

**BOILER
MASTER**

**BOILERMASTER PTE LTD
TRIDENT HYDRO JETTING PTE LTD**

About BoilerMaster

BoilerMaster Pte Ltd provides engineering services for the fabrication, repair and maintenance of heat-related equipment; supporting the marine, petrochemical, power plants, and process industries, in Brunei, Indonesia, Malaysia, Singapore and Thailand.

Typical Products and Services

Fabrication of superheaters, economizers and heat exchangers

- Designed and custom-built to client's needs
- Fabricated to international codes with acceptance test
- Drawings and documentation

Manufacture of finned tubes

- Tension wound aluminum fins (typical type LL, KL and G)
- Spiral welded fins (helical, solid and serrated)
- Economiser fins

Plant Rentals

- Tube bundle extraction
- Dehumidifiers, pumps and pumps accessories

Refractory and insulation services

- Firebricks and castable refractory
- Kaowool and ceramic fibres

Retubing and repair works (on and off-site)

- Boilers
- Heat exchangers, superheaters and economizers

Tube manipulation services

- Tube swaging
- Tube bending

Chemical cleaning

- Degreasing
- Hot oil flushing
- Passivation

Bimetallic Tubes

- Mechanically bonded bimetallic tubes

Decoking

- Pigging process

Product and Crude Oil Tank Cleaning

- Man-less Entry Tank Hydrocarbon Recovery system

Principal Clients

By industry

- All major shipyards
- Shipping agents/owners, contractors and OEM manufacturers
- Process plants (chemical, pharmaceutical and food industries)
- Utilities (incinerators and power stations)

Quality and Safety Recognition

- ISO 9001:2008 for "Repair and Fabrication of boilers"
- OHSAS 18001:2007
- A Germanischer Lloyd's registered workshop
- Holder of ASME Certification Mark for "U" & "S" stamps; NBIC "R"
- Bizstar





**BOILER
MASTER**

About Trident Hydro Jetting

Trident Hydro Jetting Pte Ltd is the leading hydrojetting provider in Singapore, serving the needs of shipyards, chemical plants and refineries within Thailand, Malaysia, Singapore, Indonesia and Brunei.

Trident operates pumps with pressure ranging from 10,000 psi to 45,000 psi, with diverse services from tank cleaning, tubes lancing, surface preparation to cold cutting and general cleaning requirements.

Water Jetting Services

- Surface preparation: a process using high and ultra-high pressure water (up to 35,000psi) to remove existing coating, rusts, and contaminants on the metal surface to SSPC/NACE and Swedish Standards Institution ISO 8501-5 for inspection or re-coating purpose.
- Tube internal lancing, the process using high and ultra-high pressure water (up to 35,000 psi) with fixed and flexible lances to clear choked and clogged tubes of heat exchanger, heaters, condenser, etc.
- Cleaning internal of vessels: where high and ultra-high pressure water is used to clean and clear the residues and coatings in an enclosed area (such as drums, towers and tanks).
- Internal pipe cleaning: where the internal of pipes up to 36 inches diameters are cleaned and cleared by self-propelling nozzles with high pressure water.
- Cold cutting is the process for cutting metal in areas where avoidance of flammable techniques is essential, for cutting non-metallic materials, as well as for undersea operations.

Competitive Edge

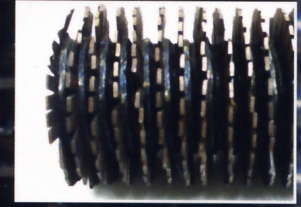
- An ITE certified OJT training centre that provides in-house training for hydro-jetters and high pressure pump operators
- Rapid mobilization and around the clock services
- In-house workshops that upkeep and ensure mechanical reliability of its pumps and accessories.
- Continuous upgrading of technical know-how by participation in projects and acquisition of newer pumps and better tools
- Meeting tight schedules with quality work

