

GJCET

LEADING PROVIDER OF ADVANCED SEMICONDUCTOR PACKAGING
AND TEST SERVICES FOR GLOBAL CUSTOMERS



Minimum Requirements for a Successful Automotive Qualification With Focus on Packaging

Jan 9, 2019



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JCET Group

JCET Group by the Numbers



OSAT Rank

#1

CHINA

#3

GLOBAL

Revenue (US\$B)

3.6

2017

1.0

3Q18

Manufacturing

CHINA

Jiangyin

Super Campus

JCET D3, JSCC, JCAP B2



SOUTH KOREA

SCK(+)

Incheon

Advanced SIP/FC/WB



SINGAPORE

SCS

Yishun

Advanced WLP/WB



IP Rank

#1

US Patents

#1

China Patents

Employees (K)

>23

Globally

>15

China

1

Automotive Semiconductor Market

2

Automotive Standard Qualification Requirements

3

Other Requirements

4

Conclusions

Automotive Market by Segment

- Global car production CAGR 2% per year
- Electronic Content is about to double by 2025

Automotive Segment	2017	2022	CAGR
ADAS	\$3.6B	\$9.2B	19.0%
Body & Convenience	6.9	9.1	5.4%
Chassis & Safety	6.1	6.9	2.5%
Infotainment	6.6	8.7	5.1%
Powertrain	8.9	12.5	6.4%
Others	3.6	4.6	4.8%
Total	\$35.8B	\$50.9B	6.9%

Source: IHS



Device Categories:

- The segments are dominated by different semiconductor families
- All show significant growth rates.
- WB packaging still dominate.
- New packaging technologies are entering the Automotive market:
 - Reaching mature status:
fcBGA, fcCSP, MEMS
 - Entering now:
SiP (MCM), WLP

Semiconductor Families	2017	2022	CAGR
Analog IC	\$11.6B	\$15.4B	5.8%
Logic IC	2.1	3.1	8.1%
Memory IC	2.5	4.0	9.9%
DSP & MCU	7.1	12.2	11.4%
Optical	2.9	4.8	10.6%
Sensor & Radars	5.1	7.1	6.8%
Discrete	4.4	6.2	7.1%
TOTALS	\$35.7B	\$52.8B	8.1%

Source: IHS

Automotive Design-in Time Line

1. Car Manufacturer defines system
2. Tier 1 design and component specification
3. Component supplier device design
4. Package design and qualification
5. Component qualification
6. System qualification
7. Summer/Winter testing
8. HVM start



