1
00:00:01,130 --> 00:00:01,730
>> Thanks again Brandy [phonetic].

2
00:00:01,730 --> 00:00:04,120
We're back here with Amy Ross,
Spacesuit Engineer, once again,

3
00:00:04,120 --> 00:00:06,340
at the anthropometry and biomechanics facility.

4
00:00:06,340 --> 00:00:09,090
It's a very NASA term but
what-- they do some cool stuff

5
00:00:09,090 --> 00:00:10,490
in here with these advanced spacesuits.

6
00:00:10,490 --> 00:00:12,880
Amy, talk once again about what
we're looking at back here.

7
00:00:12,880 --> 00:00:14,830
>> So this is a Z1 prototype space suit.

8
00:00:14,830 --> 00:00:14,930
>> Okay.

9
00:00:14,930 --> 00:00:19,880
>> And we're going to use this space suit at
the test bed and then we'll pick a configuration

10
00:00:19,880 --> 00:00:25,940
that we hopefully will end up flying on
IDTL, on ISIS or some other kind of flight.

11
00:00:25,940 --> 00:00:28,150
>> So let's back up and talk
about the history, there--

12
00:00:28,150 --> 00:00:29,420
you know, if you look at the history of NASA,

13
00:00:29,420 --> 00:00:32,510
what NASA is under actually haven't
been that many type of space suits.

14
00:00:32,510 --> 00:00:34,480
You have the Gemini Spacesuit
that [inaudible] used.

15
00:00:34,480 --> 00:00:37,200
You have the Apollo suit that went to the moon.

16
00:00:37,200 --> 00:00:40,600
And you've had the one that we've used for
shuttle and station for over 30 years now.

17
00:00:40,600 --> 00:00:45,120
And this is the first time in decades that
we've actually redesigned and try to figure out,

18
00:00:45,120 --> 00:00:47,480
you know, what is this thing need
to do on our future missions, right?

19
00:00:47,480 --> 00:00:51,590
>> Yes. And all those suits really, the
only suit that was designed for 1 purpose,

20
00:00:51,590 --> 00:00:56,000
extravehicular activity (EVA) was the
shuttle EMU suit for microgravity EVA.

21
00:00:56,000 --> 00:00:56,660
>> Yeah.

22
00:00:56,660 --> 00:01:00,450
>> And this suit is also an EVA specific suit.

23
00:01:00,450 --> 00:01:05,300
But we're trying to design both to accommodate
improved microgravity EVA capability

24
00:01:05,300 --> 00:01:07,490
as well as surface capability.

25
00:01:07,490 --> 00:01:11,700
>> So that means basically that, you know the
suit that we've known for a longtime is designed

26
00:01:11,700 --> 00:01:14,090
to float in space and build the
space station, get outside the,

27
00:01:14,090 --> 00:01:15,910
it's not designed to go walk
on the planet, right?

28
00:01:15,910 --> 00:01:18,020
>> No, it's a very, very poor walking suit.

29
00:01:18,020 --> 00:01:18,440
>> Okay, so.

30
00:01:18,440 --> 00:01:22,550
>> Well, this suit is designed with some
very good walking capability built into it.

31
00:01:22,550 --> 00:01:23,410
>> What are the main differences?

32
00:01:23,410 --> 00:01:28,620
Like what-- what is this suit going to do that
hasn't been done in so many years, may I say,

33
00:01:28,620 --> 00:01:30,560
is it the legs, is it the what-- show it off.

34
00:01:30,560 --> 00:01:32,610
>> Yeah we have, we have waist burning here.

35
00:01:32,610 --> 00:01:33,340
>> Okay.

36
00:01:33,340 --> 00:01:37,040
>> So, if you walk around with
your hand on your belt knuckle,

37
00:01:37,040 --> 00:01:39,410
you don't realize how much your
waist moves back and forth.

38
00:01:39,410 --> 00:01:39,800
>> You turn, right.

39
00:01:39,800 --> 00:01:40,890
>> As you try to walk.

40
00:01:40,890 --> 00:01:44,470
So this is a very enabling
walking feature on a suit.

41
00:01:44,470 --> 00:01:50,700
We also have bearings on the suit, here at the
hip, upper leg, which again allow you to walk.

42
00:01:50,700 --> 00:01:51,000
>> Right.

43
00:01:51,000 --> 00:01:53,240
>> And we'll see on subject do some that.

44
00:01:53,240 --> 00:01:55,480
We'll be having angle bearing
on the suit as well.

45
00:01:55,480 --> 00:01:58,580
And that's allows for fine foot placement
as you're walking over rough terrain.

