HydroPro

SOLUTIONS FOR EXTENDING EXCHANGER LIFE

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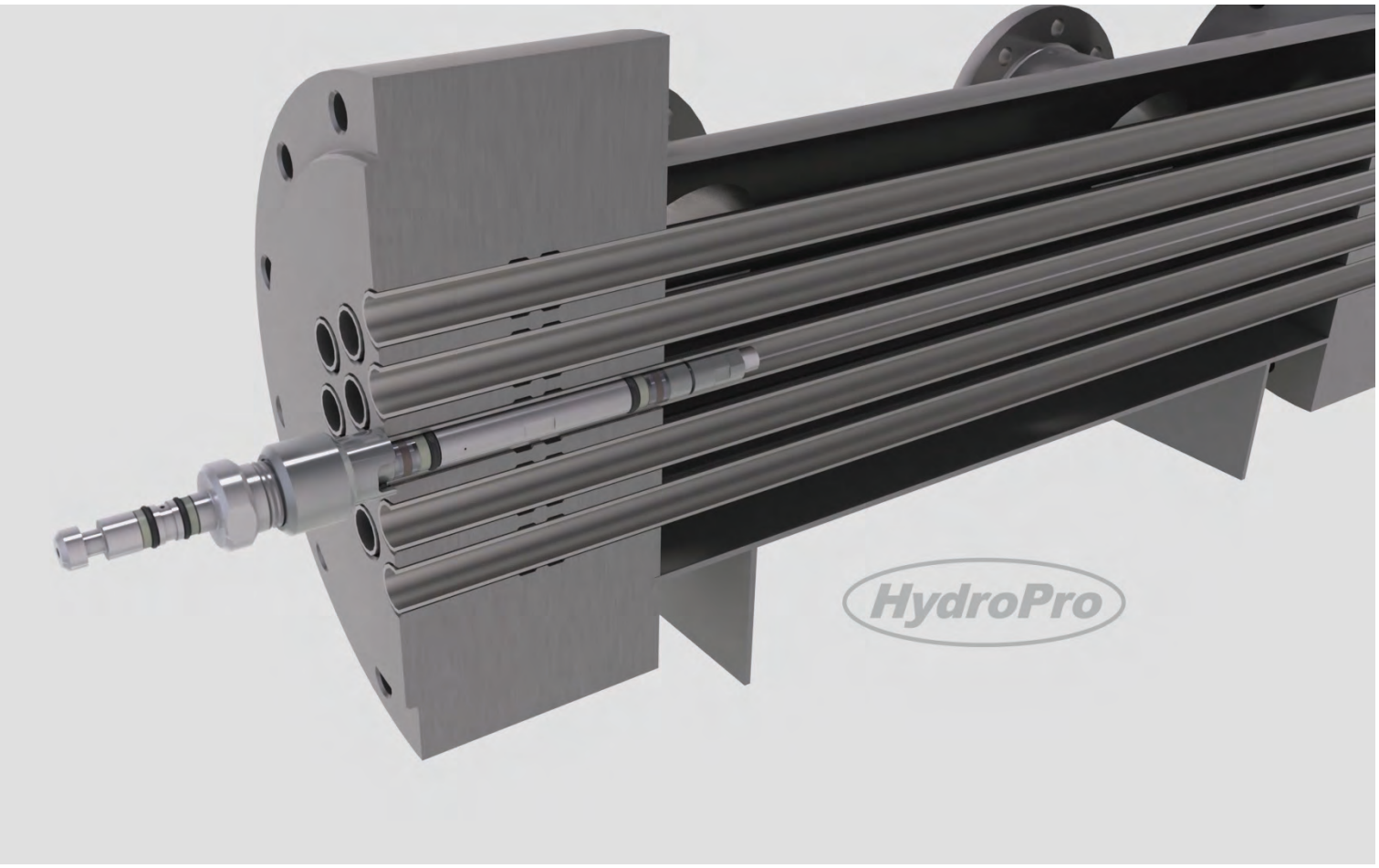

HydroPro Incorporated was founded in 1997 by 3 heat exchanger experts who were looking to apply technological advancements to the field of hydraulic tube expansion. Utilizing their engineering and manufacturing knowledge they completely redesigned and simplified the functionality of both the hydraulic expansion power supply and the tube-to-tubesheet tooling itself. Greatly improving tool life, system accuracy, and repeatability of the process as a whole. These advancements were implemented into equipment and tooling for tube setting, sleeve/ferrule expansion, plugging, and even hydrotesting.

