



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 25

CONTROLLED AND APPROVED BY:

**Lockheed Martin Aeronautics Company
Procurement Quality Assurance**

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APPLICABLE DOCUMENTS

PM-4053 PROCESS MANUAL – Access limited due to Proprietary Data contained therein.

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 requirements that are applicable as specified in this Purchase Order ("PO"). The terms "Item" or its plural "Items", "PO", "Seller", and "Buyer" as used herein, have the same meaning as the terms "Work", "Contract", "SELLER", and "LOCKHEED MARTIN", respectively.

1.3 Access to this manual can be found on the Material Management Home Page at <http://www.lockheedmartin.com/aeronautics/materialmanagement>, under Quality Requirements, Control Specs, Q15.

2.0 TOOLING DEFINITIONS

2.1. ST means all jigs, dies, fixtures, molds, patterns, taps, gages, other equipment and manufacturing aids, and replacements which are of such a specialized nature that without substantial modification or alteration, their use is limited to the development or production of particular supplies or Items thereof, or the performance of particular services.

2.2 Modification Kit Tool ("MKT") is categorized as ST and used to update or modify aircraft assemblies and structures.

2.3 "Tooling Tools" means all gage's used by Seller to control the fabrication or coordination of production tooling, holes, Interchangeable-Replaceable ("I/R") features, critical mating points and surfaces or contours it represents. Tooling Tools are for tooling purposes only and shall not be used for production purposes.

2.4 "Seller-Owned Tooling" means all ST and Tooling Tools owned by Seller and used in the process of fabricating, inspecting, assembling and coordinating of particular Items and/or tools as described in paragraphs 2.1 and 2.3.

2.5 STE means either single or multipurpose integrated test Items engineered, designed, fabricated or modified to accomplish special purpose testing. STE consists of Items that are interconnected and interdependent so as to become a new functional entity for special testing purposes. STE excludes:

Consumable property
ST

Facility Items (except necessary improvements for installing STE)
Plant equipment Items used for general plant testing purposes

2.6 MSE is used in manufacturing operations to support, test or prove the functional operation of an Item.

2.7 MSE consists of the following types of Items and shall be considered United States ("U.S.") Government property:

2.7.1 SE required to make an Item operational in its intended environment. SE includes the following:

Common and Standard SE – For use on more than one type Item
Peculiar or Non-Standard SE – For use on a peculiar or specific Item

2.7.2 MTE required for use in manufacturing operations to conduct tests and/or prove the functional operation of a specific Item. MTE is peculiar to manufacturing in that it is not normally used by Buyer to support the Item in an operational environment.

2.8 "Control Media" means tooling and electronic data used to control I/R and/or coordinating points and are categorized as follows:

2.8.1 "Master Tooling" – Master tool gages used to establish dimensions and features during manufacture of Production Tools which control I/R and/or coordination points of production Items. Unless Buyer has provided Seller with prior specific written authorization to do so, Seller shall not use Master Tooling for production purposes, i.e., Item verification, drilling, trimming or forming.

2.8.2 "Controlled Production Tooling" – Tooling such as jigs and fixtures used to establish dimensions and features of Items and which control I/R and/or coordination points of those Items.

2.8.3 "Electronic Data" – Computer-generated electronic data used to establish dimensions and features during manufacture of production tools which control I/R and also used during fabrication of production Items for control of I/R features, e.g., trim, attach holes.

2.9 Manufacturing Engineering Data Model ("MEDM") – An electronic Computer Aided Three-

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.

2.14 Seller Aircraft Tooling End Item Acceptance (“SATEIA”) Report

2.14.1 Delegation of End Item Acceptance (“EIA”), if granted by Buyer, shall be granted to Seller only by formal letter of authorization that specifically addresses Aircraft Tooling and defines applicable requirements.

2.14.2 Seller shall complete and submit a SATEIA Report for manufactured or reworked ST as defined in Part I, section 2.0 and Seller shall include such report as specified in Part II, section 4.0 of this Manual.

* 2.14.3 The SATEIA Report is a checklist utilized exclusively by Sellers that have received Buyer authorized delegation to perform EIA in-lieu of Buyer’s Representative performing the acceptance task.

