National Aeronautics and Space Administration

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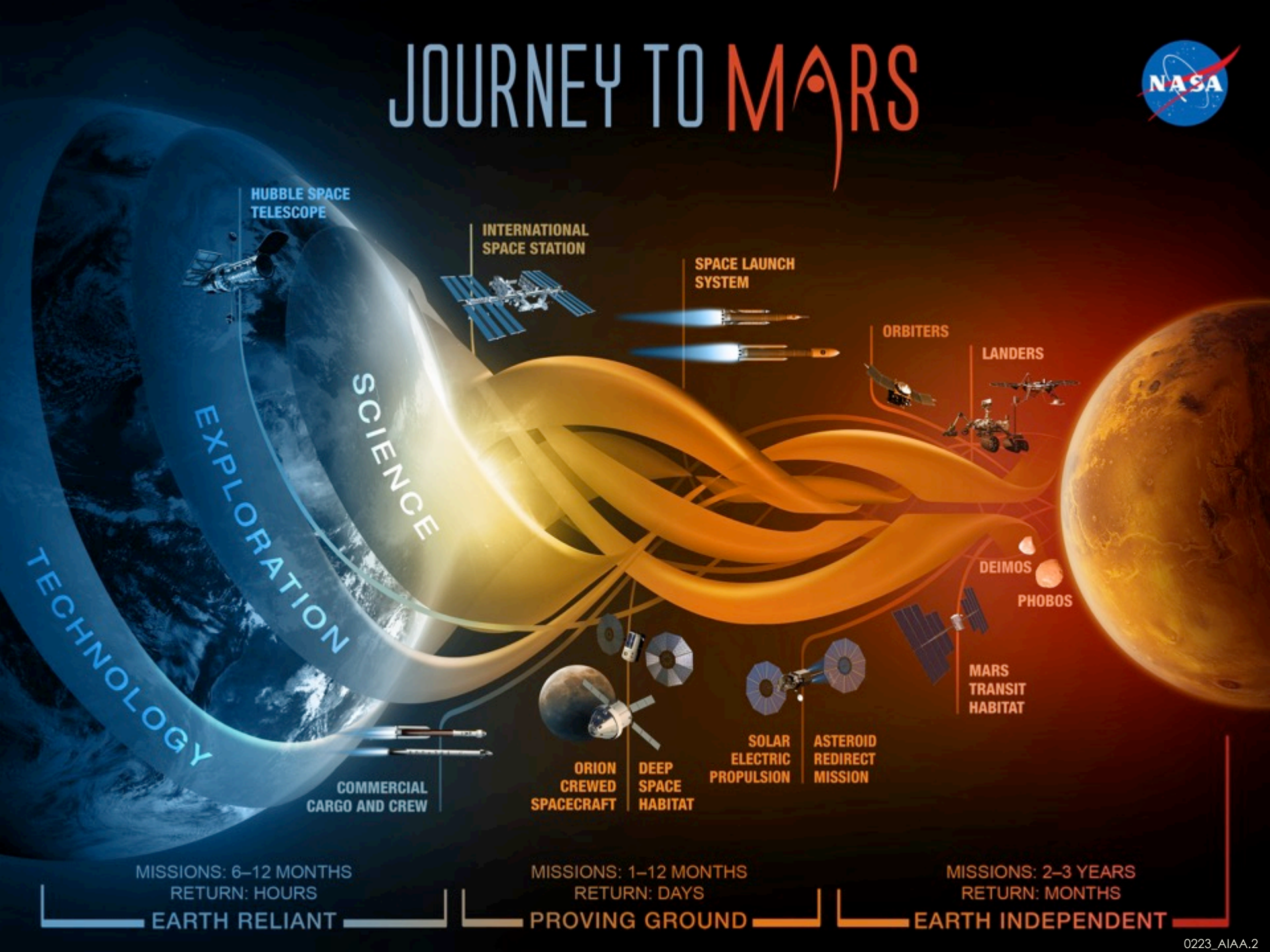
SPACE LAUNCH SYSTEM

