

Wykład z przedmiotu  
„Montaż elektroniczny i systemy testujące”  
Specjalność: Sensory i mikrosystemy

# Montaż przez klejenie

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# Plan

- Zastosowania połączeń klejonych w elektronice,
- cechy prawidłowego połączenia klejonego,
- pasty/kleje przewodzące elektrycznie i izolujące,
- pasty przewodzące ciepło, uszczelniacze, żywice i kauczuki,
- dobór klejów do różnych zastosowań,
- używane materiały,
- techniki montażu,
- parametry połączeń klejonych

# Lectures on Electronic assembly and testing systems

Speciality: Sensors and microsystems

## Gluing and sealing in electronic assembly

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# Gluing, sealing

- Glues and sealants
- Isolating and conducting glues
- Solders and coatings
- Applications in electronics



## *Sources of information:*

*Proxima NTR (<http://www.ntr.com.pl/produkty.shtml>);*

*Amepox Microelectronics (<http://www.amepox-mc.com>) - Polish company from Łódź;*

*ESL Electro-Science (<http://www.electroscience.com>)*

*Intec Adhesives Ltd. (<http://www.intek-uk.com/products.htm>)*

*EXCEL Polyurethane Adhesives (<http://www.excelglue.com/>)*

*Hylomar Ltd. (<http://www.hylomar.co.uk>)*

# Glues and sealants

1. **Cyanoacryl glues (adhesives)** – **rapid bonding**, high strength adhesives that are clean and easy to use

**Able to bond metal, plastics, rubber, wood, leather, ceramics and cork**

Ethyl cyanoacrylate - elastic joints on polymers, best solution to connect different rubbers, elastomers...

Methyl cyanoacrylate – for gluing metals, ferrite magnets

Buthyl cyanoacrylate – for delicate plastics (polystyrene, polycarbonate) – low temperature of reaction

2. **Anaerobic adhesives** - designed to cure in the absence of oxygen when activated by a metal component or primer.

A durable plastic seal is formed which has many useful characteristics:

- Wide operating temperature range
- Helps prevent corrosion
- Resistant to water, gases, oils, hydrocarbons and many other chemicals
- Absorbs vibration
- Improved load distribution
- Lubricates component

Generally used for basic assembly operation on metals:

- threadlocking of the screws



# Glues and sealants

## 3. Epoxy glues

Wide group of adhesives – one or two-component glue cured in elevated temperature

Very strong mechanical strength and chemical resistivity

Used to bind metals, glass, concrete, ie. metal constructions, window frames, brakes

## 4. Metacryl glues

Special group of glues for rapid bonding of plastics.

Metacryl glues bond without any prior preparation laminates, polycarbonate, PMMA (plexi), ABS, and metals.

Operating temperature up to 130°C. Mechanical strength up to 300 kg/cm<sup>2</sup>.

Applications: industry (automotive – buses, cars; marine – yachts, woods industry – furnishes, forming blades), lighted indicator neons etc.

## 5. Silicone adhesives

Very high thermal resistivity - even over 300°C.

Very elastic and very good adhesion to different substrates.

Used in machine construction, electronics, electrotechnics.

Examples: gluing of car headlights, heated iron foots, miner's lamp, sealing of transformers, motor engines etc.



Motor engine sealed with a silicone adhesive

6. Polyurethane adhesives - primarily engineered to bond any two materials as long as one of them is porous, i.e., wood to wood, glass to wood, plastics to M.F., stone to bronze, etc.

# Special purpose pastes – Amepox MC

- Conducting: thermally and electrically
- Isolating: solders and coatings



**Electrically conductive, glass-silver pastes Printopox** for firing (or fusing) into silica type wafers (especially for Solar Cell applications) and or to other type of ceramics.

**Flexible pastes Electon** - which are electrically conductive and flexible after polymerization and may be used in manufacturing membrane switches and elastic printed circuits.

**Electrically conductive silver-epoxy** (trade name **Elpox**), to aid in the formation of solid joints (die attached) in industry sectors such as optoelectronics, electronics and microelectronics.

**Thermally conductive and electrically insulating** pastes with the **Thermopox** name. Amepox is currently working on materials with the highest conductivity with special prepared fillers and nano size fillers.

**Fluxopox** is the name of pastes **conducting magnetic flux**, but this paste has also anti-radiolocation properties.

Amepox Microelectronics is working with electrically conductive, polymer base pastes, **Eco-Solder** (ECS) trademark. These replace the previously popular tin/lead-type soldering pastes, and are completely safe (Pb-free) for both productions staff and the environment. They do not require the use of harmful organic solutions in the production process.

