

A WORLD WITH ALUMINIUM

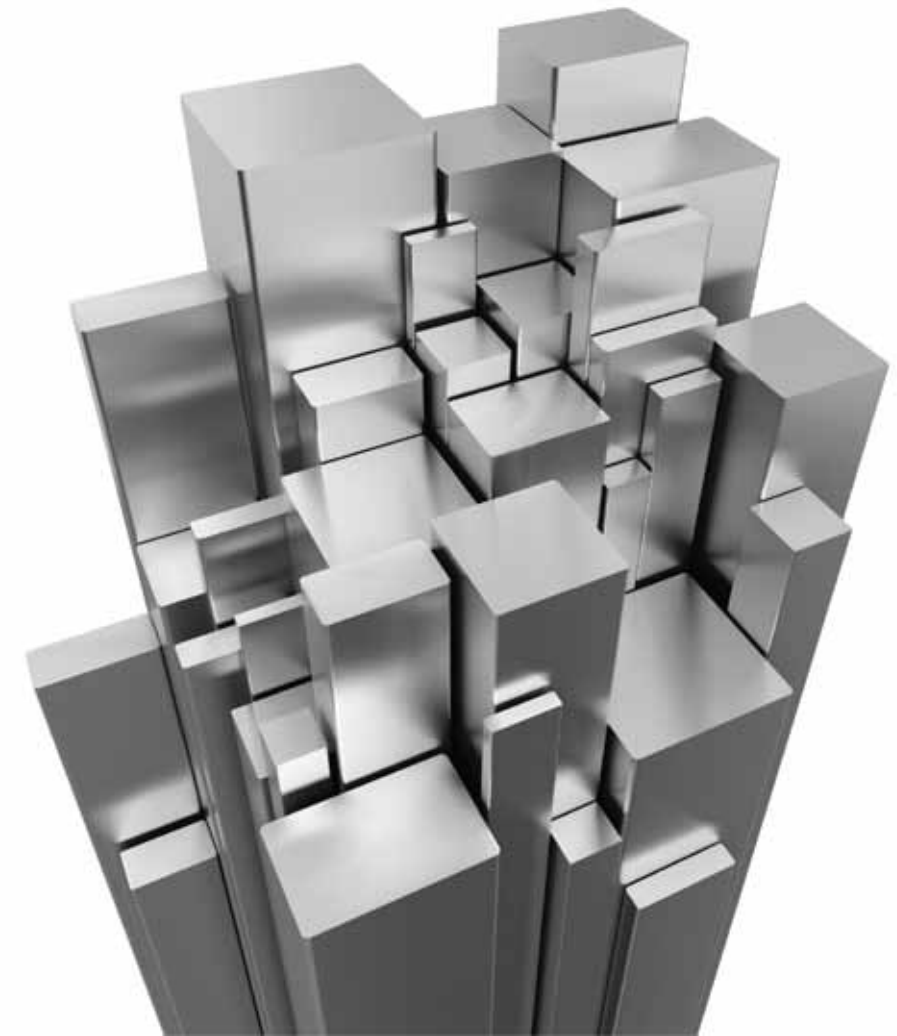
**ARMOUR
GROUP**

MISCONCEPTION



Many people have a misconception of aluminium when compared with copper. The price of copper may now be thrice as high as that of aluminium, but it doesn't mean that aluminium is not as valued now in terms of its technical performance. In fact, in 2002, the price of aluminium, at 2300 USD/MT, was more than that of copper at 1300 USD/MT. That does not mean that aluminium was "better" during that period of time.

CHALLENGES



The main reason for the high prices was the difficulty in doing connections through brazing. As technology advances, brazing aluminium is not difficult anymore. With Armour Brazing Rod ST2000, a joint can be done in 15 seconds, which is 4 times faster than when brazing copper.



GALVANIC CORROSION

Galvanic corrosion occurs when two dissimilar metals are joint together in the presence of air and contaminated water.

Armour Heat Shrink Sleeve does all the work to prevent this from happening. This product comes with a layer of organic glue, which seals the joint and act as a barrier.

An example would be the use of Armour Heat Shrink Sleeve when connecting aluminium tubes with a flare nut, which is made of Brass. An accelerated test, done according to ASTM G71, has proven that when Armour Heat Shrink Sleeve was used, no corrosion took place.

CORROSION RESISTANCE

Aluminium reacts with oxygen in the air to form an extremely thin layer of oxide. Though it is only some hundredths of a μm thick (1 μm is one thousandth of a millimetre), this layer is dense and provides excellent corrosion protection. The layer is self-repairing if damaged.

Anodising increases the thickness of the oxide layer and thus improves the strength of its natural corrosion protection. When aluminium is used outdoors, it is common to see thicknesses of between 15 and 25 μm (depending on wear and risk of corrosion). Aluminium is extremely durable in neutral and slightly acidic environments. However, in environments characterised by high acidity or high basicity, corrosion is rapid.

Untreated aluminium has very good corrosion resistance in most environments. This is primarily because aluminium spontaneously forms a thin but effective oxide layer that prevents further oxidation.

Aluminium oxide is impermeable and, unlike the oxide layers on many other metals, it adheres strongly to the parent metal. If damaged mechanically, aluminium's oxide layer repairs itself immediately. This oxide layer is one of the main reasons for aluminium's good corrosion properties. The layer is stable in the general pH range 4 to 9



ENVIRONMENT

Aluminium is more environmentally friendly than copper, and that can help provide significant gains and save costs as well.

One tonne of base bauxite ore produces 235% more material than 1 tonne of copper ore. The CO₂ emitted in the production of copper is 1.032 tonnes, whereas the production of aluminium emits less than 10% of that amount.

