



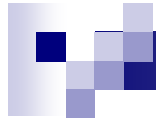
UN/ECE R16

Safety-belt

Test procedure

National Traffic Safety and Environment Laboratory

December 20, 2019



UN/ECE R16 Safety-belt Test procedure

1. Safety-belt and restraint system
2. Installation of child restraint systems
on forward facing seats
3. Safety-belt reminder



UN/ECE R16 Safety-belt Test procedure

1. Safety-belt and Restraint system
2. Installation of child restraint systems
on forward facing seats
3. Safety-belt reminder



1. Safety-belt and Restraint system

① Safety-belt test

② Requirements concerning the installation in the vehicle



① Safety-belt test

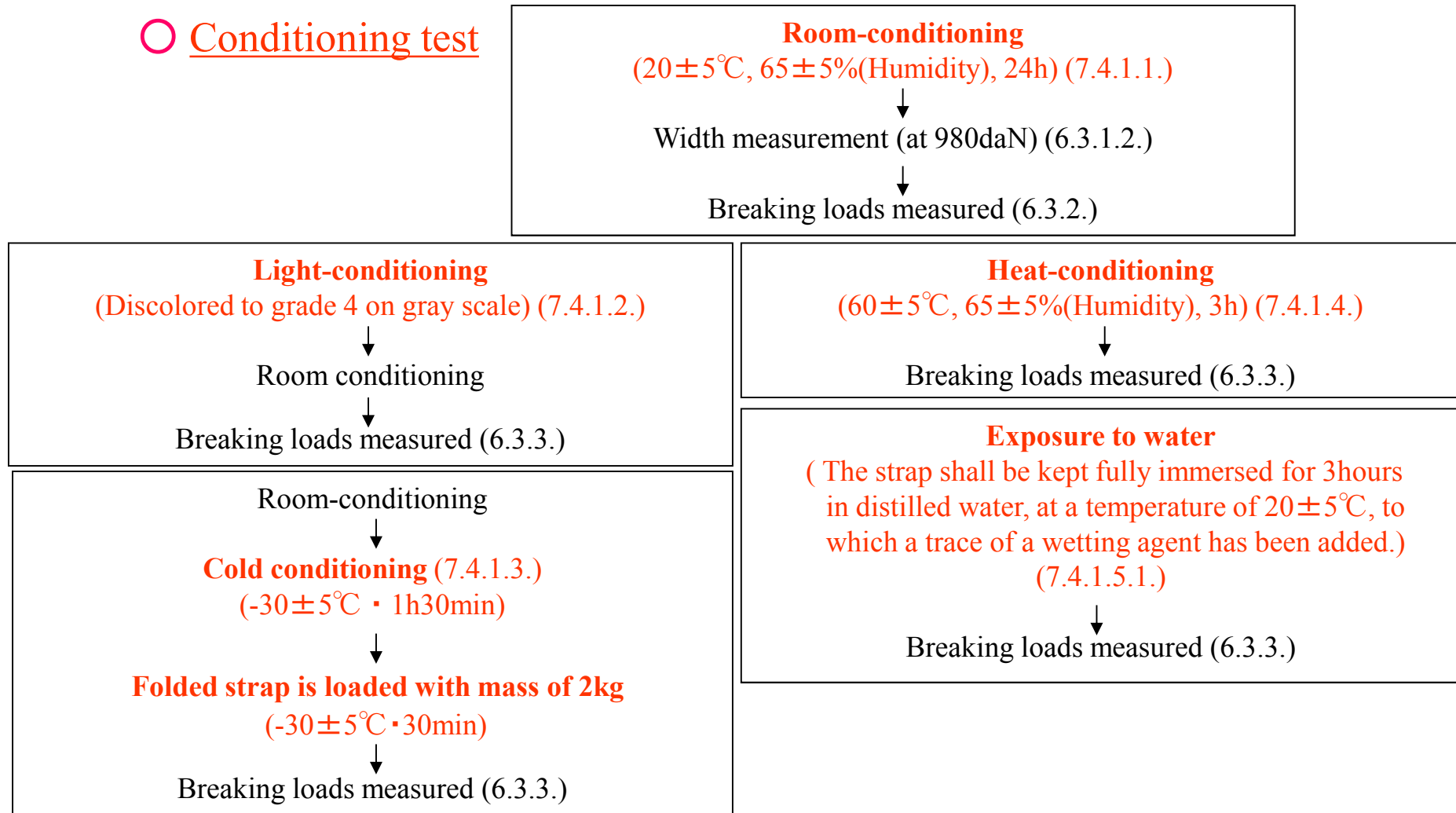
i . Straps

ii . Rigid parts (assembly) strength

iii . Belt assembly proof test
and dynamic test

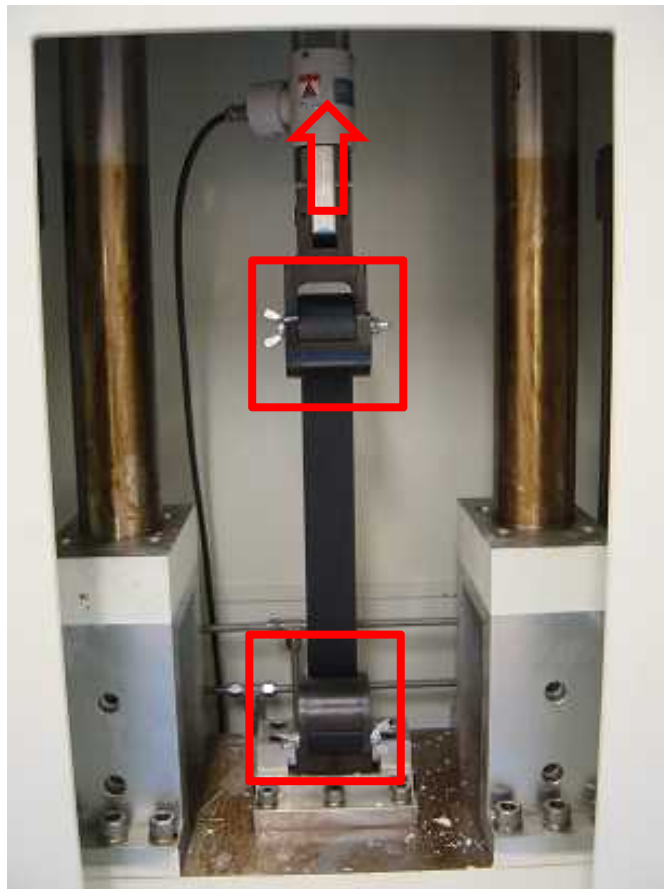
i . Straps

○ Conditioning test



i . Straps

○ Static test (6.3.2 / 6.3.3.)



Tensile testing machine



① Safety-belt test

i . Straps

ii . Rigid parts (assembly) strength

iii . Belt assembly proof test
and dynamic test





ii . Rigid parts (assembly) strength

Static test

○ Test of belt assembly components incorporating rigid parts

Test article (7.5.1 / 7.5.2.) ⇒ Buckles (6.2.2.6)
Adjusting devices (6.2.3.3.)
Attachment (6.2.4.)
Belt adjusting (6.2.4.)
Retractor (6.2.5.)

- » Measurement of breaking strength (daN) after attachment to tension device.
- » It must not break, become distorted, or become detached under the prescribed load while load is being applied.

ii . Rigid parts (assembly) strength

Abrasion conditioning and static test

- 2 samples are used in test
- The strap is in contact with a rigid part of the belt

For manual adjustment
devices test

Operating force test

Micro-slip test

Abrasion conditioning test

Test of breaking strength of strap
Test of belt assembly components incorporating rigid parts

Operate force test (7.5.6) → (6.2.3.4.)

Strap shall be drawn steadily through the adjusting device, at a rate of approximately 100mm/s and the maximum force measured to the nearest 0.1daN after the first 25mm of strap movement.

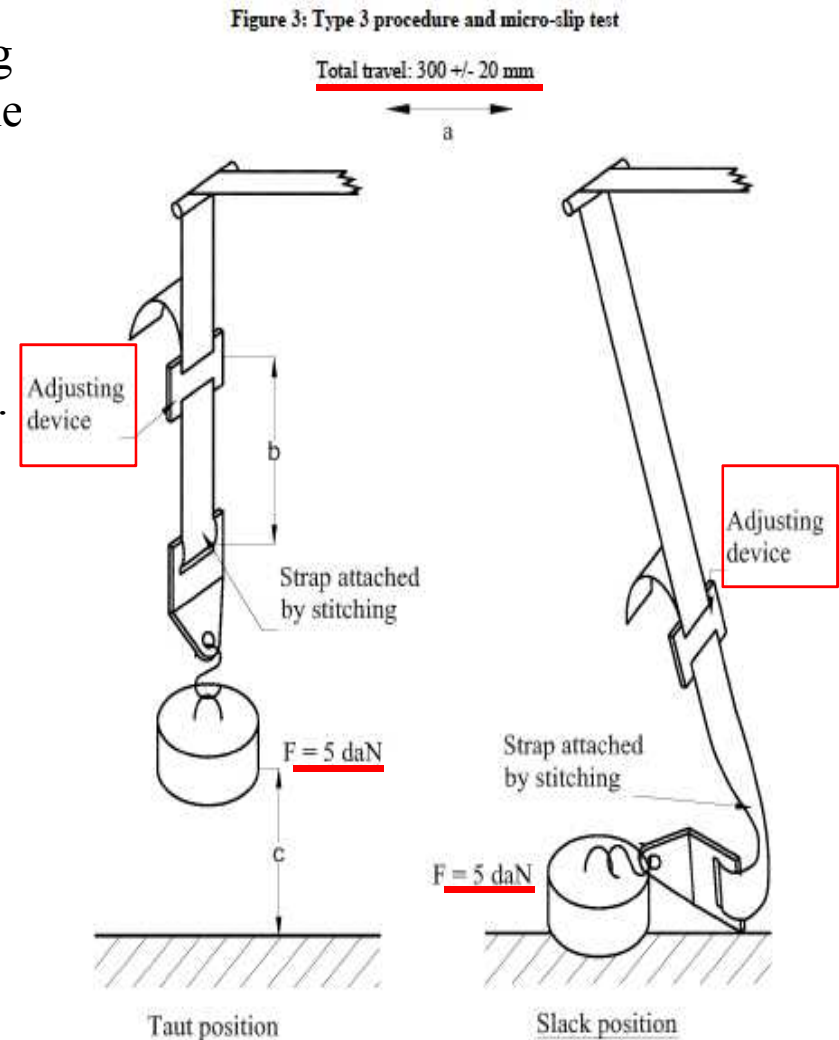
Tests shall be carried out in both directions of strap travel through the device.

The strap is cycled 10 times prior to measurement.

Micro-slip test (7.3.) → (6.2.3.2.)

1,000 cycles shall be completed at a frequency of 0.5 cycles per second, the total amplitude $300 \pm 20\text{mm}$. The 5 daN load shall be applied only during the time corresponding to a shift of $100 \pm 20\text{mm}$ for each half period.

Measurement of strap slip.

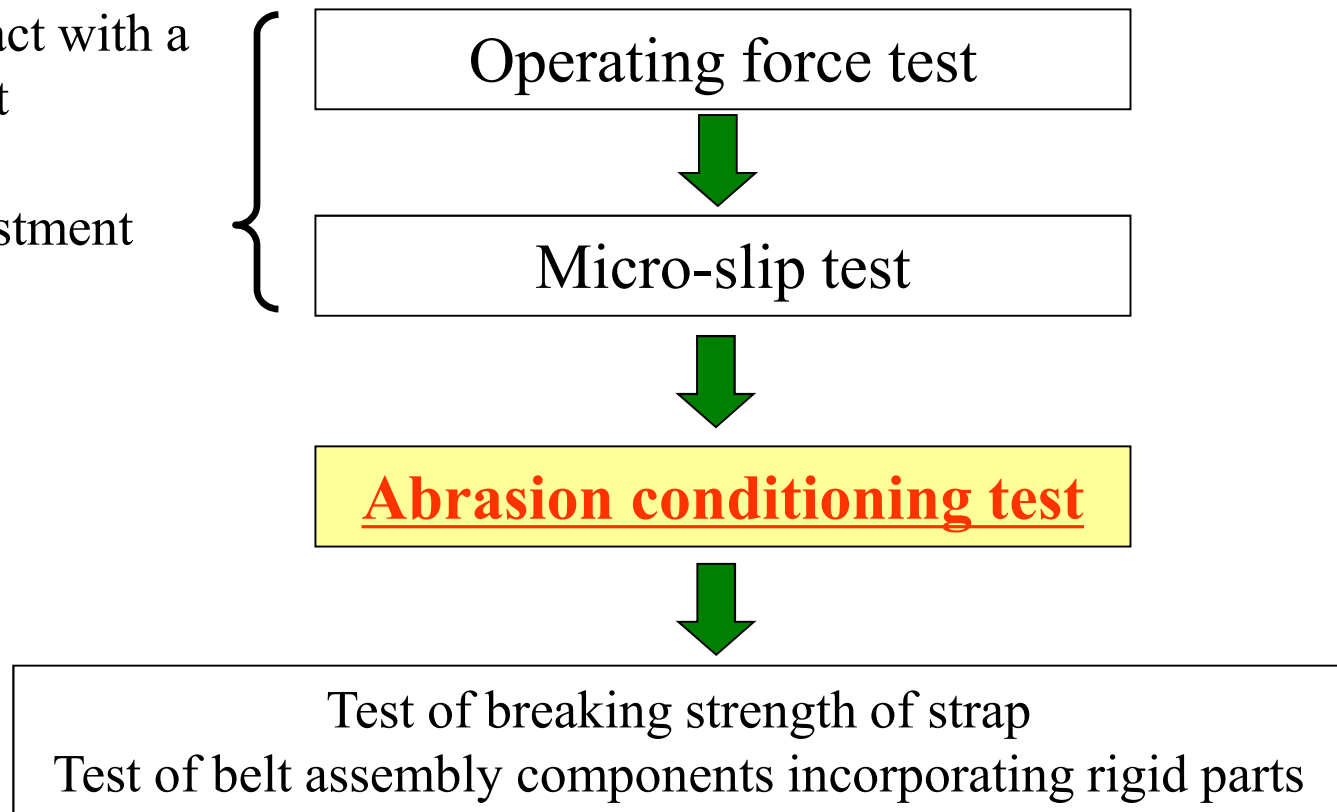


ii . Rigid parts (assembly) strength

Abrasion conditioning and static test

- 2 samples are used in test
- The strap is in contact with a rigid part of the belt

For manual adjustment
devices test



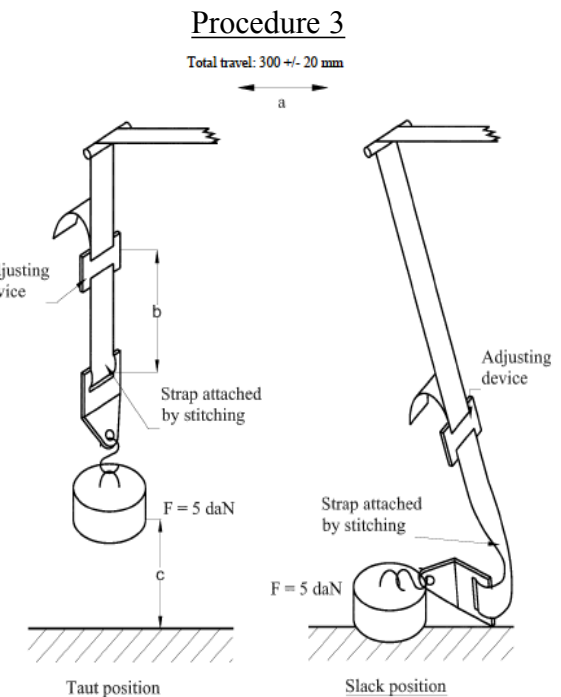
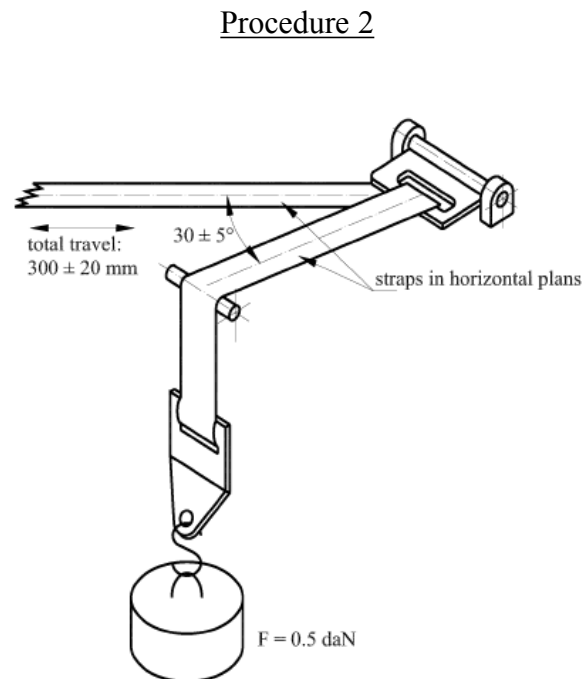
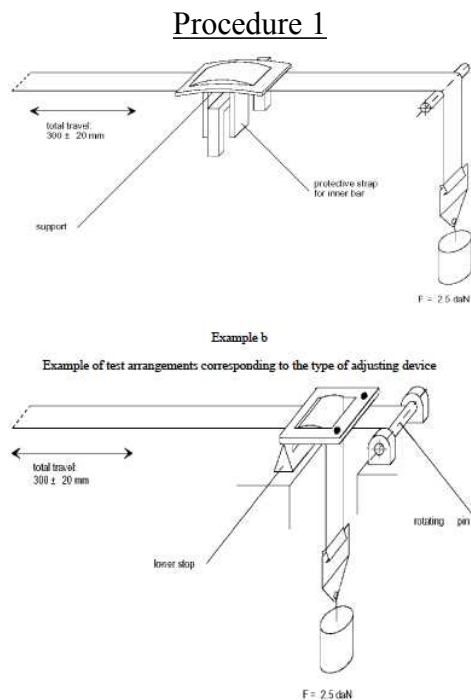
» The strap is in contact with a rigid part of the belt

○ Abrasion conditioning test (7.4.1.6.)

Procedure 1: For cases where the strap slides through an adjusting device.

Procedure 2: For cases where the strap changes direction in passing through a rigid part.

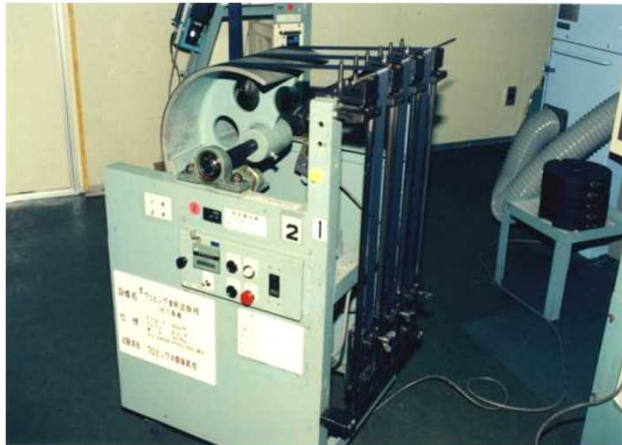
Procedure 3: For cases where the strap is fixed to a rigid part by sewing or similar means



» The strap is in contact with a rigid part of the belt

○ Abrasion conditioning test (7.4.1.6.)

