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# Proposal for (tentative) Certification Corridors for the Dynamic Full Assembly (Inverse) Certification Test Procedure

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(Federal Highway Research Institute)

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**Dynamic full assembly (inverse) certification test**

**Inverse certification test results (Flex-GTR)**

**Development of certification corridors**

## **Dynamic full assembly (inverse) certification test**

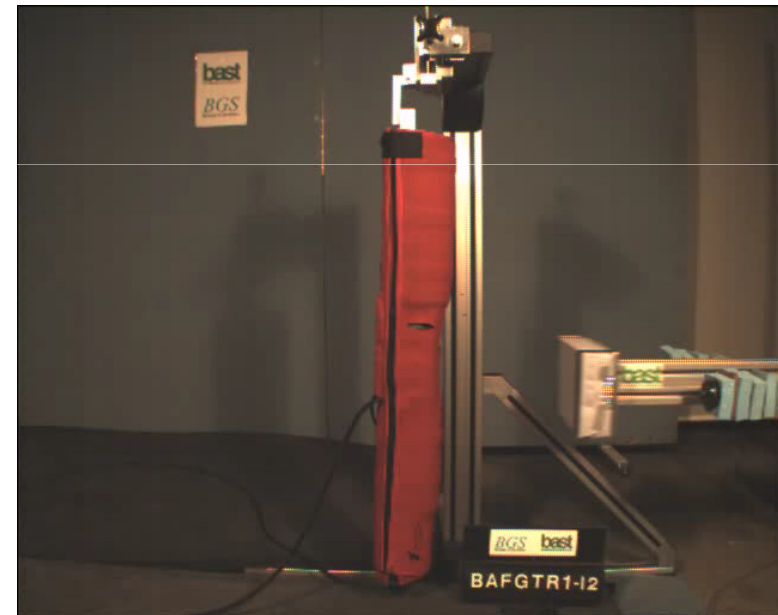
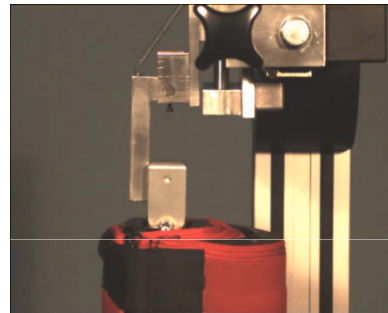
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# Dynamic full assembly certification test

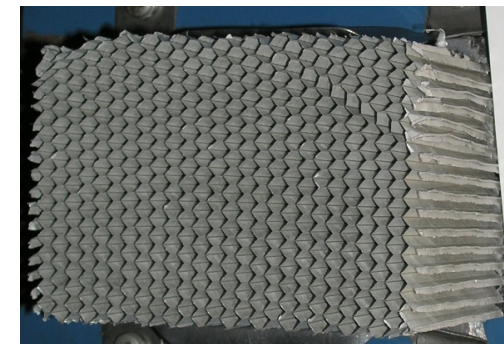
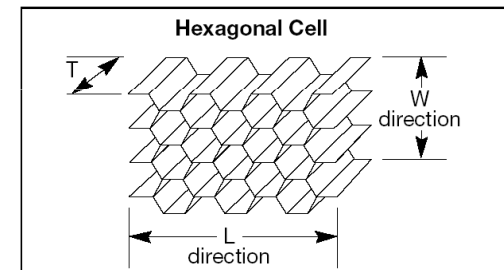


- Flex PLI (with flesh and skin) is impacted by the upper edge of a linearly guided Al honeycomb impactor at a previously defined impact speed
- Impact location: upper edge of the honeycomb in line with center of knee
- Measurement items – pass/fail parameters:  
three string potentiometers (ACL, PCL, MCL), four strain gauges (tibia moments)



- **Test parameters:**
  - **Impact speed = 40 km/h**
  - **Mass of honeycomb impactor = 8,1 kg**
  - **Impact height: upper honeycomb edge in line with center of knee**
- **Test frequency: after every 20 tests or each year**
- **Aluminium honeycomb specifications:**

