HUBBLE
TOOL TIME
SERVICING MISSION 4

1
00:00:00,000 --> 00:00:01,935
>> JOHN: Yep, when you're
working in a vacuum and you're

2
00:00:01,935 --> 00:00:05,005
inside a spacesuit with oxygen,
you know, you don't wanna cut

3
00:00:05,005 --> 00:00:07,641
your glove because then the
oxygen will leak out and then

4
00:00:07,641 --> 00:00:10,711
you die, so that's a bad day!
>> CHRISTY: It's suboptimal.

5
00:00:10,711 --> 00:00:12,379
[LAUGHTER]

6
00:00:12,379 --> 00:00:25,425
[UPBEAT MUSIC]

7
00:00:25,425 --> 00:00:28,061
>> JOHN: Hi, I'm John Grunsfeld,
NASA astronaut.

8
00:00:28,061 --> 00:00:29,696
>> CHRISTY: Hi, I'm Christy
Hansen, NASA

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00:00:29,696 --> 00:00:31,932
astronaut trainer for
spacewalking, and flight

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00:00:31,932 --> 00:00:36,069
controller. >> ED: I'm Ed Rezac,
EVA engineer for the Hubble

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00:00:36,069 --> 00:00:39,606

Space Telescope Project.
>> JOHN: Now EVA is an acronym

12
00:00:39,606 --> 00:00:43,110
that means extravehicular
activity, which is just a fancy

13
00:00:43,110 --> 00:00:46,914
way of saying “spacewalk,” and I
was lucky enough to do eight

14
00:00:46,914 --> 00:00:50,484
spacewalks on the Hubble Space
Telescope, working with Christy

15
00:00:50,484 --> 00:00:54,421
and Ed. The Hubble Space
Telescope was designed to be

16
00:00:54,421 --> 00:00:58,492
upgraded and fixed on orbit,
occasionally something would

17
00:00:58,492 --> 00:01:02,696
break that wasn’t anticipated,
and we had to come up with new

18
00:01:02,696 --> 00:01:06,466
ways of fixing it. And that was
the case on this last mission,

19
00:01:06,466 --> 00:01:09,336
the most ambitious of all the
Hubble missions, and some of the

20
00:01:09,336 --> 00:01:13,240
most difficult spacewalks ever
done. The Space Telescope

21
00:01:13,240 --> 00:01:17,077

Imaging Spectrograph failed, and
we had to figure out a way to

22
00:01:17,077 --> 00:01:20,213
fix it on orbit rather than
putting in a whole new

23
00:01:20,213 --> 00:01:22,683
scientific instrument, which is
what we usually did on Hubble.

24
00:01:22,683 --> 00:01:27,321
Unfortunately, the designers of
the Space Telescope Imaging

25
00:01:27,321 --> 00:01:30,924
Spectrograph never imagined that
we would have to open it up in

26
00:01:30,924 --> 00:01:35,028
space, and it had hundreds of
tiny little screws that we had

27
00:01:35,028 --> 00:01:39,700
to remove to access a circuit
board to replace it to bring the

28
00:01:39,700 --> 00:01:42,869
tele- the instrument back to
life. So these are some of the

29
00:01:42,869 --> 00:01:46,273
tools that we came up with to be
able to do that. >> ED: We tried

30
00:01:46,273 --> 00:01:50,744
to make the tools as astronaut
friendly as possible, and one

31
00:01:50,744 --> 00:01:55,115

way we had to do that, or that
we chose to do that, was using

32
00:01:55,115 --> 00:01:58,752
colors to color code the
different size fasteners and the

33
00:01:58,752 --> 00:02:03,323
fastener bits so the astronauts
could easily grab what they need

34
00:02:03,323 --> 00:02:06,760
and proceed with the task.
>> CHRISTY: How do we pick up an

35
00:02:06,760 --> 00:02:11,098
interface and not lose something
in orbit? Bit caddy! Which one

36
00:02:11,098 --> 00:02:15,068
do you want John? >> JOHN: I'll
take a red bit! [TOOL CLANKS]

37
00:02:15,068 --> 00:02:18,905
>> ED: John's going for the red
bit. The STIS had several

38
00:02:18,905 --> 00:02:23,210
different fastener types that
had to be removed which required

39
00:02:23,210 --> 00:02:28,548
different bits. And the fastener
capture plate which held all the

40
00:02:28,548 --> 00:02:32,419
fasteners and kept them from
drifting into the optics core of

41
00:02:32,419 --> 00:02:37,224

the telescope was also color
coded. So John could match the

42
00:02:37,224 --> 00:02:42,129
bit up with the color code on
the plate itself. >> JOHN: So we

43
00:02:42,129 --> 00:02:45,899
installed this fastener capture
plate on the front of the STIS:

44
00:02:45,899 --> 00:02:50,470
Space Telescope Imaging
Spectrograph Instrument, and the

45
00:02:50,470 --> 00:02:53,774
reason why we had to use the
fastener capture plate is, as Ed

46
00:02:53,774 --> 00:02:58,245
said, if I were to remove a
screw and let go of it and it