Quality and Safety Recognition

- ISO 9001: 2008
- OHSAS 18001: 2007
- An ITE certified OJT training centre for hydrojetters
- Bizstar
- Member of WaterJet Technology Association



Helical Steel Finned Tubes



Helical Finned Tubes are widely used in the recovery of waste heat. They are constructed by winding the fin material around the tube under tension, and the fin material and tube are bonded together using a high frequency welding technique. The product is a singular integral unit, eliminating heat contact resistance and losses, and allowing operations under severe conditions. Generally tube side temperatures up to 800°C (1500°F) for stainless steel fins are tolerated. Low carbon fins, withstanding up to 475°C (880°F) is the most common fin material.

BoilerMaster produces both solid and serrated steel helical finned tubes.

Tube materials are selected by client based on design temperature and conditions of use. Fin height and density depend on heat transfer requirements and expected fin efficiencies. Finned tubes with differential fin pitch (different fin density at different areas along the tube) can be produced to meet requirements of tube plate supports and to eliminate complicated fabrication requirements.

Quality control measures include review of material certificates and positive material identifications, dimensional checks of inputs and products, macrography and Vickers hardness test on samples. Additional requirements such as demagnetization, packing and delivery protection can be arranged to meet project requirements.

The products are generally delivered in the following conditions: tube-ends square cut, internally dried and air blown clean, externally coated with red oxide primer, both ends capped, tubes strapped with bundles for open sided crates, conventional wooden boxes, or shipment in 20ft/40ft containers. Documentation shall include mill certificates, inspection and test samples results, and certificate of manufacture.

Standard Manufacturing Programme

Helical Steel Finned Tubes Manufacturing Range		Solid Plain Fins		Serrated Fins	
		(min)	(max)	(min)	(max)
Tube OD ¹	mm	25.4	152.4	25.4	152.4
Recommended Fin Height		Tube OD/2.5		Tube OD/2.0	
Fin Height (H)	mm	10	25.4	10	32
Fin thickness	mm	0.8	2.5	0.8	2.5
Fin Density ²	fpi	1	8	1	8
Tube Length	mm	18000		18000	
Max Number of lands per tube		4		4	
Fin Materials		Carbon, Low Alloy, Stainless Steels			
Tube Material, Type and Grade		Carbon, Low Alloy, Stainless and High Alloy Steel such as A335 T91 [Cold Drawn Seamless, Hot Finished Seamless, Electric Resistance Welded]			

Key:

¹ Common range of Tube OD is 25.4mm to 66.7mm

² Minimum gap between fins is 2.8mm. Traditionally fin density is described as fins per inch (fpi)

Note:

Tubes diameters and fin heights outside the programme can also be produced.

Manufacturing

BoilerMaster manufacturing programmes include design and manufacturing of boiler parts and equipment to international code requirements.

Construction and Manufacturing Products

- Boiler and boiler-related equipment, such as superheaters and economizers
- Sub-components and replacement parts (e.g. headers and boiler tubes)
- Pressure vessels, shell & tube heat exchangers, related structural works
- Extended surface tube manufacturing
- Insulation and refractory supports

Manufacturing Codes Conformance

- ASME Section I and ASME Section VIII D 1
- ASME “U”, “R”, “S” certification
- ASME Board and NBIC Registry (Optional)
- British Standards and PED Codes
- Shipping Classification Societies requirements
- Client’s specifications