46
00:01:58,580 --> 00:01:59,700
>> And now this is new?

47
00:01:59,700 --> 00:02:03,030
Is this new based on, you know,
what is the suit is right now or.

48
00:02:03,030 --> 00:02:06,270
>> Some of the patterning of the soft
goods between the bearings is new.

49
00:02:06,270 --> 00:02:07,270
>> Okay.

50
00:02:07,270 --> 00:02:10,890
>> The specific placement of the
bearings is a little different.

51
00:02:10,890 --> 00:02:13,480
And then the shoulder is
the new shoulder design.

52
00:02:13,480 --> 00:02:17,470
>> And this based on what you've learned
throughout the entire shuttle station programs

53
00:02:17,470 --> 00:02:18,950
and in works [inaudible] to
what hasn't worked, right.

54
00:02:18,950 --> 00:02:21,680
>> Yeah, and we've had a couple
of advanced prototypes in the past

55
00:02:21,680 --> 00:02:25,260

that we both have tested
significantly and then tried to put some

56
00:02:25,260 --> 00:02:28,320
of that lesson formed into this suit.

57
00:02:28,320 --> 00:02:30,270
And then we'll again test this suit.

58
00:02:30,270 --> 00:02:32,790
And so we'll look at all the data from
all of the prototypes that we've had.

59
00:02:32,790 --> 00:02:37,410
And we'll pick the new configuration, and
hopefully does what we expect it to do,

60
00:02:37,410 --> 00:02:40,740
and perform well in microgravity and planetary.

61
00:02:40,740 --> 00:02:44,060
>> So, I mean, the main difference to me is
somebody who is not an engineer obviously is

62
00:02:44,060 --> 00:02:47,440
that the top of this looks radically
different then what we've seen in the past.

63
00:02:47,440 --> 00:02:50,310
>> Oh, yes, so one of the big
differences is-- is the reentry design.

64
00:02:50,310 --> 00:02:50,610
>> Okay.

65
00:02:50,610 --> 00:02:52,690
>> So the shuttle EMU splits at the waist.

66
00:02:52,690 --> 00:02:53,010

>> Right here.

67
00:02:53,010 --> 00:02:57,290
>> You put pants on yes, and you put the top
on separately and they connect in the middle,

68
00:02:57,290 --> 00:03:01,620
whereas this suit, the subject crawls in through
the back, and then we just shut the door.

69
00:03:01,620 --> 00:03:01,810
>> Yeah.

70
00:03:01,810 --> 00:03:03,250
>> The hatch.

71
00:03:03,250 --> 00:03:05,660
>> What are the benefits, so that
is-- is it easier to get on and off?

72
00:03:05,660 --> 00:03:09,860
>> Yeah, we think it's less prone to injuries,
especially shoulder injuries which can occur

73
00:03:09,860 --> 00:03:11,630
with the shuttle EMU dawning method.

74
00:03:11,630 --> 00:03:16,900
And then also, it provides support for
some other exploration technologies

75
00:03:16,900 --> 00:03:18,620
like a suit port that might be a good--

76
00:03:18,620 --> 00:03:21,910
>> That is what people have seen on the rover,
right, so they see, you know seen the concept

77
00:03:21,910 --> 00:03:24,620

with these suits, based them out
into the outside and we call engin--

78
00:03:24,620 --> 00:03:28,980
you don't have to go through air lock and
they just crawl in and step off and go.

79
00:03:28,980 --> 00:03:32,370
So this really represents what you've
learned throughout shuttle and station,

80
00:03:32,370 --> 00:03:35,200
and also the testing you done
out on the desert, right?

81
00:03:35,200 --> 00:03:35,590
>> Yes.

82
00:03:35,590 --> 00:03:38,750
>> Talk a little bit about what you guys
have done over the last few years out there.

83
00:03:38,750 --> 00:03:45,820
>> So, I've participated in the
second, we call it desert rats analog,

84
00:03:45,820 --> 00:03:47,580
that name actually came later [laughs].

85
00:03:47,580 --> 00:03:49,920
We just did spacesuit field
testing at the beginning,

86
00:03:49,920 --> 00:03:53,540
and so we wanted to understand
how a suit that we wanted to build

87
00:03:53,540 --> 00:03:56,480
for the moon or Mars would be doing its job.

88
00:03:56,480 --> 00:03:59,320
And the only way to do that
really is to go out and see.

89
00:03:59,320 --> 00:04:02,230
So have the subject and suit do Geology.

90
00:04:02,230 --> 00:04:02,700
>> Right.

