

Parker solar probe  
transiting the sun

## ACTIVE THERMAL CONTROL SYSTEMS

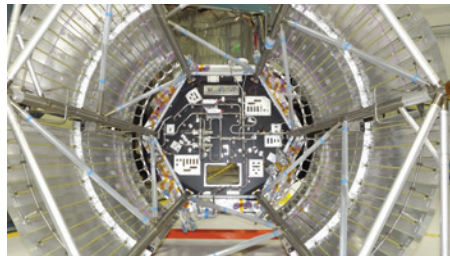
# TAMING THE HARSHTEST ENVIRONMENTS

## Cooling the closest thing to the sun

### The Parker Solar Probe

When our partners at Johns Hopkins Applied Physics Lab wanted to study our brightest star up close and personal – Collins Aerospace was there. Our team discovered they could keep NASA's Parker Solar Probe cool using the Earth's iconic life-enabling building block – water.

As a result of our rigorous design, manufacturing and testing procedures, Collins' innovative solutions enabled the Parker Solar Probe to remain cool enough to become the closest thing to the sun. Our team is also behind the proven thermal control designs on crewed elements like the Orion spacecraft and commercial satellites.



Parker Solar Probe Active Thermal Control System  
from Collins Aerospace, Windsor Locks, CT

### We're serious about longevity – balanced with budget

You value reliability, and we do too. Some of our pumps flying on the International Space Station are almost old enough to rent a car! But we know you need affordability and flexibility too.

### Modular. Proven. Available.

Collins' modular families of proven systems enable us to build custom or off-the-shelf solutions for your application. Our experience expands across many platforms including crewed systems, commercial broadband satellites and deep space exploration systems.

## KEY FEATURES AND BENEFITS

- New two-phase thermal control is lighter, smaller and more efficient for high heat load applications
- Highly reliable pumps exceed 15-year operating life
- Qualified for crewed or uncrewed applications
- Flight-qualified suite of hardware delivered faster than ever before

# Collins Active Thermal Control Systems

## APPLICATIONS

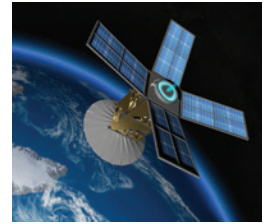
High power photovoltaic systems and electronics

Very high throughput satellites

Space laser payloads LIDAR and communication

Multi-beam active antenna payloads

Electric propulsion



## NEEDS

- High heat flux (>10 W/cm<sup>2</sup>)
- Spatial and temporal isothermality (±1° C)
- High heat loads (1 to 150 kW)
- Long transport distances (> 10 m)
- Multiple heat loads with varying duty cycles
- High reliability
- Long operating life (> 15 years)

## COLLINS PRODUCTS

- Compact heat exchangers and cold plates
- Phase change materials
- Pumps
- Accumulators/tanks/phase separators
- Valves
- Single phase and multi-phase fluid loops

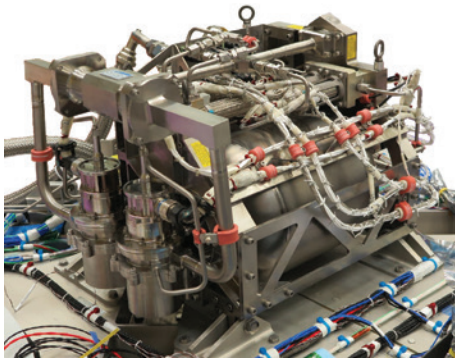
## The best match for your thermal control needs

Collins has a wide range of flight-proven capabilities in every thermal control family, as shown below. The solution family type marked "Best" is Collins' recommendation as the outstanding performer for each benefit/feature.

BENEFIT/FEATURE	PASSIVE TWO-PHASE	ACTIVE SINGLE-PHASE	ACTIVE TWO-PHASE
Heat rejection capability	Limited	Good	Best
System architecture flexibility	Limited	Best	Best
Independent of gravity	Limited	Best	Good
Heat flux	Acceptable	Good	Best
Temperature uniformity	Acceptable	Acceptable	Best
Power consumption	Best	Acceptable	Good
System mass	Best	Acceptable	Good
System complexity	Best	Good	Acceptable

