

Japan comments on *REESS Vibration Test*

EVS-GTR IWG#18_June, 2019 @ Tokyo

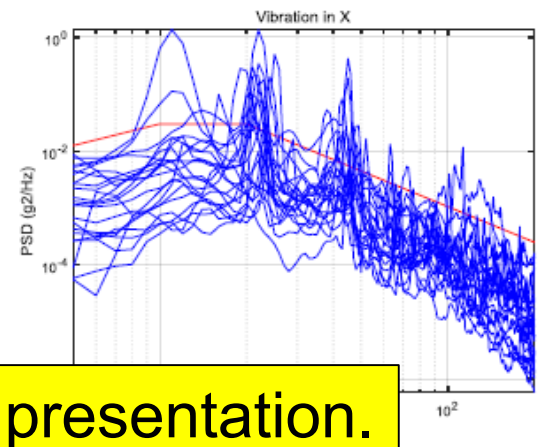
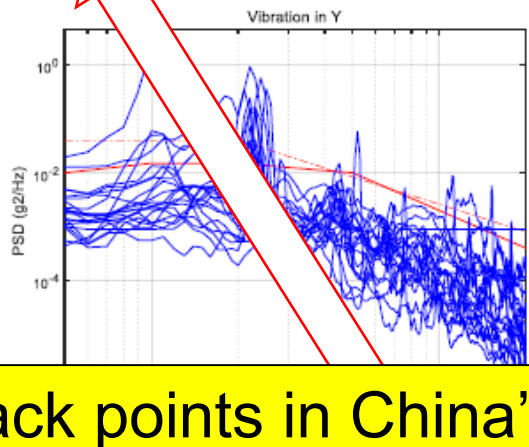
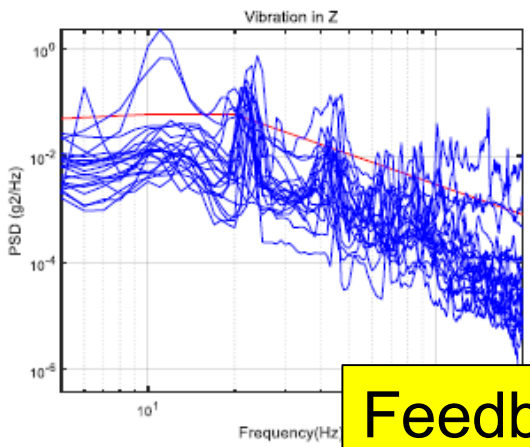
Items

- 1, Action item 6:
Scientific evidence based feedback to China's presentation
- 2, Japan position on GTR's vibration test condition
- 3, Proposals on the option using manufacturer's vibration profile

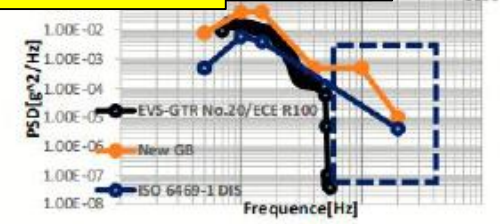
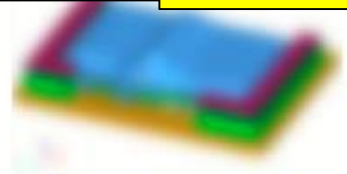
Data from vehicle operation

From data of 22 vehicles

- There are still load strength above 50Hz, which should not be ignored
- Vibration loads in x and y directions are almost 50%-70% of the loads in z direction, which should not be ignored



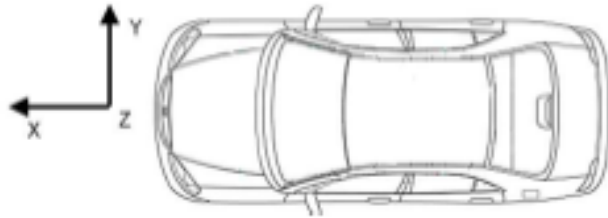
Feedback points in China's presentation.



- There are lots of pack design whose dominant frequency is higher than 50Hz especially for PHEV and HEV.
- It is very hard for current EVS GTR vibration profile to expose these pack's design defect.

