Table B-1. Guide for Welding Automotive Equipment

(See explanation of symbols at end of table)

Automotive Part	Usual Metal Composition											Recommended Welding Method						
	Gray cast iron	Malleable iron	Cast steel	Steel forgings	To 0.40 carbon steel	Over 0.40 carbon steel	Alloy steels	Aluminum	Brass, copper or bronze	Miscellaneous	Babbitt	Brazing	Welding with rod of similar composition	No. 1 HT	Soldering	Heating	Haynes stellite	Welding not recommended
DIVISION I - CYLINDERS																		
Group 1 - Cylinder Parts																		
Cylinder block	x	...	...	...	....	....	...	...	....	...	...	x						
Cylinder head	x	...	...	...	....	....	...	...	....	...	...	x						
Water jacket covers	x	...	...	...	....	....	...	...	....	...	...	x						
Valve spring cover	...	...	...	...	x	....	...	...	....	...	...	x						
Valve stem guide	n	...	...	...	n	....	...	...	....	p	...	p	....	...	...	...	...	n
Group 2 - Crank Case Parts																		
Crank case (various types)	1	...	...	...	....	....	...	2	....	...	...	1	2					
Oil pan	...	...	...	...	x	....	...	...	....	...	...	x						
Breather	...	...	...	...	x	....	...	...	....	...	...	x						
Crankshaft bearings	...	...	...	...	....	....	...	...	1	...	2	1	....	...	2			
Crankshaft bearing cap	...	...	x	...	x	....	...	...	....	...	...	x						
Crankshaft bushing supports	...	...	x	...	x	....	...	...	....	...	...	x						
Handhole cover	...	...	...	...	x	....	...	...	....	...	...	x						
Timing gear cover	...	...	...	...	x	....	...	...	....	...	...	x						
Flywheel housing	1	...	...	...	....	....	...	2	....	...	...	1	2					
Generator bracket	x	...	...	...	....	....	...	...	....	...	...	x						
Group 3 - Crankshaft Parts																		
Crankshaft	...	...	...	n	....	....	...	...	....	...	...	...	....	...	...	...	...	n
Flywheel	x	...	x	x	....	....	...	...	....	...	...	x						

Table B-1. Guide for Welding Automotive Equipment (cont)

(See explanation of symbols at end of table)

Automotive Part	Usual Metal Composition											Recommended Welding Method						
	Gray cast iron	Malleable iron	Cast steel	Steel forgings	To 0.40 carbon steel	Over 0.40 carbon steel	Alloy steels	Aluminum	Brass, copper or bronze	Miscellaneous	Babbitt	Brazing	Welding with rod of similar composition	No. 1 HT	Soldering	Heating	Haynes stellite	Welding not recommended
DIVISION I - CYLINDERS (cont)																		
Crankshaft timing gear	...	...	...	...	n	n	...	...	....	...	...	n	....	...	...	...	...	n
Flywheel starter gear	...	...	...	...	x	x	x	...	....	...	...	x						
Crankshaft starter sprocket	...	...	...	...	x	....	x	...	....	...	...	x						
Crankshaft starting jaw (or pin)	...	...	...	...	x	....	...	...	....	...	...	...	....	x				
Group 4 - Starting Crank Parts																		
Starting crank jaw	...	...	...	...	x	....	...	...	....	...	...	x						
Starting crankshaft	...	...	...	...	x	....	...	...	....	...	...	x						
Starting crankshaft spring .	...	...	...	...	....	n	n	...	....	...	...	...	....	...	...	...	...	n
Starting crank handle	...	...	...	...	x	....	...	...	....	...	...	x						
Group 5 - Connecting Rods																		
Connecting rod	...	...	...	n	....	....	n	n	....	...	...	...	....	...	...	...	...	n
Connecting rod cap	...	...	...	n	....	....	...	n	....	...	...	...	....	...	...	...	...	n
Connecting rod bushing	...	...	...	...	....	....	...	...	1	...	2	1	....	...	...	2		
Connecting rod dipper	...	...	...	...	1	....	...	2	....	...	...	1	2					
Piston pin bushing	...	...	...	...	....	n	...	...	n	...	...	...	....	...	...	...	...	n
Group 6 - Pistons and Parts .	...	...	...	...	....	....	...	...	....	...	...	...	....	...	...	...	...	n
DIVISION II - VALVES																		
Group 1 - Camshaft Parts																		
Camshaft	...	...	...	...	n	....	n	...	....	...	...	n	....	...	...	...	...	n
Eccentric shaft	...	...	...	n	....	...	...	...	....	...	...	...	....	...	...	...	...	n
Camshaft timing gear	...	...	...	...	x	....	x	...	....	...	...	x						
Camshaft idler gear	...	...	...	...	x	....	x	...	....	...	...	x						
Camshaft oil pump gear	...	...	...	...	x	....	x	...	....	...	...	x						
Camshaft ignition distributor gear	...	...	...	...	x	....	x	...	....	...	...	x						
Camshaft time drive gear ...	...	...	...	...	x	....	x	...	....	...	...	x						
Oil pump eccentric (or cam)	...	...	...	n	n	....	...	...	....	...	...	n	....	...	...	...	...	n

Table B-1. Guide for Welding Automotive Equipment (cont)

(See explanation of symbols at end of table)

Automotive Part	Usual Metal Composition											Recommended Welding Method						
	Gray cast iron	Malleable iron	Cast steel	Steel forgings	To 0.40 carbon steel	Over 0.40 carbon steel	Alloy steels	Aluminum	Brass, copper or bronze	Miscellaneous	Babbitt	Brazing	Welding with rod of similar composition	No. 1 HT	Soldering	Heating	Haynes stellite	Welding not recommended
DIVISION II - VALVES (cont)																		
Group 2 - Valves																		
Poppet valve	n	...	...	...	....	....	n	...	....	...	...	...	....	...	...	...	...	n
Inlet valve	n	...	...	...	....	....	n	...	....	...	...	...	....	...	...	...	...	n
Exhaust valve	n	...	...	...	....	....	n	...	....	...	...	...	....	...	...	...	...	n
Valve spring	...	...	...	...	....	n	n	...	....	...	...	...	....	...	...	...	...	n
Valve spring retainer	...	...	...	...	x	....	...	...	....	...	...	...	x					
Valve lifter	...	...	...	...	x	....	x	...	....	...	...	...	x					
Valve lifter guide	n	...	...	...	n	....	...	...	....	...	...	...	....	...	...	...	...	n
Valve rocker	...	...	...	...	x	....	x	...	....	...	...	x						
Valve push rod	...	...	...	...	x	x	...	...	....	...	...	x	....	...	...	...	x	
DIVISION III - COOLING SYSTEM																		
Group 1 - Fan Parts																		
Fan bracket	x	...	x	...	....	....	...	...	....	...	...	x						
Fan spindle	...	...	...	...	x	....	...	...	....	...	...	x						
Fan hub	...	...	...	...	x	....	...	...	....	...	...	x						
Fan hub bushing (or bearing)	x	...	...	...	....	....	...	...	x	...	...	x						
Fan blades	...	...	...	...	x	....	...	...	....	...	...	x						
Fan pulley	...	...	...	...	x	....	...	...	....	...	...	x						
Fan driving pulley	x	...	x	...	x	....	...	...	....	...	...	x						
Group 2 - Radiator Parts																		
Radiator core	...	...	...	...	x	....	...	...	x	...	...	...	....	...	x			
Radiator core header sheets	...	...	...	...	x	....	...	...	x	...	...	...	....	...	x			
Radiator upper tank	...	...	...	...	x	....	...	...	x	...	...	...	....	...	x			
Radiator filler neck	...	...	...	...	x	....	...	...	x	...	...	x						
Radiator filler neck sleeve	...	...	...	...	x	....	...	...	....	...	...	x						
Radiator filler cap	...	...	...	...	1	....	2	...	3	d,n	...	1,2,	....	...	...	...	...	n
Radiator tie rod fitting	...	...	...	...	x	....	...	...	....	...	...	x						

Table B-1. Guide for Welding Automotive Equipment (cont)

(See explanation of symbols at end of table)

