

An aerial photograph of a rocket launch in a vast, flat, arid desert landscape. The rocket is positioned in the lower center, with a thick, white plume of smoke and fire trailing upwards into the sky. The horizon is flat and distant, with some low mountains visible under a clear blue sky. On the right side of the image, the text "EXPLORE SPACE TECH" is overlaid in a large, white, sans-serif font. The word "EXPLORE" is on the top line, and "SPACE TECH" is on the bottom line. The letter "O" in "EXPLORE" is replaced by a white crescent moon symbol.

EXPLORE  
SPACE TECH

1  
00:00:00,560 --> 00:00:03,940

[Music]

2  
00:00:09,660 --> 00:00:13,820

>>If you're gonna go to the Moon or if you're gonna go to Mars, it's expensive, and you

3  
00:00:13,821 --> 00:00:15,970

can't do that multiple times.

4  
00:00:15,970 --> 00:00:17,380

Flight Opportunities is a great program.

5  
00:00:17,380 --> 00:00:19,060

It really mitigates the risk.

6  
00:00:19,060 --> 00:00:23,170

Many times we've had payloads come through our program, and they find problems with their

7  
00:00:23,170 --> 00:00:28,070

systems, they're basically getting space environment exposure through the means of Flight Opportunities

8  
00:00:28,070 --> 00:00:29,070

Program.

9  
00:00:29,070 --> 00:00:32,140

There's thermal problems, heat doesn't rise in space, that's a big problem.

10  
00:00:32,140 --> 00:00:35,960

There's two-phase flow, where you've got boiling, you've got gasses and liquids together, that's

11  
00:00:35,960 --> 00:00:37,149

different in space.

12

00:00:37,149 --> 00:00:43,440

>>Some payloads are looking to operate in microgravity,  
in zero-gravity.

13

00:00:43,440 --> 00:00:49,480

Other payloads are looking to be ejected from  
the vehicle and come down to Earth.

14

00:00:49,480 --> 00:00:55,329

Folks are using our testing to do some pretty  
cheap mitigations, because once this goes

15

00:00:55,329 --> 00:01:02,070

on its mission to a planetary body far away  
or coming back to Earth or what have you,

16

00:01:02,070 --> 00:01:07,080

usually there's no second chance, you gotta  
do it right the first time.

17

00:01:10,800 --> 00:01:15,220

[Music]

18

00:01:30,040 --> 00:01:31,700

>>Things look really good.

19

00:01:31,710 --> 00:01:32,730

>>Things look good?

20

00:01:32,730 --> 00:01:36,920

>>Yep, I have ten satellites on each.

21

00:01:36,920 --> 00:01:38,630

>>This is our SL-12 Rocket.

22

00:01:38,630 --> 00:01:40,130

We have a four-fin design.

23

00:01:40,130 --> 00:01:45,740

All the fins are canted at a half a degree of an angle, that provides a spin for the

24

00:01:45,740 --> 00:01:48,070  
vehicle to help with stabilization.

25

00:01:48,070 --> 00:01:53,101  
As we move forward here, we have the solid rocket motor propellant inside here, this

26

00:01:53,101 --> 00:01:58,110  
will all burn in approximately twelve seconds, pushing the vehicle approximately three-thousand

27

00:01:58,110 --> 00:02:01,630  
seven-hundred miles an hour, which is right around Mach Five.

28

00:02:01,630 --> 00:02:05,360  
Once this is spent it becomes dead weight, and we'll actually separate it into space

29

00:02:05,360 --> 00:02:06,360  
right here.

30

00:02:07,120 --> 00:02:11,920  
Inside here we have our parachute tube and recovery system along with some of our avionics

31

00:02:11,920 --> 00:02:15,760  
hardware, flight data recorders, etc.

32

00:02:15,760 --> 00:02:19,060  
Inside this section we have two wrap around antennas.

33

00:02:19,060 --> 00:02:22,200  
One is an S-Band and the other is a GPS L-1 Band.

34  
00:02:22,200 --> 00:02:29,010  
In the center of this section we have an AFTU here,  
which is actually horizontal, and then we

35  
00:02:29,010 --> 00:02:31,820  
have another AFTU which is vertical.

36  
00:02:31,820 --> 00:02:36,310  
As we move forward we get into what is known  
as our separation section right here.

