

# 5MM COTUBE/ALFIN COILS (PRODUCTION LINE AND PROCESS)

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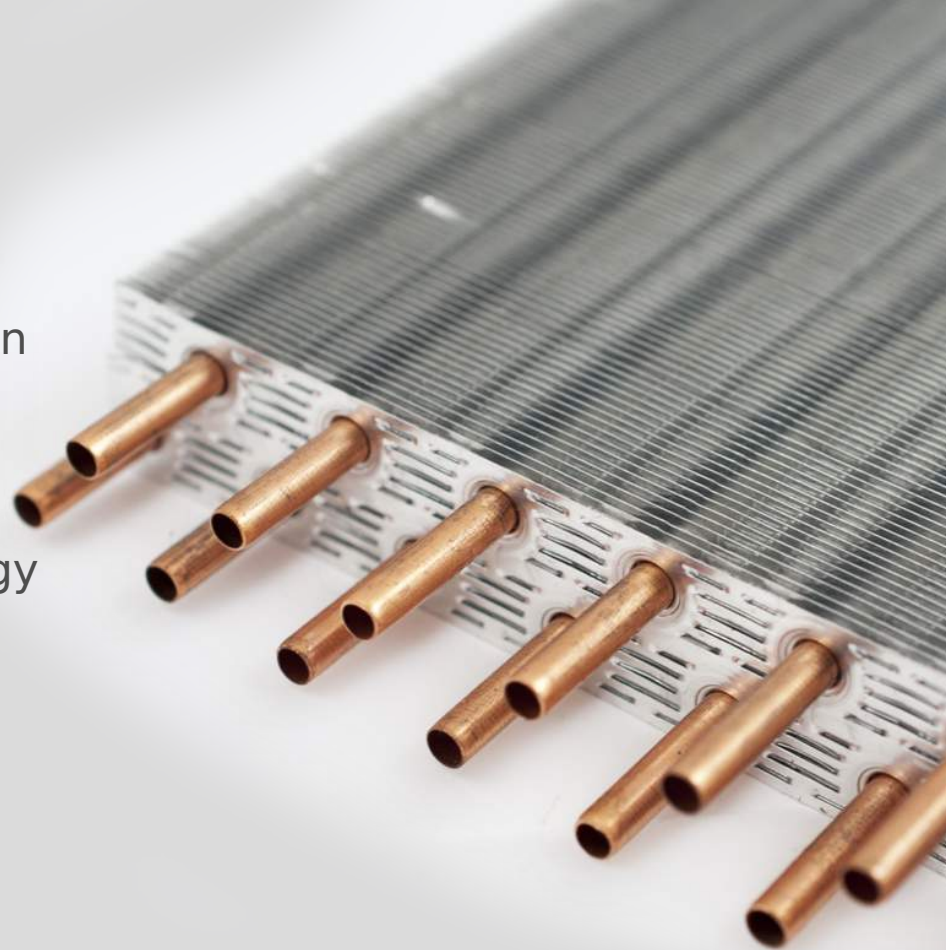
# Why go to 5mm Coils?

