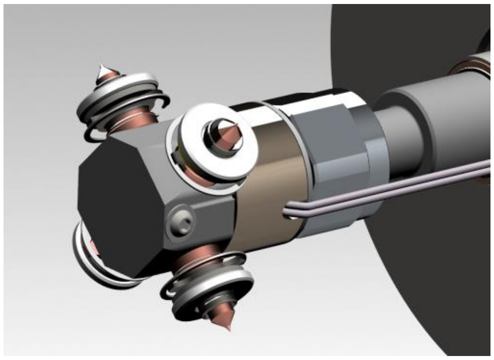
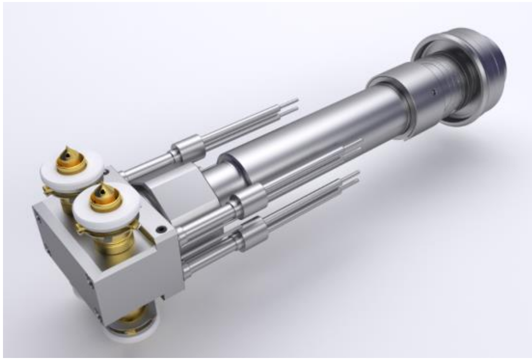
Ultra Side Gate Information for Mold Makers





Introduction

The Ultra Side Gate nozzle is intended for medical, closure, and small technical parts on which gate vestige on an end surface is unacceptable, or for which end gating is not possible due to part geometry. There are two general configurations available: Radial (1, 2, 4, or 8 tips distributed radially around the axis of the nozzle) and Inline (4 tips distributed on 2 parallel planes equidistant from the nozzle axis). Both configurations utilize a 2 piece nozzle, and both are optimized for different cavity arrangements. Radial nozzles are best used for molds with radially distributed cavities and cavity pods, while inline nozzles are better suited to high cavitation molds with parallel rows of cavities.

IMPORTANT: Since the tips for Husky side gate nozzles are mounted in the mold cavities, and rely on the position of the cavity to generate the force required to seal against the nozzle, it is **VERY** important that the cavities are made to the specifications listed in the gate detail supplied by Husky, that the mold design follows the guidelines contained in this document, and that the cavities do not move during operation. It is also **VERY** important that the cavities are positioned properly during assembly with the hot runner, and that the proper assembly procedure is followed to minimize the possibility of misalignment and potential damage to components, which can result in lack of maintaining a seal during operation. Any rotational misalignment between the cavities and nozzles that exceeds 0.1 degrees **WILL** result in damage to components.

The following guidelines identify the unique mold integration requirements of Husky's Ultra SideGate nozzle. Please read this document thoroughly before designing a mold to be used with this nozzle design.

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Side Gate Implementation Checklist

Before beginning the process of integrating a Husky Side Gate hot runner with your mold, please consider the following items so that you may maximize your chances for a seamless integration

1. What does the cavity layout look like in the mold? Is it possible to use individual cavities that can be removed independently? The Husky Side Gate design requires that high load springs be compressed while installing the cavities. This is easier to achieve (and monitor to prevent potential misalignment and damage) if the cavities can be installed individually, or at least installed for each nozzle independently.
2. Does the mold design allow for rigid support of the cavities relative to the nozzles during the entire injection process (including clamp up and injection)? It is imperative that the distance and alignment between the cavity and nozzle be maintained through the full injection process. The tip springs apply a significant load to the cavity (650lbs/2891N per tip), and at the highest allowable pressure (30ksi/207MPa) can only accommodate roughly 0.002inches/0.05mm of movement without leaking. The mold needs to support the tip spring loads in addition to the loads being applied by injection pressure and clamp up with minimal deflection.
3. Does the mold design allow for precise alignment of the cavities relative to both the cavity plate and the nozzles? To maintain the sealing force required between the tips and nozzles, the cavities (which support the tips) are required to be positioned within +/-0.0004inches/0.01mm (opposite cavities to each other) and aligned within 0.1 degrees (adjacent cavities to each other). Failure to achieve these alignments may result in the system leaking.
4. Does the mold allow the interface between the tips and nozzles to be viewed when installing the cavities and cavity plate? If all directions are followed properly, the cavity mounted tips should be in the proper position to assemble with the hot runner. To rule out any possible mistakes and prevent damage, the best way to ensure that everything is aligned properly is to observe the tips as they contact the nozzles during assembly of the cavities to the cavity plate. This can be achieved by installing the cavities for each nozzle individually (or by having a removable cover plate that allows viewing the individual tips during installation).

Nozzle Tip Retention

Ultra SideGate nozzle tips are retained by the cavity inserts. This arrangement is different from all other Husky nozzle styles, which retain the nozzle tip in the nozzle housing. Thermal expansion of the nozzle has an insignificant effect on nozzle tip position. The nozzle tips are spring-loaded with Ultra Seal technology against the nozzle for seal-off. The seal force is generated as the springs are compressed during assembly of the cavities to the hot runner. The bore in the cavity controls the amount of sealing force, and the uniformity of the seal by controlling the tip position. A retaining ring holds the nozzle tip securely in the cavity insert. A retaining ring groove machined in the tip insert bore in the cavity is required for nozzle tip retention (see figures 1 and 2).

CAUTION: Securing the tip with the retaining ring prevents movement of the tip and consequential damage during cavity plate assembly to the hot runner. If the retaining ring groove cannot be correctly machined in the cavity insert, contact Husky for other options.

See the gate detail drawing that is provided with the hot runner system for all dimensions and tolerances.

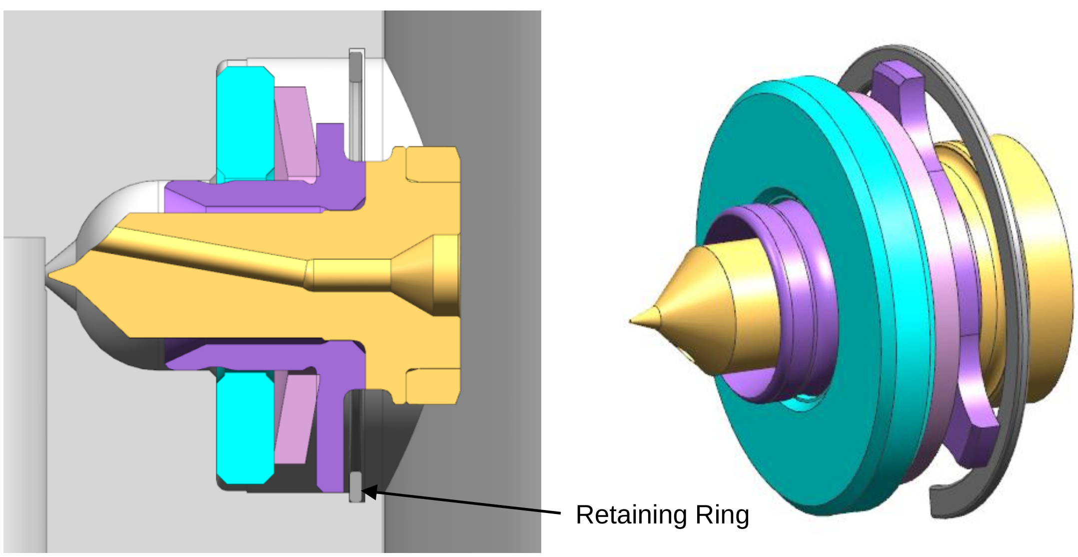

Figure 1 Ultra SideGate Nozzle Tip Assembly

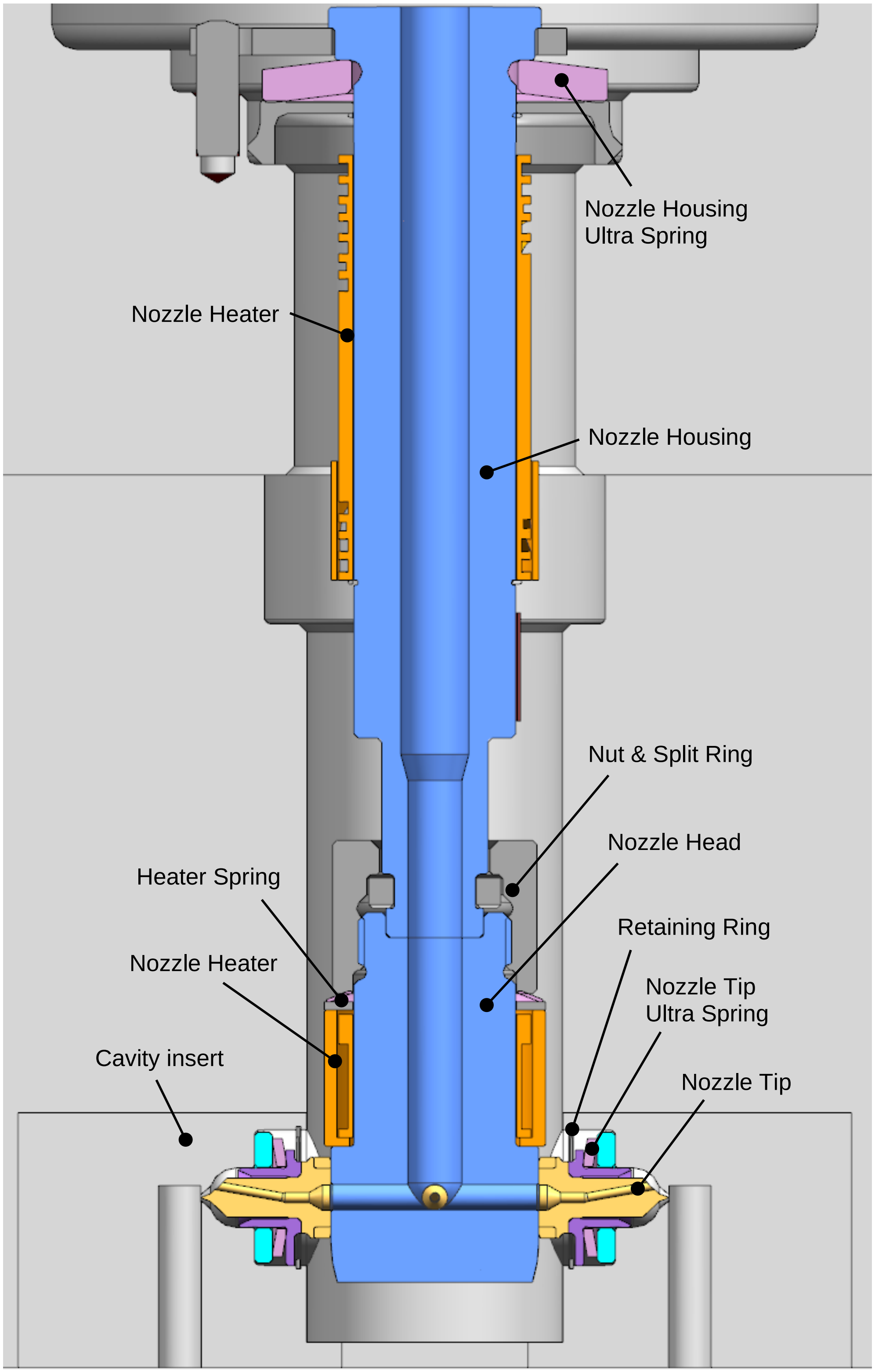

Figure 2 Ultra SideGate Nozzle

Nozzle Heating

Ultra SideGate nozzles are designed to provide heat to the nozzle housing, nozzle head, and nozzle tip. All Ultra SideGate systems have a heater located at the top of the nozzle housing to provide heat to the nozzle housing near the Ultra Seal spring and nozzle locating insulator. Some heat from this heater is transferred to the manifold plate. Although not recommended, in applications where heating zones are limited these heaters may be combined (bridged) to use one heater/TC to control multiple heaters for different nozzles.

