# TRANEMO TEXTIL AB – ANSWERS

## Agenda point 1 - Critical properties (performance) for protective clothing

**Questions**

1. Please describe quantitatively critical properties (performance) for protective clothing, see table 1, in the form of comparable measurements / studies between performance for fluorochemistry and alternative non fluorochemistry? See answer below in table 1 columns.

Table 1: *Critical properties (performance) vs Standards for protective clothing (CEN/TC 162)*

| **Critical properties (performance)** | **Standards for protective clothing (CEN/TC 162)** | **Tranemo Comments to Q 1:1: critical properties.** | **Q 2:4: Acceptable quantitative measurement results/limits** |
|---|---|---|---|
| Electrostatics | EN 1149 series | N/A for fluorocarbons. Antistatic properties are not reached by PFAS but with antistatic fibres. | N/A |
| Liquid chemicals | **EN 13034:2005+A1:2009**<br>EN 14605:2005+A1:2009<br>EN 16523-1:2015+A1:2018 | Tranemo uses EN 13034 only (EN 14605 and EN 16523-1 are N/A). Based on customer's risk assessment most of the garments still need PFAS DWOR to fulfil their demands.<br><br>PFAS-free DWR can only be used if the customers risk assessment allows that and that it passes the chemicals needed within EN 13034 (PFAS free may today pass H2SO4 30% and NaOH 10%, but not o-Xylene or Butanol). And for oil repellence there is no alternative available as of today's technology.<br><br>The standard EN 13034 is under development and there will be a new | Depending on protection needed. If only protection against small splashes of low concentrated acid and alkaline is needed, a PFAS-free DWR could be sufficient.<br><br>However, if customers risk assessment demand protection against other chemicals and/or oil repellence then C6's is needed as of today's existing technology.<br>EN 13034 is included in highest risk category 3 within the PPE |



***N/A** = Not applicable, **DWR** = Durable Water Repellent (PFAS-free), **DWOR** = Durable Water and Oil Repellent (PFAS)*

| Critical properties (performance) | Standards for protective clothing (CEN/TC 162) | Tranemo Comments to Q 1:1: critical properties. | Q 2:4: Acceptable quantitative measurement results/limits |
|---|---|---|---|
| | | one in the coming years. We do not yet know the extent of this new standard, but the same chemicals tested today seem to be involved also in the updated version. | regulation, so it is very important to comply with the customer's demand. |
| Protection against chemicals | EN ISO 17491-3, -4:2008<br>EN ISO 17491-4:2008<br>EN ISO 19918:2017/A1:2021<br>EN ISO 6530:2005 | EN ISO 19918 is N/A for Tranemo articles. EN ISO 17491-4 and EN ISO 6530 are the test standard included in EN 13034 and therefore relevant and the same answer as above is applicable here. | For EN ISO 17491-4 and EN ISO 6530 the same answer as for EN 13034 applies. |
| Liquid and gaseous chemicals, including aerosols and solid particles | EN 464:1994 | N/A for Tranemo articles | N/A for Tranemo articles |
| Against rain | EN 343:2019 | Fluorocarbon will not necessarily be needed to fulfil EN 343. PFAS-free DWR can provide a good enough protection against water.<br><br>However, included as pre-treatment in EN 343 is testing against oil and fuel. Tranemo questions if this is a necessary pre-treatment for the garments we provide. This pre-treatment is probably more applicable for rain wear to be used offshore.<br>EN 343 is PPE risk category 1 and | PFAS-free DWR provides good protection for EN 343 if only water repellence is needed to fulfil the certification. There is a risk not fulfilling EN 343 if the oil and fuel pre-treatment cannot be made optional in the certification. More evaluation and tests must be made to give further qualitative or quantitative information. |