Economic Drivers

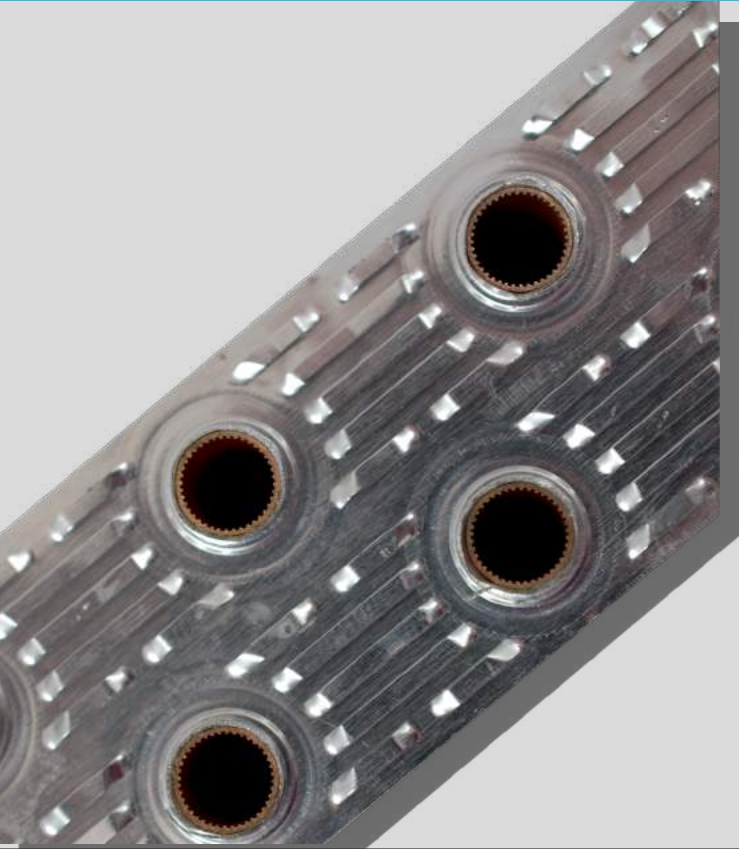
Regulation Drivers

Technology Drivers

Coil Design Factors



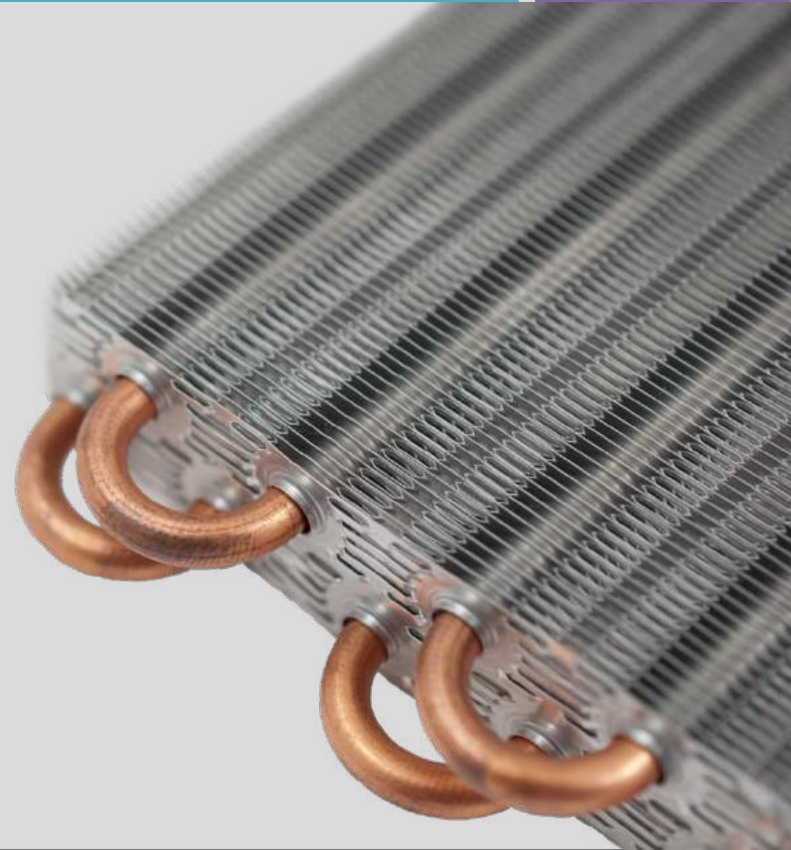
# ECONOMIC DRIVERS



- Lower capital investment vs. micro-channel
- Current coil manufacturing processes are proven and economical
- Durable/reliable
- Lower material / Manufacturing costs
- Energy efficient
- Less Refrigerant
- Field technicians are familiar with this type of coil

# REGULATION DRIVERS

- Regulatory changes in refrigerants
- Copper's metallurgic properties allow high system pressures.
- Regulated improvement in system efficiencies  
(Star Rating Requirements)