Automotive Part	Usual Metal Composition											Recommended Welding Method						
	Gray cast iron	Malleable iron	Cast steel	Steel forgings	To 0.40 carbon steel	Over 0.40 carbon steel	Alloy steels	Aluminum	Brass, copper or bronze	Miscellaneous	Babbitt	Brazing	Welding with rod of similar composition	No. 1 HT	Soldering	Heating	Haynes stellite	Welding not recommended
DIVISION III - COOLING SYSTEM - (cont)																		
Group 2 - Radiator Parts (cont)																		
Radiator baffle	...	...	...	...	x	....	...	...	x	...	...	...	....	...	x			
Radiator inlet fitting	x	...	...	...	....	....	...	...	x	...	...	x						
Radiator lower tank	...	...	...	...	x	....	...	...	x	...	...	...	....	...	x			
Radiator outlet fitting	x	...	...	...	....	....	...	...	....	...	...	x						
Radiator drain flange	...	...	...	...	x	....	...	...	x	...	...	x						
Radiator anchor plate	...	...	...	...	x	....	...	...	....	...	...	x						
Radiator overflow tube	...	...	...	...	x	....	...	...	x	...	...	...	....	...	x			
Radiator side bolting member	...	...	...	...	x	....	...	...	....	...	...	x						
Radiator shell anchorage clips	...	...	...	...	x	....	...	...	....	...	...	x						
Radiator shell	...	...	...	...	1	....	2	...	3	...	...	1	2,3					
Radiator supports	...	...	...	...	x	....	...	...	....	...	...	x						
Radiator support reinforcement	...	...	...	...	x	....	...	...	....	...	...	x						
Radiator hinge rod fitting	...	...	...	...	x	....	...	...	....	...	...	x						
Radiator brace rod fitting	...	...	...	...	x	....	...	...	....	...	...	x						
Radiator hood ledge liner strip	...	...	...	...	x	....	...	...	....	...	...	x						
Radiator starting crank hole cover	...	...	...	...	1	....	2	...	....	...	...	1	2					
Group 3 - Water Pump Parts																		
Water pump impeller	x	...	...	...	....	....	x	...	x	...	...	x						
Water pump body	1	...	...	...	....	....	...	...	....	d,n	...	1	1	...	...	...	...	n
Water pump cover	...	...	...	...	x	....	...	...	....	...	...	x						
Water pump shaft	...	...	...	...	x	....	x	...	....	...	...	x	....	...	...	...	x	

Table B-1. Guide for Welding Automotive Equipment (cont)

(See explanation of symbols at end of table)

Automotive Part	Usual Metal Composition											Recommended Welding Method						
	Gray cast iron	Malleable iron	Cast steel	Steel forgings	To 0.40 carbon steel	Over 0.40 carbon steel	Alloy steels	Aluminum	Brass, copper or bronze	Miscellaneous	Babbitt	Brazing	Welding with rod of similar composition	No. 1 HT	Soldering	Heating	Haynes stellite	Welding not recommended
DIVISION III - COOLING SYSTEM - (cont)																		
Water pump gland	...	...	...	...	x	....	...	...	....	...	...	x						
Water pump shaft gear	...	...	...	...	x	....	x	...	....	...	...	x						
Water pump shaft bushing ...	x	...	...	...	....	....	...	x	....	...	...	x						
Group 4 - Pipes																		
Engine water outlet	x	...	...	...	....	....	...	...	....	...	...	x						
Engine water inlet	x	...	...	...	....	....	...	...	....	...	...	x						
Radiator water fitting	x	...	...	...	x	....	...	...	....	...	...	x						
Water pump outlet pipe	x	...	...	...	....	....	...	...	....	...	...	x						
DIVISION IV - FUEL SYSTEM																		
Group 1 - Carburetor and Inlet Pipe																		
Carburetor	1	...	2	...	....	....	...	...	3	d,n	...	1,2,3	....	...	...	...	...	n
Inlet manifold	x	...	...	...	....	....	...	...	....	...	...	x						
Inlet pipe	...	...	...	...	....	....	...	...	x	...	...	x						
Group 2 - Carburetor Control Parts																		
Accelerator pedal	...	...	...	...	1	....	...	2	....	...	...	1	2					
Accelerator pedal bracket ..	x	...	x	...	....	....	...	...	....	...	...	x						
Accelerator pedal rod	...	...	...	...	x	....	...	...	....	...	...	x						
Carburetor mixture hand regulator	...	...	...	...	x	....	...	...	....	...	...	x						
Carburetor choke	...	...	...	...	x	....	...	...	....	...	...	x						
Group 3 - Carburetor Air Heater Parts																		
Carburetor air heater	x	...	...	...	x	....	...	...	....	...	...	x						
Carburetor hot air pipe	x	...	...	...	x	....	...	...	....	...	...	x						

Table B-1. Guide for Welding Automotive Equipment (cont)

(See explanation of symbols at end of table)

Automotive Part	Usual Metal Composition											Recommended Welding Method						
	Gray cast iron	Malleable iron	Cast steel	Steel forgings	To 0.40 carbon steel	Over 0.40 carbon steel	Alloy steels	Aluminum	Brass, copper or bronze	Miscellaneous	Babbitt	Brazing	Welding with rod of similar composition	No. 1 HT	Soldering	Heating	Haynes stellite	Welding not recommended
DIVISION IV - FUEL SYSTEM - (cont)																		
Group 4 - Fuel Tank																		
Fuel tank	...	...	...	...	x	....	...	...	....	...	...	x						
Fuel tank outlets	...	...	...	...	x	....	...	...	....	...	...	x						
Group 5 - Fuel Pipes and Feed Systems																		
Fuel pipes	...	...	...	...	....	....	...	...	x	...	...	x						
Fuel pressure pump	...	...	...	...	x	....	...	...	....	...	...	x						
Fuel hand pump	...	...	...	...	x	....	...	...	....	...	...	x						
Fuel pressure pipes	...	...	...	...	....	....	...	...	....	...	...	x						
DIVISION V - EXHAUST SYSTEM																		
Group 1 - Exhaust Manifold																		
Exhaust manifold	x	...	...	...	....	....	...	...	....	...	...	...	x					
Group 2 - Exhaust Pipe and Muffler																		
Muffler	...	...	...	...	x	....	...	...	....	...	...	x						
Exhaust pipe	...	...	...	...	x	....	...	...	....	...	...	x						
Muffler outlet pipe	...	...	...	...	x	....	...	...	....	...	...	x						
DIVISION VI - LUBRICATION SYSTEM																		
Group 1 - Oil Pan or Reservoir																		
Oil pan	...	...	...	...	x	....	...	...	....	...	...	x						
Oil filler strainer	...	...	...	...	....	....	...	...	x	...	...	...	....	...	x			
Oil filler cap	...	...	...	...	x	....	...	...	...	...	...	x						
Group 2 - Oil Pump Parts																		
Oil pump body	x	...	...	...	....	....	...	...	....	...	...	x						
Oil pump plunger	x	...	...	...	x	....	...	...	x	...	...	x						
Oil pump plunger spring	...	...	...	...	....	n	n	...	....	...	...	n	....	...	...	...	...	n
Oil pump valves	...	...	...	...	x	....	...	...	....	...	...	x						
Oil pump shaft	...	...	...	...	x	x	x	...	....	...	...	x						

Table B-1. Guide for Welding Automotive Equipment (cont)

(See explanation of symbols at end of table)

Automotive Part	Usual Metal Composition											Recommended Welding Method						
	Gray cast iron	Malleable iron	Cast steel	Steel forgings	To 0.40 carbon steel	Over 0.40 carbon steel	Alloy steels	Aluminum	Brass, copper or bronze	Miscellaneous	Babbitt	Brazing	Welding with rod of similar composition	No. 1 HT	Soldering	Heating	Haynes stellite	Welding not recommended
DIVISION VI - LUBRICATION (cont)																		
Oil pump shaft gears	...	...	...	...	n	....	n	...	....	...	...	n	....	...	...	...	...	n
Oil pump following gear	...	...	...	...	n	....	...	...	....	...	...	n	....	...	...	...	...	n
Oil pump cover	...	...	...	...	x	....	x	...	....	...	...	x						
Group 3 - Oil Pipes, Strainers, Gauges																		
Oil pipes	...	...	...	...	....	....	...	...	x	...	...	x						
Circulating oil strainer ...	...	...	...	...	....	....	...	...	x	...	...	...	....	x				
Oil strainer cap	...	...	...	...	x	....	...	...	....	...	...	x						
Oil level gauge	...	...	...	...	x	....	...	...	x	...	...	x						
DIVISION VII - IGNITION SYSTEM																		
Group 1 - Spark Plug Cables																		
Spark plug cables	...	...	...	...	....	....	...	...	x	...	...	...	....	...	x			
Coil high-tension cable	...	...	...	...	....	....	...	...	x	...	...	...	....	...	...	x		
Low-tension cables	...	...	...	...	....	....	...	...	x	...	...	...	....	...	x			
Group 2 - Battery Ignition Equipment Parts																		
Timer-distributor shaft	...	...	...	...	1	....	n	...	....	...	...	1,n	....	...	...	...	...	n
Timer-distributor shaft gear	...	...	...	...	1	....	n	...	....	...	...	1,n	....	...	...	...	...	n
Ignition drive shaft	...	...	...	...	x	....	x	...	....	...	...	x						
Ignition drive shaft gear ..	...	...	...	...	x	....	x	...	....	...	...	x						
Manual advance arm	...	...	...	...	x	....	...	...	....	...	...	x						
Automatic advance element ..	...	...	...	...	x	....	...	...	....	...	...	x						
Ignition unit, magneto-base mounting	x	...	x	...	x	....	...	...	....	...	...	x						

