



Business Case for
Natural Refrigerants

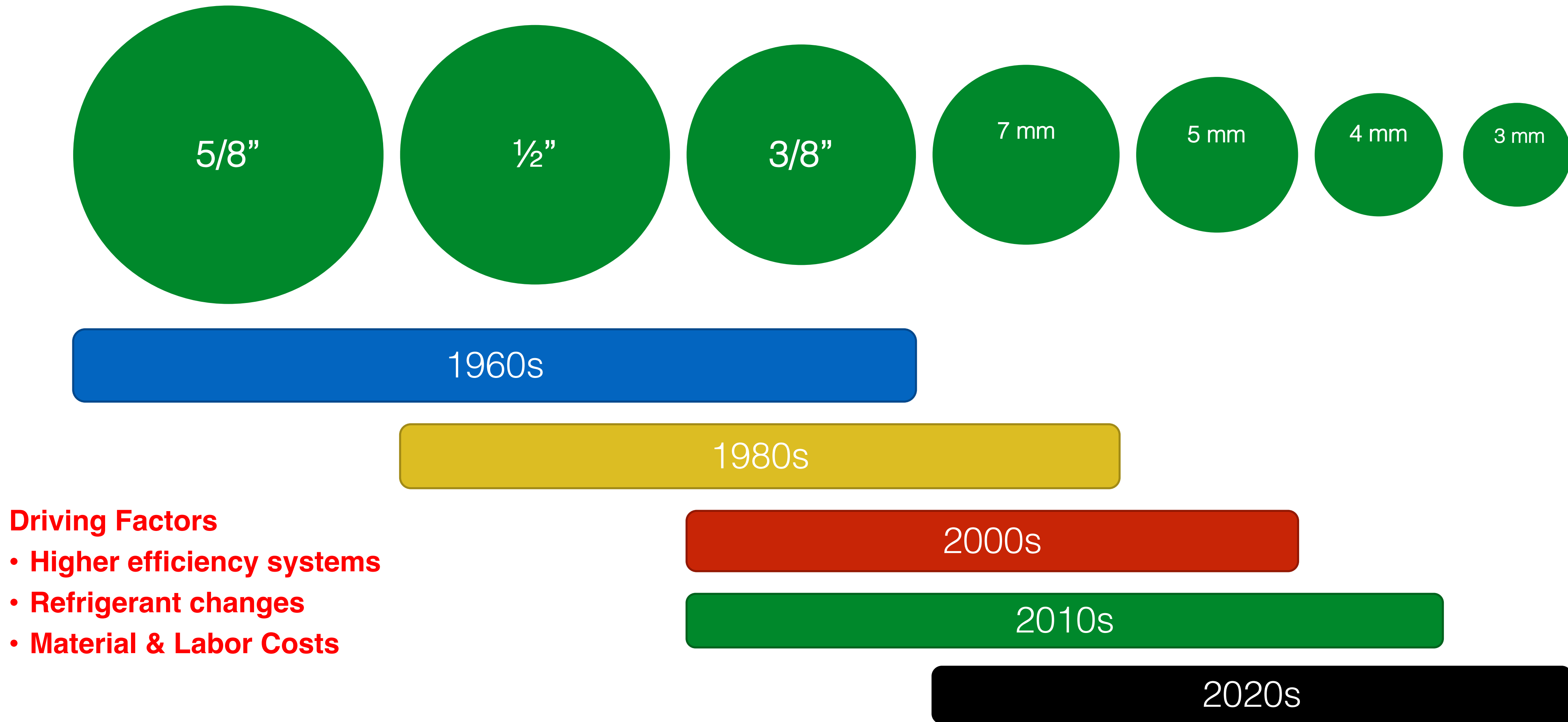
June 12-14, 2018 – Long Beach

Performance Testing of MicroGroove Heat Exchangers with Natural Refrigerants

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- 1. MicroGroove and reduced refrigerant charge.**
2. Early performance data on MicroGroove tubes
3. Success in AC arena with MicroGroove
- 4. MTL Technologies**
 - a. History
 - b. Prototype R290 heat exchangers
 - c. Recent performance data
 - d. MTL Technologies current production
5. Global Trends

MicroGroove and reduced refrigerant charge.

