Castolin Eutectic®
Eutectic Castolin

Technical Data Book

- PDF with Bookmarks to Sections and Links to Individual Products

Castolin Eutectic®
Eutectic Castolin

INSTRUCTIONS AND FEATURES

Thank you for your interest in Eutectic Corporation. This PDF is an electronic data guide of our welding electrodes, rods, wires, powders, fluxes, equipment and wear plates. To ensure that you're getting full use of this guide, you'll need to download the most current version of Adobe Reader at ***http://www.adobe.com/products/acrobat.***

Two features we've added to this PDF that will be useful in accessing and using our information are as follows:

1) ***Bookmarks***. When you click on this icon  (both here and on the left hand side of the PDF Page) you'll get a list of our data book sections. By clicking on each link, you'll come to that product area.

2) ***Links***. Links may be accessed in three ways. One way is to scroll to the rear of the book and find the "Quick Index by Product Name". The second way is to use the Bookmarks and click on "Quick Index by Product Name" (its the last bookmark in the list). A third way to access the Quick Index is to click here....Quick Index by Product Name. Once you've gone to the Quick Index, click on the product you're interested in seeing and you'll be taken to that page. Notice that some products are on more than one page. The first page has a link in red, the second page has a link in blue. You'll need to click on either page to visit that product. Once on the desired page, you'll need to either scroll back to the rear of the book or use the Bookmarks to return to the Quick Index.

If you have questions about our products or this document please contact us at 800-558-5524.

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Superior Products for the Successful Practice of Maintenance & Repair Welding and Advanced Surface Coating Technologies

SECTION 25 – EQUIPMENT

SECTION 1 – ALUMINUM-BASE PRODUCTS

Metal Notes

The use of aluminum and its many alloys has grown steadily since it was first isolated from bauxite (after Les Baux in France where it was first discovered in 1821). After oxygen and silicon, aluminum is the third most abundant element in the earth's crust.

Aluminum is a unique metal: It is lightweight and strong and an excellent conductor of both heat and electricity. In fact aluminum is second only to copper in terms of electrical conductivity on an equal volume basis. However, weight-for-weight it is twice as conductive as copper. One should note, too, that aluminum's heat transfer properties are essentially similar to copper which is why it is necessary to preheat when brazing and/or welding aluminum and its alloys.

Weldable Aluminum Grades

Typical Series	*Application Usage*	*Weldability*
1000 (EC)	Electrical conductors is the most common usage.	Good
2000 with copper	Grades 2014 & 2024 are used in aircraft fabrications.	Poor
3000 with manganese	Grade 3003 is the typical. General purpose aluminum.	Good
4000 with silicon	Grades 4343 & 4043 are used for brazing & welding.	Good
5000 with magnesium	Grade 5356 is typical. Used tanks, vessels, boats, etc.	Good
6000 with silicon & magnesium	Grade 6061 is typical. Used for structural applications and for medium strength forgings	Good
7000 with zinc	Grade 7039 is typical. aircraft structural frames	Poor

Cast Aluminum Alloys: Common casting grades are typically high in silicon which makes them fairly easy to weld-repair.

Aluminum can be readily joined either by soldering and brazing, and by many of the arc welding processes such Shielded Metal-arc, Gas Tungsten-arc, and Gas Metal-arc Processes. However, it is known as a "white metal" which could be confused with magnesium which is also white. A simple test to determine what metal it is the "Acid Test". Use a few drops of EutecSol 682…or battery acid and see if any reaction happens. If it bubbles and turns black the metal is magnesium. If there is no reaction-such as bubbling, the metal is aluminum.

ALUMINUM FILLER METAL SELECTION TABLE

Soldering	*Brazing*	*SMA Welding*	*GTA Welding*	*GMA Welding*
EutecSol 51	EutecRod 21FC-E	EutecTrode 2101	TigTectic 21	MigTectic 4043
Special Rod	EutecRod190	Xuper 2109	TigTectic 23	MigTectic 5356
	Xuper Braze 190 Al	EutecTrode 3021		
	Xuper Braze AutoRad	EutecTrode 4021		

EUTECROD® 21FC-E ALUMINUM BRAZING ROD

UNIQUELY FORMULATED FOR BOTH BUILD-UP AND THIN FLOWING PROPERTIES ON CASTINGS AND THICK-WALLED EXTRUSIONS

General Properties

EutecRod 21FC-E is a flux-coated brazing rod with excellent build-up properties. Can be used to repair cracks or re-build missing sections. Good color match with smooth, uniform fillets. Can be used on such common cast grades as 122, 355, and 356 & C612. Excellent for joining Grades 1xxx, 3xxx, 4xxx, and commonly used 5xxx & 6xxx grades.

Applications

Casting repairs, foundry patterns, aluminum framing, particularly when gaps are present, pump housings, differential casings, missing sections, agricultural implements, etc.

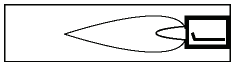
Technical Data		
• Typical Tensile Shear Strength	33,000 psi	227 N/mm^2
• Electrical Conductivity IACS	39%	
• Solidus Temperature	1090°F	585ºC
• Liquidus Temperature	1170°F	630ºC
• Max. Brazing Temperature	1190°F	640ºC
• Heating Methods	Oxy-fuel, resistance, induction	
• Color Match Properties	Similar to cast aluminum (will darken if anodized)	
• Note: EutecTor® 190 flux can be used as a supplemental flux.		

Brazing Procedure

Preparation: Clean joint area and lightly abrade using a stainless steel wire brush or wire wool. Butt joints and/or broken sections should have a 60º-80º bevel with a root opening of 1/16" to 1/8". Preheat in the range of 500º to 700ºF. Supplemental Eutectic 190 flux can be applied to the joint by making a paste with a small amount of water or alcohol.

Technique: Adjust the oxy-fuel flame so that it is slightly reducing or carburizing. Keep the torch moving from side-to-side. When the flux becomes molten apply the alloy using a bead-forming technique. Do not melt the base metal. Cool slowly.

Post-brazing: Remove flux, scrubbing in hot water and rinse. Note: It is mandatory to remove all traces of flux residues. If these are not removed they will cause corrosion.



EUTECROD® 190 ALUMINUM BRAZING ROD

A SPECIAL LOW-TEMPERATURE TORCH BRAZING ROD FOR HIGH STRENGTH JOINING OF ALUMINUM TEE AND LAP JOINTS.

General Properties

EutecRod 190 provides exceptional thin-flowing properties when oxy-fuel brazing sheet, tubing and most wrought forms of aluminum. Excellent color match with smooth, uniform fillets. Properties are highly compatible with aluminum grades 3xxx & 4xxx.

Applications

Repairing automotive, bus and light-gauge truck bodies. Irrigation piping, farming implements, office furniture, refrigeration, air-conditioning equipment, etc.

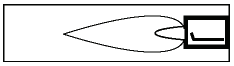
Technical Data		
• Typical Tensile Shear Strength	34,000 psi	234 N/mm^2
• Electrical Conductivity IACS	42%	
• Solidus Temperature	1070°F	575ºC
• Liquidus Temperature	1080°F	580ºC
• Max. Brazing Temperature	1120°F	605ºC
• Heating Methods	Oxy-fuel, resistance, induction	
• Color Match Properties	Similar to wrought aluminum (will darken if anodized)	
• Note: EutecRod 190 requires the use of EutecTor 190 flux.		

Brazing Procedure

Preparation: Clean joint area and lightly abrade using a stainless steel wire brush or wire wool. For best results a slight gap of between .005” and .010” is recommended. No preheat is necessary with thin gauge material. For thicknesses up to 1/8” a nominal broad preheat of 200ºF is suggested. Eutectic 190 flux can be applied to the joint by making a paste with a small amount of water or alcohol.

Technique: Adjust the oxy-fuel flame so that it is slightly reducing or carburizing. Keep the torch moving rapidly to prevent localized overheating with the inner flame cone 1” to 2” from the joint. When the flux becomes molten apply the brazing alloy at equal points along the joint seam. Cool slowly.

Post-brazing: Remove flux, scrubbing in hot water and rinse. Note: It is mandatory to remove all traces of flux residues. If these are not removed they will cause corrosion.



Xuper® Braze AutoRad

A PREMIUM BRAZING ROD FOR APPLICATIONS ON MOST GRADES OF ALUMINUM

General Properties

This specially designed alloy offers superior cleaning action and is specially formulated for Aluminum applications. This product is specially formulated for radiator and condenser repairs. This is a key product when sealing tube-to-header leaks and leaks in tube-to-block assemblies, offering high tensile strength joints as well as corrosion properties comparable to aluminum.

Applications

Tubes, Hoses, Radiators, Condenser, Oil Coolers, Boat Hulls, Rails, Extruded Aluminum Shapes, and Air Coolers.

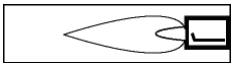
Technical Data		
	Xuper Braze Auto Rad	
• Typical Tensile Strength	34,000 psi	234 N/mm^2
• Melting Temperature	Solidus 900° F (482º C) …Liquidus 925° F (496º C)	
• Color Match to Aluminum	Very Good	
• Type of Fuel Gas	Propane-Air	
• Electrical Conductivity IACS	42%	

Brazing Procedure

Preparation: Use a clean stainless steel wire brush to remove all surface contamination. Remove all chemical residues with an OSHA-approved solvent.

Technique: Apply flux to area that is to be repaired. Slowly bring up to temperature. Keep the torch moving to prevent localized overheating, and note that the flux is formulated to take a direct flame assault. When the flux becomes liquid add filler metal to desired area using a scratching motion. Allow to slow cool in air and remove flux residue via water and a soft brush.

Note: All Flux Residues Must Be Removed To Prevent Corrosion



Xuper® Braze 190 Aluminum Paste

A SPECIAL LOW-TEMPERATURE TORCH BRAZING PASTE FOR HIGH STRENGTH JOINING OF ALUMINUM

General Properties

Xuper Braze Paste is a premium aluminum-brazing alloy for either manual use or for volume production automated processes. It is used to braze most aluminum grades including the more difficult Series 6xxx and aluminum alloys. Especially effective when used for dissimilar metal joining of aluminum-to-stainless steel. The paste is non-corrosive and is not necessary to remove flux residues after brazing.

Applications

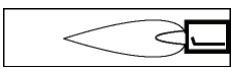
Pipes, ducts, ventilation and air conditioning systems, heat exchangers and radiators. Fabrication of frames and chassis. Electrical appliances, heating systems, bus bars.

Technical Data		
	Xuper Braze 190 Al Paste	
• Typical Tensile Strength	34,000 psi	234 N/mm^2
• Melting Temperature	Solidus 1070° F (577º C), Liquidus 1080° F (582º C)	
• Color Match to Aluminum	Very Good	
• Type of Fuel Gas	Oxy-Fuel	
• Electrical Conductivity IACS	42%	

Brazing Procedure

Preparation: Use a clean stainless steel wire brush to remove all surface contamination. Remove all chemical residues with a suitably OSHA-approved solvent.

Technique: Apply paste to area that is to be repaired, and slowly bring up to temperature. Keep the torch moving, to prevent localized overheating, and the paste is not designed to take a direct flame assault. Allow to slow cool in air and remove flux residue via water and a soft brush.



TigTectic® 21 & 23 GTA RODS

VERSATILE, AND QUALITY EXTRUDED GAS TUNGSTEN ARC RODS FOR MAINTENANCE & PRODUCTION WELDING OF WROUGHT AND CAST ALUMINUM ALLOYS

General Properties

Gas tungsten-arc welding of aluminum provides for a cosmetically clean and oxide-free weld deposit. No post-welding clean up is necessary. Alloys can be used in all-positions depending on the skill of the welder.

- Eutectic 21 is recommended when welding 1xxx, 3xxx & 4xxx grade alloys.
- Eutectic 23 recommend when welding the high strength aluminum-magnesium grades (5xxx group). Also suitable for grade 6061.

Applications

- Eutectic 21 is particularly suitable for maintenance welding office furniture, appliances, light-gauge aluminum auto bodies, refrigeration components, etc.
- Eutectic 23 is used for fabrications involving 5xxx series alloys where good strength and improved anodized color match are required.

Technical Data				
	TigTectic 21		TigTectic 23	
• Typical Tensile Strength	33,000 psi	227 N/mm^2	35,000 psi	240 N/mm^2
• Typical Yield strength	28,000 psi	192 N/mm^2	29,000 psi	200 N/mm^2
• Typical Hardness (BHN)	45%		75%	
• Electrical Conductivity IACS	39%		41%	
• Color Match Properties	Good *		Good**	
• Current & Polarity	Use alternating current with imposed high frequency.			
• Note: TigTectic 21 will darken after anodizing. Eutectic 23 will darken only marginally.				

Welding Procedure

Preparation: Thin sections can be welded after suitable cleaning and surface oxide removal. Square-butt welding is acceptable for thin-gauge material. Thicker sections should be beveled to give a minimum included angle of 60º. The selection of the preferred zirconated tungsten diameter will depend on the material thickness and corresponding amperage range. This applies similarly to gas cup size. Note: Make sure to round the tip of the electrode for better heat transfer and to minimize tungsten erosion. Heavy sections should be preheated within the range of 500º to 800ºF for non-heat-treated alloys.

Technique: Adjust argon shielding gas flow. Complex, or large parts, should be supported by tack-welds and jigs. Adjust stand-off distance so that the molten pool is always protected by the shielding gas and allow the rod-end to solidify before removing it from the gas envelope. Slow cool after welding.

EUTECTRODE® 2101 - DCEP

A PATENTED, FLUX EXTRUDED ELECTRODE FOR HEAVY ALUMINUM CASTINGS, LONG JOINTS, DEFECT FILLING, AND REBUILDING MISSING SECTIONS

General Properties

Shielded metal-arc welding of aluminum is easy and quick with EutecTrode 2101. Weld deposits are dense and porous-free. Arc is smooth and stable which makes this electrode very user-friendly. Weld deposits have a good color match with most casting grades. Slag removal is easy once the part has cooled down.

Applications

For welding engine blocks, cast differential housings, various aluminum pump casings, heavy gauge aluminum truck bodies, foundry patterns, aluminum rails, etc.

Technical Data		
	EutecTrode 2101	
• Typical Tensile Strength	34,000 psi	234 N/mm^2
• Typical Yield strength	28,000 psi	192 N/mm^2
• Typical Hardness (BHN)	45	
• Electrical Conductivity IACS	39%	
• Color Match Properties	Good, but will darken after anodizing.	
• Current & Polarity	Use direct current electrode positive (+)	

Welding Procedure

Preparation: Clean weld area to remove contaminants and surface oxides. Parts thicker then 1/8" should be beveled to have an included angle of 60-75º. Preheat heavy sections, or sections thicker than a ¼" within a 400-500ºF range. Note: Preheating reduces the need to use high amperage levels.

Technique: Start arc either by lightly drawing the electrode across the work piece or use a copper starting block. To help control the arc response it is important to maintain a very short stand-off distance and to keep the electrode almost perpendicular. Back-whip craters and allow to cool before deslagging.

Post-welding: Slag removal is very important. It can become corrosive if not removed. Scrub in hot, soapy water and rinse.

EUTECTRODE® 3021 - DCEP

A PATENTED, FLUX EXTRUDED ELECTRODE FOR HEAVY ALUMINUM CASTINGS, LONG JOINTS, DEFECT FILLING, AND REBUILDING MISSING SECTIONS

General Properties

Shielded metal-arc welding of aluminum is easy and quick with EutecTrode 3021. Weld deposits are dense and porous-free. Arc is smooth and stable which makes this electrode very user-friendly. Weld deposits have a good color match with most casting grades. Slag removal is easy easy the part has cooled down.

Applications

For welding engine blocks, cast differential housings, various aluminum pump casings, heavy gauge aluminum truck bodies, foundry patterns, aluminum rails, etc.

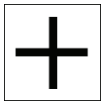
Technical Data		
	EutecTrodes 3121	
• Typical Tensile Strength	34,000 psi	234 N/mm^2
• Typical Yield strength	28,000 psi	192 N/mm^2
• Typical Hardness (BHN)	45	
• Electrical Conductivity IACS	39%	
• Color Match Properties	Good, but will darken after anodizing.	
• Current & Polarity	Use direct current electrode positive (+)	
NOTE: Data page references apply equally to the distributor product EutecTrode 4021.		

Welding Procedure

Preparation: Clean weld area to remove contaminants and surface oxides. Parts thicker then 1/8" should be beveled to have an included angle of 60-75º. Preheat heavy sections, or sections thicker than a ¼" within a 400-500ºF range. Note: Preheating reduces the need to use high amperage levels.

Technique: Start arc either by lightly drawing the electrode across the work piece or use a copper starting block. To help control the arc response it is important to maintain a very short stand-off distance and to keep the electrode almost perpendicular. Back-whip craters and allow to cool before deslagging.

Post-welding: Slag removal is very important. It can become corrosive if not removed. Scrub in hot, soapy water and rinse.



XUPER® 2109 - DCEP

EXTRUDED ELECTRODE FORMULATED TO WELD ALUMINIUM ALLOYS CONTAINING MAGNESIUM. SUPERIOR CRACK RESISTANCE ON CASTINGS & WROUGHT ALLOYS

General Properties

A smooth running electrode with little or no spatter. Deposits are porous-free with a uniform profile. Xuper 2109 is particularly useful when welding Grade 5xxx and 6xxx aluminum alloys either in the down-hand position or out-of-position. Can be used for both joining and cladding.

Applications

Excellent for repairing tanks & containers and structural frames. Particularly useful for crack repairs to truck floor-bodies and aluminum casting grades containing magnesium.

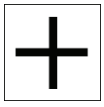
Technical Data		
	Xuper 2109	
• Typical Tensile Strength	35,000 psi	240 N/mm^2
• Typical Yield strength	29,000 psi	200 N/mm^2
• Typical Hardness (BHN)	70	
• Electrical Conductivity IACS	39%	
• Color Match Properties	Good, but will marginally darken after anodizing.	
• Current & Polarity	Use direct current electrode positive (+)	

Welding Procedure

Preparation: Clean weld area to remove contaminants and surface oxides. Parts thicker then 1/8" should be beveled to have an included angle of 60-75º. Preheat heavy sections, or sections thicker than a ¼" within a 400-500ºF range. Note: Preheating reduces the need to use high amperage levels.

Technique: Start arc either by lightly drawing the electrode across the work piece or use a copper starting block. To help control the arc response it is important to maintain a very short stand-off distance and to keep the electrode almost perpendicular. Back-whip craters and allow to cool before deslagging.

Post-welding: Slag removal is very important. It can become corrosive if not removed. Scrub in hot, soapy water and rinse.



MIGTECTIC® 5356 - DCEP

A CONTINUOUS SOLID ALUMINUM WIRE WITH CONTROLLED STIFFNESS AND SURFACE SMOTHNESS FOR EASE OF USE AND HIGHEST QUALITY WELDS

General Properties

MigTectic 5356 is an aluminum-magnesium wire die-drawn & polished to maintain wire smoothness, stiffness and hardness. These properties result in trouble-free wire feeding with most push and push-pull systems. The alloy is suitable for welding the 5xxx and 6xxx grades and associated castings.

Applications

For porous-free welding of aluminum forgings, castings and wrought alloys containing more than 3% magnesium. Typical grades welded with MigTectic 5356 are 5356: 3003, 5052, 5083, 6061, 6063, and 7039.

NOTE: *Properties are given in the Technical Data Table*

Technical Data Table re MigTectic 5356 Usage Properties	
Aluminum Alloy Grades	MigTectic 5356 Properties
• Grade 6061	Use for strength and ductility
• Grade 6063	Use for strength, ductility & anodized color matching
• Grade 3003	Use for improved strength
• Grade 5052	Use for strength, ductility & anodized color matching
• Grade 5083	Use for strength, ductility & anodized color matching
• Grade 7039	Use for improved ductility
• Current & Polarity	Use direct current electrode positive (+)
• Shielding Gas	Welding grade argon

Welding Procedure

Preparation: Parts must be clean, oil-free, and free from moisture. Surface oxides should be removed mechanically with stainless steel abradants. Jigs and supports should be used for thin gauge material. Check that the drive-rolls are smooth "u" shaped and that the gun cable liner is either Nylon™ or Teflon™. A preheat of 300ºF is helpful for parts thicker than 1/2".

Technique: The recommended electrode extension or "stick-out" is 3/8" beyond the shielding gas nozzle. Shielding gas flow rates should not be less than 30 scfh and not more than 60 scfh. The gun assembly should be tilted no more than 10° in the forehand direction.

Post-welding: Slow cooling is recommended to reduce cool-down stressing.

SECTION 2 – CAST IRON PRODUCTS

Metal Notes

The brazing and arc welding of most types of cast iron can be carried out successfully. Although a "crack sensitive" metal when welded without following established procedures, using the proper preparation, preheat, welding product, technique, and applying post-welding controls, will in most cases, guaranty a successful repair.

• ***Preparation:*** What steps to undertake depend on the type of failure. For example: 1) Is the part broken into two or more parts? 2) Is the crack open-ended? That is, does the crack start in the body of the cast iron and terminate at an edge or lip? 3) Is the crack enclosed or contained within the body of the cast iron? This is a crack with no open ends. In the first example the part(s) should be chamfered by arc-gouging with ExoTrode® AC/DC or ChamferTrode®, or by grinding, or machining. In examples 2 & 3 the standard practice is to drill a 1/8-in.diameter hole at the crack-end to prevent further crack propagation. Note: When using arc-gouging it is advisable to grind the chamfered surface layer to remove any potential hard spots.

• ***Preheat & Interpass Temperature Controls****:* Careful preheating of cast irons has a number of application advantages: Firstly, it expands the base metal that, after welding and subsequent cooling, puts the weld metal in to beneficial compression. Secondly, it reduces the hardness gradient in the heat-affected zone (HAZ). And, thirdly, it reduces excessive thermal contraction mismatching with its potential cracking tendencies. A general preheat range for most weldable grades of cast iron is 200º to 500ºF. A typical interpass temperature is ±100ºF.

• ***Low Preheat Welding:*** The general procedure is similar to that practiced at higher preheats. A low preheat 100-200ºF and a more restricted interpass temperature of ±50ºF, reduces thermal gradients and contraction stresses.

• ***Welding Product Selection:*** Please refer to the Product Selection Table for your guide in selecting the best product for specific cast irons and general properties.

Product Selection Table

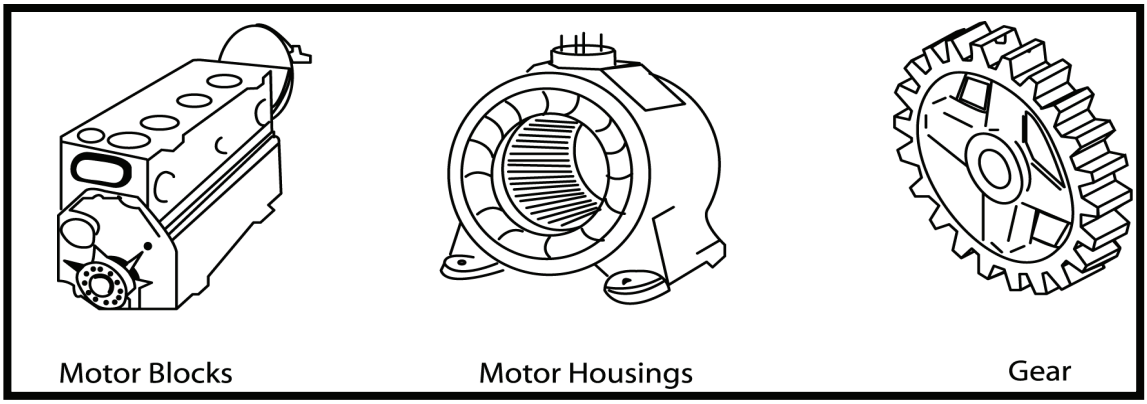
Product	*Application Key*
141	*For gas fusion welding gray cast irons for soft machinable welds.*
146XFC	*For braze welding of gray, malleable, and lower-strength ductile irons.*
*DO*23*	*A metal-cored wire for welding gray, ductile, and compacted irons.*
27	*Non-machinable, buttering electrode for porous & dirty cast irons.*
Tig 224	*A GTA rod for thin-walled SG, ductile, and gray cast irons.*
244	*For welding oil-soaked cast irons.*
2240	*Low heat input welding of spheroidal graphite (SG) irons.*
2233N	*Optimized properties when welding ductile irons with low preheat.*
3055…4055	*Formulated for crack-free welding of gray cast irons.*
3099…4099	*Improved machinable weld deposits on gray cast irons.*
OA 2600	*Repairing defects in mill rolls & automotive dies*
*DO*325*	*For crack-free hardfacing & anti-wear properties on most cast irons*

• ***Welding Technique:*** A stringer-bead technique is recommended when welding all grades of cast iron. Short beads about 2" long will reduce cumulative stresses. In addition a back-step and block & cascade technique will reduce both transverse and longitudinal shrinkage stresses. Hot peening is also helpful in reducing cracking tendencies by deforming the weld metal and relieving bulk shrinkage forces.

• ***Post Welding Steps:*** Slow cooling under thermal blankets or temperature controlled ovens will reduce cracking tendencies. Call Technical Service for information regarding cast irons that need specific heat treatment such as stress relieving and/or special annealing requirements.

• ***Gas Fusion Welding of Cast Irons:*** Fusion joining, typically of gray cast irons, is a well established procedure. It is used particularly when soft, readily machinable deposits are required such as cylinder heads, die blocks, and certain pump-case headers. Very high preheats up to 1500ºF are needed with continuous heating during welding. Special torches, fluxes and high silicon rods are also required along with very slow cooling sometimes lasting one-to-two days. Special skills are needed with this process.

• ***Braze Welding Of Cast Irons:*** Braze welding was originally developed to repair cracked and broken cast irons without resorting to the high preheats and slow cooling associated with fusion welding. With braze welding, much lower preheating is used while still achieving the benefits of little to no brittle, white cementite. There is also the benefit of the reduced likelihood that thermal gradients will cause cracking. Heavy-duty torches are still needed along with special fluxes. Filler metals are typically copper-based for use with the Braze Welding Process.



• Points To Remember When Repairing Cast Irons

1) Is it weldable? Normally, chilled irons, white irons, & high-chromium wear resistant irons are considered un-weldable due to their structure, hardness and lack of ductility.
2) Very thin-walled cast iron (less than ¼-in thick) typically contain high levels of phosphorous which critically lowers the ability to weld these without HAZ cracking.
3) From a practical viewpoint "ductile", "nodular" & "spheroidal graphite" irons are essentially similar in weldability properties.
4) Malleable iron is more readily braze-welded due to its high shrinkage rate.

EUTECROD® 141

FOR OXY-FUEL FUSION WELDING OF MAJOR CASTING DEFECTS IN MOST GRADES OF GRAY IRONS INCLUDING DUCTILE IRONS

General Properties

EutecRod141 is cast rod high in silicon for "hot" fusion welding of broken and major worn surfaces. When applied using the correct procedure the weld deposit is soft, ductile, and extremely machinable. Deposits typically match those of the base metal.

Applications

Common applications are cracked engine & pump cylinder heads, valve seat rebuilding repairing cracked engine manifolds, and for repairs where the deposit must be fully machinable and be similar in composition & properties to the cast iron.

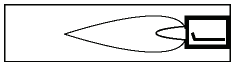
Technical Data		
	EutecRod 141	
• Typical Tensile Strength	40,000 psi	275 N/mm^2
• Typical Hardness (BHN)	200	
• Color Match Properties	Excellent. Will match the base metal.	
• Heating System (preheating)	Furnace preferred with preheating to 1500ºF (815º C)	
• Torch	High capacity oxy-fuel torch with optimized BTU's	

Fusion Welding Procedure

Preparation: Prepare broken and/or cracked sections by either pneumatic chiseling or grinding. Machined surfaces will need to be protected during both the preheating and fusion welding steps. Molybdenum disulfide is suitable as a barrier. Slowly preheat to 1500ºF and temperature check frequently. Make sure to have heat-retardant blankets available to prevent heat loss.

Technique: Preheat EutecRod 141 and dip it into the 141 flux. Keep a steady but not excessive amount of flux on the rod and along the joint surface. Note that excessive flux use can cause flux entrapment. Add filler metal until the repair surface is slightly oversize which will allow for machining-to-size.

Post-welding: Slow cooling is mandatory after oxy-fuel fusion welding. The preferred method is to slow cool in a preheated furnace set to cool-down at about 100ºF/hr. If not available cover with heat-retardant materials such as vermiculite, or continue to cover with the heat-retardant blanket.



XUPER® 146XFC

FOR OXY-FUEL BRAZE WELDING BROKEN AND FRACTURED GRAY AND MEDIUM-STRENGTH ALLOYED CAST IRONS

General Properties

Xuper 146XFC is a copper-base, flux-coated brazing rod for repairing cracks and build-up repairs of cast irons when color matching is not important and when easily machined & drilled deposits are required. The highly active flux promotes ease of wetting and excellent bonding.

Applications

Although formulated for cast iron components such as cast iron brackets, end-flanges, malleable piping and agricultural implements, Xuper 146XFC is also recommended for car body repairs, light tubular constructions, and sheet metal fabrications.

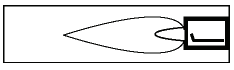
Technical Data		
	Xuper 146XFC	
• Typical Tensile Strength	65,000 psi	450 N/mm^2
• Typical Hardness (HRB)	80	
• Color Match Properties	Deposits are brass-yellow	
• Bonding Temperature	1600º to 1650ºF	
• Preheating	500º to 700ºF	
• Torch	High capacity oxy-fuel torch with optimized BTU's	

Braze Welding Procedure

Preparation: Clean joint and/or broken parts. Bevel cracks either by pneumatic chiseling or by grinding. Note: When grinding make sure not to "color" the surface that indicates overheating and potential hard-spotting. Align parts and preheat within the recommended 500º to 700ºF temperature-range.

Technique: Rapidly sear the joint by using an excess oxygen flame. Apply a small amount of EutecTor 16D as a supplemental flux along the joint area and lightly "tin" the surfaces to be joined using a neutral flame. After tinning apply filler metal using a continuous "drop-and-melt" technique. Continue until the joint is slightly overfilled.
Note: Any excess "glassy" flux residue can be readily removed by light scraping.

Post-brazing: Allow the brazed casting to slow-cool either by covering in vermiculite, wrapping in a heat-retardant blanket, or by burying in lime.



ENDOTEC® DO*23

A SPECIALLY DEVELOPED SMALL-DIAMETER METAL-CORED WIRE FORMULATED TO WELD A WIDE RANGE OF CAST IRONS

General Properties

EnDOtec DO*23 is particularly useful when welding cast iron components which are under restraint and which have variable cross-sectional and section thicknesses over 1½-in. Weld deposits have high-value mechanical properties matching many of the gray, ductile, malleable (whiteheart), and alloyed cast iron grades. It is also recommended when welding Meehanite™* castings.

** Meehanite™ is a trademark of the International Meehanite Metal Co. Ltd.*

Applications

A key maintenance & repair alloy when welding cast iron cylinder blocks, machine bases, pump housings, gear boxes, compressor casings, hydraulic cylinders, etc. Also suitable for joining cast irons to mild, and low-alloy steels.

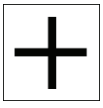
Technical Data					
	EnDOtec DO*23				
• Typical Tensile Strength	68,000 psi	470 N/mm^2			
• Typical Yield Strength	51,000 psi	350 N/mm^2			
• Typical Elongation (1=5d)	15%				
• Typical Hardness (HRB)	90				
• Machinability	Use standard single-point lathe tools. Set speed and feeds typically used when machining nickel-base alloys.				
• Guideline Parameters	For use with 0.045 (1.2mm) diameter wire				
Arc Mode	Amp Range	Volt Range	Stick-out	Shield Gas	Flow-scfh
Globular	150-250	27-30	5/8 ± 1/8	75% Ar 25% CO_2	35

Welding Procedure

Preparation: : Clean joint and/or broken parts. Bevel cracks to have a 60º-75º either by pneumatic chiseling or by grinding. Note: Thicknesses below 1-in should have a 'V" bevel. Above 1-in a single or double "J" bevel is recommended. When grinding make sure not to "color" the surface that indicates overheating and potential hard-spotting. A nominal preheat of 200º to 250ºF is beneficial in reducing lack-of-fusion joints.

Technique: Refer to the Technical Data Guideline. Select the wire speed, amperage & voltage setting, and test parameters on a piece of scrap iron. Adjust as necessary paying attention that the recommended electrode stick-out is followed.

Post-welding: As with all castings that have been welded, slow cooling is recommended. Wrapping the casting in a heat-retardant blanket should be adequate to reduce the cool-down rate.



EUTECTRODE® 27

A NON-MACHINBLE IRON-BASE ALLOY DESIGNED TO PROVIDE HIGH ARC FORCE AND CLEANING ACTION ON CONTAMINATED CAST IRONS

General Properties

EutecTrode 27 is formulated to cut through contaminants and seal and butter porous surfaces. This pre-treatment, particularly on low-grade castings, enables high-quality final welds to be deposited with other selected Eutectic cast iron products.

Applications

Recommended for non-critical welding of all cast irons where machinability is not essential…casting defects, oxidized furnace grates, oil pans, cast iron dies, etc. It is nickel-free. Deposits will rust and match the casting in color. Castings which will not be drilled or machined will benefit by providing a sound surface for follow-on welding.

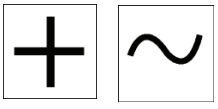
Technical Data		
	EutecTrode 27	
• Typical Tensile Strength	60,000 psi	415 N/mm^2
• Typical Hardness (HRC)	50+ after welding	
• Machinability	Non-machinable…can be ground.	
• Current & Polarity	Use direct current electrode positive (+) or AC	
• Recommended Amperage Range	1/8-in diam. 80-150	5/32-in diam. 120-170

Welding Procedure

Preparation: Prepare the casting defect by chamfering with either Eutectic ChamferTrode or ExoTrode AC/DC after nominally preheating the casting within a 150º-200ºF temperature range.

Technique: Butter or clad the prepared surfaces using a slightly longer arc length (1/4 – 3/8) than normal. The key to sealing porous surfaces is to actually "arc-seal" by lightly melting the surface while at the same time depositing the smallest amount of weld metal. After completing the sealing passes select a companion product such as Eutectic 2240 to finish the repair.

Post-welding: Slow cool using any available insulating material. Allow to slow cool out of drafts.



TIGTECTIC® 224 GTA ROD

A HIGH NICKEL FILLER METAL FOR REPAIRING THIN SECTION GRAY CAST IRONS AND FOR JOINING CASTINGS TO STEELS

General Properties

A high quality, gas tungsten-arc rod for filling small casting defects, repairing minor cracks, re-building missing sections, and surfacing machined seats for follow-on machining.

Applications

Pump valve seats, engine blocks with surface defects, re-patching large-size holes involving steel-to-cast iron welding, cylinder head cracks between inlet and exhaust ports, touch-up repairs.

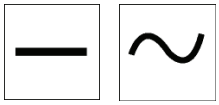
Technical Data		
	TigTectic 224	
• Typical Tensile Strength	50,000 psi	45 N/mm^2
• Typical Yield strength	38,000 psi	262 N/mm^2
• Typical Hardness (HRB)	90	
• Current & Polarity	Use direct current electrode negative.	
• Shielding Gas	Welding grade argon	

Welding Procedure

Preparation: Clean joint and/or broken parts. Lightly bevel cracks by grinding. Note: When grinding make sure not to "color" the surface which indicates overheating and potential hard-spotting. The selection of the preferred thoriated or lanthium tungsten electrode diameter will depend on the material thickness and corresponding amperage range. This applies similarly to gas cup size. Note: Make sure that the tip of the electrode is ground with the proper taper for better heat localization.
Align parts and preheat within a recommended 200º to 250ºF temperature-range. Note: This nominal preheat will help to prevent cold shutting or lack of fusion as well as reducing the amperage range with its associated dilution.

Technique: Adjust argon shielding gas flow. Complex or large parts should be supported by jigs. Use a copper arc-starting block to prevent random arc strikes and consequential hard- spotting. Adjust stand-off distance so that the molten pool is always protected by the shielding gas and allow the rod-end to solidify before removing it from the gas envelope.

Post-welding: Slow cool after welding using available insulating material such as vermiculite or heat-retardant blankets.



EUTECTRODE® 244

SPECIALLY FORMULATED ELECTRODE FOR REPAIR WELDING CONTAMINATED & OIL-SOAKED CAST IRONS

General Properties

EutecTrode 244 is a key electrode recommended for welding unknown grades of gray cast iron, particularly when these castings are seriously contaminated with oil, sulfur, etc. Also useful for cast irons whose service condition (furnace, molds, combustion chamber walls, etc.) has oxidized the surface.

Applications

For sealing old or oil-impregnated cast irons such as furnace equipment, gearboxes, oil pans, pump-rotors, compressor cases, hydraulic cylinders, engine block water jackets, etc.

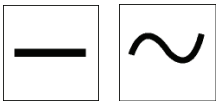
Technical Data		
	EutecTrode 244	
• Typical Tensile Strength	53,000 psi	365 N/mm^2
• Typical Yield strength	37,000 psi	255 N/mm^2
• Typical Hardness (HRB)	80	
• Current & Polarity	Use direct current electrode negative (-) or AC	
• Recommended Amperage Range	3/32-in: 80-90 1/8-in: 105-115	

Welding Procedure

Preparation: Prepare any casting defect by chamfering with either Eutectic ChamferTrode or ExoTrode AC/DC after nominally preheating the casting within a 150º-200ºF temperature range. Cracks should be prepared with either a single-V or double-V depending on casting thickness. Allow a root opening of 1/8-in. for full-penetration welds.

Technique: Deposit short runs no longer than 2-in. and moderately peen 2nd and subsequent passes. For long cracks in heavy castings some minor preheating in the 150º to 200ºF range is beneficial. For large sectional thickness castings use either a cascade or block deposition sequence…see Data Sheet for Xuper 2240 for illustrations of these two deposition sequences.

Post-welding: Slow cool after welding using available insulating material such as vermiculite or heat-retardant blankets.



XUPER® 2240

A VERSATILE JOINING AND RE-BUILD ELECTRODE FOR GRAY, DUCTILE, NODULAR AND ALLOYED CAST IRONS

General Properties

Xuper 2240 is an all-position electrode. A uniquely directed ionization arc provides controlled agitation of the weld pool that helps in removing harmful contaminants.
There is little or no spatter and the wash & fluidity are excellent. A nodular weld deposit structure imparts high crack resistance.

Applications

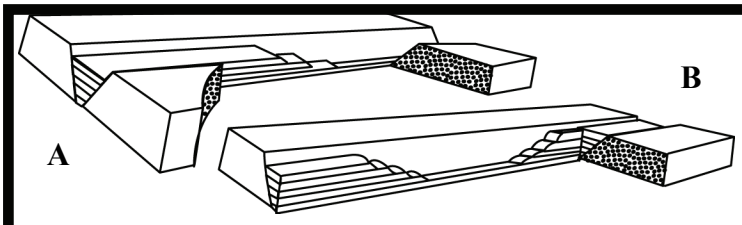
Recommended for repairing casting & foundry defects. For pump casings, high-strength alloyed cast iron gearboxes, bell housings, motor casings, machine bases, etc.

Technical Data			
	Xuper 2240		
• Typical Tensile Strength	55,000 psi	380 N/mm^2	
• Typical Yield strength	38,000 psi	262 N/mm^2	
• Typical Hardness (HRB)	75		
• Current & Polarity	Use direct current electrode negative (-) or AC		
• Recommended Amperage Range	3/32-in: 80-90	1/8-in: 105-115	5/32-in: 130-145

Welding Procedure

Preparation: Prepare any casting defect by chamfering with either Eutectic ChamferTrode or ExoTrode AC/DC after nominally preheating the casting within a 150º-200ºF temperature range. Cracks should be prepared with either a single-V or double-V depending on casting thickness. Allow a root opening of 1/8-in. for full-penetration welds.

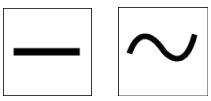
Technique: Deposit short runs no longer than 2-in. and moderately peen 2nd and subsequent passes. For long cracks in heavy castings some minor preheating is beneficial. The tendency for centerline cracking can be prevented by using either a cascade and/or block deposition sequence…see figure below.



Example A shows a cascade sequence in which the weld metal is deposited in overlapping layers.

Example B shows a block sequence in which the weld metal is deposited in intervening increments.

Post-welding: Slow cool after welding using available insulating material.



XUPER® 2233N

A PREMIUM CAST IRON ELECTRODE WITH SUPERIOR CRACK RESISTANCE AND HIGH TENSILE STRENGTH

General Properties

Xuper 2233N provides maximum security against cracking. It is an all-position electrode suitable for repair welding nodular and ductile cast iron grades including the high-strength spheroidal graphite (SG) irons. High mechanical properties assure safe welds particularly when welding thick-to-thin sections under restraint.

Applications

Typical applications are turbine & transmission housings, cast iron dies, compressor pumps, jacketed castings, electric motor casings, diesel engine heads, bell housings, etc.

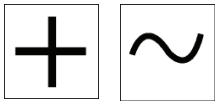
Technical Data			
	Xuper 2233N		
• Typical Tensile Strength	72,000 psi	496 N/mm^2	
• Typical Yield strength	58,000 psi	40 N/mm^2	
• Typical Elongation (1=5d)	15%		
• Typical Hardness (HRB)	90		
• Current & Polarity	Use direct current electrode positive (+) or AC		
• Recommended Amperage Range	3/32-in: 90-100	1/8-in: 110-120	5/32-in: 145-160

Welding Procedure

Preparation: Clean joint and/or broken parts. Lightly bevel cracks by grinding. Note: When grinding make sure not to "color" the surface that indicates overheating and potential hard-spotting. An alternative to grinding is to prepare casting defects by chamfering with either Eutectic ChamferTrode or ExoTrode AC/DC after nominally preheating the casting within a 150º-200ºF temperature range. Cracks should be prepared with either a single-V or double-V depending on casting thickness. Allow a root opening of 1/8-in. for full-penetration welds.

Technique: Deposit short runs no longer than 2-in. and moderately peen 2nd and subsequent passes. For long cracks in heavy castings use either a cascade and/or block deposition sequence. *Please see Data Sheet for illustrations of these two deposition sequences.*

Post-welding: Slow cool after welding using available insulating material such as vermiculite or heat-retardant blankets.



EUTECTRODE® 3055 & 3099

SPECIFICATION ELECTRODES FOR WELDING GRAY CAST IRONS WHEN STRENGTH & MACHINABILTY ARE REQUIRED

General Properties

Eutectic 3055 is recommended for welding engineering-grade cast iron when mechanical properties similar to the base metal are required. Eutectic 3099 is recommended for welding similar grades when machinability is the most important end requirement.

Applications

Eutectic 3055 deposits high-strength weld metal with excellent crack resistivity properties on thick-section casting. Ease of welding in all positions gives high welder appeal. Particularly suitable for pump and differential housings subject to high-pressure fluids.

Eutectic 3099 deposits have excellent machinability in all positions-especially on thin-section castings. Sound, dense deposits provide are porous-free. Excellent for repairing lathe beds & ways, bushings, gearboxes and cast iron die bodies.

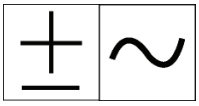
Technical Data		
	EutecTrode 3055	EutecTrode 3099
• Typical Tensile Strength	55,000 psi 380 N/mm^2	53,000 psi 365 N/mm^2
• Typical Hardness (HRB)	90	85
• Current & Polarity	DC electrode positive (+) /AC	DC electrode negative (-) /AC
• Recommended Amperage Range	3/32-in: 110-120	3/32-in: 60-65
	1/8-in: 130-140	1/8-in: 90-110
NOTE: This Data page references applies equally to the distributor products EutecTrode 4055 and 4099.		5/32-in: 120-145
		3/16-in: 145-180

Welding Procedure

Preparation: Clean joint and/or broken parts. Prepare casting defects by chamfering with either Eutectic ChamferTrode or ExoTrode AC/DC after nominally preheating the casting within a 150º-200ºF temperature range. Cracks should be prepared with either a single-V or double-V depending on casting thickness. Allow a root opening of 1/8-in. for full-penetration welds and terminate cracks by drilling a ¼" hole.

Technique: Deposit short runs no longer than 2-in. and moderately peen 2nd and subsequent passes. For long cracks in heavy castings use either a cascade and/or block deposition sequence. *Please see Data Sheet for illustrations of these two deposition sequences.*

Post-welding: Slow cool after welding using available insulating material.



TeroMatec® OA 2600

A UNIQUELY FORMULATED OPEN-ARC WIRE FOR FILLING DEFECTS IN LARGE AUTOMOTIVE CASTINGS & FOR RE-BUILDING CAST IRON ROLLS

General Properties

TeroMatec OA 600 is a self-shielded flux cored wire for repairing foundry defects to a variety of cast irons. Also recommended for re-building missing sections on massive, large cross-sectional castings. Suitable for welding malleable cast irons such as the ferritic and pearlitic grades.

Applications

TeroMatec OA 2600 can be used to weld gray cast irons, pearlitic ductile irons, and for surfacing chilled cast iron rolls using open-arc welding procedures. Excellent re-fill properties when repairing critical casting defects.

Technical Data					
	TeroMatec OA 2600				
• Typical Hardness as-deposited HRC	32 – 36 1st pass		31 – 34 2nd pass		
• Maximum Number of Passes	Unlimited passes				
• Current & Polarity	DCEP (+)				
Guideline Parameters for OA 2600					
Diameter	Amp Range	Volt Range	Stick-out	Shield Gas	Flow-scfh
1/8”	380-450	29-32	1.5” ± 1/8”	N/A	N/A

Welding Procedure

Preparation: Casting defects such as slag entrapment, porosity, risers, etc. should be removed using standard metal-removal practices such as arc-air or ChamferTrode. ***Note:*** Preheating prior to part preparation is recommended. For large castings a preheat in the range of 500º to 700ºF is suggested.

Post-welding: After welding is completed slowly cool either in a preheated oven set at 1000ºF cooling at the rate of 100ºF per hour., or wrap in a silicone blanket or bury in vermiculite to retard cooling. ***Note:*** When cast irons are heated near the melting point nearly all of the carbon goes into solution with the iron in the form of iron carbide. If the iron is cooled rapidly a large portion of the carbon will remain combined with the iron as iron carbides. However, if the welded cast iron part is allowed to cool very slowly nearly all of the carbon will pass out of the combined state and segregate as free graphite flakes resulting in a base metal and weld deposit which is both soft and machinable.

EnDOtec® DO*325

A PREMIUM METAL CORED, GAS SHIELDED, WIRE FOR CLADDING CAST IRON

General Properties

EnDOtec DO*325 is designed for build-up of a wide range of cast iron. This gas shielded, metal cored alloy wire is ideal for maintenance and repair applications or batch manufacturing where the highest integrity welding, efficiency and productivity are required. Deposits provide an excellent mechanical property match on a wide range of cast irons.

Applications

Worn Cast Iron Parts, Machine Bases, Pump Housings, Gearboxes, Dies, Closed Impression Dies, Cast Iron Foundry Defects.

Technical Data					
• Hardness as-deposited (HRC)			1st Pass 35 – 40	2nd Pass 35 – 38	
• Maximum Number of Passes			Unlimited Build up		
• Current & Polarity			DCEP (+)		
Guideline Parameters for DO*325					
Diameter	Amp Range	Volt Range	Stick-out	Shield Gas	Flow-scfh
1/16”	170-220	23-26	5/8 ± 1/8	Ar + 2% O_2	35-45

Welding Procedure

Preparation: Remove all contaminants, particularly oil & grease. Lightly grind surface to remove superficial oxides. Preheat according to the base metal make-up and potential to air-harden.

Technique: With difficult-to-weld base metals and with complex-shaped work-pieces, preheating to above 400°F (200°C) will minimize any risk of cracking in the transition zone.

Post-welding: All parts should be slow cooled out of drafts and high moisture areas.

SECTION 3 – COBALT-BASE PRODUCTS

Metal Notes

The mining of cobalt ores is often associated with nickel, iron, and silver. In the past it was considered a nuisance metal by German silver miners. They named the metal "kobalt" which means "goblin" due to the problem it gave them when refining the ore. Today is a different story. Although the unalloyed metal is soft and not particularly corrosion resistant, when alloyed with certain other elements remarkable property changes happen. These include a high coercive force (the alloy becomes readily magnetic), high hardness and wear resistance, exceptional high temperature hot hardness strength, and excellent corrosion resistance to oxidizing media at both room- and elevated temperatures.

• ***Wear Resistant Alloys:*** Although these are available as castings, powder-compacted alloys, and spray-formed materials, it is the rod, wire, and coated electrode forms which are important for Maintenance & Repair and OEM operations. Most alloys used for maintenance have enhanced properties due principally to increases in chromium and carbon. Alloys are further refined through the progressive additions of tungsten and nominal amounts of molybdenum.

• ***Types of Alloys:*** The four basic alloys making up this family and their availability are tabulated below along with associated market references.

• ***General Properties of Co-base Products:*** When selecting a product to be associated with a specific process it is important to note that the process selection can change the properties of the weld deposit. Properties particularly affected are hardness, toughness, and wear resistance. The process that affects as-deposited hardness the least is the gas welding process. However, the resultant coarse microstructure can reduce wear resistance. Fusion welding processes on the other hand can influence wear resistance and hardness due to the amount of dilution present with the first-pass being the most diluted. There is an advantage for dilution particularly when iron pick-up is involved: It increases toughness that can be advantageous when service conditions involve heavy impact.

• ***Selecting The Optimum Alloy:*** Perhaps the best way is to look briefly at seven important property features of cobalt-base alloys and then select a product based on the needs of the application.

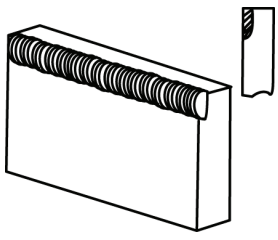
COBALT PRODUCT FEATURE TABLE

Property	9060N	9080N
Hardness-2 pass	*HRC: 38-43*	*HRC- 23-27*
Hot Hardness	*HRC: 20 avg.* *(1200ºF)*	*HRC: 18 avg.* *(1600ºF)*
Impact Resistance	*Good*	*Best*
Oxidation Resistance	*Good* *(1500ºF)*	*Very Good* *(1600ºF)*
Abrasion Resistance	*Very Good*	*Moderate*
Metal-to-Metal Wear	*Very Good*	*Good*
Machinability	*Good*	*Very Good*

***Note*:** The most widely used cobalt-base alloys shown in the Product Feature Table are EutecDur 9060N and EutecDur 9080N and their solid wire and EnDO wire equivalents. These alloys can be considered "universal" due to the wide range of applications covered by their broad range of mechanical properties.

• ***General Welding Guidelines:*** All cobalt-base alloys should be used with the proper preheat levels, interpass temperature controls, and prescribed cooling rates. Reducing excessive penetration will produce the best weld deposit properties with the selected alloy. Note that two passes are typically needed to achieve the properties given in the Product Feature Table.

• ***Typical Applications:***



EutecDur 9060N	*• Blow valves, trimming dies, extruders*
EutecDur 9080N	*• Hot forming dies & rolls, impact dies*

ENDOTEC® DO*60
EUTECDUR® 9060N

OPTIMIZED PROPERTIES AGAINST COMBINED WEAR INVOLVING HOT IMPACT, EROSION, CAVITATION, AND HOT ABRASION

General Properties

Both alloys are uniquely formulated with broad-based properties. Key application attributes are high temperature hardness stability, excellent anti-galling features, and highly specific resistance to cavitation-erosion forces. Weld deposits have excellent resistance to oxidation and corrosion.

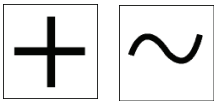
Applications

Outstanding wear results when used to surface valve seat inserts, hot work punches & trim dies, forging die blocks, coke pusher shoes, flapper gates, pump vanes, etc.
Note: Weld deposits made with either product will give similar results depending on the amount of dilution.

Technical Data					
	EnDOtec DO*60			EutecDur 9060N	
• Typical Hardness (2-passes)	HRC: 38-40			HRC: 39-43	
• Typical Hot Hardness (2-passes)	HRC: 20 avg. at 1200ºF			HRC: 20 avg. at 1200ºF	
• Current & Polarity	DC electrode positive (+)			DC electrode positive (+) /AC	
• Parameters	See Guideline Section			See Guideline Section	
• Guideline Parameters for DO*60…For use with 0.045 (1.2mm) diameter wire					
Arc Mode	Amp Range	Volt Range	Stick-out	Shield Gas	Flow-scfh
Spray	220-240	27-30	1/2 ± 1/16	Argon	35-40
Short-Arc	140-175	17-20	1/2 ± 1/16	Tri-gas mix*	35-45
* Tri-gas mix: 90% Helium + 7.5% Argon + 2.5% Carbon Dioxide					
• Recommended Amperage Range for 9060			1/8-in: 80-120	5/32-in: 130-160	

Welding Procedure

Preparation: Remove all contaminants, particularly oil & grease. Lightly grind surface to remove superficial oxides. Preheat according to the base metal make-up and potential to air harden. For tool steel surfacing use the recommended preheat & interpass temperatures for the grade and type.
Technique: Always use the lowest practical amperage range to minimize dilution. Deposit width should be between ½" and ¾". De-slag. Second, and subsequent passes should tie in to the weld deposit toe so as to avoid interpass "valleys". Alternate weld layer deposit sequence going from 9 o'clock to 3 o'clock then 12 o'clock to 6 o'clock.
Post-welding: For air-hardening steels slow cool using available insulating materials. For less sensitive base metals slow cool out of drafts.



ENDOTEC® DO*80
EUTECDUR® 9080N

SUPERIOR IMPACT AND THEMAL SHOCK PROPERTIES AT ELEVATED TEMPERATURES. WELD DEPOSITS WORK HARDEN FOR AN EXTENDED APPLICATION WEAR LIFE

General Properties

Both alloys are formulated for exacting applications involving elevated temperature service. Excellent broad-based mechanical & thermal properties with superior machinability, position these alloys for critical surfacing and repair applications across a wide range of industries.

Applications

Both alloy forms are ideal for surfacing and build-up of hot forging dies, upset dies, hot cutting shear blades, and hot punching dies. Weld deposits resist steam erosion and contact erosion from liquid metals.

Note: Weld deposits made with either product will give similar results depending on the amount of dilution.

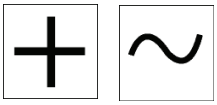
Technical Data					
	EnDOtec DO*80			EutecDur 9080N	
• Typical Hardness (2-passes)	HRC: 26-28			HRC: 28-30	
• Typical Hot Hardness (2-passes)	HRC: 18 avg. at 1600ºF			HRC: avg. at 1600ºF	
• Work Hardened Hardness	HRC: 40-45			HRC: 40-45	
• Current & Polarity	DC electrode positive (+)			DC electrode positive (+) /AC	
• Parameters	See Guideline Section			See Guideline Section	
• Guideline Parameters for DO*80…For use with 0.045 (1.2mm) diameter wire					
Arc Mode	Amp Range	Volt Range	Stick-out	Shield Gas	Flow-scfh
Spray	220-240	27-30	1/2 ± 1/16	Argon	35-40
Short-Arc	140-175	17-20	1/2 ± 1/16	Tri-gas mix*	35-45
* Tri-gas mix: 90% Helium + 7.5% Argon + 2.5% Carbon Dioxide					
• Recommended Amperage Range for 9080N			1/8-in: 90-120	5/32-in: 125-155	

Welding Procedure

Preparation: Remove all contaminants, particularly oil & grease. Lightly grind surface to remove superficial oxides. Preheat according to the base metal make-up and potential to air harden. For tool steel surfacing use the recommended preheat & interpass temperatures for the grade and type.

Technique: Always use the lowest practical amperage range to minimize dilution. Deposit width should be between ½" and ¾". De-slag. Second, and subsequent passes should tie in to the weld deposit toe so as to avoid interpass "valleys". Alternate weld layer deposit sequence going from 9 o'clock to 3 o'clock then 12 o'clock to 6 o'clock.

