

12 *Items to be Delivered by the Customer*

This chapter summarises and describes all software (documents, data and software-models) and hardware (flight units, dummies and ground equipment) which have to be supplied by the Customer as a minimum. The times and destinations for shipments are also described. Delivery times and destinations of additional software and hardware which the Customer wants to use

(e.g. mission insignias for the launch vehicle or container-external surfaces) are to be agreed on in the first two mission phases. Wherever possible, submission of data in electronic format via floppy disc, ZIP-disc, CD-ROM or e-mail is preferred by EUROCKOT in order to improve shipment times and accessibility of the data.

Table 12-1 provides a summary of all documents to be supplied during the various mission phases. Further explanations regarding their definition can be found in the following sections.

Customer-supplied Documentation Items		
1	Interface Requirements Document IRD	L - 18 months
2	Safety Submission (Phase I)	L - 18 months
3	Spacecraft Dynamic Model (Prelim)	L - 18 months
4	Safety Submission (Phase II)	L - 12 months
5	Spacecraft Mechanical Environment Test Prog ./Plan	L - 17 months
6	Spacecraft Thermal Model	L - 15 months
7	Spacecraft Dynamic Model (Final)	L - 13 months
8	Updated Mission and Spacecraft Data (for Final Mission Analysis)	L - 8 months
9	Spacecraft Operations Plan	L - 8 months
10	Spacecraft Mechanical Environment Qualification Test Res.	L - 8 months
11	Spacecraft Acceptance Test Procs	L - 8 months
12	Spacecraft Op. Procedures at Range	L - 6 months
13	Spacecraft Mechanical Environment Acceptance Test Results	L - 6 months
14	Safety Submission (Phase III)	L - 5 months
15	Final Spacecraft Mass Properties	L - 7 days
16	Orbital Tracking Operation Report	L + 2 weeks

Table 12-1: Summary of Documents to be Supplied by the Customer

12.1 *General Documents*

Interface Requirements Document	L - 18 months
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The IRD will be the technical baseline document for the first mission phase as long as no Interface Control Document has been established and agreed. The IRD will be created by the Customer. EUROCKOT will provide an outline document in order to define and clarify all important spacecraft requirements and interface items in this early phase.

With this document, the Customer will also describe the mission and spacecraft characteristics as already defined. This

focuses on mass properties, on interface dimensions, and on mission and orbit characteristics in particular. Within the outline provided by EUROCKOT, all chapters which have to be completed with information for contract signature will be marked.

Figure 12-1 shows the typical table of contents for this. Nevertheless, modifications according to dedicated demands of the mission can be implemented on the basis of joint agreements.

<p>1 INTRODUCTION</p> <ul style="list-style-type: none"> 1.1 PURPOSE 1.2 SCOPE 1.3 DEFINITIONS 1.4 REQUIREMENT STATUS <p>2 APPLICABLE DOCUMENTS</p> <ul style="list-style-type: none"> 2.1 GOVERNMENT DOCUMENTS 2.2 CONTRACTOR DOCUMENTS 2.3 REFERENCE DOCUMENTS <p>3 MISSION REQUIREMENTS AND PAYLOAD DEFINITIONS</p> <ul style="list-style-type: none"> 3.1 INTRODUCTION 3.2 MISSION REQUIREMENTS <ul style="list-style-type: none"> 3.2.1 Orbit Requirements 3.2.2 Launch Vehicle Performance 3.2.3 Launch Vehicle / Spacecraft Separation Requirements 3.3 LAUNCH DEFINITION <ul style="list-style-type: none"> 3.3.1 Launch Site 3.3.2 Launch Date(s) 3.3.3 Launch Window 3.4 MASS PROPERTIES DATA <ul style="list-style-type: none"> 3.4.1 Mass, Centre of Gravity and Inertia 3.4.2 Propellant Characteristics 3.4.3 Misalignment
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Figure 12-1: IRD Table of Contents

