Mr. Tousch wants ease

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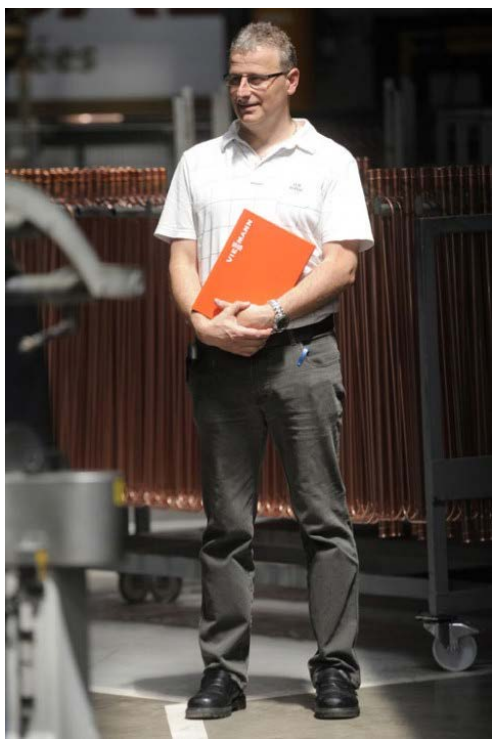
Copper on aluminum: With a cycle time of 72 seconds and high tensile strength, Viessmann has got itself precious breathing space.

The hall hasn't reached desert-like temperatures yet — that happens only at the height of summer. It's still pretty warm though. The two machine operators are spraying their faces with mists of water. Streaks of light and patches of shadow form patterns on the sheet aluminum, the copper pipes, and the fastest laser machine in the solar collector industry. The machine has held this distinction since 2010.



Claude Tousch, Production Manager at Viessmann's Département Solaire in Faulquemont, France

The hall is a former warehouse and is part of Viessmann's plant in Lorraine, in northeastern France. This is where the German company lo cated its production of solar collectors for solar thermal systems and operations soon expanded rapidly. In the shadows at the rear of the hall, special machines bend and join copper pipes, forming meanders. At the front of the hall, the recordbreaking machine is busy welding those meander pipes and sheet aluminum to create absorbers, the centerpiece of a solar collector.

The laser machine owes its presence there in large part to production manager Claude Tousch's powers of persuasion. "We hadn't planned to invest in new equipment at all. All we wanted to do was replace copper with aluminum."

That is because copper is expensive, and back then absorbers were still made entirely out of copper. Not only is the metal a very good conductor of heat, it is also extremely corrosion-resistant. However, it is only for the pipes that corrosionresistance is of significance. "As far as the backing panel was concerned, we knew that we could switch over to aluminum without any concerns," says Tousch. "It has no impact on the collector's performance or service life. And yet it brings down material costs significantly."

A 423 kelvin gap

Where the material did make a difference, however, was in the laser spot welding process, which was already widely used in the sector at that time. The melting points of the two metals are far apart: copper melts at 1,083.4 degrees Celsius; aluminum at just 660.4 degrees

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The companies

VIESMANN

With over 10,000 employees, Viessmann is one of the leading international manufacturers of heating systems. The family- run business is headquartered in Allendorf in the German state of Hesse. Its solar thermal factory is located in Faulquemont in northeastern France.

DTEC dynamic technology

The company DTEC in the Austrian town of Spital am Pyhrn is a machine construction and automation technology specialist for the solar, automotive, and home appliance industries. Founded in 2007, the family enterprise now has 20 employees.

The technology

- Viessmann's record machine is a PulsSpeed by DTEC. Meantime the company enhanced its PulsSpeed machine and integrated bending and welding in one process. Watch the new generation PulsSpeed work in this video.

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Celsius. In other words, by the time copper is gently expanding, aluminum has long melted and gone. Nevertheless, the materials are not unweldable, as Tousch explains: “It’s a matter of fulfilling a series of conditions.”

The joining partners: on the left, the coil with the coated sheet; on the right, the trolley with the meander pipes