Post-welding: For air-hardening steels slow cool using available insulating materials. For less sensitive base metals, slow cool out of drafts.



SECTION 4 – COPPER-BASE PRODUCTS

Metal Notes

Man has used copper for thousands of years…preceding the Iron Age in its use as the metal of choice due to its versatile properties. Copper had such excellent formability and corrosion resistance, particularly in seawater that the early British Navy used it to sheath the hull of its wooden ships to protect against sea borers and barnacles.
Copper, in its pure state, or alloyed with a low percentage of other elements, is widely used for electrical components and thermal applications where conductivity is a key requirement. When alloyed, principally with zinc, it forms brasses. And when alloyed with tin, bronzes. However, this is not the full story! Copper is the base element for over 800 alloys with new alloys continuously being developed.

• ***The Alloys of Copper:*** The properties and general characteristics of some of the more widely known alloys are described below along with welding and brazing product recommendations. For more information consult the product description pages.

COPPER AND ITS ALLOYS - INFORMATION TABLE

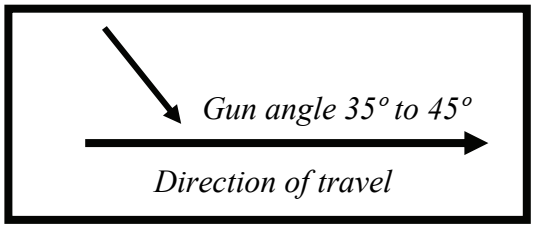
Reference	***Alloy Description***	***Potential Eutectic Product***			
COPPERS		SMA	GMA	GTA	BRAZ
Pure Copper (Cu)	*Oxygen-free copper used for busbars, switches, relays, and conductors…*		*special*	*special*	✔
Copper + Be	*Beryllium copper is used for springs, non-sparking tools & contactors..*				✔
Copper + Cd	*Cadmium copper is used for switch gears, wave guides, contact tips…*				✔
Copper + Pb	*Leaded coppers are used in electric motors, switch parts, screw machines..*				✔
Copper + Cr	*Chromium coppers are used for tips, seam welding wheels & electrodes…*				✔
BRASSES					
Low Zn	*Red brasses (low) are used for heat exchangers, piping, radiator cores…*	✔	✔	✔	✔
		Special techniques are needed when arc-welding low zinc brasses.			
High Zn	*Yellow brasses (high) for condenser plates, tubing, fasteners, lamp fixtures*				✔

BRASSES		*SMA*	*GMA*	*GTA*	*BRAZ*
With Pb	*Leaded brasses can be either low Pb or high Pb. Used for machine parts, nuts..*	*Use special high-fluoride fluxes*			✔
With Sn	*Naval brass, leaded naval brass & admiralty brass contain tin. Used for marine hardware, rivets, valves, bolts..*				✔
BRONZES					
With Al	*Aluminum bronzes are used for pump parts, tubes, condensers, dies, bolts…*	✔	✔	✔	✔
		Special fluxes needed for brazing			
With Si	*Silicon bronzes are widely used high pressure hydraulics, tubing, pumps…*	✔	✔	✔	✔
With Sn	*Tin bronzes are used for bearings, gears, bushings, piston rings, dies…*	✔	*special*	*special*	✔
With Mn	*Manganese bronze is used for gears, gun mounts, castings, valve stems…*	*special*	*special*	*special*	✔
Copper + Ni	*Copper nickels & nickel silvers (no silver) are high in Ni are widely used for marine parts, valves, pumps…*	*special*	*special*	*special*	✔

• ***General Welding Guidelines:*** Copper-base alloys vary from easy-to-weld to "must be welded with care". • Copper, and high copper-content alloys generally require preheating to 1000ºF while copper-silicon and copper-nickel alloys are welded without preheating.

• Brasses are susceptible to cracking if stressed during welding. This suggests the use of jigs and supports. • When arc welding with covered electrodes a weave bead is preferred so as to minimize slag entrapment. • When arc welding using the GTA welding process a 2% thoriated tungsten electrode is preferred due to better arc-starting and longer life. Similarly, a sharp-pointed tungsten electrode is recommended. Either100% helium or 100% argon gas mixture can be used with 100% helium being the preferred shielding gas. • Arc welding using the GMA process also has special requirements. Although 100% argon is the general shielding gas, when welding the high-copper, high-conductivity alloys a 75% argon-25% helium gas mixture is recommended. For down-hand welding the spray-arc mode is preferred. And for out-of-position welding the pulse-arc mode gives excellent puddle control. To assure that weld deposits are bright, clean, and free from oxides, the forehand technique[1] is strongly recommended…see below.

1)



Note: A black, sooty weld deposit indicates insufficient gas coverage.

Xuper® 16 XFC & EutecRod 16

SUPERIOR BRAZEABILTY ON LOW & HIGH ZINC BRASSES INCLUDING NICKEL-ENHANCED HIGH STRENGTH BRONZES. SUITABLE FOR DISSIMILAR JOINING OF STEELS TO COPPER ALLOYS

General Properties

Xuper 16 XFC and EutecRod 16 are nickel-reinforced, multi-purpose brazing alloys with very high tensile shear properties. They are suitable for brazing a wide range of copper-base alloys, including carbon and low-alloy steels, tool steels, and for joining these steels to many of the copper alloys.

Applications

Brass piping, bronze pump vanes & condenser plates, high strength bicycle frames, copper refrigeration tubing and condensers, broken tools, drill-bits , end-mill cutters, etc.

Technical Data		
	Xuper 16 XFC…EutecRod 16	
• Typical Tensile Strength	100,000 psi	689 N/mm^2
• Typical Hardness (BHN)	100	
• Color Match Properties	Deposits are light yellow	
• Bonding Temperature	1685º to 1720ºF (918º C – 938º C)	
• Preheating	300º to 500ºF (149º C- 260º C) for brasses & bronzes. 150º to 250ºF (65.5º C-121º C) for carbon, and tool steels	
• Torch • Induction and/or Furnace	High capacity oxy-fuel torch with optimized BTU's For details consult Technical Services	

Braze Welding Procedure

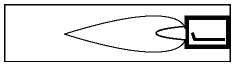
Preparation: Clean joint and/or broken parts. Bevel thickness more than ¼" using a vitrified bonded wheel or grinding disc. Align part, jig if necessary, and preheat according to the information in the above table and make-up of the base metal.

Technique: Apply a small amount of supplemental flux EutecTor 16D if the joint is long or if the preparation involves a bevel. Apply filler metal using a continuous "drop-and-melt" technique moving the torch from side-to-side to control bead width. Continue until the joint is slightly overfilled.

Notes:

1) Any excess "glassy" flux residue can be readily removed after the part has cooled down by light scraping.
2) Excessively overheating copper-base alloys and/or using excess flux can make the flux residue difficult to remove.

Post-brazing: Copper-base parts should be allowed to cool naturally in still air. For tool steel repairs slow cool by covering in vermiculite; wrapping in a heat-retardant blanket; or by burying in lime.



XUPER® 18 XFC

A FLUX COATED, LOW-FUMING UNIVERSAL BRONZE ALLOY FOR JOINING THIN SECTION BRONZE & BRASS ALLOYS, STEELS, CAST IRONS AND GALVANIZED SHEET

General Properties

Xuper 18 XFC is enhanced with tin to improve the ease of wetting on bronze alloys, and particularly when brazing zinc-coated sheet stock. Thin-flowing and build-up properties impart application versatility with ease-of-use. Recommended for brazing low and high zinc brasses and for most tin bronzes.

Applications

For brass and bronze parts typically encountered with pumps, valve, plumbing fixtures, small-size impellers, bearings & bushings, galvanized steel components, etc.

Technical Data		
	Xuper 18 XFC	
• Typical Tensile Strength	70,000 psi	485 N/mm^2
• Typical Hardness (BHN)	100	
• Color Match Properties	Deposits are a deep yellow	
• Bonding Temperature	1580º to 1640ºF (860º C-893º C)	
• Preheating	300º to 500ºF (149º C-260º C) for brasses & bronzes. 150º to 250ºF (65.5º C-121ºC) for steels	
• Torch • Induction and/or Furnace	High capacity oxy-fuel torch with optimized BTU's For details consult Technical Services	

Braze Welding Procedure

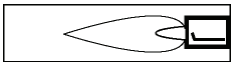
Preparation: Clean joint and/or broken parts. Bevel thickness more than ¼" using a vitrified bonded wheel or grinding disc. Align part, jig if necessary, and preheat according to the information in the above table and make-up of the base metal.

Technique: Apply a small amount of supplemental flux EutecTor 16B if the joint is long or if the preparation involves a bevel. Apply filler metal using a continuous "drop-and-melt" technique moving the torch from side-to-side to control the bead width. Continue until the joint is slightly overfilled.

Notes

1) Any excess "glassy" flux residue can be readily removed after the part has cooled down by light scraping.
2) Excessively overheating copper-base alloys and/or using excess flux can make the flux residue difficult to remove.
3)

Post-brazing: Copper-base parts should be allowed to cool naturally in still air. For tool steel repairs slow cool by covering in vermiculite, wrapping in a heat-retardant blanket, or by burying in lime.



XUPER® 146 XFC & EUTECROD® 3046 XFC

BOTH ALLOYS ARE SPECIALLY FORMULATED TO BRAZE-WELD YELLOW & RED BRASSES, PLAIN CARBON STEELS, AND GRAY CAST IRONS

General Properties

Xuper 146 XFC, and its combat equivalent EutecRod 3046 XFC, were formulated to have a highly active flux to facilitate oxide removal, particularly adherent oxides. Pool-glare is minimal which helps to reduce eye fatigue. Excellent wetting properties on high-zinc brasses.

Applications

Both alloys are versatile, general-purpose brazing rods for use with oxy-fuel systems. Use when braze-welding brass piping, copper-base plumbing fixtures, thin-walled steel assemblies and cast malleable flanges.

Technical Data		
	Xuper 146 XFC	EutecRod 3046 XFC
• Typical Tensile Strength	65,000 psi...450 N/mm^2	65,000 psi…450 N/mm^2
• Typical Hardness (HRB)	80	80
• Color Match Properties	Deposits are yellow	Deposits are yellow
• Bonding Temperature	1600º to 1650ºF	871º to 899º C
• Preheating	400º to 800ºF	
• Torch	High capacity oxy-fuel torch with optimized BTU's	

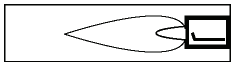
Braze Welding Procedure

Preparation: Clean joint and/or broken parts. Bevel cracks either by pneumatic chiseling or by grinding. Note: When grinding cast iron make sure not to "color" the surface which indicates overheating and potential hard-spotting. Align parts and preheat a recommended 400º to 600ºF temperature-range brass parts and 800ºF for castings.

Technique: See Section 2 for the recommended technique for cast iron.
Apply a small amount of supplemental flux Eutectic 16B if the joint is long or if the preparation involves a bevel. Apply filler metal using a continuous "drop-and-melt" technique moving the torch from side-to-side to control the bead width. Continue until the joint is slightly overfilled.
Notes:

1) Any excess "glassy" flux residue can be readily removed after the part has cooled down by light scraping.
2) Excessively overheating copper-base alloys and/or using excess flux can make the flux residue difficult to remove.

Post-brazing: Allow the brazed casting to slow-cool either by covering in vermiculite, wrapping in a heat-retardant blanket, or by burying in lime.



TIGTECTIC® 182

A COPPER-BASE ALLOY WITH A CONTROLLED AMOUNT OF SILICON. ALLOY HAS A UNIQUE RANGE OF THERMAL, MECHANICAL AND CORROSION-RESISTANT PROPERTIES

General Properties

TigTectic 182 is formulated to weld silicon bronzes (Everdur™), yellow and red brasses, and for welding galvanized and aluminized steels. It is also useful when coating low-carbon steels when a corrosion-resistant surface is required.

Applications

Hydraulic pressure couplings, heat-exchanger tubing, electrical conduits, pole-line hardware, sheet metal joining – either clad or unclad. TigTectic 182 is also suitable for use with the Oxy-Fuel Gas Process.

Technical Data		
	TigTectic 182	
• Typical Tensile Strength	62,000 psi	428 N/mm^2
• Typical Hardness (BHN)	80	
• Color Match Properties	Deposits are a dark yellow-red	
• Preheat Temperature	None required. Weld metal is extremely hot-short.	
• Interpass Temperature	Must not exceed 150ºF.	
• Welding Processes	Gas Tungsten-arc and Oxy-fuel Gas	

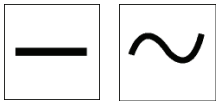
Welding Procedure

Preparation: Remove all contaminants, particularly oil & grease. Lightly grind surfaces to remove superficial oxides. Prepare cracks to have a 60-75º V-groove. A root opening of 1/8-in. is recommended. If necessary, preheat to remove moisture.

Technique: When GTA welding use welding-grade argon with the polarity set on DCEP (-). If additional weld-puddle cleaning is needed use AC-High Frequency. Maintain a small weld puddle and deposit using stringer beads (do not weave, as high silicon alloys are sensitive to hot tearing).
Note: Make sure to support the part during welding and that the inter-pass temperature does not exceed 150ºF.

Although the Oxy-fuel process can be used with silicon bronzes, it is recommended to use arc welding processes for optimum control of weld deposit properties.

Post-welding: Slow cool out of the way of drafts.



EUTECTRODE® 1851/1851 XHD & TIGTECTIC® 1851

COPPER-BASE FILLER METALS FOR WELDING ALUMINUM BRONZES AND FOR DISSIMILAR METAL JOINING OF COPPER ALLOYS TO STEELS AND CAST IRONS

General Properties

Both the SMA & GMA versions of 1851 are particularly resistant to cracking when used for dissimilar metal joining. Weld deposits contain elements that inhibit inter-granular stress corrosion cracking when used to join and surface aluminum bronze castings.

Applications

Aluminum bronze pump housings, manganese bronze impellers, ships propellers, turbine runners, press rams, joining cast iron to steel, tin plate mill rolls, hydraulic pistons, etc.

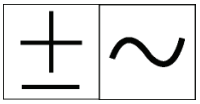
Technical Data					
	EutecTrode 1851/1851XHD		TigTectic 1851		
• Typical Tensile Strength	80,000 psi…550 N/mm^2		90,000 psi…620 N/mm^2		
• Typical Yield Strength	37,000 psi…255 N/mm^2		38,000 psi…262 N/mm^2		
• Typical Hardness (BHN)	145		150		
• Work Hardened Hardness (BHN)	200		200		
• Preheat Temperature	None is typically required.				
• Interpass Temperature	Maximum 300ºF.				
• Welding Processes	Shielded Metal-arc and Gas Tungsten-arc				
• Recommended Amperage Range:	1/8-in: 90-160 DCEP (+)		See Parameter Table		
• Parameter Table for use with 1/16-in and 3/32-in diameter rods					
Diameter	Polarity	Amp Range	Shield Gas	Cup Size	Flow-scfh
1/16-1.6mm	DCEN (-)	70-120	Argon	½-in	35-40
3/32-2.4mm	DCEN (-)	120-160	Argon	¾-in	40-55

Welding Procedure

Preparation: Remove all contaminants, particularly oil & grease. Lightly grind surfaces to remove superficial oxides. Prepare cracks to have a 60-75º V-groove. A root opening of 1/8-in. is recommended. If necessary, preheat to remove moisture.

Technique: When using EutecTrode 1851 or 1851XHD use either stringer or weave beads with the latter being preferred to minimize slag entrapment. Make sure to thoroughly de-slag between passes. When using Eutectic 1851 GMA use welding-grade argon A sharp pointed, thoriated electrode is the preferred and tip shape & type. Note: If additional weld-puddle cleaning is required use AC-High Frequency. Maintain a small weld puddle and deposit weld metal using stringer beads (do not weave as these are sensitive to cracking).
Note: Make sure that the inter-pass temperature does not exceed 300ºF.

Post-welding: Slow cool out of the way of drafts.



Xuper® 2800 XHD

A TIN-BRONZE ALLOY WITH SUPERIOR WELDABILITY…EXCELLENT METAL-TO-METAL WEAR PROPERTIES

General Properties

Eutectic 2800XHD deposits dense, porous-free welds on yellow and red brasses and phosphor bronze. Excellent for braze-welding aluminized and zinc-coated ferrous metals. Due to the presence of tin, weld deposits have a greater resistance to corrosion and improved work-hardening when compared to lower tin bronzes.

Applications

Particularly recommended for non-hot working bronzes used for condenser tubing, for piping carrying highly acidic waters in mine drainage operations, sleeve bushings used in well-drilling equipment. Also useful for upgrading steel surfaces for bearing applications.

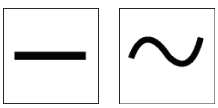
Technical Data		
	Xuper 2800 XHD	
• Typical Tensile Strength –DC	45,000 psi	310 MPa
• Typical Tensile Strength –AC	50,000 psi	345 MPa
• Typical Hardness (HRB)	82	
• Work Hardened Hardness (HRB)	95	
• Preheat Temperature	150ºF	
• Interpass Temperature	Maximum 300ºF.	
• Welding Processes	Shielded Metal-arc	
• Recommended Amperage Range:	DCEN (-)1/8-in: 85-110	5/32-in: 90-125
• Recommended Amperage Range:	AC 1/8-in: 90-120	5/32-in: 115-150

Welding Procedure

Preparation: Remove all contaminants, particularly oil & grease. Lightly grind surfaces to remove superficial oxides. Prepare cracks to have a 60-75º V-groove. A root opening of 1/8-in. is recommended. If necessary, preheat to remove moisture.

Technique: When using Xuper 2800 XHD on copper-base alloys use either stringer or weave beads with the latter being preferred to minimize slag entrapment. Make sure to thoroughly de-slag between passes. Maintain a reasonably small weld-puddle and do not weave excessively. When surfacing ferrous materials use the low-end of the amperage range to minimize dilution and deposit 3-passes for optimum results
Note: Make sure that the inter-pass temperature does not exceed 300ºF.

Post-welding: Slow cool out of the way of drafts.



EUTECTIC® ALU-BRONZE

A HIGH QUALITY, SOLID ALUMINUM BRONZE WIRE FOR PRODUCTION FABRICATIONS, LARGE VOLUME SURFACING, AND DISSIMILAR METAL JOINING OF FERROUS AND COPPER-BASE ALLOYS

General Properties

Eutectic Alu-Bronze is recommended for Gas Metal-Arc welding of alumium bronzes, silicon bronzes, manganese bronzes, and red & yellow brasses. It is also an excellent choice when weld-surfacing steels and cast irons for improved wear and corrosion resistance.

Applications

Particularly suitable for hydraulic piston heads, tin plate mill rolls, press rams, condenser boxes, ship propellers, joining steel to bronze cast iron to bronze. Use where improved sliding properties are required.

Technical Data					
	Eutectic Alu-Bronze				
Typical Tensile Strength	79,000 psi	545 N/mm^2			
Typical Yield Strength	35,000 psi	240 N/mm^2			
Typical Hardness (BHN)	140-150				
• Current & Polarity	DC electrode positive				
• Parameters	See Guideline Section				
• Guideline Parameters…For use with 0.045 (1.2mm) diameter wire					
Arc Mode	Amp Range	Volt Range	Stick-out	Shield Gas	Flow-scfh
Spray	210-230	26-29	1/2 ± 1/16	Argon[1]	45-50[2]
[1] For materials over ½-in thick use 75%He/25%Ar			[2] For lower heat input parameters use 35-45 scfh flows		

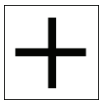
Welding Parameters

Preparation: Remove all contaminants, particularly oil & grease. Lightly grind surfaces to remove superficial oxides. Prepare cracks to have a 60-75º V-groove. A root opening of 1/8-in. is recommended. If necessary, preheat to a maximum of 300ºF to facilitate good fusion and to remove moisture.

Technique: When using Eutectic Alu-Bronze on copper-base alloys use either stringer or weave beads with the latter being preferred to minimize slag potential hot-cracking. Maintain a reasonably small weld-puddle and do not weave excessively. When surfacing ferrous materials use the low-end of the amperage range to minimize dilution and deposit 3-passes for optimum results

Note: Make sure that the inter-pass temperature does not exceed 300ºF.

Post-welding: Slow cool out of the way of drafts.



EUTECTIC® COP-SILICON

A SOLID, SMOOTH DRAWN COPPER-SILICON WIRE FOR JOINING SILICON BRONZES AND FOR WEARFACING CARBON STEELS.
EXCELLENT FOR BRAZE-WELDING ZINC COATED STEELS

General Properties

Eutectic Cop-Silicon is recommended when welding copper-zinc alloys such as the red & yellow brasses and for joining these alloys to either steels or cast irons. The *Braze Welding Process* is widely used to weld lightly coated galvanized sheet metal used by the Automotive Industry.

Applications

Hot water storage tanks, galvanized ducting, automotive body welding, silicon bronze castings, welding cast irons to steels and for repairing copper-manganese water-pump castings.

Technical Data						
		Eutectic Cop-Silicon				
Typical Tensile Strength		75,000 psi		517 N/mm^2		
Typical Yield Strength		33,000 psi		225 N/mm^2		
Typical Hardness (BHN)		80-120				
• Current & Polarity		DC electrode positive				
• Parameters		See Guideline Section				
• Guideline Parameters…For use with 0.035 (0.8mm)^A and 0.045 (1.2mm)^B diameter wires						
Arc Mode		Amp Range	Volt Range	Stick-out	Shield Gas	Flow-scfh
A	Spray	130-160	22-25	1/2 ± 1/16	Argon[1]	45-50[2]
B	Spray	170-200	22-25	1/2 ± 1/16	Argon[1]	45-50[2]
[1] For materials over ½-in thick use 75%He/25%Ar				[2] For lower heat input parameters use 35-45 scfh flows		

Welding Parameters

Preparation: Remove all contaminants, particularly oil & grease. Lightly grind surfaces to remove superficial oxides. Prepare cracks to have a 60-75º V-groove. A root opening of 1/8-in. is recommended. If necessary, preheat to a maximum of 125ºF. Do exceed this temperature by more than 25ºF.

Technique: When welding with Eutectic Cop-Silicon on copper-base alloys use stringer beads. DO NOT WEAVE! Weaving causes the base metal to overheat which can lead to hot tearing. Maintain a reasonably small weld-puddle and relatively high travel speeds. When surfacing ferrous materials use the low-end of the amperage range to minimize dilution and deposit 3-passes for optimum results.

Note: Make sure that the inter-pass temperature does not exceed 125-150ºF.

Post-welding: Slow cool out of the way of drafts.

EUTECROD® 180

SELF-FLUXING COPPER-BASE ALLOYS FOR BRAZING COPPER-TO COPPER JOINTS AND JOINING COPPER TO BRASSES & BRONZES

General Properties

EutecRod 180 is copper-phosphorus alloys with excellent brazeability on copper-base alloys when used with FloTectic® 1100…high activity brazing flux.

Applications

EutecRod 180 is an economical alloy for repairing radiators, joining various plumbing connectors, air-conditioning coils, copper tubing, etc. No clean up is needed due to its self-fluxing properties.

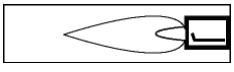
Technical Data		
	EutecRod 180	
• Typical Tensile Shear Strength	42,000 psi	290 N/mm^2
• Electrical Conductivity – IACS	22%	
• Electrical Resistivity	7.9 microhm-cm	
• Solidus Temperature[1]	1310º F	710º C
• Liquidus Temperature[2]	1460º F	795º C
• Maximum Brazing Temperature	1550º F	845º C
• Heating Methods	Oxy-fuel torch, induction & furnace brazing…	
[1] The *solidus temperature* is the highest temperature at which the part remains solid i.e. the start of melting.		
[2] The *liquidus temperature* is the lowest temperature at which the part is molten i.e. complete melting.		

Braze Welding Procedure

Preparation: Clean joint area with RotoClean OS or use a proprietary VOC-free solvent. Align parts and preheat locally to facilitate quicker joint area heat-up. When brazing copper to brass or bronze paint joint area and rod with FloTectic Flux 1100.

Technique: Use a 2x carburizing flame to prevent oxidation. After preheating, deposit filler metal using a continuous "drop-and-melt" technique. Note EutecRod 180 is very fluid. Make sure joint gaps should do not exceed 0.005". Continue until the joint is slightly overfilled.
Note: When using a flux any "glassy" residue can be readily removed by light scraping.

Post-brazing: If necessary, parts can be cooled in water.



SECTION 5 – BRAZING & SOLDERING PRODUCTS

Metal Notes

Brazing is an artisan tool nearly as old as civilization itself. In the ancient Egyptian City of Thebes there is a wall painting over 3,000 years old which shows a worker soldering gold. Today, we still use the noble metal gold, and many less noble metals, to braze materials as easy as aluminum and as difficult as zirconium...we can even braze ceramics. A deepening progress in the science of metals and rapid technological advancement have made all this possible. This combination of material and process advancement and has made the joining of metals through brazing and soldering a key industrial tool.

• ***What is Brazing****?* It is a process for joining metals & ceramics though the use of selected filler metals and the application of heat. In the case of brazing this is accomplished above 840ºF but below the melting point of the base metal, and for soldering the application temperature is generally, below 840ºF.

Brazing & soldering can best be thought of as being part of a broad family of joining methods with many shared features. You will see in the Brazing Property Grid that brazing & soldering lie midway between mechanical fastening and diffusion bonding. This means that brazed and soldered joints have properties such as ease-of-assembly typical of mechanical fastening and mechanical properties many times exceeding those of fusion welding.

BRAZING PROPERTY GRID

• *Mechanical Fastening*	Versatile…many metals with simple processes
• *Adhesive Bonding*	Brazed joints have high mechanical properties
• ***Brazing & Soldering*** →	Brazed joints exhibit shock-resisting ductility
• *Fusion welding*	Brazing is an easy-to-use process
• *Diffusion Bonding*	Ideal for dissimilar-metal joining

• ***Characteristics & Features of Brazing and Soldering:*** All operations require a heat source that can be anything from a small butane gas torch to sophisticated vacuum-retort furnaces. Because brazing is generally carried out at relatively low temperatures there is little if any distortion. Both thick and thin assemblies can be joined in a one-step operation. And brazed joints are generally strong which means there is a high safety margin. Brazing and soldering can be used on a wide variety of materials ranging from metals, ceramics, composites…even metallized plastics are amenable to these joining processes.

• ***Quick Review Table:*** Please note that the market for cadmium-containing silver brazing products is being phased out. Lead-containing soldering products are, in most cases, not sold for health & safety reasons.

SILVER BRAZING & SOLDERING - QUICK REFERENCE TABLE

Product Name	Form	Class	Description
EutecRod 180 silver-free	Bare Rod	Cu-P	A self-wetting alloy for copper tubing, piping, and air-conditioning coils…
EutecRod 1804	Bare Rod	Cu-P-Ag	For improved corrosion resistance for *"below ground"* copper connections…
EutecRod 1020FC	Coated Rod	Ag-Cu-Zn-Sn	General purpose rod for brasses, bronzes, steels, nickel alloys…
Xuper 1020 XFC	Coated Rod	Ag-Cu-Zn-Sn	Similar to 1020FC but with a more flexible flux coating…
EutecRod 1028FC	Coated Rod	Ag-Cu-Zn-Sn	Less fluid alloy for parts with wide clearances. Good for ferrous and non-ferrous metals…
EutecRod 1030 FC	Coated Rod	Ag-Cu-Zn-Cd	A general purpose brazing alloy suitable for poor fit-up joints Broad range of base metals
EutecRod 1601	Bare Rod	Ag-Cu-Zn-Ni	Ideal for carbide brazing & steels, stainless steels and copper alloys…
Xuper 1630 XFC	Coated Rod	Ag-Cu-Zn	Excellent flow properties on brasses, bronzes & low alloy steels…
Xuper 1665 XFC	Coated Rod	Ag-Cu-Zn-Sn	Increased tin content for ease of use on ferrous & non-ferrous metals…
EutecRod 1800	Bare Rod, Coil	Ag-Cu-Zn-Sn	For close fitting female-male joints, in stainless steels, nickel alloys, most copper-base metals, & steels…
EutecRod 1801G	Bare Rod Coil, Shim	Ag-Cu-Zn-Sn	Low temperature free-flowing alloy for joining dissimilar metals.
EutecRod 1803	Bare Rod	Cu-Ag-P	A higher silver alloy for improved properties and below-ground corrosion resistance…
EutecRod 1810	Bare rod	Ag-Cu-Zn-Cd	An economical brazing rod for general repair applications on most brazeable metals…
Silweld Economizer Kit # 2	Rod + Flux	Ag-Cu-Zn-Sn	A handy kit for quick repairs to small dissimilar metal assemblies…
Eutectic Shim IV Eutectic Strip 1801G	Shim-stock Strip-stock	Ag-Cu-Zn-Ni Ag-Cu-Zn-Sn	A special *"sandwich type"* alloy for pre-placement brazing of carbides…
Eutec SilWeld 1618PA	Paste Alloy	Ag-Cu-Zn-Sn	A practicable & *"brushable"* paste alloy for assembly brazing of ferrous and non-ferrous metals…
EutecRod 157	Coil	Sn-Ag	A high tin-silver soldering rod for stainless steels food-handling equipment & medical instruments…
StainTin 157PA	Paste Alloy	Sn-Ag	Similar to 157 applications but in paste + flux form…
TinWeld 2	Paste Alloy	Sn	A high-tin, lead-free paste + flux solder for pre-coating & tinning operations…

EUTECROD® 1803 & EUTECROD® 1804

SELF-FLUXING COPPER-BASE ALLOYS FOR BRAZING COPPER-TO COPPER JOINTS AND JOINING COPPER TO BRASSES & BRONZES

General Properties

EutecRods 1803 and 1804 are respectively copper-phosphorus alloys. EutecRod 1803 contains some 15% silver for improved corrosion resistance when used for below-ground electrical connectors. Excellent brazeability on copper-base alloys when used with FloTectic 1100 or Xuper Braze 100 fluxes.

Applications

• EutecRod 1803 has silver-enhanced flowability and ground-contact corrosion resistance. Use when brazing copper heat exchangers, in-ground electrical connections, copper parts subject to vibration. No clean up is needed due to its self-fluxing properties.

• EutecRod 1804 is an economical alloy for repairing radiators, joining various plumbing connectors, air-conditioning coils, copper tubing, etc. No clean-up is needed due to its self-fluxing properties.

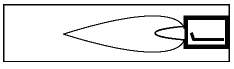
Technical Data				
	EutecRod 1803		EutecRod 1804	
• Typical Tensile Shear Strength	50,000 psi	345 N/mm^2	50,000 psi	345 N/mm^2
• Electrical Conductivity – IACS	9.9%		9.5%	
• Electrical Resistivity	17.3 microhm-cm		18.2 microhm-cm	
• Solidus Temperature[1]	1190º F	645º C	1190º F	645º C
• Liquidus Temperature[2]	1475ºF	800° C	1325ºF	720º C
• Maximum Brazing Temperature	1500º F	815º C	1500º F	815º C
• Heating Methods	Oxy-fuel torch, induction & furnace brazing…			
[1] The *solidus temperature* is the highest temperature at which the part remains solid i.e. the start of melting.				
[2] The *liquidus temperature* is the lowest temperature at which the part is molten i.e. complete melting.				

Braze Welding Procedure

Preparation: Clean joint area with RotoClean OS or use a proprietary VOC-free solvent. Align parts and preheat locally to facilitate quicker joint area heat-up. When brazing copper to brass or bronze paint joint area and rod with FloTectic 1100.

Technique: Use a 2x carburizing flame to prevent oxidation. After preheating, deposit filler metal using a continuous "drop-and-melt" technique. Note that both 183 and 1804 are very fluid with EutecRod 1803 being the most fluid. Make sure that joint gaps do not exceed 0.005". Continue until the joint is slightly overfilled.
Note: When using a flux any "glassy" residue can be readily removed by light scraping.

Post-brazing: If necessary, parts can be cooled in water.



XUPER® 1020 XFC & EUTECROD® 1020 FC

BOTH FLUX-COATED RODS ARE HIGH IN SILVER AND CADMIUM-FREE PARTICULARLY RECOMMENDED FOR FOOD-HANDLING EQUIPMENT & SURGICAL INSTRUMENTS

General Properties

• Xuper 1020 XFC is a specially coated rod with a flexible reduced-glare flux. Ideal for difficult-to-get-to locations. Suitable for most ferrous and non-ferrous metals with a good color match on stainless steel.

• EutecRod1020 FC has similar properties to Xuper 1020 XFC but with a slightly more active, non-flexible flux coating. For use on copper-base alloys, nickel-base alloy, tool steels and low-alloy/low-carbon steels.

Applications

Recommended for brazing food-handling, dairy, & brewing equipment where cross-contamination must be avoided. Excellent for joining high-quality surgical and medical instruments, small-scale tools & dies, and high-strength brazing of copper-nickel tubing.

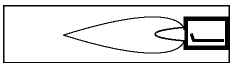
Technical Data		
	Xuper 1020 XFC & EutecRod 1020 FC	
• Typical Tensile Shear Strength	85,000 psi	585 N/mm^2
• Electrical Conductivity - IACS	8.3%	
• Electrical Resistivity	20.7 microhm-cm	
• Solidus Temperature[1]	1145º F	620º C
• Liquidus Temperature[2]	1205º F	650º C
• Maximum Brazing Temperature	1400º F	760º C
• Heating Methods	Oxy-fuel torch, induction & furnace brazing…	
[1] The *solidus temperature* is the highest temperature at which the part remains solid i.e. the start of melting.		
[2] The *liquidus temperature* is the lowest temperature at which the part is molten i.e. complete melting.		

Braze Welding Procedure

Preparation: Clean joint area with RotoClean OS or use a proprietary VOC-free solvent. Lightly roughen highly polished stainless steel to facilitate quicker bonding. Align parts and preheat copper-base alloys locally to facilitate quicker joint area heat-up.
Note: Preheating is generally not needed when brazing stainless steels or nickel alloys.

Technique: Use a 2x carburizing flame to prevent oxidation. After preheating deposit the filler metal using a continuous "drop-and-melt" technique. Note that both 1020 XFC and 1020FC are quite fluid and joint gaps should not exceed 0.005". Continue until the joint is slightly overfilled.
Notes: When additional fluxing is called for use EutecTor Wonder Flux with nickel and stainless steels. For difficult-to-wet steels use Xuper Braze 100H flux.

Post-brazing: If necessary, parts can be cooled in water to "shock off" the flux residue.



EUTECROD® 1601

HIGH FLOWABILTY ALLOY SPECIALLY FORMULATED FOR CARBIDE TOOL TIPPING AND FOR GENERAL PURPOSE BRAZING OF STAINLESS STEELS

General Properties

EutecRod 1601 is a nickel-enhanced, smooth-drawn bare rod. The addition of nickel markedly improves the alloys ability to wet difficult-to-braze carbides. And with a wide melting range, bridging gaps is relatively easy to accomplish, particularly with stainless steels

Applications

Excellent wetting action on poorly fitting tube connections, industrial and medical instrument manufacture, stainless steel food processing equipment, composite die fabrications (carbide inserts), etc.

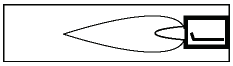
Technical Data		
	EutecRod 1601	
• Typical Tensile Shear Strength	60,000 psi	415 N/mm^2
• Electrical Conductivity - IACS	16.5%	
• Electrical Resistivity	10.2 microhm-cm	
• Solidus Temperature[1]	1240º F	670º C
• Liquidus Temperature[2]	1435º F	780º C
• Maximum Brazing Temperature	1600º F	900º C
• Heating Methods	Oxy-fuel torch, induction & furnace brazing…	
[1] The *solidus temperature* is the highest temperature at which the part remains solid i.e. the start of melting.		
[2] The *liquidus temperature* is the lowest temperature at which the part is molten i.e. complete melting.		

Braze Welding Procedure

Preparation: Clean joint area with RotoClean OS or use a proprietary VOC-free solvent. Lightly roughen highly polished stainless steel to facilitate quicker bonding. Align parts and preheat copper-base alloys locally to facilitate quicker joint area heat-up. When brazing carbides, pre-tinning of the carbide will help to assure void-free joints.
Note: Preheating is generally not needed when brazing stainless steels or nickel alloys.

Technique: Use a 2x carburizing flame to prevent oxidation. After preheating deposit the filler metal using a continuous "drop-and-melt" technique. Continue until the joint is slightly overfilled.
Notes: When additional fluxing is called for use EutecTor 1601 for both nickel and stainless steels.

Post-brazing: If necessary, parts can be cooled in water to "shock off" the flux residue.



EUTECROD® 1030 FC

AN EASY-TO-BRAZE ALLOY FOR POOR FIT-UP JOINTS AND FOR GENERAL PURPOSE BRAZING

General Properties

EutecRod 1030 FC is a flux-coated rod is recommended when brazing various ferrous and non-ferrous parts & assemblies. It is also suitable for use on carbon & low-alloy steels, and when joining these alloys to either brasses and/or bronzes

Applications

As a general purpose, economical silver brazing rod, EutecRod 1030 FC can be used for a abroad range of maintenance joining needs when joint gaps are more than 0.007-in. Motor fuel lines, small-scale brazing assemblies such tubular furniture, air conditioning assemblies, electrical connectors, plumbing fixtures, bronze ornamentals, etc.

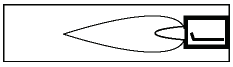
Technical Data		
	EutecRod 1030 FC	
• Typical Tensile Shear Strength	60,000 psi	415 N/mm^2
• Electrical Conductivity - IACS	23%	
• Electrical Resistivity	6.5 microhm-cm	
• Solidus Temperature[1]	1240º F	670º C
• Liquidus Temperature[2]	1435º F	778º C
• Maximum Brazing Temperature	1600º F	870º C
• Heating Methods	Oxy-fuel torch, induction & furnace brazing…	
[1] The *solidus temperature* is the highest temperature at which the part remains solid i.e. the start of melting.		
[2] The *liquidus temperature* is the lowest temperature at which the part is molten i.e. complete melting.		

Braze Welding Procedure

Preparation: Clean joint area with RotoClean OS or use a proprietary VOC-free solvent. Lightly roughen highly polished stainless steel to facilitate quicker bonding. Align parts and preheat copper-base alloys locally to facilitate quicker joint area heat-up.
Note: Preheating copper-base alloys depending on the alloy type and grade.

Technique: Use a 2x carburizing flame to prevent oxidation. After preheating deposit the filler metal using a continuous "drop-and-melt" technique. Continue until the joint is slightly overfilled.
Notes: When additional fluxing is called for use FloTectic 1100 or Xuper Braze 100 typically needed when brazing either nickel alloys or stainless steels.

Post-brazing: If necessary, parts can be cooled in water to "shock off" the flux residue.



XUPER® 1630 XFC

AN ECONOMICAL, CADMIUM-FREE ALLOY WITH A MEDIUM SILVER CONTENT FOR GENERAL PURPOSE BRAZING

General Properties

Xuper 1630 XFC is a flux-coated rod particularly recommended when brazing various bronze and brass fittings. It is also suitable for use on carbon & low-alloy steels, and when joining these alloys to either yellow or red brasses.

Applications

As a general purpose, economical silver brazing rod, Xuper 1630 XFC can be used for a abroad range of maintenance joining needs when joint gaps are more than 0.005-in. Motor fuel lines, small-scale brazing assemblies such tubular furniture, electrical connectors, plumbing fixtures, bronze ornamentals, etc.

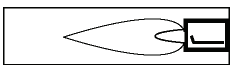
Technical Data		
	Xuper 1630 XFC	
• Typical Tensile Shear Strength	60,000 psi	415 N/mm^2
• Electrical Conductivity - IACS	25%	
• Electrical Resistivity	6.8 microhm-cm	
• Solidus Temperature[1]	1250º F	675º C
• Liquidus Temperature[2]	1410º F	765º C
• Maximum Brazing Temperature	1600º F	870º C
• Heating Methods	Oxy-fuel torch, induction & furnace brazing…	
[1] The *solidus temperature* is the highest temperature at which the part remains solid i.e. the start of melting.		
[2] The *liquidus temperature* is the lowest temperature at which the part is molten i.e. complete melting.		

Braze Welding Procedure

Preparation: Clean joint area with RotoClean OS or use a proprietary VOC-free solvent. Lightly roughen highly polished stainless steel to facilitate quicker bonding. Align parts and preheat copper-base alloys locally to facilitate quicker joint area heat-up.
Note: Preheating copper-base alloys depending on the alloy type and grade.

Technique: Use a 2x carburizing flame to prevent oxidation. After preheating deposit the filler metal using a continuous "drop-and-melt" technique. Continue until the joint is slightly overfilled.
Notes: When additional fluxing is called for use EutecTor 1100 or Xuper Braze 100 fluxes, typically needed when brazing either nickel alloys or stainless steels.

Post-brazing: If necessary, parts can be cooled in water to "shock off" the flux residue.



XUPER® 1665 XFC

A CADMIUM-FREE ALLOY WITH INCREASED SILVER AND TIN FOR IMPROVED FLOW PROPERTIES IN CLOSE FITTING APPLICATIONS

General Properties

Xuper 1665 XFC has optimized properties for brazing high quality control instrumentation. A narrow melting range assures excellent capillary properties with close fitting brazements. Recommended for both ferrous and non-ferrous metals in various combinations.

Applications

Kitchen & bathroom faucets, central air conditioner coils, non-ferrous spray can manufacture, lamp & light fixtures, medical, chemical instrument brazing and repairs, hot water tank fabrications, etc.

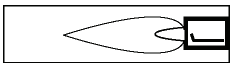
Technical Data		
	Xuper 1665 XFC	
• Typical Tensile Shear Strength	61,000 psi	420 N/mm^2
• Electrical Conductivity – IACS	18	
• Electrical Resistivity	9.6 microhm-cm	
• Solidus Temperature[1]	1225º F	665º C
• Liquidus Temperature[2]	1305º F	705º C
• Maximum Brazing Temperature	1550º F	.845º C
• Heating Methods	Oxy-fuel torch, induction & furnace brazing…	
[1] The *solidus temperature* is the highest temperature at which the part remains solid i.e. the start of melting.		
[2] The *liquidus temperature* is the lowest temperature at which the part is molten i.e. complete melting.		

Braze Welding Procedure

Preparation: Clean joint area with RotoClean OS or use a proprietary VOC-free solvent. Lightly roughen highly polished stainless steel to facilitate quicker bonding. Align parts and preheat copper-base alloys locally to facilitate quicker joint area heat-up.
Note: Preheating copper-base alloys depending on the alloy type and grade.

Technique: Use a 2x carburizing flame to prevent oxidation. After preheating deposit the filler metal using a continuous "drop-and-melt" technique. Continue until the joint is slightly overfilled.
Notes: When additional fluxing is called for use WonderFlux that is often needed when brazing many of the stainless steels and nickel alloys.

Post-brazing: If necessary, parts can be cooled in water to "shock off" the flux residue.



EUTECROD® 1800

A SILVER BRAZING ALLOY WITH A HIGH-FLUIDITY FORMULATION FOR BRAZING VERY NARROW CLEARANCE JOINTS

General Properties

EutecRod 1800 is specially formulated for male-female fitting where clearances are less than 0.005-in. such close fitting joints are typical of delicate instrumentation, optical equipment, surge control gas diaphragms, etc. Excellent wetting properties on a broad range of ferrous and non-ferrous metals, particularly nickel-base alloys.

Applications

Stainless steel dairy equipment including pasteurizers, coolers, washers, holding tanks, etc. Excellent color-match. Due to the high silver content, ductility and general corrosion resistance are superior, with applications in salt-water piping, condensers, pump connector ferrules, hospital equipment repairs, etc.

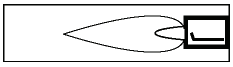
Technical Data		
	EutecRod 1800	
• Typical Tensile Shear Strength	85,000 psi	585 N/mm^2
• Electrical Conductivity - IACS	8.3%	
• Electrical Resistivity	20.7 microhm-cm	
• Solidus Temperature[1]	1145º F	620º C
• Liquidus Temperature[2]	1205º F	650º C
• Maximum Brazing Temperature	1400º F	760º C
• Heating Methods	Oxy-fuel torch, induction & furnace brazing…	
[1] The *solidus temperature* is the highest temperature at which the part remains solid i.e. the start of melting.		
[2] The *liquidus temperature* is the lowest temperature at which the part is molten i.e. complete melting.		

Braze Welding Procedure

Preparation: Clean joint area with RotoClean OS or use a proprietary VOC-free solvent. Lightly roughen highly polished stainless steel to facilitate quicker bonding. Align parts and preheat copper-base alloys locally to facilitate quicker joint area heat-up.
Note: Preheating copper-base alloys depending on the alloy type and grade.

Technique: Use a 2x carburizing flame to prevent oxidation. After preheating deposit the filler metal using a continuous "drop-and-melt" technique. Continue until the joint is slightly overfilled.
Notes: When additional fluxing is called for use WonderFlux or Xuper Braze 100 which are often needed when brazing either nickel alloys or stainless steels.

Post-brazing: If necessary, parts can be cooled in water to "shock off" the flux residue.



EUTECROD® 1801G

A FREE-FLOWING, HIGH SILVER BRAZING ROD WITH IMPROVED LOW-TEMPERATURE PROPERTIES AND WIDE BASE METAL USE

General Properties

EutecRod 1801G is a cadmium-free, high silver alloy for use with most commonly used brazing processes. Its free flowing properties facilitate narrow-gap brazing with a minimum of inter-facial voiding. Suitable for use on most brasses & bronzes, cupro-nickel alloys, stainless steels, etc.

Applications

For dissimilar metal joining of thin-gauge materials encountered with musical instrument manufacture, medical equipment brazing, general hospital equipment repairs, fitment brazing of tools & dies, evaporators, bell & retort pipe fittings, etc.

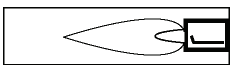
Technical Data		
	EutecRod 1801G	
• Typical Tensile Shear Strength	90,000 psi	620 N/mm^2
• Electrical Conductivity - IACS	18.0%	
• Electrical Resistivity	9.6 microhm-cm	
• Solidus Temperature[1]	1195º F	645º C
• Liquidus Temperature[2]	1250º F	675º C
• Maximum Brazing Temperature	1500º F	815º C
• Heating Methods	Oxy-fuel torch, induction & furnace brazing…	
[1] The *solidus temperature* is the highest temperature at which the part remains solid i.e. the start of melting.		
[2] The *liquidus temperature* is the lowest temperature at which the part is molten i.e. complete melting.		

Braze Welding Procedure

Preparation: Clean joint area with RotoClean OS or use a proprietary VOC-free solvent. Lightly roughen highly polished stainless steel to facilitate quicker bonding. Align parts and preheat copper-base alloys locally to facilitate quicker joint area heat-up.
Note: Preheating copper-base alloys depending on the alloy type and grade.

Technique: Use a 2x carburizing flame to prevent oxidation…important when brazing stainless steels. After preheating deposit the filler metal using a continuous "drop-and-melt" technique. Continue until the joint is slightly overfilled.
Notes: When additional fluxing is called for use WonderFlux…typically needed when brazing either nickel alloys or stainless steels.

Post-brazing: If necessary, parts can be cooled in water to "shock off" the flux residue.



EUTECROD® 1810

AN ECONOMICAL FREE-FLOWING ALLOY FOR COPPER-BASE & FERROUS-BASE BRAZING

General Properties

EutecRod 1810 is a cadmium-bearing silver alloy for use with most commonly used brazing processes. Its bridging properties make it suitable for poor fit-up joints. Suitable for use on most brasses & bronzes and ferrous base metals.

Applications

For dissimilar metal joining of thin-gauge materials encountered with musical instrument manufacture, medical equipment brazing, general hospital equipment repairs, fitment brazing of tools & dies, evaporators, bell & retort pipe fittings, etc.

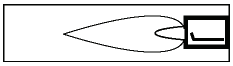
Technical Data		
	EutecRod 1810	
• Typical Tensile Shear Strength	58,000 psi	400 N/mm^2
• Electrical Conductivity - IACS	15.0%	
• Electrical Resistivity	11. microhm-cm	
• Solidus Temperature[1]	1125º F	607º C
• Liquidus Temperature[2]	1310º F	710º C
• Maximum Brazing Temperature	1500º F	815º C
• Heating Methods	Oxy-fuel torch, induction & furnace brazing…	
[1] The *solidus temperature* is the highest temperature at which the part remains solid i.e. the start of melting.		
[2] The *liquidus temperature* is the lowest temperature at which the part is molten i.e. complete melting.		

Braze Welding Procedure

Preparation: Clean joint area with RotoClean OS or use a proprietary VOC-free solvent. Lightly roughen highly polished stainless steel to facilitate quicker bonding. Align parts and preheat copper-base alloys locally to facilitate quicker joint area heat-up.
Note: Preheating copper-base alloys depending on the alloy type and grade.

Technique: Use a 2x carburizing flame to prevent oxidation…important when brazing stainless steels. Braze rapidly and avoid overheating. Deposit the filler metal using a continuous "drop-and-melt" technique. Continue until the joint is slightly overfilled.
Notes: When additional fluxing is called for use WonderFlux or Xuper Braze 100.

Post-brazing: If necessary, parts can be cooled in water to "shock off" the flux residue.



EUTECTIC® SHIM IV

A "SANDWICH-TYPE" SHIM FOR PRE-PLACEMENT BRAZING OF CARBIDE TIPS AND STEP-BRAZING FABRICATIONS

General Properties

Eutectic Shim IV consists of a pure copper centerpiece coated with a high-silver, cadmium-free alloy. The ratio of copper-to-silver is typically 1:2:1. It is available in two thicknesses to suit different carbide sizes. Suitable for use on ferrous and non-ferrous metals.

Applications

Eutectic Shim IV is used extensively by the food-processing, medical & dental instrumentation industries, and particularly Tool & Die manufacturers for pre-placement one-off and/or batch brazing.

Technical Data		
	Eutectic Shim IV	
• Typical Tensile Shear Strength	85,000 psi	585 N/mm^2
• Electrical Conductivity –IACS	18.0%	
• Electrical Resistivity	9.6 microhm-cm	
• Solidus Temperature[1]	1195º F	645º C
• Liquidus Temperature[2]	1250º F	675º C
• Maximum Brazing Temperature	1500º F	815º C
• Heating Methods	Oxy-fuel torch, induction & furnace brazing…	
• Available Thicknesses	0.010-in x 1.0-in	0.020-in x 1.0-in

Recommended Shim IV Usage Guide				
Thickness of Carbide	Size of Carbide			
	1/2-in	3/4-in	1-in	> 1-in
1/8 to 3/8-in	Shim 0.010-in	Shim 0.010-in	Shim 0.020-in	Shim 0.020-in
3/8 to 5/8-in	----------	Shim 0.010-in	Shim 0.020-in	Shim 0.020-in
5/8-in to > 5/8-in	----------	----------	Shim 0.020-in	Shim 0.020-in

[1] The *solidus temperature* is the highest temperature at which the part remains solid i.e. the start of melting.

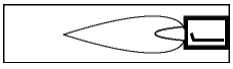
[2] The *liquidus temperature* is the lowest temperature at which the part is molten i.e. complete melting.

Braze Welding Procedure

Preparation: Clean joint area with RotoClean OS or use a proprietary VOC-free solvent. Cut appropriate size & thickness, flux all parts, and position securely. Note: If some form of tying is needed use a small-diameter nickel-base wire.

Technique: Heat insert parts indirectly to reduce thermal shock to the carbide. Note: During the melting phase it is important that the insert does not move. Observe flow indications so that all contact surfaces are seen to be brazed.

Post-brazing: Allow parts to cool naturally. Do not quench!



EUTECTIC STRIP 1801G

A FREE-FLOWING, HIGH SILVER BRAZING STRIP WITH IMPROVED APPLICATION PROPERTIES AND WIDE BASE METAL USE

General Properties

Eutectic Strip 1801G is a cadmium-free, high silver pre-placement shim for use with most commonly used brazing processes. Its free flowing properties facilitate narrow-gap brazing with a minimum of inter-facial voiding. Suitable for use on most brasses & bronzes, cupro-nickel alloys, stainless steels, etc.

Applications

For dissimilar metal joining of thin-gauge materials encountered in the dairy, food-handling & electrical industries. Also suitable for medical equipment brazing, general hospital equipment repairs, and pre-placement production brazing.

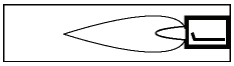
Technical Data		
	Eutectic Strip 1801G	
• Typical Tensile Shear Strength	90,000 psi	620 MPa
• Electrical Conductivity - IACS	19.0%	
• Electrical Resistivity	9.0 microhm-cm	
• Solidus Temperature[1]	1225º F	665º C
• Liquidus Temperature[2]	1370º F	745º C
• Maximum Brazing Temperature	1550º F	845º C
• Heating Methods	Oxy-fuel torch, induction & furnace brazing…	
[1] The *solidus temperature* is the highest temperature at which the part remains solid i.e. the start of melting.		
[2] The *liquidus temperature* is the lowest temperature at which the part is molten i.e. complete melting.		

Braze Welding Procedure

Preparation: Clean joint area with RotoClean OS or use a proprietary VOC-free solvent. Cut appropriate size & thickness, flux all parts, and position securely. Note: If some form of tying is needed use a small-diameter nickel-base wire. It is important not to allow any movement while the braze-alloy cools and solidifies.

Technique: Heat insert parts indirectly to reduce thermal shock to promote uniform flow. Note: During the melting phase it is important that the parts being brazed to not move. Observe flow indications so that all contact surfaces are seen to be brazed and flow-through is evident.

Post-brazing: Allow parts to cool naturally. Parts can be quenched to help with flux residue removal.



EUTEC SILWELD 1618

A SUPERIOR QUALITY "BRUSHABLE" PASTE ALLOY WITH HIGH SILVER CONTENT AND IMPROVED MECHANICAL PROPERTIES

General Properties

Eutec Silweld 1618 is a cadmium-free, high silver pre-placement paste for use with most commonly used brazing processes. Because the metal component is finely ground, heat-up times are greatly reduced and the activity of the carrier flux is not compromised. Suitable for use on most brasses & bronzes, cupro-nickel alloys, stainless steels, carbon steels, etc.

Applications

For dissimilar metal joining of thin-gauge materials encountered in the food and dairy industries, delicate jewelry brazing, tool repairs, electrical contacts, high-quality, high-volume production brazing of plumbing & water fixtures.

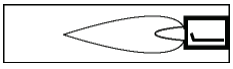
Technical Data		
	Eutec Silweld 1618	
• Typical Tensile Shear Strength	85,000 psi	585 N/mm^2
• Electrical Conductivity - IACS	8.3%	
• Electrical Resistivity	20.7 microhm-cm	
• Solidus Temperature[1]	1145º F	620º C
• Liquidus Temperature[2]	1205º F	650º C
• Maximum Brazing Temperature	1400º F	760º C
• Heating Methods	Oxy-fuel torch, induction, resistance heating & furnace brazing…	
[1] The *solidus temperature* is the highest temperature at which the part remains solid i.e. the start of melting.		
[2] The *liquidus temperature* is the lowest temperature at which the part is molten i.e. complete melting.		

Braze Welding Procedure

Preparation: Clean joint area with RotoClean OS or use a proprietary VOC-free solvent. Thoroughly mix the paste so that the flux and metal particles are well amalgamated and show a smooth consistency. Use a fine brush or spatula to apply the paste. Note, too, that it is important not to allow any movement while the braze-alloy cools and solidifies.

Technique: Heat insert parts slowly indirectly to reduce thermal shock so to promote uniform flow. Note: During the melting phase it is important that the parts being brazed to not move. Observe flow indications so that all contact surfaces are seen to be brazed and flow-through is evident.

Post-brazing: Allow parts to cool naturally. Parts can be quenched to help with flux residue removal.



