PHILIPS

TU Delft

Enhancing consumer product repairability

a case study on vacuum cleaners

Francesco De Fazio

Appendixes

Enhancing consumer product repairability

a case study on vacuum cleaners

Master Thesis
Francesco De Fazio

Appendixes

Master Thesis
August, 2019

Francesco De Fazio

MSc. Integrated Product Design
Annotation in Technology in Sustainable Development
Faculty of Industrial Design Engineering
Delft University of Technology

TU Delft

PHILIPS

Chair
Conny Bakker
Faculty of Industrial Design Engineering
Delft University of Technology

Company Mentor
Leendert Jan de Olde
Group Sustainability
Royal Philips

Mentor
Bas Flipsen
Faculty of Industrial Design Engineering
Delft University of Technology

Company Mentor
Eric Marco
Consumer Care
Royal Philips

Table of Contents

Appendix C: JRC Parameters, criteria and weights preliminarily proposed for vacuum cleaners

Parameter	Pass/fail criteria	Rating	Assessment and verification	Weight of the parameter
1) Disassembly depth/sequence	For each priority part, information about the disassembly sequence has to be available to the target group of repairers (see #6)	None (no rating is proposed since data regarding disassembly depths has not been collected for this study)	A: A description supported by illustrations of the steps needed to disassemble priority parts is needed. The description has to show that the disassembly is reversible by including the steps needed for the reassembly of priority parts. V: physical disassembly and recording of the operation are needed.	High = 2
2) Fasteners	None	A score is assigned for each priority part according to the reversibility and reusability of the fasteners used for its assembly. I) Reusable: an original fastening system that can be completely re-used, or any elements of the fastening system that cannot be re-used are supplied with the new part for a repair, re-use or upgrade process = 1 pt.	A: A description supported by illustrations of the fasteners to be removed for the disassembly of priority parts is needed. V: Physical disassembly and inventory of fasteners are needed.	High = 2

Parameter	Pass/fail criteria	Rating	Assessment and verification	Weight of the parameter
		II) Removable: an original fastening system that is not reusable, but can be removed without causing damage or leaving residue which precludes reassembly or reuse of the removed part = 0.5 pt. III) Non-removable: original fastening systems are not removable or reusable, as defined above = 0 pt. Note: In case different types of fasteners are used in the assembly of a priority part, the score corresponding to the worst type of fasteners case will be considered.		
3) Tools	The repair/upgrade process is feasible for each priority part with existing tools	A score is assigned for each priority part according to the complexity and availability of the tools needed for its repair/upgrade: I) Basic tools: repair/upgrade of the priority part is feasible without any tools, or with tools that are supplied with the product, or with the list of basic tools provided in note 1 = 1 pt. II) Other commercially available tools: repair/upgrade of the priority part is unfeasible only with basic tools and requires the use of other tools that are commercially available = 0.66 pt. III) Proprietary tools: repair/upgrade of the priority parts is feasible only with one or more proprietary tools = 0.33 pt.	A: Description of the repair/upgrade operations, including documentation of the tools to use, is needed. V: Physical disassembly and check of suitability of tools are needed.	High = 2

Parameter	Pass/fail criteria	Rating	Assessment and verification	Weight of the parameter
		Note: 1) The list of basic tools includes: Screwdriver for slotted heads, cross recess or for hexalobular recess heads (ISO2380, ISO8764, ISO10664); Hexagon socket key (ISO2936); Combination wrench (ISO7738); Combination pliers (ISO5746); Half round nose pliers (ISO5745); Diagonal cutters (ISO5749); Multigrip pliers (multiple slip joint pliers) (ISO8976); Locking pliers; Combination pliers for wire stripping & terminal crimping; Prying lever; Tweezers; Hammer, steel head (ISO15601); Utility knife (cutter) with snap-off blades; Multimeter; Voltage or socket tester; Soldering iron; Hot glue gun; Magnifying glass		
4) Disassembly time	none	none	none	None
5) Diagnosis support and interfaces	none	none	none	none
6) Type and availability of information	Information requirements for professional repairers and final users (see section 3.3.3.4).	I) A score of 1 is assigned for the product if all the information of the pass/fail criterion is made available publicly at no additional cost for consumers. II) Otherwise, 0.5 points are assigned.	A: All relevant information for maintenance, repair and upgrade needs to be compiled and made available to the target group of repairers. V: Check of actual availability.	High = 2
7) Spare parts	- Manufacturers, importers or authorised representatives have to make available to professional repairers the spare parts	For each priority part:, a) Availability of spare parts over	A: Commitment by the manufacturer about the availability	High = 2

Parameter	Pass/fail criteria	Rating	Assessment and verification	Weight of the parameter
	listed in section 3.3.2 - Spare parts have to be available for a minimum period of 5 years after placing the last unit of the model on the market - The list of these spare parts and the procedure for ordering them have to be publicly available on a free access website. - The delivery of the spare parts has to be within 15 working days after having received the order. - Price of spare parts to be also disclosed	time: I) The spare part (or compatible spare parts) is declared by the manufacturer to be available for at least 8 years = 1 pt; II) The spare part (or compatible spare parts) is declared by the manufacturer to be available for at least 5 years = 0.5 pt. b) Target group I) The spare parts is available publicly = 1 pt; II) The spare parts is available to professional repairers = 0.5 pt. Score (#7) = Score (#7a) x Score (#7b)	of spare parts over time, as well as provision of information about: - Delivery time - Recommended retail price of spare parts - Target groups - Interface used. V: Check of actual availability.	
8) Software and firmware	Software and firmware updates and support are offered to end users for a duration of 5 years after placing the last unit of the model on the market. Note: only for robot-type models	a) A score is assigned for the product based on the period of time during which software/firmware updates and support are offered: I) Software/Firmware updates and support are offered for at least 8 years = 1 pt; II) Software/Firmware updates and support are offered for at least 5 years = 0.5 pt. b) A score is assigned for the product based on the cost of the software/firmware update service: I) Software/Firmware updates and support are offered free of charge for the entire period of time during which the service is offered (either 5 or 8	A: Declaration about the duration of availability of software and firmware over time, as well as information about costs, and information about how updates will affect the original system characteristics. V: Check of actual availability, compatibility, and possibility to avoid/reverse the update.	Normal = 1

Parameter	Pass/fail criteria	Rating	Assessment and verification	Weight of the parameter
		years) = 1 pt; II) Software/Firmware updates and support are offered free of charge for X years = either X/8 or X/5 pt, depending on the entire period of time during which the service is offered. Score (#8) = Score (#8a) x Score (#8b)		
9) Safety, skills and working environment	none	none	none	none
10) Password reset and restoration of factory settings	none	none	none	none
11) Data transfer and deletion	none	none	none	none
12) Commercial guarantee	None	A score is assigned based on the availability of a "commercial guarantee" for the (entire) product offered by the guarantor, and including a "commitment to free repair as first remedy" in case of failures. I) 1 point is assigned if a commercial guarantee is offered, in addition to the legal obligations, covering a period post-sale of at least 8 years. II) Points are modulated proportionally for intermediate cases. III) 0 points are assigned in case of fulfilment of minimum legal requirements of 2 years.	A: Guarantee contract is needed, with emphasis on "free repair first" clauses. V: Check of availability of guarantee, clauses statement and actual possibility of repair in case of failure.	Not Applied

Parameter	Pass/fail criteria	Rating	Assessment and verification	Weight of the parameter
		Note: 1) "Commercial guarantee" means any undertaking by the seller or a producer (the guarantor) to the consumer, in addition to his legal obligation relating to the guarantee of conformity, to reimburse the price paid or to replace, repair or service goods in any way if they do not meet the specifications or any other requirements not related to conformity set out in the guarantee statement or in the relevant advertising available at the time of, or before the conclusion of the contract. 2) For the purpose of being able to be taken into account in the "Repair Score System", the commercial guarantee must be related to the entire product (not only specific components), provided in the entire EU, be included in the sale price of the product, and the remedies proposed by the guarantor will not result in any costs for the consumer (e.g. it means that the repair is for free).		

Appendix D: Repair monitor 2017

Brand	Product year	Model	Problem	Possible cause	Repaired
Philips			Hij maakt een tikkend geluid	Waarschijnlijk motor versleten	Nee
Philips	2016	Power Cyclone 5/FC8760	Draadbreuk		Ja
Philips	1997	hr6250/b	zuigt niet	verstopt	Ja
Philips		Performer Pro	aan-/uitschakelaar		Nee
Philips		performer Pro 200W	doet het niet meer	water gezogen of iets anders?	Nee
Philips		FC 8451	maakt veel herrie	schoep van motor defect	Ja
Philips		TCX642/B	toestel heel erg vervuild	gescheurde stofzak	Ja
Philips	2002	Mobilo	doet het niet	vervuiling	Ja
Philips		FC9171	vuil		Ja
Philips	2012	Performer Pro	slaat soms af	sleepcontact gesmolten	Ja
Philips	2001	HR8733/A	Snoer versleten op een plek middenin	gebruik/slijtage	Ja
Philips		HR 8331	Zuigt slecht	Verstopping van de slang of luchtwegen	Ja
Philips	2005	Parketto	Snoer zit vast	Snoer zit niet lekker in de snoerspoel	Ja
Philips	1975		Doet het niet	Versleten?	Nee
Philips	2008	Expression	Zuigt niet meer, snoer defect	draadbreuk	Ja
Philips	2014	RC 9153	Regelt niet goed meer	vuil	Half en/of advies gegeven
Philips	2009	Easy life	Kabel kapot, sluit niet	Kabel kapot	Half en/of advies gegeven
Philips	2006	Turba max 300	Contact problemen	onbekend	Nee
Philips	2015	SV 917001 A	Doet het plotseling niet meer	Onbekend	Ja
Philips				motor schoongemaakt	Ja
Philips	2014		motor draait onregelmatig		Ja
Philips	2010	HR 8572/B	draad breuk	meetrekken aan de draad	Ja
Philips	2013	TCX519	doet het niet	snoer aangegoten stekker defect	Ja
Philips	2001	?	aan/uit knop werkt niet	?	Ja
Philips	2006		valt iedere keer uit	draadbreuk	Ja
Philips	2010	Onbekend/n.v.t.	Draadbreuk	Slijtage	Ja
Philips	2000		Kabelbreuk	Kablebreuk	Ja
Philips		PC9150/701A	doet niets meer		Ja
Philips	1997	FC9009	Aan en uit knop functioneert niet	schakelaar	Ja
Philips			Aan-uit schakelaar kapot		Ja
Philips		HR8881/A 1600 W	deksel afgebroken		Half en/of advies gegeven
Philips		Genua	werkt niet		Nee
Philips	2005	onbekend	Electrisch snoer rolt niet meer op	?	Ja
Philips			Doet het niet goed	Slecht contact	Ja

Average life: 13 years

Main problems: Broken wire (39,4%); Switches and electric board (33,3%); Dirtiness (15,16%); Casing (3%); Motor (12,12%); Motor consumed (probably brushes) (6%)

	Repair procedure carried out	Cause of failed repair	Repairability score (1-10)	Availability of repair information	Source of the information	Tips and advices for future repairs on the same model
		Niet te openen	1	Nee		
	Snoer in de trommel aangezet		8			
			6	Niet van toepassing		
		niet open te krijgen	1	Nee		
		motor verbrand	8	Nee		
	van andere stofzuiger motor overgezet		2	Nee		
	schoongemaakt en zuigbuis/zuigvoet uit voorraad gebruikt		7	Nee		
	geheel schoongemaakt		9	Nee		
	schoongemaakt		7	Niet van toepassing		
	snoer doorverbonden zonder oprolmechanisme		3	Nee		
			9	Nee		Netjes de draden solderen en isoleren met een stukje krimpkous
	Verstopping uit slang verwijderd			Nee		
	Snoer opnieuw opgerold op de snoerspoel		7	Nee		
		Heel oude stofzuiger, condensator op print doorgebrand	7	Niet van toepassing		
	Snoer ingekort bij oproltrommel, lastig in elkaar te zetten		4	Nee		Bij de montage moet je goed opletten dat je het op volgorde doet
			7	Nee		Deze Philips stofzuigers hebben een slechte potmeter, die faalt na verloop van tijd
			5	Nee		
		Gedemonteerd en doorgemeten. Sluiting in motor (verbrand)	1	Nee		
	Kort gesloten en doorverbonden. Printplaat stuk. Werkt nu alleen nog op volle toeren.		8	Ja		
				Nee		
	de regeling uitgeschakeld			Nee		
	nieuwe stekker aangezet. Breuk zat vlak bij de stekker		10	Nee		
	nieuwe stekker aan het snoer gezet		9	Niet van toepassing		
	schoongemaakt en gesmeerd		8	Niet van toepassing		
	breuk in draad gerepareerd (bij stopcontact)		9	Niet van toepassing		
	Eigenlijk niets, geen gebreken gevonden		10	Niet van toepassing		
	Nieuwe stekker aangezet		10	Niet van toepassing		
	Schakelaar met succes hersteld		6	Niet van toepassing		
	Schakelaar gerepareerd, moet wel vervangen worden!			Niet van toepassing		Origineel nummer 996500042585 philips 6.27.56.21-0
	Bypass schakelaar		8			
			6			
		niet te openen, motor lager versleten	4			
	Open gemaakt en nieuw snoer van 10 euro		5	Nee		
	Nieuw oprolmechanisme geplaatst		2	Ja	Door gebruikers gemaakt	

Success rate:
25/33, 75%

Average score:
6,2/10

Use of guidelines:
2/33, 6%

Appendix E: Examples of disassembly diaries

Disassembly diary of the FC9569/01

First observations

Compared to the FC9934/07 the volume of the product is smaller. There are many design aspects shared with the bag FC8924/01, like the exhaust grill panel, the cord winder outlet clip and the back feet for vertical positioning (bigger that those of the FC9934/07). On the 9934 there are more independent aesthetic casings, while on the 9569 almost all the aesthetic external casing is incorporated in the top handle design. Also the structure of the first motor filter has been simplified, and it does not present the outer ABS chase anymore. Finally the hinge system to remove the dust bucket is independent from the product handle in the 9569, while in the 9934 it is integrated.

Some parts indicated as service parts were not considered in the assessment, since they have been not taken in account in the previous assessments as well (because they were not service part). Moreover, these components are not functional parts and they are not present in the list of call rates. Almost all of them can be removed just with the use of the hand, and with type 1 force intensity. These parts are 19-20-21, the hose connector to the canister body. They are numbered in the exploded view, but no service code nor name is indicated for these parts.
The same is valid for parts 38 and 39, which are supposed to be a fabric component which absorb motor vibrations. They are indicated in the exploded view, but neither name nor service code is included.
Parts 46, 47, 48, 43, 44, which are TPU seals, have been excluded as well, since they are easily disassemble and not related to any service code or name.

Troubleshooting

No troubleshooting is included in the service manual, like the 9934. Some pictures are included to explain partial disassembly, but they do not cover the complete disassembly procedure.

6. Tri-Active+ LC nozzle

Simple push button. Does not require any previous step

3. Crevice nozzle Zephyr

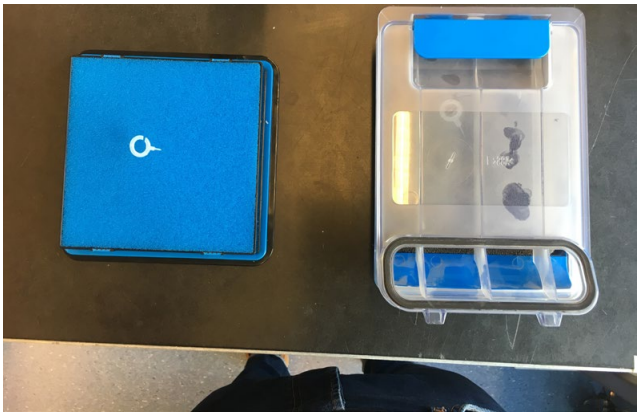
Friction fit extraction type 1. Does not require any previous step

4. Tube clip Zephyr

Snap fit hand. Type 2. Does not require any previous step

Comparison between FC9934 and FC9569 (top view)

Comparison between FC9934 and FC9569 (back view)



Comparison between the filter of the FC9934 (left) and the one of the FC9569 (right)

Longer back supports on the rear housing of the FC9569 for better stability in vertical position.

2. 2-Piece T.T. Tube
Snap fit hand type 1 push button. It. Requires previous disassembly of part 6

111. Hose assy Zephyr
In this model it is actually possible to disassemble the hose from the handle. However, the disassembly is difficult, since it is composed by a snap fit system not optimized for hand disassembly and it requires the use of a spudger with high force, wearing the junction during the procedure. It is also required to disconnect the hose from the canister body, with a Push button, snap fit hand 1. It does not require any previous disassembly. Part 111 does not really exist in the official BOM, where the official component is component 1. This component is the assembly of hose and handle (part 110). However, the hose is a priority part, therefore it has been analysed separately.

110 . C-Bend + Integrated brush
It requires the disassembly of part 2, but it is part of component 1. Therefore, it can be considered as a parallel path to n.1. This part requires the disassembly of part 2.

7-8. Dust bucket assy incl. Vortex
Push button, independent from any assembly

7. Dust bucket Lid
Snap fit with spudger, type 2 to divide 7 from 8. 7 Independent from any assembly

8. Dust bucket assy incl. Vortex
Push button. It is dependent from the disassembly of part 7.

36. Motor housing seal
The seal can be disassembled just after removing the bucket assembly 7&8. Apart from that it does not require any other disassembly. It can be removed by the help of a spudger (Friction fit type 1)

9. Integrated filter
Snap fit hand type 1, simple extraction. It requires disassembly of bucket assembly 7&8

15. Exhaust grill
Simple extraction pushing a button. It does not require any previous disassembly

16. Exhaust filter Zephyr LP
Simple extraction pushing a button. It requires the disassembly of part 15.

22. Casterwheel assy
The vacuum cleaner has to be moved upside down, since the assy is positioned beneath the product. It can be removed with a spudger (snap fit type 2). It does not require any previous disassembly.

Disassembly of the handle from the hose using a spudger

12. On/off button + CW button
As already found in the previous canister models analysed, the buttons represent a very complex part to disassemble. The main problem is that they require to apply high force with a spudger (Snap fit, type 3, spudger), and it is not clear where to apply force. This often leads to break the snap fit connectors. The design has been slightly improved in the newest products analysed (FC8924 and this model), where there is not a casing between the two buttons and, pressing one of them, it becomes easier to reach the snap fit hidden beneath the other. The buttons of the FC8924 were easier to disassemble compared to those of the FC9934 and of the FC9569.
The disassembly procedure involved pressing one button once, and then 3 snap fit type 3 spudger for each button, with low visibility. There is risk of breakage and the aesthetics of the buttons and of the surrounding surfaces is compromised after the disassembly. They do not require any previous disassembly

11. Top cover
To remove this cover, 6 screws have to be removed (Ph. 1). There are also two snap fit type 3, hidden that has to be unlocked from part 10 (Handle cover). It is very difficult to understand where to apply force with the spudger, and It is not clear from the user manual.

This part requires the disassembly of assembly 7&8 and the disassembly of the Buttons 12. This is something new compated to models 9934 and 8924, where the disassembly of the buttons was not required. This will make the disassembly deeper for many other components that will follow.

10. Handle lower cover
Unscrew two screws B (PH. 1). It requires disassembly of part 11.

24. Middle housing
Friction fit removal from the rear housing holder. It requires disassembly of part 11.

28. Power slider assembly

This assembly is actually composed by part 26, 27,28,29, which do not have a service code and are difficult to divide. They do not seem important parts which would break easily. To disassembly this part two snap fit type 2 spudger have to be disconnected. It requires previous disassembly of part 24.

17. Frame Right

Frame right and frame left (17 and 18) requires the same disassembly procedure (2 Snap fits, by hand, type 2). They do not have any service code but, since they are quite important for the aesthetics of the product, and since they are exposed to impacts, they have been included in this assessment. They require only the disassembly of part 11.

21. Hose connector

The hose connector is not integrated in the Upper housing design, like in the FC9934, but it is an additional component. It does not have any service code, but this can be due by the low failure rate and functional importance of this part. It can just be removed with a Friction fit type 1 hand, immediately after the removal of frame 17 and 18. It Is also the only component to require the disassembly of the hose assembly (just push button).

30-31 Rear housing cover and power slider PCBA

The disassembly of these two components is connected. It is impossible to disassemble them independently. First 4 screws D (PH. 1) have to be removed to disassemble part 30, then two screws C (PH. 1, but smaller than the others) have to be removed to disassemble the PCBA. There are two snap fit hidden behind the wheels that have to be opened. They require high force, but the PP case wears very easily. It was impossible not to ruin the aesthetic of the cover, since there was no visibility and it was not clear where to place the spudger. Finally, the PCBA has to be disconnected by the main PCBA (Cable Plug). Part 30 and 31 require the disassembly of the buttons and of the top and handle covers and of the power slider assembly (28). They do not require the disassembly of 17,18, 21.

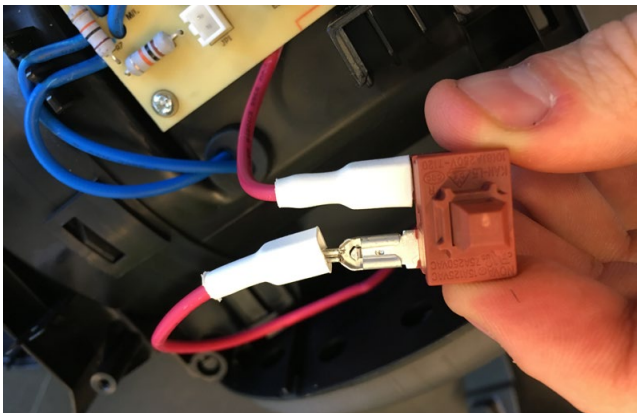
13. Cord outlet

The design of the cord outlet has been dramatically improved compared to the FC9934 and FC8924. It makes the extraction of the wire way easier, and just in one component instead of two.
To remove this part, it is required just to unscrew one screw E (PH. 1). It requires the disassembly of part 30.

32. Cord-winder Zephyr

In this model there is not cord winder cap. In general, the design of the cord-winder has been improved, integrated different part In the cord-winder itself, and saving other bulky components on top of it (like on the FC9934 and on the FC8924). To disassembly the cord-winder it is necessary to remove it from the canister body. The procedure of extraction is a hand snap fit type 2, since it requires the entire hand and medium intensity force. Eventually, two cable plugs, that connect the cord-winder to the motor, have to be disconnected. This component requires the disassembly of part 13.

Interesting design of the cord-outlet, which facilitate the disassembly of the cord winder.



Switch not soldered on the PCBA, but connected using wires

35. Switch

This component cannot be disassembled in the previous models assessed (FC9934, FC8924). In this case it can be disconnected through 2 cable plugs from the pcb and the cord winder. It requires only the disassembly of part 30, not of the Cord-winder or of the cord winder cap. It's disassembly is not required by any other component.

In order to disassembly any step further the vacuum cleaner it is necessary to remove 4 screws F and 2 screws G. The screws G are positioned on the bottom of the product, requiring manipulation. Contrary to what observed in the previous models assessed, this time there is enough space to insert a long but still common tool screw driver to reach the deep screws of the motor housing. The motor is the removed from the canister body (Friction fit type 2 hand).

41. Rearwheel assy

This part is designed differently this time copared to the FC9934 and FC8924, presenting a unibody plastic design. To extract the wheels from the canister body it is required to open 5 snap fit high intensity with a spudger. The operation is extremely difficult, since the snap fits present a very big ribs, which make the snap fit very rigid and not flexible enough for disassembly. The wheel can be removed only deforming the snap fits in such a way that the wheel cannot be reused anymore. This design is definitely worse compared to the one of the FC9934 and FC8924, where a removable iron ring is used to keep the wheel in place.

Disassembly of the wheels on the FC9934 and FC8924, removing a metal ring which fastens the wheel bearing

37. Safety Valve assy HP

To disassemble this valve it is required to open it with a spudger (snap fit type 1), like in the FC8924. On the contrary the FC9934 did not required any spudger, but it was just a friction fit system. This component requires the removal of the motor housing from the canister body.

49. Motor housing lid

Three screws H have to be removed before opening 4 stapfit type 2 spudger. This is different compared to the disassembly of the lid of the FC8924, where there were not screws but just Snap fits. This could be due to the bigger structure of the lid. Product manipulation was required since the connectors are placed all around the component. This component requires the removal of the motor housing from the canister body.