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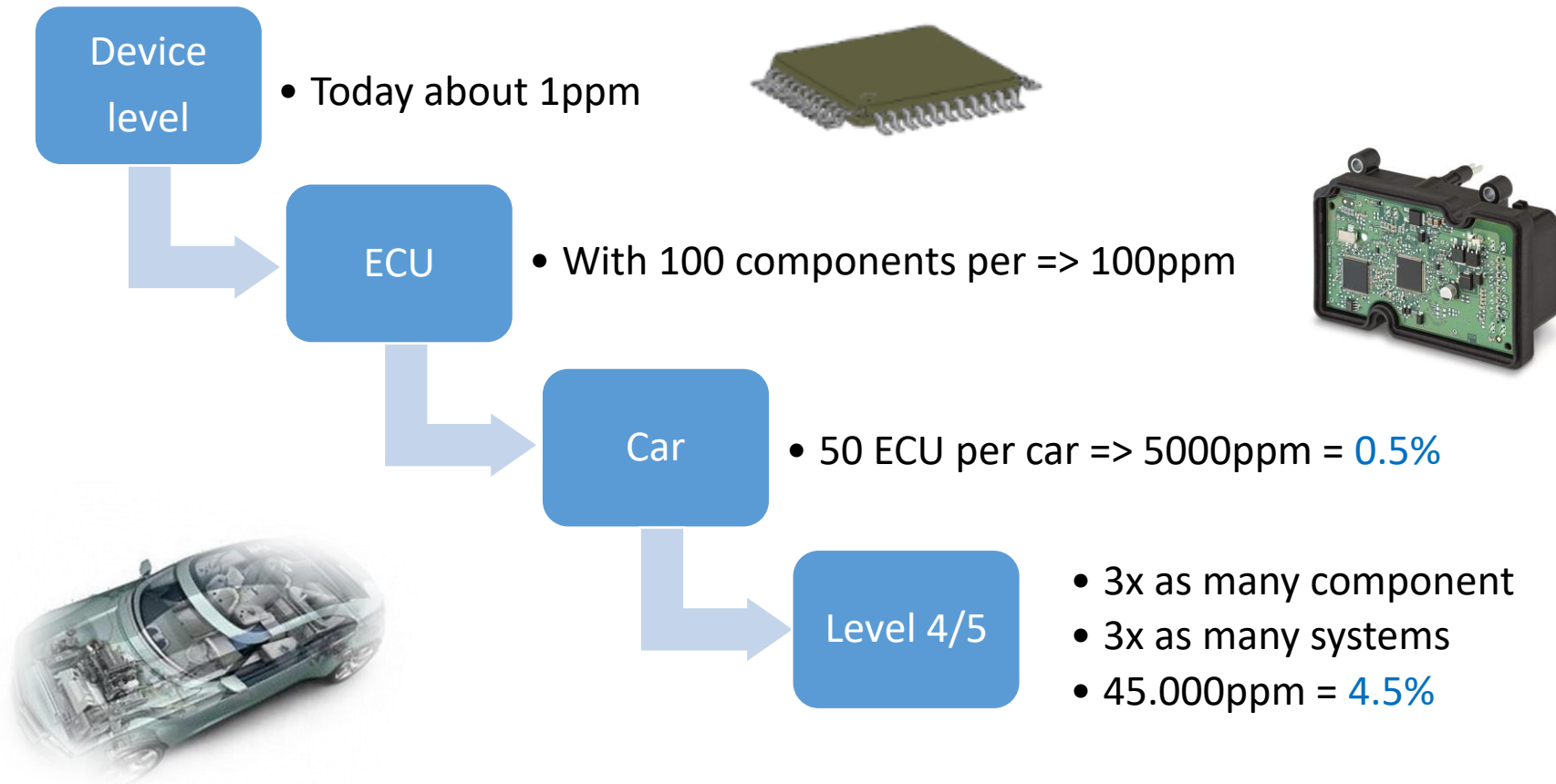
Other Requirements

4

Conclusions

Automotive Requirements

- A car has to be robust and reliable for > 15 years



We must drive to <0.1ppm

OSAT
Subcon

Device
Supplier

System
Supplier

Car
Manufacturer

System Level ISO 26262-11 Class II and III

Quality Systems IATF 16949

APQP – advanced product quality planning and control plan
FMEA – failure mode and effects analysis
MSA – measurement system analysis
SPC – statistical process control

AEC Q100, active IC; AEC Q101, discrete; AEC Q006, Copper; etc.

All above needed to support PPAP

- Titled "Road vehicles – Functional safety"
It is an international standard for functional safety of electrical and/or electronic systems in production automobiles defined by the International Organization for Standardization (ISO) in 2011
- ISO 26262 is intended to be applied to safety-related development for software, hardware and systems installed in series production passenger cars with a maximum gross weight of 3500 kg
- The ISO 26262 primarily focuses on the risks from the development of electrical and/or electronic systems, hardware and software.

Newly added chapter 11 covers functional safety on component level

It covers MCM (SiP) plus all μ C and DSPs

Announced release date year end 2018

- International Automotive Task Force
 - Purpose of this spec is the system and process improvement. It is used for factory and process qualification.
 - Main chapters cover
 - Kap. 1–3: Preamble and Generic Information
 - Kap. 4: Quality Management System (generic requirements, documents and documentation)
 - Kap. 5: Management responsibilities
 - Kap. 6: Resource Management
 - Kap. 7: Product Management
 - Kap. 8: Measurements, Analysis and Improvement
- In 1999 US (IAG), F(FIEV), UK (SMMT), GER (VDA) and I (AVSQ) combined local requirements into one TS 16949
- Several iterations have been done ever since. The latest version was released mid 2016 and is required as of Sep 2018