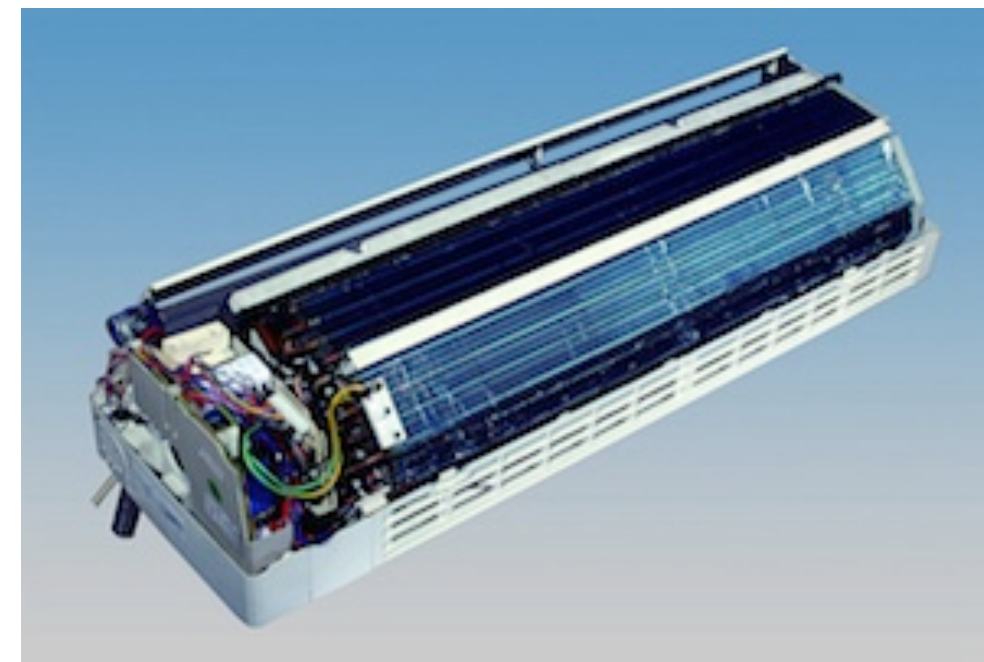


MicroGroove and reduced refrigerant charge.

Reduce the tube diameter and increase tube length:
Same performance with less refrigerant.

	Hold L Constant	Hold Performance Constant	Hold SA Constant	Hold V Constant
Tube Diameter	↓	↓	↓	↓
Total Tube Length	constant	↑	↑	↑ ↑
Surface Area	↓ ↓	↓	constant	↑
Volume	↓ ↓	↓ ↓	↓	constant
Weight	↓ ↓	↓	constant	↑
HTC	↑	↑	↑	↑
Performance	↓	constant	↑ ↑	↑ ↑ ↑

