Critical Process Training by Mfg. Engineers for Assemblers, Technicians, and Engineers

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Definition of Critical Process Training

Manufacturing Process Instructions in digital or hard copy form are often utilized by production assemblers to ensure that assemblies are completed as designed by company engineering teams. However, at least some of the content specifics of these documents are assumed to be "common knowledge" to the assemblers. **Critical Process Training is a highly valuable and necessary method of presentation that fills in process instruction gaps, expands the knowledge of these "students", (which can also include technicians and engineers) and pulls background knowledge into the present.**

Planning your training class

The best time to train is almost always during the morning hours. The last thing you want to see is one or more sleeping/inattentive students.

One of the best mood enhancers for your students is a morning snack. Most company managers will support your scheduling of delivery of at least muffins and bottled water.

If possible, arrange or have arranged tables so that the seated attendees can enjoy their snack. A table will also come in handy for test-taking after your presentation.

The W Questions: Upfront information for your audience

Your training presentation will be to and for adults, so background explanations (to some extent), I believe, is absolutely necessary.

Here are questions I answer at the beginning of my training presentations.

- Why is this necessary?
- Who will benefit from this training?
- When (how often) will it occur?
- Where will it occur?
- Will there be a test?

Safety is Numero Uno!

This type of slide should be mandatory.
Yes, many companies have safety videos that are periodically shown to all employees, but due to time limitations, your list should include only those topics that tie into your choice of critical processes.

Example:

First and Foremost.....Safety

- ☑ Cleaning agents
- ☑ Bonding agents
- ☑ Soldering
- ☑ Moving assemblies and large parts
- ☑ Safety notations in MPIs and MTIs

Safety Notations

Safety notations are often included at the beginning of manufacturing process instructions, but few assemblers review/memorize them. That's where you and your training come into the picture.

Example of common notations:

Know these notations!

Your assembly procedures use specific notations to call attention to conditions which could result in injury, damage to the equipment, or require special attention.

A Danger describes an **imminently hazardous** situation which, if not avoided, will result in death or serious injury.

A Warning describes an operating or maintenance procedure, practice, condition, or statement that, if not strictly observed, could result in **injury or loss of life**.

A Caution describes an operation or procedure or statement that, if not strictly observed, could result in **damage to or destruction of the equipment, or minor or moderate injury**.

A Note describes an essential operating or maintenance procedure, condition, or statement that **requires special attention**.

Human Error on the Manufacturing Floor

- 80% of human error is caused by human factors in systems. (any aspect of the workplace or job implementation that makes it more likely for the worker to make an error)
- 20% of human error is caused by assembler internal issues* that may be a result of outside-of-work events and/or conditions.
- We'll be focusing on the largest cause of errors.

