

Water consumption of washer/dryers

**A report for the Water Efficiency
Labelling and Standards (WELS)
Scheme**

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Australian Government

Department of the Environment, Water, Heritage and the Arts

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SUMMARY

In order to consider the costs, benefits and feasibility of including water-using dryers in the Water Efficiency Labelling and Standards (WELS) Scheme, data on the actual water use of these products is required. In addition, an assessment of the adequacy of current Australian Standards and their test procedures for dryers is also required. To address these issues, the WELS Scheme commissioned laboratory testing of a selection of combination washer/dryers.

Three popular brands of combination washer/dryers were independently purchased and each machine was subjected to three separate test methods (i.e. modes) to assess its water consumption at two different water pressures.

Although this study was primarily concerned with determining the water consumption of the machine during its drying operation, the water consumed during washing as well as the total water consumed (i.e. during washing and drying operations) by the machine were also determined.

The three test modes consisted of determining the quantity of water consumed during:

- a drying cycle as specified in Australian and New Zealand Standard AS/NZS 2442
- a complete wash and dry cycle as recommended by the manufacturer (i.e. washing a full load then separating the load and drying only the portion of the load that is equivalent to the dryer capacity) and
- a single operation of a complete wash and dry cycle (i.e. washing and drying a load that is equivalent to the dryer capacity), which is the most probable manner that the machine will actually be used by most consumers.

The study found the following:

- a) There was close correlation between the water consumption data for the wash cycle on the label and that determined in this study.

However, this was not the case for the dryer cycle where the quantity of water consumed was significantly greater than that reported when the product was registered under the energy rating scheme.

This is probably because the water consumption for the wash cycles is covered by regulations (both energy and the Water Efficiency Labelling and Standards (WELS) Scheme) and manufacturers/suppliers took more care to ensure that the products complied with labelled information. For the dryer cycle, however, the water consumption need only be reported when applying for energy registration and is not covered by regulation.

- b) Generally, the water consumption figures for the wash cycles of the tested machines were similar, irrespective of the wash load and water pressure.

An exception was Test Machine C, which appeared to incorporate means for adjusting water level relative to the wash load and as such had reduced water consumption when the wash load was reduced.

- c) Generally, each of the machines was able to reduce the moisture content of the dried load to 6 per cent or less as required in AS/NZS 2442.

In essence, each of the machines extracted more moisture from the wash load at the end of the wash cycle than required in AS/NZS 2442.

- d) Generally, the time taken to complete a wash cycle was the same irrespective of the wash load and water pressure. This was also true for the drying cycle.

However, in the case of Test Machine B the drying time was approximately double that of the wash time whereas for the other machines the wash and dry times were similar.

The total wash and dry times varied between the test machines from a little more than 3 hours to just under 7¼ hours.

In view of the findings the following could be considered:

1. The dryer component of washer/dryers could be incorporated into the WELS scheme.
2. In the immediate term, a labelling program for water-using dryers could involve a separate label for the dryer using the standardised test in AS/NZS 2442, as well as the current water use label for the wash cycle.
3. In the longer term, the labelling program could move towards a single label that indicates the total water consumed during both the washing and drying cycles of washer/dryers.
4. A project request to this effect could be lodged with Standards Committee EL/15/4 to develop an appropriate test procedure that would enable the use of a single label. Standards Committee EL/15/4 could also be requested to develop a new star rating to reflect acceptable total water consumptions limits for use with a single label.
5. Registration and assessment of products could ensure that products are tested to the requirements of the appropriate Standards. For example, if an auto-sensor is provided on a dryer then this feature should be used when testing the machine.
6. The implementation of a labelling program could be closely followed by a check testing program to ensure at least the labelled information is correct and it is adequately controlled by the manufacturer or supplier through their supply chains over time.
7. The WELS website and any WELS publications on washer/dryers could include information detailing the:
 - i differences in the washer and dryer capacities and as a consequence, the need to remove some of the washing from the machine before commencing the drying cycle and
 - ii time required for each of the wash and dry cycles.

1. OBJECTIVE

The objective of this study was to determine the water consumption of washer/dryers (particularly during their dryer operation) when subjected to a variety of test conditions.

Where appropriate, the study followed as closely as possible the test procedures specified in Australian and New Zealand Standards AS/NZS 2040 for the washing cycle and AS/NZS 2442 for the drying cycle.

