Deep Drawing: Blank Diameter and Draw Ratio (Cylindrical Cup)

Blank diameter for a cylindrical cup from its diameter and height by surface-area equality, the draw ratio and the number of draws for a limiting draw ratio.

Method: Surface-area equality for a thin cylindrical cup D = √(d² + 4dh); limiting draw ratio (Kalpakjian; Schuler, Metal Forming Handbook)

Input parameters

Unit system: SI

Parameter	Value	Unit
Cup diameter (mean)	80.000	mm
Cup height	60.000	mm
Trim allowance on height	4.0000	mm
Limiting draw ratio, first draw About 1.8–2.2 for first draws of steel.	2.0000	
Limiting draw ratio for redraws (0 = same as the first) Redraw ratios are lower than the first draw's; from your tooling data.	0	

Calculated results

Parameter	Value	Unit
Blank diameter	163.95	mm
Total draw ratio	2.0494	
Draws needed at the LDR	2.0000	

Notes for this case

- Thin sheet, sharp corners and no flange; corner radii and flanges change the blank.

Formula and method

$$D = \sqrt{d^2 + 4dh}, \quad n = 1 + \left\lceil \frac{\ln(D/(d\,LDR))}{\ln LDR_r} \right\rceil \;\; (D/d > LDR;\ \text{else } 1)$$

Variables

d	Cup diameter (mean)	m
h	Cup height	m
Δh	Trim allowance on height	m
LDR	Limiting draw ratio, first draw	-
LDR_r	Limiting draw ratio for redraws (0 = same as the first)	-
D	Blank diameter	m
D/d	Total draw ratio	-
n	Draws needed at the LDR	-

Method and standards

Area equality.

Assumptions and limits

- Thin sheet, constant thickness.
- The first draw uses LDR and each redraw LDR_r (lower in practice); with LDR_r = 0 every draw uses LDR, which underestimates the count for tall cups.

References

- Surface-area equality for a thin cylindrical cup D = √(d² + 4dh); limiting draw ratio (Kalpakjian; Schuler, Metal Forming Handbook)

Report details

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Results are for engineering estimation. Verify critical designs against the referenced standards and your own data.

This calculator online

https://calc.firecad.com/mechanical/manufacturing/deep-drawing-blank

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Reopens the calculator with the inputs of this report.