



**KEYSIGHT**  
**WORLD 2019**

# **Risk of Poor Calibration: What the Automotive Industry Should Know**

*Services Business Development Manager / Keysight Technologies*

***Renu C***



# How many of you use Cars ?





# Top 10 Causes of Road Accidents

## LET'S LOOK AT FACTS

1. Distracted Driving
2. Drunk Driving
3. Speeding
4. Reckless Driving
5. Rain
6. Running Red Lights
7. Night Driving
8. Design / Manufacturing Defects
9. Tailgating
10. Drugs



# Chances of Automotive Safety Recall ?



# **What You Need to Know About: IATF 16949:2016**

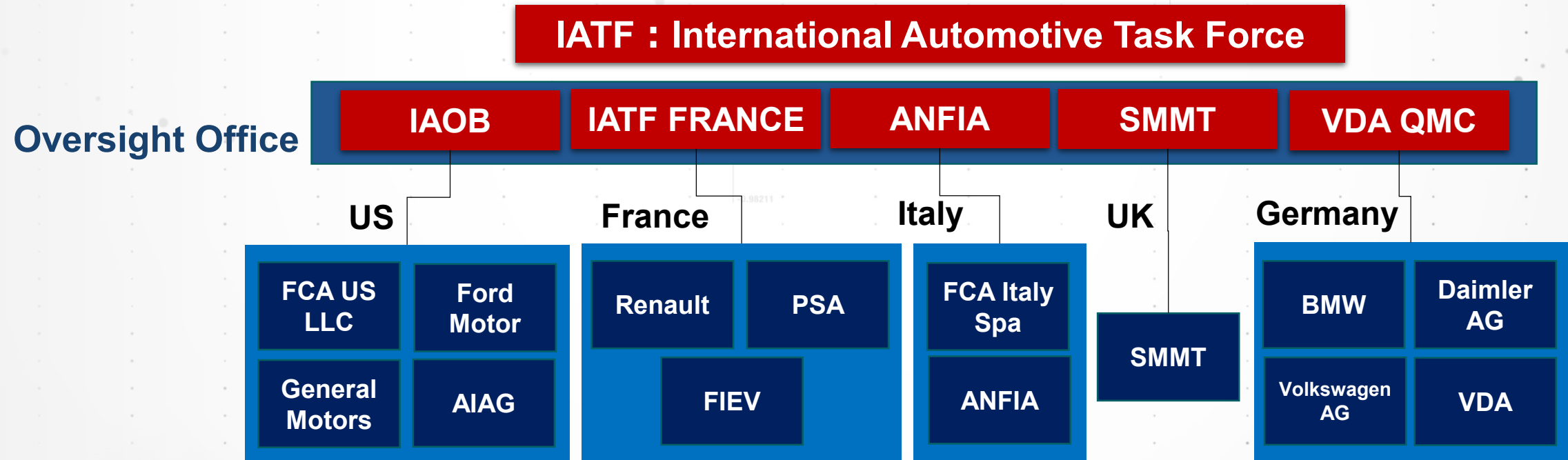


# IATF – International Automotive Task Force

## WHAT IS IT ?

An “ad hoc” group of automotive manufacturers and their respective trade associations, formed to **provide improved quality products** to automotive customers worldwide.

IATF creates guideline for QMS (quality management system) requirements.



# Why is IATF 16949:2016 Important to Your Organization?

From 14th September 2018, IATF 16949:2016 will become an essential requirement for any organization operating in the global automotive supply chain.

**Many of the world's leading car manufacturers now make certification a contractual requirement for their suppliers.**



# Goal of IATF 16949:2016

The goal of Automotive QMS standard is:

the development of quality management system that provides for continual improvement, emphasizing defect prevention and the reduction of variation and waste in the supply chain.





# The Scope of IATF 16949:2016

This automotive QMS Standard defines the quality management system requirements for the design and development, production and, when relevant, assembly installation, and services of automotive-related products, including products with embedded software.

*Applicable to sites where manufacturing of customer-specified production parts, service parts and/or accessory parts occurs.*

**Applied throughout the automotive supply chain.**



# Summary: IATF 16949:2016

## WHAT YOU NEED TO KNOW



- **What** is IATF – International Automotive Task Force
- **Why** it's Important – Leading car manufacturers making certification a contractual requirement for their suppliers
- The **Goal** – QMS system that provides **continual improvement**, emphasizing **defect prevention** and the **reduction of variation and waste** in the supply chain.
- The **Scope** – Applied **throughout the automotive supply chain**.

# Requirement for Calibration in IATF 16949:2016

## 7.1.5.2 : Measurement Traceability

### 7.1.5.2.1 : Calibration / Verification Records

## 7.1.5.3 : Laboratory Requirements

### 7.1.5.3.1 : Internal Laboratory (calibrate in your company)

### 7.1.5.3.2 : External Laboratory (calibration by vendor)





# What You Need to Know About: Calibration



# What is Calibration

**ENSURES INSTRUMENT IS PERFORMING TO ITS SPECIFICATION**

Calibration is periodically verifying instrument specifications by measuring actual performance using lab standards and are traceable to the International System of Units (SI) through standards maintained by National Institutes

