



General
Motors
Worldwide

Fixture Standards

For Suppliers of
Production
Material

Foreword

The **GM Fixture Standards for Suppliers of Production Material** was developed to establish common GM Supplier PPAP checking fixture standards worldwide. Previously, fixture standards existed at the divisional or unit level only.

In 1996, a development team was formed which included representatives from GM Truck, Mid/Lux, and the Small Car Group. In addition, the development process included collaboration with Saturn, GM Powertrain, and GM Canada Group.

In March 2005 the **GM Fixture Standards for Suppliers of Production Material GM 1925** manual was revised. The revisions contained in this March 2005 printing are the result of collaboration from representatives from GM NAVO APQP, GM NAVO Fixture Engineering, and GM Dimensional Engineering.

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Revision Information

<u>Date</u>	<u>Section</u>	<u>Revision</u>
March 2005	I A. Preface	<ul style="list-style-type: none"> Third paragraph revised as follows: The GM Supplier Quality Engineer (SQE) and/or the GM Fixture Engineer reserve the right, with engineering approval, to modify the gage standards (including Geometric Dimensioning and Tolerancing, and measurement points). The SQE and/or Fixture Engineer will obtain direction and approval from GM Dimensional Engineering prior to the modification of these standards. They are also required to procure the appropriate supporting documentation for these modifications (e.g., EWO, marked drawings approved by engineering, etc.)
	I B. Scope	<ul style="list-style-type: none"> First paragraph added: All GM suppliers must ensure that their sub-suppliers are also meeting these minimum requirements. P.E.D. -114 Checking Fixture/Gage Standards Manual and NAO Fixture Standards for Suppliers of Pre-Production Material (Ref. NAO #0042) wording revised
	II B.3 Part Supplier Responsibilities	Added: NOTE: SUPPLIER IS RESPONSIBLE FOR VERIFYING WHETHER OR NOT DUAL LOCATING SCHEMES (e.g., WITH / WITHOUT FASTENERS) ARE REQUIRED)
	II B.4	Added: Product Quality Characteristics (PQCs
	II B.5	Added: Variable data collection devices are required for all KPCs, and PQCs. For KPCs and PQCs, these variable data collection devices must be hard attached to the fixture / gages. These variable data collection devices must be capable of meeting all AIAG Measurement Systems Analysis (MSA) requirements.
	III.B.2	Added: May require multiple attaching schemes
	II. B.4	Added (e.g., standard clamping and / or using fasteners)
	III.D	Added PQCs and the need for the GM Fixture Engineer to review and approve with input from the GM SQE
	IV. Concept Approval	Added the need for the GM Fixture Engineer to approve the gage Concept with input from the GM SQE
	V Design Requirements	First paragraph new: The checking fixtures used to check the fit, form, and function of the part to the vehicle will be designed in a cooperative effort between the Supplier, GM Fixture Engineer, GM Supplier Quality Engineer, and the GM Design Engineer and built through the supplier. If assistance is required, GM Dimensional Engineering should be consulted.

V.A.	Clarified the Design source shall refer to the concept sketch and the written description provide in the Statement of Requirements (SOR) or in the customer's 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 from GM Design Engineer in order to support program deliverables.
V.B.	New section, refer to manual for detail
V.C.	New section, refer to manual for detail
V. D.	Renumbered, previously section V.B
V.D.8.	Revised as follows: Fixture designs must be generated utilizing customer approved software.
V.E.	Renumbered, previously section V.C.
V.F.	Renumbered, previously section V.D.
V.G.	Renumbered, previously section V.E.
V.H.	Renumbered, previously section V.F.
V.I.	Renumbered, previously section V.G.
V.J.	Renumbered, previously section V.H, added: 3. Storage should be included on the fixture base for interchangeable details
V.K.	Renumbered, previously section V.I.
V.L.	Renumbered, previously section V.J.
V.M.	Renumbered, previously section V.K.
V.N.	Renumbered, previously section V.L.
V.O.	Renumbered, previously section V.M.
V.P.	Renumbered, previously section V.N.
V.Q.	Renumbered, previously section V.O.
V.R.	Renumbered, previously section V.P.; added the GM Fixture Engineer for review and requester of information
VI.F. Build Requirements	Revised the use of multilingual operator instructions from should to must be considered where applicable.
VI.H.	Added GM Fixture Engineer as approver
VI.O.2.b.	Dimension revised from +/- 0.15 mm to +/- 0.10 mm
VI.O.2.d.	Dimension revised from +/- 0.20 mm to +/- 0.15 mm
VI.P.	Added: All tagging must be multilingual, as required.
VI.Q.	Clarified that the Checking Fixture Build Check List is required and may be requested by the GM Fixture Engineer or GM SQE
VII.B. Certification Requirements	Added: Must also include certification to multiple locating schemes (e.g., with / without fasteners), as required by GD&T.
V.III.A. Gage Repeatability and Reproducibility Requirements	Revised to: Supplier shall ensure that Gage R&R is conducted based on AIAG MSA Manual for all KPCs and PQC's for each locating scheme (e.g., with / without fastener.)