2. PRODUCTS

Three products were selected for this study. Each product was:

- i) independently purchased through a retail outlet
- ii) selected because it was a readily recognisable and popular brand
- iii) selected because the reported water consumption (in dryer mode) of the machines represented a lower, middle and upper point of the stock in the Australian marketplace and
- iv) selected because the machine had an auto sensing moisture control setting facility. This was necessary to minimise testing time as machines with only a timer control require a trial and error approach for the drying tests (so as to determine the point at which appropriate dryness of the test load is reached).

3. LABEL AND WEBSITE INFORMATION

Descriptive and performance data as per label and website (energy and WELS sites) information for each of the products was as indicated in Table 1.

The data in black is information from the labels supplied with the test machines.

Where data in red appear, this indicates that numbers different from label data appear on the energy or water rating websites, or that label data were missing.

Test Machine C did not include an energy dryer label but did include two identical energy washer labels. The manufacturer advised that a second energy washer label was inadvertently included in place of the required energy dryer label.

Table 1: washer/dryer information

		WASHER/DRYER		Test Machine A	Test Machine B	Test Machine C
WASHER	WELS	Wash program		Cottons normal, eco 60°C	Cotton 40°C intensive 1400 rpm	Cottons 40°C intensive
		Rated capacity	(kg)	Not required (combined label) (7)	7.0	5.5
		Star rating		4	4	4
		Water consumption	(L/Wash)	68	72 (71.5)	48
	ENERGY	Wash program		Cottons normal, eco 60°C	Cottons 40°C intensive 1400 rpm	Cottons 40°C intensive
		Rated capacity	(kg)	7.0	7.0	5.5
		Star rating		4	4 (4½)	4
		Energy consumption	(kWh/52 uses)	259	250 (212)	199
DRYER	ENERGY	Dryer program		Cottons, dry only, timed dry	Dry more	No dryer label (normal +)
		Rated capacity	(kg)	3.5	4.0	(2.5)
		Star rating		2½	2	(3½)
		Energy consumption	(kWh/52 uses)	140	174	(84)

Table 1 one shows that, apart from the missing energy dryer label in the case of Test Machine C, the information on the labels and the websites correlated well. Where there were differences these under-estimated the performance of the machine on the label. Since the label is more visible than the website, such under-estimation is probably intended to protect suppliers against any mislabelling challenges.

4. TESTING

4.1. Methodology

Although the general methodology used to determine the water consumption of the machines in this study was based on the procedures specified in Australian Standards AS/NZS 2040 and AS/NZS 2442, the procedures were varied in order to assess water consumption under different modes of machine operation.

That is, each of the machines was subjected to:

- (a) Three separate modes of operation comprising -
- i) A drying cycle as specified in AS/NZS 2442.
This mode was intended to confirm the water consumption of the drying cycle information indicated on the label for each of the machines and also to allow direct comparison with the water consumption values obtained for the respective machine when tested in Modes 2 and 3.
 - ii) A complete wash and dry cycle as recommended by the manufacturer/supplier (i.e. washing a full load then separating the load and drying only that portion of the load that is equivalent to the dryer capacity).

This mode was intended to ascertain separately the water consumption during the washing cycle (in accordance with AS/NZS 2040) and a drying cycle as recommended by the manufacturer/supplier.

- iii) A complete wash and dry cycle in a single operation, which is assumed to be how the machine will actually be used by consumers (i.e. washing and drying a load that is equivalent to the dryer capacity).

Anecdotal evidence suggests that the vast majority of washing machines are only about half loaded because consumers believe that a full load will not wash effectively because of its bulk. Moreover, the removal of part of the wash for drying later in the machine, or drying by other means such as line hanging, requires a consumer response after the washing cycle is completed. This mode of use is considered unlikely, due to the additional time and inconvenience it involves, and that a key selling point for washer/dryers is their 'straight-through' capacity to take dirty clothes through to clean and dry in a single combined cycle that requires no human intervention.

and

- (b) Supply water pressures of:
- i) 320 kPa
 - ii) 500 kPa.

4.2. Set up

Each of the test washer/dryers were examined for any obvious defects that could affect their performance. As no defects were observed, each machine was separately installed in accordance with the manufacturer's instructions, connected to power and water supplies, and all data measuring instrumentation was appropriately connected.

