

DETERMINATION AND CONTROL OF WELDING VOLTAGES

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Abstract: The purpose of this paper is to analyze methods for determining and strategies for controlling stresses in weld zones. We will review the physical principles underlying the formation of stresses, methods for their measurement, and innovative approaches to prevent and manage these stresses.

Welding stresses arise from a number of factors including thermal effects, expansion and contraction of materials, and changes in metal structure. Stress measurement techniques include the use of strain gages, deformation methods, and advanced stress visualization techniques.

Numerical modeling also plays an important role in stress prediction, and understanding the effects of factors such as the type of welding processes and their parameters is essential for effective stress management.

The paper will provide examples of innovative approaches to stress control, demonstrating practical cases of successful implementation of these strategies in different industries. Finally, we will summarize the results and highlight the importance of stress control in creating stable welded joints.

Key words: stress control, welding process optimization, treatment mechanical properties of materials, stress measurement.

In the welding industry, stresses resulting from thermal effects and metallurgical structure changes play a key role in the formation of welded joints. Understanding this influence becomes an integral part of the design and manufacturing process aimed at creating high quality and sustainable structures.

The physical principles governing the generation of stresses in welding include several key mechanisms affecting the weld and surrounding area:

- Thermal effects: One of the major sources of stresses is thermal input to materials during the welding process. Abrupt changes in temperature result in expansion and subsequent cooling of the metal, causing deformation. For example, significant thermal stresses can occur when using rapid cooling methods such as water cooling.
- Metallurgical structure change: Heating and cooling processes can also change the metallurgical structure of the metal, including the formation of solid solutions, martensitic structures, and other phases. These changes can induce internal stresses in the metal structure.
- Contraction and deformation: During the welding process, different areas of the material may be subjected to different thermal stresses, causing them to contract or deform. This creates mechanical stresses along the welded joint.
- Uneven heating: Uneven heat distribution in the weld zone, especially when multiple passes are used or when welding different materials, can lead to uneven expansion and hence the formation of stresses.
- Thermal effects on materials in the vicinity of the weld: Materials in the vicinity of the welded joint are also subject to thermal effects. This can cause changes in their mechanical properties and therefore contribute to the overall stresses in the weld zone.

Methods for measuring stresses in weld zones:

Strain gages are devices that change their resistance when the material is deformed. They are applied to the surface of the material and their resistance changes are measured to determine stresses. Strain gages are widely used to measure thermal and mechanical stresses in welding zones. They can be attached to the surface of the weld joint to monitor strains in real time.

Deformation methods of stress measurement:

- Inclinator method: This method uses angle measurement in the presence of stresses. Deformations in the material cause the angle to change, which is then measured.

- Footprint method: Creating footprints from a deformed surface allows the stress level to be assessed.

Visualize the stresses for a more complete understanding:

- Cold Ice Method: Applying a thin layer of ice to a surface and then measuring the deformation of that layer after heating allows stresses to be determined.

- Photoelastic method: Takes advantage of the ability of some materials to change color when deformed, allowing stresses to be visualized.

The combined use of these methods provides a comprehensive measurement of stresses in welded joints, which is important to ensure their strength and durability.

Various strategies for controlling and reducing welding stresses that will help ensure quality and reliable welded joints.

1. Selection of optimum welding process:

The first strategy for controlling welding stresses is to select the most appropriate welding method. Some methods, such as TIG (WIG) and plasma welding, provide low thermal strain and therefore less likelihood of stresses. This is especially important when welding materials with a high coefficient of thermal expansion.

2. Preheating and reheating of materials:

The second strategy is related to preheating and heating of the materials to be welded. A properly selected heating mode can reduce the stresses caused by the thermal cycles of welding. This method is particularly effective when welding thick-walled and high-strength materials.

3. Use of intermediate thermal control:

A third strategy for stress control is to use intermediate thermal control. During the welding process, the weld joint can be periodically cooled or heated to reduce internal stresses. This can be accomplished by using special techniques or by controlling the temperature of the welding arc.

4. Development of special anchoring methods:

The fourth strategy involves the development of special anchorage methods that distribute stresses and prevent them from concentrating at specific points. Such methods may include the use of intermediate welds, inserts of other materials, or the creation of additional anchoring elements.

Stress reduction during welding is an important aspect that affects the quality and reliability of welded joints. Each of the presented stress control strategies has its own advantages and can be used depending on the specific welding conditions. However, it is important to remember that the effectiveness of these strategies depends on the professionalism of the welder and the proper selection of welding process parameters. Only a comprehensive approach and compliance with all the necessary measures will achieve optimal results and ensure the safety and reliability of the welded joints.

Assessment of stress effects on mechanical properties is one of the important tasks in the field of materials science and structural mechanics. When designing and operating various engineering objects, it is necessary to take into account the influence of stresses on their crack resistance and fatigue characteristics.