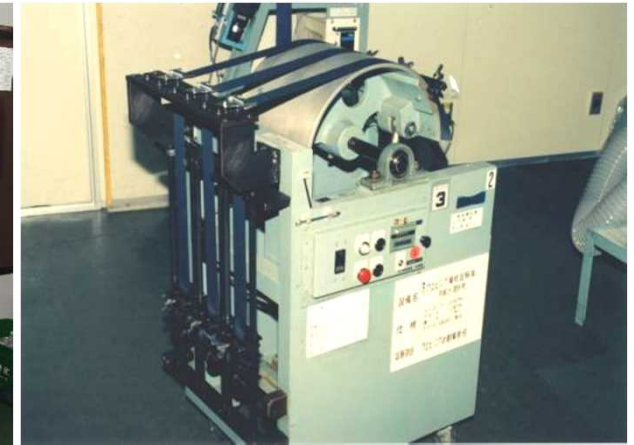
Procedure 1
Hexagon Bar



Procedure 2
Sash Guide , Tongue Plate



Procedure 3
Adjustment Device

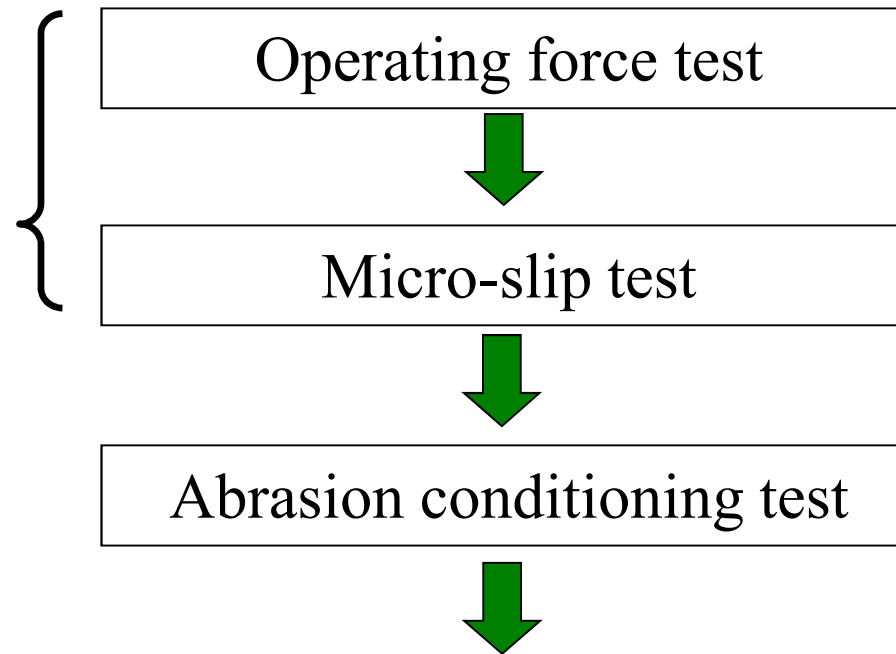


ii . Rigid parts (assembly) strength

Abrasion conditioning and static test

- 2 samples are used in test

For manual adjustment
devices test



○ Test of breaking strength of strap (7.4.2.) → (6.4.2.)



Tensile testing machine



① Safety-belt test

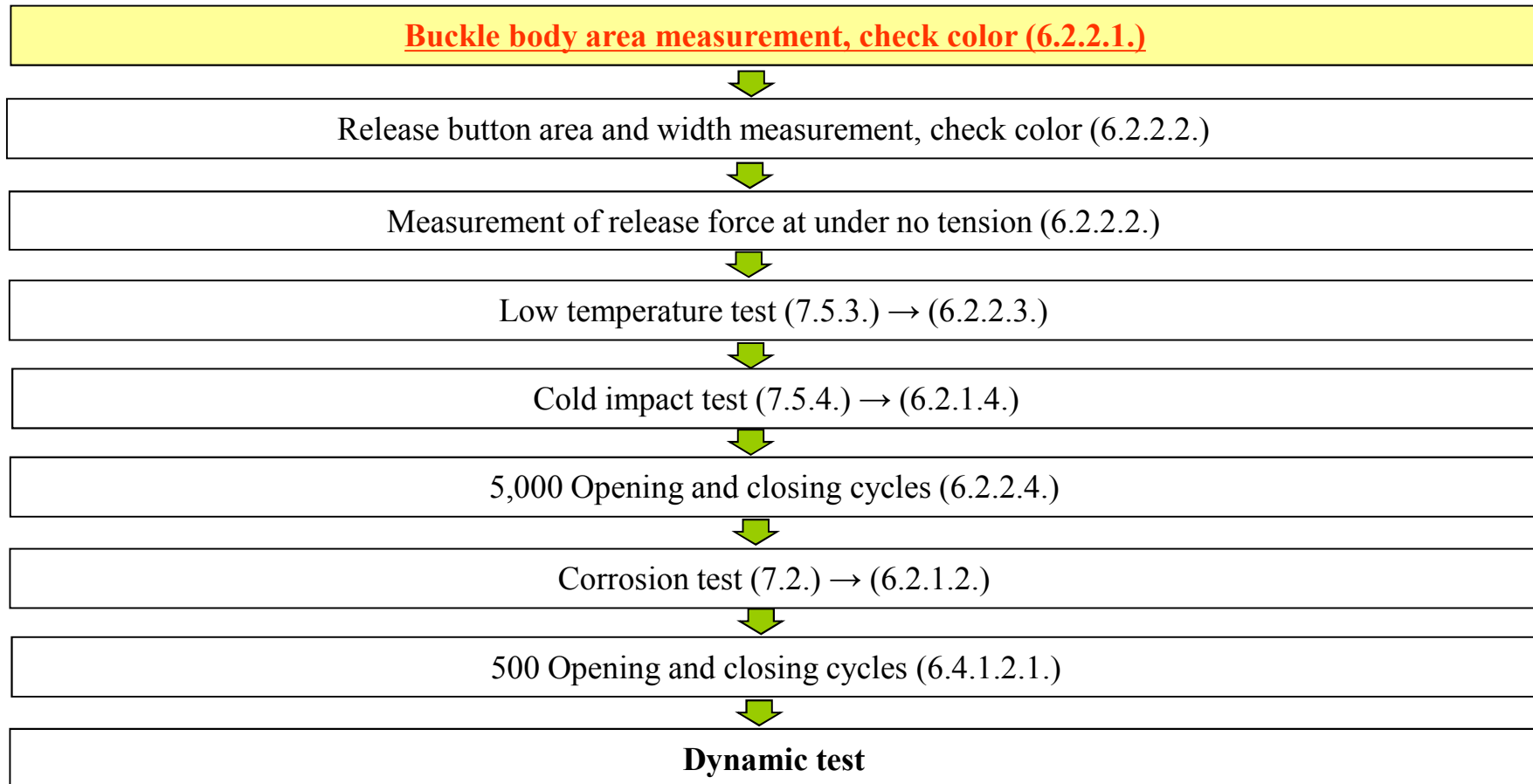
i . Straps

ii . Rigid parts (assembly) strength

iii. Belt assembly proof test
and dynamic test

iii. Belt assembly proof test and dynamic test

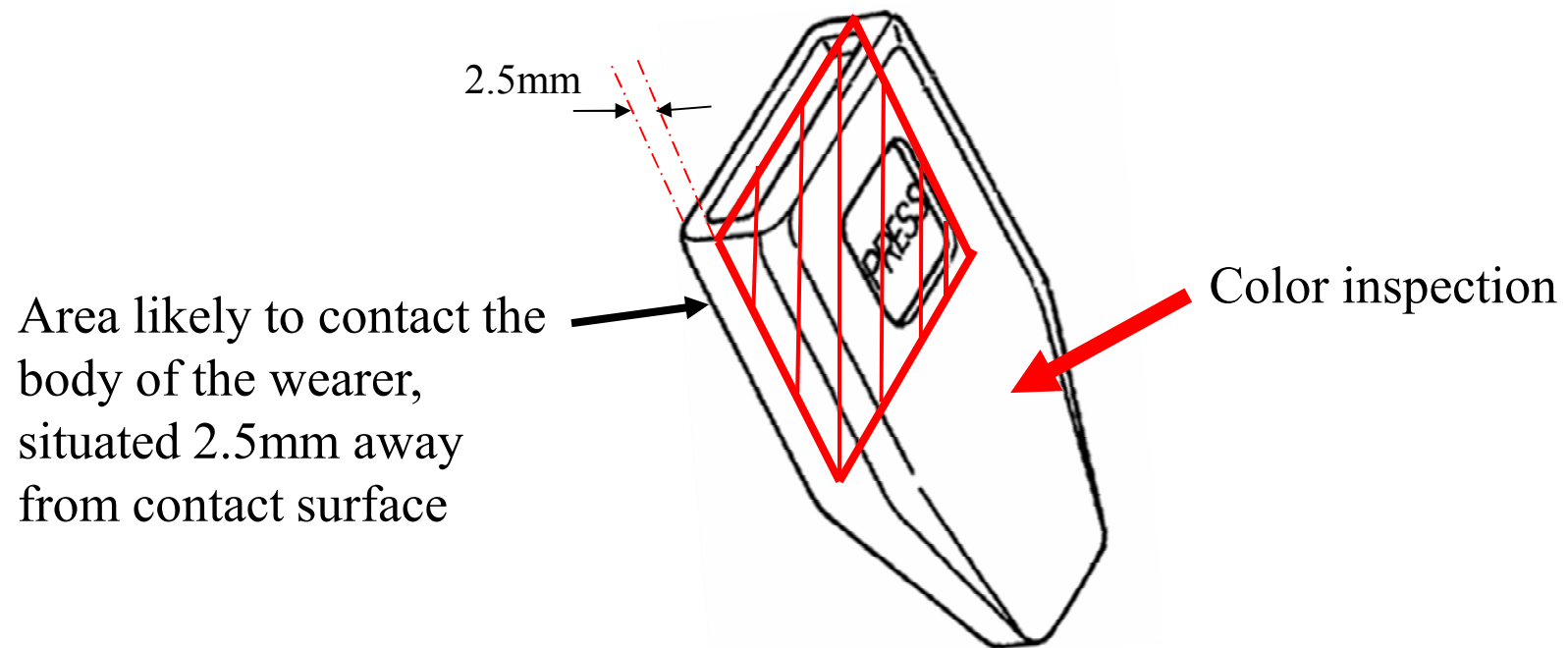
Buckle release force and duration test



iii. Belt assembly proof test and dynamic test

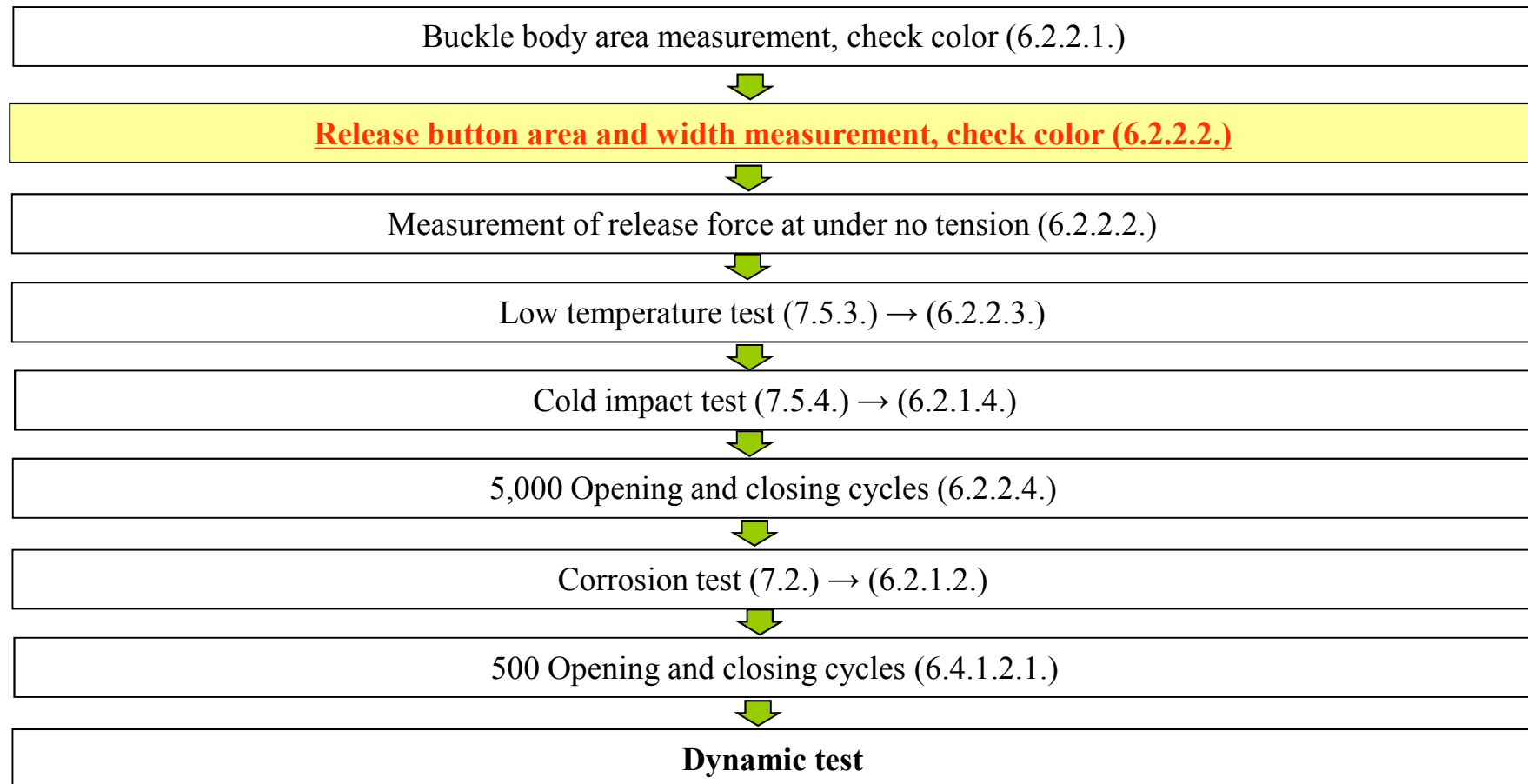
Buckle release force and duration test

○ The buckle likely to contact the body of the wearer shall present a section area measurement, check color (6.2.2.1.)



iii. Belt assembly proof test and dynamic test

Buckle release force and duration test

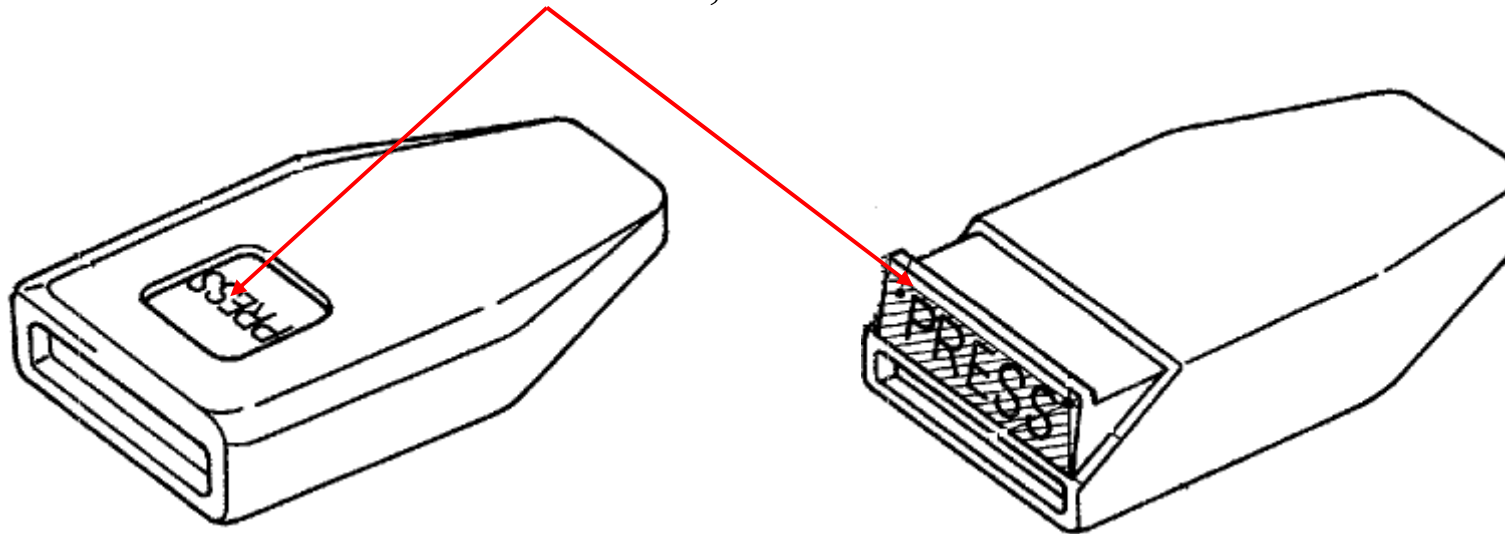


iii. Belt assembly proof test and dynamic test

Buckle release force and duration test

○Release button area and width measurement, check color (6.2.2.2.)

Release button : Area, width and color are checked.

