1

00:00:00,000 --> 00:00:02,000

I

2

00:00:24,800 --> 00:00:26,800

Yep

3

00:00:30,520 --> 00:00:32,520

All right, let's see it

4

00:00:33,840 --> 00:00:39,340

What tell me bears yep, it's a fan favorite. All right, let's do this thing

5

00:01:00,000 --> 00:01:02,000

I

6

00:01:10,880 --> 00:01:14,600

Hope you're feeling pretty smart Jamie why because in this final season episode

7

00:01:14,600 --> 00:01:17,620

We're gonna have to behave like actual rocket scientists

8

00:01:18,120 --> 00:01:25,280

Excellent. What do you got? Well as you know throughout the history of mythbusters our relationship to rocketry has been a little bit like a Clint Eastwood movie

9

00:01:25,320 --> 00:01:27,320

There's been some good

10

00:01:28,120 --> 00:01:33,560

There's been some bad and a whole lot of the ugly

11

00:01:35,400 --> 00:01:41,440

This episode we hope to put it all together for an awesome fan favorite myth about non-standard rocket fuels

12

00:01:41,480 --> 00:01:47,760

I'm gonna go out on a limb here and guess that it's gummy bears. It is Sherlock. You're absolutely right

13

00:01:47,760 --> 00:01:50,800

Well, they do have a lot of calorific energy right and if it's true

14

00:01:50,800 --> 00:01:55,060

Just imagine we could fly to the moon on a rocket tail of pure sugary goodness

15

00:01:55,500 --> 00:01:57,740

That I like I thought you would

16

00:02:02,340 --> 00:02:06,540

Rockets a crowning majestic technological achievement

17

00:02:09,620 --> 00:02:15,020

Their harnessed explosive energy is capable of taking us out of this world

18

00:02:19,940 --> 00:02:24,700

This potential has led the mythbusters to fire a fearsome variety of rocketry

19

00:02:25,900 --> 00:02:27,400

Whoa

20

00:02:27,400 --> 00:02:29,400

And they've learned a thing or two

21

00:02:31,620 --> 00:02:33,620

Rockets are bombs with wings

22

00:02:34,700 --> 00:02:36,700

Total explosion upon ignition

23

00:02:37,500 --> 00:02:41,860

And a successful launch generally requires real rocket fuel

24

00:02:44,380 --> 00:02:49,420

So to test this fan requested tall tail of gummy bear powered propulsion

25

00:02:49,900 --> 00:02:53,020

Let's get things rolling with our resident rocket scientist

26

00:02:53,980 --> 00:02:58,540

Since we will be building rockets all episode long we thought it was important to start by defining our terms

27

00:02:58,580 --> 00:03:04,380

This is not an unreasonable depiction of the kind of rocket will use fiberglass body about seven feet long

28

00:03:04,380 --> 00:03:11,380

But it's the inside that really sets it apart now the business end where the exhaust comes out is called the fuel grain and the fuel

29

00:03:11,380 --> 00:03:14,820

Grain of this rocket like our Civil War one is made of paraffin

30

00:03:14,820 --> 00:03:20,300

But it's what sprays into the fuel grain that makes this a hybrid rocket and that is this a

31

00:03:20,700 --> 00:03:23,380

Pressurized canister of liquid oxygen or locks

32

00:03:24,820 --> 00:03:32,980

Now when the locks is sprayed down through the paraffin and ignited it burns very fast and very hot and when it sprays out that nozzle

33

00:03:32,980 --> 00:03:36,100

It causes a reaction which sends this rocket into the sky

34

00:03:37,260 --> 00:03:44,500

The only difference between this hybrid rocket and the one we'll be making is that ours will be powered by delicious delicious candy

35

00:03:46,540 --> 00:03:48,540

I wouldn't taste powerful

36

00:03:48,660 --> 00:03:52,460

That's the hybrid hardware, but the fable is fuel focused

37

00:03:52,980 --> 00:03:57,940

So it's out with the standard paraffin wax and in with the edible alternative

38

00:03:59,940 --> 00:04:05,460

Question is how do they make a fuel grain out of gummy bears? So this is how this whole thing works

39

00:04:05,780 --> 00:04:08,060

This is the rocket engine liner now

40

00:04:08,060 --> 00:04:12,060

We're gonna fill this with gummy bears, but we're not gonna fill it solid

41

00:04:12,060 --> 00:04:17,700

We need to actually have a tube down the middle through which the liquid oxygen will flow so to create that

42

00:04:17,700 --> 00:04:23,260

I'm gonna insert this white plastic tube with a spacer disc so it's held in the middle

43

00:04:23,260 --> 00:04:26,500

We put the gummy bears in there and we're good to go

44

00:04:31,300 --> 00:04:33,300

Hello, oh hey

45

00:04:33,580 --> 00:04:35,580

Are we ready for this you got the mold?

46

00:04:36,180 --> 00:04:40,460

With the mold made the guys start by simply jamming the gummies in manually

47

00:04:40,700 --> 00:04:43,540

Although this won't be their only method of making the fuel grain

48

00:04:44,540 --> 00:04:50,180

Oh, I get close packing them in so tightly means there's more energy per cubic inch

49

00:04:50,780 --> 00:04:53,100

This episode sponsored by the American Dental Association

50

00:04:53,820 --> 00:04:58,060

But removing any air pockets is important too in our experience

51

00:04:58,580 --> 00:05:06,300

Airspaces in a rocket fuel grain are bad because there are places where the burning can propagate and create too much surface area

52

00:05:06,860 --> 00:05:08,740

Shove your candy in that hole

53

00:05:08,740 --> 00:05:14,660

Everything about a rocket burning is about controlling the burn and when you have too much surface area that burn can get out of control

54

00:05:14,660 --> 00:05:18,260

And really its failure mode is to blow up your rocket. That's bad

55

00:05:23,020 --> 00:05:24,660

All right

56

00:05:24,660 --> 00:05:30,900

That's one engine, but they've got two more in mind now Jamie and I are gonna cook two different fuel grains

