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agence spatiale européenne

Pages 1 to 30

## CHECKLIST FOR RESISTORS

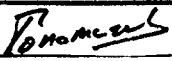
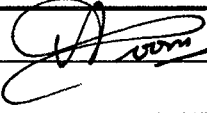
### MANUFACTURER AND LINE SURVEY

ESA/SCC Basic Specification No. 2024000

Manufacturer :  
Location :  
Survey Team Leader :  
Date of Survey :  
Resistor Type(s) :



space components  
coordination group

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		SCCG Chairman	ESA Director General or his Deputy
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ISSUE 1

**DOCUMENTATION CHANGE NOTICE**

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1. **INTRODUCTION**

This checklist is intended for use during the initial survey of a Manufacturer's ability to produce high quality articles, his management organisation, production facilities, test facilities and technical know-how. When completed, this checklist should enable the party interested in procurement of the subject components to assess the ability of the Manufacturer concerned to successfully execute a contract for the supply of high reliability space hardware.

2. **SURVEY CHECKLIST**

2.1 **INTERVIEW ON ARRIVAL OF SURVEY TEAM**

(a) Introductory Remarks by Team Leader (Explanation of purpose of survey, procedures to be followed, time limitations, etc.):-



(b) Notes (Atmosphere during reception, willingness to co-operate, interest shown, comments on personnel, general remarks):-

2.2 **MANUFACTURER AND SURVEY TEAM INFORMATION**

(a) Survey requested by :  
 Survey Team Leader :  
 Team Members :

(b) Key personnel of Manufacturer interviewed:-

Name	Function	Tlph. Ext.
1.		
2.		
3.		
4.		
5.		

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(c) Type of Company (Private company, limited company, etc.)

Affiliated with any other company? If so, which:

No. of employees:

- Total number :
- Production :
- Quality Assurance :
- Q.A. Inspection :
- Prod. Engineering :
- Design Engineering :
- Reliability Control :
- Other :

(d) Number of shifts :

(e) Plant area :

(f) General production line :

(1) Device types manufactured:

(2) Will flow diagrams of steps to produce resistors be available to Survey Team?

YES NO

Are specifications, if any, referenced in the flow diagrams?

YES NO

(g) Principal Government and industrial customers:-

- 1.
- 2.
- 3.
- 4.
- 5.

(h) The Manufacturer's Quality System is organised in accordance with:

Comments

(i) Manufacturer's Government Service Inspection:

DCAS Inspector, resident/non-resident

(j) National Inspectorate:

(k) Is the Manufacturer's resistor production

(1) Continuous?	YES	NO
(2) Pilot production?	YES	NO
(3) Advanced R&D, limited?	YES	NO

(l) The Manufacturer has adequate experience in the production of the following hi-rel parts:-

### 2.3 MANAGEMENT ORGANISATION

(a) What is general policy/attitude of the Management regarding quality/reliability programme?

(b) Which level of Management participates actively in orientating policy towards space component production?

(c) Which organisation, if any, reviews and monitors all work involved in space component production?

(d) Is work related to space components (contracts) regarded as "normal business" or as belonging to the "unique order" category?

(e) What is the general policy concerning proprietary rights?

(f) Has the "Reliability" department the same authority from Management as the "Engineering" and "Production" departments? Does this mean direct responsibility for reliability of products in the line?



(g) Has the Q.A. Manager direct authority for implementation of quality policy and actions related to the line?

(h) Does a system exist for the regular supply of quality report summaries to Management?

Does this system lead to (corrective) actions being taken in respect of the production line?

(i) Are key management staff notified of persistent out-of-control conditions?

(j) What is length of service and experience of key management personnel (Q.A., Reliability, Production, Engineering Design)?

(k) How would contract for space components be organised?

(l) How can original requirements from Orderer (Space Agency or end-user) be assumed to be correctly translated into internal instructions?

(m) How can information necessary to the Orderer (corrective actions, deviations, notification of inspections and/or problem areas) be assumed to be issued and channelled to the Orderer?



