COM,C & CE Business Unit
tyco / Electronics

Lead free press-in

T. Ocket - July 2002

Lead free press-in
Overview

- Why lead free
- Testsequence: IEC 60352-5
- Press-in zones
- Printed circuit boards
- Testgroup A: microsections
- Testgroup B: press-in and push-out forces
- Testgroup C: electrical performances
- Testgroup D: application test
- Conclusion

Why lead free

- Legislation: not earlier than January 2006
  - EU directives: WEEE (Waste Electrical and Electronic Equipment)
  - ROHS (Restriction Of Hazardous Substances)
- Marketpressure: global companies want to change to lead free in the next two years

Testprogram
Press-in connection: IEC 60352-5

- Qualification test: (testgroup A, B and C)
  - on individual press-in connection
  - retention force specified by manufacturer
  - independent of application in a component
- Application test: (testgroup D)
  - press-in connections as part of a component
  - focus on performance in a component

Testprogram
Press-in connection: IEC 60352-5

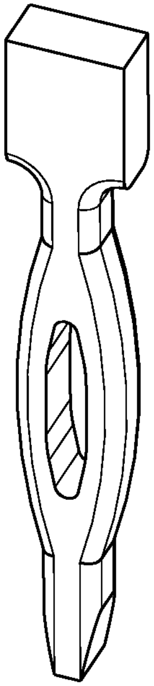
- Testgroup A
  - visual examination
  - microsectioning
- Testgroup B
  - insertion and retention forces
  - repair operations
- Testgroup C
  - Contact resistance after different tests
    - Rapid change of temperature (10 cycles :-40°C to 85°C)
    - Climatic sequence (5 cycles damp heat)
    - Dry heat (1000 h at 85°C)
    - Flowing mixed gas corrosion test (2 gasses for 10 days)

Testprogram
Press-in connection: IEC 60352-5

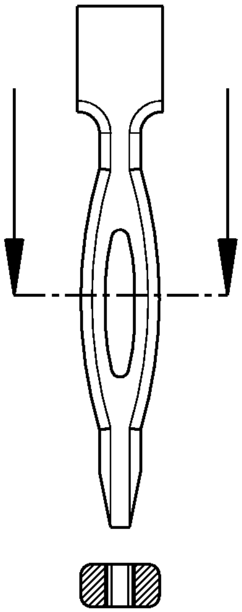
- Testgroup D:
  press-in terminations mounted in the component
  - vibration
  - rapid change of temperature
  - dry heat
  - microsectioning

Press-in terminations

Eye of the needle for ∅0.7 and ∅1.0

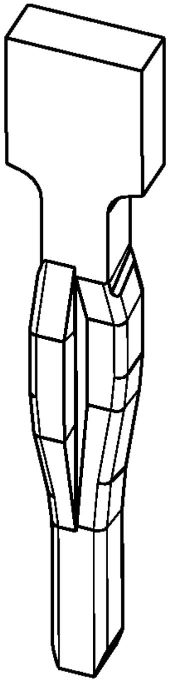


Z-Pack FB
female

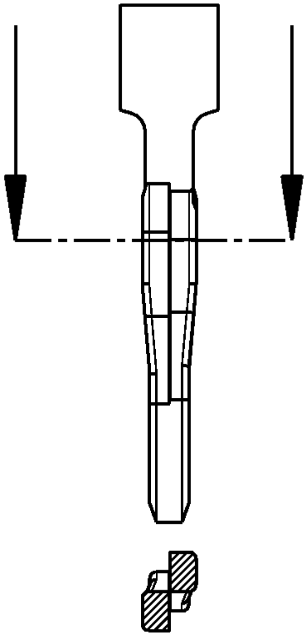


Sipac, DensiPac
Eurocard female

Action-pin for ∅0.6 and ∅1.0

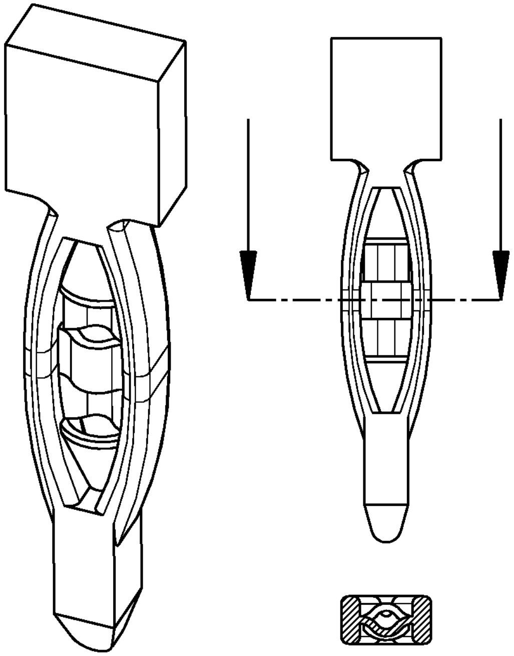


Z-Pack HM
male+female



Eurocard
male+female

Multispring for ∅1.0



Sipac, Eurocard Oostkamp
male

Press-in terminations

- Whisker-free satin-bright pure Sn as lead-free solution all with Ni underplate
- Conventional SnPb used for comparison in testgroup B

