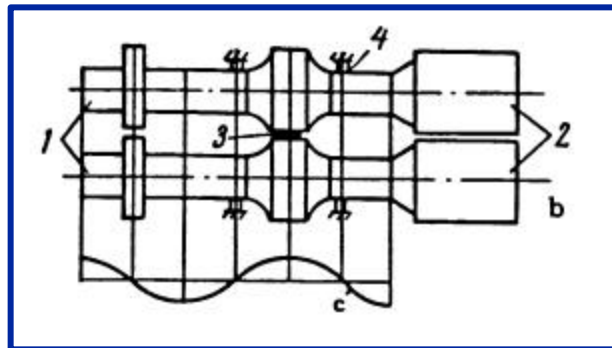
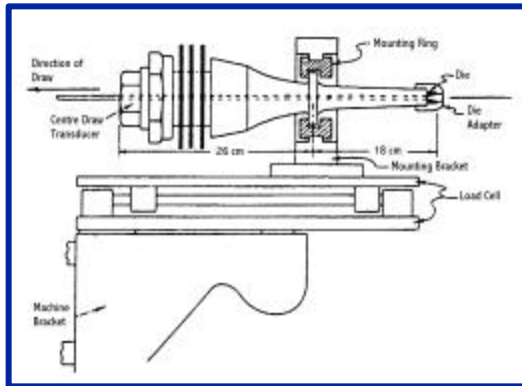


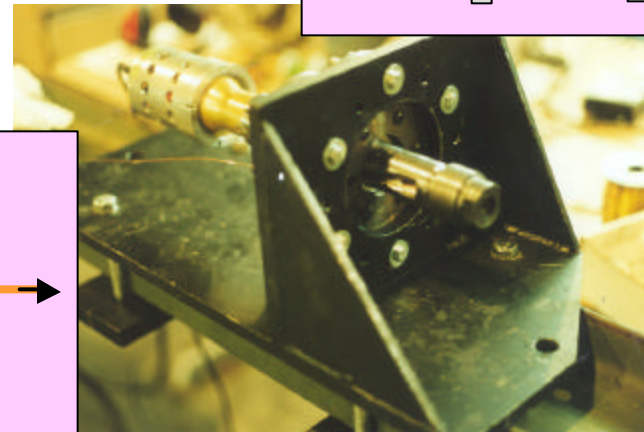
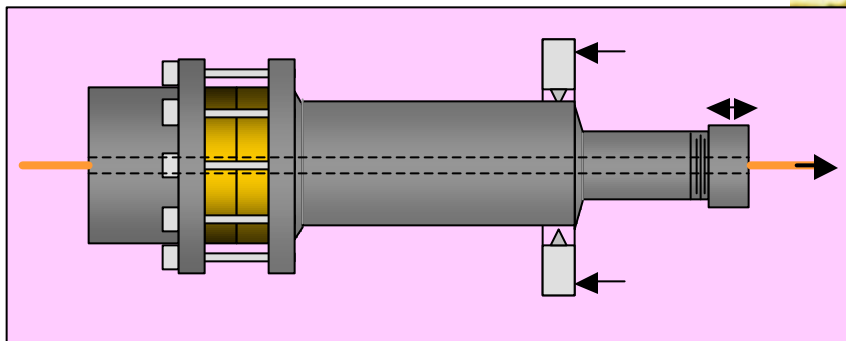
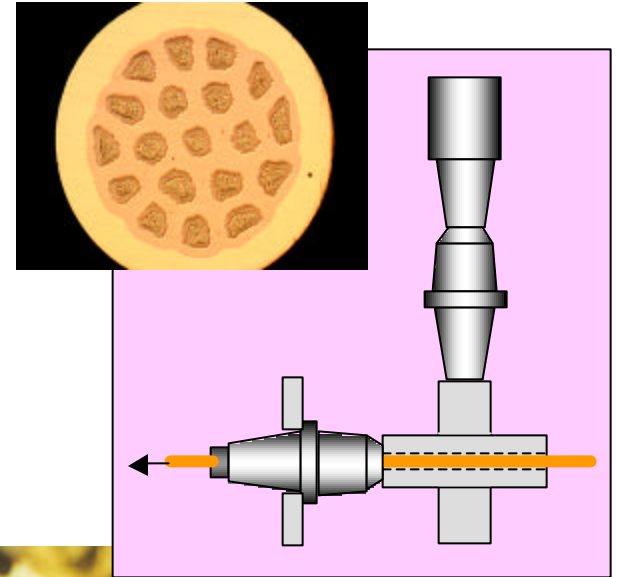
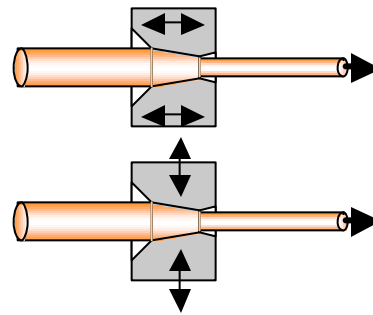
Ultrasonic Drawing of Composite Superconducting Wire

Karl Graff, EWI/Global
Mike Tomsic, Global
Edward Collings, OSU



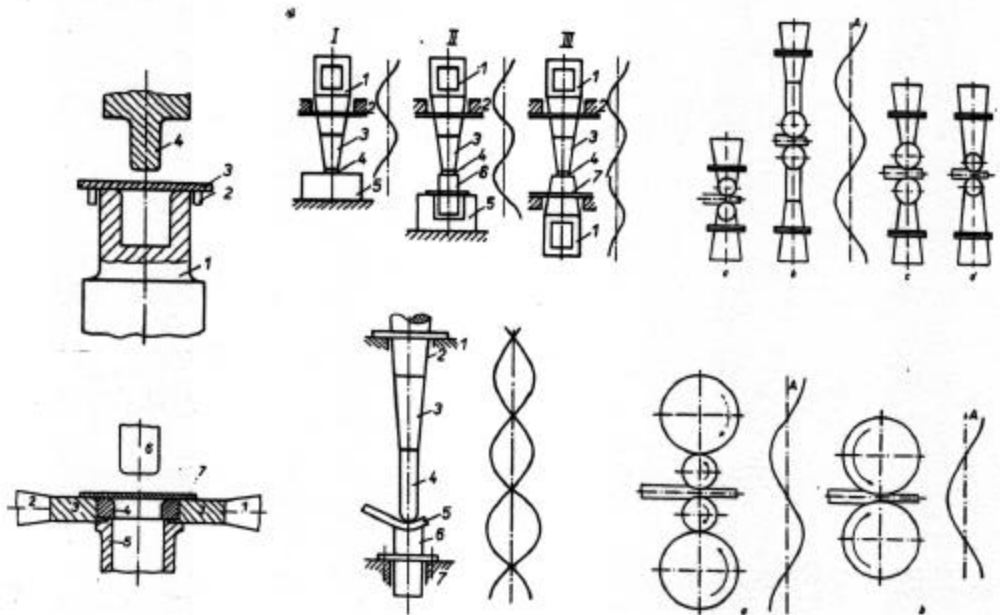
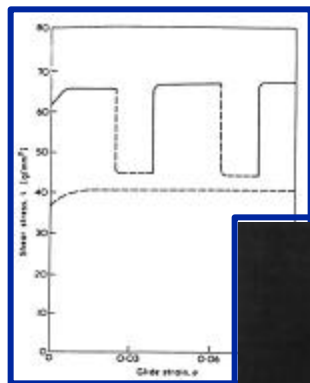
Outline

