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Vibroacoustical diagnosis of planetary precessional kinematical transmission

Iu Malcoci[1] and I Bodnariuc[2]

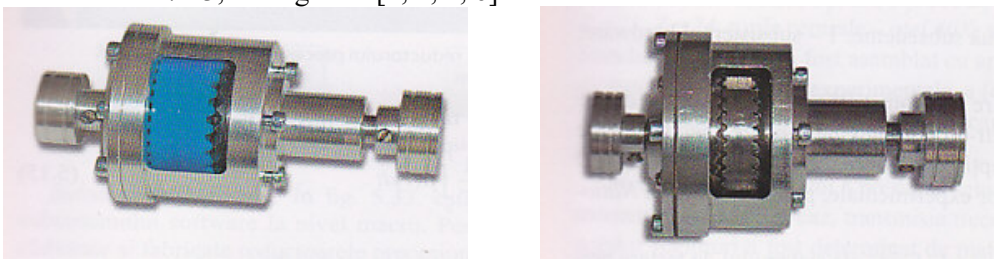
[1]Fundamentals of Machines Design Department, Technical University Moldova, Chișinău, Rep. Moldova

E-mail: naimicmic@yahoo.com

Abstract. An ideal dynamical system should not generate any vibrations, because vibrations mean a loss of energy. Vibration in planetary precessional gear box occurs at bearings, gear wheels, misaligned shafts, imbalance rotating parts, couplings. If damage occurs, not only the dynamic processes change, but also the forces that act on system components. Regarding this aspects, sound level was measured by using Brüel & Kjær Sound Level Meter Type 2250 Light that has everything needed to perform high-precision, Class 1 measurement tasks in environmental, occupational and industrial application areas. Obtained and measured results were presented in diagrams and tables to be compared with German standard VDI-2058 *Limit value for vibration severity and noise level*.

1. Introduction

The paper regarding vibroacoustical research on planetary precessional kinematical gear box with transmission ratio u= - 72.3, see figure 1 [1, 2, 4, 6].



(a) (b)

Figure 1. Planetary precessional kinematical gear box: (a) Satellite wheel made of plastic material type Hostaform C2091 (b) Satellite wheel made of powders material type Жгр7.

Acoustical analysis on planetary precessional kinematical transmission was made regarding analysis over a frequency range, here, a special analysis (FFT – Fast Fourier Transformation). In practice the simple amplitude measurement of the vibration speed signal is often used for evaluation of the balance condition. The vibration speed signal is a direct measure of the out-of-balance condition, since the balance quality is specified as the speed of the center of gravity of the rotor. An increase in amplitude over time may indicate increasing damage.

2. Constructive and technological solution to reduce vibration and noise in kinematical PPT

In practice we can use various methods to minimize vibration and noise levels in dynamic systems. Mechanical transmissions used in various machines and installations are sources of high frequency vibration and noise. The most effective, but also the most expensive way to get quieter transmission, is the method of execution of machine parts with very high precision or method of static and dynamic balancing of moving parts. For kinematical PPT we recommend correct choice of materials for gearwheels in terms of shock and vibration damping. One of the main advantages of PPT is the multiplicity meshing (up to 100% pairs of gearing teeth). For kinematical PPT satellite block can be made of plastic materials with damping properties (absorption) of gear shock. For this purpose has been developed kinematic precessional reducer (figure 2), with satellite block made of plastic materials type Hostaform C9021, and satellite wheel made of powders material type Жгр7 [3, 4] , see figure 2.

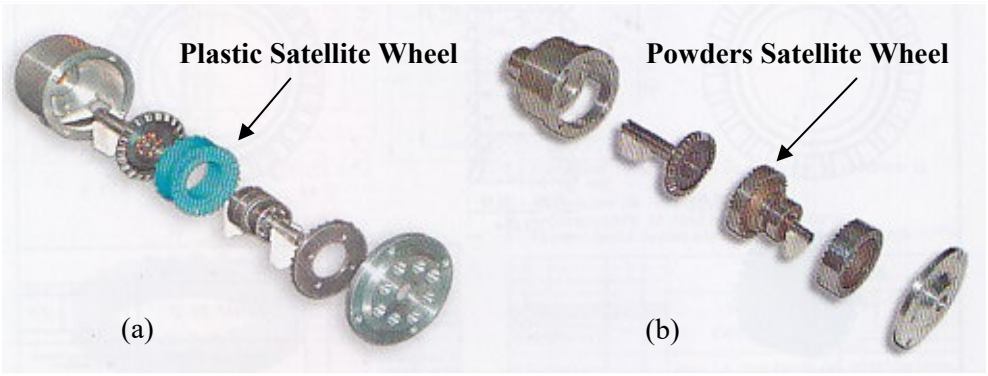


Figure 2. Planetary precesional kinematical gear box: (a) Satellite wheel made of plastic material type Hostaform C2091 (b) Satellite wheel made of powders material type Жгр7.

3. Standards for assessing the sound pressure level.

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Experimental result was compared with limits for vibration amplitude (v_{eff} in mm/s) in general engineering in line with VDI directive 2056 [5, 7]. Regarding this directive table 1, mechanical systems were divided into four main groups K (small machines), M (medium machines), G (large machines) and T (turbo machines).

Table 1. Limit values for assessment of mechanical vibration in line with VDI 2056 [5,7]

Sound pressure [dB]	Vibration amplitude v_{eff} [mm/s]	**Group *K* Small machines (< 15 kW)**	Group *M* Medium machines (15kW–75kW)	Group *G* Large machines (> 75 kW)	Group *T* Turbo machines (> 75 kW)
133	45,0	**Unacceptable**	Unacceptable	Unacceptable	Unacceptable
125	18,0				Acceptable
121	11,2			Acceptable	
117	7,1		Acceptable		Usable
113	4,5	**Acceptable**		Usable	
109	2,8		Usable		Good
105	1,8	**Usable**		Good	
101	1,12		Good		
97	0,71	**Good**			