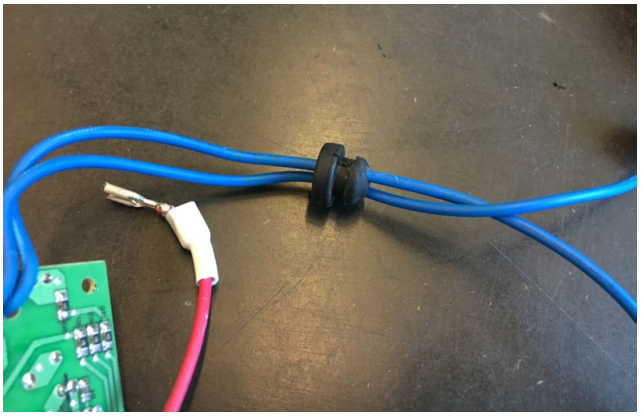
Wheel fastening system in the FC9569, composed by robust snap fits which have to be broken in order to disassemble the wheel

45. CDS Motor CDS-EY29-008 1800 W

The motor can be disassembled only after opening the motor housing lid. It has to be disconnected from the PCBA, opening two cable plugs connectors using a lever. Product manipulation is required, since the part is heavy and the connectors are on its opposite sides.

31. PCBA

To remove the PCBA, the cables that were connected to the motor have to be extracted from the motor housing (Snap fit hand type 3). The extraction actually requires high force, since the wires are kept In place in the motor housing hole by a big TPU seal. Then two Screws I (PH 1) have to be removed. This part required the removal of the motor to be disassembled. Disassembling part 31, also part 50 is obtained.



Rubber seal which fasten the wires connecting PCBA and Motor through the motor housing

Final observations

Almost all the disassembly could be carried out without removing the hose! The cord winder design has been drastically improved, simplifying the number of parts required. The motor is horizontally positioned, like in the bag FC8924. Also in this case there is a new net in front of the motor mouth, which supposedly avoid dust and dirtiness to get in. Also in this case, the cord winder, the motor and the PCB are closely connected, and their disassembly is not independent from each other. A initial improvement would be to place the connectors from the motor to the cord winder, on the top and not on the side, where they cannot be reached.

The cable plugs used in this model are more difficult to remove compared to the other vacuum cleaners assessed. They requires the use of a spudger most of the time to be opened (Cable plug labeled or L<20mm with leaver and force <5N & D>3mm).

The disassembly of this vacuum cleaner is comparable to the one of the FC9934. It is composed by less components and the disassembly time is shorter. Compared to the 9934, it requires the disassembly of buttons to disassemble most of the inside components, requiring higher deepness of disassembly. I also present an upper and lower housing, compared to the FF9934, where there is just a lower housing. This additional component complicates the product architecture, which could be based on just one external housing. This choice might be due to aesthetics reasons (the two different components are colored in two different ways), and economic ones (the upper housing in ABS, while the lower housing is in PP, a cheaper solution).

Screw hidden on the back of the product, to disassemble the upper clump

Single step disassembly of the upper clump, composed by all the plastic casings.

Disassembly diary of the Samsung SC8835

General observations before the disassembly

This model seems very similar to the Philips bagless canisters. It presents an additional caster wheel on the bottom back, which allows to move the canister even in vertical position. The product handle is positioned on the front of the item, requiring to orientate upwards the hose connector in oblique position. The bottom housing presents a marked indentation, which supposedly keep in place the Cord-winder inside the canister.

Compared to the Philips vacuum cleaners analysis, for the competitors it has been decided to focus only on the disassembly of priority parts, avoiding a complete disassembly. This is due to time limitations and to missing service manuals, which couldn't be found. Therefore, for this model there are not service codes and official part numbers. The disassembly has been conducted based on the experience acquired in the previous disassembly and from YouTube amatorial disassembly videos found on the internet. The procedures followed might not be the official ones suggested by the manufacturer to official repairer.

1. Nozzle

The disassembly of the nozzle is a simple "push button" and extraction. It is very similar to what observed for Philips products. This part is independent and does not require any previous disassembly.

2. Hose

The hose can be completely disassembled from the handle. This was observed just for the FC9569/01, but not for the FC9934 and the FC8924. It can be removed using a spudger, disconnecting two snap fit level 2. These seems to be easier to disassemble compared to those observed in the FC9569.
After that it is necessary to disconnect the hose from the canister body, pressing a lever (push button, snap fit type 1 hand). This part is independent and does not require any previous disassembly.

3. Bucket

In order to disassemble the inlet filter, the bucket has to be disassembled first. It can be removed simply pressing a button and then removing it from the canister body.

4. Inlet filter

The filter can then be removed opening a snap fit by hand type 1, and extracting the filter (friction fit type 1 hand)

5. Upper housing clump

The procedure to get to the PCBA is extremely simple. It is necessary first to remove the upper housing. This part has been numbered as part 5. The upper housing is a big plastic clump, that includes buttons, potentiometer to regulate the power, hose connector, and seals to the hose and to the inner motor. All this part can be disassembled just removing 5 screws Phillips 2, for then lifting up the clump. This disassembly requires the disassembly of the hose and of the bucket, but it doesn't require to disassemble neither the back exhausting grid nor the outlet filter.

6. Electric board (PCBA) and switches

The PCBA is reachable immediately after removing the upper housing. Thanks to many electric connectors placed on it, it is possible to disconnect it immediately from the motor, cord winder and pressure sensor. (3 cable plugs). It is kept in place by a screw Phillips 2, which has to be removed as well.

7. Rear housing

Beneath the upper housing there is the rear housing. This can be disassembled removing 4 screws Phillips 2. In this model, the upper housing is another big clump, which incorporate the cord winder cap, the cord winder lever, the safety valve and the motor duct to the dust bucket. In order to disassemble this part, it is required to at least disconnect the wires connected to the PCBA, but the electric board can stay assembled on it. Even in this case, the back exhausting grid and HEPA filter can just stay assembled to it since it does not obstacle any disassembly. Compared to some of the Philips models, like the FC9934 and the FC8921, all the screws of the rear housing can be easily reached with common tools.

8. Cord winder

Immediately after the removal of the rear housing, it is possible to independently disassemble Cord-winder and motor. To free the cable, the cord outlet (part 8) has to be disassembled, using a spudger and applying a low intensity force (snap fit spudger, type 1). The cord winder is kept in place by a snap fit connection, which can be opened using two hands, but with medium force intensity (snap fit type 2 hand).

9. Motor Housing lid

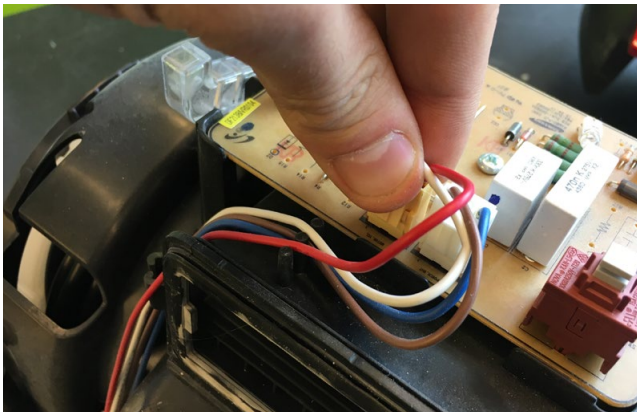
As in the Philips models, also in this case the motor is contained in a motor housing. This component can be opened and disassembled immediately after the disassembly of part 7 (rear housing). It does not require the disassembly of the cord winder, since its presence does not obstacle the removal of the motor, on the contrary of what observed in Philips vacuum cleaners. The lid can be opened removing four screws Phillips 2.

10. Motor

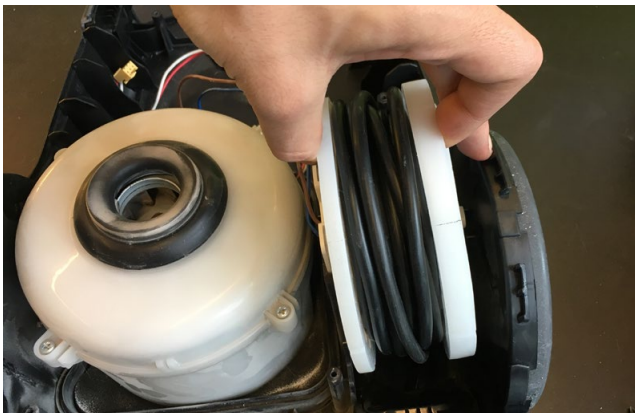
The motor can be disconnected from the motor housing removing two screws (Phillips 1) placed on the back of the motor. This action require manipulation, since the motor is heavy.

11. Motor brushes

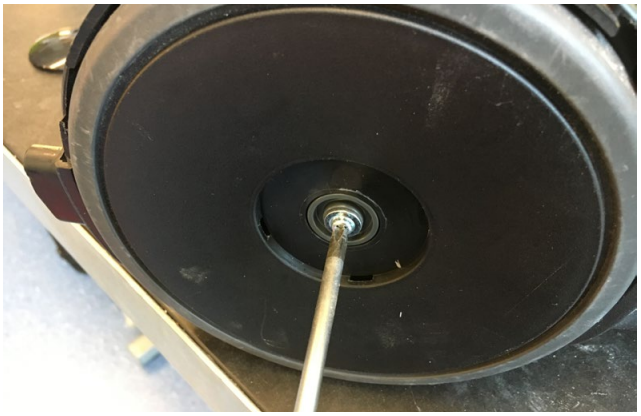
Compared to the motors found in the Philips vacuum cleaners analysed, this motor presents brushes externally positioned. They are easily reachable, and they can be disassembled just removing a screw (Phillips 2). Since this component is included in the priority part list of the JRC, it has been included in this analysis. The disassembly of the motor brushes requires to remove the motor from the motor housing.



Connectors on the PCBA, which allow to easily disconnect cord-winder and motor



Independent disassembly of cord-winder and motor assy



External disassembly of wheels, through an hidden screw on the wheel itself

12.Wheels

The wheels are extremely easy to disassemble. They do not require any previous disassembly. The fasteners that connect them to the canister body is a screw, hidden behind a plastic cover. The plastic cover (part 13) can be removed with a snap fit spudger type 2, and then the screw can be removed.

Considerations after the disassembly assessment

In this model it is definitely easier to reach all the priority parts compared to the Philips vacuum cleaners analysed. The is composed by clumps, sub-assembly of not priority part which can be removed all together. The disassembly procedure didn't require any un-common tool, and all the fasteners are clearly visible and easily reachable. The process is linear and clear: even if no service manual was used, all the disassembly steps were intuitive. No part or connector was broken during the entire procedure and all the disassembly has been carried out with confidence. Noticeable design solutions that improve repairability are:

- the use of electronic connectors on the PCBA, which allow to disconnect the electric board from motor and cord winder
- The design of the wheels does not require to open the product in order to disassemble them, but all the procedure can happen just from the outside
- The rear housing integrated together components that are currently divided in the design of Philips vacuum cleaner (cord-winder cap, cord-winder clip, rear motor housing), allowing to remove all these different cover layer in just one step.
- The cord winder and the motor are internally positioned in such a way that they do not obstacle the reciprocal disassembly. This means that motor and cord-winder can be extracted from the canister body independently from each other.
- The top housing is a big clump composed by buttons, power knob, aesthetic casing, middle housing, hose connector. All these components are assembled to each other using screws placed internally, on the side not visible by the consumer (preserving aesthetics). This big sub-assembly is connected to the rest of the body by screws hidden beneath the dust bucket. On the side, the top housing is connected to the back housing through snap fits which do not require high intensity force for disconnection.

Disassembly diary of the Rowenta RO6963EA

General observations before the disassembly

The canister structure is very similar to Philips vacuum cleaners: main canister body with a dust bucket on the top. The handle of the product also keeps in place the bucket, which can be released pressing a button. There are no visible screws; some of them are probably hidden beneath the bucket. The HEPA filter is positioned behind the dust bucket, on the front of the product. This placement of this filter is different from what observed on all the other canister analysed, where the filter is always positioned on the back of the product, guiding the airflow from the front of the product to the back. Here it seems that the motor sucks air from the top of the dust bucket (where the motor duct is positioned), and it expel it on the bottom front.

Big upper clump, grouping together all the plastic covers

Compared to the Philips vacuum cleaner's analysis, for the competitors it has been decided to focus only on the disassembly of priority parts, avoiding a complete disassembly. This is due to time limitations and to the lack of service manuals, which couldn't be found. Therefore, for this model there are not service codes and official part numbers. The disassembly has been conducted based on the experience acquired in the previous disassembles and from YouTube amatorial disassembly videos found on the internet. The procedures followed might not be the official ones suggested by the manufacturer to official repairer.

Disassembly procedure

1. Nozzle

The disassembly of the nozzle is a simple "push button" and extraction. It is very similar to what observed for Philips products. This part is independent and does not require any previous disassembly.

2. Hose

The hose can be completely disassembled from the handle. This was observed just for the Philips FC9569/01, but not for the FC9934 and the FC8924. It can be removed using a spudger, disconnecting two snap fit level 2. These seems to be easier to disassemble compared to those observed in the FC9569, but comparable with the Samsung SC8835.

After that it is necessary to disconnect the hose from the canister body. In this case there are again other two snap fit level 2 spudger that have to be opened in order to obtain only the hose and not also the plastic connector.

3. Bucket

In order to disassemble the inlet filter, the bucket has to be disassembled first. It can be removed simply pressing a button and then removing it from the canister body. Since the procedure requires the use of two hands, but with low intensity force, the action can be described as snap fit hand type 2.
4. Inlet filter
The filter can then be removed opening a friction fit by hand type 1, and extracting the filter (friction fit type 1 hand with removal time)

5. On/off button & 6. Cord-winder button

In order to remove the upper housing, it is necessary to remove first the buttons (on-off, cord-winder). This is because two screws are hidden beneath them. The disassembly of this component is very hard, similar to what observed in Philips canister. In order to remove the buttons, it is required to disconnect a hidden snap fit type 3 spudger, and then extract the button with a hand and applying a high force (snap fit type 3 hand). In both cases the procedure led to the breakage of the hidden snap fit opened by hand. The main reason of breakage is that the hidden snap fit connector is made in plastic, and it is not flexible at all. Even the aesthetics of the surrounding plastic surfaces have been ruined because of the spudger positioning and force applied.

6. Frame right & 8. Frame left

In order to reach all the hidden upper housing screws, it is necessary to remove the two aesthetic frames. These frames are fastened to the upper housing through the two hidden screws (Torx 15) positioned beneath the buttons. After removing those, the frames can be disconnected using a spudger (1 spudger type 2 hand), and then 4 snap fit hand type 3. The procedure in not intuitive, and the snap fits are hidden. The frame is very flexible and it appears delicate; all the procedure is carried out without confidence, feeling the risk of breaking the connectors.

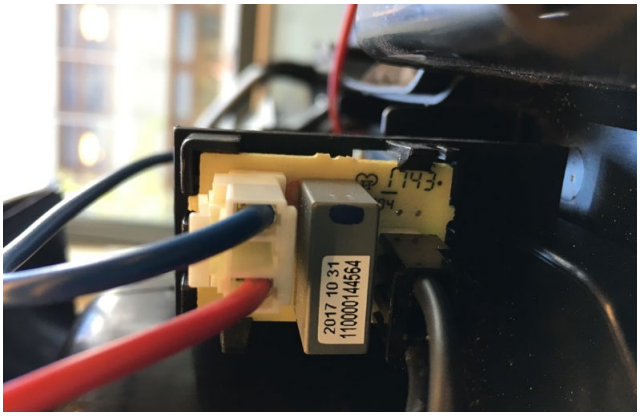
7. Handle opening lever

Even this component has to be removed (snap fit spudger type 2, it required two hands) in order to reach another hidden screw positioned beneath it. This screw has to be removed in order to disassemble the upper housing.

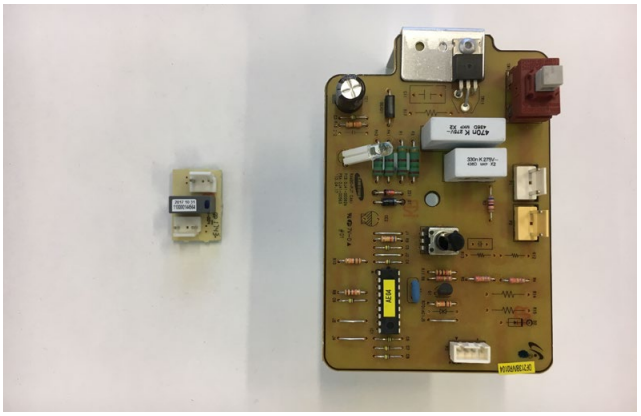
8. Upper housing

To disassemble this part, it is necessary to remove 7 screws (Torx 15). 6 of these were hidden beneath Frame right and left (7.,8.), while one was hidden beneath part 9. The housing can be removed after opening 4 snap fit type 3 with spudger. This removal is quite complicate, and it requires to apply a lot of force. It is not carried out with confidence and some snap fit got broken during the procedure. It was difficult to understand where to place the spudger, since all the snap fits are hidden. Eventually, two

Complex disassembly of buttons, necessary to reach hidden screws



Same type of connectors found on the Samsung PCBA



Considerable differences in the design of the Samsung and Rowenta PCBA

wires have to be disconnected. They connect the on-off switch to the pcba.

9. PCBA

The pcba is mounted on the motor housing. It is very small and simpler compared to those observed in either Philips and Samsung vacuum cleaners. It can be disassembled immediately after removing the upper housing, disconnecting the cord-winder and motor cable plugs. A very easy and straight forward operation. The board can be extracted using just fingers, but with high force (snap fit hand type 2).

10. Cord outlet

In order to disassemble the cord-winder, it is necessary to free the cord, opening the cord outlet. This part requires high force actions: first a snap fit type 3 spudger, then 2 snap fit type 3 hand. The component is solid and it does not break during the procedure. However, this step is not carried out with confidence, and it requires too much effort.

11. Cord winder

The cord winder does not require the disassembly of the motor housing since this one does not obstacle it extraction. In order to remove this part, it is necessary to disconnect the cable connector that connect the cord winder supply output to the PCBA. However, it does not require the complete disassembly of the PCBA. This design makes the cord-winder independently disassemblable from PCBA, motor housing and Motor. The part can be extracted opening a snap fit type 1 hand (just using fingers). It is an extremely easy procedure, one of the easiest cord-winder extraction compared to the Philips and Samsung models analysed.

12. Motor housing lid

The motor housing lid can be disassembled removing 4 screws (torx 15).

13. Motor

The motor can be disassembled unplugging two connectors coming from the PCBA. The disassembly of this part do not require the disassembly of the PCBA.

14. Motor brushes

As seen on the Samsung model, also with this Rowenta vacuum cleaner it is possible to disassemble the motor brushes. This can be done removing 2 screws (Phillips 2).

15. Wheels

The disassembly of the wheels has not been carried out. Different alternative disassembly processes have been tested on them, but it appears that the only way to disassemble them is to break the snap fits that connect them to the canister body. Since these snap fits are part of the plastic body of the wheels, it can be argued that in case of replacement, also the snap fits would be replaced. Therefore, even if these connectors have to be broken, this does not obstacle repairability of this part (As also argued by the JRC and the Benelux study). The procedure has not been tested, since this would have compromised the functioning of the product, but it can be suggested that there are at least 3 snap fits type 3 spudger that have to be broken before being able to extract the wheel. These snap fits can be reached from the outside of the product, without requiring any previous disassembly.

Considerations after the disassembly assessment

The disassembly of this model was relatively difficult. The main reasons are:

- Screws hidden beneath many plastic layers
- Plastic layers assembled on each other using high intensity force snap fit that require the use of a spudger

However, some clumping has been observed. The first one is the upper housing, which incorporates buttons and the hose connector to the canister body. The second one is the lower housing, that includes the motor housing and the mounting of the HEPA filter. Furthermore, in this model there is no rear housing! Everything is mounted on the upper housing. This design is very similar to the one observed in the FC9934, where the canister is just composed by right and left frames, followed by upper housing and eventually motor housing. Even the motor orientation is the same (vertical). However, compared to the FC9934, the disassembly of the motor is easier because of the smaller dimension of the motor housing lid, easily reachable screws and pcba not positioned on the top but on the side of the housing.
The disassembly of the cord-winder was extremely easy in this model. It just required to open a snap fit using hand and low force intensity. Moreover, thanks to the internal disposition of the components, it was possible to remove cord-winder and motor independently from each other. The independent disassembly of PCBA, Cord-winder and motor has been allowed by the use of cable connectors on the PCBA, instead of soldering the wires on it, and from the space between the different components.

The PCBA of this Rowenta model is way smaller than those found in all the other Philips and Samsung vacuum cleaners. The reason might be that in this model the PCBA is composed by just a simple capacitor and switch, while in the other models assessed it is also present an EC control system for the motor. EC motors are motor which power is regulated based on a pressure sensor. Based on the suction power read from this sensor, the power of the motor is regulated, making it more energy efficient.

Disassembly diary of the Siemens VS06A111/12

General observations before the disassembly

This canister is compact, there are no visible screws (probably some of them are positioned beneath the upper housing. There is an on-off button, which is also a power selector (potentiometer knob). It is clearly visible that the upper housing is just a lid and it can be opened using a handle on the top. The outlet filter is on the top, beneath the upper housing, therefore it is assumable that the motor inside is vertically oriented. As most of the bag canister, the inlet filter is positioned behind the dust bag, and it can be easily removed. This model presents a hinge on the front, which allows to open and close the upper housing (as also observed in the Philips bag canister FC8924). The model serial number is clearly visible on the bottom of the product. Moreover, at the bottom it is possible to observe three "caster" wheels; this is a very different design compared to the traditional one observed for Philips, Samsung and Rowenta products, where usually there is just one caster wheel on the front, and two big side wheels on the back. This will definitely facilitate their disassembly, since in the past it was just enough to use a spudger.

Disassembly procedure

1, Nozzle

The disassembly of the nozzle is a simple extraction low intensity force (Friction fit, type 1 hand, with no removal time). This part is independent and does not require any previous disassembly.

2. Hose

The hose can be completely disassembled from the handle. This was observed just for the Philips FC9569/01, but not for the FC9934 and the FC8924. It was observed in the Samsung and the Rowenta models. This time the two "push buttons" connector on the handle side can be disconnected by hand, without the use of a spudger. This is because the snap fits are more flexible compared to the other hose connectors observed.
After that it is necessary to disconnect the hose from the canister body, pressing a push button snap fit. This connector is exactly the same observed in the Samsung SC8835. This part is independent and does not require any previous disassembly.

3. Wheels

As introduced before, the wheels are all "caster" wheels. They can be all disassembled immediately from the outside of the product, without requiring any previous disassembly. In order to remove them, it is necessary to disconnect a friction fit type 2 spudger. This step requires product manipulation, since all the canister has to be turned upside down in order to reach the bottom wheels.

Easy external disassembly of the wheels, using a spudger

Hidden snap fit connector behind the wheels, which fastens rear housing and lower housing.

4. Dust bag

In order to disassemble the inlet filter, the dust bag has to be disassembled first. The upper housing has to be opened, using a handle on the top of the product (Snap fit type 1 hand). The upper housing does not have to be completely disassembled. After that the dust bag can be removed by hand, using mainly fingers (Snap fit type 1 hand). All this procedure, including the opening of the upper housing, can be carried out with the hose still connected to the canister body. Hence, this step does not require any previous disassembly.

5. Inlet filter

The filter can then be removed by hand (snap fit by hand type 1). This step requires the previous disassembly of the dust bag.

6. Rear housing

The rear housing is positioned immediately beneath the upper housing, which can be easily opened through a handle on the top of the vacuum cleaner. 3 screws (Torx 15) have to be removed first. They are clearly visible and reachable immediately after opening the upper housing. To complete the extraction of the rear housing, it is necessary to disconnect two snap fits, spudger, high intensity force. These snap fits are completely hidden beneath two bottom caster wheels, which have to be removed in order to reach the two connectors.

This sequence includes product manipulation, since the canister have to be turned around and flipped multiple times in order to dis-attach the rear housing. The disassembly of this part requires the disassembly of the two bottom back caster wheels (beneath which 2 snap fits are hidden), and the opening of the upper housing (through the top handle). It does not require nor the disassembly of the hose, neither the removal of the inlet filter. Once the rear housing is removed, PCBA, Cord-winder and Motor are exposed and easily reachable.

7.PCBA

The electric board can be extracting from the bottom housing using hand; however, this part seems very delicate and two hands and high intensity force have to be applied (Friction fit type 3, hand). After this, two cable plugs have to be disconnected from the motor. These two cable connectors are positioned in such a way that they are extremely easy to reach.

8. Cord-winder

The cord winder can be disassembled immediately after extracting the PCBA (friction fit type 2, hand). However, it is not necessary to disconnect the electric board from the motor to remove the cord-winder; the PCBA can just be left connected.

9. Motor

The motor can be easily extracted from the bottom housing (friction fit type 1, hand). The removal of the motor requires the disconnection of the two cables that connect it to the PCBA. However, it does not require neither the extraction of the PCBA, not the one of the Cord winder.

