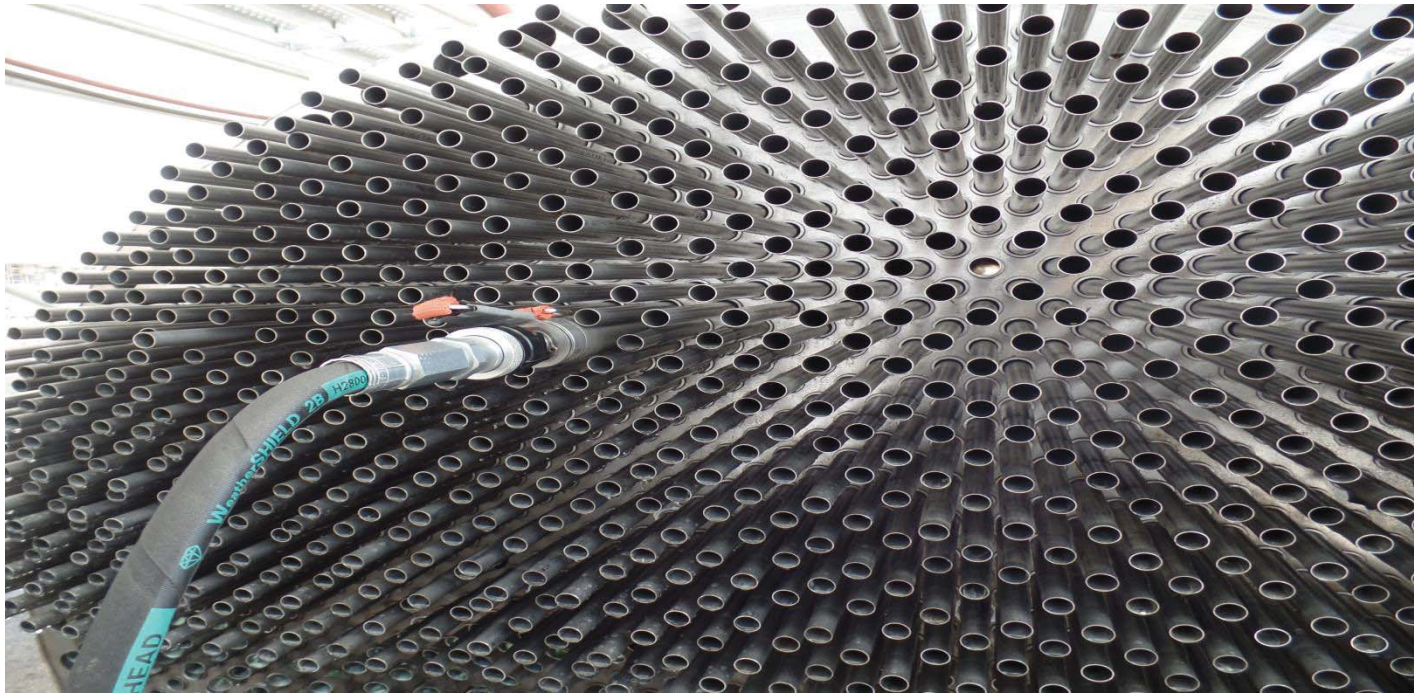
CTI FULL LENGTH TUBE LINERS



CTI Products: Full Length Tube Liners

Materials: Copper alloys to Hastelloys

Sizes:

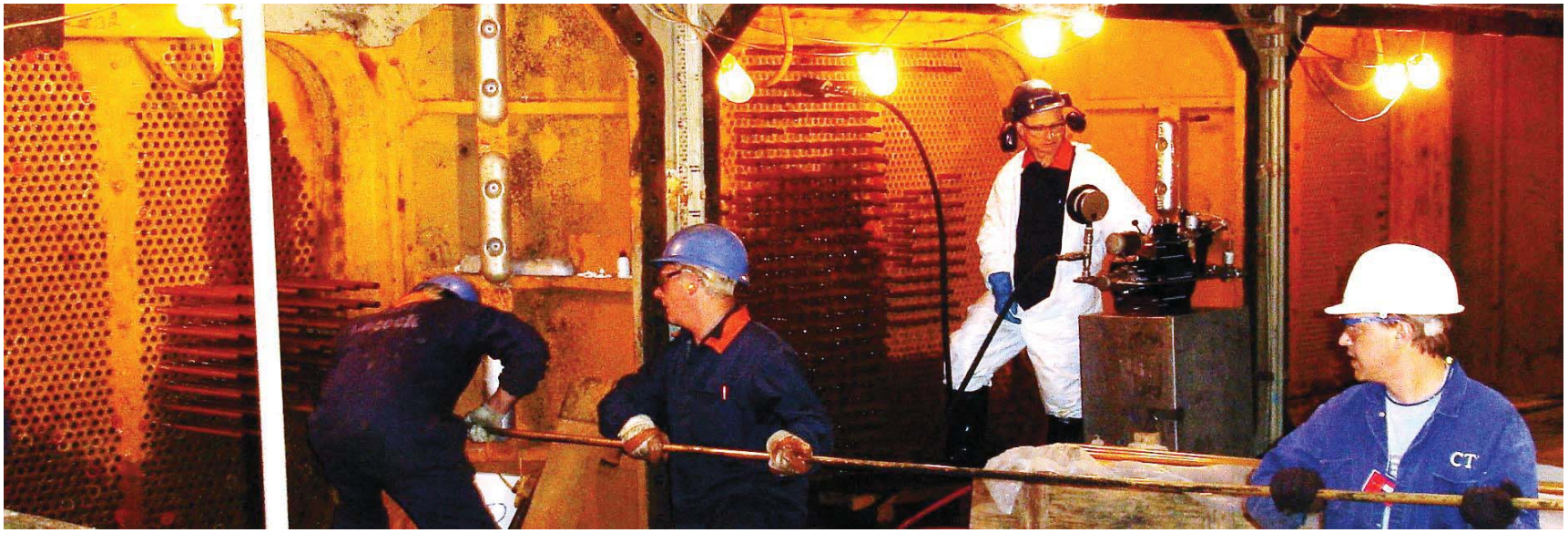
O.D. 0.410”/10.4mm up to 1.5”/38.1mm

Wall thickness 0.020”/0.5mm up to 0.028”/0.7mm

Lengths: up to 744”/18,900mm

CTI Services

CTI Full Length Tube Liners (installed in surface condenser)



How Tube Liners are sized and installed

CTI Tube Liners are sized to extend beyond the tube ends, if the exchanger is an air cooler, the Liner will extend beyond the header boxes

Sizing Liner OD

The OD of Liner is undersized approx. 0.025”/0.63mm to fit inside the existing tube ID for resistance free loading for its entire length

