To: Andrew Heafitz, Ben Linder, Future demining groups
From: Anna Bershteyn, Stephanie Dalquist
Subject: Blast testing proposal

The pickprod is a tool for breaking hard ground at a low angle in humanitarian demining. An original prototype (Figure 1) and the concept were developed by Carl Dietrich in 2003. Anna and Stephanie did experiments on the design to

- try using bolts instead of welds
- improve the hand guard and hand grips
- experiment with shock absorbers.

Our prototype (Figure 2) is made of E340 Stainless Steel (shaft), 316 Stainless Steel (handles), and neoprene hose (handle grip). It is approximately 70 cm long and 3 kg.

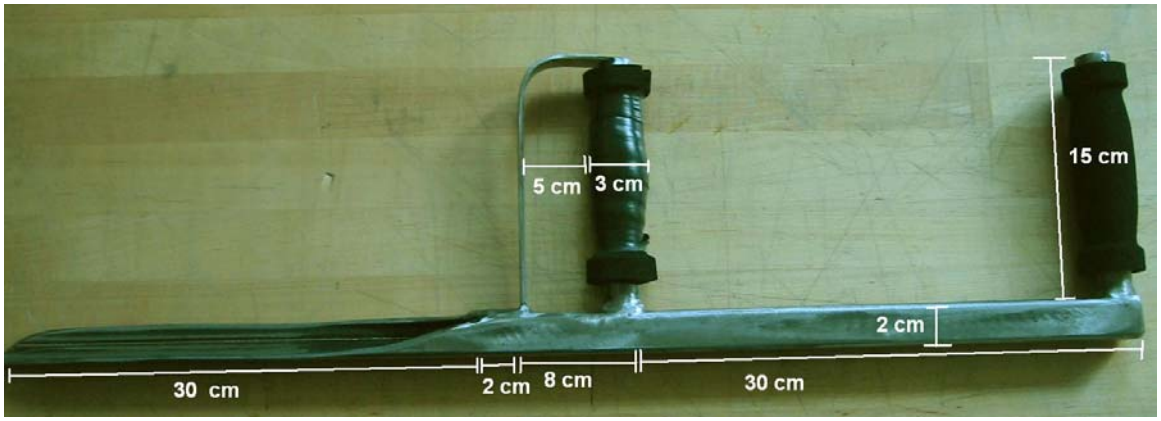

Figure 1. Prototype made by Carl Dietrich, 2003. Note ¾" handguard, bike handle grips, and welded joints.

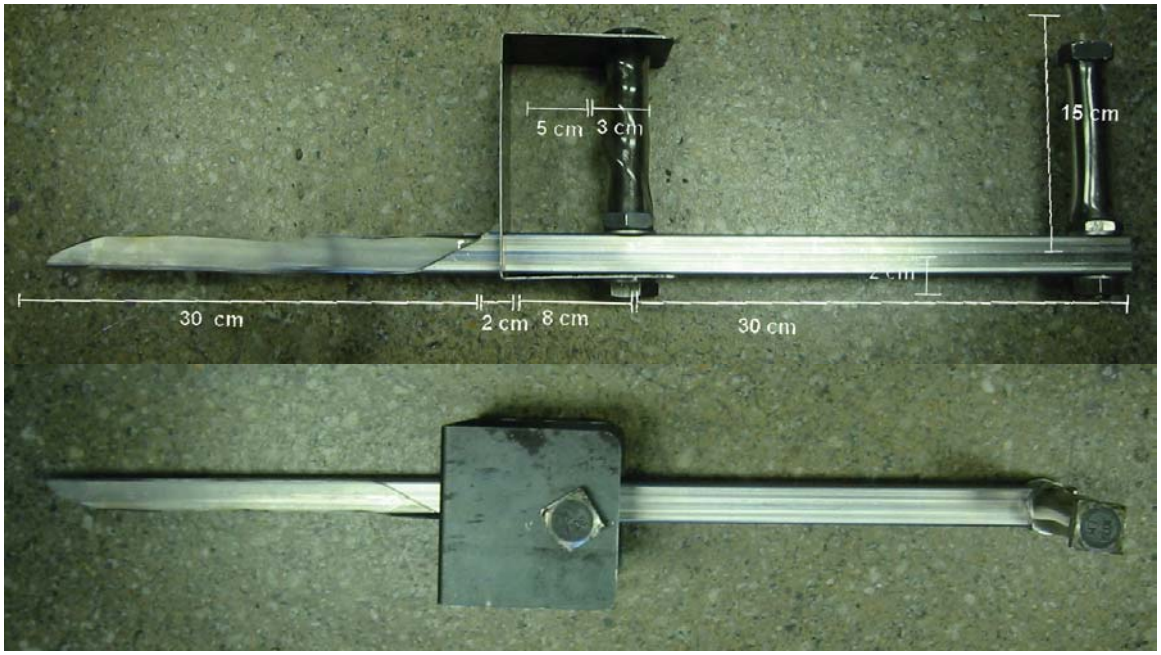

Figure 2. 2004 prototype.

