



AGUSTA

EUROCOPTER

EUROCOPTER DEUTSCHLAND

FOKKER

DOC. No : QD S000N0819E01		Issue A	WBS. No : 50000		<u>Distribution list</u> NHIGM/DGM CME/PRO ILS OPS ED AG QA EC QA ECD QA FK QA										
TITLE : Guide for writing equipment test specification															
Summary : The object of this document is to define NH90's requirements with regard to the equipment manufacturers for the drafting of test specification documents (ETSS) for equipment.															
<table border="1"> <tr> <td colspan="5"><u>Programme Archives</u> Page 1</td> </tr> <tr> <td>AG</td> <td>EC</td> <td>EC</td> <td>FK</td> <td>NH</td> </tr> </table>						<u>Programme Archives</u> Page 1					AG	EC	EC	FK	NH
<u>Programme Archives</u> Page 1															
AG	EC	EC	FK	NH											
SDRG/LF Prepared by (name) : Signature : Date : Approved by () : Signature : Date :		GAVET GAVET			GUIGNARD										
<u>Delegated authority(ies)</u> Authorized by : Signature : Date :	GIOLA QAT6/00 14/09/00 AG	MARTIN QAT6/00 14/09/00 EC	NOWAK QAT6/00 14/09/00 ECD	Van KLEFFENS QAT6/00 14/09/00 FK	GUIGNARD NHI										



CLASSIFICATION
NATO UNCLASSIFIED

FOKKER

[illegible]

This document contains proprietary information and may not be reproduced in any form whatsoever, nor may be used by or its contents divulged to third parties without written permission from the owner. All rights reserved.

Number	QD S000N0819E01	Issue	A	Date	14/09/2000	Page 2 of 28
--------	------------------------	-------	----------	------	-------------------	---------------------



AGUSTA

EUROCOPTER

EUROCOPTER DEUTSCHLAND

FOKKER

TABLE OF CONTENTS

1	GENERAL	5
1.1	Object	5
1.2	SCOPE OF APPLICATION	5
1.3	abbreviations	5
1.4	PURPOSE	5
1.5	DETAILS OF APPLICATION	6
1.6	ETS TESTING AND VALIDATION CYCLE	6
1.6.1	Start-up review	7
1.6.2	GTS works phase	7
1.6.3	GTS review	8
1.6.4	DTS work phase	8
1.6.5	DTS review	9
1.6.6	ETS technical validation phase	9
1.6.7	ETS conformity review	10
1.7	PUTTING INTO OPERATION	10
1.8	RESPONSIBILITIES	10
2	DRAFTING OF THE GENERAL TEST SPECIFICATION	11
2.1	Object	11
2.2	SCOPE OF APPLICATION	11
2.3	INCOMING/OUTGOING DOCUMENTS	11
2.4	GENERAL TEST SPECIFICATION METHOD	11
2.4.1	Principles	12
2.4.2	Equipment analysis	12
2.4.3	Definition of this test strategy	18
2.4.4	Complementary tests	19
2.4.5	Result forming	19
2.5	GTS document	19
2.5.1	Typical model	19
2.5.2	General description of the typical model	19
2.5.3	Typical model summary	20
2.5.4	Detailed description of the content of each chapter	



AGUSTA

EUROCOPTER

EUROCOPTER DEUTSCHLAND

FOKKER

3	DRAFTING OF THE DTS	24
3.1	Object	24
3.2	SCOPE OF APPLICATION	24
3.3	INCOMING/OUTGOING DOCUMENTS	24
3.4	DTS METHOD	24
3.4.1	Principles	24
3.4.2	Definition of class behaviour	25
3.4.3	Test description	25
3.4.4	Failure list	26
3.5	DTS Document	26
3.5.1	Typical model	26
3.5.2	General description of typical model	26
3.5.3	Summary of typical model	27
3.5.4	Detailed description of the content of each chapter	27

AGUSTA

EUROCOPTER

EUROCOPTER DEUTSCHLAND

FOKKER

1 GENERAL

1.1 Object

The object of this document is to define NH90's requirements with regard to the equipment manufacturers for the drafting of test specification documents (ETs) for equipment.

1.2 SCOPE OF APPLICATION

Applicable to all Suppliers of electrical and/or electronic and/or optronic equipment to a Buyer.

1.3 abbreviations

ATE Automatic Test Equipment

ATP Acceptance Test Procedure

CMM Component Maintenance Manual

CPU Central Processing Unit

ETS Equipment Test Specification

ESD Electro Static Discharge

LRU Line Replaceable Unit

I Level Intermediate Level Maintenance

DTS Detailed Test Specification

GTS General Test Specification

SRU Shop Replaceable Unit

STTE Special-to-Type Test Equipment

GOT Good Operating Test

FDR Failure Detection Rate

FLR Failure Localisation Rate

FLT Failure Localisation Test

UUT Unit Under Test

VHV Very High Voltage

1.4 PURPOSE

To employ a common test method in all stages of the equipment life cycle.

This method is described in an Equipment Test Specification (ETS) made up as to allow not only the implementation of the Good Operating Test (GOT) at the equipment level (LRU) but also Failure Localisation Tests (FLT) with determination of the smallest Shop Replaceable Unit (SRU) at I LEVEL.

The ETS refers to use of standard laboratory instrumentation and may be used on ATE, STTE or workbench.

Its use is intended:

- for equipment manufacturers to carry out functional tests on completion of the new equipment manufacturing stage or during their repair;

AGUSTA

EUROCOPTER

EUROCOPTER DEUTSCHLAND

FOKKER

- for Buyer at the time of acceptance of first series production equipment (the ETS may be included in the ATP) and into the helicopter manufacturing cycle so as to verify the correct working of onboard equipment;
- in certain cases for NH90 End-Users who, in the scope of helicopter maintenance, may need to carry out Good Operating Test or Failure Localisation Tests on equipment.

The object is to allow detection and localisation of equipment failures using a number of stimulations and measures. The results of these measures are compared with defined values with their tolerances.

