|  |  |  |  |
| --- | --- | --- | --- |
|  | |  | | --- | | **Simulation of panel\_assembly\_test**  **Date: Thursday, April 15, 2021 Designer: Solidworks**  **Study name: Static 1**  **Analysis type: Static** | | Table of Contents  [Description 1](#_Toc69414240)  [Assumptions 2](#_Toc69414241)  [Model Information 2](#_Toc69414242)  [Study Properties 3](#_Toc69414243)  [Units 4](#_Toc69414244)  [Material Properties 5](#_Toc69414245)  [Loads and Fixtures 6](#_Toc69414246)  [Connector Definitions 7](#_Toc69414247)  [Contact Information 8](#_Toc69414248)  [Mesh information 9](#_Toc69414249)  [Sensor Details 10](#_Toc69414250)  [Resultant Forces 11](#_Toc69414251)  [Beams 11](#_Toc69414252)  [Study Results 12](#_Toc69414253)  [Conclusion 14](#_Toc69414254) | |
| Description No Data |

|  |
| --- |
| Assumptions |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Model Information  |  |  |  |  |  | | --- | --- | --- | --- | --- | | |  | | --- | |  |   ****Model name:** panel\_assembly\_test**  ****Current Configuration:** Default** | | | | | ****Solid Bodies**** | | | | | ****Document Name and Reference**** | ****Treated As**** | ****Volumetric Properties**** | ****Document Path/Date Modified**** | | **Boss-Extrude1** | **Solid Body** | ****Mass:0.0151875 kg****  ****Volume:5.625e-06 m^3****  ****Density:2,700 kg/m^3****  ****Weight:0.148838 N**** | ****C:\Users\luisa\Documents\GrabCAD\Lunar Dust Challenge\Current\Mechanical\v3\_tiz\FEA\adhesive\_test.SLDPRT****  **Apr 15 20:58:13 2021** | | **CirPattern1** | **Solid Body** | ****Mass:0.260511 kg****  ****Volume:0.000103377 m^3****  ****Density:2,520 kg/m^3****  ****Weight:2.55301 N**** | ****C:\Users\luisa\Documents\GrabCAD\Lunar Dust Challenge\Current\Mechanical\v3\_tiz\FEA\bplate\_test.SLDPRT****  **Apr 15 20:58:13 2021** | | **Fillet2** | **Solid Body** | ****Mass:0.0194472 kg****  ****Volume:1.36952e-05 m^3****  ****Density:1,420 kg/m^3****  ****Weight:0.190582 N**** | ****C:\Users\luisa\Documents\GrabCAD\Lunar Dust Challenge\Current\Mechanical\v3\_tiz\FEA\pcb\_mockup\_test.SLDPRT****  **Apr 15 20:58:13 2021** | | **Split Line1** | **Solid Body** | ****Mass:0.136575 kg****  ****Volume:2.25e-05 m^3****  ****Density:6,070 kg/m^3****  ****Weight:1.33843 N**** | ****C:\Users\luisa\Documents\GrabCAD\Lunar Dust Challenge\Current\Mechanical\v3\_tiz\FEA\tplate\_test.SLDPRT****  **Apr 15 20:58:13 2021** | |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Study Properties  |  |  | | --- | --- | | Study name | Static 1 | | Analysis type | Static | | Mesh type | Solid Mesh | | Thermal Effect: | On | | Thermal option | Include temperature loads | | Zero strain temperature | 298 Kelvin | | Include fluid pressure effects from SOLIDWORKS Flow Simulation | Off | | Solver type | FFEPlus | | Inplane Effect: | Off | | Soft Spring: | Off | | Inertial Relief: | Off | | Incompatible bonding options | Automatic | | Large displacement | Off | | Compute free body forces | On | | Friction | Off | | Use Adaptive Method: | Off | | Result folder | SOLIDWORKS document (C:\Users\luisa\Documents\GrabCAD\Lunar Dust Challenge\Current\Mechanical\v3\_tiz\FEA) | |

