FALCON9R v1.2

Add-On for Orbiter 2010-P1 (v.100830)

INSTALLATION

Extract all files to the root of your Orbiter program directory, preserving the directory structure. This should NOT overwrite anything in the standard Orbiter package.

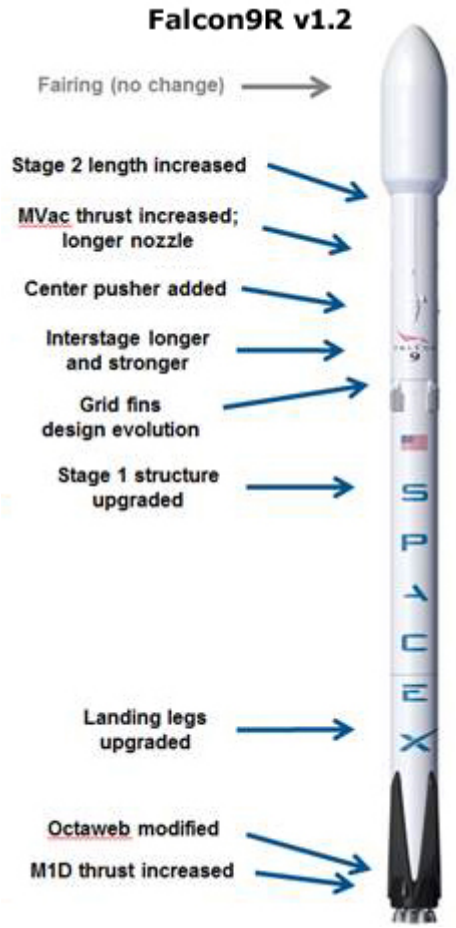


image: SpaceX

REQUIREMENTS

CRS Launch scenario requires:
"Dragon Dll"
http://www.orbithangar.com/searchid.php?ID=6795

"Canadarm2 v4"
http://www.orbithangar.com/searchid.php?ID=6883

WHAT'S IN THIS ADD-ON?

The SpaceX "Falcon9R V1.2" launcher. Historical OG2 satellites launch and test scenarios. Features optional Ascent-to-Orbit autopilot and 1st Stage Auto-Flyback-EDL, etc. Payload "attachment" by editing scenario, or in-sim by payload name input. No Fairing, Crew Dragon Adaptor, Cargo Dragon Adaptor or Custom Adaptor Mesh options. Optional Star48BV kick motor. Also includes SLC40 and SLC4E launchpads, LZ1 and LZ2 landing pads, ASDS landing barge.

QUICKSTART

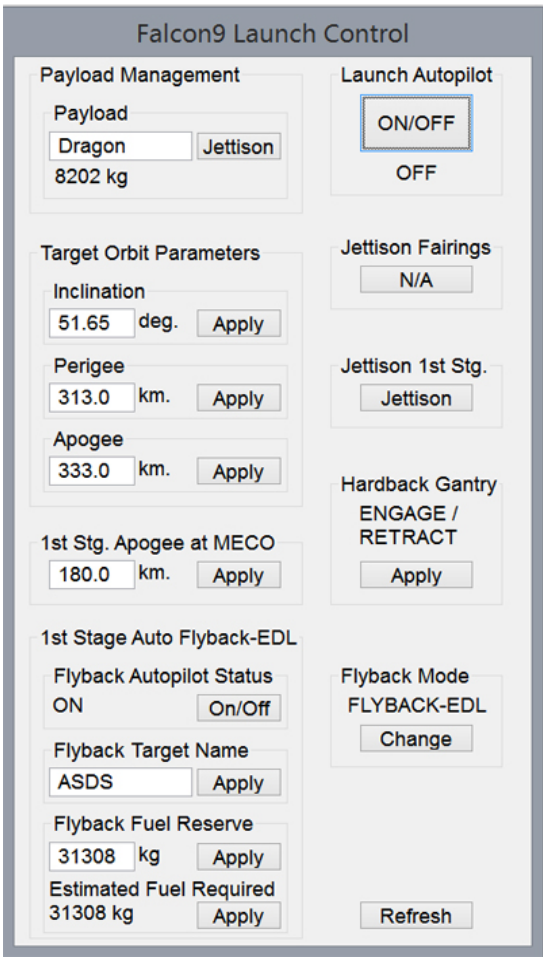
Scenarios are in the "Falcon9R v1.2" folder on your Orbiter launch pad.
Select a scenario and press [V] at T-10 to start the ascent autopilot.
All launch parameters are set and 1st Stage Auto-Flyback-EDL to the ASDS, LZ1 or LZ2 is already enabled. Sit back and watch the 2nd stage take the payload to orbit while the 1st stage lands back at base.

