



**FLEX-N-GATE BRADFORD**

**GAUGE / FIXTURE STANDARDS**

# FLEX-N-GATE FIXTURE/GAUGE STANDARDS

## INTRODUCTION

### Section 1.0

#### 1.0 GENERAL

This standard provides a common gage expectation used by all Flex-N-Gate Departments.

This standard gives the gage source guidance in the requirements for design, build, inspection and certification of Flex-N-Gate gages to check components. These Flex-N-Gate Standards shall be adhered to for all gages.

Deviations from these standards may be granted from Flex-N-Gate in writing and would be included with the standard as part of a specification package. All quotations shall then state that the gage being quoted shall be designed and built to the specification package and/or Flex-N-Gate Gage Standard.

Design approval shall not constitute a waiver or guarantee of responsibility for any gage purchased by Flex-N-Gate Corporation. An approved gage design does not constitute a certified or functional gage.

For Flex-N-Gate user plant gages only Flex-N-Gate approved design/build source shall be used, unless agreed upon by Flex-N-Gate in writing.

For outside supplier gages the Supplier shall notify the Flex-N-Gate quality department when the design/build source is not from the approved/recommended source list. Also the Flex-N-Gate quality department must review and sign-off the inspection/certification report.

The quality department at specific facilities shall distribute copies of the Gage Standard, along with all future revisions to the suppliers on the approved source list.

## GAUGE DESIGN

### SECTION 2.0

#### 2.1 General

1. All gage designs become the property of Flex-N-Gate.
2. Gage designs shall be a Computer Aided Design (CAD).
3. All CAD gage designs shall be formatted in Iges at delivery.
4. The design proposal shall have Flex-N-Gate approval at 100% completion. The design source shall submit one set of design plots for this review. All gage designs shall be signed-off by Flex-N-Gate using a Fixture Time Line Form. **(GCF-XXX)**
5. Upon shipment of the gage to the Flex-N-Gate User Plant the CAD models shall be stored and archived by Flex-N-Gate quality department along with the file containing the calibration record and fixture print.
6. The gage shall address all GD&T controls and tolerance surfaces as shown on the released part model.
7. All stamping gauges will have the max and min
8. All gages shall be designed in metric.
9. No Shims or adjustability shall be allowed in any gage. Flex-N-Gate approval required for the use of grind spacers.
10. All steps in gauge sequence; including clamping, feelers, and location pins shall be labeled in the order of intended operation. Standard gauge sequence will be.
  1. Qualify Datum's in order (A, B, C).
  2. Qualify Pitch Checks (If present).
  3. Qualify all feature sizes.
  4. Set stations to MMC condition.
  5. Verify locations of all Features of Size.
  6. Set stations to RFS condition.
  7. Verify profile Checks.

#### 2.2 Design Considerations

- A. Operator and maintenance personnel **safety**
- B. Simplicity in operator part loading without restrictions or interference. Clamping not to obstruct feeler surfaces, etc.
- C. Free accessibility to all components for ease of maintenance and replacement.
- D. Rigidity of construction for operation endurance for the life cycle of the vehicle, including protection of all additional measurement equipment IE Dial indicators and force gauges.

#### 2.3 Design Layout Requirements

1. All final assembly fixtures must be in car position. All stamping fixtures to have datum 'A' parallel to base or made in the easiest registration possible.
2. All gage designs shall be identified with Flex-N-Gate Gage Numbers.
3. The base height shall be determined by the average inspection height of 1000.0 mm of product/associate.

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4. Hinge/template drops shall have all sharp edges removed.
5. List name, address and phone number of manufacturer/supplier of all purchased parts on gage drawing.  
List commodity information on the gage drawing from the supplier's most current catalog.
6. Stamping component blocks must be parallel to 'A' datum face.

### **2.4 Recording Design Revision**

1. When a revision is made it should be recorded on the gage print along with the commodity information.
2. All designs shall be updated to include changes made during construction and noted in the revision block on the gage print.
3. Gage design or construction changes are not to be made without Flex-N-Gate authorization and controlled engineering documentation.
4. Change letters shall match the part number and revision on the part print.
5. Changes shall reference the Engineering Change Notice number and part change level.

