



Seat Comfort Questionnaires



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|---------|------|--------|
| | | |

1 FOREWORD

This document contains the questionnaires as referenced in SECO.06 and SECO.103 of The EuroSpec Seat Comfort document.

The questionnaires included in this document are voluntary and can be adopted if required.

All questionnaires can be used during multiple phases of a project to determine how discomfort / comfort develops over time.

Each questionnaire contains references to academic works. The EuroSpec Seat Comfort Working Group (WG) highly encourages the study of these academic works for a better understanding of how the questionnaires could, can and should be used.

This WG highly encourages the Railway Industry to adapt and improve upon the mentioned questionnaires.

This document supports the main EuroSpec Seat Comfort document and itself is supported by two Excel Spreadsheets:

- EuroSpec Seat Comfort Management Questionnaire, and
- EuroSpec Seat Comfort Fleet Manager VKM Questionnaire.

2 INTRODUCTION

This document is a voluntary specification, produced by SNCF-VOYAGEURS, Rail Delivery Group (RDG), Deutsche Bahn (DB), Nederlandse Spoorwegen (NS), Österreichische Bundesbahnen (ÖBB) and Schweizerische Bundesbahnen (SBB).

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Purpose of this document

This document provides a voluntary specification for Seat Comfort for use by companies in the rail sector if they so choose.

The purpose of this document is to provide a common specification for Seat Comfort in rolling stock between train operators. This document is to replace individual company specific functional requirements and constitutes a common reference being used for tendering and verification.

Application of this document

- This specification is voluntary. Individual companies may however elect to mandate all or part of its use through company procedures or contract conditions. Where this is the case, the company concerned must specify the nature and extent of application.
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3 QUESTIONNAIRES

3.1 Management questionnaire

This section includes a questionnaire for the train operator to use to decide the parameters to provide to the seat supplier on journey times, postures, etc.

The following table is also available as Excel Spreadsheets.

3.1.1 EuroSpec Seat Comfort: Management Questionnaire

| Question | Choice / Data | Unit | Remark |
|--|---------------|---------|--|
| What is the minimum station to station time on the concession / line? | | Minutes | |
| What is the maximum station to station time on the concession / line? | | Minutes | |
| | | | |
| What is the minimum time (P5) a passenger would use a seat? | | Minutes | Keep in mind that most people travel to a hub or connecting station. |
| What is the average time (P50) a passenger would use a seat? | | Minutes | Keep in mind that most people travel to a hub or connecting station. |
| What is the maximum time (P95) a passenger would use a seat? | | Minutes | Keep in mind that most people travel to a hub or connecting station. |
| Determine management ideas regarding minimum comfort and adjustability of seat. | | | |
| Are the passengers intended to feel "lucky to have a seat at all"? | Yes / No | Choose | Your service provides a low comfort station to station service without any intention to provide comfort. Think London Metro inner city. Your seat is fixed, not adjustable and one size fit all. |
| Are the passengers intended to be commuters? | Yes / No | Choose | The type of passengers define the population(s) used for anthropometry, the scientific study of measurements of the human body |

| | | | |
|---|----------|--------|---|
| Are the passengers intended to be native travellers? | Yes / No | Choose | The type of passengers define the population(s) used for anthropometry, the scientific study of measurements of the human body |
| Are the passengers intended to be continental travellers? | Yes / No | Choose | The type of passengers define the population(s) used for anthropometry, the scientific study of measurements of the human body |
| Are the passengers intended to be intercontinental travellers? | Yes / No | Choose | The type of passengers define the population(s) used for anthropometry, the scientific study of measurements of the human body |
| Are the passengers intended to be native tourists? | Yes / No | Choose | The type of passengers define the population(s) used for anthropometry, the scientific study of measurements of the human body |
| Are the passengers intended to be continental tourists? | Yes / No | Choose | The type of passengers define the population(s) used for anthropometry, the scientific study of measurements of the human body |
| Are the passengers intended to be intercontinental tourists? | Yes / No | Choose | The type of passengers define the population(s) used for anthropometry, the scientific study of measurements of the human body |
| Are the passengers intended to be able to look outside? | | | |
| Should the seat be adjustable to be able to look with comfortable back support? | Yes / No | Choose | The comfort level of the seat is dependent on the level of adjustability. Depending on this choice the manufacturer can propose the need for adjustable features on the seat. |
| Should the seat be adjustable to be able to look with comfortable neck support? | Yes / No | Choose | The comfort level of the seat is dependent on the level of adjustability. Depending on this choice the manufacturer can propose the need for |

| | | | |
|--|----------|--------|---|
| | | | adjustable features on the seat. |
| Should the seat be adjustable to be able to look with comfortable arm support? | Yes / No | Choose | The comfort level of the seat is dependent on the level of adjustability. Depending on this choice the manufacturer can propose the need for adjustable features on the seat. |
| Should the seat be adjustable to be able to look with comfortable foot support? | Yes / No | Choose | The comfort level of the seat is dependent on the level of adjustability. Depending on this choice the manufacturer can propose the need for adjustable features on the seat. |
| Are the passengers intended to be able to sleep? | | | |
| Should the seat be adjustable to be able to sleep with comfortable back support? | Yes / No | Choose | The comfort level of the seat is dependent on the level of adjustability. Depending on this choice the manufacturer can propose the need for adjustable features on the seat. |
| Should the seat be adjustable to be able to sleep with comfortable neck support? | Yes / No | Choose | The comfort level of the seat is dependent on the level of adjustability. Depending on this choice the manufacturer can propose the need for adjustable features on the seat. |
| Should the seat be adjustable to be able to sleep with comfortable arm support? | Yes / No | Choose | The comfort level of the seat is dependent on the level of adjustability. Depending on this choice the manufacturer can propose the need for adjustable features on the seat. |
| Should the seat be adjustable to be able to sleep with comfortable foot support? | Yes / No | Choose | The comfort level of the seat is dependent on the level of adjustability. Depending on this choice the manufacturer can propose the need for adjustable features on the seat. |