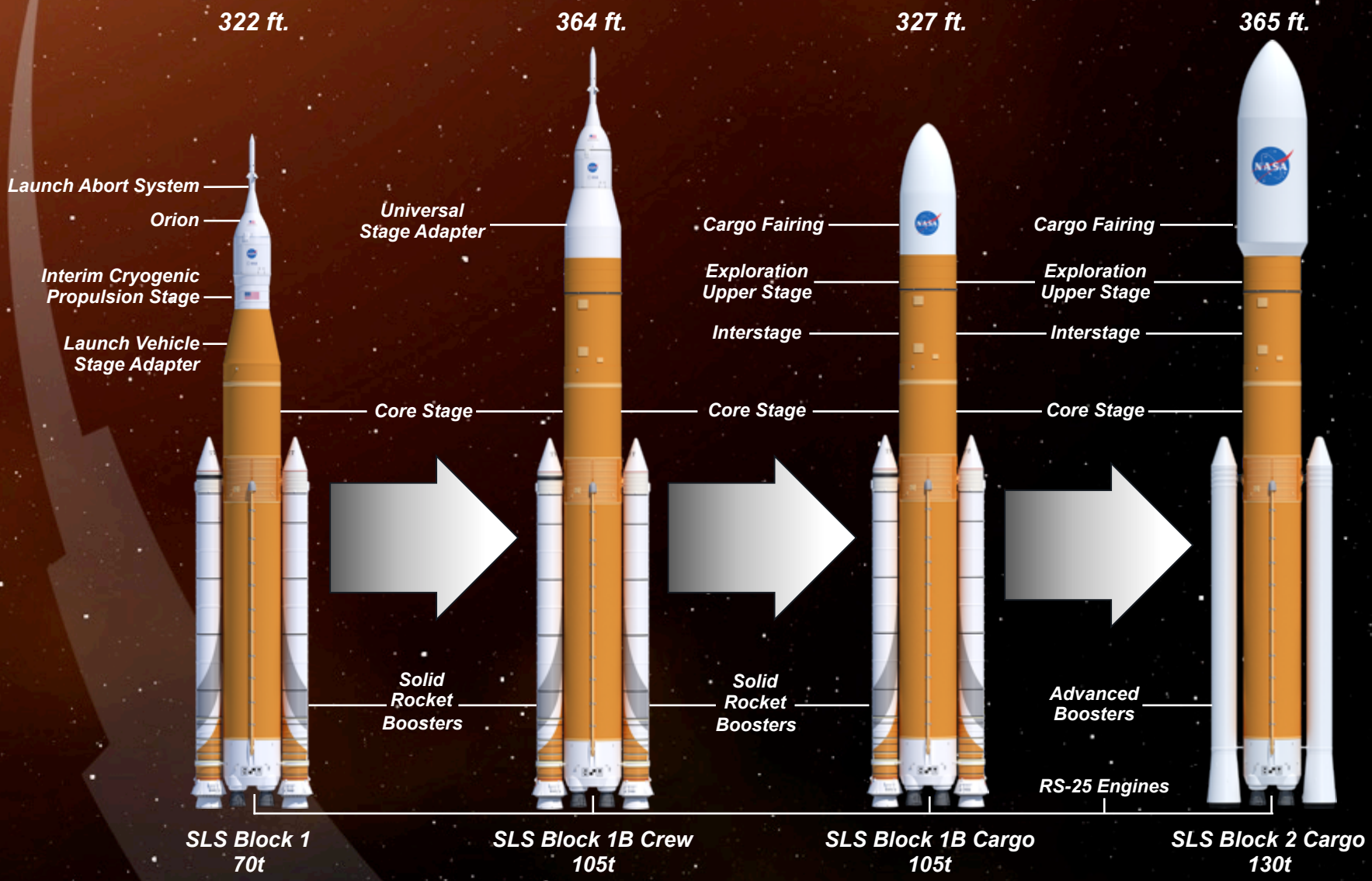
SPACE LAUNCH SYSTEM – PROGRESS TOWARDS LAUNCH

