



**SPACESTATION  
LIVE**

1  
00:00:08,150 --> 00:00:06,710  
a lot of work's been going on on board

2  
00:00:10,549 --> 00:00:08,160  
the international space station to

3  
00:00:12,950 --> 00:00:10,559  
return one of the emu's the extra

4  
00:00:15,430 --> 00:00:12,960  
vehicular mobility units uh the u.s

5  
00:00:17,189 --> 00:00:15,440  
spacesuits back to service i'm scott

6  
00:00:18,630 --> 00:00:17,199  
kelly back inside the airlocks today but

7  
00:00:20,150 --> 00:00:18,640  
he's been in there quite a bit over the

8  
00:00:21,830 --> 00:00:20,160  
last week and today we're going to learn

9  
00:00:23,590 --> 00:00:21,840  
a little bit more about what's been

10  
00:00:25,589 --> 00:00:23,600  
going on joining me here in mission

11  
00:00:28,310 --> 00:00:25,599  
control houston today one of our eva

12  
00:00:29,990 --> 00:00:28,320  
experts alex canelecos alex you're kind

13  
00:00:31,269 --> 00:00:30,000

of a regular on this show nowadays we

14

00:00:33,270 --> 00:00:31,279

always bring in we were talking about

15

00:00:34,870 --> 00:00:33,280

these spacesuits and uh it's really

16

00:00:36,470 --> 00:00:34,880

great to have you here with us now to

17

00:00:38,069 --> 00:00:36,480

give us a little bit more insight into

18

00:00:40,709 --> 00:00:38,079

what's been going on well good morning

19

00:00:42,790 --> 00:00:40,719

dan glad to be here so first i mean just

20

00:00:44,310 --> 00:00:42,800

set it up for us what's been going on

21

00:00:46,630 --> 00:00:44,320

because we've heard this is some of the

22

00:00:48,790 --> 00:00:46,640

most invasive some of the most complex

23

00:00:50,069 --> 00:00:48,800

repair work you guys have ever had to do

24

00:00:52,069 --> 00:00:50,079

on these spacesuits what's been

25

00:00:54,229 --> 00:00:52,079

happening right so

26  
00:00:55,910 --> 00:00:54,239  
what we've been dealing with is a

27  
00:00:57,750 --> 00:00:55,920  
failure of one of our fan pump

28  
00:01:00,389 --> 00:00:57,760  
separators and this is what i'm holding

29  
00:01:02,069 --> 00:01:00,399  
here today it's a it's a 3d rapid

30  
00:01:05,109 --> 00:01:02,079  
prototype of our fan pump water

31  
00:01:06,789 --> 00:01:05,119  
separator and we've had several issues

32  
00:01:10,870 --> 00:01:06,799  
on orbit with with the fan pump

33  
00:01:13,030 --> 00:01:10,880  
separators and recently well in february

34  
00:01:14,710 --> 00:01:13,040  
we actually had another failure and we

35  
00:01:18,149 --> 00:01:14,720  
decided that we would remove the fan

36  
00:01:20,469 --> 00:01:18,159  
pump separator from emu 3011.

37  
00:01:23,990 --> 00:01:20,479  
this suit was scheduled to come home uh

38  
00:01:25,830 --> 00:01:24,000

this summer on uh spacex and um

39

00:01:29,270 --> 00:01:25,840

we decided we'll bring the water

40

00:01:31,109 --> 00:01:29,280

separator and the fan pump uh home early

41

00:01:33,749 --> 00:01:31,119

and just leave that suit with an open

42

00:01:35,510 --> 00:01:33,759

cavity well unfortunately our resupply

43

00:01:38,230 --> 00:01:35,520

our new spacesuit that was also supposed

44

00:01:40,469 --> 00:01:38,240

to launch on spacex did not make it and

45

00:01:44,550 --> 00:01:40,479

um instead of

46

00:01:47,190 --> 00:01:44,560

bringing the old 3011 home we had to put

47

00:01:48,950 --> 00:01:47,200

a new fan pump separator in installed

48

00:01:51,350 --> 00:01:48,960

into this open cavity

49

00:01:53,670 --> 00:01:51,360

and get it back to service get the emu

50

00:01:55,749 --> 00:01:53,680

back to service and so

51  
00:01:57,830 --> 00:01:55,759  
in order to do that like you mentioned

52  
00:01:59,350 --> 00:01:57,840  
it's very invasive we're opening

53  
00:02:03,030 --> 00:01:59,360  
cavities that were never meant to be

54  
00:02:05,190 --> 00:02:03,040  
open during uh on orbit phases so on the

55  
00:02:08,070 --> 00:02:05,200  
ground of course when the spacesuit gets

56  
00:02:09,910 --> 00:02:08,080  
home the engineers do a lot of servicing

57  
00:02:12,309 --> 00:02:09,920  
on the on the different pieces um

58  
00:02:14,790 --> 00:02:12,319  
there's very small screws small shims

59  
00:02:16,309 --> 00:02:14,800  
that they'll take apart and um

60  
00:02:19,270 --> 00:02:16,319  
it was never designed to do that on

61  
00:02:20,150 --> 00:02:19,280  
orbit and the reason that this is is

62  
00:02:21,670 --> 00:02:20,160  
really

63  
00:02:24,070 --> 00:02:21,680

critical that we do it right is these

64

00:02:25,830 --> 00:02:24,080

small pieces could really damage the

65

00:02:27,030 --> 00:02:25,840

suit especially when we go out eba it's

66

00:02:29,589 --> 00:02:27,040

something that we don't want to have

67

00:02:31,509 --> 00:02:29,599

floating around inside the spacesuit

68

00:02:33,830 --> 00:02:31,519

so that's part of it another part of it

69

00:02:35,509 --> 00:02:33,840

is once we get the fan pump separator

70

00:02:37,350 --> 00:02:35,519

installed there's a lot of water

71

00:02:39,830 --> 00:02:37,360

maintenance that has to happen our suit

72

00:02:41,910 --> 00:02:39,840

is very sensitive to water impurities

73

00:02:43,910 --> 00:02:41,920

and so we have to basically scrub the

74

00:02:46,390 --> 00:02:43,920

water that's going through the suit we

75

00:02:48,229 --> 00:02:46,400

also have to add iodine to help combat

76

00:02:50,869 --> 00:02:48,239

any of the organic

77

00:02:53,190 --> 00:02:50,879

components inside the suit and that's

78

00:02:55,430 --> 00:02:53,200

what we've been doing the last week so

79

00:02:57,830 --> 00:02:55,440

scott and chell have both been working

80

00:02:59,910 --> 00:02:57,840

on the suit and they've been installing

81

00:03:01,589 --> 00:02:59,920

the fan pump separator we also did a

82

00:03:03,430 --> 00:03:01,599

couple

83

00:03:05,509 --> 00:03:03,440

more maintenance activities such as a

84

00:03:07,670 --> 00:03:05,519

gas trap removal and replace and a water

85

00:03:09,830 --> 00:03:07,680

line vent tube so several components we

86

00:03:11,670 --> 00:03:09,840

replaced on the spacesuit and then we

87

00:03:13,670 --> 00:03:11,680

got into our water maintenance so last

88

00:03:15,589 --> 00:03:13,680

week we did a water

89

00:03:17,750 --> 00:03:15,599

dump and fill where we dumped our

90

00:03:19,190 --> 00:03:17,760

old water and filled it with new water

91

00:03:21,110 --> 00:03:19,200

and then we started this week with

92

00:03:23,990 --> 00:03:21,120

scrubbing the water and today we're

93

00:03:26,149 --> 00:03:24,000

doing a structural integrity test to

94

00:03:28,710 --> 00:03:26,159

make sure that the fan pump separator

95

00:03:30,630 --> 00:03:28,720

was installed correctly and that we're

96

00:03:32,710 --> 00:03:30,640

not going to have any leakage when we go

97

00:03:34,149 --> 00:03:32,720

outside the next time okay and you kind

98

00:03:36,550 --> 00:03:34,159

of touched on it but you know why is it

99

00:03:37,830 --> 00:03:36,560

important to to do these

100

00:03:39,030 --> 00:03:37,840

upgrades to make sure these suits are

101  
00:03:40,869 --> 00:03:39,040  
ready to go even though i mean we're not

102  
00:03:42,550 --> 00:03:40,879  
doing an eva tomorrow why is it

103  
00:03:44,550 --> 00:03:42,560  
important to have this thing you know

104  
00:03:47,110 --> 00:03:44,560  
ready for prime time ready to go right

105  
00:03:48,789 --> 00:03:47,120  
so we the the design of the evas is that

106  
00:03:50,789 --> 00:03:48,799  
we'd always have four spacesuits ready

107  
00:03:52,630 --> 00:03:50,799  
to go at all times and the reason for

108  
00:03:54,149 --> 00:03:52,640  
that is that we never know when when one

109  
00:03:56,229 --> 00:03:54,159  
spacesuit's not going to necessarily

110  
00:03:58,070 --> 00:03:56,239  
check out correctly we want to give our

111  
00:04:00,070 --> 00:03:58,080  
crew members the best suits to go out

112  
00:04:02,070 --> 00:04:00,080  
the door with you know spacesuit is like

113  
00:04:04,149 --> 00:04:02,080

his own spacecraft once it's

114

00:04:07,030 --> 00:04:04,159

disconnected from umbilical and goes out

115

00:04:08,949 --> 00:04:07,040

during an eva uh it it's on its own it's

116

00:04:10,229 --> 00:04:08,959

it's life support everything is there

117

00:04:11,670 --> 00:04:10,239

for the crew members we want to make

118

00:04:14,390 --> 00:04:11,680

sure we're giving the best spacesuits

119

00:04:16,550 --> 00:04:14,400

for our crew members and in addition to

120

00:04:18,069 --> 00:04:16,560

that the spacesuits are sized um

121

00:04:20,390 --> 00:04:18,079

differently so

122

00:04:22,310 --> 00:04:20,400

the hard upper torso there's three

123

00:04:23,749 --> 00:04:22,320

different sizes and so they're connected

124

00:04:25,830 --> 00:04:23,759

to the life support and so those are

125

00:04:27,830 --> 00:04:25,840

have different sizes and so in order to

126

00:04:29,670 --> 00:04:27,840

give us the best complement of

127

00:04:31,830 --> 00:04:29,680

spacesuits with the crew members that we

128

00:04:34,629 --> 00:04:31,840

have on board we have different sized

129

00:04:36,950 --> 00:04:34,639

huts and and to

130

00:04:39,590 --> 00:04:36,960

basically strategically match what

131

00:04:42,870 --> 00:04:39,600

spacewalks could happen um that's that's

132

00:04:43,830 --> 00:04:42,880

how we size our spacesuits there are

133

00:04:46,070 --> 00:04:43,840

like you mentioned there are no

134

00:04:47,830 --> 00:04:46,080

scheduled evs in the near future there

135

00:04:49,990 --> 00:04:47,840

are some talks about some evas happening

136

00:04:50,790 --> 00:04:50,000

in late october or early november time

137

00:04:53,030 --> 00:04:50,800

frame

138

00:04:55,189 --> 00:04:53,040

but we can always have the need to go

139

00:04:56,790 --> 00:04:55,199

out the door if we have a major failure

140

00:04:59,590 --> 00:04:56,800

of space station where we have to go and

141

00:05:01,430 --> 00:04:59,600

replace a critical component that's why

142

00:05:03,830 --> 00:05:01,440

we have to be ready with our spacesuits

143

00:05:05,110 --> 00:05:03,840

okay and so you you said so there's once

144

00:05:07,110 --> 00:05:05,120

this one's back online there's going to

145

00:05:09,430 --> 00:05:07,120

be four suits and then aside from the

146

00:05:10,870 --> 00:05:09,440

suits you guys have spares and other

147

00:05:13,110 --> 00:05:10,880

things like that on board too like you

148

00:05:14,710 --> 00:05:13,120

had a spare fan pump ready to go you

149

00:05:16,629 --> 00:05:14,720

know what's what's the status applies

150

00:05:18,790 --> 00:05:16,639

for all that that's correct so we we do

151  
00:05:20,390 --> 00:05:18,800  
have several uh spares of the critical

152  
00:05:23,110 --> 00:05:20,400  
components of our life support in

153  
00:05:25,430 --> 00:05:23,120  
addition we have lots of spares of our

154  
00:05:26,710 --> 00:05:25,440  
um what we call the soft goods the more

155  
00:05:28,469 --> 00:05:26,720  
the sizing

156  
00:05:30,230 --> 00:05:28,479  
portions and that allows us to adapt to

157  
00:05:31,990 --> 00:05:30,240  
the different crew members we're we're

158  
00:05:34,230 --> 00:05:32,000  
fine as far as spares are considered on

159  
00:05:35,590 --> 00:05:34,240  
orbit right now okay and one thing you

160  
00:05:37,189 --> 00:05:35,600  
had touched on earlier i thought it was

161  
00:05:38,790 --> 00:05:37,199  
interesting was

162  
00:05:40,710 --> 00:05:38,800  
these suits weren't designed to

163  
00:05:42,310 --> 00:05:40,720

necessarily be repaired like this so i

164

00:05:44,230 --> 00:05:42,320

mean what this has to be a really

165

00:05:45,909 --> 00:05:44,240

difficult task you know take something

166

00:05:48,150 --> 00:05:45,919

and i assume you do a lot of work here

167

00:05:49,670 --> 00:05:48,160

on down on the ground first but to

168

00:05:51,430 --> 00:05:49,680

figure out how to fix something that was

169

00:05:53,270 --> 00:05:51,440

never meant to be fixed in this fashion

170

00:05:54,150 --> 00:05:53,280

that's correct so we work hand in hand

171

00:05:56,309 --> 00:05:54,160

with the

172

00:05:58,629 --> 00:05:56,319

ground engineers to develop procedures

173

00:06:01,270 --> 00:05:58,639

for the crew members to repair the

174

00:06:03,189 --> 00:06:01,280

spacesuit and do this invasive removal

175

00:06:05,270 --> 00:06:03,199

and replacement of critical components

176

00:06:07,270 --> 00:06:05,280

so you're right that we have to design

177

00:06:09,430 --> 00:06:07,280

new procedures we also work with the

178

00:06:11,350 --> 00:06:09,440

crew on on just training them right

179

00:06:13,029 --> 00:06:11,360

these are these are components that are

180

00:06:15,510 --> 00:06:13,039

loose once you release the screw it's

181

00:06:18,309 --> 00:06:15,520

it's free um so we have to be prepared

182

00:06:20,469 --> 00:06:18,319

for that we use a lot of kapton tape and

183

00:06:21,909 --> 00:06:20,479

and we even have a vacuum cleaner with a

184

00:06:23,990 --> 00:06:21,919

netting over it ready to capture

185

00:06:26,150 --> 00:06:24,000

anything that comes comes loose that the

186

00:06:28,309 --> 00:06:26,160

crew members are unable to grab and and

187

00:06:30,230 --> 00:06:28,319

that's really important and in addition

188

00:06:33,029 --> 00:06:30,240

um some of the the things that you don't

189

00:06:35,189 --> 00:06:33,039

think about on on the ground is that you

190

00:06:37,590 --> 00:06:35,199

have to have uh ways to restrain your

191

00:06:39,990 --> 00:06:37,600

body when you're up there so the suit in

192

00:06:42,710 --> 00:06:40,000

order to install this fan pump separator

193

00:06:45,430 --> 00:06:42,720

it can't be structurally um

194

00:06:47,670 --> 00:06:45,440

attached so that it's completely rigid

195

00:06:50,710 --> 00:06:47,680

we actually have to allow it to to kind

196

00:06:52,790 --> 00:06:50,720

of move in order to gain access to this

197

00:06:54,070 --> 00:06:52,800

area and so that can be really difficult

198

00:06:56,230 --> 00:06:54,080

for the crew members because they're

199

00:06:58,309 --> 00:06:56,240

they're not restrained um

200

00:06:59,670 --> 00:06:58,319

as far as as normally being restrained

201  
00:07:01,589 --> 00:06:59,680  
like you're you have two feet on the

202  
00:07:03,029 --> 00:07:01,599  
ground so we have to you know give them

203  
00:07:04,950 --> 00:07:03,039  
advice of all right here's a good hand

204  
00:07:06,629 --> 00:07:04,960  
hold here and and things like that while

205  
00:07:08,070 --> 00:07:06,639  
they use the tools so we're having to

206  
00:07:09,830 --> 00:07:08,080  
repair something that wasn't meant to be

207  
00:07:13,029 --> 00:07:09,840  
repaired in an environment that we can't

208  
00:07:14,710 --> 00:07:13,039  
test and then i mean it sounds tough so

209  
00:07:15,990 --> 00:07:14,720  
i mean we're always looking forward

210  
00:07:17,270 --> 00:07:16,000  
we're always looking forward what are

211  
00:07:19,029 --> 00:07:17,280  
some of the things you know we've been

212  
00:07:20,390 --> 00:07:19,039  
using this suit for decades now what are

213  
00:07:22,070 --> 00:07:20,400

some of the things that we're learning

214

00:07:23,589 --> 00:07:22,080

from having to do this kind of stuff on

215

00:07:25,430 --> 00:07:23,599

space station that we're hopefully going

216

00:07:27,589 --> 00:07:25,440

to be able to apply to suits you know

217

00:07:28,870 --> 00:07:27,599

when we're heading off to mars yeah

218

00:07:31,029 --> 00:07:28,880

that's a great point you know the

219

00:07:32,390 --> 00:07:31,039

spacesuits in big picture people think

220

00:07:34,550 --> 00:07:32,400

of spacesuits is this is how you're

221

00:07:36,309 --> 00:07:34,560

using this the space station as far as

222

00:07:38,950 --> 00:07:36,319

maintaining it you know the spacesuits

223

00:07:40,309 --> 00:07:38,960

are allow us to get basically into our

224

00:07:42,550 --> 00:07:40,319

uh

225

00:07:44,309 --> 00:07:42,560

mobility to go outside the door and

226

00:07:46,390 --> 00:07:44,319

repair things and and make sure that

227

00:07:48,629 --> 00:07:46,400

we're keeping our space station

228

00:07:50,710 --> 00:07:48,639

up and running but in addition we are

229

00:07:52,390 --> 00:07:50,720

using the spacesuits as kind of an

230

00:07:54,469 --> 00:07:52,400

experiment in themselves when we go to

231

00:07:56,390 --> 00:07:54,479

different locations or or to even

232

00:07:59,510 --> 00:07:56,400

improve on the next spacesuit so we are

233

00:08:01,189 --> 00:07:59,520

learning a lot of things just doing the

234

00:08:03,110 --> 00:08:01,199

removal and replacement we're learning

235

00:08:05,749 --> 00:08:03,120

all right we need to design our next

236

00:08:07,909 --> 00:08:05,759

spacesuit so that we can gain access to

237

00:08:09,909 --> 00:08:07,919

critical components easier we need to

238

00:08:11,909 --> 00:08:09,919

make sure that the fasteners and the

239

00:08:13,589 --> 00:08:11,919

bolts that are installed are captive so

240

00:08:15,270 --> 00:08:13,599

that when you release them they're not

241

00:08:16,629 --> 00:08:15,280

going to be floating or flying away

242

00:08:19,110 --> 00:08:16,639

right so there's there's a lot of those

243

00:08:21,909 --> 00:08:19,120

things in addition where we're learning

244

00:08:23,830 --> 00:08:21,919

um design because of what caused the

245

00:08:25,909 --> 00:08:23,840

failure we're learning how to design you

246

00:08:27,589 --> 00:08:25,919

know new components you know so that

247

00:08:30,390 --> 00:08:27,599

they're more resistance to water

248

00:08:33,110 --> 00:08:30,400

impurities and they're more resistant to

249

00:08:35,430 --> 00:08:33,120

uh corrosion things like that okay well

250

00:08:37,110 --> 00:08:35,440

again a lot of really invasive but a lot

251

00:08:38,870 --> 00:08:37,120

of really important work taking place in

252

00:08:41,269 --> 00:08:38,880

those spacesuits over the last week or

253

00:08:43,909 --> 00:08:41,279

so on board space station alex canelecoc

254

00:08:45,590 --> 00:08:43,919

our local resident eva expert giving us