57

00:05:30,900 --> 00:05:36,220

And here's where things start to get interesting in the Mythbusters rocket kitchen see a hybrid fuel grain works better

58

00:05:36,220 --> 00:05:42,660

The more consistent it is therefore our second rocket is going to be a contiguous single gummy rocket

59

00:05:42,660 --> 00:05:44,660

We're gonna gently heat up the gummy bears. Ooh

60

00:05:46,220 --> 00:05:49,500

As soon as that mass is melted we're gonna pour it into the mold

61

00:05:51,300 --> 00:06:00,100

Ah nice and voila what we should get out is a fuel grain sized single gummy nice control there Heinemann

62

00:06:02,900 --> 00:06:05,660

And Jamie comes from seven generations of candy makers

63

00:06:07,220 --> 00:06:09,220

So there's an engine

64

00:06:11,420 --> 00:06:17,940

Potential engine for the third fuel grain we're sticking to the spirit of the myth which is gummy bear rocket fuel

65

00:06:17,940 --> 00:06:20,780

But we're gonna cheat a little bit because of some basic chemistry

66

00:06:21,260 --> 00:06:27,900

These guys are mostly gelatin which is mostly water the last time I checked water doesn't burn very well

67

00:06:28,140 --> 00:06:34,740

So we're gonna boil as much water off as we can pour the syrup into a mold and let it set into a hard rock candy

68

00:06:35,300 --> 00:06:37,300

Now we wait

69

00:06:38,220 --> 00:06:44,300

But gently boiling the mixture at 250 degrees overnight has not given the guys the result they require

70

00:06:44,580 --> 00:06:48,920

This could not be farther away from hard candy

71

00:06:49,740 --> 00:06:52,700

but we called a candy expert and

72

00:06:53,020 --> 00:06:57,500

The trick is to get the candy between 300 and 310 degrees Fahrenheit

73

00:06:58,660 --> 00:07:02,220

Adam begins by testing the new technique in small scale and

74

00:07:02,940 --> 00:07:08,500

Things are getting a little more serious make no mistake. This candy is super dangerous

75

00:07:08,500 --> 00:07:11,580

It's a super heated syrup if it got on you

76

00:07:11,980 --> 00:07:15,020

Third-degree burns a trip to the hospital and a permanent scar

77

00:07:16,180 --> 00:07:22,980

305 okay excellent if it got on Jamie wouldn't be any problem. We just peel off the skin off of his exoskeleton and they repair it

78

00:07:26,900 --> 00:07:28,900

I'm good. I'm good. I'm totally good

79

00:07:32,540 --> 00:07:33,780

Wow

80

00:07:33,780 --> 00:07:38,540

Okay, I'm just gonna cool this down because I've got a compressed gas cylinder over there

81

00:07:41,860 --> 00:07:45,500

Take two. All right, welcome back to how to ruin kitchen equipment

82

00:07:46,860 --> 00:07:54,340

Now I'm about to heat up a bunch more candy using this big non glass container. I've learned from my mistakes

83

00:08:02,660 --> 00:08:03,860

Wow

84

00:08:03,860 --> 00:08:07,260

Boiling at the target temperature for an hour releases all of the water

85

00:08:08,700 --> 00:08:12,140

Just hold on to that while I pour and given the potential dangers

86

00:08:12,140 --> 00:08:15,900

The Heidemann steps in to help with the handling of the super heated syrup

87

00:08:17,020 --> 00:08:19,020

That's awesome

88

00:08:21,620 --> 00:08:24,700

Jamie I think this might be the worst mess I've ever made in your shop. I

89

00:08:26,020 --> 00:08:28,020

Don't know

90

00:08:28,100 --> 00:08:32,180

You'd have to think about it. I have to think about that. You've made some pretty significant messes

91

00:08:32,420 --> 00:08:34,420

But

92

00:08:41,380 --> 00:08:46,100

With no further mishaps or mess their work here is done. There we go

93

00:08:47,020 --> 00:08:49,300

Well, that was a lot more work than we anticipated

94

00:08:49,580 --> 00:08:53,780

But we finally have our three rocket grains. We've got the hand-packed gummies

95

00:08:53,780 --> 00:08:59,180

We got the contiguous single gummy and we've got the hard crack candy. That's all we can do here in the shop

96

00:08:59,180 --> 00:09:01,180

Now it's time to head out to the desert

97

00:09:03,100 --> 00:09:05,100

Now

98

00:09:17,460 --> 00:09:24,060

As anyone who makes gummy bear rockets will tell you actually it might be the first but as will tell you once you've completed your gummy bear

99

00:09:24,060 --> 00:09:29,200

Rocket, you're going to need a place to fire it and in the Mojave Desert at the edge of the Coen dry lake bed

100

00:09:29,200 --> 00:09:32,640

We are on the compound of the Friends of Amateur Rocketry

101

00:09:34,000 --> 00:09:39,240

This is it a little nowhere what makes this place so special is not only their

102

00:09:39,680 --> 00:09:45,600

Incredible expertise in rocketry, but it is on this exact location. We fired the Chinese rocket chair more than a decade ago

103

00:09:49,840 --> 00:09:57,340

And they hand built the rockets for our third and final attempt to fire a car across the desert the J-03 episode

104

00:10:00,200 --> 00:10:08,520

Welcome to the Mythbusters Mojave HQ the launch pad location for some spectacular final season rocket science research

105

00:10:09,320 --> 00:10:13,340

Can gummy bears really fuel a liquid oxygen hybrid rocket?