**ANY INSTRUMENT THAT IS USED & RELY ON  
THE (WARRANTED) SPECIFICATIONS NEEDS  
PERIODIC CALIBRATION**

# What is Your Criteria in Selecting Calibration Service?

Turn  
Around  
Time

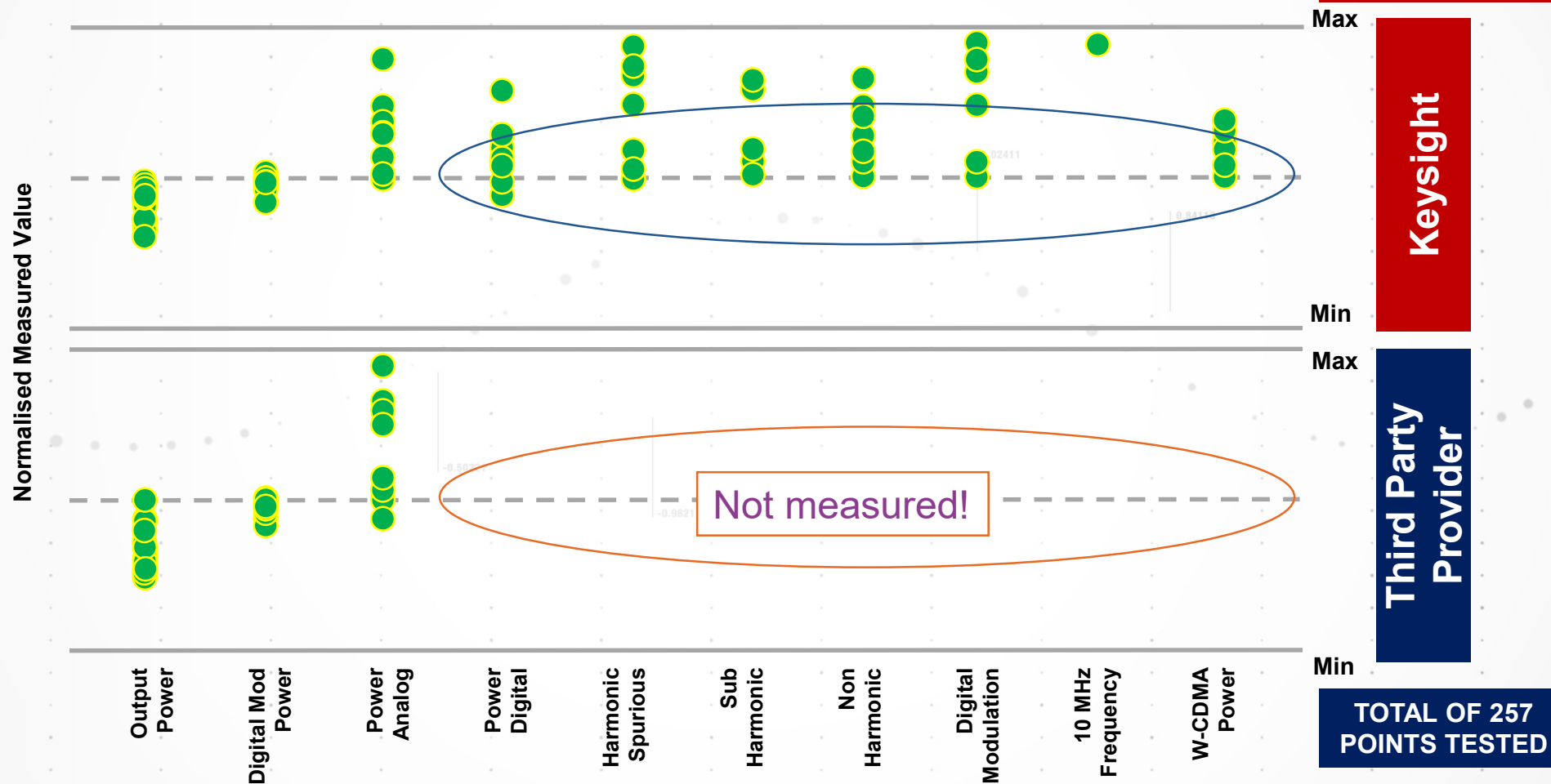
Price

Calibration  
Quality



# Quality Calibration: Risk of Poor Selection

## COMPARISON FOR MXG RF VECTOR SIGNAL GENERATOR



# Quality Calibration: Risk of Poor Selection

## COMPARISON FOR AGILENT ESG SERIES SIGNAL GENERATOR

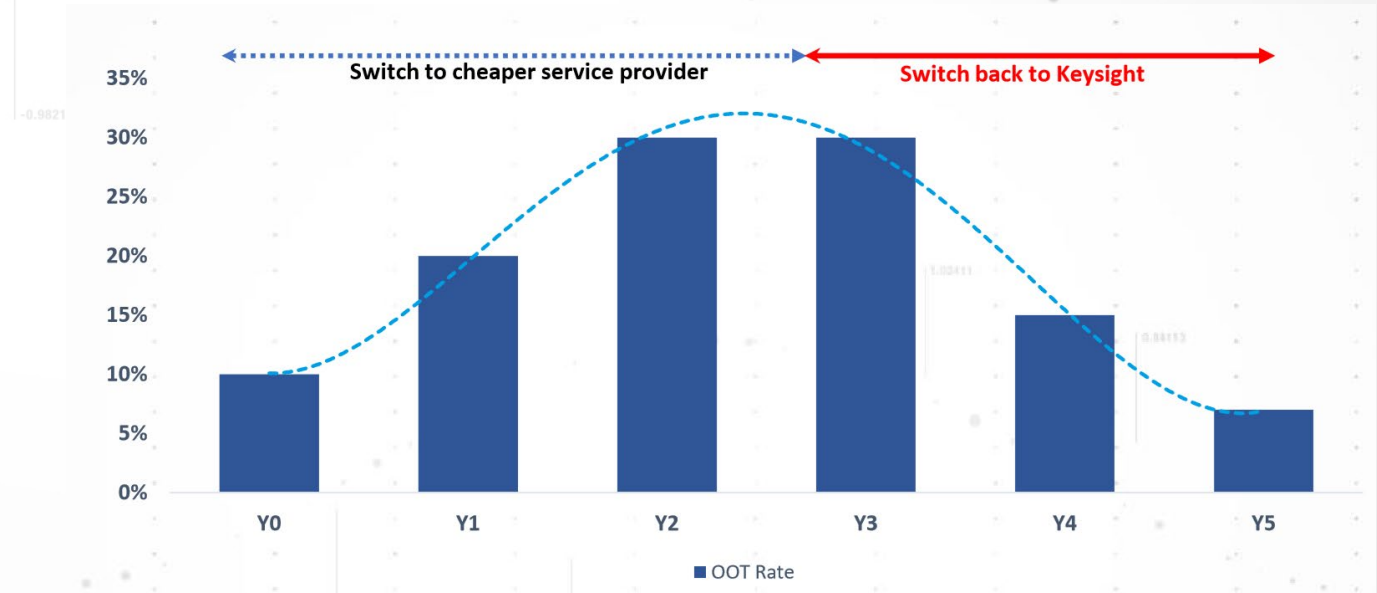
Coverage	Keysight (Accredited Cal)	Third Party Provider (Accredited Cal)
# of Test Parameters	16	6 (Only 37% of the Test Parameters are covered)
# of Test Points	435	45 (Only 9% of the Test Points are covered)
# of Calibration Equipment used	11 (including High-end equipment)	4 (Low-end equipment)
Include Adjustment ?	√	X
Report Details - # of pages	97	5