## Available space pumps

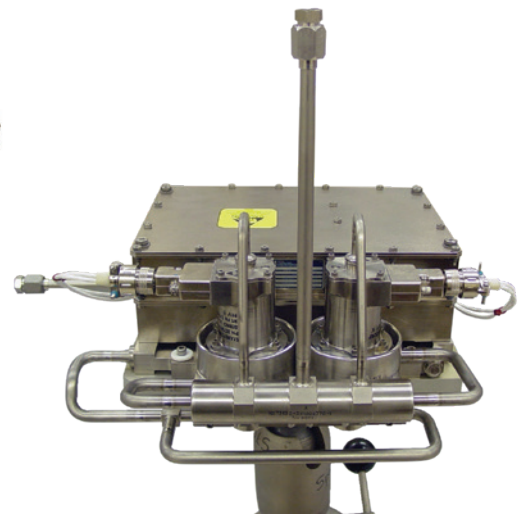
PROGRAM	PUMP TYPE	FLUID	FLOW (GPM)	PRESSURE RISE (PSID)	POWER TYPE	TRL
Space Shuttle	Centrifugal, radial, drilled hole	Freon	3.7	63.6	115 Vac 400 Hz	9
Spacelab	Freon	Freon	4.3	46.5	115 Vac 400 Hz	9
EVA space suit	Centrifugal, radial	Water	0.40	3.0	28 VDC	9
ISS EATCS (PCVP)	Mixed flow	Ammonia	26.5	52.5	120 VDC	9
ISS EEATCS (PFCS)	Centrifugal, radial, 3d blade	Ammonia	5.10	18.0	120 VDC	9
Ammonia pump and accumulator package	Centrifugal, Barske	Ammonia	0.54	7.2	28 VDC	9
Orbital express	Gear	Hydrazine	1.00	52.3	28 VDC	9
Parker Solar Probe	Centrifugal, Barske	Water	1.58	21.2	28 VDC	9
Orion liquid cooling garment Loop	Centrifugal, Barske	Water	1.00	8.7	120 VDC	6
Orion crew ATCS	Centrifugal, 2-stage Barske	PGW	0.40	29.4	120 VDC	9
Orion service module ATCS	Centrifugal, Barske	HFE7200	2.30	34.0	120 VDC	7
Commercial satellite	Centrifugal, Barske	Ammonia	0.80	21.0	100 VDC	6



Active thermal cooling for service module



Pump and accumulator system for crewed capsule



Ammonia pump loop and controller for satellite cooling

## Available accumulators

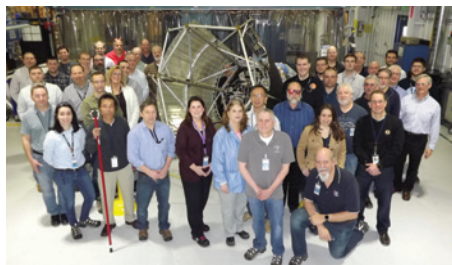
PROGRAM	APPLICATION	FLUID	FLUID CAPACITY (GALLONS)	DRY MASS (LB)	OPERATING PRESSURE (PSI)	TRL	QUALIFICATION STATUS	FLIGHT STATUS
IR&D	Multi fluid pump pkg	F114, H2O, glycol	0.4	10.56	43.5	9	Qualified	Flown
Orion MPCV	CM ATCS accumulator	PGW	0.4	17.38	79.75	9	Qualified	Flown
CST-100 (FCS)	ATCS accumulator	Galden	1.1	11	34.8	8	Qualified	Pending
Parker Solar Probe	SACS accumulator	Water	1.1	13.2	400.2	9	Qualified	Flown
Orion MPCV	SM ATCS accumulator	HFE7200	1.2	11	159.5	8	Qualified	Pending
Orion MPCV	Urine storage tank	Urine	1.5	18.04	14.5	6	In Design	Pending
Space Station	PVTCS thermal control	Ammonia	2.5	21.56	449.5	9	Qualified	Flown
Ammonia Pump & Accumulator	Ammonia pump package	Ammonia	7.1	37.84	427.75	9	Qualified	Flown
Space Shuttle	Freon pump pkg	Freon 21	7.2	24.42	259.55	9	Qualified	Retired
Space Station	Water storage tank	Potable water	15.2	67.98	30.45	9	Qualified	Flown
Space Shuttle	Water spray boiler	Water	16.8	47.08	37.7	9	Qualified	Retired

ATCS – Active Thermal Control System

PVTCS – Photovoltaic Temperature Control System

SACS – Solar Array Cooling System

## Our team and capabilities



Parker Solar Probe Active Thermal Control - Windsor Locks Team

Our Windsor Locks campus features more than 25,000 square feet of assembly and test cells including:

- Proof/burst/leak chambers
- Thermal vacuum chambers
- Launch vibration tables
- Electrical qualification testing
- EMI/EMC test facilities
- Analytical chemistry labs
- Functional performance test rigs

Workforce growth since 2019:

- Engineers added: 150+
- Technicians increased by 66%
- Production resources increased by 30%
- Suppliers added: 15+

Special fluids that we work with include:

- Anhydrous ammonia
- Glycols
- Refrigerants
- Liquid H2
- High pressure O2

Specifications subject to change without notice.



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