Design Supports

- HTRI calculations
- PV Elite calculations
- Autocad drawings

Design and Construct Manufacturing

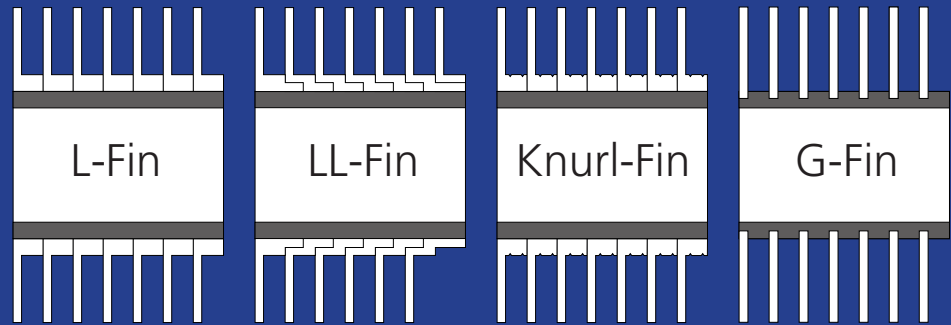
- Preliminary commercial and technical discussions
- Inspection Test Plans, Design and Drawings approval
- Client and third party inspection
- Independent Third Party NDE
- Acceptance Inspections and Test
- Manufacturer’s Report
- Code Stamping and local Jurisdiction approval (Optional)
- Passivation and Preservation (Optional)

Extended Surface Tubes Manufacturing

- Tubes from first class mills
- Manufactured to drawings and specifications
- In-house bending and other services

BoilerMaster Advantage

- One-stop solution for fabrication and installation
- Complete refractory and insulation support services
- Tube stock availability for general carbon steel tube grades
- Engineering know-how support from technical partners
- Familiarity with a very wide range of boilers and heat transfer equipment
- Quick response and shorter schedule
- Site and installation support (optional)



Tension Wound and Embedded Finned Tubes

Tension wound finned tubes are widely used due to their heat transfer effectiveness, low weight and low cost. The fins are formed by winding a strip of fin materials under tension around the tube. They are edge-wound as straight “I” fins or bent “L” fins (as L, LL and KL fin types). Under prolonged use, especially when operating at high temperatures and large temperature cycles, tension wound fins will loosen, with corrosion starting at the base of fins.

Embedded fins (G-fins) are made by mechanically inserting a fin strip into a pre-slotted helical groove, that was cut into the surface of the tube. Embedded fins are more robust than tension wound fins, and are used in slightly higher temperature environments.

Fin Types	Tube Sizes	Fin Height	Fin Density	Typical	Description
I-Fin Edge Wound	9/16”(14.29mm) to 2” (50.8mm)	from 1/4” (6.35mm) to 1” (25.4mm)	4 to 13 fins per inch	Fin Matl: Al	I-fins (edge wound) are often replaced by other tension wound fins due to better application qualities.
Wrap-on L Footed	9/16”(14.29mm) to 2” (50.8mm)	from 1/4” (6.35mm) to 1” (25.4mm)	5 to 12 fins per inch (11 fins per inch is most common)	Fin Matl: Al Tube Matl: Any metal Working Temp: <150°C (300°F)	Application: L fins provides contact area between the fin strip and the tube surface and protect the tube wall from atmosphere corrosion. This fin design is the most economical.
Overlapped LL Footed				Fin Matl: Al Tube Matl: Any metal Working Temp: <175°C (350°F)	Application: LL fins provide better adhesion and corrosion protection by overlapping the “feet” of the L’s; and can work below 175°C (350°F).
Knurled Footed	9/16”(14.29mm) to 2” (50.8mm)	from 1/4” (6.35mm) to 1” (25.4mm)	5 to 12 fins per inch	Fin Matl: Al Tube Matl: Any metal	Application: Knurling the surface, after tension winding strengthen the adhesion and reduce the tendency for fin loosening; and is preferred when used in slightly more aggressive conditions.
“G” Fins embedded	3/4” (19.05mm) to 2” (50.8mm)	Al: from 1/4” (6.35mm) CS: max 5/8” (15.8mm) SS: max 3/8” (9.5mm)	4 to 11 fins per inch	Fin Matl: Al Tube Matl: Any metal Working Temp: < 400°C (750°F)	Application: The embedded fin is designed for higher temperature and larger temperature cycles.



