One good test is worth a thousand expert opinions.

You could say we got 1000 expert opinions on the Orion Launch Abort System on July 2.

Next on the Rocket Ranch.

We are combing through the second, incredibly successful test of the Orion Launch Abort System that happened last month and we had a chance to sit down with Carlos Garcia, the lead for that launch abort system.

But first, we caught up a bit of a test flight expert, Jon Cowart, to learn more about test flights in general.

Alright, so I am now in the booth with Jon Cowart.

Jon, thanks for joining me.

Glad to be here.

This is fun.
So, if you could, tell me just really briefly, what is it that you do here in the commercial crew program for NASA?

In the commercial crew, I work in the mission management and integration office. We are charged with basically each mission has a mission manager, and that mission manager’s responsible for all aspects of getting that flight ready to go fly, working with the ISS, working with whatever partner we have for that flight, and all of the things that we within NASA have to do to get ready for that.

So, I used to be a mission manager, and then I got made deputy manager of the entire office, which means I help all the managers do all the tasks that they've got to do across all the flights and all the providers.

Cool.

So, I think, actually, the first time I ever heard you speak...
Yeah.

...you were doing a debrief after the Ares I-X flight.

And we'll never forget that, 'cause you had some humorous things to say about that.

[ Laughs ]

Which I mention only to say that you have some good experience with test flights.

So, the Ares I-X, for those that don't know, 2009, I believe?

That was it.

We launched the Ares I-X, which was a test flight, and then 2015 we had the pad abort test for SpaceX?

That was pad abort.

Right.

Exactly.
And you were involved with both of those.

Yes.

So, tell me a little bit about your experience and involvement and kind of just launch tests in general.

There's a famous quote by Wernher von Braun that kind of outlines exactly what flight tests are about.

And it's something along the lines of "one good test is worth a thousand expert opinions."

Within NASA, what we try to do is we try to design it as best we can.

You have an idea what you need, you go design it, and then you go do a little bit of testing.

That philosophy pays huge dividends.

You can think you've designed it great all day long until you go test.

And so whenever we do these flight tests, we learn so very much.
is that when you go do a test and something

goes what y'all would think is awfully wrong,
that's actually good for us, that we found

it in a flight test or some kind of a test
rather than with people onboard or when the

mission is critical.

So while it looks bad -- and we never go into
a test thinking we're going to fail.

Obviously, you go in not just optimistic,
but pretty darn sure things are gonna be successful.

When you find out that you didn't, you learn
more from your mistakes than you ever learn

from your successes.

And so when you go into a test like that,
what's the -- how do you build that?

And obviously, being a mission manager, you
have some experience with this.

Yeah.

Kind of how do you kind of construct, like,
what do we want to accomplish with a test?

So, anytime you have a flight test, you have
a set of flight-test objectives in which you

go through and you clearly outline, "Okay, when I get to this point in the countdown,

I want to do this.

When I get to this point in the flight, I want to do these things."

And you talk about them very clearly.

For example, I'll just make one up.

If I'm in flight and I want my environmental control system to keep the cabin between 65

degrees and 80 degrees, I'm going to test that. I'm going to put it at different ways toward the sun and see how the system responds and if it keeps the temperature within the bounds of where we think it should be.

If it doesn't, we go, "Okay, well, there's something going on that we didn't account for."

And if you do, you go, "Alright.
We did a good design.

Fantastic.

So, temperature inside the capsule obviously is important, but that seems, like, trivial in a way.

Is that a trivial thing to kind of analyze with a spacecraft?

No, because in the environment of space, one thing I tell people all the time is if you are out walking in space, even in Earth orbit, and you hold your hand up, the side of your hand that is facing the sun is very quickly going to get to 250 degrees.

The side of your hand that is not facing the sun, that's in shadow, will very quickly get to -150 degrees.

That feels uncomfortable, I'm assuming.

That would be very uncomfortable.
So, just controlling temperature is not a simple thing.

You insulate it as best you can.

You put reflectors on the outside, some kind of material that reflects the sun.

But, then, when you're in the shadow of the Earth, well, now you got to find heat from somewhere to keep the cabin warm.

So you may think that's a trivial example, and maybe it would seem that way to someone who's worried about the pressures and temperatures and thrust of a rocket engine, which is a very dynamic event.

Sure.

But it's equally important to the crew.

I can assure you of that.

So, can you give me some perspective on the number of things that you might test on a
And obviously, I know it's gonna change pretty heavily from what you're testing.

