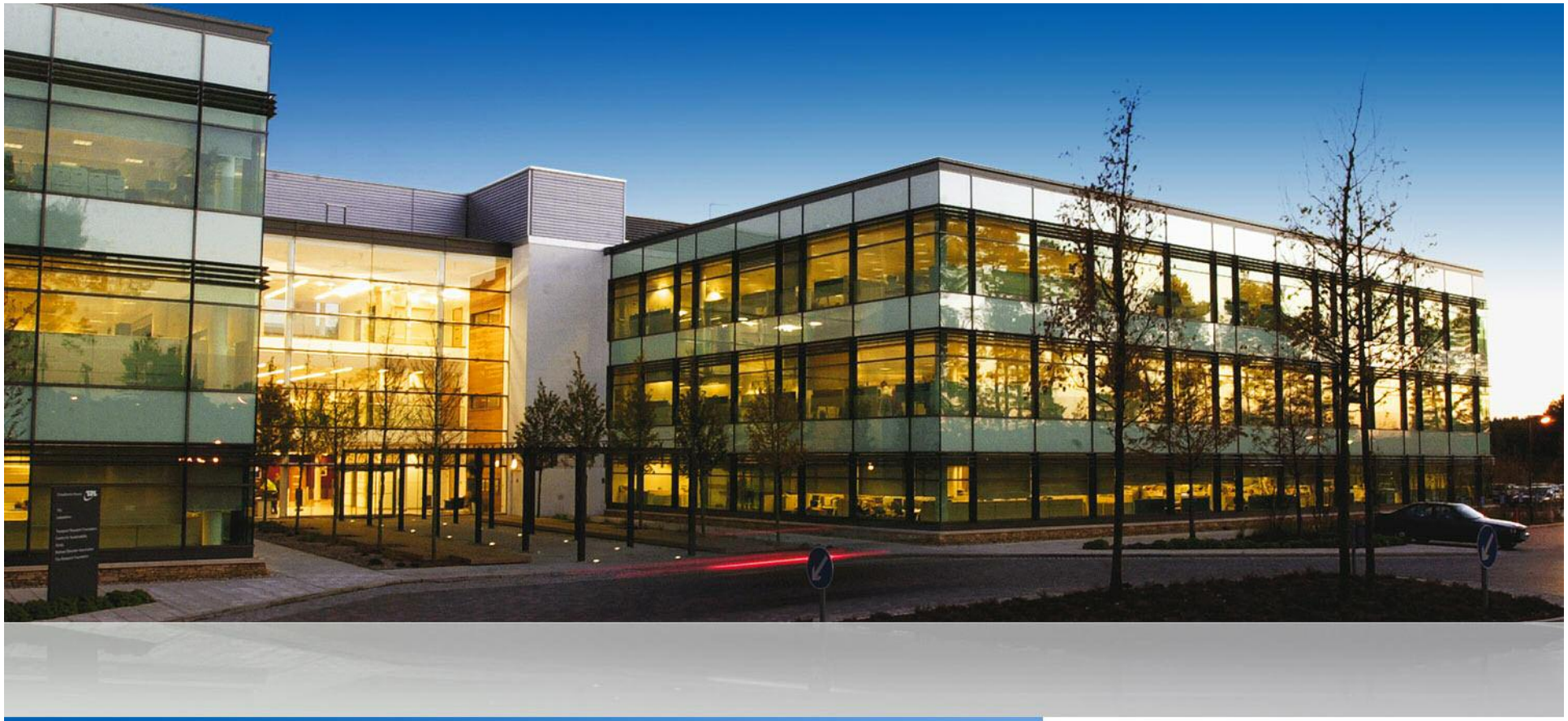


Legform Tests – Results from Round 2, Flex-PLI

Prepared by Brian Hardy & Jolyon Carroll

16-17 December 2013

Legform tests

Objectives

1

- Assess pedestrian protection levels across vehicle front
  - Could support justification for need to change bumper corner definition
  - Provide supporting information for the benefit estimate (i.e. predicted risk of injury around bumper corners)

2

- Determine practicality of extending bumper test area
  - Does impactor slide off vehicle giving very low values?
  - Does impactor rotate so as to invalidate measurements?