- Automotive Industry Action Group
- Covers all kind of production related requirements such as
 - **APQP** Advanced product Quality Planning
 - **DFMEA** Design Failure Mode and Effect Analysis
 - **PFMEA** Production Failure Mode and Effect Analysis
 - **SPC** Statistical Process Control
 - **MSA** Measurement System Analysis
 - **PPAP** Production Part Approval Process
 - This is the key document all involved parties have to contribute
 - Ultimately the Tier1 collects all data for proof of automotive qualification
 - IATF 16949, AIAG and AEC are subsequent contributing documents
 - Could be hundreds of pages



Adobe Acrobat
Document






PPAP Checklist



Requirement	Level 3	Requirement	Level 3
1. Design Record	S (R*)	10. Material, Performance Test results	S
2. Engineering Change Doc	S	11. Initial Process Study	S
3. Customer Eng. Approval	S	12. Qualified Laboratory Documentation	S
4. DFMEA	S	13. Appearance Approval Report	S
5. Process Flow Diagrams	S	14. Sample Product	S
6. PFMEA	S	15. Master Sample	R
7. Control Plan	S	16. Checking Aids	R
8 Measurement Sys. Analysis	S	17. Records of Compliance	S
9. Dimensional Results	S	18. Part Submission Warrant	S

- S=Submit
- R=Retain

- AEC covers all device qualification requirements.
- There are multiple specs depending on the component technology.
- Typically you need three production lots and approximately 1k pieces per lot for qualification.
- This is a one time action. Proof of data has to be submitted for PPAP.
Note: some Tier1s asked for periodically repeat.
Note: OSATs cover Group A and C only
- There are some requirements covering production control too (Group A).

AEC	Document	Definition
Q100	 Adobe Acrobat Document	Valid for single packaged ICs
Q101	 Adobe Acrobat Document	Valid for discrete products
Q103	*	MEMS, currently available as draft only
Q104	 Adobe Acrobat Document	MCM (=SiP), multi chip technology plus other components
Q004	*	Zero defect, currently available as draft only
Q005	 Adobe Acrobat Document	Pb free
Q006	 Adobe Acrobat Document	Cu wire

