Annex D

(informative)

Flight readiness review (FRR)

D.1 General

Some department of defense (DoD) domains may require an FRR due to the nature and complexity of the system(s) being developed.

D.2 Annex D purpose

Annex D provides for the FRR the corresponding content contained in Clause 5, Clause 6, and Clause 7 of this standard for the reviews covered in those clauses.

D.3 Annex D tailoring

If a specific program requires an FRR, Annex D content changes status as defined in D.4.

D.4 Application of annex D content

For programs that require an FRR, the content of D.5, D.6, and D.7 assume the status and are applied as listed in D.1.

Table D.1—Annex D content status and application

Annex D subclause	Content status	Application
D.5	Becomes normative	Is a normative addition to Clause 5 of this standard.
D.6	Becomes normative when tailored	Is a normative addition to Clause 6 of this standard as tailored for the program.
D.7	Remains informative	Is added as application guidance to Clause 7 of this standard.

D.5 Requirements for an FRR

D.5.1 FRR purpose

The FRR shall be conducted to help ensure that the flight vehicle and its test environment are ready to proceed into flight testing.

D.5.2 FRR description

The FRR shall confirm that

a) All applicable airworthiness standards have been met.

b) All flight test objectives have been clearly stated and documented.

c) All flight test data requirements have been clearly identified.

d) An acceptable risk management plan is defined, approved, and implemented.

e) Each configuration expected to be evaluated within the flight test effort has been clearly specified both in the flight test plan and the flight clearance.

f) All previous component, subsystem, and manufacturing test results provide an acceptable basis for proceeding with the planned tests.

g) All applicable disciplines concur with the scope of the effort that has been identified and how this effort will be executed to derive the data necessary to help ensure the system is ready to initiate and conduct flight tests or flight operations.

D.5.3 FRR timing

The FRR shall be held after CDR and test readiness review (TRR) completion, nominally two weeks prior to the first flight of any new flight vehicle.

D.5.4 FRR entry criteria

The FRR shall be conducted only after the following events have been successfully completed:

a) The acceptability criteria for each of the FRR technical review products have been established for the specific program by tailoring the contents of Table D.2.

b) All preparatory actions in Table D.3 as tailored for the specific program have been successfully accomplished to support conducting the technical review.

c) A flight clearance has been issued by the applicable technical authority.

d) All documentation in support of FRR has been completed to the degree to satisfactorily support the technical review.

D.5.5 FRR content

D.5.5.1 Products to be reviewed at FRR

The following work products at a minimum shall be reviewed by the FRR team. Other products may be added as necessary during tailoring of Table D.2 for the specific program.

a) System technical documentation
b) Test environment
c) Program execution and process control
d) Risk assessment
e) Program cost and schedule estimates

D.5.5.2 Conduct of the FRR

FRR participants shall assess the FRR work products and judge the products' acceptability according to the applicable criteria in Table D.2 as tailored for the specific program.

D.5.5.3 FRR outputs

a) Key FRR outputs shall include
   1) Verification that the flight vehicle configuration is mature, stable, under configuration control and representative to accomplish the planned flight test objectives
   2) Verification that the program office has provided the necessary safety releases to the testers prior to conducting any flight testing
   3) Verification that all prior ground tests and other informal tests of the flight vehicle and its various systems have been satisfactorily completed and that the results support entry into flight testing
   4) Completed and approved flight test plans and procedures for the planned flight test(s)
   5) Complete identification and allocation of required test resources to the planned flight test(s)
   6) A documented contingency plan for addressing technical issues and obstacles that might occur during flight testing, including flight abort conditions and procedures
   7) An updated (if necessary) risk and opportunity assessment, and associated risk mitigation and opportunity handling plans
   8) An FRR team assessment that the flight vehicle, its test environment, and all test team personnel are ready to being flight testing
b) The FRR summary report shall be distributed containing the following attachments:
   1) List of attendees
   2) Final copies of all presentations
   3) Updated risk assessment and mitigation plans
   4) Documented action items including those required for closure
   5) The tailored FRR detailed criteria tables as completed following the technical review
   6) Recommendation on readiness to commence the formal test event
   7) Meeting minutes