Japan Vehicle Test (Example of vehicle test data)

- 3 types of vehicles were tested.
- Acceleration meters are installed around battery anchor bolts
- Driving with 2 kinds of velocities



Test road	Velocity (km/h)
JARI rough road	20 km/h
	30 km/h

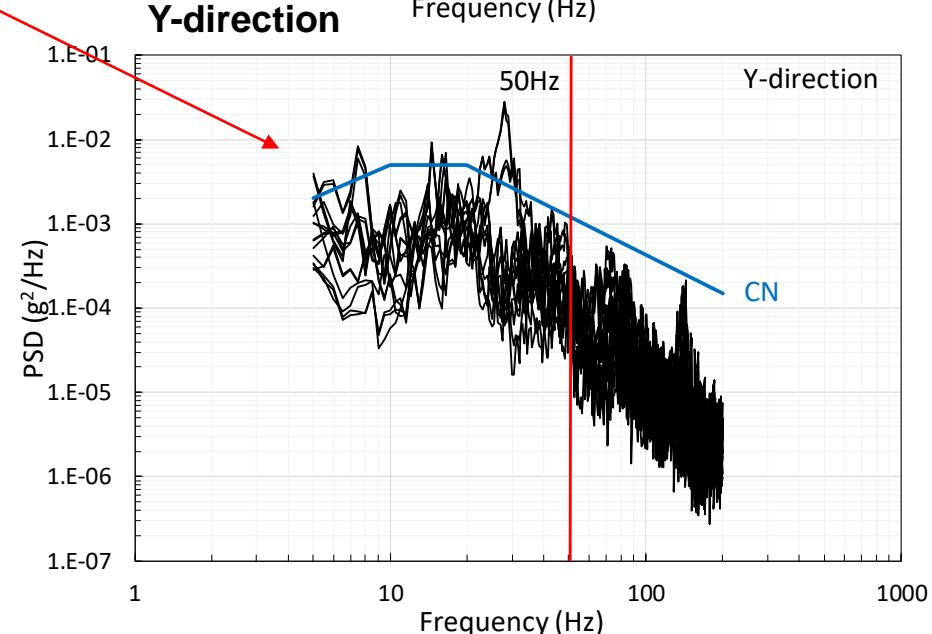
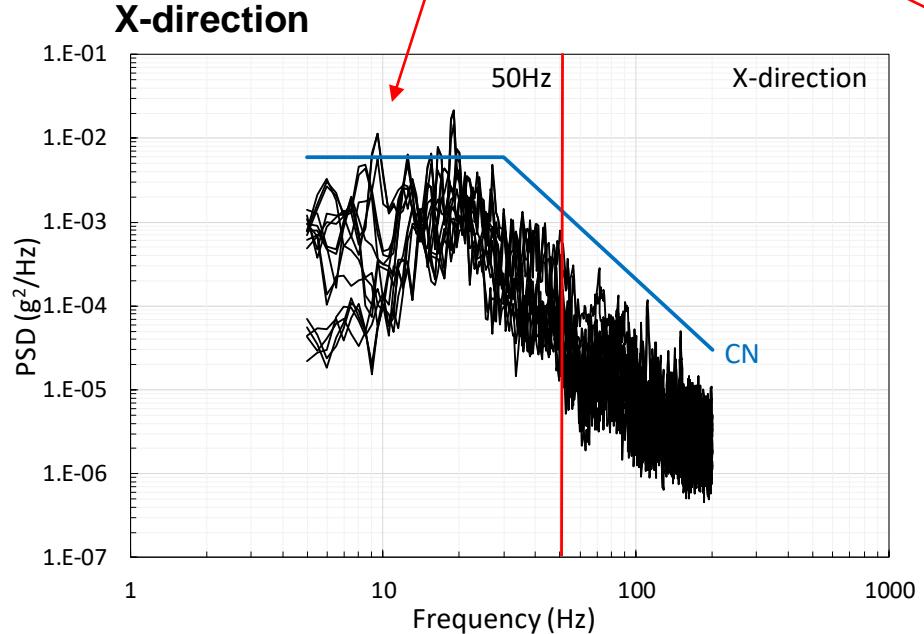
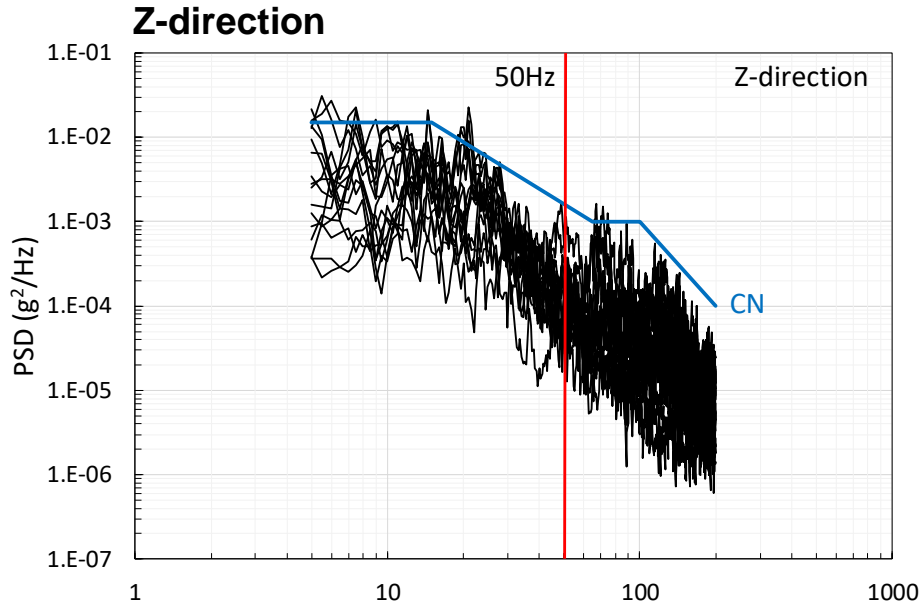
Gravel road with bumpy surface
(Representative example of common rough road in normal usage)