# Example of electrically conductive paste Electon 40AC



## ELECTON 40AC

ELECTRICALLY CONDUCTIVE, FLEXIBLE, ACRYLIC LACQUER.

### GENERAL DESCRIPTIONS:

ELECTON 40AC is single component, electrically conductive, silver filled lacquer. This lacquer is especially prepared for fast repairing and service application. This is short time, and very low temperature curing formulation.

ELECTON 40AC has high and stable electrical conductivity. Is easy to use, especially by brush or stick.

- \* LOW TEMPERATURE CURING
- \* HIGH ELECTRICALLY CONDUCTIVE
- \* FLEXIBLE AFTER CURING
- \* FOR SERVICE APPLICATION, EASY TO USE

### SPECIFICATIONS:

Number of components	One
Consistency	Floable fluid
Color	Bright silver
Percentage of silver (inside ready paste)	70 ± 1%
Specific gravity	2.5 – 2.7 g/cm <sup>3</sup>
Viscosity	42 000 – 45 000 cps (*)
Recommended curing schedule with air-circulated oven	80°C – (50 – 60) min. 100°C – (10 – 20) min.
Curing with IR tunnel oven	8 – 15 min. total time with (80 – 100)°C in peak.
Electrical resistivity	(1.0 – 1.2) x E(-5) Ωm (1.0-1.2E(-3) Ωcm)
Shelf life	6 months (when storage at 10°C – unopened)

(\*) - Brookfield DVIII; SPDL#4; 1 rpm; 25°C.

### ATTENTION:

1. Product is ready for use, but should be mixed very thoroughly before use using wood or plastic spatula. Mix smoothly from the bottom of the container. Mix carefully - not to whip air into the product. **INSURE ELECTON 40AC IS AT ROOM TEMPERATURE WHEN YOU WILL START WORKING WITH.**
2. Prepare consistency before use according your SPECIFICATION.
3. If you need, use AXMC TH # 40AC thinner. Thinner will change paste resistivity. Pls, do not exceed 1% of weight. After first tests pls let us know about your viscosity requirements – we will be able to change it for you.
4. Keep container closed. If open, thinner will evaporate very quickly.
5. Low conductivity and poor adhesion performance are symptomatic that paste is under curing conditions.
6. Refrigeration during shelf time is useful. Keep container with lacquer in temp. no less 10 C. Before use, increase paste temperature very slowly.
7. Use paste with adequate ventilation.
8. Avoid skin and eye contact. If ingested, consult a physician immediately.
9. Clean by acetone or other suitable solvents.

# Example of electrically conductive paste Elpox ER 63MN



## ELPOX ER 63MN

ELECTRICALLY CONDUCTIVE, PHENOLIC TYPE RESIN ADHESIVE

### GENERAL DESCRIPTIONS:

ELPOX ER 63MN is single component, electrically conductive, silver filled, epoxy-phenolic base resin adhesive. This paste is especially prepared for making connections to copper material and for through hole double sided PCB application.

ELPOX ER 63MN has high and stable electrical conductivity. This type is mostly for high-speed technological process. It doesn't dry out even on open screen during one shift working time.

### SPECIFICATIONS:

Number of components	One
Consistency	Floable paste
Color	Dark silver
Percentage of silver (inside ready paste)	63 ± 1%
Dry extract (total)	78 ± 1%
Specific gravity	2.5 – 2.7 g/cm <sup>3</sup>
Viscosity	28 500 – 30 000 cps (*)
Drying time before curing process	6 – 8 hours at room temperature, or 5 min. at temp. over 80°C
Recommended curing schedule with air-circulated oven	180°C – (40 – 60) min. 200°C – 20 min.
Recommended curing with IR heating tunnel	150°C in peak – 5 min. total time inside tunnel
Shelf life	6 months (when storage at 10°C – unopened)

(\*) - Brookfield DVII; SSA#14; 10 rpm; 25°C.

- \* ELECTRICALLY CONDUCTIVE
- \* SCREEN PRINTING APPLICATION
- \* VERY GOOD ADHESION FOR COPPER
- \* EPOXY-PHENOLIC TYPE RESIN ADHESIVE