But, again, in my mind, if I were building requirements, like, temperature inside the capsule is not one that comes to mind quickly.

And that raises the question of, like, how many things am I not thinking about?

You've got to look at your guidance, your navigation, your ability to control the thrust in every one of your thrusters.

Depending on which vehicle you're flying, you've got different numbers of thrusters.

Are you going to bother to test some kind of optical alignment system?

How well did that perform if you do?
You've got to worry about the thermals on the outside, thermals on the inside.

You look at did the vehicle flex the way I thought it would?

Now comes re-entry time.

I've got a heat shield on the bottom.

Will that perform?

How much of that is going to erode away?

Will any of it erode away?

What's the aerodynamics of the vehicle as I fly up through the atmosphere and then coming back through the atmosphere?

Like I said.

So each one of those things I just mentioned right there breaks down into hundreds of other little things if you test very specifically in various locations.
For example, with the structure, you don't just put a strain gauge at one point.

You put it all over the vehicle in various places to find out how the vehicle flexes.

You're checking pressures and temperatures and thermal stuff all over.

And so based on kind of that just real brief explanation, it almost starts feeling like you would treat a test flight like its entire own complete mission.

Is that a fair way to kind of assess that?

Yes.

In many ways, it might be more important, because you're trying to set the table for a nominal mission.

During a flight test, you might not -- you're not gonna try to operate out of what we call certification.

If you've got a box that's designed to operate between let's say 50 and 100 degrees, you're
not going to do anything to verify that it operates between 30 and 150.

But you don't mind testing as you get near the edges of its performance envelope.

And by the way, one of the things I forgot to mention previously, so, we're talking about hardware things, but there's also software things.

Yeah.

You're gonna test the software.

And then there's also the people aspect of it.

Did I plan on all the things that the astronauts could do?

Oh, what about the folks on the ground, the mission controllers and the flight controllers and the launch controllers, those people?

They have to be trained.

They're certified as well as the vehicle and the software.

All these things have to be tested in a flight.
test.

152
00:07:10,778 --> 00:07:15,649
And I know when I've done flight tests before, the first time, you get all the people on

153
00:07:15,649 --> 00:07:19,550
the loop talking about a test, they're saying that's like, "Hey, Joe, did you see that?"

154
00:07:19,550 --> 00:07:21,990
Well, that's not very professional, and it doesn't communicate very well.

155
00:07:21,990 --> 00:07:22,990
[ Laughs ]

156
00:07:22,990 --> 00:07:27,528
You've got to learn to say, you know, things like, "Pad leader, step 23, did you get 75?"

157
00:07:27,528 --> 00:07:30,038
You've got to be very specific.

158
00:07:30,038 --> 00:07:34,519
And then your responses and your callback -- those can be very important to you if something

159
00:07:34,519 --> 00:07:38,088
bad were to go wrong, and then you've got to go back and play the tapes and figure out,

160
00:07:38,088 --> 00:07:40,528
"Okay, what was everybody thinking?"

161
00:07:40,528 --> 00:07:42,389
What was going on at that particular time?"

162
00:07:42,389 --> 00:07:46,038
And the voice loops and the data you're getting on your screens are all just as important

163
00:07:46,038 --> 00:07:48,068
as what's going on on the vehicle.
And so, as a manager of a mission, planning a mission -- you just kind of alluded to this.

-- you have to have a procedure and kind of a guideline for how to do everything.

So, what kind of time is involved in just writing a procedure and making sure that your procedure makes sense?

Of course, you know, we're all engineers, and we know the more planning you do up front, the better you will do when you actually get to the event.

And this plays out into everything else.

I think -- what was it?

-- Muhammad Ali said, “Everybody's got a plan until they get punched in the mouth.”

Well, in particular, when things go bad, you want to have some kind of a plan.

And in that sense, he's probably correct in that, "Okay, now things have gone really south."
I didn't plan on things going this particular direction, perhaps, but because I've done the thinking that planned for similar contingencies, I have a better idea of what to expect.”

So these procedures that we -- even on a nominal mission, literally for every hour you spend in orbit, you put thousands of hours into planning what to do during that time. We're very, very thorough, and you have to be, because space is very unforgiving of inattention to detail.

So, you mentioned this idea of space being unforgiving.

Does that kind of impact the way we do testing?

'Cause I know that some testing obviously involves atmosphere and flight through atmosphere or returning into atmosphere. Right.

And some of it's in space.

So...I struggle with the question, 'cause
it's just like how do you do that?

189
00:09:17,440 --> 00:09:18,440
Yeah.

