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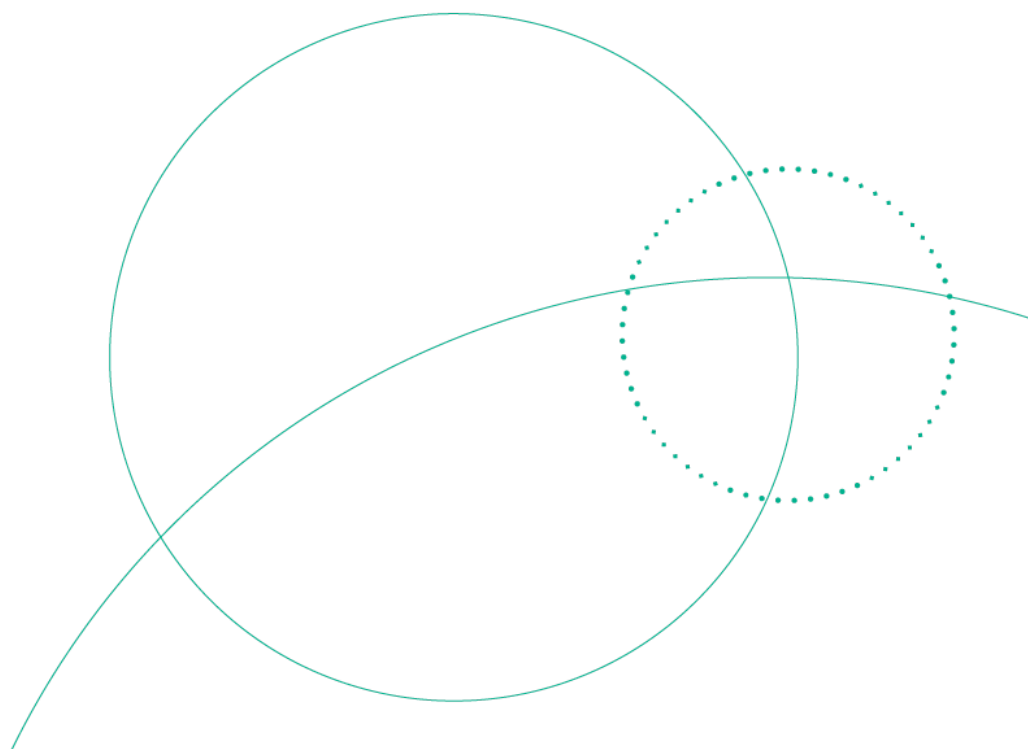
WHO Prequalification Programme / Vector Control Product Assessment

WHO Public Assessment Report: WHOPAR Part 3

PRONet Duo
(V.K.A. Polymers Private Ltd.)

P-12406

Quality Assessment



Contents

1	Chemical and physical data	3
	1.1 Chemical and physical properties	3
	1.2 Manufacturing, composition and formulant information	4
	1.3 Enforcement analytical method	4
2	Chemical and entomological fabric characterisation	5
	2.1 Laboratory studies	5
	2.1.1 Entomological characterisation	5
	2.2 Chemical and entomological fabric characterisation conclusions	7
3	Overall quality conclusions	8
4	Manufacturing release specifications	9
	4.1 Summary of manufacturing release specifications	9
	4.2 Storage.....	9
	Appendix 1. Summary of available data considered in Module 3.....	10
	Appendix 2. Manufacturing release specifications: methods and notes	15

1 Chemical and physical data

1.1 Chemical and physical properties

Data on the chemical and physical properties of the active ingredient and the product PRONet Duo were provided. These data were obtained from studies conducted according to established standards and/or Good Laboratory Practices (GLP) and are considered complete. Product specific properties are summarized in Table 1. Numerical results are presented as: mean (range). These summary results are based on the analysis of batches: VKA-257-2-1, VKA-257-2-2, VKA-257-2-3, VKA-257-2-4, VKA-257-2-5.

Complete results from the studies 23200 and 24322 (for wash resistance index only) are available in Appendix 1.