<p>3.5 PAYLOAD CONSTRAINTS / LIMITATIONS</p> <p>3.5.1 Dynamic Pressure and Thermal Constraints</p> <p>3.5.2 Spacecraft Environmental Requirements</p> <p>3.5.3 Spacecraft Clearance Requirements</p> <p>3.5.4 Spacecraft Envelope (/Drawing)</p> <p>3.5.5 Spacecraft Cleanliness</p> <p>3.6 PAYLOAD INTERFACE REQUIREMENTS</p> <p>3.6.1 Mechanical Interface (/Drawing)</p> <p>3.6.2 Electrical Interface</p> <p>3.6.3 Instrumentation Interface</p> <p>3.6.4 Ground Support Equipment Interface</p> <p>3.7 PAYLOAD ACCESS REQUIREMENTS</p> <p>3.8 SPACECRAFT / LAUNCH VEHICLE COMBINED TEST REQUIREMENTS</p> <p>4 GROUND OPERATIONS</p> <p>4.1 INTRODUCTION</p> <p>4.2 PAYLOAD PROCESSING FACILITY</p> <p>4.3 HAZARDOUS PROCESSING FACILITY</p> <p>4.4 FACILITY SUPPORT REQUIREMENTS</p> <p>5 SPECIAL SUPPORT REQUIREMENTS</p>

Figure 12-1: IRD Table of Contents – continued

Orbit Tracking Operation Report	L + 2 weeks
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In order to confirm *Rockot* performance with regard to orbit injection accuracy, the Customer is requested to submit spacecraft tracking data after third stage burnout before and subsequent to separation as far as such data are available. This must include a complete set of orbital parameters and their estimation accuracy.

12.2 *Data on Payload Design*

Updated Mission and Spacecraft Data	L - 8 months
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Initial mission and spacecraft data of this type are given within the IRD for

preliminary mission analysis. A final mission analysis, performed to confirm and/or give more detailed results of preliminary analysis, will be based on updated mission and spacecraft data. These data cover all inputs except structural and thermal models. Where affected, the updated data will also be reflected within the Interface Control Document (ICD). The characteristics to be

covered in detail as a minimum are:

- Payload dedication / designation
- Mass and inertial characteristics
- Payload drawing specifying its dimensions
- Drawings of spacecraft handling units and transport containers
- Requirements for installation

- Points for hoisting and fixing
- Requirements for the separation system
- Data on the payload elements which have to be jettisoned or deployed
- Pyrotechnic devices and related constraints
- Orbital parameters for the payload
- Requirements for injection accuracy and payload orientation prior to its deployment
- Acceptable range for thermal environments during the payload injection phase
- Requirements for protection of optical surfaces
- Thermal control requirements
- Parameters of payload/ground support equipment interfaces
- Characteristics of the payload telemetry and telecommand system and other RF systems

- Spacecraft battery charging/trickle charging cycles in integration facility and at launch pad.

Spacecraft Dynamic Model, Preliminary	L - 18 months
Final	L - 13 months

As described in Section 8.4 of this document, structural compatibility will be demonstrated with preliminary and final Coupled Load Analyses. Customer inputs, in particular structural models of the spacecraft, are requested for both preliminary and final CLA steps.

The spacecraft mathematical models must be provided by the Customer in the form of stiffness matrices and masses of non-fixed structures, mathematically reduced to a Craig-Bampton model. For detailed descriptions, refer to Section 8.4.1 of this document and to EUROCKOT document ESPE-0008.

Other presentations of the mathematical models (for example, a spring-mass model) are to be agreed with EUROCKOT.

Payload and related GSE input data:

- Allowable thermal conditioning interruptions for the payload, batteries and propellant containers
- Payload processing cycle duration in integration facility and at launch pad
- Payload ambient temperature, humidity and contamination control requirements during operations

Thermal Model	L - 15 months
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Section 8.6 describes which thermal environment studies are required to verify thermal compatibility throughout the mission. This study will be implemented using a thermal model provided by the Customer. As this study covers the period from integration of the payload onto the dispenser within the integration facility, up to spacecraft separation, the Customer has to provide the following:

- A thermal model of the spacecraft containing
 - a description of the thermal nodes (heat capacities, mass type, etc.)
 - internal thermal couplings of nodes (conductive, radiative and convective)
 - heat dissipation for all applicable modes of operation during the covered mission phases
- interface descriptions (areas of contact, conductive and/or radiative properties)
- thermal requirements for the environment to be fulfilled during integration, launch and flight

For detailed descriptions, refer to Section 8.6 of this document and EUROCKOT document ESPE-0009.

Safety Submissions	Step 1	L - 18 months
	Step 2	L - 12 months
	Step 3	L - 5 months

During the mission phases, safety submissions have to be provided by the Customer in three steps. The content and format of the data to be supplied are described in more detail in Chapter 9 of this User's Guide and in EHB-0004, the EUROCKOT Safety Handbook.

