

Technology Readiness Levels (TRL)

Research & Concept

TRL 1 – Basic principles observed and reported.

Lowest level of technology readiness. Scientific research begins to be translated into applied research and development.

TRL 2 – Technology concept and/or application formulated.

Once basic principles are observed, practical applications can be invented and R&D started. Applications are speculative and may be unproven.

TRL 3 – Analytical and experimental critical function and/or characteristic proof-of-concept.

Active research and development is initiated, including analytical and laboratory studies to validate predictions regarding the technology.

Laboratory Validation

TRL 4 – Component and/or breadboard validation in laboratory environment.

Basic technological components are integrated to establish that they will work together.

TRL 5 – Component and/or breadboard validation in relevant environment.

The basic technological components are integrated with reasonably realistic supporting elements so it can be tested in a simulated environment.

TRL 6 – System/subsystem model or prototype demonstration in a relevant environment.

A representative model or prototype system is tested in a relevant environment.

Operational Readiness

TRL 7 – System prototype demonstration in relevant environment.

A prototype system that is near, or at, the planned operational system.

TRL 8 – Actual system completed and "qualified" through test and demonstration.

In an actual system, the technology has been proven to work in its final form and under expected conditions.

TRL 9 – Actual system "proven" through successful mission operations.

The system incorporating the new technology in its final form has been used under actual mission conditions.