Data requirement	Test method ID	Result
Identification of bifenthrin and chlorfenapyr	CIPAC 5390/m	The active ingredients each comply with an identity test
Bifenthrin mean content	CIPAC 5390/m	7.28 g/kg (7.13- 7.45 g/kg)* (7.08 - 7.63 g/kg)** (98.9 -99.4%)*
Accelerated storage bifenthrin retention	CIPAC 5390/m	
Chlorfenapyr content	CIPAC 5390/m	8.34 (8.12 -8.53 g/kg)* (8.06 - 8.58 g/kg)** (98.8 -99.4%)*
Accelerated storage chlorfenapyr retention	CIPAC 5390/m	
Wash resistance index (Bifenthrin)	Adapted CIPAC (O) MT 195 - IG – Determination of wash resistance index test for ITN fabric	(98.33 -98.80%)*
Accelerated storage bifenthrin WRI	Adapted CIPAC (O) MT 195 - IG – Determination of wash resistance index test for ITN fabric	(98.29 -98.36%)*
Wash resistance index (Chlorfenapyr)	Adapted CIPAC (O) MT 195 - IG – Determination of wash resistance index test for ITN fabric	(98.36 - 98.84%)*
Accelerated storage chlorfenapyr WRI	Adapted CIPAC (O) MT 195 - IG – Determination of wash resistance index test for ITN fabric	(98.57 - 98.62%)*
Mesh size	See Appendix 2	(15-16) holes/cm ² **
Fabric weight	ISO 3801:1977 / EN 12127:1997	(35.15- 36.45 g/m ²)*
Dimensional stability of netting to washing	ISO 139:2005 ISO 3759:2011, ISO 6330:2012, ISO 5077:2007	Length: (-1.6% to -0.9%)* Width: (+0.7% to +1.0%)*
Accelerated storage dimensional stability	ISO 139:2005 ISO 3759:2011, ISO 6330:2012, ISO 5077:2007	Length: (-1.8% to -1.2%)* Width: (+0.7% to +1.0%)*
Bursting strength	ISO 13938-2:1999	(427.9 - 442.8 kPa)*
Accelerated storage bursting strength	ISO 13938-2:1999	(422.5 - 434.5 kPa)*
Seam bursting strength	ISO 13938-2:1999	(506.6 – 516.1 kPa)*
Accelerated storage seam bursting strength	ISO 13938-2:1999	(503.3 - 510.8 kPa)*
Flammability	EN 1102:2016	No ignition or propagation. Maximum hole dimension 64 mm.

* range of means

** range of individual measurements in samples

No significant differences were recorded among the properties of the product kept at ambient temperature and after accelerated storage stability test conditions.

1.2 Manufacturing, composition and formulant information

Data on the manufacturing process and product composition for PRONet Duo have been provided and are adequate. A summary is presented in Table 2. Detailed information on the manufacturing process and product formulation is considered Confidential Business Information (CBI).

Table 2. Manufacturing process and product composition data submitted for PRONet Duo	
Description of starting material	Bifenthrin TC and chlorfenapyr TC formulated as part of the production process as masterbatches. The sources of active ingredients are supported by a current evaluation report confirming compliance of the materials with the established WHO specification.
Declaration of product formulation	Included in the confidential business information.
Production / formulation process	The fabric is manufactured by the preparation of the bifenthrin and chlorfenapyr masterbatches, the extrusion and warping of the filament, warp knitting of the high-density polyethylene monofilament yarn incorporated with the active ingredients' formulation, and heat setting. The finished product is manufactured by cutting and sewing of the fabric, addition of label tag, folding prior to packaging, packing, and baling.
Packaging	Nets may be packed individually in plastic bags with printed labels or in bulk bales, of typically 50 nets (with 40, 50 or 100 nets depending on customer requirements) with one adhesive shipping mark per bale according to GS1 standards. The sizes of the bags and bales vary depending on the size of the net version being packed. Stacks of nets are compressed by a hydraulic press to the desired height and then strapped with 4 PET straps.
Discussion of impurities	There are no relevant impurities of toxicological concern.
Certification of limits	Bifenthrin: 7.0 g/kg, acceptable limits 5.95-8.05 g/kg Chlorfenapyr: 8.0 g/kg, acceptable limits 6.8-9.2 g/kg

1.3 Enforcement analytical method

Table 3. Details of the analytical method used to determine Bifenthrin and Chlorfenapyr in PRONet Duo	
Quantification of bifenthrin and chlorfenapyr	Bifenthrin and chlorfenapyr: CIPAC 5390/m

These methods are appropriate for the determination of the active ingredients content of the product.

2 Chemical and entomological fabric characterisation

Laboratory studies to characterize the availability of the active ingredients and the insecticidal effect of the fabric of PRONet Duo on Anopheline mosquito species were submitted to WHO as part of the prequalification dossier. Sampled pieces of ITNs used in the biological laboratory studies were characterized for their bifenthrin and chlorfenapyr content using GC-FID.

2.1 Laboratory studies

2.1.1 Entomological characterisation

Data on the wash regeneration and wash resistance properties of the PRONet Duo product were provided. These data were obtained from studies conducted according to established standards and/or Good Laboratory Practices (GLP). These summary results are based on ITNs drawn from batches VKA-257-2-1, VKA-257-2-2, VKA-257-2-3.

One laboratory study was submitted to characterise the PRONet Duo fabric. Bioavailability was evaluated in wash regeneration and wash resistance studies and baseline checks were conducted to assure the quality of the product received at the testing facility. The indicative test system used to evaluate results was the pyrethroid resistant mosquito strain.