### **2.5 Design Status**

Design status reports are required on a weekly basis, report status to Flex-N-Gate in writing/email to the fixture sources contact.

#### **1. Reporting Percentage Milestone Criteria**

Design

Kickoff/Approval

40% completion of the gage

80% completion of the gage

100% completion of the gage including GR

### **2.6 Design Check Elements**

1. Detail gage design is to sight check or plug check all holes determined by application.
2. All sight checks shall be 3.0 mm clear from part surface with a minimum depth of 3.0 mm. Sight checks shall be made to virtual condition; maximum material condition (MMC) minus location tolerance, or least material condition (LMC) plus location tolerance if a sight check hole becomes less than 1.5 mm diameter.
3. Identify locating points i.e. datum, locating holes or surfaces. Datum's should be labeled alphanumeric (A,B,C), all other locating holes and surfaces should utilize numbering system (1,2,3,).
4. All holes with a positional tolerance of 1.0 mm or less shall be pin checked for location unless otherwise specified.
5. All locating holes shall be Go/No-Go pin checked. When a hole size tolerance range is 0.25 mm or less, the hole shall be checked with a Go-No Go pin.
6. For checking hole location use the nominal hole size minus the hole size tolerance and location tolerance to determine the gage pin diameter to achieve virtual condition.  
Note: All hole locations and trim dimensions will be established from CAD math model.
7. For a threaded hole pin, use minor diameter of thread minus location tolerance for the pin size. Length of pin shall be equal to projected tolerance zone specified on the part model GD&T sheet.
8. All blind hole checks shall have scribe pin capability. This will allow the operator to determine if the pin is being fully inserted into the blind hole.
9. All check elements shall be normal to part surface, except flush checks, they may be within 10 degrees. Perpendicular to base.
10. Flush checks shall have a minimum of 20.0-mm flush surface, 25.0-mm where possible.
11. Flush pin type checks may be used only upon approval by Flex-N-Gate.
12. All key product characteristics and tolerance flag areas shall be checked.
13. All key product characteristic applications require variable data gathering capability.
14. Captive pins are required for all positional checks unless agreed upon by the Flex-N-Gate representative.

### **2.7 Design Specific Requirements**

1. The datum's as indicated in the part model GD&T sheet shall be utilized as locators.
2. Hand gages shall be designed as small and light as possible. Weight for hand gages shall not exceed 25 pounds for one operator. For base fixtures the weight shall not exceed 40 pounds. The total weight shall be calculated and indicated on the gage bill of materials.
3. All flush and feeler blocks shall be mounted normal/parallel to all features checked.
4. All units mounted directly to a fixture base shall be designed and built using dowel hole construction. Dowel at assembly is permitted on the details/units that are indirectly mounted to the base
5. Sub-base construction with multiple units shall utilize machined corners on the sub-base when units are doweled at assembly. Sub-base corners shall be labeled/stamped

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### 2.8 Clamp Design

1. The approval team must approve all clamping units.
2. Clamp units are to be mounted to the fixture base.
3. All toggle clamping shall be 90 degrees to surface of metal, and attached to the datum unit or by clamp towers.
4. All clamps shall be inside the edge of base when in the open position. To minimize base size, if clamp does overhang base in full open position provide a stop pin.
5. The clamp contact point shall be centered to the net block.
6. Clamping on non-planer surface requires dowels.
7. Stops shall be added when required to prevent pinch points.
8. All clamps and movable units shall be shown in open and closed position. Arc of travel and clearance to adjacent units shall also be indicated.
9. Clamp ends should be Hardened steel, a swivel foot base is preferred (No rubber feet will be allowed).

### 2.9 Tooling Balls

1. **Tooling Balls** (3) required for fixture alignment.
2. The tooling ball shall be 12.7-mm diameter, with a 6.0-mm diameter shaft; press fit with a cover.
3. The centerline of tooling ball/bushing (X, Y, Z, location) shall be stamped on the base.
4. Alignment features shall be accessible to the arm when measurement is to be on a CMM machine.
5. Alignment features shall be shown on the gage drawing.

### 2.10 CMM Holding Fixtures

1. The part shall fit within the envelope of the CMM machine, with enough clearance for the CMM to reach any point with a loaded part. Measurement head configuration and CMM parameters shall be provided by the user plant.
2. Maximum weight for holding fixtures shall be 40 lbs unless otherwise approved by the user plant.

