Master Graduation Thesis

APPENDIX

Revolutionizing pelvic exams: A sustainable, patient-centered redesign of the Vaginal Speculum

TU Delft

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MSc Integrated Product Design

Faculty of Industrial Design Engineering

Appendix

Appendix A - Interview doctor journey map

Research aim

1. Understand how the device works and answer questions arising from the literature review.
2. Create a user journey map to detect pain points and gain points from using the device and pelvic exams.
3. Identify the needs and wishes of the healthcare sector.

Method

Participants:
The recruitment of the participants was done thanks to the contacts of my mentor Msc.T Hoveling, through Linkedin and friends.

Participant	Hospital	Role
ID 1	UMC Utrecht	Gynecologist
ID 2	Maastricht UMC+	Gynecologist
ID 3	Reinier de Graaf	Nurse

Data collection: To collect the data the interview will be recorded.

Research ethics – Due to privacy sensitivity, all participants must sign a consent form. A blank copy of this informed consent and an ethics checklist.

Research environment – All the interviews are conducted online.

Activities & tasks –The interview is divided into three blocks, each focused on a different topic. Each block contains three questions, and the entire interview lasts 45 minutes.

1. **Block 1: Decontamination**
    - For reusable speculums, how is the decontamination process done? Is it done in the healthcare centre? Is high-level disinfection or sterilization needed? Where do you dispose of the metal speculum to send it to the decontamination process?
    - For the single-use speculum, how do you discard it as waste? Do you think it needs to be in a special container?
    - How does the use of a single-use speculum affect workflow and resource management within healthcare facilities? Is it more cost-effective? Why do hospitals prefer this option over the reusable one?
2. **Block 2: Journey Map**
    - Verification of the process: What are the factors involved in each part of the process? (e.g., "Here I use gloves, I throw away the packaging, etc.")
    - Why is each part of the process done this way? Are there alternatives?

    - What is the most critical moment in the process?
3. **Block 3: Future Device**
    - Are there specific patient populations or demographics that may require special considerations when designing or using speculums?
    - Have you had any bad experiences with current speculums?
    - What would you like to see in a new speculum? How would you like pelvic exams to be conducted in the future?

Equipment:

- **General:** iPad for recording audio
- **Block 1 & 3**: No equipment required.
- **Block 2**: An empty journey map, designed based on the literature review, will be used. Premo Emotions will be used for collecting emotional responses

Informed consent form

participant ID: _____

Informed consent to participate in a research study

You are being invited to participate in a research study titled "**Journey Mapping – pelvic exam"**. This study is being done by Ariadna Izcara Gual from the TU Delft.

The purpose of this research study is to explore the patient and practitioner journey map of pelvic exams with a focus on the vaginal speculum device and will take you approximately 40 minutes to complete. The data will be used for obtaining insights about the procedure and developing a journey map. We will be particularly interested in your practical and emotional experience with the use of the vaginal speculum and pelvic exams. The collected data will be used to construct a patient journey map, which will help to identify the design challenges and product requirements.

To the best of our ability, your answers in this study will remain confidential. Upon signing this consent, you will be assigned a unique participant ID number to ensure that all collected data is anonymized. We will further minimize any risks of personal data breach by storing your personally identifiable information in a password-secured electronic format at a secure TU Delft repository. All personal and raw data will be destroyed after the study is completed, and no raw data will be shared with anybody outside the research team at any time.

Your participation in this study is entirely voluntary, and you can withdraw at any time without having to give a reason and without adverse consequences. You are free to omit any questions, and your data can be removed by September 30 once the project is concluded.

PLEASE TICK THE APPROPRIATE BOXES	Yes	No
A: GENERAL AGREEMENT – RESEARCH GOALS, PARTICPANT TASKS AND VOLUNTARY PARTICIPATION		
1. I have read and understood the study information dated [/ /2024], or it has been read to me. I have been able to ask questions about the study and my questions have been answered to my satisfaction.	☐	☐
2. I consent voluntarily to be a participant in this study and understand that I can refuse to answer questions and I can withdraw from the study at any time, without having to give a reason.	☐	☐
3. I understand that taking part in the study involves in-person/online interviews which will be audio-recorded. The recordings will be transcribed and destroyed immediately after the interview to minimise personal data collection.	☐	☐
4. I understand that I will <u>not</u> be compensated for my participation	☐	☐
5. I understand that the study will end on the 30th of September	☐	☐
B: POTENTIAL RISKS OF PARTICIPATING (INCLUDING DATA PROTECTION)		
6. I understand that taking part in the study involves the risk of psychological discomfort due to potentially traumatic memories of my journey as a patient. I understand that this risk will be mitigated in the following ways: · I will be free to omit any questions; · I will be able to withdraw from the interview at any point without having to give a reason and without adverse consequences.	☐	☐
7. I understand that taking part in the study also involves collecting specific personally identifiable information (PII) [name, e-mail address] and associated personally identifiable research data (PIRD) [age, gender, audio	☐	☐

recordings of the interview] with the potential risk of my identity being revealed		
8. I understand that some of this PIRD is considered as sensitive data within GDPR legislation, specifically health-related data	☐	☐
9. I understand that the following steps will be taken to minimize the threat of a data breach, and protect my identity in the event of such a breach: · Upon signing this consent, I will be assigned a unique participant ID number, under which all information I provide during the study will be stored; · My personally identifiable information will be stored in a password-secured electronic format at a secure TU Delft repository; · Audio recordings of the interview will be transcribed and destroyed immediately after the interview	☐	☐
10. I understand that personal information collected about me that can identify me, such as name and e-mail address, will not be shared beyond the study team.	☐	☐
11. I understand that the (identifiable) personal data I provide will be destroyed after the study is complete (30th of September)	☐	☐
C: RESEARCH PUBLICATION, DISSEMINATION AND APPLICATION		
12. I understand that after the research study, the de-identified information I provide will be used to construct a patient journey map to obtain design insights for a Master's thesis at TU Delft.	☐	☐
13. I agree that my responses, views or other input can be quoted anonymously in research outputs	☐	☐
D: (LONGTERM) DATA STORAGE, ACCESS AND REUSE		
14. I give permission for the de-identified health-related data that I provide to be archived in a secure TU Delft repository, so it can be used for future research and learning.	☐	☐
15. I understand that access to this repository is restricted only to the corresponding researchers.	☐	☐

Signatures

_____	_____	_____
Name of participant [printed]	Signature	Date

I, as a researcher, have accurately read out the information sheet to the potential participant and, to the best of my ability, ensured that the participant understands to what they are freely consenting.

_____	_____	_____
Researcher name [printed]	Signature	Date

Study contact details for further information: Corresponding researcher Ariadna Izcara Gual (A.IzcaraGual@student.tudelft.nl) or the responsible researcher Tamara Hoveling (T.Hoveling@tudelft.nl)

Appendix B - Interview patient journey map

Research aim

1. Understand the emotional patient experience behind pelvic exams.
2. Understand why women reject the vaginal speculum.
3. Verify literature findings.
4. Create a user journey map to detect pain points and gain points from using the device and pelvic exams.
5. Discover the wishes of patients.

Method

Participants: The recruitment of the participants was done through WhatsApp. The participants were selected according to their experience with pelvic exams. Participants who did not have experience with pelvic exams were excluded.

Participant	Age	Nationality	GP or Hospital	Place (s) of the exam
ID 1	24	Spanish	Hospital	Spain
ID 2	23	American	Hospital	USA
ID 3	23	Italian	Both	NL and Italy
ID 4	25	Dutch	Both	NL
ID 5	25	Indian	Both	NL and India
ID 6	62	Spanish	Hospital	Spain
ID 7	58	Spanish	Hospital	Spain
ID 8	23	French	Both	NL and France

Data collection: To collect the data the interview will be recorded.

Research ethics – Due to privacy sensitivity, all participants must sign a consent form. A blank copy of this informed consent and an ethics checklist can be found at the end of the document.

Research environment – All possible interviews will be conducted face-to-face with the design faculty of TU Delft. It will use a space where the participant feels comfortable. For

those participants whose meeting in person is not possible the interview will be conducted online using Miro as a support.

Procedure: The interview is divided into three blocks, each focused on a different topic. Each block contains three questions, and the entire interview lasts 45 minutes.

1. **Block 1: General Information**
    - How often do you check your reproductive health? When was the last time you went?
    - Have you ever experienced any barriers or challenges accessing reproductive healthcare?
2. **Block 2: Emotional Journey Mapping**
    - The researcher will provide an empty journey map and ask participants to identify each step of the process with one or two Premo emotions.
    - Participants will then explain why they felt these emotions and suggest improvements for negative emotions and what they liked for positive emotions.
3. **Block 3: Device Feedback**

    Participants will be asked if they feel comfortable seeing the device. If they are comfortable, the researcher will show the device and explain how it works. If not, the interview will proceed without showing the device.

    - Could you describe the device that you have seen and how you feel?
    - Do you think that the device needs a redesign? Why?
    - How do you envision the speculum design? Which features would you like to see on it?

Equipment:

- **General**: iPad for recording.
- **Block 1**: No equipment required.
- **Block 2**: Printed empty journey map and Premo emotions for collecting emotional responses.
- **Block 3**: Current vaginal speculum, paper, and pens for drawing.

Informed consent form & check list

Participant ID:_____

Informed consent to participate in a research study

You are being invited to participate in a research study titled "**Journey Mapping – pelvic exam"**. This study is being done by Ariadna Izcara Gual from the TU Delft.

The purpose of this research study is to explore the patient and practitioner journey map of pelvic exams with a focus on the vaginal speculum device and will take you approximately 40 minutes to complete. The data will be used for obtaining insights about the procedure and developing a journey map. We will be particularly interested in your practical and emotional experience with the use of the vaginal speculum and pelvic exams. The collected data will be used to construct a patient journey map, which will help to identify the design challenges and product requirements.

To the best of our ability, your answers in this study will remain confidential. Upon signing this consent, you will be assigned a unique participant ID number to ensure that all collected data is anonymized. We will further minimize any risks of personal data breach by storing your personally identifiable information in a password-secured electronic format at a secure TU Delft repository. All personal and raw data will be destroyed after the study is completed, and no raw data will be shared with anybody outside the research team at any time.

Your participation in this study is entirely voluntary, and you can withdraw at any time without having to give a reason and without adverse consequences. You are free to omit any questions, and your data can be removed by September 30 once the project is concluded.

If you have questions about the study or the procedures, please feel free to contact the corresponding researcher Ariadna Izcara Gual (A.IzcaraGual@student.tudelft.nl) or the responsible researcher Tamara Hoveling (T.Hoveling@tudelft.nl) at any time.

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2. I consent voluntarily to be a participant in this study and understand that I can refuse to answer questions and I can withdraw from the study at any time, without having to give a reason.	☐	☐
3. I understand that taking part in the study involves in-person/online interviews which will be audio-recorded. The recordings will be transcribed and destroyed immediately after the interview to minimise personal data collection.	☐	☐
4. I understand that I will <u>not</u> be compensated for my participation	☐	☐
5. I understand that the study will end on the 30th of September	☐	☐
B: POTENTIAL RISKS OF PARTICIPATING (INCLUDING DATA PROTECTION)		
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7. I understand that taking part in the study also involves collecting specific personally identifiable information (PII) [name, e-mail address] and associated personally identifiable research data (PIRD) [age, gender, audio recordings of the interview] with the potential risk of my identity being revealed	☐	☐

8. I understand that some of this PIRD is considered as sensitive data within GDPR legislation, specifically health-related data	☐	☐
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10. I understand that personal information collected about me that can identify me, such as name and e-mail address, will not be shared beyond the study team.	☐	☐
11. I understand that the (identifiable) personal data I provide will be destroyed after the study is complete (30th of September)	☐	☐
C: RESEARCH PUBLICATION, DISSEMINATION AND APPLICATION		
12. I understand that after the research study, the de-identified information I provide will be used to construct a patient journey map to obtain design insights for a Master's thesis at TU Delft.	☐	☐
13. I agree that my responses, views or other input can be quoted anonymously in research outputs	☐	☐
D: (LONGTERM) DATA STORAGE, ACCESS AND REUSE		
14. I give permission for the de-identified health-related data that I provide to be archived in a secure TU Delft repository, so it can be used for future research and learning.	☐	☐
15. I understand that access to this repository is restricted only to the corresponding researchers.	☐	☐

Signatures

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Name of participant [printed]	Signature	Date

I, as a researcher, have accurately read out the information sheet to the potential participant and, to the best of my ability, ensured that the participant understands to what they are freely consenting.

_____	_____	_____
Researcher name [printed]	Signature	Date

Study contact details for further information: Corresponding researcher Ariadna Izcara Gual (A.IzcaraGual@student.tudelft.nl) or the responsible researcher Tamara Hoveling (T.Hoveling@tudelft.nl)

Appendix C - Menstrual cup

Research aim

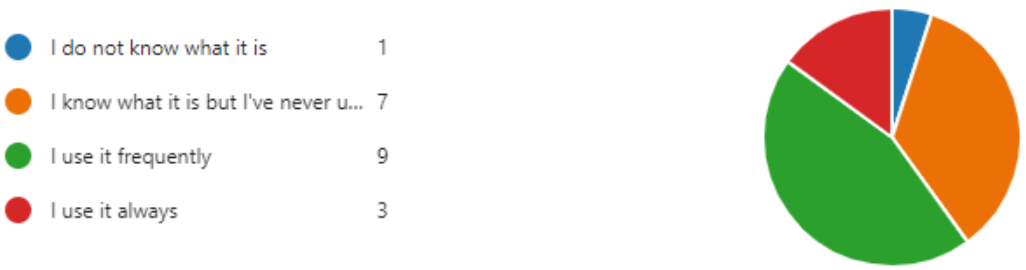
1. Identify the design features that make the menstrual cup more appealing to users.
2. Gather specific insights for the redesign of the speculum, focusing on colour and perception (adjectives) to create a mood board.

