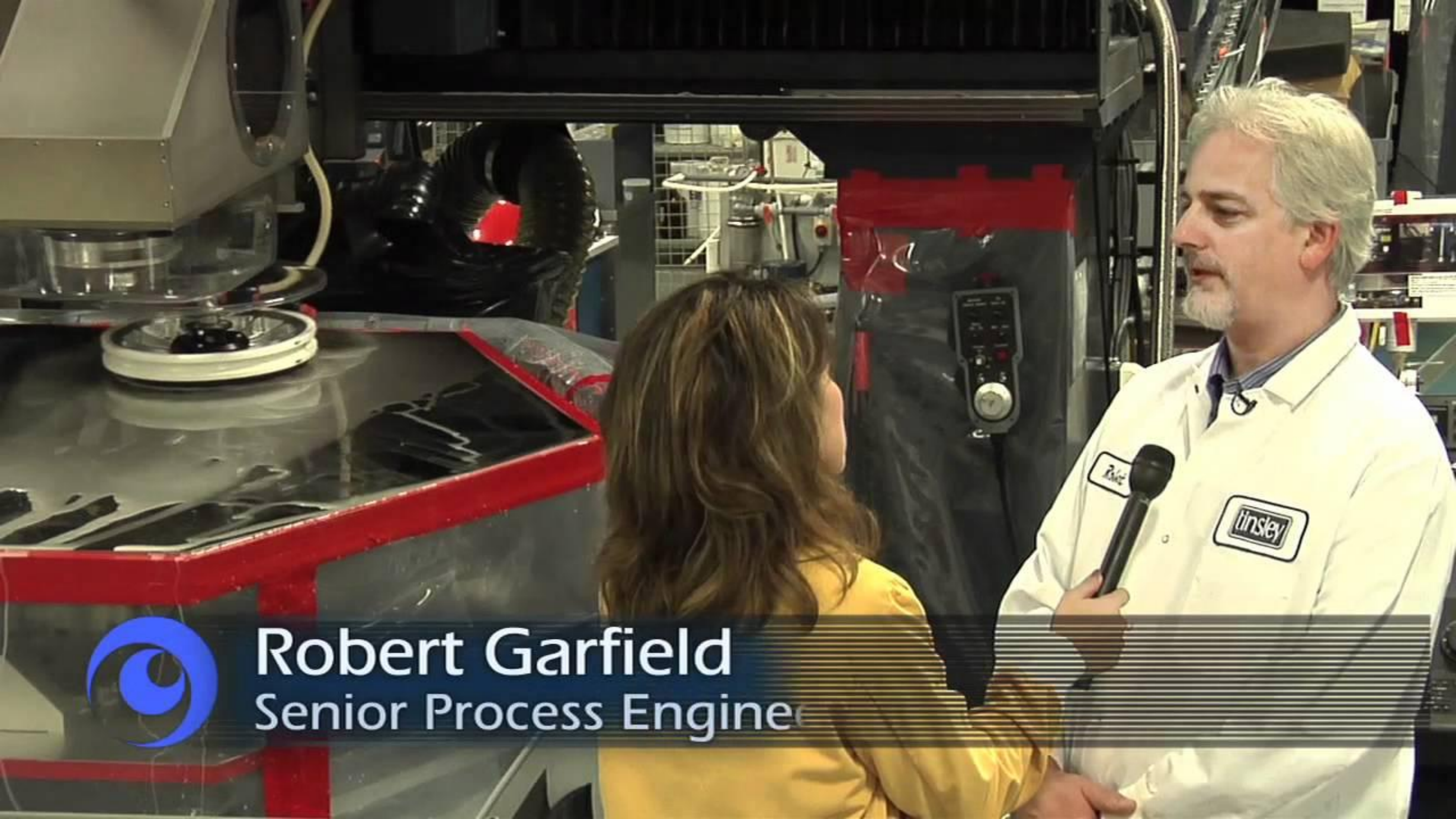
Robert Garfield
Senior Process Engine
tinsley

