

Innovation. Partnership. Performance



THE STRECON® STRIPWOUND CONTAINER

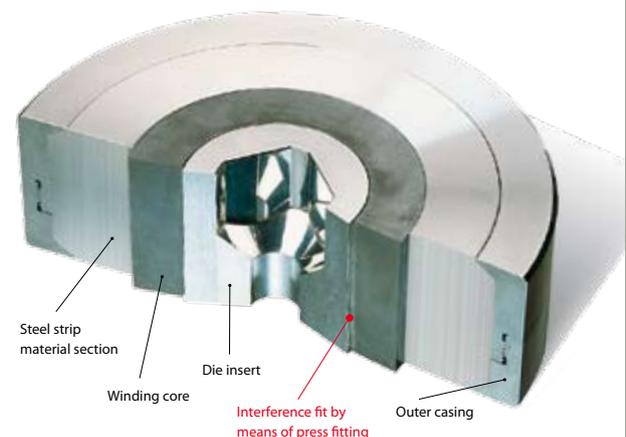
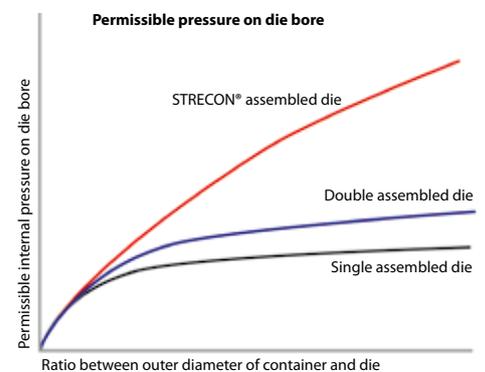
The Unique Prestressing Tool Concept based on High-Strength Steel Strip Material

The STRECON Stripwound Container is a high-strength prestressing tool based on the principle of stripwinding. In short, the stripwound container consists of hundreds or thousands of 0.1 mm layers of a specially developed steel strip material. The steel strip material used for the container tool is fully elastic up to 2000 MPa, and has a hardness of 64 HRC.

The tool concept of the STRECON Stripwound Container is presented below. The steel strip material is wound around a sleeve made of either high-alloyed hardened tool steel material (e.g. 56 HRC) or tungsten carbide with a 15% Cobalt content. This sleeve is named winding core, and its dimensions, material, level of hardness, etc. are determined in respect of application requirements, hereunder whether it would be used for cold, warm, and/or hot forging processes. The stripwinding process is performed by means of special in-house developed machinery. On the outside of the strip section of the prestressing tool, a casing of low hardened tool steel is mounted. The three elements of the winding core, the steel strip section, and the outer casing form together one enclosed tool unit into which the die insert is mounted with a prescribed level of interference fit.

The STRECON Stripwound Container can be directly compared to normal stress ring tools, and two basic merits of the STRECON prestressing tool shall be highlighted:

- The STRECON prestressing tool offers a tool loadability that is 50-100% higher than a normal stress ring. This feature allows a higher prestressing of the die insert, the use of higher hardened die insert materials, a fully consistent interference fit, and a very long service life of the prestressing tool itself.
- When having the winding core made of tungsten carbide, the stiffness of the prestressing tool is about the double of a normal ring system, i.e. 400 GPa vs. 200 GPa. This feature allows for precision forging of parts with close tolerances, and a significant reduction of the low cycle fatigue behaviour of the die insert.



Innovation. Partnership. Performance



THE STRIPWINDING PRINCIPLE

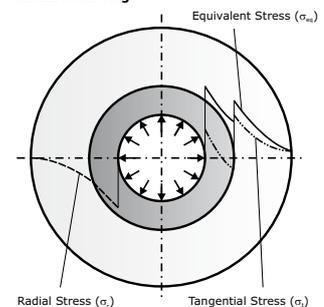
The Key to the Loadability of the STRECON® Stripwound Container

The STRECON Stripwound Container is essentially a stress ring made of several hundreds or thousands of steel strip layers, depending on the size of the prestressing tool. In fact, it takes 10 strip layers for each single millimetre. The strip material used for container tools up to 200° C has specially been developed for STRECON and is fully elastic up to 2000 MPa, and has a hardness of 64 HRC. For container tools running at higher temperatures, a special heat resistant steel strip material is applied (i.e. 450-500° C).