106

00:10:17,360 --> 00:10:20,200

Coming up it gets real

107

00:10:29,960 --> 00:10:31,960

Oh

108

00:10:40,160 --> 00:10:42,160

Majestic and magnificent

109

00:10:43,360 --> 00:10:46,280

Rockets are defined as a vehicle propelled by thrust

110

00:10:47,560 --> 00:10:49,560

From burning on board fuel

111

00:10:51,000 --> 00:10:56,720

Any fuel and the most unlikely of all the mythical gummy bear

112

00:10:56,840 --> 00:11:04,360

So we've got three different versions of our gummy bear rockets those are going to go into these four inch rocket casings

113

00:11:05,160 --> 00:11:11,800

Inside this is a tank of liquid oxygen a valve and the rocket engine with the gummy bears

114

00:11:11,800 --> 00:11:16,880

And then the rocket nozzle those are all the major components that go into a hybrid rocket

115

00:11:18,400 --> 00:11:23,340

Now if you remember it's a hybrid rocket because we're feeding liquid oxygen through our fuel grain

116

00:11:23,340 --> 00:11:30,020

And that's what this giant tank is full of liquid oxygen literally some of the scariest stuff on earth

117

00:11:30,140 --> 00:11:35,980

To say this is flammable is really it's not accurate because this is what makes things flammable

118

00:11:35,980 --> 00:11:40,100

It is the enabler for burning which is exactly what it's doing in our rockets

119

00:11:41,540 --> 00:11:47,500

With the locks and rocket casing ready to roll cue the first fuel hand-packed gummies

120

00:11:48,020 --> 00:11:53,860

And that pretty that is gorgeous. So the gummy bear fuel grain is going into its housing

121

00:11:54,420 --> 00:12:00,620

There are a lot of fiddly bits that all have to work perfectly in concert snap rings

122

00:12:00,620 --> 00:12:05,700

Oh rings rocket grants housing and everything and it all has to be properly assembled

123

00:12:06,620 --> 00:12:08,620

With the engine loaded and locked

124

00:12:09,220 --> 00:12:11,220

It's go time for launch

125

00:12:12,140 --> 00:12:14,140

This is the pre-launch setup

126

00:12:15,180 --> 00:12:17,180

We mount the rocket

127

00:12:18,500 --> 00:12:23,900

Insert the altimeter and the descent parachute into the nose cone and then erect guide rail

128

00:12:29,500 --> 00:12:32,060

After that we de-ass the area

129

00:12:35,260 --> 00:12:37,260

Here we go

130

00:12:37,340 --> 00:12:42,580

Because just as our bomb squad so the only ones qualified to do the final capping in of explosives our

131

00:12:42,740 --> 00:12:47,380

Rocket techs here are the only ones qualified to work with the super unstable liquid oxygen

132

00:12:47,500 --> 00:12:52,380

Once they have the locks in place they put in the ignition system and the countdown sequence begins

133

00:12:52,460 --> 00:12:57,580

It ends of course with me counting from five to zero and I hit the launch button the moment

134

00:12:57,580 --> 00:13:03,620

I do an igniter starts a little fire in the base of the rocket at the same time a valve opens up and liquid oxygen begins to

135

00:13:03,620 --> 00:13:09,100

Spray down the middle of the core of our fuel grain it is ignited by that flame and hopefully also in turn

136

00:13:09,220 --> 00:13:15,820

Ignites the fuel grain causing a chain reaction of explosive force that sends the rocket skyward system is armed

137

00:13:16,940 --> 00:13:22,900

Theoretically this is it will hand-packed gummy bears be a viable rocket fuel

138

00:13:40,060 --> 00:13:46,020

That's the sound of not working the sound of failure

139

00:13:49,700 --> 00:13:53,700

Well, we just fired our first gummy bear rocket and remember these were the gummy bears

140

00:13:53,700 --> 00:13:58,300

We're just jammed into a rocket grain shape with no other modification and

141

00:13:59,020 --> 00:14:04,020

We got a successful firing which is we heard it burn and shoot out some fire

142

00:14:04,020 --> 00:14:07,940

And then you started to hear the telltale sound of gummy bears individually

143

00:14:08,460 --> 00:14:10,460

peeling off from the rocket grain and

144

00:14:10,900 --> 00:14:16,140

Getting pooped out of the bottom of our rocket, but not with enough force to actually lift this rocket

145

00:14:16,140 --> 00:14:18,780

We didn't get any else. We didn't get one inch. Yeah

146

00:14:22,380 --> 00:14:30,180

The ignition flame appeared to light the locks. Oh nice you're eating it. I'd still sweet Wow

147

00:14:30,820 --> 00:14:34,300

But the loose pack flavorsome fuel simply fell apart

148

00:14:34,740 --> 00:14:36,740

You

149

00:14:37,580 --> 00:14:42,840

Gummy bear fuel number two this time we're using the melted gummy bears remember

150

00:14:42,840 --> 00:14:47,660

It's one solid contiguous gummy material molded into a tube shape

151

00:14:48,260 --> 00:14:51,340

I'm marginally more optimistic about this time. I

152

00:14:53,980 --> 00:14:56,900

Got a rocket in my pocket and I'm ready for some action

153

00:14:58,420 --> 00:15:03,780

I'm getting more and more excited the rocket grain is in there. I'm feeling very optimistic

154

00:15:05,300 --> 00:15:07,300

Oh and Sneezy

155

00:15:09,140 --> 00:15:11,140

There you go

156

00:15:11,740 --> 00:15:16,860

With the rocket ready for launch back at mission control it's countdown number two

157

00:15:17,300 --> 00:15:22,060

All right, here we go folks arming the system gummy bears are go

158

00:15:25,900 --> 00:15:30,740

Launching in three two one

159

00:15:30,740 --> 00:15:32,740

I

160

00:15:33,540 --> 00:15:37,820

See smoke that sounded good come on come on

161

00:15:39,660 --> 00:15:41,660

I hear it

162

00:15:41,660 --> 00:15:45,180

Sounds better than the last one. I am in no movement though

163

00:15:47,260 --> 00:15:49,260

No

164

00:15:51,580 --> 00:15:53,580

I'm sad

165

00:15:53,940 --> 00:16:03,300

From our bunker we push the ignition button and first we saw the igniter smoke and then as they released the liquid oxygen