Heating technology near the tips is different for the two configurations.

Radial Configuration

The Radial Configuration has a single heater which contacts a step in the nozzle head located very close to the nozzle tips. This heater is spring loaded to maintain contact with the step, and to ensure that heat is directed into the tips (see Figure 2). There is a single thermocouple mounted in the head which controls this heater. The head may be rotated by 180 degrees to move the TC location if required. If a specific orientation of the TC is required, please notify Husky, as there are ways to accommodate this in the hot runner design. This heater should always be controlled as a single zone and not combined (bridged) with any other heater.

Ultra SideGate Inline Configuration

The Ultra SideGate Inline configuration has (4) heaters in the nozzle head. The number of thermocouples depends on the level of control requested by the molder (see Figure 3). Individual control of the tips may be used to improve balance in applications with high demands for balance. This does require additional zones in the temperature controller.

Temperature may be controlled by either:

1. Individual control – each heater is controlled by a thermocouple near the heater.
2. Group control #1 – the four heaters are bridged together and controlled by a single thermocouple located near one of the heaters.
3. Group control #2 – Two heaters on the ends are bridged together and controlled by a thermocouple located near one of the heaters.

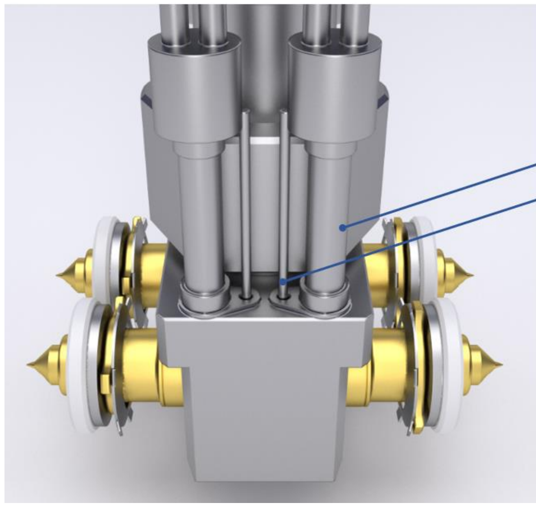

Figure 3 Ultra SideGate Inline Nozzle Head Assembly

Cavity Alignment

Alignment of the cavity inserts is critical for seal-off between the nozzle tips and the nozzle housing. All hot runners are shipped from Husky with the nozzle housings pre-aligned to minimize the risk of damage during assembly with the mold. When the cavities are installed, the tip springs are compressed to create seal-off. Since there is very little expansion of the components, most of the sealing force is generated during assembly and before heating the system. In the case of minor misalignment of the cavities, it is possible to adjust the orientation of the nozzles by actuating the cams that are installed between the manifold and backing plates of the hot runner (see Figure 26). The cams relieve the sealing force between the manifold and nozzles, allowing the nozzles to reorient themselves to the cavity position.

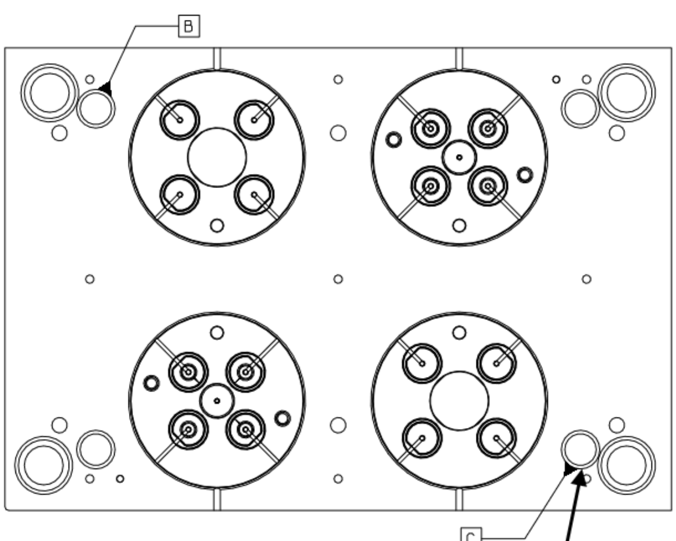

Figure 4 Hot Runner Guide Pin Bores Used as Datum Features

Husky recommends using two of the hot runner guide pin bores as datum features for accurate positioning of the gates (Figure 4). Dowels or other locating features (for instance flats on the cavity inserts) must be used to prevent excessive movement of the cavity block and of the individual cavity inserts (Figure 5). It is not, however, necessary to fix these components rigidly. They may have a degree of rotational freedom, but their final orientation must fit within the constraints defined below.

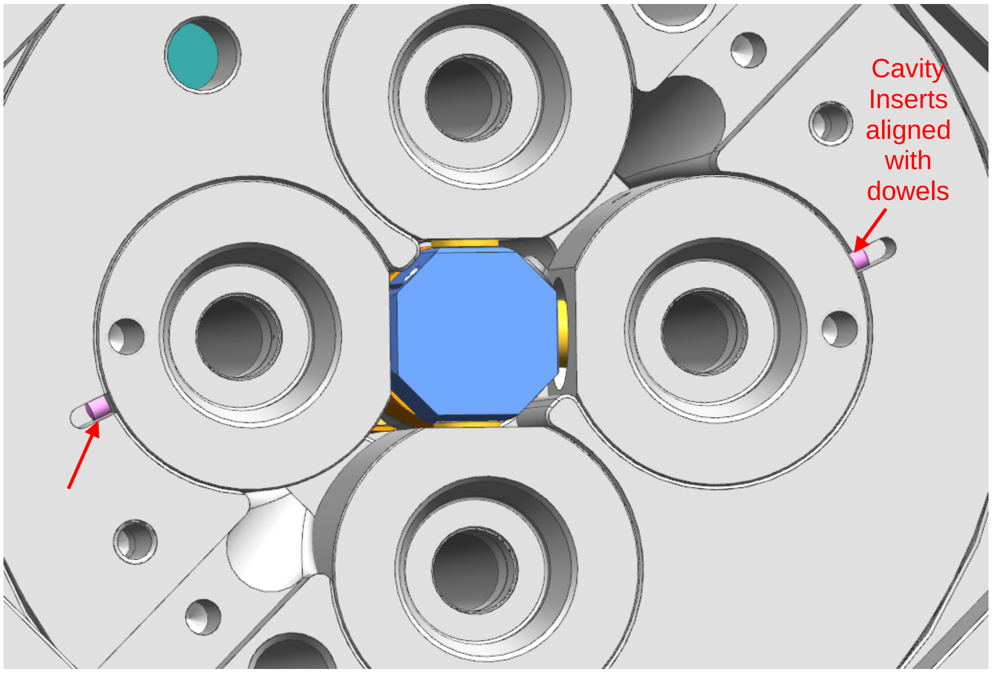

Figure 5 Cavity Insert Alignment Features

As a group, the cavity inserts should preferably be oriented to within ±0.1° of the datum reference frame of the cavity plate (Figure 6). Making sure that the cavities are properly aligned reduces the risk of damage during assembly, and using individual cavity inserts which can be carefully inserted into the cavity plate in pairs after the cavity plate is mounted to the hot runner minimizes the risk. For any misalignment over 0.1°, the cams between the manifold and backing plates **MUST BE ENGAGED** (creating a gap between the 2 plates) before assembling the cavity plate and cavities to the hot runner. This reduces the load on the hot runner nozzles, allowing them to move during assembly to help compensate for the misalignment. Without this compensation, the misalignment risks damage to the tip sealing faces, which may result in failure to seal during operation.

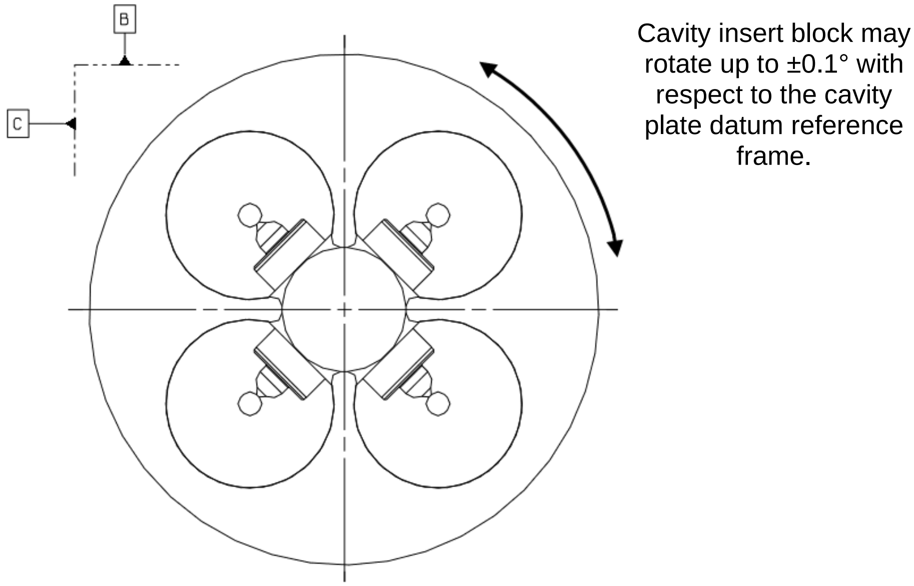

Figure 6 Allowable Max Cavity Block Rotation

The nozzle tip seating faces in the cavity inserts for a specific drop must be oriented to within ±0.1° of the required angle between each other. Again, the individual inserts may have a small degree of rotational freedom to achieve this alignment (Figure 7).