Table B-1. Guide for Welding Automotive Equipment (cont)

(See explanation of symbols at end of table)

Automotive Part	Usual Metal Composition											Recommended Welding Method						
	Gray cast iron	Malleable iron	Cast steel	Steel forgings	To 0.40 carbon steel	Over 0.40 carbon steel	Alloy steels	Aluminum	Brass, copper or bronze	Miscellaneous	Babbitt	Brazing	Welding with rod of similar composition	No. 1 HT	Soldering	Heating	Haynes stellite	Welding not recommended
DIVISION VIII - STARTING AND GENERATOR EQUIPMENT																		
Group 1 - Generator Parts																		
Generator driving gear or sprocket	...	...	...	...	....	....	...	...	x	...	...	x						
Generator shaft	...	...	...	...	x	....	...	...	....	...	...	x						
Generator coupling	...	...	...	...	x	....	...	...	....	...	...	x						
Group 2 - Starting Motor Parts																		
Starting motor pinions	...	...	...	...	....	n	n	...	....	...	...	n	....	...	...	...	...	n
Starting motor gear	...	...	...	...	....	n	n	...	....	...	...	n	....	...	...	...	...	n
Starting motor gear shaft	...	...	...	...	n	....	n	...	....	...	...	n	....	...	...	...	...	n
Group 3 - Starter Generator (See VIII - 1,2)																		
Group 4 - Ignition Generator (See VII - 2, VIII - 1)																		
Group 5 - Ignition Starter Generator (See VII - 2, VIII - 1,2)																		
Group 6 - Storage Battery Parts																		
Terminal post	...	...	...	...	....	....	...	...	....	1	...	...	x					
Plates	...	...	...	...	....	....	...	...	....	1,n	...	...	....	...	...	...	...	n
Post straps	...	...	...	...	....	....	...	...	....	1	...	...	x					
Battery holddown	...	...	...	...	x	....	...	...	....	...	...	...	x					
Handles	...	...	...	...	x	....	...	...	....	...	...	...	x					
Terminals	...	...	...	...	....	....	...	...	....	1	...	...	x					
Through bolt	...	...	...	...	x	....	...	...	....	...	...	x						

Table B-1. Guide for Welding Automotive Equipment (cont)

(See explanation of symbols at end of table)

Automotive Part	Usual Metal Composition											Recommended Welding Method						
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DIVISION IX - MISCELLANEOUS ELECTRICAL EQUIPMENT																		
Group 1 - Lamps and Wiring																		
Head lamp housing	...	...	...	...	1	....	2	...	3	...	...	1,3	2					
Head lamp housing flange ...	...	...	...	...	x	....	...	...	x	...	...	x						
Head lamp door	...	...	...	...	1	....	2	...	3	...	...	1,3	2					
Head lamp reflector	...	...	...	...	....	....	...	...	n	...	...	...	....	...	...	...	...	n
(Auxiliary light parts are similar to head lamp parts.)																		
Head lamp support tie rod ..	...	...	...	...	x	....	...	...	....	...	...	x						
Taillight support	...	...	...	...	x	....	...	...	....	...	...	x						
Group 2 - Switches and Instruments																		
Starting switch lever	...	...	...	...	x	....	...	...	....	...	...	x						
Switches and instruments ...	...	...	...	...	....	....	...	...	x	...	...	...	....	...	x			
Group 3 - Horn																		
Horn projector	...	...	...	...	x	....	...	...	....	...	...	x						
DIVISION X - CLUTCH																		
Group 1 - Clutching Parts																		
Clutch case (rotating member)	x	...	...	...	....	....	...	...	....	...	x							
Clutch housing	1	...	2	...	....	....	...	3	....	...	...	1,2	3					
Clutch cover	...	...	...	...	1	....	...	2	....	...	...	1	2					
Clutch housing cover	...	...	...	...	x	....	...	...	....	...	...	x						
Clutch driving disk	...	...	...	...	n	....	...	...	....	...	...	...	....	...	...	...	...	n
Clutch pressure plates	x	...	x	...	x	....	...	...	....	...	...	x						
Clutch driver spider (or drum)	...	...	...	...	x	....	...	...	....	...	...	x						
Clutch facing spring	...	...	...	...	....	....	n	n	....	...	...	...	....	...	...	...	...	n
Clutch spring	...	...	...	...	....	....	n	n	....	...	...	...	....	...	...	...	...	n
Clutch shaft	...	...	...	...	x	....	...	...	....	...	...	x						
Clutch pilot bearing	...	...	...	...	....	....	n	...	....	...	...	...	....	...	...	...	...	n

Table B-1. Guide for Welding Automotive Equipment (cont)

(See explanation of symbols at end of table)

Automotive Part	Usual Metal Composition											Recommended Welding Method					
	Gray cast iron	Malleable iron	Cast steel	Steel forgings	To 0.40 carbon steel	Over 0.40 carbon steel	Alloy steels	Aluminum	Brass, copper or bronze	Miscellaneous	Babbitt	Brazing	Welding with rod of similar composition	No. 1 HT	Soldering	Heating	Haynes stellite	Welding not recommended
DIVISION X - CLUTCH (cont)																		
Clutch driven plate	x	...	x	...	....	....	...	...	....	...	...	x	....	...	...	...	x	
Clutch driving plate	...	...	...	...	n	....	...	...	....	...	...	...	....	...	...	...	...	n
Clutch pressure levers	...	x	x	x	x	....	...	...	....	...	...	x						
Group 2 - Releasing Parts																		
Clutch release sleeve	x	...	...	...	x	....	...	...	....	...	...	x						
Clutch release bearing housing	...	...	...	...	x	....	...	...	....	...	...	x	....	...	...	...	x	
Clutch release bearing	...	...	...	...	....	....	n	...	....	...	...	...	....	...	...	...	...	n
Clutch release yoke	...	x	x	...	....	....	...	...	....	...	...	x	....	...	...	...	x	
Clutch release yoke shaft ..	...	...	...	...	1	....	n	...	....	...	...	1,n	....	...	...	...	...	n
Clutch pedal shaft	...	...	...	...	1	....	n	...	....	...	...	1,n	....	...	...	...	...	n
Clutch pedal adjusting link	...	...	...	...	x	....	...	...	....	...	...	x						
Clutch release yoke lever ..	...	...	...	x	....	....	...	...	....	...	...	x						
Clutch pedal	...	x	...	x	....	....	...	...	....	...	...	x						
Clutch brake	...	...	...	...	x	....	...	...	x	...	...	x						
DIVISION XI - TRANSMISSION																		
Group 1 - Transmission Parts																		
Transmission case and cover	1	...	...	...	....	....	...	2	....	...	...	1	2					
Transmission gears	...	...	...	...	....	n	n	...	....	...	...	n	....	...	...	...	...	n
Transmission bearings and bearing parts	...	...	...	...	....	n	n	...	....	...	...	...	....	...	...	...	...	n
Transmission shafts and counter shafts	...	...	...	...	n	....	n	...	....	...	...	n	....	...	...	...	...	n
Transmission shaft pilot bushings	...	...	...	...	....	....	n	...	1	...	...	1	....	...	...	...	...	n
Group 2 - Shifting Mechanism Parts																		
Control housing	x	...	...	...	....	....	...	...	....	...	...	x						

Table B-1. Guide for Welding Automotive Equipment (cont)

(See explanation of symbols at end of table)

Automotive Part	Usual Metal Composition											Recommended Welding Method						
	Gray cast iron	Malleable iron	Cast steel	Steel forgings	To 0.40 carbon steel	Over 0.40 carbon steel	Alloy steels	Aluminum	Brass, copper or bronze	Miscellaneous	Babbitt	Brazing	Welding with rod of similar composition	No. 1 HT	Soldering	Heating	Haynes stellite	Welding not recommended
DIVISION XI - TRANSMISSION																		
Control shift frame	...	x	...	x	....	....	...	...	....	...	...	x						
Transmission shift forks ...	...	x	...	x	x	....	x	...	....	...	...	x	....	...	...	...	x	
Transmission shift rails ...	...	...	...	...	1	....	n	...	....	...	...	1,n	....	...	...	...	...	n
Transmission interlock rail	...	...	...	1	2	....	n	...	....	...	...	1,2, n	....	...	...	...	...	n
Group 3 - Control Parts																		
Control lever	...	...	...	...	x	....	...	...	....	...	...	x						
Control lever fulcrum ball .	...	...	...	...	x	x	x	...	....	...	...	x	....	...	...	...	x	
Group 4 - Propeller Shaft Parts																		
Propeller shaft	...	...	...	...	1	....	n	...	....	...	...	n	....	1	...	...	...	n
Propeller shaft universal joints	...	...	...	x	x	....	x	...	....	...	...	x						
Propeller shaft bearings and bearing parts	...	...	...	...	....	n	n	...	....	...	...	...	....	...	...	...	...	n
Transmission shaft universal joint flange	...	...	...	x	x	....	...	...	....	...	...	x						
Universal joint yoke	...	n	n	n	....	....	...	...	....	...	...	n	....	...	...	...	...	n
Universal joint center cross, ring or block	...	...	...	n	....	....	...	...	....	...	...	n	....	...	...	...	...	n
Universal joint bearing bushing	...	...	...	...	....	....	...	...	x	...	...	x						
Universal joint pin	...	...	...	...	....	n	n	...	....	...	...	...	....	...	...	...	...	n
Universal joint casings	...	...	x	...	x	....	...	...	....	...	...	x						
Universal joint trunnion ...	...	...	...	...	n	....	n	...	....	...	...	n	....	...	...	...	n	n
Universal joint trunnion block	...	...	...	...	n	....	n	...	....	...	...	n	....	...	...	...	...	n