Printed circuit boards

- Platings on FR-4 PCB’s (underplate: 25-50µm Cu)
  1) HAL SnPb: max 35µm SnPb
  2) Galvanic Au: 4-5µm Ni + 0.1-0.5 µm Au
  3) Cu+OSP: 0.2-0.5µm OSP (Entek+)
  4) Immersion Sn: 0.5µm min
  5) Immersion Au: 4-5µm Ni + 0.1-0.5µm Au
  6) Immersion Ag: 0.1-0.15µm min

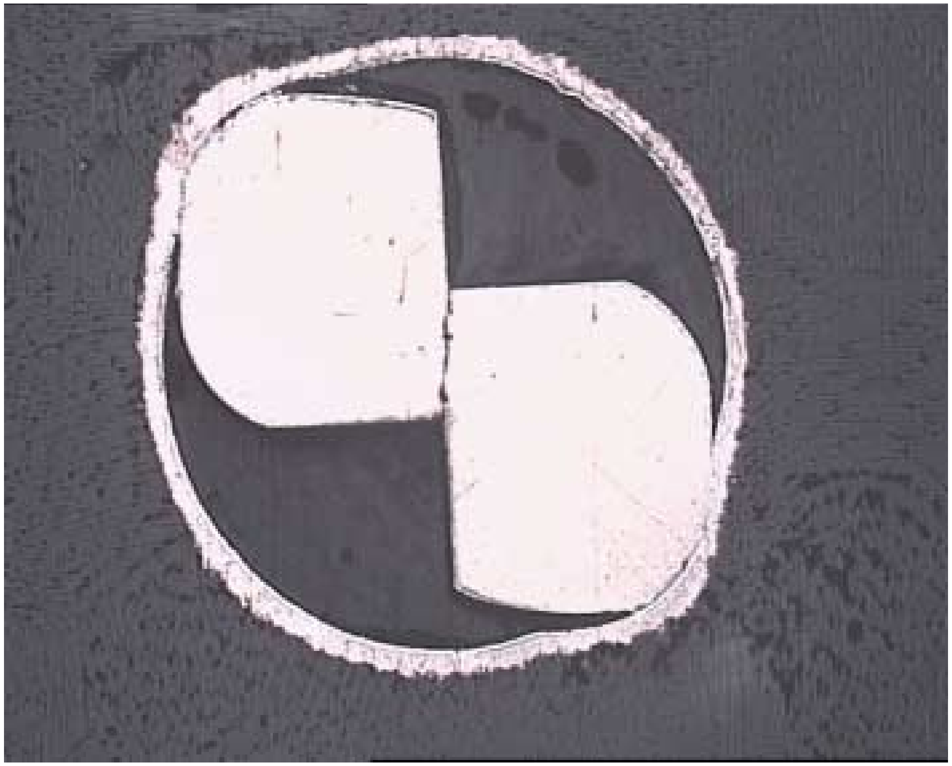
Printed circuit boards

- PCB thickness: 1.6mm
- Deviation of +/- 0.05 in drilled hole covers worst case situation of hole diameters and gives

specification	min holes	nom holes	max holes
0.55-0.65	0.55-0.57	0.60-0.62	0.63-0.65
0.65-0.80	0.64-0.66	0.69-0.71	0.73-0.76
0.94-1.09	0.94-0.95	0.99-1.02	1.04-1.06

Testgroup A: visual examination

- Action pin for ∅1.0 show most severe results, but still within specification
  - deformation of drilled hole is below 70µm
  - remaining thickness of plating is above 8µm