Important note: If the individual cavities are allowed to rotate in the cavity plate, and are locked in place with a cover plate, it is critical that their orientation to the nozzle housing be maintained. If the cavity plate is removed from the hot runner, and the individual cavities are removed and then reinstalled (and clamped to prevent rotation), they may lose their orientation to the nozzle housing, and leakage may occur after the cavity plate is reinstalled on the hot runner. Alternatively, the individual cavities may be allowed to free float (within the range specified above) when reinstalling the cavity plate on the hot runner. During compression, the tip springs will bring the cavities into proper alignment.

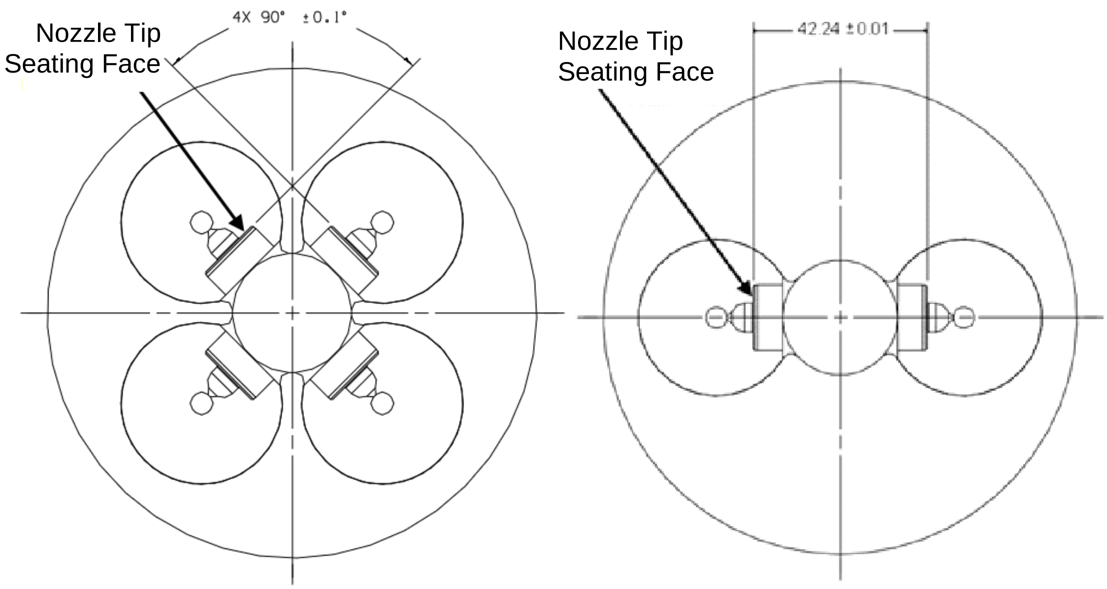

Figure 7 Cavity Insert Alignment – 4 and 2 Cavities

Another cavity insert option is a two piece rectangular cavity insert with tapered side walls. This option is ideal for tools with slight variations in part designs. Cavity inserts are screwed directly to the cavity plate and limit friction from the tip/housing during installation, due to their chamfered side wall design (Figure 8). The spring compression does not load the tip to housing seal interface until the gate insert is well engaged into the pocket.

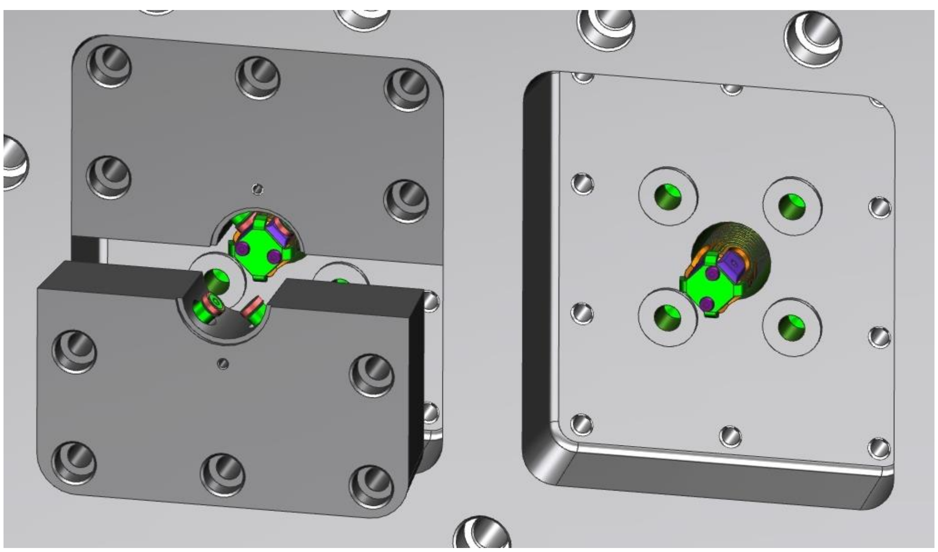

Figure 8 Cavity Insert Alignment – 2 Cavities

Caution: The cavity plate must be designed so that the cavities can be removed to gain access to the nozzle tips. Additionally, each cavity block should only contain the tips for one nozzle, and ideally, each tip should be held within an individual removable gate insert (as shown in figure 5). This allows the individual nozzles to properly locate and seal. Failure to have removable inserts will result in a system that cannot be properly maintained (Figure 9).

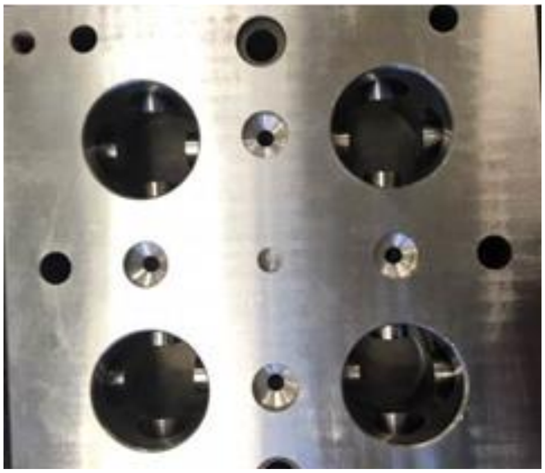

Figure 9 Improper Design of Cavity Plate

Cavity Movement

The cavities and cavity plate must be designed to support the load applied by the tip springs to the nozzle tip seating surfaces in the cavities while maintaining minimal deflection. The load applied per spring can be as high as 650lbs (295kg) at operating temperature. Due to the stiffness of the spring, a deflection of the tip seating surface as low as 0.002 inches (0.05mm) could affect the ability of the system to seal during operation. The deflection of the cavities should be maintained below this threshold.

Separating the Cavity Plate

When separating the cavity plate from the hot runner with the cavities installed, the plastic slugs between the tips and housings must all be sheared simultaneously. For larger cavitation systems (above 4 drops), this can be difficult to achieve by using only pry slots. Although the slugs are only 3mm in diameter, and shear rather easily, a large plate may complicate separation by having a tendency to tip on the guide pins. In this case, jacking bolts may be added to the cavity plate to allow the plate to separate from the hot runner evenly (Figure 10). Location and size of these jacking bolts will be dictated by the mold design and therefore are at the discretion of the mold maker. Husky recommends that 4 jacking bolts are used, that they are a minimum of M12, and that they are positioned as close to the guidepins as possible.

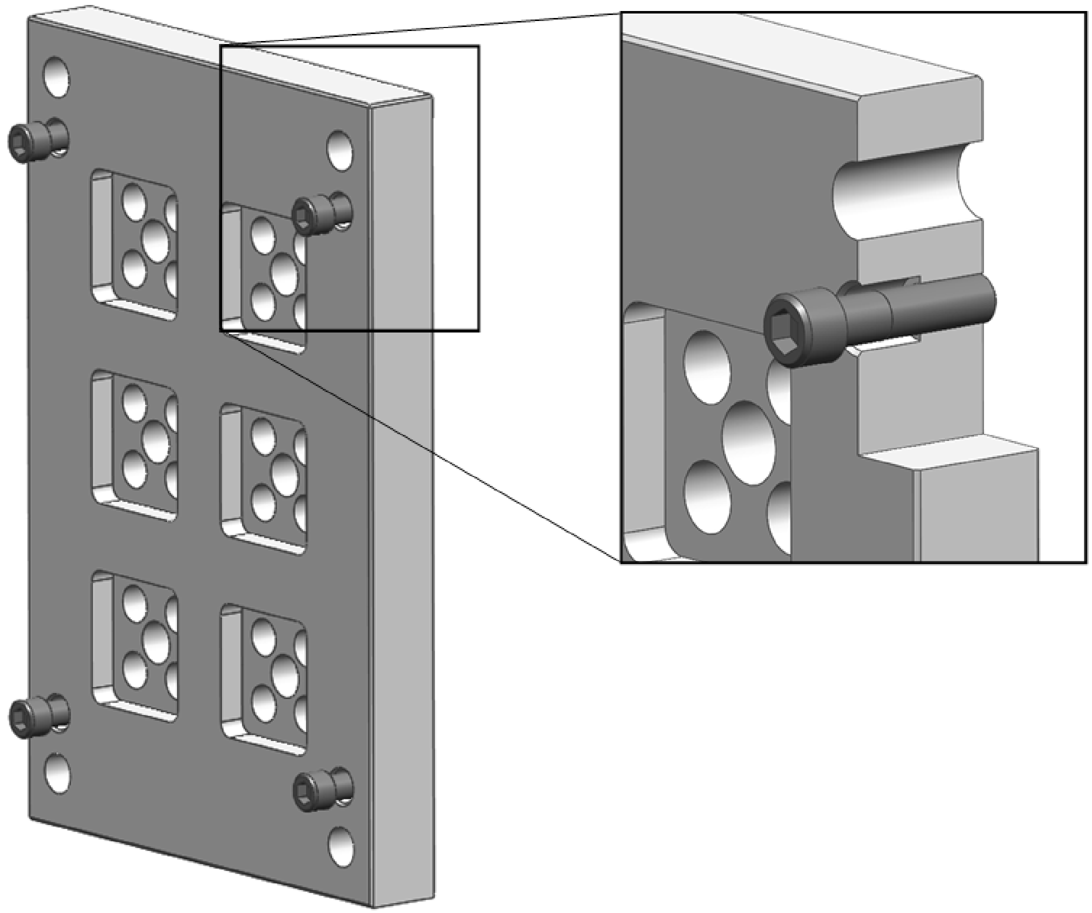

Figure 10 – Example of Jacking Bolt in Cavity Plate

Removing Cavity Inserts

When separating cavity inserts from the cavity plate, a tapped hole in the insert can be helpful to aid in removal (Figure 11). With a screw threaded into the hole in the insert, a slide hammer or small pry bar can be used to help free the insert.

