DIE CASTING DFM CHECKLIST

Design for Manufacturing Quick Reference Guide

SSOSS CAST I Precision Die Casting Since 1995 Singapore HQ I China Manufacturing I Global Delivery

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SECTION 1: MATERIAL SELECTION MATRIX

Choose Your Alloy First

YOUR REQUIREMENT	RECOMMENDED ALLOY	WHY
Thin walls (<1mm)	**Zamak 3 (Zinc)**	Flows into thin sections easily
Premium surface finish	**Zamak 3 (Zinc)**	Jewelry-grade as-cast finish
Tight tolerances (±0.05mm)	**Zamak 3 (Zinc)**	Superior dimensional stability
High volume (100K+ units)	**Zamak 3 (Zinc)**	1M+ shot tool life
Heat dissipation needed	**ADC12 (Aluminum)**	96 W/mK thermal conductivity
Lightweight critical	**ADC12 (Aluminum)**	2.74 g/cm³ density
Large structural parts	**ADC12 (Aluminum)**	Better strength-to-weight
High temperature exposure	**ADC12 (Aluminum)**	516-582°C melting range

Quick Rule: If you need precision and finish → Zinc. If you need heat and lightweight → Aluminum.

SECTION 2: WALL THICKNESS SPECIFICATIONS

Critical Dimension #1

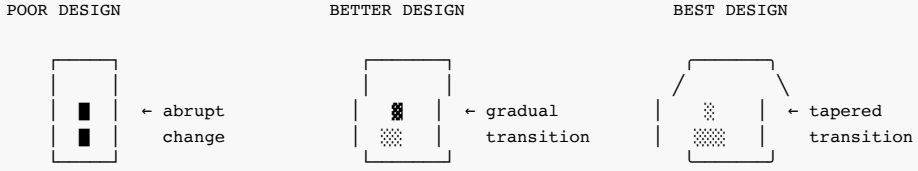
MATERIAL	ABSOLUTE MIN	OPTIMAL RANGE	MAXIMUM
Zinc (Zamak 3)	0.5mm	0.8 - 2.0mm	4.0mm
Aluminum (ADC12)	1.2mm	1.5 - 3.0mm	5.0mm

⚠️ CRITICAL RULES:

DO: - ✅ Maintain uniform thickness throughout part - ✅ Use gradual transitions (taper over 3-5x thickness difference) - ✅ Place thick sections at gating points - ✅ Use ribs instead of solid thick sections

DON'T: - ❌ Create abrupt changes (>2:1 thickness ratio) - ❌ Have isolated thick sections (causes shrinkage porosity) - ❌ Design below minimum wall thickness - ❌ Exceed maximum thickness (causes internal voids)

Transition Guidelines:



SECTION 3: DRAFT ANGLE REQUIREMENTS

Critical Dimension #2

FEATURE TYPE	ZINC MINIMUM	ALUMINUM MINIMUM	RECOMMENDED
External walls	0.5°	1.0°	1-2°
Internal walls	1.0°	2.0°	2-3°
Deep cavities (>50mm)	1.5°	2.5°	3-5°
Text / Logos	3.0°	5.0°	5-10°
Ribs	1.0°	1.5°	1-2°
Bosses	1.0°	2.0°	2-3°

⚠️ CRITICAL RULES:

DO: - ✅ Apply draft to ALL vertical surfaces - ✅ Add MORE draft to internal features than external - ✅ Use minimum 3° for any textured or embossed surface - ✅ Design draft into CAD from the start

DON'T: - ❌ Design zero-draft walls (causes sticking) - ❌ Use same draft for internal and external - ❌ Forget draft on decorative features - ❌ Try to add draft after design is complete (distorts geometry)

Draft Calculation:

Formula: Draft Height = Wall Height × tan(Draft Angle)

Wall Height	1° Draft	2° Draft	3° Draft
10mm	0.17mm	0.35mm	0.52mm
25mm	0.44mm	0.87mm	1.31mm
50mm	0.87mm	1.75mm	2.62mm
100mm	1.75mm	3.49mm	5.24mm

SECTION 4: FILLETS & RADII

Sharp Corners = Failure Points

LOCATION	MINIMUM RADIUS	RECOMMENDED	CRITICAL NOTES
Internal corners	0.5mm	1-2× wall thickness	⚠️ NEVER sharp
External corners	0.25mm	0.5-1mm	Breaks sharp edges
Wall-to-wall	1.0mm	2-3mm	Stress concentration
Rib intersections	0.8mm	1.5-2mm	Prevents cracking
Boss base	0.5mm	1-2mm	Stress relief

⚠️ CRITICAL RULES:

DO: - ✅ Use full-radius fillets on all internal corners - ✅ Make internal radii LARGER than external radii - ✅ Add radii at every intersection - ✅ Consider stress flow patterns

DON'T: - ❌ Leave sharp internal corners (reduces strength 50%) - ❌ Use same radius everywhere - ❌ Ignore radii on cosmetic surfaces

