However, an approximate value can be obtained by considering the specimen end faces as point magnetic poles of charge,

$$Q_m = \pm MA,$$

where M is the magnetization and A is the area. From this, one obtains a demagnetizing field

$$H_d = -\frac{8A}{a^2} M,$$

where a is the length of the sample. This can be written

$$H_d = -DM,$$

where

$$D = \frac{8A}{a^2}$$

is the demagnetizing factor for this geometry. The maximum value for this field is about 5 oe which is approximately 2.5% of the lowest applied fields used.

In section 4.1, it was reported that the principle purpose of the large inductor was to maintain the current constant during the shock induced demagnetization process. Arbitrarily large L cannot be used since this would require a correspondingly large current supply to drive it. A sufficient value for this inductor can be obtained from the following consideration. The current fluctuation, ΔI, produced by the shock induced emf, $\mathcal{E}'$, developed across the solenoid can be obtained from

$$L \frac{d}{dt} \Delta I + \Delta IR = \mathcal{E}'$$

with the initial condition

$$\Delta \dot{I}(0) = \frac{\mathcal{E}'}{L}.$$

The shock induced emf, $\mathcal{E}'$, is on the order of

$$\mathcal{E}' \simeq 4\pi 10^{-8} bND\delta M$$

where N is the number of turns in the solenoid. This has the solution

$$\Delta I = \frac{\mathcal{E}'}{L} t \quad \text{for} \quad t << \frac{L}{R}.$$

Thus, if τ is the shock wave transit time, it will be sufficient to maintain

$$\Delta I = \frac{\mathcal{E}'\tau}{L}$$

small compared to the initial current in the solenoid. In practice, 250 to 500 μh have been found to be adequate. It should be noted that this effect tends to increase the field and is in opposition to the demagnetizing field effect.

Passage of the stress wave across the front face of the pickup coil accelerates this face creating an effective magnetic velocity gauge. Its motion produces an emf which is superimposed on the emf produced by demagnetization. This emf is given by

$$\mathcal{E}'' = 10^{-8} NbuH_e, \tag{4.15}$$

where u is the velocity, b is the width of the pickup coil, and N is the number of turns in the pickup coil. The emf of interest, Equation (4.13), is

$$\mathcal{E} = 10^{-8} NbD4\pi\delta M.$$

The fractional ratio of the two is