Early Performance Data on MicroGroove

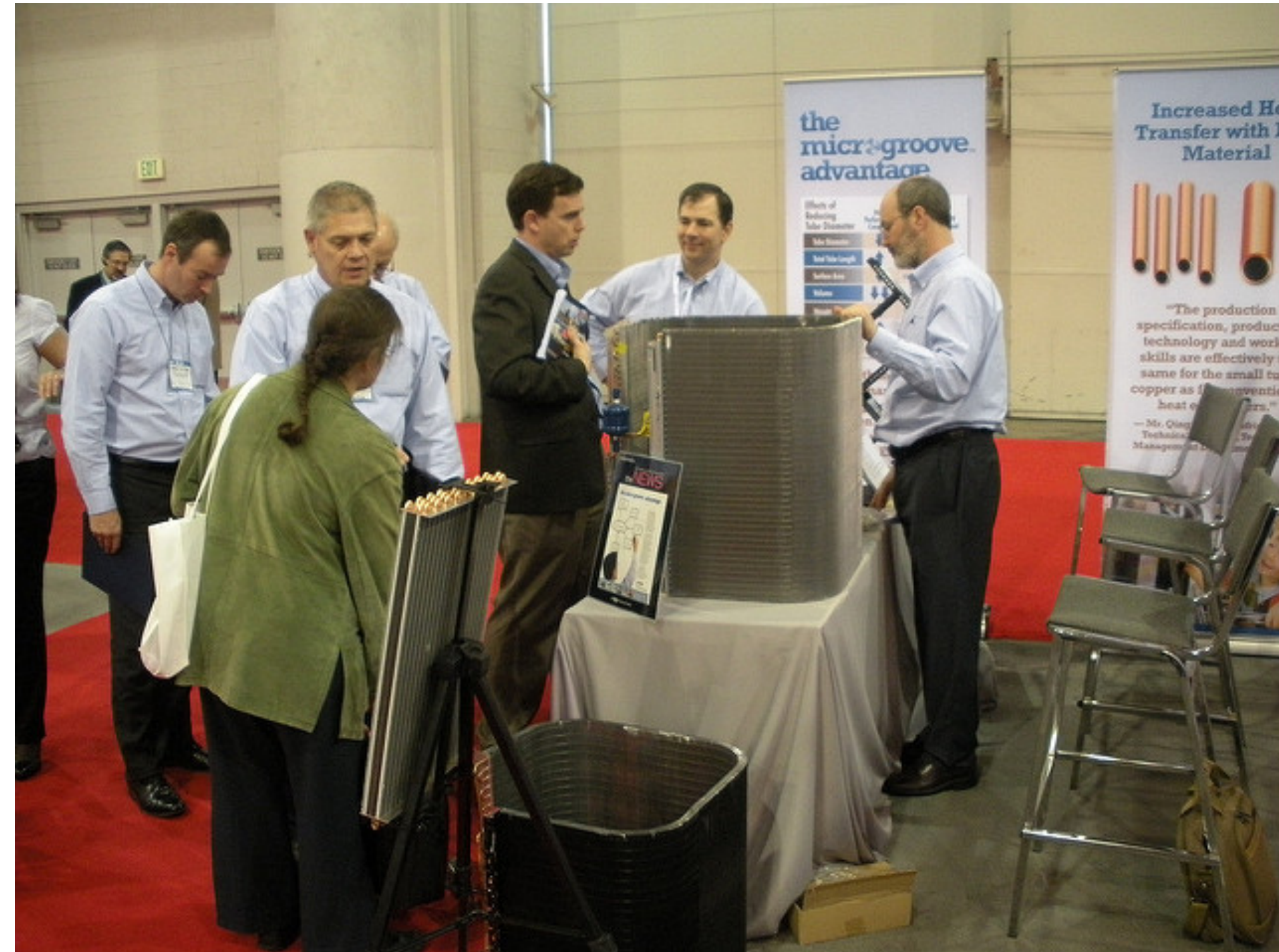


Five millimeter outer-diameter (5 mm O.D.) copper tube technology used in China since before 2010 for high volume AC applications.

Evaporator made from 5-mm copper. (Courtesy Kelon.)