### 2.11 Quality Process Operating Instructions (QPOI)

1. QPOI sheets describe the initial set-up of checking fixture, the loading of the part, the sequence of clamping operation and clear instructions for all feature inspections.
2. A blank copy of the QPOI will be available during gage design and filled out by the gage source.
3. The QPOI will have the correct clamping sequence as determined by the GR study.

## COMPUTER AIDED DESIGN

### Section 3.0

#### 3.1 General

1. The design shall adhere to Flex-N-Gate supplied product math model, and the gage study detailing gauging concepts.
2. Detailing is required for CAD design.
3. CAD model of compatible references is furnished, when available (for reference only).
4. Designs shall be broken into sub-models. Each sub-model shall consist of one complete stack of gage fixturing from product surface to base surface. For DEA flex tooling each module assembly shall have its own sub-model, using a unitized system.
5. CAD model shall be 3D & CNC compatible, 2D design shall be approved and signed off by the approval team.
6. Details shall be identified in 3D-wireframe model with a 3D number. Note a start point indicating orientation of the detail and the appropriate gage symbol indicating net, flush, feeler, etc.
7. CAD models shall be separable, individual details shall be in separate layers (base, clamps, composite, etc.)
8. Each CAD model shall be a complete representation of the finished fixturing for that sub-model, showing open position of clamps/templates and design showing the Flex-N-Gate part.
9. Designs may be completed in **Cadkey** or **IGES**, as specified in process specification package.  
When designing in wireframe tapped holes and dowel holes shall be represented by a circle of the same exact diameter as hole. The circle shall be placed on the face of the detail where screw or dowel would enter. Counterdrilled holes shall have actual depth shown on design.
10. Provide wire frame and face definitions of periphery, flush, feeler, and net surfaces, along with colour coding detailing feeler areas.
11. The gage shall be designed for N/C machining and shall be able to maintain dimensional integrity while being machined.  
Common mounting details shall use screw and dowel hole pattern.
12. File name saved as Flex-N-Gates part number and revision.

**FLEX-N-GATE FIXTURE/GAUGE STANDARDS  
BASES**

**SECTION 4.0**

**4.1 General**

1. The base shall be sized so that all clamps and targets do not overhang the periphery of the base when in the open position. Also, there shall be sufficient surface provided on the base for mounting interchangeable tooling, inspection equipment and a Flex-N-Gate identification plate.
2. The base height shall be determined by the average inspection height of 1000.0mm
3. Machined surfaces of bases shall be rustproofed.
4. All tooling plate gage bases shall have jig feet in the four corners.
5. The material for cast aluminum bases shall be SAE 315 or equivalent, with Brinell hardness of 74. The average yield strength shall be 26,000 PSI and a tensile strength of 35,000 PSI. Supplier shall furnish his or her own pattern.
6. All bases shall be machined on two adjacent edges.
7. All steel bases shall be stress relieved
8. All aluminum bases shall be normalized.