Performance data required by the ETS are at least:

- FDR \geq 95%,
- FLR \geq 90%.

taking into account the following conventions:

- independent random or multiple failures are not taken into account,
- the equipment does not break down during testing,
- the spare SRUs are in good working order,
- the means of testing is in good working order.

1.5 DETAILS OF APPLICATION

This document is made up of two parts:

- Guidelines for writing the general specification part of the test
- Guidelines for writing the detailed specification part of the test

The first set of guidelines (cf. §2) is intended for writing up of the General Test Specification part (GTS). This specification is intended to gain knowledge of the general working and the equipment test strategy. It defines the methods to be used to carry out the test.

The second set of guidelines (cf. §3) is intended for writing up of the Detailed Test Specification (DTS). This specification describes the unitary test actions to be applied to the equipment. It allows drafting of the test method.

These two specifications form part of the Equipment Test Specification (ETS) of the equipment concerned. They may be two separate documents or be combined in one same document.

The ETS may be included (as a whole or partly) in:

- the ATP for acceptance of series production equipment (for the GOT part);
- the equipment maintenance manual in compliance with chapter "Test and failure localisation".

1.6 ETS TESTING AND VALIDATION CYCLE

To carry out the ETS, it is divided into phases. At each phase, we find:

- entry and exit of provisions,
- validation in order to proceed to the next phase.

The validation of the different phases is constructed via rereading of documents generated during the phase and by a review.

AGUSTA

EUROCOPTER

EUROCOPTER DEUTSCHLAND

FOKKER

1.6.1 Start-up review

This phase corresponds to the beginning of the ETS work.

- Incoming provisions
 - Equipment technical specification
- Description of the activity

ETS start-up review:

- Introduction to the equipment
- Definition of the applicability of all or part of the implementation phases and ETS validation (according to the equipment's complexity)
- Identification of ETS performance objectives
- Implementation of a schedule for the works and deliveries of the GTSs and DTSS

Participants: Equipment Manufacturer
 Buyer

- Outgoing provisions
 - Minutes of the start-up review
- Condition to proceed to the next phase
 Integration of Buyer comments.

1.6.2 GTS works phase

During this phase, the equipment manufacturer makes up the GTS following the method defined during the start-up review.

- Incoming provisions
 - Equipment technical specification
 - Equipment technical document
 - Testability analysis
 - etc. ...
- Operation description
 - Drafting of the GTS
- Outgoing provisions
 - GTS
- Condition to proceed to the next phase
 - Integration of Buyer comments.



AGUSTA

EUROCOPTER

EUROCOPTER DEUTSCHLAND

FOKKER

1.6.3 GTS review

- Incoming provisions

- GTS
- Replies to Buyer comments

- Operation description

Review of the GTS presentation:

- GTS presentation and rereading
- Analysis of the replies to Buyer comments

Participants: Equipment Manufacturer
 Buyer

- Outgoing provisions

- Minutes of the GTS review

- Condition to proceed to the next phase

Acceptation of the GTS by Buyer if review comments are taken into account.

1.6.4 DTS work phase

During this phase, the equipment manufacturer constructs the DTS following the methods defined in the GTS.

- Incoming provisions

- GTS
- Minutes of the GTS review
- Equipment technical specification
- Equipment technical document
- Testability analysis
- etc.....

- Operation description

- Drafting of the DTS

- Outgoing provisions

- DTS

- Condition to proceed to the next phase

- Taking into account Buyer comments



AGUSTA

EUROCOPTER

EUROCOPTER DEUTSCHLAND

FOKKER

1.6.5 DTS review

- Incoming provisions

- GTS
- DTS
- Replies to Buyer rereading sheets

- Operation description

Review of the DTS presentation:

- DTS presentation and rereading

Analysis of the replies to Buyer rereading sheets

Participants: Equipment Manufacturer
 Buyer

- Outgoing provisions

- Minutes of the DTS review

- Condition to proceed to the next phase

Acceptation of the DTS by Buyer if the review remarks are taken into account.

1.6.6 ETS technical validation phase

During this phase, the equipment manufacturer and the Buyer carry out all the tests specified in the ETS as well as in the failure list. This validation is carried out in the equipment manufacturer's works using its industrial facilities and means.

- Incoming provisions

- GTS
- DTS
- Minutes of the DTS review
- Equipment
- Instrumentation and standard toolings
- Instrumentation and special toolings (if necessary)
- Means of failure simulation

- Operation description

Review of ETS technical validation:

- Carrying out of test chapters GOT and FLT of the DTS with equipment.
- UUT failure simulation according to the DTS and checking of failure detection and localisation
- Checking of interchangeable component dismantling and reassembling

Participants: Equipment Manufacturer
 Buyer

- Outgoing provisions

- Minutes of the ETS technical validation review

- Condition to proceed to the next phase

Acceptation of the ETS by Buyer if the review remarks are taken into account.

AGUSTA

EUROCOPTER

EUROCOPTER DEUTSCHLAND

FOKKER

1.6.7 ETS conformity review

As the Buyer has drafted the test method using the ETS, the equipment manufacturer must verify its behaviour. This phase allows:

- final checking of the ETS derived from adjustment of the means of testing,
- equipment manufacturer's compliance to adhere to the ETS using the means of testing.

- Incoming provisions

- ETS
- Equipment
- Means of testing
- Standard toolings (if necessary)
- Special toolings (if necessary)

- Operation description

ETS conformity review:

- Checking of the ETS completeness using Buyer rereading reports sheets
- Application of a GOT
- Checking of test result traceability compared to the ETS
- Failure simulation and detection/localisation

Participants: Equipment Manufacturer
 Buyer

- Outgoing provisions

- Minutes of the ETS conformity
- Certificate of conformity signed by equipment manufacturer

- End condition of the ETS development

- Certificate of conformity signed by equipment manufacturer.

1.7 PUTTING INTO OPERATION

Buyer uses the ETS, following conformity, for its requirements by means of the validated intermediate test. When a technical problem is discovered on equipment and confirmed by means of testing, the equipment is returned by the Buyer or the Partner Company to the equipment manufacturer indicating the paragraph of the test specification in which the problem has been located.