Important note: Husky recommends that the cavity inserts be accessible from the split line so that they can be pulled from the cavity plate without removing the mold and hot runner from the machine. This design offers the benefit of fast bubble cleaning in the press in case of contamination.

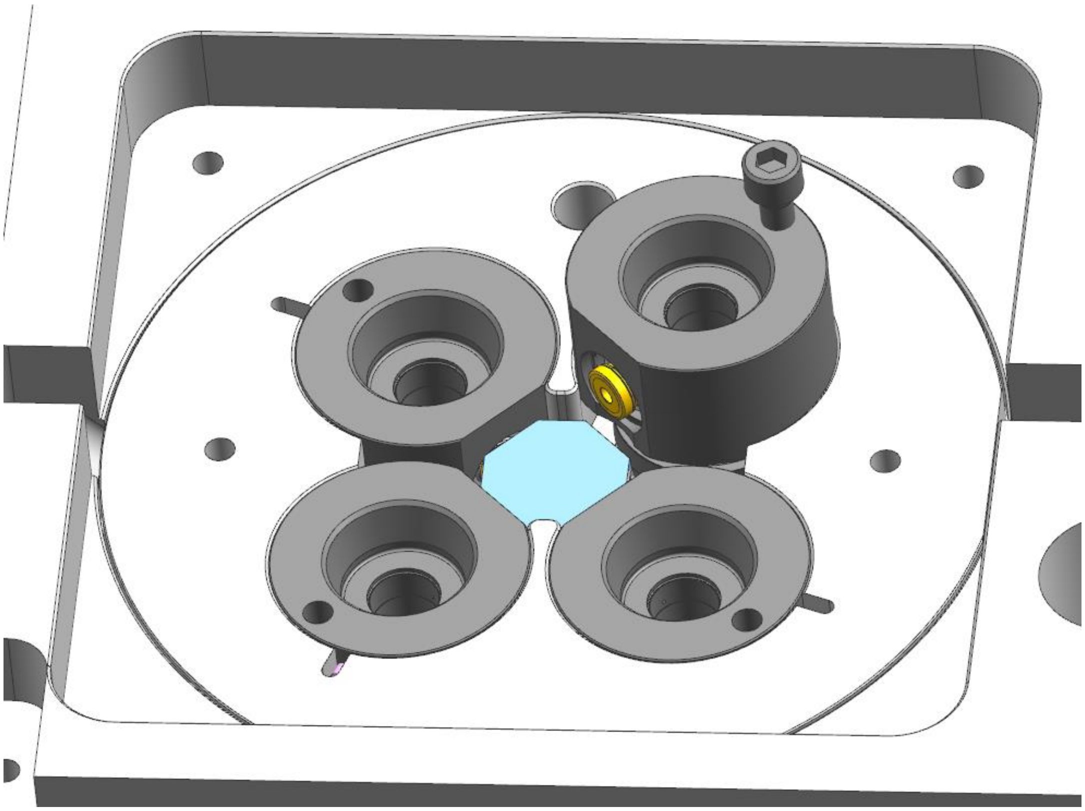

Figure 11 – Example of a Removal Screw in the Cavity Insert

Closed Nozzle Bore

In order to maintain consistent temperature control, the nozzle must not be exposed to the parting line. A cover plate is recommended, so that the tips may be visible during and after assembly of the cavity plate to the hot runner (see Figure 12).

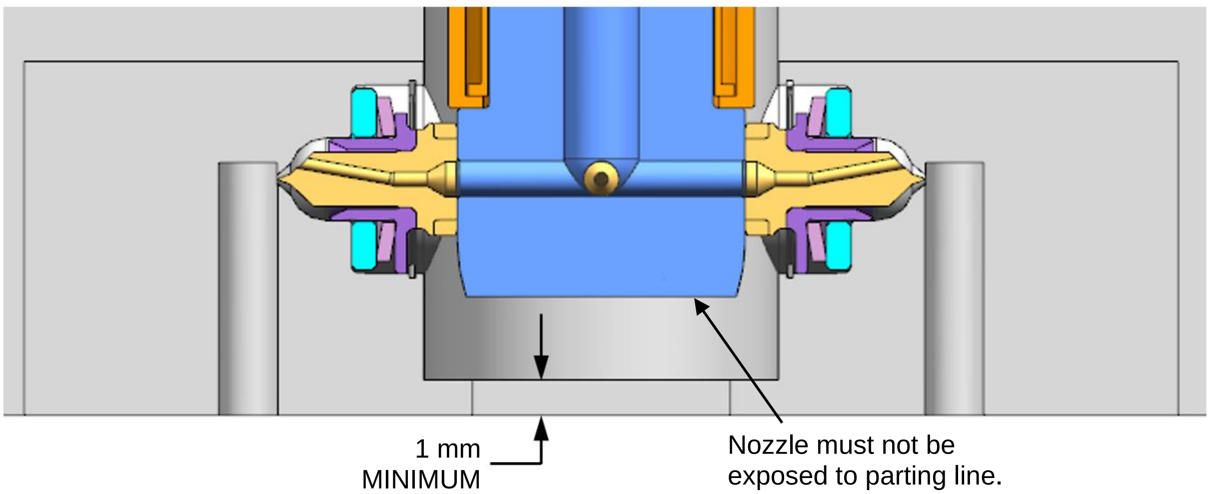

Figure 12 Closed Nozzle Bore

Cooling Recommendations

Husky recommends an independent cooling circuit for the Side Gate nozzle tips in order to ensure more precise temperature control in the gate area. The layout of the cooling lines relative to the drop (distance to drop and geometry) should be identical for all drops to ensure uniformity of cooling from drop to drop (Figure 13 and 14).

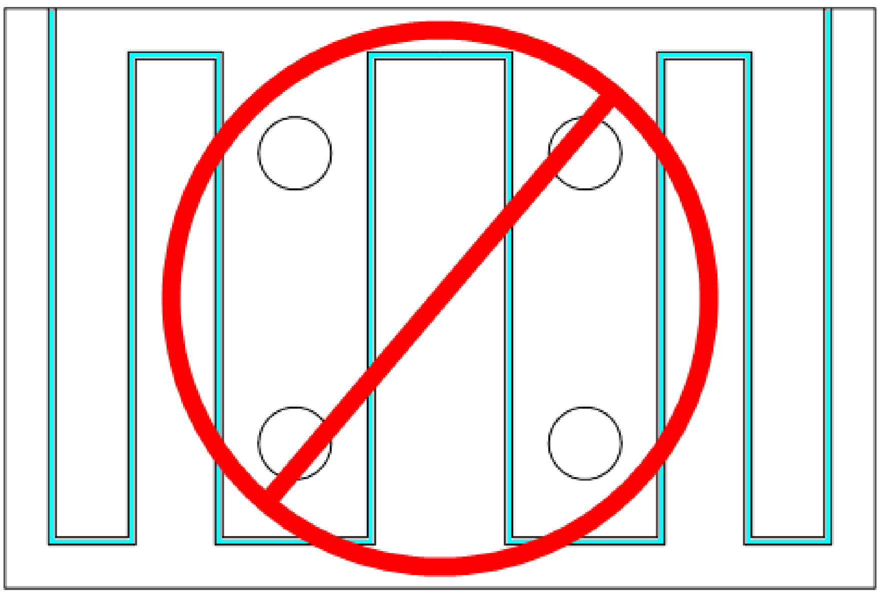

Figure 13 Limited Control of Tip Temperature

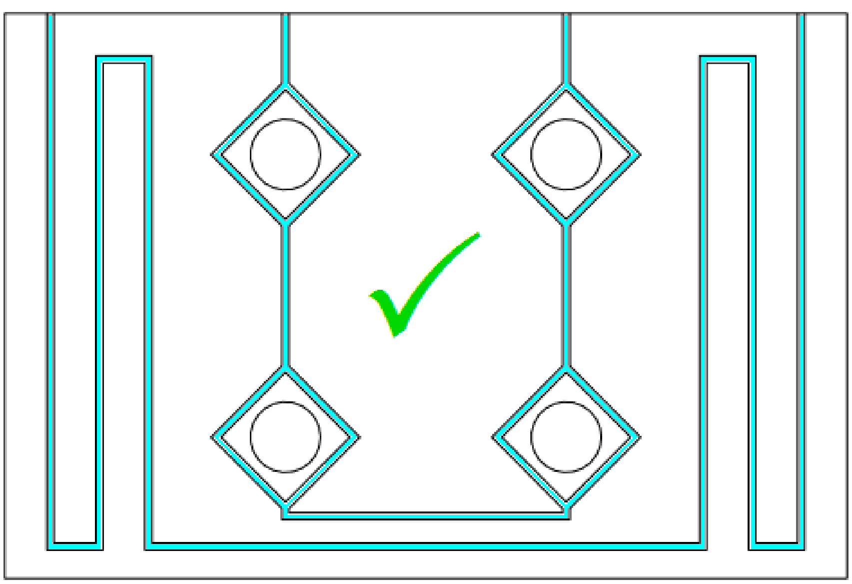

Figure 14 Optimized Control of Tip Temperature

Material Thickness Near Gate

A thin material condition near the gate may lead to early failure of the cavity insert. Adjust the design of the cavity insert for the maximum possible material thickness in this area. Husky recommends a minimum of 1.5 mm of material thickness around the gate bubble (Figure 15 and 16).

