



MINTH

Check Fixture Tooling Standards

This Gage Standard is designed as a guide for the design and building of checking gages suitable for our products, 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.

The vendor's program manager is responsible for notifying the MNA tooling engineer of any items requiring authorizations that are spelled out in this document.



Table of contents:

Section I.....Quoting
Section II.....Procedures
Section III.....Design
Section IV.....Gage Construction
Section V.....Gage Qualification

Appendices:

- RFQ
- Concept Checklist
- Design Checklist
- Buy-off Checklist
- Gage R&R Template



I. Quoting:

1. All quotes for new gages and engineering changes are to be based on these Minth Check Fixture Tooling Standards.
2. All quotes are to have the following statement on them: "Quoted to the Minth Check Fixture Tooling Standards" Rev 4 Dated 9/10/19
3. All new gage costs are to itemized and include the following:
 - Check fixture design
 - Check fixture build
 - SPC ports – noted on RFQ
 - Dial indicator with "0" block
 - Swing Templates
 - Tooling balls on 3 corners with metal covers.
 - Gage roller carts
 - CMM layout certification by vendor
 - 3rd party Certification. (Outside 3rd party must be acceptable to OEM.)
 - Gage R & R study with a 10-3-3 format
 - Include shipping containers
 - Delivery to Minth Group N.A. receiving plant location
4. All engineering change quotes are to include the following:
 - Check fixture design
 - Check fixture build
 - CMM layout certification by vendor.
 - 3rd party Certification
 - Gage R & R study with a 10-3-3 format
 - Delivery to Minth Group N.A. receiving plant location
5. Check fixture designs must meet the OEM standards.



II. Procedures:

1. A complete design concept is required and must be approved by MNA product engineer, tooling engineer and plant quality engineer prior to construction.
2. All drawings are to be identified with the Minth Group N.A. RFQ number & suffix, date, vendor name, customer name, program, part name, part number, and revision level of the part.
3. Within 3 days of kickoff the vendor is to have a **2D design concept** meeting for the purposes of setting up the layout of the check fixtures design.
4. At the design concept meeting the **Concept Approval Checklist** is to be filled out along with the schematics showing the layout concept and criteria.
5. Along with the concept design, a timeline is to be submitted showing the following time phases:
 - Kickoff
 - Design concept
 - Submission for preliminary design approval
 - Submission for final design approval
 - Gage construction
 - Gage in-house CMM
 - Gage R&R
 - Gage 3rd party certification
 - Gage buyoff
 - Delivery to Minth Group N.A. receiving plant
6. A MNA representative must approve the initial gage design and subsequent design changes. It is preferred 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 MNA representative and the Vendor must sign the final design. Other signatures may be required, as dictated by the customer design standards.
7. For Design Approval, the **Design Approval Checklist** is to be used to verify that the design meets the MNA requirements. The check list is to be filled out showing that all items are there and complete when submitting the design to the MNA Tooling Engineer.
8. Once the vendor has a 3D design complete along with the design check list filled out, a review meeting can be setup with the MNA tooling engineer who will setup a meeting



with the appropriate plant personal. In some instances, customer approval may also be required.

9. If any changes to the design have been noted it will be up to the team to document them and approve construction or have the vendor resubmit for approval the design after the modifications are made.
10. No construction is to start without a signed preliminary design approval and authorization to precede.
11. All designs are to consider:
 - Operator and maintenance personnel safety.
 - Body position relative to fixture base.
 - Simplicity in operator part loading without restrictions and interference.
 - Easy accessibility to all components for ease of maintenance and replacement.
 - Rigidity of construction for 5 year production floor endurance.
 - Detailed gage instructions mounted to fixture.
12. The Vendor is to provide the following information in order to receive final acceptance from Minth Group N.A.
 - Gage R&R acceptance - < 10% gage R&R using a 10-3-3 format
 - Supplier to provide a CMM layout of the check fixture
 - 3rd party certification
 - CAD files in STEP format
 - BOM

III. Design:

1. The gage design is intended to be an accurate representation of the gage. It should reflect how the gage 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.
2. Acceptance of design by MNA does not in any way alleviate the vendor from responsibility for the function, performance, repeatability and dependability of the check fixture being supplied.
3. The designs must have an isometric view of the gage on the design.
4. The designs will be drawn and dimensioned using the metric system unless otherwise specified by MNA.



