Servo Driven Pressing Systems

Global Manufacturing Process

SD-1048

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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 this operation. This document is to be used as a baseline for process development and source of information to be included in purchase specifications.

2. Process

The goal of the pressing process is to form material to a desired shape or assembling parts together. The standard Nexteer process for pressing is to use a servo powered press with the capability to report force and distance using but not limited to loadcells and distance encoders or lvdts. The servo press shall be able to monitor the final distance and rundown load while pressing to a force specified by the assembly print. The print requirements are set by Product Engineering by performing tolerance stack analysis.

Failure Mode	Cause of Failure Mode	Quality Control Methods *(select appropriate method(s) for your operation)*
Part Damaged during operation	1. Broken Tooling / Fixture 2. Worn Tooling / Fixture 3. Misaligned Tooling / Fixture / Part	Distance Monitoring Running Force
Pressed Short of Distance	1. Part Loaded Incorrect 2. Contamination 3. Cycle Interrupted 4. Misaligned Tooling / Fixture / Part 5. Program Parameter	Distance Monitoring Cycle Time Limit
Pressed Past of Distance	1. Contamination 2. Broken Tooling / Fixture 3. Worn Tooling / Fixture 4. Missing Tooling / Fixture 5. Program Parameter	Distance Monitoring
Low Press Load	1. Insufficient Part Interference	Final Force and Cycle Time Limit
High Press Load	1. Excessive Part Interference 2. Misaligned Tooling / Fixture 3. Worn Tooling / Fixture 4. Missing Tooling / Fixture 5. Contamination	Running Force Final Force
Part Fell Off Tooling during Operation	1. Insufficient Vacuum Pressure 2. Misaligned Tooling / Fixture	Part Sensor / Pressure Sensor Distance or Force
Improper radial orientation of components after press	1. Component dislodged from tooling during cycle 2. locating tooling not properly engaged 3. locators worn or broken	Part Sensor / Bar Code Reader Force and or Distance
Load cell drifted out of calibration	1. Load cell was not properly maintained or calibrated in a timely manner	Verification Checks

Figure 1: Failure Mode

2.1 Press Selection

Load – Selecting the correct load of a press is vital to a robust machine design. When selecting the press load capacity, consider the load parameters identified on the assembly print. Once the upper limit has been identified, the load force capacity should be 1.5x of the assembly print upper limit of load.

Stroke – Selecting the correct stroke of a press is as important as selecting load. When selecting the press stroke limit, the loading and unloading the part(s) must be taken in consideration. Also, the size of the part and direction of the pressing, wither the press needs to travel in the part.

Type of Press – Selecting the amount of control of the press, data acquisition and traceability needed. Typically, this dictates the type of press, mostly this will be a servo-controlled press. Servo presses can control speed, distance, and force. The standard Nexteer process for pressing is to use a servo powered press with the capability to report force and distance using but not limited to loadcells and distance encoders or lvdts.

The remainder of this specification will focus on the guidelines and requirements of pressing with servo control.

2.2 Press Basic Functions

A press should monitor at a minimum FORCE and DISTANCE, limits are determined based off the assembly print requirements set by Product Engineering.

When a press is selected properly, they can press parts together to a specific TARGET VALUE (force or distance) in which it is possible to control the process capability by adjusting the SPEED and TARGET VALUE.

Method of pressing, i.e. pressing to a force, a distance, rate of change or delta will be determined by the engineer in charge based on the application. Force should be monitored through the whole press sequence and overload limits should be set to protect the part and tooling from damage.

3. Programming

These are general guidelines to start programming servo press, 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 or as defined in the T-Spec.

To avoid conflicting settings, pressing 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 Force / Distance outputs, product limits per the assembly print and process limits. This data can be extracted from the device's controller, but they shall not be editable on the HMI.

3.1 Creating New Programs

When creating a new pressing program, it is best to understand how the parts are reacting to the pressing process. During the initial press, pressing at a slow constant SPEED (< 5mm/s) is key. Review the graph and use the following characteristics to build the program.