10. Motor brushes

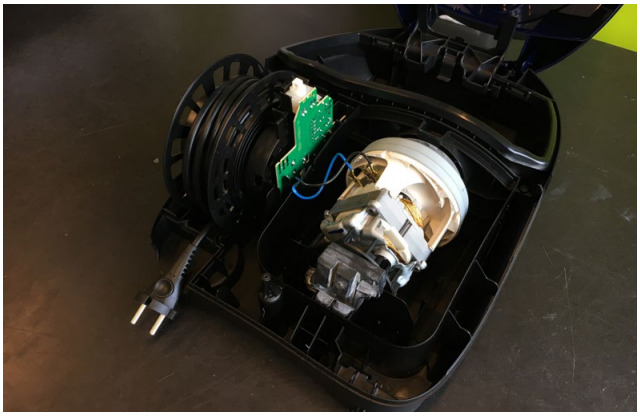
Also in this case, like the Samsung and Rowenta motor, it is possible to remove the motor brushes. The operation can be carried out using a plier, extracting the brush with a mid-intensity force (Friction fit type 2, spudger).

11. Aesthetic Upper housing

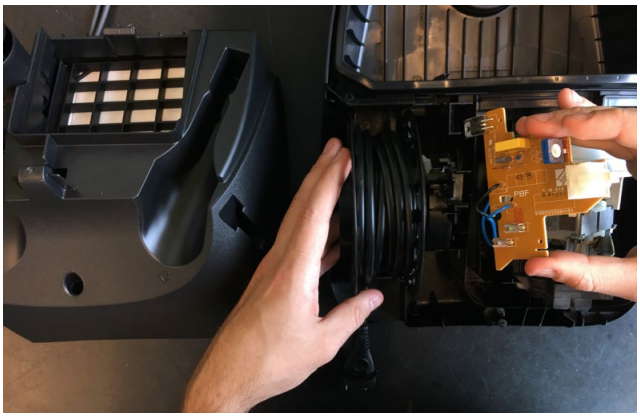
This component is not a priority part for repairability, but it might be a sensitive component for refurbishing. For this reason, its disassembly has been analysed as well. In order to disassemble the upper housing, it is necessary to open two snap fit connectors type 2 spudger. Before disassembling this part, it is necessary to unplug the hose from the canister body and open the upper housing.

Considerations after the disassembly assessment

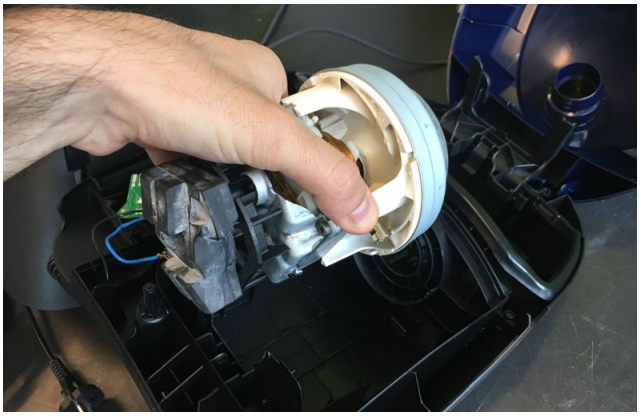
Since this assessment has been carried out without any service manual and previous disassembly experience on this model, it was impossible to know that two snap fits were hidden beneath the



Inner components immediately independently accessible after removing the rear housing



Parallel disassembly of PCBA, Cord-winder and motor



Easy vertical disassembly of the motor

Big plastic clump, grouping together rear housing and motor housing lid, removable together in one step.

bottom caster wheels. Therefore, the rear housing has been forced (using a spudger to disconnect the part form the bottom housing), and the snap fits broke. This was unavoidable, since it was impossible to spot the hidden connectors. Just after the disassembly, they have been identified and the procedure has been tested again following the correct sequence.
This model presents a unique design compared to the Philips, Samsung and Rowenta vacuum cleaners previously analysed. It is extremely essential, counting a total of 3 screws. The most interesting part is how Siemens managed to incorporate the motor housing lid in the rear housing, keeping them in place and fastened with the same 3 screws. These three screws fasten motor housing lid to the bottom housing, motor housing lid to the rear housing, and rear housing to the bottom housing. An extremely optimised design, composed by multiple clumps connected as a sandwich by a very small number of screws. Moreover, the internal components have been disposed in such a way that cord winder and motor can be independently disassembled. The entire product is composed by two big clumps:

- Upper and bottom housing, connected through a hinge at the front of the product. The bottom housing integrates also the bottom motor housing. However, the upper housing is in ABS, while the bottom housing is in PP. This mean that they would have to be disassemble for recycling purposes.
- Rear housing and motor housing lid, these two components are kept in place and fastened by the same 3 screws. By disassembling the rear housing, also the motor housing lid comes with it, revealing immediately the inner priority parts.

Disassembly diary of the Philips FC6812

Service manual

Very complete, more than FC9934. There are:

- Exploded view
- Complete list of components
- Disassembly sequence with pictures
- PCB schematic

Disassembly procedure

1. Nozzle

Push button to release it from tube and Friction fit extraction

5. Nozzle brush assy

Open using small handle snap and pull brush out. Very easy.

4. Rear wheel assy

Turn nozzle, Remove screw A (Phillips 00), and pull wheels out (snap fit hands).

1. Tube

Press button to release it from Handheld and remove with Friction fit

2. Integrated Brush

Remove two lateral screws B (Phillips 1), and then Snap fit by hand for removal (requires 2 hands).

31. Inlet Seal

The seal can be removed immediately after disconnecting the tube from the handhold. To remove it has been used a spudger (snap fit type 2, spudger).

6. Bucket assy EU for Handheld

Press button with one hand, extract the bucket with the other (Friction fit)

670. Filter assy

Remove the filter holder with a type 1 Friction fit by hand and then the filter with another Friction fit (Simple extraction)

28. Hook insert

Two screws 00 (M) has to be removed. The Hook can then be removed as a Friction fit type 1 by hand. Part 28 only requires the removal of part 6.

8. Battery pack holder service assy

Removing three screws Phillips 00, and remove the battery pack pushing on the edges with two fingers (Snap fit 3 hand). Even if there is a service number for the battery pack (810), it is impossible to remove it from the number 8. There are 8 small snap fits, which it is impossible to open without breakage.

9. Handle panel

Part 9 could be removed without removing part 8 before. But since part 8 is the battery pack, it is highly advisable to remove first 8 and then 9 for safety reasons, since under part 8 there are electronics connectors. There are two snap fits in the upper part of the handle. The part is flexible and the force to apply is high. There is high risk of breakage if the operator is not a semi-professional. Two snap fit on the top and a big snap fit on the bottom to remove by hand. The one on the bottom requires high force. Two snap fit broke in the procedure, even proceeding very carefully (one on the side, and one on the bottom). The main problem is that there are no indication of where the snap fits are. The indication is just on the top ones (space where to put screw driver).
There is no service number for this part, even if it seems high exposed to impacts during usage that could highly damage the product.

10 UI PCBA service assy

Remove screw from the top of the UI panel (Screw D, Phillips 00), disconnect connector to Service assy PCB (12), and remove the PCBA. The connector to

component 12 is very difficult to disconnect. There is no space to have leverage with the spudger. The only way to remove it is to pull it by hand applying a lot of force with the risk of disconnecting the wires to the connector.

710. Friction Interface
It is a rubber cover, that is just glued on the handheld, covering a screw. It has to be re-glued to be reused.

26. Bucket Release Button
This component is part of component 33. It can be disassembled by hand with some force (Snap fit 3 hand). It just requires the removal of part 9 and 10, but not of 8.

29. Frame
29 requires the disassembly of 26, but not of 8 since it can be pulled out from the inside. It can be removed with a spudger (Snap fit 2 spudger).

20. Screw cone
It's a basic screw with a cone on it. It is underneath part 710

7. There is no name of the part (unofficial name: Exhausting grill)
There is still no service number for this part, even if it is highly exposed to external impacts and therefore to be damaged. This might be due to the recent released of the product, a possible service number could be added later to the manual.
Remove screw E (Different screw again).

14. Sound reflector
Removed just as a Friction fit type 1 hand. No service code, but not really exposed.

15. Visual
Aesthetic cover. Removed just as a Friction fit type 1 hand. Exposed part to external impacts, high risk damage but no service number.

16. Visual cap inner
Aesthetic cover. Removed just as a Friction fit type 1 hand. No service number, internal part, lower risk of damage.
Part 15 can be removed without removing part 14.
Part 16 need to be removed after part 15 but it is independent from the removal of part 14.

12. Modified service assy
The motor's connection to the PCB are soldered. That means that to remove the PCB it is required to remove the motor. In order to do that 2 screws (G) have to be removed with a Phillips 00. Two cable connectors have to be disconnected from the PCB, it can be done by hand. The PCB can be extracted from the housing using a spudger; the procedure is quite complicate and the Snap fit that keep in place the PCB in the housing break easily (snap fit t3 spudger). After the PCB is extracted, there is a hinge connector that has to be removed. In order to do that the hinge has to be opened and the connector extracted.

22,23 - Panel Left
Very difficult to remove. There is almost no visibility on the Snap fit, it is very difficult to understand where to apply the high force required by this series of Snap fit type 3 spudger (7). Even being very careful, the aesthetics of the part is damaged after disassembly: they can still be mounted back, but they are visibly damaged. Many product manipulations are also required. In order not to damage the part, a not general tool has been used at the beginning (very thin spudger) to open the two covers. No Snap fit broken, but two have been damaged (top-back ones that you have to push).

33. Handle loop
Unscrew two screws 00 (K) and remove the part 33 (Snap fit type 1 hand)

11. Battery Pack Interface
A Screw 00 has to be removed to dis-attach 11 from part 33.

34. Frame Top
Remove two screws 00 (L) and then dis-attach 7 snap fit type 2 spudger. Two of them broke, but the force required was not higher than 20 N. Product manipulation required.

X.6 Nozzle belt
This component is not considered by Philips neither a priority part, nor a service component. Therefore, its disassembly or its position is not indicated in the exploded view shown in the service manual, and no spare part is available in case of replacement or malfunction. However, it is possible to disassemble this component, and the procedure has been analyzed.
Six components have been added to the official exploded view of the product in the service manual:
- x.1, Top casing nozzle 6
- x.2, Top casing lx nozzle 6
- x.3, Top casing rx nozzle 6
- x.4, Transparent cover nozzle 6
- x.5, nozzle motor
- x.6, nozzle motor belt

x.1 Top casing nozzle 6
All the casings and covers that compose nozzle 6 can be disassembled unscrewing 7 screws Phillips 1 at the bottom of the nozzle. However, this is only possible after disassembly component 4 and 5.
The disassembly order of the covers is: x.1, x.2, x.3, x.4

x.5 Nozzle motor
The motor placed in the active nozzle has to be

disassembled in order to reach the belt. In order to do it, it is necessary to remove two screws which fix it to the nozzle body.

x.6 Nozzle motor belt

The belt can be extracted from the nozzle body only after removing the motor. This can be done just using hand fingers (snap fit hand type one).

Optimization observation

The disassembly of the aesthetic panels 22 and 23 would result way easier if the Top Frame (34) could be removed before them. But this is not possible because in order to remove 34 it is required to remove 33. But to remove 33 the two screws K have to be removed, but they are hidden behind 22 and 23, making it impossible to be reached by a screw driver.
If the two screws K could be removed while part 22 and 23 are still on, the sequence would change in 33,34,22,23.

24. Charging Unit service assy

Remove screw 00 (J) and then extract from the back of the product the charging unit (snap fit hand type 2).

25. Wire assy

The wire assy connector can be removed from part 30 with a spudger (snap fit type 2, s). The snap fit broke during the procedure, but it can be still reused. Removing completely the part, the connector open automatically in two parts, releasing the wires inside that can be then removed through a hole.

30. Handheld Inlet

Firstly 4 screws have to be removed. They are all named Screws N, but two are Phillips 00 and two are Phillips 1. After that the part can be removed slicing it out (Friction fit type 1, hand). The product has to be manipulated a lot during the procedure to reach the four screws.

Final observations

Screws used in this model are very fragile and wear very easily. The motor is directly soldered to the PCB, therefore these two components have to be replaced together. The compactness of the product together with the high presence of electronics make the product difficult to disassemble. Although all the components can be reached, this require a lot of effort and complex procedures. Snap fit's are used extensively, lowering the disassembly time, but making the product more difficult do disassemble. No uncommon tool has been required during the disassembly, but many snap fit's broke while applying the high forces required with spudger. As it is possible to see from the results of the eDIM analysis, an important amount of time has been spent on positioning of the tools. This has been required since with high force snap fit's many times a repositioning of the spudger is needed to apply the high intensity force in the right spot, trying to avoid the breakage of the connector.
Many components are indicated as exploded parts, but few of them have a service code. This could be due to the relatively newness of the product, which has been on the market for less than one year at the moment of the disassembly analysis.
Compared to the bagless and bag canister models, this stick version contains in the service manual a comprehensive troubleshoot guide.
Compared to the canister versions analyzed, independently if bag or bagless, this model presents intensive use of different length screws. The head is most of the time a Phillips 00, but all the different lengths require to note down their different name and position all the time.

Disassembly diary of the Philips FC8924

Service manual

- Very short troubleshooting list at the end of the file
- Pictures for almost all phases disassembly

Disassembly procedure

2. to 6. Nozzles

Friction fit hand type 2, not difficult. Mid intensity force with confidence.

1. Hose

To dis-attach the hose from the canister bodies, a push button snap fit connector has to be open. Then the hose can be removed with a Friction fit type 2. Easy, with confidence, mid force intensity.

16- 17 Buttons

Open cover 14 (pressing a button). This is shared by number 16 and 17. Once done for part 16, it doesn't have to be do also for part 17.
Push the other relative button (if disassembling 16, push 17) to reveal and access to the snap fit beneath the button.
This snap fit is a type 2 spudger. The snap fit broke applying force; if the button is reassembled it still works, but aesthetically it is not aligned to the casing anymore. The problem seems to be the structure of snap fit, which is not enough strong; it is unclear where to place the spudger head and where to apply force. Perhaps applying force the a specific point on the snap fit it could work, but currently this is completely unclear.
The button can then be extracted, snap fit hand type 1.
NB. They are very difficult to reassemble. It really takes a big amount of time to reposition the snap fit in the right position.

18. Springs beneath the buttons
Friction fit type 1 hand. Not necessary disassembly, that can be neglected. It requires disassembly of part 16 or 17.

24. Switch lever
Part positioned beneath button 17. It requires only the disassembly of the button, not of spring 18. It can be removed with a snap fit type 1 spudger.

19. UI screen
It doesn't require neither the disassembly of 16 nor 17. It can be done immediately from the initial assembly.
Removal of the lid. Press button to open it (also covered in the disassembly of part 16-17), removal of the lid pushing with one hands (2 snap fit type 1 hand). Then the spring has to be removed (2 snap fit type 1 hand).
The UI screen can be removed disconnecting two snap fit type 1 spudger.

21. Led spacer
Requires removal part 19. Unscrew two screws A (Torx 15).

20. UI foil Thalys
It is just a foil with graphics. It requires to disassemble 21. Then Friction fit type 1 hand.

23. Light diffuser canister
Friction fit type 1 hand. Requires to remove 21, not 20.

22. Light guide housing
Snap fit type 1 hand. Requires to remove 23, not 20.

14. Dust cover assay
It requires all the steps before to be removed, including 16 and 17.
Removal of 3 cable plugs. The cover has to be opened using an handle (snap fit type 1, hand). Then two snap fit type 2 spudger.

8-9. Dust bag and internal plastic support
Part 8, 9 and 10, 11 can be disassembled almost immediately, just opening part 14 (snap fit type 1 hand). Before removing part 14, part 1 has to be removed. In order to remove part 1, in this case, It is not necessary to remove part from 2 to 6.
Part 8 and 9 can be disassembled one from the other with a Friction fit type 1 hand.

15. Dust chamber seal
This part can be removed immediately (Friction fit type 1, hand) after opening part 14, therefore at the same depth of part 8-9.

Assembly 10 and 11. Inlet grill Basic Blue 61192 and Triple inlet filter
It requires the previous disassembly of part 8-9 together; it is not necessary to divide them. Then Snap fit type 1 hand.

Dividing part 10 and 11
Friction fit type 1 hand from part 11.

12. Exhaust grill assy
It does not require any previous disassembly, but the product has to be manipulated and place upside down. Then the grill can be disassembled with a snap fit type 1 hand.

13. Elux HEPA 13 Non-washable filter
Part 13 requires disassembly of part 12. It can removed using a Friction fit type 1 hand.

25. Dust chamber insert Basic Blue 61192
This part can be removed just opening part 14. It does not require to disassemble anything else. Therefore it can be position in the disassembly map at the same depth level of part 8 and 9.
The part can be disassembled removing two of the 7 screws B (Torx 15). The chamber insert can be finally removed disconnecting 4 snap fit type 2 spudger.

26. Dust chamber Deep Black 80231
Part 26 can be disassembled removing the 5 remaining screws B (Torx 15). In order to reach all these screws, it is required to disassemble part 12 (not 13), part 14, part 25, part 8-9 and 10-11. Two of the 5 screws are positioned beneath the product, therefore manipulation is required. The part can be removed disconnecting 2 snap fit type 2 hand.

30. Cord-winder clip
In order to remove the Cord-winder and all the part connected to it, it is important to carefully "untighten" the cables connected to the PCB (3 Friction fit type 1 hand). After doing that, the PCB can be lifted up, and partially removed, creating space to remove the Cord-winder (Snap fit type 1, hand). Part 31 can be lifted up, disconnecting two snap fit type 1 hand. Part 30 can now be removed opening it (3 snap fit hand type 3), and leaving the cable coming out.

41. Heatsink seal
This seal can be removed after "untighten" the PCB cables (3 Friction fit type 1 hand), before removing part 30.

27. Cord-winder lever
After disassembly part 30, part 31 can be removed from the Cord-winder. Now it is possible to disconnect part 27, through a snap fit type 2 spudger.

28. Pedal spring and 31. Cord-winder cap
Part 28 can be removed from part 31 just with a Friction fit hand type 1.

29. Cord-winder Alpha /1/8m/Black/4.8/R
The cord winder can now be disconnected from the PCB (2 Cable plugs).

32. Motor inlet seal
This seal can be removed (Friction fit type 1 hand) immediately after removing part 26. It does not require to move PCB or remove the Cord-winder components.

38. RX and LX
These are the two wheels. From the service manual it is possible to find the service code for small components of the assembly of the wheels (36 and 37). These were not considered, since in the service manual of bagless canisters they don't result as service part. Considering them now would make it impossible to compare the number of steps to get to the wheels (a priority part) comparing wheels of the bagless with the one of the bag model.

43. Valve assy HP
Compared to the bagless valve, in this case there are three snap fit to open (snap fit type 1 spudger). They are very fragile (2 broke during the reassembly).

42. Motor housing lid
This part can be disassembled without removing 43 beforehand. The same is valid for all the other components inside the motor housing. To remove this lid, 7 snap fit type 1 spudger have to be opened.

39. Buffer ring front Global II
Rubber ring mounted on the motor (Friction fit type 1 hand)

44. Domus 230V/50Hz1800WIEC CCAW wire
It does not require to remove part 39 before.
Disconnection of the cable plug that connect it to the PCB.

47. Canister High range Main PCBA 750 W (1800)
Removal of the cable Motor-PCB from the motor housing (Friction fit type 1 hand).

34. Caster assy
This part can be removed immediately, without requiring any previous disassembly. It requires to manipulate the product, placing it upside down, and then remove it with a spudger (Snap fit type 2 spudger).

X. Aesthetic cover
This part can be removed only after disassembly the total cover (14). This component can be disassembled disconnected two screws Torx 15, and dis-attaching 10 snap fit type 2 spudger.

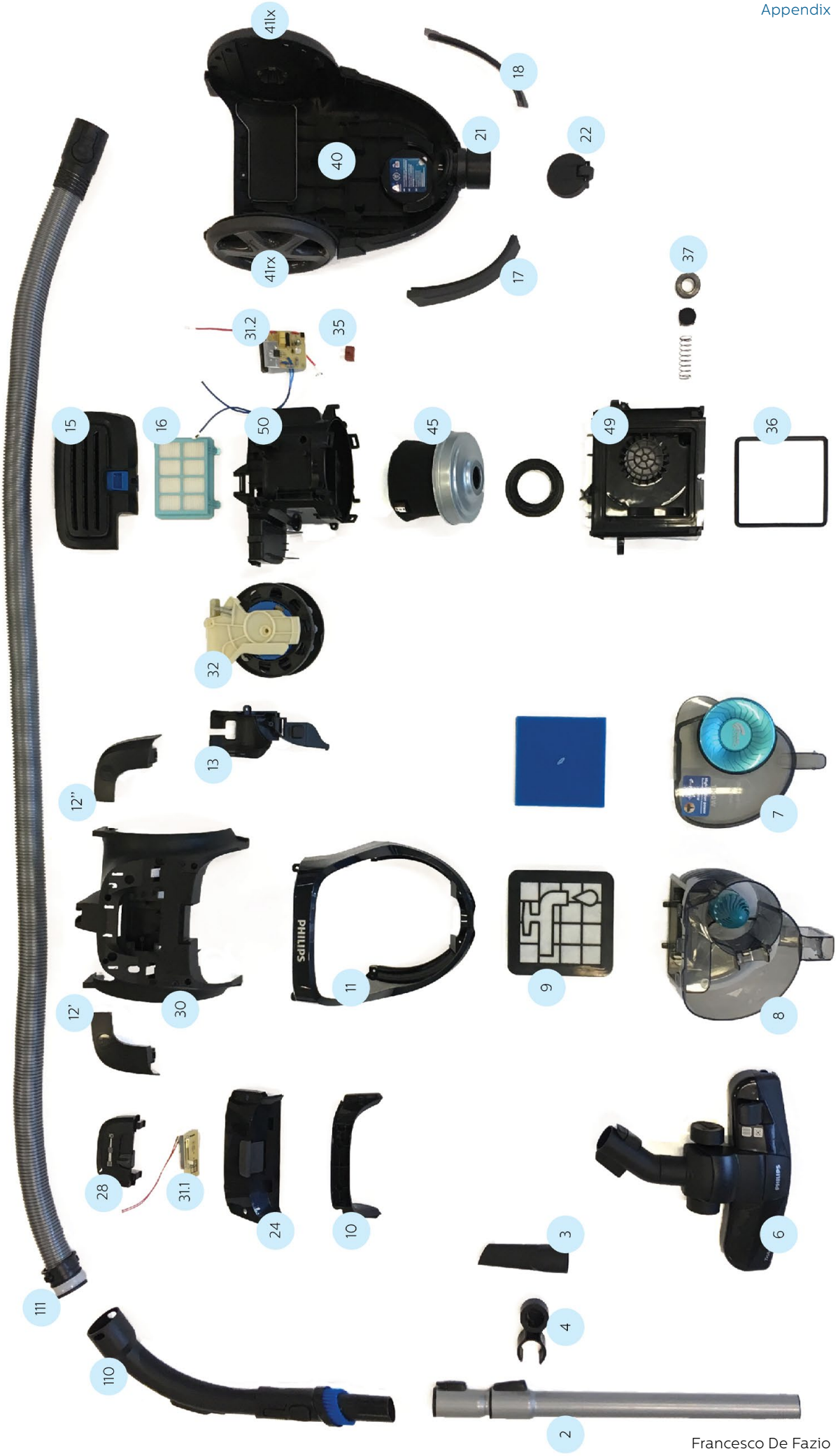
Final observations
The wheels of this bag canister are easier to disconnect compare to the bagless. On the other hand, the buttons are very complicate to reassemble.
The electronics does not seem to complicate too much the disassembly, on the contrary of the stick version, where the electronic made the disassembly of many different components very difficult.
The Cord-winder clip is way harder to disassemble compare to the one found in the bagless.
The motor is covered by many different layers of plastic in this model compared to the bagless. In particular the motor housing is composed by many different parts, like a housing cap. The horizontal inclination of the motor could be a good opportunity to disassemble it in a easier way compared to the bagless (Where it is vertical). But this is not the case, since the motor housing lid (42) cannot be open if first all the motor housing (48) is unscrewed and dis-attached from the main body (33).
Since the aesthetic of a product is very important in refurbished products, and since refurbishment is also partially covered in this research, the aesthetic external covers have been considered as important components to be analysed. If in the bagless two external covers can be easily dis-attached, in the bag one the aesthetic cover is not considered as a service component. However it is possible to disassembled it, and the phases have been included in the eDIM analysis of this model.

