



Lockheed Martin Aeronautics Company
Supplier Tooling Manual
(Tool Manufacturing Specification - Material Control - 015)
TMS-MC-015

Applicable to
FORT WORTH – MARIETTA - PALMDALE
Sites to the extent specified herein

REVISION 23

CONTROLLED AND APPROVED BY:

Lockheed Martin Aeronautics Company
Procurement Quality Assurance

January 2008

IMPORTANT NOTICE: A hard copy of this document may not be the document currently in effect. The current version is ALWAYS the version on the LOCKHEED MARTIN network.

TABLE OF CONTENTS (cont'd.)

PART III. INTERNATIONAL SELLER REQUIREMENTS

1.0	GENERAL	Page	16
2.0	CONTROL OF SUPPORT EQUIPMENT (SE), MANUFACTURING TEST EQUIPMENT (MTE) AND SPECIAL TEST EQUIPMENT (STE)	Page	16
3.0	CHANGE AUTHORIZATION	Page	17
4.0	TOOLING PRACTICES FOR BUYER-FURNISHED TOOLS	Page	17
5.0	LISTINGS OF SELLER-FABRICATED/PROCURED ST OR STE	Page	17
6.0	DRAWINGS, SKETCHES, TOOL DESIGNS, ETC.	Page	18
7.0	CALIBRATION AND RE-CALIBRATION OF BUYER-FURNISHED OR SELLER-FABRICATED STE	Page	18
8.0	TOOLING USE AND TOLERANCE REQUIREMENTS	Page	18
9.0	QUALITY ASSURANCE REQUIREMENTS OF SELLER-OWNED OR SELLER-FABRICATED PRODUCTION TOOLING	Page	18

PART IV. APPENDIX "A"

1.0	GENERAL	Page	19
2.0	PRESERVATION OF BUYER FURNISHED TOOLS	Page	19
3.0	STANDARD REPAIR, TOLERANCE AND COORDINATION	Page	20

*** LIST OF FIGURES and CHARTS**

OF77UYnLE	1. "TO MATCH" HOLE PATTERNS – Figure 1	Page	8
	2. TOOLING HOLE TOLERANCE – Figure 2	Page	20
	3. DOUBLE RAIL (INTERCHANGEABLE) – Figure 3	Page	21
OF77UYER-FURNISHED	(Page)	232	Page

PART I

AIRCRAFT ITEMS AND TOOLING - SELLER REQUIREMENTS

1.0 GENERAL

1.1 This Tooling Manual ("Manual") contains the contractual requirements to properly control and maintain Buyer-furnished and/or Seller-manufactured Special Tooling ("ST"), Support Equipment ("SE"), Manufacturing Support Equipment ("MSE"), Special Test Equipment ("STE") and Manufacturing Test Equipment ("MTE") for Buyer, as such terms are hereinafter defined, used to produce Items for Buyer.

1.2 This Manual contains general and specific

task is only accomplished during installation.

2.12 Electronic Supplier Problem and Resolution (“e-SPaR”) - This online system is available on the Buyer’s Material Management Homepage at <http://www.lockheedmartin.com/aeronautics/materialmanagement> and is the approved system to request information regarding PO requirements.

2.13 Seller Aircraft Tooling Report (“SATR”)

2.13.1 This online system is available on the Buyer’s Material Management Homepage and was created to provide Seller with a traceable electronic means of reporting ST discrepancies and achieving disposition authorization from Buyer’s program representative.

2.13.2 Access is granted by applying for an account on the Buyer’s Material Management Homepage at <http://www.lockheedmartin.com/aeronautics/materialmanagement>. Highlight “Quality Requirements” and select “Corrective Action”.

2.13.3 A SATR is a document initiated by Seller to document a discrepant Buyer-furnished ST condition. Buyer shall reply with authorization for repair, if required, of "out of engineering" discrepancies or conditions.