166

00:16:03,660 --> 00:16:10,900

Into the chamber we heard this telltale sound that really typifies a hybrid rocket, which is kind of a

167

00:16:11,660 --> 00:16:13,660

And then there's this hum

168

00:16:15,380 --> 00:16:16,580

So

169

00:16:16,580 --> 00:16:21,420

That that right there tells you you're hearing hybrid rocket fire

170

00:16:22,420 --> 00:16:27,580

Unfortunately, it did not have enough thrust to lift this rocket even an inch on its stand

171

00:16:28,620 --> 00:16:30,300

Yeah, well

172

00:16:30,300 --> 00:16:32,300

science, baby

173

00:16:32,860 --> 00:16:37,060

Now gummy bears may work like rocket fuel when you put them in little kids

174

00:16:40,900 --> 00:16:44,780

But for us not so much and that's why for the next round

175

00:16:44,780 --> 00:16:51,060

We're gonna be using gummy bears that we've boiled down to remove all of the water leaving only the sugar

176

00:16:51,460 --> 00:16:53,900

And we're hoping that we'll get a better result out of that

177

00:16:55,460 --> 00:16:59,260

Optimism is high if gummy bears can possibly provide enough thrust

178

00:17:00,100 --> 00:17:06,460

This is the one right here then this concentrated candy. Oh, that's nice is their best chance

179

00:17:08,620 --> 00:17:10,460

Right

180

00:17:10,460 --> 00:17:11,540

if

181

00:17:11,540 --> 00:17:13,180

Anything's gonna work

182

00:17:13,180 --> 00:17:17,580

This is gonna because we know sugar burns and there's a lot of energy in it actually

183

00:17:18,180 --> 00:17:20,480

Yep one pound of sugar contains

184

00:17:21,420 --> 00:17:27,620

7700 kilojoules meaning this fuel grain with 12 pounds of concentrated candy has the potential

185

00:17:28,100 --> 00:17:34,780

To lift a 50 pound rocket several thousand feet into the air. All right, my hopes are all pinned

186

00:17:35,180 --> 00:17:37,620

On a large tube of hard candy

187

00:17:39,020 --> 00:17:43,680

But will it burn here we go and will it convert that energy to thrust

188

00:17:44,580 --> 00:17:46,580

launching and

189

00:17:46,580 --> 00:17:48,580

three

190

00:17:48,580 --> 00:17:50,580

two

191

00:17:50,860 --> 00:17:52,860

one

192

00:18:11,220 --> 00:18:13,220

A duck

193

00:18:13,620 --> 00:18:16,060

Houston we have all the problems

194

00:18:16,580 --> 00:18:27,780

over the years the myth busters have learned the hard way

195

00:18:30,540 --> 00:18:33,060

That failure is a valid result

196

00:18:36,100 --> 00:18:39,500

One ignition and with a lack of thrust

197

00:18:41,940 --> 00:18:44,740

Gummy bear rocket fuel is looking like a bust

198

00:18:46,580 --> 00:18:48,580

A doctor but

199

00:18:49,700 --> 00:18:55,060

You know us we're not gonna give up just yet. We're gonna fire the hard candy rocket one more time

200

00:18:56,260 --> 00:18:59,700

I'm gonna add a susan of shall we say

201

00:19:00,580 --> 00:19:02,580

Encouragement to help it go a little more vigorously

202

00:19:03,620 --> 00:19:08,420

What I'm doing is I put a spray adhesive down the throat of this and then pour gunpowder on it

203

00:19:08,420 --> 00:19:10,340

And it coats the inside of the rocket engine

204

00:19:10,340 --> 00:19:15,980

So when we stick the igniter in there the whole surface is ignited nicely. I should be good to go

205

00:19:17,460 --> 00:19:21,820

So with an even sprinkling of black powder in place to help initiate ignition

206

00:19:22,580 --> 00:19:26,260

The guys are shooting for one last shot at gummy glory

207

00:19:26,900 --> 00:19:32,940

So we've tried all our different versions of gummy bears and nothing has worked yet. This one right here

208

00:19:33,420 --> 00:19:38,140

Has got to work. It's now or never. All right, mr. Heineman. Are you ready? I'm ready. Here we go

209

00:19:38,420 --> 00:19:41,580

Here we are launching the hard candy rocket

210

00:19:42,220 --> 00:19:43,420

three

211

00:19:43,420 --> 00:19:44,700

two

212

00:19:44,700 --> 00:19:45,540

one

213

00:19:45,660 --> 00:19:47,660

Watch

214

00:19:47,660 --> 00:19:49,660

Come on, baby

215

00:19:50,500 --> 00:19:53,300

Come on! It's gotta go!

216

00:19:59,420 --> 00:20:03,580

It was the best-case candied scenario and there was no liftoff

217

00:20:04,300 --> 00:20:08,220

But has the myth been busted or the mythbusters methodology?

218

00:20:09,340 --> 00:20:10,540

What is wrong?

219

00:20:10,540 --> 00:20:20,140

The Heineman smells a hardware rat at this point. I'm becoming suspicious as to whether it's the fuels fault or is it say the

220

00:20:20,420 --> 00:20:23,660

Oxidizer or the general rocket system that is a fault here

221

00:20:23,860 --> 00:20:30,020

So this next attempt we're going to try and eliminate that as a concern and we're gonna use paraffin as the fuel

222

00:20:30,180 --> 00:20:34,380

Which we know is capable of making a rocket like this fly really far

223

00:20:34,900 --> 00:20:41,580

Yep by replacing the gummy bears with standard rocket fuel this control launch will test the hardware itself

224

00:20:43,220 --> 00:20:46,820

Packed with paraffin the rocket experts expect an altitude of

225

00:20:47,900 --> 00:20:52,380

20,000 feet. Anything less than that we're gonna have some problems to solve

226

00:20:54,500 --> 00:21:00,900

Okay, here we go launching in three two one

227

00:21:01,540 --> 00:21:03,860

That's it I see smoke

228

00:21:12,300 --> 00:21:20,340

That's clearly not the high altitude expected here comes it doesn't look like it went higher than about six or seven hundred feet

