ISTA CHINA Packaging Symposium

September 17, 2009

9:40-10:15

No.13

Guidelines for Product Improvement:

Usage of all fragile parts' DBCs on a product

TRI Osaka Takamasa NAKAJIMA

Kobe Univ. Katsuhiko SAITO

Self-introduction of speaker

Name： Takamasa NAKAJIMA
Organization：TRI Osaka　　1988～

＜Research＞
- **Optimal cushioning design method**
- **Test method for shock fragility of products**
- **AFS (Accumulated Fatigue Spectrum)**
  & Vibration Test method by AFS (K2-Fatigue by IMV)

＜Consultancy＞
- **Packaging (Transportation)**　- **Shock & Vibration**　**etc.**

＜Test & Evaluation＞
- **Vibration**　- **Drop**　- **Compression strength**
- **Shock fragility of product**　- **Cushioning material**　**etc.**

Background of the presentation

This plan was selected as a national project, “Feasibility Study of Standardization” last year.

⇒ A new test procedure has been put together.

⇒ We visited CPRTC at Tianjin (Director Li Hua etc.)

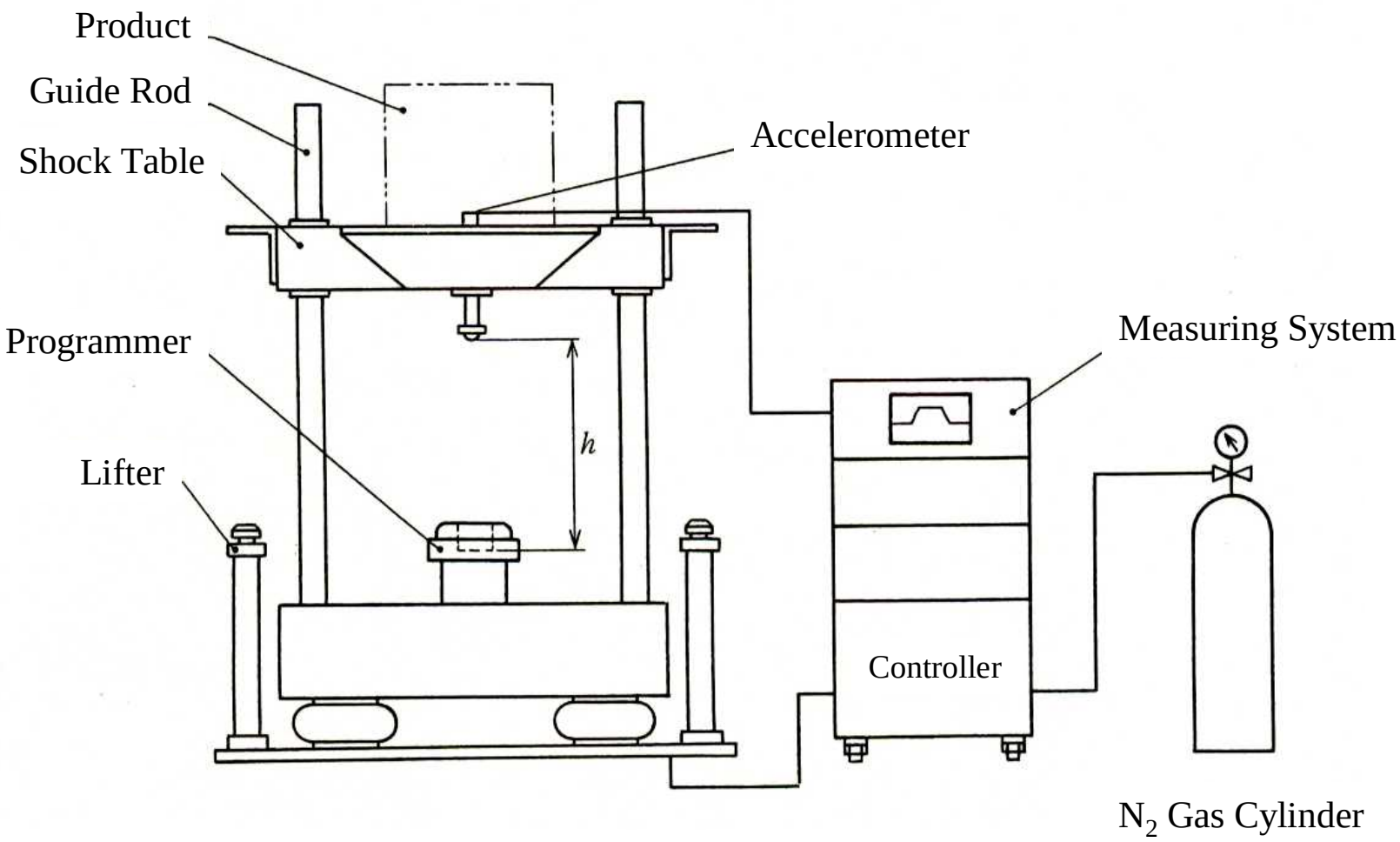
and Jinan Univ. at Zhuhai (Prof. Zhi-Wei Wang etc.).

Purpose of the presentation

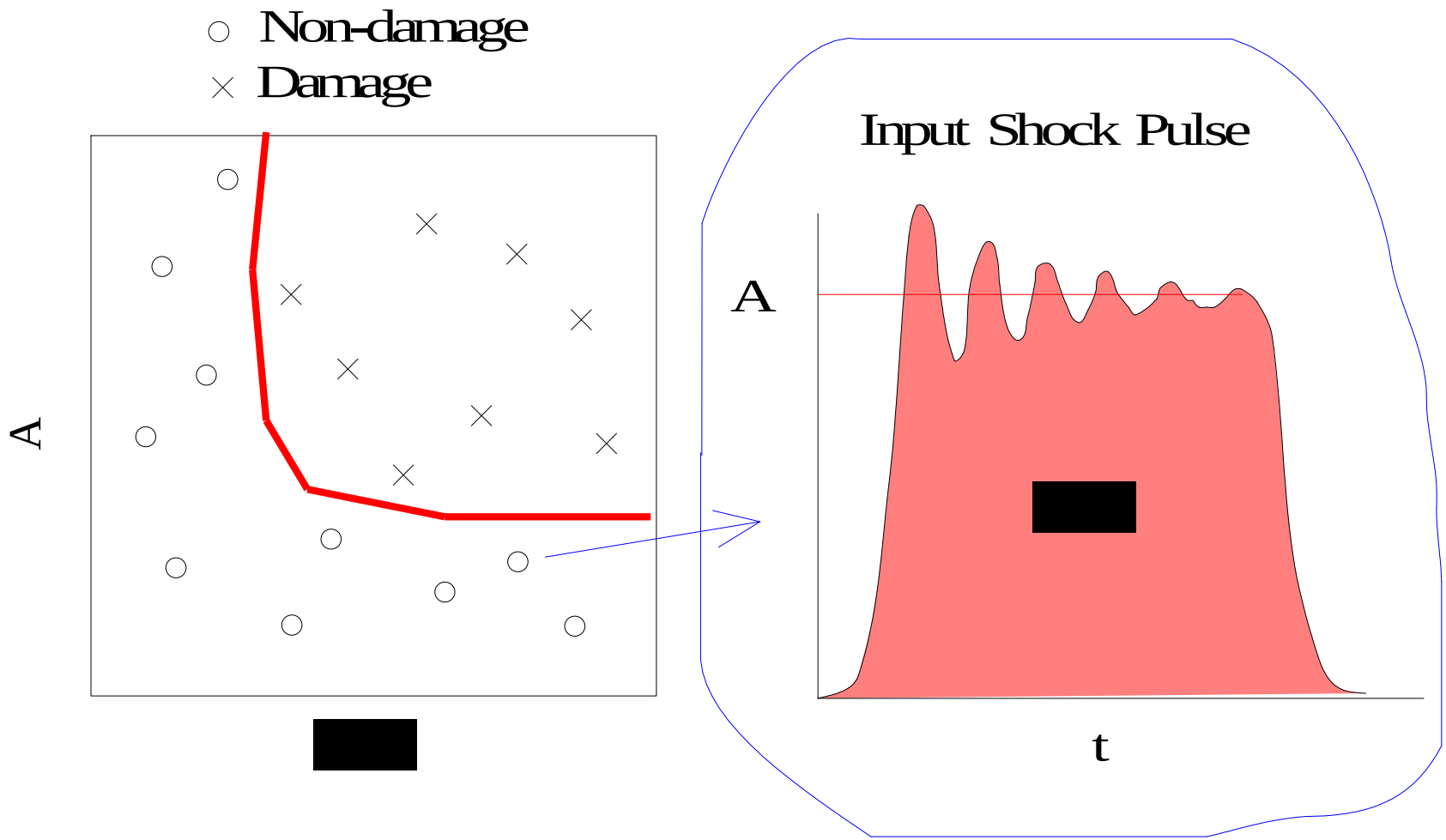
We would like to contribute a new idea to shock test standard all over the world.

⇒ Both cost-cut and high quality will be realized.

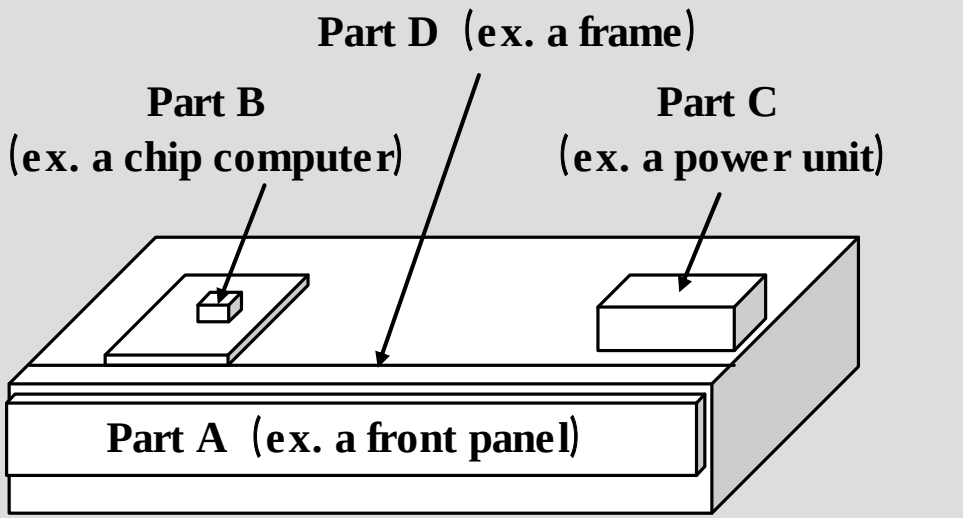
Mechanical Shock Machine



Explanation of DBC
(Damage Boundary Curve)