Tube Liner Alloys

Copper alloys: Adm. Brass, Alum. Brass, 90/10 & 70/30 Cupro Nickel

Stainless Steels: 304L, 304H, 310, 316L, 317L, 321, 347

Monel-Alloy 400

Inconel: 600

Incoloy: 800, 825

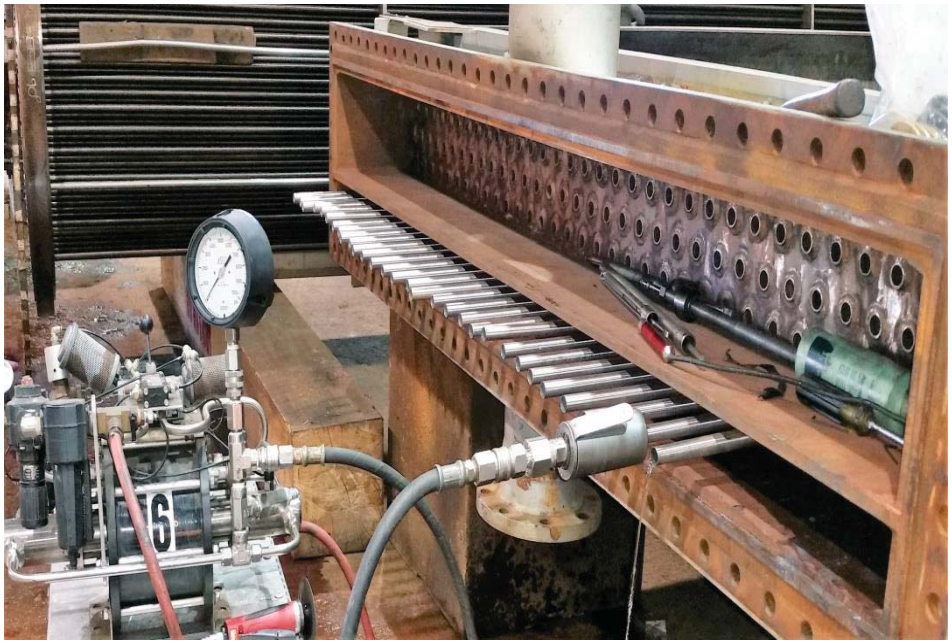
Hastelloys: C276, C22

High end alloys: AL-6XN, Ni 200

- Titanium, Duplex 2205 SS and Inconel 625 are not Liner candidates due to their limited ductility

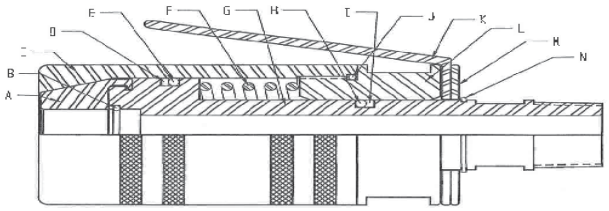
Hydraulic Liner pump and Liner chucks

Depending on the alloy and wall thickness, the pressure required to hydraulically expand Liners can range from 1,000 up to10,000 psi (68 to 680 bar)



Liner Chuck & Air Bleed Valve

Liner chuck schematic



MODEL: 64-2000-0862 MAX. OPERATING PRESSURE: 10,000 PSI

CODE	DESCRIPTION	PART NUMBER	CODE	DESCRIPTION	PART NUMBER
A	COLLET	49710-1	H	*O-RING	1779
B	*O-RING	35090	I	*BACK-UP RING	35235
C	BODY	45690	J	*O-RING	35088
D	*BACK-UP RING	35200	K	HANDLE	45272
E	*O-RING	35078	L	REAR HEAD	45273
F	SPRING	35075	M	REAR PLATE	45274
G	PISTON	49709	N	RETAINING RING	35877

