

## Kerbal Space Program - Bug #22714

### SRBs generate excessive drag even when stack-mounted

05/31/2019 08:01 PM - Streetwind

<b>Status:</b>	New	<b>Start date:</b>	05/31/2019
<b>Severity:</b>	Low	<b>% Done:</b>	0%
<b>Assignee:</b>			
<b>Category:</b>	Parts		
<b>Target version:</b>			
<b>Version:</b>	1.7.1	<b>Language:</b>	English (US)
<b>Platform:</b>	Windows	<b>Mod Related:</b>	No
<b>Expansion:</b>	Core Game		

#### Description

Observed on build 1.7.1.2539, with Making History and Breaking Ground installed. It is a completely fresh installation, not an upgrade, and had no prior gameplay on it.

#### Reproduction steps:

- 1.) Activate Aero debug display in part menus
- 2.) Construct a simple 1.25m rocket with two liquid fuel stages and a pod
- 3.) Launch it using SAS Hold Prograde, observing the drag readout on the tanks in the bottom stage as the rocket accelerates towards the sound barrier
- 4.) Revert to editor and replace the liquid first stage with a suitable SRB, such as a Thumper. Thrust limit to a sane TWR
- 5.) Launch the rocket again using SAS Hold Prograde, observing the drag readout on the SRB as the rocket accelerates towards the sound barrier

#### Expected behavior:

As both the liquid fuel tanks and the SRB are stack mounted, and SAS Hold Prograde ensures that the rocket flies perfectly straight into the airstream, both parts should report a negligible drag value.

#### Observed behavior:

While the drag on the liquid fuel tanks is indeed negligible, the SRB is a completely different picture, showing more than an order of magnitude more drag. When using a Kickback SRB, which is so heavy that the pod alone has trouble wrestling it around, the vehicle might actually be pushed off prograde.

#### Affected parts:

All four SRBs. The effect is worse the larger the SRB gets. On the Kickback I observed drag values as high as 15, on the Thumper as high as 12, on the Hammer as high as 6, and the Flea didn't burn nearly long enough but was already rising past 1.5 at burnout. By comparison, liquid fuel tanks in the bottom stage showed about 0.8 - 1.0 in the transsonic flight regime.

#### History

##### #1 - 05/31/2019 08:18 PM - Streetwind

Addendum: performing the same test in a fresh install of 1.6.1 without Breaking Ground shows the same behavior.

##### #2 - 05/31/2019 08:55 PM - Yargnit

I built my own test stand that is simply a pod on an SRB and then a pod on a stack of LF tanks and an engine tuned to match the SRB, and launched them next to each other at the same time and I don't see it. The drag values I'm seeing between the 2 vessels are more than within a normal range comparatively.

Make sure you're comparing the SRB vs the entire stack of LF tanks + engine, not just to the LF engine or 1 of the LF tanks. The stacks should come out close to even, not the individual parts.

##### #3 - 06/01/2019 10:04 AM - Streetwind

- File screenshot2.png added

- File screenshot3.png added

Okay, offering a different test case here:

- Manually deleted PartDatabase even though it was a fresh install, to remove possibility for a faulty PartDatabase shipped by installation

- Removed both expansions to make sure it can be reproduced in the core game
- Built a rocket of just three parts: parachute, pod, Thumper. Dialed it in to exactly 1.50 TWR. Launched it straight up.
- Replaced the Thumper with two FL-T800 and a Reliant, which is pretty much the same length as a Thumper. Dialed this in to exactly 1.50 TWR. Launched it straight up.

In both cases I took a screenshot just past 300 m/s, which was the peak aerodynamic load.

The Thumper scored 13.31 for the drag value.

The two tanks and Reliant combined added up to 9.85. Among the three, it was the Reliant that generated the lion's share of the drag, posting 6.49 compared to the tanks at 1.68 each.

It appears expected then that the empty engine bottom generates a significant amount of drag, and since the SRB is one part, it also generates such drag. This, however, can be a problem. If it's a liquid fuelled engine, it will be at the bottom of the stack, and generate its drag down there. This actually stabilizes the vehicle, as per the golden rule of rocketry ("heavy parts at the front, draggy parts at the back"). However, if it's a SRB, it generates the drag much further up the vehicle, because the SRB itself is long. Add the fact that SRBs are also heavy and mounted at the bottom, this is the exact opposite of what you want for vehicle stability.

As a result, if you try to use a Kickback SRB as a first stage of a 1.25m rocket, the vehicle will deviate off prograde and attempt to flip unless a large amount of control authority (more than a pod can supply) is devoted solely to keeping it straight.

Because SRBs are one single part, it is probably not possible to move the drag it generates to the bottom end, where it would realistically be expected to be. However, the issue can be alleviated slightly by improving the drag behavior of SRBs in general. In the above test case, the SRB generated about 35% more drag than a liquid fuel setup at the same physical vehicle length, acceleration force, and airspeed. If the inherent drag of all SRBs was reduced by a third each, then their negative impact on vehicle stability would be lessened. Without such a change, using the Kickback is a bad idea in almost any configuration.

## Files

screenshot2.png	2.01 MB	06/01/2019	Streetwind
screenshot3.png	2.56 MB	06/01/2019	Streetwind