DESIGN OF REAL WORKING TABLE WITH WELDING FIXTURE

Katarina Monkova[1], Peter Monka[1], Peter Soltes[2]
([1]TU Kosice, Faculty of manufacturing technologies with the seat in Presov, Slovakia
[2] IPM Solutions, Ltd., Presov, Slovakia)

Abstract. *The article deals with the design of real working table with welding fixture. It is designed for the rear headrest bracket of Audi. The fixture has to satisfy many requirements. The most important is ensuring the right position of individual components, because well done weld is the necessity of passenger?s and transport safety. The design process is realized in several steps. Firstly, the 3D model of the rear headrest bracket was created, then the components of the fixture were created and also assembled. In the next step the virtual model of the welding table for automated production was prepared in software Autodesk Inventor Professional. 3D model was the base for real fixture manufacturing, which functionality was verified in real production. After real working table implementation into the production, the efficiency of the whole welding process increased several times in comparison with the previous hand welding activities.*

Introduction

Today's trend in industry is to reduce the required parts inventory for repeat orders by keeping the manufacturing information (NC program, tools setup etc.) in electronic form. This procedure allows companies to operate more efficiently and without tying up substantial portions of their capital in static inventory of slow-moving parts. Especially, the successful running of any mass production depends upon the interchangeability to facilitate easy assembling and reduction of unit cost. The production tools that are used for accurately producing of duplicates and interchangeable parts are jigs and fixtures.

A fixture is a work-holding or support device, used to hold the work in place. The fixture is used to the work in a fixed location. It is a support device that is usually large and permanently attached to the work surface. The main purpose of a fixture is to ensure that the workpiece does not move when the machine starts operating. The fixtures can be unique, built to fit a particular part or shape. They are specially designed so that large numbers of components can be machined or assembled identically. These devices increase the productivity by eliminating the individual marking, positioning and frequent checking. The operation time is also reduced due to increase in speed, feed and depth of cut because of high clamping rigidity. Higher production, reduction in scrap, easy assembly and savings in labour cost results in ultimate reduction in unit cost.

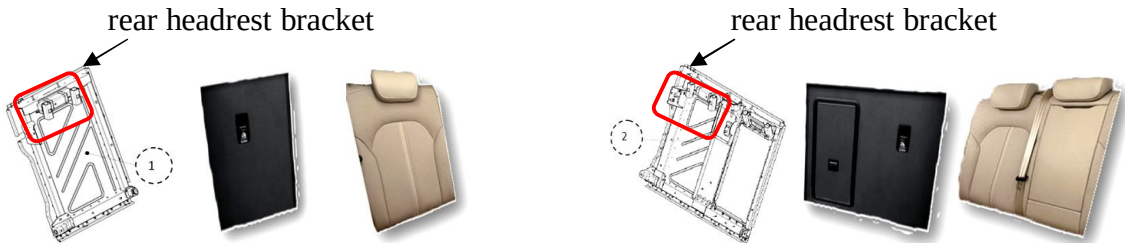
Designing of jigs and fixtures depends upon many factors. The list of them is mentioned below. It depends on: [1]

- workpiece and finished component size and geometry,
- type and capacity of the machine,
- provision of available clamping arrangements at the machine,
- available indexing devices and their accuracy,
- evaluation of variability in the performance results of the machine,
- rigidity and of the machine tool under consideration,
- required level of the products accuracy and quality to be produced, etc.

The goal of the work was to design the welding fixture for the rear headrest bracket of Audi. The well done weld is the necessity to be provided the passenger?s and transport safety.

Fixture design

There are two types of rear headrest bracket in Audi car for designing. One is for single seat and the second is for double car seat. They are both shown in the Fig. 1. [2]



a) b)

Fig. 1. Types of rear headrest bracket in Audi car

To use the fixtures at the creating and simulating manufacturing process via computer, it is necessary to define the fixture setup for the manufacturing model. Each fixture setup contains information about the fixtures that are presented in the model when the setup is active. This fixture setup can be used to manipulate fixtures within the manufacturing model. Because the fixture setup contains the fixture assembly information, each fixture setup of manufacturing model has to be explicitly defined, unlike sites or tools. So as the first, the 3D models of the components (Fig. 2) were created in the software Autodesk Inventor Professional.

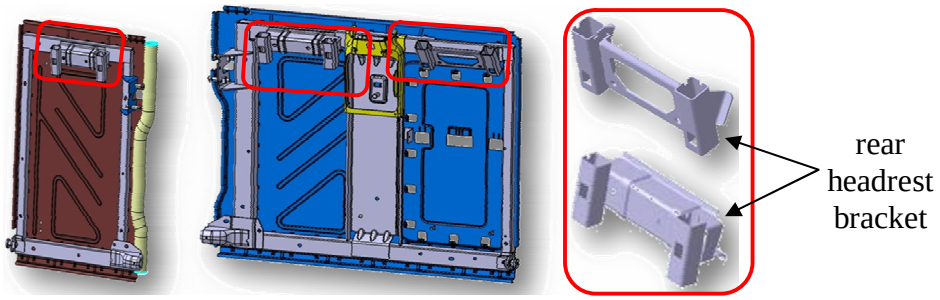


Fig. 2. The 3D model of single double car seat with detail of rear headrest bracket

Next step was the fixture designing. It was important to follow the rules listed below: [1,2]

- to compare the cost of production of work with present tools with the expected cost of production,
- to decide upon locating points and outline clamping arrangement,
- to make all clamping and binding devices as quick acting as possible,
- to make the jig fool proof,
- to make some locating points adjustable,
- to avoid complex clamping arrangements,
- to round all corners,
- to provide handles where these will make handling easy,
- to provide abundant clearance,
- to provide holes on escapes for chips,
- to locate clamps so that they will be in best position to resist the pressure of the cutting tool when at work,
- to place all clamps as nearly as possible opposite some bearing point of the work to avoid springing action,
- before using in the shop, it is needed to test all fixtures as soon as made.

The design process has started by study of production process that provides valuable information for the design phase. The special focus was devoted to the structure of a body, e.g. there were selected master control points (holes or surfaces related to the body part and assembly to arrive at the dimensional integrity by giving the parts in the correct position during joining). [3,4]

The next step was to compile the list of functional requirements. A functional requirement is a specific requirement that the device has to incorporate. Each functional requirement must contain a qualitative specification as to how the device will perform. Functional requirements were vital in keeping the device requirements clear throughout the entire design process. [3] The third step was to assign each functional requirement a design parameter. A design parameter is a possible design concept to address the functional requirement it is matched with.

On the basis of rules listed above, it was suggested three types of welding fixture for rear headrest bracket. Final design was a product of the different ideas and components originally created in the design phase. 3D model of the final fixture is shown in the Fig. 3.

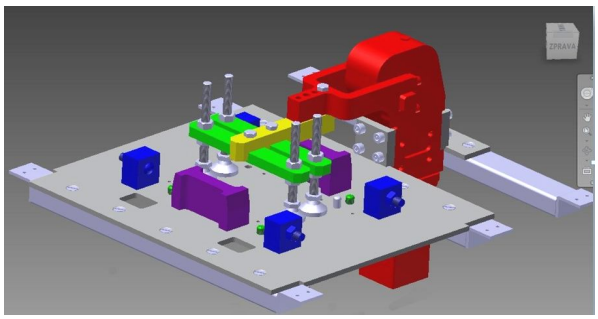


Fig. 3. The 3D model of final fixture

After designing the final version of the fixture, the next step was to make a real assembly. Finally, after the real version of the fixture production, it has been placed on the working table destined for the welding process. (Fig. 4)

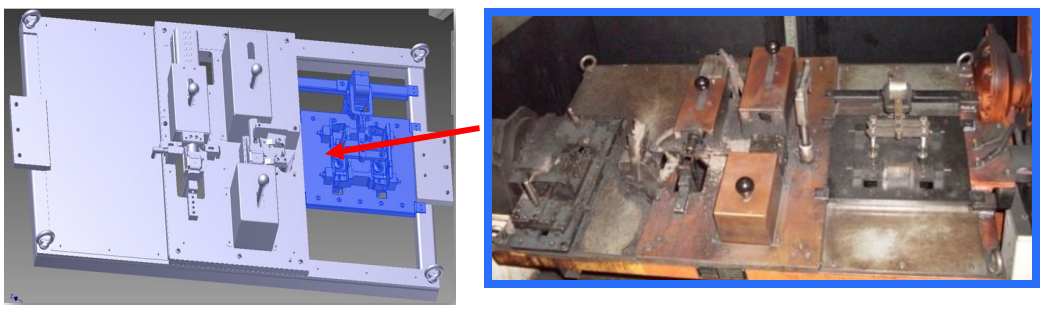


Fig. 4. Position of designed fixture on the working table

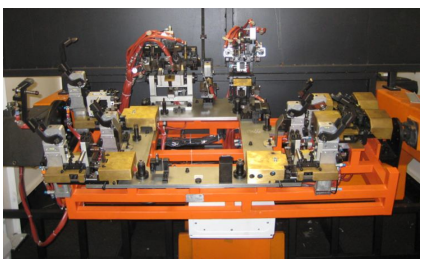


Fig. 5. Real working table with welding fixture

The fixture functionality and precision repeatability achievement were tested in real condition. At the welding process were used next additional devices as are the welding robots ABB IRB1400 and welding supplies Fronius Trans Puls Synergic 5000. The view on whole real working table is displayed in the Fig.5.

Summary

Industry development is currently driven by a competitive match and increases the technical level, while there is a substantial effort to reduce overall production time and increase productivity. Achieving a good indicator of profit and the ability to quickly respond to market demands is the only way for companies to survive and prosper. Being faster in market while increasing quality, this is a crucial competitive advantage of successful business future, which raises the need to address complex problems in all phases of development and production of selected products with the using of available technical, information and automation systems. [5]

After the fixture implementation into production, the efficiency increased several times in comparison with the previous hand welding activities. Whereas hand positioning of all parts for welding took about 2-3 hours, with the fixture it was only 15-20 minutes and hour standard increased about two welding pieces of rear headrest bracket. The initial costs invested in the automated process start-up have returned very quickly.

Acknowledgment

This article originates with the direct support of Ministry of Education of Slovak republic by grants KEGA 013TUKE-4/2014 and VEGA 1/0614/15. This article is also the result of the Project implementation: Competency Centre for Knowledge technologies applied in Innovation of Production Systems in Industry and Services, ITMS: 26220220155, supported by the Research & Development Operational Programme funded by the ERDF.

References: **1.** Boyle, I. M. et al.: A case-based reasoning fixture design method. Framework and indexing mechanisms, In: Journal of Computing and Information Science in Engineering, Vol. 6, no.1, (2005), p. 40-48 **2.** Sabol, M.: Suggestion of the welding fixture, Diploma thesis, FVT TUKE, Presov, 2013 **3.** Trebuna, P., Kovac, J.: The use of operational planning in the material flow of the production process, In: Upravlenie ekonomikoj: Metody, modely, technologii, Ufa: Ugatu, (2010), p. 166-170. **4.** Smeringaiova, A., Vojtko, I., Pavlenko, S.: Dynamic model of the station for measuring of mechanisms, In: Strojarstvo extra, no. 5 (2009), p. 57/1-57/3 **5.** Panda, A. et al.: Turning bearing rings and determination of selected cutting materials durability, In: Advanced Science Letters. Vol. 19, no. 8 (2013), p. 2486-2489

Európska únia
Európsky fond regionálneho rozvoja
Operačný program VÝSKUM a VÝVOJ
Agentúra Ministerstva školstva, vedy, výskumu a športu SR pre štrukturálne fondy EÚ
KC ZATIPS

We support research activities in Slovakia. / This project is being co-financed by the European Union