The power, plumbing and instrumentation were all as required under Australian Standards AS/NZS 2040 and AS/NZS 2442.

4.3. Test loads

4.3.1 General

The test loads used for each of the three modes in the wash and dry operations were prepared (where the test mode allowed) in accordance with the requirements specified in AS/NZS 2040 and AS/NZS 2442.

Test swatches were not attached to any of the test loads, except for Test Mode 2* and Mode 3* of Test Machine B. Test Mode 2* and Mode 3* of Test Machine B are repeat tests that were added to this study when the determined water consumption results for wash cycle in respect to Test Mode 2 and Mode 3 were significantly different to that indicated on the label. Information from the manufacturer suggested that this machine included suds detection software and to obviate any further anomalies test swatches and detergent (see 4.3.5) were used in the repeat tests.

4.3.2 Mode 1 test load

(a) Washer test load

No test load was prepared for this mode as the wash cycles in this mode and Mode 2 were the same.

Note: The wash cycle in this Mode and Mode 2 are equivalent to the standardised wash cycle and to obviate repeating tests, the wash test for this Mode was not carried out.

(b) Dryer test load

The dryer test load for the appropriate rated dryer capacity was selected in accordance with the requirements of Table E2 of Appendix E in AS/NZS 2442.1. The load was then prepared and washed so that the wet load was between 185 per cent and 190 per cent of its bone dry mass as is required by AS/NZS 2442.1.

4.3.3 Mode 2 test load

(a) Washer test load

The washer test load for the appropriate rated washer capacity was selected in accordance with the requirements of Table C2 of Appendix C in AS/NZS 2040.1. The load was then prepared as required by that Standard. Load items in the wash load that were common to the load items required for the appropriate rated dryer load of the machine were noted for retrieval for the drying cycle.

(b) Dryer test load

Following the completion of the washing cycle, the washed wet load was removed from the machine and without delay the items identified in (a) above as being common to the dryer load (for the appropriate rated dryer capacity), were separated from the washed load to make up the dryer load.

4.3.4 Mode 3 test load

(a) Washer test load

The washer test load for the appropriate rated dryer capacity, was selected in accordance with the requirements of Table C2 of Appendix C in AS/NZS 2040.1 and the load was then prepared as required by that Standard.

(b) Dryer test load

The dryer load was the same load that was selected for the washing cycle.

4.3.5 Detergent

As washing performance was not being assessed, detergent was not used in any of the tests in this study except for Test Mode 2* and Mode 3* of Test Machine B.

As mentioned previously, Test Mode 2* and Mode 3* of Test Machine B were repeat tests that were added to this study when the determined water consumption results for the wash cycle in respect to Test Mode 2 and Mode 3 were significantly different to that indicated on the label. Information from the manufacturer suggested that the machine included suds detection software and to obviate any further anomalies detergent and test swatches (see 4.3.1) were used in the repeat tests.

4.3.6 Machine controller settings

The controls for the wash cycle and the dry cycle on each of the test machines were set to the program indicated on the appropriate label, except in the following cases:

(a) Test Machine A – where the label indicated that the dryer program used a manual timer, whereas this study used the auto sensing mode as is required under Clause 3.1 of AS/NZS 2442.1.

(b) Test Machine C – where the wash program indicated on the label was not available on the control panel and the appropriate program that was used was obtained directly from the manufacturer.

5. TEST RESULTS

Tables 2 to 4 indicate details of the machine settings, the water pressure used and the test results for each of the Test Modes.

- in **tan** indicate inappropriate control settings
- in **light blue** indicate anomalies in the test results and
- in **red** indicate failure to comply with the requirements of the appropriate Standard.

6. CONCLUSIONS

- (a) For each of the machines, the water consumption for the wash cycle in Mode 2 (which is equivalent to the standardised wash test for water consumption) correlated well with the water consumption indicated on the respective energy and water rating labels.
- (b) For each of the machines, the water consumption for the wash cycle was generally similar irrespective of which test load or which water pressure was applied to that machine.

Test Machine C was an exception as it had a reduced water consumption (about 30 per cent less) when the wash load was reduced from a full load (Mode 2) to that of the dryer load (Mode 3). It is likely that this machine included a means that adjusted the water level according to the wash load. The other machines appeared to use a fixed quantity of water for all wash loads.

