Flowchart of alternative method validation/revalidation

MLIT

Black: all alternative methods
Red: mathematical method (CFD) only
Blue: measurement method (wind tunnel not fulfilling the criteria of Annex4) only
Bold italic: new proposal from MLIT on 29th Aug.
Dot square: applied only if TAA request

When obtain the approval of alternative methods

Equivalency demonstration
- Measure/Calculate by approved wind tunnel and alternative method
- $\Delta CdAf < 0.015\ m^2$
- **_Declare scope (e.g. wheels, body shapes, cooling system, aero parts)_**
- **_Submit documents (simulation model, logic including parameter setting methodology, software version)_**
- **_Only one result from one input (No dispersion)_**

NEW

If not pass →

Reject the alternative method

If pass ↓   Every 4 year ↑   Any change ↑

Determine aerodynamic influence by alternative method at type approval
- Measure/Calculate by alternative method for VL, VH and Vind within declared scope
- $\Delta CdAf_{ind} = CdAf_{Vind} - CdAf_{VL}$
- $f_{2,ind} = f_{2,H} - (f_{2,H} - f_{2,L}) \times (\Delta CdAf_{LH} - \Delta CdAf_{ind}) / \Delta CdAf_{LH}$

During type approval

NEW

If not pass ↑

If TAA require →

If pass ←

Confirm equivalency (if required by TAA)
- **_TAA select vehicles and/or parts from declared scope_**
- **_Measure/Calculate by approved wind tunnel and alternative method_**
- **_$\Delta CdAf < 0.015\ m^2$_**

Any time TAA require (during type approval or other)

$CdAf_{Vind}$: measured/calculated CdAf of vehicle individual by alternative method
$CdAf_{VL}$: measured/calculated CdAf of vehicle L by alternative method
$\Delta CdAf_{LH}$: measured/calculated CdAf difference of vehicle H and L
f_2 : quadratic term of road load equation

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When obtain the approval of alternative methods

Equivalency demonstration
- Measure/Calculate by approved wind tunnel and alternative method
- $\Delta CdAf < 0.015$ m^2
- *Declare scope (e.g. wheels, body shapes, cooling system, aero parts)*
- *Submit documents (simulation model, logic including parameter setting methodology, software version)*
- *Only one result from one input (No dispersion)*

NEW

Necessary to determine the declared scope of "determine aerodynamic influence by alternative method" and to limit the scope of "Confirm equivalency" within availability of equivalency

...D) only
...nd tunnel not fulfilling

...*n MLIT on 29th Aug.*
...request

Necessary in order to make it clear if the manufacturer change some part of the alternative method

...ative
...method

If ...
... alternative method at type approval
- Measure/Calculate by alternative method for VL, VH and Vind within declared scope
- $\Delta CdAf_{ind} = CdAf_{Vind} - CdAf_{VL}$
- $f_{2,ind} = f_{2,H} - (f_{2,H}-f_{2,L}) \times (\Delta CdAf_{LH} - \Delta CdAf_{ind}) / \Delta CdAf_{LH}$

There should not be ambiguity in the type approval procedure.

Necessary because there should be procedure that deter misuse of alternative method.
This concept is comply with the general requirement about road load (Annex4 3.).

NEW

If not pass

If TAA require

If pass

Confirm equivalency (if required by TAA)
- *TAA select vehicles and/or parts from declared scope*
- *Measure/Calculate by approved wind tunnel and alternative method*
- *$\Delta CdAf < 0.015$ m^2*

Any time TAA require (during type approval or other)

...ind : measu...
... : measure...
f$_{LH}$: measu...
...adratic term...

MLIT is planning to present this proposal for whole alternative methods (including wind tunnel not fulfilling criteria) at WLTP-IWG, since CFD sub-wg covers discussion about CFD, not other alternative methods.

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MLIT requests the further discussion on the following area when JPN introduces CFD method into JPN legislation in the future. (It is okay to introduce to EU legislation (=Lv.1a of UNR-WLTP) and GTR15 amendment 6.)

area	current draft	concern
CFD validation	at least 3 cases including baseline per types of parts and at least total 9or12or15 cases	This requirement is based on experience and there are little case (no for JPN) that used for type approval till now.

Because of above concern, JPN will not introduce CFD into JPN legislation and UNR-WLTP Lv.1b and 2 now.

○Purpose
In order to deter misuse of alternative method, this provision is necessary.
If TAA doubt the equivalency of alternative method, TAA may require this provision.
Without this provision, once equivalency is demonstrated, there are no way to catch misuse.