D.5.6 FRR exit criteria

The FRR shall be deemed completed only after the following events have been successfully completed:

a) All action items submitted during the technical review have been appropriately resolved.
b) All actions listed in the action items required for closure have been completed and approved by the required parties.
c) The content of corrective action plans, if any, for issues identified in the FRR is sufficiently complete and unambiguous to enable successful completion of all corrective actions.
d) Each of the technical review products listed in Table D.2 as tailored for the specific program meets all of its acceptability criteria, or has a corrective action plan documenting the corrective actions required to achieve acceptability.

e) The acquirer and supplier concur that the risk level is acceptable.

f) All baselines in the applicable configuration management (CM) system(s) are current and consistent with the audited FRR work products.

g) The FRR chair formally closes the review.

D.6 FRR detailed criteria

D.6.1 FRR technical review products acceptance criteria

Table D.2 lists the products that should be reviewed at FRR, and the associated acceptability criteria that should form a sufficient basis by which to assess each product's content as acceptable to support a successful FRR. If a given program requires an FRR, specific products and associated acceptability criteria shall be deleted, modified, or additional items included, in accordance with the acquirer-supplier agreement, to support a given program.

Table D.2—FRR technical review products acceptability criteria

Product	FRR acceptability criteria
System technical documentation	a) System requirements and capabilities: 1) Final specifications are complete and under configuration control. 2) All build-to drawings are complete and under configuration control. 3) All allocated system requirements have been traced to their verification plans. 4) Technical performance measures (TPM) have been traced to test plans and procedures. 5) Key performance parameters (KPP) have been traced to test plans and procedures. 6) Software media including loading instructions and version description are under configuration control. 7) The engineering data requirements agreement plan (EDRAP) or equivalent addresses all required flight test data and has been signed. 8) Threshold safety of flight requirements for anticipated configurations are documented. 9) All software to be used on the flight vehicle has been evaluated in the laboratory, has been deemed safe to fly, and verified to support flight test objectives. 10) Regression testing and retest plans are complete. b) Test, evaluation, and product certification: 1) All flight test objectives are documented in the Test and Evaluation Master Plan (TEMP) and are traceable to the CDD, and to the CPD as applicable. 2) All flight test engineering data requirements in the EDRAP (or equivalent) are supported by instrumentation. 3) Instrumentation requirements for flight test are understood and documented. 4) Data reduction and analysis roles and responsibilities are defined.

Product	FRR acceptability criteria
System technical documentation *(continued)*	5) All flight test plans have been completed and are approved. 6) All flight test procedures are complete and contain pass/fail criteria that are consistent with the verification levels and methods in the system specification. 7) Flight test plans and procedures contain all applicable test witnessing requirements and are agreed to by all affected parties. 8) Flight test requirements supporting modeling and simulation (M&S) have been documented. 9) All test plans required for certification(s) have been coordinated with the applicable certification authorities. 10) The flight clearance covers all flight vehicle configurations planned for flight testing. 11) Reliability and maintainability (R&M) scoring guidelines have been documented and agreed to by the acquirer and supplier.
Test environment	a) The configuration of the test hardware and software is documented. b) The accuracy, calibration and repeatability of all tools and test equipment are adequate to verify conformance with flight test requirements. c) The test configuration and test setup (both for the flight vehicle and the ground support systems) implement the intended environment as closely as possible, and any deviations are judged acceptable for R&M.
Program execution and process control	a) Acquirer and supplier test team responsibilities are documented. b) Critical flight test support has been identified and coordinated. c) The program's problem and deficiency reporting and tracking process is functional. d) The failure reporting and corrective action system (FRACAS) is functional. e) Test item maintainers, data collectors, flight test crew, and testers have been trained in operation of all system configurations planned for flight testing. f) Planned flight testing is adequately resourced (personnel, test articles, facilities, data systems, support equipment, logistics, spares, funding).
Risk assessment	a) Technical risks are identified, and mitigation plans are in place. b) Risk management process is in place demonstrated by documented execution results of existing mitigation plans associated with the purpose of the review.
Program cost and schedule estimates	a) Updated cost estimate for flight testing fits within the existing budget. b) Flight test schedule items have been finalized and have been integrated into the integrated master schedule (IMS) with critical path dependencies identified through flight test completion. c) The IMS includes flight envelope clearance or expansion critical path events. d) Earned value supports transition to flight testing.