Generally, all areas generating risks for personal safety such as pressurised systems, explosives (propellants, pyrotechnical devices, etc.), radioactive material, RF sources and toxic substances have to be covered, as well as safety-relevant operations to be performed during

ground preparations. It has to be proven with all available information how risks to the people involved can be minimised to acceptable levels, which safety factors have been applied and how they have been or will be verified, and which precautions are envisaged.

12.3 *Payload Environmental Test Documents*

Spacecraft Mechanical Environment Test Plan
L - 17 months

The Customer must demonstrate in this document how he will verify analytical load and structural integrity evaluations during development and/or qualification testing. Test methods, requirements to be verified and factors applied, as well as notching strategies, must be described.

Spacecraft Mechanical Environment Qual Test Report
L - 8 months

After the performing of structural qualification, test results must be submitted to EUROCKOT for a review of compliance with the structural model supplied for Coupled Load Analysis. If any discrepancies regarding loads, strength or stiffness were identified during qualification testing, corrective actions have to be agreed.

Certainly, just as for the acceptance test report below, the extent to be provided is subject to mutual agreements as far as proprietary or technology export issues are involved.

Spacecraft Mechanical Environment Accept. Test Report	L-6 months
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On completion of structural acceptance testing of the flight unit, the corresponding report confirming compliance of data and workmanship quality must be submitted.

and the relevant support and facilities required at the range. The document will also be forwarded to the range operations manager. EUROCKOT provides an outline version of this document; the table of contents is depicted in Figure 12-2.

12.4 *Operations Documents for Spacecraft*

For the organisation of work within the integration facility and on the launch pad, the following documents are required:

Spacecraft Operations Test Procedures	L-6 months
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Spacecraft Operations Plan	L-8 months
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The purpose of the SOP is to define the activities to be performed on the spacecraft during the launch campaign

All detailed launch site test procedures covering such items as transportation, handling manuals, spacecraft check-out tests, fuelling etc. have to be submitted to EUROCKOT in time to permit a review and check against available resources. For hazardous operations, compliance with safety documentation is required.

Additional input to spacecraft integrated test procedures should be submitted on request, if not already covered by SOP and SOTP.

Introduction
Management, meetings, activities, organisation
Personnel
Operations
Test plan, day-by-day planning
Preparations and check-out to be carried out in the integration facility
Assembly of the payload with the upper stage
Payload fuelling procedure
Payload control and monitoring on the launch pad
Warning regarding handling
Launch constraints
Launch window
Equipment associated with spacecraft
Electrical wiring requirements
Installations (buildings etc.)
Logistics

Figure 12-2: Spacecraft Operations Plan (SOP) – Table of Contents

12.5 Models, GSE

As a minimum, two hardware models have to be available for testing (for more details refer to the corresponding sections regarding launch operations).

Mass Frequency Simulator	L-6	months
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A spacecraft model simulating at least mechanical interfaces, mass and CoG position has to be provided by the Customer. It also has to be mutually agreed how far and with which tolerances Mols and stiffness characteristics have to be simulated. As a baseline, the main fundamental frequencies should be simulated.

Fit Check / Dummy	L - 6 months
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An advanced mock-up model similar to the flight unit regarding geometrical and mechanical interfaces has to be supplied for testing at KSRC's premises in Moscow. The fit of overall dimensions with the accommodation envelope (third stage cover, dispenser, adapter and fairing) as well as the mechanical fit of attachment provisions must be checked during this test. If it is obvious that there are no clearance issues regarding the fairing, then the fit check and the corresponding spacecraft dummy can be limited to the parts interfacing with the dispenser. If requested by the Customer, this dummy could also be used for other optional pathfinder tests, e.g. transport, unloading, handling and launch preparation simulations. Potentially, the fit check dummy could be provided in the form

of the Mass Frequency Simulator and geometric adapter mentioned above .

Flight Unit for Matchmate Test	L - 4 months
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A matchmate test with a dispenser/ adapter mock-up and the spacecraft flight unit must be performed at the facilities of the Spacecraft Manufacturer in order to prove mechanical, electrical and operational compliance of this interface. A time slot as well as personal and technical resources have to be provided by the Customer and/or Spacecraft Manufacturer of the flight unit.

Master Gauge / Drill Templates	L-10 months
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It has to be mutually agreed whether and by whom tools will be provided to enable precision positioning of attachment/fixing points at the spacecraft and the dispenser. This will not be necessary, if the same degree of precision can be achieved by fulfilling drawing requirements only

Others

Shipments of other items which the Customer will need for ground operations (e.g. unit testers for integration facilities and launch pad, pathfinder spacecraft or containers, special transportation and handling equipment, fuelling equipment as well as personal safety equipment and fuel itself, etc.) as well as their storage and application are matters for dedicated

arrangements between the Customer, EUROCKOT and the range operation organisations.