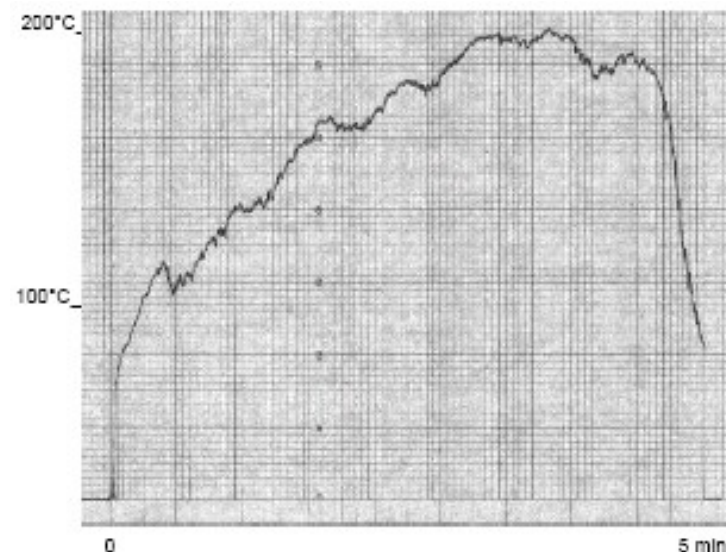


Fig.1. Example of heating tunnel profile for curing ER 63MN

### TECHNICAL PROPERTIES (\*):

Electrical sheet resistivity (curing inside oven)	0.020 Ω/sq @ 1 mil.
Electrical sheet resistivity (curing inside tunnel)	0.025 Ω/sq @ 1 mil.
Electrical resistivity	(5.0 – 6.5) × 10 <sup>-6</sup> Ωcm
Pencil hardness	9H pencil hardness (one day after curing)
Range of service for continuous temperature	(-55)°C - (+150)°C
Max. operating temperature	Over 250°C for a several sec.

(\*) - Typical value for number of tests.

5. Refrigeration during shelf time not necessary, but useful. Keep container with lacquer in temp. no less 10 C. Before use, increase paste temperature very slowly.
9. Temperature during printing process must be kept between 20°C and 25°C, with relative humidity (RH) between 40% and 65%. This condition reduces static charges on the substrate.

# Applications – chip components

## Green Products are Lead-Free, Cadmium-Free

Product	Purpose
9912-G	<b>Silver Conductor</b> Excellent solderability and leach resistance, for use on alumina or beryllia
9501-C	<b>Silver-Platinum Conductor</b> Excellent solderability, for use with R-300-P Series potentiometer applications
9512-G	<b>Silver-Platinum Conductor</b> Excellent printability, for general use
9516	<b>Silver-Platinum Conductor</b> Electrode for use with capacitor dielectrics
9693-G	<b>Silver-Palladium Conductor</b> Low cost, general purpose
9693-SA	<b>Silver-Palladium Conductor</b> For high-speed printing, excellent adhesion and solderability
9695	<b>Silver-Palladium Conductor</b> 20/1, wide firing range 625 - 930 °C
✦ <a href="#">4100 Series</a>	<b>Capacitor Dielectric Series</b> For capacitors, dielectric constant = 100 - 300
✦ <a href="#">4150 Series</a>	<b>Capacitor Dielectric Series</b> For capacitors, dielectric constant = 300 - 2,400
✦ <a href="#">4200-C Series</a>	<b>Capacitor Dielectric Series</b> For capacitors, dielectric constant = 2,000 - 10,000
✦ <a href="#">R-300-A/B series</a>	<b>Resistor Series</b> For resistors, two series, blendable in the resistivity ranges 1 - 10 kohm/sq. ar
✦ <a href="#">R-300-P Series</a>	<b>Resistor Series</b> For potentiometers, TCR = 50 ppm/°C in mid-range, CRV < -0.3%
G-481	<b>Overglaze</b> Acid resistant, excellent silver migration protection, green, 600 °C
G-482	<b>Overglaze</b> Black version of G-481

*Some ESL Electro-Science products applicable to chip components*

# Applications – displays

## Green Products are Lead-Free, Cadmium-Free

Product	Purpose
<b>2320-A</b>	<b>Copper Conductor</b> Low-temperature firing copper
<b>2554-N-1</b>	<b>Nickel Conductor</b> Nickel for gas discharge display cathode
<b>599-E</b>	<b>Silver Conductor</b> For use on touch screens, low-temperature 450 °C firing
<b>9595-A</b>	<b>Silver-Platinum Conductor</b> For use on PES, glass and alumina substrates, fires at 580 - 850 °C
<b>8835 (520C)</b>	<b>Gold Conductor</b> 520 °C firing on glass and ceramic substrates
<b>M4023-C</b>	<b>Dielectric Glass</b> Black, for use in DC gas discharge displays
<b>3100 Series</b>	<b>Resistor Series</b> Low-temperature firing, for substrates such as glass and PES
<b>4022-F</b>	<b>Sealing Glass</b> Low temperature firing (<510 °C)
<b>M4024-A</b>	<b>Dielectric Glass</b> Cd-free version of M4023-C