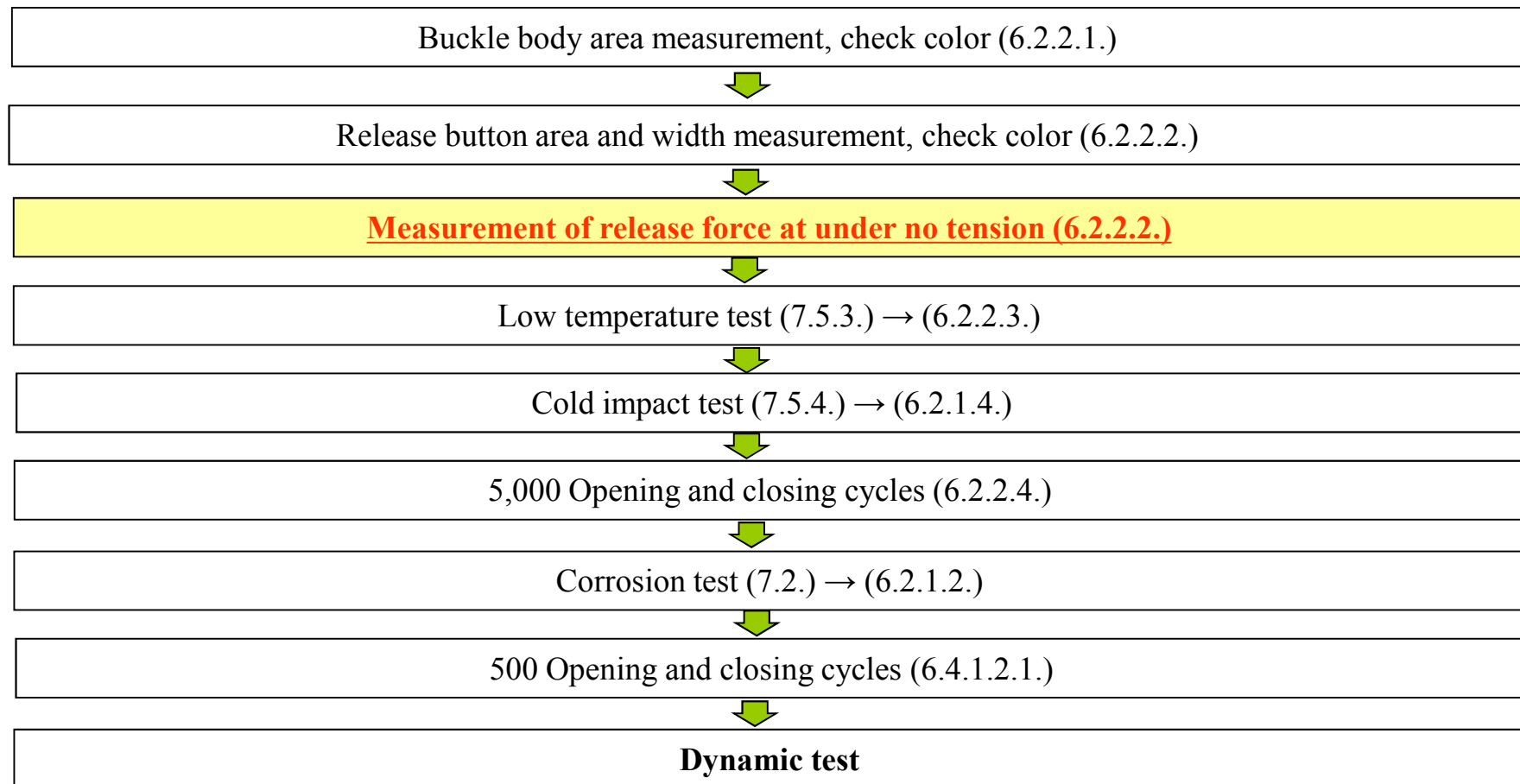


Enclosed button

Non-enclosed button

iii. Belt assembly proof test and dynamic test

Buckle release force and duration test

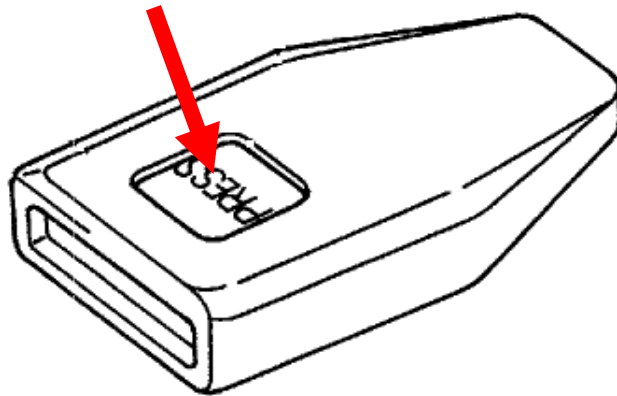


iii. Belt assembly proof test and dynamic test

Buckle release force and duration test

○ Measurement of release force under no tension (6.2.2.2.)

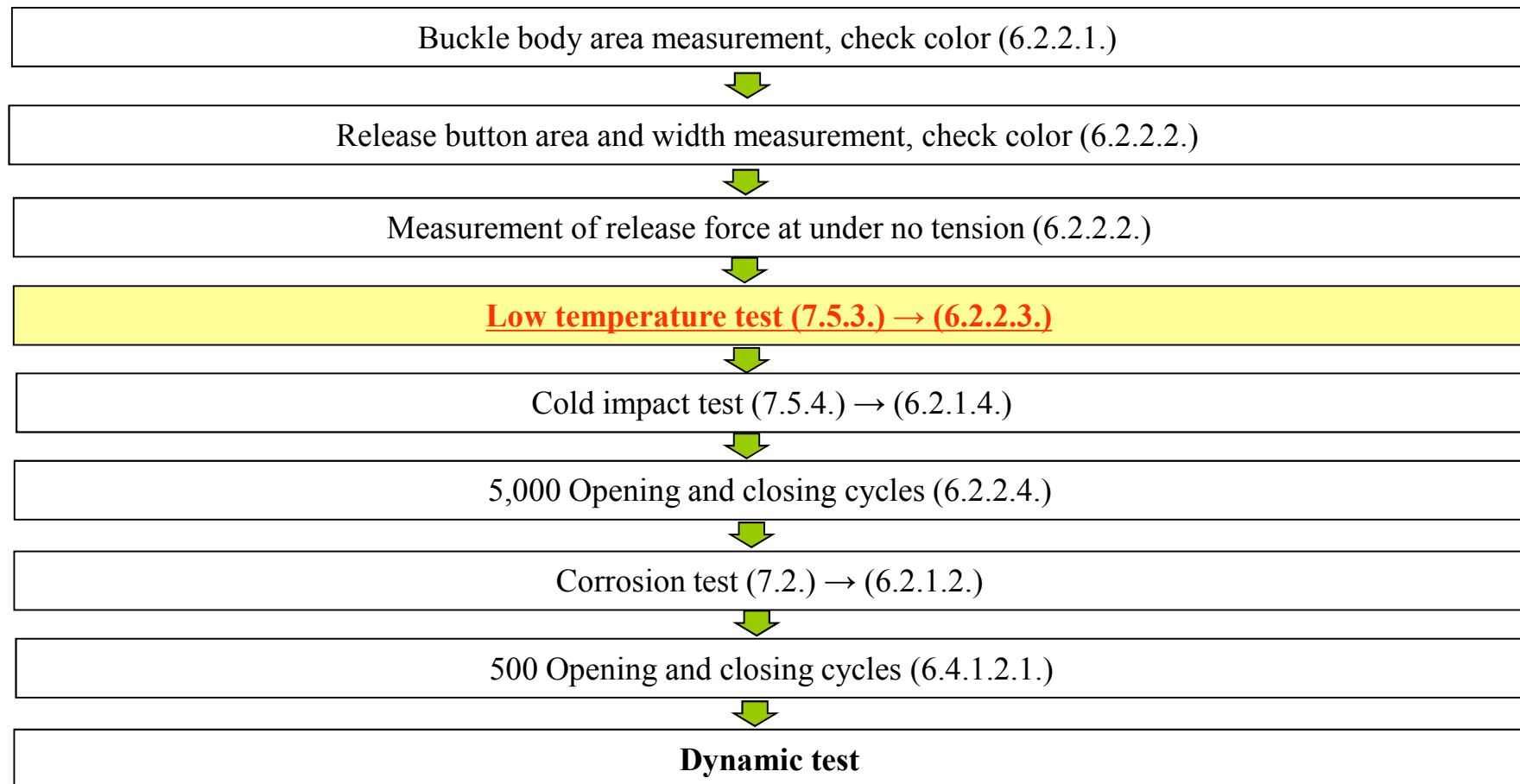
Measurement of opening force
with push-pull gauge



Buckle release testing machine

iii. Belt assembly proof test and dynamic test

Buckle release force and duration test





iii. Belt assembly proof test and dynamic test

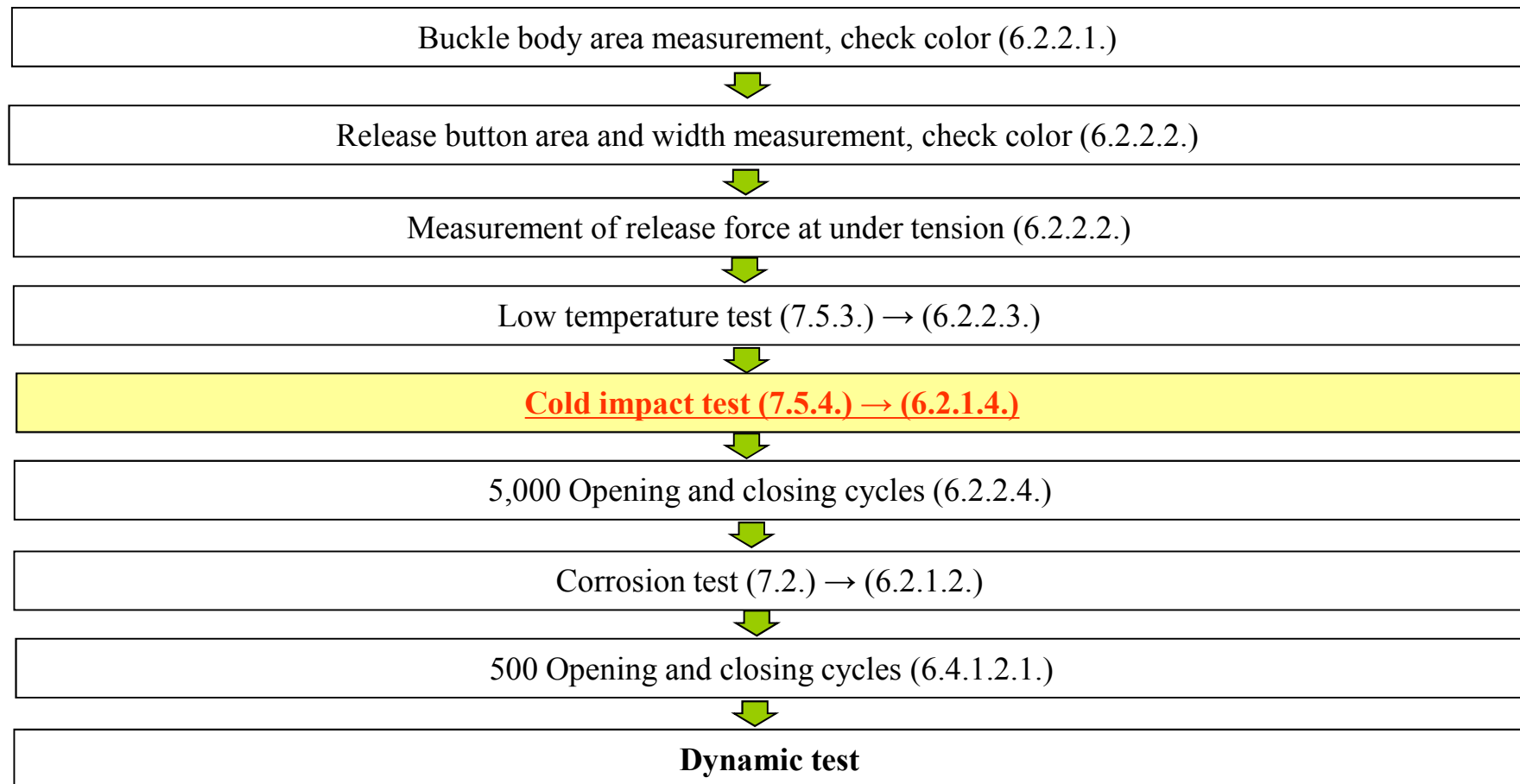
Buckle release force and duration test

○Low temperature test (7.5.3.) → (6.2.2.3.)

- Belt assembly shall be placed in a refrigerated cabinet at $-10 \pm 1^{\circ}\text{C}$ for two hours.
- The mating parts of the buckle shall be coupled together manually immediately after being removed from the refrigerated cabinet.

iii. Belt assembly proof test and dynamic test

Buckle release force and duration test



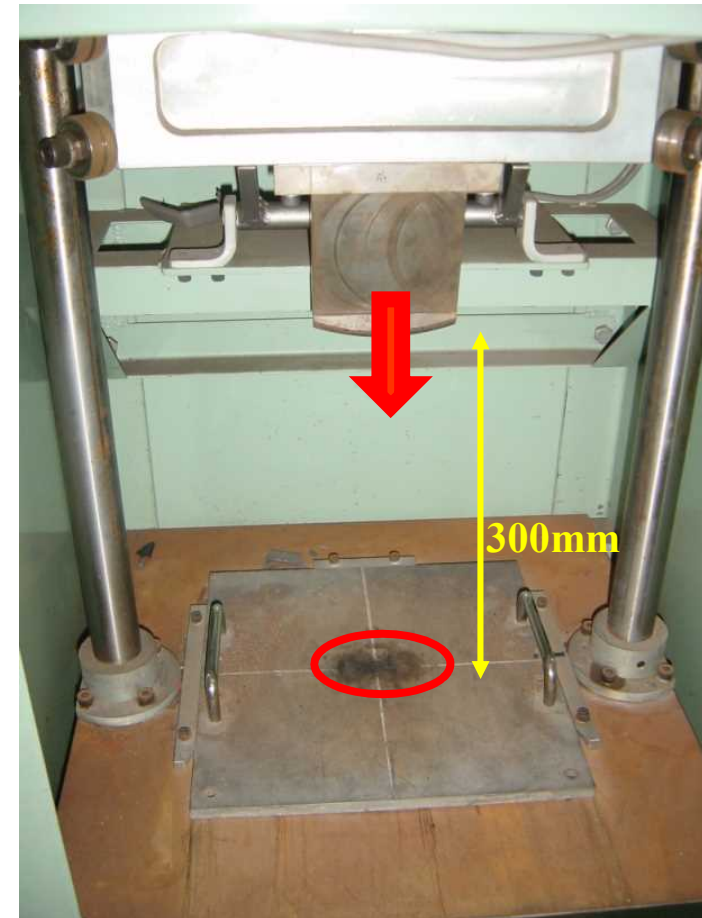
iii. Belt assembly proof test and dynamic test

Buckle release force and duration test

○ Cold impact test (7.5.4.) → (6.2.1.4.)

(Test shall be performed when the item and parts are liable to become trapped in the door etc. when installed on a vehicle.)

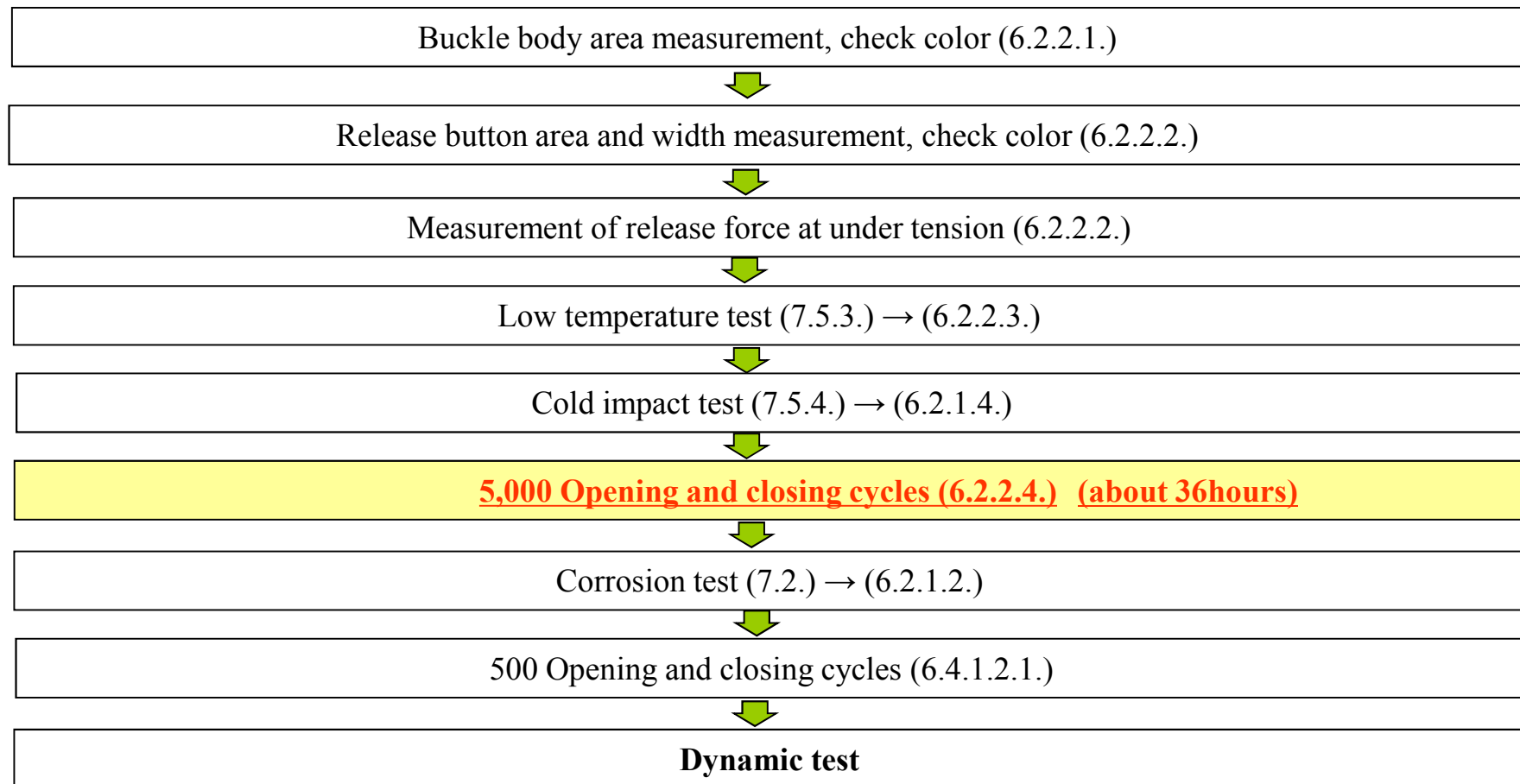
- Belt assembly shall be placed in a refrigerated cabinet at $-10 \pm 1^{\circ}\text{C}$ for two hours.
- within 30 seconds of being removed from the refrigerated cabinet, an 18 kg steel mass shall be allowed to fall under gravity through 300 mm on to the test sample.
- If the remaining assembly is still secure, or no visible cracks are present, it will then be further assessed against the test requirements specified in paragraphs 6.2.2., 6.2.3. and 6.4.