3.0 INTERCHANGEABLE- REPLACEABLE (“I/R”)

3.1 Seller shall comply with I/R requirements imposed by this PO.

3.2 “Interchangeable Items” – Interchangeable Items are completely finished and have designed/controlled features which allow them to be installed, removed, or replaced without alteration, misalignment, or damage to installed or adjoining Items. Interchangeable Items require only attaching means (bolts, nuts, screws, pins, etc.) to install. Interchangeable Items do not require any fabrication operations such as cutting, filing, drilling, hammering or forcing at the point of installation.

3.3 “Replaceable Items” – Replaceable Items are partially finished and have designed/controlled features which require alteration of the Items in addition to the normal application and/or methods of attachment at the point of installation. Such alterations are limited to specified areas and may include drilling, filing, trimming, bending, etc.

3.4 “Interchangeable Category Items” – Items so designated are typically Items which are attached by bolts or screws, readily removable and replaceable. Such Items are designed in such a manner that all like Items made within the engineering drawing tolerances will substitute one for another. Interchangeable Category Items are Items that are maintained by Seller through use of normal manufacturing methods and compliance with engineering drawing dimension tolerances, without the use of I/R Control Media.

4.0 “TO MATCH” HOLE PATTERNS AND OTHER I/R FEATURES

- * 4.1 The term “To Match”, when specified on Buyer engineering drawings relative to hole locations, indicates that the dimensions including tolerances, even when met, may not necessarily ensure physical mating of Item hole patterns at the point of installation. This is true

IMPORTANT NOTICE: A hard copy of this document may not be the document currently in effect. The current version is ALWAYS the version on the LOCKHEED MARTIN network.

even though from a dimensional standpoint the features are within engineering drawing tolerance

5.1.5 The Government or Commercial prime contract number indicated in this PO and, if applicable, type of Item (e.g., ST, STE, SE, MTE, etc.)

5.1.6 Serial number of the shipping document for tools received by Seller from Buyer or another authorized party and all packing sheet information.

5.1.7 Tool location rework, progressive inspection, calibration, maintenance and acceptance dates

5.1.8 Copy of the completed Certified Property List ("CPL") provided by Buyer

5.1.9 Indication that tool is accountable to Buyer

5.1.10 Authority for disposition of tools which are no longer in Seller's possession

5.2 Seller, on a current basis, shall maintain tool designs, sketches, photographs, and schematic drawings used in the fabrication, testing, or calibration of tooling. Seller shall show tool manufacturing tolerances on the tool design. Seller shall provide Buyer disposition for this data,

- ** 7.3.1 Seller shall review Buyer authorization for repair and contact PQAFE to discuss appropriate level of verification or oversight required to ensure that rework has been completed.
- ** 7.3.2 All I/R tooling and tooling used as a media of acceptance shall require delta FAI demonstrations upon completion of rework, unless the reworked tool is coordinated to designated control media. Additional I/R and non-I/R repair, preservation and coordination guidance is provided, but not limited to, Part IV of this Manual.
- ** 7.3.3 Seller shall initiate a SATR to receive Buyer authorization to rework and/or repair Buyer-furnished ST

7.4 Seller shall maintain the ability to produce the original, or any subsequent Item configuration, including spares, unless changes made by Buyer's engineering are retroactive to the original point of affectivity of Item. Seller shall accomplish this by fabricating other Control Media for its use, or from Buyer-furnished Control Media.

- * 7.5 When Buyer authorizes rework and when a tool is capable of producing earlier configurations, Seller shall re-identify the tool to the new configuration Item number. When Buyer-authorized rework and/or modification will render a tool incapable of producing earlier configurations without extensive alteration, Seller shall notify Buyer prior to continuing any rework and request additional specific instructions for tool rework, or for potentially manufacturing new additional tooling.

7.6 Seller shall submit an e-SPaR with itemized listing of any lost, damaged, or destroyed ("LDD") U.S. Government tooling to Buyer. Seller shall also include the following information on the e-SPaR submission for LDD tooling:

- A narrative description of the incident and corrective action taken to prevent recurrence
-

without addition or changes in construction. However, duplicate tools may be required by Buyer in some cases.

