

WELDING TO JOIN (page 1 of 2)

Welding is a widely used process for permanently joining metals and some kinds of plastic. Most of the more than 60 welding processes use heat. Some welding processes use heat and pressure.

Many welding processes involve fusion, or joining. Fusion welding melts the edges of the parts to be joined. When the melted metal cools and hardens, the two pieces are joined into one piece by the welded joint. This joint is usually as strong as any other part. Sometimes a filler metal is added to the weld

during the melting process. The filler fills in and adds strength to the joint.

Solid-state bonding is a category of welding that uses pressure and heat to join materials. Deformation bonding is a type of solid-state bonding that usually involves heating the pieces to be joined just below the melting point and applying enough pressure to create an atomic attraction between the pieces. The pressure also slightly deforms the joining edges.

APPLYING WHAT YOU KNOW

Materials:

small candle; matches; steel, copper, brass, aluminum and glass rods, each about 1/4 in. in diameter and about 6 in. long; 5 small, different-colored buttons; a metal bottle cap or jar lid; laboratory tongs; a steel-can tripod provided by your teacher; burner (or alcohol lamp); stopwatch, watch with second hand or watch or timer that displays seconds; graph paper or computer program with graphing capabilities; safety glasses; container of water

Process: Follow these steps.



Caution: Tie back long hair; wear safety glasses. Keep a container of water nearby. Know the location of the fire extinguisher. Hot wax can burn, wear heat protective gloves.

1. Clear your work area and place the fireproof mat where you will work. Place two blocks of paraffin side by side as shown in Fig. 1. Push the blocks together tightly and evenly.
2. Light the candle and slowly and carefully run the flame along the top joint as shown in Fig. 2. Move the flame slowly enough to just melt the edges of the blocks and keep the candle tilted enough to allow the melted candle wax to drip into the seam.
3. Without touching the blocks, repeat the process at both side seams.
4. Blow out the candle. Allow the paraffin to cool for two minutes, then carefully and gently turn the blocks over. Repeat the process on the bottom seam.
5. Allow the paraffin blocks to cool for one minute, then carefully set aside to cool completely.
6. Place the second set of blocks side by side as shown in Fig. 1. Push the blocks together tightly and evenly. Open the C-clamps so that you can fit them quickly and easily over the blocks as shown in Fig. 3. Put the open clamps aside.
7. Hold the paraffin blocks with tongs as shown in Fig. 4. Have your welding partner stand ready with the C-clamps. Simultaneously, dip both blocks into the hot water so that the edges to be joined are below the surface but not touching the bottom. Wait 30 seconds.

8. Quickly remove the blocks, place them on the mat with edges to be joined touching. Help your partner quickly put the clamps in place and tighten them just until the wax at the joining edge begins to deform. Try to tighten both clamps evenly. Leave the clamps on until the block is totally cool.

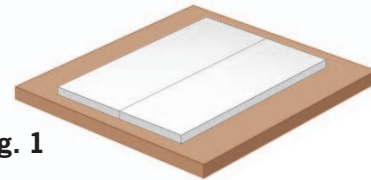


Fig. 1

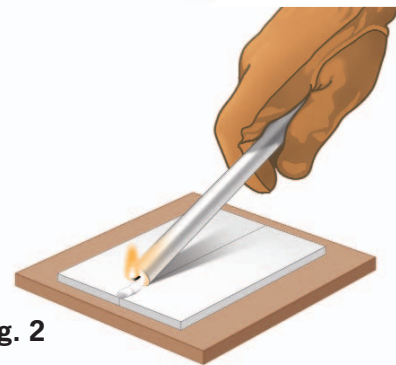


Fig. 2

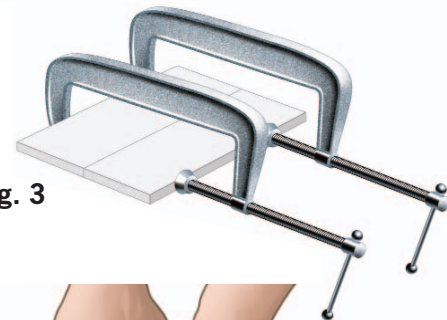


Fig. 3

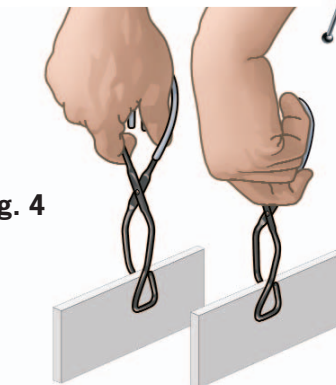


Fig. 4

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Questions & Predictions Predict and record answers to these questions. Observe and measure for Evidence & Proof below.