Cold impact testing machine

iii. Belt assembly proof test and dynamic test

Buckle release force and duration test



iii. Belt assembly proof test and dynamic test

Buckle release force and duration test

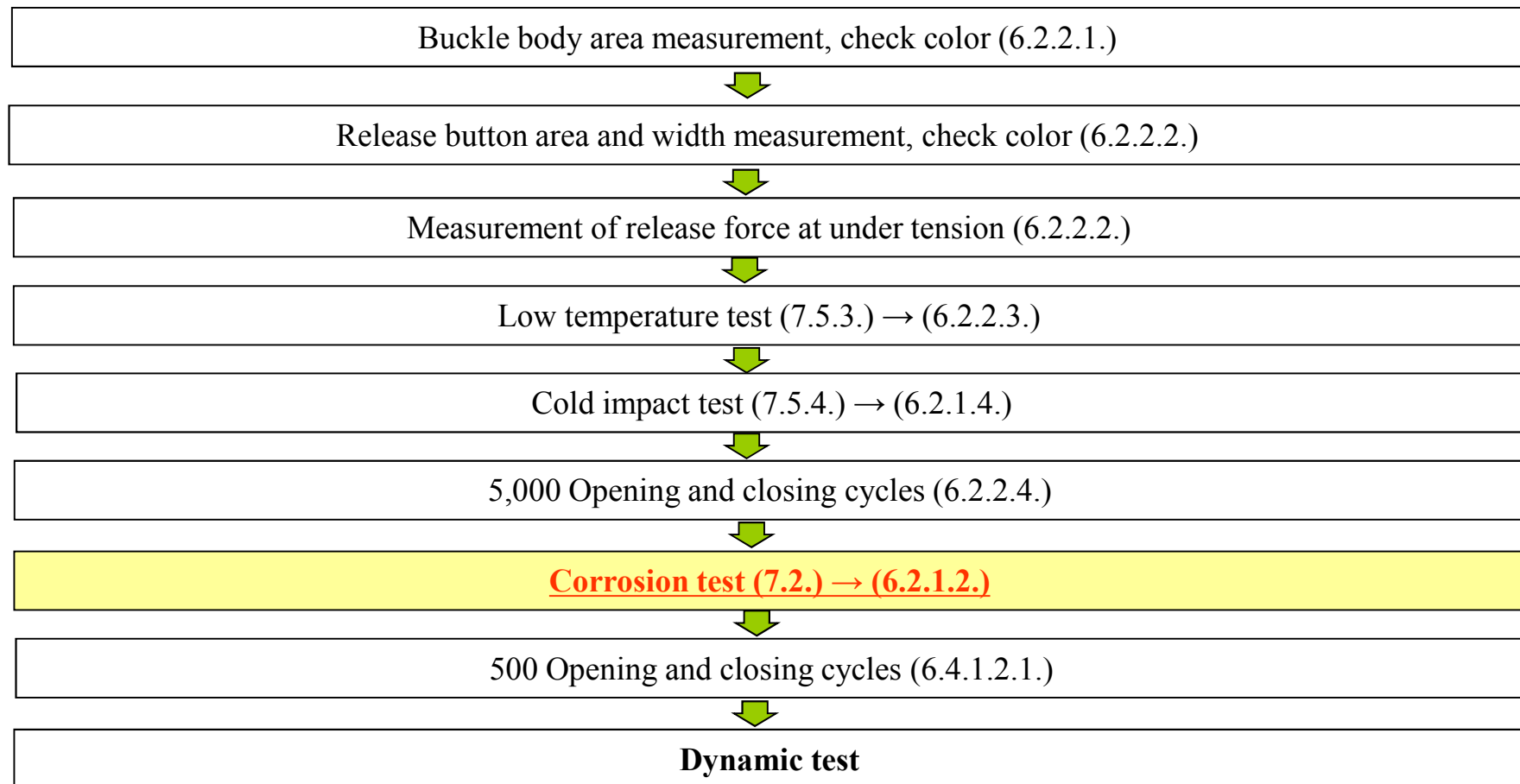
○ 5,000 Opening and closing cycles (6.2.2.4.)



Buckle Durability Testing equipment

iii. Belt assembly proof test and dynamic test

Buckle release force and duration test



iii. Belt assembly proof test and dynamic test

Buckle release force and duration test

○ Corrosion test (7.2.) → (6.2.1.2.)

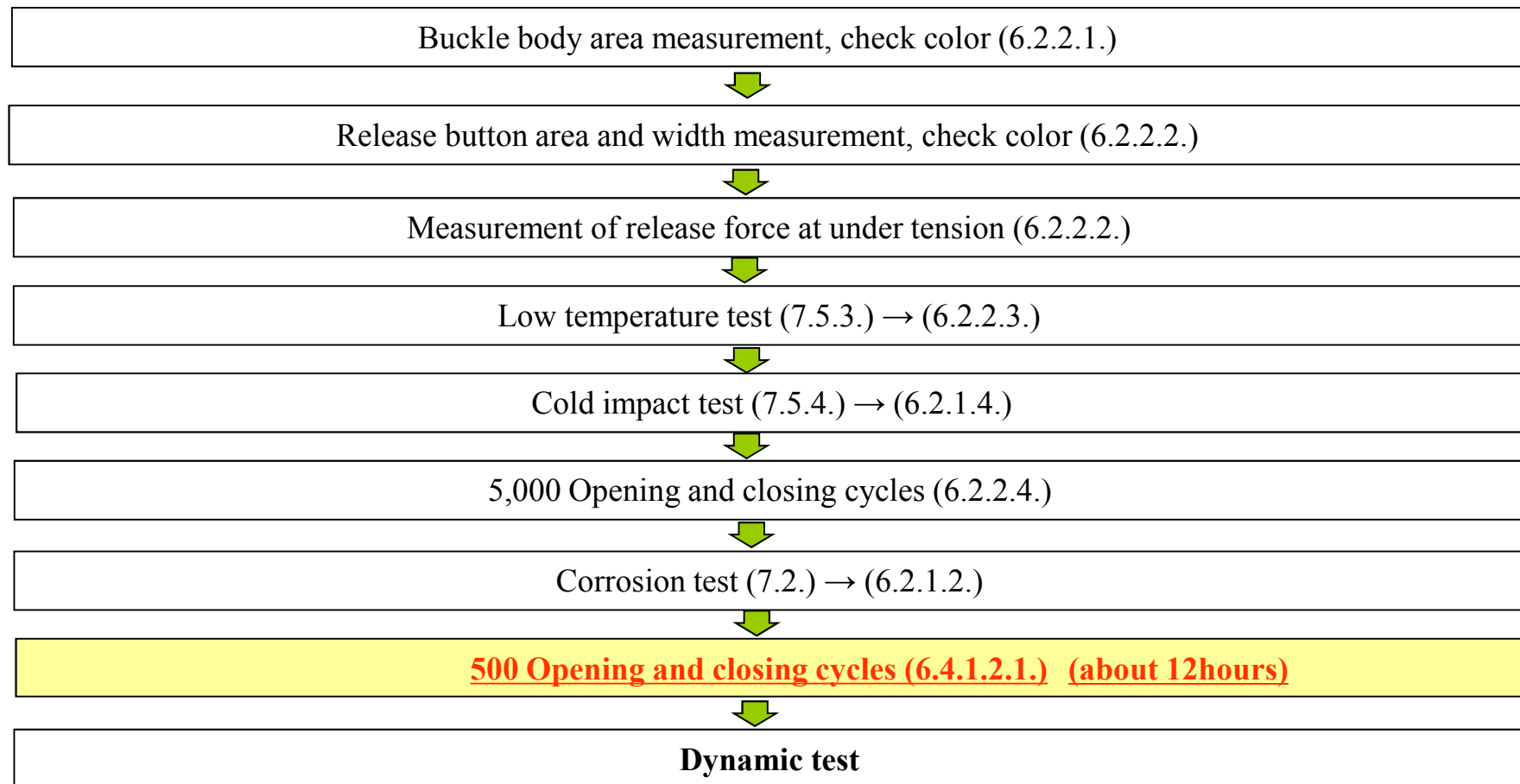
- The exposure test shall proceed continuously for a period of 50 hours.
- On completion of the exposure test the assembly shall be gently washed, or dipped in clean running water with a temperature not higher than 38 degrees C to remove any salt deposit that may have formed and then allowed to dry at room temperature for 24 hours before inspection. No deterioration or corrosion shall be visible to the unaided eye of a qualified observer.



Salt Spray Testing Chamber

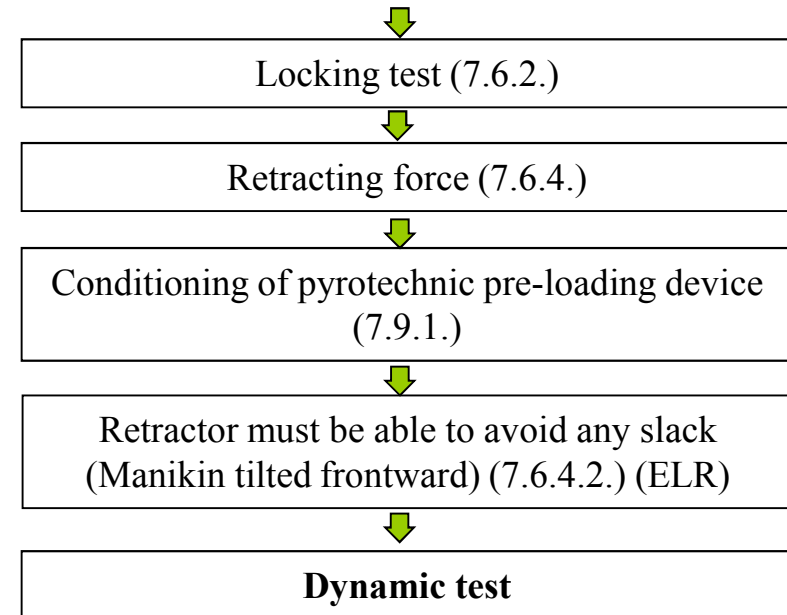
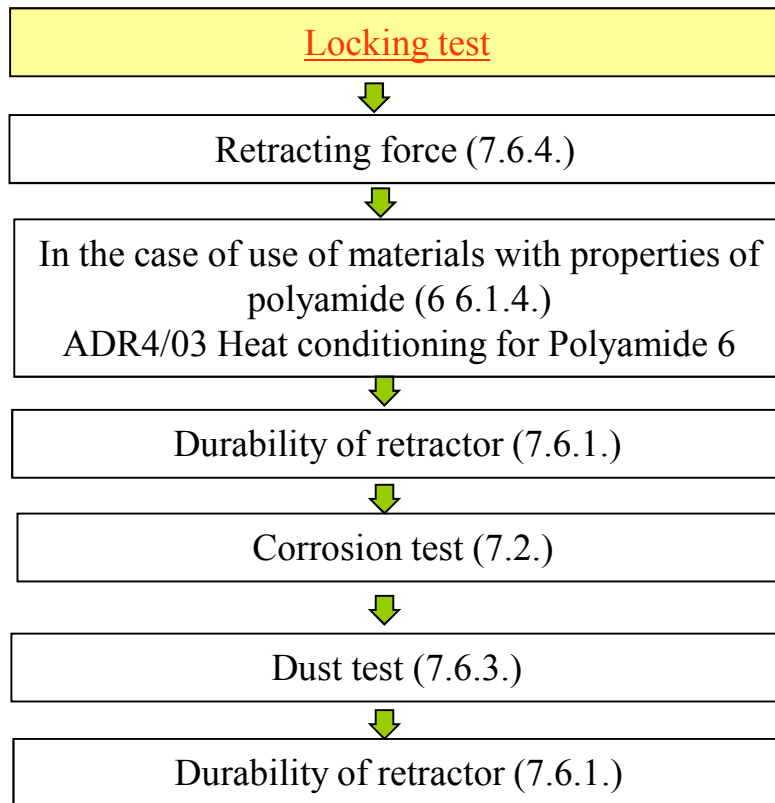
iii. Belt assembly proof test and dynamic test

Buckle release force and duration test



iii. Belt assembly proof test and dynamic test

Retractor locking and duration test





iii. Belt assembly proof test and dynamic test

Retractor locking and duration test

○ Locking test

» ELR (Emergency locking retractor) (7.6.2.) → (6.2.5.)

Locking threshold is measured according to the below methods:

Webbing is withdrawn in 4 directions.

Vehicle sense

After the webbing is secured, the retractor is accelerated in extraction direction of the webbing

Degree / Angle

After the retractor is secured, the retractor is tilted while the webbing is withdrawn.

Webbing sense

After the retractor is secured, the webbing is withdrawn.



iii . Belt assembly proof test and dynamic test

Retractor locking and duration test

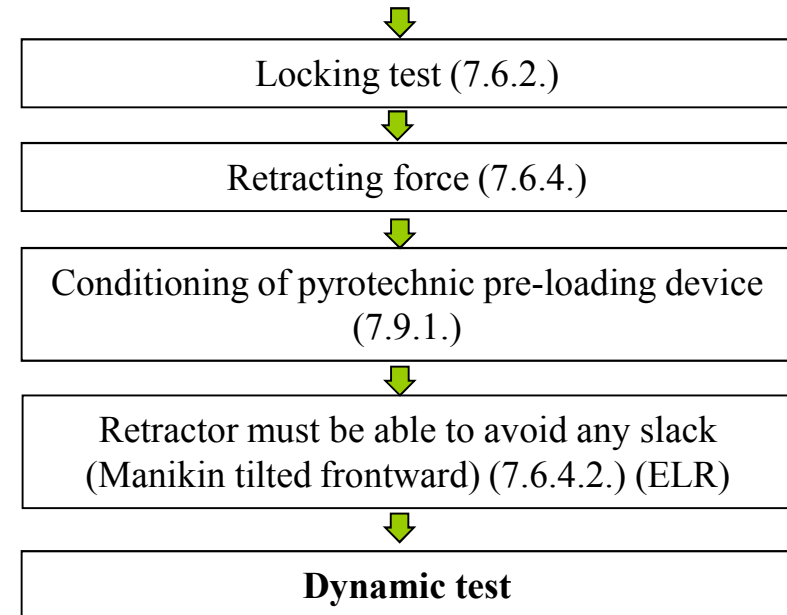
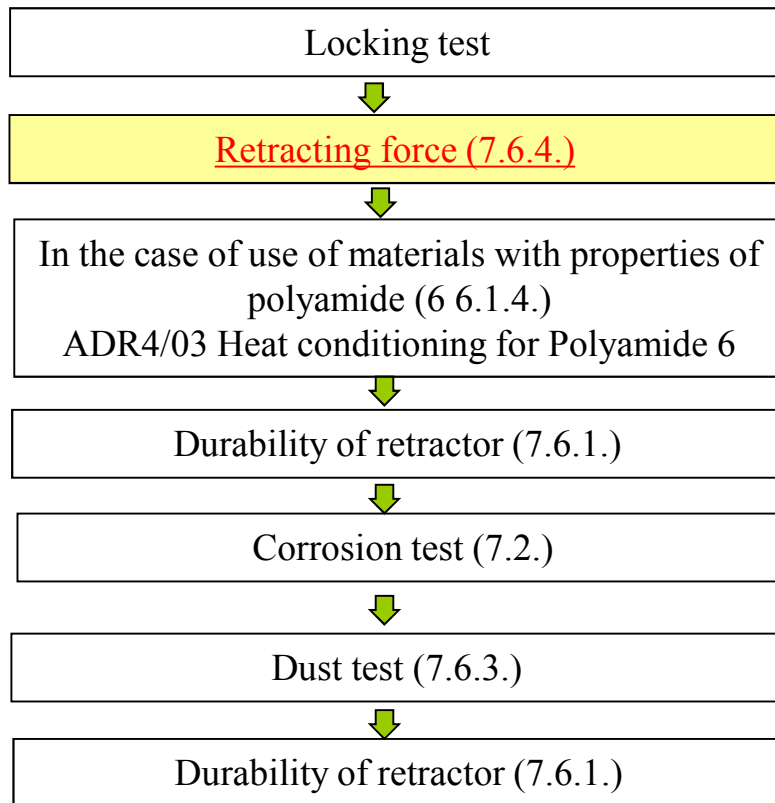
○ Locking test

» ALR (Automatically locking retractor) (6.2.5.2.)

- Automatically locking retractor shall not move more than 30 mm between locking positions of the retractor.
- After a rearward movement of the wearer, the belt must either remain at its initial position or return to that position automatically on subsequent forward movements of the wearer.

iii. Belt assembly proof test and dynamic test

Retractor locking and duration test





iii. Belt assembly proof test and dynamic test

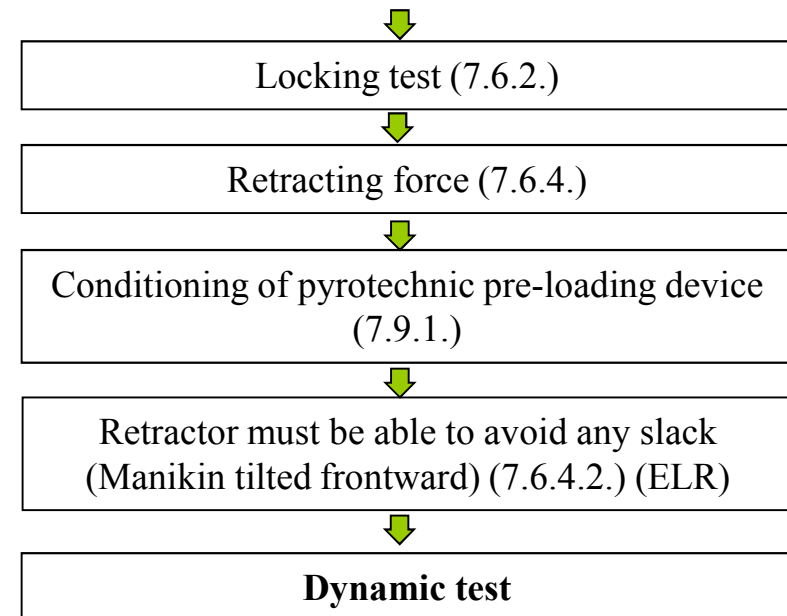
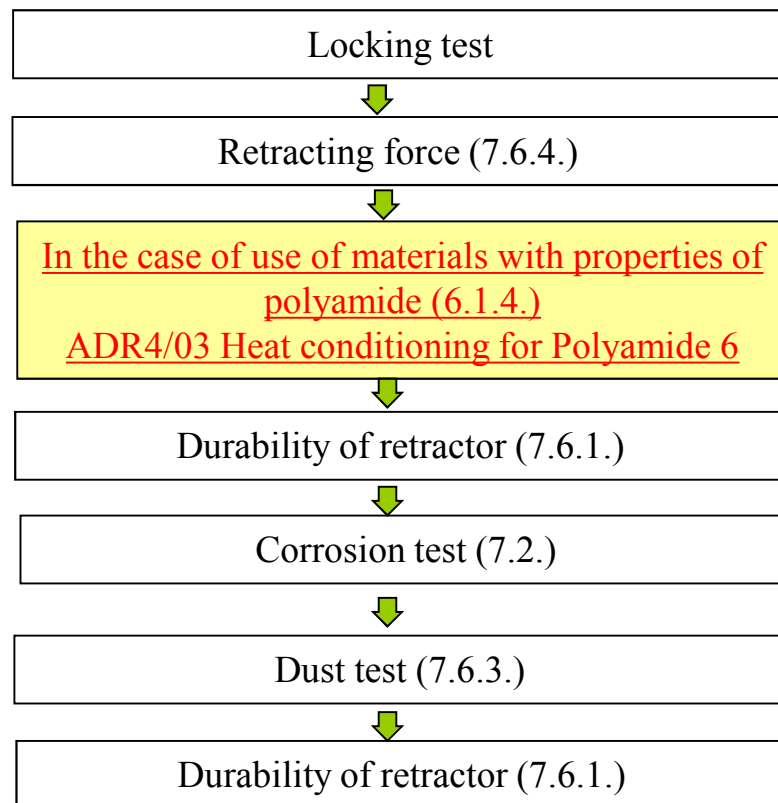
Retractor locking and duration test

○ Retracting force (7.6.4.) → (6.2.5.)

- The strap tension shall be measured at the point of contact with (but just clear of) the dummy while the strap is being retracted at the approximate rate of 0.6 m/min.
- In the case of a safety-belt with tension-reducing device, the retracting force and strap tension shall be measured with the tension-reducing device in both operation mode and non-operation mode.

iii. Belt assembly proof test and dynamic test

Retractor locking and duration test





iii . Belt assembly proof test and dynamic test

Retractor locking and duration test

○ In the case of use of materials with properties of polyamide 6 (6.1.4.)

» ADR4/03 Heat conditioning

10.3.3.

Each 'Seatbelt Assembly' which contains non-metallic material (other than a webbing 'Strap') must be exposed to environment over a water surface within a closed space, the environment having a temperature of not less than 80 degrees C, for a continuous period of not less than 24 hours and then cooled in an environment having a temperature not exceeding 23 degrees C. The cooling period must immediately be followed by three consecutive 24 hour cycles with each cycle comprising the following consecutive sequences:

10.3.3.1.

an environment having a temperature of not less than 100 degrees C must be maintained for a continuous period of 6 hours and this environment must be attained within 80 minutes of commencement of the cycle; then

10.3.3.2.

