

A Review on Durability Testing of Head Rest Sleeve

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Abstract : This paper represents durability testing technique. Durability testing is a performance testing technique used to determine the characteristics of a system under various load conditions over time. This testing helps to identify the stability of transaction response time over the duration of the test. It is generally considered a subset of reliability testing. In many large scale or small scale industries, checking of components is carried out manually. Manual testing leads to have human error, increase down time, less accuracy. Hence to overcome that prone needs automation. In this paper we are comparing durability testing methodology will use this to develop a new method to find life cycle of head rest sleeve and try to automate it.

Keywords: durability, durability testing, headrest, cyclic loading, life testing

I. Introduction

A headrest is the part of the back of a seat on which you can lean your head, especially one on the front seat of a car. Headrest sleeves are conventionally used for automobile seat backs. They receive the headrest rods that telescope more or less deeply into the head rest sleeve. Known headrest sleeves comprise a region flaring at its upper end to receive a slider cooperating by means of a locking element with recesses or notches in a headrest rod. Durability Testing is a Performance testing technique used to determine the characteristics of a system under various load conditions over time. This testing helps us to identify the stability of transaction response times over the duration of the test. It is imperative to test the structure and strength of an automotive product, from its components all the way through to the finished product, to ensure a sturdy, steadfast existence. There are wide range of mechanical, electrical and electro-mechanical Automotive Durability Testing which includes cyclic corrosion and cyclic fatigue, electro-dynamics vibration, solar irradiation, standard corrosion. Automotive vehicle such as planes, cars and trains have a number of rubber components. These components are important because they are normally used to absorb energy, vibration and sound due to excessive movement of the vehicle during operation. Due to prolonged exposure to forced vibration, the rubber components are prone to fatigue failures^[5]. The part which we are studying here is Head Rest Sleeve.

Let us first discuss the difference between reliability and durability. One measure of durability is represented by the duration of product ownership. Reliability, on the other hand, represents interruptions in usage during that ownership. The ownership of any product or system cannot be enjoyed if it is continually interrupted and the desired functions lost for even a brief time. This means reliability takes precedence over durability even though both are desired in most applications. To assess reliability or durability we rely on internal qualification tests, because it is not possible to calculate either reliability or durability from basic principles alone. Even if we can generate mathematical models to estimate reliability or durability, the models still need to be verified by testing. This brings us to a discussion about the differences between reliability testing and durability testing. A durability test is a subset of a reliability test. We may be able to estimate durability from a reliability test but we cannot estimate reliability from a durability test. Additionally, both these tests appear very similar from the testing mechanics' viewpoint; it is often difficult to discern any differences^[14]. The introduction of the paper should explain the nature of the problem, previous work, purpose, and the contribution of the paper. The contents of each section may be provided to understand easily about the paper.

II. Literature Review

[1] Review paper on durability testing of spring by using cam mechanism, this paper compares the methods to study durability testing of spring and develops own simple mechanism for testing durability of springs. The motor which was situated on base was used to drive the belt and pulley which in turn drives the shaft. Cam was fitted on shaft which is supported by two bearings. Test work piece was fitted by clamping device. Motor was allowed to run for 6000 cycles. For calculating no. of Cycles counter is used. The research done by this paper was used to develop new mechanism which eliminated the costlier machines and can be used by small scale industries.

[2] Durability testing of idlers for belt conveyers, this paper developed the method to find the durability of idler for belt conveyer. This research concluded that theoretical value of durability never meets the actual conditions which are different from experimental conditions. For that they developed the new method which tested the specimen under actual conditions. There were two idlers of diameter 133mm and 159mm respectively. There were 3 main tests which account for 112 hours. 1st test uses dust for 72 hours. 2nd test uses water for 36 hours. In the 3rd test idler was tested under load for 4 hours. Speed for these tests was 600 rpm. The last test was dynamic test for 4 hours. Idlers with the results can be used in belt conveyer for high durability and can sustain more harsh conditions. With the results of this paper the 133mm diameter idler is more efficient to use in belt conveyer. This research can be used to accurately predict the behavior of idler in real conditions.