# Case Study: Out of Tolerance

## SWITCHING FROM CHEAPER TO BETTER

- Our data shows that in customers who return to Keysight Calibration services after using other service providers, 20%-30% of the instruments are found to be out of tolerance (OOT). Highest found is over 80%.
- By the third year of Keysight calibration, the same pool of instruments shows 4%-8% OOT.
- Adjustment vs Repair

**Calibrating with trusted calibration service provider year after year reduces your risk and exposure to hidden costs.**

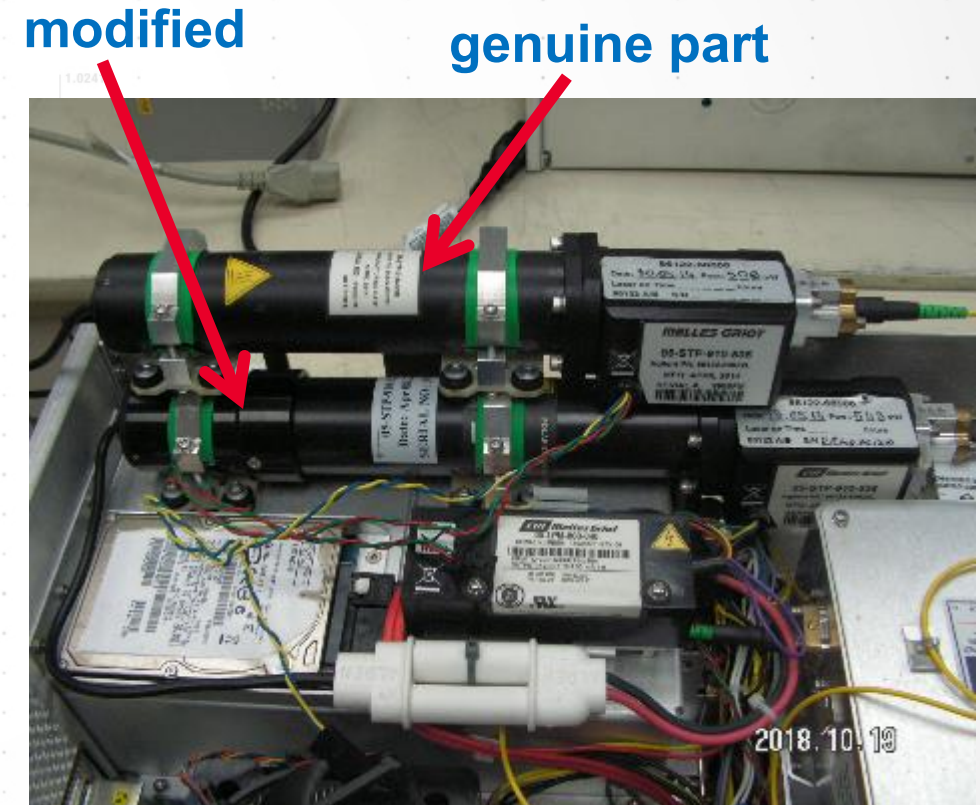




# Risk of Low Quality Calibration To Your Equipment

## HIDDEN COST OF CALIBRATION

- Use of non-genuine parts – affects the equipment performance and life span
- Poorly calibrated equipment have shorter life span



# Risk of Non-Compliance to Your Business

## AVOIDABLE UNNECESSARY COST

- The implication of **NOT** complying to IATF16949:2016 requirement:
  - Will fail compliance audit
  - Production stop
  - Will fail customer audit
  - **Risk of losing customer/business**

The cost of poor calibration on your business is **MORE** than the price of right calibration

# What is Your Criteria in Selecting Calibration Service?

Turn  
Around  
Time



# Delivery Mode & Impact to Turn-Around-Time

EXPERIENCE THE TURN-AROUND TIME YOU NEED

## Return-to-Bench

Send your equipment to us for Keysight procedures, parts, and trained technicians



## On-site Calibration Service

Reduce downtime from days to hours with an on-site service that fits your schedule



## On-site Calibration Lab

Manage calibrations and repairs with a Keysight professional at your site



# Uptime Loaner Service (System Uptime)

## MINIMIZE YOUR DOWNTIME

- **Your challenge:** Keep test systems operating
- **Typical resolution:** Stock spares, rent, or pay for expedited repairs
- **Our solution:** Let Keysight send you a loaner while your equipment is being serviced
- **Your Benefits**
  - Lower cost compared to purchasing spares or rental
  - Avoid capital and operating expenses to acquire and maintain spares
  - Avoid unplanned costs of expedited repairs and rentals
- **Keysight delivers**
  - Send a loaner by carrier or Keysight Customer Engineer
  - Speed of delivery options: same day, next day, and three-day
  - Manage maintenance of the loaner

