

Comparison of ESCC parts qualification system and JAXA parts qualification system

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Japan Aerospace Exploration Agency

Naomi IKEDA

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Mutual usage of Japanese parts in Europe / European parts in Japan has been promoted by JAXA and ESA:

- to avoid duplicated development of similar parts in Europe / Japan
- to ensure the availability of second source

So far, not many European parts are used in Japan and vice versa.

To lower the hurdle of adopting new European parts in Japan / Japanese parts in Europe, and to increase the number of those parts, it is useful to know the difference of ESCC qualification system and JAXA qualification system.

For this purpose, JAXA and ESA has started a joint work to compare JAXA specifications and ESCC specifications for part qualification and evaluate their overall equivalence

2. Items to be compared

1. Overall difference in both qualification systems

2. Detail comparison of generic specifications

Comparison chart is prepared to show the comparison result of generic specifications

Based on the comparison above, the equivalence of both qualification systems is evaluated

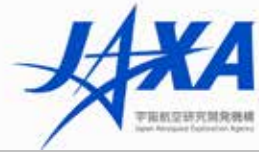
Generic specification for microcircuits was selected for the first comparison (JAXA-QTS-2010 vs ESCC9000) and joint work is currently ongoing

The first meeting was held between JAXA and ESA for this comparison

Today, introduction of JAXA part qualification system is presented with rough comparison result of JAXA-QTS-2010 and ESCC9000