| | | | |
|---|----------|--------|--|
| Should the seat accommodate a sideways seated position while sleeping? | Yes / No | Choose | The contour (shape) of the backrest and seat pan are the result of the number and type of postures a passenger can take in a seat. The more postures that are possible the higher the feeling of passenger comfort. |
| Should the seat and the adjacent seat accommodate a lying / crouched position while sleeping? | Yes / No | Choose | The sleeping comfort level of the seat is dependent on the level of adjustability. Depending on this choice the manufacturer can propose the need for adjustable features on the seat. |
| Should the seat and the adjacent seat be able to be used to support the entire body on the seat pan while sleeping? | Yes / No | Choose | The sleeping comfort level of the seat is dependent on the level of adjustability. Depending on this choice the manufacturer can propose the need for adjustable features on the seat. |
| Should the opposing seat be able to be used to support feet on the seat pan while sleeping? | Yes / No | Choose | The sleeping comfort level of the seat is dependent on the level of adjustability. Depending on this choice the manufacturer can propose the need for adjustable features on the seat. |
| Should the opposing seat be able to be used to support feet and lower legs on the seat pan while sleeping? | Yes / No | Choose | The sleeping comfort level of the seat is dependent on the level of adjustability. Depending on this choice the manufacturer can propose the need for adjustable features on the seat. |
| Should the seat and the opposing seat be able to be used to support the entire body on the seat pan while sleeping? | Yes / No | Choose | The sleeping comfort level of the seat is dependent on the level of adjustability. Depending on this choice the manufacturer can propose the need for adjustable features on the seat. |
| Should the seat pan be replaced with a bed for sleeping? | Yes / No | Choose | The sleeping comfort level of the seat is dependent on the level of adjustability. Depending on this choice the manufacturer can propose the need for adjustable features on the seat. If the seat is not able to meet the |

| | | | |
|--|----------|--------|---|
| | | | comfort level of a bed, than this will affect the coach layout. |
| Are the passengers intended to be able to interact with the other passengers? | | | |
| Should the seat accommodate a sideways seated position while talking to the adjacent passenger? | Yes / No | Choose | The contour (shape) of the backrest and seat pan are the result of the number and type of postures a passenger can take in a seat. The more postures that are possible the higher the feeling of passenger comfort. |
| Should the seat accommodate upper body contact to facilitate snuggling/cuddling with the adjacent passenger? | Yes / No | Choose | This activity of the passenger will have effects on the adjustability and/or availability of the middle arm rest. |
| Should the seat accommodate facial contact to facilitate kissing with the adjacent passenger? | Yes / No | Choose | This activity of the passenger will have effects on the adjustability and/or availability of the middle arm rest. |
| Are the passengers intended to be able to eat and/or drink a beverage? | | | |
| Are the passengers intended to be able to drink a cold beverage? | Yes / No | Choose | Depending on this choice the manufacturer can propose the need for (adjustable) features on the seat. |
| Are the passengers intended to be able to drink a hot beverage? | Yes / No | Choose | Depending on this choice the manufacturer can propose the need for (adjustable) features on the seat. |
| Are the passengers intended to be able to stow a beverage? | Yes / No | Choose | Depending on this choice the manufacturer can propose the need for (adjustable) features on the seat. |
| Are the passengers intended to be able to store a beverage? | Yes / No | Choose | Depending on this choice the manufacturer can propose the need for (adjustable) features on the seat. |
| Are the passengers intended to be able to eat a cold snack? | Yes / No | Choose | Depending on this choice the manufacturer can propose the need for (adjustable) features on the seat. |

| | | | |
|--|----------|--------|--|
| Are the passengers intended to be able to eat a warm snack? | Yes / No | Choose | Depending on this choice the manufacturer can propose the need for (adjustable) features on the seat. |
| Are the passengers intended to be able to stow a snack? | Yes / No | Choose | Depending on this choice the manufacturer can propose the need for (adjustable) features on the seat. |
| Are the passengers intended to be able to store a snack? | Yes / No | Choose | Depending on this choice the manufacturer can propose the need for (adjustable) features on the seat. |
| Are the passengers intended to be able to use a table for eating and/or drinking a beverage? | Yes / No | Choose | Depending on this choice the manufacturer can propose the need for (adjustable) features on the seat. |
| Are the passengers intended to be able to use a plate? | Yes / No | Choose | Depending on this choice the manufacturer can propose the need for (adjustable) features on the seat. |
| Are the passengers intended to be able to use cutlery? | Yes / No | Choose | Depending on this choice the manufacturer can propose the need for (adjustable) features on the seat. |
| Are the passengers intended to be able to eat a full dinner / meal? | Yes / No | Choose | Depending on this choice the manufacturer can propose the need for (adjustable) features on the seat. When the answer is yes the asset manager should consider a purpose build dining coach. |
| Are the passengers intended to be able to personally dispose of the containers within arm's length? | Yes / No | Choose | Depending on this choice the manufacturer can propose the need for (adjustable) features on the seat. |
| Are the passengers intended to be able to cross the personal space of the other passengers in order to personally dispose of the containers? | Yes / No | Choose | Depending on this choice the manufacturer can propose the need for (adjustable) features on the seat. |
| Are the passengers intended to be able to dispose of the containers in a disposal unit located outside arm's length? | Yes / No | Choose | Depending on this choice the manufacturer can propose the need for (adjustable) features on the seat. |
| Are the passengers intended to be able to secure the location of a container? | Yes / No | Choose | Depending on this choice the manufacturer can propose the need for (adjustable) features on the seat. |

