Acquisition Phase | Pre-Material Development Decisions (Pre-MDD) | Material Solution Analysis (MSA) | Technology Maturation and Risk Reduction (TMRR) | Engineering & Manufacturing Development (EMD) | Low-Rate Initial Production (LRIP) | Full-Rate Production (FRP)
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**Thread** | **Sub-Thread** | **MRL 1** | **MRL 2** | **MRL 3** | **MRL 4** | **MRL 5** | **MRL 6** | **MRL 7** | **MRL 8** | **MRL 9** | **MRL 10**
--- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | ---
Sub-Thread | Technology and Industrial Base | Potential sources identified to address technology needs. Understand state of the art. | Industrial base capabilities surveyed and known gaps/needs identified for preferred concept, key technologies, components, and/or key processes. | Industrial base capabilities assessment initiated to identify potential manufacturing sources. Solving foreign source vendors and vendors of technologies with potential obsolescence issues have been identified and plans being put into place to minimize risks. | Industrial base capabilities assessment initiated to identify potential manufacturing sources. Solving foreign source issues and obsolescence issues have been identified. | Industrial capability to support production has been analyzed. Industrial capability in place to support manufacturing of development articles. Plans to minimize solving foreign source issues and obsolescence issues are being developed. Potential alternate sources necessary. | Industrial capability assessment for FRP has been completed. Industrial capability in place to support FRP. Sources are available, multi-sourcing where cost-effective or necessary to mitigate risk. | Industrial capability for FRP has been identified to support production. Industrial capability in place to support FRP. Sources are available, multi-sourcing where cost-effective or necessary to mitigate risk. | Industrial capability for FRP has been identified to support production. Industrial capability in place to support FRP. Sources are available, multi-sourcing where cost-effective or necessary to mitigate risk. | Industrial capability for FRP has been identified to support production. Industrial capability in place to support FRP. Sources are available, multi-sourcing where cost-effective or necessary to mitigate risk. |
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### Technical Reviews

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### Key Points

- **Material scale-up issues**
  - Identified by **MRL 7** Technology Maturation and Risk Reduction (TMRR) and **Pre-Materiel Development Decision (Pre-MDD)**.
  - Should be assessed at TRL 9 or TRL 10.

- **Cost model approach defined.**
  - Integrate cost drivers and risk models. Identified potential process changes during production development.
  - Identified by **MRL 7** Technology Maturation and Risk Reduction (TMRR) and **Pre-Materiel Development Decision (Pre-MDD)**.
  - Should be assessed at TRL 7.

- **Cost model validation.**
  - Cost model approach defined.
  - Integrate cost drivers and risk models. Identified potential process changes during production development.
  - Identified by **MRL 7** Technology Maturation and Risk Reduction (TMRR) and **Pre-Materiel Development Decision (Pre-MDD)**.
  - Should be assessed at TRL 7.

- **Identify any manufacturing cost implications.**
  - Sensitivity analysis conducted to identify cost drivers and production development strategies (i.e. lab to pilot to factory).
  - Costs analyzed using prototype applicability and initial capital cost targets are achievable. Costs driven by materials, labor, equipment, testing (Special Test Equipment (STE), setup, field installation)
  - Manufacturing cost risks assessed. Identified by **MRL 7** Technology Maturation and Risk Reduction (TMRR) and **Pre-Materiel Development Decision (Pre-MDD)**.
  - Should be assessed at TRL 8 or TRL 9.

- **Material properties identified for research.**
  - Projected material cost has been identified in a laboratory environment.
  - Material properties and characteristics predicted.
  - Identified by **MRL 7** Technology Maturation and Risk Reduction (TMRR) and **Pre-Materiel Development Decision (Pre-MDD)**.
  - Should be assessed at TRL 2.

- **Material availability assessed.**
  - Material scale-up issues identified.
  - Projected lead times have been identified for all difficult to obtain, difficult to process, or hazardous materials.
  - Availability issues addressed for prototyping build.
  - Survey completed for potential supply chain capability.
  - Initial assessment of potential supply chain capability.
  - Identified by **MRL 7** Technology Maturation and Risk Reduction (TMRR) and **Pre-Materiel Development Decision (Pre-MDD)**.
  - Should be assessed at TRL 9 or TRL 10.

- **Initial evaluation of potential regulatory requirements and special handling concerns.**
  - As listed in hazardous materials.
  - Special handling procedures applied in the lab.
  - Special handling issues identified.
  - Identified by **MRL 7** Technology Maturation and Risk Reduction (TMRR) and **Pre-Materiel Development Decision (Pre-MDD)**.
  - Should be assessed at TRL 9 or TRL 10.
Acquisition Phase

Pre-Material Development Decisions (Pre-MDD)

Material Solution Analysis (MSA)

Technology Maturation and Risk Reduction (TMRR)

Engineering & Manufacturing Development (EMD)

Low-Rate Initial Production (LRIP)

Full-Rate Production (FRP)

Technical Reviews

Thread Sub-Thread MRL 1 MRL 2 MRL 3 MRL 4 MRL 5 MRL 6 MRL 7 MRL 8 MRL 9 MRL 10

Technology Maturity

Should be assessed at TRL 1.

Should be assessed at TRL 2.

Should be assessed at TRL 3.

Should be assessed at TRL 4.

Should be assessed at TRL 5.

Should be assessed at TRL 6.

Should be assessed at TRL 7.

Should be assessed at TRL 8.

Should be assessed at TRL 9.

Should be assessed at TRL 10.

MRL 1 E.1 Initial models developed, if applicable.

Identification of proposed manufacturing concepts and productivity needs based on high-level process flowchart models.

MRL 2 G.1 High level process flows completed, if applicable.


MRL 3 H.1 Initial models developed, if applicable.

Identification of proposed manufacturing concepts and productivity needs based on high-level process flowchart models.

MRL 4 Technology Maturation

MRL 5 G.1 High level process flows completed, if applicable.


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MRL 7 Technology Maturation

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MRL 10 Technology Maturation

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