Method

Participants: Participants were recruited through WhatsApp based on their experience with menstrual cups. The total number of participants was 20.

Age of the participants:

Experience with the menstrual cup:



Data collection: To collect the data was used Microsoft forms.

Research ethics – Not needed due to there was no personal data

Procedure: A short questionnaire was conducted using Microsoft Forms. The questions were divided into three blocks:

Block 1: Demographic Questions

- ➢ **How old are you?**
  - Type: Single-choice question
  - Options: Younger than 18, 18-25, 26-40, 41-60

- -**Where are you from?**
- Type: Open-answer question

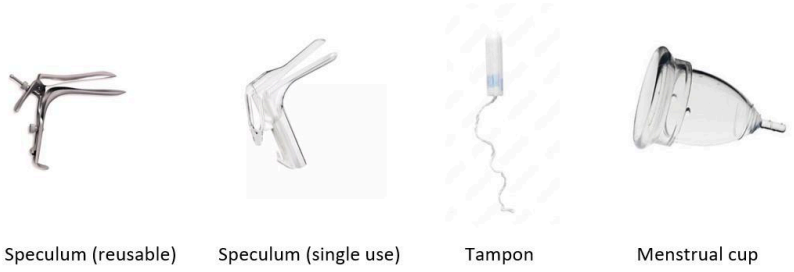
➢ **How familiar are you with the menstrual cup?**

- Type: Single-choice question
- Options: I do not know what it is, I know what it is but I do not use it, I use it frequently, I use it always

Block 2: Menstrual Cup

4**. On a scale from 1 to 5, how would you rate the comfort level of using these products?**

- Type: Matrix
- Scale: 1 (I do not want to see it), 3 (I am fine with it), 5 (I love it!)
- Picture:



5. **On a scale from 1 to 5, how much do the following aspects of the menstrual cup make it feel less intimidating compared to a vaginal speculum?**

- Type: Matrix
- Aspects: Size, material, rounded shapes, colours, sustainability, marketing, popularity, self-insertion, familiarity, ownership
- Scale: 1 (Very friendly), 5 (Extremely intimidating)

Block 3: Vaginal Speculum

6. **On a scale from 1 to 5, which one would you prefer to have in your next pelvic exam?**

- Type: Matrix
- Scale: 1 (I do not want to see it), 3 (I am fine with it), 5 (I love it!)
- Picture:

Device 1

Device 2

Device 3

Device 4

7. **Why?**

- Type: Open-answer question

8. **Which three adjectives best describe the ideal new vaginal speculum?**

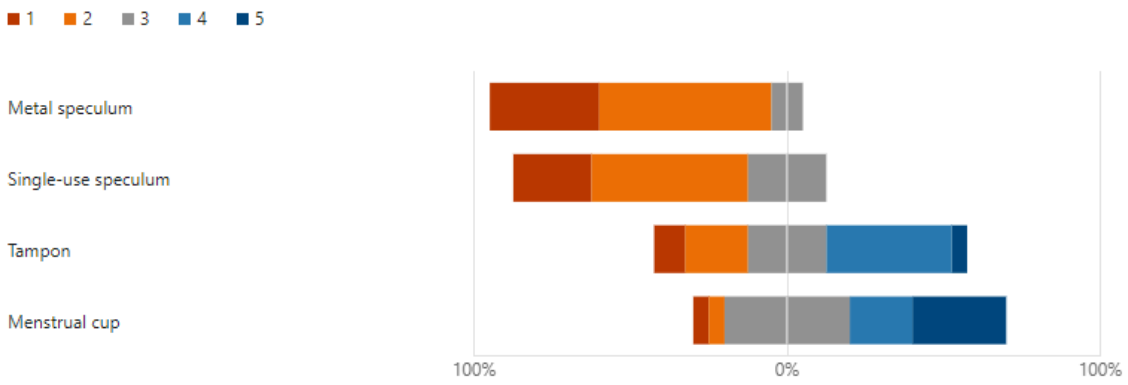
- Type: Multiple-choice question
- Options: Clean, sustainable, young, elegant, fresh, warm, uniform, discrete, powerful, minimalist, personal, funny, others (please specify)

9. **Which main colour would you like to have in the new speculum?**

- Type: Single-choice question
- Picture:

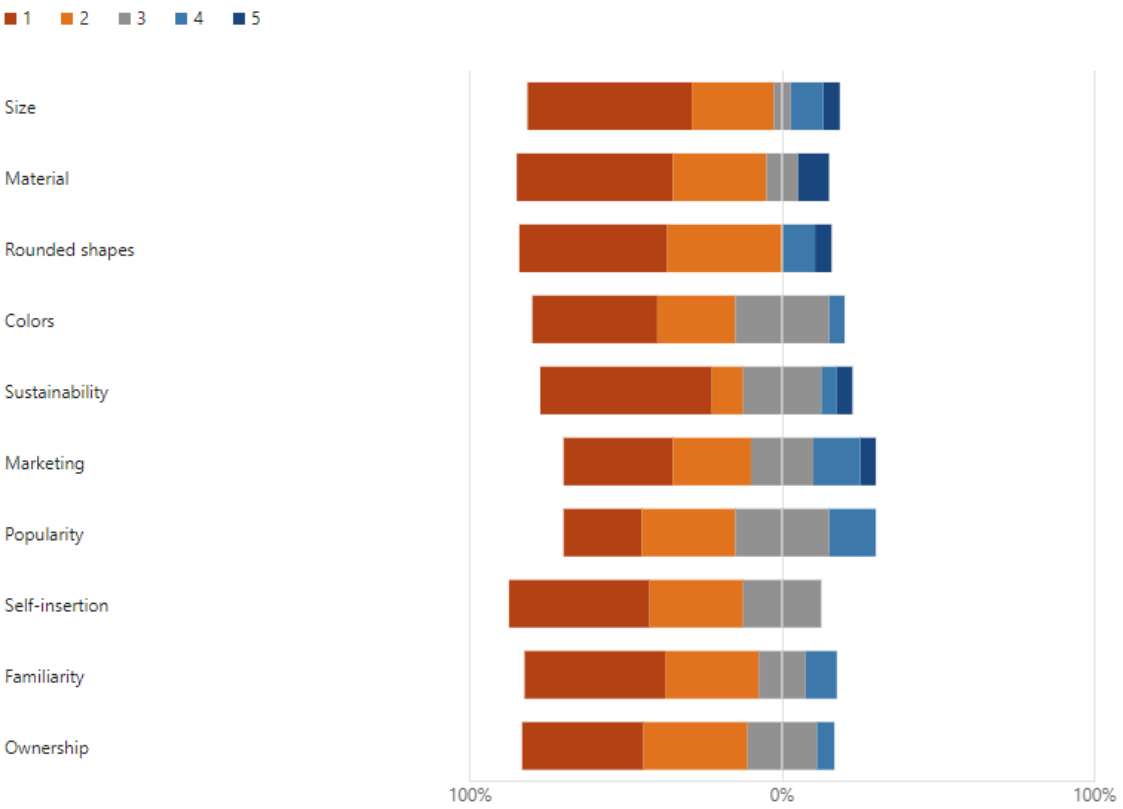
Results:

Research question 1:

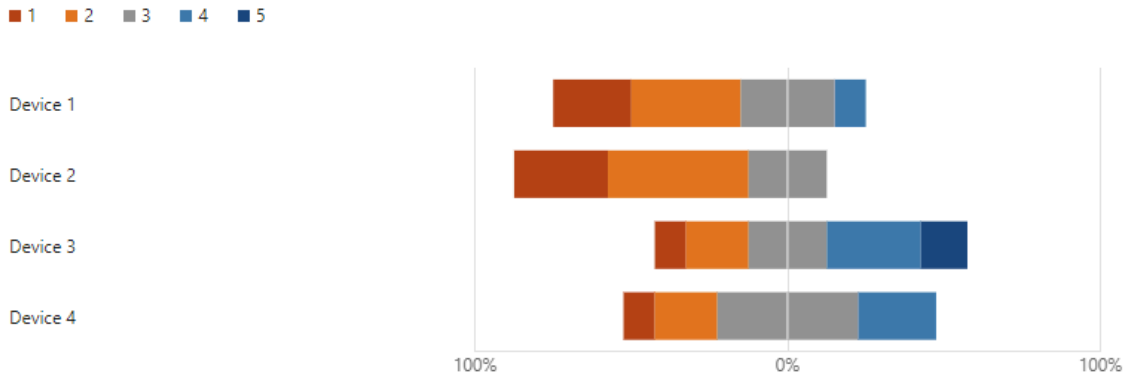


Interpretation:

Q5. Why menstrual cup is less intimidating?



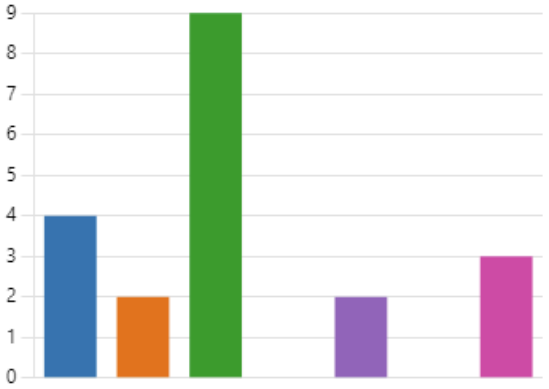
Research question 2:



9. Which main color would you like to have in the new speculum? (0 punto)

Más detalles

Peach	4
Orange	2
Apricol	9
Bermuda	0
Blue	2
Metal	0
Transparent	3



Appendix E - Co-creation session

Research aim

1. Create a collective brainstorming session with users.
2. Apply the radical emphasis method with users who are not familiar with the device to reduce bias and explore alternative options.

Method

Participants: Participants were recruited through WhatsApp and were all students from the Industrial Design (IO) faculty. All participants knew each other before starting the test, creating a more comfortable environment for the sessions. The two sessions were divided according to the gender of the participants.

Co-creation session 1 (women):

Participant	Age	Nationality
ID1	23	Spanish
ID2	25	Spanish
ID3	24	Spanish
ID4	28	Chinese

Co-creation session 2 (men):

Participant	Age	Nationality
ID1	23	American
ID2	24	Italian
ID3	24	Italian
ID4	24	Spanish

Data Collection: All sessions will be recorded to collect data.

Research Ethics: Due to privacy sensitivity, all participants must sign a consent form. A blank copy of this informed consent and an ethics checklist can be found at the end of the document.

Research Environment: The session will be conducted in a room at the design faculty of TU Delft in a space where participants feel comfortable.

Procedure: The co-creation sessions followed the double diamond method and had a duration of 1 hour

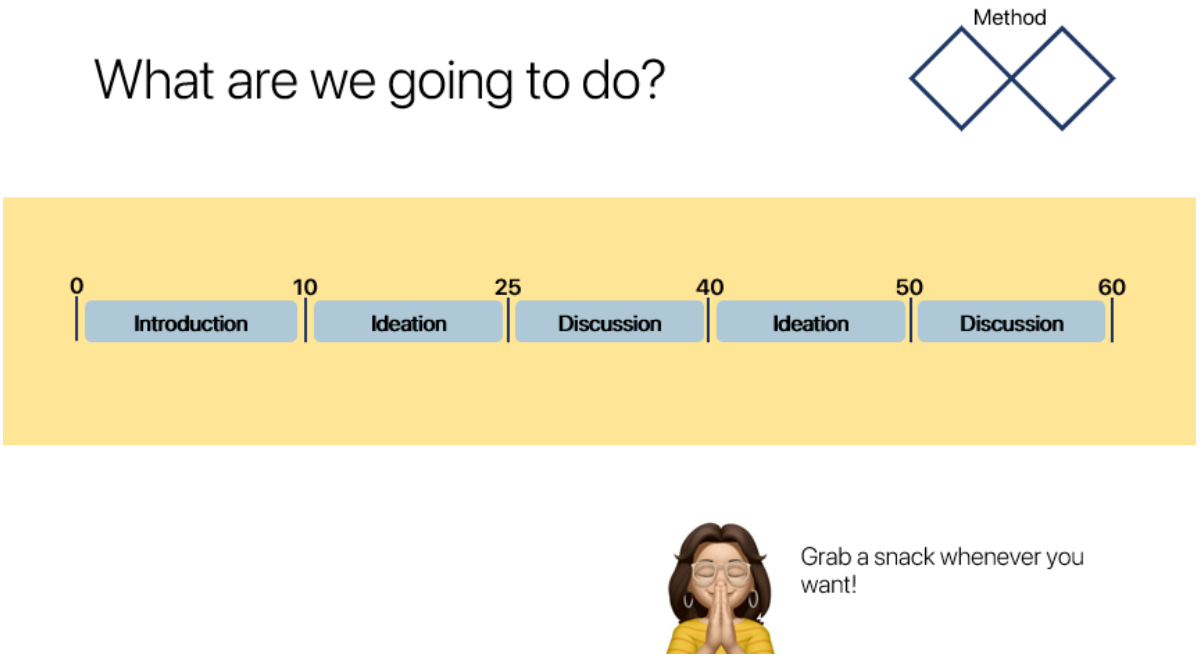


Figure 1: Planning presented to the participants before starting the session

The timing differs a bit more between women and men due to the familiarity with the topic and the number of questions from the participants

Introduction:

An overview of pelvic exams, the pain points identified, and a broad explanation of the female reproductive system. After this, two questions were addressed to the participants:

- Which parts do you think patients feel more pain?
- Which parts do you think practitioners need to pay attention to?
-

Participants were divided into pairs and given a paper with illustrations of the female reproductive system to help identify the parts. After 5 minutes, the findings were discussed and compared with the literature review and interview results.

