Background data for force level in ISO 13216-4:2020

Summary of extracts from ISO-TC22-SC36-WG2 documents

Compiled for discussions in sub-group of GRSP,

by Lotta Jakobsson, 2022-07-11

Text in ISO 13216-4:2020

Apply a force of 2 500 N to each lower tether anchorage, by means of a representative lower tether strap 38 mm ± 3 mm wide that is fitted at one end with suitable hardware for applying the force and at the other end with a bracket for the attachment to the lower tether anchorage.

For anchorages designed to be used for two adjacent CRS positions, or in case of a single LTA, the force shall be 5 000 N.

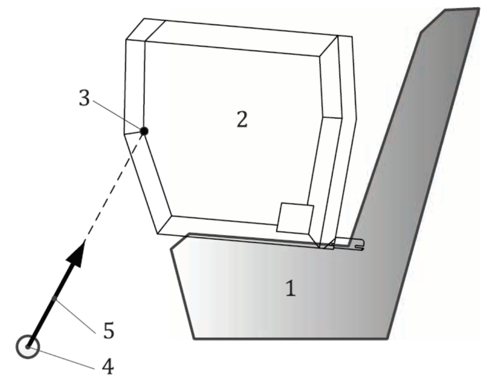
The force:

— shall be applied in a direction determined by the FDRP (force direction reference point), with a tolerance of ±20 mm in all directions given in Figure 4, noting that the FDRP lateral position coincides with the centreline of the ISO/R2 envelope,

— shall be attained within 30 s, and

— shall be maintained for a minimum of 0,2 s.

NOTE The test method is designed to be as realistic as possible. Any strap re-routing influenced by the vehicle interior, for example by the seat in front of the ISO/R2 envelope, is also considered in the strength test.



Key

1 vehicle seat illustration
2 ISO/R2 envelope installed in related vehicle seating position
3 FDRP (force direction reference point)
4 example of actual LTA position in vehicle
5 test force direction

NOTE The FDRP lateral position coincides with the centreline of the ISO/R2 envelope.

Figure 4 — FDRP, Force Direction Reference Point, and test force direction

Background compiled in this document

All N-documents refer to ISO-TC22-SC36-WG2

- N1237_Resolutions_60_Munich_2018-12-04—05, *extract*
- N1240_Input_to_LTA_discussion_WG_2_Munich_2018-12-05_Lotta_Jakobsson, *extract* – e.g., on transfer from dynamic to static level, also including crash tests from:
    - N1193_Loads_measurement_Britax_ISO_LTA_task_force_2017-10-27
    - N1219_Proposal_for_a_static_strength_test_for_LTAs_in_ISO_WD_13216-4_Britax

Status report from Dec 2017

- N1207_ISO_LTA_Topic_Update_2017-12-05_Farid_Bendjellal

N1237_Resolutions_60_Munich_2018-12-04—05, extract

Resolution 381 – Lower tether anchorages, ISO/WD 13216-4

On behalf of the Swedish experts, Lotta presented a short background on why to use LTA, new input to the force level (including a CAE study) and some response to the comments received during the NWIP ballot (see N 1240).

Based on the CAE study (static and dynamic testing applied on Top Tether) and discussions at the meeting, a ratio of 0,6-0,7 between the level of static force and dynamic force is proposed. Put in relation to the lower tether loads in the dynamic tests, it was decided to choose the static load level of 2,5 kN for an LTA made for single strap use (one of two lower tethers). In the case of two straps loading the same LTA, or an LTA for one strap taking the full load, the static load level will be 5 kN.

Input to LTA discussion

ISO TC22/SC36/WG2 meeting Dec 2018

Lotta Jakobsson

on behalf of the Swedish Expert group and Farid Bendjellal, Task Force leader LTA

Content

Why LTA?

How to evaluate?

- Proposal to allow for exemptions from the strength testing
- Force level
  - Crash test measurements
  - Example; CAE study providing input to dynamic vs static forces on anchorages

Additional comments received during the NWIP ballot

Why is Lower Tethers used and needed?

- Lower tethers have been used for large rearward facing seats for decades
- Large rearward facing seats are proven overall low injury risks and good protection in all crash configurations
  - ➢evidence of robust protection and relatively insensitive to misuse
- Lower tethers are especially essential in;
  - Rear-end impacts and rebound in frontal impacts
  - Rollover and other complex events

More information see:

ISO-TC22-SC36-WG2_N1197_Lower_Tether_history_and_motivation_Nov2017_LottaJ

Lower Tether Anchorages (LTA), examples

Factory mounted

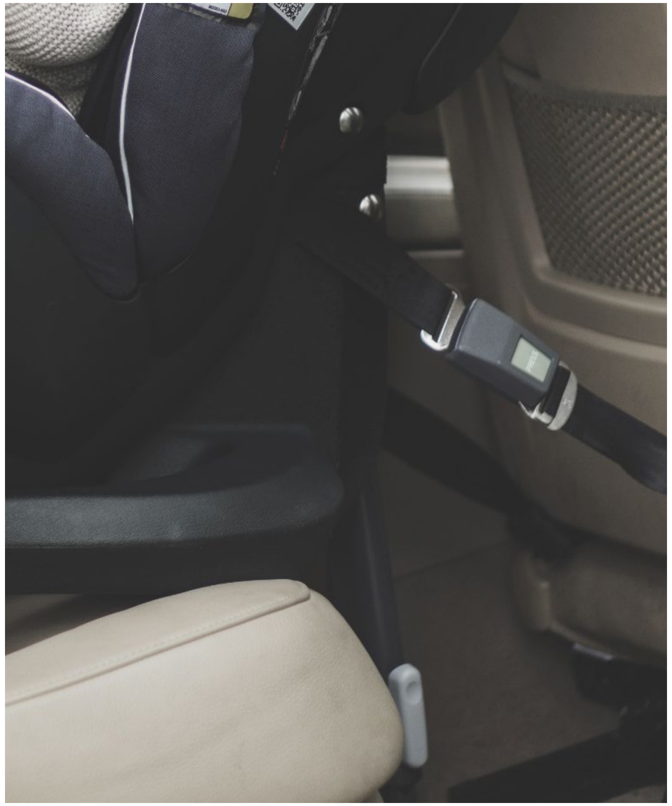
Volvo V60

Accessories / retrofit

The retrofit anchorages are mainly mounted by child seat retailers and the users. Only in a few occasions they are mounted at certified car workshops.

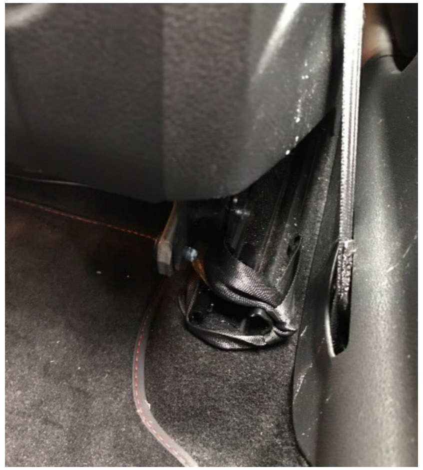
LT installations in cars without LTA, examples

Routing around the rear end of the seat rails



Routing around the seat recliners

Routing under the front seat



More examples, see: ISO-TC22-SC36-WG2_N1197_Lower_Tether_history_and_motivation_Nov2017_LottaJ

LT installations in cars without LTA, examples

Photos from the German market (Heiko Johannsen)

Why is a standard for LTA needed?

- The use of large rearward facing child seats are increasing and becoming more spread globally.
- In Sweden today, a large share of the children use rearward facing seats approved up to 25 kg (R44 group 2)
- The majority of the seats have lower tethers
- In the majority of the cars, there are no factory mounted LTA, hence:
  - retrofit LTAs are mounted in an uncontrolled process, or
  - the lower tethers are routed in different uncontrolled ways

➢ Avoid damage to car interior, seat chassis and cables under seats - of growing importance with new seat technologies

➢ Ease-of-use

See also:
ISO-TC22-SC36-WG2_N1207_ISO_LTA_Topic_Update_2017-12-05_Farid_Bendjellal

How to evaluate?

A standard is proposed to help control the attachments of the lower tethers, targeting ease-of-use and to minimize risk of vehicle damages.

- Similar to Top Tether principles
- Wide zones for geometry specifications, to allow for different arrangements
- Simple strength testing; strong areas available, reinforcements usually not needed

To simplify even further, a proposal is to allow for exemptions from the strength testing, if vehicle parts used are controlled for other purposes (e.g. adult occupant protection).

Is strength testing required for all mounting positions?

- The seat rails of the front seats are tested to sustain loads from adult front seat passengers during a crash (eg. UN R17, FMVSS 207)
- The loads from a child seat attached to the rails will be significantly lower.

- A proposal is to allow an exemption of the strength test requirements if the lower tether anchorage is an integrated part of the seat rails, eg:

This document contains … , including strength requirements and test method. In case the lower tether anchorages are part of, or attached to, a part of the vehicle seat anchorage with an already approved strength method (e.g. UN R.17, FMVSS 207, …), the strength requirements according to this document is considered fulfilled.

