THE STATE OF PLUMBING IN SOUTH AFRICA

Report to the
Water Research Commission

by

JE van Zyl*
KP Lobanga*
Faustin MT Lugoma*
AA Ilemobade**

***Department of Civil Engineering Science**
University of Johannesburg

****School of Civil & Environmental Engineering**
University of the Witwatersrand

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EXECUTIVE SUMMARY

BACKGROUND

Household plumbing products, materials and practices play an important part in the effective and efficient delivery of water and sanitation services. Good products and materials can ensure efficient use of water at domestic level, thereby reducing wastage of treated water and a scarce resource.

Significant changes over the years in the water services sector and the water supply industry has seen a plethora of imported and at times pirated products being introduced onto the market. Linked to this are indications of poor quality of workmanship. These developments impact on the supply as well as resource side of water and cost the sector billions of Rand.

Added to this are the capacity problems associated with regulating this sector, which are currently considered inadequate. It was therefore imperative to identify the scale of the problems such that actions can be taken to prevent it from spiralling out of control, thus jeopardizing the National Water Resources Strategy and water demand management objectives.

This study investigated the state of plumbing used in South Africa in order to estimate the extent of the problems of non-compliant plumbing fittings, practice and on-site leakage. The study aimed at identifying a number of problem areas and makes recommendations towards improving the situation.

OBJECTIVES

The main goals of this project was to investigate the level of compliance of plumbing fittings installed in South Africa, as well as the extent of leakage from plumbing fittings (on-site leakage).

The study focussed on drinking water plumbing components since these components are subjected to high pressures and thus the most likely to cause problems when failing.

PLUMBING SYSTEMS

Water from the municipal distribution and plumbing systems are used for drinking, cooking and washing and it is critical that these systems be designed, installed and maintained to ensure that water is supplied effectively and safely. The World Health Organization (WHO, 2006), the World Plumbing Council and others (Frankel, 2004) have defined a number of goals for water supply and plumbing systems. The main requirements are summarised below:

- Drinking water at the consumer's tap should be available reliably and in adequate quantities. The water should be safe at all times.
- The supply plumbing system should not be able to degrade the quality of drinking water. Plumbing materials should not contain harmful substances that could leach into the water creating health hazards.
- Each building should have an internal drinking-water piped system, supplying drinking water from a suitable number of accessible plumbing fixtures. Houses should have at least one toilet, one washbasin, one kitchen sink, one bathtub or shower, and provision for laundry facilities. For other buildings, the number and type of plumbing fixtures should be provided based on respective needs. Provisions should also be made for people with disabilities.
- Plumbing systems should be durable, resistant to internal and external pressures and environmental factors.
- Plumbing components and workmanship should match up with the requirements of standards.
- All new plumbing installations should be tested and disinfected.
- Water leakage and wastage should be minimized. Plumbing components should be designed, maintained, used and installed with the objective to minimise leakage and wastage.
- Hot water systems should be designed and installed in a way to avoid health hazards such as explosion and overheating.
- Building contents should be protected from adverse effects caused by a malfunction of the plumbing system.
- Plumbers should have adequate training and the public should be made aware of the dangers of poor plumbing components and work.

The consequences of inadequate plumbing systems can be severe. Below are some of the consequences that may result from inadequate plumbing systems:

- Pipes or components may leak or burst, resulting in financial losses to the building owner and/or water supply authority due to water losses, damage to property, temporary loss of use of a property, and possible replacement of the plumbing system.
- A leak or burst on a hot water pipe may also result in serious injury due to scalding. Cases of death have been reported.
- Under certain conditions, inadequate plumbing systems can cause explosion of high pressure geysers, with potential injury to people and damage to property.
- Various substances, such as lead, copper, cyanide, arsenic, iron, manganese, zinc, biological and organic matter may enter the water through leaching from plumbing materials or through interactions between the plumbing material and water. In serious cases, for instance when sub-standard materials are used, this may cause colour, taste and odour problems in the water, and have negative health impacts, including gastrointestinal discomfort and nausea, brain damage and cancer (EPA, 2007; Thompson et al., 2007).
- Under certain conditions, potentially contaminated return flow from geysers or fixtures may enter the

plumbing system and create a health risk.

- Insufficient cleaning and disinfection of the plumbing system after installation or maintenance may cause contaminated water to be supplied.

Unfortunately it is not easy to monitor the negative health effects caused by bad quality plumbing materials due to the fact that the metal occurrence varies from one building to another, and in the same building the concentration of a particular metal varies at different times of a day (Thompson at al., 2007). In addition, side effects generally appear after many years of exposure and vary from one person to the next.

THE PLUMBING INDUSTRY IN SOUTH AFRICA

There are a multitude of institutions that play a role in the South African plumbing industry, the main ones being the Department of Water Affairs and Forestry (DWAF), the South African Bureau of Standards (SABS), Water Services Authorities (WSAs), Joint Acceptance Scheme for Water Services Installation Components (JASWIC), the Institute of Plumbing of South Africa (IOPSA), Educational Bodies and the Insurance Industry.

The Minister of Water Affairs and Forestry prescribed compulsory national standards for the plumbing industry under Government notice No R. 509 of 8 June 2001, entitled Regulations Relating to Compulsory National Standards and Measures to Conserve Water (DWAF, 2001). Article 14 of this document requires that: “Every consumer installation must comply with SABS 0252: Water Supply and Drainage for Buildings and SABS 0254: The Installation of Fixed Electric Storage Water Heating Systems, or any similar substitution re-enactment or amendment thereof if the consumer installation is of a type regulated by either standard.” These two SABS standards prescribe the specifications that different types of plumbing components must comply to.

The Water Services Act also gives the power and responsibility to Water Services Authorities (WSAs) to make and enforce water bylaws, and provides for the Minister of Water Affairs and Forestry to propose model bylaws as a guide for Water Services Authorities. The Model Water Services Bylaws was published by the Minister of Water Affairs and Forestry in August 2000 (DWAF, 2000).

The Model Water Services Bylaws recommend that each WSA should maintain a Schedule of Approved Pipes and Fittings. However, it seems that few, if any, WSAs maintain their own schedules, and many rather subscribe to the JASWIC Acceptance Schedule to fulfil that function of their own bylaws. In this study, a plumbing component was taken to be compliant if it bore the SABS mark, or was included in the JASWIC list of approved products.

An important point is that the law does not prohibit the import and sale of non-compliant products, but only the installation thereof. The responsibility for enforcing the law is thus placed solely on the shoulders of

local authorities, who should ensure compliance through measures such as maintaining a schedule of approved products, site visits, building inspections and registration of plumbers. However, it became clear throughout this project that very few municipalities actually enforce the laws on plumbing components, and that many non-compliant plumbing components are being installed in buildings. Only one local authority, that of Cape Town, was found to have a system of water inspectors whose task it is to ensure compliance to their water bylaws.

In our opinion, the main reasons for this lack of enforcement are inadequate understanding of the need for maintaining high technical standards, lack of commitment to this aim, and as a result, a severe shortage of technical staff at local government level. Unless this situation improves dramatically, there is little hope that the situation regarding compliance will improve substantially in future.