Ideation:

Participants were asked how a device could be inserted and used to visualize the cervix without showing the device itself. It is important to mention that the first group (women) was already familiar with the device while the second group (men) was not familiar. The questions addressed to the participants were the following:

- How can we insert a device and visualise the cervix with it?

Participants ideated individually using paper and pens.

Discussion:
After 10’ the results were discussed.

Ideation:
The vaginal speculum was shown to the participants, allowing them to interact with it. The questions addressed to the participants were the following:

- What would you change as a designer?

Participants were given a paper with a printed speculum to support their ideas and engaged in an open discussion.

Conclusion-Feedback:

The researcher presented her initial ideas and obtained feedback from the participants based on their design expertise.

Equipment:
Presentation: Provided information and user clues for participants to understand each step.
Ideation: Paper and tools (pens, printed images) were provided.

Informed consent form & checklist

Participant ID:_____

Informed consent to participate in a research study

You are being invited to participate in a research study titled "**Co-Creation session: redesigning the speculum"**. This study is being done by Ariadna Izcara Gual from the TU Delft.

The purpose of this research study is to explore different ideas to redesign the vaginal speculum. The data will be used to obtain ideas and insights to redesign the device. The session will last 1 hour and you will work with a group of 4 other participants.

To the best of our ability, your answers in this study will remain confidential. Upon signing this consent, you will be assigned a unique participant ID number to ensure that all collected data is anonymized. We will further minimize any risks of personal data breach by storing your personally identifiable information in a password-secured electronic format at a secure TU Delft repository. All personal and raw data will be destroyed after the study is completed, and no raw data will be shared with anybody outside the research team at any time.

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PLEASE TICK THE APPROPRIATE BOXES	Yes	No
A: GENERAL AGREEMENT – RESEARCH GOALS, PARTICIPANT TASKS AND VOLUNTARY PARTICIPATION		
1. I have read and understood the study information dated [/ /2024], or it has been read to me. I have been able to ask questions about the study and my questions have been answered to my satisfaction.	☐	☐
2. I consent voluntarily to be a participant in this study and understand that I can refuse to answer questions and I can withdraw from the study at any time, without having to give a reason.	☐	☐
3. I understand that taking part in the study involves in-person/online interviews which will be audio-recorded. The recordings will be transcribed and destroyed immediately after the interview to minimise personal data collection.	☐	☐
4. I understand that I will <u>not</u> be compensated for my participation	☐	☐
5. I understand that the study will end on the 30th of September	☐	☐
B: POTENTIAL RISKS OF PARTICIPATING (INCLUDING DATA PROTECTION)		
6. I understand that taking part in the study involves the risk of psychological discomfort due to potentially traumatic memories of my journey as a patient. I understand that this risk will be mitigated in the following ways: · I will be free to omit any questions; · I will be able to withdraw from the interview at any point without having to give a reason and without adverse consequences.	☐	☐
7. I understand that taking part in the study also involves collecting specific personally identifiable information (PII) [name, e-mail address] and associated personally identifiable research data (PIRD) [age, gender, audio recordings of the interview] with the potential risk of my identity being revealed	☐	☐

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10. I understand that personal information collected about me that can identify me, such as name and e-mail address, will not be shared beyond the study team.	☐	☐
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Signatures

_____	_____	_____
Name of participant [printed]	Signature	Date

I, as a researcher, have accurately read out the information sheet to the potential participant and, to the best of my ability, ensured that the participant understands to what they are freely consenting.

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Researcher name [printed]	Signature	Date

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Appendix F - Patient concept validation interview

Research aim

1. Evaluate the concept and whether patients would like the possibility to self-insert the device.
2. Evaluate the shape of the new design with patients.
3. Evaluate the psychological interaction with patients.
4. Evaluate the service.

Method

Participants: As many participants as possible who participated in the journey mapping interview were asked for a concept evaluation interview. Rest of the participants were recruited through WhatsApp

Participant	Age	Nationality	Familiarity with the speculum
ID 1*	24	Spanish	I know what it is and I know how it works
ID 2	25	Spanish	I know what it is and I know how it works
ID 3*	23	American	I know what it is and I know how it works
ID 4*	24	Italian	I know what it is and I know how it works
ID 5	24	Italian	I do not know what it is and I do not know how it works
ID 6*	24	Dutch	I know what it is but I do not know how it works
ID 7*	23	French	I know what it is and I know how it works
ID 8	24	Chinese	I know what it is and I know how it works

*Previous participant

Data Collection: All sessions will be recorded to collect data. To help generate graphics the information was introduced into Microsoft forms

Research Ethics: Due to privacy sensitivity, all participants must sign a consent form. A blank copy of this informed consent and an ethics checklist can be found at the end of the document.

Research environment – All possible interviews will be conducted face-to-face with the design faculty of TU Delft. It will use a space where the participant feels comfortable. Those interviews that were not possible face-to-face were conducted online.

Procedure: The interview is divided into three blocks and it lasts around 45minutes

Block 1: Function

This part of the interview aims to evaluate whether patients would prefer to insert the device themselves and how this might improve or affect their experience with the speculum. The questions addressed are the following:

Figure 1: Render shown to the participants to explain the insertion mechanism

1. How would you feel if you had the chance to decide how to insert the device?

    - Type: Single-choice question
    - Options: I do not want to have this question, I do not care, POwerfull, less stressed, less scared, others

2. One of the main characteristics of the device is the possibility of self-insertion:

    - Type: Single-choice question
    - Options: I prefer that the doctor inserts and opens the device, I prefer to insert the device myself and have the doctor open it, I prefer to insert and open the device myself

3. One of the main characteristics of the device is the possibility of self-removal.

    - Type: Single-choice question
    - Options: I prefer that the doctor close the device and remove it, I prefer that the doctor closes close the device and I remove it, I prefer to close and remove the device

4. Do you think self-insertion can improve or not the experience in general? Why?

    - Type: Open question

Block 2: Aesthetics

In this part, the shape and colour of the concept were discussed with the participants. For this phase, three different prototypes and nine renders were shown. The adjectives used are the results of questions 5 and 8 from Appendix C

5. What shape is the first one that comes to your mind when you see the device?

    - Type: Open question

6. Which shape do you think is the most…

    - Type: Matrix
    - Options: User-friendly, Trustworthy, Better for self-insertion

7. Which shape is your favourite?

    - Type: Single-choice question
    - Options: shape 1, shape 2, shape 3

Renders shown in this part of the test:

Figure 3: Render with colors and materials shown to the participants

8. Which colour transmits you the most….

- Type: Matrix
- Options: User-friendly, Sustainable, Warm, Trustworthy, Better for self-insertion, clean

9. Which colour do you prefer for this device?

- Type: Single-choice question
- Options: Transparent, Orange, Pink, Metal, Blue

10. What would you like to see other colours?

- Type: Open question

11. Which material transmits you the most….

- Type: Matrix
- Options: User-friendly, Sustainable, Warm, Trustworthy, Better for self-insertion, clean

12. Which material do you prefer for this device?

- Type: Single-choice question
- Options: Transparent, Plastic semi-transparent, silicone solid, metal

13. (For this question the old specuñum and the redesign are shown to the participant) Which device would you prefer? Why?

- Type: Open question

Block 3: Service-App

This last part of the interview is to explore the possibility of having an app to improve the gap of knowledge among patients

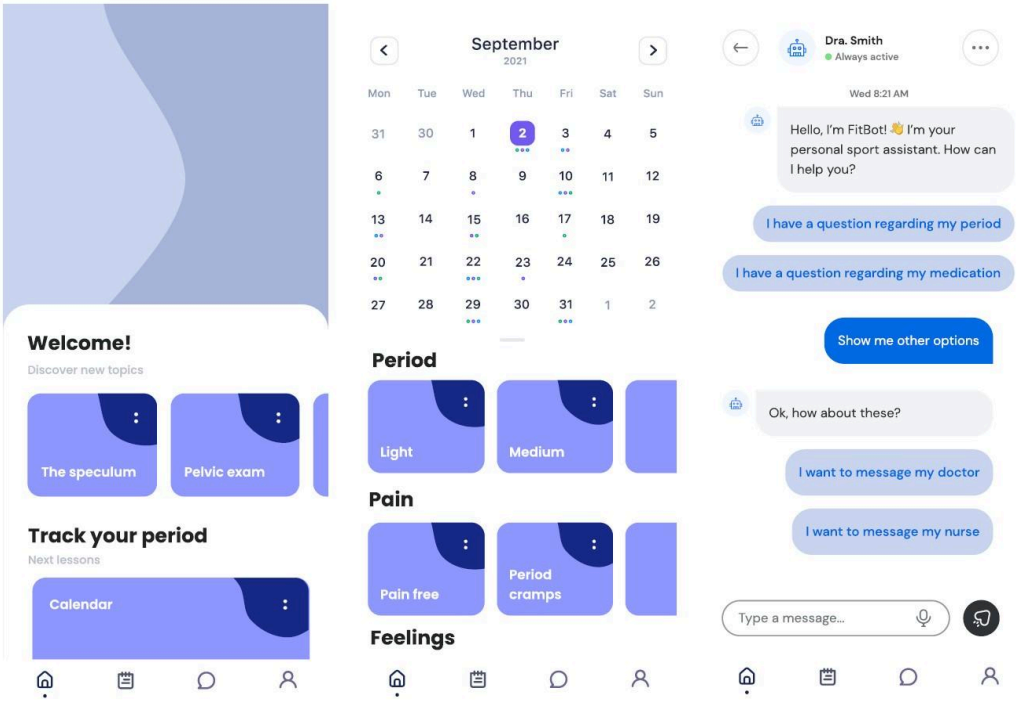


Figure 4. Mock-up of the app shown to participants

14. Do you use an app for tracking your period?

    - Type: Single-choice question
    - Options: Yes, no

15. Why?

    - Type: Open question

16. Would you like to have an app related to your reproductive care?

    - Type: Single-choice question
    - Options: Yes, no

17. Why?

    - Type: Open question

18. In the app I would like to see...

    - Type: Multiple-choice question
    - Options: Period track, Sex activity, notification according to the period data, medication information, Forum with other women, Educational material, chat with my doctor/nurse, reminders

17. What would you like to know about pelvic exams?

- Type: Open question

17. How would you like to have this information?

- Type: Open question

18. Imagine you are in the following situations, how would this help you to feel more relaxed during the exam?

- Type: Matrix
- Scale: 1 (No effect), 5 (I will be more relaxed for the exam)
- Scenarios: Through the app the doctor already has your personal information so the questions are just to validate the information, Through the app you can know the types of questions that doctors ask and understand why they are important for the exam, Through the app you have already seen the device and know how it works, Through the app you have already seen the device and know how it works, Through the app you share and read other user experiences, Through the app you already contacted your doctor, Through the app you already know how works the exam

19. Do you have any other comments related to the app?

- Type: Open question

Equipment:

- **General:** iPad for recording audio
- **Block 1**: Render of the current device to show the mechanism
- **Block 2**: An empty journey map, designed based on the literature review, will be used. Premo Emotions will be used for collecting emotional responses

Informed consent form & checklist

Participant ID:_____

Informed consent to participate in a research study

You are being invited to participate in a research study titled "**Patient Concept Evaluation Interview"**. This study is being done by Ariadna Izcara Gual from the TU Delft.

The purpose of this research study is to evaluate the redesign of the vaginal speculum. The session will last 1 hour.
To the best of our ability, your answers in this study will remain confidential. Upon signing this consent, you will be assigned a unique participant ID number to ensure that all collected data is anonymized. We will further minimize any risks of personal data breach by storing your personally identifiable information in a password-secured electronic format at a secure TU Delft repository. All personal and raw data will be destroyed after the study is completed, and no raw data will be shared with anybody outside the research team at any time.

Your participation in this study is entirely voluntary, and you can withdraw at any time without having to give a reason and without adverse consequences. You are free to omit any questions, and your data can be removed by September 30 once the project is concluded.

If you have questions about the study or the procedures, please feel free to contact the corresponding researcher Ariadna Izcara Gual (A.IzcaraGual@student.tudelft.nl) or the responsible researcher Tamara Hoveling (T.Hoveling@tudelft.nl) at any time.

