

SpaceX conducts additional Falcon 9 improvements ahead of bus schedule

written by Chris Bergin | September 7, 2015



SpaceX engineers are busily processing the Falcon 9 fleet for a salvo of missions that will mark the company's return for the CRS-7 failure. The replacement of helium bottle support struts – one of which is suspected to have caused the CRS-7 mishap in June – is being conducted alongside additional changes, as SpaceX prepare for up to four launches by the end of the year, starting with a preliminary RTF date in November.

Return From Failure:

SpaceX continues to work toward the conclusion of an investigation into [the loss of the Falcon 9 v1.1 during first stage flight with the CRS-7/SpX-7 Dragon](#).

The initial focus centered on a strut, designed to hold one of the second stage helium pressurization system bottles in place. [SpaceX believes one strut "snapped" during first stage flight](#).

The failed strut is understood to have released the [Composite Overwrapped Pressure Vessel \(COPV\)](#), resulting in it leaking helium, causing an overpressure event in the tank and the subsequent failure of the stage.



However, the flight telemetry does not fully support a “straightforward failure” of a loose helium bottle bur: ^ : second stage tank.

“It’s proving to be quite a puzzle,” noted [SpaceX CEO Chief Designer Elon Musk in July](#). “The telemetry data also somewhat confusingly shows a drop in helium pressure – which you’d expect with a breach in the system – and then, somewhat strangely, a rise (of pressure) in the system, back to its start pressure. This is obviously quite confusing.”

believed this failure sequence may revolve around the bottle breaking free, twisting around, resulting in its helium line “pinching” off the helium manifold, which subsequently restores pressure in the helium system. However, it would have still released enough helium into the tank to cause the Second Stage to fail.

Due to the lack of a clear-cut failure explanation, SpaceX engineers have been working through numerous other fault tree paths, with oversight from the FAA (Federal Aviation Administration) and the participation of NASA and the U.S. Air Force.

During the last month, a leading alternate path was examined ([L2](#)) – specific to a potential leak in a propellant feedline that runs from the upper tank, through the lower tank, to the engine. It is thought such a leak could explain the pressure increase in the system. However, following an investigation into this potential path, it was deemed not to be credible and subsequently removed from the fault tree.

The failed strut continues to be the leading candidate for the failure, backed up by additional testing that has been conducted at [SpaceX’s test facility in McGregor, Texas](#).

With SpaceX utilizing the investigation period to conduct a “deep dive” review of all their hardware and processing paths, engineers reviewed the history of modifications to their evolving Falcon 9, including elements such as the optimization of the Second Stage that have been implemented over recent years.

The review focused on changes to the Second Stage ([L2](#)), such as the reduction in weight and margins since SpaceX operated against recovery attempts of this stage in its current configuration. No negative impacts were found during the review.

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Sources note there has been at least one change implemented into the Falcon 9 fleet during this stand-down period. It has been stressed this change is not related to the CRS-7 failure.



Noticed during inspections of Falcon 9 hardware at SpaceX's base in Hawthorne, California – engineers visually observed a small issue relating to weld points associated with a helium line – hardware classed as "inconel tubes" – via inspection.

Although this issue was unlikely to have impacted on the vehicle during flight, a decision was taken to change them out on the F9-19, 21 and 22 vehicles. F9-21 and F9-22 were still without their engines at the time of the decision, expediting the changeout process.

As of last week, visual observations on the factory floor at Hawthorne (L2) noted the octoweb for F9-22 is now hosted in a fixture, ready to begin assembly.

It was also noted that one F9 first stage and interstage had already been shipped out of the factory as of late August (L2) en route to McGregor, showing SpaceX is beginning to hit the path of preparing for return to flight. However, as of last week the first stage test stand in Texas remains unoccupied (L2).

EDIT: On Tuesday morning, engineers raised a first stage onto the new test stand that will be used for both Falcon 9 v1.2 and Falcon Heavy testing.

Return To Flight:

Even during SpaceX's busy flow of nominal flights, manifests were forever subject to change. As with most launch flows, the actual launch date only becomes official after the Launch Readiness Review (LRR) has been conducted.

For planning and processing flow purposes, companies such as SpaceX schedule placeholders for upcoming missions, usually citing them as NET (No Earlier Than). However, with SpaceX planning for Return To Flight (RTF) and yet to complete



The most recent preliminary schedule ([L2](#)) shows the SES-9 telecommunications satellite as the bird that will have the honor of riding on the first Falcon 9 to launch since the CRS-7 failure. This launch will also mark the debut of the full thrust Falcon 9 unofficially called the V1.2 – which will produce an additional 10 percent of thrust. The NET for this launch date ranges from November 1 to mid-November.

SpaceX is yet to officially announce SES-9 will ride first, citing it up to the customer to reveal this information. Also, SpaceX is likely to wish to conclude its CRS-7 investigation prior to

announcing a RTF schedule.



However, based on the preliminary placeholders, [Dragon will return to Commercial Resupply Services \(CRS\)](#) duties with the CRS-8/SpX-8 mission to the International Space Station (ISS) in mid-November.

The placeholder claims a November 16 target while NASA managers later noted they were evaluating a November 15 launch date. Options in December are also being evaluated.

There is no schedule pressure on this launch date, with the outpost ably coping with its logistical and supply status despite the unprecedented run of resupply failures [since last October](#).

Another meeting to evaluate the status of both Dragon and [Cygnus CRS missions](#) – the latter set to [ride on an Atlas V this year](#) – is set to take place this week at the ISS program level.



Visual sightings of the Dragons at Hawthorne last week ([L2](#)) noted the Dragons for CRS-8, 9, and 10 are currently located in the clean room in various states of completion. CRS-8 is currently scheduled to be shipped to Florida at the end of the month.

An interesting observation relating to the CRS-11 Dragon is currently being checked into, following claims this spacecraft may include the pressure hull from a previously flown Dragon with one stripped down hull currently sporting a sign to denote it is destined for reuse ([L2](#)).



The next mission on the placeholder is a December 2 launch of the next ORBCOMM mission, although that launch date is still preliminary – would be at the mercy of both of the previous two missions launching on time. Options for late December exist.

Deeper into the placeholder is the Jason-3 mission, set to launch from Vandenberg Air Force Base in California on what is understood to be the last remaining Falcon 9 v1.1.

The placeholder cites a mid-December launch for this Ocean Surface Topography Mission, although NASA sources have

understandably noted this is highly likely to slip into early 2016.

An official outline of the RTF plans will be revealed once the CRS-7 investigation report is complete and signed off by the relevant parties. SpaceX hasn't revealed when this report is expected to be finalized at this time.

(Images: via L2's SpaceX Section, including assets from [L2's CRS-7 Video Analysis Section](#) – which involves numerous videos and techniques and evaluations with thanks to members jdeshtler, bstrong, moralec and Okan170 – these are not official SpaceX investigation assets. Other images from SpaceX, NASA and L2 Artist Nathan Koga)

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