



Insurance Institute for Highway Safety
Highway Loss Data Institute

IIHS Side Impact Test Program Rating Guidelines

(Updated November 2016)

iihs.org

Dummy measures and data filtering guidelines

- Head
 - X, Y, Z accelerations (CFC 1000)
- Neck
 - X, Y, Z forces (CFC 1000) and bending moments (CFC 600)
- Shoulder
 - X, Y, Z forces (CFC 1000)
 - Y deflection (CFC 600)
- Spine
 - T1, T4, T12 accelerations (CFC 1000)
- Thoracic and abdominal ribs
 - Deflection (CFC 600) and Y acceleration (CFC 1000)
- Pelvis
 - Acetabulum and ilium forces (CFC 600)
 - X, Y, Z accelerations (CFC 1000)
- Left leg (3 ms clip for all measures)
 - Distal femur X, Y, Z forces (CFC 600) and bending moments (CFC 600)

Dummy injury measures evaluated

- Head
 - HIC (15 ms)
- Neck
 - Axial force
 - X moment (L-M bending)
(monitor only)
 - Z moment (neck twist)
(monitor only)
- Thoracic and abdominal ribs
 - Deflection, deflection rate, and viscous criterion
 - Deflection rate calculated using OOP TWG integration method is also monitored
- Pelvis
 - Acetabulum and ilium forces
 - Combined acetabulum and ilium force
- Left leg (3 ms clip for all measures)
 - Distal femur X, Y forces and X, Y bending moments (3 ms clip for all measures)

Rib calculations

- Rib deflection data filtered to SAE CFC 180
- Differentiate filtered deflection data to obtain rib deflection rate
- Rib viscous criterion is calculated as follows:

$$VC(t)_i = 1.0 * V(t)_i * \frac{D(t)_i}{138mm}$$

Where,

$V(t)_i$ = the velocity of rib i at time t , (m/s)

$D(t)_i$ = the deflection of rib i at time t , (mm)

Rating system:

Nine aspects of performance are separately rated as **Good**, **Acceptable**, **Marginal**, or **Poor** and then combined to produce an Overall Side Impact Rating

- Three injury ratings per occupant
 - Head and neck
 - Torso (chest and abdomen)
 - Pelvis and leg
- One 'head protection' rating per occupant (kinematic evaluation of countermeasures for hard contacts)
- One structural rating for the vehicle

	Head Protection	Injury Measures			Structure
		Head & Neck	Torso	Pelvis & Legs	
Overall Side Rating					
Driver:	G	G	G	G	G
Passenger:	G	G	G		

Rating system

Overall rating

- Driver and rear passenger injury ratings are treated equally
- Head & Neck and Torso ratings are treated equally and contribute most to the overall rating, followed by:
 - Pelvis & Leg rating
 - Head Protection and Structure Ratings

Injury ratings

Head & Neck

Injury Measure	Good	Acceptable	Marginal	Poor
HIC (15 ms)	0 – 623	624 – 779	780 – 935	> 935
Neck tension (kN)	0 – 2.1	2.2 – 2.5	2.6 – 2.9	> 2.9
Neck compression (kN)	0 – 2.5	2.6 – 3.0	3.1 – 3.5	> 3.5

Head & Neck rating is the worst rating from any of the three injury measure ratings

Injury ratings

Torso (chest and abdomen)

The torso rating is determined from injury measures recorded in the chest and abdomen (5 'ribs') plus shoulder

- Chest and abdominal ribs
 - Deflection: Peak deflection of each rib and average of the five ribs are compared to rating boundaries
 - Viscous criterion: The maximum $V \cdot C$ recorded on any rib in the chest or abdomen is compared to rating boundaries
 - Deflection rate: The maximum deflection rate recorded on any rib in the chest or abdomen is compared to rating boundaries
- Shoulder: Peak deflection