5. All datum surfaces and locators must be labeled on the design with the respective GDT datum callout.
6. 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.
7. Flush, feeler and hole location pins, including Go/No-Go are to be mounted and tethered using a coated cable to the gage base with a holder and shown in design. These need to be color coded with corresponding marks on the fixture showing where they are to check the part. Color coded chart attached to fixture is also helpful.
8. All bases are to be cast aluminum type unless authorized by the OEM customer. In special cases where a 1.0" aluminum plate is used for a base it must have 1.5" X .380" min. round or square hardened (50 RC) Jig feet mounted in the four corners.
9. Bases are to be made from aluminum and ground top and bottom +/- .003 inches flat and parallel.
10. Fixture base must be large enough to include all clamps and targets in open position, permanently mounted gage use instructions and I.D. plate.
11. Any bases over 30" in length are to have eye bolt holes for handling.
12. The maximum distance between jig feet is not to exceed 28".
13. Design must be in body position as the model or part print is dimensioned or rotated (90) or (180) degrees.
14. A Bill of Material is to be supplied along with the 3-D CAD file.
15. Design must provide openings for CMM check access.
16. When designs are required, they are to be full size. The designs must show plan, front, side and perspective views.
17. All details, rails, swing templates, SPC ports are to have sections necessary to clarify design.
18. The design is to have tooling ball locators at the "0" corner and both adjacent corners.
19. The tooling ball locators are to be hardened steel.
20. The X, Y, Z dimensions for the tooling ball are to be stamped in the base plate next to the tooling ball locator.
21. All components are to be shown in all views.



22. Centerlines and body lines must be shown in (3) planes and in all views and sections and on finished adjacent edges of fixture.
23. Finished height of based for RH/LH fixtures should be identical.
24. For designs that require sections, start with section letter "A" and continue through the alphabet. The sections must be full size or larger, sections less than 1:1 are to be labeled "reference only"
25. Sections must be cut normal to surface.
26. Sections are to show tolerances from GD&T.
27. Identify master central points (i.e. datum locating holes on surface).
28. Gages are to address all G.D. & T. controls as shown on part prints.
29. Part must locate against the datum's in (3) directions.
30. When using datum holes utilize 4-way & 2-way spring loaded locators or MMC pin locators per part GD&T.
31. Designs must provide check element for mating surfaces as required.
32. All clamps and moveable units must be shown in closed and open position.
33. Design is to plug check all holes, slots and notches.
34. All gage pins are to slip fit into standard size bushing, press fit in nominal position in fixture.
35. For four-way and two-way locators whether spring loaded RFS or MMC pins, the design is to show a section through and perpendicular to each of the locators.
36. All sight checks must be approved by Minth Group N.A. product engineer.
37. If G.D. &T. information is not available on part prints, use the hole/slot size from math data and print tolerances to determine the gage pin diameter.
38. Flush and feeler checks must be identified on design drawings, in all views and sections and must be etched or steel stamped on checking fixture.
39. Identify net areas of fixture with cross-hatching on the design.
40. Identify material being used in stock list by detail.
41. The gage base is to have a "0" corner that designates two adjacent base edges as the master corner. The "0" corner is to be painted Yellow.



42. The zero corner is to be identified with a 45 degree chamfer that is no less than 15mm on each side.
43. All designs are to be supplied to MNA tooling engineer along with the **Buy-off Checklist**.
44. CAD files are to be supplied in STEP formats.
45. Gages are to be built using industry the OEM's build standards).
46. All fixtures are to be constructed from steel or aluminum unless otherwise specified.
47. Nets pads (primary datum) are to be hardened 40 RC inserts.
48. When the gage must be built to the part print dimensions or Mylar print rather than the 3-D CAD model, the dimensioned side of the part should be the fixture side unless otherwise specified.
49. Gages that check different assemblies and details must clearly identify the interchangeability for each part. Part numbers must be clearly stamped on all interchangeable parts and must be stored in a screwed down position on the fixture base.
50. All removable details which are not mounted on swing templates must be pinned into bushings and stamped with part numbers.
51. Swing template bases are to be pinned and bushed using a purchased cam type stop and hardened block to stop (do not use pins).
52. Hand applied gages must be designed as small and as light as possible.
53. The gage base must provide a place to mount and store any hand applies or interchangeable details.
54. The target datum's as indicated on the part print, must be utilized for gaging, clamping or hold down areas and must agree with part print GD&T.
55. For construction use 3-D CAD model for contour, break lines and form. When no model is available work to part prints. Dimensions for hole locations, trim edges, flange lengths, etc. must be obtained from part prints or CAD data.
56. All pivot points on drop units' must have hardened bushings.
57. Mating surfaces and all check points must be machined.
58. All details, rails, swing templates are to be screwed and dowel.
59. All feeler checks are to be a 3.0mm or 6.0mm offset. Amount of offset will be determined at concept review.