8.3 "Code 2" – Incomplete and/or low production rate quality tools that can be revised at a later date to meet the needs of an accelerated production program .1ys(2)-7Nds obeing7(wo p)5.5kisee ts

coordination or verification of a physical tool back to digitized data, applicable tolerances apply as if performing a tool-to-tool coordination. Tolerance requirements are illustrated in Part IV of this Manual.

12.0 TOOLING PERIODIC INSPECTION AND RE-VERIFICATION (PI/V) RECORDS

12.1 Seller shall maintain a record on all tools requiring PI/V. Such record shall list:

- Buyer-assigned tool number
- Buyer-assigned tool code
- Buyer-assigned part number
- Next PI/V recall date
- Quality acceptance verification
- Control Media used, if applicable, shall be recorded in the PI/V record
- History of previous PI/V
- Date of PI/V
- PI/V check sheet (if applicable)
- Inactive tools

12.2 Upon Buyer or Buyer Representative's request, Seller shall present the PI/V record.

12.3 Seller shall update or revise the data in its PI/V record to meet the requirements of 12.1 on the next PI/V cycle of each tool.

***** END PART I*****

PART II

MANUFACTURED SPECIAL TOOLING SELLER REQUIREMENTS

1.0 GENERAL – Part II of this Manual is applicable to the

3.2 Unless otherwise stated in Buyer's Build-to-Package ("BTP"), CMM, theodolite, photogrammetry, calibrated machine probe, and/or laser tracking are the only acceptable methods for contour verification, and are the preferred methods for hole pattern verification. CMM inspection is the overall preferred method for verification. Exception: if the CMM output data is such that the data is not electronically transmittable to a CATIA model for review, and/or calculations must be performed manually in order to complete the inspection activity (e.g., vector data must be manually calculated for hole locations), the use of theodolites or laser tracking when the data can be readily uploaded electronically to CATIA are then the preferred methods of inspection.

3.3 Inspection Grid Pattern: Unless otherwise stated in Buyer's BTP, Seller shall inspect surfaces

(including passwords, directory information, email notifications, and access controls), and how Seller will be notified of data transfer activities.

5.2 Hardcopy Data Transfer – Seller shall coordinate all hard copy transfer of designs through Buyer.

6.0 SEALING CRITICAL LOCATORS

6.1 Torque seal requirements for tooling are defined by site and program.

6.2 Fort Worth requirements: F-22A tooling – **Pink**
All other tooling – **Purple**

6.3 Marietta requirements: Tooling – **Pink**

6.4 Palmdale requirements: Tooling – **Pink**

***** END PART II *****

PART III

INTERNATIONAL SELLER REQUIREMENTS

1.0 GENERAL

- 1.1 Part III is applicable to F-16, F-2 and F-22 programs only where Buyer furnishes Seller with Items and/or material to support Buyer's BTP.
- 1.2 Fabrication requirements of ST, STE, and MKT by Seller or Seller's sub-tiers to produce Buyer-designed controlled Items and aircraft modifications, as specifically contracted by this PO, are defined in Part II of this Manual and controlled by PM-4053.

2.0 CONTROL OF SE, MTE AND STE

2.1 Receipt of SE – Seller shall return a stamped copy of SE receiver to Buyer within five (5) working days upon receipt of SE.

2.1.1 Maintenance and repair parts for SE – Seller shall requisition maintenance and repair parts for the SE provided as MSE from Buyer.

2.1.2 Modification of SE provided as MSE peculiar modification of SE – Seller shall receive a tool order, a peculiar modification kit and written Buyer authorization. Upon completion of modification, Seller will return the stamped off / approved copy of the tool order to Buyer.

2.1.3 Time Compliance Tech Order ("TCTO") modification of SE – Seller shall receive a TCTO modification kit and written authorization from Buyer authorizing Seller to install the kit. Upon completion of kit installation, Seller shall return a completed Letter of Certification ("LOC") to Buyer.

