SmartForge Polymers

CATAPULTING PRECISION PLASTICS TO MARKET

// TECHNICAL BRIEF · DM-K392 · COP

DM-K392 Microfluidic Chip

Precision at every feature.

A single COP-molded chip showcasing four microfluidic proof points — gradient generator, serpentine mixer, pillar filter, and constriction channels — plus three stepped-bore ferrule ports, all in one shot, with depth within 1% and widths within 5% of drawing.

1 shot
ALL FEATURES MOLDED TOGETHER

≤1 %
DEPTH · EVERY MEASURED FEATURE

≤5 %
WIDTH · EVERY MEASURED FEATURE

APR 2026

// OVERVIEW

One chip. Four proof points.

DM-K392 was engineered to answer one question: can SmartForge hold micron-scale geometry across wildly different feature types, in the same molded part? The four features below are measured against their CAD drawings. A Y-junction links them; three ferrule ports interface the fluidics to the outside world.

F101

Gradient generator

Branching serpentine network that mixes two inlets to controlled concentration gradients.

`W = 300 → 200 µm · D = 200 → 150 µm`

F102

Serpentine mixer

Long-path passive mixer for homogenising reagent streams before downstream assay.

`W = 150 µm · D = 120 µm`

F103

Pillar filter

Hexagonal array of 100 µm pillars for cell / debris capture at defined flow rates.

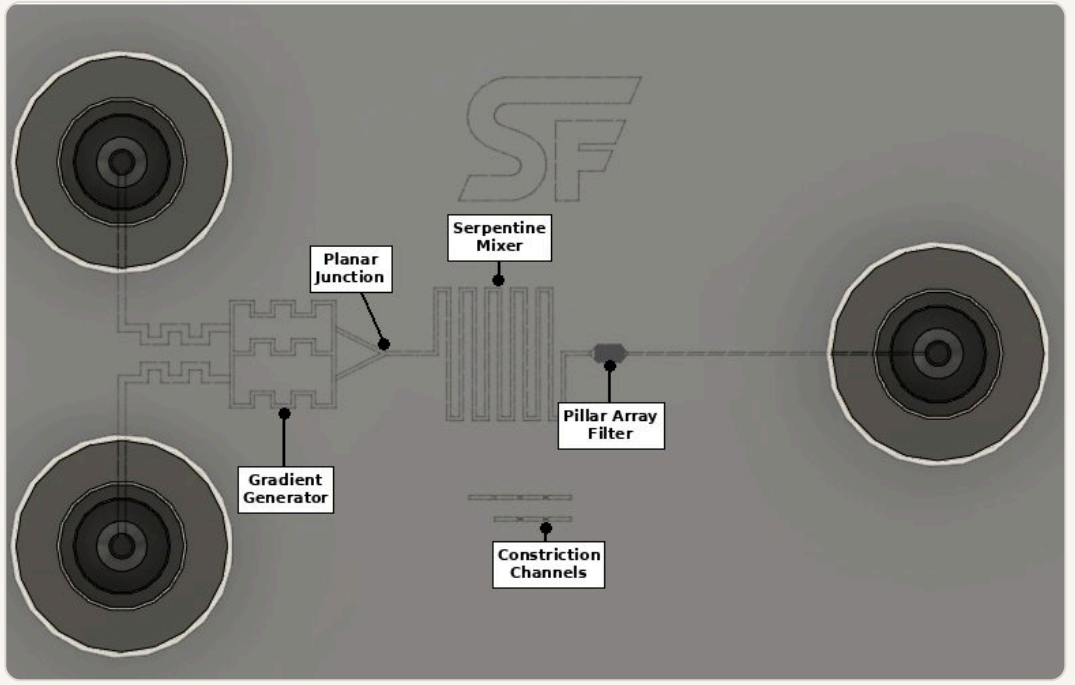
`100 µm Ø · 60 µm D · 80 → 50 µm gap`

F104

Constriction channels

Two stepped restriction zones for deformability / flow-focusing assays.