BE PREPARED.  
MAXIMIZE UPTIME.  
LOWER COST

# What is Your Criteria in Selecting Calibration Service?



# Calibration Type & Option

SELECT THE RIGHT CALIBRATION & PAY THE RIGHT PRICE

Deliverables	Keysight Calibration	Z540-1 Calibration	Keysight Cal + Uncertainties <sup>5</sup>	Keysight Cal + Uncertainties + Guardbanding <sup>6</sup>	Accredited Calibration	Standards Lab Calibration
Primary lab standards <sup>1</sup>						✓
Locally accredited					✓	✓
Measurement guardband <sup>2</sup>				✓	✓	✓
Measurement uncertainties		✓	✓	✓	✓	✓
Adjustments <sup>3</sup>	✓	✓	✓	✓	✓	✓
As received data report	✓	✓	✓	✓	✓	✓
As shipped data report <sup>4</sup>	✓	✓	✓	✓	✓	✓
Calibration certificate	✓	✓	✓	✓	✓	✓
Sample calibration certificates						

➤ Know what you need

➤ Know what you are paying for

1. Primary lab standards, such as a Josephson junction, used for lowest measurement uncertainty comparable to a National Measurement Institute.

2. Guardbanding deliverables vary based on local country accreditation body requirements.

3. See Application Note titled [Layout of Calibration Certificates and Measurement Reports](#) for information on how results are reported and when adjustments are performed.

4. Provided when adjustment(s) are made.

5. Keysight Cal + Uncertainties is offered only in China and Singapore. For other Asian countries, order Z540-1. Call us to confirm Z540-1 standard compliance.

6. Keysight Cal + Uncertainties + Guardbanding previously named ISO 17025 Cal.



# What Should You Look for in a Calibration Report ?



# Quality Calibration: Be an Informed Customer

## WHAT YOU SHOULD LOOK AT

- Type of Calibration Equipment used
- Number of Test Parameter Covered
- Number of Test Points Covered
- Is Adjustment included. Do you need to pay for it.
- Measurement Uncertainty
- The Limit used
- Is Traceability note included

READ YOUR CALIBRATION  
REPORT

# What is Your Preference: Cheap Calibration OR Value (*for \$\$*) Calibration ?





# What You Need to Know About: Traceability



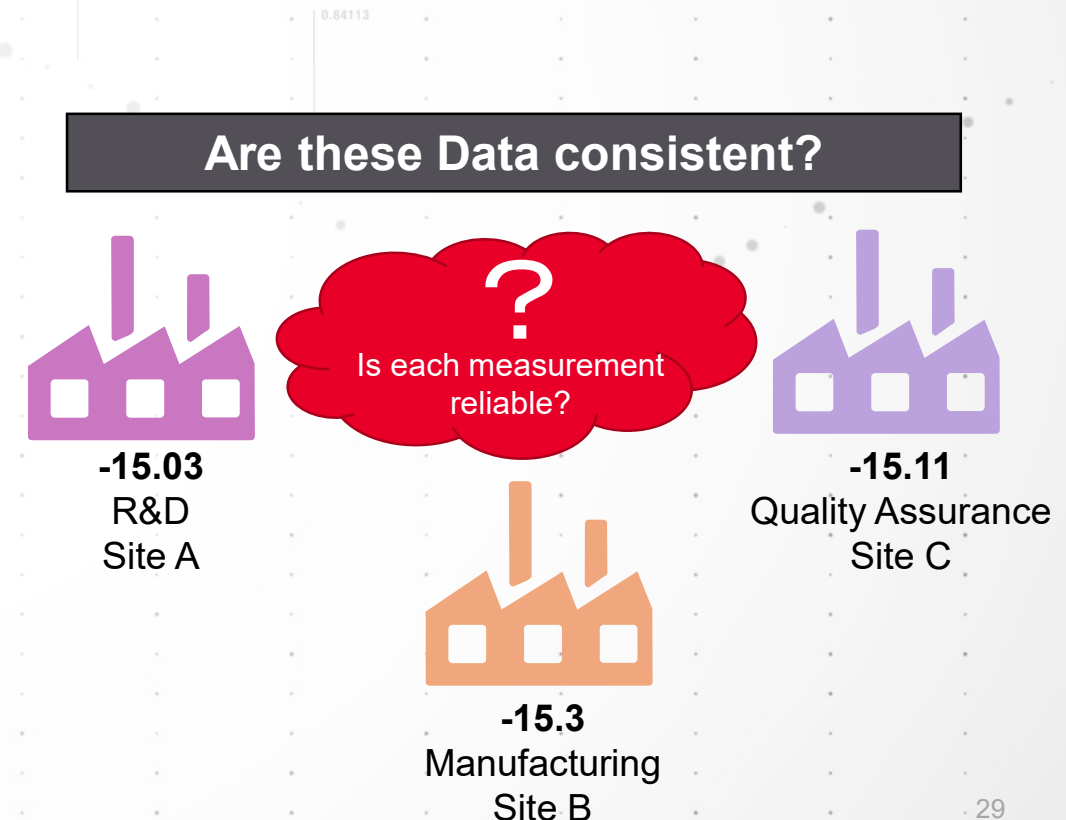


# What is Traceability

TRACEABLE MEASUREMENTS ENSURES UNIFORMITY

Property of measurement result whereby the result can be related to a reference through a documented unbroken chain of calibrations, each contributing to the measurement uncertainty

LINKAGE TO COMMON STANDARD



# What You Need to Know About: Measurement Uncertainty



# What is Measurement Uncertainty

THE IS NO PERFECT MEASUREMENT

Uncertainty is a parameter, associated with the result of a measurement, that characterises the dispersion of the values that could reasonably be attributed to the measurand.