Input to discussion on force level

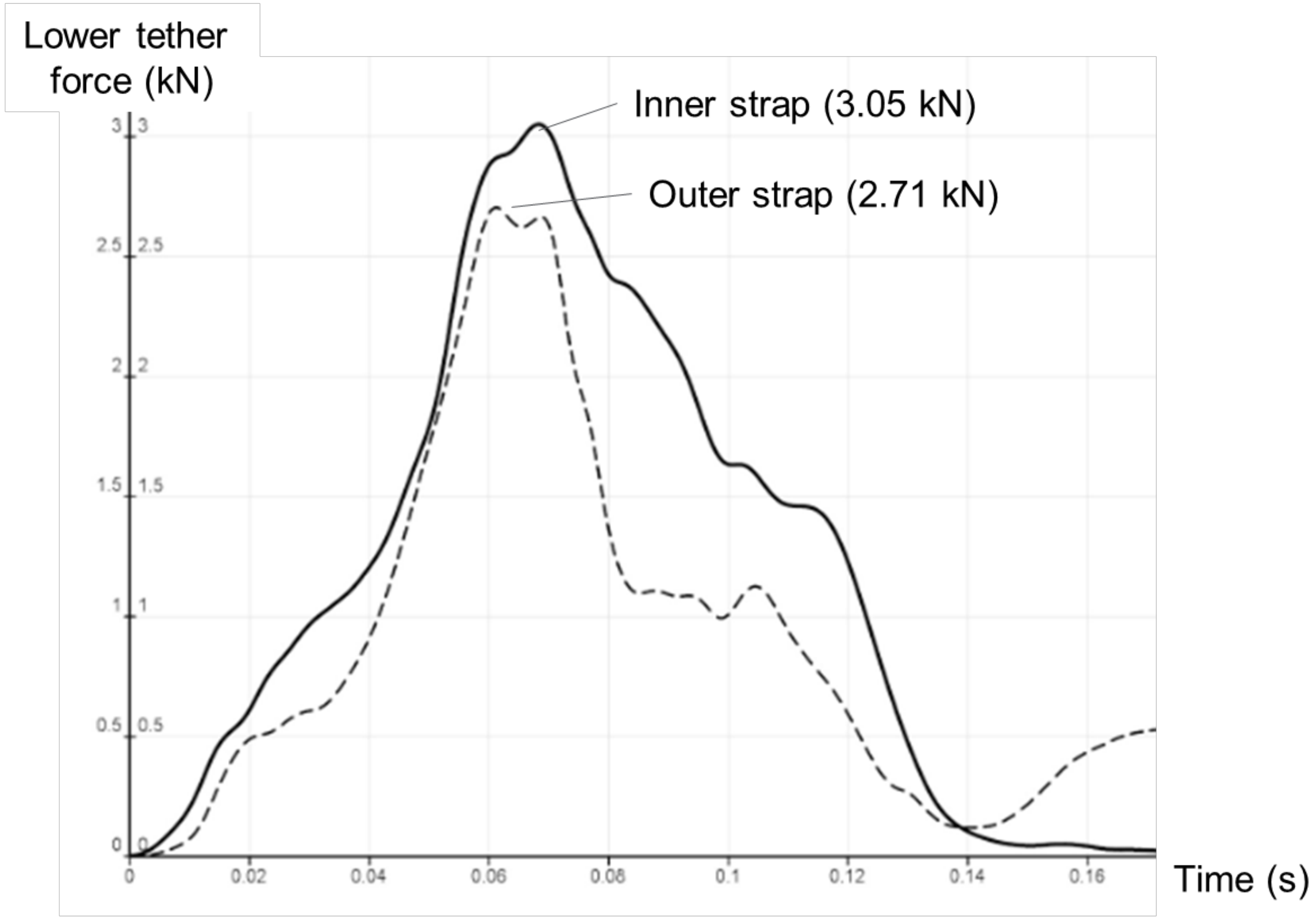
Forces measured in lower tether straps in crash tests, examples

- Vehicle tests (see following pages)
  - 2.7 kN / 3.0 kN in high severity rear-end impact with adult front seat occupant (Q3 in rear seat outer position)
  - 2.8 kN/ 1.5 kN in 70% overlap by deformable barrier in >50mph (HIII 3y in front passenger seat position)
- Britax rig tests (see: *ISO-TC22-SC36-WG2_N1193_Loads_measurement_Britax_ISO_LTA_task_force_2017-10-27*)
  - 2.6-3.7kN in R44 rear-impact tests

CRS	Britax Max-Way (RWF, G 1/2)	Britax Multi-Tech (RWF/FWF, G1/2/3)	Britax Multi-Tech (RWF/FWF, G1/2/3)
Dummy	P6	P6	P6
Anchorage point	R3/R4	R3/R4	R5
Load left tether [N]	3328	2768	3719
Load right tether [N]	3257	2653	3454

Vehicle sled test; rear-end impact

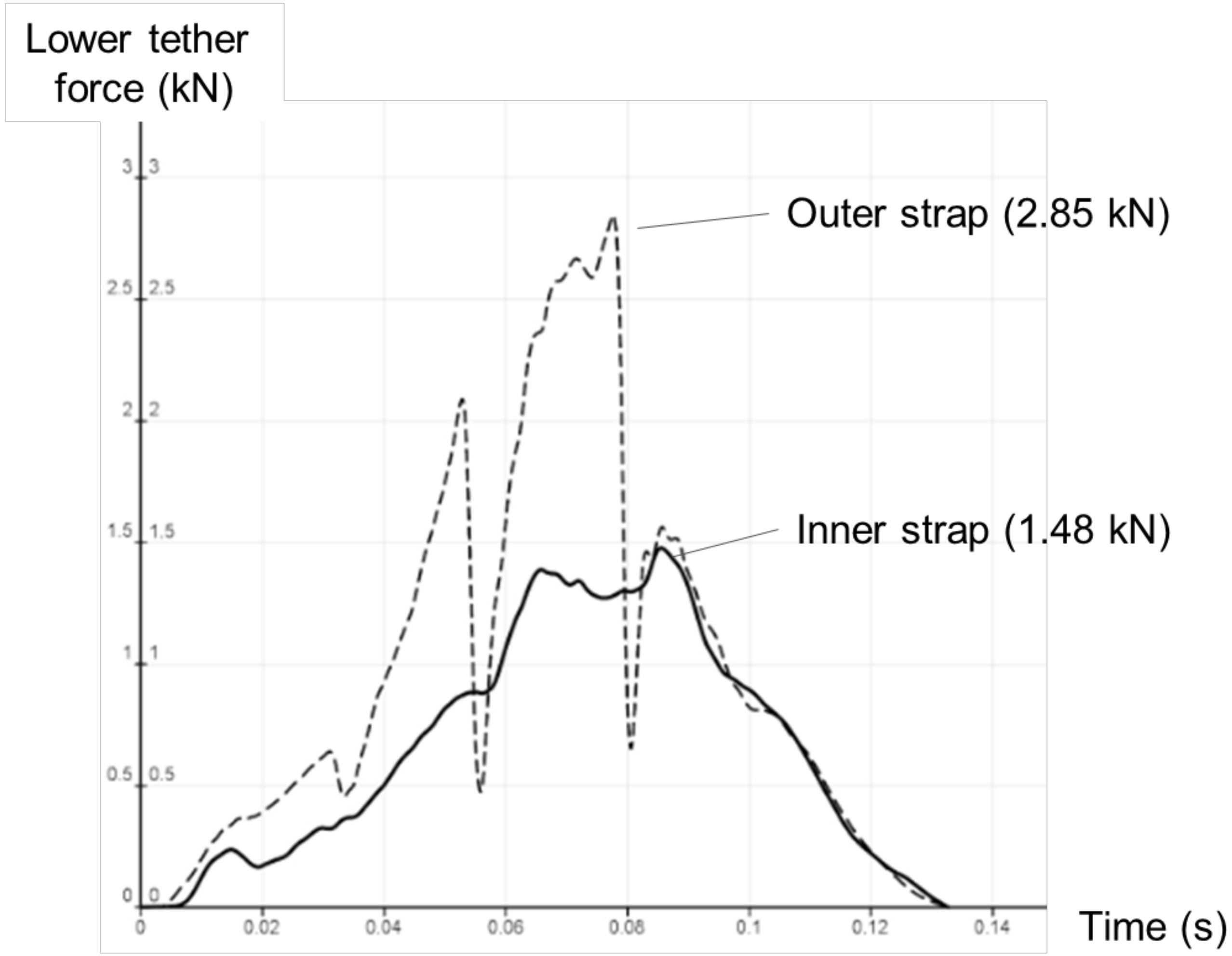
High severity (35mph / 56km/h) with front seat occupant Q3 in a rearward facing seat



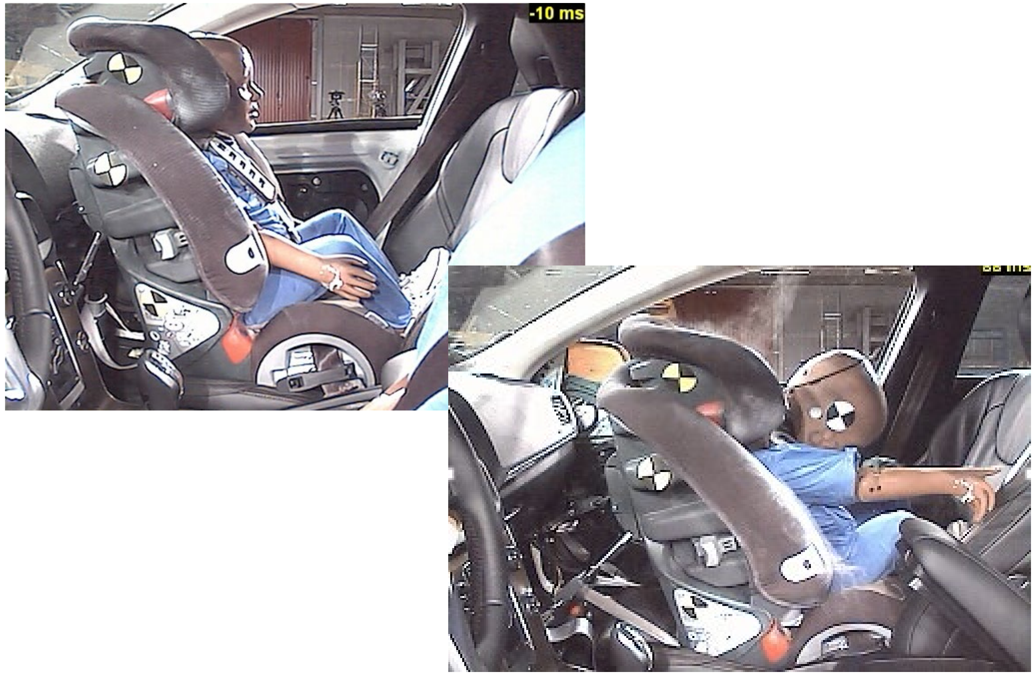
Sill acceleration:
max 18.4g, total duration 80ms

Complete vehicle test, rear-end impact;

High severity; 70% overlap by deformable barrier in >50mph / 80km/h
HIII-3y in a rearward facing seat – front passenger position



Sill acceleration:
max 23.5g, total duration 90ms



Asymmetrical placement of LTA on the vehicle floor

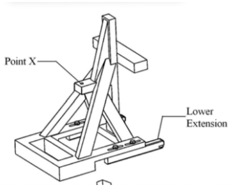
How to translate dynamic to static forces?