| Critical properties (performance) | Standards for protective clothing (CEN/TC 162) | Tranemo Comments to Q 1:1: critical properties. | Q 2:4: Acceptable quantitative measurement results/limits |
|---|---|---|---|
| | | therefore a low risk and the essential need of PFAS is questionable. | |
| Splashes of molten metal | EN 348:1992 | A standard for gloves protection. Tranemo uses this standard very limitedly. No qualitative or quantitative information can be given at this stage in regards of the need of fluorocarbons | No information to be given at this stage. |
| For firefighting activities | EN 469:2020 | N/A for Tranemo articles. | N/A |
| High visibility | EN ISO 20471:2013 | Fluorocarbons will not automatically be needed to achieve high visibility. Instead Tranemo recommends washing garments regularly to avoid getting them permanently dirty. | EN ISO 20471 does not demand DWR/DWOR finish to achieve fluorescence and luminance. Fabrics with PFAS-free DWR, or completely DWR-free could be sufficient to fulfil EN ISO 20471. |
| Use, care and maintenance | CEN/TR 14560:2018<br>CEN/TR 15419:2017<br>CEN/TR 17330:2019 | Guidance for creating a risk assessment, which are more directed to our customers. We have not any qualitative or quantitative information to give at this point. | N/A |
| Others? | EN ISO 11612 | Since fluorocarbons are oil repellent there is additional protection added with fluorocarbons since oil and dirt can act as risk factors in regards of flammability. However, to achieve | This is overlaying most of the other standards since Tranemo must guarantee that the eventual loss of PFAS's will not affect the flammability |
| | EN 61482-2 | | |
| | EN 11611 | | |
| | EN 14116 | | |
| | EN 407 (gloves) | | |



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| Critical properties (performance) | Standards for protective clothing (CEN/TC 162) | Tranemo Comments to Q 1:1: critical properties. | Q 2:4: Acceptable quantitative measurement results/limits |
|---|---|---|---|
| | | good flammability PFAS DWOR's are not a demand. The protection of flammability is reached by using inherent fibres which provide the protection. | badly due to removal of stain or oil repellence*. There is not enough data on this at today's stage to set any measurements or limits. |

**2.** Are these data available to us? See above explanations in table 1.

## Agenda point 2 – Standards for protective clothing need for PFAS

**Questions and remarks**

3. Are there comparable quantitative test results between fluorochemistry and non-fluorochemistry available to us performed with the test standards listed in table 1 (*or others, please specify*)?
   Tranemo have a new FR collection which contain PFAS-free DWR. This protects against water and water-based stains and chemicals. It is tested and approved according to EN 13034 for sulphuric acid (30%) and sodium hydroxide (10%). Tranemo have both tested positive results internally and made standardized EN 13034 (according to EN ISO 6530) at accredited lab to make sure also the PFAS-free finish repels the acid and alkaline within the standard of EN 13034. The test report from the accredited lab is approved by our notified body who approves the CE-marking of the garments.

   Since our customer's risk assessment mostly demand EN 13034-certification and/or oil repellence it is not possible as of todays technology to fully substitute the PFAS DWOR's.

   Tranemo has made a wear trial of a trouser in comparing PFAS DWOR and completely DWR-free, one leg with PFAS C6 and the other leg without any DWR. After long use and dirt exposure, after washing the results on both legs were equally dirty/clean. The Tranemo thesis is that fluorocarbons therefore are not automatically needed to achieve better high visibility after washing, but instead Tranemo recommends washing the garments more regularly to avoid the permanent dirt.

   Tranemo will be part of a Master thesis project during spring 2022 (collaboration between Swedish School of Textiles, RISE IVF and Chalmers University) which will focus on testing the comparison between PFAS and PFAS-free finishes on protective garments. After that study is finished, Tranemo will have more quantitative test results.



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4. Please indicate which quantitative measurement results/limits are acceptable for your markets for the test methods listed in table 1 below (*or others, please specify*).
   Please see answers in right column in table 1.

   **Important notice!** Almost all the PPE-garments have several certifications, including from different areas within the PPE risk categories. For example, a jacket can be certified according to both EN 343 (cat 1, rain protection), EN ISO 20471 (cat 2, high visibility), EN 13034 (Cat 3, chemical protection) and EN ISO 11612 (cat 2 and 3).
   This means that the highest risk on a fabric should decide the need of PFAS's. Even if EN 343 can be achieved by PFAS-free DWR, EN 13034 might not be sufficient with PFAS-free finish. It probably needs a C6 to achieve demanded protection according to customer's risk assessment. For an explanatory list of standards divided into the three risk categories, please see table 2 at the end of this document.