Andrew Schorr
Assistant Manager,
Spacecraft/Payload Integration and Evolution Office

September 14, 2016


JOURNEY TO MARS
NASA
HUBBLE SPACE TELESCOPE
INTERNATIONAL SPACE STATION
SPACE LAUNCH SYSTEM
ORBITERS
LANDERS
SCIENCE
EXPLORATION
TECHNOLOGY
DEIMOS
PHOBOS
MARS TRANSIT HABITAT
SOLAR ELECTRIC PROPULSION
ASTEROID REDIRECT MISSION
ORION CREWED SPACECRAFT
DEEP SPACE HABITAT
COMMERCIAL CARGO AND CREW
MISSIONS: 6–12 MONTHS
RETURN: HOURS
EARTH RELIANT
MISSIONS: 1–12 MONTHS
RETURN: DAYS
PROVING GROUND
MISSIONS: 2–3 YEARS
RETURN: MONTHS
EARTH INDEPENDENT

SLS EVOLUTION OVERVIEW



SLS SPACE LAUNCH SYSTEM

www.nasa.gov/sls

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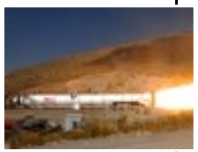
PATH TO THE PAD

2011	2012	2013	2014	2015	2016	2017	2018
✔ Mission Concept Review	✔ System Requirements Review/System Definition Review	✔ Preliminary Design Review	✔ Key Decision Point-C	✔ Critical Design Review		▽ Design Certification Review	▽ Launch Availability

With design and development work mostly complete, the SLS Program is now building and testing components of the world's most powerful rocket to be ready for launch in 2018. Each of these steps advance NASA on the Journey to Mars.



