Wire bonding test

- commonest application
- principle (test speed)
- tool alignment
- tool materials
- pull test failure modes

refer to XYZTEC bonding test science workshop

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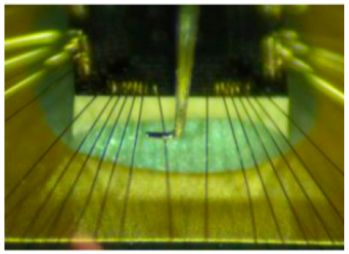
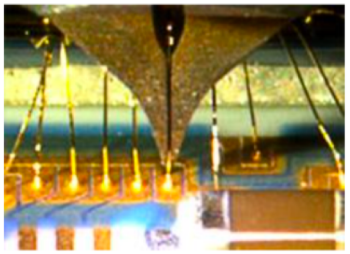
Special Topic

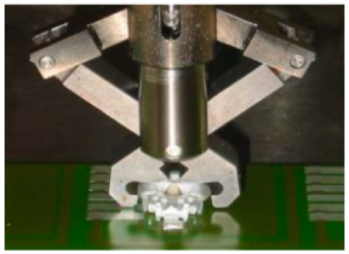
Commonest Applications

- There are many types of pull test and therefore pull tools
- Most commonly used tools are one of the following,

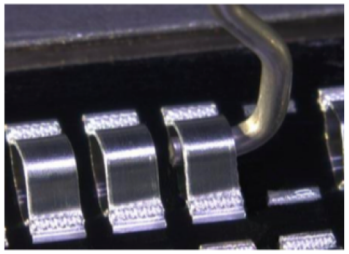


Wire pull



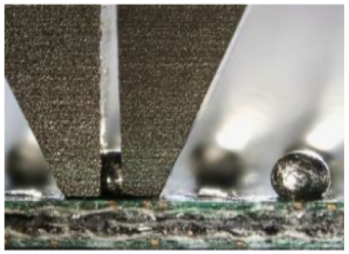


Tweezer pull

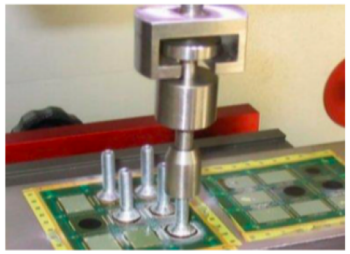


Ribbon pull

Peel test



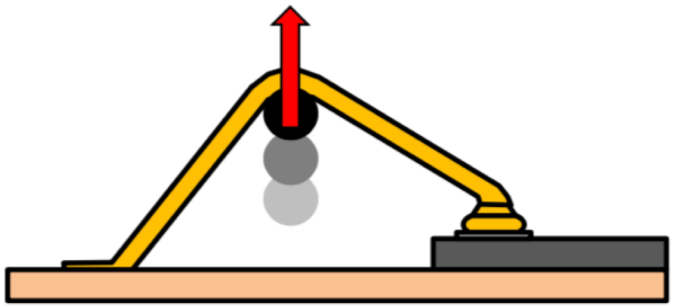
Ball Pull

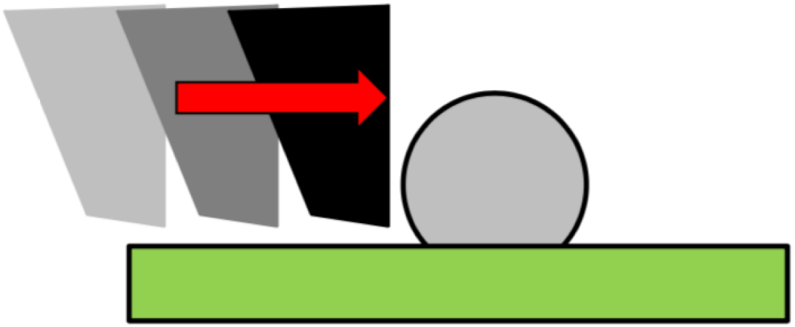


Die Pull (Stud Pull)

