1. Participating in the Auto supply chain is more than AEC grade qual and IATF 16949 registration

2. As a supplier, you must develop a culture of serving Automotive Tier 1s and OEMs

3. The AEC Q004 Zero Defects Guideline is a jumpstart on developing that culture and can be used to support any industry segment

4. Mike Brucker is older than his LinkedIn picture would indicate
Who am I?

Michael Brucker, Sr Mgr of Automotive Systems, GlobalFoundries

- ASQ Certified CQM/OE, CQE, CQA
- Proud parent of the AutoPro™ Service Package
- 20+ years of related experience including leading key initiatives for GlobalFoundries, Silicon Labs, Motorola, and Texas Instruments
- Contributing member to the AEC Q004 Zero Defects Guideline
- Husband to Linda (Sales Director for Kate Farms Medical)
- Dad to Connor, Junior Economics major at UT Dallas and Dylan, Sophomore at St. Michael’s, majoring in Football and Xbox 360
- Defensive Coordinator for St. Gabriel’s Middle School Lacrosse
- Founder, lead singer, sax and harmonica player for Sader Dads Rock band
- Pursuing MS in Quality Engineering Management from E. Michigan U.
Changing Automotive Landscape

GlobalFoundries AutoPro™ Service Package

- Acceleration of Electronics solutions within Automotive
- Promise to enhance the driving experience (navigation, remote roadside assistance, and semi- and autonomous driving)
- ICs need to combine data from multiple sensors with high-performance processors that make control decisions

- GlobalFoundries, the fastest growing auto foundry in the world, built its AutoPro™ Service Package upon 3 foundational pillars:
  - Quality Systems Readiness
  - Technology Platform Readiness and
  - Operational Readiness

- Automotive Electronics Council (AEC) and Q004 Zero Defects Guideline
What is the GF AutoPro™ Service Package?

How GlobalFoundries does Automotive

Automotive customers expect the highest levels of quality and reliability - in technology, in manufactured products, and in service and support.

The GF approach is to develop robust systems to acknowledge all customer requirements and industry expectations (such as AEC and IATF) and to standardize these systems across all factories and business groups.

The AutoPro Service Package defines these systems with three organizational pillars that serve as the foundation for our customer relationships.
# AutoPro™ Service Package

**Three Foundational Pillars**

<table>
<thead>
<tr>
<th>Quality Systems</th>
<th>Technology Platform</th>
<th>Operational Control</th>
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<tbody>
<tr>
<td>IATF 16949 Registration</td>
<td>AEC Q100 Qual (Grade 2,1,0)</td>
<td>Safe Launch Methodology</td>
</tr>
<tr>
<td>VDA 6.3 Process Approach</td>
<td>AutoPro Design Rules and DFM</td>
<td>Automated SPC</td>
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<tr>
<td>Core Tools Execution</td>
<td>ISO26262, ASIL and Functional Safety</td>
<td>Post Maintenance Control</td>
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<tr>
<td>Supplier and Sub-supplier IATF Mgt</td>
<td>AutoPro Reliability Monitoring</td>
<td>Fault Detection and Classification</td>
</tr>
<tr>
<td>Zero Defects Culture</td>
<td>DFMEA &amp; PFMEA and ASIC Design</td>
<td>Preferred Tool Path Mgt</td>
</tr>
<tr>
<td>Change Mgt and PCN Horizon Reports</td>
<td>Customer Critical Parameter Tracking</td>
<td>Lot Control and Maverick Handling</td>
</tr>
<tr>
<td>Global Standard Quality Handbook</td>
<td>Advanced Product Quality Planning</td>
<td>Enhanced Outgoing Quality Controls</td>
</tr>
</tbody>
</table>

**Customer Relationship Management**

- IATF 16949 Registration
- VDA 6.3 Process Approach
- Core Tools Execution
- Supplier and Sub-supplier IATF Mgt
- Zero Defects Culture
- Change Mgt and PCN Horizon Reports
- Global Standard Quality Handbook

- AEC Q100 Qual (Grade 2,1,0)
- AutoPro Design Rules and DFM
- ISO26262, ASIL and Functional Safety
- AutoPro Reliability Monitoring
- DFMEA & PFMEA and ASIC Design
- Customer Critical Parameter Tracking
- Advanced Product Quality Planning

- Safe Launch Methodology
- Automated SPC
- Post Maintenance Control
- Fault Detection and Classification
- Preferred Tool Path Mgt
- Lot Control and Maverick Handling
- Enhanced Outgoing Quality Controls

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**Note:** All GLOBALFOUNDRIES AutoPro sites driving to zero defects!

