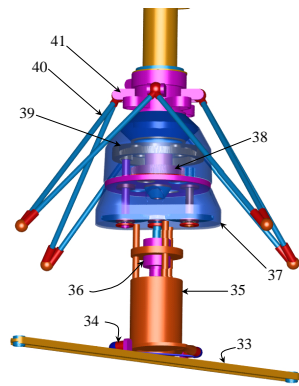
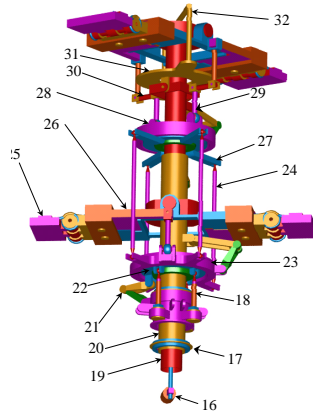


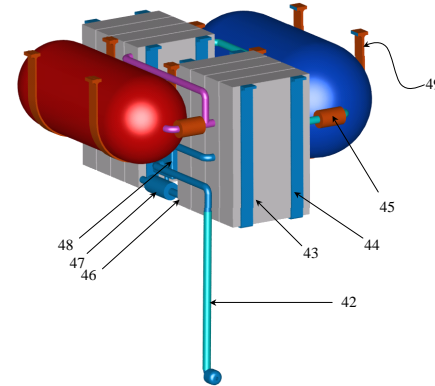
**Landing Gear Deployment Linkages**



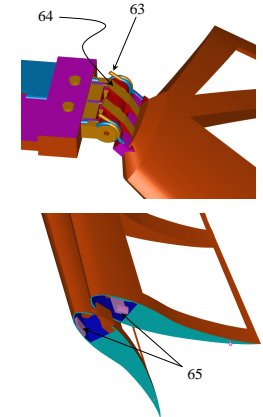
**Transmission and Suspension**



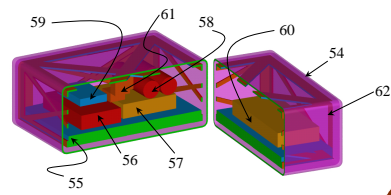
**Hub and Control System**



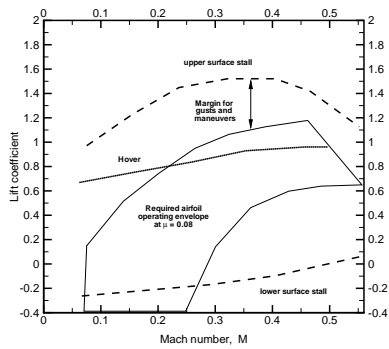
**Fuel Cell System**



**Blade Deployment Systems**



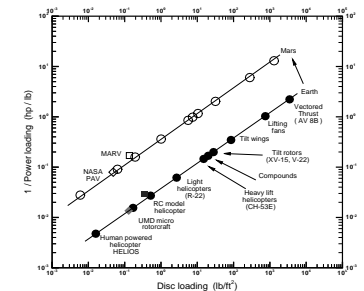
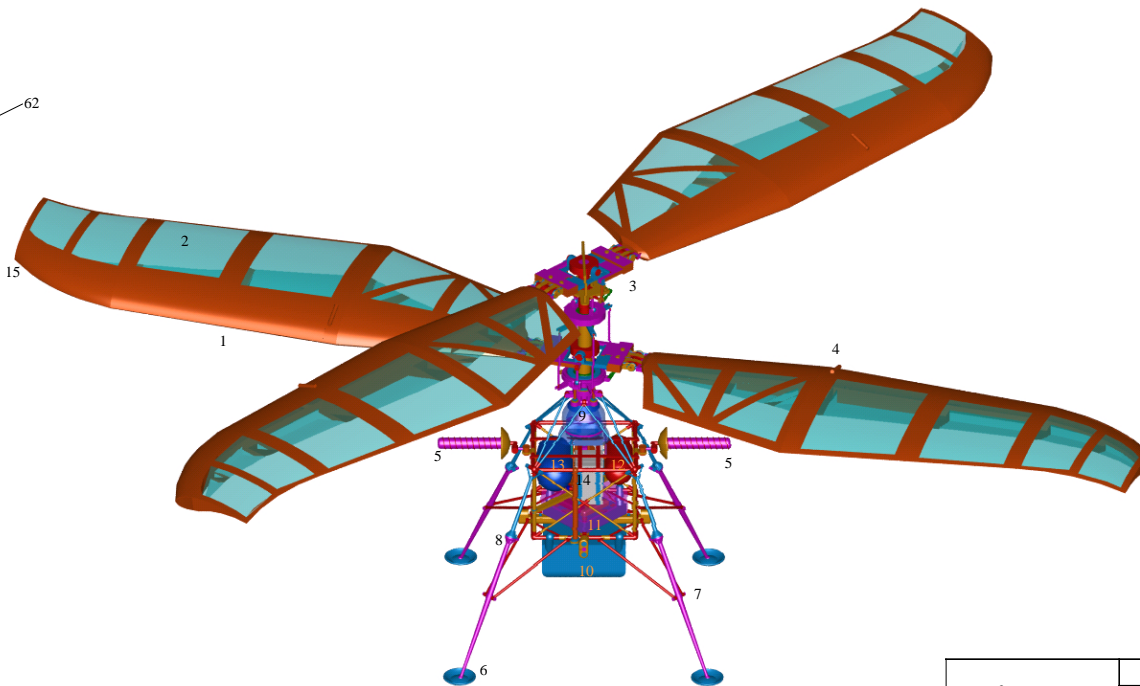
**Avionics and Navigation Package**