- There is no direct translation between corresponding forces from dynamic and static tests
- Generally, material can sustain a higher short peak load than when exposed to loads over a longer time period
  - The corresponding tolerable 'dynamic load' is higher than the 'static loads', the level depends on the material and design /structure
  - As a "rule of thumbs"; the ratio of 2/3 is commonly used in vehicle crash applications
- One way to compare the loads in static and dynamic loading conditions is through CAE where the strains in the material is compared for the two types of loading
  - Volvo Cars made a CAE comparison applied for the top tether and ISOFIX, in some different loading conditions, and came to an overall approximate relation of : **static force = dynamic force x 0.6**

Example: An estimation of dynamic load equivalent to static load – Top tether

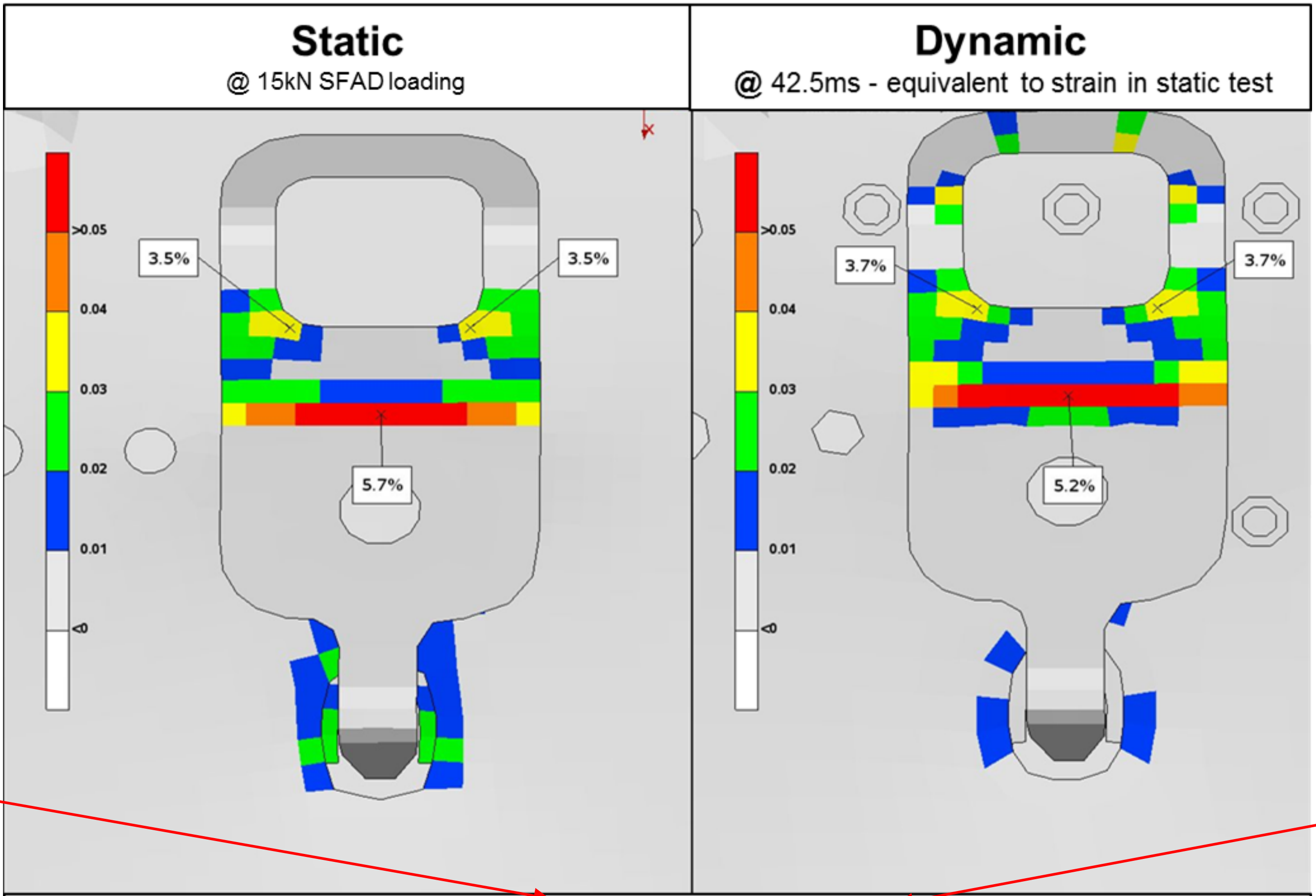
Static test:
in accordance with FMVSS225

SFAD1 + SFAD2
Pulling angle forward



TT force at legal req. load level

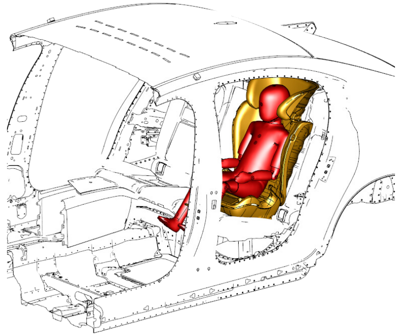
Comp.	Force [KN]
Fx	3.8
Fy	0.1
Fz	0.1

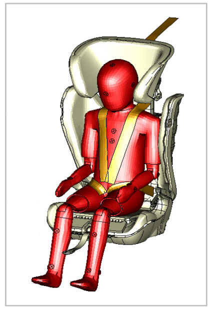


In this comparison: static loads = dynamic loads x 0.68

Dynamic test:
Full frontal impact test 40mph, using a car body.

Forward facing child seat attached by ISOFIX and Top Tether (TT); child using 5p harness.
Total weight child and child seat 45kg





TT force @ static test eqv. (42.5ms)

Comp.	Force [KN]
Fx	5.6
Fy	0.1
Fz	0.5

TT force (peak)

Comp.	Force [KN]
Fx	11.6
Fy	0.6
Fz	0.7

VOLVO'S IN-HOUSE REQUIREMENTS

Geometry requirements

- Radius requirements according to ECE R21
- Large enough to fit our standard attachments (hooks, see Figure)

Placement

- No specific requirements, best practice used

Strength test, tensile load

- No separation/breakage
- 4,5 - 5,5kN for each anchorage in specified pulling directions
  - "Pulling angle, referring to the horizontal surface, is approx. 20° on the outer anchorage and 40° on the inner anchorage".
  - "Pulling angle, referring to the vertical surface and directing towards the centre of the CRS, is approx. 55° on both the anchorages".
- The anchorages are pulled individually by using a hydraulic cylinder (or equal). The test is performed with a slow speed until load has been reached.
- The test setup and force levels are based on "sharing"; loads from two child seats.

Lower tether forces of exsiting CRS‘s

D.Braun, 27/10/2017

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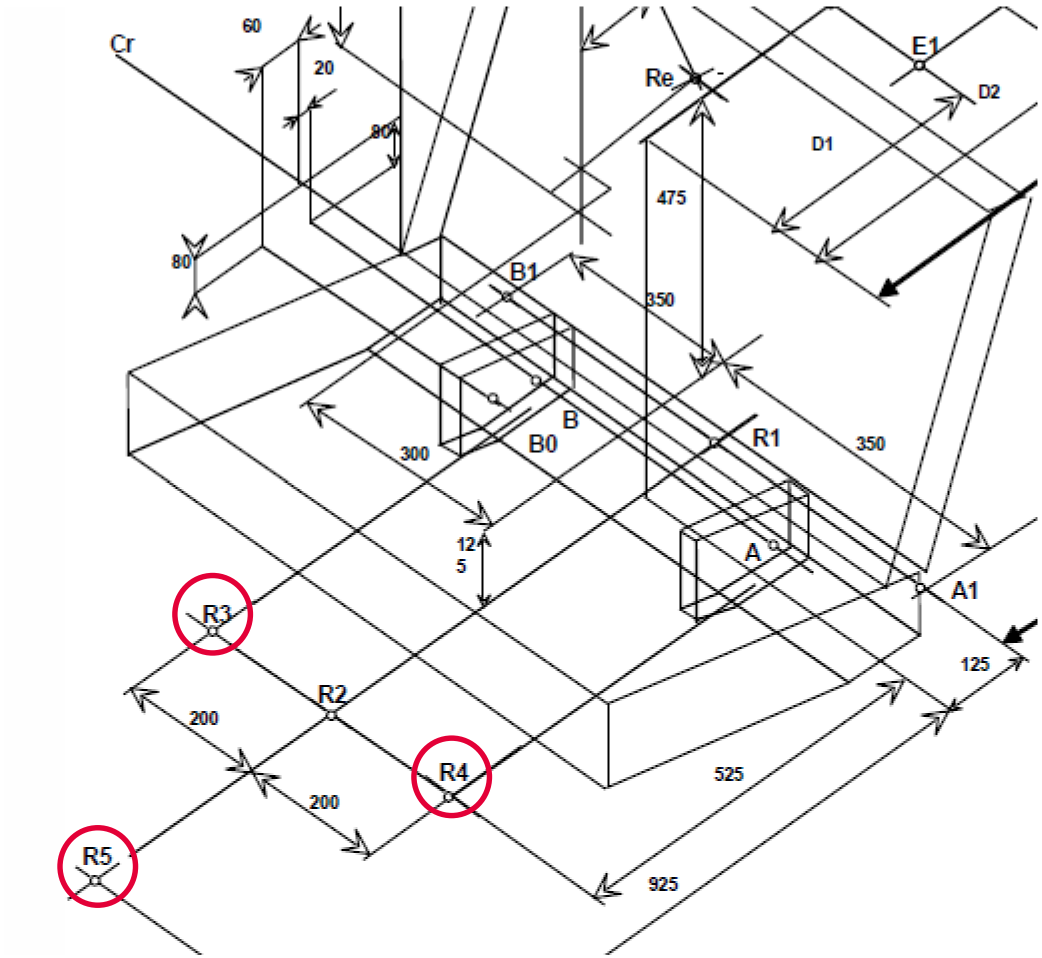
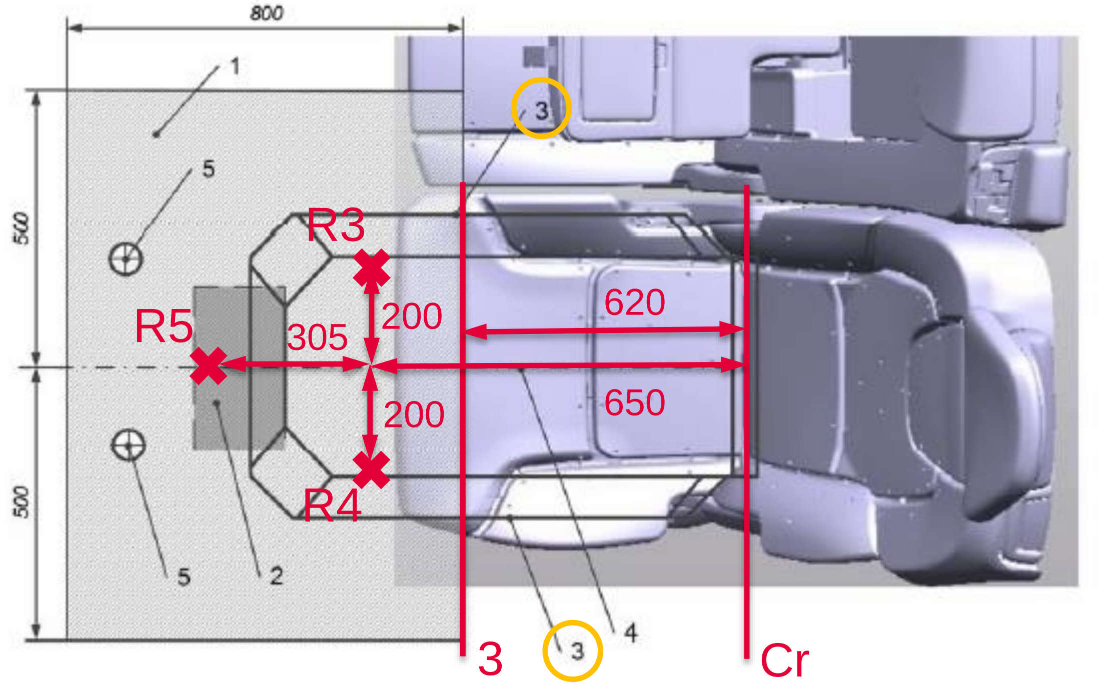
Anchorage points of R44 test bench compared to ISO LTA zone

