



1
00:00:11,430 --> 00:00:08,790
beth what are you doing i'm trying to

2
00:00:14,230 --> 00:00:11,440
create a sonic boom airplanes like the

3
00:00:16,150 --> 00:00:14,240
sr-71 once they break the sound barrier

4
00:00:17,750 --> 00:00:16,160
there's this great sonic boom well you

5
00:00:19,830 --> 00:00:17,760
can break the sound barrier with a

6
00:00:22,230 --> 00:00:19,840
bullwhip when you hear that crack that's

7
00:00:39,750 --> 00:00:22,240
actually sonic boom i'm just not very

8
00:00:43,110 --> 00:00:41,750
see that's not too hard

9
00:00:44,549 --> 00:00:43,120
no i guess i'm just gonna need some

10
00:00:46,150 --> 00:00:44,559
practice yeah a little bit of practice

11
00:00:48,069 --> 00:00:46,160
you'll be good at it you have some time

12
00:00:50,869 --> 00:00:48,079
yeah about 30 minutes

13
00:00:52,069 --> 00:00:50,879

this is 70.

14

00:01:09,030 --> 00:00:52,079

now i'm going to teach you to whip

15

00:01:11,190 --> 00:01:09,830

now

16

00:01:35,510 --> 00:01:11,200

i'm not going to do the stinky leg

17

00:01:35,520 --> 00:02:00,469

this is 7 30.