Test was conducted in 2014
at JARI Shirosato Proving Ground.

Japan test data* ([Double logarithmic plot](#))

Other than Z-direction, vibration input from X- and Y-direction exist.



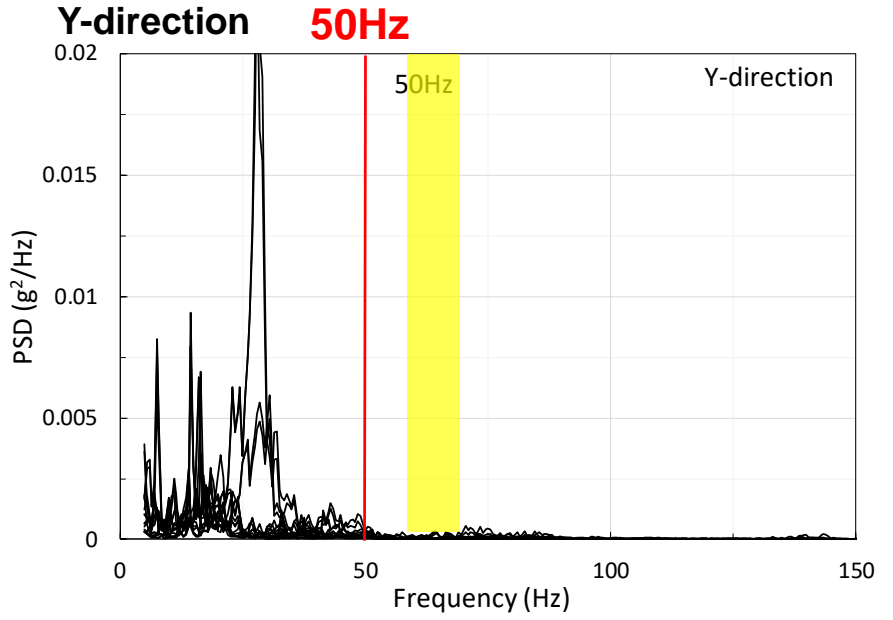
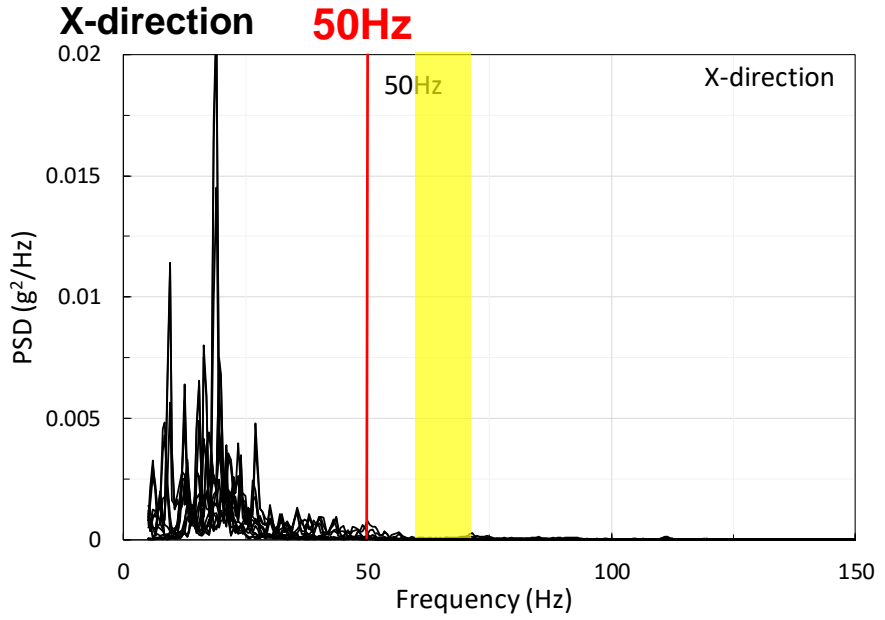
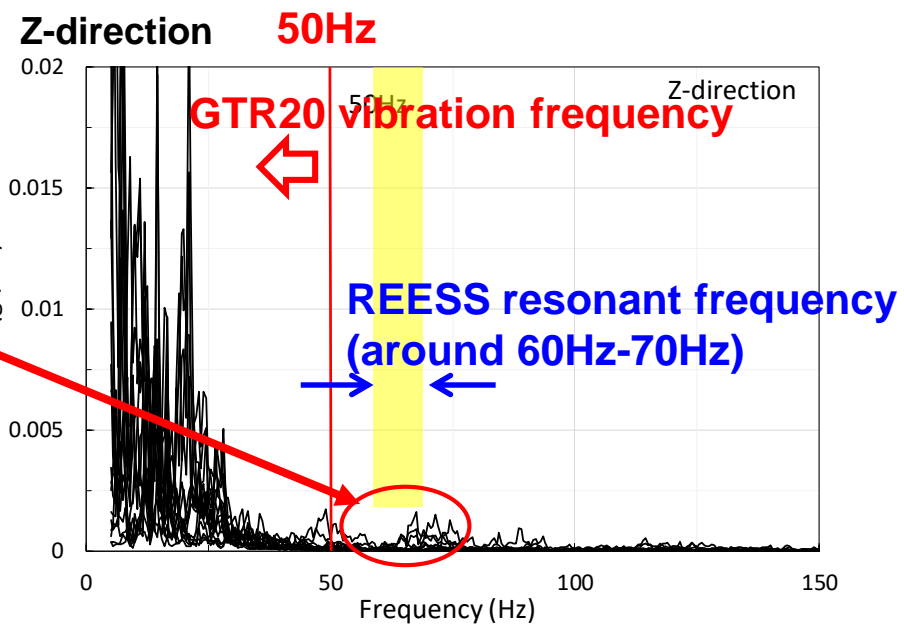
*JARI acquired these data as a part of the program for the Promotion of New Energy Infrastructure Development 'Research and development for international standardization on battery packs', entrusted by the Ministry of Economy, Trade and Industry, Natural Resources and Energy / Mitsubishi Research Institute, Inc.

Japan test data* ([Real number plot](#))

- Vibration at around 70Hz exists.
- REESS resonant frequency is about from 60Hz to 70Hz according to China test data.

↓

Justification to limit the vibration test frequency below 50Hz is not sufficient.



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Japan position

There are concerns on GTR20 sinusoidal vibration profile, such as no evaluation on X- /Y-direction and low maximum frequency of 50Hz.