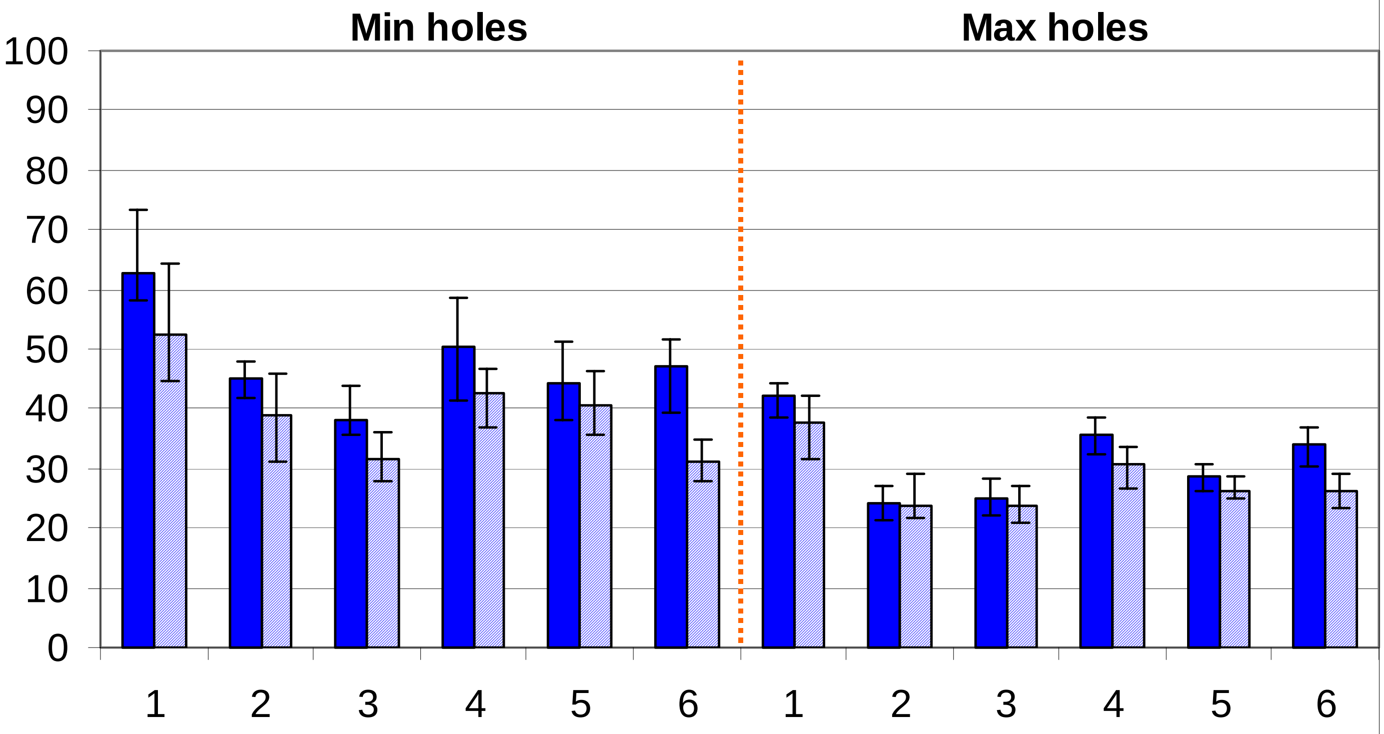


Testgroup B
Insertion and retention forces

- Circumstances
  - press-in at 25 mm/min
  - push-out at 3 mm/min
- Quantities
  - 10 contacts in min holes
    10 contacts in max holes
  - each time 2 repair-operations
  - both SnPb as pure Sn press-in terminations
  - 3600 contacts in total

Testgroup B: typical example

Eye of the needle for ∅1.0 mm
Press-in (N)