EUTECROD® 157 & STAINTIN® 157PA

BOTH ALLOYS CONTAIN A HIGH TIN CONTENT SUPPORTED BY A CONTROLLED AMOUNT OF SILVER FOR IMPROVED JOINING & MECHANICAL PROPERTIES

General Properties

EutecRod 157 & StainTin 157PA are respectively rod & paste soldering alloys particularly suitable for stainless steel assemblies, brass and bronze components, nickel alloys, and most carbon steels when used with Eutectic Flux 157. Deposits are corrosion resistant and do not tarnish in service.

Applications

For soldering dairy utensils, food-handling equipment, plumbing fixtures & potable water containers and piping. Also useful for joining electrical connectors*.
Note: Make sure to remove all flux residue traces. This will help to avoid electrolytic corrosion.

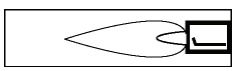
Technical Data		
	EutecRod 157 & StainTin 157PA	
• Typical Tensile Shear Strength	15,000 psi	105 N/mm^2
• Electrical Conductivity - IACS	16.5%	
• Thermal Expansion Coefficient	12 x 10^{-6} in/ ºF (20-212ºF)	
• Solidus Temperature[1]	430º F	220º C
• Liquidus Temperature[2]	430º F	220º C
• Maximum Brazing Temperature	450º F	230º C
• Heating Methods	Oxy-fuel torch, induction, resistance heating & furnace soldering…	
[1] The *solidus temperature* is the highest temperature at which the part remains solid i.e. the start of melting.		
[2] The *liquidus temperature* is the lowest temperature at which the part is molten i.e. complete melting.		

Soldering Procedure

Preparation: Clean joint area with RotoClean OS or use a proprietary VOC-free solvent. Thoroughly mix the 157PA so that the flux and metal particles are well amalgamated and show a smooth consistency. Use a fine brush or spatula to apply the paste. Note, too, that it is important not to allow any movement while the solder alloy cools and solidifies.
Note: For best results maintain joint clearances between 0.001" and 0.005".

Technique: Heat insert parts slowly indirectly to reduce thermal shock so to promote uniform flow. Note: During the melting phase it is important that the parts being soldered to not move. Observe flow indications so that all contact surfaces are seen to be soldered and flow-through is evident.

Post-brazing: Allow parts to cool naturally. Parts can be quenched to help with flux residue removal.



EUTECTIC® TINWELD 2

A HIGH-TIN, LEAD-FREE PAINT-ON PASTE ALLOY FOR GENERAL PURPOSE SOLDERING OF COPPERS, BRASSES, BRONZES & TIN PLATED SHEET STOCK

General Properties

Eutectic TinWeld 2 is paint-on alloy for 'tinning' large surfaces to enhance surface protection and to promote batch soldering with pre-tinned and cadmium-plated parts. Can be used when soldering braided electrical conductors when post-cleaning is feasible.

Applications

For parts needing a pre-placement solder with a good speadability and low application temperature. Because the solder is both lead-free & cadmium-free it can be used on food handling and sanitary equipment. Note, too, that Eutectic TinWeld 2 does not turn black like lead-bearing solders.

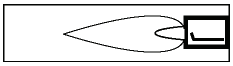
Technical Data		
	Eutectic TinWeld 2	
• Typical Tensile Shear Strength	10,000 psi	70 N/mm^2
• Electrical Conductivity - IACS	15.6%	
• Thermal Expansion Coefficient	22 x 10^{-6} in/ºF (20-212ºF)	
• Solidus Temperature[1]	450º F	230º C
• Liquidus Temperature[2]	450º F	230º C
• Maximum Brazing Temperature	470º F	245º C
• Heating Methods	Oxy-fuel torch, induction, resistance heating & furnace soldering…	
[1] The *solidus temperature* is the highest temperature at which the part remains solid i.e. the start of melting.		
[2] The *liquidus temperature* is the lowest temperature at which the part is molten i.e. complete melting.		

Soldering Procedure

Preparation: Clean joint area with RotoClean OS or use a proprietary VOC-free solvent. Thoroughly mix the TinWeld 2 so that the flux and metal particles are well amalgamated and show a smooth consistency. Use a fine brush or spatula to apply the paste. Note, too, that it is important not to allow any movement while the solder alloy cools and solidifies.

Technique: Heat insert parts slowly and indirectly to reduce thermal shock so to promote uniform flow. During the melting phase it is important that the parts being soldered to not move. Observe flow indications so that all contact surfaces are seen to be brazed and flow-through is evident. When tinning surfaces make sure to heat indirectly to prevent flux charring. Wiping with a rosin-impregnated cloth will help to smooth the surface

Post-brazing: Allow parts to cool naturally. Parts can be quenched to help with flux residue removal.



SILWELD ECONOMIZER KIT #2

A PORTABLE "TOOLBOX KIT" FOR QUICK IN-THE-FIELD BRAZING REPAIRS

General Properties

SilWeld Economizer Kit uses EutecRod 1800 as the base alloy and a companion flux. Excellent for male-female fitting where clearances are less than 0.005-in. such close fitting joints are typical of delicate instrumentation, optical equipment, surge-control gas diaphragms, etc. Excellent wetting properties on a broad range of ferrous and non-ferrous metals, particularly nickel-base alloys.

Applications

Stainless steel dairy equipment including pasteurizers, coolers, washers, holding tanks, etc. Excellent color-match when used on stainless steels. Due to the high silver content, ductility and general corrosion resistance are superior, with applications in salt-water piping, condensers, pump connector ferrules, hospital equipment repairs, etc.

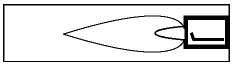
Technical Data		
	Silweld Economizer Kit #2	
• Typical Tensile Shear Strength	85,000 psi	585 N/mm^2
• Electrical Conductivity - IACS	8.3%	
• Electrical Resistivity	20.7 microhm-cm	
• Solidus Temperature[1]	1145º F	620º C
• Liquidus Temperature[2]	1205º F	650º C
• Maximum Brazing Temperature	1400º F	760º C
• Heating Methods	Oxy-fuel torch, induction & furnace brazing…	
[1] The *solidus temperature* is the highest temperature at which the part remains solid i.e. the start of melting.		
[2] The *liquidus temperature* is the lowest temperature at which the part is molten i.e. complete melting.		

Braze Welding Procedure

Preparation: Clean joint area with RotoClean OS or use a proprietary VOC-free solvent. Lightly roughen highly polished stainless steel to facilitate quicker bonding. Align parts and preheat copper-base alloys locally to facilitate quicker joint area heat-up.
Note: Preheating copper-base alloys depending on the alloy type and grade.

Technique: Use a 2x carburizing flame to prevent oxidation. After preheating deposit the filler metal using a continuous "drop-and-melt" technique. Continue until the joint is slightly overfilled.
Notes: When additional fluxing is called for use WonderFlux or Xuper Braze 100 which are often needed when brazing either nickel alloys or stainless steels.

Post-brazing: If necessary, parts can be cooled in water to "shock off" the flux residue.



SECTION 5A – BRAZING & SOLDERING FLUXES, CHEMICAL AIDS

Flux Notes

Why use a Flux: Surface reactions occur when a metal is exposed to air. Most metals are typically unstable and tend to revert to one or more of its more stable compounds with this reaction being accelerated as the temperature rises. These surface reactions are normally referred to as surface oxidation. For successful brazing to be accomplished this surface contaminant must be removed. Here, after degreasing (if needed) a flux would be used to dissolve any surface oxide and during brazing to prevent or markedly reduce its reformation.

What should a flux do? For successful brazing a high quality "application & product specific" flux is a key step. Below are some key features of the EutecTor & Xuper Braze Flux Product Lines:

- *Reduces the surface tension of the joining alloy and the base metal.*
- *Promotes surface alloying by controlled diffusion.*
- *Indicates the optimum temperature of the base metal for brazing to begin.*
- *Protects the brazing & soldering zone and brazing rod from atmospheric contamination.*
- *Promotes good capillary and flowability.*
- *Is fully & completely active during the brazing operation.*
- *Has the right consistency for easy application.*
- *Contains no coarse crystals or solid particles.*

Xuper Braze Fluxes for use with Silver Brazing Rods

• Xuper Braze 14D	General Properties
An active, high temperature dry brazing flux for The "hot brazing" of cast irons using high-silicon Brazing rods such as EutecRod® 141. Can be mixed with deionized water to make a cream paste. Meets the AWS specification A5.31-92 under Type FB3D.	• Water soluble residues
	• For use when joining carbides to stainless steels.
	• Active temperature range: 1400ºF to 2200ºF…760ºC to 1205ºC
	• Does not burn…No flash point.
	• Form: Powder
	• Color: White.

• Xuper Braze 100	General Properties
A highly active flux. For use when brazing brasses, bronzes, general copper-base alloys, carbon steels, including stainless & nickel alloys. Meets the AWS specification A5.31-92 under Type FB3A	• Water soluble residues
	• For use when brazing with the BAg and BCuP group alloys
	• Active temperature range: 1000ºF to 1600ºF…540ºC to 870ºC
	• No flash point…water-base.
	• Form: Ultra creamy white paste
	• Color: White.

• Xuper Braze 100H	General Properties
This flux has a broader active temperature range compared to Xuper Braze 100. Used when localized overheating is experienced or when there is a large volume of refractory oxides present. Meets the AWS specification A5.31-92 under Type FB3A. Also meets AMS 3410 3 & Fed. Spec. O-F 499 Type B.	• Water soluble residues • For use when brazing with the BAg and BCuP group alloys • Active temperature range: 1000ºF to 1700ºF…540ºC to 927ºC • No flash point…water-base. • Form: Ultra creamy paste • Color: Brown

• Xuper Braze 100HD	General Properties
This flux has the same formulation as Xuper Braze 100H but it is in powder form. Oxide dissolving capacity is outstanding and base metal wetting is superior. Meets the AWS specification A5.31-92 under Type FB3A. Also meets AMS 3410 3 & Fed. Spec. O-F 499 Type B.	• Water soluble residues • For use when brazing with the BAg and BCuP group alloys • Active temperature range: 1000ºF to 1700ºF…540ºC to 927ºC • No flash point…water-base. • Form: Powder • Color: Brown

• Xuper Braze 102	General Properties
A general purpose concentrated brazing flux formulated to be diluted with distilled & deionized water for "customized" consistency. Good oxide removal and surface protection. Flux is slightly alkaline. Meets the AWS specification A5.31-92 under Type FB3A. Also meets AMS 3410 3 & Fed. Spec. O-F 499 Type B.	• Water soluble residues • For use when brazing with the BAg and BCuP group alloys • Active temperature range: 1100ºF to 1625ºF…595ºC to 885ºC • No flash point…water-base. • Form: Ultra creamy paste • Color: White

• Xuper Braze 190 FP	General Properties
A uniquely formulated "dispensable" flux for use with the 1xxx & 3xxx grade aluminum alloys. Excellent when used with difficult-to-braze Alloy 6061. Flux has a higher oxide-dissolving capacity, improved flowability, and outstanding capillary action for cleaner brazements. Meets the AWS specification A5.31-92 under Type FB1A. Also meets the AMS 3412D specification.	• Water soluble residues • For use when brazing with BAlSi group alloys (2,3,4, 7,5) & Alcoa 719. • Active temperature range: 915ºF to 1350ºF…490ºC to 735ºC • No flash point…water-base. • Form: Ultra creamy paste • Color: White

EutecTor® Soldering Fluxes

• EutecTor 51 Flux	General Properties
For use when torch soldering selected Series 1xxx, 3xxx, and 4xxx, and 5257, 557,6061 aluminum grades. CAUTION! Do not use flux for moist service as this could lead to severe corrosion problems. * Use ExFlux 1005 followed by a hot water rinse.	• Remove residues with ExFlux 1005 • For use when soldering selected aluminum grades. • Active temperature range: 400ºF to 430ºF…205ºC to 220ºC • Form: Semi-liquid • Color: Amber

• EutecTor 157 Flux	General Properties
A highly reactive flux for use primarily with stainless steels. It is formulated to dissolve the chromium oxide layer to promote improved wetting. Also very effective when soldering many of the copper-base alloys. *Note:* When soldering polished stainless steels make sure to lightly roughen the surface to help with wetting.	• Remove residues with ExFlux 1005 • For use when soldering 300 series stainless steels. • Active temperature range: 450ºF to 470ºF…230ºC to 240ºC • Form: Semi-liquid • Color: Pink * Clean up residue with hot water rinse.

• EutecSol® 682 Flux	General Properties
A special soldering flux for use with difficult-to-solder metals such as the AISI 300 series stainless steels. *Note:* When soldering polished stainless steels make sure to lightly roughen the surface to help with wetting. * Use ExFlux 1005 followed by a hot water rinse.	• Remove residues with ExFlux 1005 • For use when soldering 300 series stainless steels. • Active temperature range: 450ºF to 460ºF…230ºC to 237ºC • Form: Liquid • Color: Clear

• EutecSol® 808 Flux	General Properties
Specially formulated for soldering with air-gas torches and electric soldering iron. Excellent for use on copper components in the electrical & electronic industries. Flux residues are typically non-corrosive. * Use ExFlux 1005 followed by a hot water/ cold water rinse if acceptable to the end-user.	• Remove residues with hot water.* • For use when soldering copper connectors and potable containers. • Active temperature range: 420ºF to 430ºF…215ºC to 220ºC • Form: Semi-liquid • Color: Brown

EutecTor® Aluminum & Cast Iron Brazing Fluxes

• EutecTor 190 Flux	Aluminum	General Properties
A highly reactive flux for the torch brazing of aluminum and aluminum alloys. The flux is particularly suitable when brazing such common grades as EC, 11xx, 4xxx, and selected 5xxx alloys. CAUTION! Flux residues must be removed to prevent time-in-service corrosion.		• Remove residues with hot water. • For use when brazing various aluminum assemblies & components. • Active temperature range: 1060ºF to 1150ºF…570ºC to 620ºC • Form: Powder • Color: White

• EutecTor ThinFlo 190AL	Aluminum	General Properties
A highly reactive flux for the torch brazing of aluminum and aluminum alloys. The flux is particularly suitable when brazing such common grades as EC, 11xx, 4xxx, and selected 5xxx alloys. CAUTION! Flux residues must be removed to prevent time-in-service corrosion.		• Remove residues with hot water. • For use when brazing various aluminum assemblies & components. • Active temperature range: 1060ºF to 1150ºF…570ºC to 620ºC • Form: Powder • Color: White

• AutoRad Flux FP	Aluminum	General Properties
Specially formulated flux for use with EutecRod AutoRad. It promotes controlled, low temperature brazing due to its excellent cleaning action. • For use when brazing automotive aluminum radiators, pumps, cooling fins,		• Remove residues with hot water. Application directed for aluminum auto parts. • Active temperature range: 1060ºF to 1150ºF…570ºC to 620ºC • Form: Powder • Color: White

• EutecTor 141 Flux	Cast Iron	General Properties
A proprietary formulation containing selected carbonates, borates, and other innoculants. Excellent activity when braze welding of gray, malleable, & ductile irons. Flux is particularly effective in promoting good wetting when used with EutecRod® 141…a Eutectic high silicon clean-cast braze rod.		• Remove stubborn residue by scraping or grinding if excessive. • Effective fluxing when hot braze welding of cast irons. • Active temperature range: 1850ºF to 2300ºF…1010ºC to 1260ºC • Form: Powder • Color: Gray

EutecTor Fluxes for use with Silver Brazing Rods

• EutecTor WonderFlux™	General Properties
A highly active formula for use with a broad range of silver brazing products. It is particularly effective when used to braze the AISI 300 stainless steels. Can be used as a supplemental flux with most of the EutecRod series of silver brazing rods. * Use ExFlux 1005 followed by a hot water/ cold water rinse if acceptable to the end-user.	• Remove residues with hot water. • Special flux for use when brazing metals with tenacious oxides. • Active temperature range: 1050ºF to 1600ºF…565ºC to 870ºC • Form: Paste • Color: White

• EutecTor® 1020 Flux D	General Properties
A special dry powder flux for ease of customer mixing using distilled & deionized water. Excellent activity on many brazeable metals…stainless steel, nickel alloys, copper-base alloys, etc. * Use ExFlux 1005 followed by a hot water/ cold water rinse if acceptable to the end-user.	• Remove residues with hot water. • Special dry flux for "customized" mixing. • Active temperature range: 1200ºF to 1600ºF…650ºC to 870ºC • Form: Powder • Color: White

• FloTectic® 1100 Flux	General Properties
A good general-purpose flux for use when brazing with the BAg & BCuP alloys. Easy to apply either by brushing of spreading. Use as a supplemental flux when needed. * Use ExFlux 1005 followed by a hot water/ cold water rinse if acceptable to the end-user.	• Remove residues with hot water. • Economical flux for most general brazing applications. • Active temperature range: 1040ºF to 1600ºF…560ºC to 870ºC • Form: Paste • Color: White

• EutecTor® 1601 Flux	General Properties
Formulated for use when brazing tungsten carbides to assorted machining tools. It has synergistic properties when used with EutecRod 1601. Good shock-loading resistance. * Use ExFlux 1005 followed by a hot water/ cold water rinse if acceptable to the end-user.	• Remove residues with hot water. • Application-specific flux for carbide tool brazing • Active temperature range: 1060ºF to 1600ºF…570ºC to 870ºC • Form: Paste • Color: White

• EutecTor® 1800 Flux	General Properties
Customized for ease-of-use when brazing most ferrous and non-ferrous metals. Excellent oxide dissolving (take up) properties and "clear pool" visibility. * Use ExFlux 1005 followed by a hot water/ cold water rinse if acceptable to the end-user.	• Remove residues with hot water. • Synergistic formula for use with EutecRod 1800. • Active temperature range: 1060ºF to 1600ºF…570ºC to 870ºC • Form: Paste • Color: White

• EutecTor® 1801 Flux	General Properties
Formulated for dissimilar metal brazing such as joining ferrous to non-ferrous metals. Excellent surface tension properties and "clear pool" visibility when used with poor clearance joints. * Use ExFlux 1005 followed by a hot water/ cold water rinse if acceptable to the end-user.	• Remove residues with hot water. • Synergistic formula for use with EutecRod 1801G • Active temperature range: 1060ºF to 1600ºF…570ºC to 870ºC • Form: Paste • Color: White

• EutecTor® 1865 Flux	General Properties
A special composition flux for high volume production brazing of ferrous & non-ferrous metals. Excellent for dissimilar metal brazing and for automotive tube manufacturing *(special application)*. * Use a hot water/ cold water rinse if acceptable to the end-user.	• Remove residues with hot water. • Production brazing flux with extended applications in tube welding, • Active temperature range: 1060ºF to 1600ºF…570ºC to 870ºC • Form: Paste • Color: White

• Castolin® 89870 Flux	General Properties
Used for high temperature applications and for brazing applications involving furnace fusing. The flux maintains its activity over extended brazing periods. Also useful for torch brazing when parts are subject to long heating cycles. * Use a hot water/ cold water rinse if acceptable to the end-user.	• Remove residues with hot water. • For extended-time brazing including furnace brazing. • Active temperature range: 1060ºF to 1700ºF…570ºC to 925ºC • Form: Paste • Color: Dark Brown

EutecTor Fluxes for use with Copper-Base Rods

• EutecTor® 16 Flux	General Properties
Specially formulated paste flux for improved wettability on low, medium, and high carbon steels, including selected tool steels. Excellent pool visibility with good build-up and free flowing properties. Particularly effective when used to braze the common brasses and bronzes. * Use a water bath to "shock off" the residues.	• Remove residues by shock*
	• Versatile flux for use with EutecRod 16 or, supplementary, with 16XFC
	• Active temperature range: 1400ºF to 2200ºF…760ºC to 1205ºC
	• Form: Paste
	• Color: White

• EutecTor® 16B Flux	General Properties
Similar applications to EutecTor 16 but more active. Particularly useful when brazing tool steels. Excellent pool visibility with good build-up and free flowing properties. Particularly effective when used to braze the common brasses and bronzes. * Use a water bath to "shock off" the residues.	• Remove residues by shock*
	• Versatile flux for use with EutecRod 16 or, supplementary, with 16XFC
	• Active temperature range: 1400ºF to 2200ºF…760ºC to 1205ºC
	• Form: Paste
	• Color: White
• EutecTor® 16D Flux	
Similar to EutecTor 16 but in powder form. Excellent for "application sprinkling".	• Form: Powder
	• Color: White

• Xuper® Flo Paste Flux	General Properties
High performance paste flux for improved wettability on low, medium, and high carbon steels, including selected tool steels. Excellent pool visibility with good build-up and free flowing properties. Particularly effective when used to braze the common brasses and bronzes. * Use a water bath to "shock off" the residues.	• Remove residues by shock*
	• Versatile flux for use with EutecRod 16 or, supplementary, with 16XFC
	• Active temperature range: 1400ºF to 2200ºF…760ºC to 1205ºC
	• Form: Paste
	• Color: White

Chemical Aids for Brazing

• **Anti Capillary Compound:** A special paint-on compound designed to confine the brazing and/or soldering alloy in the required joining zone.

• **ExFlux 1005 Flux Remover:** A highly effective chemical aid for removing stubborn residues. Will not attack the base metal.

• **Eutectic TinWeld Thinner** is a proprietary formulation for selectively thinning Eutectic TinWeld 2 Paste Solder.

CAUTION: Do Not Use On Aluminum or its Alloys

ANCILLIARY SUPPORT AIDS FOR GENERAL ACTIVITIES INVOLVING BRAZING, SOLDERING, WELDING & THERMAL SPRAYING

• **Eutectic Instant Hardener #75** is a cyanide-free hardening compound for case hardening tools, harrowing & furrowing farm implements, and case hardening soft materials such as mild steel for improved wear performance.

Preparation & Technique

Remove grease, rust & scale. Preheat part to a dull-red color (1400º-1600ºF) and dip and roll in Instant Hardener #75 for 30 seconds so that the part is completely coated. Re-heat surface to a dull-red for about one minute* then quench immediately in water. For deeper coatings repeat at one-minute intervals for 5 to 7 times. This will achieve an optimum hardness gradient and improved wear resistance.

Note: The holding time of one minute is necessary to develop the optimum hardness range.

• **Eutectic Eutecto-Masks:** A high-temperature compound for protecting critical surfaces from heat staining and spatter adhesion. Excellent as brazing "stop-off" compound.

• **Eutectic Solution 103:** A paint-on solution for use either as a brazing & soldering stop-off assist, or as an over-spray barrier when thermal spraying.

• **RotoGuard Sealer 1:** A paint-on sealer for thermal spray coatings. Produces a clear, deeply penetrating shield against possible corrosion agents…. See Sections 13 to 23 for more comprehensive information on Thermal Spray Coatings.

• **SealTec – LT Stick:** A deeply penetrating, non-toxic wax sealer. Recommended for sealing thermal coatings when the service temperature is below 190ºF. ...See Sections 13 to 23 for more comprehensive information on Thermal Spray Coatings.

SECTION 6 –LOW ALLOY STEEL PRODUCTS

Metal Notes

***Welding Outline**:* The welding of mild- and low-carbon, low-alloy steels can be considered to be fairly straightforward. Most of these steels are readily welded with as little preparation as reasonable, and an oil-free, rust-free surface. Most steels are non air-hardenable which means the heat affected zone (HAZ) will not become embrittled. Generally the only special requirement is for some minor level of preheat when parts are up to 1" thick or when the parts are below freezing…typically encountered when welding outside in winter.

• ***Hydrogen:*** Although low-alloy steels are not too sensitive; in general they are not immune from trouble if good welding practices are ignored. For example: Oil and grease are a prime source of hydrogen. When combined with moisture the result can be serious porosity. Make sure to degrease and that the electrodes are kept dry*!*

• ***Oxygen**:* Another source of porosity. Typically heavy mill scale or flaky rust will promote weld metal porosity when melted by the arc. Also, oxygen, if present in large quantities can lower weld metal ductility. Make sure to remove heavy scale and rust by grinding.

• ***Low Alloy Steel Grades:*** Most steels falling under the low alloy steel description are classified by the American Iron Steel Institute (AISI) and the Society of Automotive Engineers (SAE) which uses similar designations. The reference table below gives the AISI-SAE number and description. The first four classes are relevant to this Eutectic Product Section. The other steels classes will be reviewed in other sections of this Product Data Booklet, as they are generally high strength steels requiring more careful welding procedures and higher strength, higher alloy welding products.

• ***Steel Classes:*** In this classification the first two digits indicate the type of steel based on its main alloying element(s). The last two digits indicate the amount of carbon present in points. Here 100 points = 1%.

Ex.1: Class 1020 advises a plain carbon steel with 20 points or 0.020% of carbon.

AISI-SAE Low Alloy Steel Classifications		
Class	***Description***	***Product Section Guide***
10xx	*Plain carbon steels*	*Section 6*
11xx	*Re-sulphurized carbon steels*	*Section 6*
12xx	*Re-phosphorized/ re-sulphurized carbon steels*	*Section 6*
13xx	*Manganese steels*	*Section 6*
23xx	*Nickel steels*	*Section 7*
33xx	*Nickel-chromium steels*	*Section 7*
40xx	*Molybdenum steels*	*Section 7*
41xx	*Chromium-molybdenum steels*	*Section 7*
43xx	*Nickel chromium-molybdenum steels*	*Section 7*
51xx	*Chromium steels*	*Section 7*
61xx	*Chromium vanadium steels*	*Section 7*
86xx	*Nickel chromium molybdenum steels*	*Section 7*

Mild & Low Alloy Selection Table	
	Description
Product	***SMA EutecTrodes®***
BeautyWeld II	*Easy-to-use, All-position welding – spatter-free mild steel*
SteelTectic N	*For use on rusty and contaminated mild steels*
EutecTrode 66N	*Low-hydrogen welding of sulfur-bearing low alloy steels*
Xuper 66 XHD	*High crack resistance when used on low carbon steels*
EutecTrode 7018RS	*High performance AWS 7018 class electrode*
EutecTrode 6666	*Controlled low hydrogen ,bipheric coated electrode*
EutecTrode 777	*High speed deposition electrode with easy slag removal*
EutecTrode 9708QS	*For use where low hydrogen, impact properties are required*
EutecTrode Super 110	*Super high strength electrode for low-to-medium carbon steels*
▪ KEEP ELECTRODES DRY & PACKAGED WHEN NOT BEING USED!	
Product	***Metal Cored Wire - Solid Wire – Flux Core Wire***
*EnDOtec DO*66*	*Highest crack resistance with low hydrogen properties*
Mig-Tectic A88	*High quality solid wire for most plain carbon steels*
TeroMatec OA 2020	*High speed welding of construction carbon-manganese steels*
*EnDOtec DO*110*	*Similar applications to Super 110…higher welding speeds*
▪ RE-BAG WIRES AFTER USE TO PREVENT CONTAMINATION!	
Product	***Gas Tungsten-Arc (TIG) Rod***
TigTectic 66	*Quality joining & repair to critical steel & pipe fabrications*
▪ REPACK RODS AFTER USE TO MAINTAIN SURFACE CLEANLINESS!	
Product	***Braze Welding Rod***
EutecRod 3046 XFC	*Universal brazing rod for mild steels…excellent for galvanized steel brazing*
▪ REPACK TO PREVENT FLUX CHIPPING AND REDUCED PERFORMANCE!	

BEAUTYWELD® II

VERSATILE ALL-POSITION ELECTRODE FOR WELDING BOTH THIN GAUGE SHEET-METAL AND PLATE AND ANGULAR STEEL STOCK

General Applications

BeautyWeld II is an electrode with wide welder appeal. Arc-start and arc & weld pool control are superior to conventional so-called "mild steel" electrodes. Spatter is negligible and easily brushed off. Slag is readily detached and the resultant weld deposit is smooth and regular in contour with no under-cutting.

Applications

For high-speed welding of thin-gauge mild such as machine guards, tubular furniture, farming implements, steel railings, truck cabs and similar gauge fabrications.

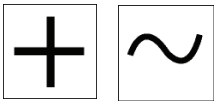
Technical Data				
	BeautyWeld II			
• Typical Tensile Strength	74,000 psi		517 N/mm^2	
• Typical Yield Strength	64,000 psi		441 N/mm^2	
• Typical Elongation (1=5d) min.	26%			
• Current & Polarity	DCEP (+) and AC			
• Diameters	1/16 – 1.6mm	3/32 - 2.4mm	1/8 - 3.2mm	5/32 - 4.0mm
• Amperage Range	40 - 55	65 - 85	80 - 125	100 - 150

Welding Procedure

Preparation: Clean weld area of scale and/or oxide. Angle prepping normally involves close-butts and infrequently bevel preparations. Preheating is generally not required when using BeautyWeld II as it is typically used with mild and plain-carbon steels. When welding thin gauge metal it is advisable to use chill-blocks or backing strips to reduce the chance of burn-through.

Technique: A "contact technique" is recommended for fillet welding and a reasonably small arc-gap for flat, bead-on-plate welding. Deposit stringer beads or 2x to 3x weave beads. Do not weave more than three times the electrode diameter otherwise slag interference will be encountered.

Post-welding: Allow parts to slow cool in still air.



STEELTECTIC® N

ALL-POSITION ELECTRODE FOR WELDING RUSTY, CONTAMINATED, AND HEAVILY MILL-SCALED STEELS

General Description

SteelTectic N has a deeply penetrating arc that effectively cuts through surface contamination. Arc control is easy which helps in "non-stop" welding. Because it can be used at very low amperage settings poor fit-up assemblies are easy to repair.

Application

Use for mild and plain carbon steels which cannot be effectively cleaned such as machine guards, farming equipment, galvanized parts, painted tanks, oil-contaminated steel housings, etc.

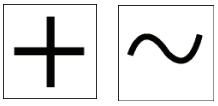
Technical Data			
	SteelTectic N		
• Typical Tensile Strength	70,000 psi	482 N/mm^2	
• Typical Yield Strength	61,000 psi	420 N/mm^2	
• Typical Elongation (1=5d) min.	25%		
• Current & Polarity	DCEP (+) and AC		
• Diameters	3/32 - 2.4mm	1/8 - 3.2mm	5/32 - 4.0mm
• Amperage Range	45 - 75	70 - 120	95 - 140

Welding Procedure

Preparation: Clean weld area of scale and/or oxide. Angle prepping normally involves close-butts and infrequently bevel preparations. Preheating is generally not required when using SteelTectic N as it is typically used with mild and plain-carbon steels. When welding parts that are contaminated with oil, grease, or paint, consider using the AirLux® 3000 Fume Eliminator…safety should always come first!

Technique: A "contact technique" is recommended for fillet welding and a reasonably small arc-gap for flat, bead-on-plate welding. Deposit stringer beads or 2x to 3x weave beads. Do not weave more than three times the electrode diameter otherwise slag interference will be encountered.

Post-welding: Allow parts to slow cool in still air.



EUTECTRODE® 66N
XUPER® 66XHD
EUTECTRODE® 7018RS

SPECIAL FEATURE, LOW-HYDROGEN ELECTRODES FOR APPLICATIONS REQUIRING CRACK-RESISTANT WELDS ON HIGH-SULFUR, HIGHER-CARBON STEELS

General Properties

• **EutecTrode 66N** is a welder-friendly electrode with excellent bead control and an easy-to-remove slag. Used for welding low-alloy & medium carbon steels, and free-machining, sulfur-bearing grades.

• **Xuper 66XHD** is a moisture-resistant electrode with high crack resistance. It is particularly suitable for out-of-position welding of both low-alloy & medium carbon steels subject to post-welding cool-down stressing.

• **EutecTrode 7018RS** meets the AWS specification A5.1 under the classification E7018. Use this electrode when a "low-hydrogen 7018 type" is required.

Applications

All three electrodes can be used on a wide variety of plain carbon and low-alloy steels. Such steel grades are typically encountered in the Mining, Construction, and Civil Engineering Industries. Applications would be heavy-duty equipment frames, chassis, truck bodies, ore cars, general fabrications, etc.

Technical Data

	EutecTrode 66N	Xuper 66XHD	EutecTrode 7018RS
• Typical Tensile Strength	80,000 psi (552 N/mm^2)	78,000 psi (538 N/mm^2)	76,000 psi (524 N/mm^2)
• Typical Yield Strength	67,000 psi (462 N/mm^2)	67,000 psi (462 N/mm^2)	65,000 psi (448 N/mm^2)
• Typical Elongation in 2 in. min.	23%	23%	22%
• Current & Polarity	DCEP (+) and AC		

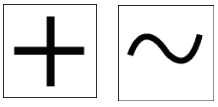
• Diameters	3/32-2.4mm	1/8-3.2mm	5/32-4.0mm	3/16-4.8mm
• Amperage Range	65-80	120-135	165-175	215-235

Note: Always keep electrodes in their container during storage. Damp electrodes can cause cracking & porosity. For re-drying procedures check with Technical Services.

Welding Procedure

Preparation: Clean weld area of scale and/or oxide. Bevel or chamfer heavy sections to have either a single or double 60º "V" prep. A nominal preheat of 150ºF is advised if part is below 40ºF or over 1" thick. For higher carbon steels higher preheats will be needed.

Technique: All low-hydrogen electrodes should be used with a non-contact, short arc-gap technique. An arc start-block is recommended to prevent starting porosity. Deposit stringer beads or 2 times to 3 times weave beads.



EUTECTRODE® 6666

SUPERIOR LOW HYDROGEN ELECTRODE WITH OUTSTANDING WELDABILITY ON AC & DC WELDERS.
PROTECTED WITH "MOISTURE GUARD" TO PREVENT HYDROGEN EMBRITLEMENT & CRACKING

General Properties

• **EutecTrode 6666** is a welder-friendly electrode with excellent all-position weldability. Its non-conductive coating prevents side arcing and strike & re-strike is a benchmark property. There is virtually no spatter or slag-drip when welding out-of-position.

Applications

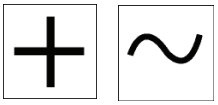
Can be used on a wide range of steel grades typically encountered in the Mining, Construction, and Civil Engineering Industries. Applications would be heavy-duty equipment frames, chassis, truck bodies, ore cars, and general fabrications.

Technical Data				
	EutecTrode 6666			
• Typical Tensile Strength	82,000 psi		565 N/mm^2	
• Typical Yield Strength	67,000 psi		462 N/mm^2	
• Typical Elongation in 2 in. min.	25%			
• Typical Impact Properties	100 ft-lbs 70ºF	59 ft-lbs -5ºF	34 ft-lbs -75º	
(ISO-V) (J)	140 J @ 20ºC	80 J @ -20ºC	>47 J @ -60ºC	
• Current & Polarity	DCEP (+) and AC			
• Diameters	3/32 2.4mm	1/8 3.2mm	5/32 4.0mm	3/16 4.8mm
• Amperage Range	65-80	120-135	165-175	215-235
Note: Always keep electrodes in their container during storage. Damp electrodes can cause cracking & porosity. For re-drying procedures check with Technical Services.				

Welding Procedure

Preparation: Clean weld area of scale and/or oxide. Bevel or chamfer heavy sections to have either a single or double 60º "V" prep. A nominal preheat of 150ºF is advised if part is below 40ºF or over 1" thick. For higher carbon steels higher preheats will be needed.

Technique: All low-hydrogen electrodes should be used with a non-contact, short arc-gap technique. An arc start-block is recommended to prevent starting porosity. Deposit stringer beads or 2x to 3x weave beads.



EUTECTRODE® 777

A HIGH DEPOSITION ELECTRODE FOR RAPID CONTACT WELDING IN THE FLAT AND HORIZOTAL POSITIONS

General Properties

EutecTrode 777 is especially suited for high productivity welding in the down-hand position. Contact welding makes it easy to maintain optimum bead profile. Slag is generally self-releasing and weld deposits are smooth and regular.

Applications

For structural steel fabrications involving H-beams, thick cross-sectional angle-bars and flat-stock steel of various thickness e.g. machine frames, truck frames & bodies, earthmoving equipment fabrications, cast steel engine blocks, water tanks, steel housings, etc.

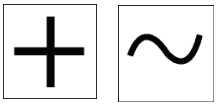
Technical Data			
	EutecTrode 777		
• Typical Tensile Strength	78,000 psi	538 N/mm^2	
• Typical Yield Strength	69,000 psi	476 N/mm^2	
• Typical Elongation (1=5d) min.	22%		
• Current & Polarity	DCEP (+) and AC		
• Diameters	3/32 - 2.4mm	1/8 - 3.2mm	5/32 - 4.0mm
• Amperage Range	80-110	130-170	180-230

Welding Procedure

Preparation: Clean weld area of scale and/or oxide. Bevel or chamfer heavy sections to have either a single or double 60º "V" prep. A nominal preheat of 150ºF is advised if part is below 40ºF or over 1" thick. For higher carbon steels higher preheats will be needed. Check the Reference Section for information regarding specific preheating levels for specific steel grades.

Technique: A "contact technique" is recommended for fillet welding and a reasonably small arc-gap for flat, bead-on-plate welding. Deposit stringer beads or 2x to 3x weave beads. Do not weave more than three times the electrode diameter otherwise slag interference will be encountered.

Post-welding: Allow parts to slow cool in still air.



EUTECTRODE® 9708QS

A PREMIUM LOW HYDROGEN ELECTRODE WITH IMPROVED IMPACT AND ARC-START PROPERTIES

General Description

EutecTrode 9708QS is a "quick-start" electrode for porous-free arc starting on plain carbon and low-to-medium carbon steels. Because of its improved impact properties and resultant increase in crack resistance, it can readily substitute for bulk low-hydrogen electrodes. Meets the AWS Specification A5.1 under class. E7018-1.

Applications

Use when welding constructional steels where improved crack-resistance is important. Fabrication & repair shops undertaking tank building, welding low-to medium carbon steels used in earthmoving equipment, farming implements, steel-mill ore cars, etc.

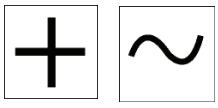
Technical Data			
	EutecTrode 9708QS		
• Typical Tensile Strength	81,000 psi	558 N/mm^2	
• Typical Yield Strength	72,000 psi	496 N/mm^2	
• Typical Elongation (1=5d) min.	25%		
• Typical Impact Strength	Minimum Charpy V-notch @-40ºF: 20 ft-lb		
• Current & Polarity	DCEP (+) and AC		
• Diameters	3/32 - 2.4mm	1/8 - 3.2mm	5/32 - 4.0mm
• Amperage Range	60-100	110-145	140-210
Note: Always keep electrodes in their container during storage. Damp electrodes can cause cracking & porosity. For re-drying procedures check with Technical Services.			

Welding Procedure

Preparation: Clean weld area of scale and/or oxide. Bevel or chamfer heavy sections to have either a single or double 60º "V" prep. A nominal preheat of 150ºF is advised if part is below 40ºF or over 1" thick. For higher carbon steels higher preheats will be needed. Check the Reference Section for information regarding specific preheating levels for specific steel grades.

Technique: All low-hydrogen electrodes should be used with a non-contact, short arc-gap technique. Deposit stringer beads or 2x to 3x weave beads. Back whip craters to reduce crater cracking tendencies. When de-slagging make sure to thoroughly remove slag at the weld deposit toes.

Post-welding: Allow parts to slow cool in still air. High carbon steels should covered with a heat-retardant blanket.



ENDOTEC® DO*66

A SUPERIOR STRENGTH, TOUGHNESS & DUCTILITY CORED WIRE FOR WELDING PLAIN CARBON, AND LOW-TO-MEDIUM ALLOY STEELS

General Properties

EnDOtec DO*66 is a premier, low-hydrogen joining wire with outstanding mechanical properties. Weld deposits ensure maximum resistance to potential hydrogen embrittlement problems. DO*66 is typically used in critical applications where a high degree of weld deposit soundness is mandated. Excellent for either thin or thick sections. Can be used in all positions.

Applications

For general fabrications including steel tanks, machinery construction, mining and earthmoving equipment, railcar repairs, and most plain carbon steel assemblies. Use with HSLA steels such as Cor-Ten™ and USS T-1™.

Technical Data						
		EnDOtec DO*66				
• Typical Tensile Strength		85,000 psi		586 N/mm^2		
• Typical Yield Strength		73,000 psi		503 N/mm^2		
• Typical Elongation (1=5d)		26%				
• Typical Impact Strength		Charpy V-notch. 35 ft-lb @ -50ºF				
• Guideline Parameters – DCEP+		A) 0.035 (0.9mm)		B) 0.045 (1.2mm)		C) 1/16 (1.6mm)
Arc Mode		Amp Range	Volt Range	Stick-out	Shield Gas	Flow-scfh
A	Spray	160-210	25-29	5/8 ± 1/8	75Ar + CO_2	35
A	Short-arc	70-140	18-21	1/2 ± 1/8	CO_2	30
B	Spray	210-270	25-29	5/8 ± 1/8	75Ar + CO_2	40
B	Short-arc	140-210	17-20	9/16 ± 1/16	CO_2	35
C	Spray	220-285	26-30	5/8 ± 1/8	75Ar + CO_2	35
C	Short-arc	160-210	17-21	9/16 ± 1/16	CO_2	30

Welding Procedure

Preparation: Clean weld area of scale and/or oxide. Bevel or chamfer heavy sections to have either a single or double 60º "V" prep. Check that the ground clamp is secure and in contact with a clean surface. A nominal preheat of 150ºF is advised if the part is below 40ºF or over 1" thick. Note: Higher carbon steels require higher preheats.

*Information on preheating levels for different steel grades is given in the Reference Section.

Technique: Make that the contact tip, gas diffuser, gas cup, & wire-drive rolls are suitable for the wire diameter and arc mode. Make a few practice runs to refine and optimize the Guideline Parameters.

Post-welding: Allow parts to slow cool in still air.

MIGTECTIC® A88

A SOLID SMOOTH DRAWN WIRE FOR GAS METAL ARC WELDING OF THIN GAUGE PLAIN CARBON STEELS

General Properties

Eutectic A88 is formulated for single and multi-pass welding of mild & plain carbon steels. Wire uniformity assures smooth deposits on sheet metal and light gauge plate. Can be used for out-of-position short-arc welding.

Applications

For general purpose sheet metal welding such as truck bodies, angle-bar & tube fit-up fabrications, farm implements, car body repairs, and other light gauge work.

Technical Data						
		MigTectic A88				
• Typical Tensile Strength		72,000 psi		496 N/mm^2		
• Typical Yield Strength		62,000 psi		427 N/mm^2		
• Typical Elongation (1=5d)		22%				
• Typical Impact Strength		Minimum Charpy V-notch @-20ºF: 22 ft-lb				
• Guideline Parameters – DCEP						
Arc Mode		Amp Range	Volt Range	Stick-out	Shield Gas	Flow-scfh
A	Spray	130-230	24-28	3/8 ± 1/8	98Ar + 2 %O_2	40
A	Short-arc	120-160	19-23	5/8 ± 1/8	75Ar + 25% CO_2	35
A	Short-arc	110-150	19-23	5/8 ± 1/8	CO_2	30
Note: Carbon dioxide shielding gas can be used instead of the 98%Ar + 25% CO_2 gas mixture. However, with 100% CO_2 the arc mode will be globular.						

Welding Procedure

Preparation: Clean weld area of scale and/or oxide. Check that the ground clamp is secure and in contact with a clean surface. Make sure all joints on thin gauge metals are tightly abutted with no gaps. Note: Backing strips are useful in preventing burn-through.

Technique: Make that the contact tip, gas diffuser, gas cup, & wire-drive rolls are suitable for the wire diameter and arc mode. Make a few practice runs to refine and optimize the Guideline Parameters.

Post-welding: Allow parts to slow cool in still air.

TEROMATEC® OA 2020

A FLUX-CORED OPEN-ARC WIRE FOR RAPID JOINING AND BUILD-UP ON LOW CARBON AND LOW ALLOY STEELS

General Description

Eutectic OA2020 is designed for open-arc welding of most constructional steels. It can be used for either single-pass or multi-pass welding applications. The arc is smooth and readily controlled. Fillet welds are slightly convex and have complete slag coverage for improved de-slagging. Excellent for poor fit-up assemblies.

Applications

A key-choice alloy for both fabrication and repair welding of construction and mining equipment. Frequently used for welding tank fabrications, ship's decking, farm implements, quarry equipment, truck bodies, etc.

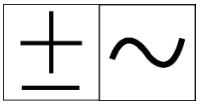
Technical Data		
	TeroMatec OA2020	
• Typical Tensile Strength	87,000 psi	600 N/mm^2
• Typical Yield Strength	62,000 psi	427 N/mm^2
• Typical Elongation (1=5d) min.	25%	
• Current & Polarity*	Flux Cored-arc Welding…DCEP (+)	
• Diameters	1/16 – 1.6mm	3/32 – 2.4mm
• Amperage Range	150-190	200-375
• Voltage range	15-22	26-30
• Electrode Stick-out (in)	1/2 ± 1/8	2½ ± ¼
* Eutectic OA2020 x 1/16 should be used with DCEN (-) polarity.		

Welding Procedure

Preparation: Clean weld area of scale and/or oxide. Check that the ground clamp is secure and in contact with a clean surface.

Technique: Make that the contact tip is the short-version which is typically used when welding in the open-arc mode, and that the gun cup and wire-drive rolls are suitable for cored-wire electrodes. Make a few practice runs to refine and optimize the Guideline Parameters. Note that deposition rates can be increased by using slightly longer stick-outs than those given in the Parameter Guideline.

Post-welding: Allow parts to slow cool in still air.



TIGTECTIC® 66

HIGH QUALITY GMA ROD WITH SURACE PROTECTION FOR GUARANTEED PERORMANCE WHEN USED TO WELD LOW-TO-MEDUM CARBON AND LOW-ALY STEELS

General Properties

TigTectic 66 is a companion product to EutecTrode 66N with similar mechanical properties. An ultra-clean weld pool enables the welder to maintain optimum control during critical pipe-joint welding and thin gauge material.

Applications

Typical applications involve medium pressure pipeline welding, railcar and auto body repairs, tank fabrications, pipe flanges, frame assemblies, etc.

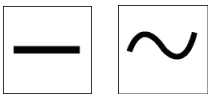
Technical Data			
	TigTectic 66		
• Typical Tensile Strength	75,000 psi	517 N/mm^2	
• Typical Yield Strength	61,000 psi	420 N/mm^2	
• Typical Elongation (1=5d) min.	25%		
• Current & Polarity	DCEN (-) or AC		
• Shielding Gas & Flows	Pure argon @ 20 cfh.		
• Tungsten Electrode-Type & Size	1% or 2% Thoriated…size will depend on part thickness		
• Diameters	1/16-1.6mm	3/32-2.4mm	1/8-3.2mm
• Amperage Range	80-100	90-120	105-150

Welding Procedure

Preparation: Clean weld area of scale and oxide. Remove grease & oil by using a suitable VOC-free solvent. Grind a lengthwise taper on the tungsten electrode and set so that about 1/8-in of the electrode protrudes passed the gas cup edge. Preheating is generally not needed when welding low- to medium carbon-manganese steels.

Technique: Start the arc by using impulse high-frequency or by using a copper start-block. Do not use a carbon block as this will contaminate the weld deposit! Deposit stringer beads. Do not weave more than 2x as wide beads can cause distortion.

Post-welding: Allow to cool.



EUTECROD® 3046 XFC

HIGHLY ACTIVE & SPECIALLY FORMULATED TO BRAZE-WELD PLAIN CARBON STEELS AS WELL AS GRAY CAST IRONS AND YELLOW & RED BRASSES,

General Properties

EutecRod 3046 XFC was formulated to have a highly active flux to facilitate oxide removal, particularly adherent oxides. Pool-glare is minimal which helps to reduce eye fatigue. Excellent wetting properties on high-zinc brasses.

Applications

Both alloys are versatile, general-purpose brazing rods for use with oxy-fuel systems. Use when braze-welding brass piping, copper-base plumbing fixtures, thin-walled steel assemblies and cast malleable flanges.

Technical Data	
	EutecRod 3046 XFC
• Typical Tensile Strength	65,000 psi…448 N/mm^2
• Typical Hardness (HRB)	80
• Color Match Properties	Deposits are yellow
• Bonding Temperature	1600º to 1650ºF (870º C – 899º C)
• Preheating	400º to 800ºF (200º C – 426º C)
• Torch	High capacity oxy-fuel torch with optimized BTU's

Braze Welding Procedure

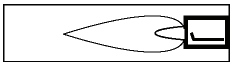
Preparation: Clean joint and/or broken parts. Bevel cracks either by pneumatic chiseling or by grinding. Note: When grinding cast iron make sure not to "color" the surface which indicates overheating and potential hard-spotting. Align parts and preheat to a recommended 400º to 600ºF temperature-range for brass parts and 800ºF for castings.

Technique: See Section 2 for the recommended technique for cast iron.
Apply a small amount of supplemental flux EutecTor 16B if the joint is long or if the preparation involves a bevel. Apply filler metal using a continuous "drop-and-melt" technique moving the torch from side-to-side to control the bead width. Continue until the joint is slightly overfilled.

Notes

1) Any excess "glassy" flux residue can be readily removed after the part has cooled down by light scraping.
2) Excessively overheating copper-base alloys and/or using excess flux can make the flux residue difficult to remove.

Post-brazing: Allow the brazed casting to slow-cool either by covering in vermiculite, wrapping in a heat-retardant blanket, or by burying in lime.



EUTECTRODE® SUPER 110 & ENDOTEC® DO*110

A PREMIUM, HIGH STRENGTH LOW HYDROGEN PRODUCTS WITH ADVANCED IMPACT RESISTANT PROPERTIES

General Description

EutecTrode Super 110 is formulated for welding critically stressed fabrications where high impact properties are needed and where the weldment is under severe restraint. Used with low-to-medium carbon steels and low HSLA steels of similar strength.EnDOtec DO*110 is the cored wire version with versatile out-of-position welding properties.

Applications

Use when welding constructional steels where advanced crack-resistance is critically important. Fabrication & repair shops undertaking tank building, welding low-to medium carbon steels used in earthmoving and construction equipment, steel-mill ore cars, etc.

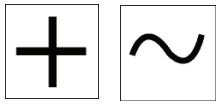
Technical Data						
	EutecTrode Super 110			EnDOtec DO*110		
• Typical Tensile Strength	110,000 psi	759 N/mm^2		110,000 psi	759 N/mm^2	
• Typical Yield Strength	98,000 psi	676 N/mm^2		100,000 psi	689 N/mm^2	
• Typical Elongation (1=5d) min.	23-25%					
• Typical Impact Strength	Minimum Charpy V-notch @-60ºF: 45-60 ft-lb					
• Current & Polarity	**Super 110: DCEP (+) and AC**					
• Diameters	1/8 – 3.2 mm		5/32 – 4.0 mm		3/16 - 4.8 mm	
• Amperage Range	60-100		110-145		140-210	
	EnDotec DO*100: DCEP (+) x 1/16" (1.6 mm)					
Arc Mode	Amp Range	Volt Range	Stick-out	Shield Gas	Flow-scfh	
Spray	220-285	26-30	5/8 ± 1/8	75Ar + CO_2	35	
Short-arc	160-210	17-21	9/16 ± 1/16	CO_2	30	

Welding Procedure

Preparation: Clean weld area of scale and/or oxide. Bevel or chamfer heavy sections to have either a single or double 60º "V" prep. A nominal preheat of 150ºF is advised if part is below 40ºF or over 1" thick. For higher carbon steels higher preheats will be needed. Check the Reference Section for information regarding specific preheating levels for specific steel grades.

Technique: All low-hydrogen electrodes should be used with a non-contact, short arc-gap technique. Deposit stringer beads or 2x to 3x weave beads. Back whip craters to reduce crater cracking tendencies. When de-slagging make sure to thoroughly remove slag at the weld deposit toes.

Post-welding: Allow parts to slow cool in still air. High carbon steels should covered with a heat-retardant blanket.



SECTION 7 – HIGH ALLOY STEEL PRODUCTS

Metal Notes

What is a High Alloy? The term "high alloy" when used to describe the products in this section can also be described by the term "high strength". High strength-high alloy electrodes, then, are broadly used to weld the high-strength low-alloy steels covered by the following AISI-SAE grades.

23xx	*Nickel steels*
33xx	*Nickel-chromium steels*
40xx	*Molybdenum steels*
41xx	*Chromium-molybdenum steels*
43xx	*Nickel chromium-molybdenum steels*
51xx	*Chromium steels*
61xx	*Chromium vanadium steels*
86xx	*Nickel chromium molybdenum steels*

• In Maintenance & Repair Welding the composition and mechanical properties of the repair electrode are the key elements that measure the fitness and usefulness of the selected alloy. In repair situations the three most important mechanical properties are:
• ***Tensile Strength***…often abbreviated 'UTS". The **U**ltimate **T**ensile **S**trength of a weld deposit is a measure of its resistance forces tending to tear it apart. It is the maximum tension the weld deposit can undergo without tearing. The values used to measure UTS are:

> • ***PSI*** *(pounds force per square inch)…most often written psi or ksi (= 1000 psi)*
> • ***N/mm²*** *(Newtons per mm²)…is the norm in the European Common Market countries and is most often seen in foreign publications. Ex.: 1000 psi = 7 N/mm²*

• ***Yield Strength***...this is sometimes referred as the 'yield point' of a metal which is a metal's resistance to breaking while being stretched. As a general rule the yield strength can be thought off as the same as the elastic limit which is the maximum stress a metal can support without permanent deformation. The values used to express the yield strength of a weld deposit are the same as those used when measuring tensile strength. You will also see the term 'Yield Strength @ 0.2% offset. min.'. All this means is that when a welded sample is tested under tension, the pulling force needed to produce 0.2% permanent deformation, or offset is, for all practical purpose the yield strength.

• ***Elongation…*** is simply the measurement of a metal's ductility or its property of being stretched and permanently deformed without breaking or fracturing. It is typically expressed as a percentage and is based on the stretched distance increase between two points originally set-off at two inches.
Example: During tensile testing a sample is stretched until it breaks. The two broken parts are then brought together and the length between the two gauge points is measured. It is found that the length is now 2.8 inches. Dividing the difference by 2 gives an elongation of 40% which would be written as: '40% Elongation in 2-in. minimum.

EUTECTIC HIGH PRODUCT PROPERTY MATRIX - TYPICAL VALUES

Product	Ultimate Tensile Strength	Yield Strength	Elong. in 2-in.
EutecTrode 670E	95,000 psi	65,000 psi	25%
EutecTrode 680	120,000 psi	79,000 psi	25%
Xuper 680 CGS	120,000 psi	79,000 psi	25%
EutecTrode 3026N	120,000 psi	85,000 psi	25%
EutecTrode 4026N	120,000 psi	85,000 psi	25%
EutecTrode 6800	85,000 psi	68,000 psi	26%
Xuper 6868 XHD	115,000 psi	85,000 psi	24%
EnDOtec DO*68S	110,000 psi	87,000 psi	26%
MigTectic 6800	85,000 psi	68,000 psi	26%
TeroMatec OA 688	105,000 psi	84,000 psi	26%
TeroMatec OA 690	105,000 psi	83,000 psi	27%
TigTectic 670	90,000 psi	62,000 psi	43%
TigTectic 680	120,000 psi	79,000 psi	25%
TigTectic 6800	85,000 psi	68,000 psi	26%
EutecRod 16	100,000 psi	N/A	N/A
Xuper 16 XFC	100,000 psi	N/A	N/A

• ***Keep in Mind***...that the terms 'high-alloy' & 'high-strength' are being used interchangeably. However, many Maintenance & Repair application steels can be low in alloy content but have very high mechanical properties. Steels which fall in to this group are known as 'HSLA' steels standing for **H**igh **S**trength **L**ow **A**lloy steels[1]. Here, one can include the Chromium-Molybdenum steels that also have very high-strength properties[2].

1) ***HSLA steels*** are widely used in fabrication of earthmoving, construction, and mining equipment. They are also used in heavy-duty processing machinery.

2) ***Chrom-moly steels*** are frequently welded with high-alloy, high-strength alloys but more typically are welded with matching filler metals. Such steels see use in power plants, oil & gas processing plants, and occasionally in heavy-duty mining equipment.

The 'Three Rules'

Rule No.1: Control the heat input.
Rule No. 2: Control preheat & weld inter-pass temperatures.
Rule No. 3: Control the rate of cooling.

