

Problem of Undamped Accelerometer in Headform Impact Test

INF GR / PS /96

Page 1

Generation of Abnormal Acceleration in Headform Impact Tests

- Causes and Solutions -

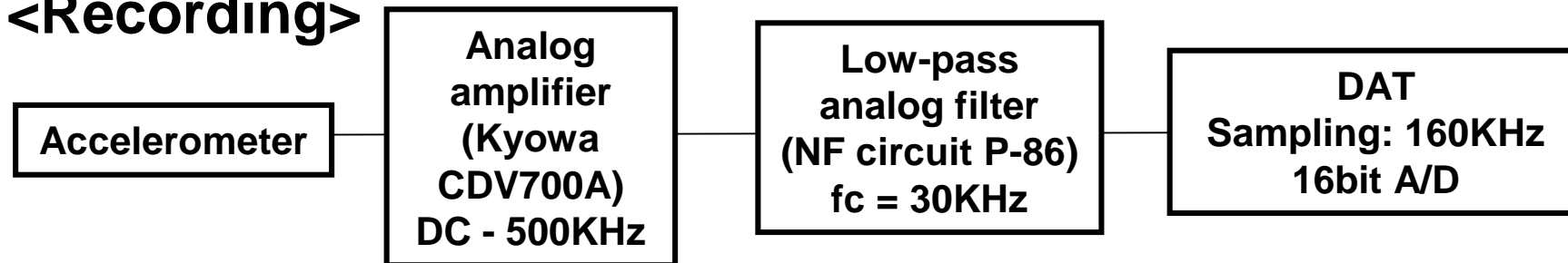
Japan Automobile Research Institute (JARI)

Background

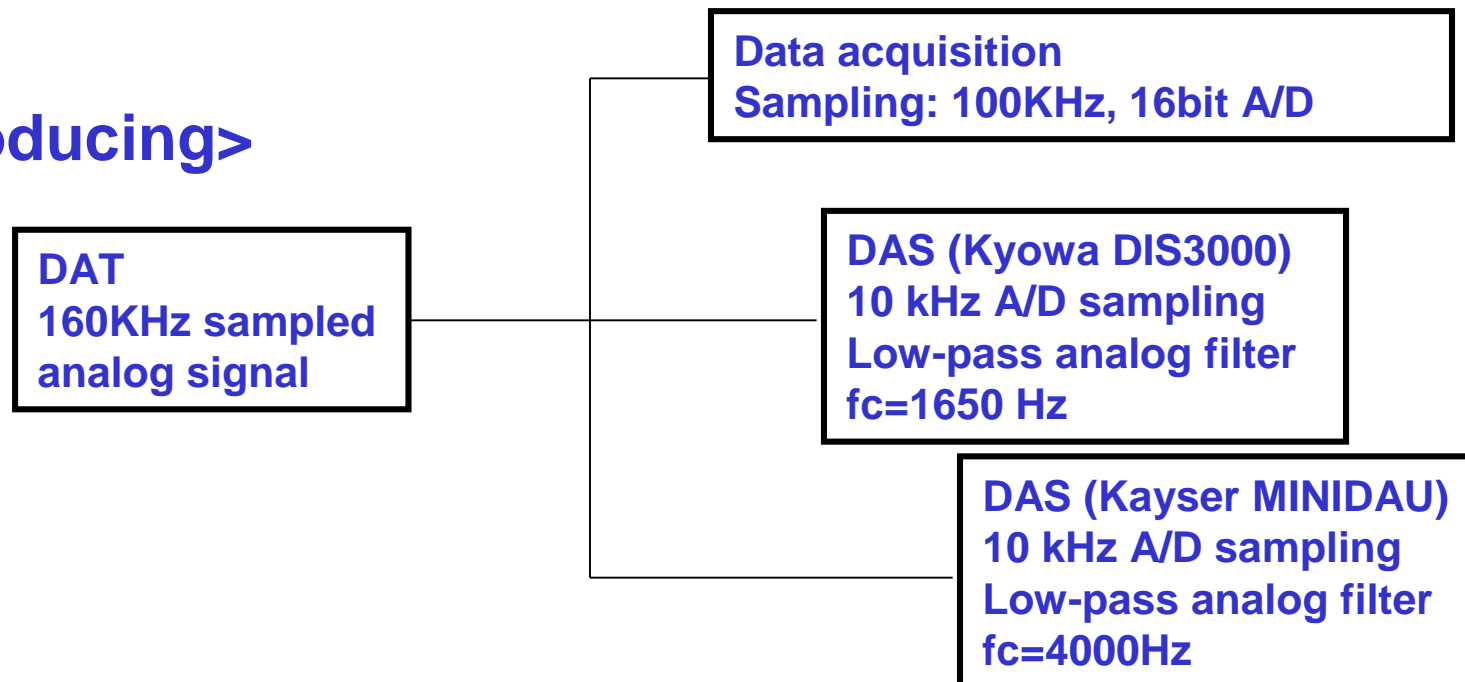
- **In a research program of 2002 J-NCAP headform test with undamped accelerometers, abnormal acceleration signals with high HIC values were recorded frequently in windshield impact and also seen in bonnet impact.**
- **It was estimated that this was due to the resonance vibration of undamped accelerometer, which would occur if the impact waveform contained the spectrum being near by resonance frequency of accelerometer.**
- **Accordingly, we replaced the undamped accelerometer (Endevco 7264B) that had been used so far with an damped accelerometer (Kyowa AS-500HA) and carried out the 2003 J-NCAP pedestrian assessment.**
- **Upon the completion of the J-NCAP pedestrian assessment, JARI studied the cause of the generation of abnormal acceleration and possible solution.**