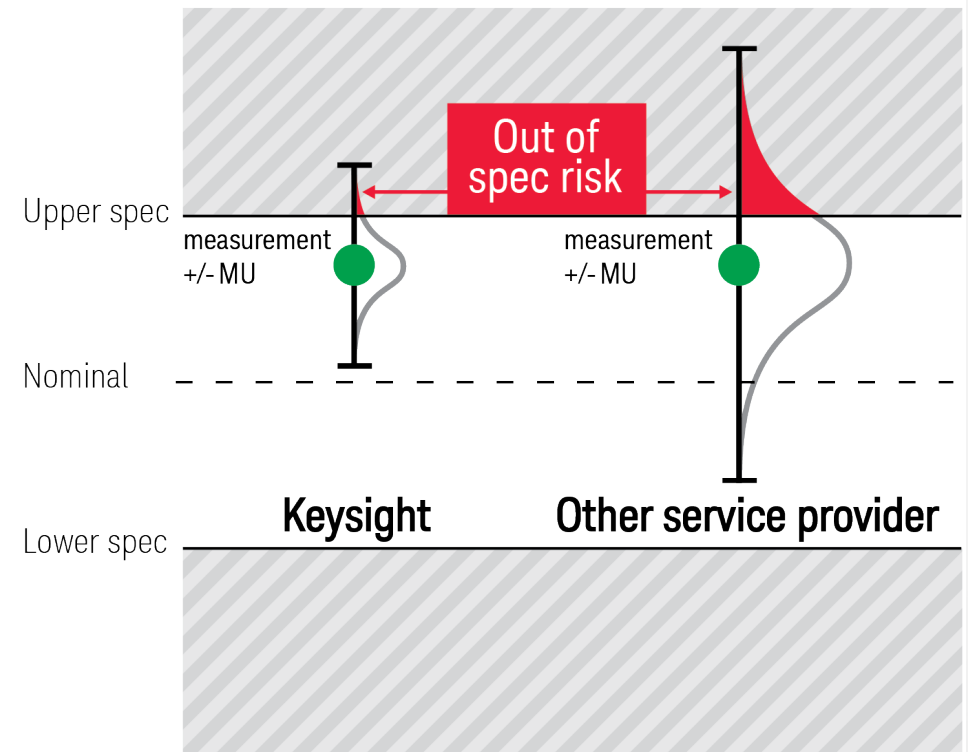
HOW ACCURATE IS THE  
MEASUREMENT

# What is Measurement Uncertainty

## THE IS NO PERFECT MEASUREMENT

- There is no perfect measurement, as they involve errors and imperfections
- Large calibration uncertainty increases the risk that your instrument is operating out-of-specification, risking instrument errors that impact the quality or performance of your design
- Calibration measurement uncertainty of your test equipment contributes to your overall test system inaccuracy: Keep it small

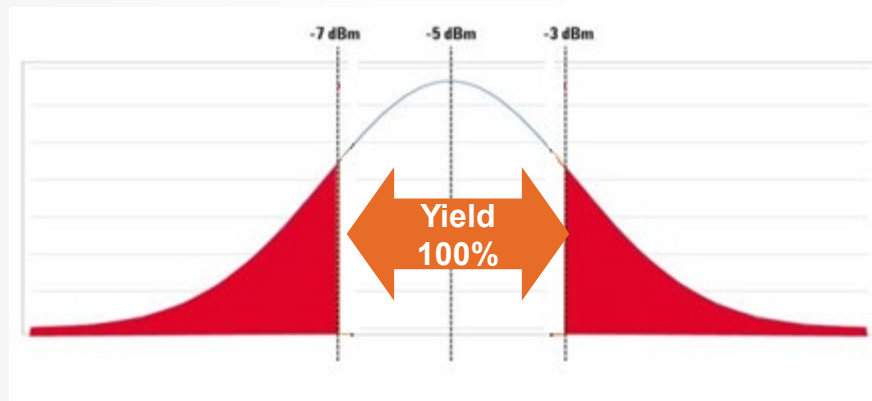
### Low measurement uncertainty (MU) matters



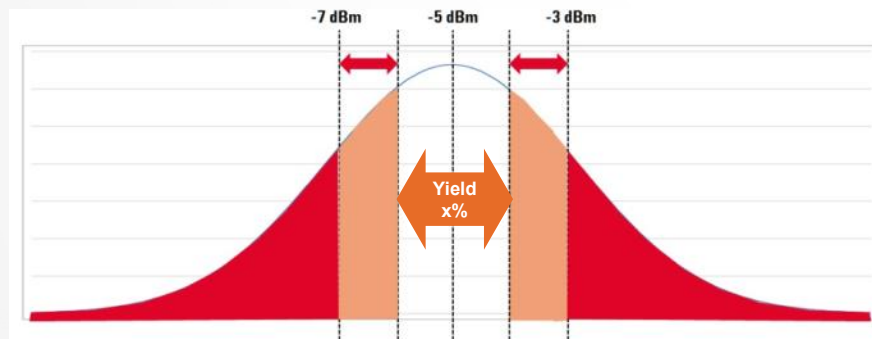


# Measurement Uncertainty : Without vs With

Without Measurement Uncertainty :



With Measurement Uncertainty :



