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Estonian explosives sector and explosion welding

Innovative solutions and
technical consulting

Content

1. Overview of the Estonian explosives sector
2. Explosion welding

Legal Regulation

- The legal basis of the Estonian explosives sector is created by the EU directives on the explosives and pyro sector.
- Both sectors (explosives and pyrotechnics) are regulated by the Explosives Act.
- On the basis of the Explosives Sector Act, 8 sub-regulations have been established that regulate handling.

Explosives, Military Weapons, Civilian Weapons and Pyrotechnics sector

- In the explosives sector, according to the Register of Economic Activities, there are **12** companies that have the right to operate with explosives in Estonia. Of these, only three companies produce explosives: Orica Estonia, Voglers Estonia and E.A.E.
- In the pyrotechnics sector, according to the Register of Economic Activities, there are **113** companies that have the right to operate with pyrotechnics in Estonia. Most of them are end sellers of pyrotechnics. Some dealers.
- In the military weapons sector, according to the Register of Economic Activities, there are **8** companies that have the right to operate with military weapons in Estonia. Most of them are transport service providers.
- In the civilian weapons sector, according to the Register of Economic Activities, there are **99** companies that have the right to operate with civilian weapons in Estonia. Most of them are shooting range and/or sales service providers.
- **NB! Civilian or military ammunition is not yet produced in Estonia!!!**

Explosion welding with environmentally safe material.

- The main materials for explosion welding include materials that are harmful to the environment (for example: TNT, RDX). These materials are sufficiently stable in the environment.
- Due to persistence, but at the same time with sufficient reactive ability, hazardous materials end up in the complex circulation of the human body and affect the physiology of the body.
- In fact, harmful substances of this kind affect all life on earth, and this bad effect can be reduced.

Explosion welding is one technical method for combining large scale metal plates.



**Picture 1. Weld plate dimensions 4700 x 4700
H Steel 50 + H Stainless 8 mm**

Explosion welding

- Explosion welding is used to combine chemically and physically poorly weldable or incompatible metals.
- In many cases, an explosion-welded joint can withstand greater forces than the metal itself.
- Vertical diesel fuel cracking reactor, operating pressure 300 bar.



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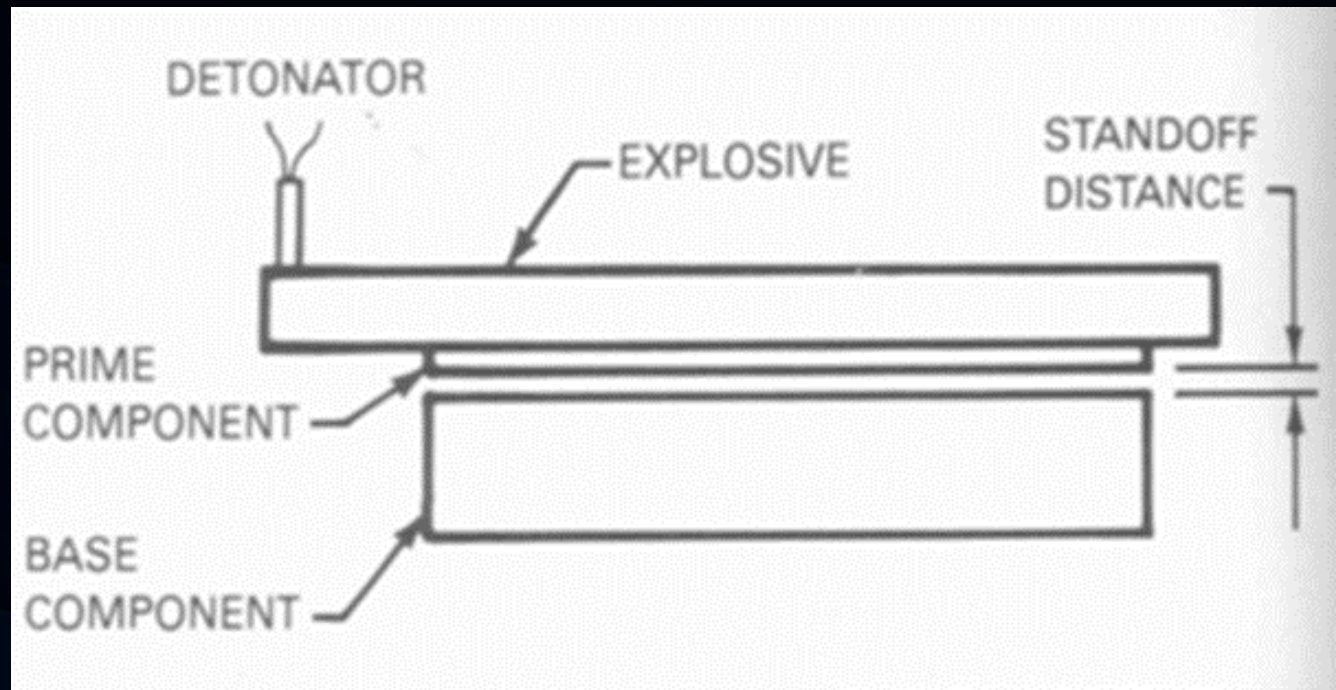
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Explosion welding materials