SCENARIOS

OG2 Satellites launch
Launch eleven OG-2 sats from KSC at 01:29 UTC, 22 Dec 2015
Target orbit 615 x 750km, 47deg inc. Press [V] for ascent autopilot at T-10.
Switch focus to ESPA vessel and press [J] to deploy OG2 sats.

Test Scenarios
Various test-mass satellites to LEO, SSO. 1st stage flyback to ASDS, LZ1, etc.
Dragon CRS Launch scenario requires "Dragon Dll" and "Canadarm2 v4" add-ons.

FALCON9R v1.2 MAIN CONTROLS



Press **K** for **Launch Control Panel** display On/Off

Payload
Shows current payload name and mass.
If there is no payload, enter payload name and click on [Attach] button to attach any existing vessel to the Falcon9R at the payload interface ring. To jettison, click on [Jettison].

Target Orbit Parameters
Enter Inclination (degrees, equatorial frame)
Use positive inclination for Northerly launch azimuth, negative inclination for Southerly azimuth. Inclination must be greater than current latitude.
Enter Perigee (km.alt.)
Enter Apogee (km.alt.)

1st Stg. Apogee at MECO
Enter 1st Stage Apogee (km.alt.) at MECO. (maximum 450km)
(Default 67% of Target Orbit Perigee)

1st Stage Auto Flyback-EDL
Enable/Disable Flyback-EDL Autopilot for 1st stage.
Enter name of vessel(landed) or base for Auto Flyback-EDL target (NULL for no target).
Enter Fuel Reserved for 1st stage flyback (kg) (Maximum 80000kg)
If the Falcon9 is on the launch pad, it will show a very aproximate estimate of the fuel required for the Flyback-EDL burns.

Flyback Mode
Change between the full FLYBACK-EDL sequence, and EDL ONLY which performs the targeted reentry and landing burns only (no Flyback burn). EDL ONLY target must be located a few (1~5) km short of ballistic impact point of 1st Stage after separation.

Launch Autopilot On/Off
Activate the Launch Autopilot at T-10 seconds. Can be stopped and re-started but this is NOT recommended, and can result in serious flight anomalies!

Jettison Fairings
Manual fairing jettison

Jettison 1st Stage
Manual 1st stage jettison

Hardback Gantry
If Falcon9 is attached to the launch pad, you can raise or lower the Hardback.

Refresh
Refresh the current parameters.

KEYBOARD SHORTCUTS

[K] = Open/Close Launch Control Panel

[V] = Start Launch Autopilot at T-10s

[J] = Manual jettison fairing or payload (if no fairing).

[E] = Set camera view +Z / -Z (forwards/backwards)

FALCON9R v1.2 1st STAGE CONTROLS (post stage separation)

[K] = Set Flyback Target
Enter name of vessel(landed) or base for flyback targeting.

[M] = Set Flyback Mode
Change between the full FLYBACK-EDL sequence, and EDL ONLY mode.

[B] = Enable/Disable Flyback Autopilot
Current sequence status is shown on the HUD.

[P] = Engine Selection
Cycle through either 9, 3 or 1 engines (not available when Auto Flyback-EDL active)

[G] = Deploy Landing Gear

[E] = Set Camera +Z / -Z
Set the camera view forwards or backwards.