REESS vibration test condition needs to be discussed in EVS-GTR Phase2 to improve its validity.



<Issues to be discussed>

1, The way to develop one standard test profile from various test results at different conditions (road surface, vehicle type, REESS weight, lifetime mileage expectancy etc.) *Page 7-9

2, Issues on time acceleration *Page 10

3, Feasibility of performing test (test time, capability of test equipment etc.)

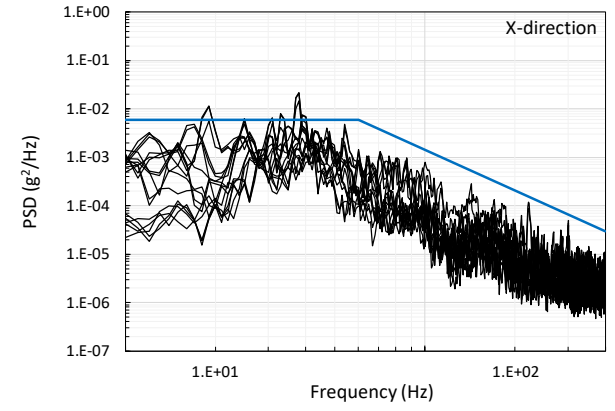
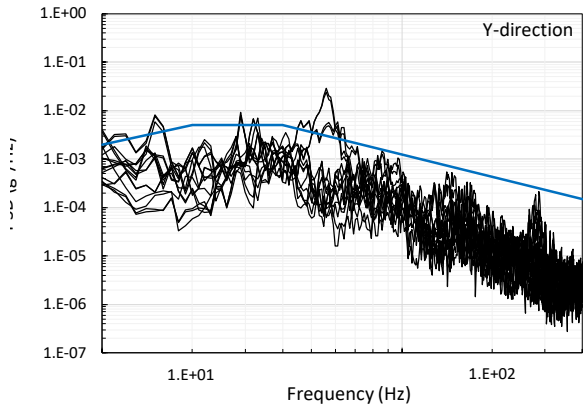
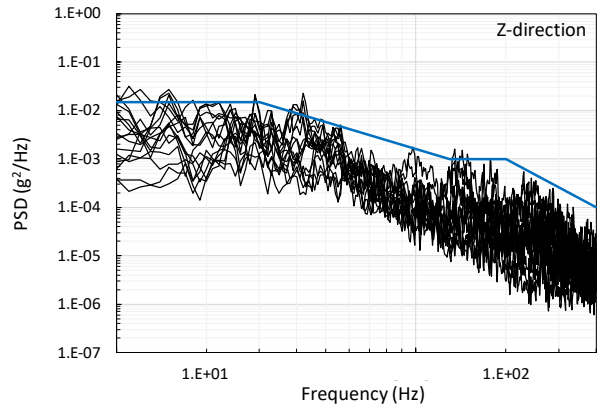
Example of Issues

