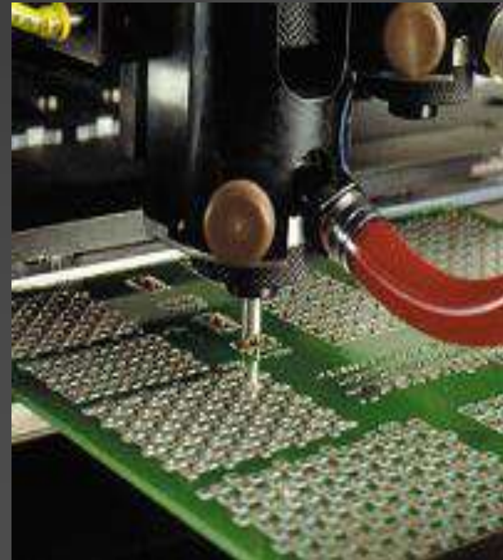
Presented by

R&D

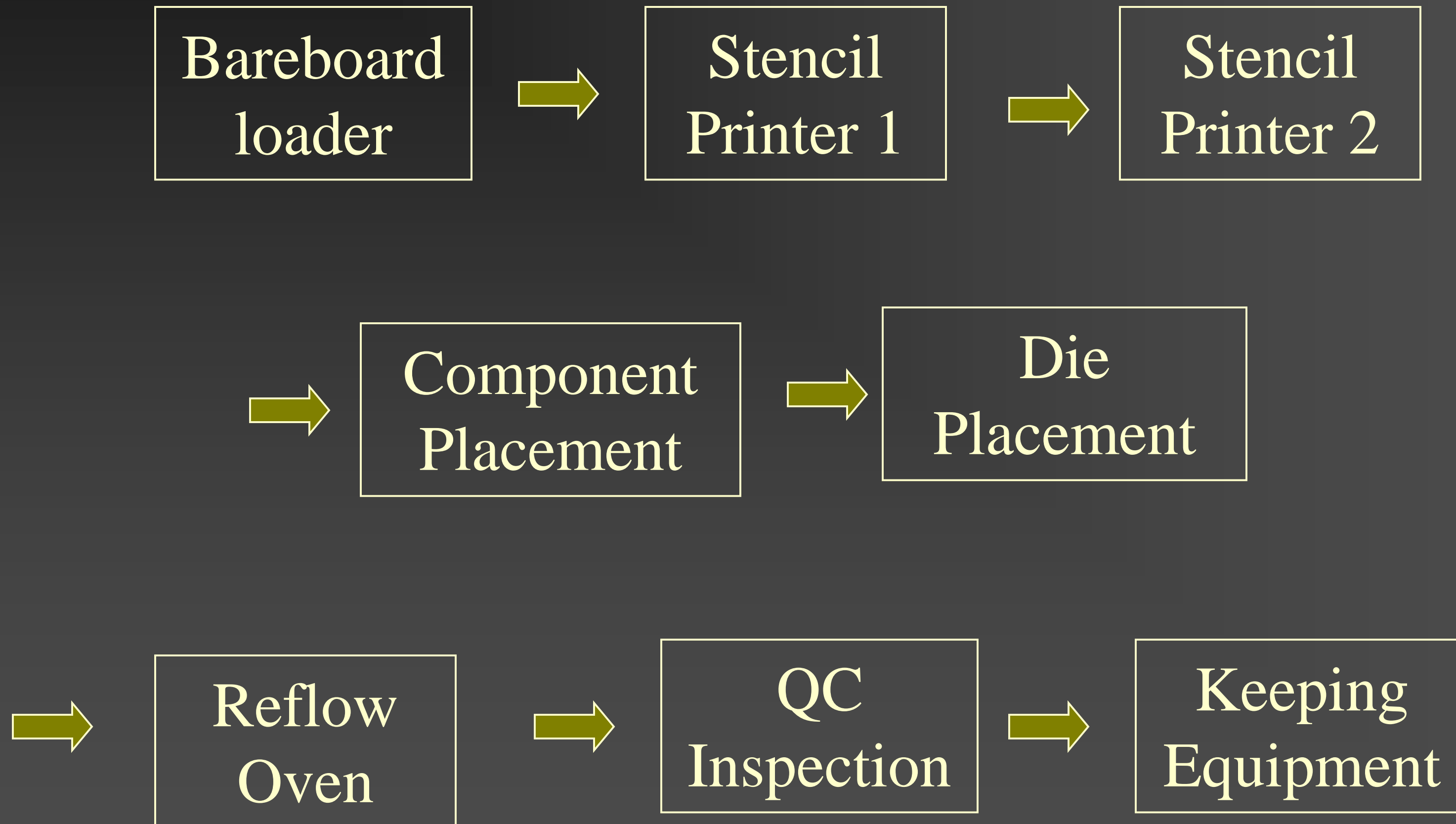
Three Bond Singapore Pte Ltd

What is SMT?

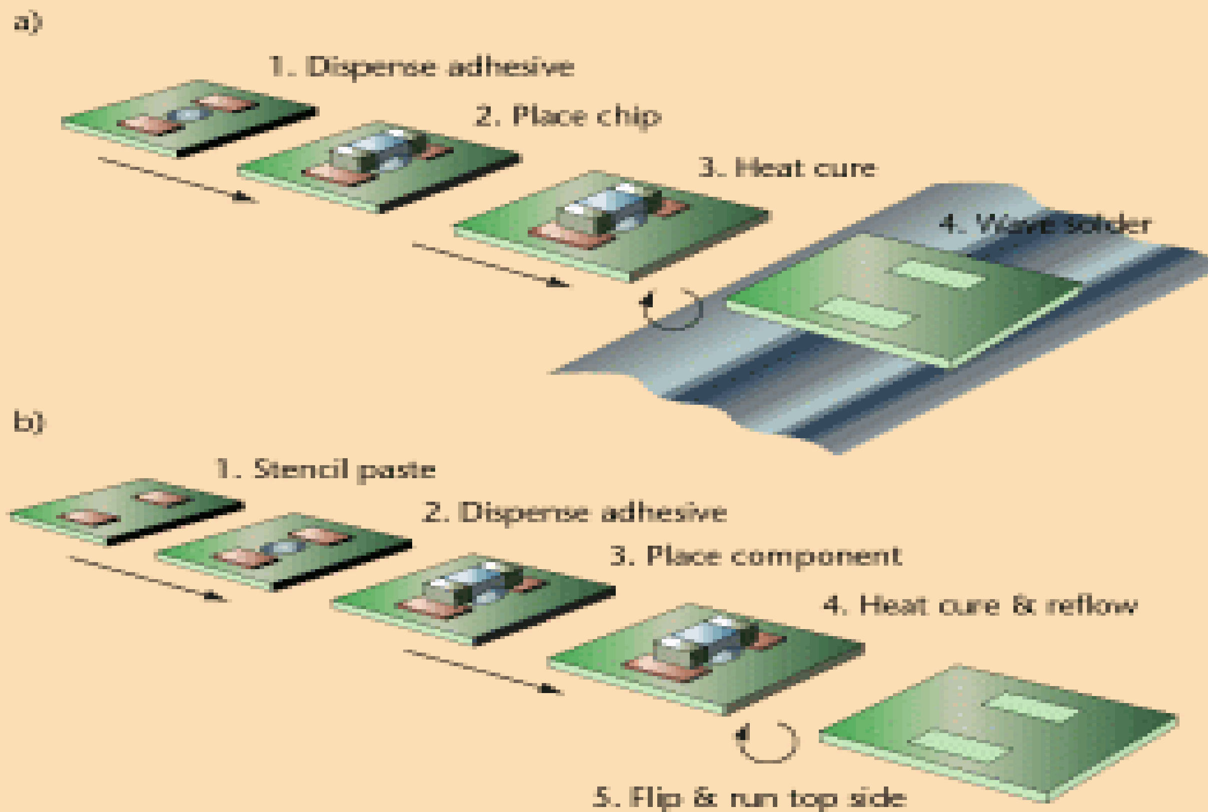
- Surface Mount Technology
- Process of fixing components, e.g. resistors, condensers, on printed circuit board (PCB)



SMT Process



SMT Process



Purpose of Using Adhesive

- To prevent the shifting of the SMD (surface mount device) after placement.
- To prevent dropping off of chips during solder reflow process.
- SMD type
  - QFP ~ 1608
  - For sizes below 1005, it is difficult to apply adhesive.

Requirements for Optimum Performance

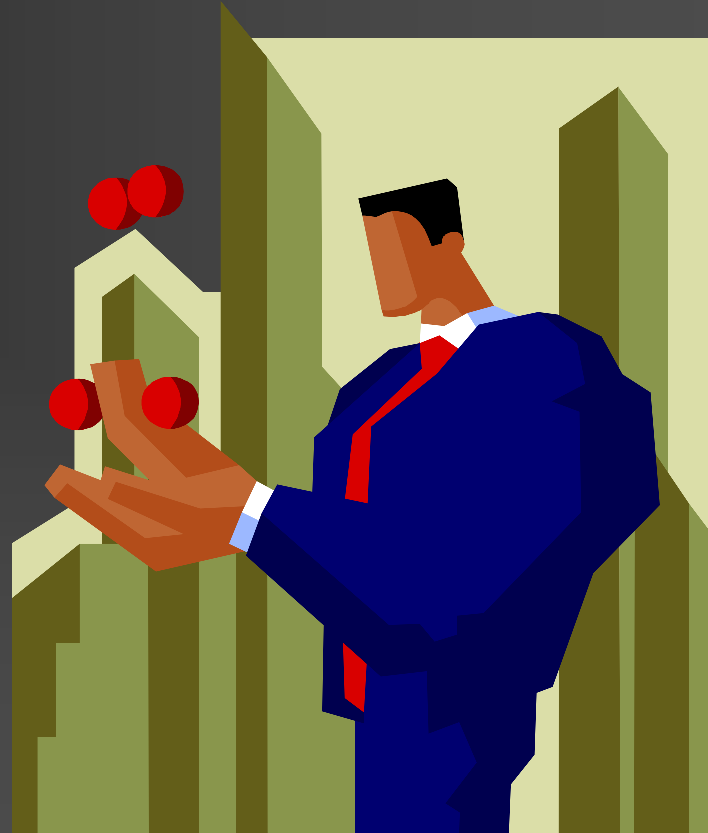
- Packed adhesive must be free of contaminants and bubbles
- Long shelf life
- Adhesive must enable high speed dispensing of very small dots
- Consistent dot profile and size
- Color must enable visual and automated detection

