



International Quality Assurance Forum

“Manufacturing Quality Assurance Guidelines”



Table 4. Elements of a QA guideline or “System”

- **Guideline element / Parts of review**
- **QA system:** Company-wide QA system/program including responsibility of each organization, document control, and Warranty return program
- **Materials qualification:** List of materials used in module fabrication; qualification program, process, criteria (properties tracked), and records for each of these materials
- **Process control:** Statistical process control and/or other process control system including: Calibration of sensors, change control, and log of data collected to support traceability
- **In-line testing:** List of measurements completed, frequency of these measurements, log of data collected



Table 4. Elements of a QA guideline or “System”

- **Traceability:** Documentation from ingot to module shipment; maintenance of records to trace future failures, ID marking of modules
- **Retest schedule:** Frequency of qualification or other module-level testing, log of data
- **Warranty return program:** Documentation of number of returns, identified failures, and corrective actions
- **Factory inspection procedure:** Frequency of inspection, fraction of manufacturing lines inspected, and evaluation criteria
- **Audit:** Internal/external audit program including factory audit procedures and retest of qualified product.



Additional Quality Management System “Elements”

- **Quality Policy:** Establish a Company “**Quality Policy**”, what the company stands for, values, etc.
- **Quality Manual:** Establish a “**Quality Manual**” that Describes;
 - How the company works / organized
 - Documentation system
 - Document control / configuration control
 - Design control, release system
 - Calibration control
 - From “hand tools” to final test simulators
 - Training / qualification of employees
 - Who is qualified to do what task?



“The Creation of a Solar Module”

Concept / Design

- Get samples
- Graphics
- Sketches

Prototype

- Drawings
- Material bids
- Eng. Build
- Test

Pre-release

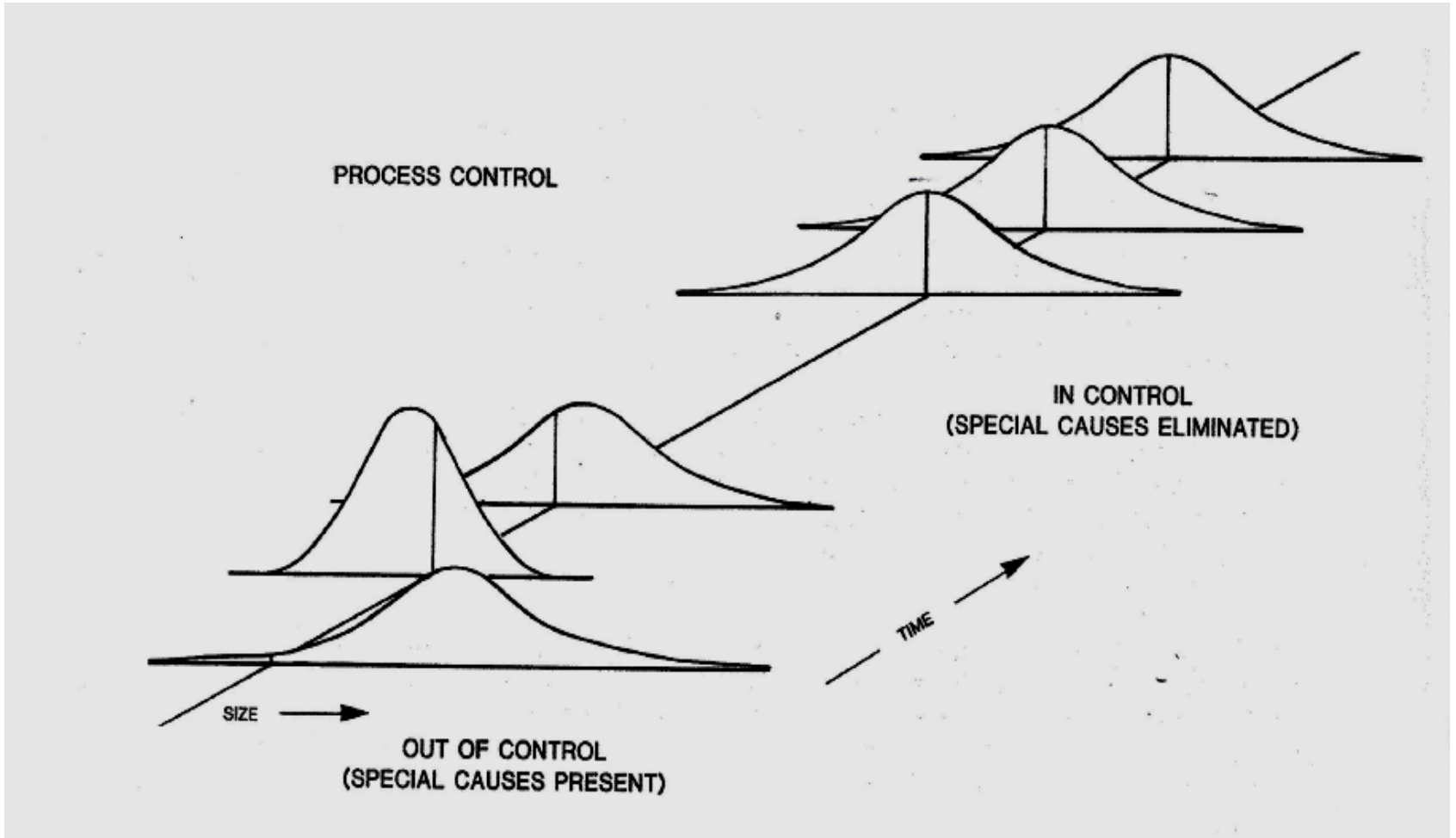
- Establish BOM's and Drawings
- Establish Tooling
- Make small runs or lots
- Test, send samples to Labs for Certification