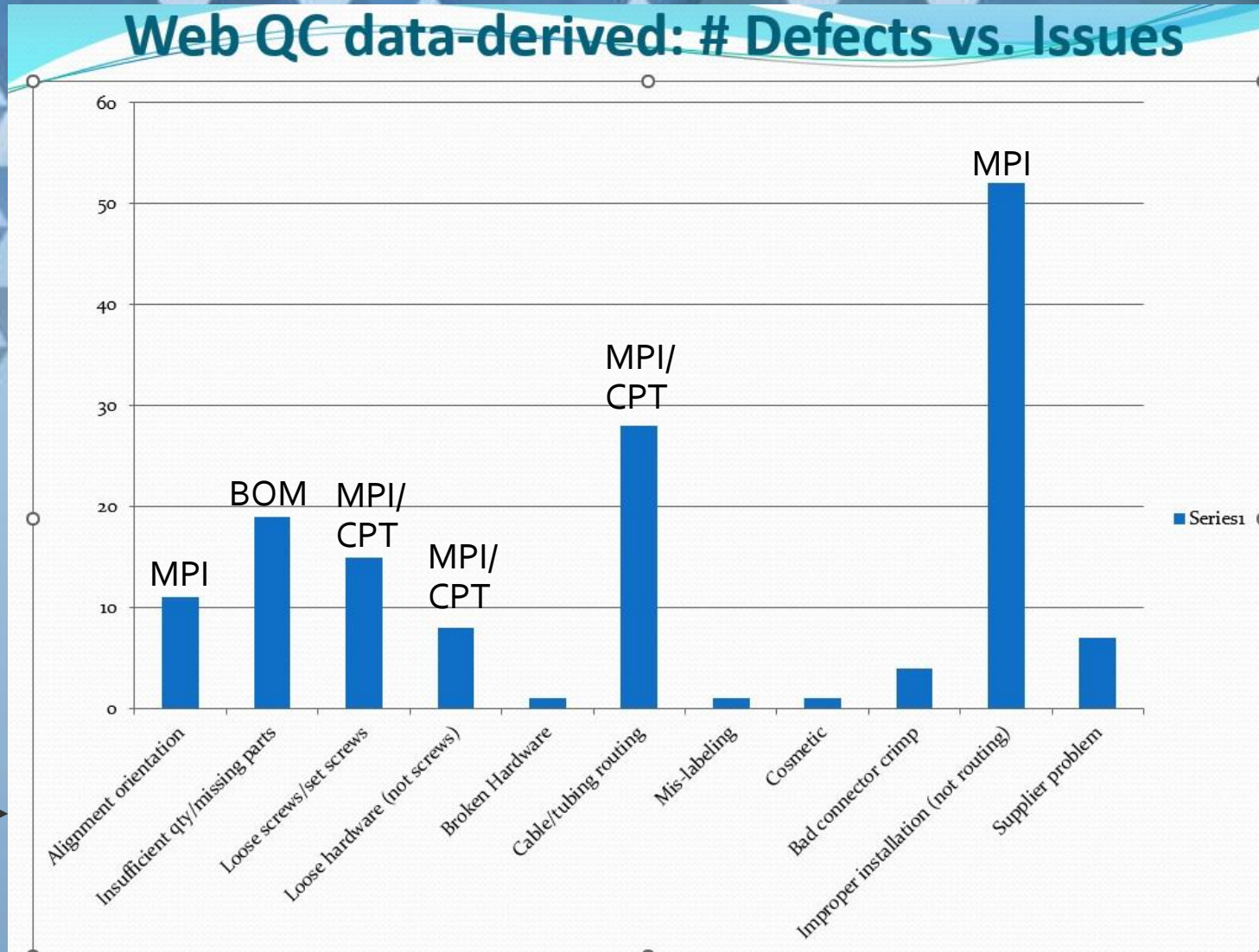
* Internal issues may include an inability to focus on and retain information, tardiness, or nearby distractions not caused by management.

Criticality of Processes

1. Create a list of processes and techniques that are common, yet critical to the quality of your company's products.

   1.1 Some companies collect data related to causes of assembly failures. Check with your Quality department regarding MRB (Material Review Board) data.

Example:



Criticality of Processes-2

2. Review manufacturing process instructions for gaps that may lead to quality issues, even those that were not captured in data.

3. Query production supervisors and assemblers about what feel are the core causes of problems during assembly.

   This is not a "who's to blame?" exercise; it is more of a gap/deficiency-finding quest.