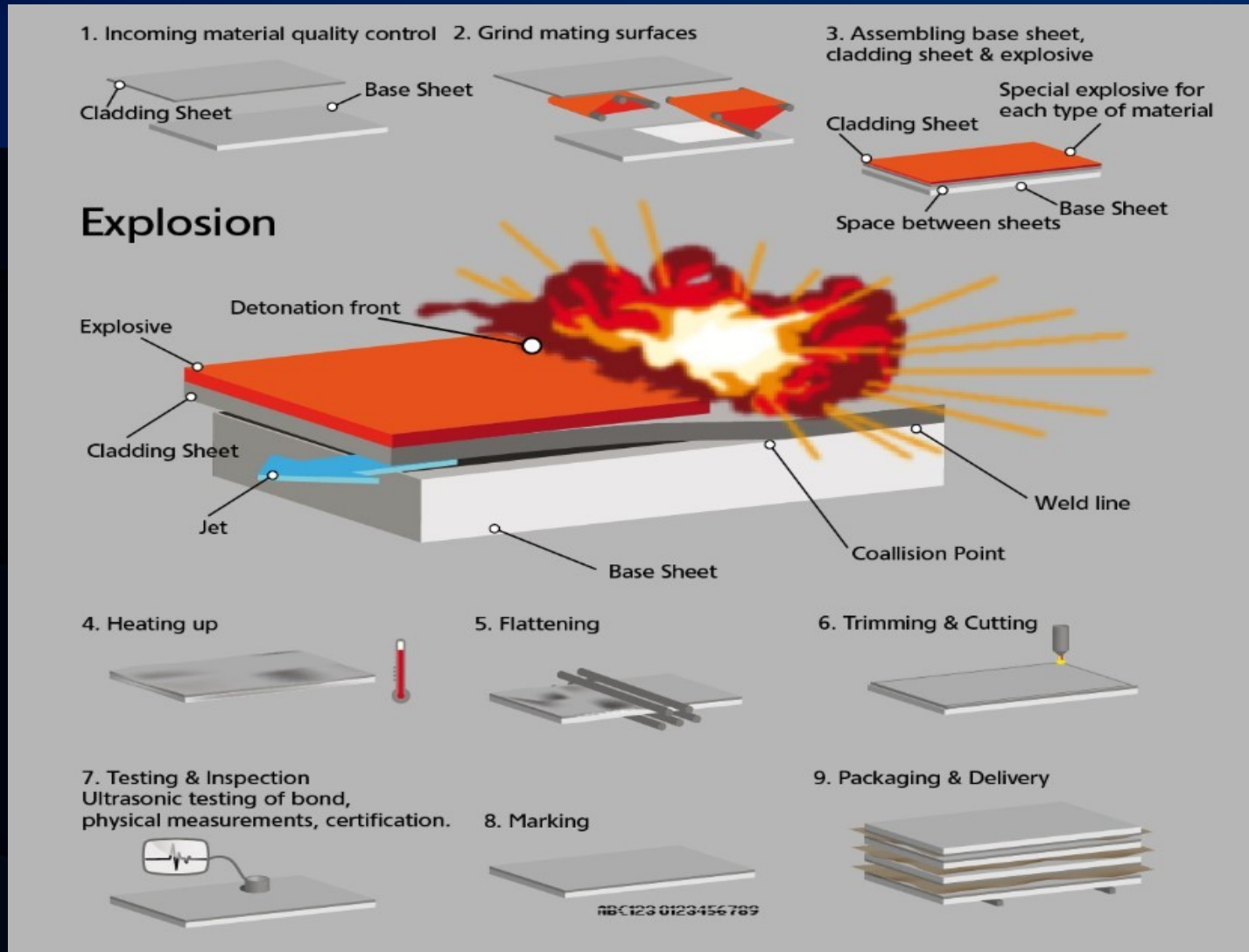
	Carbon steels	Alloy steels	Stainless steels	Aluminium alloys	Copper alloys	Nickel alloys	Cobalt alloys	Titanium	Tantalum	Magnesium	Zirconium
Carbon steels	X	X	X	X	X	X		X	X	X	X
Alloy steels		X	X	X	X	X	X	X	X	X	X
Stainless steels			X	X	X	X	X	X	X		
Aluminium alloys				X	X	X	X	X	X	X	
Copper alloys				X	X			X	X		
Nickel alloys						X		X	X	X	
Titanium								X	X	X	X