Contact finishes

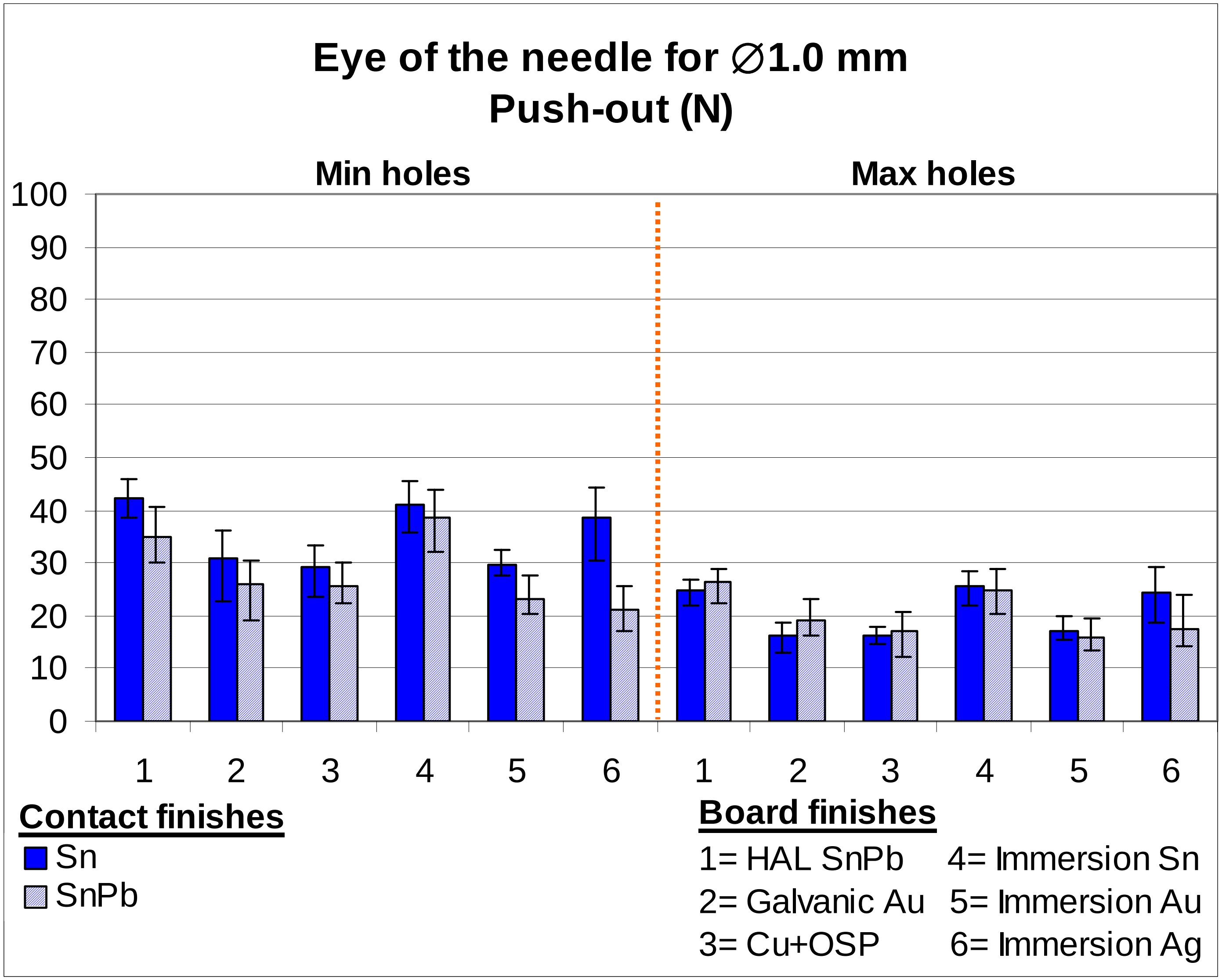
- ■ Sn
- ▨ SnPb

Board finishes

1= HAL SnPb	4= Immersion Sn
2= Galvanic Au	5= Immersion Au
3= Cu+OSP	6= Immersion Ag

