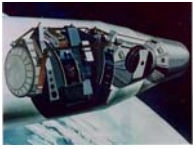


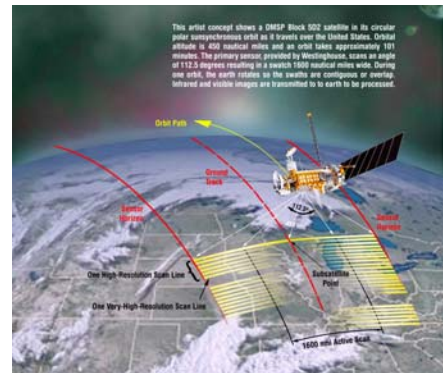
## Origins of DMSP (Defense Meteorological Program)



In the early 1960's, the National Reconnaissance Office (NRO) initiated a program using low altitude satellites as an interim measure to collect cloud cover images. The program was to support the operational needs of Corona, a series of satellites, first successfully launched in 1960, that used film to capture images of the USSR. The film was returned to Earth in a re-entry capsule. NRO wanted to preserve film by using it only when their areas of interest were cloud free. To accomplish this goal, a number of low altitude satellites were flown in conjunction with the Corona satellites. They were equipped with sensors - television cameras developed by RCA - to provide up to date meteorological information in support of Corona. Identified as Block 1 through 4, the program went under several code names because of the secret nature of the operations. The program eventually became known as the Defense Meteorological Satellite Program (DMSP)

## Primary Space Sensor Developed

In 1966, Westinghouse developed a new type of sensor, identified as the Block 5A. This sensor made use of a rotating telescope which collected data line by line as the satellite passed over the target area. The sensor made use of three detectors, two silicon dioxide detectors in the visible spectrum and a [Bolometer](#) detector to collect infrared data. The silicon detectors provided images in the visible spectrum with resolution of about 0.3 and 1.5 miles. The infrared detector provided data with a resolution of about 1.5 miles. The visible detectors provided detailed images of cloud cover, while the infrared detector added information about cloud height and the type of clouds present. The infrared detector collected relative temperature data and was able to identify the cooler tops of the higher clouds. The low resolution visible channel and the infrared channel together provide coverage at night.

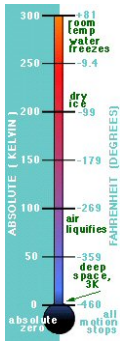


## The Mystery Device – A Passive Cooler

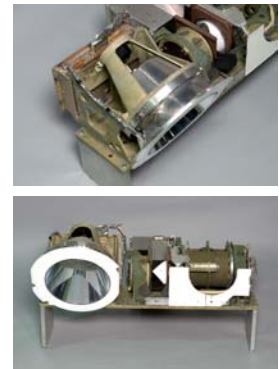


A new high resolution infrared detector that matched the high resolution visible detector was added to the upgraded Block 5B in 1970. This was accomplished through the use of a tri-metal detector (Mercury/cadmium/telluride), which can only function at extremely cold temperatures. Normal methods to achieve such a cold temperature, 100 Kelvin (-279 degrees F), involved either a mechanical or [Peltier](#) cooler both require excessive amounts of electrical power or the use of a consumable cryogenic material such as liquid Hydrogen. Neither solution was feasible in the limited carry capacity of a satellite, so our mystery device, the **Passive Radiator Cooler**, was developed by Arthur D. Little under contract to Westinghouse and the U.S. Air Force. This cooler has since been used on the Block 5 C, D and NASA/NOAA satellites, several of which are still in use.

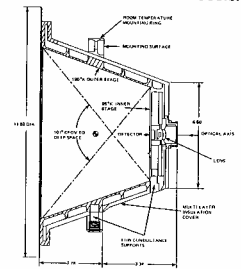
## You Could Keep Your Beverage Cold in Space



The Passive Radiator Cooler (PRC) makes use of the satellite's ability to point the polished cone and white radiators toward deep space at all times. Deep space has a background temperature of about 3 degrees above absolute zero (-459.69 degrees F). A thermally isolated object in space with no heat source would cool to that temperature. However, a satellite receives heat energy from the Sun, Earth, Moon, and any electrical power used on board. This heat energy can prevent the detector from reaching the critical temperature. The PRC cools the detector to its operating temperature through an ingenious series of paints, reflectors, and glass balls. The white surface on the outside of the PRC has a finish designed to maximize reflection and minimize the absorption of heat from the Sun, Earth, and Moon. This finish alone will cool the PRC to about 40 degrees below zero but the PRC is a two stage cooler. Pointed to deep space, the polished surface of the outer stage is designed to reflect any remaining heat energy from exposure to the Earth, Moon back into space, preventing any heat load on the inner stage. The inner stage is isolated thermally from the outer stage and since it can only see deep space, it quickly cools to about 100 Kelvins (-279 degrees F). The detector is mounted on this stage, connected to the electronics sensor by two very small gold leads that give only a small conducting path to the spacecraft. In this way the detector is cooled to its proper operating temperature.



Thermal Channel Radiator Cooler



## The Incredible Shrinking Cooler

One of the most intriguing aspects of the PRC is the way the stages are isolated from one another. The stages are supported by a series of small glass balls that provide excellent thermal isolation; however, this mechanical support could not survive the rough launch environment. To overcome this, at launch, when the cooler is at normal temperature, the two cooler stages set firmly on machined surfaces. In space, the outer stage starts to cool, and contract lifting it off the machined surface. The inner radiator can then begin to cool and it also lifts off the hard surface. Then, both the inner and outer surfaces are suspended by the thermally isolating system of glass balls.

## Learn More

For more information on the DMSP program visit <http://dmisp.ngdc.noaa.gov/dmisp.html>.

## **Definitions:**

### **Peltier Effect:**

The effect is the phenomenon whereby the passage of an electrical current through a junction consisting of two dissimilar metals results in a cooling effect. When the direction of current flow is reversed heating will occur.

### **Bolometer:**

A bolometer is a device for measuring incident electromagnetic radiation.

It consists of an "absorber", which is connected to a heat sink (area of constant temperature) through an insulating link. The result is that any radiation absorbed by the absorber raises its temperature above that of the heat sink - the higher the power absorbed, the higher the temperature will be. Temperature differences are normally measured by thermocouples.