



Threaded Fastener Process Specification  
Global Common

SD-1047

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## Purpose

To define global guidelines and requirements that will provide a common and consistent process for Manufacturing Engineering in all Nexteer locations.

## 1. Scope

The intent of this specification is to drive global standardization for the process and requirements related to threaded fasteners. This document is also meant to be a baseline for process development and source of information to be included in purchase specifications.

## 2. Process

The goal of the fastening process is to achieve clamp load to hold parts together. **The standard Nexteer process for threaded fasteners is to use an electric screwdriver with the capability to report torque and angle using a transducer and angle encoder.** The electric screwdriver shall be able to monitor the final angle and rundown angle while the fastener is driven to a torque specified by the assembly print. The specified torque limits shall be determined by the product engineering team through “Strip and Seat studies” and reflected on the assembly print. While continuously controlling the torque value, the final angle shall be used to verify the fastener is properly seated and was not stripped. Rundown angle shall be used to verify that the fastener is not cross threaded, and that an incorrect fastener was not mixed into the process.

Failure Mode	Quality Control Methods (Select appropriate method(s) for your operation)
Missing Screw(s)	<ol style="list-style-type: none"> <li>1. Position / Location Arm Sensor</li> <li>2. Sequence / Controls</li> <li>3. Final Torque and Final Angle</li> <li>4. Screw Sensor (Feeder Applications)</li> </ol>
Incorrect Location / Sequence	<ol style="list-style-type: none"> <li>1. Position / Location Arm Sensor</li> <li>2. Sequence / Controls</li> <li>3. Final Torque and Final Angle</li> <li>4. Hard Fixture Blocks</li> </ol>
Incorrect Screw	<ol style="list-style-type: none"> <li>1. Rundown Angle</li> <li>2. Final Torque and Final Angle</li> </ol>
Stripped Screw	<ol style="list-style-type: none"> <li>1. Final Torque and Final Angle</li> </ol>
Cross Threaded Screw	<ol style="list-style-type: none"> <li>1. Rundown Angle</li> </ol>
Screw Broken / Damaged	Final Torque Min/Max
Screw NOT Seated	Rundown Angle

Figure 1: Failure Mode Reference Table

## 2.1 Static vs. Dynamic Torque

There are two different methods of setting torque for a threaded fastener joint. The first is Dynamic Torque and is typically measured using an electronic screwdriver with transducer feedback to measure the torque on the fastener while assembling the joint. The second is Static Torque and is typically measured using a handheld torque wrench after the joint has been assembled to induce a minimal clockwise rotation to set the final torque. It is important to note, if static torque is used for production or auditing of production refer to Section 8 of this document. The best practice is dynamic torque, it is the most accurate and efficient method for threaded fasteners. Dynamic torque allows the electronic screwdrivers to set the appropriate torque without the need for a secondary action to set the torque with a manual tool. All specifications should use dynamic torque as the standard to provide for the best joint control and most robust process. If static torque is specified on the assembly print, a study shall be conducted between the Manufacturing and Product Engineering teams to convert the static torque requirement to a dynamic torque that can be used in the assembly process.

## 2.2 Fastener Types

- **Machine Screws** are typically used to fasten parts together with clearance holes and a threaded hole in the lower part.
- **Self-Tapping Screw**, screws a tapped hole while fastening parts together. These screws are typically used to fasten parts with clearance holes and a sized hole in the lower part.
- **Self-Drilling screws** have a drill bit tip that drills and taps a hole while fastening parts together. These screws are typically used to fasten parts without the need for a pilot hole.

## 2.3 Connection Types

This is the condition that exists between the fastener / mating surface and the relationship between the surfaces that the clamp load is being applied to. To determine the joint connection type, the characteristic shall be considered to ensure consistent information is collected by the program. There are 3 connection types: hard, soft, and natural.