Booster Development Test

Booster Qualification Tests

Boosters Fabrication Complete

Booster Assembly at KSC

Engines Delivered to Inventory

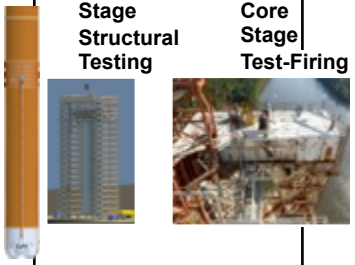
RS-25 Development Testing Begins

RS-25 Flight Testing Begins

Core Stage Structural Testing

Core Stage Test-Firing

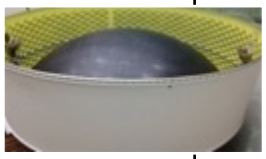
Core Stage Assembly Complete



Manufacturing Tooling Installation

Core Stage Production Begins

SLS Design Chosen



Production of Adapter for Orion Flight Test

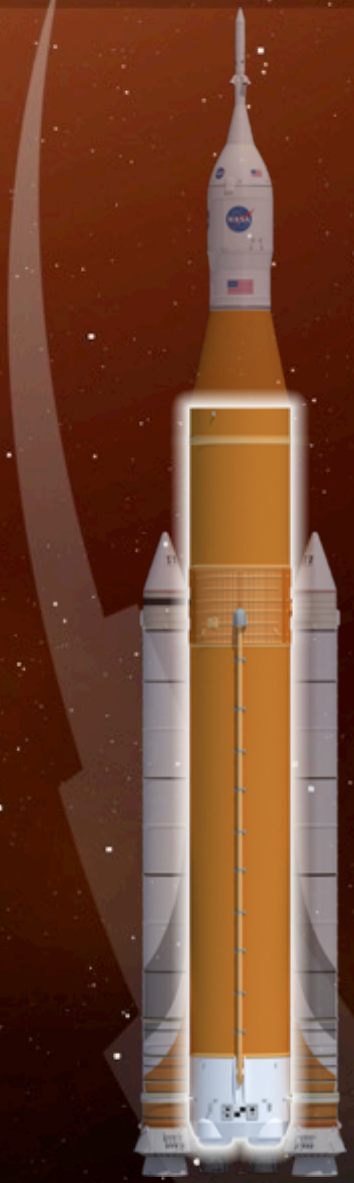
Upper Stage Production Begins

Integrated Upper Stage Structural Testing

SLS Launch Readiness

Concept Studies	Design & Development	Final Design & Fabrication	System Assembly, Integration and Test, Launch Checkout

CORE STAGE



OVERVIEW

- World's largest rocket stage
- 27.6-foot diameter; 200 feet tall
- Being built at Michoud Assembly Facility outside New Orleans, LA

STATUS

- Welding is underway currently on test and flight articles for core stage fuel tanks
- Refurbishment underway on B-2 stand at Stennis for Green Run core stage test

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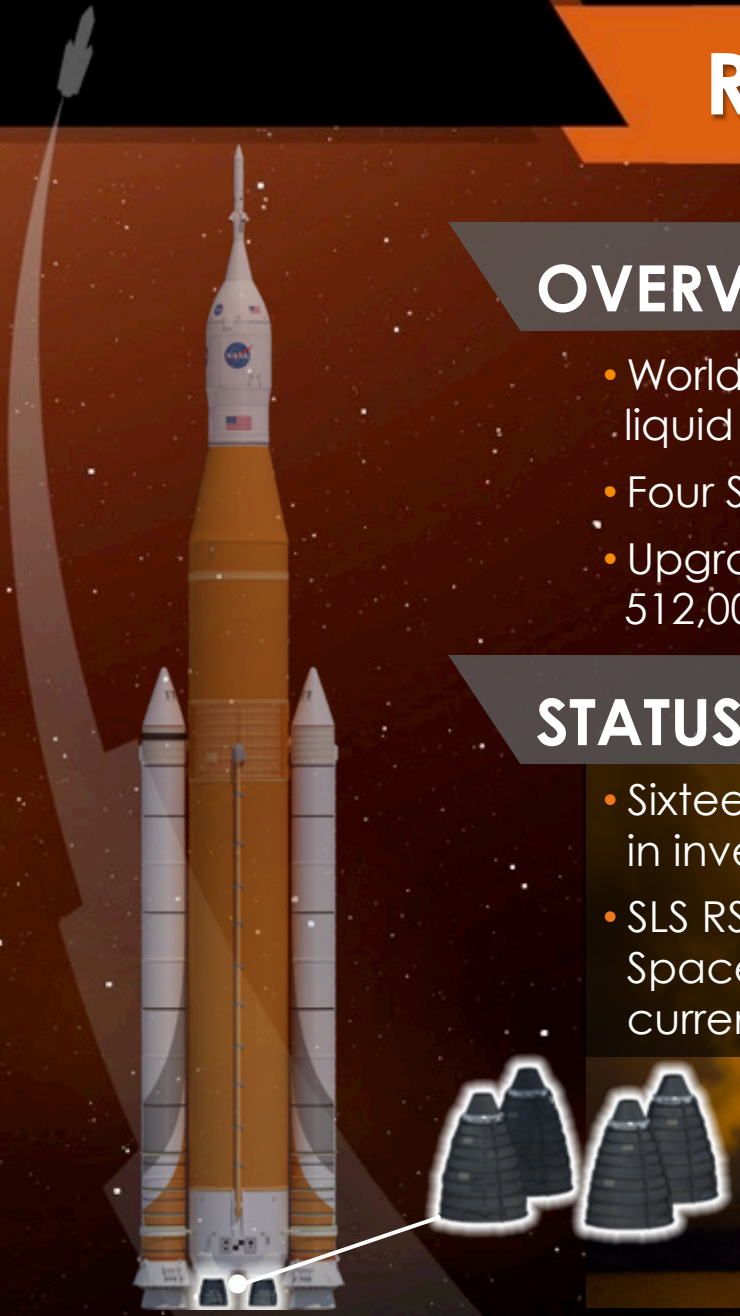
CORE STAGE

