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# CONTRIBUTIONS ON THE INFLUENCE OF MECHANICAL PARAMETERS TO THE QUALITY OF WELDED JOINTS OF SMART COMPOSITES IN ULTRASONIC FIELD

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***Abstract:*** *Quality of welded joints in ultrasonic field depends on three parameters: technological, mechanical and acoustic. The paper presents the main mechanical parameters with special influence on the quality of welded joints in ultrasonic field experimental results obtained in welding stops intelligent auto protection of smart bars.*
***Key words:*** *parameters, technological, mechanical, acoustic.*

## 1. INTRODUCTION

Ultrasonic welding process depends on a smart composites multitude of parameters grouped into three categories: technological parameters, mechanical parameters and acoustic parameters. Mechanical parameters are the result of technological scheme used in the design and construction of equipment used in welding. In general, ultrasonic welding machine built allows more welding technological schemes, depending on the shape and size ultrasound system that can be fixed or changed. The main mechanical parameters with significant influence on the quality of welded joints are static pressing force, contact local static pressure, during activation with ultrasound sonotrode shape, form anvil acoustic form factor the concentrator sonotrode and others.

## 2. THE INFLUENCE OF MECHANICAL PARAMETERS ON THE QUALITY OF THE WELDED JOINT

Mechanical parameters with significant influence on the welding process in the field ultrasonic are static pressing force, local contact pressure surfaces combined ultrasound and activation time.

### 2.1. Influence of static force push on quality welds with ultrasound smart composites

Theoretical and experimental research revealed that the size of static force push decisively influence the value of the average breaking strength of ultrasonic welds. $A_s$ shown in figure 1, the results obtained in welding ABS matrix smart composite materials there is pressure optimal static force, which depends on the optimal activation time $t_s$ and I sonotrode amplitude (fig. 2) and the density ultrasonic energy./1/, /2/, 17/, /18/.

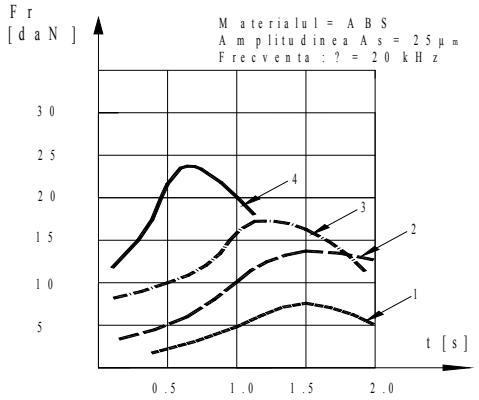


**Figure: 1**. Influence of static pressure force and duration of ultrasonic activation on resistance welded under the conditions:1 - PS = 5daN, 2 - PS = 10daN, 3 - PS = 15daN, 4 - PS = 20daN.

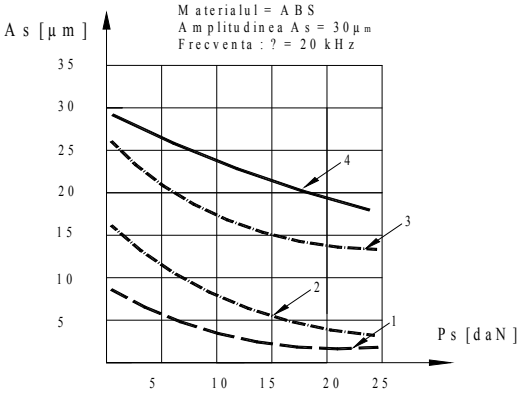


**Figure 2:** Ps static pressure force influence on the amplitude As, acoustic energy at different densities: 1 to 2 W/cm2, 2 to 4 W/cm2, 3-6 W/cm2, 4-8 W/cm2.

