
VOICE OF
Pat Ryan
JOHNSON SPACE CENTER, HOUSTON, TX

1
00:00:01,426 --> 00:00:05,766
[Pat Ryan] And Flight Engineer Andre
Kuipers is busy with a software update

2
00:00:05,766 --> 00:00:08,226
on the space station's Agricultural Camera.

3
00:00:09,216 --> 00:00:13,246
Flight Engineer Don Pettit is
scheduled to be back at work

4
00:00:13,246 --> 00:00:18,556
in the Destiny Laboratory
preparing the work space

5
00:00:18,796 --> 00:00:23,536
at the Microgravity Sciences
Glovebox for the BASS experiment.

6
00:00:24,166 --> 00:00:29,166
BASS is an acronym for Burning
and Suppression of Solids.

7
00:00:29,546 --> 00:00:33,376
It's a physical sciences
investigation into both the burning

8
00:00:33,376 --> 00:00:37,996
and the extinction characteristics
of a variety of fuels in space.

9
00:00:38,616 --> 00:00:42,846
The principal investigator
for BASS is Dr. Paul Ferkul.

10
00:00:43,136 --> 00:00:45,706
He's a staff scientist at the National Center

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00:00:45,706 --> 00:00:49,066

for Space Exploration Research
in Cleveland, Ohio.

12
00:00:49,406 --> 00:00:53,196
And he joins us on the phone this morning
from the Telescience Support Center

13
00:00:53,506 --> 00:00:55,506
at the NASA Glenn Research Center.

14
00:00:55,726 --> 00:00:56,996
Dr. Ferkul welcome!

15
00:00:56,996 --> 00:01:02,226
It some excitement for you today to get to
see your experiment being prepared for use.

16
00:01:02,816 --> 00:01:03,256
[Paul Ferkul] Oh, thanks.

17
00:01:03,256 --> 00:01:06,476
I'm glad to be here and I'm
glad to be talking with you.

18
00:01:06,476 --> 00:01:08,946
[Pat] Is this your first
experiment to be performed on orbit?

19
00:01:09,906 --> 00:01:14,266
[Paul] I was, I participated in an experiment
about 15 years ago as a co-investigator.

20
00:01:14,266 --> 00:01:18,146
But this is the first time I'm
the principal investigator.

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00:01:18,226 --> 00:01:23,176
[Pat] For you, how did you become
interested in this field of burning things?

22
00:01:24,056 --> 00:01:28,496
[Paul] I think like many of my colleagues
here at NASA I had a good mentor when I was

23
00:01:28,496 --> 00:01:33,146
in college and there was a, I had an
engineering background, engineering degree.

24
00:01:33,146 --> 00:01:36,166
And it was an opportunity to do
work at NASA here in Cleveland.

25
00:01:36,166 --> 00:01:40,016
I went to school at Case Western
Reserve University and my advisor

26
00:01:40,056 --> 00:01:44,396
at Case Western Reserve had a position
here at NASA for me to do some work.

27
00:01:44,396 --> 00:01:49,466
And I sort of, went through this fortuitous
sequence of events that led me here an area

28
00:01:49,466 --> 00:01:52,496
that I really wanted to work
in, mainly the space program.

29
00:01:53,396 --> 00:01:57,306
[Pat] Do we know much about
how things burn differently

30
00:01:57,306 --> 00:01:59,196
in space than the way they burn on Earth?

31
00:02:00,006 --> 00:02:01,476
[Paul] We actually do know quite a bit.

32
00:02:02,286 --> 00:02:06,296

We know that on Earth we have buoyancy
which is the tendency for hot air to rise.

33
00:02:06,916 --> 00:02:09,226
Whereas in zero-gravity there is no buoyancy.

34
00:02:09,746 --> 00:02:13,636
And on Earth we can do testing
on drop towers and aircraft,

35
00:02:14,036 --> 00:02:16,156
zero-gravity aircraft to get some ideas.

36
00:02:16,156 --> 00:02:20,216
So we have a good idea of how
things behave in zero-gravity.