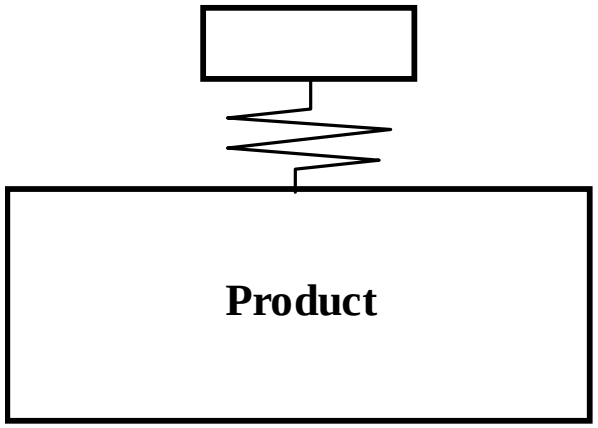


Specimen

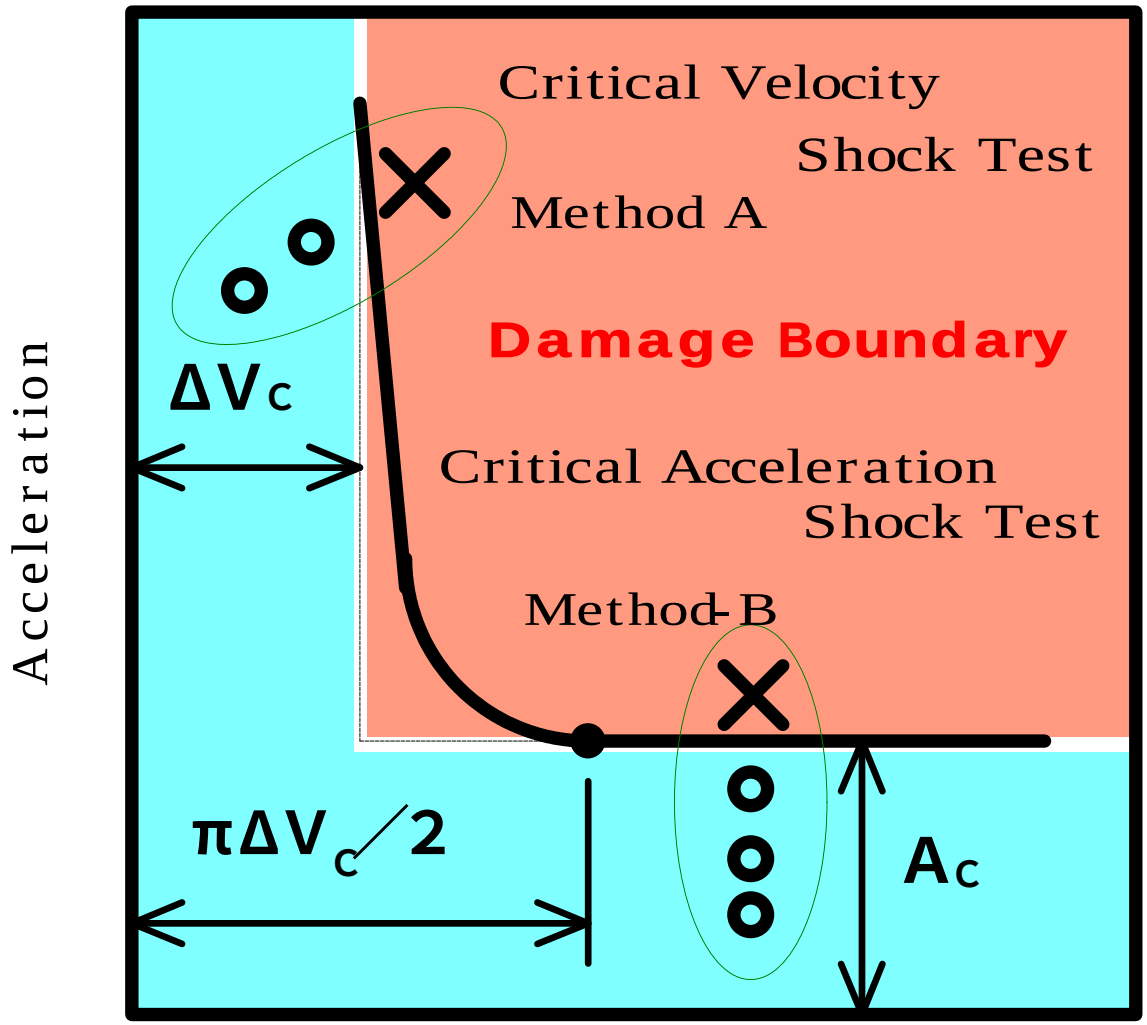


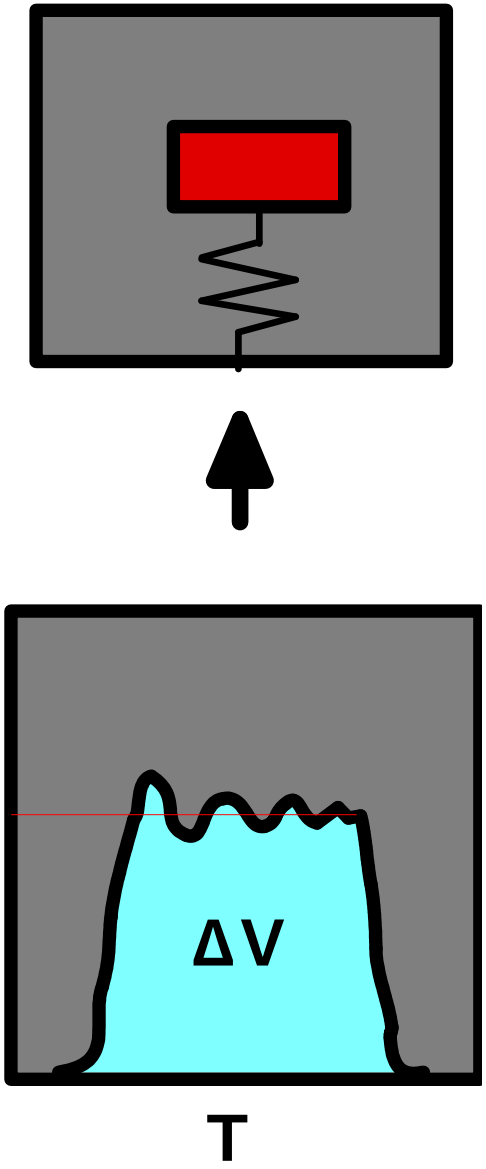
Shock Analytical Model by R. E. Newton

The most fragile part



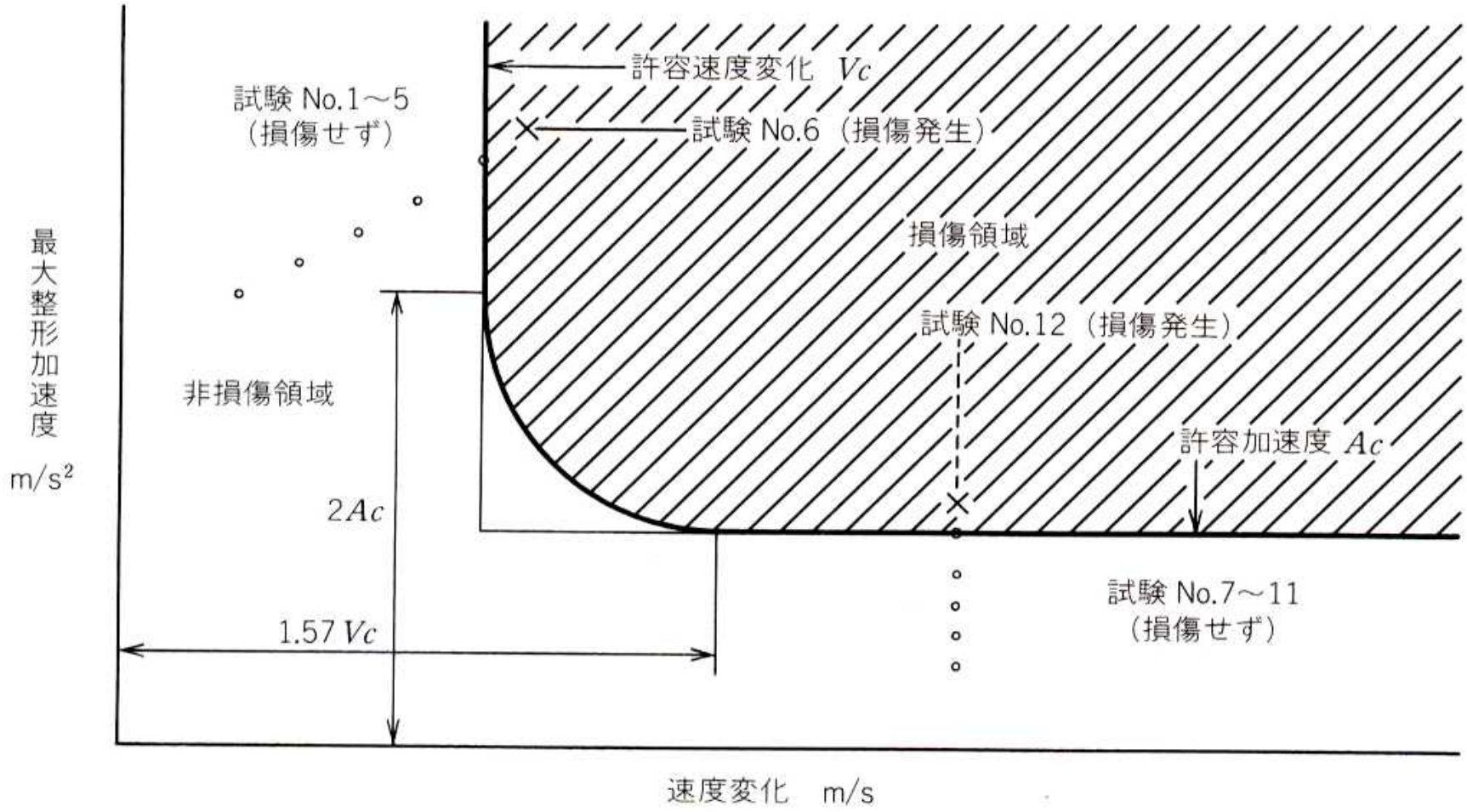
GB/T 15099, ASTM D 3332, JIS Z 0119 (Dr. R.E.Newton)





DBC and Test Method of Shock Fragility

GB/T 15099、ASTM D 3332 、JIS Z 0119
(Dr. R.E.Newton)



Shock test for packaging design	
World	–
China	GB/T 15099 -94
America	ASTM D 3332
EU	–
Japan	JIS Z 0119