As shown in figure 2 is a close connection between the pressure and the magnitude of static force active part of all As, in the sense that, as the static pressure force increases, the active part of sonotrode amplitude decreases and overcome the optimal value static pressing force, joint strength decreases substantially. Force static pressure and has a great influence on local contact static pressure (fig. 3), increasing as the power increases static pressure at different densities of acoustic energy./1/. /2/, /4/, /5/, /6/.
Static pressing force is chosen and the thickness of the parts to be joined, with a Fr optimal joint strength (fig. 4) depending on thickness and static power pressing.

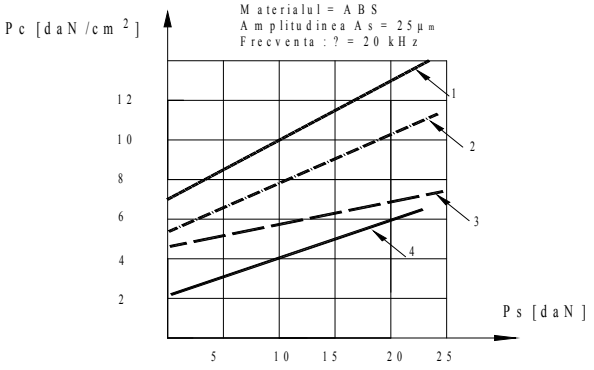


**Figure 3**: $P_s$ static pressure force influence on local contact pressure $P_c$ at different acoustic energy densities: 1 to 2 W/cm2, 2 to 4 W/cm2, 3-6 W/cm2, 4-8 W/cm2.

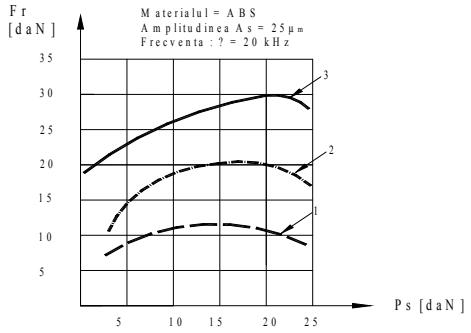


**Figure 4**: Influence of static pressure $P_s$ force, the joint resistance $F_r$, in various thicknesses:
1 - s = 1.0+ 1.0, 2 - 2.0 + 2.0 s, 3 - s = 3.0 + 3.0.

### 2.2. Contact local static pressure influence on the quality of welded joints ultrasonic smart composites

Materials brought to the experimental results obtained revealed that the contact pressure static local variable and static force depends not only on the pressure but also the thickness of the parts to be joined, the size and geometric configuration of the combined area. /1/, /16/.
It appears that as they move from stage one to stage two of the welding process, contact the local static pressure increases and decreases contact (fig. 5) and therefore decreases joint strength, above which there is a combination can not be achieved.

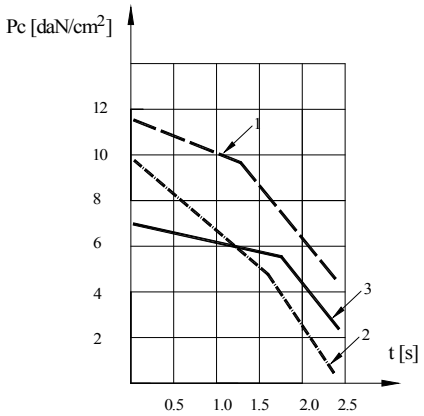


**Figure 5**: Influence the ultrasonic welding process on the contact pressure pc ts for different plastics:
1 - ABS 2 - High density polyethylene, 3 - polycarbonate.

Contact local static pressure depends on the configuration of the contact area and therefore to be possible to merge the contact area has some form in the first favorable thick pieces welded joint area and the geometric configuration of the functional role of piece (fig. 6). It appears that those acoustic energy concentrators required to be processed on the contact not only is a rapid concentration of heat in local areas but also combining static contact pressure much higher in these areas, pressure decreases as concentrators plastic melt or deform, increasing the contact area. /1/, /12/, /7/, /8/, /13/.

