

Tensile Strength

ENGR45, SRJC, Spring 2014

- TIG WELD ER70S—2 MILD STEEL WELDING ROD
- FILLET BRAZE NO. 15 LOW FUMING BRASS
- SILVER SOLDER 56% SILVER CADNIUM FREE

Project by Daniel Potts

Tig Welding

Gas tungsten arc welding (GTAW), also known as tungsten inert gas (TIG) welding, is an arc welding process that uses a non-consumable tungsten electrode to produce the weld. The weld area is protected from atmospheric contamination by an inert shielding gas (argon or helium), and a filler metal is normally used, though some welds, known as autogenous welds, do not require it. A constant-current welding power supply produces energy which is conducted across the arc through a column of highly ionized gas and metal vapors known as a plasma.

Wikipedia



Fillet Brazing



Brazing is a metal-joining process whereby a filler metal is heated above melting point and distributed between two or more close-fitting parts by capillary action. The filler metal is brought slightly above its melting (liquidus) temperature while protected by a suitable atmosphere, usually a flux. It then flows over the base metal (known as wetting) and is then cooled to join the workpieces together.[1] It is similar to soldering, except the temperatures used to melt the filler metal are higher for brazing.

[Wikipedia.com](https://en.wikipedia.org/wiki/Brazing)

Silver Solder

Soft solder is typically thought of when solder or soldering is mentioned, with a typical melting range of 90 to 450 °C (190 to 840 °F).[3] It is commonly used in electronics, plumbing, and assembly of sheet metal parts. Manual soldering uses a soldering iron or soldering gun. Alloys that melt between 180 and 190 °C (360 and 370 °F) are the most commonly used. Soldering performed using alloys with a melting point above 450 °C (840 °F) is called 'hard soldering', 'silver soldering', or brazing.

Wikipedia



Tensile Strength



Ultimate tensile strength (UTS), often shortened to tensile strength (TS) or ultimate strength,[1][2] is the maximum stress that a material can withstand while being stretched or pulled before failing or breaking. Tensile strength is defined as a stress, which is measured as force per unit area. For some non-homogeneous materials (or for assembled components) it can be reported just as a force or as a force per unit width. In the SI system, the unit is the pascal (Pa) (or a multiple thereof, often megapascals (MPa), using the mega-prefix); or, equivalently to pascals, newtons per square metre (N/m^2). A customary unit is pounds-force per square inch (lbf/in² or psi), or kilo-pounds per square inch (ksi, or sometimes kpsi), which is equal to 1000 psi; kilo-pounds per square inch are commonly used for convenience when measuring tensile strengths.

Wikipedia

Objectives

Main Objective

- ▶ Determine Ultimate Tensile Strength of Tig Weld, Fillet Braze, and Silver Solder.
- ▶ Graph Stress vs Strain for welding mediums: mild steel, brass and silver.



Preparation



The strength of the Tig Weld and Fillet Braze rely on volume of material so the edges on the weld area were chamfered.



Preparation

The strength of Silver Solder is in the surface area contact so edges were not chamfered.

A small 1/32" gap was left between both sides to allow complete penetration.



Welding

- Sample 1: Tig Welded using mild steel welding rod
- Sample 2: Fillet Brazed using NO. 15 Low Fuming Brass
- Sample 3: Silver Soldered using 56% Silver Cadmium Free Solder