Requirements for Optimum Performance

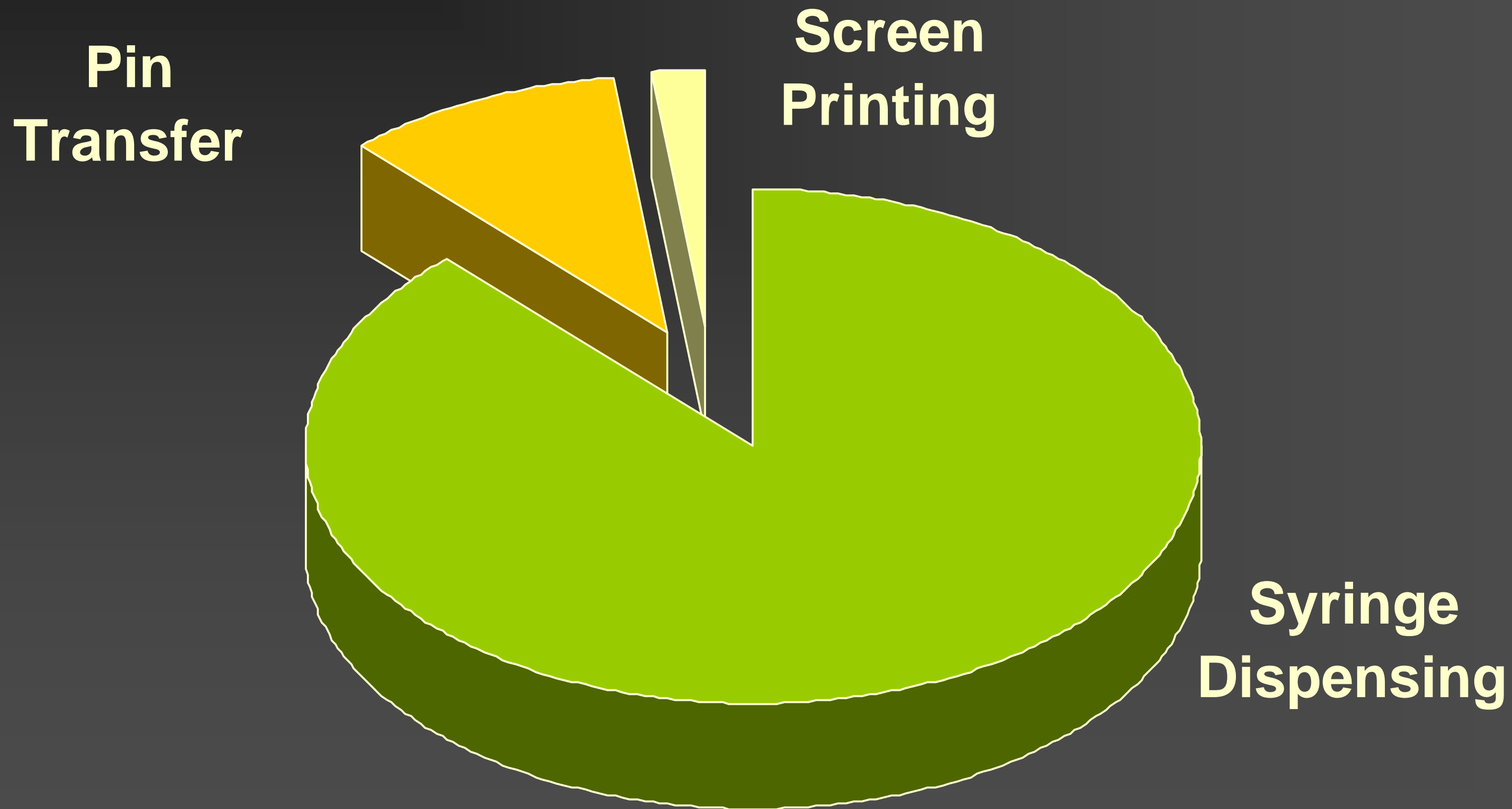
- High wet strength
- Rapid curing
- Non-slumping during cure cycle
- High strength combined with flexibility, resistance against thermal shock/ solder wave
- Good electrical properties when cured

Components of SMT Adhesive

- Epoxy resin
- Latent hardener
- Fillers
- Coloring agent
- Others



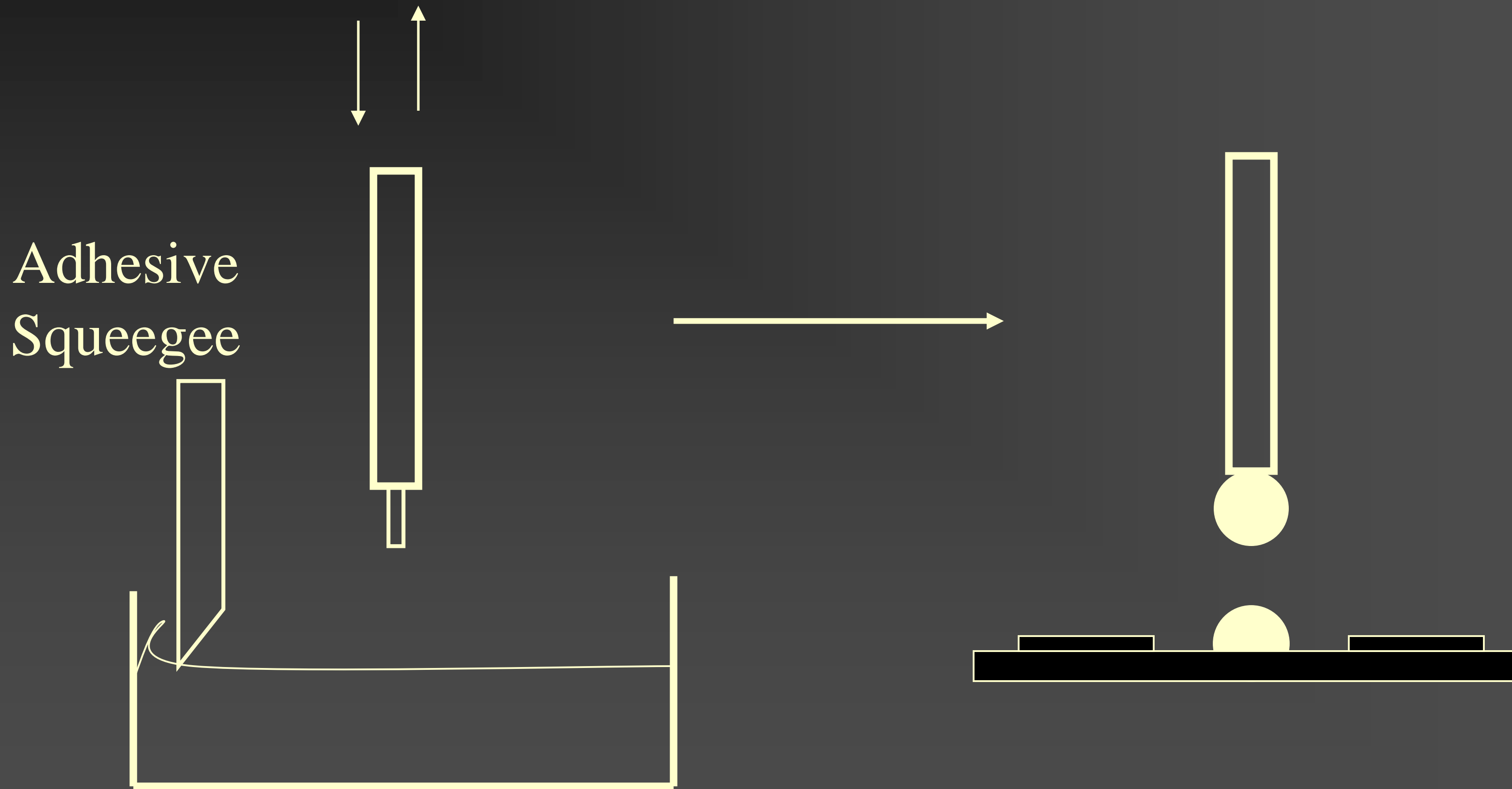
Application Methods



Method	Advantages	Disadvantages
Pin Transfer	Compact system Simple, little maintenance. Simultaneous dot placement	Needs flat board surface Open system Cannot use high yield point adhesive
Screen Printing	Simultaneous dot placement Simple process Uniform dot height	Needs flat board surface Open system Dot height limited
Pressure Syringe	Handles irregular surfaces Accepts mixed-print	Requires more maintenance