Table B-1. Guide for Welding Automotive Equipment (cont)

(See explanation of symbols at end of table)

Automotive Part	Usual Metal Composition											Recommended Welding Method						
	Gray cast iron	Malleable iron	Cast steel	Steel forgings	To 0.40 carbon steel	Over 0.40 carbon steel	Alloy steels	Aluminum	Brass, copper or bronze	Miscellaneous	Babbitt	Brazing	Welding with rod of similar composition	No. 1 HT	Soldering	Heating	Haynes stellite	Welding not recommended
DIVISION XII - REAR AXLE																		
Group 1 - Housing Parts																		
Rear axle housing	x	...	...	...	x	....	...	...	....	...	...	x						
Bevel or worm gear housing .	x	...	x	...	x	....	...	...	....	...	...	x						
Rear axle tubes	...	...	...	...	x	....	x	...	....	...	...	x						
Differential carrier	x	...	x	x	x	....	...	...	....	...	...	x						
Rear axle spring seat	...	x	x	x	....	....	...	...	....	...	...	x						
Axle brake shaft bracket ...	...	...	x	x	x	....	...	...	....	...	...	x						
Brake support	...	...	x	x	x	....	...	...	....	...	...	x						
Brake shield	...	...	...	...	x	....	...	...	....	...	...	x						
Group 2 - Torque Arm and Radius Rod Parts																		
Radius rods	...	...	...	...	x	....	...	...	....	...	...	...	....	x				
Group 3 - Drive Pinion Parts																		
Axle drive bevel pinion	...	...	...	...	n	n	n	...	....	...	...	n	....	...	...	...	...	n
Axle drive pinion shaft	...	...	...	...	n	....	n	...	....	...	...	n	....	...	...	...	...	n
Axle drive pinion bearings and bearing parts	...	...	...	...	....	n	n	...	....	...	...	...	....	...	...	...	...	n
Axle drive pinion adjusting sleeves	...	...	...	n	n	....	n	...	....	...	...	...	....	...	...	...	...	n
Axle drive pinion (or worm) carrier	x	x	x	...	x	....	...	...	....	...	...	x						
Group 4 - Differential Parts																		
Bevel drive pinion	...	...	...	...	n	n	n	...	....	...	...	n	....	...	...	...	...	n
Bevel drive gear	...	...	...	...	n	....	n	...	....	...	...	n	....	...	...	...	...	n
Differential case flange half	...	...	n	...	....	....	n	...	....	...	...	n	....	...	...	...	...	n
Differential case plain half	...	...	n	...	....	....	n	...	....	...	...	n	....	...	...	...	...	n
Differential bearing sleeve	...	...	...	...	....	n	n	...	....	...	...	...	....	...	...	...	...	n
Differential side gear	...	...	...	...	n	....	n	...	....	...	...	n	....	...	...	...	...	n

Table B-1. Guide for Welding Automotive Equipment (cont)

(See explanation of symbols at end of table)

Automotive Part	Usual Metal Composition											Recommended Welding Method						
	Gray cast iron	Malleable iron	Cast steel	Steel forgings	To 0.40 carbon steel	Over 0.40 carbon steel	Alloy steels	Aluminum	Brass, copper or bronze	Miscellaneous	Babbitt	Brazing	Welding with rod of similar composition	No. 1 HT	Soldering	Heating	Haynes stellite	Welding not recommended
DIVISION XII - REAR AXLE (cont)																		
Differential spider pinion .	...	...	...	...	n	n	n	...	....	...	...	n	....	...	...	...	...	n
Differential spider	...	...	...	...	n	n	n	...	....	...	...	n	....	...	...	...	...	n
Differential cross pin pinion	...	...	...	...	n	n	n	...	....	...	...	n	....	...	...	...	...	n
Differential cross pin	...	...	...	...	....	n	n	...	....	...	...	n	....	...	...	...	...	n
Differential side gear spacer	...	...	...	...	x	....	...	...	....	...	...	x						
Worm or worm gear	...	...	...	...	n	n	n	...	n	...	...	n	....	...	...	...	...	n
Group 5 - Axle Shafts																		
Axle shaft	...	...	...	...	n	....	n	...	....	...	...	n	....	...	...	...	...	n
Axle shaft wheel flange	...	x	x	...	x	....	...	...	....	...	...	x						
DIVISION XIII - BRAKES																		
Group 1 - Outer Brake Parts																		
Outer brake band	...	...	...	...	n	....	n	...	....	...	...	...	....	...	...	...	...	n
Outer brake band lever	...	x	...	x	x	....	...	...	....	...	...	x						
Outer brake lever shaft	...	...	...	1	2	....	n	...	....	...	...	1,2	....	...	...	...	...	n
Outer brake shaft end levers	...	...	...	x	x	....	...	...	....	...	...	x						
Group 2 - Inner Brake Parts																		
Inner brake shoe	x	...	...	x	....	....	...	...	....	...	...	x						
Inner brake toggle	...	x	...	x	x	....	...	...	....	...	...	x						
Inner brake toggle lever ...	...	x	...	x	x	....	...	...	....	...	...	x						
Inner brake toggle shaft ...	...	...	...	...	x	....	...	...	....	...	...	x						
Inner brake cam	...	...	...	...	1	2	n	...	....	...	...	1, 2,n	....	...	...	...	...	n
Inner brake camshaft	...	...	...	...	1	....	n	...	....	...	...	1,n	....	...	...	...	...	n
Inner brake camshaft lever .	...	...	...	x	x	....	...	...	....	...	...	x						
Group 3 - Pedal (or Outer) Brake Control Parts																		
Pedal brake rod	...	...	...	...	x	....	...	...	....	...	...	x						
Pedal brake rod yoke	...	...	...	...	x	....	...	...	....	...	...	x						

Table B-1. Guide for Welding Automotive Equipment (cont)

(See explanation of symbols at end of table)

Automotive Part	Usual Metal Composition											Recommended Welding Method						
	Gray cast iron	Malleable iron	Cast steel	Steel forgings	To 0.40 carbon steel	Over 0.40 carbon steel	Alloy steels	Aluminum	Brass, copper or bronze	Miscellaneous	Babbitt	Brazing	Welding with rod of similar composition	No. 1 HT	Soldering	Heating	Haynes stellite	Welding not recommended
DIVISION XIII - BRAKES (cont)																		
Pedal brake intermediate shafts	...	...	...	x	x	....	...	...	....	...	...	x						
Pedal brake equalizer levers	...	...	...	x	x	....	...	...	....	...	...	x						
Pedal brake equalizer	...	...	...	x	x	....	...	...	....	...	...	x						
Brake pedal	...	...	...	x	x	....	...	...	....	...	...	x						
Brake pedal rod	...	...	...	...	x	....	...	...	....	...	...	x						
Brake pedal rod yokes	...	...	...	x	x	....	...	...	....	...	...	x						
Brake pedal shaft	...	...	...	...	1	....	n	...	....	...	...	1,n	....	...	...	...	...	n
Group 4 - Handbrake (or Inner Brake) Control Parts																		
Handbrake rod	...	...	...	...	x	....	...	...	....	...	...	x						
Handbrake rod yoke	...	...	...	x	x	....	...	...	....	...	...	x						
Handbrake intermediate shafts	...	...	...	x	x	....	...	...	....	...	...	x						
Handbrake equalizer levers	...	...	...	x	x	....	...	...	....	...	...	x						
Handbrake equalizer	...	...	...	x	x	....	...	...	....	...	...	x						
Brake hand lever rod	...	...	...	...	x	....	...	...	....	...	...	x						
Brake hand lever rod yoke	...	...	...	x	x	....	...	...	....	...	...	x						
Brake hand lever	...	...	...	x	x	....	...	...	....	...	...	x						
DIVISION XIV - FRONT AXLE AND STEERING																		
Group 1 - Axle Center Parts																		
Front axle center	...	...	...	n	....	....	n	...	....	...	...	...	....	...	...	...	...	n
Front spring seats	...	...	...	...	....	n	n	...	....	...	...	n	....	...	...	...	...	n
Front axle bushing	...	...	...	...	....	n	n	...	1	...	...	1	....	...	...	...	...	n
Wheel spindles	...	...	n	...	....	....	...	...	....	...	...	n	....	...	...	...	...	n
Group 2 - Steering Knuckles																		
Steering knuckles	...	n	n	n	....	n	n	...	....	...	...	...	....	...	...	...	...	n

