In spacecraft design, the **Thermal Control System** (**TCS**) has the function to keep all the spacecraft parts within acceptable temperature ranges during all mission phases, withstanding the external environment, which can vary in a wide range as the spacecraft is exposed to deep space or to solar or planetary flux, and rejecting to space the internal heat dissipation of the spacecraft itself.

The thermal control is essential to guarantee the optimum performance and success of the mission, because if a component encounters a temperature which is too high or to low, it could be damaged or its performance could be severely affected. Thermal control is also necessary to keep specific components (such as optical sensors, atomic clocks, etc.) within a specified temperature stability requirement, to ensure that they perform as efficiently as possible.

The thermal control subsystem can be composed both of passive and of active items and works in two ways:

- protects the equipment from too hot temperatures, either by thermal insulation from external heat fluxes (such as the Sun or the planetary infrared and albedo flux), or by proper heat removal from internal sources (such as the heat dissipated by the internal electronic equipment).
- protects the equipment from too cold temperatures, by thermal insulation from external sinks, by enhanced heat absorption from external sources, or by heat release from internal sources.

Passive Thermal Control System (**PTCS**) items include:

- multi-layer insulation (MLI), which protects the spacecraft from excessive solar or planetary heating as well as from excessive cooling when exposed to deep space
- coatings that change the thermo-optical properties of external surfaces
- thermal fillers to improve the thermal coupling at selected interfaces (for instance on the thermal path between an electronic unit and its radiator)
- thermal washers to reduce the thermal coupling at selected interfaces
- thermal doublers to spread on the radiator surface the heat dissipated by equipment
- mirrors (secondary surface mirrors, SSM, or optical solar reflectors, OSR) to improve the heat rejection capability of the external radiators and at the same time to reduce the absorption of external solar fluxes
- radioisotope heater units (RHU), used by some planetary and exploratory missions to produce and store electrical power for TCS purposes

Active Thermal Control System (**ATCS**) items include:

- thermostatically controlled resistive electric heaters to keep the equipment temperature above its lower limit during the mission cold phases
- fluid loops to transfer the heat dissipated by equipment to the radiators. They can be:
  - single-phase loops, controlled by a pump
  - two-phase loops, composed of heat pipes (HP), loop heat pipes (LHP) or capillary pumped loops (CPL)
- louvers (which change the heat rejection capability to space as a function of temperature)
- thermoelectric coolers