Pin Transfer

Single Pin Transfer Process

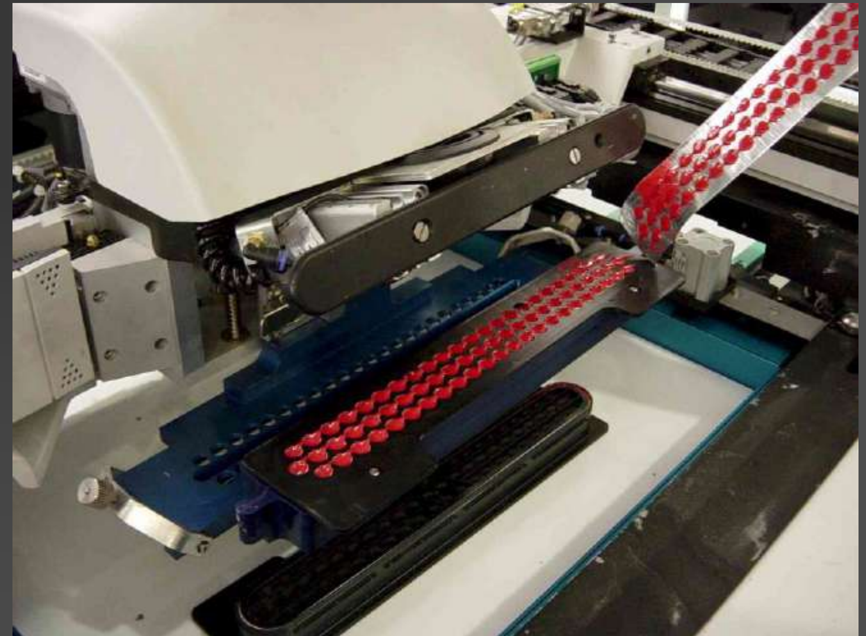


Pin Transfer

Quality of dots depends on

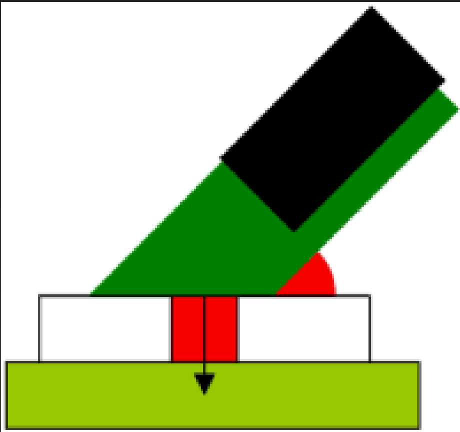
- Material
- Dwell time
- Pin diameters
- Offset height

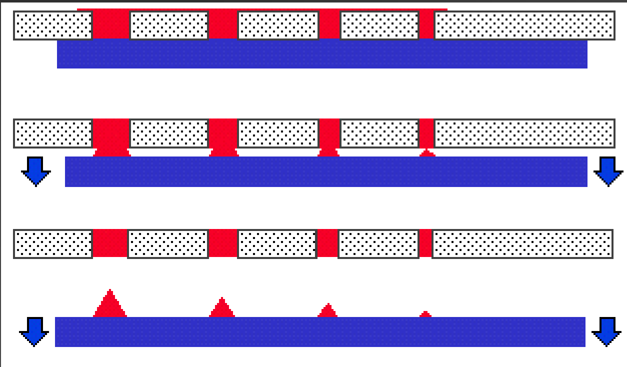
Screen Printing

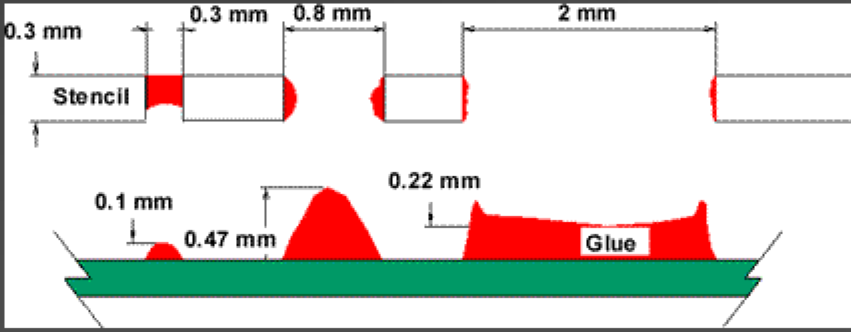


Screen Printing

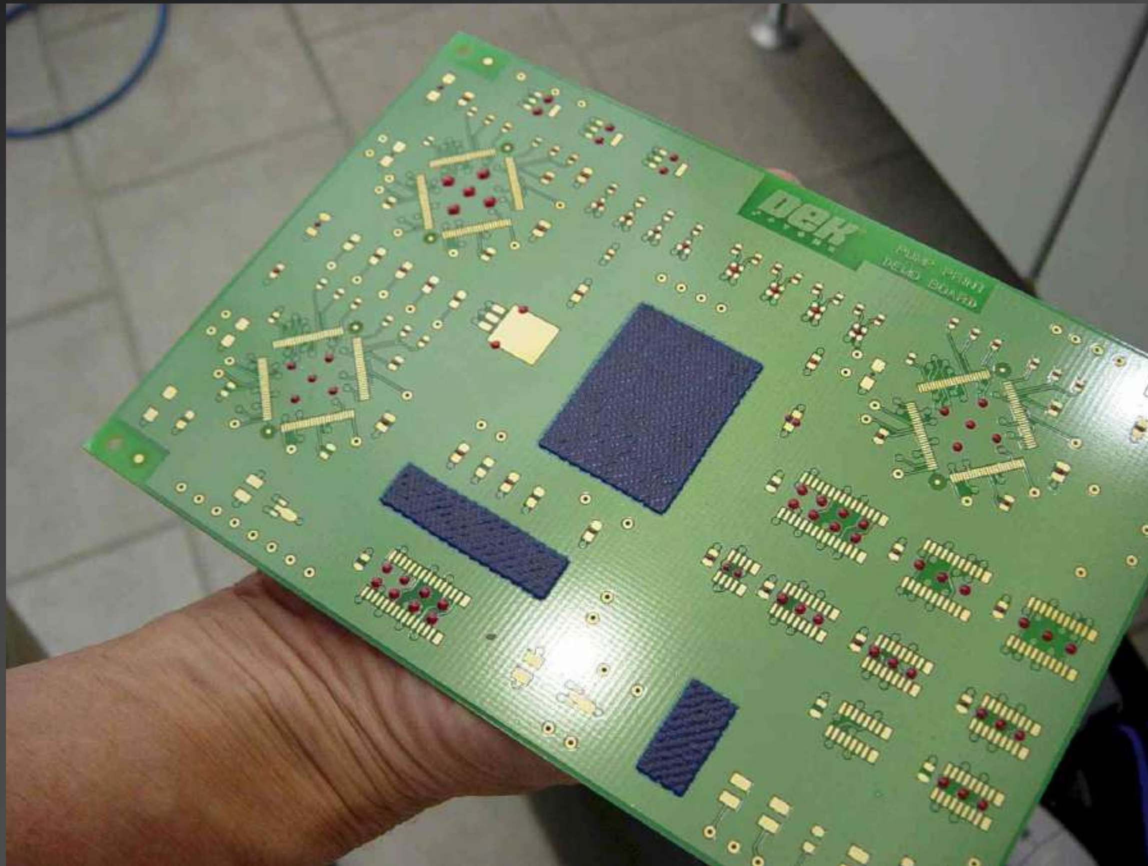
Screen Printing







Screen Printing - Result



Screen Printing

Critical variables

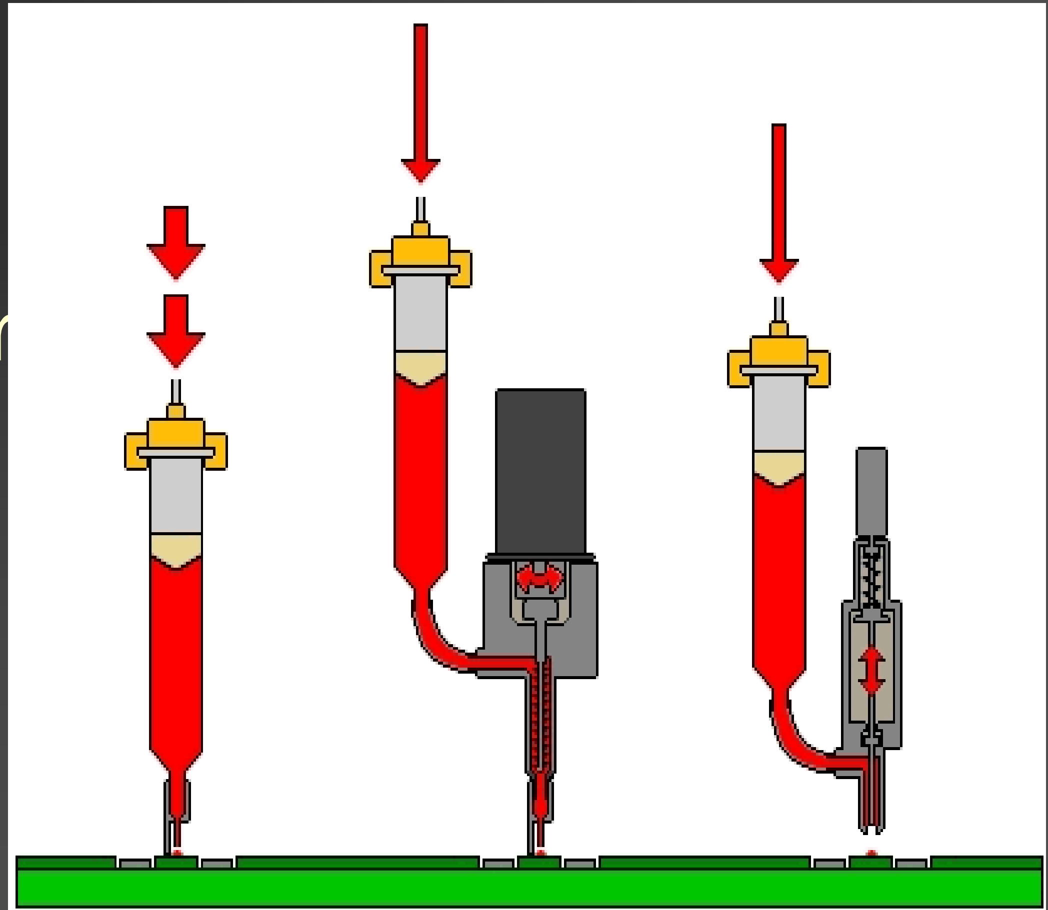
- Screen thickness
- Squeegee pressure
- Material
- Squeegee speed

To Print TB 2217H PP

System Pressure	10 kg
Pump Pressure	2 bar
Print Gap	4 mm
Print Speed	150 mm/s
Separation Speed	1 mm/s
Temperature	25°C