`W = 20 – 100 µm · D = 30 – 75 µm · stepped`

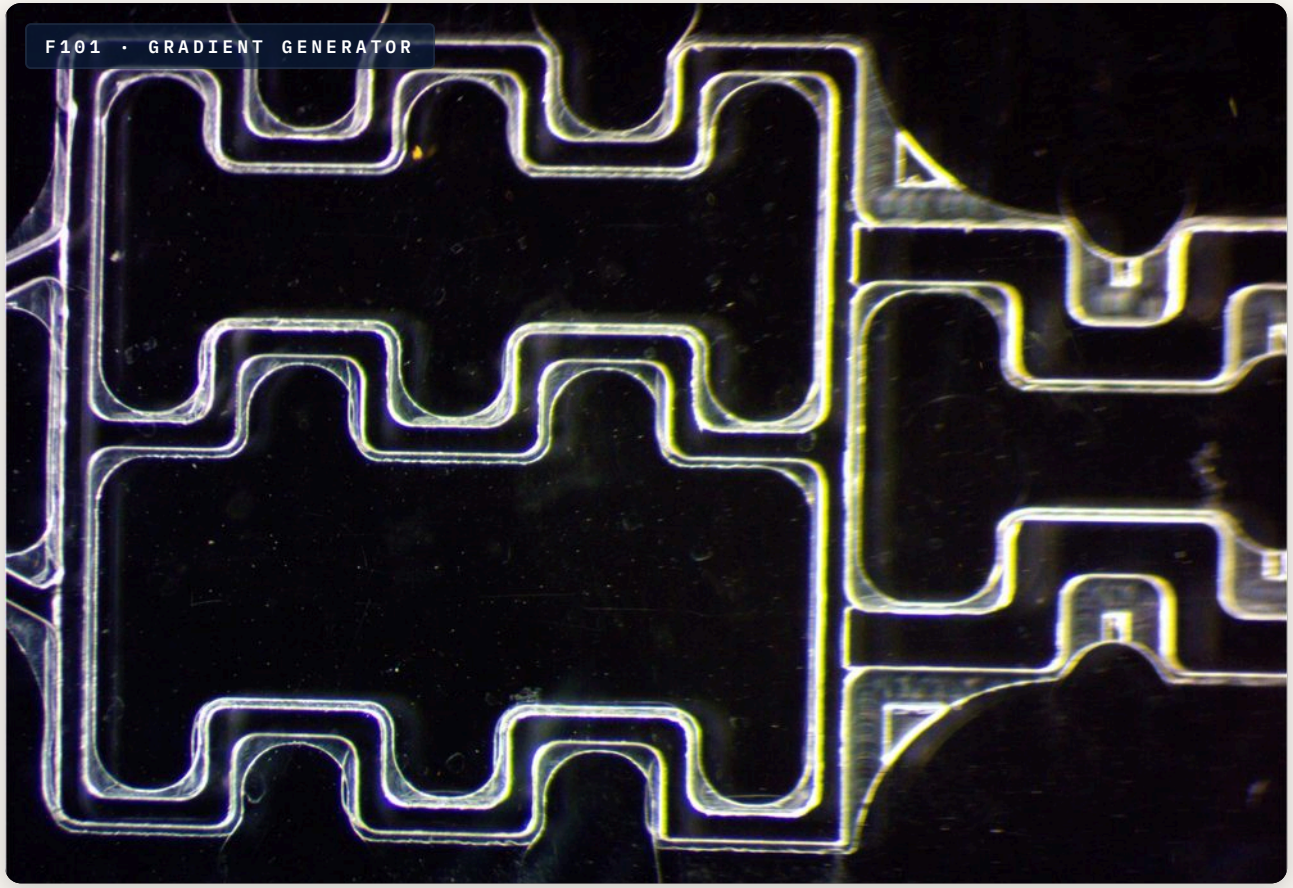


DM-K392 · FEATURE MAP

> Errors don't grow as features shrink — the tolerance is set by the mold-mill, not by the molding process.