18

00:02:04,550 --> 00:02:02,550

hi i'm beth and i'm marty and we are

19

00:02:07,030 --> 00:02:04,560

coming to you live from the stephen f

20

00:02:08,869 --> 00:02:07,040

udvarhazy center now to get started

21

00:02:11,110 --> 00:02:08,879

today we'd first like to welcome our

22

00:02:13,750 --> 00:02:11,120

in-house audience which is farmwell

23

00:02:15,990 --> 00:02:13,760

station middle school these guys have

24

00:02:17,990 --> 00:02:16,000

some great questions prepared to ask our

25

00:02:20,070 --> 00:02:18,000

experts today and this is where we need

26

00:02:22,470 --> 00:02:20,080

you our viewers at home to submit

27

00:02:25,270 --> 00:02:22,480

questions as well submit them online we

28

00:02:27,350 --> 00:02:25,280

have an expert standing by ready to

29

00:02:29,430 --> 00:02:27,360

answer those questions and some of them

30

00:02:32,150 --> 00:02:29,440

we might even use on the show now this

31

00:02:33,670 --> 00:02:32,160

museum is incredible here we can house

32

00:02:35,589 --> 00:02:33,680

objects that are too large for the

33

00:02:38,229 --> 00:02:35,599

downtown museum objects like the

34

00:02:39,990 --> 00:02:38,239

concorde and the enola gay and the space

35

00:02:42,229 --> 00:02:40,000

shuttle discovery which actually

36

00:02:44,229 --> 00:02:42,239

launched the hubble space telescope into

37

00:02:47,270 --> 00:02:44,239

low earth orbit but today we'll be

38

00:02:50,390 --> 00:02:47,280

talking about the lockheed martin sr-71

39

00:02:53,430 --> 00:02:50,400

blackbird this plane is amazing made

40

00:02:56,309 --> 00:02:53,440

mostly of titanium it is so cool this is

41

00:02:58,550 --> 00:02:56,319

actually an sr-71 toy that i had when i

42

00:03:00,309 --> 00:02:58,560

was a kid and i used to play with it all

43

00:03:02,550 --> 00:03:00,319

the time to get a chance to be close to

44

00:03:04,390 --> 00:03:02,560

this plane is really really cool now

45

00:03:06,149 --> 00:03:04,400

recently beth and i had a chance to talk

46

00:03:08,390 --> 00:03:06,159

with one of the pilots colonel buzz

47

00:03:10,790 --> 00:03:08,400

carpenter and listen to some of his

48

00:03:13,670 --> 00:03:10,800

memories about flying this this exact

49

00:03:16,149 --> 00:03:13,680

plane let's hear what he had to say

50

00:03:18,390 --> 00:03:16,159

i'm joined today by buzz carpenter who's

51
00:03:21,910 --> 00:03:18,400
a docent here at the udvar hazy center

52
00:03:24,070 --> 00:03:21,920
but also flew the sr-71 thank you so

53
00:03:26,149 --> 00:03:24,080
much for joining us today beth it's my

54
00:03:28,470 --> 00:03:26,159
pleasure to be here now would you tell

55
00:03:31,270 --> 00:03:28,480
me a little bit how were you recruited

56
00:03:32,470 --> 00:03:31,280
to fly the sr-71 beth it's an

57
00:03:34,229 --> 00:03:32,480
interesting story

58
00:03:35,910 --> 00:03:34,239
i graduated from the air force academy

59
00:03:38,309 --> 00:03:35,920
in 1967

60
00:03:40,470 --> 00:03:38,319
and one of the blackbirds flew by for

61
00:03:42,390 --> 00:03:40,480
our graduation ceremonies

62
00:03:44,390 --> 00:03:42,400
and i'd seen the airplane earlier when i

63
00:03:46,390 --> 00:03:44,400

was doing kind of a cadet internship at

64

00:03:49,350 --> 00:03:46,400

edwards air force base but i really

65

00:03:51,270 --> 00:03:49,360

never expected to fly the airplane

66

00:03:54,149 --> 00:03:51,280

on my way to vietnam and i'm flying

67

00:03:56,789 --> 00:03:54,159

tactical reconnaissance rf4s i met a

68

00:03:59,190 --> 00:03:56,799

colonel jerry o'malley it turns out he

69

00:04:02,710 --> 00:03:59,200

flew the first operational mission in

70

00:04:05,190 --> 00:04:02,720

the sr-71 out of okinawa japan

71

00:04:06,309 --> 00:04:05,200

and uh i would later serve under him and

72

00:04:08,630 --> 00:04:06,319

he uh

73

00:04:09,750 --> 00:04:08,640

kind of told me he said you're the kind

74

00:04:11,830 --> 00:04:09,760

of guy

75

00:04:13,429 --> 00:04:11,840

i think we're looking for

76
00:04:16,629 --> 00:04:13,439
but you're way too young and you don't

77
00:04:19,590 --> 00:04:16,639
have enough flying hours so i

78
00:04:22,790 --> 00:04:19,600
became stationed at okinawa japan and

79
00:04:25,749 --> 00:04:22,800
flew as much as i possibly could you had

80
00:04:28,230 --> 00:04:25,759
to be a volunteer so you submitted an

81
00:04:29,909 --> 00:04:28,240
application to beale air force base in

82
00:04:32,150 --> 00:04:29,919
northern california

83
00:04:33,830 --> 00:04:32,160
and you included your personnel record

84
00:04:35,909 --> 00:04:33,840
your medical record and your flight

85
00:04:37,990 --> 00:04:35,919
record and you hoped as they reviewed it

86
00:04:40,390 --> 00:04:38,000
they would find something interesting

87
00:04:42,790 --> 00:04:40,400
and that they would call you back for a

88
00:04:43,749 --> 00:04:42,800

week-long evaluation so i was called

89

00:04:44,710 --> 00:04:43,759

back

90

00:04:46,550 --> 00:04:44,720

uh

91

00:04:48,790 --> 00:04:46,560

i was delighted the first two days were

92

00:04:50,870 --> 00:04:48,800

an astronaut's physical wow then you had

93

00:04:52,070 --> 00:04:50,880

a series of interviews and then as a

94

00:04:54,310 --> 00:04:52,080

pilot

95

00:04:57,350 --> 00:04:54,320

i had to fly with two or three of the

96

00:05:00,150 --> 00:04:57,360

current sr-71 pilots in the companion

97

00:05:01,590 --> 00:05:00,160

trainer the t-38 to see how i handled

98

00:05:03,350 --> 00:05:01,600

the airplane

99

00:05:06,950 --> 00:05:03,360

i left at the end of the week the wing

100

00:05:08,150 --> 00:05:06,960

commander said everything looks okay

101
00:05:10,629 --> 00:05:08,160
you know

102
00:05:12,390 --> 00:05:10,639
we'll get back with you and

103
00:05:15,590 --> 00:05:12,400
about four months later i received a

104
00:05:18,550 --> 00:05:15,600
telegram in japan in december of six of

105
00:05:21,189 --> 00:05:18,560
uh 74 that i would be coming to beale in

106
00:05:24,469 --> 00:05:21,199
july 75 and start training in this

107
00:05:26,629 --> 00:05:24,479
airplane yeah i have a funny question

108
