	GAUGE DESIGN & BUILD STANDARDS			**SD.7.6.1.02**	**REV: Release**
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Exceptions from Standard: *There will be circumstances where this standard cannot be followed in its entirety, or that it would not be prudent to do so. The gauge maker is expected to inform Plaint Plastics Corporation when this is the case and obtain written authorization from Pliant Quality Assurance, the responsible Sale-Engineer, or the Project Coordinator. In no case shall the gauge maker proceed with actions they feel are unwise for the situation without informing Pliant Plastics Corporation of the expected consequences and requesting exception or deviation. All communication of this sort shall be in some form of written or electronic format, including e-mail, and shall be retained by the Pliant approving authority in the respective part engineering file.*

1. Gauge Specification and Request for Quote (RFQ):

1.1. The Project Engineer and/or Quality Assurance will specify the part features to be gauged and whether variable data, Go/No Go, or functional testing at virtual condition is required based on the customer and internal needs.

1.2. Reference to this standard, as well as any applicable customer standards, will be included in all gauge requests for quote (RFQ), as well as the purchase order.

2. Gauge Quote:

2.1. The gaugemaker will provide a gauge quote.

2.2. The gauge quote will include a brief description of how the gauge will measure or check each feature of the part, to include:

2.2.1. What datums the part feature will be referenced to when nested, & whether at MMC, RFS, or LMC with reference to each datum.

2.2.2. Will the feature be checked as an attribute or measured as a variable. If an attribute check, whether at MMC, RFS, or LMC.

2.2.3. Type of device used to measure or check after nesting the part (e.g., indicator, feeler, pins, etc)

2.3. Where applicable, the gauge quote/concept will indicate if gauging is different than what the print currently calls out in the feature control frame (e.g., the feature control frame calls out a position @ RFS with respect to datums at RFS and the gauge is designed to check @ MMC). This helps to ensure there is no miscommunication when the gauging concept is reviewed with our customer for their approval.

3. Issuance of Purchase Order:

3.1. Gauge Purchase Orders may be issued by the assigned Project Coordinator, Purchasing, or one of the Quality Technicians.

3.2. Reference to this standard, as well as any applicable customer standards, will be included in all gauge requests for quote (RFQ), as well as the purchase order. The customer name for customer-owned gauges shall be provided on the P.O. so the gauge maker knows how to mark the gauge.

4. Gauge Design:

4.1. The gauge-maker will provide an engineering drawing of the gauge in sufficient detail to allow for subsequent gauge verification/calibration. All gauge characteristics critical to accurate and repeatable part measurement will be toleranced to $1/10^{th}$ or less of the associated part characteristic tolerance, unless otherwise specifically approved in writing. Dimensions required for build, but not required for gauge certification will be identified as reference.

4.2. The drawing will be dimensioned and toleranced in accordance with the current revision of the ASME Y14.5 standard. Dimensioning and tolerancing will be in the unit of measurement used on the engineering drawing for the associated part; i.e., SI (Metric) linear units to SI linear units, US Customary linear units to US Customary liner units, etc.

4.3. Gauge drawings will contain, as a minimum:

- Detail drawing, including specification and tolerancing of the final gauge assembly
- Drawing views of any details that cannot be accurately depicted in the final assembly's view
- A stock listing identifying all of the details, including the size and material utilized
- Call-outs showing the datum scheme of the gauge (normally correlates to that of the part)

4.4. A gauge concept explaining the features checked by the gauge, the standards to which the features are verified to, and a simple explanation of how those features are measured or verified, will be included if not obvious (i.e. a simple Go/No Go plug gauge set. etc.). All calculations for virtual condition will be explained in the concept.

