

ANALYSIS OF STRUCTURAL NOISE OF DIESEL ENGINES BY APPLYING EXPERIMENTAL MODAL ANALYSIS AND SOUND INTENSITY

UDK: 621.436:534.831

The engine represent a multi-exciting source of vibration and noise originated by the assemblies and accessories, by whose operation mechanical and pressure energy is transformed into energy of wave motion. The energy of wave motion through the structure generates secondary waves and excites modal shapes of larger engine parts (block, sump, head, etc.). It is difficult to divide excitation from response in the engine, although there is an interaction between them, and the attempts to separate the single components by means of analyses do not bring adequate results. Therefore, the subject of research in this work is the determination of the source of excitation, the sensitivity of parts to excitation and the nature of acoustic emission on various duties of operation, with particular reference to the operation at max R.P.M. and full load. The results based on such researches make possible to establish the regularity in the process of generation of noise of high-speed S54 Diesel engine made by "Industrija motora Rakovica", Yugoslav producer Diesel engine (IMR).

Apart from that, the obtained results enable the optimization of engine parts and component with respect to the reduction of radiated noise. Besides the theoretical analyses, the research were based on experimental examinations. For that purpose, the methods of application of sound intensity and of experimental modal analysis have been developed in Research Department of IMR. The first method has been applied during the measurement of engine noise at max r.p.m. and full load, and the second during the determination of sensitivity of single engine components (engine block, sump and head).

Key words: diesel engine, noise, modal analysis, sound intensity.

ANALIZA STRUKTURNE BUKE DIZEL MOTORA PRIMENOM EKSPERIMENTALNE MODALNE ANALIZE I ZVUČNOG INTENZITETA

Motor predstavlja višepobudni izvor vibracije i buke inicirane od sklopova i pomoćnih agregata čijim radom se mehanička i pritisna energija pretvara u energiju talasnog kretanja. Energija talasnog kretanja kroz strukturu generiše sekundarne talase i pobuđuje modalne oblike većih delova motora (blok, korito, glava i dr.). Kod motora je teško rasčlaniti pobudu od odziva, mada se u međusobnoj interakciji, pa pokušaji razdvajanja analitičkim putem pojedinih komponenata ne daju adekvatne rezultate. Zbog toga je predmet istraživanja u ovom radu utvrđivanje izvora pobude, osetljivost delova na pobudu i karakter, akustične emisije na različitim režimima rada, sa posebnim osvrtom pri maksimalnom broju obrtaja motora i punom opterećenju. Rezultati na bazi takvih istraživanja omogućavaju uspostavljanje zakonitosti u procesu generisanja buke brzohodnog dizel motora S54 proizvedenom u Industriji motora Rakovica.

Dobijeni rezultati takođe omogućavaju optimiranje delova i komponenata motora sa aspekta smanjenja emitovanja buke.

Uz teorijske analize istraživanja su se zasnivala na eksperimentalnim ispitivanjima. Za tu svrhu u Institutu Industrije motora Rakovica iz Beograda razvijene su metode primene intenziteta zvuka i eksperimentalne modalne analize. Prva metoda je primenjena kod merenja buke motora pri maksimalnom broju obrtaja i punom opterećenju, a druga pri utvrđivanju osetljivosti pojedinih komponenata motora (blok, korito i glava motora).

Ključne reči: dizel motor, buka, modalna analiza, zvučni intenzitet.