Injury ratings

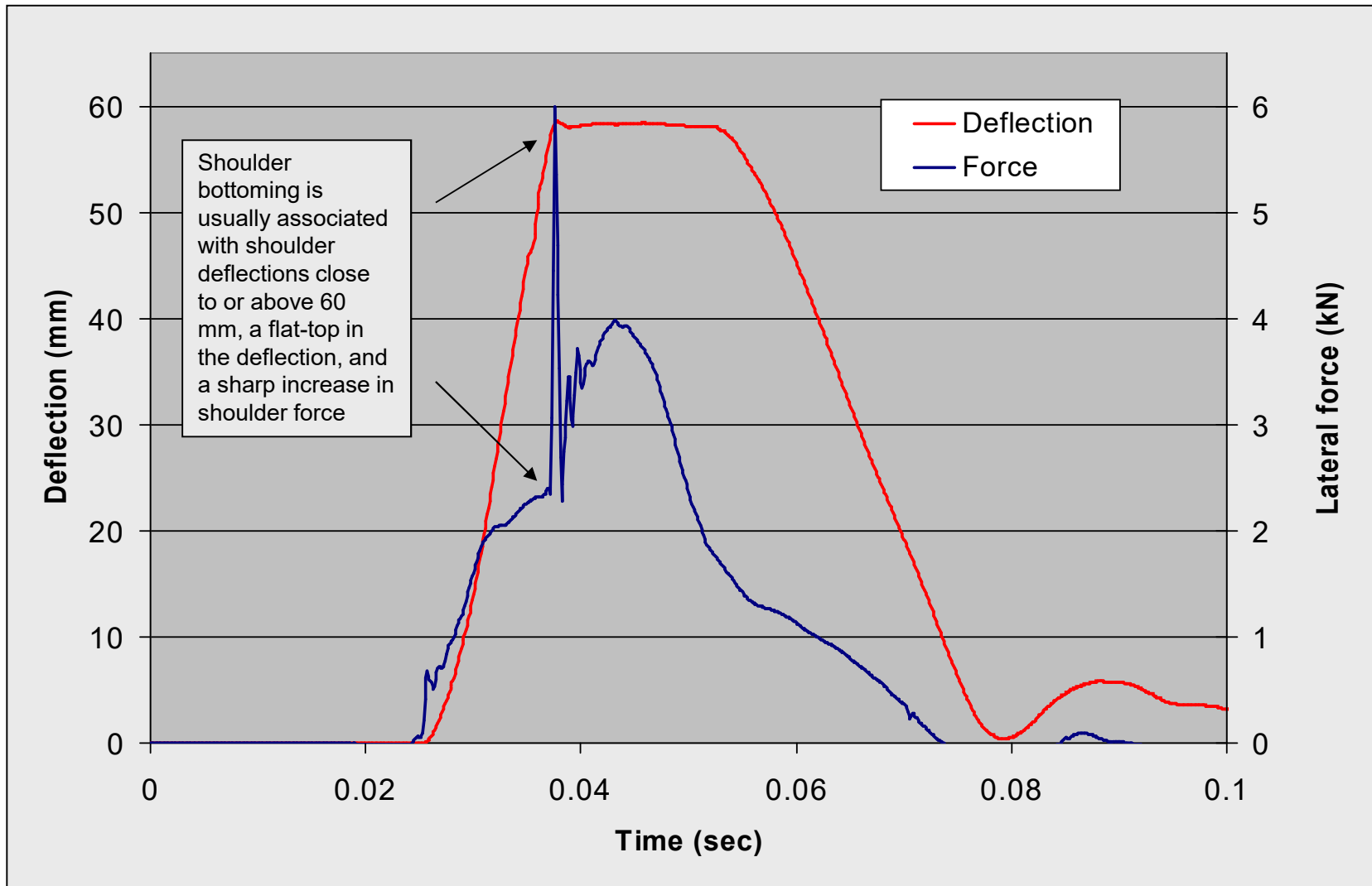
Torso rating boundaries

Injury Measure	Good	Acceptable	Marginal	Poor
Peak deflection (mm)	N/A	N/A	51 – 55	> 55
Average deflection (mm)	0 – 34	35 – 42	43 – 50	> 50
V*C (m/s)	0 – 1.00	1.01 – 1.20	1.21 – 1.40	> 1.40
Deflection rate (m/s)	0 – 8.20	8.21 – 9.84	9.85 – 11.48	> 11.48
Shoulder deflection (mm)	> 60 mm <u>or bottoming-out of shoulder</u> results in downgrade of one rating category			

