Developing a contact cleaning system for the SMT industry

A Case Study

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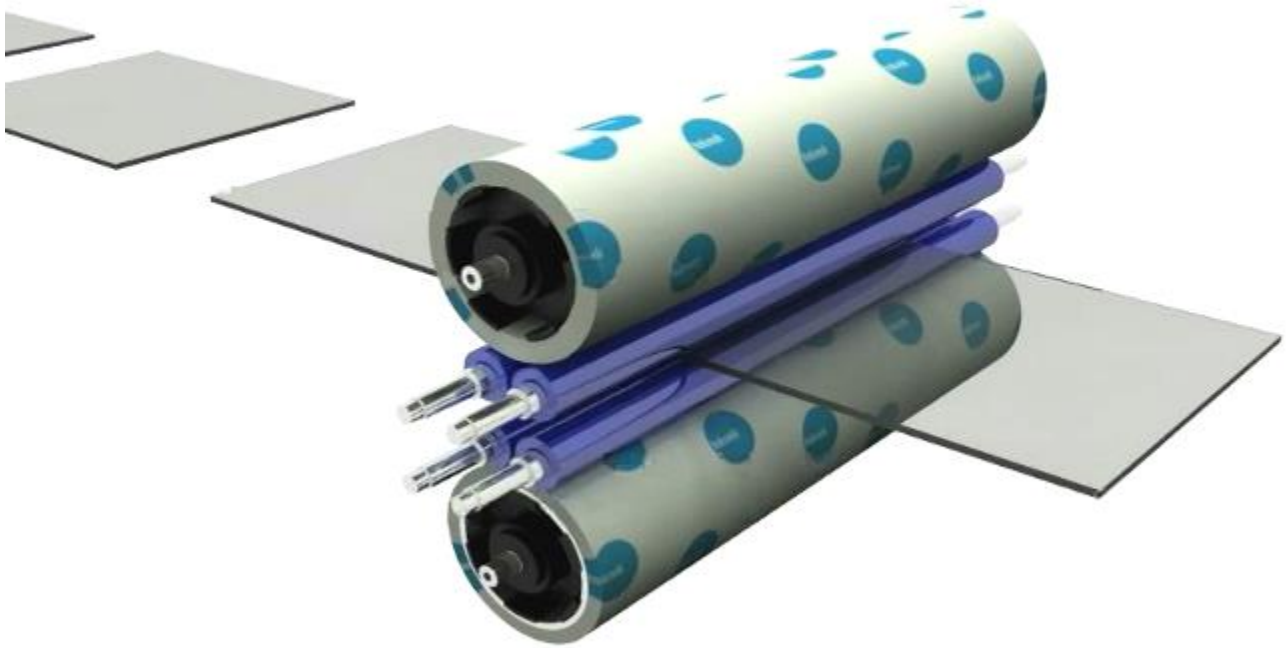
Objectives

- The key objectives of this development work are to
  - Have a contact cleaner which meets the requirements of ANSI ESD S20.20
  - Does not compromise of the cleaning effectiveness of the equipment

Outline

- The existing technology
- Applying the ANSI ESD Philosophy
- Results
- Conclusions

