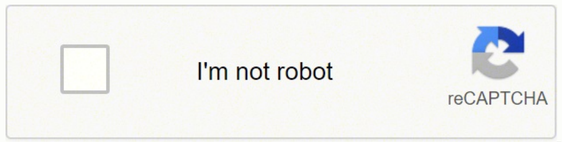

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What is solid state welding process design pdf

We use physics-based modeling to simulate conditions, set process parameters, and make sure the solution we provide is customized for the best outcome. This coupled with the clamping pressure provides for coalescence across the interface to produce the weld. Pressure may or may not be used. Heating is usually accomplished by induction, resistance, or furnace. The pressure between the two parts to be welded. In all of these processes time, temperature, and pressure individually or in combination produce coalescence of the base metal without significant melting of the base metals. Welding occurs when the ultrasonic tip or electrode, the energy coupling device, is clamped against the work pieces and is made to oscillate in a plane parallel to the weld interface. The normal weld is the lap joint weld. Another application for explosion welding is in the joining of tube-to-tube sheets for the manufacture of heat exchangers. Forge Welding (FOW) Forge welding is a solid state welding process which produces coalescence of metals by heating them in a forge and by applying pressure or blows sufficient to cause permanent deformation at the interface. The process is readily adaptable to joining ductile metals. These processes are used primarily by the aircraft and aerospace industries. When a suitable high temperature has been reached, rotational motion ceases and additional pressure is applied and coalescence occurs. It is also used for making bimetallic materials for the instrument industry. This process can be accurately controlled when speed, pressure, and time are closely regulated. This process is used extensively in the electronics, aerospace, and instrument industries. The actual operation of the machine is automatic and is controlled by a sequence controller which can be set according to the weld schedule established for the parts to be joined. With broad expertise in materials science and controls engineering, we are able to be proactive in the face of new material joining challenges. This is one of the older welding processes and at one time was called hammer welding. The process is also used as a repair tool for repairing leaking tube-to-tube sheet joints. The strength of the weld joint is equal to or greater than the strength of the weaker of the two metals joined. It, in turn, rotates one of the pieces to be welded. Heat is also released by plastic deformation associated with jetting and ripple formation at the interface between the parts being welded. Sufficiently high pressure can be obtained with simple hand tools when extremely thin materials are being joined. We’re proud to have developed resistance welding processes like these automotive industry examples: Developing in-situ heat treatment that allowed automakers to use advanced high-strength steels Integrating state-of-the-art prediction methods for assessing vehicle crash performance, which ultimately reduced physical testing requirements and enhanced product times to marketDetermining ideal local thermal processing procedures to tailor microstructures in critical sheet-metal components, which increased overall product safety and allowed a wider range of base materials Other new innovations we’ve developed include conductive heat welding, resistance hole repair, and resistance pipe cladding. It is also used for producing packages and containers and for sealing them. EWI works to stay ahead of ever-changing market demands and technological advances. To accomplish this type of joining extremely close tolerance joint preparation is required and a vacuum or inert atmosphere is used. It has been used to weld dissimilar metals that were not weldable by the arc processes. The process is used quite extensively for joining dissimilar metals. The weld apparently does not disturb the effects of cold work or other forms of mechanical or thermal treatment. Most ductile metals can be welded together and there are many combinations of dissimilar metals that can be welded. These joints may crack. Among the advantages of friction welding is the ability to produce high quality welds in a short cycle time. Normally this flash will extend beyond the outside diameter of the parts and will curl around back toward the part but will have the joint extending beyond the outside diameter of the part. Explosion Welding (EXW) Explosion welding is a solid state welding process in which coalescence is effected by high-velocity movement together of the parts to be joined produced by a controlled detonation. Welding this metal to the clean metal of the abutting part is accomplished by diffusion across the interface so that coalescence of the faying surface occurs. Roll Welding (ROW) Roll welding is a solid state welding process which produces coalescence of metals by heating and by applying pressure with rolls sufficient to cause deformation at the faying surfaces. Both methods utilize frictional heat and produce welds of similar quality. When cold welding heavier sections a press is usually required to exert sufficient pressure to make a successful weld. Since each of these processes is different each will be described. Rotating power is disengaged from the rotating piece and the pressure is increased. Atmosphere and vacuum furnaces are used and for most refractory metals a protective inert atmosphere is desirable. Diffusion Welding (DFW) Diffusion welding is a solid state welding process which produces coalescence of the faying surfaces by the application of pressure and elevated temperatures. When dissimilar metals are joined their thermal expansion and conductivity is of much less importance with solid state welding than with the arc welding processes. The process is considered diffusion brazing when a layer of filler material is placed between the faying surfaces of the parts being joined. Hot Pressure Welding (HPW) Hot pressure welding is a solid state welding process which produces coalescence of materials with heat and the application of pressure sufficient to produce macro-deformation of the base metal. This type of operation is normally carried on in closed chambers where vacuum or a shielding medium may be used. Coalescence occurs at the interface between the two parts by means of diffusion at the faying surfaces. Explosion welding creates a strong weld between almost all metals. A variation is the hot isostatic pressure welding method. The process is capable of welding most of the common metals. The flash is normally removed after welding. Friction welding requires relatively expensive apparatus similar to a machine tool. The two parts are brought in contact under pressure for a specified period of time with a specific pressure. It is normally a matter of a few seconds. One of the most widely used applications of explosion welding has been in the cladding of base metals with thinner alloys. In the original process one part is held stationary and the other part is rotated by a motor which maintains an essentially constant rotational speed. In other cases, the time is extended to several hours. Ultrasonic Welding (USW) Ultrasonic welding is a solid state welding process which produces coalescence by the local application of high-frequency vibratory energy as the work parts are held together under pressure. The motor is disengaged from the flywheel and the other part to be welded is brought in contact under pressure with the rotating piece. The process does not involve microscopic deformation melting or relative motion of the parts. Plastic interaction between the metal surfaces