*DENOTES SEAL KIT

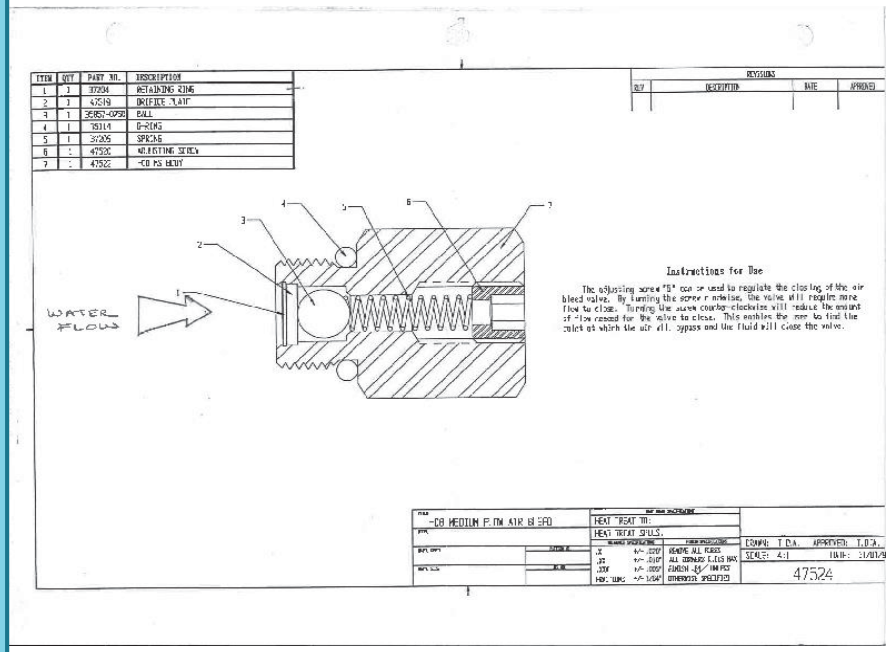
OPERATING INSTRUCTIONS

1 -Connect chuck to service line. Press handle, retracting collets. Push over end of tube pressing firmly against predetermined stop and release the handle. Collet and seal are now engaged and ready for filling and pressurization.
2 -With suitable valving, apply desired pressure. DO NOT EXCEED MAX. OPERATING PRESSURE!
3 -When pressurization is complete and pressure is released from the service line, disconnect chuck by pressing handle to unlock collet and pull tool off of tube.
4 -Slight forward hand pressure on the chuck will facilitate easy chuck removal.

MAINTENANCE

To maintain maximum o-ring sealing capacity, burrs and sharp projections should be removed from the ends of the tubing or vessel. When the tube seal becomes torn or damaged, it should be replaced. The piston and the piston seal should be cleaned and lubricated periodically with a good grade of water pump grease (a very thin film of lubricant is adequate).

Air Bleed Valve



ITEM	QTY	PART NO.	DESCRIPTION
1	1	37204	RETAINING RING
2	1	47519	ORIFICE VALVE
3	1	38857-0258	BALL
4	1	35114	O-RING
5	1	37205	SPRING
6	1	47520	ADJUSTING SCREW
7	1	47521	-CO PS BODY

REVISIONS

QTY	DESCRIPTION	DATE	APPROVED

Instructions for Use

The adjusting screw "6" can be used to regulate the closing of the air bleed valve. By turning the screw counterclockwise, the valve will require more flow to close. Turning the screw clockwise will reduce the amount of flow required for the valve to close. This enables the user to find the point at which the air will bypass and the fluid will cause the valve.

-CO MEDIUM P.TW AIR BLEED

HEAT TREAT TO:

HEAT TREAT SPEC'S.

DRAWN: T.D.A. APPROVED: T.D.A.

