



1
00:00:00,700 --> 00:00:02,235
InSight
Landing on Mars

2
00:00:03,602 --> 00:00:05,471
Rob Manning: Although
we've done it before,

3
00:00:05,504 --> 00:00:07,240
landing on Mars
is hard.

4
00:00:07,273 --> 00:00:09,375
And this mission
is no different.

5
00:00:10,643 --> 00:00:13,079
The process to get from the
top of the atmosphere of Mars

6
00:00:13,112 --> 00:00:17,450
to the surface we call "entry,
descent, and landing" or EDL.

7
00:00:18,151 --> 00:00:19,786
It takes thousands of steps

8
00:00:19,819 --> 00:00:22,422
to go from the top of the
atmosphere to the surface.

9
00:00:22,455 --> 00:00:25,391
And each one of them
has to work perfectly

10
00:00:25,424 --> 00:00:27,293
to be a successful mission.

11
00:00:28,461 --> 00:00:32,165

The process starts well above
the atmosphere of Mars.

12

00:00:32,198 --> 00:00:35,635

The cruise stage faces the Sun.

13

00:00:35,668 --> 00:00:39,539

It also has its radio antenna
which faces Earth.

14

00:00:39,572 --> 00:00:41,674

But now we don't need
the cruise stage.

15

00:00:41,707 --> 00:00:43,709

Its job is done.

16

00:00:43,742 --> 00:00:45,812

The next step, just
7 minutes before

17

00:00:45,845 --> 00:00:48,448

arriving to the top of
the Mars atmosphere,

18

00:00:48,481 --> 00:00:51,184

is to separate the
cruise stage.

19

00:00:51,217 --> 00:00:53,219

Before you hit the top of
the atmosphere though,

20

00:00:53,252 --> 00:00:55,588

the space capsule has
to orient itself

21

00:00:55,621 --> 00:00:56,956

so that the heat shield

22

00:00:56,989 --> 00:01:00,093

is precisely facing
the atmosphere.

23

00:01:00,960 --> 00:01:02,528

Now the fun begins.

24

00:01:02,561 --> 00:01:06,866

The vehicle is moving at nearly
13,000 miles an hour.

25

00:01:06,899 --> 00:01:08,501

But it's hitting the
top of the atmosphere

26

00:01:08,534 --> 00:01:10,203

at a very shallow angle.

27

00:01:10,236 --> 00:01:11,604

12 degrees.

28

00:01:11,637 --> 00:01:14,140

Any steeper, the vehicle
will hit the thicker part

29

00:01:14,173 --> 00:01:16,642

of the atmosphere and
will melt and burn up.

30

00:01:16,675 --> 00:01:19,378

Any shallower, the vehicle
will bounce off

31

00:01:19,411 --> 00:01:20,813

the atmosphere of Mars.

32

00:01:20,846 --> 00:01:22,415

At the very top
of the atmosphere

33

00:01:22,448 --> 00:01:25,751

it's about 70 miles above
the surface of Mars.

34

00:01:25,784 --> 00:01:28,387

And the air is starting to get
thicker and thicker and thicker.

35

00:01:28,420 --> 00:01:30,490

As it does that, the temperature
in the heat shield

36

00:01:30,523 --> 00:01:33,059

gets well over a thousand
degrees centigrade--

37

00:01:33,092 --> 00:01:34,827

enough to melt steel.

38

00:01:34,860 --> 00:01:37,530

Over the next 2 minutes,
the vehicle decelerates

39

00:01:37,563 --> 00:01:40,233

at a back-breaking 12 Earth G's.

40

00:01:40,266 --> 00:01:44,170

From 13,000 miles an hour to
about 1,000 miles an hour.

41

00:01:44,203 --> 00:01:47,240

At about 10 miles above
the surface of Mars

42

00:01:47,273 --> 00:01:49,842

a supersonic parachute
is launched

43

00:01:49,875 --> 00:01:51,477
out of the back of the vehicle.

44

00:01:51,510 --> 00:01:54,046
Fifteen seconds after the
parachute inflates

45

00:01:54,079 --> 00:01:55,915
it's time to get rid
of the heat shield.

46

00:01:55,948 --> 00:01:59,418
Six pyrotechnic devices
fire simultaneously

47

00:01:59,451 --> 00:02:01,654
allowing the heat shield to fall

48

00:02:01,687 --> 00:02:03,523
and tumble away
from the vehicle,

49

00:02:03,556 --> 00:02:06,359
exposing the lander to
the surface of Mars.

50

00:02:06,392 --> 00:02:08,628
Ten seconds after the heat
shield is dropped,

51

00:02:08,661 --> 00:02:11,430
three pyrotechnically
deployed legs

52

00:02:11,463 --> 00:02:14,100
are released and
locked for landing.

53

00:02:14,133 --> 00:02:17,537
About a minute later the

landing radar is turned on,

54

00:02:17,570 --> 00:02:20,573
sending pulses toward
the surface of Mars

55

00:02:20,606 --> 00:02:22,675
as the vehicle starts
to try to measure

56

00:02:22,708 --> 00:02:24,610
how high it is
above the surface

57

00:02:24,643 --> 00:02:26,279
and how fast it's going.

58

00:02:27,280 --> 00:02:29,015
At about a mile above
the surface of Mars

59

00:02:29,048 --> 00:02:31,417
the lander falls away
from the backshell

60

00:02:31,450 --> 00:02:33,052
and lights its engines.

61

00:02:33,085 --> 00:02:36,856
And very quickly the vehicle
must rotate out of the way

62

00:02:36,889 --> 00:02:38,958
so that the parachute
and the backshell

63

00:02:38,991 --> 00:02:40,893
doesn't come down to hit it.

64

00:02:40,926 --> 00:02:42,862

The last thing
that has to happen

65

00:02:42,895 --> 00:02:45,131

is that on the moment of contact

66

00:02:45,164 --> 00:02:48,734

the engines have to
shut down immediately.

67

00:02:48,767 --> 00:02:51,537

If they don't, the
vehicle will tip over.

68

00:02:51,570 --> 00:02:53,606

So if all the steps

69

00:02:53,639 --> 00:02:55,641

of entry, descent, and landing

70

00:02:55,674 --> 00:02:56,909

happen perfectly

71

00:02:56,942 --> 00:02:59,545

and we are safely on
the surface of Mars,

72

00:02:59,578 --> 00:03:03,349

we'll be ready to do some
exciting new science.

73

00:03:04,416 --> 00:03:06,385

InSight mission landing
November 26, 2018

74

00:03:08,887 --> 00:03:12,091

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