Draft Requirements: Standard Tolerances

Draft is the amount of taper or slope given to cores or other parts of the die cavity to permit easy ejection of the casting.

All die cast surfaces which are normally perpendicular to the parting line of the die require draft (taper) for proper ejection of the casting from the die. This draft requirement, expressed as an angle, is not constant. It will vary with the type of wall or surface specified, the depth of the surface and the alloy selected.

Draft values from the equations at right, using the illustration and the table below, provides Standard Draft Tolerances for draft on inside surfaces, outside surfaces and holes, achievable under normal production conditions.

Draft Example (Standard Tolerances):

In the case of an inside surface for an aluminum cast part, for which the constant "C" is 30 (6 mm), the recommended Standard Draft at three depths is:

Depth	Draft	Draft
in. (mm)	in. (mm)	Degrees
0.1 (2.50)	0.010 (0.250)	6°
1.0 (25)	0.033 (0.840)	1.9°
5.0 (127)	0.075 (1.890)	0.85°

To achieve lesser draft than normal production allows, Precision Tolerances maybe specified (see opposite page).

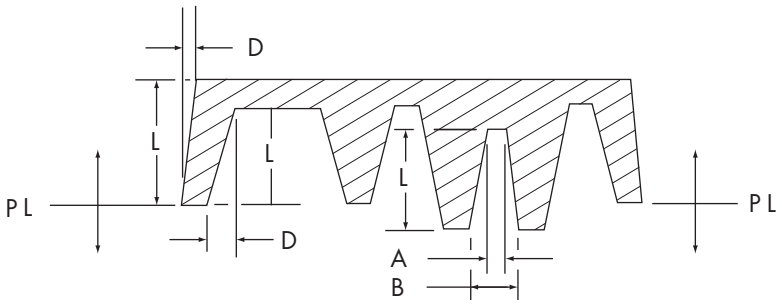
Calculation for Draft

$$D = \frac{\sqrt{L}}{C}$$

Calculation for Draft Angle

$$A = \frac{\left(\frac{D}{L}\right)}{0.01746}$$

Where:
D= Draft in inches
L= Depth or height of feature from the parting line
C= Constant, from table S-4A-7, is based on the type of feature and the die casting alloy
A= Draft angle in degrees Draft



Drawing defines draft dimensions for interior and exterior surfaces and total draft for holes (draft is exaggerated for illustration).

The formula for draft shown here represents Standard Tolerance, or normal casting production practice at the most economical level. For Precision Tolerance for draft, see the facing page.

Note:
As the formula indicates, draft, expressed as an angle, decreases as the depth of the feature increases. Twice as much draft is recommended for inside walls or surfaces as for outside walls/surfaces. This provision is required because as the alloy solidifies it shrinks onto the die features that form inside surfaces (usually located in the ejector half) and away from features that form outside surfaces (usually located in the cover half). Note also that the resulting draft calculation does not apply to cast lettering, logotypes or engraving. Such elements must be examined individually as to style, size and depth desired. Draft requirements need to be discussed with the die caster prior to die design for satisfactory results.

Engineering & Design: Coordinate Dimensioning

Draft Requirements: Standard Tolerances

Table S-4A-7: Draft Constants for Calculating Draft and Draft Angle

Values of Constant "C" by Features and Depth (Standard Tolerances)

Alloy	Inside Wall For Dim. in inches (mm)	Outside Wall For Dim. in inches (mm)	Hole, Total Draft for Dim. in inches (mm)
Zinc/ZA	**50** (9.90 mm)	**100** (19.80 mm)	**34** (6.75 mm)
Aluminum	**30** (6.00 mm)	**60** (12.00 mm)	**20** (4.68 mm)
Magnesium	**35** (7.00 mm)	**70** (14.00 mm)	**24** (4.76 mm)
Copper	**25** (4.90 mm)	**50** (9.90 mm)	**17** (3.33 mm)

It is not common practice to specify draft separately for each feature. Draft is normally specified by a general note with exceptions called out for individual features. The formula should be used to establish general draft requirements with any exceptions identified.

