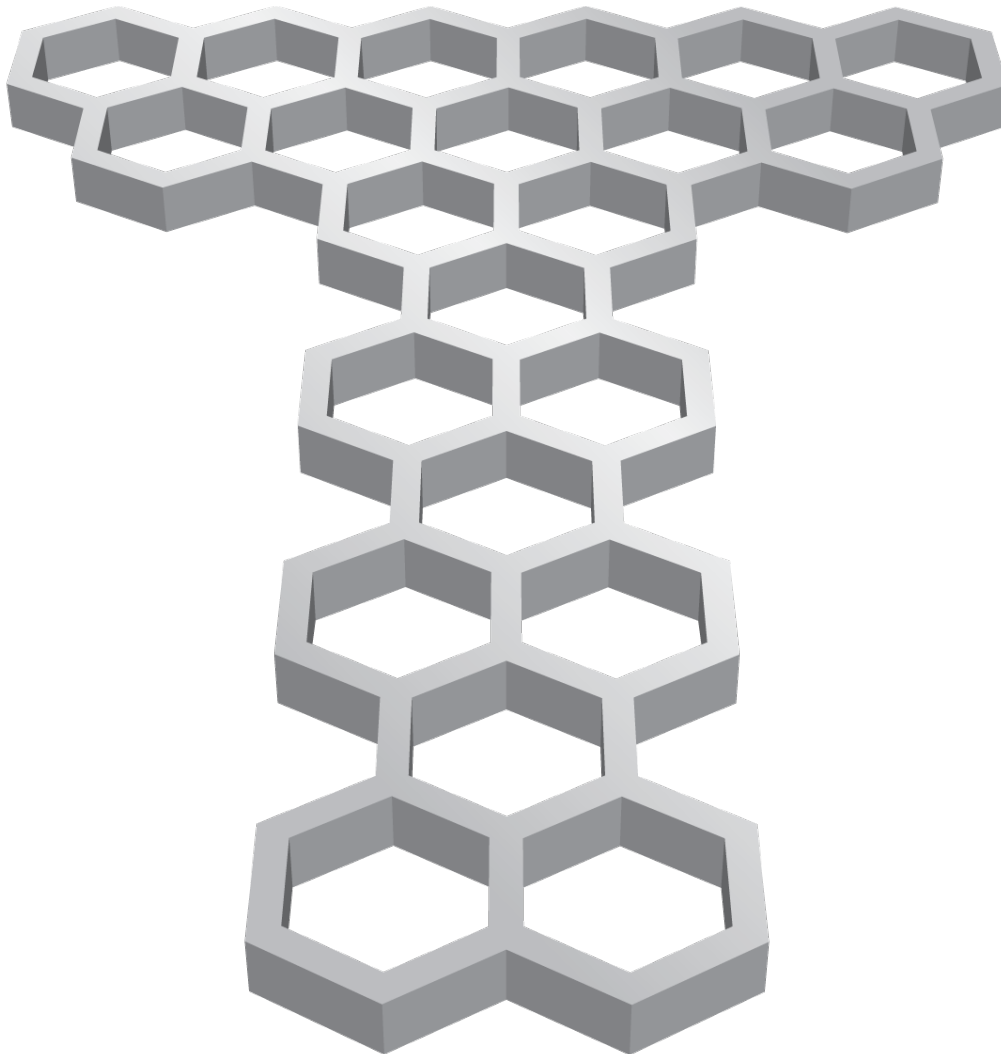


# TEMPUS™ technology



## Time for ultra productivity

At Renishaw we are always striving to innovate and transform capabilities in Additive Manufacturing (AM).

Our new TEMPUS™ technology delivers an up to 100% increase in AM productivity without compromising on part quality.

This patented technology employs seamless communication between advanced software and hardware components to synchronise the system lasers with the recoater. While traditional powder bed systems require the recoater to fully distribute powder before the layer can be consolidated, with TEMPUS technology the lasers can fire at the same time as the recoater is moving.

For every layer of the AM process, TEMPUS technology enables faster processing and maximum laser utilisation – boosting productivity and reducing part costs.

