ANALYSIS OF THE POSITIONING ACCURACY OF THE DETACHABLE AND MOVABLE PLATES AS PART-CARRIER ON THE MODULAR FIXTURE SYSTEMS

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ABSTRACT: *The paperwork presents the analysis of the positioning accuracy of the detachable & movable plates on the modular fixture systems, used as part-carrier at the prismatic parts machining, build and realized by the author into the PhD dissertation thesis at the University of Oradea, into the flexible manufacturing laboratory.*

KEYWORDS: positioning accuracy of the detachable plates on modular fixture system.

1. INTRODUCTION

Modular fixture system have an important role in the production process on a flexible manufacturing lines, because these are composed by modular elements, that allow a large technologic possibilities for the working parts by the secure grip and also allow for automatic handling of these in order to can work the part surfaces with the same modular system.

There it is know the modular fixture system for prismatic parts with detachable plates for working parts [10], [11], [12], [13], [14], [15]**.**

***Fig. 1 Modular fixture device fixed on the pallet, on which are positioned the detachable plates*[10]**

About these, the author comes with an improved system in terms of positioning accuracy of the plates on "Tombstone" fixture device, where the plates are movable together the working parts as "part-carrier" into the flexible system.

The new system for the modular fixture proposed by the author have a very good repeatability of the detachable plates on "Tombstone" prismatic support, using as principle of positioning a framing by four conical pins.

Figure 1 represents the automatic modular fixture, with detachable plates, these are fixed in device by four conical pins (as pull studs) at which one. [10]

The handling of detachable plates is realized pneumatic by the gripper, who is fixed on the robot arm.

The repeatability precision, in case the detachable plate is positioned on the device location by four conical pins is 0,005mm. (figure 2). [10]

***Fig. 2 Detachable plate of the modular fixture system, having 4 conical pins for the positioning* [10]**

2. MEASURING METHODS FOR DETACHABLE PLATE ACCURACY AT MODULAR FIXTURE

Behind the achievements and tests carried, there are realized the measurements of the positioning errors with conventional and nonconventional methods to confirm the improved quality of this system.

Repeatability precision of the detachable plate is high enough so that we can count on a calculation method for determining the work piece offset (summing matrix for offset components of the modular fixture) and we giving the final calibration of the machine with help of Renishaw touching taster for directly offset acquisition.

The doctoral thesis realized a new concept of the modular fixture device, who has measured by the classical method, dial comparator (figure 3) with measurement accuracy of 0.001 mm and unconventional method with laser “Traker Ion” type, who has precision of 0009 mm (figure 4). The deviations are measured and calculated on the direction perpendicular on plate surface.

The laser Traker Ion is a portable computer measuring machine, who have a SMR (Sphere Mounted Reflector) [5].

At the centering by four conical pins and the device surface "2" (Z-axis of the machine), the case is presented in the table 1.

The unconventional method to measure the modular fixture is provided with laser Traker Ion. [5]

Another methods for measuring the modular fixture, or palets with workpiece is directly on Computer Measuring Machine.

Sphere Mounted Reflector are 2 types: 1.5 inches and 0.5 inches.

The first with 1.5-inch is equipped with mirrors and can be used to measure a distance of 40 m with an accuracy of 0.0076 mm centering. [5]

The figures 3 present the classic method of measurements of detachable pallet with workpiece by dial comparator.

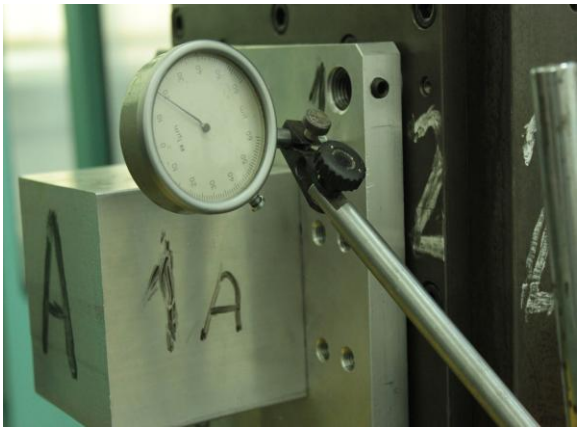

Fig. 3 Measuring deviations on machine Z axes for the detachable pallet „A” in device „2” in repetability case

The second SMR with 0.5-inch is provided with a reflector gold and can measure up to a distance of 30 m with ± 0.0127 m tolerance.

The figure 4 presents the unconventional method measurements of detachable plate with work piece using the laser “Traker Ion”.

Table 1. Deviations measured on the axis Z, for detachable plate "A", on the device "2", at the repeatability fixation

Position no.	Mesured value [mm]				Parallelism deviation
	Conical pins 1	**Conical pins 2**	**Conical pins 3**	**Conical pins 4**	
1	0	0.005	-0.005	-0.005	0.010
2	-0.010	0.005	-0.005	0.010	0.020
3	0.020	0.030	0.005	0.020	0.025
4	-0.005	0.020	0.010	0.020	0.025
5	0.020	0.030	0.010	0.020	0.020
6	0.015	0.015	-0.005	-0.010	0.025
7	0.010	0.015	0.020	0.030	0.02
8	0.005	0.020	0.015	0.010	0.015
9	-0.020	-0.005	-0.015	-0.010	0.015
10	0.015	0.020	0.025	0.030	0.015
	0.040	**0.035**	**0.035**	**0.040**	Positioning deviations

***Fig. 4 Measuring of the modular fixture with Laser Trucker* [5]**

The measurements were realized with „Tarcker Ion" Laser model 2010 from Faro company, using the Metrologic Group XG measurement software, version 13.01. In this case the 3D model of the modular fixture device was introduced in the final stage of modular virtual assembly.