1.8 RESPONSIBILITIES

Unless otherwise previously agreed and clearly stated between the Buyer and the equipment manufacturer, the provisions concerning responsibilities are as follows:

- the equipment manufacturer

- is responsible for the writing up of documents,
- agrees to produce a ETS following the agreements made during the start-up meeting,
- agrees to declare conformity of use of the ETS on the test facilities.

AGUSTA

EUROCOPTER

EUROCOPTER DEUTSCHLAND

FOKKER

- the Buyer

- is responsible for the use of the documents,
- agrees to validate the test specification document, which falls under the equipment manufacturer's responsibility.

2 DRAFTING OF THE GENERAL TEST SPECIFICATION

2.1 Object

This chapter is a guideline. It is intended to propose a procedure for drafting of the general test specification and to be used as a document model.

The general test specification generated along these guidelines will be used to draft the detail test specification.

2.2 SCOPE OF APPLICATION

This document is to be applied:

- by the equipment manufacturers,
- in order to draft equipment test specifications.

This document concerns projects relative to the development of a means of testing for all electrical and/or electronic and/or optronic equipment onboard helicopters.

2.3 INCOMING/OUTGOING DOCUMENTS

The incoming documents are:

- the testability analysis,
- the equipment development document,
- the technical specifications,
- the aircraft installation specification,
- ...

The beginning of test definition is possible by use of these documents.

The outgoing document is the general test specification.

2.4 GENERAL TEST SPECIFICATION METHOD

The method described in this document enables drafting of the GTS for given equipment. Its aim is:

- to be an independent means of testing (work bench, ATE, STTE),
- to give an identical structure for all equipment,
- to reduce the GTS study and drafting workload,
- to be legible and easy to understand.

AGUSTA

EUROCOPTER

EUROCOPTER DEUTSCHLAND

FOKKER

2.4.1 Principles

These can be broken down into two phases:

- equipment analysis,
- definition of the test strategy, allowing failures to be easily detected.

2.4.2 Equipment analysis

This analysis bears on two different aspects:

- the equipment environment, that allows determination of the interfaces through which it will be tested and preparation of the means of physical connection between the equipment and the test means,
- the composition of the equipment that will be described in terms of test targets. The test strategy may only be constructed based on analysis of this composition.

Analysis of equipment composition is intended to lead directly to definition of test targets. The testing means will detect failures, target after target.

2.4.2.1 Equipment environment

Categorisation of the different pins available on the equipment interface connectors.

Identification and description of these categories in the GTS phase will enable test description in the DTS phase.

2.4.2.1.1 Signals

The type of element to be regrouped must be specified before describing the grouping rules and the criteria allowing them to be grouped.

The equipment pins are easily located but may not be easily used in order to define the stimulations and the measures on the equipment.

This leads to definition of the "signal" concept in comparison to the "pin" concept.

A "signal" may be defined as information or a generated event or may be applied to equipment interface pins. This is preferable to the "pin" concept as it is more naturally used.

A signal is therefore an assembly of pins whose property is that any stimulation or measure using one of the pins must use all pins of this signal.

Certain signal grouping criteria are introduced as follows.

2.4.2.1.1.1 Electronic criteria

The signals ("signal" assembly) may be grouped by the similarity of the equipment electronic interfaces transmitting or receiving a signal (even if the signal attributes themselves may vary depending on their use).

For example, ARINC 429-1, ARINC 429-2, ARINC 429-3, react to the same stimulation principles.

These signal assemblies are referred to as "electronic classes", each class is considered to be an electronic interface category.



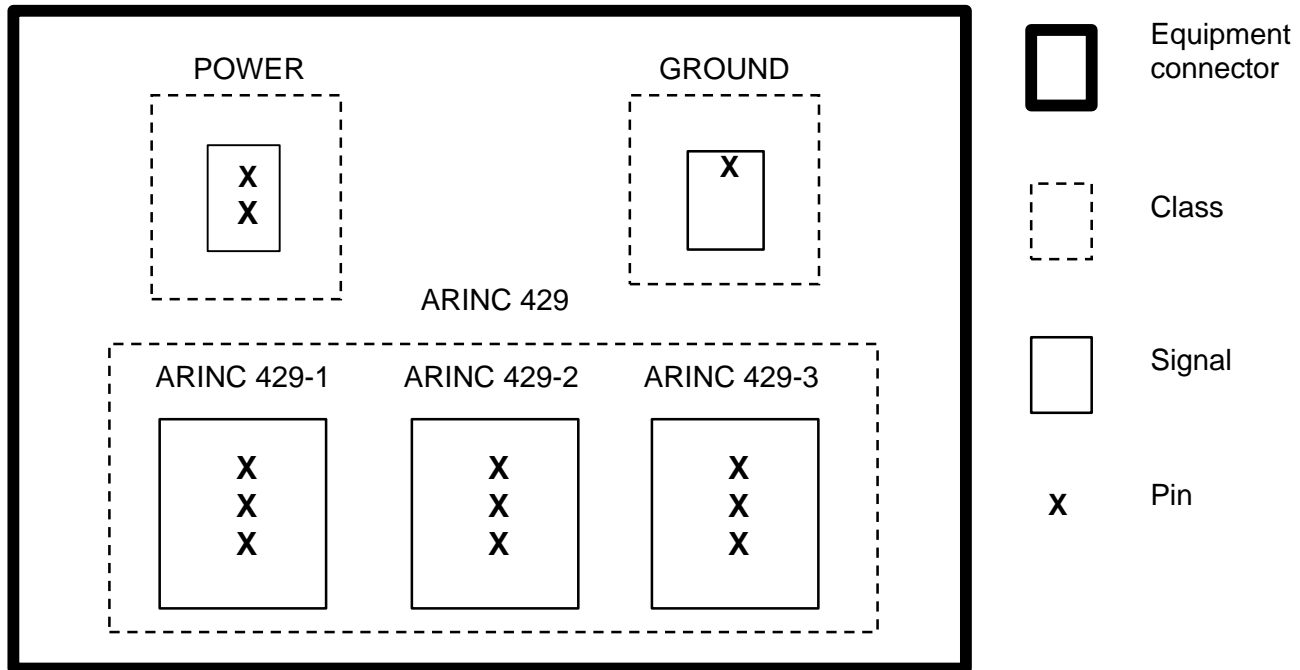
AGUSTA

EUROCOPTER

EUROCOPTER DEUTSCHLAND

FOKKER

For example: ARINC 429
GROUND
POWER



Each electronic class is specified depending on its own electronic properties (voltage, current, impedance, ...).