Table B-1. Guide for Welding Automotive Equipment (cont)

(See explanation of symbols at end of table)

Automotive Part	Usual Metal Composition											Recommended Welding Method						
	Gray cast iron	Malleable iron	Cast steel	Steel forgings	To 0.40 carbon steel	Over 0.40 carbon steel	Alloy steels	Aluminum	Brass, copper or bronze	Miscellaneous	Babbitt	Brazing	Welding with rod of similar composition	No. 1 HT	Soldering	Heating	Haynes stellite	Welding not recommended
DIVISION XIV - FRONT AXLE AND STEERING (cont)																		
Steering knuckle bushing ..	x	...	...	...	....	....	...	...	x	...	...	x						
Steering knuckle pivot	...	...	...	...	n	....	n	...	....	...	...	...	....	...	...	...	...	n
Steering knuckle thrust bearing	...	...	...	...	....	n	n	...	....	...	...	...	....	...	...	...	...	n
Steering knuckle arms	...	n	...	n	n	....	n	...	....	...	...	...	....	...	...	...	...	n
Steering knuckle gear rod arm	...	...	...	n	n	....	n	...	....	...	...	...	....	...	...	...	...	n
Group 3 - Steering Rods																		
Steering knuckle tie rod ...	...	...	...	...	n	....	...	...	....	...	...	...	....	...	...	...	...	n
Steering gear connecting rod	...	...	...	...	n	....	...	...	....	...	...	...	....	...	...	...	...	n
Group 4 - Steering Gear Parts																		
Steering gear case	...	...	...	...	x	....	...	...	....	...	...	x						
Steering gear bracket	...	x	x	...	x	....	...	...	....	...	...	x						
Steering gear arm	...	n	...	n	....	....	...	...	....	...	...	...	....	...	...	...	...	n
Steering gear shaft	...	...	...	...	n	....	...	...	....	...	...	...	....	...	...	...	...	n
Steering wheel spider	...	...	...	...	x	....	...	...	....	...	...	x						
Steering wheel tube (or shaft)	...	...	...	...	n	....	...	...	....	...	...	...	....	...	...	...	...	n
Spark and throttle sector ..	x	...	x	...	x	....	...	...	....	...	...	x						
Spark and throttle sector tube	...	...	...	...	x	....	...	...	....	...	...	x						
Spark hand lever	...	...	...	...	x	....	...	...	....	...	...	x						
Spark hand lever tube (or rod)	...	...	...	...	x	....	...	...	....	...	...	x						
Throttle hand lever	...	...	...	...	x	....	...	...	....	...	...	x						
Throttle hand lever tube (or rod)	...	...	...	...	x	....	...	...	....	...	...	x						

Table B-1. Guide for Welding Automotive Equipment (cont)

(See explanation of symbols at end of table)

Automotive Part	Usual Metal Composition											Recommended Welding Method						
	Gray cast iron	Malleable iron	Cast steel	Steel forgings	To 0.40 carbon steel	Over 0.40 carbon steel	Alloy steels	Aluminum	Brass, copper or bronze	Miscellaneous	Babbitt	Brazing	Welding with rod of similar composition	No. 1 HT	Soldering	Heating	Haynes stellite	Welding not recommended
DIVISION XIV - FRONT AXLE AND STEERING (cont)																		
Steering column bracket	...	...	1	...	2	....	...	...	....	d,n	...	1,2	....	...	...	...	...	n
Steering worm	...	...	...	...	n	....	n	...	n	...	...	...	....	...	...	...	...	n
Steering worm sector (or gear)	...	...	...	...	n	....	n	...	n	...	...	...	....	...	...	...	...	n
Steering worm shaft	...	...	...	...	n	....	...	...	....	...	...	...	....	...	...	...	...	n
DIVISION XV - WHEELS																		
Group 1 - Wheels																		
Wheel rims	...	...	...	...	x	....	...	...	....	...	...	...	....	x				
Wheel hub	...	...	n	...	....	....	n	...	....	...	...	n	....	...	...	...	...	n
Wheel hub flanges	...	...	...	...	x	....	...	...	....	...	...	x						
Wheel bearings and bearing parts	...	...	...	...	....	n	n	...	....	...	...	...	....	...	...	...	...	n
Wheel brake drums	x	...	x	...	x	....	...	...	....	...	...	x						
DIVISION XVI - FRAME AND SPRINGS																		
Group 1 - Frame parts																		
Frame members	...	...	...	...	x	....	...	...	....	...	...	...	....	x	...	x		
Gussets	...	...	...	...	x	....	...	...	....	...	...	...	....	x	...	x		
Group 2 - Frame Brackets and Sockets																		
Spring brackets	...	...	...	...	x	....	...	...	....	...	...	x						
Running board brackets	...	...	...	...	x	....	...	...	....	...	...	x						
Engine support brackets	...	...	...	...	x	....	...	...	....	...	...	...	....	x				
Torque arm bracket	...	...	...	...	x	....	...	...	....	...	...	x						
Radius rod bracket	...	...	...	...	x	....	...	...	....	...	...	...	....	x				
Group 3 - Front Springs																		
Front springs	...	...	...	...	....	n	n	...	....	...	...	...	....	...	...	...	n	
Front spring shackle	...	...	...	...	x	....	...	...	....	...	...	...	....	x				
Front spring seat	...	...	...	...	x	....	...	...	....	...	...	...	x					
Front spring clip plate	...	...	...	...	x	....	...	...	....	...	...	...	x					

Table B-1. Guide for Welding Automotive Equipment (cont)

(See explanation of symbols at end of table)

Automotive Part	Usual Metal Composition											Recommended Welding Method						
	Gray cast iron	Malleable iron	Cast steel	Steel forgings	To 0.40 carbon steel	Over 0.40 carbon steel	Alloy steels	Aluminum	Brass, copper or bronze	Miscellaneous	Babbitt	Brazing	Welding with rod of similar composition	No. 1 HT	Soldering	Heating	Haynes stellite	Welding not recommended
DIVISION XVI - FRAME AND SPRINGS (cont)																		
Group 4 - Rear Springs																		
Rear springs	...	...	...	...	....	n	n	...	....	...	...	...	....	...	...	...	...	n
Rear spring pivot seat	...	...	...	...	x	....	...	...	....	...	...	x						
Rear spring double shackle	...	...	...	...	x	....	...	...	....	...	...	...	....	x				
(Other parts as for front spring)																		
DIVISION XVII - HOOD, FENDERS, AND SHIELDS																		
Group 1 - Hood Parts																		
Hood	...	...	...	...	x	....	...	x	....	...	...	...	x					
Hood sill	...	...	...	...	x	....	...	...	....	...	...	x						
Hood handle	...	...	...	...	x	....	...	...	....	...	...	x						
Hood fastener	...	...	...	...	x	....	...	...	....	...	...	x						
Hood fastener bracket	...	...	x	...	x	....	...	...	....	...	...	x						
Group 2 - Engine Shield Parts																		
Engine shield	...	...	...	...	x	....	...	...	....	...	...	x						
Engine shield bracket	...	...	...	...	x	....	...	...	....	...	...	x						
Group 3 - Fenders and Running Boards																		
Running boards	...	...	...	...	x	....	...	...	....	...	...	...	x					
Running board shields	...	...	...	...	x	....	...	...	....	...	...	...	x					
Fenders	...	...	...	...	x	....	...	...	....	...	...	...	x					
Fender support socket	...	...	...	...	x	....	...	...	....	...	...	x						
Fender supports	...	...	...	...	x	....	...	...	....	...	...	x						
DIVISION XVIII - BODY																		
Group 1 - Floorboards and Dash																		
Floorboards (metal parts)	...	...	...	...	x	....	...	...	....	...	...	...	x					
Dash	...	...	...	...	x	....	...	...	....	...	...	...	x					
Instrument board	...	...	...	...	x	....	...	...	....	...	...	...	x					
Group 2 - Body Parts (Metal)																		

Table B-1. Guide for Welding Automotive Equipment (cont)

(See explanation of symbols at end of table)