Torso rating is the worst rating from any of the four injury measure ratings, downgraded one category if shoulder deflection limit is exceeded

Injury ratings

Example of shoulder bottoming-out



Injury ratings

Pelvis/Leg

Injury Measure	Good	Acceptable	Marginal	Poor
Iliac force (kN)	0 – 4.0	4.1 – 4.8	4.9 – 5.6	> 5.6
Acetabulum force (kN)	0 – 4.0	4.1 – 4.8	4.9 – 5.6	> 5.6
Combined acetabulum and Ilium force (kN)	0 – 5.1	5.2 – 6.1	6.2 – 7.1	> 7.1
Distal femur A-P and L-M force (3ms clip, kN)	0 – 2.8	2.9 – 3.4	3.5 – 3.9	> 3.9
Distal femur A-P and L-M moment (3ms clip, Nm)	0 – 254	255 – 305	306 – 356	> 356

Pelvis & Leg rating is the worst rating from any of the five injury measure ratings

Head protection rating

Driver and passenger head kinematics

Head Kinematic Description	Rating
Head effectively protected by head protection system (typically an airbag)	Good
Head protected from contacting the MDB by the interposition of an FMVSS 201 compliant surface or structure	Acceptable
No head contact with vehicle interior, but head approaches and is not protected from contact with MDB ('near miss')	Marginal
Head contacts vehicle interior surfaces/structures not covered by FMVSS 201 (i.e., not padded) and/or head not protected from contacts outside the vehicle	Marginal
Head contact with the MDB	Poor

Note: These are typical examples of head protection ratings and are not intended to be a complete list of all possibilities.

Structural rating

Fuel Spill / High Voltage Battery

If a significant fuel leak or compromise of a high-voltage system (i.e., electric drivetrain) is observed during a test, both the structural and overall ratings may be downgraded to poor

- Significant fuel leaks are those that exceed the leak rate allowed following tests conducted to assess fuel system integrity under U.S. Federal Motor Vehicle Safety Standard (FMVSS) No. 301
- High-voltage systems must meet the electrolyte spillage, battery retention, and electrical isolation requirements in FMVSS 305 to avoid downgrade. Additionally, the temperature of the high-voltage battery will be monitored both with a thermocouple and a thermal imaging camera, before and after a crash test. If an increase in temperature is detected, the vehicle will be moved immediately outdoors where continued monitoring will take place
- See Moderate Overlap Guidelines for Rating Structural Performance, for more information

