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South African Shower Heads Testing Report

OCTOBER 2022

AUTHOR

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ACKNOWLEDGEMENTS

We would like to thank Tshepo Movundlela for all photographic material of tests. We would like to thank Monica Wambui from CLASP, Ashanti Mbanga from SANEDI, Plumblink and On Tap for the assistance with sales data and supply of shower heads.

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Executive Summary

A growing population and reliance on increasingly unpredictable rainfall has left South Africa in a water crisis. In partnership with the South African Energy Development Institute (SANEDI) and Institute of Plumber South Africa (IOPSA), CLASP is supporting water efficiency policies to preserve this diminishing and essential resource.

The Department of Water and Sanitation (DWS) published the South African Water and Sanitation Masterplan, outlining a strategy to introduce a Water Efficiency Labelling Scheme (WELS) by 2025. The plan identified showerheads as a key component of future water efficiency programs and the WELS scheme. Since 2021, CLASP has published two reports on the opportunity for water efficiency standards to support a more resilient water and energy system in the country. The previous are outlined below:

1. In-depth Assessment of Water Efficiency Opportunities in South Africa – the report found that water efficiency standards could address the country's interlinked water, energy and carbon emissions crises.
2. South African Tap and Flow Rate Gap Analysis - the report provides side-by-side comparisons of South African National Standards and international best practices to reduce flow rates. The report recommends South Africa align with international standards for shower heads – these new standards could reduce the amount of water used, while also reducing electricity needed to heat water.

Limited data on the flow rate performance of commercially available shower heads poses a challenge for researchers and policymakers. This report builds on previous CLASP research and provides an overview of the flow rate profiles of the tested shower heads, as well as depictions of product spray patterns.

Some of the key findings from the showerhead testing include:

- **Less expensive showerheads are less water efficient.** Less costly options have an average higher flow rate: over 30 l/min. More expensive showerheads have lower flow rates: less than 10 l/min.
- **Using flow rate regulators can significantly reduce flow rates.**
- **South Africa will experience significant water savings by complying with CLASP recommendations.** In previous reports, CLASP recommended the 7.5 L/min flow rate across showerhead options – this could substantially reduce water wastage across the country.
- **The majority of shower heads available in South Africa are inefficient.** The research found that 58% of the showerheads were of a fixed orifice type and delivered flow rates at an average of 27 L/min when tested at 300 kPa pressure.

Based on these findings CLASP recommends South African National Standards (SANS) for shower heads in line with international standards. Performance requirements such as maximum flow rate and water saving flow rate should aim to ensure positive user experienced when using showerheads with lower flow rates.

With insights from this report, DWS, the South African National Energy Development Institute (SANEDI) and other relevant agencies can establish flow rate requirements for shower heads. The data in this study can also help determine appropriate water efficiency levels for the WELS.

All brand and model identifications have been removed and obscured in depictions to maintain anonymity.

1. Selection of Showerheads

The report identified a selection of common shower heads available across South Africa. Shower heads are typically procured in two ways: either by a consumer who buys directly from a retail outlet or by a plumber, builder, or a developer, buying from a distributor. The showerhead selection was informed by the following criteria and assumptions in relation to the points of sale.

1.1 Plumbing component distributors (Category designation "Distributors").

Two distributors of plumbing components, Plumblink and On Tap, supported the project by making shower head sales data available. Plumblink has over 120 branches, and On Tap has 21 branches across the country. This study assumed that sales data from other distribution outlets would be similar to that of Plumblink and On Tap distributors because of their national footprints.

The top-selling shower heads were grouped in price categories that were defined as follows:

	PRICE (ZAR)	
PRICE CATEGORY	FROM	TO
Budget	R 0	R 100
Low-Price	R 101	R 200
Medium-Price	R 201	R 600
High	R 601	Unlimited

Table 1: Price categories of the top-selling shower heads

Note: All prices refer to the retail price including Value Added Tax at 15%.

This project acquired a selection of the top sellers of budget, low-price and medium-price shower heads and one popular high-priced shower head.

1.2 Retail outlets (Category designation "House Brand").

Many retail outlets sell self-branded shower heads, making it difficult to identify the product manufacturers. In this report, these shower heads are referred to as "House Brand." Higher volumes of these shower heads are sold to consumers in retail outlets, compared to branded shower heads. The study includes a representational selection of House Branded shower heads to reflect consumer purchasing trends.

While the research team selected two retail outlets with national footprints, the brand names were not published to maintain anonymity.

Sales data were not available to select the most popular house branded shower heads. The selection was made to include:

- largest and smallest sizes of shower heads;

- shower heads from the four price categories; budget, low-price, medium-price and high-price;
- shower heads with different shapes; and
- shower heads marketed as water saving and non-water saving.

1.3 Selected Shower Heads[1]

Table 2 provides a list of all shower heads tested in the study. Below is a description of table heading.

- **Sample** – Indicates a reference number allocated to the shower head for identification in this report.
- **Price category** – Indicates the retail price of shower head as described in the "Selection of shower heads" section of this report.
- **Shape** – Indicates the general sectional shape across the spray nozzles of the showerhead.
- **Nominal Size (mm)** – Indicates the nominal diameter of round shower heads, and the nominal width of square shower heads. This reflects the nominal size as published. Where no size was published, a measurement was taken of the outside dimension of the body and rounded to the nearest 5mm
- **Marketed as water saving** – Where the packaging or marketing material of a shower head includes wording that suggests it is a water saving device, the table input is "yes". This includes wording such as "water saving", "low flow" etc.
- **Number of spray pattern settings** – Where shower heads include an adjusting mechanism that allow for different types of spray patterns, the number of different spray patterns are indicated in this column. Where no adjustments are available, the column indicates a value of 1.
- **Selection Category** – Indicates the category of shower heads as described in the "Selection of shower heads" section of this report.

[1] This report is not intended as a comparison between different shower head brands and models and to maintain anonymity, no brand and model identification is provided. Descriptions of the shower heads are provided in a format to distinguish the main features of the shower heads

SAMPLE	PRICE CATEGORY	SHAPE	NOMINAL SIZE (MM)	MARKETED AS WATER SAVING	NUMBER OF SPRAY PATTERN SETTINGS	SELECTION CATEGORY
A	Budget	Round	220	No	1	Distributor
B	Budget	Round	75	No	1	House Brand
C	Budget	Round	60	Yes	3	House Brand
D	Budget	Round	50	No	1	Distributor
E	Low-Price	Round	85	No	1	Distributor
F	Low-Price	Round	100	No	1	Distributor
G	Low-Price	Round	100	No	3	Distributor
H	Low-Price	Round	60	Yes	1	House Brand
I	Low-Price	Square	200	Yes	1	House Brand
J	Medium-Price	Square	200	No	1	Distributor
K	Medium-Price	Round	160	No	1	House Brand
L	Medium-Price	Round	85	Yes	1	Distributor
M	Medium-Price	Round	90	No	5	Distributor
N	Medium-Price	Round	100	Yes	4	House Brand
O	Medium-Price	Square	200	No	1	House Brand
P	Medium-Price	Round	70	Yes	2	House Brand
Q	Medium-Price	Square	250	No	1	Distributor
R	High	Round	30	Yes	1	Distributor
S	High	Round	150	Yes	1	Distributor

Table 2: Summary of shower heads

1. Test Methodology

2.1 The Organisation Performing the Tests

Omega Test House (Pty) Ltd performed the tests at a testing laboratory located in Centurion, Gauteng, South Africa. The laboratory holds South African National Accreditation Scheme (SANAS) and International Laboratory Accreditation Cooperation (ILAC) accreditation for various test methods related to the testing of plumbing components. All tests performed comply with the standard ISO 17025 "General requirements for the competence of testing and calibration laboratories."

2.2 The Test Equipment

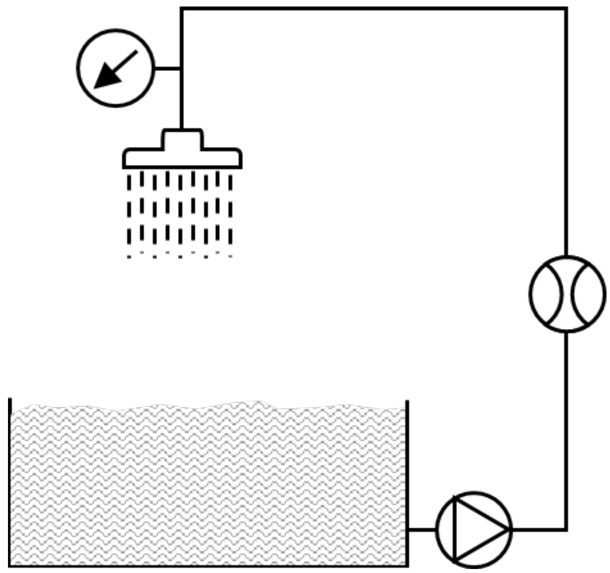
Each shower head was tested individually and against all its specified settings. The shower head was connected to a test setup that included a variable water supply pressure, a flow meter, and a pressure transmitter. A schematic layout of the test apparatus is provided in the figure below. The water flow meter was an Endress + Hauser model DMA20, mass flow type water meter. The instrument uncertainty of measure was 0.3% reading based on a confidence level of 95%. The flow meter was connected to the water supply line after the pump and before the pressure transmitter, and the shower head being tested.

Figure 1: Depiction of flow meter model

The pressure transmitter is a WIKA model A-10 (P#12783359). The instrument uncertainty of measure was 2.9% reading based on a confidence level of 95%. The pressure transmitter was directly connected to the water supply line before the shower head was tested using a special fitting that allows the static component of the water pressure to be measured without being affected by the velocity component. This connection is equivalent to the pressure take-off tee described in Annex A of the standard EN 200:2008 as well as figure 4 of SANS 226:2009

Figure 2: Depiction of pressure transmitter model

The water supply line connecting all components was a 22mm copper pipe and the shower head under test was mounted facing vertically downwards.



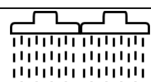
SYMBOL	DESCRIPTION
	Water supply pump
	Water flow meter
	Pressure transmitter
	Shower head under test

Figure 3: Schematic layout of test apparatus

2.3 The Test Procedure

After fitting the shower head to the test apparatus, the water supply was initiated at a low pressure of approximately 250 kPa and gradually increased up to a pressure of approximately 550 kPa. At intervals, the water supply rate was increased to record stabilised water flow rates and pressures. The water flow rates and pressure were continuously recorded. The data was used to plot a characteristic flow pattern of each set for each showerhead.

Flow rate measurements were recorded in L/min (Litre per minute) to at least one decimal point. i.e. 0.1 L/min.

All graphs presented in this report reflect flow rate measurements accurate of one decimal point.

To reflect significant values all quoted flow rate values have been rounded to zero decimal point. i.e. 1 L/min

Pressure measurements were recorded in kPa (kilo Pascal) to a zero decimal points. i.e. 1 kPa.

All data presented in this report reflect pressure measurements accurate to zero decimal points. i.e. 1 kPa.

2.4 Pressure Ranges

The water supply pressures were selected to include the commonly used pressure control valves in South Africa; 400 kPa and 600 kPa valves.

Most domestic installations use pressure reducing valves that comply with the national standard SANS 198, functional-control valves, and safety valves for domestic hot and cold-water supply systems. This standard defines a set of designated nominal pressures. The 400 kPa and 600 kPa pressure control valves are predominantly used for domestic installations in South Africa. The standard specifies the allowed range of pressures required by such a control valve. Figure 3 provides a graphical illustration of the allowed set pressures for each designated nominal pressure.

The minimum allowed set pressure for a 400 kPa pressure control valve is 280 kPa while the maximum permitted pressure for a 600 kPa pressure control valve is 510 kPa. To cover the complete range of pressures, the shower head flow rates were measured from approximately 250 kPa up to about 550 kPa

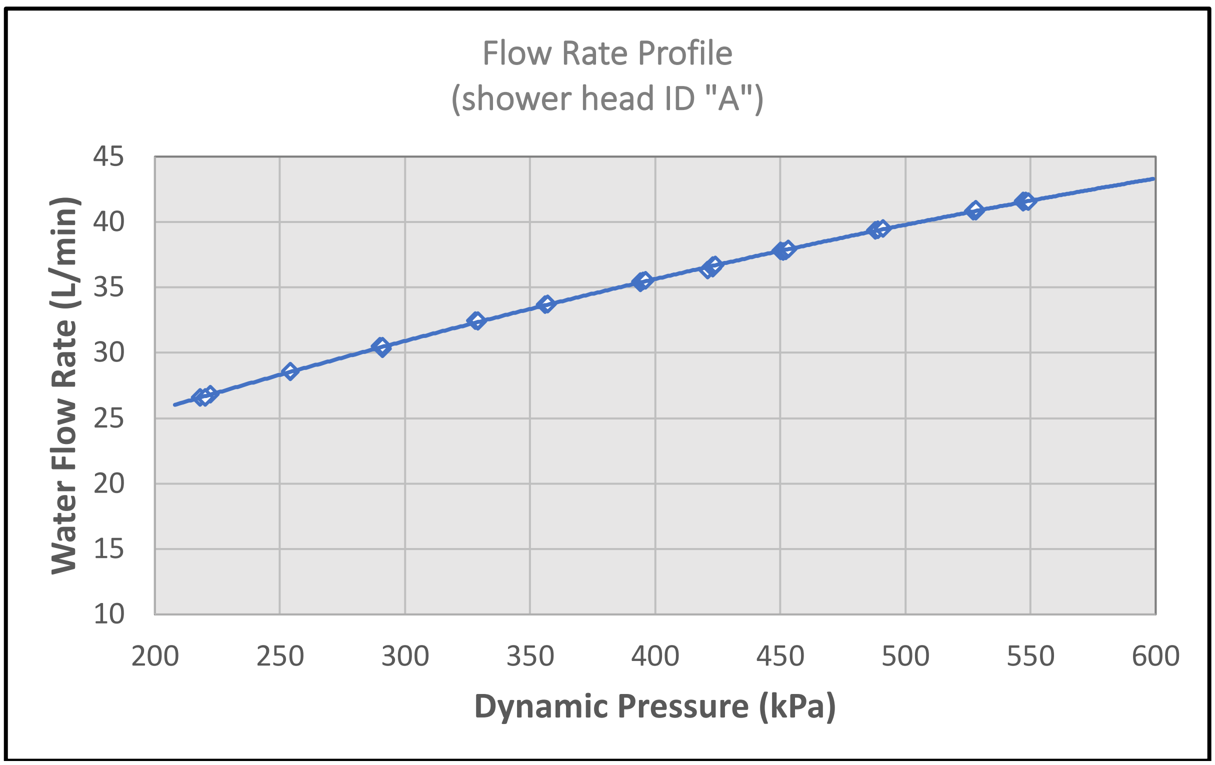
2. Test Data

The flow profiles of the various shower heads are depicted in the following series of graphs, where markers indicate data points. In addition, the provided regression line is based on interpolating and extrapolating data between the data points. For consistency of referencing between the different graphs, the scale of the x-axis of each graph is identical. This is because the x-axis represents the water pressure in kPa.

To ensure the readability of all graphs, the y-axis of each graph is scaled appropriately to the data points. The provided image shows the spray pattern of the showerhead reflective of a dynamic pressure of 300 kPa. In addition, a background grid pattern is supplied with grid lines 10cm apart for reference purposes.

