UN ECE - GRSG - IGPG
4th Meeting
Test Combinations

2012-03-06 Dr. Frank Buckel
Plastic windscreens
approval test combinations

- approval test combinations already existing in ECE R43 (rigid plastic glazings other than windscreens)
  - resistance to humidity test followed by ball drop test
  - resistance to weathering test followed by a cross cut test
Plastic windscreens
approval test combinations

- approval test combinations recommended by Japan at the 1st meeting of the IGPG
  - stone chipping tests followed by a solvent test
  - abrasion resistance followed by a solvent test

1. stone chipping
   ISO 20567-1

2. chemical attack
   ECE R43
   A, B, C, D, E

1. car wash abrasion
   ISO 20566

or

1. falling sand abrasion
   ECE R22

2. chemical attack
   ECE R43
   A, B, C, D, E
Stone chipping test
according to ISO 20567-1

ISO 20567-1 “Paints and varnishes - Determination of stone-chip resistance of coatings - Part 1: Multi-impact testing”

Multi Grit Tester 508 VDA from Erichsen GmbH

1. pressure chamber
2. pressure reducer (to working pressure)
3. manometer
4. grit feed funnel
5. test panel holder
6. grit-catching chamber

chilled-iron grit (particle size of 4 to 5 mm)

sketch from ISO 20567-1
Stone chipping test according to ISO 20567-1 - results

- Image of coated PC after two test runs using 500g grit at a pressure of 2 bar (method B (harshest conditions) of ISO 20567-1))

- Image of 6 mm laminated glass after two tests runs using 500g grit at a pressure of 2 bar

- Cracks in the glass layer
Stone chipping test according to ISO 20567-1 - results

image of coated PC after two tests runs using 500g grit at a pressure of 2 bar (method B (harshest conditions) of ISO 20567-1))

image of 6 mm laminated glass after two tests runs using 500g grit at a pressure of 2 bar
Stone chipping test according to ISO 20567-1 - results

image of coated PC after two tests runs using 500g grit at a pressure of 2 bar (method B (hardest conditions) of ISO 20567-1))

After the stone chipping test only the coating is damaged (in this areas PC is exposed).

image of 6 mm laminated glass after two tests runs using 500g grit at a pressure of 2 bar

After the stone chipping test the glass is damaged (cracked)!
Combination test
immersion into chemicals according to ECE R43 after ISO 20567-1 (method B)

**Purpose:** testing the resistance of a plastic windscreen after stone chip damage against chemicals like window cleaning agents used e.g. in the windscreen wiper system

**Test:**
- samples used
  - damaged “coated PC samples” obtained after performing the stone chip test (ISO 20567-1 (2x500g grit with 2bar))
  - chemicals used (as defined in ECE R43)
    - cleaning agents (non-abrasive soap, window cleaning-solution, alcohol)
    - motor fuels (reference petrol, reference kerosene)
- procedure used
  - test pieces were immersed completely in the test fluid and held for one minute, removed and wiped dry
- evaluation after the test
  - checked for any softening, tackiness, crazing or additional loss of transparency

**Results:**

<table>
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<th>previous damage</th>
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No issue with typical windscreen cleaning solutions (according to ECE R43 this is an alkaline solution with anti-freezing agents (glycol))!

Even if someone is inadvertently pouring motor fuel onto the stone chip damaged (with bare PC!) plastic windscreen no additional issue occurs!
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network cleaning solution
 reference petrol

stone chip samples after immersion for 1min into window cleaning solution

reference petrol
Combination test
immersion into chemicals according to
ECE R43 after ISO 20567-1 (method B)

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comparison to glass (stone chip - repair - reference petrol)

info: the UV curable resin used to repair a stone chip damage on a glass windscreen can be removed from the screen with reference petrol (1min contact is enough)
Combination test
options for approvals

**Option 1:** Including the stone chip test according to ISO 20567-1 into ECE R43 for plastic windscreens, in order to be able to combine this test with chemical resistance

If the purpose is to test the chemical resistance after the protecting coating is “somehow” damaged in a way that bare plastic is exposed, it is also possible to

**Option 2:** use cross cut test according to ECE R43 in order to cut through the coating into the plastic substrate and immerse this “damage” into the chemicals defined in ECE R43
Combination test
immersion into chemicals after cross cut
both according to ECE R43

Test:
- cutting tool (see picture) was used to cut through the coating onto the subsurface of new “coated PC sample” a grid pattern
- chemicals, procedure, and evaluation as described previously

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➢ Both kinds of previous damage (in both case bare PC is exposed) leads to the same chemical resistance.
Combination test
immersion into chemicals after cross cut both according to ECE R43

info: if uncoated PC is contacted for 1 min with reference petrol (see picture of a uncoated PC roof after pouring reference petrol onto it), **no craze formation occurs** (some tackiness, and some haze can be observed)

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➢ Both kinds of previous damage (in both case bare PC is exposed) leads to the same chemical resistance.
Combination test
immersion into chemicals according to ECE R43 after abrasion

**Purpose:** testing the resistance of a plastic windscreen after abrasion damage against chemicals like window cleaning agents used e.g. in the windscreen wiper system

**Test:**
- samples used
  - scratched “coated PC samples” obtained after performing the car wash test (ISO 20566)
  - abraded “coated PC sample” obtained after performing the sand drop test according to ECE R22
- chemicals, procedure, and evaluation as described previously

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- Both cases no additional issue occurs after the chemical resistance test (haze increase due to abrasion test of course remains).
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Summary

combination tests

already existing combination tests for rigid plastic glazing other than windscreens

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Purpose is to test mechanical behavior in tropical climate

Proposal for further combination tests for rigid plastic windscreens

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Purpose is to check chemical resistance after damaging the coating
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Thank you!

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