Appendix F: Pictures of the products completely disassembled

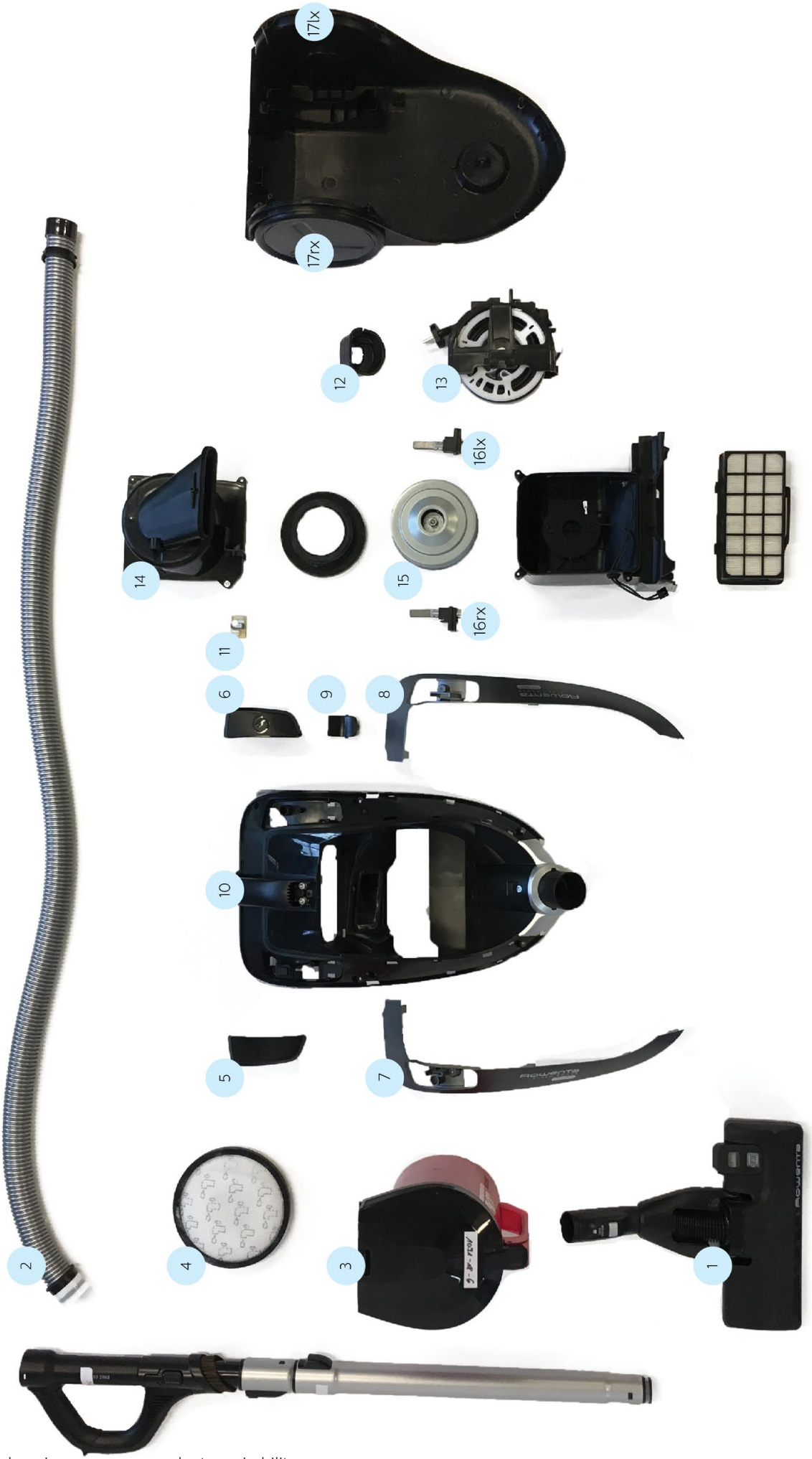
Complete disassembly FC6812/01

Complete disassembly FC9934/07

Complete disassembly FC9569/01



Complete disassembly Rowenta RO6963EA



Complete disassembly SAMSUNG SC8835

Complete disassembly Siemens VSO6A111/12

Appendix G: eDiM disassembly action sequences used in this research

Connector system label	Connector type characteristics	Tool	Tool Change Time (s)	Tool Positioning Time (s)	Disassembly MOST sequence
Screws same / component or labeled D<3mm and L<3mm Phillips screwdriver #1	Screws same / component or labeled D<3mm and L<3mm	Phillips screwdriver #1	1,4	2,5	5*|L1|+ |A1B0G1|+ |A1B0P1|
Screws same / component or labeled D<3mm and L<3mm 5-point Pentalobe Screwdriver	Screws same / component or labeled D<3mm and L<3mm	5-point Pentalobe Screwdriver	1,4	2,5	5*|L1|+ |A1B0G1|+ |A1B0P1|
Screws same / component or labeled D<3mm and L<3mm Torx T5 Screwdriver	Screws same / component or labeled D<3mm and L<3mm	Torx T5 Screwdriver	1,4	2,5	5*|L1|+ |A1B0G1|+ |A1B0P1|
Screws same / component or labeled D<3mm and L<3mm Phillips 00 Screwdriver	Screws same / component or labeled D<3mm and L<3mm	Phillips 00 Screwdriver	1,4	2,5	5*|L1|+ |A1B0G1|+ |A1B0P1|
Screws same / component or labeled D<3mm and L<3mm Torx T10 Screwdriver	Screws same / component or labeled D<3mm and L<3mm	Torx T10 Screwdriver	1,4	2,5	5*|L1|+ |A1B0G1|+ |A1B0P1|
	Screws different /component D<3mm and L<3mm	Phillips screwdriver #1	1,4	2,5	5*|L1|+ |A1B0G1|+ |A1B0P1|+|R6|
Screws same / component or labeled D>3mm and L>5mm Torx T15 Screwdriver	Screws same / component or labeled D>3mm and L>5mm	Torx T15 Screwdriver	1,4	2,5	10*|L3|+ |A1B0G1|+ |A1B0P1|
Screws different /component D<3mm and L<3mm5-point Pentalobe Screwdriver	Screws different /component D<3mm and L<3mm	5-point Pentalobe Screwdriver	1,4	2,5	5*|L1|+ |A1B0G1|+ |A1B0P1|+|R6|
Screws different /component D<3mm and L<3mmTorx T5 Screwdriver	Screws different /component D<3mm and L<3mm	Torx T5 Screwdriver	1,4	2,5	5*|L1|+ |A1B0G1|+ |A1B0P1|+|R6|
Screws different /component D<3mm and L<3mmPhillips 00 Screwdriver	Screws different /component D<3mm and L<3mm	Phillips 00 Screwdriver	1,4	2,5	5*|L1|+ |A1B0G1|+ |A1B0P1|+|R6|
Screws different /component D<3mm and L<3mmTorx T8 Screwdriver	Screws different /component D<3mm and L<3mm	Torx T8 Screwdriver	1,4	2,5	5*|L1|+ |A1B0G1|+ |A1B0P1|+|R6|
Cable plug labeled or L<20mm with leaver and force <5N & D<3mmSpudger	Cable plug labeled or L<20mm with leaver and force <5N & D<3mm	Spudger	1,4	2,5	|L1|+|L1|
Cable plug unlabeled with leaver and force <5N & D<3mmSpudger	Cable plug unlabeled with leaver and force <5N & D<3mm	Spudger	1,4	2,5	|A1B0G1|+|R1|+|A1B0P1| +|L1|+|L1|
Cable plug labeled or L<20mm without leaver and force <5N & D<3mmHand	Cable plug labeled or L<20mm without leaver and force <5N & D<3mm	Hand	0,0	2,5	|L1|
Cable plug unlabeled without leaver and force <5N & D<3mmHand	Cable plug unlabeled without leaver and force <5N & D<3mm	Hand	0,0	2,5	|A1B0G1|+|R1|+|A1B0P1|+ |L1|
Cable plug labeled or L<20mm with leaver and force <5N & D>3mmHand	Cable plug labeled or L<20mm with leaver and force <5N & D>3mm	Hand	0,0	1,4	|L1|+|L1|
Cable plug unlabeled with leaver and force <5N & D>3mmHand	Cable plug unlabeled with leaver and force <5N & D>3mm	Hand	0,0	1,4	|A1B0G1|+|R1|+|A1B0P1| +|L1|+|L1|
Cable plug labeled or L<20mm without leaver and force <5N & D>3mmHand	Cable plug labeled or L<20mm without leaver and force <5N & D>3mm	Hand	0,0	1,4	|L1|
Cable plug unlabeled without leaver and force <5N & D>3mmHand	Cable plug unlabeled without leaver and force <5N & D>3mm	Hand	0,0	1,4	|A1B0G1|+|R1|+|A1B0P1|+ |L1|
Hinge with force <5 NHand	Hinge with force <5 N	Hand	0,0	1,4	|L1|
Hinge with force <5 NSpudger	Hinge with force <5 N	Spudger	1,4	1,4	|L1|
Hinge with 5N<force <20 NHand	Hinge with 5N<force <20 N	Hand	0,0	1,4	|L3|
Adhesive with < 5 N peal of forceHand	Adhesive with < 5 N peal of force	Hand	0,0	2,5	|L1|
Adhesive with pull-off force < 5N Spudger	Adhesive with pull-off force < 5N	Spudger	1,4	2,5	|L1|
Adhesive with pull-off force < 5N Hand	Adhesive with pull-off force < 5N	Hand	0,0	2,5	|L1|
Adhesive with pull-off force > 5N / 5cm nominal lenght Spudger	Adhesive with pull-off force > 5N / 5cm nominal lenght	Spudger	1,4	2,5	|L6|
Temperature reversible adhesive > 5N / 5cm nominal lengthSpudger	Temperature reversible adhesive > 5N / 5cm nominal length	Spudger	1,4	2,5	|heat up=30s|+|L6|
Snap fit Type 1 SSpudger	Snap fit Type 1 S	Spudger	1,44	1,44	|L1|
Snap Fit Type 2 SSpudger	Snap Fit Type 2 S	Spudger	1,44	1,44	|L3|
Snap fit Type 3 SSpudger	Snap fit Type 3 S	Spudger	1,44	2,52	|L6|
Snap fit Type 1 HHand	Snap fit Type 1 H	Hand	0,0	1,4	|L1|
Snap Fit Type 2 HHand	Snap Fit Type 2 H	Hand	0,0	1,4	|L3|
Snap fit Type 3 HHand	Snap fit Type 3 H	Hand	0,0	2,5	|L6|
Friction Fit Type 1 SSpudger	Friction Fit Type 1 S	Spudger	1,44	1,44	|L1|
Friction Fit Type 2 SSpudger	Friction Fit Type 2 S	Spudger	1,44	1,44	|L3|
Friction Fit Type 3 SSpudger	Friction Fit Type 3 S	Spudger	1,44	2,52	|L6|
Friction Fit Type 1 HHand	Friction Fit Type 1 H	Hand	0,0	1,4	|L1|
Friction Fit Type 2 HHand	Friction Fit Type 2 H	Hand	0,0	1,4	|L3|
Friction Fit Type 3 HHand	Friction Fit Type 3 H	Hand	0,0	2,5	|L6|

	Disassembly TMU	Disassembly Time (s)	Total Disassembly Time (s)	Tool Change Time (s)	Tool Positioning Time (s)	Assembly MOST sequence	Assembly TMU	Assembly Time (s)	Total Assembly Time (s)	Total Assembly and Disassembly Time (s)
	90,0	3,2	7,2	1,4	2,5	5*|F1|+|A1B0G1|+|A1B0P6|	140,0	5,0	9,0	16,2
	90,0	3,2	7,2	1,4	2,5	5*|F1|+|A1B0G1|+|A1B0P6|	140,0	5,0	9,0	16,2
	90,0	3,2	7,2	1,4	2,5	5*|F1|+|A1B0G1|+|A1B0P6|	140,0	5,0	9,0	16,2
	90,0	3,2	7,2	1,4	2,5	5*|F1|+|A1B0G1|+|A1B0P6|	140,0	5,0	9,0	16,2
	90,0	3,2	7,2	1,4	2,5	5*|F1|+|A1B0G1|+|A1B0P6|	140,0	5,0	9,0	16,2
	90,0	3,2	7,2	1,4	2,5	5*|F1|+|A1B0G1|+|A1B0P6|+|I1|	140,0	5,0	9,0	16,2
	340,0	12,2	16,2	1,4	2,5	10*|F3|+|A1B0G1|+|A1B0P6|+|I1|	390,0	14,0	18,0	34,2
	90,0	3,2	7,2	1,4	2,5	5*|F1|+|A1B0G1|+|A1B0P6|+|I1|	150,0	5,4	9,4	16,6
	90,0	3,2	7,2	1,4	2,5	5*|F1|+|A1B0G1|+|A1B0P6|+|I1|	150,0	5,4	9,4	16,6
	90,0	3,2	7,2	1,4	2,5	5*|F1|+|A1B0G1|+|A1B0P6|+|I1|	150,0	5,4	9,4	16,6
	90,0	3,2	7,2	1,4	2,5	5*|F1|+|A1B0G1|+|A1B0P6|+|I1|	150,0	5,4	9,4	16,6
	20,0	0,7	4,7	1,4	2,5	|F1|+|F1|	300,0	10,8	14,8	19,4
	20,0	0,7	4,7	1,4	2,5	|F1|	150,0	5,4	9,4	14,0
	10,0	0,4	2,9	0,0	2,5	|F1|+|F1|	300,0	10,8	13,3	16,2
	10,0	0,4	2,9	0,0	2,5	|F1|	150,0	5,4	7,9	10,8
	20,0	0,7	2,2	0,0	1,4	|F1|+|F1|	20,0	0,7	2,2	4,3
	20,0	0,7	2,2	0,0	1,4	|F1|	10,0	0,4	1,8	4,0
	10,0	0,4	1,8	0,0	1,4	|F1|+|F1|	20,0	0,7	2,2	4,0
	10,0	0,4	1,8	0,0	1,4	|F1|	10,0	0,4	1,8	3,6
	10,0	0,4	1,8	0,0	1,4	|F1|	10,0	0,4	1,8	3,6
	10,0	0,4	3,2	1,4	1,4	|F1|	10,0	0,4	3,2	6,5
	30,0	1,1	2,5	0,0	1,4	|F3|	30,0	1,1	2,5	5,0
	10,0	0,4	2,9	0,0	2,5	|A1B0G3|+|L3|+|A1B0P6|	140,0	5,0	7,6	10,4
	10,0	0,4	4,3	1,4	2,5	|A1B0G3|+|L3|+|A1B0P6|	140,0	5,0	9,0	13,3
	10,0	0,4	2,9	0,0	2,5	|A1B0G3|+|L3|+|A1B0P6|	140,0	5,0	7,6	10,4
	60,0	2,2	6,1	1,4	2,5	|A1B0G3|+|L3|+|A1B0P6|	140,0	5,0	9,0	15,1
	8393,3	302,2	306,1	1,4	2,5	|A1B0G3|+|L3|+|A1B0P6|	140,0	5,0	9,0	315,1
	10	0,4	3,2	0,0	1,4	|F1|	10	0,36	1,8	5,0
	30	1,1	4,0	0	1,44	|F3|	30	1,08	2,5	6,5
	60	2,2	6,1	0	1,44	|F6|	60	2,16	3,6	9,7
	10	0,4	1,8	0,0	1,4	|F1|	10	0,4	1,8	3,6
	30	1,1	2,5	0,0	1,44	|F3|	30	1,1	2,5	5,0
	60	2,2	4,7	0,0	1,44	|F6|	60	2,2	3,6	8,3
	10	0,4	3,2	0,0	1,4	|F1|	10	0,36	1,8	5,0
	30	1,1	4,0	0	1,44	|F3|	30	1,08	2,5	6,5
	60	2,2	6,1	0	1,44	|F6|	60	2,16	3,6	9,7
	10	0,4	1,8	0,0	1,4	|F1|	10	0,4	1,8	3,6
	30	1,1	2,5	0,0	1,44	|F3|	30	1,1	2,5	5,0
	60	2,2	4,7	0,0	1,44	|F6|	60	2,2	3,6	8,3

Appendix H: eDiM calculation sheets

Philips FC6812

	1	2		3	4	5	6
Component Code	Disassembly sequence of components	Disassembly sequence of connections of components	Connector type	Number of connectors	Number of product manipulations	Identifiability (0,1)	Tool type
3000 014 67851	3. Nozzle	Push button	Snap fit Type 1 H	1			Hand
3000 005 19651	5. Nozzle brush assy	Extract brush using handle	Snap fit Type 1 H	1			Hand
3000 005 19701	4. Rearwheel assy	Screw A	Screws same / component or labeled D<3mm and L<3mm	1	1		Philips 00 Screwdriver
		Snap fit	Snap fit Type 1 H	1			Hand
3000 005 04471	1. Tube	Push button	Friction Fit Type 1 H	1			Hand
		Friction Fit	Friction Fit Type 1 H	1			Hand
3000 005 19761	2. Integrated Brush	Screws B	Screws same / component or labeled D<3mm and L<3mm	2			Philips screwdriver #1
		Snap fit	Snap Fit Type 2 H	1			Hand
3000 016 03101	6. Bucket assy EU for Handheld	Push button	Friction Fit Type 1 H	1			hand
		Friction Fit	Friction Fit Type 1 H	1			hand
3000 005 19471	670. Filter assy	Friction Fit	Friction Fit Type 1 H	2			hand
3000 011 83741	8. Battery pack holder service assy	Screw C	screws same / component or labeled D<3mm and L<3mm	3			Philips 00 Screwdriver
		Removing batter pushing with two fingers	Snap fit Type 3 H	1			hand
	9. Handle panel	Snap fits	snap fit type 3 s	2			Spudger
		Snap fit	Snap fit Type 3 H	1			hand
3000 005 19911	10. UI PCBA service assy	Screw D	screws same / component or labeled D<3mm and L<3mm	1			Philips 00 Screwdriver
		Connector to PCB 12	Cable plug labeled or L<20mm without leaver and force <5N & D>3mm	1			hand
		Pcb removal	Friction Fit Type 1 H	1			hand
3000 005 46161	710. Friction Interface	Adhesive WITH SPUDGER NOT HAND	Adhesive with < 5 N peal of force	1			Hand
3000 011 83721	20. Screw cone	Screw F	Screws same / component or labeled D<3mm and L<3mm	1			Philips 00 Screwdriver
	7. Exhausting grill	Screw E	screws same / component or labeled D<3mm and L<3mm	1			Philips 00 Screwdriver
		Friction Fit	Friction Fit Type 1 H	1			hand
	14. Sound reflector	Friction Fit	Friction Fit Type 1 H	1			hand
	15. Visual	Friction Fit	Friction Fit Type 1 H	1			hand
	16.Visual cap inner	Friction Fit	Friction Fit Type 1 H	1			hand
3000 030 06981	12. Modified service assy	Screw G	screws same / component or labeled D<3mm and L<3mm	2			Philips 00 Screwdriver
		Friction Fit (motor extraction	Friction Fit Type 1 H	1			hand
		2 connectors to PCB mothor	Cable plug labeled or L<20mm without leaver and force <5N & D>3mm	2			hand
		extraction PCB from housing	snap fit type 3 s	1			spudger
		hinge connector to PCB	Hinge with 5N<force <20 N	1			hand
		extraction hinge connector	cable plug labeled or L<20mm without leaver and force <5N & D>3mm	1			hand
	13. Motor rubber	Friction Fit	Friction Fit Type 1 H	1			hand
	22. Panel Left	Snap fits	snap fit type 3 s	7	1	1	spudger
	23. Panel Rigth	Snap fits	snap fit type 3 s	7	1	1	spudger
	33. Handle loop	Screws K	screws same / component or labeled D<3mm and L<3mm	2			Philips 00 Screwdriver
		Piece extraction	Snap fit Type 1 H	1			hand
	34. Frame Top	Screws L	screws same / component or labeled D<3mm and L<3mm	2			Philips 00 Screwdriver
		Snap fits	Snap Fit Type 2 S	7	1		spudger
	24. Charging Unit service assy	Screw J	screws same / component or labeled D<3mm and L<3mm	1			Philips 00 Screwdriver
		Snap fit	Snap fit Type 1 H	1			hand
	11. Battery Pack Interface	Screw 00	screws same / component or labeled D<3mm and L<3mm	1			Philips 00 Screwdriver
		Part extraction from housing	Friction Fit Type 1 H	1			hand
	25. Wire assy	Snap fit from part 30	Snap Fit Type 2 S	1			spudger
	31. Inlet Seal	Snap fit	Snap Fit Type 2 S	1			spudger
	30- Handheld Inlet	Screws N	screws same / component or labeled D<3mm and L<3mm	2	1		Philips 00 Screwdriver
			Screws same / component or labeled D<3mm and L<3mm	2			Philips screwdriver #1
			Friction Fit Type 1 H	1			hand
	26. Bucket Release Button	Snap fit	Snap fit Type 3 H	1			hand
	29. Frame	Snap fit	Snap Fit Type 2 S	1			spudger
	28. Hook insert	Screws M	screws same / component or labeled D<3mm and L<3mm	2			Philips 00 Screwdriver
			Friction Fit Type 1 H	1			hand
	X.1 Top chasing nozzle 6	Screws	Screws same / component or labeled D<3mm and L<3mm	2			Philips screwdriver #1
	X.2 Top-left chasing nozzle 6	Screws	Screws same / component or labeled D<3mm and L<3mm	3			Philips screwdriver #1
	X.3 Top-right chasing nozzle 6	Screws	Screws same / component or labeled D<3mm and L<3mm	3			Philips screwdriver #1
	X.4 Top transparent chasing nozzle 6	Screws	Screws same / component or labeled D<3mm and L<3mm	1			Philips screwdriver #1
	X.5 Nozzle motor	Screws	Screws same / component or labeled D<3mm and L<3mm	2	1		Philips screwdriver #1
	X.6 Nozzle motor belt	Snap fit hand	Snap fit Type 1 H	1			Hand
	27. Frame						