190
00:09:18,440 --> 00:09:21,400
Like, I don't want to lose the reality of, like, "This is rocket science, and it's really
difficult."

191
00:09:21,399 --> 00:09:22,399
Right.

192
00:09:22,399 --> 00:09:23,399
Which has become almost kind of a trite statement.

193
00:09:23,399 --> 00:09:24,759
But it's not to us, because we know how difficult
it is.

194
00:09:24,759 --> 00:09:28,250
And like you're suggesting, we've got to look
at all of these things.

195
00:09:28,250 --> 00:09:31,769
And so it is a mountain of work to get over.

196
00:09:31,769 --> 00:09:34,230
I alluded to it before, where if a box is
designed to operate let's say between 50 and

197
00:09:34,230 --> 00:09:39,278
100 degrees, when we certify that box for
use in spaceflight, and in particular human

198
00:09:39,278 --> 00:09:44,129
spaceflight, I will certify that it can operate
between 30 and 150.

199
00:09:44,129 --> 00:09:48,470
When I qualify that box, I will test it between
30 and 150.
And from then on, my flight plan should always keep it between 50 and 100.

These are all just examples so people can easily understand.

So, that's how you certify something.

You qualify to a greater number so that you can have some error in what you're doing, and then you try to operate within normal bounds.

That way, if you occasionally deviate outside of that, you know, hey, the box will still work, whatever it's got to go do.

So, space is tough because, like I said, it's unforgiving, and so we have to think very carefully about everything, the way we design it.

Even when we're designing something, we go through something called a PDR, a preliminary design review.

That's where you're about 10% of the way into the design.
You say, "Okay, I kind of think this is where I'm heading."

Everybody sit down and look at this.

What do you think?

Are we designing in the right direction?"

You design a lot more.

You get to about what you would call the 90% of what we call a critical design review.

At this point, you might have actually made some test hardware and tested a couple things you weren't sure were gonna operate.

But at CDR, you're essentially saying, "Okay, once we leave this meeting, we're gonna go build this box that I have designed that's 90%.

And there's maybe like 10% left there, but we're gonna go start building this for flight,

and we're gonna go build a test model first and go test it, and, then, once we've gotten
to CDR and we've built a test model, we'll go test it.

If it works out fine, that's the box we're gonna go build, and that's the box we're gonna go fly.

And as we kind of look at the history of NASA, with test flights ranging for about 60 years now...

...do we find a lot of these things like CDR and PDR you mentioned.

Are those legacy products?

Do we have a guidance of how to do test flights well, or are we kind of trying to reinvent it a little bit every time?

So, we're trying to be smart.

It is the 21st Century, and what we did in the '50s and '60s might need a little updating.
The kind of the process with the CDR and the PDR, we continue to do that sort of thing, but with the modern tools we have available and the computers that can do -- I mean, you know, the whole -- we went to the moon practically with slide rules. "[ Laughs ]" Literally."

Yeah.

So we're trying to be smart, and I would say particularly in the commercial crew program.

Boeing and SpaceX are both trying to drag us in some ways into the 21st Century and use more modern tools.

But we still do and mentally, we still follow that PDR and CDR process. SpaceX in particular seems to prefer to do less design work up front and go build something real quick, because, like I said, one good
test is worth a thousand analyses.

251
00:12:34,230 --> 00:12:35,230
Right.

252
00:12:35,230 --> 00:12:38,930
They tend to be more of a design, test, design, test, design, test, whereas traditionally,

253
00:12:38,929 --> 00:12:43,338
NASA has been kind of a design, design, design, design, design, test -- one big test.

254
00:12:43,339 --> 00:12:45,370
We put all our eggs in one big basket.

255
00:12:45,370 --> 00:12:47,100
They've got a slightly different philosophy.

256
00:12:47,100 --> 00:12:51,000
And that's closer to what our Russian colleagues do, what their philosophy is.

257
00:12:51,000 --> 00:12:55,980
So, there's more than one way to go skin this cat, and we're trying to find the smartest way at all times.

258
00:12:55,980 --> 00:12:57,319
Yeah.

259
00:12:57,318 --> 00:12:58,318
So, obviously, NASA, we are on a path to the moon, hopefully here 2024.
Yeah.

And we have a lot of test flights coming up, preparing for that, getting ready and on our way.

Right.

So, Jon, appreciate your expertise.

Thanks for coming.

My pleasure.

I think people should hear this and know that this is a tough business, but we love doing it.

