



## **Extrusion Blow Mold Tool Standard**

### **1 Introduction**

**Note:** Nothing in this standard supercedes applicable laws and regulations.

**Note:** In the event of conflict between the English and domestic language, the English language shall take precedence.

**1.1 Purpose.** This standard enables the global production of high-quality blow mold tools at the lowest investment cost. Essential part specific concessions to this standard must be agreed upon by the GM Manufacturing engineer, the GM Product Development Design Engineer (DE), the molding supplier, and the tool source.

**Note:** Report to GM Engineering when GM Manufacturing engineer is not allocated.

**1.2 Applicability.** This standard applies to the design and construction of blow mold tools that will produce thermoplastic vehicle parts globally.

### **2 References**

**Note:** Only the latest approved standards are applicable unless otherwise specified.

#### **2.1 External Standards/Specifications.**

None

#### **2.2 GM Standards/Specifications.**

GMW3059

GMW15850

GMW16375

#### **2.3 Additional References.**

- Statement of Requirements (SOR) Appendix E8

### **3 Requirements**

#### **3.1 Design Standards.**

**3.1.1 General Information.** Refer to GMW15850.

**3.1.2 GM Part Math Information.** Refer to GMW15850.

##### **3.1.3 Tool Math Information.**

**3.1.3.1** The tool source must provide the tool math file including, but not limited to (as layers with a legend provided):

**3.1.3.1.1** Stock list of components.

**3.1.3.1.1.1** Vendor.

**3.1.3.1.1.2** Catalog number.

**3.1.3.1.1.3** Description (sufficient descriptive information for ordering including vendor address and phone number).

**3.1.3.1.2** Cavity A weight.

**3.1.3.1.3** Cavity B weight.

**3.1.3.1.4** Shrinkage information.

**3.1.3.1.5** Material to be molded.

**3.1.3.1.6** Tool identification tag information/illustration.

**3.1.3.1.7** Part identification information.

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**Documents**

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3.1.3.1.8 Electrical schematic.

3.1.3.1.9 Water schematic (including all manifolds).

3.1.3.1.10 Hydraulic schematics and diagnostic diagrams.

3.1.3.1.11 Part layout (with the items 3.1.3.1.11.1 through 3.1.3.1.11.2 indicated).

3.1.3.1.11.1 Parting lines.

3.1.3.1.11.2 Slide lines.

3.1.3.1.12 Block sizes (cavity A and cavity B).

3.1.3.1.13 Lifters/slides.

3.1.3.1.14 Lifter/slide pockets.

3.1.3.1.15 Clamp plates.

3.1.3.1.16 Vent schematic (with vent sizes and lands labeled with dimensions).

3.1.3.1.17 Blow needles.

3.1.3.1.18 Fastener core pulls.

3.1.3.1.19 Complete detailed component layouts.

3.1.3.1.20 Thermocouple zone layout (if applicable).

3.1.3.2 At GM's request, A3 drawings should be made available of all tool construction and manifold design.

#### 3.1.4 Design Direction.

**3.1.4.1 Tool Construction Design Direction.** The tool designer should provide tooling solutions that meet the requirements for tool construction items including, but not limited to:

3.1.4.1.1 Die line.

3.1.4.1.2 Die locks/undercuts.

3.1.4.1.3 Part draft/open angle.

3.1.4.1.4 Seal at pinch-off.

3.1.4.1.5 Part/tool radii.

3.1.4.1.6 Part thickness.

3.1.4.1.7 Part layout in tool.

3.1.4.1.8 Tool size/mass.

3.1.4.1.9 Tool materials (steel versus aluminum).

3.1.4.1.10 Parting lines, variations and options.

3.1.4.1.11 Slides (3 piece tools).

3.1.4.1.12 Fastener core pulls.

3.1.4.1.13 Inserts (Porcerax, MoldMAX, etc.)

3.1.4.1.14 Wear plates/Ampco (when needed).

3.1.4.1.15 Support pillars.

3.1.4.1.16 Mold locks.

3.1.4.1.17 Part ejection and removal from mold.

3.1.4.1.18 Cooling.

3.1.4.1.19 Venting.

3.1.4.1.20 Serviceability.

3.1.4.1.21 Tool finish (polish, coatings, etc.)

3.1.4.1.22 Steel safe validation/optimization (i.e., for backside features).

3.1.4.1.23 Local (production region) electrical equipment voltage limits.

**3.1.4.1.24 Noise Level.** Noise level produced by the molding system must not exceed 70 dB (a) (decibels, a-weighted) and peak c-weighted sound pressure at work stations.