	V.III.B. From 12/97 Printing	Removed was previous D
	V.III.B.	Previously V.III.D.
	V.III.C. From 12/97 Printing	Removed
	V.III.C.	Previously V.III.F.
	V.III.E. From 12/97 Printing	Removed
	IX.A. Gage Final Approval	Was Maintenance Requirements, now new section for Gage Final Approval; reference manual for detail
	X. Maintenance Requirements	Previously section IX
	XI. Glossary	Previously section X
	XI	Added Product Quality Characteristics (PQCs), reference Glossary for detail
	Back cover page	Removed

Revisions, if any to this document will be documented on this page as shown. This list will be extended as new revisions are made, retaining the old entries for documentation

purposes. The versions will sequence 1.0, 2.0, 3.0, etc. for revisions. The section and item changed can be referenced to quickly locate any changes made from version to version.

This manual supersedes the following documents:

- Truck & Bus Checking Fixture/Gage Standards (T&B 391), December, 1989.
- MID/LUX Part Fixturing Design/Build Standards, April, 1996.

GM Fixture Standards

I. Preface

A. Introduction

In accordance with The Automotive Industry Action Group (AIAG), The Advanced Product Quality Planning (APQP) Manual, and The Production Part Approval Process (PPAP), part suppliers will obtain fixtures, if and when required, to monitor their product as part of their quality plan.

Production part suppliers shall utilize this manual in addition to their own standards and requirements when quoting, designing, and building fixtures for General Motors purchased parts.

The GM Supplier Quality Engineer (SQE) and/or the GM Fixture Engineer reserve the right, with engineering approval, to modify the gage standards (including Geometric Dimensioning and Tolerancing, and measurement points). The SQE and/or Fixture Engineer will obtain direction and approval from GM Dimensional Engineering prior to the modification of these standards. They are also required to procure the appropriate supporting documentation for these modifications (e.g., EWO, marked drawings approved by engineering, etc.)

B. Scope

The **GM Fixture Standards** summarize the *minimum* requirements that apply to all GM suppliers PPAP checking fixtures worldwide. All GM suppliers must ensure that their sub-suppliers are also meeting these minimum requirements.

This manual exists to provide a uniform process for the procurement of PPAP checking fixtures, suppliers shall incorporate these standards into their in-process and / or sub-assembly gaging.

In addition to these standards, the following manuals must be utilized where applicable:

The GM P.E.D.-114 Checking Fixture/Gage Standards Manual

The NAO Fixture Standards for Suppliers of Pre-Production Material (Ref. NAO #0042)