   *The process of changing a component within a PPE-fabric is very complex. To even change a minor component, one is at risk to re-certify fabrics and garments again. This means that if PFAS's are to be changed to PFAS-free surface treatment, Tranemo and our fabric suppliers must secure the protection of all the certifications that the fabric holds. For example, if a fabric is certified: EN ISO 11612, EN ISO 11611, EN 61482-1, EN 13034 etc, all these certification tests is at risk to be updated with the new finish. First it must be approved by accredited lab on fabric level and then all the garments' certification must be updated according to the new fabric test results. This is both a very costly and a very time-consuming process. For an estimated summary of costs and time, please see table 3 at the end of this document.

## Agenda point 3 - Potential alternatives to PFAS

In the ongoing restriction work of PFAS in EU/EEA, a range of non-fluorinated alternatives to PFAS have been identified

- Hyperbranched functionalized polymers (dendric polyurethanes)
- Paraffins (hydrocarbons)
- Waxes (fatty acid esters)
- Silicones (polydimethylsiloxanes abbr. PDMS)
- Polymeric compounds such as non-fluorinated (meth)acrylates
- Plasma treatment
- Graphene structures
- Other?

**Questions**

5. For these above listed non fluorinated alternatives (and possibly other) to fluorochemistry, what are the biggest specific challenges to phase in those non fluorinated alternatives that may be feasible for your applications?

Oil repellence and protection to chemicals - *Some chemicals, e.g. acids and alkaline, in low concentration, can be repelled by PFAS-free DWR, but the others needs PFAS's based upon todays*

*knowledge and the technical limitations of the PFAS-free alternatives.*

6. Have you evaluated other fluorochemicals / materials as substitutes for the currently used fluorochemistry? If so, please specify this chemistry.

We have evaluated hydrocarbon based PFAS-free (paraffins) DWR at Tranemo.

An important notice is the flammability potential of other DWR's than PFAS. When PFAS are applied onto fabric it does not pose as an additional risk, it does not increase flammability.
If paraffins or other DWRs are being used the flammability of the finish must be evaluated to see if it's suitable. Paraffins are hydrocarbon based and are quite easily ignitable in their own. One must make sure that the finish applied onto the fabric does not pose as an additional risk for the flammability.

## Agenda point 4 – Quantities of PFAS in protective clothing

**Questions**

7. What are the quantities of PFAS used in protective clothing applications in the EEA?
   No information in general, but for the Tranemo calculation of used PFAS (in kilogram) during period 20/21, please see table 4 at the end of the document.
8. Annex I of the PPE regulation (EU 2016/425) divides PPEs into three risk categories. What share of the quantities of PFAS are used in the three risk categories, respectively?
   Fabrics (by article, in approximate %):
   Cat 1 = 8 %
   Cat 2 = 18 %
   Cat 3 = 74 %

   Important notice: The percentual grouping of PPE-categories on fabrics is approximate since the same fabric can be used in both 2 and 3 depending on which certifications it holds.
   It is not definite that a fabric itself is either cat 2 or 3. The garments however are defined according to the highest PPE-level.
   It is therefore important to have the highest risk category in mind on the fabric level when evaluating if PFAS's are essential or not, even if the fabric is used in both category 2 or 3 garments.

9. Do you apply industrial re-impregnation of PFAS in your products? If so, what quantities of PFAS are used for industrial re-impregnation of your products?
   Tranemo recommends reimpregnation by at least every 5$^{th}$ wash on EN 13034 garments to fulfil protection also after washing. This service is not provided by Tranemo, but our partners in the industrial laundry business provides this reimpregnation to our customers. We also recommend heating (by tumbler for example) the garments after wash to re-activate the PFAS finish which will prolong the repellent functions in between re-impregnations.
   The reactivation and reimpregnation process will continuously be needed also for PFAS-free DWR's, for example if using hydrocarbon DWR's.

