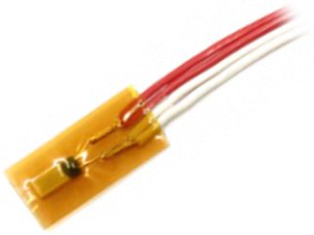
# Minco Temperature Sensors for Use in Space

*Rugged Temperature Sensors Engineered for the Demands of Space*

# Flexible Surface Mount Temperature Sensors for Space Applications

*Platinum PT100 and PT1000 RTD in Polyimide Body*



## Product Overview

Minco's flexible surface mount temperature sensors provide accurate, fast-response temperature measurements in a lightweight, low-profile design. Built with robust construction and proven materials, these sensors have an extensive history of reliable operation in spaceflight missions where durability and performance under extreme conditions are critical.

Available as commercial off-the-shelf components or fully customized designs, Minco sensors are well suited to meet demanding space application requirements. The S240880/S240881 series incorporates testing based on NASA EEE-INST-002, Section T1, Table 2, Level 2, covering the most common test parameters used for resistance temperature detectors (RTDs) in space flight applications. Section T1 establishes baseline criteria for thermistors, which is the closest applicable category for RTDs.

For over half a century, Minco has engineered rugged temperature sensors and heaters to withstand the harshest environments of space. We partner with mission teams to define and perform screening and qualification testing to meet or exceed reliability requirements. Minco offers tailored products and test plans to align with program-specific needs, including extended qualification testing per EEE-INST-002, Section T1, Table 3.

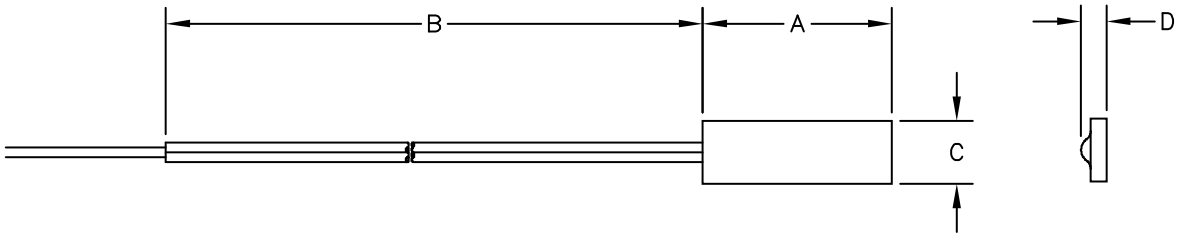
In addition to NASA-defined protocols, Minco provides testing based on ESCC Generic Specification No. 4006 (see ESCC Detail Specification Number 4006/S220185).

## Product Features

| Characteristic | Details |
|---|---|
| Temperature Range | -196°C to 200°C |
| Resistance at 0°C | 100 Ω or 1000 Ω (IEC60751 Class B) |
| Temperature Coefficient of Resistance | 0.003851 Ω/Ω/°C from 0°C to 100°C |
| Excitation Current | 1 mA MAX recommended |
| Screening Testing | Based on NASA EEE-INST-002, Section T1, Table 2 |
| Construction | Flat, flexible polyimide body for easy mounting |
| Outgassing | Meets NASA low outgassing requirements |
| Wiring Options | 2-, 3-, or 4-wire AWG 26 leads |
| Lead Customization | Variable lead length and insulation (PTFE or polyimide) |
| Configurability | Customizable specifications and screening/testing levels |

## Model Number Options

| Model Number | Body Dimensions: *C* (Width) x *A* (Length) x *D* (Thickness) | Top Shield |
|---|---|---|
| S240880 | 0.28" x 0.60" x 0.08" (7 mm x 15 mm x 2 mm) | None |
| S240881 | 0.40" x 0.80" x 0.08" (10 mm x 20 mm x 2 mm) | None |
| S240882 | 0.28" x 0.60" x 0.08" (7 mm x 15 mm x 2 mm) | 0.003" Aluminum |
| S240883 | 0.40" x 0.80" x 0.08" (10 mm x 20 mm x 2 mm) | 0.003" Aluminum |




## Specification Options

| S240880 | Model Number from Table |
|---|---|
| PD | Sensing element:<br>PD: Platinum 100 Ω +/- 0.12% at 0C IEC 60751 Class B<br>PF: Platinum 1000 Ω +/- 0.12% at 0C IEC 60751 Class B |
| Z | Number of AWG 26 leads:<br>Y = 2 leads<br>Z = 3 leads<br>X = 4 leads |
| T | Leadwire insulation:<br>T = PTFE<br>K = Polyimide |
| 40 | Lead length *B* in inches |
| A | Adhesive backing:<br>A = No adhesive<br>B = Pressure-sensitive adhesive (PSA)[1] |
| **S240880PDZT40A = Sample part number** | |

[1] PSA reduces temperature to 177°C and adds 0.002" (0.05 mm).