D.6.2 FRR preparation

Table D.3 lists the actions that should be considered during preparation for the FRR. The responsible people listed are those most often tasked with the listed preparation actions, but the acquirer and supplier may agree to assign the actions to different people or organizations depending on a given program's organizational structure. If a given program requires a FRR, the specific actions shall be deleted, modified, or additional items included, in accordance with the acquirer-supplier agreement. If a given program requires a FRR, responsibilities shall be assigned to people or organizations in accordance with the acquirer-supplier agreement.

Table D.3—FRR technical review preparation actions

Responsible person	FRR preparation actions
Program manager	a) Approve, fund, and staff the FRR as planned in the Systems Engineering Plan (SEP) developed by the systems engineer. b) Appoint an FRR chair no later than 60 days prior to the technical review, in coordination with the systems engineer and program test lead. c) Coordinate a preliminary agenda between the program integrated product team (IPT) and other acquirer subject matter experts (SME) no later than 30 days prior to the FRR.
Systems engineer	a) Ensure all of the technical review products whose acceptability criteria are defined in Table D.2 are completed for the FRR. b) Coordinate preparatory technical interchange meetings (TIM) among all affected program teams and disciplines sufficiently early to prepare for FRR, and carry any outstanding actions or issues forward to the FRR. c) Ensure flight clearance authorities have access to all critical data, CDR and TRR results, and risk assessment in sufficient time to issue clearance for flight testing. d) Ensure all FRR presentation material is coordinated across program teams.
Program test lead	a) Coordinate arrangements for FRR location and support. b) Coordinate requirements for the FRR chair with the systems engineer and program manager. c) Coordinate the preliminary FRR agenda with the systems engineer and program manager. d) Ensure the test team supplies all test-related presentation material to the systems engineer sufficiently early to support team coordination.
FRR chair	a) Determine FRR team membership. b) Approve the final FRR agenda. c) Approve any final Clause D.6 FRR detailed criteria tailoring for the specific program. d) Identify any specific elements for in-depth technical review as required.

D.6.3 FRR conduct

Table D.4 lists the technical review elements and associated content details that should be considered for the conduct of the FRR. If a given program requires an FRR specific elements and their content details shall be deleted, modified, or additional items included, in accordance with the acquirer-supplier agreement, to support a given program.

Table D.4—FRR conduct elements

FRR review element	Content details
Introduction, agenda, administrative	a) Review location layout and safety procedures b) Security procedures if applicable c) Introduction of chair and team members d) Purpose of the technical review e) FRR agenda f) Action item procedures g) Risk assessment procedures h) Program, schedule, and technical overview i) Overall test and evaluation (T&E) program overview and how the planned flight testing supports the overall program
System technical documentation review	a) New system elements and modifications since CDR b) System configuration(s) planned for flight testing c) Specification and drawing status d) Flight test requirements (including certification and R&M), applicable TPMs, and KPPs e) Safety-of-flight requirements corresponding to system configuration(s) f) Requirements traceability to test documentation g) Overview of the software to be used for flight testing, including test status to date h) Structure, content, and status of the TEMP i) Flight test objectives j) Flight test engineering data requirements and instrumentation status to support data collection k) Flight test plans and procedures content and status l) Flight test support to M&S m) Technical basis for flight clearance
Test environment review	a) Flight test hardware and software configuration, including flight vehicle and ground support b) Capability and calibration status of all test support equipment c) Test configuration as related to the operational environment, and discussion of differences
Program execution and process control review	a) Resources allocations to flight test (personnel, test articles, facilities, data systems, support equipment, logistics, spares, funding) b) Test team roles and responsibilities c) Critical flight test support requirements and status d) Test team training status e) Problem and deficiency reporting system status and review of action items from CDR (and prior reviews if applicable) f) Program metrics status
Risk assessment review	a) Risk identification and mitigation including consideration of elements impacting successful flight testing