Note: This type of class contains either only inputs or only outputs.

This analysis results in electronic classification of all equipment signals. The classification summary, for given equipment, is given in a table of the following type:

CLASSES	SIGNALS	PINS
C1	I1 I2 I3	b1 b2 b1 b3 b1 b4
C2	O1 O2	b5 b6 b7 b8

In each class, the electronic criteria for which it is grouped must be given (for example: ARINC 429).

2.4.2.1.1.2 Criteria for internal rel looping

The signals may be grouped depending on the possibility (used or not) to connect them using a means inside the equipment to the same stimulation or measure device.

Note: this type of class contains either inputs or outputs.



AGUSTA

EUROCOPTER

EUROCOPTER DEUTSCHLAND

FOKKER

For example: if certain ARINC 429 inputs may be sent to an ARINC 429 output, then the relative inputs and the ARINC 429 output make the "ARINC 429 relooping class".

This classification of signals is referred to as "internal relooping class" and may be summarised in a table of the following type:

CLASSES	SIGNALS	RELOOPING MEANS	RELOOPED SIGNALS
C1	I1 I2 I3	internal 1	O1
C2	O2 O3	internal 2	I1

2.4.2.1.1.3 External relooping criteria

The signals may be grouped depending on the requirement (regardless of the operation mode "operational" or "test") to connect them outside of the equipment using a permanent and continuous transfer function.

Each class of signals made up in this way is specified by the necessary transfer function.

Note: this type of class contains both inputs and outputs.

This classification of signals is referred to as "external relooping class" and may be summarised in a table of the following type:

CLASSES	SIGNALS	TRANSFER FUNCTION
C1	O1 O2 I1	$I1 = k1O1 + O2$

Note: Depending on the complexity of the transfer function, the equipment manufacturer must provide a detailed description of the means to be implemented for its derivation (electrical diagrams, conversion formulas, algorithms,...). When necessary, special toolings may be used for this function.

2.4.2.1.1.4 Time criteria

Signals may be grouped depending on the need to synchronise them (either simultaneously or sequentially).

Each class is specified by the time relationship existing between signals in the class.

The relationships must be described using the appearance of events (relative to the signals) and the time between them.

Note: this type of class contains either only inputs, or only outputs as synchronisation between the inputs and outputs does not depend on time criteria but on the test field themselves.

For example: following a power supply sequence is in fact a time criterion.

AGUSTA

EUROCOPTER

EUROCOPTER DEUTSCHLAND

FOKKER

This classification of signals is referred to as "time class" and may be summarised in a table of the following type:

CLASSES	SIGNALS	TIME LINK
C1	O1, O2	Evt 1: O1 front post Evt 2: O2 front post Evt 2: 30 min after Evt 1

2.4.2.1.1.5 Protocol criteria

Signals may be grouped according to the need to follow a communication protocol (regardless of the operation mode: "operational" or "test") using inputs or outputs.

Each class is defined by the protocol allowing communication.

Note: this type of class contains inputs and outputs.

For example: Rx, Tx may be grouped in a Xon/Xoff class.

This classification of signals is referred to as "protocol class" and may be summarised in a table of the following type:

CLASSES	SIGNALS	PROTOCOL
C1	I1 O1	Xon/Xoff

2.4.2.1.2 Procedure

All classes of signals are identified and their organisation specified. This must be done in the following order:

- 1) electronic classes,
- 2) internal rel looping classes,
- 3) external rel looping classes,
- 4) time classes,
- 5) protocol classes.

It is important to note that:

- a signal may belong to several classes,
- all signals belong to at least one electronic class.

The different summary tables resulting from the environment analysis steps make up part of the GTS.

AGUSTA

EUROCOPTER

EUROCOPTER DEUTSCHLAND

FOKKER

2.4.2.2 Means of application

Identification of the different signal classes makes the means of application to be used to carry out the equipment test stand out. These means are put into 4 categories:

- standard resources,
- special resources,
- standard toolings,
- special toolings.

In general, the special resources and toolings are to be avoided as much as possible.

If their use may not be avoided, a precise description of their operation and performance is to be inserted into the GTS.

The description of their use is to be as general as possible so that any other means having at least the same performance data may be used.

2.4.2.3 Equipment analysis

2.4.2.3.1 Object

Internal analysis of the equipment will allow the dividing up of each equipment SRU into an assembly of functions each able to be subjected to a specific test.

The dependability of this breakdown defines the equipment test cover.

These operations are hereafter referred to as « units » in this document.

A unit is designed as a component or an assembly of component located on the same SRU capable of being a test target.

A unit may contain:

- only one element, if it is possible and useful to carry out a diagnosis at this level (for example, a CPU),
- a whole SRU if, for example, it is impossible to isolate one test target whose size is less than the SRU.

Most of the time, a unit test results in other units' involvement besides the unit targeted due to the equipment construction. Nevertheless, a test must be constructed for each unit (one test only targets one unit).

To summarise, a unit is a sub-assembly of an SRU or an SRU for which a specific test exists. Each test will give a result ("GOOD" or "NO GOOD") which will enable exact determination in the case of "NO GOOD " which unit (therefore which SRU) is implied and in the "GOOD" case which degree of confidence may be accorded to the test sequence.