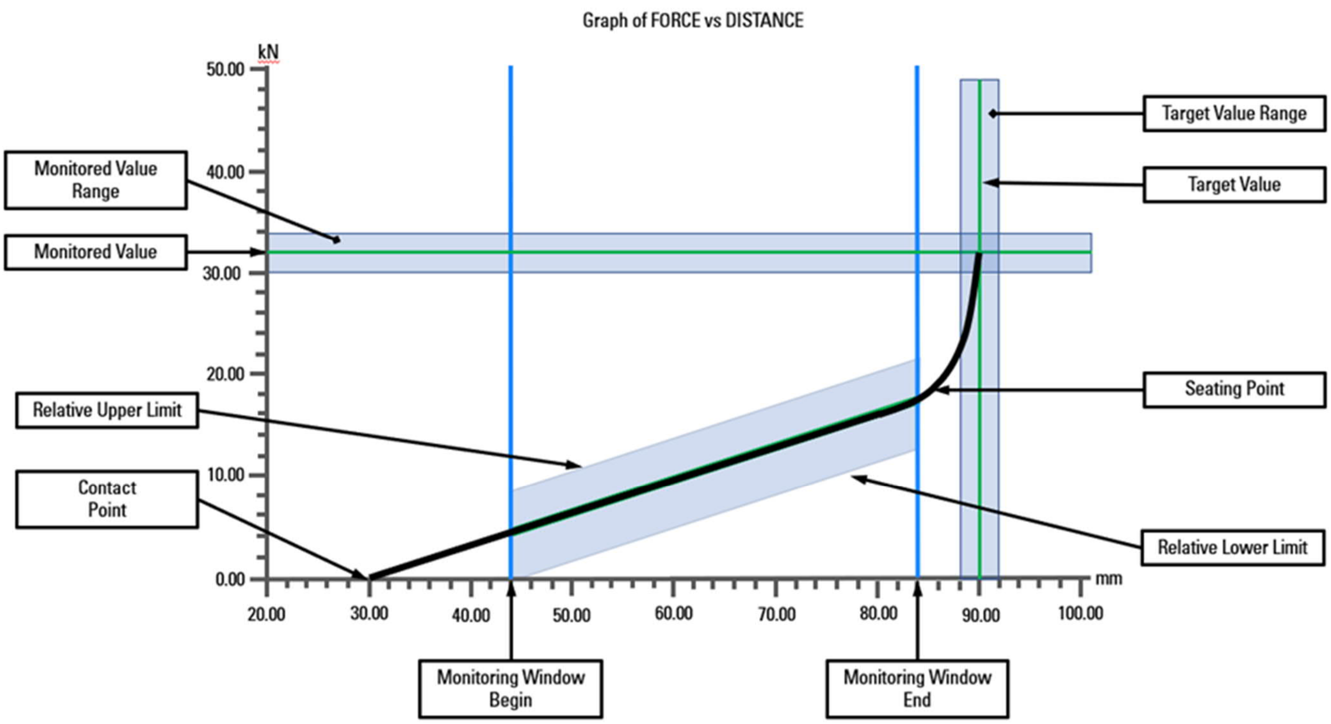

Figure 2: Pressing Characteristics Graph

Contact Point – The point where the press tooling first contacts the assembly component. At this point the Force vs. Distance graph should begin.

Monitoring Window Begin – The monitoring window is used to evaluate the running load (pre-seating) portion of the press curve to ensure the curve behaves in a consistent smooth manner. The monitoring window should begin after the Contact Point. This point is the starting point for capturing the running load (pre-seating) if required.

Monitoring Window End – The end monitoring point marks the end of the monitoring window. The Monitoring Window End should be before the Seating Point. This point is the end point for capturing the running load (pre-seating) if required.

Relative Lower Limit (Running Load) – A lower limit that runs parallel to the typical press curve. If the press curve crosses the Relative Lower Limit, the curve has acted abnormally, and will automatically fail. Relative limits are set based on the application and what is deemed appropriate to the process by the engineer in charge.