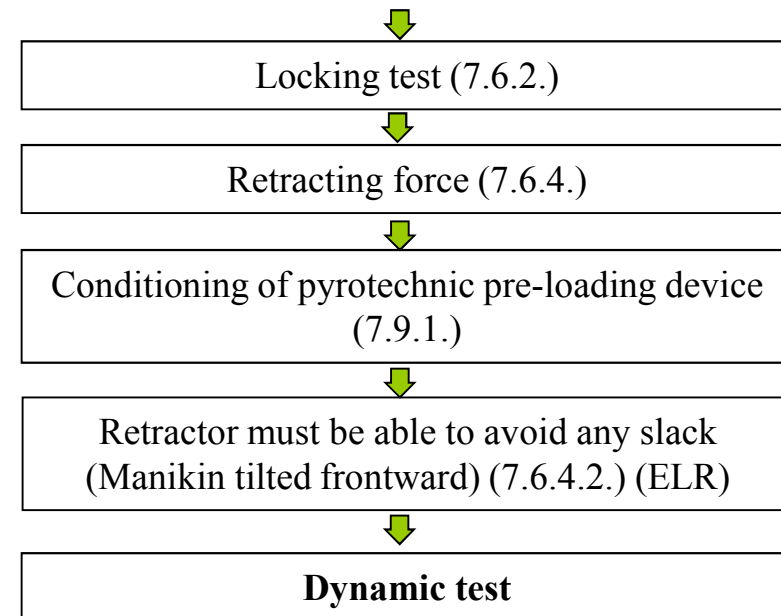
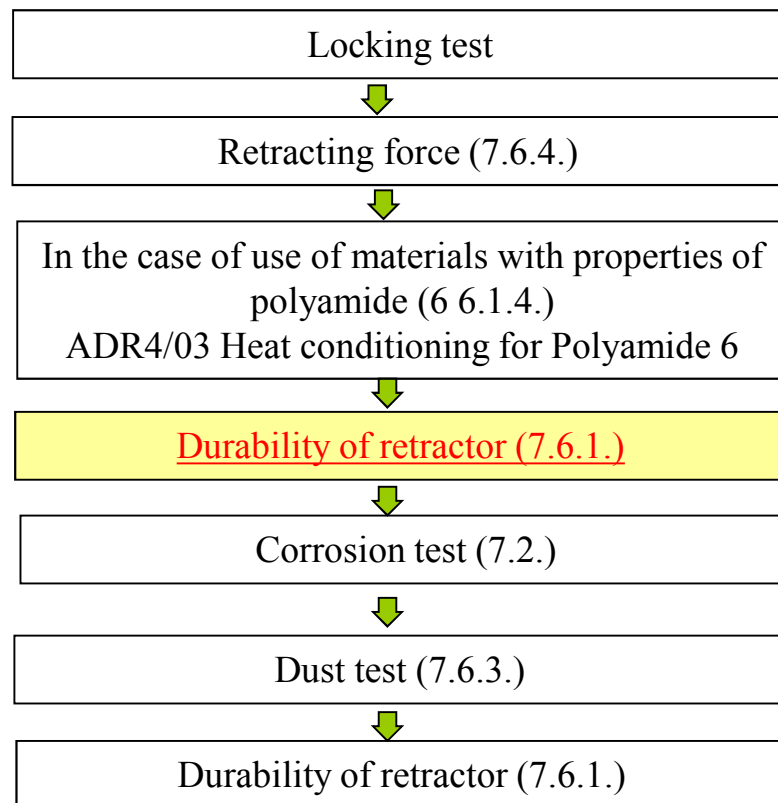
an environment having a temperature of not more than 0 degrees C must be maintained for a continuous period of 6 hours and this environment must be attained within 20 minutes; then

10.3.3.3.

an environment having a temperature of not more than 23 degrees C must be maintained during the remainder of the 24 hour cycle.

iii. Belt assembly proof test and dynamic test

Retractor locking and duration test



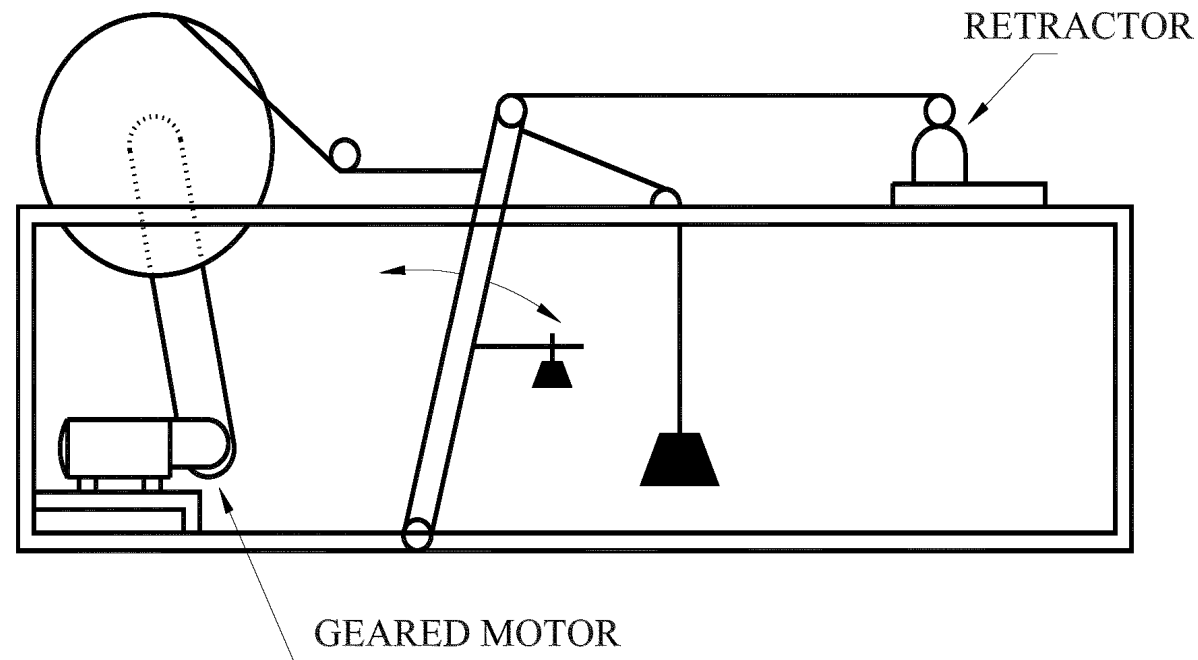
iii. Belt assembly proof test and dynamic test

Retractor locking and duration test

○ Durability of retractor

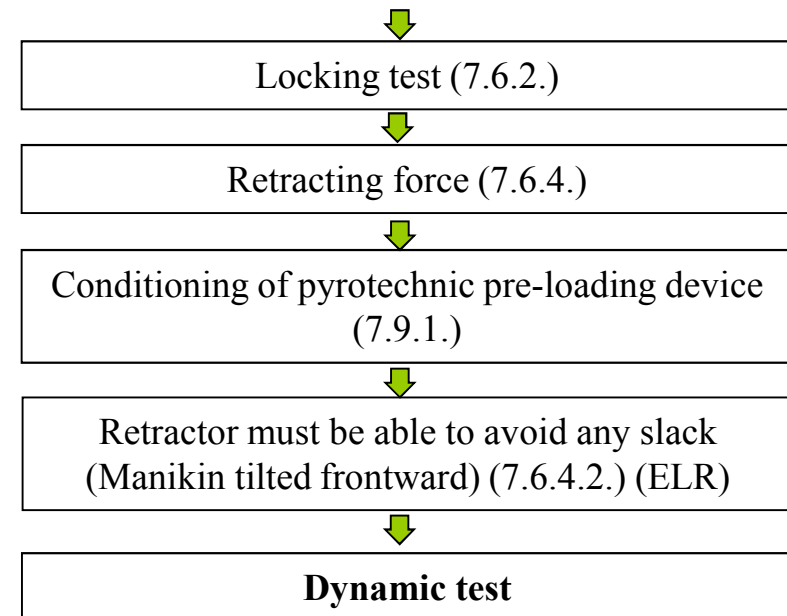
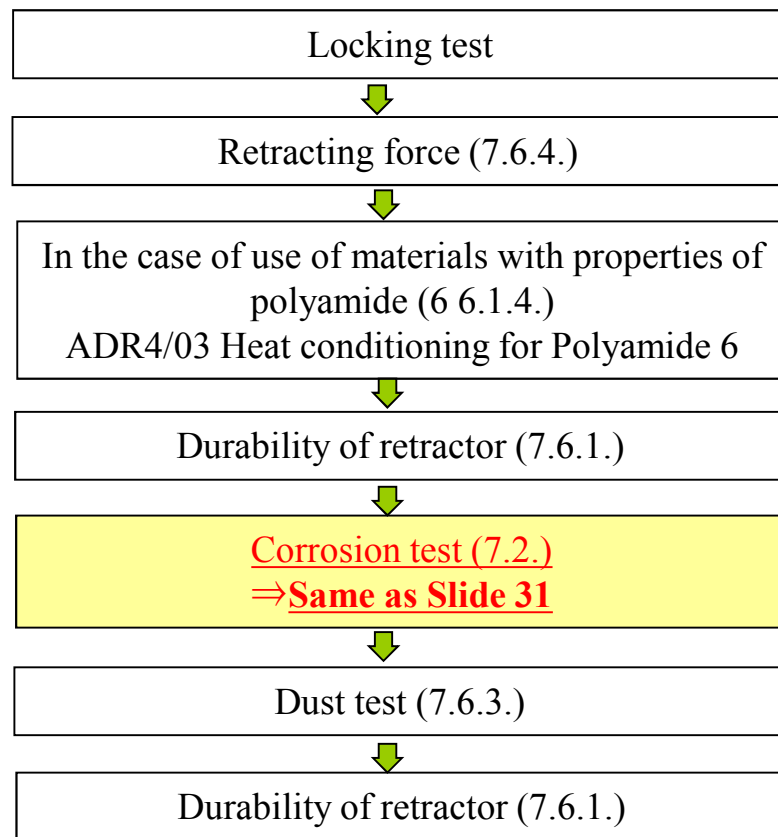
» ALR 5,000 cycles (7.6.1.) → (6.2.5.2.3.) (about 24hours)

» ELR 40,000 cycles (7.6.1.) → (6.2.5.3.5.) (about 5days)



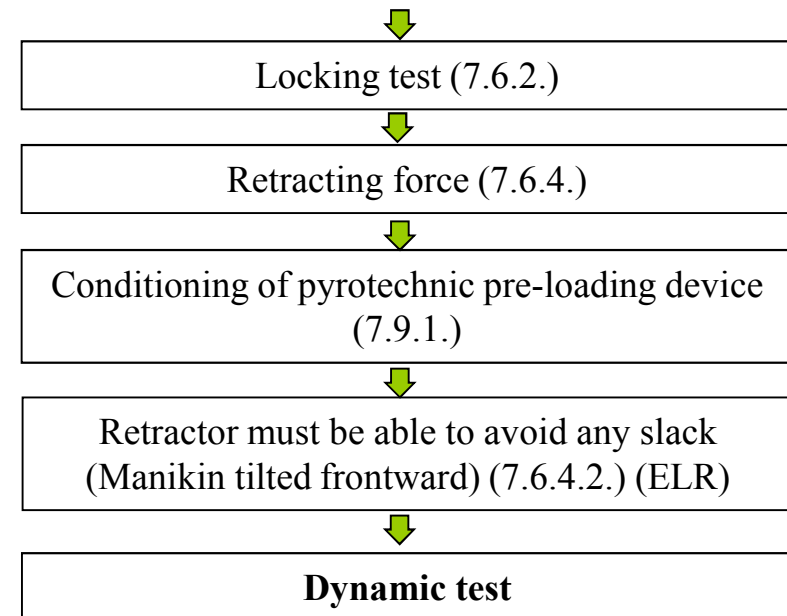
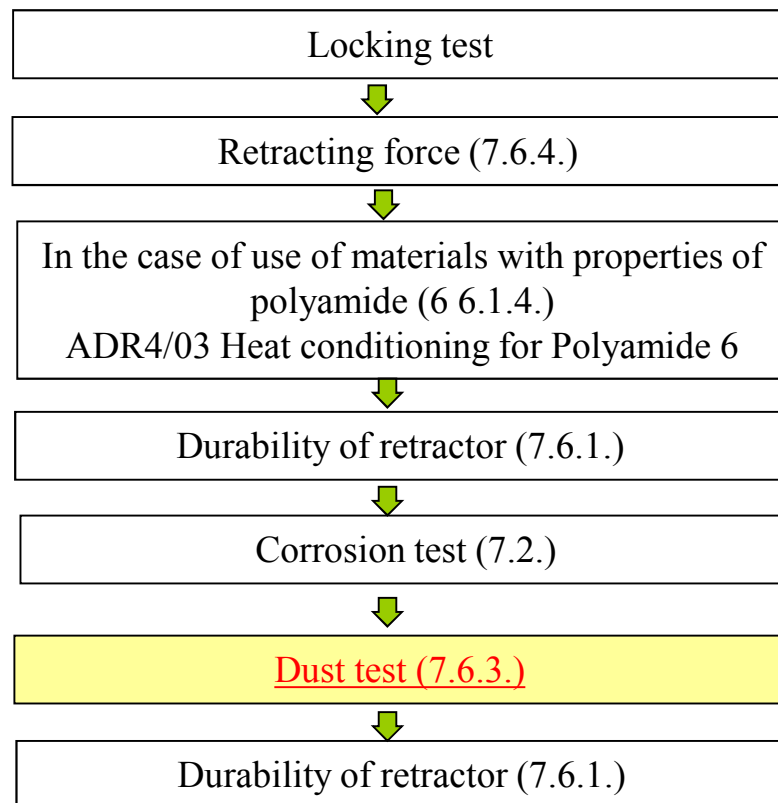
iii. Belt assembly proof test and dynamic test

Retractor locking and duration test



iii. Belt assembly proof test and dynamic test

Retractor locking and duration test

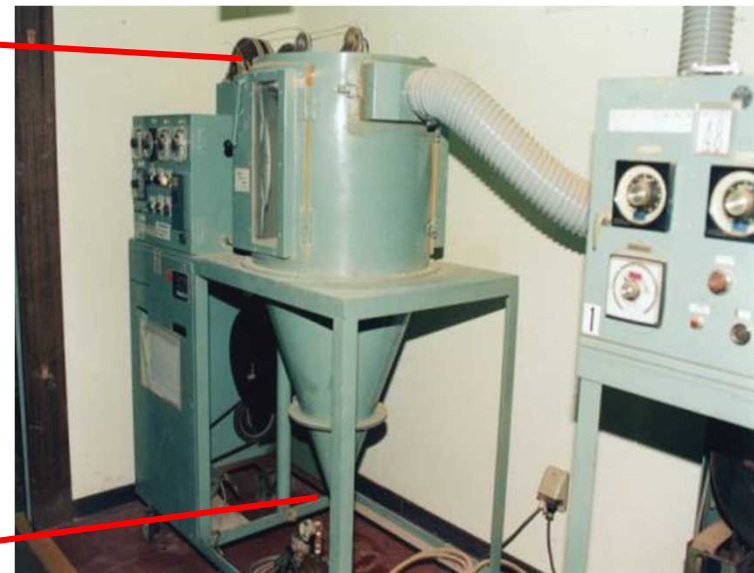
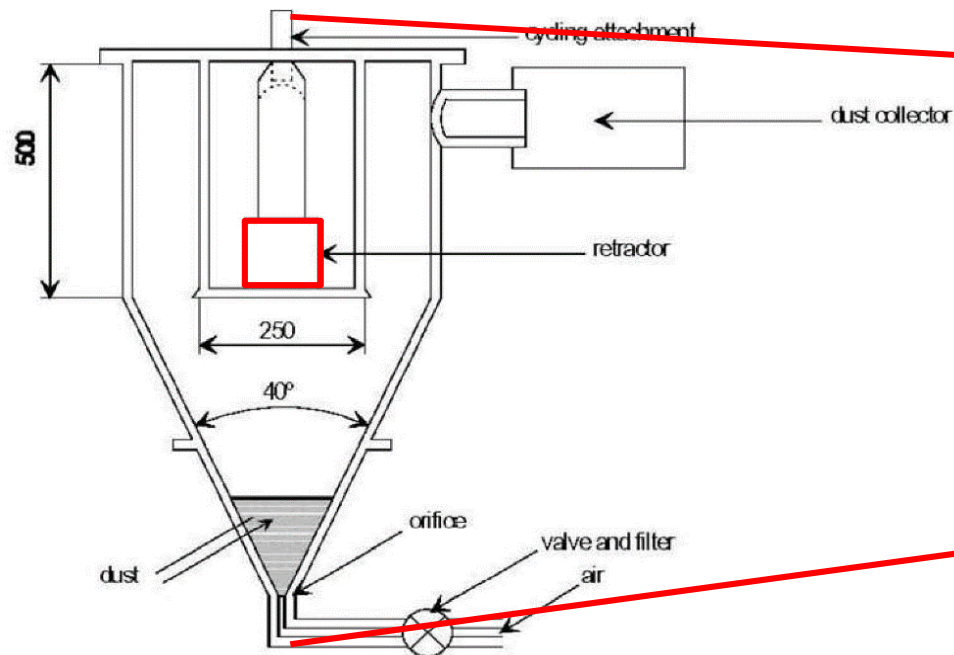


iii. Belt assembly proof test and dynamic test

Retractor locking and duration test

○ Dust test (7.6.3.) → (6.2.5.)