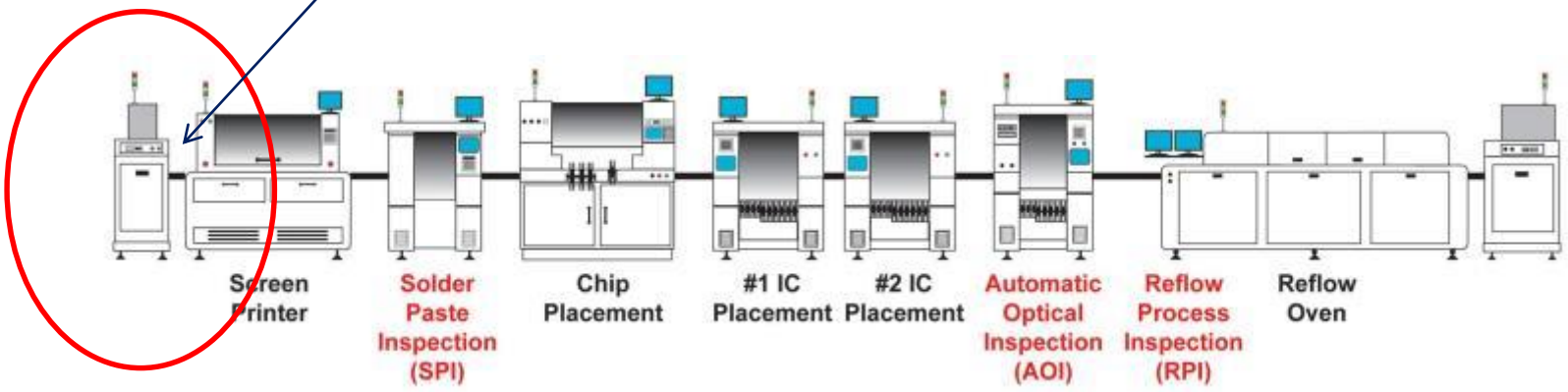
Existing Technology



SMT Application

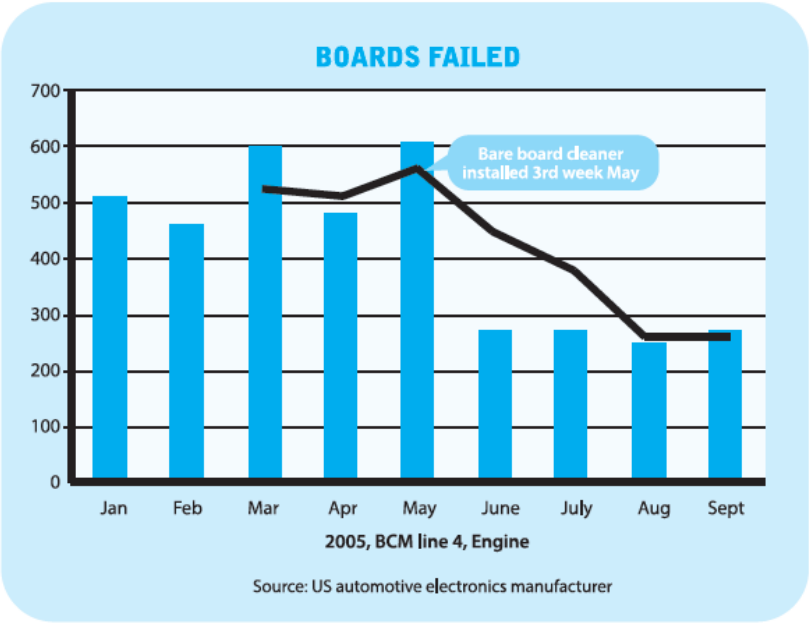
- SMT2017 in the SMT Process
  - Clean before solder paste print
  - Clean after laser marking