R44 test bench



R44 test bench anchorages located in LTA zone

(Difficult to locate correctly as no connection of LTA zone and Cr)



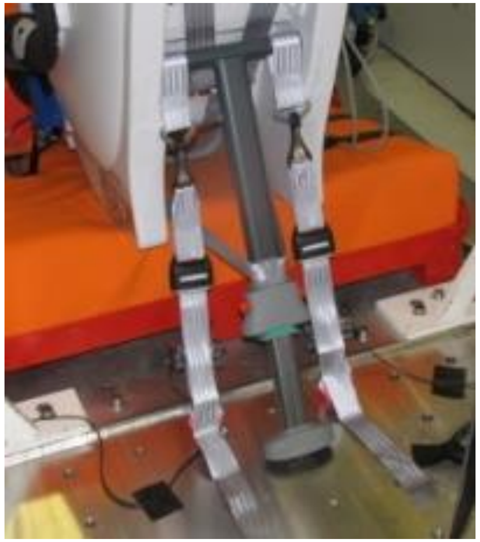
Key

1 Lower tether anchorage zone, top view
2 Support leg zone (to be avoided)
3 ISO/R2 envelope installed in related vehicle seating position
4 Centreline of ISO/R2 and ISOFIX anchorage positions
5 Lower tether anchorage, example positions

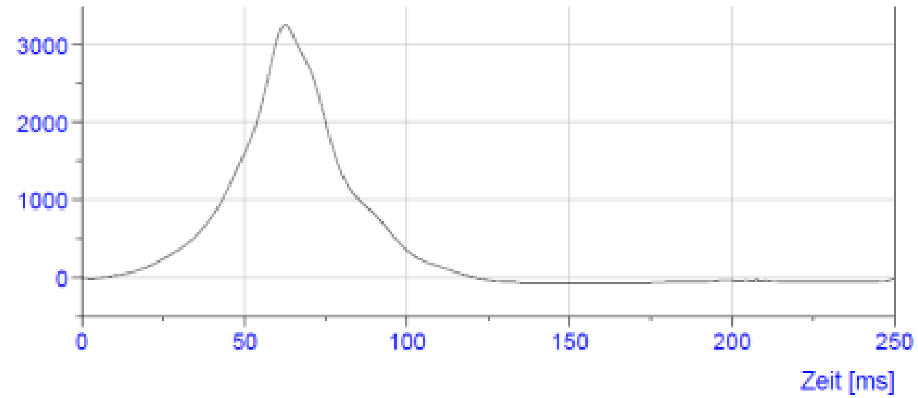
There are two different points 3 in the picture?

Lower tethers loads - Britax Max-Way R3/R4

CRS	Dummy	Anchorage point	Load, left tether [N]	Load, right tether [N]
Britax Max-Way (RWF, G 1/2)	P6	R3/R4	3328	3257



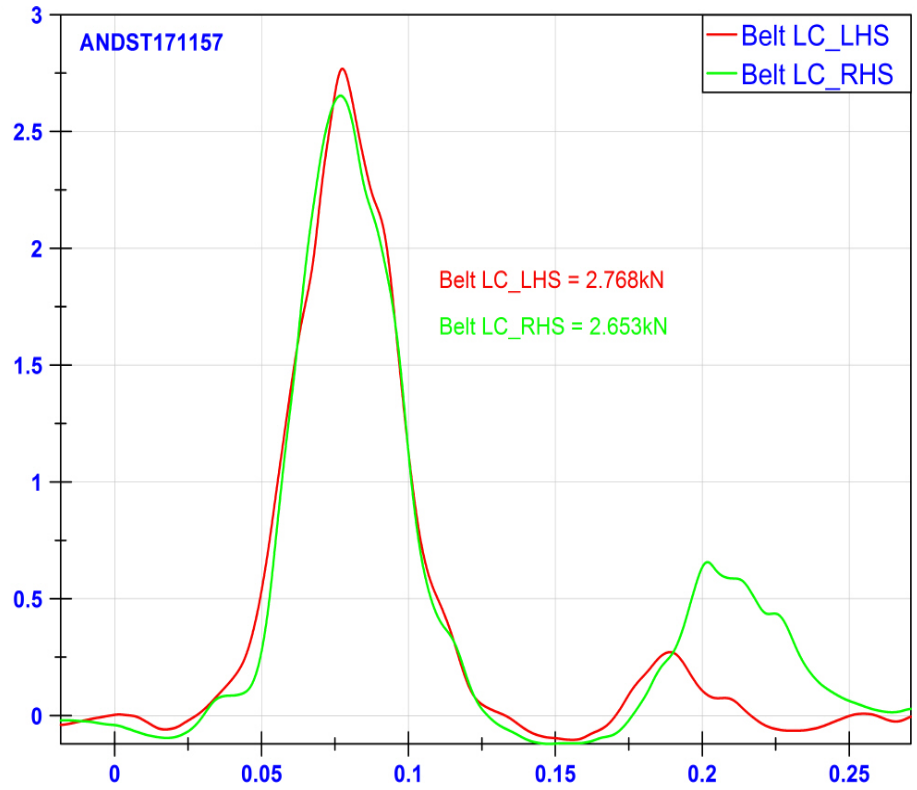
Load measurement, left tether



Load measurement, right tether

Lower tethers loads - Britax Multi-Tech, R3/R4

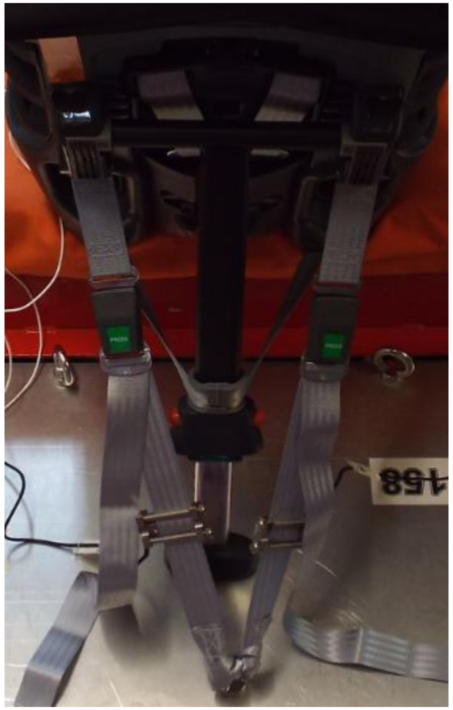
CRS	Dummy	Anchorage point	Load, left tether [N]	Load, right tether [N]
Britax Multi-Tech (RWF/FWF, G1/2/3)	P6	R3/R4	2768	2653