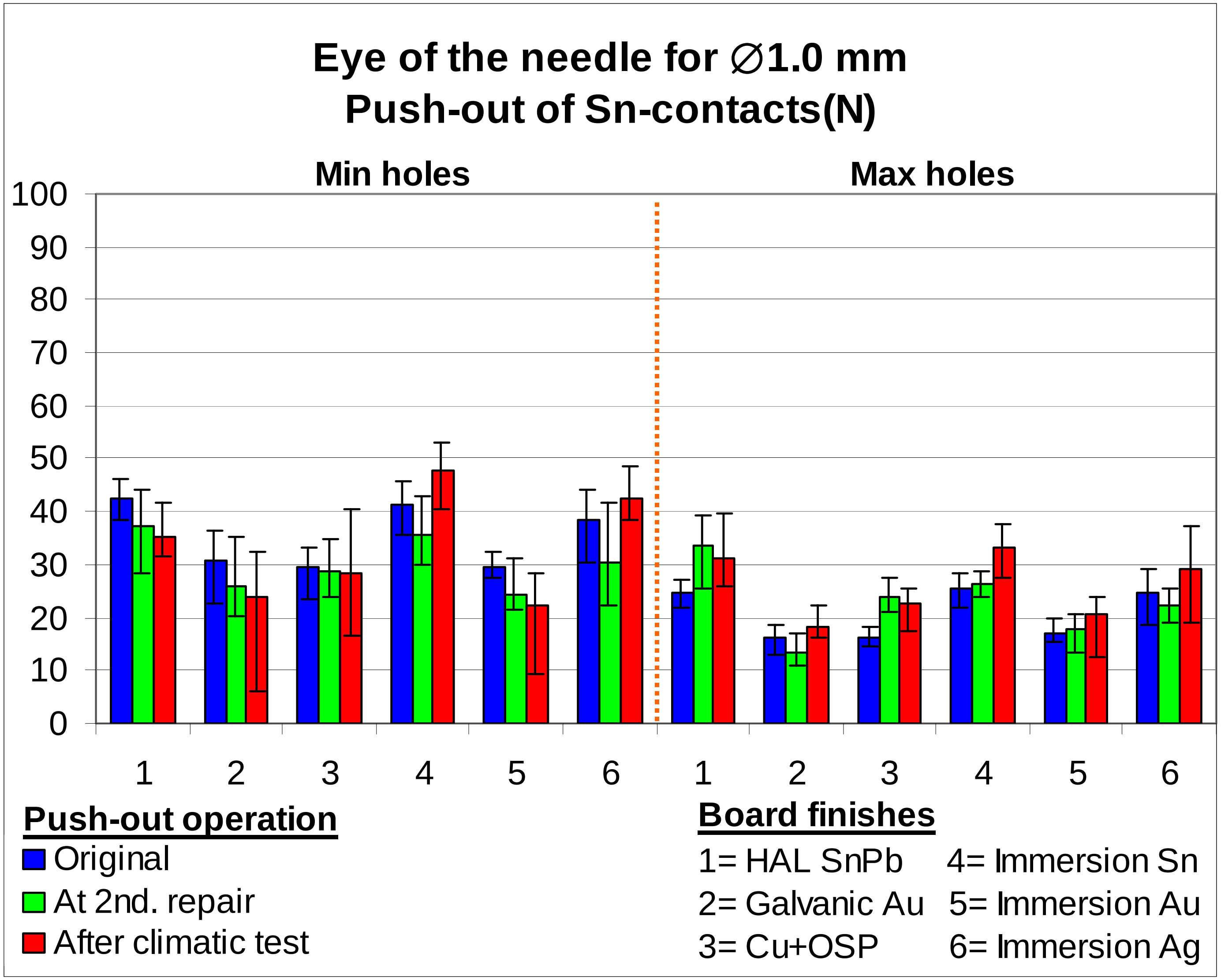
- Press-in forces are 15% higher for Sn than SnPb contacts

Testgroup B: typical example



- Push-out forces are 15% higher for Sn than SnPb contacts