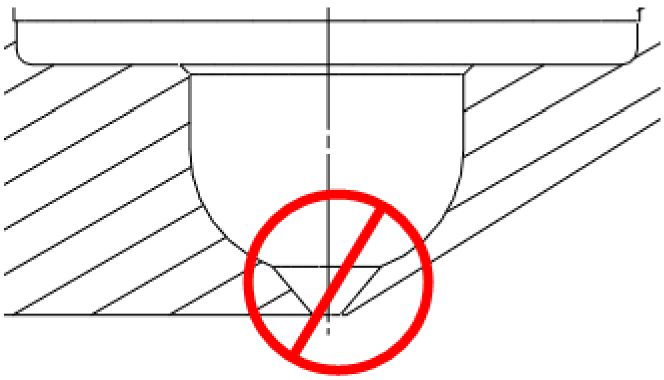

Figure 15 Thin Steel Condition

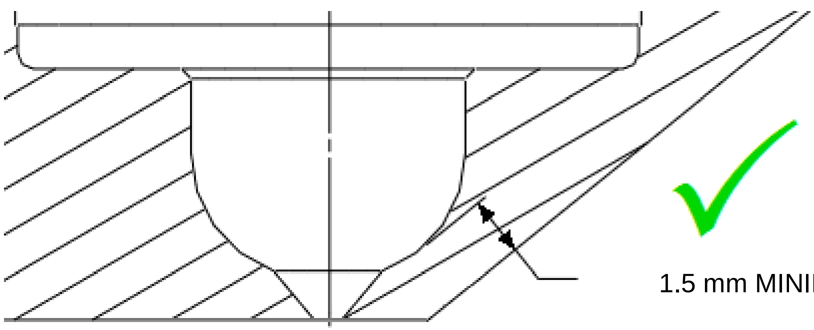

Figure 16 Improved Cavity Insert Design

Gate Related Part Geometry Considerations

For optimal gate quality, Husky recommends that a localized flat be positioned on the part around the gate, and that a section of minimal draft angle (preferably 0 degrees) equal to or greater than the gate diameter exists on the part opposite the direction of demolding. This will ensure that the frozen cold slug in the gate shears cleanly and does not pull molten material from the gate bubble (Figure 17).

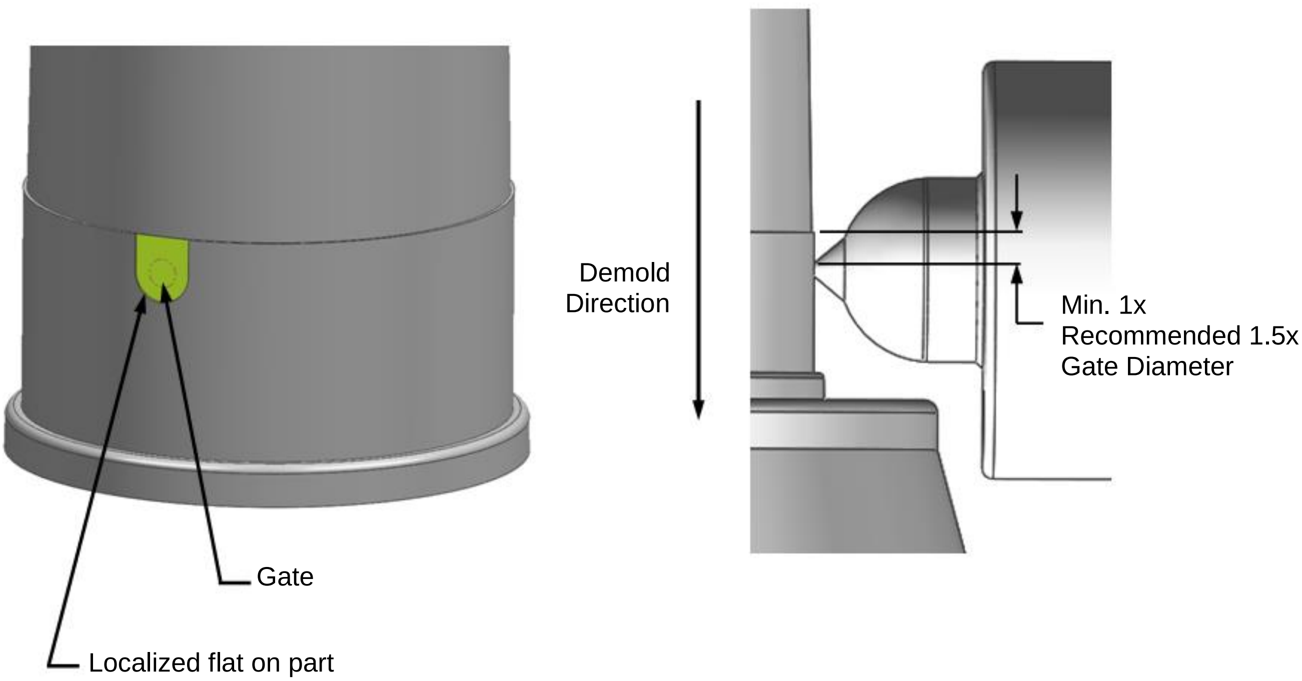

Figure 17 Part Geometry Considerations

L-Dimension

On hot runner systems, the L-dimension is measured from the injection face of the cavity plate to the centerline of the gate (Figure 18).

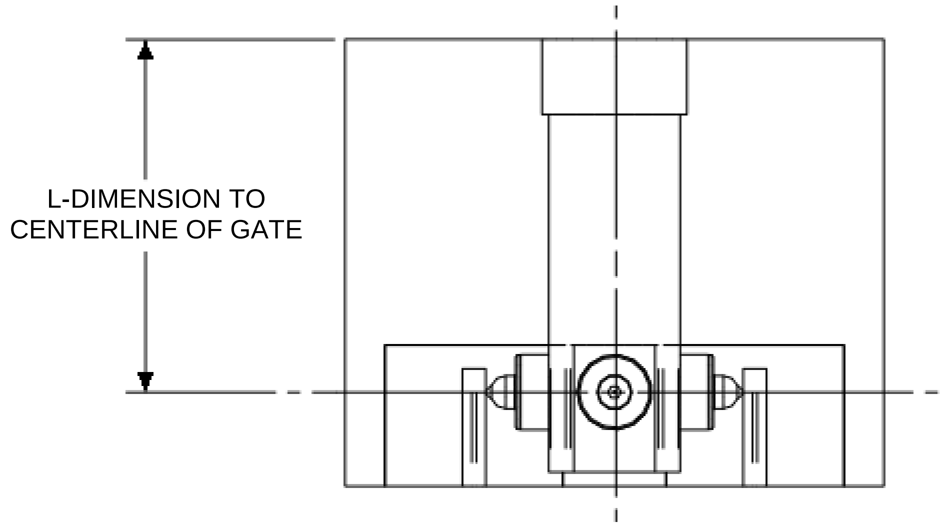

Figure 18   L-Dimension

PL and BL Dimensions

On hot sprue systems, the PL and BL dimensions are measured to the centerline of the gate (Figure 19).

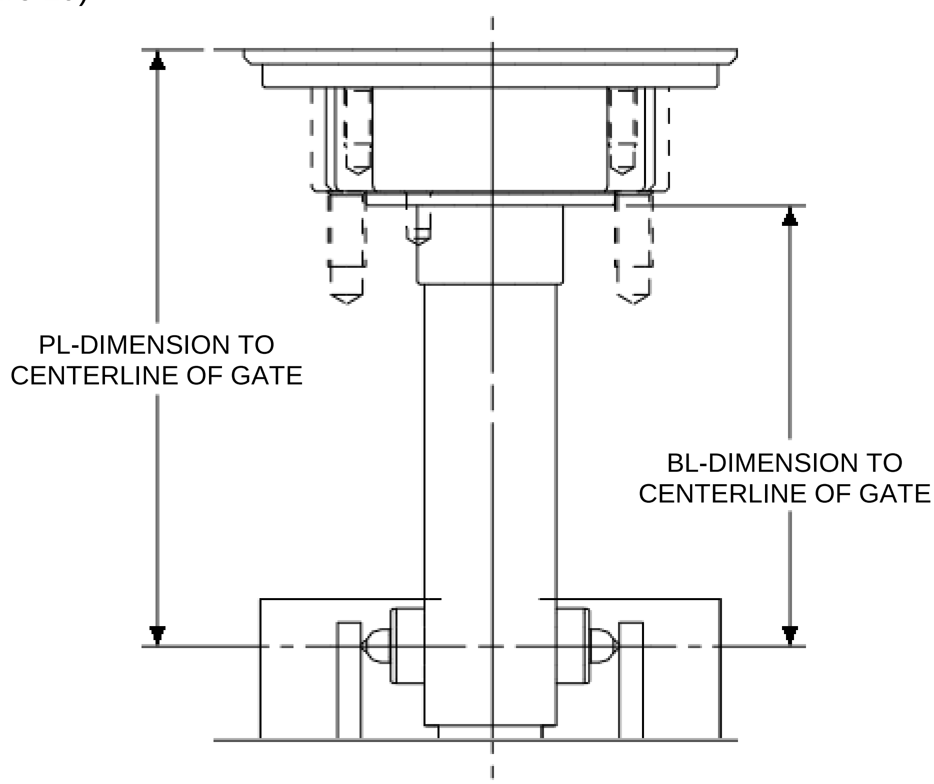

Figure 19 PL and BL Dimensions

Hot Sprue Dowel Location

On a 2 drop or single drop hot sprue, the dowel location in the customers plate (relative to the cavity orientation) is critical to insure that the housing lines up properly with installed tips (Figure 20).