Data Acquisition System to See the Problem

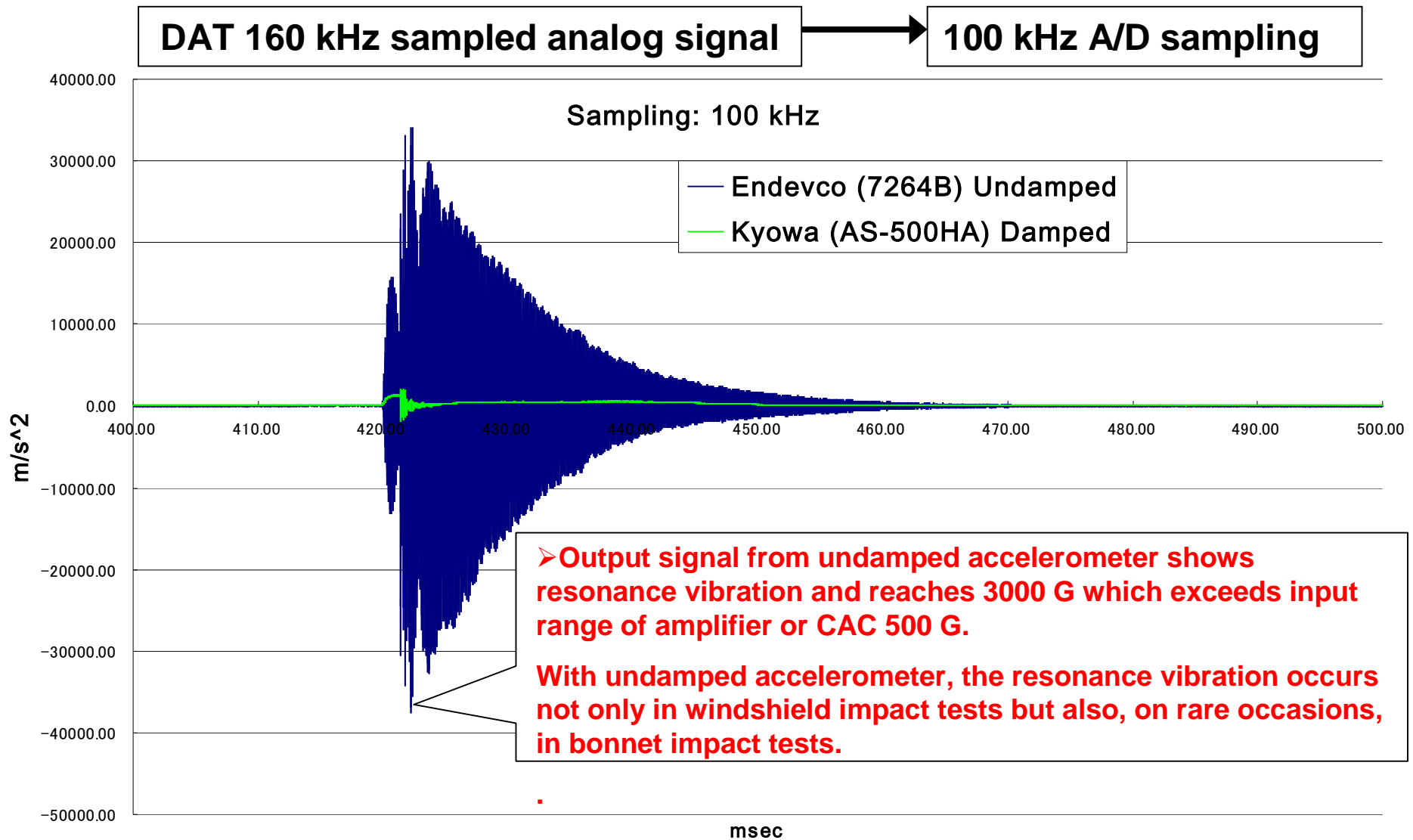
<Recording>



<Reproducing>