- **Hard Connections** typically occur when both parts that the clamp load is being applied to are metal with no material between them. This results with an angle of less than 30° between 10% of the Target Torque and the Target Angle.
- **Soft Connections** typically occur when one or both parts that the clamp load is being applied to are metal or plastic with grease / sealant between them. This results with an angle of greater than 720° between 10% of the Target Torque and the Target Angle.
- **Neutral Connections** typically occur when one or both parts that the clamp load is being applied to are metal or plastic with no material between them. This results with an angle of between 30° and 720° between 10% of the Target Torque and the Target Angle.

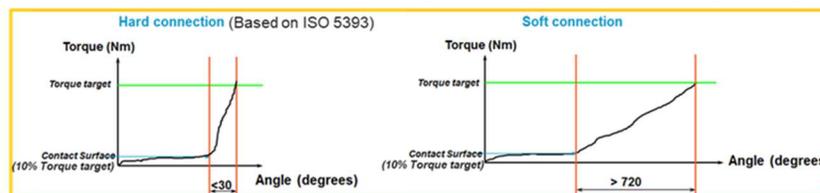


Figure 2: Fastener Connection

### 3. Programing

The following are general guidelines to start programming electronic screwdrivers. All programs SHALL be validated considering all programable variables to optimize process capability and cycle time.

This section is intended to describe the basic strategy programs and parameters within the programs. There are processes that use specialized programs specifically designed for that process, for those programs reference the SMD/PMD within TcM.

To avoid conflicting settings, fastening settings shall only be programmed in the software or controller. This will limit the potential tampering of unauthorized employees through the controller and or HMI. The use of the software allows engineers with knowledge of the device to adjust settings without the need to alter the PLC logic.

The HMI shall at minimum display the Torque / Angle outputs, product limits per the assembly print and process limits. This data can be extracted from the device's controller but shall not be editable on the HMI.

#### 3.1 Strategy

- **Torque Control / Angle Monitor** – This is the strategy that is used most often when driving threaded fasteners. When a setting is “controlled” it means it is the target. This is typically set to the just below the mid-point between the upper and lower limits for torquing. The program is continuously evaluating the torque during fastening and will halt when the target is achieved. The actual torque reading may be slightly higher than the target torque, this is overshoot. Overshoot is the increase in torque that occurs during the time it takes the tool to stop after reaching the target value. The magnitude of overshoot depends on the speed of the driver and lubricity friction of the parts. To optimize the capability study results, the target value and / or the speed may need to be adjusted.

When a setting is “monitored” it means that it is continuously being evaluated by the program. When the program reaches the target value, the monitored setting is evaluated to the upper and lower limits of the monitored setting. If the result of the monitored value is within the limits it will pass, if the value is outside the limits it will fail.

Torque is typically specified on the assembly print because it directly relates to clamp load. To achieve the assembly design intent, the program needs to control torque throughout the cycle. The angle measurement is monitored to verify the correct fastener is used, cross threading and stripped fasteners do not occur, fasteners do not become damaged or broken, and that the fastener is fully seated after the correct torque has been achieved.

- **Two Stage (Quick Step Version)** – This strategy is best used when “Joint Relaxation or Creep” happen while fastening, especially when softer materials are present in the joint which causes the joint to relax.

Therefore, using a two-stage program with a 100ms dwell (pause) when the clamping force / torque begins to steadily increase, helps reduce the effects of the joint relaxation.

The program begins with a high RPM (speed) to a specified value, either a torque or angle value can be used. When this value is achieved the device will dwell for the specified time. The program continues at a low RPM for the second stage to a target. This is typically set to the just below the mid-point between the upper and lower limits for torquing. The actual torque reading may be slightly higher than the target torque parameter, this can be a combination of speed and friction. To optimize the capability study results the target and / or the speed may need to be adjusted slightly. When the program reaches the target, the monitored setting is evaluated to the upper and lower limits. If the result of the monitored value is within the limits it will pass, if the value is outside the limits it will fail.

The “two-stage strategy” may also be referred to as “double hitting torque”.