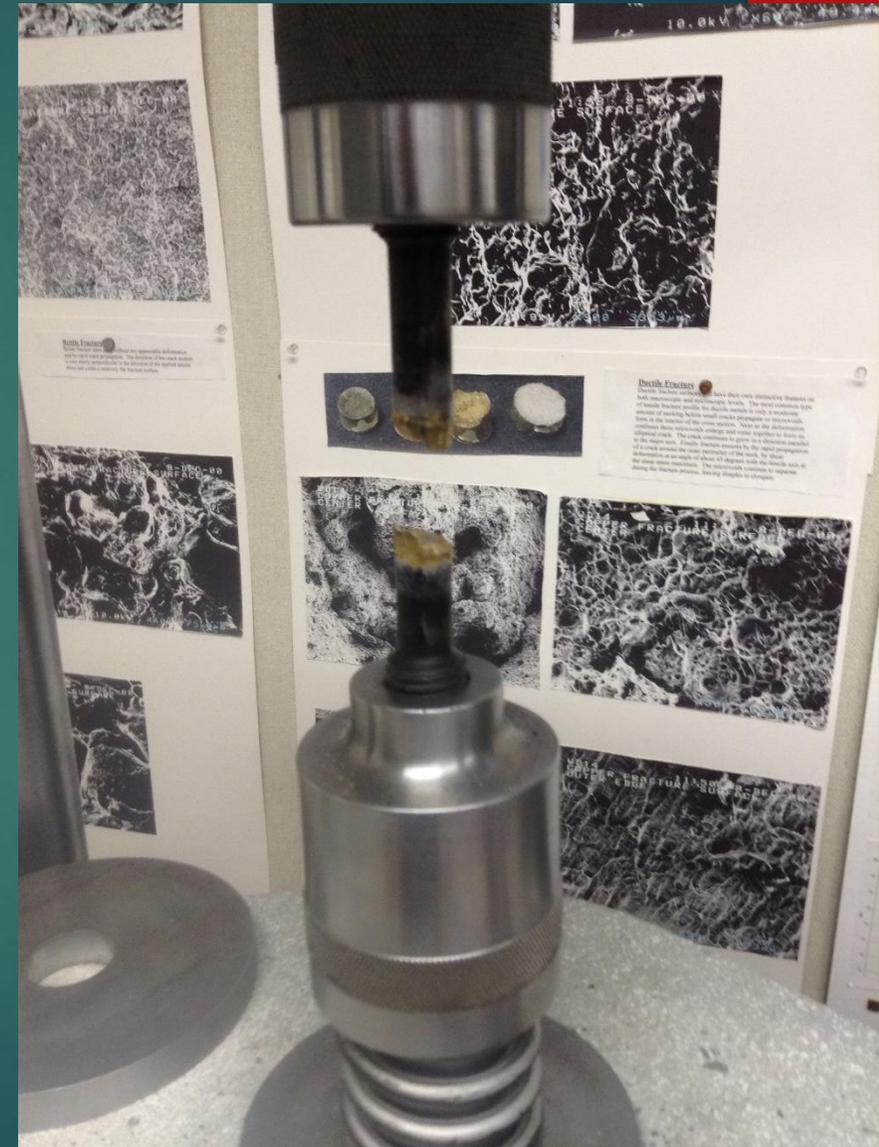


Experiment



Both the silver solder and braze joints failed.
The steel sample broke before the tig weld.