[3] Durability of cutting tools during machining of very hard and solid materials, this paper studies the effect of coatings and thin films on durability of carbide end mills. These tools were tested while machining of DIN X210Cr12 hardened steel. There were 4 tools and diameter of each tool was same with slight difference in no. of cutting edges and angle of cutting edges. Testing was done by 2 tests. 1st test was short term test to find the optimal cutting speed while machining for 15 minutes. In this test all four cutting tools were passed by work piece from all sides for 15 minutes of durability. The result was used to find tool life in 2nd test respectively. This paper concludes that the last tool which is called as Etalon tool achieved the highest durability as tool life is most influenced by coating and related processes. To achieve the high durability appropriate preparation of cutting edge (micro-geometry) and the appropriate choice of carbide substrate gives a good coherence of thin-film and carbide substrate without any defects.

[4] Design and durability testing of composite mono leaf spring, in this paper, they first designed four leaves conventional leaf spring by using ANSYS 11 and found out stresses and deflections by applying different loads. Leaf is mounted in such a way that whose one end is fixed and other end is movable. Load on spring is centrally acted and distributed longitudinally along it. Spring thus vibrates and prevents vibration to pass over other body. Cam follower mechanism is used to vibrate spring on basis of road conditions. Above test is performed for specific frequency of vibration as per road condition and durability of steel leaf spring and composite leaf spring is calculated. By using UTM machine stiffness of steel and composite leaf spring is calculated. Again vibration is given to spring for one hour and stiffness is calculated. This test was repeated for each hour respectively. Paper concludes that composite mono leaf spring reduces weight by 68% over conventional steel leaf spring. Also composite leaf spring gives better results for durability than conventional steel leaf spring.

[5] Durability of automobile jounce bumper, in this paper Finite Element Analysis is used to find durability of jounce bumper. Most of automotive vehicles such as car, plane and train have rubber components like bumper. Bumper is used to absorb energy, vibration and sound due to excessive movement of vehicle during operation. This rubber component was prone to have fatigue failure. Hence durability testing was required to know its life span. For this displacement controlled method was used in which the displacements were predetermined and load acting was observed. The Components experienced a Mullin's (stress-softening) effect. The value of the strains and their correlation with fatigue life were determined. From this study it has observed that the experimental fatigue life did not match with predicted fatigue life because of differences of compositions of material. Hence fatigue life of an automotive bumper was validated and predicted by simulation and experimentation. By this experiment, locations of crack initiation can be found by FEA before it occurs. Also we came to know that crack initiates from calcium carbonate compound in rubber component.

[6] Approaches to testing the durability of materials used in the construction and maintenance of building, in this paper the approaches and the factors involved in durability testing of construction material are taken into consideration. The study of current approaches or standards is considered and problems with these approaches are stated. Also in this paper the future approaches are recommended to overcome the problems with current approaches and standards. The recommended approaches in this paper thus improve the material response to environment, which ultimately result in accurate prediction of life of the service. Approaches stated in this paper involve following steps:-

- i. Consider the factors which affect the durability of material.
- ii. Rapid testing to know the cause behind the degradation and the mechanism of degradation.
- iii. Evaluation of the factors and mechanism that causes degradation in the end user environment.
- iv. Preparation of models and damage functions for the material response on the rapid test results and environmental measurements.

Materials used in construction and maintenance of building can be tested by the approaches stated in the paper.

[7] Durability prediction of EN1.4512 exhaust mufflers under thermos-mechanical loading, in this paper, approach is used to predict the damage of a thermodynamically loaded exhaust muffler. An exhaust muffler is mounted on back end of an automotive exhaust system. It is also called as its cold part. An exhaust muffler mainly made of stainless steel EN 1.4512 because of cost and corrosion resistance. In this work, the

durability prediction of exhaust muffler was carried out by thermal and finite element analysis (FEA) in which temperature and stress tensor from FEA at selected nodes uses for durability prediction. Temperature field was calculated by the thermal FEA and stress tensors were obtained by structural FEA. Various properties such as tensile, fatigue and creep-rupture were studied to calculate life span of exhaust muffler. Critical locations of exhaust muffler were found out by the simulation to increase durability.

