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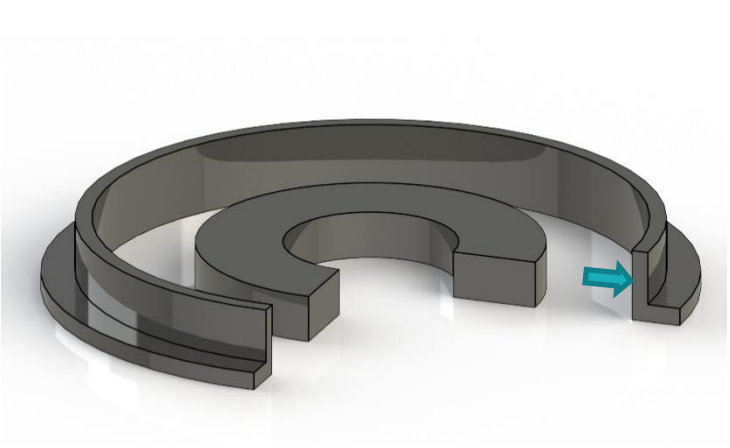
# Flexible profile ring rolling

High productivity in near-to-net shape seamless rings

Case Ref: All-3115-15



## Step change in productivity for making profiled rings

Seamless ring components used in rotating machinery and fluid transfer applications are ring rolled into large semi-finished rings and machined to final shape, removing up to 90% of the starting material. Producing near net shape rings by ring rolling presents a challenge: even with dedicated toolsets, controlling the flow of material from preform to final shape is difficult and currently requires **large development effort.**

A University of Cambridge research team, with input from supply chain stakeholders, has delivered a step change in the productivity of making profiled rings. Their new process demonstrates **both** greater **control over material flow** during forming *and* the ability to produce a range of near net shape profiles **without dedicated tooling sets**.

**New machine features** (see overleaf)

1. **Extra constraining rolls** that control the flow of material circumferentially
2. **Main rolls** that can be repositioned vertically under CNC control
3. **Axial rolls** co-located with the main rolls

**Technical benefits**

- Allows **deep profiles** to be made without needing to shape the starting workpiece
- Makes profiled rings **without a tool change**
- Gives **precise control** over material flow
- Increases hydrostatic pressure during forming, **reducing micro-cracks/damage**

**Commercial benefits**

- ✓ **Material and energy** savings of 25-50%
- ✓ Significant reduction in upstream and downstream **processing requirements**
- ✓ Elimination of tool change **set-up time**
- ✓ Increased **process stability**

**Further information overleaf**

## Target market

The principal users of this technology are **forging companies** in the supply chain for industrial equipment such as transport equipment, electricity generation, mechanical assemblies.

Seamless rings are used in many engineering products, making up 7% of forging industry output. Components are in such demand there are over 200 ring rolling facilities worldwide and the demand for **profiled rings** is growing year on year.

Our new profile rolling technology will give an equipment supplier a distinctive new offering in this marketplace, particularly where sustainability and resource efficiency are important drivers.