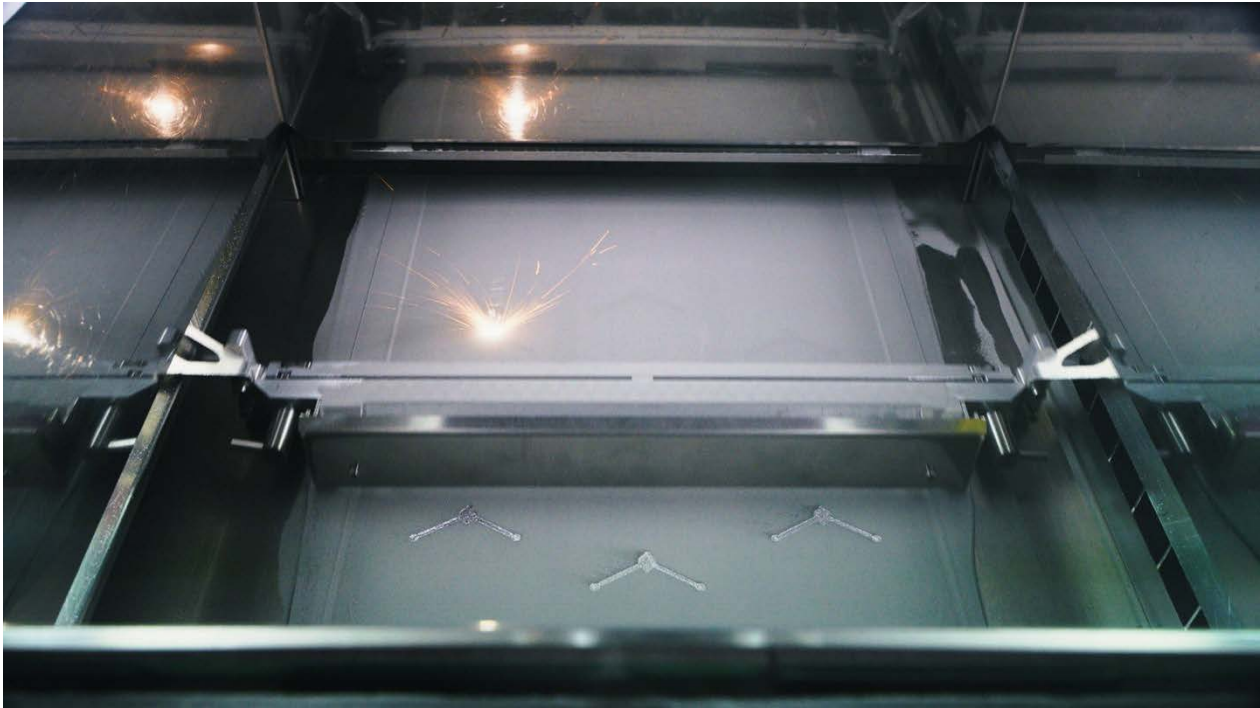
Learn more at: [www.renishaw.com/am](http://www.renishaw.com/am)



**Figure 1** Parts made using TEMPUS technology

## Productivity boost

By enabling laser processing while the powder recoater moves, TEMPUS technology can save up to 9 seconds of build time every layer. With builds frequently containing thousands of layers, this time saving enables TEMPUS to reduce build times by tens of hours.



**Figure 2** Laser firing as the powder recoater is moving

With optimised geometry, processing with TEMPUS can increase productivity by up to 100%, to cut build times in half.

### Examples of productivity levels possible with TEMPUS technology on the RenAM 500 series platform:

Sector	Example application	Build height (mm)	Layer thickness (µm)	TEMPUS productivity boost (%)	TEMPUS build time saving (%)
Medical	Tibial trays	39	60	31	24
Aerospace	Radial recuperator	191	60	61	38
Dental	Removable partial dentures	31	40	66	40
Sport	Offroad bike lugs	174	60	53	35