Early performance data on MicroGroove tubes

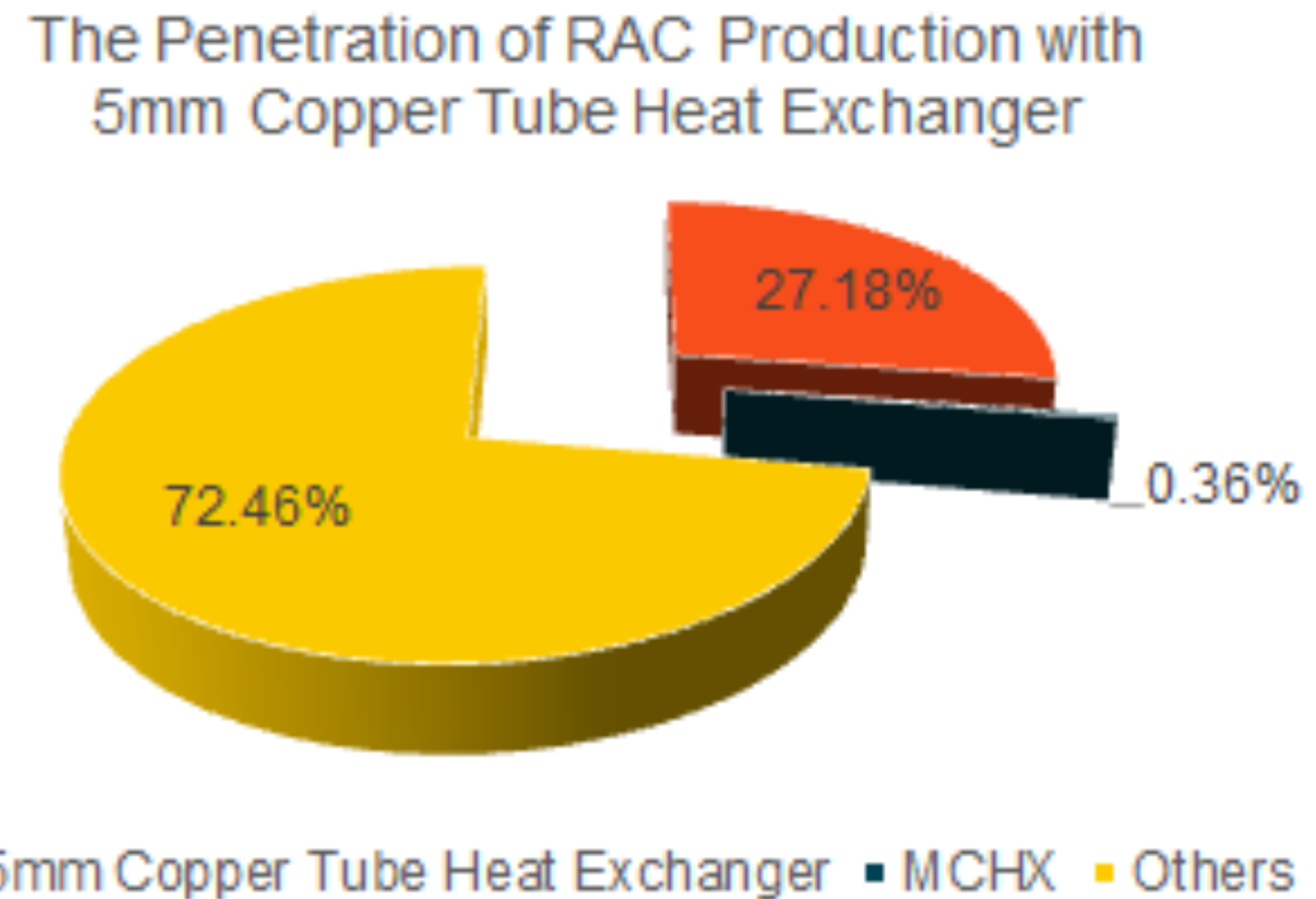
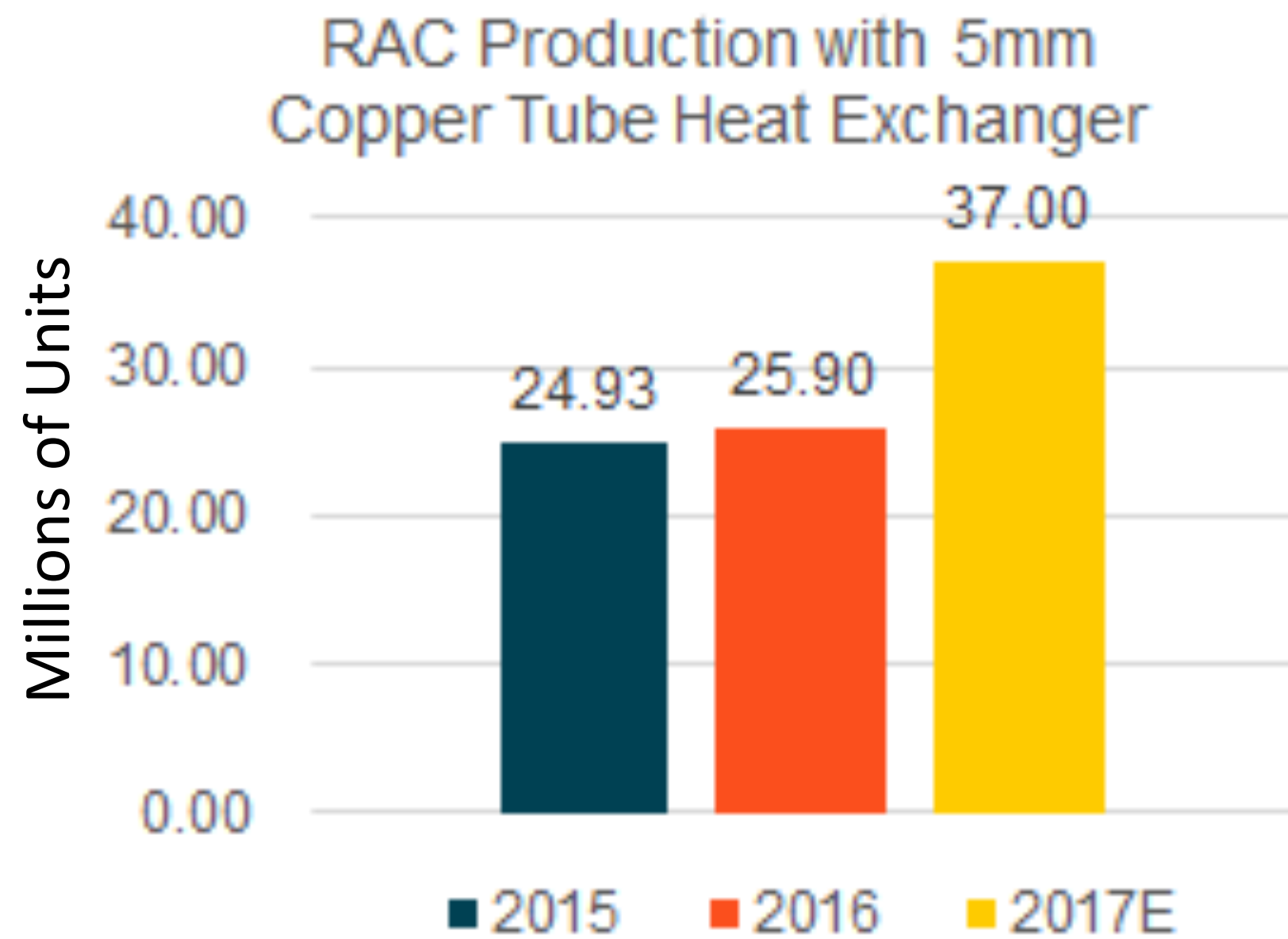
MicroGroove Debuted at the AHR Expo in 2011