SCALE: 4:1

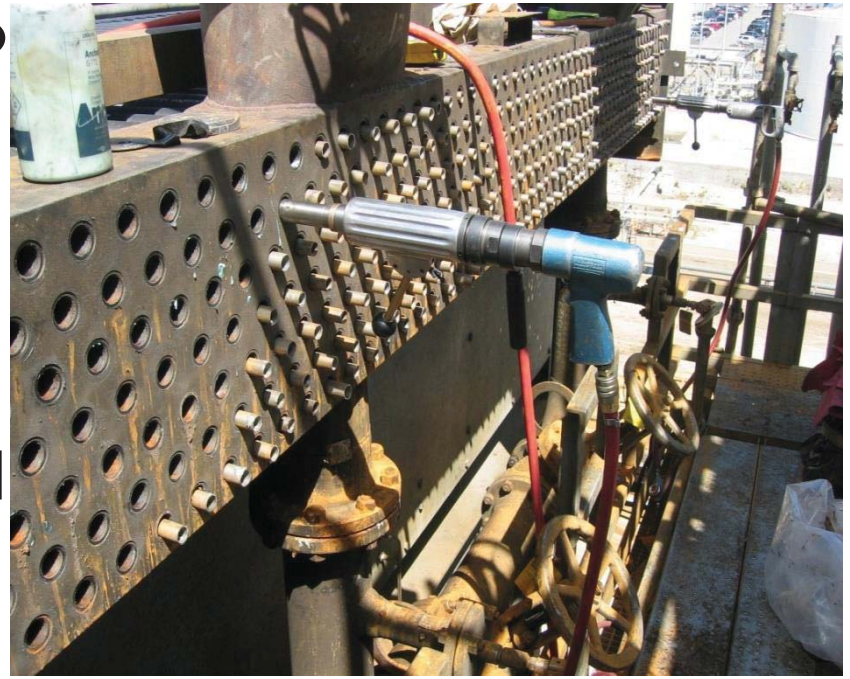
47524

Hydraulic Liner Expansion Process

- Wire brush tube ID's at each tubesheet & clear debris with compressed air
- Measure tube ID's at each tube end (tubesheet) and at 12"/300mm depth
- Measure wall thickness of Liners
- Load Liners into tubes, leaving 3"-4" (75mm-100mm) projection at each tube end or header box
- Attach hydraulic feed and air bleed chuck to Liners
- Hydraulically expand Liners full length until projecting Liner OD exceeds largest tube ID and is tight
- Measure Liner to verify metal to metal contact at 12"/300mm depth
- Trim projecting Liners with abrasive cut-off saw to within 0.5"/13mm of tube end or header box
- Roller expand Liners at the first inch (at both tubesheets) to specified AWR%
- Measure roller expanded Liner ID's at first inch to verify AWR
- ID cut or Tube End Face Liners flush to tube ends or to a uniform projection is flaring is required

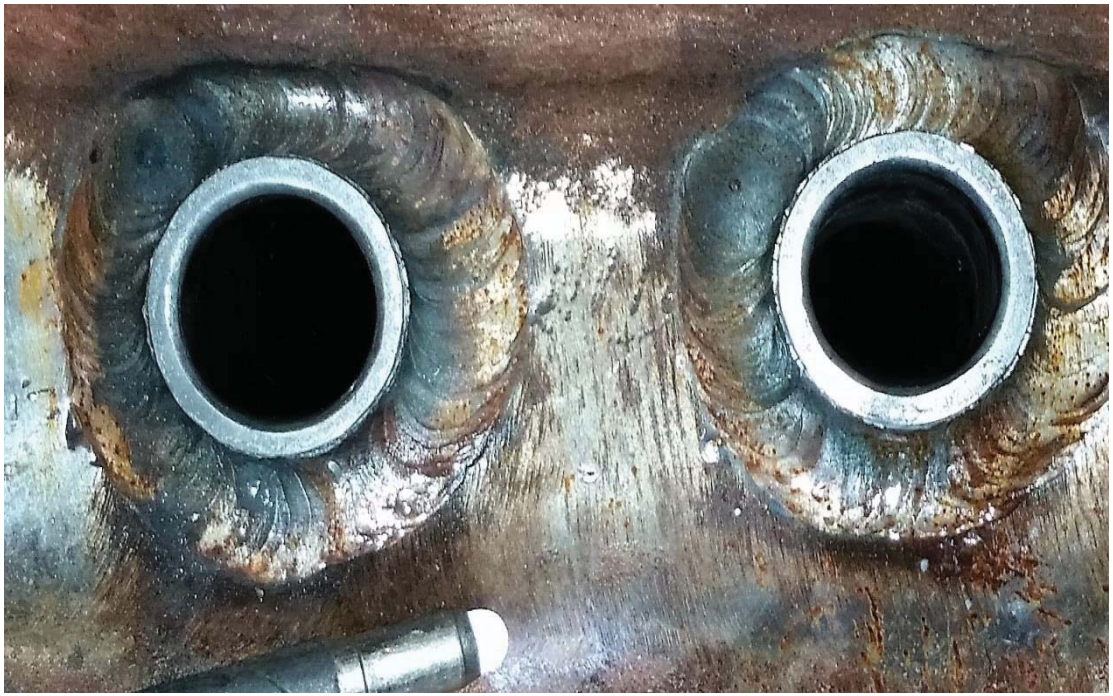
After Liner expansion, ID cut Liners

ID tube cutters are used to trim the projecting Liners flush* to the tube ends after they're hydraulically & mechanically expanded