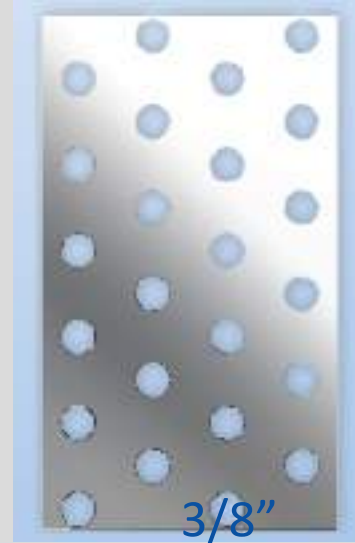


# TECHNOLOGY DRIVERS

- Reduced or no refrigeration distribution issues
- More flexibility of coil/circuit design
- More surface area / volume of coil
- As tube diameters get smaller there is a surface gain in relation to the amount of refrigerant in the tube.
- Smaller diameter tubes can hold the same operating pressures as larger diameter coils with thinner tube wall

# COIL DESIGN FACTORS

- Reduction in distance between tubes
- More fins per inch
- Less Volume of Coil with Increased surface Area
- Better Heat Transfer





# How to manufacture 5mm (micro-groove) Coils



Fin Production




Hairpin  
Bending



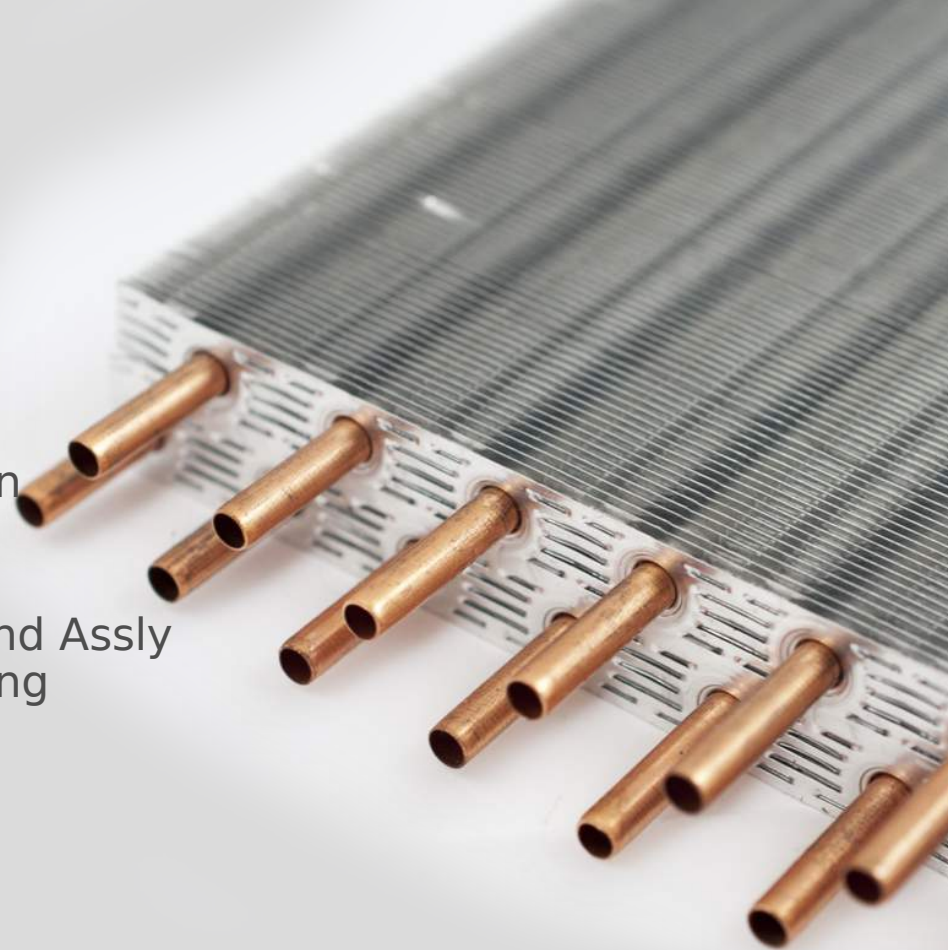
Expansion



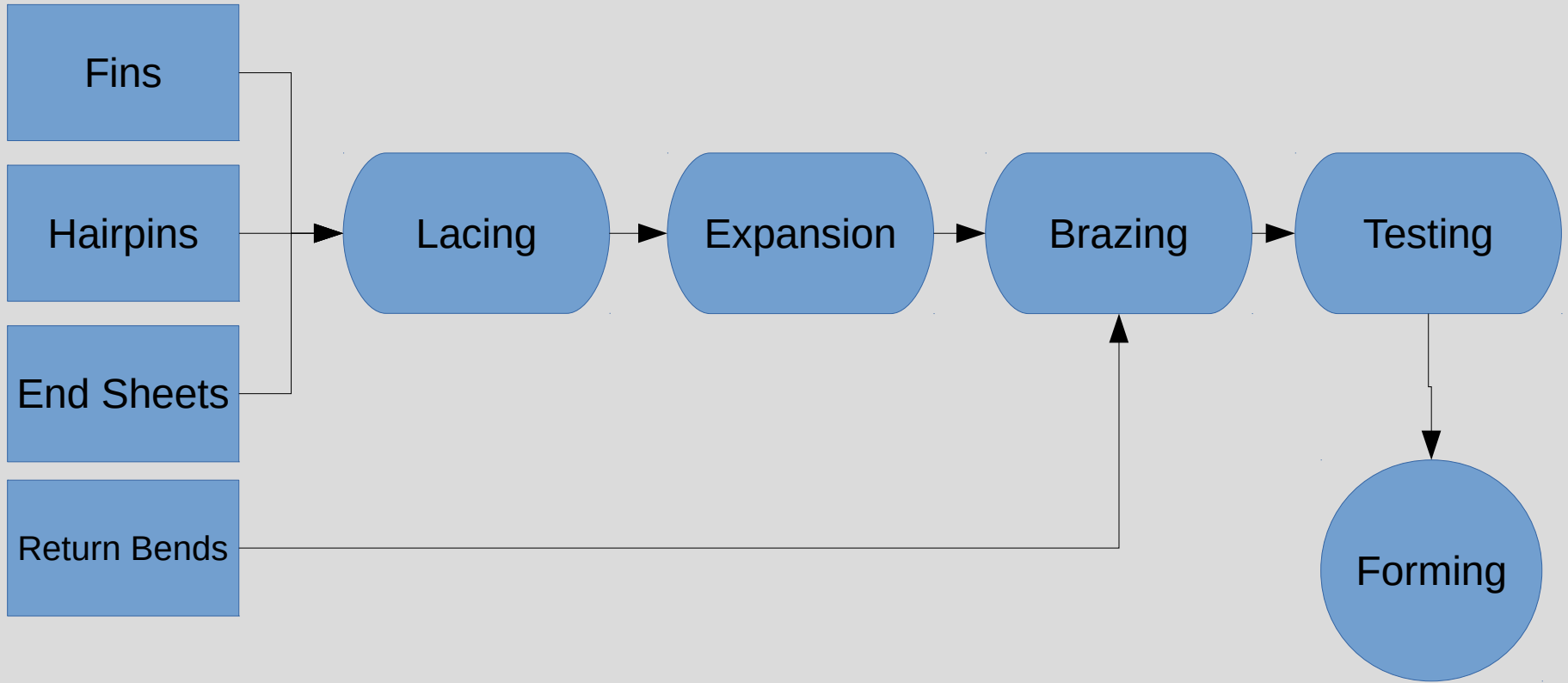
Return Bend Assly  
and Brazing



Testing and  
Forming

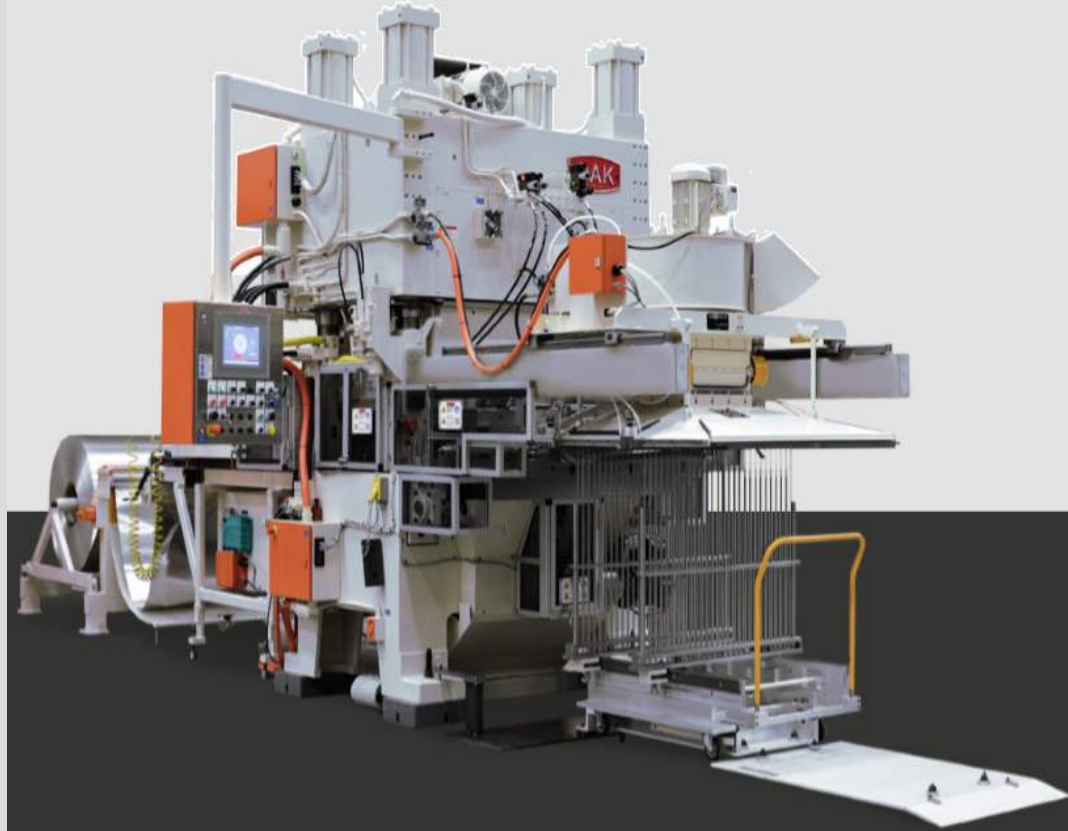


# COIL MANUFACTURING PROCESS





# FIN PRODUCTION MACHINES



## FIN LINE:

- FIN PRESS
- STACKER
- UNCOILER
- FIN DIE

# FIN PRODUCTION CHALLENGES

- More holes / unit area ... denser pattern .. more work for die