**3.1.4.1.25 Stress/Strain.** The compressive yield stress and compressive ultimate stress values will be considered equivalent to the tensile stress values. Shear yield stress, modulus of rigidity, and ultimate shear stress will be calculated utilizing 0.4 of the proportional limit using stress-strain ultimate strength data.

**3.1.4.2 Part Design for Manufacturability (DFM) Design Direction.** The tool design must seek to eliminate or minimize common molding defects including, but not limited to the following:

**3.1.4.2.1** To achieve the best possible match lines, the tool design will ensure that all tool mechanisms creating the match line are designed to be nested and locked/bolted in the position they will be in during the molding process.

**3.1.4.2.2** Sink marks.

**3.1.4.2.3** Excessive flash.

**3.1.4.2.4** Distortion during ejection.

**3.1.4.2.5** Rough surface.

**3.1.4.2.6** Flow marks.

**3.1.4.2.7** Excessive shrinkage.

**3.1.4.2.8** Unintentional sticking in cavity.

**3.1.4.2.9** Trapped gas.

**3.1.4.2.10** Warpage.

**3.1.4.2.11** Weld lines.

**3.1.4.2.12** Thin wall at parting line.

**3.1.4.2.13** Thin edges.

**3.1.4.2.14** Thin wall thickness at fasteners/inserts.

**3.1.4.2.15** Incorrect part thickness for material.

**3.1.4.2.16** Dimensional issues.

**3.1.4.2.17** Assembly issues (i.e., clearance issues).

**3.1.4.2.18** Poor fastener torque/pull-out.

**3.1.4.2.19** Deep die draw conditions (deep points in mold touch and begin to stretch parison prior to mold closing).

**3.1.4.3** Prior to approval of tool, a review of the tool design and part DFM tradeoffs must be held. The GM engineer, GM DE, molding supplier, tool source, and material supplier must agree to these tradeoffs. See Appendix A, Figure A1 for example of the Approval To Tool form.