Explosion welding

- The explosion welding process is a combination of two metal surfaces at high speed. Where interfacing occurs between the softened metal surfaces of a collision, metal thinning and welding joints are ready.



Explosion welding process

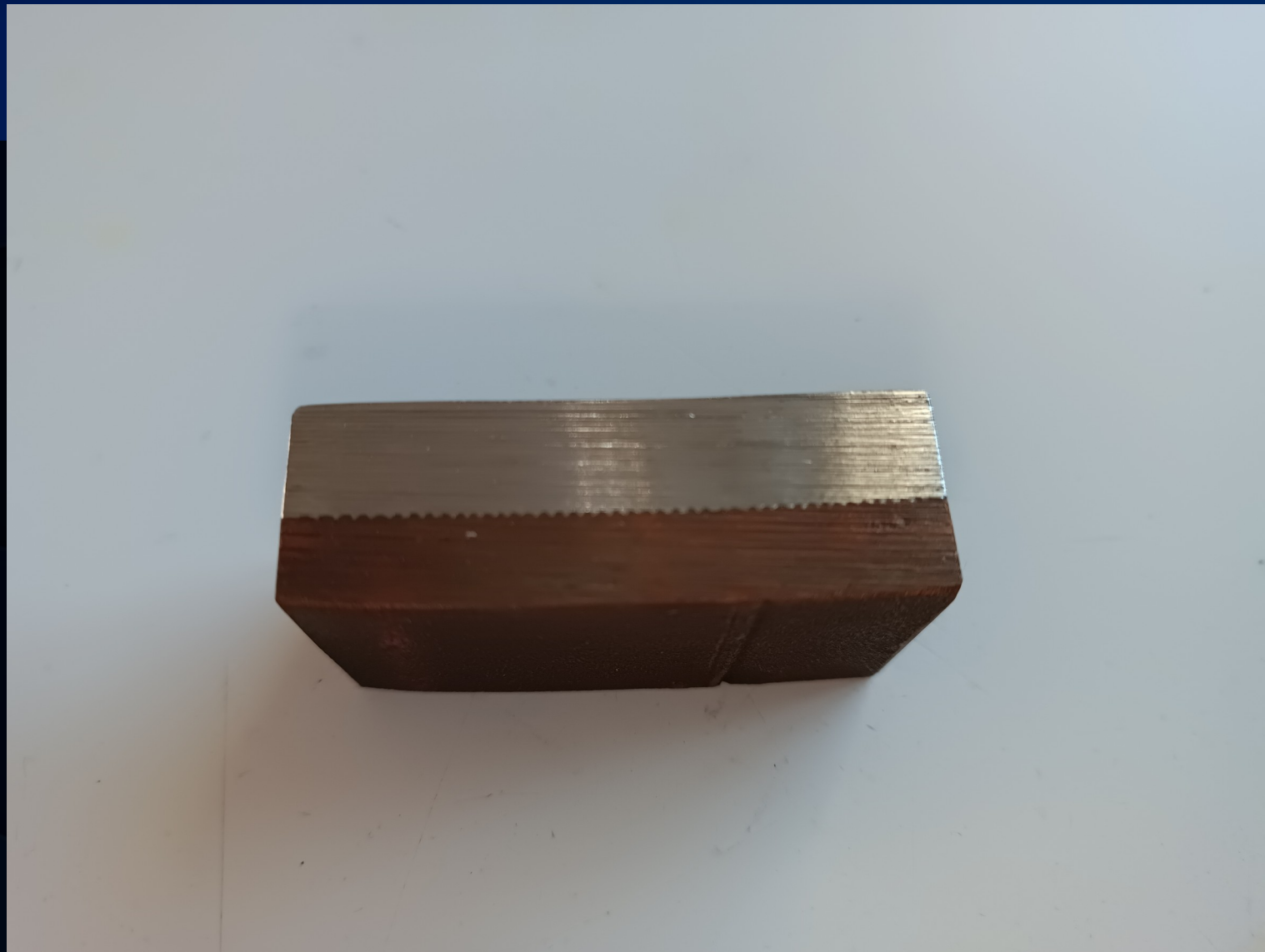


Picture 2. A large explosion generates severe blast wave / noise. 90 dB SPL for up to 15 km

- An energetic material used to combine metals must have sufficient detonation velocity and brisance.
- The sheet of metal must have sufficient energy on collision.
- The right amount of energy is needed to make the metal surfaces softer as a result of the collision.
- As a result of the softening of the metal surface, will form so-called **sea waves**. Sea waves must have the correct frequency and amplitude since these parameters determine the strength of the explosion welding.
- The explosion temperature affects the strength and stability of the welding over time (**internal corrosion**).
- The energy material used for explosion welding must explode at the same speed as the sonic velocity of the welded metals, and produce the lowest possible explosive temperature.
- In many cases, explosive welding uses energetic materials that contain chemicals harmful to the environment or attracting theft.



Picture 3. Sea waves on welded Bi-metal plate Cu/Stainless



Explosion welding