**For further information please contact:**

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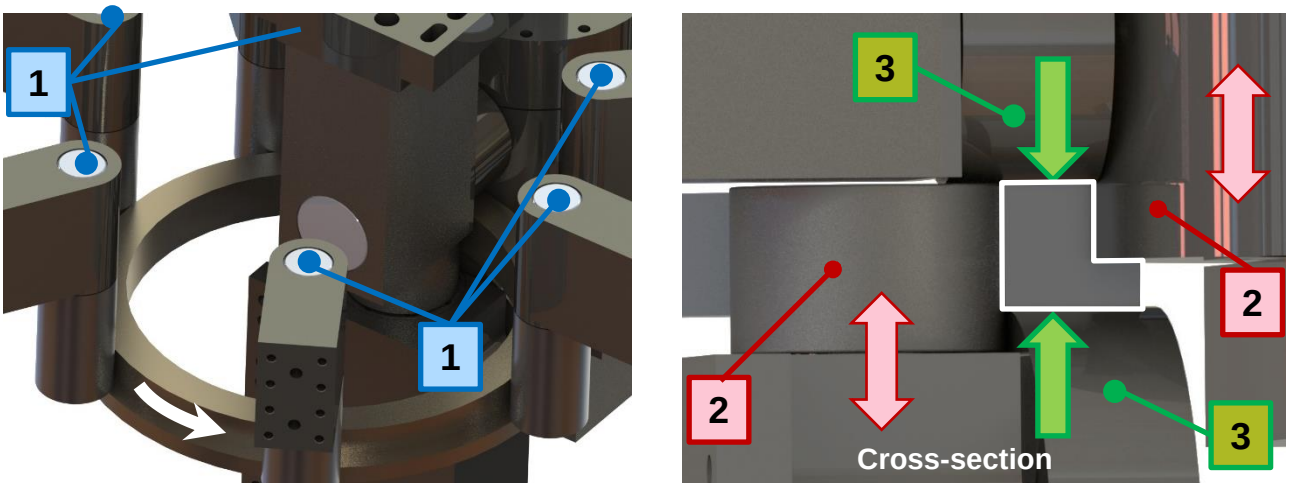
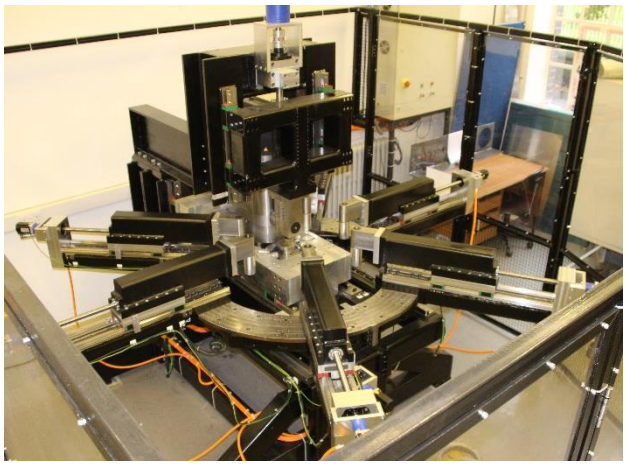



*The flexible profile ring rolling concept featuring: 1) six constraining rolls around the ring, that control the flow of material circumferentially (in blue); 2) main rolls that can move vertically under CNC control (in red); and 3) axial rolls co-located with the main rolls on the top and bottom ring surface (in green)*

## Stage of development

The inventors, advised by an industrial consortium spanning users, forging companies and control system suppliers, developed the flexible profile rolling concept and have **built a machine capable of processing soft metals** at room temperature up to 1m diameter. They have proven that the concept: producing a large range of profiled rings including L-shapes, T-shapes and conical profiles, deeper than any previous method.

Advanced **finite element simulations** on rolling of high-strength materials have been completed and suggest **high process feasibility**, even on difficult to roll materials such as Nickel alloys. We now want to validate these promising findings in a hot-working environment.



*The Cambridge lab machine: **process proven** on soft metals at room temperature*

## Implementation

The new process could be implemented as a retrofit to an existing ring mill, or the complete package can be delivered as a standalone project to meet a new need for flexibly profiled rings. New control software and ongoing customer support offer further revenue streams for the machine supplier.

## The inventors

### Dr Christopher Cleaver

Dr Chris Cleaver is a Senior Research Associate at the Department of Engineering, Cambridge. His PhD brought together supply-chain players to develop the flexible rolling process. He led the designing, building and commissioning of the lab machine.

### Prof Julian Allwood FREng

Prof Julian Allwood has a longstanding interest in novel flexible metal forming processes. He heads the Use Less research group at Cambridge, pursuing world leading research into the sustainable use of materials, energy and resources.

## Commercialisation

This technology is protected by US, EU and JP patents (International patent WO2016142661A1)

We are looking to partner with an equipment manufacturer to jointly develop from lab pilot to full-scale commercial system through TRL5-9.