37
00:02:20,786 --> 00:02:25,226
But what is lacking for us is actual
experimental data for long duration burns.

38
00:02:25,226 --> 00:02:27,896
And that's what we hope to gain in
the space station tests we're doing.

39
00:02:28,366 --> 00:02:32,506
[Pat] Now there have been
experiments with burning previously

40
00:02:32,506 --> 00:02:34,726
on the station and on shuttle missions too.

41
00:02:34,726 --> 00:02:39,126
But this one is going to have more
of an extended period of time?

42
00:02:39,126 --> 00:02:39,696
[Paul] That's certainly true.

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00:02:39,696 --> 00:02:43,226
There've been other, earlier
experiments even going back to the 1980's.

44
00:02:43,786 --> 00:02:46,536
There were some simple solid
fuel combustion experiments done.

45
00:02:46,986 --> 00:02:48,056
They were limited in scope.

46
00:02:48,056 --> 00:02:51,236
They were generally very small
samples and not very numerous.

47
00:02:51,236 --> 00:02:55,226
So what we hope to do, and there have been other
tests as well that have looked at combustion

48
00:02:55,226 --> 00:02:58,646
on either the space shuttle or
the Russian Mir space station.

49
00:02:59,166 --> 00:03:01,756
But this one we, we're trying
to build a database.

50
00:03:01,756 --> 00:03:05,706
We have many samples we're flying,
actually, a total of 41 samples.

51
00:03:06,086 --> 00:03:08,586
We're going to burn multiple times
and try to really build a database

52
00:03:08,586 --> 00:03:11,826
and get some experimental
knowledge of how things behave

53
00:03:11,826 --> 00:03:13,286

for long-durations in zero-gravity.

54
00:03:14,096 --> 00:03:18,236
[Pat] Is there a central hypothesis
that's driving your operations here?

55
00:03:18,576 --> 00:03:18,956
[Paul] There is.

56
00:03:18,956 --> 00:03:24,366
The basic applied hypothesis is that we
believe that in certain conditions a material

57
00:03:24,456 --> 00:03:28,326
in zero-gravity will actually be more
flammable than it is normal gravity.

58
00:03:28,836 --> 00:03:32,436
And there's some theoretical basis for
this and we've done some drop tower tests

59
00:03:32,436 --> 00:03:34,616
to begin to verify this phenomenon.

60
00:03:35,036 --> 00:03:37,636
The testing we do right now
to select materials for,

61
00:03:38,166 --> 00:03:43,376
for use in space for the astronauts' safety all
the tests are done in normal gravity on Earth.

62
00:03:44,036 --> 00:03:47,956
And so it's always assumed that normal gravity
tests will be conservative and that things

63
00:03:47,956 --> 00:03:50,826
in space will burn less dangerous.

64

00:03:51,126 --> 00:03:53,386
But again it turns out our hypothesis is

65
00:03:53,386 --> 00:03:55,396
that there may be conditions
where the opposite is true.

66
00:03:55,396 --> 00:03:57,776
That actually in space things
could be more dangerous.

67
00:03:57,776 --> 00:04:00,356
And of course, that's a concern to NASA.

68
00:04:00,786 --> 00:04:03,956
[Pat] I mentioned that Don Pettit is
going to be working this morning setting

69
00:04:03,956 --> 00:04:07,036
up the hardware for, where this
experiment will be conducted.

70
00:04:07,366 --> 00:04:10,256
Can you describe what hardware is involved here?

71
00:04:10,256 --> 00:04:11,996
What work is Don doing today?

72
00:04:12,636 --> 00:04:12,866
[Paul] Sure.

73
00:04:12,866 --> 00:04:15,796
He's working in a facility called
the Microgravity Science Glovebox.

74
00:04:16,356 --> 00:04:20,776
It's essentially a large glovebox that
you might see in an ordinary laboratory

75

00:04:20,776 --> 00:04:24,496
with gloveports in a fairly big working volume.

76
00:04:25,056 --> 00:04:27,026
Our experiment will plug into that volume.

77
00:04:27,026 --> 00:04:28,316
So it's a level of containment.