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Success in AC arena with MicroGroove



Of the 136 million RAC units made in 2017, 37 million were made with 5-mm smaller diameter copper-tubes. (Source: Brilliant Consulting.)

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MTL Technologies history

Noticed two trends in the refrigeration:

1. Progression to smaller-diameter tubes
2. Use of low-GWP natural refrigerants

Applying their know-how in process cooling systems, MTL Engineers designed a whole new line of light commercial refrigeration systems using R290.

Freshpet® was among its first customers.

Super Radiator Coils provides prototype heat exchanger designs.



MTL Technologies history

Manufacturing Production Line Opened in 2017

Punch



Insulate



Paint



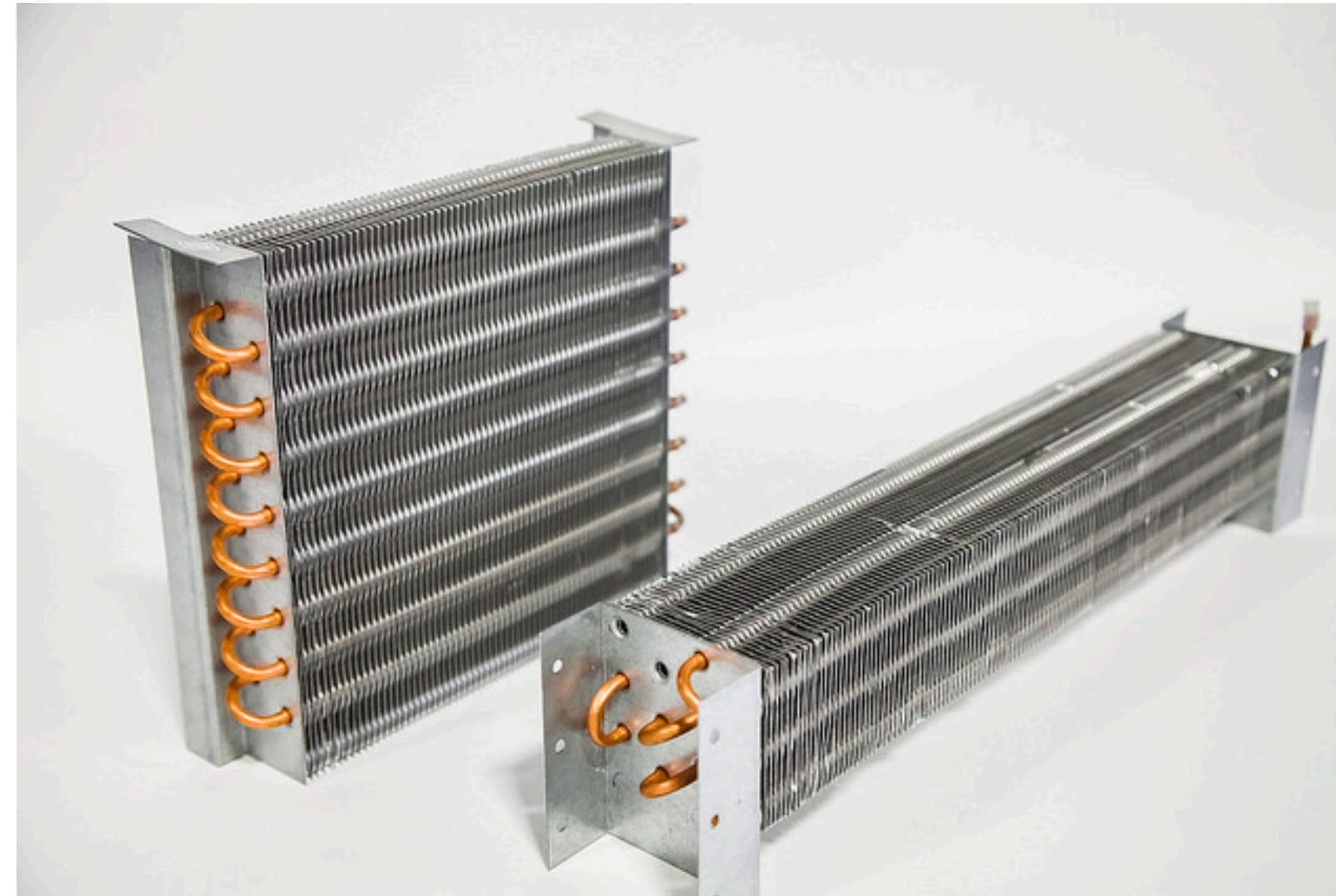
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Prototype MTL Heat Exchangers