229

00:21:22,700 --> 00:21:25,220

It should have got at least 30 times higher

230

00:21:26,220 --> 00:21:33,520

After the failure of all of our gummy bear rockets we fired off this paraffin rocket as a test of our hardware and technology and it flew

231

00:21:35,060 --> 00:21:37,060

675 feet that is

232

00:21:37,900 --> 00:21:39,900

unremarkable

233

00:21:39,900 --> 00:21:45,340

That is a pretty clear marker that we need to review our hardware and our technology before proceeding

234

00:21:47,380 --> 00:21:53,260

Well the rockets just aren't working no and the gummy bear results have to be thrown out completely

235

00:21:53,300 --> 00:21:58,260

It's the tricky finicky business of these hybrid rockets is getting in the way of us getting any actual results

236

00:21:58,260 --> 00:22:00,260

I don't know what we're gonna do well

237

00:22:01,060 --> 00:22:05,340

Let's head back to the shop and regroup. All right. We'll have a total rethink about this. Yeah

238

00:22:06,580 --> 00:22:10,140

With the hardware fail all their results are redundant

239

00:22:10,420 --> 00:22:16,380

All they've proved so far is they're facing one of the most challenging experiments in myth busters

history

240

00:22:17,180 --> 00:22:20,460

So it's back to the shop and square one

241

00:22:21,060 --> 00:22:25,460

So these are the parts we were trying to use in the desert. We've got your gummy bears here

242

00:22:25,460 --> 00:22:30,980

We've got your oxidizer pressurized tank here with the valves and the touch the ignition systems

243

00:22:30,980 --> 00:22:35,260

Look, I think we just bit off more than we can chew we are moving on instead

244

00:22:35,260 --> 00:22:37,260

We're gonna use a solid rocket motor like this

245

00:22:37,540 --> 00:22:44,500

It may not look like that much, but it's actually a very carefully prepared mixture of fuel
oxidizer and a binder to hold it all together

246

00:22:45,220 --> 00:22:49,420

Now it's nice and simple because in theory all you do is light it and off it goes

247

00:22:49,500 --> 00:22:55,780

We're gonna make our own version of it using gummy bears as fuel along with same oxidizer and binder

248

00:22:56,620 --> 00:23:03,340

Solid rockets. They've ejected busters bond seed our Jato and fired the watcha

249

00:23:03,900 --> 00:23:10,100

They're simple and effective, but producing fuel grains like this is not only time-consuming and difficult

250

00:23:10,100 --> 00:23:13,620

But you need a special license which neither Jamie nor I possess

251

00:23:13,740 --> 00:23:18,900

So what we're going to do here is to turn these gummies into a powder. There we go

252

00:23:19,420 --> 00:23:24,120

And then send them off to a specialist who will produce for us fuel grains that look like this

253

00:23:24,860 --> 00:23:28,100

The specialist require the fuel as a fine dry powder

254

00:23:29,060 --> 00:23:31,060

three two one

255

00:23:33,340 --> 00:23:41,340

And to convert the gummies Adam has hit upon a technique that doesn't involve large quantities of lethal lava like serum

256

00:23:42,300 --> 00:23:43,500

Seems like it's working

257

00:23:43,700 --> 00:23:45,700

Exactly

258

00:23:46,060 --> 00:23:49,980

Okay, I'm gonna use a coffee grinder to make them even more powdery

259

00:23:52,420 --> 00:23:58,140

Dude look at that that is a super fine powder that used to be gummy bears

260

00:23:58,780 --> 00:24:00,780

That's exactly what our rocketeers want

261

00:24:02,460 --> 00:24:04,460

Time to make a whole bunch more

262

00:24:05,300 --> 00:24:11,500

While Adam ramps up production on his gummy bear crystal method Jamie is well being Jamie

263

00:24:12,280 --> 00:24:17,380

Look, I'm loving the technical challenge of making a gummy bear powered rocket and if it works cool

264

00:24:17,920 --> 00:24:22,500

But let's face it ultimately. There's no real practical application for it

265

00:24:22,620 --> 00:24:28,100

So I'm gonna make a second fuel powder one that could conceivably be useful. Oh

266

00:24:29,180 --> 00:24:31,180

God

267

00:24:31,900 --> 00:24:33,900

That's

268

00:24:33,900 --> 00:24:35,900

That's awful. I'm gonna use poop

269

00:24:36,900 --> 00:24:41,620

It's a pretty disgusting sequence up next so you might want to put down your snacks

270

00:24:42,620 --> 00:24:48,620

Yep, Jamie's moving on from the myth and is thinking ahead. He's looking into the future of space travel

271

00:24:49,140 --> 00:24:51,140

No, really?

272

00:24:51,180 --> 00:24:52,940

Man, that's nasty

273

00:24:52,940 --> 00:24:57,980

Add like Adam his first step is to turn his potential fuel into a dry powder

274

00:24:58,420 --> 00:25:04,140

First I'm gonna dry it out up here in the Sun, which has the added benefit of keeping the stink out at the shop

275

00:25:04,420 --> 00:25:09,740

They're already giving me nightmares and then I'm gonna grind it down into a fine dry powder

276

00:25:11,660 --> 00:25:17,900

Some sun-dried poop coming right up. I want them nice and dry and crispy. That's where I like

277

00:25:23,980 --> 00:25:29,420

Processing dog waste into powder is one thing but the big question is why look?

278

00:25:29,420 --> 00:25:33,340

I know it sounds kind of crazy, but crazy is kind of Jamie's MO

279

00:25:33,580 --> 00:25:36,500

I have no idea if this is gonna work or not, but

280

00:25:37,300 --> 00:25:41,420

Little soon find out whenever he can design a system that has no waste

281

00:25:41,820 --> 00:25:48,260

whatsoever where he's expended just enough energy to get the job done and no more he is the happiest

282

00:25:49,540 --> 00:25:55,700

Well, it's definitely breaking it up and where does that philosophy reach its zenith in space?