For example, the results at the left indicate that an aluminum casting with most features at least 1.0 in. deep can be covered with a general note indicating 2° minimum draft on inside surfaces and 1° minimum on outside surfaces (based on outside surfaces requiring half as much draft).

Precision Tolerances for draft resulting from the calculations outlined here involve extra precision in die construction and/or special control in production. They should be specified only when necessary. Draft or the lack of draft can greatly affect castability. Early die caster consultation will aid in designing for minimum draft, yet sufficient draft for castability.

Draft Requirements: Precision Tolerances

All cast surfaces normally perpendicular to the parting line of the die require draft (taper) for proper ejection of the casting from the die. Minimum precision draft for inside walls is generally recommended at 3/4 degrees per side; with outside walls requiring half as much draft.

Draft values from the equation at right, using the illustration and the table below, estimate specific Precision Draft Tolerances for draft on inside surfaces, outside surfaces and holes. Precision Draft Tolerances will vary with the type of wall or surface specified, the depth of the wall, and the alloy selected.

Draft Example (Precision Tolerances):

In the case of an inside surface for an aluminum cast part, for which the constant "C" is 40 (7.80 mm), the recommended Precision Draft at three depths is:

Depth	Draft	Draft
in. (mm)	in. (mm)	Degrees
0.1 (2.50)	0.006 (0.150)	3.6°
1.0 (25)	0.020 (0.510)	1.1°
2.5 (63.50)	0.032 (1.140)	0.72°

To achieve lesser draft than normal production allows, Precision Tolerances maybe specified (see opposite page).

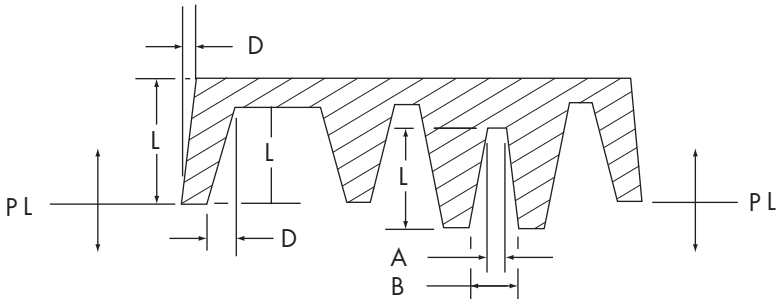
Calculation for Draft

$$D = \frac{\sqrt{L} \times 0.8}{C}$$

Calculation for Draft Angle

$$A = \frac{\left(\frac{D}{L}\right)}{0.01746}$$

Where: **D=** Draft in inches
L= Depth or height of feature from the parting line
C= Constant, from table S-4A-*7*, is based on the type of feature and the die casting alloy
A= Draft angle in degrees Draft



Drawing defines draft dimensions for interior and exterior surfaces and total draft for holes (draft is exaggerated for illustration).

Note:
As the formula indicates, draft, expressed as an angle, decreases as the depth of the feature increases. See graphical representation on the following pages for various alloys. Twice as much draft is recommended for inside walls or surfaces as for outside walls/surfaces. This provision is required because as the alloy solidifies it shrinks onto the die features that form inside surfaces (usually located in the ejector half) and away from features that form outside surfaces (usually located in the cover half). Note also that the resulting draft calculation does not apply to die cast lettering, logotypes or engraving. Such elements must be examined individually as to style, size and depth desired. Draft requirements need to be discussed with the die caster prior to die design for satisfactory results.