## Case study: High performance, automotive refrigeration system component

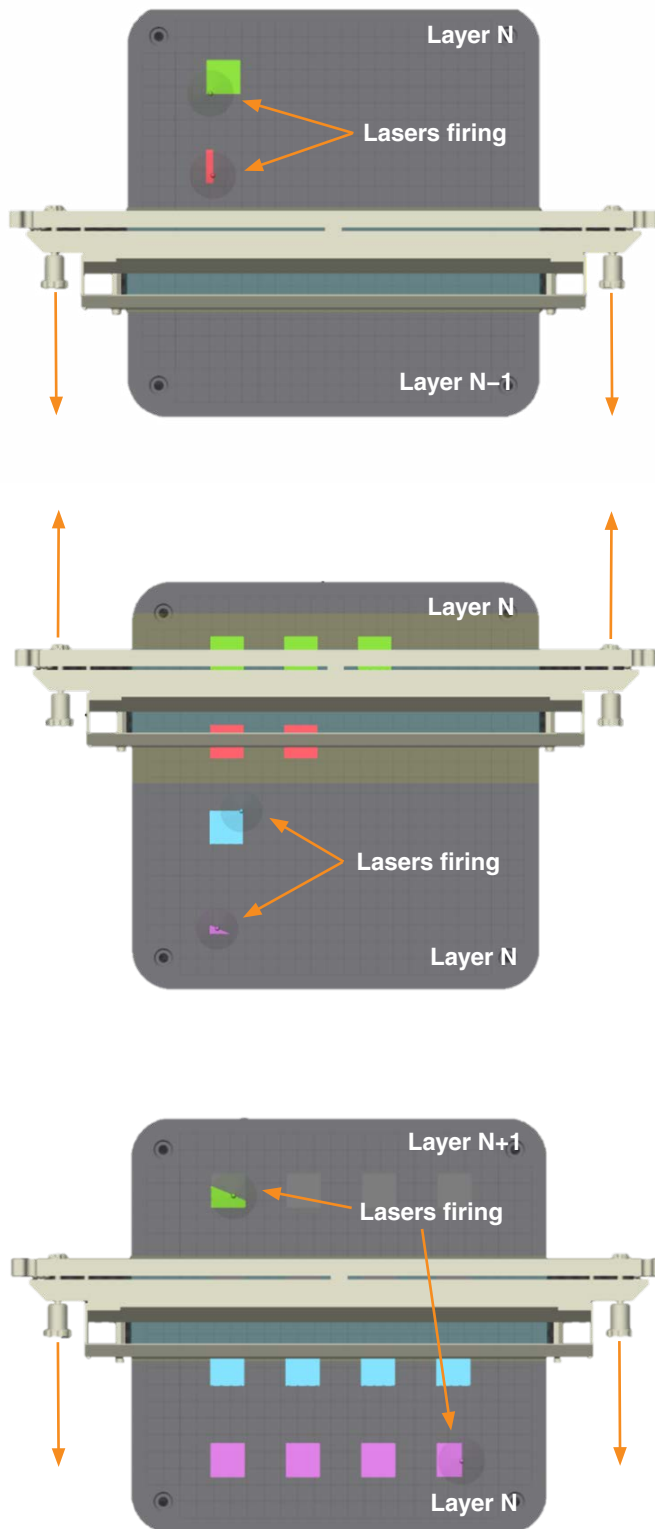
<b>Material</b>	Aluminium alloy (AlSi10Mg)
<b>Layer thickness</b>	80 µm
<b>Build height</b>	263 mm (3,287 layers)
<b>Laser scanning strategy</b>	Continuous wave, stripe hatching, single laser-per-part, maximum power 465 W, hatch scan speed 2.25 m/s, 24 parts per build



**Figure 3** Case study components attached to build plate

	Typical single-laser system	500S + TEMPUS	Typical four-laser system	500Q + TEMPUS
Total build time (hh:mm)	30:40	23:54	14:03	7:04
<b>TEMPUS productivity boost</b>		<b>28%</b>		<b>99%</b>