Relative Upper Limit (Running Load) – An upper limit that runs parallel to the typical press curve. If the press curve crosses the Relative Upper Limit, the curve has acted abnormally, and will automatically fail. Relative limits are set based on the application and what is deemed appropriate to the process by the engineer in charge.

Seating Point – The point where the slope of the graph begins to rapidly increase as the pressed component gets near its final position.

Target Value – The target force or distance value. The cycle is complete when the Target Value is met. The target value is slightly below the nominal value of the print required seating force, but this is at the discretion of the engineer in-charge.

Target Value Range - The allowable range for the Target Value per the assembly print.

** These are the basics of a pressing program; more sophisticated controls are available in the servo press software. Training modules for these advanced functions are available from the servo press supplier.*

3.2 Program Parameter

3.2.1 Force

Final Force Minimum (determined by assembly print or data) – This defines the minimum acceptable force for the process. The process does not complete (unless cycle times expire) until this is meet.

Final Force Target (determined by assembly print or data) – This defines when the final target value (force) is reached the press ceases advancing and the pressing 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 Force Maximum (determined by assembly print or data) - This defines the maximum acceptable Force for the pressing process. The pressing process should be complete when the Final Force Target is reached. In the chance that the force exceeded, the process will FAIL.

Cycle Start – This defines when the press detects the cycle start value, it begins collecting measurements data. This is used to create consistent and repeatable data.

Shift Target – This defines the force value at which the speed changes between the first and second stage in a two-stage program.

Cycle Complete - This defines when the press detects the cycle complete value, it stops collecting measurements data. This is used to consistently and repeatability stop measure force and distance and record for traces.

Press Complete – This defines the force value when the press phase is complete. When the pressing is complete, the program ceases to measure the pressing distance.

Force Peak – This defines what point of the program the force is measured. The force peak setting gives the highest force value during the pressing cycle and is used to ensure the force limits are not exceeded after the target value (force or distance) is reached because of overshoot.

3.2.2 Distance

Final Distance Minimum (determined by trial data and interpreting traces) – This defines the minimum acceptable distance for the pressing process from a given point during the process. At completion of the pressing process if the distance is below the set parameter it will 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 misalignment.

Target Distance (determined by assembly print or data) – This defines when the final target value (distance) is reached the press ceases advancing and the pressing cycle finishes. This value is typically set at the just below midpoint between the minimum and maximum limits to allow for variation in both the minimum and maximum direction without exceeding the specification limits.

Final Distance Maximum (determined by trial data and interpreting traces) – This defines the maximum acceptable distance for the pressing process. The pressing process should be complete when the Final Target parameter is reached. In the chance that the distance exceeded this parameter, the process will. If the final distance is above this limit it indicates that the assembly traveled an abnormally distance to reach the target value (force or distance).

Start Final Distance (set equal or greater than "CYCLE START") - This defines when the press begins collecting distance measurements data, when force achieves this value. This is used to create consistent and repeatable results by starting the measurement from a consistent point in each pressing sequence. The final distance is used to verify that the assembly is properly seated.

3.2.3 Speed and Accelerations

Starting Speed (suggested start set point at 100mm/sec) This defines the tool speed during the start. The start speed is used to help get the press head to pre-contact point fast to reduce cycle time.

Starting Speed Acceleration / Deceleration (refer to MFG) This defines the time that it will take to get to the program to reach speed. This is used to accelerate / decelerate the press to help engage the assembly and ease transition between speeds.

Final Speed (suggested start set point between 1 – 5 mm/sec) This defines speed known as final speed or pressing speed. This speed is used to slow the press down to allow time to accurately evaluate the target value and minimize overshot of the target value.

Final Speed Acceleration / Deceleration (refer to MFG) This defines the time that it will take to get to the program to reach speed. This is used to accelerate / decelerate the press as it transitions from Starting Speed to Final Speed to Final Position to avoid overshooting the control target.

3.2.4 Time

Cycle Time (defined by trial data and interpreting traces) - This defines the time required for the process to reach the target value. For example, from when "Cycle Start" is initiated till the press has reached the target value required for assembly. If the operation is consistently failing for "Cycle Time", the time may be too low, or if a compound is being used on the assembly it may be creating inconsistencies.