00:05:28,230 --> 00:05:26,639
how did you heat up your lunch in this

109
00:05:29,350 --> 00:05:28,240
you could heat up your lunch if you want

110
00:05:30,550 --> 00:05:29,360
because it looked like a tube of

111
00:05:32,230 --> 00:05:30,560
toothpaste

112
00:05:33,670 --> 00:05:32,240
and you put on actually i have it in my

113
00:05:37,430 --> 00:05:33,680

pocket

114

00:05:39,430 --> 00:05:37,440

a tube like this you screwed it on

115

00:05:41,189 --> 00:05:39,440

you broke the seal and then you could

116

00:05:44,230 --> 00:05:41,199

hold this whole thing against the the

117

00:05:45,830 --> 00:05:44,240

window because my window was about 580

118

00:05:49,110 --> 00:05:45,840

degrees because the way the airplane

119

00:05:51,110 --> 00:05:49,120

heated so that was one way if you had a

120

00:05:53,110 --> 00:05:51,120

meal that you could heat it actually in

121

00:05:55,590 --> 00:05:53,120

the cockpit when you think of all the

122

00:05:57,749 --> 00:05:55,600

missions you flew what's one that stands

123

00:06:00,309 --> 00:05:57,759

out which was one of your favorite ones

124

00:06:02,550 --> 00:06:00,319

in march of 79

125

00:06:04,790 --> 00:06:02,560

it's almost like the news today the

126
00:06:06,870 --> 00:06:04,800
saudi arabians and the yemenis were

127
00:06:08,710 --> 00:06:06,880
fighting along with some of the others

128
00:06:10,950 --> 00:06:08,720
and the satellites were not in the right

129
00:06:13,670 --> 00:06:10,960
position so it was the first time the

130
00:06:15,830 --> 00:06:13,680
british or your any europeans allowed us

131
00:06:18,390 --> 00:06:15,840
to fly out of europe into the middle

132
00:06:20,550 --> 00:06:18,400
east and come back there so this is

133
00:06:22,070 --> 00:06:20,560
probably the most memorable mission and

134
00:06:24,230 --> 00:06:22,080
president carter

135
00:06:25,590 --> 00:06:24,240
monitored the mission the whole way

136
00:06:27,590 --> 00:06:25,600
the interesting thing is the french

137
00:06:29,510 --> 00:06:27,600
wouldn't let us overfly so instead of

138
00:06:31,670 --> 00:06:29,520

flying out of england and cutting across

139

00:06:34,390 --> 00:06:31,680

france into the mediterranean i had to

140

00:06:36,710 --> 00:06:34,400

fly around portugal and spain so it

141

00:06:39,189 --> 00:06:36,720

ended up being nine hours and 45 minutes

142

00:06:41,029 --> 00:06:39,199

and five sets of refuelings and two of

143

00:06:42,870 --> 00:06:41,039

the sets of tankers came out of egypt

144

00:06:45,189 --> 00:06:42,880

they didn't they looked like regular

145

00:06:47,189 --> 00:06:45,199

tankers so the egyptians were not aware

146

00:06:48,950 --> 00:06:47,199

of exactly what we were doing collecting

147

00:06:51,029 --> 00:06:48,960

the information

148

00:06:53,270 --> 00:06:51,039

now i understand there's an origin story

149

00:06:54,550 --> 00:06:53,280

that these things were called habu

150

00:06:56,870 --> 00:06:54,560

that's correct

151
00:06:58,390 --> 00:06:56,880
they were first flown the a12 which was

152
00:07:01,189 --> 00:06:58,400
the single seat

153
00:07:03,830 --> 00:07:01,199
cia predecessor they built beautiful

154
00:07:06,870 --> 00:07:03,840
facilities on at kadena air base on the

155
00:07:08,870 --> 00:07:06,880
island of okinawa in japan

156
00:07:11,430 --> 00:07:08,880
when the japanese saw this airplane when

157
00:07:13,270 --> 00:07:11,440
it takes off it's black

158
00:07:14,070 --> 00:07:13,280
it takes off rather steeply it looks

159
00:07:18,070 --> 00:07:14,080
like

160
00:07:20,790 --> 00:07:18,080
snake on the island that's very

161
00:07:22,710 --> 00:07:20,800
poisonous that's called a habu so the

162
00:07:23,909 --> 00:07:22,720
japanese started calling this airplane

163
00:07:25,510 --> 00:07:23,919

the habu

164

00:07:26,469 --> 00:07:25,520

the name stuck because the air force

165

00:07:28,469 --> 00:07:26,479

never

166

00:07:29,909 --> 00:07:28,479

came up with a different name to it

167

00:07:31,670 --> 00:07:29,919

other than calling it the blackberry we

168

00:07:34,550 --> 00:07:31,680

called the blackbird right exactly thank

169

00:07:37,510 --> 00:07:34,560

you so much for joining us today i am

170

00:07:39,749 --> 00:07:37,520

delighted to be here

171

00:07:41,270 --> 00:07:39,759

we're now joined by dr lane carafantas a

172

00:07:42,870 --> 00:07:41,280

curator here at the national air and

173

00:07:44,790 --> 00:07:42,880

space museum thanks so much for talking

174

00:07:47,189 --> 00:07:44,800

with us today glad to be here now the

175

00:07:48,790 --> 00:07:47,199

sr-71 wasn't necessarily the first spy

176

00:07:51,110 --> 00:07:48,800

plane there were a few predecessors to

177

00:07:53,270 --> 00:07:51,120

it right that's true in the post-war

178

00:07:55,589 --> 00:07:53,280

years the cia wanted to find a way to

179

00:07:57,510 --> 00:07:55,599

take pictures over the soviet union to

180

00:07:59,110 --> 00:07:57,520

see what sort of air defense systems

181

00:08:02,469 --> 00:07:59,120

they had what sort of planes they were

182

00:08:04,629 --> 00:08:02,479

building and so one of the designers at

183

00:08:07,350 --> 00:08:04,639

lockheed created the u-2 which was a

184

00:08:09,749 --> 00:08:07,360

very high-flying reconnaissance aircraft

185

00:08:12,230 --> 00:08:09,759

now unfortunately the u2 flew very

186

00:08:13,510 --> 00:08:12,240

slowly so there was a high probability

187

00:08:17,589 --> 00:08:13,520

it would get shot down and one

188

00:08:19,990 --> 00:08:17,599

eventually did so before the u2's

189

00:08:21,589 --> 00:08:20,000

tour was even fully over

190

00:08:23,589 --> 00:08:21,599

the

191

00:08:26,150 --> 00:08:23,599

division at lockheed was already trying

192

00:08:28,710 --> 00:08:26,160

to come up with a design for a plane

193

00:08:30,550 --> 00:08:28,720

that would both be high-flying and very

194

00:08:33,029 --> 00:08:30,560

very fast and this one definitely fits

195

00:08:35,350 --> 00:08:33,039

that bill is very very fast now kelly

196

00:08:37,909 --> 00:08:35,360

johnson was instrumental in getting this

197

00:08:39,670 --> 00:08:37,919