3. Overall JAXA qualification system (1/3)

-- Qualification method



ESCC qualification system

- Component Qual. ➡
- Technology Flow Qual. ➡
- Capability Approval ➡

<total>

35-40 manuf., 120 certificates

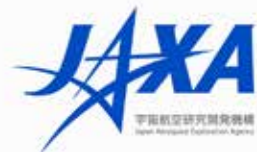
JAXA qualification system

- QPL (4 manuf. 38 parts)
- QML (25 manuf. 148 parts)
- <as of Mar.11, 2013>

**JAXA is considering maintaining only QML system
in the future**

3. Overall JAXA qualification system (2/3)

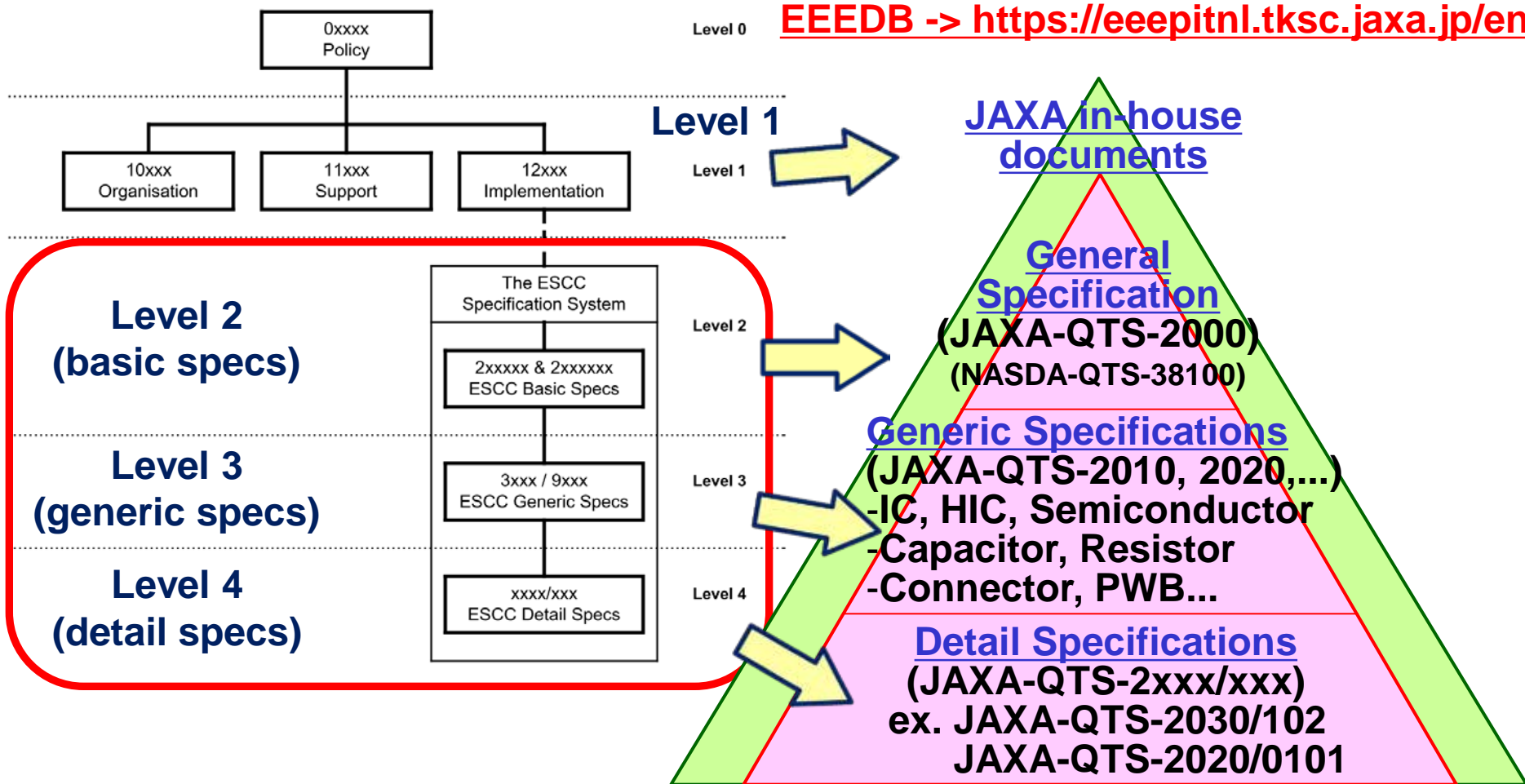
-- QPL vs QML (vs ESCC)



	JAXA/QPL (NASDA-QTS-38100) <ESCC Comp. Qual.> ESCC20100	JAXA/QML (JAXA-QTS-2000) <ESCC Tech. Flow Qual.> ESCC25400
Subject	Parts <same as JAXA system>	Manufacturing line <manufacturing technology>
Duration	1 year <2 years>	3 years <2 years>
Manufacturing line	Dedicated lines for space parts <commercial lines may be used>	Commercial lines may be used <same as JAXA system>
Change control of QA program	Review and approval by JAXA <same as JAXA system>	Decision can be made by TRB (shall be reported to JAXA) <same as JAXA system>
Test optimisation	-Restricted -Review and approval by JAXA <same as JAXA system>	-Decision can be made by TRB (shall be reported to JAXA) -Change must be described with rationale in the detail spec. <same as JAXA system>

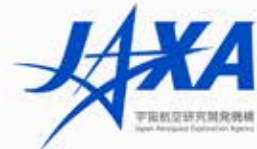
3. Overall JAXA qualification system (3/3)

-- Document tree



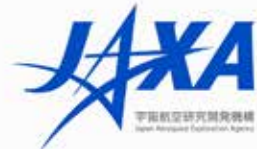
- Same document tree from Level 2 to Level 4
- Only 2 documents on Level 2 in JAXA system (each for QML and QPL)

4. EEE components qualification requirements -- JAXA-QTS-2000 vs ESCC documents (1/2)



JAXA-QTS-2000 Common Parts/Materials, Space Use, General Specification for	ESCC (No. 20000, 20100/25400)
1. General	
2. Applicable Documents	
3. Requirements 3.1 General Requirements 3.2 Detail Requirements 3.3 Requirements for a Quality Assurance Program (QA program plan, QA manager, Registered Inspector, and TRB) 3.4 QML Certification Requirements (Initial qual., retention of qual., requalification, certification and de- certification) 3.5 Part Number and Marking 3.6 Nonconformance	20200, 22600, 22700 20100/25400 21700 22800
4. Quality Assurance Provisions 4.1 Implementation of Quality Assurance Program 4.2 Change Control for the Quality Assurance Program 4.3 Requirements for Tests and Inspections (QT, in-process inspection, QCI, products stored for long term) 4.4 Changes to Tests and Inspections	20100/25400