283

00:25:56,300 --> 00:26:01,340

Astronauts are already drinking their own urine. I mean after filtering with Jamie's plan

284

00:26:01,340 --> 00:26:06,300

They'd also be using their feces as rocket fuel. What could be more efficient? So

285

00:26:06,780 --> 00:26:09,620

While it sounds crazy, there might just be something to this

286

00:26:09,940 --> 00:26:12,740

It may have seemed like a gag to make you gag

287

00:26:13,420 --> 00:26:17,300

But typically by focusing on the details tell you one thing

288

00:26:18,700 --> 00:26:20,700

This rocket better work

289

00:26:20,780 --> 00:26:27,700

Jamie's actually thinking big so with the gummies and poop powderized. Yep. That's pretty well ground up

290

00:26:27,700 --> 00:26:29,700

It's packaged and sent off

291

00:26:31,340 --> 00:26:39,060

After the dangerous process of combining it into a solid motor is complete. It'll be back to the desert for a date with detonation

292

00:26:40,780 --> 00:26:45,380

Gummy bear rocket in three two one

293

00:27:02,340 --> 00:27:09,820

Welcome back to the Mojave Desert last time we were here we were testing rockets made of gummy bears and the results

294

00:27:10,260 --> 00:27:14,140

were spectacularly unspectacular round two

295

00:27:15,020 --> 00:27:17,020

We had rockets that did this

296

00:27:19,580 --> 00:27:21,580

And rockets that did this

297

00:27:23,180 --> 00:27:24,940

A duck

298

00:27:24,940 --> 00:27:26,940

Yeah, so we've changed our methodology

299

00:27:27,740 --> 00:27:34,620

Entirely we've gone from hybrid rockets to solid rocket motors and we've come back out to the site with a gummy bear rocket to test

300

00:27:34,620 --> 00:27:37,700

We've also come out with something I might call

301

00:27:38,300 --> 00:27:40,620

Heinemaniin or within or

302

00:27:42,180 --> 00:27:47,700

Mr. Heinemann has gotten a bee in his bonnet about making a rocket using poop and we are also going to test that

303

00:27:48,540 --> 00:27:54,620

Last time we saw the sweet and sour fuel. They were powderized and sent off to the rocket scientists

304

00:27:55,020 --> 00:28:01,420

And here is what they did with them. They turned them into two official rocket motors one made out of gummy bears

305

00:28:03,140 --> 00:28:05,140

One made out of poop

306

00:28:07,740 --> 00:28:09,740

Barely worse than the gummy bears

307

00:28:10,340 --> 00:28:14,860

Yep, they've been converted into solid rocket propellant. It looks like this

308

00:28:15,300 --> 00:28:21,900

Basically, it's composed of an oxidizer and the fuel which is held in place by a binder made up of a variety of rubber resins

309

00:28:21,900 --> 00:28:27,220

Now when that starts to burn all those expanding gases are forced out through the rocket nozzle that

310

00:28:27,580 --> 00:28:31,860

Accelerates those gases creating a lot of thrust and up the rocket goes

311

00:28:32,620 --> 00:28:41,740

In stark contrast to the hybrid system. It couldn't be simpler an electronic matches lit and in theory the gummy and poop based fuels

312

00:28:42,020 --> 00:28:44,020

Begin an explosive chain reaction

313

00:28:44,620 --> 00:28:48,500

Question is how will the mythical fuels performance be measured?

314

00:28:49,500 --> 00:28:56,140

It's almost time for launch now our first launch is surprisingly not going to be either a gummy bear rocket or a poop rocket

315

00:28:56,140 --> 00:29:01,580

It is in fact going to be a control launch of a best-case scenario rocket. Otherwise known as a

316

00:29:02,300 --> 00:29:08,020

Rocket big rocket coming through it has the ideal mixture of fuel binder and oxidizer

317

00:29:08,340 --> 00:29:16,260

Okay, and goes the engine with standard rocket propellant and it will give us the best case scenario of how high a

318

00:29:16,420 --> 00:29:22,180

Rocket can go of this size and weight. All right. Well, that's it. Let's put it on the rail. All right

319

00:29:34,140 --> 00:29:38,300

Now I know we've already spent a bunch of time explaining a difference between this rocket and its predecessors

320

00:29:38,300 --> 00:29:46,020

But you might not notice we've got three cameras attached to this rocket so that we can see the rocket's eye view of its own

321

00:29:46,020 --> 00:29:47,220

launch

322

00:29:47,220 --> 00:29:49,220

That's pretty cool

323

00:29:52,580 --> 00:29:56,380

Oh, yeah, I remember this part sucks

324

00:29:59,860 --> 00:30:01,860

There we go, she's up

325

00:30:02,300 --> 00:30:08,060

All right, you ready? I'm ready. Okay. Here we go. Bitbuster solid rocket motor control in

326

00:30:09,220 --> 00:30:12,180

three two one

327

00:30:16,020 --> 00:30:18,020

Oh

328

00:30:23,580 --> 00:30:25,580

We'd see a rocket fire eventually

329

00:30:31,540 --> 00:30:33,700

Little pop that was the pop of parachute

330

00:30:35,140 --> 00:30:38,900

Unlike the hybrid system the ignition and launch was successful

331

00:30:40,740 --> 00:30:44,700

And the rockets I view of the Mojave Desert spectacular

332

00:30:46,860 --> 00:30:50,340

However, oh and it's tripping

333

00:30:50,740 --> 00:30:59,420

It's true. It's tripping a lot proving once again that rocket science is well rocket science when conditions were less than ideal

334

00:31:02,100 --> 00:31:04,340

All right, let's go get our rocket

335

00:31:06,820 --> 00:31:12,140

During ascent the rocket was pushed significantly sideways. I might be wondering care for a little while

336

00:31:12,140 --> 00:31:14,140

But

337

00:31:14,660 --> 00:31:19,820

After a successful search and rescue they head back to base where they discover it reached