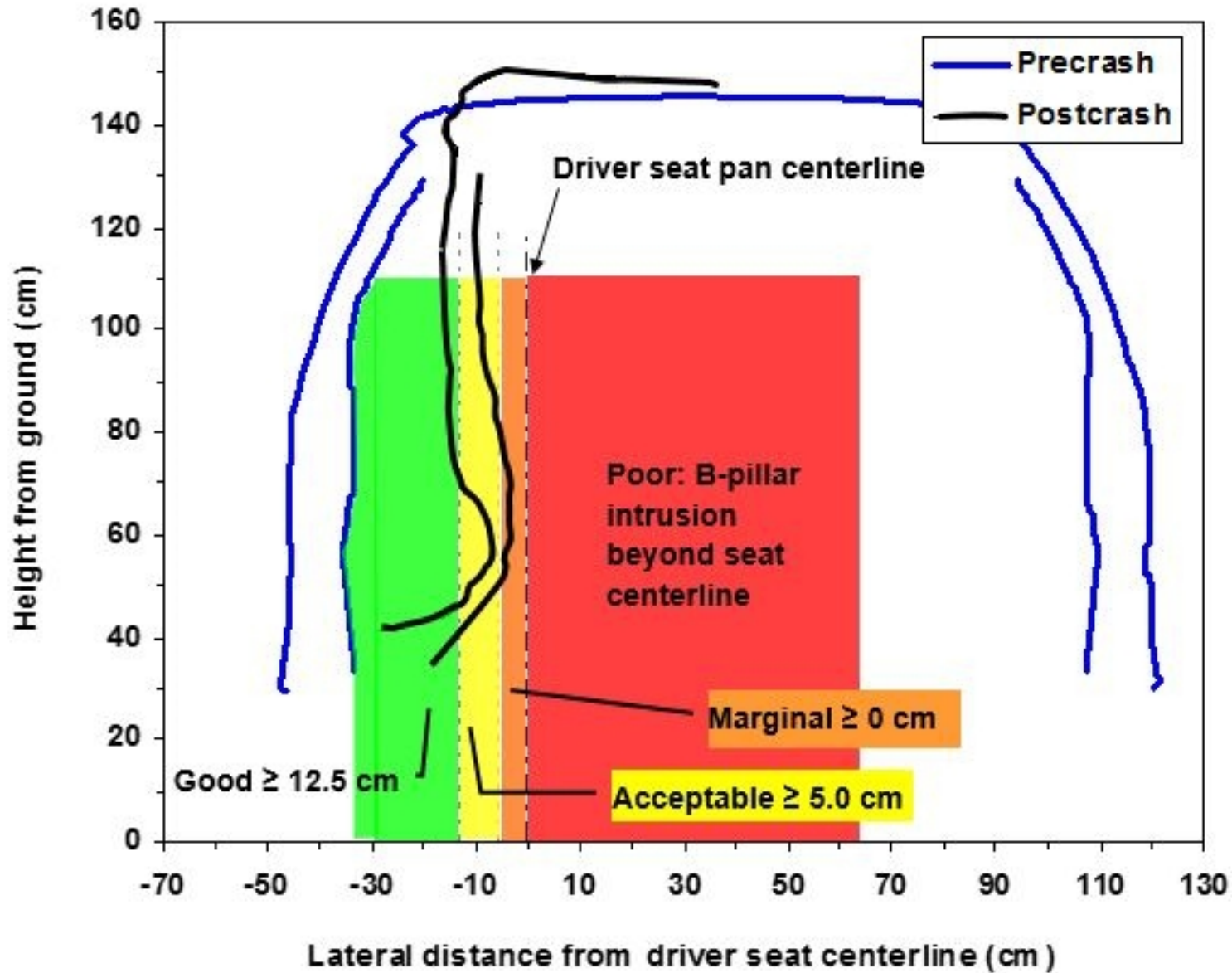
Structural rating

B-pillar deformation

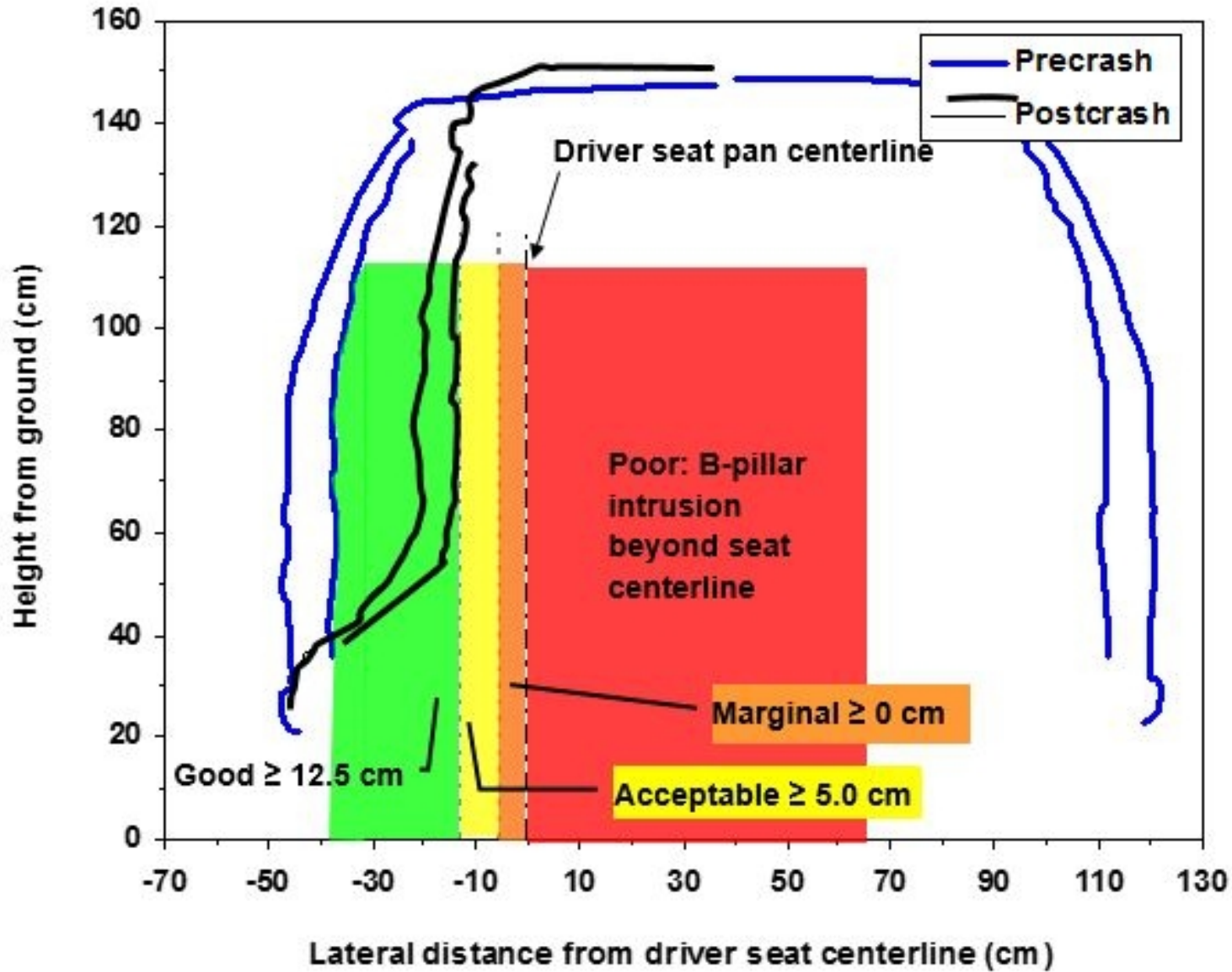
Boundary line	Good	Acceptable	Marginal	Poor
B-pillar to driver seat centerline distance (cm)	12.5	5.0	0.0	
Structural failures	Downgrade structural rating by one category			

Note: The vertical range considered for structural rating extends from the base