4. Take a look at what you've uncovered and feel free to add your own topics.

5. Now open a company template/blank Powerpoint presentation and dig into information that is rarely taught, yet is so very important to know.
   5.1. Include plenty of photos and other images. And don't be afraid to brighten slide changes……

Example Number 1: Hardware

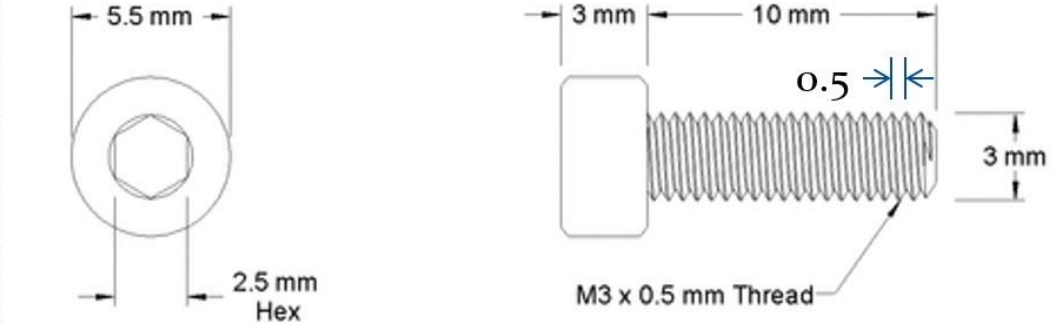
Many of us take hardware knowledge for granted, yet catching hardware mismatches during assembly can prevent problems for the end user of the product. Example:

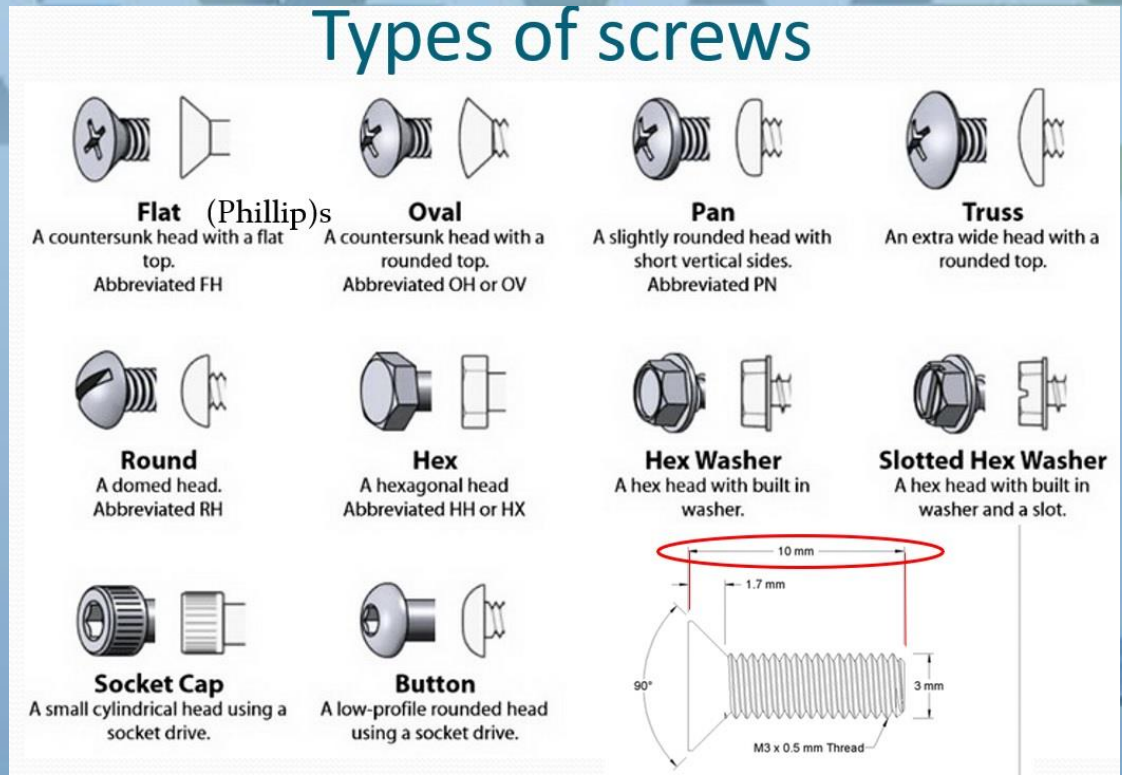
Socket Head Cap Screw (SHC)