Generally, EUROCKOT is open to agreements on any modification imposed by special mission requirements if it is possible to consider it within the overall schedule.

12.6 Hardware, Software and Document Time Schedule

A summary of all hardware, software and documents to be provided by the Customer is shown in Figure 12-3.

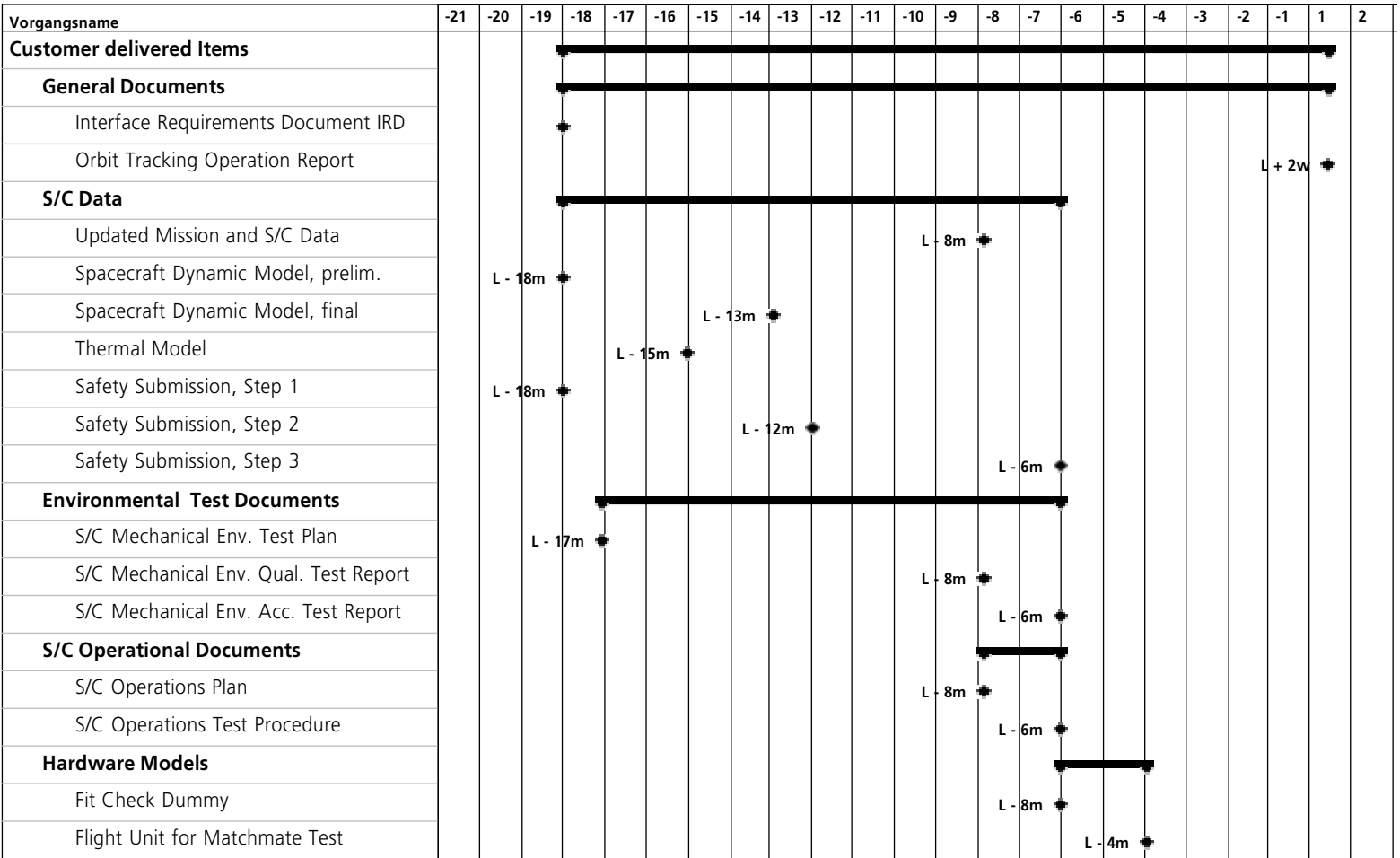


Figure 12-3: Schedule for Documents, Software and Hardware to be Supplied by the Customer