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Units  |  |  | | --- | --- | | Unit system: | SI (MKS) | | Length/Displacement | mm | | Temperature | Kelvin | | Angular velocity | Rad/sec | | Pressure/Stress | N/m^2 | |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Material Properties  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | ****Model Reference**** | ****Properties**** | ****Components**** | | | | | |  | |  |  | | --- | --- | | ****Name:**** | **STYCAST 2850FT/Catalyst 23LV** | | ****Model type:**** | **Linear Elastic Isotropic** | | ****Default failure criterion:**** | **Mohr-Coulomb Stress** | | ****Tensile strength:**** | **1.0549e+08 N/m^2** | | ****Compressive strength:**** | **1.19969e+08 N/m^2** | | ****Elastic modulus:**** | **9e+10 N/m^2** | | ****Poisson's ratio:**** | **0.3** | | ****Mass density:**** | **2,700 kg/m^3** | | **SolidBody 1(Boss-Extrude1)(adhesive\_test-1)** | | | | | | **Curve Data:N/A** | | | | | | | |  | |  |  | | --- | --- | | ****Name:**** | **Macor (1)** | | ****Model type:**** | **Linear Elastic Isotropic** | | ****Default failure criterion:**** | **Unknown** | | ****Yield strength:**** | **3.29e+07 N/m^2** | | ****Tensile strength:**** | **9.4e+07 N/m^2** | | ****Compressive strength:**** | **3.45e+08 N/m^2** | | ****Elastic modulus:**** | **6.69e+10 N/m^2** | | ****Poisson's ratio:**** | **0.29** | | ****Mass density:**** | **2,520 kg/m^3** | | ****Shear modulus:**** | **2.55e+10 N/m^2** | | ****Thermal expansion coefficient:**** | **8e-06 /Kelvin** | | **SolidBody 1(CirPattern1)(bplate\_test-1)** | | | | | | **Curve Data:N/A** | | | | | | | |  | |  |  | | --- | --- | | ****Name:**** | **Kapton** | | ****Model type:**** | **Linear Elastic Isotropic** | | ****Default failure criterion:**** | **Mohr-Coulomb Stress** | | ****Yield strength:**** | **6.9e+07 N/m^2** | | ****Tensile strength:**** | **2.31e+08 N/m^2** | | ****Compressive strength:**** | **2.31e+08 N/m^2** | | ****Elastic modulus:**** | **2.76e+09 N/m^2** | | ****Poisson's ratio:**** | **0.34** | | ****Mass density:**** | **1,420 kg/m^3** | | ****Thermal expansion coefficient:**** | **20 /Kelvin** | | **SolidBody 1(Fillet2)(pcb\_mockup\_test-1)** | | | | | | **Curve Data:N/A** | | | | | | | |  | |  |  | | --- | --- | | ****Name:**** | **Zirconia** | | ****Model type:**** | **Linear Elastic Isotropic** | | ****Default failure criterion:**** | **Unknown** | | ****Yield strength:**** | **1.15e+08 N/m^2** | | ****Tensile strength:**** | **1.4e+09 N/m^2** | | ****Compressive strength:**** | **2.1e+09 N/m^2** | | ****Elastic modulus:**** | **2e+11 N/m^2** | | ****Poisson's ratio:**** | **0.3** | | ****Mass density:**** | **6,070 kg/m^3** | | ****Thermal expansion coefficient:**** | **1e-06 /Kelvin** | | **SolidBody 1(Split Line1)(tplate\_test-1)** | | | | | | **Curve Data:N/A** | | | | | | | |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Loads and Fixtures**  | ****Fixture name**** | ****Fixture Image**** | ****Fixture Details**** | | --- | --- | --- | | **Fixed-1** |  | |  |  | | --- | --- | | Entities: | **1 face(s)** | | Type: | **Fixed Geometry** | | | ****Resultant Forces****   |  |  |  |  |  | | --- | --- | --- | --- | --- | | **Components** | **X** | **Y** | **Z** | **Resultant** | | **Reaction force(N)** | **-8.92021e-06** | **486** | **-3.27826e-07** | **486** | | **Reaction Moment(N.m)** | **0** | **0** | **0** | **0** | | | |  | ****Load name**** | ****Load Image**** | ****Load Details**** | | --- | --- | --- | | **Force-1** |  | |  |  | | --- | --- | | Entities: | **1 face(s)** | | Type: | **Apply normal force** | | Value: | **486 N** | | |