- Objective
- Approach
- Results
- Phase 2



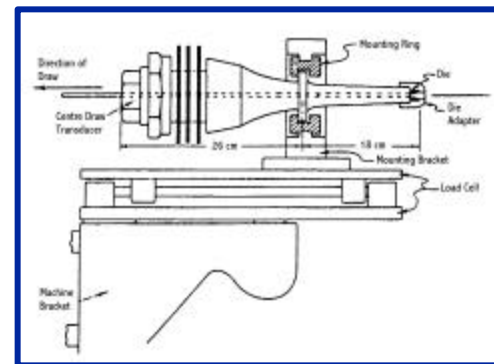
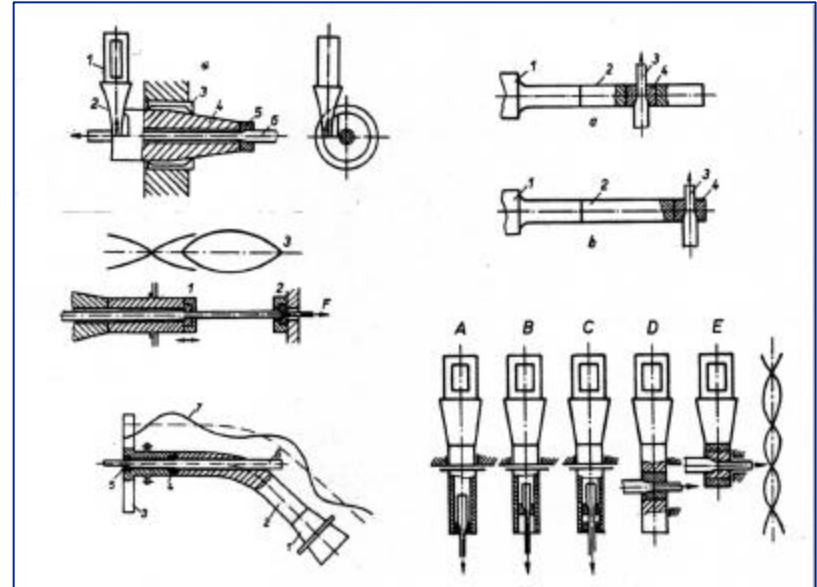
USWD - Background

- “Acoustic softening” report led to much work in metal forming
- Deformation mechanism still unclear (acoustic softening or superposition)



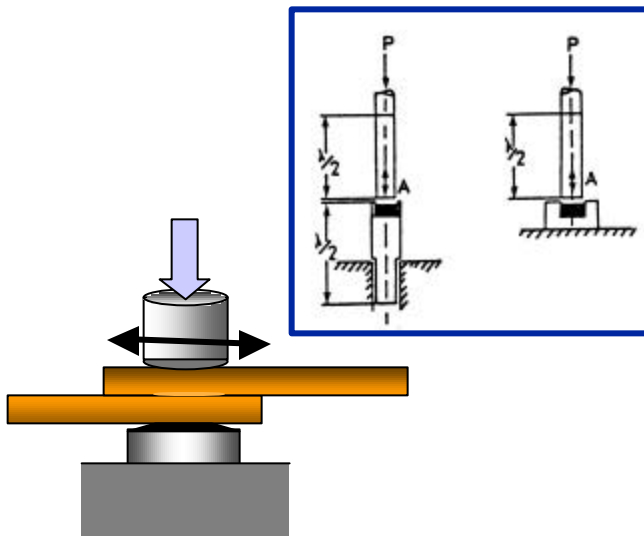
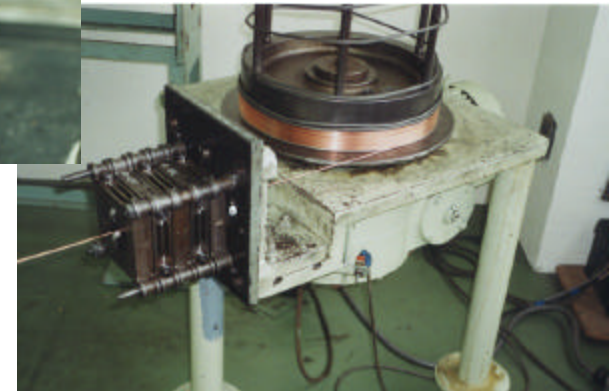
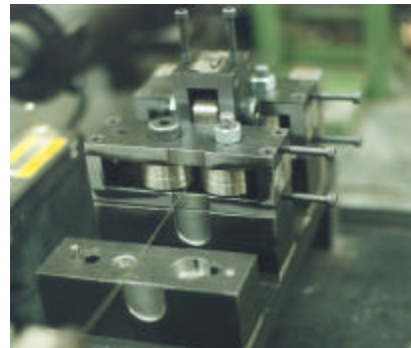
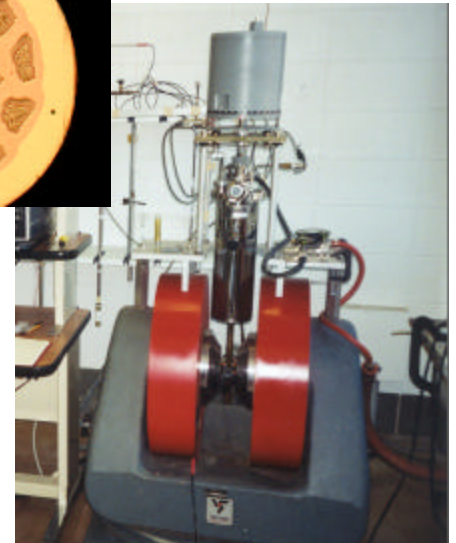
USWD - Background