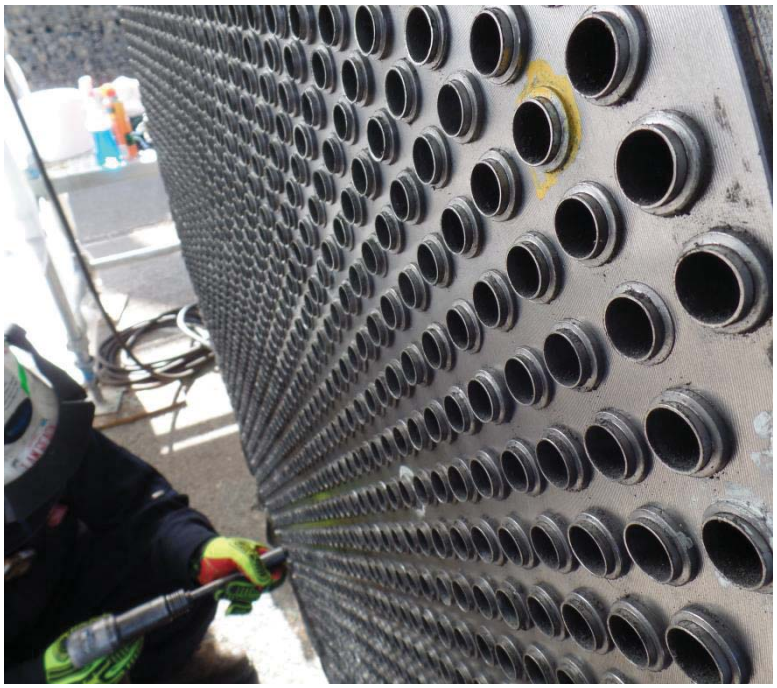
Liner ends flared & seated against tube end

The Liners can be ID cut to a uniform projection and flared/seated against the tube ends- if required.



Liners ID Cut Before Flaring

- Liners are ID cut to a uniform projection prior to 2-step flaring (45° & 90°)



Liner flaring on welds over tube ends

Liners flared to seat against welds that overlapped the tube ends

C276 Liners installed in Overhead Crude Shell & Tube HX's

Guide for Material Availability

Guide

CTI Shield & Liner Material Selection List

Material	Shield	Liner
304/304L Stainless Steel	Yes	Yes
310S Stainless Steel	Yes	Yes
316/316L Stainless Steel	Yes	Yes
317L Stainless Steel	Yes	Yes
321 Stainless Steel	Yes	Yes
347 Stainless Steel	Yes	Yes
410 Stainless Steel (ferritic)	Yes [1]	**No**
439 Stainless Steel (ferritic)	Yes [1]	**No**
2205 Duplex Stainless Steel (austenitic/ferritic)	Yes[2]	**No**
2507 Super Duplex Stainless Steel	**No**	**No**
Seacure (super ferritic)	**No**	**No**
AL-6XN Stainless Steel (super austenitic)	Yes	Yes
Monel (Alloy 400)	Yes	Yes
Inconel (Alloy 600)	Yes	TBD
Inconel (Alloy 601)	Yes	**No**
Inconel (Alloy 625)	Yes	**No**
Incoloy (Alloy 800)	Yes	Yes
Incoloy (Alloy 825)	Yes	Yes
Nickel 200	Yes	Yes
Hastelloy C22	**No**	Yes[3]
Hastelloy C276	Yes	Yes
Zirconium Gr. 702	Yes [1]	**No**
Titanium Gr. 2 (seamless only)	Yes[1, 2]	**No**
Tantalum	**No**	**No**
DHP Copper (Alloy C12200)	Yes	Yes
Admiralty Brass (Alloy C44300)	Yes	Yes
Aluminum Brass (Alloy C68700)	**No**	Yes[1]
90/10 CuNi (Alloy C70600)	Yes	Yes
80/20 CuNi (Alloy C71000)	Yes[3]	Yes[3]
70/30 CuNi (Alloy C71500)	Yes	Yes
66/30/2/2 CuNiMnFe (Alloy C71640)	Yes[4]	Yes[4]

Notes:

[1] Difficult material to redraw. Will depend on size and/or quantity

[2] Only for installation in new tubes and/or measured tubes with consistent ID's

[3] Full coil (10,000 lbs.) orders only

[4] 1,000 lbs. minimum orders

The above list includes materials tested as Shields and/or Liners. There may be exceptions based on OD, wall thickness, length, quantity, etc. This will be determined on a case by case basis.

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