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The refractory metals below are groups of metal compositions whose elements consist basically of the refractory metals tungsten, molybdenum and tungsten carbide combined with copper. Combinations of these elements produce dense, hard, metals of superior wear resistance and strength at elevated temperatures, coupled with good thermal and electrical conductivity. The mechanical and physical properties of these materials make them particularly suitable as the die inserts and facings for volume projection welding, flash and butt welding, electrical upsetting, electroforging and mash welding applications.

These materials are also used successfully as facing on spot welding electrodes where heat balance or mechanical wear resistance are required. The initial premium cost of these refractory metals is offset by lower production cost per weld due to long tool life and less electrode dressing time. The high stability of these materials insures uniform heating and prevents misalignment, resulting in a higher quality weld.

Typical Physical and Mechanical Properties of Refractory Based Materials

Grade	Refractory Based Materials	Type of Material	R.W.M.A. Group B Material	Hardness Rockwell	Electrical Conductivity %I.A.C.S.	Ultimate Tensile Strength, psi	Cross Breaking Strength psi
1W	RWMA CLASS 10	Tungsten-Copper	10.74450	77 B	53	63,000	110,000
10W	RWMA CLASS 11	Tungsten-Copper	11.74400	98 B	45	90,000	150,000
30W	RWMA CLASS 12	Tungsten-Copper	12.74350	103 B	41	98,000	170,000
100W	RWMA CLASS 13	Tungsten	13.74300	39 C	30	150,000	200,000
100M	RWMA CLASS 14	Molybdenum	14.42300	90 B	30	80,000	120,000

Note: All properties shown are TYPICAL and should not be used for specifications

* Properties are in fully heat treated condition

** Hardness is 56 HRA at 1475 °F (800°C)

TYPICAL USES

RWMA CLASS 10 materials are generally used for flash and butt welding die inserts where higher electrical and thermal conductivity is necessary and where a degree of malleability is desirable. These materials are also used for spot welding (as a radius faced electrode) low conductivity ferrous metals such as stainless steel.

RWMA CLASS 11 material is used for electrode and die inserts in most flash and butt welding dies and for projection welding dies where welding pressures are moderate. It is also used for light electrical upsetting, electroforging dies and seam welder bushing inserts.

RWMA CLASS 12 alloy is recommended for volume projection welding dies where the pressures involved are relatively high. Electrical upsetting of non-ferrous metals and low carbon steel is usually accomplished by the use of such RWMA CLASS materials as die facings. Cross-wire welding of large, diameter wire and rod is accomplished with such RWMA CLASS materials.

RWMA CLASS 13 is extremely hard and its ductility is relatively low. It cannot be machined but may be ground to the required shape. It does not alloy appreciably with nonferrous materials and is used for cross-wire welding of metals such as copper and brass. It is also used for electrobrazing electrode material and for some electrical upsetting operations.

RWMA CLASS 14 is used principally for electrobrazing electrode material and for cross-wire welding of nonferrous metals. It is not as hard as RWMA CLASS 13 material and may be machined or drilled to fit the parts to be joined. A typical application of this material, as an electrode, is the welding or brazing of braided or solid copper conductors to ferrous or nonferrous terminals, lugs or fittings.