

FR-IMG-003 — Immutable Infrastructure Workflows

[Go to Crucible Image Management Requirements](#)

Statement

Crucible SHALL replace an existing deployed image with a newly built image rather than modifying the deployed_image in place.

Source Statement

The system shall support immutable infrastructure workflows.

Source

Crucible System Requirements Specification, Version 1.1 Draft, Functional Requirements, FR-IMG-003.

Assessment

The source statement expresses the approved intent but does not provide a fully testable formulation.

The following Specification Discipline and Authoring findings apply:

- **The system** does not use the defined system name
- **shall** does not follow the established uppercase normative convention
- **Support** is a weak verb that does not identify the required behavior
- **Immutable infrastructure workflows** names a practice but does not identify the operation Crucible performs
- The source statement does not identify the subject that remains unmodified
- The source statement does not identify how a required change is applied
- The source statement does not distinguish replacement from in-place modification
- The source statement does not require signing, verification, promotion, rollback, or deployment validation

The normalized Statement:

- Replaces **The system** with **Crucible**
- Replaces **support** with the direct behavior **replace**
- Identifies the existing deployed image as the subject that is not modified in place
- Identifies a newly built image as the replacement
- Expresses the distinguishing behavior of an immutable infrastructure workflow

- Retains one primary required behavior

The normalized Statement does not require a particular virtualization platform, container runtime, image format, deployment mechanism, or replacement algorithm.

Rationale

An immutable infrastructure workflow applies a required change by building and deploying a replacement image rather than modifying the existing deployed image.

This approach preserves the relationship between a deployed subject and the image [Artifact](#) from which the subject was created.

Replacement-based image workflows contribute to:

- Consistent deployed state
- Reduced configuration drift
- Repeatable deployment
- Controlled image changes
- Recovery through replacement
- Comparison of prior and succeeding image [Revisions](#)
- [Reproducibility](#)
- [Provenance](#)
- [Traceability](#)

A newly built image may incorporate:

- Updated software
- Updated configuration
- Updated [Image Layers](#)
- Updated security controls
- Updated operating-system content
- Corrective changes
- A new [Revision](#) of an applicable [Baseline](#)

The workflow then replaces the existing deployed image with the newly built image.

FR-IMG-003 does not prohibit changes to external stateful resources, persistent data, credentials, network resources, or other subjects that remain separate from the deployed image.

Applies To

This requirement applies to:

- [Crucible](#)
- [Machine Images](#)
- Container images
- Deployed images

- Replacement images
- Image [Revisions](#)
- Image build workflows
- Image replacement workflows
- Virtual machines
- Containerized workloads
- [Infrastructure Environments](#)
- [CI/CD Pipelines](#)

Verification

1. Verification SHALL confirm that a required change produces a newly built image
2. Verification SHALL confirm that [Crucible](#) replaces the existing deployed image with the newly built image
3. Verification SHALL confirm that Crucible does not modify the existing deployed image in place

Verification may include:

- Machine Image replacement testing
- Container-image replacement testing
- Deployed-image inspection
- Image-Revision comparison
- Deployment-log inspection
- File-system comparison
- Configuration-drift inspection
- Automated [CI/CD Pipeline](#) testing

The verification record SHALL identify:

1. The existing deployed image
2. The required change
3. The newly built image
4. The replacement operation
5. The observed state of the existing deployed image
6. The observed state of the replacement image
7. The replacement result
8. The generated [Evidence](#)

Outgoing Traceability

This requirement realizes:

- [MO-001](#)
- [MO-005](#)
- [MO-006](#)

This requirement relates to:

- [FR-IMG-001 — Build Virtual Machine Images](#)

- [FR-IMG-002 — Build Container Images](#)
- [FR-IMG-004 — Image Signing](#)
- [FR-IMG-005 — Image Verification](#)
- [FR-IMG-006 — Image Promotion Workflows](#)
- [FR-DEP-002 — Deploy Virtual Machines](#)
- [FR-DEP-004 — Deploy Containerized Workloads](#)
- [7. Infrastructure and Deployment](#)
- [10. Reproducibility, Provenance, and Traceability](#)

Referenced By

The wiki Backlinks function provides the current list of pages that reference FR-IMG-003.

Incoming [Traceability](#) should be derived dynamically from backlinks rather than maintained as a duplicate manual list.

Backlinks identify incoming references but do not define the semantics of each relationship. Referencing pages should identify whether the relationship represents realization, refinement, verification, dependency, or another defined traceability relationship.

ConOps Relationship

The Crucible Concept of Operations describes a Phase 1 workflow that builds controlled image Artifacts and deploys infrastructure through automated [CI/CD Pipeline](#) activities.

FR-IMG-003 establishes that image changes use replacement-based workflow behavior rather than modification of an existing deployed image in place.

Requirements governing image build, signing, verification, promotion, deployment, rollback, and validation define separate behavior within the broader workflow.

Delivery Phase

Phase 1

Implementation Status

Not Assessed

Implementation status requires verification that [Crucible](#) replaces an existing deployed image with a newly built image rather than modifying the deployed image in place.

Requirement Status

Draft

The source System Requirements Specification identifies Version 1.1 as a draft.

Notes for Editors

This requirement page should retain the stable requirement identifier FR-IMG-003.

Changes to the Statement SHALL preserve the approved intent of the source requirement.

The Source Statement should preserve the original wording from the controlling System Requirements Specification.

The Statement should remain limited to replacement-based image workflow behavior.

Requirements for building, signing, verifying, promoting, deploying, rolling back, and validating images should remain in their applicable requirement pages.

Verification criteria should test only the behavior stated in the normalized Statement and should not introduce additional normative obligations.

Incoming Traceability should use the wiki Backlinks function rather than a manually maintained list.

To reference this requirement Statement from another wiki page, insert:

```
{{section>dido:02-crusible:99-annexes:annex-c-requirements:03-functional-requirements:03-02-image-management:fr-img-003#Statement&noheader&nofooter&noeditbtn}}
```

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