Today HydroPro stands as the world leader in equipment and technology for hydraulic tube expansion. Offering advanced solutions for extending exchanger life from original production, to preventative maintenance and in-place repair options.

Stephen Waldron - Business Development

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HydroPro Tube Expansion Solutions

TUBE SETTING

· WeldLock · TubePro · BoilerPro

HydroPro's tube setting technologies include the TubePro, WeldLock, and BoilerPro systems, each with its own primary function and benefit of use. The TubePro and BoilerPro tooling systems utilize polyurethane expanders to create solid contact between the tube and tubesheet, 100% of the way around the tube's circumference. This level of contact makes them ideal for tube setting in high yield tube applications, u-tubes, or for ensuring proper tube protrusions prior to final expansion. The WeldLock tool system utilizes metal segments which open up and lightly lock the tube into place, leaving gaps for weld gasses to escape. This makes the WeldLock ideal for use prior to joint welding and/or final tube expansion.

Above: TubePro Tool (Left) & WeldLock Tool (Right)

TUBE-TO-TUBESHEET EXPANSION

· HydroPro · Fastool

Above: HydroPro mandrel in a tube-to-tubesheet joint

Hydraulic tube-to-tubesheet joint expansion technology has seen many major advancements over the years. Unfortunately, most manufacturers only seem to update their power supplies, by adding "bells and whistles" such as touchscreens and inflated capabilities, like ultra-high pressure capability that in practicality will never actually be used.

HydroPro has been at the forefront of where the technology counts, with quality tooling actually capable of sustained and repeatable results at pressures no other system can achieve. We focus on the features that matter like system accuracy, simple operation and ease of maintenance, along with a unique tool design capable of ultra-high pressures and extended parts life, ensuring the HydroPro system is the most advanced method of tube expansion available anywhere in the world.

Maintenance & Repair Solutions

HydroPro

HYDRO-TESTING · HydroProof

The HydroProof system is an innovative solution allowing a true hydro-test to be performed on an individual tube, or an individual tube-to-tubesheet joint, at up to 2,000 psi. The test fixtures can be made for virtually any tube size and the power supply is designed to fit into manways and tight spaces utilizing a hand pump for ultimate portability.

FERRULE / SLEEVE / LINER EXPANSION · SleevePro

The SleevePro system allows for ultimate pressure control over the hydraulic expansion process, making it possible to expand thin tubes (sleeves / liners) into existing tubes. This can be for preventative measures against erosion and corrosion, or to repair a damaged tube and keep it in service. Rather than plugging a substantial number of tubes during a shut down, sleeves or liners allow your tubes to remain in service. The SleevePro is also used for tube-to-fin applications, where greater pressure control is required.

PLUGGING · HydroPlug

HydroPlugs are the most advanced method of plugging a tube available anywhere. By utilizing the same concepts used in hydraulic tube-to-tubesheet expansion, offering the ability to combine virtually any material and size combination, customizable plug length, and allowing for installation down-tube set the HydroPlug apart from all other plugging options on the market. Our technology is trusted in chemical plants, gas processing facilities, nuclear power generation, and by the US Navy for their plugging needs.

Technical References

GROOVE WIDTH

According to TEMA's *Standard of The Tubular Exchanger Manufacturers Association*, Section RB/C 7.44 states that "When utilizing hydraulic expansion, grooves shall be 1/4" (6.4mm) wide.".