|  |
| --- |
| Connector Definitions No Data |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Contact Information  | Contact | Contact Image | Contact Properties | | --- | --- | --- | | Contact Set-1 |  | |  |  | | --- | --- | | Type: | **Bonded contact pair** | | Entities: | **2 face(s)** | | | ****Contact/Friction force****   |  |  |  |  |  | | --- | --- | --- | --- | --- | | **Components** | **X** | **Y** | **Z** | **Resultant** | | **Contact Force(N)** | **-9.1615E-18** | **-111.8** | **1.6805E-18** | **111.8** | | | | | Contact Set-2 |  | |  |  | | --- | --- | | Type: | **Bonded contact pair** | | Entities: | **10 face(s)** | | | ****Contact/Friction force****   |  |  |  |  |  | | --- | --- | --- | --- | --- | | **Components** | **X** | **Y** | **Z** | **Resultant** | | **Contact Force(N)** | **-6.8894E-05** | **110.17** | **0.001173** | **110.17** | | | | | Global Contact |  | |  |  | | --- | --- | | Type: | **Bonded** | | Components: | **1 component(s)** | | Options: | **Compatible mesh** | | | Component Contact-2 |  | |  |  | | --- | --- | | Type: | **No penetration (Surface to surface)** | | Components: | **4 Solid Body (s)** | | |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Mesh information  |  |  | | --- | --- | | Mesh type | Solid Mesh | | Mesher Used: | Standard mesh | | Automatic Transition: | Off | | Include Mesh Auto Loops: | Off | | Jacobian points | 4 Points | | Element Size | 0.37302 in | | Tolerance | 0.018651 in | | Mesh Quality Plot | High | | Remesh failed parts with incompatible mesh | Off |  Mesh information - Details  |  |  | | --- | --- | | Total Nodes | 26673 | | Total Elements | 13655 | | Maximum Aspect Ratio | 541.55 | | % of elements with Aspect Ratio < 3 | 18.3 | | % of elements with Aspect Ratio > 10 | 50.6 | | % of distorted elements(Jacobian) | 0 | | Time to complete mesh(hh;mm;ss): | 00:00:06 | | Computer name: |  | |  | | |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Sensor Details  | Sensor name | Location | Sensor Details | | --- | --- | --- | | Stress1 |  | Value : 5.025e+05 N/m^2  Entities :1 face(s)  Result :Stress  Component :VON: von Mises Stress  Criterion :Max over Selected Entities  Step Criterion : Across all Steps  Step No.:1  Alert Value: NA | |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Resultant ForcesReaction forces  | Selection set | Units | Sum X | Sum Y | Sum Z | Resultant | | --- | --- | --- | --- | --- | --- | | Entire Model | N | -8.92021e-06 | 486 | -3.27826e-07 | 486 |  Reaction Moments  | Selection set | Units | Sum X | Sum Y | Sum Z | Resultant | | --- | --- | --- | --- | --- | --- | | Entire Model | N.m | 0 | 0 | 0 | 0 | |
|  |

|  |
| --- |
| Beams No Data |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Study Results  | Name | Type | Min | Max | | --- | --- | --- | --- | | Displacement1 | URES: Resultant Displacement | 0.000e+00 mm  Node: 5248 | 4.280e-04 mm  Node: 24660 | | **panel\_assembly\_test-Static 1-Displacement-Displacement1** | | | |  | Name | Type | Min | Max | | --- | --- | --- | --- | | Strain1 | ESTRN: Equivalent Strain | 2.527e-11  Element: 4280 | 7.595e-05  Element: 10914 | | **panel\_assembly\_test-Static 1-Strain-Strain1** | | | |  | Name | Type | Min | Max | | --- | --- | --- | --- | | Factor of Safety1 | Mohr-Coulomb Stress | 5.528e+01  Node: 13219 | 5.323e+07  Node: 12083 | | **panel\_assembly\_test-Static 1-Factor of Safety-Factor of Safety1** | | | | |

|  |
| --- |
| Conclusion |