1
00:00:19,590 --> 00:00:17,269
one of the reasons the james webb space

2
00:00:22,870 --> 00:00:19,600
telescope will usher in a new era of

3
00:00:24,630 --> 00:00:22,880
astronomy is its unique set of mirrors

4
00:00:26,630 --> 00:00:24,640
to perform at their very best these

5
00:00:29,269 --> 00:00:26,640
mirrors need to be shaped with exact

6
00:00:32,229 --> 00:00:29,279
precision to find out just how that gets

7
00:00:34,389 --> 00:00:32,239
done we're here at l three iowas tinsley

8
00:00:36,069 --> 00:00:34,399
in richmond california

9
00:00:37,670 --> 00:00:36,079
so ed what's going on here

10
00:00:39,430 --> 00:00:37,680
well we're shaping the mirror using

11
00:00:41,990 --> 00:00:39,440
several different processes to take it

12
00:00:43,510 --> 00:00:42,000
down to about 20 nanometers of surface

13
00:00:45,910 --> 00:00:43,520

error which is about one-fifth the

14
00:00:47,350 --> 00:00:45,920
diameter of a human hair what else are

15
00:00:49,110 --> 00:00:47,360
you trying to get rid of

16
00:00:50,869 --> 00:00:49,120
we have to remove fine scratches down to

17
00:00:52,549 --> 00:00:50,879
about eight thousandths of an inch

18
00:00:54,630 --> 00:00:52,559
anything wider than that and it starts

19
00:00:56,310 --> 00:00:54,640
to reflect light and

20
00:00:58,229 --> 00:00:56,320
diffuse it so you don't get a good image

21
00:01:00,229 --> 00:00:58,239
off the telescope we're removing the

22
00:01:02,150 --> 00:01:00,239
grinding compound actually it's a rough

23
00:01:03,750 --> 00:01:02,160
polish compound and beryllium that's

24
00:01:05,509 --> 00:01:03,760
actually on the surface of the mirror we

25
00:01:06,789 --> 00:01:05,519
have to clean it before we go on to the

26
00:01:09,030 --> 00:01:06,799
next process

27
00:01:11,350 --> 00:01:09,040
he's removing it off of the part using a

28
00:01:13,510 --> 00:01:11,360
solvent the solvent he's using it is it

29
00:01:15,190 --> 00:01:13,520
just windex or much more no we can't we

30
00:01:16,630 --> 00:01:15,200
can't use windex it has chemicals in it

31
00:01:19,190 --> 00:01:16,640
that will actually attack the surface of

32
00:01:21,910 --> 00:01:19,200
the beryllium and cause it to corrode so

33
00:01:24,789 --> 00:01:21,920
we have to use a isopropyl alcohol

34
00:01:27,510 --> 00:01:24,799
in order to clean the part and acetone

35
00:01:30,069 --> 00:01:27,520
robert ed showed us the cleaning of the

36
00:01:31,670 --> 00:01:30,079
mirrors so what's going on here after

37
00:01:33,990 --> 00:01:31,680
rough polishing we have to get rid of

38
00:01:35,910 --> 00:01:34,000

the texture that's left on the surface

39
00:01:38,390 --> 00:01:35,920
the smoothing process will plane over

40
00:01:40,710 --> 00:01:38,400
that texture and give us a true mirror

41
00:01:42,789 --> 00:01:40,720
surface could you do this by hand

42
00:01:44,789 --> 00:01:42,799
people used to do this by hand but you

43
00:01:46,870 --> 00:01:44,799
could not make these mirrors

44
00:01:49,429 --> 00:01:46,880
it'd be very difficult to not have

45
00:01:52,149 --> 00:01:49,439
residual texture in these mirrors

46
00:01:54,630 --> 00:01:52,159
it looks like water is it water no it's

47
00:01:55,910 --> 00:01:54,640
not water it has a fine abrasive

48
00:01:56,870 --> 00:01:55,920
particle in it

49
00:01:57,670 --> 00:01:56,880
and some

50
00:01:59,270 --> 00:01:57,680
other

51
00:02:01,030 --> 00:01:59,280
chemistries that we know work well with

52
00:02:03,830 --> 00:02:01,040
beryllium

53
00:02:06,149 --> 00:02:03,840
polish

54
00:02:08,550 --> 00:02:06,159
so robert it kind of reminds me of what

55
00:02:10,229 --> 00:02:08,560
women tried to do exfoliate their skin

56
00:02:12,949 --> 00:02:10,239
trying to get rid of that top layer of

57
00:02:15,350 --> 00:02:12,959
skin cells to show a brighter layer

58
00:02:16,470 --> 00:02:15,360
underneath well the mirror surface when

59
00:02:19,510 --> 00:02:16,480
it comes to this

60
00:02:21,910 --> 00:02:19,520
process has a texturing on it and so

61
00:02:24,229 --> 00:02:21,920
this process will take the little peaks

62
00:02:25,990 --> 00:02:24,239
sawed off sawed off until finally you

63
00:02:28,710 --> 00:02:26,000

have this perfect plane

64
00:02:30,390 --> 00:02:28,720
and these are not flat mirrors but you

65
00:02:33,350 --> 00:02:30,400
want that surface to be just very

66
00:02:35,910 --> 00:02:33,360
continuous if it has roughness in it it

67
00:02:37,350 --> 00:02:35,920
won't perform well because each little

68
00:02:39,350 --> 00:02:37,360
lump and bump on the surface then

69
00:02:40,949 --> 00:02:39,360
reflects light in a different direction

70
00:02:44,150 --> 00:02:40,959
and so it doesn't come back to the

71
00:02:45,910 --> 00:02:44,160
detectors so this process helps it to be

72
00:02:48,470 --> 00:02:45,920
extremely uniform so you have the

73
00:02:50,869 --> 00:02:48,480
maximum amount of surface area returning

74
00:02:52,790 --> 00:02:50,879
the light for you well thanks a lot for

75
00:02:54,949 --> 00:02:52,800
showing us this thank you so these

76
00:02:57,030 --> 00:02:54,959
processes the mirrors go through like

77
00:02:59,670 --> 00:02:57,040
the rough polishing and the smoothing

78
00:03:01,509 --> 00:02:59,680
are done over and over again to make

79
00:03:04,390 --> 00:03:01,519
sure the mirrors on the james webb space

80
00:03:06,710 --> 00:03:04,400
telescope have a smooth surface and the