   For EN ISO 20471 certified garments there is no recommendation to reimpregnate garments to maintain stain-/oil-/dirt repellence. Industrial laundries do not automatically re-

impregnate garments where the highest risk is EN ISO 20471 (cat 2, PPE regulation) – as far as our knowledge extends.

## Agenda point 5 – Emissions and waste management

10. What are the quantities of emissions of PFAS from reimpregnation of your products?
    Tranemo can only recommend reimpregnation, but it is up to the industrial laundry partner to do so. Tranemo therefore has no informative number of emissions.
11. What measures can be taken to minimize the emissions from reimpregnation? What are the costs associated with these measures?
    Tranemo can only recommend reimpregnation, but it is up to the industrial laundry partner to do so. Minimize emissions from reimpregnation and their additional costs are questions for the industrial laundry partners.
12. How are your PFAS containing protective clothing dealt with at end-of-life?
    The producer's responsibility is not yet applied onto textiles.
    A reasonable theory would be to incinerate garment in high temperature (over 1000'C) to get rid of any PFAS. It is still under research at which temperature should be sufficient to remove the PFAS completely.
13. What are the quantities of emissions of PFAS from protective clothing in the waste phase?
    Tranemo has no information.
14. What measures can be taken to minimize the emissions from the waste phase? What are the costs associated with these measures?
    Our idea: To recommend incineration for garments containing PFAS's – and to not allowing it to end up in land fill or extended life span outside our, our customers and our laundry partners, control.

## TRANEMO – additional comments

- For Tranemo, the PPE garments containing PFAS's are today certified in accordance with EN 13034 Type 6 [PB].
  Due to design demands the EN 13034 might not be reached, but the repellent function of the fabric still needs to be there.
  This is because EN 13034-garments are subordinate (in customers risk assessment) to the main protections: flame, electric arc, hi-vis, and anti-static. For example, if the design for EN 13034 contradicts another certification, then EN 13034 will be lost as certification in garment certification. However, having repellent fabrics is still very important for those garments.
  This is because the main idea of EN 13034 Type 6 Partial Body protective wear is to get oneself away from the danger in case of an accident - repellent fabrics gives additional reaction time to do so. By having the fabrics repellent to chemicals, the wearer gets more time to react and get oneself away from the danger and remove all the contaminated clothing. Workers are not supposed to continue working if an accident occurs. If that kind of protection is needed, then Partial Body protection Type 6 [PB] as certification is not sufficient and higher chemical protection must be evaluated in the customers risk assessment. It is the

same as when comparing EN 469 with EN ISO 11612 when you are deliberately exposed to risk (EN 469) compared to when a risk arises in the event of an accident (EN ISO 11612).

- It is mentioned and suggested 3-10 years as transition time in the TULAC-report for removal of PFAS for PPE. Tranemo find it very unlikely to find a substitute for PFAS's when it comes to oil- and chemical repellence during this period. Tranemo is agreeing and supporting the broader ban of all PFAS. However, if the protection for the wearer using the garments is affected and reduced, there cannot a complete removal of PFAS's. The personal safety for workers must be Tranemo's number one priority.

- One must also consider the safety stock of PPE garments. To be able to supply our customers with PPE we need a safety stock – which is we need to have several years of stock. If an alternative to PFAS with excellent properties against oil- and chemical repellence is found in the future, the transition time for the stock also must be taken into consideration. According to Tranemo's calculations, at least 5 years must be added to the transition time to make sure the stock is able to rotate from PFAS to PFAS free.