Bimetalllic Tubes

Bimetalllic tubes offer an excellent technical and economical solution for the production of high performance heat exchangers with high stress and corrosive conditions.

Bimetalllic tube is formed by two tubes of different materials: usually the inner tube material is a corrosion resistant alloy (copper, aluminium-brass, titanium) whereas the outer tube material has a higher yield stress (stainless steel, carbon steel, titanium). It is possible to manufacture bimetalllic tubes with any material combination.

In applications for high pressures and corrosive conditions, bimetalllic tube provides a large economical savings in comparison to a costlier single alloy tube, as the use of the costlier material is reduced to the minimum.

Applications

The common application fields are:

- heat exchangers for power plants (electric, nuclear, thermal and geothermal power plants)
- high corrosive systems (condensers, evaporators, sea water desalinations, fertilizing, urea systems, ammonia, gas, corrosive acids)
- chemical and petrochemical industries
- food processing and refrigeration industries

Inspections and Tests

The bimetalllic tube quality is assured by hydrostatic and pneumatic tests, eddy current tests and tensile tests in order to verify the mechanical bonding between inner and outer tubes.

Ordering

The bimetalllic tube can be supplied with ferrules to match inner tube material; with any type of commercially available tube materials, using tubes up to diameters of 4 inches.

**BOILER
MASTER**

TRIDENT HYDRO JETTING PTE LTD

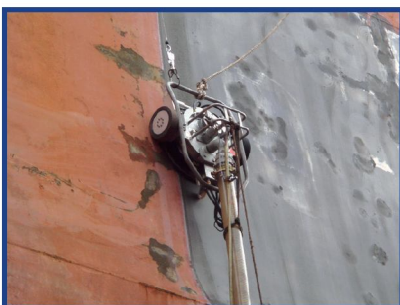
 TEL : 6268 1752
 FAX : 6268 3095


Equipment Rental

Equipment rental is an elegant solution for clients and subcontractors who need to use specialty tools and equipment for projects for once-off or on a short term basis. Trident Hydro Jetting Pte Ltd provides rental services to clients who understand the use and operations of these equipments.

Rental Services

- Supply of operators (Compulsory for clients without experienced operators)
- Supply of accessories
- Equipment familiarization training (On request)
- Maintenance, parts and replacement support services
- Technical advice for selection of equipment and accessories
- Flexible rental periods



Rental Equipment

- Hydro Jetting Service
High pressure pumps and accessories for pump pressures ranging from 10,000psi to 40,000psi for rental. The provision of pump operators is compulsory.
- Grit blasting service
- Dehumidifier
- Blasting pot
- Vacuum pumps and silo

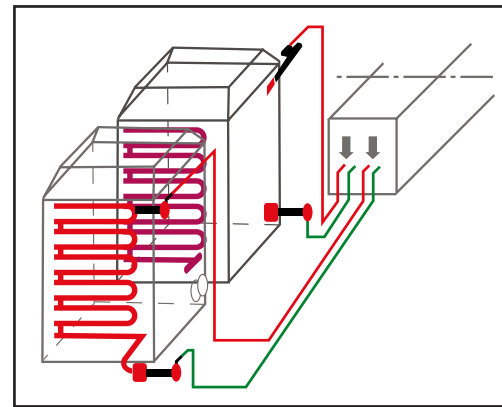
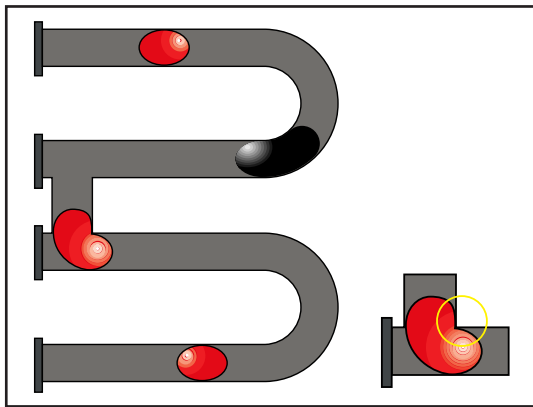
Other specialized equipment