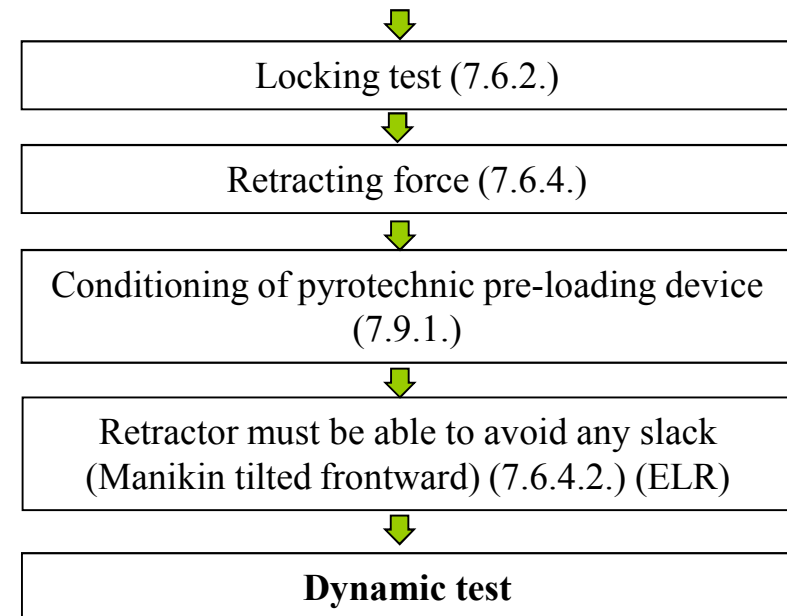
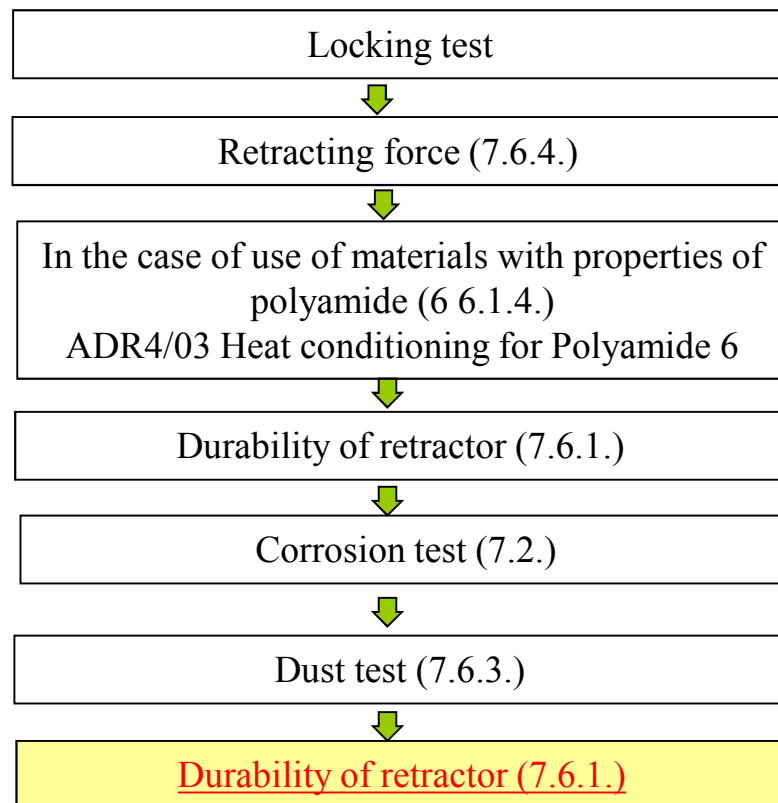
- It shall be subjected to 10 complete cycles of retraction and withdrawal within one or two minutes after each agitation of the dust.
- For a period of five hours, the dust shall be agitated every 20 minutes for five seconds by compressed air free of oil and moisture at a gauge pressure of $5.5 \times 10^5 \pm 0.5 \times 10^5$ Pa entering through an orifice, 1.5 ± 0.1 mm in diameter.



Sand and dust chamber

iii. Belt assembly proof test and dynamic test

Retractor locking and duration test



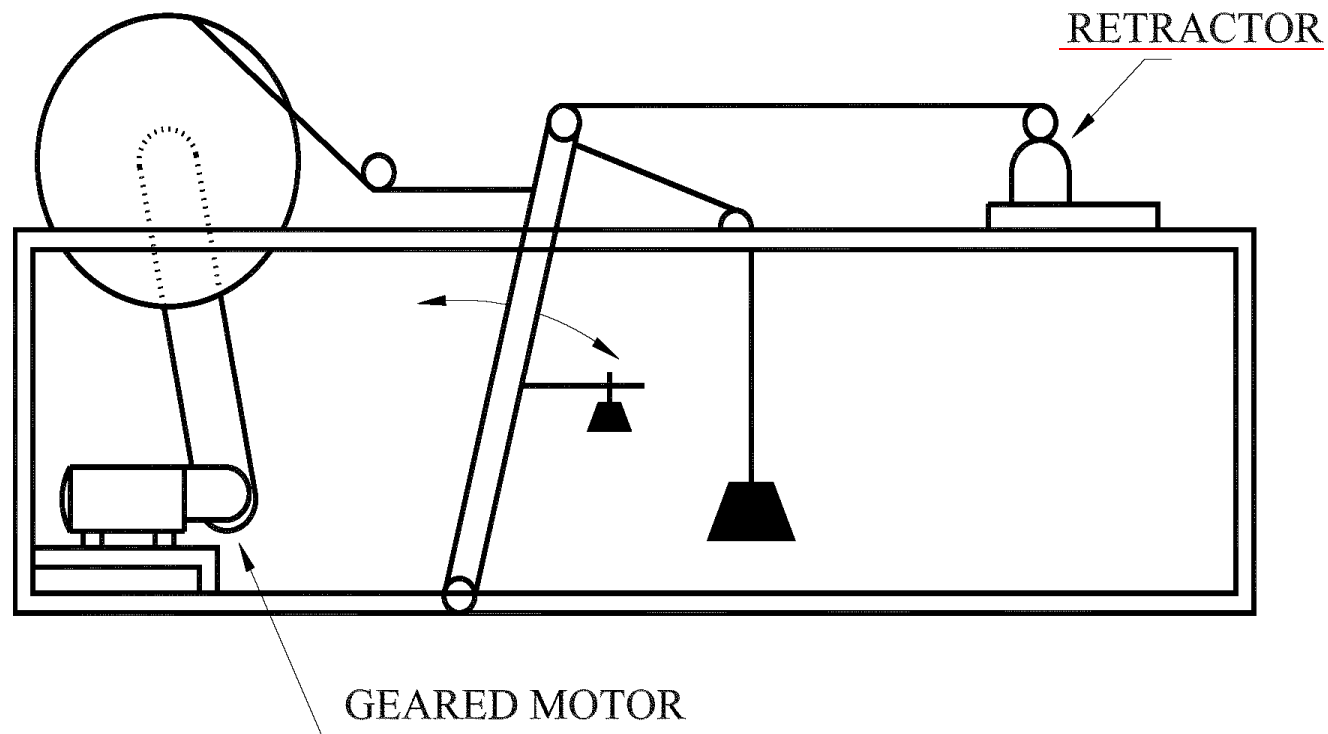
iii. Belt assembly proof test and dynamic test

Retractor locking and duration test

○ Durability of retractor

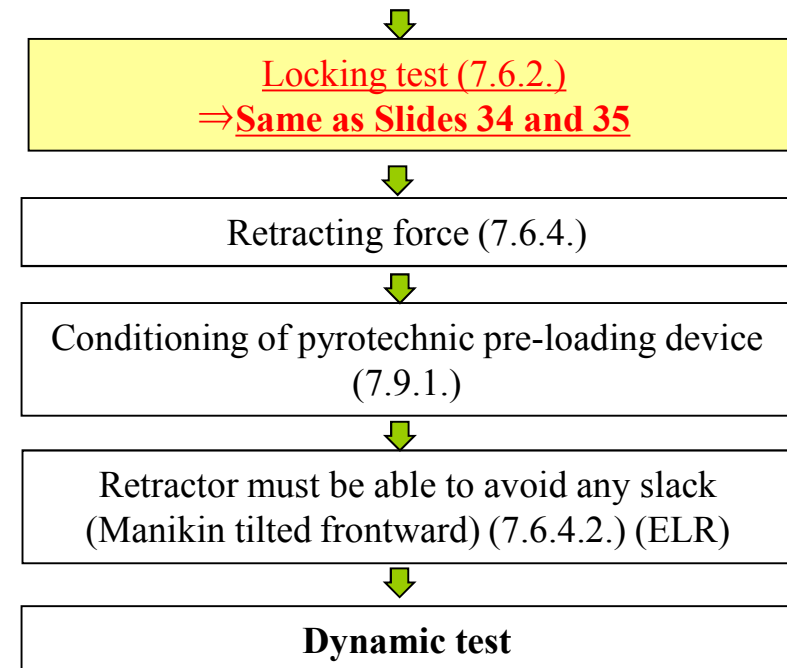
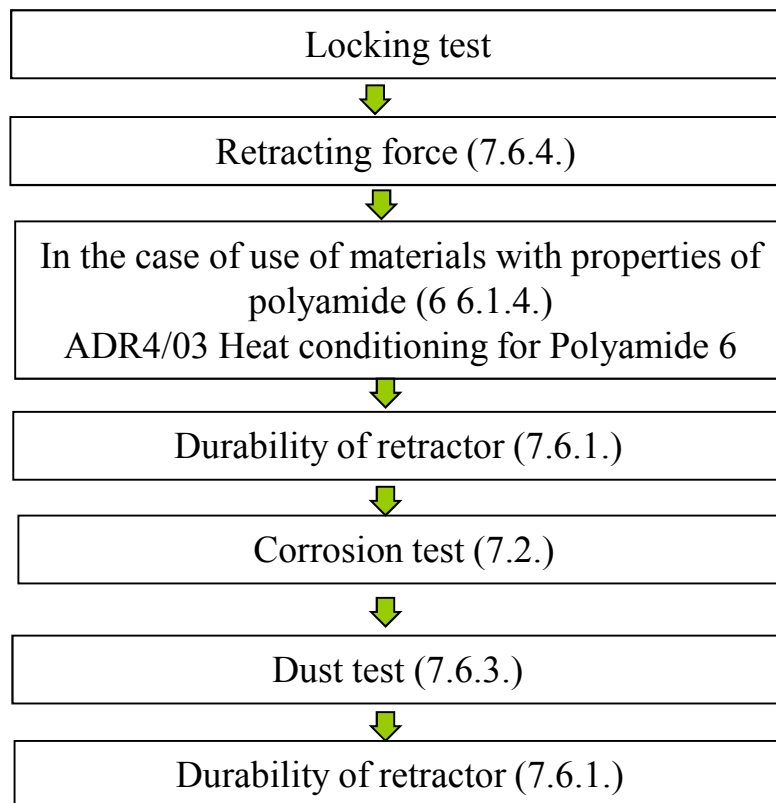
» ALR 5,000 cycles (7.6.1.) → (6.2.5.2.3.) (about 24hours)

» ELR 5,000 cycles (7.6.1.) → (6.2.5.3.5.) (about 24hours)



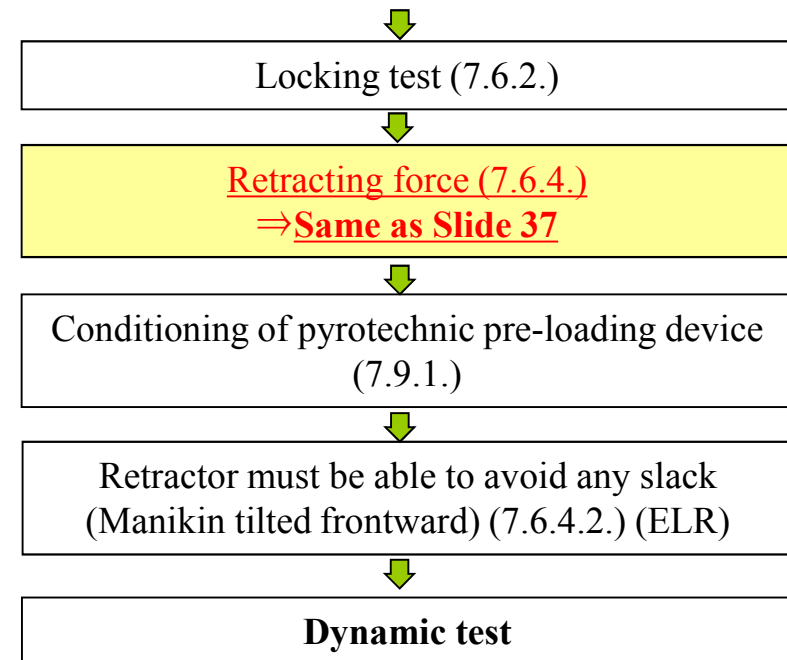
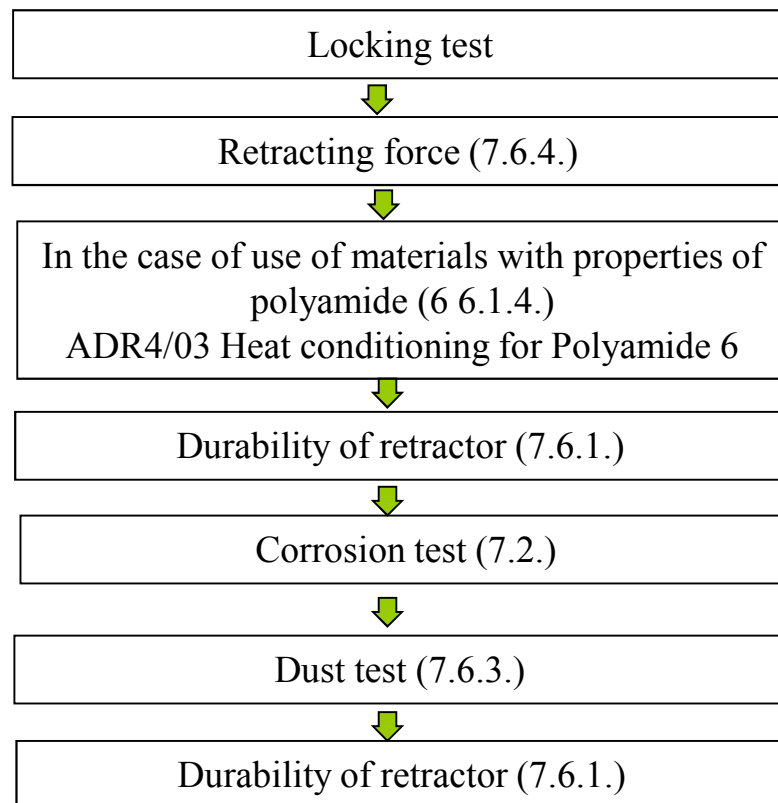
iii. Belt assembly proof test and dynamic test

Retractor locking and duration test



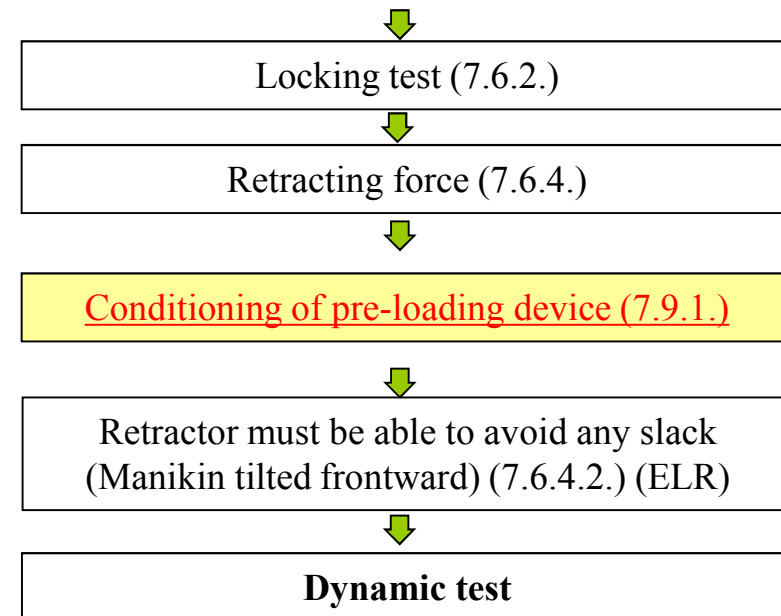
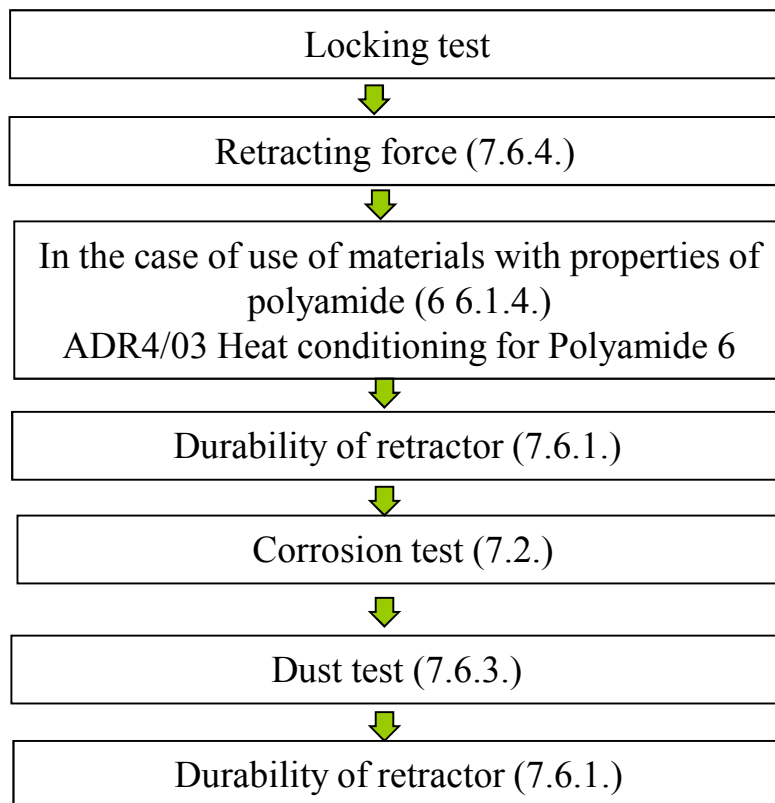
iii. Belt assembly proof test and dynamic test

Retractor locking and duration test



iii. Belt assembly proof test and dynamic test

Retractor locking and duration test



iii. Belt assembly proof test and dynamic test

Retractor locking and duration test

○ Conditioning of pre-loading device (7.9.1.) → (6.2.6.3.1.)

