



1  
00:00:01,100 --> 00:00:02,168  
Painting Cars for Mars

2  
00:00:02,201 --> 00:00:03,636  
We're putting together a rover.

3  
00:00:03,669 --> 00:00:06,339  
And this is what it will look  
like when it gets to Mars.

4  
00:00:06,372 --> 00:00:07,774  
But before we get to this point

5  
00:00:07,807 --> 00:00:09,776  
we've got to put  
Mars 2020 together.

6  
00:00:10,610 --> 00:00:12,912  
I'm Chris Salvo.  
I manage the team

7  
00:00:12,945 --> 00:00:15,681  
that puts together the rover  
mechanical subsystem.

8  
00:00:15,714 --> 00:00:17,850  
You see here it's a fully  
assembled chassis.

9  
00:00:17,883 --> 00:00:20,019  
But it's all still  
shiny aluminum.

10  
00:00:20,052 --> 00:00:22,522  
We paint it white so that  
it reflects sunlight.

11  
00:00:22,555 --> 00:00:24,924  
The white reflective property

of the paint is important

12

00:00:24,957 --> 00:00:28,394

because our paint will need to survive in temperatures

13

00:00:28,427 --> 00:00:29,762

as hot as your oven

14

00:00:29,795 --> 00:00:33,933

and down to temperatures colder than occur any place on Earth.

15

00:00:34,834 --> 00:00:36,502

There are lots of areas on the chassis

16

00:00:36,535 --> 00:00:38,371

that must not have paint on them.

17

00:00:38,404 --> 00:00:41,240

And each of those has to be carefully masked.

18

00:00:41,273 --> 00:00:45,211

There can't be any folds. There can't be any stray edges.

19

00:00:45,244 --> 00:00:46,813

It all has to be perfect.

20

00:00:46,846 --> 00:00:49,082

Otherwise we'll wind up with paint in places

21

00:00:49,115 --> 00:00:50,216

where we can't have it

22

00:00:50,249 --> 00:00:52,285  
or portions of the structure  
that are missing paint

23

00:00:52,318 --> 00:00:53,886  
where we need it.

24

00:00:53,919 --> 00:00:56,055  
Here we are rolling up to  
the paint building.

25

00:00:57,323 --> 00:01:00,259  
This very special formulation of  
paint has to live through

26

00:01:00,292 --> 00:01:02,462  
all of the difficulties  
of getting to Mars,

27

00:01:02,495 --> 00:01:04,063  
shaking on the launch vehicle,

28

00:01:04,096 --> 00:01:06,432  
as well as existing on  
the surface of Mars

29

00:01:06,465 --> 00:01:08,634  
in the hot and cold cycles.

30

00:01:08,667 --> 00:01:09,969  
For the paint to work right,

31

00:01:10,002 --> 00:01:11,904  
it has to be just the  
right thickness

32

00:01:11,937 --> 00:01:13,706  
and evenly applied.

33

00:01:13,739 --> 00:01:15,575

To prepare the  
aluminum surfaces,

34

00:01:15,608 --> 00:01:17,910

we have to make sure  
they're very clean.

35

00:01:17,943 --> 00:01:20,546

The shiny aluminum surface  
is then reduced to

36

00:01:20,579 --> 00:01:23,449

more of a scuffed surface  
that's ready to accept paint.

37

00:01:23,482 --> 00:01:26,419

This generates dust as well.

38

00:01:26,452 --> 00:01:29,088

That all has to be cleaned  
and vacuumed off

39

00:01:29,121 --> 00:01:30,623

so that we don't have any  
particles that are

40

00:01:30,656 --> 00:01:32,258

going to get under the paint

41

00:01:32,291 --> 00:01:35,595

and keep it from adhering  
or cause it to flake off.

42

00:01:35,628 --> 00:01:37,630

There are rules for the  
application of this paint

43

00:01:37,663 --> 00:01:39,899

that include things

like a time limit

44

00:01:39,932 --> 00:01:42,502  
between when you scuff the  
surface of the aluminum

45

00:01:42,535 --> 00:01:45,171  
and when you have to  
apply the paint.

46

00:01:45,204 --> 00:01:47,440  
Like most of the assembly  
of the rover,

47

00:01:47,473 --> 00:01:49,675  
the painting process is  
not fully automated

48

00:01:49,708 --> 00:01:52,111  
like you might see in a  
manufacturing plant,

49

00:01:52,144 --> 00:01:55,648  
because we're building  
one-of-a-kind machines.

