CHECKING FIXTURE/GAUGE STANDARD

Document Number

80-ENG-D-413

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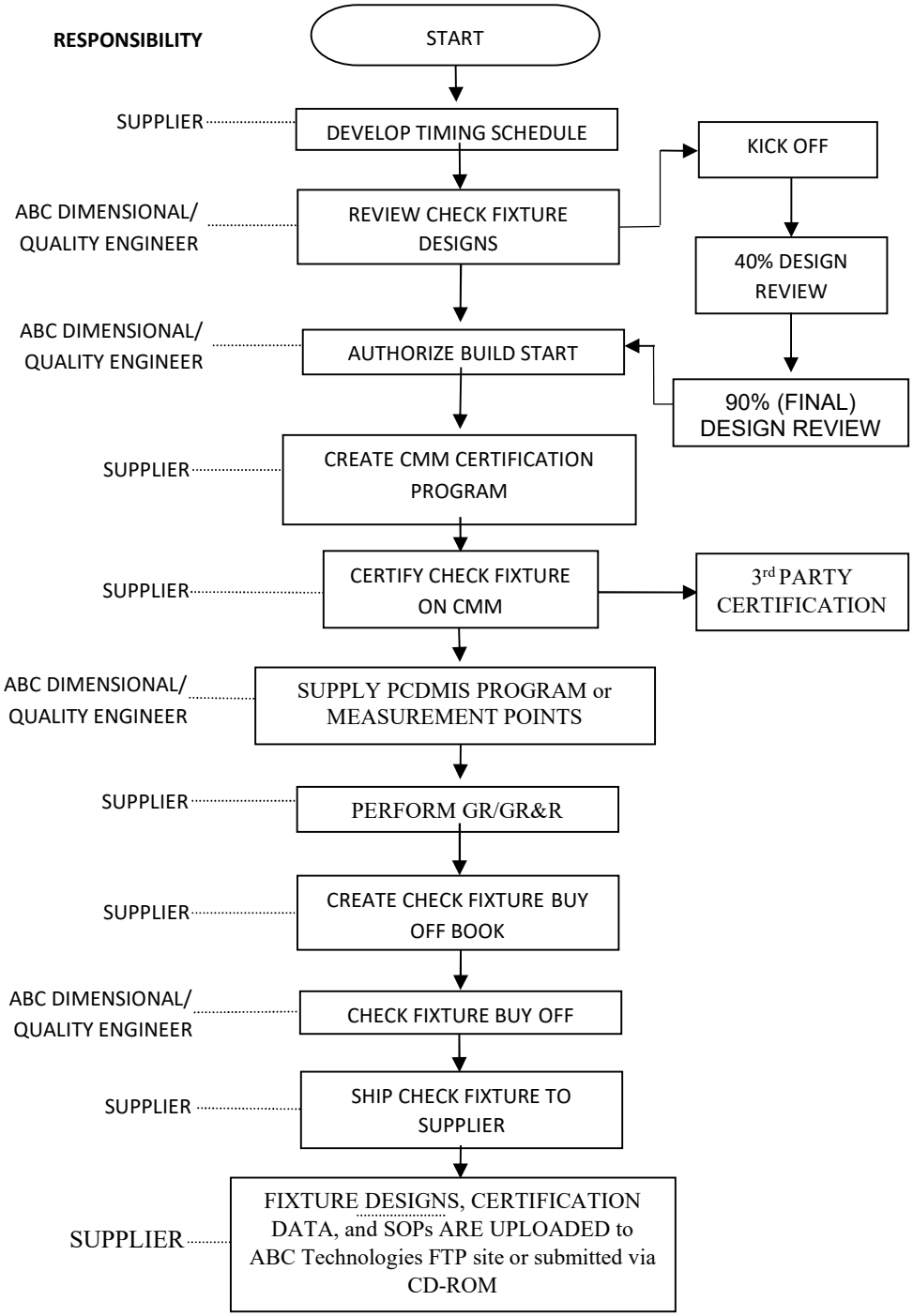
CHECK FIXTURE FLOW CHART



1. Purpose and Scope

This Gauge standard has been developed by ABC Technologies to document best practices and lessons learned and convert them into a standard for the design and building of checking gauges. The experience from our plants and with various product types was taken into consideration in the development of this standard.

The design of a good checking gauge that permits the easy, repeatable and reproducible verification of product over time is the best way to ensure we do not produce unnecessary non-conforming product and our customers continue to receive verified good product from ABC.

This Gauge Standard is designed as a guide for the design, manufacture and approval of checking gauges suitable for our product. This guideline is to be considered as a minimum requirement. Along with our experiences we have taken into consideration our customer's requirements and their commonly held standard practices for gauge building. The intent of this document is not to include all possible requirements and therefore consultation of specific customer standards or requirements with each new project is a must.

This document must be provided to gauge suppliers to describe and clarify ABC's requirement for checking gauge designs and builds, and the approval requirements to justify final payment for any gauges.

Customer expectations and requirements can change from program to program, product to product, customer to customer, and evolve over time. Therefore, this standard is intended to meet all ABC customer requirements for checking fixtures; should any conflict be found between the customer written requirements and this standard, the customer requirements will always prevail. Unless otherwise directed in writing from the customer, all requirements of AIAG Core Tools manuals and IATF16949:2016 must be met.

2. Version History

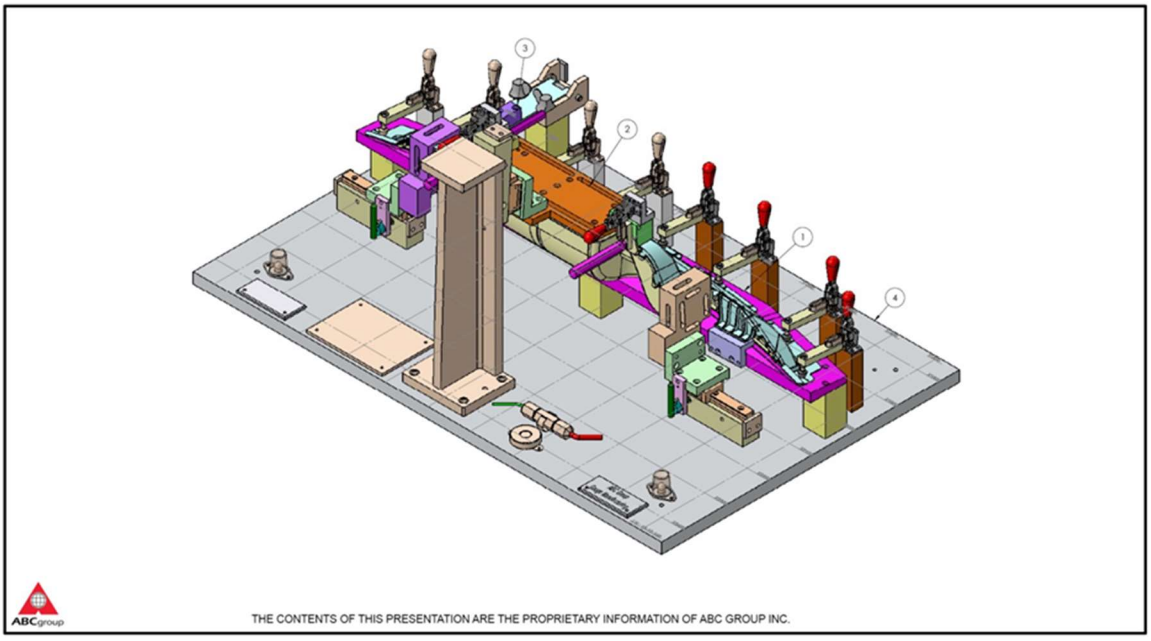
Version	Description of Version Changes
1	Original Version

3. Definitions

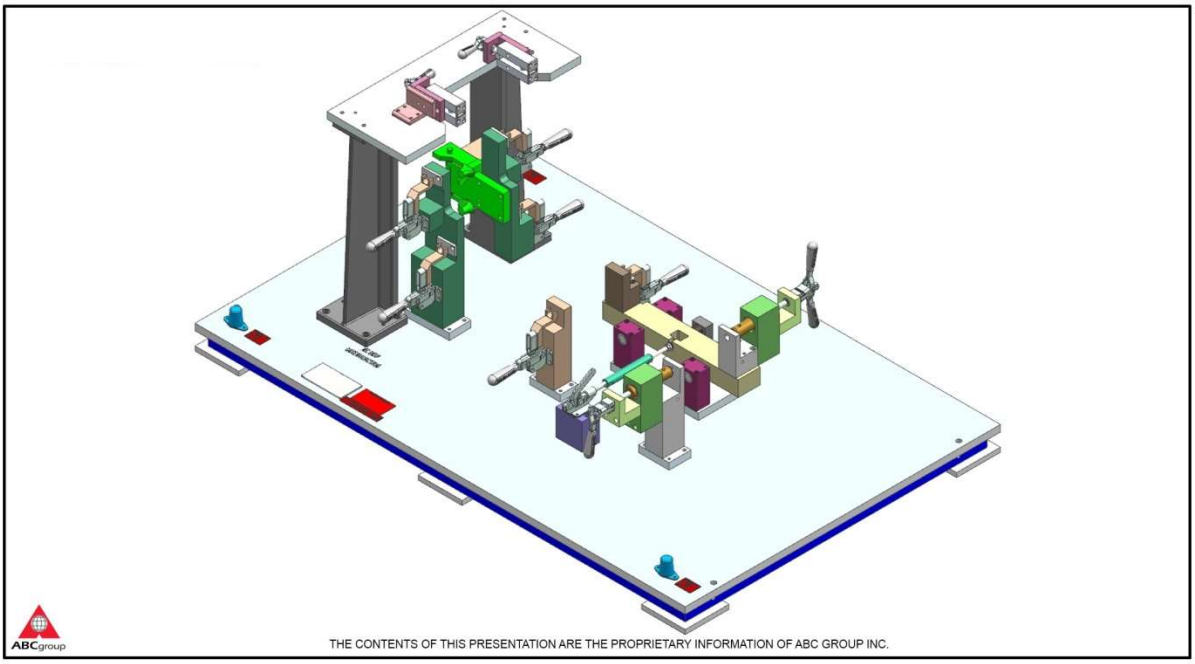
The following terms are defined to clarify this Gauge Standard.

Term	Definition
Checking Fixture	A piece of equipment used to hold a part in a fixed position for CMM Checks or other. It is sometimes referred to as CMM Fixture.
Checking Gauge	A piece of equipment used as an inspection tool which would help make decisions regarding the quality status of a product.
Modification	Any changes made to the Checking Gauge/Fixture or its documents due to ABC Technologies or OEM directed change, repair or correction.

3.1 Checking Gauge



3.2 Checking Fixture



4. SAFETY AND ERGONOMIC REQUIREMENTS

SAFETY:

The Gauge Supplier must take all necessary steps to avoid safety incidents on the Fixture or and Checking Gauge. The following safety requirement is the minimum safety expectation of ABC Fixture or Checking Gauge Suppliers. If there is any deviation from this minimum safety requirement it is the responsibility of the Supplier to consult ABC Representative for written approval.

1. The entire gauge must be free of sharp edges / burrs.
2. No pinch points allowed. Use Clamps with no pinch points. Stops shall be added when required to eliminate, where possible, pinch points.
3. Toggle Clamps and hinged drops must have mechanisms installed that prevent free falling onto the operator. Examples of such mechanisms are handle stops, toggle clamp lockout and hinge drop lockout.
4. The Supplier must make an effort to ensure that any removable detail does not exceed 40 lbs. In the case where the weight exceeds 22 lbs, assist devices such as counter balances must be used.

PLEASE NOTE THE FOLLOWING WEIGHT RESTRICTIONS OF ABC TECHNOLOGIES CHECKING FIXTURES AND GAUGES:

- Weight less than 22 pounds (10kg) must have two (2) handles installed.
- Weight greater than 22 pounds must have lift areas called out, labeled and shown in the design for both Hilo and crane.
- Weight greater than 300 pounds must have eyebolts or forklift sleeves installed.

ERGONOMIC:

Gauge Suppliers are required to design and build good ergonomics into the gauge. ABC is a Global Company and it is the Supplier's responsibility to build the gauge by considering the following for the final Operator of the Gauge.

- Arm reach
- Work Envelope
- Arm elevation
- Work forces of the final destination of the Checking Gauge.
- Motion, including bending and twisting
- Right hand versus left hand

The gauge must be user-friendly to the Operator to prevent or minimize unnecessary motion and bad posturing.

5. QUOTATION REQUIREMENTS

Checking Gauges and Fixtures need to be robust enough to maintain Dimensional Integrity during the life cycle of the program.

Use steel or aluminum for risers, support members and brackets of N/C machined fixtures and checking details, this decision should in part, be based on the following factors: vehicle volumes, material cost, structural requirements, weight, ability to machine and corrosion resistance.

1. Any assumptions and /or exceptions that affect cost and timing must be clearly identified on the quotation.

2. The Checking Fixture or Gauge design information is the property of ABC Technologies or their Customer. It is required for the Gauge Supplier to send the 3D and 2D CAD data in native format (i.e. Solid Works, Mechanical Desktop Pro-E Catia V5, NX) of the Checking Fixture or Gauge or both to ABC Technologies Inc. using the following address.

   designer@abctech.com
   For File transfer please use ABC Group webftp:
   https://webftp.abcgroup.ca/

   If the Supplier needs any help to send the data please consult the ABC representative for the Project.