* 2.14.4 Seller shall obtain a copy of the SATEIA Report from Buyer’s Representative or Seller shall utilize and submit an equivalent report with each tool delivered to a buyer or sites.

** 2.15 Order of Precedence

2.15.1 F-16 document 16PP1957 - "Order of Precedence for Control Media for Manufacture of the F-16" takes precedence over all engineering dimensional requirements where master tools conflict with engineering requirements.

2.15.2 F-22 document 5PD41327 – “Order of Precedence for Control Media for Manufacture of the F-22TJ-2atsn Twirrg diron for riplrent JJ19.158080 TD-.0002 Tc-.0022 Tw[Ation fa)5.1(ad anag)5.31(me)5.1

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 even though from a dimensional standpoint the features are within engineering drawing tolerance limits. “To Match” features are physically established, within engineering drawing tolerance limits, through the use of Master Tooling. Once Seller physically establishes the features, Seller must maintain the actual positions to achieve and sustain “To Match” capability (example in Figure 1).

4.2 Buyer’s Tooling Policy, relative to Item features requiring physical control for configuration management purposes, is to provide Control Media, e.g., master gage, tooling gage, master plate, MEDM or other Electronic Data, to establish and maintain those Item features requiring control, over and above only the engineering drawing dimensions and their associated tolerances. If the Item feature requiring control has a critical configuration relationship requirement to other Item features, the Control Media will also establish those Item feature relationships, one to the other. Additionally, even though Item features may be within engineering drawing dimension tolerance band for those features, if an actual feature location does not comply with applicable Control Media allowed tolerance deviation, the feature location is not acceptable.

4.3 Buyer’s Control Media drawing, if applicable, will denote maximum tool deviations permitted in feature location and/or relation to critical features that are acceptable on finished Items.

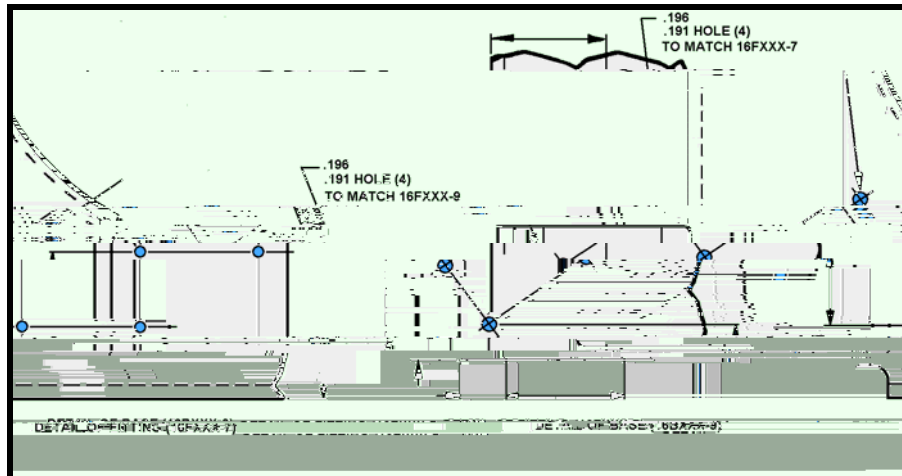


Figure 1. Example of “To Match” hole patterns as defined on engineering drawings.

* **5.0 CONTROL OF RECORDS FOR BUYER FURNISHED TOOLING**

5.1 Seller shall include the following information for each tool, as a minimum, in its records:

5.1.1 Tool number assigned by Buyer

5.1.2 Buyer-assigned Item number and “Also Use” Item number/dash number that the tool will fabricate

5.1.3 Tool Code

5.1.4 Purchase order number (or other authorization) under which the tool was furnished to or fabricated by Seller

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, as requested, at the same time disposition for related tooling is given.

point of affectivity of Item. Seller shall accomplish this by fabricating other Control Media for its use, or from Buyer-furnished Control Media.

making Items with this type of tooling, a maximum amount of handwork, standard setups, layouts, etc. is permitted.