RS-25 CORE STAGE ENGINES

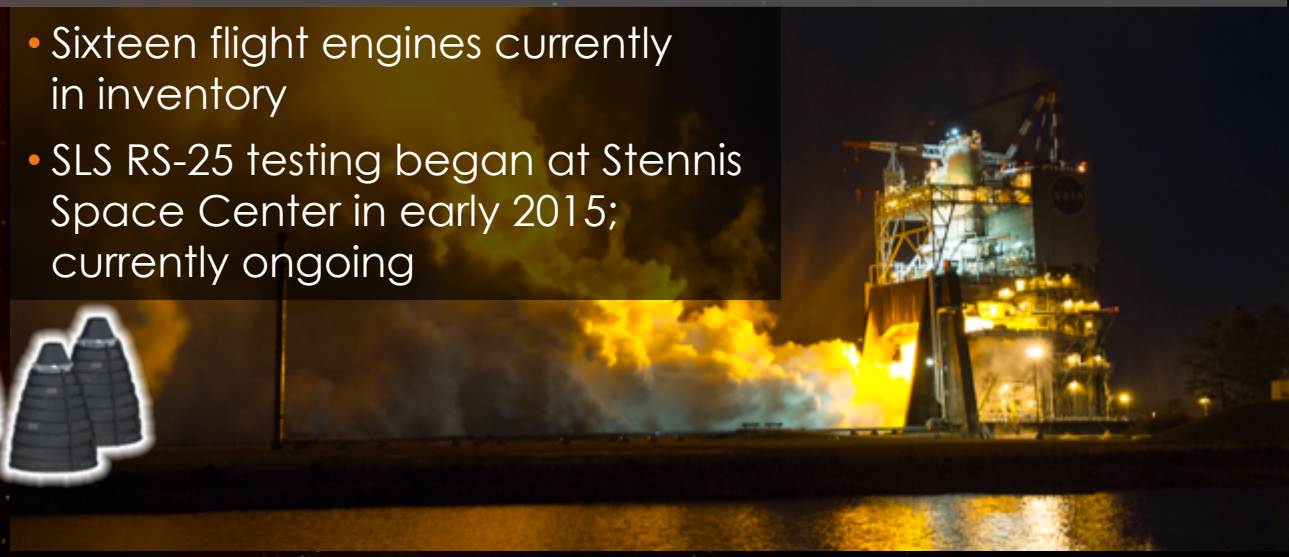


OVERVIEW

- World's most powerful, efficient and reliable liquid rocket engine
- Four Space Shuttle-heritage RS-25s
- Upgraded with new controller; engines certified at 512,000 pounds of thrust each

STATUS

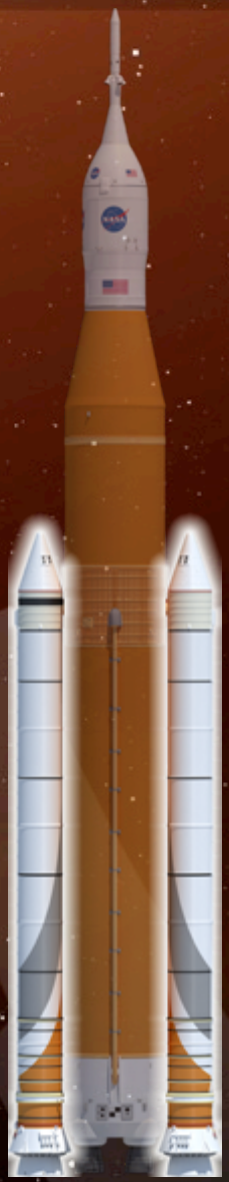
- Sixteen flight engines currently in inventory
- SLS RS-25 testing began at Stennis Space Center in early 2015; currently ongoing