- Extensive work in WD/TD continues
- Advantages sought (reduce force, area reduction, finish, die life, speed)
- Specialty applications



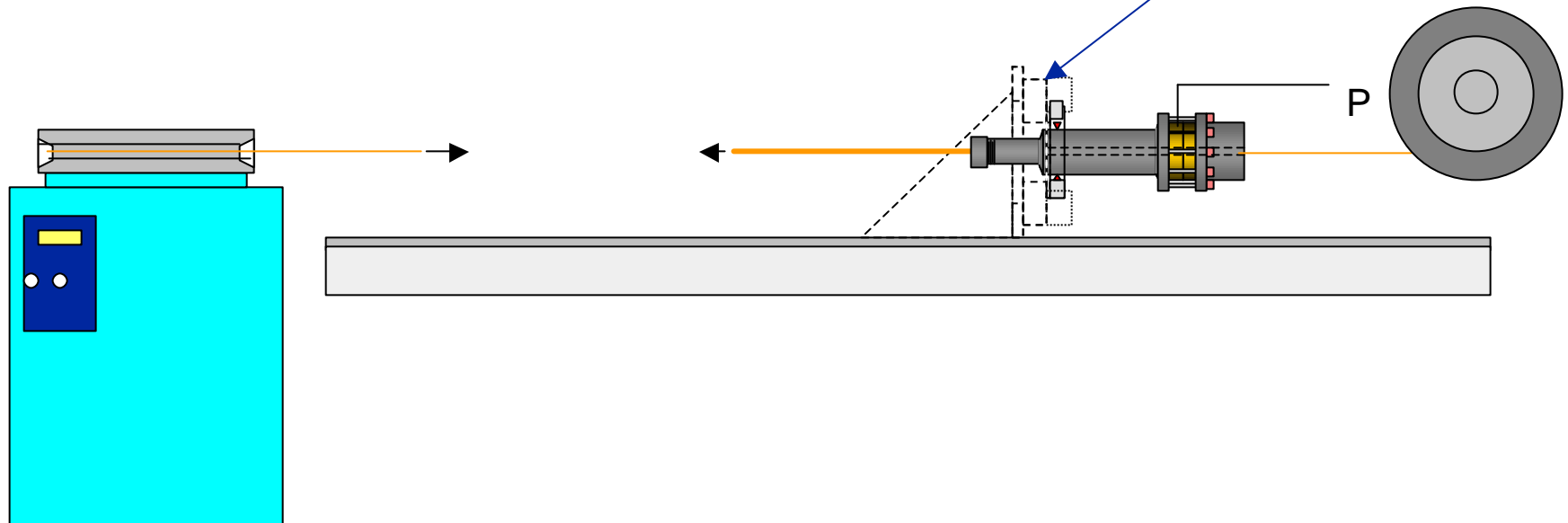
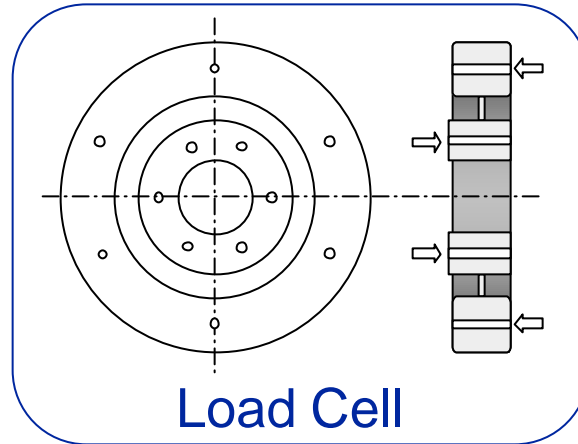
Current Application

- Superconducting wire
- Key issue – breakage
- Bonding/consolidation
- Global/OSU background



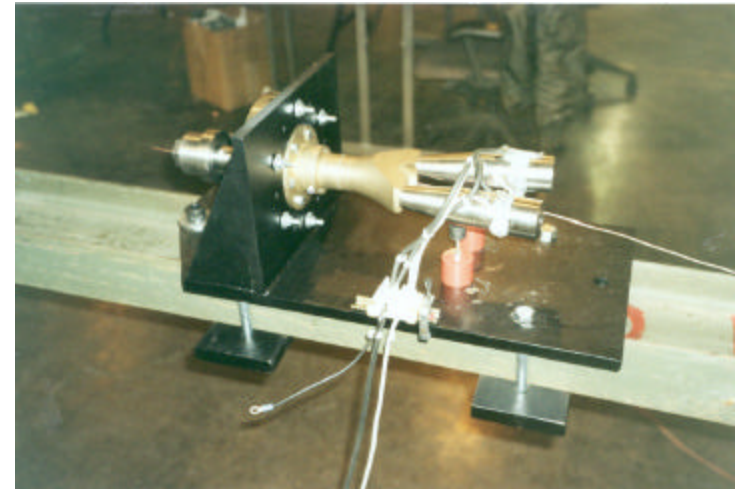
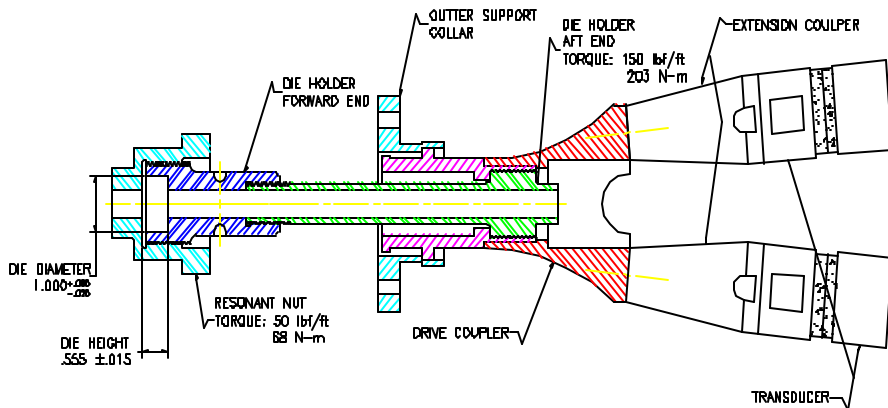
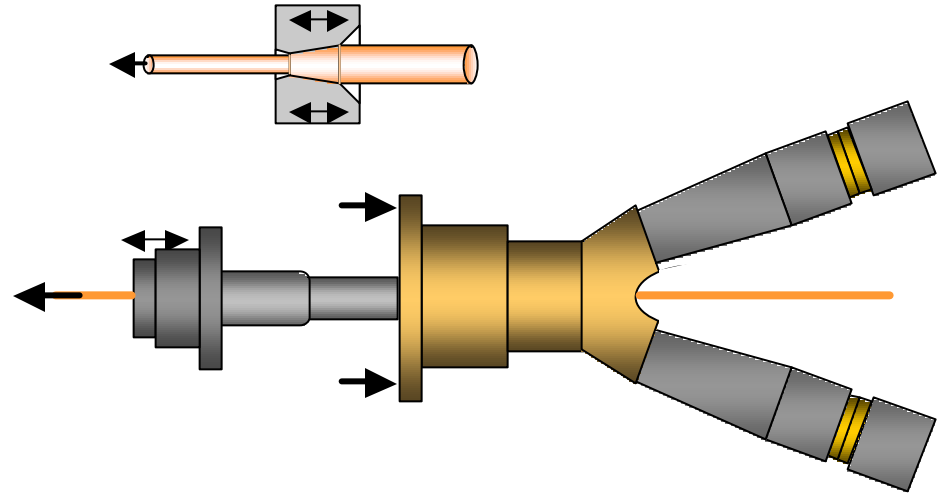
Wire Drawing System