LEVEL OF COMPLIANCE

A number of different methods were employed to investigate the level of compliance of plumbing components in South Africa:

- Information on plumbing components available on the market was gathered and analysed. Of the 2 626 plumbing products identified, 1 512 or 58% were found to be non-compliant. In addition, six companies, supplying 10% of the products identified, claimed to be SABS-mark holders while they were not included in the SABS list of mark holders.
- A questionnaire-based survey was conducted on plumbers. Most of the questionnaires were completed by plumbers active in IOPSA, and thus the results may be biased towards more responsible plumbers, and thus be conservative. From the survey, it is estimated that 43% of products used in South Africa are non-compliant, and that 52% of plumbers install non-compliant products.
- Representatives of a number of local plumbing manufacturers were interviewed. The local manufacturers agreed that around 50% of plumbing products used in South Africa are non-compliant. They complained that legislation is not being sufficiently enforced, and that it is impossible for them to compete on price with non-compliant products. As a result, South African companies lose market share and job losses occur.
- A limited investigation was done to approximate the availability and price of non-compliant plumbing components at different retailers. It was found that hardware stores sold the most non-compliant products, followed by building suppliers and then specialist plumbing suppliers. On average, SABS compliant products were 43% more expensive than non-SABS compliant products.
- A limited investigation was conducted to approximate the level of compliance in ten different RDP housing developments. It was found that less than more than 90% of the products installed were non-compliant, and that these components failed and leaked at an early age. While the average house visited was only 1.5 years old, 50% of the toilets were already leaking.
- An analysis of the level of compliance was done for a rural water supply project in Venda, supplied by

standpipes. Of the 108 standpipes supplying the area, 45% had compliant taps, 41% non-compliant taps and 13% no taps at all. A disturbing finding was that the taps were supplied by the local WSA, and thus very authority that is tasked with enforcing legislation on plumbing components was found to supply non-compliant components.

ON-SITE LEAKAGE

A field investigation to determine the extent of on-site leakage in a number of suburbs in Johannesburg was done through physical inspection of 182 randomly selected properties. Leakage rates were measured with the municipal water meters used to measure normal water consumption. To ensure that the meters used were as accurate as possible, only meters not older than five years were used. A procedure was developed to ensure that accurate leakage readings were taken, and that these readings did not include any legitimate demands. Leakage was found to often fall in the lower accuracy range of flow meters, and corrections were made to the readings to account for this.

A study of 182 randomly selected properties in Johannesburg showed that 59% of the properties had on-site leaks present. The average leakage rate of leaking properties was found to be 40.7 l/h, or 30 kl/month. The average leakage rate for all properties was 24.2 l/h, or 17 kl/month.

On-site leakage rates were found to follow an exponential frequency distribution with most leaks being small, meaning that the leakage rate will frequently be lower than the starting flow of a municipal water meter (and will thus not be measured), or in the range of least accuracy of the meter (and thus be under-registered). A rough estimate based on the survey conducted showed that the apparent losses for a municipality due to on-site leakage is 3.9 l/h (2.8 kl/month) per Residential (houses on single stands in suburbs) property, and 12.4 l/h (8.9 kl/month) per Other (non-domestic and large domestic) property.

DISCUSSION AND CONCLUSIONS

High quality plumbing systems are essential to ensure that water supplied is used effectively, and leakage is minimised. South African law is clear that only plumbing components that comply with SANS 10252 and 10254 are allowed to be installed in South Africa. However, a number of worrying trends were found in this study that do not support the provision of high quality plumbing systems, and may have severe implications for future water demands and leakage in South Africa.

The main aim of this study was to quantify the extent of non-compliant plumbing components installed in South Africa. It was found that a substantial fraction, approximately 50%, of plumbing components installed do not comply with the legal requirements.

The main reasons for the high level of non-compliance are the lack of enforcement of the legislation at local government level, and the fact that there is no prohibition on the import and sale of non-compliant products. In some instances where national and local government play leading roles in service provision to the poor (in particular RDP housing and a rural water supply), the problem of non-compliance was found to be particularly bad and even caused by government purchasing non-compliant products.

The consequences of such a high fraction of non-compliant plumbing products are dire and include:

- Undermining authority of government and the law if government does not comply with its own rules.
- Potential negative health impacts by contamination of the drinking water through failed components or leaching of chemicals such as lead, iron, arsenic, copper from plumbing components made from sub-standard materials.
- Higher fail frequencies and shorter life-spans of plumbing components, resulting in greater future damage to property and higher water losses. This was evident in the investigation of RDP houses, where the majority of non-compliant products failed in a very short period of time (less than 1.5 years) and 50% toilets were found to be already leaking.
- Undermining of local plumbing manufacturing industry, resulting in closure of manufacturers and job losses, since they are not able to compete in a fair manner with imported poor quality and non-compliant products.

A study of 182 randomly selected properties in Johannesburg showed that at least 59% of the properties had on-site leaks present. The average leakage rate on properties where leaks could be measured was found to be 40.7 l/h, or 30 kl/month. The average leakage rate for all properties (those where leaks could be measured and those where there were no leaks or had leaks that were too small to be measured) was 24.2 l/h, or 17 kl/month. The implication is that almost a third of municipal water consumption is made up of on-site leakage. Blocks of flats were found to particularly problematic with both a large frequency of leakage and large leakage rates.

On-site leakage rates were found to follow an exponential frequency distribution with the smallest leaks having the highest rate of occurrence. This indicates that on-site leakage rates will frequently be lower than the starting flows of municipal water meters (and will thus not be measured), or in the range of least accuracy of the meter (and thus be under-registered). An estimate based on the survey conducted showed that the apparent losses for a municipality due to on-site leakage is 3.9 l/h (2.8 kl/month) on residential (houses on single stands in suburbs) properties, and 12.4 l/h (8.9 kl/month) on other (non-domestic and large domestic) properties.

The following actions are recommended to improve the situation:

- The import and sale of non-compliant products should be restricted.
- Plumbing legislation should be enforced at local government level through a system of trained water inspectors.
- National, Provincial and Local Government structures should lead by example through complying with legislation regarding plumbing components.
- A national workshop involving Government at all levels, the plumbing industry and related organisations should be held to discuss the way forward to manage this problem.
- A plumbing compliance certificate should be required when transfer of ownership of properties occur.
- Better control of plumbers, such as a national register of qualified plumbers, should be enforced.
- Better training of plumbers should be implemented, and the training process should be streamlined to increase the numbers and quality of new plumbers entering the trade.
- A media campaign should be launched to inform people of the importance and requirements of plumbing components, and the prevalence and risks of on-site leakage.
- The SABS should make information on compliance of specific plumbing components available to the public.
- Insurance companies have to require compliance when insuring properties, and ensure compliance when honouring claims.
- Serious consideration should be given to national legislation to encourage the use of ‘leak free’ toilet systems and external cistern overflows.