	Disassembly Times (s)							(Re) Assembly Times (s)								Hot Spot mapping	
	7	8	9	10,0	11	12	13	14	15	16	16	17,0	18	19	20		
	Tool Change (s)	Identifying (s)	Manipulation (s)	Positioning (s)	Disconnection (s)	Removing (s)	Total Disassembly (s)	Tool change (s)	Identifying (s)	Manipulation (s)	Positioning (s)	Fastening (s)	Adding (s)	Total (Re) Assembly (s)	Total (s)	Part weight (g)	Material
	0	0	0	1,4	0,36	1,4	3,16	0	0,0	0,0	1,4	0,4	1,4	3,2	6,4	722,6	Mainly ABS
	0	0	0	1,4	0,36	1,4	3,16	0	0,0	0,0	1,4	0,4	1,4	3,2	6,4	86,0	Presumably ABS
	1,44	0	1,8	2,5	3,24	1,4	10,4	1,44	0,0	1,8	2,5	5,0	1,4	12,2	22,6	25,0	POM and TPU
	0	0	0	1,4	0,36	0,0	1,76	0	0,0	0,0	1,4	0,4	0,0	1,8	3,6		
	0	0	0	1,4	0,36	0,0	1,76	0	0,0	0,0	1,4	0,4	0,0	1,8	3,6	365,2	Alluminum and ABS
	0	0	0	1,4	0,36	0,0	1,76	0	0,0	0,0	1,4	0,4	0,0	1,8	3,6		
	1,44	0	0	5,0	6,48	1,4	14,36	1,44	0,0	0,0	5,0	10,1	1,4	18,0	32,3	23,2	Mainly ABS
	0	0	0	1,4	1,08	0,0	2,48	0	0,0	0,0	1,4	1,1	0,0	2,5	5,0		
	0	0	0	1,4	0,36	1,4	3,16	0	0,0	0,0	1,4	0,4	1,4	3,2	6,4	295,2	Presumably mainly ABS
	0	0	0	1,4	0,36	0,0	1,76	0	0,0	0,0	1,4	0,4	0,0	1,8	3,6		
	0	0	0	2,8	0,72	0,0	3,52	0	0,0	0,0	2,9	0,7	0,0	3,6	7,1	4,0	Sponge
	1,44	0	0	7,6	9,72	1,4	20,12	1,44	0,0	0,0	7,6	15,1	1,4	25,5	45,6	323,4	Assembly of battery pack and case in ABS (Presumably)
	0	0	0	2,5	2,16	0,0	4,68	0	0,0	0,0	1,4	2,2	0,0	3,6	8,3		
	1,44	0	0	5,0	4,32	1,4	12,2	0	0,0	0,0	2,9	4,3	1,4	8,6	20,8	21,2	Mainly ABS, second plastic unknown
	0	0	0	2,5	2,16	0,0	4,68	0	0,0	0,0	1,4	2,2	0,0	3,6	8,3		
	1,44	0	0	2,5	3,24	1,4	8,6	1,44	0,0	0,0	2,5	5,0	1,4	10,4	19,0	19,8	Electronic PCB
	0	0	0	1,4	0,36	0,0	1,8	0	0,0	0,0	1,4	0,7	0,0	2,2	4,0		
	0	0	0	1,4	0,36	0,0	1,76	0	0,0	0,0	1,4	0,4	0,0	1,8	3,6		
	0	0	0	2,5	0,36	1,4	4,28	0	0,0	0,0	2,5	5,0	1,4	9,0	13,2	1,8	Presumably TPU
	1,44	0	0	2,5	3,24	1,4	8,6	0	0,0	0,0	2,5	5,0	1,4	9,0	17,6		
	0	0	0	2,5	3,24	1,4	7,16	1,44	0,0	0,0	2,5	5,0	1,4	10,4	17,6	51,6	Assembly, ABS
	0	0	0	1,4	0,36	0,0	1,76	0	0,0	0,0	1,4	0,4	0,0	1,8	3,6		
	0	0	0	1,4	0,36	0,0	1,76	0	0,0	0,0	1,4	0,4	0,0	1,8	3,6	7,8	PP
	0	0	0	1,4	0,36	0,0	1,76	0	0,0	0,0	1,4	0,4	0,0	1,8	3,6	37,4	Presumably PP or PC
	0	0	0	1,4	0,36	0,0	1,76	0	0,0	0,0	1,4	0,4	0,0	1,8	3,6	18,6	Presumably PP
	1,44	0	0	5,0	6,48	1,4	14,36	1,44	0,0	0,0	5,0	10,1	1,4	18,0	32,3	214,4	Motor+PCB
	0	0	0	1,4	0,36	0,0	1,76	0	0,0	0,0	1,4	0,4	0,0	1,8	3,6		
	0	0	0	2,9	0,72	0,0	3,6	0	0,0	0,0	2,9	1,4	0,0	4,3	7,9		
	1,44	0	0	2,5	2,16	0,0	6,12	0	0,0	0,0	1,4	2,2	0,0	3,6	9,7		
	0	0	0	1,4	1,08	0,0	2,52	0	0,0	0,0	1,4	1,1	0,0	2,5	5,0		
	0	0	0	1,4	0,36	0,0	1,8	0	0,0	0,0	1,4	0,7	0,0	2,2	4,0		
	0	0	0	1,4	0,36	0,0	1,76	0	0,0	0,0	1,4	0,4	0,0	1,8	3,6	20,8	TPU
	1,44	25,2	1,8	17,6	15,12	1,4	62,6	0	25,2	1,8	10,1	15,1	1,4	53,6	116,2		
	0	25,2	1,8	17,6	15,12	1,4	61,16	0	25,2	1,8	10,1	15,1	1,4	53,6	114,8		
	1,44	0	0	5,0	6,48	1,4	14,36	1,44	0,0	0,0	5,0	10,1	1,4	18,0	32,3	63,6	ABS
	0	0	0	1,4	0,36	0,0	1,76	0	0,0	0,0	1,4	0,4	0,0	1,8	3,6		
	1,44	0	0	5,0	6,48	1,4	14,36	1,44	0,0	0,0	5,0	10,1	1,4	18,0	32,3	12,8	ABS
	1,44	0	1,8	10,1	7,56	0,0	20,88	0	0,0	1,8	10,1	7,6	0,0	19,4	40,3		
	1,44	0	0	2,5	3,24	1,4	8,6	1,44	0,0	0,0	2,5	5,0	1,4	10,4	19,0	16,2	PC 11g + wires
	0	0	0	1,4	0,36	0,0	1,76	0	0,0	0,0	1,4	0,4	0,0	1,8	3,6		
	1,44	0	0	2,5	3,24	1,4	8,6	1,44	0,0	0,0	2,5	5,0	1,4	10,4	19,0	9,2	PC+ wires
	0	0	0	1,4	0,36	0,0	1,76	0	0,0	0,0	1,4	0,4	0,0	1,8	3,6		
	1,44	0	0	1,4	1,08	1,4	5,36	0	0,0	0,0	1,4	1,1	1,4	3,9	9,3	19,2	ABS 1,4g+ wires
	0	0	0	1,4	1,08	0,0	2,52	0	0,0	0,0	1,4	1,1	0,0	2,5	5,0	0,4	TPU
	1,44	0	1,8	5,0	6,48	1,4	16,16	1,44	0,0	1,8	5,0	10,1	1,4	19,8	35,9	57,0	ABS
	1,44	0	0	5,0	6,48	0,0	12,96	1,44	0,0	0,0	5,0	10,1	0,0	16,6	29,5		
	0	0	0	1,4	0,36	0,0	1,76	0	0,0	0,0	1,4	0,4	0,0	1,8	3,6		
	0	0	0	2,5	2,16	1,4	6,08	0	0,0	0,0	1,4	2,2	1,4	5,0	11,1	2,0	ABS
	1,44	0	0	1,4	1,08	1,4	5,36	0	0,0	0,0	1,4	1,1	1,4	3,9	9,3	0,6	ABS
	1,44	0	0	5,0	6,48	1,4	14,36	1,44	0,0	0,0	5,0	10,1	1,4	18,0	32,3	1,6	ABS
	0	0	0	1,4	0,36	0,0	1,76	0	0,0	0,0	1,4	0,4	0,0	1,8	3,6		
	1,44	0	0	5,0	6,48	1,4	14,36	0	0,0	0,0	5,0	10,1	1,4	16,5	30,9		
	0	0	0	7,6	9,72	1,4	18,68	0	0,0	0,0	7,6	15,1	1,4	24,1	42,8		
	0	0	0	7,6	9,72	1,4	18,68	0	0,0	0,0	7,6	15,1	1,4	24,1	42,8		
	0	0	0	2,5	3,24	1,4	7,16	0	0,0	0,0	2,5	5,0	1,4	9,0	16,1		
	0	0	1,8	5,0	6,48	1,4	14,72	1,44	0,0	1,8	5,0	10,1	1,4	19,8	34,5		
	0	0	0	1,4	0,36	1,4	3,16	0	0,0	0,0	1,4	0,4	1,4	3,2	6,4		
																183,6	ABS
Total (s)	29	50	11	192	176	36	499	20	50	11	172	243	41	537	1036	1770,6	TOTAL WEIGTH

Philips FC8924

	1	2		3	4	5	6
Component Code	Disassembly sequence of components	Disassembly sequence of connections of components	Connector type	Number of connectors	Number of product manipulations	Identifiability (0,1)	Tool type
4322 004 27501	6. Tri-Active Zigzag A with lights HP	Friction fit	Friction fit Type 2 H	1			Hand
4322 004 24681	3. Crevice nozzle Con 35 mm Deep Black 80231	Friction fit (counted in part 6.)	Friction fit Type 2 H	1			Hand
4322 004 24691	4. Small brush Deep Black 80231	Friction fit (counted in part 6.)	Friction fit Type 2 H	1			Hand
4322 004 24671	5. Small nozzle Con 35 mm Deep Black 80231 SR	Friction fit (counted in part 6.)	Friction fit Type 1 H	1			Hand
4322 004 26561	2. Thalys tube assy	Friction fit (counted in part 1.)	Friction fit Type 2 H	1			Hand
4322 004 26571	1. Thalys hose assy	Push buttons	Snap fit Type 1 H	1			hand
		Friction fit	Friction fit Type 2 H	1			Hand
4322 005 37551	17. On/Off button Pr.	Open n. 14, (PUSH BUTTON)	Snap fit Type 1 H	1			Hand
		Push n. 16 (PUSH BUTTON)	Snap fit Type 1 H	1			Hand
		Snap Fit	Snap Fit Type 2 S	1		1	Spudger
		Extract button	Snap fit Type 1 H	1			Hand
4322 005 37541	16. Cordwinder button Pr.	Snap Fit	Snap Fit Type 2 S	1		1	Spudger
		Extract button	Snap fit Type 1 H	1			Hand
4322 003 61481	19. UI Thalys Transl. Mistery Bl. 80229	Removing lid	Snap Fit Type 2 H	2			Hand
		Removing spring	Snap fit Type 1 H	2			Hand
		Removing UI screen	Snap Fit Type 2 S	2			Spudger
4322 003 61701	21. LED spacer	Screws A	Screws same / component or labeled D>3mm and L>5mm	2			Torx T15 Screwdriver
4322 003 61841	23. Light diffuser canister	Friction fit	Friction fit Type 1 H	1			Hand
4322 003 61851	22. Light guide housing	Snap Fit	Snap fit Type 1 H	1			Hand
4322 005 37821	14. Dust cover assy Beluga Titanium HP	Cable plugs	Cable plug labeled or L<20mm without leaver and force <5N & D<3mm	3			Hand
		Cover opening	Snap fit Type 1 H	1			Hand
		Snap Fit	Snap Fit Type 2 S	2			Spudger
Assembly	Assembly of part 8 and 9	Push buttons (already considered for part 1)	Snap fit Type 1 H				
		Friction fit (already considered for part 1)	Friction fit Type 2 H				
		Cover opening	Snap fit Type 1 H	1			Hand
		Removing 8&9	Friction fit Type 1 H	1			Hand
4322 003 61631, 4322 004 93613	8&9. S-Bag ultra long performance	Dividing part 8 from part 9	Friction fit Type 1 H	1			Hand
4322 001 75811	15. Dust chamber seal	Friction fit	Friction fit Type 1 H	1			Hand
Assembly	Assembly 10 and 11	Snap Fit	Snap fit Type 1 H	1			Hand
4322 000 37302, 4322 003 61921	10 & 11	Dividing part 10 from part 11	Friction fit Type 1 H	1			Hand
4322 009 01241	12. Exhaust grill assy	Snap Fit	Snap fit Type 1 H	1	1		Hand
4322 004 94132	13. Elux HEPA 13 Non-washable filter	Friction fit	Friction fit Type 1 H	1			Hand
4322 003 61641	25. Dust chamber insert Basic Blue 61192	2 Screws B	Screws same / component or labeled D>3mm and L>5mm	2			Torx T15 Screwdriver
		Snap Fit	Snap Fit Type 2 S	4			Spudger
4322 003 61621	26. Dust chamber Deep Black 80231	5 Screws B	Screws same / component or labeled D>3mm and L>5mm	5	1		Torx T15 Screwdriver
		Removal	Snap Fit Type 2 H	2			hand
4322 001 75801	32. Motor inlet seal	Friction fit	Friction fit Type 1 H	1			Hand
4322 003 62221	30. Cordwinder clip	Untight cambles from PCB	Friction fit Type 1 H	3			Hand
		Partial removal PCB	Snap fit Type 1 H	1			Hand
		Partial removal part 31	Snap fit Type 1 H	2			Hand
		Removing the cable from inside	Snap fit Type 3 H	3			Hand
4322 003 61611	27. Cordwinder lever	Removing part 27 from part 31	Snap Fit Type 2 S	1			Spudger
4322 005 37531	29. Cordwinder Alpha /1/8m/Black/4.8/R	Disconnection from PCB	Cable plug labeled or L<20mm without leaver and force <5N & D<3mm	2			Hand
4322 005 37621	38. Rear wheel assy RX	Screws C (1 is an UNCOMMON TOOL, TOO DEEP)	Screws same / component or labeled D>3mm and L>5mm	4			Torx T15 Screwdriver
		Snap Fit	Snap fit Type 3 S	1			Spudger
4322 005 37621	38. Rear wheel assy SX	Snap Fit	Snap fit Type 3 S	1			Spudger
4322 009 01221	43. Valve assy HP	Snap Fit	Snap fit Type 1 S	3			Spudger
4322 003 61591	42. Motor housing lid	Snap Fit	Snap Fit Type 2 S	7	1		Spudger
4322 006 99041	44. Domus 230V/50Hz1800WIEC CCAW wire	Cable Plug	Cable plug labeled or L<20mm without leaver and force <5N & D>3mm	1			Hand
4322 006 25522	47. Canister High range Main PCBA 750 W (1800)	Friction fit	Friction fit Type 1 H	1			Hand
4322 005 37611	34. Caster assy	Snap fit	Snap fit Type 3 S	1	1		Spudger
X	X. Aesthetic cover	Screw	Screws same / component or labeled D>3mm and L>5mm	2			Torx T15 Screwdriver
		Snap fit	Snap Fit Type 2 S	10			Spudger
4322 003 61581	48. Motor pot housing outer	Already divided from motor by the Friction fit type 1 hand					
4322 003 61491	33. Lower housing Deep Black 80231	Remaining from the rest of the disassembly					

	Disassembly Times (s)							(Re) Assembly Times (s)								Hot Spot mapping	
	7	8	9	10,0	11	12	13	14	15	16	16	17,0	18	19	20		
	Tool Change (s)	Identifying (s)	Manipulation (s)	Positioning (s)	Disconnection (s)	Removing (s)	Total Disassembly (s)	Tool change (s)	Identifying (s)	Manipulation (s)	Positioning (s)	Fastening (s)	Adding (s)	Total (Re) Assembly (s)	Total (s)	Part weight (g)	Material
	0	0	0	1,4	1,08	0,0	2,48	0	0,0	0,0	1,4	1,1	0,0	2,5	5,0	672,8	Assembly, Presumably ABS
																23,2	Presumably PP
																28,0	Presumably PP
																26,8	Presumably PP+ plastic brushes
																491,0	Mainly All, plastic parts in ABS
	0	0	0	1,4	0,36	0,0	1,76	0	0,0	0,0	1,4	0,4	0,0	1,8	3,6	1159,8	Handle ABS+PCB, tube ND
	0	0	0	1,4	1,08	0,0	2,48	0	0,0	0,0	1,4	1,1	0,0	2,5	5,0		
	0	0	0	1,4	0,36	0,0	1,76	0	0,0	0,0	1,4	0,4	0,0	1,8	3,6	31,8	ABS+ 0,4g iron spring (18)
	0	0	0	1,4	0,36	0,0	1,76	0	0,0	0,0	1,4	0,4	0,0	1,8	3,6		
	1,44	3,6	0	1,4	1,08	0,0	7,56	0	3,6	0,0	1,4	1,1	0,0	6,1	13,7		
	0	0	0	1,4	0,36	0,0	1,76	0	0,0	0,0	1,4	0,4	0,0	1,8	3,6		
	1,44	3,6	0	1,4	1,08	0,0	7,56	0	3,6	0,0	1,4	1,1	0,0	6,1	13,7	32,2	ABS+ 0,4g iron spring (18)
	0	0	0	1,4	0,36	0,0	1,76	0	0,0	0,0	1,4	0,4	0,0	1,8	3,6		
	0	0	0	2,8	2,16	0,0	4,96	0	0,0	0,0	2,9	2,2	0,0	5,0	10,0	21,0	Presumably PC + 1,6 g plastic foil
	0	0	0	2,8	0,72	0,0	3,52	0	0,0	0,0	2,9	0,7	0,0	3,6	7,1		
	1,44	0	0	2,9	2,16	0,0	6,48	0	0,0	0,0	2,9	2,2	0,0	5,0	11,5		
	1,44	0	0	5,0	24,48	1,4	32,36	1,44	0,0	0,0	5,0	28,1	1,4	36,0	68,3	24,2	PP
	0	0	0	1,4	0,36	1,4	3,16	0	0,0	0,0	1,4	0,4	1,4	3,2	6,4	6,8	Presumably PC
	0	0	0	1,4	0,36	1,4	3,16	0	0,0	0,0	1,4	0,4	1,4	3,2	6,4	28,0	PC
	0	0	0	7,6	1,08	1,4	10,04	0	0,0	0,0	7,6	32,4	1,4	41,4	51,4	852,6	519,4g mainly PP, PC and wires. + 214,4 Aesthetic cover ABS + 117g Upper lid ABS + 2 metal spring
	0	0	0	1,4	0,36	0,0	1,76	0	0,0	0,0	1,4	0,4	0,0	1,8	3,6		
	1,44	0	0	2,9	2,16	0,0	6,48	0	0,0	0,0	2,9	2,2	0,0	5,0	11,5		
																59,2	PART 8, PP
																45,6	PART 9, VC bag
	0	0	0	1,4	0,36	0,0	1,76	0	0,0	0,0	1,4	0,4	0,0	1,8	3,6		
	0	0	0	1,4	0,36	0,0	1,76	0	0,0	0,0	1,4	0,4	0,0	1,8	3,6		
	0	0	0	1,4	0,36	1,4	3,16	0	0,0	0,0	1,4	0,4	1,4	3,2	6,4		
	0	0	0	1,4	0,36	1,4	3,16	0	0,0	0,0	1,4	0,4	1,4	3,2	6,4	17,6	TPU
	0	0	0	1,4	0,36	1,4	3,16	0	0,0	0,0	1,4	0,4	1,4	3,2	6,4	9,0	PART 10, Sponge
	0	0	0	1,4	0,36	0,0	1,76	0	0,0	0,0	1,4	0,4	0,0	1,8	3,6	34,0	PART 11, PP
	0	0	1,8	1,4	0,36	1,4	4,96	0	0,0	1,8	1,4	0,4	1,4	5,0	10,0	231,0	PC, small finishing ABS
	0	0	0	1,4	0,36	0,0	1,76	0	0,0	0,0	1,4	0,4	0,0	1,8	3,6	76,6	Filter, frame in PP
	1,44	0	0	5,0	24,48	1,4	32,36	1,44	0,0	0,0	5,0	28,1	1,4	36,0	68,3	78,0	ABS+ finishing in alluminum foil
	1,44	0	0	5,8	4,32	0,0	11,52	0	0,0	0,0	5,8	4,3	0,0	10,1	21,6		
	1,44	0	1,8	12,6	61,20	1,4	78,44	1,44	0,0	1,8	12,6	70,2	1,4	87,4	165,9	768,8	PP
	0	0	0	2,8	2,16	0,0	4,96	0	0,0	0,0	2,9	2,2	0,0	5,0	10,0		
	0	0	0	1,4	0,36	1,4	3,16	0	0,0	0,0	1,4	0,4	1,4	3,2	6,4	16,0	Presumably TPU
	0	0	0	4,2	1,08	1,4	6,68	0	0,0	0,0	4,3	1,1	1,4	6,8	13,5	2,4	Presumably PP
	0	0	0	1,4	0,36	0,0	1,76	0	0,0	0,0	1,4	0,4	0,0	1,8	3,6		
	0	0	0	2,8	0,72	0,0	3,52	0	0,0	0,0	2,9	0,7	0,0	3,6	7,1		
	0	0	0	7,6	6,48	0,0	14,04	0	0,0	0,0	4,3	6,5	0,0	10,8	24,8	12,6	PART 27, 12,2g ABS+0,4 iron Spring (28)
	1,44	0	0	1,4	1,08	1,4	5,36	0	0,0	0,0	1,4	1,1	1,4	3,9	9,3	79,8	PART 31, PP
	0	0	0	5,0	0,72	1,4	7,16	0	0,0	0,0	5,0	21,6	1,4	28,0	35,2	755,0	Wire+ PP frame
	1,44	0	0	10,1	48,96	0,0	60,48	1,44	0,0	0,0	10,1	56,2	0,0	67,7	128,2	160,0	2K, ABS+TPU. Iron pin
	1,44	0	0	2,5	2,16	1,4	7,52	0	0,0	0,0	1,4	2,2	1,4	5,0	12,5		
	0	0	0	2,5	2,16	1,4	6,08	0	0,0	0,0	1,4	2,2	1,4	5,0	11,1	160,0	2K, ABS+TPU. Iron pin
	0	0	0	4,3	1,08	1,4	6,8	0	0,0	0,0	4,3	1,1	1,4	6,8	13,6	9,8	6,6g ABS+ 3,2g iron spring
	0	0	1,8	10,1	7,56	1,4	20,84	0	0,0	1,8	10,1	7,6	1,4	20,8	41,7	153,0	ABS+ 9,2 g TPU seal
	0	0	0	1,4	0,36	1,4	3,2	0	0,0	0,0	1,4	0,7	1,4	3,6	6,8	1349,8	Motor+ 35g TPU Buffer ring (39)+ 15,2 g TPU Buffer back (49)
	0	0	0	1,4	0,36	1,4	3,16	0	0,0	0,0	1,4	0,4	1,4	3,2	6,4	119,2	PCB+ 13g TPU Heatsink seal (41)
	1,44	0	1,8	2,5	2,16	1,4	9,32	0	0,0	1,8	1,4	2,2	1,4	6,8	16,1	30,2	Assembly: PP+ iron Pin + tpu wheel
	1,44	0	0	5,0	24,48	1,4	32,36	1,44	0,0	0,0	5,0	28,1	1,4	36,0	68,3		
	1,44	0	0	14,4	10,80	0,0	26,64	0	0,0	0,0	14,4	10,8	0,0	25,2	51,8		
																383,0	ABS+ 28,6g TPU seal
																655,8	PP
Total (s)	20	7	7	156	246	31	468	7	7	7	151	325	31	529	997	8604,6	TOTAL WEIGHT

Philips FC9934

	1	2		3	4	5	6
Component Code	Disassembly sequence of components	Disassembly sequence of connections of components	Connector type	Number of connectors	Number of product manipulations	Identifiability (0,1)	Tool type
4322 004 26891	29. Tri-Active Zigzag A with lights LP Non flaps	Friction Fit	Friction Fit Type 2 H	1			Hand
4322 004 26563	27. Thalys tube assy	Friction Fit	Friction Fit Type 2 H	1			Hand
4322 004 26821	26. Thalys hose assy bagless	Push button	Snap fit Type 1 H	1			Hand
4322 004 24812	28. Accessory holder assy 2	Friction Fit (already counted with 29)	Friction Fit Type 2 H	1			Hand
4322 004 26511	30. Alma HF nozzle 35 mm No PH Deep Black	Friction Fit (already counted with 29)	Friction Fit Type 2 H	1			Hand
4322 004 26642	31. Milton SF nozzle	Friction Fit (already counted with 29)	Friction Fit Type 2 H	1			Hand
4322 009 01361	1. Bucket assy	Push button	Snap fit Type 1 H	1			Hand
4322 009 01401	2. Bucket lid assy	Snap fit	Snap fit Type 1 S	1			Spudger
4322 009 01131	3. Filter casing assy	Snap fit	Friction Fit Type 1 H	1			Hand
4322 005 35751	4. Cordwinder button	Snap fit	Snap fit Type 3 S	1		1	Spudger
		Friction Fit	Friction Fit Type 2 H	1			Hand
4322 005 35761	5. On/Off button	Snap fit	Snap fit Type 3 S	1	1		Spudger
		Friction Fit	Friction Fit Type 2 H	1			Hand
4322 005 27081	9. Frame Top cover	Snap fit	Snap Fit Type 2 S	2	1		Spudger
4322 005 29501	10. Frame Right	Snap fit	Snap Fit Type 2 S	1			spudger
		Snap fit	Snap fit Type 2 S	1	1		spudger
4322 005 29491	11. Frame Right	Snap fit	Snap fit Type 2 S	1			spudger
		Snap fit	Snap fit Type 2 S	1	1		spudger
4322 009 01351	6. Exhaust grill assy	Snap fit	Snap fit Type 1 H	1			Hand
4322 004 94132	8. Elux HEPA 13	Friction Fit	Friction Fit Type 1 H	1			hand
4322 000 39691	7. Exhaust foam	Friction Fit	Friction Fit Type 1 H	1			hand
4322 003 48871	12. Upper housing	Screws (Trox T15)	Screws same / component or labeled D>3mm and L>5mm	7			Torx T15 Screwdriver
		Unplugging Caster assy connector	Cable plug unlabeled without leaver and force <5N & D<3mm	1			Hand
		Lifting housing, disconnecting snap fit	Snap Fit Type 2 H	1			hand
4322 005 27051	35. Top handle assy PAT	Pushing out the metal pin and final extraction using pliers	Friction Fit Type 2 S	2			Spudger
4322 005 32131	20. Caster assy	Screws (Trox T8)	Screws different /component D<3mm and L<3mm	1	1		Torx T8 Screwdriver
		Friction Fit	Friction Fit Type 2 S	1			Spudger
4322 003 48803	13. Cordwinder lever	Snap fit	Snap Fit Type 2 H	1			Hand
4322 003 48812	14. Cordwinder cap	Snap fit	Snap fit Type 1 H	2			hand
4322 003 48783	18. Cord outlet	Snap fit	Snap Fit Type 2 S	1			spudger
4322 003 01071	19. Cord outlet piece	Snap fit	Snap fit Type 1 H	1			hand
4322 005 36272	15. Cordwinder Performer expert	Snap fit	Snap Fit Type 2 H	1			hand
		2 PCB connectors for Cord winder	Cable plug unlabeled without leaver and force <5N & D<3mm	2			hand
		Cable extraction from Cord outlet	Friction Fit Type 1 H	1			hand
4322 003 48841	23. Light guide housing	Friction Fit from PCB	Friction Fit Type 1 H	1			hand
4322 003 48831	24. Diffusor	Snap fit from the Light guide housing	Snap fit Type 1 S	4			Spudger
4322 001 75631	17. Inlet sealing	Friction Fit	Friction Fit Type 1 H	1			hand
4322 006 10362	33. Typhoon PAT Dalin wire harness	1connector on the PCB	Cable plug unlabeled without leaver and force <5N & D<3mm	1			hand
		1 Screw (D), ground pin screwed on lower housing	Screws same / component or labeled D>3mm and L>5mm	1			Torx T15 Screwdriver
		Friction Fit	Friction Fit Type 1 H	1			hand
4322 009 01091	34 Safety valve assy	Friction fit	Friction Fit Type 1 H	1			hand
4322 003 48791	16. Back panel	Screws (Trox T15). Very deep and difficult to reach (NOT GENERAL)	screws same / component or labeled D>3mm and L>5mm	6		1	Torx T15 Screwdriver
		Pulling out back panel	Friction Fit Type 2 H	1			hand
4322 005 35661	25. Rear wheel assy RX	Removing iron ring, snap fit	Snap fit Type 3 S	1	1		spudger
4322 005 35661	25. Rear wheel assy LX	Removing iron ring, snap fit	Snap fit Type 3 S	1	1		spudger
4322 006 99782	21. Motor 458NG 650 Watt	Screws (Trox T15). Very deep and difficult to reach (NOT GENERAL)	screws same / component or labeled D>3mm and L>5mm	3	1		Torx T15 Screwdriver
		Extraction motor from cover	Friction Fit Type 1 H	1			hand
4322 006 25651	22. Typhoon PAT Main PCBA	Connector to motor	cable plug unlabeled without leaver and force <5N & D<3mm	1			hand
4322 003 48733	36. Lower housing						

