

Current Status of Test Technology

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Abstract: Quality testing centered on reliability test technology is a strong driving force for promoting social and economic development, and it is the basic development law that puts quality and reliability in the strategic direction of national and social development. To accelerate the building of a manufacturing power, we must firmly grasp the foundation of manufacturing industry, reflect the key core of quality, and make "quality power" a strategic choice and only way for the transformation and upgrading of manufacturing industry and achieve leapfrog development. Quality is the lifeline of building a manufacturing power. Made in China 2025 is the planning direction of leading the building of a manufacturing power in the next five years and the realization system in the next 25 years. The fundamental document of the dream of building a strong country, so the "quality first" is listed as one of the important basic guidelines by the Made in China 2025.

Keywords: purpose of reliability test; new reliability technology reinforcement test; reliability acceleration test

1. Introduction

Since the introduction of reliability technology in the 1960s, through 30 years of continuous efforts, a set of reliability management and technology system was initially formed in the 1990s [1, 2]. The competent units and relevant departments of the national industrial system have issued some reliability management technical standards, regulatory documents and works, and the reliability engineering technology has become more and more widely acting in different engineering fields. In particular, the reliability test technology has obtained numerous applications in a number of major industrial technology fields and the military equipment industry [3]. Through reliability test, our equipment reliability capacity is improved significantly, which provides our equipment production and industrial products manufacturing. The guarantee is strong.

2. Test Purpose

Reliability test is the general term to improve the reliability and quality. Reliability test is a means of reliability testing, verification, and evaluation of a product. Exposed defects in various aspects in the development stage provide information for monitoring the production process, and the test results provide basis for fault analysis, research to take effective corrective

measures and judge whether the product reaches the index requirements [4].

3. Reliability and New Technology Reinforcement Test

3.1. Development and Characteristics of RET

In the early 1980s, while stress screening developed rapidly, designers had noticed the amount of defects caused by design, providing considerable room for reliability, price and development time, which are the focus of the equipment production and industrial product market. Reliability reinforcement testing (RET) is a good solution to this problem. This method achieves higher reliability than traditional reliability tests, and more importantly, RET can obtain early high reliability in a short time, without having to do as the old methods of the past. Long reliability growth to reduce costs.

The first people in this field and pioneers were G.K.Hobbs, K.A.Gray and L.W.Condra. This test is divided into High Accelerated Life Test (HALT), the former corresponding design, the latter corresponding production and high Accelerated stress screening (HASS), the core essence of this reinforcement test is to apply large stress, little applied stress, little elimination of insufficiency, to obtain high reliability.

3.2. The Effect of the RET

Mr. Gregg K.Hobbs has studied the fatigue life of a metal component caused by increasing its stress strength. It was found that if the stress strength was increased, the fatigue life was reduced to $1/1000$, and failure caused by vibration during the use of components was in this category [5]. In addition to applying reinforced stress, because the stress concentration factor of the defective product is up to 1~4 times that of the stress concentration factor of the defect-free product, it thus reduces the fatigue life of the defective product by several orders of magnitude, which makes the defective element of the product under the same reinforced stress conditions. The fatigue life has different manifestations, making the defective element more damaged or even harmless than the defect-free element, which is exactly what we need.

Temperature cycle is thermal fatigue, and Mr. S. Smithson gives a similar effect in Efficiency and Economy. If two different temperature rates, one is $5\text{ }^{\circ}\text{C}/\text{min}$, and another strengthened to $40\text{ }^{\circ}\text{C}/\text{min}$, their fatigue life efficiency ratio is 4400:1 [6].

Other temperature change rates are shown in Table 1

Table 1. Test comparison table

Temperature Change Rate (°C / min)	5	10	15	20	30	40
Number of loops	400	55	17	7	2.2	1
Time per cycle (min)	66	33	22	16.5	11	8
Total Time (h)	440	30	6	1.9	0.7	0.1

According to the above data, you can see that the comprehensive effect of RET is: greatly reduce the time, improve the reliability of the product, so also reduce the cost.

4. Reliability Acceleration Test

4.1. Purpose and Characteristics of the Acceleration Test

The purpose of the accelerated test can be summarized as follows.

- To adapt to the increasingly competitive environment.
- Reduce the time to put on the market.
- Meet the user's expected needs.

4.2. Accelerated Test Characteristics

Accelerated test is the method of obtaining more information (possible information) than in the normal test conditions at the same test time. This approach is to make

the product a more brutal experimental environment than the environment experienced during use. Acceleration factors should be used individually or comprehensively during the acceleration test, mainly including the following items.

- Power cycle at a higher frequency.
- Higher vibration levels.
- High humidity.
- More er temperature cycle.
- Higher temperatures.

4.3. Accelerating Test Classification

Accelerated test is mainly divided into two categories
 Accelerated Life Test – Estimated Life expectancy
 Accelerated stress test – confirms and correct the meager test link.

Table 2. Compares these two acceleration tests with the acceleration

Test	Purpose and methods	Innotation
accelerated life test (ALT)	Determine how long life by performing reliability tests using stronger stress conditions than expected during normal application	Requirements: Understand the expected failure mechanism. Learn extensive information about accelerating the failure mechanism
accelerated stress test (AST)	Apply accelerated environmental stress to reflect the missing defects and design deficiencies, and confirm the problems in the design, manufacturing, and distribution process in use	Requirements to understand the basic failure principle of the product and estimate the life

4.4. Accelerated Test Model

The accelerated test model links the life or loss of efficiency of the product to the applied stress, and then the

Table 3. Common acceleration test models

data obtained in the acceleration test can be used to infer the performance under normal use conditions.

Table 3 are 3 more common accelerated test models

Model name	Description
Inverse Power Law	/
Arrhen Acceleration Model	For the subject parts, L is the life measure; A is th e constant determined by the experiment; e is the bottom of the natural logarithm; ε is the activation energy, it is the proprietary value of each failure mechanism; k is the Boltzmann constant, namely $8.61741 \times 10^{-5} \text{Ev/W}$; T is the temperature (opening degree)
Mainer Rule (fatigue damage)	$CD = \sum_{i=1}^k \frac{C_{s_i}}{N_i} \leq 1$ CD is the accumulated damage; C_{s_i} is the number of cycles of a given average stress s_i ; N_i is the number of failure cycles under stress s_i ; i is the number of loads applied

5. Conclusion

Through the analysis of new reliability technology, strengthening test and accelerated test, the quality progress depends on continuous technological

innovation . Reliability technology is the "multiplier" of combat effectiveness in the field of major industrial equipment, and reliability technology directly reflects the technical level of major industrial equipment field . This paper introduces intensive test and accelerated test, reflecting the characteristics of intensive test to "reduce cost and increase efficiency", and reflects the higher, faster and more accurate stress characteristics of accelerated test . It can promote the progress of various Chinese reliability test technology and the improvement of product reliability level . Implement the issuance of Made in China 2025 well Exhibition strategy, for China's new rise to the top of the world contribution!

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