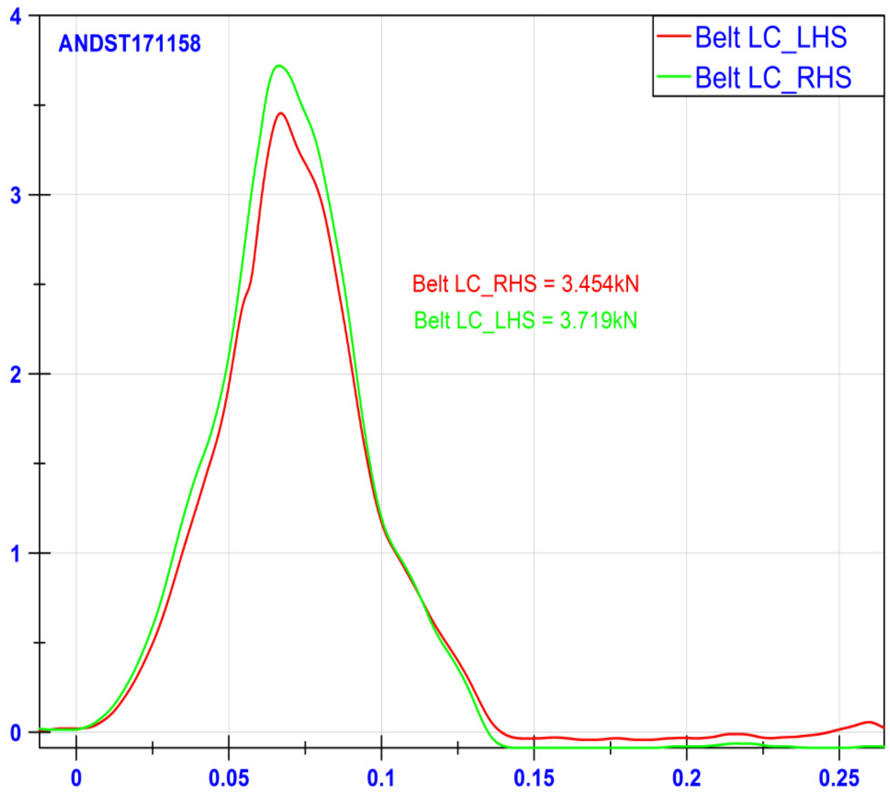


britax safe·n·sound B·O·B britax römer

Lower tethers loads - Britax Multi-Tech, R5

CRS	Dummy	Anchorage point	Load, left tether [N]	Load, right tether [N]
Britax Multi-Tech (RWF/FWF, G1/2/3)	P6	R5	3719	3454





Summary loads

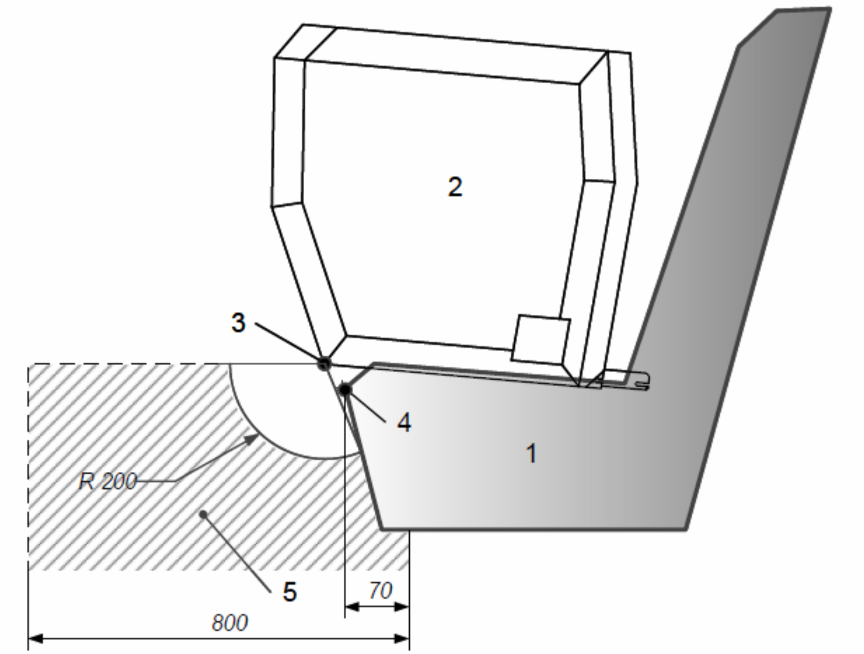
CRS	Britax Max-Way (RWF, G 1/2)	Britax Multi-Tech (RWF/FWF, G1/2/3)	Britax Multi-Tech (RWF/FWF, G1/2/3)
Dummy	P6	P6	P6
Anchorage point	R3/R4	R3/R4	R5
Load left tether [N]	3328	2768	3719
Load right tether [N]	3257	2653	3454

Conclusion

- » Max. dyn. load is in a range between 2.6 – 3.7 kN
- » Current load for strength test of anchorages [2.5 kN] could be to low?

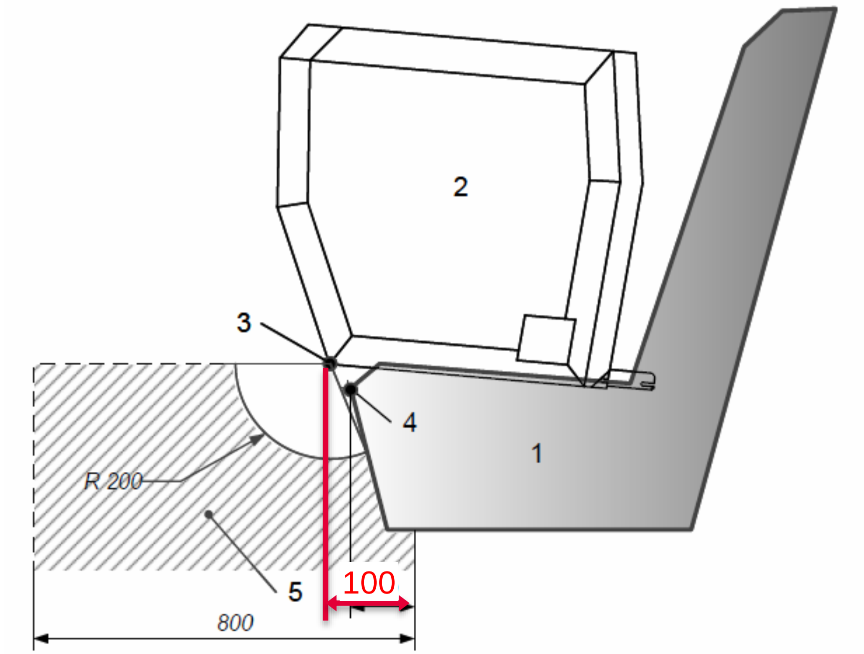
Reference point of the LTA zone to vehicle

- Starting point of the LTA zone in x-direction is currently defined by **4**
- This point is not well defined, as the seat cushion in every vehcile is different
- As the ISO/R2 envelope is used anyway and this will make reference of the LTA zone to Cr we propose to also link the x-direction of the LTA zone to **3**



Key

1 Vehicle seat illustration (front seating position)
2 ISO/R2 envelope installed in related vehicle seating position
3 Reference point on ISO/R2 envelope for LTA zone measurements
4 Foremost seat cushion reference point
5 Lower tether anchorage zone in side view, with upper limitation



Key

1 Vehicle seat illustration (front seating position)
2 ISO/R2 envelope installed in related vehicle seating position
3 Reference point on ISO/R2 envelope for LTA zone measurements
~~4 Foremost seat cushion reference point~~
5 Lower tether anchorage zone in side view, with upper limitation

Proposal to define a static strength test for LTAs

59th meeting of ISO WG2 (CRS) in Paris, 23&24/05/2018

D.Braun

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Background

- Britax volunteered during the call of the LTA task force on 26/03/2018 to review the draft standard and prepare a proposal for the static strength test on LTAs. This presentation summarizes the parameters proposed for such a static test
- The parameters of the static strength test defined in the draft standard where derived from other standards and experience.
- A connection to the actual load case had to be found to verify the suggested parameters outlined in the draft.
- Volvo as well as Britax provided data from dynamic tests where the loads in the lower tethers were measured in different test conditions (sled tests on R44 bench, sled tests with BIW, full scale rear impact).
- The max. loads from these dynamic tests were mostly higher than that required in the draft standard, therefore a load connection between these test conditions has to be found.
- It furthermore has to be clarified if the proposed test procedure is in line with existing test procedures of CRS anchorages.

LT loads measured in various dynamic tests

#	CRS	Dummy	LT anchorage point	Tether loads [N]		Speed [km/h]	Comment
				Left	Right		
1	Britax Multi-Tech	P6	R3/R4	2768	2653	27	Rear Impact, sled test, R44 test bench
2	Britax Multi-Tech	P6	R5	3719	3454	27	
3	Britax Max-Way	P6	R3/R4	3328	3257	27	
4	Britax Max-Way	Q3	Seat rails of front seat	3000	2700	56	Rear Impact, sled test, body in white (Volvo), adult on front seat
5	Britax Multi-Tech	HIII-3Y	Two points in footwell	2850	1480	> 80	Rear Impact, Complete vehicle, 70% overlap by deformable barrier, CRS on front passenger seat

- Test #2 generated the highest loads.
- It has to be considered that the LT‘s on the R44 test bench are attached to a very rigid base plate pratically not allowing any deformation.
- Peak forces from vehicle tests are lower than bench tests (lighter dummies, less rigid anchorages)

Various static strength tests as references

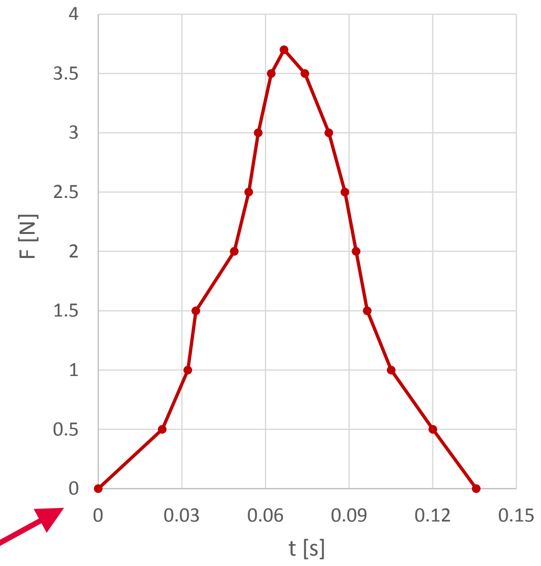
Component to be tested	Regulation/ Standard (Paragraph)	Peak load [kN]	Time to reach peak load [s]	Min. load application time [s]	Comment
ISOFIX + TT	R14 (6.6.4.4.)	8.0	30*	0.2	50 N preload, deformation limited to 125 mm
ISOFIX only (forward)	R14 (6.6.4.3.1.)	8.0	30*	0.2	
ISOFIX only (oblique)	R14 (6.6.4.3.2.)	5.0	30*	0.2	
Seat belt anchorages	R14 (6.3.3.)	13.5	60*	0.2	Test load is applied to two anchorages of a 3-point belt
LTA (Internal VOLVO test)	N1172	4.5 – 5.5	?	?	Loads are based on using one anchorage for two LT's
LTA (ISO draft)	ISO/WD 13216-4 (5.1)	2.5	30	1.0	Current details in the draft standard