LIQUID MAIN ENGINES

RS-25 Development Test
June 29 2016

SOLID ROCKET BOOSTERS



OVERVIEW

- World's most powerful solid boosters for flight
- Two Space Shuttle-heritage solid rocket boosters
- Upgraded via fifth propellant segment to 3.6 million pounds of thrust capability, and with new avionics and insulation

STATUS

- Second Qualification Motor test completed in June 2016
- Flight hardware in inventory at Kennedy Space Center; processing underway at Orbital ATK in Utah

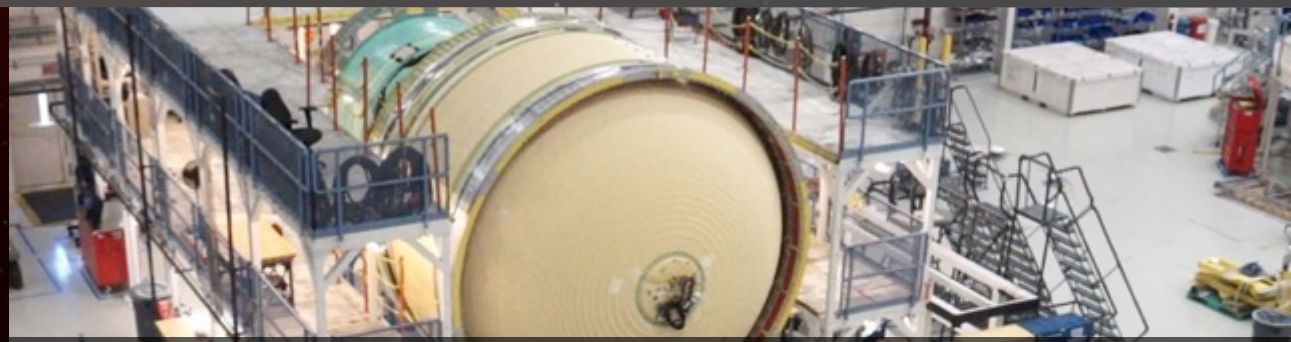
FIVE-SEGMENT SOLID ROCKET BOOSTER

UPPER STAGE AND ADAPTERS

OVERVIEW

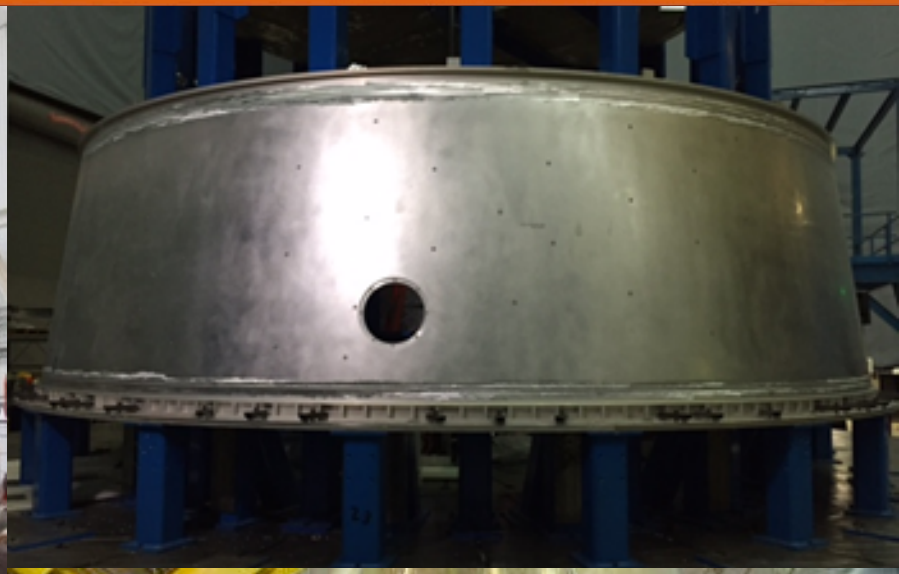
- Interim Cryogenic Propulsion Stage is derived from proven second stage of Delta IV Heavy
- Launch Vehicle Stage Adapter and Orion Stage Adapter mate ICPS to core stage and Orion, respectively