6. CHECKING FIXTURE/GAUGE DESIGN REQUIREMENTS

A - DESIGN CONCEPT

The Design Concept must show the "Gauge Intent." It should reflect the GD&T datum locating scheme, customer requirements, and any special requirements reviewed during the quotation stage. The design concept shall consist of a minimum of a sketch and a written description of the gauge with sufficient detail in order that the gauge design concept could be better communicated. The design concept should not be as detailed as a complete design, but it should include the following information:

1. The part position in relationship to the gauge base. Body position (The positioning of the part in the gage in the identical orientation the part will have in the final vehicle assembly.) is preferred; however, other orientations may be appropriate to maximize part/gage usage (e.g. first-use position). 90 degree Increments should be used when deviating from body position. Please note that any deviation from orientating the part in body position must be approved by ABC Dimensional Engineer or Quality Engineer.

2. Location of datums should be shown. A datum scheme consistent with the part specified Geometric Dimensioning and Tolerance may require multiple attaching schemes.

3. Approximate base size and detailed devices for supporting the part.

4. Location and orientation of clamps, and proposed clamping techniques (e.g., standard clamping and / or using fasteners)

5. Details and devices for inspection of features such as:
   a. KPCs (Key Product Characteristic), PQCs (Product Quality Characteristic),
   b. Feature lines
   c. Functional holes
   d. Historic areas of high process variability

6. Acceptable construction materials based on gauge usage and environment to ensure functionality, repeatability, and reproducibility throughout the length of the part program. The concept review and approval **DOES NOT** give the authority to order gauge materials. Approval of the gauge design authorizes the ordering of materials and components. If gauge materials have been ordered prior to final design approval,

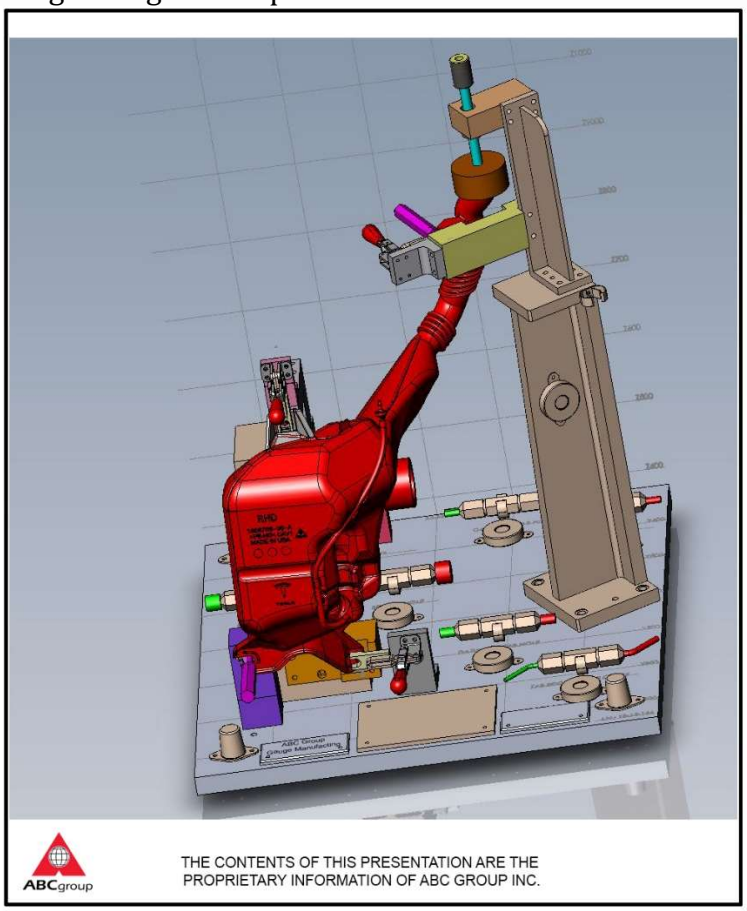
and changes are made to the gauge design that affect these materials, the material costs for the unusable stock will be absorbed by the Supplier.

7. Mating or adjacent part representations or features, where applicable.

8. The X, Y, Z location(s) on product features where SPC data will be collected to monitor KPCs and PQCs shall be reviewed and approved by the ABC Dimensional Engineer.

9. The Gauge Supplier must receive a signed fixture concept approval checksheet from ABC Dimensional or Quality Engineer indicating whether concept approval by Customer is required or not. If Concept Approval is required by customer and/or ABC Dimensional Engineer, the **(gauge)** supplier shall obtain Concept Approval prior to initiating the gauge design process. Any change which may occur during the gauge procurement process that has significant impact on the original concept should be reviewed with the customer or ABC Dimensional Engineer.

Gauge Design Concept



B - GAUGE DESIGN

The checking gauges used to check the fit, form, and function of the part to the vehicle will be designed in a cooperative effort between the Supplier, Customer, and ABC representative. Based on commodity differences and plant location differences, any specific requirement could be requested by the customer and ABC Representative. The Design source shall refer to the design concept and the written description provided in the Statement of Requirements (SOR) or in the Technical Review as the controlling expression of the design. If this information was not supplied in the SOR or at the Technical Review, it is the Supplier's responsibility for obtaining it from the ABC representative in order to support the program deliverables.

1. The gauge design is intended to be an accurate representation of the gauge. It should reflect how the gauge will be constructed and must include the basic information such as, base size and type, part orientation, location, size and orientation of all stanchions, details and clamps, size and location of datums, location of flush rails / feeler rails, and location of SPC ports. It must have all necessary section cuts to show detail and any required blow up sections. Also, all internally manufactured "one-of-a-kind" components need to be drawn and dimensioned on the design.

2. The environment in which the gauge is to be used should be considered when choosing the material, slides, pins, clamps, etc. to ensure that they remain functional throughout the product program (including service requirements.) It is the Gauge Supplier's responsibility to inquire the usage location of the gauge and the program life span.

3. All drawings should be full-size, and accurately represent the dimensions shown. In addition:
   e. Details shall be completed in all views and must be dimensioned to machined surfaces and/or body and/or work lines.
   f. All designs must have an isometric view of the gage on the design. All section views shall be referenced by section and sheet number corresponding to the call-out on the gage design drawing. (i.e., SEC C-C or 100.0; Sheet 1).

   g. The design (model & prints) will show the part in a different color other than black. The part will be shown using solid lines. If the fixture is to be used for an assembly, then show all detail parts using different colors.

h. If there are model change or interchangeable areas on the check fixture, then they are to be identified with part number or tool number and clearly called out in design using phantom lines with a different color other than the color of the part.

i. Drawings should include a representation of the part (phantom) shown in its gaging position.

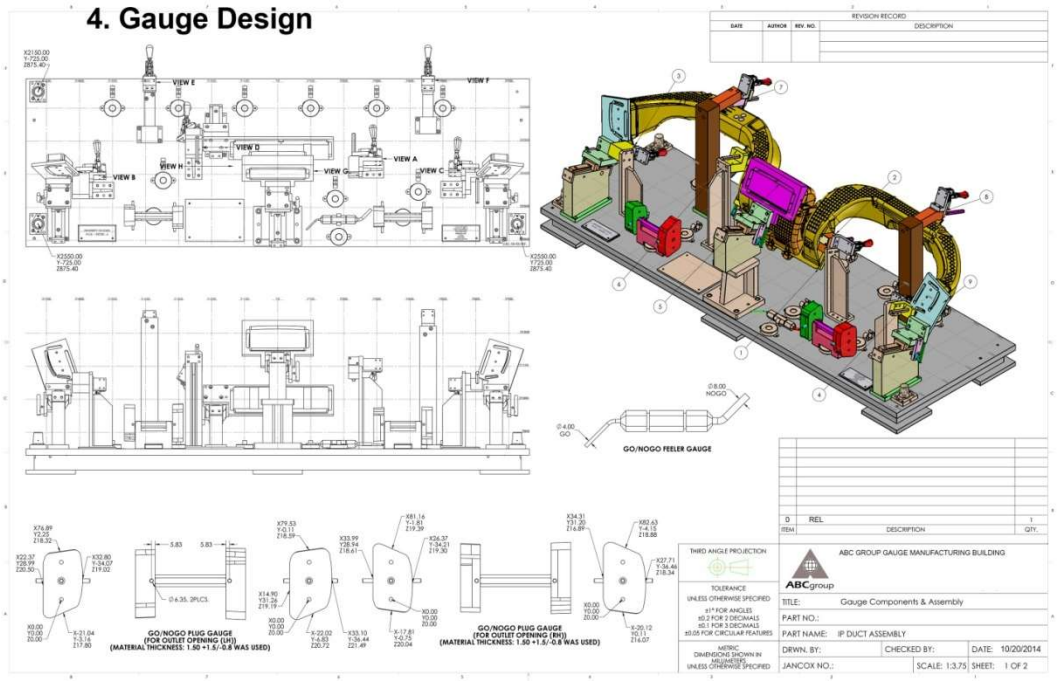
j. The stock list shall include all stock sizes and must identify standard items by supplier name and full catalog number.

k. Gauge design details should be drawn separately from the gauge assembly only when needed for build clarification.

l. All dimensions should be in metric however, the stock list may contain items in Standard English dimensions.

m. Stock items (i.e., angle brackets, risers, hinge drops, slides, screws, dowels, etc.) should consist of standard commercially available materials whenever possible.

n. Gauge designs must be generated electronically, utilizing customer approved software (CATIA, NX, etc.). Format to be same as CAD product files sent



4. The datum scheme(s) shall be applied to the gauge design. The general concept is to locate the part in three dimensions by use of datum locators referred to as “primary,” “secondary,” and “tertiary” datums. Datums that are located on or near parting lines, gates, ejector pins, welds or any similar features must be brought to the attention of

the responsible Dimensional Engineer. If the datum cannot be re-located, clearance shall be provided on the gauge detail to facilitate gauge R and GR & R.

5. Datum Hole Locator(s):
   o. Gauge pins that are not used as datum locators shall not restrict part movement in any direction not specified as a datum. This situation may be addressed by utilizing a sliding or movable detail allowing movement in the non-datum direction. The slide, however, should be a precision slide in that it must not affect the specified location tolerance for the datum locator.
   p. For attribute gaging to take full advantage of allowable tolerances, the part should be checked in the gage with datum locators made at Maximum Material Condition (MMC). This locating feature may be attached to a slide or movable detail to allow free movement in the non-datum direction.
   q. For variable gaging all datum locators are Regardless of Feature Size (RFS), and shall be used to positively locate the part in the datum direction specified. This locating feature may be attached to a slide or movable detail to allow free movement in the non-datum direction.

6. All datum surfaces and locators must be labeled on the design with the respective GDT datum callout.

7. All designs must list all parts (assemblies, subassemblies or versions) that can be verified on the gage. Part numbers that are referenced must be the “without finish” part number(s) without color designation.

8. To ensure consistent dimensional checking from construction to certification, the design should include documented start points for base alignment on a coordinate measuring device. These points can be tooling balls, pins, blocks, or some other clearly identified zones on the base.

9. The design must reflect the CAD part coordinate system of X, Y, Z system.

10. If the part is to be positioned in a different coordinate system than the CAD model (tool die draw or work line versus body position), the design must be labeled in a distinct manner with the appropriate rotation points and angles to reflect the original position.

11. Consideration for maximum CMM access must be given when designing the clamp type and location. Horizontal handle or bayonet type clamps should be used when CMM access is a priority.

12. All Pins and Blocks used for part inspection (i.e. go/no-go pin, plug gage, virtual condition pin) must be labeled on the design with their respective size as well as the calculation(s) used to obtain that size.

13. All pins and feelers are to be color-coded. Check pins and go / no go pins used for the same hole should be coded the same and stamped with the sizes. See color chart (page 34, Figure L-6a)

14. The design must show the storage locations for removable details or interchangeable details, and loose components (SPC Indicator, GO-NOGO pins, and Plug gages). Also, when loose details or components are needed, a general note for tethering of the details is required to be on the design.

15. The design must reflect the proper clearance for dimensional layout inspection.

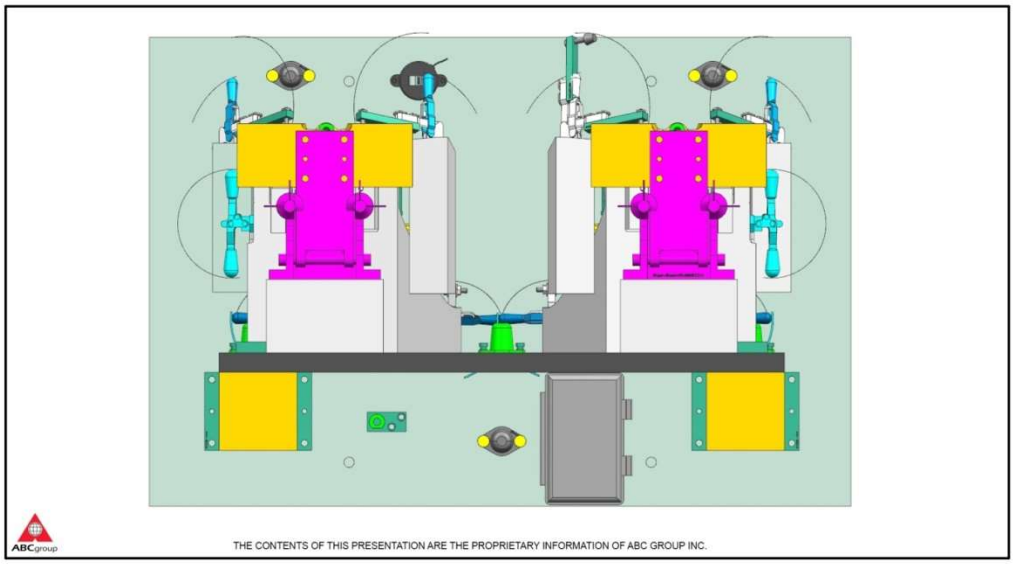
16. The ABC Dimensional Engineer and the Plant APQP Team must meet and approve the initial gage design and subsequent design changes. It is recommended that two reviews take place – one at or about 50% completion and one at 100% completion. The design does not have to be signed at the 50% review, but must be for the 100% review. The ABC Dimensional/Quality Engineer and the Supplier must sign the final design. Other signatures may be required, as dictated by the customer design standards and/or the ABC Dimensional Engineer. It is the Supplier's responsibility to notify the ABC representative prior to completing the design for ABC to state who is required to sign the final design.