The endpoint used to evaluate bioavailability was 72-hour mortality. Demonstration of bioavailability post-wash was used to determine the wash interval that was selected for use in the wash resistance study. WHO cone tests and tunnel tests were the experimental methods used in bioavailability studies.

The bioavailability of bifenthrin and chlorfenapyr on the surface of the ITN was characterized using the insecticide susceptible test system *Anopheles gambiae* s.s. Ifakara strain and the pyrethroid resistant test system *Anopheles arabiensis* Kingani strain, with pyrethroid resistance mediated by the over-expression of cytochrome P450 enzymes and observed mortality to the diagnostic doses of alpha-cypermethrin, deltamethrin, and permethrin of 25%, 45% and 23%, respectively. Susceptibility to bifenthrin and chlorfenapyr was not determined.

In baseline quality checks, the 72-hour mortality was 100% for both the insecticide susceptible and insecticide resistant test systems in tunnel tests.

The wash interval was determined to be one day. Using this wash interval, PRONet Duo was wash resistant to 20 washes using insecticide susceptible and pyrethroid resistant mosquito test systems. These results are summarized in Tables 4-5.



Table 4. Wash regeneration study bioassay results for ProNet Duo batch numbers VKA-257-1-1, VKA-257-1-2, VKA 257-1-3 using tunnel tests against pyrethroid resistant *An. arabiensis* and insecticide susceptible *An. gambiae* test systems

Days post-wash	<i>An. gambiae</i> Ifakara			<i>An. arabiensis</i> Kingani		
	N [mos]	Mean M24 (%) (95% CI)	BFI (%) (95% CI)	N [mos]	Mean M72 (%) (95% CI)	BFI (%) (95% CI)
UW	201	100	100	205	100	100
1	196	100	100	201	100	100
2	196	100	97.6 (92.8 – 100)	201	100	99.3 (97.9 – 100)
3	197	100	99.1 (97.3 – 100)	201	100	100
5	200	99.5 (98.5 – 100)	100	202	100	100
7	199	100	99.2 (97.7 – 100)	206	100	100

Table 5. Wash resistance study bioassay results for ProNet Duo batch numbers VKA-257-1-1, VKA-257-1-2, VKA 257-1-3 using tunnel tests against pyrethroid resistant *An. arabiensis* and insecticide susceptible *An. gambiae* test systems

N [washes]	<i>An. gambiae</i> Ifakara			<i>An. arabiensis</i> Kingani		
	N [mos]	Mean M24 (%) (95% CI)	BFI (%) (95% CI)	N [mos]	Mean M72 (%) (95% CI)	BFI (%) (95% CI)
0	209	100	100	206	100	100
1	196	100	100	195	100	100
3	199	100	100	208	99.0 (97.0 – 100)	100
5	193	100	100	217	98.6 (96.8 – 100)	100
10	201	99.5 (98.5 – 100)	100	214	97.9 (94.9 – 100)	100
15	193	100	100	212	91.1 (81.8 – 100)	100
20	188	99.4 (98.3 – 100)	100	204	92.0 (89.5 – 94.5)	100

2.1.1.1 Chemical characterisation

Data on the bifenthrin and chlorfenapyr content of sampled pieces of the PRONet Duo product used in the entomological laboratory wash resistance study were provided. These data were obtained from studies conducted according to established standards and/or Good Laboratory Practices (GLP). These summary results are based on ITNs drawn from batches VKA- 257-2-1, VKA-257-2-2, VKA-257-2-3. The results are summarized in Table 6.

Wash No.	Mean bifenthrin content (g/kg)	RSD (%)	Bifenthrin retention	Bifenthrin retention per wash	Mean chlorfenapyr content (g/kg)	RSD (%)	Chlorfenapyr retention	Chlorfenapyr retention per wash
0	7.17 (7.14 - 7.18)	0.40	-	-	8.18 (8.10 - 8.25)	1.30	-	-
1	6.89 (6.60 - 7.01)	3.30	96.09	96.09	7.63 (7.44 - 7.81)	3.43	93.31	93.31
3	5.28 (5.24 - 5.33)	1.20	73.73	90.34	6.06 (5.64 - 6.66)	0.25	74.07	90.48
5	5.05 (5.00 - 5.09)	1.26	70.48	93.24	4.79 (4.74 - 4.83)	1.33	58.53	89.84
10	4.52 (4.51 - 4.53)	0.31	63.06	95.49	4.34 (4.25 - 4.43)	2.93	53.09	93.86
15	3.82 (3.81 - 3.84)	0.55	53.29	95.89	3.11 (2.94 - 3.23)	6.65	38.07	93.77
20	3.52 (3.49 - 3.62)	2.59	49.10	96.51	2.17 (2.10 - 2.22)	3.93	26.52	93.58

The mean AI content presented in Table 6 was determined based on 4 net samples belonging to 3 batches (VKA- 257-2-1, VKA- 257-2-2, VKA-257-2-3), indicating ranges to the AI content in parenthesis.

