Impact Test

Impact loading promotes brittle fracture as stresses build up faster than the sample can absorb energy by plastic yielding. A test to investigate resistance to brittle failure is the *impact test*, which breaks a sample by striking it with a heavy pendulum. From physics, the difference in height of the pendulum before and after breaking the sample can compute the energy that the sample absorbed. Impact test machines read out this energy directly. Brittle samples absorb less energy to fracture than ductile samples.

Impact energy absorbed is not a material property. It depends on the dimensions of the sample, which is notched by machining to further promote brittle fracture by introducing a *stress concentration*. Two common sample geometries are the *Charpy Impact Test* and the *Izod Impact Test*.

Important information can be obtained by testing at different sample temperatures. Structural steel used to build Liberty ships during World War II was subsequently found to be ductile at the temperatures of fabrication in the United States, but brittle at temperatures in the Arctic Ocean.

Figure 1: Liberty Ship[1]

How fast is impact? Here is an approximate comparison of strain rates:

IMPACT	0.1% in 1 ms	(strain rate) ≈ $1\ s^{-1}$
TENSILE TEST	10% in 30 sec	(strain rate) ≈ $10^{-3}\ s^{-1}$
CREEP	1% in 1000 hours	(strain rate) ≈ $10^{-8}\ s^{-1}$
	1% in 10 years	(strain rate) ≈ $10^{-10}\ s^{-1}$

[1] The source image can be found on this page. This image is in the public domain.