off the ground can you tell us about him

198

00:08:42,230 --> 00:08:39,680

yeah kelly johnson was one of the lead

199

00:08:44,310 --> 00:08:42,240

designers at skunk works which was a

200

00:08:47,350 --> 00:08:44,320

division of of lockheed and he was

201
00:08:50,470 --> 00:08:47,360
responsible for designing the p80 the

202
00:08:52,470 --> 00:08:50,480
the u2 the sr-71 and a number of other

203
00:08:53,750 --> 00:08:52,480
very very famous planes

204
00:08:55,350 --> 00:08:53,760
now um

205
00:08:57,190 --> 00:08:55,360
you mentioned skunk works and there's a

206
00:08:58,389 --> 00:08:57,200
skunk on the tail here can you tell us

207
00:09:00,790 --> 00:08:58,399
that story

208
00:09:02,470 --> 00:09:00,800
right uh during world war ii there was a

209
00:09:04,710 --> 00:09:02,480
need for a very secret jet to be

210
00:09:07,030 --> 00:09:04,720
developed and lockheed was asked hey

211
00:09:08,630 --> 00:09:07,040
could you put together some designs for

212
00:09:10,150 --> 00:09:08,640
us but it has to be done under the

213
00:09:13,190 --> 00:09:10,160

utmost secrecy

214

00:09:15,750 --> 00:09:13,200

so uh there was a division a part of

215

00:09:17,829 --> 00:09:15,760

lockheed that was dedicated to creating

216

00:09:19,430 --> 00:09:17,839

these craft and the engineers that were

217

00:09:21,190 --> 00:09:19,440

there were told you can't tell anybody

218

00:09:23,350 --> 00:09:21,200

about this it's a very very secret

219

00:09:24,870 --> 00:09:23,360

project you're working on and at the

220

00:09:27,350 --> 00:09:24,880

time there was a comic strip called

221

00:09:29,350 --> 00:09:27,360

little abner and within this comic strip

222

00:09:30,870 --> 00:09:29,360

a very mysterious part of the forest

223

00:09:33,670 --> 00:09:30,880

where secret things were created was

224

00:09:36,150 --> 00:09:33,680

called skunk work so the story goes that

225

00:09:38,550 --> 00:09:36,160

one day an engineer answered the phone

226

00:09:40,230 --> 00:09:38,560

skunk works and then the nickname just

227

00:09:41,590 --> 00:09:40,240

stuck awesome are you ready to take some

228

00:09:43,750 --> 00:09:41,600

questions sure all right let's start

229

00:09:46,389 --> 00:09:43,760

with a video question my name is noah

230

00:09:48,470 --> 00:09:46,399

and my question is how many sr-71

231

00:09:50,150 --> 00:09:48,480

blackbirds failed in the making and what

232

00:09:52,230 --> 00:09:50,160

was the hardest piece of technology to

233

00:09:54,630 --> 00:09:52,240

make or obtain

234

00:09:57,430 --> 00:09:54,640

yeah great i wouldn't say that any of

235

00:10:00,150 --> 00:09:57,440

the blackbirds were failures there were

236

00:10:02,630 --> 00:10:00,160

a few that were lost in test flights but

237

00:10:04,310 --> 00:10:02,640

there were 32 blackbirds made and they

238

00:10:06,949 --> 00:10:04,320

were all fired at thousands and

239

00:10:09,350 --> 00:10:06,959

thousands of times and not one was lost

240

00:10:11,190 --> 00:10:09,360

to enemy fire over the years

241

00:10:13,110 --> 00:10:11,200

as far as the really difficult

242

00:10:15,590 --> 00:10:13,120

technologies that were able to make or

243

00:10:19,509 --> 00:10:15,600

obtain almost every component of this

244

00:10:22,069 --> 00:10:19,519

aircraft was innovated and so um you can

245

00:10:25,350 --> 00:10:22,079

talk about the the titanium that was

246

00:10:28,150 --> 00:10:25,360

used the cameras almost every aspect of

247

00:10:29,430 --> 00:10:28,160

this craft was difficult and innovative

248

00:10:30,630 --> 00:10:29,440

wow all right how about an online

249

00:10:32,630 --> 00:10:30,640

question

250

00:10:35,829 --> 00:10:32,640

how long does it take the sr-71 to

251
00:10:38,069 --> 00:10:35,839
accelerate to top speed mach 3 that's a

252
00:10:40,069 --> 00:10:38,079
great question actually the the black

253
00:10:41,590 --> 00:10:40,079
bird will accelerate to about 200 miles

254
00:10:43,750 --> 00:10:41,600
per hour before it takes off of the

255
00:10:45,829 --> 00:10:43,760
runway and then after seven minutes or

256
00:10:48,230 --> 00:10:45,839
so it needs to be immediately refueled

257
00:10:50,550 --> 00:10:48,240
because the the fuel have

258
00:10:55,190 --> 00:10:50,560
been leaking out of it so far it gets up

259
00:10:58,550 --> 00:10:55,200
to about 35 000 feet and it is refueled

260
00:11:01,829 --> 00:10:58,560
and then after 20 minutes or so it will

261
00:11:05,030 --> 00:11:01,839
accelerate from 350 miles per hour to

262
00:11:06,310 --> 00:11:05,040
more than mach 3. wow that's incredible

263
00:11:08,790 --> 00:11:06,320

all right we've got an audience question

264

00:11:12,230 --> 00:11:10,150

are there plans to make a new and

265

00:11:13,190 --> 00:11:12,240

improved blackbird if so what would they

266

00:11:14,710 --> 00:11:13,200

change

267

00:11:16,389 --> 00:11:14,720

any plans for a new and improved

268

00:11:19,030 --> 00:11:16,399

blackbird oh that's a really good

269

00:11:21,990 --> 00:11:19,040

question actually lockheed is trying to

270

00:11:24,870 --> 00:11:22,000

propose a follow-up to the sr-71 which

271

00:11:26,310 --> 00:11:24,880

would be called the sr-72 even though

272

00:11:28,389 --> 00:11:26,320

it'd be a

273

00:11:30,790 --> 00:11:28,399

really altogether different craft it

274

00:11:33,509 --> 00:11:30,800

would be just as large as the sr-71 but

275

00:11:35,990 --> 00:11:33,519

it would be unmanned and it would also

276

00:11:38,630 --> 00:11:36,000

go even faster than this plane already

277

00:11:42,230 --> 00:11:38,640

goes it would be going hypersonic which

278

00:11:45,430 --> 00:11:42,240

is faster than mach 6. wow that's

279

00:11:48,790 --> 00:11:45,440

unbelievable now if uh you can actually

280

00:11:50,310 --> 00:11:48,800

find sr-71s and and uh a12s around the

281

00:11:51,670 --> 00:11:50,320

country at different museums we

282

00:11:53,190 --> 00:11:51,680

encourage you to look around and find a

283

00:11:55,509 --> 00:11:53,200

museum that has one because this plane

284

00:11:56,949 --> 00:11:55,519

is super cool now recently i had a