STATUS



- Orion Stage Adapter became first original SLS hardware to fly on Exploration Flight Test-1 in December 2014
- Flight in manufacture currently; test articles will begin stacking for loads testing in late 2016

UPPER STAGE AND ADAPTERS



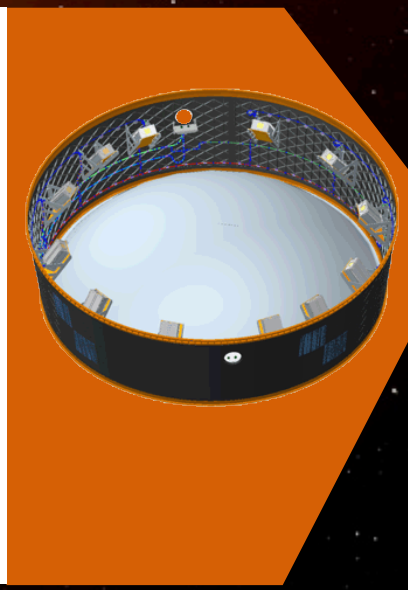
UPPER STAGE AND ADAPTERS

LVSA Manufacture

SECONDARY PAYLOAD CAPABILITY

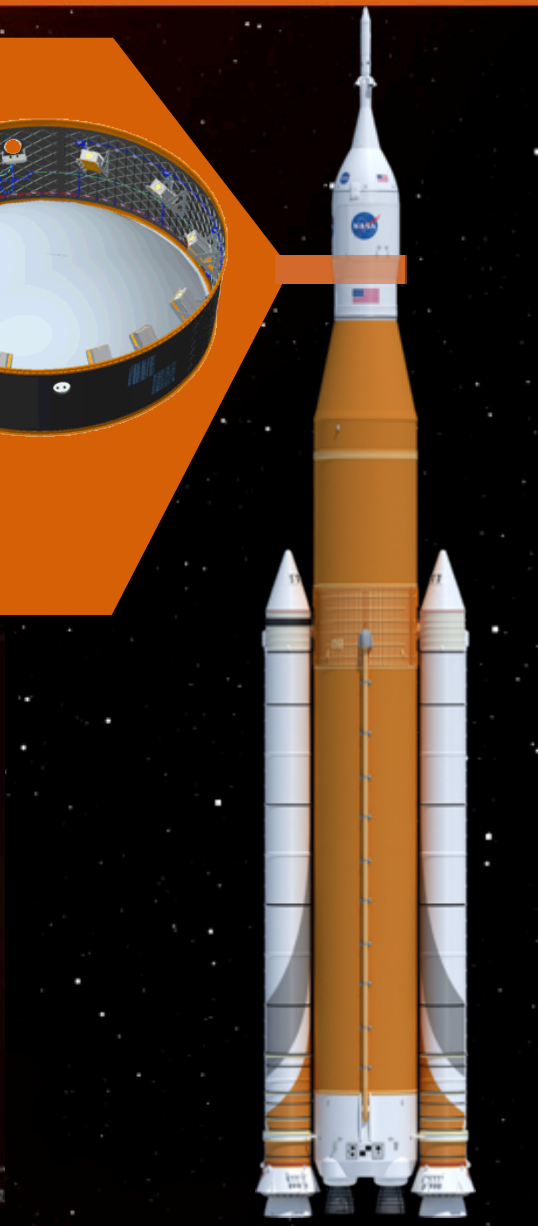
Accommodations

- SLS for Exploration Mission-1 will include thirteen 6U payload locations
- 6U volume/mass is the current standard (14 kg payload mass)



Future Capability

- Options for larger secondary payloads being evaluated



ONE LAUNCH, MULTIPLE DISCIPLINES

Along with Orion, the first SLS launch will carry 13 6U smallsats, representing multiple disciplines and partners. The smallsats will be deployed from the Orion Stage Adapter.

