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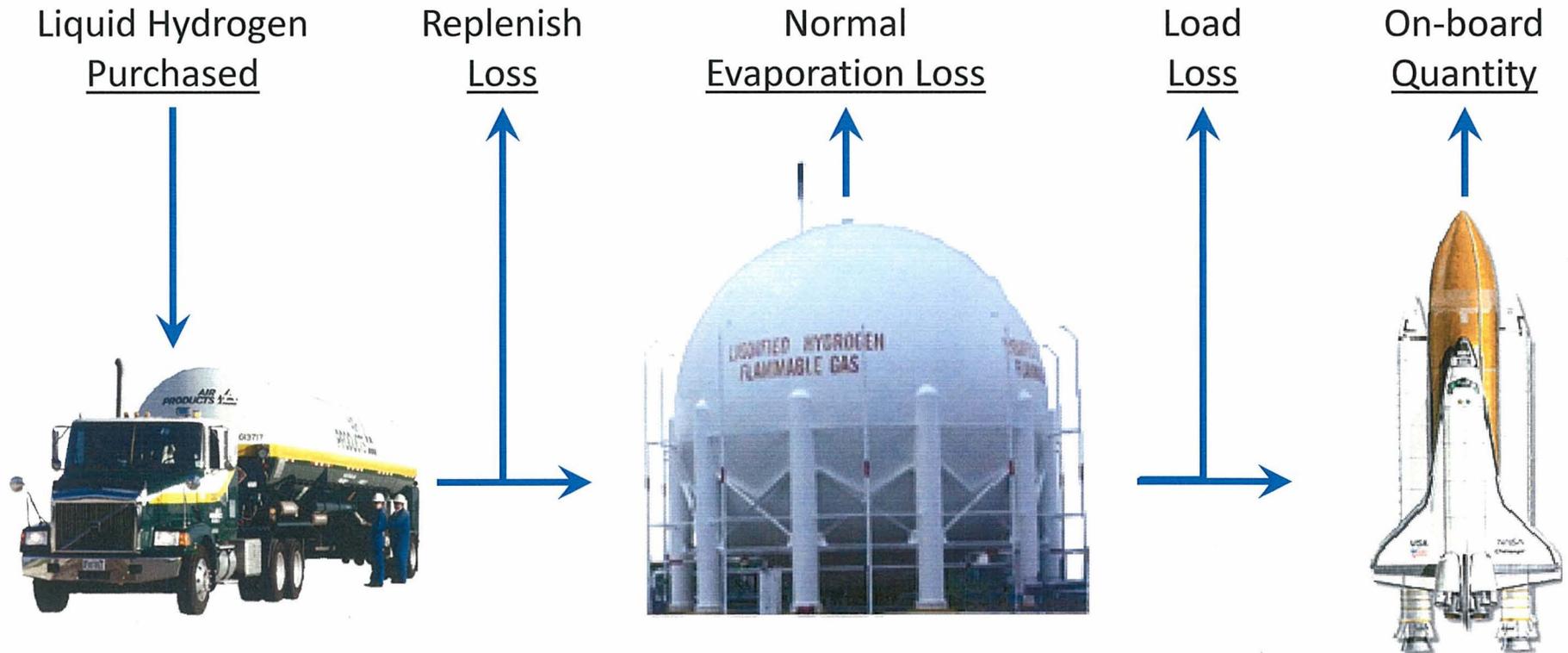
# Liquid Hydrogen Consumption During Space Shuttle Program