Engineering & Design: Coordinate Dimensioning

Draft Requirements: Precision Tolerances

Table P-4A-7: Draft Constants for Calculating Draft and Draft Angle

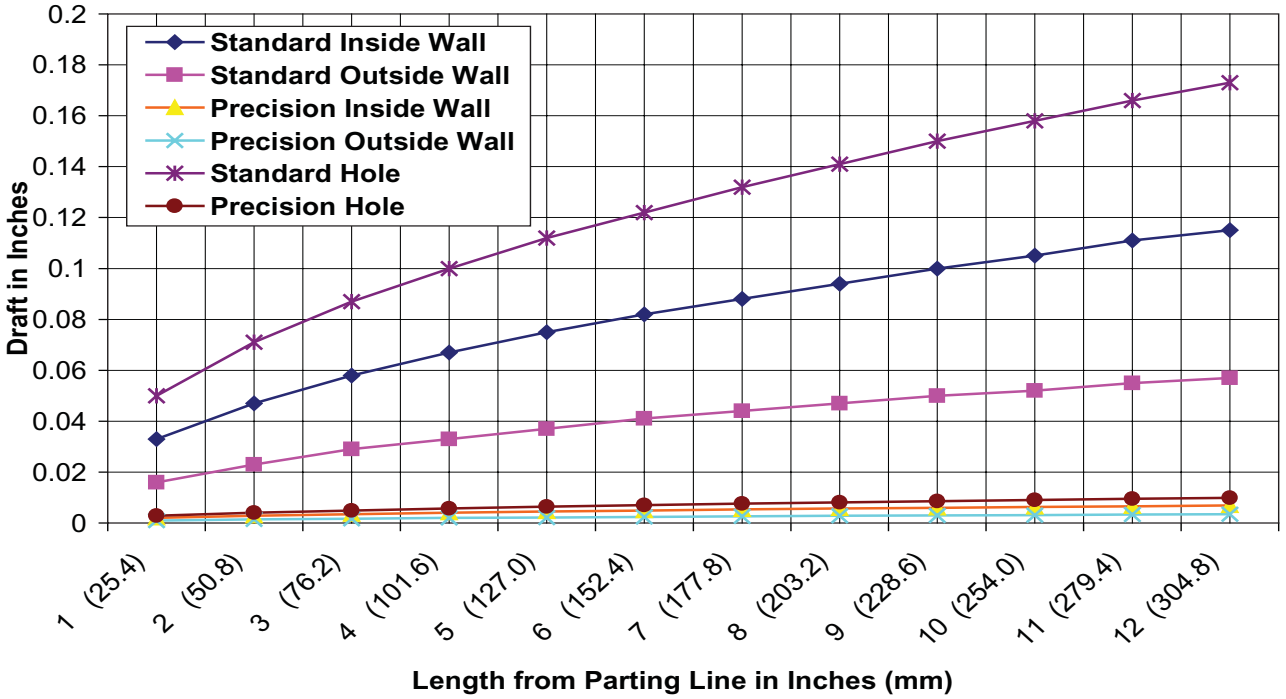
Values of Constant "C" by Features and Depth (Precision Tolerances)

Alloy	Inside Wall For Dim. in inches (mm)	Outside Wall For Dim. in inches (mm)	Hole, Total Draft For Dim. in inches (mm)
Zinc/ZA	**60** (12.00 mm)	**120** (24.00 mm)	**40** (7.80 mm)
Al/Mg/Cu	**40** (7.80 mm)	**80** (15.60 mm)	**28** (5.30 mm)