Accelerometer Output Signal in High Speed Sampling

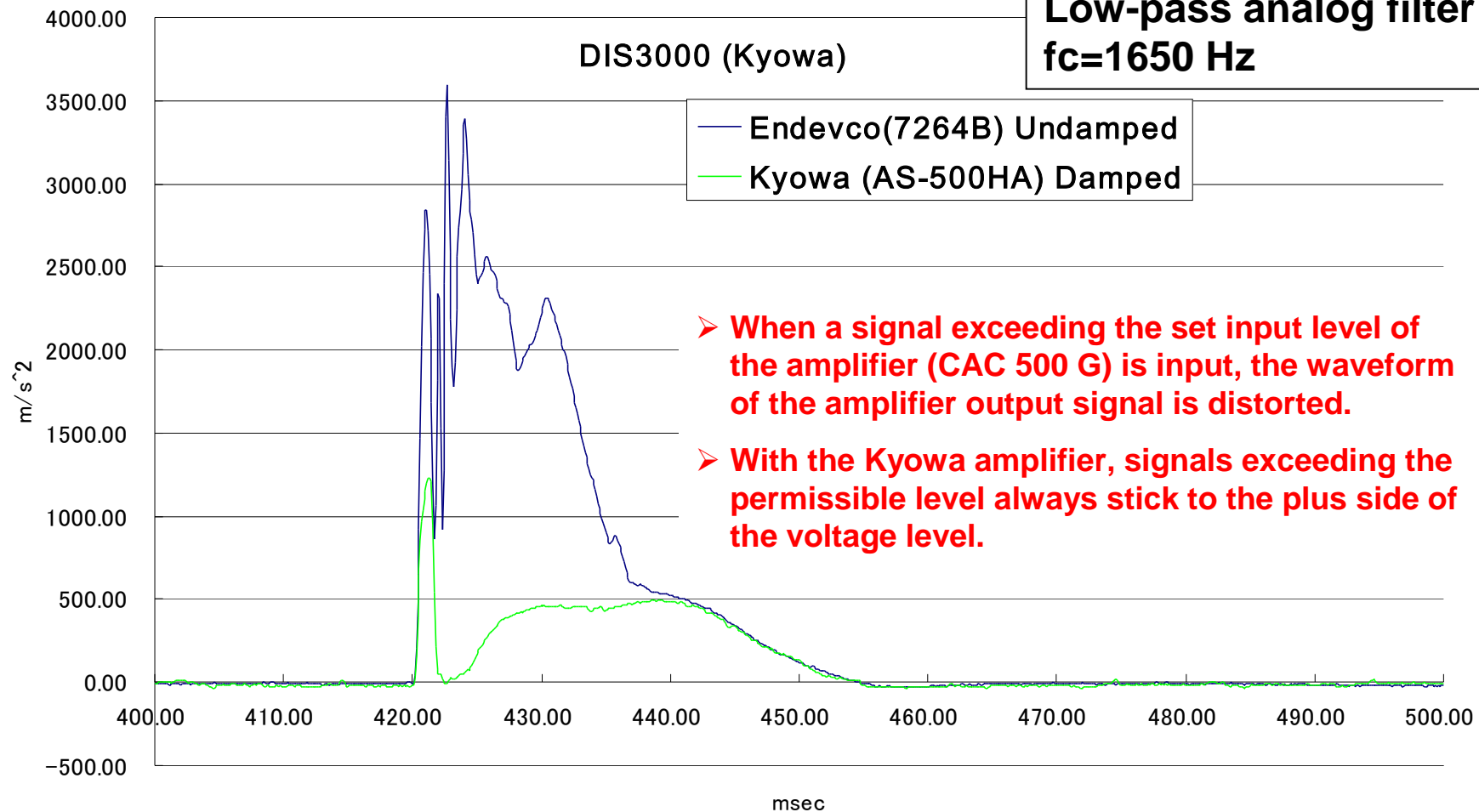


Recorded Data in DAS (Kyowa)