2.4 QUALITY ASSURANCE SYSTEM AND ORGANISATION

(a) To whom does Q.A. Manager report?

(b) Does the company reflect a positive attitude towards Quality Assurance?      YES      NO  
\_\_\_\_\_      \_\_\_\_\_  
Comments

(c) Has the Q.A. group sufficient authority in relation to its position  
within the company's organisation (see organigram)?      \_\_\_\_\_      \_\_\_\_\_  
Comments

(d) Are areas of responsibility within the Q.A. group clearly defined?      \_\_\_\_\_      \_\_\_\_\_  
Comments

(e) Are corrective actions to which Q.A. management is committed delegated  
to responsible staff or does Q.A. management have direct authority  
regarding the line?      \_\_\_\_\_      \_\_\_\_\_  
Which?

(f) Is there a periodic and comprehensive quality data reporting system which  
covers all operational phases?      \_\_\_\_\_      \_\_\_\_\_  
Comments

(g) What is the relationship between Q.A. and Reliability?

(h) Is a Q.A. manual or equivalent document supplied to all levels of  
appropriate supervisory personnel?      \_\_\_\_\_      \_\_\_\_\_  
Is such document kept updated?      \_\_\_\_\_      \_\_\_\_\_  
Comments





	YES	NO
(i) Are written procedures available for identification and positive control of accepted/rejected materials?	___	___
Comments		
(j) What is ratio Q.A. inspectors : personnel directly involved in production?		
(k) Is inspection (acceptance sampling or sorting) performed by Q.A. personnel:-		
On receipt?                      Sampling ___                      Sorting ___                      None ___		
During processing?              Sampling ___                      Sorting ___                      None ___		
During final testing?            Sampling ___                      Sorting ___                      None ___		
Comments		
(l) Are written procedures kept and used in areas for:-		
Receiving inspection?	___	___
In-process inspection?	___	___
Fabrication processing?	___	___
Final testing?	___	___
Comments		
(m) Does Q.A. maintain a system of written procedures for statistic controls (control chart, lot plot, etc.) in any of the following areas?		
In-process inspection?	___	___
Fabrication processing?	___	___
Final inspection?	___	___
Comments		
(n) Is Q.A. responsible for determination of need for, and the conducting of, quality training?	___	___
Comments		
(o) Are training programmes provided for special process personnel?	___	___
Comments		



	YES	NO
(p) Do employees have to pass tests:-		
After training?	___	___
Periodically?	___	___
Comments		
(q) Are production operators provided with visual aids and working instructions?	___	___
Comments		

2.5 CALIBRATION

(a) Does Manufacturer maintain calibration facilities and standards?	___	___
Is this service purchased?	___	___
If so, from whom?		
(b) Do calibration personnel have written procedures for control and a time schedule for measurement frequency?	___	___
Comments		
(c) Is there an effective calibration record control system?	___	___
(d) Are calibration procedures adhered to and up-to-date?	___	___
Comments		
(e) Are decals used for equipment identification to show that units have been calibrated; when next calibration date is due and calibrator identification?	___	___
Are decals up-to-date?	___	___
(f) Are adjustments of calibrated equipment required to be sealed and tamper-proof?	___	___
(g) Who is in charge of initiating calibration steps?		
User	___	___
Calibration personnel	___	___
Q.A.	___	___



- |                                                                                                                                                                                                | YES               | NO                |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|-------------------|
| (h) Do calibration procedures provide for removal of any equipment not maintained or calibrated according to established schedules?<br>Comments                                                | ___               | ___               |
| (i) Have calibrating personnel up-to-date certification records reflecting date, traceability to NBS and identification of calibrator?<br>(1) Mechanical standard?<br>(2) Electrical standard? | ___<br>___<br>___ | ___<br>___<br>___ |
| (j) Is modified and/or repaired equipment calibrated prior to release?                                                                                                                         | ___               | ___               |

