Frenzelit
creating hightech solutions

# Technical article:

# Expansion joints with a high degree of tightness in strip galvanizing lines and continuous annealing

Frenzelit supplies fabric expansion joints for strip galvanizing lines and continuous annealing

## Secure sealing of $H_2$ inert gas

*Fabric expansion joints must meet demanding requirements with regard to temperatures, movements, pressures or demanding media. Strip galvanizing and continuous annealing lines in cold rolling mills additionally require a very high level of tightness in order to reliably seal off the inert gas atmosphere of hydrogen and nitrogen that is present in certain sections of the annealing furnace. Frenzelit GmbH uses different versions of specially developed fabric expansion joints in these applications.*

Pre-rolled sheets are further treated in continuous annealing lines and receive special material properties by means of a targeted structural transformation through annealing and cooling of the sheet metal bands – a process that runs continuously, day and night. This type of sheet metal is used, for example, as deep-drawn sheet metal for body parts in the automotive industry, in the home appliance sector, i.e. to cover washing machines or dryers, but also in the construction industry, e.g. to create profiles for quick-build walls. The strips come in coils and run through to the end of the approx. 150 m long annealing plant where they are wound up again as coils. Perfect alignment at all times is key so that they can be moved centrically through the furnace via steering rolls that guide and redirect the sheet metal bands. These are generally vertical furnaces that contain significantly more steering rolls for redirection than in horizontal furnaces where the sheets can pass through almost flat. The steering rolls are each equipped with a pair of fabric expansion joints to compensate for these roll movements that guide the bands, some of which can be 200 to 250 mm laterally.

**RAL quality criterion “Nekal tight”**

Here the expansion joints do not function as part of a pipeline through which a medium flows, as is often the case. Instead they are a flexible seal to the outside with a more or less stationary atmosphere inside the furnace. In addition to the high temperatures in the area of the expansion joint, another challenge is the tight installation space along with its complex geometry and folds. To ensure that the installation is gas tight, the bearing – including the bearing plate – must be pulled on both sides of the rolls in order to insert the expansion joint, which was built and tested for tightness in the workshop, and bolted to the furnace wall on one side and the bearing plate on the other.

“Nekal tightness” is a quality criterion for the tightness of expansion joints defined by the RAL Gütegemeinschaft Weichstoff-Kompensatoren e.V. (“The Quality Association for Fabric Expansion Joints”) – of which Frenzelit is a member. The steering roll expansion joints fully meet this criterion. This qualitative test method can detect leaks through a bubble method using foam-forming Nekal® liquid.

**Double expansion joint for higher $H_2$ content**

Another area of continuous annealing or strip galvanizing lines in which Frenzelit expansion joints are used is the rapid cooling line. Double expansion joints are used here to seal the significantly higher hydrogen content within the inert gas atmosphere, while the $H_2$ content in the furnace area of the steering rolls described above is no more than five to fifteen percent. Leaks in the rapid cooling line as a result of the higher hydrogen content in the gas can have even more serious consequences if the medium leaks over time and accumulates in other ways. This is why the expansion joints must do more and ensure even greater process reliability. Frenzelit offers solutions with double expansion joints for this reason – with an inner metal or fabric expansion joint and an outer fabric expansion joint. The inner expansion joint shields the higher $H_2$ content. There is a slight overpressure between the expansion joints in order to keep the oxygen out of the system so that no ambient air can penetrate from the outside and destroy the process through oxidizing reactions. The interior space that is created between the two expansion joints is flushed with nitrogen. Leaking nitrogen to the outside means less risk for the environment than hydrogen; leaking nitrogen to the inside also has a less negative effect on the process than oxygen.

This double expansion joint solution requires a high level of design expertise to ensure that the functionality is guaranteed in the long term. Frenzelit precisely designs the fold geometry of the two fabric expansion joints so that they can interlock without obstructing each other. In addition, reinforcements in the form of pipe rings are necessary to prevent certain materials from collapsing or ballooning.

**In a class of their own: “Snout bellows”**

The top tier of expansion joints used exclusively in strip galvanizing lines are the so-called “snout bellows”, which are positioned in front of the zinc bath. When the sheet metal leaves the furnace it runs into a kind of “snout” or nozzle and the nozzle dips into the liquid zinc with the sheet metal passing through. The submerged nozzle ensures the exclusion of oxygen and prevents the inert gas atmosphere from escaping. The sheet metal comes out the other side and is pulled vertically upwards, where excess zinc is blown off with so-called air knives in order to achieve the desired coating thickness. Then the sheet metal cools down with the zinc during the vertical ascent.

The expansion joint is the connection here between this “snout” mounted on an inclined trestle and the fixed furnace outlet. In order to renew the zinc bath regularly, the nozzle must be pulled back far while it is



Frenzelit GmbH | Postfach/P.O.B. 11 40 | 95456 Bad Berneck | Germany | Phone: +49 9273 72-0 | info@frenzelit.com

still hot; the expansion joint compensates for this movement of approx. 400 to 1,400 mm so that the entire structure does not have to be completely dismantled every time.