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SECTION 5: RIB DESIGN

Strength Without Bulk

PARAMETER	FORMULA	EXAMPLE (2mm wall)
Height	≤ 3× wall thickness	Max 6mm height
Thickness	0.6-0.8× wall thickness	1.2-1.6mm thick
Spacing	≥ 2× wall thickness	Min 4mm apart
Draft	1-2°	Standard draft
Base fillet	0.5-1mm	Stress distribution
Top radius	0.25-0.5mm	Safety/cosmetic

⚠️ CRITICAL RULES:

DO: - ✅ Use ribs instead of thick walls for strength - ✅ Keep ribs thinner than main walls - ✅ Space ribs adequately for filling - ✅ Add draft to all rib surfaces

DON'T: - ❌ Make ribs same thickness as walls (causes sink marks) - ❌ Crowd ribs too close together - ❌ Forget fillets at rib bases

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SECTION 6: BOSS DESIGN

Mounting Features Done Right

PARAMETER	SPECIFICATION	WHY IT MATTERS
Height	≤ 2.5× diameter	Prevents wobble/deflection
Wall thickness	0.6-0.8× main wall	Prevents sink marks
Core pin draft	1-2°	Ejection from mold
Base relief	0.5mm radius	Stress reduction
Distance to wall	≥ 1.5× wall thickness	Cooling balance

Boss Configuration Options:

⚠️ CRITICAL RULES:

DO: - ✅ Isolate bosses from walls when possible - ✅ Use metal inserts for high-load threads - ✅ Vent trapped air with relief channels - ✅ Consider core pin deflection on tall bosses

DON'T: - ❌ Create tall, thin bosses (core pin bends) - ❌ Connect bosses directly to thick walls - ❌ Forget draft on internal holes

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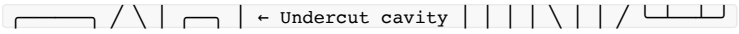
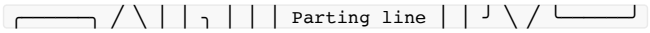
SECTION 7: UNDERCUTS & SIDE ACTIONS

Complexity = Cost

UNDERCUT TYPE	SOLUTION	ADDED TOOL COST
Minor external	Draft + elastic ejection	$0
Major external	Side core/slide	+$2,000-3,000
Internal thread	Collapsible core	+$3,000-5,000
Complex geometry	Multi-slide tool	+$5,000-10,000
Deep internal	Core pulls	+$1,500-3,000

Elimination Strategies:

BEFORE: Complex undercut requiring side action 

AFTER: Redesigned with split parting line 

⚠️ CRITICAL RULES:

DO: - ✅ Eliminate undercuts where possible - ✅ Use parting line changes to capture features - ✅ Consider elastic ejection for zinc parts - ✅ Limit side actions to essential features only

DON'T: - ❌ Accept complex undercuts without cost analysis - ❌ Design undercuts on cosmetic surfaces - ❌ Create intersecting side actions

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SECTION 8: TOLERANCE SPECIFICATIONS

Specify Critical Dimensions Only

DIMENSION TYPE	ZINC	ALUMINUM	NOTES
Linear	±0.05-0.1mm	±0.1-0.2mm	Commercial grade
Linear (precision)	±0.025mm	±0.05mm	Cost premium
Angularity	±0.5°	±1.0°	Relative to datum
Concentricity	0.1mm TIR	0.2mm TIR	Hole to hole
Flatness	0.1mm/100mm	0.2mm/100mm	Sealing surfaces
Cylindricity	0.05mm	0.1mm	Pin/bore features

Tolerance Cost Impact:

Tolerance Zone	Relative Cost	Use Case
Standard	1.0×	Non-critical features
Commercial	1.2×	General assembly
Precision	1.5×	Fit-critical features
Fine	2.0×+	Precision interfaces

⚠️ CRITICAL RULES:

DO: - ✅ Specify tight tolerances only where necessary - ✅ Use GD&T for complex requirements - ✅ Identify datum references clearly - ✅ Allow standard tolerances for non-critical areas

DON'T: - ❌ Tolerance every dimension tightly - ❌ Mix tolerance systems (ISO/ANSI) - ❌ Forget thermal expansion effects

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SECTION 9: SURFACE FINISH SPECIFICATIONS

Set Realistic Expectations

FINISH TYPE	ZINC As-Cast	ALUMINUM As-Cast	POST-PROCESSING
Standard	0.8-1.6 Ra	1.6-3.2 Ra	None required
Fine	0.4-0.8 Ra	1.2-1.6 Ra	Light polish/blasting
Cosmetic	0.2-0.4 Ra	0.8-1.2 Ra	Polish + coat/plate
Optical	N/A	N/A	Precision machining

Common Finish Options:

For Zinc: - Chrome plating (jewelry-grade) - Nickel plating (corrosion resistance) - Powder coating (durable color) - Raw tumbled (functional)

For Aluminum: - Anodizing (Type II/III) - Powder coating - Wet painting - Raw + protective coating

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SECTION 10: COMMON DEFECTS PREVENTION