- **Rundown Angle and Trace Start – Cycle Start** – This strategy is added to the beginning of a program. Rundown angle is used to verify that a fastener is not cross threaded and / or that the correct fastener is being used. Tightening traces (Torque vs Time, Torque vs Angle, and Angle vs Time graphs) are started from the cycle start. The cycle start value is a programable torque input that, when the driver detects, starts the programmed measurements and recordings. The cycle start is set to create consistent and repeatable results by ignoring the time between when the operator triggers the tool and before the fastener engages the joint.

### 3.2 Torque Parameters

- **Final Torque Minimum** (determined by assembly print or data) – Defines the minimum acceptable torque for the fastening process. The fastening process does not complete (unless cycle times expire) until the minimum acceptable torque is met.
- **Final Torque Target** (determined by assembly print or data) – Defines when the final target value (torque) is reached. The driver ceases advancing, and the fastening cycle finishes. This value is typically set to the just below the mid-point between the upper and lower limits typically to allow for variation in both the min and max direction without exceeding the specification limits.
- **Final Torque Maximum** (determined by assembly print or data) - Defines the maximum acceptable torque for the fastening process. The fastening process should be complete when the Final Torque Target is reached. In the chance that the torque exceeded, the process shall FAIL.
- **Cycle Start** – Defines when the driver detects the cycle start value, it begins collecting measurements data. This is used to create consistent and repeatable results by ignoring the time between when the operator triggers the tool and before the fastener engages the joint.
- **Shift Target** – Defines the torque value at which the driver speed changes between the first and second stage in a two-stage tightening program.
- **Cycle Complete** - Defines when the driver detects the cycle complete value, it stops collecting measurements data. This is used to consistently and repeatably stop measure torque and angle and record for traces.
- **Rundown Complete** – Defines the torque value when the rundown phase is complete. When the rundown is complete, the program ceases to measure the rundown angle.

- **Torque Peak** – Defines what point of the program the torque is measured. The torque peak setting gives the highest torque value during the tightening cycle and is used to ensure the torque limits are not exceeded after the target value (torque or angle) is reached due to overshoot.
- **Loosening Limit** – Defines the lower threshold for the program to consider a reverse cycle a valid loosening cycle. This is used ensuring the operator removes a fastener when the driver is triggered in reverse, if the limit is not exceeded the program shall send a fault signal. Adjustable from 0 to Tool max torque.

### 3.3 Angle Parameters

- **Final Angle Minimum** (determined by trial data and interpreting traces) – Defines the minimum acceptable angle for the fastening process from a given point during the process. At completion of the fastening process if the angle is below the set parameter it shall fail. The failure of this limit can be caused, but not limited by a defect in the joint (burr and debris or grease contamination) or a cross thread.
- **Target Angle** (determined by assembly print or data) – Defines when the final target value (angle) is reached. The driver ceases advancing, and the fastening cycle finishes. This value is typically set at the midpoint between the minimum and maximum limits to allow for variation in both the minimum and maximum direction without exceeding the specification limits. When a back off angle is required it is important to note that the target angle shall include additional travel to eliminate the lash in the tool and the bit. The lash can also be eliminated by increasing the cycle start value for the back off portion of the program.
- **Final Angle Maximum** (determined by trial data and interpreting traces) – Defines the maximum acceptable angle for the fastening process. The fastening process should be complete when the Final Target parameter is reached. In the chance that the angle exceeded this parameter, the process shall FAIL and the joint or fastener is believed to be stripped. If the final angle is above this limit, the value indicates that the fastener took an abnormal number of rotations to reach the target value (torque or angle). The failure of this limit can be caused by the fastener or joint stripping and the driver continuing to rotate the fastener forward without increasing clamping force. Eventually the stripped joint or fastener debris will bind the fastener and the Final Target will be reached, but when the program evaluates the final angle it will have exceeded this limit and send a fault / failed status.
- **Start Final Angle** (set equal or greater than "CYCLE START") - Defines when the driver begins collecting angle measurements data, when torque achieves this value. This is used to create consistent and repeatable results by starting the measurement from a consistent point in each fastening sequence. The final angle is used to verify that the fastener is properly seated and that the joint is not stripped.
- **Measure Angle to Torque Peak** - Defines at what point of the program the final angle is measured. The torque peak setting gives the final angle measurement at the highest torque value during the tightening cycle. The start point is always from the "START FINAL ANGLE" setting.
- **Rundown Angle Min** (determined by trial data and interpreting traces) - Defines the minimum acceptable angle for the rundown portion of the fastening sequence starting from the "CYCLE