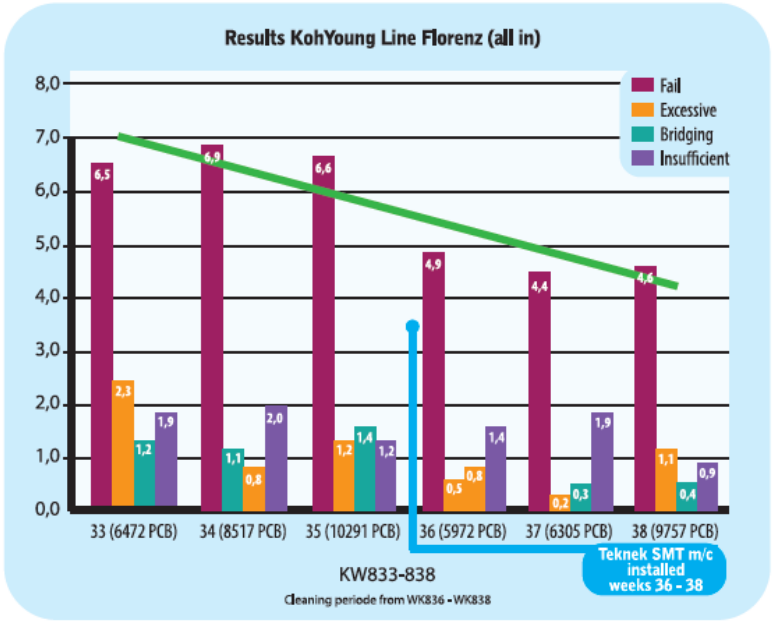
•Technology



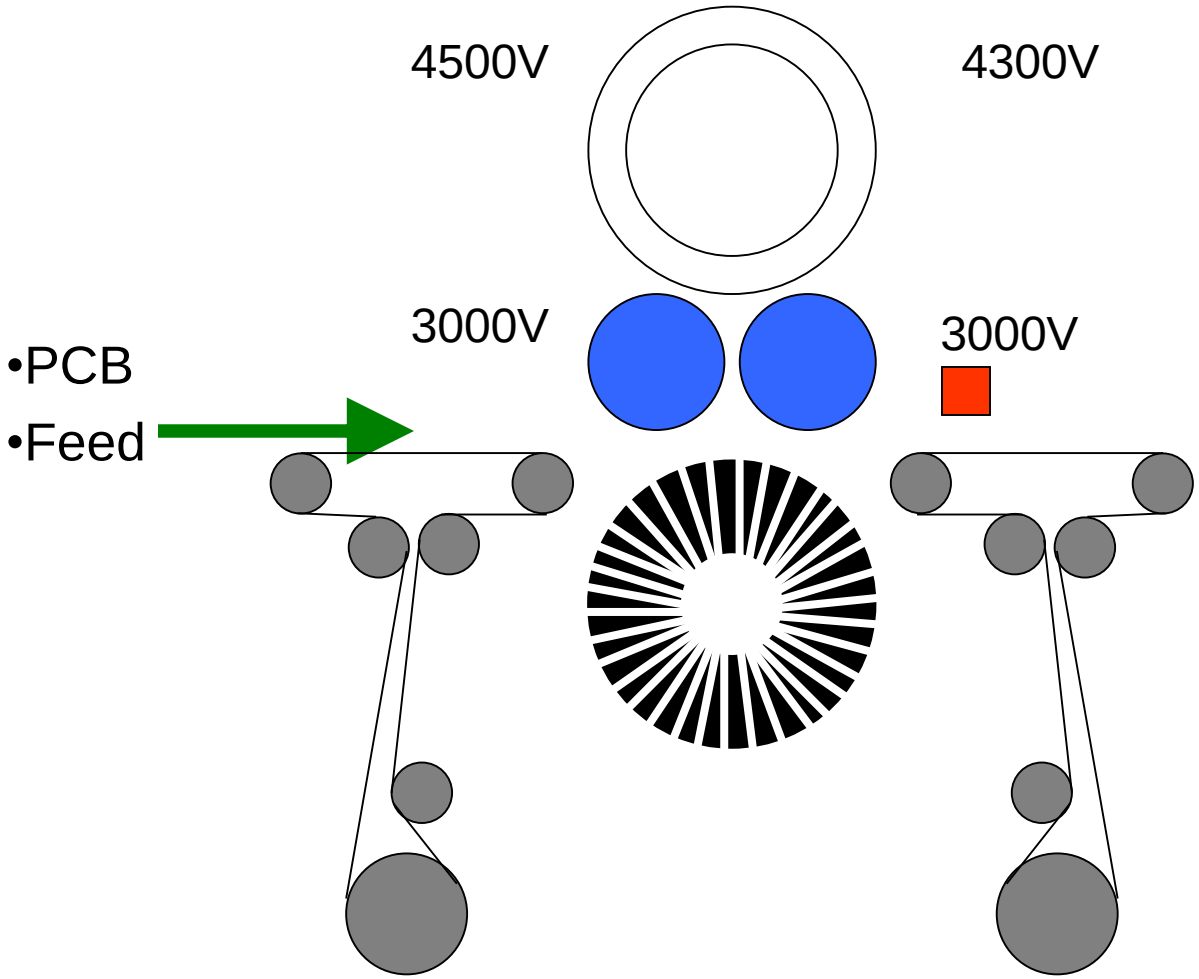
Cleaning Performance

SMT DATA





Existing static environment



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Grounding

- The rubber rollers which touch the PCB require to be grounded. This is challenging both because they are rotating but also because they have to be able to be pulled out from the machine frame as shown below

New Grounding Mechanism

Rubber cleaning rollers

- **ANSI ESD S20.20 requires all components which touch the board to have a surface resistance < 10^9 Ohms**

- Current conductive rollers do not meet this requirement at 10^{10} Ohms.