4. EEE components qualification requirements -- JAXA-QTS-2000 vs ESCC documents (2/2)



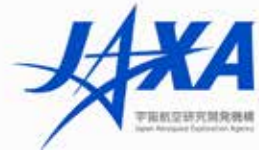
5. Preparation for Delivery	20600
6. Control of Applicable Specifications 6.1 Establishment and Revision of Detail Specifications 6.2 Changes 6.3 Cancellation of Applicable Specification 6.4 Registration Publication	20800
7. Terminology	21300
Appendix Appx A Preparation of Applicable Specifications Appx C Requirements for Quality Assurance Program Appx D Quality Assurance Manager and Registered Inspector Appx E Certification Procedure Appx F Application Form and Procedures Appx G Preparation of Application Data Sheet Appx H Supplementary Requirements for Tests and Inspections Appx K TRB Guidelines (Appendix B and J are cancelled)	20800, 21700 21500, 22700, 24600, 24900 20100/25400 ESCIES 25400

Both systems are based on ISO9001

Overall requirements are the same in both qualification systems

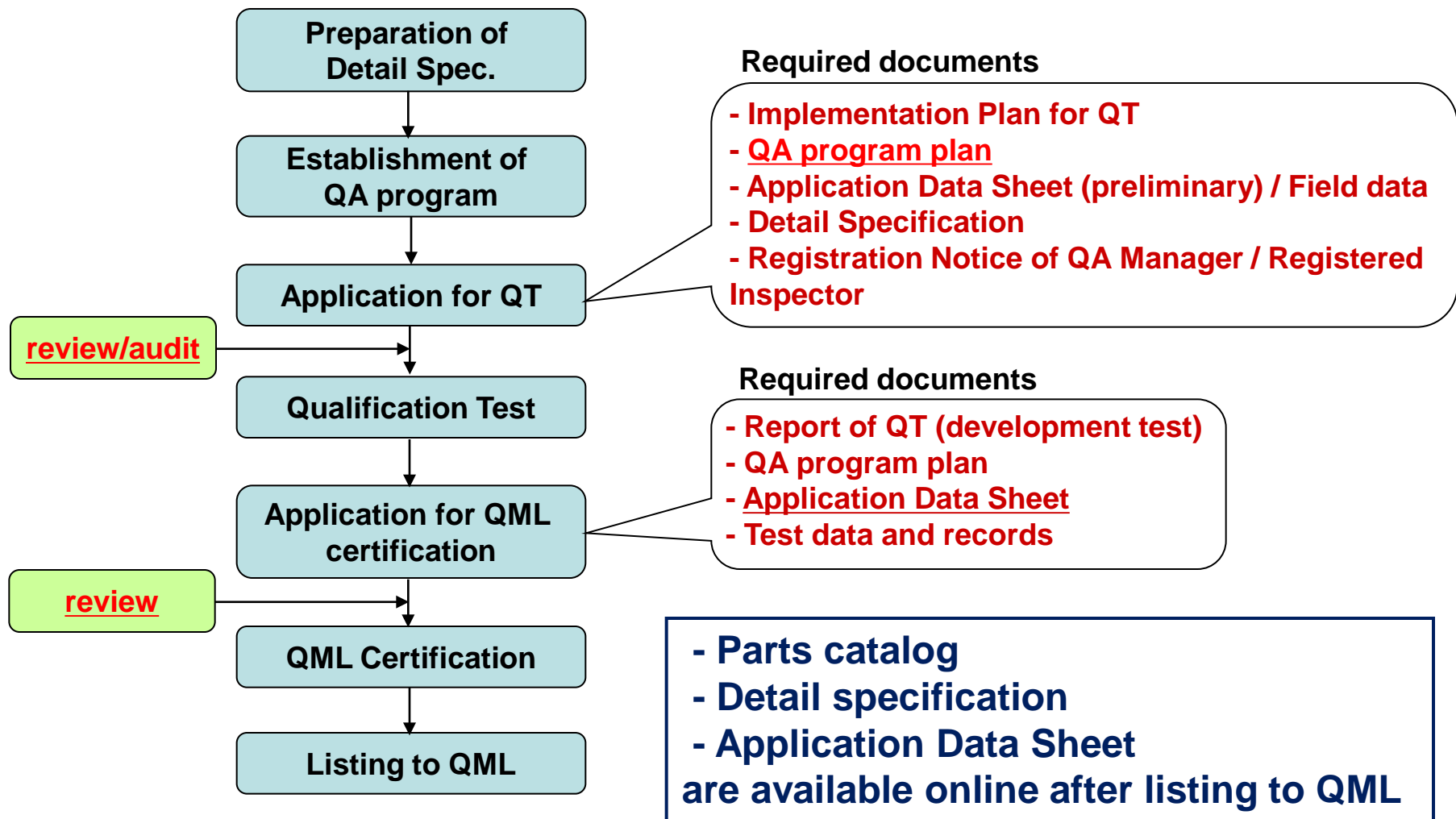
4. EEE components qualification requirements