Test Speed

- Test speed is the speed that the bond tester tool moves at as it loads the bond





Test Speed

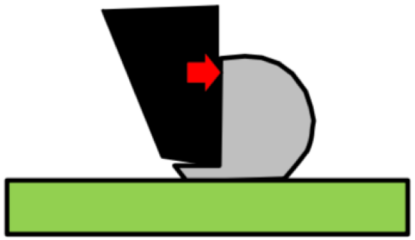
- In scientific terms bond deformation is Bond Strain
- And , the speed of bond deformation is Bond Strain Rate

- Material properties are a function of Strain Rate
- And, material properties affect the bond strength and failure mode
- So,

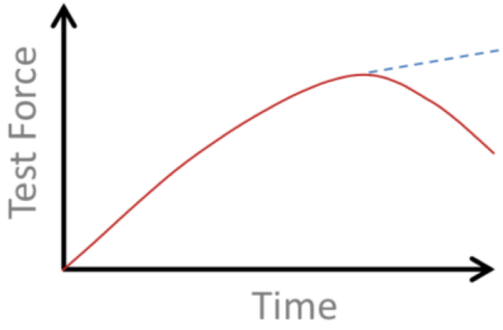
  Test Speed (Strain Rate) affects Bond Strength and Failure Mode

Typically higher strain rates with ductile deformation and failure result in higher bond strengths up to the point where the failure becomes Brittle when the bond strength then reduces