Because aluminium is much lighter than copper, transportation costs and emissions are lower. The laden weight of a building can also be further reduced.

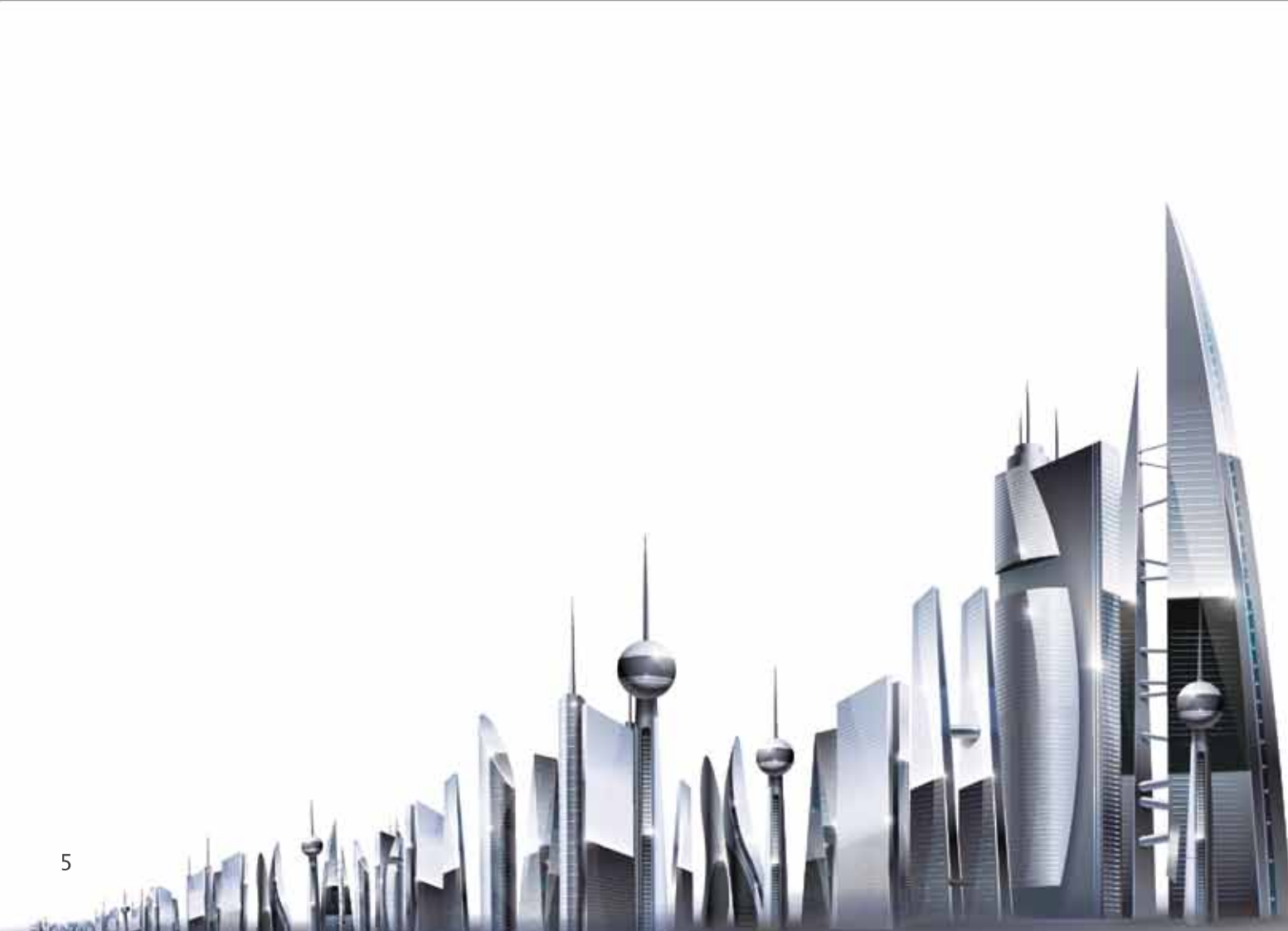


NOT ALL ALUMINIUM WORKS

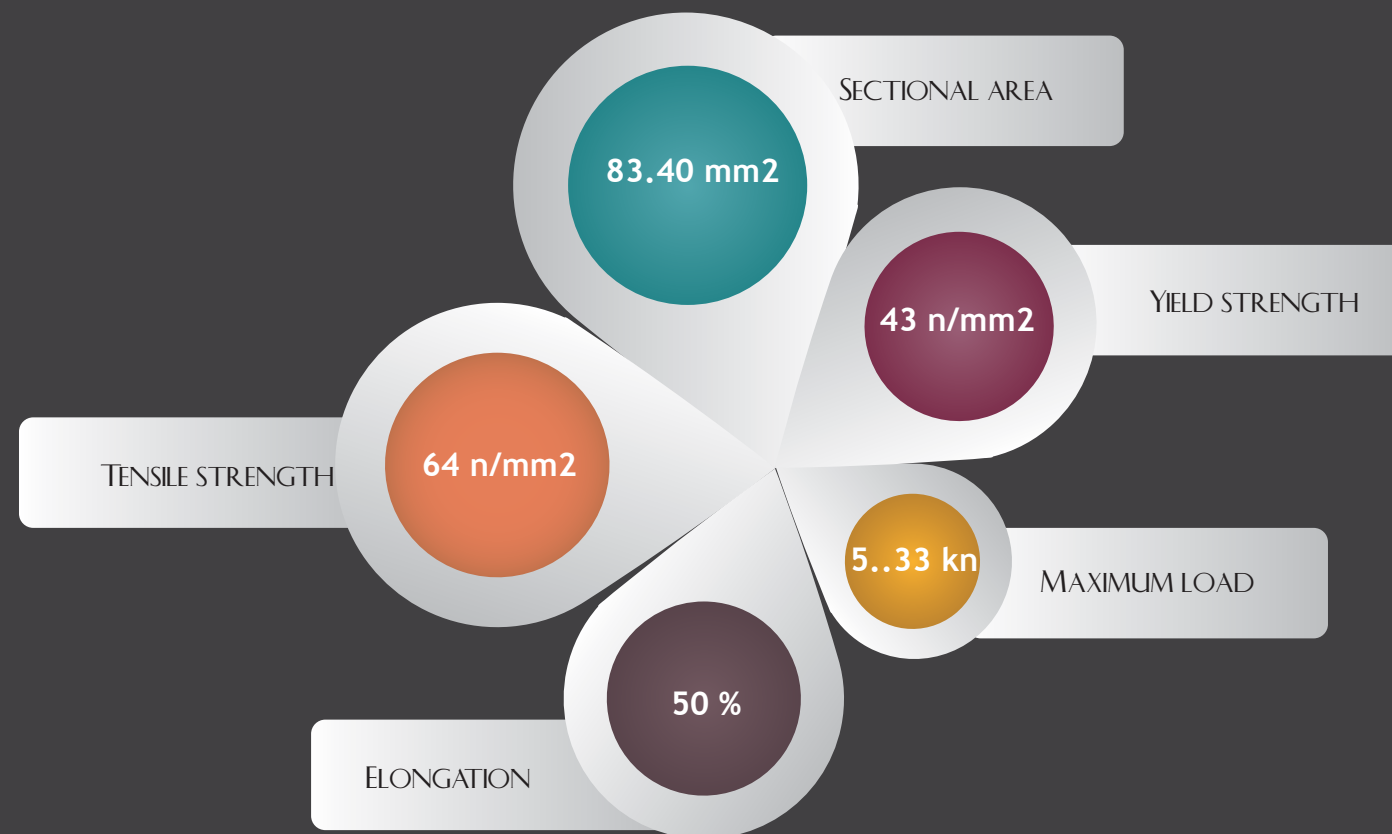
Aluminium can be classified into different series—from 1,000 series to 7,000 series. Under each series, there are sub-categories in which different combinations of metals are alloyed.

You might have had a bad experience in using Aluminium tubes when installing air-conditioners, so that might deter you from using aluminium again.

THE FACT IS "NOT ALL
ALUMINIUM WORKS", AND WE
UNDERSTAND THAT.

