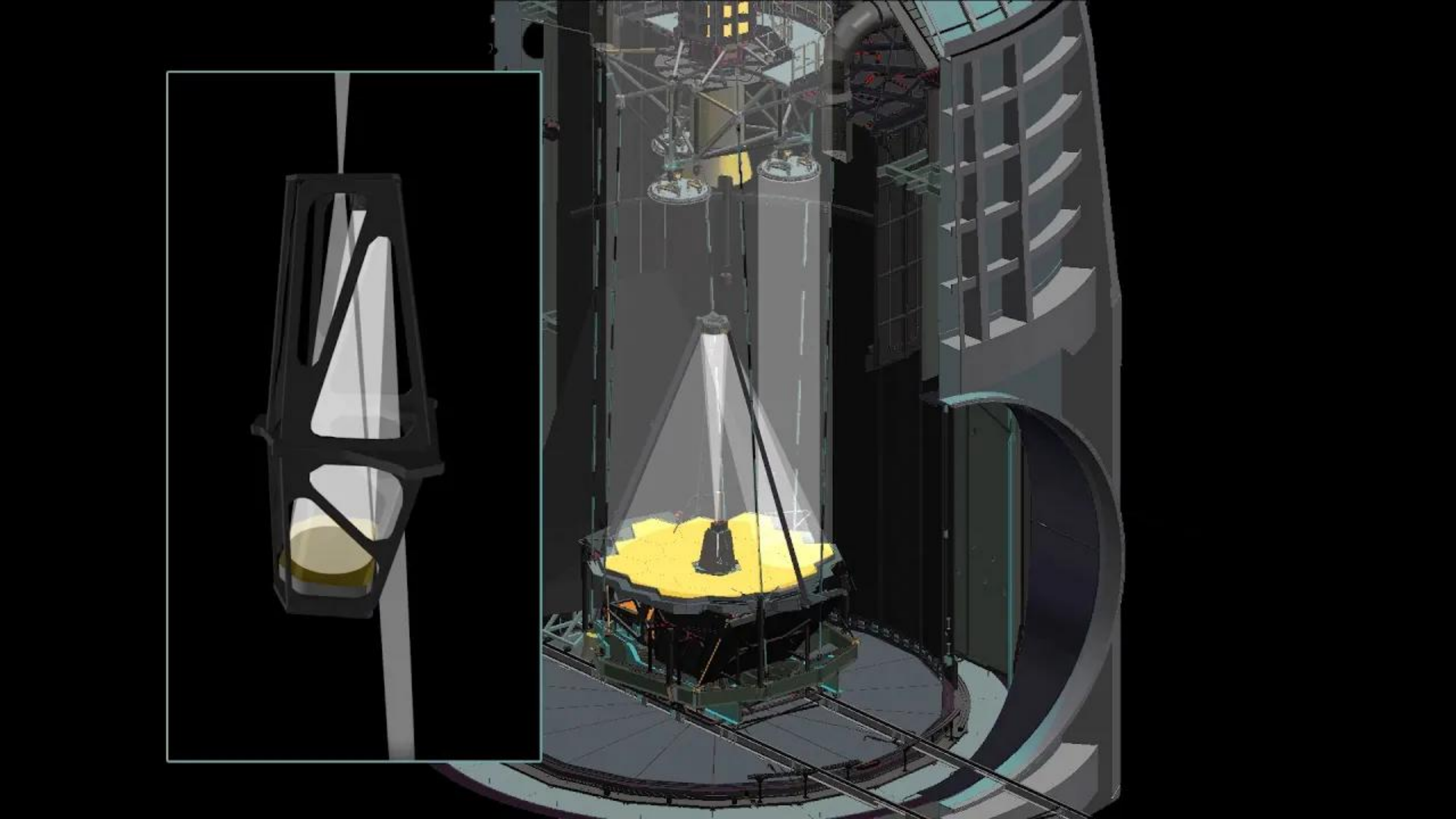

1
00:00:13,440 --> 00:00:18,090
At the Johnson Space Center in Houston, Texas…
you can walk along a Saturn V rocket that

2
00:00:18,090 --> 00:00:22,860
was designed to help humans get to the moon.
But now, this center is helping NASA prepare

3
00:00:22,860 --> 00:00:28,020
for our next great adventure in astronomy:
a telescope what will look way past the moon

4
00:00:28,020 --> 00:00:31,529
out to the universe's farthest horizons.

5
00:00:31,529 --> 00:00:36,000
Here is the vacuum chamber that was used to
test spacecraft during the Apollo era, so

6
00:00:36,000 --> 00:00:38,690
Lee, I understand it’s being used for the
James Webb Space Telescope, too?

7
00:00:38,690 --> 00:00:40,539
Lee Feinberg/JWST Optical Telescope Element
Manager: Yes, this is where we will be doing

8
00:00:40,539 --> 00:00:45,579
the full-scale test of the James Webb Space
Telescope, including the telescope and the

9
00:00:45,579 --> 00:00:50,070
instruments, and we’re going to be doing
optical testing and thermal testing of those

10
00:00:50,070 --> 00:00:50,820
components.

11
00:00:50,820 --> 00:00:55,489

We've seen tests before but this is like
the largest scale that we've done so far

12
00:00:55,489 --> 00:00:56,249
on Webb, right?

13
00:00:56,249 --> 00:01:00,409
Yeah, in fact, it's probably the largest
optical test that NASA has ever done and that's

14
00:01:00,409 --> 00:01:03,350
because Webb is the largest space telescope
we've ever built. So we're going to be

15
00:01:03,350 --> 00:01:07,500
testing the full primary mirror, which is
6 ½ meters in diameter … And we're going

16
00:01:07,500 --> 00:01:10,120
to be testing the whole telescope and the
instruments with it.

