Outline: The conical liner is the actual part in the shaped charge system which will perform the perforation tunnel. High density cone materials which are composed with tungsten powders are used for deep rock penetration. Different powder metallurgy (P/M) parameters are playing a role in building the jet profile. The criteria for design improvement will be based on the collapse of the liner material which is capable to achieve hypervelocity jet for deep penetration onto the specific rock formation. The trade off in the cone material design should consider: Deep penetration _ Hole diameter _ Volume _ No debris.

**Material Shape's Jets** *(Flash X-Ray by Lichtenberger)*

**Copper Base:**
- Basic Cu powder (Particle size 5µm)
- Mix Cu/Ni (Particle size 5µm)
- Mix Cu with Org. binder

80W/20Cu - Particle size:

- CuW (15µm)
- CuW (5µm)

**Cone Materials – Design Aspects**

- **High Density** - Increased Tungsten and packing content in regular Cu/Pb
- **Lead free** – Copper Coated Tungsten Powder with special lubricant
- **Pyrophoric** - High density reactive powders react over 1600°C and consumes residual slug.
- **Bimodal** - Liner walls buildup with two selected compositions

**Cone Pressing Technology**

Non uniformity in density between cone Apex and Skirt will lead to different velocities in the material during the jet development. The parametric pressing design should lead to uniformity in density.

**Uniformity**

Geometrical design and dimension accuracy are leading parameters in the liner performance. However, insufficient powder mixing and pressing technique may introduce porosity and density non uniformity in any radial plane of the liner and finally causing non coherence of Jets. Densitometry technique should provide the answer for the detection of the liner homogeneity.

**Shelf Life:** Cold pressed liners holds limited shelf life.

The liners tend to be somewhat brittle which leads to fragile product. Liners produced by cold working may expand after being assembled and stored. Even slight expansion reduces charge effectiveness and repeatability.