37  
00:02:36,310 --> 00:02:40,450  
We have a cradle system that will actually  
hold the ADEPT payload.

38  
00:02:40,450 --> 00:02:44,690  
It just seats up against our, what we call  
the aftsebaeu.

39  
00:02:44,690 --> 00:02:50,200  
After a certain time, that afsebeau will push  
ADEPT out, but before we can even do that,

40  
00:02:50,200 --> 00:02:55,750  
we have this nose cone here, which is being  
held in by two eighth-inch aircraft-grade

41  
00:02:55,750 --> 00:03:01,290  
cables that will be cut at T plus sixty-five  
seconds, which will remove everything from

42  
00:03:01,290 --> 00:03:06,100  
here to the end of the nose cone, getting  
it out of the path of the ADEPT payload.

43  
00:03:06,100 --> 00:03:09,430  
>>Attention launch crew, this is the launch  
conductor, prepare to give your ready for

44

00:03:09,430 --> 00:03:11,650  
pre-countdown operation start.

45

00:03:11,650 --> 00:03:12,650  
Flight?

46

00:03:12,650 --> 00:03:13,660  
>>Flight is ready.

47

00:03:13,660 --> 00:03:14,660  
>>TLM?

48

00:03:14,660 --> 00:03:16,500  
>>TLM is ready.

49

00:03:16,580 --> 00:03:22,180  
[Background conversation]

50

00:03:23,600 --> 00:03:25,740  
>>The ADEPT payload is powered on and ready  
to proceed.

51

00:03:26,440 --> 00:03:29,580  
LCO to LC, Slamstick payload is powered on.

52

00:03:29,920 --> 00:03:36,980  
>>ADEPT, like with everything at NASA, is an  
acronym; it stands for Adaptable Portable

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00:03:36,990 --> 00:03:39,260  
Entry and Placement Technology.

54

00:03:39,260 --> 00:03:44,560  
ADEPT is a heat shield that can stow folded  
up like an umbrella, and then it can open

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00:03:44,560 --> 00:03:50,980  
up in space, before it enters a planet's atmosphere,  
and do its job as far as slowing down and

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00:03:50,980 --> 00:03:52,340  
safely protecting your payload.

57

00:03:52,340 --> 00:04:01,450  
And that allows us to launch a payload in  
a much smaller rocket than a traditional rigid

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00:04:01,450 --> 00:04:03,130  
heat shield would need.

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00:04:03,130 --> 00:04:07,600  
>>This is a suborbital vehicle, which means  
that it gets shot almost straight up, and

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00:04:07,600 --> 00:04:11,320  
then essentially falls once it reaches its  
apogee, or its highest point.

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00:04:11,320 --> 00:04:15,290  
For this vehicle, we'll get to about one-hundred  
and twenty kilometers above sea level, well

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00:04:15,290 --> 00:04:19,660  
into the vacuum of space, and we can test  
our deployment system in a flight-like environment,

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00:04:19,660 --> 00:04:24,280  
just like it would be in a real mission, and  
then it will reenter the atmosphere, and as

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00:04:24,280 --> 00:04:26,659  
it reenters the atmosphere, it will start  
to sense some G-load.

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00:04:26,659 --> 00:04:30,789  
And eventually we'll accelerate all the way  
to Mach Three.

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00:04:30,789 --> 00:04:32,780

Heating essentially starts at about Mach Five.

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00:04:32,780 --> 00:04:36,719

So five times the speed of sound, there's enough energy in the flow to actually start

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00:04:36,719 --> 00:04:38,219

creating significant heat.

69

00:04:38,219 --> 00:04:42,050

There will be a little heat, but nothing significant, nothing to worry about.

70

00:04:42,050 --> 00:04:47,960

So this is essentially a test of stability and also the in-space deployment.

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00:04:47,960 --> 00:04:51,999

We'd like to do further testing at higher altitudes where we could actually get to Mach

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00:04:52,000 --> 00:04:55,580

five or higher, and then get some real heating as well.

73

00:04:55,820 --> 00:04:59,680

[Crickets chirping]

74

00:04:59,840 --> 00:05:04,880

>>We're gonna proceed with payload power-up sequencing, and we're gonna start with ADEPT, and if

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00:05:04,900 --> 00:05:08,580

you remove access panels on both sides of the separation section.