is especially pronounced when surface jetting occurs. In this case, the pressure is applied by means of a hot inert gas in a pressure vessel. Friction Welding (FRW) Friction welding is a solid state welding process which produces coalescence of materials by the heat obtained from mechanically-induced sliding motion between rubbing surfaces. There are two variations of the friction welding process. In this process coalescence occurs at the interface between the parts because of pressure and heat which is accompanied by noticeable deformation. This process usually involves the rotating of one part against another to generate frictional heat at the junction. Time is related to the shape and the type of metal and the surface area. Welding is accomplished by using extremely high pressures on extremely clean interfacing materials. The process is restricted to relatively thin materials normally in the foil or extremely thin gauge thicknesses. If the flash sticks out relatively straight from the joint it is an indication that the time was too short, the pressure was too low, or the speed was too high. The transducer is coupled to the work by various types of tooling which can range from tips similar to resistance welding tips to resistance roll welding electrode wheels. Forge welds made by blacksmiths were made by heating the parts to be joined to a red heat considerably below the molten temperature. This heat comes from several sources, from the shock wave associated with impact and from the energy expended in collision. The process is used for joining refractory metals at temperatures that do not affect their metallurgical properties. This may be in the form of electroplated surfaces. Slightly better control is claimed with the original process. This produces minute deformations which create a moderate temperature rise in the base metal at the weld zone. Much of that trust, however, comes from our ability to help throughout the development of a new production process, from tailoring technology to developing/executing design-of-experiment (DOE) methods. Weld strength is equal to the strength of the base metal. Time, temperature, and pressure are involved; however, in some processes the time element is extremely short, in the microsecond range or up to a few seconds. The combined clamping pressure and oscillating forces introduce dynamic stresses in the base metal. It is found necessary to allow the metal to flow plastically in order to provide a quality weld. It can also be used to join many combinations of dissimilar metals. Between these extremes is the correct flash shape. Explosion welding has not become too widely used except in a few limited fields. Successful welds have been made on refractory metals at temperatures slightly over half the normal melting temperature of the metal. Filler metal may or may not be used. Indentations are usually made in the parts being cold welded. No filler metal is required and flux is not used. There are three important factors involved in making a friction weld: The rotational speed which is related to the material to be welded and the diameter of the weld at the interface. If the flash curls too far back on the outside diameter it is an indication that the time was too long and the pressure was too high. When can we get started? Normal practice was to apply flux to the interface. The other variation is called inertia welding. WE MANUFACTURE INNOVATION. One of the major uses of this process is the cladding of mild or low-alloy steel with a high-alloy material such as stainless steel. The metals being joined retain their original properties without the heat-affected zone problems involved when there is base metal melting. These processes are sometimes erroneously called solid state bonding processes: this group of welding processes includes cold welding, diffusion welding, explosion welding, forge welding, friction welding, hot pressure welding, roll welding, and ultrasonic welding. Pressure changes during the weld sequence. This application will be of increasing importance in the future. The deformation of the surface cracks the surface oxide film and increases the areas of clean metal. The work parts are held together under pressure. Solid state welding includes some of the very oldest of the welding processes and some of the very newest. Another and new application has been the joining of pipes in a socket joint. By developing novel technical approaches using established processes, we help manufacturers turn their design challenges into tangible successes. The blacksmith by skillful use of a hammer and an anvil was able to create pressure at the faying surfaces sufficient to cause coalescence. Solid state welding is a group of welding processes which produces coalescence at temperatures essentially below the melting point of the base materials being joined, without the addition of brazing filler metal. The process is self-contained, it is portable, and welding can be achieved quickly over large areas. When the rotating piece stops the weld is completed. As temperature increases time is usually reduced. Cold Welding (CW) Cold welding is a solid state welding process which uses pressure at room temperature to produce coalescence of metals with substantial deformation at the weld. Aluminum and copper can be joined together by cold welding. When the rotation is stopped pressure is rapidly increased so that forging takes place immediately before or after rotation is stopped. Organizations often come to us with these goals in mind: Join difficult material combinationsDevelop tailored metallurgical properties, such as locally softening materials without sacrificing strength Develop customized repair technologyAccomplish all goals in a timely, resource-conscious manner EWI’s broad resistance and solid-state welding capabilities have made us a trusted partner for organizations in industries like automotive, aerospace, rail, and oil and gas. Visual inspection of weld quality can be based on the flash, which occurs around the outside perimeter of the weld. Even though heat is not applied in making an explosion weld it appears that the metal at the interface is molten during welding. Some of the processes offer certain advantages since the base metal does not melt and form a nugget. The vibratory energy that produces the minute deformation comes from a transducer which converts high-frequency alternating electrical energy into mechanical energy. The welding time. This process is similar to forge welding except that pressure is applied by means of rolls rather than by means of hammer blows. Here a flywheel is revolved by a motor until a preset speed is reached. It is used primarily in the production of weldments for the aerospace industry. Ultrasonic energy will aid in cleaning the weld area by breaking up oxide films and causing them to be carried away. Normally for friction welding one of the parts to be welded is round in cross section; however, this is not an absolute necessity. This process is of minor industrial significance today. The temperature at the weld is not raised to the melting point and therefore there is no nugget similar to resistance welding. EWI specializes in all types of resistance and solid-state welding. Aluminum and copper are readily cold welded. During the predetermined time during which the rotational speed of the part is reduced the flywheel is brought to an immediate stop and additional pressure is provided to complete the weld. At the start it is very low, but it is increased to create the frictional heat. No matter your industry, we’re ready to explore resistance and solid-state options for your job.