Request of comments from China

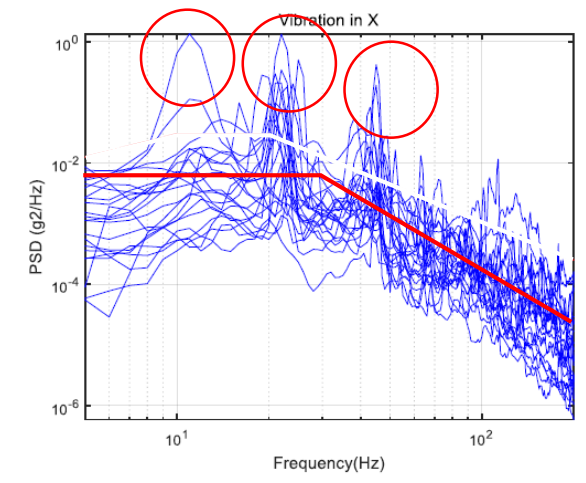
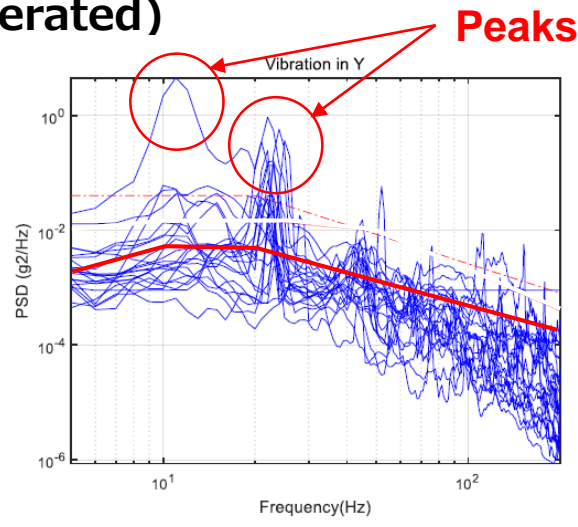
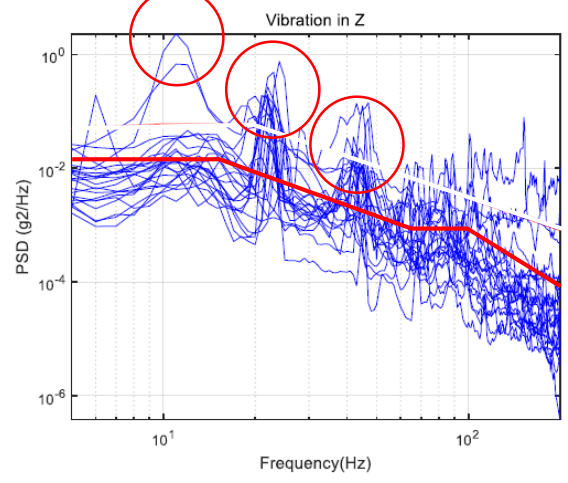
Test data differences

China data is higher than Japan data and some peaks at several frequencies are observed. → Detailed analysis to identify the cause of differences are necessary.

Japan PSD Data* (no time accelerated)



China PSD Data (time accelerated)



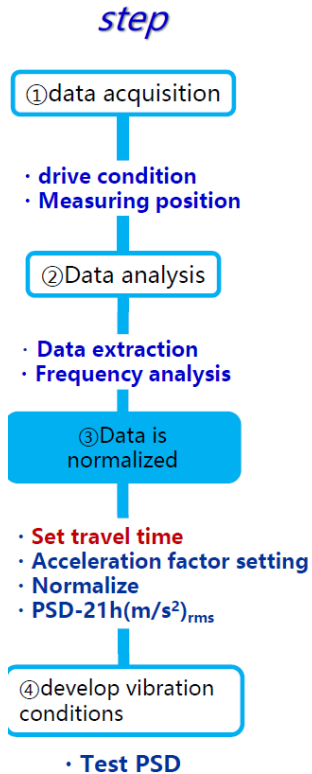
Peaks

*JARI acquired these data as a part of the program for the Promotion of New Energy Infrastructure Development 'Research and development for international standardization on battery packs', entrusted by the Ministry of Economy, Trade and Industry, Natural Resources and Energy / Mitsubishi Research Institute, Inc.

Example of Issues

Comments on China's proposal

Procedure 3—data normalized



One loop (passenger car)				
		①	②	③=①/②/1000
Seq	Rough roads	length (m)	Vehicle speed (km/h)	Driving time (h)
1	Twisted road B	85	10	0.008500
2	Belgian road C	800	40	0.020000
3	Belgian road B	1189	40	0.029725
4	Belgian road B	1189	40	0.029725
5	Cobble-stone road B	335	50	0.006700
6	Gravel road	2113	40	0.052825
7	Washboard Road C	300	50	0.006000
8	Belgian road C	800	40	0.020000
9	Long wave road	90	50	0.001800

Take Tong Xian test ground car product stereotypes reliability driving test specification (2000)

Extended to required distance	
①*X	③*X
life distance	life time
60690	6.069
571200	14.28
848946	21.22365
848946	21.22365
239190	4.7838
1508682	37.71705
214200	4.284
571200	14.28
64260	1.2852

X value is different for different vehicles:

- Passenger car X=714;
- Minicar X=476
- Cargo Van X=1274
- Bus X=882

300,000km for whole Vehicle

Assumption of lifetime mileage affects test time for durability evaluation and usually varies with vehicle type, market and manufacturer.