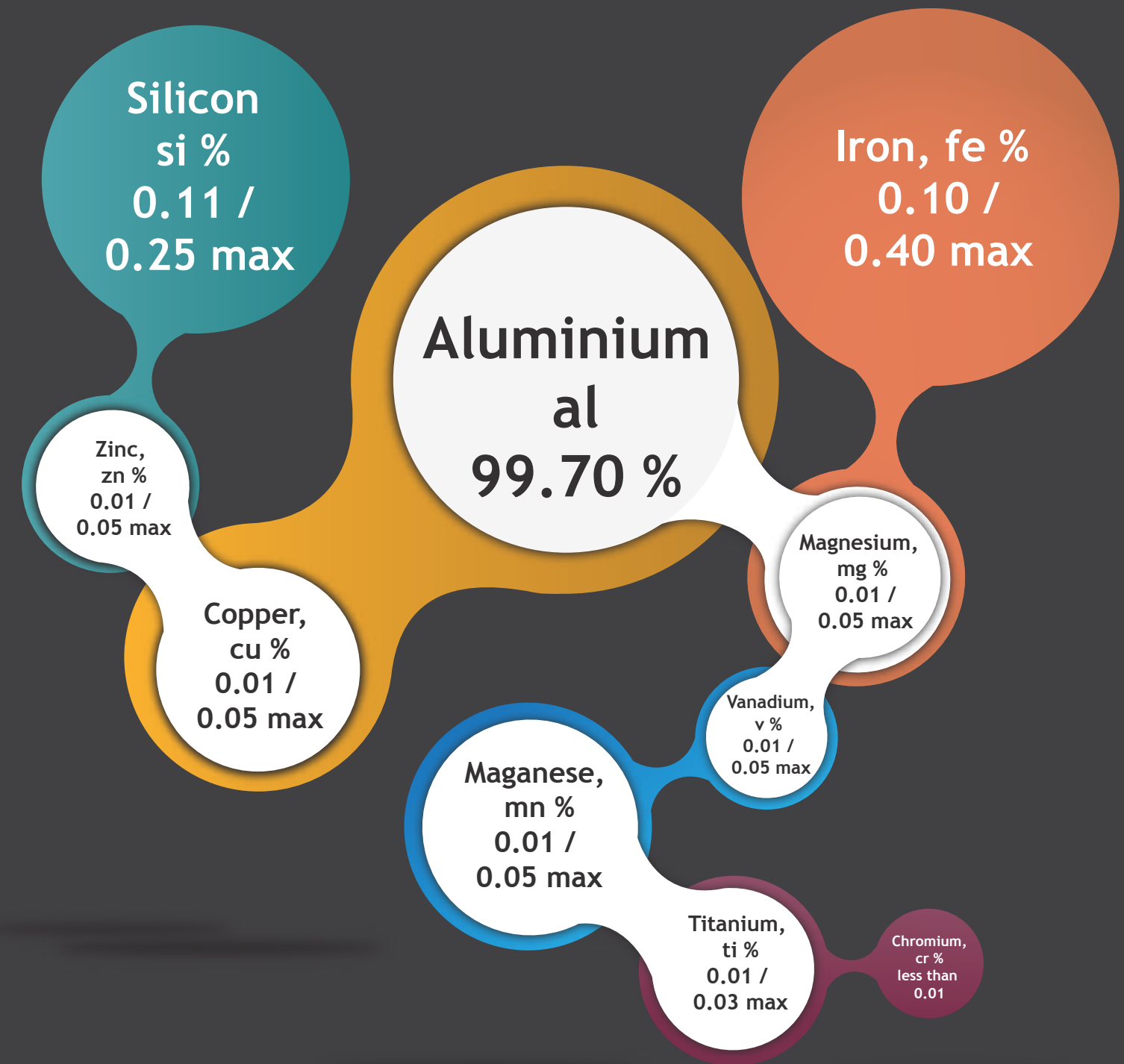


TENSILE PROPERTIES ACCORDING TO ASTM B491 REQUIREMENT



TUBES ARE TESTED PNEUMATICALLY AT NOT LESS THAN 400 KPA AIR PRESSURE WHILE IMMERSED IN WATER.

NO LEAK AGE OBSERVED !



CHEMICAL COMPOSITION ACCORDING TO ASTM B491 REQUIREMENT

MAX TIGHTENING TORQUE

THE COMMON PROBLEM OF LEAKAGE CAN MOSTLY BE ATTRIBUTED TO THE OVER-TIGHTENING OF THE FLARE NUT. ALUMINIUM REQUIRES LESS STRENGTH TO TIGHTEN WHEN COMPARED WITH COPPER. WHEN A GOOD FLARE IS DONE, THE CONTACTING POINT OF THE FLARE WILL WRAP AROUND THE CURVE OF THE VALVE THREAD.

RECOMMENDED TORQUE

6.35MM (1/4")	OD	16 N.M
9.52MM (3/8")	OD	23 N.M
12.7MM (1/2")	OD	33 N.M
15.88MM (5/8")	OD	35 N.M
19.05MM (3/4")	OD	56 N.M



ROYALE SPRING HILL, JAKARTA INDONESIA

The first development to be certified with the "Green Label", Royale Spring Hill Residences is a 6 – tower apartment complex consisting of 37 floors in each tower.

Armour Group is proud to be a supplier for this prestigious project. This also serves as a tremendous addition to our portfolio. A total of 64,000 meters of Armour Aluminium Tubes, pre-insulated with cross-linked PE, were supplied for the installation of split air-conditioning units.

January, 2014



ROYAL CITY, HANOI VIETNAM

Armour Group was recently awarded the project to produce aluminium tubes for 4,460 apartments at the newly-developed Royal City in Hanoi.

Located at 72A Nguyen Trai Street, Thanh Xuan District, this property was one of Vingroup's most highly-anticipated projects in Vietnam. The 4,460 apartments are spread across 6 towers, with 39 different layouts ranging from 2-bedroom to 4-bedroom units. These apartments were handed over to residents in late October 2013. Armour Group supplied a total of 580,000 meters of aluminium piping for the installation of split air-conditioning units.

May, 2013



TIMES CITY, HANOI VIETNAM

Following the completion of Royal City project, Armour Group continued to supply for Vingroup's mega-project, Times City.