Launch Autopilot Sequence
T-10s ..... Countdown
T -2s ..... Throttle-up to 100%
100m alt. ..... Start roll to launch azimuth
57m/s vel. ..... Start pitch down, follow gravity turn
30km alt. ..... Start guidance steering, 4g limiter (3g for Dragon)
Flyback fuel res. limit reached..... 1st Stage MECO and separation, 2nd stage ignition
1st Stage separation +20s ..... Fairing separation
Final Orbit reached ..... 2nd stage MECO

FLYBACK-EDL Autopilot Sequence
1st Stage separation..... Go to flyback burn attitude, perform burn (3 engines)
Burn complete..... Go to reentry attitude
Reentry 100km - 20km alt. ..... Enable/perform reentry burn (1 or 3 engines)
20km – 2km alt. ..... Enable aerodynamic steering
2km - 1km alt. ..... Start landing burn, deploy landing gear (1 engine)

EDL ONLY Autopilot Sequence
1st Stage separation..... Go to reentry attitude
Reentry 100km - 20km alt. ..... Enable/perform reentry burn (3 engines)
20km – 2km alt. ..... Enable aerodynamic steering
2km - 1km alt. ..... Start landing burn, deploy landing gear (1 engine)

Notes
FLYBACK-EDL usually requires 30000kg – 50000kg fuel reserve.
EDL ONLY fuel reserve is restricted to ~21000kg
The Estimated Fuel Required display may not be completely reliable!

Setting a fuel reserve will reduce the maximum 1st Stage Apogee by ~50km per 10000kg (from a maximum of 450km using no fuel reserve). Setting 1st Stage Apogee higher than current maximum will reduce fuel reserve by ~10000kg per 50km. Fuel reserve will compensate automatically for changes to apogee, and vice versa.

PAYLOAD MANAGEMENT

You can attach any existing vessel during simulation runtime. Press [K] for the Launch Control Panel, enter vessel name and click on [Attach] button. This will select the first available attachment point on the payload and attach it to Falcon9 at the centre of payload interface on 2nd stage.

You can also edit the scenario manually by adding the ATTACHED line to the payload vessel entry. (See included scenarios for examples).

FAIRING / PAYLOAD ADAPTOR OPTIONS in CFG file

Config files for the Falcon9R v1.2 are located in Config/Vessels/Falcon9R_V12/ folder.
By editing the .cfg file for the Falcon9R you can have four variations:

Dragon = 1	Add adaptor for *Cargo* Dragon, no fairing
Dragon = 2	Add adaptor for *Crew* Dragon, no fairing
NoFairing	Remove Fairing
Adaptor = Falcon9R_V12/star48bv_adaptor	Add custom mesh to 2nd stage payload ring.

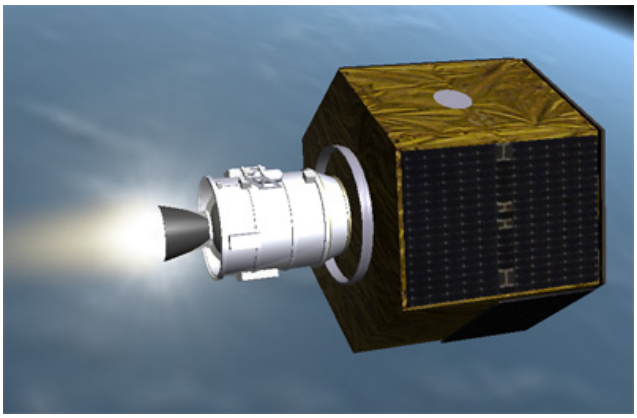
See examples in:
f9_v12.cfg, f9_v12_drg.cfg, 9_v12_drg2.cfg and f9_v12_star48.cfg

STAR48BV KICK-MOTOR

An optional Star48BV solid rocket motor is included. It can be attached to the Falcon9R like any other payload.

A further payload can be attached to the Star48BV during simulation by pressing [P] and entering vessel name, or edit the ATTACHED parameter in the scenario file before starting the sim.

Payload mass is added to Star48BV.



A 62" to 48" adaptor for attaching the Star48BV to the Falcon9R is included (see Fairing / Payload Adaptor Options)

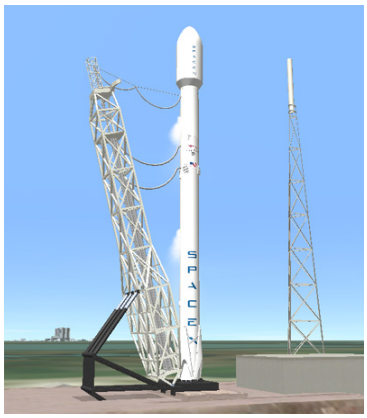
[P] = Enter Payload Name
Attach any existing vessel to the Star48BV, at the payload interface ring.