New procedure

DBCs for all fragile parts

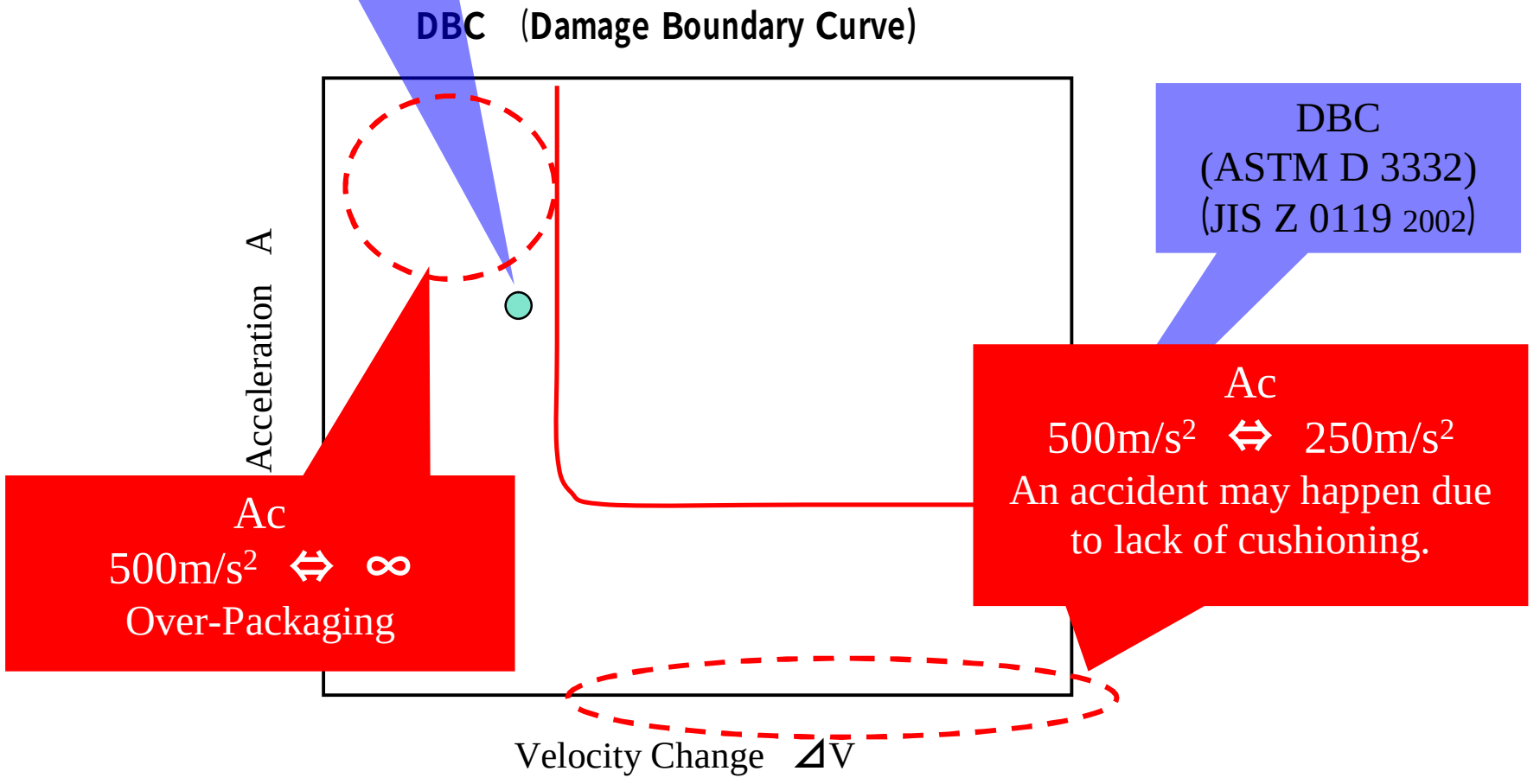
↓

Guideline for product improvement

Shock Test by Product Designer (IEC 68-2-27) & Shock Test by Package Designer (ASTM D 3332, JIS Z 0119)

500m/s², 11ms
(IEC 68-2-27)

If this result is used in packaging design, ...



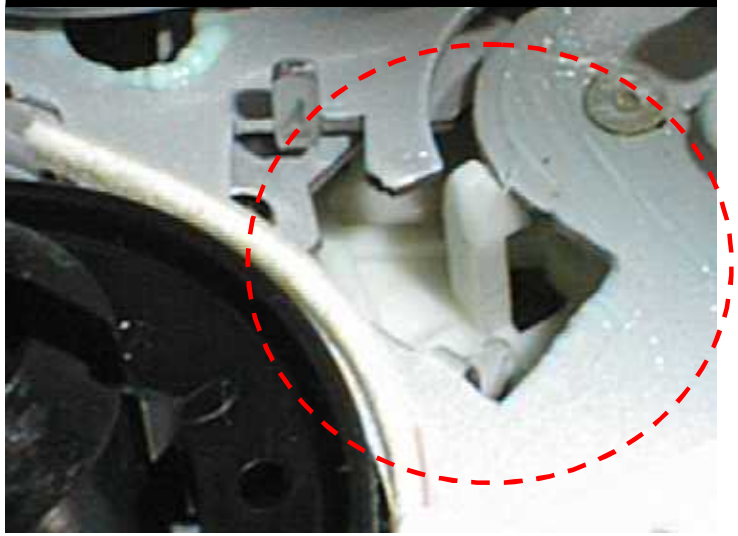
DBC
(ASTM D 3332)
(JIS Z 0119 2002)

Ac
500m/s² ⇔ 250m/s²
An accident may happen due to lack of cushioning.

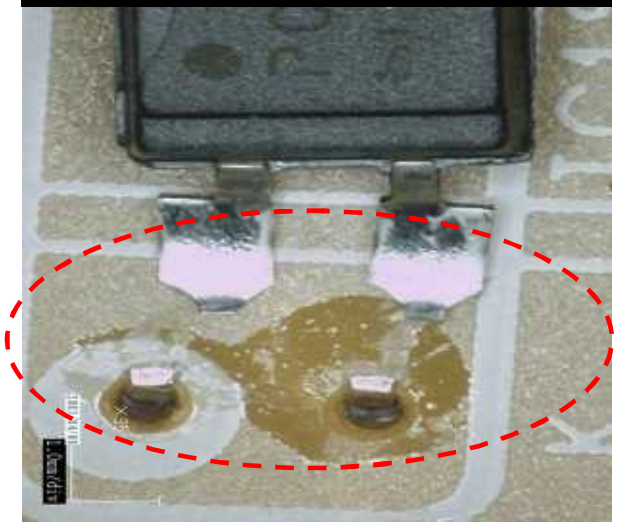
Ac
500m/s² ⇔ ∞
Over-Packaging

Result of Shock Test for a Video-player

A hook of a gear comes off.

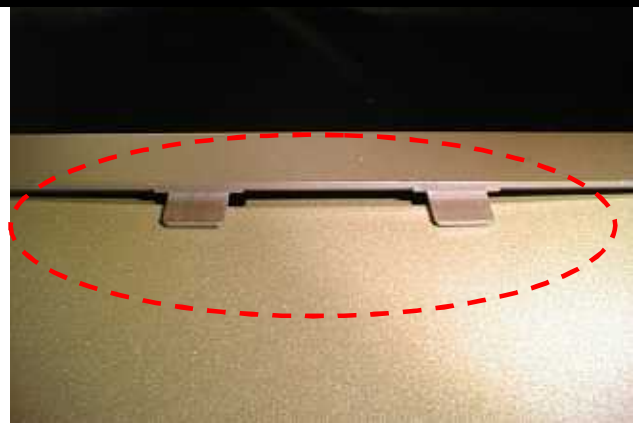


Legs of a coupler break.

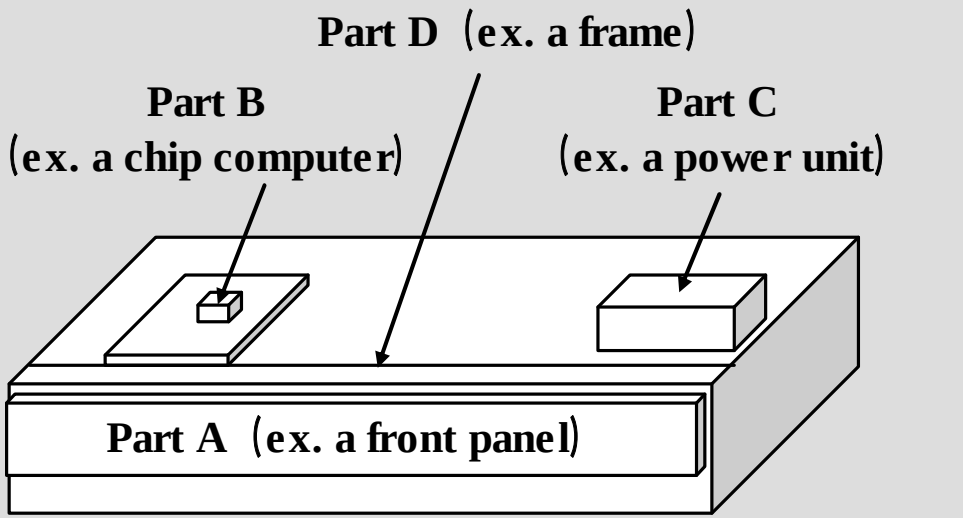


A front panel breaks.

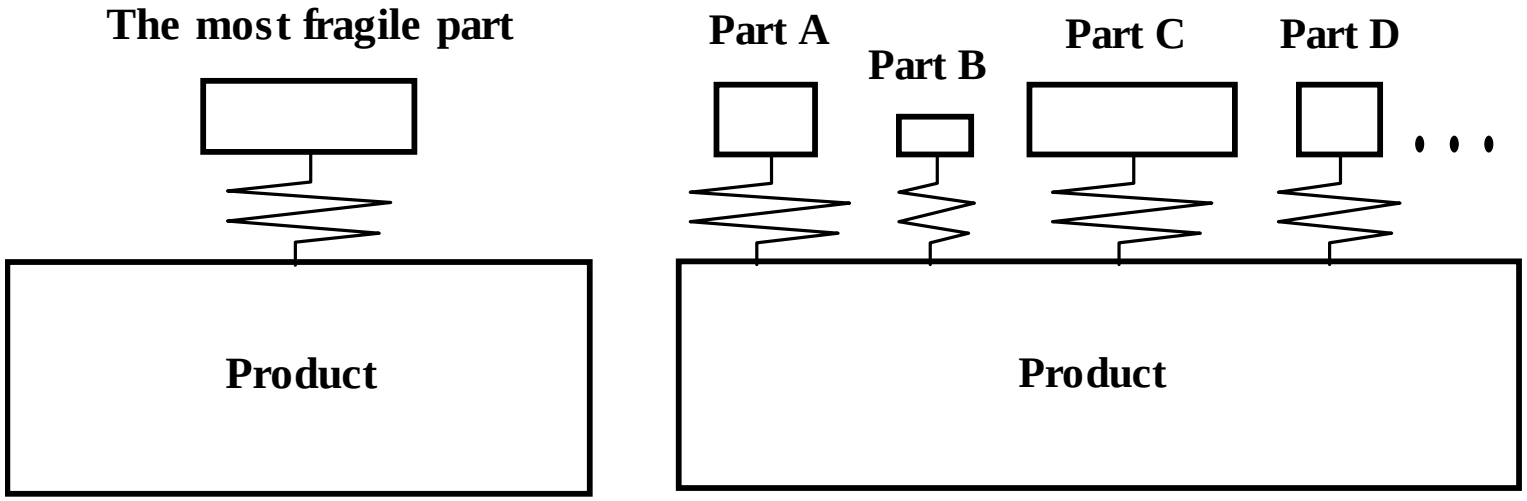
Stoppers of a front frame come off.