# Overview of Liquid Hydrogen Consumption

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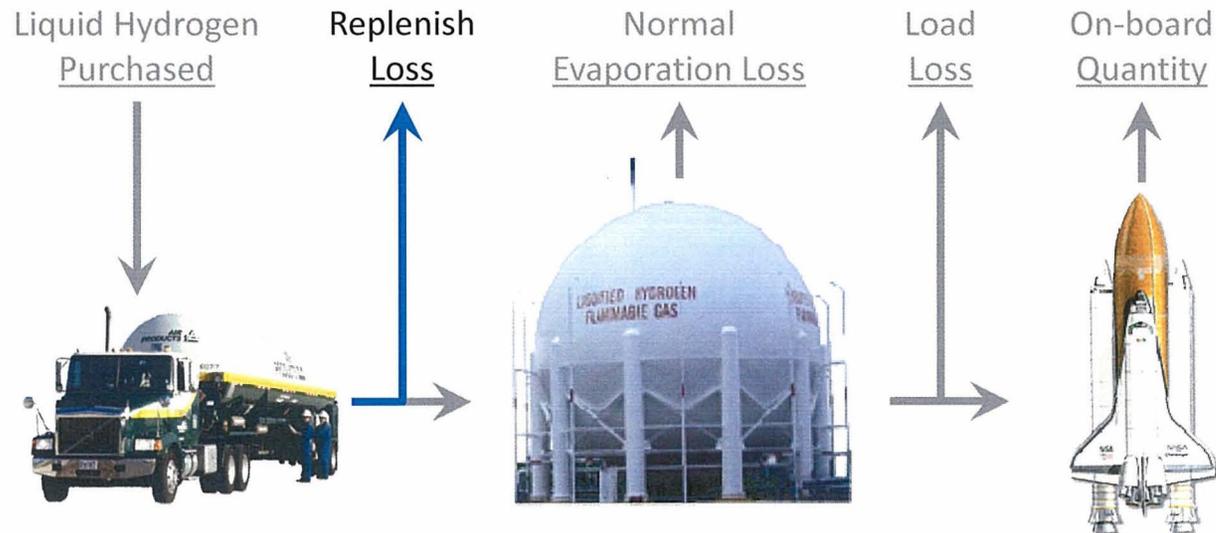
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# Replenish Loss



Replenish Loss is based on quantity of liquid hydrogen transferred to Ground Storage Tank or total amount of liquid hydrogen purchased

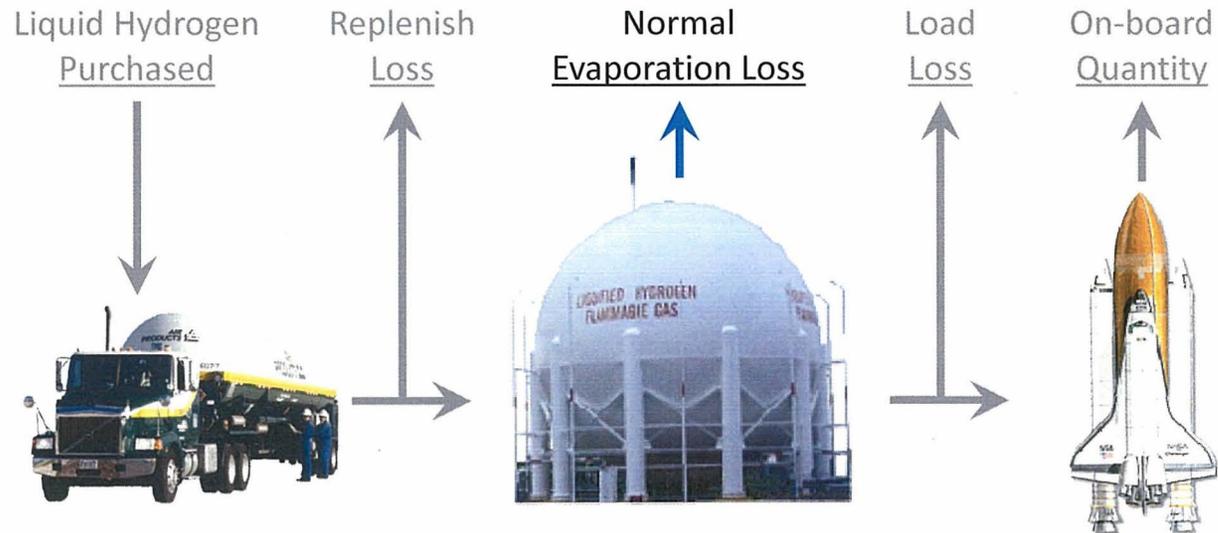
Replenish Loss occurs due to chill-down of transfer system and tanker pressurization.