2.4.2.3.2 Procedure

The procedure is as follows:

- 1) consider the equipment as an assembly of components,
- 2) following the electronic diagram, identify the component assemblies for each SRU on which an isolated diagnosis may be carried out, and take these assemblies to be units,
- 3) describe each identified unit specifying:
 - its identifier,
 - its general organisation, using unit description as black boxes, with a diagram if necessary,
 - the principles of the test it is to be targeted by: initial conditions, test characteristics, etc ...



AGUSTA

EUROCOPTER

EUROCOPTER DEUTSCHLAND

FOKKER

- the other units which will be included in its test.

This whole analysis may be summarised in a table showing:

- on line:
 - * list of SRU units targeted (U1 to Un),
 - * list of units included in a test belonging to other SRUs (Um).
- in column:
 - * the list of targeted SRU tests (T1 to Tn),
 - * identification of SRUs to which the units belong.

Units ---> Tests	U1	U2	U3	Un	Um		
T1	T								
T2		T							
T3		X	T			X			
.									
.									
.									
.									
Tn	X		X		T				
Cards --->	Z1					Z5			

T: targeted X: included

How to read this table:

Let us consider the third line and the third column:

when test T3 targets U3 (T), the U2 and Um units are included (U2 and Um are needed to carry out the U3 test).

U3 belongs to the Z1 SRU and Um belongs to the Z5 SRU.

This table shows the relationship between the units during the test.

2.4.2.4 Repair methods

When a failed unit is found, details of the mode of operation to follow in order to repair the corresponding SRU must be given.

Different repair methods are:

- **Substitution**: one by one module replacement with preceding module replacement until the final measure in the line returns to its correct value;
- **FLT-SERIES**: (failure finding of a function spread over several series mounted modules) one by one module replacement without replacement of prior module until the end line measure returns to its correct value, followed by replacement of those modules laid out to check repair;
- **FLT-BUS**: (failure finding of a function spread on several parallel mounted modules) remove all modules thought to be failed then replace them one by one in order to determine the failure generating module;



AGUSTA

EUROCOPTER

EUROCOPTER DEUTSCHLAND

FOKKER

- **FLT-EXTERNAL-POWER-SUPPLY**: the method is identical to FLT-BUS for failure finding on power supply or stimulus delivered to equipment (the measure is made at the line entry);
- **FLT-INTERNAL-POWER-SUPPLY**: the method is identical to the FLT-BUS for failure finding on power supply or stimulus generated by the equipment. All modules found after the one generating the signal are removed and these are replaced one by one if the failure disappears up until the failure reappears;
- **ADJUSTMENT**: this is the case where the found failure may be corrected by an adjustment accessible to the I LEVEL;
- **NO FLT**: if no repair method may be applied, the equipment must be returned to a higher grade.

2.4.2.5 Failure classification

There are 2 failure categories:

- **Fatal failure**: when this type of failure is detected, equipment test may not be carried out without resorting to a repair method. For example, if equipment power supply is failed, it is useless, or even dangerous for the material state, to continue the tests;
- **Non fatal failure**: these are failures extending only to the tested unit and which may be left in this state without influencing the rest of the tests to be carried out and their results.

Each unit must be classed in one of these 2 categories.

2.4.3 Definition of this test strategy

A test strategy is efficient when it allows the following goals to be reached:

- check, as quickly as possible and on as wider range as possible, that the equipment functions normally,
- where equipment is found to be functioning badly, find the failure on one SRU with a large probability of diagnosis reliability and identify, if possible, the failed unit inside the SRU,
- allows a separate diagnosis for each SRU and enable after repair, relooping of the tests intended for the SRU,
- reduce and regroup the operator manual interventions.

Sequencing the tests must take into account that, as the units may not often be stipulated and tested independently, it is therefore advised to proceed as follows:

- begin by integrity tests, for example, continuities;
- follow with diagnoses of ancillary service or shared units:
 - * power supply;
 - * CPU;
 - * memory;
 - * inputs/outputs;
- check the autotest results and the BITE memory decoding;
- check each SRU one after one;
- take into account unit interactions;
- integrate the following simple hypotheses:
 - * the testing means is presumed to be in working order,
 - * the replaceable SRUs are presumed to be in working order,
 - * the replaceable module adjustment is possible in the environment,
 - * only if all the tests are carried out may the equipment be deemed to be in good working order,
 - * multiple failures will not be taken into account. However, the test must enable to find several simple failures (each separately),
 - * sporadic failures and failures that do not appear during the tests will not be taken into account.

The strategy must therefore describe:



AGUSTA

EUROCOPTER

EUROCOPTER DEUTSCHLAND

FOKKER

- the chosen constraints and hypotheses,
- the list of tests, their use and principles of stimulation and measurement,
- the target and the general diagnosis associated with each test, as well as restrictions if necessary.

All these elements give a global view of the test strategy.

2.4.4 Complementary tests

When a failure is detected, where diagnosis of the failed unit is ambiguous, complementary tests may be carried out in order to improve the probability rate of an SRU. These tests, as well as their operational conditions are taken into account in the test strategy.

Complementary tests should lead to a given repair method (see. § 2.4.2.4).

2.4.5 Result forming

The test strategy is presented in chapters, each chapter applying to an SRU test.

The goals of chapter breakdown is as follows:

- to reach a modular test in order to be able to carry out a chapter, to test one SRU in particular,
- to have the possibility to choose a chapter depending on a given orientation derived from the in-house or ordered autotests or by the BITE memory,
- to be able to choose only the parts of the test which are useful depending on the given circumstances in order to carry out a rapid test process and have an effective failure localisation.

The chapter definition criteria are as follows:

- begin tests off line then check supplies,
- use the BITE memory and the autotests,
- have a chapter for each SRU,
- assemble operator interventions at the beginning or on completion of the test sequence,
- describe complementary failure finding tests or adjustments in the specified chapters.

2.5 GTS document

The aim of this chapter is to enable the writing up of the GTS document. It is divided into two parts:

- the first part introduces the typical GTS document model,
- the second part gives each paragraph in detail.

2.5.1 Typical model

The typical model enables:

- to give guidelines for writing up, i.e. to help by suggesting GTS documentation organisation,
- to suggest a structure organising the different tasks necessary in order to produce the document.