| | | | |
|---|----------|--------|---|
| Are the passengers expected to be able to read a book / magazine? | | | |
| Should the seat include a table to rest the book on? | Yes / No | Choose | Depending on this choice the manufacturer can propose the need for (adjustable) features on the seat. |
| Are the passengers intended to be able to stow the book? | Yes / No | Choose | Depending on this choice the manufacturer can propose the need for (adjustable) features on the seat. |
| Are the passengers intended to be able to store the book? | Yes / No | Choose | Depending on this choice the manufacturer can propose the need for (adjustable) features on the seat. |
| Should the seat be adjustable to be able to read a book with comfortable back support? | Yes / No | Choose | Depending on this choice the manufacturer can propose the need for (adjustable) features on the seat. |
| Should the seat be adjustable to be able to read a book with comfortable neck support? | Yes / No | Choose | Depending on this choice the manufacturer can propose the need for (adjustable) features on the seat. |
| Should the seat be adjustable to be able to read a book with comfortable arm support? | Yes / No | Choose | Depending on this choice the manufacturer can propose the need for (adjustable) features on the seat. |
| Should the seat be adjustable to be able to read a book with comfortable foot support? | Yes / No | Choose | Depending on this choice the manufacturer can propose the need for (adjustable) features on the seat. |
| Are the passengers expected to be able to work on a laptop (or mobile device with a keyboard)? | | | |
| Should the seat include a table to rest the laptop on? | Yes / No | Choose | It's a laptop, so why need a table? Depending on this choice the manufacturer can propose the need for (adjustable) features on the seat. |
| Should the seat be adjustable to be able to work on a laptop with comfortable back support? | Yes / No | Choose | Depending on this choice the manufacturer can propose the need for (adjustable) features on the seat. |
| Should the seat be adjustable to be able to work on a laptop with comfortable neck support? | Yes / No | Choose | Depending on this choice the manufacturer can propose the need for (adjustable) features on the seat. |

| | | | |
|--|----------|--------|---|
| Should the seat be adjustable to be able to work on a laptop with comfortable arm support? | Yes / No | Choose | Depending on this choice the manufacturer can propose the need for (adjustable) features on the seat. |
| Should the seat be adjustable to be able to work on a laptop with comfortable foot support? | Yes / No | Choose | Depending on this choice the manufacturer can propose the need for (adjustable) features on the seat. |
| Should the seat be adjustable to be able to compensate for differences in elbow and hand length? | Yes / No | Choose | Depending on this choice the manufacturer can propose the need for (adjustable) features on the seat. |
| Are the passengers expected to be able to work on a tablet (or mobile device without a keyboard)? | | | |
| Should the seat include a table to rest the tablet on? | Yes / No | Choose | Depending on this choice the manufacturer can propose the need for (adjustable) features on the seat. |
| Should the seat be adjustable to be able to work on a tablet with comfortable back support? | Yes / No | Choose | Depending on this choice the manufacturer can propose the need for (adjustable) features on the seat. |
| Should the seat be adjustable to be able to work on a tablet with comfortable neck support? | Yes / No | Choose | Depending on this choice the manufacturer can propose the need for (adjustable) features on the seat. |
| Should the seat be adjustable to be able to work on a tablet with comfortable arm support? | Yes / No | Choose | Depending on this choice the manufacturer can propose the need for (adjustable) features on the seat. |
| Should the seat be adjustable to be able to work on a tablet with comfortable foot support? | Yes / No | Choose | Depending on this choice the manufacturer can propose the need for (adjustable) features on the seat. |
| Should the seat be adjustable to be able to compensate for differences in elbow and hand length? | Yes / No | Choose | Depending on this choice the manufacturer can propose the need for (adjustable) features on the seat. |

3.2 Comfort assessment questionnaires

The following questionnaires are examples of ones used to ask participants in comfort tests their opinions on different aspects. They can be used early on in the process, for selection of a choice of seats or for improvements.

They may be used individually or in multiple in order to create a specific questionnaire for the gaining of information as necessary.

Each has an explanation of what it is trying to achieve and a reference to its origin to allow further reading.

3.2.1 Comfort scale from 1 to 10

A ten point-Borg scale can be used to assess discomfort (ranging from 'No Discomfort' at 0 and 'Extreme Discomfort' at 10). This method is in fact applied many times, sometimes a 7 point Likert scale or 5 point is used. An example of the 5 point scale can be found in Bazley et al. (2015). In this case the question on comfort was asked three times. A set of survey questions for a Likert scale rating, 1-5 (1, excellent to 5, very bad), asked about physical, psychological, and emotional comfort at different times at the day to study comfort patterns. An examples of applications of the 10 point scale can be found in Vink et al. (2012) and Lille et al. (2016).

What is the comfort rating of your last journey, circle the correct value (0-10; 0 = lowest rating, 10 = highest)?