**4.2 BASE SIZES:**

Material

| Base Size<br>(base must fit within parameters in both directions) | Base Material  | Base Size<br>(base must fit within parameters in both directions) | Base Material  |
|---|--|---|--|
| 6.0 in. x 6.0 in. to 6.0 in. x 12.0 in.                           | 1.0 in. aluminum tooling plate, blanchard ground flat & parallel to +/- 0.05 mm overall  | 24.0 in. x 24.0 in. to 24.0 in. x 36.0 in.                        | 1.0 in. Thick (clean up) B.P. with 3.0 in. channel all around 24.0 in. x 36.0 in., 1.5.0 in. from edge of plate with (4) 0.75 in. thick pads on corners  |
| 12.0 in. x 8.0 in. to 12.0 in. x 16.0 in.                         | 1.0 in. aluminum tooling plate, blanchard ground flat & parallel to +/- 0.05 mm overall  | 30.0 in. x 36.0 in. to 30.0 in. x 42.0 in.<br>18.0 in. x 30.0 in. | 1.0 in. Thick (cleanup) B.P. with 4.0 in. channel iron all around 1.50 in. from edge of plate with (Use mean thickness of web on channel iron) (4) 0.75 in. thick pads on corners  |
| 18.0 in. x 12.0 in. to 18.0 in. x 18.0 in.                        | 1.0 in. aluminum tooling plate, blanchard ground flat & parallel to +/- 0.05 mm overall with jig feet 1.50 in. x 1.50 in. x 0.44 in. | 36.0 in. x 42.0 in. to 36.0 in. x 48.0 in.                        | Same as above except that maximum thickness for web channel iron to be used  |
| 18.0 in. x 18.0 in. to 48.0 in. x 48.0 in.                        | Aluminum Casting   | 48.0 in. x 48.0 in. to 48.0 in. x 84.0 in.                        | 1.25 in. Thick (Clean up) B.P. with 6.0 in. channel all around 3.0 in. from edge of plate plus sufficient channel braces and (4) 0.75 in. thick 7.0 in. x 7.0 in. pads on corners. Legs and jack screws shall be provided on all four corners plus (1) in center of base |
| 18.0 in. x 12.0 in. to 18.0 in. x 18.0 in.                        | 0.75 in. Thick (Clean up) B.P. with Jig Feet 1.50 in. x 1.50 in. x 0.44 in.  | 48.0 in. x 84.0 in. to 48.0 in. x 120.0 in.                       | Same as 48.0 in. x 48.0 in. except use 8.0 in. channel iron  |
| 18.0 in. x 24.0 in. to 18.0 in. x 30.0 in.                        | 1.0 in. Thick (Clean up) B.P. with Jig Feet 1.50 in. x 1.50 in. x 0.44 in.   | 48.0 in. x 120.0 in and over                                      | Same as 48.0 in. x 48.0 in. except use 10.0 in. channel iron. Provide for (6) legs and jack screws plus (1) in the center of base  |

**4.3 Base Machined Tolerances**

1. Overall squareness relationship of machined edges, length, and width shall be +/- 0.08 mm.
2. Overall parallelism between top and bottom surfaces shall be +/- 0.08 mm.
3. Bases shall be flat within +/- 0.13 mm per square foot of area with a maximum of +/- 0.10-mm total in any length.

## FLEX-N-GATE FIXTURE/GAUGE STANDARDS

### GAGE CONSTRUCTION

#### SECTION 5.0

##### 5.1 General

1. After all issues from the 100% design review are resolved, the Gage Manufacturer is authorized to begin build. This authorization is documented on the Fixture Timing Form and is signed by the approval team.
2. Fixtures will be machined to math data. Math data will always be the master document.
3. All gage pins shall slip fit into standard size bushings. The bushings shall be press fit in nominal position in the gage. Lock-Tite is not allowed.
4. Adequate protective safety devices shall be provided for protection of personnel and equipment, including stops for drop assemblies and clamps.
5. Scribed lines are permissible as sight checks only.
6. A GR study shall be performed upon completion of the gage dimensional certification. The study shall be performed prior to shipment to the user plant, unless otherwise agreed to by the approval team.
7. Fastening and storage shall be provided as required for all loose details when not in use on the gage.
8. All Feelers to be on keybacks and stored underneath base with a protective cover.
9. All Go/No go's to be labeled
10. All Feeler pins and corresponding area to be labeled with alpha characters with zones.
11. A base fixture will be 40 pounds max unless otherwise agreed upon.
12. Feelers to be a minimum of 3mm clear.
13. No feeler under 2.00mm will be allowed on fixtures. If a profile is called out of greater than 2mm the fixture must be cleared back 5mm and an appropriate feeler added.
14. Source ID tags to be put on the underside of base with job number.
15. Trim surfaces must be scribed
16. All assembly fixtures are to be built in car position.
17. Check fixtures to be labeled in English and Language of user plant, this will be specified at design review.
18. All feelers, location pins, go/no go pins and all other gauges that are not press fit or screwed into the base must be stamped or scribed with the part number (excluding the revision level) on the handle of the gauge. example – 1710008XXX
19. All flipper features must use a doweled lock down position locator. Twist locks will not be accepted.
20. All pins on fixture will be hardened and then ground. (No turned or soft pins will be accepted)
21. All fixture to part contact surfaces and all feeler surfaces will be made from hardened steel (Hardened inserts are acceptable). If the use hardened steel is not possible on certain feeler surfaces 2-Step Electrolytic (Anolok) anodizing is acceptable if agreed upon during the design review. Also proof of anodizing must be provided with the certification of the fixture, and need to reference the part or fixture number on the document. IE Invoice or test certificate. **NOTE: 2-Step Electrolytic (Anolok) (Black Finish) is the only anodizing that will be acceptable, no painting of surfaces or clear anodizing will be acceptable.**
22. All pins, feelers, and bushings will be made of hardened steel.