-- Requirement of JAXA-QTS-2000



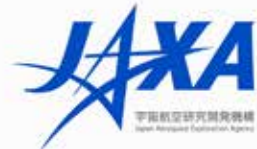
- **Establishment and maintenance of a Quality Assurance Program**
- **Establishment and operation of TRB**
- **Requirement for qualification**
 - Initial qualification/ Retention of qualification / Requalification
- **Requirement for tests and inspections**
 - In-process inspections / Screening tests / Qualification tests / Quality conformance tests
- **Test items**
 - Screening / Electrical performance / Mechanical performance / Environmental performance / Durability
- **Disposition of nonconformance**

4. EEE components qualification requirements -- JAXA-QML initial qualification flow



Evaluation test is performed before QT, however it is out of the official procedure of qualification in JAXA system

4. EEE components qualification requirements -- Quality Assurance Program Plan



Quality Assurance Program Plan

Document to ensure that a manufacturer can continuously produce parts / materials with a consistent quality

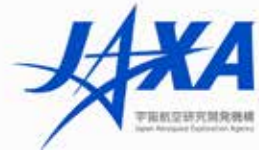
QAP plan = PID + Quality Management Plan (Technology Flow)

QAP plan	PID (Process Id. Doc.)
1. Scope	Section 1
2. Organizational structure	Section 2, QM plan
3. Quality assurance system	Section 3
4. Applicable documents and standards constituting the quality assurance program	Section 5
5. Education and training	QM plan
6. Design control	-
7. Control of production processes	Section 3, QM plan
8. Management of production facilities	Section 6
9. Management system of measuring instruments	QM plan
10. Procurement management of materials	Section 5
11. Nonconformance disposition system	QM plan
12. Failure analyses and corrective actions	QM plan
13. Packaging, storage and delivery	-
14. Change control of quality assurance program	QM plan
15. Design and construction	Section 4
16. Formats and examples of completed formats	Section 3

Similar document is required and prepared in both systems

4. EEE components qualification requirements

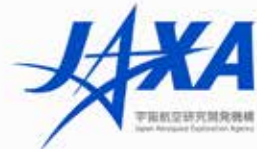
-- Qualification test in JAXA system



- Generic specifications are aimed to be used for qualified parts (rarely used for non-qualified parts in Japan)**
- Since evaluation phase is outside of the qualification procedure in JAXA qualification system, more tests are included in QT phase than in ESCC system**