That path to the moon leads through the Orion spacecraft.

Here's Carlos Garcia with more.

So, the title is fairly self-explanatory, I think -- launch abort system.

This is a system that we use to abort a launch.

Is that a fair way to describe it?
Yes, that's correct.

In addition to abort a launch, we also have ascent abort.

So, not to get terribly specific yet, but we have the capability to provide ascent abort roughly, you know, of course after launch, up until about 2 1/2 minutes after the solid rocket boosters separate from the launch vehicle.

Can you just give me a quick rundown kind of the process from start to finish of what is involved in utilizing the launch abort system.

So, imagine the crew ingresses via the crew module and the crew access arm is retracted.

So, at that point, the launch abort system is armed, and if there is an anomaly detected on the pad, the launch control center will obviously be concerned about the crew and initiate a pad abort with the launch control system.

Their boat motor will fire and propel the
crew module away from any harm, and the bulk

00:14:36,679 --> 00:14:39,870
of that thrust occurs within three seconds.

00:14:39,870 --> 00:14:42,959
It burns to an additional two more seconds.

00:14:42,958 --> 00:14:47,388
At the same time, the attitude control motor
reorients the crew module to allow for the

00:14:47,389 --> 00:14:52,579
jettison of the launch abort system, which
will allow the crew module to deploy its parachutes

00:14:52,578 --> 00:14:54,989
and land safely in the ocean.

00:14:54,990 --> 00:15:03,639
At that time, the rescue crew will be on its
way to arrive and safely egress the crew from

00:15:03,639 --> 00:15:05,629
the crew module.

00:15:05,629 --> 00:15:08,649
Where are we talking about landing taking
place?

00:15:08,649 --> 00:15:13,820
And can you kind of compare and contrast if
we do the pad abort versus an ascent abort?

00:15:13,820 --> 00:15:16,370
I'm assuming we're going into the Atlantic
Ocean regardless.

00:15:16,370 --> 00:15:17,370
Yes.

00:15:17,370 --> 00:15:22,009
We'll be going in the Atlantic Ocean during
most of the abort phase.
Again, I don't have the specific details on how many nautical miles out, you know, in that trajectory.

But yes, we'll be in the Atlantic Ocean.

And obviously, depending on when in flight you would abort, you're gonna be in a different spot anyway.

That's correct.

Let's, again, assume we kind of had a bad day.

We ended up with astronauts in the ocean, in a capsule.

Mm-hmm.

They're alive.

How do we get them out of the water, and how fast can we do that?

Let's see.

So, we've been working very closely with our partners here at Patrick Air Force Base and...
those recovery assets.

You know, we've been training various times.

They have -- and I don't recall all the details of the simulators that were used, but they have to know exactly where the crew module is.

We have lat long, of course.

We have a locator beacon and so forth.

So we have pre-deployed assets through the whole path of that flight trajectory.

And I know -- I forget the actual time limit, but I believe they have to be there within,

you know, several hours.

Okay.

So it's not an instantaneous kind of thing, but they'll be there pretty quick...

That's correct.

...to kind of get to the crew and get them
And they obviously train for all this, as well, about how to deal with that if they end up in the water...

Oh, yes.

...what to do, how to be safe, those kinds of things?

Yes.

I mean, we have to put handholds in certain areas on the crew module so the flight and rescue crew can actually get there, you know, and help open up the hatch and get our astronauts out.

So, once they get there -- so it's a couple hours later, a few hours later, they get to the capsule -- are the astronauts trained to be outside the capsule as soon as possible?

Are they supposed to wait inside the capsule?

What's kind of that process at that point?
They're supposed to wait inside the capsule, right, until help arrives, yes?

Okay.

And then the crews that come in, obviously, are trained on how to get in, pull them out...

That's correct.

...and to safety?

Great.

So, there's part of me that thinks that this sounds like a really fun ride -- a high-speed ride.

You chuckle, and so your response kind of makes me think that maybe this isn't, like,

your typical amusement-park thrill ride.

Probably times 10.

Which is a good thing or a bad thing?
'Cause I feel like at some point, it gets dangerous.

I'm guessing we're not in that range yet.

No, it's not dangerous.

That's why we have our amazing astronauts that can sustain these kind of loads.

And the abort motor essentially can produce up to 11 G's of force, you know, on the body, which is not insignificant.

So, but they do have pressurized suits, of course, yes.

Okay.

So it's a pretty wild ride.

Yes.

But obviously, the goal here being a rough ride, maybe, but you live.

Correct, correct.