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Mr JN Bhagwan	Water Research Commission (Chairman)
Mr C Cain	DWAF – Water Use Efficiency Directorate
Mr G Constandinides	Water Supply Strategies
Mr B de Swardt	IUI
Mr K Deist	SABS
Ms S Erskine	Partners in Development cc
Mr G Price	WRP (Pty) Ltd
Mr H Sussens	DWAF
Mr C Tsatsi	DWAF – Water Use Efficiency Directorate
Mr M van Dijk	University of Pretoria
Mr T Westman	Tshwane Metropolitan Municipality

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LIST OF ACRONYMS AND ABBREVIATIONS

CETA	The Construction Education and Training Authority
cPVC	Chlorinated polyvinylchloride
DoE	Department of Education
DoL	Department of Labour
DPW	Department of Public Works
DTI	Department of Trade and Industry
DWAF	Department of Water Affairs and Forestry
EBSMIA	European Brassware Sanitary ware Manufacturers and Importers Association
EPA	Environmental Protection Agency
FET	Further Education and Training Colleges
FET Act	Further Education and Training Act
IBCDSA	Institute of Building and Drainage Control SA
IOPSA	Institute of Plumbing South Africa
JASWIC	Joint Acceptance Scheme for Water Services Installation Components
MWSB	Model Water Services Bylaws
NHBRC	National Home Builder's Registration Council
NWA	The National Water Act (Act No. 36 of 1998)
PE	Polyethylene
PHACT	Polymer Hot & Cold Technology Group
PLASMA	Plumbing and Sanitary ware Manufacturers Association
PP	Polypropylene
q	starting flow rate
q_{min}	minimum flow rate
q_p	permanent flow rate
q_s	overload flow rate / maximum flow rate
q_t	transitional flow rate
SABS	The South African Bureau of Standards
SAC	Standards Approval Committee
SAIA	South African Insurance Association
SANS	South African National Standards
SAPPMA	Southern African Plastic Pipe Manufacturing Association
SAQA	South African Qualification Authority
uPVC	Unplasticised polyvinylchloride
WHO	World Health Organisation
WSA	Water Services Authority

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CHAPTER 1: INTRODUCTION

1.1 Background

Household plumbing products, materials and practices play an important part in the effective and efficient delivery of water and sanitation services. Good products and materials can ensure efficient use of water at a domestic level, thereby reducing wastage of treated water and a scarce resource.

Significant changes over the years in the water services sector and the water supply industry has seen a plethora of imported and at times pirated products being introduced onto the market. Linked to this are indications of poor quality of workmanship. These developments impact on the supply as well as resource side of water and cost the sector billions of Rand.

Added to this are the capacity problems associated with regulating this sector, which are currently considered inadequate. It was therefore imperative to identify the scale of the problems such that actions can be taken to prevent it from spiralling out of control, thus jeopardizing the National Water Resources Strategy and water demand management objectives.

This study investigated the state of plumbing used in South Africa in order to estimate the extent of the problems of non-compliant plumbing fittings, practice and on-site leakage. The study aimed at identifying a number of problem areas and makes recommendations towards improving the situation.

1.2 Objectives

The main goals of this project was to investigate the level of compliance of plumbing fittings installed in South Africa, as well as the extent of leakage from plumbing fittings (on-site leakage).

The objectives of the study were:

1) To determine the extent of compliance to legal requirements for plumbing components in South Africa.
2) To determine the condition and extent of leakage from plumbing components.
3) To estimate the potential effect of non-compliance to SABS plumbing codes on water demand projections.
4) To provide a summary of current plumbing codes and identify needs for new codes or guidelines.

The study focussed on drinking water plumbing components since these components are subjected to high pressures and thus the most likely to cause problems when failing.

The term ‘compliant’ is used throughout the report to refer to a fitting that complies with the legal requirements for plumbing fittings in South Africa. In practice this means that the fitting holds the SABS mark, or is listed as an approved fitting on the JASWIC list of approved fittings.

1.3 Methodology

The study was conducted using a number of different methods, including literature surveys, questionnaires, interviews and meetings with role-players, analysing commercially available plumbing fittings, site investigations and linking to other projects where on-site leakage was addressed. The details and research methods used are discussed in detail in the relevant sections of the report.

1.4 Structure of this report

Chapter 1 gives an introduction to the problems addressed in this report, and sets specific goals and objectives for the project.

Chapter 2 provides an overview of literature related to plumbing fittings and on-site leakage.

Chapter 3 describes the plumbing industry in South Africa, including the main role-players, legislation, standards and guidelines and the implementation of these.

Chapter 4 addresses the level of compliance to plumbing fittings in South Africa through a number of investigations.

Chapter 5 addresses the problem of on-site leakage through an on-site investigation in the Johannesburg area.

Chapter 6 describes a number of cases studies that highlight specific problems with plumbing fittings and on-site leakage.

Chapter 7 summarises the conclusions of the study and makes recommendations for steps to address the problems identified, and for future research.

CHAPTER 2: PLUMBING SYSTEMS

2.1 Introduction

Water plumbing components are used to give people access to drinking water in their businesses and homes. A plumbing fixture is a water using appliance in a home or business. A plumbing fitting or component is a component used to connect a plumbing fixture with the municipal water supply system. Table 2.1 shows common plumbing fixtures with their associated fittings or components. In order to preserve good health, safety and well-being of the people using the water and to avoid its wastage, there are some requirements not only for the material to use for each plumbing component but also, for the design and the installation of plumbing systems. Some plumbing fixtures and components are shown in Figure 2.1.

Table 2.1 Common water plumbing fixtures and fittings

Common fixtures	Common fittings
Flush toilets	Shut-off valve and flush mechanism
Urinals	Shut-off valve and flush mechanism
Lavatories (Bathroom sinks)	Taps (hot and cold water)
Kitchen sinks	Taps (hot and cold water)
Utility sinks	Taps (hot and cold water)
Bathtubs	Taps (hot and cold water)
Showers	Taps (hot and cold water) and shower rose
Bidets	Taps (hot and cold water)
Drinking fountains	Automatic shut-off valve
Stand pipe	Tap
Dishwasher, washing machine etc.	Filling mechanism and shut-off valve
Garden taps	Tap
Geyser	Valve
All fixtures	Pipe, cross, tee, elbow, coupling, plug, cap, union, nipple, cleanout, wye, hosebibb, valve

Water tap [a]

Bathtub [a]

Bidet [a]

Geyser [a]

Urinal [a]

Toilet [b]

Hand washer [b]

Sink [b]

Fountain [b]

Elbow [b]

Tee [b]

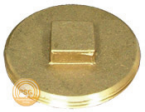
Cross [b]

Plug [b]

Coupling [b]

Caps [b]

Union [b]



Cleanout [b]

Nipple [b]

Wye [b]

Hosebibb [b]

Closet flange [b]

Trap [b]

Gate valve [b]

a: (Cobra Watertech, 2008)

b: (Famous Plumbingsupply, 2008)

Figure 2.1 Some plumbing fixtures and components

2.2 Plumbing systems

The World Health Organisation (WHO) defines a water plumbing system as *"the drinking-water supply that serves a building and the system for liquid waste removal that connects the building to the sewer main"* (WHO, 2006). Only drinking water plumbing systems were included in this study.