Figure 5 presents the measuring deviations for the detachable plate „A" on the device „2", in the repetability case.

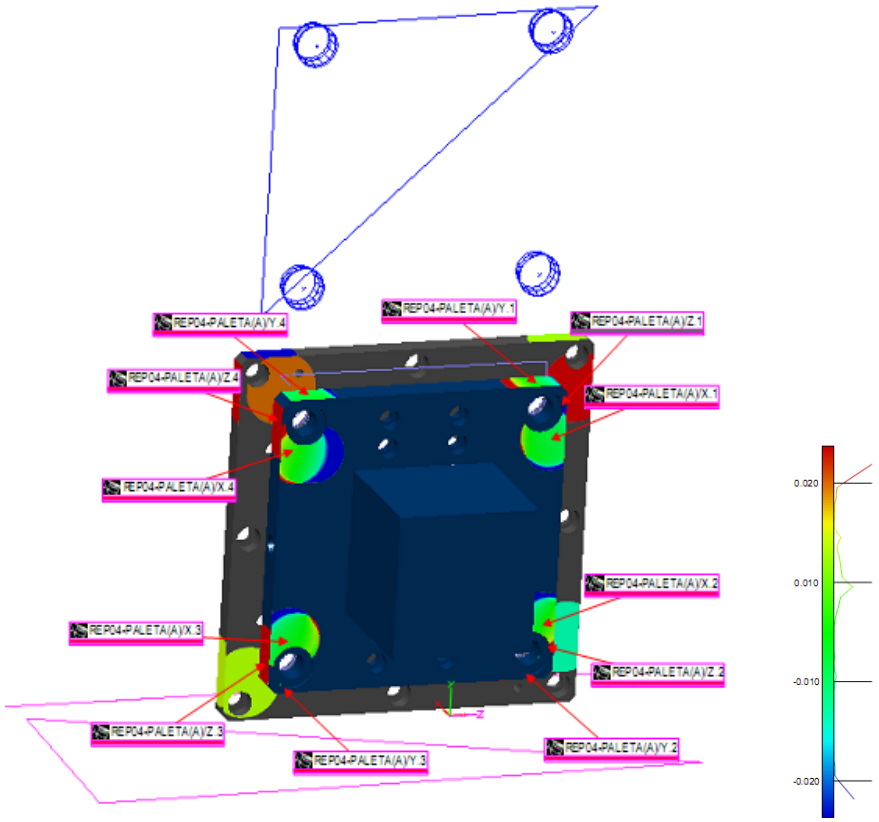

Fig. 5 Measuring deviations on machine Z axis for the detachable plate „A", on the device „2", in the repetability case by laser Traker Ion

Tab. 2 Deviations measured by laser Traker Ion on the axis Z, for detachable plate "A", in the device "2", at the repeatability fixation

REFER.	NOMINAL	ACTUAL	TOL-	TOL+	DEV.	OUT OF TOL.
Puncte de repetabilitate pentru paleta mobila A in placa suport (cuib) B						
REP04-PALETA(A)/X.1 Surf. Pnt X	-353.700	-353.724	-0.020	0.020	-0.024	-0.004
REP04-PALETA(A)/Y.1 Surf. Pnt Y	352.000	351.980	-0.020	0.020	-0.020	-0.000
REP04-PALETA(A)/Z.1 Surf. Pnt Z	-54.300	-54.281	-0.020	0.020	0.019	
REP04-PALETA(A)/X.2 Surf. Pnt X	-353.700	-353.727	-0.020	0.020	-0.027	-0.007
REP04-PALETA(A)/Y.2 Surf. Pnt Y	147.000	147.021	-0.020	0.020	0.021	0.001
REP04-PALETA(A)/Z.2 Surf. Pnt Z	-54.300	-54.277	-0.020	0.020	0.023	0.003
REP04-PALETA(A)/X.3 Surf. Pnt X	-353.700	-353.729	-0.020	0.020	-0.029	-0.009
REP04-PALETA(A)/Y.3 Surf. Pnt Y	147.000	147.022	-0.020	0.020	0.022	0.002
REP04-PALETA(A)/Z.3 Surf. Pnt Z	-259.300	-259.321	-0.020	0.020	-0.021	-0.001
REP04-PALETA(A)/X.4 Surf. Pnt X	-353.700	-353.726	-0.020	0.020	-0.026	-0.006
REP04-PALETA(A)/Y.4 Surf. Pnt Y	352.000	351.976	-0.020	0.020	-0.024	-0.004
REP04-PALETA(A)/Z.4 Surf. Pnt Z	-259.300	-259.324	-0.020	0.020	-0.024	-0.004

In the table 2 are present the measured deviations for repeatability (Rep.4) between detachable plate "A" and the device surface "2".

Table 2 presents the deviations of the detachable plate, wich are min 0.020 mm and max. 0029 mm, and the remark that the deviations are outside of the tolerance with min. -0009 mm and max. 0002 mm.

3. CONCLUSIONS

The authors of the present paper works have realized the measurements of the positioning errors with conventional and nonconventional methods, in order to confirm the improved quality of the new system for modular fixture system, adapted at FMS level for prismatic part machining.

Due to the obtained acceptable accuracy of the repeatability of the detachable part (as part-carrier into the FMS) on the prismatic central fixture surfaces, it can be eliminated the stage of touching probe based on Renishaw taster for direct capture of the part off-set with important active time reducing.

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