

## Launch Footage Description

This description of the launch of Astro-E2 (Suzaku), written by Dr. Kevin Boyce (who was present in Japan for the launch), is designed to accompany the launch footage. Dr. Boyce's essay explains the sequence of events during the launch, and also gives you a taste of what it would be like to be present for a satellite launch.

*"nijyuu-go... nijyuu-yon..." ("25... 24...")*

The rocket is on its launcher, hanging from the underside of the launch rail by means of a few small cogs on the side. Beneath the rocket is a cloud of spray where cooling jets have begun squirting water. This water will boil when the rocket fires, absorbing some of the heat that would otherwise destroy the concrete flame diverter.

*"jyuu-go... jyuu-yon..." ("15... 14...")*

The Solid Propellant Gas Generator (SPGG) is fired. This is a small solid rocket within the rocket, whose exhaust gasses power the hydraulic pumps for the nozzle steering system. These exhaust gases create the large cloud of black smoke at the bottom of the rocket.

*"jyuu-san..." ("13...")*

We switch to the rocket-cam view. This is a view from a camera mounted on the side of the rocket (the camera is actually inside, looking out through a tiny prism on the side of the rocket). The black plume from the SPGG is clearly visible.

*"nana... roku..." ("7... 6...")*

That's a lot of exhaust from the SPGG, isn't it!

*"san... ni... ichi... zero"*

This is it! Everyone in the control room is focused on their job. Actually, in the satellite control room there's nothing to do, because there's nothing we can do. The rocket team is monitoring the rocket's progress and the range safety team is standing by to blow up the rocket if it strays outside its predefined airspace, but at this point the satellite is just along for the ride.

The XRS instrument, for instance, isn't even powered. All we can do is watch the video of the rocket, hoping to see a nice smooth trajectory.

The roar reaches us. The rocket team is in a concrete bunker very close to the launch tower, but the satellite control room is about a mile away, so it's a few seconds before we hear the sound of the rocket. But boy is it loud when it gets there. The whole room rattles and shakes. The control room is directly beneath a 30 m diameter radio antenna, which weighs 180 tons and is built to survive a Category 5 hurricane. So if the room is rattling, you know something big is happening.

*12:30:15 (time of launch)*

By this point the rocket has reached the level of the clouds, so the view switches to a different camera. Fortunately the weather is only partly cloudy, so the rocket is visible

from one camera or another. Southern Japan in August is tropical, and quite hazy, which cuts down the visibility. Watch the rocket climb through additional layers of clouds.

*00:20 (time since launch)*

Back to the rocket camera. You can see the small black plume of smoke from the exhaust of the SPGG as well as the bright yellow plume of the rocket itself. Watch how fast the clouds fade into the distance. The Japanese announcer is counting up the seconds since launch.

We switch back to the ground-based camera to see mainly the rocket plume. This is what we would expect, since the rocket is already many miles away, and of course with the rocket end still pointed at the launch site.

*00:51*

Back on the rocket camera now, the blinking icon indicates where the camera is on the rocket. The first stage of the rocket is not shown in the icon; it represents the second and third stages.

*01:15*

"Nanajyuu-go" ("75" seconds). The first stage separates from the rest of the rocket in a blinding flash, and the second stage begins firing. For those of us at the first ASTRO-E launch, this is a great relief. The first stage, which failed last time, appears to have worked perfectly. Our Japanese colleagues, who are in close communication with the rocket team, give us the thumbs-up.

At this point we realize that a minute and a half has passed and we really should start breathing again.

*02:30*

The second stage begins to burn out, on schedule. Everything is still looking good.

*02:34*

The rocket begins rolling, then pitching to the correct attitude for orbital insertion.

*02:36*

As the second stage burns out, the rocket begins pitching so that it's parallel to the ground. It's now above the atmosphere, so it's time to stop thrusting upward and start pushing purely sideways. The upward motion of the rocket is just to get above the atmosphere; it's the sideways change in velocity ("delta-v") that actually puts the satellite into orbit. Most of this delta-v will be provided by the third stage.

*03:00*

We switch to a split view, showing two cameras looking up at the third stage and satellite, which are covered by the nose faring. The one on the right is completely dark while the nose faring is on.

*03:06*

The nose faring is jettisoned. It splits down the middle like a clamshell and falls away to the sides, allowing light onto both sides of the third stage. The spacecraft is now exposed directly to space.

The right half of the image shows the black outer edge of the third stage motor, while the left shows some of the support structure. Because the two cameras aren't directly opposite each other, the view is somewhat confusing.

*03:20*

The second stage separates from the third stage and spacecraft. The cameras are on the second stage, so we see the third stage moving away from us.

*03:24*

The extendible nozzle of the third stage rocket is extended. It was collapsed before this point to save space. Part of the extension mechanism consists of cable-like objects which fly away from the spacecraft.

*03:25*

The third-stage rocket fires, directly at the second stage, thereby obliterating the cameras and their transmitters, and ending our video.