2.3 Water supply goals

The following goals are defined for water supply systems by the World Health Organisation (WHO, 2006):

- Drinking water should be safe, available, reliable and in adequate quantity. Not only should the water meet national standards at consumer's tap, but there should be minimal leakage in the distribution system which should be constructed of suitable materials.
- Drinking water should be safe at all times. The supply plumbing system should not be able to degrade the quality of drinking water.
- Each building should have an internal drinking-water piped system.
- Water leakage and wastage should be minimized. Plumbing components should be designed, maintained, used and installed with the objective to minimise leakage and wastage.
- Drinking water should be supplied from a suitable number of accessible plumbing fixtures. Each house should have at least one toilet, one washbasin, one kitchen sink, one bathtub or shower, and provision for laundry facilities. For other buildings, the number and type of plumbing fixtures should be provided based on respective needs. Provisions for people with disabilities should also be made, mandating the number and layout of and barrier-free access to those fixtures (Frankel, 2004).
- Building contents should be protected from adverse effects caused by a malfunction of the plumbing system.
- Toilet and washing fixtures should be properly ventilated and lighted. Plumbing fixtures like flush toilets, urinals or similar fixtures should not be allowed in a room used for living, working, food preparation or other such purposes.
- Hot water systems should be designed and installed in a way to avoid health hazards such as explosion and overheating.

The World Health Organisation defines the following goals for plumbing systems:

- Plumbing components and workmanship should match up with the requirements of standards.
- All new plumbing installations should be tested and disinfected.
- Plumbers should have adequate training and the public should be made aware of the dangers of poor plumbing components and work.
- Plumbing systems should be adequately maintained in order to avoid or minimise risks.

No plumbing components used for the supply of drinking water or the removal of wastewater must contain

hazardous substances above the specified amount that could leach into the water. They should be able to transport water at a nominal pressure within a prescribed environment, and should be sufficiently strong to contain internal pressures. They should also be resistant to external pressures if they are to be buried. Their resistance to the environmental factors such as heat, cold, expansion, contraction, corrosion, pH and bacterial levels should also be considered.

The standards developed for materials in contact with potable water are normally minimum requirements and are based on a specific use; for example, an appropriate material for cold water system will, in most cases, not be suitable to use for hot water system.

2.4 General Requirements for Plumbing Components

All plumbing components have to meet quality and performance specifications determined by the authorities, or an acceptable certification organization (WHO, 2006).

The materials of plumbing fixtures should be smooth, non-absorbent, non-porous and corrosion-resistant. Both internal and external surfaces of plumbing fixtures should be easily cleaned and free from hidden surfaces that could become fouled. Plumbing fixtures should be sufficiently durable to give satisfactory service over a long period (Jordan, 2004; Frankel, 2004 & WHO, 2006). They should be user friendly and hygienic and, their surface should be free of sharp surfaces that may cause injury (Jordan, 2004). Potable water discharged from plumbing fixtures should be limited to a maximum flow rate depending on the requirements for water conservation (Frankel, 2004). Plumbing fixtures should be equipped with overflow capacity. Roof tanks and other hidden elements of the plumbing system should be provided with overflows that discharge in such a way as to act as a warning before causing damage.

Each pressure container should be equipped with a temperature and pressure relief valve. Equipment for heating and storing heated water should be designed and installed in ventilated areas to protect against dangers from explosion or overheating (WHO, 2006).

The materials of pipes used to convey hot water should be resistant to high temperatures and water temperature should be maintained at the level specified by the regulation.

Plumbing fittings are often of the same material as the tubing to be connected. The general criterion is the compatibility with the other materials in the system, the water transported, and the temperatures and pressures inside and outside the system. Fire hazards, earthquakes, and other factors also influence plumbing fitting materials.

The velocity of water flowing in pipe is generally limited at approximately 1.8 to 2.5 m/s for the reason of reducing noise (Frankel, 2004 & Jordan, 2004). For quiet buildings like theatres the water velocity in pipes

should vary between 0.6 and 1.2 m/s. Where rapidly closing valves are installed, the maximum velocity allowed is generally 1.2 m/s to reduce water hammer. In industrial buildings and such other facilities where noise is not a problem, the water velocity can go up to 4 m/s. This number is the highest velocity that should not cause erosion of the internal surface of a pipe (Frankel, 2004).

The quality and the maintenance of the material of the plumbing component are very important. That is the case of the lead which presence in drinking water may cause negative health effects (EPA, 2007). Copper concentration above 3mg/L may cause acute gastrointestinal discomfort and nausea, and give rise to staining of plumbing fixtures. Some metals like iron, manganese and zinc can create problems with appearance and taste of the water (Thompson at al., 2007).

According to the US Environmental Protection Agency, around 20% of human exposure to lead in the USA is due to lead found in drinking water (EPA, 2006). It is primarily through plumbing material that lead enters into potable water (EPA, 2007).

It is not easy to monitor the negative health effects caused by bad quality plumbing materials due to the fact that the metal occurrence varies from one building to another and, in the same building the concentration of a particular metal varies at different times of a day (Thompson at al., 2007). In addition side effects generally appear after many years of exposure and vary from one person to next.

2.5 Plumbing pipe materials

The most common materials used for drinking-water supply piping are:

- Galvanized steel or iron
- Copper
- Polybutylene
- Unplasticised polyvinylchloride (uPVC)
- Chlorinated polyvinylchloride (cPVC)
- Polyethylene (PE)
- Polypropylene (PP)

Metal alloys are also used. New materials and construction technologies are continually being developed for the plumbing industry, as the case with other industries (WHO, 2006).

2.5.1 Galvanised steel or iron

The popularity of galvanized steel or iron pipe is decreasing, except in the fire protection industry where it is still commonly used. In general there are limitations concerning the conditions and places to use galvanised steel or iron in plumbing components. This is due to the internal and external corrosions that occur when it is assemble with fittings made of other materials. Its internal corrosion may result in high concentration of iron in water which may cause a bad taste in drinking water and can produce precipitation of iron residue on clothes. It can also result in an unpleasant smell of the water. If the water flow is slow or static for long periods, the internal corrosion causes rust that discolours water. Galvanised steel and iron pipes are generally accepted for outdoor use, but are generally not suitable for internal water plumbing systems (WHO, 2006).

2.5.2 Copper

Copper pipes are highly resistant to corrosion because copper combines with moisture (H_2O), carbon dioxide (CO_2) and similar substances when exposed to form a self-protecting surface film (Webster, 1957). However, it is recommended to avoid contact of copper pipes with other metals like galvanized plumbing components, because it will result in electrolytic corrosion (WHO, 2006).

Due to its flexibility, lightness, availability in coil form and straight lengths, copper piping is often installed in buildings. It can also be used for hot water supply systems provided that insulation is done (WHO, 2006). In order to avoid the erosion of the internal bore of a pipe due to high flow and velocity scouring, the water flow in the copper pipes should never exceed 3 m/s (WHO, 2006).

2.5.3 Polybutylene

Although not accepted in USA because of leaks at joints, Polybutylene pipe is accepted in many industrialized as a good material to convey drinking water. Used at home for both cold and hot water systems, the polybutylene pipe is a light and flexible material that is easy to handle and install (WHO, 2006). However, it is subjected to high pressure and temperature and is exposed for a long period to ultraviolet rays (sunlight), it will be damaged (Webster, 1957; WHO, 2006).