AI retention per wash in Table 6 (ranges in parenthesis) is calculated as:

- AI retention per wash = $100 \times \sqrt[n]{t_n/t_0}$ where:
 t_n = total active ingredient content after n washing cycles
 t_0 = total active ingredient content before washing
n = number of washes.

2.2 Chemical and entomological fabric characterisation conclusions

The submitted laboratory studies characterize the fabric of PRONet Duo against two strains of *An. gambiae* complex mosquitoes. Following three washes intended to deplete the surface of the fabric of bioavailable insecticide, the laboratory results demonstrate that sufficient bioavailable insecticide to induce mortality in insecticide susceptible and pyrethroid resistant test systems was present one day after washing.

Wash resistance to 20 washes using standardised washing methods was demonstrated against two *An. gambiae* complex test systems, one of which was insecticide susceptible and one pyrethroid resistant system carrying metabolic resistance mechanisms. Based on the submitted studies, PRONet Duo is wash resistant to 20 washes using a one-day wash interval against pyrethroid susceptible *An. gambiae* Ifakara and pyrethroid resistant *An. arabiensis* Kingani which carries metabolic resistance mediated by the over-expression of cytochrome P450 enzymes.

3 Overall quality conclusions

Based on the studies and information provided, all data requirements for the prequalification assessment of product quality have been satisfied. These data have been relied upon to assess the formulation, manufacturing process, physical/chemical characteristics, biological regeneration time, and bioavailability using products prepared with a defined wash interval of the proposed product for the purpose of establishing the identity of the product and assuring that the product can be produced consistently.

The methods for assessing the physical/chemical properties of the product were CIPAC methods and/or validated methods.

The quality component of the dossier is considered complete, and the assessment of the submitted information on quality supports prequalification of the product.

Table 7. List of studies submitted to WHO as part of the prequalification dossier	
Studies that were relied upon for decision making	
Study number	Study title
BIT103	Laboratory and experimental hut evaluation of PRONet Duo Insecticide Treated Net (ITN) in comparison with Interceptor G2 ITN and MAGNet ITN against strongly pyrethroid-resistant <i>Anopheles arabiensis</i> and fully susceptible <i>Anopheles gambiae</i> s.s. in Tanzania
24083, Revision No.1	Chemical Analysis of PRONet Duo ITN samples used as an investigational item in the Laboratory Wash Resistance study BIT 103 conducted at Ifakara Health Institute, Tanzania
23200	Physical and Chemical Analysis of PRONet Duo LN Long-Lasting (Incorporated into filaments) Insecticidal Net having Bifenthrin 7.0 g/kg and Chlorfenapyr 8.0 g/kg
24322	This study has been only assessed for the Wash Resistance Index property: Five batch analysis (Physical and Chemical Analysis) of PRONet Duo Long-Lasting Insecticidal Net having Bifenthrin 7.0 g/kg \pm 25%, and Chlorfenapyr 8.0 g/kg \pm 25% incorporated into monofilaments
Studies that were not used to inform decision making	
	None

4 Manufacturing release specifications

4.1 Summary of manufacturing release specifications

Table 8. Summary of manufacturing release specifications

Description			
The material shall be in the form of netting, consisting of 120* knitted mono-filament polyethylene yarn, incorporating technical bifenthrin complying with the requirements of WHO specification 415/TC (current version) and with technical chlorfenapyr complying with the requirements of WHO specification 570/TC (current version) together with any necessary other formulants. The product shall appear clean and shall be free from visible extraneous matter,* visible damage (such as splitting or tearing) and visible manufacturing defects (such as poorly made seams or a weave that is either not uniform or too loose to remain uniform in use) and shall be suitable for use as an insecticidal net with long-lasting activity.*			
ID	Property	Method	Declared value
1*	Sampling Plan	See Appendix 2	
2	Bifenthrin content	CIPAC 5390/m	7.0 g/kg \pm 15%
3	Chlorfenapyr content	CIPAC 5390/m	8.0 g/kg \pm 15%
4*	Bifenthrin wash resistance index	Adapted CIPAC (O) MT 195 - IG – Determination of wash resistance index test for ITN fabric	Within the range 97% to 100%
5*	Chlorfenapyr wash resistance index	Adapted CIPAC (O) MT 195 - IG – Determination of wash resistance index test for ITN fabric	Within the range 88% to 100%
6	Fabric weight	ISO 3801:1977 / EN 12127:1997	35 g/m ² \pm 10%
7*	Bursting strength – fabric	ISO 13938-2:1999	Min 380 kPa
8*	Bursting strength – seam	ISO 13938-2:1999	Not less than the average bursting strength for fabric
9*	Netting mesh size	See Appendix 2	Min. 14 holes/cm ²
10*	Dimensional stability of netting to washing	See Appendix 2	Not more than 10% shrinkage and not more than 5% expansion in both directions.