○Requirement
TAA selects test vehicle and/or parts from declared scope.
Test the vehicle by wind tunnel and alternative method, and calculate ΔCdA for each method.
Compare ΔCdA of wind tunnel and ΔCdA of alternative method, and the difference shall be below 0.015m2. (examples are shown in following slides)

○Similar requirement
Annex4 3. (General requirements for road load measurement) mentions the responsibility of road load and demonstration of road load coefficients.
Alternative method is applicable only if the alternative method is equivalent to wind tunnel in GTR15. In order to be responsible for road load coefficient, manufacturer is responsible for the equivalency of alternative method. Therefore, equivalency demonstration requested by TAA is an appropriate way to prove that road load coefficients are correct.
It is true that this demonstration puts burden to the manufacturer, therefore, this provision is recommended to apply only if there are some doubt or ambiguity for equivalency.

(reference)
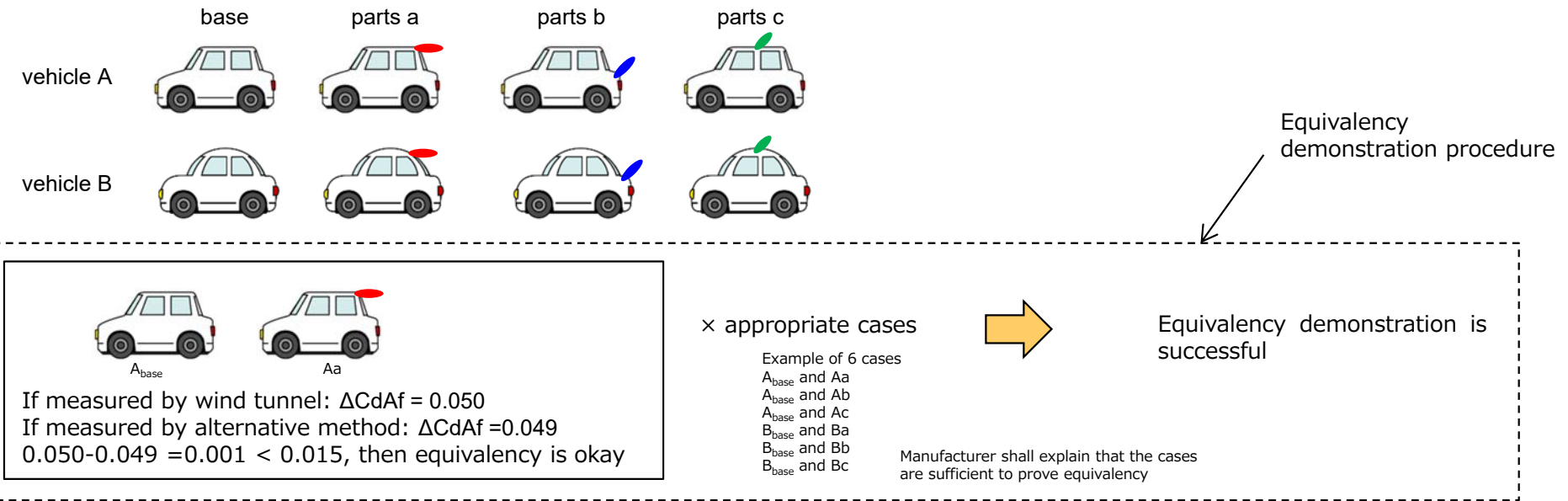GTR15 Annex4 3.General requirements
The manufacturer shall be responsible for the accuracy of the road load coefficients and shall ensure this for each production vehicle within the road load family. Tolerances within the road load determination, simulation and calculation methods shall not be used to underestimate the road load of production vehicles. At the request of the responsible authority, the accuracy of the road load coefficients of an individual vehicle shall be demonstrated.

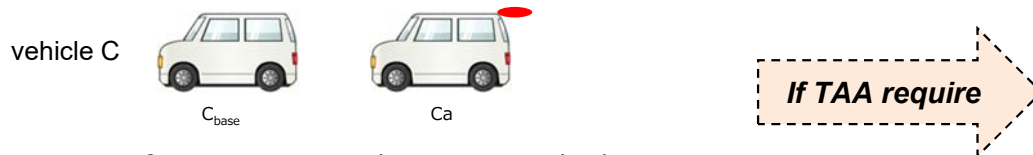○Case1: Limit the scope within "aerodynamic parts a,b and c"