50

00:01:55,681 --> 00:01:58,017  
When you send a  
spacecraft into space,

51

00:01:58,050 --> 00:02:00,119  
all of what we call the  
volatile materials

52

00:02:00,152 --> 00:02:01,454  
that you take with you--

53

00:02:01,487 --> 00:02:04,724  
the water that's absorbed into  
things or other chemicals--

54

00:02:04,757 --> 00:02:06,692

tend to come out in  
the vacuum of space.

55

00:02:06,725 --> 00:02:08,561

And they float around  
and redeposit

56

00:02:08,594 --> 00:02:11,130

on surfaces where  
you don't want.

57

00:02:12,231 --> 00:02:14,367

One of the ways to prevent  
this is to bake it out.

58

00:02:15,468 --> 00:02:18,804

This is one of our larger  
thermal vacuum chambers.

59

00:02:18,837 --> 00:02:21,073

This oven is 10 feet  
in diameter.

60

00:02:21,106 --> 00:02:23,209

We cook out all of  
those chemicals

61

00:02:23,242 --> 00:02:25,311

that might cause us  
problems later.

62

00:02:26,312 --> 00:02:27,980

After the baking, we  
need only to deliver it

63

00:02:28,013 --> 00:02:29,582

to the assembly facility.

64

00:02:29,615 --> 00:02:32,852

We have to keep it clean, so  
we put it in a double bag.

65

00:02:32,885 --> 00:02:34,320

When we get to the  
assembly building,

66

00:02:34,353 --> 00:02:35,821

there's a room called  
an airlock,

67

00:02:35,854 --> 00:02:38,124

where we transition from  
the dirty outside

68

00:02:38,157 --> 00:02:40,993

to the clean inside of  
the assembly facility.

69

00:02:41,026 --> 00:02:43,196

We very carefully clean  
portions of the fixture

70

00:02:43,229 --> 00:02:46,232

that are going to touch areas  
inside the airlock.

71

00:02:46,966 --> 00:02:48,501

The outer bag got dirty outside.

72

00:02:48,534 --> 00:02:50,002

So we take that off  
and throw it away.

73

00:02:50,035 --> 00:02:52,538

And the bag inside  
is relatively clean.

74

00:02:53,472 --> 00:02:54,840

Then we're ready to  
leave the airlock

75

00:02:54,873 --> 00:02:57,610

and come into the main  
assembly facility.

76

00:02:58,778 --> 00:03:01,414

The descent stage and the cruise  
stage are here already.

77

00:03:01,447 --> 00:03:04,016

The rover now joins them so  
that the whole spacecraft

78

00:03:04,049 --> 00:03:06,385

can be put together  
and ready for Mars.

79

00:03:07,753 --> 00:03:09,755

We can then remove  
the inner bag.

80

00:03:11,056 --> 00:03:12,692

This is a big moment!

81

00:03:13,960 --> 00:03:16,829

All the components that will  
control the actions of the rover

82

00:03:16,862 --> 00:03:19,465

--all the instruments that will  
be looking for things on Mars

83

00:03:19,498 --> 00:03:21,133

go inside this chassis,

84

00:03:21,166 --> 00:03:24,937

as it forms the foundation

for the entire rover.

85

00:03:25,838 --> 00:03:27,373

Starting from a pile of  
aluminum panels,

86

00:03:27,406 --> 00:03:30,343

it took 4 months and  
over 5,000 work hours

87

00:03:30,376 --> 00:03:32,144

to get the chassis  
to this point.

88

00:03:32,177 --> 00:03:35,147

It'll take another 3 or 4 months  
in the assembly facility

89

00:03:35,180 --> 00:03:37,717

to turn this chassis into  
something that looks like

90

00:03:37,750 --> 00:03:39,151

a completed rover.

91

00:03:39,184 --> 00:03:41,320

It'll be an amazing day  
for all of us

92

00:03:41,353 --> 00:03:45,458

to see this rover on top of the  
rocket in July of 2020.

93

00:03:45,491 --> 00:03:47,793

[ ■ ]

94

00:03:47,826 --> 00:03:49,228

NASA Jet Propulsion Laboratory