### **3.1.5 Tool Dimensions.**

**3.1.5.1** The following tool stack-up and dimensions must be shown in the tool math file (see Figure 1):

**3.1.5.1.1** Overall shut/stack height (A).

**3.1.5.1.2** Dimension from parting line to Cavity A (B).

**3.1.5.1.3** Dimension from parting line to the Cavity B (C).

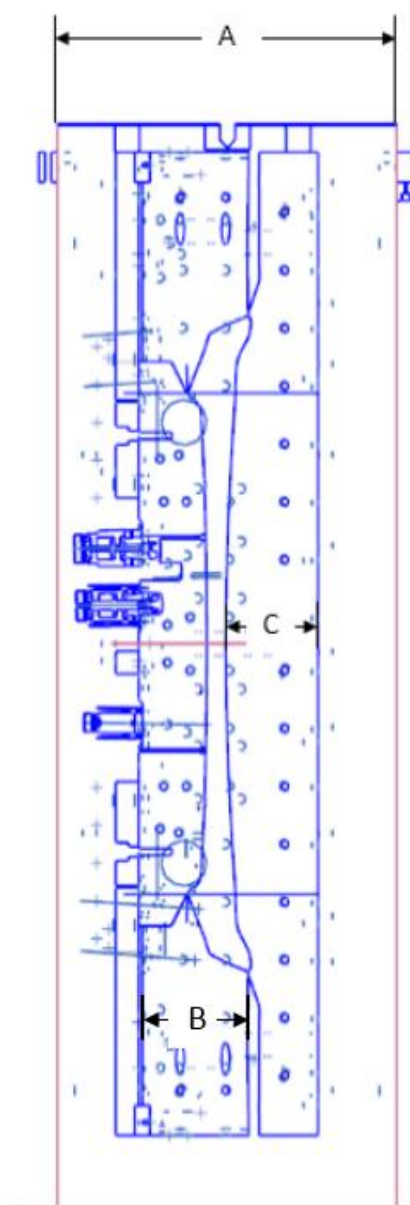


**Figure 1: Tool Dimensions**

**3.1.5.2** Travel of all moving parts must be dimensioned. Moving parts must be shown with phantom lines in the mold open position on all sections or on a separate layer of the tool math file.

**3.1.5.3** The part must be verified and documented in full ejector forward position with phantom lines as molded in the molding supplier production press for the part unloading mechanism.

**3.1.5.4** All tool and part dimensions must be in millimeters. Component/connection dimensions must be compatible with the published standards for the target molding supplier equipment.

**3.1.5.5** All tools must fit within the platen and tie bars of the molding machine.

**3.1.5.5.1** Deviations from this requirement must be approved by the molding machine manufacturer and the GM engineer. (Head tool size must also be considered when choosing the correct molding machine size.)

**3.1.5.6** Use of finite element analysis should be used to determine actual stress values for tool fatigue life limits.

**3.1.5.7** Tool steel sizes are dependent on part and mold design and must be validated prior to construction. See Table 1 for Minimum Tool Steel Sizes. See Figure 2 and Figure 3 for spoiler steel size examples.

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**3.1.5.8** All steel sizes must be agreed to by the GM engineer prior to the approval to tool.

Table 1: Minimum Tool Steel Sizes

| Location                                                              | Spoiler Tools |
|-----------------------------------------------------------------------|---------------|
| End of Part to Top of Tool                                            | 100 mm (4 in) |
| End of Part to Bottom of Tool                                         | 100 mm (4 in) |
| End of Part (Front/Rear) to Sides of Tool                             | 100 mm (4 in) |
| Part Cavity - To Back of Block                                        | 100 mm (4 in) |
| Part to Guide Pin/Bushing Block (ensure no interference with parison) | 75 mm (3 in)  |