8.6 "Code 5" – Lowest cost tooling that is used for production operations. These tools are needed for making Items or assemblies where it is not possible to make them by layout, handwork, standard tools, or setups. Use of handwork, standard clamps, etc., is permitted when finishing Items to meet engineering tolerances.

- * **9.0 TOOL PROTECTION AND STORAGE REQUIREMENTS** – Seller shall ensure their quality system maintains surveillance in order for Control Media to not be abused or damaged while out of storage/shipping containers. Seller shall take particular care when tools are being loaded into and removed from jigs and fixtures. Preservation, storage and shipping container requirements are illustrated in Part IV of this Manual.

10.0 SHIPPING INSTRUCTIONS

- * 10.1 Buyer shall specify destination and mode of transportation for tools that are to be shipped from any point of origin.

10.2 Seller shall provide advance notice to the Buyer's Representative when performing closure of a Control Media container.

10.3 Seller shall contact Buyer's Representative for closure of the Control Media container. If Buyer's Representative is unavailable within two (2) business days to witness the closure of the Control Media container, Seller's QA shall fill out the form FWP-1209, "Gage Storage Record" or tooling log book as applicable. Seller's QA and/or Buyer's Representative shall verify the following are complete and included before closure and sealing:

- A. Control Media contents are complete
- B. Applicable surfaces are greased
- C. Contents are shored
- D. Gage storage record is stamped and complete

10.4 Prior to shipment, Seller shall note physical damage, if any, to the tools and shall document

10.8 Upon Buyer's written notification and transfer of tool title from Buyer to Seller, Seller shall remove all evidence of ownership markings from tools and tool containers or render markings unrecognizable. This tooling identification removal includes, but is not limited to, the following:

- Ownership markings on plaques
- Barcodes
- Steel stamping
- Vibro-engrave etching
- Paint markings

Seller shall reference FAR 45.506 for contractor requirements of U.S. Government-owned property. Seller shall exercise caution to ensure that Tool Code and part number identifications are not removed.

11.0 TOOLING PERIODIC INSPECTION AND VERIFICATION ("PI/V")

11.1 PI/V is a process comprised of the cyclical verification of "Selected Tooling", as defined in paragraph 11.2, used as a media of acceptance of a feature(s) of an Item.

Example of Selected Tooling that would be placed into a PI/V recall cycle: A Drill Jig (DRJI) used to drill four holes in an aircraft part and subsequently used to verify the same four holes spacing, location, diameter, depth, or under circumstances where Seller is not employing any other verification method.

11.1.1 Seller shall place all Buyer-furnished or Seller-owned Inspection Gages ("INGA") or Check Fixtures ("CKFX") into a PI/V recall cycle.

11.1.2 Seller shall place all tooling that controls I/R into a PI/V recall cycle.

11.1.3 Seller shall utilize the coordination tolerances provided in Part IV of this manual.

11.2 "Selected Tooling" is defined as any Buyer-furnished or Seller-owned tool used as a media of acceptance for a feature of any Item deliverable to Buyer. Seller shall be responsible for establishing a PI/V procedure for Buyer-furnished or Seller-owned tools used as a media of acceptance to produce Buyer Items, and present proof of administering these procedures to Buyer or Buyer's Representative upon request. Tools designated by Buyer as Master Tooling or Tooling Tools and used for coordinating purposes only, do not require PI/V but do require unique preservation controls to ensure configuration and integrity of tools are maintained. Preservation, maintenance and standard repair specifications are illustrated in Part IV of this Manual.

11.3 Seller shall perform PI/V of Selected Tooling at Seller's facility annually and review tool history after each PI/V to determine whether tool performance has been such that subsequent periodic cycles can be increased, remain as scheduled or be reduced. Seller shall coordinate any deviations from the annual requirement through Buyer by initiating an E-SPaR and subsequently receiving authorization from Buyer's Program Management, e.g. F-16, F-22, C-130, etc. Seller shall receive deviation authorization only through PO revision.

11.4 Seller shall place all tooling in storage that is not in use and designate same tooling as "Inactive". Seller shall perform PI/V on all "Inactive" tools prior to their being returned to "Active" status.