Syringe Dispensing

- Pressure-time systems
- Volumetric syster
  - Piston pump
  - Auger pump



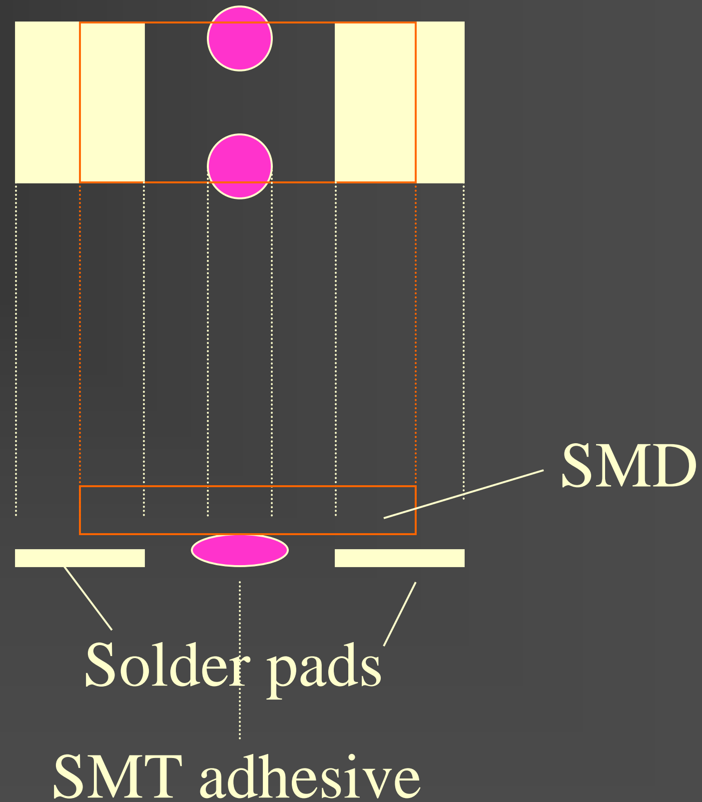
Non-contact Dispensing (Jetting)

Factors Affecting Syringe Dispensability

- Needle size
- PCB to needle “stand-off”
- Dispense time & pressure
- Dispense cycle profile
- Temperature

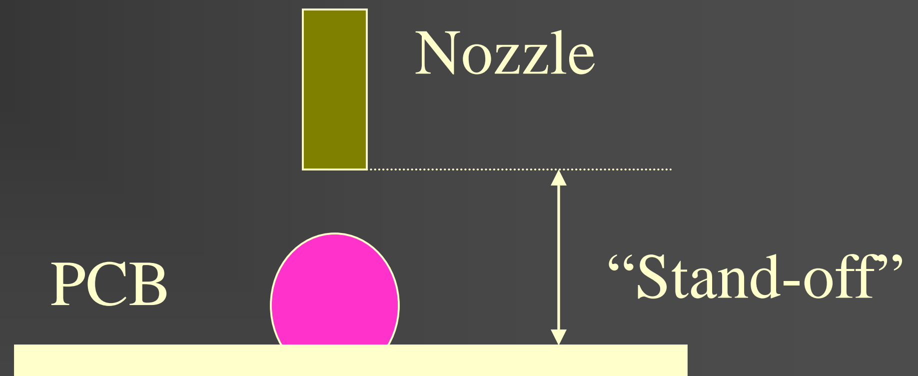
Factor Affecting Syringe Dispensability

- Needle / nozzle size (Internal diameter)

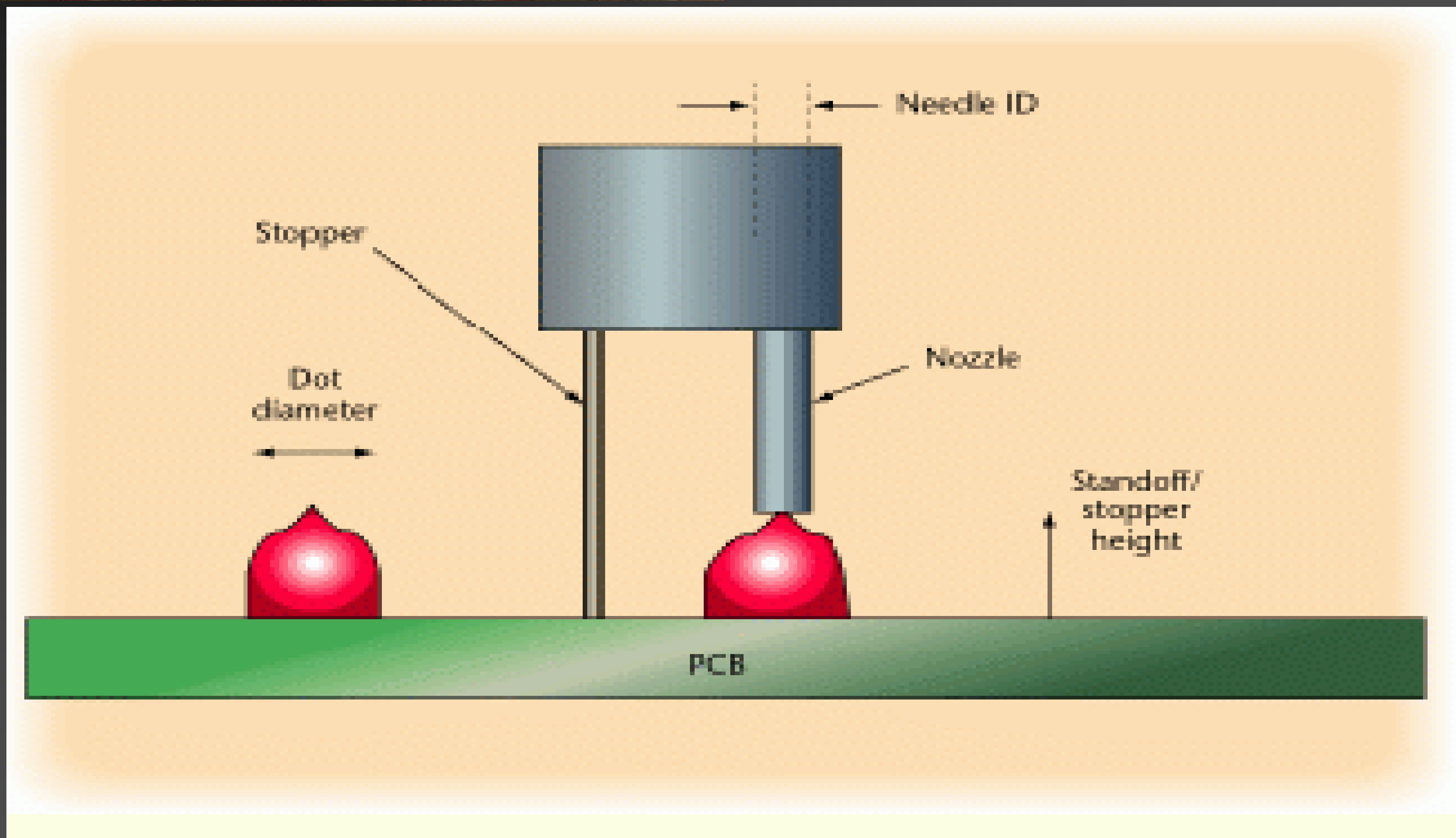


Factor Affecting Syringe Dispensability

- PCB to needle “stand-off”



Standoff Stopper

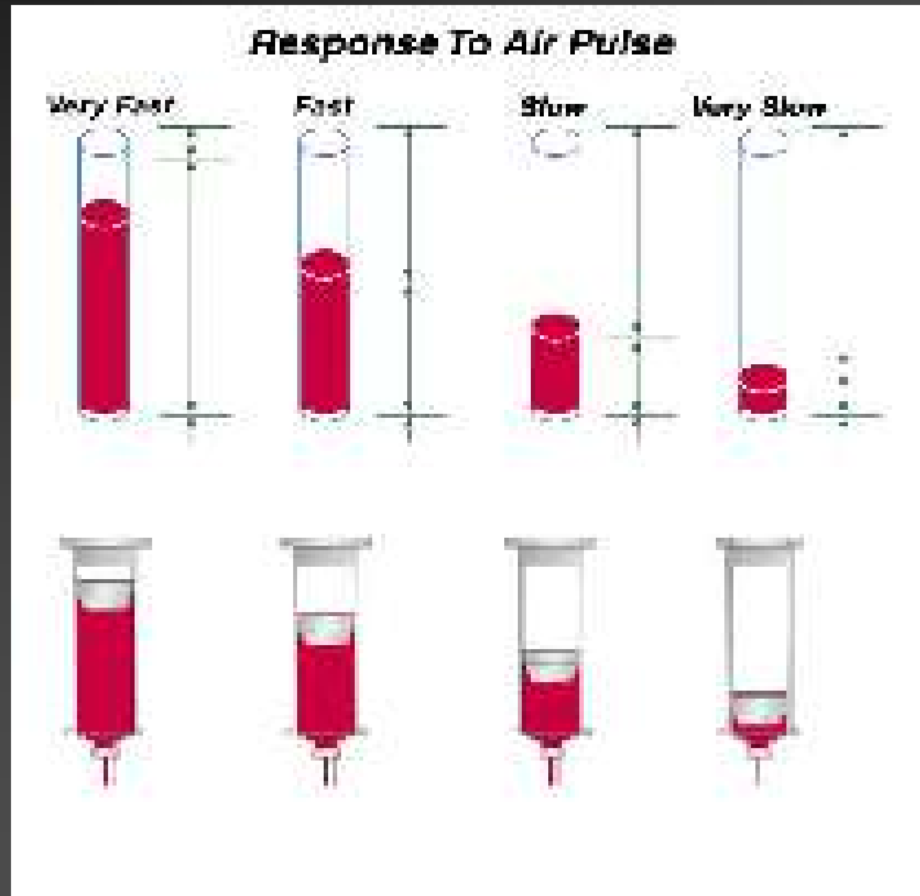


Factor Affecting Syringe Dispensability

Dispense Time & Pressure

- Controls the volume of adhesive dispensed
- Short dispense time and high pressure speed up the cycle time.
- Note: Ability of the pressure regulation system to respond.