Replenish Loss is approximately 13%



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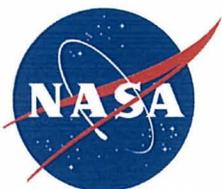
# Normal Evaporation Loss



Normal Evaporation Loss occurs due to the heat transferred from the ambient to the Ground Storage Tank, which results in liquid hydrogen evaporation

Normal Evaporation Loss is dependent upon time and heat gain rate.

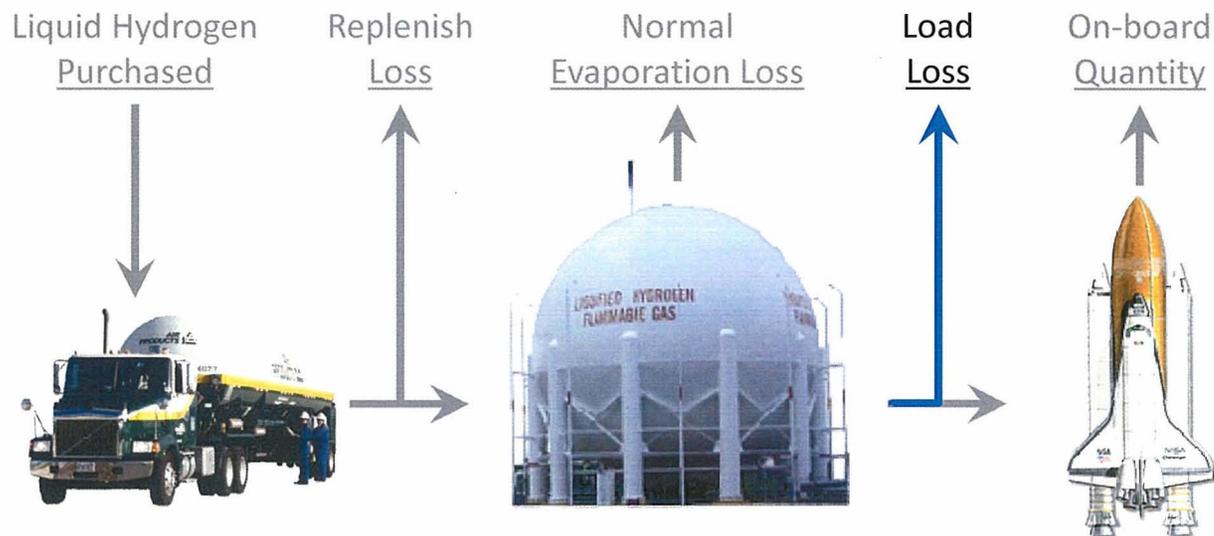
Normal Evaporation Loss resulted in approximately 12% of the total liquid hydrogen purchased over the entire Space Shuttle Program.



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# Load Loss



Load Loss occurs due to: (1) chill-down of ground system, (2) chill-down of flight system, and (3) evaporation through External Tank during stable replenishment

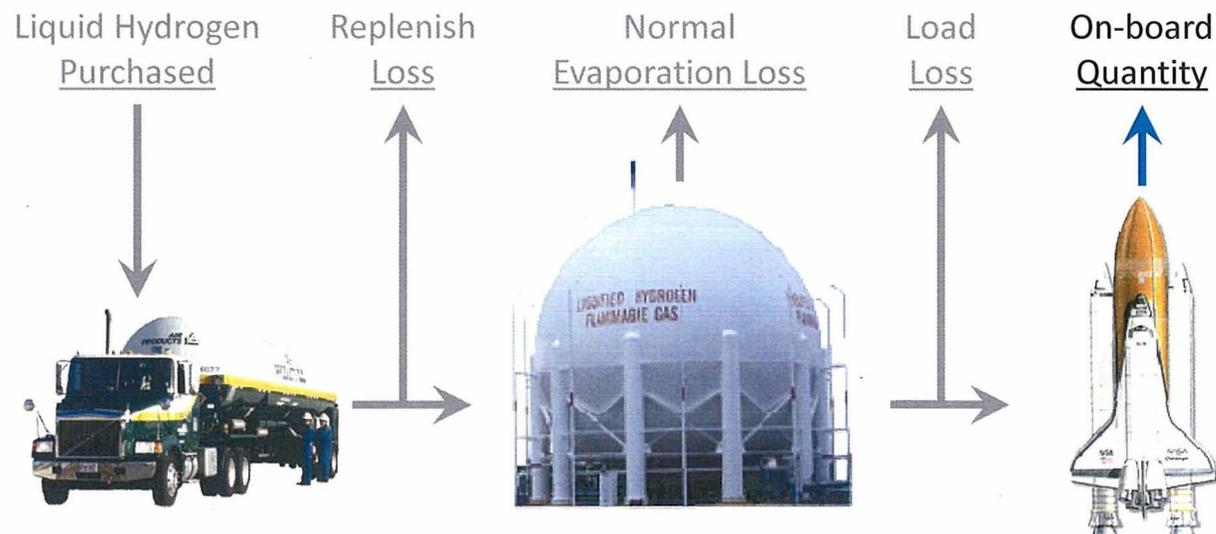
Load Loss is dependent upon number of occurrence (launch, scrub, tanking test, Flight Readiness Firing)