285

00:11:58,550 --> 00:11:56,959

chance to talk with one of the pilots

286

00:12:00,470 --> 00:11:58,560

buzz carpenter and we walked around the

287

00:12:02,550 --> 00:12:00,480

plane and we started out by looking at

288

00:12:04,069 --> 00:12:02,560

the cameras and the nose of this plane

289

00:12:05,269 --> 00:12:04,079

check this out

290

00:12:07,030 --> 00:12:05,279

well now we're going to get a chance to

291

00:12:09,269 --> 00:12:07,040

actually walk around the plane with buzz

292

00:12:11,829 --> 00:12:09,279

carpet who actually flew it now

293

00:12:13,910 --> 00:12:11,839

this nose cone comes off doesn't it it's

294

00:12:15,590 --> 00:12:13,920

actually three noses there's a training

295

00:12:19,509 --> 00:12:15,600

nose that looks like the nose you see

296

00:12:22,710 --> 00:12:19,519

there the radar nose has a similar uh

297

00:12:24,629 --> 00:12:22,720

external view and if the optical camera

298

00:12:27,350 --> 00:12:24,639

was in we called it the country's camera

299

00:12:29,190 --> 00:12:27,360

because it took a picture 72 miles wide

300

00:12:31,430 --> 00:12:29,200

there was a big glass window that came

301
00:12:33,990 --> 00:12:31,440
along the hole from either side of the

302
00:12:36,550 --> 00:12:34,000
nose that the camera fit into

303
00:12:38,710 --> 00:12:36,560
now four bolts held this on only four

304
00:12:40,230 --> 00:12:38,720
bolts held the nose on because the air

305
00:12:42,710 --> 00:12:40,240
pressure as you're flying along is

306
00:12:44,470 --> 00:12:42,720
keeping the nose very firmly in place

307
00:12:46,470 --> 00:12:44,480
and the four bolts is all they required

308
00:12:48,710 --> 00:12:46,480
which had made it easier on the ground

309
00:12:50,470 --> 00:12:48,720
for them to swap out noses if the

310
00:12:52,069 --> 00:12:50,480
mission was changed now tell me about

311
00:12:53,590 --> 00:12:52,079
the camera that would be on board here

312
00:12:54,310 --> 00:12:53,600
there was a little bit of film in there

313
00:12:56,310 --> 00:12:54,320

right

314

00:12:59,269 --> 00:12:56,320

the camera in the nose which took that

315

00:13:01,670 --> 00:12:59,279

picture 72 miles wide the film itself

316

00:13:04,870 --> 00:13:01,680

was five inches wide

317

00:13:05,990 --> 00:13:04,880

two miles long so when you landed and

318

00:13:07,750 --> 00:13:06,000

the

319

00:13:09,269 --> 00:13:07,760

photo maintenance people took it down

320

00:13:09,990 --> 00:13:09,279

they had quite a job because they had to

321

00:13:12,150 --> 00:13:10,000

take

322

00:13:13,030 --> 00:13:12,160

the nose and the film back to the photo

323

00:13:15,350 --> 00:13:13,040

lab

324

00:13:17,670 --> 00:13:15,360

cut it into 500 foot lengths put on

325

00:13:19,190 --> 00:13:17,680

cotton surgical gloves go the whole

326

00:13:21,670 --> 00:13:19,200

length of the film to make sure there's

327

00:13:23,670 --> 00:13:21,680

no cuts or tears and then put it in for

328

00:13:25,110 --> 00:13:23,680

processing so it wasn't a very fast

329

00:13:26,470 --> 00:13:25,120

process to get the pictures back to

330

00:13:28,310 --> 00:13:26,480

somebody on the ground to actually look

331

00:13:30,790 --> 00:13:28,320

at that's correct and that's part of the

332

00:13:33,030 --> 00:13:30,800

reason this airplane was retired because

333

00:13:34,790 --> 00:13:33,040

it took a while hours sometimes measured

334

00:13:37,030 --> 00:13:34,800

in days to get the information that had

335

00:13:39,110 --> 00:13:37,040

been requested to the people who who had

336

00:13:41,509 --> 00:13:39,120

requested it

337

00:13:42,949 --> 00:13:41,519

and now i'm joined by james david he is

338

00:13:44,710 --> 00:13:42,959

one of the curators here at the national

339

00:13:46,069 --> 00:13:44,720

air and space museum jim thank you so

340

00:13:47,509 --> 00:13:46,079

much for being here with us today glad

341

00:13:50,310 --> 00:13:47,519

to be here do you want to tell us a

342

00:13:53,910 --> 00:13:50,320

little bit about what this plane did

343

00:13:55,110 --> 00:13:53,920

what the sr-71 did as with the u-2 and

344

00:13:57,430 --> 00:13:55,120

a-12

345

00:14:00,310 --> 00:13:57,440

that lane mentioned and some planes that

346

00:14:01,750 --> 00:14:00,320

flew at lower altitudes they collected

347

00:14:04,949 --> 00:14:01,760

information

348

00:14:07,750 --> 00:14:04,959

and in the case of the sr-71

349

00:14:10,870 --> 00:14:07,760

that was mostly photographs very very

350

00:14:13,189 --> 00:14:10,880

important for a military to photograph

351

00:14:16,230 --> 00:14:13,199

areas of the world and not just do it

352

00:14:19,030 --> 00:14:16,240

once but to do it repeatedly

353

00:14:20,310 --> 00:14:19,040

okay go ahead for example

354

00:14:25,189 --> 00:14:20,320

airfields

355

00:14:27,509 --> 00:14:25,199

planes are on them

356

00:14:29,590 --> 00:14:27,519

what sort of defensive weapons do they

357

00:14:32,629 --> 00:14:29,600

have around them so those are the kind

358

00:14:34,949 --> 00:14:32,639

of things that sr-71 and these other

359

00:14:37,110 --> 00:14:34,959

aircraft photographed

360

00:14:39,750 --> 00:14:37,120

now buzz mentioned that there was a

361

00:14:41,750 --> 00:14:39,760

radar and a camera why would you need a

362

00:14:44,230 --> 00:14:41,760

camera on a plane that or why would you

363

00:14:47,269 --> 00:14:44,240

need a radar on a plane that was taking

364

00:14:49,509 --> 00:14:47,279

photos well the nodes of the sr-71

365

00:14:50,550 --> 00:14:49,519

carried either a camera

366

00:14:53,509 --> 00:14:50,560

or

367

00:14:57,030 --> 00:14:53,519

a radar imager and there was a separate

368

00:14:59,509 --> 00:14:57,040

camera that flew on all sr-71s further

369

00:15:02,389 --> 00:14:59,519

back on the fuselage

370

00:15:05,590 --> 00:15:02,399

but the advantage of radar

371

00:15:06,790 --> 00:15:05,600

over an ordinary camera is is that a

372

00:15:09,030 --> 00:15:06,800

radar

373

00:15:11,990 --> 00:15:09,040

can capture an image

374

00:15:15,110 --> 00:15:12,000

at night or in bad weather the cameras

