# 『Study on the effectiveness of simultaneous multi-axis vibration in transport packaging test』

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# Study on the effectiveness of simultaneous multi-axis vibration in transport packaging test

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## Ⅰ INTRODUCTION

Recent years, Carrying out the vibration test in order to prevent the damage of packaged products is generally. However, even if you clear the vibration test specified by the standard, many persons in charge are suffering about damage of packaged products during transportation.

There is a gap between the actual transport and vibration testing is the cause.

One of the cause is carrying out the 1-axis vibration test, but there is the 3-axis simultaneous vibration in transportation. Case study on the multi-axis vibration there is little in the past.

In this study, we verified for Accumulated Fatigue Damage on the effectiveness of simultaneous multi-axis vibration.

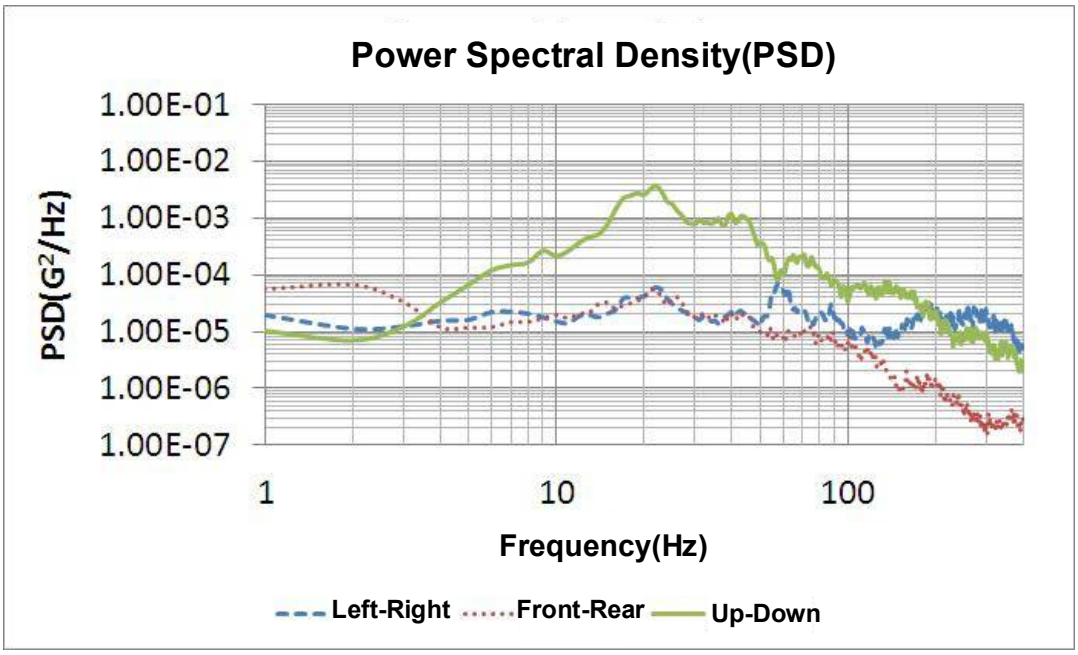
## Ⅱ EXPERIMENTS

Accumulated Fatigue model consisted in nuts and bolts. The model and vibration measurement system was fixed to the cart 【Fig.1】. During transportation, we measured cart vibration and displacement of the nut. we carried out various vibration tests based on cart vibration. We compared the displacement of each nuts.

【Fig.1 Transportation test】

## Ⅲ TRANSPORTATION TEST

Transportation test was performed 7 times for 10 minutes at a normal walking pace. Then, Vibration of a cart that runs for 600s are measured at a sampling time of 1ms,and 600,000 data points are obtained. 【Fig.2】 is power spectral density (PSD) of the measured acceleration data.




【Fig.2　The average PSD of transportation】

## Ⅳ　VIBRATION TEST

We carried out 3 types vibration tests, 3-axis simultaneous sine-wave, switching 3-axis sine-wave, and 1-axis random-wave. Each test conditions decided based on the vibration data of transportation. The test of 1-axis random-wave was run same PSD condition as transportation. In contrast, in two tests of sine-wave applied the method that zero-crossing peak count.[1)] We were calculated Accumulated Fatigue Damage by acceleration data of transportation, and the test condition was set to be equal to Accumulated Fatigue Damage of transportation.【Fig.3】is the test equipment 3-axis simultaneous sine-wave vibration tester [Transportation Tester:BF-50UT].