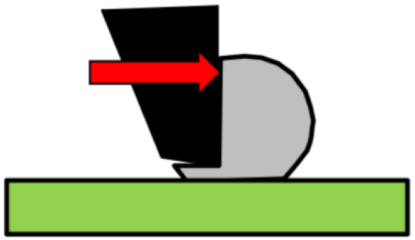
50µm/s



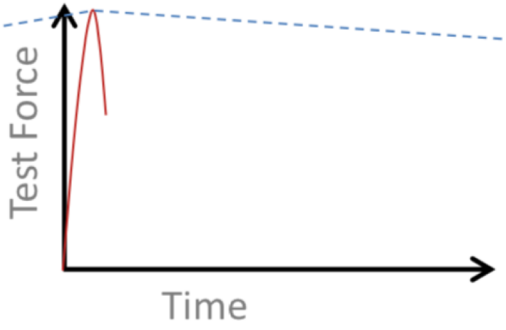
Ductile failure



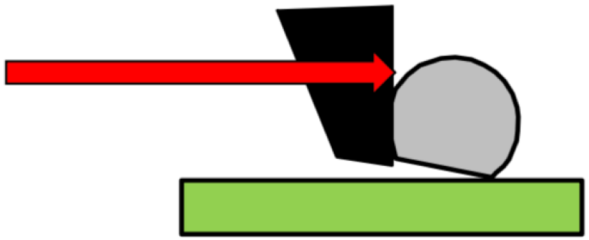
5,000µm/s



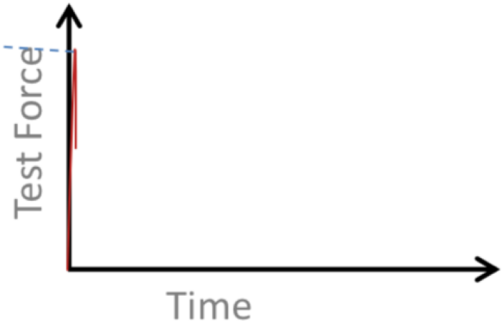
Ductile failure, higher force



50,000µm/s



Brittle fracture with drop in force



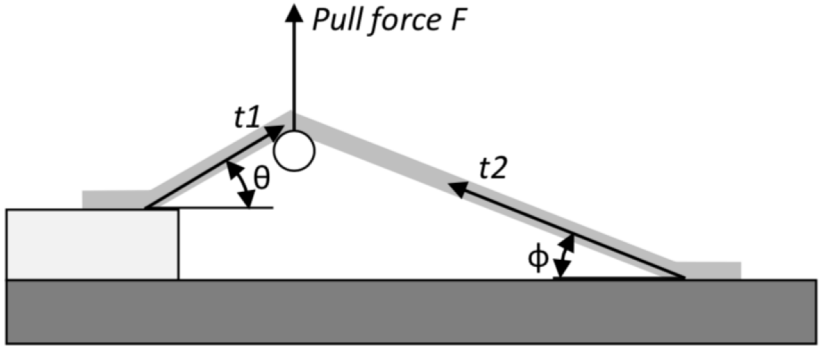
Test Speed

SUMMARY

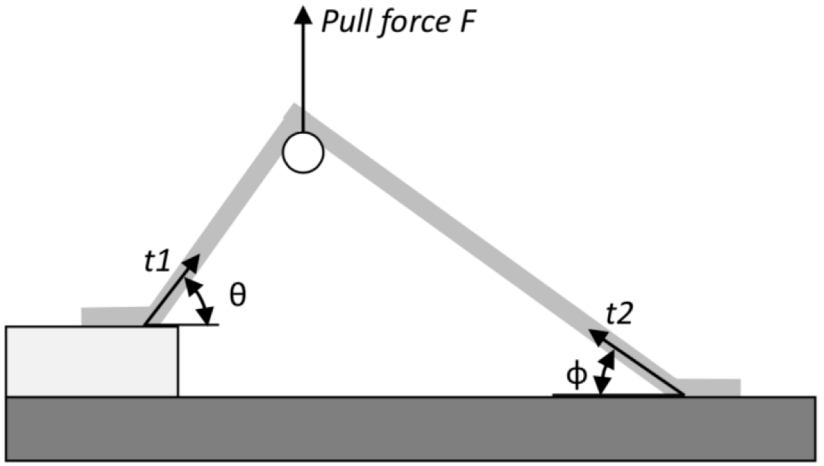
- In most cases the yield stress of a material increases with rate of strain
- Because strain rate increases with test speed in many cases the bond test value will increase with increased test speed
- This is true up to the point where the bond failure mode may change accompanied with a change in bond strength
- So, the failure mode of interest should be considered when selecting the test speed
- Because bond strength and failure mode are affected by test speed, the same test speed should be used when comparing results from similar bonds

Wire Pull - Tool Alignment

- The angle of pull changes the load on the bond



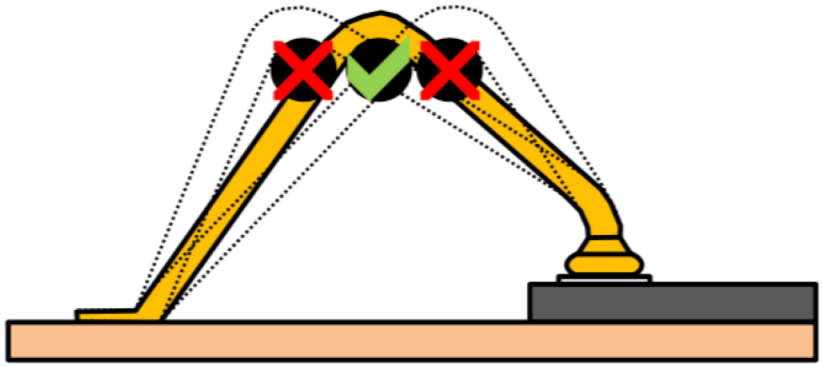
Higher loads on bond



Lower loads on bond

Wire Pull - Tool Alignment

- It is important to pull in the same place



- Not pulling in the same place will,
  - **Increase the test force distribution**
  - **Affect the failure modes**