// FEATURE F101 PROOF POINT · 01 / 04

Gradient generator — 300 × 200 µm channel.



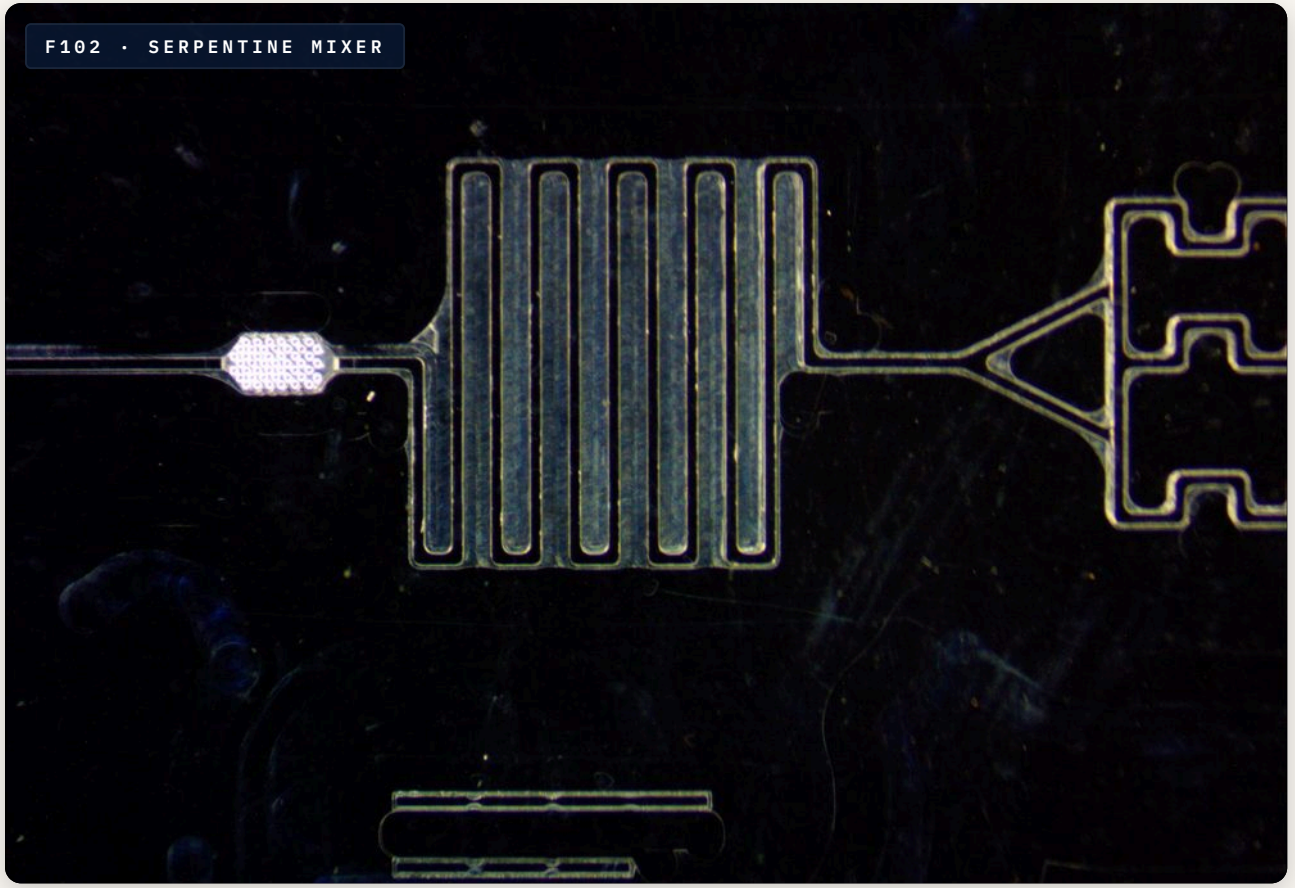
Drawing vs. measured part

PARAMETER	DRAWING	MEASURED	ERROR
Channel width	300 µm	305.30 µm	+1.77 %
Channel depth	200 µm	197.98 µm	−1.01 %