- PCB's with Galvanic Au, Cu+OSP and immersion Au give push-out forces of only 60% compared to HAL SnPb

Testgroup B: typical example



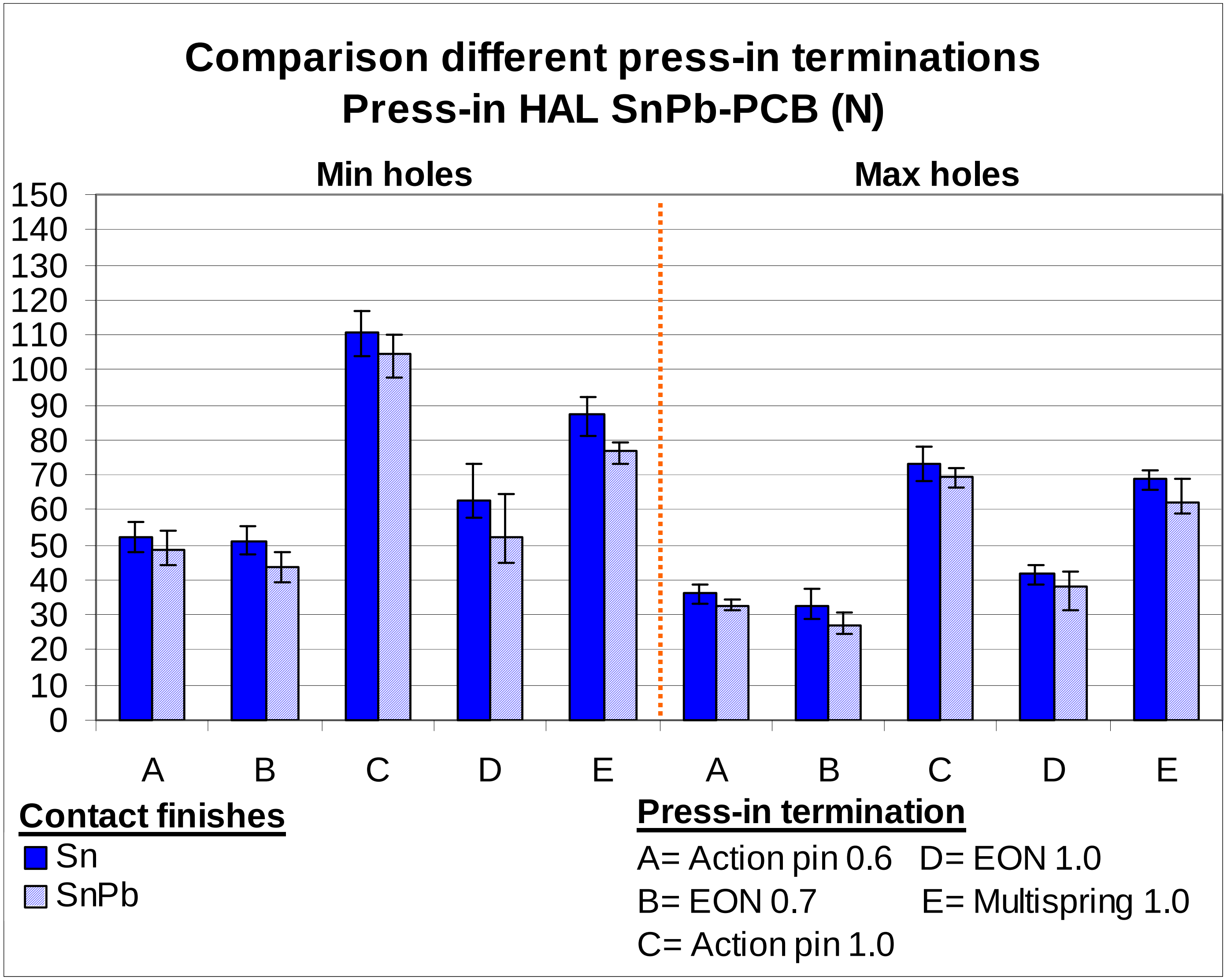
Eye of the needle for ∅1.0 mm
Push-out of Sn-contacts(N)