47
00:02:58,245 --> 00:03:01,715
floated away it could damage the
telescope. So all of the screws

48
00:03:01,715 --> 00:03:06,286
were behind this plate.
>> CHRISTY: And you had 111

49
00:03:06,286 --> 00:03:10,691
chances to lose screws. >> JOHN:
And you would insert the bit

50
00:03:10,691 --> 00:03:13,760
through a tiny little hole on
the fastener capture plate,

51
00:03:13,760 --> 00:03:15,395

engage the head
of the screw,

52
00:03:15,395 --> 00:03:18,665
[TOOL WHIRRS] undo
it, and then when you take the

53
00:03:18,665 --> 00:03:22,269
bit out the screw would float
around inside of this little

54
00:03:22,269 --> 00:03:26,473
cavity, and the screw was big
enough that it wouldn't fit

55
00:03:26,473 --> 00:03:30,944
through the hole. And then
repeat 111 times.

56
00:03:30,944 --> 00:03:34,614
>> CHRISTY: And how do we track
all that John? >> JOHN: Well,

57
00:03:34,614 --> 00:03:37,984
like any good spacewalk we had a
set of procedures that you

58
00:03:37,984 --> 00:03:40,821
helped write. >> CHRISTY:
Exactly, so we had a whole

59
00:03:40,821 --> 00:03:44,057
ground team associated with
developing the procedures,

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00:03:44,057 --> 00:03:47,160
capturing all the requirements,
and flying an EVA

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00:03:47,160 --> 00:03:48,595

spacewalking checklist on orbit.

62
00:03:48,595 --> 00:03:51,698
So when John and Mike Massimino,
who actually performed this task

63
00:03:51,698 --> 00:03:54,668
on spacewalk number four,
removed each one, we had a

64
00:03:54,668 --> 00:03:57,537
requirement that he actually
read to the ground, “okay I’m

65
00:03:57,537 --> 00:04:00,173
releasing screw number one,” and
we would all be on the ground,

66
00:04:00,173 --> 00:04:04,177
“check, screw number one,” “now
screw number two,” 111 times to

67
00:04:04,177 --> 00:04:06,446
make sure that everything was
fully released, so that when he

68
00:04:06,446 --> 00:04:09,950
went to remove the interface
nothing was stuck, it wasn’t

69
00:04:09,950 --> 00:04:12,819
stuck on the telescope. >> JOHN:
Really amazing, all the

70
00:04:12,819 --> 00:04:15,889
complexity to do something as
simple as removing hundreds of

71
00:04:15,889 --> 00:04:20,260
tiny screws so that we can get

access to the circuit board and

72
00:04:20,260 --> 00:04:23,930
use another tool to pull it out,
put a new one in, put a new

73
00:04:23,930 --> 00:04:27,934
cover on with no screws that
locked on, >> ED: Right.

74
00:04:27,934 --> 00:04:30,203
>> JOHN: and bring that
instrument back to life so that

75
00:04:30,203 --> 00:04:34,241
it could continue looking at
black holes and the distant

76
00:04:34,241 --> 00:04:36,243
universe, really pretty
amazing, all worked

77
00:04:36,243 --> 00:04:37,744
out great.
>> CHRISTY: In addition

78
00:04:37,744 --> 00:04:40,380
to what John said, the
astronauts had to be trained on

79
00:04:40,380 --> 00:04:42,716
“stay away from this,” “don’t
touch that,” they’re taking

80
00:04:42,716 --> 00:04:45,418
something off and handing it off
to another astronaut, they have

81
00:04:45,418 --> 00:04:48,555
to make sure that they don’t cut

gloves in the process of doing

82
00:04:48,555 --> 00:04:51,224
those transfers. So all that is
designed, and trained, into

83
00:04:51,224 --> 00:04:53,927
their repeated training tasks so
they have this muscle memory to

84
00:04:53,927 --> 00:04:56,029
be careful every single time.
>> JOHN: Yep, when you’re

85
00:04:56,029 --> 00:04:57,631
working in a vacuum
and you're inside a

86
00:04:57,631 --> 00:04:59,766
spacesuit with
oxygen, you know,

87
00:04:59,766 --> 00:05:01,968
you don’t wanna cut your glove
because then the oxygen will

88
00:05:01,968 --> 00:05:04,838
leak out and then you die, so
that’s a bad day!

89
00:05:04,838 --> 00:05:08,108
>> CHRISTY: It’s suboptimal.
[LAUGHTER] >> JOHN: Thanks for

90
00:05:08,108 --> 00:05:10,010
joining us on Hubble Tool Time!
>> CHRISTY: Thank you!

91
00:05:10,010 --> 00:05:11,478
>> ED: See ya!

92
00:05:11,478 --> 00:05:14,981
[UPBEAT MUSIC]

93
00:05:14,981 --> 00:05:21,454
[SILENCE]

94
00:05:21,454 --> 00:05:25,831
>>CHRISTY: I like
all the pretty colors.

95
00:05:25,831 --> 00:05:34,105
[UPBEAT MUSIC]

96
00:05:34,105 --> 00:05:35,860
>>JOHN:
That’s pretty stable.