2.2 Receipt of MTE – Seller shall acknowledge receipt of the CPL by signing and returning the original CPL to Buyer.

2.2.1 Maintenance and Repair parts for MTE – Seller shall requisition maintenance and repair parts for the MTE from Buyer.

2.2.2 Modification of MTE – Seller shall not perform modification on MTE without prior written authorization from Buyer.

2.3 Receipt, Maintenance and Modification of STE other than MTE Receipt – Seller shall

5.2 Seller shall produce and maintain listings of all tools required to fabricate Federal Identification Item Number ("FIIN") spare Items.

6.0 DRAWINGS, SKETCHES, TOOL DESIGNS, ETC.

6.1 Seller shall maintain Seller-owned or Buyer-furnished current tool designs, sketches, photographs, and schematic drawings used in the fabrication, testing, or calibration of tooling. Seller shall provide a disposition of this data at the same time disposition for related tooling is given, as requested by Buyer.

6.2 Seller shall ensure Seller's STE drawings of any electrical, electronic, hydraulic or pneumatic type, at a minimum, consist of a schematic with component parts called out by characteristics and/or part number, including adequate calibration and operation instructions.

7.0 CALIBRATION AND RE-CALIBRATION OF BUYER-FURNISHED OR SELLER-FABRICATED STE

7.1 Seller shall develop and maintain a schedule for maintaining calibration of Buyer-furnished or Seller-fabricated STE. Seller's schedule is subject to approval of Buyer's representative and Seller shall ensure such schedule includes the following:

- Name and function of test equipment
- Serial or identification number of test equipment
- Criteria or standard to which test equipment is checked
- Frequency of test

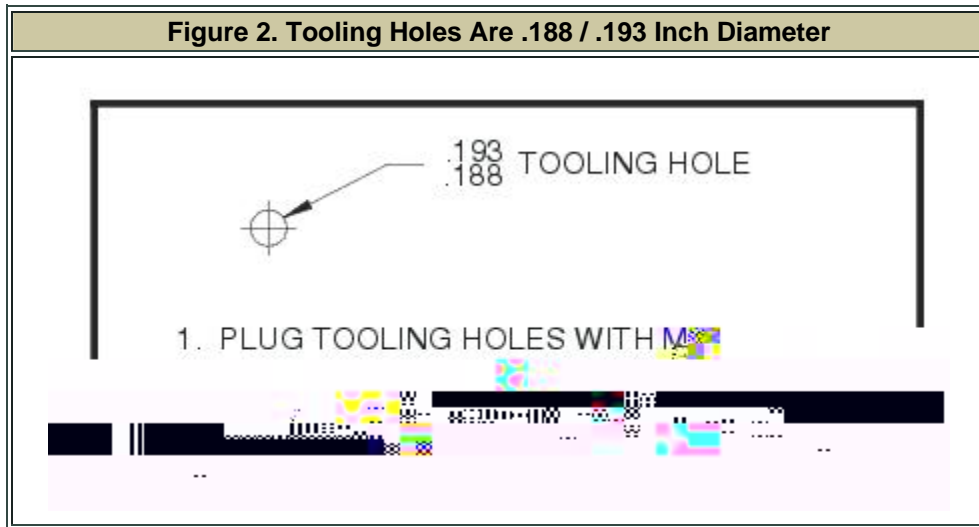
design. Seller shall ensure the containers provide adequate support and protection of tools from the environment and mishandling during movement.

3.0 STANDARD REPAIR, TOLERANCES AND COORDINATION

3.1 For standard repairs, tolerances and coordination of Buyer-furnished tools, Seller shall:

Produce tooling holes which have a hole size tolerance of $+.005/-.000$ and are located within one-half of such tolerance.

Locate and identify tooling holes on Item(s), as directed by Buyer, or illustrated in Figure 2. When Seller must plug tooling holes, Seller shall provide a general note to that effect as illustrated in Figure 2.