Typical heat exchanger coils using smaller diameter copper

Evaporator



Condenser

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MTL Technologies Recent Performance Data



VISTA DOUBLE-DOOR DISPLAY CABINET 115V

CAPACITY: 750 L (26.5 CU FT)

- Type 1 Refrigerator. Ambient conditions 75°F/55% RH
- AMPERAGE:
 - R134a – 10.50A
 - R290a – 6.09A.....**42% reduction**
 - ✓ 5mm MicroGroove evaporator tubing
 - ✓ 5mm MicroGroove condenser tubing
 - ✓ ECM fan motors on both evaporator and condenser
 - ✓ LED lighting
- Refrigerant charge reduction.....**38%**
- Product Pulldown from 75°F to 38°F, improved by..... 9%

MTL Technologies

Recent Performance Data



LP-300 SINGLE DOOR DISPLAY CABINET 115V

CAPACITY: 300 L (10.6 CU FT)

- Type 1 Refrigerator. Ambient conditions 75°F/55% RH
- AMPERAGE:
 - R134a – 3.60A
 - R290a – 1.90A.....**47% reduction**
 - ✓ 5mm MicroGroove evaporator tubing
 - ✓ 5mm MicroGroove condenser tubing
 - ✓ ECM fan motors on both evaporator and condenser
 - ✓ LED lighting
- Refrigerant charge reduction.....**43%**
- Product Pulldown from 75°F to 38°F, improved by..... 8%