## Good & Bad Products

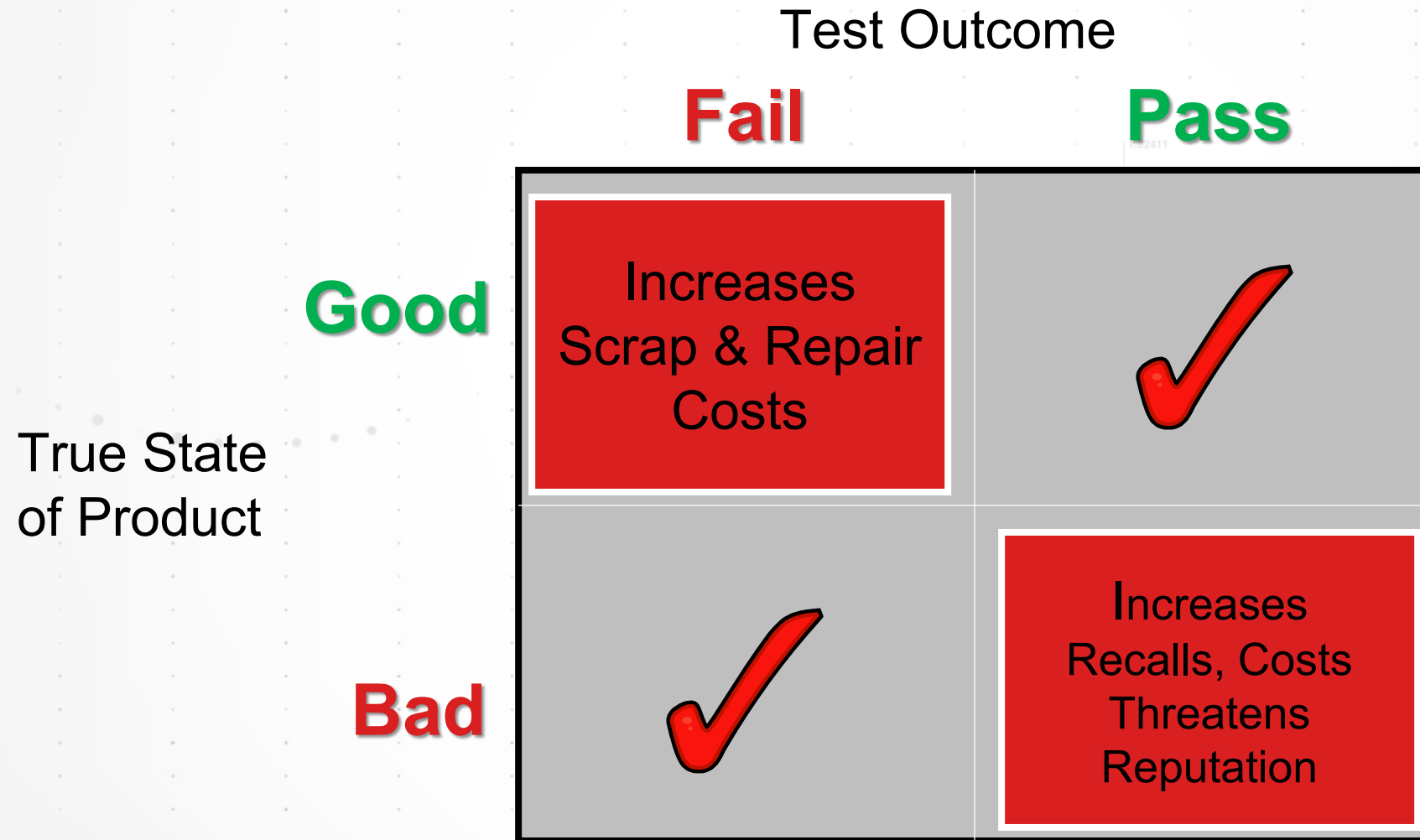
X Recall | X Long investigation |  
X Intermittent issues | X Cost |  
X Reputation

**Release bad products into the market**

## Good Products

# Calibration Impacts Measurement Uncertainty

MEASUREMENT UNCERTAINTY IMPACTS YIELD



# **Risk of Poor Calibration: Recap & Solution**



# Risk of Poor Calibration - Business



NON-COMPLIANCE



AFFECT TO EQUIPMENT



# Risk of Poor Calibration - People



YOU AND ME

# Solution

## RISK OF POOR CALIBRATION: WHAT THE AUTOMOTIVE INDUSTRY SHOULD KNOW

- **Know your NEEDS & Ensure its FULFILLED**
  - *Know what type of calibration you need & what you are paying for*
- **Ensure PROPER Calibration**
  - *Accredited Cal*
  - *All required parameters & points are covered, right test limits is used etc.*
- **Select TRUSTED Calibration Service Provider**
  - *Quality Calibration vs Cheap Calibration*





# Conclusion

## RISK OF POOR CALIBRATION: WHAT THE AUTOMOTIVE INDUSTRY SHOULD KNOW

- **Ensure only good products are released**
  - *Higher measurement accuracy*
  - *Reduce the risk of bad products slipping through*
- **Ensure compliance**
  - *Accredited Cal*
  - *Trusted calibration service provider*
- **Win business opportunity**
  - *IATF 16949:2016 - essential requirement for any organization operating in the global automotive supply chain.*
  - *Accreditation a contractual requirement for automotive suppliers*







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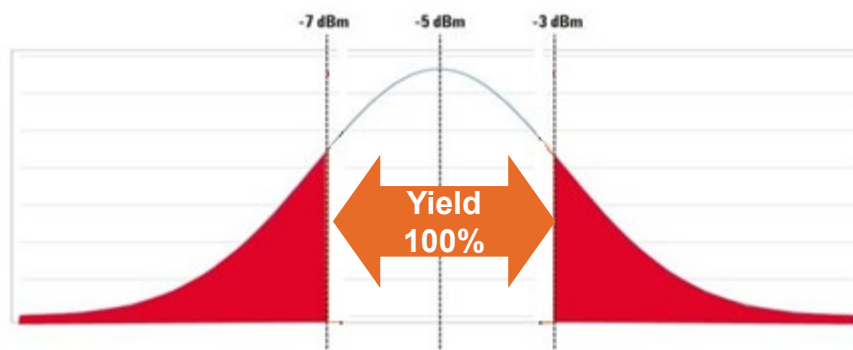