1.1 SHOWER HEAD ID "A"

SAMPLE	PRICE CATEGORY	SHAPE	NOMINAL SIZE (MM)	MARKETED AS WATER SAVING	NUMBER OF SPRAY PATTERN SETTINGS	SELECTION GROUP
A	Budget	Round	220	No	1	Distributor



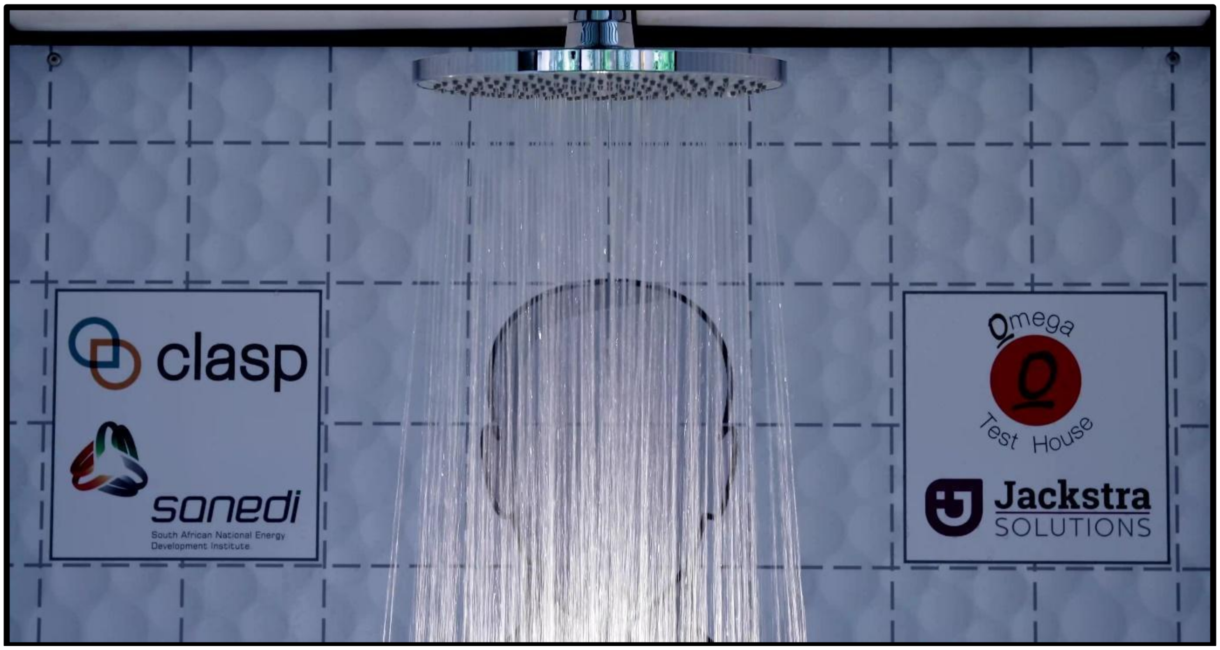


Figure 5: Spray pattern of shower head A

1.2 SHOWER HEAD ID "B"

SAMPLE	PRICE CATEGORY	SHAPE	NOMINAL SIZE (MM)	MARKETED AS WATER SAVING	NUMBER OF SPRAY PATTERN SETTINGS	SELECTION GROUP
B	Budget	Round	75	No	1	House Brand

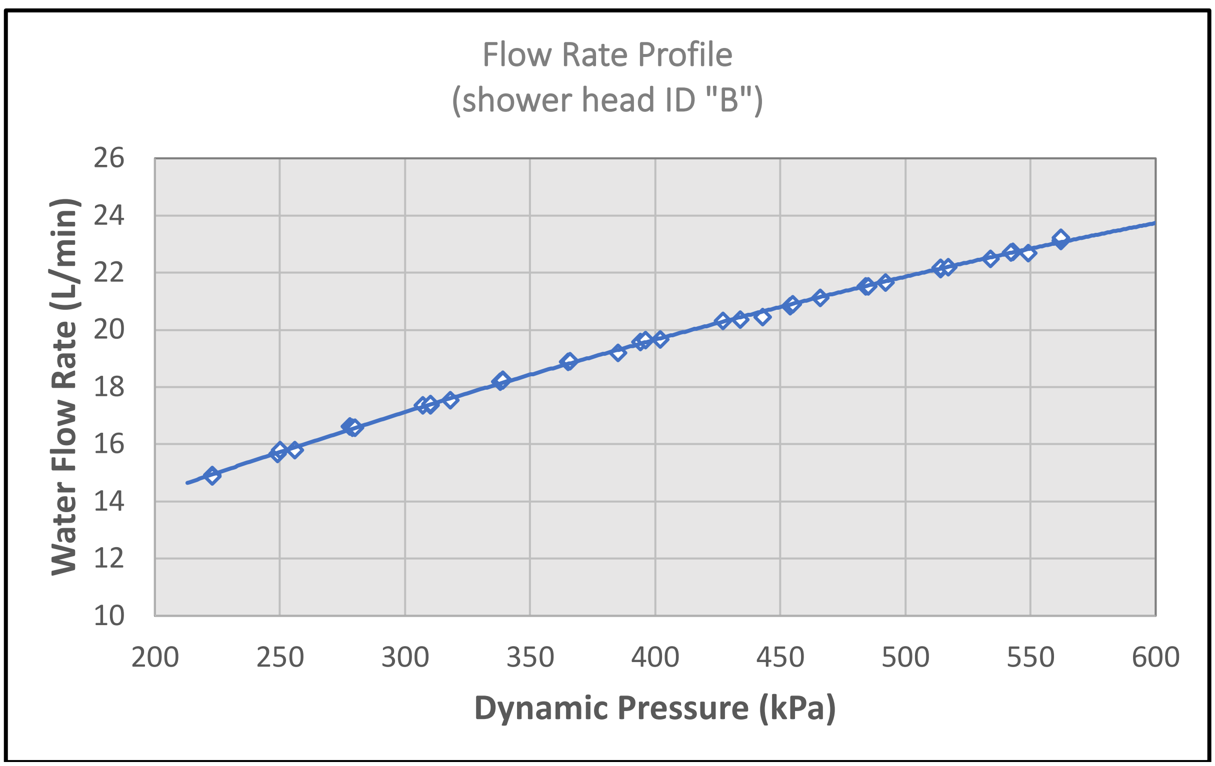


Figure 6: Spray pattern of shower head B

1.3 SHOWER HEAD ID "C"

SAMPLE	PRICE CATEGORY	SHAPE	NOMINAL SIZE (MM)	MARKETED AS WATER SAVING	NUMBER OF SPRAY PATTERN SETTINGS	SELECTION GROUP
C	Budget	Round	60	Yes	3	House Brand

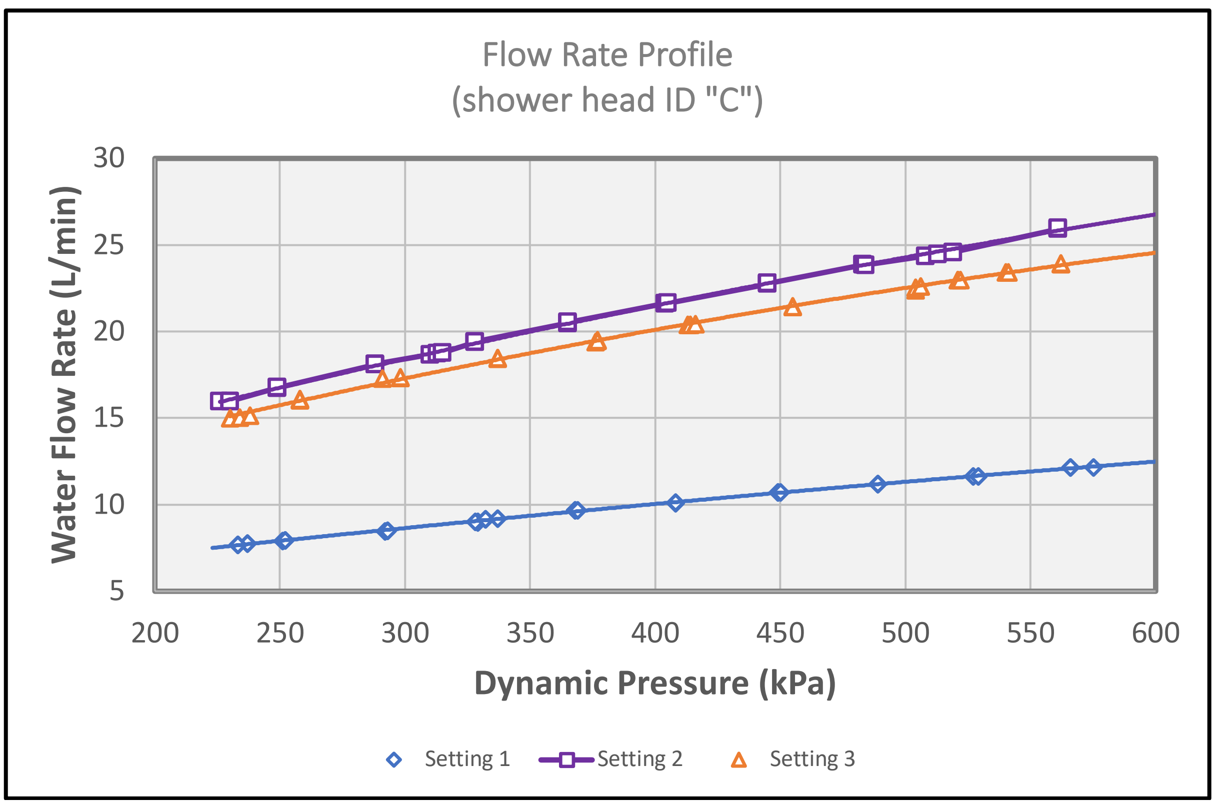


Figure 7 : Spray pattern of shower head C, Setting 1

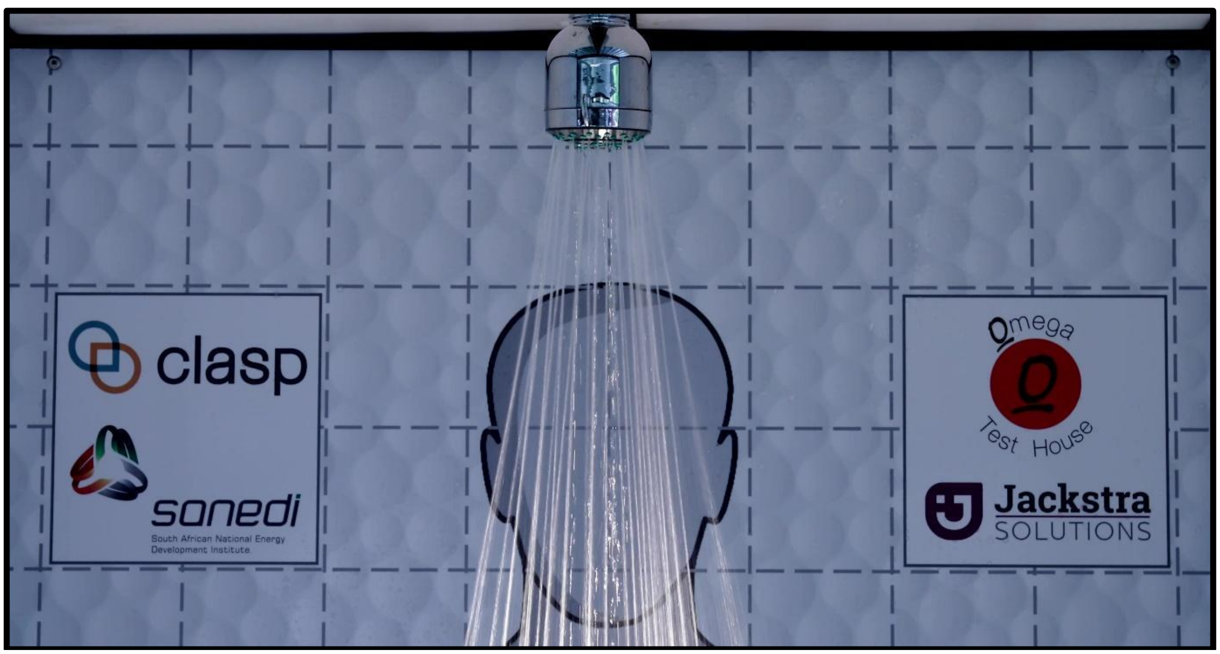


Figure 8 : Spray pattern of shower head C, Setting 2

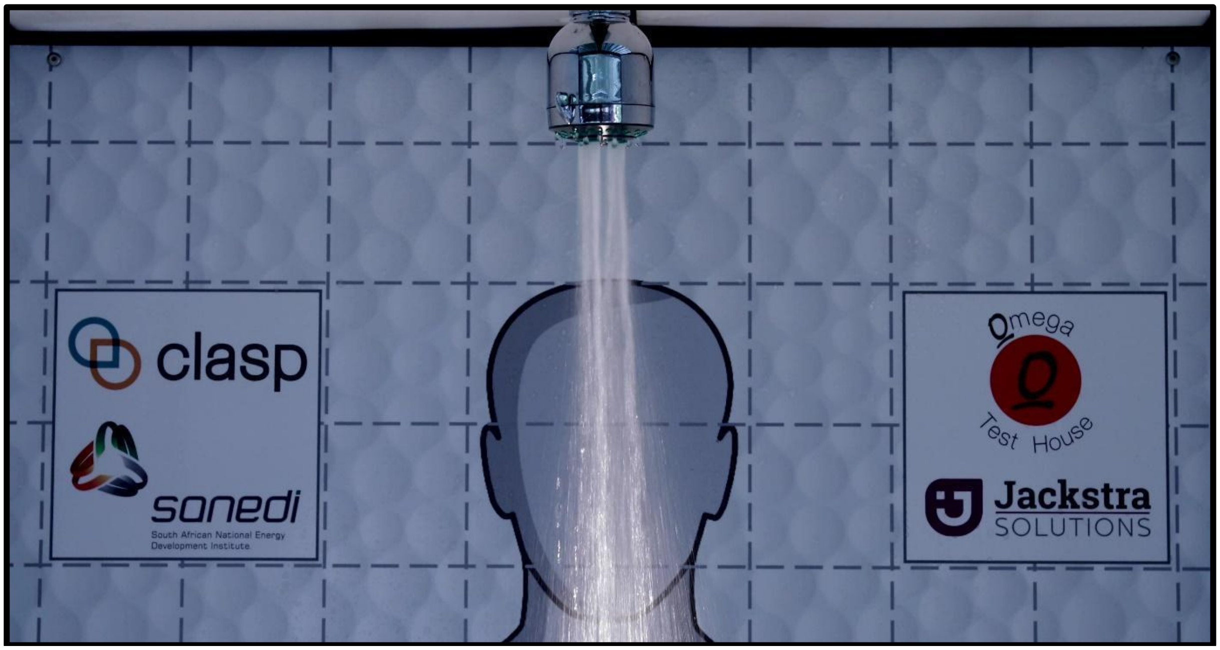


Figure 9 : Spray pattern of shower head C, Setting 3

1.4 SHOWER HEAD ID "D"

SAMPLE	PRICE CATEGORY	SHAPE	NOMINAL SIZE (MM)	MARKETED AS WATER SAVING	NUMBER OF SPRAY PATTERN SETTINGS	SELECTION GROUP
D	Budget	Round	50	No	1	Distributor

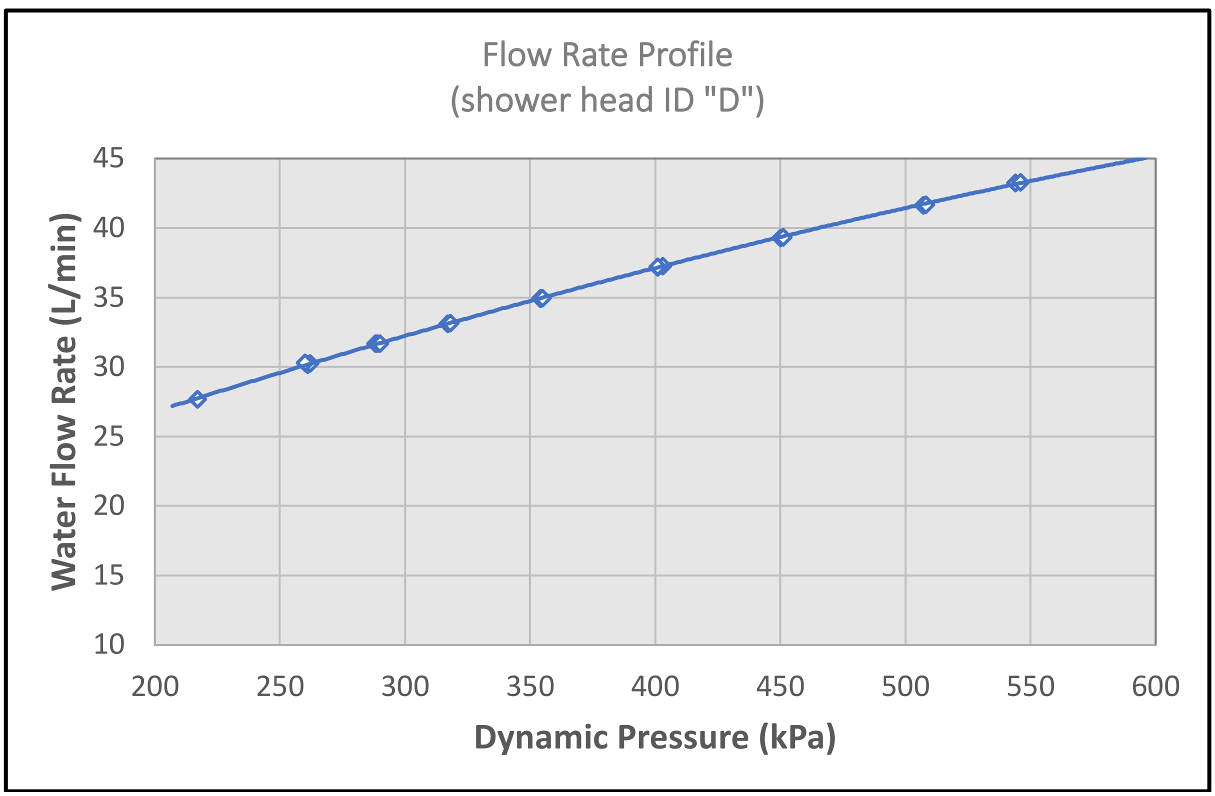


Figure 10: Spray pattern of shower head D

1.5 SHOWER HEAD ID "E"

SAMPLE	PRICE CATEGORY	SHAPE	NOMINAL SIZE (MM)	MARKETED AS WATER SAVING	NUMBER OF SPRAY PATTERN SETTINGS	SELECTION GROUP
E	Low-Price	Round	85	No	1	Distributor