Response to Air Pulse



Factor Affecting Syringe Dispensability

Dispense Cycle Profile

- Timing for the dispense pressure to start before nozzle arrives at the dispensing position.
- Speed at which nozzle retracts
- Retraction height
- Delay between end of dispensing and start of nozzle retraction.

Common Syringe Dispensing Defects

- Stringing or tailing
- Low viscosity product
- Inconsistent dot size
- Missed dots

Stringing

- Static stringing
- Directional stringing
- Random stringing
- Erratic stringing

Contamination of solder pads

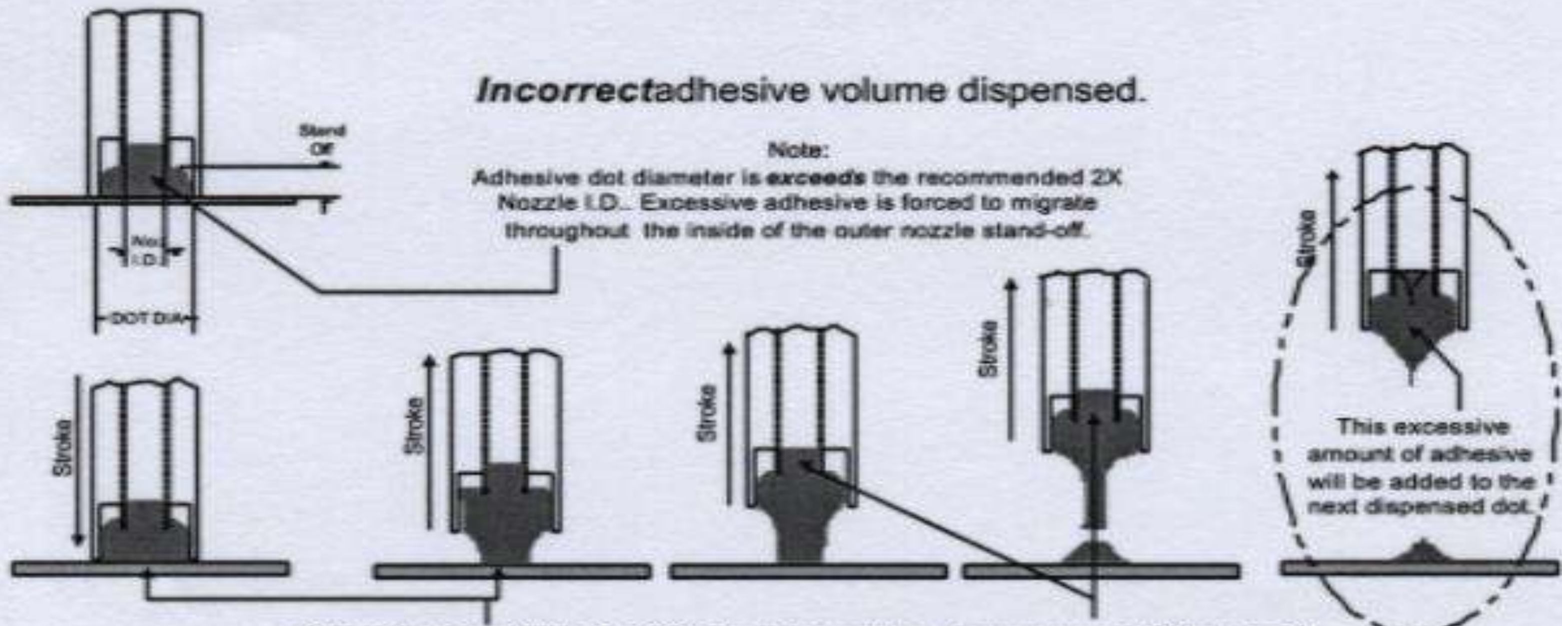
To correct stringing

- Use a smaller needle diameter / stand-off height combination.
- Increase anti-string dwell timer

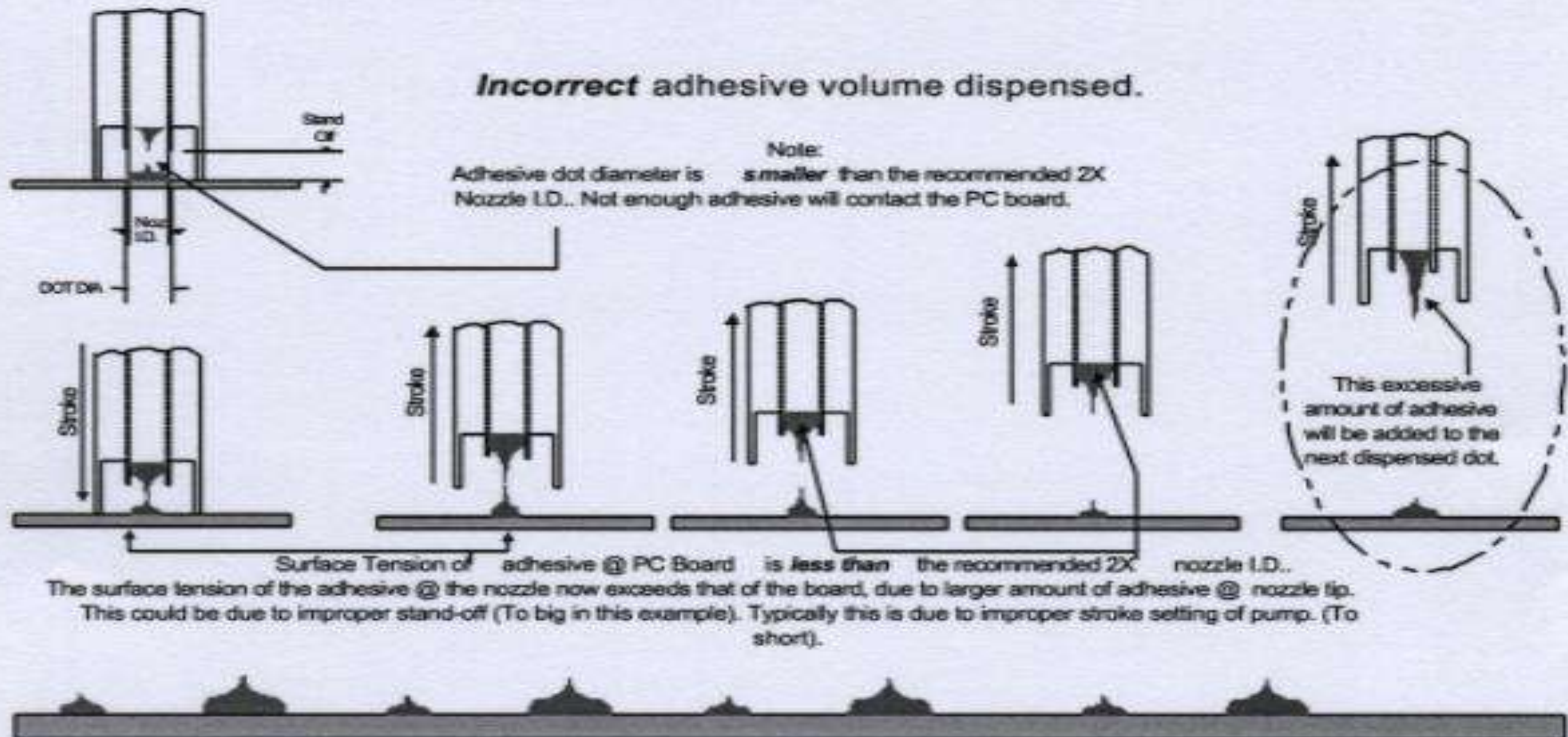
Inconsistent dot size

- Dot size is too small for the needle diameter.
- Temperature changes causes viscosity variations.
- Pressure variations, esp. changing air volume and temperature behind piston.
- Partial blockage or build up on the walls of the needle.
- Imbalance in flow through multiple needle nozzles.