* Indicates that additional information is available in Appendix 2.

Manufacturers are expected to rely on the information above as part of a QC management plan and for validation of product quality when released. To the extent required, Certificates of Analysis to support the release of products should present results for the attributes identified in the above table.

4.2 Storage

Accelerated storage stability data were generated as per CIPAC MT 46.3. Test samples were stored for 14 days at 54°C. No significant differences were recorded among the properties of the product kept at ambient temperature and after accelerated storage stability test conditions.

Products should be stored and transported in appropriate conditions in accordance with the recommendations of the manufacturer.

Where products have been subjected to prolonged storage or adverse conditions during storage, analysis and testing are recommended to assess changes in characteristics and their suitability for use.

Appendix 1. Summary of available data considered in Module 3

Batches used to generate the physical/chemical data

Batch Number	Date	Formulation	Uses
VKA-257-2-1	9/2022	White	5 batch analysis/storage stability/laboratory bioassays/Experimental hut studies
VKA-257-2-2	9/2022	White	5 batch analysis/storage stability/laboratory bioassays/Experimental hut studies
VKA-257-2-3	9/2022	White	5 batch analysis/storage stability/laboratory bioassays/Experimental hut studies
VKA-257-2-4	9/2022	White	5 batch analysis
VKA-257-2-5	9/2022	White	5 batch analysis

Product characteristics

Study 23200

Property	Batch ID	Test Method	Results
Bifenthrin mean content	VKA-257-2-1	CIPAC 5390/m	7.25 (7.15-7.33) g/kg, RSD 0.92%
	VKA-257-2-2		7.19 (7.11-7.24) g/kg, RSD 0.68%
	VKA-257-2-3		7.13 (7.08-7.20) g/kg, RSD 0.65%
	VKA-257-2-4		7.36 (7.25-7.46) g/kg, RSD 1.09%
	VKA-257-2-5		7.45 (7.32-7.63) g/kg, RSD 1.66%
Bifenthrin distribution (Numbers in parenthesis indicate percentage of target dose)	VKA-257-2-1	CIPAC 5390/m	7.25 g/kg (102%- 104%)
	VKA-257-2-2		7.19 g/kg (101%- 103%)
	VKA-257-2-3		7.13 g/kg (101%- 103%)
	VKA-257-2-4		7.36 g/kg (104%- 107%)
	VKA-257-2-5		7.45 g/kg (105%- 109%)
Chlorfenapyr mean content	VKA-257-2-1	CIPAC 5390/m	8.48 (8.37-8.55) g/kg, RSD 0.83%
	VKA-257-2-2		8.34 (8.16-8.49) g/kg, RSD 1.56%
	VKA-257-2-3		8.53 (8.47-8.58) g/kg, RSD 0.59%
	VKA-257-2-4		8.22 (8.14-8.31) g/kg, RSD 0.73%
	VKA-257-2-5		8.12 (8.06-8.17) g/kg, RSD 0.62%
Chlorfenapyr distribution (Numbers in parenthesis indicate percentage of target dose)	VKA-257-2-1	CIPAC 5390/m	8.48 g/kg (105%- 107%)
	VKA-257-2-2		8.34 g/kg (102%- 106%)
	VKA-257-2-3		8.53 g/kg (106%- 107%)
	VKA-257-2-4		8.22 g/kg (102%- 104%)
	VKA-257-2-5		8.12 g/kg (101%- 102%)
Wash resistance index (Bifenthrin)	VKA-257-2-1	MT195, CIPAC Handbook O, p. 205, 2017	98.45%
	VKA-257-2-2		98.24%
	VKA-257-2-3		98.30%
	VKA-257-2-4		98.74%
	VKA-257-2-5		98.13%
Wash resistance index (Chlorfenapyr)	VKA-257-2-1	MT195, CIPAC Handbook O, p. 205, 2017	97.47 %
	VKA-257-2-2		97.60 %
	VKA-257-2-3		97.56 %
	VKA-257-2-4		97.73 %
	VKA-257-2-5		97.54 %
Dimensional stability (warp / weft)	VKA-257-2-1	ISO 139:2005	-0.9 %, 0.9 %
	VKA-257-2-2	ISO 3759:2011,	-1.4 %, 1.0 %