11.5 On a tool-by-tool basis with appropriate written authorization from Buyer and in the absence of designated Control Media, Seller shall accomplish PI/V by means of visual inspection in lieu of performing physical tooling coordination. Seller shall accomplish the visual PI/V using the below criteria:

Seller shall use "Fit Check Items" or originally manufactured Items to the maximum extent possible.

Seller shall obtain an up-to-date quality history data file for Item(s) affected by applicable tooling, and perform a quality analysis relative to any discrepancies which may be tool related. Seller shall take appropriate action based on analysis results.

Seller shall perform a visual tool examination for obvious damage, excessive wear, broken, loose, worn, or missing Items, e.g., both integral and removable, bushings, pins, and clamps.

Seller shall immediately identify any adverse conditions revealed as a result of the above actions and request direction from Buyer by submitting a SATR.

Seller shall determine any adverse affect on

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 P

any dimensions specifically identified for inclusion in Buyer's BTP, into the PIL, but is not required to log one (1) and two (2) place dimensions, (1 place for metric) in the PIL.

3.6 Seller shall include a statement in the PIL to document inspection and acceptance of all one and two place dimensions, (1 place for metric).

3.7 Seller shall document tooling anomalies, requests for deviation or waiver, and other non-conformances, if any, identified during or subsequent to Seller's tool manufacturing and acceptance process by submitting a SATR.

4.0 TOOL IDENTIFICATION AND SHIPPING REQUIREMENTS

4.1 Tool identification for Buyer tooling is controlled by PM-4053. Seller shall check for the latest revision of PM-4053 requirements.

4.2 Seller shall identify each Seller-manufactured

3.0 CHANGE AUTHORIZATION

3.1 Seller shall not rework or in any way alter control tools without prior Buyer written authorization with a revised CPL and tool drawings, if required, to rework and/or re-stamp control tools.

3.2 Seller shall return to Buyer the stamped and signed Tool Rework Form (TRF) document and CPL.

4.0 TOOLING PRACTICES FOR BUYER-FURNISHED TOOLS – Category “A” tools are control tools that establish dimensions and features of production tools which control I/R and/or coordination points of other production tools. Seller shall use these tools as Control Media only to fabricate production and inspection tools. The following is a list of the affected tools:

- COMG – Component Master Gage
- FCGA – Facility Gage
- MSFM/TOFM - For contour only. Lines on MSFM/TOFM are for reference only and Seller may revise or add these lines to satisfy their production tool requirements without prior written authorization from Buyer.
- MSGa – Master Gage
- MSPE – Master Plate
- PDSE – Production Samples (Tube)
- TOGA – Tooling Gage
- TOSE – Tooling Sample (Welded Tubes/Ducts)

Any tool identified by this PO and provided as a control tool

5.0 LISTINGS OF SELLER-FABRICATED/PROCURED ST OR STE

5.1 Seller shall establish and maintain a part list and tool list, by manufacturer's part number, of ST or STE fabricated or procured by Seller, as required by Buyer. Seller shall not include any Buyer-furnished ST or STE in the list(s).

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

7.2 Buyer shall determine mode of transportation for STE and make arrangements for shipment, when STE is required at another location.

8.0 TOOLING USE AND TOLERANCE REQUIREMENTS – Seller shall comply with the tool usage and tolerance requirements as defined in PM-4053, unless unique requirements are otherwise specified on the Statement of Work ("SOW"), BTP, or this PO.

9.0 QUALITY ASSURANCE REQUIREMENTS OF SELLER-OWNED OR SELLER-FABRICATED PRODUCTION TOOLING

9.1 Seller shall submit applicable data of all Seller-fabricated or Seller-owned production tooling to Buyer's Program management for review and approval prior to release of tool for trial run or First Article Inspection ("FAI"). Such data may include, but is not limited to, engineering data, drawings, designs, Master Layouts ("MEL"), etc. In addition, Seller shall use data generated by trial run to satisfy Buyer's FAI requirement, if witnessed by Buyer's representative or designated alternate.

9.2 Seller shall inspect all Seller-fabricated production tooling, which has been manufactured utilizing Buyer-furnished Control Media, by utilizing applicable tooling tolerances defined in PM-4053.