2.5.4 Chlorinated polyvinylchloride cPVC

Used for both cold and hot water systems, this type of plastic pipe offers many advantages including good resistance to corrosion, high tolerance to acids, fire resistance, low weight, and it is non-toxic and odourless. It also diminishes growth of fungi, algae and bacteria and, is able to resist continuous operating pressure of 600 kPa at a temperature of 95^{o} C (WHO, 2006). However, when burned it produces toxic fumes composed of dioxins (WHO, 2006 & Wikipedia, 2008).

2.5.5 Unplasticised polyvinylchloride uPVC

PVC pipe has the advantages of low weight and high resistance to corrosion, and is the most widely used plastic pipe in the world (Frankel, 2004). Disadvantages of PVC include its susceptibility to physical damage when exposed, a reduction in its strength when exposed to ultraviolet rays, and is not suited for hot water. It is generally too bulky for internal use in buildings, and is mainly used for drainage systems (WHO, 2006).

2.5.6 Polyethylene PE

There are 3 types of PE pipes. High-density PE is used mainly for drainage applications where it can support higher temperatures than PVC. Medium-density PE is sometimes used for long distance drinking water piping. It has the advantage to be more flexible and can resist to higher internal pressure than low-density PE. Low-density PE pipe is mainly used in irrigation industry because the operating pressures are low. Due to its requirement of low operating pressure and susceptibility to leakage, this type of PE material is not accepted in many counties (WHO, 2006).

2.5.7 Polypropylene PP

Polypropylene pipe can withstand higher operating temperatures (up to 95^{o} C) than high-density PE and PVC. It is also very resistant to corrosion (SAPPMA, 2006) and thus is suitable to use for both cold and hot water plumbing systems.

2.6 Plumbing fixture materials

Different materials are used for plumbing fixtures, depending on the application and requirements of the fixtures. Vitreous china is widely used for plumbing fixtures like toilet bowls, urinal and washbasins. The best material for kitchen sinks and laundry tubs is stainless steel, but enamelled pressed steel and appropriate plastics are also used. Plastics are common materials for bathtubs, showers trays, laundry tubs, cisterns, washbasins and toilets. In order to improve the durability and strength, plastic materials are generally reinforced with fibreglass (WHO, 2006).

The preferred material used in commercial or industrial food preparation buildings is the stainless steel (WHO, 2006). In buildings such as stadiums, schools etc. where there is a high risk of damaging plumbing fixtures by users, stainless steel is also the preferred material. Plastic materials are not recommended because they can easily be damaged by scratches and cuts (WHO, 2006).

Special plumbing fixtures are made of soapstone, chemical stoneware, or are lined with lead, copper-base alloy, nickel-copper alloy, corrosion-resisting steel or another appropriate material. Special fixtures are those used in laboratories, printing establishments, and similar other establishments where special corrosion-resistant fixture materials are required (Manas, 1957).

Although they are of inferior quality, concrete is also used for plumbing fixtures such as shower trays, baths and laundry troughs. Ceramic tiles are sometimes put on the surface of plumbing fixtures to solve the problem of permeability of these products WHO, 2006).

CHAPTER 3: PLUMBING INDUSTRY IN SOUTH AFRICA

3.1 Introduction

This chapter provides an overview of the plumbing industry in South Africa. This includes the identification of role-players, standards and documents, law and legislation, and implementation.

3.2 Role-players

The plumbing industry is composed of different role-players that range from the government bodies to private companies. These role-players are discussed under the categories of government bodies, local authorities and regulatory bodies, industry bodies, educational institutions, financial and insurance bodies and plumbing companies.

3.2.1 Government Bodies

Department of Water Affairs and Forestry (DWAF)

The Department of Water Affairs and Forestry (DWAF) is the guardian of the water resources of the country (DWAF, 2007). DWAF is responsible for the formulation and implementation of policies governing this sector (DWAF, 2007).

In order to achieve its mission DWAF aims to (DWAF, 2007):

- guide, lead, develop legislative documents, and regulate and control the water sector.
- conserve, manage and develop water resources.
- ensure that water services are provided to all the people.
- educate people on ways to manage, conserve and sustain water resources.
- cooperate with all spheres of government in order to achieve better development.
- create the best possible opportunities for employment.

The legislation and documents published by DWAF stipulate the responsibilities of various bodies in the collection, treatment and distribution of water supplies, as well as the collection and treatment of effluent.

Department of Labour (DoL)

The Department of Labour is in charge of legislation regulating labour practices and activities countrywide. In consultation with other partners, the DoL helps to develop the skills of the South African workforce (DoL, 2008). The Construction Education and Training Authority (CETA), which deals with the plumber training, is a statutory body of the DoL.

Department of Education (DoE)

The Department of Education is responsible for the education sector of the country at a national level. Private Further Education and Training (FET) colleges must be registered with DoE (FET Act, 1998), while public FET colleges fall under the control of provincial education departments.

Department of Trade and Industry (DTI)

The Department of Trade and Industry deals with the import of products and is responsible to ensure that all imported products comply with South African legislation.

Department of Housing (DoH)

The Department of Housing is responsible for serving the housing and basic services needs of the people of South Africa. Plumbing systems are installed inside houses and thus fall, at least partly, under the responsibility of the DoH.

Department of Public Works (DPW)

The Department of Public Works help to “enhance skills development through internships, learnerships and external bursary programme focusing on the built environment professions” (DPW, 2008).

3.2.2 Local Authorities and Regulatory Bodies

Water Services Authorities

The Water Services Act (1997)delegates to Water Services Authorities the power to make bylaws relating to the conditions for the provision of water services. A Water Services Authority is a municipality that is responsible for providing access to water services in its area of jurisdiction. It has the power to approve and monitor a Water Services Provider as well as the Water Services Intermediaries. It must also prepare and adopt a Water Development Plan at intervals determined by the Minister of DWAF.

It is the duty for every Water Services Authority to promulgate a water supply bylaw. Only 169 of the 284 municipalities in South Africa (6 Metropolitan Municipalities, 47 District Municipalities and 231 Local Municipalities) are Water Services Authorities (see Table 3.1).

Table 3.1 Number of Water Service Authorities by province

Province	Number of Water Service Authorities
Eastern Cape	17
Free State	21
Gauteng	12
KwaZulu-Natal	14
Limpopo	11
Mpumalanga	19
Northern Cape	32
North West	13
Western Cape	30
Total	169

Adapted from (DWAF, 2007b).

The South African Bureau of Standards (SABS)

Established in 1945, the South African Bureau of Standards is the national institution in charge of the promotion and maintenance of standards in South Africa (SABS, 2007). It has a mission to provide and promote standardisation services in South Africa and abroad, and carries out the following activities (SABS, 2007a):

- The publication of national standards. Since November 2002, all the standards published are identified by the letters SANS (South African National Standards) and not by the letters SABS as it was before (Jordan, 2004).
- The test and certification of products and services to the standards.
- The development of technical regulations based on national standards, as well as their monitoring and enforcement.
- The monitoring and enforcement legal metrology legislation.
- The promotion of design excellence.
- The provision of training on aspects of standardisation.