3) Rules 1-3 make up what is known as an '**A**pplication **P**rocedure **C**ontrol'. For critical applications consult Technical Services for a suitable APC.

4) ***Gas Contamination…***when welding any high-strength steel it is very important to prevent contamination from hydrogen[A], nitrogen[B] , and oxygen[C].

A) ***Hydrogen:*** When absorbed can cause immediate cracking, or worse, time-delayed cracking, particularly if the part is stressed.

B) ***Nitrogen:*** When absorbed, can cause brittle iron nitrides to form. When present these can act as stress-points as well as reduce toughness.

C) ***Oxygen:*** Is a potent porosity former that critically affects both base metal & weld-metal integrity.

High Alloy Product Selection Table	
	Description
Product	**SMA EutecTrodes®**
EutecTrode 670E	*For welding stainless steels when the composition is unknown*
EutecTrode 680	*Optimum crack resistance when welding dissimilar steels*
Xuper 680 CGS	*Best weldability for tool steels & high alloy steel welding*
EutecTrode 3026N	*Ideal electrode for welding dissimilar steel combinations*
EutecTrode 4026N	*Good choice electrode when welding manganese steels*
EutecTrode 6800	*Use when corrosion resistance is needed for nitric acid mixes*
Xuper 6868 XHD	*Ultra-fast high deposition electrode for joining & underlayers*
▪ KEEP ELECTRODES DRY & PACKAGED WHEN NOT BEING USED!	
Product	**Metal Cored Wire - Solid Wire – Flux Core Wire**
EnDOtec DO*68S	*For joining hard-to-weld steels & dissimilar steel*
MigTectic 6800	*Special corrosion resistance alloy for nickel-base alloys*
TeroMatec OA 688	*High deposition wire for high speed joining & overlaying*
TeroMatec OA 690	*Joining and build-up wire for Mn steels & constructional steels*
▪ RE-BAG WIRES AFTER USE TO PREVENT CONTAMINATION!	
Product	**Gas Tungsten-Arc (TIG) Rod**
TigTectic 670	*For welding crack-sensitive steels & stainless steels*
TigTectic 680	*For critical repairs to dissimilar alloy steels & tool/die steels*
TigTectic 6800	*Special corrosion resistance alloy for nickel-base alloys*
▪ REPACK RODS AFTER USE TO MAINTAIN SURFACE CLEANLINESS!	
Product	**Braze Welding Rod**
EutecRod 16	*A high strength bronze alloy with nickel additions (bare rod)*
Xuper 16 XFC	*Flux coated version with low-glare properties*
▪ REPACK TO PREVENT FLUX CHIPPING AND REDUCED PERFORMANCE!	

EUTECTRODE® 670E

A HIGH ALLOY CONTENT ELECTRODE FOR WELDING STEELS OF UNKNOWN COMPOSITION AND FOR DISSIMILAR STEELS

General Properties

EutecTrode 670E has been specially formulated to meet the critical metallurgical demands when joining steels of unknown composition. Its composition also makes it an ideal candidate product when welding dissimilar steels and when such steels need scaling resistance up to 1800ºF.

Applications

Use in marine applications such as salt-water discharge pumps, desalination equipment, furnace baskets that work in both carburizing and reducing environments, salt baths used in drawing & tempering operations, etc.

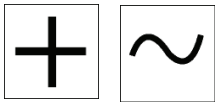
Technical Data			
	EutecTrode 670E		
• Typical Tensile Strength	95,000 psi	655 N/mm^2	
• Typical Yield Strength	65,000 psi	448 N/mm^2	
• Typical Elongation (1=5d) min.	25%		
• Hardness as-deposited (HRB)	85		
• Maximum Temperature	1800ºF steady-state		
• Current & Polarity	DCEP (+) and AC		
• Diameters	3/32 - 2.4mm	1/8 - 3.2mm	5/32 - 4.0mm
• Amperage Range	50 - 70	70 – 110	----------
Note: When using Eutectic 670E keep to the low-end of the amperage range for optimized results.			

Welding Procedure

Preparation: Clean weld area of scale and/or oxide. Angle prepping normally involves close-butts and infrequently bevel preparations. If needed, a 60º bevel is acceptable. Preheat & inter-pass temperatures will depend on the grade of steel, if known. Unknown grades should be nominally preheated within a 400-500ºF range.

Technique: A short, non-contact technique is recommended for both fillet and butt welding. Use a slightly longer arc-length for bead-on-plate welding. Deposit stringer beads or 2x to 3x weave beads. Do not weave more than three times the electrode diameter otherwise slag interference will be encountered.

Post-welding: Parts which have been preheated should be wrapped or covered with heat – retardant material to help with slow cooling.



EUTECTRODE® 680
XUPER® 680 CGS

SPECIALLY FORMULATED HIGH-ALLOY ELECTRODES FOR WELDING 'PROBLEM' STEELS WHICH NEED HIGH INTEGRITY, SAFETY, AND WELDER-FRIENDLY USEABILITY

General Properties

• **EutecTrode 680** mechanical properties are maximized for use on all difficult-to-weld steels. Weld deposits have superior crack-resistance even when welding dissimilar steels and making repairs to critical components.

• **Xuper 680 CGS** has similar mechanical properties but has a flux formulation designed to optimize weld deposit appearance…a feature-demand typically required when welding Tools & Dies.

Applications

The combined application range is broad: From jigs, molds, dies, leaf springs, high-strength repairs to earthmoving, mining, and constructional equipment…chassis, under-carriage repairs, composite die fabrications, manganese steel components, etc.

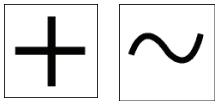
Technical Data					
		EutecTrode 680 & Xuper 680 CGS*			
• Typical Tensile Strength		120,000 psi	827 N/mm^2		
• Typical Yield Strength		79,000 psi	545 N/mm^2		
• Typical Elongation (1=5d) min.		25%			
• Hardness as-deposited (HRB)		90			
• Maximum Temperature		800ºF steady-state			
• Current & Polarity		DCEP (+) and AC			
• Diameters	1/16-1.6mm	3/32-2.4mm	1/8-3.2mm	5/32-4.0mm	3/16-4.8mm
• Amperage Range	----------	55-70	75-95	90-115	135-190
5/64-2.0mm 35-50	25-40*	45-60*	70-90*	85-110*	----------

Welding Procedure

Preparation: Clean weld area of scale and/or oxide. Angle prepping normally involves close-butts and infrequently bevel preparations. If needed, a 60º bevel is acceptable. Preheat & inter-pass temperatures will depend on the grade of steel, if known. Unknown grades should be nominally preheated within a 400-500ºF range. For steels of known composition check the preheat/Inter-pass reference in the Reference Section.

Technique: A short, non-contact technique is recommended for both fillet and butt-welding. Use a slightly longer arc-length for bead-on-plate welding. Deposit stringer beads or 2x to 3x weave beads. Do not weave more than three times the electrode diameter otherwise slag interference will be encountered.

Post-welding: Parts which have been preheated should be wrapped or covered with heat –retardant material to slow cool parts…critical for Tools & Dies



EUTECTRODE® 3026N
EUTECRODE® 4026N

A HIGH-STRENGTH COMBAT ALLOYS FOR WELDING DISSIMILAR STEEL COMBINATIONS & HADFIELD MANGANESE CASTINGS

General Properties

Both EutecTrode 3026N and 4026N deposit a two-phase microstructure which imparts very high resistance to cracking, particularly when diluted. Strike and restrike properties are excellent, and deposits are readily de-slagged. Deposits exhibit smooth regular bead contours free from undercutting which minimizes any post-welding work or machining.

Applications

Attaching wear strips, welding broken leaf-springs, bucket-lip teeth inserts, scraper blades, gear tooth facing, dissimilar steel welding e.g. welding manganese steel to high-strength low-alloy steels.

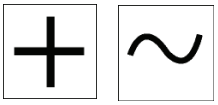
Technical Data				
	Eutectic 3026N			
• Typical Tensile Strength	120,000 psi		827 N/mm^2	
• Typical Yield Strength	79,000 psi		545 N/mm^2	
• Typical Elongation (1=5d) min.	25%			
• Hardness as-deposited (HRB)	90			
• Maximum Temperature	800ºF steady-state			
• Current & Polarity	DCEP (+) and AC			
• Diameters	3/32-2.4mm	1/8-3.2mm	5/32-4.0mm	3/16-4.8mm
• Amperage Range	55-70	75-95	----------	----------

Welding Procedure

Preparation: Clean weld area of scale and/or oxide. Angle prepping normally involves close-butts and/or bevel preparations. If a joint preparation is needed, a 60º bevel is acceptable. Preheat & inter-pass temperatures will depend on the grade of steel, if known. Unknown grades should be nominally preheated within a 400-500ºF range.

Technique: A short, non-contact technique is recommended for both fillet and butt welding. Use a slightly longer arc-length for bead-on-plate welding. Deposit stringer beads or 2x to 3x weave beads. Do not weave more than three times the electrode diameter otherwise slag interference will be encountered.

Post-welding: Parts which have been preheated should be wrapped or covered with heat –retardant material to help with slow cooling



EUTECTRODE® 6800, MIGTECTIC® 6800 & TIGTECTIC® 6800

ALL THREE PRODUCT VERSIONS USE THE SAME SPECIAL FORMULATION WHEN WELDING & OVERLAYING FOR ENHANCED CORROSION OXIDATION RESISTANCE

General Properties

This trio of key application products deposit weld metal high in corrosion resistance to nitric acid and chloride-containing solutions. Excellent high-temperature oxidation resistance up to1800ºF. Deposits exhibit smooth regular bead contours free from undercutting and with easy-to-remove slag when using EutecTrode 6800.

Applications

Superior properties when welding hot working blocker dies, die rings, pump vanes, shear blades, trim tools, pickling & plating tanks, pressure valves, press punches, etc.

Technical Data			
	EutecTrode 6800 – MigTectic 6800 – TigTectic 6800		
• Typical Tensile Strength	85,000 psi	827 N/mm^2	
• Typical Yield Strength	65,000 psi	545 N/mm^2	
• Typical Elongation (1=5d) min.	30%		
• Hardness as-deposited (HRB)	210-work hardens in service		
• Maximum Temperature	800ºF steady-state		
• Current & Polarity	DCEP (+) & AC	DCEP (+)	DCEN (-)
• Diameters	3/32…2.4 mm 1/8…3.2 mm 5/32…4.0 mm	0.045…1.2 mm	1/16…1.6 mm 3/32…2.4 mm
• Amperage Ranges	65-75 75-100 115-135	75-100 Argon Shielding 30-35 scfh	70-110 90-130 Argon Shielding

Welding Procedure

Preparation: Clean joint and/or broken parts. Lightly bevel cracks by grinding. Note: The selection of the preferred thoriated or lanthium tungsten electrode diameter will depend on the material thickness and corresponding amperage range. This applies similarly to gas cup size. Note: Make sure that the tip of the electrode is ground with the proper taper for better heat localization. Preheating is normally not required when welding high nickel alloys. For tool steel welding refer to the Reference Section for recommended preheat & inter-pass temperatures.

Technique (GMAW & GTAW): Adjust argon shielding gas flow. Complex or large parts should be supported by jigs. Use a copper arc-starting block to prevent random arc strikes and consequential hard- spotting. Adjust the stand-off distance so that the molten pool is always protected by the shielding gas and allow the rod/wire-end to solidify before removing from the protective gas envelope.

Post-welding: For air-hardening steels slow cool using available insulating materials. For less-sensitive base metals, slow cool out of drafts.

XUPER® 6868 XHD

ULTRA-FAST, HIGH-STRENGTH, HIGH DEPOSITION ELECTRODE FOR JOINING & CLADDING MOST COMMON INDUSTRIAL STEELS

General Properties

Xuper 6868 XHD is uniquely formulated for both high-strength joining of low-to-medium carbon steels and for surface cladding prior to hardfacing. Weld deposits are tough and crack-resistant and well not spall under repeated impacts. Electrode does not overheat at the recommended amperage settings.

Applications

Auger re-builds, mold repairs, coal washing screens, high-speed welding of wear plates, journal boxes hydraulic cylinders, manganese steel bucket lips, latch-bar repairs, etc.

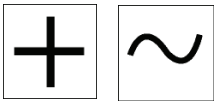
Technical Data					
		Xuper 6868 XHD			
• Typical Tensile Strength		115,000 psi		793 N/mm^2	
• Typical Yield Strength		85,000 psi		586 N/mm^2	
• Typical Elongation (1=5d) min.		24%			
• Hardness as-deposited (HRB)		90			
• Maximum Temperature		800ºF steady-state			
• Current & Polarity		DCEP (+) and AC			
• Diameters	1/16-1.6mm	5/64-2.0mm	3/32-2.4mm	1/8-3.2mm	5/32-4.0mm
• Amperage Range	40-60	60-70	70-85	90-120	125-155

Welding Procedure

Preparation: Clean weld area of scale and/or oxide. Angle prepping normally involves close-butts and/or bevel preparations. If a joint preparation is needed, a 60º bevel is acceptable. Preheat & inter-pass temperatures will depend on the grade of steel, if known. Unknown grades should be nominally preheated within a 400-500ºF range.

Technique: A short, non-contact technique is recommended for both fillet and butt welding. Use a slightly longer arc-length for bead-on-plate welding. Deposit stringer beads or 2x to 3x weave beads. Do not weave more than three times the electrode diameter otherwise slag interference will be encountered.

Post-welding: Parts which have been preheated should be wrapped or covered with heat – retardant material to help with slow cooling



ENDOTEC® DO*68S

A UNIVERAL, HIGH-STRENGTH JOINING AND HARDFACING CORED WIRE FOR USE ON MOST LOW, MEDIUM, & HIGH ALLOY STEELS

General Properties

EnDOtec DO*68S is a multi-purpose alloy with a wide application range. It is a key product to select when difficulties are experienced with cracking, particularly hydrogen-induced time-delayed cracking.

Applications

Stressed components-particularly earthmoving equipment such as goose necks, dozer arms, bucket re-flooring, chassis repairs, die body build-up, impellers, auger flights, hydraulic-ram frames, etc.

Technical Data					
	EnDOtec DO*68S				
• Typical Tensile Strength	125,000 psi				
• Typical Yield Strength	87,000 psi	600 N/mm^2			
• Typical Elongation (1=5d) min.	26%				
• Hardness as-deposited (HRB)	90-100				
• Current & Polarity	DCEP (+)				
• Guideline Parameters for DO*68S for use with 0.045 (1.2mm) diameter wire					
Arc Mode	Amp Range	Volt Range	Stick-out	Shield Gas	Flow-scfh
Spray	180-250	25-30	5/8 ± 1/8	CO_2	35-45
Spray	170-250	25-30	5/8 ± 1/8	Ar + 25% CO_2	35-45

Welding Procedure

Preparation: Remove all contaminants, particularly oil & grease. Lightly grind surface to remove superficial oxides. Preheat according to the base metal make-up and potential to air harden. For tool steel surfacing use the recommended preheat & interpass temperatures for the grade and type.

Technique: Always use the lowest practical amperage range to minimize dilution. Deposit width should be between ½" and ¾". De-slag. Second, and subsequent passes should tie in to the weld deposit toe so as to avoid interpass "valleys". Alternate weld layer deposit sequence going from 9 o'clock to 3 o'clock then 12 o'clock to 6 o'clock.

Post-welding: For air-hardening steels slow cool using available insulating materials. For less sensitive base metals, slow cool out of drafts.

TEROMATEC® OA 688

ULTRA HIGH STRENGTH FLUX CORED OPEN-ARC WIRE DESIGNED FOR CLADDING & JOINING STEELS FOR MAXIMUM CRACKING RESISTANCE

General Properties

TeroMatec OA 688 is a high chromium-nickel alloy formulated for joining plain-carbon and medium-to-high alloy steels when base metal cracking is a problem. When used as a cushion layer it offers superior spalling resistance under impact.

Applications

Cement clinker hammers as a cushion layer, joining manganese steel castings to fabricated steel assemblies, wear plate welding, chassis, highly stressed frames, conveyor flights, large-size tool & die repairs, etc.

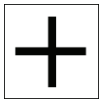
Technical Data		
	TeroMatec OA688	
• Typical Tensile Strength	105,000 psi	724 N/mm^2
• Typical Yield Strength	84,000 psi	579 N/mm^2
• Typical Elongation (1=5d) min.	26%	
• Current & Polarity	Flux Cored-arc Welding…DCEP (+)	
• Diameters	7/64-in (2.8mm)	
• Amperage Range	250-340	
• Voltage range	26-30	
• Electrode Stick-out (in)	2½ ± ¼	

Welding Procedure

Preparation: Remove all contaminants, particularly oil & grease. Lightly grind surface to remove superficial oxides. Preheat according to the base metal make-up and potential to air harden. For tool steel surfacing use the recommended preheat & interpass temperatures for the grade and type. Do not preheat 14% manganese steel!

Technique: Always use the lowest practical amperage range to minimize dilution. Use a circular weaving motion to obtain a compact deposit. De-slag. Second and subsequent passes should tie-in to the weld deposit toe so as to avoid interpass "valleys". Adopt a balanced welding technique to minimize base meat overheating.

Post-welding: For air-hardening steels slow cool using available insulating materials. For less sensitive base metals, slow cool out of drafts.



TEROMATEC® OA 690

FOR JOINING AND PROTECTIVE CLADDING OF ALL TYPES OF PLAIN CARBON AND LOW-ALLOY STEELS

General Properties

TeroMatec OA690 is a highly alloyed flux cored wire formulated for both joining and protective cladding of such construction steels Cor-Ten, Man-Ten, T-1, and HY80. Weld deposits are resistant to hydrogen-delayed cracking particularly in highly stressed applications.

Applications

Manganese steel bucket parts, constructional & mining equipment repairs, bucket & truck bodies, tooth sockets, skip-cars, latch-bar keeps, deck plates, bearing surfaces, etc.

Technical Data		
	TeroMatec OA 690	
• Typical Tensile Strength	105,000 psi	724 N/mm^2
• Typical Yield Strength	83,000 psi	572 N/mm^2
• Typical Elongation (1=5d) min.	27%	
• Current & Polarity	Flux Cored-arc Welding…DCEP (+)	
• Diameters	7/64-in (2.8mm)	
• Amperage Range	250-340	
• Voltage range	26-30	
• Electrode Stick-out (in)	2½ ± ¼	

Welding Procedure

Preparation: Remove all contaminants, particularly oil & grease. Lightly grind surface to remove superficial oxides. Preheat according to the base metal make-up and potential to air harden. For tool steel surfacing use the recommended preheat & interpass temperatures for the grade and type. Do not preheat 14% manganese steel!

Technique: Always use the lowest practical amperage range to minimize dilution. Use a circular weaving motion to obtain a compact deposit. De-slag. Second, and subsequent passes should tie-in to the weld deposit toe so as to avoid interpass "valleys". Adopt a balanced welding technique to minimize base metal overheating.

Post-welding: For air-hardening steels slow cool using available insulating materials. For less sensitive base metals, slow cool out of drafts.

TIGTECTIC® 670

A HIGH CHROMIUM-NICKEL ROD FOR USE IN HIGH TEMPERATURE APPLICATIONS…RESISTANT TO SCALING UP TO 2000ºF

General Properties

TigTectic 670 can be used to weld the heat resistant austenitic steels and to join steels of unknown composition. Weld deposits are suitable for parts subject to sulphurous atmospheres up to 1950ºF. Deposits are also dilution-tolerant when used for dissimilar metal joining.

Applications

Suitable for welding heat-treating baskets and handling equipment, heating and exhausting gas assemblies, thin-walled fully austenitic tubing used in the Pulp & Paper Industry, exhaust valves, acid pump vanes & discharge outlets, etc.

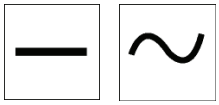
Technical Data		
	TigTectic 670 GTA	
• Typical Tensile Strength	90,000 psi	620 N/mm^2
• Typical Yield Strength	62,000 psi	427 N/mm^2
• Typical Elongation (1=5d) min.	43%	
• Hardness as-deposited (HRB)	85	
• Maximum Temperature	1200ºF in reducing atmospheres	
• Current & Polarity	DCEN (-) or AC	
• Shielding Gas & Flows	Pure argon @ 20 cfh.	
• Tungsten Electrode-Type & Size	1% or 2% Thoriated…size will depend on part thickness	
• Diameters	3/32-2.4mm	1/8-3.2mm
• Amperage Range	90-120	105-150

Welding Procedure

Preparation: Clean weld area of scale and oxide. Remove grease & oil by using a suitable VOC-free solvent. Grind a lengthwise taper on the tungsten electrode and set so that about 1/8-in of the electrode protrudes passed the gas cup edge. Preheating is generally not needed when welding stainless steels. For hardenable steels check the preheat/inter-pass reference in the Reference Section.

Technique: Start the arc by using impulse high-frequency or by using a copper start-block. Do not use a carbon block as this will contaminate the weld deposit! Deposit stringer beads. Do not weave more than 2x as wide beads can cause distortion.

Post-welding: Parts that have been preheated should be wrapped or covered with heat – retardant material to help with slow cooling. Series 300 stainless steels should cool naturally in still air.



TIGTECTIC® 680

A HIGHLY ALLOYED ROD FOR HIGH-STRENGTH JOINING OF TOOLS AND DIES, DISSIMILAR HIGH-STRENGTH ALLOY & SPRING STEELS

General Properties

TigTectic 680 is a uniquely formulated Gas Tungsten-arc rod for welding virtually all commonly used industrial steels, particularly those alloys requiring very high strength joining properties. Suitable for joining stainless steels of unknown composition.

Applications

Use as an under-bead cushion when surfacing tools & dies and for critical joining of composite die assemblies. Dissimilar metal welding of thin tubing, surgical instrument, dairy equipment, etc.

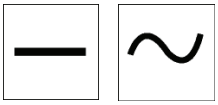
Technical Data			
	TigTectic 680 GTA		
• Typical Tensile Strength	120,000 psi	827 N/mm^2	
• Typical Yield Strength	79,000 psi	545 N/mm^2	
• Typical Elongation (1=5d) min.	25%		
• Hardness as-deposited (HRB)	95		
• Current & Polarity	DCEN (-) or AC		
• Shielding Gas & Flows	Pure argon @ 20 cfh.		
• Tungsten Electrode-Type & Size	1% or 2% Thoriated…size will depend on part thickness		
• Diameters	1/16-1.6mm	3/32-2.4mm	1/8-3.2mm
• Amperage Range	80-100	90-120	105-150

Welding Procedure

Preparation: Clean weld area of scale and oxide. Remove grease & oil by using a suitable VOC-free solvent. Grind a lengthwise taper on the tungsten electrode and set so that about 1/8-in of the electrode protrudes passed the gas cup edge. Preheating is generally not needed when welding stainless steels. For hardenable tool steels check the preheat/inter-pass temperature guidelines in the Reference Section.

Technique: Start the arc by using impulse high-frequency or by using a copper start-block. Do not use a carbon block as this will contaminate the weld deposit! Deposit stringer beads. Do not weave more than 2x as wide beads can cause distortion.

Post-welding: Parts which have been preheated should be wrapped or covered with heat –retardant material to help with slow cooling. Series 300 stainless steels should cool naturally in still air.



XUPER® 16XFC & EUTECROD® 16

SUPERIOR BRAZEABILTY ON LOW & HIGH ZINC BRASSES INCLUDING NICKEL-ENHANCED HIGH STRENGTH BRONZES. SUITABLE FOR DISSIMILAR JOINING OF STEELS TO COPPER ALLOYS

General Properties

Xuper 16 XFC and EutecRod 16 are nickel-reinforced, multi-purpose brazing alloys with very high tensile shear properties. They are suitable for brazing a wide range of copper-base alloys, including carbon and low-alloy steels, tool steels, and for joining these steels to many of the copper alloys.

Applications

Brass piping, bronze pump vanes & condenser plates, high strength bicycle frames, copper refrigeration tubing and condensers, broken tools, drill-bits , end-mill cutters, etc.

Technical Data		
	Xuper 16XFC…EutecRod 16	
• Typical Tensile Strength	100,000 psi	689 N/mm^2
• Typical Hardness (BHN)	100	
• Color Match Properties	Deposits are light yellow	
• Bonding Temperature	1685º to 1720ºF	
• Preheating	300º to 500ºF for brasses & bronzes. 150º to 250ºF for carbon, and tool steels	
• Torch • Induction and/or Furnace	High capacity oxy-fuel torch with optimized BTU's For details consult Technical Services	

Braze Welding Procedure

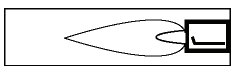
Preparation: Clean joint and/or broken parts. Bevel thickness more than ¼" using a vitrified bonded wheel or grinding disc. Align part, jig if necessary, and preheat according to the information in the above table and make-up of the base metal.

Technique: Apply a small amount of supplemental flux EutecTor 16D if the joint is long or if the preparation involves a bevel. Apply filler metal using a continuous "drop-and-melt" technique moving the torch from side-to-side to control bead width. Continue until the joint is slightly overfilled.

Notes:

1) Any excess "glassy" flux residue can be readily removed after the part has cooled down by light scraping.
2) Excessively overheating copper-base alloys and/or using excess flux can make the flux residue difficult to remove.

Post-brazing: Copper-base parts should be allowed to cool naturally in still air. For tool steel repairs slow cool by covering in vermiculite; wrapping in a heat-retardant blanket; or by burying in lime.



Metal Notes

• ***Background Information:*** Nickel is one of the most versatile of the metal elements. It is widely used as an alloying element in iron and steel, and when used in combination with chromium forms the well -known Series 300 stainless steels. At the low-end (0.25-5.0%) nickel imparts the property of hardenability and toughness. From around 40% to 100% nickel forms a complex series of alloys some of which are briefly reviewed. The more common high-nickel alloys are shown below.

Some Common High Nickel Alloys & Typical Applications

Alloy	*Principal Alloying Elements (%)*	*Typical Applications*
Nickel 200	*Nickel – 99%*	*Chemical & food processing equipment…*
*Monel® 400**	*Nickel + Copper*	*Sea water pumps, valves, heat exchangers…*
*Monel® K500**	*Nickel + Copper + Aluminum*	*Pump shafts, valve stems, springs, acid piping assemblies…*
*Inconel® 600**	*Nickel + Chromium + Iron*	*High temperature corrosion % caustic corrosion applications…*
*Inconel® 625**	*Nickel + Cr, Mo,Cb, Fe*	*Chemical processing & pollution equipment, marine applications…*
*Incoloy® 800**	*Nickel + Chromium + Iron*	*Heat exchangers, process piping, furnace handling equipment…*
*Incoloy® 825**	*Nickel + Cr, Fe, Cu*	*For equipment handling sulfuric & phosphoric acids, pumps…*
*Hastelloy® C***	*Nickel + Chromium + Mo*	*For equipment handling chloride solutions at temperature…*

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*** Trademark of Haynes International*

Some NOT So Common High Nickel Alloys

Alloy	*Application Area*
Hastelloy® X	*Jet engine sheet & assembly parts*
Renè 41	*Jet engine parts & sub-assemblies*
Udimet® 700	*Jet engine parts & sub-assemblies*
Waspaloy®	*Jet engine parts & sub-assemblies*
Nimonic® A	*Jet engine parts & sub-assemblies*

Note: Nickel has good high and low-temperature strength, high oxidation resistance, and good corrosion resistance. When alloyed with selected elements most of these properties are markedly enhanced.

• *Welding Notes*

1) ***Base Metal Cleaning:*** When welding on nickel-base alloys it is mandatory to remove any oxides that might be present. Also, any contaminant source that might involve sulfur, phosphorous, lead, tin, or zinc MUST BE REMOVED! The same goes for oil & grease which should be removed with a suitable VOC-free solvent. As a final cleaning note make sure that all tools used for preparation are equally free of contaminants.
2) ***Base Metal Preheating:*** When welding nickel-base alloys preheating is generally not needed. Preheating is normally done when the part to be welded is below room temperature (55-65ºF). To prevent condensation problems a nominal preheat of ~200ºF is recommended.
3) ***Heat Input & Inter-pass Temperature:*** These requirements are not as critical as those typically used when welding the HSLA steels. However, to insure optimum as-welded corrosion resistance, particularly when welding nickel alloys which contain appreciable levels of chromium & molybdenum, a maximum inter-pass temperature of 300ºF is advised.
4) ***Welding Technique:*** Because the welding pool fluidity of nickel alloys is low, high nickel weld metal does not wet out very readily. To accommodate this characteristic, weaving is normally employed. Similarly, when welding parts which have been prepared with a "V" preparation it is good practice to open the joint angle to ~80º. When weaving, make sure not to exceed 3x the electrode diameter and pause slightly at each side of the joint face. This technique will prevent side-face undercutting.

EUTECTIC NICKEL ALLOYS - PROPERTY MATRIX

PRODUCT	PROPERTY
NucleoTec® 2222	Specially formulated for welding the Ni-Cr-Fe alloys, including the welding of nickel-base alloys to dissimilar steels. Heat cycling tolerance is high at steady-state temperatures up to 1800ºF. A high elongation property enhances deep-refill operations on massive parts.
Xuper® 2222 XHD	Excellent combined mechanical properties for use with 9% Ni steels and applications involving both high temperature and sub-zero cryogenic temperatures. Improved high temperature impact Properties.

Typical Features & Benefits

Corrosion resistant, **H**igh weld metal crack resistance, **E**xcellent oxidation resistance, **S**uperior elevated temperature resistance & **O**ptimized impact resistance.

NUCLEOTEC® 2222

A HIGH NICKEL ALLOY WITH OPTIMIZED MECHANICL & PHYSICAL PROPERTIES OF CRACK RESISTANCE, THERMAL STABILTY, DUCTILITY, AND CORROSION & OXIDATION RESISTANCE

General Properties

NucleoTec 2222 is a unique alloy with unique properties. Weld deposits are highly tolerant under thermal cycling conditions, or when subject to severe restraint during deep re-fill operations, or when joining high nickel alloys to dissimilar steels, including stainless & HSLA steels and cryogenic steels.

Applications

Heat treating racks and baskets, ingot pick-up tongs, cryogenic/refrigeration equipment, heat exchanging equipment, Freon®-controlling gate valves, 9% Nickel steels, injection molds, forging dies, etc.

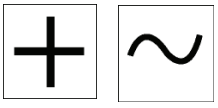
Technical Data			
	NucleoTec 2222N		
• Typical Tensile Strength	100,000 psi	689 N/mm^2	
• Typical Yield Strength	77,500 psi	534 N/mm^2	
• Typical Elongation (1=5d) min.	40%		
• Typical Hardness (BHN)	180		
• Current & Polarity	DCEP (+) or AC		
• Diameters	3/32 – 2.4mm	1/8 – 3.2mm	5/32 – 4.0mm
• Amperage Range	60-85	75-110	100-140
Note: When welding with Eutectic 2222N make sure to remove ALL sources of sulfur often an ingredient in both oils and greases.			

Welding Procedure

Preparation: Remove all contaminants, particularly oil & grease. Lightly grind surface to remove superficial oxides. Preheating is not necessary unless the part is massive or has a large cross-section. In these situations preheating within a range of 250-300ºF is advised.

Technique: Always use the lowest practical amperage range to minimize dilution. Use a medium-to-short arc length and stringer-beads. Terminate welds either on end-blocks and back-whip or use a “side-up technique”. Adopt a balanced welding sequence to minimize base metal overheating. De-slag thoroughly, particularly

Post-welding: For air-hardening steels slow cool using available insulating materials. For less-sensitive base metals, slow cool out of drafts.



XUPER® 2222 XHD

A HIGH DEPOSITION, NICKEL-BASE ELECTRODE WITH SUPERIOR DUCTILITY AND CRACK-RESISTANCE. EXCELLENT HIGH & LOW TEMPERATURE PROPERTIES

General Properties

Xuper 2222 XHD is formulated for high-speed welding of critically stressed applications. A combination of high tensile strength and ductility imparts a high level of security even under the toughest conditions.

Applications

For use with flame-hardening equipment, heat-treating trays & baskets, kiln tire repairs, ingot tongs, continuous casting molds, merchant mill roll guides, LNG processing pumps and related equipment, etc.

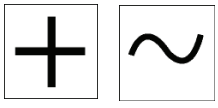
Technical Data			
	Xuper 2222 XHD		
• Typical Tensile Strength	90,000 psi	620 N/mm^2	
• Typical Yield Strength	65,500 psi	451 N/mm^2	
• Typical Elongation (1=5d) min.	40%		
• Typical Hardness (BHN)	180		
• Current & Polarity	DCEP (+) or AC		
• Diameters	3/32 – 2.4mm	1/8 – 3.2mm	5/32 – 4.0mm
• Amperage Range	80-120	110-160	150-190
Note: When welding with Eutectic 2222XHD make sure to remove ALL sources of sulfur often an ingredient in both oils and greases.			

Welding Procedure

Preparation: Remove all contaminants, particularly oil & grease. Lightly grind surface to remove superficial oxides. Preheating is not necessary unless the part is massive or has a large cross-section. In these situations preheating within a range of 250-300ºF is advised.

Technique: Always use the lowest practical amperage range to minimize dilution. Use a medium-to-short arc length and stringer-beads. Terminate welds either on end-blocks and back-whip or use a “side-up technique”. Adopt a balanced welding sequence to minimize base metal overheating. De-slag thoroughly, particularly

Post-welding: For air-hardening steels slow cool using available insulating materials. For less-sensitive base metals, slow cool out of drafts.



Metal Notes

The Influence of Key Elements

• ***The Chromium Effect:*** Stainless steels are known in many parts of the world as "rust-free" steels. Although a highly descriptive phrase it is really not the best term. Everyone is familiar with the red rust of steel and cast iron. What this is, is an oxide of iron, and in the case of stainless steel, it is an oxide of chromium. Chromium is the most basic element in stainless steels and is dominantly responsible for the protective coating or surface film the steel develops when exposed to air. Generally, increasing amounts of chromium provide increased corrosion and increased high-temperature oxidation resistance.

• ***The Nickel Effect*:** Nickel has a "compounding effect" with respect to corrosion resistance. When added in sufficient quantities it enhances general corrosion resistance while imparting other desirable properties such as high-temperature ductility and work-hardenability.

• ***The Molybdenum Effect:*** This key element imparts a more specific resistance to corrosion, particularly against sea-water and chloride salts. In addition molybdenum imparts increased strength, toughness and resistance to creep-derformation at high temperature.

• ***The Titanium Effect:*** This element is known for its "stabilizing" effect. It stabilizes carbon by forming titanium carbides which prevent the free-carbon affect of inter-crystalline attack. Titanium also imparts high temperature stability between 1000ºF and 1600ºF.

• ***The Columbium/Niobium Effect:*** Columbium imparts to stainless steel resistance to inter-granular corrosion. Because it has a strong attraction to carbon it ties it up in the form of columbium carbides which are uniformly dispersed throughout the steel. By doing so it prevents the formation of harmful grain-boundary carbides.

• ***The Carbon Effect:*** Carbon is an important element in stainless steels. It imparts high hardenability in straight chromium steels…forms a complex series of carbides, and when the steel is heated in the range of 1000ºF to1600ºF, it makes it sensitive to a selective form of corrosion known as inter-granular corrosion. It does this by depleting the chromium through the formation of chromium-rich carbides.

STAINLESS STEEL BASE METAL REFERENCE TABLE

Group	Short Summary	Typical Grades	
Austenitic Series Fe-Cr-Ni + Mo-Cb-Ti-Mn	Most commonly used series with excellent corrosion resistance and reasonable work hardening properties. Generally non-magnetic. Tendency to hot crack and non-stabilized grades are sensitive to carbide precipitation. Non-heat-treatable.	• 302	**! 304**
		• 307	• 308/L
		• 310	• 309/L
		• 316/L	• 312
		• 318	• 317/L
		• 347	• 321
!	**Most common wrought austenitic steel grade.**		
Martensitic Series Fe-Cr-Mn + Ni-P/S-C	These steels are known as "straight" chromium alloys and typically contain 12-17% Cr. They have moderate corrosion resistance and are air hardening. Steels are magnetic and need pre-heat during welding and are often post-weld heat-treated. Grade 410 is the general-purpose alloy.	• 403	**! 410**
		• 414	• 416
		• 416Se	• 420F
		• 420	• 431
		• 422	• 440A
		• 440B	• 440C
!	**Most common wrought martensitic steel grade.**		
Ferritic Series Fe-Cr-Ni + Mn-Cb-Al	These steels are also known as "straight" chromium alloys but typically contain 15-30% Cr and lower carbon.They have good corrosion resistance. Steels are sensitive to grain growth that calls for little or no pre-heat. Steels are magnetic. Grade 430 is the general-purpose alloy	• 405	• 409
		• 429	**! 430**
		• 430FSe	• 430F
		• 436	• 434
		• 444	• 442
		• 446	
!	**Most common wrought ferritic steel grade**		
Super-Duplex Series Fe-Cr-Ni-Mo + N-Cu	These steels are also known as austenitic-ferritic alloys due to an essentially balanced mixing of the two phases. They have enhanced mechanical properties and much improved corrosion resistance. They are highly resistant to corrosive mixtures of liquids and gases. Grade 2205 is the general-purpose alloy.	• 2304 no Mo content	
		! 2205	
		• Alloy 255 & DP-3	
		• 2507 & DP-3W	
		• 329	
!	**Most common wrought duplex steel grade**		
PH-Series Fe-Cr-Ni-Mo + Nb-Al-Ti-N	PH, or precipitation hardening steels owe their unique properties to a specific heat-treatment. The treatment results in the formation of martensite followed by heat treating to *precipitate* a phase which both toughens and strengthens the alloy. Grade 17-4 PH is a fairly typical alloy.	• PH 13-8 Mo	
		• 15-5 PH	
		• 15-7 PH	
		! 17-4 PH	
		• 17-7 PH	
		• Nitronic 19D*	
	* Nitronic 19D is a registered trademark of ARMCO.		
!	**Most common precipitation hardening**		

PREMIUM STAINLESS STEEL PRODUCTS

STAINTRODE® A – Premium Electrode

BRIGHT FINISHED FOR CONTAMINATION-FREE WELDS. THE ROD IS A HIGH CHROMIUM-NICKEL ALLOY WITH ADDITIONAL ELEMENT ENHANCEMENTS FOR IMPROVED PERFORMANCE

General Properties

StainTrode A composition is suitable for welding AISI grades 321 & 347 when carbide precipitation is damaging and must be avoided. When optimally applied, weld deposits are smooth and free from out-gassing and porosity.

Applications

StainTrode A possess excellent resistance to inter-granular corrosion with improved performance between 800º and 1500ºF. Use to weld furnace stacks, heat exchangers, and high temperature refining equipment, automotive exhaust, radiant super heaters, etc…

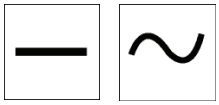
Technical Data		
	StainTrode A	
• Typical Tensile Strength	85,000 psi	568 N/mm^2
• Typical Yield Strength	60,000 psi	414 N/mm^2
• Typical Elongation (1=5d) min.	42%	
• Typical Hardness (BHN)	160	
• Impact Strength (Charpy V)	34 Ft-lbs at –320 0186F	
• Current & Polarity	DCEP (+) or AC	
• Diameters	3/32…2.4 mm	1/8…3.2 mm
• Typical Amperage Range	65-80	85-105
• Typical Ferrite Number	10 – DeLong Diagram	

Welding Procedure

Preparation: Clean weld area of scale and/or oxide. Make sure all oily contaminants are removed with a suitable VOC cleaner. Angle prepping normally involves close-butts and infrequently bevel preparations. If needed, a 60º V bevel is acceptable.
Pre-heating of stainless steels is generally not required.

Technique: A short, non-contact technique is recommended for both fillet and butt welding. Use a slightly longer arc-length for bead-on-plate welding. Deposit stringer beads or 2x to 3x weave beads. Do not weave more than three times the electrode diameter otherwise excessive heat input will cause distortion.

Post-welding: Allow parts to cool naturally in still air.



STAINTRODE® AMoL – Premium Electrode

A HIGH CHROMIUM-NICKEL STAINLESS STEEL ELECTRODE WITH CONTROLLED ADDITIONS OF MOLYBDENUM AND LOW CARBON FOR ENHANCED CORROSION RESISTANCE

General Properties

StainTrode AMoL is formulated with a highly refined flux coating for all-position welding of stainless steel. Arc control is outstanding and slag is virtually self-releasing. Ideal for welding grades AISI 301, 302, 304, 304L, 316, and 316L.

Applications

Common applications are pasteurizers, chemical vats, pulp digesters, settling tanks, plating baskets, boiler pumps & pumps handling salt water. Also for use on dairy, food, and distillery equipment, and for creep-resistance at elevated temperatures.

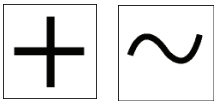
Technical Data		
	StainTrode AMoL	
• Typical Tensile Strength	85,000 psi	586 N/mm^2
• Typical Yield Strength	62,000 psi	427 N/mm^2
• Typical Elongation (1=5d) min.	45% at room temperature	40% at 550ºF
• Typical Hardness (BHN)	210	
• Impact Strength (Charpy V)	40 Ft-lbs at –150ºF	
• Current & Polarity	DCEP (+) or AC	
• Diameters	3/32…2.4mm	1/8…3.2mm
• Amperage Range	65-80	85-105
• Typical Ferrite Content	Magna Gauge Value: Between 5% and 10%	
Note: When using Eutectic AMoL keep to the low-end of the amperage range for optimized results.		

Welding Procedure

Preparation: Clean weld area of scale and/or oxide. Make sure all oily contaminants are removed with a suitable VOC cleaner. Angle prepping normally involves close-butts and infrequently bevel preparations. If needed, a 60º V bevel is acceptable.
Pre-heating of stainless steels is generally not required.

Technique: A short, non-contact technique is recommended for both fillet and butt-welding. Use a slightly longer arc length for bead-on-plate welding. Deposit stringer beads or 2x to 3x weave beads. Do not weave more than three times the electrode diameter otherwise excessive heat input will cause distortion.

Post-welding: Allow parts to cool naturally in still air.



STAINTRODE® BMoL – Premium Electrode

A HIGH CHROMIUM-NICKEL STAINLESS STEEL ELECTRODE WITH INCREASED MOLYBDENUM AND LOW CARBON FOR IMPROVED PITTING RESISTANCE IN CHLORIDE-BEARING SOLUTIONS

General Properties

StainTrode BMoL is formulated with increased molybdenum so as to impart improved resistance to most inorganic and organic acids. Resistance to inter-granular corrosion is further enhanced due to the low carbon content.

Applications

Various pump parts in the Petro-Chemical Industry where improved corrosion resistance compared to AISI 316L stainless steel is required. Excellent for Pulp & Paper applications involved in the transportation of either black or white liquor.

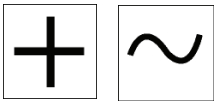
Technical Data		
	StainTrode BMoL	
• Typical Tensile Strength	85,000 psi	586 N/mm^2
• Typical Yield Strength	69,000 psi	476 N/mm^2
• Typical Elongation (1=5d) min.	40% at room temperature	
• Typical Hardness (BHN)	220	
• Impact Strength (Charpy V)	40 Ft-lbs at –150ºF	
• Current & Polarity	DCEP (+) or AC	
• Diameters	3/32 – 2.4mm	1/8 – 3.2mm
• Amperage Range	65-80	85-105
• Typical Ferrite Content	Magna Gauge Value: Between 4% and 10%	
Note: When using Eutectic BMoL keep to the low-end of the amperage range for optimized results.		

Welding Procedure

Preparation: Clean weld area of scale and/or oxide. Make sure all oily contaminants are removed with a suitable VOC cleaner. Angle prepping normally involves close-butts and infrequently bevel preparations. If needed, a 60º V bevel is acceptable.
Pre-heating of stainless steels is generally not required.

Technique: A short, non-contact technique is recommended for both fillet and butt-welding. Use a slightly longer arc-length for bead-on-plate welding. Deposit stringer beads or 2x to 3x weave beads. Do not weave more than three times the electrode diameter otherwise excessive heat input will cause distortion.

Post-welding: Allow parts to cool naturally in still air.



STAINTRODE® D – Premium Electrode

ENHANCED CHROMIUM-NICKEL STAINLESS STEEL ELECTRODE FOR WELDING STAINLESS STEELS OF UNKNOWN COMPOSITION

General Properties

StainTrode D is a multi-use electrode formulated to weld dissimilar stainless steels. Its composition is enriched for use with AISI grade 310. Due to the high alloy content this high performance electrode has very good scaling and oxidation resistance up to 2100ºF.

Applications

For use on oven linings, boiler baffles, kilns, lead pots, radiant tubes, annealing covers, burners, combustion tubes, refractory anchor bolts, fire box sheets, furnace components and related high temperature containers.

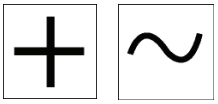
Technical Data		
	StainTrode D	
• Typical Tensile Strength	95,000 psi	655 N/mm^2
• Typical Yield Strength	64,000 psi	441 N/mm^2
• Typical Elongation (1=5d) min.	35% at room temperature	
• Typical Hardness (BHN)	190	
• Impact Strength (Charpy V)	35 Ft-lbs at minus 150ºF	
• Current & Polarity	DCEP (+) or AC	
• Diameters	3/32 – 2.4mm	1/8 – 3.2mm
• Amperage Range	65-80	85-105
• Typical Ferrite Content	Fully austenitic	
Note: When using Eutectic D keep to the low-end of the amperage range for optimized results.		

Welding Procedure

Preparation: Clean weld area of scale and/or oxide. Make sure all oily contaminants are removed with a suitable VOC cleaner. Angle prepping normally involves close-butts and infrequently bevel preparations. If needed, a 60º V bevel is acceptable.
Pre-heating of stainless steels is generally not required.

Technique: A short, non-contact technique is recommended for both fillet and butt-welding. Use a slightly longer arc-length for bead-on-plate welding. Deposit stringer beads or 2x to 3x weave beads. Do not weave more than three times the electrode diameter otherwise excessive heat input will cause distortion.

Post-welding: Allow parts to cool naturally in still air.



EUTECTRODE® 53L – Quality Industrial Grade

AN INDUSTRIAL GRADE ALLOY FOR WELDING AISI STAINLESS GRADES SUCH AS 316L, 316, 302, and 304

General Properties

EutecTrode 53L is formulated for all-position welding of selected grades stainless steel. Arc control is welder-friendly and slag-release is virtually self-releasing. Ideal for welding grades AISI 301, 302, 304, 304L, 316, and 316L.

Applications

Common applications are pasteurizers, chemical vats, pulp digesters, settling tanks, plating baskets, boiler pumps & pumps handling salt water. Also for use on dairy, food, and distillery equipment, and for creep-resistance at elevated temperatures.

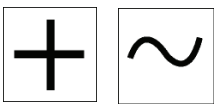
Technical Data		
	EutecTrode 53L	
• Typical Tensile Strength	80,000 psi	551 N/mm^2
• Typical Yield Strength	58,000 psi	400 N/mm^2
• Typical Elongation (1=5d) min.	45% at room temperature	40% at 550ºF
• Typical Hardness (BHN)	210	
• Impact Strength (Charpy V)	40 Ft-lbs at –150ºF	
• Current & Polarity	DCEP (+) or AC	
• Diameters	3/32…2.4mm	1/8…3.2mm
• Amperage Range	65-80	85-105
• Typical Ferrite Content	Magna Gauge Value: Between 5% and 10%	
Note: When using EutecTrode 53L weld at the low-end of the amperage range for best results.		

Welding Procedure

Preparation: Clean weld area of scale and/or oxide. Make sure all oily contaminants are removed with a suitable VOC cleaner. Angle prepping normally involves close-butts and infrequently bevel preparations. If needed, a 60º V bevel is acceptable.
Pre-heating of stainless steels is generally not required.

Technique: A short, non-contact technique is recommended for both fillet and butt-welding. Use a slightly longer arc length for bead-on-plate welding. Deposit stringer beads or 2x to 3x weave beads. Do not weave more than three times the electrode diameter otherwise excessive heat input will cause distortion.

Post-welding: Allow parts to cool naturally in still air.



EUTECTRODE® 4057 – Series 4000 Electrode

A UNIVERSAL HIGH-QUALITY ELECTRODE FOR WELDING A WIDE VARIETY OF STEEL SUBSTRATES. EXCELLENT CORROSION RESISTANCE AND OXIDATION RESISTANCE UP TO 2200ºF

General Properties

EutecTrode 4057 is formulated for all-position welding of selected range of stainless steels. It is particularly resistant to intergranular corrosion due to its low carbon content. Ideal alloy when welding stainless steels to low- and medium carbon steels. Arc control is welder-friendly and slag-release is virtually self-releasing.

Applications

Common applications are typically found in the petro-chemical industry, food processing facilities, milk processing parts & assemblies, distilleries, etc

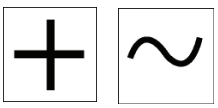
Technical Data		
	EutecTrode 4057	
• Typical Tensile Strength	80,000 psi	551 N/mm^2
• Typical Yield Strength	57,000 psi	393 N/mm^2
• Typical Elongation (1=5d) min.	40% at room temperature	22% at 600ºF
• Typical Hardness (BHN)	210	
• Impact Strength (Charpy V)	35 Ft-lbs at –150ºF	
• Current & Polarity	DCEP (+) or AC	
• Diameters	3/32…2.4mm	1/8…3.2mm
• Amperage Range	65-80	85-105
• Typical Ferrite Content	Magna Gauge Value: Between 4% and 10%	
Note: When using EutecTrode 4057 weld at the low-end of the amperage range for best results.		

Welding Procedure

Preparation: Clean weld area of scale and/or oxide. Make sure all oily contaminants are removed with a suitable VOC cleaner. Angle prepping normally involves close-butts and infrequently bevel preparations. If needed, a 60º V bevel is acceptable.
Pre-heating of stainless steels is generally not required.

Technique: A short, non-contact technique is recommended for both fillet and butt-welding. Use a slightly longer arc length for bead-on-plate welding. Deposit stringer beads or 2x to 3x weave beads. Do not weave more than three times the electrode diameter otherwise excessive heat input will cause distortion.

Post-welding: Allow parts to cool naturally in still air.



TIGTECTIC® A & AMoL - Premium GTAW Rods

BRIGHT FINISHED FOR CONTAMINATION-FREE WELDS. BOTH RODS ARE HIGH CHROMIUM-NICKEL ALLOYS WITH ELEMENT ENHANCEMENTS FOR IMPROVED PERFORMANCE

General Properties

• TigTectic A composition is suitable for welding AISI grades 321 & 347 when carbide precipitation is to be avoided. When optimally applied weld deposits are smooth and free from out-gassing and porosity.

• TigTectic AMoL composition is suitable for welding AISI grades 316L & 308L when improved resistance to pitting corrosion is required. Deposits have superior resistance under salt-water conditions.

Applications

• TigTectic A possess excellent resistance to inter-granular corrosion with improved performance between 800º and 1500ºF. Use to weld furnace stacks, heat exchangers, and high temperature refining equipment, automotive exhaust, radiant super heaters, etc…

• TigTectic AMoL typical uses include valve & pump trim, digester tanks, pulp, paper, and textile processing equipment, marine applications, evaporators…etc. with improved performance due to the molybdenum content.

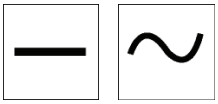
Technical Data			
	TigTectic A		TigTectic AMoL
• Typical Tensile Strength	85,000 psi….586 N/mm^2		75,000 psi….537 N/mm^2
• Typical Yield Strength	60,000 psi….414 N/mm^2		58,000 psi….400 N/mm^2
• Typical Elongation (1=5d) min.	42%		35%
• Typical Hardness (BHN)	160		160
• Impact Strength (Charpy V)	34 Ft-lbs at –320ºF		35 Ft-lbs at –320ºF
• Current & Polarity	DCEN (-) or AC		DCEN (-) or AC
• Diameters	1/16…1.6 mm	3/32…2.4 mm	1/8…3.2 mm
• Typical Amperage Range	Refer to Table 2 – Gas Tungsten-Arc Welding		
• Typical Ferrite Number	10 – DeLong Diagram		9 – DeLong Diagram

Welding Procedure

Preparation: Clean joint and/or broken parts. Lightly bevel cracks by grinding. Note: The selection of the preferred thoriated or lanthium tungsten electrode diameter will depend on the material thickness and corresponding amperage range. This applies similarly to gas cup size. Note: Make sure that the tip of the electrode is ground with the proper taper for better heat localization.

Technique: Adjust argon shielding gas flow. Adjust standoff distance so that the shielding gas always protects the molten pool and allows the rod-end to solidify before removing it from the gas envelope.

Post-welding: Allow parts to cool naturally in still air.



ENDOTEC® DO*29S - Premium Cored Wire

AN ALL-POSITION JOINING & CLADDING CORED WIRE FORMULATED TO RESIST PITTING CORROSION AND HIGH TEMPERATURE SCALING ON MANY OF THE MORE COMMON STAINLESS STEELS

General Properties

ENDOtec DO*29S has excellent out-of-position weldability with optimum application versatility. Used as a hardfacing adjunct it improves surface performance, particularly oxidation resistance up to 1200ºF. As a joining alloy, the high chromium, nickel, and molybdenum content improves all-round performance with high integrity welds.

Applications

Pulp digesters, acid filters, pasteurizers, and pickling-tank fabrications, annealing baths, food- handling equipment, joining stainless steels to mild- and low-alloy steels.

Technical Data

	EnDOtec DO*29S	
• Typical Tensile Strength	80,000 psi	551 N/mm^2
• Typical Yield Strength	68,000 psi	469 N/mm^2
• Typical Elongation (1=5d) min.	26%	
• Hardness as-deposited (HRB)	90-100	
• Current & Polarity	DCEP (+)	
• Guideline Parameters for DO*29S	For use with 0.045 (1.2mm) diameter wire	

Arc Mode	Amp Range	Volt Range	Stick-out	Shield Gas	Flow-scfh
Spray	180-250	25-30	5/8 ± 1/8	CO_2	35-45
Spray	170-250	25-30	5/8 ± 1/8	Ar + 25% CO_2	35-45

Welding Procedure

Preparation: Remove all contaminants, particularly oil & grease. Lightly grind surface to remove superficial oxides. Preheat according to the base metal make-up and potential to air harden. For tool steel surfacing use the recommended preheat & interpass temperatures for the grade and type.

Technique: Always use the lowest practical amperage range to minimize dilution. Deposit width should be between ½" and ¾ ". De-slag. Second, and subsequent passes, should tie in to the weld deposit toe so as to avoid interpass "valleys". Alternate weld layer deposit sequence going from 9 o'clock to 3 o'clock then 12 o'clock to 6 o'clock.

Post-welding: For air-hardening steels slow cool using available insulating materials. For less sensitive base metals, slow cool out of drafts.