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AutoPro™ Quality Systems Highlights

Focus on Risk Management throughout the process

- All factories transitioned to IATF* 16949:2016 registration [*International Automotive Task Force]
- Corporate and Site Automotive Steering Committees address automotive business strategy and performance; includes Executive leadership from Business, Manufacturing, Product Development and Quality
- Supplier & sub-suppliers are managed using IATF 16949 requirements
- Customer expectations supported by a Zero Excursion, Zero Defect approach
AutoPro™ Technology & Design Highlights

Qual to AEC-Q100 and full support of APQP

- AEC Grade based on customer mission profile and product line technology roadmap; foundation IP qualified to AEC-Q100 up to Grade 0 (Grade 2 is standard offering)

- Design Risk Assessment
  - IC Design: includes FMECA, FTA, DFMEA, DFM/DFT
  - Wafer Fab: includes FMEA and 3x5 Why per customer DFMEA

- Mandatory AutoPro Design Rule Checks and Design for Mfg checklist before Tapeout

- Product roadmap and process longevity to meet automotive market needs
GF AutoPro™ Safe Launch Highlights

Safe Launch driven by GF’s Release to Production process

- Aligns with Automotive APQP (Advanced Product Quality Planning) and customer DFMEA
- Risk assessment and Lessons Learned-based improvement plans
- Extended validation of critical process steps
- Increased inline metrology and defect density inspection sampling and electrical and reliability monitoring based on risk assessment

Fab1 Dresden
GF AutoPro™ Automated Mfg Control Highlights

Error-proofed Automation support of Production

- Product designation invokes Lot Identification and AutoPro controls
- Preferred Tool Path and enhanced tool control including automotive lot restriction subsequent to tool maintenance and repair
- Measurement System Analysis and tighter Statistical Process Control (greater sampling, CpK 1.67 for CTQs) based on Tool and Process FMEAs
- Control plan-based, automated Lot Hold, and Maverick Lot identification
GF AutoPro™ Mfg Control Highlights

Designated AutoPro Production based on APQP

- Special OCAPs, Restricted process rework
- Increased inline defect density inspection
- Reliability and DPPM monitoring exceeding commercial product
GF AutoPro™ Service Highlights
Automotive market means AutoPro Support

- PPAP capability and support
- Automotive Change Management and Horizon Reporting
- Prioritized Failure Analysis; Corrective Actions using 8D methodology with 24 hour containment
- Continual Improvement plans in support of customer expectations
GF AutoPro™ Service Package Summary

Integrated into the OEM Supply Chain

- AEC Qualification to Grade 0, 1, 2, 3
- Sites certified to IATF 16949
- Product Development per APQP
- Automated Manufacturing controls based on a zero defects culture
What is the AEC?

Automotive Electronics Council History

- Created at a JEDEC meeting in 1992 when Delco (GM) and Chrysler discussed the idea of common IC qualification specifications; Ford later invited

- Test Qualification for Integrated Circuits defined in AEC Q100, which documented the preferred qualification for Chrysler, Delco, and Ford

- Following this initial start, qualification specifications for other part categories were developed

- AEC hosts an annual Reliability Workshop
A set of tools and processes suppliers and users of integrated circuits can use to approach or achieve a goal of zero defects during a product's lifetime.

This guideline makes suggestions for when each of these tools and methods should be used depending on the application or business case.

This is not to used as a requirements document, but a tool box of methods.

As a part and/or process is optimized and matures over time, less tools are needed to improve or maintain quality and reliability.
AEC Home Page [aecouncil.com]

AEC Documents

- AEC History
- AEC Members
- Updated: AEC Documents
- Selected Technical Papers
- Links to Related Web Sites
- Updated: 2018 European AEC Reliability Workshop
- Contact the Technical Committee
AEC Documents

AEC - Q004 Zero Defects Guideline

- AEC Component Technical Committee Charter
- AEC Component Technical Committee Charter - Rev-F
- AEC Membership Application - Rev-F
- AEC - Q100: Failure Mechanism Based Stress Test Qualification
  - AEC - Q100 Rev - H: Failure Mechanism Based Stress Test Qualification
  - AEC - Q100-001: Rev-C: Wire Bond Shear Test
  - AEC - Q100-002: Rev-B: Human Body Model (HBM) Electrostatic Discharge Test
  - AEC - Q100-003: Rev-E: Machine Monitor Test
  - AEC - Q100-004: Rev-D: IC Latch-Up Test
  - AEC - Q100-005: Rev-D1: Non-Volatile Memory Program