Specification	Data
Cell size	3/16
Alloy	5052
Foil gauge	.001
Density	3.1
Crush strength	75 PSI
Dimensions (L*W*T)	250 (200) * 160 * 60 mm

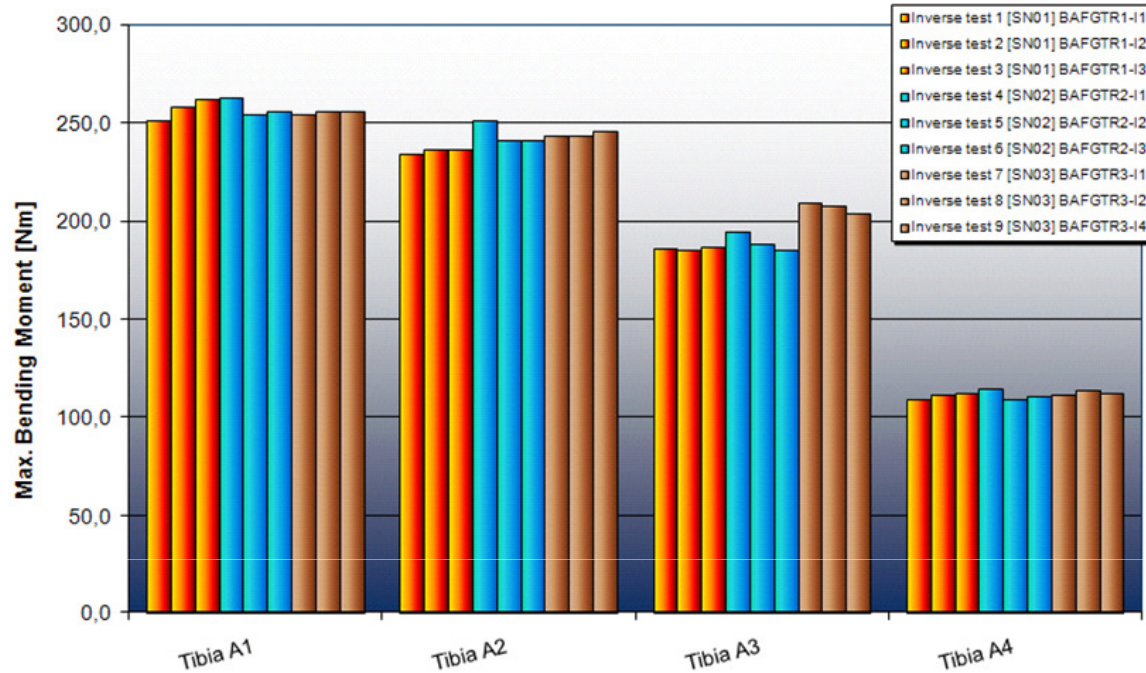


Dynamic full assembly (inverse) certification test

**Inverse certification test results (Flex-GTR)**

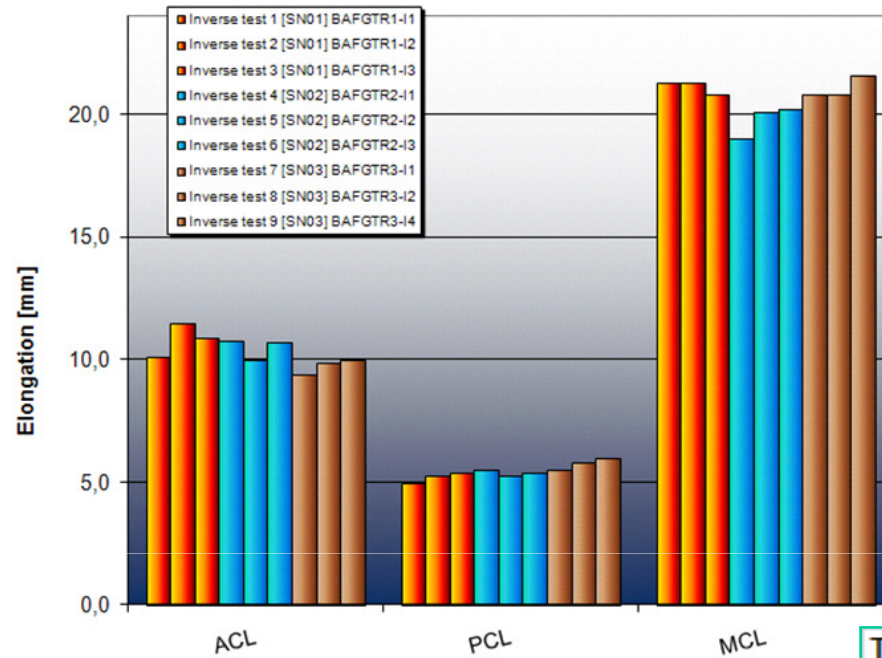
Development of certification corridors

# Tibia test results (Flex-GTR)



Test #	Tibia A1	Tibia A2	Tibia A3	Tibia A4
Inverse test 1 [SN01]	251,4	234,3	186,2	108,9
Inverse test 2 [SN01]	257,9	236,6	184,9	111,8
Inverse test 3 [SN01]	262,0	236,1	186,8	112,7
Inverse test 4 [SN02]	262,7	251,3	194,9	114,5
Inverse test 5 [SN02]	254,0	241,2	188,4	108,9
Inverse test 6 [SN02]	256,1	240,9	185,1	110,5
Inverse test 7 [SN03]	254,2	243,2	209,0	111,5
Inverse test 8 [SN03]	255,8	243,7	207,9	113,6
Inverse test 9 [SN03]	255,6	245,8	204,0	112,6
MV	256,6	241,5	194,1	111,7
CV [%]	1,4	2,2	5,2	1,7

# Ligament test results (Flex-GTR)



Test #	ACL	PCL	MCL
Inverse test 1 [SN01]	10,1	5,0	21,3
Inverse test 2 [SN01]	11,5	5,3	21,3
Inverse test 3 [SN01]	10,9	5,4	20,8
Inverse test 4 [SN02]	10,8	5,5	19,0
Inverse test 5 [SN02]	10,0	5,3	20,1