Legform tests – Round 2

Scheme for tests with Flex-PLI – updated at 4th TF-BTA meeting

1	Centre of bumper, no vehicle rotation
2	Centre of bumper, vehicle rotated 30 degrees
3	End of bumper beam, no vehicle rotation
4	End of bumper beam, vehicle rotated to remove oblique component
5	45 degree position with car rotated 15 degrees

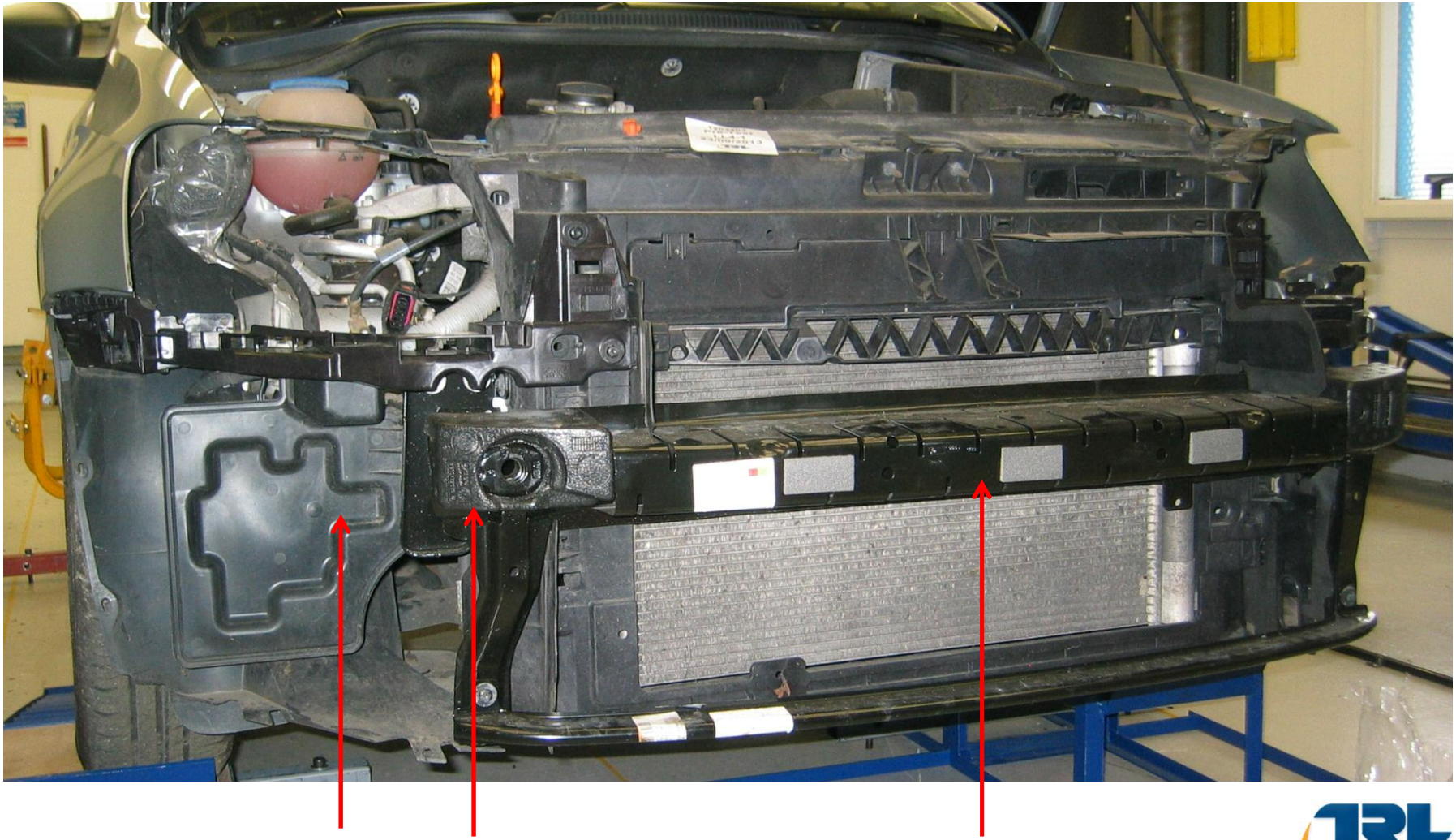
Legform tests – Round 2

Scheme for tests with Flex-PLI – updated at 4th TF-BTA meeting

Test number	Position on bumper	Vehicle rotation	Impact speed (m/s)
1	Centre	None	Usual (11.1 m/s)
2	Centre	30 degrees	9.1 m/s
3	End of bumper beam	None	Usual (11.1 m/s)
4	End of bumper beam	Sufficient for normal impact	Calculated based on vehicle rotation
5	45 degree plane	15 degrees	9.1 m/s