	Disassembly Times (s)							(Re) Assembly Times (s)								Hot Spot mapping	
	7	8	9	10,0	11	12	13	14	15	16	16	17,0	18	19	20		
	Tool Change (s)	Identifying (s)	Manipulation (s)	Positioning (s)	Disconnection (s)	Removing (s)	Total Disassembly (s)	Tool change (s)	Identifying (s)	Manipulation (s)	Positioning (s)	Fastening (s)	Adding (s)	Total (Re) Assembly (s)	Total (s)	Part weight (g)	Material
	0	0	0	1,4	1,08	0,0	2,48	0	0,0	0,0	1,4	1,1	0,0	2,5	5,0	675,4	Plastic assembly (mainly PP, ABS)
	0	0	0	1,4	1,08	0,0	2,48	0	0,0	0,0	1,4	1,1	0,0	2,5	5,0	495,0	Assembly of alluminum and PP. Parts of ABS
	0	0	0	1,4	0,36	0,0	1,76	0	0,0	0,0	1,4	0,4	0,0	1,8	3,6	1100,0	Handle (ABS+PCB)
																	/
																	/
																683,2	Plastic assembly (mainly PP and ABS)
	0	0	0	1,4	0,36	1,4	3,16	0	0,0	0,0	1,4	0,4	1,4	3,2	6,4	597,0	ABS
	1,44	0	0	1,4	0,36	1,4	4,64	0	0,0	0,0	1,4	0,4	1,4	3,2	7,8		
	0	0	0	1,4	0,36	1,4	3,16	0	0,0	0,0	1,4	0,4	1,4	3,2	6,4	227,8	ABS
	1,44	3,6	0	2,5	2,16	1,4	11,12	0	3,6	0,0	1,4	2,2	1,4	8,6	19,7	216,4	ABS 64,4+141,4, spong 10,2
	0	0	0	1,4	1,08	0,0	2,48	0	0,0	0,0	1,4	1,1	0,0	2,5	5,0	41,6	ABS
	1,44	0	1,8	2,5	2,16	1,4	9,32	0	0,0	1,8	1,4	2,2	1,4	6,8	16,1		
	0	0	0	1,4	1,08	0,0	2,48	0	0,0	0,0	1,4	1,1	0,0	2,5	5,0	43,8	ABS 41,6, iron spring 2,2
	1,44	0	1,8	2,9	2,16	1,4	9,68	0	0,0	1,8	2,9	2,2	1,4	8,2	17,9		
	0	0	0	1,4	1,08	1,4	3,92	0	0,0	0,0	1,4	1,1	1,4	3,9	7,8	37,6	ABS
	0	0	1,8	1,4	1,08	0,0	4,32	0	0,0	1,8	1,4	1,1	0,0	4,3	8,6	79,6	ABS
	0	0	0	1,4	1,08	1,4	3,92	0	0,0	0,0	1,4	1,1	1,4	3,9	7,8		
	0	0	1,8	1,4	1,08	0,0	4,32	0	0,0	1,8	1,4	1,1	0,0	4,3	8,6	79,6	ABS
	0	0	0	1,4	0,36	1,4	3,16	0	0,0	0,0	1,4	0,4	1,4	3,2	6,4		
	0	0	0	1,4	0,36	0,0	1,76	0	0,0	0,0	1,4	0,4	0,0	1,8	3,6	212,4	ABS
	0	0	0	1,4	0,36	0,0	1,76	0	0,0	0,0	1,4	0,4	0,0	1,8	3,6	78,8	Paper filter and ABS frame
	1,44	0	0	17,6	85,68	1,4	106,16	1,44	0,0	0,0	17,6	98,3	1,4	118,8	224,9		/
	0	0	0	2,5	0,36	0,0	2,88	0	0,0	0,0	2,5	5,4	0,0	7,9	10,8	698,2	Upper housing ABS 644,8; ABS connector 42,4; TPU sealing 10,4
	0	0	0	1,4	1,08	0,0	2,48	0	0,0	0,0	1,4	1,1	0,0	2,5	5,0		
	1,44	0	0	2,9	2,16	1,4	7,88	0	0,0	0,0	2,9	2,2	1,4	6,4	14,3		
	1,44	0	1,8	2,5	3,24	1,4	10,4	1,44	0,0	1,8	2,5	5,4	1,4	12,6	23,0	189,2	ABS 180,4 g, Iron 8,8g, electornics not considered
	1,44	0	0	1,4	1,08	0,0	3,96	0	0,0	0,0	1,4	1,1	0,0	2,5	6,5	51,4	PP 30,4, Steel 21
	0	0	0	1,4	1,08	1,4	3,88	0	0,0	0,0	1,4	1,1	1,4	3,9	7,8		
	0	0	0	2,8	0,72	1,4	4,92	0	0,0	0,0	2,9	0,7	1,4	5,0	9,9	17,6	ABS 15,4, iron spring 2,2
	1,44	0	0	1,4	1,08	1,4	5,36	0	0,0	0,0	1,4	1,1	1,4	3,9	9,3	45,4	PP
	0	0	0	1,4	0,36	1,4	3,16	0	0,0	0,0	1,4	0,4	1,4	3,2	6,4	35,0	PP
	0	0	0	1,4	1,08	1,4	3,88	0	0,0	0,0	1,4	1,1	1,4	3,9	7,8	2,2	PP
	0	0	0	5,0	0,72	0,0	5,76	0	0,0	0,0	5,0	10,8	0,0	15,8	21,6	650,4	Assembly of electric wire, white structure PP, and metal spring
	0	0	0	1,4	0,36	0,0	1,76	0	0,0	0,0	1,4	0,4	0,0	1,8	3,6		
	0	0	0	1,4	0,36	0,0	1,76	0	0,0	0,0	1,4	0,4	0,0	1,8	3,6		
	1,44	0	0	5,8	1,44	0,0	8,64	0	0,0	0,0	5,8	1,4	0,0	7,2	15,8	18,0	PC
	0	0	0	1,4	0,36	0,0	1,76	0	0,0	0,0	1,4	0,4	0,0	1,8	3,6	4,0	PC
	0	0	0	2,5	0,36	0,0	2,88	0	0,0	0,0	2,5	5,4	0,0	7,9	10,8	32,0	TPU sealing
	1,44	0	0	2,5	12,24	0,0	16,2	1,44	0,0	0,0	2,5	14,0	0,0	18,0	34,2	21,4	PP connector+ wires
	0	0	0	1,4	0,36	0,0	1,76	0	0,0	0,0	1,4	0,4	0,0	1,8	3,6		
	0	0	0	1,4	0,36	0,0	1,76	0	0,0	0,0	1,4	0,4	0,0	1,8	3,6		
	1,44	21,6	0	15,1	73,44	0,0	111,6	1,44	21,6	0,0	15,1	84,2	0,0	122,4	234,0	11,6	ABS 6,8, Iron 4,6
	0	0	0	1,4	1,08	0,0	2,48	0	0,0	0,0	1,4	1,1	0,0	2,5	5,0	678,8	ABS (TPU sealing)
	1,44	0	1,8	2,5	2,16	1,4	9,32	0	0,0	1,8	1,4	2,2	1,4	6,8	16,1		
	0	0	1,8	2,5	2,16	1,4	7,88	0	0,0	1,8	1,4	2,2	1,4	6,8	14,7	168,6	ABS+TPU 158,2 (2K), POM 10,4
	1,44	0	1,8	7,6	36,72	1,4	48,92	1,44	0,0	1,8	7,6	42,1	1,4	54,3	103,2	946,0	Motor 730,2, PP cover 180, TPU sealing 35,8
	0	0	0	1,4	0,36	0,0	1,76	0	0,0	0,0	1,4	0,4	0,0	1,8	3,6	168,6	ABS+TPU 158,2 (2K), POM 10,4
	0	0	0	2,5	0,36	1,4	4,28	0	0,0	0,0	2,5	5,4	1,4	9,3	13,6	105,4	Electric Board PCB
																627,6	PP, TPU sealing
Total (s)	20	25	14	122	248	29	459	7	25	14	118	306	29	501	960	8356,4	TOTAL WEIGHT

Philips FC9569

	1	2		3	4	5	6
Component Code	Disassembly sequence of components	Disassembly sequence of connections of components	Connector type	Number of connectors	Number of product manipulations	Identifiability (0,1)	Tool type
4322 004 26191	6. Tri-Active+ LC nozzle	Push button	Snap fit Type 1 H	1			Hand
3000 029 40441	3. Crevice nozzle Zephyr	Friction fit, simple extraction	Friction Fit Type 1 H	1			Hand
3000 029 40381	4. Tube clip Zephyr	Snap Fit, no removing, similar to friction fit	Snap Fit Type 2 H	1			Hand
4322 004 26243	2. 2-Piece T.T. Tube	Push button	Snap fit Type 1 H	1			Hand
3000 029 40371	110. C-Bend + Integrated brush	Snap fits	Snap Fit Type 2 S	2			Spudger
3000 029 40431	1. Hose assy Zephyr	Push button	Snap fit Type 1 H	1			Hand
	7&8	Push button	Snap fit Type 1 H	1			Hand
9965 100 79985	7. Dust bucket Lid	Dividing 7 from 8 through a Snap fit	Snap fit Type 1 S	1			Spudger
9965 100 79999	8. Dust bucket assy incl. Vortex	Disassembly considered in part n. 7.					
3000 029 40251	9. Integrated filter	Snap fit	Snap fit Type 1 H	1			Hand
9965 100 79989	15. Exhaust grill	Push button	Snap fit Type 1 H	1			Hand
3000 029 40241	16. Exhaust filter Zephyr LP	Snap fit	Snap fit Type 1 H	1			Hand
9965 100 79987	22. Casterwheel assy	Snap fit	Friction Fit Type 2 S	1	1		Spudger
9965 100 79997	12. On/off button	Snap fit	Snap fit Type 3 S	3		1	Spudger
9965 100 79997	12. On/off button	Push button	Snap fit Type 1 H	1			Hand
9965 100 79997	12. CW button	Snap fit	Snap fit Type 3 S	3		1	Spudger
9965 100 79977	11. Top cover	Screws A	Screws same / component or labeled D<3mm and L<3mm	6			Philips screwdriver #1
		Snap fits	Snap fit Type 3 S	2		1	Spudger
	10. Lower handle cover	Screws B	Screws same / component or labeled D<3mm and L<3mm	2			Philips screwdriver #1
9965 100 79978	24. Middle housing	Friction fit, simple extraction	Friction Fit Type 1 H	1			Hand
9965 100 79998	28. Power slider assembly	Snap fits	Snap Fit Type 2 S	2			Spudger
	17. Frame Right	Snap fit extraction by hand	Snap Fit Type 2 H	2			Hand
	18. Frame Left	Snap fit extraction by hand	Snap Fit Type 2 H	2			Hand
	21. Hose connector	friction fit, simple extraction	Friction Fit Type 1 H	1			Hand
	30&31 Rear housing cover and power slider PCBA	Screws D	Screws same / component or labeled D<3mm and L<3mm	4			Philips screwdriver #1
		Screws C	Screws same / component or labeled D<3mm and L<3mm	2			Philips screwdriver #1
		Snap fit	Snap fit Type 3 S	2		1	Spudger
		Cable Plug	Cable plug labeled or L<20mm with leaver and force <5N & D>3mm	1			Hand
9965 100 79986	13. Cord outlet	Screws E	screws same / component or labeled D<3mm and L<3mm	1			Philips screwdriver #1
3000 029 40302	32. Cordwinder Zephyr	Snap fit extraction by hand	Snap Fit Type 2 H	2			Hand
		Cable Plug	Cable plug labeled or L<20mm with leaver and force <5N & D>3mm	2			Hand
	35. Switch	Cable Plug	Cable plug labeled or L<20mm with leaver and force <5N & D>3mm	2			Hand
	36. Motor housing seal	Friction fit, simple extraction	Friction Fit Type 1 S	1			Spudger
	Intermediate step: motor housing screws	Screws F ONE SCREW IS TOO DEEP (UNCOMMON TOOL)	Screws same / component or labeled D<3mm and L<3mm	4			Philips screwdriver #1
		Screws G	Screws same / component or labeled D<3mm and L<3mm	2	1		Philips screwdriver #1
		Friction fit, simple extraction	Friction Fit Type 2 H	1			Hand
9965 100 79976	41. Rearwheel assy RX	UREAUSABLE Snap fit	Snap fit Type 3 S	5	1		Spudger
9965 100 79976	41. Rearwheel assy LX	UREAUSABLE Snap fit	Snap fit Type 3 S	5	1		Spudger
	49. Motor housing lid	Screws H	Screws same / component or labeled D<3mm and L<3mm	3			Philips screwdriver #1
		Snap fit	Snap Fit Type 2 S	4	1		Spudger
3000 029 40271	37. Safety Valve assy HP	Snap fit	Snap fit Type 1 S	1			Spudger
3000 016 56171	45. CDS Motor CDS-EY29-008 1800 W	Friction fit, simple extraction	Friction Fit Type 1 H	1			HAnd
		Cable Plugs	Cable plug labeled or L<20mm with leaver and force <5N & D>3mm	2	1		HAnd
3000 029 40361	31. PCBA	Snap fit, extraction	Snap fit Type 3 H	1			Hand
		Screws I	Screws same / component or labeled D<3mm and L<3mm	2			Philips screwdriver #1
	Motor brushes	Screws	Screws same / component or labeled D<3mm and L<3mm	2			Philips screwdriver #1
	50. Motor back housing	Left from the disassembly of the other components					
	40. Lower housing	Left from the disassembly of the other components					

	Disassembly Times (s)							(Re) Assembly Times (s)								Hot Spot mapping	
	7	8	9	10,0	11	12	13	14	15	16	16	17,0	18	19	20		
	Tool Change (s)	Identifying (s)	Manipulation (s)	Positioning (s)	Disconnection (s)	Removing (s)	Total Disassembly (s)	Tool change (s)	Identifying (s)	Manipulation (s)	Positioning (s)	Fastening (s)	Adding (s)	Total (Re) Assembly (s)	Total (s)	Part weight (g)	Material
	0	0	0	1,4	0,36	1,4	3,16	0	0,0	0,0	1,4	0,4	1,4	3,2	6,4	479,6	PP and ABS
	0	0	0	1,4	0,36	0,0	1,76	0	0,0	0,0	1,4	0,4	0,0	1,8	3,6	19,4	PP
	0	0	0	1,4	1,08	0,0	2,48	0	0,0	0,0	1,4	1,1	0,0	2,5	5,0	30,0	ABS
	0	0	0	1,4	0,36	1,4	3,16	0	0,0	0,0	1,4	0,4	1,4	3,2	6,4	521,6	Presumably Alluminum+ ABS finishing
	1,44	0	0	2,9	2,16	1,4	7,88	0	0,0	0,0	2,9	2,2	1,4	6,4	14,3	195,4	JUST HANDLE (110), presumably ABS
	0	0	0	1,4	0,36	1,4	3,16	0	0,0	0,0	1,4	0,4	1,4	3,2	6,4	355,4	JUST HOSE, presumably PP and ABS finishing
	0	0	0	1,4	0,36	1,4	3,16	0	0,0	0,0	1,4	0,4	1,4	3,2	6,4		
	1,44	0	0	1,4	0,36	1,4	4,64	0	0,0	0,0	1,4	0,4	1,4	3,2	7,8	151,4	ABS
																532,6	ABS
	0	0	0	1,4	0,36	1,4	3,16	0	0,0	0,0	1,4	0,4	1,4	3,2	6,4	73,6	Frame (64 g, presumably 2K ABS+TPU)+ Filter (sponge)
	0	0	0	1,4	0,36	1,4	3,16	0	0,0	0,0	1,4	0,4	1,4	3,2	6,4	99,4	Mainly ABS
	0	0	0	1,4	0,36	1,4	3,16	0	0,0	0,0	1,4	0,4	1,4	3,2	6,4	50,8	Paper filter+ presumably ABS frame
	1,44	0	1,8	1,4	1,08	1,4	7,16	0	0,0	1,8	1,4	1,1	1,4	5,7	12,9	26,6	PA6+30%GF (Nylon enriched with Glass fibers)
	0	10,8	0	7,6	6,48	1,4	26,24	0	10,8	0,0	4,3	6,5	1,4	23,0	49,2	24, 6	23,8 g ABS, 0,8 g iron spring
	0	0	0	1,4	0,36	0,0	1,76	0	0,0	0,0	1,4	0,4	0,0	1,8	3,6		
	1,44	10,8	0	7,6	6,48	1,4	27,68	0	10,8	0,0	4,3	6,5	1,4	23,0	50,7	25,2	24,4 ABS, 0,8 g iron spring
	1,44	0	0	15,1	19,44	1,4	37,4	1,44	0,0	0,0	15,1	30,2	1,4	48,2	85,6	143,2	ABS
	1,44	7,2	0	5,0	4,32	0,0	18	0	7,2	0,0	2,9	4,3	0,0	14,4	32,4		
	1,44	0	0	5,0	6,48	1,4	14,36	1,44	0,0	0,0	5,0	10,1	1,4	18,0	32,3	30,6	PP
	0	0	0	1,4	0,36	0,0	1,76	0	0,0	0,0	1,4	0,4	0,0	1,8	3,6	64,8	ABS (iron sping inside)
	1,44	0	0	2,9	2,16	1,4	7,88	0	0,0	0,0	2,9	2,2	1,4	6,4	14,3	28,8	ABS
	0	0	0	2,8	2,16	0,0	4,96	0	0,0	0,0	2,9	2,2	0,0	5,0	10,0	24,2	presumably PP
	0	0	0	2,8	2,16	0,0	4,96	0	0,0	0,0	2,9	2,2	0,0	5,0	10,0	25,0	presumably PP
	0	0	0	1,4	0,36	0,0	1,76	0	0,0	0,0	1,4	0,4	0,0	1,8	3,6	54,0	ABS
	1,44	0	0	10,1	12,96	1,4	25,88	0	0,0	0,0	10,1	20,2	1,4	31,6	57,5	224,6	30. PP
	0	0	0	5,0	6,48	0,0	11,52	1,44	0,0	0,0	5,0	10,1	0,0	16,6	28,1	16,4	31. PCBA
	1,44	7,2	0	5,0	4,32	0,0	18	0	7,2	0,0	2,9	4,3	0,0	14,4	32,4		
	0	0	0	1,4	0,72	0,0	2,16	0	0,0	0,0	1,4	0,7	0,0	2,2	4,3		
	1,44	0	0	2,5	3,24	1,4	8,6	1,44	0,0	0,0	2,5	5,0	1,4	10,4	19,0	44,6	ABS
	0	0	0	2,8	2,16	0,0	4,96	0	0,0	0,0	2,9	2,2	0,0	5,0	10,0	595,6	Mainly PP and ABS
	0	0	0	2,9	1,44	0,0	4,32	0	0,0	0,0	2,9	1,4	0,0	4,3	8,6		
	0	0	0	2,9	1,44	1,4	5,72	0	0,0	0,0	2,9	1,4	1,4	5,7	11,4	4,2	Electric switch, Body in PP
	1,44	0	0	1,4	0,36	0,0	3,24	0	0,0	0,0	1,4	0,4	0,0	1,8	5,0	13,0	presumably TPU
	1,44	0	0	10,1	12,96	1,4	25,88	0	0,0	0,0	10,1	20,2	1,4	31,6	57,5		
	0	0	1,8	5,0	6,48	0,0	13,32	1,44	0,0	1,8	5,0	10,1	0,0	18,4	31,7		
	0	0	0	1,4	1,08	0,0	2,48	0	0,0	0,0	1,4	1,1	0,0	2,5	5,0		
	1,44	0	1,8	12,6	10,8	1,4	28,04	0	0,0	1,8	7,2	10,8	1,4	21,2	49,2	158,2	ABS+TPU 158,2 (2K)
	0	0	1,8	12,6	10,8	1,4	26,6	0	0,0	1,8	7,2	10,8	1,4	21,2	47,8	158,2	ABS+TPU 158,2 (2K)
	1,44	0	0	7,6	9,72	1,4	20,12	1,44	0,0	0,0	7,6	15,1	1,4	25,5	45,6	200,4	PP
	1,44	0	1,8	5,8	4,32	0,0	13,32	0	0,0	1,8	5,8	4,3	0,0	11,9	25,2		
	0	0	0	1,4	0,36	1,4	3,2	0	0,0	0,0	1,4	0,4	1,4	3,2	6,4	8,8	5,4 ABS, 3,4 g Iron spring
	0	0	0	1,4	0,36	0,0	1,76	0	0,0	0,0	1,4	0,4	0,0	1,8	3,6	1406,6	Motor
	0	0	1,8	2,9	1,44	0,0	6,12	0	0,0	1,8	2,9	1,4	0,0	6,1	12,2		
	0	0	0	2,5	2,16	1,4	6,08	0	0,0	0,0	1,4	2,2	1,4	5,0	11,1	49,8	PCBA 43,2 + TPU seal
	1,44	0	0	5,0	6,48	0,0	12,96	0	0,0	0,0	5,0	10,1	0,0	15,1	28,1		
	0	0	0	5,0	6,48	1,4	12,92	1,44	0,0	0,0	5,0	10,1	1,4	18,0	30,9	50,0	Motor brushes, magnets
																336,2	PP
																353,0	PP
Total (s)	24	36	11	179	165	35	450	10	36	11	157	215	35	464	914	6551,2	TOTAL WEIGHT

Rowenta RO6963EA

	1	2		3	4	5	6
Component Code	Disassembly sequence of components	Disassembly sequence of connections of components	Connector type	Number of connectors	Number of product manipulations	Identifiability (0,1)	Tool type
1	Nozzle	Push button	Snap fit Type 1 H	1			Hand
2	Hose	Snap fits	Snap Fit Type 2 S	4			Spudger
3	Bucket	Push button	Snap fit Type 1 H	1			Hand
4	Inlet filter	Friction fit with removal	Friction Fit Type 1 H	1			Hand
5	On-off button	Snap fit	Snap fit Type 3 S	1		1	Spudger
		Snap fit by hand	Snap fit Type 3 H	1		1	Hand
6	Cord-winder button	Snap fit	Snap fit Type 3 S	1		1	Spudger
		Snap fit by hand	Snap fit Type 3 H	1		1	Hand
7	Frame right	Screw	Screws same / component or labeled D>3mm and L>5mm	1			Torx T15 Screwdriver
		Snap fit	Snap Fit Type 2 S	1		1	Spudger
		Snap fit by hand	Snap fit Type 3 H	3			Hand
8	Frame left	Screw	Screws same / component or labeled D>3mm and L>5mm	1			Torx T15 Screwdriver
		Snap fit	Snap Fit Type 2 S	1		1	Spudger
		Snap fit by hand	Snap fit Type 3 H	3			Hand
9	Handle opening lever	Snap fit	Snap Fit Type 2 S	1			Spudger
10	Upper housing	Screws	Screws same / component or labeled D>3mm and L>5mm	7			Torx T15 Screwdriver
		Snap fit	Snap fit Type 3 S	4		1	Spudger
		Cable plugs	Cable plug labeled or L<20mm without leaver and force <5N & D>3mm	2			Hand
11	PCBA	Cable plugs	Cable plug labeled or L<20mm without leaver and force <5N & D>3mm	2			Hand
		Snap fit	Snap Fit Type 2 H	1			Hand
12	Cord outlet	Snap fit	Snap fit Type 3 S	1			Spudger
		Snap fit by hand	Snap fit Type 3 H	2			Hand
13	Cord winder	Snap fit by hand	Snap fit Type 1 H	1			Hand
14	Motor housing lid	Screws	Screws same / component or labeled D>3mm and L>5mm	4			Torx T15 Screwdriver
15	Motor	Cable plugs	Cable plug labeled or L<20mm without leaver and force <5N & D>3mm	2			Hand
16	Motor brushes	Screws	Screws same / component or labeled D<3mm and L<3mm	2			Philips screwdriver #1
17	Wheel	Snap fit breaking	Snap fit Type 3 S	4			Spudger