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MTL Current Production

Typical MTL Products



MTL Sample Production



LPC series,
R290



Alpine Series,
R290



Aspen Series,
R600

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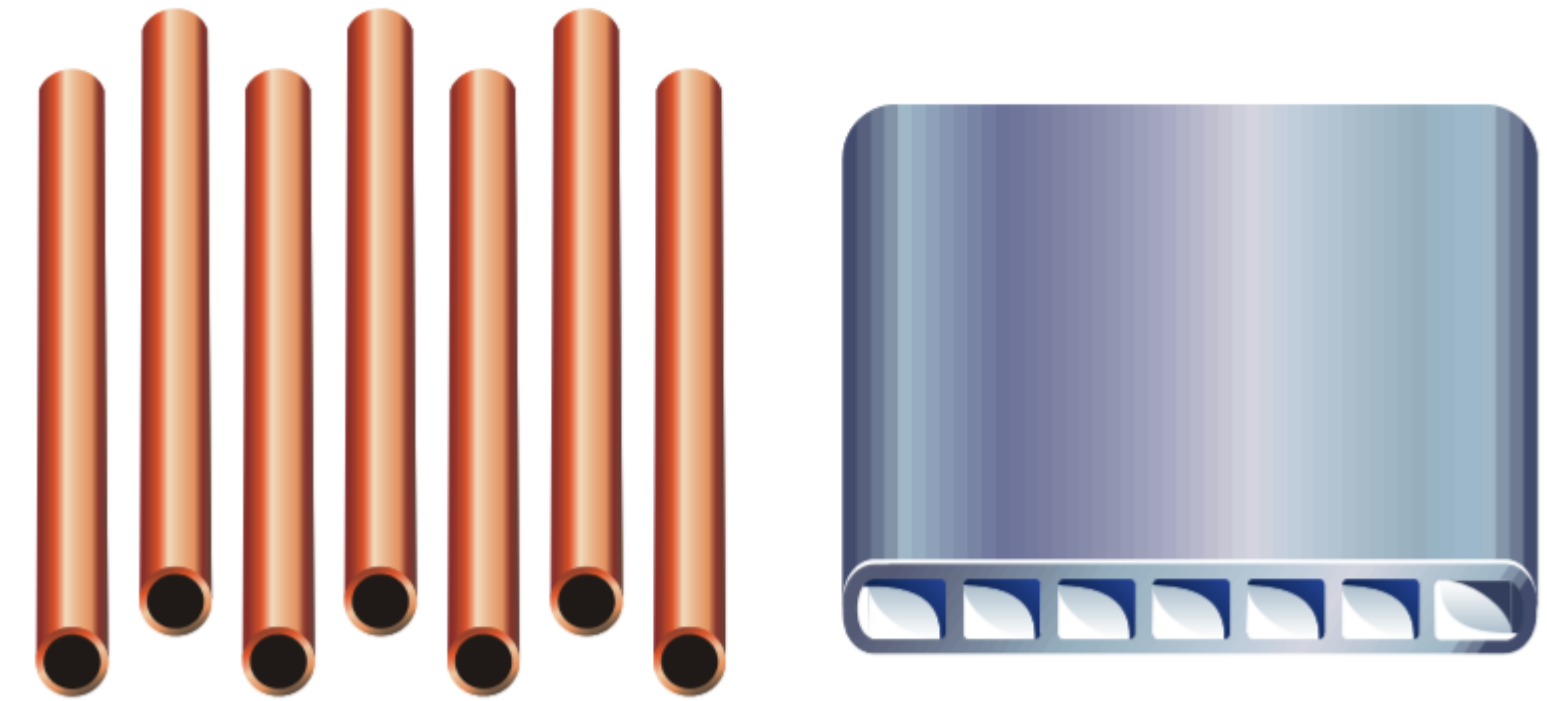
MicroGroove versus MicroChannel:

Stefano Filippini, Umberto Merlo, New Finned Heat Exchanger Development with Low Refrigerant Charge, ICR 2011, August 21 - 26 - Prague, Czech Republic, Paper 296.

Hipchen, J.C.; Weed, R.D.; Zhang, M., & Nasuta, D. (2012). Simulation-Based Comparison of Optimized AC Coils Using Small Diameter Copper and Aluminum Micro-Channel Tubes. *International Refrigeration and Air Conditioning Conference*.

Lu-Ve MINICHANNEL[®] heat exchanger

“The extraordinarily efficient performance of the heat exchanger is due to the optimum combination of special profile aluminium fins and high-efficiency \varnothing 5 mm tubes with internal grooves.”



2012: Propane AC Designs in China!

Guoliang Ding *et alia*, Developing Low Charge R290 Room Air Conditioner by Using Smaller Diameter Copper Tubes, *10th IIR Gustav Lorentzen Conference on Natural Refrigerants*, Delft, The Netherlands (2012) Paper 183.

Developing low charge R290 room air conditioners using smaller diameter copper tubes, ATMOsphere America 2013

Presented by: John Hipchen

Author: Wenson Zheng, Copper Alliance, Asia

<http://www.atmo.org/media.presentation.php?id=270>

Prior ATMO Presentations

Prototype R290 heat exchanger designs described at ATMOSphere Conferences:

Chicago, 2016 <http://www.atmo.org/media.presentation.php?id=920>

New copper-tube technologies for heat exchangers: R290 coil and R744 gas cooler

By Yoram Shabtay, Jian Yu & Nigel Cotton

San Diego, 2017 <http://www.atmo.org/media.presentation.php?id=1051>

Select case studies of copper heat exchanger coils for natural refrigerants

By Yoram Shabtay & Nigel Cotton



ATMO
sphere

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**Thank you very
much!**