Is the launch abort system for Orion particularly sophisticated?
Obviously, we know that we're building it now, so it is current in technology.

But is there something that sets it apart from commercial launch abort systems or past launch abort systems?

Well, the systems are essentially a heritage technology.

Solid rocket motors have been around for some time.

We do have advanced avionics, you know, with the computers, of course, in addition to -- we have composite materials on the fairing -- what we call the O-Jives.

And that essentially, you know, makes the shroud of the launch abort system as light as possible.

What's an O-Jive?

That's what we call the actual fairing that goes around the crew module for the launch abort system.
Is there a story behind that, or is that just a shortening of its name?

I've never questioned it.

Sorry.

[ Laughs ] And that, my friend, is indicative of some NASA things.

We don't necessarily question.

We just kind of use them and know what they mean.

[ Laughs ]

And what's a shroud?

A shroud, essentially, is the protective area of the crew module to protect the crew and the actual crew module from aerodynamic loads.

For people that are on the ground, and maybe if this unfortunately were to happen someday,

what's a spectator gonna see?

What's this visually like?
So, obviously, with all the cameras, you know, prior to launch, the spectators would definitely see a pad abort.

They may not notice some anomaly on the pad, but, you know, they'll just like, "Wow."

What happened?"

You can see the actual, you know, crew module with the launch abort system take off, and

as I mentioned before, you know, the abort motor will propel it over the ocean and then

jettison, and then the crew module would deploy its parachutes and land, you know, in the ocean to be recovered from our flight and rescue team at Patrick.

So, something that you noticed, but not necessarily the same kind of visual impact as a launch?

Of course.

Now, obviously, you know, if it's a pad abort, we would definitely be able to see, you know,
If it occurs during ascent, as we talked, for an ascent abort, that altitude can be

greater than 24,000 feet.

So, you know, from the layman’s eye, you won’t necessarily see an ascent abort, you know,

obviously, very clearly.

Just ‘cause it’s so high and it’s traveling downrange so far?

That’s correct.

Gotcha.

Cool.

So, what’s the likelihood of needing to use this?

Obviously, like, it’s super important because we’re dealing with safety of humans, and so

we want it, but what’s the likelihood that we will ever use this system?

It’s highly unlikely.

You know, and I don’t have numbers I can share with you.
I'm sure we do have some, but I just don't have those in front of me.

It's extremely unlikely.

I do recall from the Russian rocket, they did have to use their pad abort system sometime,

but I think it only was used once.

But it did save the crew.

Awesome.

So, you know, again, it's something you definitely never want to use, but if you need it, it's there.

Believe it or not, shortly after we interviewed Carlos, a Russian Soyuz launch headed to the Space Station was aborted successfully, pulling the capsule and two crew members to safety.

And how does the call, so to speak, take place to use this?

You mentioned a minute ago about a team kind of deciding that.
Mm-hmm.

Is this a human decision, or are there computers involved here to help make this decision?

Carlos Garcia: Well, there's three instances.

You know, of course, the Orion has abort software in that, you know, monitors its situation awareness, as well as the launch vehicle.

So, in most cases, because this has to occur extremely fast, Orion itself will initiate an abort if needed.

If we're in flight, then Mission Control and Houston will initiate abort, or, during launch,

the launch control system can initiate an abort, as well as if, for some reason, the crew needs to do it, they have that ability, as well.

Okay.

So, just piquing my curiosity there.

So, obviously, if Orion, the software is essentially making that choice.
Then it's an automatic thing.

Mm-hmm.

Correct.

Is there a button that somebody has to push that does this?

Is it a physical button, or what is it?

Well, normally, it's a fire and arm, so it's more than just one button.

Okay.

[ Laughs ] So not just like an "ah-choo," like, "Whoops."

Yes.

[ Laughs ]

But you got to do a couple things.

Right.

Yes.
But it is a physical toggle of some nature that you have to --

If it's a manual input, yes.

Okay.

Alright, cool.

Let me just mention this.

So, we kind of touched on it, but the launch abort system, you know, can be automatically initiated by the Orion software -- we talked about that -- or initiated manually through several different paths.

And that's either through the crew or the launch control center or mission control center.

Again, during flight, so, the Orion monitors its health and status during the whole time.

It also has input from the launch vehicle, and it's looking for several abort conditions.

from the launch vehicle.

And obviously, if some of those conditions are met, it's gonna receive a command to go
ahead and initiate an abort.

And what's the window to be able to use this?

'Cause you talked about having the crew onboard and having armed the system.