No comfort extreme comfort
0 - 1 - 2 - 3 - 4 - 5 - 6 - 7 - 8 - 9 - 10

What is the discomfort rating of your last journey, circle the correct value (0-10; 0 = no discomfort; 10 = highest)?

no discomfort extreme discomfort
0 - 1 - 2 - 3 - 4 - 5 - 6 - 7 - 8 - 9 - 10

Comfort scale 1-10

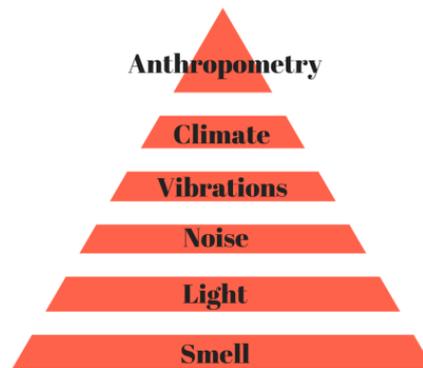
References:

- Bazley C, Nugent R, Vink P. Patterns of Discomfort. J of Ergonomics 2015, 5:1
- Lille, C. de, Santema, S., Bouwens, J., Schultheis, U., Vink, P. 2016. Designing the compartment interior knowing high and low peaks in a passenger flight. AEGATS conference, AEGATS2016_48 on stick
- Vink P, Bazley C, Kamp I, Blok M. 2012. Possibilities to improve the aircraft interior comfort experience. Applied Ergonomics 43: 354-359.

3.2.2 Environmental factors related to comfort

Different factors related to discomfort to set priorities. In this case the posture sleeping is taken.

The factors are based on studies of Bubb (2008): seat, temperature, vibrations, noise, light, smell.



Pyramid of Bubb (2018) showing the importance of the factors related to discomfort.

The questionnaire:

What factor is most important when sleeping?

- Noise - Possibility to reduce compartment noise
- Seat - Adjustable seat to match personal body measurements

What factor is most important when sleeping?

- Seat - Adjustable seat to match personal body measurements
- Light - Control the intensity and colour of the light

What factor is most important when sleeping?

- Smell - Possibility to reduce bad odours in the train compartment
- Seat - Adjustable seat to match personal body measurements

What factor is most important when sleeping?

- Noise - Possibility to reduce compartment noise
- Temperature - Manipulate temperature to personal preference

What factor is most important when sleeping?

- Temperature - Manipulate temperature to personal preference
- Vibrations - Control vibrations caused by the train

What factor is most important when sleeping?

- Light - Control intensity and colour of the light
- Temperature - Manipulate temperature to personal preference

What factor is most important when sleeping?

- Temperature - Manipulate temperature to personal preference
- Smell - Possibility to reduce bad odours in the train compartment

What factor is most important when sleeping?

- Vibrations - Control vibrations caused by the train
- Noise - Possibility to reduce compartment noise

What factor is most important when sleeping?

- Seat - Adjustable seat to match personal body measurements
- Temperature - Manipulate temperature to personal preference

What factor is most important when sleeping?

- Seat - Adjustable seat to match personal body measurements
- Vibrations - Control vibrations caused by the train

What factor is most important when sleeping?

- Noise - Possibility to reduce compartment noise
- Light - Control intensity and colour of the light

What factor is most important when sleeping?

- Smell - Possibility to reduce bad odours in the train compartment
- Noise - Possibility to reduce compartment noise

What factor is most important when sleeping?

- Vibrations - Control vibrations caused by the train
- Light - Control intensity and colour of the light

What factor is most important when sleeping?

- Vibrations - Control vibrations caused by the train
- Smell - Possibility to reduce bad odours in the train compartment

What factor is most important when sleeping?

- Light - Control intensity and colour of the light
- Smell - Possibility to reduce bad odours in the train compartment

References:

Bubb, R. (2008). Sitting Comfort. Paper presented at IQPC aircraft interior innovation. 11 November 2008. Hamburg.

3.2.3 Body part discomfort scale

The Body Part Discomfort Scale is a subjective discomfort rating method which can be applied to identify areas of discomfort.

This questionnaire can be used during any phase of the development process of a seat.

Repeated evaluation during the development of a seat can show if the discomfort is decreased after making changes to a seat.

1 Not uncomfortable 4 Very uncomfortable
2 Barely uncomfortable 5 Extremely uncomfortable
3 Quite uncomfortable

| | | | | | |
|-----------------|---|---|---|---|---|
| 1 Head and neck | 1 | 2 | 3 | 4 | 5 |
| 2 Shoulder | 1 | 2 | 3 | 4 | 5 |
| 3 Arm | 1 | 2 | 3 | 4 | 5 |
| 4 Middle back | 1 | 2 | 3 | 4 | 5 |
| 5 Low back | 1 | 2 | 3 | 4 | 5 |
| 6 Buttock | 1 | 2 | 3 | 4 | 5 |
| 7 Thigh | 1 | 2 | 3 | 4 | 5 |
| 8 Knee | 1 | 2 | 3 | 4 | 5 |
| 9 Leg and foot | 1 | 2 | 3 | 4 | 5 |

References:

Corlett, E.N., Bishop, R.P., 1976. A technique for assessing postural discomfort. *Ergonomics* 19, 175-182.

Friedman, H.H., Amoo, T., 1999. Rating the rating scales. *J. Mark. Manag.* 9, 114-123

Wenhua Li, Suihuai Yu, Haicheng Yang, Huining Pei, Chuan Zhao, 2017, Effects of long- duration sitting with limited space on discomfort, body flexibility, and surface pressure, *International Journal of Industrial Ergonomics* 58: 12-24

3.2.4 Method cp50

CP-50 category partitioning scale is described by Shen and Parsons (1997) and used, for instance, by Franz (2010) and Mergl et al. (2005).