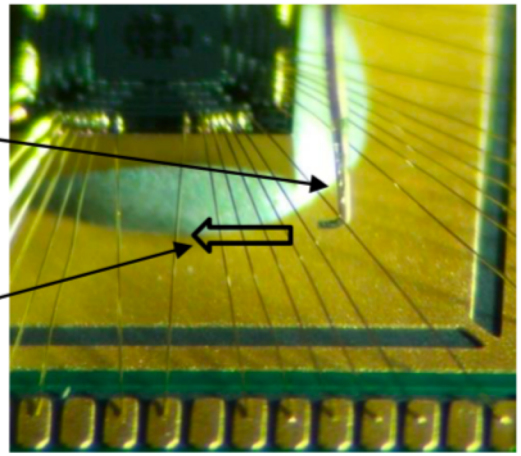
- **XYZTEC Automation ensures tool alignment is always the same**

Wire pull – Tool Alignment

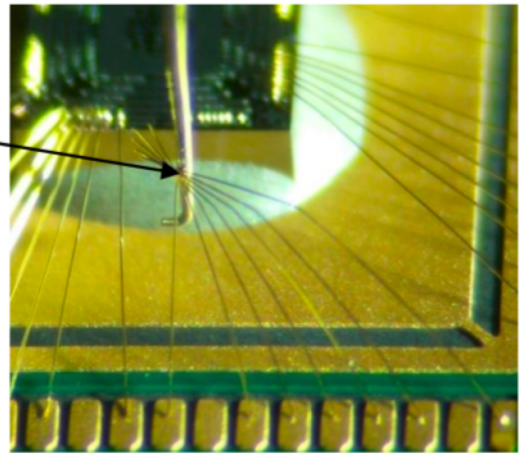
- If you want to test all the wires in a fan out it is simple to start at one end and let the tested wires build up on the hook as you proceed

1. Start at one end

2. Test each wire in turn



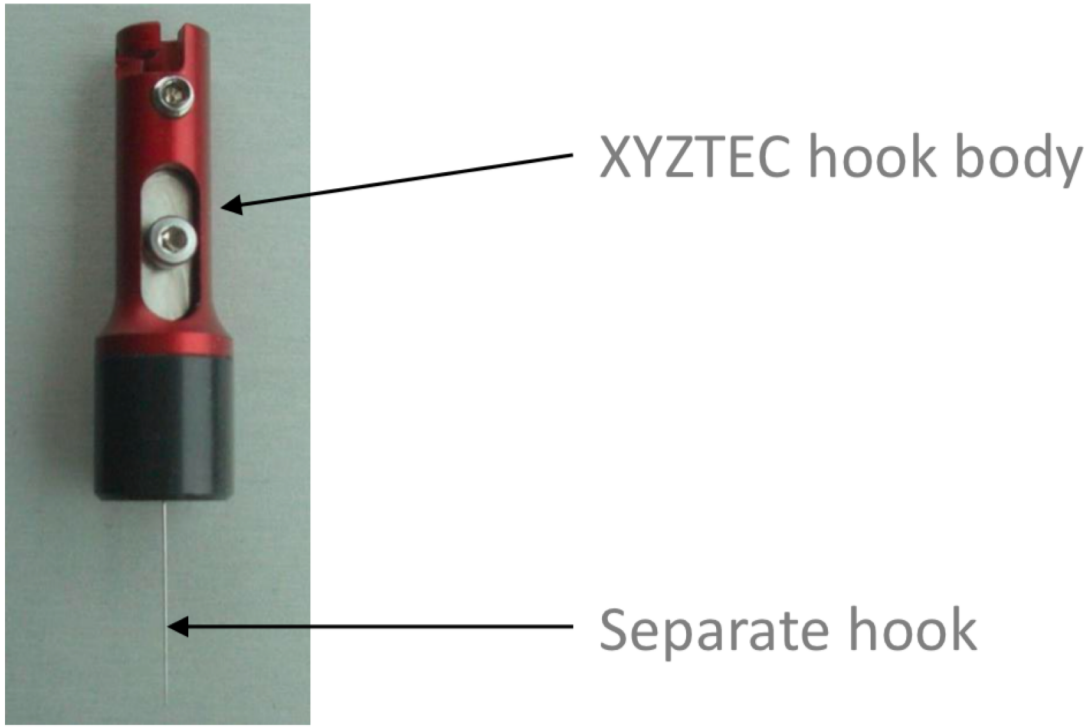
3. Tested wires build up on the hook



- For fine wires their build up on the hook has negligible affect on the test result. This is not true for heavy wires
- You can start anywhere and test in any direction
- It is a fast way to test both manually and automatically