- (c) With the exception of Test Machine C, the quantity of water consumed during the drying cycle as determined by the standardised procedure specified in AS/NZS 2442.1 (i.e. Mode 1), was significantly greater (about 26 per cent in the case of Test Machine B and 39 per cent in the case of Test Machine A) than that reported when the product was registered under the energy rating scheme.
- (d) Generally, each of the machines in this study was able to reduce the moisture content of the dried load to 6 per cent or less.

However, in the case of Test Machine A, as the dryer was tested using the moisture auto sensor rather than the manual timer as specified on the energy label, the moisture content of the dried washing was found to be approximately three times greater than the 6 per cent limit. When the machine was tested under Modes 2 or 3 conditions however, the machine was able to easily achieve the 6 per cent limit.

Test Machine B marginally exceeded the 6 per cent limit when the water supply pressure was increased to 500 kPa.

Note: See (a) of 4.3.6.

- (e) For each of the machines, the damp mass of the test load in Modes 2 and 3, after the washing cycle, was substantially less than required under AS/NZS 2442.1 (Mode 1). Clearly, the machines extracted more moisture from the washing during their spin dry process than required by AS/NZS 2442.1.

However, although the moisture content of the test load in Modes 2 and 3 (i.e. where the dampness of the load is determined by the machine) was less than that in Mode 1 (i.e. standardised dampness), the quantity of water used during the drying cycle for Modes 2 and 3 was not always less than that used in Mode 1.

Test Machine C had a slight, but noticeable, reduction in water consumption (about 10 per cent less) in Modes 2 and 3 presumably due to the reduced moisture content of the test loads.

For Test Machines A and C (apart from some anomalies in Test Machine A), the time taken for their respective wash cycle and that for their dry cycle was approximately the same irrespective of the Mode in which the machine was tested.

The total wash and dry times for these machines varied from a little more than 3 hours to nearly 5 hours.

However, for Test Machine B the drying time was nearly double that of the wash time for each of the test modes and its combined wash and dry times varied from just under 6 ³/₄ hours to just under 7 ¹/₄ hours.

7. RECOMMENDATIONS

Resulting from this study and the previous washer/dryer study at www.waterrating.gov.au/publications/washer-dryer.html, the following could be considered:

1. A labelling program for the dryer component of washer/dryer machines is proposed because:
 - i) consumers are generally not aware that these machines use water in the drying process
 - ii) labelling would inform consumers of the substantial quantities of water that are used by these machines and as such consumers would have a basis for comparison with other machines and
 - iii) manufacturers/suppliers would be required to more accurately indicate the water consumption of these machines when in drying mode.
2. In the immediate term, the labelling program could be a separate label for the drying cycle using the standardised test in AS/NZS 2442.1.
3. In the longer term, the labelling program could be a single label that indicates the total water consumed during both the washing and drying cycles.
4. It is recommended that this issue be referred to Standards Committee EL/15/4 so that an appropriate test procedure for a single label can be developed.

With regard to a possible procedure, since for energy determinations the washing and drying components of the combination unit will need to comply with AS/NZS 2040 and AS/NZS 2442 respectively, the total water consumption could be taken as either:

- i) the sum of the water used as determined by the aforementioned standardised test procedures or
- ii) the total water used by a complete wash and dry cycle (preferably as used in Mode 3 rather than Mode 2 as Mode 3 more closely approximates how the unit would be used).

With regard to (i) above, this study found that the damp mass of each of the test loads following a wash cycle is significantly less than that required for testing under AS/NZS 2442.

It can be argued that the greater damp mass required for testing under AS/NZS 2442 does not create anomalies because all dryers are tested using a load having the same degree of wetness. However this approach does not encourage technological development that would reduce water (and energy) consumption due to a reduced damp load. A mechanism of this type appears to be present in Test Machine C. It is our belief that such devices should be encouraged and given recognition.

With regard to (ii) above, although this option would take machine technology into consideration and probably provide a more accurate indication of actual water consumption, it would require an additional test to that of AS/NZS 2040 and AS/NZS 2442 and as such would have associated additional testing costs.

A single label may also require new star rating bands to reflect acceptable water consumptions of combination units. Moreover, the new ratings for combination units should allow for direct correlation with stand alone water using dryers when these become available in Australia.