In this method, subjects are asked to state a number from 0-50 that matches their feeling after sitting for a certain amount of time.

A score from 1-10 indicates very slight discomfort, 11-20 slight discomfort, 21-30 medium discomfort, 31-40 severe discomfort, and 41-50 very severe discomfort.

Scores of 51 and 52 are for anything exceeding this

| | |
|----|------------------------|
| 52 | |
| 51 | |
| 50 | very severe discomfort |
| 49 | |
| 48 | |
| 47 | |
| 46 | |
| 45 | |
| 44 | |
| 43 | |
| 42 | |
| 41 | |
| 40 | severe discomfort |
| 39 | |
| 38 | |
| 37 | |
| 36 | |
| 35 | |
| 34 | |
| 33 | |
| 32 | |
| 31 | |
| 30 | medium discomfort |
| 29 | |
| 28 | |
| 27 | |
| 26 | |
| 25 | |
| 24 | |
| 23 | |
| 22 | |
| 21 | |
| 20 | slight discomfort |
| 19 | |
| 18 | |
| 17 | |
| 16 | |
| 15 | |
| 14 | |
| 13 | |
| 12 | |
| 11 | |
| 10 | very slight discomfort |
| 9 | |
| 8 | |
| 7 | |
| 6 | |
| 5 | |
| 4 | |
| 3 | |
| 2 | |
| 1 | |
| 0 | |

References:

Franz M. 2010. Comfort, experience, physiology and car seat innovation, PhD thesis, Delft University of Technology.

Mergl C, Klendauer M, Mangen C, Bubb H, 2005. Predicting Long Term Riding Comfort in Cars by Contact Forces between Human and Seat. SAE, Warrendale. Technical Paper No. 2005-01-2690.

Shen W, Parsons KC, 1997. Validity and reliability of rating scales for seated pressure discomfort. International Journal of Industrial Ergonomics 20: 249-461

3.2.5 Method LPD

This method may be old, but it is still useful in seat testing and used, for instance, by Bronkhorst and Krause (2005) and Groenesteijn (2015).

In this method, subjects are first taught the Borg scale (0-10) (Borg, 1999). They are asked to hold a 1 kg weight in a horizontally extended arm. At first, they feel very little discomfort. As time goes by, this moves up the scale towards extreme discomfort, until the point at which they can no longer hold the weight (=10).

The subjects are then shown a body map containing 12 regions, and asked to put a score in the regions where they feel discomfort (Van der Grinten and Smitt, 1992). Usually, the shoulder region receives a score of 10.

The advantage of this method is that it reveals the location of the areas to be improved, which provides input for redesign.

The method is not useful for short sessions (less than an hour), however, as it takes time for discomfort to be noticed, especially in well-designed seats.

Localised Postural Discomfort

| | |
|-----|--|
| 0 | = no discomfort at all |
| 0.5 | = extremely little discomfort (hardly noticeable) |
| 1 | = very little discomfort |
| 2 | = little discomfort |
| 3 | = moderate discomfort |
| 4 | = somewhat high discomfort |
| 5 | = high discomfort |
| 6 | |
| 7 | = very high discomfort |
| 8 | |
| 9 | |
| 10 | = extreme discomfort (almost maximum) |

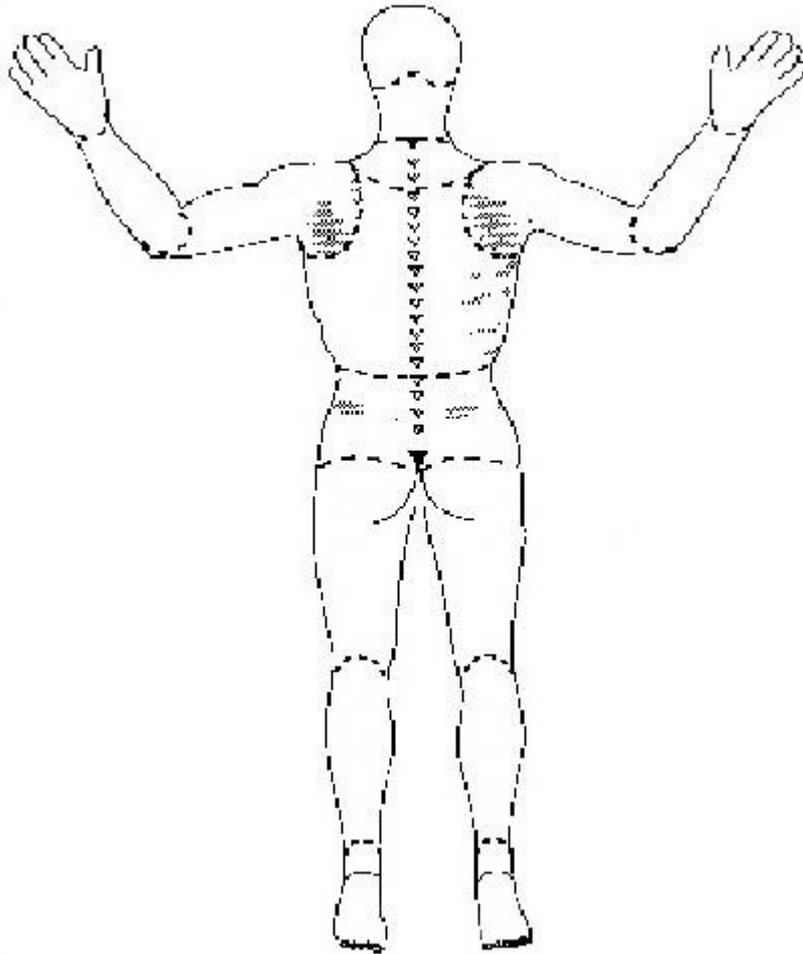
References:

Bronkhorst RE, Krause F . 2005. Designing comfortable passenger seats. in: Vink P, ed. *Comfort and Design: Principles and Good Practice*. Boca Raton: CRC Press: 155-168

Grinten MP van der, Smitt P. 1992. Development of a practical method for measuring body part discomfort. In: Kumar, S. (Ed.), *Advances in Industrial Ergonomics and Safety IV*. Taylor & Francis, London, 311–318.