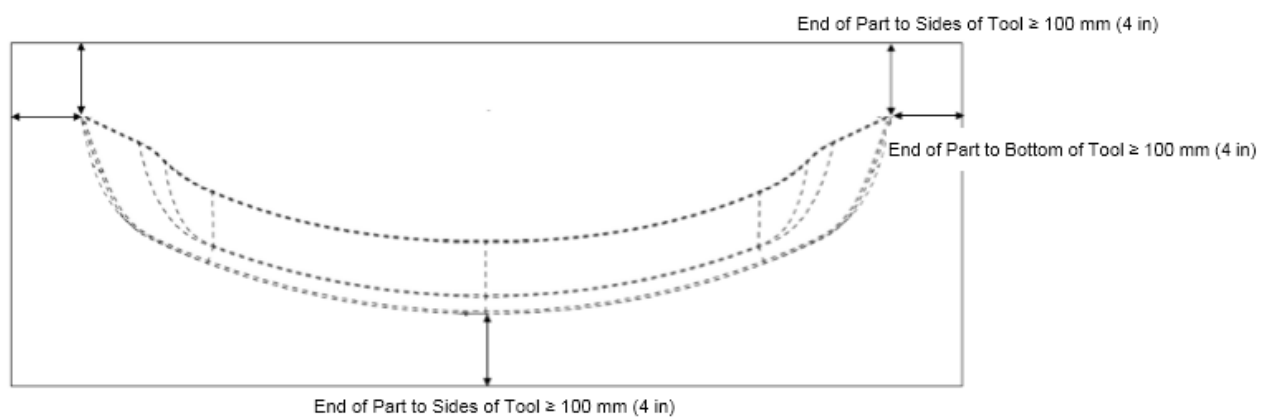


**Figure 2: Spoiler Steel Sizes (View 1)**

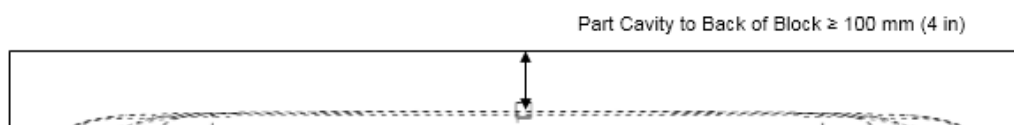


**Figure 3: Spoiler Steel Sizes (View 2)**

**3.1.5.9** Required blow ratio is 2:1 (L:H) minimum in any cavity (as shown in Figure 4). Higher blow ratios may require the use of a slide to draw more material into the deep draw areas. See 3.2.4.2 for material requirements and 3.2.9 for design requirements.

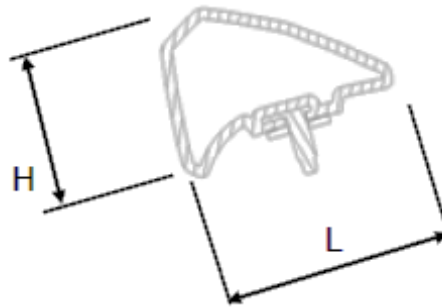


**Figure 4: Blow Ratio = H (Maximum Cavity Depth)/L (Smallest Dimension at Opening of Cavity)**

**3.1.5.10** There must be adequate daylight in the machine to allow for End of Arm (EOA) part removal from the tool (as shown in Figure 5). The daylight requirement is dependent on part removal method (manual, picker/grabber bar, or EOA robot). Minimum clearance requirement for manual part removal is the depth of the parison plus 152 mm (6 in) (76 mm (3 in) clearance from each mold half). Other part removal methods may require more clearance.

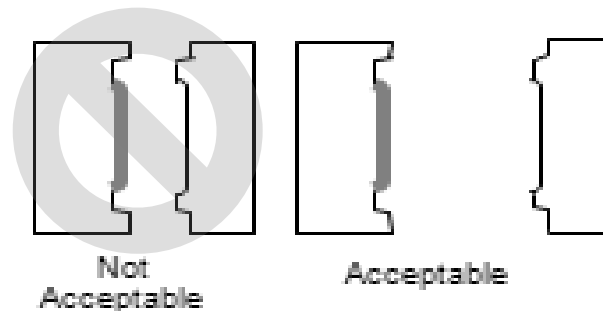


**Figure 5: Adequate Daylight for EOA Part Removal**

### 3.1.6 Components.

#### 3.1.6.1 Component Definitions.

**3.1.6.1.1 Manufactured Details.** Anything made from a raw piece of steel

**3.1.6.1.2 Standard Purchased Parts.** Any components that are integrated as purchased (i.e., leader pins, bushings, socket head cap screws, dowels, hydraulic cylinders, hose fittings, limit switches, etc.)

**3.1.6.1.3 Altered Purchased Parts.** Standard components that must be altered before integration into the tool (i.e., pins used as core pins or ejector pins, plates, etc.)

**3.1.6.1.4 Extruder System.** All components, either manufactured or purchased, included in the parison material delivery system.

**3.1.6.2** For standard tool components, D-M-E is the preferred global source ([www.dme.net](http://www.dme.net)). If another source is used, the components must be of equal quality (for materials, construction, and tolerances) to the D-M-E components.

**3.1.6.3** Prior to construction, the stock list of tool components must be confirmed as available in the part production region for use in tool repairs.

**3.1.7 Clamp Plates.** It is the molder's responsibility to ensure the clamp/plates are supporting the tool weight.

#### 3.1.8 Tool Weight/Molding Machine Requirements.

**3.1.8.1** Tool designs should seek to minimize the tool mass.

**3.1.8.2** Tool weights must not exceed the molding supplier crane capacities. The molding supplier must be capable of moving the complete tool (core and cavity) as one assembly.