Why this matters

Gradient generators rely on balanced hydrodynamic resistance between branches. A 2 µm deviation on a 200 µm channel is **~1%** — well inside the tolerance needed for reproducible concentration profiles at the outlet.

Serpentine mixer — 120 µm depth, crisp turns.



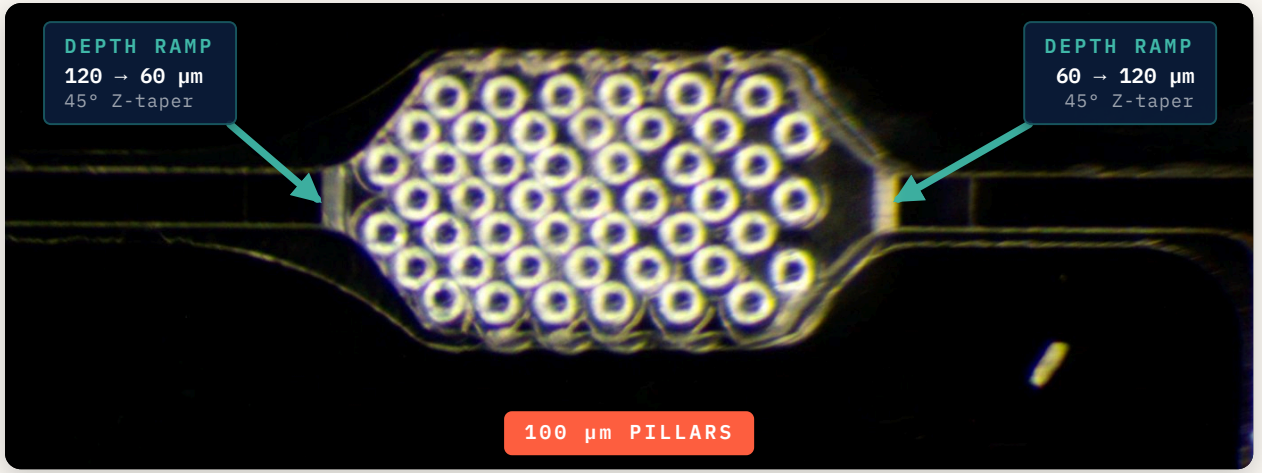
Drawing vs. measured part

PARAMETER	DRAWING	MEASURED	ERROR
Channel depth	120 µm	119.30 µm	−0.58 %
Channel width	150 µm	149.12 µm	−0.59 %

Why this matters

Passive mixing performance scales with the number of turns and the sharpness of the corner radius. SmartForge-molded serpentines show **< 1 µm** depth drift across every turn in the path and no sag or rounding at the apex — uncommon for injection-molded plastic at this scale.

Pillar filter system — two depths, one shot.



Why this matters

The 60 µm pillar region sits inline with a 120 µm main flow path — a depth change that standard injection molding cannot produce in a single shot. Entrance and exit **Z-tapers** at 45° transition cleanly between the two depths in the **same molding run**, with full-height pillars at the floor.