[8] Durability studies of single cylinder diesel engine running on emulsion fuel, this research studied durability of single cylinder diesel engine running on emulsion fuel. Two emulsion fuels were used such as E10 (i.e. 10% water concentration in diesel) and E20 (i.e. 20% water concentration in diesel) instead of pure diesel. Two emulsion fuels consists water, low grade diesel fuel and surfactant in ratio of 10:89:1 v/v% (E10) and 20:79:1 v/v% (E20). Where D2 is nothing but low grade diesel fuel. The emulsion mixture were produced by using electrical mixer with a propeller speed of 2500 rpm for 5 min. for stabilization purpose of emulsions, a 1% by volume of surfactant known as span 80 was used. By using two types of emulsion fuel in a constant speed diesel engine generator, the effect of their emissions, carbon deposits, lubricants and wear of diesel engine components were studied. Engine emissions were measured before and after the engine durability test to calculate significant increase in NO_x, PM (particulate matter), carbon monoxide (CO), Carbon dioxide (CO₂) and exhaust temperature. Three sets of 5 KW diesel engine generators were used for each type of emulsion fuel. The engine was made to run at a constant speed of 3000 rpm with varying engine loads. load applied on engine was controlled by voltage regulator. And then emission measurements were noted according to the specification and procedure described in SAE Engine Test Code J816b. this devise named as portable Testo 350 emission analyzer. The results obtained by using emulsion fuel were compared with Malaysian Conventional diesel fuel (D2). Therefore after running the engine for 200 Hrs, engine components got worn out by E10 and E20 than D2 fuel. Also higher wear can be found because of E20 than with E10. As a result, emulsion fuel collects the less carbon deposits on fuel injection tips, cylinder head, piston crown leads to increase durability of single cylinder diesel engine.

[9] Analytical durability modeling and evaluation complementary techniques for physical testing of automotive components, in this paper some of the computational aspects of fatigue damage analysis and life prediction i.e. durability were studied and a practical fatigue evaluation tool was presented to meet this challenge. In this paper analytical CAE tools are used to predict performance of subsystem and components instead of physical testing. The methodology was based on local strain approach for fatigue damage assessment. This paper stated analytical modeling for durability evaluation. The paper concluded with analytical modeling to predict the durability and was successful.

[10] Aluminium and Durability: reviewed by inspection and testing, in this paper structures which are more than 25 years old and made up of Aluminium are studied and tested for checking durability of Aluminium. Three projects were included for testing which were: Cambridge University Library (architect Sir Giles Gilbert Scott, 1934), an apartment building in London (Farrell & Grimshaw, 1968), 1 Finsbury Circus, London (Sir Edwin Lutyens, 1925) with new rear façades (Brookes & Stacey, 1989). The testing was done in four parts, things required before testing were done first like Gain permission to undertake the non-destructive testing of in situ aluminium component(s); Undertake a detailed photographic survey, making field notes including weather condition; Identify an independent accredited testing organization to undertake the testing; Prior to all tests finish is washed with warm soapy water to remove any build-up of dirt or chalking. Anodized aluminium was tested in second part. Testing of polyester powder coated aluminium was done in third part and finally samples were tested batch wise. This paper concludes that the introduction of other metals, like copper will reduce the durability of the aluminium alloy. Also Aluminium is more durable when washed by rain and therefore architects and engineers should detail buildings, where possible, to facilitate the washing of the surface by rain.

[11] Methodology for designing accelerated structural durability tests on agricultural machinery, in this paper new method for structural durability test on agricultural machinery was studied and developed. Accelerated structural testing (AST) aims at reducing the time and resources required for structural durability assessment stage. The method developed in this paper is given in following diagram:-