Groenesteijn L. 2015. *Seat design in the context of knowledge work*. PhD thesis, TU-Delft.

3.2.6 Method red discomfort / green comfort body map



Use the product and put a red cross in regions where you experience discomfort after use and put a green cross in regions where you experience comfort.

References:

Van Veen S, 2016. Driver vitalization. Investigating sensory stimulation to achieve a positive driving experience. TU-Delft. PhD thesis, Delft.

Hiemstra-van Mastrigt, S. (2015). Comfortable passenger seats: Recommendations for design and research. Delft: Suzanne Hiemstra-van Mastrigt. doi.org/10.4233/uuid:eedd25e6-c625-45e9-9d32-f818aa89c19d (Section 5.3)

3.2.7 Method shackle comfort

Shackle comfort questionnaire (Shackel et al., 1969):

| Scale statement | Scale | Position |
|-------------------------------|-------|----------|
| feel completely relaxed | 1 | |
| feel perfectly comfortable | 2 | |
| feel quite comfortable | 3 | |
| feel barely comfortable | 4 | |
| feel uncomfortable | 5 | |
| feel restless and fidgety | 6 | |
| feel cramped | 7 | |
| feel stiff | 8 | |
| feel numb (or pins & needles) | 9 | |
| feel sore and tender | 10 | |
| feel unbearable pain | 11 | |

Used by Osborne & Clark, 1975.

References:

Osborne, D.J. and M.J. Clarke, 1975. Questionnaire surveys of passenger comfort, *Applied Ergonomics* 1975, 6.2, 97-103

Shackel, B., Chidsey, K.D., and Shipley, P., 1969 The assessment of chair comfort. *Ergonomics*, 12: 269-306.

| | Scale from ... to... | Scale | | | | | |
|--|---|------------------|---------------------|----------------|------------------|---------------|--------------------|
| | | 1 | 2 | 3 | 4 | 5 | 6 |
| What are your expectations regarding the comfort of this chair? | 1 very good - 6 very bad | Very good | Good | Rather good | Rather bad | Bad | Very Bad |
| What influences might this chair have on your health? | 1 very positive - 5 very negative | Very positive | Positive | None | Negative | Very negative | - |
| How much would you like to have this chair? | 1 strongly willing - 6 strongly unwilling | Strongly willing | Willing | Rather willing | Rather unwilling | Unwilling | Strongly unwilling |
| Discomfort (evening-morning) | 1 none - 2 light - 3 middle - 4 strong | None | Light | Middle | Strong | - | - |
| How do you assess the comfort of this chair? | 1 very good - 6 very bad | Very good | Good | Rather good | Rather bad | Bad | Very Bad |
| How safe do you feel while sitting on this chair? | 1 very safe - 6 very unsafe | Very save | Save | Rather save | Rather unsafe | Unsafe | Very unsafe |
| Does this chair assist your physical well-being? | 1 applicable - 3 not applicable | Applicable | Applicable in parts | Not applicable | - | - | - |
| What influences will have this on your work performance? | 1 very positive - 5 very negative | Very positive | Positive | None | Negative | Very negative | - |
| On which level did you percieve the mobility of the seat pan? | 1 very obvious = 4 not at all | Very obvious | Obvious | Little | Not at all | - | - |
| How do you like the mobility of the seat pan? | 1 very good - 6 very bad | Very good | Good | Rather good | Rather bad | Bad | Very Bad |
| How do you like the overall dynamics and movement of this chair? | 1 very good - 6 very bad | Very good | Good | Rather good | Rather bad | Bad | Very Bad |
| How did the chair dynamics influence the exercise of your job? | 1 very positive - 5 very negative | Very positive | Positive | None | Negative | Very negative | - |
| To what extend is this chair adjustable accoring to your wishes? | 1 very good - 6 very bad | Very good | Good | Rather good | Rather bad | Bad | Very Bad |
| How do you evaluate the overall comfort of the seat pan? | 1 very good - 6 very bad | Very good | Good | Rather good | Rather bad | Bad | Very Bad |