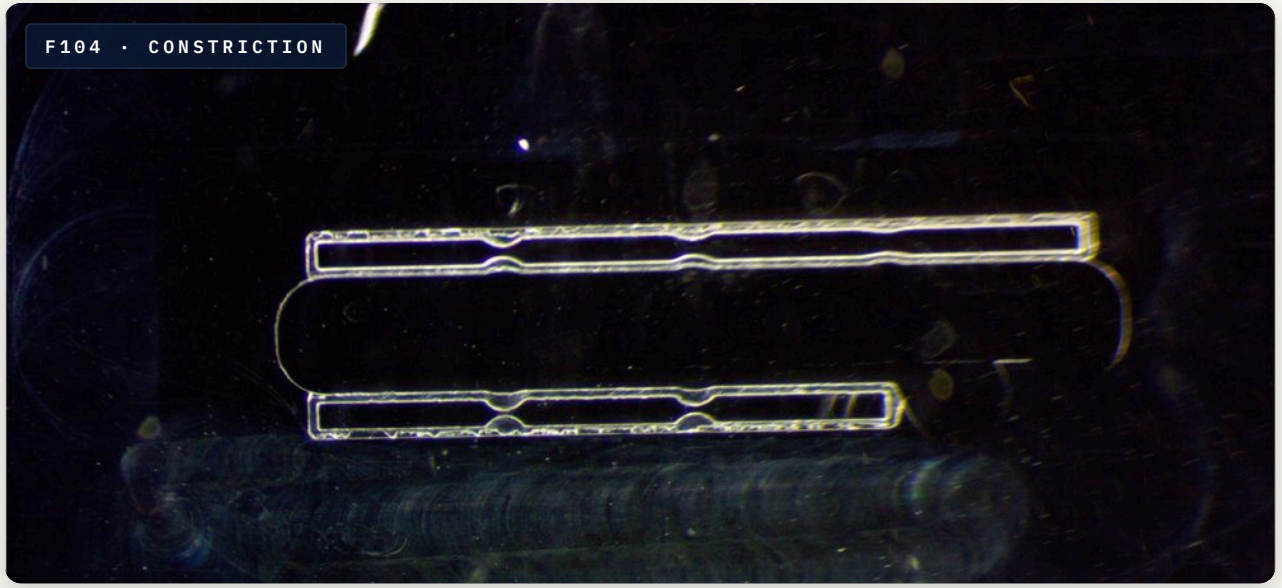
Drawing spec

PARAMETER	DRAWING	NOTES
Pillar diameter	100 µm	Hexagonal array
Pillar height	60 µm	Full-height fill
Pillar gap	80 → 50 µm	Decreases across array
Filter-floor depth	60 µm	vs 120 µm main channel
Depth ramp (Z-taper)	45°	Entrance & exit

// CUSTOMER RELEVANCE

Running a filter at a different depth from the main flow path is a common diagnostic need. Molding it inline — rather than in a separate bonded layer — removes a qualification step.

Constriction channels — two stepped restriction zones.



Why this matters

At **20 µm width / 30 µm depth**, deviation from drawing stays below **1 µm** — the tolerance envelope needed for cell-deformability and flow-focusing assays.