Load Loss resulted in approximately 21% of the total liquid hydrogen purchased over the entire Space Shuttle Program.



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# On-board Quantity



On-board Quantity is the volume of the External Tank

On-board Quantity is dependent upon number of launches

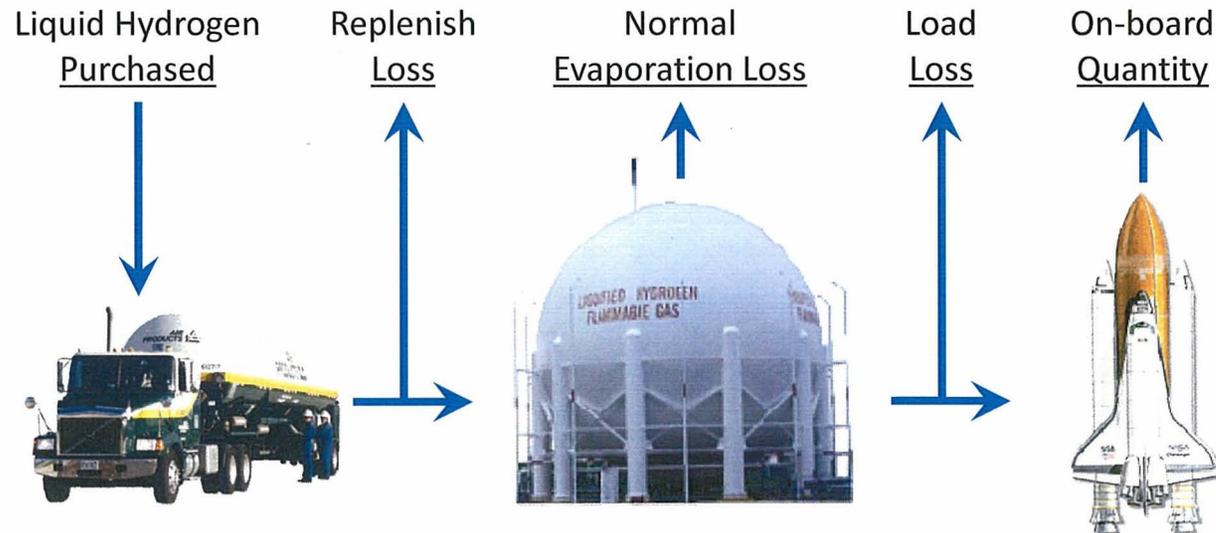
On-board Quantity resulted in approximately 55% of the total liquid hydrogen purchased over the entire Space Shuttle Program.



# Historical Consumption Summary

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## Liquid Hydrogen Consumption over Entire Space Shuttle Program

Liquid Hydrogen Purchased	100.0%	54,200,000 lb
Replenish Loss	12.6%	6,800,000 lb
Normal Evaporation Loss	12.2%	6,600,000 lb
Load Loss	20.6%	11,200,000 lb
On-board Quantity	54.6%	29,600,000 lb