INDUSTRIAL STAINLESS STEEL PRODUCTS

General Information & Metal Notes

AWS Specification References

• SMA Electrodes

A5.4…"Specification for Stainless Steel Electrodes for Shielded Metal Arc Welding"

• GMA Solid Wires & GTA Rods:

A5.9…"Specification for Bare Stainless Steel Welding Electrodes and Rods"

• Cored Wires:

A5.22…"Specification for Stainless Steel Electrodes for Flux Cored Arc Welding and Stainless Steel Flux cored Rods for Gas Tungsten Arc Welding"

EUTECTIC INDUSTRIAL STAINLESS STEEL PRODUCTS
MATRIX USAGE TABLE

Product	For use with AISI Grades	Application Industry
EutecTrodes®		
308L-16*…...308L-17	304, 304L, 308, 308L	Food, Dairy, Brewing, Auto…
309L-16……..309-17	309, 309L	Petro-chemical, Food, Surfacing...
310-16……310-17	310, 310S	Chemical, Heat-treat, Transport…
316L-16*…...316L-17	316, 316Ti, 318, 319L	Pulp & Paper, Marine, Food…
* Available in a Vertical-Down (VD) Versions		
MigTectic® Solid Wires		
MigTectic 308L	308L, 304L, 302, 301,	Tanks, Liquid food, Chemical…
MigTectic 308LSi	308L, 304L, 302, 301,	Food, Dairy, Brewing, Auto…
MigTectic309L	309L, 304L, 304	Petro-chemical, Food, Heat-treat..
MigTectic 316LSi	316L, 316, 318L, 304L	Pulp & Paper, Marine, Food…
TigTectic® Rods		
TigTectic 308L	308L, 304L, 302, 301,	Food, Dairy, Brewing, Auto…
TigTectic 308LSi	308L, 304L, 302, 301,	Food, Dairy, Brewing, Auto…
TigTectic 309L	309, 309L	Petro-chemical, Food, Surfacing...
TigTectic 310	310, 310S	Chemical, Heat-treat, Transport…
TigTectic 316LSi	316L, 316, 318L, 304L	Pulp & Paper, Marine, Food…
Eutectic® FW Cored Wires		
308LT1FW	302, 304, 304L, 308, 308L	Mining, Earthmoving, Steel…

WELDING NOTES & REFERENCE TABLES

• Notes for when welding AISI 300 Grade Stainless Steels:

1) ***Make allowance for expansion.*** *Most grades have coefficients of expansion some 50% higher than plain carbon steels. Increase joint spacing to reduce warping.*

2) ***Make allowance for potential overheating.*** *Most grades of stainless steel have a much higher electrical resistance compared to plain carbon steels. To reduce electrode overheating maintain the lowest practicable amperage level.*

3) ***Make allowance for thermal conductivity.*** *Because stainless steels only have half the heat conductivity of plain carbon steels, distortion can become a problem. To prevent excessive heat build-up always use the smallest practicable diameter and use a staggered deposition sequence.*

Table 1	**Parameters for Gas Metal-Arc Welding**			
Short-Arc Welding				
Wire Diameter	**Wire Feed Rate**	**Amperage Range**	**Voltage Range**	**Shielding Gas***
0.035 – 0.9mm	13 – 26 ft/min	65 - 145	20 - 25	20-25 scfh
Spray-Arc Welding				
0.035 – 0.9mm	20 – 40	145 - 225	22 – 28	35-40 scfh
0.045 – 1.2mm	16 – 30	180 - 260	23 - 28	35-40 scfh

* For Short-Arc Welding use 90% Ar + 7.5 He + 2.5% CO_2
For Spray-Arc Welding use 98% Ar + 2% O_2

Table 2		**Parameters for Gas Tungsten-Arc Welding**				
Work Thickness		**Filler Rod Ø**	**Welding Current**	**Tungsten Diameter [1]**	**Shielding Cup Size**	**Gas Flow [2]**
1/16	1.6mm	1/16	70-110	1/16	1/4-5/16-3/8	25 scfh
3/32	2.4mm	3/32	90-130	1/16	1/4-5/16-3/8	25 scfh
1/8	3.2mm	3/32	105-150	3/32	1/4-5/16-3/8	25 scfh
3/16	5.0mm	1/8	150-225	1/8	3/8-7/16-1/2	30 scfh
1/4	6.3mm	3/12	210-325	1/8	Water cooled	30 scfh

1) Use 100% argon for general welding. For heavy-duty welding use 75%He + 25%Ar.
2) Use lanthiated or 2% thoriated electrodes.

SECTION 10 – HARDFACING PRODUCTS

General Information

• Some Basic Information on Various Types of Wear

How industrial components wear can be classified under nine categories. The nine categories described below essentially cover the basic types of wear that results in the physical removal of metal from a solid surface by another metal surface or material.

BASIC WEAR TYPES AND DESCRIPTIONS

	Wear Type	Description
1	Abrasion + Impact	Causes loss of part shape and lowers part performance due to loss of surface material.
2	Gouging Abrasion	High material rubbing & point loading forces gouge out surface material at major sites.
3	Grinding Abrasion	Also known as "3-body abrasion". Wear is caused by high surface stresses imparted from surface-to-surface by the material being processed.
4	Sliding Abrasion	Also known as "2-body abrasion" or "low-stress abrasion". Wear is caused by surface loss due to micro-grooving.
5	Abrasive Erosion	Also known as "scratching abrasion". Wear is caused by the micro-machining action of hard particles.
6	Impingement Erosion	Also known as "large particle impact wear". Wear results from the action of repeated impacts leading to surface deformation.
7	Slurry Erosion	This type of wear is a form of abrasion involving a liquid carrier. The large-scale effect is similar to 2-body abrasion.
8	a) Impact Wear b) Compressive Wear	a) Causes wear due to either severe deformation or fatigue fracture. b) High rolling or static loads causes wear due to surface fatigue.
9	Frictional Wear	Also known as "metal-to-metal wear" or "sliding wear". Causes metal loss due to surface-to-surface contact tearing.

NOTE

Refer to Pages 109 to 113 for Detailed Information on Brazing Products.
Refer to Pages 114 to 127 for Detailed Information on Welding Electrodes.
Refer to Pages 128 to 150 for Detailed Information on Cored Wires & Rods.

XUPER® 185 XFC

A NICKEL ENHANCED COPPER-BASE BRAZING ROD FOR TOUGH RE-BUILDS AND LOW FRICTIONAL OVERLAYS

General Properties

Xuper 185 XFC is a premium flux-coated brazing rod for applications involving wear due to frictional compressive forces. The controlled nickel addition improves application toughness and depresses fuming tendencies for welder-friendly use.

Applications

For selective bearing surfaces on cast iron, steel, and some nickel alloys. Good deep-drawing properties make Xuper 185 XFC excellent for stamping and drawing dies, bearing surfaces, guide arms, hydraulic seal areas, etc.

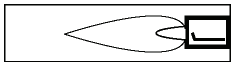
Technical Data		
	Xuper 185XFC	
• Typical Tensile Shear Strength	85,000 psi	586 N/mm^2
• As-deposited Hardness (BHN)	130	
• Work Hardened Hardness (BHN)	200	
• Brazing Temperature Range	1680º - 1720ºF	915º - 940ºC
• Base Metal Use	Plain carbon & low-alloy steels, cast irons, tool steels, low-zinc brasses, bronzes…	
• Heating Methods	Oxy-fuel, induction, air furnace…	
• Supplemental Flux	EutecTor® 16 or 16B*	
Note: When brazing bronzes the preferred flux is the more active EutecTor 16B.		

Braze Welding Procedure

Preparation: Clean joint area with RotoClean OS or use a proprietary VOC-free solvent. Lightly roughen highly polished base metals to facilitate quicker bonding. Align parts and preheat locally to facilitate quicker joint area heat-up. When brazing on cast iron prepare the surface by searing using an oxidizing flame. This will help to remove free graphite from the surface and help with bonding.

Technique: Use a neutral to 1x carburizing flame to prevent oxidation. After preheating deposit the filler metal using a continuous "drop-and-melt" technique. Continue until the joint is slightly overfilled.
Notes: When additional fluxing is called for use EutecTor 16, and for bronzes and chromium-bearing tool steels used EutecTor 16B

Post-brazing: If necessary, parts can be cooled in water to "shock off" the flux residue.



XUPER® DRILTEC 8800

A COPPER-BASE MATRIX WITH FRACTIONALLY-SIZES TUNGSTEN CARBIDE NUGGETS FOR CUTTING AND GRIPPING APPLICATIONS

General Properties

Xuper DrilTec 8800, in its various sizes, contains tungsten carbide nuggets with specific minimum-maximum carbide sizes. Sizes range from 1/6" (smallest) to 3/8" (largest). Because the matrix is enhanced with nickel, carbide wetting and retention are maximized. As a general guide, the coarser carbides resist coarse materials and give a better cutting action. The smaller carbides resist fine abrasive materials while maintaining a more uniform wear rate.

Applications

Typical applications requiring over-burden retention, a gripping action, or a cutting action are drill bits, mixer paddles, rotary cutters, timber grippers, volute stirrers, percussive drills, etc…

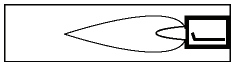
Technical Data				
	Xuper DrilTec 8800			
• Brazing Temp. Range	1685º - 1710ºF		915ºC - 930ºC	
• Matrix Hardness – BHN	200			
• Carbide Hardness (HV)	2000			
• Wear Index vs Steel Plate	0.060 vs 1.00*			
• Tungsten Carbide Content	55-65%			
• Matrix composition	Copper-base with nickel additions			
• Carbide Size (max-min)	-1/8+1/16	-3/16+1/8	-1/4 +3/16	-3/8+1/4
* Note re Wear Index: The larger the number the greater the rate of wear.				

Braze Welding Procedure

Preparation: Clean joint area with RotoClean OS or use a proprietary VOC-free solvent. Lightly grind the part to be coated to facilitate quicker bonding. Preheat broadly at first then locally for a good soaking preheat to 1000 to 1200ºF.

Technique: Use a large neutral flame to 2x carburizing. Use the rod surplus end to "tin" the part to be coated. Do not use an oxidizing flame as this can seriously oxidize the carbides. After tinning with a thin layer, deposit a more generous build-up using a continuous "drop-and-melt" technique. Continue until the surface is built-up to the required dimensions.

Post-brazing: Allow parts to cool naturally in still air or wrap in a heat-retardant material such as vermiculite or silicone blanket.



XUPER® ELASTODUR® R8811

A SPECIAL EXTRUDED HARDFACING ROD WITH 80% TUNGSTEN CARBIDE FOR MAXIMUM ABRASION RESISTANCE

General Properties

Xuper ElastoDur R8811 is a self-fluxing hardfacing brazing rod extruded around a central core wire for ease of use. The unique organic binder facilitates improved wetting and inter-particle bonding with excellent base-metal adhesion. Can be used on plain carbon and low-alloy steels, cast irons, and series 300 & 400 stainless steels.

Applications

Xuper ElastoDur R8811's unique properties cover a broad range of applications covering guide plates, mixer blades, mud pump rotors, debarker knives, drill augers, core barrels, gravel washer auger flights, wiper blocks, stabilizers, bag-packing augers, undercutter bits, etc…

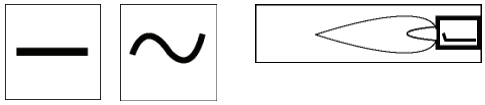
Technical Data		
	Xuper ElastoDur R8811	
• Brazing Temp. Range	1950º - 2100ºF	1065ºC – 1150ºC
• Bulk Hardness – HRC	65	
• Carbide Hardness (kg/mm²)	2000 or Ra 89-91	
• Tungsten Carbide Content	80%	
• Matrix composition	Nickel + Chromium + Boron…carbon & silicon	
• Gas Tungsten-arc Welding	Refer to the GTAW Procedure for the "T" Series Alloys	

Braze Welding Procedure

Preparation: Clean joint area with RotoClean OS or use a proprietary VOC-free solvent. Lightly grind the part to be coated to facilitate quicker bonding. Preheat broadly at first then locally to a good soaking preheat to 1000 to 1200ºF. Note that when brazing on cast iron make sure to prepare the surface by searing using an oxidizing flame. This will help to remove free graphite from the surface and help with bonding.

Technique: Use a large neutral flame to 1x carburizing. Do not use an oxidizing flame as this can reduce the self-fluxing properties and oxidize the wear-resistant carbides. After preheating, deposit the filler metal using a continuous "drop-and-melt" technique. Continue until the surface is built-up slightly oversize. This surplus will aid in grinding to profile if needed.

Post-brazing: Allow part(s) to cool naturally in still air or wrap in a heat-retardant material such as vermiculite or silicone blanket.



XUPER® EUTECBOR® 9000

A SPECIAL CAST ROD OF NICKEL, CHROMIUM, BORON, AND SILICON WITH SUPERIOR WEAR, OXIDATION, AND SCALING RESISTANCE

General Properties

Xuper EutecBor 9000 is a self-fluxing brazing rod with a wide range of wear-resisting properties. Deposits resist softening at elevated temperatures, and at "red heat" show little if any scaling. Deposits are non-magnetic & non-sparking. EutecBor 9000 can be applied to most steels, including stainless steels, nickel alloys, and cast irons.

Applications

Excellent for hardfacing valve seats, engine tappets, tool rests, cam lobes, cam seal rings, ceramic die cutters, plug gauges, cement pump screws, auger flights, core drills, etc…

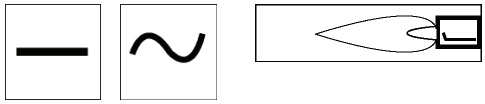
Technical Data			
	Xuper EutecBor 9000		
• Brazing Temperature Range	1850-2000ºF (1010º C – 1093º C)		
• Macro-hardness - HRC	58-60		
• Hot Hardness - DPH	585 at room temp.	440 at 1000ºF (537º C)	250 at 1200ºF (649º C)
• Wear Resistance [1]	9-11 mm²		
• Matrix composition	Nickel + Chromium + Boron + Silicon + Iron		
Note 1: Wear tests conducted under ASTM G-65 Test			
• Wear Properties			
Abrasion Resistance-2 body	Excellent!		
Galling Resistance	Excellent!		
General Corrosion Resistance	Excellent!		
High Temperature Property	Excellent!		

Braze Welding Procedure

Preparation: Clean joint area with RotoClean OS or use a proprietary VOC-free solvent. Lightly grind the part to be coated to facilitate quicker bonding. Preheat broadly at first then locally to a good soaking preheat to 1000 to 1200ºF. Note that when brazing on cast iron make sure to prepare the surface by searing using an oxidizing flame. This will help to remove free graphite from the surface and help with bonding.

Technique: Use a large neutral flame to 1x carburizing. Do not use an oxidizing flame as this can reduce the self-fluxing properties and oxidize the wear-resistant carbides. After preheating, deposit the filler metal using a continuous "drop-and-melt" technique. Continue until the surface is built-up slightly oversize.

Post-brazing: Allow part(s) to cool naturally in still air or wrap in a heat-retardant material such as vermiculite or silicone blanket.



TEROCOTE® 7888T

A CARBIDE-CONTAINING ALLOY IN COIL FORM FOR HEAVY-DUTY PROTECTION AGAINST SEVERE ABRASION

General Properties

TeroCote® 7888 T is a high performance anti-wear alloy. Produced in a single continuous coil form, 7888 T is a flexible continuous cord, comprised of a nickel core wire covered with an elastic binder that contains a high proportion of angular tungsten carbides and alloy powder. The coil is wound onto an easy-to-fit spool that can be mounted to facilitate use with automated wire-feeder systems.

Applications

Ripper Teeth, Drill Bits, Stabilizers, Mixer & Scraper Blades, Extrusion Press Screws, Conveyor Screws, Pump Rotors, Auger Screws, Press Screws, & Trencher Tool Holders.

Technical Data		
• Hardness – bulk properties	Matrix: HRC 35	Carbide: HV 2500
• Maximum Service Temp.	1300°F	704°C
• Maximum Number of Passes	1 pass only	
• Type of fuel gas	Oxy Acetylene	

Brazing Procedure using the Oxy-Acetylene Process

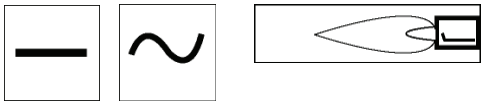
1. Mechanically clean the area to be coated by grinding or grit blasting.
2. Adjust torch for a neutral to slightly oxidizing flame. Apply a general preheat, 400-650°F, followed by a concentrated local heating of the area to be coated to around 900-1000°F.
3. Bring the end of the coil into contact with the work piece, at an angle of 35° from the work surface, with the torch nozzle at 60-70° pointing in the direction of travel.
4. As the alloy begins to melt, oscillate the torch nozzle from side to side advancing the flame along the alloy, which should be kept in contact with the work surface.

Note: Maintain a 3/16" gap between the inner flame cone and the work surface.

Deposition using the GTA Welding Process

Procedure is similar to that for the flame process. Maintain a gap of approximately 3/16" between the electrode and the work surface. Use low amperage settings to avoid excessive carbide melting.

Note: For both processes allow the work piece to cool slowly.



CAVITEC™-SMA

A SPECIALLY FORMULATED ELECTRODE HIGHLY RESISTANT TO CAVITATION-EROSION DAMAGE IN HYDRO-TURBINES AND PUMPS

General Properties

CaviTec-SMA is a proprietary alloy manufactured under license from Hydro-Québec-Canada. The composition of each alloy can best be described as "a high strain-hardening austenitic steel" where the strain-hardening mechanism is controlled by discrete additions of chromium, cobalt, silicon, and manganese. These alloy additions impart to the iron-base matrix wear characteristics similar to the cobalt-base alloys.

Applications

Principally for the repair of cavitated damage zones on Francis-type turbine runners, including Kaplan, Propeller, and Bulb models. Other application repair candidates are possible due to the enhanced composition and austenitic structure of the weld deposits. These are: Water pumps, desalination equipment, chemical rotor pumps, sugar/molasses pumps, liquid control valves, draft tubes, etc…

Technical Data		
	CaviTec-SMA	
• Hardness as-deposited (HV_{50})	250-280 – typical 270-300 on A27plain carbon steel 230-260 on 308/309 stainless steel	
• Work Hardened Hardness (HV_{50})	400-450	
• Metallurgical Structure	Essentially an austenitic γ-phase structure. The phase is metastable which transforms under cyclical stress to an α-martensitic phase which results in very fine deformation twinning.	
• Current & Polarity	DCEP (+)	
• Diameter	3/32…2.4mm	1/18…3.2mm
• Amperage Range	55-70	95-135

Welding Procedure

Preparation: Remove damaged area with arc-air or plasma gouging. Grind gouged surface to remove oxides and slag. Minimum depth of preparation should be 1/8". If the refill depth is greater than 3/8" first fill in with a grade 308 or 309 or the "L" versions. This preparation is needed to maintain a maximum CaviTec deposit depth of 3/8".

Technique: Maintain a medium-to-short arc and incline the electrode at a 45º angle in the direction of travel. The preferred bead profile should be a non-weave. Back whip craters to reduce crater-cracking tendencies.

Post-welding: Grind to profile

CASTOSTAR® 1 XHD

A WELDING ELECTRODE FORMULATED TO HAVE A MIX OF WEAR RESISTANCE AND HARDNESS AT ELEVATED TEMPERATURES

General Properties

CastoStar 1 XHD is an all-position electrode for applications involving abrasive wear at temperatures up to 1500ºF. Deposits work-harden and maintain good hot hardness properties up to 1000ºF. Deposits are compatible on carbon and low-alloy steels, stainless steels, and nickel-base alloys.

Applications

For hot forging die blocks, upsetting dies, hot punches, open-hearth rams, continuous casting rolls, valves, hot billet tongs, steel mill guide panels, forming dies, etc…

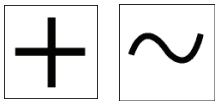
Technical Data		
	CastoStar 1 XHD	
• Hardness as-deposited (HRC)	38-40	
• Work Hardened Hardness (HRC)	43-45	
• Maximum Temperature	1500ºF excursion maximum	
• Maximum Temperature	1000ºF steady-state	
• Current & Polarity	DCEP (+) and AC	
• Diameters	1/8…3.2mm	5/32…4.0mm
• Amperage Range	120-160	160-220

Welding Procedure

Preparation: Clean weld area of scale and/or oxide. A nominal preheat of 150ºF is advised if part is below 40ºF or over 1" thick. For higher carbon steels higher preheats will be needed. Check the Reference Section for information regarding specific preheating levels for specific steel grades.

Technique: Deposit stringer beads or 2x to 3x weave beads. Excessive weaving is not advised as wide beads can cause excessive base metal overheating and degrade the weld deposit wear properties. Back whip craters to reduce crater-cracking tendencies. When de-slagging make sure to thoroughly remove slag at the weld deposit toes.

Post-welding: Allow parts to slow cool in still air. High carbon steels and air hardenable steels should be covered with a heat-retardant blanket. When machining is needed use tool set-up & speeds typically used with Series 300 stainless steels.



EUTECTRODE® 2B

A MACHINABLE, IMPACT-RESISTANT ELECTRODE WITH HIGH COMPRESSIVE STRENGTH…EXCELLENT CUSHIONING ALLOY

General Properties

EutecTrode 2B is principally formulated to resist severe impact on plain carbon steels, low-alloy steels, and many construction steels. Deposits have high compressive strength that makes them ideal for re-builds involving a cushion layer followed by a harder final hardface.

Applications

For build-ups prior to hardfacing and for slideways, wheel crowns, guides & couplings, rope winches and brake drums, etc…

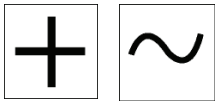
Technical Data		
	EutecTrode 2B	
• Hardness as-deposited (HRC)	30	
• Current & Polarity	DCEP (+) and AC	
• Diameters	1/8…3.2mm	5/32…4.0mm
• Amperage Range	90-110	120-180

Welding Procedure

Preparation: Clean weld area of scale and/or oxide. A nominal preheat of 150ºF is advised if part is below 40ºF or over 1" thick. For higher carbon steels higher preheats will be needed. Check the Reference Section for information regarding specific preheating levels for specific steel grades.

Technique: Deposit stringer beads or 2 times to 3 times weave beads. Excessive weaving is not advised as wide beads can cause excessive base metal overheating and degrade the weld deposit wear properties. Back whip craters to reduce crater-cracking tendencies. When de-slagging make sure to thoroughly remove slag at the weld deposit toes.

Post-welding: Allow parts to slow cool in still air. High carbon steels and air hardenable steels should be covered with a heat-retardant blanket. When machining is needed use tool set-up & speeds typically used with fine-grained pearlitic steels



EUTECTRODE® 40

A VERSATILE ELECTRODE FOR BOTH BUILD UP AND JOINING APPLICATIONS WITH SUPERIOR IMPACT RESISTANCE

General Properties

EutecTrode 40 deposits weld metal capable of withstanding high impact and compression loading. Deposits work harden in service These properties give versatility for both joining and hardfacing cushioning applications. Can be used on manganese steels and carbon steels.

Applications

Bucket lips & sides, Dozer cutting edges, Loader scoops, Ripper shanks, Sprockets Trencher teeth, Bucket teeth, Hammers, Augers, Undercarriage components, Scraper blades, Crusher roll jaws…

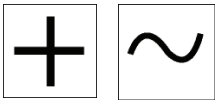
Technical Data		
	EutecTrode 40	
• Hardness as-deposited (HRB)	90-95	
• Work Hardened Hardness (HRC)	28-30	
• Current & Polarity	DCEP (+) and AC	
• Diameters	1/8…3.2mm	5/32…4.0mm
• Amperage Range	140-170	170-230
Note: Always keep electrodes in their container during storage. Damp electrodes can cause cracking & porosity. For re-drying procedures check with Technical Services.		

Welding Procedure

Preparation: Clean weld area of scale and/or oxide. A nominal preheat of 150ºF is advised if part is below 40ºF or over 1" thick. For higher carbon steels higher preheats will be needed. Check the Reference Section for information regarding specific preheating levels for specific steel grades. Note: Do not preheat Hadfield manganese steel castings above 400ºF, as this will cause time-temperature embrittlement.

Technique: Maintain a medium arc and incline the electrode at a 45º angle in the direction of travel. Excessive weaving (more than 2 x the electrode diameter) is not advised as wide beads can cause excessive base metal overheating and degrade the weld deposit wear properties. Back whip craters to reduce crater-cracking tendencies. When de-slagging make sure to thoroughly remove slag at the weld deposit toes.

Post-welding: Allow parts to slow cool in still air. High carbon steels and air hardenable steels should be covered with a heat-retardant blanket.



ULTIMIUM® N112

THE ULTIMATE TUNGSTEN CARBIDE ELECTRODE FOR 2-BODY ABRASION AND PARTICULATE EROSION RESISTANCE

General Properties

Ultimium N112 contains a high percentage of sintered tungsten carbides that impart significant abrasion and erosion resistance. Single pass deposits have full-through wear resistance that reduces application costs compared to non-tungsten carbide alloys.

Applications

Fly-ash conveyors, fan blades, pug mill knives, dry cement pumps, plastic mixer paddles, tool bits, muller plows, rotary drill bits, ash plows, ore chutes, sand slinger cups… etc

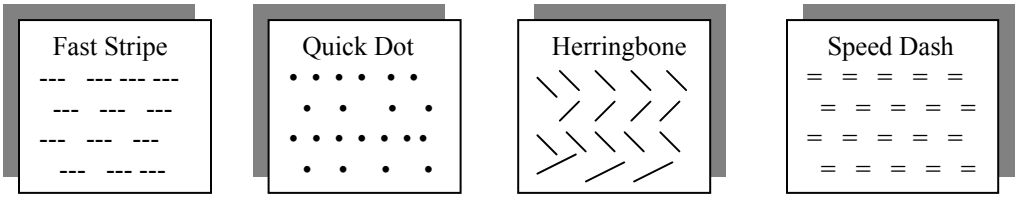
Technical Data	
	Ultimium N112
• Hardness as-deposited (HRC)	64-66 two-pass deposit
• Carbide Hardness (kg/mm²)	2000 or Ra 89-91
• Current & Polarity	DCEP (+) and AC
• Diameters	3/13-4.8mm
• Amperage Range	160-225

Welding Procedure

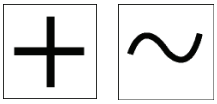
Preparation: Clean weld area of scale and/or oxide. A nominal preheat of 150ºF is advised if part is below 40ºF or over 1" thick. For higher carbon steels higher preheats will be needed. Check the Reference Section for information regarding specific preheating levels for specific steel grades.

Technique: Maintain a medium arc and incline the electrode at a 45º angle in the direction of travel. Excessive weaving is not advised as wide beads can cause excessive base metal overheating and degrade the weld deposit wear properties. Back whip craters to reduce crater-cracking tendencies. When de-slagging make sure to thoroughly remove slag at the weld deposit toes.

Wear Patterns: The use of wear patterns is a highly way or reducing both overall hardfacing costs while effectively decreasing welding time.



Post-welding: Allow parts to slow cool in still air. High carbon steels and air hardenable steels should be covered with a heat-retardant blanket.



XUPER® 646 XHD

A MUTLI-PROPERTY ELECTRODE FOR BOTH IMPACT AND JOINING APPLICATIONS WITH ENHANCED CRACK RESISTANCE

General Properties

Xuper 646 XHD deposits weld metal capable of withstanding high impact as well as having excellent crack resistance. These properties give versatility for both joining and hardfacing cushioning applications. Can be used on manganese steels, carbon steels, and dissimilar steel combinations.

Applications

- *Joining:* Bucket lips & sides, dozer cutting edges, loader scoops, ripper shanks
- *Build-up:* impactors, sprockets, trencher teeth, bucket teeth, hammers, augers under-carriage components, scraper blades, crusher roll jaws…

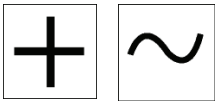
Technical Data		
	Xuper 646 XHD	
• Typical Tensile Strength	88,000 psi	607 N/mm^2
• Hardness as-deposited (HRB)	90-95	
• Work Hardened Hardness (HRC)	28-30	
• Current & Polarity	DCEP (+) and AC	
• Diameters	1/8…3.2mm	5/32…4.0mm
• Amperage Range	140-170	170-230
Note: Always keep electrodes in their container during storage. Damp electrodes can cause cracking & porosity. For re-drying procedures check with Technical Services.		

Welding Procedure

Preparation: Clean weld area of scale and/or oxide. A nominal preheat of 150ºF is advised if part is below 40ºF or over 1" thick. For higher carbon steels higher preheats will be needed. Check the Reference Section for information regarding specific preheating levels for specific steel grades. Note: Do not preheat Hadfield manganese steel castings above 400ºF as this will cause time-temperature embrittlement.

Technique: Maintain a medium arc and incline the electrode at a 45º angle in the direction of travel. Excessive weaving (more than 2 x the electrode diameter) is not advised as wide beads can cause excessive base metal overheating and degrade the weld deposit wear properties. Back whip craters to reduce crater-cracking tendencies. When de-slagging make sure to thoroughly remove slag at the weld deposit toes.

Post-welding: Allow parts to slow cool in still air. High carbon steels and air hardenable steels should be covered with a heat-retardant blanket.



EUTECTRODE® 700E

A VERSATILE GENERAL PURPOSE HARDFACING ELECTRODE FOR BOTH 2-BODY & 3-BODY ABRASION APPLICATIONS

General Properties

EutecTrode N700E is a medium chromium alloy with a very fine dispersion of chromium carbides. This fine carbide dispersion imparts high resistance to matrix erosion while maintaining superior general abrasion resistance.

Applications

Dredger teeth, excavator buckets, plow shares, pulverizers, cement grinder rings, augers, cultivator chisel points, dredge pumps, sub-soiler blades, slurry pipe elbows, etc…

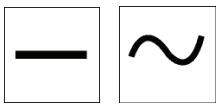
Technical Data		
	EutecTrode 700E	
• Hardness as-deposited (HRC)	58-60 average	
• Carbide Hardness (VPN)	1200 (Cr_7C_3)	
• Current & Polarity	DCEN (-) and AC	
• Diameters	1/8…3.2mm	5/32 …4.0mm
• Amperage Range	105-140	120-170

Welding Procedure

Preparation: Clean weld area of scale and/or oxide. A nominal preheat of 150ºF is advised if part is below 40ºF or over 1" thick. For higher carbon steels higher preheats will be needed. Check the Reference Section for information regarding specific preheating levels for specific steel grades. Note: Do not preheat Hadfield manganese steel castings above 400ºF as this will cause time-temperature embrittlement.

Technique: Maintain a medium arc and incline the electrode at a 45º angle in the direction of travel. Excessive weaving (more than 2 x the electrode diameter) is not advised as wide beads can cause excessive base metal overheating and degrade the weld deposit wear properties. Back whip craters to reduce crater-cracking tendencies.
Note: If wide beads are needed to produce thin coatings, hold a short-to-medium arc length and move rapidly from side-to-side.

Post-welding: Allow parts to slow cool in still air. High carbon steels and air hardenable steels should be covered with a heat-retardant blanket.



EUTECTRODE® 4002

AN ALL-POSITION IMPACT-RESISTANT ELECTRODE WITH HIGH COMPRESSIVE STRENGTH & EXCELLENT IMPACT RESISTANT PROPERTIES

General Properties

EutecTrode 4002 has been formulated to resist severe impact on plain carbon steels, low-alloy steels, and many construction steels. Deposits have high compressive strength that makes them ideal for re-builds involving a cushion layer followed by a harder final hardface.

Applications

For build-ups prior to hardfacing and for slideways, wheel crowns, guides & couplings, rope winches and brake drums, etc…

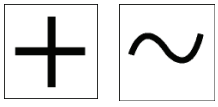
Technical Data			
	EutecTrode 4002		
• Hardness as-deposited (HRC)	28 – 30 average		
• Current & Polarity	DCEP (+) and AC		
• Diameters	1/8…3.2mm	5/32…4.0mm	3/16…4.8mm
• Amperage Range	90-110	120-180	205-245

Welding Procedure

Preparation: Clean weld area of scale and/or oxide. A nominal preheat of 150ºF is advised if part is below 40ºF or over 1" thick. For higher carbon steels higher preheats will be needed. Check the Reference Section for information regarding specific preheating levels for specific steel grades.

Technique: Deposit stringer beads or 2x to 3x weave beads. Excessive weaving is not advised as wide beads can cause excessive base metal overheating and degrade the weld deposit wear properties. Back whip craters to reduce crater-cracking tendencies. When de-slagging make sure to thoroughly remove slag at the weld deposit toes.

Post-welding: Allow parts to slow cool in still air. High carbon steels and air hardenable steels should be covered with a heat-retardant blanket. When machining is needed use tool set-up & speeds typically used with fine-grained pearlitic steels



EUTECTRODE® 4004N

UNIQUELY FEATURED HARDFACING ELECTRODES WITH SPECIFIC APPLICATION ABRASION RESISTANT PROPERTIES

General Properties

An improved chromium carbide electrode with enhanced weldability. An ideal candidate alloy when parts wear due to abrasion and moderate impact.

Applications

Augers, crusher liners, scrapers, dredge pumps, dipper teeth/lips, muller tires, anvils, dredger parts, bucket arms, pug mill paddles, impactor bars, tamper tips, pusher shoes, auger bits, ore chutes, etc…

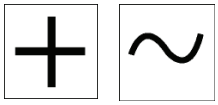
Technical Data			
	EutecTrode 4004N		
• Hardness as-deposited (HRC)	55-60 average		
• Carbide Hardness (VPN)	1200 (Cr_7C_3)		
• Carbide % avg. count	Medium		
• Current & Polarity	DCEP (+) and AC		
• Diameters	1/8…3.2mm	5/32…4.0mm	3/16…4.8mm
• Amperage Range	120-150	130-170	170-230

Welding Procedure

Preparation: Clean weld area of scale and/or oxide. A nominal preheat of 150ºF is advised if part is below 40ºF or over 1" thick. For higher carbon steels higher preheats will be needed. Check the Reference Section for information regarding specific preheating levels for specific steel grades. Note: Do not preheat Hadfield manganese steel castings above 400ºF as this will cause time-temperature embrittlement.

Technique: Maintain a medium arc and incline the electrode at a 45º angle in the direction of travel. Excessive weaving (more than 2 x the electrode diameter) is not advised as wide beads can cause excessive base metal overheating and degrade the weld deposit wear properties. Back whip craters to reduce crater-cracking tendencies.

Post-welding: Allow parts to slow cool in still air. High carbon steels and air hardenable steels should be covered with a heat-retardant blanket.



CHROMIUM CARBIDE ELECTRODE FAMILY EUTECTRODE® 5003, EUTECTRODE® 5005 & CHROMCARB® N6006

UNIQUELY FEATURED HARDFACING ELECTRODES WITH SPECIFIC APPLICATION ABRASION RESISTANT PROPERTIES

General Properties

• *EutecTrode 5003* is a combat product with improved weldability. Ideal for combating abrasion when accompanied by moderate impact.
• *EutecTrode 5005* has superior weldability on most construction and earthmoving equipment steels and alloys.
• *ChromCarb N6006* is the benchmark chromium carbide product for applications involving abrasion and gouging impact.

Applications

• Eutectic 5003: Augers, crusher liners, scrapers, dredge pumps, dipper teeth/lips, etc…
• Eutectic N5005: Muller tires, anvils, dredger parts, bucket arms, pug mill paddles, etc…
• Eutectic N6006: Impactor bars, tamper tips, pusher shoes, auger bits, ore chutes, etc…

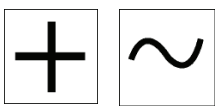
Technical Data			
	EutecTrode 5003	EutecTrode 5005	ChromCarb N6006
• Hardness as-deposited (HRC)	55-58	57-60	57-60
• Carbide Hardness (VPN)	1200 (Cr_7C_3)	1200 (Cr_7C_3)	1200 (Cr_7C_3)
• Carbide % avg. count	Medium	Medium-to-High	Medium-to-High
• Current & Polarity	DCEP (+) and AC		
• Diameters	1/8…3.2mm	5/32…4.0mm	3/16…4.8mm
• Amperage Range 5003	120-150	130-170	170-230
5005 & N6006	90-130	120-160	150-210

Welding Procedure

Preparation: Clean weld area of scale and/or oxide. A nominal preheat of 150ºF is advised if part is below 40ºF or over 1" thick. For higher carbon steels higher preheats will be needed. Check the Reference Section for information regarding specific preheating levels for specific steel grades. Note: Do not preheat Hadfield manganese steel castings above 400ºF as this will cause time-temperature embrittlement.

Technique: Maintain a medium arc and incline the electrode at a 45º angle in the direction of travel. Excessive weaving (more than 2 times the electrode diameter) is not advised as wide beads can cause excessive base metal overheating and degrade the weld deposit wear properties. Back whip craters to reduce crater-cracking tendencies.

Post-welding: Allow parts to slow cool in still air. High carbon steels and air hardenable steels should be covered with a heat-retardant blanket.



ABRATEC® N6710 XHD & ABRATEC® N6715 XHD MULTI-CARBIDE ELECTRODE FAMILY

BOTH PREMIUM HARDFACING ELECTRODES ARE SUPPORTED BY A SELECTIVE MIX OF PRIMARY AND SECONDARY CARBIDES

General Properties

• *Eutectic N6710XHD* deposits high abrasion-resistant weld metal with a single-pass and double the deposition rate compared with more conventional electrodes.
• *Eutectic N6715XHD* deposits weld metal resistant to high temperature abrasion with a single-pass.

Applications

• *AbraTec N6710 XHD* can be used on plain carbon and low-alloy steels, manganese steel castings & AR plate weld reinforcement. For use when hardfacing various dragline bucket parts, scraper blades, conveyor chains, mixer paddles, sludge pumps, etc.
• *AbraTec N6715 XHD* is ideal for hardfacing hot agglomeration fans, coke pusher shoes, blast furnace hoppers conveyor links, sinter equipment, auger flights, pug mill knives, etc.

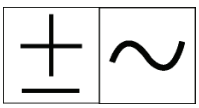
Technical Data				
		AbraTec N6710 XHD	AbraTec N6715 XHD	
• Hardness as-deposited (HRC)		63–65 single-pass	64-66 single-pass	
• Carbide Hardness (VPN)		1200 –1300 (M_7C_3)*	1250 –1400 (M_7C_3)	
• Typical Temperature Range		1000ºF	1200ºF	
• Carbide Content		Medium-to-High	High	
• Current & Polarity		DCEN (-) and AC	DCEP (+) and AC	
• Diameters		1/8…3.2mm	5/32…4.0mm	3/16…4.8mm
• Amperage Range	N6710XHD	120-190	170-230	220-290
• Amperage Range	N6715XHD	160-240	180-270	230-375
* The "M" stands for Cr-W-Cb-Mo indicating a complex of mixed, wear-reducing carbides.				

Welding Procedure

Preparation: Clean weld area of scale and/or oxide. A nominal preheat of 150ºF is advised if part is below 40ºF or over 1" thick. For higher carbon steels higher preheats will be needed. Check the Reference Section for information regarding specific preheating levels for specific steel grades. Note: Do not preheat Hadfield manganese steel castings above 400ºF as this will cause time-temperature embrittlement.

Technique: Maintain a medium-to-short arc and incline the electrode at a 45º angle in the direction of travel. Excessive weaving (more than 2 times the electrode diameter) is not advised as wide beads can cause excessive base metal overheating and degrade the weld deposit wear properties. Back whip craters to reduce crater-cracking tendencies.

Post-welding: Allow parts to slow cool in still air. High carbon steels and air hardenable steels should be covered with a heat-retardant blanket.



EUTECTIC® 6804 XHD

AN IRON-BASE "SUPER ALLOY" WITH HIGH CREEP RESISTANCE AND SUPERIOR METAL-TO-METAL WEAR AT ELEVATED TEMPERATURES

General Properties

Eutectic 6804XHD weld deposits achieve a beneficial hardness value with only a single-pass. Deposits have reduced cracking sensitivity compared to similar hardness iron-base alloys and excellent creep resistance upto 1200ºF. Deposits are heat-treatable.

Applications

For hardfacing and re-building of stamping & trimming dies, hot forging dies and formers, hot extrusion plungers, mandrels, steel mill table rolls, etc…

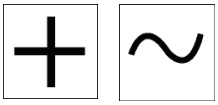
Technical Data			
	Eutectic 6804 XHD		
• Hardness as-deposited (HRC)	46-49		
• Work Hardened Hardness (HRC)	54-57		
• Annealing Temperature • Hardening Temperature • Tempering temperature	1400 to 800ºF 1920 to 2010ºF 750ºF…cool in still air.		760-800ºC 1050-1100ºC 400ºC
• Current & Polarity	DCEP (+) and AC		
• Diameters	1/8…3.2mm	5/32…4.0mm	3/16…4.8mm
• Amperage Range	85-140	120-165	170-220
Note: Always keep electrodes in their container during storage. Damp electrodes can cause cracking & porosity. For re-drying procedures check with Technical Services.			

Welding Procedure

Preparation: Clean weld area of scale and/or oxide. For tool & die preheats refer to the Reference Section under the specific grade of tool steel. For all other low carbon steels a nominal preheat of 150ºF is advised if part is below 40ºF or over 1" thick. For higher carbon steels higher preheats will be needed. Again, check the Reference Section for information regarding specific preheating levels for specific application steel.

Technique: Maintain a medium-to-short arc and incline the electrode at a 45º angle in the direction of travel. Excessive weaving (more than 2 times the electrode diameter) is not advised as wide beads can cause excessive base metal overheating and degrade the weld deposit wear properties. The optimum bead width is a stringer bead. Back whip craters to reduce crater-cracking tendencies.

Post-welding: Allow parts to slow cool in still air. High carbon steels, air hardenable steels, and all tool steels, should be covered with a heat-retardant blanket to control the cool-down rate.



EUTECTIC® 6899 XHD

A SPECIALLY FORMULATED ELECTRODE FOR CRITICAL APPLICATIONS INVOLVING IMPACT AT HIGH HEAT

General Properties

Eutectic 6899 XHD is a nickel-base electrode with controlled additions of chromium, molybdenum, tungsten and iron. These discrete alloying elements impart high temperature oxidation resistance, hot abrasion resistance, and elevated temperature toughness. For use on most steels, heat-treatable tool & die alloys, and nickel-base alloys

Applications

Principal applications are hot forging & shaping dies, blanking dies, cutting and trimming tools, steel mill ingot tongs, tuyères, impact dies and press tools, water valve seats, steam valves & seats, etc.

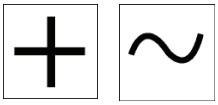
Technical Data			
	Eutectic 6899 XHD		
• Hardness as-deposited (HRC)	22-25…typical hardness range		
• Work Hardened Hardness (HRC)	39-42…typical hardness range		
• Temperature Limit Range	1000 – 1100ºF	540ºC – 595ºC	
• Hot Hardness at 1000ºF (VPN)	350 average		
• Current & Polarity	DCEP (+) and AC		
• Diameters	1/8…3.2mm	5/32…4.0mm	3/16…4.8mm
• Amperage Range	85-140	120-165	170-220
Note: Always keep electrodes in their container during storage. Damp electrodes can cause cracking & porosity. For re-drying procedures check with Technical Services.			

Welding Procedure

Preparation: Clean weld area of scale and/or oxide. For tool & die preheats refer to the Reference Section under the specific grade of tool or die steel. For low carbon steels a nominal preheat of 150ºF is advised if the part is below 40ºF or over 1" thick. For higher carbon steels higher preheats will be needed. Again, check the Reference Section for information regarding specific preheating levels for specific application steel.

Technique: Maintain a short arc, or use a contact technique when appropriate and incline the electrode at a 45º angle in the direction of travel. Excessive weaving (more than 2 times the electrode diameter) is not advised as wide beads can cause excessive base metal overheating and degrade the weld deposit wear properties. The optimum bead width is a stringer bead. Back whip craters to reduce crater-cracking tendencies.

Post-welding: Allow parts to slow cool in still air. High carbon steels, air hardenable steels, and all tool steels, should be covered with a heat-retardant blanket to control the cool-down rate.



SERIES 7000 TUBULAR ELECTRODES
EUTECTRODE® 7020 - 7030 - 7040

HIGH SPEED-HIGH VOLUME TUBULAR HARDFACING ELECTRODES DESIGNED FOR MAXIMUM EFFICIENCY AND PRODUCTIVITY

General Properties

• *EutecTrode 7020* has a highly alloyed composition suitable for severe abrasion and medium impact. Maintains hardness up to 1000ºF. Diameters electrodes are all-positional
• *EutecTrode 7030* is specifically formulated to resist fine particle erosion, 2-body abrasion, when accompanied by light impact. Large diameter electrodes are all-position.
• *EutecTrode 7040* for severe abrasion and high temperature erosion up to 1500ºF.
Large diameter electrodes are all-position.

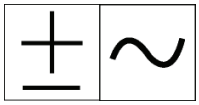
Applications

• *EutecTrode 7020:* Bag packer screws, pug mill augers, muller tires, end-bits, sheepsfoot tampers, cage crushers, asphalt mixer paddles, etc.
• *EutecTrode7030:* Ripper shanks, impeller bars, stripper bars, grizzly bars, drag chain links, cement chutes, clinker belt links, skip car lips, discharge chutes, cone crusher rolls.
• *EutecTrode 7040:* Ash conveyor links, feeder screws, rotor & impeller bars, dust collector fans, ash conveyor elbows, sintering plant augers, kiln flights, kiln agitators flights, etc…

Technical Data			
	EutecTrode 7020	EutecTrode 7030	EutecTrode 7040
• Hardness as-deposited (HRC)	55-60	55-60	62-64
• Work Hardened Hardness (HRC)	Not Applicable		
• Typical Temperature Range	1000ºF (538ºC)	1000ºF (538ºC)	1500ºF (816ºC)
• Carbide Content & Concentration	Medium	Med.-to-High	High
• Carbide Hardness (VPN)	~1200 (M_7C_3)*		
• Current & Polarity	DCEN/P (±) and AC		
• Diameters	1/4 …6.4mm	3/8…9.0mm	1/2…12.7mm
• Amperage Range	95-145	150-210	180-340
* The "M" stands for Cr-W-Cb-Mo indicating a complex of mixed, wear-reducing carbides.			

Welding Procedure

Preparation: Clean weld area of scale and/or oxide. A nominal preheat of 150ºF is advised if part is below 40ºF or over 1" thick. For higher carbon steels higher preheats will be needed. Check the Reference Section for information regarding specific preheating levels for specific steel grades. Note: Do not preheat Hadfield manganese steel castings above 400ºF as this will cause time-temperature embrittlement.
Technique: Maintain a medium-to-short arc and incline the electrode at a 45º angle in the direction of travel. Excessive weaving (more than 2 times the electrode diameter) is not advised as wide beads can cause excessive base metal overheating and degrade the weld deposit wear properties. Back whip craters to reduce crater-cracking tendencies.
Post-welding: Allow parts to slow cool in still air. High carbon steels and air hardenable steels should be covered with a heat-retardant blanket.



EUTECTIC® CAVITEC™ GMA

Technical Data			
	Eutectic CaviTec-GMA		
• Hardness as-deposited (HV_{50})	250-280 – typical 270-300 on A27plain carbon steel 230-260 on 308/309 stainless steel		
• Work Hardened Hardness (HV_{50})	400-450		
• Metallurgical Structure	Essentially an austenitic γ-phase structure. The phase is metastable which transforms under cyclical stress to a α-martensitic phase which results in very fine deformation twinning.		
Pulsed-Arc Program Parameters			
• Current & Polarity	DCEP (+)		
• Diameters	0.045 – 1.2mm		1/16 – 1.6mm
• Shielding Gas (preferred)	100% Argon		100% Argon
• Shielding Gas (alternative)	Argon + 2% O_2		Argon + 2% O_2
• Shielding Gas Flow Rate (cfh)	40		40
• Electrode stick-out: flat position	A	1/2-5/8 (12-16mm)	5/8-7/8 (16-22mm)
• Electrode stick-out: out-of-position	B	3/8-5/8 (10-16mm)	1/2-3/4 (12-19mm)
• Wire Speed (in/min): flat position	A	195	315
• Wire Speed (in/min): out-of-position	B	125	275
• Maximum Peak Current	A B	165 amps 125 amps	240 amps 190 amps
• Average Voltage	A B	28 volts 30 volts	30 volts 30 volts
• Pulse per Second	A B	60 70	50 60
• Pulse Width	A B	35% 30%	35% 30%

Welding Procedure

Preparation: Remove damaged area with arc-air or plasma gouging. Grind gouged surface to remove oxides and slag. Minimum depth of preparation should be 1/8-in. If the refill depth is greater than 3/8-in first fill in with a grade 308 or 309 or the "L" versions. This preparation is needed to maintain a maximum CaviTec deposit depth of 3/8-in.

Technique: Maintain a medium-to-short arc and incline the electrode at a 45º angle in the direction of travel. The preferred bead profile should be a non-weave. Back whip craters to reduce crater-cracking tendencies.

Post-welding: Grind to profile.

ENDOTEC® DO*05

A SPECIAL GAS-SHIELDED CORED WIRE FOR SEVERE IMPACT AND HIGH COMPRESSION WEAR DAMAGE

General Properties

EnDOtec DO*05 is a high manganese-chromium wire formulated to resist severe impact without spalling. It can be used as a "stand alone" re-build wire or used as a cushion layer for harder top coat alloys.

Applications

Battering tools, crusher rolls, end-plates, grizzlies, impeller bars, jaw crushers, latch bars, quarry augers, bucket teeth, wear plates, gyratory crushers & mantles, frogs, etc…

Technical Data				
		EnDOtec DO*05		
• Hardness as-deposited (HRC)		20-22 with 2 to 3 passes		
• Work Hardened Hardness (HRC)		39-42		
• Current & Polarity		DCEP (+) GMA Parameters		
Diameter	Shielding Gas*	Amperage	Voltage	Wire Stickout
0.045-spray	Argon + 2% O_2	180-250	23-28	5/8 ± 1/8
0.045-spray	Argon + 25% CO_2	180-250	24-30	5/8 ± 1/8
0.045-short-arc	100% CO_2	100-200	17-22	9/16 ± 1/16
1/16-spray	Argon + 2% O_2	230-320	24-28	5/8 ± 1/8
1/16-spray	Argon + 25% CO_2	240-320	24-30	5/8 ± 1/8
1/16-short-arc	100% CO_2	100-200	17-22	9/16 ± 1/16
Notes: Flow rates 30 to 40 scfh. Deposits of DO*05 cannot be cut with an oxy-fuel torch. Plasma cutting or arc-air gouging processes are suggested.				

Welding Procedure

Preparation: Clean weld area of scale and/or oxide. A nominal preheat of 150ºF is advised if part is below 40ºF or over 1" thick. For higher carbon steels higher preheats will be needed. Check the Reference Section for information regarding specific preheating levels for specific steel grades. Note: Do not preheat Hadfield manganese steel castings above 400ºF as this will cause time-temperature embrittlement.

Technique: Maintain the optimum electrode stickout and hold a 75º angle from the vertical in the direction of travel. Do not weave excessively. Wide beads can cause porosity, excessive base metal overheating, and degrade the weld deposit wear properties. Back whip craters to reduce crater-cracking tendencies and potential crater out-gassing

Post-welding: Allow parts to slow cool in still air. High carbon steels and air hardenable steels should be covered with a heat-retardant blanket. Note: Manganese castings can be cooled more rapidly by using air quenches.

ENDOTEC® DO*10

A QUALITY HARDFACING CORED WIRE FOR GRINDING ABRASION & MODERATE IMPACT APPLICATIONS

General Properties

EnDOtec DO*10 is recommended for rapid build-up on low and medium carbon steels. Weld metal contains vanadium & molybdenum for improved toughness and improved resistance to cross-checking. A double carbide network imparts excellent wear resistant properties. Superior all-position weldability is part of the EnDOTec Product Line.

Applications

Rebuilding worn construction equipment, shovel buckets, cutter heads, bucket floors, feed rolls, muller plows, conveyor screws.

Technical Data				
		EnDOtec DO*10		
• Hardness as-deposited (HRC)		1st pass: 52	2nd pass: 56	
• Number of passes		Unlimited but practical at 1" (25mm) maximum.		
• Current & Polarity		**DCEP (+) GMA Parameters**		
Diameter	Shielding Gas*	Amperage	Voltage	Wire Stickout
0.045-spray	98%Ar + 2% O_2	175-200	28-31	5/8 ± 1/8
0.045-short-arc	98%Ar + 2%O_2	100-175	25-29	5/8 ± 1/8
1/16-spray	100% CO_2	230-290	25-30	5/8 ± 1/8
1/16-short-arc	100% CO_2	185-250	25-30	5/8 ± 1/8

• Flow rates 30 - 40 scfh.
• ***Hardness Influence****:* As hardness increases wear typically decreases
• ***Load or Pressure Influence:*** Wear rates typically increase with higher loads & compression.
• *Temperature Influence:* In general, as the temperature increases so does the wear rate.
• *Particle or burden Speed Influence:* Any increase will, and can, increase wear.

Welding Procedure

Preparation: Clean weld area of scale and/or oxide. A nominal preheat of 150ºF is advised if part is below 40ºF or over 1" thick. For higher carbon steels higher preheats will be needed. Check the Reference Section for information regarding specific preheating levels for specific steel grades and tool & die steels.

Technique: Maintain the optimum electrode stickout and hold a 75º angle from the vertical in the direction of travel. Do not weave excessively. Wide beads can cause porosity, excessive base metal overheating, and degrade the weld deposit wear properties. Back whip craters to reduce crater-cracking tendencies and potential crater out-gassing

Post-welding: Allow parts to slow cool in still air

EnDOtec® DO*11

A PREMIUM METAL CORED, GAS SHIELDED, WIRE FOR EXCEPTIONAL RESISTANCE TO SEVERE ABRASION

General Properties

Exclusive, gas shielded, metal cored alloy wire ideal for maintenance and repair applications or batch manufacturing where the highest integrity welding, efficiency and productivity are required. The slag-free deposit features a high density of cast tungsten carbide particles evenly distributed in a nickel matrix. This gives exceptional resistance to abrasive and erosive particles with moderate impact and is specifically for applications in hot or corrosive environments.

Applications

High Speed Fan Blades, Ash Handling Systems, Brick and Tile Extruders, Sintering Parts, Slag Breakers, Transfer Chutes, Stabilizers, Screw Conveyers, Press Rolls, Mixers and Paddles.

Technical Data					
• Hardness as-deposited (HRC)	54 - 56		55 –57		
• Maximum Service Temp.	1000°F		540°C		
• Maximum Number of Passes	1 – 2 passes				
• Current & Polarity	DCEP (+)				
• Hardness Carbide (HV)	~2400 HV				
*• Guideline Parameters for DO*11*					
Diameter	Amp Range	Volt Range	Stick-out	Shielding Gas	Flow-scfh
1/16”	90-130	17-22	1/2 ± 1/8	Ar + 2% O_2	35-45
Note: It is very important to keep the welding amperage below 130 to prevent a loss of in-service performance. If higher welding amperages are needed use EnDOtec DO*611.					

Welding Procedure

Preparation: Remove all contaminants, particularly oil & grease. Lightly grind surface to remove superficial oxides. Preheat according to the base metal make-up and potential to air harden.

Technique: After checking that the welding conditions are optimal by testing on scrap metal, position the gun head at a 70-80º angle and use a "push" technique for downhand welding. For fully automated welding such as hardfacing crusher rolls, the wire should exit at about a 10º lagging angle from top-dead-center. Using this technique will assure a smooth and regular weld deposit profile with the optimum level of fusion and deposit integrity.

Post-welding: All parts should be slow-cooled out of drafts and high moisture areas.

ENDOTEC® DO*14

FORMULATED FOR COMBINED TOUGHNESS AND HARDNESS

General Properties

EnDOtec DO*14 deposits will provide a property balance between hardness and toughness. The gas shielded wire can be used for multi-pass build-ups without bulk cracking and/or fracturing. Useful for tooling applications up to 900ºF.

Applications

Hog anvils, hot forming & shaping dies, pump casings, die punches, press tools, cable sheaves, sintering grates, bag packer screws, debarker hammers, etc…

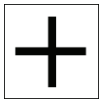
Technical Data				
		EnDOtec DO*14		
• Hardness as-deposited (HRC)		1st pass: 20	2nd pass: 38	3rd pass: 45
• Work Hardened Hardness (HRC)		50		
• Multi-Pass Build-up		Unlimited but practical at ½-in (12mm)		
• Current & Polarity		**DCEP (+) GMA Parameters**		
Diameter	Shielding Gas*	Amperage	Voltage	Wire Stickout
0.045-spray	Argon + 2% O_2	150-250	24-29	5/8 ± 1/8
0.045-short-arc	75%Ar + 25% CO_2	100-180	14-18	9/16 ± 1/16
1/16-spray	Argon + 2% O_2	220-330	25-30	5/8 ± 1/8
1/16-short-arc	75%Ar + 25% CO_2	130-200	15-19	9/16 ± 1/16
Notes: Flow rates 30 - 40 scfh. Weld metal responds to heat-treating and can be machined using carbide single-point tools.				