Wire pull – Tool Material

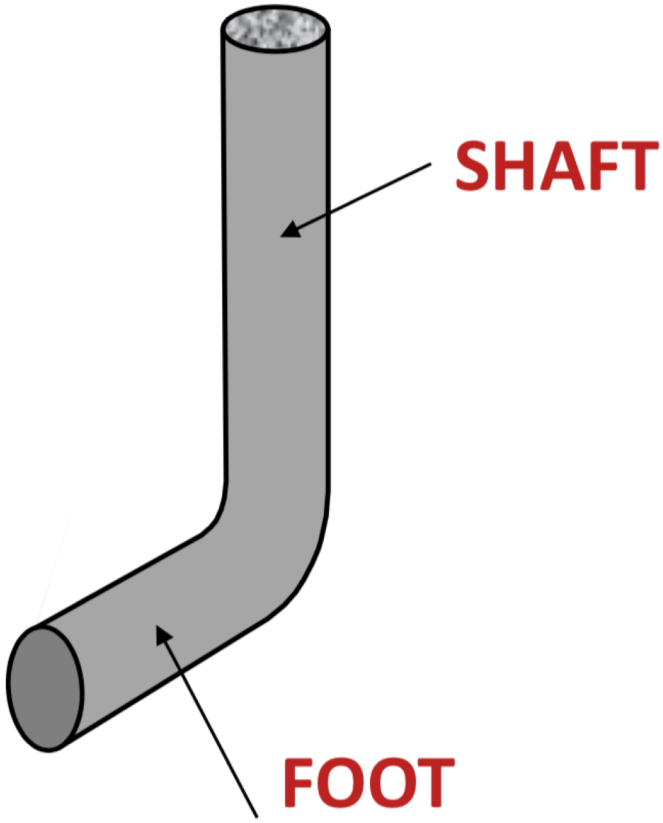
- A suitable hook material must be,
  - Possible to manufacture to the required shape and accuracy
  - Sufficient strength to withstand the maximum pull force
- Tungsten often meets these requirements and is widely used



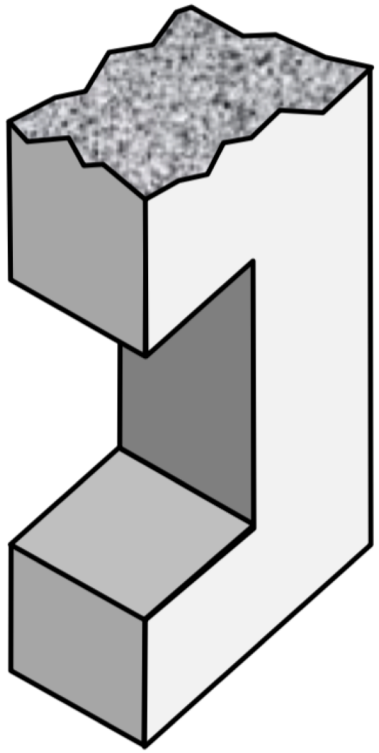
Wire pull – Tool Design

- Wire pull is done using a hook

Most hooks are made from bent round wire as shown



Special machined hooks of any shape are also available



Wire Pull – Failure Modes

- Aluminum wire

Mid span
Bond strength unknown
Acceptability depends on strength

Heel strength known
Acceptability depends on strength

Wedge bond
Wedge bond strength known
Acceptability depends on strength

Both wedge bonds
Possibly weak bonds

Wedge crater
Acceptability depends on strength
Possibly bonder process problem

Both wedge crater
Probably weak bonds
Possibly bonder process problem