- Rubber has been reformulated to increase its conductivity .
- Nanocleen™ 20.20 now has surface resistance 10^8 Ohms verified by SGS
  - There are no conductive particles, the polymer is inherently conductive

Adhesive Roll

- Adhesive roll does not touch the PCB but is sited within 30mm of it.
- Allowable charge for HBM is 125V/25mm on an insulator giving a maximum of 150V for the adhesive roll
- Current charge levels are 4500V

- Adhesive roll has been made more conductive – allowing more disspation of charge
- Adhesive roll has been formulated to have 45% lower tack reducing charge generation

Triboelectric Properties

- Silicone rollers: -120nC/J
- Nanocleen Rollers: +40nC/J
- Pressure sensitive adhesive: -10nC/J
- Epoxy Printed Circuit board: -32nC

- Silicone/ Adhesive Triboelectric gap: 110nC/J
- Silicone/ PCB Triboelectric gap: 88nC/J
- Nanocleen/ Adhesive Triboelectric gap: 50nC/J
- Nanocleen/PCB Triboelectric gap:72nC/J

Measurement Ref: www.alphalabinc.com/triboelectric-series/

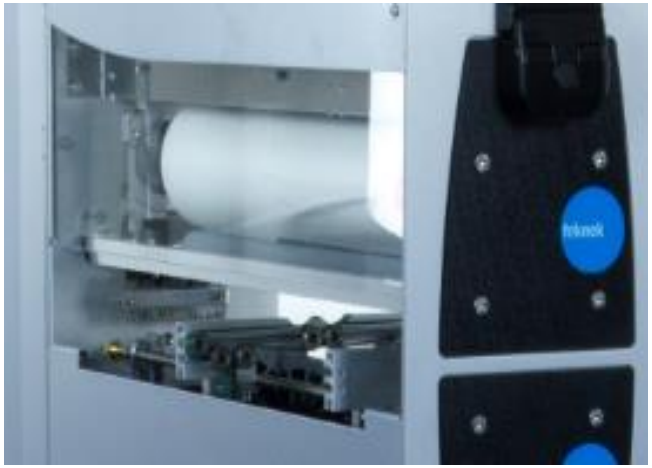
Reducing Tribocharging

- Second reformulation of rubber including additives to reduce the triboelectric gap between the rubber rollers and the board and also the rubber rollers and the PCB
- This formula also reduces the adhesion between the rollers and the adhesive – reducing charge generation
- New lighter weight roller with pressure control to reduce nip pressure
- New adhesive formulation with 45% reduction in tack to the rubber roller