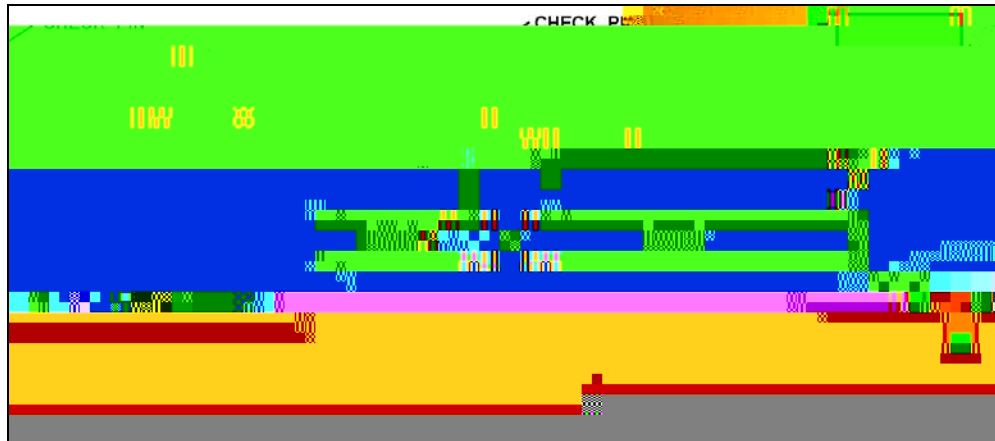


Maintain allowable production tolerances on interchangeable Items produced/verified with controlled production tooling as illustrated in Figure 3.

Utilize a check pin for all I/R hole patterns to ensure patterns are made in accordance with the tool coordination tolerance tables included herein.

Utilize controlled production tooling to check and verify allowable production tolerances on interchangeable Items are from .010 smaller, to .010 larger than the tool, as illustrated in Figure 3.

Utilize a check pin to check and verify the I/R hole pattern is made in accordance with the tool coordination tolerance tables included herein.



**Figure 5. SINGLE RAIL
SETBACK TYPE (REPLACEABLE, AND NON I/R, NET OR WITH EXCESS)**

3.2 For tool inspection requirements of I/R tool coordination (applicable to new make, rework and coordination orders), Seller shall only utilize check pins which are AISI01 tool steel with a heat treat callout of RC 55-65 for pins with a diameter of .2500 or larger, and a RC 38-48 for pins with diameters smaller than .2500.

- 3.2.1 For Control Tool to Production Tool Coordination – Seller shall pin the control tool to the tool being coordinated with .0000 to .0005 undersize pins at four(4) locations reasonably close to the corners of the control tool. Seller shall inspect the remaining holes in accordance with pin tolerances shown in Table 2.0 for “Coordination Check of Control Tools”.
- 3.2.2 For Control Tool to Control Tool Coordination (Make New) – Seller shall install new control tool bushings utilizing pins with +.0000/-.0002 tolerance on diameter (Ref.: Transfer of hole pattern, Table 1.0).
- 3.2.3 For Control Tool to Control Tool Coordination (Rework) – During rework of control tools bushing, Seller shall install bushings utilizing pins with +.0000/-.0002 tolerance on diameter. (Ref.: Table 1.0, Transfer of hole pattern).
- 3.2.4 For Control Tool to Control Tool (Coordination Check Only) – Seller shall check the control tool back to the tool it was made from. During coordination checks of control tools, (Example: MSGA to TOGA), Seller shall pin four corner holes utilizing pins with +.0000/-.0002 undersize diameter. Ninety percent (90%) of the remaining holes are acceptable with .0000 to .0010 undersize diameter pins and the remaining ten percent (10%) of the holes are acceptable with +.0000/-.0025 undersize diameter pins.
- 3.2.5 For Cross-Coordination of Control Tools – When duplicate control tools are fabricated, Seller shall cross-coordinate control tools in accordance with Table 1.0 "Coordination Check of Control Tools" to ensure compatibility.