2.6 DRAWING AND CHANGE CONTROL

- |                                                                                                                                                                                                                           |            |            |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|------------|
| (a) Has Manufacturer adequate written procedures for control of specification and contract changes?<br>Comments                                                                                                           | ___        | ___        |
| (b) Does Manufacturer's system provide for documented change control guaranteeing availability of required drawing at relevant manufacturing or inspection step?<br>Do flow documents show current revisions?<br>Comments | ___<br>___ | ___<br>___ |
| (c) Are drawings furnished by ESTEC and contract changes adequately controlled?<br>Comments                                                                                                                               | ___        | ___        |
| (d) Does Q.A. review all drawings and changes therein prior to their becoming effective?<br>Comments                                                                                                                      | ___        | ___        |
| (e) Has Manufacturer established a procedure for notifying his Supplier of changes in drawings?<br>Comments                                                                                                               | ___        | ___        |
| (f) Are current specification revisions shown on prints of drawings?                                                                                                                                                      | ___        | ___        |



		YES	NO
2.7	<u>RELIABILITY</u>		
(a)	Is structure of Reliability organisation clearly defined?	___	___
	Has Reliability same authority in respect of the line as Production or Engineering management?	___	___
	Comments		
(b)	Is there a direct feed-back of information between Reliability, Design Engineering and Q.A. groups to ensure timely notification of all relevant data?	___	___
	Comments		
(c)	Does Reliability respond promptly and efficiently to unexpected and/or newly detected failure modes?	___	___
	Comments		
(d)	Are line failures (types and causes) analysed and reported to those responsible for corrective actions?	___	___
(e)	Are corrective actions resulting from failure analysis agreed with the Q.A. group involved or Reliability if parts or process changes must be made?		
	Q.A. Group	___	___
	Reliability	___	___
	Comments		
(f)	Has Reliability right to approve test specifications, data tabulation, parts or process changes?	___	___
(g)	Is there a system for in-process failure analysis?	___	___
	End-item failure?	___	___
	Reporting?	___	___
	Comments		



	YES	NO
(h) Are following items submitted to failure analysis as a matter of routine?		
- Production line rejects	___	___
- Lots with a high rejection rate	___	___
Define:-		
- Items returned by Orderer	___	___
- Items returned by Orderer with special request for failure analysis	___	___
(i) Has Manufacturer a failure analysis laboratory or an equivalent facility?	___	___
Comments		
(j) Are failure analysis procedures:-		
(1) Available?	___	___
(2) In use?	___	___
(3) Adequate?	___	___
Comments		
(k) Is failure analysis equipment:-		
(1) Available?	___	___
(2) In use?	___	___
(3) Adequate?	___	___
Comments		
(l) Are there special personnel for failure analysis?	___	___
Comments		
(m) Are failure analysis reports:-		
(1) Available?	___	___
(2) Adequate?	___	___
Comments		
(n) Has Reliability a programme to ensure reliability of resistor designs prior to release thereof?	___	___
Comments		



	YES	NO
(o) Has Reliability access to all pertinent development and production data of resistors for analysis purposes? Comments	—	—
(p) Is reliability data available of resistors from the line(s) which the Manufacturer wishes to be approved? Comments	—	—
(q) Has Manufacturer an evaluation laboratory for determination of product characteristics? Comments	—	—
(r) If Manufacturer has an evaluation laboratory: - Does it operate according to an established programme? or - According to special requests? Comments	— —	— —
(s) Give examples of problems investigated by evaluation laboratory		
(t) Are laboratory results available on request?	—	—
(u) Are data sheets based on these results?	—	—

2.8 CONTROL OF PROCUREMENT SOURCES

(a) Has Manufacturer adequate written procedures for purchase control of materials, components and services? Comments	—	—
(b) Has Manufacturer an effective vendor rating system? Comments	—	—



	YES	NO
(c) Does rating system provide for effectiveness of written corrective actions received from Suppliers? Comments	___	___
(d) Do purchase documents require delivery of test reports if such reports are specified in the relevant ESA contract? Comments	___	___
(e) Is there a means of channelling information when specification changes require modification of current purchase orders? Is "Receiving Inspection" notified of changes in purchase orders? Comments	___ ___	___ ___