PLEASE TICK THE APPROPRIATE BOXES	Yes	No
A: GENERAL AGREEMENT – RESEARCH GOALS, PARTICIPANT TASKS AND VOLUNTARY PARTICIPATION		
1. I have read and understood the study information dated [/ /2024], or it has been read to me. I have been able to ask questions about the study and my questions have been answered to my satisfaction.	☐	☐
2. I consent voluntarily to be a participant in this study and understand that I can refuse to answer questions and I can withdraw from the study at any time, without having to give a reason.	☐	☐
3. I understand that taking part in the study involves in-person/online interviews which will be audio-recorded. The recordings will be transcribed and destroyed immediately after the interview to minimise personal data collection.	☐	☐
4. I understand that I will <u>not</u> be compensated for my participation	☐	☐
5. I understand that the study will end on the 30th of September	☐	☐
B: POTENTIAL RISKS OF PARTICIPATING (INCLUDING DATA PROTECTION)		
6. I understand that taking part in the study involves the risk of psychological discomfort due to potentially traumatic memories of my journey as a patient. I understand that this risk will be mitigated in the following ways: · I will be free to omit any questions; · I will be able to withdraw from the interview at any point without having to give a reason and without adverse consequences.	☐	☐
7. I understand that taking part in the study also involves collecting specific personally identifiable information (PII) [name, e-mail address] and associated personally identifiable research data (PIRD) [age, gender, audio recordings of the interview] with the potential risk of my identity being revealed	☐	☐

8. I understand that some of this PIRD is considered as sensitive data within GDPR legislation, specifically health-related data	☐	☐
9. I understand that the following steps will be taken to minimize the threat of a data breach, and protect my identity in the event of such a breach: · Upon signing this consent, I will be assigned a unique participant ID number, under which all information I provide during the study will be stored; · My personally identifiable information will be stored in a password-secured electronic format at a secure TU Delft repository; · Audio recordings of the interview will be transcribed and destroyed immediately after the interview	☐	☐
10. I understand that personal information collected about me that can identify me, such as name and e-mail address, will not be shared beyond the study team.	☐	☐
11. I understand that the (identifiable) personal data I provide will be destroyed after the study is complete (30th of September)	☐	☐
C: RESEARCH PUBLICATION, DISSEMINATION AND APPLICATION		
12. I understand that after the research study, the de-identified information I provide will be used to construct a patient journey map to obtain design insights for a Master's thesis at TU Delft.	☐	☐
13. I agree that my responses, views or other input can be quoted anonymously in research outputs	☐	☐
D: (LONGTERM) DATA STORAGE, ACCESS AND REUSE		
14. I give permission for the de-identified health-related data that I provide to be archived in a secure TU Delft repository, so it can be used for future research and learning.	☐	☐
15. I understand that access to this repository is restricted only to the corresponding researchers.	☐	☐

Signatures

_____	_____	_____
Name of participant [printed]	Signature	Date

I, as a researcher, have accurately read out the information sheet to the potential participant and, to the best of my ability, ensured that the participant understands to what they are freely consenting.

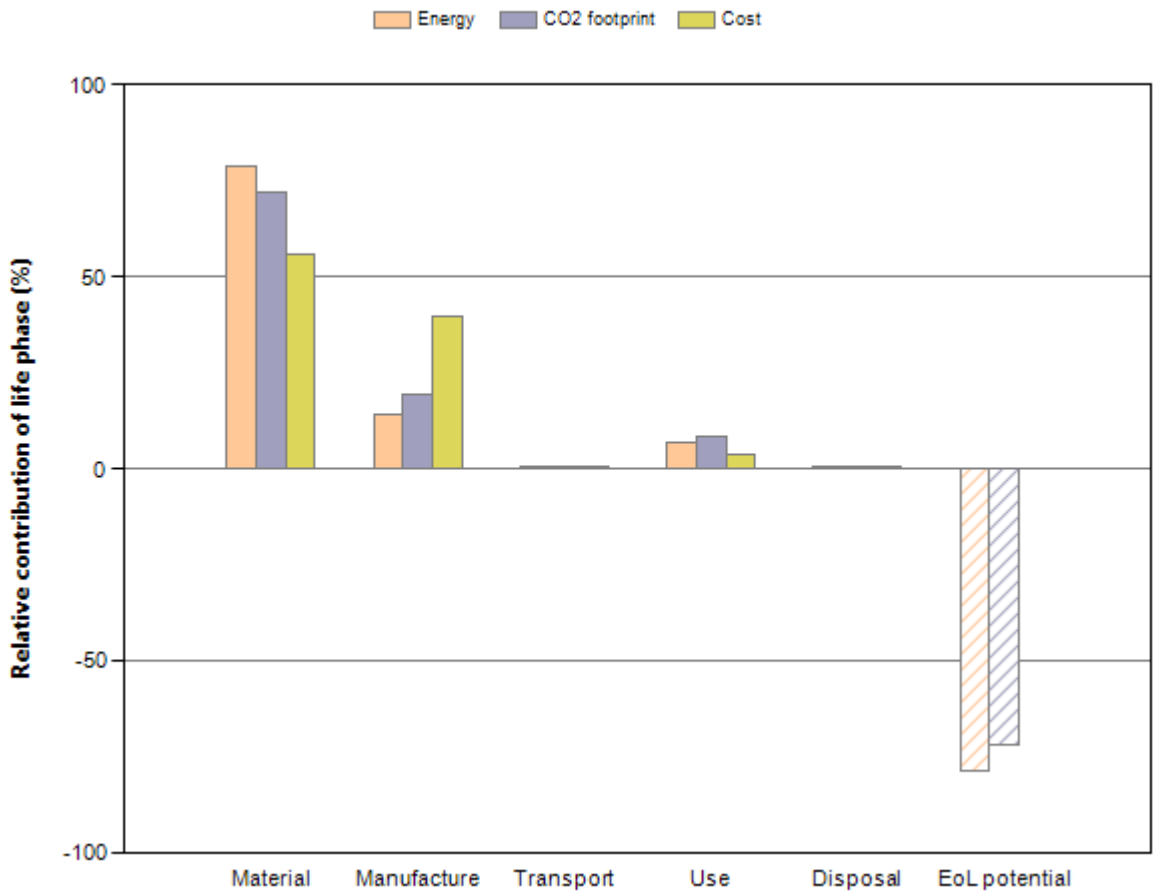
_____	_____	_____
Researcher name [printed]	Signature	Date

Study contact details for further information: Corresponding researcher Ariadna Izcara Gual (A.IzcaraGual@student.tudelft.nl) or the responsible researcher Tamara Hoveling (T.Hoveling@tudelft.nl)

Appendix F- Ecoaudit

Product name	Lilium
Country of manufacture	Europe
Country of use	Netherlands
Product life (years)	0,5

Summary:



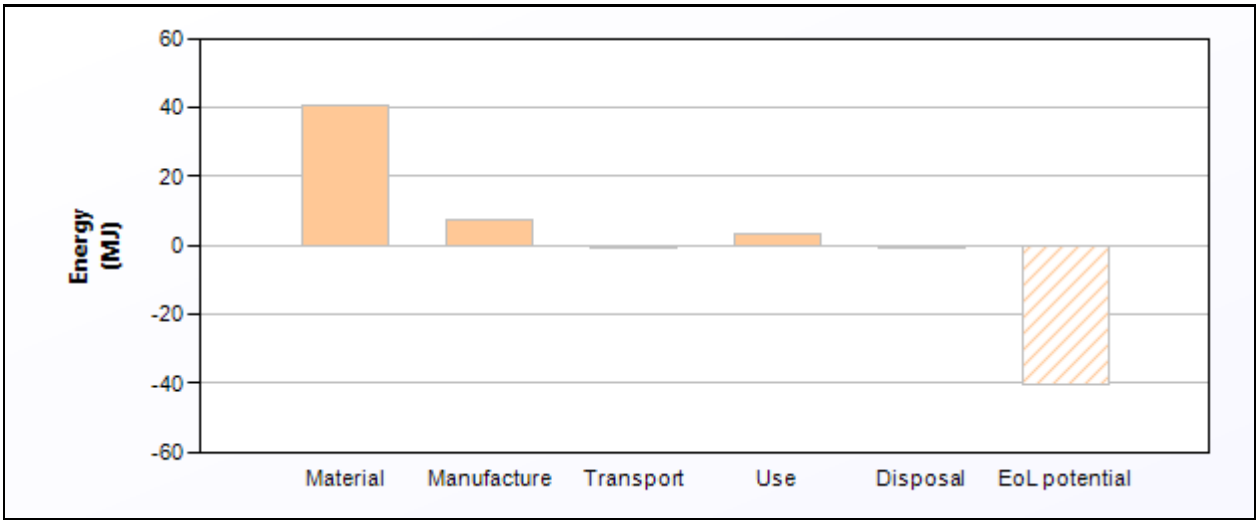
Energy details CO2 footprint details Cost details

Phase	Energy (MJ)	Energy (%)	CO2 footprint (kg)	CO2 footprint (%)	Cost (EUR)	Cost (%)
Material	40,5	78,7	2,01	72,0	1,09	55,8
Manufacture	7,23	14,0	0,542	19,4	0,774	39,6
Transport	0,1	0,2	0,00721	0,3	0,0156	0,798
Use	3,56	6,9	0,229	8,2	0,0719	3,68
Disposal	0,0667	0,1	0,00467	0,2	0,00183	0,0935
Total (for first life)	**51,5**	**100**	**2,79**	**100**	**1,95**	**100**
End of life potential	-40,5		-2,01			

Eco Audit Report

Energy Analysis

Summary



	Energy (MJ/year)
Equivalent annual environmental burden (averaged over 0,5 year product life):	103

Detailed breakdown of individual life phases

Material:

Summary

Component	Material	Recycled content* (%)	Part mass (kg)	Qty.	Total mass processed** (kg)	Energy (MJ)	%
Flower	TPV (PP+EP(D)M, Shore A90/D40)	Virgin (0%)	0,2	1	0,2	25	61,0
Inner	TPV (PP+EP(D)M, Shore D50)	Virgin (0%)	0,13	1	0,13	16	39,0
Total				**2**	**0,33**	**41**	**100**

*Typical: Includes 'recycle fraction in current supply'

**Where applicable, includes material mass removed by secondary processes

Manufacture:

Summary

Component	Process	% Removed	Amount processed	Energy (MJ)	%
Flower	Polymer molding	-	0,2 kg	4,4	61,0
Inner	Polymer molding	-	0,13 kg	2,8	39,0
Total				**7,2**	**100**

Transport:

Summary

Breakdown by transport stage

Stage name	Transport type	Distance (km)	Energy (MJ)	%
	14 tonne (2 axle) truck	2e+02	0,1	100,0
Total		**2e+02**	**0,1**	**100**

Breakdown by components

Component	Mass (kg)	Energy (MJ)	%
Flower	0,2	0,061	61,0
Inner	0,13	0,039	39,0
Total	**0,33**	**0,1**	**100**

Use:

Summary

Static mode

Energy input and output type	Electric to em radiation (incandescent lamp)
Country of use	Netherlands
Power rating (kW)	0,008
Usage (hours per day)	0,2
Usage (days per year)	1e+02
Product life (years)	0,5

Relative contribution of static and mobile modes

Mode	Energy (MJ)	%
Static	3,6	100,0
Mobile	0	
Total	**3,6**	**100**

Disposal:

Summary

Component	End of life option	% recovered	Energy (MJ)	%
Flower	Reuse	100,0	0,041	61,0
Inner	Reuse	100,0	0,026	39,0
Total			**0,067**	**100**

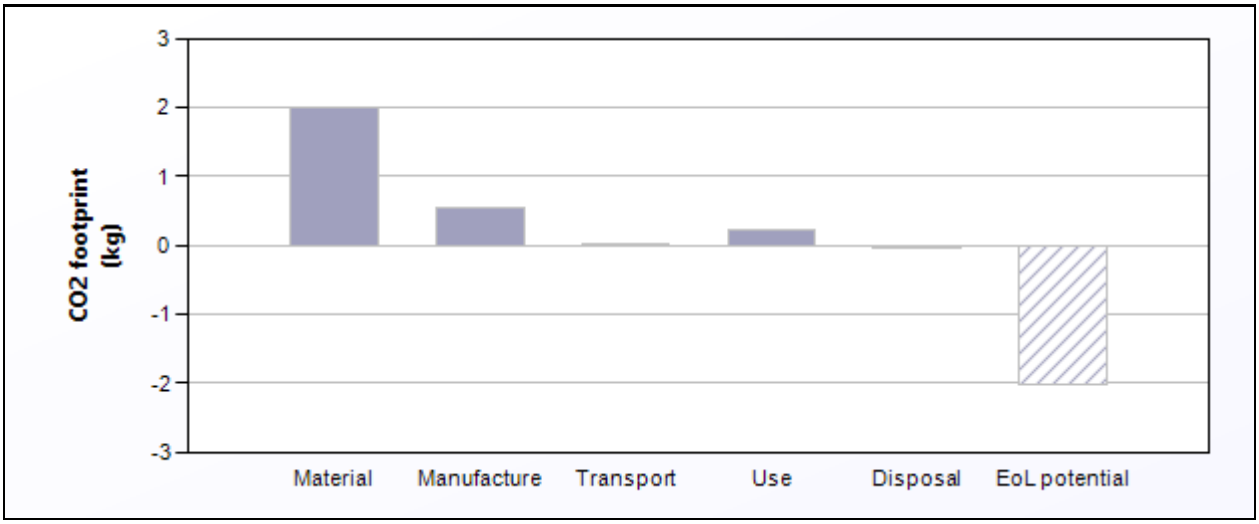
EoL potential:

Component	End of life option	% recovered	Energy (MJ)	%
Flower	Reuse	100,0	-25	61,0
Inner	Reuse	100,0	-16	39,0
Total			**-41**	**100**

Eco Audit Report

CO2 Footprint Analysis

Summary



	CO2 (kg/year)
Equivalent annual environmental burden (averaged over 0,5 year product life):	5,59

Detailed breakdown of individual life phases

Material:

Summary

Component	Material	Recycled content* (%)	Part mass (kg)	Qty.	Total mass processed** (kg)	CO2 footprint (kg)	%
Flower	TPV (PP+EP(D)M, Shore A90/D40)	Virgin (0%)	0,2	1	0,2	1,2	61,0
Inner	TPV (PP+EP(D)M, Shore D50)	Virgin (0%)	0,13	1	0,13	0,78	39,0
Total				**2**	**0,33**	**2**	**100**

*Typical: Includes 'recycle fraction in current supply'

**Where applicable, includes material mass removed by secondary processes

Manufacture:

Summary

Component	Process	% Removed	Amount processed	CO2 footprint (kg)	%
Flower	Polymer molding	-	0,2 kg	0,33	61,0
Inner	Polymer molding	-	0,13 kg	0,21	39,0
Total				**0,54**	**100**

Transport:

Summary

Breakdown by transport stage

Stage name	Transport type	Distance (km)	CO2 footprint (kg)	%
	14 tonne (2 axle) truck	2e+02	0,0072	100,0
Total		**2e+02**	**0,0072**	**100**

Breakdown by components

Component	Mass (kg)	CO2 footprint (kg)	%
Flower	0,2	0,0044	61,0
Inner	0,13	0,0028	39,0
Total	**0,33**	**0,0072**	**100**

Use:

Summary

Static mode

Energy input and output type	Electric to em radiation (incandescent lamp)
Country of use	Netherlands
Power rating (kW)	0,008
Usage (hours per day)	0,2
Usage (days per year)	1e+02
Product life (years)	0,5

Relative contribution of static and mobile modes

Mode	CO2 footprint (kg)	%
Static	0,23	100,0
Mobile	0	
Total	**0,23**	**100**

Disposal:

Summary

Component	End of life option	% recovered	CO2 footprint (kg)	%
Flower	Reuse	100,0	0,0029	61,0
Inner	Reuse	100,0	0,0018	39,0
Total			**0,0047**	**100**

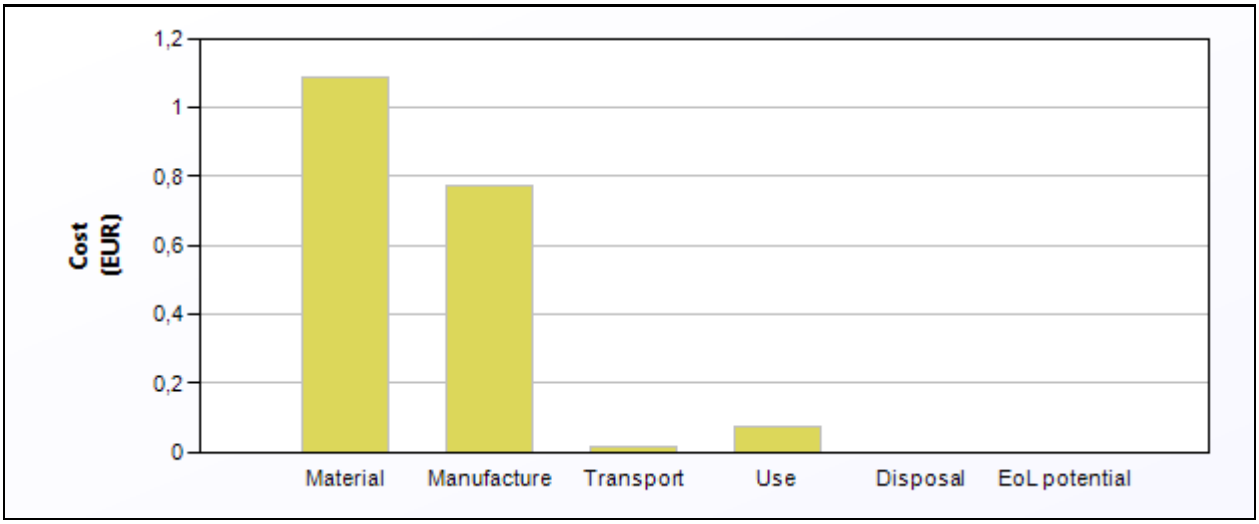
EoL potential:

Component	End of life option	% recovered	CO2 footprint (kg)	%
Flower	Reuse	100,0	-1,2	61,0
Inner	Reuse	100,0	-0,78	39,0
Total			**-2**	**100**

Eco Audit Report

Cost Analysis

Summary



	Cost (EUR/year)
Equivalent annual environmental burden (averaged over 0,5 year product life):	3,91

Detailed breakdown of individual life phases

Material:

Summary

Component	Material	Recycled content* (%)	Part mass (kg)	Qty.	Total mass processed** (kg)	Cost (EUR)	%
Flower	TPV (PP+EP(D)M, Shore A90/D40)	Virgin (0%)	0,2	1	0,2	0,67	61,0
Inner	TPV (PP+EP(D)M, Shore D50)	Virgin (0%)	0,13	1	0,13	0,42	39,0
Total				**2**	**0,33**	**1,1**	**100**

*Typical: Includes 'recycle fraction in current supply'

**Where applicable, includes material mass removed by secondary processes

Manufacture:

Summary

Country of manufacture Europe

Component	Process	Length (m)	% Removed	Amount processed		Cost (EUR)	%
Flower	Polymer molding	-	-	0,2	kg	0,42	53,6
Inner	Polymer molding	-	-	0,13	kg	0,36	46,4
Total						**0,77**	**100**

Transport:

Summary

Package dimensions

Height (m)	Width (m)	Depth (m)
0,1	0,1	0,1

Breakdown by transport stage

Stage name	Transport type	Distance (km)	Cost (EUR)	%
	14 tonne (2 axle) truck	2e+02	0,016	100,0
Total		**2e+02**	**0,016**	**100**

Breakdown by components

Component	Mass (kg)	Cost (EUR)	%
Flower	0,2	0,0095	61,0
Inner	0,13	0,0061	39,0
Total	**0,33**	**0,016**	**100**

Use:

Summary

Static mode

Energy input and output type	Electric to em radiation (incandescent lamp)
Country of use	Netherlands
Fuel rate	Commercial
Power rating (kW)	0,008
Usage (hours per day)	0,2
Usage (days per year)	1e+02
Product life (years)	0,5

Relative contribution of static and mobile modes

Mode	Cost (EUR)	%
Static	0,072	100,0
Mobile	0	
Total	**0,072**	**100**

Disposal:

Summary

Component	End of life option	% recovered	Cost (EUR)	%
Flower	Reuse	100,0	0,0011	61,0
Inner	Reuse	100,0	0,00071	39,0
Total			**0,0018**	**100**

Notes:

Summary

Appendix G

TPV (PP+EP(D)M, Shore A90/D40)

General information

Designation

TPV (PP+EP(D)M, Shore A90/D40), Thermoplastic Vulcanizate

Tradenames

Actymer, Alfater, Dryflex, Elastron, Enflex, Epigum, Excelink, Ezprene, Flexiteq, Forprene, Gelast, Geolast, Innoprene, Invision, Kebaflex, Keyflex, K-Prene, Michiflex, Milastomer, Neoplast, Novalast, Onflex-V, Primoprene, Salflex, Santoprene, Sarlink, Solplast, Taroprene, Tectron, Tivilon, Tpsiv, Trexprene, Uniprene, Viprene, Vyram, Zeotherm

Typical uses

Automotive applications, construction applications, consumer applications, general purpose, industrial applications, appliance components, automotive under the hood, blow molding applications, cable jacketing, diaphrams, gaskets, pump parts, seals, tubing, valves/valve parts, appliances, business equipment, electrical/electronic applications, fluid handling, medical applications, tools, power/others, hose, garden, weatherstripping, expansion joint, lawn and garden equipment, marine applications, outdoor applications, profiles, irrigation applications, plumbing parts, closures, containers, food, cookware, microwave, food applications, non-specific, food service applications, kitchenware, hospital goods, hypodermic syringe parts, medical appliances, prosthetics, connectors, coverings, protective, glazing, housing, electrical, wheels

Biomaterials - All	True
Biomedical materials	True

Composition overview

Compositional summary

Blend of PP (~40%) and vulcanized EPDM rubber (~60%). EPDM particles encased in a continuous matrix of PP.

Material family	Elastomer (thermoplastic, TPE)
Base material	TPV (Thermoplastic vulcanizate)
Polymer code	TPV

Composition detail (polymers and natural materials)

Polymer	100			%

Price

Price	* 2,86	-	3,03	EUR/kg
Price per unit volume	* 2,67e3	-	2,9e3	EUR/m^3

Physical properties

Density	935	-	956	kg/m^3

Mechanical properties

Young's modulus	0,123	-	0,127	GPa
Specific stiffness	0,13	-	0,134	MN.m/kg
Yield strength (elastic limit)	7,32	-	7,69	MPa
Tensile strength	16,4	-	21,1	MPa
Tensile stress at 100% strain	8,44	-	9,17	MPa
Tensile stress at 300% strain	8,77	-	9,22	MPa
Specific strength	7,72	-	8,15	kN.m/kg
Elongation	547	-	619	% strain

Elongation at yield		28,9	-	31,1	% strain
Compressive modulus	*	0,119	-	0,131	GPa
Compressive strength	*	8,57	-	9,46	MPa
Flexural modulus		0,137	-	0,144	GPa
Flexural strength (modulus of rupture)	*	30,1	-	37	MPa
Shear modulus	*	0,0413	-	0,0434	GPa
Shear strength	*	13,2	-	21,1	MPa
Bulk modulus	*	0,631	-	1,56	GPa
Poisson's ratio	*	0,467	-	0,486	
Shape factor		2			
Hardness - Vickers		2			HV
Hardness - Rockwell M	*	13	-	25	
Hardness - Rockwell R	*	13	-	25	
Hardness - Shore D		35	-	45	
Hardness - Shore A		88	-	93	
Elastic stored energy (springs)		214	-	237	kJ/m^3
Fatigue strength at 10^7 cycles	*	6,58	-	8,46	MPa
Compression set at 23°C		38	-	40	%
Compression set at 70°C		55,4	-	59,7	%
Compression set at 100°C		61,8	-	66	%
Tear strength		63,1	-	78,8	N/mm

Impact & fracture properties

Fracture toughness		1,74	-	1,97	MPa.m^0.5
Toughness (G)		24,2	-	31	kJ/m^2
Impact strength, notched 23 °C	*	590	-	600	kJ/m^2
Impact strength, notched -30 °C	*	590	-	600	kJ/m^2
Impact strength, unnotched 23 °C	*	590	-	600	kJ/m^2
Impact strength, unnotched -30 °C		590	-	600	kJ/m^2

Thermal properties

Melting point	*	152	-	170	°C
Glass temperature	*	-104	-	-95	°C
Heat deflection temperature 0.45MPa		54	-	59	°C
Maximum service temperature		130	-	140	°C
Minimum service temperature		-61	-	-51	°C
Thermal conductivity	*	0,267	-	0,289	W/m.°C
Specific heat capacity	*	1,81e3	-	1,89e3	J/kg.°C
Thermal expansion coefficient	*	205	-	215	µstrain/°C
Thermal shock resistance	*	275	-	296	°C
Thermal distortion resistance	*	0,00126	-	0,00138	MW/m

Electrical properties

Electrical resistivity	*	4,3e23	-	6,6e24	µohm.cm
Electrical conductivity	*	2,61e-23	-	4,01e-22	%IACS
Dielectric constant (relative permittivity)		2,25	-	2,35	
Dissipation factor (dielectric loss tangent)	*	2,6e-4	-	4,4e-4	
Dielectric strength (dielectric breakdown)		19,5	-	20,3	MV/m
Comparative tracking index		600			V

Magnetic properties

Magnetic type	Non-magnetic

Optical, aesthetic and acoustic properties

Transparency	Opaque			
Acoustic velocity	361	-	367	m/s
Mechanical loss coefficient (tan delta)	0,07	-	0,09	

Healthcare & food

Food contact	Yes
Medical grades? (USP Class VI, ISO 10993)	True

Medical tradenames

Santoprene, Uniprene

Sterilizability (ethylene oxide)	Good
Sterilizability (radiation)	Marginal
Sterilizability (steam autoclave)	Good
Guidance for MRI Safety	No Interaction - MR Safe

Restricted substances risk indicators

RoHS 2 (EU) compliant grades?	True
SIN List indicator (0-1, 1 = high risk)	0,02

Notes

May contain restricted (wt%): UV-stabilizer up to 2%

Critical materials risk

Contains >5wt% critical elements?	No

Absorption & permeability

Water absorption @ 24 hrs	*	0,0127	-	0,0154	%
Water absorption @ sat	*	0,0779	-	0,0947	%
Humidity absorption @ sat	*	0,0234	-	0,0285	%
Water vapor transmission	*	0,121	-	0,162	g.mm/m².day
Permeability (O2)	*	346	-	462	cm³.mm/m².day.atm