II. Part Supplier Responsibilities

- A. When fixtures are required, the part supplier is directly responsible for all elements of the fixture procurement process. In addition, the part supplier shall document all relevant activity. Due to the varying complexity of component parts covered under this document, the supplier must contact the procuring unit to determine the appropriate extent of the GM SQE's involvement.
- B. The Supplier shall ensure that the following apply to all fixtures:
1. Are procured in a timely manner to meet program timing objectives, including GP-11, where applicable.
 2. Agree with functional part usage.
 3. Comply with part Geometric Dimensioning and Tolerancing (GD&T) by honoring the datum scheme.
3.1 NOTE: SUPPLIER IS RESPONSIBLE FOR VERIFYING WHETHER OR NOT DUAL LOCATING SCHEMES (e.g., WITH / WITHOUT FASTENERS) ARE REQUIRED
 4. Must include the measurement of all Key Product Characteristics (KPC's), and Product Quality Characteristics (PQCs).
 5. Variable data collection devices are required for all KPCs, and PQCs. For KPCs and PQCs, these variable data collection devices must be hard attached to the fixture / gages. These variable data collection devices must be capable of meeting all AIAG Measurement Systems Analysis (MSA) requirements.
 6. Include the ability to discriminate part variation from nominal.
- C. In accordance with QS-9000 Element 4.11, the supplier shall establish and maintain documented procedures for measuring equipment control. This documentation should include:
1. A dimensional inspection report. The use of a Coordinate Measuring Machine (CMM) is preferred.
 2. Documentation of engineering changes.
 3. A Gage Repeatability and Reproducibility study.

4. A fixture design print.

The supplier shall maintain the change columns of both the fixture design and the fixture. The change column shall reflect the latest production design level whether the fixture has been affected or not (see Section VI, Item P).

The supplier is expected to resolve design problems in a timely manner. The design and construction source is responsible for immediate notification that a problem exists. Any revision that changes the original fixture cost must be approved by GM Purchasing.

III. Design Concept

- A. Prior to starting a fixture design, a preliminary design concept meeting should be held. Core members expected to participate include the following: the supplier fixture engineer, the fixture design/construction source representative, and the GM SQE. Other members may include: the GM Release Engineer, the Dimensional Engineering Engineer, a manufacturing plant representative, and the GM Purchasing representative.
- B. The design concept shall consist of a sketch and a written description of the fixture with sufficient detail in order that the fixture design process can proceed. 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 fixture base. Body position 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.
 2. A datum scheme consistent with the specified Geometric Dimensioning and Tolerancing. May require multiple attaching schemes.
 3. Details and devices for supporting the part.
 4. Proposed clamping techniques (e.g., standard clamping and / or using fasteners)
 5. Details and devices for inspection of features such as:
 - KPCs, PQCs, PMPs
 - Feature lines

- Functional holes
 - Historic areas of high process variability
6. Acceptable construction materials based on fixture usage and environment to ensure functionality, repeatability, and reproducibility throughout the length of the part program. (Reference P.E.D. 114)
 7. Mating or adjacent part representations or features, where applicable.
- C. Operator ergonomics, part loading and unloading, and accessibility for CMM inspection and Statistical Process Control (SPC) data collection should be considered in the Design Concept. Operator usage should also be considered when fixtures are required on vehicle programs that are global in scope (Language for region of use).
 - D. The X,Y,Z location(s) on product features where SPC data will be collected to monitor KPCs and PQC's shall be reviewed and approved by the GM Fixture Engineer with input from the GM SQE.

IV. Concept Approval

If Concept Approval is required by the procuring division, the part supplier shall obtain Concept Approval by the GM Fixture Engineer with input from the GM SQE prior to initiating the fixture design process (see Section II, Item A).

Any change which may occur during the fixture procurement process that has significant impact on the original concept should be reviewed with the GM Fixture Engineer and GM SQE.

V. Design Requirements

The checking fixtures used to check the fit, form, and function of the part to the vehicle will be designed in a cooperative effort between the Supplier, GM Fixture Engineer, GM Supplier Quality Engineer, and the GM Design Engineer and built through the supplier. If assistance is required, GM Dimensional Engineering should be consulted.

- A. The Design source shall refer to the concept sketch and the written description provided in the Statement of Requirements (SOR) or in the customer's 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 from GM Design

Engineer in order to support program deliverables.