The pre-loading device may be separated from the safety-belt.

temperature of 60 degrees +/- 5 degrees C

for 24 hours



temperature of 100 degrees +/- 5 degrees C

for 2 hours



temperature of -30 degrees +/- 5 degrees C

for 24 hours

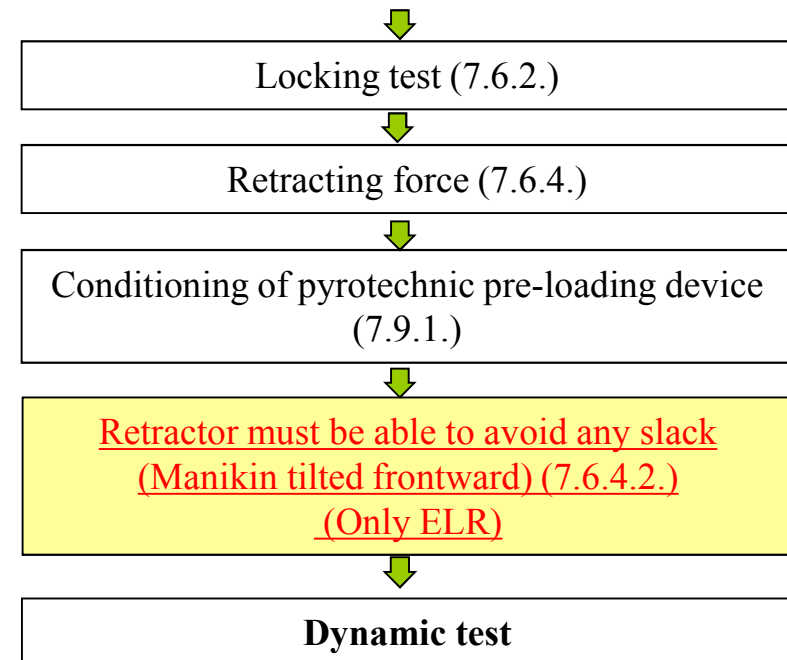
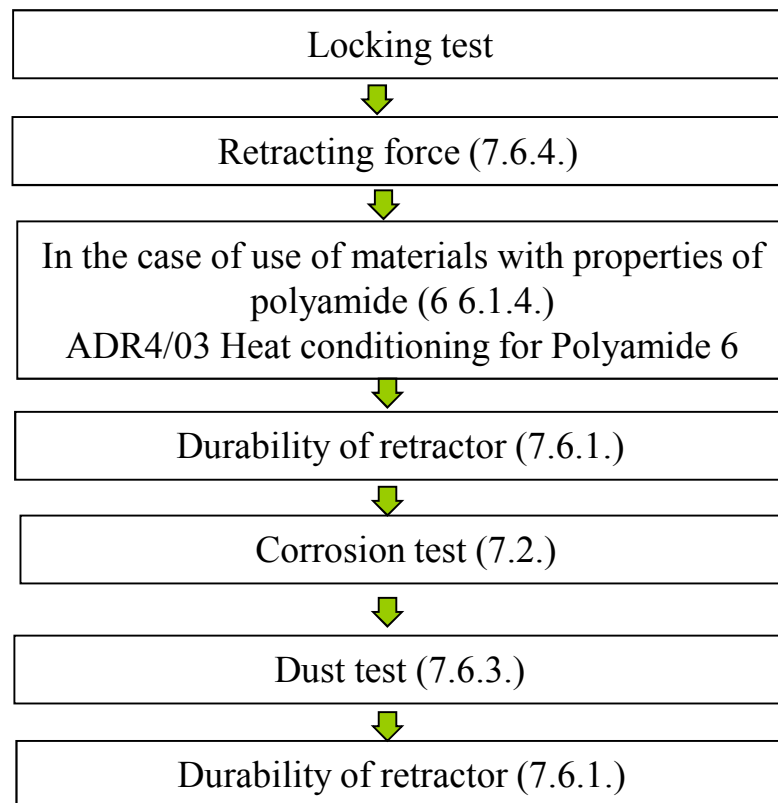


warm up to ambient temperature

If it has been separated it shall be fitted again to the safety-belt.

iii. Belt assembly proof test and dynamic test

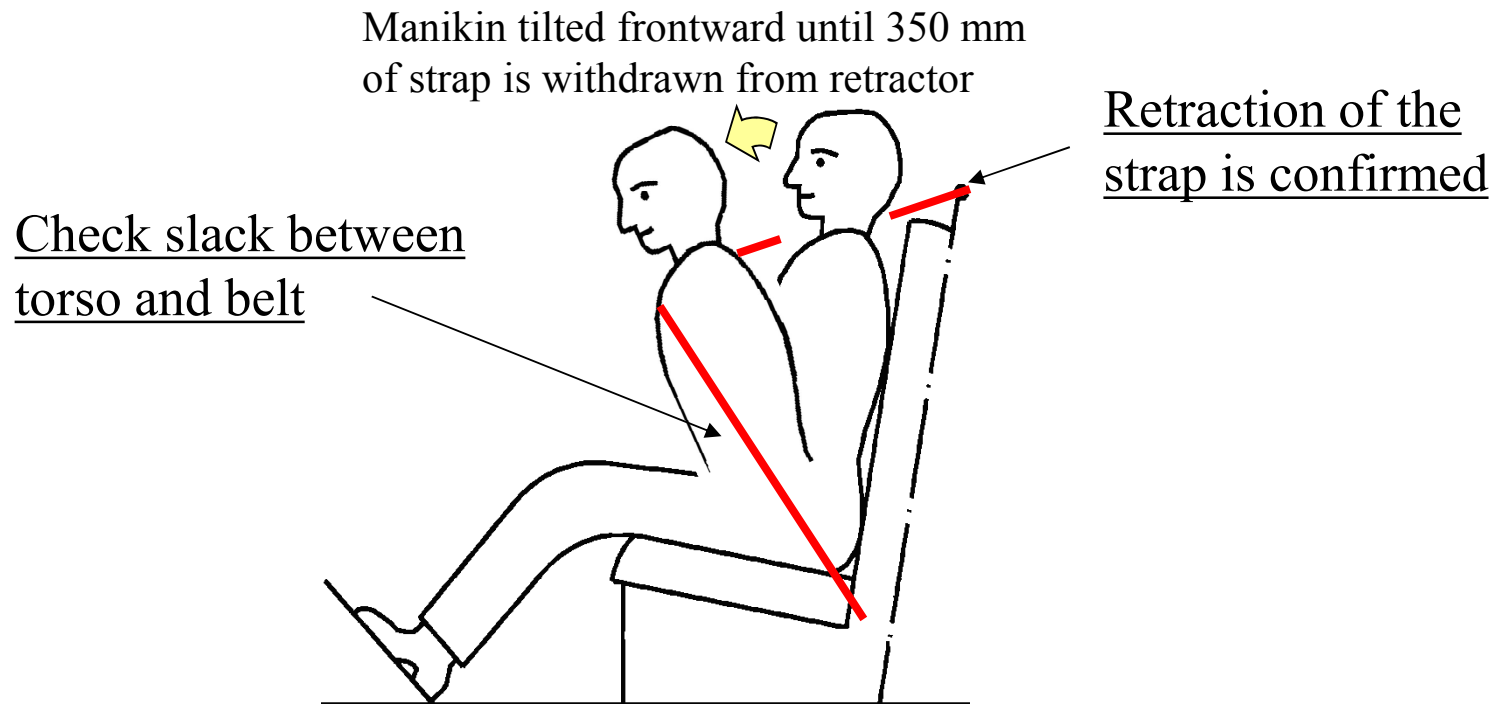
Retractor locking and duration test



iii. Belt assembly proof test and dynamic test

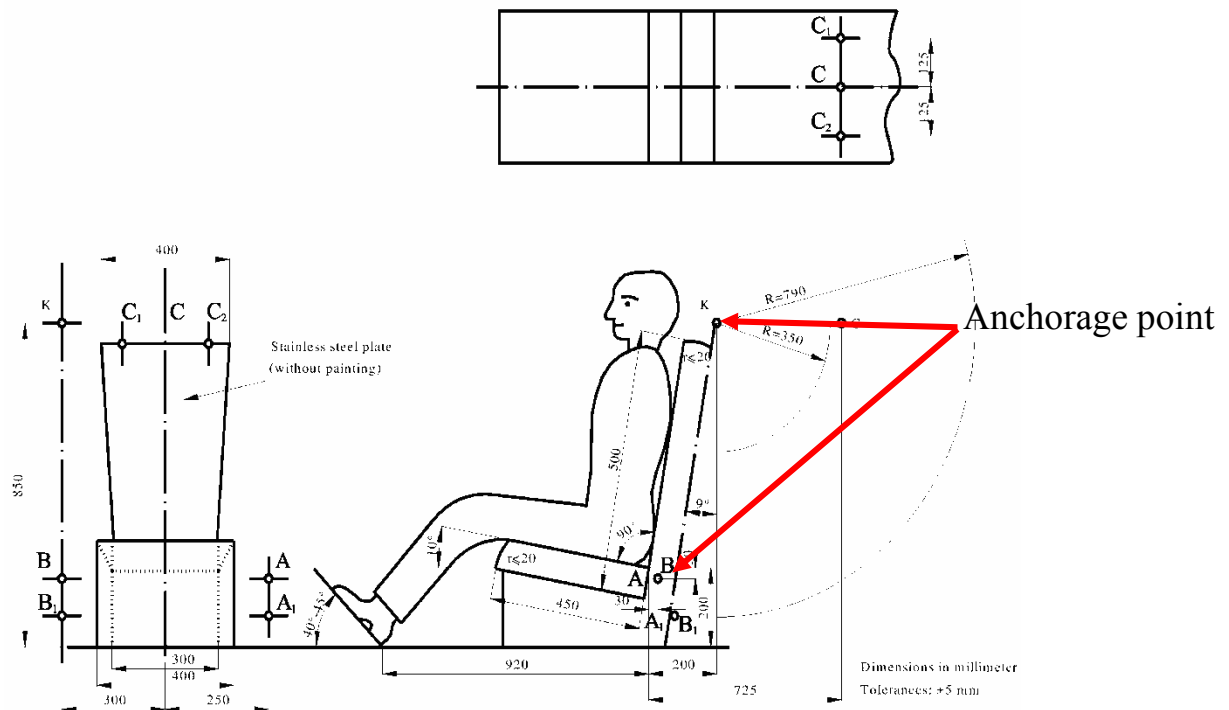
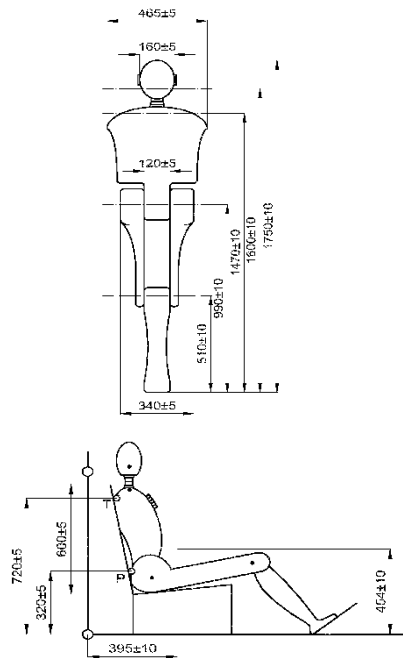
Retractor locking and duration test

- Retractor must be able to avoid any slack
(Manikin tilted frontward)(7.6.4.2.)→(6.2.5.4.1. / 6.2.5.4.2.)



Dynamic test

- In the case of specific vehicles, devices are attached to the design position.
- Belt adjustment device for height is adjusted to the design standard position.
- Manikin (dummy)
- Trolley, seat, anchorage





iii. Belt assembly proof test and dynamic test

Dynamic test

» Test device

- Deceleration device
- Acceleration device

⇒ The applicant shall choose to use one of the following two devices:

iii. Belt assembly proof test and dynamic test

Dynamic test

» Test device

▪ Deceleration device

Test speed : $50 \pm 1 \text{ km/h}$

(During calibration of the stopping device : $50 \pm 1 \text{ km/h}$)

Stopping distance : $40 \pm 5 \text{ cm}$

(During calibration of the stopping device : $40 \pm 2 \text{ mm}$)

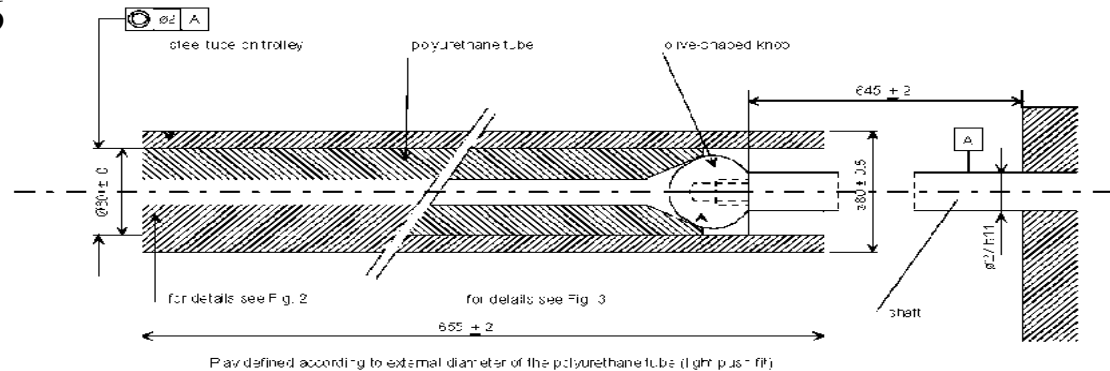
Trolley mass : Safety belt $455 \pm 20 \text{ kg}$

Restraint system $910 \pm 40 \text{ kg}$

(The nominal mass of the trolley and vehicle structure is 800 kg)

The total mass of the trolley and vehicle structure and inert mass differ the nominal value for calibration tests by more than $\pm 40 \text{ kg}$.

Stopping device : Annex 6



iii. Belt assembly proof test and dynamic test

Dynamic test

» Test device

▪ Acceleration device

Total velocity change : $51 \pm 2/-0$ km/h

Trolley mass : greater than 380kg

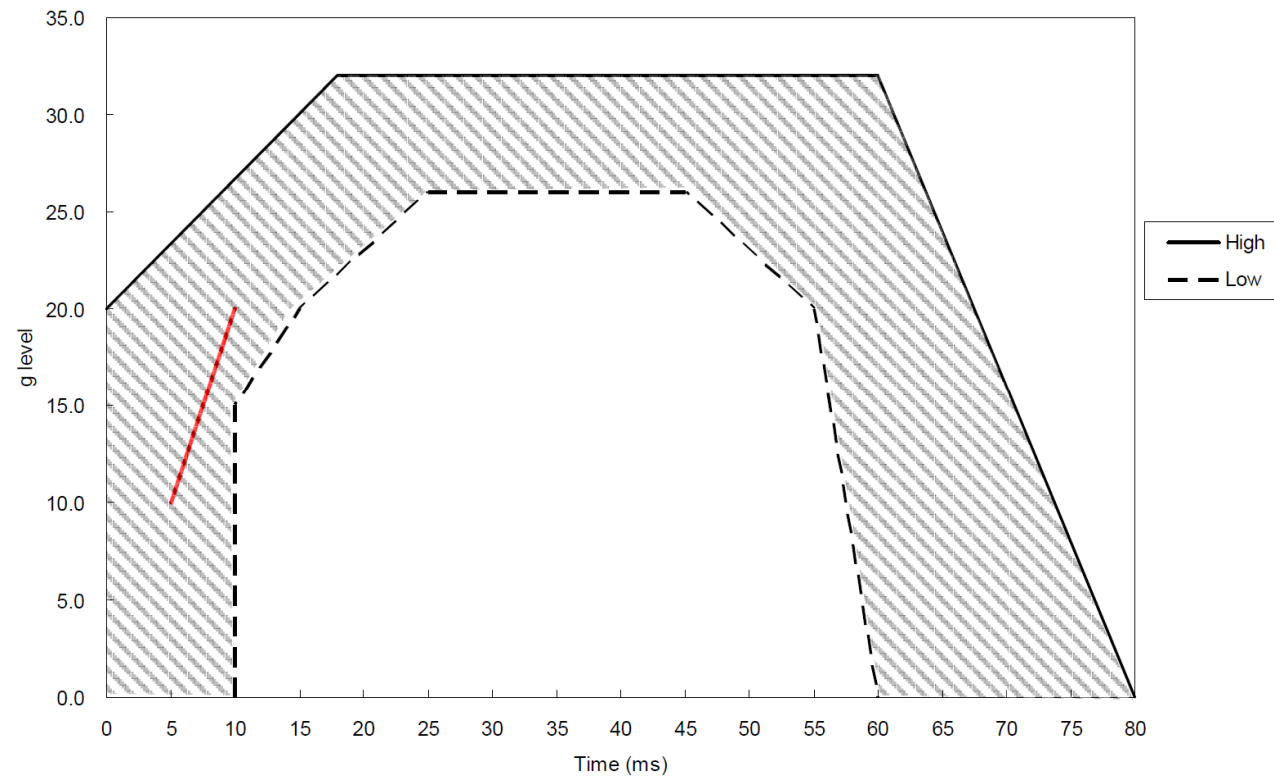


NTSEL
Acceleration Sled

iii. Belt assembly proof test and dynamic test

Dynamic test

» Curve of trolley's deceleration or acceleration, as function of time



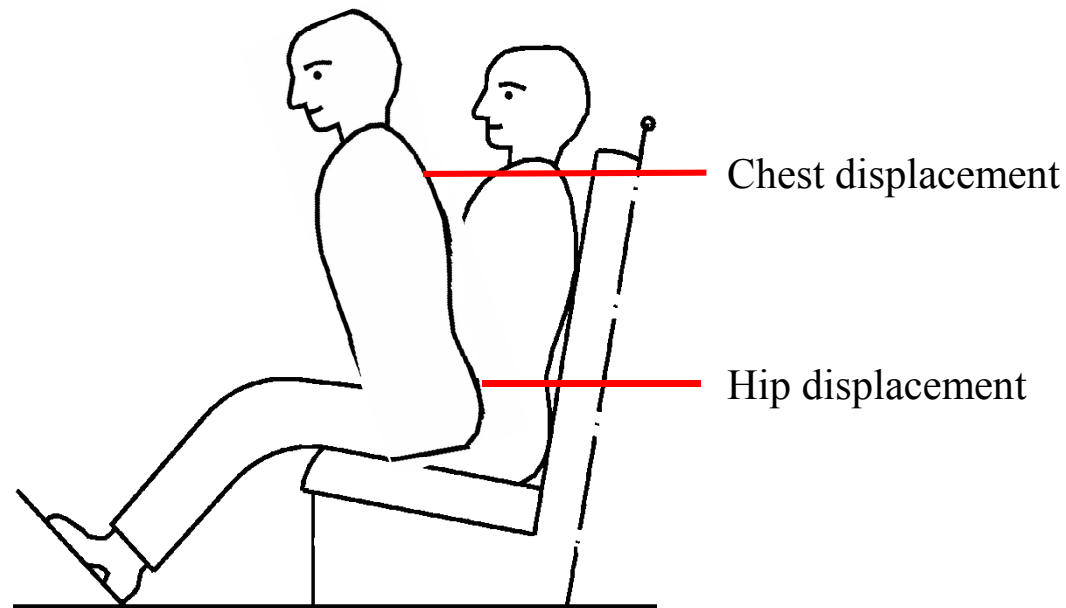
The additional segment (see paragraph 7.7.4.2.) applies only for the acceleration sled

iii. Belt assembly proof test and dynamic test

Dynamic test

» Measurement item

- Impact speed (Deceleration) or total velocity change ΔV (Acceleration) (7.10.)
- Trolley stopping distance (Deceleration) (7.10.)
- Forward displacement of manikin (Chest and hip) (6.4.1.3.2.)



iii. Belt assembly proof test and dynamic test

Dynamic test

» Measurement item

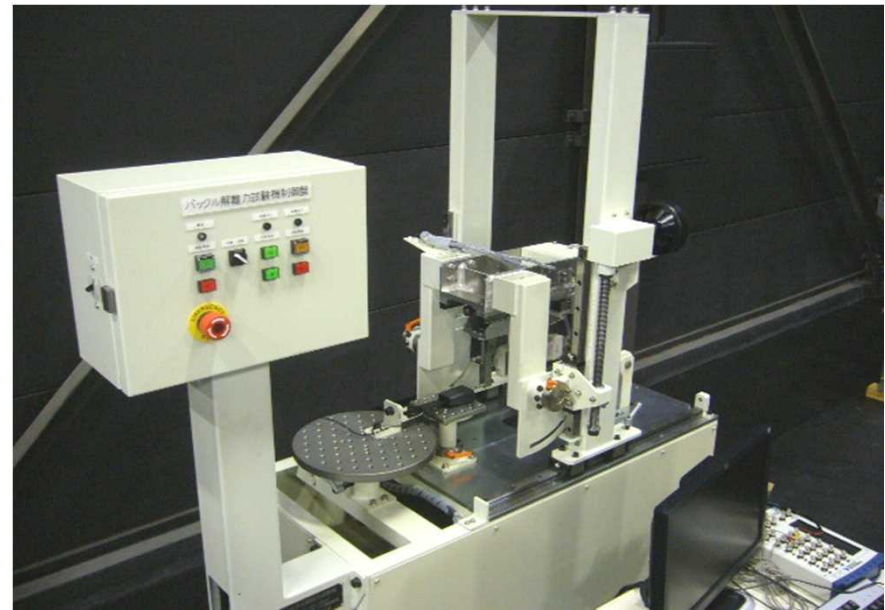
- Speed of chest at a 300mm displacement of chest (6.4.1.3.3.)
(For the seat belts intended to be used in an outboard front seating position protected by airbag in front of it.)
- Contact speed of chest and steering assembly (6.4.1.4.1.)
(In the case of restraint systems, those fulfilling UNECE agreement Regulation 12)
- Buckle opening force (7.8.) → (6.2.2.5.)