## Table 2: Standards divided by PPE category

| STANDARD | CAT I | CAT II | CAT III | Comments |
|---|---|---|---|---|
| EN 343 | X | | | |
| EN 342 | | X | | Only garment certification, not applicable on fabrics |
| EN ISO 20471 | | X | | |
| EN ISO 14116 | | X | | |
| EN ISO 11612 | | X | X | Depends on which code letter and/or level if it's cat 2 or 3. |
| EN ISO 11611 | | X | | |
| EN 13034 | | | X | |
| EN 61482-2 | | | X | |



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## Table 3: Fabric and garment certification costs for one FR-collection

| GARMENT CERTIFICATION COSTS<br>*At Tranemo's expense* | | | |
|---|---|---|---|
| Certification cost* | 880 € | 9 | **7 920 €** |
| **Mean value is 9 certificates per collection* | | | |
| EN 61482-2 Open Arc (1 layer) | | | **750 €** |
| EN 61482-2 APC 1 (1 layer) | | | **670 €** |
| Seam test (Strength, A1, A2) | | | **1 150 €** |
| EN 61482-2 APC 2 (2 layer) | 1 600 € | 2 | **3 200 €** |
| Garment test APC 2 | 670 € | 2 | **1 340 €** |
| EN 61482-2 Open Arc (2 layer) | 2 200 € | 2 | **4 400 €** |
| Garment test Open Arc | 1 200 € | 2 | **2 400 €** |
| Garment cost for Skinsafe tests (jacket) | 85 € | 12 | **1 025 €** |
| Garment cost for Skinsafe tests (underwear) | 30 € | 8 | **240 €** |
| | | | **23 095 €** |

| FABRIC CERTIFICATION COSTS<br>*At our supplier's expense several* | |
|---|---|
| EN ISO 11612 | **1 541 €** |
| EN ISO 11611 Class 2 | **262 €** |
| EN 61482-1-2 Box test | **1 850 €** |
| EN 61482-1-1 Open arc | **1 642 €** |
| EN 1149-3 | **288 €** |
| EN 13034 | **1 041 €** |
| EN 343 | **744 €** |
| EN ISO 20471 | **1 715 €** |
| 50x 15795: Coordinates 20471, 1149-3, 11612 A1 | **2 195 €** |
| | **11 278 €** |

| | |
|---|---|
| **TOTAL SUM FOR RE-CERTIFYING GARMENTS** | **34 373 €** |
| **Estimated time for completed garment certifications** | 6-8 months in average |
| **Estimated time for completed fabric certifications** | 3-4 months in average |

| INFORMATION |
|---|
| *Please note that above calculations are if all certifications must be updated due to change from C6 to C0.*<br>*Tranemo has over 10 FR-collections where the same calculation cost is applicable.* |



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## Table 4: Estimated calculation for amount of PFAS amount in garments sold during July 2020 – June 2021 from Tranemo warehouse

| | |
|---|---|
| **Fabric weight (g/rm)**<br>mean value (260g/m² x 1,5m width)<br>390 | **Approx. amount of PFAS added (%)**<br>mean value (range 2 - 6,7‰)<br>0,50% |
| **Workwear fabrics (m)**<br>(sold running meters (rm) with PFAS-finish)<br>87 571 | **Flame Retardant fabrics (m)**<br>(sold running meters (rm) with PFAS-finish)<br>245 783 |
| **Running meters x weight x amount PFAS** | |
| **Workwear fabrics (kg)**<br>total weigh of PFAS C6<br>171 | **Flame Retardant fabrics (kg)**<br>total weigh of PFAS C6<br>479 |
| **SUMMARY** | |
| **Workwear fabrics:** | **171 kg** as total PFAS in fabrics sold during 20/21 |
| **FR fabrics:** | **479 kg** as total PFAS in fabrics sold during 20/21 |
| **Workwear fabrics**<br>(PFAS-fabrics in % by total running meters sold during 20/21)<br>**31%** | **Flame Retardant fabrics**<br>(PFAS-fabrics in % by total running meters sold during 20/21)<br>**42%** |
| **Total PFAS-fabrics in % by total running meters sold 20/21**<br>**38%** | |
| **INFORMATION** | |
| *- A 15% fabric waste rate is included in the calculation*<br>*- This calculation includes all fabrics in garments sold from Tranemo warehouse during the period 2020.07.01 to 2021.06.30*<br>*- PPE fabrics are included in both workwear fabrics and FR fabrics. However, PPE cat 3 fabrics are only used in FR.* | |



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