SUN

- CuSP (Southwest Research Institute)

EARTH

- EQUULEUS (JAXA)
- Skyfire (Lockheed Martin)

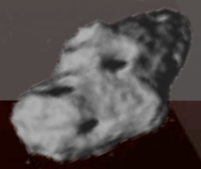
AND BEYOND

- Biosentinel (NASA)
- ArgoMoon (ESA/ASI)
- Three Centennial Challenge Winners (TBD)

MOON

- Lunar Flashlight (NASA)
- Lunar IceCube (Morehead State University)
- LunaH-Map (Arizona State University)
- Omotenashi (JAXA)

ASTEROID



- NEA Scout

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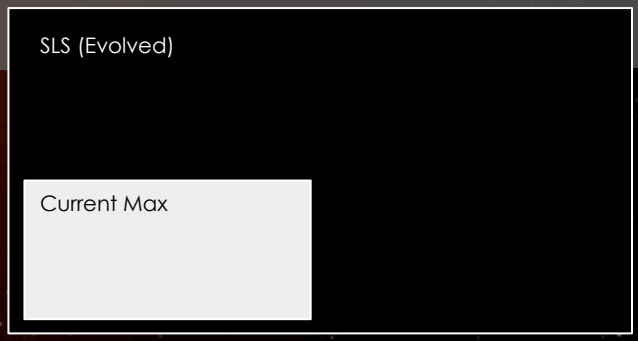
BENEFITS OF SPACE LAUNCH SYSTEM

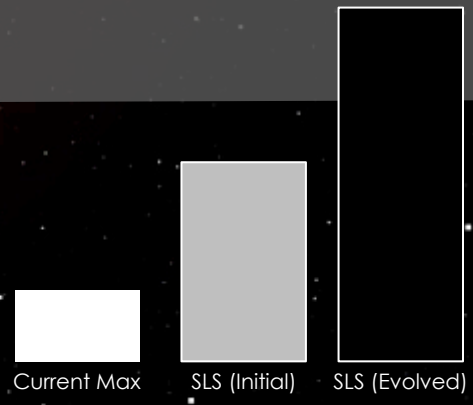
VOLUME

- Space Launch System will be able to offer payload accommodations with five times more volume than any contemporary launch vehicle
- Payload fairings of up to 10-meter diameter are planned



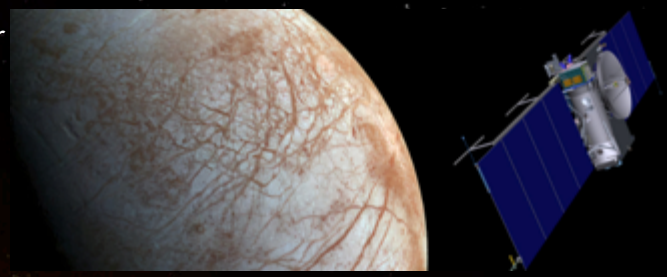
MASS

- Space Launch System will offer an initial capability of greater than 70 metric tons to low Earth orbit; current U.S. launch vehicle maximum is 28 t
- Evolved version of SLS will offer Mars-enabling capability of greater than 130 t to LEO



DEPARTURE ENERGY

- SLS offers reduced transit times to the outer solar system by half or greater
- Higher characteristic energy (C3) also enables larger payloads to destination

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