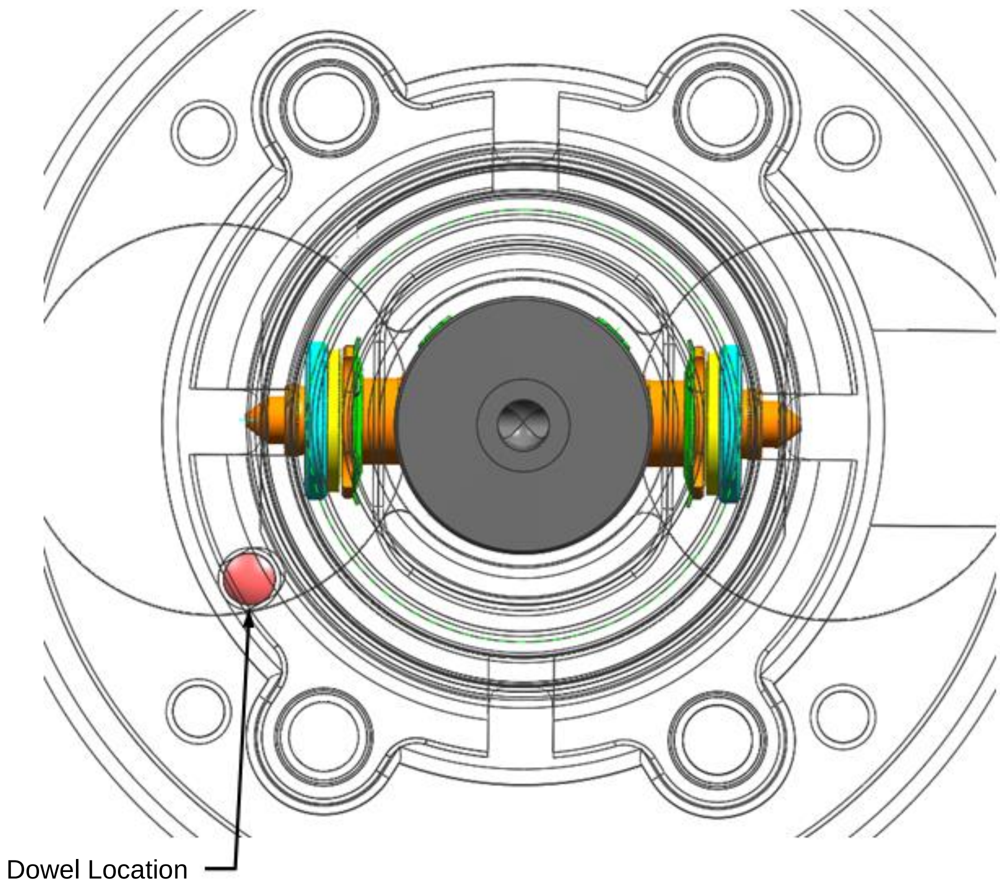

Figure 20 – Dowel Location for 2 Cavity Hot Sprue

Nozzle Inspection

On conventional hot runners, Dimension A is defined as the nozzle tip height. However, for side gate hot runner inspection, Dimension A is defined as the distance from the face of the manifold plate to the end of the nozzle head (Figure 21).

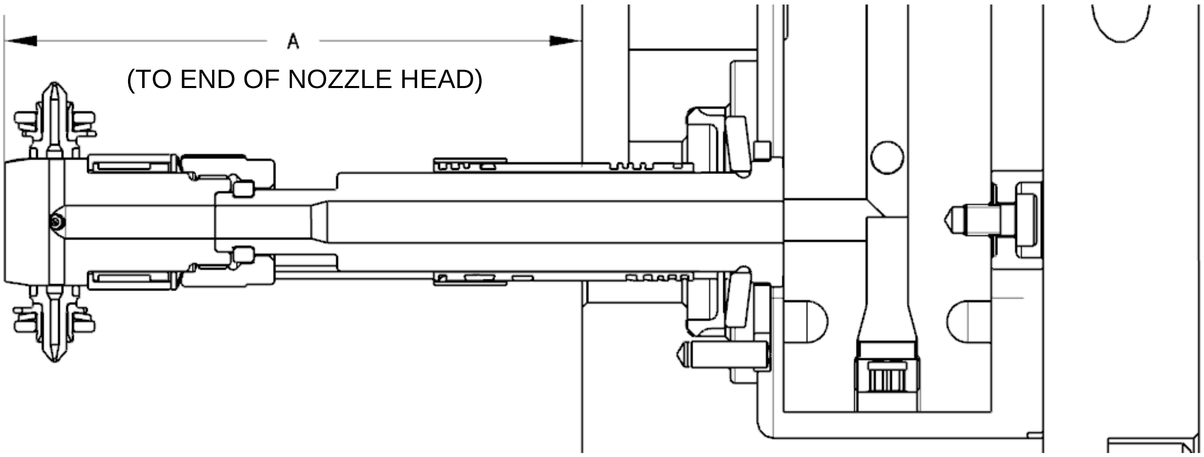

Figure 21 Dimension A

Cavity Shut Off

In the case when a cavity needs to be shut down for any reason (such as cavity damage or part flash), an available blank tip with no melt channel can be used. This is a standard item which can be ordered from Husky. Simply remove the tip from the affected cavity, and install the blank tip in its place. The blank tip should be installed with all the same components used with the regular tip (insulator, spring, and retaining ring) (Figure 22). Please be aware that part balance will be negatively affected for the remaining cavities.

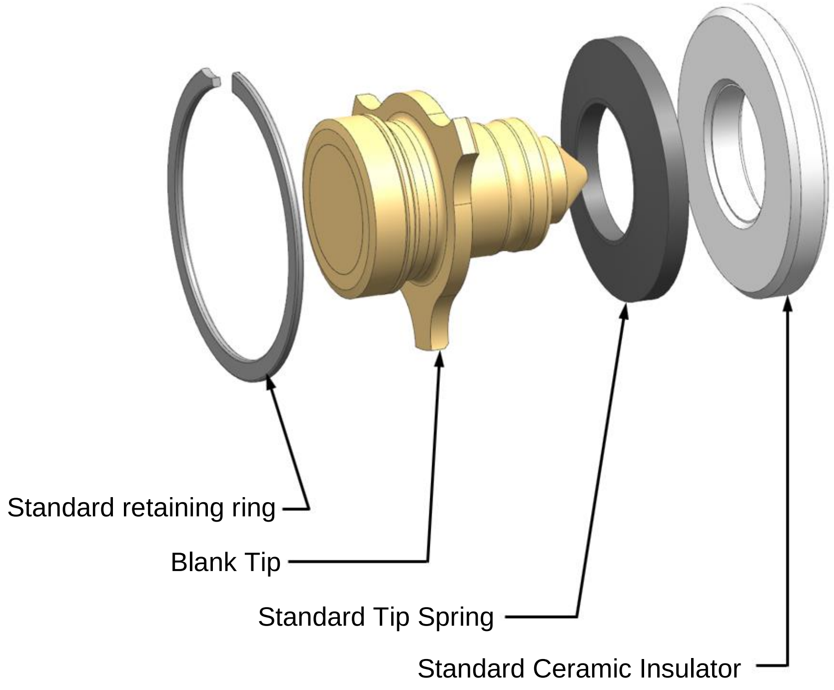

Figure 22 Blank Tip Assembled with Standard Components

Multi-Material Systems with Side Gate

On rare occasions, customers may wish to combine side gated parts and conventionally gated parts (either hot tip or valve gate) in the same mold. This requires some special considerations relative to the hot runner when designing the mold.

One of the unique characteristics of the Husky side gate is the ability of the nozzle to align itself to the tips and cavities after installation to the cavity plate. This is critical to prevent leakage, which is caused by misalignment between the spring loaded tip and the nozzle. To allow nozzle movement, special cams are installed between the manifold plate and backing plate which, when turned to the open position, relieve the spring pressure between the manifold and nozzle (Figure 23). This allows the nozzle to rotate and align itself to the tips which are installed in the cavities.

On a multi-material system, actuating the cams relieves the spring force on all the drops. Because the spring load for the conventional drops may be significantly different than the spring load for the side gate drops, there may be a different gap created between the spring and the nozzle. If the gap is large, it can cause the housings to tilt, and become misaligned with the cavities, which can cause damage if this is done before assembly to the cavity plate. Since the side gate housings are pre-aligned, and assembly should be performed before actuating the cams, this should not cause an issue in most cases. If the side gate housings are not aligned

Important Note: If this 2 step assembly procedure is performed, at least one set of cavities (either the conventional or the side gate cavities or both) MUST have the ability to be removed from the parting line. Husky recommends that the side gate cavities have this ability, due to the additional benefit of fast bubble cleaning in the press in case of contamination. In this case, the conventional drop cavities may still be sandwiched between the cavity plate and manifold plate.

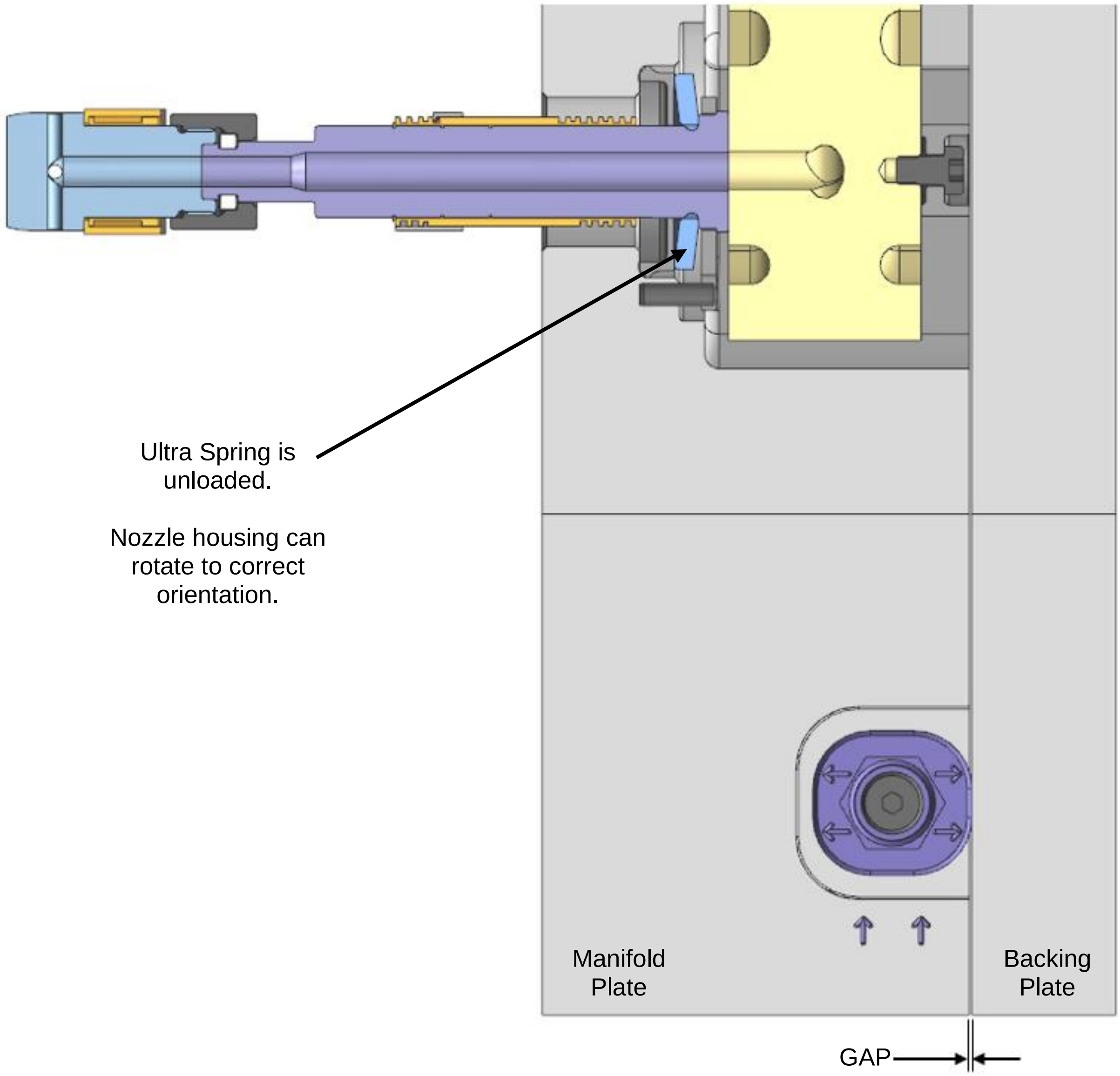

Figure 23 Cams in Open Position

Manifold System with Side Gate

Specific SideGate installations which much be considered for plate design. Images show the installation envelope, the installation details will be on the customer prints.