5. The WELS website and any WELS publications giving information on these products should include the following details:
 - i) that the dryer load capacity is approximately half that of the washer load capacity and that users may have to divide the washed load into two lots which have to be dried separately and
 - ii) the extensive time required for each of the wash and dry programs.

Table 2: washer/dryer – Test Machine A

Dynamic Water Pressure	320 kPa			500 kPa		
Test mode	Mode 1	Mode 2	Mode 3	Mode 1	Mode 2	Mode 3
Wash program on label		Cottons normal, eco 60°C	Cottons normal, eco 60°C		Cottons normal, eco 60°C	Cottons normal, eco 60°C
Wash program used		Cottons normal, eco 60°C	Cottons normal, eco 60°C		Cottons normal, eco 60°C	Cottons normal, eco 60°C
Washer load – (kg)		7.0	3.5		7.0	3.5
Bone dry mass of test load – (kg)		6.478	3.250		6.471	3.250
Damp mass after wash – (kg)		10.138	5.115		10.195	5.128
Time – (h:m:s)		2:25:34	2:29:44		2:26:56	2:27:06
Energy consumption of washer – E _i (kWh)		0.577	0.663		0.610	0.615
Total water consumption of washer – (l)	68	68.4	69.8		70.1	66.4
Dryer program on label	Cottons, dry only, timed dry	Cottons, dry only, timed dry	Cottons, dry only, timed dry	Cottons, dry only, timed dry	Cottons, dry only, timed dry	Cottons, dry only, timed dry
Dryer program used	Extra dry	Extra dry	Extra dry	Extra dry	Extra dry	Extra dry
Dryer rated capacity – (kg)	3.5	3.5	3.5	3.5	3.5	3.5
Bone dry mass of dryer load – m _{bd} (kg)	3.250	3.250 #	3.250	3.238	3.243 #	3.250
Damp mass – m _w (kg)	6.175	5.094	5.115	6.148	4.984	5.128
Mass of moisture – (kg)	2.925	1.845	1.865	2.910	1.741	1.878
Percentage moisture before drying	90.0	56.8	57.4	89.9	53.7	57.8
Mass test load at the end of cycle – m _t (kg)	3.874	3.375	3.417	3.763	3.283	3.353
Mass of moisture removed from test load – m _r (kg)	2.301	1.719	1.698	2.385	1.701	1.775
Time – (h:m:s)	1:45:53	1:45:33	1:40:53	1:43:02	2:27:06	1:39:50
Moisture content at the end of dryer cycle – m _e (%) (Not to exceed 6 per cent)	19.2	3.85	5.14	16.21	1.23	3.17
Energy consumption dryer – E _d (kWh)	2.724	2.636	2.581	2.763	2.584	2.555
Total water consumption of dryer – (l)	35.0	35.2	33.8	33.2	33.9	33.7

Tan = inappropriate control settings; light blue = anomalies in the test results; red = failure to comply with the requirements of the appropriate Standard.