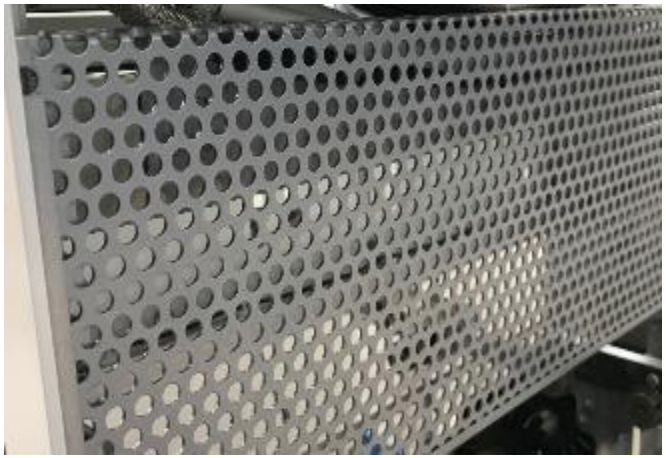
Insulator Removal

- ANSI/ESD recommends the removal of non-essential insulators

Existing Perspex Window



New Metal Window



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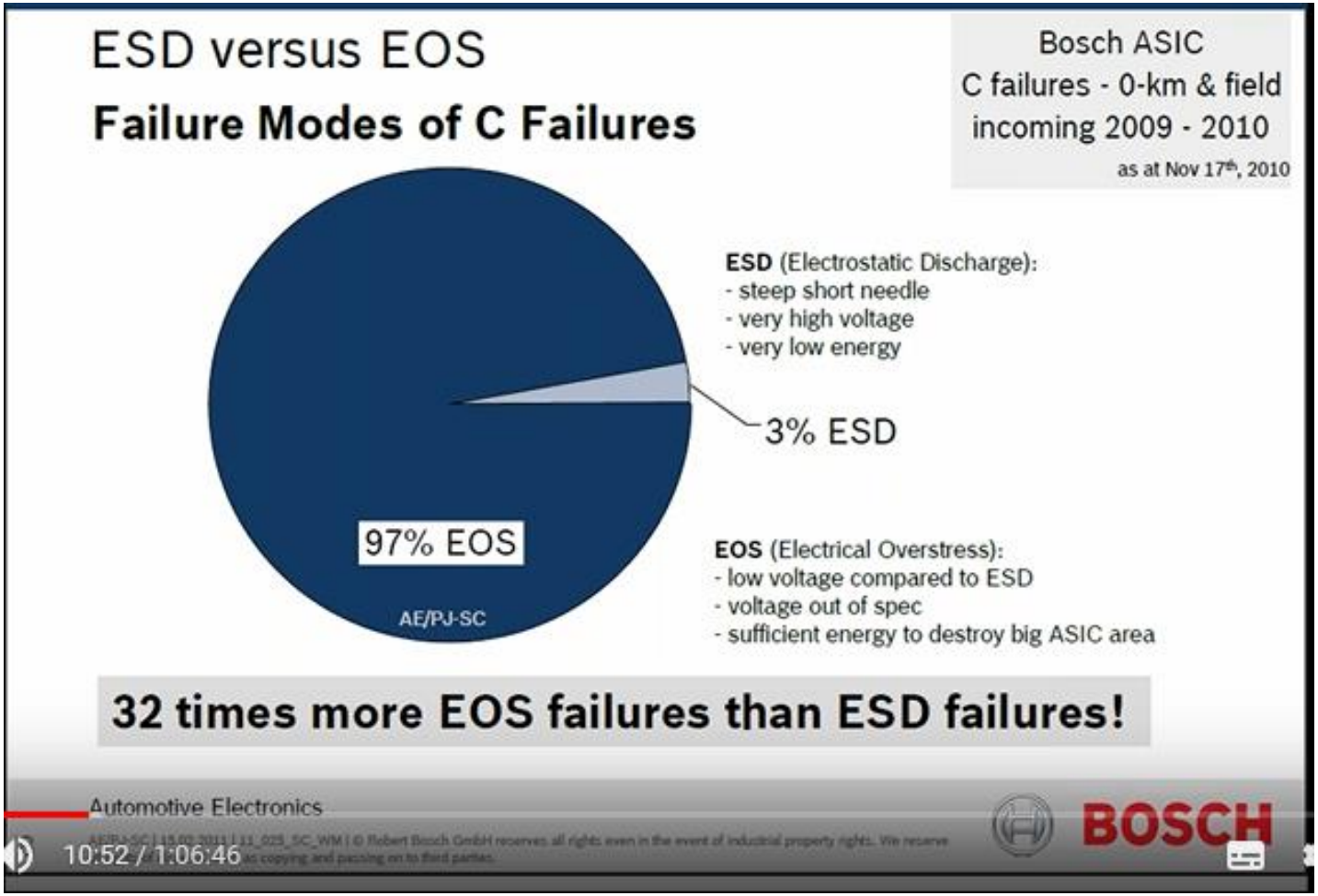
Static Results