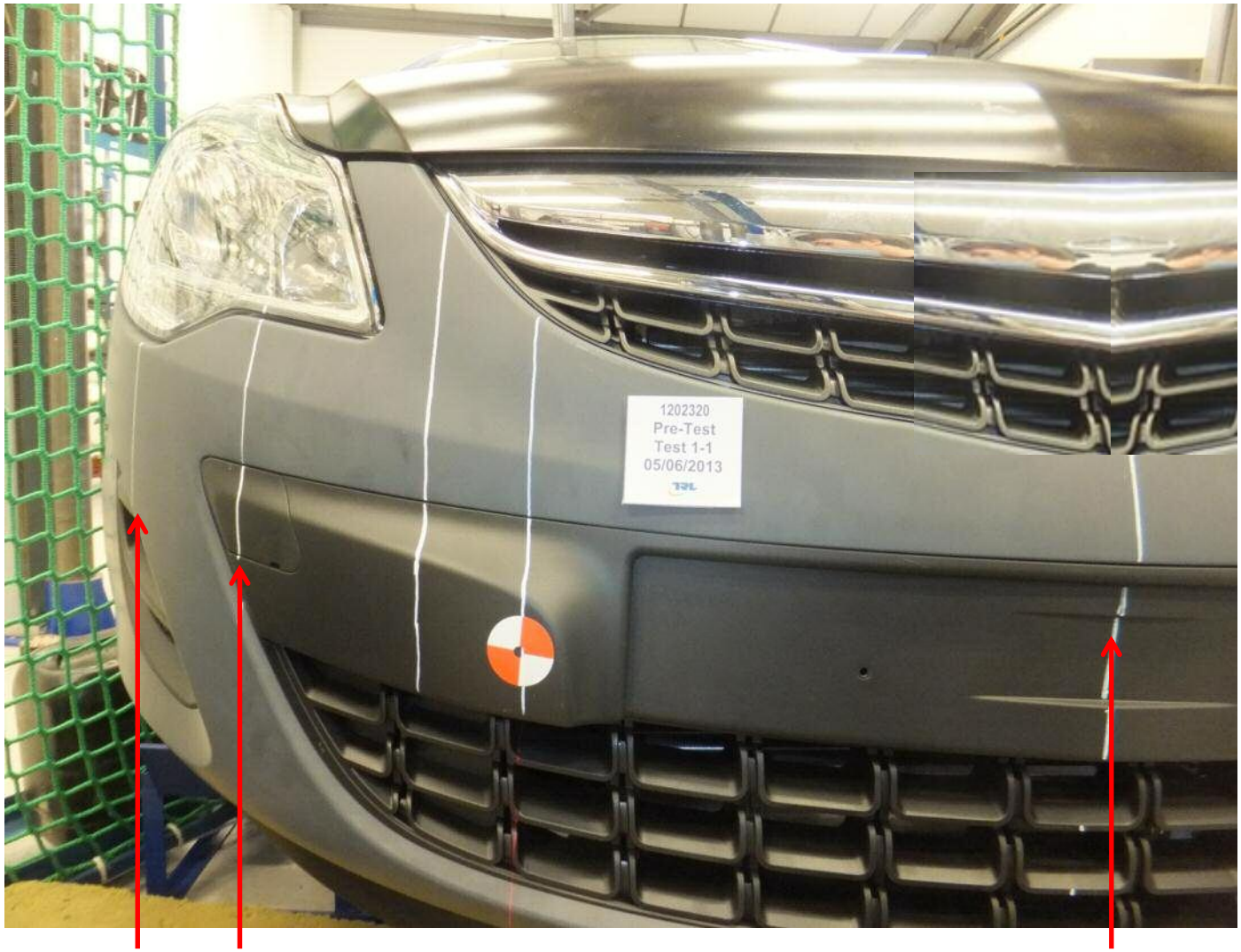
Legform tests – Round 2

Alignment on Vehicle 1



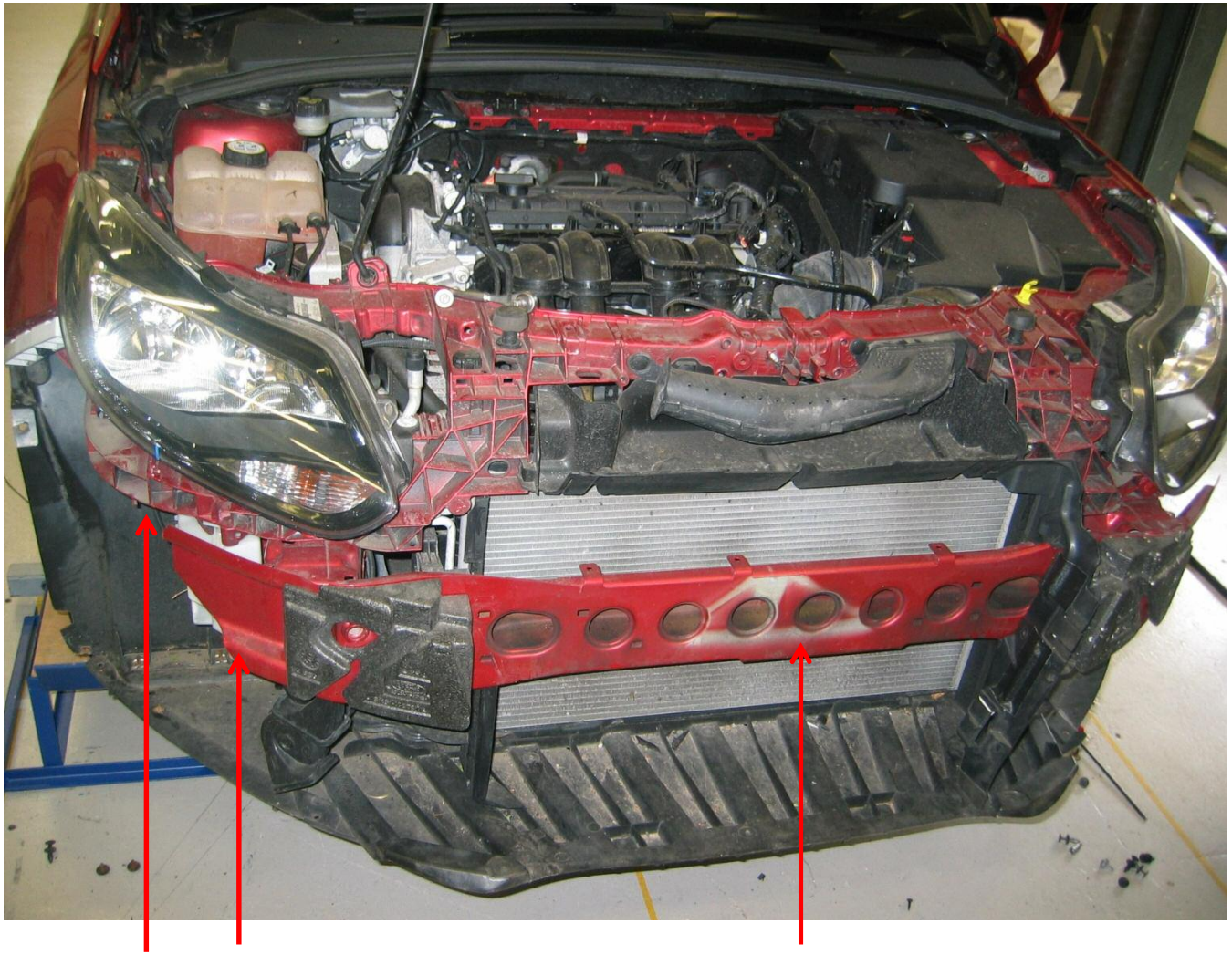
Legform tests – Round 2

Alignment on Vehicle 2



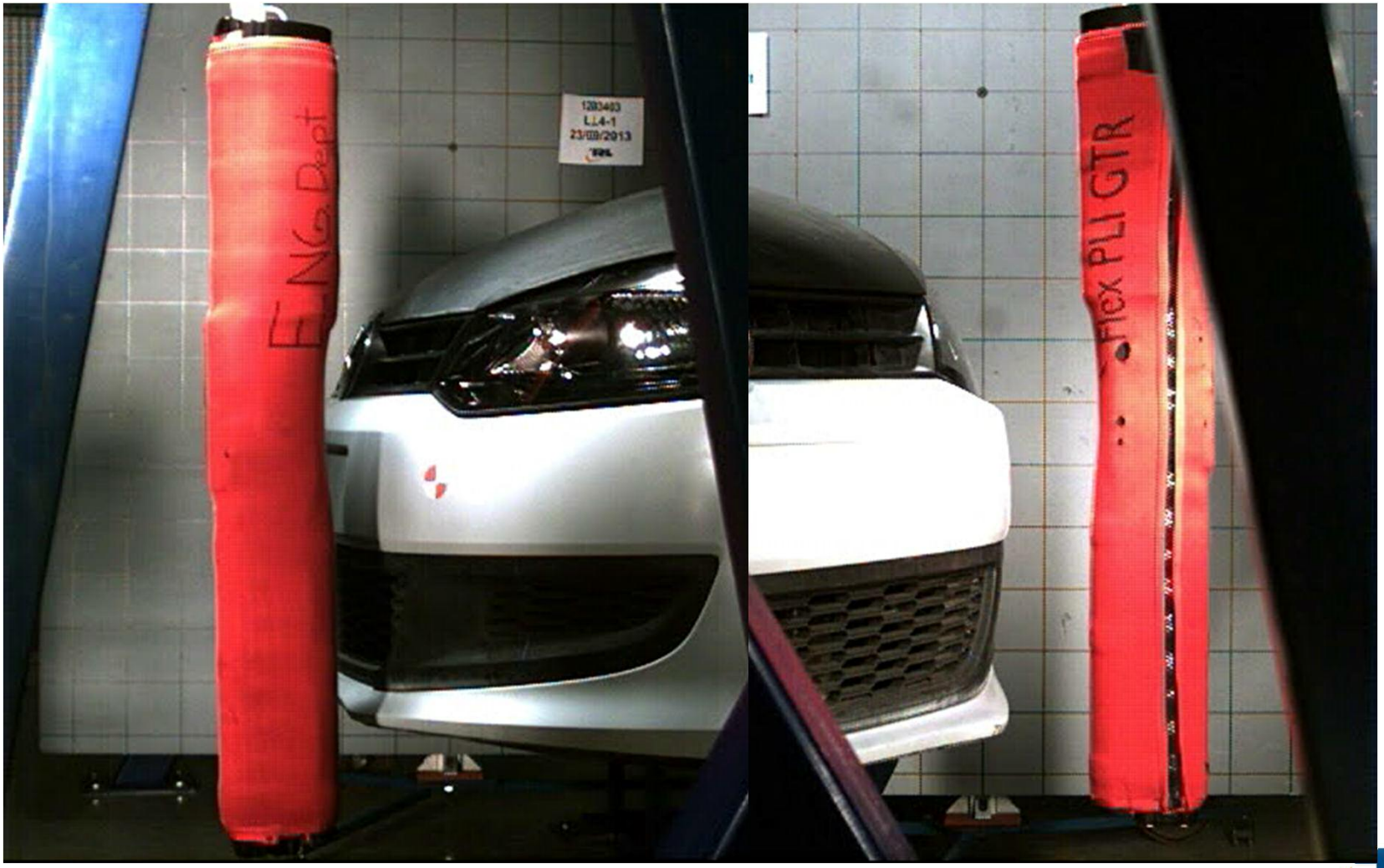
Legform tests – Round 2

Alignment on Vehicle 3



Vehicle 1

Angle of rotation – visual

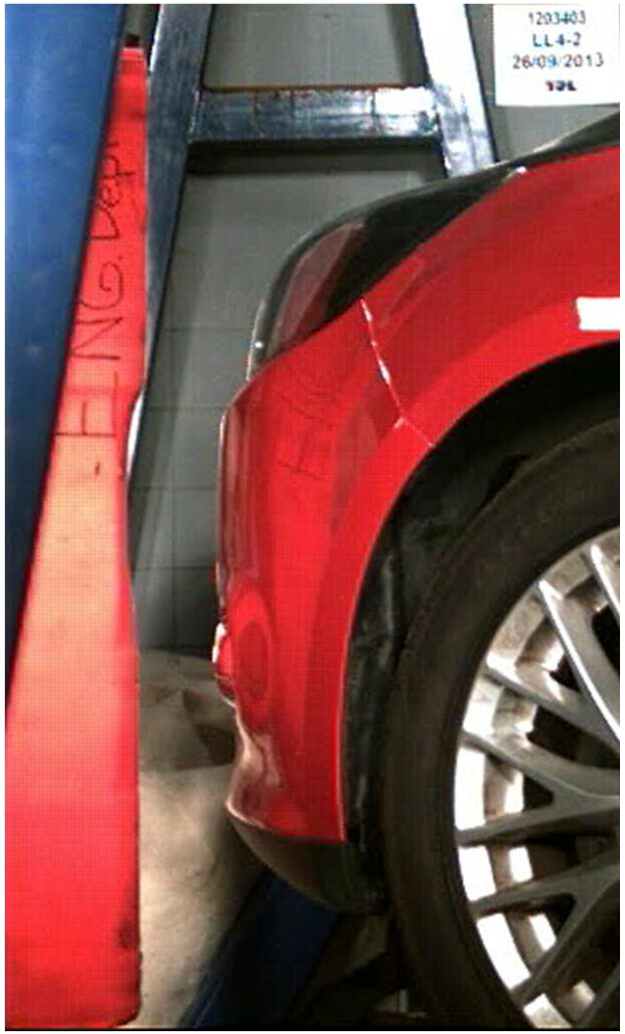


Vehicle 2

Angle of rotation – visual

Vehicle 3

Angle of rotation – visual



Vehicle 1

Peak values

Description of test location and rotation	ACL	PCL	MCL	Peak tibia bending moment
Centre	5.6	5.6	18.2	225
Centre – 30 degree rotation of car	4.3	5.4	12.1	175
End of bumper beam	10.0	6.3	18.8	314
End of bumper beam – normal impact (car rotated 35 degrees)	9.5	5.2	15.8	286
45 degrees – 15 degree rotation of car	5.4	4.9	14.7	151

Vehicle 1

Peak values

Description of test location and rotation	ACL	PCL	MCL	Peak tibia bending moment
Centre	5.6	5.6	18.2	225
Centre – 30				175