Such a complex expansion joint consists of ten to twelve layers of fabric, including fabric insulating layers and special sealing layers. This makes it resistant to the high application temperatures of approx. 400 to 650 °C that can occur in the furnace areas around the expansion joint. Apart from the combination of the various fabric materials, the expansion joint achieves its high level of tightness through special joining processes that Frenzelit uses. The company typically also supplies all of the steel parts required for assembly so that the expansion joint is completely ready to install and only the flange screw connection has to be carried out on site. Under these conditions, all of the three compensator versions presented here have a service life of between six and 15 years, depending on the application, load and maintenance of the component.

**Interview with Stefan Puchtler, General Manager Expansion Joint Division at Frenzelit, on the tightness requirements for $H_2$ applications**

*Hydrogen is a topic that is becoming more and more present in various areas from mobility to power and heat supply. Many industrial processes already use hydrogen. This places high demands on the tightness of systems, gaskets and connecting elements such as expansion joints. What are important considerations in hydrogen applications, Mr. Puchtler?*

Puchtler: The challenge in sealing hydrogen is that $H_2$ molecules are extremely small, light and can quickly volatilize. Hydrogen is also highly flammable and, in certain concentrations and mixtures with oxygen, it is also explosive. High tightness classes are therefore required to ensure process reliability for all components and materials that come into direct contact with $H_2$.

*Would you say that the tightness requirements for expansion joints and other gasket materials will continue to increase?*

We have always had high tightness requirements for our expansion joints, especially in steel processing where hydrogen is commonly used as an inert gas in many processes (often in conjunction with nitrogen). However, the requirements for process reliability are also increasing in other countries in which the focus had previously been on economic efficiency alone; regulations are being tightened and cost pressure is also rising. If the tightness requirements cannot be adequately met, sometimes very unorthodox solutions are used.



Frenzelit GmbH | Postfach/P.O.B. 11 40 | 95456 Bad Berneck | Germany | Phone: +49 9273 72-0 | info@frenzelit.com

*In what way? Do you have an example?*

I have seen expansion joints in India and also in China that were not tight enough. To eliminate the danger from the escaping hydrogen, huge fans were set up to distribute the escaping hydrogen over a wide area. That cannot be the way to resolve a leak!

*What do you recommend to customers so that they can make their systems tighter for $H_2$ processes? After all, you don't just support OEMs but also retrofit projects for end customers, right?*

Correct. In modernization projects – this can also include other manufacturers' systems – the first thing we do is take a look at the installation situation on site and provide a clear assessment of what is possible and what is not. In other words, where conversion work and flange modifications are necessary, whether a double expansion joint is a better solution than the existing one, etc. Incidentally, our experience shows that leakages most frequently occur at the flange connection and rarely in the bellows. The prerequisite for this, however, is proper design by the manufacturer.

Our aim is to communicate promptly with our customers worldwide in emergency situations and, if possible, assess the situation on site. Then we build and deliver the replacement expansion joint as quickly as possible. After all, we're talking about system availability – and this means real money. Flexibility is simply a matter of course for us in this area. The time required for third-party installations – including assessment and redesign – is a bit higher, but we are happy to provide companies with a timely offer here as well.

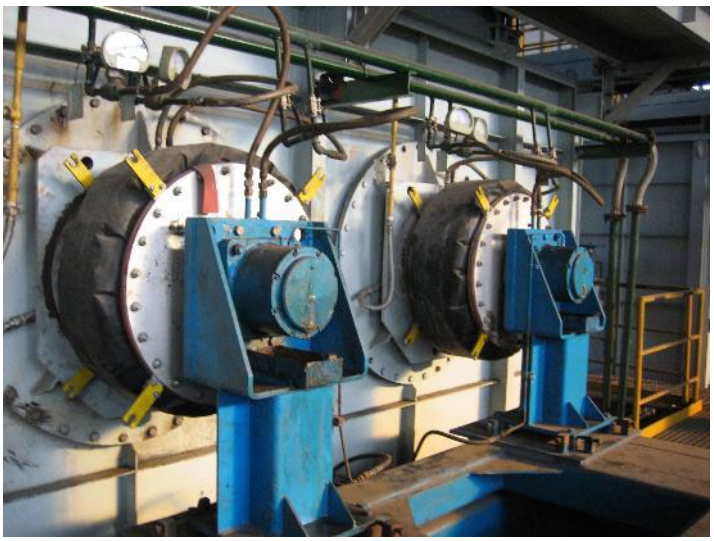
Characters: approx. 10,000



Frenzelit GmbH | Postfach/P.O.B. 11 40 | 95456 Bad Berneck | Germany | Phone: +49 9273 72-0 | info@frenzelit.com