17. Design approval gives the authority for the Supplier to order Checking Gauge / Fixture materials. If materials have been ordered prior to final design approval and changes are made to the gage design that affect these materials, the material costs for the unusable stock will be absorbed by the Supplier.

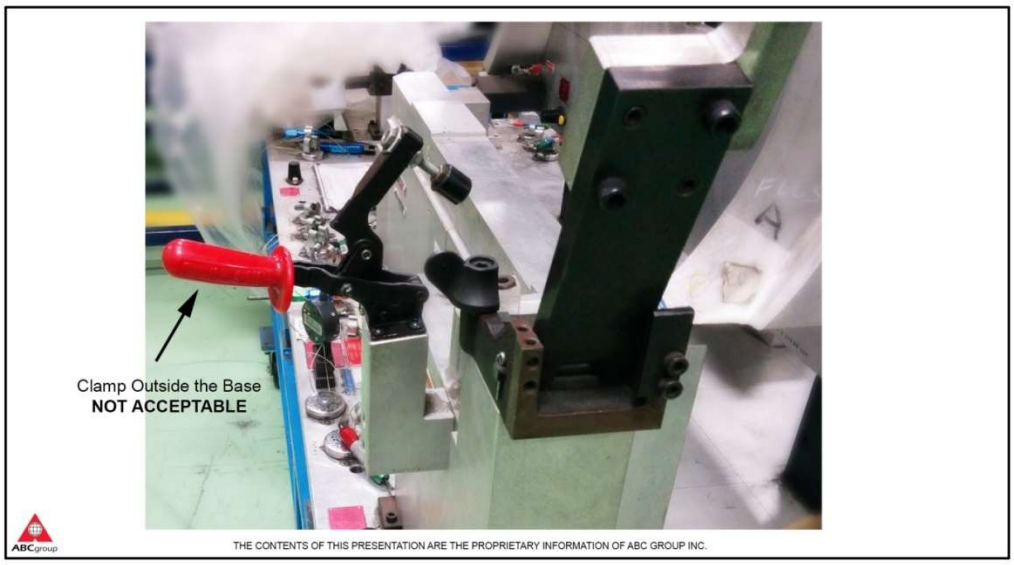
18. All design changes must be recorded in a standard change column on the design.

19. All gage details must be confined within the boundaries of the base, including details that move (toggle clamps, hinge drops, etc.) To minimize base size, if the unit does overhang the base in full open position, provide a stop pin. Part load and unload consideration must be made with all open details.

5a. Gauge Design Shows Details Outside of the Base



5b. Gauge Detail Outside the Base



Operator instructions and/or a sequence of operations on the use of the gauge shall be shown on the completed design. The use of multilingual operator instructions must be considered where applicable. See section on operator instructions for further definition.

7. GAUGE BUILD REQUIREMENTS

A - BASES

1. All fixture details including fixture bases, datums, and inspection details shall be manufactured using the recommended specifications. Deviation need to be approved by ABC Dimensional Engineer.

   It is the responsibility of all ABC Technologies' Suppliers to ensure that the base of a checking gauge meet the flatness, parallelism and the profile of a surface tolerances as specified below.

   The **datum Scheme for these base measurements** is defined as the base bottom as it sits in the horizontal position.

   Base Specifications

   Profile of surface variation within 300mm square .....± 0.05 mm
   Profile of surface variation over entire .....± 0.10 mm
   Parallelism between top and bottom surface .....± 0.05 mm
   Overall Flatness .....± 0.13 mm

   Note: All dimensions should be in metric however, the stock list may contain items in Standard English dimensions.

2. All edges must be machined square and beveled.

3. The base must have the J-Corner identified.

4. A minimum of (4) Jig Feet (38.0mm tall) are required for all fixtures on aluminum plate. The maximum distance between two feet may not exceed 500mm (see figure A)

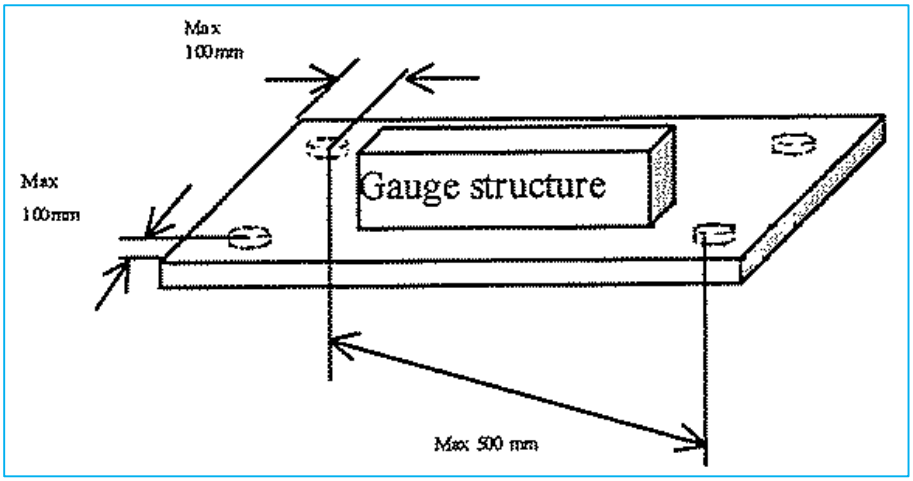


Figure A

5. Aluminum plate with a thickness of 25mm up to 30mm shall be used depending on base plate dimensions.
6. If base plate exceeds dimensions of 600mm x 600mm, this base body shall be made of cast aluminum or welded aluminum or steel, depending on size or weight of the part.

7. Base plate dimensions should be in full inch (25.0mm) increments.

8. Cast aluminum, welded aluminum or steel bases must be stress relieved.

9. All bases must be of uniform thickness. It is the Supplier's responsibility to inspect the base for uniformity before construction. If the gage is constructed and the base is found to be varying in thickness, the base will have to be replaced and reconstructed at the expense of the Supplier.

GENERAL GUIDELINES ARE AS FOLLOWS:

Surfaces

Net Pads (datum surfaces)	± 0.05 mm
Net Pads (boundary location/non-working axis)	± 1.00 mm
SPC Bushings (check direction)	± 0.05 mm
SPC Bushings (locations)	± 0.15 mm
SPC Bushings (perpendicular to surfaces)	± 1.0°
Feelers and Templates	± 0.10 mm *
Flush Surfaces	± 0.10 mm *

* Not to exceed .20 mm zone in 100 mm.

Unless otherwise specified, all templates are to be located perpendicular to surfaces within ± 1.0° degrees.

Holes

Locator Pins (locations)± 0.05 mm
Locator Pins (size) .....+ 0.00 mm / -0.02 mm
Go Pins (size) .....+ 0.00 mm / - 0.02 mm
No – Go Pins (size) .....+ 0.02 mm / - 0.00 mm
Pin Check Bushings (location) .....± 0.10 mm
Pin Check Bushings (perpendicular to surfaces).....± 1.0°
Pin Check (size) .....+ 0.00 mm / - 0.02 mm
Sight Check (location) .....± 0.20 mm

Sight Check (size) .....± 0.12 mm
Units or Sub-Bases (location) .....± 0.05 mm

A. When certain part features drive deviations from the above specifications, the 1/10th rule can be utilized for fixture tolerance. (Ten percent of the tolerance specification indicated on the part.)

B. Drawing for the particular part feature can be used for build tolerances.

ABC TECHNOLOGIES
INNOVATION IN PLASTICS & LIGHTWEIGHTING

Check Fixture Tag

GAUGE NO._____ CUSTOMER _____

PART NUMBER(s)	PART DESCRIPTION	PART REV. LEVEL	LD REV. LEVEL

FIXTURE WEIGHT _____ FIXTURE SIZE _____

CERTIFICATION DATE _____ CERTIFICATION APPROVAL _____ APPROVER's NAME _____

Effective Date 04/01/2020 XX-XX-XXX Dimensional Engineering

C. Check Fixture Tags (80-ENG-F-447) are to be paper laminated and attached to the fixture between the base and a clear plastic sheet attached by 4 screws in each corner.

D. A metal identification tag shall be affixed to each fixture with the following information at a minimum and updated as required:
   r. Part name(s)
   s. Less finish part number(s)
   t. Engineering change level
   u. Part Math Data Level
   v. Product line, year, and usage
   w. Build source name
   x. "Property of xxxxxxxxx(ABC Customer)"
   y. Customer specific requirements for identification tag

All tagging must be multilingual, if required

IDENTIFICATION OF TOLERANCE PLATES

All tolerance plates should identify the corresponding part number.

B - TOOLING BALLS/TOOLING BUSHINGS

1. Three (3) Tooling balls or Tooling bushings must be located and identified with the start coordinates on the base of the gage. These features will be used to establish the origin of the fixture for certification and part layout.

2. Tooling Bushings

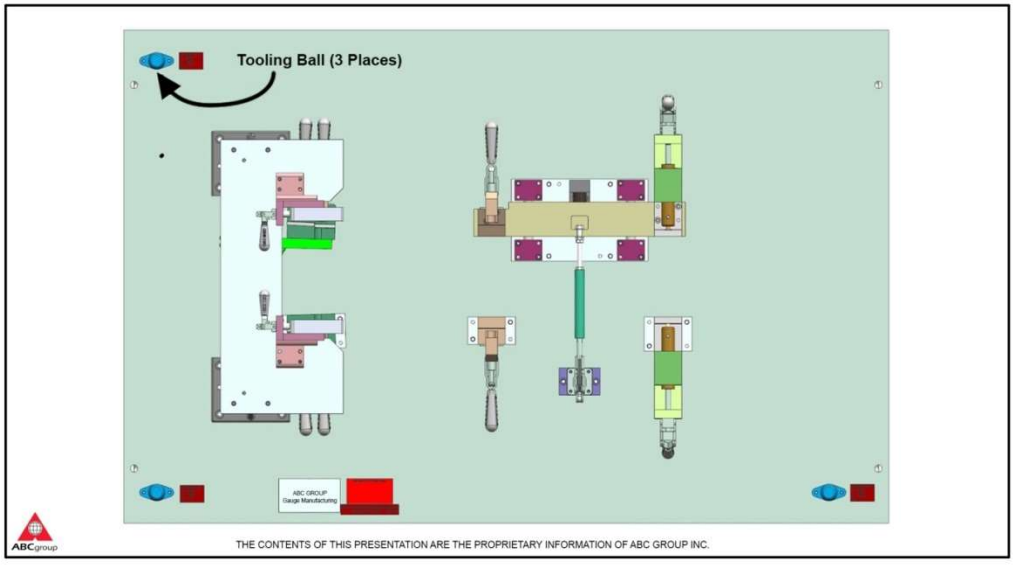
   The use of (3) tooling bushings shall be 12 mm diameter I.D. with a 40 mm diameter scribed circle around the bushing to be used as a known clean surface area. One additional 40 mm diameter scribed circle shall be added to base to create a triangle for surface (planar) alignment. Each 40 mm diameter scribed circle shall have removable protective covers. Covers must not interfere with the start coordinate labels.