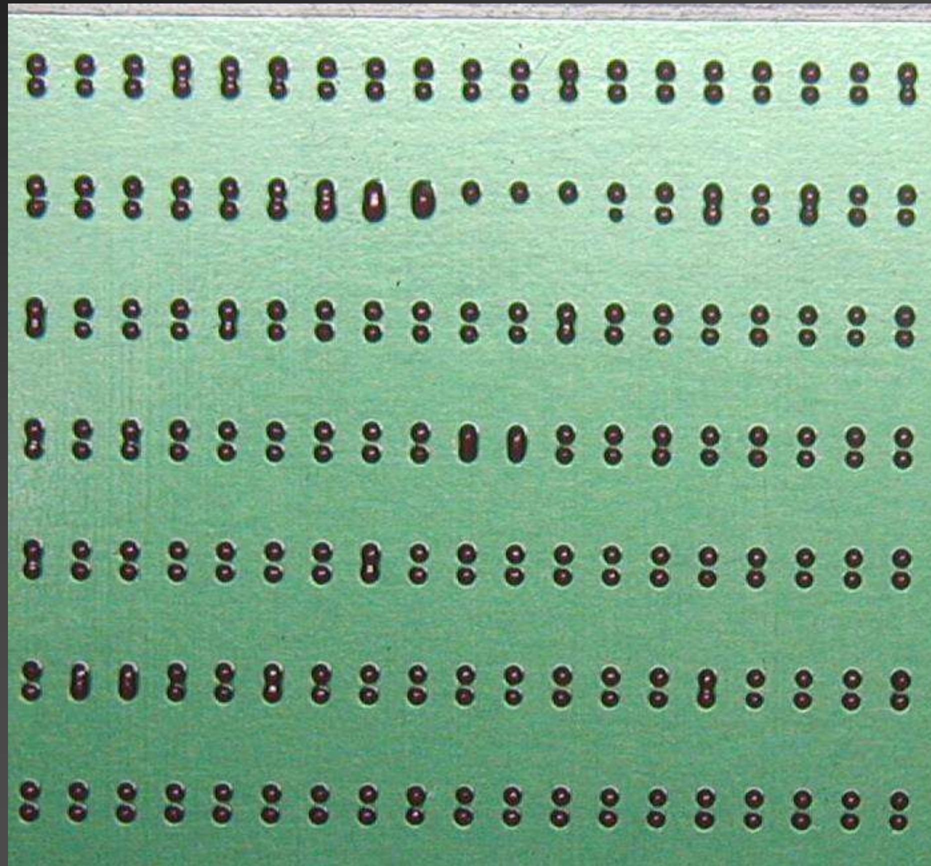
Inconsistent dot size



Inconsistent dot size



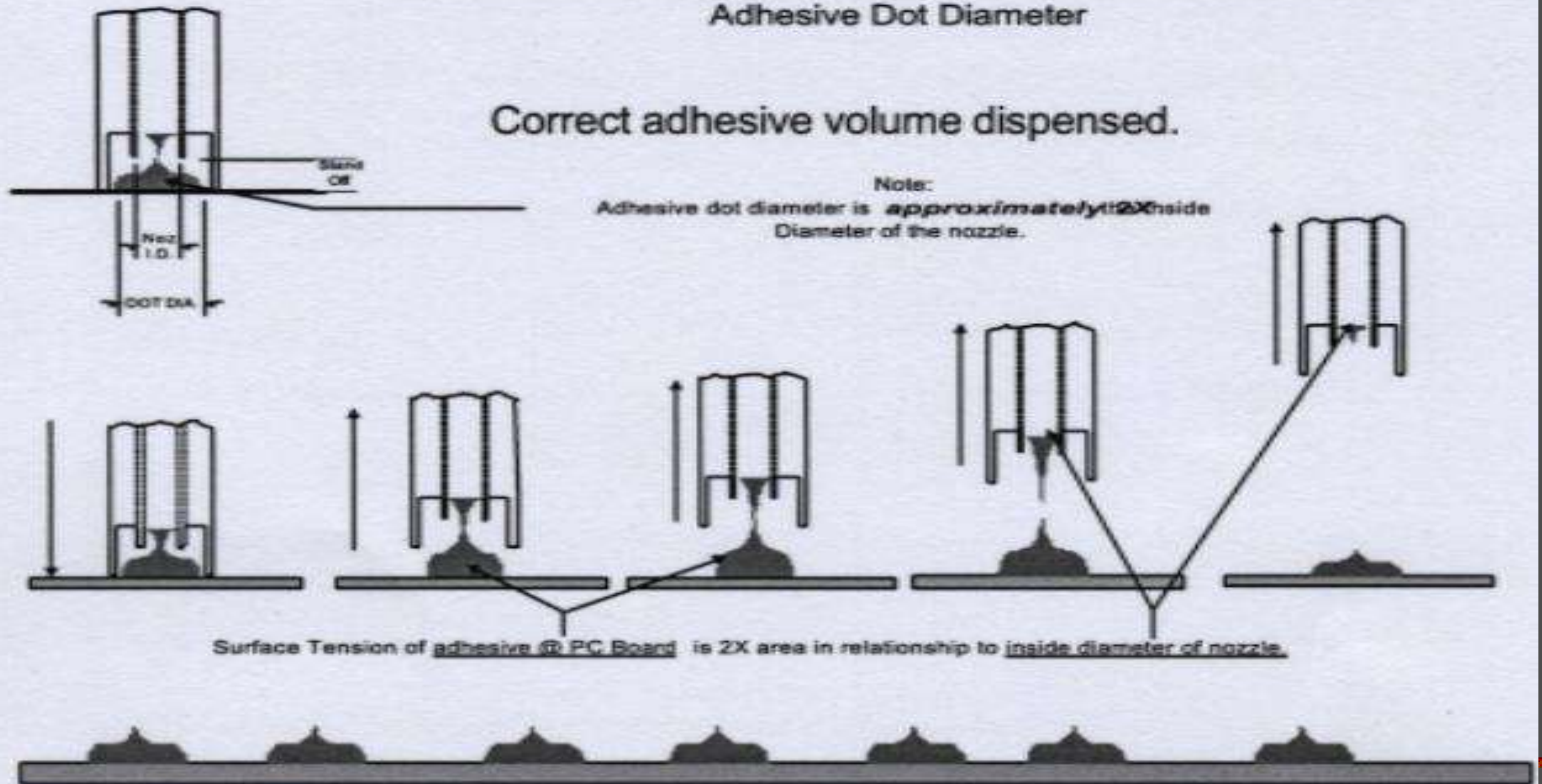
Inconsistent dot size



To correct inconsistent dot size

- Increase dot size or use smaller needle
- Temperature control and vision system feedback control of dot quantity
- Venting of air out of the syringe between ‘dispense-on’ signals
- Clean nozzles
- Check for damage in nozzles

To obtain consistent dot size



Missed Dots

- Blockage in nozzle due to a large particle or foreign material.
- Air bubbles.
- Line Pressure
- Dispense Pressure
- Dispense Cycle – pressure on time

To correct missed dots

- Clean nozzle
- Check line pressure gauge and status of system compressor
- Increase pressure setting
- Changing the pressure on timing

Types of High Speed Dispenser

Maker	Model
Panasonic	HDP-GIII (Pressure) HDF (Volumetric)
Kyushu Matsushita	BD-30S
Sanyo	TDM-3000E

Dispensing Factors

	Factors	General Setting
1	Nozzle diameter	For 1608 chip 0.3 ~ 0.4 mm
2	Temperature	28 ~ 35°C
3	Pressure	0.1 ~ 0.5 MPa
4	Timing	Depending on dispensing speed

Three Bond 2217H

Features of Three Bond 2217H

- Good fixing shape
- Stable under working environment
- Low temperature, fast cure
- Suitable for high speed dispenser
- Nice Color

Properties of Three Bond 2217H

Item	Units	2217H	Test Method
Appearance		Pink paste	3TS-201-01
Viscosity	Pa.s	196	3TS-210-02
Thixotropic Index		2.9	3TS-211-03
Specific Gravity		1.25	3TS-213-02

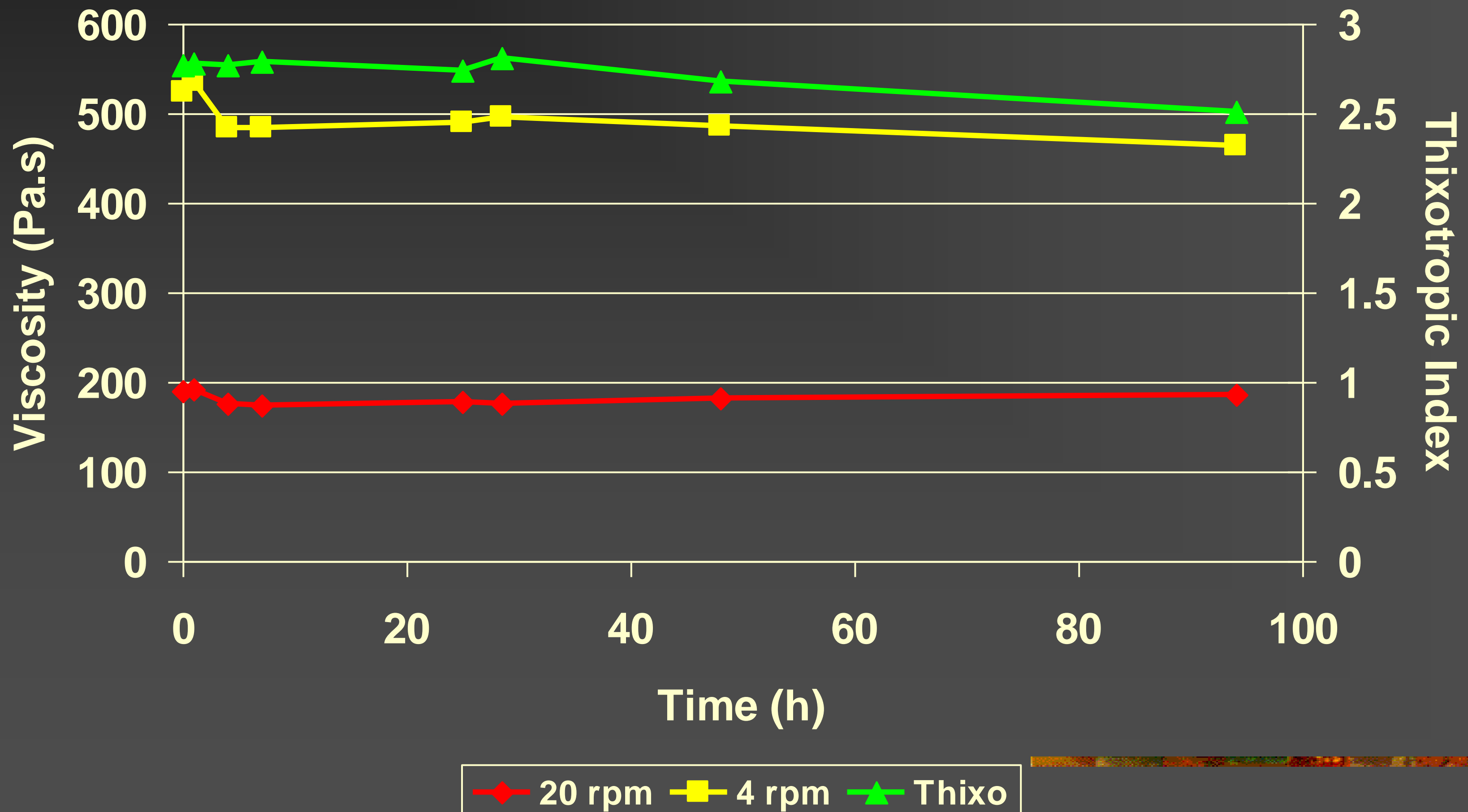
Properties of Three Bond 2217H (after cure)