- Draw bench
- Load cell



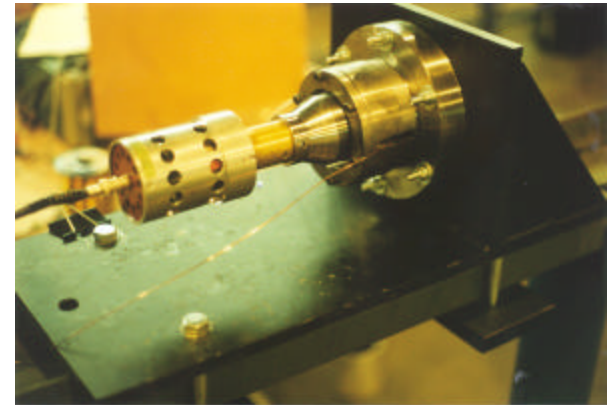
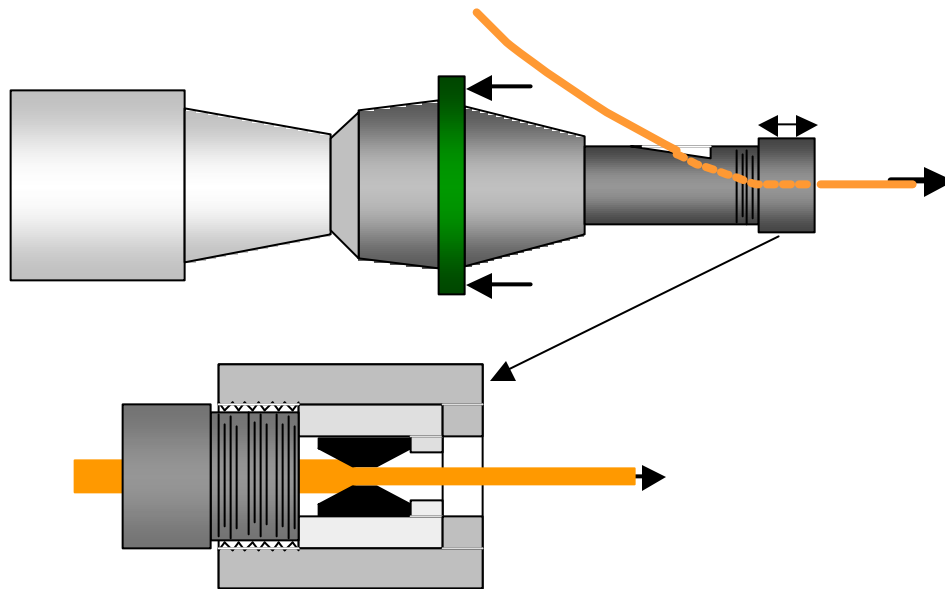
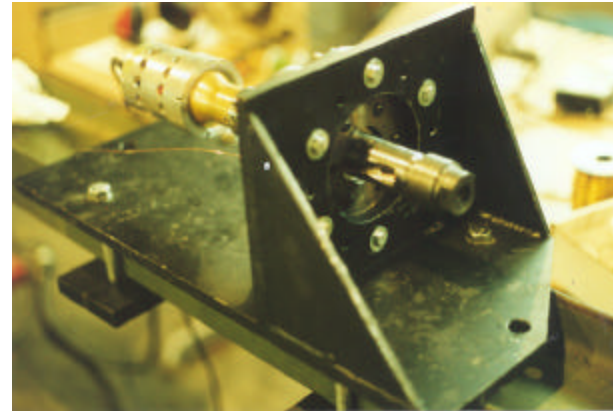
Y-Coupler System