The successive parts of the typical model are as follows:

- physical description of the equipment,
- functional and organical description of the equipment,
- description of the test method,
- performance data of the test strategy.

The content detail of each part is given in the following paragraphs.

2.5.2 General description of the typical model

AGUSTA

EUROCOPTER

EUROCOPTER DEUTSCHLAND

FOKKER

The first chapter (1. Equipment description) is a physical description of the equipment. This description shows the material elements that make up the equipment. These elements are numbered and described in order to show each element. Any adjustments of intervening "closed" or "open" equipment which come into the category of a functional test, of a failure localisation test, of an SRU replacement, of SRU harmonisation are located here and their functions described. If certain adjustments are not retained, reasons for this must be given. The aim is to give a definition of the entire equipment operational environment and to identify its components and interfaces.

Note: within the paragraph on adjustments and the paragraph on interchangeable modules, module implantation and equipment adjustments must be indicated as well as difficulties encountered or dismantling/reassembling constraints for module replacement and the adjustment operations used. The nature and references of toolings used for these operations must also be indicated.

The second chapter (2. Functional test description) is the description of the equipment in units and the description of the functional tests of these units. The organical description shows the equipment as a white box made up of an assembly of units, each unit being considered as a black box. This description is an internal view, which will be used to define the test strategy, as a unit is the target of a test. The functional test description shows the behaviour of the equipment units in the test mode (non-operational). This description is essentially an external view.

The third chapter (3. Test method) gives details of the test strategy and how each test targets a unit. The strategy defines the test sequence, which allows each unit to be diagnosed, as well as justifying this sequence. The general characteristics of resources used by the tests complete the description. For example, necessary instrumentation, and for each of these, its role and characteristics.

The fourth chapter (4 Performance data of the test strategy) gives performance data of the test strategy, previously defined, in terms of FDR and FLR.

2.5.3 Typical model summary

1 EQUIPMENT DESCRIPTION

- 1.1 Designation of the Equipment
- 1.2 Equipment presentation
- 1.3 Applicable documents and reference documents
- 1.4 Physical description
 - 1.4.1 Physical characteristics
 - 1.4.2 List of SRU replaceable at I level
 - 1.4.3 Distribution of signals over the connectors
 - 1.4.4 Description of active sides
- 1.5 Special environment
- 1.6 Adjustments
- 1.7 Restrictions

2 FUNCTIONAL TEST DESCRIPTION

- 2.1 Organical description of the equipment
- 2.2 BITE memory
- 2.3 Autotests
- 2.4 Identification of signal classes

3 METHOD

- 3.1 General test strategy
- 3.2 Unit tests
- 3.3 Resources list

AGUSTA

EUROCOPTER

EUROCOPTER DEUTSCHLAND

FOKKER

4 PERFORMANCE DATA OF THE TEST STRATEGY

2.5.4 Detailed description of the content of each chapter

CHAPTER 1 EQUIPMENT DESCRIPTION

Paragraph 1.1 Designation of the Equipment

- Designation;
- Abbreviation;
- Part Number.

Paragraph 1.2 Equipment presentation

This paragraph introduces the equipment operation, its role in the system in which it is contained, the different equipment with which it is linked in order to carry out its function.

Paragraph 1.3 Applicable documents and reference documents

This paragraph lists the applicable documents and reference documents that have been used to define the tests.

Paragraph 1.4 Physical description

Paragraph 1.4.1 Physical characteristics

- equipment dimensions as well as the general drawing, when this is possible,
- equipment connectors (equipment manufacturer's references) used on the helicopter installation or for this particular test,
- mechanical interfaces to be put into place (centring peg, alignment, ...),
- any other information which may complete this description.

Paragraph 1.4.2 SRU list

List of replaceable units at the I LEVEL with the mnemonic and the survey reference.

Paragraph 1.4.3 Distribution of signals over the connectors

For each contact, the following is specified in a table:

- type of signals transmitted;
- name of signal;
- transmission direction (Input / Output);
- any particular contact characteristics.

Paragraph 1.4.4 Description of active sides

A presentation to the equipment's active sides completes the description along with identification of all controls and visualisation elements that will be used during the tests.

Paragraph 1.5 Special environment

This part specifies particular constraints to be taken into consideration during the tests in order to achieve good equipment behaviour.

For example, consumption, temperature, vibration, ESD protections, VHV, etc... constraints.

AGUSTA

EUROCOPTER

EUROCOPTER DEUTSCHLAND

FOKKER

Paragraph 1.6 Resources and toolings

This part recalls all the resources and toolings (standard and special) required in order to proceed to the equipment test.

Paragraph 1.7 Test restriction

In this paragraph, all elements unchecked by the test specification must be indicated, with associated explanations.

CHAPTER 2 FUNCTIONAL TEST DESCRIPTION

Paragraph 2.1 Organical description of the equipment

This section contains all information relating to the internal analysis of the equipment as defined in paragraph 2.4.2.3.

Paragraph 2.2 BITE memory

If a BITE memory exists, it must be noted here and in this case, its size, the format of the information it contains, its protocol and the manner in which it will be used during the tests.

All necessary information in order to use the content of the BITE memory are indicated:

- read/write protocol;
- erase protocol (only used in the event of a complete test being carried out without failure).

Paragraph 2.3 Autotests

This part specifies if integrated or downloaded autotests are to be put in place. If so, the following details must be given:

- their name and role,
- the protocol which allows them to be charged, run and results taken,
- their functional cover,
- the checked elements.

Paragraph 2.4 Identification of signal classes

Introduction to the identified classes according to the method described in paragraph 2.4.2.1 (Equipment environment):

- protocols of the digital links used,
- representation of the interfaces between equipment contacts and methods used for the test,
- layout drawing.

CHAPTER 3 TEST METHOD

This chapter is intended to gather the results of the study used to define the test strategy, as well as the test strategy itself. This part therefore uses the equipment elements as an assembly of units.