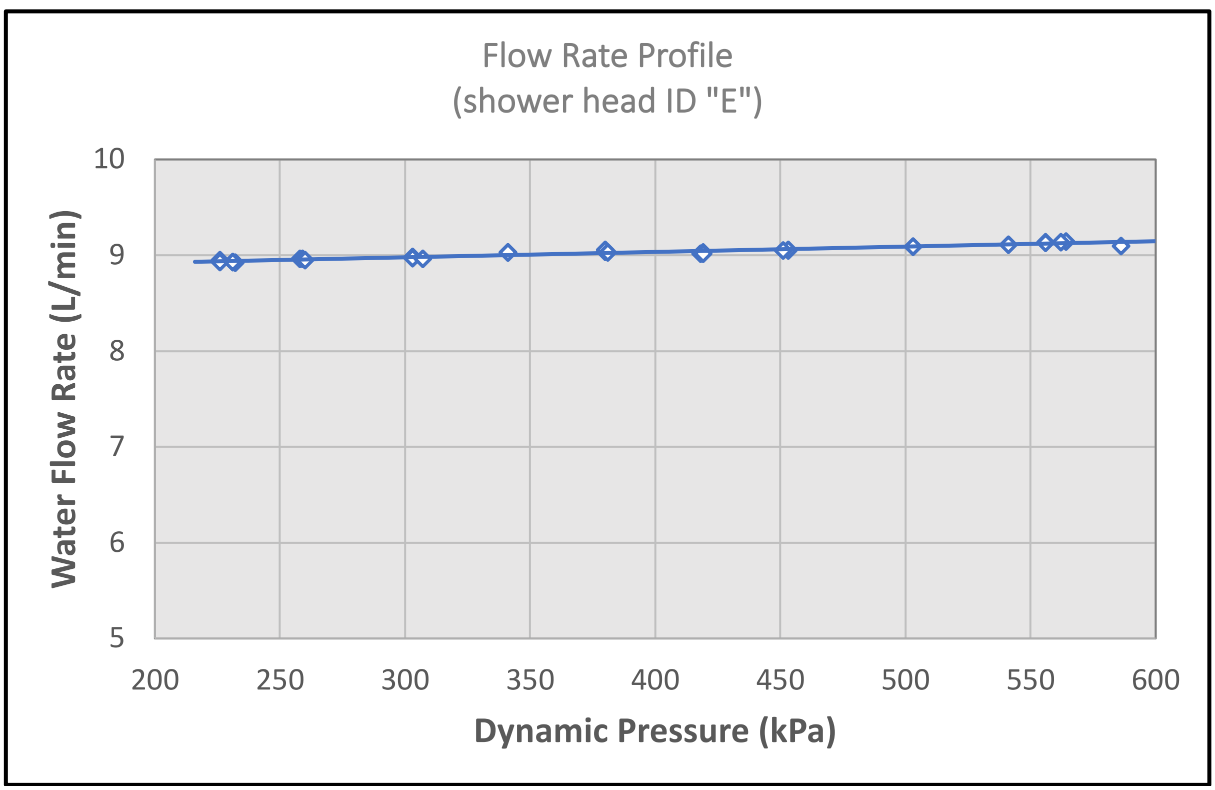


Figure 11: Spray pattern of shower head E

1.6 SHOWER HEAD ID "F"

SAMPLE	PRICE CATEGORY	SHAPE	NOMINAL SIZE (MM)	MARKETED AS WATER SAVING	NUMBER OF SPRAY PATTERN SETTINGS	SELECTION GROUP
F	Low-Price	Round	100	No	1	Distributor

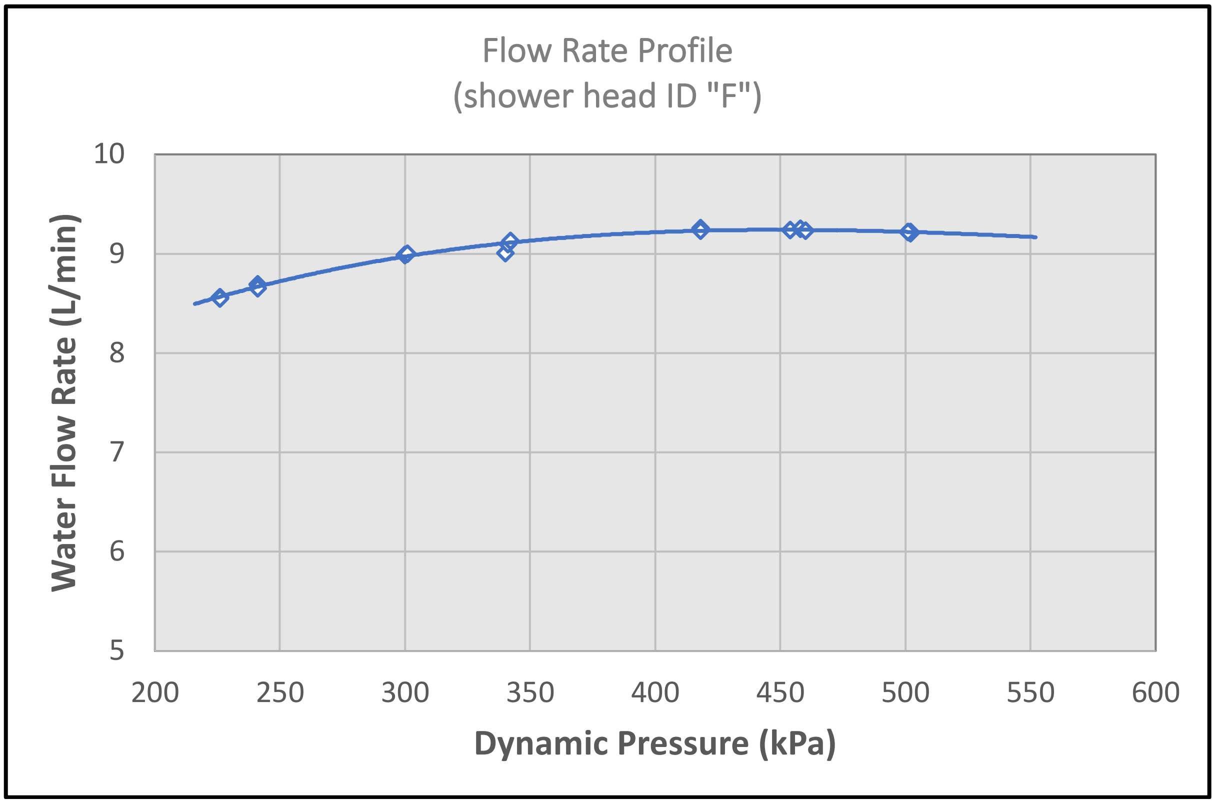
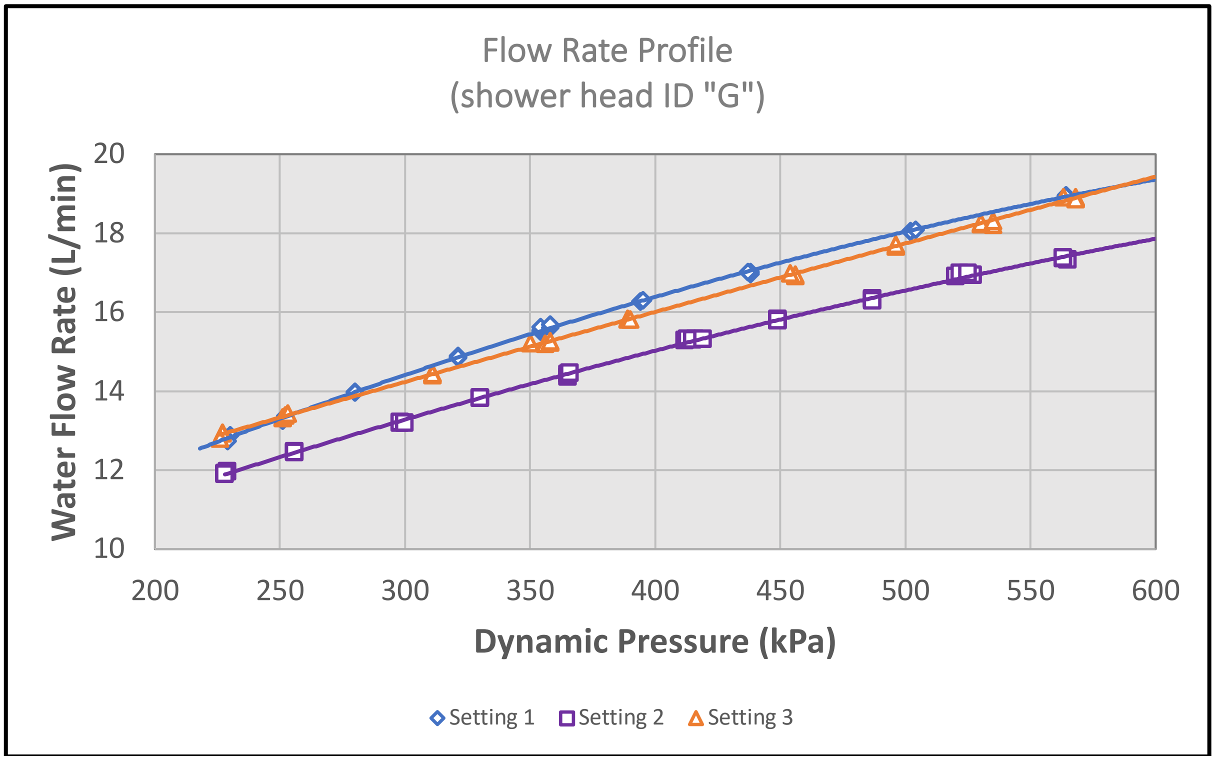


Figure 12: Spray pattern of shower head F

1.7 SHOWER HEAD ID "G"

SAMPLE	PRICE CATEGORY	SHAPE	NOMINAL SIZE (MM)	MARKETED AS WATER SAVING	NUMBER OF SPRAY PATTERN SETTINGS	SELECTION GROUP
G	Low-Price	Round	100	No	3	Distributor



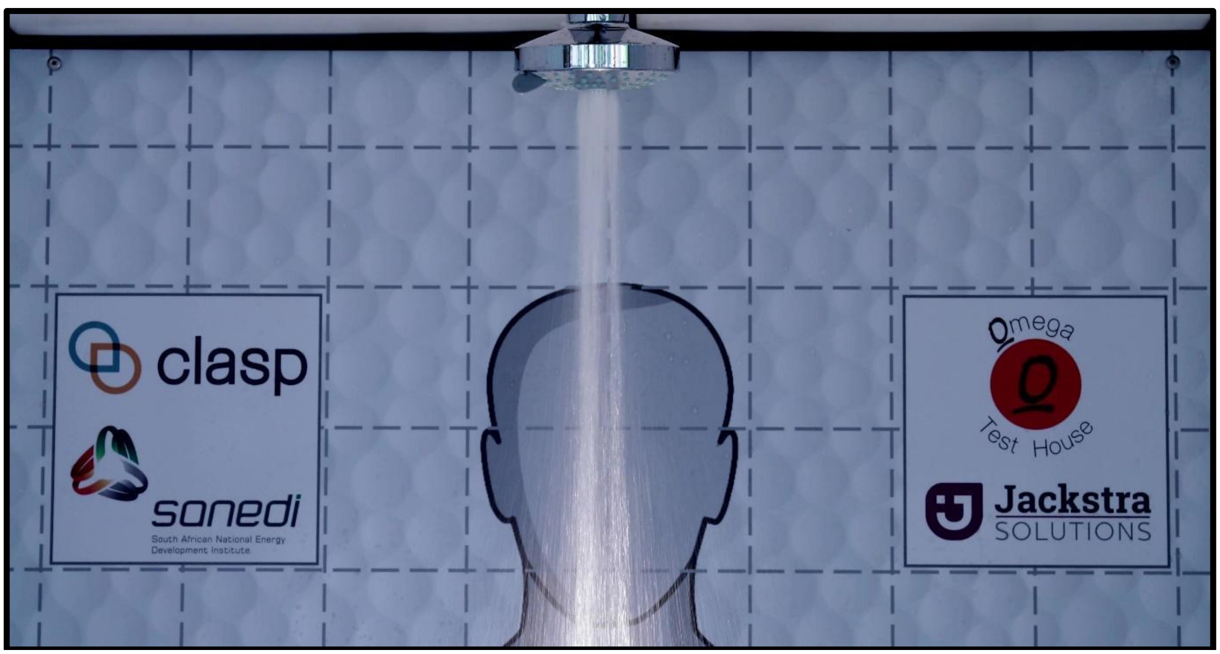


Figure 13: Spray pattern of shower head G, Setting 1

Figure 14: Spray pattern of shower head G, Setting 2

Figure 15: Spray pattern of shower head G, Setting 3

1.8 SHOWER HEAD ID "H"

SAMPLE	PRICE CATEGORY	SHAPE	NOMINAL SIZE (MM)	MARKETED AS WATER SAVING	NUMBER OF SPRAY PATTERN SETTINGS	SELECTION GROUP
H	Low-Price	Round	60	Yes	1	House Brand

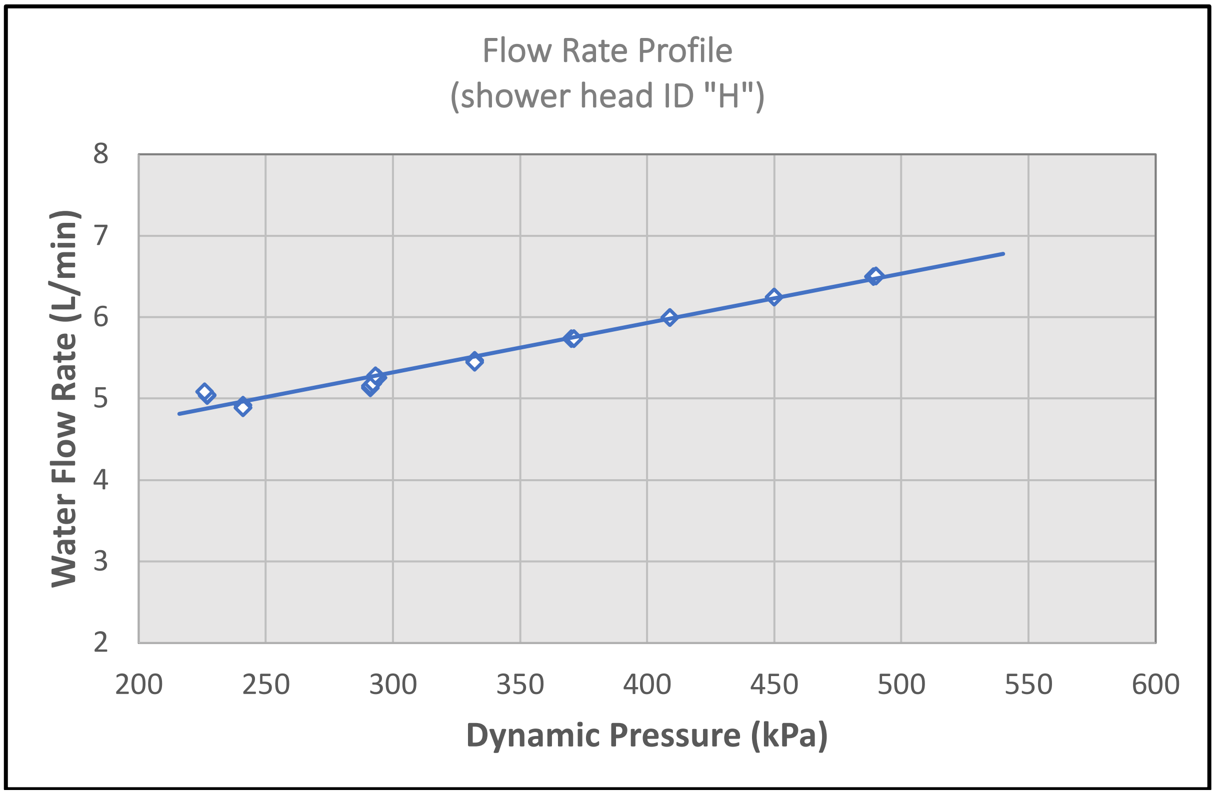


Figure 16: Spray pattern of shower head H

1.9 SHOWER HEAD ID "I"

SAMPLE	PRICE CATEGORY	SHAPE	NOMINAL SIZE (MM)	MARKETED AS WATER SAVING	NUMBER OF SPRAY PATTERN SETTINGS	SELECTION GROUP
I	Low-price	Square	200	Yes	1	House brand