60. Clamps in open position are to be inside the edge of base (to minimize base size).
61. Indicators are to be digital probe type.
62. Indicators are to have a storage box and be shown in design.
63. SPC bushing I.D. size to be 3/8" diameter.
64. A sensitive indicator must be used if the inspection point on the part is flexible. The indicator cannot move the part during inspection.

IV. Check Fixture Construction:

1. All gages are to be constructed from Steel or Aluminum unless otherwise specified.
2. All nets (Primary Datum) on all fixtures are to be 40 RC hardened inserts.
3. All clamps to be permanently marked to show clamping order.
4. Clamps must have a clamp direction of 90° to the part surface.
5. Clamp pressure must be the minimum required to locate the part, but stronger than the opposing spring-loaded features.
6. All bases are to be cast aluminum (Equivalent) type.
7. Bases are to have scribed body lines every 100mm.
8. No shims of adjustability will be allowed in any checking fixture.
9. Mating surfaces and all check points must be machined.
10. Provide fastening and storage for all loose details to the fixture when not in use.
11. Go/No-Go pins are to be in a colored handle with Green for Go and Red for No-Go.
12. Stamp on gage in appropriate places:
 - Datum surfaces or locations
 - As indicated, use 3.0mm feeler flush and 3.0mm clearance on sight check
 - Relationship of body lines or part to base.
 - Body lines.
 - Part number and gage diameter on all gage pins and loose templates.
13. Any components that are called out to be hardened steel are to be a minimum of 40 RC.
14. Stamp following information on identification plate:
 - Part number



- Part name
 - Latest part print e/c
 - RH or LH part
 - Ownership
15. Body coordinates for SPC point to be stamped on fixture.
16. Gage roller carts are to be 30" in height, wide enough not to tip over and sturdy enough to hold the weight of the fixtures. Carts are to be painted dark blue.
17. Gage roller carts are to have urethane covered caster.
- 3" – 4" diameter casters
 - Two swivel type with brakes
 - Two straight type

V. Gage Qualification:

1. Check fixtures must meet $\leq 10\%$ Gage R&R using a 10-3-3 format. One of the three personal shall be someone from MNA.
2. Operator instructions are to be followed for clamping sequence.
3. All gages are to have a CMM layout done by vendor (In-House) and 3rd party to validate all datums, surface, KPC's and SPC's.
4. All gages are required to have a 3rd party certification. Layout by the 3rd party is to be done from math data only.
5. Vendors providing third parts certification layouts are to be approved by the OEM supplier.
6. Data collected for the Gage R&R study is to be by digital indicator or CMM only. Data from calipers, scales or taper gages are not acceptable. Attribute Gage R&R requirements to be agreed with program engineering and should follow AIAG MSA guidelines.
7. Check fixture buyoff requires the following:
 - 3rd party certification
 - Gage R&R study report $< 10\%$
 - Supplier CMM certification
 - CAD files in STEP format



8. General build tolerances:

Feature	Tolerance
Location tolerance	
4-way & 2-way locator pins	+/- .05 mm
Net pad surface	+/- .05 mm
Form / Feeler check	+/- .12 mm
Trim / Flush check	+/- .15 mm
Sight check	+/- .20 mm
Check pin or bushing	+/- .10 mm
Data port - controlling direction	+/- .05 mm
Data port - non-controlling direction	+/- .50 mm
Size tolerance for locator pin / check pin / go /no go pin (inside or outside diameter)	+/- .01 mm