The overall dimensions of the pickprod stayed the same. Bolts were used instead of welds to form handles. Though this was a good experiment, we also concluded that it is not the best design strategy. Bolts give the manufacturer a huge variety in parts (materials, style, dimensions) that can result in the production of an unsafe product when a manufacturer substitutes whatever they have for whatever we meant them to use. The size needed (about ¾" diameter and 6" long) is difficult to obtain, and would make local manufacturing prohibitively expensive. In addition, the nut above the shaft makes digging difficult. The hand has a tendency to run into the points on the nut on impact. People with larger hands have also experienced difficulty with the head of the bolt. Discussions with representatives of Whirlwind Wheelchair confirm the preference of welding over bolts. Whirlwind has worked all over the world but has particular experience in Zambia. Future prototypes should return to welding for joints.

A new grip style was attempted by compressing vinyl hose along the bolt. This material is readily available, but compression caused twisting (visible on front handle) that, though reparable, is difficult to control. It also lacks the squishiness that made the bike handle grip comfortable. Suggestions for new grips include adhesive cloth handlebar tape and different types of hose.

The hand guard was made of steel and is 4" wide – wide enough to cover the hand when wrapped around the handle behind it. The C-shape has a square hole punched through it for the shaft and two round holes for the bolts. These would be difficult to manufacture locally because we had to use a good drill press and a set of specialized punches. The future version will be ┌-shaped (Figure 3) so the square does not need to be cut. This will also be a simpler shape to weld.

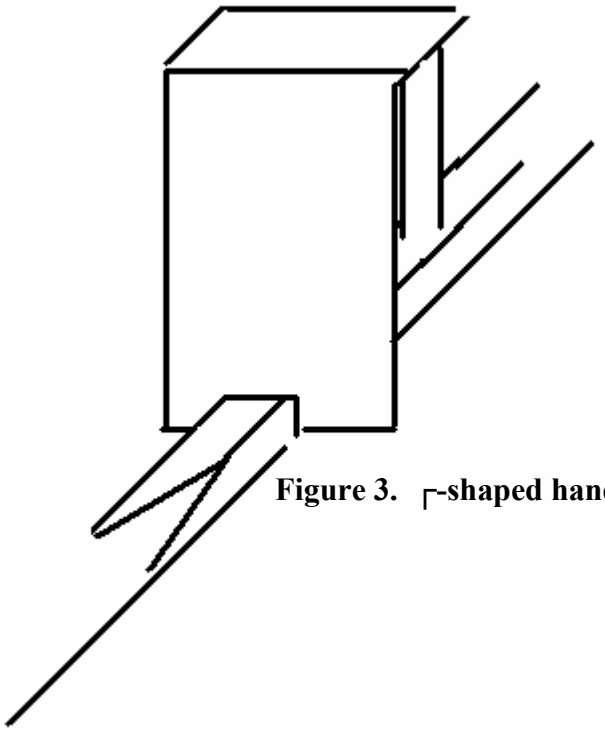

Figure 3. ┌-shaped hand guard.

Experiments in using the pickprod showed that vibration could be a problem. The pickprod could break apart cinder blocks, but at the expense of shock, particularly to the rear arm. Rolled-up rubber at the front end of the shaft dampened the vibrations some, but not enough. More complete experiments should be done on future prototypes. We have attempted to fix this by using a spring steel dampening system (Figure 4). This does improve absorption. However, Whirlwind tells us that spring steel would not be widely available except in wire form (from mattresses). The top contact between the spring steel and handle shows signs of impact, and concerns about the effects of long-term use should be addressed.

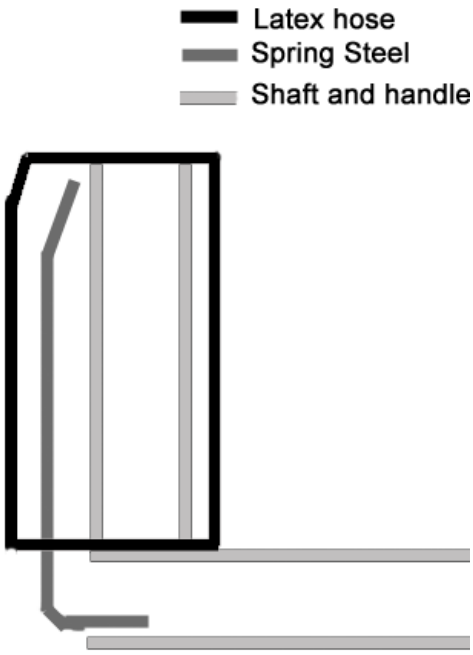

Figure 4. Spring steel shock absorption.

After finding the appropriate "middle ground" between the two existing prototypes, blast testing should be performed. A memo was written this spring with Andy Smith's recommended techniques for the guidance of future teams.