- LM system
- 28 kHz, rigid mount
- Results, Plan B



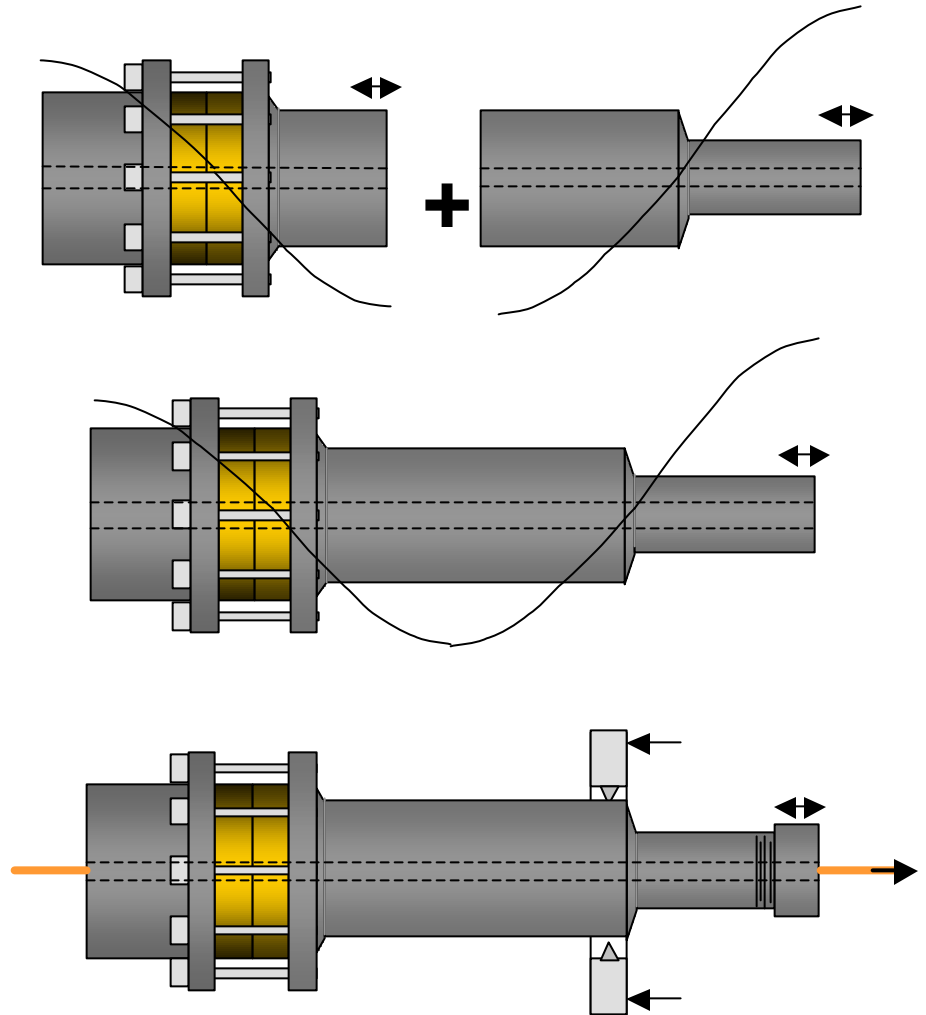
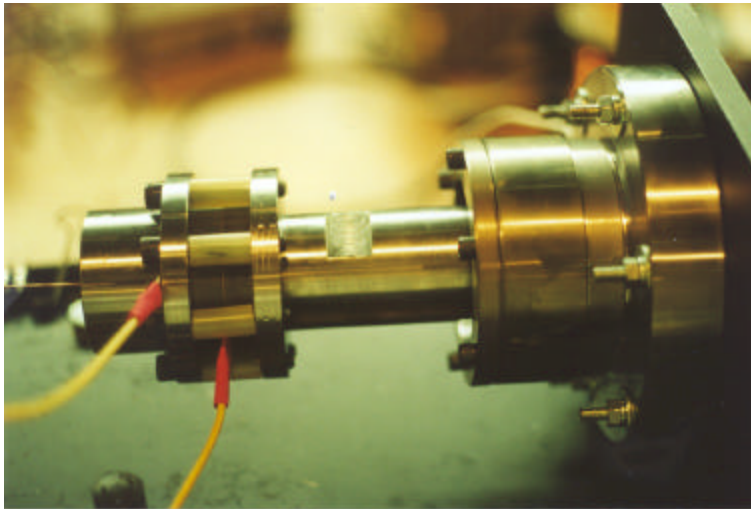
Side Draw System

- Standard Xducer, booster
- Special sonotrode
- Results



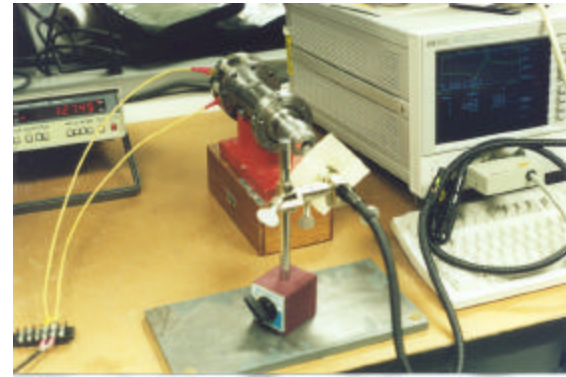
Center Draw System

- 3-step design
- Results

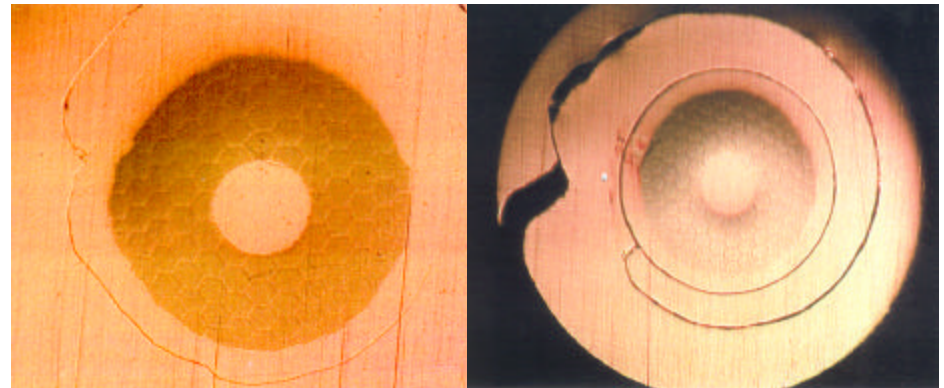


Results – Phase 1

- Plan B1, B2 systems developed
- Draw force reductions
- Evidence of bonding

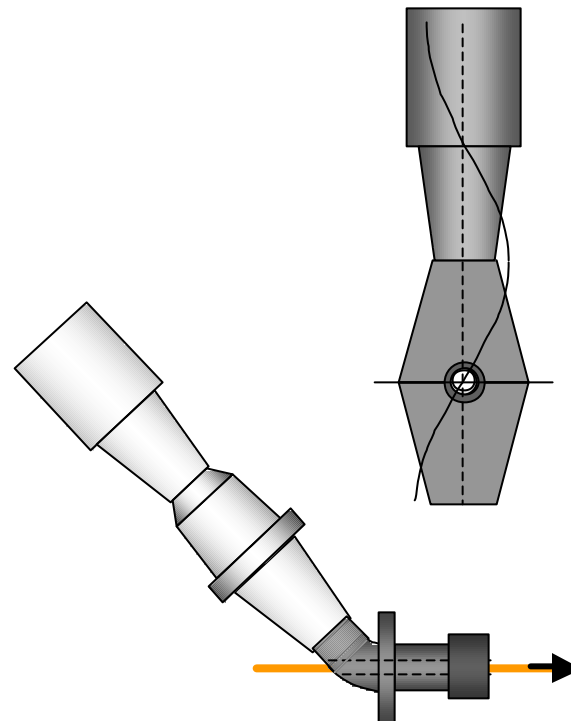
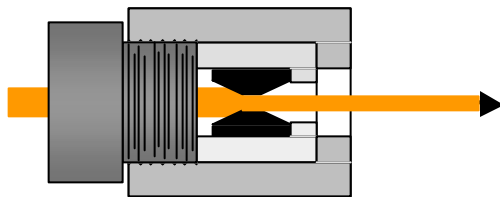
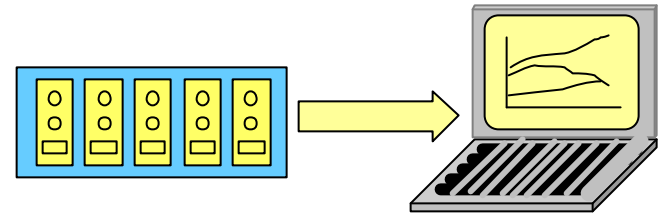