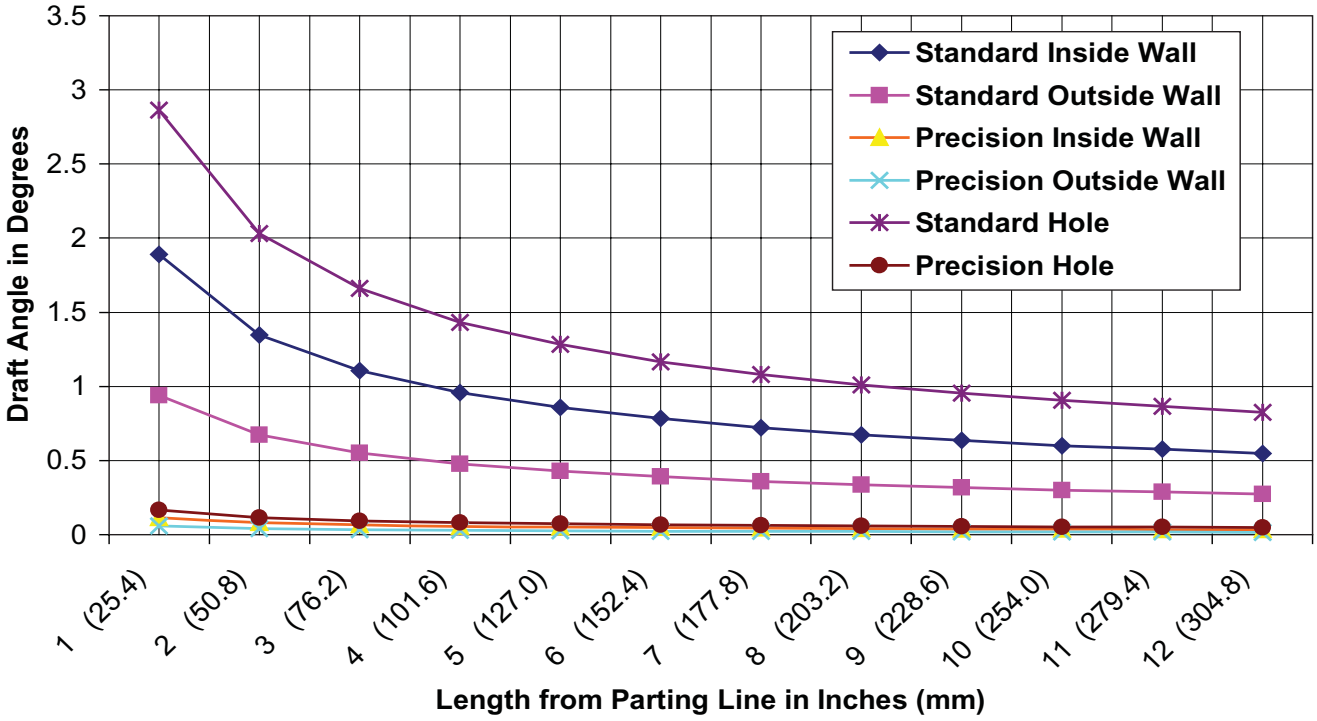
It is not common practice to specify draft separately for each feature. Draft is normally specified by a general note with exceptions called out for individual features. The formula should be used to establish general draft requirements with any exceptions identified.

For example, the results at the left indicate that an aluminum casting with most features at least 1.0 in. deep can be covered with a general note indicating 1° minimum draft on inside surfaces and 0.5° minimum on outside surfaces (based on outside surfaces requiring half as much draft).