***Images:***

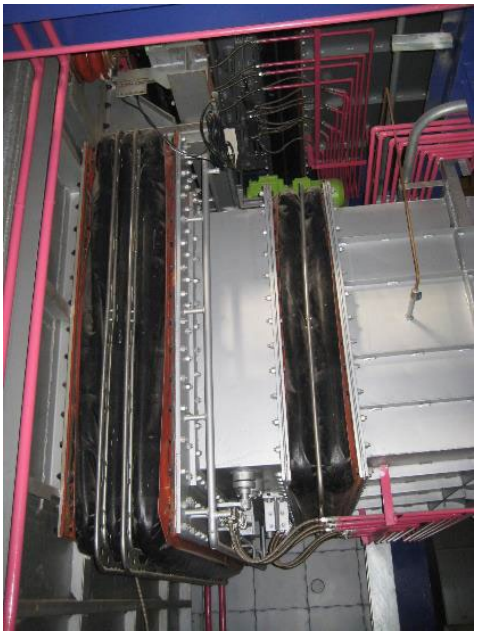
Partial view of a vertical furnace in a continuous annealing line with steering roll expansion joints in the upper area. Image: ©Frenzelit GmbH



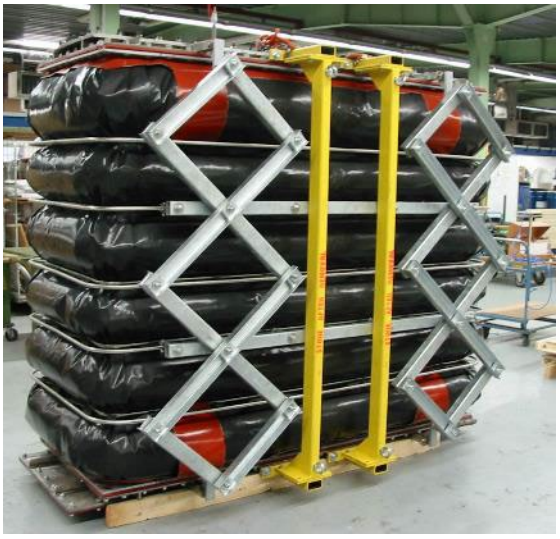
Fabric expansion joints compensate for the movements of the steering rolls that centrically guide the sheet metal bands through the furnace. Image: ©Frenzelit GmbH



Frenzelit GmbH | Postfach/P.O.B. 11 40 | 95456 Bad Berneck | Germany | Phone: +49 9273 72-0 | info@frenzelit.com



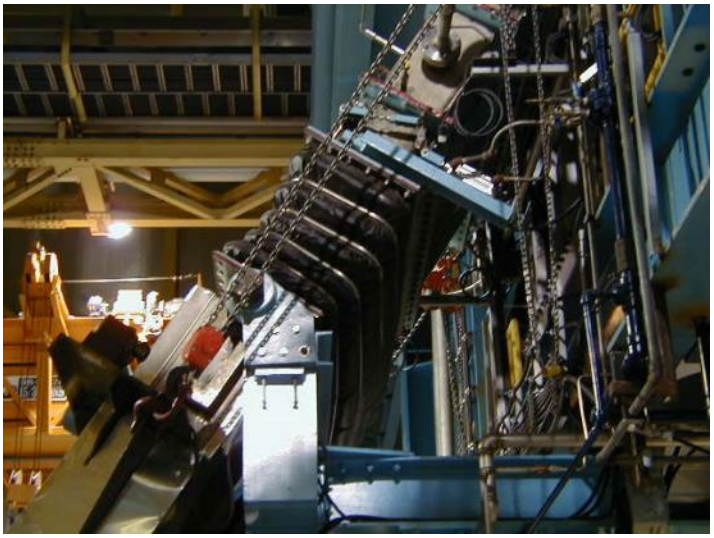
A much larger share of hydrogen must be sealed off within the inert gas atmosphere in a rapid cooling line; double expansion joints with inner and outer fabric expansion joints are used for this. Image: ©Frenzelit GmbH



Snout bellows are complex fabric expansion joints that consist of up to twelve layers of fabric, including fabric insulating layers and special sealing layers. Frenzelit uses special joining processes to ensure that the expansion joints are tight. Image: ©Frenzelit GmbH



Frenzelit GmbH | Postfach/P.O.B. 11 40 | 95456 Bad Berneck | Germany | Phone: +49 9273 72-0 | info@frenzelit.com



Snout bellows are used exclusively in strip galvanizing lines to move the nozzle that dips the sheet metal into the zinc bath forward and backward. Image: ©Frenzelit GmbH

**For questions, contact: pr@frenzelit.com**



Frenzelit GmbH | Postfach/P.O.B. 11 40 | 95456 Bad Berneck | Germany | Phone: +49 9273 72-0 | info@frenzelit.com