Design-Related Issues

DEFECT	CAUSE	DESIGN SOLUTION
Shrinkage Porosity	Thick sections cool slowly	Hollow out thick areas, use ribs
Cold Shuts	Thin walls solidify early	Maintain minimum thickness, add overflow
Gas Porosity	Trapped air	Add vents, overflows at last-fill
Hot Tears	Uneven cooling	Uniform walls, gradual transitions
Sinks	Thick ribs/bosses	Reduce thickness, add relief
Flow Lines	Uneven filling	Proper gating, consistent thickness
Warpage	Thermal stress	Symmetrical design, uniform cooling

SECTION 11: PRE-RFQ DESIGN CHECKLIST

Before You Request a Quote

MATERIAL & PROCESS

- [ ] Alloy selected based on application requirements
- [ ] Production volume determined
- [ ] Secondary operations identified (machining, plating, etc.)
- [ ] Critical-to-quality features marked

GEOMETRY VERIFICATION

- [ ] All walls within recommended thickness range
- [ ] Draft angles applied to ALL vertical surfaces
- [ ] Fillets on all internal corners (minimum 0.5mm)
- [ ] No zero-draft shutoffs or features
- [ ] Undercuts minimized or eliminated
- [ ] Ribs designed per guidelines (0.6-0.8× wall)
- [ ] Bosses optimized (0.6-0.8× wall, isolated)

QUALITY SPECIFICATIONS

- [ ] Critical dimensions identified and toleranced
- [ ] Surface finish requirements specified
- [ ] Defect acceptance criteria defined
- [ ] Inspection requirements stated

PRODUCTION CONSIDERATIONS

- [ ] Parting line location acceptable
- [ ] Ejector pin locations reviewed
- [ ] Gate location considered
- [ ] Trimming/degating method feasible
- [ ] Packaging/shipping requirements defined

SECTION 12: DESIGN CALCULATION WORKSHEET

Quick Reference Formulas

Wall Thickness Check:

```
Minimum: Zinc 0.5mm / Aluminum 1.2mm Optimal: Wall × 0.8 to 2.0× (Zinc) / 1.5 to 3.0× (Aluminum) Maximum: Zinc 4.0mm / Aluminum 5.0
```

Draft Calculation:

```
Draft Amount = Height × tan(Angle) Example: 50mm wall with 2° draft = 50 × tan(2°) = 50 × 0.035 = 1.75mm per side
```

Rib Sizing: `Rib Height ≤ 3 × Wall Thickness Rib Thickness = 0.6 to 0.8 × Wall Thickness Rib Spacing ≥ 2 × Wall Thickness`

Boss Sizing:

`Boss Height ≤ 2.5 × Boss Diameter Boss Wall = 0.6 to 0.8 × Main Wall Thickness Distance to Wall ≥ 1.5 × Wall Thickness`

QUICK REFERENCE CARD

Die Casting DFM at a Glance

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┌─────────────────────────────────────────────────┐
│  WALL THICKNESS                                 │
│  Zinc: 0.5mm min | 0.8–2.0mm optimal | 4.0mm max │
│  Aluminum: 1.2mm min | 1.5–3.0mm optimal | 5.0mm max │
├─────────────────────────────────────────────────┤
│  DRAFT ANGLES                                   │
│  External: 1–2° | Internal: 2–3° | Text: 5–10°  │
├─────────────────────────────────────────────────┤
│  FILLET RADII                                   │
│  Internal: 0.5mm min | External: 0.25mm min     │
├─────────────────────────────────────────────────┤
│  RIBS                                           │
│  Height ≤ 3× wall | Thickness = 0.6–0.8× wall   │
├─────────────────────────────────────────────────┤
│  BOSSES                                         │
│  Height ≤ 2.5× diameter | Wall = 0.6–0.8× main wall │
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ABOUT SSOSS CAST

30+ Years of Precision Manufacturing Excellence

Since 1995, SSOSS Cast has delivered precision die casting solutions to global clients. Our Singapore headquarters coordinates with our China manufacturing facility to provide:

- **Precision Zinc Die Casting** (Zamak 3, Zamak 5)
- **Precision Aluminum Die Casting** (ADC12, A380)
- **CNC Machining** (Secondary operations)
- **Plastic Injection Moulding**
- **Surface Finishing** (Plating, coating, anodizing)
- **Tool Fabrication** (In-house mold making)

Our Commitment: - Low MOQ possibilities - Zero defect quality - DFM-led design process - Singapore coordination + China manufacturing

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FREE DFM REVIEW

Submit Your Design for Expert Analysis

Our engineering team will review your CAD files and provide: - Design optimization recommendations - Material selection guidance - Defect prevention strategies - Cost reduction opportunities - Tolerance review

No cost. No obligation. Just expertise.

Request your free DFM review: 📧 info@ssosscast.com 📞 +65 6286 9388 🌐 www.ssosscast.com/contact-us

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This checklist is provided as a design reference guide. Specific applications may require additional considerations. Contact SSOSS Cast for project-specific guidance.

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