of the B-pillar interior up to a point that is 540 mm above the H-point measurement taken with the seat in the full-rear and full-down position. This corresponds approximately to the shoulder height of a 95th percentile male.

Structural rating



Structural rating



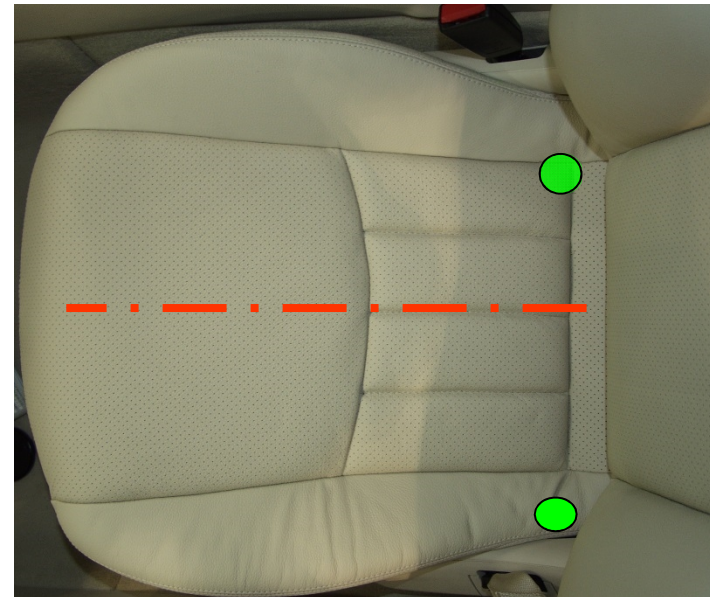
Structural rating

Determine location of seat centerline (precrash)