Paragraph 3.1 General test strategy

This paragraph gives the chosen principles used to define the test strategy. These must be given beginning with the general principles explained in chapter 2.3 (Method of drafting of the GTS):

- characteristics of equipment having an influence on this strategy;
- use of the BITE memory and the in-house or ordered equipment autotests (taking into account the fact that these tests may not be carried out until certain ancillary tests have been carried out);
- list of test chapters.



AGUSTA

EUROCOPTER

EUROCOPTER DEUTSCHLAND

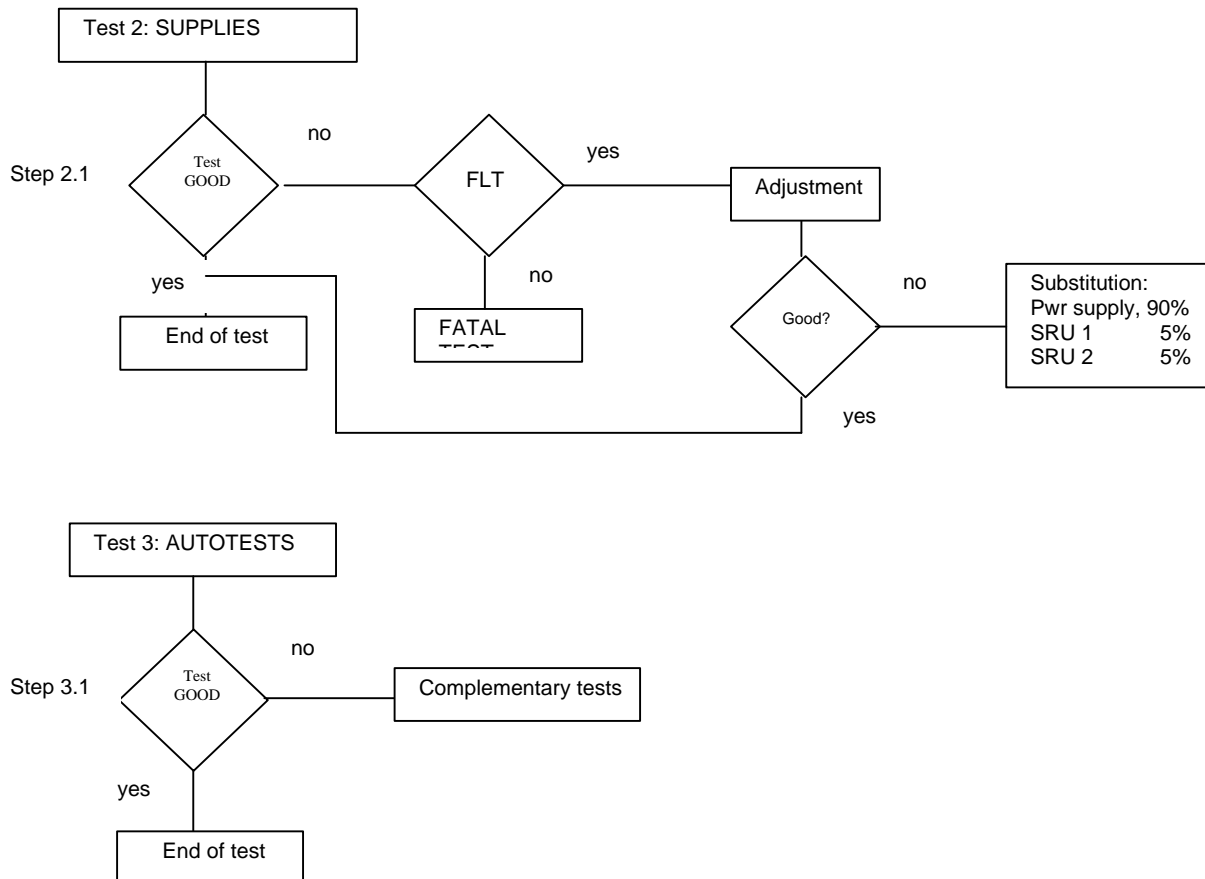
FOKKER

Paragraph 3.2 Unit tests

This paragraph describes the test strategy itself. As we have seen earlier, a unit is targeted by a test and so each test targets a unit. The strategy is given as a series of test lines.

For each test, the unit targeted by the test is described (this leads to a diagnosis of its state) and the different units implied (where a possibility of failure must be small in comparison with the targeted unit).

The presentation may be in the form of flow charts as shown in the following examples:



Even if a diagnosis contains several units, the test only targets one unit. The failure possibility of the targeted SRU must be much more than that of each SRU implied.

The SRUs must be introduced in the preferred order of replacement in case of failure. The presentation must take into account the rate of possibility of failure (these must be specified), ease of access or all other criteria having an influence on the operations.

CHAPTER 4 PERFORMANCE DATA OF THE TEST STRATEGY

This chapter gives the results of:

FDR	Failure Detection Rate	=	number of detected failures/number of possible failures
FLR	Failure Localisation Rate	=	number of located failures/number of possible failures

3 Drafting of the DTS

3.1 Object

To suggest a procedure for the drafting of the detailed part of the test specification as well as a document structure.

The DTS follows the GTS and completes the ETS.

The GTS has defined the test strategy for the equipment by organising the testing of the different units and identifying each test. Depending on this definition of the test strategy, the DTS formalises the tests, i.e. the stimulations, measurements and diagnosis sequences.

3.2 SCOPE OF APPLICATION

To be applied by the equipment manufacturers in order to carry out the equipment DTSs.

This document is intended for projects relative to the development of test specifications of all electrical and/or electronic and/or optronic equipment onboard helicopters.

3.3 INCOMING/OUTGOING DOCUMENTS

The incoming documents are:

- the equipment technical specifications,
- the general test specification.

The outgoing document is the detailed test specification.

3.4 DTS METHOD

The method described in this paragraph enables the formalisation of a form of test strategy defined in the GTS. Characteristics of this method are:

- independence with respect to means of testing,
- formal standardisation for all the equipment,
- reduction of study time and DTS development.
- to be legible and easy to understand.