9.3 Seller shall inspect or re-verify subsequent parts produced utilizing Seller-fabricated production tooling to the criteria defined in Part I, Section 4.0 "To Match" Hole Patterns of this Manual and as further defined in PM-4053.

9.4 Seller shall ensure each Item manufactured with Seller-fabricated ST and STE is identified in a conspicuous place with the current part number and dash number, Tool Code, any peculiar tool number, the "Also Use" current part number (if applicable), and/or Engineering Change Notice ("ECN"). Seller shall identify STE and MKT as "Property of USGOVT" and ST as "Property of Seller", or as directed by this PO.

***** END OF PART III *****

Verify replaceable and non-I/R part perimeters produced with production trim tools or check fixtures have allowable production tolerances from a maximum of .030 smaller, to a maximum of .030 larger than the tool, relative to the engineering drawing applicable feature tolerance as illustrated in Figure 4 and 5.

Verify perimeters are plus or minus .030 tolerances, unless otherwise stated on face of drawing. Example: An E.O.P. dimensioned as +.015, -.030 from a F.S., W.L., B.L. would apply. A "Tab" dimensioned as + or -.010 for overall width, would apply if stated on the drawing.

Utilize a check pin to verify all I/R hole patterns are made in accordance with the tool coordination tolerance table.

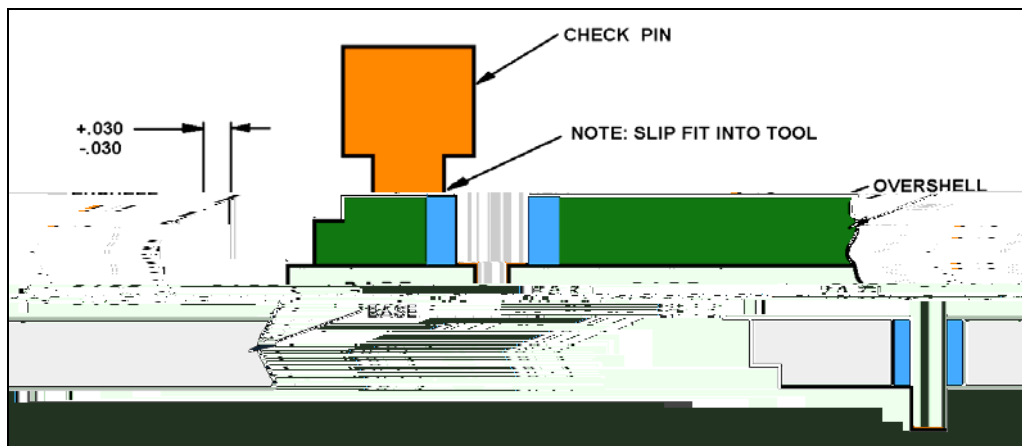


Figure 4. DOUBLE RAIL (REPLACEABLE, AND NON I/R, NET OR WITH EXCESS)

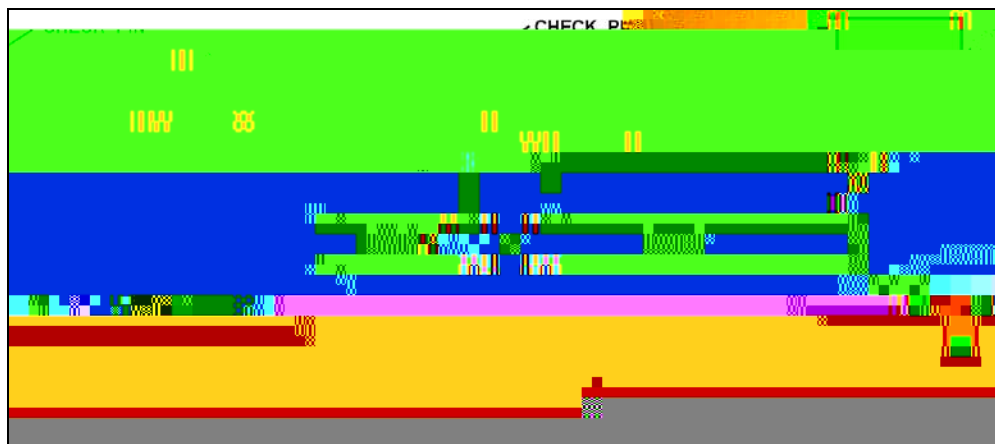


Figure 5. SINGLE RAIL
SETBACK TYPE (REPLACEABLE, AND NON I/R, NET OR WITH EXCESS)