- 3.2.6 For Bushing Installation – During the manufacture of new tools and reworks, Seller shall utilize tooling pins with +.0000/-.0002 tolerance to install all tooling bushings (ref.: Table 1.0 and Table 2.0, Transfer of hole pattern).
- 3.2.7 For Inspection of Control Tool Bushing Wear – NOTE: During tool use activities, control tool bushing wear can occur. Seller shall inspect control tool bushings to ensure the maximum wear is limited in accordance with Table 1.0 and Table 2.0. Seller shall not use any control tools where bushing wear exceeds the maximum wear tolerance of +.0010 on the inside diameter.

Table 1.0 Coordination Check of Control Tools

HOLES UNDER .250	STRAIGHT PINS	HOLES .250 AND OVER
Nominal +.0001/+.0004 Nominal +.0000/-.0002	Transfer of Hole Pattern Bushing I.D. Tolerance Pin Tolerance	Nominal +.0001/+.0006 Nominal +.0000/-.0002
Nominal +.0001/+.0010 Nominal -.0015/-.0020	Cross Coordination / Coord. Check of Control Tools Bushing I.D. Tolerance Pin Tolerance	Nominal +.0001/+.0010 Nominal -.0020/-.0025
STEP PINS		
Nominal +.0001/+.0004 Nominal +.0000/-.0002 Nominal +.0000/-.0002 .0005 Max	Transfer of Hole Pattern (New Make) Bushing I.D. Tolerance Lg. Dia. Pin Tolerance Sm. Dia. Pin Tolerance Concentricity	Nominal +.0001/+.0006 Nominal +.0000/-.0002 Nominal +.0000/-.0002 .0005 Max
Nominal +.0001/+.0010 Nominal -.0000/-.0002 Nominal -.0015/-.0020	Cross Coordination / Coord. Check of Control Tools Bushing I.D. Tolerance Lg. Dia. Pin Tolerance Sm. Dia. Pin Tolerance	Nominal +.0001/+.0010 Nominal -.0000/-.0002 Nominal -.0020/-.0025

Table 2.0 Coordination Check of Production Tools

HOLES UNDER .250	STRAIGHT PINS	HOLES .250 AND OVER
Nominal +.0001/+.0004 Nominal +.0000/-.0002 Nominal +.0001/+.0004	Transfer of Hole Pattern (New Make) C/T Bushing I.D. Tolerance Pin Tolerance P/T Bushing I.D. Tolerance	Nominal +.0001/+.0006 Nominal +.0000/-.0002 Nominal +.0001/+.0006
Nominal +.0001/+.0010 Nominal -.0020/-.0025	Coordination Check of Control Tools to Prod. Tools Bushing I.D. Tolerance Pin Tolerance	Nominal +.0001/+.0010 Nominal -.0030/-.0035
	STEP PINS	
Nominal +.0001/+.0004 Nominal +.0001/+.0004 Nominal +.0000/-.0002 Nominal +.0000/-.0002 .0005 Max	Transfer of Hole Pattern (New Make) C/T Bushing I.D. Tolerance P/T Bushing I.D. Tolerance Lg. Dia. Pin Tolerance Sm. Dia. Pin Tolerance Concentricity	Nominal +.0001/+.0006 Nominal +.0000/-.0006 Nominal +.0000/-.0002 Nominal +.0000/-.0002 .0005 Max
Nominal +.0001/+.0010 Nominal +.0000/-.0002 Nominal -.0020/-.0025 .0005 Max	Coordination Check of Control Tools to Prod. Tools Bushing I.D. Tolerance Lg. Dia. Pin Tolerance Sm. Dia. Pin Tolerance Concentricity	Nominal +.0001/+.0010 Nominal +.0000/-.0002 Nominal -.0030/-.0035 .0005 Max
Nominal +.0000/-.0002 Nominal +.0001/+.0004 .0003	Additional Production Tool Tolerances O/D of Slip Bushing I/D of Slip Bushing Concentricity O/D to I/D	
Nominal +.0000/-.0002 Nominal -.0010/-.0012 .0005 Max	Hinge Line Tool Tolerances Pins for End Hinges Pins for Middle	

3.3 Seller shall utilize step pins, as illustrated in Table 3.0, to perform a verification check of production items to production tools. Seller shall ensure the check-pin diameter is made to the low engineering range of the hole diameter being checked with the pin diameter tolerance as shown in Table 3.0.