### INSPECTION AND VERIFICATION

#### SECTION 6.0

##### 6.1 Certification

1. The gage must be certified prior to shipping to the user plant by one of the approved third parts sources listed on Flex-N-Gate's **"Approved Source List – Third Party Certification"**.
2. Supplier shall include for Flex-N-Gate upon deliver the following:
  - A paper plotted approved design
  - **Third party inspection from an approved third party source on Flex-N-Gate's "Approved Source List – Third Party Certification"**
  - Detailed math data of the fixture with the part on a compact disk.
  - Gauge R report.
3. When a fixture is removed from the parent Flex-N-Gate plant for any reason the fixture must be re-certified upon return by CMM layout or third party certification.

## FLEX-N-GATE FIXTURE/GAUGE STANDARDS

### 6.2 Standard Build Tolerances for Checking Fixtures

All product math data is assumed basic, unless otherwise noted.

|            | Datum Pins                               | Locational Pins                          | Flush Check | Feeler Surfaces | Go Pins      | No/Go Pins   | Drilled and Tapped Holes | Feeler Gauges                               | Fixture Bases         |
|------------|--|--|-------------|-----------------|--------------|--------------|--------------------------|---|-----------------------|
| Positional | 10% of Tolerance. To a max of +/- 0.05mm | 10% of Tolerance. To a max of +/- 0.05mm |             |                 |              |              | +/- 0.13mm               |   |                       |
| Size       | +0.0/-0.02mm                             | +0.0/-0.02mm                             |             |                 | -0.0/+0.02mm | -0.02/+0.0mm |                          | Go<br>-0.0/+0.02mm<br>No Go<br>-0.02/+0.0mm | Reference Section 4.0 |
| Surface    |  |  | +/- 0.10mm  | +/- 0.10mm      |              |              |                          |   | Reference Section 4.0 |

## GAGE REPEATABILITY

### SECTION 7.0

#### 7.1 General

1. All gages shall be inspected, data verified and certified prior to a GR study.
2. All gages shall pass an approved GR procedure as outlined in the AIAG Measurement System Analysis Manual. The GR study shall be performed by the gage supplier and approved by Flex-N-Gate approval team prior to shipment to the user plant.
3. Flex-N-Gate shall provide parts to the Gage Build Supplier to conduct GR study. Gage Construction Supplier shall notify Flex-N-Gate prior to conducting study.
4. Inspection points used in the GR study are to be approved/ supplied by Flex-N-Gate.
5. Clamping sequence shall follow Gauge instructions.

#### 7.2 Acceptable Value For The Gauge R

- A. Less than 10% error is required for critical product characteristics.
- B. 10% to 30% may be acceptable based upon the importance of the application i.e. non-critical product characteristics, cost of gage, cost of repair, etc. The Flex-N-Gate approval team shall determine acceptability.
- C. Over 30% error, the measurement system needs improvement. Identify the problems and have them corrected.

#### 7.3 Gauge R Study

This shall be performed at the gage construction source. In a GR study, two operators measure the same part ten times using the CMM. Each time removing the part from the fixture and re-clamping. Calculations for repeatability are then performed and analyzed. Flex-N-Gate will supply which points to CMM. Flex-N-Gate shall provide part/assembly to gage build supplier to conduct GR study. The gage build supplier shall notify Flex-N-Gate prior to conducting study. Calculations for repeatability are performed and analyzed as outlined in the AIAG Measurement System Analysis Manual.

**FLEX-N-GATE FIXTURE/GAUGE STANDARDS  
FIXTURE BUY-OFF**

**SECTION 8.0**

**8.1**

Upon completion of certification and GR Study a fixture buy-off is required.