The rest of the section relates to traditionally rolled joints, stating the depth of 1/64" (0.4mm) and width of 1/8" (3.2mm), and also calls for two grooves on any tubes larger than 5/8 (15.9mm) OD and a tubesheet thickness more than 1" (under 1" only requires a single groove according to the section).

It can therefore be assumed that anytime that hydraulic expansion is utilized these same parameters must be met, with the exception that a 1/4" wide groove should be used in place of the 1/8". However, according to Stanley Yokell's *Appropriate Correlations for Assessing Expanded Tube-to-Tubesheet Joint Strength*, optimal groove width should be calculated using the formula $W = 1.56\sqrt{Rt}$, where R is the tube's radius, t is the tube wall thickness, and W is the optimal groove width.

TUBE WALL REDUCTION

Typical tube wall reduction does not apply to hydraulic expansion, the reason being that tube wall reduction calculations were originally developed as a way to determine whether mechanical rollers were performing an adequate expansion without the need to measure and log every tube and hole dimension. As rollers do not uniformly expand tubes (due to their limited number of contact points), this was the best method for determining the expansions success as an overall result. The concept is that the rollers will extrude (remove) material from the expansion area, so it is assumed that once the tube has been adequately expanded to contact, the material will begin to extrude and thus wall thinning occurs. This does not take into account any variations in tube hole size, tube wall thickness, or hole shape. Instead wall reduction measurements can only take into consideration the supplied dimensions and the result following any effect the tool has at its maximum OD and shape.

Hydraulic expansion on the other hand is a form of uniform expansion, with water being the expansion medium. Therefore, the OD of the expansion tool has no bearing on the end result, instead the ID of the resistance force and the tube wall thickness will determine the end result of an expansion. Due to the industry's understanding of "wall reduction" we have modified the calculations to look for "apparent wall reduction" or "wall compression" in an effort to validate expansion results, without the need to measure and log each individual hole, tube, etc. This uses essentially the same calculations as wall reduction, with the understanding that the end result will not be as drastic. Where traditional expansion may have a goal of 1-3% as a light expansion, or 3-6% as a hard expansion, hydraulic expansion will only result in roughly 1/2 this figure to achieve the same results. This is because hydraulic expansion does not extrude the material out of the expansion zone, it instead opens the tube to intimate contact regardless of the hole size or shape, then compresses it slightly before achieving optimal expansion. Hydraulic expansion results in far less work hardening of the tube material, and reduces stress between expanded and unexpanded regions of the tube.

Technical References

SUGGESTED TECHNICAL PAPERS - All are available for download at *www.hpro.com*

- Appropriate Correlations for Assessing Expanded Tube-to-Tubesheet Joint Strength
  By Stanley Yokell
- Hydraulically Expanded Tube-to-Tubesheet Joints
  By D.A. Scott, G.A. Wolgemuth, & J.A. Aikin
- Residual Stresses in Transition Zones of Heat Exchanger Tubes
  By D.P Updike, A. Kalnins, & S.M. Caldwell
- Selecting Reliable Heat Exchanger Tube Materials - Factors to Consider
  By Daniel S. Janikowski
- Tubesheet Groove Design
  By HydroPro
- Hydraulic Expansion Groove Formula
  By Stanley Yokell
- Expanded, and Welded-and-Expanded Tube-to-Tubesheet Joints
  By Stanley Yokell
- Elastic-Plastic Analysis of Tube Expansion in Tubesheets
  By B. Kasraie, J.S. Porowski, W.J. O'Donnell, & A. Selz

ADDITIONAL RESOURCES - Available upon Request

- Application Data Sheets - Available on *www.hpro.com*
- Pressure Drop Calculations with Short Sleeves
- Pressure Drop Calculations with Full Length Liners
- Thermal Effects of Sleeving Feedwater Heaters
- Flow Bypass and Hole Sizing Calculations
- Baffle Expansion using HydroPro Technology
- Transfer Line Exchanger Sleeving