* Please feel free contact me for more details

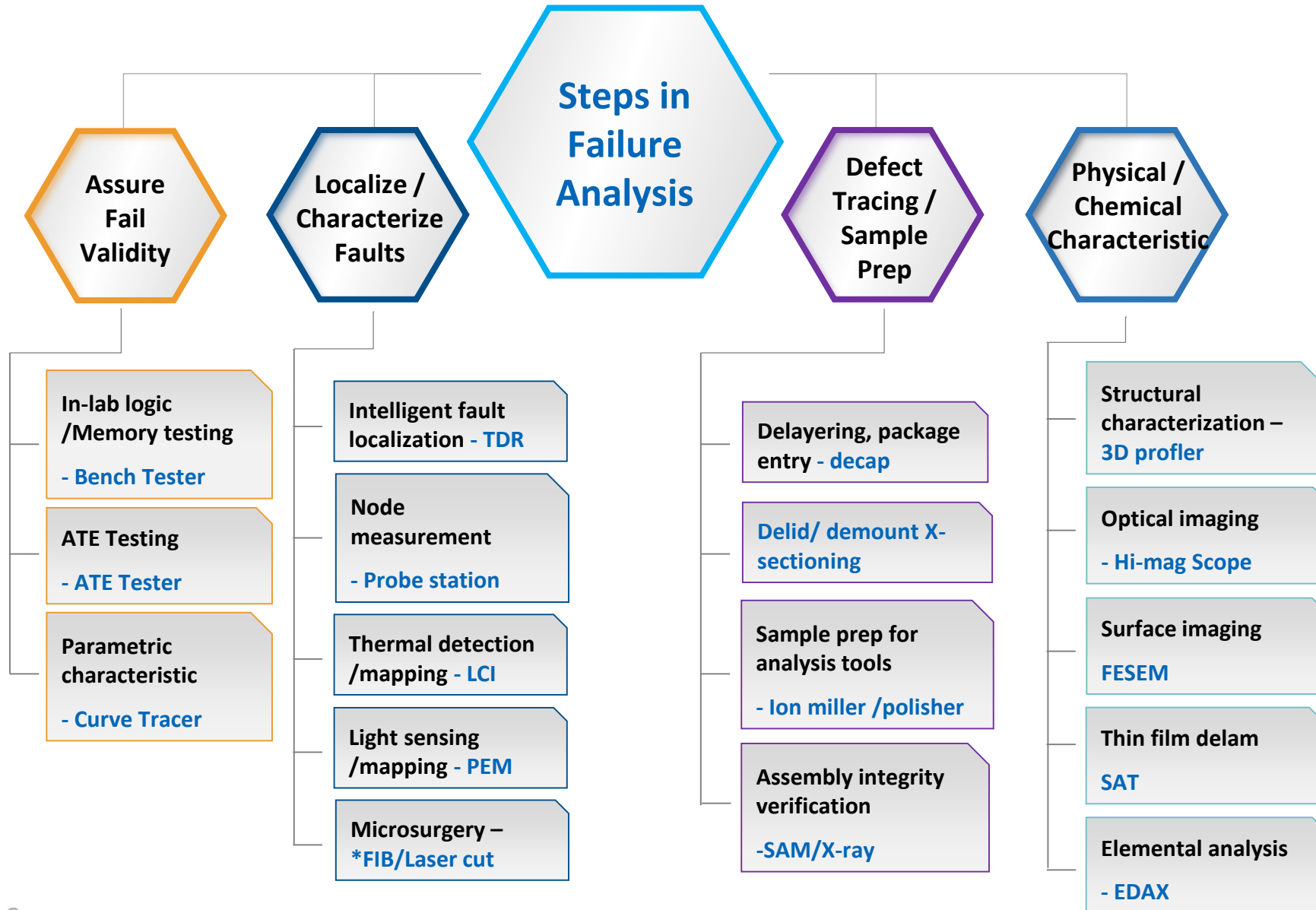
Automotive Part Grade Level Mapping

Grade	Field Temperature Range	Typically required for	Segment Guide Line
0	-40C to +150C	Under the hood	Powertrain if close/at engine
1	-40C to +125C	Safety and System critical	Can be any Application if defined as critical
2	-40C to +105C	Safety, not critical e.g. ABS, you still can stop the car without	ADAS, Chassis & Safety, Powertrain
3	-40C to +85C	Cabin electronics	ADAS, Infotainment, Body electronics