- Hydraulic Bundle Extractor
- External Bundle Cleaner
- Tools and modifications (On Request)

**BOILER
MASTER**

**BOILER
MASTER**

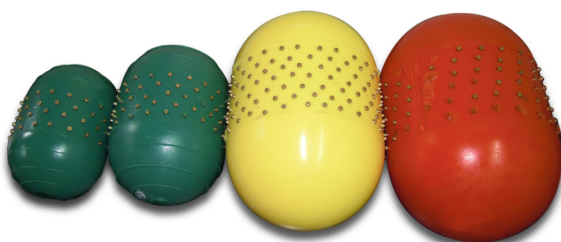
Heater Tubes



The pigging process is a closed loop system that removes coke and scale deposits from heater tubes and pipelines. Heater tubes in industrial fired heaters or furnaces are characterized by tubes with tight radius tube bends and header boxes. Pigs must be selected to negotiate through the entire length whilst removing deposits and scraping scales, travelling at reasonable speed and pressure, with less passes required.

Boilermaster's double pump decoking unit can:

- (a) Carry out two jobs at once, cleaning one heater with two passes simultaneously
- (b) Indirectly assist in locating existing leaks
- (c) Houses the launching and receiving units within a single skid; thereby recovering waste and pigs at a single location



The advantages of our decoking process are:

1. Our decoking unit is a stand-alone unit that can be located close to equipment to be cleaned
2. A full range of sizing, polishing and de-scraping pigs are available for clearing 3 to 8 inches pipes/tubes
3. High proportion of water used to drive the pigs are recirculated for use
4. All removed coke and deposits are collected through filtration units located within the unit
5. Real-time tracking of pigs through the heater and use accurate pressure differential signals/flow rate detection and comparison to determine coke thickness and location
6. Rapid Mobilization and Demobilization


**TRIDENT
HYDRO**

Lancing

The use of high pressure water jetting process to clean the internal of tubes for boilers, air-fin coolers, condensers or any heat exchangers is accepted as the most effective and environmentally friendly way to clean the tube internal. Where the tube bundle is extracted for these purposes, the tube externals, bundle and shell are also cleaned before being reinstalled.

The recommended pressure range between 10,000 psi and 30,000 psi, tube material type, wall thickness and operating conditions permitting, is used to clean and clear tubes with different medium in it, like rust scale, coke, oil, polymer, chemical, etc.

Two main methods to clean and clear the tube internal are:

- Flexible Lancing – flexible high pressure hoses with a selected nozzle are introduced into tubes where the water pressure jets can clean and “polish” tubes, including maneuvering bends.
- Rigid Lancing – small diameters rigid tubes capable of withstanding extreme pressures and carrying a clearing nozzle are introduced into the choked pipes or tubes where the high water pressure jets “unplug” these pipes or tubes.

Trident Hydro Jetting has a complete line of water jetting equipment to fit any tube internal application.

Where applicable, we recommend our automatic lance feeding system such as the “3-lance TLE Special” and the “Single Lance Tube cleaner” to provide consistent cleaning speed and excellent cleaning results. Where manual applications are used, trained hydrojetters using the correct machines, pressure ratings and recommended nozzles ensures fast and good results.

For pipe internal cleaning, Trident Hydro Jetting offers several different types of pipe internal hydrojetting equipment and processes. These processes include the use of rotating nozzles, driven forward by the nozzle or with the assistance of compressed air or mechanical attachments and allowances for whirling effects. The choice depends on the residues within the pipes, the diameters, lengths and the number of bends in the pipelines.

For tube bundle external cleaning, Trident Hydro Jetting uses a “Outside Bundle Cleaner”, a safe and efficient cleaning machine that is operated and controlled by a cabin operator. The bundle (up to 30 ton weight) is placed on two hydraulic driven heavy rollers where it can be rotated, and high pressure water jets manipulated by mechanical levers moving horizontally and vertically clean the bundle.