Item	Units	2217H	Test Method
Shear strength	MPa	**25.2**	3TS-301-11
Hardness		**89**	3TS-215-01
Tg	^{o}C	**99**	3TS-501-05
CTE	$/^{o}C$	**$7.7x10^{-5}$**	3TS-501-05
Rate of water absorption	%	**+ 0.62**	3TS-233-02

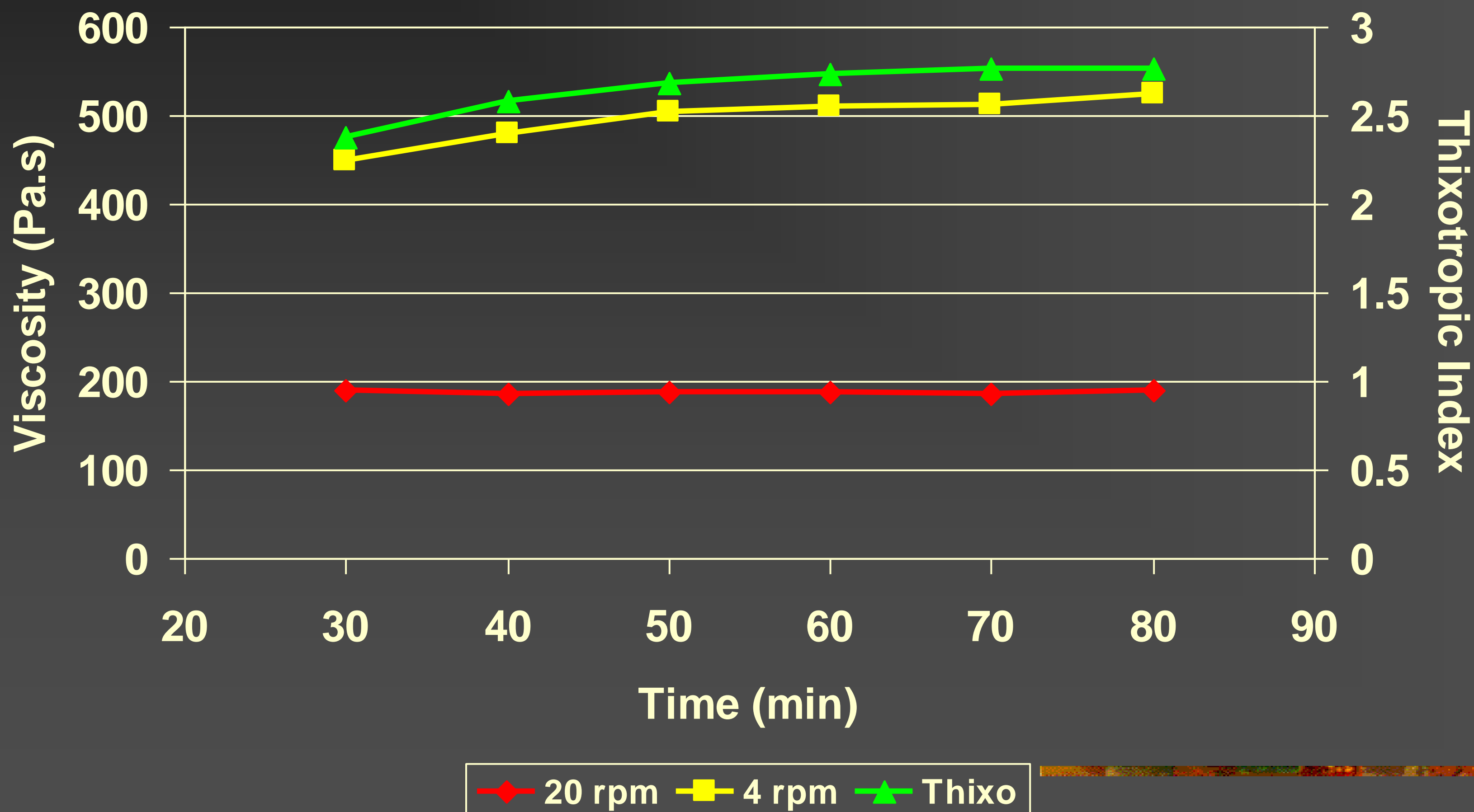
Electrical Properties of 2217H

Item	Units	2217H	Test Method
Surface Resistivity	Ω	**9.2×10^{13}**	3TS-402-01
Volume Resistivity	Ω.m	**1.7×10^{14}**	3TS-401-01
Dielectric Constant (1 MHz)		**3.26**	3TS-405-01
Dielectric Breakdown Voltage	kV/mm	**24**	3TS-406-01

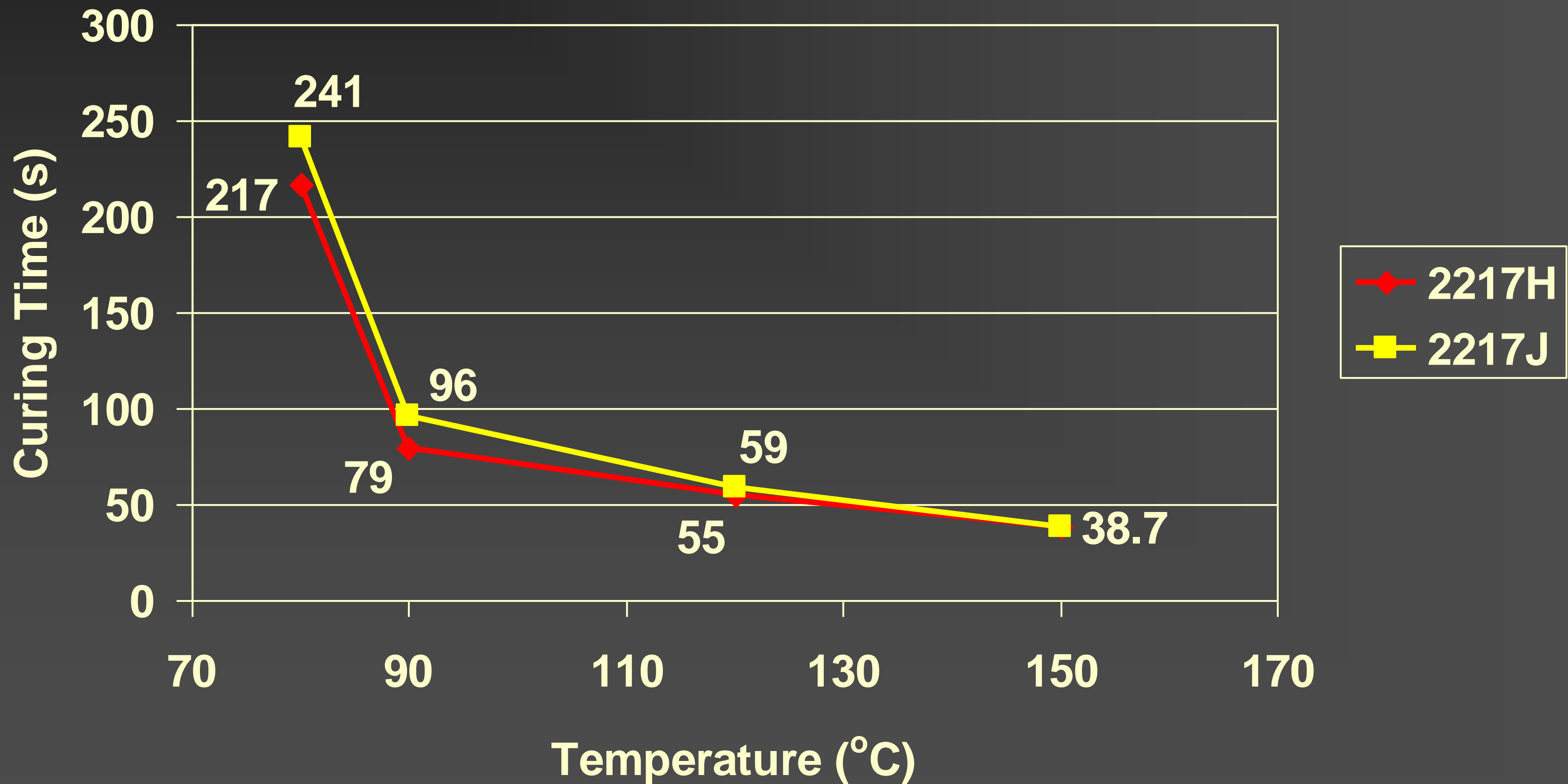
Stability at Working Environment 1 (35°C)



Stability at Working Environment 2 (high speed mixing)