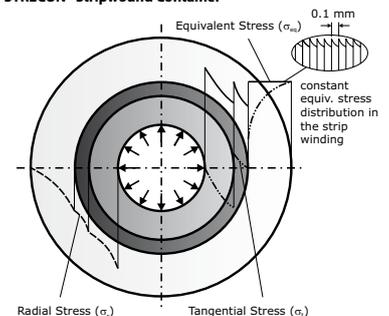
The steel strip material is wound around a winding core (i.e. a sleeve) of either a hardened high-alloyed tool steel material or tungsten carbide. The optimum stress distribution is obtained by varying the winding tension from layer to layer. Thus, the winding core and the single strip layers are prestressed to a well-defined level providing a very high loadability and safety of the tool.

In a normal prestressing system (e.g. single or double ring), there is a maximum equivalent stress at the inside of each ring that leads to high stresses and local plastification. In daily operation this will show as an expansion of the inner diameter of the prestressing tool, and resulting in reduced prestressing of the die insert. This may be as high as 50% of the prescribed interference level. In the STRECON Stripwound Container tool system, the equivalent stress is equally distributed over hundreds or thousands of strip layers, thus avoiding local stress concentrations. In addition to an increased tool loadability of 50% or some, the STRECON Stripwound Container remains fully elastic throughout its service life. In daily operation this means constant prestressing of die insert at the prescribed level of interference, and in many cases at a higher level than would be possible with normal stress rings. No other tool system offers such an enduring strength feature.

Normal stress ring



STRECON® Stripwound Container



Innovation. Partnership. Performance



STRECON® BASIC CONTAINER

Optimum Die Support through increased Interference Fit

The STRECON Basic Container is directly comparable with a single ring or double ring tool system. The key difference is the design and materials applied for the STRECON stripwound container technology, and consequently, the manufacturing process itself. Thanks to the strength properties of the steel strip material used, the tool loadability of the STRECON Basic Container is 50-100% higher than a normal stress ring. No other tool system offers this improvement.

The STRECON Basic Container is applied for optimizing the radial prestressing of die inserts including the cases of actual vertical die cracking due to overloading. The stripwound container remains fully elastic even during very high process loads. The interference fit of the die insert can be as high as 1.1% if required for optimum prestressing. The improvement of the service life of the die insert would be 50% at minimum, but in many cases much higher.

The STRECON Basic container can be used for both cold, warm, and hot precision forging applications. The minimum feasible container size is $\varnothing 80 \times \varnothing 30$ / H35 mm. The delivery time will be 4-6 working weeks plus shipment.



STRECON® BASIC

Innovation. Partnership. Performance



NOVELTY

STRECON® LEAN CONTAINER

Cost Effective and Long-lasting Prestressing Ring for Cold and Hot Forging

The STRECON Lean Container is designed for facilitating cost effective forging operations of various precision parts. This objective has been achieved through optimizing the design and manufacture of the ring (i.e. turned surfaces), and through careful selection of materials. The ring is priced approx. 30% lower than the STRECON Basic Container and is designed as a direct substitute to single and double ring solutions.

The Lean Container is like any other STRECON Container based on the stripwinding technique, and offers the following unique product features compared to any other prestressing system:

- At least 50% higher tool loadability (e.g. 1900 MPa with Ø200x 70 mm container)
- Fully controlled interference fit of the die insert up to 8-9 %
- No expansion of the inside diameter of the prestressing ring (i.e. fully elastic)
- Very high reusability of the ring measured as number of die exchanges

Put into a business context, the STRECON Lean Container offers a highly cost effective substitute to single and double ring solutions as these are limited in material strength, service life, and flexibility. Cost savings of 20-30% should be expected with STRECON Lean due to improved service life of the die insert and the stripwound prestressing ring itself.

The STRECON Lean Container can be used for cold, warm, and hot precision forging applications up to 200° C. Against additional costs, the Lean Container can be designed for 400° C. The minimum feasible container size is Ø80 x Ø30 / H35 mm. The delivery time will be 4-6 working weeks plus shipment.



Small samples of applicable parts for STRECON® Lean Container.



STRECON® Lean – a low cost container for cold and hot forging. The ring design will be matched to customer specifications.

Innovation. Partnership. Performance



STRECON® E+ CONTAINER

Increased Tool Stiffness for Closer Part Tolerances and Reduced Low Cycle Fatigue

The STRECON E+ Container is a quite unique prestressing tool system. Compared to a double ring system, the inner ring has been replaced by a sleeve of tungsten carbide. In normal prestressing systems, however, such a ring tool design is really not feasible due to the strength limitation of the outer steel ring. This strength problem is addressed very effectively by the steel strip material used for the STRECON stripwound container technology (i.e. fully elastic up to 2000 MPa).