Specimen

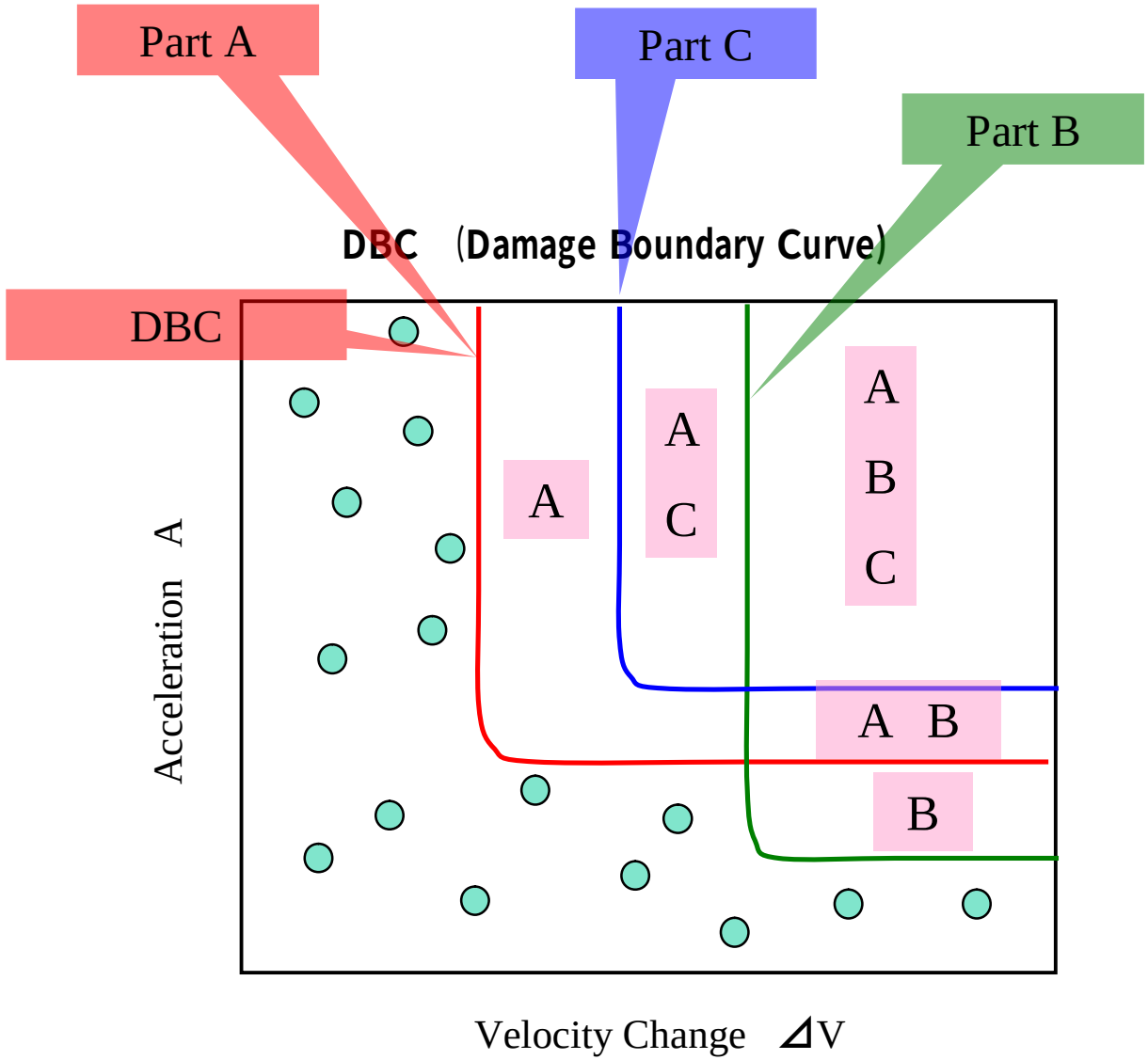


Shock Analytical Model by R. E. Newton



Shock Test by Product Designer & Shock Test by Package Designer

(IEC 68-2-27 ASTM D 3332, JIS Z 0119)



A shock test result of a certain product

Test No.	Accele. m/s^2	⊿V m/s	⊿T ms	Observations	
1	1930	2.31	2.01	No damage	⊿V Test
2	2110	2.49	1.98	No damage	
3	2660	2.90	1.94	Part A was deformed.	
4	2790	3.14	1.59	Part B was deformed.	
5	3360	3.41	1.50	No damage except for A & B.	