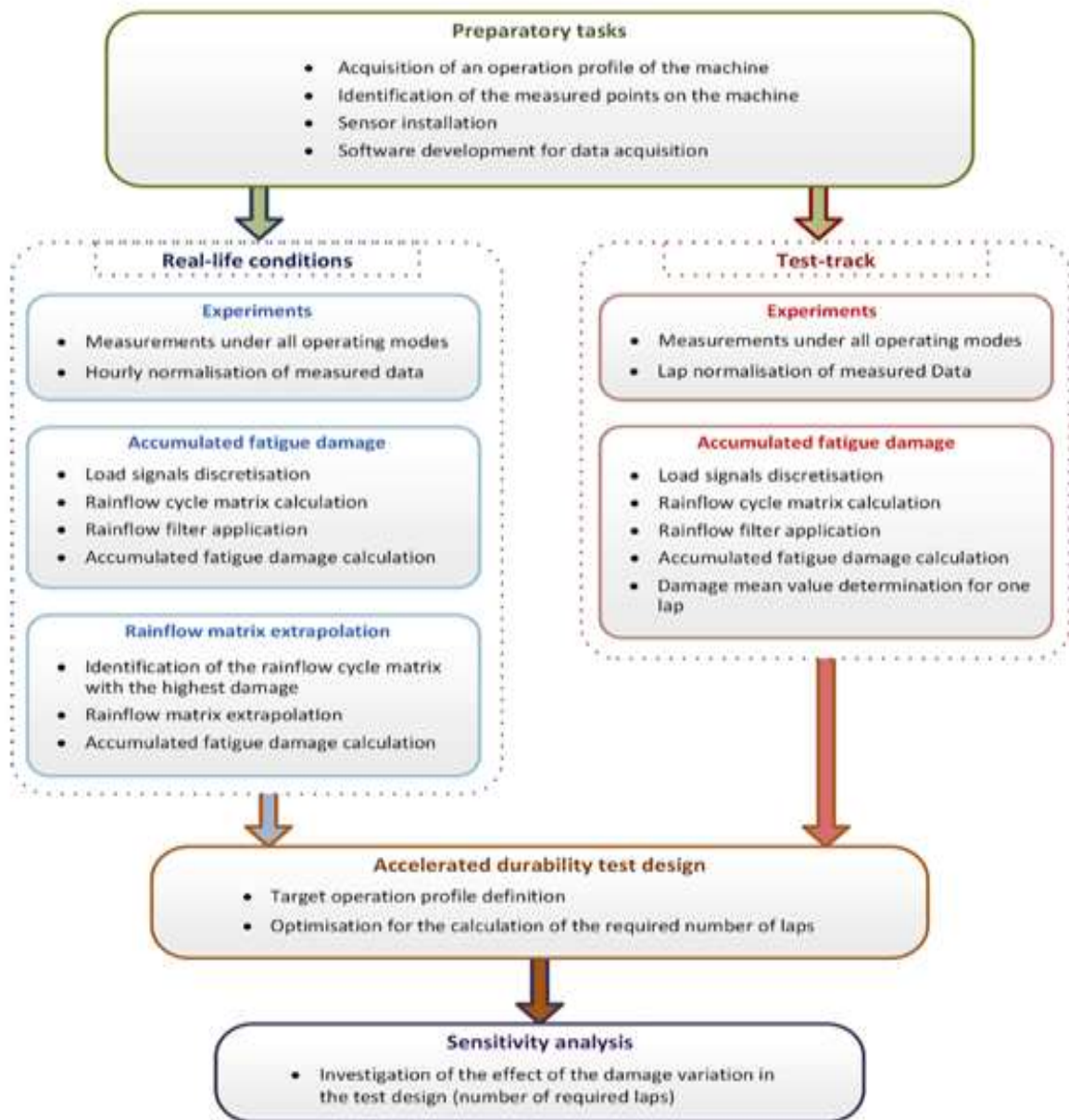


Fig 1 – Methodology for accelerated structural durability test [11]

Paper developed an improved design and methodology for accelerated structural durability test for agricultural machinery which was applied to four rotor swather.

[12] Durability improvement method for plastic spur gears, in this paper an experimental investigation of power-transmission plastic spur gears was performed by inspecting characteristics of both wear and durability, and a durability improvement method was proposed. The method proposed either drills an internal hole or inserts a steel-pin in the internal hole of the gear tooth, and this proposed method was verified. Three kinds of plastic pinions were manufactured: plastic pinion without any variation (hereinafter solid-type); and plastic pinions with holes or steel-pins on the tooth centerline (hereinafter hole-type and insert-type, respectively). On these pinions gear test was performed by gear test machine of power circulating type and results were obtained according to points such as specific wear rate, service life and different application of loads. The paper concludes that after drilling a hole or inserting a steel-pin in the tooth body of nylon pinion tooth surface temperature was decreased by a range of 3–10 1C. This led to a reduction in wear rate by over 30% and greatly increased the service life by up to 415%. Also proposed method in this paper can applied to visco- elastic materials.

[13] A device for testing the durability and exploitation reliability of dental prostheses, this paper aimed to develop construction of a stand for testing the operational stability of dental prostheses. This was their own idea. The researchers studied the previous devices for testing durability of dental prostheses and developed their own device which was very reliable. The test stand was simple and was low cost. The paper concluded with successfully making own test stand for testing durability of dental prostheses. The whole machine was a compact construction and made possible to assess the functional quality of elements of dental prostheses as to their reliability and operational stability.

III. Future scope

After comparing all these papers we can establish that there is currently no methodology for testing durability of head rest sleeve. So there is scope to design and develop new method for testing durability of head rest sleeve for calculating more accurate service life.

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