Welding Procedure

Preparation: Clean weld area of scale and/or oxide. A nominal preheat of 150ºF is advised if part is below 40ºF or over 1" thick. For higher carbon steels higher preheats will be needed. Check the Reference Section for information regarding specific preheating levels for specific steel grades and tool & die steels.

Technique: Maintain the optimum electrode stickout and hold a 75º angle from the vertical in the direction of travel. Do not weave excessively. Wide beads can cause porosity, excessive base metal overheating, and degrade the weld deposit wear properties. Back whip craters to reduce crater-cracking tendencies and potential crater out-gassing

Post-welding: Allow parts to slow cool in still air. High carbon steels and air hardenable steels should be covered with a heat-retardant blanket



OilTec™ OTW-16

A UNIQUELY FORMULATED HIGH-PERFORMANCE WIRE FOR HARDBANDING APPLICATIONS IN THE OIL EXTRACTION INDUSTRY

General Properties

OTW-16 achieves optimized wear-resistant properties due to a uniquely modified microstructure supported by an ultra-dispersed network of wear resistant carbides. A weighted mix of multi-carbides (Cr, Mo, W, and Ti) imparts both a uniform & tempered martensitic microstructure with optimized deposit through-thickness properties for maximum wear resistance. The deposit is considered "casing friendly" and will not prematurely wear casing typical of other, carbide-laden deposits.

Applications

The primary application for this newly formulated wire is for hard-banding drill collars & stems. The alloy is also recommended for applications requiring multi-pass, crack-free welds with optimized hardness and wear-resistant properties.

Technical Data					
• Hardness as-deposited (HRC)	53 – 54 1st pass		53 –55 2nd pass		
• Maximum Number of Passes	3 passes				
• Current & Polarity	DCEP (+)				
• Secondary Shielding Gas	Argon + 25% CO_2				
• Guideline Parameters for OilTecW-16					
Diameter	Amp Range	Volt Range	Stick-out	Shield Gas	Flow-scfh
1/16”	205-220	22-25	3/4 ± 1/8	Ar + 2% O_2	35-45

Welding Procedure

Preparation: Clean weld area of scale and/or oxide and make sure there is no oil or grease present. Use a suitably approved OSHA solvent to remove any surface contaminants. When welding the heat treatable low-alloy steels (HSLA), a good rule-of-thumb is to use the Ms temperature as a guide to preheating and for interpass temperature control. Based on the material thickness, the minimum preheat & interpass temperature for a thickness of ~2"-in. (50mm) for grade AISI 4130 is 450ºF with a +50ºF excursion. For AISI Grade 4140 use 500ºF with a +50ºF excursion.

Technique: After checking that the welding conditions are optimal by testing on scrap metal, position the gun head at a 70-80º angle and use a "push" technique for downhand welding. For fully automated welding such as hardfacing cement crusher rolls, the wire should exit at about a 10º lagging angle from top dead center. Using this technique will assure a smooth and regular weld deposit profile with the optimum level of fusion and deposit integrity.

Post-welding: All parts should be slow cooled out of drafts and high moisture areas.

EnDOtec® DO*17

A UNIQUE ENDOTEC CORED SURFACING AND BUILD-UP WELDING WIRE DESIGNED FOR COATING SIDES OF SUGAR CANE CRUSHER ROLL TEETH

General Properties

DO*17 is a unique surfacing and build-up EnDOtec® wire designed specifically for coating sides of teeth on sugar cane crushing rolls. Deposit is flat and crack free, which is critical in maintaining crusher tolerance and efficiency. DO*17 is also a base coat for the Eutectic "Pull and Tear" profile.

Applications

Sugar cane crusher rolls. DO*17 is typically designed for applications involving low tooth angles of 39º. For tooth angles of 44º and higher or when welding outside in windy conditions, use TeroMatec® AN 4617.

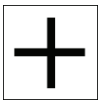
Technical Data					
• Hardness as-deposited (HRC)	48 – 50 1st pass		50 –52 2nd pass		
• Current & Polarity	DCEP (+)				
• Guideline Parameters for DO*17					
Diameter	Amp Range	Volt Range	Stick-out	Shield Gas	Flow-scfh
0.045”	180-220	26-30	5/8 ± 1/8	Ar + 2% O_2	35-45

Welding Procedure

Preparation: Remove all contaminants, particularly oil & grease. Lightly grind surface to remove superficial oxides. Preheat according to the base metal make-up and potentials to air harden.

Technique: Remove any fatigued material from the surface using Eutectic ChamferTrode®. If base material is contaminated a buffer layer of DO*21 wire or Eutectic 27 electrode may be needed. Pre-Heat is generally not necessary. Use stringer beads to prevent over heating the base material.

Post-welding: All parts should be slow cooled out of drafts and high moisture areas.

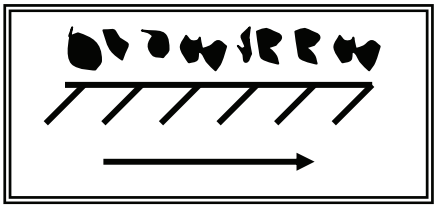


ENDOTEC® DO*33

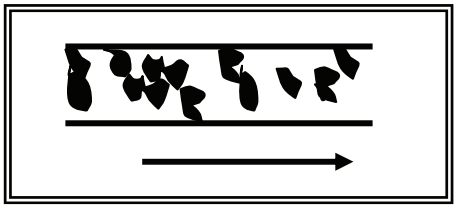
A GAS SHIELDED CORED WIRE WITH A HIGH SINGLE PASS HARDNESS AND MAXIMUM ABRASION & EROSION RESISTANCE

General Properties

EnDOtec DO*33 is a highly alloyed core wire which maintains abrasion resistance and hot hardness properties up to 1000ºF. Weld deposits offer the maximum resistance to both 2-body and 3-body abrasion with a single pass!



2-Body Abrasion



3-Body Abrasion

Applications

Rolling mill guides, slurry pump casings, transfer augers, screw conveyors, feed rolls, cutter heads, bucket lips/side frames, mixer paddles, brick die cores, induced-draft, etc…

Technical Data				
		EnDOtec DO*33		
• Hardness as-deposited (HRC)		65-68		
• Maximum Number of Passes		2		
• Current & Polarity		**DCEP (+) GMA Parameters**		
Diameter	Shielding Gas*	Amperage	Voltage	Wire Stickout
0.045-spray	75%Ar + 25% CO_2	200-250	25-30	3/4 ± 1/16
0.045-short-arc	75%Ar + 25% CO_2	150-180	25-28	1/2 ± 1/16
1/16-spray	75%Ar + 25% CO_2	220-350	25-32	3/4 ± 1/16
1/16-short-arc	75%Ar + 25% CO_2	200-250	25-28	1/2 ± 1/16
Note: Flow rates 30 - 40 scfh.				

Welding Procedure

Preparation: Clean weld area of scale and/or oxide. A nominal preheat of 150ºF is advised if part is below 40ºF or over 1" thick. For higher carbon steels higher preheats will be needed. Check the Reference Section for preheat information.

Technique: Maintain the optimum electrode stickout and hold a 75º angle from the vertical in the direction of travel. Do not weave excessively. Wide beads can cause porosity, excessive base metal overheating, and degrade the weld deposit wear properties. Back whip craters to reduce crater-cracking tendencies and potential crater out-gassing.

Post-welding: Allow parts to slow cool in still air.

EnDOtec® DO*327

A UNIQUE GAS SHIELDED METAL CORED WIRE FOR BOTH EXTREME ABRASION AND HEAVY IMPACT AND/OR PRESSURE

General Properties

EnDOtec DO*327 is a unique anti-wear alloy formulated to develop a dense, but very fine network of primary columbium-carbides supported by a Cr-Mo matrix. Here, the addition of both chromium & molybdenum promotes the formation of a complex martensite & retained austenite matrix structure. This unique matrix structure develops outstanding resistance to both high-pressure grinding abrasion and point-impact loading. Weld deposits are ideal for multi-pass build-up and are slag-free for improved weldability and high-volume weld deposit coverage for reduced labor costs.

Applications

Roll Grinders, Anvils, Breaker Bars, Latch Keys, Side Lips, Teeth, Bucket Scoops, Plows, Recycle Screws, Stump Grinders, Scraper Blades, Pump Castings.

Technical Data					
• Hardness as-deposited (HRC)	54 – 56 1st pass		55 –59 2nd pass		
• Maximum Service Temp.	500°F		260°C		
• Maximum Number of Passes	3 – 5 passes				
• Current & Polarity	DCEP (+)				
• Guideline Parameters for DO*327					
Diameter	Amp Range	Volt Range	Stick-out	Shield Gas	Flow-scfh
1/16”	125-250	21-28	5/8” ± 1/8”	Ar + 2% O_2	35-45
Note: Secondary Shielding Gas AR + 25% CO_2					

Welding Procedure

Preparation: Remove all contaminants, particularly oil & grease. Lightly grind surface to remove superficial oxides. Preheat according to the base metal make-up and potentials to air harden.

Technique: After checking that the welding conditions are optimal by testing on scrap metal, position the gun head at a 70-80º angle and use a "push" technique for downhand welding. For fully automated welding such as hardfacing crusher rolls, the wire should exit at about a 10º lagging angle from top dead center. Using this technique will assure a smooth and regular weld deposit profile with the optimum level of fusion and deposit integrity.

Post-welding: All parts should be slow cooled out of drafts and high moisture areas.

EnDOtec® DO*390N

A UNIQUE "FIRST-TIME" WEARFACING ALLOY RESISTANT TO MANY TYPES OF AGGRESSIVE WEAR

General Properties

EnDOtec 390N is the newest development in cored wire technology. A new generation of wearfacing products based on the science & engineering of ultra -fine, submicron grains structures. Weld deposits have a high volume fraction of ultra-hard borocarbides distributed in a mesomorphous iron-alloy matrix.

Applications

Auger Screws, Press Screws, Mixer Paddles and Blades, High Pressure Conveyors, Slag Dryer Blades, Aggregate Gate Sizers, Trencher Tool Holders, Exhaust Fans, Furnace Chutes, Kiln Mixers, Asphalt Mixer Paddles, Coal Grinder Mixers.

Technical Data					
• Hardness as-deposited (HRC)		1st Pass 66 – 68		2nd Pass 67 - 71	
• Maximum Service Temp.		1400°F		760º C	
• Maximum Number of Passes		4 – 5 passes			
• Current & Polarity		DCEP (+)			
• Guideline Parameters for DO*390N					
Diameter	Amp Range	Volt Range	Stick-out	Shield Gas	Flow-scfh
.045"	120 - 175	24-26	5/8 ± 1/8	Ar + 2% O_2	35-45
1/16"	170-220	23-26	5/8 ± 1/8	Ar + 2% O_2	35-45
Note: Due to the very high hardness microstructure, applications involving impact should be avoided					

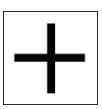
Welding Procedure

Preparation: Remove all contaminants, particularly oil & grease. Lightly grind surface to remove superficial oxides. Preheat according to the base metal make-up and potential to air harden. For tool steel surfacing use the recommended preheat & interpass temperatures for the grade and type.

Technique: For most downhand welding the pull method is suggested with the wire positioned at a 70º-80º angle. This will provide a clean, virtually spatter-free, high-crowned weld deposit.

Post-welding: For air-hardening steels slow-cool using available insulating materials. For less sensitive base metals, slow cool out of drafts.

DO NOT OVERHEAT THE BASE METAL OR USE TOO HIGH AN AMPERAGE!



EnDOtec® DO*611

A PREMIUM METAL CORED, GAS SHIELDED WIRE FOR EXCEPTIONAL RESISTANCE TO SEVERE ABRASION

General Properties

EnDOtec DO*611 is a benchmark anti-wear alloy! Due to a very high density of Monocrystalline Tungsten Carbides (MTC) particles evenly distributed in a corrosion-resistant nickel matrix, weld deposits exhibit enhanced anti-wear properties. Carbide segregation is greatly minimized due to the special coating pre-treatment given to the MTC particles. Even when subject to extreme abrasion, including those involving general corrosion media, weld deposits remain resistant throughout their through-thickness. In addition, weld deposits have little if any cross checking and tolerate low-to-moderate impact.

Applications

Drill Collars, Ash Handling Units, Pug Mill Augers, Kiln Feed Screws, Animal Feed Screws, Chemical Feed Screws, Asphalt Mixers, Hammers, Drill Stabilizers

Technical Data					
• Hardness as-deposited (HRC)	54 – 56 1st pass		55 –57 2nd pass		
• Maximum Service Temp.	1000°F		537°C		
• Maximum Number of Passes	2- passes				
• Current & Polarity	DCEP (+)				
• Hardness Carbide (HV)	~2100 HV				
• Guideline Parameters for DO*611					
Diameter	Amp Range	Volt Range	Stick-out	Shield Gas	Flow-scfh
1/16”	120-180	17-24	1/2 ± 1/8	Ar + 2% O_2	35-45
Note: To maximize service life it is very important to keep welding amperages below 180 or application performance will be compromised.					

Welding Procedure

Preparation: Remove all contaminants, particularly oil & grease. Lightly grind surface to remove superficial oxides. Preheat according to the base metal make-up and potential to air harden.

Technique: After checking that the welding conditions are optimal by testing on scrap metal, position the gun head at a 70-80º angle and use a "push" technique for downhand welding. For fully automated welding such as hardfacing cement crusher rolls, the wire should exit at about a 10º lagging angle from top dead center. Using this technique will assure a smooth and regular weld deposit profile with the optimum level of fusion and deposit integrity.

Post-welding: All parts should be slow-cooled out of drafts and high moisture areas.

TEROMATEC® OA 3010

A QUALITY RE-BUILD OPEN-ARC FLUX COREDWIRE FOR GENERAL MAINTENANCE AND REPAIR

General Properties

TeroMatec OA 3010 is recommended for rapid build-up on low and medium carbon steels. Deposits are exceptionally tough and exhibit superior crack-resistance. Re-built parts are readily machined using carbide tools and can be easily shaped and cut using oxy-fuel processes.

Applications

Re-building worn trunnions, steel mill wobblers & pods, shovel pads, wheel burns, cast steel parts, rollers, idlers, etc…

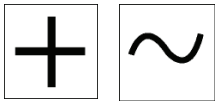
Technical Data			
	TeroMatec OA 3010		
• Hardness as-deposited (HRC)	34-37 with 2 passes		
• Maximum Number of Passes	Unlimited but practical at 1" (25mm)		
• Current & Polarity	**DCEP (+) Open-Arc Parameters**		
Diameter	Amperage	Voltage	Wire Stickout
7/64 (2.8mm) – max. deposition	300-375	27-30	1½ ± 1/4
7/64 (2.8mm) – thin sections	225-300	25-28	1½ ± 1/4
Notes: *Hardness Influence:* In general, an increase in deposit hardness will decrease wear. *Load Influence*: Wear rates typically increase as the load increases. *Speed Influence:* An increase in either the part or material being moved will increase wear. *Temperature:* In general, as the temperature increases the wear rate increases			

Welding Procedure

Preparation: Clean weld area of scale and/or oxide. A nominal preheat of 150ºF is advised if part is below 40ºF or over 1" thick. For higher carbon steels higher preheats will be needed. Check the Reference Section for preheat information.

Technique: Maintain the optimum electrode stickout and hold a 75º angle from the vertical in the direction of travel. Do not weave excessively. Wide beads can cause porosity, excessive base metal overheating, and degrade the weld deposit wear properties. Back whip craters to reduce crater-cracking tendencies and potential crater out-gassing.

Post-welding: Allow parts to slow cool in still air.



TEROMATEC® OA 3205

A HIGH MANGANESE OPEN-ARC WIRE WITH A BALANCED RESISTANCE TO BOTH IMPACT AND COMPRESSION

General Properties

TeroMatec OA3205 is ideal for high deposition welding where large amounts of weld metal are needed and when work hardening is an application requirement.

Applications

Pug-mill knives, impeller bars, ball-mill scoops, shovel teeth, manganese cast rail frogs, crusher mantles & concaves, jaw crushers, mill lines (new), crusher rolls, grizzly bars, etc…

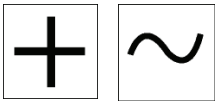
Technical Data			
	TeroMatec OA 3205		
• Hardness as-deposited (HRC)	16-20 with 2 passes		
• Work Hardened Hardness (HRC)	40-45		
• Maximum Number of Passes	Unlimited but practical at 2-in (50mm)		
• Current & Polarity	**DCEP (+) Open-Arc Parameters**		
Diameter	Amperage	Voltage	Wire Stickout
1/16-high speed	200-250	24-27	1 ± ¼
1/16-first & last pass	140-200	23-26	1 ± ¼
7/64-high speed	320-425	27-30	2¼ ± ½
7/64 –first and last pass	225-300	25-30	2¼ ± ½
Notes Regarding Impact and Compressive Wear. *Weld Metal:* Should be tough and works harden under impact & high compressive loads. *Pre-harden:* Best results are obtained if the weld deposit is part work-hardened prior to service. *Temperature Control:* Never exceed 400ºF during welding.			

Welding Procedure

Preparation: Clean weld area of scale and/or oxide. A nominal preheat of 150ºF is advised if part is below 40ºF or over 1" thick. For higher carbon steels higher preheats will be needed. Check the Reference Section for information regarding specific preheating levels for specific steel grades. Note: Do not preheat Hadfield manganese steel castings above 400ºF as this will cause time-temperature embrittlement.

Technique: Maintain the optimum electrode stickout and hold a 75º angle from the vertical in the direction of travel. Do not weave excessively. Wide beads can cause porosity, excessive base metal overheating, and degrade the weld deposit wear properties. Back whip craters to reduce crater-cracking tendencies and potential crater out-gassing

Post-welding: Allow parts to slow cool in still air. High carbon steels and air hardenable steels should be covered with a heat-retardant blanket. Note: Manganese castings can be cooled more rapidly by using air quenches.



TEROMATEC® OA 4601
EUTECTIC® 5306FW HIGH CHROME

HIGH CHROMIUM FLUX-CORED WIRES WITH PLATELET CHROMIUM CARBIDES SUPPORTED BY A HIGHLY ALLOYED MATRIX

General Properties

• *Eutectic OA 4601* is a premium chromium carbide open-arc hardfacing wire with outstanding weldability. Deposits have a high concentration of finely dispersed carbides and have superior resistance to 2-body abrasion and low-to-medium impact.

• *Eutectic 5306FW* is a small-diameter wire with properties best suited to grinding abrasion. Weld deposit carbides are finely dispersed in a chromium-enriched matrix.

Applications

• *TeroMatec OA 4601:* Conveyor screws, scraper blades, earthmoving equipment, auger flights, dredger buckets, etc…

• *Eutectic 5306FW:* Cement grinder rings, ash plows, bucket lips, pug mill paddles, refuse crusher rolls, bucket teeth, etc…

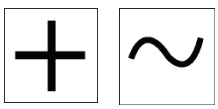
Technical Data						
		Eutectic OA4601	A	Eutectic FW5306	B	
• Hardness as-deposited (HRC)		55-60		55-58		
• Wear Data (ASTM G65 test)		20-mm³	AISI D2 tool steel = 35-mm³		23-mm³	
• Maximum Number of Passes		2		2		
• Current & Polarity		**DCEP (+) Open-Arc & GMA Parameters**				
Diameter		Amperage	Voltage	Wire Stickout		
A	7/64-high speed	320-425	25-32	2¼ ± ½		
A	7/64-first & last pass	225-300	25-30	2¼ ± ½		
B	1/16-open-arc	170-220	24-28	1 ± 1/8		
B	1/16-gas shielded*	190-250	24-28	¾ ± 1/8		
Notes: Carbon dioxide (CO_2) shielding gas can be used to reduce fuming and to cool the gun assembly when used at high currents. Typical flow rates are 35-45 scfh.						

Welding Procedure

Preparation: Clean weld area of scale and/or oxide. A nominal preheat of 150ºF is advised if part is below 40ºF or over 1" thick. For higher carbon steels higher preheats will be needed. Check the Reference Section for preheat information.

Technique: Maintain the optimum electrode stickout and hold a 75º angle from the vertical in the direction of travel. Do not weave excessively. Wide beads can cause porosity, excessive base metal overheating, and degrade the weld deposit wear properties. Back whip craters to reduce crater-cracking tendencies and potential crater out-gassing.

Post-welding: Allow parts to slow cool in still air.



TEROMATEC® OA 4603

A SPECIFICALLY FORMULATED OPEN-ARC WIRE FOR APPLICATIONS INVOLVING HIGH-SPEED PARTICLE & GRINDING ABRASION

General Properties

TeroMatec OA4603 achieves optimized wear-resisting properties due to the alloys *hyper-eutectic microstructure.* Even when the weld metal is base metal diluted, the structure remains hypereutectic, which is further supported by a high volume of hexagonal chromium carbides.

Applications

Typical applications involving either or both types of wear are earthmoving equipment, conveyor systems, screws, augers impellers, bucket components, crushers, pump casings, clinker crusher rolls, etc…

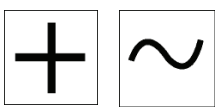
Technical Data			
	TeroMatec OA 4603		
• Hardness as-deposited (HRC)	1st pass: 55.	2nd pass: 60	
• Wear Data (ASTM G65 test)	20-mm³	Reference: AISI D2 tool steel = 35-mm³	
• Maximum Number of Passes	2		
• Current & Polarity	**DCEP (+) Open-Arc & GMA Parameters**		
Diameter	Amperage	Voltage	Wire Stickout
7/64-high speed	320-425	25-30	2¼ ± ½
7/64-first & last pass	225-300	25-30	2¼ ± ½
0.045-open-arc	180-230	24-28	¾ ± 1/8
0.045-gas shielded*	190-250	24-28	¾ ± 1/8
*Carbon dioxide (CO_2) shielding gas can be used to reduce fuming and to cool the gun assembly when used at high currents. Typical flow rates are 35-45 scfh.			

Welding Procedure

Preparation: Clean weld area of scale and/or oxide. A nominal preheat of 150ºF is advised if part is below 40ºF or over 1" thick. For higher carbon steels higher preheats will be needed. Check the Reference Section for preheat information.

Technique: Establish an arc and weld with a circular motion. Maintain an arc length appropriate to the electrode stickout. Do not weave excessively. Wide beads can cause porosity, excessive base metal overheating, and degrade the weld deposit wear properties. Back whip craters to reduce crater-cracking tendencies and potential crater out-gassing.

Post-welding: Allow parts to slow cool in still air. High carbon steels and air hardenable steels should be covered with a heat-retardant blanket. *Note:* Manganese castings can be cooled more rapidly by using air quenches. If deposits have to be cut or pierced, Plasma-arc or Arc-air cutting processes should be used.



TEROMATEC® OA 4625
EUTECTIC® 5716FW CHROMIUM IRON

HIGH CHROMIUM FLUX-CORED WIRES WITH HEXAGONAL CHROMIUM CARBIDES SUPPORTED BY A CHROMIUM ALLOYED MATRIX

General Properties

• *TeroMatec OA 4625* is a general chromium carbide open-arc hardfacing wire with superior weldability. Deposits have a high concentration of ultra-fine carbides which impart superior resistance to 3-body abrasion and moderate-to-heavy impact.

• *Eutectic 5716FW* is a small-diameter wire with properties best suited to sliding abrasion. Weld deposit carbides are finely dispersed in a chromium-enriched matrix.

Applications

• *TeroMatec OA 4625:* Skids, pulverizes, grizzly bars, bucket teeth, adapters, crushers hammers, screws, impellers, etc.

• *Eutectic 5716FW:* Cement grinder rings, ash plows, bucket lips, pug mill paddles, refuse crusher rolls, bucket teeth, etc.

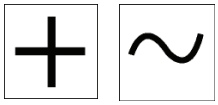
Technical Data					
		TeroMatec OA 4625	A	Eutectic 5716FW	B
• Hardness as-deposited (HRC)		55-60		55-58	
• Wear Data (ASTM G65 Test)		33-mm³	AISI D2 tool steel = 35-mm³		35-mm³
• Current & Polarity		DCEP (+) Open-Arc & GMA Parameters			
Diameter		**Amperage**		**Voltage**	**Wire Stickout**
A	7/64-high speed	320-425		25-32	2¼ ± ½
A	7/64-first & last pass	225-300		25-30	1¾ ± ¼
B	1/16-open-arc	170-220		24-28	5/8± 1/8
B	1/16-gas shielded*	190-250		24-28	5/8± 1/8
B	0.045-open-arc	175-200		24-28	5/8± 1/8
B	0.045-gas shielded	190-210		24-28	5/8± 1/8
*Carbon dioxide (CO_2) shielding gas can be used to reduce fuming and to cool the gun assembly when used at high currents. Typical flow rates are 35-45 scfh.					

Welding Procedure

Preparation: Clean weld area of scale and/or oxide. A nominal preheat of 150ºF is advised if part is below 40ºF or over 1" thick. For higher carbon steels higher preheats will be needed. Check the Reference Section for preheat information.

Technique: Maintain the optimum electrode stickout and hold a 75º angle from the vertical in the direction of travel. Do not weave excessively. Wide beads can cause porosity, excessive base metal overheating, and degrade the weld deposit wear properties. Back whip craters to reduce crater-cracking tendencies and potential crater out-gassing.

Post-welding: Allow parts to slow cool in still air.



TEROMATEC® OA 4652
EUTECTIC® 5256FW MIXED CARBIDE

WIRES FORM A FAMILY OF COMPLEX MIXEDCARBIDE OPEN-ARC HARDFACING ALLOYS FOR VARIOUS TYPES OF WEAR

General Properties

• *TeroMatec OA 4652* has a composition best suited for scratching abasion/erosion at elevated temperatures.

• *Eutectic 5256FW* is a small-diameter wire with composite properties for applications involving gouging and scratching abrasion.

Applications

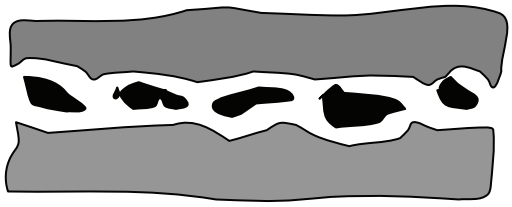
• *TeroMatec OA 4652:* Kiln mixer blades, skip-car lips, hot ash elbows, slag rakes, cement dryers, hot wire guides, coke pusher rams, exhaust fans, etc…

• *Eutectic 5256FW:* Hot screens, mixer blades, wear plates, slurry control valves, spiral conveyors, brick die cores etc…

Technical Data					
		TeroMatec OA 4652	A	Eutectic 5256FW	B
• Hardness as-deposited (HRC)		62-64		57-60	
• Typical Temperature Range		1200ºF		1000ºF	
• Maximum Number of Passes*		1 (2 max)		2 (3 max)	
• Current & Polarity		**DCEP (+) Open-Arc & GMA Parameters**			
Diameter		Amperage	Voltage	Wire Stickout	
A	7/64-high speed	320-425	26-32	2¼ ± ½	
A	7/64-first & last pass	225-300	25-30	2¼ ± ½	
B	1/16-open-arc	180-230	24-28	1 ± 1/8	
B	1/16-gas shielded**	190-250	24-28	¾ ± 1/8	

*See note post-welding. **Carbon dioxide (CO_2) shielding gas can be used to reduce fuming and to cool the gun assembly when used at high currents. Typical flow rates are 35-45 scfh.

Application Note re Multi-Wear Complex Carbides



Gouging Abrasive Wear

When applications involve high-temperature, it is most important that the weld metal be sufficiently alloyed so it can withstand the damaging effects of severe oxidation. Chromium, columbium, molybdenum, & tungsten are the most important elements in such situations.

Welding Procedure

Preparation: Clean weld area of scale and/or oxide. A nominal preheat of 150ºF is advised if part is below 40ºF or over 1" thick. For higher carbon steels higher preheats will be needed. Check the Reference Section for information regarding specific preheating levels for specific steel grades. Note: Do not preheat Hadfield manganese steel castings above 400ºF as this will cause time-temperature embrittlement.

Technique: Technique: Maintain a medium-to-short arc and incline the electrode at a 45º angle in the direction of travel. The preferred bead profile should be a non-weave. However, if necessary, a 3x weave is acceptable. Do not weave excessively. Wide beads can cause porosity, excessive base metal overheating, and degrade the weld deposit wear properties. Back whip craters to reduce crater-cracking tendencies and potential crater out-gassing

Post-welding: Allow parts to slow cool in still air. High carbon steels and air hardenable steels should be covered with a heat-retardant blanket. Note: Manganese castings can be cooled more rapidly by using air quenches. If deposits have to be cut or pierced, Plasma-arc or Arc-air cutting processes should be used.

Note Re Weld Pass Limitations

A good rule-of-thumb is to equate the potential number of passes based on the bulk hardness of the weld metal. Typically, as the deposit hardness increases fewer layers should be applied. An excessive build-up with alloys whose hardness is in the range of HRC 58-68 can cause the weld deposits to bulk fracture and break up. As a general guide use the number of passes shown below.

Weld Pass Limitations	
Deposit Hardness	Number of Passes
62-68 HRC	1
55-62 HRC	2
50-55 HRC	3
40-50 HRC	4
20-40 HRC	Unlimited

TEROMATEC® OA 4811
EUTECTIC® 56FW

PREMIUM TUNGSTEN CARBIDE FLUX CORED WIRES WITH OPTIMIZED WEAR RESISTANCE TO SEVERE ABRASION

General Properties

• *TeroMatec OA 4811* offers the ultimate resistance to both grinding & gouging abrasion. It is a self-shielded wire for use on standard high-duty wire feeders. Single-pass deposits provide the maximum protection against extreme abrasion.

• *Eutectic 56FW* is a small-diameter wire that deposits weld metal containing a very dispersion of ultra wear resistant tungsten carbides. Weld deposits resist wear from sliding & erosive abrasion and show all-position welding capability.

Applications

• *TeroMatec OA 4811:* Coal pulverizers, chute liners, conveyor screws, scraper blades, earthmoving equipment, auger flights, dredger buckets, etc…

• *Eutectic 56FW:* Cement grinder rings, kiln feed screws, stripper bars, auger flights, tamping tools, ash plows, bucket lips, pug mill paddles, refuse crusher rolls, bucket teeth, etc…

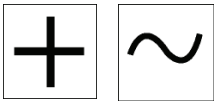
Technical Data					
	TeroMatec OA 4811	A	Eutectic 56FW	B	
• Hardness as-deposited (HRC)	62-65		62+		
• Wear Data (ASTM G65 test)	10-mm³	AISI D2 tool steel = 35-mm³		14-mm³	
• Maximum Number of Passes	2		2		
• Carbide Content	60%		45%		
• Carbide Hardness (Knoop Scale)	K3000		K26000		
• Current & Polarity	**DCEP (+) Open-Arc & GMA Parameters**				
Diameter		Amperage	Voltage	Wire Stickout	
A	7/64-high speed	320-425	25-32	2¼ ± ½	
A	7/64-first & last pass	225-300	25-30	2¼ ± ½	
B	1/16-open-arc	170-220	24-28	1 ± 1/8	
B	1/16-gas shielded*	190-250	24-28	¾ ± 1/8	
Notes: Carbon dioxide (CO_2) shielding gas can be used to reduce fuming and to cool the gun assembly when used at high currents. Typical flow rates are 35-45 scfh.					

Welding Procedure

Preparation: Clean weld area of scale and/or oxide. A nominal preheat of 150ºF is advised if part is below 40ºF or over 1" thick. For higher carbon steels higher preheats will be needed. Check the Reference Section for preheat information.

Technique: Maintain the optimum electrode stickout and hold a 75º angle from the vertical in the direction of travel. Do not weave excessively. Wide beads can cause porosity, excessive base metal overheating, and degrade the weld deposit wear properties. Back whip craters to reduce crater-cracking tendencies and potential crater out-gassing.

Post-welding: Allow parts to slow cool in still air.



EUTECTIC® 5022FW MANGANESE STEEL

A SMALL DIAMETER HIGH MANGANESE OPEN-ARC WIRE WITH A BALANCED RESISTANCE TO BOTH IMPACT AND COMPRESSION

General Properties

Eutectic 5022FW is ideal for high deposition welding where large amounts of weld metal are needed and when work hardening is an application requirement.

Applications

Pug-mill knives, impeller bars, ball-mill scoops, shovel teeth, manganese cast rail frogs, crusher mantles & concaves, jaw crushers, mill lines (new), crusher rolls, grizzly bars, etc…

Technical Data				
		Eutectic 5022FW		
• Hardness as-deposited (HRC)		16-20 with 2 passes		
• Work Hardened Hardness (HRC)		40-45…typical		
• Maximum Number of Passes		Unlimited but practical at 3/4-in (20 mm)		
• Current & Polarity		**DCEP (+) Open-Arc & GMA Parameters**		
Diameter		Amperage	Voltage	Wire Stickout
0.045-in	100% CO_2 @ 30-35 scfh	190-210	26-29	½ ± 1/16
1/16-in	100% CO_2 @ 30-35 scfh	170-280	25-29	½ ± 1/16
0.045-in	Open-arc	170-190	24-28	9/16± 1/16
1/16-in	Open-arc	190-250	24-28	9/16 ± 1/16

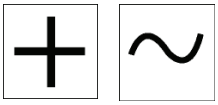
Notes: Regarding Impact and Compressive Wear.
Weld Metal: Should be tough and work harden under impact & high compressive loads.
Pre-harden: Best results are obtained if the weld deposit is part work-hardened prior to service.
Temperature Control: Never exceed 400ºF during welding.

Welding Procedure

Preparation: Clean weld area of scale and/or oxide. A nominal preheat of 150ºF is advised if part is below 40ºF or over 1" thick. For higher carbon steels higher preheats will be needed. Check the Reference Section for information regarding specific preheating levels for specific steel grades. Note: Do not preheat Hadfield manganese steel castings above 400ºF as this will cause time-temperature embrittlement.

Technique: Maintain the optimum electrode stickout and hold a 75º angle from the vertical in the direction of travel. Do not weave excessively. Wide beads can cause porosity, excessive base metal overheating, and degrade the weld deposit wear properties. Back whip craters to reduce crater-cracking tendencies and potential crater out-gassing

Post-welding: Allow parts to slow cool in still air. High carbon steels and air hardenable steels should be covered with a heat-retardant blanket. *Note:* Manganese castings can be cooled more rapidly by using air quenches.



TEROMATEC® OA 4923

FORMULATED TO RESIST EXTREME IMPACT WITHOUT SPALLING, BULK FRACTURING OR CRACKING

General Properties

TeroMatec OA 4923 is an open-arc, flux-cored wire which deposits weld metal with a very fine dispersion of ultra hard & ultra tough titanium carbides contained in a tough martensitic matrix. Multi-passes can be deposited without the need for cushion layers.

Applications

Crusher hammers, crusher bars & anvils, muller tires, refuse hammers, high pressure cement/clinker grinding rolls, dry cement transfer screws, et.

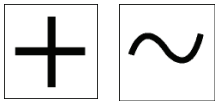
Technical Data			
	TeroMatec OA 4923		
• Hardness as-deposited (HRC)	1st Pass: 45	2nd Pass: 50	3rd Pass: 55
• Carbide hardness (Knoop Scale)	2,470		
Maximum Number of Passes	1-in (25mm) is a typical build-up height		
• Maximum Number of Passes	Unlimited but practical at 3/4-in (20 mm)		
• Current & Polarity	**DCEP (+) Open-Arc & GMA Parameters**		
Diameter	Amperage	Voltage	Wire Stickout
7/64-high speed	300-375	26-30	1½ ± ¼
7/64-first & last pass	225-275	25-29	1½ ± ¼
1/16-high speed	180-200	25-28	½ ± 1/16
1/16-first & last pass	150-190	25-28	½ ± 1/16
Notes: Regarding Impact and Compressive Wear. *Weld Metal:* Should be tough and work harden under impact & high compressive loads. It should not spall or crack.			

Welding Procedure

Preparation: Clean weld area of scale and/or oxide. A nominal preheat of 150ºF is advised if part is below 40ºF or over 1" thick. For higher carbon steels higher preheats will be needed. Check the Reference Section for information regarding specific preheating levels for specific steel grades. Note: Do not preheat Hadfield manganese steel castings above 400ºF as this will cause time-temperature embrittlement.

Technique: Technique: Maintain a medium-to-short arc and incline the electrode at a 45º angle in the direction of travel. The preferred bead profile should be a non-weave. However, if necessary, a 3x weave is acceptable. Do not weave excessively. Wide beads can cause porosity, excessive base metal overheating, and degrade the weld deposit wear properties. Back whip craters to reduce crater-cracking tendencies and potential crater out-gassing

Post-welding: Allow parts to slow cool in still air.



TEROMATEC® AN 4617

A UNIQUE FLUX-CORED OPEN-ARC SURFACING AND BUILD-UP WELDING WIRE DESIGNED FOR COATING SIDES OF SUGAR CANE CRUSHER ROLL TEETH

General Properties

TeroMatec AN 4617 is a unique flux-cored open-arc surfacing and buildup wire designed specifically for coating sides of teeth on sugar cane crushing rolls. Deposit is flat and crack free, which is critical in maintaining crusher tolerance and efficiency. The wire is also a base coat for the Eutectic "Pull and Tear" profile.

Applications

For use on sugar cane crusher rolls when welding outside, or in bad weather conditions. TeroMatec AN 4617 is typically designed for applications involving tooth angles of 44º or higher. For lower tooth angles EnDOtec DO*17 should be used.

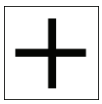
Technical Data					
• Typical Hardness as-deposited HRC	48 – 50 1st pass		49 –52 2nd pass		
• Maximum Number of Passes	1 – 3 passes				
• Current & Polarity	DCEP (+)				
• Guideline Parameters for AN 4617					
Diameter	Amp Range	Volt Range	Stick-out	Shield Gas	Flow-scfh
1/16”	170-250	23-27	1 1/8 ± 1/8	N/A	N/A

Welding Procedure

Preparation: Remove all contaminants, particularly oil & grease. Lightly grind surface to remove superficial oxides. Preheat according to the base metal make-up and potentials to air harden.

Technique: Remove any fatigued material from the surface using Eutectic ChamferTrode®. If base material is contaminated a buffer layer of DO*21 wire or EutecTrode™ 27 electrode may be needed. Pre-Heat is generally not necessary. Use stringer beads to keep from over heating base material.

Post-welding: All parts should be slow cooled out of drafts and high moisture areas.



TEROMATEC® AN 4633

A PROPRIETARY OPEN-ARC FLUX-CORED WIRE DESIGNED FOR CREATING THE EUTECTIC "PULL AND TEAR" PROFILE ON SUGAR CANE CRUSHER ROLLS

General Properties

TeroMatec AN 4633 is a fast freeze chromium carbide hardfacing wire designed for protecting and profiling sugar cane crusher rolls. Used as the final coat in producing the Eutectic "Pull and Tear" profile. Deposits have superior resistance to abrasion, compression and impact experienced in sugar cane crusher rolls.

Applications

For use on sugar cane crusher rolls when welding outside or in bad weather conditions. AN 4617 is typically designed for applications involving tooth angles of 44º or higher. For lower tooth angles DO*17 should be used.

Technical Data					
• Typical Hardness as-deposited HRC	58 – 59 1st pass		59 – 60 2nd pass		
• Maximum Number of Passes	1 – 3 passes				
• Current & Polarity	DCEP (+)				
• Guideline Parameters for AN 4617					
Diameter	Amp Range	Volt Range	Stick-out	Shield Gas	Flow-scfh
1/16"	170-220	22-26	1 1/8 ± 1/8	N/A	N/A

Welding Procedure

Preparation: Remove all contaminants, particularly oil & grease. Lightly grind surface to remove superficial oxides. Preheat according to the base metal make-up and potentials to air harden.

Technique: Please contact your Technical Sales or Technical Services Representative for the Eutectic "Pull and Tear" Procedures.

Post-welding: All parts should be slow cooled out of drafts and high moisture areas.

SECTION 11 – TOOL STEEL PRODUCTS

General Information

What is a Tool or Die Steel? A tool or die steel can be defined as an alloy steel in which one or more alloying elements have been added to impart special properties. These special characteristics specific to Tool & Die Steels are briefly described below and are further expanded in the Tool Steel Handbook.

1) Toughness

Toughness is the property that enables a tool to withstand shock loads. Most designers specify the toughness level specific to the type of work the tool has to do. The value selected is typically associated with an adequate level of wear resistance.

2) Wear Resistance

Wear resistance for most tool steels is directly related to hardness. However, different steels act quite differently even when similar in hardness. This difference is directly related to the variations in carbon, chromium, tungsten, molybdenum and vanadium. Tools with higher levels of one or more of these elements generally have superior wear resistance.

3) Heat Resistance

Many die steels are use to shape or form metals when they are hot which subjects the surface of the die to elevated temperatures. Typically, hot work and high-speed tool steels are used because they contain fairly large amounts of chromium, tungsten**, cobalt** and molybdenum. These elements in the correct amounts impart improved high temperature stability, abrasion resistance, and resistance to many forms of heat-checking.

4) Hardening Stability

It is a well-known truism that most steels when heated, will expand. This is particularly so with tool steels during heat treatment. You will learn during the reading of this Tooltec Handbook that steels are quenched after heat treatment to "lock-in" key properties. However, note that the hardening stability is affected by the severity or rate of cooling of the quenching media.

5) Machinability

When tool & die steels are received by the end-user they are normally supplied in the annealed or fully softened condition which is known as "best machinability". However, tool steels with high levels of carbon and/or alloy content often have a higher annealed hardness which makes them more difficult to machine. To improve machining properties to certain tool grades a small amount (< 0.15%) of sulfur is added.

6) Polishability

Due to the increasing use of tool steels in plastic injection and mold forming operations, the property of a steel to be finished to a high degree of smoothness is known as "polishability". With vacuum de-gassing now a commonly used manufacturing process, steels are being produced with very high levels of purity and cleanliness, all of which improve surface finish.

What is the role of alloying elements? Some of the elements commonly used in the manufacture of Tool & Die Steels have been mentioned above. To these we can add manganese, nickel, titanium, zirconium, nitrogen and silicon. All these elements when added to plain- carbon tool steels impart a unique and highly useful set of properties. *These are:*

1. *Greater hardness and abrasion resistance*
2. *Higher hardness at elevated temperatures*
3. *Less distortion during hardening*
4. *Higher levels of toughness*
5. *Increased strength in both thin and thick sections*
6. *Improved micro-structure response during heat treatment*

All of the improved properties are in most cases achieved through one or all of the following three changes:

1. *Changes to the hardening characteristics of the tool steel*
2. *Changes in the amount and type of carbides present*
3. *Changes to the tempering characteristics of the tool steel*

Important Terms used with Tools & Dies.

• ***Annealing*** Is a process of heating a steel within a certain temperature zone known as the critical range. This critical range (approximately 1350º to 1600ºF) will vary for each type of steel. Annealing is used to soften a steel, improve machinability, restore ductility, and for stress reduction.

• ***Normalizing*** This is kind of treatment involving heating a steel to a temperature above the critical range, holding for a predetermined time, then cooling at fixed rate. This treatment promotes structure uniformity and improves mechanical properties.

• ***Stress Relief*** Is a form of treatment used to reduce internal stresses. It involves heating a tool or die to a temperature below the critical range, holding for a predetermined time so as to equalize bulk temperature, then followed by cooling at a set rate.

• ***Time & Temperature*** These are the two of the most important variables where tools and dies are concerned. Because changes in metallurgical structure occur more rapidly at high temperatures, the time spent is critical.When a tool is held in the austenitic temperature range for a given length of time a number of things happen: 1) More alloying elements and carbides are taken in to solution. 2) Grain size becomes larger. Also important is the rate of cooling which determines what the structure will be at room temperature.

• ***Grain Size*** Typically refers to austenite. When a steel is heated through the critical temperature range, the structure changes to all-austenite. First the grain size is small but becomes progressively larger as the temperature increases above the upper critical range. When a steel has Number 1grain size the grain is considered large occupying about 1.5 grains per square inch. At Number 8 the grain size is considerably smaller and occupies about 96 grains per square inch. Normally steels with grain sizes in the 6, 7, and 8 are described as fine-grained. A finer grain structure imparts greater toughness and shock-resistance.

• ***Soaking Time & Hardening*** Refers to the length of time a tool or die is held at a temperature either below 2000ºF or a within a +2000º to 2400ºF range during hardening A good rule-of-thumb for furnace heating below 2000ºF is to use 10 minutes per inch of maximum thickness as a guide. Note: using salt baths will reduce the time. For steels heated at the higher range such as the Hot Work Steels, the time-at-temperature is controlled by the cross-sectional thickness.

• ***Tool Protection & Hardening*** To protect the surface of a tool or die from de-carburization during hardening, it is often necessary to "pack" or use some form of protective coating. In many cases hardening is carried out using a self-protecting salt bath of reducing atmosphere furnace. Where very high hardening temperature are used a reducing atmosphere furnace is highly recommended.

• ***Stress Relieving or Tempering?*** Two important points to remember when welding tools and dies: 1) If the part to be weld-repaired is annealed follow-up by stress relieving. 2) If the tool was in the hardened condition follow-up by tempering immediately… a double-draw is preferred.

• ***Quenching*** Perhaps the first mention of quenching is quoted in Book IX of Homer's Odyssey where the blinding of Polyphemus is mentioned. Some useful quenching hints are: 1) Quench immediately after hardening. 2) Allow to cool to "hand-warm" condition or about 150ºF. If water is used it must be agitated to help with effective cooling. If oil is used make sure it is preheated to around 150ºF. When air quenching make sure that the air circulates over the whole tool or die.

TOOLTECTIC® 6NHSS
TIGTECTIC® 5HSS ROD

SPECIALLY FORMULATED TO REPAIR M-CLASS TOOL & DIE STEELS AND FOR SURFACE ENHANCEMENT OF LOW-ALLOY STEELS

General Properties

• ToolTectic 6NHSS is a coated electrode modified to weld M-series tool steels such as M1, M2, & M10 and to surface-enhance lower alloy tool & die steels during fabrication. Weld deposits are tolerant of high heat and maintain excellent hot hardness properties.

• Tig-Tectic 5HSS is a rod version for more precise welding of more intricate tools & dies. Properties, depending upon dilution, are similar to ToolTectic 6NHSS.

Applications

For M-series tool steels, particularly grade M2. This grade, and the other grades, are noted for use in blanking, piercing, forming, and deep cutting operations. Weld deposits resist softening at elevated temperatures, have excellent resistance to tool contact wear, and have superior application toughness.

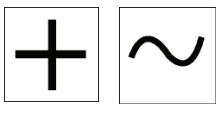
Technical & Property Data		
	ToolTectic 6NHSS & Tig-Tectic 5HSS Rod	
• Typical Hardness (HRC)	62-64 as-deposited	
• Typical Hot Hardness (HRC)	45-50 up to 1200ºF	
• Annealing Temperature	1650ºF	
• Hardening Temperature	2225-2250ºF…quench in hot oil	
• Tempering Temperature	1000-1050ºF…also known as the "draw" temperature.	
• Preheat Temperature	950-1000ºF when welding M1, M2 & M10 grades. For general applications a preheat of 400ºF is suitable	
• Inter-pass Temperature	950-1100ºF when welding M-grade steels. For general applications use a ± 25ºF inter-pass range.	
• Current & Polarity	DCEP (+) and AC	
• Diameters	1/8…3.2mm	5/32…4.0mm
• Amperage Range	85 - 125	115 - 155

Welding Procedure

Preparation: Clean weld area of scale and/or oxide and degrease using VOC-free cleaners. Dye penetrant test to locate cracks. Prepare cracks by grinding so as to generate a "U" profile. For enclosed cracks without a terminus point continue the preparation some 1" (25mm) ahead of the crack. Preheat slowly according to the grade and heat-treated condition of the tool or die.

Technique: Maintain a short arc length and do not use a contact technique. Use stringer-beads & back whip craters to reduce crater-cracking tendencies. Check the inter-pass temperature frequently. For GTAW refer to instructions given for TigTectic 680

Post-welding: Parts should be covered with a heat-retardant blanket or placed in a pre-heated furnace for controlled cool-down.



TOOLTECTIC® 6NHW
TIGTECTIC® 5HW ROD

SPECIALLY FORMULATED TO REPAIR H-CLASS HOT WORK TOOL & DIE STEELS AND FOR SURFACE MODIFICATION OF LOW-ALLOY STEELS

General Properties

• ToolTectic 6NHW is a coated electrode modified to weld H-series tool steels such as H11, H12, & H13 and to surface enhance lower alloy tool & die steels during composite fabrication. Weld deposits show minimum heat crazing and are tolerant of high and in-service quenching operations. Deposits maintain excellent hot-hardness properties.
• Tig-Tectic 5HW is a GTA rod version for more precise welding of more intricate tools & dies. Properties, depending upon dilution, are similar to 6NHW.

Applications

For H-series tool steels, particularly grade H13. This grade, and other grades, are typically used for repairing forging dies, hot piercing punches, die casting dies and gripper & header dies. Weld deposits maintain impression profiles over many forging cycles & resist time-in-service tempering while maintaining superior toughness.

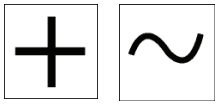
Technical & Property Data		
	ToolTectic 6NHW & Tig-Tectic 5HW Rod	
• Typical Hardness (HRC)	50-53 as-deposited	
• Typical Hot Hardness (HRC)	45-50 up to 1200ºF	
• Annealing Temperature	1600ºF	
• Hardening Temperature	Typically 1850ºF followed by air quenching	
• Tempering Temperature	900-1200ºF…also known as the "draw" temperature.	
• Preheat Temperature	950-1000ºF when welding H11, H12, and H13 grades. For general applications a preheat of 400ºF is suitable	
• Inter-pass Temperature	900-1150ºF when welding H13-grade steel. For general applications use a ± 50ºF inter-pass range.	
• Current & Polarity	DCEP (+) and AC	
• Diameters	1/8…3.2mm	5/32…4.0mm
• Amperage Range	85 - 125	115 - 155

Welding Procedure

Preparation: Clean weld area of scale and/or oxide and degrease using VOC-free cleaners. Dye penetrant test to locate cracks. Prepare cracks by grinding so as to generate a "U" profile. For enclosed cracks without a terminus point continue the preparation some 1' (25mm) ahead of the crack. Preheat slowly according to the grade and heat-treated condition of the tool or die.

Technique: Maintain a short arc length and do not use a contact technique. Use stringer-beads & back whip craters to reduce crater-cracking tendencies. Check the inter-pass temperature frequently. For GTAW refer to instructions given for TigTectic® 680 given in Section 7.

Post-welding: Parts should be covered with a heat-retardant blanket or placed in a pre-heated furnace for controlled cool-down.



TOOLTECTIC® 6SH
TIGTECTIC® 5AH

AN AIR-HARDENING TOOL STEEL ELECTRODE FOR REPAIRING WORN TOOLS & DIES CAUSED BY SERVICE IMPACT & SCALE ABRASION

General Properties

• ToolTectic 6SH is a coated electrode formulated to weld A-series tool steels and particularly Grade A-2. This grade of electrodes is an air-hardening steel with superior non-deforming properties. Weld deposits show minimum heat crazing and are tolerant of high and in-service quenching operations. Deposits maintain shape and tolerance dimensions during service.

• TigTectic 5AH is a GTA rod version for more precise welding of more intricate tools & dies. Properties, depending upon dilution, are similar to 6SH.

Applications

ToolTectic 6SH & TigTectic 5AH are similar to a Grade A-2, is also known as a cold-work tool steel, that is most frequently used to repair worn drawing dies, coining dies, blanking & shaping dies, including many cold forming dies. It is also used in the fabrication of composite air hardening steel dies, gripper dies and hobbing dies.

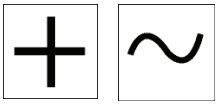
Technical & Property Data			
	ToolTectic 6SH & TigTectic 5AH		
• Typical Hardness (HRC)	50-55 as-deposited		
• Typical Hot Hardness (HRC)	Not frequently used for hot work operations.		
• Annealing Temperature	1550 – 1600ºF		
• Hardening Temperature	Heat slowly to 1300-1400ºF		
• Tempering Temperature	500-1000ºF depending on the hardness required.		
• Preheat Temperature	300 – 400ºF		
• Inter-pass Temperature	For general applications use ± 50ºF inter-pass range is OK!		
• Current & Polarity	DCEP (+) and AC		
• Diameters	3/32…2.4mm	1/8…3.2mm	5/32…4.0mm
• Amperage Range	55 -70	85 - 125	115 - 155

Welding Procedure

Preparation: Clean weld area of scale and/or oxide and degrease using VOC-free cleaners. Dye penetrant test to locate cracks. Prepare cracks by grinding so as to generate a "U" profile. For enclosed cracks without a terminus point continue the preparation some 1" (25mm) ahead of the crack. Preheat slowly according to the grade and heat-treated condition of the tool or die.

Technique: Maintain a short arc length and do not use a contact technique. Use stringer-beads & back whip craters to reduce crater-cracking tendencies. Check the inter-pass temperature frequently. For GTAW refer to instructions given for TigTectic® 680 given in Section 7.

Post-welding: Parts should be covered with a heat-retardant blanket or placed in a pre-heated furnace for controlled cool-down.



TIGTECTIC® 5OH

AN OIL HARDENING TOOL STEEL ALLOY FOR WELDING TOOL & DIES WHEN SHAPE RETENTION AFTER HARDENING & TEMPERING IS CRITICAL

General Properties

• TigTectic 5OH is formulated to weld Grades O-1 and O-6 oil-hardening tool steels. Deposited weld metal is highly conformable with the base metal and will respond similarly to annealing, hardening, and tempering requirements.

Applications

TigTectic 5OH is quite similar to a Grade O-6. Applications such as slitting dies, blanking dies, gauge tool repairs, feeding rolls, and many trimming die blocks are typical for this Tool & Die maintenance alloy.

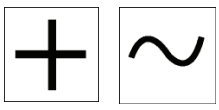
Technical & Property Data	
	TigTectic 5OH
• Typical Hardness (HRC)	57-62 as-deposited
• Typical Hot Hardness (HRC)	Not frequently used for hot work operations, as they do not have any "red hardness" properties.
• Annealing Temperature	1700 – 1900ºF
• Hardening Temperature	Heat slowly to 1425-1500ºF
• Tempering Temperature	500-1000ºF depending on the hardness required.
• Preheat Temperature	300 – 475ºF
• Inter-pass Temperature	For general applications a ± 50ºF inter-pass range is adequate.
• Current & Polarity	DCEN (-) and AC
• Diameters	0.045…1.2mm
• Amperage Range	Will depend on die mass and repair needs…see note below.

Welding Procedure

Preparation: Clean weld area of scale and/or oxide and degrease using VOC-free cleaners. Dye penetrant test to locate cracks. Prepare cracks by grinding so as to generate a "U" profile. For enclosed cracks without a terminus point continue the preparation some 1" (25mm) ahead of the crack. Preheat slowly according to the grade and heat-treated condition of the tool or die.

Technique: Maintain a short arc length and do not use a contact technique. Use stringer-beads & back whip craters to reduce crater-cracking tendencies. Check the inter-pass temperature frequently. For GTAW refer to instructions given for TigTectic® 680 given in Section 7.

Post-welding: Parts should be covered with a heat-retardant blanket or placed in a pre-heated furnace for controlled cool-down.



TIGTECTIC® 5P20

SPECIALLY FORMULATED FOR REPAIRS TO INJECTION MOLDING DIES WHERE HIGH POLISHABILITY IS CRITICALLY IMPORTANT

General Properties

• TigTectic 5P20 is formulated to develop a microstructure and hardness level suitable for general-purpose injection molds used for forming plastic and zinc die casting die components. Weld metal has characteristics that allow the weld deposit to be polished to an extremely high finish required for quality plastic moldings & die cast finish.