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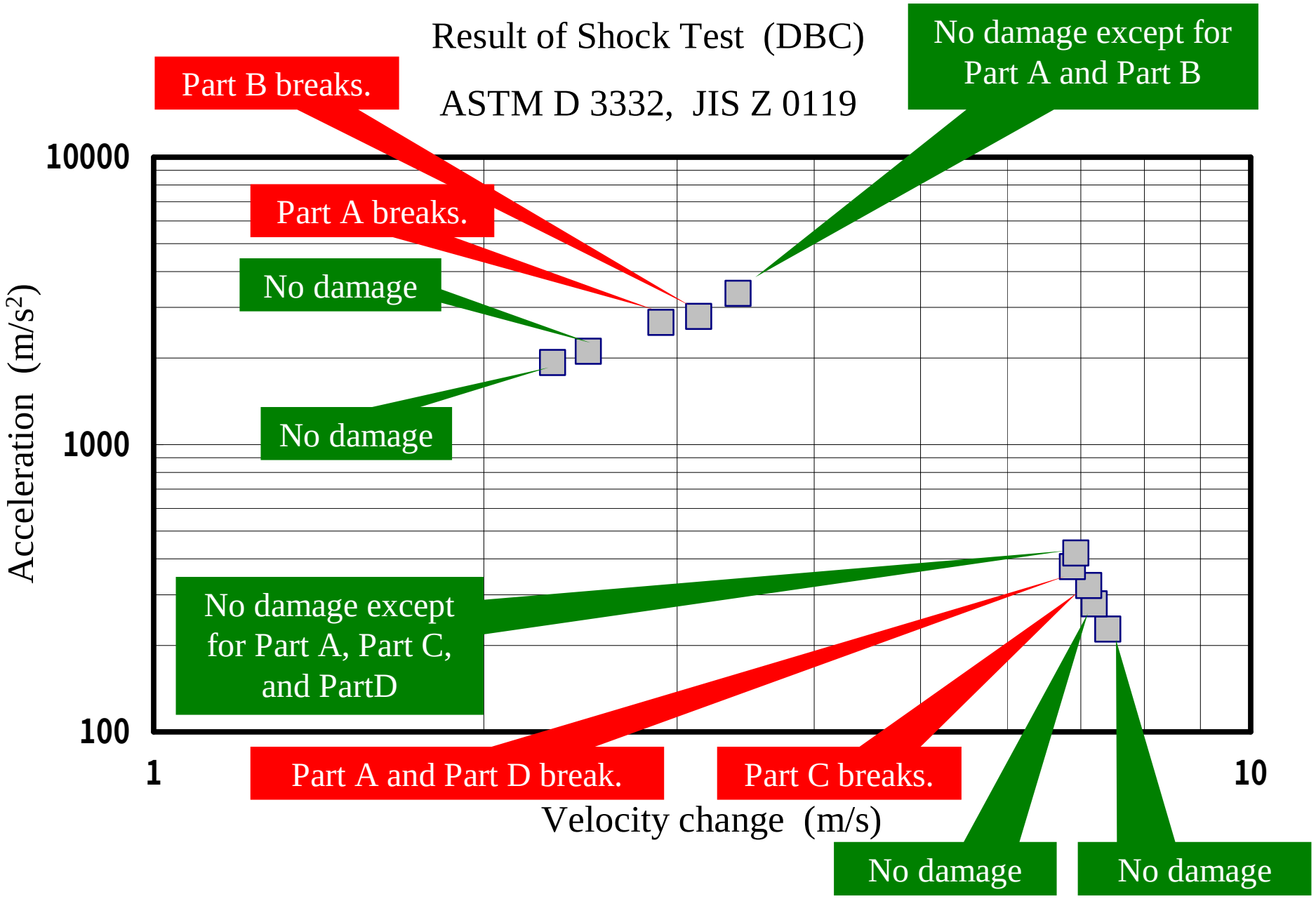
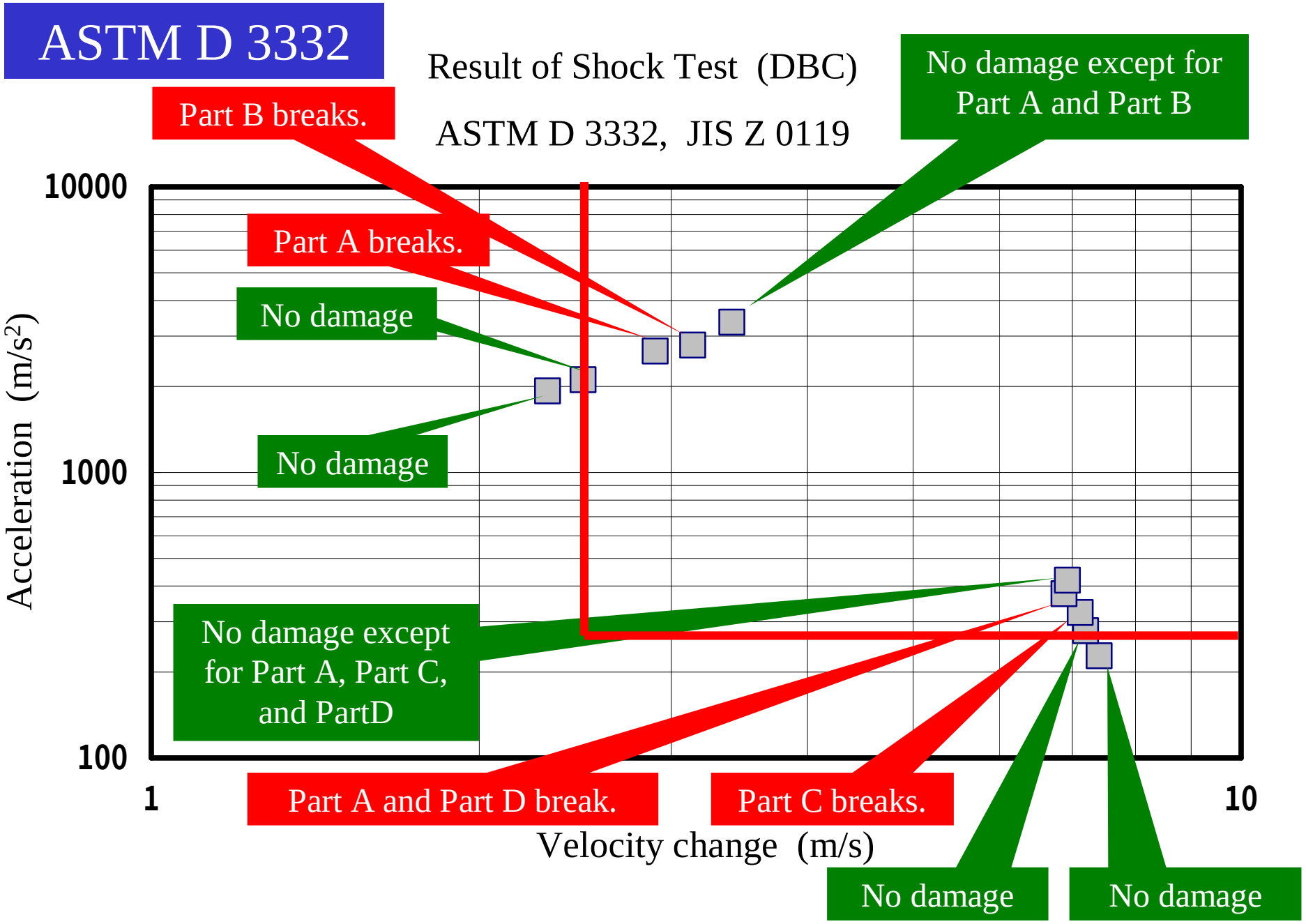
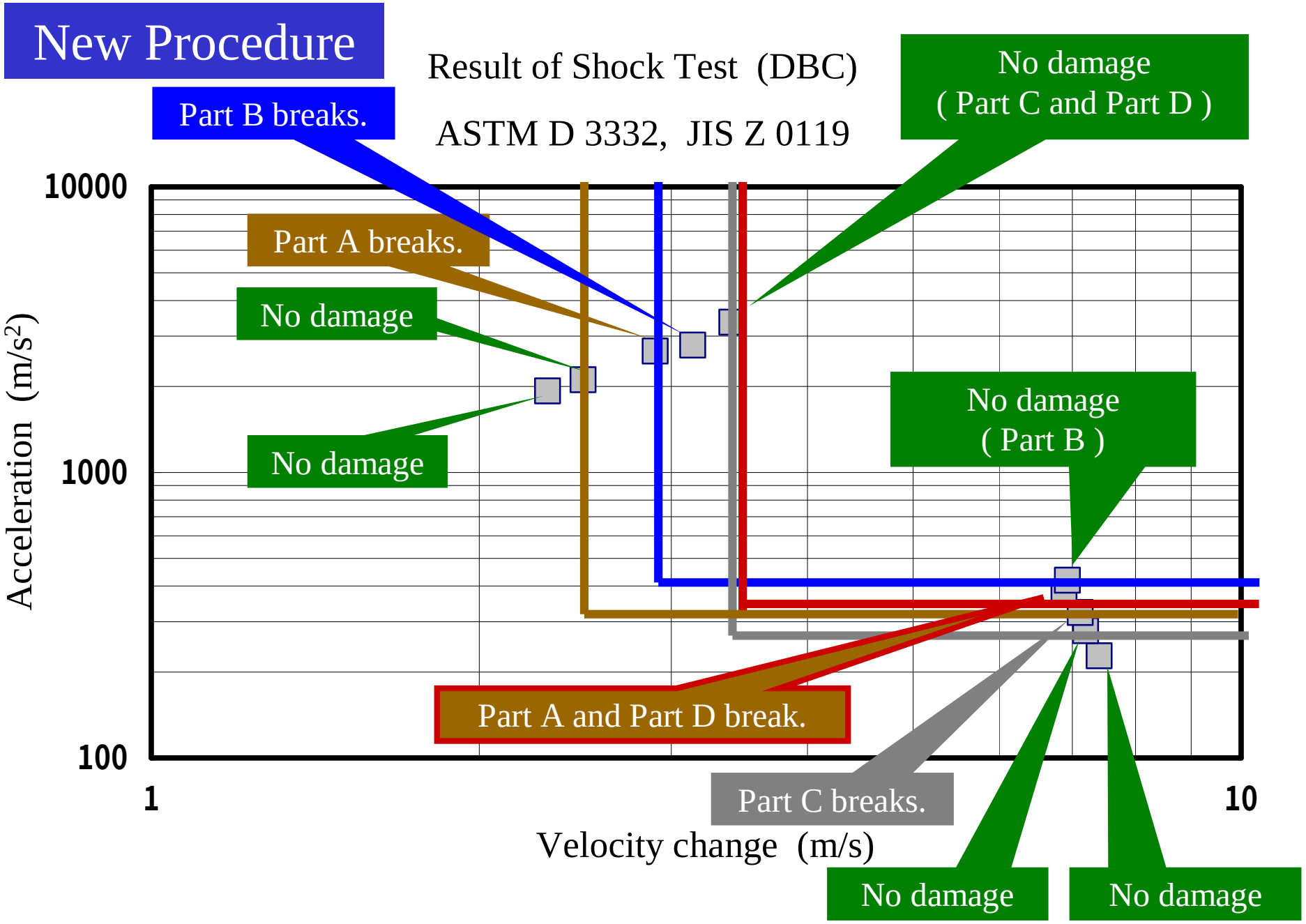
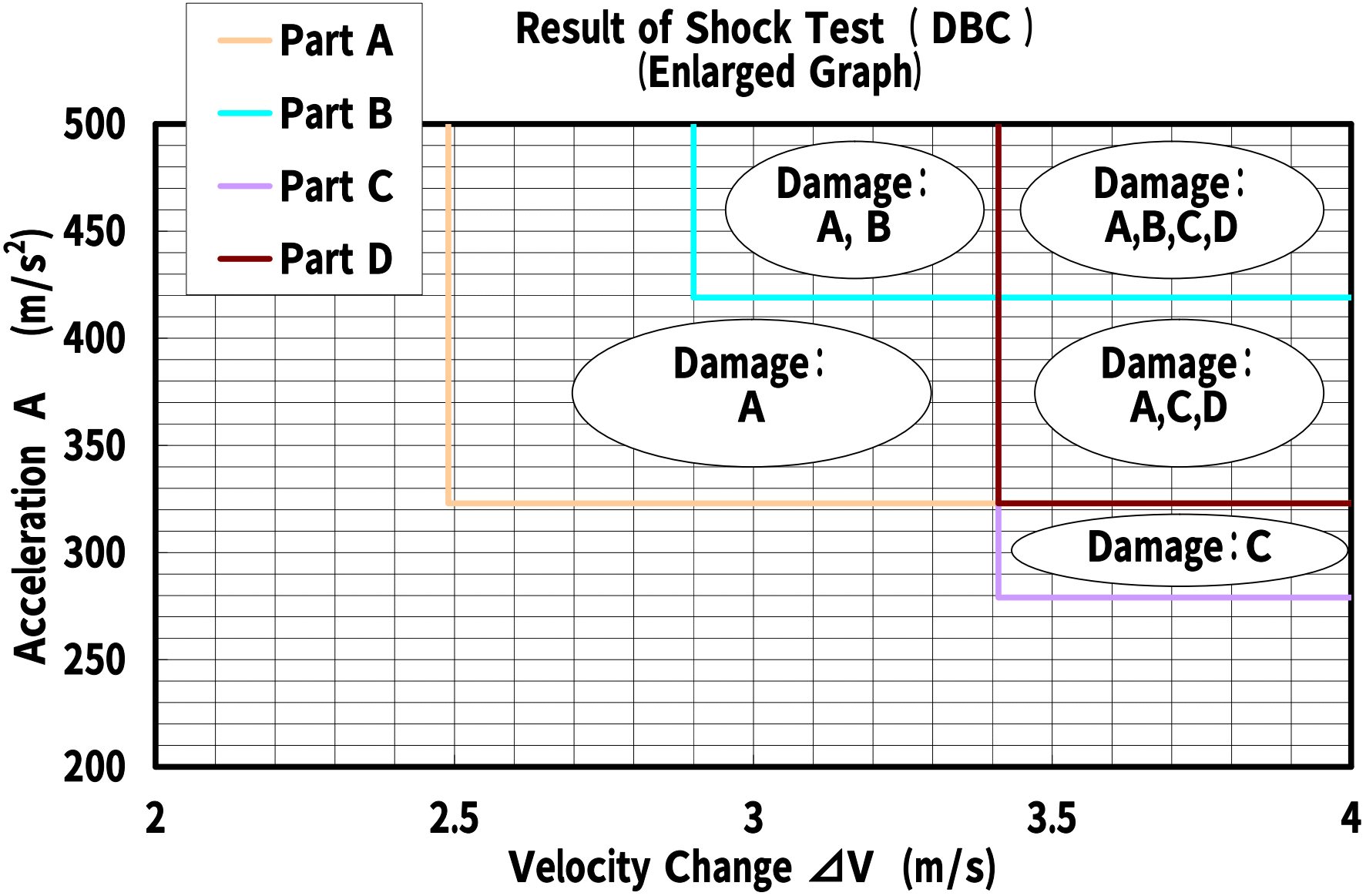
5	3360	3.41	1.50	No damage except for A & B	
6	228	7.41	32.9	No damage	A_C Test
7	279	7.20	26.1	No damage	
8	323	7.12	22.3	Part C was deformed.	
9	376	6.88	18.4	Part A & B was deformed.	
10	419	6.93	16.8	No damage except for A,C & D	


Result of Shock Test (DBC)
ASTM D 3332, JIS Z 0119
Part B breaks.
No damage except for Part A and Part B
Part A breaks.
No damage
No damage
10000
1000
100
Acceleration (m/s²)
No damage except for Part A, Part C, and PartD
Part A and Part D break.
Part C breaks.
No damage
No damage
1
10
Velocity change (m/s)