| | | | | | | | |
|--|-------------------------------------|----------------|------------------|---------------|------------|-----|----------------|
| How do you like the hardness of the seat cushion? | 1 very good - 6 very bad | Very good | Good | Rather good | Rather bad | Bad | Very Bad |
| How do you like the uniformity with which the seat pan supports you? | 1 very good - 6 very bad | Very good | Good | Rather good | Rather bad | Bad | Very Bad |
| How do you evaluate the overall comfort of the backrest? | 1 very good - 6 very bad | Very good | Good | Rather good | Rather bad | Bad | Very Bad |
| How do you like the hardness of the backrest cushion? | 1 very good - 6 very bad | Very good | Good | Rather good | Rather bad | Bad | Very Bad |
| How do you like the uniformity with which the backrest supports you? | 1 very good - 6 very bad | Very good | Good | Rather good | Rather bad | Bad | Very Bad |
| How do you access the comfort of the armrest? | 1 very good - 6 very bad | Very good | Good | Rather good | Rather bad | Bad | Very Bad |
| Did you use the armrest during your working time? | 1 always - 4 not at all | Always | Most of the time | Just a little | Not at all | - | - |
| Do you like the look of this chair? | 1 yes, very much - 6 no, not at all | Yes, very much | Yes | Rather yes | Rather no | No | No, not at all |
| How long the backrest was flexibly adjusted today? (daily protocol) | 1 always - 4 not at all | Always | Most of the time | Just a little | Not at all | - | - |
| Did you adjust the backrest flexibility? | 1 always - 4 not at all | Always | Most of the time | Just a little | Not at all | - | - |

References:

Ellegast, R.P., Keller, K., Hamburger, R., Berger, H., Krause, F., Groenesteijn, L., Blok, M., Vink, P., 2008. Ergonomische Untersuchung besonderer Büroarbeitsstühle. Deutsche Gesetzliche Unfallversicherung (DGUV), Sankt Augustin. BGIA-Report 5/2008.

Groenesteijn, Liesbeth, Rolf Ellegast, Kathrin Keller, Helmut Berger, Peter Vink, In: Vink P, Kantola J, Eds. Advances in Occupational, Social and Organizational Ergonomics. Boca Raton (etc.): CRC Press, 2010: Pages 452-461

3.2.9 Feeling of discomfort

Feelings of discomfort:

Please indicate for the discomfort factors below how you feel on a scale from 1 to 7 (1= not at all, 7= extremely).

| | | | | | | |
|-------------------------------|-------------------------------|-------------------------------|-------------------------------|-------------------------------|-------------------------------|-------------------------------|
| 1. I feel stiff | | | | | | |
| <i>Not at all</i> | | | <i>Extremely</i> | | | |
| <input type="checkbox"/> 1 | <input type="checkbox"/> 2 | <input type="checkbox"/> 3 | <input type="checkbox"/> 4 | <input type="checkbox"/> 5 | <input type="checkbox"/> 6 | <input type="checkbox"/> 7 |

| | | | | | | |
|--|-------------------------------|-------------------------------|-------------------------------|-------------------------------|-------------------------------|-------------------------------|
| 2. I feel uneven pressure from my seat | | | | | | |
| <i>Not at all</i> | | | <i>Extremely</i> | | | |
| <input type="checkbox"/> 1 | <input type="checkbox"/> 2 | <input type="checkbox"/> 3 | <input type="checkbox"/> 4 | <input type="checkbox"/> 5 | <input type="checkbox"/> 6 | <input type="checkbox"/> 7 |

| | | | | | | |
|-------------------------------|-------------------------------|-------------------------------|-------------------------------|-------------------------------|-------------------------------|-------------------------------|
| 3. I feel tired | | | | | | |
| <i>Not at all</i> | | | <i>Extremely</i> | | | |
| <input type="checkbox"/> 1 | <input type="checkbox"/> 2 | <input type="checkbox"/> 3 | <input type="checkbox"/> 4 | <input type="checkbox"/> 5 | <input type="checkbox"/> 6 | <input type="checkbox"/> 7 |

| | | | | | | |
|---------------------------------|-------------------------------|-------------------------------|-------------------------------|-------------------------------|-------------------------------|-------------------------------|
| 4. Part(s) of my body feel numb | | | | | | |
| <i>Not at all</i> | | | <i>Extremely</i> | | | |
| <input type="checkbox"/> 1 | <input type="checkbox"/> 2 | <input type="checkbox"/> 3 | <input type="checkbox"/> 4 | <input type="checkbox"/> 5 | <input type="checkbox"/> 6 | <input type="checkbox"/> 7 |

| | | | | | | |
|-------------------------------|-------------------------------|-------------------------------|-------------------------------|-------------------------------|-------------------------------|-------------------------------|
| 5. I feel uncomfortable | | | | | | |
| <i>Not at all</i> | | | <i>Extremely</i> | | | |
| <input type="checkbox"/> 1 | <input type="checkbox"/> 2 | <input type="checkbox"/> 3 | <input type="checkbox"/> 4 | <input type="checkbox"/> 5 | <input type="checkbox"/> 6 | <input type="checkbox"/> 7 |

Feelings of comfort:

Please indicate for the comfort factors below how you feel on a scale from 1 to 7 (1= not at all, 7= extremely)

| | | | | | | |
|-------------------------------|-------------------------------|-------------------------------|-------------------------------|-------------------------------|-------------------------------|-------------------------------|
| 6. I feel relaxed | | | | | | |
| <i>Not at all</i> | | | <i>Extremely</i> | | | |
| <input type="checkbox"/> 1 | <input type="checkbox"/> 2 | <input type="checkbox"/> 3 | <input type="checkbox"/> 4 | <input type="checkbox"/> 5 | <input type="checkbox"/> 6 | <input type="checkbox"/> 7 |

| | | | | | | |
|-------------------------------|-------------------------------|-------------------------------|-------------------------------|-------------------------------|-------------------------------|-------------------------------|
| 7. I feel refreshed | | | | | | |
| <i>Not at all</i> | | | <i>Extremely</i> | | | |
| <input type="checkbox"/> 1 | <input type="checkbox"/> 2 | <input type="checkbox"/> 3 | <input type="checkbox"/> 4 | <input type="checkbox"/> 5 | <input type="checkbox"/> 6 | <input type="checkbox"/> 7 |

