MAGNETIC DIPOLE ALLOCATION

Practice:

Magnetic dipole allocation is an empirical method for initiating control of spacecraft magnetic contamination. The practice is necessary for missions which incorporate instruments to measure low level magnetic fields.

Benefit:

Control of the net magnetic dipole of the spacecraft will assure the integrity of magnetic field measurements made during the mission.

Measurement of the individual contributions from various assemblies, subassemblies, and components allows the identification of the major dipole sources. The major contributors can then be evaluated for corrective action, and they can be monitored individually to assure that they are at the lowest level of magnetization at the time of installation on the spacecraft.

Programs That Certified Usage:

Mariner, Voyager, Galileo, Ulysses, and Cassini

Center to Contact for Information:

Jet Propulsion Laboratory (JPL)

Implementation Method:

Divide the spacecraft into several groups which will most likely contain significant magnetic moment sources. Divide the total magnetic field cleanliness allocation by the number of groups to determine the total allotment for each group. If possible, divide each group into a number of equal components and, again, assign equal amounts of the group magnetic moment allotment to each component.

Determine the distance between the geometric center of each group and the effective center of the scientific magnetometer.

Using the relationship:

$B = B_t\left(\frac{g}{r}\right)^3$, calculate the allocation for each component, where:

B = magnetic field allocation of a component in a group at 1 meter expressed in nanoTeslas (nT),

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B_t = total magnetic field allocation at sensor (nT),
r_g = distance between group geometric center and sensor (meters),
r_r = reference distance, 1 meter,
m = number of components in the group, and
n = number of groups with significant magnetic moment.

When the dipole moment of a component unavoidably exceeds the allocation, the techniques described in *Magnetic Design Control for Space Instruments*, Practice No. PD-ED-1207, can be invoked to meet the allocation. These techniques include:

1. Addition of magnetic shielding,
2. Addition of compensation magnets,
3. Redesign of DC current paths to reduce loop area,
4. Replacement of ferromagnetic parts with non-magnetic parts.

Technical Rationale:

By using this technique, the design and test of each subsystem can proceed independently with the assurance that the end result will meet the spacecraft magnetic cleanliness requirement.

Impact of Non-Practice:

After spacecraft assembly, the self-produced magnetic field may be higher than tolerable and result in a bias at the magnetometer sensor. Unless a test facility is available to measure the magnetic moment of the assembled spacecraft, this condition cannot be detected until after launch.

Related Practices:

1. *Magnetic Design Control For Space Instruments*, Practice No. PD-ED-1207,
2. *Magnetic Field Restraints For Spacecraft Systems and Subsystems*, Practice No. PD-ED-1222