The inspiring design of Times City is derived from the idea of a modern urban area influenced by Singapore's eco-friendly architecture. This project is a complex comprising of retail podium, a Grade A office building as well as luxury apartments, providing a working space that meets international standards. All office areas of Times City occupy a total of 15,000 sqm. In addition to the comfortable working environment, tenants directly benefit from many amenities such as green parks, a 100,000 sqm lake, an entertainment park, a luxurious shopping center, an aquarium and healthcare facilities.

November, 2013

ARMOUR ALUMINIUM REFRIGERANT TUBE



Introduction

Why Aluminium is the best alternative material for HVAC & R?

- Stable and low price compared to using copper.
- Provides excellent metal properties with the advancement of technology.
- Has excellent formability characteristics that make it highly suitable for use in HVAC & R.
- Improves system weight significantly in HVAC & R applications.
- Improves energy consumption and efficiency since thermal conductivity ratio is lower, hence heat gain and loss is lower.
- Pure aluminium lasts longer than other metals when used appropriately.

Characteristics & Advantages

- ➔ **Lightweight & Durable**
 - Requires less strength to bend.
 - Manufactured up to 1.5mm wall thickness, providing superior rigidity.
 - Using the same set of bending tools as copper.
- ➔ **Swaging & Expanding**
 - 30% expansion from original OD.
 - Using the same set of swaging tools as copper.
- ➔ **Length & Packaging**
 - Designed to 50-meter length per coil.
 - Less joint, less tendency of leakage.
 - Longer length, less wastage.
- ➔ **Thermal Conductivity**
 - Lower than copper by almost 50%, which translates to the rate of condensation.

TÜV SÜD PSB Pte Ltd - 1 Science Park Drive, Singapore 118221

SUMMARY OF TEST REPORTS FOR:

Armour Group Holdings Pte Ltd
10 Marina Boulevard
Marina Bay Financial Centre Tower 2 Level 39
Singapore 018983