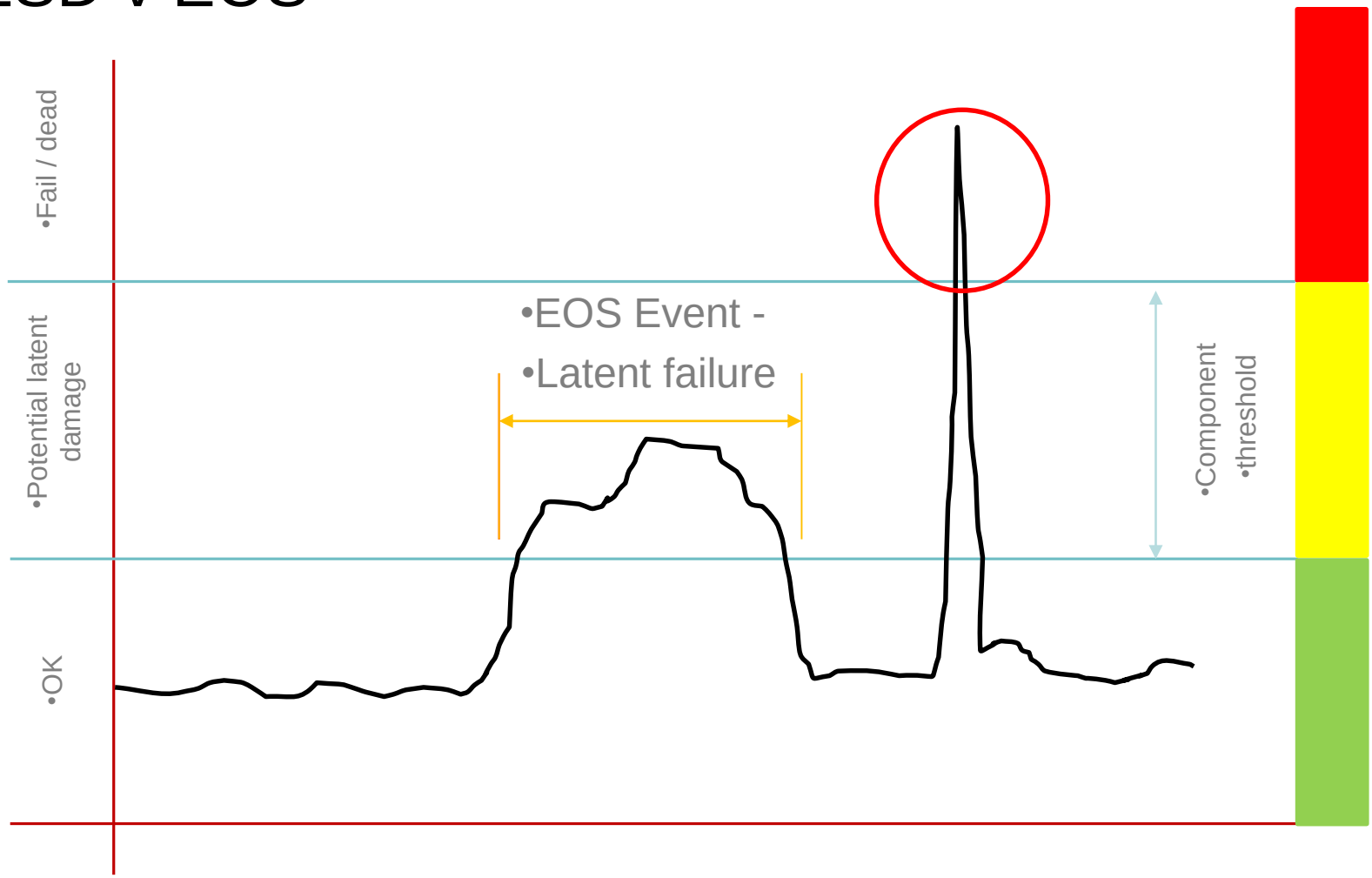
TEST POSITION	TRADITIONAL (V)	New SMT 2017 (V)
Elastomer roller at machine entry	3000	10
Elastomer roller at machine exit	3000	10
Adhesive roll at machine entry	4500	90
Adhesive roll at machine exit	4300	80