FRR review element	Content details
Program cost and schedule estimates review	a) Current program cost estimates and relation to flight test program budget b) Flight test schedule events including envelope clearance or expansion c) IMS status and flight test event critical path dependencies d) Earned value management (EVM) status

D.6.4 FRR closure

Table D.5 lists the actions that should be considered for FRR closure. The responsible people listed are those most often tasked with the listed closure actions. The acquirer and supplier may agree to assign the program manager and systems engineer actions to different people or organizations depending on a given program's organizational structure. If a given program requires a FRR, the specific actions shall be deleted, modified, or additional items included, in accordance with the acquirer-supplier agreement. If a given program requires a FRR, responsibilities shall be assigned to people or organizations in accordance with the acquirer-supplier agreement.

Table D.5—FRR closure actions

Responsible person	FRR closure actions
Program manager	a) If funding profiles are insufficient to support further test and evaluation, notify user/sponsor of funding shortfall and request funding profile adjustments. b) Support development of the FRR summary report.
Systems engineer	a) Organize and supervise the responses to all action items generated during FRR. b) Support development of the FRR summary report.
Program test lead	a) Organize and supervise the detailed documentation of all action items assigned during the FRR. b) Support development of the FRR summary report.
FRR chair	a) Ensure preparation of the FRR summary report with the support of the program manager, systems engineer and program test lead. b) Sign off final approval of all action items. c) Prepare the formal FRR completion letter.
Recorder	a) Collate all action items for submission to the FRR chair. b) Prepare the FRR summary report and FRR minutes for signature and distribution by the FRR chair. c) Prepare the FRR closure letter for signature by the FRR chair.

D.7 FRR application guidance

The following is a set of observed good practices for consideration:

a) For complex systems where there are numerous subsystems or major system element groupings, it may be appropriate to conduct multiple FRRs at the subsystem level.

b) The FRR scope should be tailored to the technical scope of the specific system, subsystem or group of system elements to be reviewed.

c) The request for the FRR chair should occur at least 60 days prior to conduct of the technical review.

d) The systems engineer, in conjunction with the chief flight test engineer or organizational-level chief engineer, should recommend to the program manager whether or not to conduct an FRR for major modifications to an existing flight vehicle.

e) Typical changes to an existing flight vehicle that require an FRR include but are not limited to

1) Configuration changes such as new engine(s)
2) Significant changes to electrical or hydraulic systems
3) Significant changes to vehicle guidance and control systems
4) New wings or other major airframe changes or modifications
5) Major upgrades to flight control hardware or software
6) Changes to the number or material selection of propellers or rotors
7) Changes to material selection for thermal control systems of space vehicles
8) Changes in vehicle utilization or mission
9) Changes that affect safety, security, or other flight-worthiness-related attributes

e) An FRR is typically not required for ongoing developmental testing changes or modifications such as the following:

1) Minor software changes that can be fully tested in the laboratory and that do not affect safety of flight.
2) Expansions to a flight envelope previously reviewed in a flight clearance pre-planning meeting.
3) Minor changes to weapons, stores, or other deployable items that do not affect release, safe separation, or delivery.
4) Minor changes to weight or balance.
5) Wing dressings such as vortex generators, fences, porous wing fold fairing covers, etc.

f) The systems engineer should conduct a pre-FRR prior to the actual FRR with the purpose of identifying critical issues and risks that need resolution prior to the FRR. The pre-FRR should be held sufficiently in advance of FRR to adjudicate any resulting action items.

g) In order to help ensure a comprehensive and balanced assessment of all FRR work products, FRR participants from both the acquirer and supplier should include the following, as applicable:

1) Program management
2) Program test and evaluation team lead
3) Program security representative
4) Configuration management
5) Systems engineering
6) Software engineering
7) Hardware engineering
8) Logistics
9) Chief test engineer, chief test pilot, and appropriate flight test engineering team members
10) Lead instrumentation engineer
11) All certification authorities
12) System safety
13) System users
14) Cost estimating team
15) Legal counsel, if required
16) Contracting officers
17) Recorder or secretary

NOTE—These roles do not dictate that a single individual is provided for each role. A single individual may perform more than one of these roles within the team. Depending on the complexity of the system, more than one individual may also be assigned to a specific role.