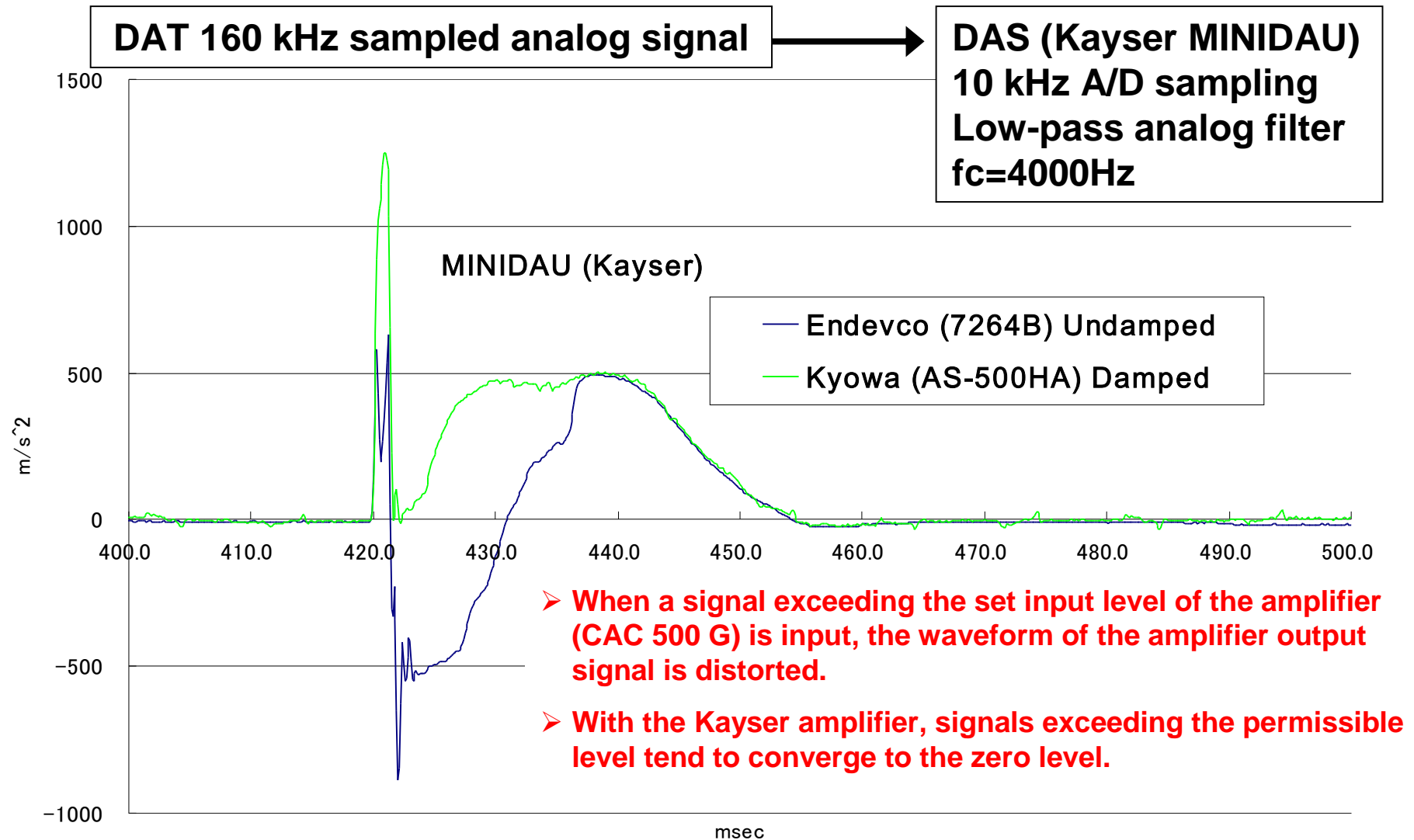
DAT 160 kHz sampled analog signal



DAS (Kyowa DIS3000)
10 kHz A/D sampling
Low-pass analog filter
 $f_c=1650$ Hz



Recorded Data in DAS (Kayser)



Conclusions

-
- **In headform tests, damped accelerometers should be used.**
 - **Undamped accelerometers sometimes generate an apparent excessive acceleration caused by self-excited oscillation (resonance) and the peak value of the unfiltered original waveform exceeds 3000 G.**
 - **When a signal exceeding the set input level of the amplifier (CAC 500 G) is input, the waveform of the amplifier output signal is distorted, forming an abnormal acceleration.**
 - **The phenomenon of the waveform distortion of the amplifier output signal varies with the types of amplifiers and the level of excessive input.**
 - **The self-excited oscillation (resonance) of an undamped accelerometer occurs not only in windshield impact tests, but, on rare occasions, also in bonnet impact tests.**
 - **Undamped accelerometers should not be used. If unavoidable, design the measurement system such that the unfiltered original waveform can be obtained as backup data by high-speed sampling (see the measurement block diagram of JARI) and, in case of a problem, it is possible to check for the generation of excessive acceleration caused by self-excited oscillation (resonance).**