All straps are subjected to the force of 60n/daN.

(“n” is number of straps linked to the buckle when it is in a locked position.)

A load shall be applied at a speed of 400 ± 20 mm/min to the geometric center of the buckle-release button.

NTSEL
Buckle release testing machine





iii. Belt assembly proof test and dynamic test

Dynamic test

» Inspection item

- Breakage of belt assembly or restraint system (7.8.4.) → (6.4.1.3.1.)
- Release on buckle or locking system or displacement system (6.4.1.3.1.)
- Displacement system enabling occupants to leave vehicle, manual operation of locking system (6.4.1.4.2.)
- Operation of pre-loading device (6.2.6.1., 6.2.6.3.1.)
- Strap
 - Exposure of sharp edges likely to cause injury (6.1.3.)
 - Impact absorption (6.3.1.1.)
 - Twisting (6.3.1.1.)



1. Safety-belt and Restraint system

① Safety-belt test

② Requirements concerning the
installation in the vehicle

② Requirements concerning the installation in the vehicle

6.2.1.4. **Belt assembly**

The rigid items and parts made of plastics are liable to become trapped in seats or doors of the vehicle.

6.2.6.3.2. **Pyrotechnic pre-loading device**

The device is structured so as to prevent ignition of adjacent flammable material by hot gas.



② Requirements concerning the installation in the vehicle

Buckle

6.2.2.2.

Engaged with movement of one hand.

8.3.2.

The releasing device shall be clearly visible to the wearer and within his or her easy reach and shall be so designed that it cannot be opened inadvertently or accidentally.

8.3.2.

The buckle shall be located in such a position that it is readily accessible to a rescuer needing to release the wearer in an emergency.

8.3.2.

The buckle shall be so installed that, both when not under load and when sustaining the wearer's mass, it is capable of being released by the wearer with a simple movement of either hand in one direction.



② Requirements concerning the installation in the vehicle

Seat-belt adjustment device

8.3.3.

» In the case the belt is adjusted manually or automatically, the device shall be readily accessible, and shall be used with ease.

» Belt is tightened with one hand.

Retractor (In the case of three point belts)

8.1.4. One device must operate at least on the diagonal strap.

8.3.4. The retractor shall be operate correctly and stow the strap efficiently.

Airbag warning label

8.1.8.

Requirement for rigid parts

8.3.1. The rigid parts shall be not increase the risk of bodily injury to the wearer or to other occupants of the vehicle in the event of an accident.



② Requirements concerning the installation in the vehicle

General requirement

8.2.1.

Safety-belts, restraint systems, ISOFIX child restraint systems according to Table 2 of Annex 17 - Appendix 3, as well as i-Size child restraint systems according to Table 3 of Annex 17 - Appendix 3, shall be fixed to anchorages and in case of i-Size child restraint systems, supported by a vehicle floor contact surface, conforming to the specifications of Regulation No. 14, such as the design and dimensional characteristics, the number of anchorages, and the strength requirements.

8.2.2.1.

The straps are not liable to assume a dangerous configuration.

8.2.2.2.

That the danger of a correctly positioned belt slipping from the shoulder of a wearer as a result of his/her forward movement is reduced to a minimum.

8.2.2.3.

The risk of the strap deteriorating through contact with sharp parts of the vehicle or seat structure, and child restraint system recommended by the manufacturer, is reduced to a minimum.

8.2.2.4.

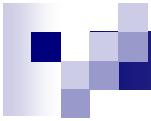
If the seat structure can be folded to permit access to rear of the vehicle or to luggage compartment, after folding and restoring those seats to the seating position, the belts provided for those seats be accessible for use or can be easily recovered by one person.





UN/ECE R16 Safety-belt Test procedure

1. Safety-belt and restraint system
2. Installation of child restraint systems
on forward facing seats
3. Safety-belt reminder



2. Installation of child restraint systems on forward facing seats

- ① child restraint system installed with the safety-belt equipment of the vehicle
- ② ISOFIX child restraint systems
- ③ i-Size child restraint systems

① child restraint system installed with the safety-belt equipment of the vehicle

Suitable installation of child restraint system

8.2.2.5.1.

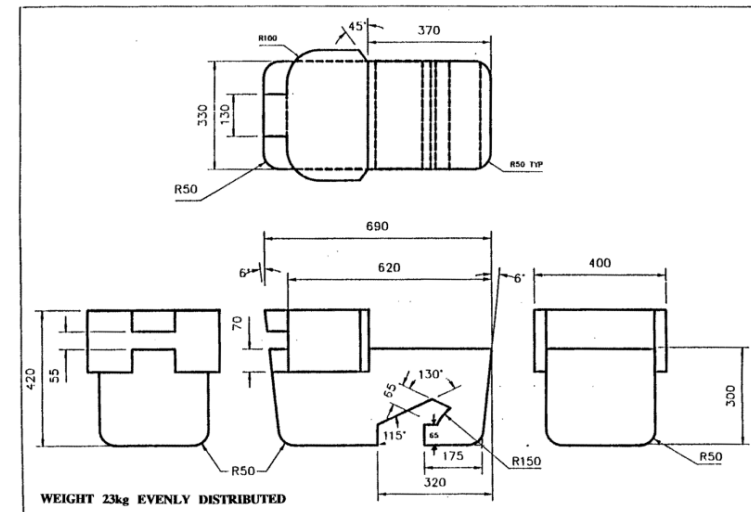
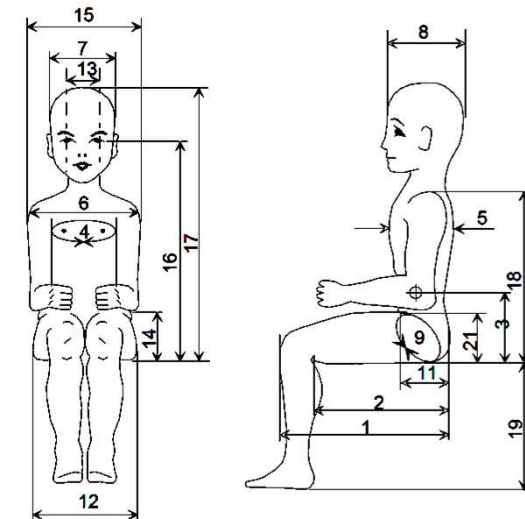
The possible slack in the belt does not prevent the correct installation of child restraint systems recommended by the manufacturer

8.2.2.5.2.

in the case of three-point belts, a tension of at least 50 N can be established in the lap section of the belt by external application of tension in the diagonal section of the belt, when positioned:

(a) on a 10-year manikin as specified in Annex 8, Appendix 1 to Regulation No. 44 and set in accordance with Annex 17, Appendix 4 to the present Regulation;

(b) or on the fixture specified in Annex 17, Appendix 1, figure 1 to the present Regulation for the seats that enable the installation of a child restraint device of universal category.





① child restraint system installed with the safety-belt equipment of the vehicle

(Annex 17-Appendix 1)

» “universal” category child restraint Systems Installed with the safety-belt

2.1.

Adjust the seat to its fully rearward and lowest position.

2.2.

Adjust the seat-back angle to the manufacturer's design position. In the absence of any specification, an angle of 25 degrees from the vertical, or the nearest fixed position of the seat-back, should be used.

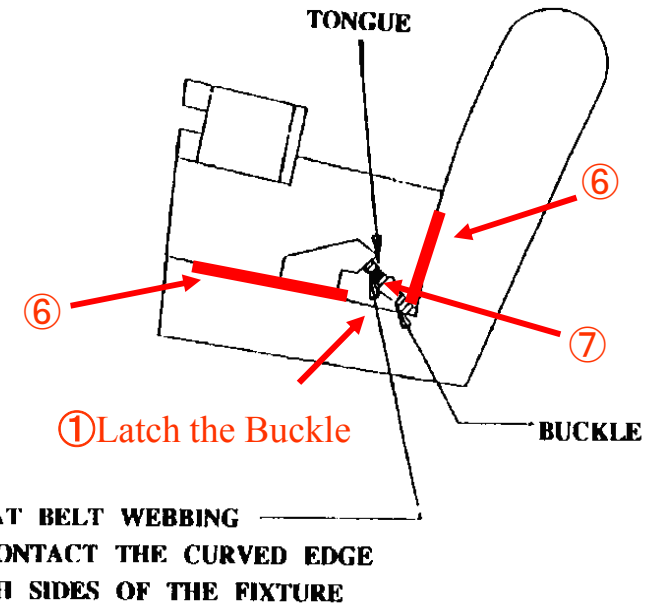
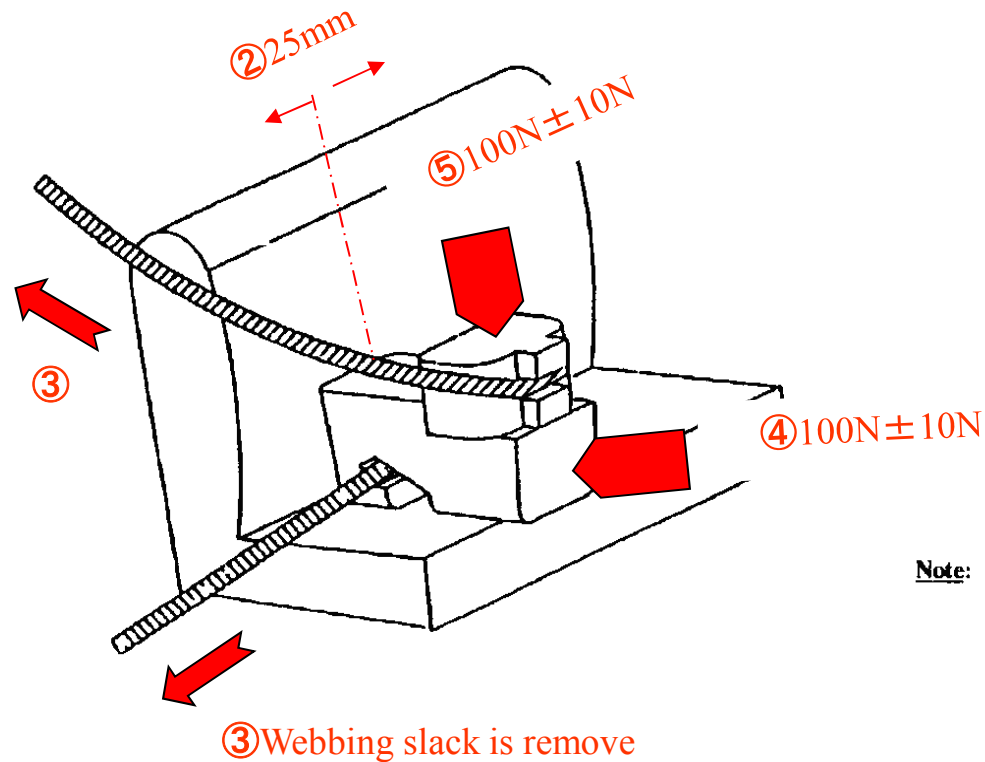
2.3.

Set the shoulder anchorage to the lowest position.

① child restraint system installed with the safety-belt equipment of the vehicle

(Annex 17-Appendix 1)

» “universal” category child restraint Systems Installed with the safety-belt



LAP BELT ONLY SHOWN



2. Installation of child restraint systems on forward facing seats

- ① child restraint system installed with the safety-belt equipment of the vehicle
- ② ISOFIX child restraint systems
- ③ i-Size child restraint systems



② ISOFIX child restraint systems

(Annex 17-Appendix 2)

» The installation of forward-facing and rearward-facing ISOFIX child restraint system of universal and semi-universal categories installed on ISOFIX positions

2.1.

When checking a CRF on a seat, this seat may be adjusted longitudinally to its rearmost position and in its lowest position.

2.2.

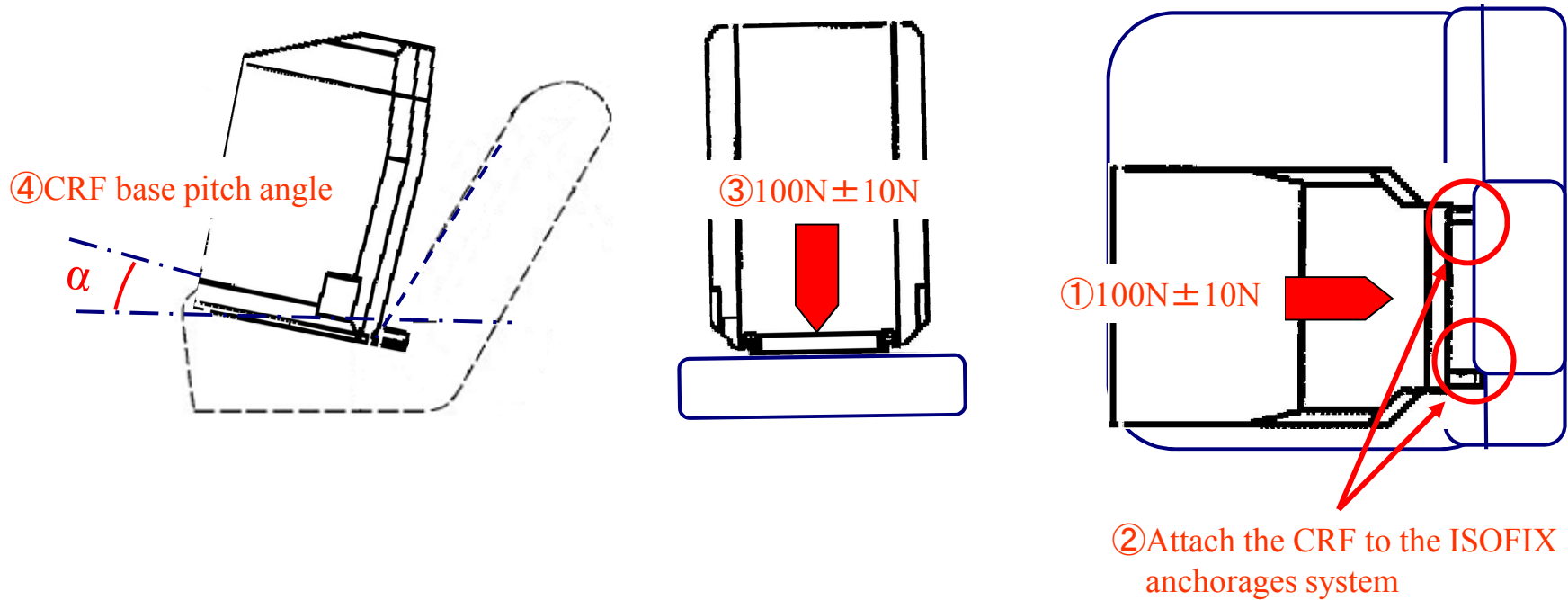
Adjust the seat-back angle to the manufacturer's design position and the head restraint in the lowest and rearmost position. In the absence of any specification an angle of the seat-back corresponding to a torso angle of 25 degrees from the vertical, or the nearest fixed position of the seat-back, shall be used.

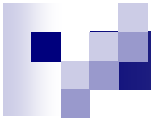
When checking a CRF on a rear seat, the vehicle seat located in front of this rear seat may be adjusted longitudinally forward but not further than the mid position between its rearmost and fore most positions. The seat backrest angle may also be adjusted, but not to a more upright angle than corresponding to a torso angle of 15 degrees.

② ISOFIX child restraint systems

(8.3.5., Annex 17)

» The installation of forward-facing and rearward-facing ISOFIX child restraint system of universal and semi-universal categories installed on ISOFIX positions





2. Installation of child restraint systems on forward facing seats

- ① child restraint system installed with the safety-belt equipment of the vehicle
- ② ISOFIX child restraint systems
- ③ i-Size child restraint systems

③ i-Size child restraint systems

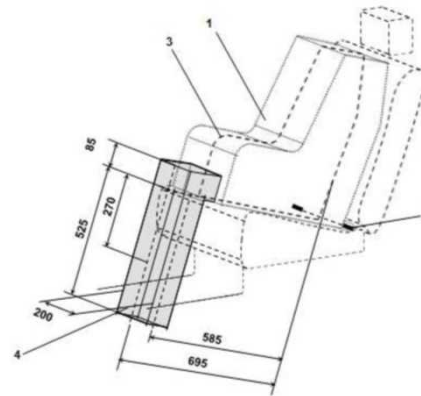
Supplemental requirement for i-size child restraint system

8.3.6.

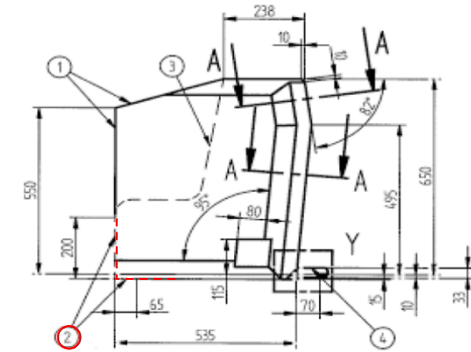
Any i-Size seating position shall allow the installation of the ISOFIX child restraint fixtures "ISO/F2X" (B1), "ISO/R2" (D) and the support leg installation assessment volume as defined in Appendix 2 of Annex 17.

There shall be no interference between the support leg installation assessment volume and any vehicle part.

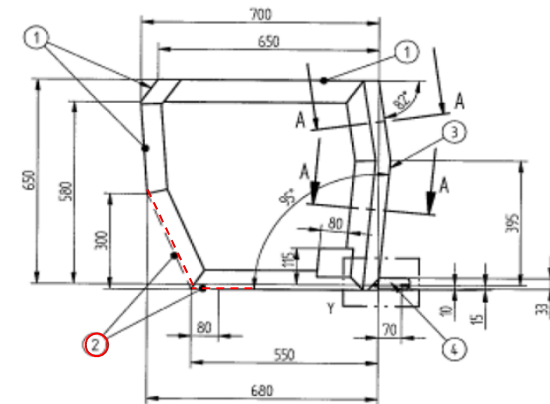
Compliance with this requirement can be proven by a physical test or computer simulation or representative drawings.



3D view of the i-Size support leg installation assessment volume



Side view of "ISO/F2X" (B1)



Side view of "ISO/R2" (D)



UN/ECE R16 Safety-belt Test procedure

1. Safety-belt and restraint system
2. Installation of child restraint systems
on forward facing seats
3. Safety-belt reminder

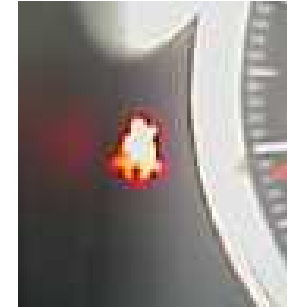
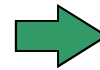
3. Safety-belt reminder tests

» Visual warning

» Audible warning

First level warning

The ignition switch is engaged.
The driver seat belt is not fastened.

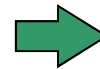


Visual warning shall be activated for 4s or longer.

Second level warning

The vehicle is in normal operation.
The driver seat belt is not fastened.
When at least one of the following conditions is fulfilled.

- a) driving distance $\leq 500\text{m}$
- b) running speed $\leq 25\text{km/h}$
- c) engine running duration time $\leq 60\text{s}$



Visual and audible warning shall be activated for 30s or longer.



Thank you for your attention.