78
00:04:28,896 --> 00:04:31,546
And our experiment is relatively small.

79
00:04:31,546 --> 00:04:33,636
It's about the size of an ordinary toaster.

80
00:04:34,186 --> 00:04:36,066
It consists of a flow duct.

81
00:04:36,586 --> 00:04:41,156
So there's a fan in our experiment
module to generate airflow.

82
00:04:41,626 --> 00:04:46,526
We install fuel samples inside our
experiment module which are then ignited,

83
00:04:47,166 --> 00:04:53,296
observed with video cameras and burned either to
completion or until we decide to put them out.

84
00:04:54,606 --> 00:04:57,076
[Pat] So there's some, you don't
know how long they'll burn?

85
00:04:57,946 --> 00:05:00,556
[Paul] We have a limit generally
of a two minute maximum.

86
00:05:00,636 --> 00:05:04,456

Because within two minutes we should be able
to reach the information that we need to get.

87
00:05:04,456 --> 00:05:05,626
That should be achievable.

88
00:05:05,626 --> 00:05:10,946
And were trying to you know, use our fuel
judiciously so we'll try to have them put

89
00:05:10,946 --> 00:05:13,866
out the fuel at that point so we can
continue in the future with additional tests.

90
00:05:15,006 --> 00:05:18,486
[Pat] At the time that the experiment
is operating, how is the flame lit?

91
00:05:18,486 --> 00:05:20,356
I mean Don's not up there
striking matches is he?

92
00:05:20,636 --> 00:05:21,186
[Paul] That's correct.

93
00:05:21,446 --> 00:05:22,816
They'll be remotely igniting them.

94
00:05:23,156 --> 00:05:24,716
Actually, we use a hotwire igniter.

95
00:05:25,256 --> 00:05:29,146
So again think of a toaster and you have
heated elements in there that glow red hot

96
00:05:29,146 --> 00:05:30,436
when you apply electrical current.

97
00:05:30,496 --> 00:05:31,456

So it'll be the same idea.

98
00:05:31,456 --> 00:05:35,426
We have a small group of igniter wire
that'll glow red hot or almost, actually,

99
00:05:35,426 --> 00:05:38,796
yellow hot which will be in close
proximity to the fuel sample then ignited.

100
00:05:39,816 --> 00:05:42,036
[Pat] Now you said there
were 41 different samples.

101
00:05:42,036 --> 00:05:44,796
Each of them is going to
be ignited multiple times.

102
00:05:45,346 --> 00:05:45,876
[Paul] That's correct.

103
00:05:45,876 --> 00:05:47,426
Actually, some will be a onetime use.

104
00:05:47,456 --> 00:05:49,676
The vast majority will be multiple use samples.

105
00:05:50,006 --> 00:05:52,206
[Pat] And when are the first
data takes going to begin?

106
00:05:52,856 --> 00:05:54,366
[Paul] We begin to operations on Friday.

107
00:05:54,866 --> 00:05:55,276
[Pat] This week?

108
00:05:55,506 --> 00:05:55,906
[Paul] That's correct.

109
00:05:56,416 --> 00:06:01,846
[Pat] Now I take it that there aren't
any experiment samples to be returned

110
00:06:02,056 --> 00:06:03,426
since that would have burned I guess?

111
00:06:03,426 --> 00:06:04,646
How do you get your data?

112
00:06:05,516 --> 00:06:07,876
[Paul] Most of our data will
be through our photo.

113
00:06:07,876 --> 00:06:12,406
So either 35 millimeter still
camera photos or video images

114
00:06:12,406 --> 00:06:14,246
which will be downlinked everyday to us.

115
00:06:14,246 --> 00:06:17,376
It will have the full resolution video
and 35 millimeter still pictures.

116
00:06:18,606 --> 00:06:21,876
[Pat] And then your analysis
is studying the photographs?

117
00:06:22,226 --> 00:06:22,756
[Paul] That's correct.