End of bum				314
End of bumper beam – normal impact	9.5	5.2	15.8	286
45 degrees – 15 degree rotation of car	5.4	4.9	14.7	151

All peak values within proposed acceptance criteria

Vehicle 2

Peak values

Description of test location and rotation	ACL	PCL	MCL	Peak tibia bending moment
Centre	1.8	2.3	6.8	191
Centre – 30 degree rotation of car	3.0	5.9	10.2	140
End of bumper beam	12.9	7.4	23.7	395
End of bumper beam – normal impact (car rotated 54 degrees)	9.3	6.0	20.3	332
45 degrees – 15 degree rotation of car	7.1	7.1	18.9	166

Vehicle 2

Peak values

Description of test location and rotation	ACL	PCL	MCL	Peak tibia bending moment
Centre	1.8	2.3	6.8	191
Centre – 30 degree rotation of car	3.0	5.9	10.2	140
End of bumper beam	12.9	7.4	23.7	395
End of bumper beam – normal impact	9.3	6.0	20.3	332
45 degrees – 15 degree rotation of car	7.1	7.1	18.9	166

Exceeding thresholds

Vehicle 3

Peak values

Description of test location and rotation	ACL	PCL	MCL	Peak tibia bending moment
Centre	3.7	3.7	12.1	230
Centre – 30 degree rotation of car	2.3	3.2	9.0	144
End of bumper beam	9.4	8.6	24.8	265
End of bumper beam – normal impact (car rotated 45 degrees)	7.7	8.6	23.1	271
45 degrees – 15 degree rotation of car	4.5	5.9	14.6	195

Vehicle 3

Peak values

Description of test location and rotation	ACL	PCL	MCL	Peak tibia bending moment
Centre	3.7	3.7	12.1	230
Centre – 30 degree rotation of car	2.3	3.2	9.0	144
End of bumper beam	9.4	8.6	24.8	265
End of bumper beam – normal impact	7.7	8.6	23.1	271
45 degrees – 15 degree rotation of car	4.5	5.9	14.6	195

Exceeding thresholds

Legform tests – Round 2

Initial thoughts

Injury causing points

- At the end of the bumper beam
  - Some vehicles have 'stiff' structures
  - Pedestrian protection could be improved
- Beyond the bumper beam
  - Typically not a problem for protection

Testing

- Testing at oblique angles
  - Seems as though rotation of vehicle provides an option to mitigate legform rotation
- Practicality
  - Not sure how much car rotation is feasible
  - Not sure how much car rotation is desirable

Angle of rotation

- Need to finish analysis of legform rotation
  - Previously shown large rotation at peak values for EEVC leg
  - Highest peak values occur when the car is aligned with firing direction

Initial benefit estimates

Estimates of casualty and financial benefits of extending the test area

Estimate	Casualties		Value (€ million)	
	Lower	Upper	Lower	Upper
Target population	505	2,955	107	627
Effectiveness (14 to 16 %)	71	473	15	100

- The central estimates are thus that extending the test area could:
  - prevent 272 serious injuries in the EU per annum (± 201)
  - save €58 million per annum (± €43m)

Thank you...
Questions?

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16-17 December 2013

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