Trident Hydro Jetting is constantly searching for the best value technology and to use them safely and effectively to meet your needs.



**BOILER
MASTER**



Refractory & Insulation

Selecting suitable refractory and insulation materials is crucial for the operational durability, reliability and safety of the plants. Our specialists are continuously involved with new products and product development, as well as engaging clients in discussing and analyzing requirements. Our in-house trained and experienced masons and fitters can carry out the repairs and on-site installation. We also offer management, supervisory and training services for clients who prefer to do their own installations.

The equipment and techniques to be employed for the refractory installation, such as pouring, ramming, casting and gunning will depend on the types of refractory selected. Insulation materials include calcium silicate, thermal blankets and rockwool, and Boilermaster provides pipe insulation and cladding services upon requests.

Principal Industry Served

- Refineries and chemical process plants
- Marine boilers
- Power stations
- Incineration and waste burning
- Cremators
- Foundries, galvanizing plants and furnace installations

Some Typical Products

- Plastic and castable refractory which can be grouped into:
 - pouring refractory
 - ramming mix
 - casting refractory
 - gunning mix
- Rockwool, calcium silicate boards,
- Refractory Anchors

Boilermaster's Competitive Edges:

Diagnosis

- Damage evaluation, expert guidance, material selection, budgets, recommendations and construction drawings.

Fast Response

- An experienced in-house technical team available for fast mobilization.

- Availability of common stocks; short material delivery periods.

Project Management

- Project management
- Training of customer's installation team and site supervision support
- Installation per client's or manufacturer's recommended methodology



Retube, Repair, Renew

Repair, replace and renew are the most common options for maintenance and operational staff. They are widely used because:

- There is no shelf-ready replacement available. Almost every component is designed to be user specific.
- Immediacy. The availability of fast responses, including on-site repairs, decreases the downtime and prevents the breakdown of minor component from shutting down an entire system over a prolonged period.
- High component costs and long delivery periods. Unless driven by product needs and efficiency improvements, direct replacement of entire components with newer units generally do not make economic sense.
- Reliability. Repairs generally support the equipment through its projected life.

Key Benefits

- We are a one-stop shop solution to repairs and refurbishments, offering full mechanical repair works, from refractory and insulation works, to tube replacements and voyage repairs.
- We participate in all marine repairs and is a Germanisher Lloyd workshop.
- Meet the requirements of the ASME Boiler and Pressure Vessel Code.

- We keep stocks of common sizes for carbon and steel tubes, as well as insulation and refractory materials.
- We provide complete records of approved processes and tests results. Records are kept per ISO 9001:2008 and ASME.

Capabilities

- Repairs of all forms of boilers, boiler components and heat transfer equipment.
- Materials include carbon steel, alloyed steel (e.g. T22 and T91), stainless steel, aluminium, brass and copper nickel.
- All welding processes meeting ASMA IX requirements
- Tube bending (up to tube OD 4 inches)
- Installation of refractory and insulation
- Withdrawing and reinstalling tube bundles of 30 tonnes load

Certificate Holder of ASME “U”, “S” and NBIC “R” requirements.





Surface Preparation

Trident Hydro Jetting (THJ) operates a wide range of pumps, with high flow rates and pressure reaching 45,000 psi. We have a complete range of pumps and services for surface preparation and other water jetting techniques. THJ trains its operators and hydrojetters with approved in-house programmes.

Full Range of Pump Pressures

- Low Pressure Water Cleaning (LP WC) (< 5,000psi)
- High Pressure Water Cleaning (HP WC) (5,000 to 10,000 psi)
- High Pressure Water Jetting (HP WJ) (10,000 to 25,000 psi)
- Ultra-high Pressure Water Jetting (UHP WJ) (> 25,000 psi)

Surface Preparation Standards (>10,000 psi)

- SSPC - SP12 / NACE 5 (WJ-1/2/3/4 & SC-1/2/3)
- ISO 8501 -1
- HB (International Paint) and paint maker's requirements

Note: Water jetting will not produce a profile, it exposes the original surface profile.

