

Operational issues in U140/U240/U241 automatic transmissions

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GOAL OF THE STUDY

The U140E/U240E/U241E automatic transmissions were commonly used in Toyota and Lexus vehicles from 1998 to 2013.

Research objective: The primary objective of the current study is twofold:

1. To identify mechanical defects that may arise during the operation of the gearbox.
2. To assess the operational condition of the valve body and recommend effective repair methods. First, confirm that you have the correct template for your paper size.

METHODOLOGY OF THE INVESTIGATION

In contrast, the SLT, SL1 and SL2 solenoids function as pressure regulators and operate on a "Duty cycle" system. Duty cycle is the fraction of a time period a system or signal is active, or "on," compared to its total period, typically expressed as a percentage. Testing for these solenoids must be conducted on a specialised bench that simulates the operational conditions within the gearbox, with a frequency of 300 Hz. To that effect, two regulators were selected from a total of six solenoids acquired from two different gearboxes. Both gearboxes exhibited mechanical defects, including worn clutches that required repair.

MAIN RESULTS FROM THE STUDY

The solenoids were tested on the bench – under two conditions: with cold oil and with oil at operating temperature. The results of pressure [bar] tests are summarised in graphs in Fig. 1.

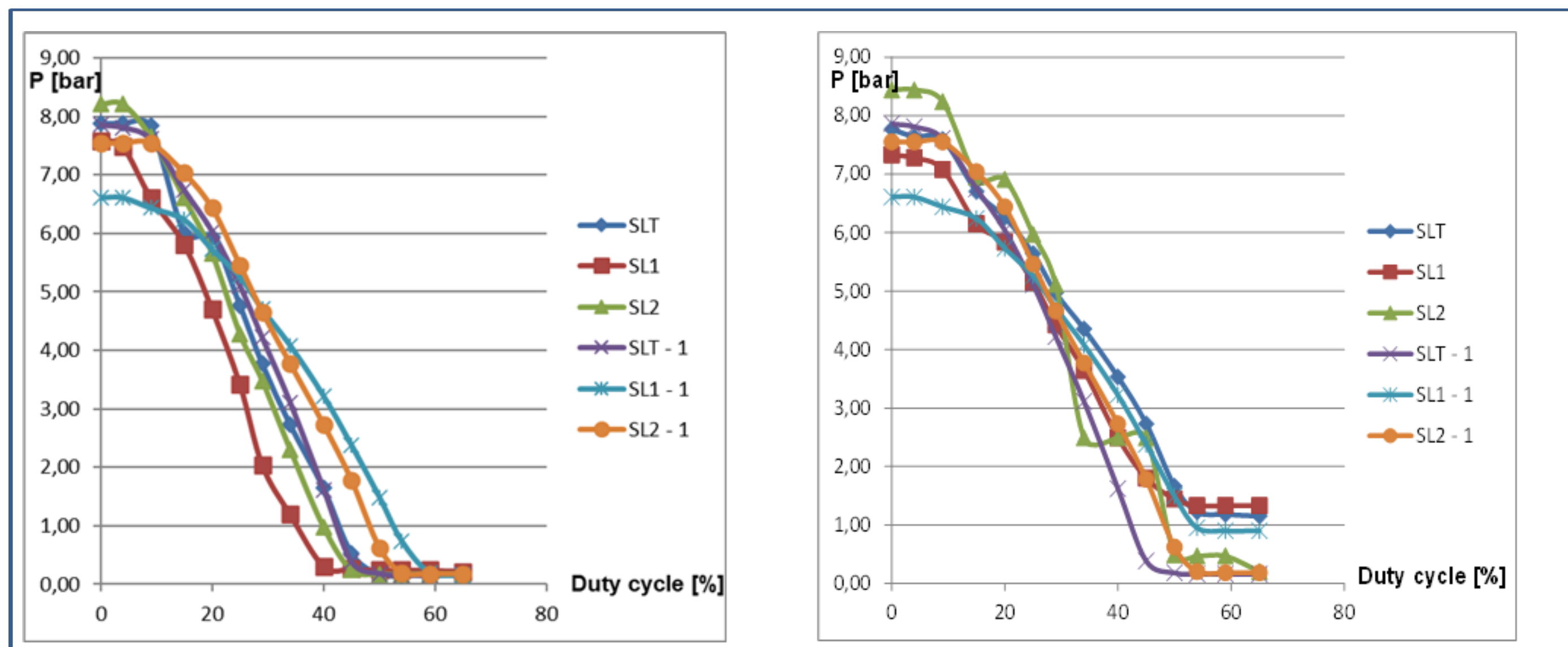


Fig. 1. Characteristics of solenoids cold and hot oil

Table 1. Characteristics of solenoids after repair

Duty cycle	Designation of solenoids					
%	SLT	SL1	SL2	SLT - 1	SL1 - 1	SL2 - 1
0	7,50	7,72	7,44	7,81	8,04	7,88
4	7,50	7,66	7,35	7,79	7,99	7,88
9	7,35	7,37	7,24	7,50	7,72	7,59
15	6,84	6,88	6,61	7,19	7,37	7,28
20	6,28	6,46	6,15	6,61	6,77	6,66
25	5,73	5,88	5,48	5,99	6,22	6,10
29	5,04	5,19	4,73	5,46	5,59	5,55
34	4,33	4,44	4,17	4,71	4,97	4,79
40	3,60	3,84	3,40	3,97	4,11	4,04
45	2,82	3,00	2,51	3,20	3,35	3,24
50	1,84	2,00	1,66	2,18	2,22	2,22
54	0,91	1,11	0,53	0,71	0,73	0,60
59	0,27	0,22	0,18	0,16	0,22	0,18
65	0,18	0,16	0,13	0,16	0,18	0,13