Japan's point

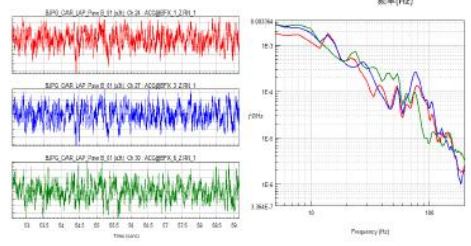
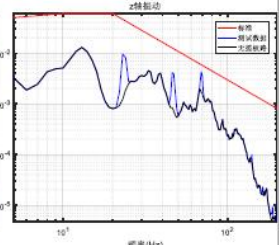
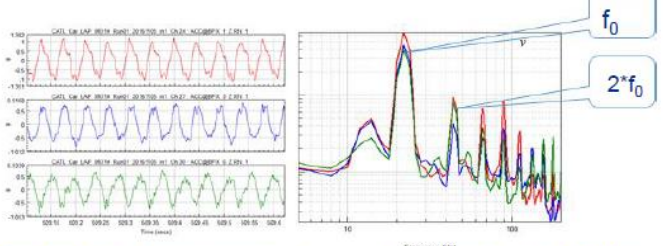
Durability evaluation should not be the purpose of GTR's vibration test (see Page 10).

Comments on China's conditions

Data Collection and Analysis

1. Corrugation road

✓ The data of corrugation road was extracted separately to carry out the constant frequency vibration, and the other roads surface data were developed to obtain random vibration test condition



✓ Excitation frequency $f = v/\lambda$, here $\lambda=0.58m$

v(km/h)	10	20	30	40	50	60	70
f(Hz)	4.8	9.6	14.4	19.2	24.0	28.7	33.5



Very limited and severe driving condition

is	X-axis (PSD) g ² /Hz
0)	
Hz	
2	0.006
5	/
	/
5	/
	0.006
	/
	/

200	0.0001	0.00015	0.00003
RMS	0.64 g	0.45 g	0.50 g
时间	12 h	12 h	12 h
Constant Frequency			
Amplitude	±1.5 g	±1.0 g	±1.0 g
Frequency	24 Hz	24 Hz	24 Hz
Time	1 h	1 h	1 h

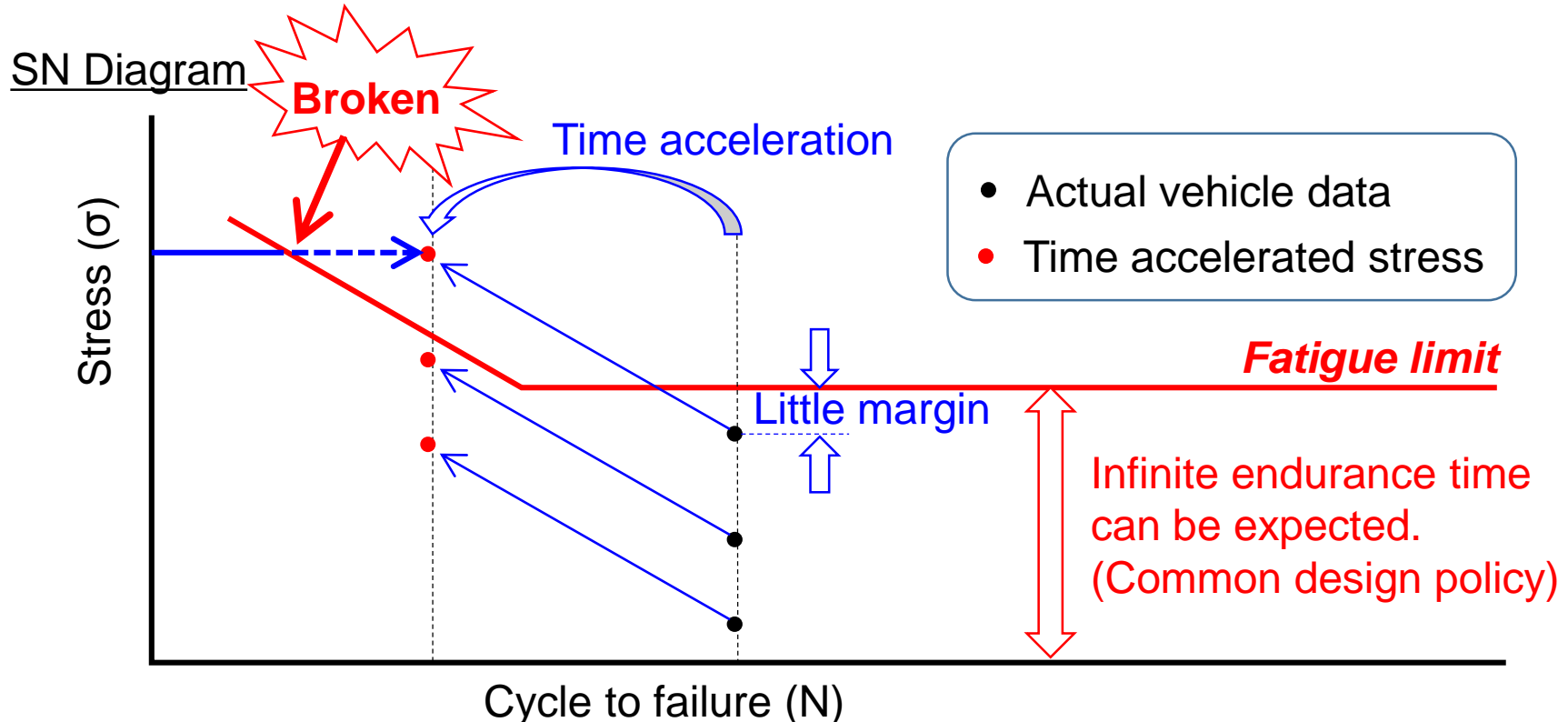
Continuous driving on a same corrugation road for 1hr at 50km/h is not practical in real world situation.