375

00:15:17,590 --> 00:15:15,120

can operate at night or in bad weather

376

00:15:19,750 --> 00:15:17,600

but all they're taking pictures of are

377

00:15:22,230 --> 00:15:19,760

cloud cover or the blackness of the

378

00:15:23,189 --> 00:15:22,240

earth with the electric lights of a few

379

00:15:25,189 --> 00:15:23,199

towns

380

00:15:27,670 --> 00:15:25,199

and that's not the kind of information

381

00:15:31,110 --> 00:15:27,680

that the people who run the program want

382

00:15:34,230 --> 00:15:31,120

to get now these were not digital images

383

00:15:36,310 --> 00:15:34,240

so correct this is a piece of film so we

384

00:15:38,629 --> 00:15:36,320

would put this film in

385

00:15:40,710 --> 00:15:38,639

and it would have to come back and be

386

00:15:43,110 --> 00:15:40,720

processed and

387

00:15:45,590 --> 00:15:43,120

once it's processed then what happens

388

00:15:49,030 --> 00:15:45,600

well just let me say beth that this is

389

00:15:51,749 --> 00:15:49,040

70 millimeter film which the cameras

390

00:15:53,590 --> 00:15:51,759

towards the rear of the plane used

391

00:15:54,389 --> 00:15:53,600

when they flew a camera in the nose of

392

00:15:57,030 --> 00:15:54,399

the plane

393

00:15:58,629 --> 00:15:57,040

they flew film a five inch

394

00:16:00,710 --> 00:15:58,639

width

395

00:16:03,269 --> 00:16:00,720

but once the film came back and was

396

00:16:06,629 --> 00:16:03,279

developed and a lot of people don't

397

00:16:09,189 --> 00:16:06,639

understand film today because very very

398

00:16:10,230 --> 00:16:09,199

few people use it everybody has digital

399

00:16:12,710 --> 00:16:10,240

cameras

400

00:16:15,110 --> 00:16:12,720

but it has to be developed and then as

401
00:16:17,829 --> 00:16:15,120
buzz said it was cut into sections and

402
00:16:20,389 --> 00:16:17,839
then highly trained men and women looked

403
00:16:22,710 --> 00:16:20,399
at it on various pieces of equipment

404
00:16:26,069 --> 00:16:22,720
including light tables and they went

405
00:16:28,470 --> 00:16:26,079
through these long rolls of film looking

406
00:16:30,389 --> 00:16:28,480
for airfields and naval bases and

407
00:16:33,430 --> 00:16:30,399
missile complexes

408
00:16:35,350 --> 00:16:33,440
and new roads in the jungle and all

409
00:16:37,990 --> 00:16:35,360
sorts of things like that

410
00:16:40,389 --> 00:16:38,000
so this wasn't an easy job it was not by

411
00:16:43,030 --> 00:16:40,399
any means and it was complicated because

412
00:16:44,069 --> 00:16:43,040
some countries tried to camouflage their

413
00:16:46,710 --> 00:16:44,079

activities

414

00:16:49,269 --> 00:16:46,720

and so the analysts had to determine

415

00:16:52,470 --> 00:16:49,279

when that was going on well this looks

416

00:16:54,790 --> 00:16:52,480

like just uh an ordinary forest but we

417

00:16:58,069 --> 00:16:54,800

have a couple roads going into it and

418

00:16:59,590 --> 00:16:58,079

maybe there's some hidden activity there

419

00:17:01,749 --> 00:16:59,600

okay jim do you want to take some

420

00:17:03,350 --> 00:17:01,759

questions certainly okay let's start

421

00:17:05,829 --> 00:17:03,360

with the video question

422

00:17:08,230 --> 00:17:05,839

my name is felix and my question is how

423

00:17:10,150 --> 00:17:08,240

is the stealth technology in the sr-71

424

00:17:13,189 --> 00:17:10,160

used in today's aircraft

425

00:17:15,669 --> 00:17:13,199

well the sr-71 was not a stealth

426

00:17:18,390 --> 00:17:15,679

aircraft it incorporated some

427

00:17:20,870 --> 00:17:18,400

early stealth features to

428

00:17:22,870 --> 00:17:20,880

cut down on the radar cross section and

429

00:17:25,510 --> 00:17:22,880

make it less detectable

430

00:17:27,270 --> 00:17:25,520

by countries we were flying over but

431

00:17:30,150 --> 00:17:27,280

today we have completely stealth

432

00:17:34,630 --> 00:17:30,160

aircraft the f-117 fighter

433

00:17:36,870 --> 00:17:34,640

and two bombers uh but sr-71

434

00:17:39,029 --> 00:17:36,880

was a stepping stone in in the

435

00:17:41,190 --> 00:17:39,039

development of that technology for those

436

00:17:44,310 --> 00:17:41,200

completely stealth aircraft

437

00:17:47,590 --> 00:17:44,320

let's take an online question

438

00:17:48,950 --> 00:17:47,600

what was a normal mission like

439

00:17:51,430 --> 00:17:48,960

all missions

440

00:17:53,990 --> 00:17:51,440

sr-71 or any other

441

00:17:57,029 --> 00:17:54,000

aircraft that collected intelligence for

442

00:17:59,590 --> 00:17:57,039

that matter was highly planned

443

00:18:01,830 --> 00:17:59,600

and they did not want to fly around

444

00:18:03,909 --> 00:18:01,840

surface-to-air missile sites and things

445

00:18:05,270 --> 00:18:03,919

like that but at the same time the

446

00:18:06,950 --> 00:18:05,280

aircraft

447

00:18:08,390 --> 00:18:06,960

and the crew was tasked with

448

00:18:10,710 --> 00:18:08,400

photographing

449

00:18:12,549 --> 00:18:10,720

certain targets on earth so they were

450

00:18:14,070 --> 00:18:12,559

highly planned

451
00:18:16,710 --> 00:18:14,080
and of course in part they were

452
00:18:18,310 --> 00:18:16,720
dependent on weather

453
00:18:22,150 --> 00:18:18,320
all right

454
00:18:25,190 --> 00:18:22,160
good and so uh uh if everything was a go

455
00:18:28,549 --> 00:18:25,200
weather-wise and so on and so forth

456
00:18:31,830 --> 00:18:28,559
uh the mission would would uh take place

457
00:18:34,710 --> 00:18:31,840
and as as buzz said some of the missions

458
00:18:37,110 --> 00:18:34,720
were 9 10 11 hours long wow

459
00:18:38,390 --> 00:18:37,120
we have a an audience question what's

460
00:18:40,870 --> 00:18:38,400
your question

461
00:18:44,310 --> 00:18:40,880
was the sr-71 kept a secret from other

462
00:18:46,789 --> 00:18:44,320
countries and if so how was it done

463
00:18:48,710 --> 00:18:46,799

the sr-71

464

00:18:50,870 --> 00:18:48,720
was not kept a secret from other

465

00:18:52,950 --> 00:18:50,880
countries the world knew about it

466

00:18:54,630 --> 00:18:52,960
actually beginning in

467

00:18:57,110 --> 00:18:54,640
1964.