Table 3.0 COORDINATION CHECK OF PRODUCTION TOOLS

HOLES UNDER .250	STEP PINS	HOLES .250 AND OVER
Nominal +.0001/+.0010 Nominal +.0000/-.0002 Nominal +.0000/-.0030 * .0005 Max	Coordination of Production Parts to Production Tools	

C/T - CONTROL TOOL P/T - PRODUCTION TOOL	I/D - INSIDE DIAMETER O/D - OUTSIDE DIAMETER
---	---

3.4 Seller shall verify I/R tooling tolerances are as follows:

Master Tooling is net (nominal).

Master Tooling to production tooling for trim and contour is +/- .005

Production tool to production Item for edge and/or cutout trim is +/- .010, except replaceable edges, net or with excess, which is +/- .030, unless otherwise stated on the engineering drawings.

Production tool to production Item tolerance for contour is .000 to +.020.

Note: This tolerance is a tooling application which recognizes the engineering drawing tolerance of +/- .010, unless otherwise specified, for sheet metal Item contour relative to Item being placed against a solid tool surface for checking. The tooling application also recognizes restraint in the tool, in accordance with the engineering drawing.

Indenture tool development does not exceed +/- .005 total back to the master.

Buyer-furnished Master Control Tooling is not used for production purposes, i.e., Item verification, trimming, drilling, and forming.

3.5 Seller shall verify non-I/R tooling perimeter, holes and contour tolerances are as follows:

Non I-R Tooling Tools are net to engineering, unless otherwise identified, i.e., excess on a tooling sample.

Tolerance from tooling tool to controlled production tooling is +/- .015" tolerance allowable over 80% of the gauging surface, and +/- .020" over 20% of the gauging surface as illustrated in Figure 6.0.

Tolerance from controlled production tooling to production Item equals +/- the engineering drawing tolerance, for edge and/or cutout trim and holes.

Controlled production tool to production Item tolerance for contour is .000 to +.020.

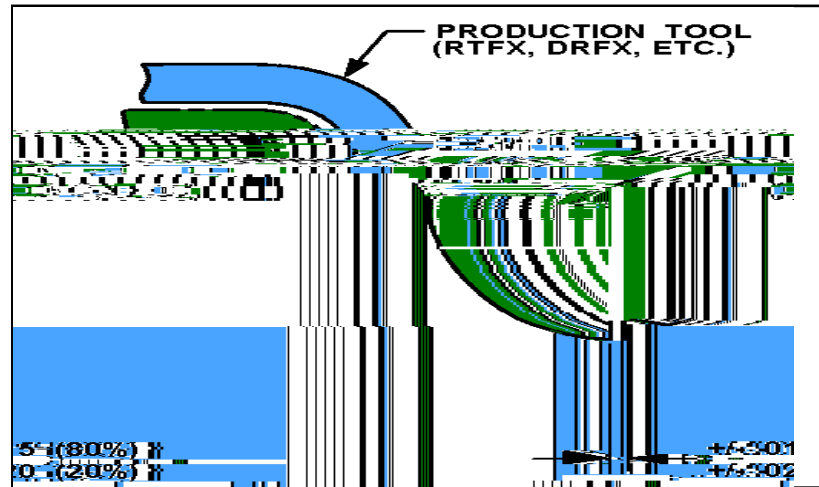


Figure 6. Production Tool to Control Tool

3.6 Seller shall verify Seller-developed tools yield an Item not to exceed +/- .010 variance from applicable Master Control Tooling.

3.7 Seller shall verify coordinated tool holes are direct pinning without undue interference.

3.8 I/R Tooling tolerance examples:

MASTER TOOLING
(LM AERO- FORT WORTH)

+/- .005 (MASTER TOOL TO PROD. TOOL)

+/- .010 (PROD. TOOL TO PROD. ITEM)

END OF APPENDIX A

END OF TMS-MC-015 MANUAL