* OEM can request to minimize time to reach peak load to 2 s resp. 4 s (seat belt)

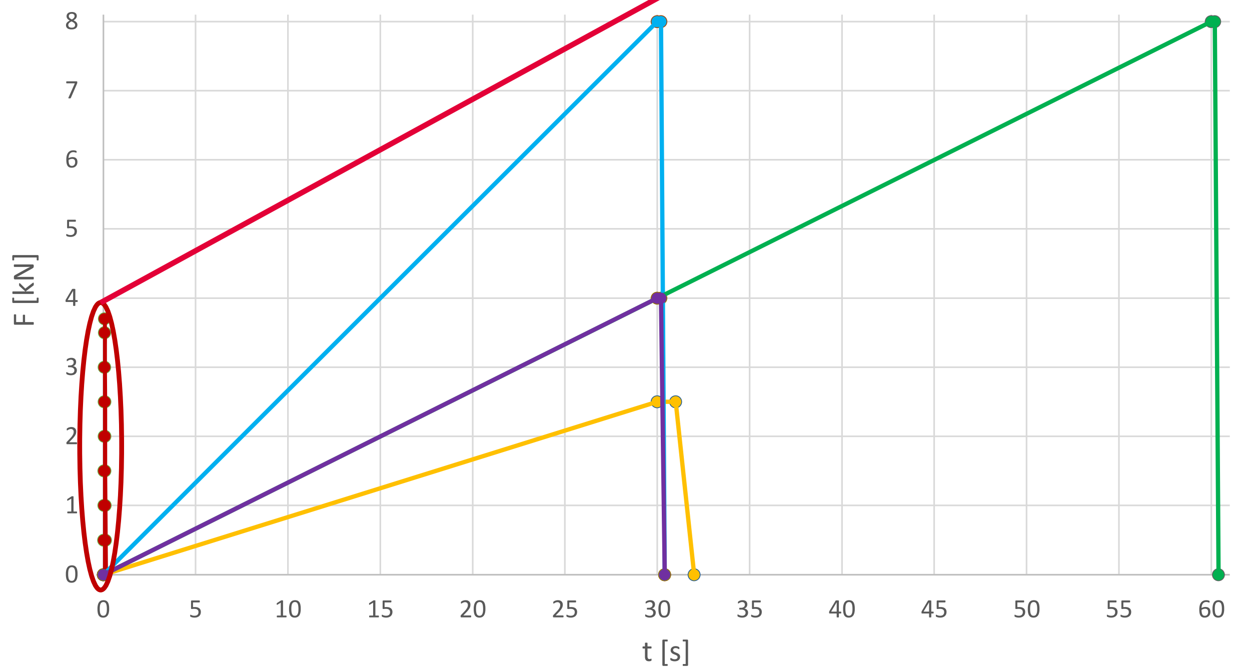
- The time to reach the peak load from the current draft is in line with most other static strength tests considered.
- Do we also want to include optionally a shorter time to reach the peak load like at other tests?
- The minimum load application time of the current draft lasts much longer than those of other strength test procedures.

Comparison between dynamic and static test loads

Test type	Dynamic	Static			
	Max. load	Draft ISO/WD 13216-4	R14, ISOFIX + TT	R14, seat belt anchorage	Britax Proposal
Peak load [kN]	3.7	2.5	8	13.5	4
Time to reach peak load [s]	≈ 0.067	30	30	60	30
Load application time [s]	-	1	0.2	0.2	0.2
Equivalent energy (Momentum) [kNs]	0.2	41	122	242	61



- First of all the static strength test should cover the peak load occuring in dynamic tests
- Furthermore the equivalent energy (surface under the graph) which is induced into the anchorage should be considered
- The equivalent energy of a dynamic test is by far covered through any static strength test



Summary of our observations

- Considering the peak loads from the dynamic tests (Test bench & vehicle tests) the loads from the current draft standard seems to be a bit too low.

- Compared to other static strength tests from ECE regulations the load application time seems to be too long.

- We propose to increase the test load to cover the maximum force found in the dynamic tests and align the load application time to those of other ECE standards.

- It needs to be decided if a optional reduction of the time to reach the test load on the request of the OEM shall also be included?

Proposal for a static strength test

	Test load [kN]	**Time to reach test load [s]**	**Min. load application time [s]**	**Comment**
Current draft	2.5	30	1	Onset force rate of 135 000 N/s
Britax Proposal	4	30	0.2	Onset force rate is not considered anymore.

Suggested revision of ISO draft standard (Deleted characters are striked through and new characters are marked in bold):

Apply a force of ~~[2500 N]~~ **[4000 N]** to each lower tether anchorage, by means of a representative lower tether strap [38 mm ±3 mm wide] that is fitted at one end with suitable hardware for applying the force and at the other end with a bracket for the attachment of the lower tether anchorage. For anchorages designed to be used for two adjacent CRS positions, the force shall be ~~[5000 N]~~ **[8000 N]**.

The force

- shall be applied in a direction determined by the FDRP (Force Direction Reference Point), with a tolerance of [± 20 mm] in all directions given in Figure 4,
- shall be attained within 30 s ~~at any onset force rate of not more than 135 000 N/s~~ and
- shall be maintained for a minimum of ~~1 s~~ **0.2 s**.

Lower tether anchorages

ISO Working Group Meeting
Munich 5-6 December 2017

F.Bendjellal, Britax Group

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What lower tethers and their anchorages are?

» Lower tether (LT):

Type of anti-rotation device intended to limit the rearward rotation of a rearward-facing CRS.

It usually comprises a tether strap or other hardware attached near the back or base of the CRS that connects to a lower tether anchorage. It incorporates a device to enable it to be connected to such an anchorage.

Figure 1 - RWF CRS using lower tethers

» Lower tether anchorage (LTA):

An anchorage located on the vehicle floor (on the seat track or in the vicinity of the seat track) to which a lower tether can be attached.

Figure 2 - Example of LTA‘s

ISO Resolutions regarding Lower tether anchorages

» Resolution 344 – Project lead

With reference to WG 2 resolution 336, and noting that the work on LTA was now registered as a preliminary work item, WG 2 confirmed Farid Bendjellal to lead the work on this part.

Experts interested in participating in the LTA work are asked to contact the WG 2 secretary (peter.claeson@sis.se).

» Resolution 345 – Further work on ISO/WD 13216-4

Reviewing the latest draft (N 1160), WG 2 agreed with the general approach for the specifications. The following items are suggested for the next version:

- Review the introduction to explain the objectives;
- Further work is needed to determine the reference point of the LTA zones. Preferably we should apply an established method (e.g. the determination of the support leg zone in UN R129);
- The LTA zones proposed (Figures 1, 2a and 2b) should be checked by vehicle manufacturers within WG 2. Feedback should be sent to Farid Bendjellal (farid.bendjellal@britax.com) and the secretary (peter.claeson@sis.se);
- Strength requirements: The method should be further explored, e.g. application of the FMVSS 225, AS/NZ 1754 and ADR standards used for top tether strength testing;
- A test run by Britax (rear impact UN R44 with P6, no rebound bar) suggests that we may need to raise the strength requirements;
- Visibility, marking, easy access and potential aggressiveness of anchorages should be considered.

It is intended to hold a WebEx meeting in the near future.

ISO 13216 – Four parts of this standard

ISO 13216-1: Seat bight anchorages and attachments (ISOFIX)
Defines a direct connection between the vehicle structure and a child restraint system. It comprises the configuration of the attachments at the CRS and the anchorages on the vehicle as well as their positioning.

This standard is state of the art and is included in UN ECE R14 (Seat belt anchorages) as well as in both European CRS regulations (UN ECE R44 & UN ECE R129)

ISO 13216-2: Top tether anchorages and attachments
Complements the ISOFIX requirements with the definition of the anchorages and attachments of the top tether as one of the possible anti-rotation devices to be used with ISOFIX.

This standard is state of the art and is included in UN ECE R14 (Seat belt anchorages) as well as in both European CRS regulations (UN ECE R44 & UN ECE R129)

ISO 13216-3: Classification of child restraint dimensions and vehicle space
A classification system is provided which makes it possible to assess if a CRS of a specific type fit into a specific vehicle.

This standard is state of the art and is included in UN ECE R16 (Seat belts)

DRAFT - ISO/WD 13216-4: Lower tether anchorages
Defines anchorages at the vehicle which are specifically designed to accommodate lower tethers.

This standard – non obligatory- is planned to be ~~included to UN ECE R14 on a voluntary basis to include a consistent standard~~ a reference for lower tether anchorages.

Historical references of lower tethers

» Rearward facing CRS's are available on the market since the late 1960's. In Scandinavian countries they are mainly used for children up to a age of about 4 years.

» Most of the larger rearward facing CRS's use lower tethers to secure the CRS in specific situations. This is an attachment method used for more than 40 years for example in Sweden.

» Lower tethers limit the CRS displacement in case of a rear impact and also minimize the rebound of such a seat in case of a frontal impact.

» The lower tether anchorages are located in front of the used seating positions and are comparable to the known top tether anchorages.

» Lower tethers are only an additional installation feature and intended to be used together with the vehicle belt and a support leg.

Figure 3 – Installation of a RWF CRS using lower tethers

Currently used methods to attach lower tethers to the vehicle

- Some vehicle manufacturers already provide LTA that are mostly located on the rails of the front seat. (Figure 2 on slide 3)
- Most cars don't provide LTA. In that case the lower tethers are attached to the seatback of the front seat. (Figure 4)
- There is a potential risk of misuse installations and/or interaction with vehicle components located on (or under) the vehicle seat. (Figure 5-7)
- To improve the use of such seats and minimize the potential risks highlighted above a standard method to define LTA's is needed.