B. For mechanically attached parts the gage must check:

1. Free state check for contour conformance to surface
2. All Part Of Assembly (POA) fastener locations without fasteners
3. Fixture must have capability to measure flushness without any restraint and with the fasteners, by installing part to the fixture. Fixture shall also contain release mechanisms by which to remove the part. No clamping pressure permissible on A-Surface during part check with fasteners. Also should be able to measure gap at critical locations.
4. Part size
5. Profile / contour

C. For tape applied parts the gage must check:

1. Free state check of contour conformance to surface
2. Flush / gap fit of part to fixture surface (less than 1 mm is default unless otherwise specified by GD&T)
3. Part size
4. Profile / contour
5. Location of locating features such as pins, slots, holes, etc.

D. All drawings should be full-size, and accurately represent the dimensions shown. In addition:

1. Details shall be complete in all views and must be dimensioned to machined surfaces and/or body and/or work lines.
2. 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).

3. Drawings should include a representation of the part (phantom) shown in its gaging position. Line weight must be sufficient for reproduction.
 4. The stock list shall include all stock sizes, and must identify standard items by supplier name and full catalog number.
 5. Fixture design details should be drawn separately from the fixture assembly only when needed for build clarification.
 6. All dimensions should be in metric however, the stock list may contain items in Standard English dimensions.
 7. Stock items (i.e., angle brackets, risers, hinge drops, slides, screws, dowels, etc.) should consist of standard commercially available materials whenever possible.
 8. Fixture designs must be generated utilizing customer approved software.
- E. The environment in which the gage 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.)
- F. The datum scheme(s) shall be applied to the fixture design drawing and the gage. The general concept is to locate the part in three dimensions by use of datum locators referred to as “primary,” “secondary,” and “tertiary” datums.
- G. Datum Hole Locator(s):
1. Gage 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.
 2. 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.

3. 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.
- H. Datums that are positioned directly adjacent to a spot-weld, seam weld or parting line shall be brought to the attention of the responsible Design Engineer. If the datum cannot be re-located, clearance shall be provided on the fixture detail to facilitate gage R & R.
- I. Normal build practice notes, (i.e., dimensions for cable attachments or screws and dowels) are not necessary on the fixture design.
- J. All details utilized for part inspection including check pin sizes shall be identified on the gage design. In addition, all removable and interchangeable details shall be identified including their associated function. The use of color coding details has proven to be an effective technique in communicating the use of multiple model applications on the same gage or fixture. Interchangeable details require the following:
 1. Hardened steel bushings for locator pins.
 2. Permanently attached hand knobs.
 3. Storage should be included on the fixture base for interchangeable details
- K. Cut lines (i.e. body grid lines) in bases larger than 48” should be considered when utilizing height gages for part evaluation.
- L. 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.
- M. The gage design shall be such that no detail overhangs the gage base when the detail is in any position.
- N. Showing redundant or right to left symmetry is not necessary on fixture designs. Wherever practical include only unique, one sided detail information with a “Symmetrical About C/L Except as Shown” note.
- O. All part information including math data used in the design and required for fixture construction must be identified on the fixture design (including latest revision level / date.)

- P. All changes to the fixture design shall be alpha-numerically indicated in a change notice block affixed to the upper right hand corner of sheet one and ballooned throughout the design where applicable. A brief change description referencing the appropriate Engineering Work Order (EWO) or applicable engineering change number should be identified with each change event.
- Q. Operator instructions and/or a sequence of operations on the use of the fixture shall be shown on the completed design. The use of multilingual operator instructions must be considered where applicable.
- R. The production part supplier shall review the finished design with the design source and provide the fixture/gage design to the GM Fixture Engineer and /or GM SQE when requested. The use of the Checking Fixture Design Check List is (ref. Appendix A) required and may be requested by GM Fixture Engineer or GM SQE.