2.9 CONTROL OF INCOMING MATERIALS (Performed in situ)

(a) Are Manufacturer's written standard inspection procedures adequate for control of incoming materials and services received? Do inspectors know how and when to apply these procedures? Comments	___ ___	___ ___
(b) Are materials received in a controlled area from which removal prior to inspection is impossible? Comments	___	___
(c) Are materials properly handled and protected during the receiving process? Comments	___	___
(d) Does Receiving Inspection use drawings and purchase orders? If so, do these documents show Quality Control review? Comments	___ ___	___ ___
(e) Are test reports from Suppliers being reviewed? Comments	___	___



	YES	NO
(f) Are accepted materials adequately identified?	___	___
Do documents show evidence of acceptance?	___	___
Comments		
(g) Are rejected materials adequately identified and segregated?	___	___
Comments		
(h) Which materials are subject to limited shelf life limitations?		
Comments		
(i) Are shelf life and cure date materials properly identified and controlled?	___	___
Comments		
(j) Do records indicate traceability of units, lots and sublots to applicable documents (specification, revision letter - if any - and inspection record)?	___	___
Comments		
(k) Are materials stored in a controlled area under the responsibility of an authorised Custodian?	___	___
Comments		
(l) Are suitable inspections and tests, including physical and chemical tests, performed on raw materials?	___	___
Comments		
(m) Are such tests performed:		
- In-house?	___	___
- At other locations?	___	___
Comments		





	YES	NO
(n) Are storage containers, racks, bins, etc. adequate for type of material stored?	—	—
Comments		
(o) Is lot traceability maintained?	—	—
Comments		
(p) Is "first in/first out" method applied?	—	—
<b>2.10 <u>IN-PROCESS INSPECTIONS AND TESTS</u></b>		
(a) To whom does In-process Q.A. Inspection report?		
(b) Are inspection and/or operation travellers used sequential to performance and control of all operations and processes?	—	—
Comments		
(c) Do travellers refer to inspection procedures?	—	—
Do inspectors know how and when to use them?	—	—
Comments		
(d) Do travellers refer to controlled <u>specifications</u> ?	—	—
Do specifications show <u>current</u> revision status?	—	—
Comments		
(e) Does Q.A. have written in-process procedures to control acceptance of products?	—	—
Comments		
(f) Is type and quantity of available inspection equipment adequate for type of work being accomplished?	—	—
Comments		



	YES	NO
(g) Are documentation and instruments used by inspectors subject to calibration control?	___	___
Is calibration evident and up-to-date?	___	___
Comments		
(h) Is there a specific material review procedure?	___	___
Comments		
(i) Do in-process Q.A. inspectors summarise quality experience on the basis of specific process stages?	___	___
Do they issue quality reports on a regular basis?	___	___
Do reports result in assistance and/or action?	___	___
Comments		
(j) Are requests for corrective action issued in writing?	___	___
Are such requests answered?	___	___
Does corrective action ensue?	___	___
Comments		
(k) Does Q.A. maintain any statistic controls (X&R, etc.) in the in-process area?	___	___
Are these controls up-to-date and at individual process stations?	___	___
Comments		
(l) Is lot identification maintained throughout processing?	___	___
Comments		
(m) Are there documents describing in-process manufacturing procedures and controls?	___	___
Comments		



	YES	NO
(n) Are there documents describing in-process inspections? Do inspectors know how and when to use them? Comments	___	___
(o) Are there specific standards for handling, cleanliness and care of materials, parts and equipment? Comments	___	___
(p) Are calibrations evidenced and up-to-date?	___	___
(q) Has Q.A. authority to stop production flow in case of out-of-control conditions? Is a written material review procedure in use? Comments	___	___
(r) Are records maintained of training and competence of operators for welding, soldering, radiography, radiflo and plating? Comments	___	___
(s) Are certified operators identifiable by means of a card or badge on their clothing? Comments	___	___

2.11 SURVEY OF MANUFACTURING LINE

This review shall be performed in 2 phases:-

- (1) Identification of the various steps listed in the flow chart to define the corresponding operations and collect all relevant information.
- (2) Actual line survey (indicate if inspection was performed).