Example: M3x0.5 x 10

BOM callout: SCREW, M3X10, SHC

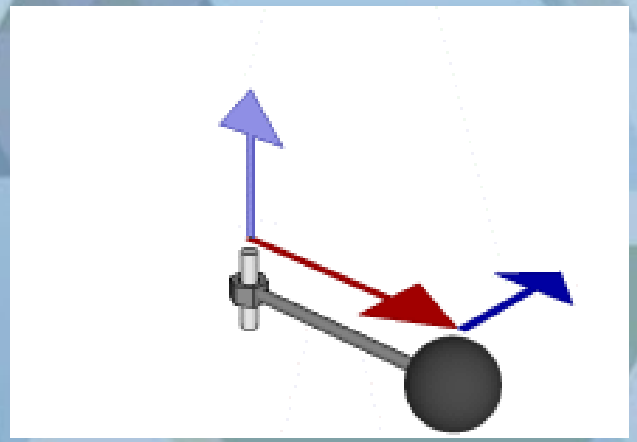
Part number: 6503001008





Example Number 2: Hardware Torque

Add imagery to definitions and briefly discuss how accurate torque may be compromised when using certain types of torque wrenches. Understand the limitations of your torque wrenches.



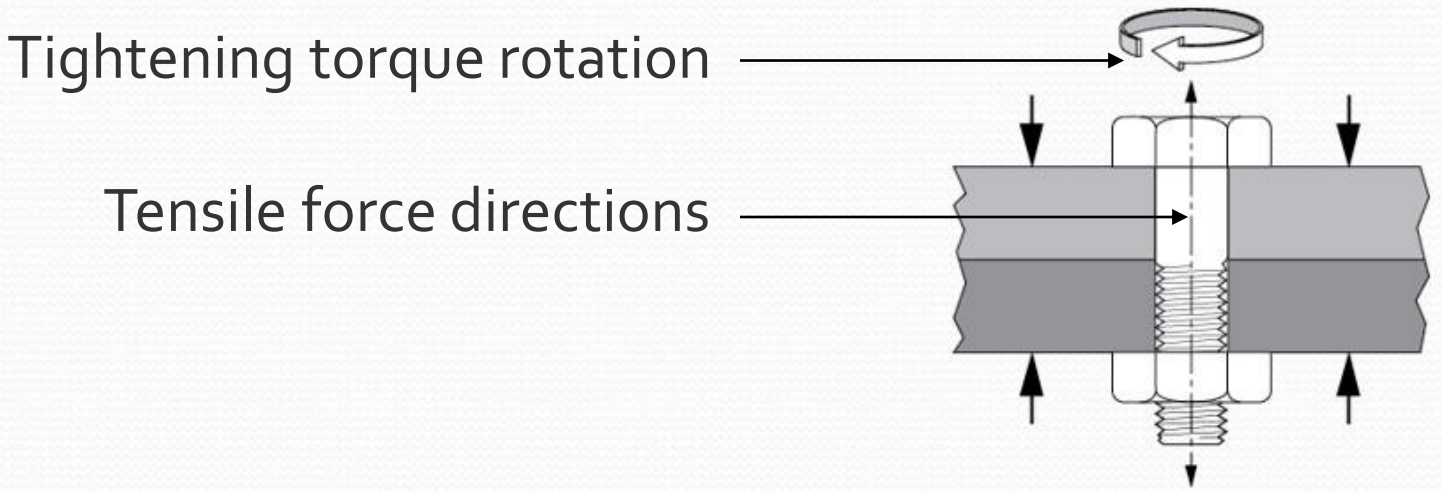
Torque = Force x Distance

Mountz Cam-Over torque wrench

Example 3: Why is a thread-locking compound and accurate torque often necessary?

Why do we have to torque AND apply Loctite to most screws and nuts?