3. Tooling bushings shall be recessed into the fixture base approximately 2mm from the fixture base surface.

4. Tooling ball size will be 0.500 inches (12.7mm) Tooling hole size will be a minimum of 10 millimeters.

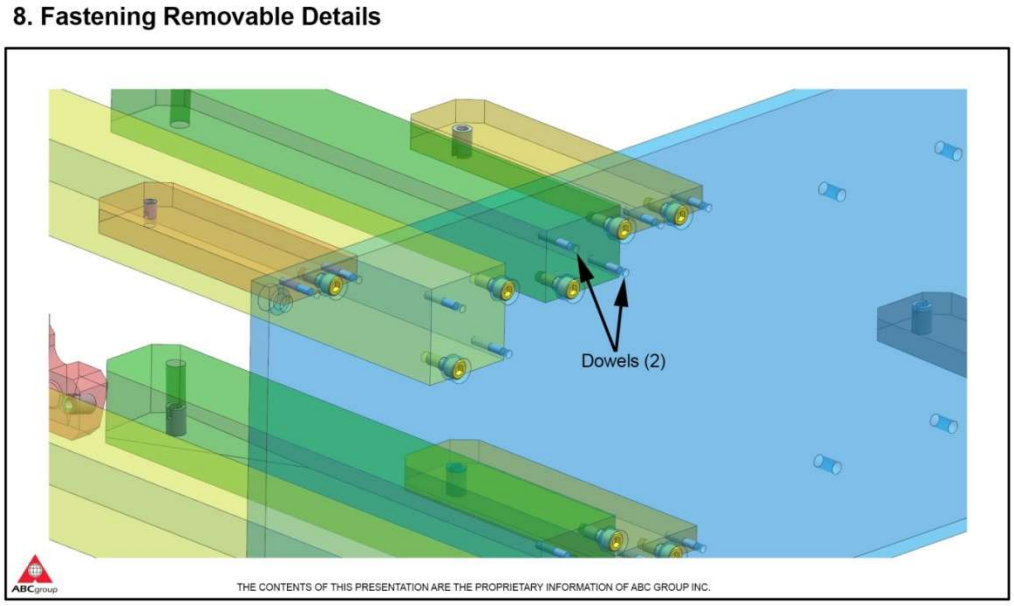
5. Each Tooling ball must have a protective cover. The cover must not interfere with the start coordinate labels.

7. Tooling Balls



C - RISERS AND STANCHIONS

1. The risers and stanchions must be attached to the base securely with a minimum of two (2) dowels and two (2) cap screws unless specified in the design as a removable detail.



2. Risers and stanchions may be relieved or cut away in certain areas to gain access to the part for dimensional inspection. It is the Supplier's responsibility to ensure the area(s) that are removed do not affect the integrity or stability of the gage.

D - DETAILS

1. All details must be attached to the base securely with dowels and cap screws. It is the Supplier's responsibility to ensure that the correct quantities of dowel and cap screws are used. If the quantity is substandard, the Supplier must fix or replace the detail without costs to ABC Group.

2. All datums, inspection details, clamps, and interchangeable details shall be identified on the fixture in a visible location as shown on the design.

3. The use of shims or shim stock **is not an acceptable** in the construction of ABC or ABC's Customers checking fixtures.

4. Details used as net surfaces must be made of hardened steel. Nets should be held in place by a minimum of (2) flat head screws (if space allows). The heads of the screws must fall below the net surface. Steel plates located on aluminum details may be used.

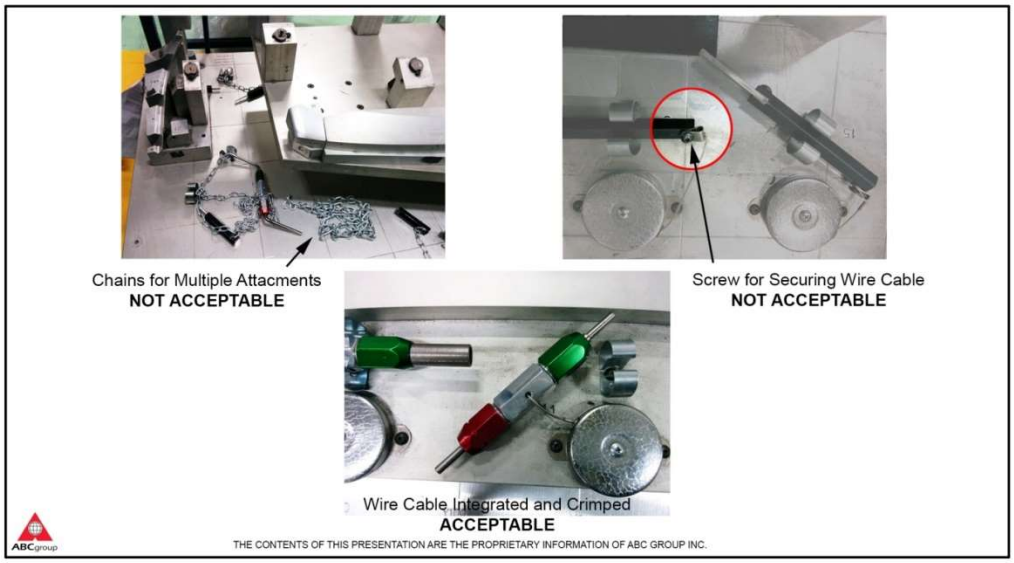
5. Flush rails, feeler rails and sheet metal representations must be constructed of aluminum or fixture plank. Fixture plank must be sectioned into details no larger than 400 mm in length each.

6. A 6 mm gap distance is to be used, unless otherwise specified by the ABC Dimensional Engineer or customer gage build standards.

7. All net details that net around the area of a hole or cutout in the part must have **CMM probe clearances** cut into the detail. These clearances must be a minimum of five (5) mm deep and two (2) mm bigger than the part feature.

8. All loose and interchangeable details such as hand knobs, Plug gages, and check pins shall be permanently attached to the fixture using Car-Lane cable, plastic coil or retractable spring-loaded cases with cable lockouts depending on the quantity and location of attachments. Self-storing (restrained) devices or recoil type cables are preferred. Chains are not recommended.

9. Attachment of Loose and Interchangeable Details



9. All noncircular plug gages must be keyed for orientation.

10. Unless otherwise specified by the customer, a plug gage located in a bushing and clamped on top will be the method to represent a **screw or fastener pin**.

11. When a single point datum target is required, a tooling ball must be used. The associated clamp must be adjusted to not deform the part.

12. Each feeler rail must have an associated go/nogo feeler pin that reflects the proper tolerance.

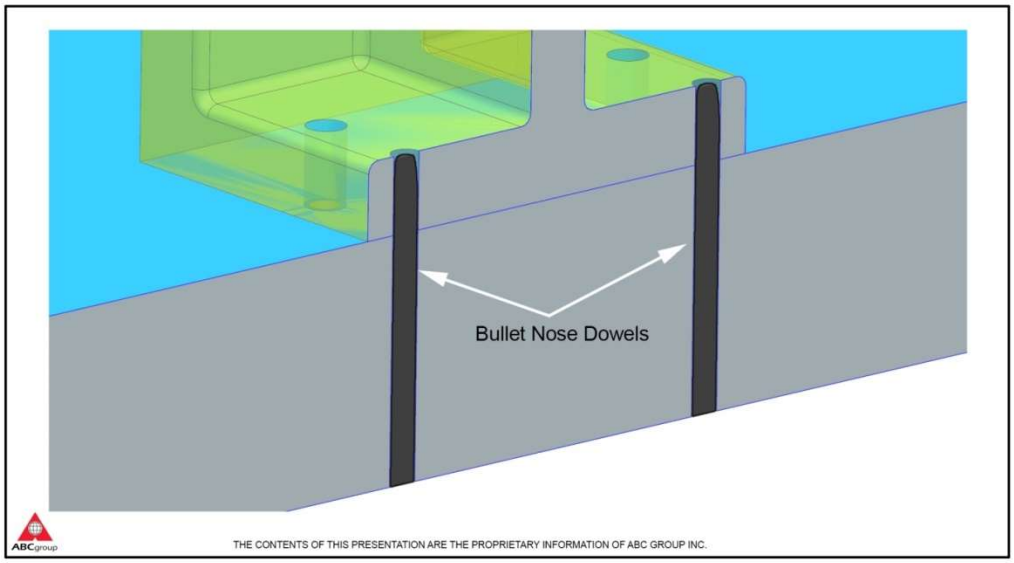
E - REMOVABLE DETAILS

1. All removable details must use hardened bushings and bullet nose or slide fit dowels. The bushings must be in the detail and the slide fit dowels must be in the mating component.

DESIGN REQUIREMENTS:

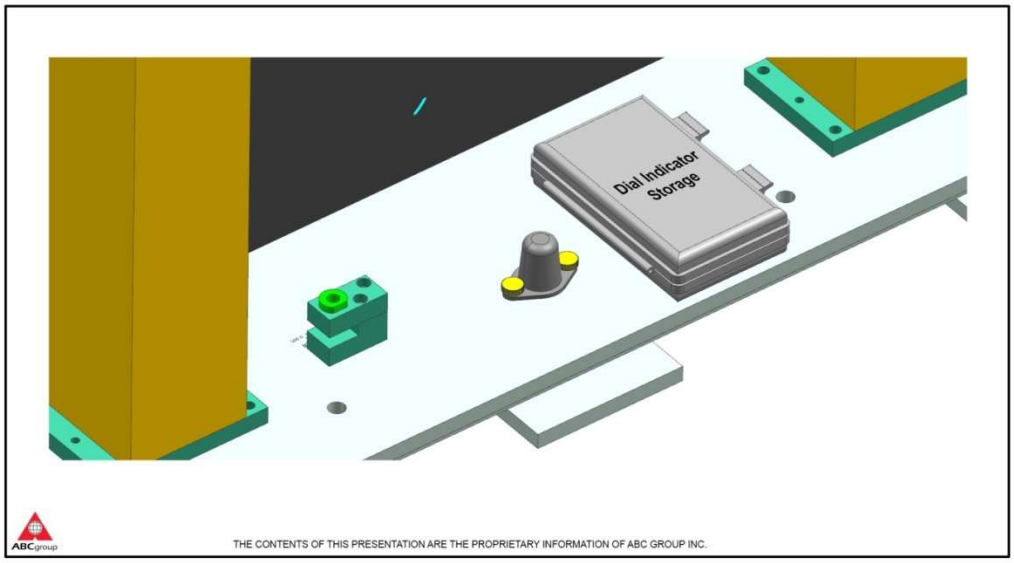
The design must show the storage locations for removable details or interchangeable details and loose components, such as SPC Indicator, GO-NOGO pins and Plug gages.

10a. Removable Detail with Bullet Nose Dowels

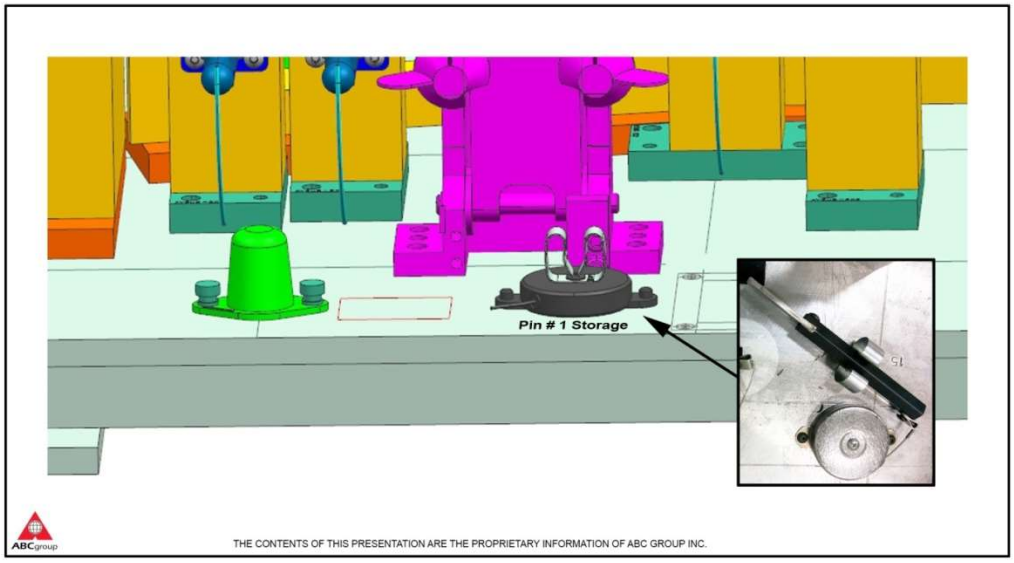


2. When there are similar removable details used on the same gauge, the details must have a unique locating scheme for each. Each detail and storage location must be clearly labeled or color-coded.