Stresses occur in materials under the influence of external loads or thermal deformations. They can lead to the formation of cracks, material failure or a reduction in strength. To avoid such negative consequences, it is necessary to analyze the effect of stresses on the mechanical properties of materials.

Analyzing the effect of stresses on crack resistance is a relevant topic, especially for welded joints. During welding, materials are subjected to various thermal and mechanical stresses, which can lead to crack formation and joint damage. To assess the crack resistance of such joints, crack resistance tests are performed to check the resistance of the welded joint to cracking under stress.

In addition to crack resistance, it is also important to evaluate the fatigue performance of materials and welded joints. Fatigue characteristics determine the ability of a material or welded joint to operate under cyclic loading conditions without failure. This is accomplished by fatigue testing, where the material or joint is subjected to repeated loads until failure. The fatigue strength evaluation helps to determine the durability of a structure and to predict its service life.

Analyzing the effect of stresses on crack resistance and fatigue performance requires the use of special methods and tools. First, stress calculations are carried out, taking into account the geometry of the object, loads and material properties. Then laboratory tests are performed to check the mechanical properties of the material under various loads. The results are compared with the calculated values to determine the durability of the joint.

The relationship between stresses and durability of welded joints can be quite complex as it depends on many factors including type of welded joint, materials, welding methods, etc. Therefore, it is necessary to consider all these factors for a more accurate assessment of the durability of a welded joint.

Analyzing the effect of stresses on mechanical properties is an important stage in the design and operation of various engineering objects. It helps to prevent cracking, joint damage and reduction in strength of materials. For a more accurate analysis, it is necessary to consider all factors affecting the durability of joints, such as the type of welded joint, materials, welding methods and others. Such a comprehensive approach will provide more reliable results and ensure the reliability of structures.

Stress control plays a critical role in many industries that utilize structures subjected to various mechanical and thermal stresses. Let's look at some practical examples of successful stress control in various industries.

1. Aviation Industry: In the aviation industry, stress control is particularly important because of the tremendous stresses faced by airplanes and other aircraft. Various techniques for stress control are used here, including the use of special welding methods and the use of innovative materials with high crack resistance and fatigue resistance.

2. Oil and Gas: In the oil and gas industry, stress control is particularly important due to the extreme conditions under which pipelines and other equipment operate. Techniques and materials that can withstand high pressures, temperatures and corrosive effects are used. Stress control involves not only the design and selection of the right materials, but also regular inspections and monitoring of the condition of the equipment.

3. Automotive Industry: In the automotive industry, stress control is an important factor in ensuring the safety, reliability and durability of vehicles. Here, various methods and techniques are used to minimize the stresses occurring in key assemblies and parts of automobiles. This includes the use of special materials, optimal structural design and thorough strength and fatigue testing.

Now let us look at innovative approaches to stress management in welding.

1. using laser welding: Laser welding has some advantages over conventional arc welding in that it produces a narrower and deeper weld, which reduces stresses and improves the mechanical properties of the joint. In addition, laser welding allows for more precise control of the thermal effects and the weld zone.

2. Application of heat separation technology: Heat separation technology, or DHT, allows to control the heat effects during welding. It is based on the application of various tools and techniques to separate heat under the welding action to reduce stresses and prevent material deformation.

3. Use of real-time stress monitoring: Modern stress monitoring systems allow monitoring and analyzing stress values in real time. This allows rapid response to possible stress problems and appropriate measures to reduce them. Such systems help to improve the reliability and durability of welded joints.

In conclusion, the determination and control of welding stresses are important aspects of the welding process. Stresses can have a significant influence on the quality and strength of welded joints, so their control is essential. However, there are still a number of challenges and unsolved problems in this field at the moment. The determination of welding stresses is a complex task requiring specialized equipment and measurement techniques. In addition, many factors such as materials, welding techniques, environmental conditions, etc. have to be taken into account. Further research and development in this field is of great importance. More accurate and efficient methods for determining and controlling welding stresses need to be developed. This will improve the quality of welded joints, increase their strength and reliability. It is also worth paying attention to the development of new materials and welding technologies that will reduce welding stresses. This will help to reduce the risk of defects and damage in welded joints. In addition, there is a need to educate and train welding professionals to improve their skills and awareness of the importance of controlling welding stresses. In summary, the determination and control of welding stresses are relevant problems that require further research and development.

List of references

1. Сварочные деформации и напряжения. Талыпов Г.Б. 1973
2. "Residual Stress and Distortion in Welding" by J.G. Bowness
3. "Welding Residual Stress and Its Effects on Fatigue and Fracture" by H. Murakawa and Y. Hatamura
4. "Welding Metallurgy and Weldability" by John C. Lippold and Damian J. Kotecki
5. УДК621.791 : 621.7.011 Сварочные деформации и напряжения. Винокуров В. А. «Машиностроение», 1968, 236 стр.