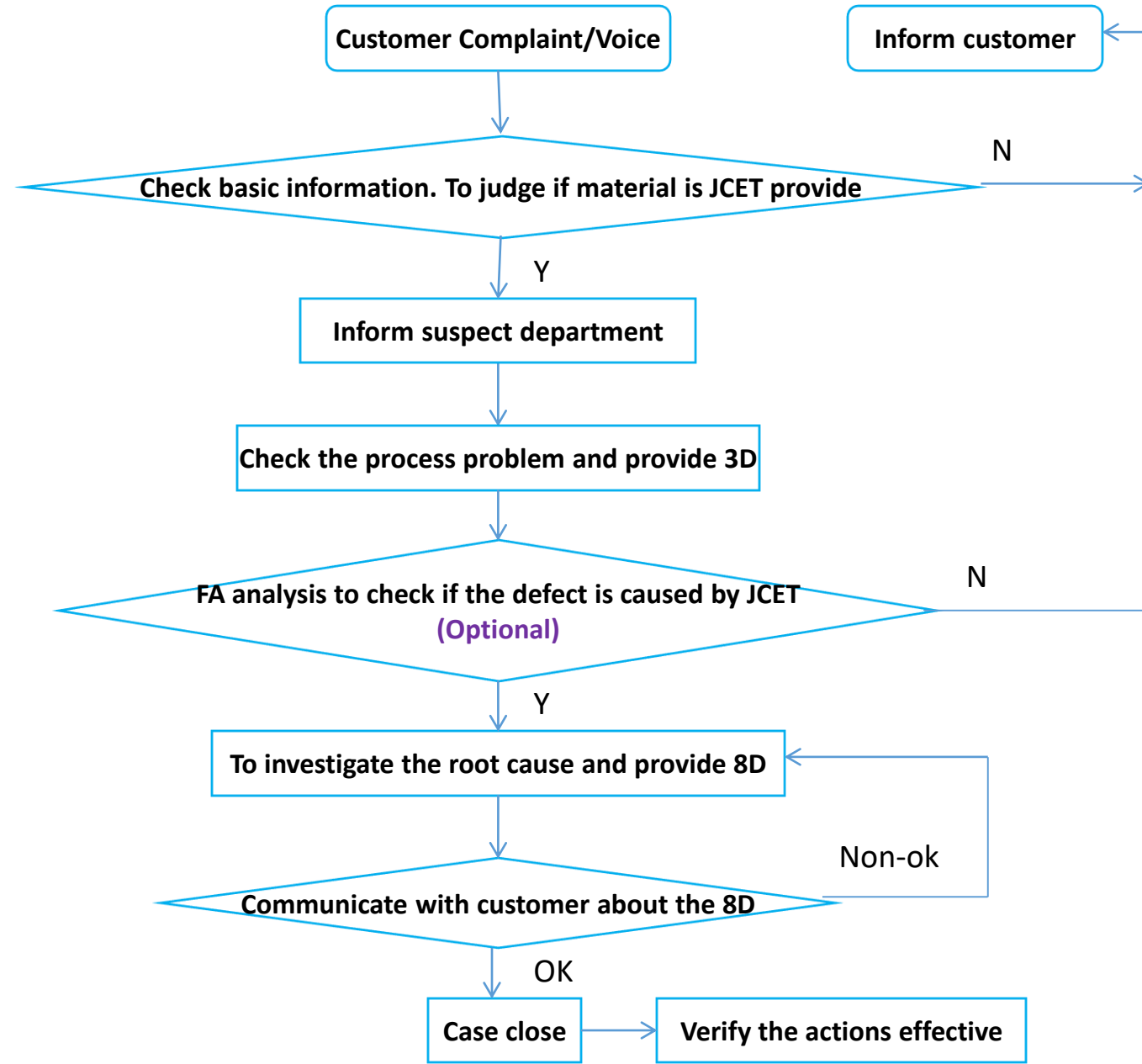
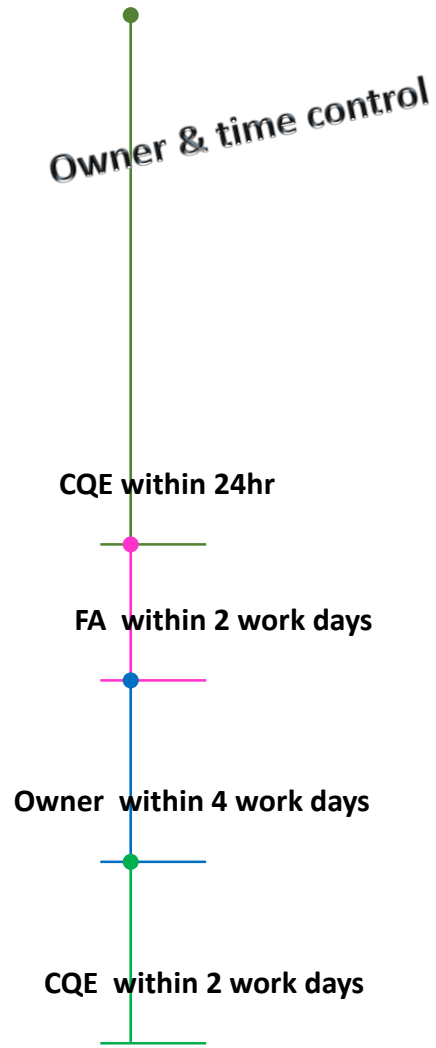
Trend to use higher grade level than required for reliability margin

- 1 Automotive Semiconductor Market
- 2 Automotive Standard Qualification Requirements
- 3 **Other Requirements**
- 4 Conclusions