PSB Singapore

Choose certainty.
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Test Method	Test Report Reference
ASTM B491/B491M : 2006 – Standard Specification for Aluminium and Aluminium-Alloy Extruded Round Tubes for General-Purpose Applications (Test Standard scope includes refrigeration services, gas lines, oil lines and instrument lines)	7191017704-MEC11/01-TXM 7191017704-CHM11-02-MCY
Adopted BS EN 248 : 2002 for Corrosion Resistance Testing	7191007742-CHM11-PGK(MEC)
ISO 9227 : 2006 – Corrosion tests in artificial atmospheres – Salt Spray Tests	7191007742-CHM11-PGK(MEC)
ASHRAE 97 – Thermal Stability of Armour Refrigerant Aluminium Tube in refrigerant gas (R410A)	7191046273-CHM12-AJH
ASTM G71 – Conducting and evaluating galvanic corrosion test in electrolytes (Test for Brass/Copper Joints and Aluminium Tube insulated with Shrink Sleeve – No sign of corrosion under microscopic image)	7191039110-CHM12-CHY
Adopted ASTM B75 : 2002 – Standard Specification for Seamless Copper Tube (Hydrostatic test was done up to 1000 psi)	719191806-MEC10_CR1-CYW
Burst Test according to Client’s requirements	7191017704-MEC11/03-TXM

Diameter (mm)	Burst Pressure (PSI)
Ø6.35	3900
Ø9.52	2400
Ø12.70	2000
Ø15.88	1800
Ø19.05	1700
Ø9.52 with brazing joint (brazed with Armour brazing rod)	2400 (No crack or leak observed visually on seal)

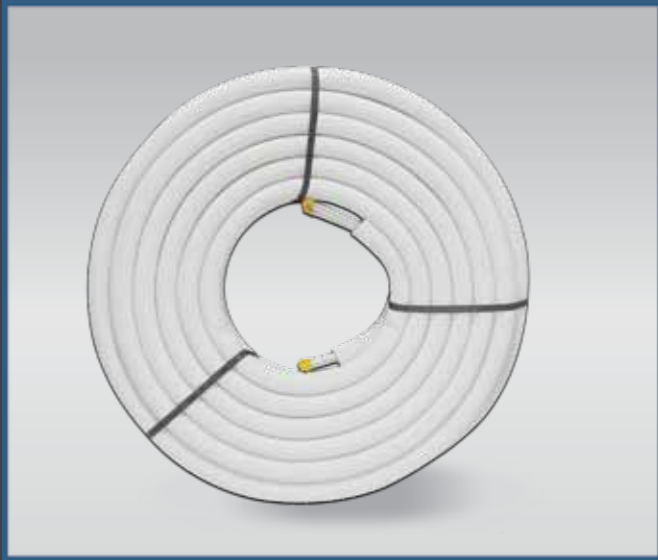
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ARMOUR PRE-INSULATED ALUMINIUM TUBE



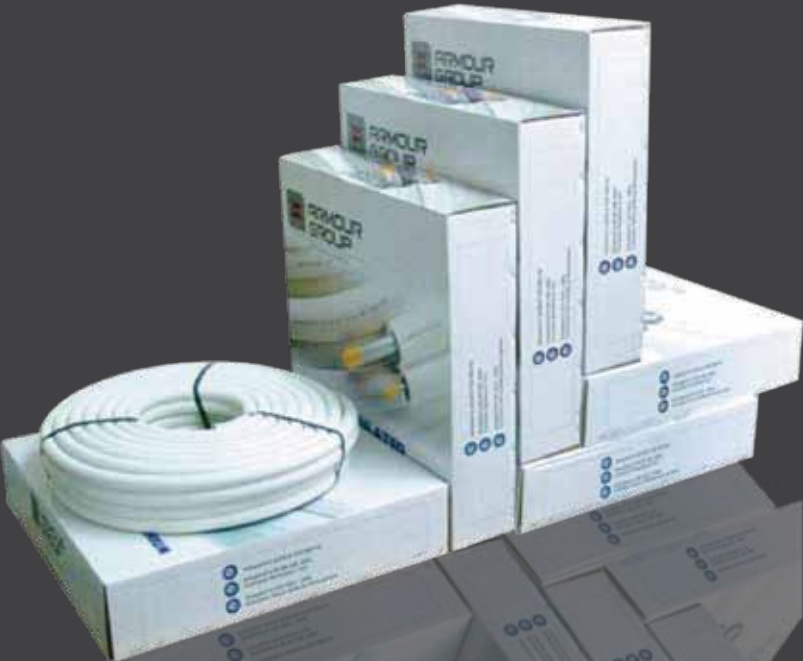
Introduction

The development of Armour, the first pre-insulated aluminium tube, revolutionized the air-conditioning industry in the 21st century. It brought an end to the lengthy process of inserting insulation, as well as gluing and taping on-site, saving up to 60% of the time spent on insulation.

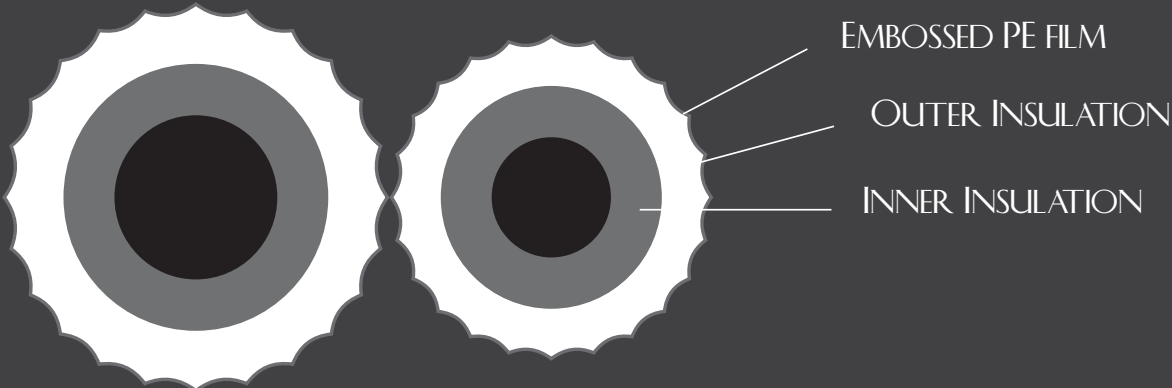
Installers are backed with confidence as Armour adopts stringent process in quality control. All tubes are pre-pumped with Nitrogen gas and when cut, an oozing sound of gas signals let you know that the tubes are 100% leak free.