START". At completion of the fastening process if the angle is below the set parameter it shall fail. If the result is below this limit the value indicates that the fastener reached completion at an abnormally early point of the fastening cycle. The failure of this parameter can be caused but not limited by a cross threaded fastener or an incorrect fastener with a shorter threaded shank.

- **Rundown Angle Max** (defined by trial data and interpreting traces) - Defines the Maximum acceptable angle for the entire fastening process from the "CYCLE START". At completion of the fastening process if the angle is above the set parameter it shall fail. If the result is above this limit, the value indicates that the fastener reached rundown completion at an abnormally late point of the fastening cycle. The failure of this parameter can be caused but not limited by an incorrect fastener with a longer threaded shank.

### 3.4 Speed and Acceleration Parameters

- **Starting Speed** (suggested start set point at 200 RPM) - Defines the tool speed during the start. The start speed is used to help get the fastener started in the joint before the driver speed increases to rundown speed.
- **Starting Speed Acceleration** (refer to MFG) - Defines the time that it will take to get to the programmed speed for the associated speed. This is used to accelerate the driver to help engage the fastener or help the fastener engage a pre-threaded mating hole to avoid cross threading. This is also used on self-tapping fasteners to help get started in the mating joint before the rapid rundown.
- **Rundown Speed** (suggested start set point at 200 RPM) - Defines the speed known as rundown speed. The primary use of this is to decrease cycle time by rapidly driving the fastener; from first engagement to just above the mating surface.
- **Rundown Speed Acceleration** (refer to MFG) - Defines the time that it will take to get to the programmed speed for the associated speed. This used to accelerate the driver as it transitions from Starting Speed to Rundown speed to avoid overshooting the transition point.
- **Tighten Speed** (suggested start set point at 50 RPM) - Defines the speed known as final speed or tighten speed. This speed is used to slow the driver down to allow time to accurately evaluate the target value and minimize overshoot of the target value.
- **Tighten Speed Acceleration** (refer to MFG) - Defines the time that it will take to get to the programmed speed for the associated speed. This is used to accelerate the driver as it transitions from Rundown Speed to Tighten Speed to avoid overshooting the control target.
- **Loosening Speed** (suggested start set point at 200 RPM) - Defines the speed know as loosening (reverse mode). The reverse mode is typically only used when there is a fault with the fastener cycle and the fastener needs to be removed from the assembly and discarded. To save cycle time loosening speed is generally set near the Rundown speed of the driver.
- **Loosening Acceleration** (refer to MFG) - Defines the time that it will take to get to the programmed speed for the associated speed. When loosening, the goal is typically to remove the fastener from the assembly as quick as possible, therefore a quick acceleration is used to get to the loosening speed.

### 3.5 Time Parameters

- **Tighten Time** (defined by trial data and interpreting traces) - Defines the time required for the torque level to stay below "Cycle Complete" before the tightening cycle is aborted (valid if the tool has not shut off prior to reaching cycle complete). The end time is used to ensure the torque does not raise above the cycle start value and then drops below the cycle complete value for an extended period before the control value is reached. If the program is consistently failing for this limit the cycle start value may be too low, or if a locking compound is being used on the fastener it may be creating inconsistencies.
- **Start Time** (defined by trial data and interpreting traces) - Defines the duration of the start speed. The start speed helps gives the operator a chance to properly align the driver and fastener to the joint and help engage the tool to the fastener before the driver ramps to the increased rundown speed. The timer is started from the moment that the tool trigger is pressed.
- **Tool Idle Time** (typically set 100ms multistage programs) - Defines the dwell time between a completed tightening cycle and a second tightening cycle. This allows the joint to relax and the tool time to reset speeds within multistage programs.
- **Cycle Abort Timer** (defined by trial data and interpreting traces) - This defines the overall time from when the device is activated to reach target. If the tool does not reach its target control value, this timer will shut off the driver. This value is helpful when automated tools are being used to abort the cycle if an issue arises that prevents the cycle from reaching the control value or if a fastener is completely stripped / unable to reach the control torque value.