# Backup Slides



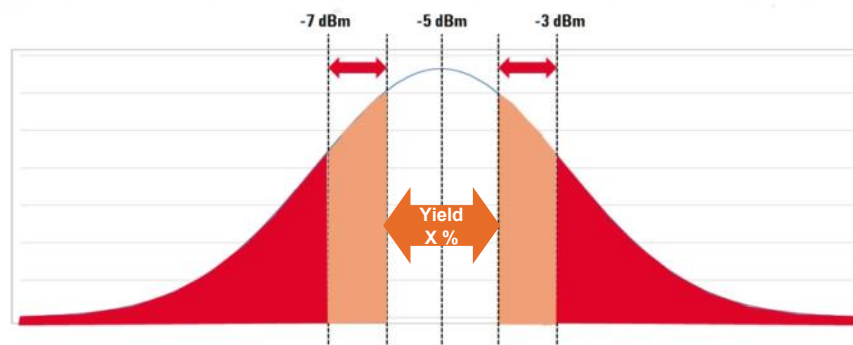
# Measurement Uncertainty : Making the Right Selection

**Without** Measurement Uncertainty :



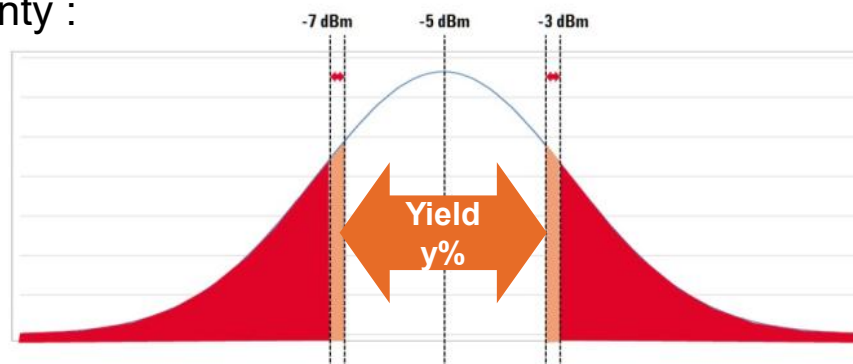
**Good & Bad** Products

**With** Measurement Uncertainty :



**Good** Products

**With** (lower) Measurement Uncertainty :

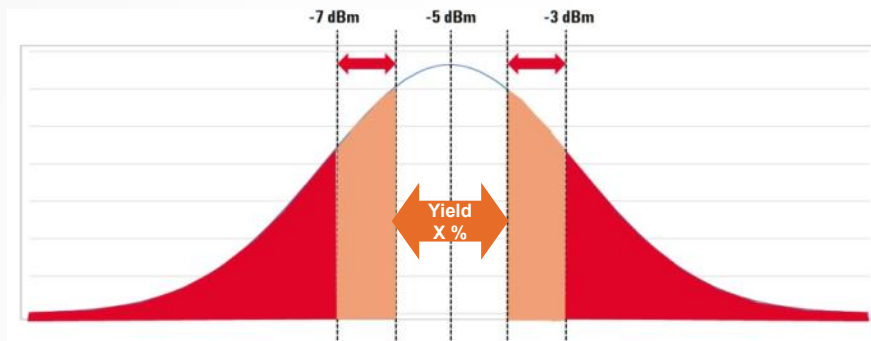


**Good** Products  
+  
**Improved Yield**

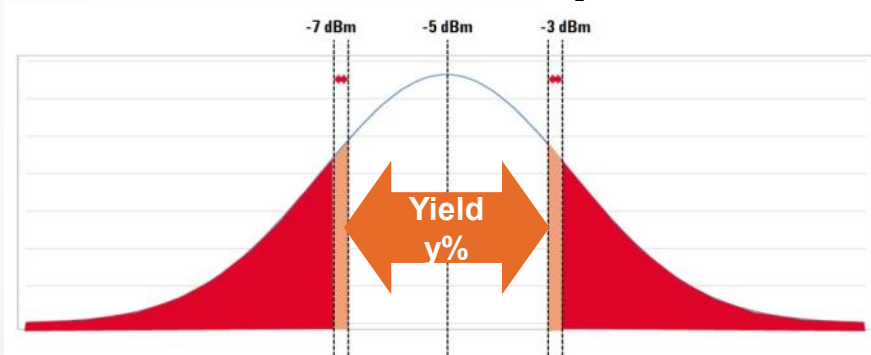
# Measurement Uncertainty : Risk of Poor Selection