338

00:31:21,580 --> 00:31:26,140

4,133 feet but more detailed data reveals a potential problem

339

00:31:27,380 --> 00:31:28,580

So we had a good launch

340

00:31:28,580 --> 00:31:34,300

But the telemetry and GPS is telling us that we had a lot of lateral drift that may have compromised our data

341

00:31:34,780 --> 00:31:40,540

Because if that curve was straightened out it might have actually given us a higher altitude

342

00:31:41,100 --> 00:31:43,500

So we've got another one of these rockets

343

00:31:44,140 --> 00:31:47,500

Control test number two and we're gonna go again just to be sure

344

00:31:47,900 --> 00:31:53,180

Yep to ensure all the launches have equal conditions. They wait until the wind dies down

345

00:31:54,460 --> 00:31:59,340

All right, let's do this. You ready? Yeah, this is control number two

346

00:32:00,180 --> 00:32:03,620

firing in three two one

347

00:32:10,540 --> 00:32:12,540

Wow

348

00:32:16,540 --> 00:32:22,300

That one went straight up straight up almost straight down

349

00:32:24,780 --> 00:32:30,460

Do I think that one's gonna land like right here it was coming right down right on top of us

350

00:32:34,020 --> 00:32:39,060

Nice walking distance from bunker and telemetry says the distance this went to was

351

00:32:39,860 --> 00:32:46,820

4491 feet well that gives us our baseline time to fire up the gummy bear rocket. Let's do it

352

00:32:49,420 --> 00:32:57,140

Unaffected by wind control number two went almost 400 feet high and the benchmark for gummy bears has been established

353

00:33:02,220 --> 00:33:07,660

The rocket propellant we've been using is 77 percent ammonium perchlorate oxidizer and

354

00:33:08,180 --> 00:33:15,380

23 percent fuel mixed with a rubber binder now. We're replacing that fuel component with gummy bear powder

355

00:33:16,940 --> 00:33:18,940

In goes the gummy bear motor

356

00:33:19,420 --> 00:33:25,740

What we're looking to find out is how the gummy bear fuel component compares to the conventional fuel component

357

00:33:27,300 --> 00:33:29,300

Good to go

358

00:33:29,300 --> 00:33:39,060

It's been one of the most technically challenging experiments in myth busters history, but this is it a gummy bears are good to go

359

00:33:40,940 --> 00:33:45,220

You know Jamie not many people know this but gummy bears are actually the poop of baby unicorns

360

00:33:45,820 --> 00:33:50,500

Really? Yeah, no one's ever gotten close enough to figure out how their sphincter makes that bear shape, but

361

00:33:51,260 --> 00:33:53,260

In fact

362

00:33:54,900 --> 00:34:01,340

The key point of comparison for the energy and efficiency of the propellant will be the maximum altitude attained

363

00:34:02,260 --> 00:34:07,620

All right, so this is it you ready are you ready? I'm totally ready. Let's gummy the sky open

364

00:34:08,500 --> 00:34:12,700

Conventional propellant launch this eight-foot rocket with 50 pound payload to

365

00:34:14,100 --> 00:34:16,100

4491 feet

366

00:34:16,420 --> 00:34:18,420

How will the gummies go?

367

00:34:18,740 --> 00:34:23,380

Gummy bear rocket in three two one

368

00:34:25,540 --> 00:34:27,540

There goes you have ignition

369

00:34:34,260 --> 00:34:36,260

Way up there it did

370

00:34:36,260 --> 00:34:38,260

Ha ha ha

371

00:34:42,260 --> 00:34:44,580

Yep, they did give you something right there

372

00:34:45,380 --> 00:34:48,340

Boom, it's been a long and frustrating journey

373

00:34:49,020 --> 00:34:53,220

But that one successful launch has made it all worthwhile

374

00:34:54,260 --> 00:34:56,260

beeping is good

375

00:34:57,500 --> 00:35:02,020

Coming up the guys find out exactly how high the gummies flew

376

00:35:07,140 --> 00:35:15,300

In this final season number crunching countdown it's liftoff for an all-time fan favorite theme

377

00:35:17,940 --> 00:35:22,740

In over 14 years of myth busting rockets sure have racked up the stats

378

00:35:25,460 --> 00:35:27,460

There have been

379

00:35:27,460 --> 00:35:29,460

964 countdowns

380

00:35:30,500 --> 00:35:32,500

Jato was attempted four times

381

00:35:33,460 --> 00:35:36,740

The rocket sled successfully fired five times

382

00:35:42,340 --> 00:35:49,140

Then there were at least six of adam's gloriously insane liftoff vocal

383

00:36:03,300 --> 00:36:05,300

Go from 800 start

384

00:36:05,300 --> 00:36:07,300

two one

385

00:36:07,540 --> 00:36:10,900

Booster ignition and the final liftoff of discovery

386

00:36:11,620 --> 00:36:15,220

Rocket science is knife edge sensitive technology

387

00:36:15,540 --> 00:36:20,340

Harnessing an explosive chain reaction for propulsion as its pitfalls

388

00:36:21,860 --> 00:36:28,900

And not enough energy or poor design a duck means you don't get off the launch pad one

389

00:36:32,900 --> 00:36:39,540

But how did the gummy bears and their sinister black vapor trail perform boom

390

00:36:42,340 --> 00:36:45,380

After finding the landing site beeping is good

391

00:36:46,580 --> 00:36:48,580

That is beautiful

392

00:36:48,980 --> 00:36:50,980

It's the mythical moment of truth

393

00:36:52,660 --> 00:36:54,660

It flew it's true

394

00:36:56,180 --> 00:36:59,300

But how did it perform compared to real rocket fuel?

395

00:37:02,500 --> 00:37:07,140

So when you decode the altimeter it says that our gummy bear rocket got up to

396

00:37:08,420 --> 00:37:10,900

3,691 feet

397

00:37:10,900 --> 00:37:13,700

That's pretty respectable only respectable

398

00:37:14,180 --> 00:37:21,300

So gummies flew man. They did night and they shot into the sky flew almost 3700 feet into the air that was awesome

399

00:37:21,860 --> 00:37:26,020

What does it mean? Is it time to break out the champagne and call nasa about our new rocket fuel?