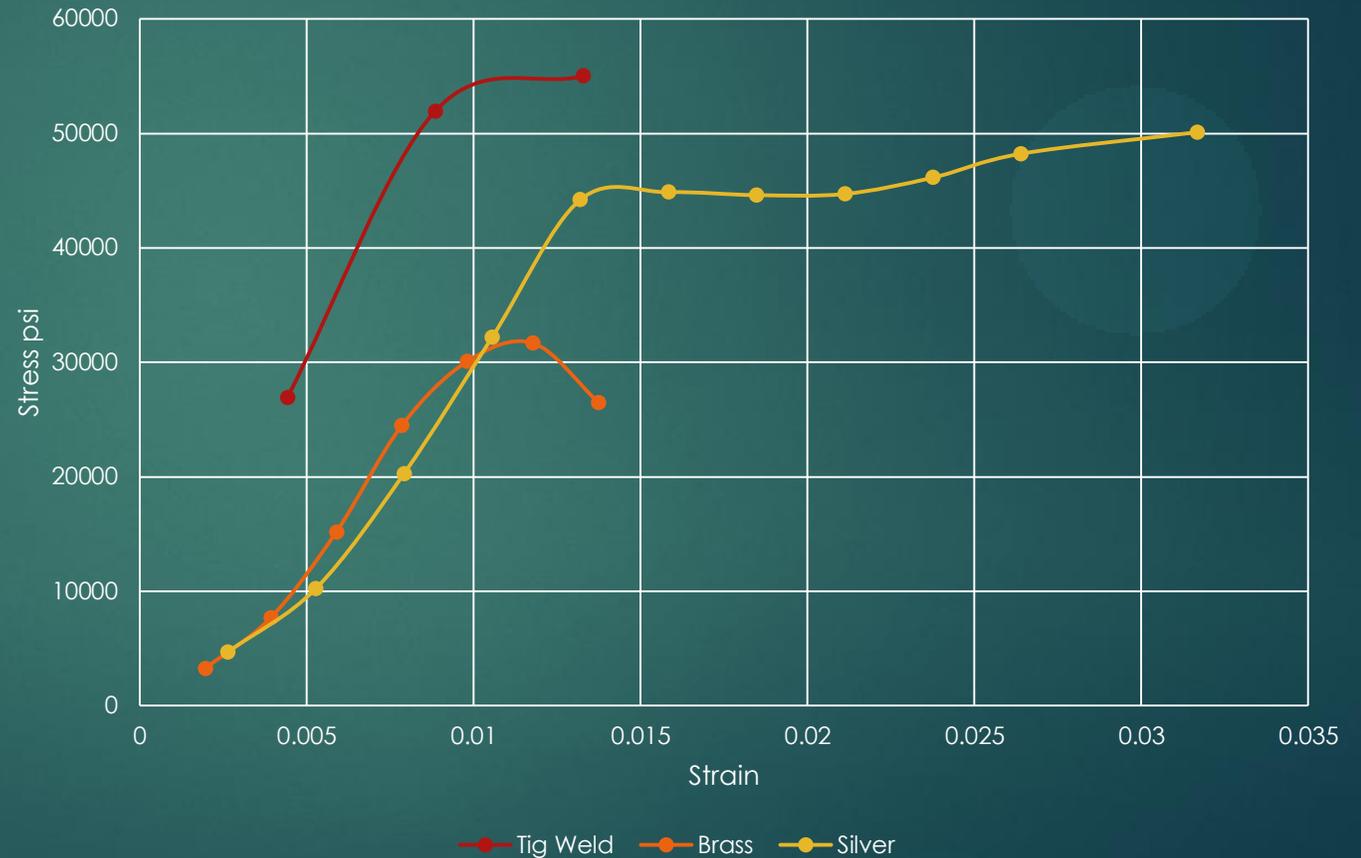
In the tig sample, the metal was brittle in all areas except the weld joint where the tig weld had annealed it. The weld joint did not break as a result of increased toughness.