10b. Storage Location for Dial Indicator

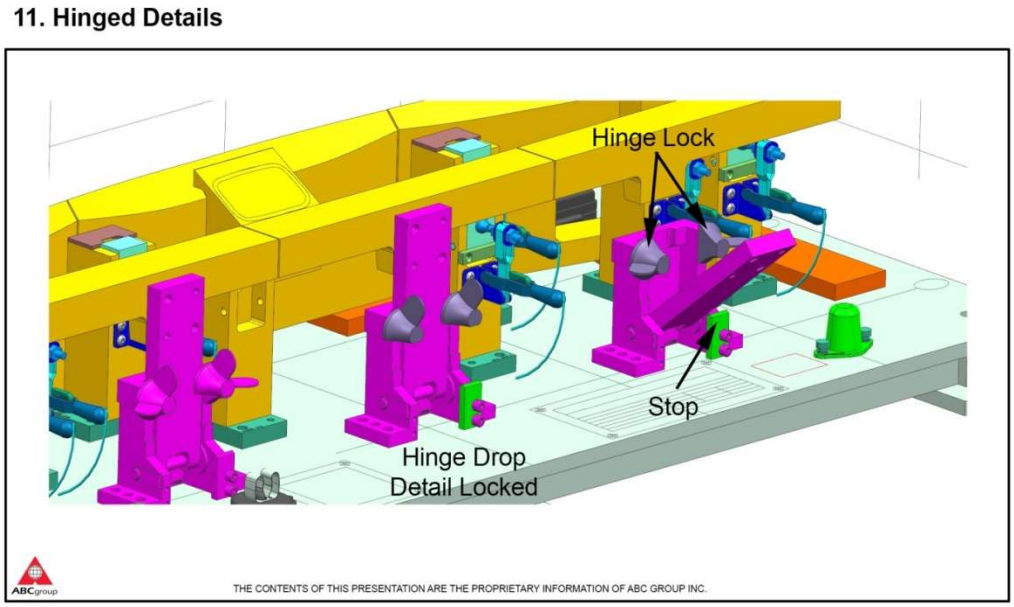


10c. Pin Storage



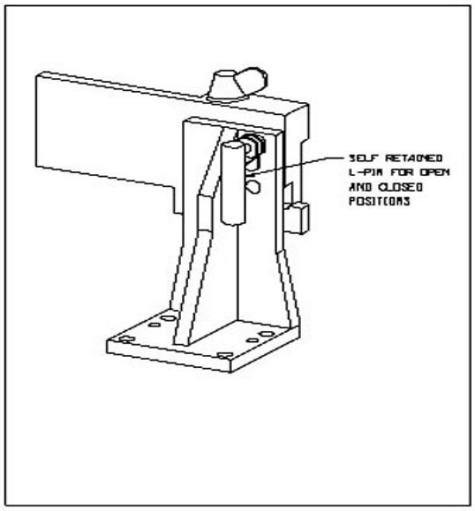
F - HINGED DETAILS

1. All hinge drop details must be counterbalanced or have a lock out mechanism installed.



2. All hinge drop details must have rubber stops installed to prevent damage.

3. Any swing bracket having a SPC bushing mounted to it, must have a captive type locator, or "T" handle pin, with bushings as a positive locator (captive pins are preferred). (Figure below)



G - LOCATING PINS

1.0 The part GD&T datums will define the type of pin to be used (RFS, MMC, etc.). ABC Group Dimensional Engineer must approve all other pins (MMC pin, LMC pin) that don't follow the part GD&T.

1.1 All tapered RFS pins must locate the part approximately at the midpoint of the taper.

1.2 All locating pins must be made of hardened steel.

1.3 If a locating pin must be locked out to load the part, the lockout mechanism must be positive. For instance, if a detail has an "L" shaped cut to lockout the locating pin, the cut must have enough lead in to disengage the locating pin and hold it out of position.

1.4 The locating pin spring pressure must be strong enough to locate the part without distortion when clamped.

1.5 Spring loaded locating pins must move freely in all directions except the locating direction using graphite lubricant.

H - CLAMPS

1. All clamps must have a clamp direction of 90° to the part surface. (See diagram below). Additionally, clamp contact point shall be centered to the net block.

2. Clamps that are spring loaded must have a positive lockout mechanism. (See diagram below).

3. When clamping over a hole, the clamp foot must be cut to allow access to the hole. Clamp foot must also have an anti-rotate attachment.

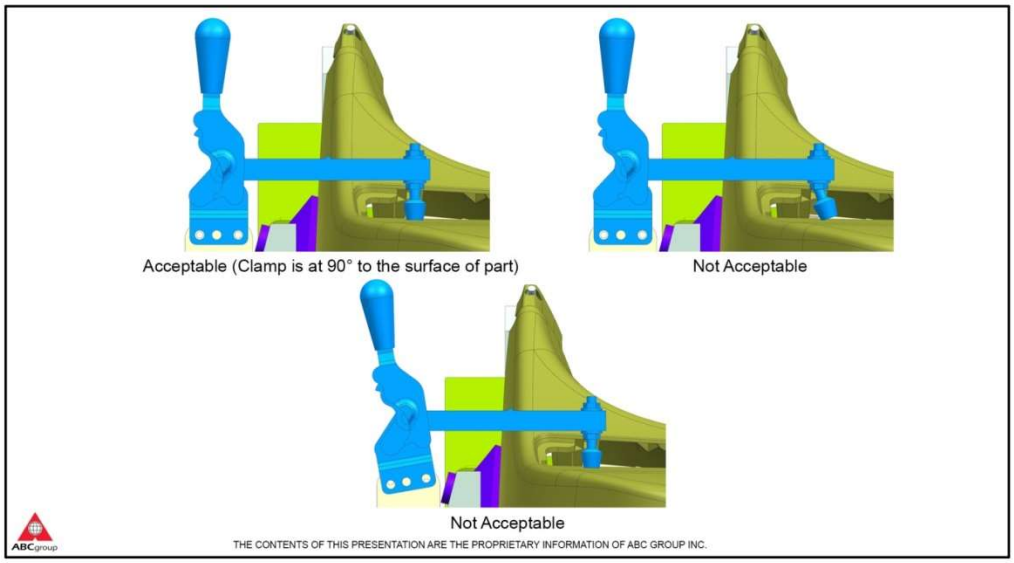
4. When engaging a clamp, it must not interfere with the part or any other detail(s) on the gage.

5. Clamp pressure must be the minimum required to locate the part, but stronger than the opposing spring-loaded features. Clamping must not distort or damage the part. Typically 5-7 pounds (2.3-3.2kg) of pressure.

6. All clamp pressure feet must not damage or scratch. Examples are rubber, neoprene or nylon. If metal clamp feet are required, they must be free of burrs and sharp edges and have a mar-proof coating.

7. The gage design shall be such that no detail overhangs the gage base when the detail is in any position.

13. Clamp Directions



I - SCRIBE LINES/TOLERANCE BANDS

1. All scribe lines and tolerance bands must be scribed or milled into the surface. Painted lines on the surface are not acceptable.

2. All scribe lines and tolerance bands must be identified with a distinct color to ensure good visibility for measurement. If a nominal line is included in the tolerance band, the nominal line must be contrasting color within the tolerance band.

3. Every effort must be made to minimize or eliminate the effect of the parallax error.

4. As required by the Customer or ABC Technologies Dimensional Engineer, gage bases may have bodylines scribed on them. It is recommended that the bodylines are scribed every 100 mm for smaller fixtures and 200 mm for larger fixtures. These bodylines must be labeled with the appropriate body coordinate and left hand (-) or right hand (+) signification.

J - SPC INDICATORS

1. The SPC indicator type to be used on all gauges supplied to ABC Group Inc. will be Mitutoyo series 543 or 575 or customer specific requirements. Specific indicator features (resolution, discrimination, travel, and sensitivity) will be dictated by each application.

2. Design shall also include clearance to utilize a LMI-200-SB-31W wireless transducer for SPC measurements. A Step file of this transducer is available either from the ABC Dimensional Engineer or from LMI's website.

3. Design shall also allow for CMM access to measure part at same location as SPC point. This is necessary for CMM to SPC point correlation.

4. Master set blocks will be at a length of 31mm. Any areas that cannot fit this standard, must be approved by the ABC dimensional engineer or quality engineer.

5. All indicators must be set up to zero out in the approximate center of its travel length. For instance, if an indicator has a 1-inch travel, the indicator must be zeroed out at .5 inch.

6. All data collection bushings are to be located 31 mm from the head of the bushing to the part. The bushing is to be a Carr-Lane head type P.F. bushing #H-40-12 x 9.52mm I.D. or equivalent. Bushing I.D. must be 9.52mm + .0127 - .000 after assembly in fixture. Any data collection bushing that had the head ground down must have a 0.75mm x 45-degree chamfer incorporated on the I.D. of the bushing to ensure that the SPC probe will seat properly.
7. All SPC bushings must be identified with a sequence number and the corresponding point ID from the part/GD&T CAD model.

8. The check direction of each indicator must be 90º to the surface it is measuring.

9. The proper indicator tip must be used for each application. Examples are listed below:
   a. Ball point/spherical/conical tip – used to check a point on a compound surface or overall length indicating on a Micro slide.
   b. Flat tip – used to check a part edge that has a radius at the checkpoint.
   c. Knife blade (chisel) tip – used to check a part edge with a flat contour.

10. If more than (1) type of tip/indicator is used on a fixture an error proofing method must be incorporated to ensure the wrong indicator cannot be used.

11. Indicator extensions should be used sparingly or only as the application dictates. Extensions must be kept to the shortest length possible to obtain an accurate measurement.

12. All indicator extensions and tips must be tightened without using lock-tite or other chemical fasteners.

13. A feather-light indicator must be used if the inspection point on the part is flexible or touch sensitive.

K - BUILD TOLERANCES

NOTE:

1.0 Tolerances are established using the following gage certification datum scheme - the primary datum is the surface plane established by the tooling balls or tooling holes, the secondary datum is the longer line established by the tooling balls or tooling holes and the tertiary datum is the shorter line established by a single tooling ball or surface target.

d. The check direction is defined as the direction(s) in which the part is to be held.

e. The non-check direction is defined as the direction(s) that the part is not to be held.

f. All tolerances are in millimeters unless otherwise noted.

Surfaces

Net Pads (datum surfaces) .....± 0.05 mm
Net Pads (boundary location/non-working axis)....± 1.00 mm
SPC Bushings (check direction).....± 0.05 mm
SPC Bushings (locations)± 0.15 mm
SPC Bushings (perpendicular to surfaces) .....± 1.0°
Feelers and Templates .....± 0.12 mm *
Flush Surfaces .....± 0.15 mm **
*Not to exceed .25 mm zone in 100 mm.
**Not to exceed .30 mm zone in 100 mm.

Unless otherwise specified, all templates are to be located perpendicular to surfaces within ± 1.0° degrees.

Holes

Locator Pins (locations) .....± 0.05 mm
Locator Pins (size) .....+ 0.00 mm / -0.02 mm
Go Pins (size) .....+ 0.00 mm / - 0.02 mm
No – Go Pins (size) .....+ 0.02 mm / - 0.00 mm
Pin Check Bushings (location).....± 0.10 mm
Pin Check Bushings (perpendicular to surfaces)...± 1.0°
Pin Check (size) .....+ 0.00 mm / - 0.02 mm
Sight Check (location) .....± 0.20 mm

Sight Check (size) .....± 0.12 mm
Units or Sub-Bases (location) .....± 0.05 mm

L - LABELING

1. All labeling on the Checking Gauges/Fixtures must be legible and descriptive. The labeling must be placed in such a manner that it is readable when the part is on the gauge. Labels may be engraved, printed or stamped. If tags are used, they must be permanently attached to the gage.

2. The following detail types must be labeled on the gage:
   g. All datums (net surfaces and locators)
   h. Clamp sequence
   i. Flush rail location and offset measurement
   j. Feeler rail location and offset measurement
   k. Go/No-go pin sizes
   l. Indicator port reference number
   m. Master set block offset measurement
   n. Body line references (appropriate customer references – XYZ or LWH)
   o. Specific measurement locations

3. Color code and assign alpha numeric value for all hole pin checks.

4. Dimple pin handle and its corresponding storage position on the base of the check fixture.

5. Dimple and label corresponding bushing area on the check fixture and fill with paint to coordinate with item 1.19.1 above.

6. Assign each hole (slot/feature) an alpha numeric value and stamp both pin handle and storage position with the number assigned the hole. This should be coordinated with the color codes.

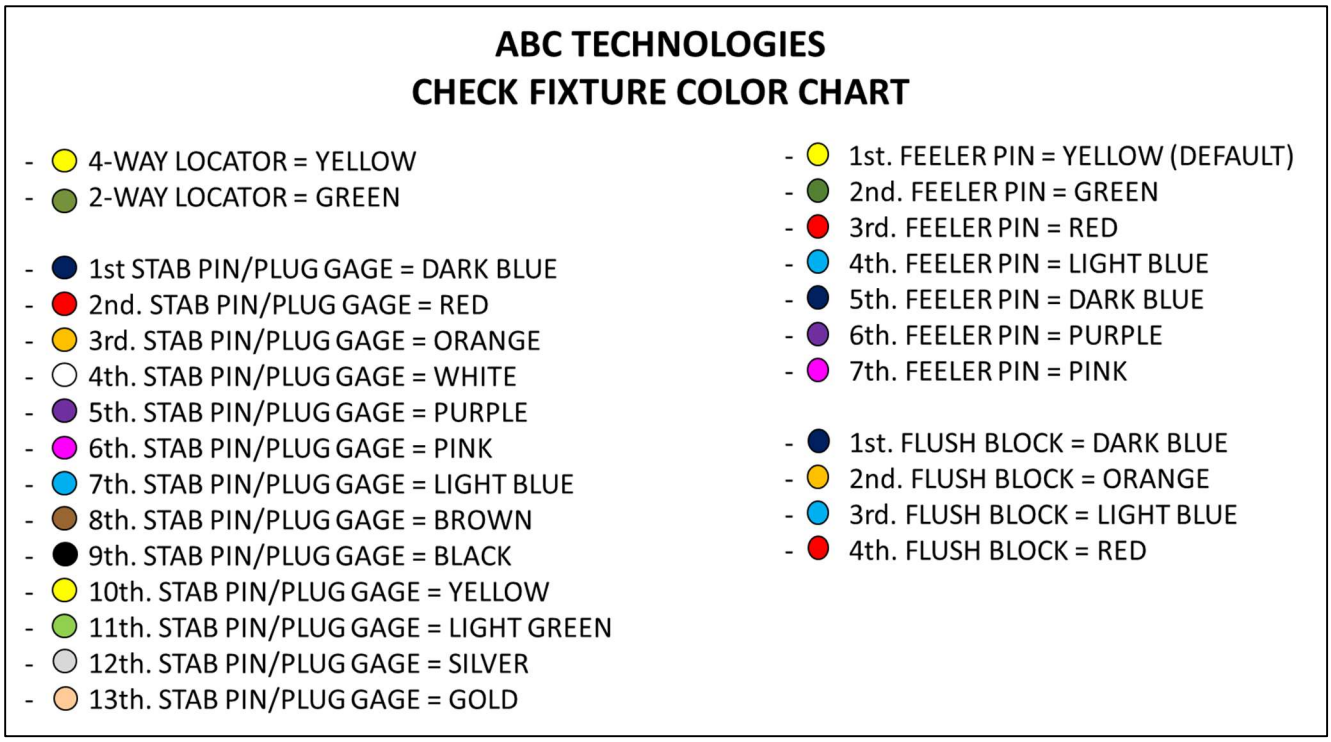


Figure L-6a

7. Tooling balls or tooling bushings on the base must be clearly stamped with the appropriate coordinates. If there are more than three (3) tooling balls or tooling bushings on the base, the three (3) that are used to certify the gauge must be stamped with the appropriate coordinates. Coordinates will be assumed to be in body position, but if they are in work line or other, they must be clearly identified with the coordinate system used.

