JSC Thermal Vacuum Testing

Daniel Newswander
JSC/ES3
281-483-8868

JSC Thermal Vacuum Testing - Programs

- Programs Supported with Thermal Testing
  - Space Shuttle
  - International Space Station (ISS)
  - Extravehicular Activities (EVA) – Space Walks
  - Robotic Interplanetary Missions

JSC Thermal Vacuum Testing - Environments

- Thermal Testing for Encountered Environments
  - Orbital (Shuttle, ISS, EVA)
    - Thermal Vacuum
    - Thermal Cycling
  - Cabin (Shuttle, ISS)
    - Thermal Cycling
  - Space (Interplanetary Missions)
    - Thermal Vacuum
    - Thermal Cycling
  - Planetary (Interplanetary Missions)
    - Thermal Vacuum
    - Thermal Cycling

JSC Thermal Vacuum Testing - Documentation

- Thermal Testing Requirement Documentation
  - Shuttle
    - Space Shuttle Specification Environmental Acceptance Testing (SP-T-0023B)
  - ISS
    - Qualification and Acceptance Environmental Test Requirements – International Space Station Program (SSP 41172)
  - EVA
    - Project Management of Government Furnished Equipment Flight Projects (EA-WI-023)
    - General Operating Procedures Manual for Engineering Directorate Testing Facilities (EA-WI-024)
  - Planetary Missions
    - Testing done in accordance with JPL procedures/requirements?
- Thermal Testing Guideline Handbooks
  - Military Standard – Test Requirements for Launch, Upper-Stage, and Space Vehicles (MIL-STD-1540C)
  - NASA JSC Specification Environmental Acceptance Testing (SP-T-0023B)
  - Satellite Thermal Control Handbook

JSC Thermal Vacuum Testing*

- Thermal Vacuum Test, Component Qualification
  - Purpose: demonstrates the ability of the component to perform in a thermal vacuum environment that simulates the maximum and minimum predicted level temperature environment for the component
- Thermal Cycling Test, Component Qualification
  - Purpose: demonstrates the ability of components to operate over the design temperature range and to survive the thermal cycling screening test imposed upon the component during acceptance testing
- Thermal Vacuum Test, Component Acceptance
  - Purpose: detects material and workmanship defects prior to installation into a flight element by subjecting the article to a thermal vacuum environment
- Thermal Cycling Test, Component Acceptance
  - Purpose: detects material and workmanship defects prior to installation of the component into a flight element by subjecting the component to thermal cycling
- Noncritical Component Testing
  - Purpose: demonstrates the functionality and reliability of the hardware while enabling lower cost and faster development due to its lower criticality

* per SSP 41172

JSC Thermal Vacuum Testing*

Test	Pressure	Thermal Cycles	Dwell Time at Extremes	Thermal Margins	Hardware
Thermal Vacuum (TV), Qual	< 10^{-4} Torr	≥ 3	12 hrs on first cycle; thereafter ≥ 1 hr after reaching internal thermal equilibrium	± 20 F (11.1 C) beyond acc test limits. Electronics min sweep (140 F).	External
Thermal Cycling (TC), Qual	Ambient	3 x TC Acc test but not less than 24	≥ 1 hr after reaching internal thermal equilibrium	± 20 F (11.1 C) beyond acc test limits. Electronics min sweep (140 F).	External or Internal
Thermal Vacuum, Acc	< 10^{-4} Torr	≥ 1	≥ 1 hr after reaching internal thermal equilibrium	Max acceptance limits. Electronics min sweep (100 F)	External
Thermal Cycling, Acc	Ambient	≥ 8	≥ 1 hr after reaching internal thermal equilibrium	Max acceptance limits. Electronics min sweep (100 F)	External or Internal
Noncritical – TV, Qual	< 10^{-4} Torr	1.5 (2 max dwells and 1 min dwell)	12 hrs on first cycle; thereafter ≥ 1 hr after reaching internal thermal equilibrium	± 20 F (11.1 C) beyond acc test limits. Electronics min sweep (140 F).	External
Noncritical – TC, Qual	Ambient	6	≥ 1 hr after reaching internal thermal equilibrium	± 20 F (11.1 C) beyond acc test limits. Electronics min sweep (140 F).	External or Internal
Noncritical – TV, Acc	< 10^{-4} Torr	1	≥ 1 hr after reaching internal thermal equilibrium	Max acceptance limits. Electronics min sweep (100 F)	External
Noncritical – TC, Acc	Ambient	3	≥ 1 hr after reaching internal thermal equilibrium	Max acceptance limits. Electronics min sweep (100 F)	External or Internal