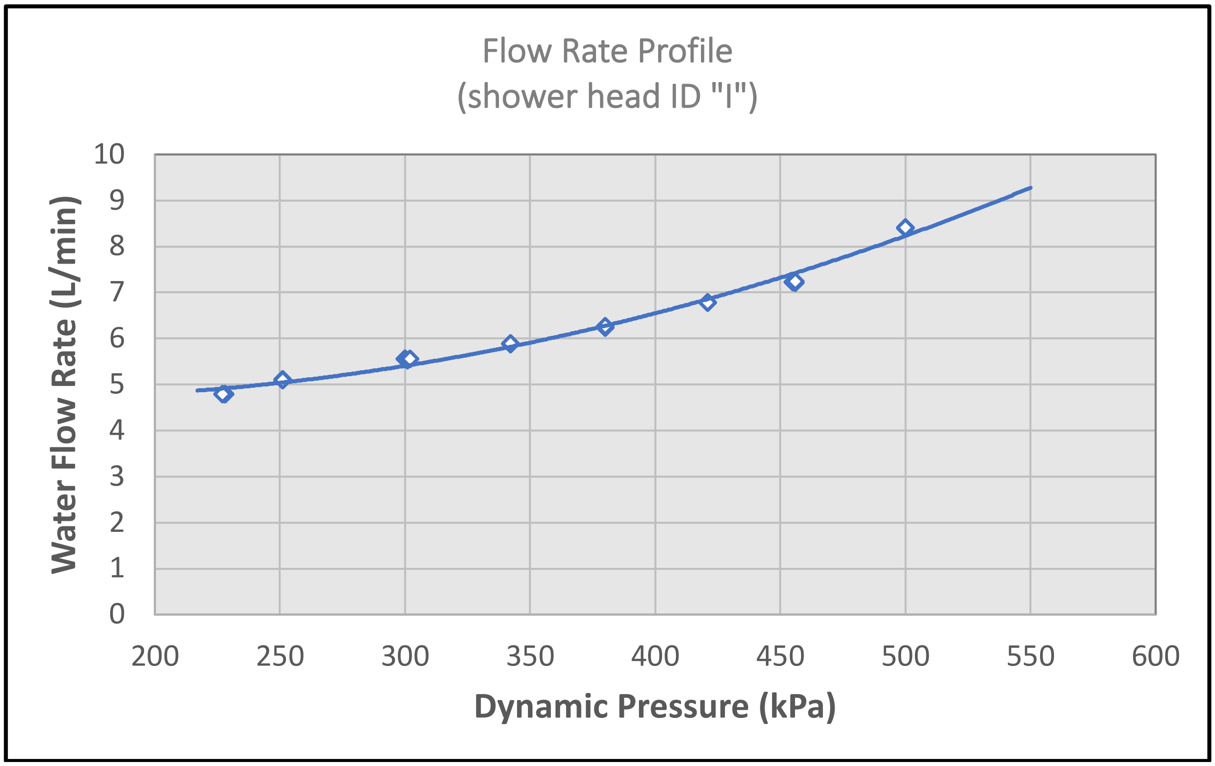


Figure 17: Spray pattern of shower head

1.10 SHOWER HEAD ID "J"

SAMPLE	PRICE CATEGORY	SHAPE	NOMINAL SIZE (MM)	MARKETED AS WATER SAVING	NUMBER OF SPRAY PATTERN SETTINGS	SELECTION GROUP
J	Medium-Price	Square	200	No	1	Distributor

Note: The packaging included a flow regulator to be fitted separately.

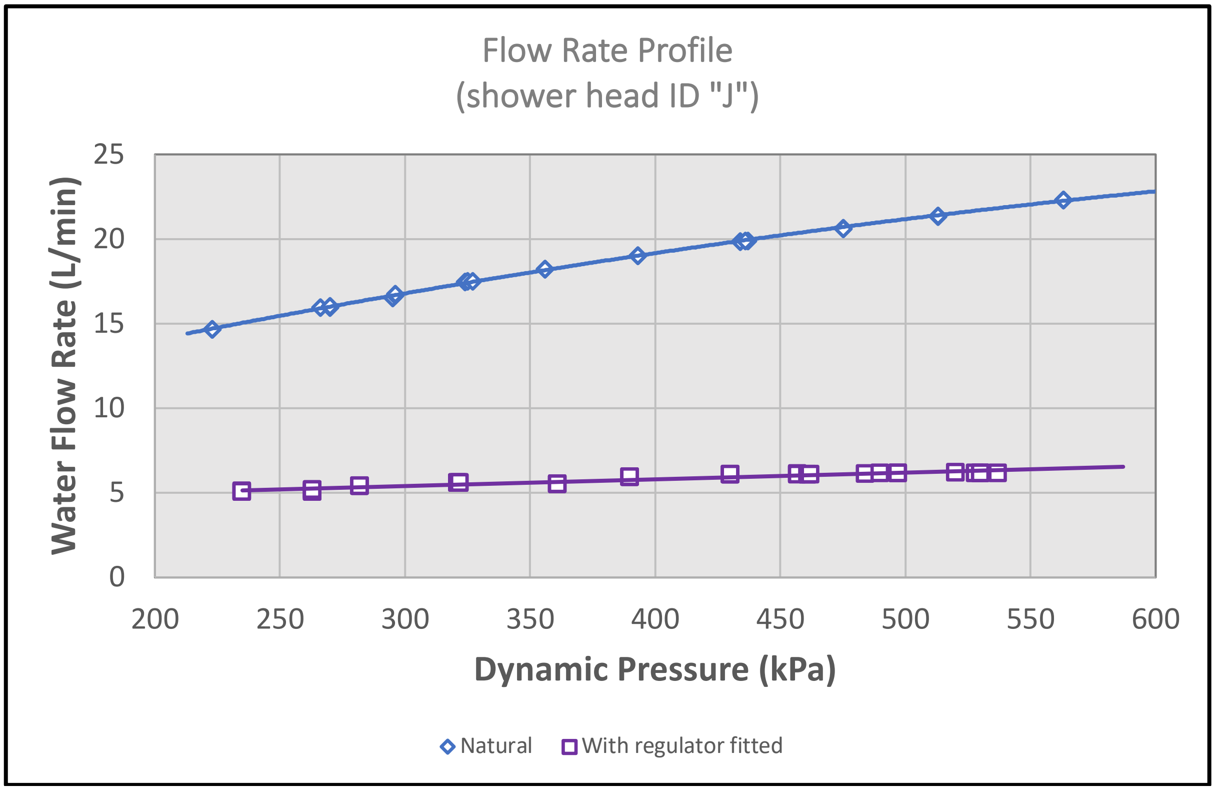
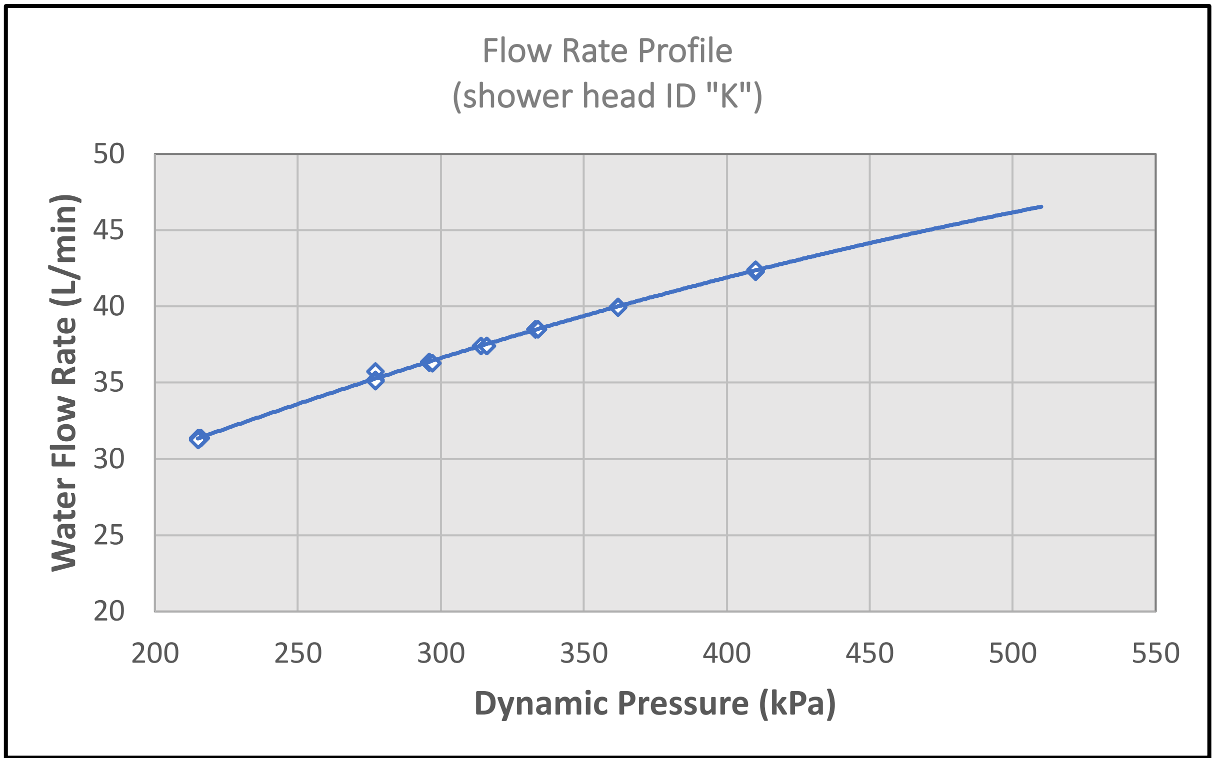


Figure 18: Spray pattern of shower head J, with flow regulator fitted

1.11 SHOWER HEAD ID "K"

SAMPLE	PRICE CATEGORY	SHAPE	NOMINAL SIZE (MM)	MARKETED AS WATER SAVING	NUMBER OF SPRAY PATTERN SETTINGS	SELECTION GROUP
K	Medium-Price	Round	160	No	1	House Brand



The shower head suffered a mechanical failure at a dynamic pressure of approximately 450 kPa. No graphical images are available of the spray pattern prior to the mechanical failure.

1.12 SHOWER HEAD ID "L"

SAMPLE	PRICE CATEGORY	SHAPE	NOMINAL SIZE (MM)	MARKETED AS WATER SAVING	NUMBER OF SPRAY PATTERN SETTINGS	SELECTION GROUP
L	Medium-Price	Round	85	Yes	1	Distributor

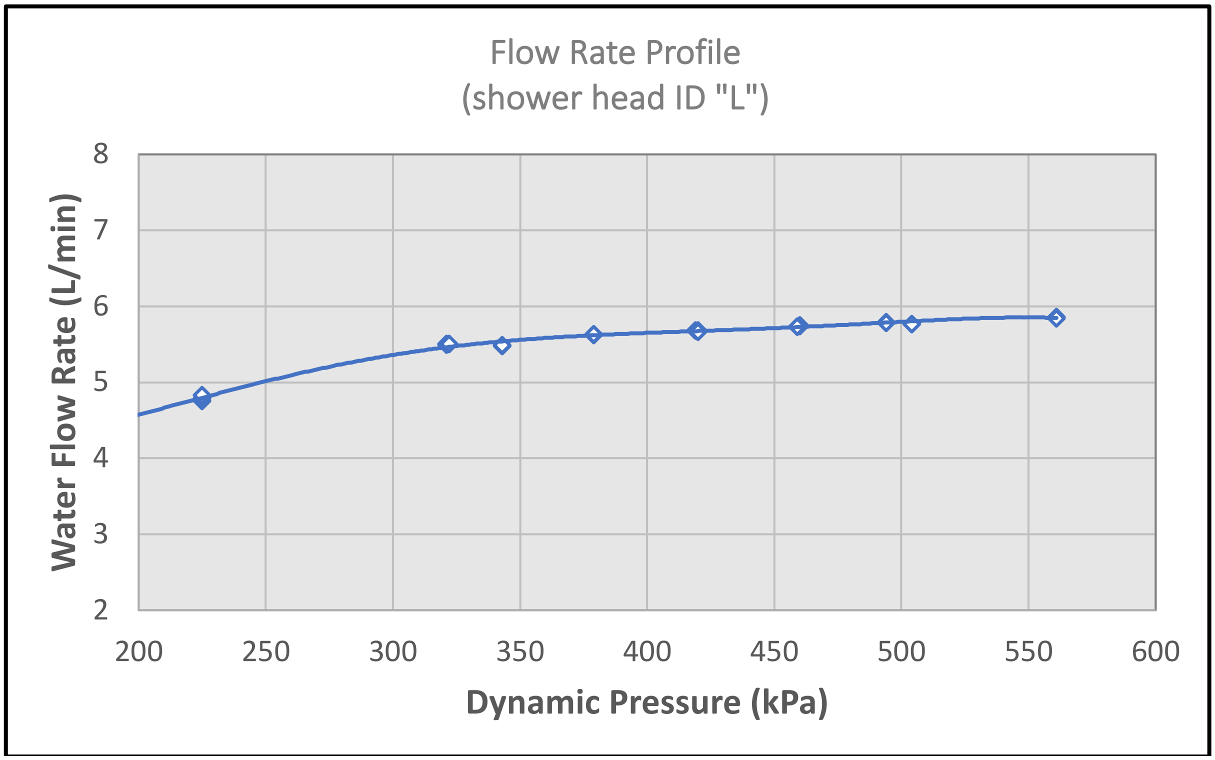
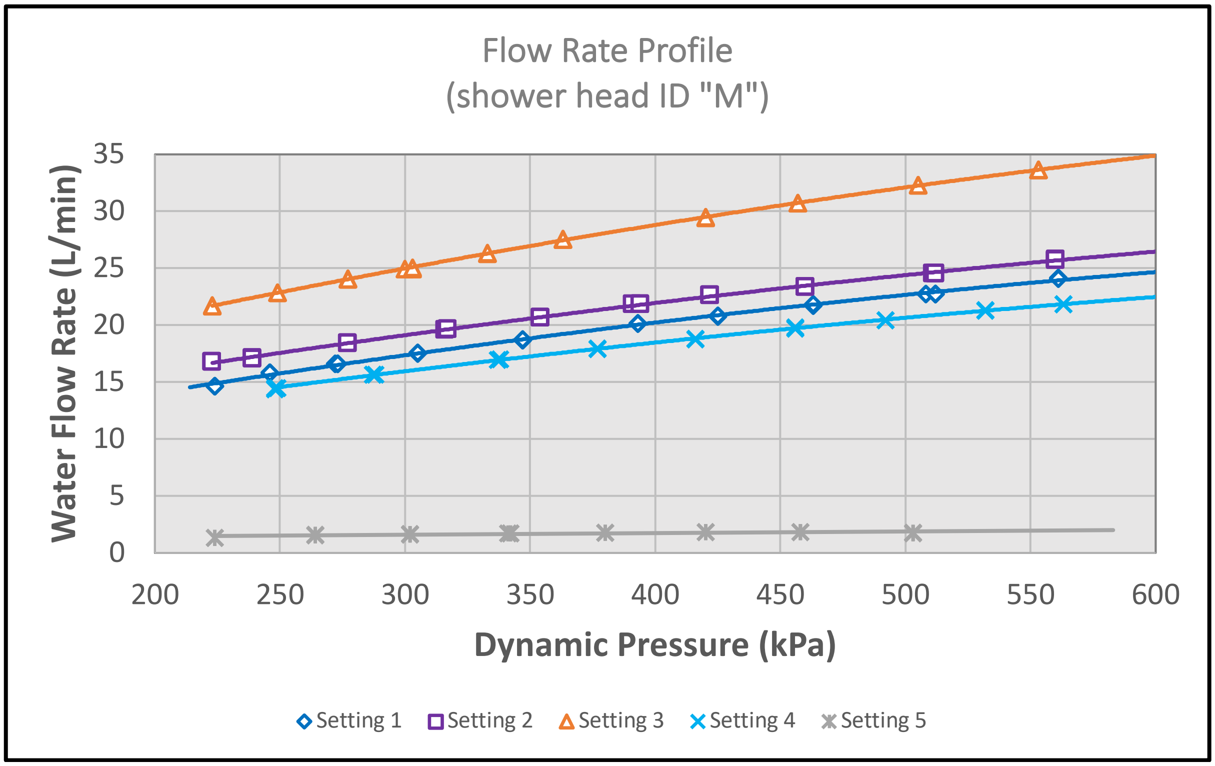


Figure 19: Spray pattern of shower head L

1.13 SHOWER HEAD ID "M"

SAMPLE	PRICE CATEGORY	SHAPE	NOMINAL SIZE (MM)	MARKETED AS WATER SAVING	NUMBER OF SPRAY PATTERN SETTINGS	SELECTION GROUP
M	Medium-Price	Round	90	No	5	Distributor



