

Q: My boss assigned me the project of buying a resistance spot welding machine for welding a sheet metal part made from two pieces of 18-gauge mild steel in a production line environment. I know very little about the process. How do I begin?

A: With so many types, sizes, and brands of resistance welding machines on the market today, choosing what to buy can be a challenging assignment. However, if you start by documenting the part to be welded, the selection process should flow from there.

Although spot welding machines are traditionally compared and selected by their respective kVA ratings, this is potentially confusing because kVA (kilovolt amps) is only a thermal rating and kVA does not do the welding. To choose a spot welding machine for a particular application, it's more important to understand the variables known in the world of resistance welding as PCT (pressure, current, time).

To spot weld a part successfully, the machine must produce the proper amount of pressure (weld force) and current (amperage), which must flow for a given duration of time. I limit this discussion to single-phase AC spot welding machines, which are much more common than three-phase MFDC inverter-type welding machines. Also not addressed are any of the other resistance welding processes, which include projection welding, seam welding, and flash butt welding.

To determine what's needed to spot weld two pieces of 18-gauge sheet metal, first refer to one of the welding charts in the *Resistance Welding Handbook* available from the Resistance Welding Manufacturing Alliance (RWMA) at www.rwma.org. The pressure and current required to weld the two sheets are shown. If the sheets are of different thicknesses, you would size the machine for the thinner of the two sheets.

Some charts show welding schedules for Class A, Class B, and Class C welds, with different pressure and current settings for each. However, for maximum weld strength and best appearance, always select a machine that will meet Class A spot welding specifications.

For your 18-gauge application, Class A specifications in the *RWMA Handbook* call for pressure (welding force) of 650 lb, current of 10,300 A, and a relatively short weld time of 12 cycles (each cycle is 1/60th of a second).

Welding to Class B and C specifications uses lower force and current settings, plus



Fig. 1 — A 50-kVA rocker arm spot welding machine. A machine like this, manufactured to RWMA standards, is a good general-purpose machine. The modern control improves welding quality, and a built-in SOFT-TOUCH system protects the operator from pinch-point injury. A reputable dealer who asks lots of questions about how the machine will be used can be a great help in explaining the many machine and control options available today.

a longer weld (current flow) time, which allows the heat-affected zone to expand and leaves the weld less attractive and not as strong as a Class A joint.

Part configuration is the next consideration. What throat depth and gap (arm length and shut height) are required to reach all the welds? Choose a throat configuration that reaches all the welds but is not so large that the output of the machine is compromised. Just as a drill connected to an extremely long extension cord won't work as well as one plugged directly into a wall outlet, welding current delivered to the tips is reduced due to electrical losses as the total area between the welding arms is increased.

The next major decision is to choose between a rocker arm-type spot welding machine (Fig. 1) and a vertical action press-type machine (Fig. 2). While a rocker arm usually beats a press welding machine in versatility and price, a press-type machine often produces superior weld quality and appearance, since the weld force is applied in a straight line motion instead of the inherent arc of a rocker arm design. It is important to note that this factor alone makes a rocker arm un-

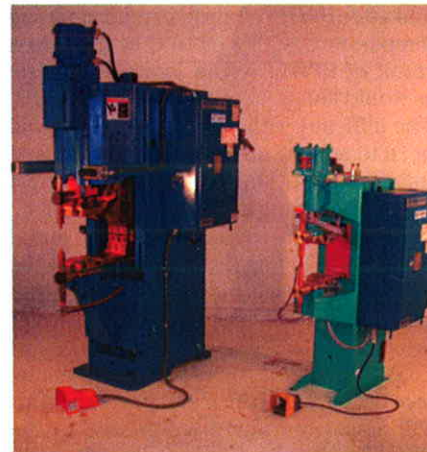


Fig. 2 — Press-type spot welding machines. Both of these press-type resistance spot welding machines are rated 100 kVA by their manufacturers, and one machine may be better suited for a particular application than the other. However, the difference in physical size illustrates why the kVA rating is not the only specification that should be considered when selecting a spot welding machine to purchase.

suitable for projection welding nuts and studs.

When choosing a spot welding machine, weld forging force is an often-overlooked variable. Since most machines are air operated, the diameter and mounting position of the air cylinder must be considered a critical factor.

The lever-type action of the rocker arm is a potential drawback of that design since, assuming that incoming air pressure remains constant, weld force decreases as the weld tips are extended farther away from the fulcrum point.