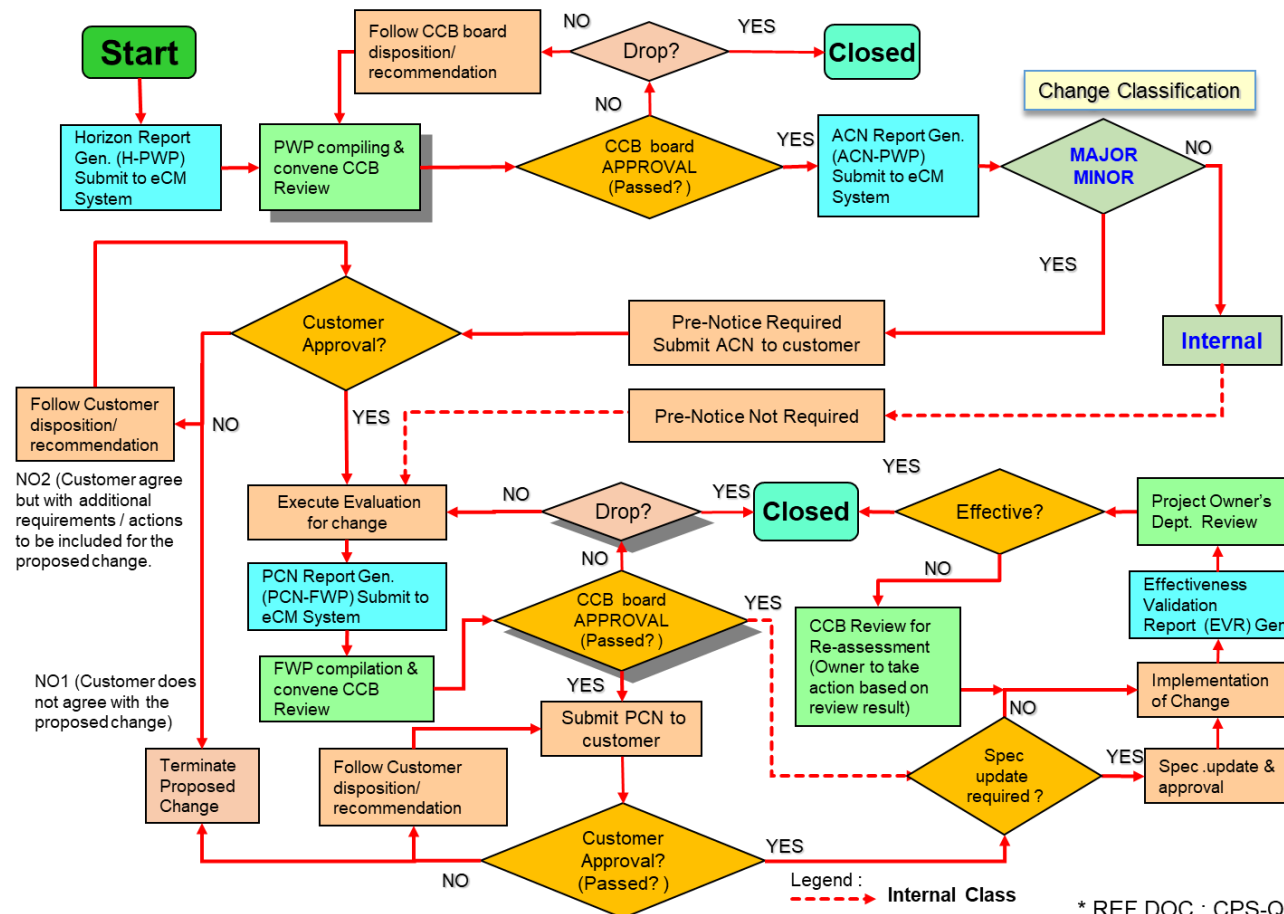
Failure Analysis Capabilities



Customer Complaint Handling

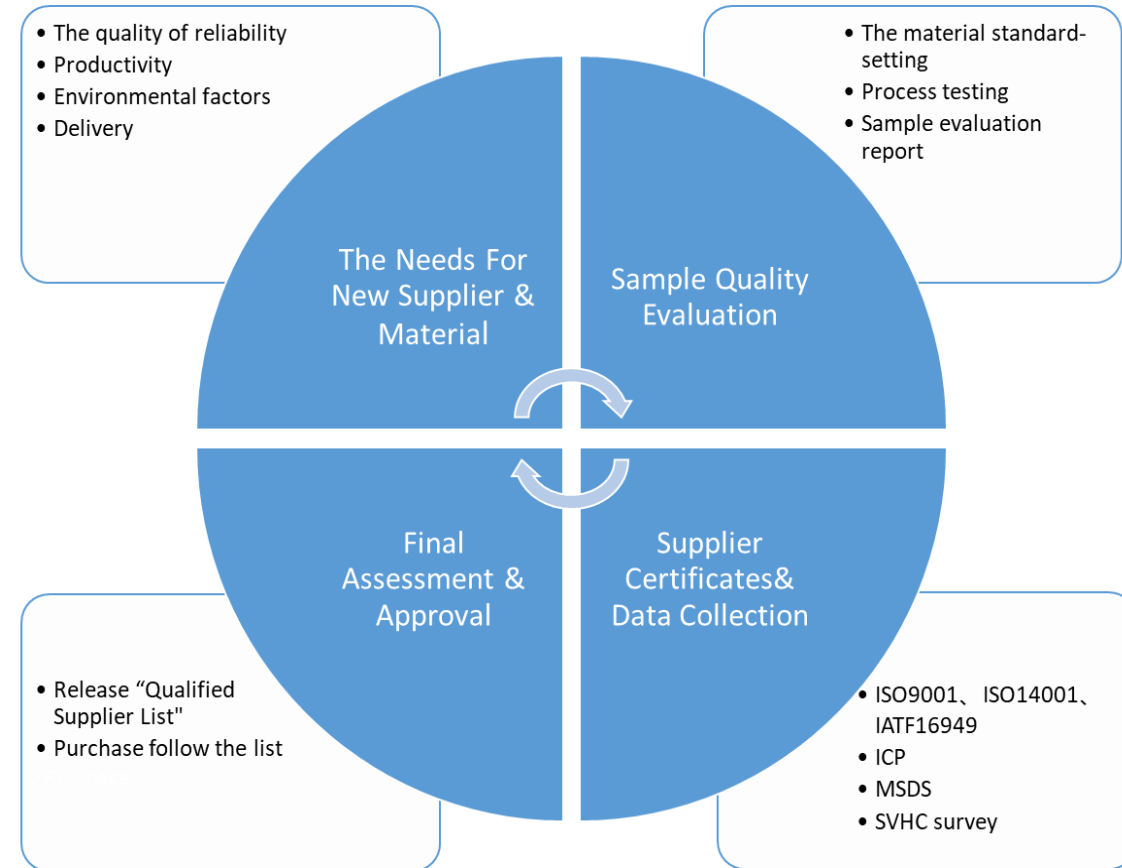


- Product change/cancelation notification.
- JEDC 046 is a good baseline document. However time frames in automotive are much longer.
 - Notification 6 Months
 - Approval 6 Months
 - Cancellation 2 Years
- A typical flow looks like



Supplier Qualification

- Every supplier has to qualify his supplier according to IATF 16949
- Typically this means qualifying the supplier against IATF 16949
- Bulk material is excluded, though some sort of qualification and control has to be in place
- OSATs do not need to qualify their supplier against IATF but need to have a qualification and monitoring in place



- Automotive requires 15 years (data and documents)
 - Typically 5 years on-line
 - Thereafter T&R
- Customer Specific Requirements
 - Supporting the standards is not sufficient
 - All customers do have additional requirements
 - You need to have a system in place to handle such requests

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Automotive Manufacturing Footprint




