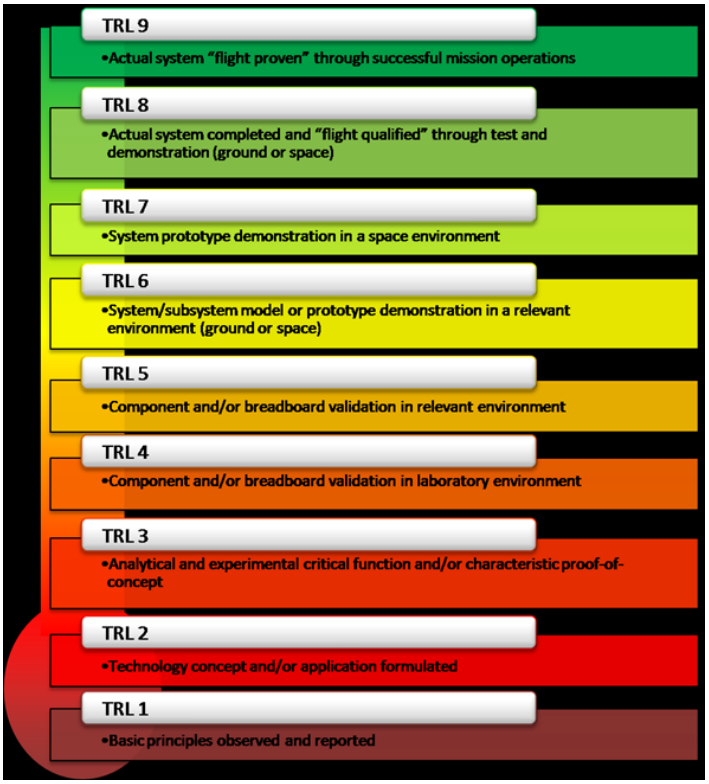
Measuring Technology Maturity

TechPort entries contain both descriptive and technical information about technology development activities within NASA projects. One such piece of information is the technology's maturity at the start and end of its development, as well as its current maturity. NASA and other technology development organizations determine this maturity using the Technology Readiness Level (TRL) scale, which was created by NASA in the 1970s and enhanced over the years.

TRLs are a type of measurement system used to assess the maturity level of a particular technology. Each technology project is evaluated against the parameters for each technology level and then assigned a TRL rating based on the project's progress. There are nine TRLs. The TRL scale starts at the initiation of technology development (TRLs 1 and 2). As a technology is further developed, demonstrated, and eventually tested, it moves up the scale. There are milestones and benchmarks along the way that help identify where a technology is within the TRL scale. By TRL 8 and 9, a technology is ready to be or is already incorporated into a system for use in a mission.



TRL summary chart

Below is a brief summary of each TRL.

TRL 1: Basic principles observed and reported

When a technology is at TRL 1, scientific research is beginning and those results are being translated into future research and development.

TRL 2: Technology concept and/or application formulated

TRL 2 occurs once the basic principles have been studied and practical applications can be applied to those initial findings. TRL 2 technology is very speculative, as there is little to no experimental proof of concept for the technology.

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

When active research and design begin, a technology is elevated to TRL 3. Generally both analytical and laboratory studies are required at this level to see if a technology is viable and ready to proceed further through the development process. Often during TRL 3, a proof-of-concept model is constructed.

TRL 4: Component and/or breadboard validation in laboratory environment

Once the proof-of-concept technology is ready, the technology advances to TRL 4. During TRL 4, multiple component pieces are tested with one another.

TRL 5: Component and/or breadboard validation in relevant environment

TRL 5 is a continuation of TRL 4, however, a technology that is at 5 is identified as a breadboard technology and must undergo more rigorous testing than technology that is only at TRL 4. Simulations should be run in environments that are as close to realistic as possible.

TRL 6: System/subsystem model or prototype demonstration in a relevant environment (ground or space)

Once the testing of TRL 5 is complete, a technology may advance to TRL 6. A TRL 6 technology has a fully functional prototype or representational model.

TRL 7: System prototype demonstration in a space environment

TRL 7 technology requires that the working model or prototype be demonstrated in a space environment.

TRL 8: Actual system completed and "flight qualified" through test and demonstration (ground or space)

TRL 8 technology has been tested and "flight qualified" and it's ready for implementation into an already existing technology or technology system.

TRL 9: Actual system "flight proven" through successful mission operations

Once a technology has been "flight proven" during a successful mission, it can be called TRL 9.

For more information about TRLs at NASA you can reference the following sites:
http://www.nasa.gov/pdf/458490main_TRL_Definitions.pdf
http://www.nasa.gov/content/technology-readiness-level/#.VMEqJS4g2R1