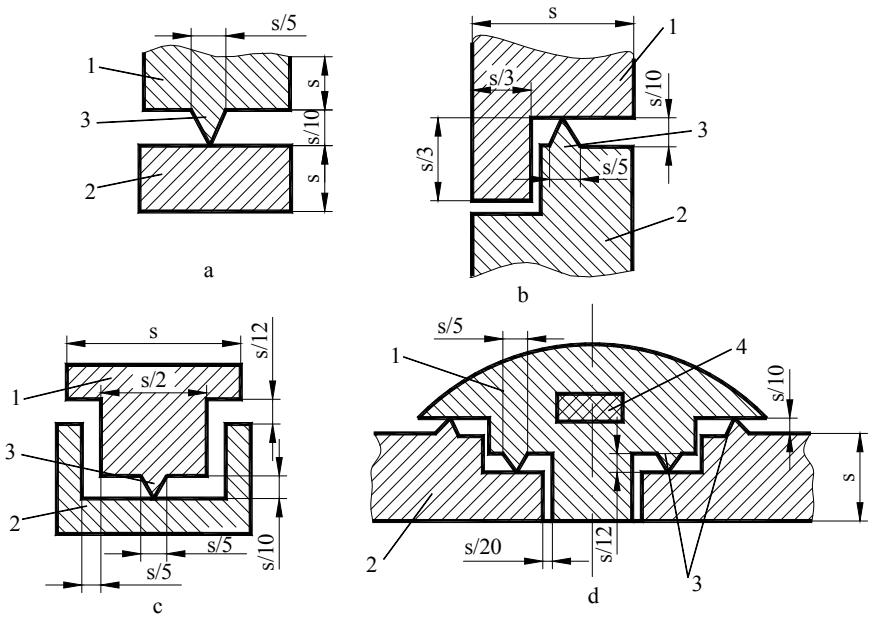


**Figure 6**: Types of Training contact area depending on the thickness of the welded parts and the local static pressure required contact: a - the interval b - in steps c - channel and wedge d - specifically, 1 - piece top, 2 - play less, 3 - acoustic energy concentrator, 4 - piezoceramic plates

Number, size and distances that puts the concentrate acoustic energy and heat that are based on the geometric configuration of the joint and combined nature of the material. Training module shown in figure 6, d is especially determined to achieve arrest Smart Car Smart Car or a bar, which serves to acoustic and optical signal near the vehicle remotely dangerous./8/, /9/, /10/, /11/, /12/.

### 2.3. Influence the quality of welded joints welding ultrasonic intelligent composite materials

During welding, which is the ultrasound waves drive the contact area has a great influence not only on the possibility of achieving joint but also the quality and the strength of the welded joint.

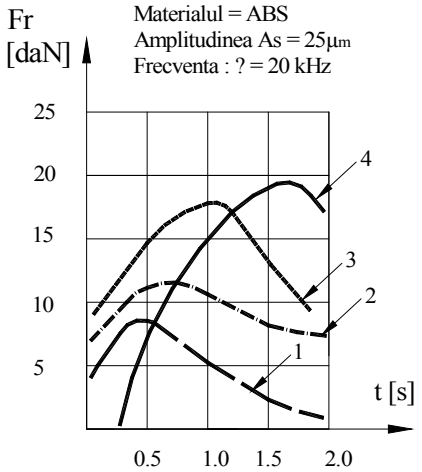


**Figure 7**: Influence of duration $t_s$ welding, the joint resistance $F_r$, depending on the thickness of the parts to be joined:1 to 1.0 +1.0, 2 to 2.0+ 2.0, 3 to 3.0+ 3.0, 4 to 4.0+ 4.0.