On the other hand, weld force produced by a vertical-action press-type machine is applied directly and at a ratio of one to one to the output of the cylinder.

Just as you would not drive your car at the red line for rev/min every day if you expect it to last, choosing a spot welding machine that must run wide open to weld your application in a production line environment is not advisable. Instead, select a machine that has enough "head room" available to accomplish your weld at about 60–80% of its rated capacity.

As an example, if your plant's air supply averages 80 lb/in.², choose a welding machine that can produce the required forging force at about 60 lb/in.² of regulated air pressure. Just as an undersized air cylinder is undesirable, one that is oversized can also cause problems, since

welding at low regulated air pressures (below about 20–30 lb on the gauge) may result in improper follow-up during the weld, which is a critical part of the forging process.

Another important welding machine performance comparison measure is the maximum rated secondary amperage available when the machine is fired short circuit or tip to tip, with no steel in the throat. This rating should be shown in the machine manufacturer's spec sheet and, again, you should choose a machine with plenty of extra capacity. Figure that the short circuit secondary amperage rating will be reduced by about 15% with a part in the throat and then allow for another 25–30% of head room.

Now comes the most confusing part: Resistance spot welding machines have always been rated in kVA, a thermal rating that can be stated in several ways depending on the duty cycle of the machine. As an example, a machine rated 100 kVA at 50% duty cycle may also be rated 141 kVA at 25% duty cycle or 224 kVA at 10% duty cycle.

Although it is unusual for a resistance spot welding machine to operate at or even close to 50% duty cycle (when current flow "on time" equals cool or "off time" between welds), it is important during the machine selection process to understand that RWMA specifications call for resistance welding machines to be rated at 50% duty cycle as a standard for comparison.

However, not all machines being sold today meet RWMA standards and the kVA rating of a spot welding machine can be inflated, as illustrated above, by citing a lower duty cycle in the fine print of the specifications or even just omitting that spec altogether.

While a light-duty spot welding machine may be adequate for occasional use or a light-duty production line application, it's important to understand the variables of PCT in order to make a wise purchase.

Now, let's choose a welding machine for your 18-gauge application. Assuming that a rocker arm machine is adequate and assuming that all the spot welding machines being considered meet RWMA standards and that a 12-in.-deep by 8-in.-high throat will reach all your weld locations, let's see if a 20-kVA machine will work.

First, let's look at welding pressure: RWMA specifications for a 20-kVA rocker arm with a 12-in. throat are 970 lb of force at 80 lb/in.². Since we want to operate the machine at about 75% of rated force capacity (60 lb/in.² on the gauge), that gives us a working force range of just over 700 lb, which is okay, since our Class A weld spec calls for 650.

Now, let's look at welding current: A 20-kVA rocker arm welding machine is typically rated at 16,000 short circuit secondary amps at a 12-in. x 8-in. throat. Subtracting 15% to go from short circuit amps to usable welding amps gives us 13,600 A. Subtracting another 25% for head room leaves us with 10,200 A for welding, which is close enough to the 10,300 we're looking for.

So, a short throat 20-kVA welding machine that meets RWMA minimum specs is adequate for this application, if that's all your budget will allow.

However, a larger welding machine would probably be a better choice, since a 30-kVA machine, with 21,000 short circuit secondary amps available at a 12-in. x 8-in. throat, comes in a larger frame size with more weld force available. This would allow you to specify a longer throat depth, such as 18 or 24 in., which could be handy for future applications.

And, since an RWMA standard 50-kVA spot welding machine comes in the same frame as a 30 kVA and does not cost much more per kVA, consider investing in even more welding capacity to handle future applications.

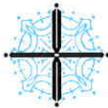
A reputable spot welding machine dealer can be a great help to you in explaining these choices, as well as the many

machine and control options available. Be ready to supply the salesperson with the following information:

1. The maximum metal thickness to be welded for each alloy
2. The deepest dimension needed from the electrode to the back of the welding machine throat (opening)
3. The highest vertical clearance needed to clear the parts being welded
4. Your available line voltage
5. If welds are to be spot, seam, projection, etc.
6. If you will be working with weld nuts or weld studs.

And remember, if a potential vendor does not ask lots of questions about your welding application, you should probably just keep on shopping. ♦

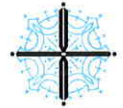
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