*Some ESL Electro-Science products used in displays technology*

# Applications – Hybrid & Multilayer Systems (gold-based)

Product	Purpose
8835-1A	<b>Gold Conductor</b> Alloyed gold for both Au and Al wire bonding
8835-1B	<b>Gold Conductor</b> General purpose, high adhesion, excellent line definition for Au wire bonding up to 33 µm
8844-G	<b>Gold Conductor</b> General purpose for use on alumina and 4920 dielectric, gives thin, smooth and dense films, excellent results with thermosonic gold wire bonding
8844	<b>Gold Conductor</b> General purpose, Cd-free, fritless, 850 °C firing
8846-G	<b>Gold Conductor</b> General purpose, alloyed, for aluminum wire bonding use on alumina and 4920, gives thin, smooth and dense films, excellent results with thermosonic gold wire bonding
8881-B	<b>Gold Conductor</b> Etchable, fritless, 850 °C firing, thin printing (6-8µm), dense film for 25 µm Au wire bonding
8881-BA	<b>Gold Conductor</b> Etchable, fritless, 850 °C firing, thin printing (6-8µm), alloyed Au for 25 µm Al wire bonding
8884-G	<b>Gold Conductor</b> Excellent wire bonding and conductivity, fritless, 850 °C firing
5837-G	<b>Platinum-Gold Conductor</b> Solderable both on alumina and when printed and fired over 4917 dielectric, can also be used on beryllia
5837	<b>Platinum-Gold Conductor</b> For use on alumina, solderable
5837-A	<b>Platinum-Gold Conductor</b> For use on multilayer dielectric, solderable
8835-Via Fill	<b>Gold Via Fill</b> For multilayers
✧ <a href="#">R-300-A/B series</a>	<b>Resistor Series</b> For resistors, two series, blendable in the resistivity ranges 1 - 10 kohm/sq. and 10 k - 1 Mohm/sq.
4905-C	<b>Multilayer Dielectric</b> Filled glass-ceramic, for use with gold conductors
4911	<b>Multilayer Dielectric</b> Multilayer dielectric, for high-frequency, low-loss applications, k = 4

*Some ESL Electro-Science products used in technology of hybrid and multilayer systems*

# Applications – chip components

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*Some ESL Electro-Science products applicable to chip components*

# Example of polymer dielectric paste ESL 14401



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**POLYMER DIELECTRIC**

**14401**

## High Temperature Insulating Coating

ESL 14401 is a high temperature dielectric, that provides very good adhesion, thermal stability, and electrical insulation when used over metal substrates such as aluminum or steel. It is designed for use with 19101 polymer silver conductor for heater applications requiring high temperature stability.

### PASTE DATA

<b>RHEOLOGY:</b>	Thixotropic, screen printable paste
<b>VISCOSITY:</b> (Brookfield RVT, ABZ Spindle, 10 rpm, 25.5°C±0.5°C)	60±10 Pa·s
<b>COLOR:</b>	Brown
<b>SHELF LIFE:</b> (at 5°C)	3 months

### PROCESSING

<b>SCREEN MESH/EMULSION:</b>	165-200/0-30 µm
<b>LEVELING TIME:</b>	5-10 minutes
<b>DRYING AT 125°C:</b>	10-15 minutes
<b>CURING CYCLE:</b>	320°C/150 minutes (10°C-15°C/min. rise)
<b>SUBSTRATE FOR CALIBRATION:</b>	alumina
<b>THINNER:</b>	ESL 455

### TYPICAL PROPERTIES (five print, dry, co-cured layers, 320°C/150 minutes, ≥50 µm)

<b>CURED THICKNESS:</b>	≥50 µm
<b>DIELECTRIC CONSTANT (K) AT 1 MHz: (25°C)</b>	3.8-4.8
<b>DISSIPATION FACTOR AT 1 MHz: (25°C)</b>	< 0.2%
<b>INSULATION RESISTANCE: (at 100 VDC)</b>	> 10 <sup>12</sup> Ω·cm
<b>BREAKDOWN VOLTAGE:</b> (at 25°C in air)	≥ 1500VDC/25µm
<b>FLASH BREAKDOWN VOLTAGE:</b> (at 250°C, one minute, 5mA leakage current trip using a standard Clare Flash Tester, aluminum substrate)	≥ 1250VAC
<b>STABILITY: (16 hrs. at 250°C)</b>	No measurable change of electrical properties
<b>COMPATIBLE MATERIALS:</b>	ESL 19101 Silver Conductor ESL 15501 Resistor

**Thixotropy** is the property of some non-newtonian pseudoplastic fluids to show a time-dependent change in viscosity; the longer the fluid undergoes shear, the lower its viscosity. A thixotropic fluid is a fluid which takes a finite amount of time to reach an equilibrium viscosity when introduced to a step change in shear rate. ([Source: Wikipedia](#))