## Resistance/Temperature Characteristics

| Element | $R_Z$[1] | -196°C[2] | -50°C | 0°C | +25°C | +75°C | +100°C | +200°C |
|---|---|---|---|---|---|---|---|---|
| PD | Nom. (Ω) | 20.25 | 80.31 | 100.00 | 109.73 | 128.99 | 138.51 | 175.86 |
| PF | Nom. (Ω) | 202.5 | 803.1 | 1000.0 | 1097.3 | 1289.9 | 1385.1 | 1758.6 |
| PD, PF | Tol. (±%) | 5.45 | 0.27 | 0.12 | 0.15 | 0.20 | 0.22 | 0.27 |
| | Tol. (±°C) | 2.56 | 0.55 | 0.30 | 0.43 | 0.68 | 0.80 | 1.30 |

[1] $R_Z$ = Zero Power Resistance. Measured with 1 mA maximum excitation current. The minimal effects of self-heating are included in measurements for RTDs.
[2] IEC 60751 does not define class B (F 0.3) tolerance at temperatures below -50°C for thin-film elements. The stated tolerance at -196°C is based on double the tolerance allowed for wire wound elements per IEC 60751 at the minimum temperature.

## Summary of Screening Testing

| Inspection/Test | Test Parameters | Acceptance Criteria |
|---|---|---|
| **Preconditioning** | 5 cycles<br><br>25C +10/-5C; 5 minutes MIN<br>-196C +/- 5C; 30 seconds MIN | N/A |
| **Zero Power Resistance** | 0°C | Resistance/Temperature Characteristics Table |
| **Thermal Shock** | MIL-STD-202, Method 107<br><br>10 cycles<br><br>-65C +0/-5C; 30 minutes MIN<br>25C +10/-5C; 5 minutes MAX<br>200C +5/-0C; 30 minutes MIN<br>25C +10/-5C; 5 minutes MAX | N/A |
| **High Temperature Storage** | MIL-STD-202, Method 108<br><br>200°C +/- 10°C<br><br>100 +10/-0 hours | N/A |
| **Zero Power Resistance** | 0°C | Resistance/Temperature Characteristics Table |
| **Insulation Resistance** | MIL-STD-202, Method 301 | 10,000 megohms minimum at 500 V DC |
| **Visual** | Weld quality, trim border, lamination, foreign material, workmanship, and overall appearance | Minco visual inspection criteria |
| **Dimensional** | Measure dimensions | Specification Drawing |
| **Resistance Ratio Characteristic** | R100°C/R0°C | 1.3862 MAX/1.3838 MIN |
| **Resistance Temperature Characteristic**<br>*Optional Testing:*<br>*Must add "-RT" to end of the part number to include this test item* | -196°C, -50°C, 0°C, 100°C, 200°C | Resistance/Temperature Characteristics Table |
| **Percent Defective Allowable** | Cumulative defects from testing | 10% |

Minco's flexible surface mount temperature sensors provide precise, reliable temperature measurements in lightweight, space-qualified designs. With customizable configurations and testing aligned to NASA or ESCC standards, they provide mission-critical performance trusted for demanding spaceflight applications.

# Bolt-On and Embedment Temperature Sensors for Space Applications

*Platinum PT100 and PT1000 RTD in Easy-install Case*

## Product Overview

Minco's bolt-on and embedment temperature sensors are available in a variety of rugged metallic case styles designed for quick and secure installation. Built to endure the extreme temperatures, vibration, and vacuum conditions of space, these miniature potted sensors are offered as commercial off-the-shelf products or fully customized designs to meet specific mission requirements.