Cam Jack installations 2 on the Operator and 2 on the Non-Operator side of the manifold plate near the corners. (Figure 24)

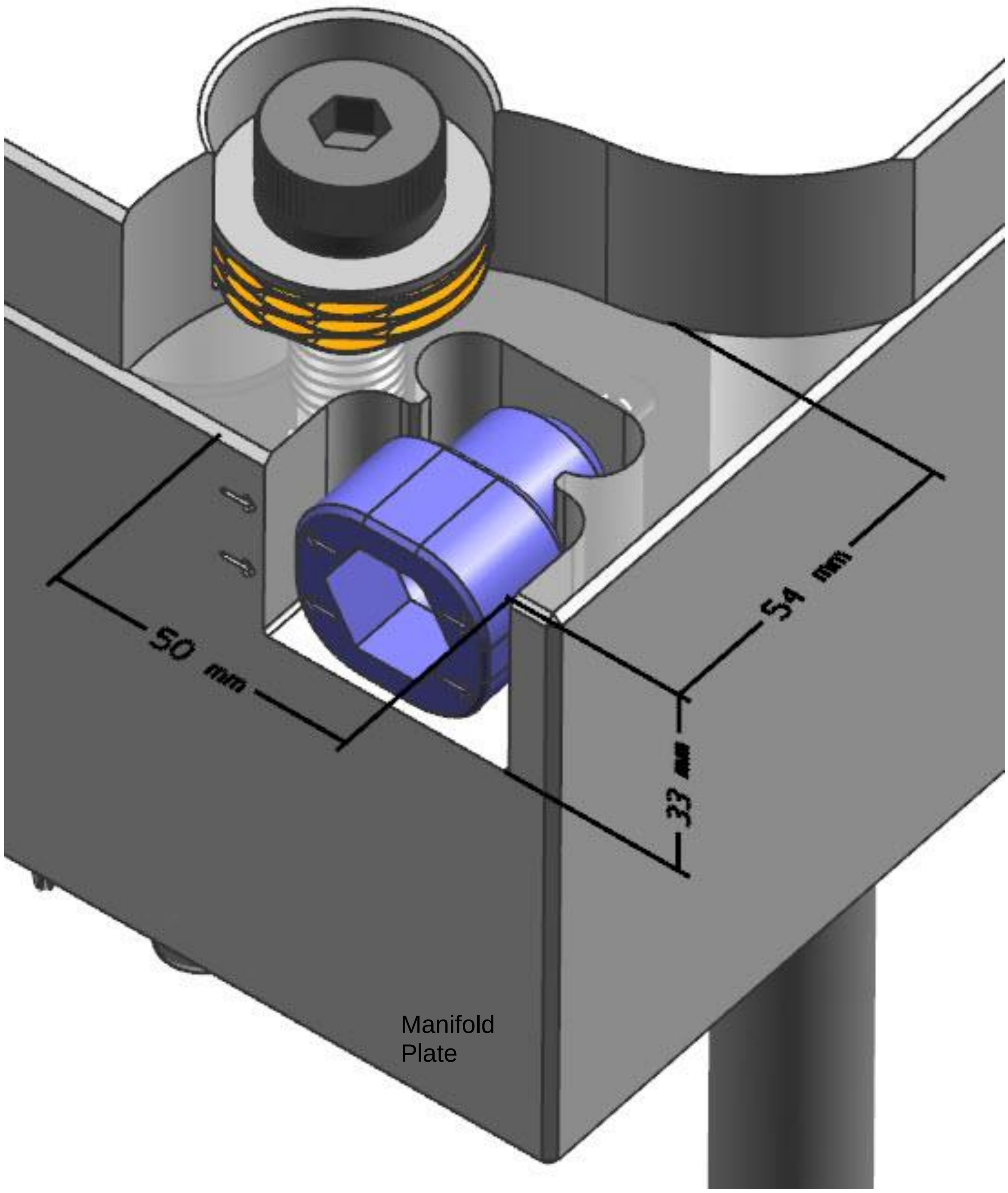

Figure 24 Cam Jack Installation

Spring Loaded Shoulder Screws (Figure 25). Recommend locating near Cam Jacks

- 4 required for Backing plates that are ≤49.5 kg,
- For Backing plates that are >49.5 kg, use the following formula:
  - Number of spring located shoulder screws ≥ 1.5 x (Backing plate weight in kg)/18.6

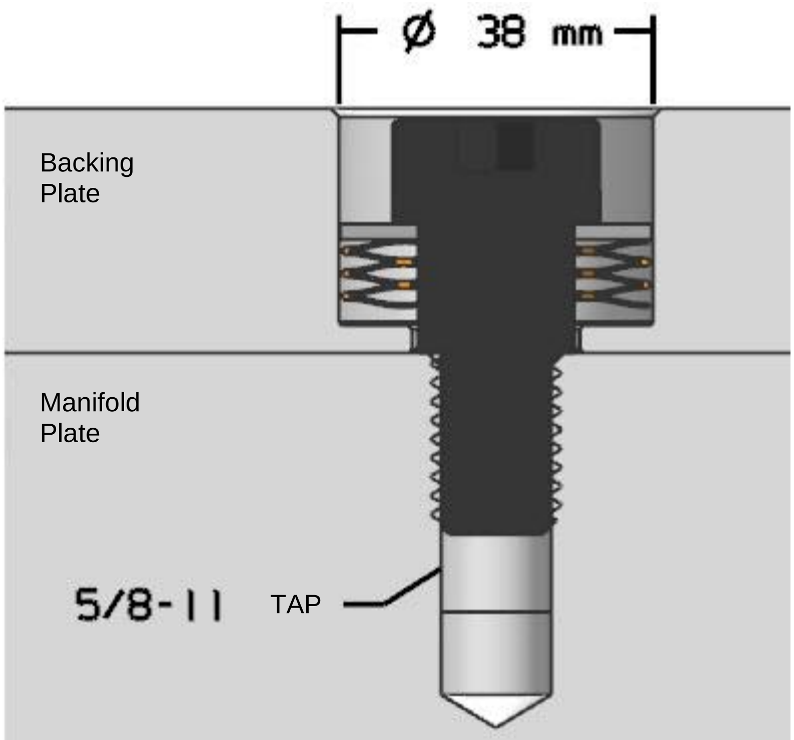

Figure 25 Spring Loaded Shoulder Screw Installation

Cam Jack Information Plate to be placed on the Operator side of the manifold plate, Second option is the Non-Operator side. (Figure 26)

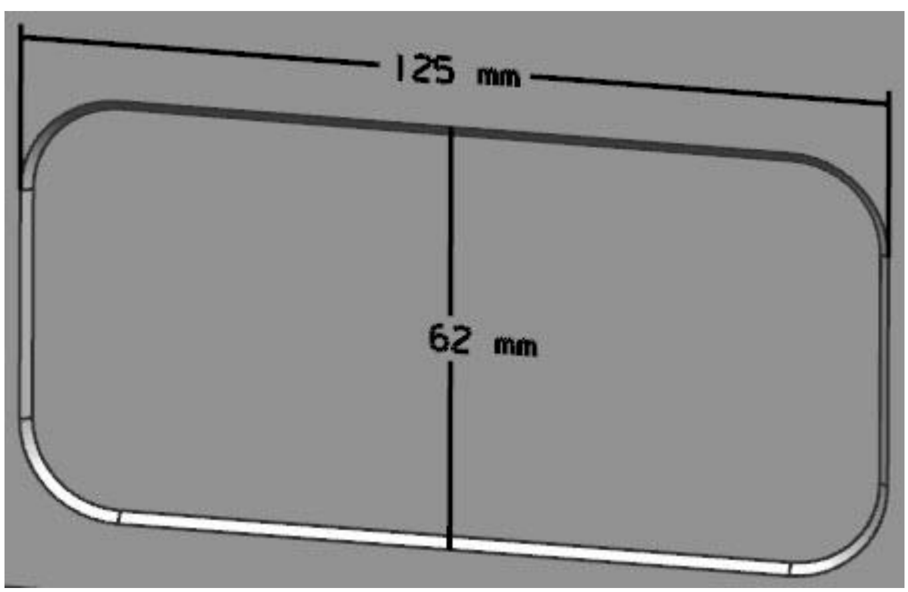

Figure 26 Cam Jack Information Plate Installation

Side Gate Stack Systems

The application of Ultra SideGate nozzles in a stack mold configuration requires special consideration in the mold and hot runner design. Contact Husky for consultation related to stack system design.

Measuring Cavity Alignment

The tight tolerance required between the nozzle tip seating faces (Figure 27) may present a challenge to measure with conventional tools. The preferred method for measuring the location of these faces is by CMM. If a CMM is not available, there are a couple of alternate methods that can be used to measure the distance between faces. Each of these methods introduces additional error and should only be used if a CMM is not available. In addition, neither of these methods account for location of the nozzle tip seating surfaces relative to the mold or hot runner datums. They only give an indication of the distance between tip seating faces for a single drop.

The primary difficulty in measuring the distance between the seating faces is the ability of a tool to extend into both bores at the same time. The first method involves machining a flat reference surface on each cavity (Figure 28). The bore depth can then be measured relative to the flat on each cavity, and the distance between the flats can be measured after the cavities are installed in the cavity plate. To get a better indication of surface orientation, measure at the 4 quadrants in each bore, and then 4 corresponding locations between the flats (Figure 28). The similar numbers in the figure indicate measurements between the same features, only in different locations (for example A2 and B2 indicate measurements between the 2 cavity flats only A2 being on one side of the bore and B2 being on the other side of the bore).