Data

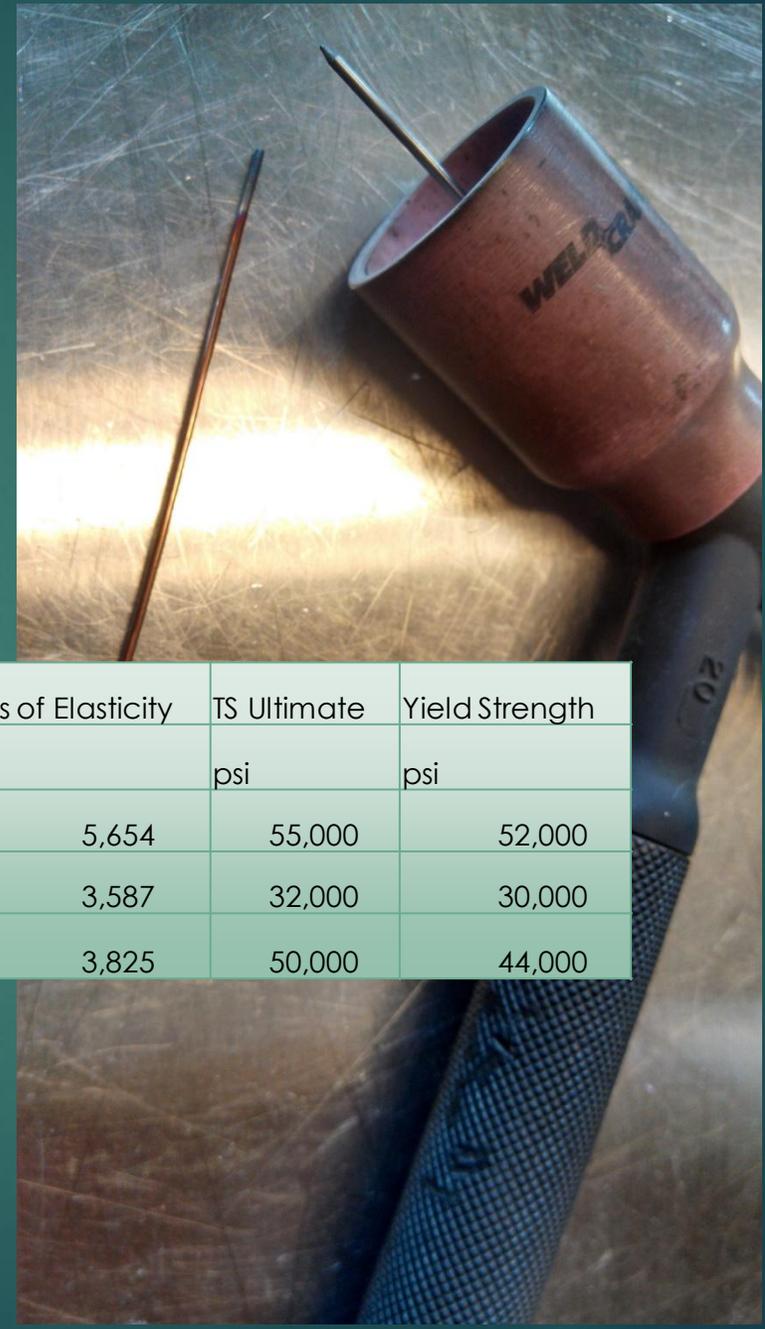
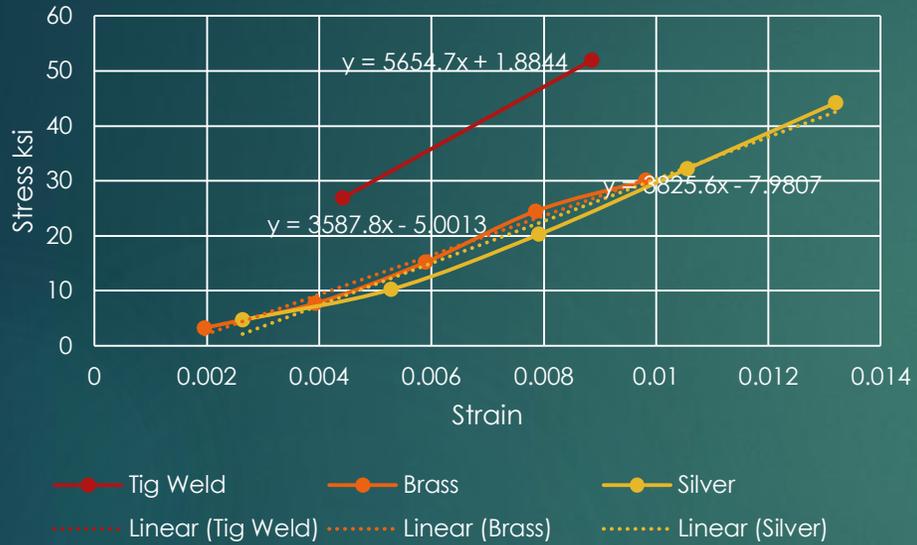
Tig Weld		Brass		Silver	
LO	2.259	LO	2.545	LO	1.894
Max F	N/A	Max F	6220 lb	Max F	9840 lb
DL	F	DL	F	DL	F
in	lb force	in	lb force	in	lb force
0.01	5285	0.005	640	0.005	920
0.02	10200	0.01	1510	0.01	2010
0.03	10800	0.015	2980	0.015	3980
		0.02	4810	0.02	6320
		0.025	5910	0.025	8680
		0.03	6220	0.03	8810
		0.035	5200	0.035	8760
				0.04	8780
				0.045	9060
				0.05	9470
				0.06	9840
Strain	Stress	Strain	Stress	Strain	Stress
in/in	psi	in/in	psi		psi
0.004427	26916.28	0.001965	3259.493	0.00264	4685.522
0.008853	51948.17	0.003929	7690.367	0.00528	10236.85
0.01328	55003.95	0.005894	15177.02	0.00792	20269.97
		0.007859	24497.13	0.01056	32187.5
		0.009823	30099.38	0.0132	44206.88
		0.011788	31678.2	0.015839	44868.96
		0.013752	26483.38	0.018479	44614.31
				0.021119	44716.17
				0.023759	46142.2
				0.026399	48230.31
				0.031679	50114.71