## How does TEMPUS work?

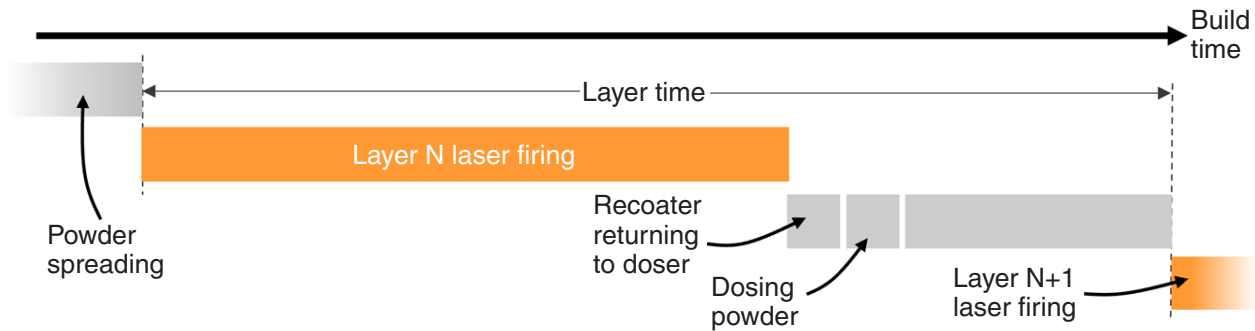


1. As the recoater spreads a layer of powder, the lasers 'follow' the recoater, melting the powder being spread before the recoater completes its stroke.
2. When the recoater returns to the doser to collect more powder, the lasers 'jump over' the recoater and continue melting the current layer.
3. As the recoater begins spreading the next layer of powder, the lasers finish the previous layer and start processing the new layer simultaneously.

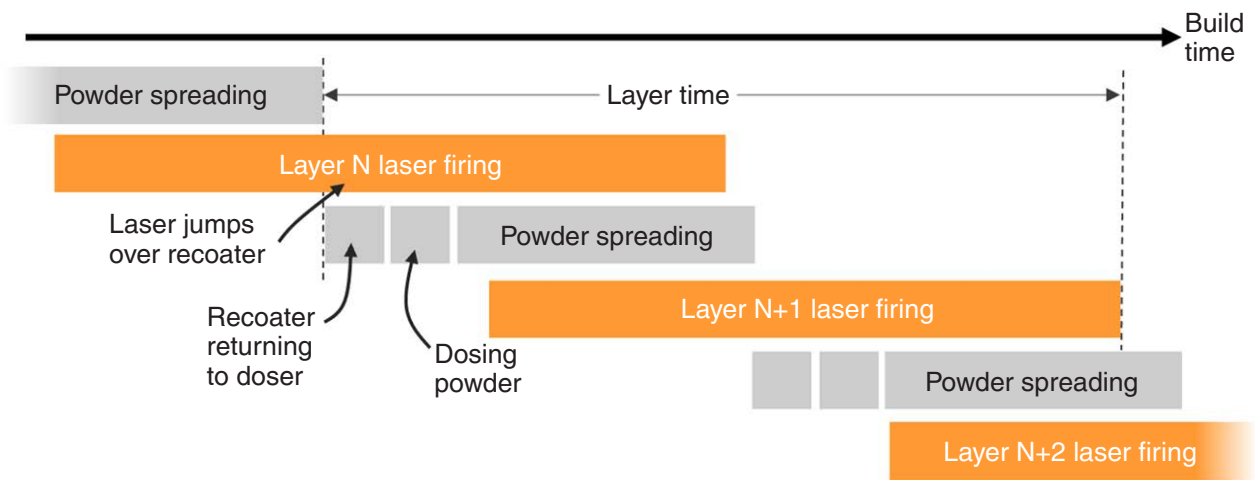
TEMPUS utilises Renishaw's advanced file format to deterministically control both the lasers and recoater. Optimising a build can be achieved in Renishaw's QuantAM software.

## Layer timing

By firing the laser while the recoater is moving, the AM process efficiency can be boosted, with more layers being processed in the same build time.



With traditional layer timing, each action is sequential.