Minco sensors are designed to meet the rigorous requirements of space applications. The S240890-S240893 series incorporates testing based on NASA EEE-INST-002, Section T1, Table 2, Level 2, covering the most common test parameters used for resistance temperature detectors (RTDs) in space flight applications. Section T1 establishes baseline criteria for thermistors, which is the closest applicable category for RTDs.

For over half a century, Minco has engineered rugged temperature sensors and heaters to withstand the harshest environments of space. We partner with mission teams to define and perform screening and qualification testing to meet or exceed reliability requirements. Minco offers tailored products and test plans to align with program-specific needs, including extended qualification testing per EEE-INST-002, Section T1, Table 3, or testing aligned with ESCC Generic Specification No. 4006.

## Product Features

| Characteristic | Details |
|---|---|
| Temperature Range | -196°C to 200°C |
| Resistance at 0°C | 100 Ω or 1000 Ω (IEC60751 Class B) |
| Temperature Coefficient of Resistance | 0.003851 Ω/Ω/°C from 0°C to 100°C |
| Excitation Current | 1 mA MAX recommended |
| Screening Testing | Based on NASA EEE-INST-002, Section T1, Table 2 |
| Construction | Multiple case options for easy installation |
| Outgassing | Meets NASA low outgassing requirements |
| Wiring Options | 2-, 3-, or 4-wire AWG 26 leads |
| Lead Customization | Variable lead length and insulation (PTFE or polyimide) |
| Configurability | Customizable specifications and screening/testing levels |

## Model Number Options

| | Model Number | Case Dimensions | Case material |
|---|---|---|---|
|  | S240890 | 0.50 x 0.375 x 0.188” w/ 0.166” diameter hole (12.7 x 9.5 x 4.8mm w/ 4.2mm diameter hole) | Stainless steel |
|  | S240891 | 1/4- 20 x 3/8” long thread w/ 7/16” hex head | Stainless steel |
|  | S240892 | M6 x 1 thread, 10mm long, w/ 10mm hex | Stainless steel |
|  | S240893 | Case Style C<br>Case length: 0.300” (7.6 mm)<br>Case diameter: 0.125” (3.2 mm) | Stainless steel |

## Specification Options

| S240890 | Model Number from Table |
|---|---|
| PD | Sensing element:<br>PD: Platinum 100 Ω +/- 0.12% at 0C IEC 60751 Class B<br>PF: Platinum 1000 Ω +/- 0.12% at 0C IEC 60751 Class B |
| Z | Number of leads:<br>Y: 2 (AWG 24)<br>Z: 3 (AWG 26)<br>X: 4 (AWG 30) |
| T | Leadwire insulation/shield:<br>T = PTFE<br>K = Polyimide<br>S = Stainless steel braid over PTFE<br>E = ETFE |
| 40 | Lead length in inches |
| **S240890PDZT40 = Sample part number** | |

## Resistance/Temperature Characteristics

| Element | $R_Z$[1] | -196°C[2] | -50°C | 0°C | +25°C | +75°C | +100°C | +200°C |
|---|---|---|---|---|---|---|---|---|
| PD | Nom. (Ω) | 20.25 | 80.31 | 100.00 | 109.73 | 128.99 | 138.51 | 175.86 |
| PF | Nom. (Ω) | 202.5 | 803.1 | 1000.0 | 1097.3 | 1289.9 | 1385.1 | 1758.6 |
| PD, PF | Tol. (±%) | 5.45 | 0.27 | 0.12 | 0.15 | 0.20 | 0.22 | 0.27 |
| | Tol. (±°C) | 2.56 | 0.55 | 0.30 | 0.43 | 0.68 | 0.80 | 1.30 |

[1] $R_Z$ = Zero Power Resistance. Measured with 1 mA maximum excitation current. The minimal effects of self-heating are included in measurements for RTDs.
[2] IEC 60751 does not define class B (F 0.3) tolerance at temperatures below -50°C for thin-film elements. The stated tolerance at -196°C is based on double the tolerance allowed for wire wound elements per IEC 60751 at the minimum temperature.