Processing properties

Polymer injection molding	Acceptable			
Polymer extrusion	Excellent			
Polymer thermoforming	Acceptable			
Linear mold shrinkage	1,76	-	1,85	%
Melt temperature	199	-	220	°C
Mold temperature	9	-	61	°C
Molding pressure range	80,5	-	128	MPa

Durability

Water (fresh)	Excellent
Water (salt)	Excellent
Weak acids	Excellent
Strong acids	Excellent
Weak alkalis	Excellent
Strong alkalis	Excellent
Organic solvents	Limited use
Oils and fuels	Limited use
Oxidation at 500C	Unacceptable
UV radiation (sunlight)	Poor
Flammability	Highly flammable

Oxygen index	*	17	-	20	%

Primary production energy, CO2 and water

Embodied energy, primary production (virgin grade)	* 116	-	127	MJ/kg
Embodied energy, primary production (typical grade)	* 116	-	127	MJ/kg
CO2 footprint, primary production (virgin grade)	* 5,74	-	6,33	kg/kg
CO2 footprint, primary production (typical grade)	* 5,74	-	6,33	kg/kg
Water usage	* 267	-	295	l/kg

Processing energy, CO2 footprint & water

Polymer extrusion energy	* 5,89	-	6,51	MJ/kg
Polymer extrusion CO2	* 0,442	-	0,488	kg/kg
Polymer extrusion water	* 4,86	-	7,28	l/kg
Polymer molding energy	* 20,6	-	22,8	MJ/kg
Polymer molding CO2	* 1,54	-	1,71	kg/kg
Polymer molding water	* 13,4	-	20,1	l/kg
Grinding energy (per unit wt removed)	* 2,28	-	2,52	MJ/kg
Grinding CO2 (per unit wt removed)	* 0,171	-	0,189	kg/kg

Recycling and end of life

Recycle	True			
Embodied energy, recycling	39,2	-	43,3	MJ/kg
CO2 footprint, recycling	2	-	2,15	kg/kg
Recycle fraction in current supply	0,1			%
Downcycle	True			
Combust for energy recovery	True			
Heat of combustion (net)	* 44	-	46,2	MJ/kg
Combustion CO2	* 3,06	-	3,22	kg/kg
Landfill	True			
Biodegrade	False			

Links

ProcessUniverse
Producers
Reference
Shape
Values marked * are estimates.

TPV (PP+EP(D)M, Shore D50)

General information

Designation

TPV (PP+EP(D)M, Shore D50), Thermoplastic Vulcanizate

Tradenames

Actymer, Alfater, Dryflex, Elastron, Enflex, Epigum, Excelink, Ezprene, Flexiteq, Forprene, Gelast, Geolast, Innoprene, Invision, Kebaflex, Keyflex, K-Prene, Michiflex, Milastomer, Neoplast, Novalast, Onflex-V, Primoprene, Salflex, Santoprene, Sarlink, Solplast, Taroprene, Tectron, Tivilon, Tpsiv, Trexprene, Uniprene, Viprene, Vyram, Zeotherm

Typical uses

Appliances, automotive applications, cable jacketing, connectors, construction applications, gaskets, glazing, housing, electrical, seals, tubing, weatherstripping, wheels, coverings, protective, closures, containers, food, cookware, microwave, food applications, non-specific, food service applications, kitchenware, diaphrams, fluid handling, irrigation applications, plumbing parts, appliance components, automotive under the hood, blow molding applications, general purpose, industrial applications, expansion joint, lawn and garden equipment, marine applications, outdoor applications, profiles, consumer applications, business equipment, electrical/electronic applications, medical applications, tools, power/others, pump parts, valves/valve parts, hose, garden, automotive bumper, automotive exterior parts, automotive exterior trim, automotive interior parts, belts/belt repair, household goods, insulation, electronic, panels, reinforced, piping, sporting goods, toys

Biomaterials - All	True
Biomedical materials	True

Composition overview

Compositional summary

Blend of PP (~40%) and vulcanized EPDM rubber (~60%). EPDM particles encased in a continuous matrix of PP.

Material family	Elastomer (thermoplastic, TPE)
Base material	TPV (Thermoplastic vulcanizate)
Polymer code	TPV

Composition detail (polymers and natural materials)

Polymer	100			%

Price

Price	*	2,86	-	3,03	EUR/kg
Price per unit volume	*	2,67e3	-	2,88e3	EUR/m^3

Physical properties

Density	936	-	952	kg/m^3

Mechanical properties

Young's modulus	0,232	-	0,238	GPa
Specific stiffness	0,245	-	0,253	MN.m/kg
Yield strength (elastic limit)	11,7	-	12,3	MPa
Tensile strength	18,5	-	20,8	MPa
Tensile stress at 100% strain	9,19	-	10	MPa
Tensile stress at 300% strain	9,96	-	11,2	MPa
Specific strength	12,4	-	13,1	kN.m/kg
Elongation	613	-	660	% strain

Elongation at yield		30,1	-	32,4	% strain
Compressive modulus	*	0,224	-	0,247	GPa
Compressive strength	*	13,7	-	15,1	MPa
Flexural modulus		0,339	-	0,356	GPa
Flexural strength (modulus of rupture)	*	33,1	-	36,6	MPa
Shear modulus	*	0,0786	-	0,0826	GPa
Shear strength	*	14,8	-	20,8	MPa
Bulk modulus	*	0,773	-	1,25	GPa
Poisson's ratio	*	0,45	-	0,468	
Shape factor		2			
Hardness - Vickers	*	3	-	4	HV
Hardness - Rockwell M	*	27	-	33	
Hardness - Rockwell R	*	27	-	42	
Hardness - Shore D		46	-	55	
Hardness - Shore A	*	92	-	98	
Elastic stored energy (springs)		291	-	322	kJ/m^3
Fatigue strength at 10^7 cycles	*	7,39	-	8,34	MPa
Compression set at 23°C		40	-	42	%
Compression set at 70°C		61	-	64,1	%
Compression set at 100°C		79	-	83	%
Tear strength		87,1	-	91,5	N/mm

Impact & fracture properties

Fracture toughness	*	2,25	-	2,26	MPa.m^0.5
Toughness (G)		21,4	-	21,9	kJ/m^2
Impact strength, notched 23 °C	*	590	-	600	kJ/m^2
Impact strength, notched -30 °C	*	590	-	600	kJ/m^2
Impact strength, unnotched 23 °C	*	590	-	600	kJ/m^2
Impact strength, unnotched -30 °C		590	-	600	kJ/m^2

Thermal properties

Melting point	*	153	-	169	°C
Glass temperature	*	-69	-	-54	°C
Heat deflection temperature 0.45MPa		54	-	59	°C
Maximum service temperature		130	-	140	°C
Minimum service temperature		-40	-	-30	°C
Thermal conductivity	*	0,416	-	0,45	W/m.°C
Specific heat capacity	*	1,82e3	-	1,89e3	J/kg.°C
Thermal expansion coefficient	*	183	-	193	µstrain/°C
Thermal shock resistance	*	262	-	282	°C
Thermal distortion resistance	*	0,0022	-	0,00241	MW/m

Electrical properties

Electrical resistivity	*	4,3e23	-	6,6e24	µohm.cm
Electrical conductivity	*	2,61e-23	-	4,01e-22	%IACS
Dielectric constant (relative permittivity)		2,25	-	2,35	
Dissipation factor (dielectric loss tangent)	*	2,6e-4	-	4,4e-4	
Dielectric strength (dielectric breakdown)		19,5	-	20,3	MV/m
Comparative tracking index		600			V

Magnetic properties

Magnetic type	Non-magnetic

Optical, aesthetic and acoustic properties

Transparency	Opaque			
Acoustic velocity	495	-	503	m/s
Mechanical loss coefficient (tan delta)	0,05	-	0,07	

Healthcare & food

Food contact	Yes
Medical grades? (USP Class VI, ISO 10993)	True

Medical tradenames

Santoprene, Uniprene

Sterilizability (ethylene oxide)	Good
Sterilizability (radiation)	Marginal
Sterilizability (steam autoclave)	Good
Guidance for MRI Safety	No Interaction - MR Safe

Restricted substances risk indicators

RoHS 2 (EU) compliant grades?	True
SIN List indicator (0-1, 1 = high risk)	0,02

Notes

May contain restricted (wt%): UV-stabilizer up to 2%

Critical materials risk

Contains >5wt% critical elements?	No

Absorption & permeability

Water absorption @ 24 hrs	*	0,0204	-	0,0248	%
Water absorption @ sat	*	0,125	-	0,152	%
Humidity absorption @ sat	*	0,0376	-	0,0457	%
Water vapor transmission		0,209	-	0,242	g.mm/m².day
Permeability (O2)		260	-	300	cm³.mm/m².day.atm

Processing properties

Polymer injection molding	Acceptable			
Polymer extrusion	Excellent			
Polymer thermoforming	Acceptable			
Linear mold shrinkage	1,76	-	1,85	%
Melt temperature	201	-	218	°C
Mold temperature	5	-	44	°C
Molding pressure range	80,5	-	128	MPa

Durability

Water (fresh)	Excellent				
Water (salt)	Excellent				
Weak acids	Excellent				
Strong acids	Excellent				
Weak alkalis	Excellent				
Strong alkalis	Excellent				
Organic solvents	Limited use				
Oils and fuels	Limited use				
Oxidation at 500C	Unacceptable				
UV radiation (sunlight)	Poor				
Flammability	Highly flammable				
Oxygen index	*	17	-	20	%

Primary production energy, CO2 and water

Embodied energy, primary production (virgin grade)	*	116	-	127	MJ/kg
Embodied energy, primary production (typical grade)	*	116	-	127	MJ/kg

CO2 footprint, primary production (virgin grade)	*	5,74	-	6,33	kg/kg
CO2 footprint, primary production (typical grade)	*	5,74	-	6,33	kg/kg
Water usage	*	267	-	295	l/kg

Processing energy, CO2 footprint & water

Polymer extrusion energy	*	5,89	-	6,51	MJ/kg
Polymer extrusion CO2	*	0,442	-	0,488	kg/kg
Polymer extrusion water	*	4,86	-	7,28	l/kg
Polymer molding energy	*	20,6	-	22,8	MJ/kg
Polymer molding CO2	*	1,55	-	1,71	kg/kg
Polymer molding water	*	13,4	-	20,1	l/kg
Grinding energy (per unit wt removed)	*	3,37	-	3,72	MJ/kg
Grinding CO2 (per unit wt removed)	*	0,253	-	0,279	kg/kg

Recycling and end of life

Recycle		True			
Embodied energy, recycling		39,2	-	43,3	MJ/kg
CO2 footprint, recycling		2	-	2,15	kg/kg
Recycle fraction in current supply		0,1			%
Downcycle		True			
Combust for energy recovery		True			
Heat of combustion (net)	*	44	-	46,2	MJ/kg
Combustion CO2	*	3,06	-	3,22	kg/kg
Landfill		True			
Biodegrade		False			

	TPV (PP+EP(D)M, Shore A90/D40)	TPV (PP+EP(D)M, Shore D50)
General information		
Biomedical materials	✓	✓
Price		
Price (EUR/kg)	2,94	2,94
Mechanical properties		
Young's modulus (GPa)	0,125	0,235
Yield strength (elastic limit) (MPa)	7,5	12
Hardness - Vickers (HV)	2	3,46
Thermal properties		
Maximum service temperature (°C)	135	135
Healthcare & food		
Medical grades? (USP Class VI, ISO 10993)	✓	✓
Sterilizability (steam autoclave)	Good	Good
Processing properties		
Polymer injection molding	Acceptable	Acceptable
Durability		
Water (fresh)	Excellent	Excellent
Weak acids	Excellent	Excellent
Primary production energy, CO2 and water		
Embodied energy, primary production (virgin grade) (MJ/kg)	121	121
CO2 footprint, primary production (virgin grade) (kg/kg)	6,03	6,03
CO2 footprint, primary production (typical grade) (kg/kg)	6,02	6,02
Processing energy, CO2 footprint & water		
Polymer extrusion energy (MJ/kg)	6,19	6,19
Polymer extrusion CO2 (kg/kg)	0,464	0,465
Polymer extrusion water (l/kg)	5,95	5,95
Polymer molding energy (MJ/kg)	21,6	21,7
Polymer molding CO2 (kg/kg)	1,62	1,63
Recycling and end of life		
Recycle	✓	✓
CO2 footprint, recycling (kg/kg)	2,07	2,07
Downcycle	✓	✓
Combust for energy recovery	✓	✓
Combustion CO2 (kg/kg)	3,14	3,14
Landfill	✓	✓
Biodegrade	✗	✗
Links		