## 4. Equipment Qualification / Documentation

### 4.1 Process Failure Mode Effects Analysis

PFMEA is a critical tool used by a cross-functional team that identifies and evaluates potential failures of a process. It helps to establish the impact of failures. It identifies and prioritizes action items with the goal of relieving risk. It is a living document that should be initiated prior to design of a process and maintained through the lifecycle of the equipment.

The PFMEA documents all potential failure modes and potential causes of each failure mode for the process. All failure detections shall be verified at design review and at qualification runs.

**Note:** New failure modes and or causes of failure may exist. Contact the PFMEA Coordinator to start the process of creating a specific PFMEA for your process / machine.

Refer to the Standard Machine Design (SMD) / Production Machine Design (PMD) for a starting PFMEA and or the e1ns template.

Reference PFMEA Form 07-1-5-F23 (X3441).

Reference Process Documentation (17-1-4-1)

### 4.2 Machine Qualification (MQ) Plan

The MQ Plan shall document the required characteristics that determine the PASS and FAIL criteria for the process / machine.

Reference the PFMEA when creating the MQ Plan to ensure all the detections are listed as evaluation and proper verifications can be performed during the qualification process.

Reference Process Documentation (17-1-4-1)

Refer to the Standard Machine Design (SMD) / Production Machine Design (PMD) for a starting MQ Plan.

- **Process Capability** – Please refer to SD-002 for Process Capability requirements.  
When Servo Fasteners are selected properly, they can drive fasteners to a specific target value (torque or angle) in which it is possible to control the process capability by adjusting the speed and target value.
- **Speed** – by increasing the speed the overshoot increases, which widens the capability distributions of the final value.
- **Target Value** – by studying the capability distribution and adjusting the value, the capability distribution can be balanced between the upper and lower limits of the process.  
**To ensure an efficient process for the manufacturing plant it is important to achieve a optimize balance between capability and cycle time.**
- **Torque Max & Min** – The maximum and minimum torque limits from the assembly print shall be included on the MQ Plan.

Linearity / Bias Study – determines whether the device is outputting accurately. The study checks how accurate the device outputs through the limits range and how the device is comparing to an external device.

A calibrated transducer with an encoder is used to verify the servo torque gun transducer and encoder, by driving fastener to a given values within the limit.

Reference AIAG MSA document to perform a Linearity and Bias Study.

Reference the SMD/PMD for MQ Plan.

- **Angle Max & Min** – The maximum and minimum angle is process driven limit; it is determined from collecting and evaluating data. The data that is collected to be included on the MQ Plan on the Data Tab.

**After each stage of the of the MQ process the angle data is evaluated and the limits are adjusted to suit the data collected.**

Linearity / Bias Study – determines whether the device is outputting accurately. The study checks how accurate the device outputs through the limits range and how the device is comparing to an external device.

A calibrated transducer with an encoder is used to verify the servo torque gun transducer and encoder, by driving fastener to a given values within the limit.

Reference AIAG MSA document to perform a Linearity and Bias Study.

Reference the SMD/PMD for MQ Plan.

- **Fully Seated** – When noted on the assembly print it must be on MQ Plan and it needs to be fully understood the intension of the Product Engineer. Fully seated can be difficult to detect 100% of the time with automated controls. The Product Engineer shall preform a Seat and Strip Study to ensure that the design / stack is correct.

Use MQ data collected and multiple over laying curves to demonstrate that a screw is fully seated. If this is inconclusive, a physical study may be needed. The type of physical study and quantity of parts will be at the discretion of the Manufacturing Engineer in charge.

- **Correct Position / Sequence** – When noted on the assembly print it must be on MQ Plan and it needs to be fully understood the intension of the Product Engineer. It is critical the sequence and pattern that multiple fasteners be set at in the same operation.