## Summary of Screening Testing

| Inspection/Test | Test Parameters | Acceptance Criteria |
|---|---|---|
| **Preconditioning** | 5 cycles<br><br>25C +10/-5C; 5 minutes MIN<br>-196C +/- 5C; 30 seconds MIN | N/A |
| **Visual** | Weld quality prior to potting | Minco visual inspection criteria |
| **Zero Power Resistance** | 0°C | Resistance/Temperature Characteristics Table |
| **Thermal Shock** | MIL-STD-202, Method 107<br><br>10 cycles<br><br>-65C +0/-5C; 30 minutes MIN<br>25C +10/-5C; 5 minutes MAX<br>200C +5/-0C; 30 minutes MIN<br>25C +10/-5C; 5 minutes MAX | N/A |
| **High Temperature Storage** | MIL-STD-202, Method 108<br><br>200°C +/- 10°C<br><br>100 +10/-0 hours | N/A |
| **Zero Power Resistance** | 0°C | Resistance/Temperature Characteristics Table |
| **Insulation Resistance** | MIL-STD-202, Method 301 | 1,000 megohms minimum at 500 V DC |
| **Visual** | Potting, workmanship, and appearance | Minco visual inspection criteria |
| **Dimensional** | Measure dimensions | Specification Drawing |
| **Resistance Ratio Characteristic** | R100°C/R0°C | 1.3862 MAX/1.3838 MIN |
| **Resistance Temperature Characteristic**<br>*Optional Testing:*<br>*Must add "-RT" to end of the part number to include this test item* | -196°C, -50°C, 0°C, 100°C, 200°C | Resistance/Temperature Characteristics Table |
| **Percent Defective Allowable** | Cumulative defects from testing | 10% |

Minco's bolt-on and embedment temperature sensors deliver precise, reliable measurements in rugged cases built for the extremes of space. With customizable configurations and testing aligned to NASA or ESCC standards, they provide mission-critical performance trusted for demanding spaceflight applications.

# Aerospace Temperature Sensors

## Overview

RTCA DO-160G is a comprehensive standard that defines environmental conditions and test procedures for airborne equipment. It ensures that aerospace components can withstand the diverse and harsh environments encountered in aviation. The specifications cover a wide range of factors, including temperature extremes, vibration, humidity, water resistance, and electromagnetic interference. Components must pass rigorous tests for each of these factors to demonstrate their reliability and durability under operational conditions. Compliance with RTCA DO-160G is critical for ensuring the safety and performance of avionics and other aircraft systems, making it a fundamental standard for the aerospace industry.

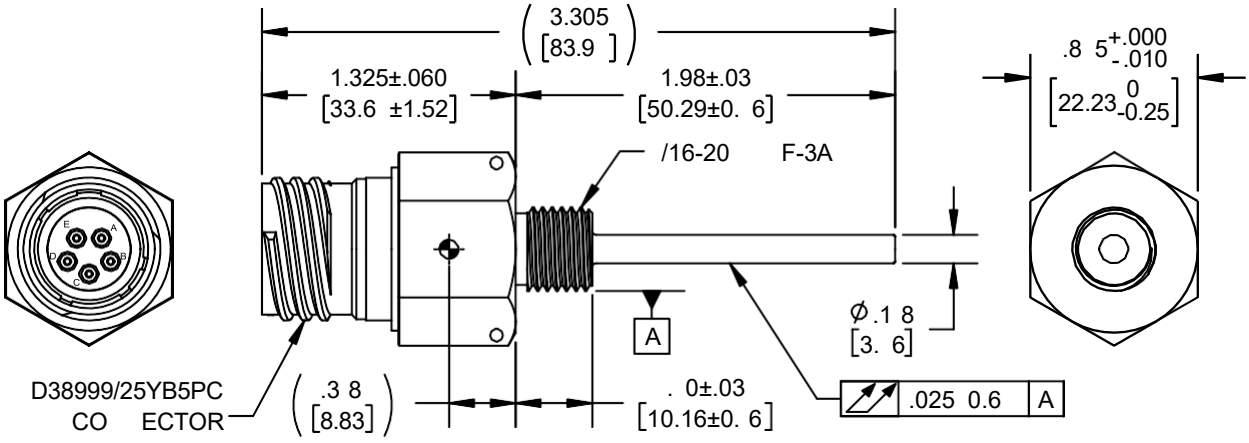
Minco's RTCA DO-160G qualified Aerospace Temperature Sensors offer fast and reliable sensing solutions for aircraft environmental systems and fluid temperature sensing applications. These sensors are designed to exceed performance expectations beyond the requirements of DO-160, including response time, operational range, reliability, durability, accuracy, and repeatability.