Start Time (defined by trial data and interpreting traces) - Defines the duration of the time from home position to pre-contact position. The timer is started from the moment that the equipment cycle is started.

Tool Idle Time (typically set 100ms multistage programs) - This defines the dwell time between a completed cycle and a second cycle. This allows the assembly 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 about the cycle. 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.

3.3 Pressing Strategy / Programs

3.3.1 Press / Pull to Force - Pressing to a Force is used when the print requires just Force. Distance will be monitored; it is used to find critical points during the pressing sequence such as the Seating Point. Curve monitoring is used in this application to monitor press curve consistency and protect the program from falsely accepting a discrepant part because of inconsistencies in the mating surfaces (burrs, deformation, etc.). The curve is also used to monitor the pre-seating force to ensure the parts have the correct interference fit before bottoming out on the seating surface.

1. Move rapidly to Initial Position (just before Contact Point). Overload is set to a low Force to protect against a crash condition.
2. Press slows down to a very low speed (~1-5mm/s but may be outside this limit based on application) to contact the part and begin pressing components together at a constant speed.
3. At this point the program is targeting the final force and monitoring distance and curve monitors.
4. When the target force is achieved, the press stops and checks the final distance to ensure it is inside the final distance limits.
5. Servo program makes decision to accept or reject the part depending on programed limits for force, distance, and curve monitoring.
6. Press rapid retracts to home position.
7. End of cycle.

3.3.2 **Press/Pull to Distance -** Press to a distance is used when the print requires the component that is being pressed to be held to a dimension and you are not just pressing to a shoulder. Curve monitoring is used in this application to monitor press curve consistency and protect the program from falsely accepting a discrepant part because of inconsistencies in the mating surfaces (burrs, deformation, etc.). The curve is also used to monitor the pre-seating force to ensure the parts have the correct interference fit before bottoming out on the seating surface.

1. Press rapid moves to initial position above assembly, monitoring overload force for a crash condition.
2. Press slows down to a very low speed (~1-5mm/s but may be outside this limit based on application) to contact the part and begin pressing components together at a constant speed.
3. At this point the program is targeting the final press distance and monitoring force and curve monitors.
4. When the target distance is achieved, the press stops and checks the final press force to ensure it is inside the press force limits.
5. Servo program makes decision to accept or reject the part depending on programed limits for force, distance, and curve monitoring.
6. Press rapid retracts to home position.
7. End of cycle.

3.3.3 **Press/Pull to Seat/Shoulder (Rate of Change) -** Pressing to a rate of change is used when you do not want to put excessive force into a component. Using this method will result in more sporadic seating loads. Curve monitoring is used in this application to monitor press curve consistency and protect the program from falsely accepting a discrepant part because of inconsistencies in the mating surfaces (burrs, deformation, etc.). The curve is also used to monitor the pre-seating force to ensure the parts have the correct interference fit before bottoming out on the seating surface.

1. Press rapid moves to initial position above assembly, monitoring overload force for a crash condition.
2. Press slows down to a very low speed (~1-5mm/s but may be outside this limit based on application) to contact the part and begin pressing components together at a constant speed. At this point the program is targeting the specified slope for the force vs distance curve and monitoring distance and pre-seating force.
3. When the target slope is achieved, the press stops and checks the final distance, final force, and pre-seating force to ensure they are all inside their respective limits.
4. Servo program makes decision to accept or reject the part depending on programed limits for force, distance, and curve monitoring.
5. Press rapid retracts to home position.
6. End of cycle.

3.3.4 **Press/Pull to a Delta -** Press to a delta is used to verify that a component is seated against a shoulder. Curve monitoring is used in this application to monitor press curve consistency and protect the program from falsely accepting a discrepant part because of inconsistencies in the mating surfaces (burrs, deformation, etc.). The curve is also used to monitor the pre-seating force to ensure the parts have the correct interference fit before bottoming out on the seating surface.