- Feeding Issues
- Die design, complicated louvers and profiles
- Stacking issues
- Restriking issues when progression changes
- High tonnage press requirements

# OAK SOLUTIONS – FP1000/1400 FINPRESS

- FP-1000/1400 Fin Line
- Reduced floor space
- Reduced capital costs
- HD stacker
- Servo Feed



# OAK SOLUTIONS – REMOTE FEED AND CUT OFF



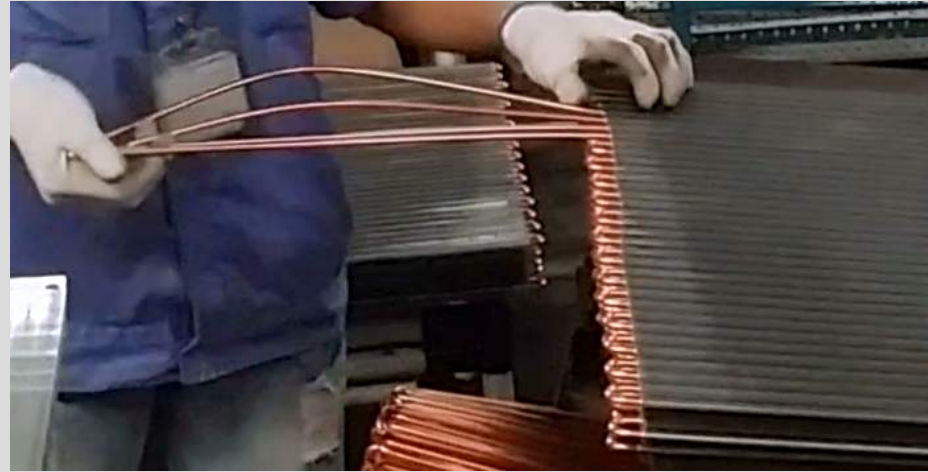
- Improved Stacking
- Higher speeds
- Elimination of progression changer from most dies
- Press vibrations are isolated
- Better quality fin