Table 3: washer/dryer – Test Machine B

Dynamic Water Pressure	320 kPa					500 kPa			
	Test mode	Mode 1	Mode 2	Mode 2*	Mode 3	Mode 3*	Mode 1	Mode 2	Mode 3
WASHER	Wash program on label		Cotton 40°C intensive 1400 rpm	Cotton 40°C intensive 1400 rpm	Cotton 40°C intensive 1400 rpm	Cotton 40°C intensive 1400 rpm		Cotton 40°C intensive 1400 rpm	Cotton 40°C intensive 1400 rpm
	Wash program used		Cotton 40°C intensive 1400 rpm	Cotton 40°C intensive 1400 rpm	Cotton 40°C intensive 1400 rpm	Cotton 40°C intensive 1400 rpm		Cotton 40°C intensive 1400 rpm	Cotton 40°C intensive 1400 rpm
	Washer load – (kg)		7.0	7.0	4.0	4.0		7.0	4.0
	Bone dry mass of test load – (kg)		6.490	6.481	3.703	3.688		6.48	3.705
	Damp mass after wash – (kg)		9.695	10.148	5.505	5.589		9.744	5.88
	Time – (h:m:s)		2:14:53	2:55:44	2:16:04	2:51:15		2:48:00	2:21:00
	Energy consumption of washer – E ₁ (kWh)		0.591	0.646	0.631	0.708		0.626	0.661
	Total water consumption of washer – (l)	72	44.7	77.7	43.6	71.7		84.4	45.3
	Dryer program on label	Dry more	Dry more		Dry more		Dry more	Dry more	Dry more
	Dryer program used	Dry more	Dry more		Dry more		Dry more	Dry more	Dry more
	Dryer rated capacity – (kg)	4.0	4.0		4.0		4.0	4.0	4.0
	Bone dry mass of dryer load – m _{bd} (kg)	3.702	3.703 #		3.703		3.695	3.670 #	3.705
	Damp mass – m _w (kg)	7.030	5.533		5.505		7.011	5.462	5.88
Mass of moisture – (kg)	3.328	1.830		1.802		3.316	1.792	2.175	
Percentage moisture before drying	89.9	49.4		48.7		89.7	48.8	58.7	
Mass test load at the end of cycle – m _t (kg)	3.812	3.724		3.775		3.952	3.721	3.787	
Mass of moisture removed from test load – m ₁ (kg)	3.218	1.809		1.730		3.059	1.741	2.093	
Time – (h:m:s)	4:24:56	4:25:07		4:25:07		4:23:10	4:23:50	4:25:20	
Moisture content at the end of dryer cycle – m _c (%) (Not to exceed 6per cent)	2.97	0.57		1.94		6.96	1.39	2.21	
Energy consumption dryer – E ₁ (kWh)	3.904	3.611		3.536		3.272	3.775	3.802	
Total water consumption of dryer – (l)	72.8	73.1		73.2		72.3	72.3	72.7	
DRYER									

Tan = inappropriate control settings; **light blue** = anomalies in the test results; **red** = failure to comply with the requirements of the appropriate Standard.

Table 4: washer/dryer – Test Machine C

Dynamic Water Pressure	320 kPa			500 kPa		
	Mode 1	Mode 2	Mode 3	Mode 1	Mode 2	Mode 3
Test mode						
Wash program on label		Cottons 40°C intensive	Cottons 40°C intensive		Cottons 40°C intensive	Cottons 40°C intensive
Wash program used		Cotton 40°C 1600 RPM	Cotton 40°C 1600 RPM		Cotton 40°C 1600 RPM	Cotton 40°C 1600 RPM
Washer load – (kg)		5.5	2.5		5.5	2.5
Bone dry mass of test load – (kg)		5.097	2.317		5.092	2.338
Damp mass after wash – (kg)		7.636	3.548		7.754	3.559
Time – (h:m:s)		1:58:54	2:00:53		2:00:00	1:54:07
Energy consumption of washer – E ₁ (kWh/h)		0.583	0.480		0.472	0.452
Total water consumption of washer – (l)	48	44.3	34.4		49.1	35.9
Dryer program on label		NO	DRYER		LABEL	
Dryer program used	Normal + 1600 RPM	Normal + 1600 RPM	Normal + 1600 RPM	Normal + 1600 RPM	Normal + 1600 RPM	Normal + 1600 RPM
Dryer rated capacity – (kg)	2.5	2.5	2.5	2.5	2.5	2.5
Bone dry mass of dryer load – m _{bd} (kg)	2.327	2.327#	2.317	2.331	2.338#	2.338
Damp mass – m _w (kg)	4.422	3.400	3.548	4.424	3.445	3.559
Mass of moisture – (kg)	2.095	1.073	1.231	2.093	1.057	1.221
Percentage moisture before drying	90.0	46.1	53.1	89.8	44.3	52.2
Mass test load at the end of cycle – m _t (kg)	2.464	2.371	2.453	2.471	2.415	2.450
Mass of moisture removed from test load – m ₁ (kg)	1.958	1.029	1.095	1.953	1.030	1.109
Time – (h:m:s)	1:20:22	1:11:22	1:31:32	1:18:25	1:09:40	1:15:00
Moisture content at the end of dryer cycle – m _e (%) (Not to exceed 6 per cent)	5.89	1.89	5.87	6.01	3.29	4.79
Energy consumption dryer – E ₁ (kWh/h)	1.566	1.350	1.419	1.488	1.363	1.435
Total water consumption of dryer – (l)	11.4	9.7	10.3	11.0	10.5	9.9

Tan = inappropriate control settings; **light blue** = anomalies in the test results; **red** = failure to comply with the requirements of the appropriate Standard.