17
00:01:10,120 --> 00:01:14,890
So before we get in there, give us a preview
of what's been done to prepare for this

18
00:01:14,890 --> 00:01:15,860
test right now.

19
00:01:15,860 --> 00:01:19,340
Well, first of all, this is the first test
where we actually have flight hardware. It's

20
00:01:19,340 --> 00:01:24,260
the Aft Optics System which is part of the
telescope itself. We've put the Aft Optics

21
00:01:24,260 --> 00:01:28,470
System onto the Pathfinder telescope, which
is a model of the telescope and includes primary

22
00:01:28,470 --> 00:01:33,660
mirror segments on it. We then put that Pathfinder
telescope with the Aft Optics system onto

23
00:01:33,660 --> 00:01:37,540
a large structure and a rail system that allowed
us to put it in the chamber.

24
00:01:37,540 --> 00:01:40,790
So, what's the real purpose of the test?

25
00:01:40,790 --> 00:01:44,630
We're going to be cooling the telescope
down and we're going to be making sure that

26
00:01:44,630 --> 00:01:49,660
all of the mirrors are aligned the way they're
supposed to be and also that the system as

27
00:01:49,660 --> 00:01:54,280
a telescope really works the way we expect
at the very cold temperatures that it'll

28
00:01:54,280 --> 00:01:57,800
be at in space. It looks like they're all
set up for the tests, so let's get out of

29
00:01:57,800 --> 00:01:59,540
the chamber now.

30
00:01:59,540 --> 00:02:04,270
Now they're going to be closing the chamber
door. The liquid nitrogen is used to cool

31
00:02:04,270 --> 00:02:09,050
the inside of the vacuum shell to about 70
degrees above absolute zero. But inside of

32

00:02:09,050 --> 00:02:13,330
that is a helium shell. The helium shell is
what cools us to even colder temperatures

33
00:02:13,330 --> 00:02:16,030
to the 30 to 50 degrees above absolute zero.

34
00:02:16,030 --> 00:02:19,180
We're now well into the optical testing.

35
00:02:19,180 --> 00:02:21,090
So what do you mean by optical testing?

36
00:02:21,090 --> 00:02:24,790
We actually put light through the entire telescope
chain, including the tertiary mirror and the

37
00:02:24,790 --> 00:02:25,620
fine steering mirror.

38
00:02:25,620 --> 00:02:30,010
Do you want to see some of the images from
light that's going through the entire telescope?

39
00:02:30,010 --> 00:02:30,690
Oh yeah!

40
00:02:30,690 --> 00:02:32,410
Let me show you that.

41
00:02:32,410 --> 00:02:36,340
We actually simulate what looks like little
stars running through the entire end-to-end

42
00:02:36,340 --> 00:02:41,160
telescope and um, by looking at how these stars
go through focus, we can understand what the

43
00:02:41,160 --> 00:02:43,000

telescope is doing.

44
00:02:43,000 --> 00:02:47,260
So that's how you test the end-to-end telescope
through the full light path. How about the

45
00:02:47,260 --> 00:02:49,000
primary mirror alone?

46
00:02:49,000 --> 00:02:53,920
We use special test equipment that lets us
test the primary mirror just by itself and

47
00:02:53,920 --> 00:02:57,900
by doing that, we can determine the alignment
of each of the mirror segments individually,

48
00:02:57,900 --> 00:03:02,209
but also how they relate to each other and
make sure that they are aligned properly.

49
00:03:02,209 --> 00:03:06,860
When we have the full telescope, we'll have
18 of these hexagons. The pathfinder only

50
00:03:06,860 --> 00:03:11,420
has two mirror segments but it's enough
to really let us practice all the things we

51
00:03:11,420 --> 00:03:13,800
need to practice in terms of the testing and
the alignment.

52
00:03:13,800 --> 00:03:16,860
The images look like they have fingerprints
on them?

53
00:03:16,860 --> 00:03:21,750
Yeah, those fingerprints are really just contour
maps … kind of like taking slices through

54
00:03:21,750 --> 00:03:25,980
a mountain. As we tilt the mirrors around,
the contour maps tell us how much the mirrors

55
00:03:25,980 --> 00:03:29,870
are tilted and we use that information as
we align the primary mirror.

56
00:03:29,870 --> 00:03:34,240
What's the deal with this dark line right
here, through one of the primary mirror segments?

57
00:03:34,240 --> 00:03:39,170
Yes, so that is just a shadow from the big
strut that holds the secondary mirror. Remember

58
00:03:39,170 --> 00:03:43,510
the secondary mirror's on a tripod and so
the light that is hitting the mirrors is actually

59
00:03:43,510 --> 00:03:47,420
going and it's casting a shadow from that
strut. And what we're trying to do is align

60
00:03:47,420 --> 00:03:50,750
the mirrors to create essentially a single
mirror.

61
00:03:50,750 --> 00:03:55,090
Ok, so we're finishing up the test. And
what we're doing is sort of reversing the

62
00:03:55,090 --> 00:03:59,860
process of getting it in. We have to be very
careful with all of the sensitive hardware,

63
00:03:59,860 --> 00:04:01,340
including flight hardware, that we're removing.

64
00:04:01,340 --> 00:04:06,150
Well, thanks, Lee, for your time and letting
us see what the first large-scale test on

65
00:04:06,150 --> 00:04:07,390
James Webb has been like.

66
00:04:07,390 --> 00:04:09,290
You’re very welcome.

67
00:04:09,290 --> 00:04:14,030
The Aft Optics System has been removed from
the test setup and will be joining other flight

68
00:04:14,030 --> 00:04:19,349
hardware for more testing at NASA’s Goddard
Space Flight Center in Greenbelt, MD. Thanks