Property	Batch ID	Test Method	Results
	VKA-257-2-3 VKA-257-2-4 VKA-257-2-5 Mean RSD %	ISO 6330:2012, ISO 5077:2007	-1.6 %, 0.7 % -1.4 %, 0.8 % -1.6 %, 0.9 % -1.38 %, 0.86 % -20.75 %, 13.26 %
Bursting strength	VKA-257-2-1 VKA-257-2-2 VKA-257-2-3 VKA-257-2-4 VKA-257-2-5 Mean RSD %	ISO 13938-2:1999	427.9 kPa 431.4 kPa 437.5 kPa 436.4 kPa 442.8 kPa 435.2 kPa 1.32 %
Seam bursting strength (inner seam / outer seam)	VKA-257-2-1 VKA-257-2-2 VKA-257-2-3 VKA-257-2-4 VKA-257-2-5		541.2 / 509.4 kPa 555.3 / 508.1 kPa 551.0 / 516.1 kPa 553.7 / 506.6 kPa 558.2 / 511.8 kPa
Mesh size	VKA-257-2-1 VKA-257-2-2 VKA-257-2-3 VKA-257-2-4 VKA-257-2-5	ISO 139:2005	16 (15-16) holes/cm2 15 (15-16) holes/cm2 16 (15-16) holes/cm2 15 (15-16) holes/cm2 16 (15-16) holes/cm2
Fabric weight	VKA-257-2-1 VKA-257-2-2 VKA-257-2-3 VKA-257-2-4 VKA-257-2-5 Mean RSD %	ISO 3801:1977 / EN 12127:1997	35.75 g/m2 36.34 g/m2 35.76 g/m2 36.45 g/m2 35.15 g/m2 35.89 g/m2 1.5 %
Flammability	VKA-257-2-1 VKA-257-2-2 VKA-257-2-3 VKA-257-2-4 VKA-257-2-5	EN 1102:2016	No ignition or propagation. Maximum hole dimension 64 mm.

The values shown are means of five individual determinations except for WRIs, which are calculated from means of three individual determinations each before and after washing, dimensional stability, which is the mean of four individual determinations, and flammability, which is the worst outcome observed from six individual determinations. Ranges of individual values are also shown for AI contents and mesh size, as well as RSDs for AI contents.

Study 24322

Wash resistance index (Bifenthrin)	VKA-257-2-1	Adapted CIPAC (O) MT 195 - IG – Determination of wash resistance index test for ITN fabric	98.49%
	VKA-257-2-2		98.48%
	VKA-257-2-3		98.80%
	VKA-257-2-4		98.33%
	VKA-257-2-5		98.45%
Wash resistance index (Chlorfenapyr)	VKA-257-2-1		98.61 %
	VKA-257-2-2		98.58 %
	VKA-257-2-3		98.84 %
	VKA-257-2-4		98.36 %
	VKA-257-2-5		98.54 %
Wash resistance index (Bifenthrin)	VKA-257-2-1	MT195, CIPAC Handbook O, p. 205, 2017	98.21%
	VKA-257-2-2		98.30%
	VKA-257-2-3		98.40%
	VKA-257-2-4		98.75%
	VKA-257-2-5		98.43%
Wash resistance index (Chlorfenapyr)	VKA-257-2-1		98.17 %
	VKA-257-2-2		98.28 %
	VKA-257-2-3		98.39 %
	VKA-257-2-4		98.71 %
	VKA-257-2-5		98.41 %