	TPV D40	PLA	PETG	TPU A85
Mechanical properties				
Young's modulus (GPa)	0,125	3,45	2,06	0,0233
Specific stiffness (MN.m/kg)	0,132	2,75	1,62	0,0199
Yield strength (elastic limit) (MPa)	7,5	52,4	50,3	33,3
Tensile strength (MPa)	18,6	62,9	62,9	33,3
Tensile stress at 100% strain (MPa)	8,8			5,94
Tensile stress at 300% strain (MPa)	8,99			10,7
Specific strength (kN.m/kg)	7,93	50,1	39,6	28,5
Elongation (% strain)	581	3,87	110	561
Elongation at yield (% strain)	30	2,65		561
Compressive modulus (GPa)	0,125	3,45	2,06	0,0233
Compressive strength (MPa)	9	75,5	60,4	39,9
Flexural modulus (GPa)	0,14	3,34	2,06	0,0454
Flexural strength (modulus of MPa)	33,4	94,7	70,3	55,1
Shear modulus (GPa)	0,0423	1,24	0,734	0,00783
Shear strength (MPa)	16,7			29,8
Bulk modulus (GPa)	0,992	5,99	3,53	0,388
Poisson's ratio	0,477	0,39	0,403	0,487
Shape factor	2	5,6	4,8	1,6
Hardness - Vickers (HV)	2	19,3	15	9,95
Hardness - Rockwell M	18	52	68,9	29,5
Hardness - Rockwell R	18	33,5	106	30,4
Hardness - Shore D	39,7	81		48,5
Hardness - Shore A	90,5			84,9
Elastic stored energy (springs)	225	575	615	23800
Fatigue strength at 10^7 cycles (MPa)	7,46	24,8	25	13,3

Compression set at 23°C (%)	39			27,2
Compression set at 70°C (%)	57,5			73,5
Compression set at 100°C (%)	63,8			
Tear strength (N/mm)	70,5			90,9

Table imported from Granta EduPack

Selection Report

Summary

Stage Details

1. Selection data

Database	Level 3 Bioengineering
Table	MaterialUniverse
Subset	Polymers - All
Reference	

2. Selection criteria (summary)

Stage	Attribute	Constraints
1	Young's modulus (GPa)	
	Yield strength (elastic limit) (MPa)	
2	Maximum service temperature (°C)	≥ 130
	Medical grades? (USP Class VI, ISO 10993)	✔
	Sterilizability (steam autoclave)	Good, Excellent
3	Price (EUR/kg)	≤ 10
	Hardness - Vickers (HV)	≤ 10
	Downcycle	✔
	Combust for energy recovery	✔
4	Biomedical materials	✔
	Water (fresh)	Acceptable, Excellent
	Weak acids	Unacceptable, Limited use, Acceptable, Excellent
5	Recycle	✔

3. Selection results

Records passing: All Stages 10 of 927
Ranked by: Alphabetically
Ranked order: Low to high

Rank	Material
1	FEP (unfilled)
2	TPC (Shore D40)
3	TPC (Shore D55)
4	TPC (Shore D70)
5	TPV (PP+EP(D)M, Shore A40)
6	TPV (PP+EP(D)M, Shore A55)
7	TPV (PP+EP(D)M, Shore A70)
8	TPV (PP+EP(D)M, Shore A85)
9	TPV (PP+EP(D)M, Shore A90/D40)

Selection Report

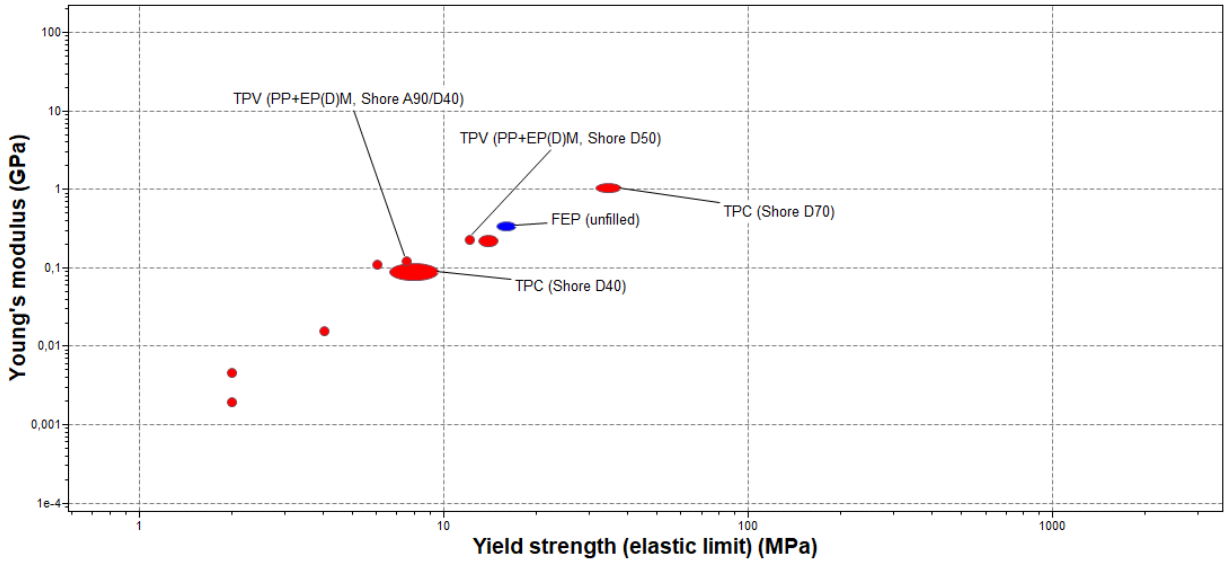
Rank	Material
10	TPV (PP+EP(D)M, Shore D50)

Change number of records to display...

Stage Details

Selection Report

Stage 1:	Yield strength (elastic limit) (MPa), Young's modulus (GPa)	Summary



Display & selection settings:
Show results from all enabled stages: On, Pass records with no data: Off, Fail estimated records: Off
Pass when: Any part of record within selection

Records passing: 923 of 927

Selection Report

Stage 2:	Limit	Summary

Constraints

Attribute	Constraints
Maximum service temperature (°C)	≥ 130
Medical grades? (USP Class VI, ISO 10993)	✔
Sterilizability (steam autoclave)	Good, Excellent

Display & Selection settings:

Pass when:	Any part of record within selection
Fail estimated records:	Off

Records passing: 59 of 927

Selection Report

Stage 3:	Limit	Summary

Constraints

Attribute	Constraints
Price (EUR/kg)	≤ 10
Hardness - Vickers (HV)	≤ 10
Downcycle	✔
Combust for energy recovery	✔

Display & Selection settings:

Pass when:	Any part of record within selection
Fail estimated records:	Off

Records passing: 278 of 927

Selection Report

Stage 4:	Limit	Summary

Constraints

Attribute	Constraints
Biomedical materials	✔
Water (fresh)	Acceptable, Excellent
Weak acids	Unacceptable, Limited use, Acceptable, Excellent

Display & Selection settings:

Pass when:	Any part of record within selection
Fail estimated records:	Off

Records passing: 189 of 927

Selection Report

Stage 5:	Limit	Summary

Constraints

Attribute	Constraints
Recycle	✔

Display & Selection settings:	
Pass when:	Any part of record within selection
Fail estimated records:	Off

Records passing: 346 of 927

4. Comparison table

	Silicone (VMQ, thermally conductive, 40-70% mineral)	TPC (Shore D40)	TPC (Shore D70)	TPV (PP+EP(D)M, Shore A90/D40)
General information				
Biomaterials - All	Yes	Yes	Yes	Yes
Biomedical materials	Yes	Yes	Yes	Yes
Included in Materials Data for Simulation	Yes	Yes	Yes	
Materials Data for Simulation name	Rubber, silicone (VMQ, thermally conductive)	Rubber, TPC (Shore D40)	Rubber, TPC (Shore D70)	
Composition overview				
Material family	Elastomer (thermoset, rubber)	Elastomer (thermoplastic, TPE)	Elastomer (thermoplastic, TPE)	Elastomer (thermoplastic, TPE)
Base material	SI-VMQ(rt) (Silicone rubber, vinyl methyl type, room temp. vulcanizing)	TPC (Thermoplastic copolyester-ether elastomer)	TPC (Thermoplastic copolyester-ether elastomer)	TPV (Thermoplastic vulcanizate)
% filler (by weight) (%)	40 - 70	0	0	0
Filler/reinforcement	Mineral	None (unfilled)	None (unfilled)	None (unfilled)
Filler/reinforcement form	Particulate	Not applicable (unfilled)	Not applicable (unfilled)	Not applicable (unfilled)
Polymer code	SI-VMQ-MD55	TPC	TPC	TPV
Composition detail (polymers and natural materials)				
Polymer (%)	30 - 60	100	100	100
Mineral (unspecified) (%)	40 - 70	0	0	0
Price				
Price (EUR/kg)	2,3 - 3,13	6,11 - 7,52	6,11 - 7,52	2,86 - 3,03
Price per unit volume (EUR/m^3)	4940 - 7190	6990 - 8860	7660 - 9720	2670 - 2900
Physical properties				
Density (kg/m^3)	2150 - 2300	1140 - 1180	1250 - 1290	935 - 956
Mechanical properties				
Young's modulus (GPa)	0,0075 - 0,018	0,0708 - 0,115	0,985 - 1,16	0,123 - 0,127
Specific stiffness (MN.m/kg)	0,00337 - 0,0081	0,061 - 0,0993	0,774 - 0,911	0,13 - 0,134
Yield strength (elastic limit) (MPa)	3,4 - 3,6	6,64 - 9,48	31,6 - 37,7	7,32 - 7,69
Tensile strength (MPa)	3,4 - 3,6	17,5 - 22,7	32,5 - 39,6	16,4 - 21,1
Tensile stress at 100% strain (MPa)		9,69 - 13,4	25 - 35	8,44 - 9,17
Tensile stress at 300% strain (MPa)		11,4 - 12,6		8,77 - 9,22
Specific strength (kN.m/kg)	1,51 - 1,64	5,72 - 8,17	24,8 - 29,7	7,72 - 8,15
Elongation (% strain)	80 - 90	226 - 324	248 - 303	547 - 619
Elongation at yield (% strain)	80 - 90	24,9 - 89,2	18,9 - 23,6	28,9 - 31,1

TPV (PP+EP(D)M, Shore D50)	FEP (unfilled)
Yes	Yes
Yes	Yes
	Yes
	Plastic, FEP
Elastomer (thermoplastic, TPE)	Plastic (thermoplastic, semi-crystalline)
TPV (Thermoplastic vulcanizate)	FEP (Fluorinated ethylene propylene)
0	0
None (unfilled)	None (unfilled)
Not applicable (unfilled)	Not applicable (unfilled)
TPV	FEP
100	100
0	0
2,86 - 3,03	8,25 - 9,12
2670 - 2880	17500 - 19800
936 - 952	2120 - 2170
0,232 - 0,238	0,336 - 0,353
0,245 - 0,253	0,156 - 0,165
11,7 - 12,3	14,9 - 17,1
18,5 - 20,8	18,6 - 21,4
9,19 - 10	
9,96 - 11,2	
12,4 - 13,1	6,93 - 7,99
613 - 660	250 - 330
30,1 - 32,4	

Compressive modulus (GPa)	0,0075 - 0,018	0,0488 - 0,0512	0,341 - 0,359	0,119 - 0,131
Compressive strength (MPa)	4,08 - 4,32	7,97 - 11,4	37,9 - 45,2	8,57 - 9,46
Compressive stress @ 25% strain (MPa)		12,4 - 26,5	12,4 - 26,5	
Flexural modulus (GPa)	0,0075 - 0,018	0,0663 - 0,0697	0,585 - 0,615	0,137 - 0,144
Flexural strength (modulus of rupture) (MPa)	10,7 - 11	2,29 - 3,14	15,6 - 16,4	30,1 - 37
Shear modulus (GPa)	0,0025 - 0,06	0,0237 - 0,0391	0,346 - 0,411	0,0413 - 0,0434
Shear strength (MPa)		14 - 22,7	26 - 39,6	13,2 - 21,1
Bulk modulus (GPa)	1,5 - 2	0,483 - 3,82	1,78 - 2,56	0,631 - 1,56
Poisson's ratio	0,47 - 0,49	0,476 - 0,495	0,408 - 0,425	0,467 - 0,486
Shape factor	1,7	2	2,1	2
Hardness - Vickers (HV)	2	2 - 3	9 - 11	2
Hardness - Rockwell M		13 - 24	41 - 56	13 - 25
Hardness - Rockwell R		13 - 24	66 - 92	13 - 25
Hardness - Shore D	17 - 25	35 - 44	65 - 74	35 - 45
Hardness - Shore A	70 - 85	84 - 90	98 - 100	88 - 93
Elastic stored energy (springs) (kJ/m^3)	339 - 818	236 - 515	463 - 670	214 - 237
Fatigue strength at 10^7 cycles (MPa)	1,36 - 1,44	6,99 - 9,06	13 - 15,9	6,58 - 8,46
Compression set at 23°C (%)	5 - 10	25,4 - 26,6	19,5 - 20,5	38 - 40
Compression set at 70°C (%)	5 - 10	48,8 - 51,3	34,1 - 35,9	55,4 - 59,7
Compression set at 100°C (%)	5 - 10			61,8 - 66
Tear strength (N/mm)	14 - 15	70 - 135	200 - 267	63,1 - 78,8
Impact & fracture properties				
Fracture toughness (MPa.m^0.5)	0,194 - 0,338	1,77 - 1,95	8,45 - 10,6	1,74 - 1,97
Toughness (G) (kJ/m^2)	3,06 - 10,4	29,6 - 49,5	66,8 - 105	24,2 - 31
Impact strength, notched 23 °C (kJ/m^2)	590 - 600	590 - 600	9,69 - 15,5	590 - 600
Impact strength, notched -30 °C (kJ/m^2)	590 - 600	590 - 600	5,08 - 6,27	590 - 600
Impact strength, unnotched 23 °C (kJ/m^2)		590 - 600	590 - 600	590 - 600
Impact strength, unnotched -30 °C (kJ/m^2)		590 - 600	590 - 600	590 - 600
Thermal properties				
Melting point (°C)		171 - 210	215 - 221	152 - 170
Glass temperature (°C)	-70 - -60	-70 - -40	20 - 55	-104 - -95
Heat deflection temperature 0.45MPa (°C)		52 - 64	94 - 119	54 - 59
Heat deflection temperature 1.8MPa (°C)			42 - 47	