118
00:06:22,756 --> 00:06:26,016
We'll basically get flame
luminosity data, flame shape,

119
00:06:26,466 --> 00:06:30,706
structure and I guess most importantly how

the flame reacts to different changes in flow

120
00:06:31,266 --> 00:06:33,096
or when we go to put the flame out.

121
00:06:33,096 --> 00:06:36,616
How we can extinguish the flame and how
the flame reacts as you extinguish it.

122
00:06:36,686 --> 00:06:40,736
Then we could use all this information to
compare to our existing models and improve them.

123
00:06:41,076 --> 00:06:42,906
And develop the better models as a result.

124
00:06:43,936 --> 00:06:47,436
[Pat] Is there any way at this point to
generalize about what you expect to see?

125
00:06:49,046 --> 00:06:51,496
[Paul] We expect, well we've got,
we've seen, we've done some tests

126
00:06:51,496 --> 00:06:52,936
in zero-gravity with these flames.

127
00:06:52,936 --> 00:06:56,636
Generally they tend to be weaker but
it's a big function of the flow speed.

128
00:06:56,636 --> 00:07:01,906
So if we, if we blow on them gently we'll
probably get a relatively dim blue flame.

129
00:07:02,556 --> 00:07:06,586
And as we increase the flow velocity it
will start to transition to a brighter blue

130

00:07:06,586 --> 00:07:09,066
and then ultimately yellow and sooty.

131
00:07:09,586 --> 00:07:11,496
So that's how the flame will look.

132
00:07:11,836 --> 00:07:15,716
We expect, again there will
be some cases that, you know,

133
00:07:15,996 --> 00:07:20,776
these materials might actually be observed
to burn in zero-gravity and conditions

134
00:07:20,776 --> 00:07:22,606
that we can't get them to
burn in normal gravity.

135
00:07:22,606 --> 00:07:24,516
So that will be the exciting finding for us.

136
00:07:24,516 --> 00:07:27,766
So we expect, we've flown some samples
that we expect will burn up there

137
00:07:28,106 --> 00:07:29,846
that we can't get to burn in normal gravity.

138
00:07:30,866 --> 00:07:35,096
[Pat] That would certainly be something that
would be important to know, if there's something

139
00:07:35,096 --> 00:07:37,346
that does burn in space that we wouldn't expect?

140
00:07:37,736 --> 00:07:38,226
[Paul] That's correct.

141
00:07:38,226 --> 00:07:40,846

And we've done some drop tower
tests which are limited in time.

142
00:07:40,846 --> 00:07:42,786
So we're not sure how they're
going to go for long-duration.

143
00:07:42,786 --> 00:07:46,246
But we believe they might
actually, might burn up there.

144
00:07:47,246 --> 00:07:50,676
[Pat] At this point how would
the findings that you get,

145
00:07:50,676 --> 00:07:53,396
how could they be applied
both in space and on Earth?

146
00:07:54,666 --> 00:07:58,076
[Paul] I guess as far as NASA is concerned
a direct application is for fire safety.

147
00:07:58,646 --> 00:08:03,136
You know because NASA selects, is very careful
about selecting materials, configurations

148
00:08:03,426 --> 00:08:06,566
and is concerned about NASA's,
or astronaut safety.

149
00:08:07,226 --> 00:08:10,956
There's an extensive set of tests
done on Earth to select materials.

150
00:08:11,096 --> 00:08:13,936
And it's all done, all these
tests are done on normal gravity.

151
00:08:14,646 --> 00:08:19,696

Now if our findings, if our hypothesis proves
to be correct we might need to modify the tests

152
00:08:19,696 --> 00:08:24,076
that we do in normal gravity to consider
effects and conditions where, actually,

153
00:08:24,456 --> 00:08:27,216
the materials could be more
dangerous in space so we have

154
00:08:27,276 --> 00:08:29,936
to revisit the testing procedure
that do on Earth.

155
00:08:30,346 --> 00:08:35,956
And more widely applicable are the results
of these, of these experiments to models.