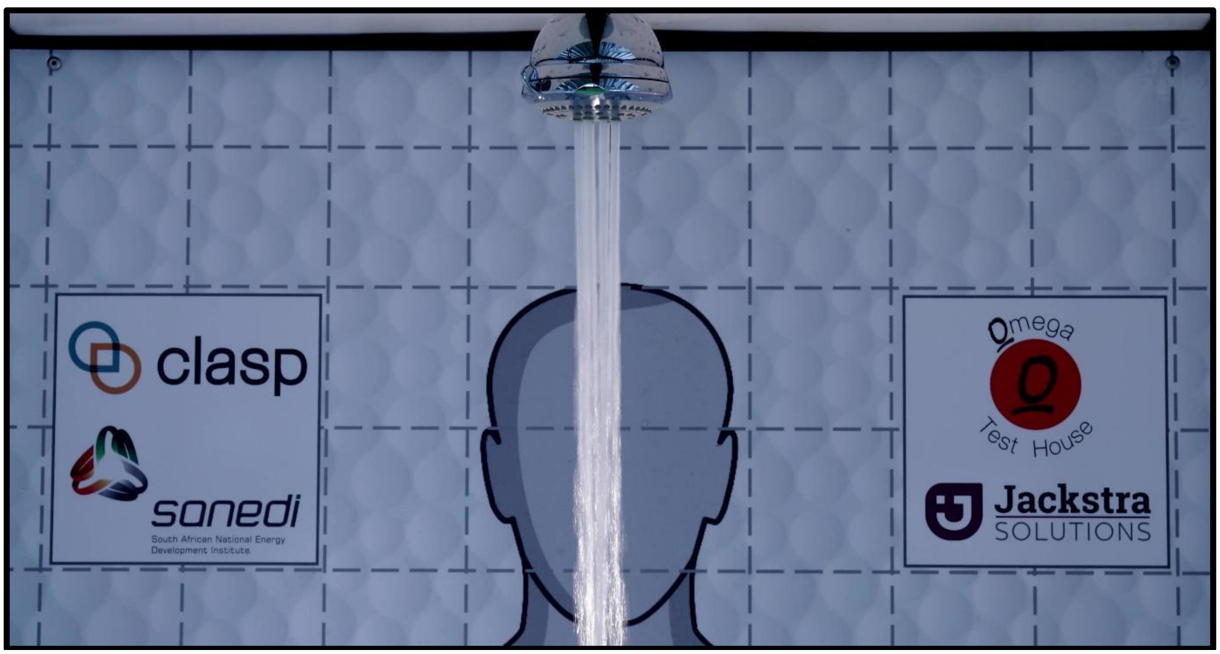


Figure 20: Spray pattern of shower head M, Setting 1

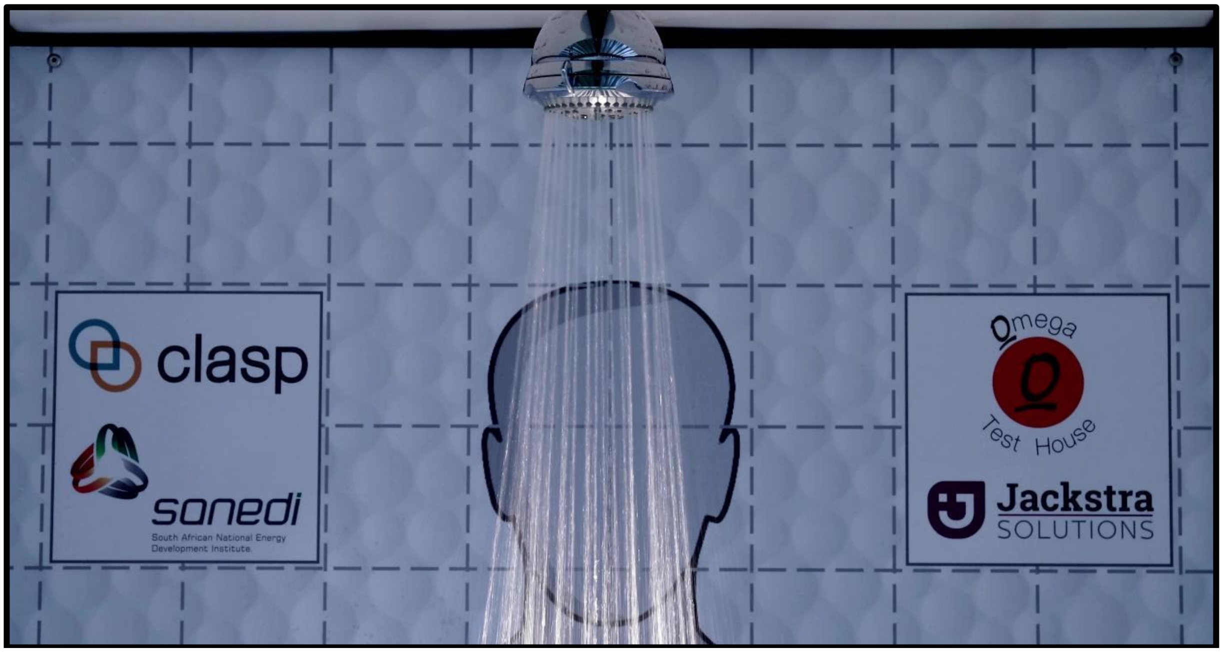


Figure 21: Spray pattern of shower head M, Setting 2

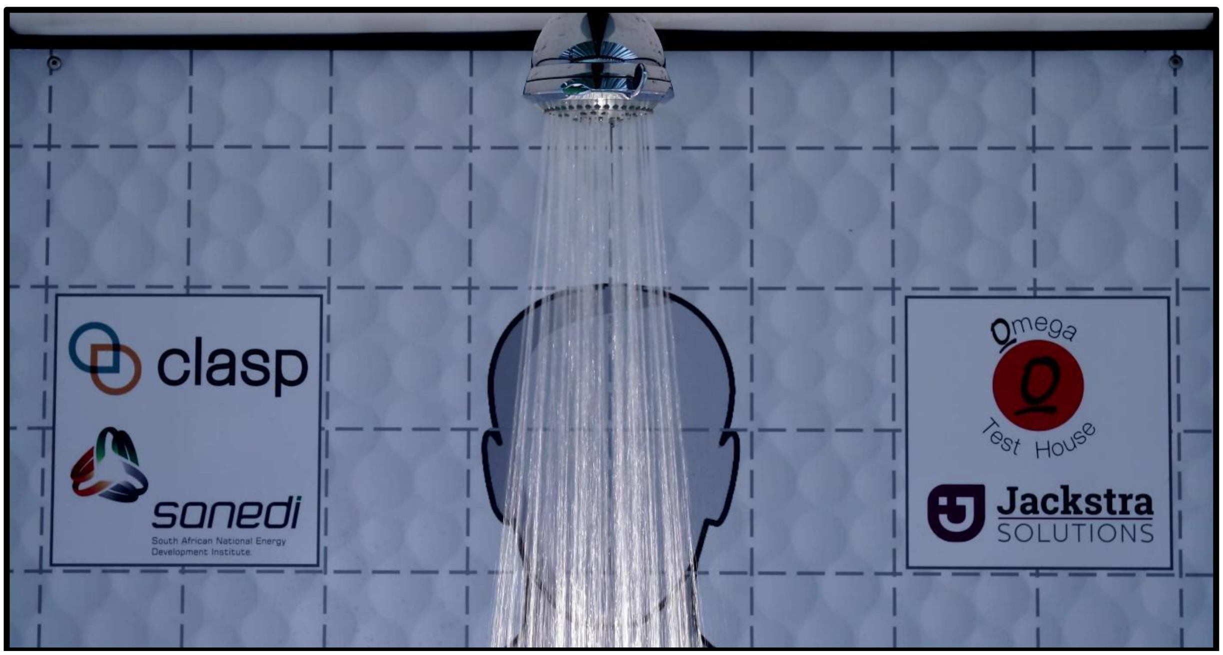


Figure 22: Spray pattern of shower head M, Setting 3

Figure 23: Spray pattern of shower head M, Setting 4

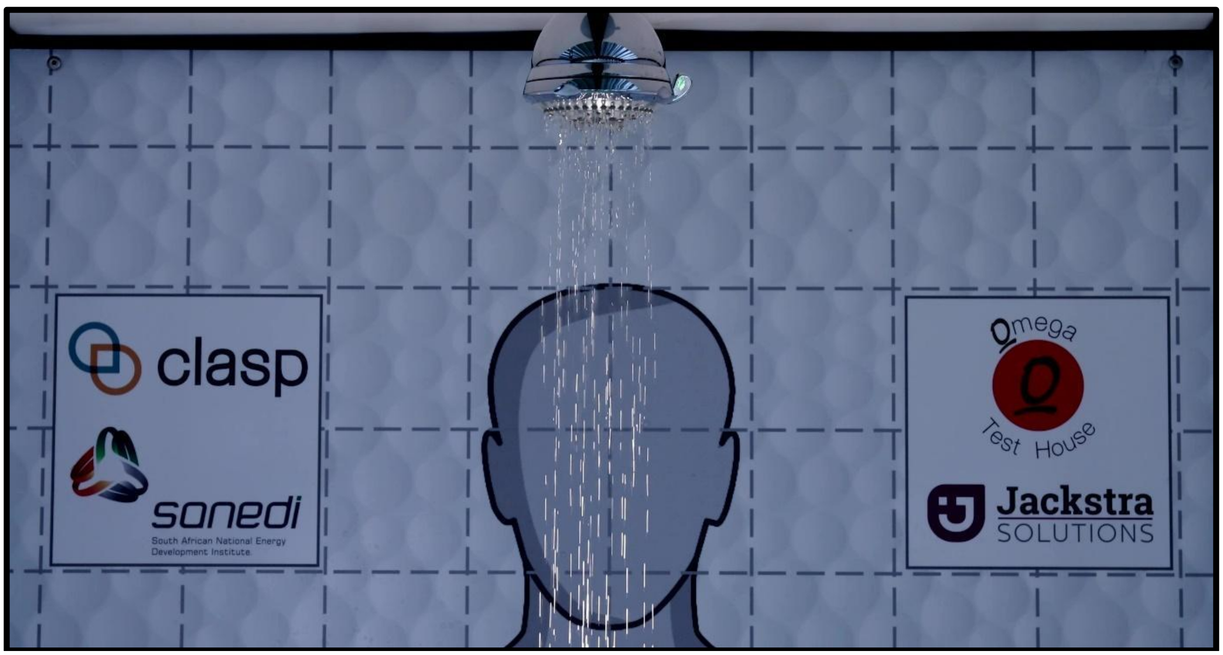
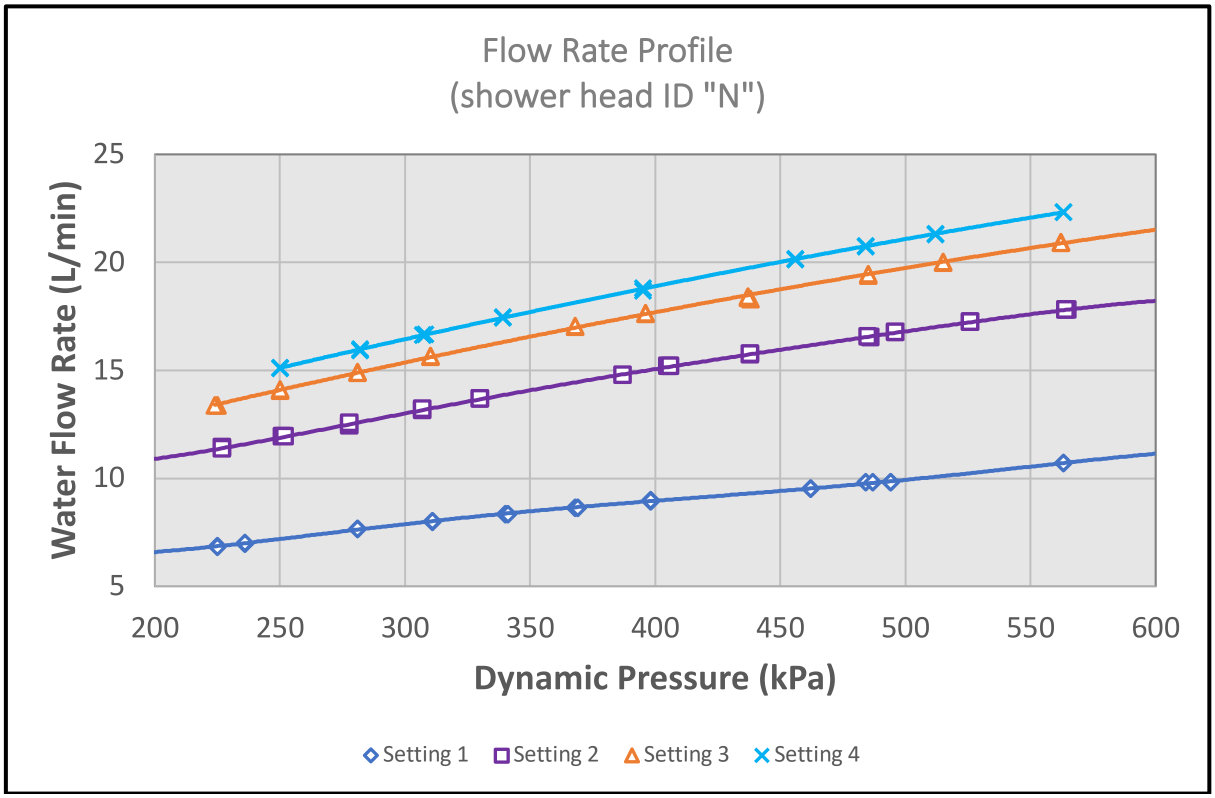


Figure 24: Spray pattern of shower head M, Setting 5

1.14 SHOWER HEAD ID "N"

SAMPLE	PRICE CATEGORY	SHAPE	NOMINAL SIZE (MM)	MARKETED AS WATER SAVING	NUMBER OF SPRAY PATTERN SETTINGS	SELECTION GROUP
N	Medium-Price	Round	100	Yes	4	House Brand