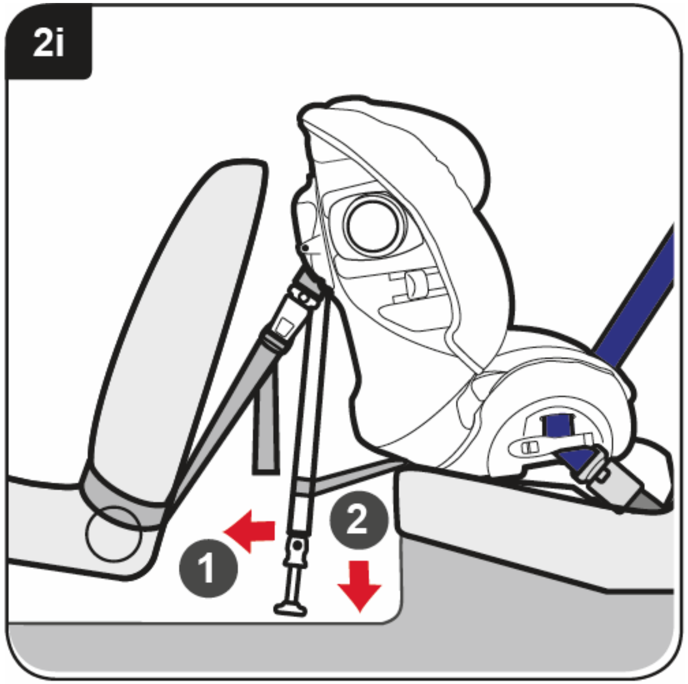
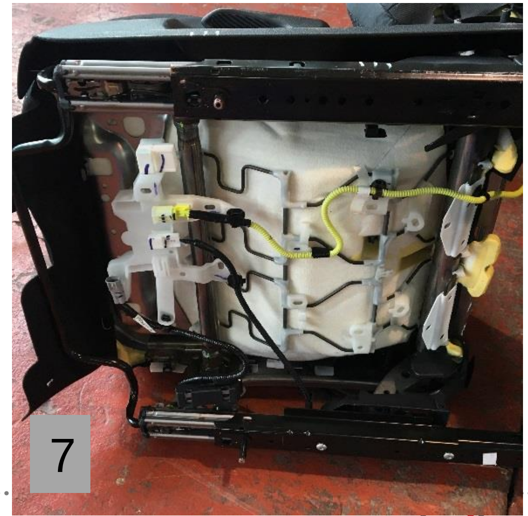


Figure 4 – Example of installation LT's routed through the seat back



Why LTA are needed ?

» Control the CRS displacement in case of a rear impact and also minimize the rebound of such a seat in case of a frontal impact.

Example of a R44 rear impact test with a RWF CRS no LT's - Photo sequence:

t=0

Middle of loading phase

Max. vertical head excursion

Exceeding the seat backrest

Example of a R44 rear impact test with a RWF CRS using LT's - Photo sequence:

t=0

Middle of loading phase

Max. vertical head excursion

Max. loading

» Other option to control CRS displacement : Anti rebound bar

- Limitation : generally used up to 83 cm child stature

Implementing lower tethers & anchorages in regulation R129

1. Starting point: ISO work as described in WD 13216-4 2017

2. In R129 define the lower tethers
and how they are attached to the CRS

3. Subsequent steps to be defined

Video 1 – Example of a rear impact test according to R44 with a RWF CRS using LT's

Positioning of lower tether anchorages ISO/WD 13216-4:2017(E)

» A zone was defined within which the two lower tether anchorages for the respective seating position need to be located in.

- LTA zone – side view

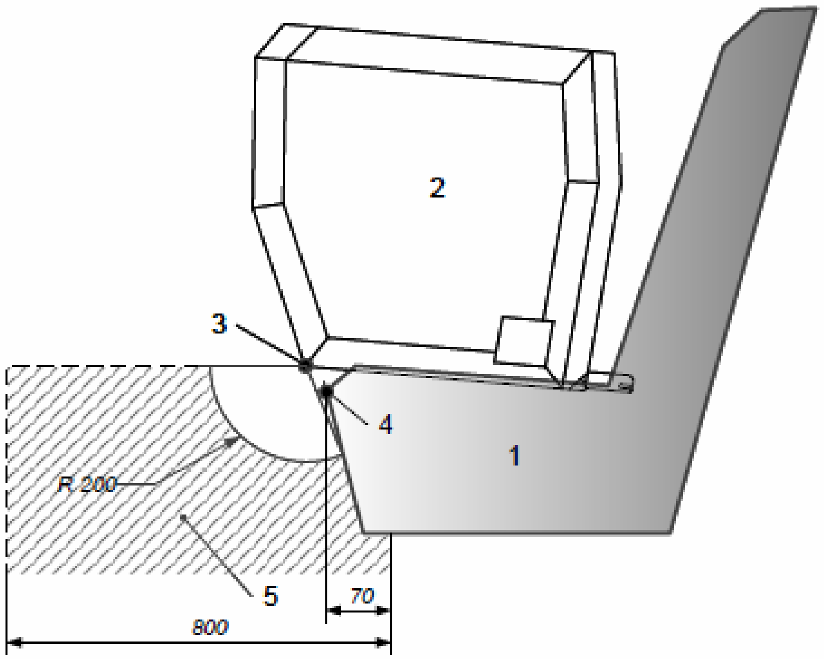


Figure 6 - Front seating position

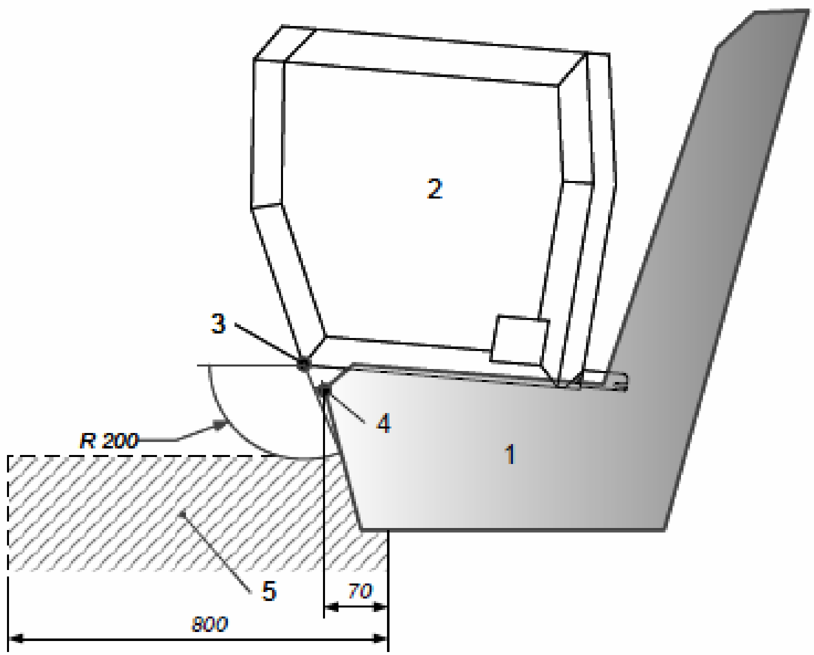


Figure 7 - Rear seating position

Key

1	Vehicle seat illustration (seating positions)
2	ISO/R2 envelope installed in related vehicle seating position
3	Reference point on ISO/R2 envelope for LTA zone measurements
4	Foremost seat cushion reference point
5	Lower tether anchorage zone in side view, with upper limitation

All dimensions in mm

Positioning of lower tether anchorages ISO/WD 13216-4:2017(E)

- LTA zone, top view:

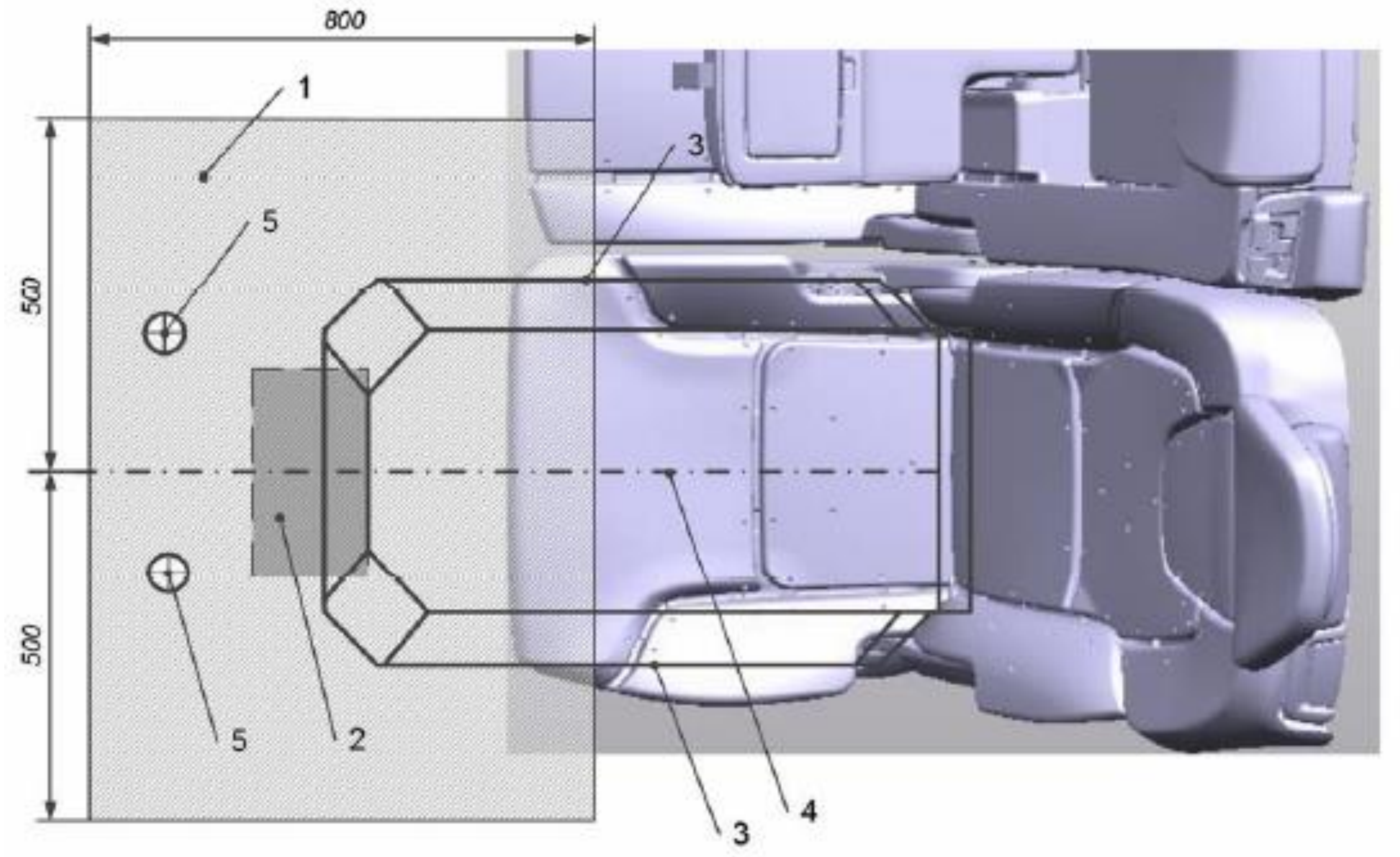


Figure 8 - Front and rear passenger seating position

Key

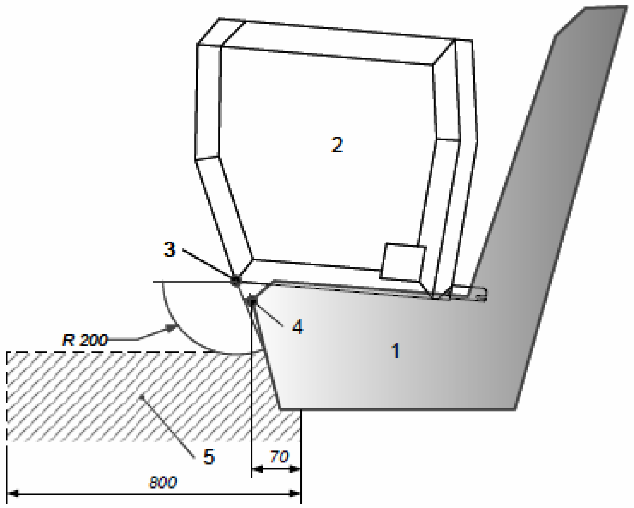
1	Lower tether anchorage zone, top view
2	Support leg zone (to be avoided)
3	ISO/R2 envelope installed in related vehicle seating position
4	Centerline of ISO/R2 and ISOFIX anchorage positions
5	Lower tether anchorage, example positions

All dimensions in mm

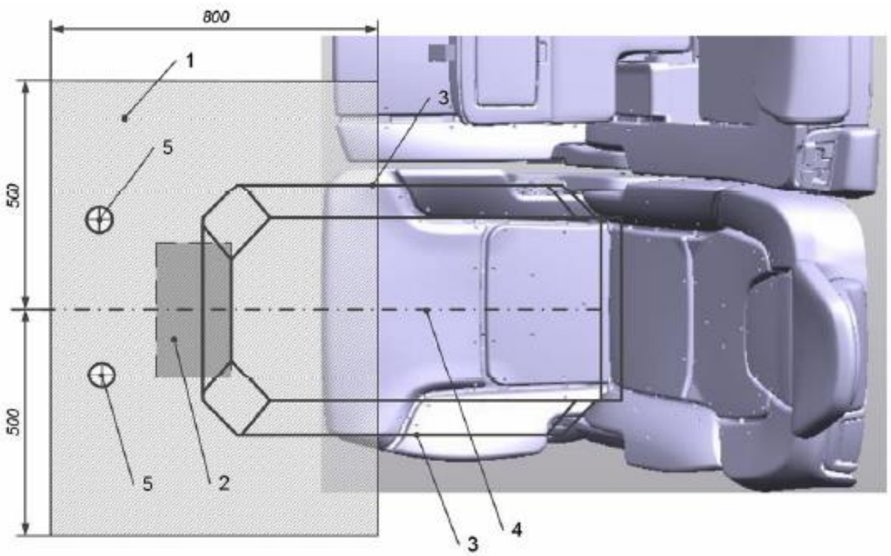
Positioning of lower tether anchorages

Apart from being located in this zone the following specifications also need to be fulfilled:

- » A reference point for measurements is obtained by installing the ISO/R2 envelope (or physical fixture) in the vehicle seat; (Key 3 in upper figure)
- » The distance between both LTA's of the respective seating position shall be at least [280mm].
- » Both LTA's do not need to be positioned symmetrically with respect to the centerline through the envelop/fixture, however:
  - Both LTA's shall not positioned on the same side of the centerline
  - Offset of centerline between the anchorages and the envelope/fixture shall not be more than [200mm]
- » The zone intended for support legs shall not be used for lower tether anchorages. (Key 2 in the lower figure)
- » Lower tethers can interact with vehicle interior, but its function or that of vehicle components shall not be affect.



Rear seating position



Front and rear passenger seating position

Lower tether anchorage dimensions

» Lower tether anchorages shall have an open and clearance space to allow the attachment of the standard top tether connector (Figure 8, ISO 13216-2)

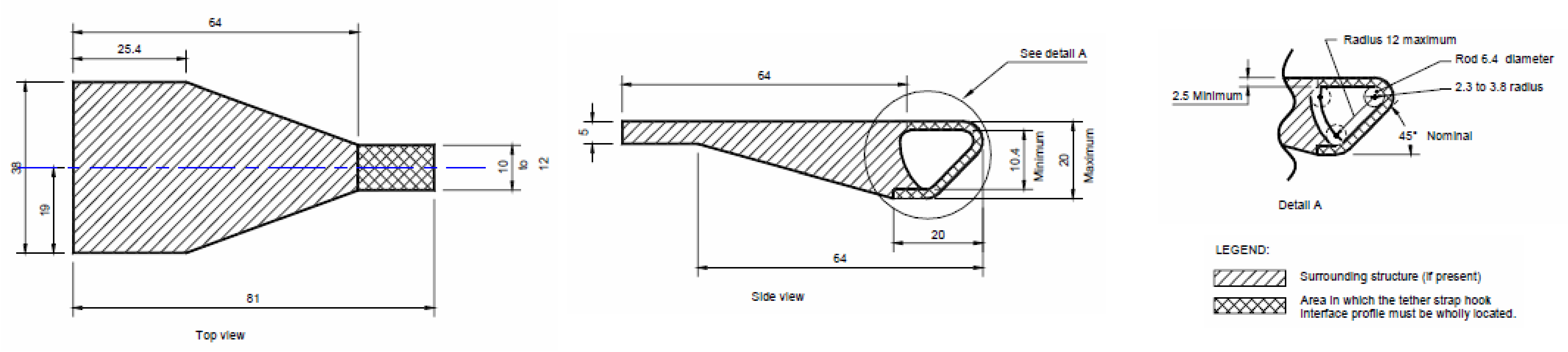


Figure 9 – Top tether connector (hook type) dimensions

» If a anchorage is intended to be used for two adjacent CRS positions the opening and clearance space shall allow the simultaneous attachment with two standard top tether connectors.

Strength test method

» All interior components shall be assembled for the test

» Adjustable seats shall be positioned in a middle position (as defined for…)

» A force of [2500 N] shall be applied to every LTA by means of a representative lower tether strap

» To anchorages which are designed to be used for two adjacent CRS positions the double force of [5000 N] shall be applied.

» The direction of the force is defined through two points:

- A Force Direction Reference Point (Key 3 in figure 10) including a tolerance of [± 20 mm] in all directions
- The LTA position (Key 4 in figure 10)

» The force shall be attained within [30] s with a rate of not more than [135 000] N/s and shall be maintained for at least [1] s.

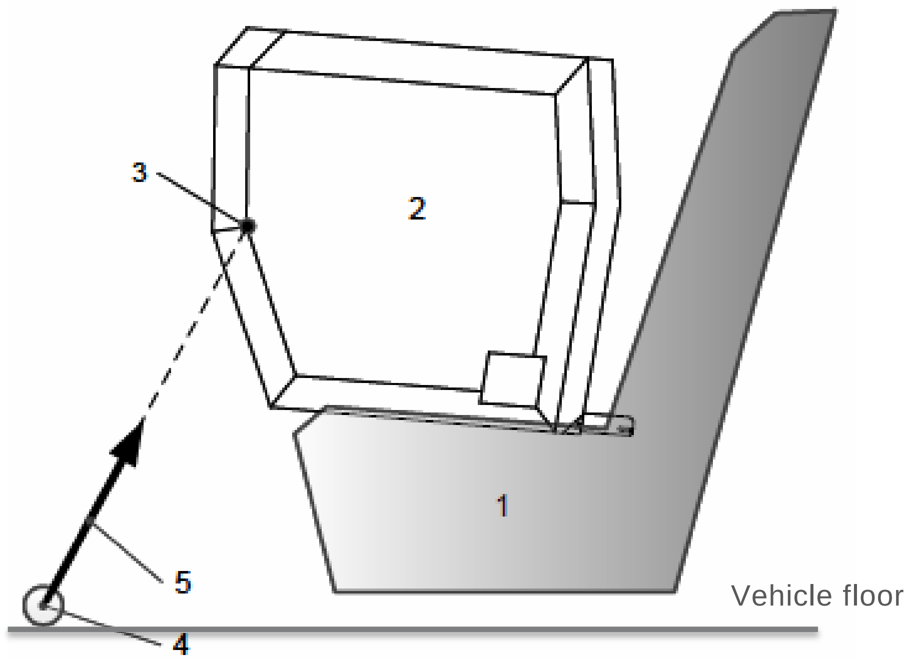


Figure 10 - Test force direction

Key

1 Vehicle seat illustration

2 ISO/R2 envelope installed in related vehicle seating position

3 Force Direction Reference Point (FDRP)

4 Example of actual LTA position in vehicle

5 Test force direction

Note: Lateral position of FDRP is coincident w centerline of ISO/R2 envelope.

Next steps

» Implement definition and requirements for lower tethers in R129-03 series of amendments