I used the water displacement method to measure an initial iron density of 7.868 ± 0.012 gm/cm^3. Hardness values ranged from 69 to 71 on the Rockwell F scale for two different iron samples with faces surface-ground. No difference in hardness beyond experimental scatter was detected along diameter paths on the faces of the samples.

An unshocked iron sample from the center of the bar was polished and etched with a 2 percent Nital solution (2 cc of concentrated HNO_3 and 100 cc of amyl alcohol). Grains were irregular in shape and had an average diameter of approximately 0.1 mm. Signs of foreign material were evident in the photomicrograph.

3.2.2. Sample Preparations

Samples were cut with faces perpendicular to the bar axis. Each disc was turned to the desired diameter and its faces were surface-ground to the desired thickness, which ranged from 1 to 25.4 mm. Faces were then lapped to a flatness of less than 2 fringes measured with sodium light and an optical flat. An exception was the 25.4-mm-thick plate used to obtain the equilibrium transformation stress. This iron plate would not fit the available lapping wheel and was therefore hand lapped on 600 grit paper placed on a flat layout table. Its final flatness measured less than 20 fringes using sodium light and an optical flat. The two faces were parallel to better than 12 μ for all samples as measured by a dial indicator.

3.3. Types of Experiments

The three types of experiments performed in this work are summarized in Table 3.1. In elastic precursor experiments, the iron samples were impacted by an aluminum projectile. Stress histories were obtained by recording with oscilloscopes the current output of a quartz gage affixed to the rear face of the sample. In plate slap experiments the iron samples were impacted by an aluminum flier plate. In the explosively driven experiment, the 25.4-mm-thick iron sample was impacted by a detonation wave. In plate slap and explosively driven experiments, shock wave transmission times and free surface velocities were determined by recording with a streak camera changes in the amount of light being reflected from the surfaces of mirrors.

All experiments were designed to be one-dimensional. Lateral relief from the sides of samples during the recording time was avoided by maintaining a sample ratio of diameter to thickness greater than three. The only two-dimensional hydrodynamic effects present were those induced by tilted or unavoidably curved shock fronts.

3.4. Elastic Precursor Experiments

Two elastic precursor experiments were performed using the gas gun facility at Washington State University. Experimental details for these were essentially the same as reported elsewhere.[41]