The role of the SABS in the plumbing industry is to publish standards, and test and certify plumbing products to these standards. It is important to distinguish between products that carry the SABS mark and products that have an SABS test certificate. The former is the correct and thorough process that ensures that a particular product complies with the relevant standards through regular random testing of the product and visits to the manufacturing plant by SABS staff. The latter is simply a certificate that a particular product has passed the relevant SABS test of compliance. The certificate is only valid for the specific fitting tested and provides no guarantee that other copies of the same product also complies to the SABS standard. A Water Service Authority may also request a supplier to enter into a contract with the SABS for regular tests and inspections, even though this will not allow the product to bear the SABS mark.

When a new standard is required, the two following options are available:

- A direct adoption without change of an existing international (or regional) standard. The advantage of this option is that it is cost effective, quick and simple to do. The SABS encourages committees to adopt international (or regional) standards because of the goal to have globalization of standards.
- A development of a South African standard containing at least some different requirements. The advantage of this option is that the standard is focused on local needs. However it is costly, time-consuming and, there is a possibility of duplication of the work done for international similar standard.

Here are the stages for the adoption of a new standard:

- Any person or organization can submit a proposal for a new standard.
- Once the responsible committee and the Standards Approval Committee (SAC) approve it, the project leader prepares one or many working drafts of the standards, in collaboration with the working group.
- The draft is passed on to the technical committee (TC) or subcommittee (SC) for consideration.
- All the above steps have to be repeated until the TC or SC votes favourably.
- If the TC or SC does not accept the standard within the required period of time, the SAC may suggest a re-submission of the new work item or request the market relevance to be re-evaluated. A cancellation of the project can also be requested.
- Once consensus is reached, a draft South African standard is launched to the public for comments.
- The comments received are analysed by the TC or SC. If there is no comment or significant technical changes to introduce, the standard is considered to be approved. It is sent to the SAC for ratification.
- The style, layout and language of the standard are done by the Standards Development Support Department of Standards South Africa. Standards South Africa is the branch of the SABS dealing with the development of standards.

Current SABS standards relevant to the plumbing industry are listed in Appendix A. The standards cover different aspect of the plumbing sector including the quality of plastic, ceramic, concrete, steel metallic materials, the design of water heating installations and related components, and the design of different other products like taps, pipes and valves.

The steps for obtaining the SABS Certification Mark for a plumbing component are as follows (SABS, 2007b):

- *The product must fall within a SABS/SANS national specification*
- *The product is then fully tested to the specification*
- *The quality system is assessed to ISO 9000 or specific permit conditions*
- *If the product and quality system comply with the requirements, a permit to apply the mark is issued*
- *Regular product testing is conducted throughout the year, and feedback of test results is given*

- *Assessments of the quality system are made at least twice per year, and full reports are issued.*

Joint Acceptance Scheme for Water Services Installation Components (JASWIC)

JASWIC is a voluntary membership organisation composed of Water Service Authorities, Water Service Institutions, Water Service Providers and Municipalities

Its mission is: *"To promote the use of acceptable components in water and sanitation installations in the interest of water conservation, health, safety and the prevention of water pollution, to the mutual benefit of consumers, suppliers, water service authorities and water service providers and the promotion of efficiency in service delivery by co-operation and the exchange of information"* (JASWIC, 2007).

The main goal of JASWIC is to assist the SABS in the setting and maintaining of national standards for water supply and sanitation, thereby promoting (JASWIC, 2007):

- The prevention of wastage of water
- The efficient use of water
- The efficient delivery of water services
- The safety of water installations.

This is done through (JASWIC, 2007):

- *Acceptance standards – maintaining lists of acceptable components, advising the SABS on standards, preparing interim performance specifications in the absence of relevant SABS standards, liaison with other bodies and handling appeals relating to rejected applications.*
- *Training – developing training curricula and standards, liaising with other bodies on skills requirements.*

JASWIC maintains a list of approved plumbing products. To qualify for inclusion in the JASWIC list, a product has to bear the SABS mark, or enter into a JASWIC Inspection Contract with the SABS (JASWIC, 1999). According to this contract, the SABS will regularly inspect the supplier's premises and conduct tests on samples of the product. Once a plumbing product is approved and published on the lists of JASWIC approved products, it provides guidance to a municipality and can thus be installed in any municipality that accepts the use of JASWIC approved products.

The guidelines adopted by the Executive Committee of the JASWIC when considering application are given below (JASWIC, 1999):

- All components bearing the SABS mark are accepted on application without any costs, and remain on the list for as long as they bear the SABS mark.
- Other components: if they are accepted by the JASWIC, they are subjected to an agreement with the SABS for a periodic inspection and evaluation. Their acceptance by the Executive Committee has to be renewed after a period of two years.

- Imported Components bearing a Standards Mark of the Country of Origin are accepted as long as the specification of the country of origin is equivalent or superior to the SABS Specification.
- Components not bearing a SABS Mark or a Standards Mark of the Country of Origin must comply with a SABS specification if it exists.
- Components for which no acceptable Standard Specification exists must comply with the standards JASWIC requirements if such requirements exist, or otherwise with the criteria determined by the Executive Committee in consultation with the SABS.

Agrément South Africa

Agrément South Africa was established as an independent organisation in 1969, with the objective of certifying construction products that are not standardised (Agrément SA, 2008). Agrément SA delivers a technical approval for a product when there is no national standard or when it is an unconventional product. It is an alternative body for those who seek an independent approval (Jordan, 2004).

One of the advantages of Agrément SA is to help to introduce innovative products into the market (Jordan, 2004), but it is mainly focussed in the construction sector. Agrément SA and the SABS have complementary roles. Agrément SA is predominant in the introduction phase of the product on the market. Once the product is on the market and accepted by people and starts growing, the role of Agrément SA decreases and is replaced by the SABS after developing a relevant standard (Agrément SA, 2008).

3.2.3 Industry Bodies

Institute of Plumbing South Africa (IOPSA)

Created in 1989, the Institute of Plumbing of South Africa has more than 765 plumbing companies, 3 500 qualified plumbers, and 10 000 semi skilled persons working in the plumbing industry as voluntary members (IOPSA, 2008).

The main goal of IOPSA is the maintenance of standards in the plumbing industry by using only quality plumbing products and compliant plumbing installation works (IOPSA, 2008). IOPSA is the main organization of plumbers in South Africa. It represents the interests of the plumbing industry at many organisations including the World Plumbing Council (Macnamara, 2007; IOPSA, 2008), Department of Water Affairs and Forestry (DWAF), Department of Education (DoE), Department of Labour (DoL), South African Qualification Authority (SAQA), Construction Education and Training Authority (CETA), South African Bureau of Standards (SABS), and the Joint Acceptance Scheme for Water Services Installation Components (JASWIC).

Plumbing and Sanitary ware Manufacturers Association (PLASMA)

The Plumbing and Sanitary ware Manufacturers Association is a national association for local manufacturers of plumbing products. Members are required to only supply SABS approved products.

