CHECKLIST FOR QUARTZ CRYSTALS MANUFACTURER AND LINE SURVEY

ESCC Basic Specification No. 2023501

Manufacturer:	.
Location:	.
Survey Team Leader:	.
Date of Survey	.
Crystal Unit Types:	.

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DOCUMENTATION CHANGE NOTICE

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DCR No.	CHANGE DESCRIPTION
826	Specification upissued to incorporate editorial changes per DCR.

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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			

(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 quartz crystal units 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 quartz crystal unit 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?

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

	YES	NO
(l) Are written procedures kept and used in areas for:		
- Receiving inspection?	☐	☐
- In-process inspection?	☐	☐
- Fabrication processing?	☐	☐
- Final testing?	☐	☐

Comments

	YES	NO
(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

	YES	NO
(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		

(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

		YES	NO
(a)	Does Manufacturer maintain calibration facilities and standards?	☐	☐
	Is this service purchased? If so, from whom?	☐	☐
	Comments		
(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? Comments	☐	☐
(i)	Have calibrating personnel up-to-date certification records reflecting date, traceability to NBS and identification of calibrator?	☐	☐
	(1) Mechanical Standard?	☐	☐
	(2) Electrical Standard?	☐	☐
(j)	Is modified and/or repaired equipment calibrated prior to release?	☐	☐

2.6 DRAWING AND CHANGE CONTROL

		YES	NO
(a)	Has Manufacturer adequate written procedures for control of specification and contract changes? Comments	☐	☐
(b)	Does Manufacturer's system provide for documented change control guaranteeing availability of required drawing at relevant manufacturing or inspection step?	☐	☐
	Do flow documents show current revisions? Comments	☐	☐
(c)	Are drawings furnished by ESTEC and contract changes adequately controlled? Comments	☐	☐
(d)	Does Q.A. review all drawings and changes therein prior to their becoming effective? Comments	☐	☐
(e)	Has Manufacturer established a procedure for notifying his Supplier of changes in drawings? Comments	☐	☐
(f)	Are current specification revisions shown on prints of drawings?	☐	☐

2.7 RELIABILITY

		YES	NO
(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		

		YES	NO
(n)	Has Reliability a programme to ensure reliability of discrete device designs prior to release thereof? comments	☐	☐
(o)	Has Reliability access to all pertinent development and production data of discrete devices for analysis purposes? Comments	☐	☐
(p)	Is reliability data available of discrete devices from the line(s) which the Manufacturer wishes to be approved? Comments	☐	☐
(q)	Has Manufacturer an evaluation laboratory for determination of product characteristics?	☐	☐
(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

	YES	NO
(a) Has Manufacturer adequate written procedures for purchase control of materials, components and services?	☐	☐
Comments		
(b) Has Manufacturer an effective vendor rating system?	☐	☐
Comments		
(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)

	YES	NO
(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		

		YES	NO
(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		
(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 sublets 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?	☐	☐

2.10 IN-PROCESS INSPECTIONS AND TESTS

		YES	NO
(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 specifications?	☐	☐
	Do specifications show current revision status? Comments	☐	☐
(e)	Does Q.A. have written in-process procedures to control acceptance of products? Comments	☐	☐
(f)	Does the manufacturer test for early failures as part of in-process controls?	☐	☐
(g)	Does the manufacturer maintain and document standard screening tests as part of their own in-process controls?	☐	☐
(h)	Does the manufacturer review the in-process control tests results against the screening tests requirements defined in the relevant Generic Specification?	☐	☐

		YES	NO
(i)	Is type and quantity of available inspection equipment adequate for type of work being accomplished?	☐	☐
	Comments		
(j)	Are documentation and instruments used by inspectors subject to calibration control?	☐	☐
	Is calibration evident and up-to-date?	☐	☐
	Comments		
(k)	Is there a specific material review procedure?	☐	☐
	Comments		
(l)	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		
(m)	Are requests for corrective action issued in writing?	☐	☐
	Are such requests answered?	☐	☐
	Does corrective action ensue?	☐	☐
	Comments		
(n)	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		
(o)	Is lot identification maintained throughout processing?	☐	☐
	Comments		
(p)	Are there documents describing in-process manufacturing procedures and controls?	☐	☐
	Comments		
(q)	Are there documents describing in-process inspections?	☐	☐
	Do inspectors know how and when to use them?	☐	☐
	Comments		

		YES	NO
(r)	Are there specific standards for handling, cleanliness and care of materials, parts and equipment? Comments	☐	☐
(s)	Are calibrations evidenced and up-to-date?	☐	☐
(t)	Has Q.A. authority to stop production flow in case of out-of-control conditions? Is a written material review procedure in use? Comments	☐ ☐	☐ ☐
(u)	Are records maintained of training and competence of operators for welding, soldering, radiography, radiflo and plating? Comments	☐	☐
(v)	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 Manufacturing Environment

(a) Which phases of manufacture are carried out under controlled environmental conditions?

(b) Give details of conditions.

2.11.2 Preparation of Crystal Element

(a) State type of quartz used (natural/synthetic).

(b) State source of quartz.

(c) State method of optical axis location.

(d) Which method is used to slice into individual elements?

(e) How are edges of crystal elements finished?

(f) Which method is used for adjustment of frequency and angle of cut?

(g) Describe method of finishing crystal elements, i.e. etching, polishing, etc.

(h) Which method is used to locate and mark the optical axis of individual elements?

2.11.3 Application of Electrodes

(a) Describe the cleaning technique used for elements prior to application of electrodes.

(b) Which electrode materials are used?

(c) Which method of application is used?

(d) Describe method used for final adjustment to desired frequency.

(e) How is this monitored?

2.11.4 Mounting of Crystal Element

(a) State material and plating of mounting tabs or wires and method of attachment to connecting leads.

(b) State method of attachment of crystal element to mounting tabs.

(c) Which type of bonding cement is used and how are quality of material and application controlled?

(d) Which method of curing is used for bonding cement?

2.11.5 Crystal Enclosure

	YES	NO
(a) Is there any additional environmental control used for the enclosure process?	☐	☐

(b) Which material and plating is used for the enclosure and connecting leads?

(c) Describe cleaning techniques for enclosure parts prior to sealing.

	YES	NO
(d) State method of sealing and enclosed atmosphere.		
(e) Which tests are used for fine/gross leak detection?		
(f) State criteria for radiographic inspection.		

2.11.6 Visual Inspection – General

Following relevant operations in Para's. 2.11.1 to 2.11.5:-

	YES	NO
(a) Are visual aids and criteria provided for inspection purposes? If so, state for which operations:	☐	☐
(b) Are visual aids applied to the production line? If so, state for which operations:	☐	☐
(c) Are visual aids and criteria adequate?	☐	☐

2.11.7 Final Test Area and Screening Facility

		YES	NO
(a)	Are they separate operations?	☐	☐
(b)	Are final production test (see ESCC specification) performed by personnel under Q.A. monitoring? or	☐	☐
	Are they performed by Q.A. personnel?	☐	☐
	Comments		
(c)	Are written inspection and test procedures for product classes on the line available for the final test (Q.A.)?	☐	☐
	Comments		
(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 defectives, 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		
(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

(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

(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:

- ESCC Level ‘B’

- ESCC 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

		YES	NO
(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	☐	☐
(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 =	.

2.14 GENERAL OBSERVATIONS (NOT TO EXCEED 2 PAGES)

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