System	% Force Reduction
Side Draw	29
Center Draw	26

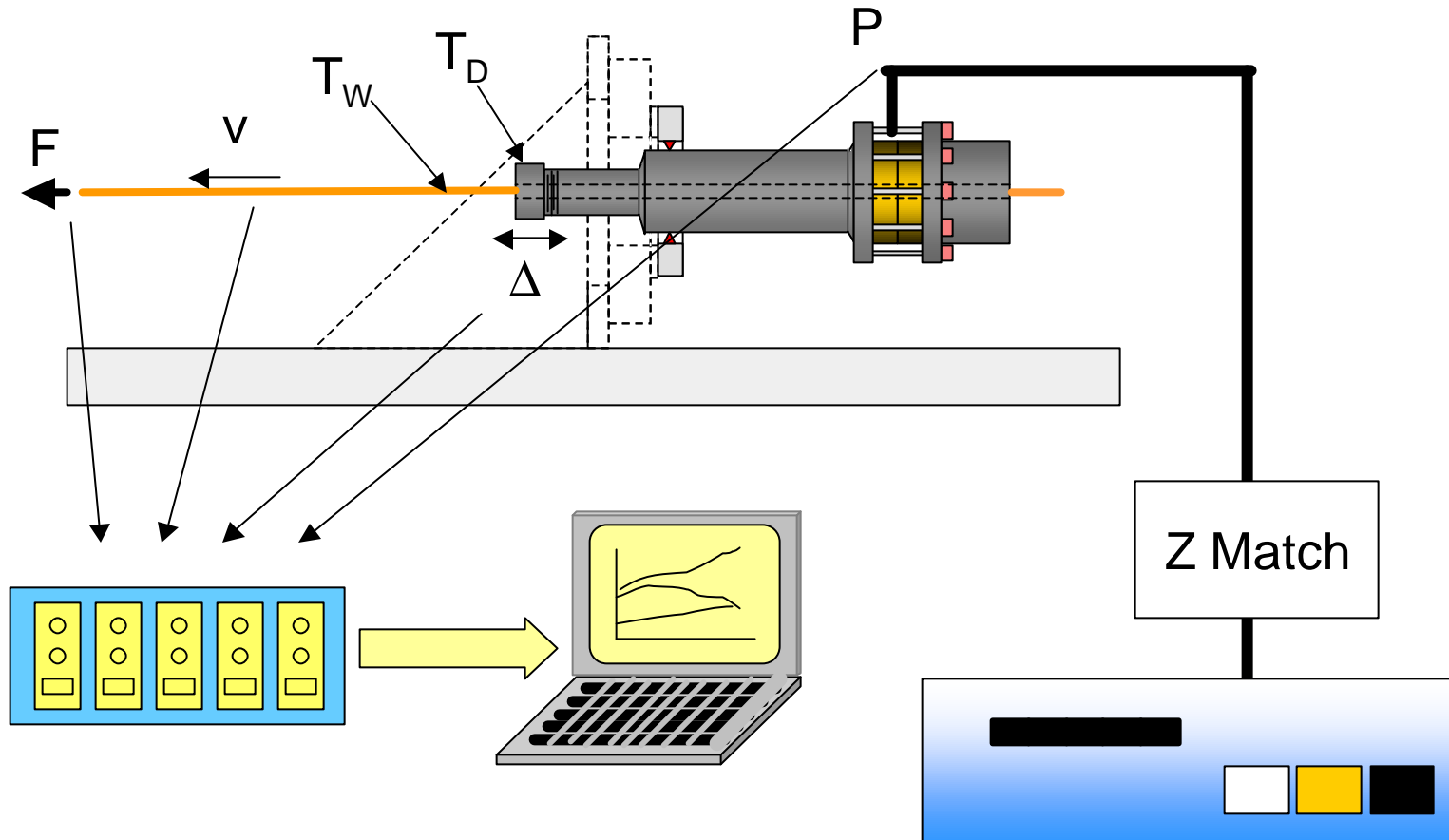


Phase 2 – Objective/Approach

- Can US yield long draws, other benefits?
- Optimize LM system
- Develop radial mode
- Die design
- Instrumentation

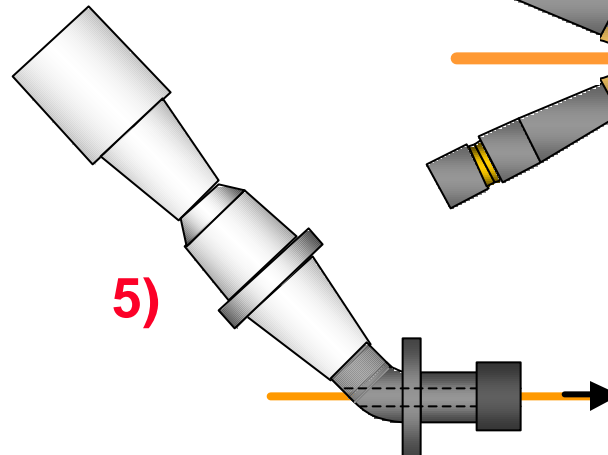
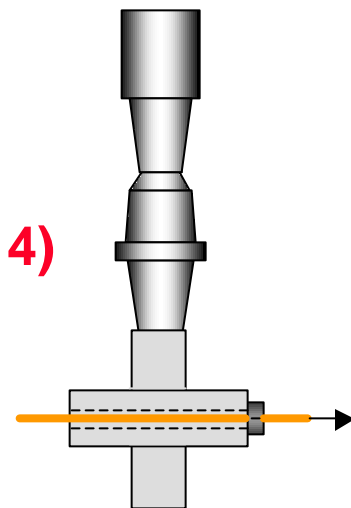
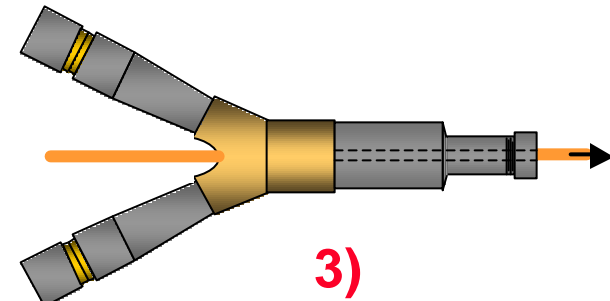
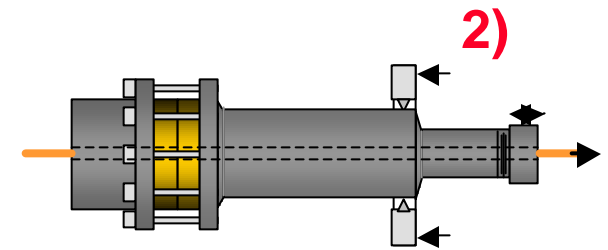
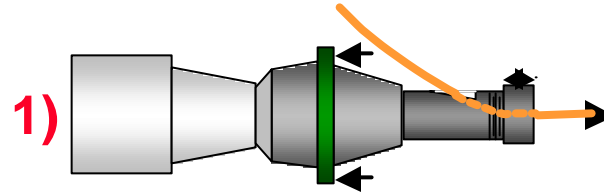