If different technologies are applied, the inspection results shall be supplied on separate sheets.

2.11.1 Leads

- (a) Which lead material and plating is used?



(b) Which body material and plating is used for lead/body junction?

(c) Lead/body type of junction.

(d) How are parameters controlled?

(e) How is quality controlled?

#### 2.11.2 Resistor Element

(a) Which technology is used?

(b) Description

(c) Materials used

(d) Which assembly method is used?

(e) How is process controlled?

(f) How is position of elements defined?



YES NO

(g) How is quality of assembly controlled?

(h) Which criteria are applied to radiographic inspection?

(i) Additional items (if necessary).

2.11.3 Resistor Enclosure

(a) By which means is the device protected?

- Lacquer \_\_\_ \_\_\_
- Sealing in a plastic case \_\_\_ \_\_\_
- Sealing in a hermetic enclosure \_\_\_ \_\_\_
- Pressure moulding \_\_\_ \_\_\_
- Coating \_\_\_ \_\_\_

Comments

(b) Is resistor element heated before protection is applied?

\_\_\_

Comments

(c) How is protection applied?

- By hand \_\_\_ \_\_\_
- Automatically \_\_\_ \_\_\_

Comments



- (d) If several layers, how are they made? YES      NO
- (e) List parameters of resin controlled during application:-
- (f) Are controls deemed to be adequate? \_\_\_\_\_
- (g) Which curing and inspection procedures are applied to:
- Intermediate coatings?
  
  
  - Final coatings?
- (h) Which solvent is recommended for analysis of devices?
- (i) Are records available to check actual curing conditions? \_\_\_\_\_
- (j) How does Manufacturer control sealing dimensions during processing?
- (k) How does Manufacturer control dimensions during inspection?



	YES	NO
(l) Is such inspection scheduled?	—	—
Which aspects are inspected?		

(m) Who performs the inspection(s)?

(n) Are visual aids and criteria provided for inspection purposes?	—	—
--------------------------------------------------------------------	---	---

(o) Are visual aids and criteria applied to the production line?	—	—
------------------------------------------------------------------	---	---

(p) Are visual aids and criteria adequate?	—	—
--------------------------------------------	---	---

#### 2.11.4 Final Test Area and Screening Facility

(a) Are they separate operations?	—	—
-----------------------------------	---	---

(b) Are final production tests (see ESA/SCC specification) performed by personnel under Q.A. monitoring? or	—	—
-------------------------------------------------------------------------------------------------------------	---	---

Are they performed by Q.A. personnel?	—	—
---------------------------------------	---	---

Comments

(c) Does the final test have written inspection and test procedures for product classes on the line?	—	—
------------------------------------------------------------------------------------------------------	---	---

Do inspectors know when and how to use them?	—	—
----------------------------------------------	---	---

Comments



	YES	NO
(d) Do inspectors use assigned stamps to indicate inspection status on materials and accompanying documents?	___	___
Comments		
(e) Are requests for corrective action made in writing?	___	___
Are such requests answered?	___	___
Comments		
(f) Are rejected devices identified and segregated in a controlled area?	___	___
Comments		
(g) Are records of accepted and rejected material maintained?	___	___
Are these records identifiable with such materials?	___	___
Comments		
(h) Are device failures analysed?	___	___
Are device failure analyses summarised and reported by final Q.A.?	___	___
Comments		
(i) Is a summary inspection and test report sent regularly to quality management (lot acceptance, percentage of defects, types of failure)?	___	___
Comments		
(j) Is a testing laboratory or equivalent facility available for quality assurance purposes?	___	___
Which of the following tests are performed in the laboratory or facility?		
(1) Electrical tests	___	___
(2) Mechanical tests	___	___
(3) Chemical tests	___	___
Comments		