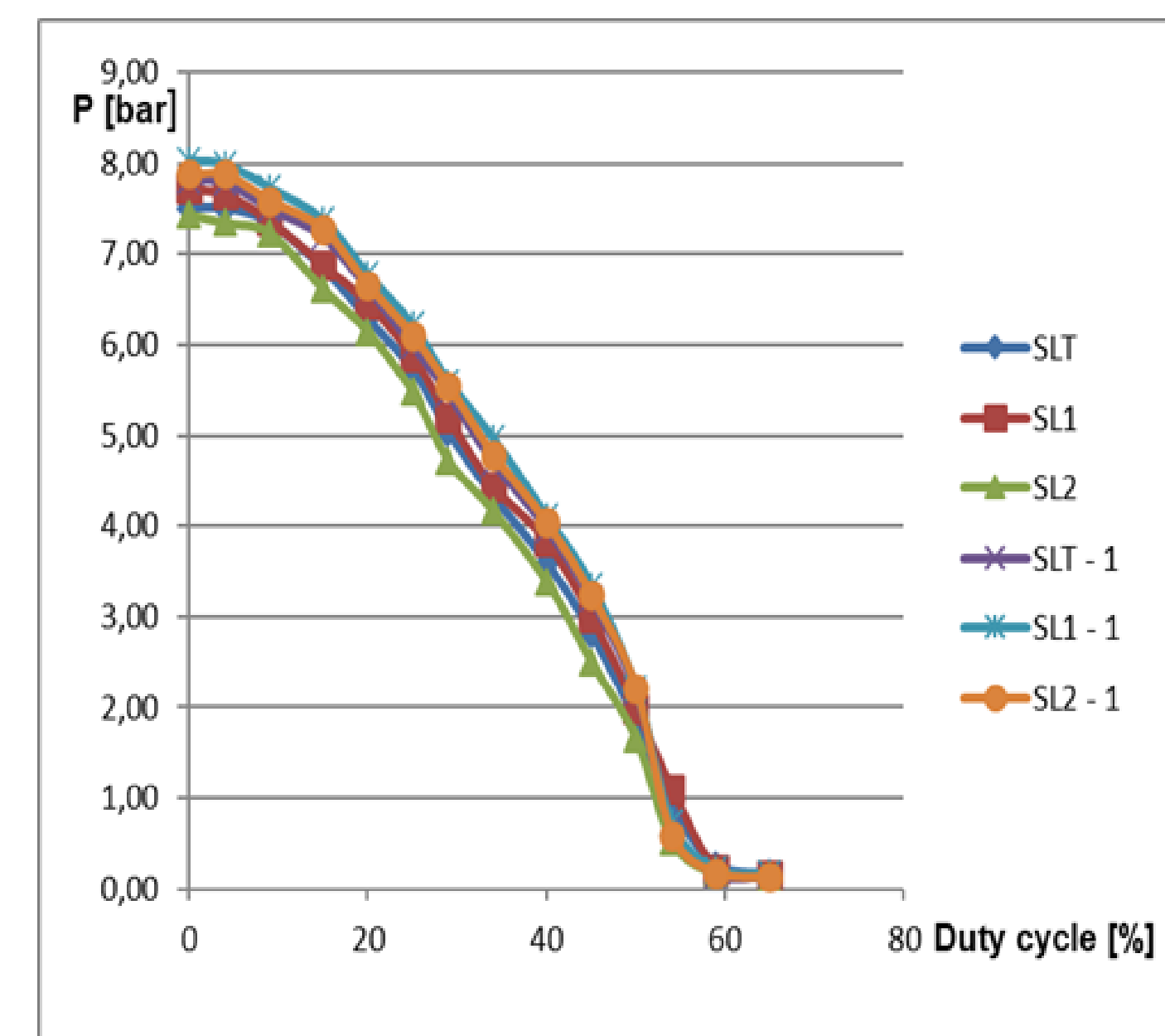


Fig. 2. Characteristics of solenoids after repair

Following the repairs, the solenoids are retested on the bench at both room and operating temperatures. The results of these tests are presented in Table 1, with a graphical representation provided in Figure 2. At room temperature (with cold oil), the solenoids exhibited characteristics that aligned closely with their expected performance curves. It is worth mentioning, though, that some solenoids displayed significant deviations from the required specifications. Practical experience indicates that the transmission performs relatively well with cold oil. However, as the oil temperature within the system increases, the performance of the transmission tends to deteriorate. This decline is manifested through harder gear shifts, delayed shifting responses, and an increase in engine crankshaft rotation frequency during gear changes.

CONCLUSIONS

The failure of these gearboxes may be attributed to several factors, including the selection of an unsuitable filter, the use of oil that does not meet the specifications for this transmission, or an incorrectly set oil level – either insufficiently low or excessively high.

When replacing the valve body, it is crucial to install a valve body that is specifically compatible with the specifications of this particular transmission model.

The valve body should be thoroughly cleaned and inspected for wear using a vacuum test. Any worn components should be repaired to ensure optimal performance.

Should there be delays or challenges in shifting into reverse and the second or third gears, it is advisable to consider repairing the transmission control module if feasible, or replacing it with a new unit. This proactive measure can prevent potential mechanical failures within the transmission.

Pressure regulator solenoids must be bench-tested to verify their proper functionality. Any malfunctioning solenoid ought to be mended if possible or replaced with new ones to ensure system reliability.

Adhering to proper maintenance protocols and executing appropriate repairs on these transmissions will ensure a long-lasting and trouble-free service for the vehicle owner.