| | | | | | | |
|-------------------------------|-------------------------------|-------------------------------|-------------------------------|-------------------------------|-------------------------------|-------------------------------|
| 8. The seat feels soft | | | | | | |
| <i>Not at all</i> | | | <i>Extremely</i> | | | |
| <input type="checkbox"/> 1 | <input type="checkbox"/> 2 | <input type="checkbox"/> 3 | <input type="checkbox"/> 4 | <input type="checkbox"/> 5 | <input type="checkbox"/> 6 | <input type="checkbox"/> 7 |

| | | | | | | |
|-------------------------------|-------------------------------|-------------------------------|-------------------------------|-------------------------------|-------------------------------|-------------------------------|
| 9. I feel fit | | | | | | |
| <i>Not at all</i> | | | <i>Extremely</i> | | | |
| <input type="checkbox"/> 1 | <input type="checkbox"/> 2 | <input type="checkbox"/> 3 | <input type="checkbox"/> 4 | <input type="checkbox"/> 5 | <input type="checkbox"/> 6 | <input type="checkbox"/> 7 |

| | | | | | | |
|-------------------------------|-------------------------------|-------------------------------|-------------------------------|-------------------------------|-------------------------------|-------------------------------|
| 10. I feel comfortable | | | | | | |
| <i>Not at all</i> | | | <i>Extremely</i> | | | |
| <input type="checkbox"/> 1 | <input type="checkbox"/> 2 | <input type="checkbox"/> 3 | <input type="checkbox"/> 4 | <input type="checkbox"/> 5 | <input type="checkbox"/> 6 | <input type="checkbox"/> 7 |

References:

Hiemstra-van Mastrigt S. 2015. Comfortable passenger seats. Recommendations for design and research. PhD thesis, TU-Delft.

Zhang, L., Helander, M.G., Drury, C.G., 1996. Identifying Factors of Comfort and Discomfort in Sitting. Human Factors 38(3): 377–389.

4 REFERENCES

- Carcone, S., & Keir, P. (2007). Effects of backrest design on biomechanics and comfort during seated work. *Applied Ergonomics*, Vol. 38, Issue 6, 755-764.
- Bazley C, Nugent R, Vink P. Patterns of Discomfort. *J of Ergonomics* 2015, 5:1
- Lille, C. de, Santema, S., Bouwens, J., Schultheis, U., Vink, P. 2016. Designing the compartment interior knowing high and low peaks in a passenger flight. AEGATS conference, AEGATS2016_48 on stick
- Vink P, Bazley C, Kamp I, Blok M. 2012. Possibilities to improve the aircraft interior comfort experience. *Applied Ergonomics* 43: 354-359.
- Bubb, R. (2008). Sitting Comfort. Paper presented at IQPC aircraft interior innovation. 11 November 2008. Hamburg.
- Corlett, E.N., Bishop, R.P., 1976. A technique for assessing postural discomfort. *Ergonomics* 19, 175-182.
- Franz M. 2010. Comfort, experience, physiology and car seat innovation, PhD thesis, Delft University of Technology.
- Mergl C, Klendauer M, Mangen C, Bubb H, 2005. Predicting Long Term Riding Comfort in Cars by Contact Forces between Human and Seat. SAE, Warrendale. Technical Paper No. 2005-01-2690.
- Shen W, Parsons KC, 1997. Validity and reliability of rating scales for seated pressure discomfort. *International Journal of Industrial Ergonomics* 20: 249-461
- Bronkhorst RE, Krause F . 2005. Designing comfortable passenger seats. in: Vink P, ed. *Comfort and Design: Principles and Good Practice*. Boca Raton: CRC Press: 155-168
- Grinten MP van der, Smitt P. 1992. Development of a practical method for measuring body part discomfort. In: Kumar, S. (Ed.), *Advances in Industrial Ergonomics and Safety IV*. Taylor & Francis, London, 311–318.
- Groenesteijn L. 2015. Seat design in the context of knowledge work. PhD thesis, TU-Delft.
- Oborne, D.J. and M.J. Clarke, 1975. Questionnaire surveys of passenger comfort, *Applied Ergonomics* 1975, 6.2, 97-103
- Shackel, B., Chidsey, K.D., and Shipley, P., 1969 The assessment of chair comfort. *Ergonomics*, 12: 269-306.
- Ellegast, R.P., Keller, K., Hamburger, R., Berger, H., Krause, F., Groenesteijn, L., Blok, M., Vink, P., 2008. Ergonomische Untersuchung besonderer Büroarbeitsstühle. Deutsche Gesetzliche Unfallversicherung (DGUV), Sankt Augustin. BGIA-Report 5/2008.
- Groenesteijn, Liesbeth, Rolf Ellegast, Kathrin Keller, Helmut Berger, Peter Vink, In: Vink P, Kantola J, Eds. *Advances in Occupational, Social and Organizational Ergonomics*. Boca Raton (etc.): CRC Press, 2010: Pages 452-461
- Hiemstra-van Mastrigt S. 2015. Comfortable passenger seats. Recommendations for design and research. PhD thesis, TU-Delft.

Zhang, L., Helander, M.G., Drury, C.G., 1996. Identifying Factors of Comfort and Discomfort in Sitting. *Human Factors* 38(3): 377–389.

EuroSpec

“EuroSpec” stands for European Specifications for railway rolling stock. The activity is an initiative of several European train operating companies (TOC). The main focus is on trains consisting of self-propelled carriages, using electricity as the motive power (EMU).

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