See SD.4.2.3.1.06, Definition of Terms & Abbreviations

4.5. Unless otherwise specified the simulated datum surfaces and origin must align to the datum reference frame and origin as specified on the engineering drawing. The gauge datum scheme and rationale will be fully described if different from that shown on the associated part's engineering drawing.
4.6. Gauges will be designed and built "customer safe." All gauge error must be directed inside the tolerance limits (- for maximum limits and + for minimum limits).
4.7. If known, the laboratory intended to be used for gauge verification should be specified in the initial design submittal (see Section 3).
4.8. Gauge designs will be approved by Pliant Quality Assurance or Sales-Engineering before build will begin.

5. General Gauge Construction

5.1. The owner's name (either Pliant Plastics Corporation or the owning customers if customer owned), the part name, part number and revision, and date of construction shall be permanently marked on the gauge in a visible location.
5.2. Unless otherwise approved in writing, base plates shall be constructed:
- of a precision quality & stable material (steel or cast aluminum) thick enough so that the base plate will remain true and not warp in a manufacturing environment
- with the top and bottom machined so that surfaces are parallel within .0001"/1.00" length
- with adjacent edges are square to each other within .0001"/1.000" length
- with all corners broken – no sharp edges
- with jig feet mounted to the bottom of the base plate near each corner
- with the following stamped on the top of the gauge base or on a metal plate permanently attached to the top of the base:
  - Part Number – End Customer's or Pliant's (as specified for the individual gauge)
  - End-Customer Name or Pliant Plastics Corporation (as specified for the individual gauge)
  - Pliant or Customer Gauge Number (as specified for the individual gauge)
  - Engineering revision level to which the gauge was designed (or most recently reworked to)

5.3. Stamp on gage in the appropriate places:
5.3.1. Datum surfaces or locations
5.3.2. Gage size on all gage pins and feelers
5.4. Gauge Details: Unless otherwise approved in writing, gauge details shall meet the following criteria:
5.4.1. Details containing sliding members will be made from either 4140 pre-hardened steel or cast aluminum containing hardened bushings.
5.4.2. Other non-contact details, such as riser blocks or clamp blocks, may be made from mild steel or aluminum.
5.4.3. Details containing precision located checking features must be doweled to the base plate with hardened dowels and screws.
5.4.4. Sliding details, such as positional checking pins, locating pins, and go/no go pins, must be hardened and slip fit with no shake
5.4.5. Sliding details that are vertically mounted or that are to be used for flush checks must have a handle attached to the sliding detail.
5.4.6. Storage blocks must be furnished and attached to the base for all loose details; the details shall be attached to the block by a cable.
5.4.7. Datum locating points will be hardened deck points.
5.4.8. Hole datum features that are referenced RFS must be located with conical taper pins
5.5. Clamping and Loading
5.5.1. Clamping shall be positioned such that it does not impede part loading, unloading, or gauge operation.
5.5.2. Clamping must be in-line with provided gauge datum targets such that the part is nested into the datum targets.

6. Gauge Verification and Approval

6.1. All gauge builds will be verified by a full dimensional inspection to a “bubbled copy” of the approved design drawing. Gauges used for automotive applications normally require use of a qualified internal laboratory or a contracted ISO 17025 accredited laboratory with a scope consistent to the inspection performed. Gauges used for other markets may not, but the source must be approved by Pliant Plastics Corporation. Unless otherwise specified in writing, the default shall be to use an accredited laboratory. A copy of the lab accreditation with scope shall be provided where applicable.

6.2. Dimensioning and tolerancing will be in the unit of measurement used on associated gauge design drawing; i.e., SI (Metric) linear units to SI linear units, US Customary linear units to US Customary liner units, etc.

6.3. All measurements must fall within the specified tolerances on the approved gauge drawing unless otherwise approved in writing by Pliant Quality Assurance or Engineering.

6.4. Gauges will be designed to meet a repeatability and reproducibility measurement of ≤10% for variable data using the Average and Range Method or pass an Attribute Gage Short Study (as established in the AIAG Measurement Systems Analysis Manual), as applicable. Normally the gauge verification will be performed by Plaint Plastics; the gauge maker will be required to help investigate cause and make corrections if Pliant personnel cannot attain acceptable results.