Southern African Plastic Pipe Manufacturing Association (SAPPMA)

The Southern African Plastic Pipe Manufacturing Association is a national association of plastic pipe manufacturers, which aims to create consumer confidence by encouraging its members to manufacture only products that comply with national and international standards (SAPPMA, 2008).

European Brassware Sanitary ware Manufacturers and Importers Association (EBSMIA)

The European Brassware Sanitary ware Manufacturers and Importers Association is a national association for plumbing importers. Members import plumbing fittings from everywhere in the world, and not only Europe as the name suggests. Its main objectives are to lower the taxes of imports and to negotiate matters concerning the acceptance of standards of the products supplied by its members who are bound by a tight code of conduct to import only products that meet the highest quality standards (EBSMIA, 2008).

Other

Other organizations playing a role in the plumbing industry are:

- The Institute of Building and Drainage Control (IBDCSA), representing building inspectors.
- National Home Builder's Registration Council (NHBRC)

3.2.4 Educational Institutions

A number of different plumbing qualifications are available from different educational institutions. The available qualifications are as follows:

- The Plumbing Trade Test Certificate. It is a special plumbing qualification delivered to a plumber assistant who has spent more than 5 years working in the industry under the supervision of a qualified plumber. The assistant plumber needs to pass a compulsory trade test in plumbing in order to get the qualification.
- Further Education and Training Certificate: Plumbing Level 4 SAQA ID 58782. Registered in September 2007 (CETA, 2008), this new qualification has replaced the National Certificate: Construction Plumbing NQF level 3 SAQA ID 21853.
- National Certificate (Vocational) in Construction Plumbing NQF level 3 SAQA ID 50442.
- National Certificate (Vocational) in Construction Plumbing NQF level 4 SAQA ID 50441.

The Construction Education and Training Authority (CETA)

Established in April 2000, the main objective of CETA is to influence the course of training and skills

developments by ensuring that all training reflects the needs and requirements of the construction industry (CETA, 2008).

CETA does not offer training itself but it accredits and monitors the delivery of training by Accredited Training Providers. Table 3.2 gives a list of Training Providers of the Construction Plumber Learnership in 2006. The basic requirement for a candidate to enrol for the plumbing learnership program is that the candidate has to be employed by a qualified plumber who provides practical training while the Training Providers provide theoretical training (DPW, 2007).

Table 3.2 List of Plumbing Training Providers

SAQA ID	Qualification Title NQF level	Minimum Credits	
21853	National Certificate: CONSTRUCTION PLUMBING NQF level 3	159	
Learnerships registered number	**Title of Learnership registered**	**Credits**	**Months**
05Q050015201593	CONSTRUCTION PLUMBER	159	20
Training Provider	**Contact Name**		
Fhatalishaka Training Centre c.c.	J. Mokhwevho		
Inala Training Development	J. Mitchell		
East Cape Training – Volveni	George Holtman		
CSIR Internal Services	E.C de wet		
Construction Resource Development Centre	Keith Brown		
Drain Surgeon Plumbing Academy	Samuel Dubazana		
Unique training Solutions	Mike Redman		
Tjeka Training Matters	Frans Toua		
Khuphuka Training Center	Rosenberg		
Thusa Go Bereka Training School	-		
Tiger Kloof Educational Institution	D.W Jacobs		
Umgungundlovu FET College	-		
Sedibeng Training Centre	Mordecai Kocha		
Santhobisa Training Provider	D.M Nkambule		
Tshipi training Centre	Neels de Jager		
Industries Education and Training Institute (Pty) Ltd	-		
Yms Skills development Training Centre	Yusef Mkhuseli Sihlangu		
Tsheole Recruitment Counselling and Training	-		
LMK Consultants	-		
Training & Education On Call	-		
Ithuseng training Centre	Sejamoholo		
Tshwane North College (Soshanguve Campus)	-		

Mpumalanga Regional Training Trust	N.D Moropane
Mantshonga Skills Institute	-
Nokuthula Dube & associates c.c.	S N. Dube

Adapted from (CETA, 2006)

Further Education and Training (FET) Colleges

Plumbing programmes are offered to learners in some FET colleges. Learners receive theoretical and limited practical training in the plumbing field of study with the aim of improving their practical training when they will start working (DPW, 2007).

From 2008, learners from Public FET colleges will be able to get a National Certificate (Vocational) in Construction Plumbing NQF level 3 and from 2009 a National Certificate (Vocational) in Construction Plumbing level 4 (FET, 2008). However, since these colleges do not provide adequate practical training, graduates require a further two to four years in-service training and a trade test before qualifying as plumbers.

We were able to identify six public FET colleges that offer plumbing qualifications. However, none of the 20 private FET colleges identified were found to offer plumbing qualifications.

3.2.5 Financial and Insurance bodies

The insurance industry plays a large role in the plumbing industry. According to Clayton (2005), geyser failures cost to the insurance industry up to R300 million a year in claims. Most of the failures occur not because of the bad quality of the product but because of the incorrect installation. The number of geysers installed monthly is between 30 000 and 40 000.

The 52 short term insurance companies in SA are grouped together in an association called South African Insurance Association – SAIA. This organisation is authorised to negotiate on their behalf (SAIA, 2007a). There is only one insurance company, i.e. Hollard, which is included in the specialist list of insurers for plumbing installations (SAIA, 2007b).

3.2.6 Plumbing Companies

The list of all plumbing companies, including manufacturers, importers, distributors and merchants, is given in Plumbing Africa Magazine's Directory and the IOPSA website. The large number of suppliers is an indication of a good market for plumbing components in South Africa.

3.3 Legislation

3.3.1 Introduction

The two main laws dealing with the water supply in South Africa on a national level are the National Water Act (Act No. 36 of 1998) and the Water Services Act (Act No. 108 of 1997).

The National Water Act provides the necessary legislative framework to improve water resource management (Thompson, 2006:358). The supply of water to consumers is governed by the Water Services Act, and thus it is of main interest to this study.

The Water Services Act allows the Minister of Water Affairs and Forestry to prescribe from time to time compulsory national standards relating to many aspects, including the requirement for persons who shall install and operate water services works and the construction and functioning of water services works and consumer installations. Such standards were published for the plumbing industry under Government notice No R. 509 of 8 June 2001 entitled Regulations Relating to Compulsory National Standards and Measures to Conserve Water (DWAF, 2001). Article 14 of this document requires that: "Every consumer installation must comply with SABS 0252: Water Supply and Drainage for Buildings and SABS 0254: The Installation of Fixed Electric Storage Water Heating Systems, or any similar substitution re-enactment or amendment thereof if the consumer installation is of a type regulated by either standard." The two SABS standards mentioned prescribe the specifications that different types of plumbing components must comply to.

The Water Services Act gives the power and responsibility to municipalities that are Water Services Authorities to make Water Bylaws, and also provides for the Minister of Water Affairs and Forestry to propose model bylaws to as a guide by Water Services Authorities. The "Model Water Services Bylaws" was published by the Minister of Water Affairs and Forestry in August 2000.

New legislation is currently being developed by DWAF, which will likely introduce a labelling system for plumbing products and may prohibit the import of non-compliant plumbing products into the country.