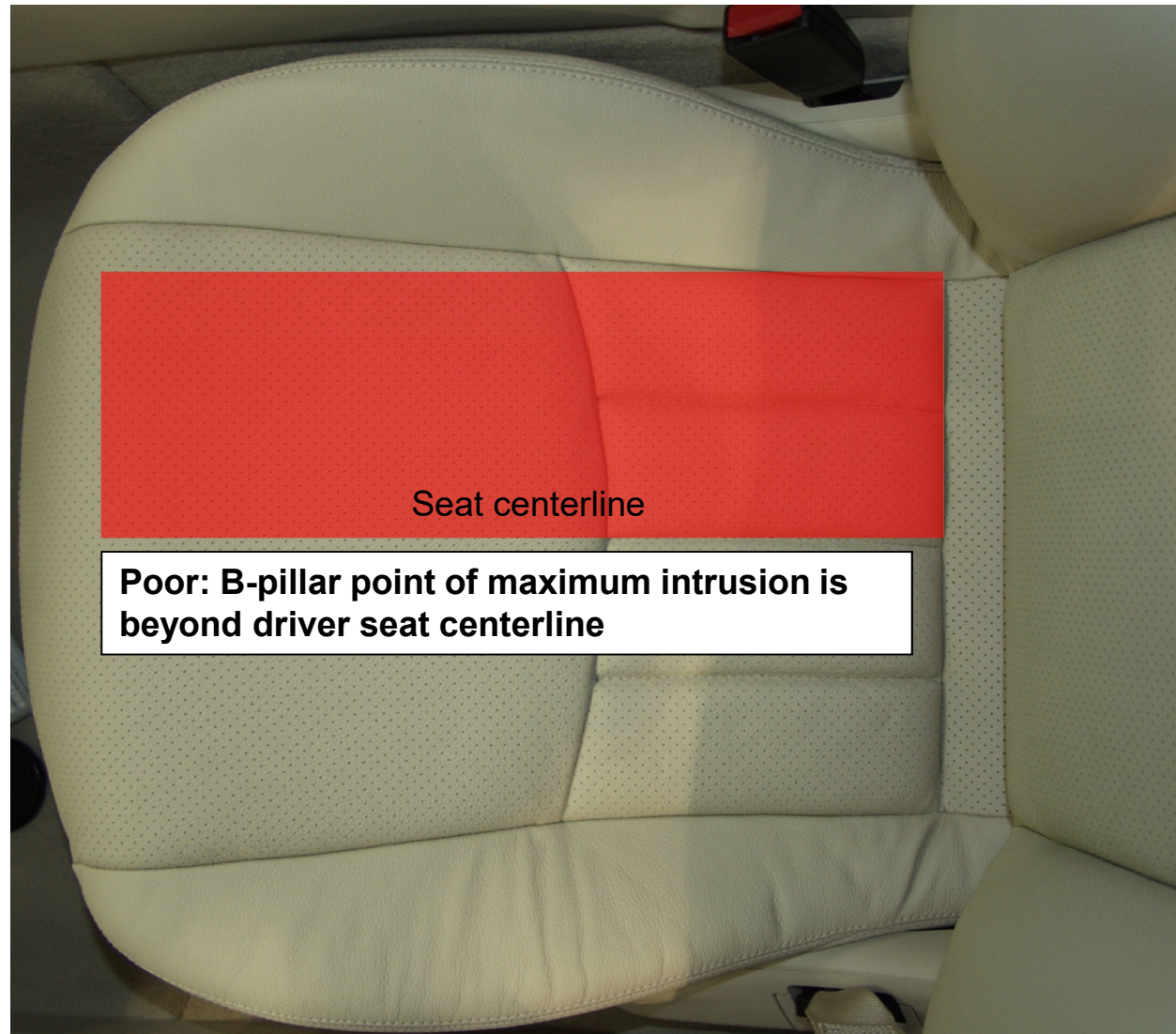
Record the coordinates of two points on the driver's seat pan (left and right side)

- Seat pan upholstery lines can serve as left and right side reference point locations. If the seat pan has no usable reference lines, seat back upholstery lines can be used. In cases where there are no seat pan or seat back reference lines, the center of the head restraint or head restraint posts should be used.