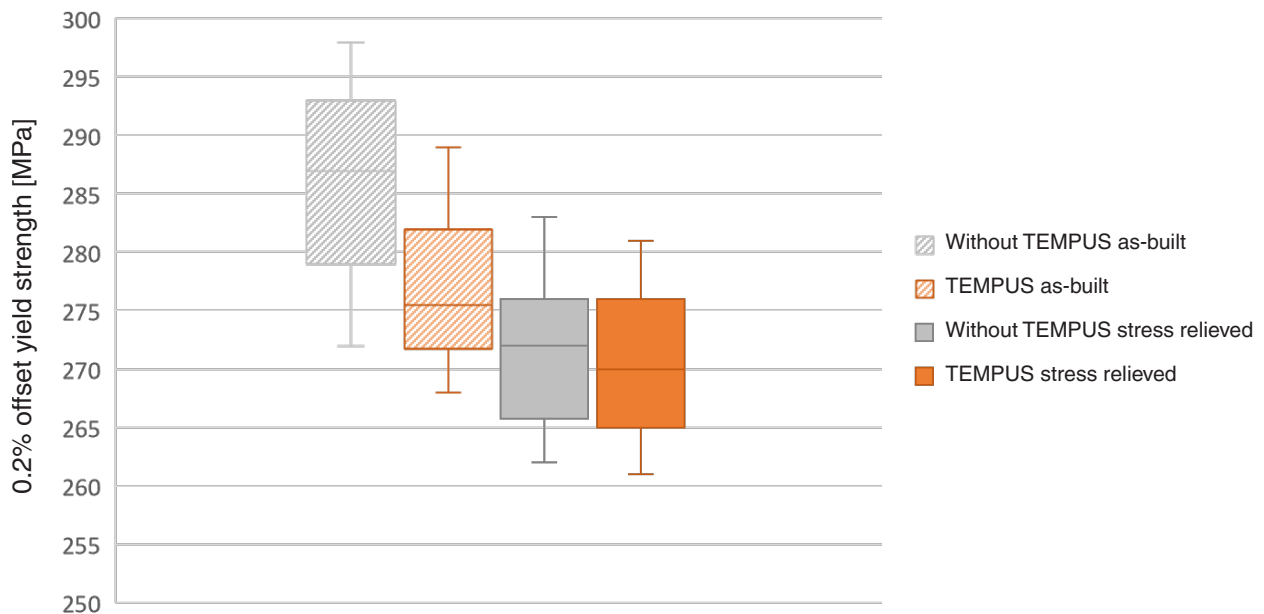
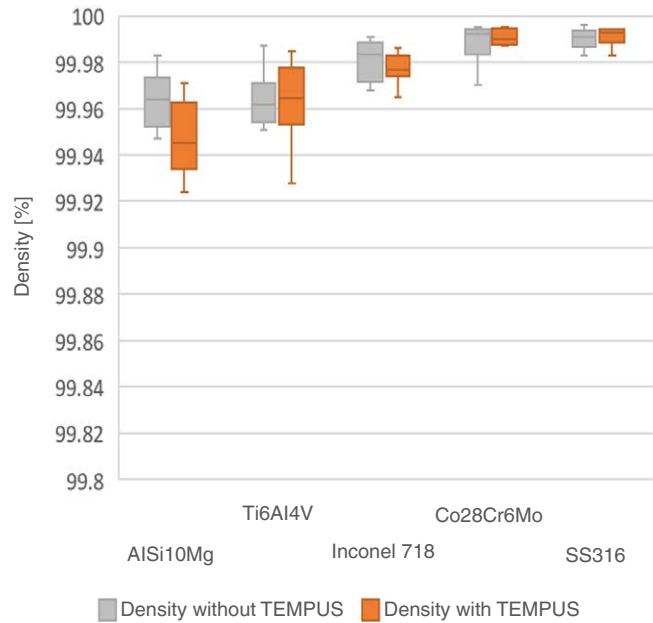
With TEMPUS technology, the laser can be fired during the recoating process. With fully optimised data, the lasers can be firing continuously throughout the build, significantly boosting productivity.

## Material properties

Printing faster using any method, including TEMPUS, changes the thermal profile of the build. This can change the metallurgy, resulting in different mechanical properties.