VI. Build Requirements

- A. The construction source shall treat the design as the controlling expression of gage construction.
- B. Whenever possible, all fixtures should be built to math data. Part design drawing information should be utilized when math data is not available.
 - 1. Die models, die model duplications, cutter tapes, etc. if available are construction aids only.
 - 2. Surfaces of gages taken from any die models, die model duplications, etc. are to be completely checked and certified to engineering data per above specifications.
- C. All datums, inspection details, clamps, and interchangeable details shall be identified on the fixture in a visible location as shown on the design.
- D. For attribute checking details, the use of scribe lines, part outlines, and trim lines are an acceptable method for part evaluation. An additional alternative is to scribe a "Max/Min" line, capturing the theoretical nominal trim line.
- E. For variable data collection devices, a standard zero block, with bushing, is to be mounted to the fixture base. The set-up dimension should be a nominal value, i.e., 50.00 mm.

- F. Operator instructions and/or a sequence of operations on the use of the fixture shall be securely affixed to the gage. The use of multilingual operator instructions must be considered where applicable. These must be the same instructions as shown on the fixture design (see Section V, item O).
- G. The use of eye-bolts for fixtures over 50 pounds is recommended.
- H. All weldments shall be stress relieved, unless prior approval is obtained by the GM Fixture Engineer and/or GM SQE.
- I. All loose and interchangeable details such as hand knobs and check pins shall be permanently attached to the fixture. The use of self storing (restrained) devices or recoil type cables are recommended.
- J. The use of shims or shim stock is **not** an acceptable practice in the construction of GM checking fixtures.
- K. When templates are utilized, 1/4" aluminum stock is an acceptable choice for template construction.
- L. All non-check fixture surfaces shall be painted medium blue.
- M. Any steel non-check details susceptible to oxidation should be coated in such a manner as to provide long term protection based on usage, environment, etc. Wipe-on solutions that are removed by normal handling of the details are not recommended.
- N. All check pins shall be manufactured from an acceptable material and hardness to ensure durability and functionality throughout the life of the part program.
- O. Fixture Construction Tolerances
 - 1. All fixture details including fixture bases, datums, and inspection details shall be accurately manufactured in order to ensure the accuracy required for product inspection.
 - 2. General guidelines are as follows:
 - a. All datums used to position the part in the gage are to be located in the gage within +/- 0.10 mm.

- b. All fixture details such as check pins and bushings, details used for electronic measuring devices, etc. which check part features are to be located within +/- 0.10 mm.
 - c. Surface contour features for in-line/feeler checks are to be within +/- 0.15 mm.
 - d. Trim line features for in-line/feeler checks are to be within +/- 0.15 mm.
 - e. Templates are to be within +/- 0.25 mm.
 - f. Sight checks are to be within +/- 0.50 mm.
3. When certain part features drive deviations from the above specifications, the 1/10th rule can be utilized for fixture tolerancing. Ten percent of the tolerance specification indicated on the part drawing for the particular part feature can be used for build tolerances.
- P. A metal identification tag shall be affixed to each fixture with the following information at a minimum and updated as required:
- Part name(s).
 - Less finish part number(s).
 - Engineering change level.
 - Product line, year, and usage.
 - Build source name.
 - "Property of General Motors."

If the 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.

- Q. The production part supplier shall review the finished fixture with the construction source. The use of the Checking Fixture Build Check List (Appendix B) is required and may be requested by GM Fixture Engineer or GM SQE.

VII. Certification Requirements

- A. Prior to part supplier approval, the construction source shall inspect and certify in writing the completed fixture.
- B. The certification must include at a minimum the following: datums, and functional gage features such as data collection devices, flush checks, nets, gage pins, pin locations, mating part representations construction balls, etc.) Must also include certification to multiple locating schemes (e.g., with / without fasteners), as required by GD&T.
- C. The construction source shall develop an easily comprehensible X Y Z type check sheet and/or coordinate print-out from a coordinate measuring machine. The check sheet should be sufficiently documented to easily relate the check points back to the part drawing. An example is provided below:

X Master	X Check	X Diff.	Y Master	Y Check	Y Diff.	Z Master	Z Check	Z Diff.	Vec.Diff.	Type
Datum A2										
3900.000	3899.942	-0.058	500.000	500.086	0.086	1592.500	1592.500	-0.000	0.1033	SurfRd
Det #5 3MM Flr. Const.										
3910.000	3909.998	-0.002	-207.700	-207.812	-0.112	1605.000	1605.000	-0.000	-0.1119	SurfRd

- D. In addition to the certification provided by the construction source, an independent third party audit should be considered at the discretion of either the part supplier or the GM SQE. The purpose of the certification is to have a third party verify dimensionally the master coordinates and points checked and documented by the build source.
- E. To ensure consistency in base alignment, the certification source should use the same start points as the construction source, and not just arbitrary points.
- F. A copy of the certification is to be provided to the part supplier/ GM SQE when requested.
- G. When a fixture is inspected and found to be dimensionally incorrect or specifications are not met, the part supplier is directly responsible to identify the root cause and implement corrective action.