5. JAXA generic specification

-- List of JAXA Generic Specifications

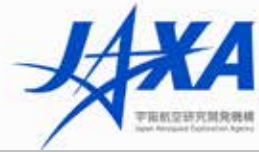


JAXA-QTS-2010	ICs <9xxx>	JAXA-QTS-2120	Wires & Cables <390x>
JAXA-QTS-2020	HICs <Q-60-05>	JAXA-QTS-2130	Solar Cells <E-20-08>
JAXA-QTS-2030	Semiconductor Devices <5xxx>	JAXA-QTS-2140	Printed Wiring Boards <Q-70-10>
JAXA-QTS-2040	Capacitors <30xx>	JAXA-QTS-2150	Latching Valves
JAXA-QTS-2050	Resistors <400x>	JAXA-QTS-2160	Thermistors <4006>
JAXA-QTS-2060	Connectors <340x>	-	Heaters <4009>
JAXA-QTS-2070	Crystal Units <350x>	JAXA-QTS-2180	Temp. Sensors, Platinum
JAXA-QTS-2080	Filters <310x>	JAXA-QTS-2190	Thermal Control Materials <Q-70>
-	Relays <360x>	JAXA-QTS-2200	Adhesive Materials <Q-70>
-	Switches <370x>		
JAXA-QTS-2110	Transformers & Coils <320x>	JAXA-QTS-2210	Fuses <4008>

Mechanical parts and materials are also included in JAXA system
Including hybrids, they are covered by ECSS system

5. JAXA generic specification

-- Comparison of generic specifications



Part type is selected and its generic specifications from ESCC / JAXA are compared:

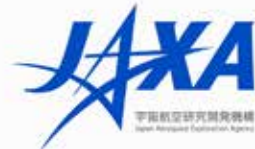
- Test items**
- Sample size**
- Test method / condition**
- Interval of the test**

Discussion will be made between ESA and JAXA for each difference with rationale of doing/not doing the test to evaluate the overall equivalence

First example : Microcircuits (JAXA-QTS-2010/ESCC9000)

5. JAXA generic specification

-- JAXA-QTS-2010 vs ESCC9000 (In-Process Inspection)



Appx. A Wafer Lot Inspection Item

Metallization

Thermal stability

SEM (MIL883-TM2018)

Glassivation thickness

Wafer thickness

Gold Plating thickness on the back (if applicable)

4.5 a) Internal visual inspection of semi-finished products (100% non-destructive or sampled inspection) (MIL883-TM2010)

4.5 b) Physical or chemical inspection of semi-finished products (destructive or non-destructive sampled inspection)

4.5 c) Characterization of semi-fished products (100% non-destructive or sampled inspection)

Still under discussion for a detail comparison

← ESCC21400 for ESCC9000

← ESCC20400 for ESCC9000

← e.g. Die attach, bond strength

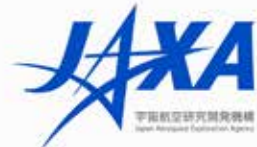
← e.g. Electrical paramete test

covered in Production control in ESCC9000

Most of the detailed items seem to be included in process monitoring items in ESCC 9000 and requirement seems to be similar in both specs

5. JAXA generic specification

-- JAXA-QTS-2010 vs ESCC9000 (Screening)



Screening tests
Stabilisation bake
Temperature cycling
Visual inspection
Radiographic inspection (<u>MIL883-TM2012</u>)
Interim (pre burn-in) electrical parameters
Burn-in test
Interim (pre burn-in) electrical parameters
Reverse bias burn-in test
Interim (post burn-in) electrical parameters
Hermeticity
Final electrical parameter test static @ 25degC, <u>max/min temp.</u> dynamic/functional @ 25degC
External visual inspection (<u>MIL883-TM2009</u>)

Still under discussion
for a detail comparison

← ESCC20900 for ESCC9000

covered in screening
tests in ESCC9000

covered in evaluation
tests in ESCC9000

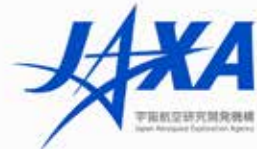
← Temperature as specified in the
detail specification for ESCC9000

← ESCC20500 for ESCC9000

- All the tests are covered in ESCC9000 except radiographic inspection
- PIND is not performed at screening test in JAXA-QTS-2010