Stress vs. Strain



Analysis

Linear Stress vs. Strain



Sample	Modulus of Elasticity	TS Ultimate	Yield Strength
	ksi	psi	psi
Tig Weld*	5,654	55,000	52,000
Fillet Braze	3,587	32,000	30,000
Silver Solder	3,825	50,000	44,000

*The tig welded sample failed at the threading not the weld. data reflects this.

Error

- The tig weld sample broke at the threading instead of the weld. Its possible that the steel was brittle from a previous heat treatment experiment. The tig weld annealed the sample at that area and increased its toughness

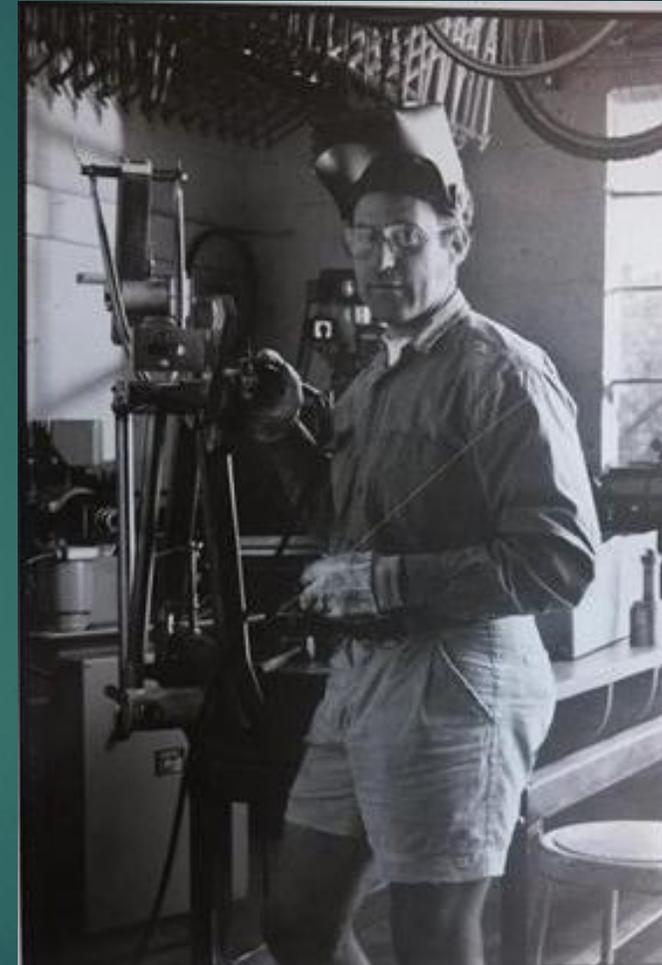


- The brass did not penetrate all the way to the center of the weld. As a result, the tensile strength was skewed lower.



Credits

Project by Daniel Potts



Welding by Steve Potts