Production

- Formal release all drawings, parts, etc.
- Make changes as required
- Achieve certs.
 - Qualification / Performance
 - Safety
- Manufacture the module!



Example of Process Control





“The MFG Journey of a Solar Module”

Purchased Materials

- Specifications required to buy
- Establish incoming Monitoring Techniques
- Establish Supplier Agreements

Warehouse / Staging

- Protect the incoming supplies
- Storage temperatures
- Inventory “turns” & Shelf Life

Production Processes

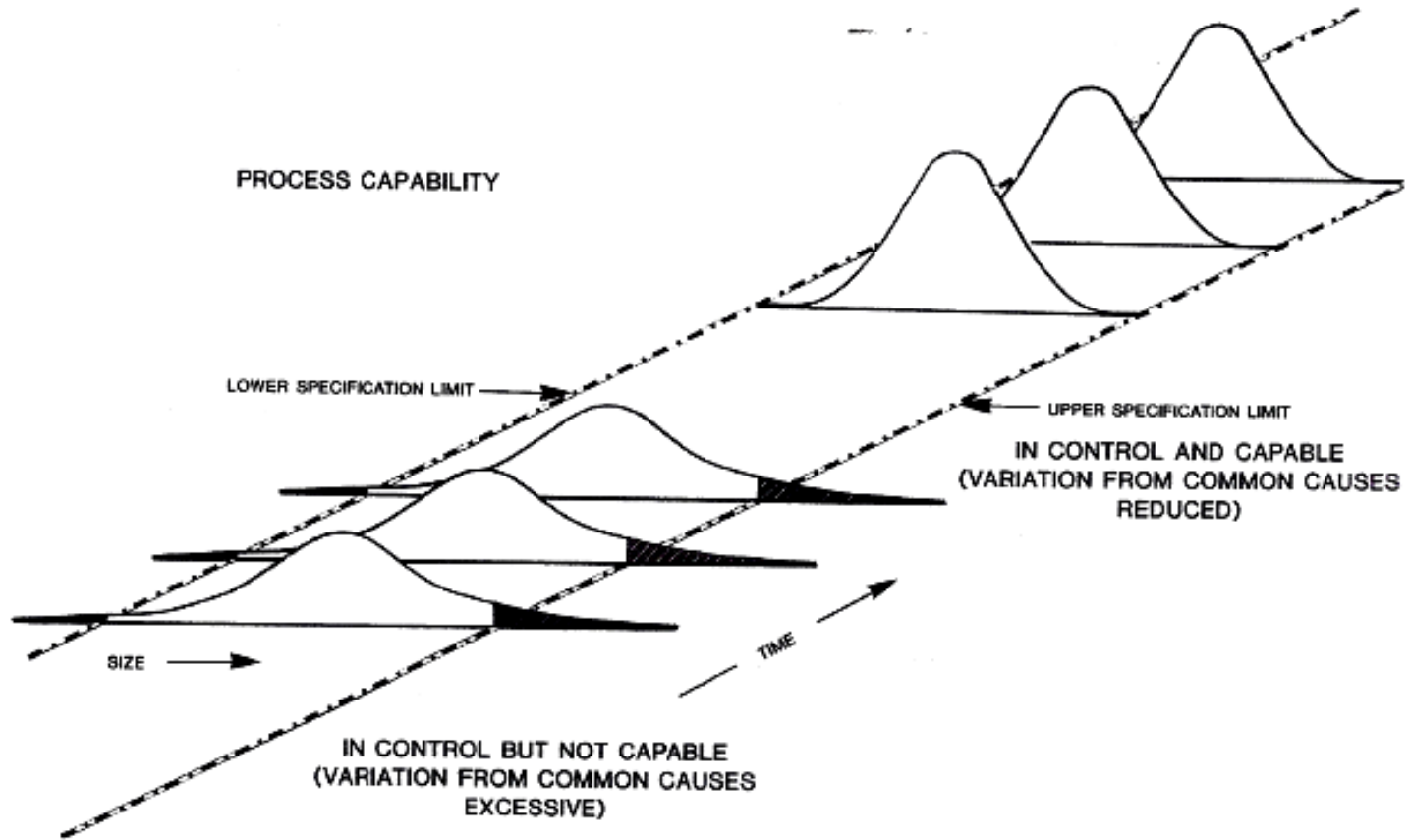
- Establish Work Instructions, SOP's
- Assemble Strings of Cells
- “Lay up” glass, EVA, Strings, Buss bars, EVA, Back Sheets & Laminate
- Attach Junction Box /Cap, Frame, continuity / Hi Pot