# HAIRPIN PRODUCTION MACHINE



# HAIRPIN PRODUCTION AND LACING CHALLENGES

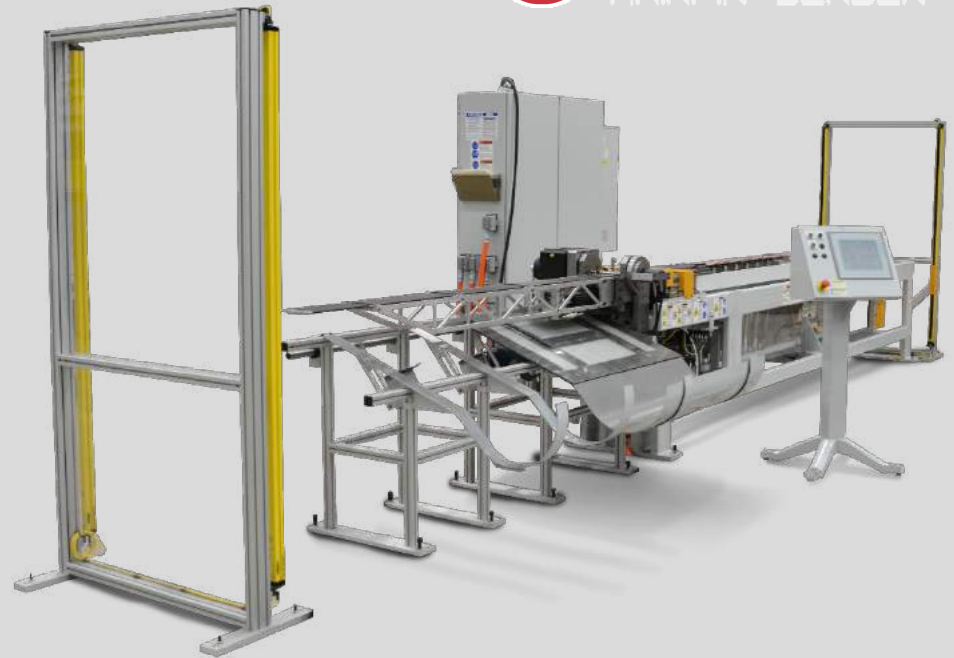
- Feeding of tube through rollers, belts and guide tubes
- Peg leg problems
- More tubes needed per coil
- Potential bulging while lacing the coil due to hairpin straightness



# OAK SOLUTION - TRIUMPH BENDER

TRIUMPH  
HAIRPIN BENDER

- Designed specifically for small tube
- 70% increase in productivity
- More tubes/cycle, reduced changeover time, faster speeds
- Reduced floor space
- Reduced capital costs
- Improved quality
- **Stretch Straightening**



