MAGNA 8N12

The "Missing Link" Electrode that eliminates the Sigma Phase Problem in Welding and Maintaining Structures used at Elevated Temperatures.

When Magna 8N12 was first introduced to the Maintenance Industry, it's fame and use spread like wildfire literally all over the world. It was hailed as a miracle electrode and its properties were considered incredible. It rapidly became one of the best known welding electrodes of all time. Today it is used in over 100 countries.

Magna 8N12 appeals to just about everyone in industry. Metallurgists call its physical properties "astounding". Welders call it "The Missing Link". Engineers think of it as "The Problem Solver". Maintenance Planners call it "The Key" . Plant Managers call it the "Money Saver". Plant Engineers think of it as "The Downtime Preventer". The reason for all of this enthusiasm from such a variety of Industrial Persons, all with different points of view, may be understood by looking at the features of this most interesting product.

Physical Properties - Prevention of Sigma Phase

No doubt the most outstanding feature of Magna 8N12 that has captured the loyalty to Magna 8N12 by metallurgists is the incredible ability of Magna 8N12 to resist the formation of Sigma Phase. The problem of Sigma Phase, which is an embrittling chromium-iron compound that causes complete weld failure, had been a source of extreme anxiety to two generations of metallurgists. They simply could not make weldments that would not fail in the critical temperature range of 1200°F (650°C) to 1600°F (870°C). Welds that would be X-Ray perfect in the test laboratory would become brittle and fail when brought to the Sigma Phase danger range of 1200°F (650°C) to 1600°F (870°C). Many metallurgists felt no solution would ever be found to this problem that limited the use of metals in industries where heat was a factor, such as steel mills, the glass industry, smelters, foundries, etc.

Magna 8N12 solves this historic problem. Because of special in-built stabilizers of its austenitic structure, the deposits of Magna 8N12 represent one of the few metals in the world that does not form the embrittling Sigma Phase even after

long periods of use in the critical temperature range of 1200°F (650°C) to 1600°F (870°C).

Had Magna 8N12 made no other contribution to maintenance welding than this, it would have gone down in metallurgical history as a great contribution to successful maintenance welding.

The remarkable feature of Magna 8N12 in eliminating all of the long history of Sigma Phase Problems prompted metallurgists to make further and exhaustive tests on weld deposits made with Magna 8N12 and the following additional remarkable features have been found: -

(1) Machinability

The deposit is readily machinable. Even though it contains titanium, it does not form hard unmachinable titanium carbides as most titanium bearing electrodes do. The carbon content of Magna 8N12 is nominally only 0.03% and the high columbium content completely stabilizes the carbon, preventing the formation of titanium carbides and also eliminating carbide precipitation.

(2) Mechanical Properties

Magna 8N12 provides these outstanding mechanical properties at room-temperature: -

	Tensile Strength P.S.I.(Kg/cm^2)	**Yield Strength (0.2% Offset) P.S.I. (Kg/cm^2)**	**Elongation in 2 in %**	**Hardness Brinell**
Annealed	Up to 100,000 (7,000)	Up to 60,000 (4,000)	Up to 60	120 to 180
As Welded	Up to 120,000 (8,500)	Up to 90,000 (6,5000)	Up to 50	140 to 215
Cold Worked	Up to 150,000 (10,600)	Up to 125,000 (9,000)	Up to 30	Up to 300

(3) Physical Constants

The physical constants and thermal properties of Magna 8N12 are:-

Melting Range: 2470°F to 2520°F (1355°C to 1380°C)

Curie Temperature: 175°(80°C)

Specific Heat, BTU/lb/°F at 70°F 0.12

Poisson's Ratio

Modulus of Elasticity

Tension 28,500,000 P.S.I .(2,003,500 kg/sq.cm.)

Torsion 10,600,000 P.S.I (150,000 kg/sq.cm.)

Density, lb/cu in. 0.287

(4) Corrosion Resistance

One of the most outstanding characteristics that makes Magna 8N12 so remarkable is it's exemplary corrosion resistance, even at elevated temperatures. Some examples:-

(a) Requires no post-weld heat-treatment to maintain its extraordinary corrosion resistance.

(b) Resists reducing acids, sea water, sulfuric acid solutions.

(c) Provides incredible resistance to sulfur.

(d) Resists cavitation and erosion.

(e) The high or inconsistent sulfur content of many high nickel electrodes greatly increases their cracking tendency, lower their physical properties, and limit their corrosion resistance. The sulfur content of Magna 8N12 is rigidly controlled at 0.012% or less.

(f) At elevated temperatures, special inbuilt passivating compounds in the special chemistry of Magna 8N 12 causes this nickel-rich, chromium-rich, niobium stabilized electrode deposit to form a surface covering of uniformly thick oxide, which acts as an "armour plate" on the deposit. This "shell" of oxide layer enables Magna 8N12 to resist the most extreme corrosion even at ultra-high temperatures.

(5) Super Crack Resistant

A feature of Magna 8N12 that has caused engineers to place such great confidence in this electrode is it's extraordinary crack resistance. Some examples:-

(a) It is virtually immune to chloride-ion stress corrosion cracking.

(b) Magna 8N12 has extraordinary fatigue strength. This remarkable electrode has exceptional resistance to post-weld strainage cracking, which is a problem with many nickel alloys.

(c) Provides outstanding and almost unprecedented stress rupture properties at elevated temperatures.

(d) Magna 8N12 has exceptionally high creep and rupture strengths.