Characteristics

- R410A Compliant.
- Easy to install.
- Bends easily without kinking.
- Aesthetic.
- No powder.
- No glue.
- Convenient packaging.
- 6 different combinations.



OUTER LAYER OF INSULATION IS MANUFACTURED WITH CROSS LINKING TECHNOLOGY THAT ENABLES THE PRODUCT TO OFFER EXCELLENT THERMAL RESISTANCE.



Description

Item Number	Outer Diameter (inch)	OD x Wall Thickness (mm)	Carton Dimension (cm)	Length (m)	Gross Weight (kg)	Color Code
AATT06350952T10	1/4" – 3/8"	6.35 x 1.0 9.52 x 1.0	72.5 x 14.5 x 72.5	20	5.5	
AATT06351270T10	1/4" – 1/2"	6.35 x 1.0 12.70 x 1.2	72.5 x 14.5 x 72.5	20	6.4	
AATT06351588T10	1/4" – 5/8"	6.35 x 1.0 15.88 x 1.2	76 x 17 x 76	20	7.0	
AATT09521588T10	3/8" – 5/8"	9.52 x 1.0 15.88 x 1.2	76 x 17 x 76	20	7.8	
AATT09521905T10	3/8" – 3/4"	9.52 x 1.0 19.05 x 1.5	76 x 17 x 76	20	9.8	
AATT12701905T10	1/2" – 3/4"	12.70 x 1.2 19.05 x 1.5	76 x 17 x 76	20	10.2	

ARMOUR HARD DRAWN ALUMINIUM TUBE



Introduction

Armour Aluminium Hard Drawn Tube is manufactured to international specifications using our own dies, and goes through a robust extrusion process. All relevant pressure tests are conducted by TÜV SÜD, making it suitable for use in all modern refrigeration systems from R22 through to R410A.

Our inventory facility carries stocks from 7/8" through to 1-5/8" to meet market's demand while odd/large size pipes can be produced on intent basis. Our air conditioning pipeline components, fittings and pipe joint kits are compatible with the world's leading VRF air conditioning and refrigeration systems.

Characteristics

- ➔ Mechanically cleaned and capped.
- ➔ Compatible Couplings & Elbow.
- ➔ 99.7% purity.
- ➔ Tested to ASTM B491 Standard.

Advantages

- ➔ NO special brazing/ flaring/ swaging tools required.
- ➔ NO big equipment and heavy machinery required.
- ➔ NO nitrogen required.
- ➔ NO system contamination.

Test Report No. 7191069340-MEC13/01-SMS
dated 13 SEP 2013



PSB Singapore

Note: This report is issued subject to the Testing and Certification Regulations of the TÜV SÜD General Terms and Conditions of Business of TÜV SÜD PSB Pte Ltd. In addition, this report is governed by the terms set out within this report.

Choose certainty.
Add value.

SUBJECT:

Testing of aluminium tubes

TESTED FOR:

Armour Group Holdings Pte Ltd
10, Marina Boulevard, Level 39
Marina Bay Financial Centre Tower 2
Singapore 018983

Attention to: Mr. Christopher Wee

TEST RESULTS:

Burst Pressure			
S/No.	Sample Reference	Burst pressure (psi)	Remarks
1	22.22mm(7/8") OD x 1.5mm Thickness	1450	Burst at pipe section
2	34.93mm(1-3/8") OD x 1.85mm Thickness	1160	Burst at pipe section
3	41.28mm(1-5/8") OD x 2mm Thickness	870	Burst at pipe section
4	28.58mm(1-1/8") OD x 1.85mm Thickness sealed (brazing with Armour brazing rod) with aluminium socket(Armour brand) at both ends	1160	Burst at pipe section No leakage at the joint area




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The Franklin, Singapore 118223
TÜV®

ARMOUR ALUMINIUM BRAZING ROD ST2000



Introduction

Technological advancement has been eliminating traditional method of joining & repairing Aluminium. With Armour Brazing Rod ST2000, joining Aluminium tubes has never come faster ! A join could be achieved within 15 seconds without additional flux (4 times faster than copper). Armour makes the impossible possible.

Argon Gas is no longer required to repair Aluminium. Armour Brazing Rod ST2000 is specially formulated to enhance the strength of the joints.

Coupled with Armour rotatable torch, butane gas is all we need and this adds to more savings as compared to other heavy cylinder of gas.

Advantages

- Used the same method as brazing copper.
- No argon gas, wire spool, gloves, shield or electricity required.
- Armour Brazing Rods ST2000 allow up to 45-50 joints per rod.
- Estimated \$0.05 per joint.
- Joints are stronger than main materials.



➤ **Tools Required:**
Tube cutter, emery cloth or steel cloth, reamer of file.



Cleaning the metal parts is seldom a complicated job, but it has to be done in the right sequence.

ARMOUR HEAT SHRINK SLEEVES

Introduction

Armour Heat Shrink sleeves are a corrosion protective coating to protect the joint from exposure to atmospheric air and moisture. This will keep the joint system free of corrosion. Fully seal the joint between the two metals and cover the complete joint.

An example would be a connection between aluminium tube and copper tube , Armour Heat Shrink Sleeves take an important role to protect the connection against corrosion.



Characteristics

- Minimum Shrinkage Temperature: + 80°C.
- Excellent flexibility and insulation.
- Excellent flame retardant properties.