Machine controls that monitor the position and the sequence tracked. This shall be tested at qualification verifying that it cannot be defeated.

Reference the SMD/PMD for MQ Plan.

- **Breakaway & Removal Torque** – When noted on the assembly print it must be on MQ Plan and it needs to be fully understood the intensions of the Product Engineer. Destructive tests required for qualification using a calibrated variable tool with the ability to capture peak torques. The quantity of samples for the destructive test is determined by customer requirements; if customer requirements do not exist 30 samples are required for each qualification run.

Reference the SMD/PMD for MQ Plan.

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### 4.3 Machine Process Sheet (MPS)

The MPS shall document all the required program(s) and machine settings that affect the quality of the process. Program parameters should be recorded and stored in the MPS on the corresponding tab for the process for use if the backup is missing or unusable. Also, an electronic copy of the program will be uploaded to TcM at end of MQ2 that reflects the MPS. The MPS is the recovery for the recovery and there is no means to revert to the original program parameter.

All threaded fasteners that are rated 9 or 10 severity will be reviewed by a board led by the Subject Matter Expert.

This is not to replace 07-1-4-10 "G1172" Software Security and Disaster Recovery for Programmable Devices.

Reference Process Documentation (17-1-4-1)

Reference the SMD/PMD for MPS.

## 5. Quality Control / Documentation

### 5.1 Operator Control Plan (OCP)

The OCP shall document the required process controls that evaluate / measure the pass or fail criteria for the assembly process.

Reference 07-1-4-1 (G1100) Process Documentation

Reference 06-1-4-7 (G1331) Product Characteristics – QCL

Reference 07-1-5-F24 (X3453) OPC Form.

Reference the SMD/PMD for OCP.

### 5.2 Traceability

It is the responsibility of Manufacturing Engineering to specify the traceability system requirements to meet product and process requirements with input from Product Engineering, Industrial Engineering, Controls Engineering, Manufacturing IT, Quality, Operations, and Customer Requirements.

Reference SD-1052 (Machine Controls Traceability Interface)

Reference Traceability System Process Development (07-1-4-15)

Reference Traceability Input Document (07-1-5-F33)

Reference Traceability Audit Checklist (07-1-5-F34)

Reference the SMD/PMD for Trace Input Document

### 5.3 Reworking Fasteners

Reusing fasteners and the number of times a joint can be reworked is at the discretion of Product Engineering to ensure that the joint is not comprised by repeating assembly and disassembly. Product Engineering takes in account the joint material and mating feature condition when determining if the joint and or fastener can be reused.

Reference Reject Reconciliation Process (15-1-4-28)

When components can be reworked a reject bin with sensor(s) shall be provided to ensure that the rejected components are discarded and cannot be reused. The equipment controls shall verify that the rejected component has been placed in the reject bin before enabling the equipment to continue with the reprocessed cycle.

### 5.4 Contamination

Contaminates with threaded fasteners are foreign material other than the fastener itself, such as but not limited to grease, oil, water, metal chips, locking compound. These foreign materials affect the fastening process by causing variations in friction resulting in changes in final angle. With such changes joint clamp loads are affected and possible compromised.

## 6. Verification / Calibration

All equipment (covered by this specification) used in the assembly of production parts will be required to be calibrated. This process validates that the equipment is outputting the desired result necessary to assemble the product within specified parameters. This process will be documented via local procedures or work instructions. If the equipment is not outputting the desired result, adjustment(s) to the equipment must be made. The performance of the calibration process is conducted by Manufacturing Engineer, Maintenance or Quality (dependent on which area has primary responsibility for calibration/maintenance of the equipment).