8. Each Checking Gauge/Fixture must have a Supplier and Customer Identification tag permanently attached to it.

SUPPLIER IDENTIFICATION TAG:

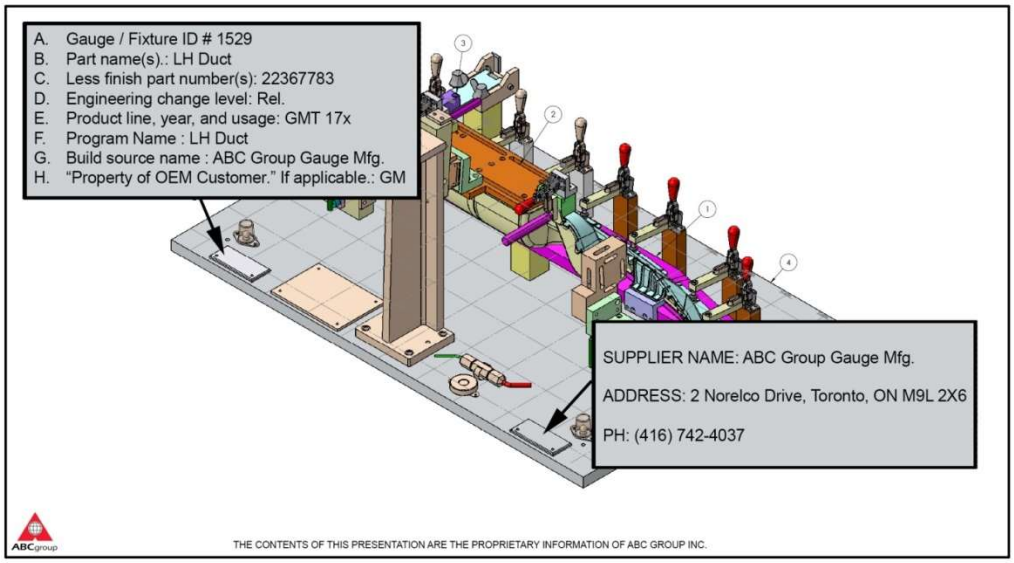
A. Supplier Name
B. Address
C. Phone number

CUSTOMER IDENTIFICATION TAG

A metal identification tag shall be affixed to each Checking Gauge / fixture with the following updated information at a minimum. The information shall be updated as required:

A. Gauge/Fixture ID # 1529
B. Part name(s).: LH Duct
C. Less finish part number(s): 22367783
D. Engineering change level: Rel.
E. Product line, year, and usage: GMT 17x
F. Program Name : LH Duct
G. Build source name: ABC Group Gauge Mfg.
H. "Property of OEM Customer." If applicable.: GM

16. Customer and Supplier Gauge Identification Tags



If the Checking Gauge / fixture is utilized to inspect additional parts or assemblies, a separate tag containing the drawing numbers, engineering levels, and dates may be required. All tagging must be multilingual, as required.

M - CORROSION PROTECTION

a. All steel components shall be protected by black oxide coating.

All non-mating surfaces must be painted with the customer-required color. If a color is not specified, blue is to be used.

N – GAUGE CERTIFICATION

1. All Checking Gauges must be certified. The Certifying Laboratory must be ISO/IEC 17025 accredited. The accreditation certificate must be the current level and valid (Check the Expiring date). It is the responsibility of ABC Checking Gauge Supplier to ensure that accredited laboratory is used to certify the Checking Gauge and their certificate is not expired.

2. A Third Party Certification is required on all gages that are manufactured by a Supplier who's certification department IS NOT accredited to a nationally recognized laboratory or inspection standard (i.e. ISO Guide 17025:2005). This accreditation must be performed by a duly recognized accreditation body (American Association for Laboratory Accreditation – A2LA or equivalent).

3. The accuracy of the Checking Gauge / Fixture must be verified using a certified CMM (traceable to a national standard). Step blocks or thickness feelers, may be certified with traceable hand held equipment such as micrometers, and Vernier Calipers. Purchased inspection details and devices (gage pins, scales, protractors, and indicators) may be certified by including the certification report from the manufacturer.

Inspection Certificate

ABC Metrology Inc.

ABCgroup

INSPECTION CERTIFICATE

Company:	ABC Metrology Inc. 2 Norelco Drive Toronto ON M9L 2X6	***Certificate No:***	2014-1
		INSP Date:	2014-11-1
		Next INSP:	2015-11-1
Part Number:	23579846	***Issue Date:***	2015-11-1
Drawing No:	23579846	***Tech Initials:***	SKT
		P.O. Number:	1614
Description:	Checking Gauge		

** (yyyy/mm/dd)*

Remarks:

Found within the supplied tolerance, see attached report for details.

ABC Metrology Inc. certifies that the item listed above meets or exceeds, unless otherwise noted, specification(s) listed as: PER DRAWING

UNCERTAINTY STATEMENT: All inspection results in this certificate conform to a manufacturer's test uncertainty of +/- 0.0004"

ENVIROMENTAL CONDITIONS: In accordance with CLAS-06E-95 for type III laboratories.

TRACEABILITY STATEMENT: The Coordinate Measurement Machine (CMM) measurement capabiltiy of this laboratory and its traceability of measurement are to recognized standards and the SI or derived unit of measurement realized at the corresponding National Laboratory. CMM calibration is generally performed by the Original Equipment Manufacturer. Interim CMM performance is verified with the use of control standards. Control standards are normally calibrated in house, or by an acceptable laboratory. Control standard traceability is established by calibrating working standards, transfer and reference standards at intervals dictated by their performance and capability requirements; taking into account measurement uncertainty at each level.

International Standard Reference: ISO/IEC 17025:2005, compliant for dimensional verification of multiple feature artifacts.

NRC/NIST TRACEABLE CALIBRATION STANDARDS

Asset:	Type:	Next Cal: (mm/dd/yyyy)
M910	MEASURING MACHINE, 3 COORDINATE LK G80	2015-11-1

APPROVED BY : _____

(CMM Team Leader)

Certificate No: 2014-1

Page 1 of 1

2 Norelco Drive, Toronto ON M9L 2X6 Tel: (416) 742-4037 Fax: (416) 246-1552

ABC Metrology Inc. Page 1

ABCgroup

CERTIFICATE: 2014-1 Inspection Date: 2014-11-1

All dimensions are in mm. U.O.S. ** = Deviation from Nominal * = Out of Tolerance

ITEM		NOMINAL	HI TOL	LO TOL	ACTUAL	ERROR	COMMENT
1	X	3650.290					11-03-030 / 11197
	Y	596.660					
	Z	395.620					
2	X	3680.290	0.100	-0.100	3680.252		
	Y	596.660					
	Z	395.620					
3	X	3716.560	0.200	-0.200	3716.560		
	Y	676.760	0.200	-0.200	676.775		
	Z	401.530	0.200	-0.200	401.476		
4	X	3719.810	0.200	-0.200	3719.815		
	Y	717.640	0.200	-0.200	717.611		
	Z	400.930	0.200	-0.200	400.742		
5	X	3740.850	0.200	-0.200	3740.852		
	Y	688.030	0.200	-0.200	688.068		
	Z	403.310	0.200	-0.200	403.225		
6	X	3722.080	0.200	-0.200	3722.080		
	Y	655.150	0.200	-0.200	655.019		
	Z	389.170	0.200	-0.200	389.224		
7	X	3749.980	0.200	-0.200	3749.983		
	Y	658.680	0.200	-0.200	658.628		
	Z	385.830	0.200	-0.200	385.892		

NOTES:

2 Norelco Drive, Toronto ON M9L 2X6 Tel: (416) 742-4037 Fax: (416) 246-1552

4. The certification must include (at a minimum) the following: datums, and functional gage features such as data collection devices, feeler checks, flush checks, nets, gage pins, pin locations, mating part representations, construction balls, etc. The certification must also include certification to multiple locating schemes (e.g., with / without fasteners).

5. The number of certification masters developed for each detail is dependent on the size and complexity of the detail. It is the Supplier's responsibility to develop a sufficient amount of points to demonstrate that the gage is dimensionally correct. As an example, on a typical 25 mm x 25 mm net block, it is recommended that a minimum of five (5) masters be used. There must be enough masters to evaluate any single or combination of elements of size, location, orientation and profile.

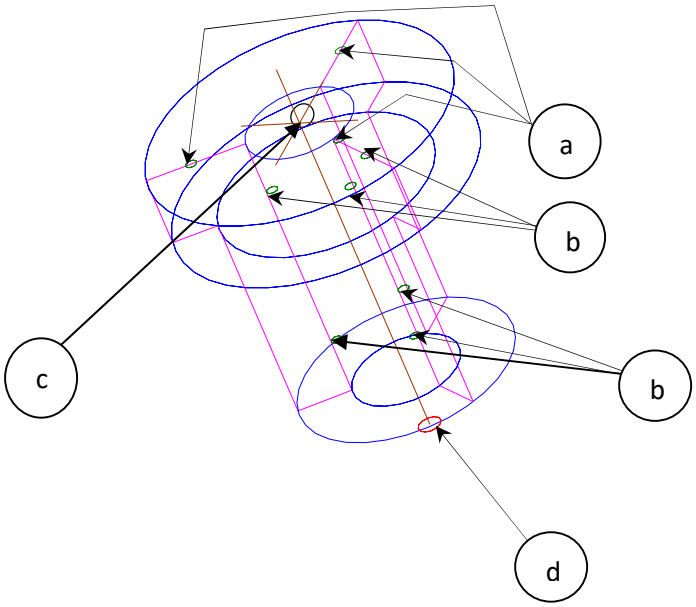
6. The construction source shall develop an easily comprehensible X Y Z and vector type CMM certification report. The check sheet should be sufficiently documented to easily relate the check points back to the part drawing.

7. All gauge certifications must include a "road map" of the certification points.

8. A new fixture certification is required for any fixture shipped outside of the country / region from which it was manufactured. This is to verify that no shipping damage has been done to the fixture.

9. Certifying the Location of SPC Bushings
    a. All SPC bushings will be certified using a coordinate measuring machine (CMM)
    b. The CMM operator will create a plane, using three (3) points that portray a true representation of the surface, off the top ground surface of the SPC bushing (see figure 9.1a)
    c. The CMM operator will create a cylinder using six (6) points that portray a true representation of the surface approx. 5mm from the top and bottom of the bushing, inside of the cylinder of the SPC bushing.
    d. The CMM operator will construct a point that will fall on the plane constructed by using the top ground surface described in Step 1 and on the center of the cylinder described in step 2 and check for perpendicularity and location.
    e. The CMM operator will construct and project the point down the vector of the cylinder located 31.0mm away from the point described in step 3, to the target

point normal to the surface of the plane described in step 1, in the direction of the intended part surface on the gage. Check for perpendicularity and location.



10. The following results must be reported:
    a. The X, Y, Z, and perpendicularity of the point in step 3 (actual & nominal.
    b. The X, Y, Z, and perpendicularity of the point in step 4 (actual & nominal)

    c. Acceptable tolerance for the non-check direction are as follows:

X = ± 0.15mm
Y = ± 0.15mm
Z = ± 0.15mm

Any deviation from this procedure requires the written approval of the assigned Dimensional/Quality Engineer to satisfy gage certification requirements.

O - GAUGE INSTRUCTIONS

1. All Checking Gauges must have the Instructions attached to the gage. An electronic copy must be supplied to the ABC Dimensional / Quality Engineer.

2. The gage instructions must be detailed and understandable. The Checking Gauge must be clearly labelled to reflect the reference(s) of the instructions. The instruction should help an inspector / operator to load, clamp, inspect and unload the part. The instructions must include all part configurations. They must include a picture of the gage with the appropriate references identified (locators, net surfaces, check points, etc.)

3. Gauge instruction templates are required for each check fixture and should follow the following order:

   Template # SOPS-01 (Operator Procedure)

   a. Isometric view with part in check fixture showing datums, nets and clamps.

   b. Clamps must be numbered showing clamping sequence used, from an acceptable GR/GR&R

   c. Detail operator instruction description

   Template # SOPS-02 (Hole Checks)

   a. Isometric view of part, showing all holes
   b. Holes to be uniquely identified
   c. Hole Identification chart listing:
      i. Hole number
      ii. Hole nominal size
      iii. Hole size tolerance
      iv. Hole description

   Template # SOPS-03 (Trim Checks)

   a. Isometric view of part showing different trim areas, outlined in color, for each tolerance check

   Template # SOPS-04 (Profile Checks)

   a. Isometric view of part showing different surface areas, outlined in color, for each tolerance check

- Note: Template/Sheets for the Trim and Profile checks may be combined into one where the instruction is still operator friendly, easy to follow.

