## 44. The Danger of Drilling into Sealed and Filled Plow Frames

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A serious and totally unexpected hazard has been found with some plow frames that have sealed sections filled with sundry metal scrap from machine shops. An agricultural nurse, conducting case-based surveillance with New York's Community Partners for Health Farming project, identified two incidents of serious, explosion-related injuries to farm workers. NIOSH and the NY agricultural nurse investigated these incidents in which farm workers were drilling into the frames of chisel plows when a jet of flame was emitted from the drill hole, producing serious burns. The plows had been made by the same manufacturer, though many years apart, and the incidents occurred in the same New York county. Limited sampling of the solids taken from the hole in one plow frame showed the presence of steel and galvanized steel disks that appear to be punchouts from a machine shop operation. More extensive sampling from a frame involved in the other incident showed a wide variety of metal scrap fill, including disks ranging in size from several millimeters to several inches, ovals, and rounded strips. These metal pieces were steel, stainless steel, galvanized steel, and, even, titanium. The latter metal is expensive and light weight, and would not deliberately be used for ballast. Most metal pieces were covered with a gray-greenish deposit that appeared to consist largely of zinc and iron (ferrous) oxides. The fill in all the frame sections tested produced hydrogen, an extremely flammable gas. The most graphic demonstration of this phenomenon, other than the actual fire incidents, occurred after a safe means was found of drilling into an intact sealed frame section while keeping the gas from escaping. Nearly pure (94%) hydrogen at a pressure of 185 psi was thereby discovered in this frame section. Had the drilling been done with a conventional electric drill, the escaping strong jet would have been ignited by the drill motor and burned the operator. The evidence to date suggests that the hydrogen is produced by an electrochemical mechanism involving the oxidation of zinc (and iron) and the reduction of water (and oxygen). Such explosions can be prevented by using only clean, dry metal fill of a uniform composition, and providing a means of venting excess pressure; only qualified personnel using specialized equipment should vent existing sealed frames. We do not know the extent of this problem: if others have been injured, how many of these plows exist, or if any other manufacturers use or have used potentially explosive ballast in chisel plows. NIOSH, the New York State Department of Health, and the nurse will continue working with the manufacturer and others to reduce this hazard and to disseminate findings. This finding supports the value of case-based surveillance and follow-back investigations of selected cases.

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