Storage stability

Study 23200

Property	Batch ID	Before	After	Change
Bifenthrin content	VKA-257-2-1	7.25 g/kg	7.18 g/kg	-0.07 g/kg (-1.0%)
	VKA-257-2-2	7.19 g/kg	7.12 g/kg	-0.07 g/kg (-1.0%)
	VKA-257-2-3	7.13 g/kg	7.09 g/kg	-0.04 g/kg (-0.6%)
	VKA-257-2-4	7.36 g/kg	7.28 g/kg	-0.08 g/kg (-1.1%)
	VKA-257-2-5	7.45 g/kg	7.37 g/kg	-0.08 g/kg (-1.1%)
Chlorfenapyr content	VKA-257-2-1	8.48 g/kg	8.38 g/kg	-0.10 g/kg (-1.2%)
	VKA-257-2-2	8.34 g/kg	8.29 g/kg	-0.05 g/kg (-0.6%)
	VKA-257-2-3	8.53 g/kg	8.45 g/kg	-0.08 g/kg (-0.9%)
	VKA-257-2-4	8.22 g/kg	8.17 g/kg	-0.05 g/kg (-0.6%)
	VKA-257-2-5	8.12 g/kg	8.07 g/kg	-0.05 g/kg (-0.6%)
Wash resistance index (Bifenthrin)	VKA-257-2-1	98.45%	98.33%	-0.12%
	VKA-257-2-2	98.24%	98.16%	-0.08%
	VKA-257-2-3	98.30%	98.18%	-0.12%
	VKA-257-2-4	98.74%	98.47%	-0.26%
	VKA-257-2-5	98.13%	98.07%	-0.06%
Wash resistance index (Chlorfenapyr)	VKA-257-2-1	97.47%	97.36%	-0.11%
	VKA-257-2-2	97.60%	97.51%	-0.09%
	VKA-257-2-3	97.56%	97.42%	-0.14%
	VKA-257-2-4	97.73%	97.48%	-0.25%
	VKA-257-2-5	97.54%	97.37%	-0.17%
Dimensional stability	VKA-257-2-1	-0.9% / +0.9%	-1.5% / +0.7%	-
	VKA-257-2-2	-1.4% / +1.0%	-1.6% / +0.9%	-
	VKA-257-2-3	-1.6% / +0.7%	-1.2% / +0.9%	-
	VKA-257-2-4	-1.4% / +0.8%	-1.6% / +0.9%	-
	VKA-257-2-5	-1.6% / +0.9%	-1.8% / +1.0%	-
Bursting strength (fabric / outer seam)	VKA-257-2-1	427.9 / 509.4 kPa	422.5 / 504.4 kPa	-
	VKA-257-2-2	431.4 / 508.1 kPa	427.5 / 503.3 kPa	-
	VKA-257-2-3	437.5 / 516.1 kPa	430.6 / 510.8 kPa	-
	VKA-257-2-4	436.4 / 506.6 kPa	432.5 / 503.8 kPa	-
	VKA-257-2-5	442.8 / 511.8 kPa	434.5 / 507.1 kPa	-

Study 24322

Property	Batch ID	Before	After	Change
Wash resistance index* (Bifenthrin)	VKA-257-2-1	98.49%	98.36%	-0.13%
	VKA-257-2-2	98.48%	98.35%	-0.13%
	VKA-257-2-3	98.80%	98.29%	-0.51%
	VKA-257-2-4	98.33%	-	-
	VKA-257-2-5	98.45%	-	-
Wash resistance index* (Chlorfenapyr)	VKA-257-2-1	98.61%	98.60%	-0.01%
	VKA-257-2-2	98.58%	98.57%	-0.01%
	VKA-257-2-3	98.84%	98.62%	-0.22%
	VKA-257-2-4	98.36%	-	-
	VKA-257-2-5	98.54%	-	-

* Adapted CIPAC (O) MT 195 - IG – Determination of wash resistance index test for ITN fabric

Property	Batch ID	Before	After	Change
Wash resistance index* (Bifenthrin)	VKA-257-2-1	98.21%	98.51%	+0.30%
	VKA-257-2-2	98.30%	98.73%	+0.43%
	VKA-257-2-3	98.40%	98.49%	+0.09%
	VKA-257-2-4	98.75%	-	-
	VKA-257-2-5	98.43%	-	-
Wash resistance index* (Chlorfenapyr)	VKA-257-2-1	98.17%	98.48%	+0.31%
	VKA-257-2-2	98.28%	98.71%	+0.43%
	VKA-257-2-3	98.39%	98.55%	+0.16%
	VKA-257-2-4	98.71%	-	-
	VKA-257-2-5	98.41%	-	-

*MT195, CIPAC Handbook O, p. 205, 2017

Appendix 2. Manufacturing release specifications: methods and notes

Description

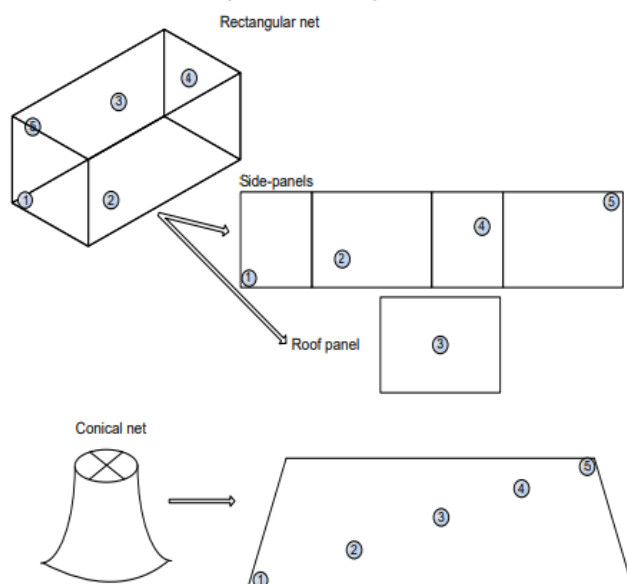
- The linear density (denier) of the yarn cannot be measured in the netting or the manufactured bed net but it should be identified on the packaging.
- Occasional short lengths of loose thread present in the netting are not considered to be extraneous matter.
- Long-lasting insecticidal netting is expected to retain its insecticidal activity during its lifespan and through a number of washes (public health products) or in worst-case expected climatic conditions (agricultural products).