Restriction zone 1 / 100, 75, 50 µm

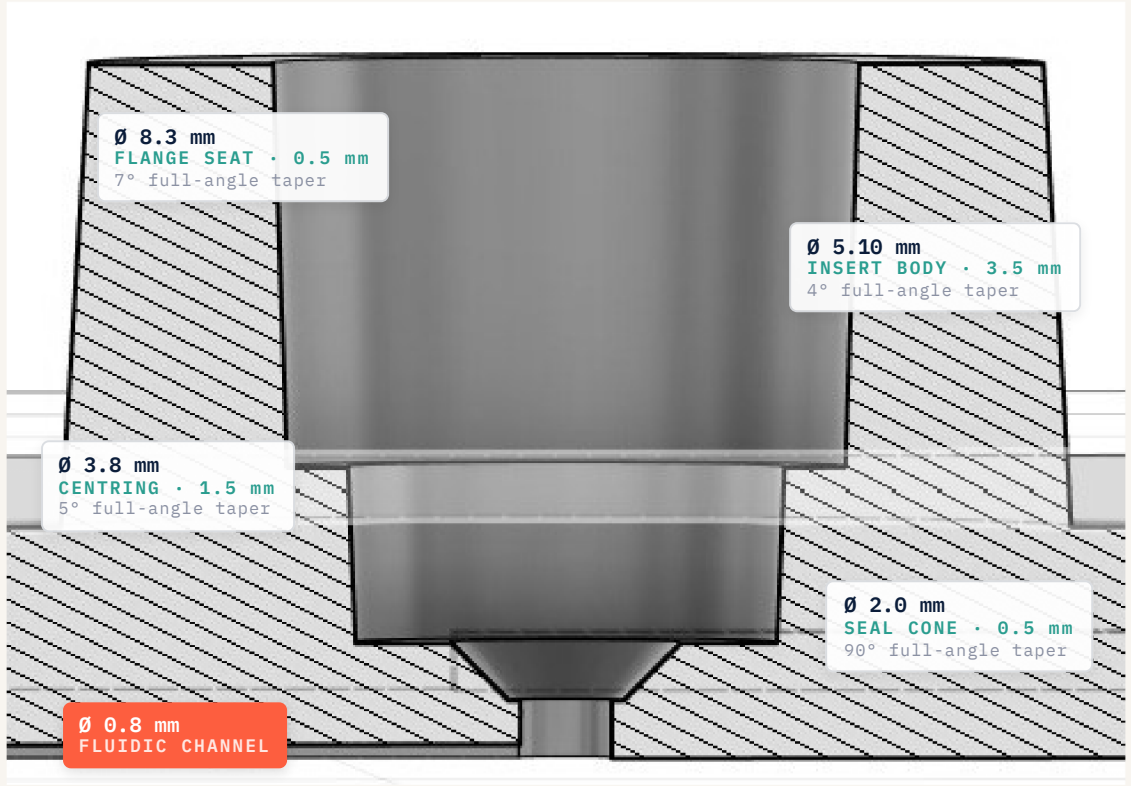
STEP	DRAWING	MEASURED	ERROR
Width A	100 µm	104.72 µm	+4.72 %
Width B	75 µm	74.61 µm	−0.52 %
Width C	50 µm	49.37 µm	−1.26 %
Depth	75 µm	75.15 µm	+0.20 %

Restriction zone 2 / 20, 30 µm

STEP	DRAWING	MEASURED	ERROR
Width A	30 µm	29.48 µm	−1.73 %
Width B	20 µm	19.18 µm	−4.10 %
Depth	30 µm	29.94 µm	+0.20 %

From 20 µm channels to 8.3 mm bores — same shot.

CROSS-SECTION · SINGLE MOLDED FERRULE PORT



STEPPED BORE PROFILE · SINGLE MOLDING SHOT

Why this matters

Millimeter-scale stepped bores alongside 20 µm constrictions is a **> 400× feature-size range** in a single molding shot. Standard injection tools lose resolution at one end or short-shot at the other. Three of these ports on every part, at the tolerance shown.

Assembly

HARDWARE	**RAF_632x150C fitting**
ASSEMBLY	Pressed in at **210 °C** with push-fit pressure
SEAL	Around **Ø 0.8 mm** fluidic inlet
MATES	Ferrule connectors **M-650 / M-660**

// FINISHED PART

From drawing to molded part.



// DIMENSIONAL SUMMARY

Every measured feature within 5% of drawing.

From 300 µm gradient channels down to 20 µm constrictions, alongside millimeter-scale ferrule bores — every measured feature lands within single-digit-% of its CAD target, in one molded COP part.

Where we take it from here

1. **Share your CAD.**
   Send the feature drawings for your assay. We mark up moldability and tolerance risk in one pass.

2. **Single-shot prototype.**
   Same tool path, same substrate, same molding run — so the prototype you test is the part you scale.

3. **Scale without re-qualifying.**
   Production units come off the same process — no geometry drift from prototype to pilot to launch.

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