VIII. Gage Repeatability and Reproducibility Requirements

- A. Supplier shall ensure that Gage R&R is conducted based on AIAG MSA Manual for all KPCs and PQC's for each locating scheme (e.g., with / without fasteners.)
- B. The Average and Range method is a mathematical method which will determine both repeatability and reproducibility for a measurement system. This method is required for PPAP.

Guidelines for acceptance of an Average and Range Gage R & R study are:

- | | |
|---------------------|--|
| 1. Under 10% error | Gage system acceptable |
| 2. 10% to 30% error | May be acceptable based on the importance of the application, gage cost, cost of repairs, etc. |
| 3. Over 30% error | Gage system needs improvement. Make every effort to identify the problems and have them corrected. |

If there is any question whether the percentage of gage error listed in item 2 above requires improvement, contact the procuring division SQE (see Section II, Item A).

- C. A Gage R & R study should be performed after any modifications are made to the fixture which might affect the repeatability and reproducibility performance. (See Section IX, item B)

IX. Gage Final Approval

- A. Supplier is required to obtain from GM Fixture Engineer and / or GM SQE an approved copy of the GM Global Request for Gage Construction / Design Review worksheet GM 1927-29 (posted in www.gmsupplypower.com). Supplier is required to submit / maintain this document with PPAP documentation.

X. Maintenance Requirements

- A. In accordance with QS-9000 Element 4.11, the part supplier must perform regularly scheduled fixture maintenance (based on usage) to retain the measurement capability of the fixture throughout the entire part program.

- B. The part supplier must continually update fixtures to the latest engineering level, whether the ongoing changes affect the fixture or not. When an engineering change does affect fixtures, the gage must be modified, re-certified, and a Gage R & R study must be performed. This applies to any engineering change which may take place throughout the entire length of the part program.

XI. Glossary

Body Position:

The positioning of the part in the gage in the identical orientation the part will have in the final assembled vehicle.

Design Concept:

The first level of development in the gage design process. The purpose of the design concept is to establish and document the requirements of the gage. This will ensure the gage designed includes all the requirements of the part supplier and GM.

First-Use Position:

The positioning of the part in the gage in the identical orientation the part will initially have in the assembly tooling as it is first assembled. An example of first-use position is a door ring which may be laying on its side as brackets are welded to it in the assembly process.

Gage Certification:

The dimensional verification that the gage details (i.e. datums, SPC details, etc.) have been manufactured to facilitate accurate part measurement.

Gage Design:

The final construction drawings that will enable the gage builder to construct the gage intended for the part supplier.

Gage Repeatability and Reproducibility:

A measurement system analysis of the gage. The analysis is described in the AIAG Measurement Systems Analysis Manual.

Key Product Characteristics (KPC's):

Product characteristics for which reasonably anticipated variation could significantly affect the product's safety or compliance with governmental standards or regulations, or is likely to significantly affect customer satisfaction with a product.

Product Quality Characteristics (PQCs)

A special characteristic in which the customer is equally satisfied across the entire specification, but the loss function is steep just outside of the specification limits.

- a. Variation within the tolerance does not significantly affect customer satisfaction, whereas variation outside the tolerance may significantly impact customer satisfaction.
- b. For organizations that use symbols to designate special characteristics, use the symbols in Figure 4. i.e. non vehicle assembly drawings.

X,Y,Z Check Sheet:

A table which is used to document the dimensional inspection of a gage. It consists of columns representing the original design dimensioned coordinates, the coordinates of the actual built gage, and the deviation between the design dimensions and the actual dimensions.