Wide Range of Surface Cleaning Systems to Match Needs

- manual, e.g. using hand held equipment
- semi-automated, e.g. tube bundle externals
- automated, e.g. internals of large diameter pipes.

General Work Procedures

- Pre-start site and access visits
- Equipment selection, preparation and Mobilization
- Safety conformance and start of work
- Inspection by client or third party
- Handling over upon acceptance

THJ Advantage

- In-house operators and hydrojetters training programmes
- In-house equipment maintenance and inspection
- Wide range of techniques and equipment
- Support of chemical cleaning
- Support for equipment repairs and replacements
- ISO certification
- Continuous adoption of new technology

THJ is a member of Water Jet Technology Association.



Tube Bending

BoilerMaster provides mechanical cold bending services for ferrous and non-ferrous tubes.

Our cold draw bend facilities can bend ferrous tubes up to 4 inches nominal diameters.

General configurations of bends are planar bends of elbows up to 180 degrees (U-bends). Three dimensional bends based on samples or drawings are also carried out. In general, bending is carried out after considering the bending ratio (i.e. radius of tube to centre-line bend radius), strain, tube ovality and minimum wall thickness after bending.

Codes and Specifications

Our bending process and quality control is designed to meet client's specifications including ASME, TEMA, PED and BS Codes.

Quality Assurance Programme

- Identifying thinning and ovality requirements
- 2-pieces destructive tests of production pieces for thinning measurements and internal visual inspection
- Ovality measurements at 3 points of U-bends (random sampling of each lot bending)
- Ovality measurement at 1 point close to the critical bend area of 45 and 90 degrees elbows (random sampling of each lot of bending)
- Ultrasonic measurement of thickness at critical bend, upon request
- Dye penetration test for surface cracks upon request
- General dimensional checks for tolerance against drawing

- Stress Relief Heat Treatment (Post Bend Heat Treatment) where required
- Tube Bending Report
- Packing and delivery to be advised by client

Bending Production Range (Elbows and U-Bends)

Other configurations can be manufactured to meet specific requirements (please specify O.D., Length, Thickness, Material Type and Specifications).

Material: Carbon Steel/Stainless Steel

- O.D.(mm): 25 to 102
- L(m): Up to 22m
- T(mm): 1.6 to 4.5
- Materials: ASTM, DIN or equivalent
- Remarks: Drawing preferred

Material: Copper/Copper Nickel

- O.D.(mm): 13 to 38.1
- L(m): 6m
- T(mm): Up to 6mm
- Materials: All
- Remarks: Test piece acceptance

Tube Swaging

Tubes and pipes of different diameters are often joined in a flow process. For common materials and sizes, this is done by adding a nozzle or reducer to the larger tube. Two welds are made on the reducer ends, one at larger diameter tube and the other on the smaller diameter tube.

Tube swaging is a process where the cross sectional diameter of a tube at one end is decreased. Only one weld, at the reduced diameter, is required to join the two tubes or pipes.

Tubes swaging offers the following advantages:

- Swaging becomes a necessity where standard reducers are not suitable due to the type of tube materials and non-standard sizing.
- Control of tapering angle leading to better flow control
- Cost savings where swaging is carried out with tubes bending
- Reduction in welding joints requirements leading to faster site construction
- Customized factory fit and factory controlled quality

When ordering, kindly provide the following information:

- The minimum and maximum tube wall thickness per your design requirement
- If post bend heat treatment is required
- If the design takes into consideration cyclic conditions, vibrations and temperature cycling due to induced weakness of cold working
- If the taper differs from our nominal taper of 70 degrees