156
00:08:36,456 --> 00:08:41,956
So again computer modelers can use these results
to develop sophisticated systems and simulations

157
00:08:42,326 --> 00:08:44,476
that would apply to many different
kinds of combustion systems,

158
00:08:44,476 --> 00:08:49,226
not just for these simple fuels and
flames but for wide ranging applications

159
00:08:49,226 --> 00:08:52,056
such as engines, boilers and so on.

160
00:08:52,056 --> 00:08:54,356
Anything in our everyday life
that relies on combustion,

161
00:08:54,356 --> 00:08:58,776
which is as you could imagine

is much of what we rely upon.

162
00:08:59,336 --> 00:09:03,396
[Pat] The obvious question, that of course
I saved it for last, how dangerous is it

163
00:09:03,816 --> 00:09:05,986
to be setting fires inside the space station?

164
00:09:05,986 --> 00:09:07,396
[Paul] Well that's a good question.

165
00:09:07,396 --> 00:09:09,826
Generally, speaking we don't want the
astronauts to set anything on fire.

166
00:09:10,206 --> 00:09:12,946
But this has been carefully designed
so there's two levels of containment.

167
00:09:12,946 --> 00:09:16,716
So as I mentioned earlier, the glovebox
itself is one level of containment.

168
00:09:17,056 --> 00:09:20,116
Within that, which is a,
that is a sealed vessel,

169
00:09:20,486 --> 00:09:23,196
there's our experiment which
is also a sealed vessel.

170
00:09:23,286 --> 00:09:27,986
So there's two levels of containment and
there's no way to set the fuel on fire

171
00:09:28,646 --> 00:09:30,826
to ignite it unless all the doors are closed.

172

00:09:30,896 --> 00:09:32,606
So there's many safety constraints in place.

173
00:09:33,366 --> 00:09:37,586
[Pat] And the first of these
experiment runs gets started on Friday?

174
00:09:38,096 --> 00:09:39,356
[Paul] That's correct.

175
00:09:39,896 --> 00:09:43,966
[Pat] Besides, we have another, one other
question that came to us over Twitter

176
00:09:44,016 --> 00:09:49,376
from @karenofearth asked, "besides
rocket fuel, which we know will burn,

177
00:09:49,646 --> 00:09:53,226
what else is self-oxidizing and
will burn even in a vacuum."

178
00:09:54,096 --> 00:09:57,636
[Paul] I guess it depends how you define
rocket fuel and if there's any materials

179
00:09:57,636 --> 00:10:00,826
that you could imagine that you
have fuel and oxygen pre-mixed,

180
00:10:01,266 --> 00:10:06,836
that's how a rocket engine works is you deliver
fuel and oxygen separately to the engine

181
00:10:06,876 --> 00:10:08,896
to generate thrust even in a vacuum of space.

182
00:10:09,266 --> 00:10:12,436
So you need to, if you don't have
air, like you don't have in space,

183
00:10:12,886 --> 00:10:14,466
you need to supply your own oxygen.

184
00:10:14,846 --> 00:10:17,686
So you can imagine there's other
materials on earth that can do that,

185
00:10:18,136 --> 00:10:22,706
that would also basically ignite and
burn in space besides rocket fuel,

186
00:10:23,116 --> 00:10:28,306
such as some of the solid rocket engines
that are used for the, even simple, you know,

187
00:10:28,306 --> 00:10:30,386
rockets that you might buy in
a hobby store to light off.

188
00:10:30,386 --> 00:10:32,846
Those would also ignite and
burn in space just fine.

189
00:10:33,766 --> 00:10:34,086
[Pat] Great.

190
00:10:34,296 --> 00:10:38,036
Your experiment gets started,
its operations, on Friday.

191
00:10:38,036 --> 00:10:38,396
Good luck.

192
00:10:38,836 --> 00:10:39,636
[Paul] Thank you very much.

193
00:10:40,046 --> 00:10:45,306
[Pat] Dr. Paul Ferkul is the Principal

Investigator for Burning and Suppression

194
00:10:45,306 --> 00:10:50,236
of Solids which is a physical science
investigation into the burning and extinction,

195
00:10:50,236 --> 00:10:54,656
the characteristics of a
variety of fuels in space.