# EXPANSIONMACHINE

MECHANICAL  
EXPANDER



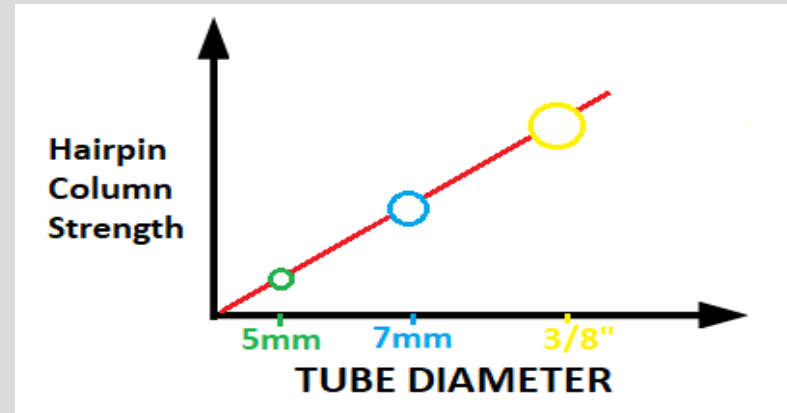
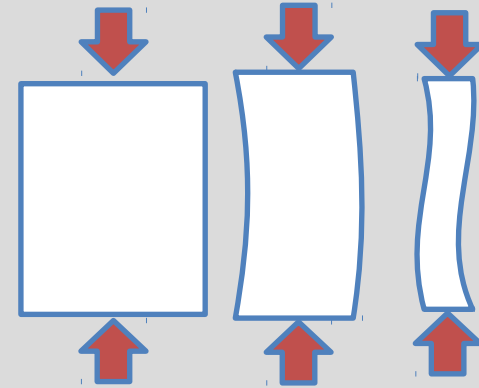
PRESSURE EXPANDER





# EXPANSION CHALLENGES

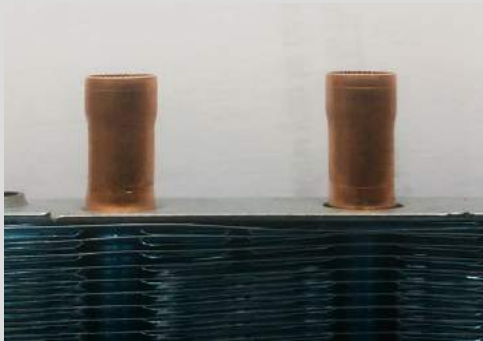
- Increase in the force required to expand as hoop strength of tube increases
- Hairpin's column strength decreases with Diameter
- Coil can easily bend



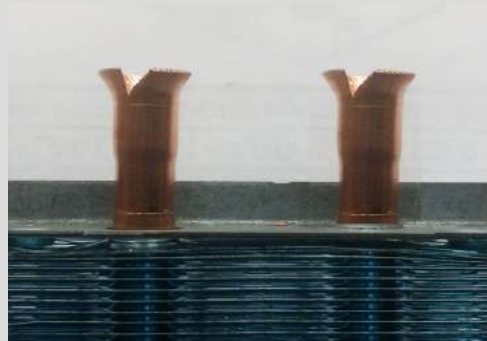
# EXPANSION CHALLENGES

- Flaring Issues

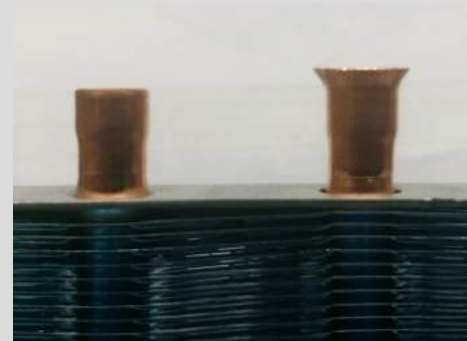
Too Short = No Flare



Too Long = Splits



Peg Leg = Splits & No Flare



# OAK SOLUTION – PHOENIX PRESSURE EXPANDER

- No vertical forces on the tube – zero shrink
- No peg leg issues when combined with OAK Triumph Hairpin Bender
- No derogation of internal groove of the tube
- Potential advancements of internal grooves
- Innovative Bell and Flare

PHOENIX  
EXPANSION REBORN



# OAK SOLUTION – MECHANICAL EXPANDER

- Auto Height Control
- Auto Rod Storage
- Automatic Back plates
- Extra guide plates for 5mm
- Shrinkage synchronized back plates
- Rod Short out
- Tube entry guide



## Straight Tube Cutoff



# RETURN BEND PRODUCTION



**RECB**

**Return Bend Cleaning Unit**



## Coil Form Machine