1. The correct application of torque results in a pulling (tensile) force to the screw threads, which keeps the clamped parts under compression.



2. Loctite, after curing, increases the friction that would be required to be exceeded to loosen the screw.

Example 4: Thread-locking (anti-loosening compounds)

Fill Gaps

Loctite® threadlockers are single-component adhesives that cure in the absence of air and in contact with active metal to form a tough thermoset plastic. They completely fill all voids between the interfacing threads, which makes the assembly a unitized component and ultimately prevents loosening.

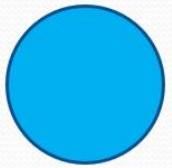
Loctite® threadlocker between the interfacing threads

- Screws that are M5 (or 10-32) or smaller

Pink Loctite 222 or 222MS

- Screws that are M6 (or 1/4-inch) to M20 (3/4-inch)

Blue Loctite 242



Blue Loctite 425
For non-metallic hardware or metallic hardware that may contact plastic components

Other possible content

Title	Details
Screw and nut torque marking	Provides visual affirmation for Test/Field service technicians and customers
Ground wire hardware stacking	Sequence of lock, star, flat washers, and nuts when installing screws
Ground wire electrical conduction	Warning that thread locking compound should never be used.
Static electricity dissipation	Wrist strap and earth ground connections, foot strap routing, handling of PCAs
Pipe thread sealing	Liquid or dry, wrap orientation, application/seating of dry tape, grade of tape
Pipe and straight thread sizes	Dimensions and size designations
Optical and vision sensors	Brief explanation of operation, setup and calibration
Linear rails and carriages/runner blocks	Reference features, alignment, cleaning, lubrication
O-rings and gaskets	Materials/applications, lubrication and fastener torque sequence
Adhesives, encapsulants, and sealants, molding materials and techniques	Surface preparation and assembly considerations
Dowel pin installation	Types of fits, tools, bonding agents

Utilizing active 3D models as visual aids

You can insert exported 3D component and assembly models that can be manipulated to position as needed.

Powerpoint 3D Model
Insert > 3D Models

.stl or .obj export from CAD program

File extension	Description
.fbx	Filmbox Format
.obj	Object Format
.3mf	3D Manufacturing
.ply	Polygon Format
.stl	StereoLithography Format
.glb	Binary GL Transmission Format

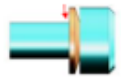
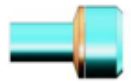
Testing your students

Knowledge of an impending test encourages trainee focus on audio and visual training material.

Manufacturing Workmanship Standards Test

Instructor Dave Sulli	Empl. Name
Score	Dept. #
Date	Superv.

Carefully read each question and then circle the letter that corresponds to the best answer.

1. When paint-marking a screw, what color marking is used by subassembly and assembly personnel?
   a. Red
   b. White
   c. Blue
2. When using serrated Bellville washers, which position against the screw is correct?
   a. 
   b. 
   c. It doesn't matter
3. Which Loctite thread locking compound is used on screw threads M5 (or #10) and smaller?
   a. 242 - blue
   b. 425 - light blue
   c. 222 or 222MS - pink

Follow up

After all tests are received from one or more groups, I would mark any that are incorrect and circle in red the correct answer. If the class were held for assemblers, bring the corrected tests to the supervisor(s) of the their department(s).

Rewards and periodic changing of tests

Regarding testing of assemblers, consider giving anyone who received a grade of 100%, a reward. I determined the number and type of rewards after the test results were known. One each of the die-cast car shown was given to race enthusiasts and reward recipients.

Every so often, the test questions should be changed. You can always revert back to previous tests as current test grades improve to a predetermined level.

Thanks for attending!

This presentation was designed so that it can be used as a guide when creating your own training presentation.

If you would like a copy in pdf format, or if have any questions, feel free to contact me at:

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dsulli@conceptualpolymer.com
...or connect with me on LinkedIn (David Sulli)

If we have remaining time, please enter your questions in the comments window.