

## COPPER STAVES BEND-RESISTANT TECHNOLOGY

The use of copper staves in higher heat and liquid zones of the blast furnace has proven successful in furnace cooling. Although reliable in protecting the structural integrity of the furnace shell, premature failure through stave bending (known as the 'banana' effect) persists.

The bend-resistant copper staves from Primetals Technologies prevents such failure. This leads to safer, stable furnace operations and longer campaigns.

### STAVE BENDING

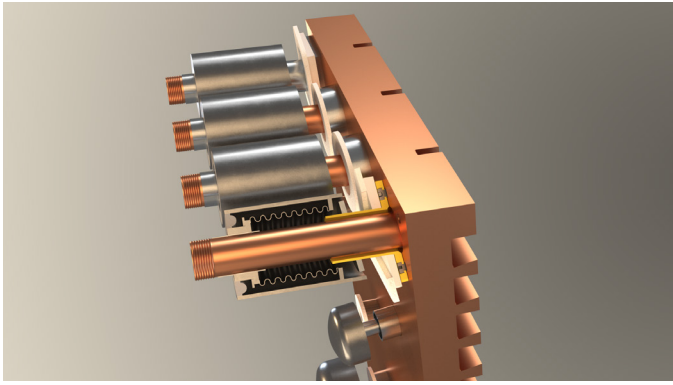
Rapid changes of temperature due to variations in furnace conditions cause the stave temperatures to cycle and deflect at points where it is least restrained.

Deflection at the corners of the staves allows burden material to get behind it. This forces the corners inwards into the furnace and allows dust to enter the compensators which restricts their movement.

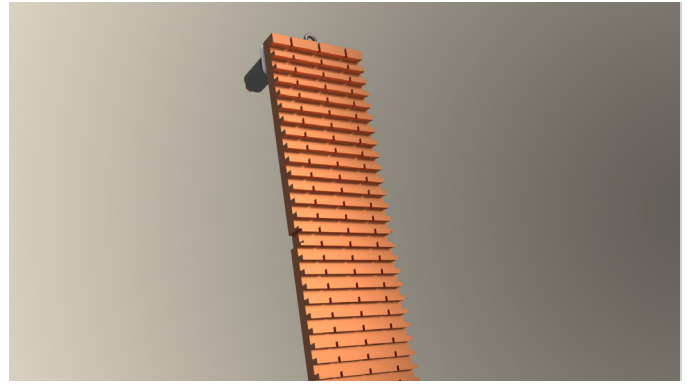
As thermal cycling continues, further bending occurs allowing more material to get behind the staves, eventually resulting in failure of the welded connection of the cooling water pipes and stave body.

If the water pipe is restrained by contact with the furnace shell, then the failure will be accelerated. Only Primetals Technologies anti-bending solution can avoid this.

SEVEN  
REFERENCES  
ZERO FAILURES



Rendered image of anti-bending bracket and compensators



Rendered image of copper stove hot face

### BEND-RESISTANT TECHNOLOGY

The anti-bending solution from Primetals Technologies is patented. It prevents premature failure of the staves by allowing the cooling water pipes to move during thermal expansion but prevents any bending of the stove corners occurring.

Performing successfully throughout campaigns of 15 years without any failures, the key features of the patented anti-bending solution include:

- Compensator to enable thermal expansion of the stove
- Anti-bending bracket fixed to the back of the stove
- Anti-bending washer welded to the anti-bending bracket but not to the furnace shell

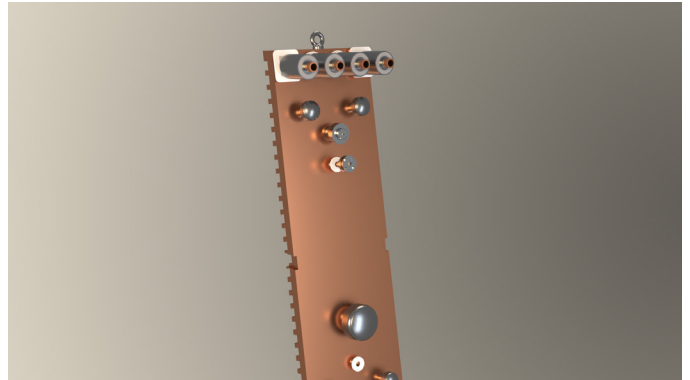
### FIXATION AND GUIDING

The incorporation of the patented anti-bending solution in combination with other critical design features such as the correct positioning of the fixing bolts, fixed pin and guide pin (unique to Primetals Technologies) ensures that uncontrolled bending is not an issue with the Primetals Technologies copper staves.

### PRIMETALS TECHNOLOGIES STAVES PORTFOLIO

As a leading supplier of blast furnace staves for over 40 years, Primetals Technologies recognizes that optimum furnace cooling design starts with understanding the profile of the furnace and the process conditions.

It is this understanding, along with the application of different materials, shapes and arrangements that has led to further copper staves developments including **wear-resistant copper staves**.



Rendered image of fixation and guiding system

### MAIN BENEFITS

- Proven anti-bending solution prevents bending of the stove corners, eliminating premature failure of cooling pipe connections
- Fixed pin and unique guide pin with optimum positioning allows for stove thermal expansion without bending
- Standard and retro-fit solutions for new furnaces and furnace relines, with minimal installation and downtime requirements
- Significant reduction in unplanned maintenance - long campaign lifetime



**Primetals Technologies Ltd**  
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