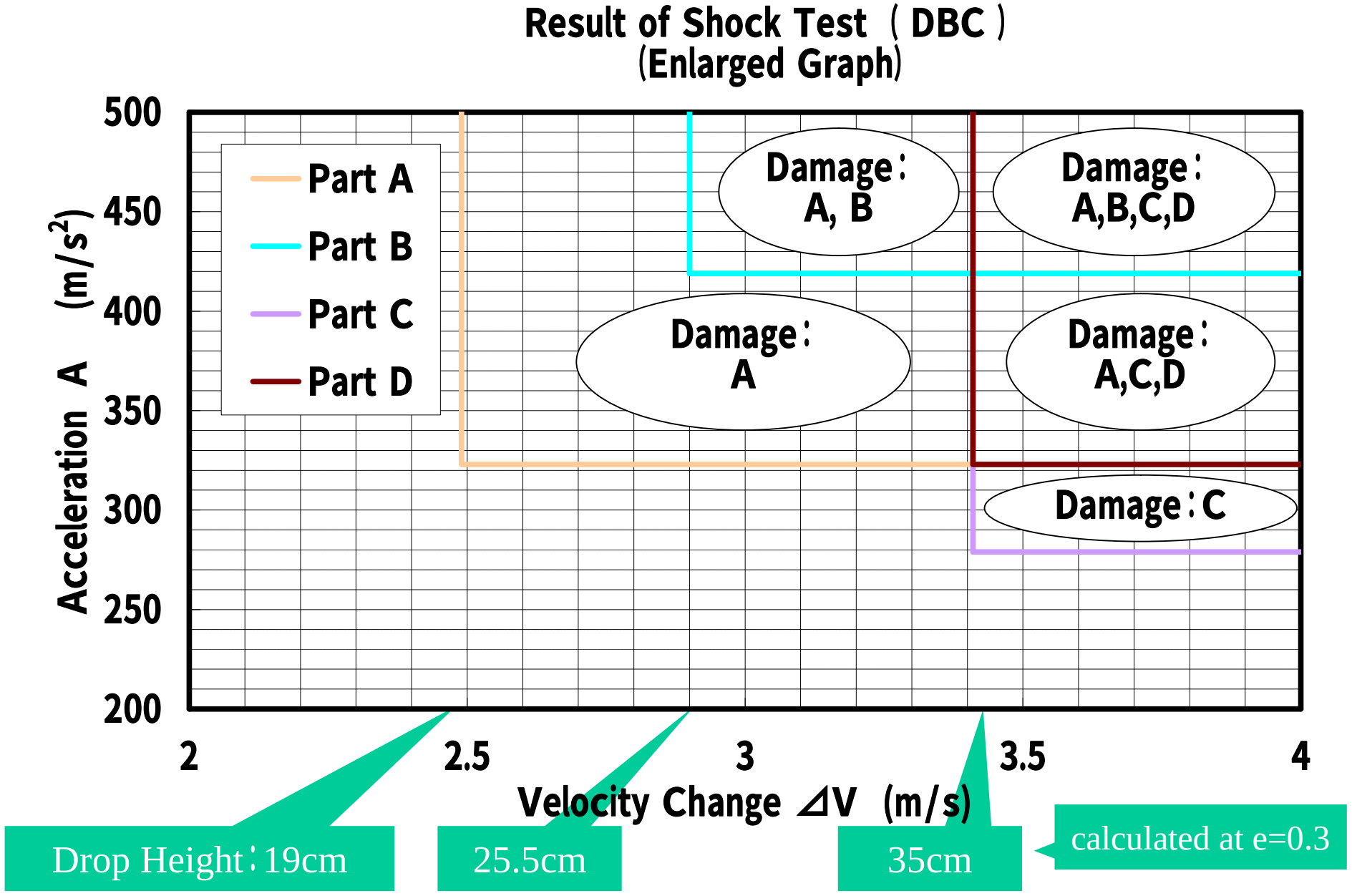

ASTM D 3332
Result of Shock Test (DBC)
ASTM D 3332, JIS Z 0119
Part B breaks.
No damage except for Part A and Part B
Part A breaks.
No damage
No damage
No damage except for Part A, Part C, and PartD
Part A and Part D break.
Part C breaks.
No damage
No damage
10000
1000
100
1
10
Acceleration (m/s²)
Velocity change (m/s)


New Procedure
Result of Shock Test (DBC)
ASTM D 3332, JIS Z 0119
Part B breaks.
No damage
(Part C and Part D)
Part A breaks.
No damage
No damage
No damage
(Part B)
Part A and Part D break.
Part C breaks.
No damage
No damage
10000
1000
100
1
10
Acceleration (m/s²)
Velocity change (m/s)