Push-out operation
- 🟦 Original
- 🟩 At 2nd. repair
- 🟥 After climatic test

Board finishes
- 1= HAL SnPb
- 2= Galvanic Au
- 3= Cu+OSP
- 4= Immersion Sn
- 5= Immersion Au
- 6= Immersion Ag

- Repair operation and climatic sequence (testgroup C) show only minor influences

Testgroup B: comparison terminations



Comparison different press-in terminations
Press-in HAL SnPb-PCB (N)

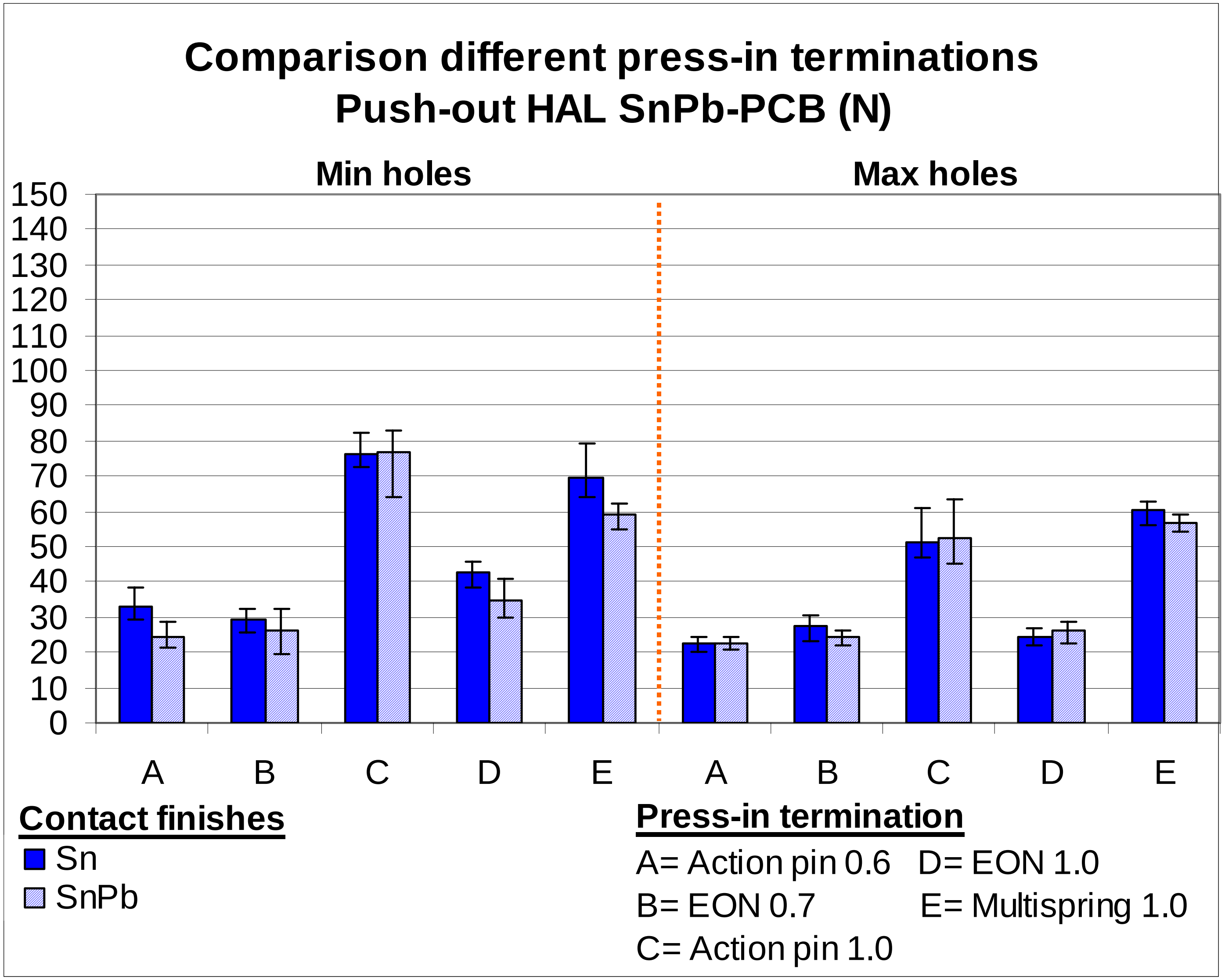
Contact finishes

- ■ Sn
- ▨ SnPb

Press-in termination

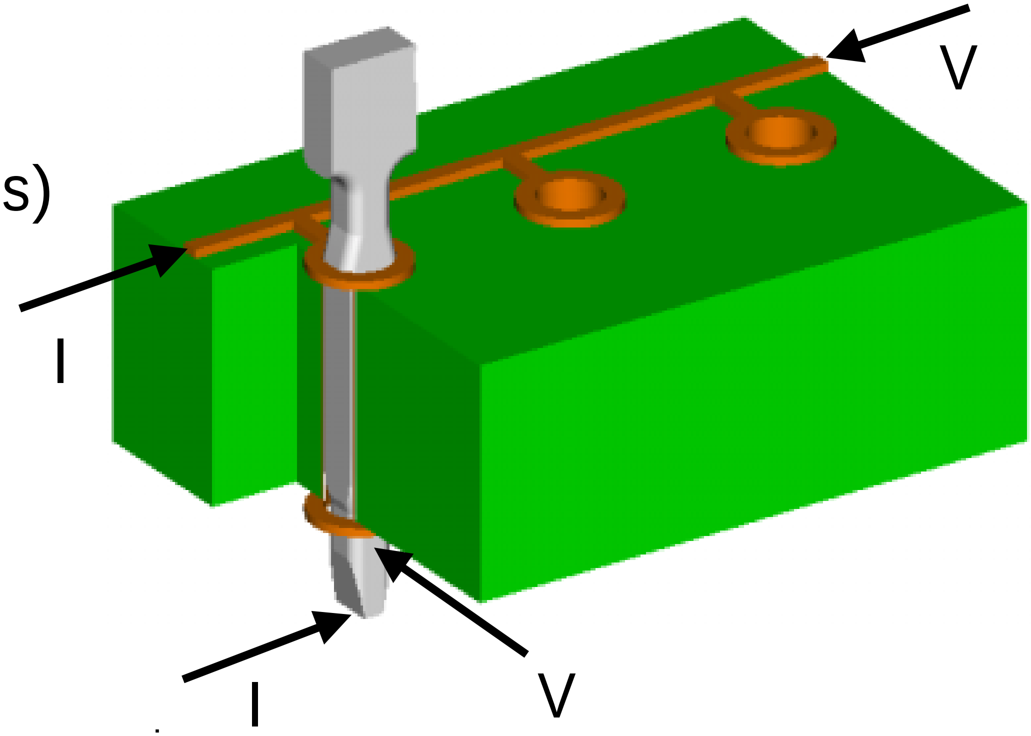
A= Action pin 0.6
B= EON 0.7
C= Action pin 1.0
D= EON 1.0
E= Multispring 1.0