	YES	NO
(k) Are statistical controls of device parameter distribution maintained?	___	___
Are they reported to Q.A. or Reliability?	___	___
Comments		
(l) Is an environmental test facility maintained in-house?	___	___
If not, state where:		
Are the following tests performed at this facility?		
(1) Temperature (high, low, cycle)	___	___
(2) Shock (mechanical, thermal)	___	___
(3) Acceleration	___	___
(4) Vibration (fixed, variable)	___	___
(5) Moisture resistance	___	___
(6) Altitude	___	___
(7) Radiographic	___	___
(8) Hermeticity tests	___	___
(a) Fine leak, if applicable	___	___
(b) Gross leak or penetrant dye	___	___
(9) Lead fatigue	___	___
(10) Life tests - operating	___	___
Comments		
(m) Is available equipment used:		
- For production?	___	___
- In R&D?	___	___
- For Quality Control on a sample basis?	___	___
- For screening?	___	___
(n) Are charts provided for the monitoring of environmental test equipment?	___	___
Comments		



	YES	NO
(o) Is test equipment adequate for fulfilment of specification requirements? Comments	___	___
(p) Is final external visual inspection performed on 100% of the devices? Comments	___	___
(q) Are devices stored in a limited access area? Comments	___	___
(r) Are devices adequately identified to Customer requirements? Comments	___	___
(s) Are there provisions for lot identification? Comments	___	___
(t) How many burn-in positions are available: - At room ambient temperature?  - At specified ambient temperature?  - At specified case temperature (cooled hot plate)?		
(u) Does burn-in require soldering of leads? Comments	___	___



YES NO

(v) What precautions are taken to maintain solderability of leads after burn-in?

Comments

(w) How does Manufacturer ensure that failed devices are separated from processed lots of:

- SCC Level 'B'

- SCC Level 'C'

(x) Has Manufacturer all test equipment necessary to perform all qualification tests:

- In-house?

\_\_\_ \_\_\_

- In nearby facility?

\_\_\_ \_\_\_

Specify equipment and its location:

- In remote location

\_\_\_ \_\_\_

Specify equipment and its location:

2.12 PRESERVATION, PACKING AND SHIPPING

(a) Are there adequate written procedures for control of shipping?

\_\_\_ \_\_\_

Comments

(b) Are materials designated for shipment properly identified, handled and protected?

\_\_\_ \_\_\_

Comments

(c) Do copies of Customer's purchase order and evidence of inspection acceptance accompany materials from end of final test up to the time of shipment?

\_\_\_ \_\_\_

Comments

	YES	NO
(d) Do Q.A. personnel perform audits of all outgoing lots?	—	—
Comments		
(e) Do shipping documents reflect inspection status or evidence of inspection, identification and similar shipping requirements?	—	—
Comments		
(f) Does Manufacturer verify conformity of devices and invoices with purchase order?	—	—
Comments		
(g) Does Manufacturer implement special packaging methods for hi-rel devices?	—	—
If so, which of following methods is used?		
- Individual packages	—	—
- Mechanical protection	—	—
- Environmental protection	—	—
- Special warning labels	—	—
(h) Is shipping method designed to allow official inspection by Customs without actual removal of protective material?	—	—
Comments		
(i) Do instructions prohibit the use of substandard packaging methods for shipment of hi-rel devices?	—	—



2.13 SUMMARY OF INSPECTION RESULTS

Indicate inspection results per manufacturing and testing area, whereby:

- V = Adequate.
- O = Insufficient or non-adequate.
- = Not checked or not applicable.

---

	1	2	3	4	5	6	7
--	---	---	---	---	---	---	---

---

Environmental conditions:

- Cleanliness
- Temperature control
- Humidity control
- Occupancy

Procedures available:

- Travellers
- Calibration
- Segregation of rejects
- Inspection evidence

Area No.

- 1 =
- 2 =
- 3 =
- 4 =
- 5 =
- 6 =
- 7 =



SCC

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2.14 GENERAL OBSERVATIONS (Not to exceed 2 pages)