5. JAXA generic specification

-- JAXA-QTS-2010 vs ESCC9000 (QT/ QCI-LVT)



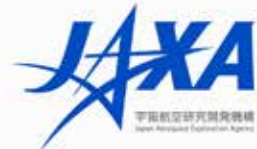
Group A*	Electrical parameter tests	Every inspection lot
Group B		Every inspection lot
Group C	Die related tests	1 year period
Group D	Package related tests	1 year period
Group E	Radiation test	every wafer lot

*** Non-destructive, can be used for Gr. B-E test**

- QCI (Quality Conformance Inspection) = LVT / LAT in ESCC specs**
- All the tests that are included as QT / periodic tests in ESCC9000 are included in JAXA-QTS-2010**

5. JAXA generic specification

-- JAXA-QTS-2010 vs ESCC9000 (Group A)



Gr. A (electrical parameter tests)
every inspection lot

SG1	Static tests @ $T_A=25\text{degC}$
SG2	Static tests @ max. T_{op}
SG3	Static tests @ min. T_{op}
SG4	Dynamic tests @ $T_A=25\text{degC}$
SG5	Dynamic tests @ max. T_{op}
SG6	Dynamic tests @ min. T_{op}
SG7	Functional tests @ $T_A=25\text{degC}$
SG8	Functional tests @ max./min. T_{op}
SG9	Switching tests @ $T_A=25\text{degC}$
SG10	Switching tests @ max. T_{op}
SG11	Switching tests @ min. T_{op}

Still under discussion
for a detail comparison

SG1-4, 7, 9 are performed
as screening test for
JAXA-QTS-2010

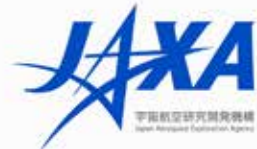
Static, dynamic, functional
and swtching test are all
included in one group of
“electrical measurement”
for ESCC9000

covered in screening tests in ESCC9000 red letter : difference in sample size

All the tests are covered as screening test in ESCC9000

5. JAXA generic specification

-- JAXA-QTS-2010 vs ESCC9000 (Group B)



Gr. B, every inspection lot	
SG1	a) External physical dimensions (MIL883-TM2016)
	b) Internal gas analysis
SG2	a) Resistance to solvents (MIL883-TM2015)
	b) Internal visual and mechanical (MIL883-TM2013)
	c) Bond strength <ul style="list-style-type: none"> 1) Thermo compression 2) Ultrasonic
	d) Die shear test
	e) Verification of glassivation layer integrity
SG3	Solderability
SG4	a) Lead integrity
	b) Hermeticity test (seal) <ul style="list-style-type: none"> 1) Fine leak 2) Gross leak

Still under discussion
for a detail comparison

← ESCC20500 for ESCC9000

← ESCC24800 for ESCC9000

← ESCC20400 for ESCC9000

-Most of the tests are covered in ESCC9000
- Less samples are tested in JAXA-QTS-2010, however tests are performed in shorter period than ESCC9000

covered in QT/periodic tests in ESCC9000

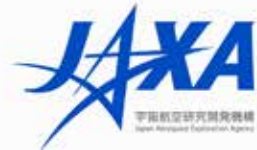
covered in screening test in ESCC9000

covered in evaluation tests in ESCC9000

red letter : difference in sample size

5. JAXA generic specification

-- JAXA-QTS-2010 vs ESCC9000 (Group C)



Still under discussion
for a detail comparison

Gr. C (die related tests), 1 year period	
SG1	a) Steady-state life test (1000h)
	b) End-point electrical parameter test
SG2	a) Temperature cycling test
	b) Constant acceleration
	c) Hermeticity test (seal) 1) Fine 2) Gross
	d) End-point electrical parameter test
SG3	a) Electrical discharge sensitivity test
	b) End-point electrical parameter test