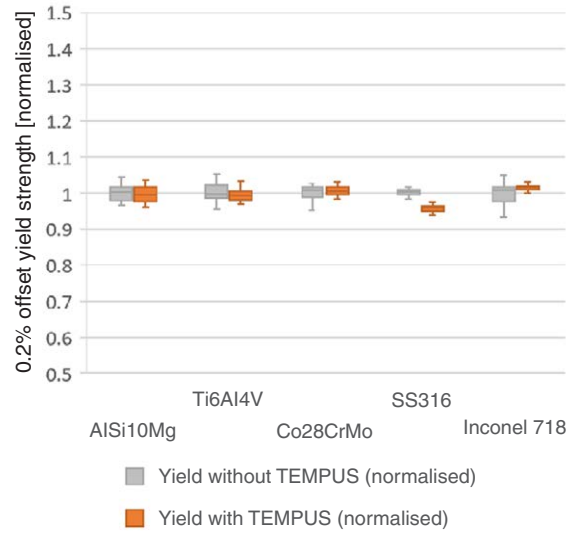
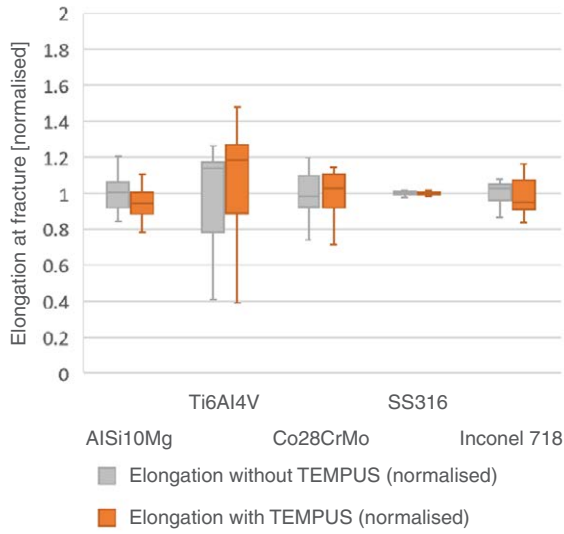
These differences can typically be eliminated through subsequent heat treatment – after which there is no difference between parts produced with or without TEMPUS.

Thanks to the optimised gas flow of the RenAM 500 series, density values are consistently > 99.9% for parts produced with and without TEMPUS technology.

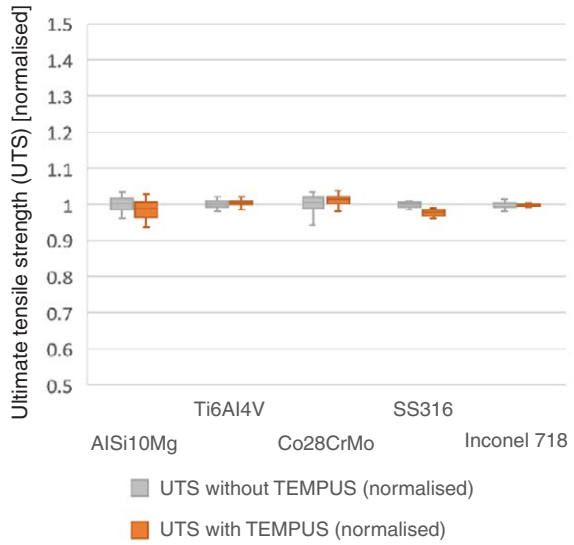
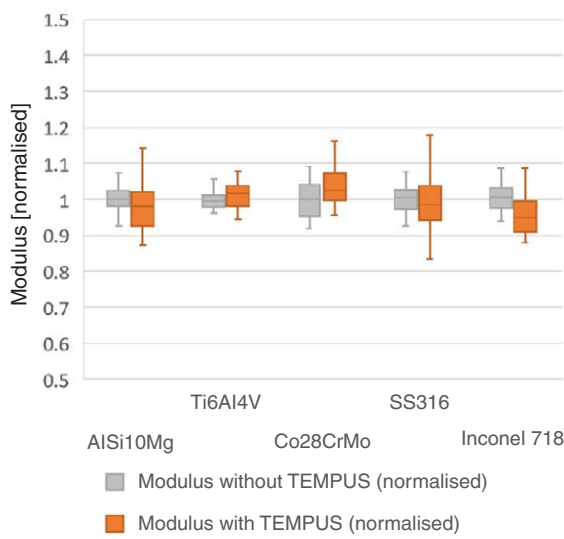


Differences in AlSi10 mechanical properties directly after printing are eliminated through appropriate stress relief and annealing heat treatments.





Processing with TEMPUS technology maintains the class-leading material properties achievable on the RenAM 500 series.





## Availability

TEMPUS technology is exclusively available on the RenAM 500 series from Renishaw.

RenAM 500 Ultra models include TEMPUS technology as standard, and it can be purchased as an upgrade on all other RenAM 500 series models. The upgrade includes powder circuit, electronic, chamber and software modifications.

TEMPUS technology utilises the Renishaw `.renam` file format – which can be optimised in Renishaw’s QuantAM build preparation software.



**Figure 4** RenAM 500 series, including the Flex and Ultra models

[www.renishaw.com/contact](http://www.renishaw.com/contact)



#renishaw

 **+44 (0) 1453 524524**

 **uk@renishaw.com**

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