76

00:05:08,980 --> 00:05:17,600

[Background conversation/Music]

77

00:05:19,120 --> 00:05:21,940

>>ADEPT is go for launch.

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00:05:23,560 --> 00:05:25,240

>>All payloads are flight mode verified.

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00:05:25,620 --> 00:05:28,220

>>LPS raise launcher to nominal firing position.

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00:05:33,340 --> 00:05:37,060

All systems are go for launch, check fifteen.

81

00:05:37,120 --> 00:05:47,440

Standby for terminal count at T minus ten,  
nine, eight, seven, six, five, four, three,

82

00:05:47,440 --> 00:05:50,000

two, one, fire.

83

00:05:50,080 --> 00:05:51,600

[Rocket Launch]

84

00:05:51,600 --> 00:05:53,440

Missile away.

85

00:05:54,160 --> 00:06:02,240

[Rocket/Mission Chatter]

86

00:06:03,120 --> 00:06:04,880

>>Burnout.

87

00:06:04,960 --> 00:06:06,000

>>Good burn.

88

00:06:06,000 --> 00:06:07,120

>>Copy good burn.

89

00:06:08,080 --> 00:06:09,840

[Applause]

90

00:06:11,760 --> 00:06:24,160

[Music/Rocket Staging]

91

00:06:44,320 --> 00:06:48,000

>>This vehicle does not have a parachute, it will hit the ground going approximately fifty

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00:06:48,020 --> 00:06:49,029

miles an hour.

93

00:06:49,029 --> 00:06:52,849

What we've done is we've built in load attenuation systems into this.

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00:06:52,849 --> 00:06:57,839

And so, there's essentially a block of crushable foam between the nose cap and some of the

95

00:06:57,839 --> 00:06:59,580

critical electronics.

96

00:06:59,580 --> 00:07:04,020

And so if it hits right on the nose, what happens is that carriage will break intentionally,

97

00:07:04,020 --> 00:07:08,669

and slide through that foam, and that attenuates the load, so it limits the load that the electronics

98

00:07:08,669 --> 00:07:11,090

see to about one thousand Gs.

99

00:07:11,090 --> 00:07:14,180

And that's a range that an SD card, or a typical memory will survive.

100

00:07:14,180 --> 00:07:18,839

And if it lands at a different angle, it actually reduces the load even more, because you actually

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00:07:18,839 --> 00:07:22,439

start bending structure, and that's another way to attenuate load.

102

00:07:22,439 --> 00:07:27,920

>>Right after the payload hits the ground, we deploy on a helicopter and go and recover

103

00:07:27,920 --> 00:07:30,700

the payloads.

104

00:07:30,720 --> 00:07:36,400

[Music/Chopper]

105

00:07:39,840 --> 00:07:42,320

>>Wow, mangled.

106

00:07:43,120 --> 00:07:47,200

>>We had a good time today, everybody's really happy, that's the end of a good day, when

107

00:07:47,200 --> 00:07:52,240

the payloaders have their data and they're able to pull it out and start comparing it to their

108

00:07:52,270 --> 00:07:57,199

computer simulations and models and things like that, so a successful mission, you know,

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00:07:57,199 --> 00:08:00,199

means a lot, and that's really what we're all about it.

110

00:08:00,199 --> 00:08:05,529

>>Watching this launch was super exciting, even the payload I'm working on is not maybe as

111

00:08:05,529 --> 00:08:10,610

complex as the ADEPT payload, it's still, it's a part of you that goes above the Karman line, that

112

00:08:10,610 --> 00:08:11,710

is very exciting.

113

00:08:11,710 --> 00:08:18,029

So a bit of, a bit anxious, but also relieved and very excited when I saw that rocket roar

114

00:08:18,029 --> 00:08:19,029

across the sky.

115

00:08:19,029 --> 00:08:22,449

>>Well the technologies that NASA's working on, it's broad-reaching.

116

00:08:22,449 --> 00:08:27,770

It covers all kinds of different things that will benefit, you know, the American people,

117

00:08:27,770 --> 00:08:33,060

and really even the world, some of these technologies, like today, the ADEPT, that could support

118

00:08:33,060 --> 00:08:34,760

a Mars mission someday.