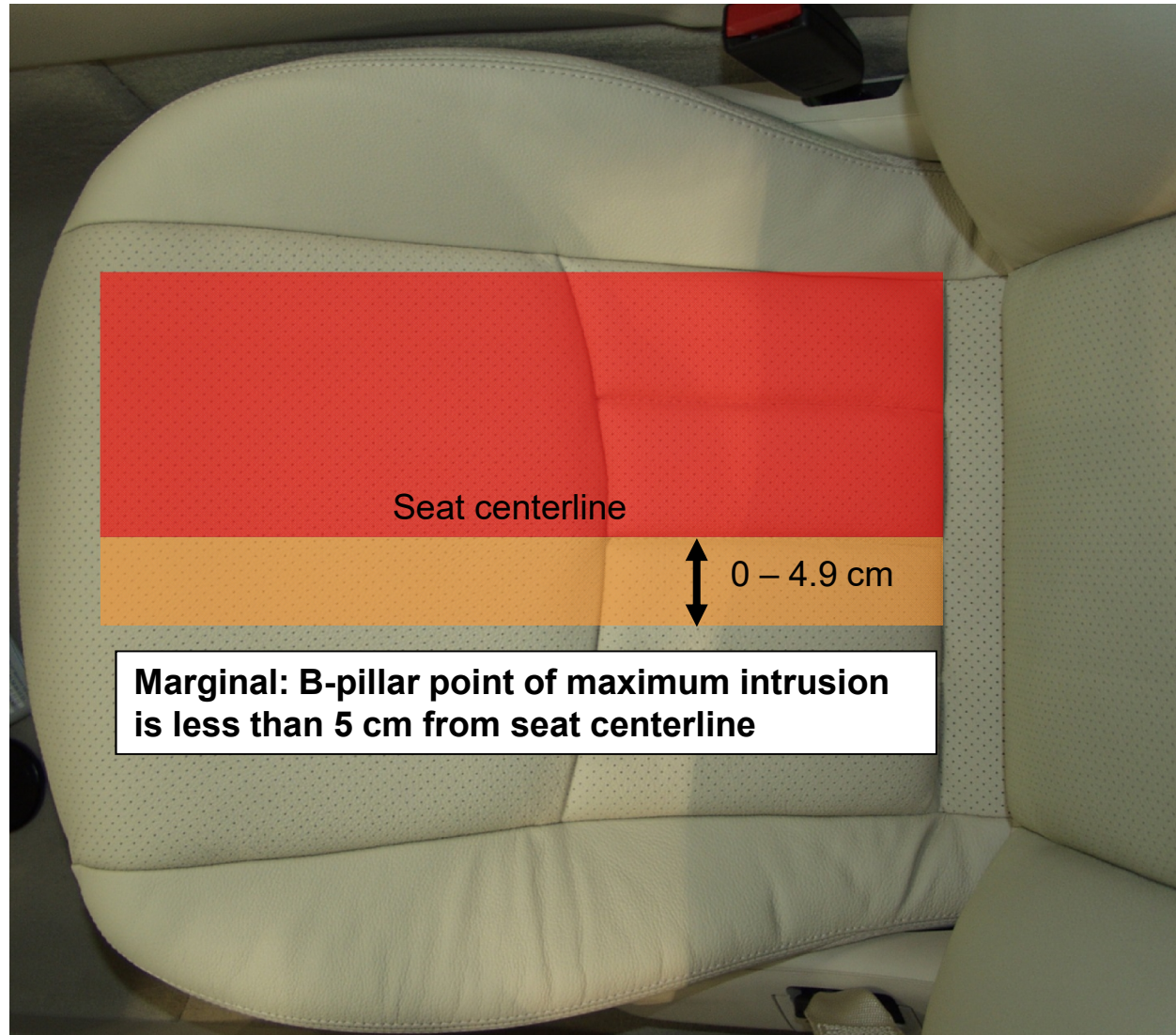
Average Y-coordinates of seat pan points to determine the location of the seat centerline