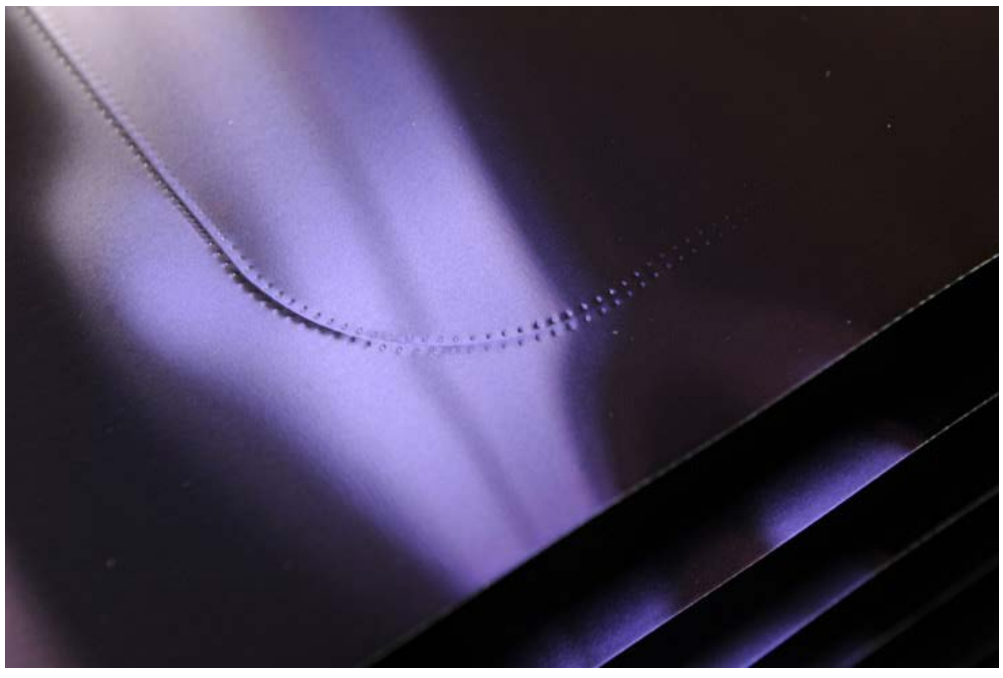
To deal with the extreme differences in melting points, the welding laser is not pointed at the contact point where pipe and sheet touch. Instead, the pulses hit the copper pipe a few hundredths of a millimeter above this point. The cop per pipe passes a portion of the heat generated to the aluminum.

And when everything is just right — when the pipe is in seamless contact with the sheet metal, when the focus is perfect, and when pulse energy and pulse power are precisely metered — the hot, melting copper conducts exactly the right amount of energy to the aluminum, causing it to melt, too. The resulting series of welding spots joins the workpieces. However, the decisive question is: How securely does it actually join the pipe to the sheet?

Because Viessmann’s solar collectors have to satisfy very high quality standards, Tousch set a detachment force of 30 newtons as the target, which was double the amount the spot welds have to be able to withstand. But: “In hundreds of welding tests, we didn’t even get close to the target with the old machine.”

Tests on DTEC’s welding machine

“It was in this state of mental frustration that I went to Austria,” remembers Tousch. Michael Dietl, managing director at machinery manufacturer DTEC, had promised Tousch something special: tests on DTEC’s new welding machine for absorber sheets — on a real installation, belonging to a real Viessmann competitor.



Finished laser seam on the front of the absorber. You can clearly see the curve, which follows the bend of the meander pipe.

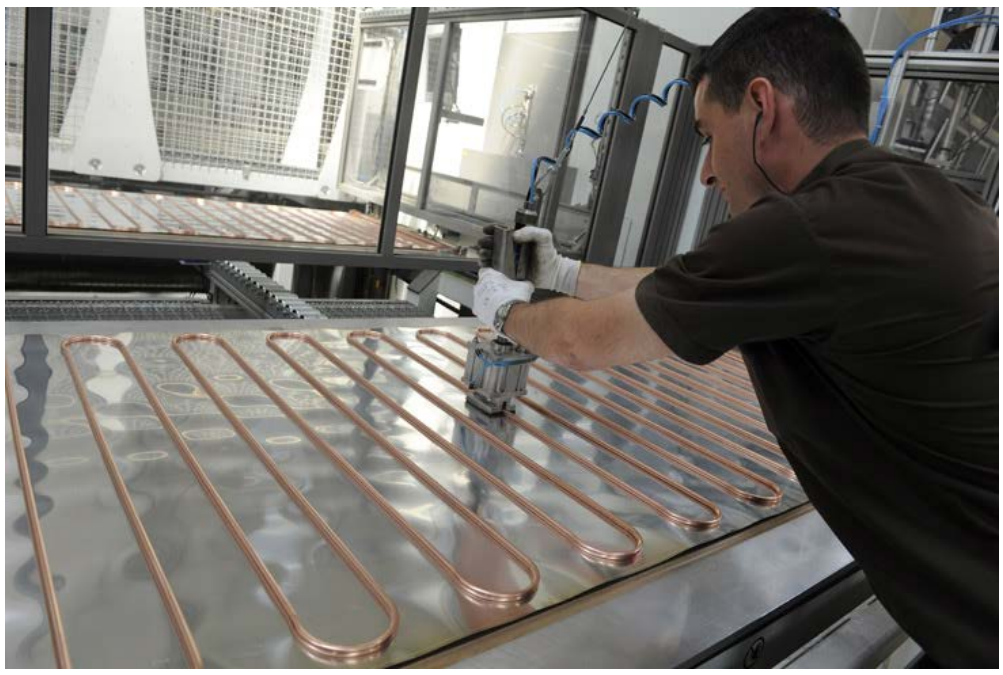
Tousch and his colleagues unpacked their metal sheets and meanders, got started welding, and were amazed at the results. Every single spot

- **Happy with aluminum** Whatever method you use, aluminum is very difficult to weld. So Thomas Schnekenburger decided the laser was his best option. read…

was welded perfectly the first time! That was some thing that had mostly eluded the team back home. Then came the critical tensile test. The spots held at forces up to 45 newtons — far beyond what is required.