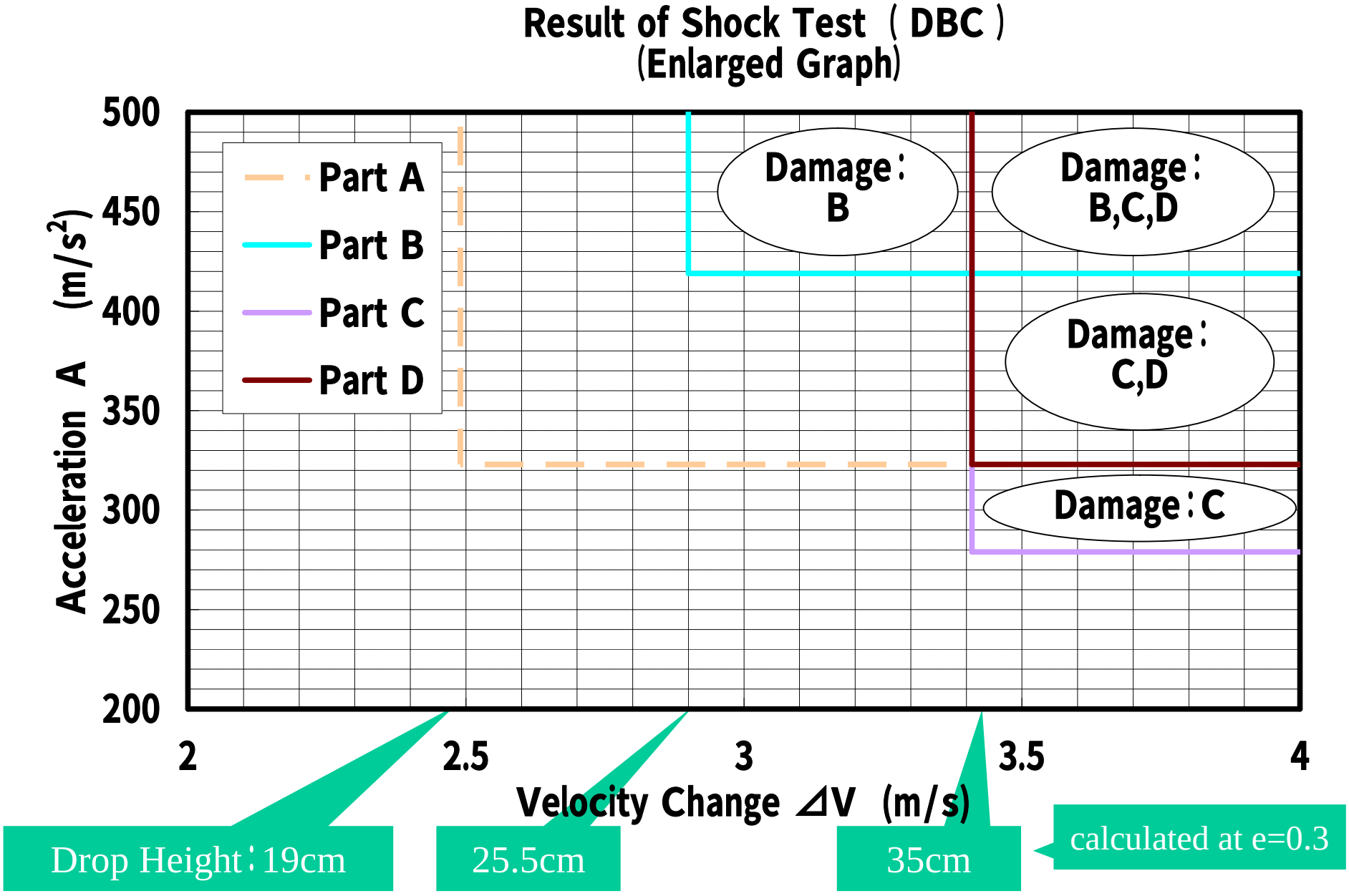
New Procedure



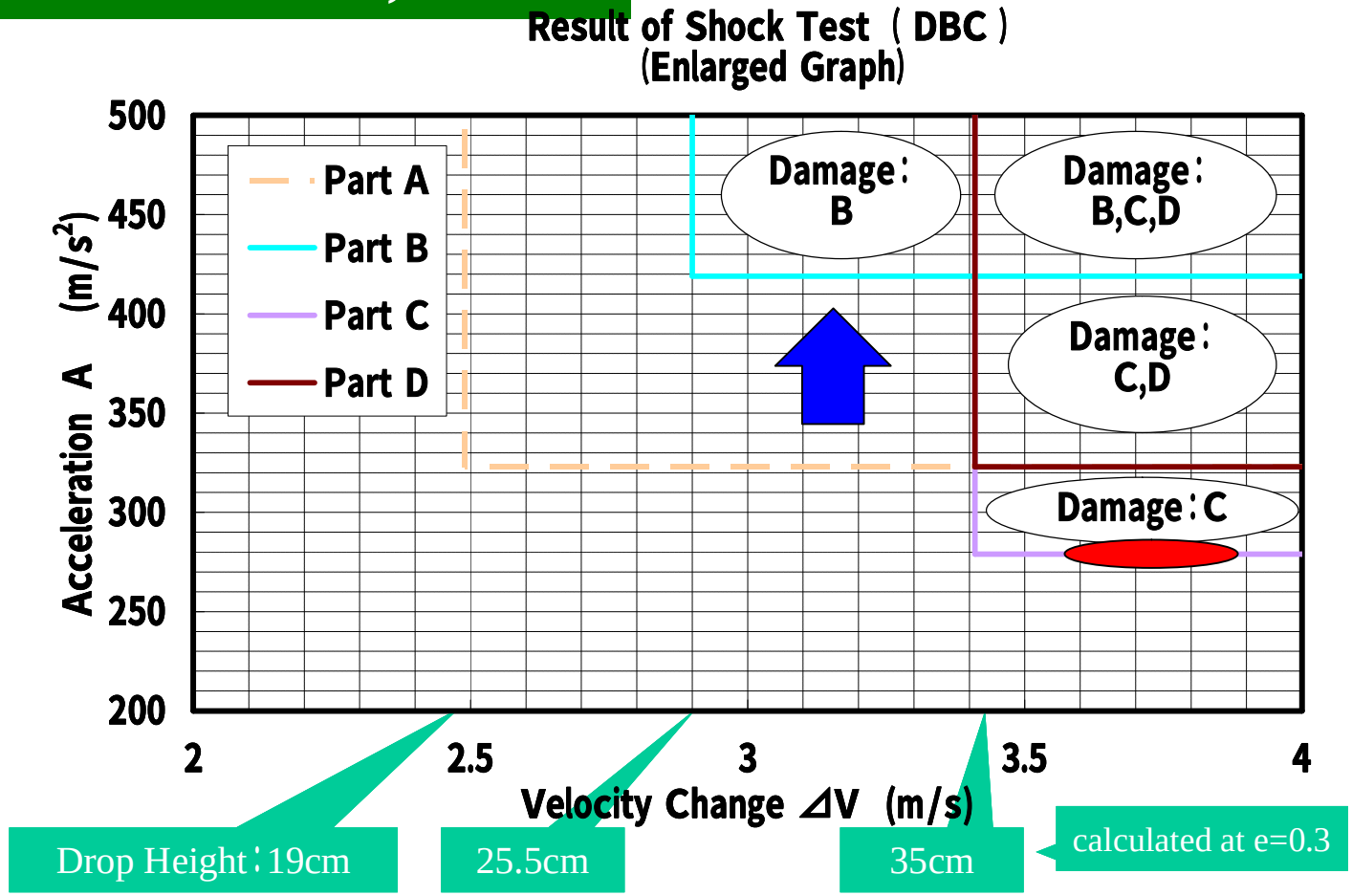
New Procedure



If Part A is refined, ・・・



If Part A is refined, ・・・



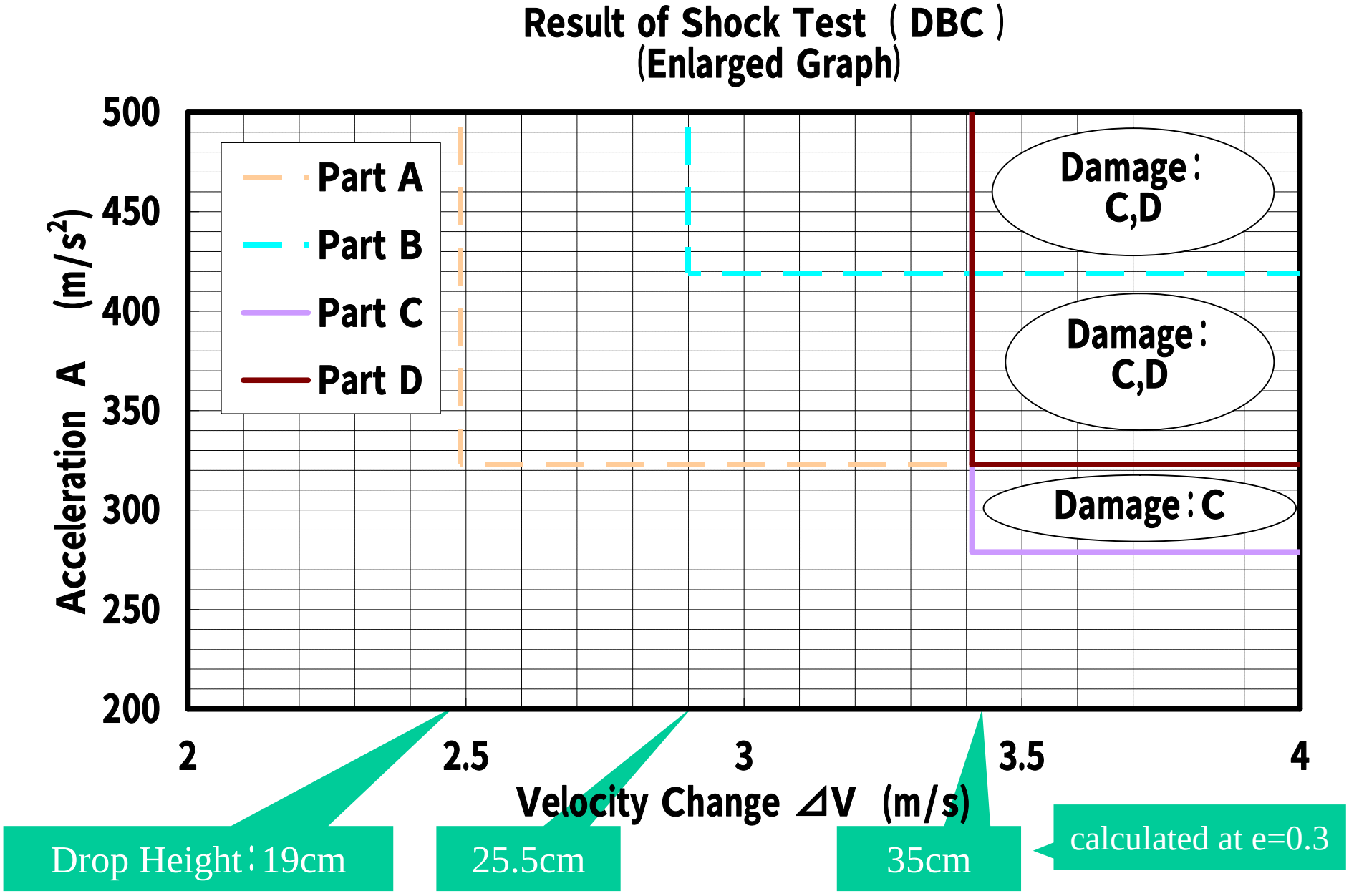
ex. 1 When the max drop height is 30cm, Ac will be improved from **323 ⇒ 419 m/s²**.

Effective

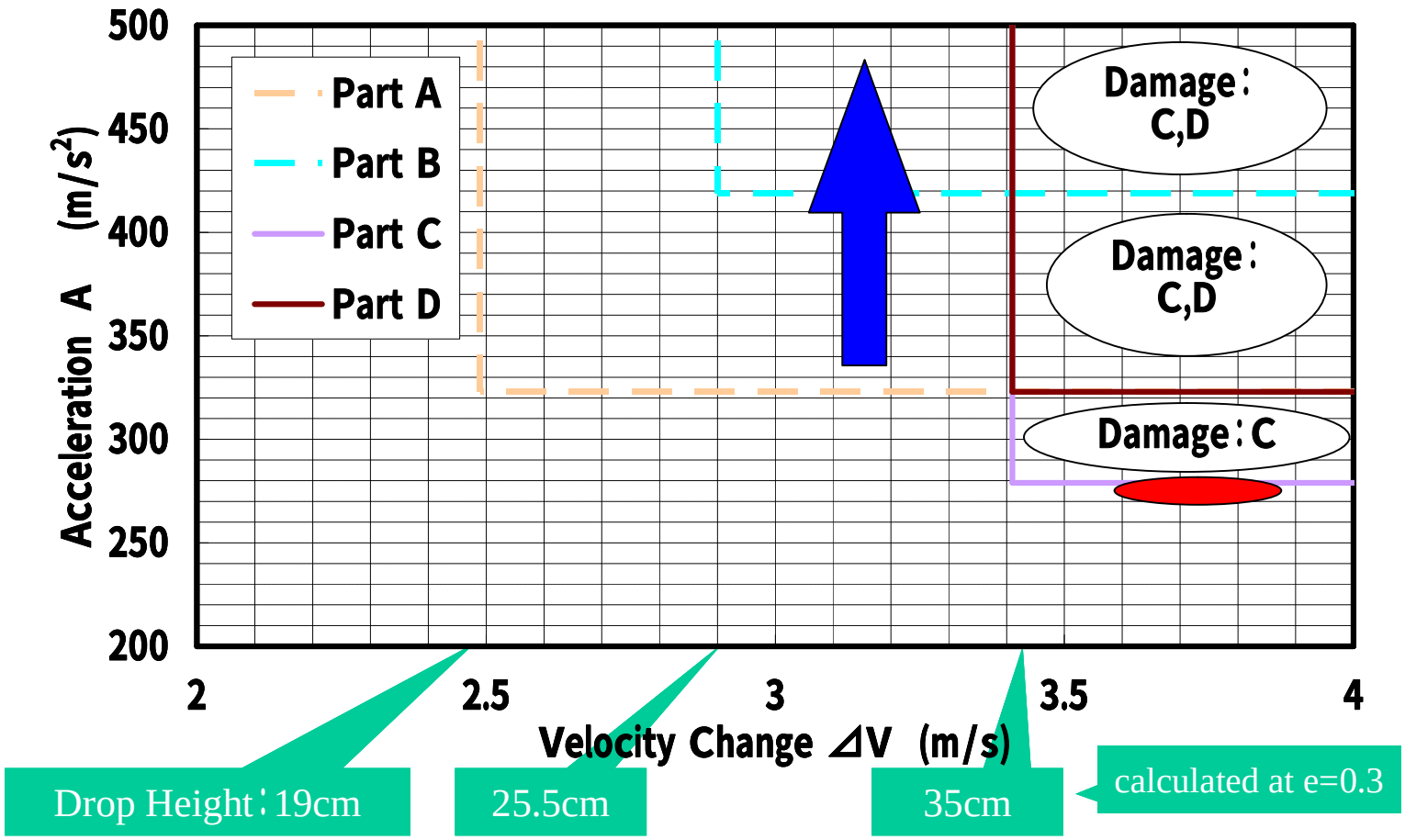
ex. 2 When the max drop height is 40cm, Ac will not be improved.

Meaningless

If Part A and Part B are refined, ・・・



If Part A and Part B are refined:



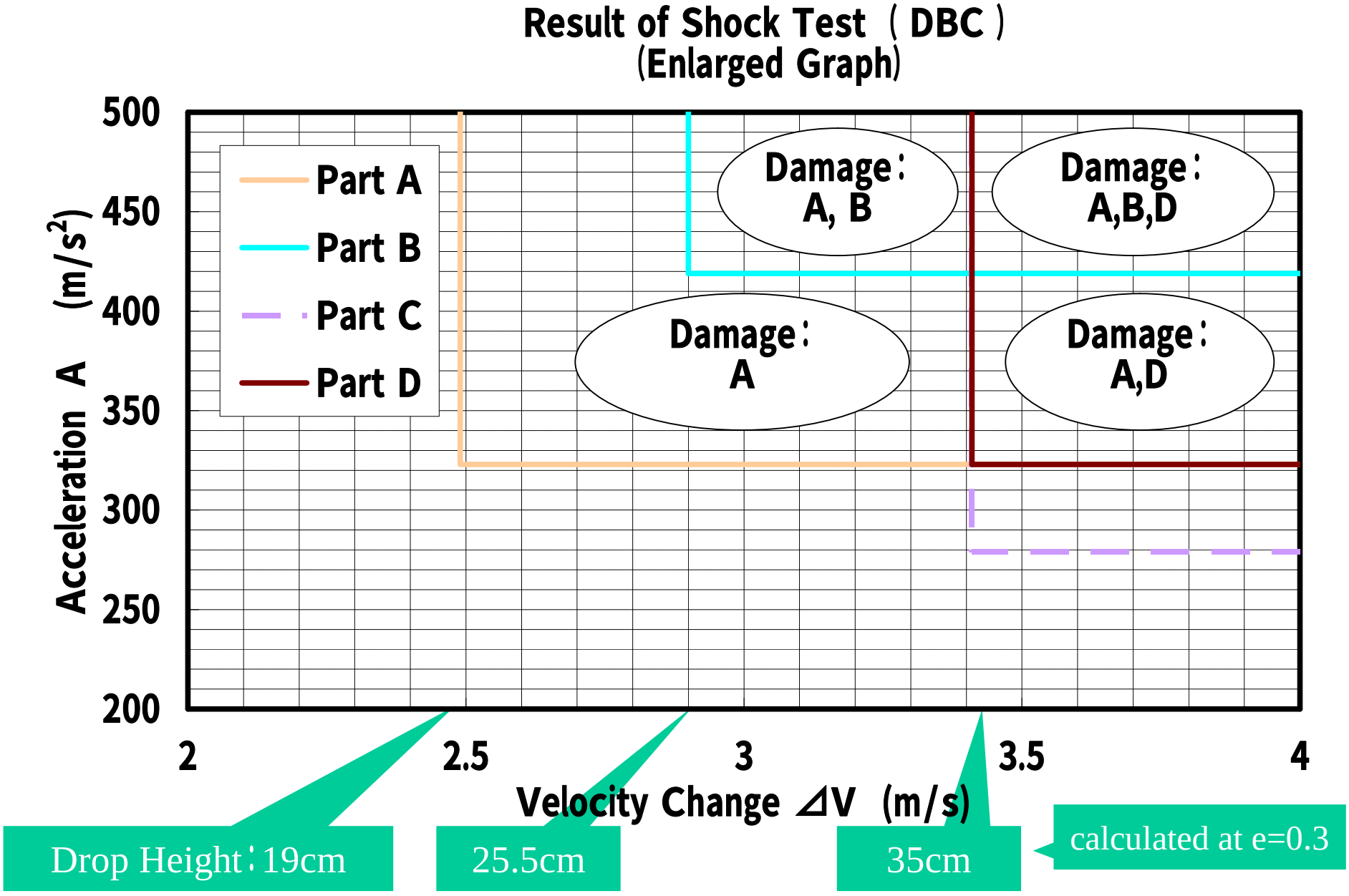
ex. 1 When the max drop height is 30cm, Ac will be improved from **323 ⇒ ∞ m/s²**.

Very Effective

ex. 2 When the max drop height is 40cm, Ac will not be improved.

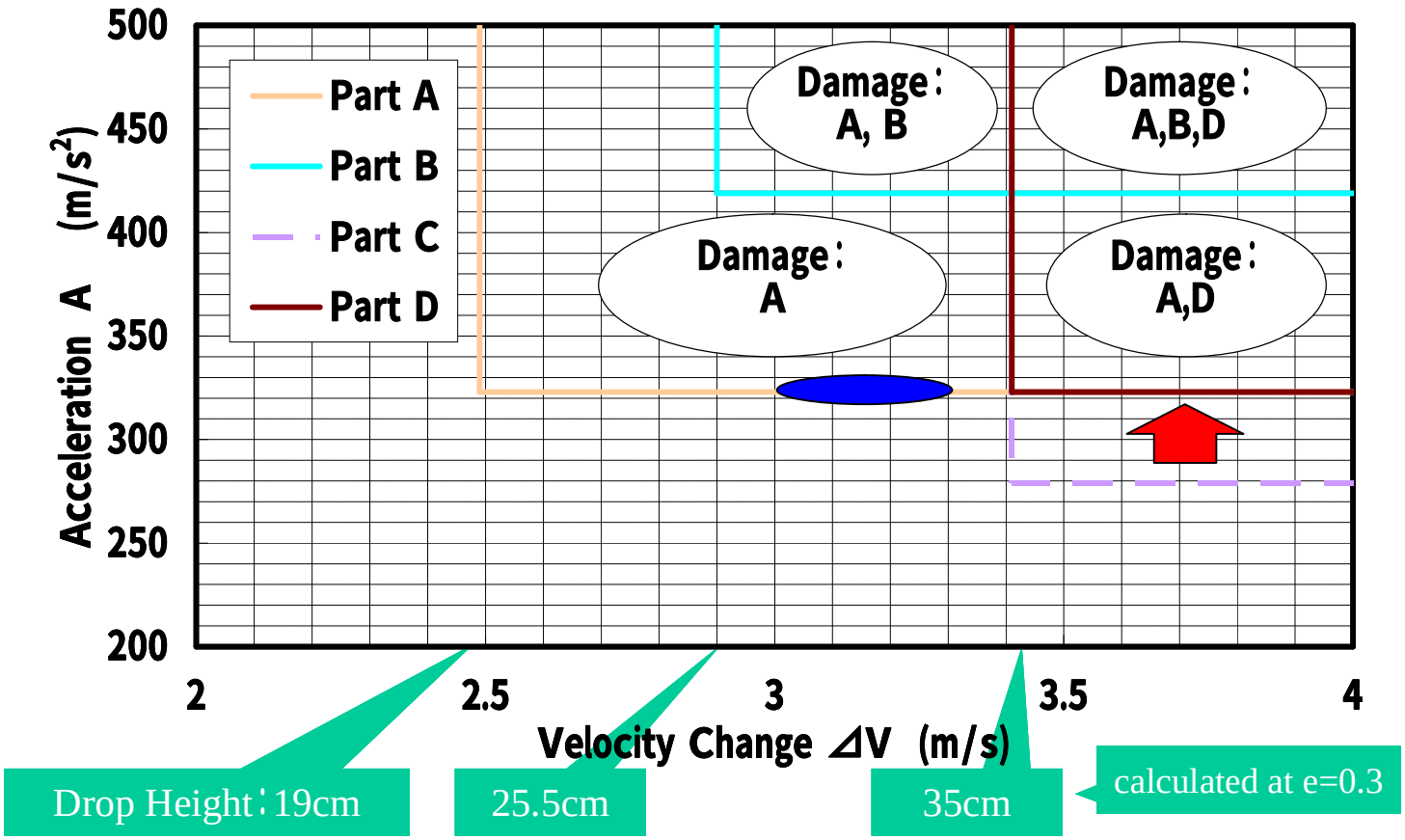
Meaningless

If Part C is refined, ・・・



If Part C is refined, ・・・

Result of Shock Test （DBC）
(Enlarged Graph)



ex. 1 When the max drop height is 30cm, Ac will not be improved.

Effective

ex. 2 When the max drop height is 40cm, Ac will be improved from **279 ⇒ 323 m/s²**.

Meaningless

--- The point ---

By this new test procedure,
product designers can get
a guideline of part's improvement.

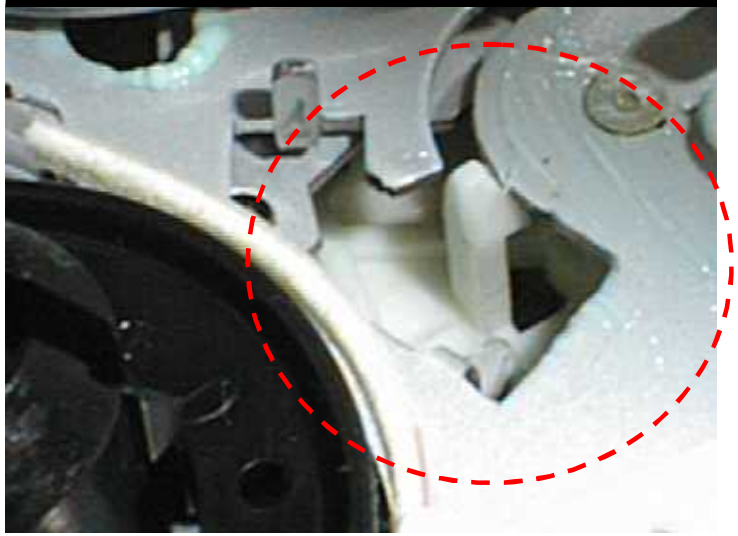
Ex.

H=30cm ⇒ "Refine Part A."
or "Refine Part A and B."

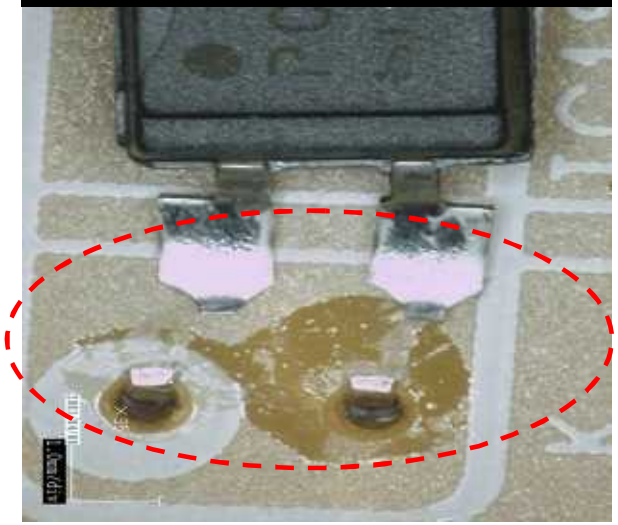
H=40cm ⇒ "No need to refine"
or "Refine Part C."

Result of Shock Test for a Video-player

A hook of a gear comes off.

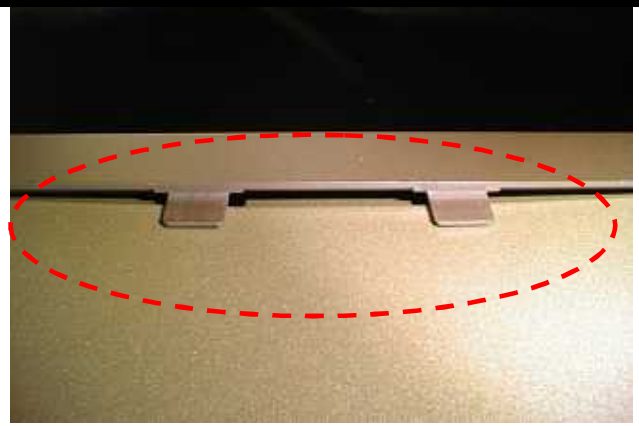


Legs of a coupler break.



A front panel breaks.

Stoppers of a front frame come off.



A shock test result of a certain product

Test No.	A m/s^2	⊿V m/s	⊿T ms	Observations	
1	1180	1.42	2.10	No damage	⊿Vc Test
2	1800	2.01	1.95	No damage	
3	2280	2.89	2.10	No damage	
4	2940	4.09	2.45	No damage	
5	4100	4.96	2.05	Gear, Coupler, Panel, Frame	
6	199	5.51	28.2	No damage	Ac Test
7	389	5.48	14.5	No damage	
8	596	5.39	9.55	No damage	
9	772	5.52	7.56	Gear, Coupler	
10	951	5.38	6.16	No damage except for the above	

Thank you very much

for your kind attention.