Issues on test time acceleration

Though there is no problem in real world usage, REESS may break during vibration test with time accelerated conditions.



- Issues of time acceleration on the REESS vibration test need to be well-considered.
 - *Traction battery packs are commonly designed with little margin for mechanical stress.
- Validation for strength in a certain period of use, not for durability is appropriate.



3, Proposals on the option using manufacturer's vibration profile

Request of comments from IWG

1, It should be clearly mentioned that there is no severity requirement for the manufacture's profile.

e.g.) Manufacturer's vibration profile is based on vehicle specific vibration inputs. It does not require severer conditions than the standard vibration profile.

2, Guidelines for using manufacture's profile should be discussed and included in EVS-GTR. (See next page.)

- Test data to be acquired and the way how to measure them
- Specific procedures how to handle the data and make vibration test profile
- Contents in a material to explain the validity of the manufacturer's profile

TUV's current type approval test procedures using manufacturer's profile must be a very useful reference.

3, Addition of a new option like the component water test in Annex 2 of GTR20. (See next page.)

- Manufactures can submit a material that includes test condition and test data. Testing authority will verify and confirm the authenticity of the document.

(Large-size REESSs of heavy vehicles require special test equipment and facilities to conduct vibration test.)

Guidelines for using manufacture's profile should be included in EVS-GTR.

8.2.2.3.2. Test procedures

At the choice of the manufacturer, a **vibration test profile determined by the vehicle - manufacturer verified for the vehicle application** may be used as a substitute for the frequency - acceleration correlation of Table 6. The REESS certified according to this condition shall be limited to the installation for a specific vehicle type.

This option for the component water test should also be applied to vibration test.

Annex 2 _ 1. **Documentation shall contain** the following information:

- (a) on how the manufacturer tested isolation resistance compliance of electrical design of the vehicle by using fresh water;
- (b) on how, after the test had been **carried out**, the high-voltage component or system was inspected for ingress of water and how, depending on its mounting location, each high voltage component/system **met the appropriate degree of protection against water**.

2. The **testing authority will verify and confirm the authenticity** of documented conditions that have been observed, and should have been **complied with**, during the **process of certification by manufacturer**:

Text proposal:

In case that manufacturer's profile is applied, certain justification of the profile will be required in a documented manner. In such case, the vibration test results can also be a part of the documentation and the vibration test by the technical service may be omitted.