In addition to an increased tool loadability of 50-100%, the stiffness of the prestressing tool is about twice the level of conventional prestressing tools (i.e. 400 GPa vs. 200 GPa). No other tool system offers these basic advantages.

The STRECON E+ Container is used for optimizing the interference fit of the die insert as well as reducing the low cycle fatigue of the die. Improvement of the die life would be 50% at minimum, but in many cases much higher. The die deflection can be reduced as much as 30% with this container system, and offers effective means in precision forging of parts with close tolerances.

The tool system is valuable for both steel and carbide dies, and used for cold, warm, and hot forging processes. The minimum feasible container size is Ø80 x Ø30 / H35 mm. The delivery time will be 7-10 working weeks plus shipment.



STRECON® E+

Innovation. Partnership. Performance



STRECON® AXI-FIT CONTAINER

Two-Directional Prestressing for Optimum Tool Performance

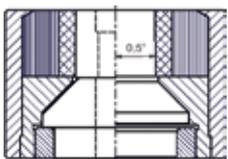
The STRECON Axi-Fit Container offers two-directional die support at the same time: Radial prestressing and axial prestressing. The radial prestressing is obtained by press fitting whereas the axial prestressing is ensured by locking the tool system under high axial loading during tool assembly. The STRECON Axi-Fit Container is offered with the winding core of steel or tungsten carbide, of which the later mentioned tool concept ensures a stiffness of approx. 400 GPa. The tool loadability is 50-100% higher than a normal stress ring. Examples of different axial prestressing design concepts are shown below.

The STRECON Axi-Fit Container is applied to split-die tool designs as well as dies that suffer from horizontal or transverse cracking. The improvement of the die life would be 50% at minimum, but in many cases much higher.

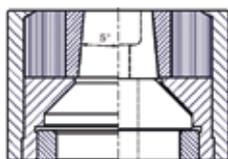
The STRECON Axi-Fit Container can be used for both cold, warm, and hot precision forging applications. The minimum feasible container size is $\varnothing 80 \times \varnothing 30 / H70$ mm. The delivery time will be at minimum 5-6 weeks plus shipment depending on tool design and volume.



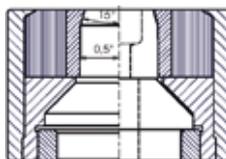
STRECON® AXI-FIT



Cone with an angle of 0.5°
(for axial positioning)



Cone with an angle of 3 to 5°



Double cone with two different angles (only with HSS winding core)

Innovation. Partnership. Performance



STRECON® VARI-FIT CONTAINER

Die Diameter Adjustment by Varying the Interference Fit

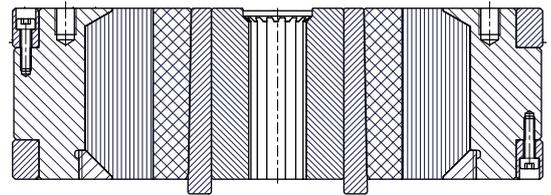
The STRECON Vari-Fit has been developed for facilitating an easy, economical, and fully controlled adjustment of the inner diameter of the die insert. By means of an intermediate sleeve inserted between the die insert itself and the STRECON stripwound container, the inner diameter of the die insert can be adjusted in just a few microns (2-5 μm). This is especially valuable in super net shape applications like spline forming and similar high-tech applications.

The STRECON Vari-Fit tool system offers the following benefits:

- Compensation for tolerances from the die manufacture
- Fine adjustment of the die diameter before production start
- Fine adjustment of the die diameter caused by variations in the billet material from charge to charge
- Compensation from die wear and micro-plastic deformation of the die

The customer obtains improved tool efficiency, formed parts of a very high and consistent quality, and improved service life of the expensive die inserts. The STRECON Vari-Fit Container is mainly developed for cold forging, but is applicable for warm forging applications as well. Both die inserts of steel and tungsten carbide are applicable.

The STRECON Vari-Fit Container is an extension of the STRECON Axi-Fit Container system with the winding core made of tungsten carbide. This provides a tool system with a stiffness of approx. 400 GPa. The STRECON Vari-Fit tool system remains fully elastic even during very high process loads and ensures a long service life and reliable performance. The minimum feasible tool system size is $\text{Ø}120 \times \text{Ø}40 / \text{H}50$ mm. The delivery time will be about 8-10 working weeks plus shipment.