  **NOTE (dated August 20, 2013):** The AEC - Q100-005 Rev-D Revision was approved by the AEC Technical Committee.

- AEC - Q101: Failure Mechanism Based Stress Test Qualification
  - AEC - Q101 Rev - F: Failure Mechanism Based Stress Test Qualification
  - [Decommissioned] AEC - Q101-002: Rev-C: Wire Bond Shear Test
  - AEC - Q101-003: Rev-A: Wire Bond Shear Test
  - AEC - Q101-004: Rev-B: Electrical Distribution Assessment
  - AEC - Q101-005: Rev-A: Solder Ball Shear Test
  - AEC - Q101-006: Rev-A: Charged Device Model (CDM) Stress Test

  **NOTE (dated March 12, 2013):** The AEC - Q100-005 Rev-D Revision was approved by the AEC Technical Committee.

- AEC - Q104: Failure Mechanism Based Stress Test Qualification
  - AEC - Q104 Rev - A: Final Release

- AEC - Q200: Stress Test Qualification For Reliability
  - AEC - Q200 Rev - B: Stress Test Qualification For Reliability
  - AEC - Q200-001: Rev-B: Flame Retardant Test
  - AEC - Q200-002: Rev-B: Human Body Model (HBM) Electrostatic Discharge Test
  - AEC - Q200-003: Rev-B: Beam Load Test
  - AEC - Q200-004: Rev-B: Measurement
  - AEC - Q200-005: Rev-A: Board Flex Test
  - AEC - Q200-006: Rev-A: Terminal Strength Test
  - AEC - Q200-007: Rev-A: Voltage Stress Test

  **AEC - Q001 Rev - D: Guidelines for Part A: specified) provide "Known Good Die."}

- AEC - Q002 Rev - B: Guidelines for Statistical Quality Control

- AEC - Q004 Proposed DRAFT: Zero Defects Guideline

- AEC - Q005 Rev - A: Pb-Free Test Re Liability for automotive electronics application

- AEC - Q006 Rev - A: Qualification Requirements for Reliability

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Zero Defects Design Tools

From DFMEAs to Simulation and Characterization

3.1 Failure Mode and Effect Analysis DFMEA
3.2 Redundancy
3.3.5.2 Built-in Self Test
3.4.5.1 Design for Test
3.5.8.1 Design for Analysis
3.6 Design for Manufacture
3.7 Design for Reliability
3.8 Simulation
3.9 Characterization
Zero Defects *Manufacturing Tools*

*From PFMEAs to Control Plans*

4.1 Process FMEA
4.2 Statistical Analysis of Variance
4.3 Control Plan
4.4 Statistical Process Control
4.5 Internal Audits
Zero Defects Test Tools

From Statistical Controls to Data Management

5.3 Process/Part Average Testing
5.4 Statistical Bin Yield Analysis
5.5 Data Collection, Storage and Retrieval
5.6 Screens
5.7 Lot Acceptance Gates
Zero Defects Capabilities Tools

From Industry-Specific Tests to Industry Standards

6.1 Stress-Strength Analysis
6.2 Data Analysis
6.3 Industry Standards
6.4 Environmental Stress Testing
6.5 Part Derating
Zero Defects *Improvement, Problem Solving Tools*

*From Continual Improvement to Test/QC Monitoring*

7.1 Wafer Level Fail Mechanism Monitoring
7.2 Process/Product Improvements
7.3 Production Part Monitoring
8.2 Problem Solving Techniques
8.3 Failure Analysis Process
8.x Six Sigma Approach
8.x Lean / Kaizen Approach
9.1 System Engineering
9.2 Quality Function Deployment
What’s in *Your Toolbox*?

*And where do you get more useful & better tools?*

- Systemic approach
- Process approach
- Risk-Based thinking
- Benchmarking (societies like ASQ and AEC)
- Know your standard Quality tools (Fishbone diagrams, Pareto charts, SPC, DOE, Brainstorming, etc.)
- **Get ASQ certified!**
The Culture of Automotive

This is not your father's Oldsmobile

- AEC Qualification & IATF 16949 Registration
- Zero Defect Approach
- Commitment to service and support
- Continual improvement and cost reduction
- Trust relationship
- Must bring value beyond supplied product

Result is long-term customer commitment!
What Did I Learn Today?
Automotive Service and Zero Defects

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Final Word

Really, this is the last slide

Don’t sacrifice the important for the urgent!

- Have a plan
- Stay connected
- Communicate
- **Value people, what they bring, and leverage their contribution**
- Keep learning