Inverse test 6 [SN02]	10,7	5,4	20,2
Inverse test 7 [SN03]	9,4	5,5	20,8
Inverse test 8 [SN03]	9,9	5,8	20,8
Inverse test 9 [SN03]	10,0	6,0	21,6
MV	10,4	5,5	20,7
CV [%]	6,3	5,3	3,8



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Inverse certification tibia test results (Flex-GTR)

**Development of certification corridors**

# Development of certification corridors



## Tibia sections:

Peak Bending Moments [Nm]	Tibia A1	Tibia A2	Tibia A3	Tibia A4
Max	262,7	251,3	209,0	114,5
Min	251,4	234,3	184,9	108,9
MV	256,6	241,5	194,1	111,7
max. Dev. from MV [%]	2,4	4,1	7,7	2,5
<b>Upper Limit (Max*1,05)</b>	<b>276</b>	<b>264</b>	<b>220</b>	<b>120</b>
<b>Lower Limit (Min/1,05)</b>	<b>240</b>	<b>223</b>	<b>176</b>	<b>104</b>

## Knee elongations:

Peak Elongations [mm]	ACL	PCL	MCL
Max	11,5	6,0	21,6
Min	9,4	5,0	19,0
MV	10,4	5,5	20,7
max. Dev. from MV [%]	10,9	9,8	8,0
<b>Upper Limit (Max*1,05)</b>	<b>12</b>	<b>7</b>	<b>23</b>
<b>Lower Limit (Min/1,05)</b>	<b>9</b>	<b>4</b>	<b>18</b>

**Tentative threshold values are recommended to be in line with test results of round robin tests !**

Thank you!

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