1



Jiaying Super Campus

- 2,914K ft² mfg
- JCET D3, JSCC, JCAP
- Flip chip, leaded, laminate, bumping, WLCSP, MIS, Test


2



Low Power Discrete

- Chuzhou, Anhui Province
- 753K ft² mfg
- Leaded, discrete package and test

3




Power Packaging

- Suqian, Jiangsu Province
- 538K ft² mfg
- Power package and test




4



SCK

- Incheon (IFEZ)
- 2,445K ft²
- Adv laminate (flip chip and stacked wirebond); SiP, pre-stack, SLT & final test

5



SCS

- Yishun
- 808K ft²
- 8"/12" WLCSP, eWLB, QFN, laminate; probe & final test

Automotive Capability

Product	JSCC	SCK	SCS	JCET	JCAP
Flip Chip	✓	✓		✓	✓
Wirebond	✓	✓	✓	✓	
WLP			✓		✓
SiP	✓	✓		✓	
TEST	✓	✓	✓	✓	✓

- These automotive standards are a must comply
 - ISO 26262-11
 - IATF 16949
 - AIAG
 - AEC
- On top of this, there are customer specific requirements
- Documentation and data retention are important
- Customer want to buy a part and never hear from it again
 - For 15 years
 - Rain or shine

JCET Group is ready to support your Automotive needs!



For further support, contact:

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