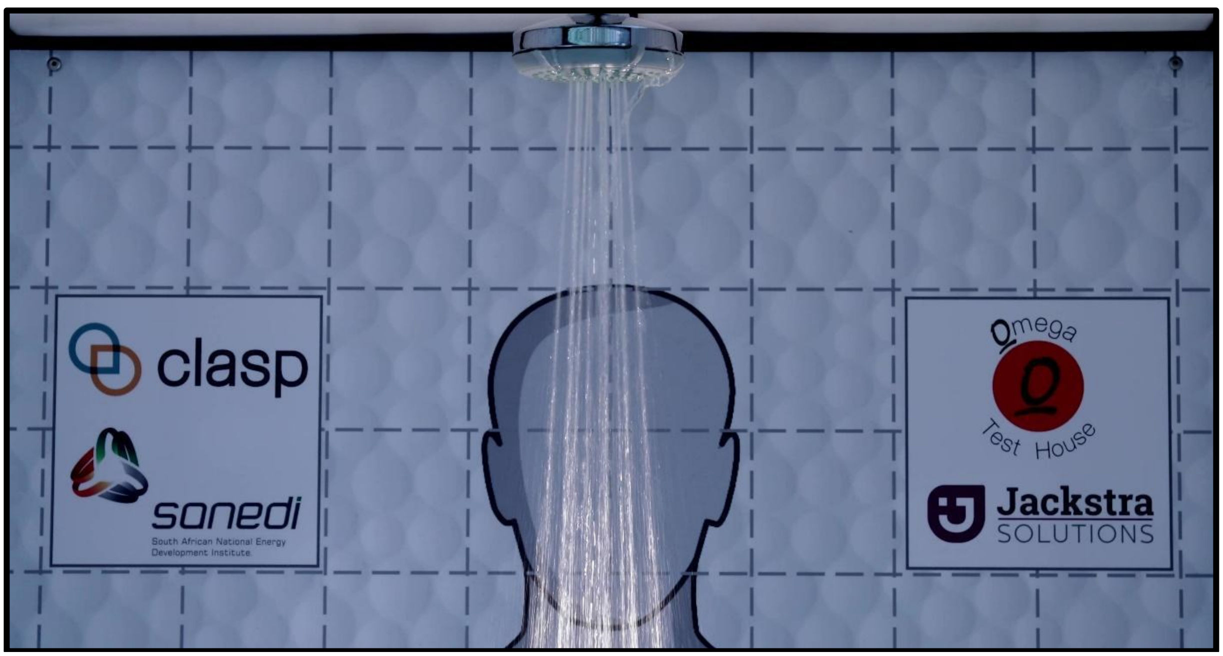


Figure 25: Spray pattern of shower head N, Setting 1

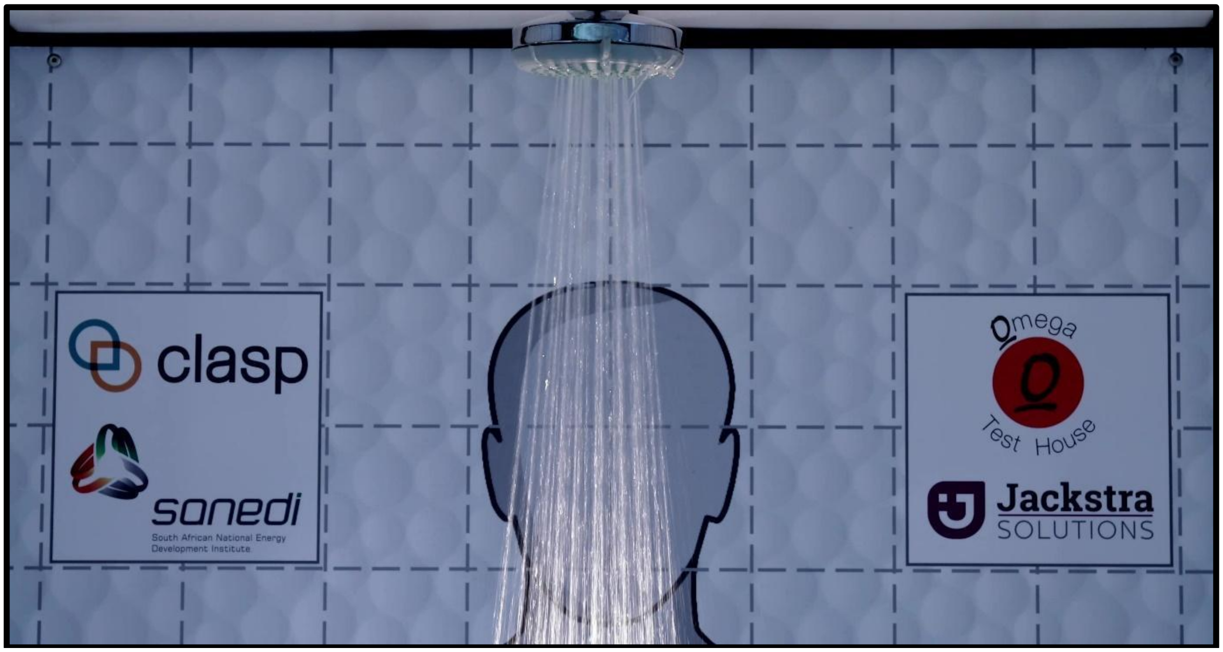


Figure 26: Spray pattern of shower head N, Setting 2

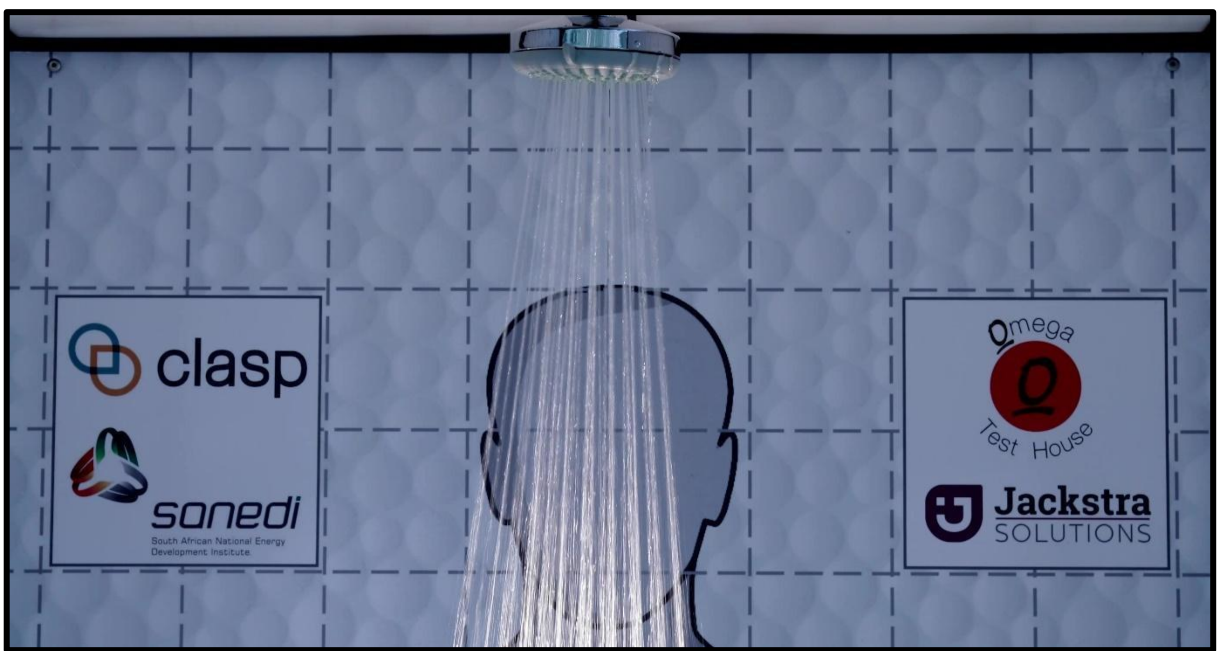


Figure 27: Spray pattern of shower head N, Setting 3

Figure 28: Spray pattern of shower head N, Setting 4

1.15 SHOWER HEAD ID "O"

SAMPLE	PRICE CATEGORY	SHAPE	NOMINAL SIZE (MM)	MARKETED AS WATER SAVING	NUMBER OF SPRAY PATTERN SETTINGS	SELECTION GROUP
O	Medium-Price	Square	200	No	1	House Brand

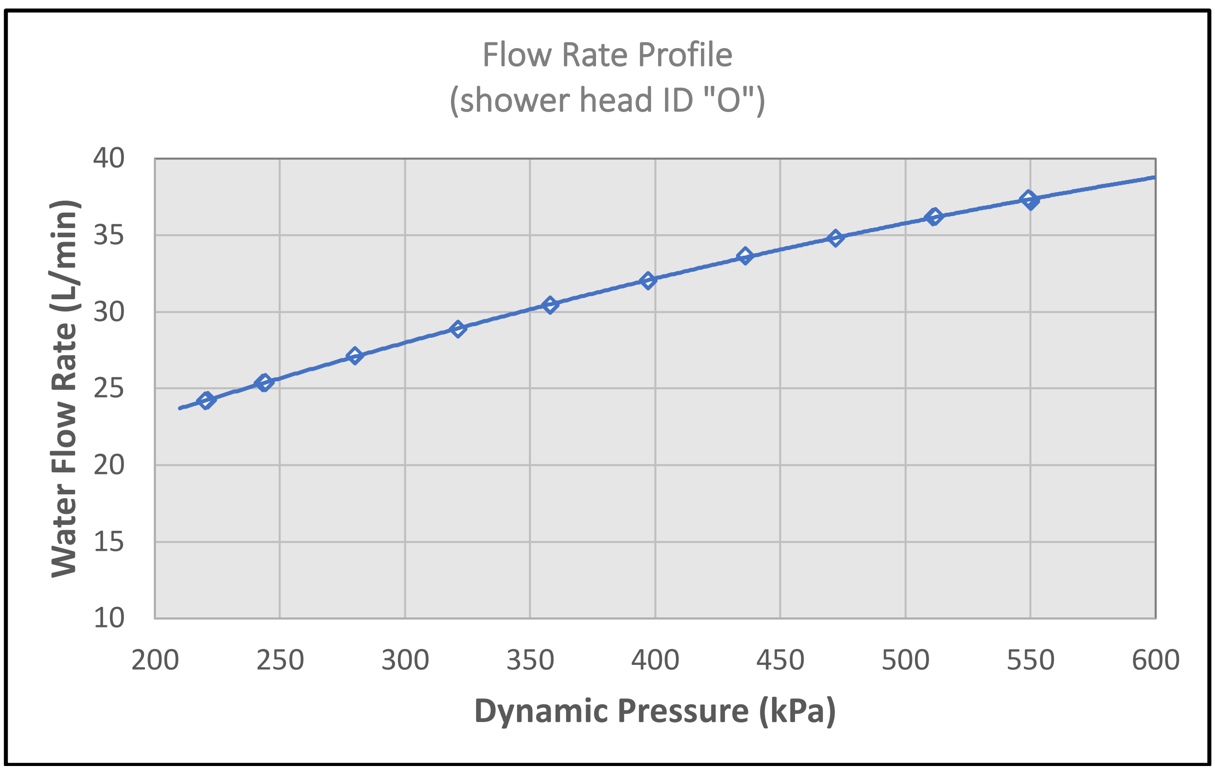


Figure 29: Spray pattern of shower head O

1.16 SHOWER HEAD ID "P"

SAMPLE	PRICE CATEGORY	SHAPE	NOMINAL SIZE (MM)	MARKETED AS WATER SAVING	NUMBER OF SPRAY PATTERN SETTINGS	SELECTION GROUP
P	Medium-Price	Round	70	Yes	2	House Brand

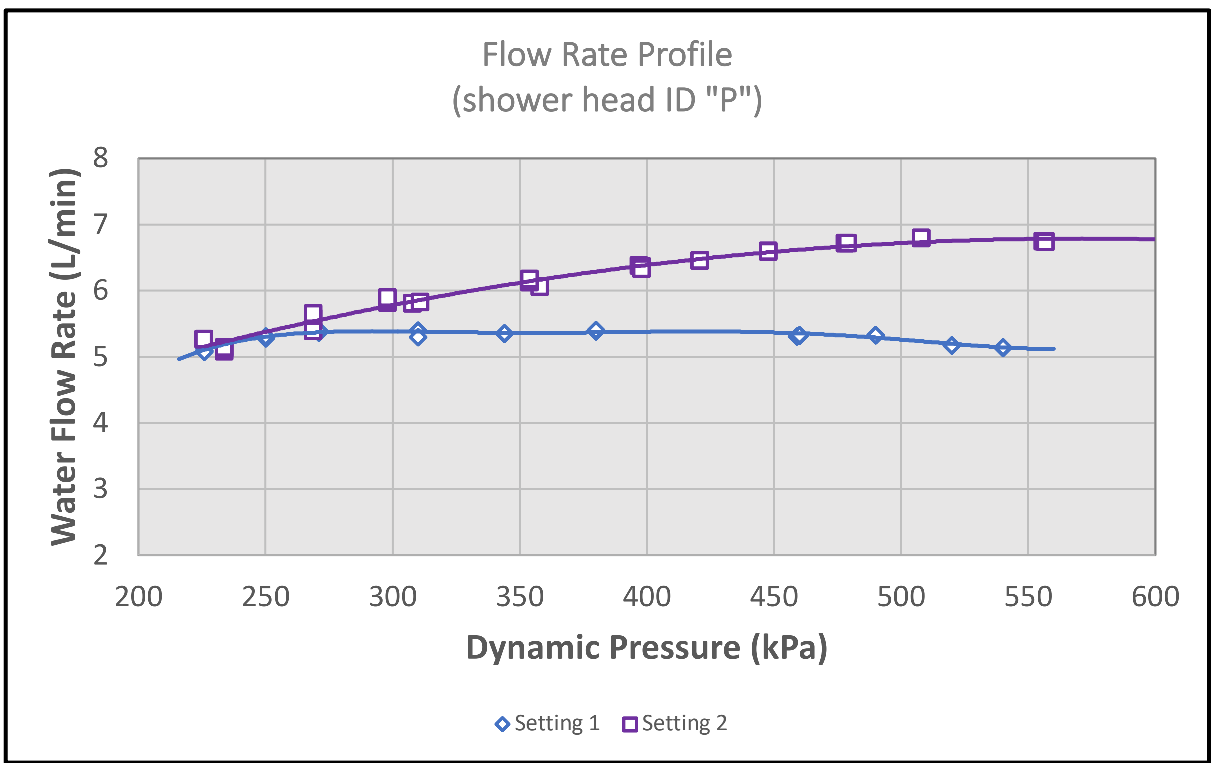


Figure 30: Spray pattern of shower head P, Setting 1

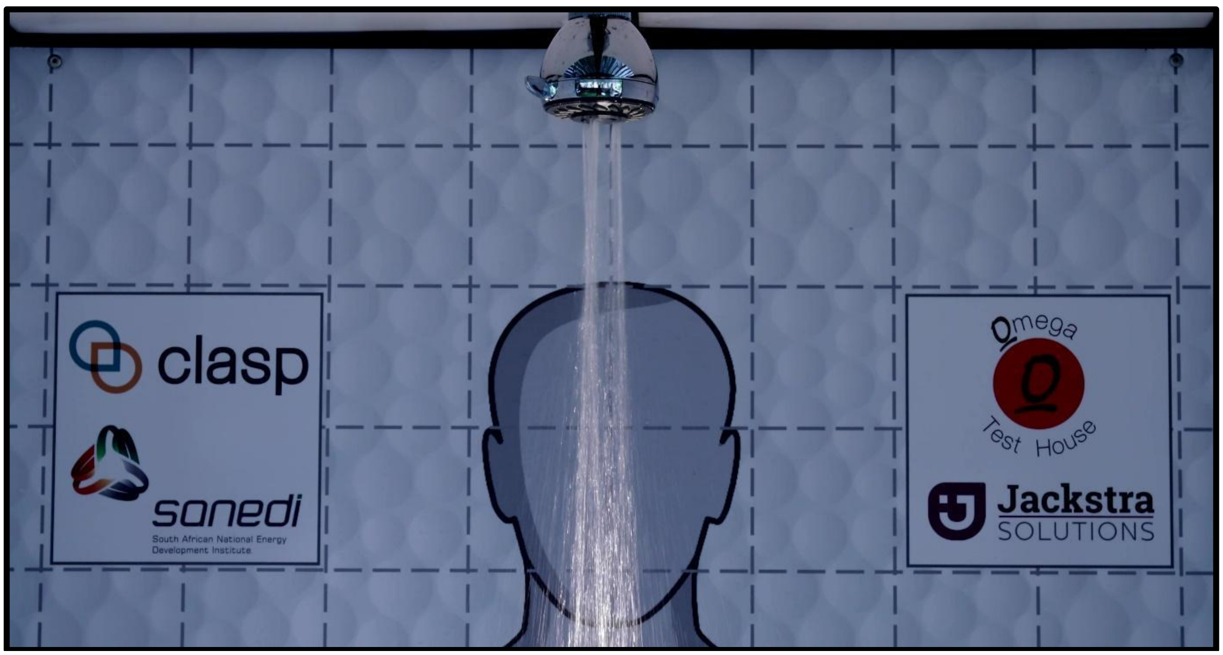


Figure 31: Spray pattern of shower head P, Setting 2

1.17 SHOWER HEAD ID "Q"

SAMPLE	PRICE CATEGORY	SHAPE	NOMINAL SIZE (MM)	MARKETED AS WATER SAVING	NUMBER OF SPRAY PATTERN SETTINGS	SELECTION GROUP
Q	Medium-Price	Square	250	No	1	Distributor

Note: The packaging included a flow regulator to be fitted separately. The shower head was tested with and without the flow regulator being fitted.

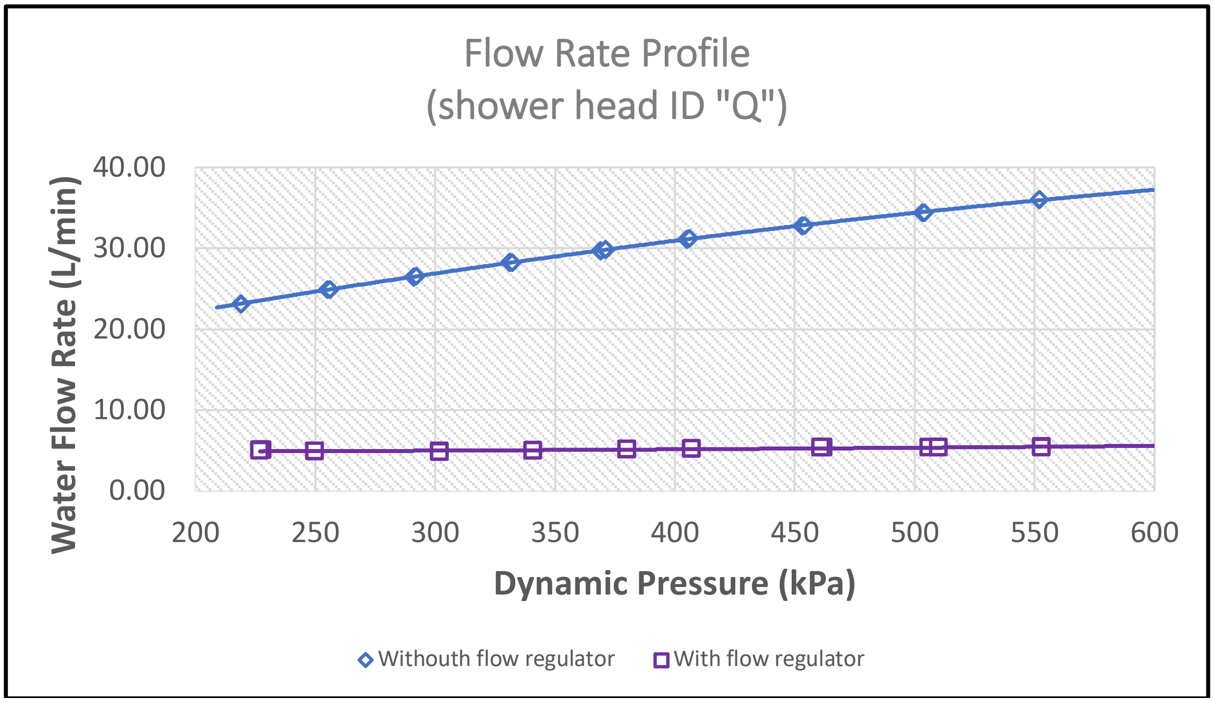


Figure 32: Spray pattern of shower head Q, with flow regulator fitted

1.18 SHOWER HEAD ID "R"

SAMPLE	PRICE CATEGORY	SHAPE	NOMINAL SIZE (MM)	MARKETED AS WATER SAVING	NUMBER OF SPRAY PATTERN SETTINGS	SELECTION GROUP
R	High	Round	30	No	1	Distributor