Test and Shipping

- Flash Test,
- Label
- Packaging
- Ship



Example of Process Capability





Where do we focus?

- **Approximately 95% of a Module's costs is in purchased materials**
- **Variation in the incoming materials significantly affect Reliability and mfg. efficiency**
- ***"Variation Costs you Money"***



Purchased Materials

- Purchased Materials
 - Specifications needed to buy
 - Establish Supplier Agreements
 - Process Capability
 - Notification of changes
 - Packaging,
 - Automation compatibility
 - “Shelf life”
 - Establish incoming Monitoring Techniques
 - Sampling, Testing, “Certification of Compliance” etc.



Purchased Materials

- Cells
- Glass
- Junction Box / Cap, cables
- Frames
- EVA
- Backsheet
- Interconnect Ribbon
- Buss Bars
- Solder, Flux, Paste, etc.
- RTV
- Tape

- All of these materials over my 17 years of solar Module manufacturing have stopped production or caused serious reliability or performance risks!

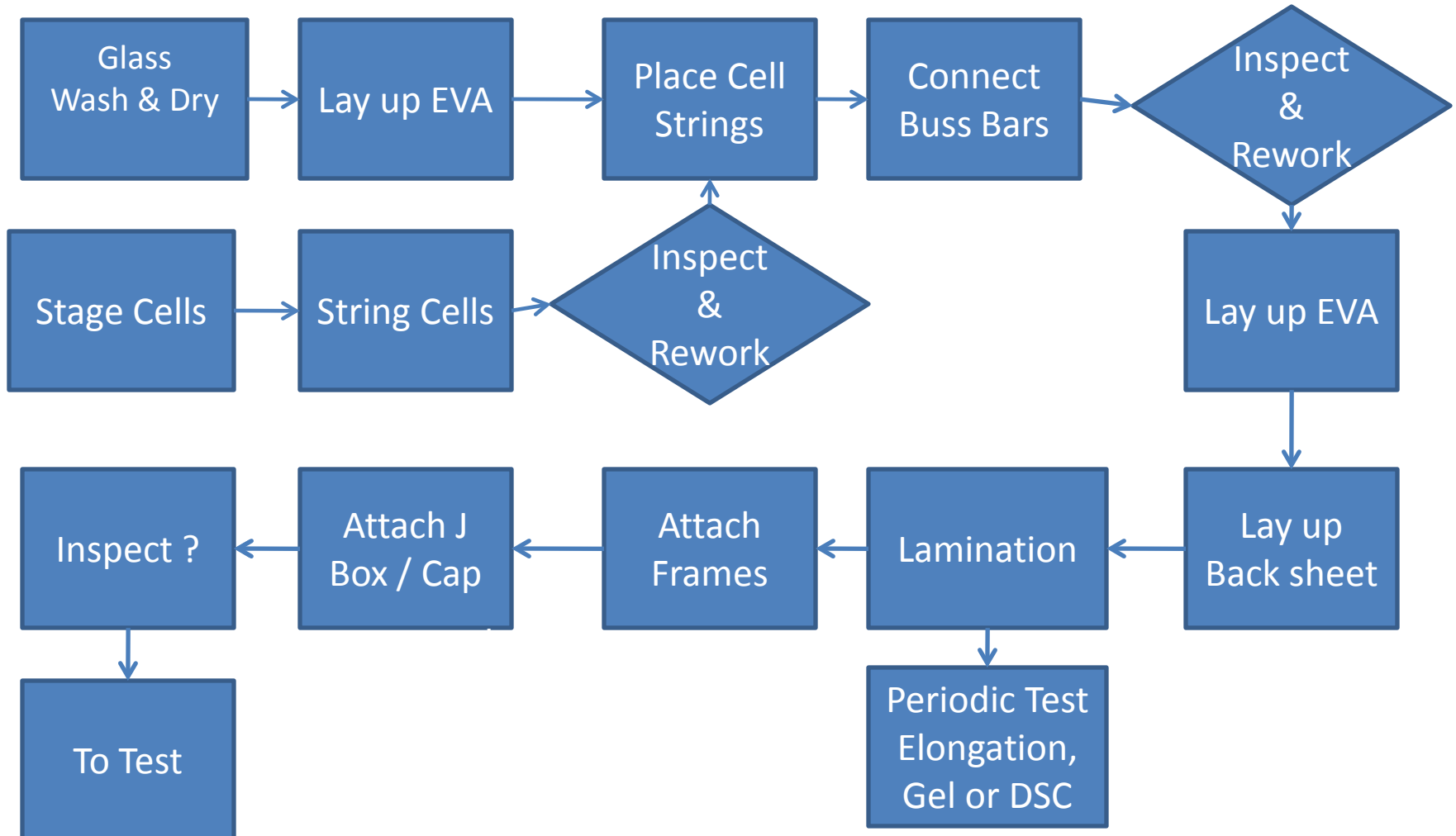


Warehouse / Staging

- Warehousing task is to:
 - Receive, store & distribute materials & consumables
 - Maintain **First In, First Out, FIFO**
 - Protect materials from harm, moisture, dust, heat etc.
 - Assure Date Codes are current and consumable
- Staging Task is to:
 - Break down shipments and stage for the daily / weekly / monthly / demand