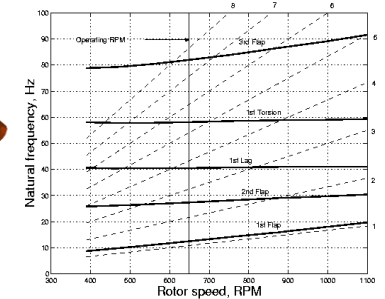
**Operating Envelope**

**MARV, cutaway drawing key**

- |  |  |                               |                                     |                                    |
|--|--|-------------------------------|-------------------------------------|------------------------------------|
| 1. Fully composite rotor blade               | 14. Fuel cell system (see detail)      | 27. Upper control swashplate  | 40. Lift transfer links to fuselage | 53. Hinged landing gear attachment |
| 2. Ultrathin Mylar skin                      | 15. Swept tip for constant Mach number | 28. Upper rotating swashplate | 41. Fuselage attachment hard point  | 54. Aerogel insulation             |
| 3. Hub and control system (see detail)       | 16. Yaw actuator                       | 29. Pitch control link        | 42. Heated water exhaust            | 55. Flight computer                |
| 4. Midspan blade deployment hinge            | 17. Outer shaft lower bearing          | 30. Yaw fork link             | 43. Fuel cell stacks                | 56. Data multiplexer               |
| 5. Directional UHF antennas and actuator     | 18. Cyclic and collective actuators    | 31. Yaw actuation disk        | 44. Stack attachment                | 57. Transceiver                    |
| 6. Landing gear foot pads                    | 19. Inner shaft                        | 32. Yaw control linkages      | 45. Fuel valve                      | 58. Backup batteries               |
| 7. Secondary support studs                   | 20. Outer shaft                        | 33. Motor torsion support     | 46. Cell unit (8 modules)           | 59. Computerized compass           |
| 8. Landing gear deployment hinge(see detail) | 21. Torque link                        | 34. Elastomeric bushing       | 47. Humidizer                       | 60. Temperature sensor             |
| 9. Gearbox (see detail)                      | 22. Non-rotating swashplate            | 35. Aveox brushless DC motor  | 48. Water reservoir                 | 61. Gyroscopes                     |
| 10. Main payload bay                         | 23. Lower rotating swashplate          | 36. Clutch                    | 49. Tank attachment                 | 62. Heated container               |
| 11. Main avionics bay                        | 24. Swashplate links                   | 37. Gearbox casing            | 50. Pawl latch                      | 63. Deployment torsion spring      |
| 12. Liquid O <sub>2</sub> tank               | 25. Blade deployment hinge             | 38. Inner shaft spur gear     | 51. Torsion spring                  | 64. Positive hinge lock            |
| 13. Liquid H <sub>2</sub> tank               | 26. Compact feathering door hinge      | 39. Outer shaft spur gear     | 52. Primary support strut           | 65. Pawl locking mechanism         |



**Design Space Envelope**



**Rotor Frequency Plot**

<b>Performance at mission gross take off mass</b>	Maximum cruise speed	11.5 m/s	
	Maximum vertical rate of climb	2.5 m/s	
<b>Power plant PEM Fuel cell stack</b>	Range	25 km	
	Endurance	39 minutes	
	Average power output	4.63 kW	
<b>Mass</b>	Maximum power output	6.43 kW	
	Maximum take off mass	50 kg	
<b>Major dimensions</b>	Payload	10.8 kg	
	Deployed	Rotor diameter	4266 mm
		Height from ground level	1510 mm
	Retracted	Folded rotor diameter	1520 mm
		Height from ground level	1338 mm
	Inter rotor spacing	340 mm	



**THE MARTIAN AUTONOMOUS ROTARY-WING VEHICLE (MARV)**