Applications

TigTectic 5P20 is quite similar to an AISI P20 mold steel. Typical applications are zinc die casting dies, prototype molds, compression molds, holders & backers on transfer molds, etc.

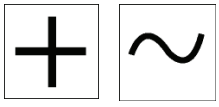
Technical Data	
	TigTectic 5P20
• Typical Hardness (HRC)	30-35 as-deposited
• Typical Hot Hardness (HRC)	Not used for metal hot work operations, as they do not have any "red hardness" properties.
• Annealing Temperature	1450 – 1500ºF with annealed hardness of 185-225 BHN
• Hardening Temperature	Heat slowly to 1100ºF then transfer to 1preheated 575ºF oven.
• Tempering Temperature	-1000ºF depending on the hardness required.
• Preheat Temperature	800º – 900ºF when the mold is prehardened
• Inter-pass Temperature	For general applications a ± 50ºF inter-pass range is adequate.
• Current & Polarity	DCEN (-) and AC
• Diameters	0.045…1.2mm
• Amperage Range	Will depend on die mass and repair needs…see note below.

Welding Procedure

Preparation: Clean weld area of scale and/or oxide and degrease using VOC-free cleaners. Dye penetrant test to locate cracks. Prepare cracks by grinding so as to generate a "U" profile. For enclosed cracks without a terminus point continue the preparation some 1" (25mm) ahead of the crack. Preheat slowly according to the grade and heat-treated condition of the tool or die.

Technique: Maintain a short arc length and do not use a contact technique. Use stringer-beads & back whip craters to reduce crater-cracking tendencies. Check the inter-pass temperature frequently. For GTAW refer to instructions given for TigTectic® 680 given in Section 7.

Post-welding: Parts should be covered with a heat-retardant blanket or placed in a pre-heated furnace for controlled cool-down.



SECTION 12 – METAL WORKING PRODUCTS

General Information: Cutting & Gouging

Metal working electrodes are tools all maintenance personnel should have. They are formulated to cut, pierce, and chamfer virtually all metals. There is no special set-up required other than a welding machine with the required output (200-amps minimum) and properly sized ground & electrode cables.

CHAMFERCUT®, CHAMFERTRODE®, CUTTRODE® & EXOTRODE®

• ChamferCut DCEN-AC: This special high-speed cutting and gouging and piercing electrode is particularly efficient with most ferrous and non-ferrous alloys - including stainless steels and nickel alloys. Excellent for use with Arc-Air and Carbon-arc metal removal processes.

• ChamferTrode DCEN-AC: The "benchmark" product for gouging and beveling nearly all metals. Excellent for removing defects in weld deposits such as slag inclusions, cracks, and surface and underbead porosity.

• CutTrode DCEN-AC: For use when deep cuts and plate or part break-throughs are needed. Particularly useful with many of the non-ferrous metals which require special equipment to cut and/or piece.

• ExoTrode AC/DCEN: Specially formulated for dual performance on both DC and AC welding machines. Can be used as both a cutting and as a chamfering electrode.

APPLICATION & SET-UP INFORMATION

ChamferCut		ChamferTrode		CutTrode		ExoTrode	
Diam.	Amps.	Diam.	Amps.	Diam.	Amps.	Diam.	Amps.
3/32	150-190	----------	----------	----------	----------	3/32	150-190
1/8	230-310	1/8	250-350	1/8	120-200	1/8	230-310
5/32	280-380	5/32	280-380	5/32	180-330	5/32	280-380
----------	----------	3/16	380-475	3/16	350-430	----------	----------
----------	----------	----------	----------	1/4	400-500	----------	----------

Note: The suggested amperage ranges are considered typical set-up values. Adjust for the particular metal being cut and/or chamfered and base metal thickness.

SECTIONS 13-23 THERMAL SPRAY POWDERS + SPECIAL MATERIALS

Product Information

Thermal spray technology is defined as a group of processes in which finely divided metallic or nonmetallic materials are deposited in a molten or semi-molten condition onto a prepared surface to form a coating. The focus at Eutectic is on the flame spray process that utilizes finely sized metallic and nonmetallic powders in combination with the various combustion spray, transferred-arc, non transferred-arc and HVOF systems

SECTION 13: EUTALLOY® FUSIBLE MICROFLO POWDERS

Eutalloy 10xxx Series Powders

• *BoroTec® 10009*

Hard, nickel-base alloy with excellent wear properties. Coatings are resistant to abrasion, erosion and adhesive wear. Eutectic 10009 coatings produce a smooth wear scar in service. Finish by grinding.
Typical Hardness: HRC 60
Nominal Chemistry: Ni + 27% (Cr, B, Si, Fe, C)

Typical Mesh Size:	-140 + 20 µm
ASTM G65 Wear:	20 mm³ vol. loss
Max. Service Temp:	1020ºF (550ºC)
Applications	
Mandrels, Tappets, Plug Gauges, Molds, Cams, Camshafts, Screws, etc.	

• *Gritalloy® 10011*

Blend of a coarsely sized tungsten carbide and nickel-base alloy powder. Coatings are hard, wear resistant and are used primarily when a gripping, non-skid surface is required.
Use in the as-fused condition.
Typical Hardness: HRC 59
Nominal Chemistry: 8 0% WC-W_2C + 20% (Ni, Cr, B, Si, Fe, C)

Typical Mesh Size:	-100 + 325 Mesh
ASTM G65 Wear:	8 mm^3 vol., loss
Max. Service Temp:	1020 °F (550°C)
Applications	
Grapple Arms, Blades, Grippers, Plowshares, Debarker Chains…	

• *Eutectic® 10020*

A blended Ni-Cu alloy coating that is resistant to corrosion, particularly salt corrosion, and galling. Deposits are non-magnetic.
Typical Hardness: HRC 16-20
Nominal Chemistry: Nickel + Copper

Typical Mesh Size:	-140 + 20 µm
ASTM G65 Wear:	N/A
Max. Service Temp:	1200°F (650°C)
Applications	
Control Valves and Seats, Die Plates, Sea Water Pumps, etc.	

• ***Eutallite® 10092***		
A tough cobalt-base coating that will resist softening and scaling at elevated temperatures. Alloying additions of chromium and tungsten insure good hot hardness properties. Finish by grinding. Typical Hardness: HRC 48 Nominal Chemistry: Co+64 % (Ni, Cr, W, B, Si)	Typical Mesh Size:	-140 + 20 µm
	ASTM G65 Wear:	30 mm^3 vol. loss
	Max. Service Temp:	1550°F (845°C)
	Applications	
	Exhaust Valves and Seats, Hot Punches, Ingot Tongs, Drawing Blocks, Step Tips, Water-cooled Pokers, Wire Draw Blocks, Impellers…	

• ***TungTec® 10112***		
Blend of a nickel-base fusible alloy plus 60% cast and crushed tungsten carbide particles. The coating offers exceptional resistance to abrasion and erosion. Finish by grinding. Typical Hardness: HRC 62 Nominal Chemistry: 60% WC-W_2C + (Ni, Cr, B, Si, Fe, C)	Typical Mesh Size:	-140 + 20 µm
	ASTM G65 Wear:	15 mm^3 vol. loss
	Max. Service Temp:	1020 °F (550°C)
	Applications	
	Mixer Paddles, Screw Flights, Auger Points, Conveyor Chains, Drill Bits…	

• ***BronzTec® 10146***		
A copper-tin-nickel powder for joining and build-up on copper-base alloys. Deposits are readily machined with standard HSS tool bits. Typical Hardness: HRB 30 Nominal Chemistry: Cu +10% (Sn, Ni)	Typical Mesh Size:	-140 + 20 µm
	ASTM G65 Wear:	N/A
	Max. Service Temp:	700°F (370°C)
	Applications	
	Shafts, Gears, Gauges Slideways, Beds, Molds, Keyways…	

• ***CuproTec® 10180***		
A Copper-phosphorus alloy for joining & build-up on copper-base alloys. Deposits are smooth can be machined (when necessary) using standard HSS tool bits. Typical Hardness: N/A Nominal Chemistry: Cu + 7% P.	Typical Mesh Size:	-140 + 20 µm
	ASTM G65 Wear:	N/A
	Max. Service Temp:	700°F (370°C)
	Applications	
	Plumbing Fixtures, Bus Bars, Coils, Evaporators, Tanks, Kettles…	

• *BronzoChrom® 10185*

Offers the best combination of hardness and wear resistance coupled with good machining properties. Coatings have unlimited build-up capability and can be machined with carbide tool bits. Typical Hardness: HRC 42 Nominal Chemistry: Ni + 6% (B, Si, Fe)	Typical Mesh Size:	-140 + 20 µm
	ASTM G65 Wear:	N/A
	Max. Service Temp:	1200°F (650°C)
	Applications	
	Shafts, Gears, Tools, Gauges, Feed Rolls,	

• *NiTe®c 10224*

Nickel-base fusible alloy designed for sealing, cladding, filling and joining cast irons. Alloying additions insure good wettability and high ductility. Finish by machining. Typical Hardness: HRB 90 Nominal Chemistry: Ni + 4% (B, Si, Fe)	Typical Mesh Size:	-140 + 20 µm
	ASTM G65 Wear:	N/A
	Max. Service Temp:	1000°F (590°C)
	Applications	
	Engine Blocks, Manifolds, Gears, Molds, Valve Bodies, Differential Housings…	

• *ChromTec® 10680*

High shear strength nickel-base alloy for cladding, joining and sealing steels, stainless steels and nickel-base metals. Coatings have high build-up capability. Finish by machining. Typical Hardness: HRB 95 Nominal Chemistry: Ni + 5% (B, Si, Fe)	Typical Mesh Size:	-140 + 20 µm
	Shear Strength:	75,000 psi
	Max. Service Temp:	1200°F (650°C)
	Applications	
	Gears, Shafts, Patterns, Clutches, Gears, Forks, Bushings, Guides, Cleats, Hooks…	

• *DiaMax 10999N*

Blend of a nickel-base fusible alloy plus 20% cast and crushed tungsten carbide particles. The coatings offer exceptional resistance to abrasion and wear by friction. Finish by grinding. Typical Hardness: HRC 60 Nominal Chemistry: 20% WC-W_2C + (Ni, Cr, B, Si, Fe, C)	Typical Mesh Size:	-140 + 20 µm
	ASTM G65 Wear:	15 mm^3 vol. loss
	Max. Service Temp:	1020 °F (550°C)
	Applications	
	Mixer Paddles, Screw Flights, Auger Points, Conveyor Chains, Drill Bits…	

Eutalloy® 11xxx Series Powders

• *Eutectic® 11490*		
Similar to 10680. High shear strength nickel-base alloy for cladding, joining and sealing steels stainless steels and nickel-base metals. Coatings have high build-up capability. Finish by machining. Typical Hardness: HRB 95 Nominal Chemistry: Ni + 5% (B, Si, Fe)	Typical Mesh Size:	-140 + 20 µm
	Shear Strength:	75,000 psi
	Max. Service Temp:	1200°F (650°C)
	Applications	
	Gears, Shafts, Patterns, Clutches, Molds, Keyways, Cams…	

• *Eutectic® 11493*		
Similar to 10185. Offers the best combination of hardness and wear resistance coupled with good machining properties. Coatings have unlimited build-up capability and can be machined with carbide tool bits. Typical Hardness: HRC 42 Nominal Chemistry: Ni + 6% (B, Si, Fe)	Typical Mesh Size:	-140 + 20 µm
	ASTM G65 Wear:	N/A
	Max. Service Temp:	1200°F (650°C)
	Applications	
	Shafts, Gears, Tools, Gauges, Feed Rolls, Molds, Keyways…	

• *Eutectic® 11494*		
An intermediate hardness alloy with a good combination of hardness and wear resistance coupled with good machining properties. Coatings have unlimited build-up capability and can be machined with carbide tool bits. Typical Hardness: HRC 38 Nominal Chemistry: Ni + 6% (B, Si, Fe)	Typical Mesh Size:	-140 + 20 µm
	ASTM G65 Wear:	N/A
	Max. Service Temp:	1200°F (760°C)
	Applications	
	Shafts, Gears, Tools, Gauges, Feed Rolls, Molds, Keyways…	

• *Eutectic® 11496*		
Similar to 10009. Hard, nickel-base alloy with excellent wear properties. Coatings are resistant to abrasion, erosion and adhesive wear. Eutectic 11496 coatings produce a smooth wear scar during use that improves service life. Finish by grinding. Typical Hardness: HRC 60 Nominal Chemistry: Ni + 27% (Cr, B, Si, Fe, C)	Typical Mesh Size:	-140 + 20 µm
	ASTM G65 Wear:	30 mm^3 vol. loss
	Max. Service Temp:	1020ºF (550ºC)
	Applications	
	Mandrels, Tappets, Plug Gauges, Molds, Cams, Camshafts, Screws, Valves, Vanes, Mixers, Nozzles…	

• *Eutectic® 11497*		
A low-to-medium hardness alloy with a good combination of impact and wear resistant properties. Excellent machining properties. Coatings have unlimited build-up capability and can be machined with carbide tool bits. Typical Hardness: HRC 25 Nominal Chemistry: Ni + 6% (B, Si, Fe)	Typical Mesh Size:	-140 + 20 µm
	ASTM G65 Wear:	N/A
	Max. Service Temp:	1200°F (760°C)
	Applications	
	Shafts, Gears, Tools, Gauges, Feed Rolls, Molds, Keyways…	

• *Eutectic® 11498*		
Similar to NiTec 10224. A nickel-base fusible alloy designed for sealing, cladding, filling and joining cast irons. Alloying additions insure good wettability and high ductility. Finish by machining. Typical Hardness: HRB 90 Nominal Chemistry: Ni + 4% (B, Si, Fe)	Typical Mesh Size:	-140 + 20 µm
	ASTM G65 Wear:	N/A
	Max. Service Temp:	1000°F (590°C)
	Applications	
	Engine Blocks, Manifolds, Gears, Molds, Valve Bodies, Differential Housings…	

Eutalloy® 12xx Glass Mold Series Powders

• *Glass Mold 1202*		
A nickel-base fusible alloy designed for sealing, cladding, filling and joining cast irons. Excellent build up properties with reduced overspray. Easily hand-worked. Finish by machining. Typical Hardness: HRB 90-100 Nominal Chemistry: Ni + 4% (B, Si, Fe)	Typical Mesh Size:	-140 + 20 µm
	ASTM G65 Wear:	N/A
	Max. Service Temp:	1000°F (590°C)
	Applications	
	For repairing glass mold corners and edges, including mold necks and bases.	

• *Glass Mold 1203*		
A slightly less-hard nickel-base fusible alloy designed for sealing, cladding, filling and joining cast irons. Excellent build up properties with reduced overspray. Easily hand-worked. Finish by machining. Typical Hardness: HRB 87-94 Nominal Chemistry: Ni + 4% (B, Si, Fe)	Typical Mesh Size:	-140 + 20 µm
	ASTM G65 Wear:	N/A
	Max. Service Temp:	1000°F (590°C)
	Applications	
	For repairing glass mold corners and edges, including mold necks and bases, funnels rings, etc.	

• *Glass Mold 1204*

Specially formulated nickel-base fusible alloy designed for optimized surface finishing. Good for cladding, filling and joining cast irons. Excellent build up properties with reduced overspray.
Typical Hardness: HRC 31
Nominal Chemistry: Ni + 4% (B, Si, Fe)

Typical Mesh Size:	-140 + 20 µm
ASTM G65 Wear:	N/A
Max. Service Temp:	1000°F (590°C)

Applications

For repairing glass mold corners and edges, including mold necks and bases…

• *Glass Mold 1205*

A mid-range hardness alloy with excellent puddle control with a good combination of wear resistant properties. Excellent machining properties. Coatings have unlimited build-up capability and can be machined with carbide tool bits.
Typical Hardness: HRC 20-27
Nominal Chemistry: Ni + 6% (B, Si, Fe)

Typical Mesh Size:	-140 + 20 µm
ASTM G65 Wear:	N/A
Max. Service Temp:	1200°F (760°C)

Applications

Mold necks, mold edges & corners, bottom plates and guide rings…

• *Glass Mold 1206*

A specially formulated nickel-base fusible alloy designed for coating preheated mold necks. Excellent for sealing, cladding, filling and joining cast irons. Excellent build up properties with reduced overspray. Easily hand-worked.
Finish by machining.
Typical Hardness: HRB 90-96
Nominal Chemistry: Ni + 4% (B, Si, Fe)

Typical Mesh Size:	-140 + 20 µm
ASTM G65 Wear:	N/A
Max. Service Temp:	1000°F (590°C)

Applications

For repairing mold necks & edges, including Press & Blow plungers, guide rings and bottom plates…

• *Glass Mold 1207*

For exceptionally clean & porosity-free coatings. For use with air-assist powder delivery systems. A nickel-base alloy with excellent wear properties. Coatings are resistant to abrasion, hot-glass erosion and adhesive wear. Finish by grinding.
Typical Hardness: HRC 35-40
Nominal Chemistry: Ni + 27% (Cr, B, Si, Fe, C)

Typical Mesh Size:	-140 + 20 µm
ASTM G65 Wear:	30 mm³ vol. loss
Max. Service Temp:	1020ºF (550ºC)

Applications

Mold plungers and baffles…

• *Glass Mold 1210*

Unique mid-range hardness alloy with exceptional wettability and point-to-point deposition control. Coatings have unlimited build-up capability and can be machined with carbide tool bits.
Typical Hardness: HRC 25-27
Nominal Chemistry: Ni + 6% (B, Si, Fe)

Typical Mesh Size:	-140 + 20 µm
ASTM G65 Wear:	N/A
Max. Service Temp:	1100°F (590°C)
Applications	
Mold edges & corners especially when used on bronze-type alloys…	

Eutalloy® 9xxx & 8xxx Glass Mold Series Powders

• *Glass Mold 9001*

A medium hardness alloy specifically developed to reduce overspray with improved fluidity and machinability. Formulated for both cast irons & bronze alloys. Readily machined with standard tool bits.
Typical Hardness: HRC 25
Nominal Chemistry: Ni + 5% (B, Si, Fe)

Typical Mesh Size:	-140 + 20 µm
ASTM G65 Wear:	N/A
Max. Service Temp:	1050°F (565°C)
Applications	
Guide rings and bottom plates	

• *Glass Mold 9002*

A low hardness alloy specifically developed to reduce overspray with improved fluidity and machinability. Formulated for both cast irons & bronze alloys. Readily machined with standard tool bits.
Typical Hardness: HRC 15
Nominal Chemistry: Ni + 5% (B, Si, Fe)

Typical Mesh Size:	-140 + 20 µm
ASTM G65 Wear:	N/A
Max. Service Temp:	1050°F (565°C)
Applications	
Finish neck rings and molds	

• *Glass Mold 9003*

A soft-to-medium hardness alloy specifically developed to reduce overspray with improved fluidity and machinability. Formulated for both cast irons & bronze alloys. Readily machined with standard tool bits.
Typical Hardness: HRC 18
Nominal Chemistry: Ni + 5% (B, Si, Fe)

Typical Mesh Size:	-140 + 20 µm
ASTM G65 Wear:	N/A
Max. Service Temp:	1050°F (565°C)
Applications	
Finish neck rings and molds…	

• *Glass Mold 9005*

An intermediate hardness alloy with a good combination of hardness and wear resistance coupled with good machining properties. Coatings have unlimited build-up capability and can be machined with carbide tool bits.
Typical Hardness: HRC 35-40
Nominal Chemistry: Ni + 6% (B, Si, Fe)

Typical Mesh Size:	-140 + 20 µm
ASTM G65 Wear:	N/A
Max. Service Temp:	1200°F (760°C)
Applications	
Press & blow and blow & blow plungers, baffles…	

• *Glass Mold 8718*

A proprietary NiBSi powder alloy with additives to lower the melting point and improve fluidity and with a prescribed target hardness. Readily machined with standard tool bits.
Typical Hardness: HRC 18
Nominal Chemistry: Ni + 5% (B, Si, Fe)

Typical Mesh Size:	-140 + 20 µm
ASTM G65 Wear:	N/A
Max. Service Temp:	1050°F (565°C)
Applications	
For general repairs to various glass mold components…	

• *Glass Mold 8726*

A proprietary NiBSi powder alloy with additives to lower the melting point and improve fluidity and with a prescribed target hardness. Readily machined with standard tool bits.
Typical Hardness: HRC 26
Nominal Chemistry: Ni + 5% (B, Si, Fe)

Typical Mesh Size:	-140 + 20 µm
ASTM G65 Wear:	N/A
Max. Service Temp:	1050°F (565°C)
Applications	
Formulated for OEM applications	

Eutalloy® CPW 5xxx Tungsten Carbide Powders + Special Powders

• *CPW 5127*

Blend of a nickel-base fusible alloy plus 50% cast and crushed tungsten carbide particles. Has higher fluidity when compared to TungTec 10112. The coating offers exceptional resistance to abrasion and erosion. Finish by grinding.
Typical Hardness: HRC 59
Nominal Chemistry:
50% WC-W_2C + (Ni, Cr, B, Si, Fe, C)

Typical Mesh Size:	-140 + 20 µm
ASTM G65 Wear:	16 mm^3 vol. loss
Max. Service Temp:	1200 °F (760°C)
Applications	
Mixer Paddles, Screw Flights, Auger Points, Conveyor Chains, Drill Bits	

• *CPW 5057N*

Blend of a nickel-base fusible alloy plus 45% cast and crushed tungsten carbide particles. Has higher fluidity when compared to TungTec 10112. The coating offers exceptional resistance to abrasion and erosion. Finish by grinding. Typical Hardness: HRC 59 Nominal Chemistry: 45% WC-W_2C + (Ni, Cr, B, Si, Fe, C)	Typical Mesh Size:	-140 + 20 µm
	ASTM G65 Wear:	18 mm^3 vol. loss
	Max. Service Temp:	1200 °F (760°C)
	Applications	
	Mixer Paddles, Screw Flights, Auger Points, Conveyor Chains, Drill Bits	

• *CPM 1249*

Similar to 10112. A blend of a nickel-base fusible alloy plus 60% cast and crushed tungsten carbide particles. The coating offers exceptional resistance to abrasion and erosion. Finish by grinding. Typical Hardness: HRC 62 Nominal Chemistry: 60% WC-W_2C + (Ni, Cr, B, Si, Fe, C)	Typical Mesh Size:	-140 + 20 µm
	ASTM G65 Wear:	15 mm^3 vol. loss
	Max. Service Temp:	1020 °F (550°C)
	Applications	
	Mixer Paddles, Screw Flights, Auger Points, Conveyor Chains, Drill Bits	

Air Assist Powder Delivery Systems – 12xxx Series Powders

• *Eutectic® 12494*

An intermediate hardness alloy with a good combination of hardness and wear resistance coupled with good machining properties. Coatings have unlimited build-up capability and can be machined with carbide tool bits. Typical Hardness: HRC 38 Nominal Chemistry: Ni + 6% (B, S, Fe)	Typical Mesh Size:	-140 + 20 µm
	ASTM G65 Wear:	N/A
	Max. Service Temp:	1200°F (760°C)
	Applications	
	Shafts, Gears, Tools, Gauges, Feed Rolls, Molds, Keyways	

• *Eutectic® 12496*

Hard, nickel-base alloy with excellent wear properties. Coatings are resistant to abrasion, erosion and adhesive wear. Eutectic 11496 coatings produce a smooth wear scar during use that improves service life. Finish by grinding. Typical Hardness: HRC 59 Nominal Chemistry: Ni + 27% (Cr, B, Si, Fe, C)	Typical Mesh Size:	-140 + 20 µm
	ASTM G65 Wear:	30 mm^3 vol. loss
	Max. Service Temp:	1020ºF (550ºC)
	Applications	
	Mandrels, Tappets, Plug Gauges, Molds, Cams, Camshafts, Screws, etc.	

Eutalloy® X-TraLife 4xxx Series Powders

• *X-TraLife 4510*

Nickel-base fusible alloy designed for sealing, cladding, filling and joining cast irons, stainless steels & nickel-base alloys. Alloying additions insure good wettability, high ductility and excellent machinability.
Finish by machining.
Typical Hardness: HRC 18
Nominal Chemistry: Ni + 4% (BSiFe)

Typical Mesh Size:	-140 + 20 µm
ASTM G65 Wear:	N/A
Max. Service Temp:	1000°F (590°C)
Applications	
Engine Blocks, Manifolds, Gears, Molds, Valve Bodies, Differential Housings…	

• X-*TraLife 4520*

Similar to 10009. Hard, nickel-base alloy with excellent wear properties. Coatings are resistant to abrasion, erosion and adhesive wear. Coatings produce a smooth wear scar in service. Finish by grinding.
Typical Hardness: HRC 60
Nominal Chemistry: Ni + 27% (Cr, B, Si, Fe, C)

Typical Mesh Size:	-140 + 20 µm
ASTM G65 Wear:	20 mm^3 vol. loss
Max. Service Temp:	1020ºF (550ºC)
Applications	
Mandrels, Tappets, Plug Gauges, Molds, Cams, Camshafts, Screws, etc.	

• X-*TraLife 4530*

Similar to 10185. A unique combination of hardness and wear resistance coupled with good machining properties. Coatings have unlimited build-up capability and can be machined with carbide tool bits to a very fine finishes
Typical Hardness: HRC 42
Nominal Chemistry: Ni + 6% (B, Si, Fe)

Typical Mesh Size:	-140 + 20 µm
ASTM G65 Wear:	N/A
Max. Service Temp:	1200°F (650°C)
Applications	
Shafts, Gears, Tools, Gauges, Feed Rolls, Molds, Keyways…	

• X-*TraLife 4540*

A nickel-base fusible alloy plus 45% cast and crushed tungsten carbide particles. Has excellent fluidity and are easier to finish when compared to X-TraLife 4550 The coating offers exceptional resistance to abrasion and erosion. Finish by wet grinding.
Typical Hardness: HRC 60
Nominal Chemistry:
45% WC-W_2C + (Ni, Cr, B, Si, Fe, C)

Typical Mesh Size:	-140 + 20 µm
ASTM G65 Wear:	18 mm^3 vol. loss
Max. Service Temp:	1200 °F (760°C)
Applications	
Mixer Paddles, Screw Flights, Auger Points, Conveyor Chains, Drill Bits	

• *X-TraLife 4550*		
Similar to 10112. A nickel-base fusible alloy plus 60% cast and crushed tungsten carbide particles. The coating offers exceptional resistance to abrasion and erosion. Finish by grinding. Typical Hardness: HRC 62 Nominal Chemistry: 60% WC-W_2C + (Ni, Cr, B, Si, Fe, C)	Typical Mesh Size:	-140 + 20 µm
	ASTM G65 Wear:	15 mm^3 vol. loss
	Max. Service Temp:	1020 °F (550°C)
	Applications	
	Mixer Paddles, Screw Flights, Auger Points, Conveyor Chains, Drill Bits…	

SECTION 14: PROXON® 19xxx MICROFLO POWDERS ROTOTEC SYSTEM

• *ProXon® 19121*		
Nickel alloy one-step powder designed for use with the RotoTec 1A Torch. Coatings produce a medium hard, wear resistant bearing surface. Finish by machining with carbide tool bits. Typical Hardness: HRB 75 Nominal Chemistry: Ni + 11% (Al, Mo)	Typical Mesh Size:	-140 + 325 Mesh
	ASTM Bond Value:	4000 psi
	Max. Service Temp:	1000°F (540°C)
	Applications	
	Machine Element Repairs	

• *ProXon® 19122*		
Modified version of ProXon 19121. The additions of chromium, boron and silicon give improved machinability and increased service temperature capability. Finish by machining. Typical Hardness: HRB 80 Nominal Chemistry: Ni + 11% (Al, Mo, Cr, B, Si)	Typical Mesh Size:	- 140 + 325 Mesh
	ASTM Bond Value:	3500 psi
	Max. Service Temp:	1200°F (650°C)
	Applications	
	Pump and Motor Shafts, Bearing Fits, Machine Element repair	

• *ProXon® 19132*		
Self-bonding, nickel-base alloy powder developed for use with the RotoTec Torch. Coatings provide a unique combination of resistance to corrosion and abrasion. Finish by machining. Typical Hardness: HRC 30 Nominal Chemistry: Ni + 56% (Mo, Fe, Ti, Si, W)	Typical Mesh Size:	-140 + 400 Mesh
	ASTM Bond Value:	4000 psi
	Max. Service Temp:	1200°F (650°C)
	Applications	
	Impellers, Pump Shafts, Wear Rings, Seal Surfaces, Recovery Boilers…	

• *ProXon® 19132S*		
A slightly coarser version of ProXon 19132 designed for use with the RotoTec 1A, DS 8000, and TeroDyn 2000 Systems. Typical Hardness: HRC 30 Nominal Chemistry: Ni + 56% (Mo, Fe, Ti, Si, W)	Typical Mesh Size:	-140 + 325 Mesh
	ASTM Bond Value:	4000 psi
	Max. Service Temp:	1200°F (650°C)
	Applications	
	Impellers, Pump Shafts, Wear Rings, Seal Surfaces, Recovery Boilers…	

• *ProXon® 19171*		
Self-bonding, aluminum bronze alloy for soft bearing applications. Coatings are easily machined with carbide tool bits. Typical Hardness: HRB 60 Nominal Chemistry: Cu + 11% (Al, Fe)	Typical Mesh Size:	-140 + 325 Mesh
	ASTM Bond Value:	2000 psi
	Max. Service Temp:	700°F (370°C)
	Applications	
	Reclamation of copper base metal parts	

SECTION 15: PROXON® 21xxx MICROFLO™ POWDERS TERODYN™ & CASTODYN™ SYSTEMS

• *ProXon® 21021*		
Nickel-aluminum-molybdenum powder designed to produce a medium hard, wear resistant bearing surface. Finish by machining with carbide tool bits. Typical Hardness: HRB 75 Nominal Chemistry: Ni + 11% (Al, Mo)	Typical Mesh Size:	-140 + 325 Mesh
	ASTM Bond Value:	5000 psi
	Max. Service Temp:	1000°F (540°C)
	Applications	
	Impellers, Pump Shafts, Wear Rings	

• *ProXon® 21022*		
Modified version of ProXon 21021 with additions of chromium, boron and silicon to enhance machinability and service temperature. Machine using carbide tool bits. Typical Hardness: HRB 80 Nominal Chemistry: Ni + 12% (Al, Mo, Cr,B, Si)	Typical Mesh Size:	-140 + 325 Mesh
	ASTM Bond Value:	4500 psi
	Max. Service Temp:	1200°F (650°C)
	Applications	
	Pump and Motor Shafts, Bearing Fits, Seal Surfaces…	

• *ProXon® 21023*		
An iron-base composite powder with additions of nickel, aluminum and molybdenum offering excellent bonding and machining characteristics. Typical Hardness: HRB 90 Nominal Chemistry: Fe + 52% (Ni, Al, Mo)	Typical Mesh Size:	-100 + 325 Mesh
	ASTM Bond Value:	4000 psi
	Max. Service Temp:	1500°F (815°C)
	Applications	
	Heat Treat Fixtures, Machine Element Repair, Bearing Fits…	

• *ProXon® 21031*		
Nickel chromium alloy powder offering excellent resistance to oxidation and corrosion at elevated temperature. Machine using carbide tool bits. Typical Hardness: HRB 90 Nominal Chemistry: Ni + 30% (Cr, Al, Fe, Mo)	Typical Mesh Size:	-140 + 325 Mesh
	ASTM Bond Value:	5000 psi
	Max. Service Temp:	1600°F (870°C)
	Applications	
	Heat Treat Fixtures, Motor Shafts, Boiler Tubes and Pump Impellers…	

• *ProXon® 21032S*		
Nickel-base alloy offering the best combination of resistance to oxidation and corrosion. Coatings have excellent anti-galling properties. Finish by machining. Typical Hardness: HRC 30 Nominal Chemistry: Ni + 56% (Mo, Fe, Ti, Si, W)	Typical Mesh Size:	-140 + 325 Mesh
	ASTM Bond Value:	5000 psi
	Max. Service Temp:	1200°F (650°C)
	Applications	
	Impellers, Pump Shafts, Wear Rings, Print Rolls, Seal Surfaces…	

• *ProXon® 21041*		
Self-bonding, nickel-chromium alloy with additions of boron and silicon to provide enhanced resistance to abrasion and erosion. Finish by grinding. Typical Hardness: HRC 32 Nominal Chemistry: Ni + 37% (Cr, Al, Fe, Mo, B, Si)	Typical Mesh Size:	-140 + 325 Mesh
	ASTM Bond Value:	4000 psi
	Max. Service Temp:	1200°F (650°C)
	Applications	
	Wear Rings, Seal Surfaces, Bearing Fits…	

• *ProXon® 21071*		
Self-bonding, aluminum bronze alloy for use in soft-bearing applications. Coatings are easily machined to a fine finish using carbide tool bits. Typical Hardness: HRB 60 Nominal Chemistry: Cu + 11% (Al, Fe)	Typical Mesh Size:	-140 + 325 Mesh
	ASTM Bond Value:	3000 psi
	Max. Service Temp:	700°F (370°C)
	Applications	
	Reclamation of copper base metal parts	

SECTION 16: METACERAM® 23xxx & 13xxx FUSIBLE POWDER TERODYN™ & CASTODYN™ SYSTEMS

• *MetaCeram® 23005*		
Blend of a nickel-base fusible and tungsten carbide/cobalt powders. Coatings are designed to provide resistance to abrasion, erosion and fretting. Finish by grinding. Typical Hardness: HRC 58 Nominal Chemistry: 35% WC/Co + (Ni, Cr, B, Si, Fe, C)	Typical Mesh Size:	-140 + 325 Mesh
	ASTM Wear Value:	17 mm^3 vol. loss
	Max. Service Temp:	1200°F (650°C)
	Applications	
	Brick Dies, Agricultural Knives and Shear Bars, Wear Rings, Sand Buckets	
Note: Also available with a finer carbide size for increased wear resistance & deposition efficiency. Request *MetaCeram 23005F.*		

• *MetaCeram® 23045*		
Nickel-base fusible alloy that combines high hardness and ease of application. Coatings produce a smooth wear scar in service and exhibit a relatively low coefficient of friction. Typical Hardness: HRC 58 Nominal Chemistry: Ni + 27% (Cr, B, Si, Fe, C)	Typical Mesh Size:	-140 + 325 Mesh
	ASTM Wear Value:	32 mm^3 vol. loss
	Max. Service Temp:	1200°F (650°C)
	Applications	
	Plug Gauges, Dies, Wear Rings, etc.	

• *MetaCeram® 23065*		
Nickel-base fusible powder with alloying additions of copper and molybdenum to give enhanced resistance to pitting and corrosion. Typical Hardness: HRC 58 Nominal Chemistry: Ni + 36% (Cr, B, Si, Fe, Cu, Mo, C)	Typical Mesh Size:	-140 + 325 Mesh
	ASTM Wear Value:	32 mm^3 vol. loss
	Max. Service Temp:	1200°F (650°C)
	Applications	
	Boat Sleeves, Plug Gauges, Valve Trim…	

• *MetaCeram® 23075*		
Unique blend of a nickel-base fusible and 40% WC/Co powders. The carbide is sized to give the coating enhanced resistance to solid particle erosion. Typical Hardness: HRC 58 Nominal Chemistry: 40% WC/Co + Ni, Cr, B, Si, Fe, C	Typical Mesh Size:	-140 + 325 Mesh
	ASTM Wear Value:	15 mm^3 vol. loss
	Max. Service Temp:	1200°F (650°C)
	Applications	
	Brick Dies, Agricultural Knives and Shear Bars, Pump Pistons, Impellers	

• *MetaCeram® 13017*		
Nickel-base fusible powder with additions of copper and molybdenum to provide enhanced resistance to corrosion. Finish by grinding. Typical Hardness: HRC 58 Nominal Chemistry: Ni + 36% (Cr, B, Si, Fe, Cu, Mo, C)	Typical Mesh Size:	-140 + 325 Mesh
	ASTM Wear Value:	32 mm^3 vol. loss
	Max. Service Temp:	1200°F (650°C)
	Applications	
	Boat Sleeves, Shafts, Screw Flights, Plug Gauges, Valve trim…	

• *MetaCeram® 13494*		
Intermediate hardness coating for use on crack sensitive base metals or when a machinable fused deposit is required. Finish using carbide tool bits. Typical hardness: HRC 39 Nominal Chemistry: Ni + 18% (Cr, B, Si, Fe, C)	Typical Mesh Size:	-140 + 325 Mesh
	ASTM Bond Value:	N/A
	Max. Service Temp:	1200°F (650°C)
	Applications	
	Camshafts, Diesel Valves, Transmission Shafts, Bearing Sleeves…	

• *Eutecti® 13495*		
Provides an optimal combination of hardness and wear resistance with a reduced tendency for cracking. Finish by grinding. Typical Hardness: HRC 48 Nominal Chemistry: Ni + 18% (Cr, B, Si, Fe, C)	Typical Mesh Size:	-140 + 325 Mesh
	ASTM Bond Value:	N/A
	Max. Service Temp:	1200°F (650°C)
	Applications	
	Ash Plates, Steam Nozzles, Camshafts, Bearing Fits…	

• *Eutectic® 13496*		
Combines high hardness and wear resistance in an easy-to-fuse alloy form. Coatings provide a smooth wear surface in service coupled with a low coefficient of friction. Typical Hardness: HRC 58 Nominal Chemistry: Ni + 27% (Cr, B, Si, Fe, C)	Typical Mesh Size:	-140 + 325 Mesh
	ASTM Wear Value:	32 mm^3 vol. loss
	Max. Service Temp:	N/A
	Applications	
	Feed Screws, Slurry Pipes, Wear Rings, Steam Nozzles, Brick Dies, Plug Gauges…	

SECTION 17: METACERAM® 25xxx CERAMIC POWDERS TERODYN™ & CASTODYN™ SYSTEMS

• *MetaCeram® 25010*

Aluminum oxide powder produces a hard, dense, wear resistant coating suitable for use at elevated temperatures. Excellent electrical insulating properties. Finish by grinding.
Typical Hardness: HRC 50
Nominal Chemistry: Al_2O_3

Typical Mesh Size:	-325 + 15 µm
ASTM Bond Value:	N/A
Max. Service Temp:	3000°F (1650°C)
Applications	
Slag troughs, Pump Seals, Impellers…	

• *MetaCeram® 25020*

Aluminum oxide-titanium dioxide blend with excellent resistance to heat, cavitation, and liquid metal erosion. Finish by grinding.
Typical Hardness: HRC 55
Nominal Chemistry: Al_2O_3 + 3% TiO_2

Typical Mesh Size:	-325 + 15 µm
ASTM Bond Value:	N/A
Max. Service Temp:	2000°F (1100°C)
Applications	
Piston Rods, Rocker Arms, Pump Sleeves, Thread Guides, Piston Rods…	

• *MetaCeram® 25030*

Aluminum oxide-titanium dioxide blend that produces coatings which have a slightly lower resistance to abrasion than 25010 but produce a better grind finish.
Typical Hardness: HRC 60
Nominal Chemistry: Al_2O_3 + 13% TiO_2

Typical Mesh Size:	-325 + 15 µm
ASTM Bond Value:	N/A
Max. Service Temp:	1000°F (540°C)
Applications	
Piston Rods, Rocker Arms, Pump Sleeves, Thread guides, Piston Rods…	

• *MetaCeram® 25040*

Titanium dioxide coatings offer the best finish capability and provide excellent resistance to mild cavitation. Good abrasion resistance.
Typical Hardness: HRC 57
Nominal Chemistry: TiO_2

Typical Mesh Size:	-325 + 15µm
ASTM Bond Value:	N/A
Max. Service Temp:	1200°F (650°C)
Applications	
Pump Sleeves, Impellers, Propeller Shaft Bearings, Thread Guides…	

• *MetaCeram® 25050*		
Chromium oxide coatings offer the best resistance to hard particle abrasion and are resistant to most acids and alkali solutions when properly sealed. Typical Hardness: HRC 65 Nominal Chemistry: Cr_2O_3	Typical Mesh Size:	-325 + 15 µm
	ASTM Bond Value:	N/A
	Max. Service Temp:	1000°F (540°C)
	Applications	
	Buffing Fixtures, Wear Rings, Plungers, Pump Seals, Cylinder Liners…	

• *MetaCeram® 25060*		
Aluminum oxide - titanium oxide blend that is less technique sensitive to apply and easier to finish than 25010 or 25030. Excellent finishes are possible via grinding and lapping. Typical Hardness: HRC 57 (HV 800) Nominal Chemistry: Al_2O_3 + 40% TiO_2	Typical Mesh Size:	-325 + 15µm
	ASTM Bond Value:	N/A
	Max. Service Temp:	1000°F (540°C)
	Applications	
	Piston Rods, Buffing Fixtures, Thread Guides, Pump Sleeves…	

• *MetaCeram® 25088*		
MetaCeram 25088 is suitable for use as a thermal barrier coating, to resist wetting by molten metals or to resist hard particle abrasion. Typical Hardness: HRC 55 Nominal Chemistry: ZrO_2 + 32% (Al_2O_3, SiO_2, TiO_2)	Typical Mesh Size:	-200 + 15µm
	ASTM Bond Value:	N/A
	Max. Service Temp:	1800°F (980°C)
	Applications	
	Heat Treat Fixtures, Pouring Troughs, Ingot Molds, Tuyères…	

SECTION 18: METACERAM® 29xxx 2-STEP POWDERS TERODYN & CASTODYN SYSTEMS

• *MetaCeram 29011*		
Low carbon, 300 Series austenitic stainless steel alloy offering excellent resistance to a side range of corrosive media. Finish by machining. Typical Hardness: HRB 85 Nominal Chemistry: Fe + 34% (Cr, Ni, Mo, Si)	Typical Mesh Size:	-140 + 325 Mesh
	ASTM Bond Value:	N/A
	Max. Service Temp:	1000°F (540°C)
	Applications	
	Valve Trim, Pistons, Pump Shafts, Machine Element Repair	

• ***MetaCeram® 29012***		
A high chromium, martensitic stainless steel offering excellent metal-to-metal wear characteristics. Finish by grinding. Typical Hardness: HRC 30 Nominal Chemistry: Fe + 18% (Cr, Ni, C)	Typical Mesh Size:	-140 + 325 Mesh
	ASTM Bond Value:	N/A
	Max. Service Temp:	1200°F (650°C)
	Applications	
	Pistons, Rolls, Sleeves, Cylinder Liners	

• ***MetaCeram® 29021***		
A hard, grindable final coat formulated to reduce bearing-seat wear due to severe friction. Finish by grinding Typical Hardness: HRC 32 Nominal Chemistry: Ni + 17% (Cr, Si, Fe, B)	Typical Mesh Size:	-140 + 325 Mesh
	ASTM Bond Value:	N/A
	Max. Service Temp:	800°F (430°C)
	Applications	
	Valve Trim, Pistons, Pump Shafts, Machine Element Repair…	

• ***MetaCeram® 29029***		
Similar to UltraBond 50000. A nickel-base alloy used as a bond coat for two-step 25000 and 29000 series powders. Bonds to most metals except pure copper. Apply to a thickness in the 0.004-0.008 in. range. Nominal Chemistry: Ni + 12% (Al, Mo)	Typical Mesh Size:	-140 + 325 Mesh
	ASTM Bond Value:	5500 psi
	Max. Service Temp:	1000°F (540°C)
	Applications	
	Use as a bond layer for two-step powders	

• ***MetaCeram® 29061***		
Aluminum bronze coating with good resistance to fretting wear. Coatings are most often used for bearing applications. Finish by machining with carbide tool bits. Typical Hardness: HRB 70 Nominal Chemistry: Cu + 11% (Al, Fe)	Typical Mesh Size:	-140 + 325 Mesh
	ASTM Bond Value:	N/A
	Max. Service Temp:	700°F (370°C)
	Applications	
	Pump Shafts, Impellers, Seals, Guides…	

• ***MetaCeram® 29077***		
Low carbon steel powder used primarily as a cushion layer or for heavy build-ups, particularly when cost is a prime concern. Finish by machining with carbide tool bits. Typical Hardness: HRB 92 Nominal Chemistry: Fe + 2.5% (C, Ni, Mo)	Typical Mesh Size:	-140 + 325 Mesh
	ASTM Bond Value:	N/A
	Max. Service Temp:	800°F (430°C)
	Applications	
	Machine Element Repair of Steel Parts	

• *MetaCeram® 29079*		
Aluminum bronze alloy with additions of nickel to increase hardness and to enhance bearing properties. Use in place of 29061 when a harder bronze coating is required. Typical Hardness: HRB 90 Nominal Chemistry: Cu + 16% (Al, Ni, Fe)	Typical Mesh Size:	-140 + 325 Mesh
	ASTM Bond Value:	N/A
	Max. Service Temp:	1600°F (870°C)
	Applications	
	Bearing Surfaces, Piston Guides, Shafts	

• *MetaCeram® 29096*		
Corrosion resistant, machinable nickel-base alloy coating used in the reclamation of steel and nickel alloy parts. Finish by machining. Typical Hardness: HRB 82 Nominal Chemistry: Ni + 24% (Cr, Fe, Si)	Typical Mesh Size:	-140 + 325 Mesh
	ASTM Bond Value:	N/A
	Max. Service Temp:	1200°F (650°C)
	Applications	
	Motor Shafts, Journals, Sleeves	

• *MetaCeram® 29123*		
Blend of WC / Co and nickel-base alloy powders. Coatings provide excellent resistance to abrasion and erosion. Do not grind. Use in the as-sprayed condition. Typical Hardness: HRC 50 Nominal Chemistry: 75% WC/Co +NiCrBSi	Typical Mesh Size:	-170 + 325 Mesh
	ASTM Bond Value:	N/A
	Max. Service Temp:	1200°F (650°C)
	Applications	
	Fan Blades, Grain Chutes, Gripping Rolls	

• *Alu*Tec® 29210*		
Aluminum-12% silicon alloy powder widely used to repair worn aluminum or magnesium parts. Finish by machining. Typical Hardness: RH 90 Nominal Chemistry: Al + 12% Si	Typical Mesh Size:	-100 + 325 Mesh
	ASTM Bond Value:	N/A
	Max. Service Temp:	500°F (260°C)
	Applications	
	Shafts, Casings, Pumps, Blower Housings	

• *Cor*Resist® 29230*		
Pure zinc powder used to protect iron & steel structures and fabrications from rusting and corrosion. Excellent for repairing ruptured galvanized coatings. Typical Hardness: RH 40 Nominal Chemistry: 100% Zinc	Typical Mesh Size: ASTM Bond Value: Melting Point:	-100 + 270 Mesh N/A 466ºF (240ºC)
	Applications	
	Bridges, Castings, Christmas-tree pipe assemblies, tubing, etc…	

SECTION 19: METACERAM® CPW 1xxx 2-STEP POWDERS TERODYN™ & CASTODYN™ SYSTEMS

• *CPW 1720*

Pure copper powder generally used for electrical applications. Coatings have good electrical conductivity and RF shielding properties.
Typical Hardness: RH 85
Nominal Chemistry: Copper @ 99% min.

Typical Mesh Size:	-170 + 325 Mesh
ASTM Bond Value:	N/A
Melting Point:	1980°F (1020°C)
Applications	
Capacitor Contacts, Ground Connectors	

• *CPW 1954*

Tin base alloy powder used to rebuild worn Babbitt bearings. The powder meets the requirements of ASTM Grade 2. Coatings are easily machined with HS steel tool bits.
Typical Hardness: RY 30
Nominal Chemistry: Sn + 12% (Cu, Sb)

Typical Mesh Size:	-100 + 270 Mesh
ASTM Bond Value:	N/A
Melting Point:	466°F (240°C)
Applications	
Journals, Bearings, Shoes, Skirts	

• *CPW 1960*

Elemental zinc powder used to provide galvanic protection for iron and steel parts. Do not use at service temperatures above 140 °F. Use as-sprayed; do not finish.
Typical Hardness: HRH 40
Nominal Chemistry: Zinc @ 99.9 % min.

Typical Mesh Size:	140 + 400 Mesh
ASTM Bond Value:	N/A
Melting Point:	787°F (420°C)
Applications	
Steel Structures, Hand Rails	

• *CPW 1961*

Elemental aluminum powder used to provide galvanic protection for iron and steel parts. Coatings are generally used in the as-sprayed condition.
Typical Hardness: HRH 30
Nominal Chemistry: Al ~99% min.

Typical Mesh Size:	-140 + 325 mesh
ASTM Bond Value:	N/A
Melting Point:	1220°F (660°C)
Applications	
Steam Piping, Valve Bodies, I-Beams	

• *CPW 5018 & 5094*	
These are respectively white & gray nylon powders. Their combination of light weight, high strength and resistance to environmental factors make these two thermoplastics ideal materials for industrial, municipal, commercial and industrial applications. Powder coatings have broad corrosion resistance and excellent low-friction properties.	Typical Hardness: Rockwell D…….. ~75 Typical UTS:…….~5,000-9,000 psi Typical YS:…….....~2,200-4,000 psi Maximum Service Temperature:…..~ 250ºF Melting Point:……~360ºF
	Applications
	Reduced friction wear applications, barrier coatings including particulate erosion resistance, pipe flanges, brackish water pumps, etc…

SECTION 20: GAP 375 16xxx & PG POWDERS TRANSFERRED-ARC PTA SYSTEM

• *Eutroloy® 16001*		
A cobalt 1-type alloy designed for high abrasion and severe corrosion applications. Typical Hardness: HRC 52 Nominal Chemistry: Co + 48% (Cr, W, Fe, Si, Ni, Mo, Mn, C)	Typical Mesh Size:	- 80 + 270 Mesh
	ASTM Bond Value:	N/A
	Max. Service Temp:	1800°F (980°C)
	Applications	
	Pressure Dies, Valve Seats, Ball Valves,	
	Auger Screws, Grinding abrasion applications including dry & wet erosion	

• *Eutroloy® 16006*		
A Cobalt 6-type alloy designed for metal-to-metal wear applications involving heat and corrosion. Excellent anti-galling and adhesive wear resistance. Typical Hardness: HRC 42 Nominal Chemistry: Co + 38% (Cr, W, Fe, Si, Ni, Mo, Mn, C)	Typical Mesh Size:	- 80 + 270 Mesh
	ASTM Bond Value:	N/A
	Max. Service Temp:	1800°F (980°C)
	Applications	
	Forging Dies, Valve Seats, Valve Trim, Conveyor Screws…	

• *Eutroloy® 16012*		
A cobalt 12-type alloy designed for a combination of abrasion & friction, with moderate-to-good corrosion resistance. Typical Hardness: HRC 46 Nominal Chemistry: Co + 53% (Cr, W, Fe, Si, Ni, Mo, Mn, C)	Typical Mesh Size:	- 80 + 270 Mesh
	ASTM Bond Value:	N/A
	Max. Service Temp:	1800°F (980°C)
	Applications	
	Valve Seats, Guide Bars, Billet Saw Teeth, Screws…	

• ***Eutroloy® 16112***		
Blend of 60% cast and crushed tungsten carbide plus NiCrBSi alloy powder. Coatings provide excellent resistance to abrasion and erosion. Use as a single pass deposit only. Typical Hardness: HRC 60 Nominal Chemistry: 60% WC-W2C + (Ni, Cr, B, Si, Fe, C)	Typical Mesh Size:	-140 + 325 Mesh
	ASTM Wear Value:	10 mm^3 vol. loss
	Max. Service Temp:	1200°F (650°C)
	Applications	
	Mixer Paddles, Fan Blades, Screw Flights, Conveyors…	

• ***Eutroloy® 16113***		
Blend of 60% cast and crushed tungsten carbide plus NiBSi alloy powder. Coatings are resistant to abrasion and erosion and can tolerate mild levels of impact. Typical Hardness: HRC 54 Nominal Chemistry: 60% WC-W2C + (Ni, B, Si)	Typical Mesh Size:	-100 + 325 Mesh
	ASTM Wear Value:	13 mm^3 vol. loss
	Max. Service Temp:	1200°F (650°C)
	Applications	
	Mixer Paddles, Screw Flights, Drill Stabilizers, Fan Blades…	

• ***Eutroloy® 16220***		
Proprietary nickel-base alloy with special alloying additions to allow easier welding to cast iron parts. Typical Hardness: HRC 25 Nominal Chemistry: Ni + 11% (B, Si)	Typical Mesh Size:	-100 + 325 Mesh
	ASTM Bond Value:	N/A
	Max. Service Temp:	1400°F (760°C)
	Applications	
	Cast Iron Glass Molds…	

• ***Eutroloy® 16221***		
Proprietary nickel-base alloy with special alloying additions to allow easier welding to cast iron parts. Typical Hardness: HRC 30 Nominal Chemistry: Ni + 13% (Cr, B, Si)	Typical Mesh Size:	-100 + 325 Mesh
	ASTM Bond Value:	N/A
	Max. Service Temp:	1400°F (760°C)
	Applications	
	Cast Iron Glass Molds…	

• ***Eutroloy® 16227***		
Proprietary nickel-base alloy with special alloying additions to allow easier welding to cast iron parts. Formulated with a higher hardness and greater toughness. Typical Hardness: HRC 35-40 Nominal Chemistry: Ni + 15% (Cr, B, Si)	Typical Mesh Size:	-100 + 325 Mesh
	ASTM Bond Value:	N/A
	Max. Service Temp:	1400°F (760°C)
	Applications	
	Cast Iron Glass Molds…	

• ***Eutroloy® 16300LC***		
Gas atomized, type 316L stainless steel powder for use as a cushion layer or when a machinable corrosion resistant deposit is required. Typical Hardness: HRB 80 Nominal Chemistry: Fe + 30% (Cr, Ni, Mo)	Typical Mesh Size:	-80 + 270 Mesh
	ASTM Bond Value:	N/A
	Max. Service Temp:	1500°F (815°C)
	Applications *Ideal for re-builds on shafts, valve bodies stirrers, mixer paddles, etc…*	

• ***Eutroloy® 16410***		
Multi-component iron-base alloy with Mn & Cr for enhanced properties. Deposits exhibit a tempered martensitic structure with good wear resistance. Typical Hardness: HRC 35 Nominal Chemistry: Fe + 15% (Cr, C)	Typical Mesh Size:	-80 + 270 Mesh
	ASTM Bond Value:	N/A
	Max. Service Temp:	1000°F (540°C)
	Applications *Ideal for re-builds on shafts, valve bodies stirrers, mixer paddles, etc…*	

• ***Eutroloy® 16495***		
Hard, wear resistant nickel base alloy coating suitable for applications requiring resistance to abrasion and erosion. Typical hardness: HRC 50 Nominal Chemistry: Ni + 24% (Cr, B, Si, Fe, C)	Typical Mesh Size:	-100 + 325 Mesh
	ASTM Bond Value:	N/A
	Max. Service Temp:	1020°F (550°C)
	Applications	
	Screw Flights, Wear Rings, Brick Dies…	

• ***Eutroloy® 16496***		
Hard, wear resistant nickel base alloy coating suitable for applications requiring resistance to abrasion and erosion. Typical hardness: HRC 58 Nominal Chemistry: Ni + 27% (Cr, B, Si, Fe, C)	Typical Mesh Size:	-100 + 325 Mesh
	ASTM Bond Value:	N/A
	Max. Service Temp:	1200°F (650°C)
	Applications	
	Screw Flights, Wear Rings, Brick Dies, Steel Mill Rolls…	

• ***Eutroloy® 16496A***		
Equivalent to Eutroloy 16496 but sized specifically sized to reduce anode build-up when using the GAP 375 Process. Coated parts should be finished by wet grinding. Typical hardness: HRC 58 Nominal Chemistry: Ni + 27% (Cr, B, Si, Fe, C)	Typical Mesh Size:	-100 + 325 Mesh
	ASTM Bond Value:	N/A
	Max. Service Temp:	1200°F (650°C)
	Applications	
	Cam Lobes, Valve Stems & Seats, Plug Gauges, etc.	

