GGMULTI™

Technical Information

Utilization of GGMULTI is a “win-win” solution for both the customer and producing mill. Both entities benefit from the result of reduced items for inventory control. Also, the customer may have the added advantage of a better performing material. This technical document highlights the metallurgical aspects and benefits of this material.
GGMULTI is intended for products as described in the Table below.

GGMULTI Products

Product	Size Range
Angles	1-1/2” and greater (20’ and 40’)
Channels	3” – 6” (20’ and 40’)
Channels	6” and greater (20’, 40’, 50’, 60’)
MC Channels	6” and greater (20’, 40’, 50’, 60’)
Flats	2” and greater (20’ and 40’)

Angles

Channels & MC Channels

Flats

GGMULTI specification has been designed to have a 50 KSI minimum yield strength. Grades included in this are: ASTM A36, A529-50, A572-50, A709-36, A709-50, AASHTO M270-36, M270-50, ASME SA36 and CSA G40.21-04 44W, 50W.

There are significant differences in chemical and mechanical requirements for the individual grades, as shown in the table below, and accordingly the GGMULTI is made to the most restrictive specification. This assures that GGMULTI will have consistent mechanical properties as compared to the individual specifications.

GGMULTI Physical and Chemical Characteristics

Characteristics	A36	A572-50	A529-50	CSA 44W	CSA 50W	GGMULTI
Carbon, max	0.26%	0.23%	0.27%	0.22%	0.23%	0.22%
Manganese		1.35% max	1.35% max	0.50-1.50%	0.50-1.50%	0.50-1.35%
Vanadium or Columbium		V - 0.01-0.15% Cb- 0.005-0.05%		0.10% max	0.10% max	V - 0.01-0.10% Cb - 0.005-0.05%
Yield Strength, min.	36 ksi	50 ksi	50 ksi	44 ksi	50 ksi	50 ksi
Tensile Strength	58-80 ksi	65 ksi min	70-100 ksi (flats) 65-100 ksi (shapes with flange or leg thickness up to 1-1/2”	65-90 ksi	65-95 ksi	70 – 80 ksi (flats) 65 – 80 ksi (shapes with flange or leg thickness up to 1-1/2”
Ductility / elongation, in 8” gage length, min	20%	18%	18%	20%	19%	20%

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GGMULTI Benefits

GGMULTI has more restrictive carbon and manganese ranges assuring that mechanical and ductility properties will be more consistent. GGMULTI also has a tensile range of 70-80 KSI for flats and 65-80 KSI for shapes. This will result in consistent mechanical properties compared to the individual specifications. The carbon maximum of 0.22% assures better steel ductility. Achieving consistent mechanical properties with minimum carbon content will improve fabrication processes, such as shearing, punching and bending.

GGMULTI will also have improved weldability as compared to A529-50 due to the lower carbon (0.22% max) and resulting lower carbon equivalent (CE). Lower CE is important for weldability when specifically used for welded structural members in pre-engineered buildings.

GGMULTI tensile strength is controlled within narrow limits as stated, and as a result the yield strength will be more consistent. This will have the effect of making the spring-back after bending more consistent. Spring-back is closely related to the elastic strain or in effect the yield strength.

GGMULTI		Min	Max
	Y	50	
	T	70*	80
	E	20	

*65 for shapes

A36 A709-36 M270-36 SA36		Min	Max
	Y	36	
	T	58	80
	E	20	

CSA 44W		Min	Max
	Y	44	
	T	65	90
	E	20	

CSA 50W		Min	Max
	Y	50	
	T	65	95
	E	19	

A529-50		Min	Max
	Y	50	
	T	70*	100
	E	18	

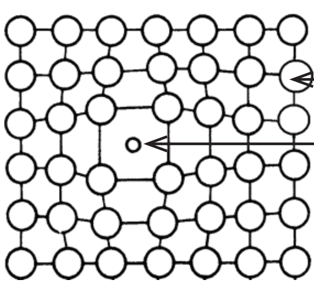
A572-50 A709-50 M270-50		Min	Max
	Y	50	
	T	65	
	E	18	

The Importance of reduced carbon content in steel

Carbon is necessary for achieving strength requirements in steel. However, lower carbon content for the same strength level improves steel toughness and ductility necessary for shearing, hole punching and bending operations that are all important in steel fabrication.

Carbon as an interstitial Atom

The following diagram schematically shows how the atomic arrangement of iron atoms in steel are distorted by the presence of interstitially dissolved carbon atoms. The distortion caused by carbon atoms even in minute quantities (<0.02%) increases strength and reduces ductility.



Carbon as a Compound

Most of the carbon in steel is present as a compound of iron and carbon called cementite (Fe_3C). Cementite forms during the cooling of the steel along with the iron base (ferrite) to form a new phase (pearlite). The combined microstructure is shown at high magnification in Figure 1. Because almost all of the carbon is present in the steel as the Fe_3C component in the pearlite phase, higher carbon content results in higher proportion of the pearlite phase as compared to the ferrite phase. Higher carbon and resulting pearlite content is the primary method of strengthening structural steels, however the higher proportion of pearlite results in a less ductile steel.

Pearlite colonies

Iron (Ferrite) Base

Microstructure of structural Steel- Ferrite (white) and pearlite (dark)

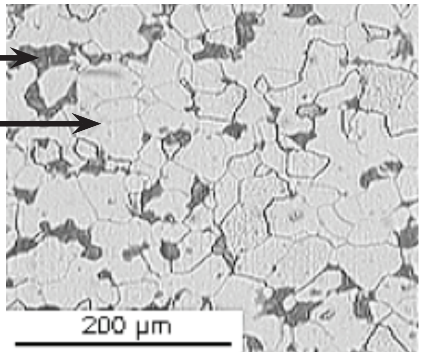


Fig. 1

Welding Characteristics

Weldability is inversely related to the carbon content and to a lesser extent by the alloy content of the steel; that is, steel with higher carbon and alloy content is less weldable due to the potential of forming brittle microstructure in the Heat Affected Zone (HAZ) of the weld. The weldability of the base steel can be estimated from what is known as the carbon equivalent. Generally, weldability is improved with lower carbon equivalent. Various empirical equations have been used to calculate the carbon equivalent: one of which is shown below:

CE, Carbon Equivalent, = % C + %Mn/6 + %(Cr + Mo +V)/5 + % (Cu +Ni)/15 [from ASTM A6]

Higher CE values will have greater susceptibility to forming brittle microstructures in the HAZ making it more susceptible to cracking. An example of cracking in the HAZ of a butt weld is shown below in Figure 2.

Transverse section of a butt weld with base metal and weld metal cracks shown by etching and magnetic particle inspection. Magnification 5X

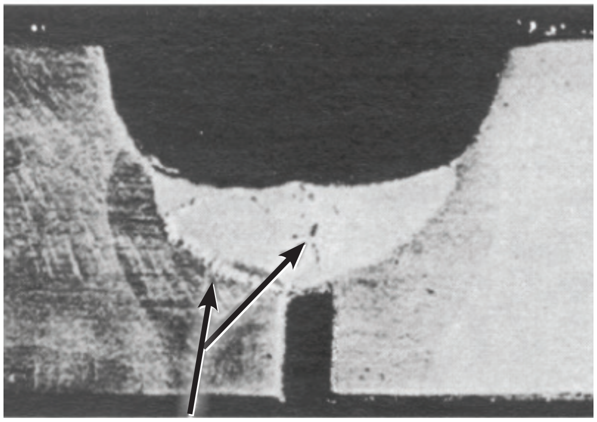


Fig. 2