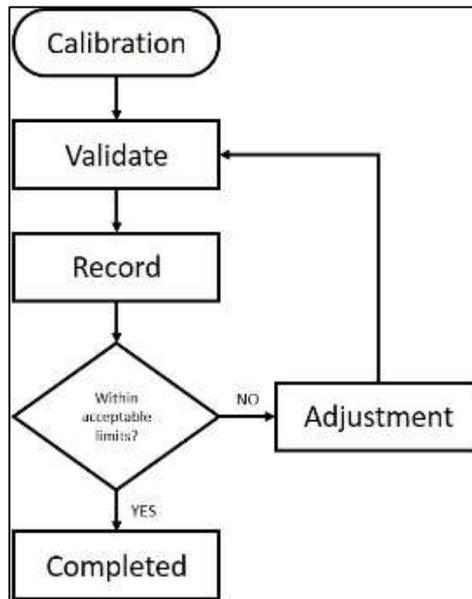


Figure 3: Calibration Flow Chart

### 6.1 Validate

This process shall also be documented on the Calibration Standard Work Instructions (SWI). Always refer to the SWI for Calibration process provided with the equipment and or Local Procedures supported by Quality documents. The manufacturing plant shall have the capability to verify equipment. Validation equipment includes but not limited to transducer / loadcell / etc. with digital-display and tooling / nests to fixture validation equipment for validate step.

The process of validating, at a minimum, shall be done by measuring the "Target Value" five times.

The values collected from the master device (md) and production device (pd) will be used to calculate the percent variation, % Difference = absolute value  $((pd - md)/md) * 100$ , average the results to have resulted percent variation.

- The allowable percent variation will take into consideration the devices guaranteed accuracy, mounted or free hand-held, program speed and the part severity. For manufactures accuracy, refer to certification provided with device.
- For part severity refer to the product specification.

The allowable variation, at a minimum, shall be:

- < 5%; accept
- 5% - 10%; rejected, adjustments need to be performed
- >10%; rejected, adjustments need to be performed, contact manufacture / certified service provider for further intervention needed, and connect local Quality Engineer to determine further actions

## 6.2 Records

Documenting the results of the Validate process is a key step in Calibration. This is the record that the equipment used in the assembly of production parts are tracked by Quality or other designated personal. This calibration tracking process will be documented via local procedures, work instructions, or recording document. Any calibration tracking process shall include but not limited to the following information for each calibration record:

- Date calibration completed and next calibration due date (or frequency).
- Unique identification of the equipment, each piece of measuring and test equipment
- Identification of person performing the calibration.
- Calibration results.
- Accept/Reject criteria (if not shown on SWI).
- Maintenance and calibration adjustments performed on the equipment.

## 6.3 Adjust

This process shall also be documented on the Calibration Standard Work Instructions (SWI). Always refer to the SWI for Calibration process provided with the equipment and or Local Procedures supported by Quality documents. It is highly recommended to follow the process provided by the equipment manufacturer for adjustments.

## 6.4 Frequency

Calibration frequency will be established by Quality and or Manufacturing Engineering. Criteria to be used in establishing frequency should include previous calibration history, criticality of the characteristic, manufacturer's recommendations, equipment environment is used in, etc. Calibration frequencies exceeding one year for active production must be justified / approved by Quality and Manufacturing Engineering.

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## 7. Error Proofing

Please refer to 15-1-4-14 "G1765" Error Proofing.

## 8. Process Verification

Is used in manufacturing to check equipment / process that are producing parts accordingly to product print parameters / requirements. The frequency will be established by Quality and or Manufacturing Engineering. Criteria to be used in establishing frequency should include but not limited to criticality of the characteristic that is being checked.

Example of a Process Verification

- Torque Verification can be done by using a "Click Wrench" set to the products lower parameter (MIN) and turning in the tightening direction while monitoring the angle (that the screw has not rotated) or using a Shim Gage to verify that there is no gap between screw head and surface.
- Programed limits can be checked by entering the device software in the appropriate location or either reviewing the most recent data in the Traceability Log or by the software "Process Data Monitor"

## RECORD OF REVISIONS

Revision No	Date	Section	Description
001	070C19	ALL	Initial Release
002	070C21	ALL	Formatting update. Added sections 6, 8, and 9. All other changes are highlighted
003	12MY22	ALL	Removed section 7 – Linearity. Formatting update. All other changes are highlighted
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