1. What welding process did you model in Steps 2-4? What key terms or phrases in the definition of the process actually tell you that Steps 2-4 model that process?

2. What welding process did you model in Steps 7-8? What key terms or phrases in the definition of this process actually tell you that Steps 7-8 model that process?
3. Predict whether the deformation bonding joint will show equal resistance, greater resistance or less resistance to an equal amount of tensile (pulling) force that the fusion joint will show. Record and explain your predictions.

EVIDENCE & PROOF

Materials:

candle in holder;
heavy nail long enough to go through a paraffin block;
metric ruler; several small weights,
sinkers or heavy washers;
balance scale; drink carton bucket used in Workshop 8;
2 C-clamps; matches; fireproof mat; tongs;
heat protective gloves;
safety glasses; container of water

Process: Follow these steps. Compare your results with your predicted answers to the questions.



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1. Measure and mark a line 1 1/4 in. from the edge of one model. Draw an X at the center of the line as shown in Fig. 5. Repeat for the other model.
2. Light the candle. Use tongs to heat the nail as shown in Fig. 6. Still using the tongs to hold the nail, force the hot nail to make a hole in the blocks at the X's.
3. Clamp the fusion welding model to the back of a chair and attach the "bucket" by running the cord handle through the hole, as shown in Fig. 7.
4. Add small weights into the bucket, one at a time. Record the mass of each weight added. Continue until the joint breaks. Note the last amount the joint supported before it broke.
5. Repeat Steps 3-4 with the other model.

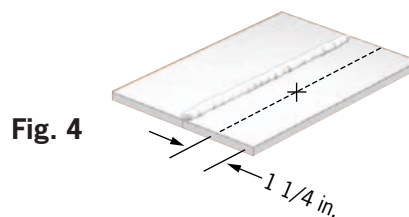


Fig. 4

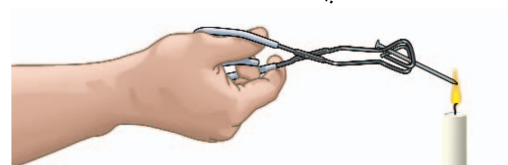


Fig. 5

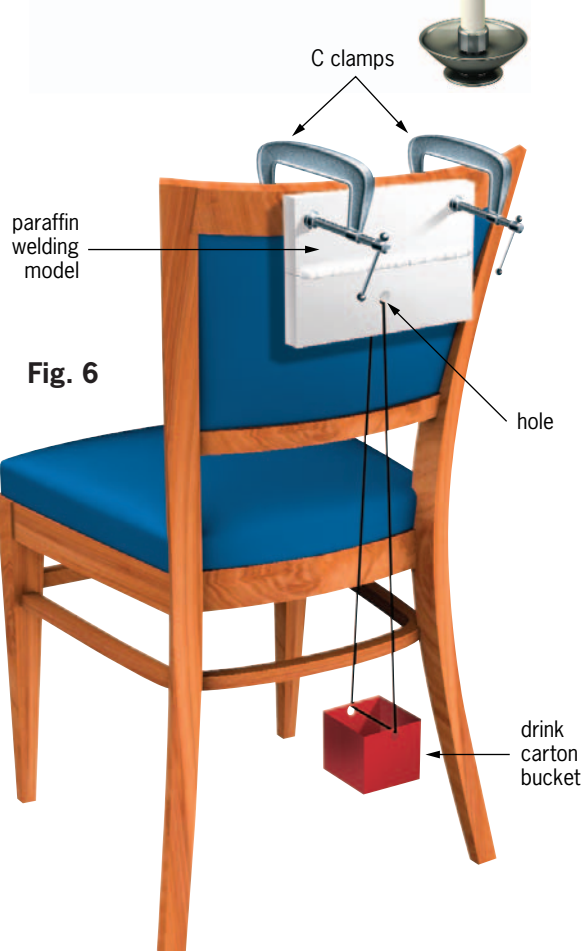


Fig. 6

CONCLUSIONS & INFERENCE

Were your predictions correct? Why? If anything unexpected happened during your investigation, describe it and explain why you think it happened.

Do you think you can make dependable inferences about real metal welded joints from these wax models? Why?