Declared scope
This alternative method is applicable **only when parts a,b and c are added to base vehicle**. **Body shape shall be the same** when using this alternative method.
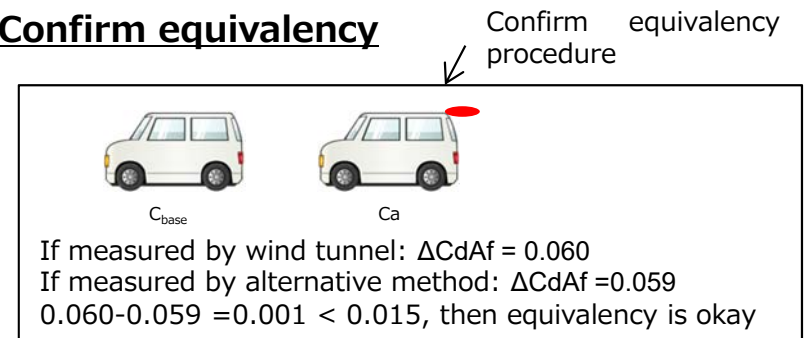
Equivalency demonstration

If measured by wind tunnel: ΔCdAf = 0.050
If measured by alternative method: ΔCdAf =0.049
0.050-0.049 =0.001 < 0.015, then equivalency is okay

× appropriate cases

Example of 6 cases
A_{base} and Aa
A_{base} and Ab
A_{base} and Ac
B_{base} and Ba
B_{base} and Bb
B_{base} and Bc

Manufacturer shall explain that the cases
are sufficient to prove equivalency

Equivalency demonstration is successful

Equivalency demonstration procedure

Type approval

vehicle C

C_{base} Ca

Manufacturer can use alternative method to determine ΔCdAf for vehicle Ca.

Manufacturer **cannot** use alternative method for parts d because it's out of the declared scope.

Cd

If TAA require

Confirm equivalency

Confirm equivalency procedure

C_{base} Ca

If measured by wind tunnel: ΔCdAf = 0.060
If measured by alternative method: ΔCdAf =0.059
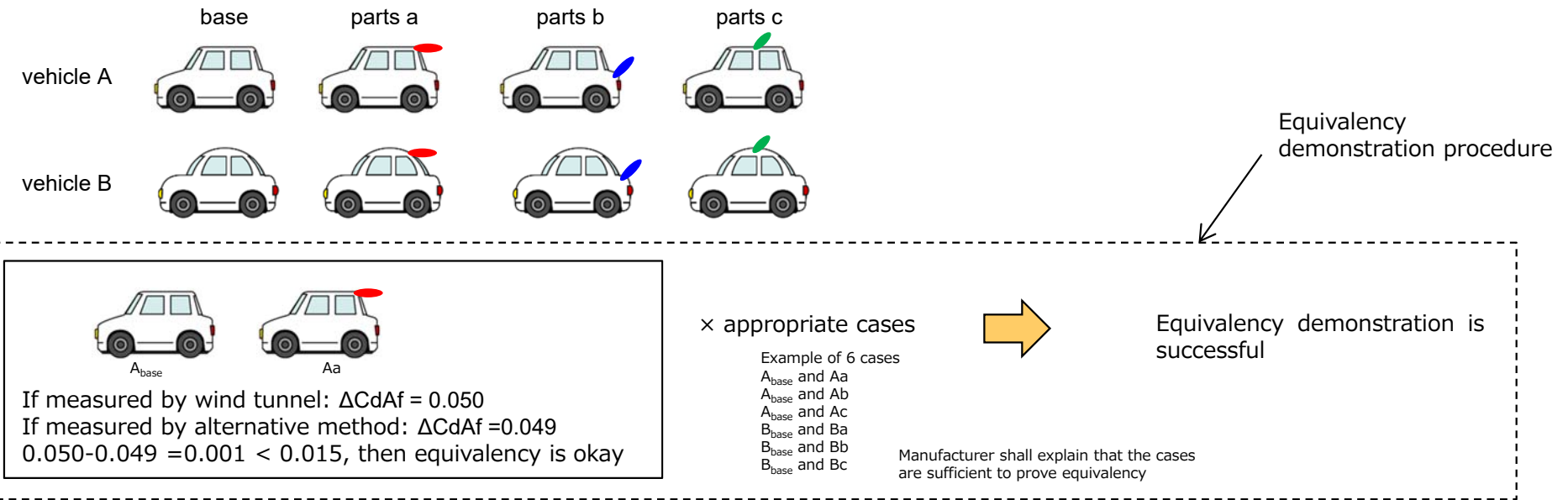0.060-0.059 =0.001 < 0.015, then equivalency is okay

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○Case2: Limit the scope within "any aerodynamic parts but not for body shape"