	Disassembly Times (s)							(Re) Assembly Times (s)							
7	8	9	10,0	11	12	13	14	15	16	16	17,0	18	19	20
Tool Change (s)	Identifying (s)	Manipulation (s)	Positioning (s)	Disconnection (s)	Removing (s)	Total Disassembly (s)	Tool change (s)	Identifying (s)	Manipulation (s)	Positioning (s)	Fastening (s)	Adding (s)	Total (Re) Assembly (s)	Total (s)
0	0	0	1,4	0,36	1,4	3,16	0	0,0	0,0	1,4	0,4	1,4	3,2	6,4
1,44	0	0	5,8	4,32	1,4	12,92	0	0,0	0,0	5,8	4,3	1,4	11,5	24,4
0	0	0	1,4	0,36	1,4	3,16	0	0,0	0,0	1,4	0,4	1,4	3,2	6,4
0	0	0	1,4	0,36	1,4	3,16	0	0,0	0,0	1,4	0,4	1,4	3,2	6,4
1,44	3,6	0	2,5	2,16	1,4	11,12	0	3,6	0,0	1,4	2,2	1,4	8,6	19,7
0	3,6	0	2,5	2,16	0,0	8,28	0	3,6	0,0	1,4	2,2	0,0	7,2	15,5
1,44	3,6	0	2,5	2,16	1,4	11,12	0	3,6	0,0	1,4	2,2	1,4	8,6	19,7
0	3,6	0	2,5	2,16	0,0	8,28	0	3,6	0,0	1,4	2,2	0,0	7,2	15,5
1,44	0	0	2,5	12,24	1,4	17,6	1,44	0,0	0,0	2,5	14,0	1,4	19,4	37,0
1,44	3,6	0	1,4	1,08	0,0	7,56	0	3,6	0,0	1,4	1,1	0,0	6,1	13,7
0	0	0	7,6	6,48	0,0	14,04	0	0,0	0,0	4,3	6,5	0,0	10,8	24,8
1,44	0	0	2,5	12,24	1,4	17,6	1,44	0,0	0,0	2,5	14,0	1,4	19,4	37,0
1,44	3,6	0	1,4	1,08	0,0	7,56	0	3,6	0,0	1,4	1,1	0,0	6,1	13,7
0	0	0	7,6	6,48	0,0	14,04	0	0,0	0,0	4,3	6,5	0,0	10,8	24,8
1,44	0	0	1,4	1,08	1,4	5,36	0	0,0	0,0	1,4	1,1	1,4	3,9	9,3
1,44	0	0	17,6	85,68	1,4	106,16	1,44	0,0	0,0	17,6	98,3	1,4	118,8	224,9
1,44	14,4	0	10,1	8,64	0,0	34,56	0	14,4	0,0	5,8	8,6	0,0	28,8	63,4
0	0	0	2,9	0,72	0,0	3,6	0	0,0	0,0	2,9	1,4	0,0	4,3	7,9
0	0	0	2,9	0,72	1,4	5	0	0,0	0,0	2,9	1,4	1,4	5,7	10,7
0	0	0	1,4	1,08	0,0	2,48	0	0,0	0,0	1,4	1,1	0,0	2,5	5,0
1,44	0	0	2,5	2,16	1,4	7,52	0	0,0	0,0	1,4	2,2	1,4	5,0	12,5
0	0	0	5,0	4,32	0,0	9,36	0	0,0	0,0	2,9	4,3	0,0	7,2	16,6
0	0	0	1,4	0,36	1,4	3,16	0	0,0	0,0	1,4	0,4	1,4	3,2	6,4
1,44	0	0	10,1	48,96	1,4	61,88	1,44	0,0	0,0	10,1	56,2	1,4	69,1	131,0
0	0	0	2,9	0,72	1,4	5	0	0,0	0,0	2,9	1,4	1,4	5,7	10,7
1,44	0	0	5,0	6,48	1,4	14,36	1,44	0,0	0,0	5,0	10,1	1,4	18,0	32,3
1,44	0	0	10,1	8,64	1,4	21,56	0	0,0	0,0	5,8	8,6	1,4	15,8	37,4

H Appendix

Samsung SC8835

	1	2		3	4	5	6
Component Code	Disassembly sequence of components	Disassembly sequence of connections of components	Connector type	Number of connectors	Number of product manipulations	Identifiability (0,1)	Tool type
1	Nozzle	Push button	Snap fit Type 1 H	1			Hand
2	Hose	Snap fits	Snap Fit Type 2 S	2			Spudger
		Push button	Snap fit Type 1 H	1			Hand
3	Bucket	Push button	Snap fit Type 1 H	1			Hand
4	Inlet filter	Snap fit	Snap fit Type 1 H	1			Hand
		Removal	Friction Fit Type 1 H	1			Hand
5	Upper housing clump	Screws	Screws same / component or labeled D<3mm and L<3mm	5			Philips screwdriver #1
6	PCBA and switches	Cable plugs	Cable plug labeled or L<20mm without leaver and force <5N & D>3mm	3			Hand
		Screw	Screws same / component or labeled D<3mm and L<3mm	1			Philips screwdriver #1
7	Rear Housing	Screws	Screws same / component or labeled D<3mm and L<3mm	4			Philips screwdriver #1
9	Cord-winder	Extraction cord-winder from back housing	Snap Fit Type 2 H	1			Hand
8	Cord outlet	Cord outlet removal	Snap fit Type 1 S	1			Spudger
10	Motor housing lid	Screws	Screws same / component or labeled D<3mm and L<3mm	4			Philips screwdriver #1
11	Motor	Screws	Screws same / component or labeled D<3mm and L<3mm	2			Philips screwdriver #1
12	Motor brush	Screws	Screws same / component or labeled D<3mm and L<3mm	2			Philips screwdriver #1
13	Wheel screw cover	Snap fit	Snap Fit Type 2 S	1			Spudger
14	Wheel	Screw	Screws same / component or labeled D<3mm and L<3mm	1			Philips screwdriver #1

Siemens VS06A111/12

	1	2		3	4	5	6
Component Code	Disassembly sequence of components	Disassembly sequence of connections of components	Connector type	Number of connectors	Number of product manipulations	Identifiability (0,1)	Tool type
1	Nozzle	Friction fit extraction	Friction Fit Type 1 H	1			Hand
2	Hose	Push button	Snap fit Type 1 H	1			Hand
		Push button	Snap fit Type 1 H	1			Hand
3 rx	Wheel rx	Friction fit	Friction Fit Type 2 S	1	1		Spudger
3 lx	Wheel lx	Friction fit	Friction Fit Type 2 S	1			Spudger
4	Dust bag	Opening handle (upper housing	Snap fit Type 1 H	1			Hand
		Removing bag	Snap fit Type 1 H	1			Hand
5	Inlet filter	Removal of the filter	Snap fit Type 1 H	1			Hand
6	Rear Housing	Screws	Screws same / component or labeled D>3mm and L>5mm	3			Torx T15 Screwdriver
		Hidden snap fits beneath caster wheels	Snap fit Type 3 S	2	1	1	Spudger
7	PCBA and switches	Extraction by hand	Friction Fit Type 3 H	1			Hand
		Cable plugs	Cable plug labeled or L<20mm without leaver and force <5N & D>3mm	2			Hand
8	Cord-winder	Extraction cord-winder from back housing	Friction Fit Type 2 H	1			Hand
9	Motor	Extraction cord-winder from back housing	Friction Fit Type 1 H	1			Hand
10	Motor brushes	Entraction using pliers	Friction Fit Type 2 S	1			Spudger
11	Aesthetic Upper housing	Snap fits	Snap Fit Type 2 S	2			Spudger

	Disassembly Times (s)							(Re) Assembly Times (s)							
7	8	9	10,0	11	12	13	14	15	16	16	17,0	18	19	20
Tool Change (s)	Identifying (s)	Manipulation (s)	Positioning (s)	Disconnection (s)	Removing (s)	Total Disassembly (s)	Tool change (s)	Identifying (s)	Manipulation (s)	Positioning (s)	Fastening (s)	Adding (s)	Total (Re) Assembly (s)	Total (s)
0	0	0	1,4	0,36	1,4	3,16	0	0,0	0,0	1,4	0,4	1,4	3,2	6,4
1,44	0	0	2,9	2,16	1,4	7,88	0	0,0	0,0	2,9	2,2	1,4	6,4	14,3
0	0	0	1,4	0,36	0,0	1,76	0	0,0	0,0	1,4	0,4	0,0	1,8	3,6
0	0	0	1,4	0,36	1,4	3,16	0	0,0	0,0	1,4	0,4	1,4	3,2	6,4
0	0	0	1,4	0,36	1,4	3,16	0	0,0	0,0	1,4	0,4	1,4	3,2	6,4
0	0	0	1,4	0,36	0,0	1,76	0	0,0	0,0	1,4	0,4	0,0	1,8	3,6
1,44	0	0	12,6	16,2	1,4	31,64	1,44	0,0	0,0	12,6	25,2	1,4	40,6	72,3
0	0	0	4,3	1,08	1,4	6,8	0	0,0	0,0	4,3	2,2	1,4	7,9	14,7
1,44	0	0	2,5	3,24	0,0	7,2	0	0,0	0,0	2,5	5,0	0,0	7,6	14,8
0	0	0	10,1	12,96	1,4	24,44	1,44	0,0	0,0	10,1	20,2	1,4	33,1	57,5
0	0	0	1,4	1,08	1,4	3,88	0	0,0	0,0	1,4	1,1	1,4	3,9	7,8
1,44	0	0	1,4	0,36	1,4	4,64	0	0,0	0,0	1,4	0,4	1,4	3,2	7,8
1,44	0	0	10,1	12,96	1,4	25,88	0	0,0	0,0	10,1	20,2	1,4	31,6	57,5
0	0	0	5,0	6,48	1,4	12,92	0	0,0	0,0	5,0	10,1	1,4	16,5	29,4
0	0	0	5,0	6,48	1,4	12,92	1,44	0,0	0,0	5,0	10,1	1,4	18,0	30,9
1,44	0	0	1,4	1,08	1,4	5,36	0	0,0	0,0	1,4	1,1	1,4	3,9	9,3
1,44	0	0	2,5	3,24	1,4	8,6	1,44	0,0	0,0	2,5	5,0	1,4	10,4	19,0

	Disassembly Times (s)							(Re) Assembly Times (s)							
7	8	9	10,0	11	12	13	14	15	16	16	17,0	18	19	20
Tool Change (s)	Identifying (s)	Manipulation (s)	Positioning (s)	Disconnection (s)	Removing (s)	Total Disassembly (s)	Tool change (s)	Identifying (s)	Manipulation (s)	Positioning (s)	Fastening (s)	Adding (s)	Total (Re) Assembly (s)	Total (s)
0	0	0	1,4	0,36	0,0	1,76	0	0,0	0,0	1,4	0,4	0,0	1,8	3,6
0	0	0	1,4	0,36	1,4	3,16	0	0,0	0,0	1,4	0,4	1,4	3,2	6,4
0	0	0	1,4	0,36	0,0	1,76	0	0,0	0,0	1,4	0,4	0,0	1,8	3,6
1,44	0	1,8	1,4	1,08	0,0	5,76	0	0,0	1,8	1,4	1,1	0,0	4,3	10,1
0	0	0	1,4	1,08	1,4	3,92	0	0,0	0,0	1,4	1,1	1,4	3,9	7,8
0	0	0	1,4	0,36	1,4	3,16	0	0,0	0,0	1,4	0,4	1,4	3,2	6,4
0	0	0	1,4	0,36	0,0	1,76	0	0,0	0,0	1,4	0,4	0,0	1,8	3,6
0	0	0	1,4	0,36	1,4	3,16	0	0,0	0,0	1,4	0,4	1,4	3,2	6,4
1,44	0	0	7,6	36,72	1,4	47,12	1,44	0,0	0,0	7,6	42,1	1,4	52,5	99,6
1,44	7,2	1,8	5,0	4,32	0,0	19,8	0	7,2	1,8	2,9	4,3	0,0	16,2	36,0
0	0	0	2,5	2,16		4,66	0	0,0	0,0	1,4	2,2	0,0	3,6	8,3
0	0	0	2,9	0,72	0,0	3,6	0	0,0	0,0	2,9	1,4	0,0	4,3	7,9
0	0	0	1,4	1,08	1,4	3,88	0	0,0	0,0	1,4	1,1	1,4	3,9	7,8
0	0	0	1,4	0,36	1,4	3,16	0	0,0	0,0	1,4	0,4	1,4	3,2	6,4
1,44	0	0	1,4	1,08	1,4	5,36	0	0,0	0,0	1,4	1,1	1,4	3,9	9,3
0	0	0	2,9	2,16	1,4	6,44	0	0,0	0,0	2,9	2,2	1,4	6,4	12,9

Disassembly results Philips FC6812							
Part	Steps (n.)	Tool changes (n.)	Connections (n.)	eDIM (s)	% of total disassembly time	% of total connectors	Uncommon tools
Total Disassembly	37	20	93	1036	100	100	
Nozzles (3)	1	0	2	6,36	0,613852212	2,150537634	
Brush (5)	1	0	1	6,36	0,613852212	1,075268817	
Battery charger (18)	0	0	0	0	0	0	
Wheels (4)	1	1	2	26,16	2,524901552	2,150537634	
Battery pack (8)	2	2	5	60,28	5,818083546	5,376344086	
PCB and Motor (12)	11	12	27	244,56	23,60435488	29,03225806	
External casing (22-23)	13	13	40	351,76	33,95104625	43,01075269	
Filter (670)	2	0	3	17,04	1,644660644	3,225806452	
Nozzle motor belt (X.6)	8	2	15	205,88	19,87105243	16,12903226	

Disassembly results Philips FC8924							
Part	Steps (n.)	Tool changes (n.)	Connections (n.)	eDIM (s)	% of total disassembly time	% of total connectors	Uncommon tools
Total Disassembly	32	14	90	997	100	100	
Nozzles (3,4,6)	1	0	1	5	0,50166553	1,111111111	
Hose (1)	1	0	2	8,56	0,858851387	2,222222222	
Cordwinder (29)	14	8	49	573,16	57,50692298	54,44444444	Trox 15, Group B
Wheel (38rx or lx)	15	10	50	689	69,12950997	55,55555556	Extended Trox 15, Uncommon tool
Motor (44)	16	10	57	749,76	75,22574949	63,33333333	Extended Trox 15, Uncommon tool
PCB (47)	17	10	58	756,12	75,86386804	64,44444444	Extended Trox 15, Uncommon tool
External casing (X)	9	7	34	346,48	34,76341454	37,77777778	Trox 15, Group B
Filter (10)	3	0	4	17,04	1,709676125	4,444444444	
Motor brushes	/	/	/	/	/	/	not possible to disassemble motor brushes

Disassembly results Philips FC9934							
Part	Steps (n.)	Tool changes (n.)	Connections (n.)	eDIM (s)	% of total disassembly time	% of total connectors	Remarks
Total Disassembly	32	15	65	960	100	100	
Nozzles (28,29,30,31)	1	0	1	5	0,52061641	1,538461538	
Hose (26)	2	0	2	8,56	0,891295294	3,076923077	Hose not disattachable from handle
Cordwinder (15)	11	3	27	370,64	38,59225323	41,53846154	Trox 15, Group B
Wheel (25rx or lx)	10	4	31	602,32	62,71553519	47,69230769	Extended Trox 15, Uncommon tool
Motor (21)	10	4	25	693	72,1574344	38,46153846	Extended Trox 15, Uncommon tool
PCB (22)	11	4	26	706,6	73,57351104	40	Extended Trox 15, Uncommon tool
External casing (10-11)	3	0	6	50,88	5,297792586	9,230769231	
Filter (3)	2	0	2	12,72	1,324448147	3,076923077	
Motor brushes	/	/	/	/	/	/	not possible to disassemble motor brushes

Disassembly results Philips FC9569							
Part	Steps (n.)	Tool changes (n.)	Connections (n.)	eDIM (s)	% of total disassembly time	% of total connectors	Uncommon tools
Total Disassembly	33	17	86	914	100	100	
Nozzles (6,3)	1	0	1	6,36	0,695751105	1,162790698	
Hose (111)	1	0	3	20,68	2,262285039	3,488372093	
Cordwinder (32)	10	7	31	395,6	43,27659388	36,04651163	
Wheel (41 rx or lx)	12	8	43	539,04	58,96818798	50	1 too deep screw (PH2)
Motor (45)	13	9	48	576,44	63,05955454	55,81395349	1 too deep screw (PH2)
PCB (31)	14	11	55	615,6	67,343456	63,95348837	1 too deep screw (PH2)
External casing (11)	4	3	16	227,84	24,92451757	18,60465116	1 too deep screw (PH2)
Filter (9)	2	0	2	12,72	1,39150221	2,325581395	
Motor brushes	14	10	50	607,32	66,43766683	58,13953488	

Disassembly results Rowenta RO6963EA					
Part	Steps (n.)	Tool changes (n.)	Connections (n.)	eDIM (s)	Uncommon tools
Nozzles (1)	1	0	1	6,36	
Hose (2)	1	1	4	24,4	
Cordwinder (13)	9	10	35	574,08	Trox 15, Group B
Wheel (17 rx or 17lx)	1	1	4	37,36	
Motor (15)	9	10	35	674,96	Trox 15, Group B
PCB (11)	8	9	32	543,64	Trox 15, Group B
External casing (7&8)	4	6	14	221,44	Trox 15, Group B
Filter (4)	2	0	2	12,72	
Motor Brushes (16lx&16rx)	11	11	37	739,6	Trox 15, Group B

Disassembly results Samsung SC8835					
Part	Steps (n.)	Tool changes (n.)	Connections (n.)	eDIM (s)	Uncommon tools
Nozzles (1)	1	0	1	6,36	
Hose (2)	1	1	4	17,88	
Cordwinder (9)	5	3	15	108,08	
Wheel (14 rx or 14 lx)	2	2	2	28,28	
Motor (11)	5	2	19	237,8	
PCB (6)	3	2	10	108,08	
External casing (5)	2	1	6	78,64	
Filter (4)	2	0	3	16,28	
Motor Brushes (12lx&12rx)	7	2	21	299,56	

Disassembly results Siemens VS06A111/12					
Part	Steps (n.)	Tool changes (n.)	Connections (n.)	eDIM (s)	Uncommon tools
Nozzles (1)	1	0	1	3,56	
Hose (2)	1	0	2	5	
Cordwinder (8)	5	4	10	175,98	Trox 15, Group B
Wheel (3 rx or 3 lx)	1	1	1	10,08	
Motor (9)	5	4	11	174,2	Trox 15, Group B
PCB (7)	5	4	11	176,1	Trox 15, Group B
External casing (11)	3	1	4	25,6	
Filter (5)	2	0	3	16,28	
Motor Brushes (10lx &10rx)	7	5	13	192,76	Trox 15, Group B

Appendix I: Interview with official professional repairers and visit to the European Repair Center

This interview has been carried out with a professional, but unofficial, repairer (electrical engineer) at the Delft Repair Cafè. This is an association that organizes monthly social meetings in different cities of the Netherlands. The aim of this initiative is to help private consumers to fix their appliances, promoting repairing over purcasing of new products. This interview has been carried out to discuss product repairability (focusing on vacuum cleaners) with a not-official professional repairer. The insights of this interview have been analysed and compared to those collected from the official Philips repairer in Trier. In order to make the experience and interview more realistic, a broken vacuum cleaner has been brought to the repair facility, simulating a real repair procedure. However, the repair did not actually happen, since it would have taken too long to open the product (as explained in the interview) and it was not really relevant for the scope of the interview. Despite this, the repair steps have been simulated and described precisely from the interviewee, who always follow the same repair procedure for vacuum cleaners. The interviewee didn't give consent to an audio-recorded interview, therefore the answers transcribed in this appendix have been creating from personal notes taken on the spot. They have been transcribed in third person to remark that the answers collected are not exactly the same words expressed by the repairer.

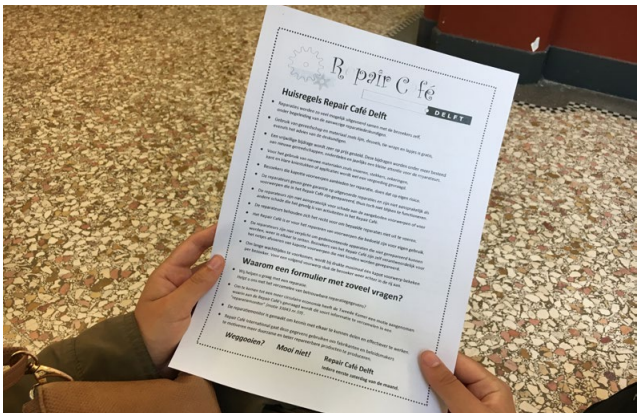
Repair cafè "check-in"

The first step at the Repair café is the "check-in". A person from the staff checked the vacuum cleaner, looking for brand and serial number of the product. It has been asked the reason of the visit and possible reasons of malfunctioning of the product. The staff inspected the outside of the item, without opening or testing it. Eventually, a form has been filled, indicating information possibly useful for the repairer. After the registration, the client is assigned to the first repairer available with previous experience in repairing the specific product presented during the check-in. While waiting, an information sheet is provided, explaining how the repair café works, rules, funding and legal responsibilities.

Repair and interview

The repair procedure is usually carried out together with the client, showing the reasons of product malfunctioning and how to repair them. In this case, the repairer interviewed was a retired Electrical Engineer, therefore with a high knowledge level. However, his experience with vacuum cleaners was relatively limited (this was his fifth vacuum cleaner), since he often focuses on Senseo coffee machines. He explained that there are no specific repairer figures for each product group, but all the staff helps with different type of appliances, except for Laptops and clothes where specialised people are assigned. The working surface was limited, since different repairs happen on the same tables. The repairer was equipped with a tool box.

First inspection of the product at the check-in



List of rules about the Repair Cafè

- How old are usually the VC brought to the Repair Café?

The interviewee didn't have an answer. The product age can vary a lot and usually it is difficult to determine it if the production year is not indicated on the product label. However, this data is checked afterwards while creating the repair monitor, using the product serial number.

- How easy/difficult is to repair a vacuum cleaner?

The repair procedure is not difficult, but it can take a lot of time. This is mainly due to the assembly complexity and presence of many hidden snap fit, difficult to spot and easy to break. The average time required for the disassembly is 30 minutes, reaching 1 hour when there are no visible screws and all the fasteners are hidden.

- Do you see any differences between the Philips vacuum cleaners and those from other brands?

Not only Philips vacuum cleaners, but all their product in general, often present not standard components. This can vary from screw heads to electric components on the electric board (he made some examples related to capacitors on Senseo machines, TV and audio appliances). It happens very often that, to repair Philips product, only official parts can be used.

- Is there any brand or model you think is very well designed and easy to repair?

The interviewee could not think about any brand in particular. Since the product architecture of vacuum cleaners is relatively simple, their design does not vary a lot based on the brand.

- Which type of tools do you use for the repair? Are they easy to find (common tools)?

Often not-common tools are required. The interviewee showed a special kit that he had to buy to be able to disassemble all the different type of appliances. Screws are often difficult to reach, because hidden in the product housing or too deep. Moreover, they often have not-standard screw heads, brand specific and difficult to find.

- Do you use any manual or guideline? Troubleshooting guides?

No, manuals and guidelines are often very difficult to find. Sometimes, service manuals or disassembly videos can be found on the internet. It would be very helpful if the service manuals would be publicly available. In particular, electric board schematic and disassembly steps are the most important information.

- What are the most common faults?

The two main faults the interviewee found in the five vacuum cleaners previously repaired are motor brushes, electric cable and electric board components. He strongly suggested to check this information in the repair monitor (which can be found in Appendix D), since his experience with vacuum cleaner was very limited. However, he thinks that motor brushes and cable plug are the two components repaired more often in vacuum cleaner at the Repair Café.

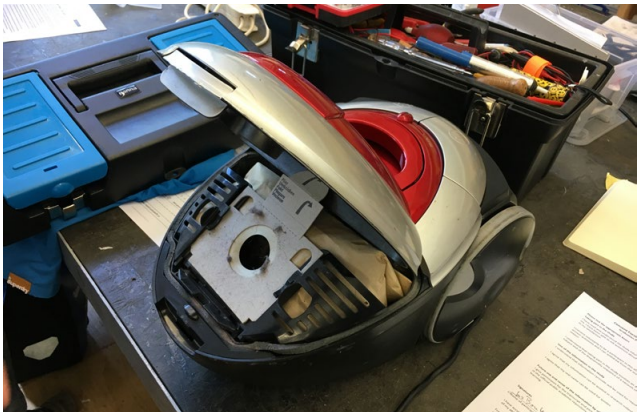
- How easy/difficult is to understand what is the problem?

Since the design of vacuum cleaners is relatively simple, it is also easy to find the reason of the product malfunctioning. A multimeter is often used to identify electric malfunctioning.

- What do you think about user maintenance? Is it an important cause of faults?

According to the interviewee, user maintenance is always important to prevent product faults.