Copper-aluminum welding by PulsSpeed

And over the following tests, DTEC's PulsSpeed machine also reliably satisfied the many "musts" of the copper-aluminum welding process, for every single weld spot.



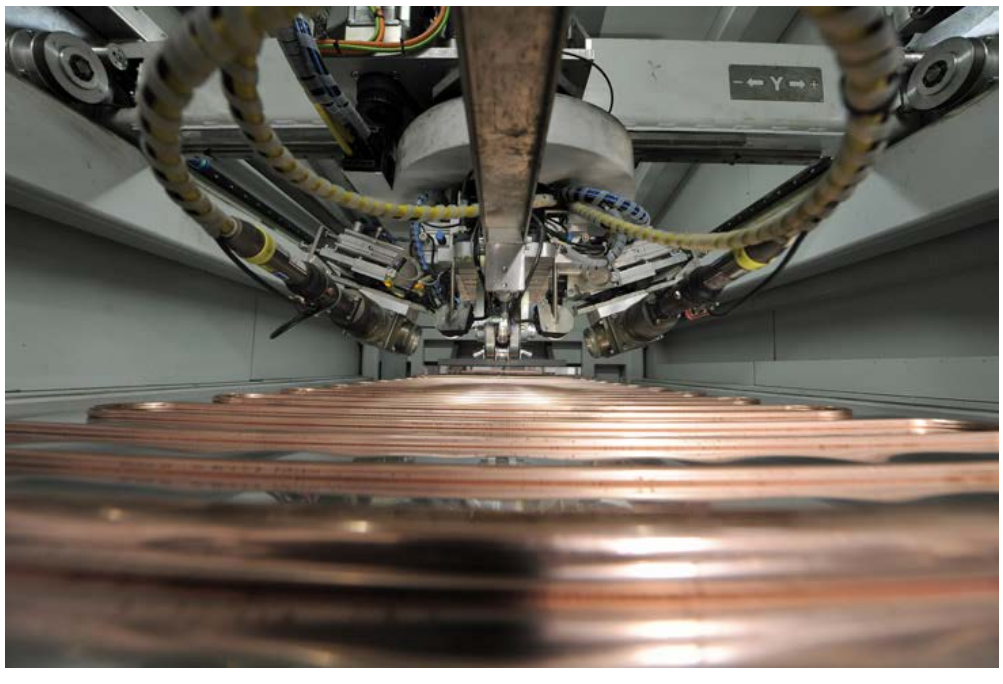
Quality control directly at the machine: using a non-destructive measuring technique, employees test the quality of the weld at defined intervals while production is running.

In the past it was common practice in the solar thermal sector to use sensors to guide the head along the pipe. But the fractions of a second between sensor signal and control command kept causing small deviations in the focal position. In the case of copper on aluminum, that is enough to jeopardize the process.

"Instead, we employ a non-displaceable mechanical guide system: A roller presses the pipe to the sheet and the swiveling welding head follows the contours of the pipe — even around the bends," explains Michael Dietl. "That ensures that the heat flows correctly, the position of the pipe is always exactly defined, and the lasers simply have no option but to hit their mark."

No breaks, no snags

Of course, they were not giving this engineering feat away for free. "I was certain that our future lay in this machine," says Tousch. "If the machine worked fast enough, it would allow us to tighten up the whole process and we would be able to reduce our inventory." For Tousch, there was an important prerequisite: he had to be able to rely on the machine one hundred percent. The machine had to work without interruptions, without snags, and without unplanned additional costs, idle-time costs, or re-pair costs. He wrote all that down for DTEC in the performance specification. As for the cycle time: he wanted a finished absorber every 72 seconds.



The welding head: you can clearly make out the rollers, which press the pipe against the absorber sheet, and the two welding optics, which apply weld spots from both sides in the groove between pipe and sheet.

DTEC designed the machine to have two laser chambers. That way, the machine can continue working with one chamber while the other is being maintained. Seven tables controlled by the machine move between the loading station and the chambers.

Four TRUMPF TruPulse lasers supply the pulses. The solid-state lasers work reliably even in the face of the reflectance that is so typical for copper. “We’ve never had any trouble with the beam sources. We replace the lamps on schedule and then forget about them until the next maintenance cycle comes around,” says Tousch.

DTEC-maschine welds and welds and welds…

The DTEC machine has been in operation at Viessmann’s plant in northeastern France for three years now, welding 17 different types of solar absorber. “We pushed the button and since then it has been working away. We haven’t even had to correct the parameters yet,” notes Tousch.

The reliability of the machine is neatly illustrated by the lack of clutter: there are 50 absorbers at most in interim storage. That would feed thedownstream production line for exactly four hours. “In the past, my palms would start to sweat whenever we had fewer than ten hours’ worth of stock in reserve,” says Tousch, before adding: “Today we make far fewer absorbers to have in reserve; I know I can rely on my machine.” He looks at the laser welding machine. “We paid a bit extra for it. But we got ease. Everyone wants ease. And we’ve got it.”

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