91
00:04:02,700 --> 00:04:05,460
>> And see how well the suit allows
and doesn't allow them to do that job

92
00:04:05,460 --> 00:04:09,620
so you know what features you need
to focus on for-- for development.

93
00:04:09,620 --> 00:04:12,980
>> Talk about the weight, because I don't think
people understand exactly how heavy these suits

94
00:04:12,980 --> 00:04:16,280
are, I mean, they're several hundred pounds,
if they ask from-- obviously up and, you know,

95
00:04:16,280 --> 00:04:18,230
there up in space it's--
they're not weighing them down.

96
00:04:18,230 --> 00:04:19,690
But here on earth, they're pretty heavy, right?

97
00:04:19,690 --> 00:04:24,360
>> This suit, with all of its complement,
including the suit [inaudible] is 158 pounds.

98
00:04:24,360 --> 00:04:24,720
>> Yeah.

99
00:04:24,720 --> 00:04:25,850
>> So it's a heavy suit.

100
00:04:25,850 --> 00:04:27,690
>> Yeah.

101
00:04:27,690 --> 00:04:32,350
>> We have the March 3 prototype on the lab
and that weighs right around 100 pounds.

102
00:04:32,350 --> 00:04:38,930
So it sounds very heavy, but when you inflate
the suit, it does help to support itself

103
00:04:38,930 --> 00:04:42,180
but the difference between this suit
and that March 3 is significant,

104
00:04:42,180 --> 00:04:45,130
and we are seeing that in
the workload of the subject.

105
00:04:45,130 --> 00:04:49,380
So they're able to do it, bear
the weight, move around very well,

106
00:04:49,380 --> 00:04:51,280
but weight doesn't still matter [laughs].

107
00:04:51,280 --> 00:04:51,830
>> Yeah.

108
00:04:51,830 --> 00:04:54,550
>> Even if you're going to Mars
where it's one third gravity.

109
00:04:54,550 --> 00:04:55,990
>> So last question here in this segment.

110
00:04:55,990 --> 00:04:58,810
You know you talked a little bit about
having to design this suit to not only go

111
00:04:58,810 --> 00:05:00,810
with the microgravity which
is what you see on station,

112
00:05:00,810 --> 00:05:03,340
they're after floating, rather
not walking on anything.

113
00:05:03,340 --> 00:05:06,630
So our future missions obviously are
going be on asteroids and later to Mars,

114
00:05:06,630 --> 00:05:10,850
so you're saying that you're basically designing
this suit to kind of tackle both of those,

115
00:05:10,850 --> 00:05:12,050
even if those were radically different.

116
00:05:12,050 --> 00:05:15,570
>> Yes, right here, we're taking right now
is trying to look at all of are requirements

117
00:05:15,570 --> 00:05:20,400
and all of potential destinations and try
to understand what the most challenging

118
00:05:20,400 --> 00:05:25,140
of any aspect is, like for mobility,
it's probably walking on a surface.

119
00:05:25,140 --> 00:05:25,640
>> Yeah.

120

00:05:25,640 --> 00:05:27,970
>> For radiation protection, it's deep space.

121
00:05:27,970 --> 00:05:32,370
So you look at each aspect of the suit design
and you try to pick the most challenging.

122
00:05:32,370 --> 00:05:37,050
And you try to design so that you're capable for
that and then when you need to just specialize

123
00:05:37,050 --> 00:05:40,280
for one specific mission, you already
have that information and capability

124
00:05:40,280 --> 00:05:42,290
to build the suit that's going
to work for that mission.

125
00:05:42,290 --> 00:05:45,370
>> Well it's been a while since we've
walked on a planet, planetary body.

126
00:05:45,370 --> 00:05:47,980
So do you go back and do you take a
look what Apollo, the lessons learned,

127
00:05:47,980 --> 00:05:49,290
I mean, there's only a few flights but.

128
00:05:49,290 --> 00:05:49,490
>> Yes.

129
00:05:49,490 --> 00:05:51,800
>> They learned a lot about
those suits just from,

130
00:05:51,800 --> 00:05:53,350
you know the astronauts being
up there walking around.

131
00:05:53,350 --> 00:05:55,460
>> Yes, so we've read through
all of the debrief comments.

132
00:05:55,460 --> 00:05:58,060
We've talked to the crew members multiple times.

133
00:05:58,060 --> 00:06:01,320
So, we are very aware of what
they did like, didn't like,

134
00:06:01,320 --> 00:06:04,100
we're capable of, weren't capable of.

135
00:06:04,100 --> 00:06:08,140
And so, we do take that in consideration
and then we work with the current crew

136
00:06:08,140 --> 00:06:11,860
and help take comments from them to understand