

A Spreadsheet for Preliminary Analysis of Spacecraft Power and Temperatures (SSC16-P1-04)

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For Systems Engineers and Students:

Configuration Options & 'Reality Checks' for Complex Thermal Analysis Programs.

Assumptions:

Circular Orbit

One of Two Fixed Attitudes: Vertical or Horizontal

Inputs:

Altitude

Mass

Surface Dimensions

Thermal Properties

Electrical Power System parameters: efficiencies, degradation, battery depth of discharge and solar cell packing factors

Solar Position (beta angle) and Intensity

Planet IR

Albedo

Equipment Power Dissipation (sunlight and eclipse)

Outputs:

Min. / Max. / Avg. Temperatures.

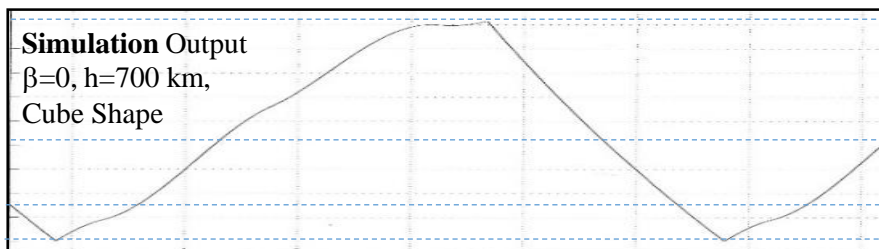
Required battery capacity

Maximum Supportable Power Load

Simulation Output

$\beta=0$, $h=700$ km,

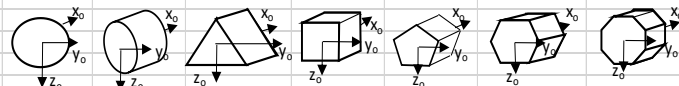
Cube Shape



INPUT: Orbit, Thermal & Power System Data					
Beta angle ~deg	0	Altitude~km	700	Solar cell efficiency	0.25
Solar flux ~W/m ²	1317	Planet equator radius~km	6378.14	Inherent degradation	0.85
Planet IR ~W/m ²	217	Sunlight equip't pwr ~W	200	8yr Life degradation	0.961
Albedo coefficient	0.22	Eclipse equip'mt pwr ~W	200	Xd, daylight drt. energy xfer	0.85
Mass~kg	130	Absorptivity	0.85	Xe, eclipse drt. energy xfer	0.65
Heat cap. ~W.s / kg / K	900	Emissivity	0.9	SA panels packing factor	0.9
Planet GM~km ³ /s ²	398600.4	Battery DOD	0.35	Battery xfer efficiency	0.9

INPUT: Spacecraft Geometry							
X-section Shape	Sphere	Cylinder	Triangle	Square	Pentagon	Hexagon	Octagon
X-section O.D. ~m	1.0	1.0	1.0	1.414	1.0	1.0	1.0
Length ~m		1.5	1.5	1.0	1.5	1.5	1.5

HORIZONTAL ATTITUDE



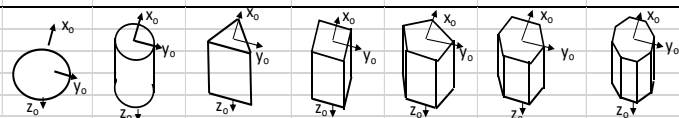
Output Temperature Data

Upper Temperature ~ °C	14.0	6.3	5.7	3.3	5.8	7.0	4.3
Ave. Temperature ~ °C	8.6	-3.5	-2.1	-5.0	-3.1	-2.4	-4.8
Lower Temperature ~ °C	2.6	-14.6	-9.9	-15.0	-12.9	-12.7	-15.0

Output Power Data

Peol - Preg'd ~ W	-10.0	132.5	26.9	103.5	90.0	109.1	104.0
Total Batt Cap ~ Whr	671.8						

VERTICAL ATTITUDE



Output Temperature Data

Upper Temperature ~ °C	14.0	8.4	8.6	3.3	8.3	4.5	6.2
Ave. Temperature ~ °C	8.6	-1.2	1.2	-5.0	-0.5	-4.0	-2.8
Lower Temperature ~ °C	2.6	-12.8	-7.2	-15.0	-10.8	-14.0	-13.4

Output Power Data

Peol - Preg'd ~ W	-10.0	161.1	65.9	103.5	123.4	108.7	131.2
Total Batt Cap ~ Whr	671.8						

Spreadsheet Output

$\beta=0$, $h=700$ km,

Cube Shape