Automotive Part	Usual Metal Composition											Recommended Welding Method						
	Gray cast iron	Malleable iron	Cast steel	Steel forgings	To 0.40 carbon steel	Over 0.40 carbon steel	Alloy steels	Aluminum	Brass, copper or bronze	Miscellaneous	Babbitt	Brazing	Welding with rod of similar composition	No. 1 HT	Soldering	Heating	Haynes stellite	Welding not recommended
DIVISION XVIII - BODY (cont)																		
All metal panels	...	...	...	...	x	....	...	...	....	...	...	...	x	...	...	x		
Body posts and braces	...	...	...	...	x	....	...	...	....	...	...	...	x	...	...	x		
Window frames	...	...	...	...	x	....	...	...	....	...	...	...	x	...	...	x		
Group 3 - Seat Frames	...	...	...	...	x	....	...	...	....	...	...	...	x	...	...	x		
DIVISION XIX - ACCESSORIES																		
Group 1 - Speedometer (and Parts)	...	...	...	...	....	....	...	...	....	n	...	...	....	...	...	...	...	n
Group 2 - Tire Pump Parts																		
Tire pump driving gear	...	...	...	...	x	....	x	...	....	...	...	x						
Tire pump shaft gear	...	...	...	...	x	....	x	...	....	...	...	x						
Tire pump idler gear	...	...	...	...	x	....	x	...	....	...	...	x						
Group 3 - Body Furnishings																		
Door and window handles	...	...	...	...	1	....	2	...	3	d,n	...	...	1,2, 3	...	...	...	...	n
Bumpers	...	...	...	...	....	x	x	...	....	...	...	x						
Bumper brackets	...	...	...	...	x	....	...	...	....	...	...	x						

x - Indicates the metal composition and the recommended welding method.
1,2,3 - Indicates corresponding compositions and methods.
n - Welding not recommended. Minor areas may be built up if an "n" is placed in one of the welding method columns. Otherwise do not weld and do not build up.
l - Lead.
d - Die cast metal.
p - Indicates corresponding method for composition other than "Gray cast iron" or "to 0.40 carbon steel."

Table B-2. Guide for Oxyacetylene Welding
(See footnotes at the end of the table)

Base Metal or Alloy	Welding Process[1]	Flame Adjustment	Welding Rod	Flux Required	Preheating Required
IRON					
1. Wrought iron	FW	Neutral	Low carbon or high strength steel	No	No
	B	S1 oxidizing	Bronze	Brazing	No
2. Low carbon iron	FW	Neutral	Low carbon steel	No	No
	B	S1 oxidizing	Bronze	Brazing	No
CARBON STEELS					
1. Low carbon (up to 0.30 percent C)	FW	Neutral	Low carbon steel	No	No
	B	S1 oxidizing	Bronze	Brazing	No
2. Medium carbon (0.30 to 0.55 percent C)	FW	S1 carburizing	Low carbon or high strength steel	No	300 to 500 °F (149 to 260 °C)
	B	S1 oxidizing	Bronze	Brazing	200 to 400 °F) (93 to 204 °C)
3. High carbon (exceeding 0.55 percent C)	FW	Carburizing	Medium or high carbon steel	No	500 to 800 °F (260 to 427 °C)
	B	S1 oxidizing	Bronze	Brazing	300 to 500 °F (149 to 260 °C)
4. Tool steel (exceeding 0.83 percent C)	FW	Carburizing	Drill rod	Some cast iron flux	Up to 1000 °F (538 °C)
	B	S1 oxidizing	Bronze	Brazing	500 to 600 °F (260 to 316 °C)
CAST STEELS					
1. Plain carbon (Up to 0.25 percent C)	FW	Neutral	Low carbon	No	200 °F (93 °C)
	B	S1 oxidizing	Bronze	Brazing	200 °F (93 °C)
2. High manganese (12 percent Mn)	FW	S1 carburizing	Nickel-manganese steel	Wrap rod with Al wire	No
	B	S1 oxidizing	Bronze	Brazing	No
3. Other alloys	FW	Neutral to S1 carburizing	Same as base metal	No	In some cases
	B	S1 oxidizing	Bronze	Brazing	In some cases
CAST IRONS					
1. Gray cast iron	FW	Neutral	Cast iron	Cast iron flux	750 to 900 °F (399 to 482 °C)
	B	S1 oxidizing	Bronze	Brazing	Locally to 500 °F (260 °C)
2. Malleable iron	FW[2]	Neutral	White cast iron	Cast iron flux	750 to 900 °F (399 to 482 °C)
	B[3]	S1 oxidizing	Bronze	Brazing	Locally to 500 °F (260 °C)

Table B-2. Guide for Oxyacetylene Welding (cont)
(See footnotes at the end of the table)

Base Metal or Alloy	Welding Process[1]	Flame Adjustment	Welding Rod	Flux Required	Preheating Required
3. Alloy cast irons	FW	Neutral	Same as base metal, or cast iron	Cast iron flux	500 to 1000 °F (260 to 538 °C)
	B	Sl oxidizing	Bronze	Brazing	Locally to 500 °F (260 °C)
LOW ALLOY HIGH TENSILE STEELS (General)	FW	Neutral to sl carburizing	Same as base metal, or high strength steel	No	Yes
1. Nickel alloy steel (3 to 3-1/2 percent Ni)					
(Up to 0.25 percent C)	FW	Neutral to sl carburizing	Same as base metal, or high strength steel	No	No preheating, slow cool
(More than 0.25 percent C)	FW	Neutral to sl carburizing	Same as base metal, or high strength steel	No	300 to 600 °F (149 to 316 °C), slow cool
2. Nickel-copper alloy steels	FW	Neutral to sl carburizing	Same as base metal, or high strength steel	No	250 to 300 °F (121 to 149 °C)
3. Manganese-molybdenum alloy steels	FW	Neutral to sl carburizing	Carbon-molybdenum or high strength rod	No	250 to 300 °F) (121 to 149 °C)
4. Carbon-molybdenum alloy steels (0.10 to 0.20 percent C)	FW	Neutral to sl carburizing	Carbon-molybdenum or high strength rod	No	300 to 400 °F (149 to 204 °C)
(0.20 to 0.30 percent C)	FW	Neutral to sl carburizing	Carbon-molybdenum or high strength rod	No	400 to 500 °F (204 to 260 °C), slow cool
5. Nickel-chromium alloy steels (up to 0.20 percent C)	FW	Neutral to sl carburizing	Same as base metal, or high strength rod	No	200 to 300 °F (93 to 149 °C), slow cool
6. Chrome-molybdenum alloy steels	FW	Neutral to sl carburizing	Same as base metal, or high strength rod	No	300 to 800 °F (149 to 427 °C), slow cool
7. Chromium alloy steels	FW	Neutral to sl carburizing	Same as base metal, or high strength rod	No	300 to 800 °F (149 to 427 °C)
8. Chromium-vanadium alloy steels	FW	Neutral to sl carburizing	Same as base metal, or high strength rod	No	200 to 800 °F (93 to 427 °C)

Table B-2. Guide for Oxyacetylene Welding (cont)
(See footnotes at the end of the table)

Base Metal or Alloy	Welding Process[1]	Flame Adjustment	Welding Rod	Flux Required	Preheating Required
9. Manganese alloy steels (1.6 percent-1.9 percent Mn)	FW	Neutral to sl carburizing	Same as base metal, or high strength rod	No	300 to 800 °F (149 to 427 °C)
STAINLESS STEELS					
1. Chromium alloys (12 percent to 28 percent Cr) (Stainless irons)	FW	Neutral	Same as base metal, or 18-8 stainless steel	Stainless	No
2. Chromium nickel alloys	FW	Neutral to sl carburizing	(18-8) stainless steel	Stainless	No
COPPER AND COPPER ALLOYS					
1. Deoxidized copper	FW	Sl oxidizing	Deoxidized copper	No	500 to 800 °F (260 to 427 °C)
	B	Sl oxidizing	Silver, copper-phosphorous, or copper-phosphorous-silver alloys	Brazing	400 to 600 °F (204 to 316 °C)
2. Commercial bronze and low brass	FW	Oxidizing	Same as base metal	Brazing	200 to 300 °F (93 to 149 °C)
	B	Sl oxidizing	Bronze	Brazing	200 to 300 °F (93 to 149 °C)
3. Spring, admiralty, and yellow brass	FW	Oxidizing	Same as base metal, or bronze	Brazing	200 to 300 °F (93 to 149 °C)
4. Muntz metal, Tobin bronze, naval brass, manganese bronze	FW	Oxidizing	Bronze	Brazing	200 to 300 °F (93 to 149 °C)
5. Nickel silver	FW	Neutral	Nickel silver	Brazing	200 to 300 °F (93 to 149 °C)
6. Phosphor bronze	FW	Neutral	Bronze	Brazing	300 to 500 °F (149 to 260 °C)
	B	Neutral or sl oxidizing	Bronze	Brazing	200 to 300 °F (93 to 149 °C)
7. Aluminum bronze	FW	Sl carburizing	Aluminum bronze	Brazing	200 to 300 °F (93 to 149 °C)
8. Beryllium copper	Oxyacetylene welding or brazing not recommended; use silver solder and flux.				
ALUMINUM AND ALUMINUM ALLOYS					
1. Pure aluminum (1100)	FW	Neutral	Pure aluminum	Aluminum	500 to 800 °F (260 to 427 °C)