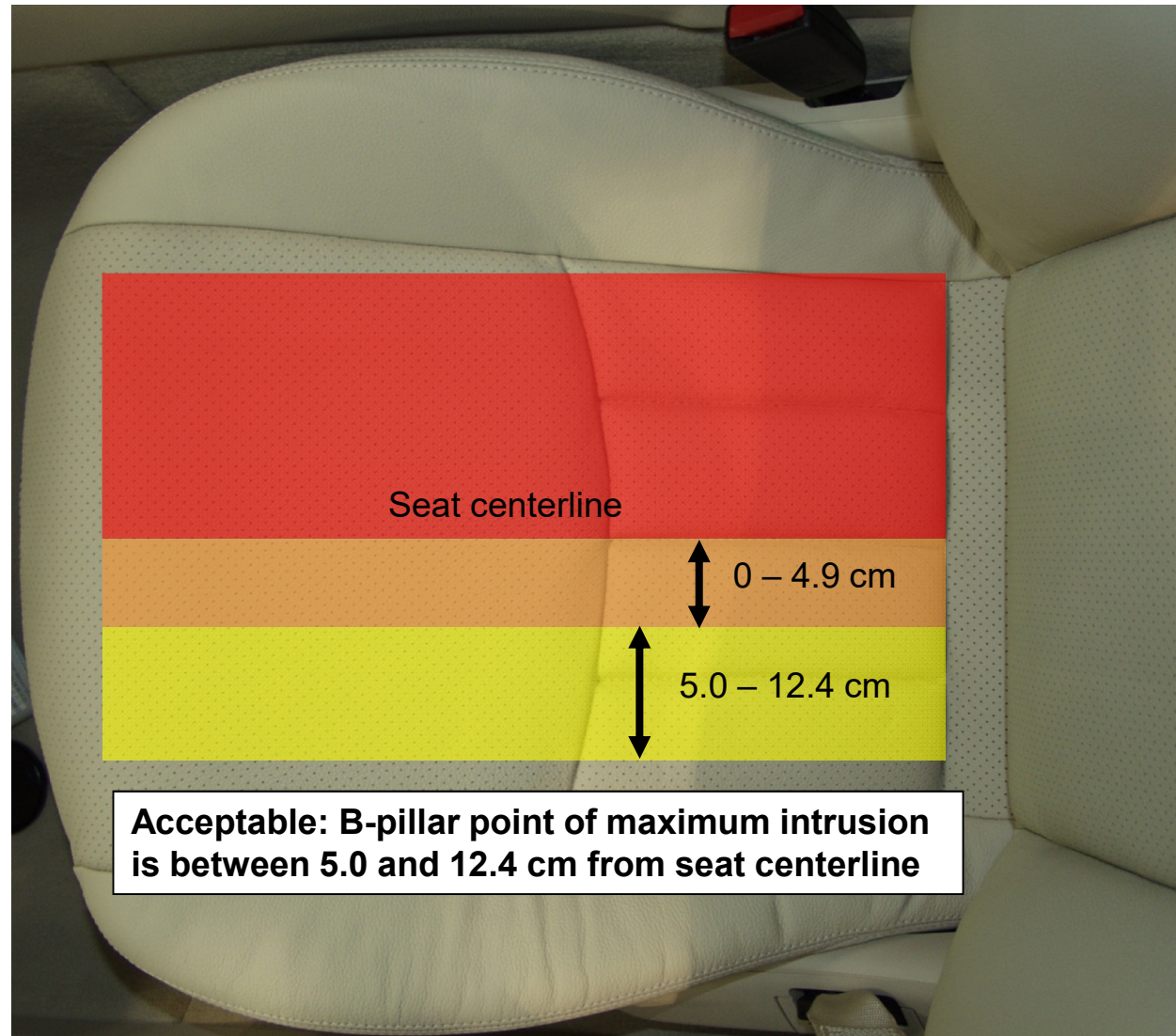
Structural rating



Structural rating



Structural rating



Structural rating