Declared scope
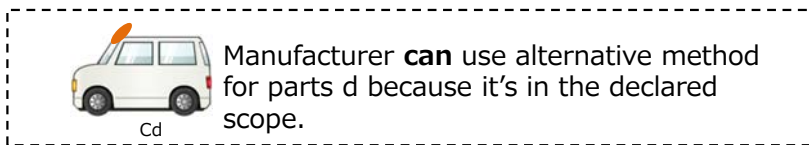This alternative method is applicable for **any aerodynamic parts if the body shape is the same**.
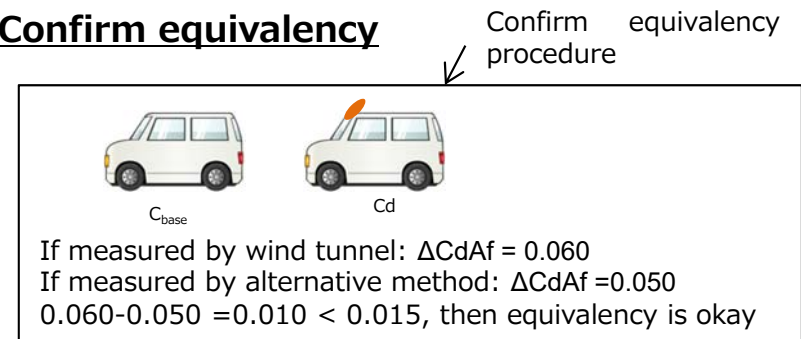
Equivalency demonstration

If measured by wind tunnel: ΔCdAf = 0.050
If measured by alternative method: ΔCdAf =0.049
0.050-0.049 =0.001 < 0.015, then equivalency is okay

× appropriate cases

Example of 6 cases
A_{base} and Aa
A_{base} and Ab
A_{base} and Ac
B_{base} and Ba
B_{base} and Bb
B_{base} and Bc

Manufacturer shall explain that the cases are sufficient to prove equivalency

Equivalency demonstration is successful

Equivalency demonstration procedure

Type approval

vehicle C

C_{base} Ca   Cd

Manufacturer can use alternative method to determine ΔCdAf for vehicle Ca and Cd.

Cd

Manufacturer **can** use alternative method for parts d because it's in the declared scope.

If TAA require

Confirm equivalency

Confirm equivalency procedure

C_{base} Cd

If measured by wind tunnel: ΔCdAf = 0.060
If measured by alternative method: ΔCdAf =0.050
0.060-0.050 =0.010 < 0.015, then equivalency is okay

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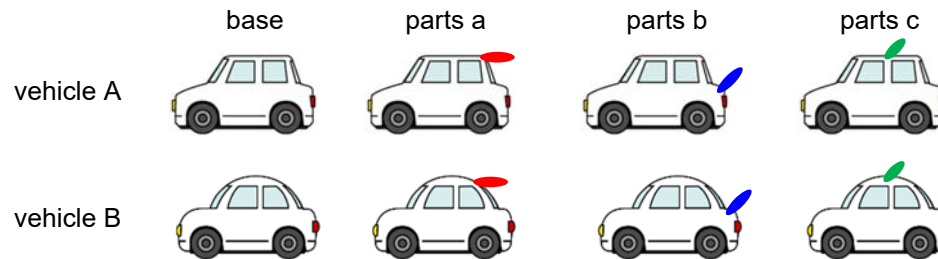# Example of "Declared scope" and application of confirmation

○Case3: No limit of the scope

Declared scope
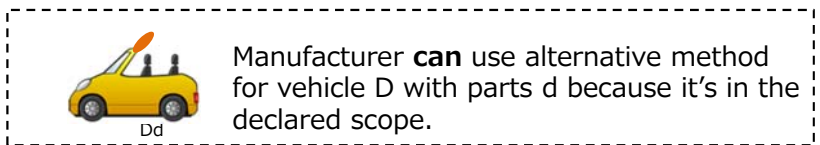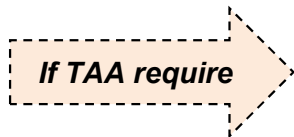This alternative method is applicable to **all vehicles.**

Equivalency demonstration

base   parts a   parts b   parts c

vehicle A

vehicle B

Equivalency demonstration procedure

A_{base} Aa

If measured by wind tunnel: ΔCdAf = 0.050
If measured by alternative method: ΔCdAf =0.049
0.050-0.049 =0.001 < 0.015, then equivalency is okay

× appropriate cases

Example of 7 cases
A_{base} and Aa
A_{base} and Ab
A_{base} and Ac
A_{base} and B_{base}
A_{base} and Ba
A_{base} and Bb
A_{base} and Bc

Manufacturer shall explain that the cases are sufficient to prove equivalency

Equivalency demonstration is successful

Type approval

A_{base} Ca   Dd

Manufacturer can use alternative method to determine ΔCdAf for vehicle Ca and Dd.

Manufacturer **can** use alternative method for vehicle D with parts d because it's in the declared scope.
Dd

If TAA require

Confirm equivalency

Confirm equivalency procedure

A_{base} Dd

If measured by wind tunnel: ΔCdAf = 0.060
If measured by alternative method: ΔCdAf =0.040
0.060-0.040 =0.020 > 0.015, then equivalency is **not okay**

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