Template # SOPS-05 (SPC Checks)

a. Isometric view of part showing all SPC measuring points
b. Each SPC point shall be uniquely identified with a numerical number & the corresponding CAD (product math model) point ID.
c. Applicable customer naming convention shall be used if applicable
d. ABC Technologies Advanced Dimensional/Quality Engineer to approve.

4. Additional Operator Instruction sheets shall be used to capture information regarding removable details, location of L-pin placements, etc.

5. The Operator Instruction Sheets shall be plastic laminated and attached to the check fixture base.

6. The Operator Instruction Sheets shall have the correct clamping sequence as determined by an acceptable GR / GR&R Study.

7. All SPC measurement points shall be numbered and shown in the Operator Instruction Sheets.

8. Master templates for the Operator Instruction Sheets will be supplied by the ABC Technologies Dimensional/Quality Engineer (see figure O-8a). Completed file to be returned to ABC Technologies in excel format.

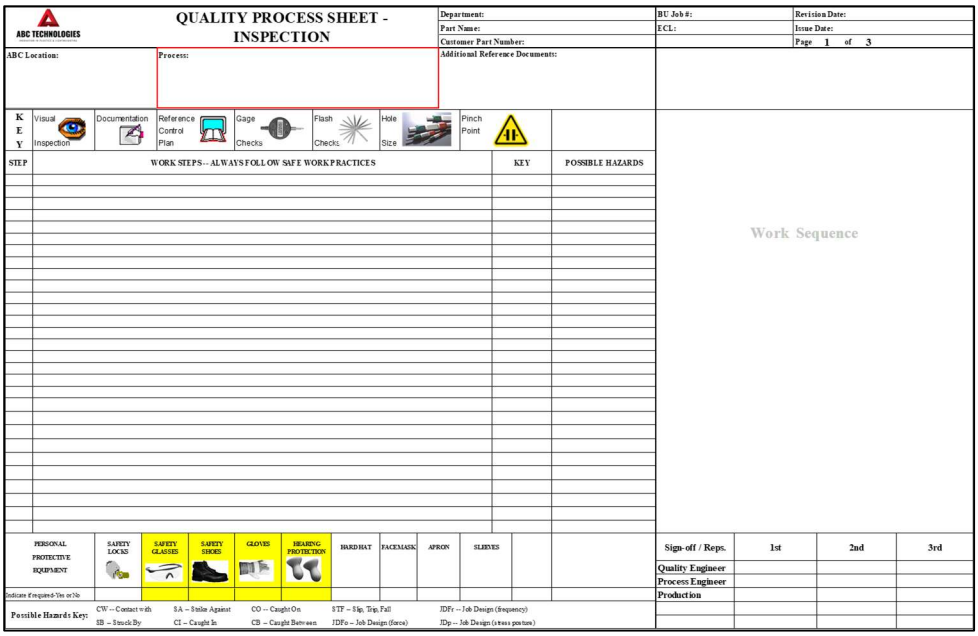


Figure 0-8a

9. The Operator Instruction excel file name must include the customer part number in its entirety (where possible), the ABC Technologies part number, part version level, file date and a "CFSOP" designation to indicate check fixture SOP file.

   Example: 9B73-98J16041_22543_AB01_CFSOP_2019_05_21

   - Indicates the Ford Console Assembly Fixture, AB01 part version. ABC Technologies part number 22543, the file is the Check Fixture SOP, file last revised on May 21, 2019.

10. SOPs shall be laminated and attached in all 4 corners via drive screws or clear tape.
    10.1 SOPs to be in font size of "12" and identify clamp sequence, etc.
    10.2 The SOP word file name must include the customer part number in its entirety (where possible), the ABC Technologies part number, part version level, file date and a "CFSOP" designation to indicate check fixture SOP file.

11. Operator Instructions shall also reference part GD&T for tolerances, and size of features of size (holes, slots, etc.)

P - GAUGE EVALUATION

1. A function check must be performed prior to delivery of the Checking Gauge / Fixture using sample part provided by ABC Representative. The Supplier may utilize their own completion checklist, but they must complete the ABC Checking Gauge Completion Check sheet before buy-off. The functional check of the gauges must consist of the following steps as a minimum requirement.

   A. Evaluate the gauge against the gauge design.
   B. Functional check of all components on the gauge.
   C. Using the gauge instructions, load the part on the gauge.
   D. Type 1 Gauge R study
   E. Identify and remove all interferences.
   F. Document the results.
   G. Correct any discrepancies.

It is the Supplier's responsibility to request parts for the Gauge Evaluation and Buy-off. If the gage is to be delivered prior to part availability, all items above must be performed, with the exception of items C and D. When parts become available, i~~I~~t is the responsibility of the Supplier to complete the Gauge Evaluation and Buy-off process.

Q - MEASUREMENT SYSTEMS ANALYSIS

GAGE REPEATABILITY AND REPRODUCIBILITY STUDY

REQUIREMENTS:

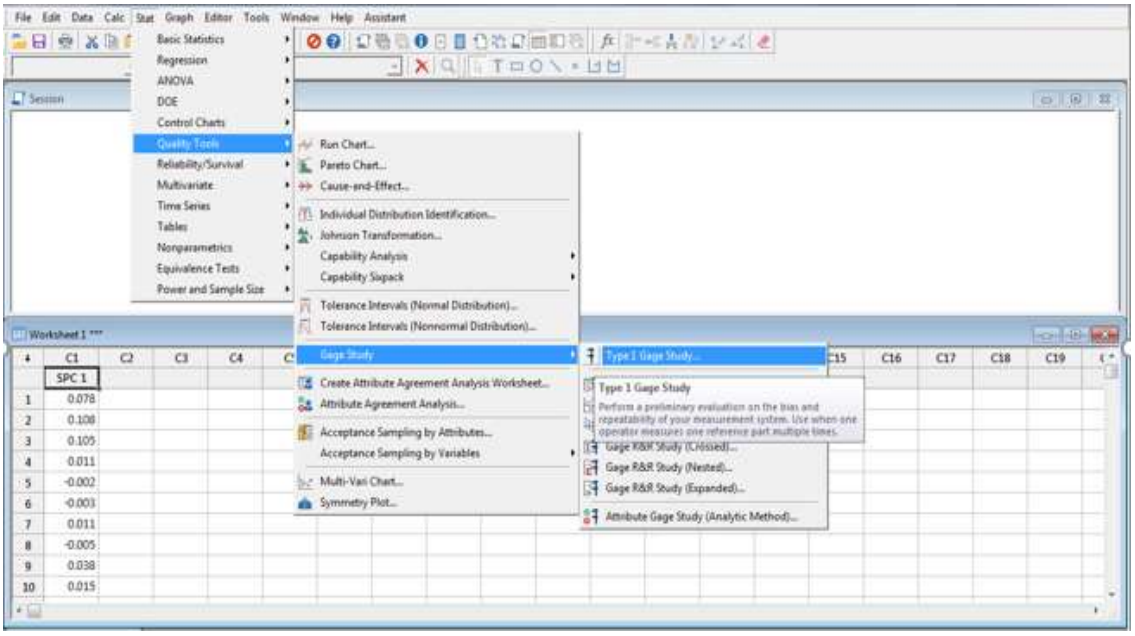
VARIABLE GAUGE STUDY

A. Supplier shall conduct a Type 1 Gauge R study before shipment
B. Type 1 Gauge R study shall be conducted for all KPCs and PQCs for each locating scheme (e.g., with/without fasteners), and performed after any modifications are made to the Checking Gauge/Fixture which might affect the repeatability and reproducibility performance.
C. Excel or Minitab software are the ABC default softwares unless otherwise directed by the customer and is strongly recommended to be the tool for the studies.
    a. ABC can supply an Excel formatted GR formatted study file, if Minitab is not available.
    b. ABC can supply an ANOVA GR&R Excel formatted study file, if Minitab is not available.
D. If there are no customer identified KPC / PQC / Critical dimensional points from the customer designs, the Gauge R&R must be performed on at least 3 dimensions from the gauge representing X, Y and Z coordinates; the selected features should be determined by review with the ABC Dimensional Engineer or plant Quality Manager; the R&R points should be selected based on one or more of the following criteria: Smallest tolerances allowed, Customer used locating features or attachment points; high difficulty in accessing measurement locations; customer preferences not shown on the design records.
    a. An ABC Technologies GR excel file standard, shall be by the ABC Technologies Dimensional Engineer.

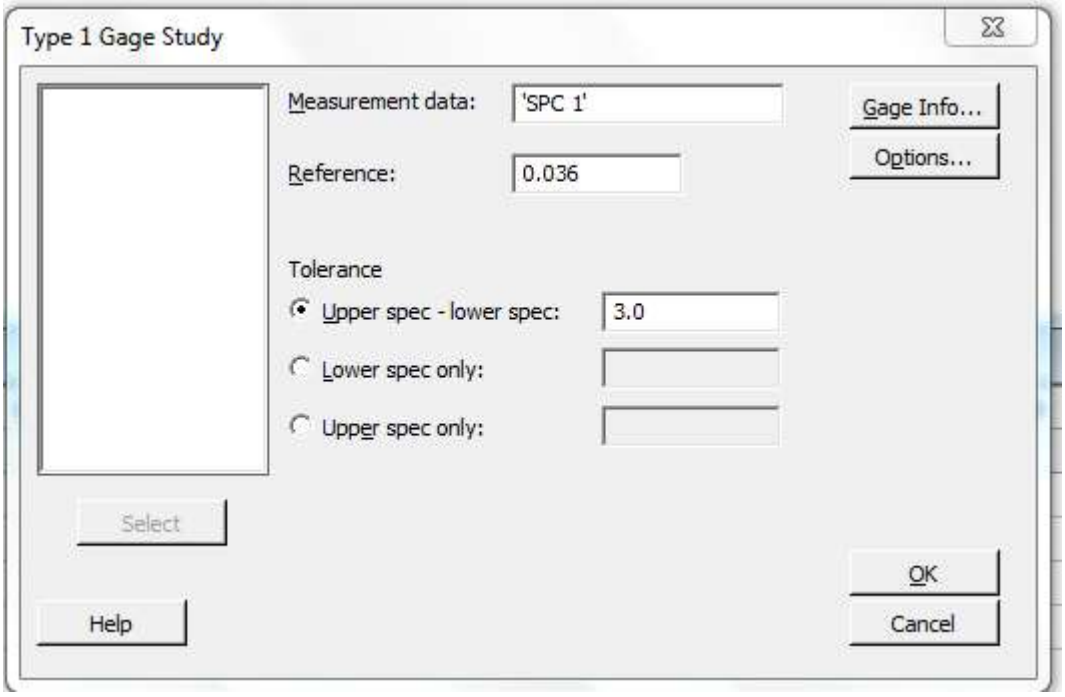
Minitab steps for Type 1 Gauge R study: 1 Sample X 1 Operator X 10 trials

Acceptability Criteria: %Var(Repeatability)<=15% and Pvalue>=0.05

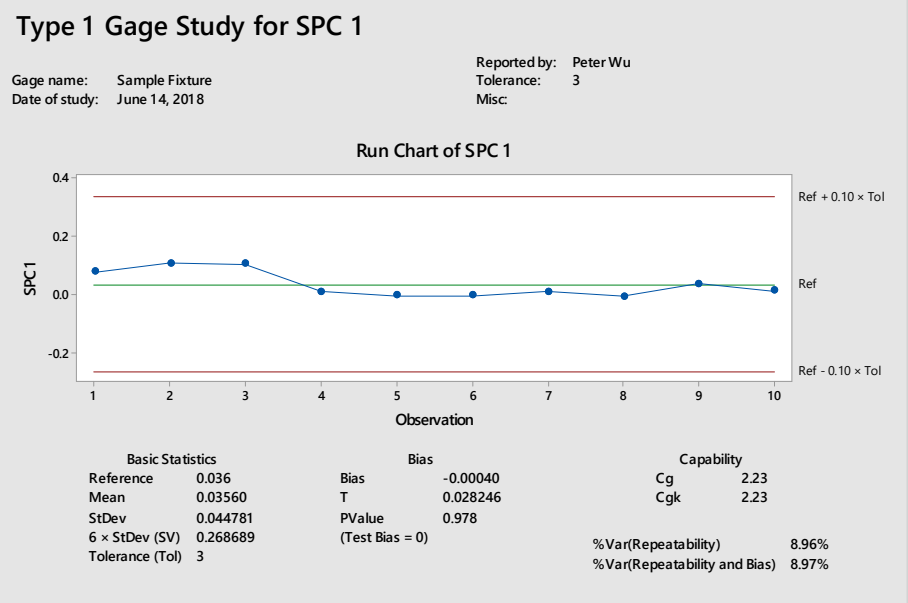
1. Go to: Stat > Quality Tools > Gage Study > Type 1 Gage Study



2. Fill in the fields with data. At least 10 observations are required for measurement data. Use the CMM measurement for reference value if it is not known. Upper spec - lower spec is tolerance range.