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 Nominal +.0001/+.0010 Nominal -.0000/-.0002 Nominal -.0015/-.0020	Transfer of Hole Pattern (New Make) Bushing I.D. Tolerance Lg. Dia. Pin Tolerance Sm. Dia. Pin Tolerance Concentricity	

Table 2.0 Coordination Check of Production Tools

Table 3.0 COORDINATION CHECK OF PRODUCTION TOOLS

C/T - CONTROL TOOL	I/D - INSIDE DIAMETER
P/T - PRODUCTION TOOL	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 shall be +/- .030, unless otherwise stated on the engineering drawings.

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

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

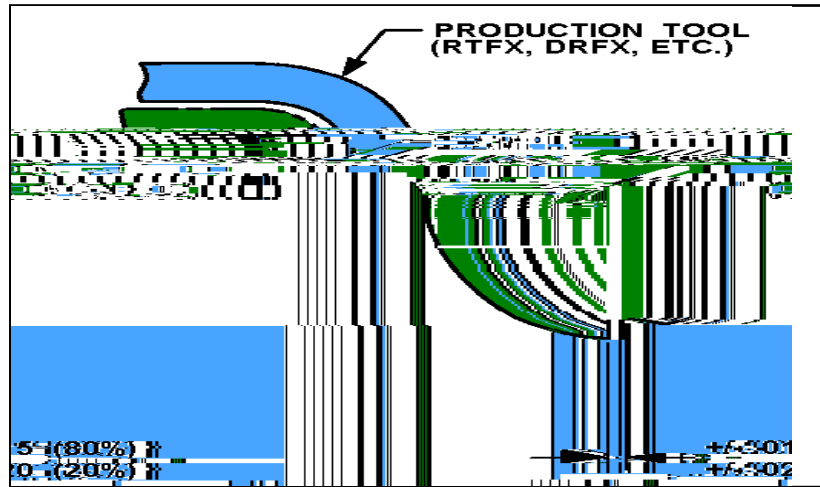
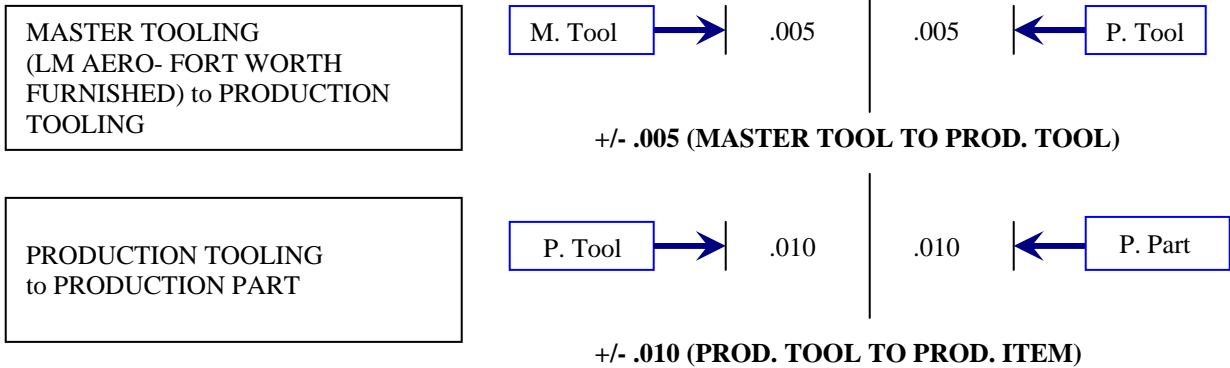


Figure 6. Production Tool to Control Tool

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:



*****END OF APPENDIX A*****

*****END OF TMS-MC-015 MANUAL*****