**8.2**

A Gage Record book with the following information is required prior to Buy-Off

1. Cad file on a disc with fixture and part.
2. Third party certification.
3. Fixture source certification.
4. Paper plot with the current revision and gauge BOM.
5. An approved GR study.
6. Flex-N-Gate Timing Schedule.
7. Flex-N-Gate APQP team approval.
8. Original vendor invoice sent to accounts payable.

**SHIPPING**

**SECTION 9.0**

**9.1**

1. At the suppliers expense.
2. Any issues with the gauge prior to certification will also be at the suppliers' expense.

**APPROVED SOURCE LIST**

**SECTION 10.0**

**1. Approved Source List - Gage Design and Build**

| SUPPLIER               | ADDRESS   | Contact Name    | PHONE #               |
|------------------------|---|-----------------|-----------------------|
| A.V. Gauge & Fixture   | 4000 Delduca Dr. R.R. #1<br>Oldcastle ONT<br>N0R 1L0          | Gary Dodich     | 519-737-7677          |
| Accu-Gauge             | 160 Stoney Creek Road,<br>Lindsay, Ont.,<br>k9v, 4r4          | Lloyd R. McNeil | <u>(705) 878-8593</u> |
| ALP TOOL               | 757 O'Brien Drive Unit #1<br>Peterborough, ONT<br>K9J 6X7     | Drew Calhoun    | 705-876-0831          |
| Axis Tool & Gauge      | 664 Bishop Street, North<br>Unit #3, Cambridge Ont<br>N3H 4V6 | Ken Pannunzio   | 519-653-2977          |
| Daniel Patit           | 45 Cowansview Road<br>Cambridge Ont<br>N1R, 7L2               | Daniel Patit    | (519) 622-0322        |
| Dual Design & Machine  | 1131 Gorham St. Unit#19<br>Newmarket ONT,<br>L3Y 7V1          | Jeff or Mark    | 905-830-5188          |
| Durham Pattern         | 22 Caristrap St.<br>Bomanville ONT,<br>L1C 3Y7                | Jim McIlroy     | 905-623-8700          |
| Lasard Fixture & Gauge | 5325 Brendan Lane<br>Old Castle, ON N0R 1L0                   | Larry Savard    | (519) 737-9890        |

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|                        |  |             |                |
|------------------------|--|-------------|----------------|
|                        | Canada   |             |                |
| Oshawa Pattern & Model | 102 Industrial Drive<br>Whitby, Ont<br>L1N 5Z8       | Victor      | (905) 668-6854 |
| Pinnacle               | 150 Werlich Drive #1&2<br>Cambridge, Ont<br>N1T, 1N6 | John Brooks | (519) 740-1573 |

**2. Approved Source List – Third Party Certification**

| SUPPLIER               | ADDRESS  | Contact Name       | PHONE #      |
|------------------------|--|--------------------|--------------|
| Check-IT               | 7506 County RD 18<br>Harrow ONT, N0R 1G0             | Patty              | 519-738-2875 |
| CMM                    | 2433 Meadowvale, BLVD<br>Mississauga ONT<br>L5N 5S2  | Elliot Foster JR.  | 905-819-7878 |
| CMT                    | 295 SouthGate Drive Unit<br>#3<br>R.R. #6 Guelph ONT | Ron Dorrans        | 519-822-5524 |
| J&K Measuring Services | 41 Maple Avenue Unit # 9<br>Richmond Hill ONT        | Jadwiga Dyjecinska | 905-881-9416 |
| Technical Measures     | 330 Marwood Dr Unit #10<br>Oshawa ONT                | Gary Vaille        | 905-438-9191 |
| Inspectex              | 5575 Roscon DR<br>Oldcastle ONT                      | Brad               | 519-737-2667 |
| Saturn Tool            | 5175 Hennin Dr R.R. #1<br>Oldcastle Ont<br>N0R 1L0   | Stan               | 519-737-6811 |

**3. Approved Source List – Anodizing**

| SUPPLIER              | ADDRESS  | Contact Name | PHONE #      |
|-----------------------|--|--------------|--------------|
| Progressive Anodizers | 41 Crockford Blvd.,<br>Scarborough, Ontario,<br>Canada M1R 3B7 |              | 416-751-5487 |