468

00:18:59,669 --> 00:18:57,120
they knew about the plane but the

469

00:19:01,350 --> 00:18:59,679
individual missions or flights

470

00:19:02,870 --> 00:19:01,360
were highly secret

471

00:19:05,350 --> 00:19:02,880
because you didn't want to tell the

472

00:19:06,789 --> 00:19:05,360
countries you were flying over that we'd

473

00:19:09,190 --> 00:19:06,799
be flying over

474

00:19:11,110 --> 00:19:09,200
at 10 o'clock local time tomorrow

475

00:19:13,750 --> 00:19:11,120
morning and then they could get their

476
00:19:15,590 --> 00:19:13,760
defenses ready now some countries knew

477
00:19:17,510 --> 00:19:15,600
they were being overflown because they

478
00:19:19,590 --> 00:19:17,520
had radars on the ground and things like

479
00:19:21,510 --> 00:19:19,600
that but you never give advance warning

480
00:19:22,830 --> 00:19:21,520
of that but the world knew about the

481
00:19:25,430 --> 00:19:22,840
existence of the

482
00:19:27,110 --> 00:19:25,440
airplane thank you sure

483
00:19:29,350 --> 00:19:27,120
now jim you

484
00:19:31,190 --> 00:19:29,360
went over how much work it was to look

485
00:19:33,510 --> 00:19:31,200
at these photographs and we've got a

486
00:19:35,350 --> 00:19:33,520
couple and marty is with some students

487
00:19:36,789 --> 00:19:35,360
and they are actually taking a look at

488
00:19:38,789 --> 00:19:36,799

some photos so marty do you want to tell

489

00:19:40,230 --> 00:19:38,799

us what's going on terrific sure beth so

490

00:19:41,830 --> 00:19:40,240

we've got a couple of images here you

491

00:19:43,590 --> 00:19:41,840

guys go ahead and start looking at these

492

00:19:46,310 --> 00:19:43,600

these are images similar to what might

493

00:19:48,150 --> 00:19:46,320

have been brought back by an sr-71 and

494

00:19:50,070 --> 00:19:48,160

these guys are no longer students they

495

00:19:52,470 --> 00:19:50,080

are analysts they are looking at these

496

00:19:54,310 --> 00:19:52,480

images seeing what they find so caitlin

497

00:19:57,909 --> 00:19:54,320

what do you see on this image

498

00:19:58,950 --> 00:19:57,919

um i think that this is an airfield okay

499

00:20:00,150 --> 00:19:58,960

you've got an airfield what did you

500

00:20:01,990 --> 00:20:00,160

notice over here

501
00:20:03,909 --> 00:20:02,000
rivers mountains

502
00:20:06,230 --> 00:20:03,919
maybe some land over there okay great so

503
00:20:07,990 --> 00:20:06,240
you guys found some really interesting

504
00:20:10,149 --> 00:20:08,000
geographic features but then kailyn

505
00:20:11,590 --> 00:20:10,159
jumped right in and found an airfield

506
00:20:13,029 --> 00:20:11,600
and that's exactly what we're looking

507
00:20:15,510 --> 00:20:13,039
for we're looking for targets of

508
00:20:17,190 --> 00:20:15,520
military importance to see what other

509
00:20:19,270 --> 00:20:17,200
countries are doing

510
00:20:21,029 --> 00:20:19,280
with either airfields or even ports to

511
00:20:22,310 --> 00:20:21,039
look for submarines all kinds of

512
00:20:26,149 --> 00:20:22,320
different things you guys did a really

513
00:20:27,990 --> 00:20:26,159

nice job being analysts on this now

514

00:20:29,830 --> 00:20:28,000

i want you to help me with this okay so

515

00:20:31,830 --> 00:20:29,840

what we've got here is a metal sphere

516

00:20:33,029 --> 00:20:31,840

and a metal ring now do those two fit

517

00:20:34,789 --> 00:20:33,039

together

518

00:20:37,110 --> 00:20:34,799

yeah so the sphere goes right through

519

00:20:39,430 --> 00:20:37,120

the ring and we're going to start

520

00:20:41,669 --> 00:20:39,440

heating this sphere up to see what

521

00:20:42,870 --> 00:20:41,679

happens to it so let's go ahead and turn

522

00:20:43,750 --> 00:20:42,880

this on go and hold that right over

523

00:20:44,630 --> 00:20:43,760

there

524

00:20:47,270 --> 00:20:44,640

all right

525

00:20:50,070 --> 00:20:47,280

so we're getting uh all warmed up here

526

00:20:52,630 --> 00:20:50,080

beth what's going on over with you

527

00:20:54,310 --> 00:20:52,640

well i'm now joined by titanium expert

528

00:20:56,310 --> 00:20:54,320

stan siegel thank you so much for being

529

00:21:00,470 --> 00:20:56,320

here today it's my pleasure

530

00:21:03,110 --> 00:21:00,480

stan why was titanium a good choice

531

00:21:05,029 --> 00:21:03,120

uh as the medal for the sr-71

532

00:21:07,029 --> 00:21:05,039

well we've seen that the mission is very

533

00:21:08,950 --> 00:21:07,039

difficult yes

534

00:21:11,190 --> 00:21:08,960

the metal that we choose has to be very

535

00:21:14,070 --> 00:21:11,200

light to get to these heights it has to

536

00:21:15,750 --> 00:21:14,080

be very strong at these speeds and also

537

00:21:17,590 --> 00:21:15,760

there's a lot of heating occurring so it

538

00:21:18,870 --> 00:21:17,600

has to have good strength at high

539

00:21:20,630 --> 00:21:18,880

temperatures

540

00:21:24,070 --> 00:21:20,640

so in looking at it there were three

541

00:21:25,669 --> 00:21:24,080

choices and i have these choices here

542

00:21:28,310 --> 00:21:25,679

i have aluminum

543

00:21:30,230 --> 00:21:28,320

titanium and steel

544

00:21:32,710 --> 00:21:30,240

now there are two common things about

545

00:21:36,710 --> 00:21:32,720

what i have in front of me here first of

546

00:21:38,630 --> 00:21:36,720

all the diameters are all the same right

547

00:21:40,710 --> 00:21:38,640

the other thing that's the same they all

548

00:21:42,149 --> 00:21:40,720

weigh the same

549

00:21:43,350 --> 00:21:42,159

so look at that

550

00:21:44,870 --> 00:21:43,360

if you're going to build an aircraft

551
00:21:46,789 --> 00:21:44,880
this is aluminum wouldn't this be the

552
00:21:48,710 --> 00:21:46,799
logical material to use

553
00:21:51,430 --> 00:21:48,720
however this plane

554
00:21:54,310 --> 00:21:51,440
the skin is over 500 fahrenheit

555
00:21:56,070 --> 00:21:54,320
and aluminum is not really good over 250

556
00:21:59,029 --> 00:21:56,080
it gets too soft

557
00:22:01,830 --> 00:21:59,039
so that limits the use of this to uh

558
00:22:04,310 --> 00:22:01,840
lower speeds like mach 2 and that was

559
00:22:06,950 --> 00:22:04,320
the concorde which is also in this

560
00:22:09,909 --> 00:22:06,960
museum so it was built out of aluminum

561
00:22:12,789 --> 00:22:09,919
so choices that we now have are two

562
00:22:14,789 --> 00:22:12,799
steel and titanium and the titanium is

563
00:22:16,630 --> 00:22:14,799

almost half the weight so what are you

564

00:22:18,630 --> 00:22:16,640

going to build it up these are two

565

00:22:21,430 --> 00:22:18,640

strong metals and they're good at high

566

00:22:23,750 --> 00:22:21,440

temperatures so it became titanium this

567

00:22:24,830 --> 00:22:23,760

plane is 93

568

00:22:29,190 --> 00:22:24,840

by weight

569

00:22:30,149 --> 00:22:29,200

titanium now titanium is used for other

570

00:22:32,870 --> 00:22:30,159

things

571

00:22:34,390 --> 00:22:32,880

commercially and you have something

572

00:22:36,149 --> 00:22:34,400

funny here do you want to tell us a

573

00:22:37,350 --> 00:22:36,159

little bit about this

574

00:22:38,950 --> 00:22:37,360

yes that

575

00:22:40,950 --> 00:22:38,960

maybe somebody might guess what that

576

00:22:43,909 --> 00:22:40,960

shape is for

577

00:22:45,590 --> 00:22:43,919

and it is a straw

578

00:22:48,310 --> 00:22:45,600

a titanium straw

579

00:22:50,950 --> 00:22:48,320

beyonce insisted that they have titanium

580

00:22:52,950 --> 00:22:50,960

straws on one of her world tours

581

00:22:55,029 --> 00:22:52,960

now that's not a big market for titanium

582

00:22:57,750 --> 00:22:55,039

because you know what other materials

583

00:23:00,390 --> 00:22:57,760

can be used as a straw plastic and this

584

00:23:02,070 --> 00:23:00,400

is very expensive straw by the way but

585

00:23:04,390 --> 00:23:02,080

there are other applications when

586

00:23:05,430 --> 00:23:04,400

titanium was first industrialized in the

587

00:23:07,270 --> 00:23:05,440

50s

588

00:23:08,950 --> 00:23:07,280

it was all military

589

00:23:10,710 --> 00:23:08,960

and gradually

590

00:23:12,390 --> 00:23:10,720

and it was military aerospace and

591

00:23:15,750 --> 00:23:12,400

gradually it got into commercial

592

00:23:18,230 --> 00:23:15,760

airspace and today about 50 percent of

593

00:23:19,990 --> 00:23:18,240

all the titanium is used in aerospace

594

00:23:22,470 --> 00:23:20,000

applications

595

00:23:25,029 --> 00:23:22,480

now that leaves another 50 for other new

596

00:23:26,549 --> 00:23:25,039

applications and that that includes

597

00:23:28,870 --> 00:23:26,559

the chemical industry and heat

598

00:23:30,950 --> 00:23:28,880

exchangers and vessels

599

00:23:33,029 --> 00:23:30,960

for production of many different types

600

00:23:35,190 --> 00:23:33,039

of chemicals like chlorine but there's

601
00:23:37,669 --> 00:23:35,200
also some consumer applications which

602
00:23:40,390 --> 00:23:37,679
are sort of interesting which include

603
00:23:42,710 --> 00:23:40,400
this but that's very minor but titanium

604
00:23:46,230 --> 00:23:42,720
maybe you've heard of golf club heads of

605
00:23:47,990 --> 00:23:46,240
titanium and it's uh used as exhausts

606
00:23:50,789 --> 00:23:48,000
and motorcycles

607
00:23:53,190 --> 00:23:50,799
and probably more important is what's

608
00:23:55,430 --> 00:23:53,200
used in the body because titanium has

609
00:23:57,430 --> 00:23:55,440
excellent corrosion resistance

610
00:24:00,470 --> 00:23:57,440
and it likes the body

611
00:24:03,269 --> 00:24:00,480
and as a result knee replacements

612
00:24:05,990 --> 00:24:03,279
hip replacements and also structures and

613
00:24:08,710 --> 00:24:06,000

replacing bones in the body are now

614

00:24:10,950 --> 00:24:08,720

usually titanium so they're

615

00:24:13,830 --> 00:24:10,960

better applications than drinking stress

616

00:24:15,430 --> 00:24:13,840

that's right okay well buzz and marty as

617

00:24:18,549 --> 00:24:15,440

they were walking around noticed

618

00:24:20,549 --> 00:24:18,559

something interesting on the sr-71 skin

619

00:24:22,149 --> 00:24:20,559

let's see what they found out well we've

620

00:24:23,830 --> 00:24:22,159

moved a lot closer to the plane and as

621

00:24:25,669 --> 00:24:23,840

you get closer you can see there are

622

00:24:27,430 --> 00:24:25,679

some pretty significant gaps here can

623

00:24:29,830 --> 00:24:27,440

you tell us about those

624

00:24:32,710 --> 00:24:29,840

because of the heating on the airplane

625

00:24:34,230 --> 00:24:32,720

an average temperature over 600 degrees

626
00:24:36,310 --> 00:24:34,240
overhead here this is the most

627
00:24:38,149 --> 00:24:36,320
significant gap the airplane grows three

628
00:24:40,789 --> 00:24:38,159
to four inches in length and this

629
00:24:43,190 --> 00:24:40,799
particular gap here can expand anywhere

630
00:24:45,830 --> 00:24:43,200
from one to two inches to account for

631
00:24:48,710 --> 00:24:45,840
the heating that the titanium metal goes

632
00:24:50,470 --> 00:24:48,720
through as the airplane goes into cruise

633
00:24:51,909 --> 00:24:50,480
there's a couple other expansion joints

634
00:24:54,149 --> 00:24:51,919
on the airplane but this is the most

635
00:24:56,789 --> 00:24:54,159
significant one and the airplane grows

636
00:25:00,310 --> 00:24:56,799
one to two inches in width also because

637
00:25:02,789 --> 00:25:00,320
of the heating inside the engine because

638
00:25:05,909 --> 00:25:02,799

heated the core of the engine to 2000

639

00:25:08,149 --> 00:25:05,919

degrees and the afterburner to 3200

640

00:25:10,710 --> 00:25:08,159

degrees the engine actually grows six

641

00:25:13,029 --> 00:25:10,720

inches in length and a couple inches in

642

00:25:14,870 --> 00:25:13,039

width to accommodate this tremendous

643

00:25:16,310 --> 00:25:14,880

heating that it sustains for an hour and

644

00:25:17,830 --> 00:25:16,320

a half at a time

645

00:25:18,630 --> 00:25:17,840

how hot would the outside of the plane

646

00:25:19,350 --> 00:25:18,640

get

647

00:25:29,029 --> 00:25:19,360

the

648

00:25:31,110 --> 00:25:29,039

1200 degrees

649

00:25:32,789 --> 00:25:31,120

all right well caitlin's been uh heating

650

00:25:34,789 --> 00:25:32,799

this up caitlyn now see if that'll fit

651

00:25:38,230 --> 00:25:34,799

back through

652

00:25:39,990 --> 00:25:38,240

thing called thermal expansion stan can

653

00:25:41,190 --> 00:25:40,000

you tell us what's going on there yes

654

00:25:43,350 --> 00:25:41,200

i'd like to

655

00:25:44,870 --> 00:25:43,360

all metals will expand if we heat it

656

00:25:46,230 --> 00:25:44,880

from room temperature

657

00:25:48,390 --> 00:25:46,240

and as we go to higher and higher

658

00:25:50,149 --> 00:25:48,400

temperatures it expands more

659

00:25:52,390 --> 00:25:50,159

and there's a coefficient of thermal

660

00:25:53,990 --> 00:25:52,400

expansion where we can for each metal

661

00:25:56,630 --> 00:25:54,000

and it's slightly different and we can

662

00:25:58,630 --> 00:25:56,640

calculate exactly what the change that

663

00:26:00,549 --> 00:25:58,640

occurs if we know the temperature that's

664

00:26:03,029 --> 00:26:00,559

there great now katelyn dunk that in the

665

00:26:04,630 --> 00:26:03,039

water and see what happens

666

00:26:07,590 --> 00:26:04,640

all right now see if it'll fit through

667

00:26:10,149 --> 00:26:08,789

it fits back through that metal has

668

00:26:12,390 --> 00:26:10,159

cooled back down and it's gone back to

669

00:26:13,430 --> 00:26:12,400

its original shape really nice job well

670

00:26:14,950 --> 00:26:13,440

stan you ready to take a couple

671

00:26:19,669 --> 00:26:14,960

questions we'll try all right let's

672

00:26:23,190 --> 00:26:20,870

titanium

673

00:26:25,750 --> 00:26:23,200

well basically as i indicated earlier

674

00:26:28,710 --> 00:26:25,760

it's 93 of the airframe

675

00:26:30,390 --> 00:26:28,720

and uh so that's most of the airplane

676
00:26:32,789 --> 00:26:30,400
also what's sort of interesting we have

677
00:26:34,630 --> 00:26:32,799
talked about the engine made by pratt

678
00:26:36,950 --> 00:26:34,640
whitney uh about

679
00:26:39,830 --> 00:26:36,960
seven percent of that engine is titanium

680
00:26:41,269 --> 00:26:39,840
current engines are closer to 30 percent

681
00:26:42,950 --> 00:26:41,279
titanium

682
00:26:46,390 --> 00:26:42,960
wow all right well let's head back over

683
00:26:49,590 --> 00:26:47,990
now that's all the time we have for

684
00:26:51,750 --> 00:26:49,600
today i want to thank you all for being

685
00:26:55,590 --> 00:26:51,760
here i also want to thank the

686
00:26:57,590 --> 00:26:55,600
international titanium association and

687
00:27:02,870 --> 00:26:57,600
if you're looking forward to our next

688
00:27:07,350 --> 00:27:04,710

i'm beth wilson i'm one of the hosts of

689

00:27:09,190 --> 00:27:07,360

stem 30. did you know that the national

690

00:27:12,070 --> 00:27:09,200

air and space museum actually has an

691

00:27:17,590 --> 00:27:12,080

artifact on mars

692

00:27:21,430 --> 00:27:19,350

actually the museum and the red planet

693

00:27:23,909 --> 00:27:21,440

have a really long history together it

694

00:27:25,590 --> 00:27:23,919

was a signal sent from mars that

695

00:27:28,710 --> 00:27:25,600

triggered the ribbon cutting that opened

696

00:27:30,950 --> 00:27:28,720

the museum in 1976

697

00:27:33,350 --> 00:27:30,960

later nasa transferred ownership of the

698

00:27:36,149 --> 00:27:33,360

viking lander to us so we actually have

699

00:27:38,149 --> 00:27:36,159

an artifact on mars

700

00:27:40,389 --> 00:27:38,159

this one here in the museum is a viking

701

00:27:42,070 --> 00:27:40,399

lander test article if you want to learn

702

00:27:43,909 --> 00:27:42,080

more about what's roving around on the

703

00:27:50,549 --> 00:27:43,919

red planet be sure to check out the next

704

00:27:55,110 --> 00:27:52,950

now if you enjoyed our interview with

705

00:27:57,110 --> 00:27:55,120

buzz carpenter there's a longer one that