Table B-2. Guide for Oxyacetylene Welding (cont)
(See footnotes at the end of the table)

Base Metal or Alloy	Welding Process[1]	Flame Adjustment	Welding Rod	Flux Required	Preheating Required
2. Aluminum alloys (General)	FW	Neutral	Same as base metal, or 95 percent aluminum-5 percent silicon	Aluminum	500 to 800 °F (260 to 427 °C)
3. Aluminum-manganese alloy (3003)	FW	Neutral	95 percent aluminum-5 percent silicon	Aluminum	500 to 800 °F (260 to 427 °C)
4. Aluminum-magnesium-chromium alloy (5052)	FW	Neutral	95 percent aluminum-5 percent silicon	Aluminum	500 to 800 °F (260 to 427 °C)
5. Aluminum-manganese-magnesium alloy (3004)	FW	Neutral	95 percent aluminum-5 percent silicon	Aluminum	500 to 800 °F (260 to 427 °C)
6. Aluminum-magnesium-silicon alloy (6151) (6053)	FW[4]	Neutral	95 percent aluminum-5 percent silicon	Aluminum	Up to 400 °F (204 °C)
7. Aluminum-copper-magnesium-manganese alloy (duraluminum) (2017) (2024)		Welding not recommended.			
8. Aluminum clad		Welding not recommended.			
NICKEL AND NICKEL ALLOYS					
1. Nickel	FW	S1 carburizing	Nickel	No	200 to 300 °F (93 to 149 °C)
	B	S1 oxidizing	Bronze	Brazing	200 to 300 °F (93 to 149 °C)
2. Monel (67 percent Ni-29 percent Cu)	FW	S1 carburizing	Monel	Brazing	200 to 300 °F (93 to 149 °C)
	B	S1 oxidizing	Bronze	Brazing	200 to 300 °F (93 to 149 °C)
3. Inconel (79 percent Ni-13 percent Cr-6 percent Fe)	FW	S1 carburizing	Inconel	Brazing	200 to 300 °F (93 to 149 °C)
	B	S1 oxidizing	Bronze	Brazing	200 to 300 °F (93 to 149 °C)
LEAD	FW	Neutral	Same as base metal	No	No
	FW	Neutral to S1 carburizing	Same as base metal	Special flux	500 °F to 650 °F (260 °C to 343 °C)
MAGNESIUM ALLOYS[5]					
WHITE METAL	FW	Carburizing	Same as base metal	No	No

In general, in welding low alloy, high tensile steels, it is recommended that the filler metal used should be of the same composition as the base metal to obtain good corrosion resistance at the welded joint.

In welding low alloy, high tensile steels in the heat treated condition, it is recommended that the filler metal used should be of the austenitic type, such as the 18 percent chromium-8 percent nickel stainless steel welding rod.

In all cases where the low alloy, high tensile steels are to be heat treated after welding, the filler metals used should be of the same composition as the base metal or other suitable high strength welding rod.

[1] In the welding process column, FW indicates fusion welding and B indicates brazing. In the flame adjustment column, Sl indicates "slightly."

[2] Welded as white cast iron only and should be followed by heat treatment to induce malleability. Fusion welding is not recommended for malleable iron.

[3] Brazing, rather than fusion welding, is the preferred method for repairing malleable iron.

[4] Heat treat (6151) and (6053) after welding. Properties of (2017) and (2024) alloys cannot be restored by heat treatment after welding.

[5] Welding is not recommended on some magnesium alloys because of their porous nature, and such welds are made only as emergency repairs until a replacement can be obtained.

Table B-3. Guide for Electric Arc Welding
(See footnotes at the end of table)

Base Metal or Alloy	Welding Process[1]	Polarity	Welding Electrode or Filler Metal: Material	Welding Electrode or Filler Metal: Type	Preheating Required
IRON					
1. Wrought iron	MAW	Reverse	Mild steel	Shielded arc[2]	No
	CAW	Straight	Mild steel	Use a flux	No
	MAB	Reverse	Bronze	Shielded arc	No
2. Low carbon iron	MAW	Reverse	Mild steel	Shielded arc	No
CARBON STEELS					
1. Low carbon (Up to 0.30 percent C)	MAW	Straight	Mild steel	Bare or light coated	Up to 300 °F (149 °C)
	MAW	Reverse	Mild steel	Shielded arc	Up to 300 °F (149 °C)
	CAW	Straight	Mild steel	Use a flux	Up to 300 °F (149 °C)
	MAB	Reverse	Bronze	Shielded arc	Up to 300 °F (149 °C)
2. Medium carbon (0.30 to 0.55 percent C)	MAW	Reverse	25-20 or modified 18-8 stainless steel	Shielded arc	No
	MAW	Reverse	Mild steel or high strength steel	Shielded arc	300 to 500 °F (149 to 260 °C)
3. High carbon (0.55 to 0.83 percent C)	MAW[3]	Reverse	25-20 modified 18-8 stainless steel	Shielded arc	No
	MAW	Reverse	Mild or high strength steel	Shielded arc	500 to 800 °F (260 to 427 °C)
4. Tool steel (0.83 to 1.55 percent C)	MAW	Reverse	25-20 or modified 18-8 stainless steel	Shielded arc	Up to 800 °F (427 °C)
	MAW	Reverse	Mild or high strength steel	Shielded arc	Up to 1000 °F (538 °C)

Table B-3. Guide for Electric Arc Welding (cont)
(See footnotes at the end of table)

Base Metal or Alloy	Welding Process[1]	Polarity	Welding Electrode or Filler Metal: Material	Welding Electrode or Filler Metal: Type	Preheating Required
CAST STEELS					
1. Plain carbon (Up to 0.25 percent C)	MAW	Reverse	Mild steel	Shielded arc	200 °F (93 °C)
	MAB	Reverse	Bronze	Shielded arc	200 °F (93 °C)
2. High manganese (12 percent Mn)	MAW	Reverse	Weld with 25-20 stainless steel and surface with nickel-manganese steel	Shielded arc	No
	To build up sections	Reverse	Nickel-manganese steel	Shielded arc	No preheating; quench and peen weld
3. Other alloys	MAW	Reverse	Mild steel	Shielded arc	In some cases
CAST IRONS					
1. Gray cast iron (Machinable welds)	MAW	Reverse	Cast iron or monel	Shielded arc	700 to 800 °F (371 to 427 °C), or no preheating but peen weld
(Nonmachinable welds)	MAW	Reverse	18-8 stainless steel or mild steel	Shielded arc	700 to 800 °F (371 to 427 °C)
	MAB	Reverse	Bronze	Shielded arc	Up to 500 °F (260 °C)
	CAB	Straight	Bronze	Shielded arc	Up to 500 °F (260 °C)
2. Malleable iron (Machinable welds)	MAW	Reverse	Cast iron or monel	Shielded arc	700 to 800 °F (371 to 427 °C), anneal weld
(Nonmachinable welds)	MAW	Reverse	18-8 stainless steel or mild steel	Shielded arc	700 to 800 °F (371 to 427 °C), anneal weld
	MAB	Reverse	Bronze	Shielded arc	Up to 500 °F (260 °C)
	CAB	Straight	Bronze	Shielded arc	Up to 500 °F (260 °C)
3. Alloy cast irons			(Same as gray cast iron)		
LOW ALLOY HIGH TENSILE STEELS (General)	MAW[4]	Reverse	Same as base metal; or high strength or mild steel, or 25-20 stainless steel	Shielded arc	Yes

Table B-3. Guide for Electric Arc Welding (cont)
(See footnotes at the end of table)

Base Metal or Alloy	Welding Process[1]	Polarity	Welding Electrode or Filler Metal		Preheating Required
			Material	Type	
1. Nickel alloy steel (3 to 3-1/2 percent Ni)					
(Up to 0.25 percent C)	MAW	Reverse	Nickel alloy or 25-20 stainless steel	Shielded arc	No preheating, slow cool
(More than 0.25 percent C)	MAW	Reverse	Nickel alloy or 25-20 stainless steel	Shielded arc	300 to 600 °F (149 to 316 °C)
2. Nickel-copper alloy steels	MAW	Reverse	Nickel alloy or 25-20 stainless steel	Shielded arc	250 to 300 °F (121 to 149 °C)
3. Manganese-molybdenum alloy steels	MAW	Reverse	Carbon-molybdenum or special electrode	Shielded arc	250 to 300 °F (121 to 149 °C)
4. Carbon-molybdenum alloy steels (0.10 to 0.20 percent C)	MAW	Straight or reverse	Carbon-molybdenum steel	Shielded arc	300 to 400 °F (149 to 204 °C)
(0.20 to 0.30 percent C)	MAW	Straight or reverse	Carbon-molybdenum steel	Shielded arc	400 to 500 °F (204 to 260 °C), slow cool
5. Nickel-chromium alloy steels (1 to 3-1/2 percent Ni)					
(Up to 0.20 percent C)	MAW	Reverse	Same as base metal, or 25-20 stainless steel	Shielded arc	200 to 300 °F (93 to 149 °C), slow cool
(0.20 to 0.55 percent C)	MAW	Reverse	Same as base metal, or 25-20 stainless steel	Shielded arc	600 to 800 °F (316 to 427 °C), slow cool
(High alloy content)	MAW	Reverse	Same as base metal, or 25-20 stainless steel	Shielded arc	900 to 1000 °F (482 to 538 °C), slow cool
6. Chrome-molybdenum alloy steels	MAW	Straight or reverse	Chrome-molybdenum or carbon-molybdenum steel	Shielded arc	300 to 800 °F (149 to 427 °C), slow cool
	CAW	Straight	Same as base metal	Use a flux	300 to 800 °F (149 to 427 °C), slow cool
7. Chromium alloy steels	MAW	Reverse	Same as base metal, or 25-20 or 18-8 stainless steel	Shielded arc	300 to 800 °F (149 to 427 °C)
8. Chromium-vanadium alloy steels	MAW	Reverse	Chrome-molybdenum or carbon-molybdenum steel	Shielded arc	200 to 800 °F (93 to 427 °C)