Appendix A

Checking Fixture Design Check List

(rev 23 Sep 1997)

Part #	Assembly Part #	
Year & Style:	G, D, & T Dwg.#	E/C Level
Tool / Part Name:	Tool Design Sheet/s #	

Supplier:	SQE:	Ph:
DUNS/Z-Code:	Source C/F Eng:	Ph:
Design Source:	Contact:	Ph:
Const. Source:	Contact:	Ph:
Prod. Plant:	Contact:	Ph:

ITEM	CHECKING FIXTURE DESIGN CHECK LIST	Approved by --->	CKR	ENG
1	Are standard and commercial items used, where possible, to minimize cost and simplify construction?			
2	Does component or assembly orientation on design conform to GD&T?			
3	Does parts list reflect latest engineering changes?			
4	Are operational procedures (OP's) part of the design and are they complete?			
5	Are clamp pivot points in line with pressure points?			
6	Are all applicable datum locating points identified?			
7	Is adequate clearance provided for component or assembly load and unload?			
8	Are all check features practical and accessible?			
9	Do swing details clear other components?			
10	Are swing rails or details within perimeter of base when in opened position?			
11	Are counterbalances required for swing rails or details?			
12	Is 25.0 mm sight hole required on swing unit to confirm seating of hinge?			
13	Are all fixture design check rails and check details properly identified?			
14	Decals, i.e., tile block, math data required, sign off, etc., on design?			
15	Have provisions been made for handling?			
16	Will handling chains clear all details of fixture?			
17	Are all operational safety issues addressed?			

Comments:

Approved by ---->	Source C/F Eng:	SQE:
Date:	Const. Source:	Plant Rep:

Appendix B

Checking Fixture Build Check List

(rev 23 Sep 1997)

Part #	Assembly Part #	
Year & Style:	G, D, & T Dwg #	E/C Level:
Tool / Part Name:		

Supplier:	SQE:	Ph:
DUNS/Z-Code:	Source C/F Eng:	Ph:
Design Source:	Contact:	Ph:
Const. Source:	Contact:	Ph:
Prod. Plant:	Contact:	Ph:

ITEM	FIXTURE CONSTRUCTION CHECK LIST	Approved by --->	CKR	ENG
1	Completed fixture is built to the latest tool design revision level.			
2	The fixture base is certified & reference body grid lines are properly identified.			
3	All datums & checks exist & are properly identified as per the gage design.			
4	All details are properly color coded, painted, or corrosion resistant coated.			
5	All details are attached to the fixture & properly identified with gage # & detail #.			
6	Check for loose dowels, shims, burrs, dirt between surfaces, etc.			
7	Check for proper slip fit of locating pins, check pins, slide units, etc.			
8	Check for proper & safe function of swing units, templates, etc., (pinch points).			
9	Check for proper fit & pivot align. of clamps to contact surface, (w/ mtl. thickness).			
10	Check for proper function & clearance for SPC data collection units.			
11	Check for proper function, storage, & I.D. of apply & style change units.			
12	Certification documentation is provided & verified for the below listed items.			
a.	The complete fixture certification, in its assembled condition.			
b.	Net datum surfaces, gage holes, tooling ball locators, etc.			
c.	Check rails, check blocks, templates, etc.			
d.	Data collection bushings, transfer pins, pivot devices, etc.			
e.	Locator pins, MMC plug checks, scribe pins, go/no go pins, etc.			
f.	Sight checks, scribed lines, painted trim lines, (max/min tolerance bands), etc.			
13	Certification & revision tags are properly filled out & attached to the fixture.			
14	Operator instructions are completed & attached to the fixture.			
15	Functionality and R&R checks are completed & documented as per A.I.A.G.			
16	Fixture has adequate features (lift rings) for safe movement of the fixture.			
17	The fixture is constructed to G.M. standards & construction tolerances.			
18	Shipping instructions are provided as required.			

Comments:

Approved by ---->	Source C/F Eng:	SQE:
Date:	Const. Source:	Plant Rep: