

## CLAMPING FIXTURE FOR NEW PARADIGMS OF MANUFACTURING

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**Abstract:** *Today manufacturing processes are characterized as small batch production. Effective small batch production is possible only by using automation in all possible tasks of production. Very important task of automated small batch production is a workpiece clamping. The automated clamping task for this type of production contains several particular tasks to solving. One of them is a task of creating some intelligence in automated clamping device.*

**Key words:** *fixture, jaw, gripper, assembly, sensor*

### 1. INTRODUCTION

In these days become manufacturing to be customer oriented. Product ranges are widened and innovative cycles are shortening. The products are changing the shape, material and there are fill up with new functions. Short innovative cycle needs changing of actual manufacturing structure to the flexible cell aided manufacture structure. Manufacturing time and its shortening is coming to be important. Manufacturing strategy which is time oriented needs also change of manufacturing structure to the manufacture in manufacturing cells, or lines.

The manufacturing cell is an open manufacturing unit with transparent manufacturing processes. Flexible manufacturing cells represents today trend to manufacturing innovations and productivity increasing. (Mudriková et al 2009)

Flexible manufacturing cell manufacture is the most important philosophy in last time. This manufacturing philosophy is based on:

- manufactured products similarities
- manufacturing progress similarities

### 2. NEW GENERATION OF CLAMPING FIXTURES

Main target of every manufacturing process is creating of some product in asked quality. There are some differences between manufacture in automated production systems and manufacture in conventional production systems. These differences are standing in problematic of operation elimination from the production system. Automated manufacturing systems have to be able to provide long term needed quality level. This quality level has to be reached without labour intervention. That means, that all automated manufacturing systems subsystems are dealing on outcome quality realization. For quality realization in automated manufacturing systems it is necessary to create proper single functions composition, which are created between single subsystems. The exact time coordination of such function is very important. Clamping device effectiveness is affecting to the effectiveness of whole production machine or manufacturing system. (Velišek et al 2008)

Fixture device is clamping work piece on technological devices. Such clamping operation has to be realized that way, that exact position between the tool and work piece have to hold. This position has to exact during whole technological process realization. Clamping devices are using for reason of quality and effectiveness increasing. Such quality and

effectiveness increasing is also leading to the decreasing of production costs. In many cases using of proper fixture device is needed also for reason of better manufacturability. There is a wide number of technological operation which can not be realized without proper clamping device. Design of used clamping device is also based to the production series. In case of low series production are usually used universal clamping devices, which can be little adapted for each production machine. In low series production can be also used fixtures with modular design. Such modular clamping devices are usually not very expensive. That why, also the price of final product is also not very high. In case of high series production and mass production are usually used one purpose clamping devices or specialized fixture systems, which are characterized by high effectiveness. Such fixture system can ensure also some advanced function such as cooperation with control system of manufacturing devices. In case of its using in high series production or mass production, the price of such devices is not a problem, because such high price is compensated by effectiveness increasing. According to the rising use of low series production, there is an effort to reach same mass production economical effect also in low series production. That means that producers are making great researches about decreasing of production costs. (Mudriková et al 2009)

In this production segment are with effort used flexible manufacturing systems of various levels. Its using has wide range of advantages. Such manufacturing systems have to be equipped by proper fixture devices, what will lead to the maximal using of the machine. Such new generation clamping systems are different not by its design but also by advanced functions. (Velišek et al 2008)

Development of new manufacturing machines generation needs that such machines and systems have to be equipped by proper clamping systems. Such clamping systems and devices are usually developed and designed in the same time as production machines. This is done because bad clamping device can decrease using properties of whole machine. Clamping device effectiveness is affecting to the effectiveness of whole production machine or manufacturing system.

Main areas of intelligent fixtures application are following:

- clamping during cutting system
- clamping during assembly operations
- clamping during measuring and control operations
- clamping during functional exams

Intelligent clamping systems are able to offer many advanced (intelligent) functions such as:

- forces and torque measuring
- clamping cycle monitoring
- single functional parts monitoring
- other job oriented functions

In case of single functional parts monitoring of clamping device, the system has information about function of single system elements. Automated production and assembly are areas in which can be used clamping systems of new generation. Area of automated assembly is one of most complex operation in the manufacturing process and every possibility how to

increase the effectiveness is a great addition. Very important area of flexibility increasing is an using of intelligent clamping systems and also to this area belongs automated tool changing system and system of end effectors identification.

### 3. SENSORIC EQUIPMENT OF CLAMPING FIXTURE

With sensor equipment of double clam fixture we are able to reach, that if will cooperate with control system of flexible manufacturing cell. On figure number 1 are showed various kinds of double clam fixtures MHF2. The advantage of this double clam fixture is that it satisfies requirements such as simply design, safety, reliability, big clamping scale, simply maintenance and operation, high lifetime and minimal dimensions.



Fig. 1. Several dimensions of clamping device MHF2

The clams will be pneumatic driven with helps of double-acting linear actuators. Movement synchronization will be ensured with the helps of geared transmission. The position of clams can be scan with helps of one or two magnetic sensors, which can be fixed in slots on the actuators body.

In first place it will be necessary to equip the fixture with sensors, which will scan presence of clamping clams because they will be modular. Next, sensor which will scan the presence of object is necessary. To this sensor will be connected sensors which will scan the position of clams and also sensor which will scan the largeness of clamping force. The pneumatic fixture has small dimensions, that why we have to look at the dimensions and sizes of sensors. Next we have to respect simply design, precision, stability, scan speed, market ability, simple and safe assembly, compactness and of course finance availability. (Charbulová & Mudriková 2009)

Mechanical micro-switches are able to recognize two positions, opened and closed state. If is contact of the switch in position closed there is no signal at his output. (logical "0") This signalize, that on the movable parts of the fixture are claps not located. If we will fix the clams on movable part of the fixture, contact of the switch will be closed and on the signal will be found on the output of the micro-switch. This signal will be logical "1" and will be sending to the control unit.

The simplest solution for clams position scan is using of two magnetic position sensors dedicated for pneumatic actuators. These kinds of sensors are located in slot on the side of the fixture body. Sensors are affixed with screws.

The part can not unfix during the work (production). That why we have to provide equally high clamping toughness of the object. Equally high clamping toughness can be provided with accordingly high clamping force. The clamping force is created pneumatically and that why we can measure it with helps of pressure scanning inside of the fixture pneumatic cylinder. Modern pressure sensors also allow regulation of the pressure and so change of the clamping force.

Model fixture equipped with sensors is shown at the Fig. 2. (Hrušková & Matúšová 2006)

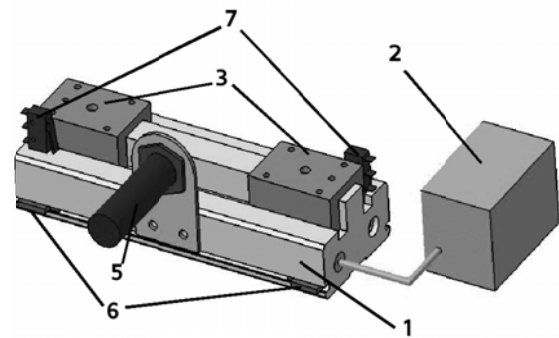


Fig. 2. CAD model of clamping fixture equipped by sensors: 1 - body of clamping fixture, 2 - pressure regulator, 3 - clamping jig holders, 4 - sensor holder, 5 - optical sensor for workpiece detection, 6 - magnetic sensors for clamping jig position detection, 7 - micro switches for clamping jig detection

### 4. COCLUSION

Using of proper fixture device type will lead to the quality increasing, manufacturing time decreasing and whole manufacturing process effectiveness increasing. In many cases is using of proper clamping device necessary because of realization of some technological operation.

Specific design of clamping device depends on asking manufacturing series. In case of low number series can be used universal fixture devices, or also simple modular fixtures can be used. In case of production in large series or in case of mass production are often used special one purpose fixtures, which are designed and optimized for one concrete work piece type.

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