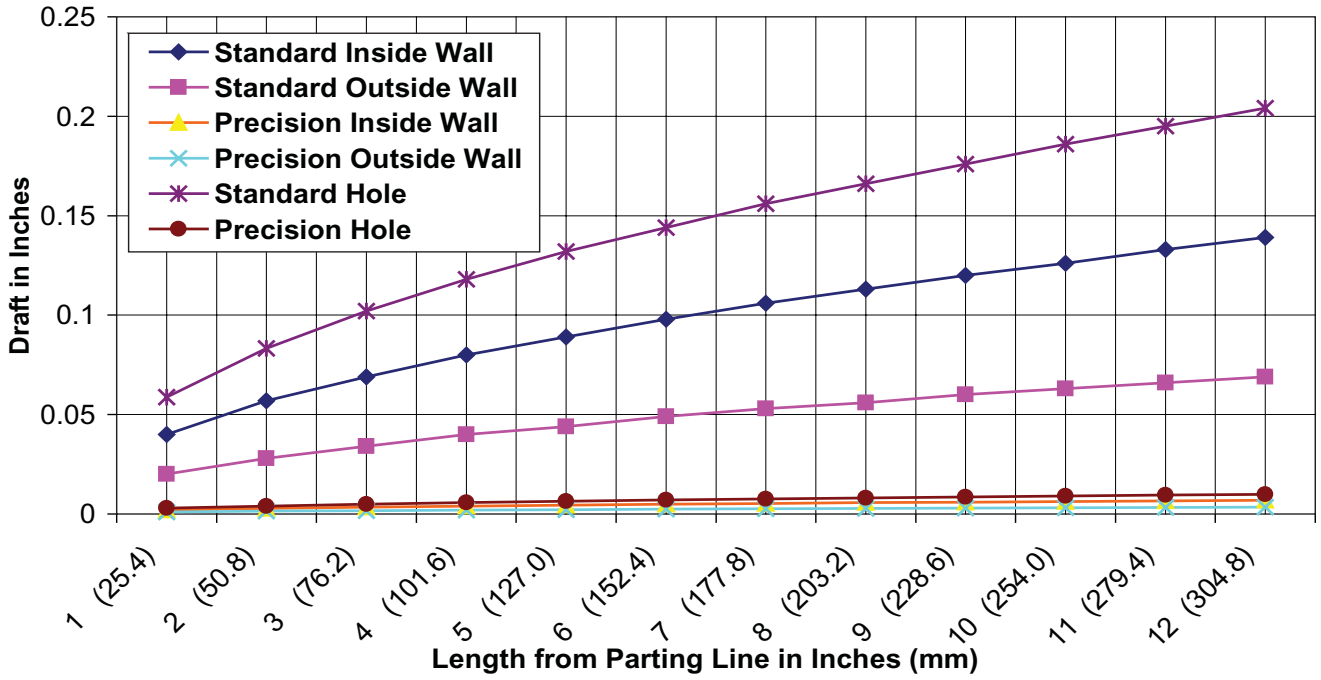
Aluminum Draft



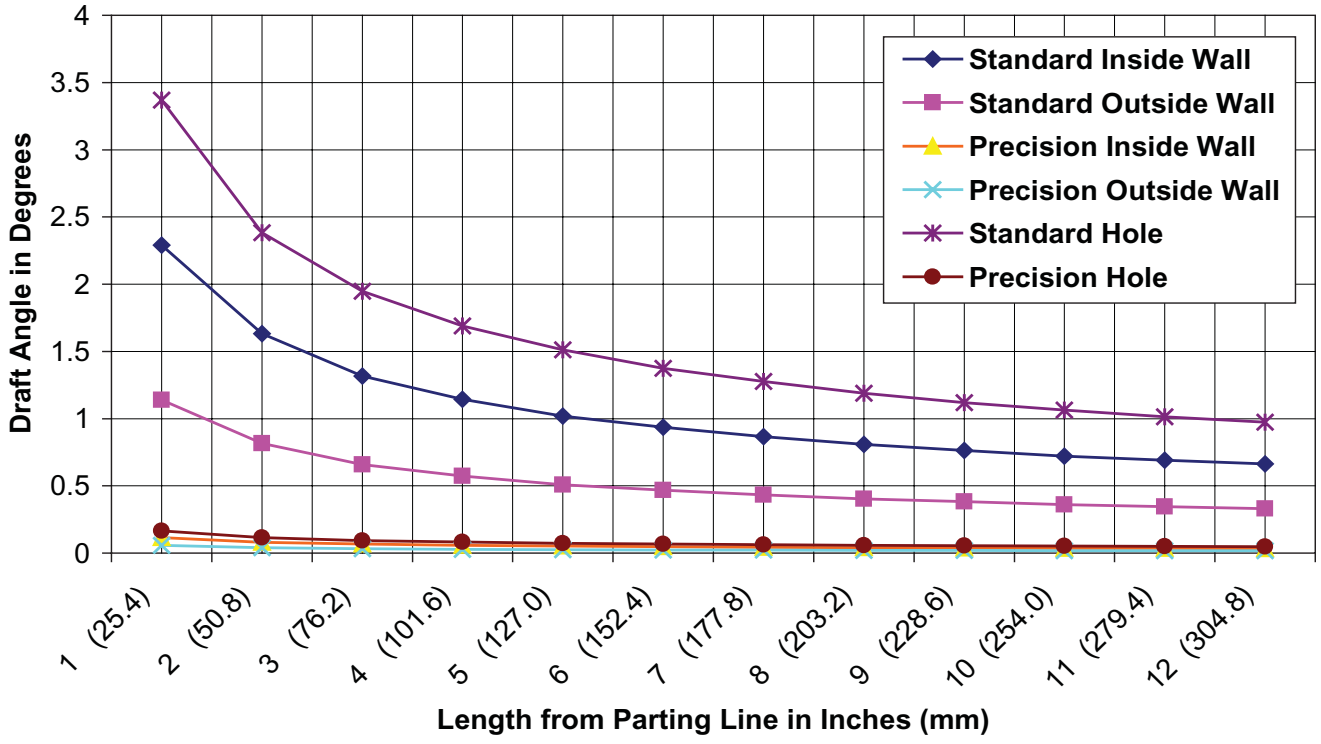
Aluminum Draft Angle

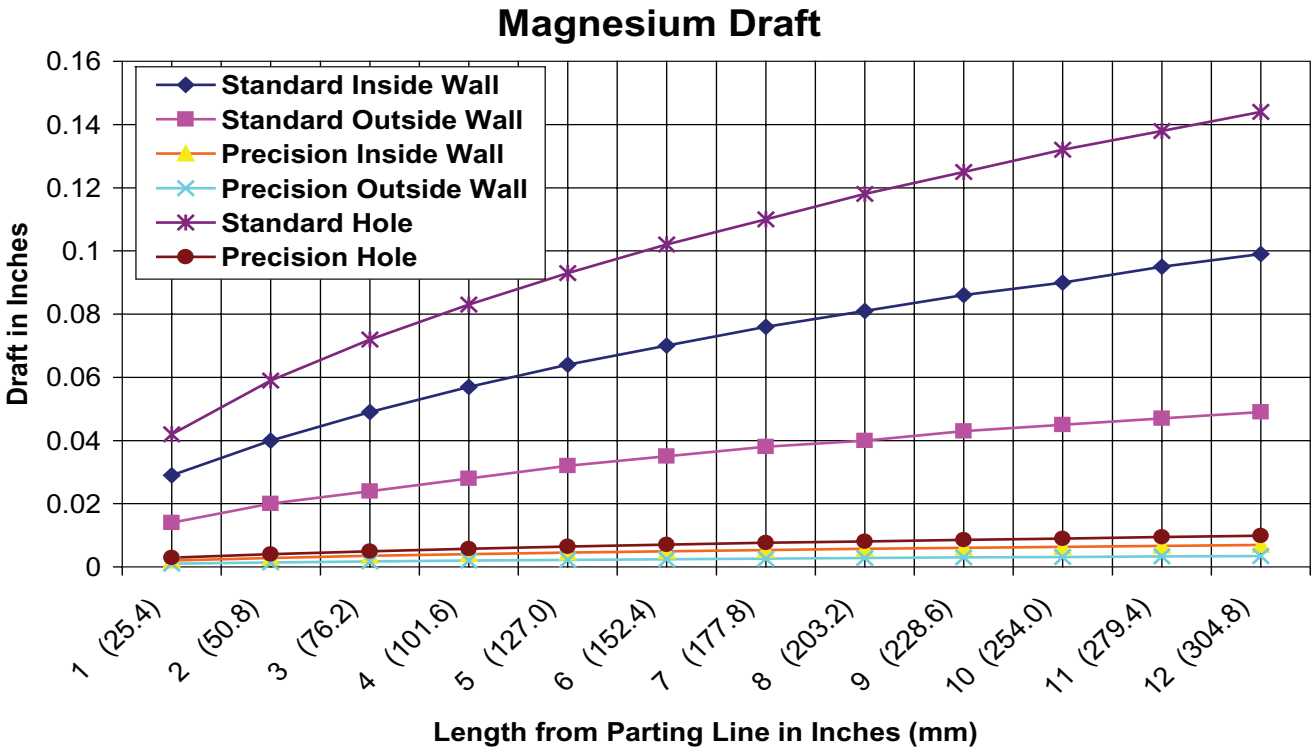


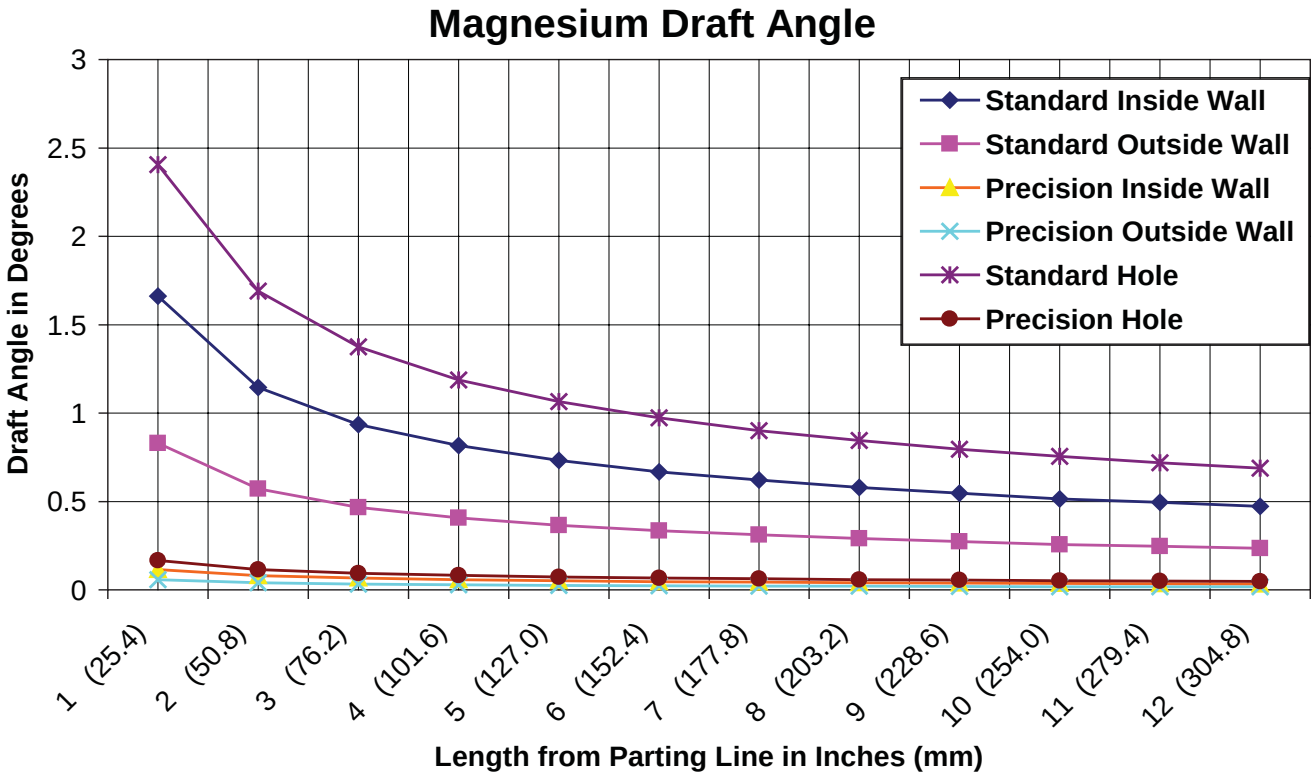
Copper Draft



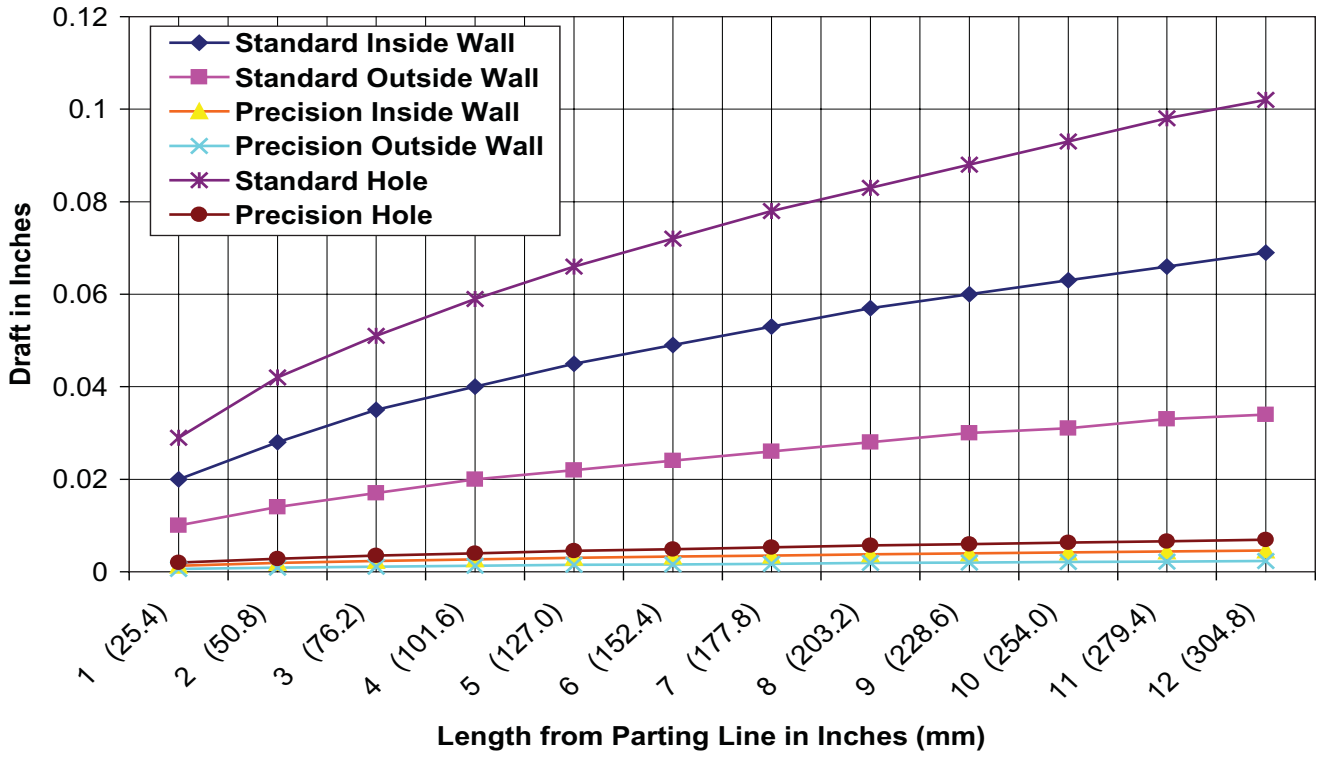
Copper Draft Angle




Magnesium Draft
Standard Inside Wall
Standard Outside Wall
Precision Inside Wall
Precision Outside Wall
Standard Hole
Precision Hole
Draft in Inches
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
1 (25.4)
2 (50.8)
3 (76.2)
4 (101.6)
5 (127.0)
6 (152.4)
7 (177.8)
8 (203.2)
9 (228.6)
10 (254.0)
11 (279.4)
12 (304.8)
Length from Parting Line in Inches (mm)


Magnesium Draft Angle
Standard Inside Wall
Standard Outside Wall
Precision Inside Wall
Precision Outside Wall
Standard Hole
Precision Hole
Draft Angle in Degrees
3
2.5
2
1.5
1
0.5
0
1 (25.4)
2 (50.8)
3 (76.2)
4 (101.6)
5 (127.0)
6 (152.4)
7 (177.8)
8 (203.2)
9 (228.6)
10 (254.0)
11 (279.4)
12 (304.8)
Length from Parting Line in Inches (mm)

Zinc Draft



Zinc Draft Angle