1. Press rapid moves to initial position above assembly, monitoring overload force for a crash condition.
2. Press slows down to a very low speed (~1-5mm/s but may be outside this limit based on application) to contact the part and begin pressing components together at a constant speed. At this point the program is targeting the seating point (programmed position) and monitoring force and curve monitors.
3. The seating point is determined based on the application. It can be a dimension on the print or found running multiple parts.
4. When the seating point is achieved, the press captures the seating force and then adds the specified delta force to seat the component. Example Specification: Press to a force that is greater than the load that is measured during press motion at distance X mm, with max force not to exceed ## kN.
5. Servo program makes decision to accept or reject the part depending on programed limits for force, distance and curve monitoring.
6. Press rapid retracts to home position.
7. End of cycle.

3.3.5 Press/Pull with a Post View Delta - Press/pulling with a post view delta is used when a component needs to be seated against a blind shoulder. It can be used with other methods, such as pulling to a force, to verify seating. The post view delta is an analysis in the software and does not affect the press/pulling sequence. The sequence below is based on pressing to a force. Curve monitoring is used in this application to monitor press curve consistency and protect the program from falsely accepting a discrepant part because of inconsistencies in the mating surfaces (burrs, deformation, etc.). The curve is also used to monitor the pre-seating force to ensure the parts have the correct interference fit before bottoming out on the seating surface.

1. Press rapid moves to initial position above assembly, monitoring overload force for a crash condition.
2. Press slows down to a very low speed (~1-5mm/s but may be outside this limit based on application) to contact the part and begin pressing components together at a constant speed. At this point the program is targeting the final force and monitoring distance and curve monitors.
3. When the target force is achieved, the press stops and checks the final distance to ensure it is inside the final distance limits.
4. The press software captures a force at x.xx mm before the target force is achieved and calculates a delta by subtracting that force from the seating/target force. The dimension x.xx and delta force will be set by Product and Manufacturing engineering and is dependent on the process.
5. Servo program makes decision to accept or reject the part depending on programed limits for force, distance, delta force and curve monitoring.
6. Press rapid retracts to home position.
7. End of cycle.

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 that 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)

Question to ask oneself when working on a PFMEA for torquing applications:

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 Presses are selected properly, they can press components to a specific target value (force or distance) 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.

Max & Min Seating Force – The maximum and minimum seating force limits from the assembly print must 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 loadcell is used to verify the servo press loadcell, by pressing 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.

Max and Min Running Load (Pre-Seating Force) (if required) – The maximum and minimum pre-seating force limits from the assembly print must 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 loadcell is used to verify the servo press loadcell, by pressing 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.

Max and Min Seating Distance – The maximum and minimum seating distance limits from the assembly print must 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 LVDT or certified gage blocks is used to verify the servo press position, by pressing 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.

Delta Force – The delta force limit(s) from the assembly print must be included on the MQ Plan. Since delta force is calculated by the software, the linearity from the seating and running (pre-seating) force is applicable for verification.

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 loadcell is used to verify the servo press loadcell, by pressing 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.

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 press process 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 Programable 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 Recovery

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

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

When recovery is allowed, 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 components are foreign material other than the components itself, such as but not limited to grease, oil, water, metal chips. These foreign materials affect the assembly process by causing variations in friction resulting in changes in assembly outcome. With such changes components assembly 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).

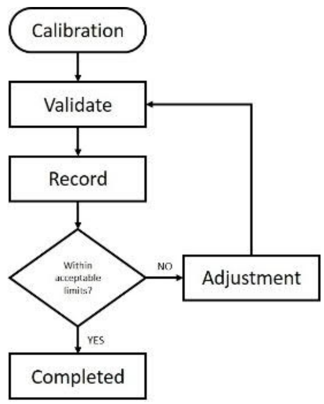

Figure 3: Calibration Flow Chart

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 = **|** ((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.

7. Linearity

Linearity shall be performed within the print requirement or quality control range and calculated using statistical software. Reference SD-005 and MSA manual for linearity procedure.

8. Error Proofing

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

9. 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.

RECORD OF REVISIONS

Revision No	Date	Section	Description
001	29OC19	ALL	Initial Release
002	27SE22	ALL	Complete review and update of entire document.
003			
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