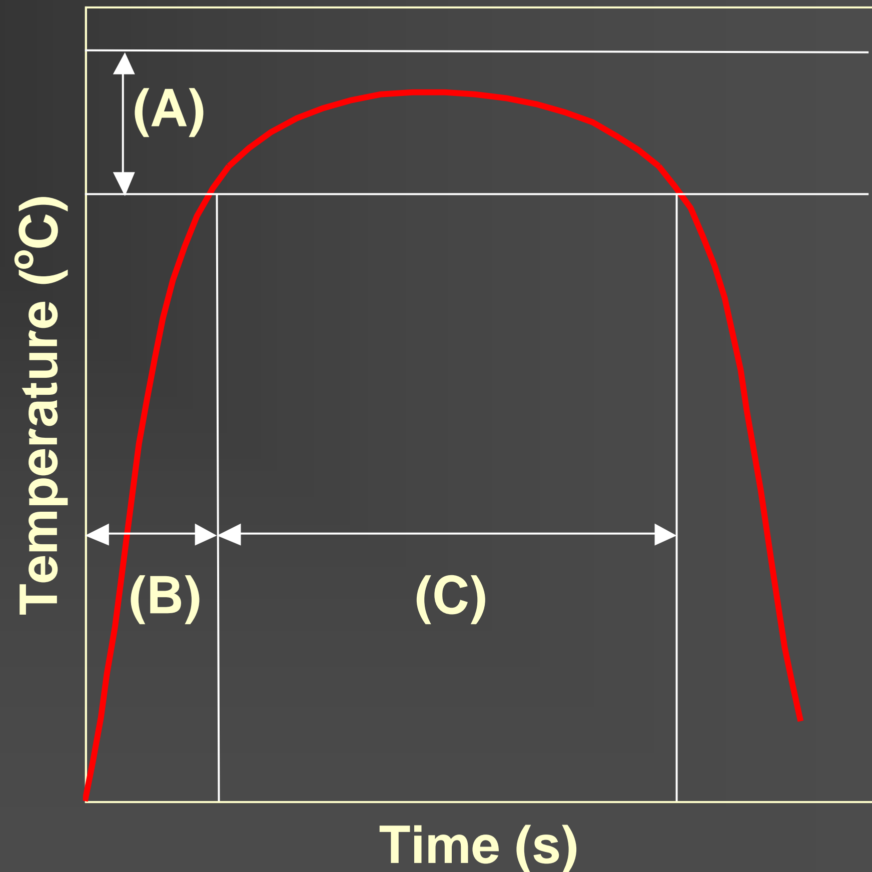


Low Temperature, Rapid Cure



Curing Profile

- (A) Temperature range at which the adhesive will cure
- (B) Time taken is dependent on the total setup
- (C) Curing time for adhesive

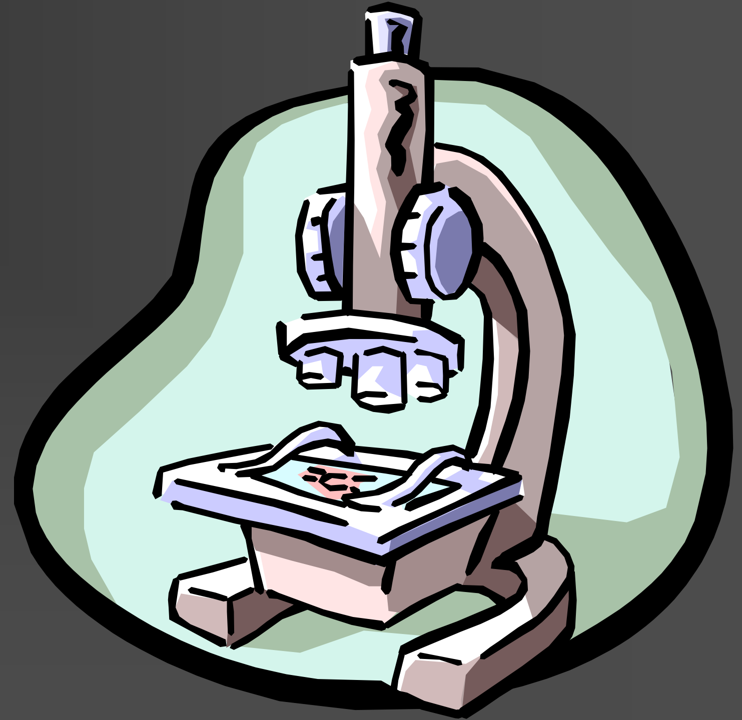


Factors Affecting Bond Strength

- Adhesion to Component
- Adhesion to PCB
- Size and configuration of adhesive dots
- Degree of cure
- Method of testing

Causes of Poor Bond Strength

- Inadequate adhesive cure
- Insufficient adhesive
- Poor adhesion



Comparison of Chip Strength 1

Chip size	QFP	3216	2125	1608
2217H	Above 5 kgf	3.8 kgf	3.2 kgf	1.9 kgf
L/T 348	Above 5 kgf	3.2 kgf	2.9 kgf	1.6 kgf

Curing condition: 150°C x 90s

Comparison of Chip Strength 2

Curing Condition	100ºC x 90s	100ºC x 180s	120ºC x 60s	150ºC x 45s
2217H	1.2 kgf	2.4 kgf	2.9 kgf	2.9 kgf
Seal glue	Not cure	Not cure	1.4 kgf	1.8 kgf

Chip size: 1608, Base plate: glass epoxy

Strength for Glass Diode 1

	TB 2217H		PD955M		PD860002SPA	
	130°C	265°C	130°C	265°C	130°C	265°C
Ave	1.66	1.56	1.42	0.87	1.56	1.0
Max	2.2	2.7	2.6	1.3	1.8	2.1
Min	1.1	0.8	0.6	0.2	1.5	0.5

Units: kgf

Strength For Glass Diode 2

	100°C x 3min		110°C x 3 min		125°C x 3 min	
265°C	Before	After	Before	After	Before	After
Ave	0.54	1.90	0.56	2.22	1.00	2.77
Max	0.9	2.6	0.9	3.2	1.6	4.1
Min	0.3	1.1	0.4	1.8	0.6	1.8

Units: kgf

High Speed Dispenser

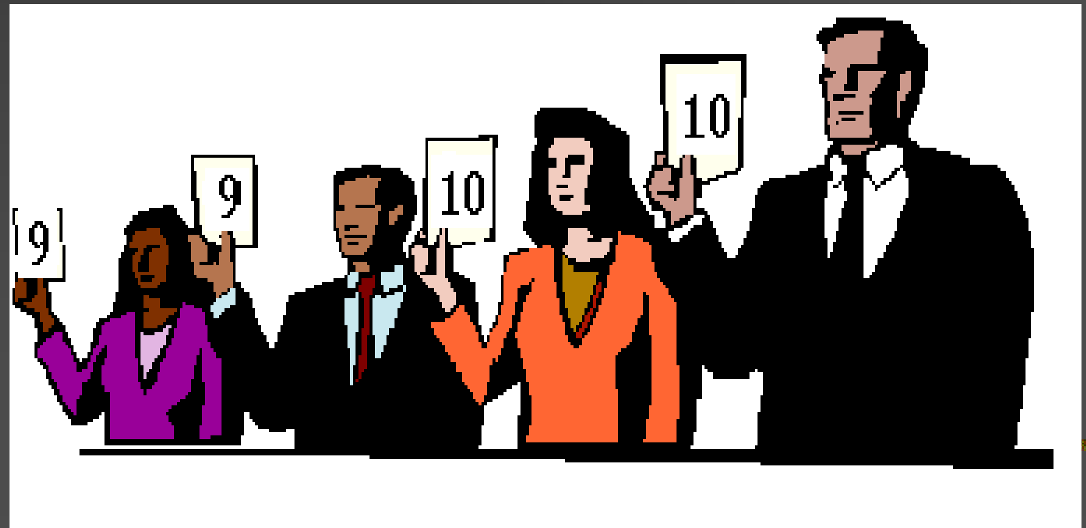
TB 2217H Fitted Onto Dispenser

DEK Pump Printing

- Mr Andy Bain of 3BEu (UK) had worked with DEK (UK) to evaluate TB 2217H-PP for use on their machine.
- The test results show that TB 2217H-PP behaved well at high print speed, giving neat, conical deposits
- Hence, TB 2217H-PP goes into DEK's database as a Grade "C" material, i.e., it has passed all aspects of the ProFlow Paste Evaluation.

Advantage of 2217H

- Advantage over other competitor's product
  - Good bonding strength (even for IC)
  - Low temperature curing possible
- Product can be used on high-speed dispenser.



Disadvantages of TB 2217H

- High filler system, different from conventional SMA
- Requires higher nozzle temperature (more than 30°C) to achieve easy dispensing
- Due to high pressure exchange, heat is generated and causes curing around the plunger

Latest Product

- Three Bond 2235H
- For use on Pin Transfer machines
- Currently used by Sharp Roxy Electronics Corporation Sdn Bhd in Malaysia
- Helped in reducing the chip-drop rate
- Achieve higher chip strength (mostly material failure of the resist)

Three Bond 2235H

Item		Units	TB 2235H	Test Method
Appearance			RED	3TS-201-01
Viscosity		Pa.s	183.6	3TS 210-02
Thixotropic Index			3.15	3TS 211-03
Curing Speed	120°C	s	52	3TS 220-08
	130°C		20	
	150°C		20	

Three Bond 2235H (after cure)

Item	Units	TB2235H	Test Method
Shear Strength	MPa	16.5	3TS 301-11
Hardness		90	3TS 215-01
Tg	^{o}C	110	3TS 501-05
Coefficient of Thermal Expansion	$/^{o}C$	64.9×10^{-6}	

Curing condition: 130°C x 15 minutes

Future Development

- Lower filler content but good strength
- Low temperature cure type

Handling Precautions

Storage

- Keep at 5 ~ 10°C for maximum shelf life, unopened.

Before use

- Take out from storage and stand at room temperature for about 2 hours.
- Open the cap only after the temperature of the epoxy has reached room temperature.

Handling Precautions - Dot Size

- Needle Temperature
- Shot Time
- Air Pressure
- Needle size

Factors Affecting Cure

Heating Temperature

Adherent Material

Verify the Surface Temperature Profile Regularly !!!

Panel Size

Type and amount of chips

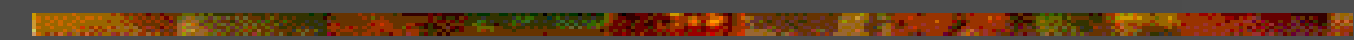
Handling Precautions - Cleaning

- Do not dip or soak nozzle in solvent
- Solvent will cause the resin to harden in the nozzle
- Remove excess resin from nozzle
- Remove resin in nozzle with fine needle
- Wash with solvent (through flushing or ultrasonic cleaning)
- Dry thoroughly with an air gun

Handling Precautions - Others

- Use appropriate local ventilation for work areas and heating areas
- Do not spill during handling
- Compound may cause inflammation when kept in contact with skin for a prolonged period. Wipe off with wet towel or cloth and then wash with soap and water. Use protective equipment such as gloves, etc.

Questions and Answers



Thank You

For your kind attention & future help