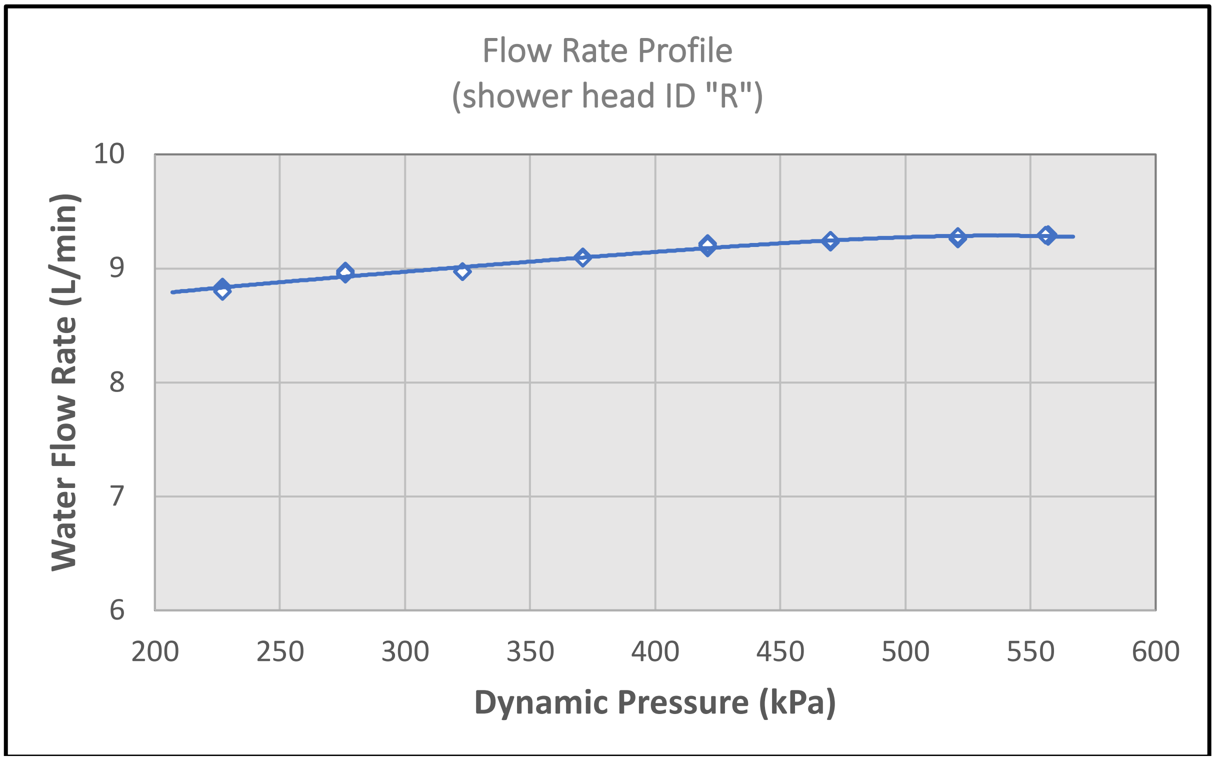
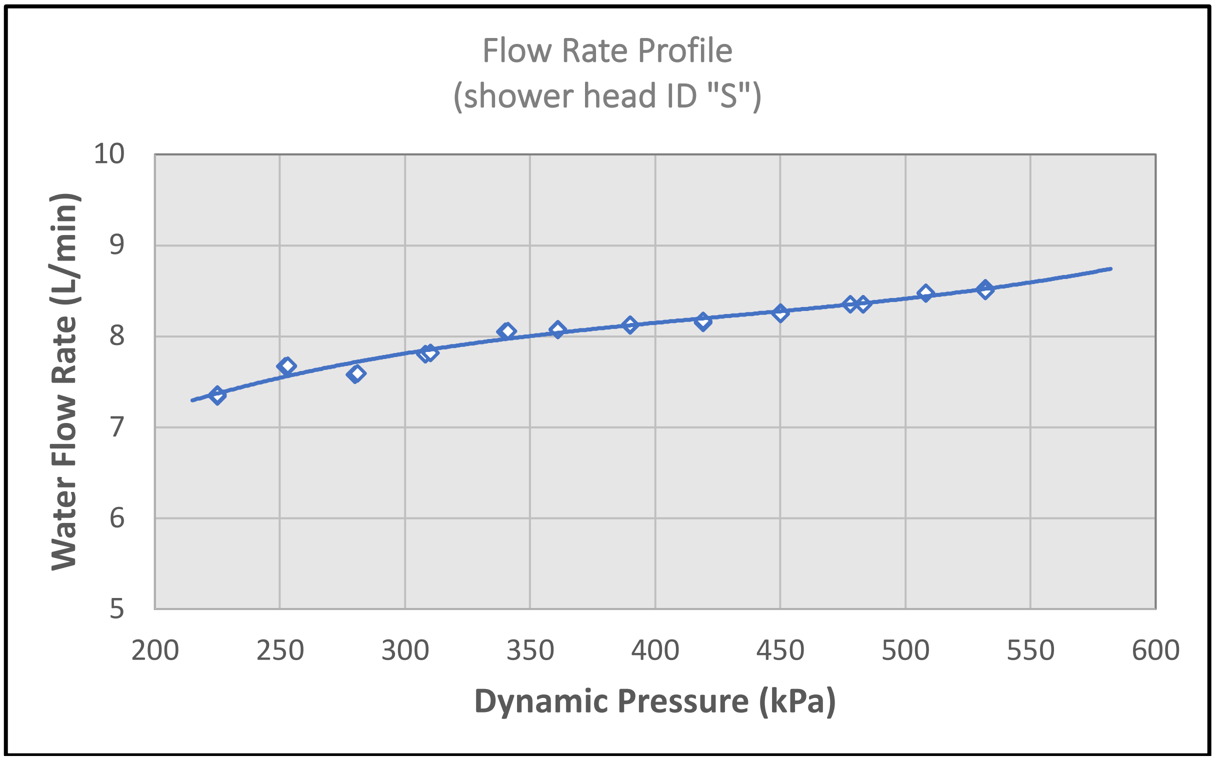


Figure 33 : Spray pattern of shower head R

1.19 SHOWER HEAD ID "S"

SAMPLE	PRICE CATEGORY	SHAPE	NOMINAL SIZE (MM)	MARKETED AS WATER SAVING	NUMBER OF SPRAY PATTERN SETTINGS	SELECTION GROUP
S	High	Round	150	Yes	1	Distributor



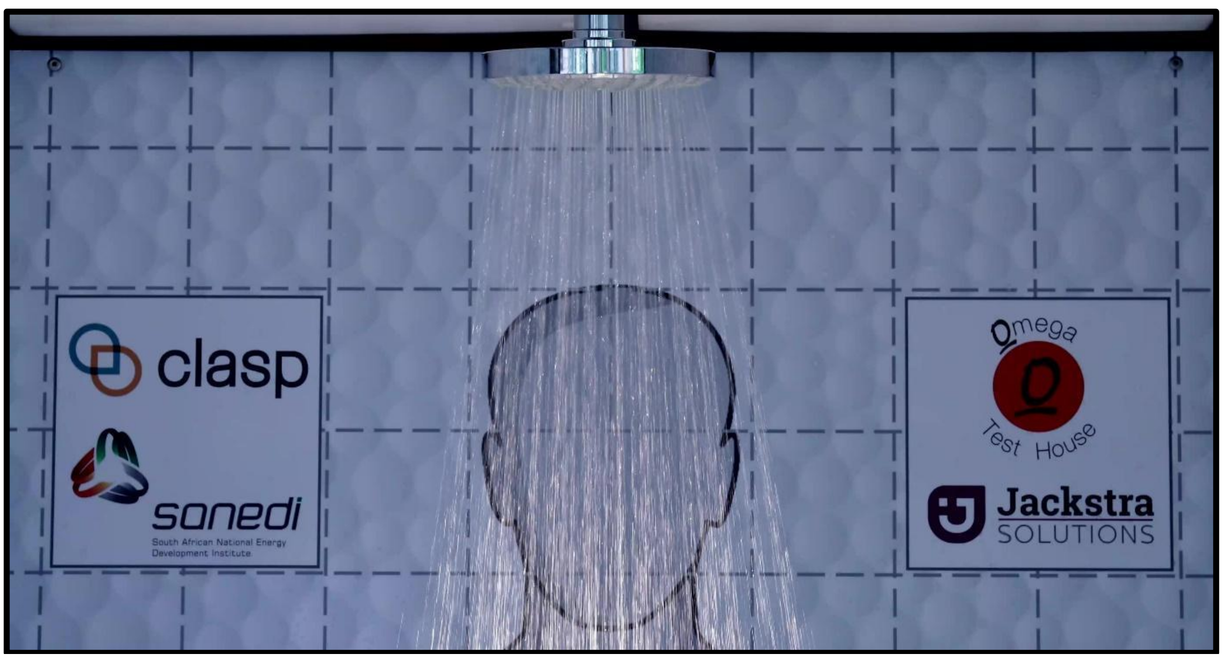


Figure 34: Spray pattern of shower head

3. Analysis

Through the various tests, two distinct flow patterns emerged. First, 42% of the patterns were aligned with the typical flow pattern of a pressure compensated flow regulator. Second, 58% of the patterns were aligned with a typical fixed orifice type flow pattern. The proportions of these patterns were:

4.1 Pressure compensating flow regulator

Pressure compensating flow regulators limit the fluctuation of flow rates with changes in water pressure. Such a device will allow the flow rate to be relatively stable over wider pressures. The range of pressures is typically aligned with the pressures a consumer is likely to use, limiting consumer dissatisfaction. The green line illustrates this factor on the graph presented in Figure 35 below.

In Figure 35, the blue line is a traditional fixed-orifice aerator that may meet a flow-rate specification at one pressure but deliver unsatisfactory flow at lower pressures while wasting water at higher pressures. The green line shows the desired performance that maintains a satisfactory flow rate across various pressures, achievable with a pressure-compensating aerator.

4.2 Fixed orifice

On shower heads with fixed orifices[2], the relationship between pressure and flow rate is based on the Bernoulli equation which is widely published[3].

A shower head with a fixed orifice type design and a large effective orifice size will deliver a very high flow rate; however, when used at a lower pressure, the flow rate will reduce, and the spray pattern is likely to change. This change can have a negative effect on the experience of the user, discouraging its use at low flow rates.

A shower head with a fixed orifice design and a small orifice size (small enough to limit the maximum water flow rate to acceptable limits) is prone to meagre flow rates and limited spray patterns when water pressures are reduced. As a result, the same shower head will be perceived to perform significantly differently in different installations, discouraging its use in favour of a shower head that more consistently delivers acceptable flow rates. This is illustrated by the blue line on the graph presented in Figure 35.

4.3 Summary of data

To compare the flow rates of all the tested shower heads, the study determined equivalent flow rates for three different pressures. The pressures were 250 kPa, 300 kPa and 500 kPa. The flow rate values were determined using interpolation, while the maximum flow rate of shower head #12 was determined using extrapolation. All flow rates were rounded to the closest 1 L/min.

The data collected is summarised in the table below. Below is a definition of each heading in the table:

- **Sample** – Indicates a reference number allocated to the shower head for identification in this report.
- **Marketed as water saving** – Where the packaging or marketing material of a shower head includes wording that suggests that the shower head could be used as a water saving device, the table reflects the word “yes”. This includes wording such as “water saving” and “low flow”.
- **Fixed orifice type** – In this column, “X” indicates that the shower head displayed a flow pattern aligned with a fixed orifice type design (as described under the “fixed orifice” heading in the “Analysis” section of this report.)
- **Pressure compensating type** – In this column, “X” indicates that the shower head displayed a flow pattern aligned with a pressure compensating type design (as described under the “Pressure compensating flow regulator” heading in the “Analysis” section of this report.)
- **Max flow rate** – Provides the water flow rate measured at the dynamic pressure corresponding to the column subheading. Where a shower head has multiple settings, the highest flow rate measures is presented in this column.

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[2] On a shower head a fixed orifice is regarded as a single or multiple openings with dimensions that remain fixed under all water pressure conditions. The flow rate is a function of this orifice size, shape and water pressure.

[3] For reference an explanation of the Bernoulli equation is provided by openstax.org at the following link: https://openstax.org/books/university-physics-volume-1/pages/14-6-bernoullis-equation

SAMPLE	MARKETED AS WATER SAVING	FIXED ORIFICE TYPE	PRESSURE COMPENSATING TYPE	MAX FLOW RATE (L/MIN)		
				250 (KPA)	300 (KPA)	500 (KPA)
A		X		32	35	49
B		X		18	20	31
C	Yes	X		17	20	24
D		X		30	32	41
E			X	9	9	9
F			X	9	9	9
G		X		13	14	18
H	Yes	X	X	16 5	17 5	21 7
I	Yes		X	5	5	78
J	Yes	X	X	5 16	5 17	821
K		X		34	37	46
L	Yes		X	5	6	6
M		X		23	25	32
N	Yes	X		15	17	21
O		X		26	28	36
P	Yes		X	6	6	7
Q		X		25	27	34
R	Yes		X	9	9	9
S	Yes		X	7	7	8

Table 3: Summary of maximum flow rates of all shower heads

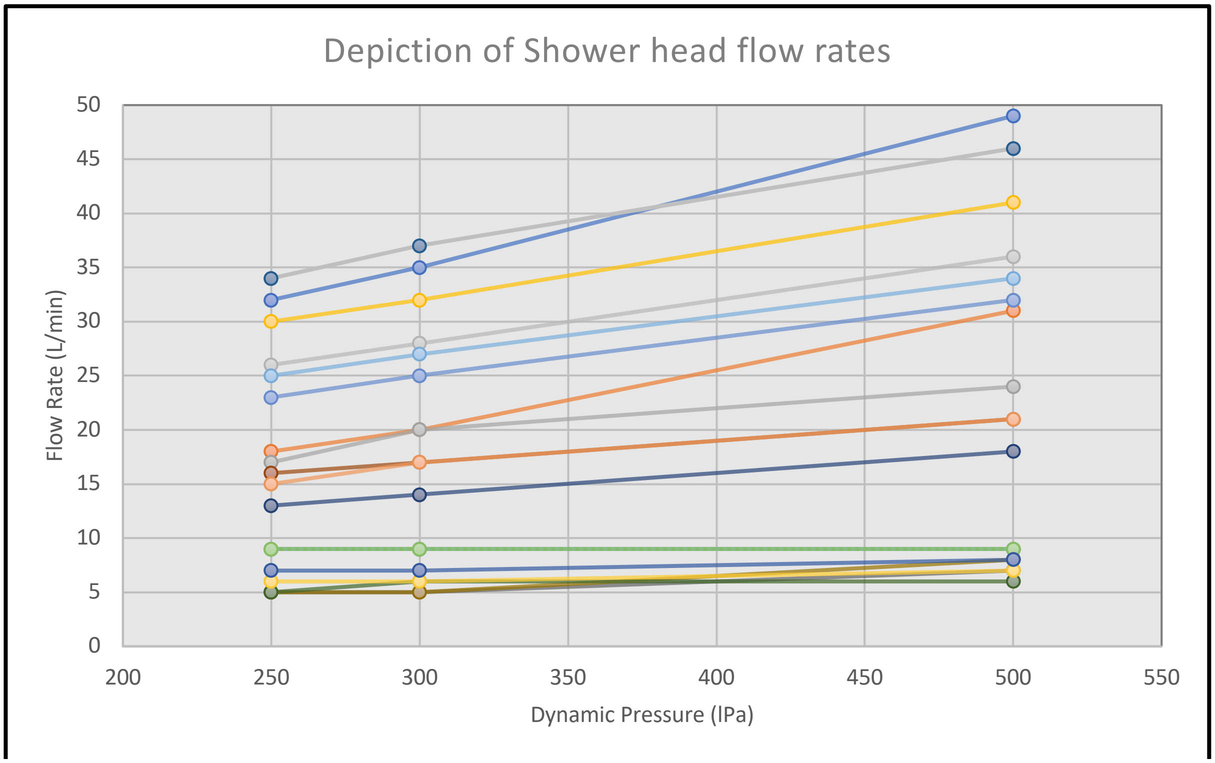

Figure 36: Graphical depiction of the summary of the maximum flow rates of all shower heads

Using a flow rate at 300 kPa as a reference, the following averages were identified:

DESCRIPTION	AVERAGE FLOW RATE
Shower heads sold at BUDGET price	26.8 l/min
Shower heads sold at LOW price	10.8 l/min
Shower heads sold at MEDIUM price	18.9 l/min
Shower heads sold at HIGH price	8.0 l/min
*Shower heads marked as water saving	10.9 l/min
Shower heads with a fixed orifice type flow profile	25 l/min
Shower heads with a pressure compensating type flow profile	7 l/min

4.3.1 Water saving shower needs

Of the 8 water saving shower heads, two (C&H) had multiple shower pattern settings allowing for multiple flow rates. The maximum flow rate allowed for these shower heads presented a flow pattern typical of a fixed orifice type flow profile. The flow rates are also significantly higher than the other four shower heads in this category. This is presented in the table below.