0,224 - 0,247	0,336 - 0,353
13,7 - 15,1	14,4 - 15,9
0,339 - 0,356	0,55 - 0,653
33,1 - 36,6	26 - 30
0,0786 - 0,0826	0,117 - 0,122
14,8 - 20,8	
0,773 - 1,25	0,949 - 0,997
0,45 - 0,468	0,432 - 0,45
2	3,6
3 - 4	5
27 - 33	29 - 31
27 - 42	40 - 50
46 - 55	
92 - 98	
291 - 322	322 - 424
7,39 - 8,34	7,02 - 9,12
40 - 42	
61 - 64,1	
79 - 83	
87,1 - 91,5	
2,25 - 2,26	1,49 - 4,18
21,4 - 21,9	7,66 - 42,4
590 - 600	590 - 600
590 - 600	
590 - 600	590 - 600
590 - 600	
153 - 169	264 - 286
-69 - -54	81 - 96
54 - 59	119 - 161
	49 - 82

Vicat softening point (°C)		105 - 127	162 - 213	
Maximum service temperature (°C)	250 - 260	116 - 147	151 - 171	130 - 140
Minimum service temperature (°C)	-60 - -50	-66 - -56	-80 - -60	-61 - -51
Thermal conductivity (W/m.°C)	1,2 - 1,4	0,162 - 0,168	0,146 - 0,152	0,267 - 0,289
Thermal conductivity with temperature (W/m.°C) #		0,18		
Specific heat capacity (J/kg.°C)	1050 - 1100	1600 - 1740	1260 - 1340	1810 - 1890
Specific heat capacity with temperature (J/kg.°C) #		1670	1440	
Thermal expansion coefficient (µstrain/°C)	150 - 165	162 - 227	126 - 180	205 - 215
Thermal shock resistance (°C)	1230 - 2970	331 - 633	174 - 264	275 - 296
Thermal distortion resistance (MW/m)	0,00753 - 0,00901	0,000726 - 0,00102	0,000828 - 0,00118	0,00126 - 0,00138
Electrical properties				
Electrical resistivity (µohm.cm)	1e20 - 1e21	1,79e19 - 8,53e20	7,14e20 - 1,4e21	4,3e23 - 6,6e24
Electrical conductivity (%IACS)	1,72e-19 - 1,72e-18	2,02e-19 - 9,65e-18	1,23e-19 - 2,41e-19	2,61e-23 - 4,01e-22
Dielectric constant (relative permittivity)	5 - 5,1	5,24 - 5,83	3,63 - 3,97	2,25 - 2,35
Dissipation factor (dielectric loss tangent)	0,002 - 0,004	0,0127 - 0,0815	0,00876 - 0,0217	0,00026 - 0,00044
Dielectric strength (dielectric breakdown) (MV/m)	19 - 21	13,3 - 18,1	21,2 - 23,5	19,5 - 20,3
Comparative tracking index (V)	400 - 600	600	600	600
Magnetic properties				
Magnetic type	Non-magnetic	Non-magnetic	Non-magnetic	Non-magnetic
Optical, aesthetic and acoustic properties				
Refractive index				
Transparency	Opaque	Opaque	Opaque	Opaque
Acoustic velocity (m/s)	56,7 - 92,2	245 - 317	879 - 955	361 - 367
Mechanical loss coefficient (tan delta)	0,1 - 0,18	0,025 - 0,075	0,035 - 0,1	0,07 - 0,09
Healthcare & food				
Food contact	No	No	No	Yes
Medical grades? (USP Class VI, ISO 10993)	Yes	Yes	Yes	Yes

Selection Report

130 - 140	196 - 215
-40 - -30	-205 - -195
0,416 - 0,45	0,242 - 0,261
1820 - 1890	1010 - 1050
183 - 193	83 - 105
262 - 282	433 - 569
0,0022 - 0,00241	0,00238 - 0,00304
4,3e23 - 6,6e24	3,3e23 - 3e24
2,61e-23 - 4,01e-22	5,75e-23 - 5,22e-22
2,25 - 2,35	2 - 2,2
0,00026 - 0,00044	0,000285 - 0,000315
19,5 - 20,3	19,7 - 23,6
600	
Non-magnetic	Non-magnetic
	1,34 - 1,35
Opaque	Transparent
495 - 503	395 - 406
0,05 - 0,07	0,113 - 0,119
Yes	Yes
Yes	Yes

Healthcare applications	Bone fixation and repair, Catheters and cannulas, Electrodes, Embolization and occlusion devices, Endoscopes, Grafts, Haemodialysis devices, Heart valves, Implantable pacemakers and defibrillators, Joint replacement, Nerve stimulators, Ossicular replacement, Patches, Peritoneal dialysis devices, Shunts, Spinal devices, Surgical instruments, Surgical mesh, Wound and tissue closure			
Sterilizability (ethylene oxide)	Excellent	Excellent	Excellent	Good
Sterilizability (radiation)	Marginal	Good	Good	Marginal
Sterilizability (steam autoclave)	Good	Good	Good	Good
Guidance for MRI Safety	No Interaction - MR Safe	No Interaction - MR Safe	No Interaction - MR Safe	No Interaction - MR Safe
Restricted substances risk indicators				
RoHS 2 (EU) compliant grades?	Yes	Yes	Yes	Yes
SIN List indicator (0-1, 1 = high risk)	0,01	0,02	0,02	0,02
Critical materials risk				
Contains >5wt% critical elements?	No	No	No	No
Absorption & permeability				
Water absorption @ 24 hrs (%)	0,1 - 0,15	2 - 2,2	0,286 - 0,315	0,0127 - 0,0154
Water absorption @ sat (%)		3,52 - 3,88	0,571 - 0,63	0,0779 - 0,0947
Humidity absorption @ sat (%)		0,381 - 0,42	0,19 - 0,21	0,0234 - 0,0285
Water vapor transmission (g.mm/m².day)	1,53 - 3,51	18,8 - 25,1	14,7 - 19,6	0,121 - 0,162
Permeability (O2) (cm³.mm/m².day.atm)	12900 - 30100	422 - 564	69,2 - 92,4	346 - 462
Processing properties				
Polymer injection molding	Acceptable	Acceptable	Acceptable	Acceptable
Polymer extrusion	Acceptable	Acceptable	Acceptable	Excellent
Polymer thermoforming	Unsuitable	Unsuitable	Unsuitable	Acceptable
Linear mold shrinkage (%)		0,765 - 1,2	1,58 - 1,68	1,76 - 1,84
Melt temperature (°C)		185 - 221	233 - 243	199 - 220
Mold temperature (°C)		21 - 52	30 - 40	9 - 61
Molding pressure range (MPa)		73,2 - 77,8	127 - 154	80,5 - 128

Selection Report

	Catheters and cannulas, Surgical instruments
Good	Excellent
Marginal	Marginal
Good	Good
No Interaction - MR Safe	No Interaction - MR Safe
Yes	Yes
0,02	0
No	No
0,0204 - 0,0248	0,005 - 0,01
0,125 - 0,152	
0,0376 - 0,0457	
0,209 - 0,242	0,101 - 0,244
260 - 300	98,1 - 119
Acceptable	Limited use
Excellent	Limited use
Acceptable	Unsuitable
1,76 - 1,84	3 - 6
201 - 218	289 - 404
5 - 44	50 - 200
80,5 - 128	34,4 - 138

Selection Report

Durability				
Water (fresh)	Excellent	Excellent	Excellent	Excellent
Water (salt)	Excellent	Excellent	Excellent	Excellent
Weak acids	Excellent	Acceptable	Acceptable	Excellent
Strong acids	Excellent	Unacceptable	Unacceptable	Excellent
Weak alkalis	Excellent	Acceptable	Acceptable	Excellent
Strong alkalis	Excellent	Unacceptable	Unacceptable	Excellent
Organic solvents	Acceptable	Limited use	Limited use	Limited use
Oils and fuels	Limited use	Excellent	Excellent	Limited use
Oxidation at 500C	Unacceptable	Unacceptable	Unacceptable	Unacceptable
UV radiation (sunlight)	Good	Fair	Fair	Poor
Flammability	Self-extinguishing	Highly flammable	Slow-burning	Highly flammable
Oxygen index (%)	40 - 42	19 - 20	21 - 22	17 - 20
Primary production energy, CO2 and water				
Embodied energy, primary production (virgin grade) (MJ/kg)	68,9 - 76	128 - 141	128 - 141	116 - 127
Embodied energy, primary production (typical grade) (MJ/kg)	68,9 - 76	128 - 141	128 - 141	116 - 127
CO2 footprint, primary production (virgin grade) (kg/kg)	3,66 - 4,04	6,48 - 7,14	6,48 - 7,14	5,74 - 6,33
CO2 footprint, primary production (typical grade) (kg/kg)	3,66 - 4,04	6,48 - 7,14	6,48 - 7,14	5,74 - 6,33
Water usage (l/kg)	190 - 571			267 - 295
Processing energy, CO2 footprint & water				
Polymer extrusion energy (MJ/kg)		5,77 - 6,38	5,8 - 6,41	5,89 - 6,51
Polymer extrusion CO2 (kg/kg)		0,433 - 0,478	0,435 - 0,481	0,442 - 0,488
Polymer extrusion water (l/kg)				4,86 - 7,28
Polymer molding energy (MJ/kg)	14,1 - 15,5	17,2 - 19	18 - 19,9	20,6 - 22,8
Polymer molding CO2 (kg/kg)	1,13 - 1,24	1,29 - 1,43	1,35 - 1,5	1,54 - 1,71
Polymer molding water (l/kg)	10,7 - 16			13,4 - 20,1
Coarse machining energy (per unit wt removed) (MJ/kg)				
Coarse machining CO2 (per unit wt removed) (kg/kg)				
Fine machining energy (per unit wt removed) (MJ/kg)				
Fine machining CO2 (per unit wt removed) (kg/kg)				
Grinding energy (per unit wt removed) (MJ/kg)	0,834 - 0,921	2,04 - 2,25	6,67 - 7,37	2,28 - 2,52
Grinding CO2 (per unit wt removed) (kg/kg)	0,0625 - 0,0691	0,153 - 0,169	0,5 - 0,553	0,171 - 0,189

Selection Report

Excellent	Excellent
Excellent	Excellent
Excellent	Excellent
Excellent	Excellent
Excellent	Excellent
Excellent	Excellent
Limited use	Excellent
Limited use	
Unacceptable	Unacceptable
Poor	Good
Highly flammable	Non-flammable
17 - 20	94 - 96
116 - 127	216 - 238
116 - 127	215 - 237
5,74 - 6,33	11,7 - 12,9
5,74 - 6,33	11,6 - 12,8
267 - 295	554 - 612
5,89 - 6,51	5,86 - 6,48
0,442 - 0,488	0,44 - 0,486
4,86 - 7,28	4,84 - 7,27
20,6 - 22,8	19,9 - 22
1,55 - 1,71	1,49 - 1,65
13,4 - 20,1	13,1 - 19,6
	0,542 - 0,599
	0,0407 - 0,0449
	1,15 - 1,27
	0,0859 - 0,0949
3,37 - 3,72	1,82 - 2,01
0,253 - 0,279	0,136 - 0,15

Selection Report

Recycling and end of life				
Recycle	No	Yes	Yes	Yes
Embodied energy, recycling (MJ/kg)		43,4 - 48	43,4 - 48	39,2 - 43,3
CO2 footprint, recycling (kg/kg)		2,2 - 2,43	2,2 - 2,43	2 - 2,15
Recycle fraction in current supply (%)		0,1	0,1	0,1
Downcycle	Yes	Yes	Yes	Yes
Combust for energy recovery	Yes	Yes	Yes	Yes
Heat of combustion (net) (MJ/kg)	5,63 - 6,08	29,6 - 31,1	29,7 - 31,2	44 - 46,2
Combustion CO2 (kg/kg)	0,558 - 0,586	2,37 - 2,49	2,37 - 2,49	3,06 - 3,22
Landfill	Yes	Yes	Yes	Yes
Biodegrade	No	No	No	No
Links				
ProcessUniverse	32	15	15	16
Producers	6	4	4	14
Reference	5	5	5	2
Shape	16	24	24	24
Full Datasheet				

 # Functional Parameters

Temperature (°C) 23

Selection Report

Yes	Yes
39,2 - 43,3	73,2 - 80,9
2 - 2,15	4 - 4,39
0,1	0,672 - 0,742
Yes	Yes
Yes	Yes
44 - 46,2	4,69 - 4,92
3,06 - 3,22	0,859 - 0,903
Yes	Yes
No	No
16	57
14	1
2	10
24	24