Description

Item Number	Quantity (pcs/bag)	Color	Length	Net weight (kg/bag)
ID19mm x L15cm	5	Black	15 cm	0.04
ID24mm x L15cm	5	Black	15 cm	0.05
ID28mm x L15cm	5	Black	15 cm	0.07
ID30mm x L15cm	5	Black	15 cm	0.08
ID35mm x L15cm	5	Black	15 cm	0.09

Note: If you require any size not shown in the catalogue, please contact us for prices and more information.

ARMOURCLAD



Introduction

ArmourCLAD not only provides professional connections but an innovative system of solder-free tubes.

ArmourCLAD can be made without a great deal of force, using simple hand assembly tools. ArmourCLAD guarantees an absolutely clean, permanent and purely mechanical tube connection with long-term hermetic air-tightness. All these make ArmourCLAD one of the most economical and reliable methods of connecting refrigerant tubes.

Characteristics & Advantages

- Approx. 40% time saving.
- Absolutely clean, efficient and reliable.
- Installation work during business hours and public access.
- Installation work in situations where there is a fire hazard.
- Light hand assembly tool without energy exertion.
- Installation can also be carried out by non-skilled workers.
- No nitrogen as purge gas.
- No solder-related quality problem.

Description

Item Number	Article name	Outer Diameter	
		mm	inch
AC001635	ArmourCLAD/NP 150635	6.35	1/4"
AC002952	ArmourCLAD/NP 150952	9.52	3/8"
AC031270	ArmourCLAD/NP 151270	12.70	1/2"
AC041588	ArmourCLAD/NP 151588	15.88	5/8"
AC051905	ArmourCLAD/NP 151905	19.05	3/4"
AC062222	ArmourCLAD/NP 152222	22.22	7/8"
AC072858	ArmourCLAD/NP 152858	28.58	1-1/8"
AC083492	ArmourCLAD/NP 153492	34.92	1-3/8"
AC094127	ArmourCLAD/NP 154127	41.27	1-5/8"



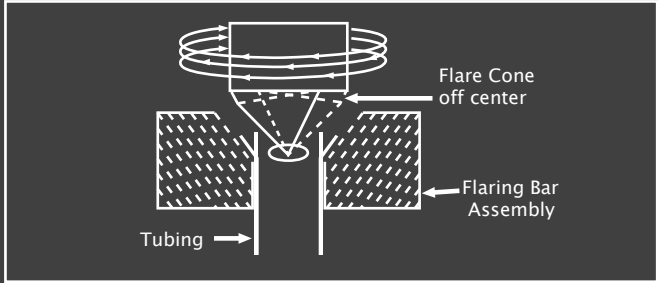
For connecting aluminium and aluminium/ copper/ or steel tubes with identical tube outer diameters.

ARMOUR ECCENTRIC FLARING TOOL

Introduction

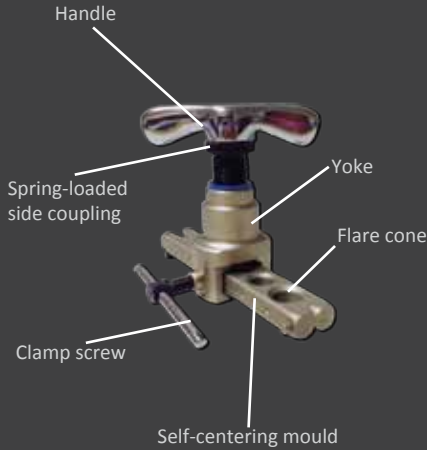
Amour Eccentric Flaring Tool is constructed from forged high quality steel and features a clutch to prevent over tightening and thinning of flare wall. The tool lets you create a 45-degree on both aluminium and copper tubings, hard drawn and soft drawn.

Armour Flaring Tool is completely sure with its self centering, non-slip tubing and hardened flare cone.



Characteristics

- Self-centering mold made from forged steel: TOUGH AND LONG-LASTING & HIGHEST FLARE PRECISION.
- Flare cone rotates off-center in needle bearings: CONTROLLED EXPANDING AND SHAPING OF TUBE END WITHOUT TEARING.
- Spring-loaded side coupling: NO REDUCTION IN WALL THICKNESS.
- Easy operation, save time and energy.
- Packaging is easy to carry.



Description

Item Number	VFT - 808 - I					
For O.D Tubing (inch)	1/4"	5/16"	3/8"	1/2"	5/8"	3/4"
For O.D Tubing (mm)	6.35	7.94	9.52	12.70	15.88	19.05
Net Weight (kg)	1.5					

The set is suitable for copper, brass, aluminium and precision steel.

ARMOUR ASSEMBLY TOOL



Armour Hand Assembly Tool

Our patented hand assembly tools were developed especially for ArmourCLAD assembly and can be used in areas that are difficult to access.

You only need one tool, because the assembly jaws can be exchanged quickly and easily.

Description

Item Number	AAT – NT2015001
Article Name	Hand Assembly Tool

Armour Assembly Jaws

The assembly jaws fit all the hand assembly tools. They can be replaced quickly and easily. Thus making ArmourCLAD assembly possible with only one tool for different tube diameters.

It is necessary to use two assembly jaws. The unit is one piece.