Sampling Plan – Applicable to all attributes for which samples are to be taken from various parts of the constructed ITN.

- Sampling should be noted as Figure 1:

Figure 1 General method for sampling rectangular and conical nets

Recommended positions from which 5 pieces of netting should be taken from a made up bed net and combined to form a representative sample.



Samples should be taken according to Figure 1 or on a convenient diagonal across the width of bulk material. Samples must be sufficiently large to conduct all tests required and representative of the net or netting. Except where seams are to be tested, do not test material within 10 cm of seams or selvages. Where a final product is made from more than one type of netting, each type of netting should be sampled and tested separately.

Use sharp scissors, or equivalent, to minimize damage to the fibres and fabric and thus avoid any consequential bias in the results of certain tests. Roll up the strips or squares and place them in labelled, new, clean aluminium foil prior to analysis. Samples should be kept cool, avoiding heat sources (including direct sunlight) or freezing, and analyzed/tested with minimum delay. Representative portions (sub-samples) for testing should be taken as described in each test method.

For the purposes of chemical analysis, the analytical method and the number and size of test portions analyzed should be designed to provide results with a relative standard deviation (RSD) $\leq 5\%$ or as applicable in certain justifiable cases. Test portion and replication requirements for physical test methods are defined in the methods or Notes referenced.

Attributes 4 and 5: Bifenthrin and Chlorfenapyr wash resistance index

The content of bifenthrin and chlorfenapyr in the net pieces before and after washing should be determined Adapted CIPAC (O) MT 195 - IG – Determination of wash resistance index test for ITN fabric.

Attributes 7 and 8: Bursting strength – fabric and bursting strength – seam

Test method: ISO 13938 part 2 with conditioning of the fabric as specified in the ISO standard. The declared bursting strength, and testing for compliance with it, should be based on tests of 7.3 cm² areas of fabric. Proposed specifications based on tests of 50 cm² area must be supported by data showing the suitability of the proposed value and its relationship to minimum of 250 kPa (which is based on 7.3 cm² area). Five replicate tests should be conducted on samples taken at approximately equal distances on a diagonal across the netting, taking no sample within 10 cm of a border or seam. In made up rectangular nets, the “diagonal” may correspond to figure 1. The average of the 5 measurements is calculated.

The method to test seam bursting strength is identical to that used to test the fabric, except that 5 replicate tests should be made, with the seam centred on the test head. Up to 5 seams may be tested but, if there are < 5 seams, replicate measurements should be made on 1 or more seams, to provide a total of 5 measurements.

Attribute 9: Mesh size

In the absence of a simple or standard method to determine the size of holes, which may have complex shapes, in highly flexible fabrics, mesh size is determined by counting the number of holes in a square of the fabric. Counting may be done directly on the fabric or indirectly by taking a picture/photocopy of the fabric. Indirect methods may ease counting and provide a permanent record. The number of holes per measured area is converted in holes/cm². Before counting, the fabric should be conditioned according to ISO 139 (4 h, 20°C, 65% relative humidity).

Use a template to define the square of netting, taking care not to stretch or distort the fabric. The template should be a 1-2 mm thick rigid sheet, in/on which an accurately calibrated ($\pm 1\%$ in each dimension) square (e.g., 1 x 1 in or 5 x 5 cm) has been cut/marked. If a template is not available and a ruler must be used, great care is required to ensure that the area counted is square. Where practicable, one edge of the square to be counted should be aligned with a row of complete holes in the fabric. Incomplete holes $\geq \frac{1}{2}$ are counted as complete holes, whereas those $< \frac{1}{2}$ are not counted. Count 5 replicate squares selected according to the sampling plan, calculate the average and note the lowest value.

Another suitable method is the use of a stereomicroscope with an image analyser software, where the number of holes in a defined area is counted. In case of discrepancy between the netting mesh size using stereomicroscopic method and direct or indirect counting method, the stereomicroscopic method shall be the referee method.

Attribute 10: Dimensional stability of netting to washing

Method of preparation, marking and measuring: ISO 3759. Method of washing: ISO 6330. Method of calculation: ISO 5077. Size of test portions: 500 mm x 500 mm; mark off 350 mm x 350 mm within each test portion. Test a total of 4 replicate portions, 2 washed in each of 2 separate loads. Type of washing machine: ISO type A (front loading). Washing programme: 30°C Mild programme. Fill the washer with fabrics and ballast Type III (polyester ballast) up to 2 kg (according to the ISO 6330 standard). Drying: flat drying.