Minco offers these sensors with element configurations to suit any application, along with two physical configurations commonly used in commercial aircraft. They are offered as commercial off-the-shelf products or can be customized to meet your specific requirements.

## Features

| Characteristic | RTD Probe S239610 | Thermistor Probe TS239620 |
|---|---|---|
| Element | IEC60751 Class A, Class B<br>Platinum, 1.3851 ppm/°C<br>100 Ω, 500 Ω, or 1000 Ω at 0°C | 10,000 Ω ± 1% at 25°C<br>BETA 25-85 = 3976K ± 2% |
| Temperature range | -55 to 300°C continuous use<br>• Capable of frequent excursions to 300°C<br>• Capable of reporting fail conditions outside of continuous use range without damage:<br>○ excursions below -80°C<br>○ short duration excursions up to 500°C | -55 to 260°C continuous use<br>• Capable of frequent excursions to 300°C |
| Material | AISI 304/304L (all external surfaces) | AISI 304/304L (all external surfaces) |
| Environmental protection | Fully hermetic | Fully hermetic |
| Mass | 53 g ± 10% | 65 g ± 10% |
| Connector | MIL-DTL-38999, Shell Size 11<br>• D38999/25YB5PC stocked | MIL-DTL-38999, Shell Size 11<br>• D38999/25YB5PC stocked |
| Self-heating (still air) | .195 °C/mW<br>Dissipation constant: 5.1 mW/°C | .370 °C/mW<br>Dissipation constant: 2.7 mW/°C |
| Response time | (τ0.632 in 1 m/s water): 1 s | (τ0.632 in 1 m/s water): <1 s |
| Response time variation | (σ, part-part): .2 s typical | (σ, part-part): .2 s typical |
| Additional features: | • Robust to extreme icing and physical load conditions<br>• Single or dual element variations<br>• Customizable element resistance and interchangeability | |

# Minco RTD Probe S239610




## RTCA DO-160G Qualifications

S239610 RTD Probe

| § | Title | Category | Additional details |
|---|---|---|---|
| **4** | Temperature and Altitude | D3 | • Duct outside: 120°C<br>• Duct inside: 260°C |
| **5** | Temperature Variation | A | |
| **6** | Humidity | B | |
| **7** | Operational Shocks and Crash Safety | B | • 20 *g* each axis |
| **8** | Vibration | Random: R<br>Sinusoidal: H | • Random: Greatest of curves D & E + Greatest of curves D1 & E1<br>• Sinusoidal: Curve P |
| **9** | Explosive Atmosphere | E, H | |
| **10** | Waterproofness | R | |
| **11** | Fluids Susceptibility | F | |
| **12** | Sand and Dust | S | |
| **13** | Fungus Resistance | F | |
| **14** | Salt Fog | S | |
| **15** | Magnetic Effect | Z | |
| **22** | Lightning Induced Transient Susceptibility | Z4XXXX | • 1500 $V_{AC, RMS}$ (2000 $V_{peak}$) |
| **23** | Lightning Direct Effects | N/A | |
| **24** | Icing | A | |
| **25** | Electrostatic Discharge | N/A | |
| **26** | Fire and Flammability | C | |

Note: §16-21 are omitted because they cannot be considered without other system components.