Testgroup B: comparison terminations

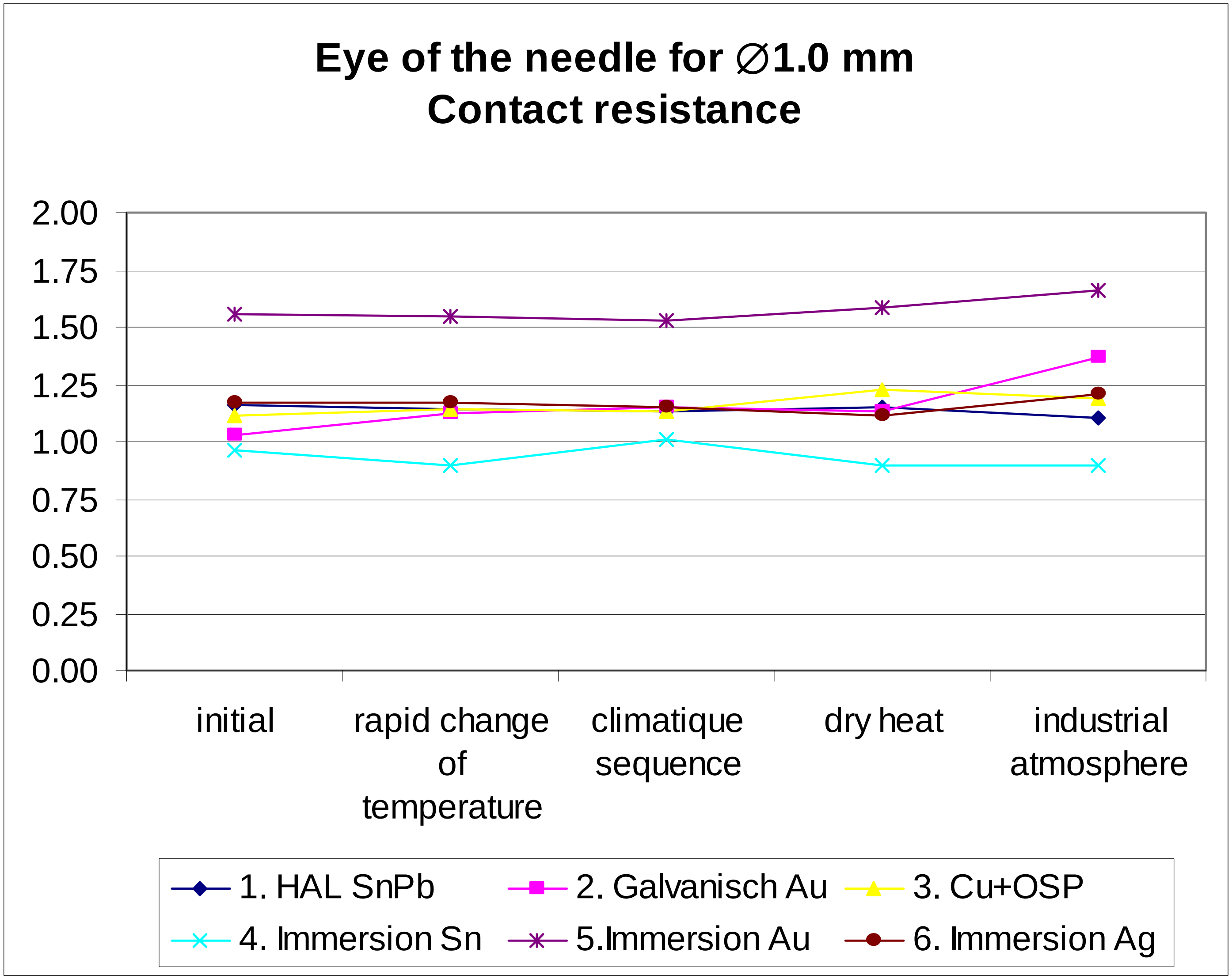


Testgroup C
Electrical performances

- IEC method gives sometimes false results (negative Rd)
- Small bulk-resistance is measured
  - small PCB-trace
  - small part of contact
- Quantities (only Sn-contacts)
  - 10 in min holes
    20 in nom holes
    10 in max holes
  - 1200 contacts in total
- Demand: rise < 0.5mOhm



Testgroup C: typical example



◆ All terminations had a rise < 0.5 mOhm

Testgroup D application test

- Press-in terminations mounted in the component
  - Check if the the press-in zone is rigid enough for the specific connector
  - Have all been done during qualification testing of all connectors with SnPb plating
  - No reason to do this testing, since pure Sn show higher retention forces than SnPb

Conclusion

- Pure Sn is a good alternative for SnPb for press-in terminations
- Lead free manufacturing could cause higher insertion forces, mainly due to lead free board finishes.
  - Straight headers: force applied directly on contact
  - Receptacles: force is applied on the housing potential damage to housing or buckling of pins is depending on customer specific tooling
- Galvanic Au and Cu+OSP show lower retention forces, but no effect on electrical performances.