* per SSP 41172

JSC Thermal Vacuum Testing*

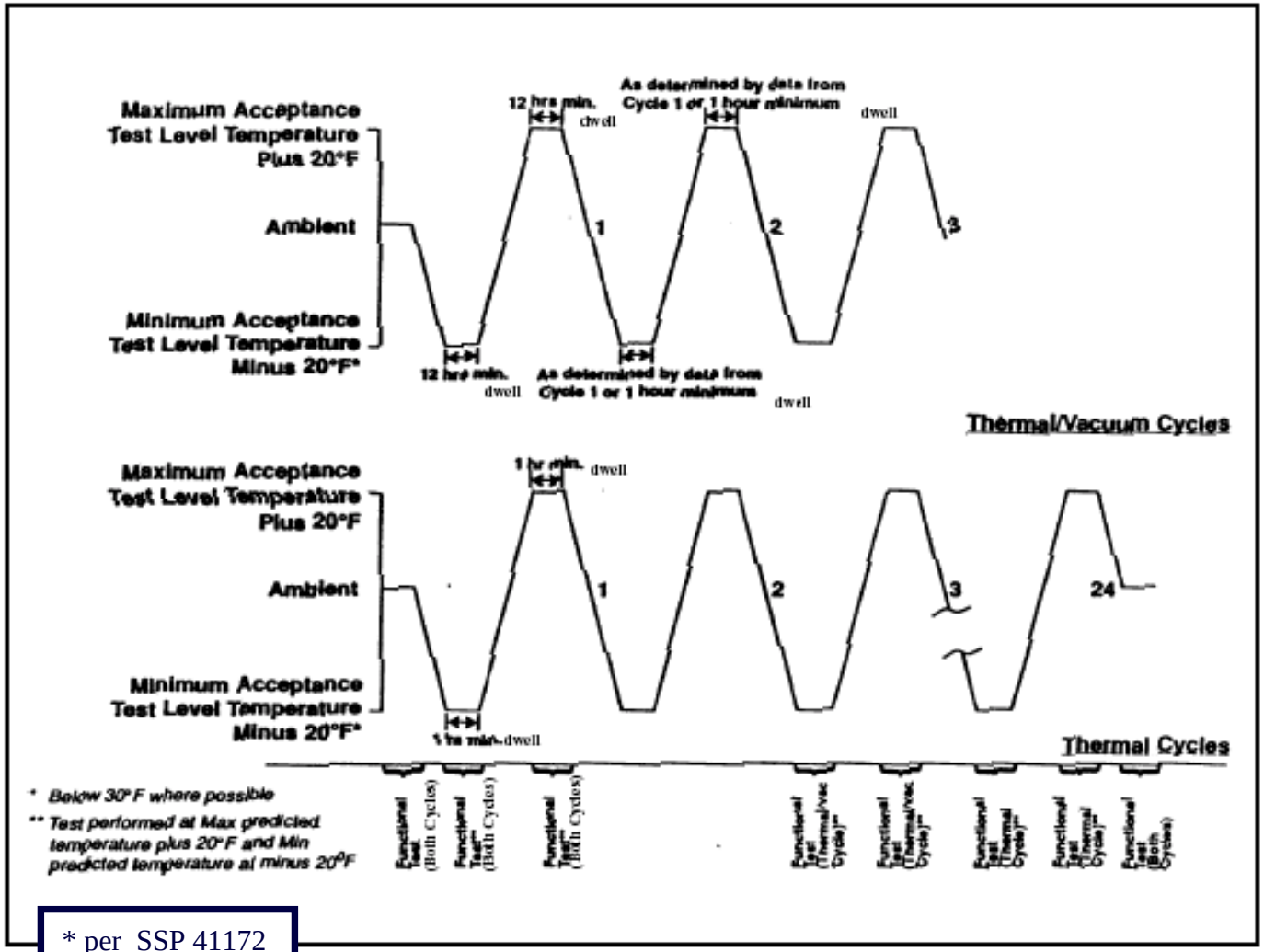
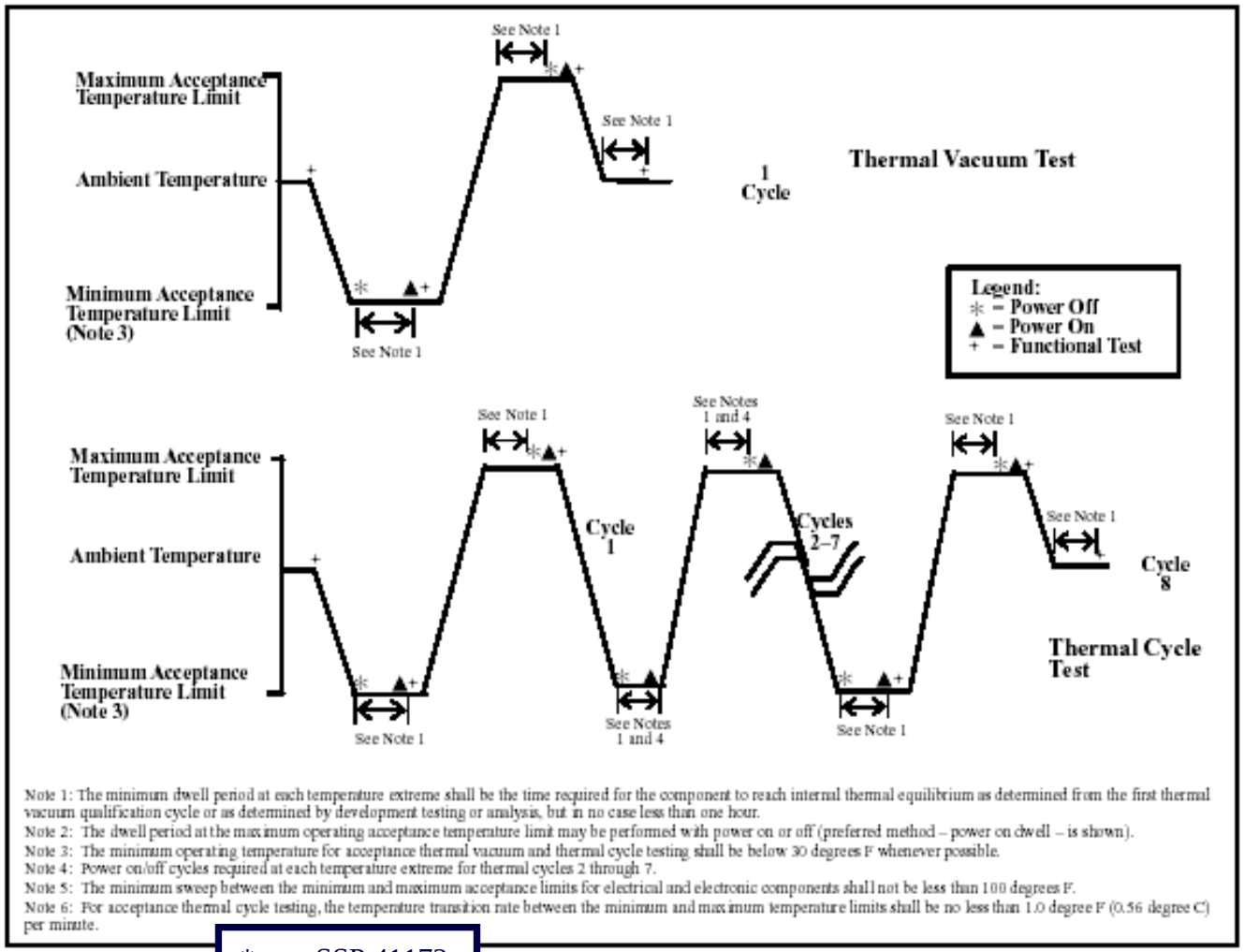


FIGURE 4-1 COMPONENT THERMAL/VACUUM QUALIFICATION TESTS

* per SSP 41172

JSC Thermal Vacuum Testing*



* per SSP 41172