Aluminum Filler metal selection chart 12-16-11.ai 1 12/16/2011 8:02:01 AM

ALUMINUM FILLER METAL SELECTION CHART

Explanation of Relative Rating A, B, C, & D
Filler metal property ratings A, B, C and D are relative values for welding base metals indicated in a specific box. An "A" rating is the best fit for the weldment property and "D" rating is the least fit. A "blank" rating indicates that the filler metal is not recommended for that specific weldment property application. All ratings listed are in the as welded condition. For post weld heat treatment (PWHT) ratings, refer to the table on the right.

Explanation of Ratings A, B, C, & D - Comparison Between Boxes
Ratings have comparative meaning within a single box only. For example, an "A" rating in one box does not have any comparative value to an "A" rating in another box.

****Special Filler Metal Considerations**
Filler Metal 4943
4943 will provide substantially higher strength with comparable weldability and crack sensitivity when compared to 4043. This filler metal has an addition of Mg which provides it with higher as-welded strength without dependence on dilution from base material. It will also provide greater strength in components that are subjected to post weld heat treatment (solutionizing and/or precipitation hardening).
Filler Metal 4047
4047 has a lower melting temperature, slightly higher shear strength, higher fluidity and reduced sensitivity to termination cracking when compared to 4043. It is often selected for leak-tight joints and may also make a good substitute for 4043 when welding other types of thin sections.

WELD METAL PROPERTIES

CRACKING — CRACK SENSITIVITY The Probability of Hot Cracking - this rating is established through use of crack sensitivity curves (Developed by Alcoa) and the consideration of filler metal and base metal chemistry combinations. There are levels of various alloying elements within aluminum that have been identified as seriously affecting hot cracking susceptibility during weld solidification. This rating is primarily based on the probability of producing a weld outside these crack sensitive chemistry ranges.

STRENGTH — STRENGTH Ratings are for fillet weld and groove weld strength in the as welded condition.
Groove welds – Any specified filler metal with a rating can provide minimum transverse tensile strength in groove welds that will meet the as-welded strength of the base material.
Fillet welds – Ratings provided are for fillet weld shear strength.

DUCTILITY — DUCTILITY This characteristic of the completed weld may be of consideration if forming operations are to be used on a completed weldment during fabrication.
Note: Testing procedure requirements for guided bend tests may need to be adjusted to accommodate the varying ductility of filler alloys (AWS D1.2).

CORROSION — CORROSION RESISTANCE This variable may be a consideration for some environmental conditions. The rating is based on exposure to fresh and salt water environments and is not associated with a specific chemical exposure. It gives an indication as to the possibility of galvanic corrosion due to the difference in the electrode potential between the base metal and the filler metal. For consideration for other environmental and chemical exposures contact MAXAL.

ELEVATED TEMPERATURE — ELEVATED TEMPERATURE SERVICE This rating is based on the reaction of some filler metals when exposed to sustained elevated temperature: 150°F to 350°F (66°C to 180°C). If 5xxx series base metal or filler metal with more than 3% magnesium content are subjected to prolonged exposure to these temperatures, precipitate can form within them that is highly anodic to the aluminum-magnesium matrix. It is this continuous grain boundary network of precipitate that produces susceptibility to stress corrosion cracking (SCC) and the potential for premature component failure.

COLOR — COLOR MATCH AFTER ANODIZING Base metal and filler metal color match after post-weld anodizing can be of major concern in cosmetic applications. Some filler metals closely match the base metal color after anodizing and others will react to the anodizing process by changing to a color very different to that of the base metal.

PWHT — POST WELD HEAT TREATMENT This rating applies to the ability of a weld to respond to post-weld heat treatment in the form of solution heat treatment and artificial aging. An "A" rating indicates that the filler metal is heat treatable and will therefore respond to post weld heat treatment even without dilution of the base metal. A "B" rating indicates that the filler metal is not heat treatable. However, it may be used for applications requiring post weld heat treatment but with the understanding that the weld may or may not acquire substantial increase in strength dependent on the joint design, welding procedure, and resultant amount of dilution of base metal obtained during welding. A "C" rating requires consultation with MAXAL®. No rating indicates that the filler metal is not heat treatable and that it should not be used for applications requiring post weld heat treatment as it may result in substantial reduction in weld performance.