2000hr, every year for ESCC9000

ESCC23800 for ESCC9000

covered in QT/periodic
tests in ESCC9000

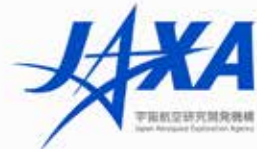
covered in evaluation
tests in ESCC9000

red letter : difference
in sample size

- All the tests are covered in ESCC9000 except ESDS
 - * ESDS test is not performed in the parts that are currently qualified
- Less samples are tested in JAXA-QTS-2010 for most of the tests, however tests are performed in shorter period than ESCC9000

5. JAXA generic specification

-- JAXA-QTS-2010 vs ESCC9000 (Group D)



Gr. D (package related tests), 1 year period

SG1	a) Thermal shock (MIL883-TM1011 <u>cond. B</u>)
	b) Temperature cycling test
	c) Moisture resistance
	d) Hermeticity test (seal) 1) Fine 2) Gross
	e) Visual Inspection (<u>MIL883-TM1004/1010/10111</u>)
	f) End-point electrical parameter test
SG2	a) Mechanical shock
	b) Vibration test
	c) Hermeticity test (seal) 1) Fine 2) Gross
	d) Visual inspection (<u>MIL883-TM2002/2007</u>)
	e) End-point electrical parameter test
SG3	a) Salt atmosphere test
	b) Visual inspection

Still under discussion
for a detail comparison

MIL883-TM1011 cond.C for
ESCC9000

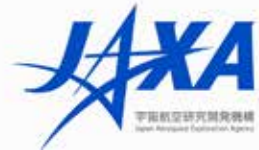
ESCC20500 for ESCC9000

- All the tests are covered in ESCC9000 except for salt atmosphere
- Sample size is the same for all the tests in both specifications, however period of performing the tests is shorter in JAXA-QTS-2010

covered in QT/periodic
tests in ESCC9000

red letter : difference
in sample size

5. JAXA generic specification -- JAXA-QTS-2010 vs ESCC9000 (Group E)



Gr. E (radiation tests), every wafer lot	
SG1	a) Radiation hardness test (total dose) (MIL883-TM1019)
	b) End-point electrical parameter test

Still under discussion
for a detail comparison

ESCC22900 for ESCC9000

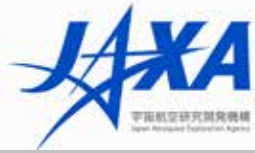
covered in production control in ESCC9000

red letter : difference in sample size

Both specifications require to perform TID test for every wafer lot

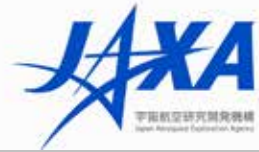
5. JAXA generic specification

-- JAXA-QTS-2010 vs ESCC9000 (Overall comparison)



- Basically most of the test requirements are the same in both specifications
- There are some differences in the test requirement. Further / detailed discussion is needed to evaluate the overall equivalence of both specifications

6. Summary and future work



- Overall comparison of JAXA part qualification system and ESCC qualification system was made to promote the mutual usage of JAXA qualified parts and ESCC qualified parts
- Detailed comparison of generic specification has begun, starting from JAXA-QTS-2010 / ESCC 9000 (Microcircuits). Discussion between JAXA and ESA is ongoing based on the first draft of comparison chart to evaluate their overall equivalence
- Most of the test are covered in both specifications. Some differences were identified and detail comparison is necessary to show the overall equivalence of both specifications

Next step / Future work

JAXA and ESA will continue this work for other part types, aiming for the better mutual understanding and increasing the number of JAXA / ESCC qualified parts to be used in Europe and Japan.

Candidates:

Discrete semiconductors, hybrids, Tantalum capacitors
ceramic capacitors, chip film resistors....

Appendix Difference in terminology

ESCC	JAXA
<component> part	<component> subsystem / equipment
basic specification	general specification
<periodical test> LAT (lot acceptance test) / LVT (lot validation test)	<periodical test> QCI (quality conformance inspection)
extension of qualification	retention of qualification
lapse of qualification	de-certification
chief inspector	registered inspector