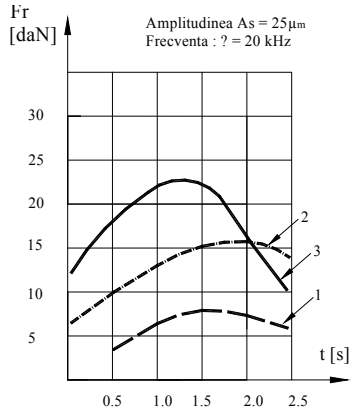


**Figure 8**. Influence of duration ts welding, the joint resistance $F_r$, depending on the nature of the materials to be joined: 1 - High density polyethylene, 2 - ABS, 3 - polycarbonate.

Experimental results have shown that the optimal value depending on the length of welding Welding thickness (Fig. 7), the maximum joint strength moving according to the combined thickness reduction. In the determination of optimal welding time should be taken into account the nature of the materials to be welded, activation time is very different depending on the material properties combined (Fig. 8).
Operation during ultrasonic contact area depends not only on the material to be welded and welding parts but thick and static pressure force (Fig. 9) and section sonotrode form in the contact area (Fig. 10).

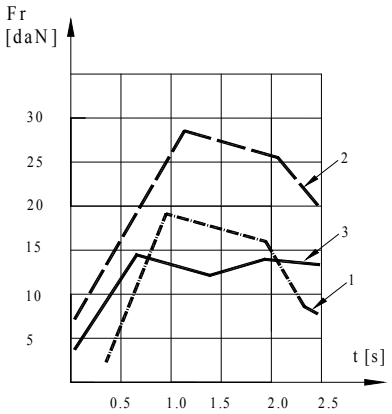


**Figure 9**: Influence of duration $t_s$ welding, the joint resistance $F_r$, according to the static pressure force: 1 - $P_S$ = 15daN, 2 - $P_S$ = 25daN, 3 - $P_S$ = 35daN.

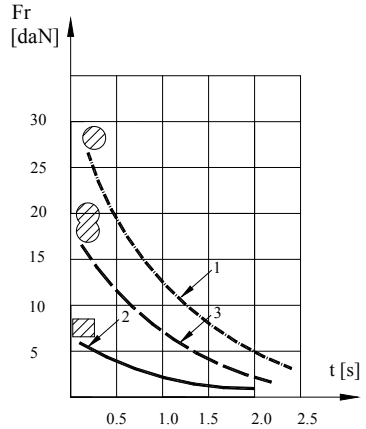


**Figure 10**: Influence of duration ts welding, the joint resistance $F_r$, depending on the final part of the sonotrode section:1 - Section Round 2 - the square, 3 - section some.

In direct correlation with the speed of flow during welding plastic contact areas as increasing plastic flow velocity in a short time based on the application of acoustic energy in the joint, creating favorable conditions for joint deployment process./11/, /2/, /12/, /13/, /14/, /15/.

Experiments were carried out on machines at different businesses or facilities constructed in the department TMS as prototype models in various composite materials. or different products.
**Note!** In addition to the parameters mentioned above and treated, the quality of welded joints in composite materials smart ultrasound also depends on other parameters which also include: nature of the material it is made sonotrode, condition and quality of the contact surface sonotrode-piece, state combined cleaning area; nature of the material anvil acoustic condition and lower anvil surface; physical limit of the area of contact of the two materials to be joined, the nature of the environment in which the process of welding and others.

## 3. CONCLUSIONS

Experimental results in the field ultrasonic welding of automotive taillights smart and intelligent auto bar leads to the following conclusions:
- Development of intelligent composite parts through assembly by welding. Ultrasound technology is very complex because it must take into account a number of factors related to the intelligent processing of composite materials and the mechanical and technological parameters influencing differently acoustic welding process;
- Size static pressure force decisive influence average resistance value. Breaking the welded joints in ultrasonic field there is a optimal value according to nature of the materials to be joined and ultrasonic activation time;
- Experimental results obtained on various smart composite materials were removed shows that local pressures-pressure static pressure but also the thickness of the parts to be joined, dimensions and geometric configuration combined area;
- During ultrasonic activation in the contact area has a great influence not only on joint implementation possibilities but the quality and on resistance welded joint.

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