So how much window are we talking about?

Because, not knowing how the processing will go for SLS, I know that for shuttle, we had

hours where we had a crew onboard, and we weren't flying yet.

So are we looking at a similar timeline where that could be a possibility?

It's a possibility, but nominally.

You know, we don't want to have the crew in there any longer than we have to.

So, you know, you imagine the crew getting in the actual Orion crew module, you know,

they have to walk through the access arm, get situated, get strapped in.

Once that is, you know, essentially behind us, we move the crew access arm, this launch
Abort system is then armed, and anytime after, you know, the crew access arm has actually been retracted and the crew is inside the crew module, they have the capability for a pad abort.

And that can be, you know, five minutes before a launch, or if there is a delay, you know, that can be, you know, hours per weather or what have you.

And, again, so, we have pad abort of course on the pad, and then ascent abort up to about 2 1/2 minutes in-flight, just after solid rocket booster separation from the launch vehicle.

After 2 1/2 minutes, what's kind of the situation at that point?

Are we at a point where we're much safer or --
Well, yes.

We're much safer, because if we -- well, you know, the roughest ride structurally is with the solid rocket boosters on the launch vehicle.

Once we have those separated, yes, the ride is much smoother, but then we have to jettison the launch abort system because it's no longer needed.

But there are other abort modes for Orion if needed.

But essentially, that's just, you know, the Orion capsule separating and then either landing in the ocean or whatever abort to orbit or those other abort modes that are needed.

So, the Orion monitors its health and status during the whole time.
It also has input from the launch vehicle, and it's looking for several abort conditions.

And obviously, if some of those conditions are met, it's gonna receive a command to go ahead and initiate an abort.

Can you give me a few examples?

Like, what kinds of things?

Obviously, that's probably a long list, but what are some of the things that would trigger that?

If for some reason the trajectory is off its nominal path, right?

Therefore, you know, hey, we have unsafe condition.

Sure.

You know, we're reaching some aerodynamic loads that exceed what the vehicle have been designed for, and therefore it would initiate
an automatic abort.

And on the ground, what kinds of things would
the system be looking for, as well?

Those would be mostly launch-pad conditions.

You know, if for some reason there's a fire
on the pad or anomaly with a launch vehicle
during loading, a leak in the fire with the
launch vehicle, then yeah, then the launch
control system would initiate an abort -- a
pad abort.

So, Carlos, you're working on a system that
is designed to save people's lives in the
event of an emergency.

I'm guessing there's some sort of really great
feeling that comes along with that.

Do you kind of process that day-to-day?

Yes and no.

I mean, not necessarily.

The bulk of our time is essentially trying
to build, you know, the launch abort system,
you know, in a timely manner to support our schedules.

But in the back of our minds, we do know how important this particular piece of hardware is.

There's a great team, you know, in Houston, as well as the Langley Research Center, that have been working on this for some time.

We have proven this with our pad abort test back in -- I believe it was 2010.

So, you know, we try not to, you know, worry about everything that can go wrong, but ensure ourselves, you know, when days go right.

The launch abort system is essentially, you know, insurance for the Orion capsule, but,

more importantly, the crew.

As all things, we hope never to have to use our launch abort system, but in the event

that we do have, unfortunately, a bad day, either on the pad or during ascent, we are
very confident that our launch abort system will safely remove the crew from harm and we can recover them and rescue them safely.

Alright, so, Carlos, I appreciate you being here today.

Big thank you to you and your entire team for the work you're doing and for making spaceflight that much safer for the future.

You're very welcome.

Thanks for having me.

The completion of the three and half minute Ascent Abort 2 test saw the Orion mockup travel 6 miles in altitude before the abort motor successfully pulled the capsule away from the modified peacekeeper.

Definitively proving that we can outrun a speeding rocket.

Every test and every day that goes by we take another small step towards the moon and Mars.

I'm Joshua Santora, and that's our show.
Thanks for stoppin’ by the rocket ranch.

And special thanks to our guests Jon Cowart and Carlos Garcia.

To learn more about Orion visit nasa.gov/orion
And to learn more about everything going on at the Kennedy Space Center, go to nasa.gov/kennedy.

Check out NASA’s other podcasts to learn more about what's happening at all of our centers at nasa.gov/podcasts.

A special shout-out to our producer, John Sackman, our soundman Lorne Mathre, editor

Michelle Stone, and special thanks to Brittney Thorpe and Stephanie Martin.

And remember: on the rocket ranch... even the sky isn’t the limit.