400

00:37:26,660 --> 00:37:29,780

Let's slow down just a little bit and take a look here's the thing

401

00:37:30,100 --> 00:37:36,980

The whole point of real rocketry is to maximize thrust and efficiency to get the largest possible payload as far from earth as possible

402

00:37:37,380 --> 00:37:44,900

So the discovery of a rocket fuel that is less efficient than the fuel we currently use is not

really cause for celebration

403

00:37:44,900 --> 00:37:51,940

It's more a reason to celebrate rocketry's flexibility. Let's say I'm going to say this one is plausible

404

00:37:52,340 --> 00:37:59,540

Yep, the sweet mythical snacks carefully combined with a potent oxidizer and binder had enough energy for liftoff

405

00:37:59,780 --> 00:38:03,140

But in such a high performance technology

406

00:38:03,780 --> 00:38:07,460

82 percent is merely viable and barely successful

407

00:38:08,180 --> 00:38:11,940

Cue the high demand. Well, it was fun and it actually worked

408

00:38:13,860 --> 00:38:17,220

But let's face it. There's not really any practical reason to use it

409

00:38:18,340 --> 00:38:23,140

There is however another fuel that on the face of it might seem just as frivolous

410

00:38:23,780 --> 00:38:30,100

But in reality it might just have a practical use in future space travel

411

00:38:34,100 --> 00:38:36,660

All right, you might be forgiven for thinking jayme has lost his marbles

412

00:38:37,620 --> 00:38:44,580

Let me allow me to explain what makes a rocket fly what makes a good rocket fuel is a hydrocarbon because it burns well in the presence of oxygen

413

00:38:44,900 --> 00:38:47,460

and poop is a hydrocarbon

414

00:38:48,180 --> 00:38:51,700

Back in the shop jayme did some calorific testing of poop versus rocket fuel

415

00:38:53,060 --> 00:38:57,540

2,916 calories per gram even though it was several orders less efficient than rocket fuel

416

00:38:57,700 --> 00:38:59,700

It's a lot easier to find than gummy bears

417

00:38:59,860 --> 00:39:06,260

Up on the rocket. It's being made all the time and on a rocket where every gram counts in terms of the energy expenditure

418

00:39:06,580 --> 00:39:08,580

He might just be on to something

419

00:39:17,860 --> 00:39:23,860

So after all that nasty smelly disgusting

420

00:39:24,260 --> 00:39:30,980

Doggy doo doo we end up with this sleek carbon fiber beauty right here. And there we go. All right

421

00:39:32,340 --> 00:39:34,100

Ladies and gentlemen

422

00:39:34,100 --> 00:39:37,380

The first poo rocket coming out of midbusters

423

00:39:38,020 --> 00:39:40,500

It's time to pronounce my poop rocket prediction

424

00:39:40,820 --> 00:39:46,580

And I want to get this right because I don't want to poop the bed. I mean rocketry is something that we do do

425

00:39:47,140 --> 00:39:49,140

So I'm here to say that I think that

426

00:39:49,860 --> 00:39:51,860

While the poop may launch

427

00:39:52,180 --> 00:39:56,260

I don't think that our number two solution here will become our number one solution

428

00:39:59,220 --> 00:40:02,660

Mind if I set this one off not at all be my guest

429

00:40:03,380 --> 00:40:07,220

The standard rocket fuel control nearly hit 4500 feet

430

00:40:08,260 --> 00:40:11,460

How will jayme's no waste waste fuel compare?

431

00:40:12,740 --> 00:40:15,860

All right, this is it poop rocket the final

432

00:40:16,580 --> 00:40:19,460

Launch in five four

433

00:40:20,260 --> 00:40:21,540

three

434

00:40:21,540 --> 00:40:22,580

two

435

00:40:22,580 --> 00:40:24,580

one

436

00:40:38,580 --> 00:40:42,340

It's got a very appropriately dark smoke trail doesn't it?

437

00:40:42,340 --> 00:40:44,340

So

438

00:40:45,780 --> 00:40:53,540

Jamie that was really respectable. Yeah, that was fantastic

439

00:41:07,780 --> 00:41:09,780

Well done little poop rocket

440

00:41:10,260 --> 00:41:17,060

Okay, so the telemetry is telling me that we got 2900 feet. That's pretty respectable

441

00:41:17,460 --> 00:41:22,420

Respectable. It's downright phenomenal. I mean, I know it didn't go as high as the gummy bears

442

00:41:22,500 --> 00:41:25,540

But that was never the point. The fact is that it did launch

443

00:41:26,980 --> 00:41:29,460

Here's the thing you need to know about why poo is amazing

444

00:41:30,180 --> 00:41:33,380

It's always going to be there and it's totally useless

445

00:41:34,340 --> 00:41:40,740

If you're on a long space voyage every gram counts as far as your payload

446

00:41:40,740 --> 00:41:44,740

So you're gonna want to recycle as much as possible with something like urine

447

00:41:45,140 --> 00:41:48,740

It's not so hard. You can filter it and treat it and then drink it again

448

00:41:49,460 --> 00:41:54,180

But with poop it's not like you're gonna be able to process it and then re-consume it

449

00:41:54,500 --> 00:41:58,660

We have however shown that it might just be a viable rocket fuel

450

00:41:59,300 --> 00:42:01,300

Who knew

451

00:42:04,020 --> 00:42:10,260

You heard it here first nessa or maybe you already thought of it. Probably did a bunch of smart guys

452

00:42:11,380 --> 00:42:15,940

Now we gotta call this before we go gummy bears and poop as rocket fuel. How do we find?

453

00:42:16,180 --> 00:42:20,180

I think it's pretty clear. They're both plausible. I think they are. Let's get out of here