Description

Item Number	AAJ-A001				
Article Name	Armour Assembly Jaws				
For O.D Tubing (inch)	1/4"	3/8"	1/2"	5/8"	3/4"
For O.D Tubing (mm)	6.35	9.52	12.70	15.88	19.05

ARMOURCLAMP TOOL 2000

Introduction

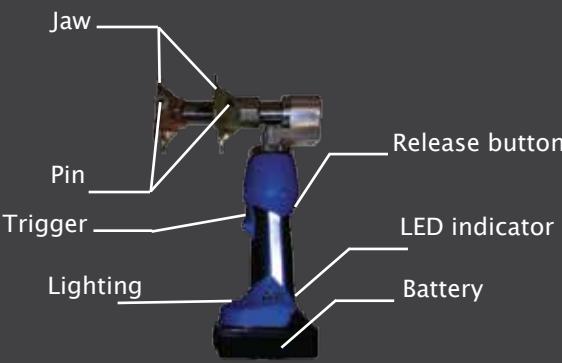
ArmourCLAMP 2000, one of the battery powered pipe crimping tools, is used to clamp Armour Aluminium Hard Drawn Tubes with its ArmourCLAD.

It's powered by 18V Lithium-Ion batteries. With a high pressure hydraulic system, it's a perfect tool to be used for installers.



Accessories

Dies	1-1/8" to 1-3/8"
Battery	2 pcs
Charger	1 pc
Sealing ring of cylinder	1 set
Sealing ring of safety valve	1 set



Technical Properties

Item Name	ArmourCLAMP 2000
Max. clamping force	20KN
Clamping range	12-40mm
Stroke	40mm
Crimp/Charge	320 times
Working cycle	3-10s
Ambient temperature	-10-40 C
Capacity	3.0Ah
Voltage	18V
Charging time	Approx.2 hours

ARMOUR ROTATABLE TORCH

ARMPRO 3000



Introduction

A butane torch is a tool which creates an intensely hot flame using butane, a flammable gas. Consumer air butane torches are often claimed to develop flame temperatures up to approximately 1,700 K (1,430°C; 2,600°F). This temperature is high enough to melt many common metals, such as aluminium and copper, and hot enough to vaporise many organic compounds as well.

Characteristics

Gas used	Butane gas cartridge
Output	1600 Watt ~ 1400 Kcal/hr
Gas consumption	110 g/hr
Flame Temperature	1200 C (blue flame)
Weight	180g
Dimension	40 x 180 x 67 mm (blister)

Advantages

- One-touch automatic piezo-ignition, ultra light compact design, adjustment flame control, convenient and easy to use.
- Multi purpose butane torch:
 - Used in restaurants: Bakery, burning hair...
 - In daily operation: Make a fire, burning insects and garbage...
 - In industrial use: Bending steel pipe, doing Neon-sign, used at construction sites...

Note: Turn the torch's knob clockwise to the gas lock position before using and performing the following steps.

Instruction manual:



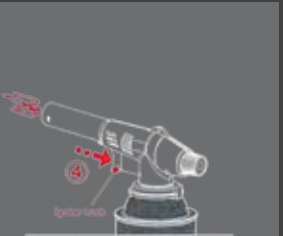
1. Install the torch into the gas cartridge: The notch collar on top of gas cartridge should match the index arm of the torch.



2. Turn the torch according to arrow direction until the torch attaches to the cartridge.



3. Turn the knob a quarter of a round according to arrow direction to open gas.



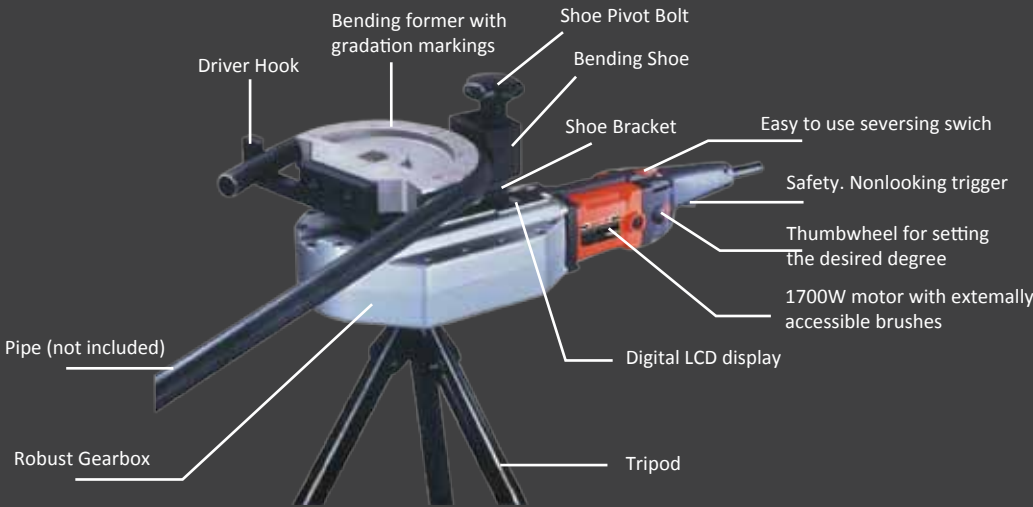
4. Press the igniter knob according to arrow direction till you hear a noise. Adjust suitable flame for use.

Introduction

Universal applications in sanitary and heating installations, refrigeration, climate control as well as industrial systems possible. Cold bending up to 180 manually or automatically.

Characteristics

- Eliminates costs in the purchase and storage of fittings Simplified work preparation.
- Less joints: Increased safety in installation work.
- Elimination of joints, saving material and energy: Quick return on investment.
- Production of repeated alternate angled bends possible: Universal application.
- Bending former made of high quality forged aluminium: Retains shape and is table.



Technical properties

Model	AB32
Voltage	110-120V~ 50-60Hz, 220-240V~ 50-60Hz
Power Input	1700W
No Load min-1	3.5
Max. Capacity	32mm (7-1 3/8")
Dimension	630mm x 230mm x 183mm
Net Weight (Machine only)	14kg (30.8 Lbs)