(6) Superior Cryogenic Properties

The Charpy V notch values of Magna 8N12 deposits are: -

(-160°C) -320°F (4.7 to 4.9 Kilogram Metres) 67 to 70 Foot Pounds

This electrode performs nobly at ultra low temperatures as well as super high temperature. As an example consider: -

	At-320°F (-160°C)	At 1500°F (815°C)
Electrical Resisitivty (OHM/CIRC MIL/FT)	531	763

(7) High Heat Resistance

Magna 8N12 is resistant to oxidation at temperatures up to 2100°F (1,150°C) and for short periods of time up to 2200°F (1205°C).

Magna 8N12 resists both oxidation and carburization at elevated temperatures.

(8) Versatility

Purchasing agents and accounting departments have found Magna 8N12 to be an economical proposition because this one electrode is capable of welding a wide variety of different super alloys, nickel alloys, stainless steel alloys and steel alloys.

Whereas before Magna 8N12, many maintenance departments had to stock many different electrodes in order to be in a position to repair the variety of nickel alloys now in wide usage, they now have reduced their electrode stock to this one electrode.

Formerly it was necessary to stock nickel electrodes, inconel electrodes, monel electrodes, incoloy electrodes, Hastelloy electrodes, and a wide range of "super alloy" electrodes. Magna 8N12 welds all these and many others, greatly reducing inventory and the tieing up of money in stocking all the many different electrodes. Magna 8N12 is considered the "Common Denominator" since this one electrode welds virtually all of the noble, high alloy, and super alloy base metals.

In view of the great usage of a wide range of the higher alloys that is occurring toward the end of the 20th century, this money-saving feature of Magna 8N12 has taken on a great significance.

(9) The Missing Link

Before Magna Research brought Magna 8N12 to industry, welders often were faced with the necessity to make "welds that couldn't be made". Many welders often were called upon to join dissimilar alloys that simply could not

be welded with any product the welder could find. Some welds just could not be safely or reliably made. Some combinations just would not join.

Magna 8N12 has solved this problem because it is the "Common Denominator", or the "Missing Link" that joins virtually any noble alloy, any stainless steel, any high alloy, any super metal, any austenitic steel, any ferretic steel to any other! In this respect, Magna 8N12 "solves the unsolvable". Some examples of applications which are formerly difficult or impossible but can now be performed with Magna 8N12 follow:-

(a) Austenitic Stainless Steel to Carbon Steel.

With stainless steel electrodes this application was less than satisfactory because of carbon pick-up and dilution from the steel. The carbon caused inter-granular corrosion and the iron dilution caused the deposit Austenitic to martensitic and thus became crack sensitive.

This application is easily solved with Magna 8N12. The dilution is almost non-existent and the ultra high alloy content of Magna 8N12 which is well over 60% nickel can withstand considerable dilution without going out of the austenitic structure. This electrode contains approximately 2% columbium which stabilizes the carbon and prevents inter-granular corrosion.

(b) Monel to Steel.

This has long been considered a problem welding application. With stainless steel electrodes the weld was ultra-brittle and provided practically no strength. With monel electrodes a series of problems occurred, accelerated by the high copper content of monel. Some of these problems were hot and cold cracking, stress corrosion cracking, and the welded tensile strength as using a monel electrode seldom exceeds one-half the tensile strength of the steel, and usually is much less.

Magna 8N12 makes dependable reliable welds on monel to steel joints. The tensile strength of the joint in practically all cases is greater than the monel or the steel and the weld is not brittle.

(c) Monel to Stainless Steel.

This is virtually impossible using monel or stainless steel electrodes, but easily accomplished with Magna 8N12. The weld exceeds the

properties of either base metal. including corrosion resistance, heat resistance, and mechanical properties in practically every combination.

(d) Magna 8N12 makes possible an almost endless variety of combinations of metals such as: -

Wrought to cast high nickel alloys
Hastelloy to inconel
Monel to inconel
Nickel to steel
Duranickel to stainless steel
Stellite to steel
Inconel to inconel
Stellite to stainless steel
Hastelloy C to steel
and many others.

Magna 8N12 is truly the Common Denominator that makes it possible to join vastly different metals that have little compatibility for each other.

Examples of specific applications for Magna 8N12: -

Extrusion Press Parts
Furnace Nozzles
Heat Exchanger Tubing
Corrosion Resisting Tanks
Combustion Systems
Thrust Reverse Assemblies
Internal Combustion Engine Valves
Phosphoric Acid Evaporaters
Pickling Tank Heaters
Steam Service Parts
Heat Element Housings
Joining parts for Ethylene and Steam Methane Reforming Furnaces
Hot Sizing Dies
Pickling Hooks
Propeller Shafts
Special High Nickel Moulds used in the Glass Industry
Carburizing Baskets
Fixtures
After Burners
Spray Bars
After Burner Liners
Furnace Components
Chemical Process Equipment
Turbine Frames
Heat Resisting Fixtures
Extrusion Dies
Forming Tools
Deacrating Heaters

APPLICATION

Application Procedure For Magna 8N12

Magna 8N12 is easily applied in all positions including vertical and overhead. Thin parts do not require bevelling. Bevel all thicknesses over 1/8" (3.17mm).

AC or DC Reverse Polarity (Electrode Positive) may be used. Recommended amperage is:-
Size 1/8" (3.17 mm) 60-100 AMPS

After arc is established, close the arc gap and maintain the shortest arc possible. At the end of the weld bead, backwhip the crater and extinguish the arc over previously deposited weld metal to avoid leaving a crater. The slag is easily removed with slight impact and should be removed before welding over the previously deposited weld metal.

Preheat is not necessary except when welding on heavy sections of carbon steels.

Magna 8N12 can be used for overlay as well as joining and is often used to overlay lower quality metals such as carbon steels to improve their heat and/or corrosion resistance. When this is done. either stringer beads or a weave may be used because of the high crack resistance of Magna 8N12.