Verification

Next stage – Electrical Overstress



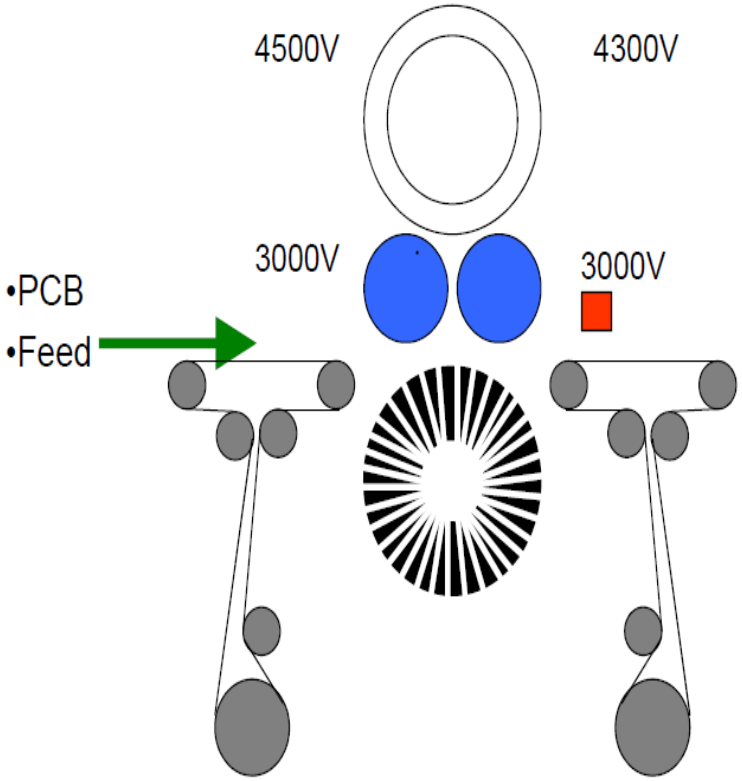
- ESD v EOS

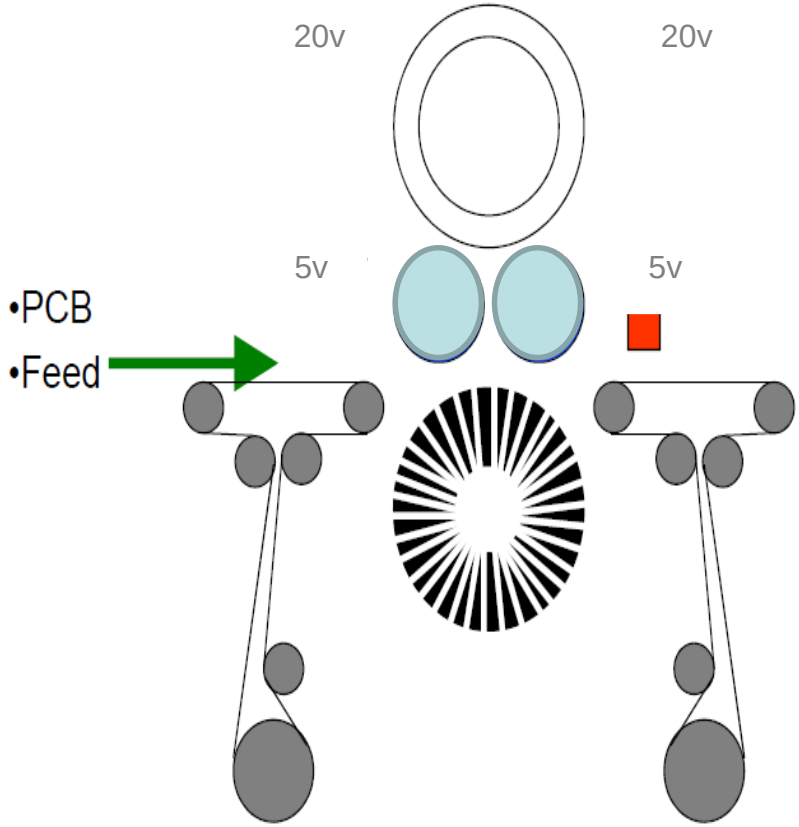

•Fail / dead
•Potential latent damage
•OK
•EOS Event -
•Latent failure
•Component
•threshold

EOS Mitigation

- In addition to the measures taken for ANSI ESD S20.20
- Adding Nanoparticle additives to standard elastomer rollers to give high conductivity
- Altering the adhesive material to give increased conductivity
- Reformulating the adhesive to reduce the adhesive forces between the adhesive and the Elastomer rollers reducing the tribocharging
- Removing the static bar from the exit of the machine to reduce the risk of induced current

Results





Case Study

- Major Scandinavian Automotive electronics Manufacturer
- Issue: Blowing of LED's during second side cleaning when using a Teknek SMT machine with conventional elastomer rollers and adhesive.
- Tried the ANSI ESD S20.20 verified machine and the issue disappeared but still had a concern about static levels
- Tested the latest developments, including removal of the static bars and decided to implement the new equipment upgrade to their Teknek machines in facilities across the world.

Conclusions

- Through careful design and material developments Teknek have overcome the challenges of Tribocharging in Contact cleaning to produce a very low static environment within their machine.
- This development also removes the necessity to have static bars after the machine.
- Together this not only significantly reduces the risk of ESD but also mitigates any potential for EOS caused by induced current in the connectors passing through any electric field within the equipment
- The combination of the highest efficiency particle cleaning with negligible ESD/EOS risk provides assemblers with the highest reliability cleaning method for boards prior to solder paste application