

1  
00:00:15,429 --> 00:00:18,559  
Mary Estacion/Reporter: One of the reasons  
the James Webb Space Telescope will usher

2  
00:00:18,559 --> 00:00:24,589  
in a new era of astronomy is its unique set  
of mirrors. To perform at their very best,

3  
00:00:24,589 --> 00:00:29,448  
these mirrors need to be shaped with exact  
precision. To find out just how that gets

4  
00:00:29,449 --> 00:00:34,539  
done, we're here at L3 IOS Tinsley in Richmond,  
CA.

5  
00:00:34,539 --> 00:00:36,609  
So Ed, what's going on here?  
Ed Boese/JWST Manufacturing Supervisor: Well,

6  
00:00:36,609 --> 00:00:41,140  
we're shaping the mirror using several different  
processes to take it down to about 20 nanometers

7  
00:00:41,140 --> 00:00:45,270  
of surface error, which is about 1/5 the diameter  
of a human hair.

8  
00:00:45,270 --> 00:00:47,120  
Mary: What else are you trying to get rid  
of?

9  
00:00:47,119 --> 00:00:51,659  
Ed: We have to remove fine scratches down  
to about 8/1000ths of an inch. Anything wider

10  
00:00:51,659 --> 00:00:56,500  
than that and it starts to reflect light and  
diffuse it so you don't get a good image off

11  
00:00:56,500 --> 00:00:59,359  
the telescope.  
Ed: We're removing the grinding compound,

12

00:00:59,359 --> 00:01:03,469  
actually it's a rough polish compound and beryllium that's actually on the surface of

13  
00:01:03,469 --> 00:01:07,150  
the mirror. And we have to clean it before we go on to the next process.

14  
00:01:07,150 --> 00:01:12,210  
He's removing it off the part using a solvent. Mary:  
The solvent he's using... is it just Windex

15  
00:01:12,209 --> 00:01:15,069  
or is it much more particular than that?  
Ed: No, no, we can't use Windex. It has chemicals

16  
00:01:15,069 --> 00:01:19,250  
in it that will actually attack the surface of the beryllium and cause it to corrode,

17  
00:01:19,250 --> 00:01:24,489  
so we have to use a isopropyl alcohol and acetone it.

18  
00:01:24,489 --> 00:01:29,629  
Mary: Ed showed us the cleaning of the mirrors, so what's going on here?

19  
00:01:29,629 --> 00:01:33,079  
Robert: After rough polishing, we have to get rid of the texture that's left on the

20  
00:01:33,079 --> 00:01:38,438  
surface. The smoothing process will plane over that texture and give us a true mirror

21  
00:01:38,438 --> 00:01:40,149  
surface.  
Mary: Could you do this by hand?

22  
00:01:40,150 --> 00:01:45,040  
Robert: People used to do this by hand, but you could not make these mirrors by hand.

23  
00:01:45,040 --> 00:01:49,219  
It would be very difficult not to have residual

texture in these mirrors.

24

00:01:49,219 --> 00:01:54,209

Mary: It looks like water, is it water?

Robert: No, it's not water. It has a fine

25

00:01:54,209 --> 00:01:59,830

abrasive particle in it and some other chemistries that we know work well with beryllium. Beryllium

26

00:01:59,831 --> 00:02:06,290

is a very difficult metal to polish

Mary: So Robert, it kind of reminds of what

27

00:02:06,290 --> 00:02:11,390

women try to do, exfoliate their skin, trying to get rid of that top layer of skin cells,

28

00:02:11,389 --> 00:02:15,939

to show a brighter layer underneath?

Robert: Well, the mirror surface, when it

29

00:02:15,939 --> 00:02:21,810

comes to this process has a texturing on it, so this process will take the little peaks,

30

00:02:21,810 --> 00:02:27,389

saw it off, saw it off, until finally, you have this perfect plane. And these are not

31

00:02:27,389 --> 00:02:30,870

flat mirrors, but you want that surface to be just very continuous.

32

00:02:30,870 --> 00:02:36,419

Robert: If it has roughness in it, it won't perform well, because each little lump and

33

00:02:36,419 --> 00:02:41,020

bump on the surface reflects light in a different direction and so it doesn't come back to the

34

00:02:41,020 --> 00:02:46,590

detectors. So this process helps it to be extremely uniform so you have the maximum

35  
00:02:46,590 --> 00:02:49,628  
amount of surface area returning the light  
for you.

36  
00:02:49,628 --> 00:02:52,158  
Mary: Well, thanks a lot for showing us this.  
Robert: Thank you.

37  
00:02:52,158 --> 00:02:58,378  
Mary: So, these processes the mirrors go through,  
like the rough polishing are done over and

38  
00:02:58,378 --> 00:03:04,128  
over again to make sure the mirrors on the  
James Webb Space Telescope have a smooth surface

39  
00:03:04,128 --> 00:03:08,938  
and the correct shape. Thanks for joining  
us on another edition of Behind the Webb.