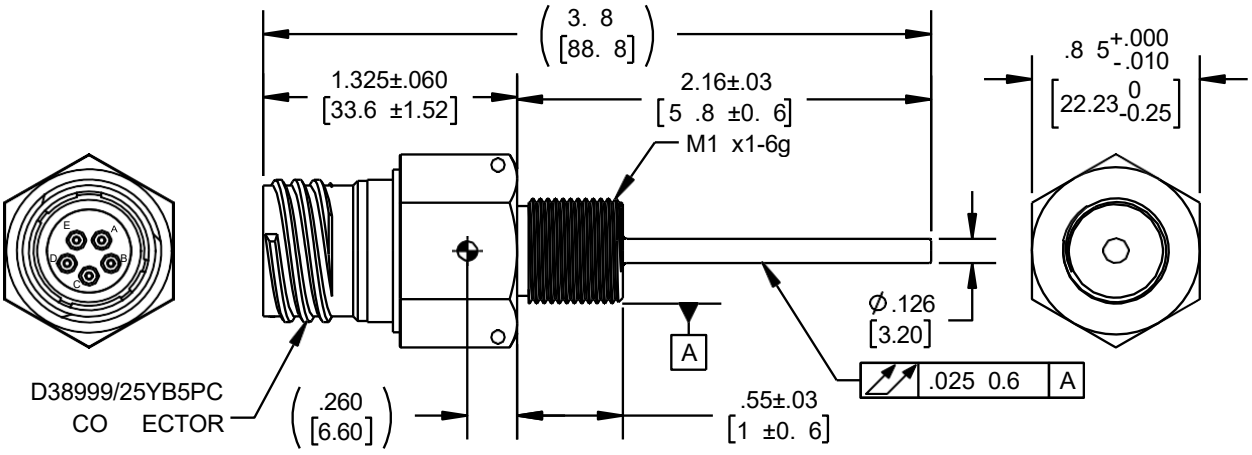
## Other Tests

S239610 RTD Probe

Beyond standard qualification testing, these sensors have undergone rigorous robustness and maturity testing to ensure long-term performance. Leveraging decades of sensor design experience, Minco has engineered these sensors for minimal part-to-part thermal response time variation and the ability to withstand extreme conditions that competitors' products cannot.

| Test | Details |
|---|---|
| **Proof Pressure** | >>1200 psig (at 300°C) |
| **Burst Pressure** | >>2500 psig (at 300°C) |
| **High Temp Endurance** | >1700 h at 300°C, >236 h at 270°C, >1487 h at 260°C |
| **Low Temp Endurance** | >50 h at -55°C |
| **Thermal Cycling** | >10000 cycles between 0 and 250°C |
| **Vibration** | 1.5 * DO-160 Qualification level (~20 $g_{RMS}$) |
| **Shock** | 1.5 * DO-160 Qualification level (30 *g*) |
| **HALT** | 25C to -94°C to 181°C (1 hour cycle) at each 9 *g*, 12 *g*, 15 *g*, 21 *g*, 27 *g*, 33 *g*, 39 *g*, and 45 *g* (8 hours total) → no failures |

# Minco Thermistor Probe TS239620



## RTCA DO-160G Qualifications

TS239620 Thermistor Probe

| § | Title | Category | Additional details |
|---|---|---|---|
| **4** | Temperature and Altitude | D2 | |
| **5** | Temperature Variation | A | |
| **6** | Humidity | B | |
| **7** | Operational Shocks and Crash Safety | B | • 20 *g* each axis |
| **8** | Vibration | Random: R<br>Sinusoidal: H | • Random: Greatest of curves D & E + Greatest of curves D1 & E1<br>• Sinusoidal: Curve P |
| **9** | Explosive Atmosphere | E, H | |
| **10** | Waterproofness | R | |
| **11** | Fluids Susceptibility | F | |
| **12** | Sand and Dust | S | |
| **13** | Fungus Resistance | F | |
| **14** | Salt Fog | S | |
| **15** | Magnetic Effect | B | |
| **22** | Lightning Induced Transient Susceptibility | Z4XXXX | • 1500 $V_{AC,\ RMS}$ (2000 $V_{peak}$) |
| **23** | Lightning Direct Effects | N/A | |
| **24** | Icing | A | |
| **25** | Electrostatic Discharge | N/A | |
| **26** | Fire and Flammability | C | |

Note: §16-21 are omitted because they cannot be considered without other system components.

## Other Tests

TS239620 Thermistor Probe

The TS239620 thermistor temperature sensor offers the same design features and considerations as the RTD model but has been specifically tested for use in a narrower ambient temperature range.

| Test | Details |
|---|---|
| **Proof Pressure** | >>1250 psig (at 260°C) |
| **Burst Pressure** | >>3200 psig (at 260°C) |
| **High Temp Endurance** | >1800 h at 125°C |
| **Low Temp Endurance** | >50 h at -55°C |
| **Thermal Cycling** | >10000 cycles between 0 and 75°C |
| **Vibration** | 1.5 * DO-160 Qualification level (~20 $g_{RMS}$) |
| **Shock** | 1.5 * DO-160 Qualification level (30 *g*) |
| **HALT** | 25C to -94°C to 181°C (1 hour cycle) at each 9 *g*, 12 *g*, 15 *g*, 21 *g*, 27 *g*, 33 *g*, 39 *g*, and 45 *g* (8 hours total) → no failures |