Instrumentation



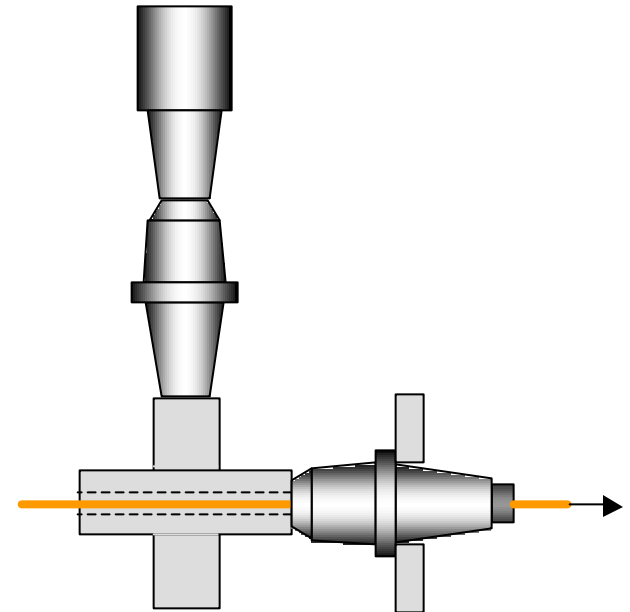
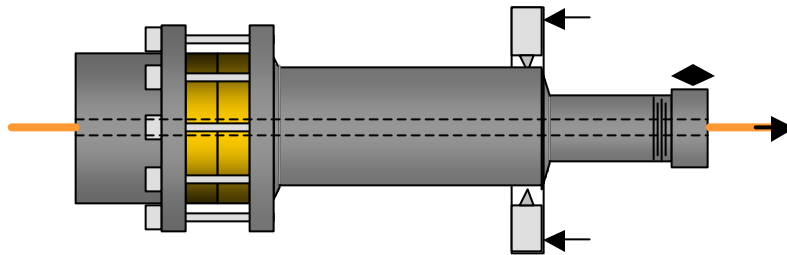
Longitudinal Mode Options

- 1) Side draw
- 2) Center draw
- 3) Y-coupler
- 4) Cross die
- 5) Curved line



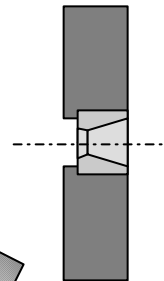
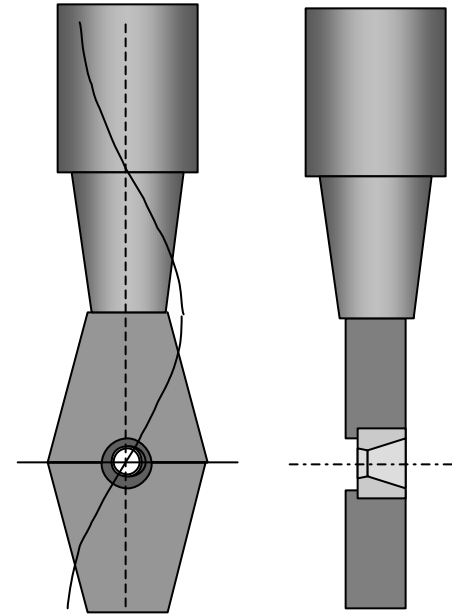
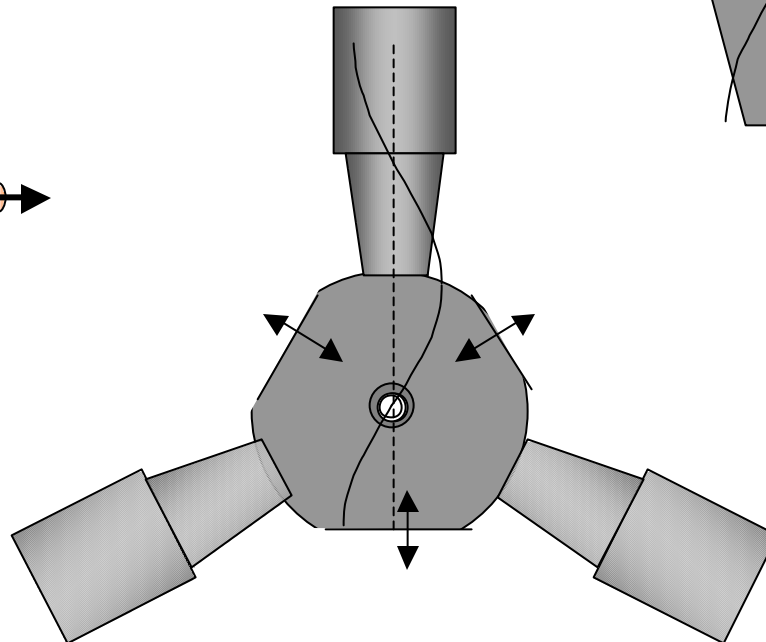
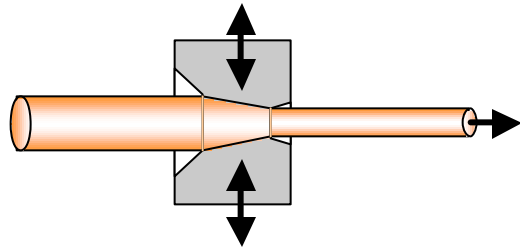
LM Systems

- Cross die design – load cell
- New CD system – match to standard PS
- Die design