3.4.1 Principles

This method relies on the following principles:

- to efficiently use all information defined in the GTS,
- to clearly and precisely formalise the tests

The associated tasks to be carried out are as follows:

- 1. Describe the behaviour of classes of signals and their functioning methods.
- 2. Describe in plain English the test sequences defined in the GTS with for each of these:



AGUSTA

EUROCOPTER

EUROCOPTER DEUTSCHLAND

FOKKER

- initial conditions to be respected;
 - stimulations to be sent to the equipment;
 - measures to be taken;
 - results to be obtained with their tolerances;
 - the diagnoses associated with each result;
 - the repair method;
 - conditions to be fulfilled to exit the test;
- 3 Define the failures that may be simulated to check the precision of the diagnoses.

3.4.2 Definition of class behaviour

The aim is to describe all the operations to be carried out on each class of signals during the unit test. This description is valid for:

- the resources necessary for the class functioning,
- the algorithms necessary to activate resources depending on the actions and the parameters.

This approach is equipment-oriented rather than test resources.

This allows identification for each class, of the characteristics to be taken into account.

In order to define these characteristics, it is possible to use diagrams containing description of connections to the resources, to explain the electronic circuits put into place during the class functioning.

These characteristics are derived from constraints that must be respected in order for the class to function.

3.4.3 Test description

This phase is divided into two activities:

- to clearly identify the test objects,
 - to lay down a formal description of the identified tests.

3.4.3.1 Test objects

For each test, it is necessary to characterise the targeted unit by giving its characteristics, for example:

- static characteristics,
- electric characteristics,
 - functional characteristics.

Each characteristic will undergo a test sequence.

3.4.3.2 Formalisation

Each test belongs to a chapter. Most of the time, a chapter is a group of tests, the necessary initial state for each group must therefore be specified at the beginning of the chapter,.

For each test of this chapter, the following must be defined:

- the required equipment initialisations for the test,
 - the different test steps with reference to the targeted unit characteristics.

To totally specify the tests, we must have:

- a vocabulary allowing definition of the stimulations, measures, diagnoses and treatments,
- control structures for the measures and the stimulations,
 - a general process which may contain the stimulations, the measures, the control structures and the diagnoses all at the same time.

A process based on the following table concept may be used.

This document contains proprietary information and may not be reproduced in any form whatsoever, nor may be used by or its contents divulged to third parties without written permission from the owner. All rights reserved.				
Number	QD S000N0819E01	Issue	A	Date 14/09/2000
			Page 25 of 28	



AGUSTA

EUROCOPTER

EUROCOPTER DEUTSCHLAND

FOKKER

For example:

TEST	CLASS	VERB	SIGNAL	PARAMETER	PINS	DIAGNOSES
	PWR SUPPLY	Apply	PWR SUPPLY 1	28 V	HI P1-A LO P1-B	
		Wait		300 ms		
Test-n	PWR SUPPLY	Check current	PWR SUPPLY 1	1A ± 0,2 A		Unit X 90% Unit Y 5 % Unit Z 5 %

3.4.4 Failure list

When the procedure of the functional test is finalised, the failure we wish to simulate must be determined for each SRU (or unit) in order to check the diagnoses. It being understood that simulated failures are non destructive for the equipment (opening of a link on a cut-off box, giving a negative response to a question, not reacting to a control unit on the front side, etc, ...).

This failure list allows us to check the FDR and the FLR of a test specification.

3.5 DTS Document

The aim of this chapter is to facilitate the writing up of the DTS, it is divided up into two parts:

- the first part introduces the typical model itself, i.e. the names and numbering of paragraphs,
- the second part gives details of the content of each paragraph.

3.5.1 Typical model

The typical model:

- aids the task of writing up of detailed test specifications by giving a standard organisation,
- offers a structure in order to efficiently incorporate the results of the detailed specification analysis phase,
- leads to a compatibility with the data and concepts of the GTS document.

3.5.2 General description of typical model

The first chapter (1. Equipment description) is simply an identification of equipment references and reference documents. In the case where the GTS and the DTS are both in the same document, these paragraphs should not be repeated.

The second chapter (2. Signal description) extends the description of classes defined in the GTS document. Each class is described with all necessary actions that are associated with it. For each class, the means to be implemented its operation must be defined.

In the third chapter (3. Detail specification of test functions), the tests are distinctly described.

In the fourth chapter, the table with the list of non-destructive failures is found.

AGUSTA

EUROCOPTER

EUROCOPTER DEUTSCHLAND

FOKKER

3.5.3 Summary of typical model

1 EQUIPMENT DESCRIPTION

- 1.1 Equipment designation
- 1.2 Reference documents and applicable documents

2 SIGNAL DESCRIPTION

- 2.1 List of signal classes
- 2.2 Description of each class

3 DETAILED TEST SPECIFICATION OF UNITS

4 LIST OF NON-DESTRUCTIVE FAILURES

3.5.4 Detailed description of the content of each chapter

CHAPTER 1 EQUIPMENT DESIGNATION

Paragraph 1.1 Equipment description

- Designation;
- Abbreviation;
- Part Number.
-

Paragraph 1.2 Reference documents and applicable documents

This paragraph lists the applicable documents and reference documents used to define the tests.

CHAPTER 2 SIGNAL DESCRIPTION

Paragraph 2.1 List of signal classes

The list of classes defined in the GTS document is repeated.

Paragraph 2.2 Description of each class

For each class, the resources and characteristics of the resources that its activation requires must be specified. This specification is given for each independent class, without taking into account any possible optimisation of resources.

A diagram showing connections to the resources may complete the description of the necessary availability of class functioning.



AGUSTA

EUROCOPTER

EUROCOPTER DEUTSCHLAND

FOKKER

CHAPTER 3 DETAILED TEST SPECIFICATION OF UNITS

This chapter is the final point of all work, which has taken place in the previous chapters.

It describes all test steps to be carried out, to check the correct working of units and therefore of the equipment.

CHAPTER 4 FAILURE LIST

This chapter lists the group of failures to be simulated with the associated diagnosis for each of them.