【Fig.3 Transportation Tester:BF-50UT】

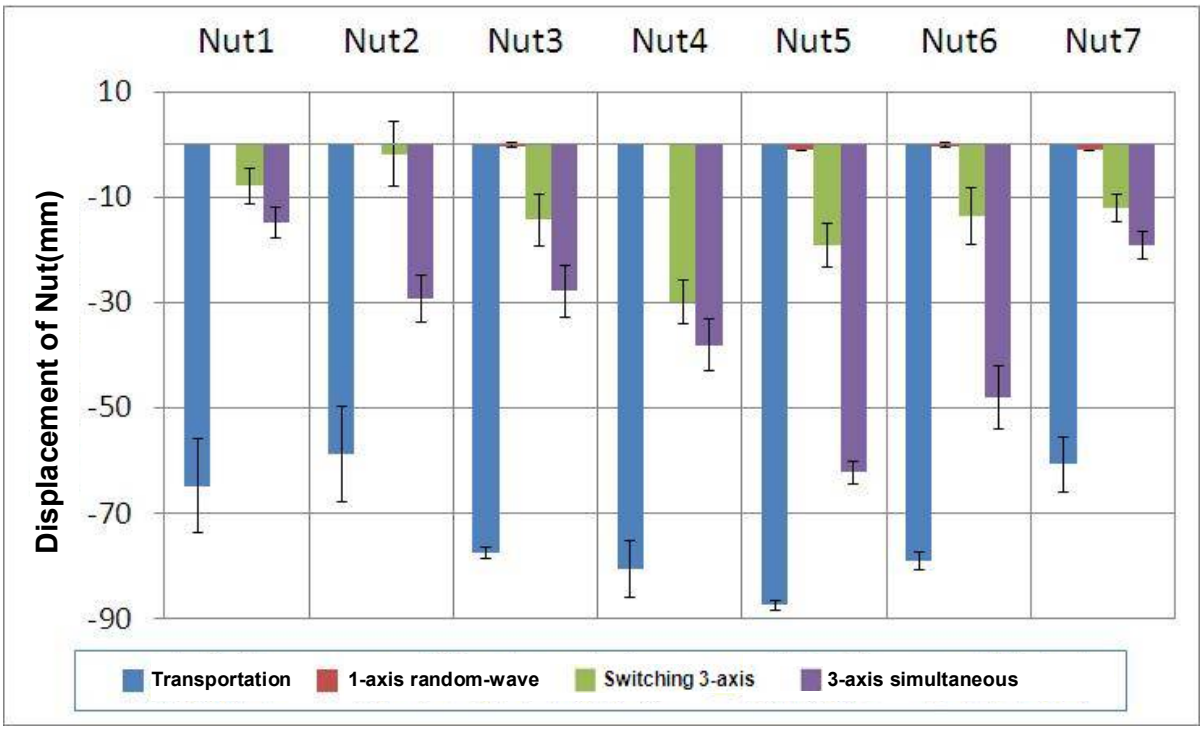
Transportation Tester BF-50UT has unique vibration generator. In frequency sweep test, displacement is almost same. Left-Right: Front-Rear: up-down percentage of vibration is fixed at 10:8:2.[2)]

This test was run same condition the Accumulated Fatigue Damage of vertical vibrations in transportation.

## Ⅴ　RESULTS AND DISCUSSION

【Fig.4】 is the displacement of the nut in transportation and various vibration tests. Accumulated Fatigue model consisted in 7 nuts and 7 bolts. And each was Nut1～Nut7. Each vibration test set conditions based on the actual data transport, It was hard to say that vibration tests is equivalent to transportation, by the comparison of displacement of the nut. However, the displacement of nut

in 3-axis simultaneous vibration test better than the others. So, it Can be determined that given the accumulated fatigue on the transportation more close.




【Fig.4　The displacement of Nut of various tests】

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