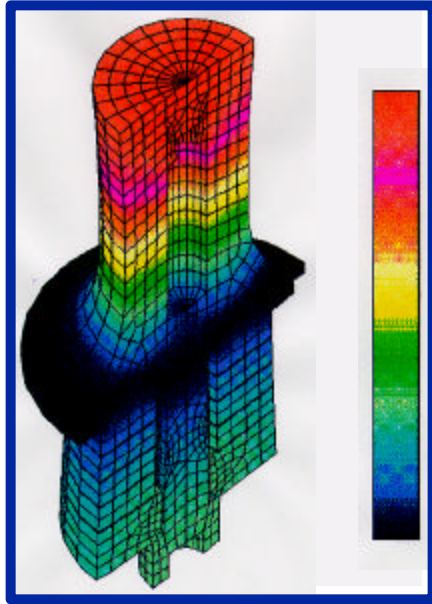


Radial Mode Systems

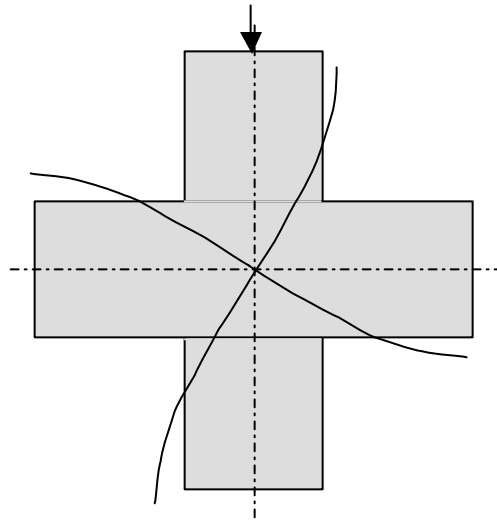
- Enhance compaction
- Small diameter – less US action
- Complex modes



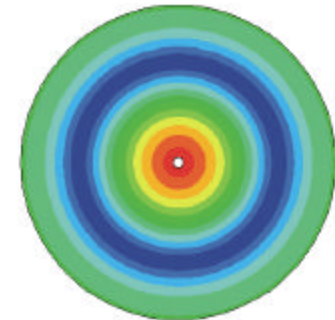
FEA of US Components



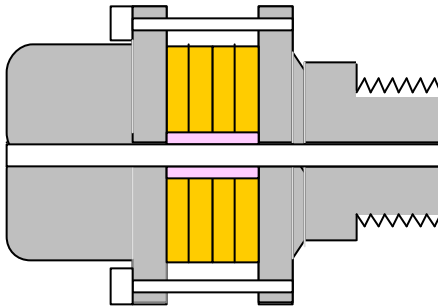
Krell Engineering



Breathing Mode

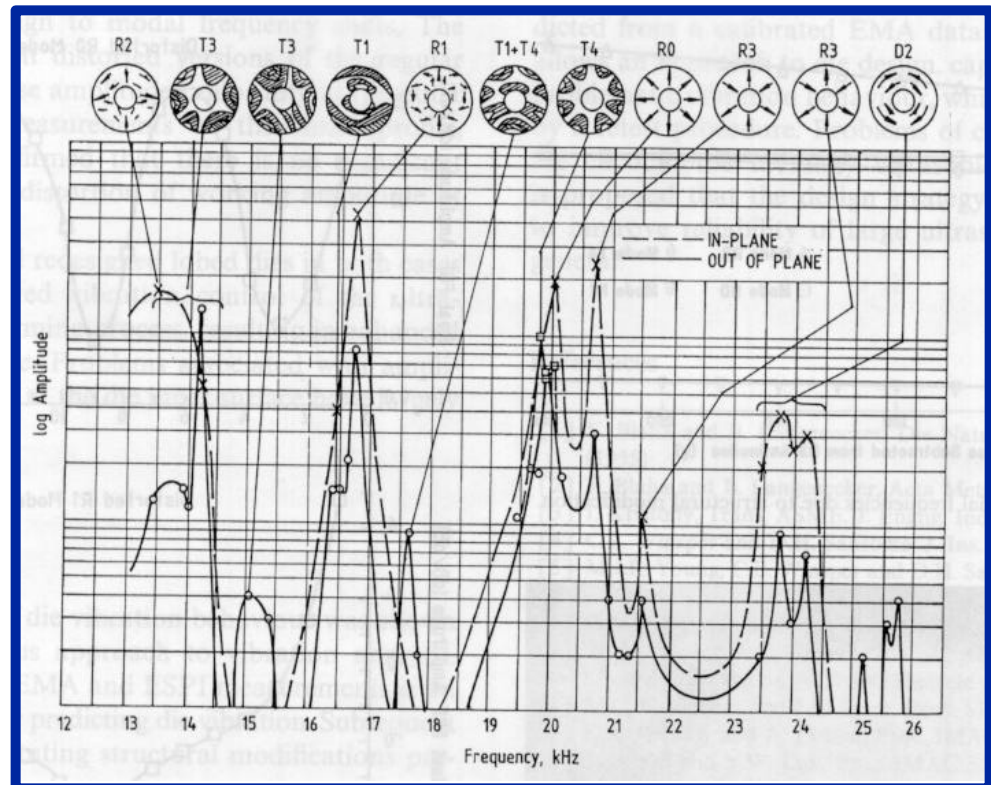
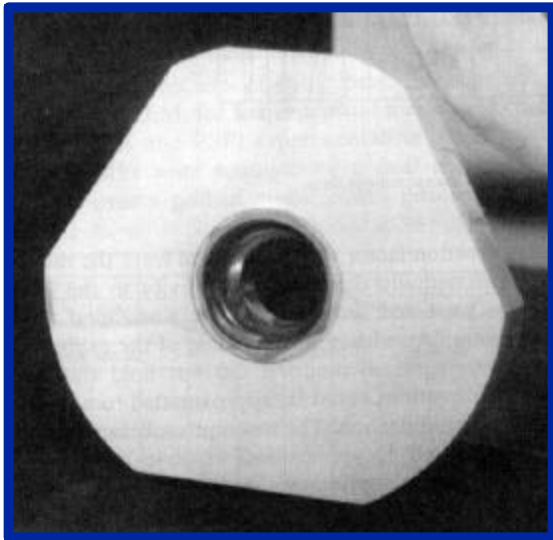


First Mode



Prior Work

- Lucas ('96)



Summary

- “B1, B2” WD systems developed
- Draw forces reduced
- Bonding achieved
- Phase 2 – in-depth development of LM and RM systems