• *Eutroloy® PG 5224*		
A proprietary non-magnetic composite nickel-base alloy containing a discrete fraction of tungsten carbides. Typical hardness: HRC 50 Nominal Chemistry: 25% WC-W_2C in a Ni Cr, B, Si, Fe, C matrix.	Typical Mesh Size:	-100 + 325 Mesh
	ASTM Bond Value:	N/A
	Max. Service Temp:	1020°F (550°C)
	Applications	
	For specialized "down-hole" tool drilling	

• *Eutroloy® PG 6503*		
Blend of 60% cast and crushed tungsten carbide plus NiBSi alloy powder. Coatings are resistant to abrasion and erosion and have improved wear resistance and can tolerate greater levels of impact compared to 16113 Typical Hardness: HRC 50 Nominal Chemistry: 60% WC-W2C + Ni, B, Si matrix	Typical Mesh Size:	-100 + 325 Mesh
	ASTM Wear Value:	13 mm^3 vol. loss
	Max. Service Temp:	1200°F (650°C)
	Applications	
	Oil Sand Processing Equipment, Mixer Paddles	

• *CPW 5056*		
A special nickel-base alloy suitable for use on cast iron, iron-nickel bronze alloy glass mold parts. Deposits are readily machined with standard HSS or carbide tooling. Typical Hardness: HRC 20 Nominal Chemistry: Ni + 4% (C, B, Si, Fe)	Typical Mesh Size:	-100 + 325 Mesh
	ASTM Bond Value:	N/A
	Max. Service Temp:	1000°F (590°C)
	Applications	
	Bronze preforming and finishing molds, bottom plates, etc.	

SECTION 21: TEROJET HVOF 55-xxx POWDERS TEROJET™ SYSTEM

Tero-Jet 55-116		
A type 316 stainless steel powder designed for use with HVOF equipment. Coatings exhibit less than 1-% porosity and are resistant to corrosion and cavitation. Typical Hardness: HRC 27 Nominal Chemistry: Fe + 30% (Cr, Ni, Mo)	Typical Mesh Size:	-270 + 15 µm
	ASTM Bond Value:	7000 psi
	Max. Service Temp:	1000°F (540°C)
	Applications	
	Print Rolls, Pump Shafts, Valve Seals…etc	

• *TeroJet 55-125*		
Nickel chromium alloy powder that produces coatings with excellent resistance to a wide range of acid and alkaline environments. Typical Hardness: HRC 35 Nominal Chemistry: Ni + 40% (Cr, Mo, Fe,Nb, Mn)	Typical Mesh Size:	-270 + 15 µm
	ASTM Bond Value:	7000 psi
	Max. Service Temp:	1600°F (870°C)
	Applications	
	Chemical Processing / Pump Parts, Heat Treat Fixtures, Mixing Blades	

• *TeroJet 55-396*		
A nickel-base alloy with superior resistance to high frictional forces and scratching and particulate abrasion Finish using diamond grinding wheels or belts. Typical Hardness: HRC 55 Nominal Chemistry: Ni + 28% (C,, Si, B, Fe)	Typical Mesh Size:	-325 + 15 µm
	ASTM Bond Value:	N/A
	Max. Service Temp:	1020°F (550°C)
	Applications	
	Screw Flights, Wear Rings, Brick Dies, Fan Blades, Extrusion Dies, Tile Molds	

• *TeroJet 55-575*		
Composite of chromium carbide and nickel chromium alloy powders. Coatings are suitable for applications requiring resistance to abrasion, corrosion and oxidation at elevated temperatures. Typical Hardness: HRC 57 Nominal Chemistry: 75% Cr_3C_2 + NiCr	Typical Mesh Size:	-325 + 15 µm
	ASTM Bond Value:	10,000 psi
	Max. Service Temp:	1500°F (815°C)
	Applications	
	Mixer Paddles, Forging Tools, Mandrels, Exhaust Valves and Seats	

• *TeroJet 55-583*		
Sintered tungsten carbide 17% cobalt powder suitable for applications requiring resistance to abrasion, erosion and fretting wear. Finish using diamond grinding wheels or belts. Typical Hardness: HRC 62 Nominal Chemistry: WC + 17% Co	Typical Mesh Size:	-325 + 15µm
	ASTM Bond Value:	10,000 psi
	Max. Service Temp:	1020°F (550°C)
	Applications	
	Wire Drawing Blocks and Capstans, Fan Blades, Extrusion Dies, Brick Molds	

• *TeroJet 55-586*		
Premium grade sintered tungsten carbide plus 12% cobalt & 5% chromium powder that produces coatings resistant to abrasion and erosion. Coatings can be finished to less than 5 µ-in. AA when ground and lapped. Typical Hardness: HRC 59-67…converted Nominal Chemistry: WC + 12% Co & 5%Cr	Typical Mesh Size:	-325 + 15µm
	ASTM Bond Value:	10,000 psi
	Max. Service Temp:	1150°F (620°C)
	Applications	
	Compressor Shafts, Pump Seals, Impellers, Paper Rolls, ID Fan Blades…	

• *TeroJet 55-588T*		
Premium grade sintered tungsten carbide plus 12% cobalt powder that produces coatings resistant to abrasion and erosion. Coatings can be finished to less than 10 µ-in. AA. Typical Hardness: HRC 62 Nominal Chemistry: WC + 12% Co	Typical Mesh Size:	-325 + 20 µm
	ASTM Bond Value:	10,000 psi
	Max. Service Temp:	1020°F (550°C)
	Applications	
	Extrusion Dies, Wire Drawing Blocks, Fan Blades, Leveling Rolls, Pump Rotors	

• *TeroJet 55-588VF*		
Similar to 55-588T but with a finer particle size for denser coatings. Ultimate abrasion and erosion resistance. Coatings can be finished to less than 10µ-in. AA. Typical Hardness: HRC 62 Nominal Chemistry: WC + 12% Co	Typical Mesh Size:	-400 + 25 µm
	ASTM Bond Value:	10,000 psi
	Max. Service Temp:	1020°F (550°C)
	Applications Pump Rotor, rolls, Extrusion Dies, Wire Drawing Blocks,	

• *TeroJet 55-590*		
Premium grade sintered tungsten carbide with 10% nickel for improved corrosion resistance Coatings are further resistant to abrasion and erosion. Coatings can be finished to less than 5 µ-in. AA when ground and lapped. Typical Hardness: HRC 59-67 Nominal Chemistry: WC + 10% Ni	Typical Mesh Size:	-325 + 15µm
	ASTM Bond Value:	10,000 psi
	Max. Service Temp:	1020°F (550°C)
	Applications	
	Chemical Pump Seals Pump Volutes, Fluid Impellers,	

• *TeroJet 2506*		
A tungsten carbide 83:17 alloy designed for oxy-kerosene HVOF systems. Extremely high wear resistance including superior particulate erosion resistance. Typical Hardness: HRC 62 Nominal Chemistry:	Typical Mesh Size:	-325 + 20 µm
	ASTM Bond Value:	10,000 psi
	Max. Service Temp:	1500°F (815°C)
	Applications	
	Fan Blades, Flow Deflectors, Butterfly Valves, Ball Valves, Bagging Equipment	

SECTION 22: Plasma Non-Transferred Arc 18xxx Powder+ Specialized Application Powders

• *ThermoTec 18910*		
A fine grade 88-12 tungsten carbide powder. Coatings are dense and highly resistant to fretting corrosion and particulate abrasion. Finish by diamond wheel grinding and/or lapping as needed. Typical Hardness: HRC 53 Nominal Chemistry: W + 19% (Co, Fe, C)	Typical Mesh Size:	-230 + 10µm
	ASTM Bond Value:	N/A
	Max. Service Temp:	1600°F (870°C)
	Applications	
	High-load Bearing Seats, I.D. Fan Blades, Pump Volutes, Steam Valves…	

• *ThermoTec 18923*		
Nickel-chromium alloy powder suitable for use with combustion or plasma spray systems. Coatings have excellent high temperature oxidation resistance. Typical Hardness: HRB 90 Nominal Chemistry: Ni + 20% Cr	Typical Mesh Size:	-230 + 10µm
	ASTM Bond Value:	N/A
	Max. Service Temp:	1800°F (980°C)
	Applications	
	Bond Coating for Ceramics, Annealing Pans, Exhaust Mufflers, Braze Fixtures…	

• *ThermoTec® 18995*		
Nickel-aluminum bond coat alloy meeting aircraft specifications - GE B50TF56, Class B and PWA 1380. Suitable for use with combustion or plasma spray systems. Typical Hardness: HRB 65 Nominal Chemistry: Ni + 4.5% Al	Typical Mesh Size:	-170 + 325 Mesh
	ASTM Bond Value:	> 3000 psi
	Max. Service Temp:	1200°F (650°C)
	Applications	
	Bond Coating, Abradable Seal Coating	

Specialized Application Powders

• *EverTuff ET 11…Thermoplastic*		
High performance thermoplastic copolymer that offers the best combination of resistance to corrosion and ease of application. Provides an excellent barrier coating to resist most acids, alkalis and aqueous solutions. Typical Hardness: Shore D 48 Available Colors: Black, Blue, Gray, Red, Green and white.	Elongation:	580%
	Melting Point:	221°F (105°C)
	Max. Service Temp:	160°F (71°C)
	Applications	
	Motor Covers, Pump Bodies, I-Beams Handrails, Snow Plows, Salt Spreaders…	

• *UltraBond® 50000…Bond Coat Alloy*		
Nickel-base alloy used as a bond coating for two-step 29xxx Series Powders and selected Specialized Application Powders. Apply to a thickness in the 0.004-0.008 in. range. Nominal Chemistry: Ni + 12% (Al, Mo)	Typical Mesh Size:	-140 + 325 Mesh
	ASTM Bond Value:	5500 psi
	Max. Service Temp:	1000°F (540°C)
	Use as a bond layer for two step powders	

SECTION 23: AbraCor Composites (Epoxy-based Materials)

• *AbraCor™ Express*		
Fast curing (four minute), two-part epoxy for use on metallic and non-metallic surfaces. Well suited for repairing leaks in tanks and piping, rebuilding seals, stripped threads, keyways and shafts. Typical Hardness: Barcol 36	Comp. Strength:	10,400 psi
	Tensile bond:	4,500 psi
	Max. Service Temp:	250°F (125° C)
	Applications	
	Piping, Castings, Threads, Seal Surfaces..	

• *AbraCor™ General Repair*		
High performance, two-part epoxy for use on metallic and non-metallic surfaces. General Repair has an extended pot life to allow its use on larger parts. Deposits are easily machined. Typical Hardness: Barcol 36	Comp. Strength:	12,100 psi
	Tensile bond:	4,200 psi
	Max. Service Temp:	250°F (125° C)
	Applications	
	Casting Defects, Hydraulic Rams, Machine Element Repair, Impellers…	

• *AbraCor™ Ceramic Rebuild*		
High performance, two-part epoxy with additions of silicon carbide. Deposits are well suited to restore dimension and to increase resistance to abrasion and erosion. Typical Hardness: Barcol 38 Carbide Hardness: 3.2 Moh	Comp. Strength:	12,500 psi
	Tensile bond:	4,000 psi
	Max. Service Temp:	250°F (125° C)
	Applications	
	Pump Components, Valves, Electrical Insulation, Piping/Elbows…	

• *AbraCor™ Ceramic Rebuild OF*		
Modified version of AbraCor Rebuild containing a higher volume percentage of hard, silicon carbide particles. Deposits are non-sagging and have enhanced resistance to abrasion. Typical Hardness: Barcol 38 Carbide Hardness: 3.2 Moh	Comp. Strength:	12,500 psi
	Tensile bond:	4,000 psi
	Max. Service Temp:	250°F (125° C)
	Applications	
	Piping, Elbows, Conveyors, Fan Blades, Pump Components, Valves…	

• *AbraCor™ Ceramic Brush-On*		
Two-part epoxy with additions of fine silicon carbide particles. Brush-On can be used to provide a smooth, non-stick top coating for other more abrasion resistant AbraCor composites. Typical Hardness: Barcol 36	Comp. Strength:	14,400 psi
	Tensile bond:	4,450 psi
	Max. Service Temp:	250°F (125° C)
	Applications	
	Impellers, Valves, Screw Flights, Fans…	

• *AbraCor™ Ceramic Paint-On*		
A modified version of Ceramic Brush-On which is more fluid and thinner in consistency. Excellent for applications where an ultra-thin coating or top-coating is required. Typical Hardness: Barcol 36	Comp. Strength:	12,500 psi
	Tensile bond:	4,000 psi
	Max. Service Temp:	250°F
	Applications	
	Impellers, Valves, Screw Flights, Fans…	

• *AbraCor™ Kevlar® 5*		
High performance epoxy containing a high volume percentage of angular aluminum oxide and silicon carbide particles. Additions of ***Kevlar*** fibers reinforce the matrix promoting exceptional resistance to abrasion and erosion. Typical Hardness: Barcol 37	Comp. Strength:	17,000 psi
	Lap Shear Strength:	3,600 psi
	Max. Service Temp:	250°F
	Kevlar® is a reg. TM of Dupont	
	Applications	
	Transport Piping, Chutes, Impellers…	

• *AbraCor™ Kevlar® 5 Hi-Temp*		
The use of a high temperature epoxy matrix extends the range of applications of standard AbraCor Kevlar 5. Contains the same volume percentage of ceramic and carbide fillers, including the use of ***Kevlar*** fibers. Typical Hardness: Barcol 37	Comp. Strength:	17,000 psi
	Lap Shear Strength:	3,600 psi
	Max. Service Temp:	450°F
	Kevlar® is a reg. TM of Dupont	
	Applications	
	Transport Piping, Valves, Coal Mills…	

• *AbraCor™ LF*		
Specifically formulated to promote low-friction response under fluid flow conditions. Resistant to damaging affects of corrosion-erosion. Typical Hardness: Shore D 60-70	Comp. Strength:	17,000 psi
	Tensile bond Strength:	3,000 psi
	Max. Service Temp:	250°F
	Applications	
	Fine slurry Piping, Fluid Control Systems, Discharge Pumps, Liquid Control Valves,	

Quick Glance Product Powder Table

Section 13 - Eutalloy Fusible MicroFlo Powders

Series 10xxx	Hardness	Series 11xxx	Hardness	Series 12xx	Hardness
• 10009	HRC 60	• 11490	HRB 95	• 1202	HRB 90-100
• 10011	HRC 59	• 11493	HRC 42	• 1203	HRB 87-94
• 10020	HRC 16-20	• 11494	HRC 38	• 1204	HRC 31
• 10092	HRC 48	• 11496	HRC 60	• 1205	HRC 20-27
• 10112	HRC 62	• 11497	HRC 25	• 1206	HRB 90-96
• 10146	HRB 30	• 11498	HRB 90	• 1207	HRC 35-40
• 10180	N/A	• CPM 1249	HRC 62	• 1210	HRC 25-27
• 10224	HRB 90				
• 10680	HRB 95				
• 10999N	HRC 60				

Series 8xxx&9xxx	Hardness	WC & "specials"	Hardness	Series X-TraLife	Hardness
• 8718	HRC 18	• 5127	HRC 59	• 4510	HRC 18
• 8726	HRC 26	• 5057N	HRC 59	• 4520	HRC 60
• 9001	HRC 25	• 1249	HRC 62	• 4530	HRC 42
• 9002	HRC 15	• 1873	HRC 25	• 4540	HRC 60
• 9003	HRC 18	**Air-Assist Powder Systems**			
• 9005	HRC 35-40	• 12494	HRC 38		
		• 12496	HRC 59		

Section 14 - ProXon 19xxx MicroFlo Powders <RotoTec System>

Series 19xxx	Hardness
• 19121	HRB 75
• 19122	HRB 80
• 19132	HRC 30
• 19132S	HRC 30
• 19171	HRB 60

Section 15 - ProXon 21xxx MicroFlo Powders <TeroDyn & CastoDyn Systems>

Series 21xxx	Hardness
• 21021	HRB 75
• 21022	HRB 80
• 21023	HRB 90
• 21031	HRB 90
• 21032S	HRC 30
• 21041	HRC 32
• 21071	HRB 60

Section 16 - MetaCeram 23xxx & 13xxx Fusible Powders <TeroDyn & CastoDyn Systems>

Series 23xxx	Hardness	Series 13xxx	Hardness
• 23005	HRC 58	• 13017	HRC 58
• 23005F	HRC 58	• 13494	HRC 39
• 23045	HRC 58	• 13495	HRC 48
• 23065	HRC 58	•13496	HRC 58
• 23075	HRC 58		

Section 17 - MetaCeram 25xxx Ceramic Powders <TeroDyn & CastoDyn Systems>	
Series 25xxx	**Hardness**
• 25010	HRC 50
• 25020	HRC 55
• 25030	HRC 60
• 25040	HRC 57
• 25050	HRC 65
• 25060	HRC 57
• 25088	HRC 55
Section 18 - MetaCeram 29xxx 2-Step Powders <TeroDyn & CastoDyn Systems>	
Series 29xxx	**Hardness**
• 29011	HRB 85
• 29012	HRC 30
• 29021	HRC 32
• 29029	Bond Coat Powder
• 29061	HRB 70
• 29077	HRB 92
• 29079	HRB 90
• 29096	HRB 82
• 29123	HRC 50
• 29210	HRH 90
• 29230	HRH 40
• 29240	HRH 30
Section 19 - MetaCeram CPW 1xxx 2-Step Powders <TeroDyn & CastoDyn Systems>	
Series 1xxx	**Hardness**
• 1720	HRH 85
• 1954	HRY 30
• 1960	HRH 40
• 1961	HRH 90
Nylon Powders	
• 5018…white color	HRD 75
• 5094…gray color	HRD 75
Section 20 - GAP 375 16xxx Powders <Transferred-Arc System>	
Series 16xxx	**Hardness**
• 16001	HRC 52
• 16006	HRC 42
• 16012	HRC 46
• 16112	HRC 60
• 16113	HRC 54
• 16220	HRC 25
• 16221	HRC 30
• 16227	HRC 40
• 16300L	HRB 80
• 16410	HRC 35
• 16495	HRC 50
• 16496	HRC 58
• 16496A	HRC 58
• 5056	HRC 20

Section 21 - TeroJet HVOF 55-xxx Powders <High Velocity Oxy-Fuel System>	
Series 55-xxx	**Hardness**
• 55-116	HRC 27
• 55-125	HRC 35
• 55-396	HRC 55
• 55-575	HRC 57
• 55-583	HRC 62
• 55-586	HRC 63
• 55-588T	HRC 62
• 55-588VF	HRC 62
• 55-590	HRC 63
• 2506	HRC 62
Section 22 - Plasma Non-Transferred Arc 18xxx Powders + Specialized Application Powders	
Series 18xxx	**Hardness**
• 18910	HRC 53
• 18923	HRB 90
• 18995	HRB 65
Specialized Application Powders	
EverTuff ET 11	Shore D 48
UltraBond 50000	N/A
Section 23 – AbraCor Composites (Epoxy-based Materials)	
Series AbraCor	**Hardness**
• Express	Barcol 36
• General Repair	Barcol 36
• Ceramic Rebuild	Barcol 36…carbide 3.2 Moh
• Ceramic Rebuild OF	Barcol 38…carbide 3.2 Moh
• Ceramic Brush-on	Barcol 38…carbide 3.2 Moh
• Ceramic Paint-on	Barcol 36
• Kevlar® 5	Barcol 37
• Kevlar® 5 Hi-temp	Barcol 37
• AbraCor LF	Shore 60-70

SECTION 24 –CASTOTUBE & WEAR PLATES

General Information

EutecDur® Wear Plate & CastoTube are materials coated with state-of-art welded coatings. Properties are optimized through uniform and consistent through-thickness properties, with bulk properties optimized for critical wear applications.

• *CastoTube*

Castotube are piping assemblies hardfaced with a high wear resistant complex carbide overlay. The high concentration and & volume of carbide, and the smooth uniform bead contours contribute to superior protection against both severe 2-body abrasion and high attack-angle erosion.

Available Diameters	
4" to 12" 102 mm 305 mm	
Service Temp. (max)	1000ºF
Typical Hardness	HRC 63-65
ASTM G-65 Test	Average 17-mm^3
Applications	
Slurry pipes, fly-ash piping, coal feeder…	

• *EutecDur® CDP 112*

EutecDur CDP 112 contains a high fraction of ultra wear resistant fused tungsten carbides contained in a highly alloyed matrix. high concentration and & volume of carbide, and the smooth uniform bead contours contribute to superior protection against both severe 2-body abrasion and high attack-angle erosion.

• Typically 20 times superior to AR plate!

Available Plate Sizes		
Thickness:	1/4"	6.5mm
Overlay/Base	5/64"on 5/32" 2 mm on 4 mm	
Package Size:	10.34 sq.ft.	
Service Temp. (max)	~800-1000ºF	
Typical Hardness	HRC 60-64	
ASTM G-65 Test	Average 14-mm^3	
Applications		
Fan blades I.D., fan housing, chutes…		

• *EutecDur® 4603*

EutecDur CDP 4603 achieves optimized wear resistance due to its *hypereutectic microstructure. The* weld coating is supported by a high concentration of chromium carbides such as Cr_7C_3 which is maintained through the coating's full cross-section…superior wear resistance through superior properties.

• Microhardness of chromium carbide is typically in the DPH Range of 1800-2000.

• Typically 4 times superior to AR plate!

Available Plate Sizes	
Thicknesses:	3/8" – 1/2" – 3/4" 9.5 mm –13 mm-19 mm
Overlay/Base Info:	3/8"- 5/32" on 1/4" 4 mm on 6 mm
	1/2"- 3/16" on 5/16" 5 mm on 8 mm
	3/4"- 1/4" on ½" 7 mm on 12 mm
Package Size:	36 sq.ft.
Service Temp. (max)	~1000ºF
Typical Hardness	HRC 55-59
ASTM G-65 Test	Average 24-mm^3
Applications	
Buckets, sand blasting cabinets, mixers…	

• *EutecDur® 4666*

EutecDur CDP 4666 is a proprietary formulation coating. The superior complex carbide weld deposit offers the highest level of abrasion resistance. This is due to a high distribution of over 57% of primary chromium carbides & wear resistant matrix.

• Microhardness of chromium carbide is typically in the DPH Range of 1800-2000.

• Typically 2-4 times life cycle compared to standard chromium carbide plate!

Available Plate Sizes	
Thicknesses: 5/16" – 3/8" –1/2" - 3/4" - 8 mm – 10 mm-13 mm - 19 mm	
Overlay/Base Info:	5/16"- 1/8" on 3/16" 3 mm on 5 mm
	3/8"- 5/32" on 1/4" 4 mm on 6 mm
	1/2"- 3/6" on 5/16" 5 mm on 8 mm
	3/4"- 1/4" on ½" 7 mm on 12 mm
Package Size:	36 sq.ft.
Service Temp. (max)	~1000ºF
Typical Hardness	HRC 60-64
ASTM G-65 Test	Average 17-mm^3
Applications	
Cement paddles, chutes, liners, cyclones…	

• *EutecDur® CDP 4923*

EutecDur CDP 4923 is the first wear plate designed to resist combination wear situations Involving both high impact and severe abrasion. Weld metal consists of a very fine dispersion of hard and tough titanium carbides contained in a tough matrix for added application performance.

Available Plate Sizes		
Thickness:	3/4"	19 mm
Overlay/Base	1/4" on 1/2" 7 mm on 12 mm	
Package Size:	4 ft. x 9ft.	
Service Temp. (max)	~800-1000ºF	
Typical Hardness	Average HRC 56	
Applications		
Crusher liners, discharge chutes…		

• *EutecDur® CDP 6503*

EutecDur CDP 6503 is a high performance wear plate coated with a high volume of tungsten carbides. The combination of carbide and high chromium matrix imparts superior anti-wear properties involving abrasion, erosion, and multi-media corrosion resistance.

Available Plate Sizes		
Thicknesses:	5/16" 3/8"	7 mm 9 mm
Overlay/Base	5/16"- 5/64" on 1/4" 3/8" – 3/16" on 1/4"	
Package Size:	16 sq.ft.	
Service Temp. (max)	~1000ºF	
Typical Hardness	Bulk: HRC 62-64 Matrix: HRC 53-54	
ASTM G-65 Test	Average 10-mm^3	
Applications		
Classifier blades, skid-pads, guides…		

SECTION 25 – EQUIPMENT

The equipment portfolio falls in to three distinct categories:

1) Point Source welding fume extraction & elimination with high saturation filter performance.

2) Assorted safety flow-safe check valves, flash-back arrestors, hoses, nozzles, gas manifold systems, etc.

3) A range of powder coating equipment ranging from a simple and easy-to-use thermal combustion spray torch to sophisticated HVOF and PTA systems. All of these specialized processes provide key methods for "Engineering the Surface" for extended, economic service life, improved in-situ performance, and coating repeatability.

1 - Fume Extraction System

• **AirLux® 3000:** This high performance fume extraction system is designed to work in enclosed work spaces, and to provide welders with the highest level of comfort due to the efficiency point-source extraction. The unit is lightweight and portable for easy site-to-site locations. The AirLux 3000 does not need to be vented for better overall energy conservation. Unit is equipped with "filter-fill" light and has a built-in on-off feature for ease of use.

Operational & Technical Features – AirLux 3000 System	
• Air Flow Rate:	96 cubic feet per minute (163 m³/hr)
• Air Flow Rate with 8ft. hose:	88 cubic feet per minute (150 m³/hr)
• Filter Area:	57 square feet (5.3 m²)
• Unit Efficiency with Standard Filter:	99.7% @ 0.5 microns
• Unit Efficiency with optional H.E.P.F/charcoal Filter:	99.97% @ 0.3 microns
• Maximum Vacuum:	85-in water pressure (163 m³/hr)
• Motor Horse Power:	1.4 HP
• Power Draw:	115 AC; 1000 watts, @ 10 amps.
• Weight:	34-lbs (15.5 kg)

2 - Oxy-Fuel Parts

• **Assorted Oxy-Fuel Parts:** These are listed below with key features highlighted.

Oxy-Fuel Safety & Process Components	
KEY PARTS	FEATURE - BENEFIT
• Reverse Flow Check Valves	Prevents back-flow gas mixing and possible torch or regulator explosion.
• Flash-back Arrestors	Prevent back-flame propagation and potential fuel-gas cylinder explosion
• Gas Regulators	Engineered to provide a balanced, non-fluctuating supply of gases for trouble-free brazing & cutting.
• Air Filter Regulators	Balanced non-pulsing air supply.

3 - Powder Thermal Spray Equipment

Thermal Spray Equipment: A brief description with features is shown below. For more information please consult with Technical Service personnel or review the more comprehensive Process Manuals.

Model Description & Features

• Eutalloy® B Torch & Kits: This "workhorse" spraying torch is designed to spray a full range of 10xxx & 11xxx series plus additional powdered MicroFlo® alloys covered in Section 13. A versatile torch featuring a modular design for point-of-source accuracy when spraying. Easy to use, all-position torch with advanced safety features. Rugged in construction for years of trouble-free service.

MicroFlo Alloys: Series 10xxx Series 11xxx Series 12xx Series 9xxx

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• SuperJet™ Torch & Kits: Is an exclusive, advanced MicroFlo delivery system with newly engineered features. With versatile high-speed operation, maximum safety, and venturi-controlled (partial vacuum method) powder feeding and coating consistency are assured. In addition to the MicroFlo metal alloys used with the Eutalloy B Torch, the advanced SuperJet torch also produces superior X-TraLife 45xx coatings.

MicroFlo Alloys: Series 10xxx Series 11xxx Series 12xx Series 9xxx

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• TeroDyn® Systems 2000 & 3000: Both units are benchmark systems and represent the optimum in spraying versatility and ease-of-use. Multi-alloy spraying capabilities are engineered in both systems that impart precise control over spraying parameters and coating quality. With multi-fuel capability (acetylene, propylene, Propane, MAPP®, etc) and the ability to spray the widest range of metal, ceramic, and polymer materials, make these units indispensable for key coating operations.

For full information on powders refer to Sections 15-19.

TeroDyn System Alloys: ProXon® 21xxx MetaCeram® 23xxx & 13xxx MetaCeram® 25xxx MetaCeram® 29xxx CPW 1xxx

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• CastoDyn System 8000: The latest in advanced design spraying systems. User-friendly, adaptable, with single valve process controls, enables the operator to produce highly consistent coatings. With its ergonomic design, operator fatigue is reduced which further enhances coating quality and operational simplicity.

For full information on powders refer to Sections 15-19.

CastoDyn System Alloys: ProXon® 21xxx MetaCeram® 23xxx & 13xxx MetaCeram® 25xxx MetaCeram® 29xxx CPW 1xxx

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• EuTronic® GAP System: A high performance Plasma Transferred-Arc System (PTA) using innovative hardware add-ons. Engineered for accuracy and simplicity of operation. PTA coatings are metallurgically bonded and have quality soundness & are freed from slag inclusions and through-coating defects. Many types of powdered metal alloys such as nickel-base, cobalt-base, iron-base, and tungsten-bearing powders are all readily and easily deposited either through a hand-held torch or torches for fully automatic operations.

Some Key Features

• Coatings are metallurgically bonded for added security.
• Deposit efficiencies are near 95% for improved application economics.
• Base metal dilution is typically less than 10% for improved through-thickness coating properties.
• Both thin & thick deposits (1/16 to 1/2") are possible with a single pass for added ease of operation & application.

EuTronic GAP System Alloys	Eutroloy 16xxx Series…for more detailed product information refer to Section 20.

• TeroJet™ AC HVOF System Model 2: This unique system is solution-oriented for many key-coating applications. It is a highly adaptable system, easy to use, as well as being robust for extended spraying operations. The primary components & ancillary supporting components have all been designed for maximum compatibility. The TeroJet AC is highly portable, easy to use, and features both hand-held as well as machine-mount capabilities.

Some Key Features

• Produces superior tungsten carbide, chromium carbide and other metallic coatings.
• Can use multi-fuel types such as propane, propylene, and natural gas.
• Non-loading nozzle design for extended spraying times.
• Lower operating costs compared other HVOF systems.
• High spraying efficiencies in the 60-70% range.

TeroJet AC HVOF System Alloys	TeroJet 55-xxx Series…for more detailed product information refer to Section 21.

4 – Arc Welding Equipment

• Total Arc® 160: This light, portable shielded metal arc welding (SMAW) system, based on inverter technology, is ideal for plant maintenance and repair applications. Total Arc 160 will run on either 110v or 220v and also has gas tungsten arc welding (GTAW) capabilities.

Some Key Features

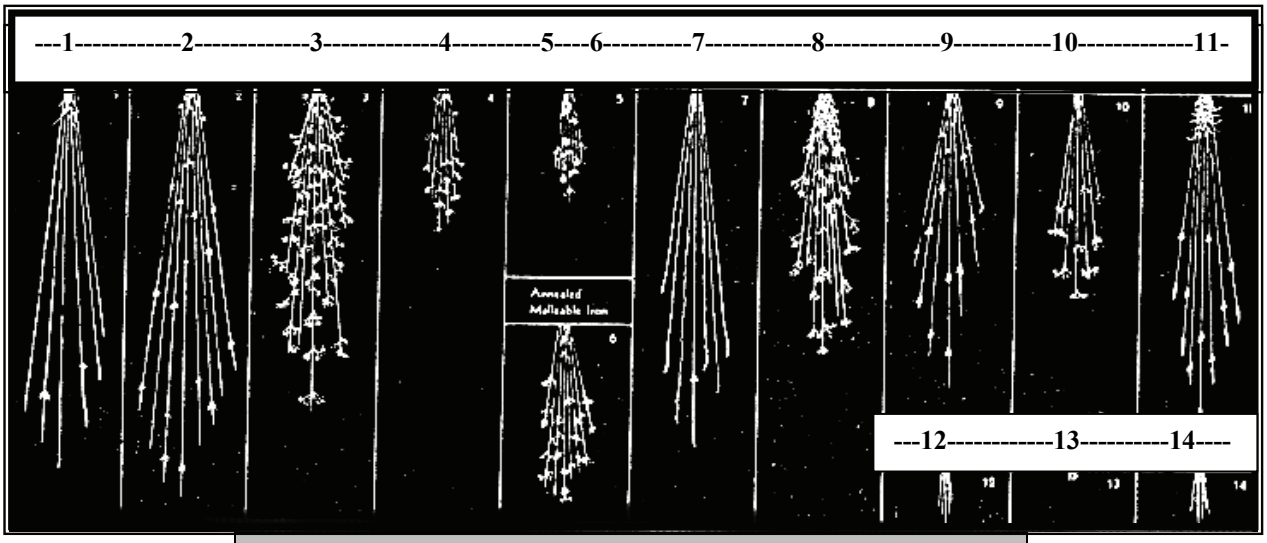
• Light weight, highly portable (approximately 20 lbs).
• Versatile; may be used for both stick or TIG welding operations.
• User friendly digital display.

TECHNICAL INFORMATION & REFERENCES

Some Physical Properties of Metals, Alloys and Materials

Material	Melting Point ^{o}C	Melting Point ^{o}F	Density g/cm^3	Density lbs/in^3
Aluminum	660.4	1220	2.7	0.098
Aluminum 4043	575	1065	2.68	0.097
Aluminum 5356	574	1065	2.64	0.095
Aluminum oxide	2050	3722	3.8	0.137
Brass & Bronze	871-904	1600-1660	8.5-8.8	0.307-0.318
Cast iron (gray)	1260	2300	7.2	0.260
Cast iron (white)	1130	2065	7.7	0.278
Cobalt	1494	2721	8.9	0.321
Copper	1084.5	1984	8.92	0.322
Chromium	1900	3452	7.2	0.260
Chromium carbide	1890	3434	6.68	0.241
Chromium oxide	2435	4415	5.21	0.188
Ductile iron	1538	2800	7.88	0.284
Gold	1064.4	1947	19.32	0.697
Lead	327.5	621.5	11.34	0.409
Lead-Tin solder (eutectic composition)	182.8	361	8.34	0.301
Magnesium	650	1202	1.74	0.063
Manganese	1244	2271	7.47	0.270
Molybdenum	2610	4730	9.01	0.352
Monel	1351	2462	8.8	0.318
Nickel	1455	2651	8.9	0.321
Nylon	189	372	1.12	0.040
Platinum	1769	3217	21.46	0.775
Silver	961.9	1763	10.5	0.379
Steel (high carbon)	1371	2500	7.84	0.283
Steel (medium carbon)	1427	2600	7.85	0.283
Steel (low carbon)	1482	2700	7.86	0.284
Stainless steel (18-8)	1399	2550	7.93	0.286
Tantalum	2996	5424	16.6	0.599
Tin	232	450	7.3	0.264
Tin Babbit	241	466	6.7	0.242
Tin-Silver solder (eutectic composition)	221	430	7.4	0.267
Titanium	1672	3042	4.51	0.163
Titanium 6Al4V	1650	3002	4.4	0.159
Titanium dioxide	1840	3344	4.26	0.154
Tungsten	3410	6170	19.4	0.700
Tungsten carbide	2870	5198	15.6	0.563
Tungsten carbide (cast, eutectic)	2525	4577	16.4	0.592
Tungsten carbide (6% cobalt)	see cobalt & tungsten carbide	see cobalt & tungsten carbide	14.9	0.538
Tungsten carbide (15% cobalt)	see cobalt & tungsten carbide	see cobalt & tungsten carbide	14.0	0.505
Zinc	419.6	787	7.14	0.258
Zirconium oxide	2715	4919	5.6	0.202

Spark Test to Help Identify Metals and Alloys



Courtesy of Norton Company, Worcester, Massachusetts

Metal	Volume of Stream	Relative Length of Stream (inches)[i]	Color of Stream Close to Wheel	Color of Streaks near end of Stream	Quantity of Spurts	Nature of Spurts
1. Wrought iron	Large	65	Straw	White	Very few	Forked
2. Machine steel	Large	70	White	White	Few	Forked
3.Carbon tool steel	Moderately large	55	White	White	Very many	Fine, repeating
4. Gray cast iron	Small	25	Red	Straw	Many	Fine, repeating
5. White cast iron	Very small	20	Red	Straw	Few	Fine, repeating
6. Annealed mall, iron	Moderate	30	Red	Straw	Many	Fine, repeating
7. High speed steel	Small	60	Red	Straw	Extremely few	Forked
8. Manganese steel	Moderately large	45	White	White	Many	Fine, repeating
9. Stainless steel	Moderate	50	Straw	White	Moderate	Forked
10. W-Cr die steel	Small	35	Red	Straw	Many	Fine, repeating[ii]
11. Nitrided Nitralloy	Large (curved)	55	White	White	Moderate	Forked
12. Stellite	Very small	10	Orange	Orange	None	
13. Tungsten carbide	Extremely small	2	Light orange	Light orange	None	
14. Nickel	Very small[iii]	10	Orange	Orange	None	
15. Brass & Aluminum	None				None	

I-Figures were obtained with a 12” wheel on a bench-stand and are relative only. Actual length in each instance will vary with, grinding wheel, pressure, etc.
II-Blue-white spurts.
III-Some wavy streaks.

Hardness Conversion Chart – Hard Metals & Alloys

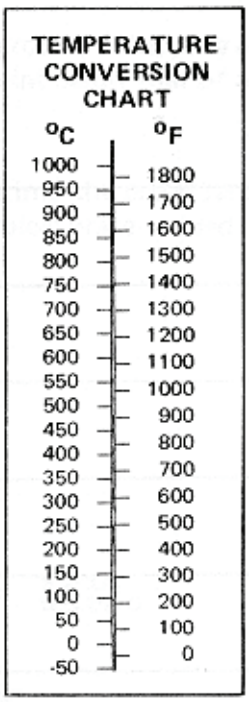
Rockwell C 150 kg "Brale"	Rockwell A 60 kg "Brale	Rockwell D 100 kg "Brale"	Rockwell 15-N 15 kg N "Brale"	Rockwell 30-N 30 kg N "Brale"	Rockwell 45-N 45 kg N "Brale"	DPH micro-hardness 10 kg	Knoop micro-hardness >500 g	Brinell 3000 kg	Rockwell G 150 kg 1/16" ball	Approx UTS for steel[1]
80	**92**	**86.5**	**96.5**	**92**	**87**	**1865**				
79						**1787**				
78	**91**		**96**	**91**	**85.5**	**1710**				
77		**84**				**1633**				
76	**90**	**83**	**95.5**	**90**		**1556**				
75				**89**	**82.5**	**1478**				
74	**89**		**95**			**1400**				
73		**81**		**88**		**1323**				
72	**88**	**80**	**94.5**	**87**	**79.5**	**1245**				
71	**87**					**1160**				
70			**94**	**86**		**1076**	**972**			
69	**86**		**93.5**	**85**	**76.5**	**1004**	**946**			
68		**77**			**75.5**	**942**	**920**			
67	**85**	**76**	**93**		**74.5**	**894**	**895**			
66			**92.5**	**83**	**73**	**854**	**870**			
65	**84**		**92**	**82**	**72**	**820**	**846**			
64		**74**		**81**	**71**	**789**	**822**			
63	**83**	**73**	**91.5**	**80**	**70**	**763**	**799**			
62			**91**	**79**	**69**	**739**	**776**			
61			**90.5**	**78.5**	**67.5**	**716**	**754**			
60	**81**	**71**	**90**	**77.5**	**66.5**	**695**	**732**	**614**		
59		**70**	**89.5**	**76.5**	**65.5**	**675**	**710**	**600**		
58	**80**	**69**		**75.5**	**64**	**655**	**690**	**587**		
57			**89**	**75**	**63**	**636**	**670**	**573**		
56	**79**			**74**	**62**	**617**	**650**	**560**		
55		**67**	**88**	**73**	**61**	**598**	**630**	**547**		**301**
54	**78**	**66**		**72**	**59.5**	**580**	**612**	**534**		**291**
53			**87**	**71**	**58.5**	**562**	**594**	**522**		**282**
52	**77**			**70.5**	**57.5**	**545**	**576**	**509**		**273**
51		**64**	**86**	**69.5**	**56**	**528**	**558**	**496**		**264**
50	**76**	**63**		**68.5**	**55**	**513**	**542**	**484**		**255**
49		**62**	**85**	**67.5**	**54**	**498**	**526**	**472**		**246**
48				**66.5**	**52.5**	**485**	**510**	**460**		**237**
47	**74**		**84**	**66**	**51.5**	**471**	**495**	**448**		**229**
46		**60**		**65**	**50**	**458**	**480**	**437**		**221**
45	**73**	**59**	**83**	**64**	**49**	**446**	**466**	**426**		**214**
44				**63**	**48**	**435**	**452**	**415**		**207**
43	**72**		**82**	**62**	**46.5**	**424**	**438**	**404**		**200**
42		**57**		**61.5**	**45.5**	**413**	**426**	**393**		**194**
41	**71**	**56**	**81**	**60.5**	**44.5**	**403**	**414**	**382**		**188**
40				**59.5**	**43**	**393**	**402**	**372**		**182**
39	**70**		**80**	**58.5**	**42**	**383**	**391**	**362**		**177**
38		**54**		**57.5**	**41**	**373**	**380**	**352**		**171**
37	**69**	**53**	**79**	**56.5**	**39.5**	**363**	**370**	**342**		**166**
36				**56**	**38.5**	**353**	**360**	**332**		**162**
35	**68**		**78**	**55**	**37**	**343**	**351**	**322**		**157**
34			**77**	**54**	**36**	**334**	**342**	**313**		**153**
33	**67**	**50**		**53**	**35**	**325**	**334**	**305**		**148**
32		**49**	**76**	**52**	**33.5**	**317**	**326**	**297**		**144**
31	**66**			**51.5**	**32.5**	**309**	**318**	**290**		**140**
30			**75**	**50.5**	**31.5**	**301**	**311**	**283**	**92**	**136**
29	**65**	**47**		**49.5**	**30**	**293**	**304**	**276**	**91**	**132**
28		**46**	**74**	**48.5**	**29**	**285**	**297**	**270**	**90**	**129**
27	**64**			**47.5**	**28**	**278**	**290**	**265**	**89**	**126**
26				**47**	**26.5**	**271**	**284**	**260**	**88**	**123**
25	**63**	**44**	**72**	**46**	**25.5**	**264**	**278**	**2255**	**87**	**120**
24		**43**		**45**	**24**	**257**	**272**	**250**	**86**	**117**
23	**62**		**71**	**44**	**23**	**251**	**266**	**245**	**84.5**	**115**
22				**43**	**22**	**246**	**261**	**240**	**83.5**	**112**
21	**61**	**41**	**70**	**42.5**	**20.5**	**241**	**256**	**235**	**82.5**	**110**
20	**60.5**	**40**	**69.5**	**41.5**	**19.5**	**236**	**251**	**230**	**81**	**108**

1- Inexact, and only for hardened steels…In thousands of pounds per square inch.

Hardness Conversion Chart – Soft Steels, Cast Irons and Most Non-Ferrous Metals

Rockwell B 100 kg 1/16" ball	Rockwell F 60 kg 1/16" ball	Rockwell G 150 kg 1/16" ball	Rockwell 15T 15 kg 1/16" ball	Rockwell 30T 30 kg 1/16" ball	Rockwell 45T 45 kg 1/16" ball	Rockwell E 100 kg 1/8" ball	Rockwell K 150 kg 1/8" ball	Rockwell A 60 kg "brale"	Knoop micro-hardness >500 g	Brinell 500 kg 10 mm ball
100		**82.5**	**93**	**82**	**72**			**61.5**	**251**	**201**
99		**81**	**92.5**		**71**			**61**	**246**	**195**
98		**79**		**81**	**70**			**60**	**241**	**189**
97		**77.5**	**92**		**69**				**236**	**184**
96		**76**		**80**	**68**			**59**	**231**	**179**
95		**74**	**91.5**	**79**	**67**			**58**	**226**	**175**
94		**72.5**			**66**				**221**	**171**
93		**71**	**91**	**78**	**65.5**			**57**	**216**	**167**
92		**69**	**90.5**		**64.5**		**100**		**211**	**163**
91		**67.5**		**77**	**63.5**			**56**	**206**	**160**
90		**66**	**90**	**76**	**62.5**				**201**	**157**
89		**64**	**89.5**		**61.5**		**98**	**55**	**196**	**154**
88		**62.5**		**75**	**60.5**		**97**	**54**	**192**	**151**
87		**61**	**89**		**59.5**				**188**	**148**
86		**59**	**88.5**	**74**	**58.5**			**53**	**184**	**145**
85		**57.5**			**58**				**180**	**142**
84		**56**	**88**	**73**	**57**		**94**	**52**	**176**	**140**
83		**54**	**87.5**	**72**	**56**		**93**	**51**	**173**	**137**
82		**52.5**			**55**		**92**		**170**	**135**
81		**51**	**87**	**71**	**54**		**91**	**50**	**167**	**133**
80		**49**	**86.5**	**70**	**53**				**164**	**130**
79		**47.5**			**52**			**49**	**161**	**128**
78		**46**	**86**	**69**	**51**				**158**	**126**
77		**44**	**85.5**	**68**	**50**		**88**	**48**	**155**	**124**
76		**42.5**			**49**		**87**	**47**	**152**	**122**
75	**99.5**	**41**	**85**	**67**	**48.5**		**86**		**150**	**120**
74	**99**	**39**		**66**	**47.5**		**85**	**46**	**147**	**118**
73		**37.5**	**84.5**		**46.5**				**145**	**116**
72	**98**	**36**	**84**	**65**	**45.5**			**45**	**143**	**114**
71		**34.5**		**64**	**44.5**	**100**			**141**	**112**
70	**97**	**32.5**	**83.5**		**43.5**	**99.5**		**44**	**139**	**110**
69	**96**	**31**	**83**		**42.5**	**99**	**81**		**137**	**109**
68		**29.5**		**62**	**41.5**	**98**	**80**	**43**	**135**	**107**
67	**95**	**28**	**82.5**		**40.5**	**97.5**	**79**		**133**	**106**
66		**26.5**	**82**		**39.5**	**97**	**78**	**42**	**131**	**104**
65	**94**	**25**		**60**	**38.5**	**96**			**129**	**102**
64		**23.5**	**81.5**		**37.5**	**95.5**			**127**	**101**
63	**93**	**22**	**81**		**36.5**	**95**		**41**	**125**	**99**
62	**92**	**20.5**		**58**	**35.5**	**94.5**			**124**	**98**
61		**19**	**80.5**	**57**	**34.5**	**93.5**	**74**	**40**	**122**	**96**
60	**91**	**17.5**			**33.5**	**93**	**73**		**120**	**95**
59		**16**	**80**	**56**	**32**	**92.5**	**72**	**39**	**118**	**94**
58	**90**	**14.5**	**79.5**	**55**	**31**	**92**	**71**		**117**	**92**
57		**13**			**30**	**91**		**38**	**115**	**91**
56	**89**	**11.5**	**79**	**54**	**29**	**90.5**			**114**	**90**
55	**88**	**10**	**78.5**	**53**	**28**	**90**			**112**	**89**
54		**8.5**			**27**	**89.5**	**68**	**37**	**111**	**87**
53	**87**	**7**	**78**		**26**	**89**	**67**		**110**	**86**
52		**5.5**	**77.5**	**51**	**25**	**88**	**66**	**36**	**109**	**85**
51	**86**	**4**			**24**	**87.5**	**65**		**108**	**84**
50	**85.5**	**2.5**	**77**	**49.5**	**23**	**87**	**64.5**	**35**	**107**	**83**

Temperature Conversions



Temperatures expressed as DEGREES CELSIUS:

°F	°C
425	219
1050	566
1090	588
1125	607
1130	610
1400	760
1600	871
2000	1093

EXAMPLES

$^{o}F = {}^{o}C \times 9/5 + 32 = {}^{o}C \times 1.8 + 32$

$^{o}C = ({}^{o}F - 32) \times 5/9 = ({}^{o}F - 32) \div 1.8$

Ex.: $212^{o}F \rightarrow {}^{o}C = (212 - 32) \div 1.8 = 100\,{}^{o}C$

Ex.: $-40^{o}C \rightarrow {}^{o}F = (-42 \times 1.8) + 32 = -40\,{}^{o}F$

Useful Metric Conversion Factors

N = Newtons	1 N = 9.80665 kgm/s^2
Pa = Pascals	1 Pa = 1 N/m^2 = 9.80665 kg/ms^2
KPa = kiloPascals	1 KPa = 1000 Pa = 1 KN/m^2
MPa = megaPascals	1 MPa = 1000 KPa = one million Pascals
GPa = gigaPascals	1 GPa = 1000 MPa = one million KPa
M = meters	
Kg = kilograms	
s = Seconds	
PSI = pounds per square inch	

Examples

1 PSI = 6.894757 KN/m^2 = 6.894757 KPa

To convert PSI to MPa multiply PSI by 0.006894757. Ex.: 120,000psi x 6.895×10^{-4} = 827.4 MPa

To convert MPa to PSI divide by 0.006894757. Ex.: 1000MPa ÷ 6.895×10^{-4} = 145,038 PSI

Approximate Inch to Metric Equivalents

Decimal - in	Fraction - in	Millimeter -mm
0.375	3/8	9.5
0.3125	5/16	8.0
0.250	1/4	6.4
0.1875	3/16	4.8
0.156	5/32	4.0
0.125	1/8	3.2
0.109	7/64	2.8
0.094	3/32	2.4
0.078	5/64	2.0
0.062	1/16	1.6
0.045	3/64	1.2

Sieve Mesh Size Reference Chart ASTM E-11

U.S. Mesh Number	Sieve Opening in Microns	Sieve Opening in Inches
No. 18	1000	0.0390
No. 20	850	0.0328
No. 25	710	0.0276
No. 30	600	0.0232
No. 35	500	0.0195
No. 40	425	0.0164
No. 45	355	0.0138
No. 50	300	0.0116
No. 60	250	0.0097
No. 70	212	0.0082
No. 80	180	0.0069
No. 100	150	0.0058
No. 120	125	0.0049
No. 140	106	0.0041
No. 170	90	0.0035
No. 200	75	0.0029
No. 230	63	0.0024
No. 270	53	0.0021
No. 325	45	0.0017
No. 400	38	0.0015
No. 500	25	0.0010
No. 635	20	0.0008

Typical Mesh Sizes - Thermal Spray Powders

	Powder Type	Mesh Distribution
1	10xxx Series	140 x down with up to 90% -325 mesh.
2	11xxx Series	Generally 100 x 325 mesh with up to 60% -325 mesh.
3	12xxx Series	Generally 170 x 325 with up to 10% -325 mesh.
4	13xxx Series	Generally 100 x 325 with up to 5% -325 mesh.
5	16xxx Series	Generally gas atomized 60 x 270 mesh with up to 1% -325.
6	18xxx Series	Generally –100 mesh many variations.
7	21xxx Series	Generally 120 x 325 mesh with less than 20% -325 mesh.
8	23xxx Series	Generally 120 x 325 mesh with less than 3% -325 mesh.
9	25xxx Series	Generally 270 x down and controlled amount – 15 micron.
10	29xxx Series	Generally 140 x 325 mesh with less than 15% -325 mesh.
11	55xxx Series	270 x down with controlled amount of –20 micron.
12	Custom Powders	From –16 mesh to –270 mesh.
13	Low Temperature Powders	Generally 100 x 325 mesh with up to 60% -325 mesh.

Conversion Table*						
US Common System - Lbs			=	Troy Ounces		
	1		=		14.58	
	2		=		29.16	
	3		=		43.74	
	4		=		58.32	
	5		=		72.90	
	6		=		87.48	
	7		=		102.06	
	8		=		116.64	
	9		=		131.22	
	10		=		145.80	
* This table is typically used when calculating the silver content in silver brazing alloys.						

Preheat Temperature by Class of Steel					
Class	Description	Thickness Up to ½"	Thickness ½" to 1"	Thickness ½" to 2"	Recommended Interpass Temp.
10xx	Carbon steels	100-600ºF	100-700ºF	100-800ºF	200-700ºF
13xx	Mn steels	350-500ºF	400-600ºF	450-700ºF	450-600ºF
23xx	Ni steels	200-400ºF	200-500ºF	30-700ºF	300-600ºF
31xx	Ni-Cr steels	200-600ºF	300-700ºF	400-900ºF	>400ºF
32xx	Ni-Cr steels	300-900ºF	400-1000ºF	500-1100ºF	500-900ºF
33xx	Ni-Cr steels	500-900ºF	600-1000ºF	7001100ºF	700-900ºF
34xx	Ni-Cr steels	900-1100ºF	900-1100ºF	900-1100ºF	900-1100ºF
4140	Cr-Mo steel	600ºF max.	700ºF max.	800ºF max.	600-800ºF
4340	Cr-Mo steel	600ºF max.	800ºF max.	900ºF max.	700-900ºF
4630	Cr-Mo/Ni steel	400-600ºF	500-700ºF	600-800ºF	~ 600ºF
4820	Ni-Mo steel	400-500ºF	500-600ºF	550-700ºF	600-800ºF
5120	Cr-Mn steel	100ºF min.	200-300ºF	250-350ºF	~ 300ºF
5145	Cr-Mn steel	400-500ºF	450-550ºF	500-600ºF	~ 500ºF
86xx	Ni-Cr-Mo steels	100-400ºF	200-500ºF	300-600ºF	~ 400ºF
High Strength, Quenched & Tempered Low Alloy Steels					
A533, B	HSLA steels	50-200ºF	100-350ºF	200-450ºF	100-350ºF
A542	HSLA steel	150-300ºF	200-350ºF	200-450ºF	200-350ºF
Hy-130	HSLA steel	75-225ºF	75-275ºF	200-375ºF	200-350ºF

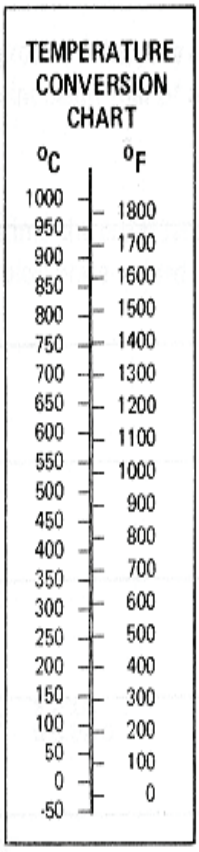
Tool Steel Heat Treatment Data						
Eutectic Alloy	Anneal ºF	Harden ºF	Quench Medium	Temper ºF	Hardness HRC	Preheat Levels
5 & 6 HSS	1650	2225-2250	Hot Oil	1000	62-66	400ºF. Double temper
5 & 6 OH	1450	1450-1475	Oil	250-450	59-62	200-400ºF
5 & 6 HW	1550	1750-1800	Oil	900-1150	52-55	500-900ºF. Double harden before tempering
		1800-1900	Air	900-1150	52-55	

5 & 6 A/SH	1575	1800-1850	Air	300-1000	53-61	400-500ºF
5 & 6 WH	1450	1400-1475	Water	300-450	56-59	300-400ºF Inter-pass max. 450ºF

Tool Steel Grade	Preheat-Annealed Grade	Preheat-Hardened Grade
W1, WS…	250-450ºF	250-450ºF
S1, S6, S7…	300-500ºF	300-500ºF
O1, O6…	300-400ºF	300-400ºF
A1, A4…	300-500ºF	300-400ºF
D2	700-900ºF	700-900ºF
H11, H12, H13…	900-1200ºF	700-1000ºF
M1, M2, M10…	950-1100ºF	950-1050ºF

Temperature Conversion Data

Quick Conversions



Temperatures expressed as DEGREES CELSIUS:

°F	°C
425	219
1050	566
1090	588
1125	607
1130	610
1400	760
1600	871
2000	1093

Temperature Colors

Bright yellow	2000ºF
Dark yellow	1900ºF
Orange yellow	1800ºF
Orange	1700ºF
Orange red	1600ºF
Bright red	1500ºF
Slighty red	1400ºF
Red	1300ºF
Slightly red	1200ºF
Gray red	1100ºF
Dark gray	1000ºF
Blue	800ºF
Dark purple	575ºF
Purple	540ºF
Brown purple	520ºF
Brown	500ºF
Dark straw	480ºF
Light straw	465ºF
Faint straw	445ºF
	390ºF

Quick Index by Product Name

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NOTES

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