REDUCING MEASUREMENT UNCERTAINTY IMPROVES YIELD

$\pm 1.0$  dB meas uncertainty



$\pm 0.25$  dB meas uncertainty



=



More Defects Reported

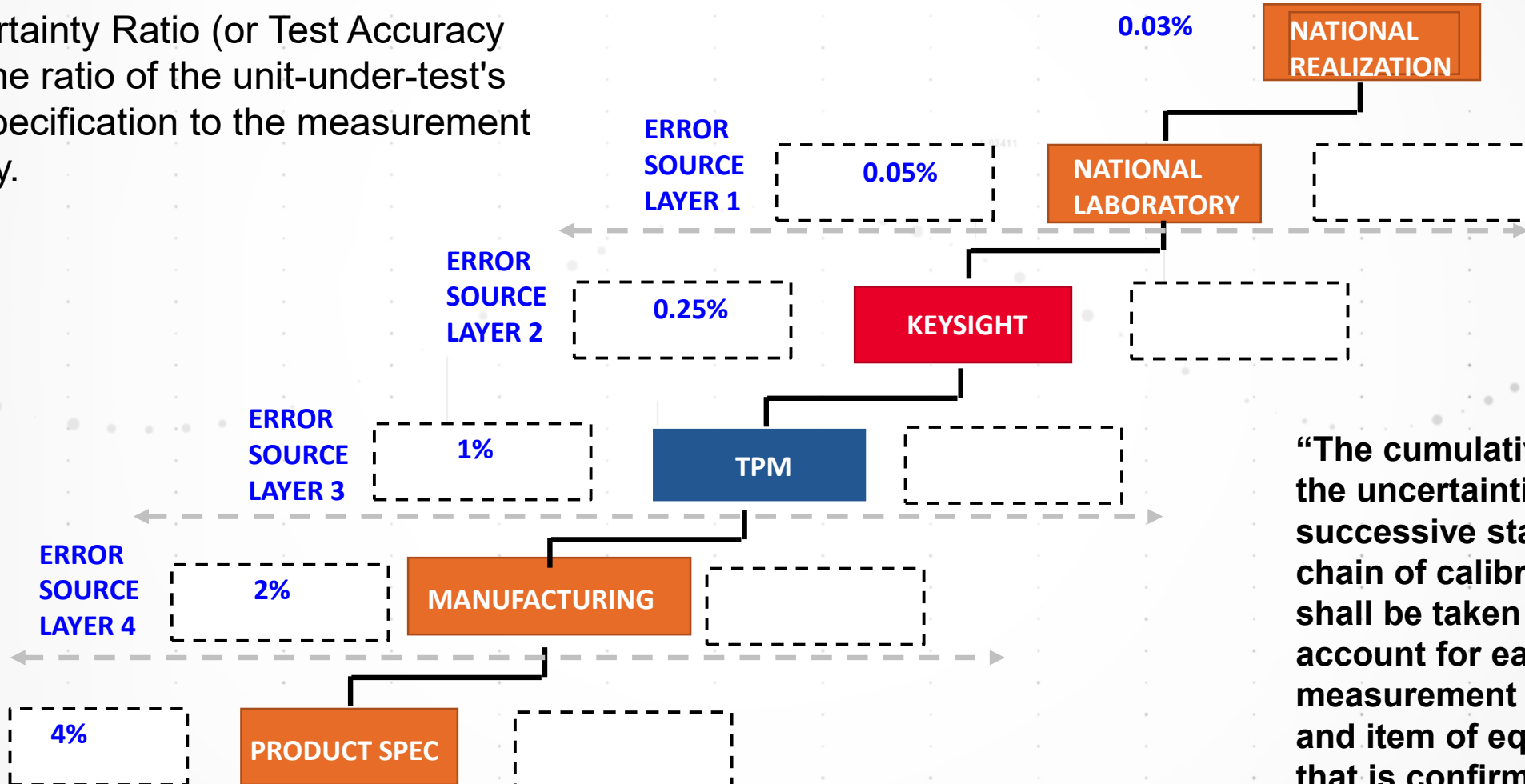




# Measurement Traceability Chain Effects on Uncertainty

## THE POTENTIAL INACCURACY AT EACH LEVEL OF THE CHAIN

Test Uncertainty Ratio (or Test Accuracy Ratio) is the ratio of the unit-under-test's working specification to the measurement uncertainty.



“The cumulative effect of the uncertainties of each successive stage in a chain of calibrations shall be taken into account for each measurement standard and item of equipment that is confirmed.”



# ISO/TS16949 to IATF16949

WHAT DOES IT MEAN TO AUTOMOTIVE SUPPLIER

**More strict requirement comes to QMS for automotive supplier**



**ISO/TS16949 managed by ISO has been changed to IATF16949 managed by IATF**

**All TS sites to comply by Sep 14<sup>th</sup> 2018**

# Requirement for Calibration in IATF 16949:2016

## 7.1.5.2 : Measurement Traceability

### 7.1.5.2.1 : Calibration / Verification Records

Records of the calibration/verification activity for all gauges and measuring and test equipment (including employee-owned equipment relevant for measuring, customer-owned equipment , or on-site supplier-owned equipment.) needed to provide evidence of conformity to internal requirements, legislative and regulatory requirements, and customer-defined requirements shall be retained.

# Requirement for Calibration in IATF 16949:2016

## 7.1.5.3 : Laboratory Requirements

### 7.1.5.3.1 : Internal Laboratory (calibrate in your company)

The laboratory comply to requirements including – the capability to perform these services correctly, traceable to the relevant process standard;

Included in the quality management system documentation;

# Requirement for Calibration in IATF 16949:2016

## Summary of 7.1.5.3.2 : External Laboratory (calibration by vendor)

Basically it requires ISO/IEC 17025 accredited calibration:



- Calibrated by ISO/IEC 17025 authorized vendor
- Certification of Calibration needs accredited “logo”
- Accepted by the customer

\* When no qualified laboratory is available, calibration can be performed by the equipment original manufacturer (OEM calibration). *In such cases, the requirements listed in Section 7.1.5.3.1 must be met.*



# Is Accredited Cal and Standard Cal the Same?



Deliverables	Keysight Calibration	Accredited Calibration
Primary lab standards <sup>1</sup>		
Locally accredited		✓
Measurement guardband <sup>2</sup>		✓
Measurement uncertainties		✓
Adjustments <sup>3</sup>	✓	✓
As received data report	✓	✓
As shipped data report <sup>4</sup>	✓	✓
Calibration certificate	✓	✓
Sample calibration certificates		



# Requirement for Calibration in IATF 16949:2016

## 7.1.5.3 : Laboratory Requirements

### 7.1.5.3.2 : External Laboratory (calibration by vendor)

The laboratory shall be accredited to ISO/IEC 17025 or national equivalent; and calibration service in the scope of accreditation (certificate); The certificate of calibration shall include the mark of a national accreditation body. There shall be evidence that the external laboratory is acceptable to the customer.