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HydroPro inc

World Leaders in Equipment and Technology for Hydraulic Tube Expansion

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Comparisons between Hydraulic Expansion & Mechanical Rolling

COMPARISON	MECHANICAL ROLLING	HYDRAULIC EXPANSION
Expansion Medium (primary expansion component)	**Rotating Metal Pieces** (typically called "pills" or "rolls")	**Water under Pressure** (deionized or distilled water)
Type of Expansion	**Metal-to-Metal Pressure** Typically 3 or 5 points of contact from rotating sections of metal. These metal components have a very strict range, and will not allow a tube to conform to a hole that isn't round. Instead, it will expand each tube until the tool's given range of allowed expansion is exhausted, regardless of whether or not the tube has made intimate contact throughout the expansion area. This will cause unknown gaps between the tube and tubesheet in out-of-round holes, large holes, or holes that are cone shaped.	**Uniform Tube Expansion** Imagine a tool with an infinite number of contact points, all pushing the tube outward at the same time. "Uniform" pressure expands the tube into intimate contact with the tube hole, even if the hole isn't round. Because expansion is driven by pressure, not a given maximum measurement, the process will allow a tube to expand to absolute contact with a hole that is larger than anticipated or one that is non-cylindrical.
Wall Reduction?	**Yes** Mechanical rolling reduces a tube's wall thickness through extrusion. The process forces tube material axially out of the expansion zone, while simultaneously stretching the tube radially. This literally reduces the amount of material making up the tube wall , thereby resulting in common "Wall Reduction"	**No** **(well… not technically)** Hydraulic Expansion does not remove tube material from the expansion area, therefore it doesn't "reduce" the tube wall in the same sense as rolling. It instead expands the tube radially without stretching it longitudinally, thereby compressing the tube's wall into intimate contact with the tubesheet until it achieves the desired "Apparent" Wall Reduction, also sometimes called "Wall Compression". The resulting interfacial fit provides the optimal tube-to-tubesheet joint.

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Grooved Tubesheet Holes	**Extrusion** Mechanical rolling extrudes the tube material into the groove, further removing material from the tube wall in order to force it into the groove. This creates a weak point in the tube where the wall thickness is now substantially thinner than before.	**Metal Flow** Hydraulic expansion is a form of "hydro-forming". This is a process using high pressure water to form something. In this case, the tube-to-tubesheet joint. When tubesheet groove(s) are present the tube will "flow" into the groove creating additional tightness where the groove edges meet the tube. It also offers a visible indication of expansion when viewed from the tube ID.
Work Hardening	**Significant** Metallurgically speaking, Mechanical Expansion is a relatively slow process. This is because the expansion occurs as metal components are pressing outward at very specific points of contact inside the tube. These parts are rotating while pushing the material outward a little each time the tool rotates. This results in significant work hardening due to the constant applied then unapplied forces used in a single step of rolling.	**Minimal** While any physical change imparted on metal, whether it be mechanical or other, will cause some work hardening to occur, Hydraulic Expansion produces minimal work hardening due to its inherent nature. The water applies equal pressure throughout the tube surface and alters the material very quickly, resulting in minimal work hardening. This makes it the ideal method of expansion for exotic materials such as Titanium, Duplex, Inconel, etc.
Stress Corrosion Cracking Stress Corrosion Cracking is most commonly experienced in tubes that have been subjected to drastic differences in stress levels from one area to another	**The most Common Reason for Stress Corrosion** As a rather harsh method of tube expansion, Mechanical Rolling is the leading cause of tube end stresses. This is largely due to the drastic transition between the unexpanded and expanded portions of the tube, which is caused by reducing the tube's original wall thickness, work hardening of the material, and changing its molecular structure.	**The answer to Stress Corrosion** As a method of uniform expansion offering minimal work hardening, no extrusion, and little change to the original wall thickness; Hydraulic Expansion creates a smooth transition from expanded to unexpanded area. This drastically reduces the amount of stress on the tube, as well as the possibility of stress induced failures.

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Rotational Force	**Unfortunately** Mechanical rollers expand tube by rotating. This force is held by the operator during expansion. If the roller stalls or seizes, the motor may spin out of the operator's control and strike him/her, causing injury.	**None** Hydraulic expansion produces no rotational forces, instead requires little-to-no effort on the part of the operator during expansion. This helps to alleviate issues involving operator fatigue.
Step Rolling	**Unfortunately** Mechanical rollers are limited to around a maximum of 2" expansion zone per pass. This means that for something as common as a 3-1/2" thick tubesheet, rolling will require two steps per tube. For a unit with 3,000 tube ends, that translates to 6,000 expansions, vs. only 3,000 when using hydraulic expansion.	**No Need** Hydraulic expansion technology allows for tube-to-tubesheet expansion in a single step, regardless of tubesheet thickness. Feedwater heaters can have tubesheets in excess of 24" thick, hydraulic expansion is still only a single step for full depth expansion.
Accuracy & Repeatability	**Marginal** Mechanical rolling accuracy is largely dependent on operator experience, fatigue, and care in addition to other extraneous variables such as coefficients of friction. This results in varying expansion results across a single exchanger.	**Precise** Accuracy of Hydraulic Expansion is controlled in the system itself, regardless of the operator or their experience. The system will apply additional water volume as necessary to achieve the desired pre-set expansion pressure. This results in extremely repeatable results across an entire exchanger.

As you can see, Hydraulic Expansion is a method of uniform tube expansion which can repeatedly expand tube-to-tubesheet joints accurately and with minimal change to the original tube. This is very different from Mechanical Rolling which cannot apply uniform pressure during expansion and causes significant changes to the tubes molecular structure, regardless of drive motor, number of "pills", brand, or operator.