Innovation. Partnership. Performance



STRECON® DYNA-FIT CONTAINER

Dynamic Tool System for Friction-Free Part Ejection

The STRECON Dyna-Fit is a new tool system that builds on the well-proven stripwound container technology. The basic idea of the tool system is to ensure a fully controlled opening and closure of the die insert with the two principal benefits:

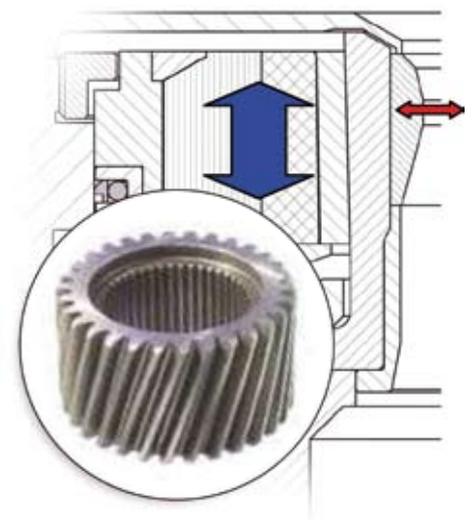
- Friction-free part injection after the forming process, and
- Forming of part with geometries not usually possible in traditional die forming systems, for example parts with small undercuts and bally shape

As the STRECON Dyna-Fit is a further extension of the STRECON Vari-Fit tool system, the following additional tool benefits can be mentioned:

- Compensation for tolerances from die manufacture
- Fine adjustment of the die insert before production start
- Compensation of changes in tool dimensions due to changes in temperature and friction
- Compensation for variations in billet material from charge to charge
- Compensation for wear and micro-plastic deformation of the die insert

The tool system is applicable for high-tech cold forming operations and applicable for both hydraulic, mechanical, and servo press. The opening and closing of the tool system is controlled in the range of 0.3 – 0.7% of the die diameter. The tool adjustment and opening can be integrated into the control board of the press machine.

The STRECON Dyna-Fit is usually based on the high stiffness tool concept ensured by the winding core of the stripwound container made of tungsten carbide. This provides a tool system with a stiffness of approx. 400 GPa. The STRECON Dyna-Fit tool system remains fully elastic even during high process loads and ensures a long service life and reliable performance. The design of the tool system is made to fit the specific requirements of the individual application. The delivery time will be about 15-20 working weeks plus shipment.



Innovation. Partnership. Performance



HOW TO SELECT

Selecting the Proper Prestressing Concept is Key to Tool Performance

The single ring followed by the double ring is today the most commonly used prestressing tool system. However, in many cases these simple prestressing tools would not be sufficient to give the required die support in terms of compressive stress and stiffness. The overall tool performance including extension of the service life of both the die insert and the

prestressing tool itself would benefit significantly from an optimized tool design including the selection of prestressing system and level of interference fit. The figure below provides an overview table of different prestressing tool systems and can serve as guideline for the selection of tool system.

Prestressing of the die insert	Winding core of steel	Winding core of tungsten carbide
<p>Radial prestressing</p>  <p>STRECON® BASIC</p> <p>STRECON® E+</p>	<p>The die is prestressed in radial direction by means of compressive stress distribution on the outside diameter of the die (i.e. reduced tangential stresses in the die).</p> <p>The system is designed for longitudinal die cracks.</p> <p>Tool systems available: Single ring, double ring, STRECON® Basic Container</p>	<p>In addition to radial prestressing, the tool system has a higher stiffness due to the carbide inner ring / winding core. The stiffness reduces the stress-strain behaviour of the die, resulting also in less die deflection during process load.</p> <p>The system is designed for longitudinal die cracks, dies with complex geometry and sharp corners.</p> <p>Tool systems available: STRECON® E+ Container</p>
<p>Radial and axial prestressing</p>  <p>STRECON® AXI-FIT</p>	<p>In addition to the radial prestressing, the die is prestressed in axial direction. In short, a two-directional die support is ensured during tool assembly.</p> <p>The system is designed for transverse and horizontal die cracking, and split-die tool designs.</p> <p>Tool systems available: Single ring and double ring system with axial prestressing feature, STRECON® Axi-Fit Container</p>	<p>In addition to radial and axial prestressing, the tool system has a higher stiffness that reduces the stress-strain behaviour of the die, resulting also in less die deflection during process load.</p> <p>The system is designed for complex die geometry, tool designs suffering from transverse and horizontal die cracking, and split-die tool designs.</p> <p>Tool systems available: STRECON® E+ Axi-Fit Container</p>