[J] = Jettison Payload

Once ignited, the Star48BV will burn at full throttle until depletion.

LAUNCH PADS and LANDING PADS

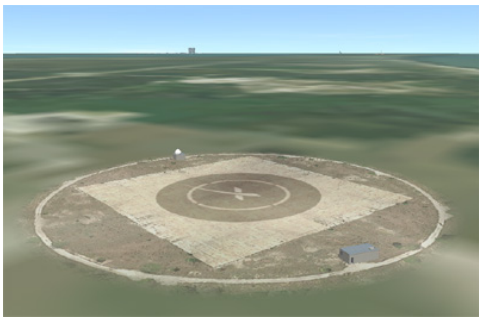
Launch pads feature retractable gantry, LOX vent and liftoff smoke effects, auto night lights.

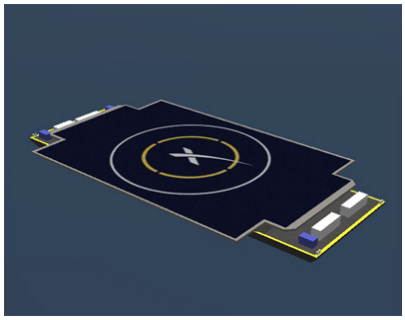


[G] = Raise / Lower Gantry
[K] = Night Lights On/Off
[V] = LOX vent On/Off

LAUNCH PAD "HOLD DOWN"
If Falcon9R is attached to launch pad (see ATTACHED parameter in scenario file), attachment is released when Falcon9R main engine reaches %95 thrust (after 2 seconds if using Launch Autopilot)

LANDING PADS / ASDS BARGE
Auto proximity night lights – illuminated when any vessel approaches within 5km.
ASDS should be placed along the launch groundtrack, some distance ahead of the 1st Stage Core at separation (or close to 1st Stage ballistic impact point if EDL ONLY flyback mode is selected)





FALCON 9R v1.2 ADD-ON SPECS

1st Stage Empty Mass	22100 kg
1st Stage Fuel Mass	402500 kg
1st Stage Max Thrust SL	756222N x 9
1st Stage RCS (gimballed main engines)	38000 N (4 pairs, pitch/yaw/roll)
1st Stage ISP SL	2767 Ns/kg
1st Stage ISP Vac	3051 Ns/kg
1st Stage RCS(N) Fuel Mass	400 kg
1st Stage RCS(N) Max. Thrust	1000 N (6 pairs)
1st Stage RCS(N) ISP SL	800 Ns/kg
2nd Stage Empty Mass	4300 kg
2nd Stage Fuel Mass	104275 kg
2nd Stage Max Thrust Vac	934000 N
2nd Stage RCS (gimballed main engine)	13000 N (pitch/yaw)
2nd Stage ISP Vac	3549 Ns/kg
2nd Stage RCS(N) Fuel Mass	100 kg
2nd Stage RCS(N) Max. Thrust	500 N (4 pairs)
2nd Stage RCS(N) ISP Vac	800 Ns/kg
Payload Interface Ring	1.57m diameter
Fairing Mass	1750 kg
Star48BV Empty Mass	144.7 kg
Star48BV Fuel Mass	2011.8 kg
Star48BV Max Thrust Vac	68720 N
Star48BV ISP Vac	2865.5 Ns/kg
Star48BV RCS Fuel Mass	20 kg
Payload Interface Ring	1.05m diameter

NOTES
Gimballed main engine attitude control is simulated by separate RCS thrusters equivalent to 3° main engine offset. When main engine is off, attitude control is by cold nitrogen thrusters. RCS Nitrogen is very limited.

I've tried to make the performance of the Falcon9R v1.2 as realistic as possible, given the estimates, data, information and mis-information I have managed to gather on the www.

The flyback and landing algorithms are entirely my own nonsense, just to see if and how it can be done. Have fun :-)

Thanks as ever to Dr.S, Don, Barry, Fred18, IronRain and everyone else.

BrianJ
March 2016