- An innovative approach to developing safe, energetic materials suitable for explosion welding was the use of environmentally safe chemicals and, which in the long run became less useful and less attractive to terrorists and other criminals.
- In essence, an energetic material was developed that successfully welded metal plates with dimensions up to approx. 2.5 x 8 m. During the development, 358 tests were carried out. During the tests were determined: technical parameters of the explosion, noise, blast wave strength, safe aging of the mixture and non-usability of the mixture for other purposes.
- The technical parameters of the mixture's explosion are easy to modify due to the simplicity of the blend White snow[®] (Valge lumi[®]).

White snow[©] data

- Detonation velocity (VOD): 1600 – 2200 m/s
- Brisance (author's method): 6-9 mm
- Oxygen balance: approx. – 4 %
- Does not contain nitro esters or other nitro compounds associated with aromatic or cyclo.



Picture 4. Brisance, Author's method.

Explosion welding used

Industries that use explosion welded Bi-metal:

- **Chemical Processing, Petroleum Refining, Hydrometallurgy, Aluminum Smelting, Metal Production**
- **Shipbuilding, Electrochemical, Oil & Gas, Power Generation**
- **Cryogenic Processing, Pulp & Paper, Air conditioning & Chillers**

Summary

- **The developed material is relatively low cost, safe to use and less attractive to steal. And most importantly - able to weld metals.**

The End!
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