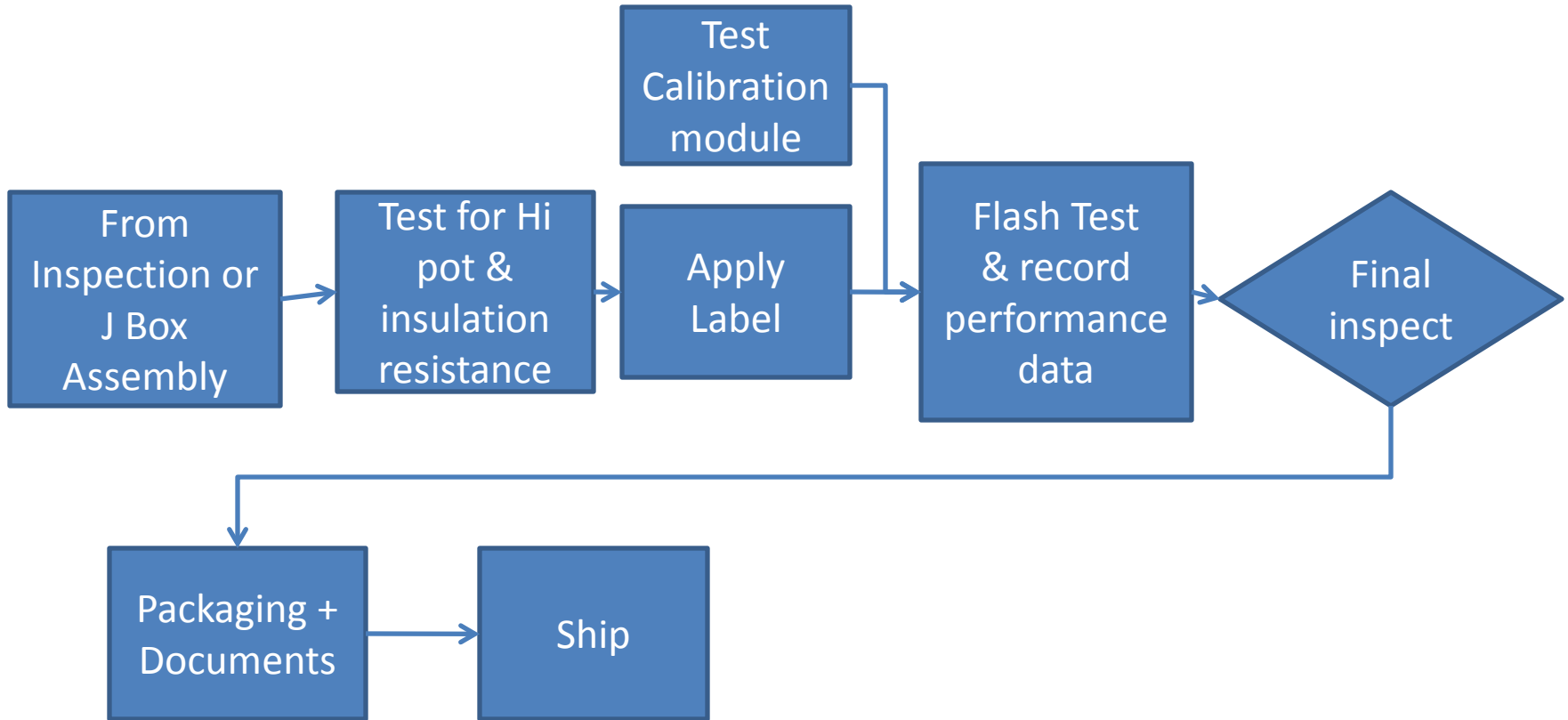


Production Process





Test & Shipping





Addition Monitoring / Reliability Testing

- Ongoing test and evaluation system
 - Continuously test samples of outgoing product
 - Frequently test samples of incoming material & / or proposed new material
 - Constantly monitor customer returns & feedback for clues
- Establishment of warranty reserves based on field data.



How does the “Manufacturing Quality Assurance Methods or Guidelines” apply?

- ✓ Check the Quality System;
 - ✓ Quality Policy
 - ✓ Statement of Company Commitment, beliefs, goals etc.
 - ✓ Quality manual
 - ✓ Organization relationships
 - ✓ Documentation system, release requirements, etc.
 - ✓ Registration, ISO?, IECEE? Etc.
 - ✓ Calibration
 - ✓ Critical task Training
 - ✓ Supplier management

- ✓ Check Warranty behaviors
 - ✓ Reserves
 - ✓ How to use, etc.
 - ✓ Details and caveats



How does the “Manufacturing Quality Assurance Methods or Guidelines” apply?

- ✓ Control of Suppliers
 - ✓ Notification requirements of changes to their product
 - ✓ Procurement Specifications
 - ✓ Supplier for their supplier agreements
 - ✓ Establishment of “Certification of compliance” usage



How does the “Manufacturing Quality Assurance Methods or Guidelines” apply?

- ✓ Control of Processes (examples)
 - ✓ EVA in lamination process, elongation test, Gel test, DFC “calorimetry”
 - ✓ Glass in handling, storage, and consistency, transmissivity
 - ✓ Backsheet integrity for protection, safety etc.
 - ✓ Junction Boxes or connection schemes for connectivity, welds, solder, etc.
 - ✓ Preventative Maintenance system,
 - ✓ tracking, periods between actions
 - ✓ frequency of replacement of consumables, i.e. tips, suction cups, “pogo pins” etc.



“Manufacturing Quality Assurance Guidelines”

- **In Summary;**
 - The Industry as a whole needs to recognize the whole system (Quality / Business System) and educate the public.
 - The Consumers (Big or Small) need to Demand the publication of lists of “certified companies” that supply under the ISO and IEC requirements etc.
(IEC 61215, IEC 61730 1&2, “Quality Management system” ISO 9000-2008)
 - **For it is the Total Quality System that Consistently delivers the “Goods”.**



Thank you for your
attention and patience
Questions?