Table B-3. Guide for Electric Arc Welding (cont)
(See footnotes at the end of table)

Base Metal or Alloy	Welding Process[1]	Polarity	Welding Electrode or Filler Metal		Preheating Required
			Material	Type	
9. Manganese alloy steels (1.6 to 1.9 percent Mn)	MAW	Reverse	Carbon-molybdenum or mild steel	Shielded arc	300 to 800 °F (149 to 427 °C)
STAINLESS STEELS					
1. Chromium alloys (12 to 28 percent Cr) (Stainless irons)	MAW	Reverse	25-20 or columbium-bearing 18-8 stainless steel	Shielded arc	No
2. Chromium-nickel alloys	MAW	Reverse	25-20 or columbium-bearing 18-8 stainless steel	Shielded arc	No
COPPER AND COPPER ALLOYS					
1. Deoxidized copper	MAW	Reverse	Deoxidized copper, phosphor bronze, or silicon copper	Shielded arc	500 to 800 °F (260 to 427 °C)
	CAW	Straight	Deoxidized copper, phosphor bronze, or silicon copper	Use of flux optional	500 to 800 °F (260 to 427 °C)
2. Commercial bronze and low brass	MAW	Reverse	Phosphor bronze or silicon bronze	Shielded arc	200 to 300 °F (93 to 149 °C)
	CAW	Straight	Phosphor bronze or silicon bronze	Use a flux	200 to 300 °F (93 to 149 °C)
3. Spring, admiralty, and yellow brass	CAW	Straight	Phosphor bronze	Use a flux	200 to 300 °F (93 to 149 °C)
4. Muntz metal, Tobin bronze, naval bronze, manganese bronze	CAW	Straight	Phosphor bronze	Use a flux	200 to 300 °F (93 to 149 °C)
5. Nickel silver	MAW	Reverse	High nickel alloy, phosphor bronze, or silicon copper	Use a flux	300 to 500 °F (149 to 260 °C)
	CAB	Straight	High nickel alloy, phosphor bronze, or silicon copper	Use a flux	300 to 500 °F (149 to 260 °C)
6. Phosphor bronze	MAW	Reverse	Phosphor bronze	Shielded arc	200 to 300 °F (93 to 149 °C)
	CAW	Straight	Phosphor bronze	Use a flux	200 to 300 °F (93 to 149 °C)
7. Aluminum bronze	MAW	Reverse	Aluminum bronze or phosphor bronze	Shielded arc	200 to 300 °F (93 to 149 °C)
	CAW	Straight	Aluminum bronze or phosphor bronze	Use of flux optional	200 to 300 °F (93 to 149 °C)
8. Beryllium copper	CAW	Straight	Beryllium copper	Use of flux optional	500 to 700 °F (260 to 371 °C)

Table B-3. Guide for Electric Arc Welding (cont)
(See footnotes at the end of table)

Base Metal or Alloy	Welding Process[1]	Polarity	Welding Electrode or Filler Metal		Preheating Required
			Material	Type	
ALUMINUM AND ALUMINUM ALLOYS					
1. Pure aluminum (1100)	MAW	Reverse	Pure aluminum or 95 percent aluminum-5 percent silicon	Shielded arc	500 to 800 °F (260 to 427 °C)
	CAW	Straight	Pure aluminum or 95 percent aluminum-5 percent silicon	Flux-coated welding rod	500 to 800 °F (260 to 427 °C)
2. Aluminum alloys (General)	MAW	Reverse	95 percent aluminum-5 percent silicon	Shielded arc	500 to 800 °F (260 to 427 °C)
	CAW	Straight	95 percent aluminum-5 percent silicon	Flux-coated welding rod	500 to 800 °F (260 to 427 °C)
3. Aluminum-manganese alloy (3003)	MAW	Reverse	95 percent aluminum-5 percent silicon	Shielded arc	500 to 800 °F (260 to 427 °C)
	CAW	Straight	95 percent aluminum-5 percent silicon	Flux-coated welding rod	500 to 800 °F (260 to 427 °C)
4. Aluminum-magnesium-chromium alloy (5052)	MAW	Reverse	95 percent aluminum-5 percent silicon	Shielded arc	500 to 800 °F (260 to 427 °C)
	CAW	Straight	95 percent aluminum-5 percent silicon	Flux-coated welding rod	500 to 800 °F (260 to 427 °C)
5. Aluminum-magnesium-manganese alloy (3004)	MAW	Reverse	95 percent aluminum-5 percent silicon	Shielded arc	500 to 800 °F (260 to 427 °C)
	CAW	Straight	95 percent aluminum-5 percent silicon	Flux-coated welding rod	500 to 800 °F (260 to 427 °C)
6. Aluminum-silicon-magnesium alloys (6151) (6053)	MAW	Reverse	95 percent aluminum-5 percent silicon	Shielded arc	Up to 400 °F (204 °C)
7. Aluminum-copper-magnesium-manganese alloys -- Duraluminum (2017) (2024)	CAW	Straight	95 percent aluminum-5 percent silicon	Flux-coated welding rod	Up to 400 °F (204 °C)
8. Aluminum clad			Arc welding not recommended		
NICKEL AND NICKEL ALLOYS					
1. Nickel	MAW	Reverse	Nickel	Shielded arc	200 to 300 °F (93 to 149 °C)
	CAW	Straight	Nickel	Lightly flux-coated welding rod	200 to 300 °F (93 to 149 °C)
2. Monel (67 percent Ni-29 percent Cu)	MAW	Reverse	Monel	Shielded arc	200 to 300 °F (93 to 149 °C)
	CAW	Straight	Monel	Lightly flux-coated welding rod	200 to 300 °F (93 to 149 °C)

Table B-3. Guide for Electric Arc Welding (cont)
(See footnotes at the end of table)

Base Metal or Alloy	Welding Process[1]	Polarity	Welding Electrode or Filler Metal		Preheating Required
			Material	Type	
3. Inconel (79 percent Ni-13 percent Cr-6 percent Fe)	MAW	Reverse	Same as base metal	Shielded arc	200 to 300 °F (93 to 149 °C)
LEAD			Lead cannot be arc welded		
MAGNESIUM ALLOYS	MAW	Reverse	Tungsten	Shielded arc	No
	MAW	Reverse	Magnesium	Shielded arc	No

[1] In the welding process column, MAW indicates metal-arc welding, CAW indicates carbon-arc welding, MAB indicates metal-arc brazing, and CAB indicates carbon-arc brazing.

[2] Shielded arc electrodes are heavy-coated and usually require reverse polarity; however, manufacturer's recommendations specify the preferred polarity for special electrodes, which may differ from the polarity recommended above in some cases.

[3] Stress relieve by heating to between 1200 and 1450 °F (649 and 788 °C), for 1 hour per inch of thickness and cooling slowly.

[4] A large number and variety of low alloy high tensile steels are used in ordnance construction. In arc welding these steels, certain special precautions are required, such as preheating before welding, use of special electrodes, and a postheating treatment. In general, where good corrosion resistance is required or when the welded joint is to be heat treated after welding, electrodes having the same composition or properties as the base metal are used. Where these steels are in the heat treated condition, it is recommended that the filler metal used should be of the austenitic type, such as 25 percent chromium-12 percent nickel, 25 percent chromium-20 percent nickel or 18 percent chromium-8 percent nickel stainless steel, in order to obtain good weld metal properties. Some of these stainless steel electrodes have columbium or other alloying elements added to retain their properties after welding. An example of this is the so-called modified 18-8 stainless steel electrode, which contains small percentages of either manganese or molybdenum. This electrode may be used in place of the 25-20 type of electrode in any of the welding processes for which 25-20 electrodes are specified. Usually no preheating is required in welding with these electrodes.