TOUGHNESS — TOUGHNESS This rating applies to the ability of an aluminum weldment to deform plastically in the presence of stress raisers without low-energy initiation and propagation of cracks. The most useful test data is from tear resistance testing expressed in unit propagation energy of measured crack lengths. In structural design, notch toughness is becoming more emphasized by designers to facilitate the ability to inspect highly stressed structures and find cracks in weldments before catastrophic failure occurs. It may also be a design consideration if fatigue and impact loading are factors directly associated with a weldment.

METAL GROUPS		Pure Aluminum	Aluminum - Copper		Aluminum - Manganese		Aluminum - Magnesium					AL-Mg$_2$Si	AL - Zinc	AL - Castings		METAL GROUPS	
BASE METAL	FILLER METAL	1100, 1060, 1070, 1080, 1350	2014, 2036	2219	3003, Alclad 3003	3004, Alclad 3004	5005, 5050 5052, 5652	5086, 5083, 5456, 5383	511.0, 512.0 513.0, 514.0 535.0 5154, 5254	5454		6061,6005 6063,6070 6151,6201 6351,6951,6082	7005, 7021 7039, 7046 7146 710.0, 711.0	413.0, 443.0 444.0, 356.0 A356.0, 357.0 359.0	319.0, 333.0 354.0, 355.0 C355.0, 380.0	FILLER METAL	BASE METAL
WELD METAL PROPERTIES		CRACKING	STRENGTH	DUCTILITY	CORROSION	ELEVATED TEMPERATURE	COLOR	PWHT	TOUGHNESS							WELD METAL PROPERTIES	
319.0, 333.0 354.0, 355.0 C355.0, 380.0	2319 4043/4943** 4145	B A A A A A C A A A A A	B A A A A A A B C A A A A A	C B B A A A A C D A A A A A	B B A A A A A C D A A A A A							B B A A A A C D A A B A A	B B A A A A C D A A B A A	B B A A A A C D A A B A A	B A A A A A A C B B A A A D	2319 4043/4943** 4145	319.0, 333.0 354.0, 355.0 C355.0, 380.0
413.0, 443.0 444.0, 356.0 A356.0, 357.0 359.0	4043/4943** 4145 A356.0 A357.0 5356	A A A A A A A A B A	C B B A A A A B C D A A B A A A A B C D	D A A A A A A	D A A A A A A	D B A B A A D B A B A A						A B A A A A C D A A B A A	A B A A A A C D A A B A A	A D B B A A A C C D A C B A A A A A A C B	4043/4943** 4145 A356.0 A357.0 5356	413.0, 443.0 444.0, 356.0 A356.0, 357.0 359.0	
7005, 7021 7039, 7046 7146 710.0, 711.0	4043/4943** 4145 5183 5356 5554 5556 5654	A D C A A B A A A B B A A A B B A A A B	D B B A A A C D A A B A A	D A D C A A D A D C B A D B B A B A A B A A A B C A A A A B B B A A A B B C A A A A B B B A A A B B	D A D C B A D B A B A A B A A B C A A A A B B B A A A B B	D B D C B A D B A B A A B A A B C A A A A B B B A A A B B	B A A B A A B A A B A A B A A B C A A A A B B B A A A B B	B A A B A A B A A B A A B A A B C A A A A B B B A A A B B	B A A B A A B A A B A A B A A B C A A A A B B B A A A B B	B A A B A A B A A B A A B A A B C A A A A B B B A A A B B	B A A B A A B A A B A A B A A B C A A A A B B B A A A B B	A D C B A A D B A B A A B A A B C A A A A B B B A A A B B	4043/4943** 4145 5183 5356 5554 5556 5654	7005, 7021 7039, 7046 7146 710.0, 711.0	
6061,6005 6063,6070 6151,6201 6351,6951,6082	4043** 4145 4943 5183 5356 5554 5556 5654	A D C A A A C D B A A C D B A B A A B A B A A B A B A A