Inside of the repair café



Second product inspection, carried out by the repairer

However, this is less important in vacuum cleaners compared to coffee machines. In his opinion dirty filters or blocked hoses are not the main cause of product failing.

- Where do you find the spare parts? Do you ever buy them from Philips?

The Repair Café in Delft does not have any spare parts because of lack of storage space. The only exception is Senseo machine spare parts, since this is the most repaired product. If a spare part is required to fix the product, as usually happens, the repairer suggest to the client to by the part by himself in a physical shop in Delft (Handy Man). If the repair procedure is easy, the repairer would just explain how to replace the part to the consumer, who will complete the repair by him/herself. On the contrary, if the repair procedure is difficult or dangerous, the customer can come back with the spare part needed.

- Which connectors type do you find easier to disconnect?

Screws are the easiest fasteners to disconnect. This is because they are easy to locate on the product. On the contrary, snap fits are the most difficult ones since they are often hidden. Even if screws take more time for the disconnection action, the snap fits require way more time to be located. Another drawback of snap fits is that it is difficult to

understand where to correctly apply force through the spudger. Applying high intensity force in the wrong position always leads to part breakage or ruining the aesthetic of the surrounding plastic surfaces. However, if there were clear indications that helped to identify snap fits location, snap fits would become faster to disassemble compare to screws.

- How would you change the inner architecture of vacuum cleaners? Would you change the disposition of the internal components?

The interviewee would not change the disposition of the inner components. In his opinion, the inner components are organized in such a way that the product is balanced and easy to move. For instance, the motor has to stay on the bottom since it is the heaviest part. What has to be improved is accessibility to the inner components. The main problem observed is that the removal of all the external covers and plastic casings is very time consuming. They are composed by many different components, which have to be carefully removed locating the hidden snap fits. It would be ideal to reach the inner components in one or two steps, without the risk of damaging any plastic surface or component. The interviewee talked about “modularity” and “hidden back door to reach the motor from the outside”.

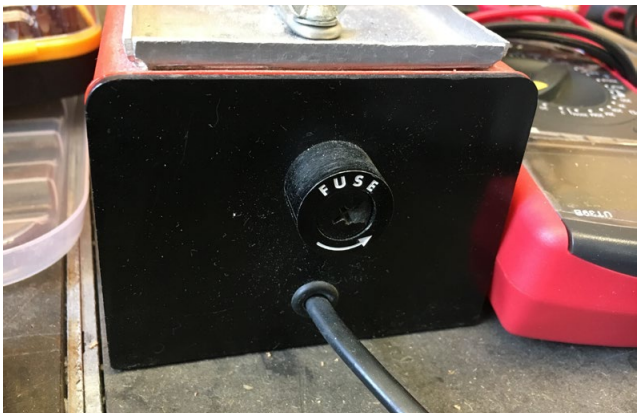
- Are repair procedures on vacuum cleaners safe? Could they be carried out by any private consumer?

The interviewee thinks that it is not safe since the product is supplied using high voltage current. This is valid for all the products supplied with 220v, while it is safer to repair products which are supplied using low voltage batteries. If a completely inexpert user forgot to disconnect the vacuum cleaner from the current supply, the disassembly of the product would be very risky. The PCBA connectors are completely exposed and can be easily involuntary touched by the consumer.

- How often do you change motor brushes? Does it happen often that you have to replace them?

The interviewee explained that in his opinion it is very important to be able to reach the motor brushes, since he thinks they are the main cause of motor malfunctioning. However, he did not state in how many cases he had to replaced them in his past experience. He also talked about a thermal fuse which is sometimes placed in the motor. This was also identified as possible cause of motor breakage. However, since this fuse is always difficult to reach and replace, it is not possible to make sure that it is the real cause. The repairer suggested that fuses should always be accessible, by placing them on the outside of the components. As an example, he pointed to a solder, where the fuse is clearly located on the external housing.

Special kit of uncommon tools used by the repairer



Example of external product fuse, used by the repairer to explain the importance of accessible priority components

- What repair sequence do you usually follow?

First of all, the repairer checked the form filled in by the staff member at the check in. This step speeds up the process. When the repairer welcomes the client, he/she already knows what the item diagnosis is. The sequence carried out by the repairer interviewed specifically for vacuum cleaners is:

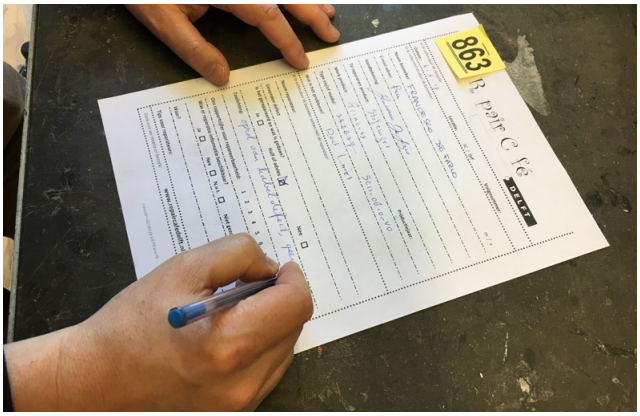
1. External product inspection. The repairer checks if the problem is just some external component (hose, cable plug, casing), or if the entire product does not work (e.g. it is not possible to turn it on).
2. Cable plug. In case the product was completely not working, the cable is the first part to be checked. This is because the plug is one of the main faults found for this product group, and its replacement does not require to disassemble the product body.
3. Cord winder. If the plug was not the problem, the product has to be disassembled in order to check if there is electric contact between the cable plug and the cord-winder output to the PCBA. In order to understand how to disassemble correctly the product, the repairer would first look for screws. They are usually placed on the back or beneath the dust bucket/bag. After removing the screws,

the interviewee looks for hidden snap fits. This is the disassembly steps that requires more time. Clients usually care about the aesthetic of the product; therefore, these connectors have to be disconnected without ruining the surrounding plastic surfaces.

4. PCBA. If no problem was found in the cord winder, the PCBA would be then inspected. The repairer usually looks for possible burnt components, and he check that the connection to the motor is correct. If the fault is due to a single electric component, the repairer would replace it using a solder and spare electric components he is equipped with.
5. Motor. If the PCBA was not the problem, the motor would be finally inspected. Reaching the motor requires long disassembly time and effort, therefore this component is the last one to be checked. In this case, no specific test is carried out. The motor brushes are the only component that can be checked if externally placed and reachable. In case they were completely worn out, they would be replaced.

Post-repair form

The normal procedure of the Repair Café usually includes a final form that the repairer has to fill in, describing the repair procedure just carried out. This information is used to take track of all the repairs and create the repair monitor.



Final check list and notes about what was the problem, the solutions and if the repair went well

Appendix J: Interview with official professional repairers and visit to the European Repair Center

The Repair Centre

The European Repair Center (ERC), is one of the main Philips repair centres in Europe. 1000 products from all Europe are shipped to here every day. This centre is not owned by Philips. However more than 90% of the products collected and repaired here are Philips products.

During the visit, it was explained that not all the products are actually repaired. In fact, very cheap items (low-end product categories), are immediately replaced by Philips with new ones. Carrying out a repair procedure on this kind of goods, by involving the use of spare parts and labour costs, is less convenient for the company compared to send back to the consumer a new product. This practice is internally called X to X. The broken items are therefore collected together, and sent away for disposal or recycling (This has not been clearly explained). The users can also decide to dispose the product by themselves; Philips always suggests to use the current collecting channels for electric appliances. Products containing batteries are divided from wired ones.

It has been pointed out how the cost of transportation is rapidly increasing in the recent years (written in 2019). This might lead in the future to increase the number of X to X practices, since repairing product is becoming less and less continent compared to providing a new item instead.
A big stock volume is represented by products returned within 15 days from the purchase (European free return period). These products are usually almost untouched and in good state. Those in best conditions are refurbished, while the ruined or broken ones are disassembled for parts harvesting. There are no preferred components in this case; as many components as possible are harvested. Currently the centre is relying on more than 30% of harvested spare parts. This decreases the cost spent for spare components required for repairs, which are usually ordered directly from Philips. It is important to underline that most of the repairs carried out in this centre happen under warranty period, which means that their cost is covered by Philips itself and not by the consumer. Therefore, repairs are actually a cost for the company, not a gain.
Some products, in particular coffee machines, are cleaned in a cleaning area before carrying out repair procedures. This is not the case with vacuum cleaners.

European Repair Center in Trier, Germany

Products waiting to be repaired


X to X practice


Spare parts supplies

Usually each product is repaired just by one person. In the past it has been tried to place beginners alongside an expert repairer, but it was not very time efficient. In general, training a new employee can takes between one and two years, in order to cover most of the product groups.

Each repairer has a personal working station, composed by a desk, electric instrumentations (multimeter, oscilloscope), different disassembly tools, and a PC. The working surface is always very full of objects, there is no much space for movements and operations. The PC is used to consult "At your service", a Philips online website reserved to official repairers. On this portal it is possible to find all the service manuals and the service information. The service information is a document that collect all the latest repair information concerning a specific model. This includes troubleshooting, repairing advices, repair check list, product recalls, specific product problems identified just after production. This information is not included in the service manual, since the service information document has to be updated very often. A frequent update could not happen with the service manual, since it is a very standard and widely spread document.

Interview with two Philips official repairers

The two interviewees are both involved mainly in vacuum cleaners' repairs. It was not possible to record the interview; the answers have been transcribed from notes taken on the spot. The "third person" has been used in order to remark the fact that they do not represent the exact literal words used by the interviewees.

- What is your expertise level?

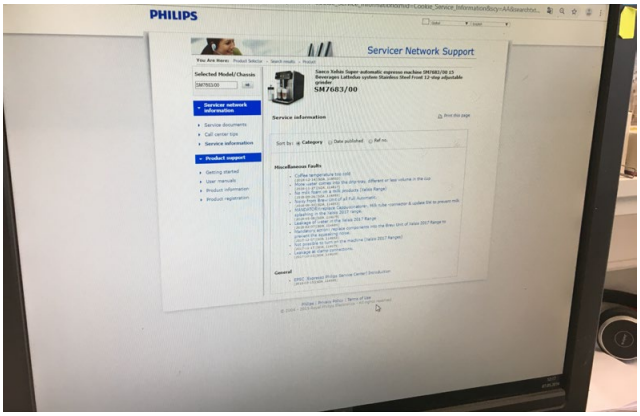
They are both professional repairers, with almost 8 years of experience. One of them has been working on vacuum cleaners for three years, while the other for 6 months. Previously, they were both focus on Philips audio appliances. Currently they repair around 25-30 vacuum cleaners each per day.

- Which models are more often received at the Central Repair Centre?

In general, low end products (they indicated series FC93XX and FC97XX) are received more often (at least 3-4 per day) compared to high-end (series FC99XX and FC89XX). However, many FC89XX and FC82XX have been received because of motor malfunction. Recently, many SpeedPro max (stick vacuum cleaners, series FC68XX) have been also received at the repair centre.

- How old are usually the VC's?

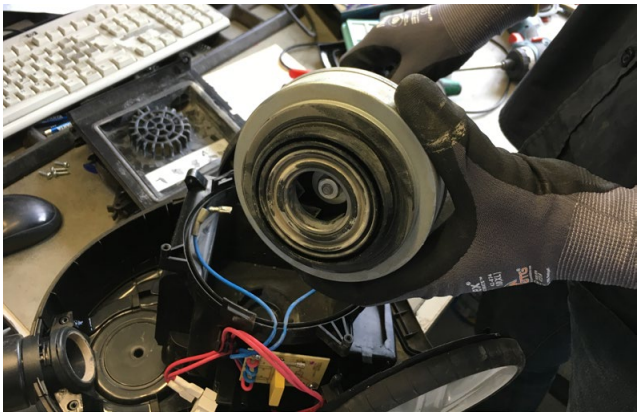
Most of the vacuum cleaners have less than one year. Sometimes it also happened that they



Online service portal used by the repairs

Repairer working station

Simple part harvesting carried out by the repairers for specific components of which they don't have spare parts



Repairer showing and explaining main causes of motor breakage

received also very old product, but it is rarer since in that case the repair costs are on the consumers.

- How long does it take to complete a repair on average? Are there models that takes more/ less time?

The entire repair procedure is actually composed by two different parts:

1. Actual product repair; this usually takes between 10 and 15 minutes for normal devices, and 20-30 minutes for products with remote controls, which involves many electronic components
2. Product tests; these are test carried out in order to check that the product is fully working. It usually takes 20-30 minutes

- What are the most common faults?

Usually the parts that fails more often are Cord-winder, filter clogged and motor. PCBA and switches are not replaced very often.

- What doesn't work when you change the cord-winder?

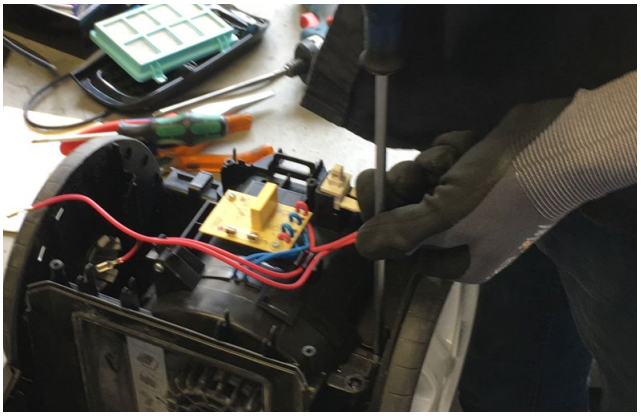
The cord-winder mechanism is often working. The main problem is the cable plug. Consumers tend to pull and move the plug too much while connected to the socket, and this determines the wear of its plastic neck. This part cannot be disassembled by itself, therefore all the cord-winder has to be replaced. Often it also happens that there is some dust accumulated on the mechanism part which should block the rolling mechanism. In this case, it is just enough the clean it. However, sometimes also the general mechanism breaks and has to be replaced.

- What doesn't work when you change the hose?

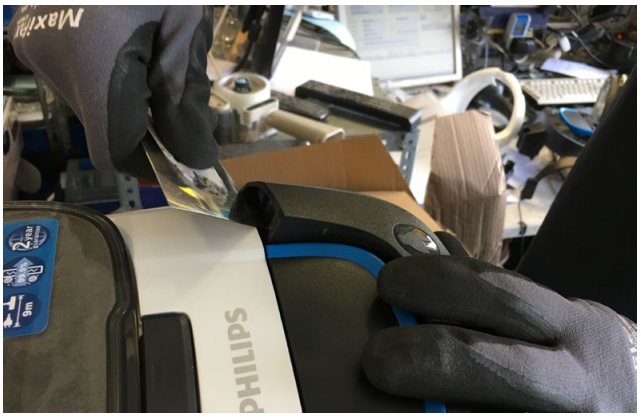
The hose is often clogged. Many times, it is just enough to clean it without actually replacing the part. It has been pointed out that the plastic insert for flow regulation placed on the handle often breaks. Handle and hose are provided together with the same spare parts and this would mean that for just a small insert, all the hose would have to be replaced. The repairers are currently avoiding this by harvesting that specific small plastic component from other vacuum cleaners. It has been shown how all these small clips are collected together in a glass next to the working space.

- What is broken when the motor doesn't work? What do you think about motor brushes? Should Philips make them replaceable?

Motor breakage is often caused by incorrect user maintenance. Often, consumers clean the inlet filter with water, and they place it back before it gets completely dry. Part of the water finishes in the motor and this causes its malfunctioning. Another important cause of motor breakage is dust accumulation in the motor, also partially related to



Use of un-common tools to reach very deep screws



Special technique used to disassemble hidden snap fits

Broken hidden snap fits while trying to disassemble the part

Example of hidden assembly difficult to disassemble

lack of user maintenance.
Both the interviewees do not think that motor brushes are related to motor malfunction and they do not think it would be relevant if Philips would make them replaceable.

- What doesn't work when you change the PCBA? All the PCBA or the buttons?

The PCBA is not replaced very often. However, with some models of the series FC99XX it happened that the PCBA burned because of the motor. The power switch sometimes breaks because of dust accumulated inside of it.

- Does the nozzle motor belt even break in uprights? Can you change it?

It is not possible to change the nozzle motor belt, since there are no spare parts. Despite this, not many upright active nozzles fail; usually the main problem with nozzles is clogging. In case the active nozzle is broken, the entire part is replaced.

- What about user maintenance? Is it an important cause of faults?

User maintenance is very important. Most of the malfunctions are related to filter and hose clogging, determined by lack of maintenance.

- How easy/difficult is to repair a vacuum cleaner?

Vacuum cleaners are relatively simple to repair. The most difficult and time-consuming part is to actually reach the inner components, removing all the first plastic layers.

- Which models are the most easy/difficult models to repair? Why?

Usually the models with remote control integrated in the handle are the most difficult to repair. This is because they present more internal components, due to the electronics involved. The easiest ones are the low-end canisters (series FC93XX) and the SpeedPro Max (series FC68XX). The SpeedPro max is considered simple because it is very easy to reach the motor and the PCBA. However, these two parts cannot be disconnected from each other, and this requires to always disassemble them together. Therefore, this model is simple, but time consuming to disassemble (around 15-20 min). Even the motor spare part of this motor is provided together with the PCBA.

- Which type of tools do you use for the repair? Do you use a manual or electric screw driver?

Usually they both use an electric screw driver, since it is faster. However, the SpeedPro max uses very fragile Phillips 1 screws, which wear very easily. For this reason, in that case they use a manual screw driver.
When the product simply does not turn on, a multimeter is used in order to determine the cause of malfunctioning. Different electric contacts and capacitors on the PCBA are checked in order to find to the fault.
Some screws, like the one used to fasten the motor housing, are very deep. Therefore, a very long screw driver is used. This is also mounted on the electric version.
A special tool to check the power consumption of the motor is used in order to check at the end of the repair if the suction power is constant.

- Do you use any manual or guideline? Troubleshooting guides? Check list?

The service manual is used when new models

Repairer showing a small insert which is always lost during the disassembly

Repairer showing a components which wears often, but which doesn't have spare parts

Spare part of the hose, always provided with the handle as well

are released. Usually, after the first repairs, the user manual is not necessary anymore, since they remember by heart the procedures. The same is valid for the checklist and troubleshooting, part of the service information. They are usually very clear and contain all the information needed.

- How easy/difficult is to understand what the problem is?

Usually it is easy. The two main problems encountered are low suction power or product not turning on. In the first case the cause is usually hose ore filter clogged, while in the second case the cause could be related to cord-winder, PCBA or motor.

- Which connectors type do you find easy/ difficult to disconnect? Why?

They are used to all the types of connectors. However, sometimes they struggle with snap fits, in particular with the on-off and cord-winder buttons. In this case they use a spatula instead of a spudger to disassemble them. By showing me the procedure, they broke the snap fits hidden beneath the buttons, but they argued that this does not happen often. The snap fit connection hidden in the hose connectors to the canister body of the series FC97XX is also quite difficult to open.

- Do you always have spare parts available?

Almost always. The spare parts more often used are always in stock and directly available at the repair centre. If they are not, they can be ordered from Philips, and they are sent usually in around 3 days, therefore very fast. In case spare parts cannot be ordered from Philips anymore, the only solutions are harvesting or ordering from Flex.

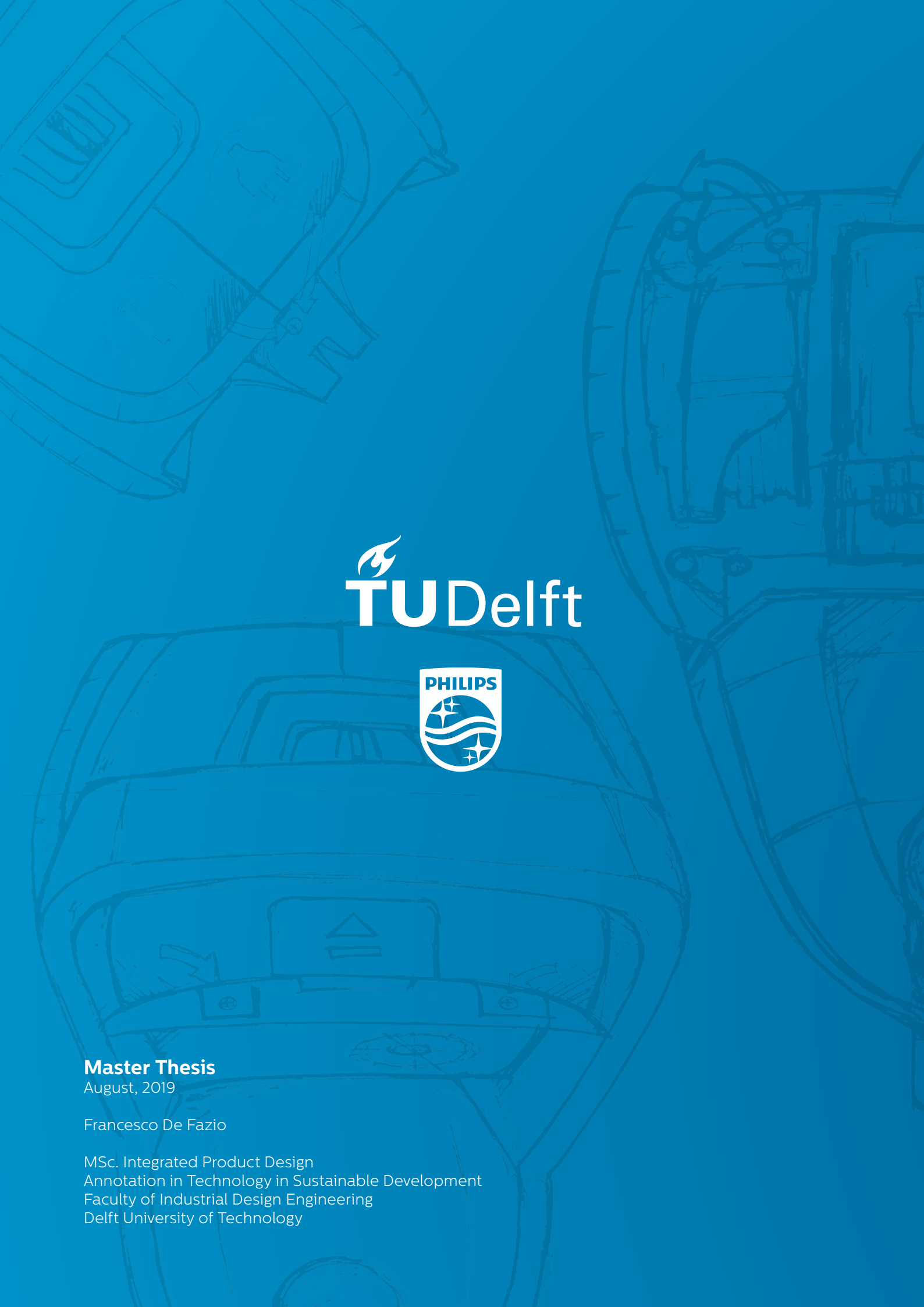
- Which repair procedures do you usually follow?

If the suction power is low, they immediately check if the hose or the inlet filter is clogged. If the product does not turn on, they first check the cable plug, then the PCBA and finally the motor.

- What would you change in the design of the product?

The two repairers could not think about real changes in the design, but they had many feedbacks about different components and different models. They have been listed here:

1. It is very easy to loose the screw cone of the SpeedPro Max FC68XX, since it is too small
2. A connector on the PCBA from the motor would be very handy.
3. In the SpeedPro Max it is very difficult to disassembly and also reassemble the outer aesthetic frames. These are not often removed, but when it happens it takes a lot of time
4. In the SpeedPro max it should be possible to disconnect the PCBA from the motor. Having to disassemble always both together raise the disassembly time. Moreover, it is a waste of spare parts.
5. In the low and mid end canister models, the wheels can be disassembled just breaking completely their snap fits. This usually takes a lot of effort and time.
6. Usually all the canisters have to be disassembled completely in order to get to the wheels. They are not replaced very often, but if this happens it takes a lot of time.
7. In the SpeedPro Max there is a rubber ring positioned on the tube connector which wears very easily. The ring should often be changed but, at the moment, there is no spare part for this ring.
8. On the packaging of the inlet filter sold by Philips for bagless canister, there is the illustration of a filter (in blue) and of the filter holder (in black). Very often, the consumer throws away also the filter holder, by thinking that it is included in the spare part purchased. This is not the case, and the incorrect mounting of the filter causes breakage of the dust bucket.
9. Many of the screws used in the Speed Pro Max are too short, and they wear too easily.
10. In the series FC82XX the hose connector to the canister body breaks very often, because badly glued. In order to replace this part, also the handle has to be replaced, since they are provided in just one piece
11. In the spare part for the dust bucket of the model FC93wwXX, the small iron spring is not included. The original one is often lost by the consumer, and it is not possible to replace it.
12. The design of the cord-winders is always different based on the model. It would be preferable to use just a standard part.



Master Thesis
August, 2019

Francesco De Fazio

MSc. Integrated Product Design
Annotation in Technology in Sustainable Development
Faculty of Industrial Design Engineering
Delft University of Technology