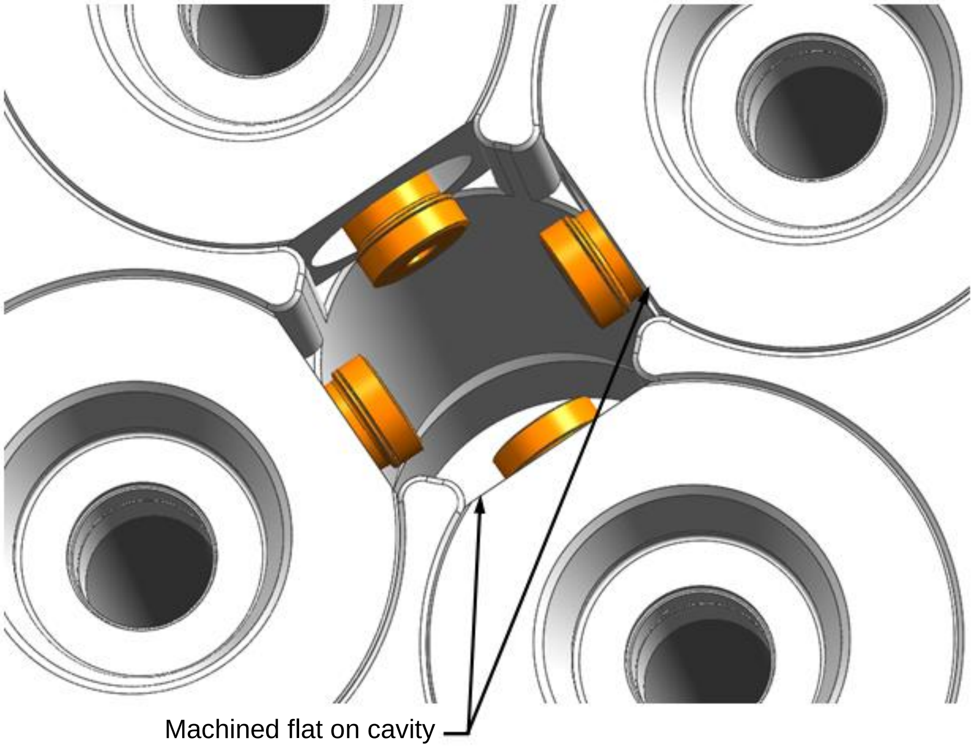

Figure 27 Cavity Insert Reference Flats

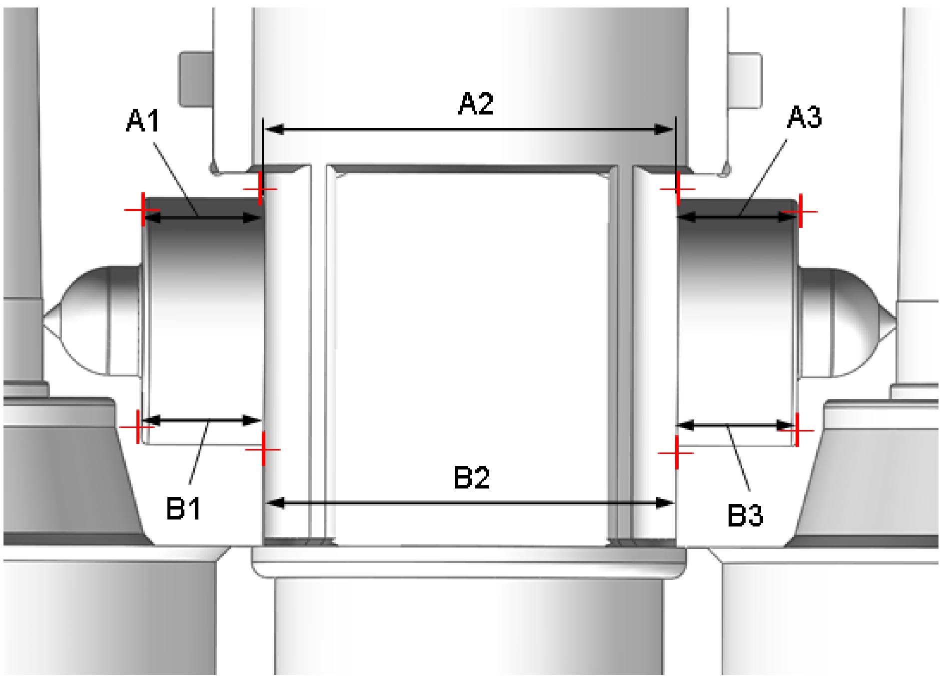

Figure 28 Using Compound Measurements to Determine Seating Face Distance & Orientation

The second method involves using the tip components to determine distance between the seating faces. This is the easiest method to get a quick indication of bore depths. Install all tip components into the bores (insulators, springs, and tips), making sure that components are bottomed out in the bore or against each other. Measure the distance between the back faces of the tips (Figure 29). Measure in 4 locations (each quadrant) to determine the orientation of the faces relative to each other. The nominal distance between these faces for the standard 55mm tip to tip pitch is 24.16mm. The measured distance should be within +/- 0.06mm of the nominal dimension. This dimension will change for alternate pitch systems by the difference between the alternate pitch and the standard (55mm).

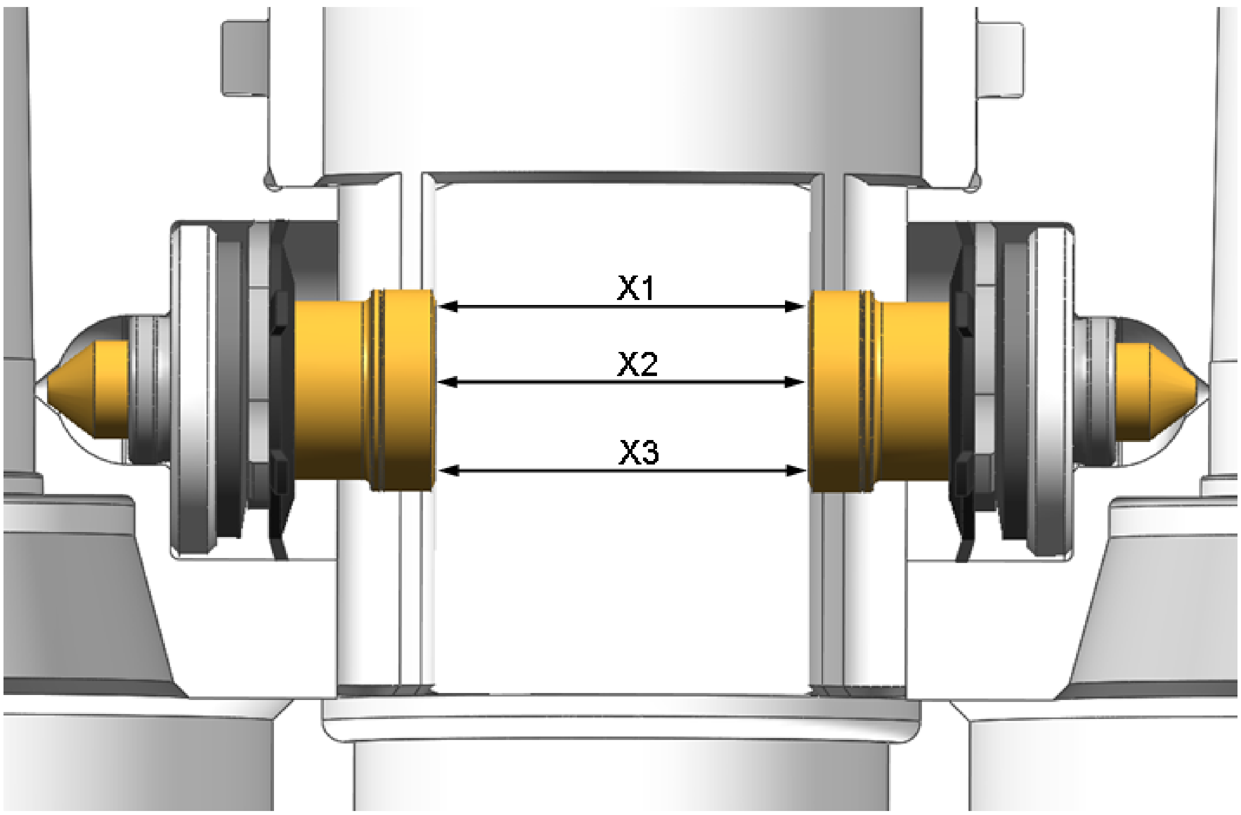

Figure 29 – Measuring Between Tip Sealing Faces

Rev.	Change Description	Name	Date	Driven by
0	Original Issue	T.Lawrence	2011-05-09	
1	Added cooling guideline.	T.Lawrence	2011-05-20	
2	Added measuring cavity align, sep. cavity plate, HS dowel location	S.Gray	2012-03-08	
3	Added part geometry considerations and jacking bolt image	S.Gray	2012-06-08	
4	Added cavity orientation note	S.Gray	2013-02-25	
5	Added cavity shut off and multi material sections	S.Gray	2013-07-11	
6	Added section for stack systems (pages 21-27)	S.Gray/M.Thweatt	2014-08-18	SR 41368
7	Figure 13 Changed Minimum Plate thickness from 3mm to 1mm Added two piece cavity insert and image to Cavity Alignment Section	S.Rainville	2015-01-30	SR 41301
8	Reworded side gate stack system section for clarity	S.Rainville	2015-02-21	SR 41301
9	Updated Stack Section, Added Inline, various format updates	W. Gunn	2017-02-24	
10	Added SideGate specific installations for manifold systems	S.Rainville	2018-02-23	SR 51663
11	Added warning regarding tip retention and individual gate insert	A.Dufour	2020-12-10	SR 61580
12	Clean up document for translation	A.Dufour	2021-11-12	SR 61861
13	Add max draft angle	A.Dufour	2021-12-13	SR 63474
14	Reword demolding information in draft angle section Add side angle section	A.Dufour M.Zong	2023-05-15	SR 66429
15	Updated to reflect GEN 2 design	S.Gray	2024-04-23	SR 68372
16	Update figure to align with part geometry considerations	A.Dufour	2024-12-05	SR 68513