SAMPLE	PRICE CATEGORY	SPRAY PATTERN SETTING	FIXED ORIFICE TYPE	PRESSURE COMPENSATING TYPE	MAX FLOW RATE (L/MIN)		
					250 (KPA)	300 (KPA)	500 (KPA)
C	Budget	1	X		8	9	11
		2	X		17	20	24
		3	X		16	17	23
H	Low-Price	N/A		X	5	5	7
I	Low-Price	N/A		X	5	5	8
L	Medium-Price	N/A		X	5	6	6
N	Medium-Price	1		X	7	8	10
		2	X		12	13	17
		3	X		14	15	20
		4	X		15	17	21
P	Medium-Price	N/A		X	6	6	7
R	High	N/A		X	9	9	9
S	High	N/A		X	7	7	8

Table 4: Indicates that the shower head did not include adjustable spray patterns

4.4 Relationship between rates and price

Figure 37 provides a depiction of the various flow rates in the four price categories. According to the data, budget price shower heads flow rates were all above 30 L/min. This is more than three times the flow rate of a water saving shower head as published in SANS 10252-1:2018. However, in low and medium price categories, no correlation could be made between flow rate and price range. Shower heads with significantly high flow rates and those with flow rates below 10 litres/minute were available in both ranges.

The flow rates of the shower heads in the high-price category were all below 10 L/min. This is in line with the maximum flow rate allowed for a water saving shower head as published in SANS 10252-1:2018 Table 6.

It should be noted that the sample size of shower heads from each price category was limited. In order to determine a statistically significant trend between flow rates and price category it is recommended that tests be performed on larger sample sizes from each price category.

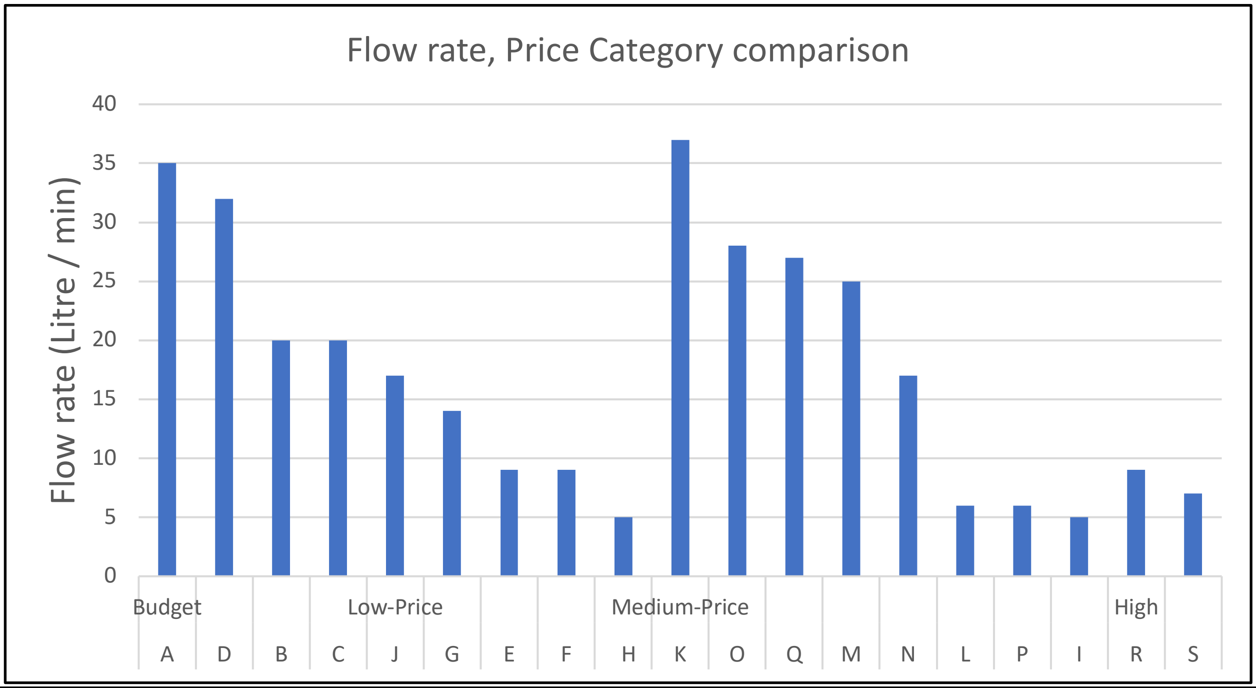

Figure 37: Flow rate, Price Category comparison

4.5 Impact of flow rate regulators

To evaluate the feasibility of utilizing pressure compensating flow rate regulators to reduce the flow rates of showers, sample ID "D" was fitted with such devices and the flow rates and spray patterns compared to the original test. This shower head was selected because of its high flow rates. The flow regulators used were commercially available at a retail price of approximately R10 each. The flow regulators are depicted below:

 Marked 10 L/min	 Marked 8 L/min	 Marked 6 L/min

The flow profiles recorded are depicted in Figure 38 below.

The results of this test suggest that a significant reduction in flow rates can potentially be achieved without significantly increasing the price of a showerhead. The images of the spray patterns indicate a similar water spray distribution pattern as was noted when no flow regulator was fitted. It suggests that a showerhead fitted with a flow regulators offers a positive user experience.

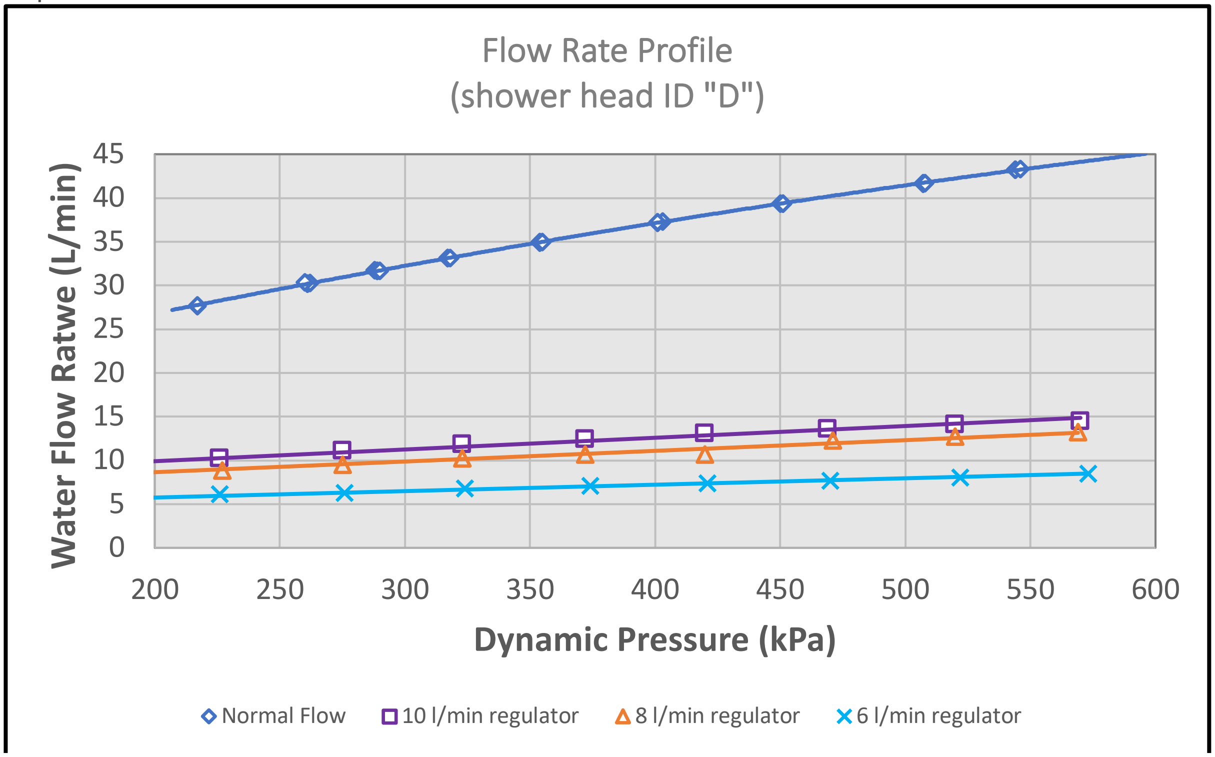

Figure 38: Graphical depiction of the flow rates of shower head D with various flow regulators fitted

Figure 39: Spray pattern at 300 kPa with no flow regulator fitted.

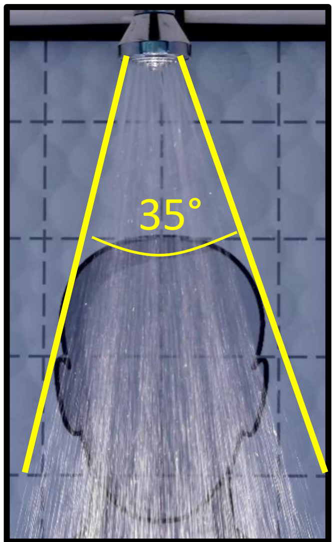	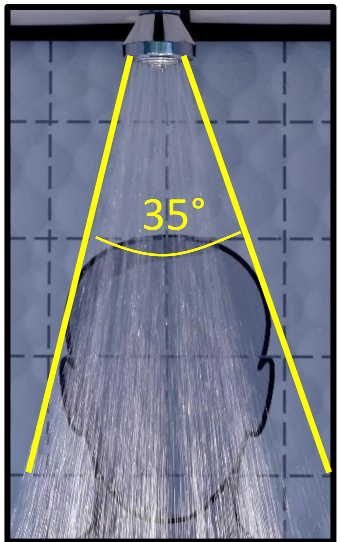	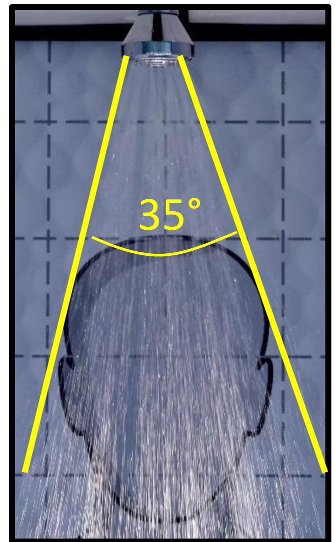
Fitted with 10 L/min flow regulator at 300 kPa	Fitted with 8 L/min flow regulator at 300 kPa	Fitted with 6 L/min flow regulator at 300 kPa

Figure 40: Spray patterns with flow regulators fitted

4. Recommendations

5.1 Publishing of a national standard for showerheads

Based on the findings of this report and reviews of existing literature, we recommended that the government of South Africa write a South African National Standard(SANS) for shower heads that is aligned with international standards. For future water efficiency programs, such a standard should include requirements for acceptable flow rates, and performance requirements. The requirements for acceptable water flow rates should address at least the following:

- The maximum allowed water flow rate.
- Recommended water saving flow rate.

Performance requirements that encourage low flow rates should aim to ensure a positive user experience so consumers don't default to purchasing higher flow rate shower heads. It is recommended that the following aspects be considered at minimum when determining the performance requirements:

- **Spray force**: The spray force requirement of ASME A112.18.1-2018 clause 5.12.3 can be evaluated to form the basis for a similar spray force test.
- **Spray coverage**: The spray coverage requirement of ASME A112.18.1-2018 clause 5.12.4 can be evaluated to form the basis for a similar spray coverage test.

5.2 Inclusion of water flow regulators

Standards should encourage the use of acceptable water flow rate regulators, thereby promoting the use of shower heads with limited deviation in water flow rates at different pressure settings. The national technical committee developing the standard should determine the requirements that would deem a flow rate regulator to be acceptable for use in the South African environments.

Flow rate performance requirements of AS 3662 should also be evaluated to form the basis for similar flow rate performance tests.

AS 3662 requires the flow rate to be measured multiple times at the pressures, 150 kPa, 250 kPa & 350 kPa. The average of all flow rate readings is used as the reference flow rate on which the water efficiency rating level is based. The standard ASNZS 6400 provided the star ratings that should be allocated to a shower head based on the flow rate test. This is depicted in Figure 40. For a South African National Standard, data led to recommendation that flow rates should be measured at least at 300 kPa, and at 150 kPa. When measured at 300 kPa, the water flow rate should not exceed 10 Litres per minute.

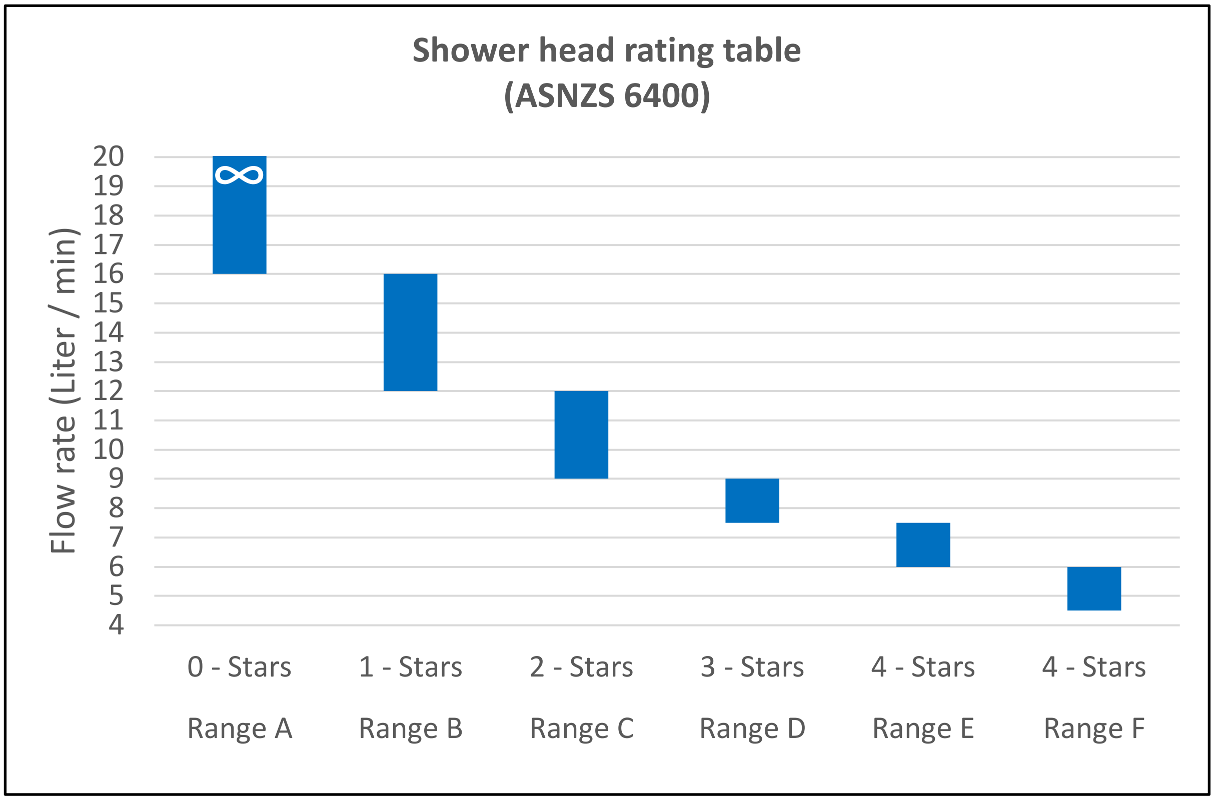

Figure 41: Australian Watermark ratings for shower heads

Water efficiency labelling schemes should rate shower heads with flow rates of between 4.5 - 6 litres per minute as the highest preferential rating, provided that it complies with the performance requirements referred to in these recommendations. It is further recommended that the star rating allocations provided in ASNZS 6400 be considered for adoption in the South African National Standard.

References

All referred standards

CLASP: In-depth Assessment of Water Efficiency Opportunities in South Africa

CLASP South African Tap and Flow Rate Gap Analysis March 2022

EN 200:2008 “Sanitary tapware — Single taps and combination taps for water supply systems of type 1 and type 2 — General technical specification”

AS 3662:2003 – “Performance of showers for bathing” as published by Standards Australia.

ASNZS 6400:2005 – “Water efficient products—Rating and labelling” as published by Standards Australia

ASME A112.18.1-2018 – “Plumbing supply fittings” as published by the American Society of Mechanical Engineers

SANS 198:2012 “Functional-control valves and safety valves for domestic hot and cold water supply systems”

SANS 10252-1:2018 “ Water supply and drainage for buildings Part 1: Water supply installations for Buildings” as published by the South African Bureau of Standards

Bernoulli equation: Openstax https://openstax.org/books/university-physics-volume-1/pages/14-6-bernoullis-equation

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