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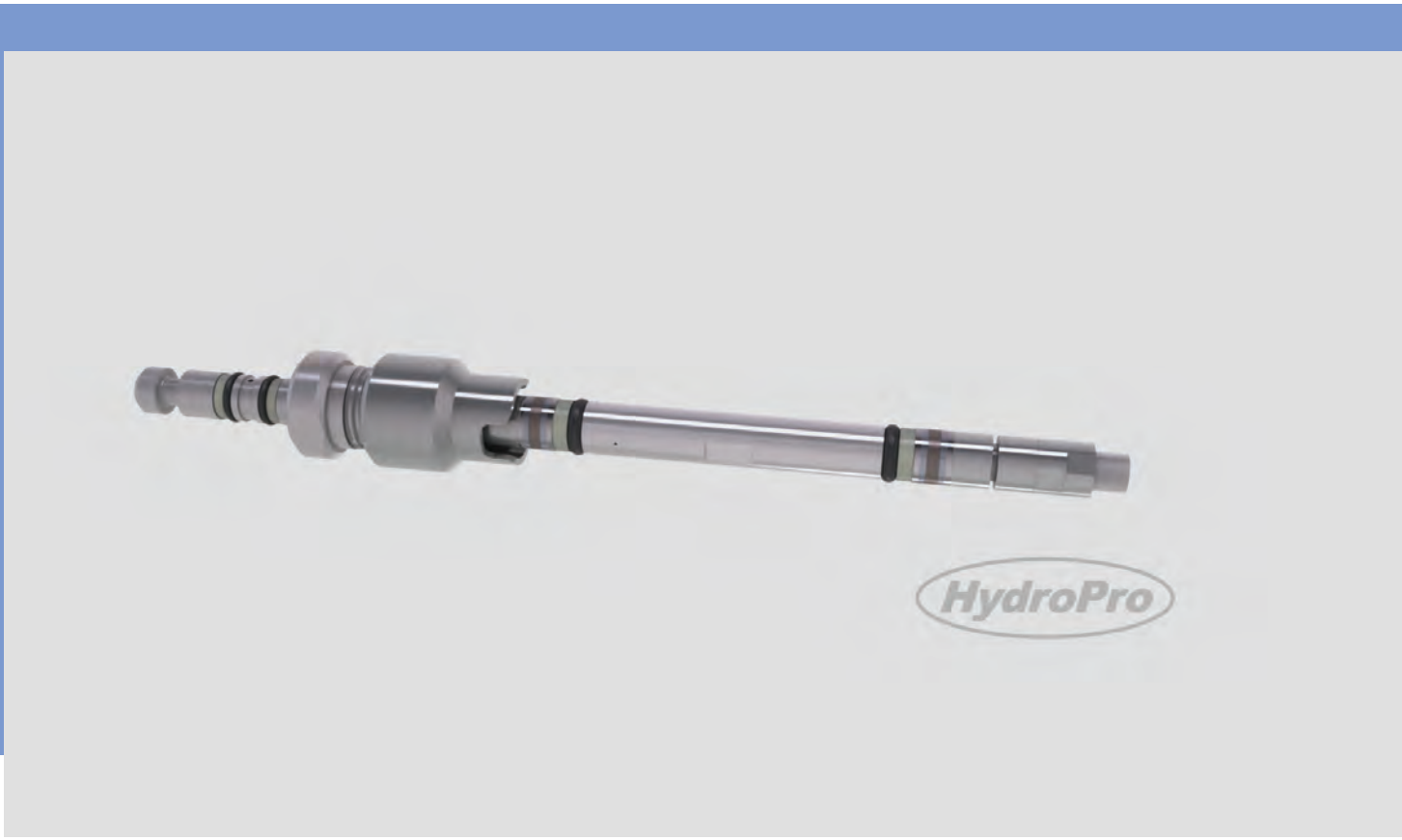

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