3. Press OK for report.



For GR&R, where requested of the supplier, ABC Technologies has a standard Excel based format for both the ANOVA method and the standard MSA method. Please request these from the ABC Technologies dimensional engineer if not provided.

Minitab steps for Gauge R&R Study(Crossed): 10 Samples X 3 Operators X 3 Trials

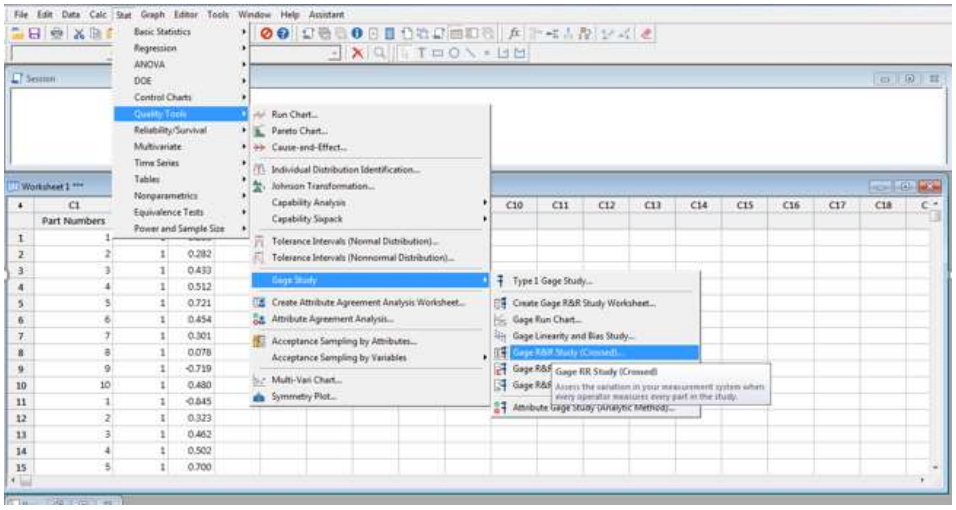
Acceptability Criteria:
Number of Distinct Categories (NDC)>=5 and
Total Gage R&R of %Study Var as per the following:
Under 10% - generally considered to be an acceptable measurement system.

10% to 30% - may be acceptable based upon importance of application, cost of measurement device, cost of repair, etc.

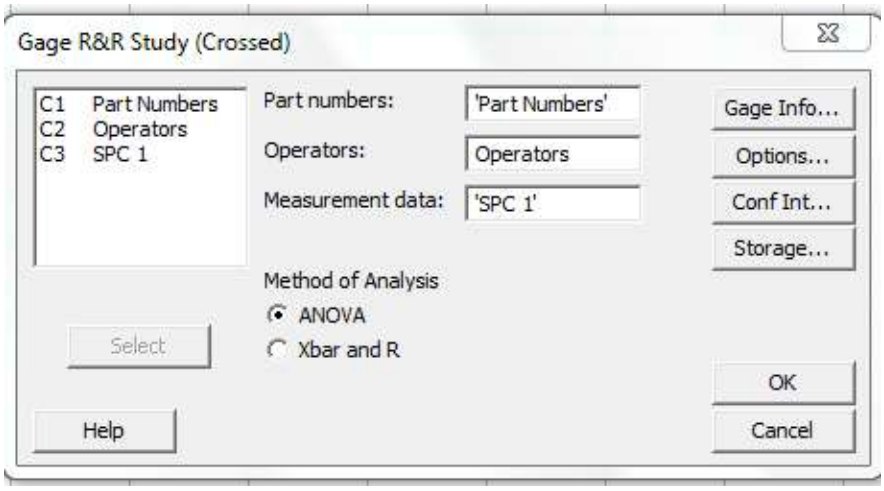
over 30% - considered to be not acceptable- every effort should be made to improve the measurement system. Written customer approval is required before gauge can be considered for use.

Where the NDC is less than 5, the Total Gage R&R of % of Tolerance will be used. The same percentages listed above applies to the % of tolerance.

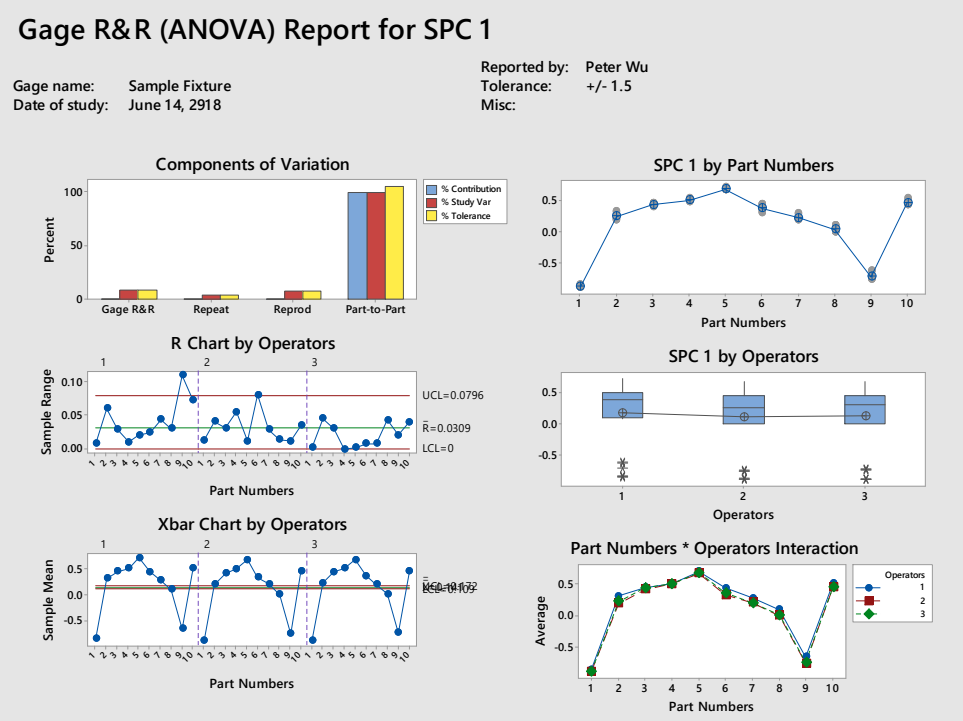
1. Go to: Stat > Quality Tools > Gage Study > Gage R&R Study(Crossed)…



2. Specify data and select ANOVA method.



3. Press OK for report.



Gage R&R Study - ANOVA Method

Source	StdDev (SD)	Study Var (6 × SD)	%Study Var (%SV)	%Tolerance (SV/Toler)
Total Gage R&R	0.044888	0.26933	8.53	8.98
Repeatability	0.020902	0.12541	3.97	4.18
Reproducibility	0.039724	0.23835	7.55	7.94
Operators	0.035382	0.21229	6.73	7.08
Operators*Part Numbers	0.018059	0.10835	3.43	3.61
Part-To-Part	0.524104	3.14463	99.64	104.82
Total Variation	0.526023	3.15614	100.00	105.20

Number of Distinct Categories = 16

ATTRIBUTE GAUGE STUDY: 50 Samples X 3 Operators X 3 Trials

In the case where Attribute Gauge RR is required, refer to AIAG MSA 4th Edition.

R - SHIPPING/TRANSPORTATION

1. All Checking Gauges/Fixtures must be completely protected from the environment when being shipped.

2. All Checking Gauges / Fixtures must be secured to avoid damage when shipping.

3. ABC Technologies will not accept the Checking Gauge/Fixture if it is delivered with damage or defect.

S - PREVENTIVE MAINTENANCE INSTRUCTIONS

1. All Checking Gauges/Fixtures must have **Preventive Maintenance instructions** supplied electronically to the ABC Dimensional/Quality Engineer prior to delivery.

2. The Preventive Maintenance instructions must be detailed and understandable with references to the gage clearly labeled. They must identify the maintenance instructions, recommended frequency of maintenance, recommended chemicals/solutions to use for maintenance and long-term storage preparation instructions.

- **NOTE:** If the chemicals/solutions cannot be purchased "over the counter", then a hardcopy of the MSDS sheet must be included with the gauge upon delivery.

Gauge Preventative Maintenance

GAUGE PREVENTATIVE MAINTENANCE INSTRUCTIONS

GAGE #: ___ **GAUGE NAME:** ____

E/C LEVEL: _____ **E/C DATE:** _____ **RECERT FREQ:** _____

Type of Checking Gauge / Fixture: ☑ CMM ☑ SPC ☑ ATTR

PART NUMBER(s): _____

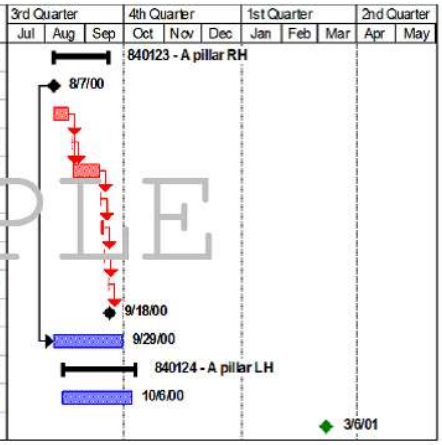
	INSTRUCTIONS:	RESP.	MAINTENANCE FREQUENCY	TOOLS NEEDED
1	Inspect fixture for damage.	ABC	Every use	None
2	Inspect electronic equipment for damage and ensure it powers up.	ABC	Every use	None
3	Remove all loose debris and wipe clean	ABC	End of shift	Broo*m, rag, mild soap.*
4	Lubricate moving parts. Ensure all screws and bolts are tight.	ABC	Once a month	Light oil, silicone spray, Allen wrench.
5	Inspect fixture for loose clamps and mechanisms and worn details	ABC	Once a month	None
6	Remove rust and small scratches	ABC	Annually	Wet/Dry sand paper, steel wool, light oil.
7	Replace batteries in electronic equipment.	ABC	Annually	#2 Phillips screwdriver, battery # EV321
8	Inspect if there is any missing attachment or other items.	ABC	Once a month	None
9		ABC	Once a month	None

T - DOCUMENTATION

1. The Supplier is responsible to provide timing for each Checking Gauge / Fixture from initial kickoff and review with ABC Dimensional/Quality Engineer throughout the project on a set periodic basis. Delays in program timing must be reported immediately, first verbally, then on the timeline.

Gauge Timeline

ID	Task Name	Duration	Start	Finish
1	840123 - A pillar RH	6.2 wks	Mon 8/7/00	Mon 9/18/00
2	Gage Kickoff	0 days	Mon 8/7/00	Mon 8/7/00
3	Design	2 wks	Mon 8/7/00	Fri 8/18/00
4	Design Approval	1 day	Mon 8/21/00	Mon 8/21/00
5	Build	3 wks	Tue 8/22/00	Mon 9/11/00
6	Certification	1 day	Tue 9/12/00	Tue 9/12/00
7	3rd Party Certification	2 days	Wed 9/13/00	Thu 9/14/00
8	Gage R	1 day	Fri 9/15/00	Fri 9/15/00
9	Function Check	1 day	Mon 9/18/00	Mon 9/18/00
10	GAGE DELIVERY	0 days	Mon 9/18/00	Mon 9/18/00
11	Quoted Timing	8 wks	Mon 8/7/00	Fri 9/29/00
12	840124 - A pillar LH	8.2 wks	Mon 8/14/00	Mon 10/9/00
22	Quoted Timing	8 wks	Mon 8/14/00	Fri 10/6/00
23	PPAP DATE	0 days	Tue 3/6/01	Tue 3/6/01



2. Supplier is responsible to provide two (2) electronic copies of the latest documents each time the gage is modified. One copy will be attached to the Checking Gauge / Fixture and the other will be delivered to the ABC Group representative.

3. The approved (signed) design is the property of ABC and will be stored at the Supplier location while a copy shall be delivered to ABC Representative. An electronic copy (and hard copy as required by the ABC representative) must be supplied with the Checking Gauge / Fixture each time the design is updated.
   q. Native CAD model
   r. Checking Gauge / Fixture Design
   s. Checking Gauge / Fixture Certification
   t. Measurement Device Certification (device used to certify fixture)
   u. Checking Gauge / Fixture R&R and/or Gauge R or Attribute study or studies
   v. Checking Gauge / Fixture Instructions
   w. Checking Gauge / Fixture Preventive Maintenance Instructions
   x. Digital picture of the Checking Gauge / Fixture

y. Any other pertinent documents as required
z. Final Checking Gauge / Fixture timeline - OPTIONAL
aa. Final Gauge / Fixture Check Sheet

4. ABC Technologies will supply all CAD models in its native format (CATIA, UNIGRAPHICS, etc.). Every effort will be made to minimize the file size while ensuring all the critical data is supplied. All IGES translation errors or problems are the Supplier's responsibility.

5. The CD jacket must be labeled with the Supplier name, Supplier job number, ABC TECHNOLOGIES' Tool Number, Gage Description, and revision level.

6. All documents that require signed approval will be in original hard copy format and kept at the Supplier.

U – CHECKING FIXTURE APPROVAL RECORD

For final approval of a Checking Fixture, by the program/business unit team and plant quality engineer, a signed check fixture buyoff XX-XX-X-XX approval will be provided by the ABC dimensional engineer prior to check fixture/gauge shipping.

V - RECEIVING INSPECTION

Please use this check sheet on initially receiving the gauge to immediately identify any problems as received. It can be found on MyABC Doc Control as 80-QA-F-36.