3.3.2 Water Bylaws

It was only possible to find the Water Bylaws of 19 of the 169 municipal Water Services Authorities in South Africa (see Table 3.3).

Table 3.3 Municipal water Bylaws investigated in this study

Water Services Authority (Municipality)	Bylaws	Year of publication if available
Amajuba District Municipality	Water Services By-Laws	20 April 2005
Bloemfontein (Mangaung Local Municipality)	Water Supply Regulations	25 April 1975 (Last amendment 2 November 1990)
City of Cape Town Metropolitan Municipality	Water By-law	01 September 2006
Ekurhuleni Metropolitan Municipality	Water Supply By-laws	06 March 2002
Emfuleni Local Municipality	Water Services By-laws	21 May 2004
eThekwini Metropolitan Municipality	Water Supply Bylaws	Information not available
City of Johannesburg Metropolitan Municipality	Water Services By-laws	21 May 2004
Kouga Local Municipality	Water Supply and Sanitation Services By-laws	2005
Makana Local Municipality	Water And Sanitation Services By-Laws	Not available but after WSA (1997)
Mbombela Local Municipality	Water Supply Services By-laws	Not available but after WSA (1997)
Msukaligwa Local Municipality	Water By-law	Not available but after the WSA of 1997
Msunduzi Local Municipality	Water Services By-laws	17 March 2005
Nelson Mandela Metropolitan Municipality	Water Services By-laws	Not available but after the WSA of 1997
Overstrand Local Municipality (Hermanus)	Standard Water Regulations	19 June 1953
Polokwane Local Municipality	Water and Sanitation By-laws	Draft
Sol Plaatjie Local Municipality	Water Services By-law	2006
City of Tshwane Municipal Metropolitan Municipality	Water Supply By-laws	05 November 2003
Ugu District Municipality	Water Services By- Laws	Not available but after the WSA (1997)
uMhlathuze Local Municipality	Water Services By- Laws	Final draft. 2005*

* Date found from Walker et al. (2007).

The Model Water Services Bylaws (MWSB) is a guide that assists municipalities with the composition of their own bylaws, and was included in this study. The comparison of the bylaws concentrated on the following aspects:

- Quality of plumbing products
- Qualification of persons permitted to do plumbing work.
- Enforcement

Almost all the Municipal bylaws studied incorporated the requirements of the MWSB.

Quality of Plumbing Products

The MWSB recommends that each municipality should have a Schedule of Approved Pipes and Fittings.

Only the pipes and fittings included in this schedule are allowed to be used in the given municipalities' areas of service.

All the other products require a written authorisation by the municipality or its authorised agent in order to be used. The WSA has the right to impose additional conditions on plumbing components included in the Schedule, but is bound by the Water Services Act, and thus may not include products that do not comply to SANS 10252 and/or 10254.

Almost all the municipal bylaws studied specify the requirements for plumbing products to be included in their Schedule of Approved Pipes and Fittings. For almost all the bylaws analysed, a pipe or fitting is included in the above-mentioned schedule if:

- it bears the standardisation mark of the SABS
- it bears a certification mark issued by the SABS

Only four municipalities (Cape Town, Richards Bay, Tshwane and Nelson Mandela Bay Many) include the JASWIC list of approved products in their schedules of approved products.

The Water Bylaws of the Mbombela, Emfuleni and Makala Municipalities specify that a plumbing product should be included by the municipality in the schedule if deemed acceptable by the Municipality, but does not list specific products. The Mbombela Municipality is the only municipality to include the Agrément South Africa approved products in the Schedule of Approved products.

Persons allowed to do plumbing work

There is a section reserved for persons allowed to do plumbing work in the MWSB, but it is currently empty. It is stipulated that regulations will be published once the process of registration of persons in the Water Supply Industry is in place.

Most of the bylaws analysed specify that only either a plumber or a person working under the control of a plumber is permitted to do plumbing work. A qualified plumber is defined by most bylaws as a person who has passed the Plumbing trade Test or has been issued such other qualification as may be required by the South African Qualification Authority Act, 1995.

The law also states that no person may require or engage a person who is not a qualified plumber to do plumbing work. Nevertheless, most municipality bylaws allow a building owner who is not a plumber to do some plumbing work on the premises occupied by himself, on condition that such work is inspected by a qualified plumber.

eThekwini and Cape Town are the only municipalities to provide in their water bylaws the registration of plumbers. The list of plumbers has to be available at the municipality.

Enforcement

The MWSB and municipal bylaws specify that each municipality should have employees (water inspectors) who should execute work, conduct inspections, monitor, and enforce compliance with the bylaws. It is interesting to note that the law does not specify the qualification of the inspector, but only that the municipality may authorize any person in its employment to be a designated officer. The inspector has the right to enter with or without a written authorization in any premise at any reasonable time. It is also stipulated that no person may prevent or restrict the access of an inspector to any premise. In some cases, the inspectors have the power to use force to enter a property.

Some aspects of the inspection consist of:

- inspecting premises,
- questioning different people present on premises,
- inspecting different documents required relevant to the work,
- taking samples of any substance,
- monitoring, taking reading or making measurement,
- doing what is required to conduct an inspection.

In case of non-compliance to the bylaws, the bylaws allows for a fine or, in default of payment, for imprisonment. In the event of a continuous offence, a further fine for every day that the offence was committed may be imposed. For a second offence, there is a further fine or imprisonment that is greater than that of the first offence.

Each municipal bylaw has its own fines and periods of imprisonment. The range of fines is from a minimum of R100 (Bloemfontein) to a maximum of R20 000 (Ekurhuleni). The period of imprisonment is from a minimum of 3 months (Bloemfontein) to a maximum of a year (Sol Plaatje). Fines are generally small relative to the cost of construction projects and are unlikely to ensure by themselves that large developers comply with the bylaws. However, if the developers are required to rectify non-compliant installations, the time and cost involved can be a strong deterrent against installing non-compliant fittings.

3.4 Standards, Guidelines and Documents

3.4.1 SANS Standards

It is SABS policy to review standards periodically because they have to be updated with the development of technologies and use. When there is no agreed period, the review period is of 5 years (SABS, 2003). A list of SABS standards relevant to the plumbing industry is given in Appendix A. The main SABS standards relevant to the plumbing industry are as follows:

- SANS 10252 Water Supply and drainage for buildings – Part 1: Water supply installations for buildings. This standard also refers to other relevant standards that products and materials should comply to.
- SANS 10254 The installation, maintenance, replacement and repair of fixed electric storage water heating systems. This standard regulates water heaters, including all relevant plumbing fittings.
- SABS 0400 The code of practice for the application of the National Building Regulations. The National Building Regulations set requirements for the technical performance for all buildings constructed to ensure the health and safety of occupants. It specifies what persons may do plumbing work, but does not specify much regarding water supply plumbing components. SABS 0400 provide deemed-to-satisfy rules for compliance to the National Building Regulations.

3.4.2 SA Plumber's Handbook

Published in 2004 by the Pipe Trade Media Group, this document gives practical and useful information that can help the different categories of people involved in the plumbing industry, including plumbers, learner plumbers, plumbing contractors, decision makers, inspectors and insurers.

It contains practical information about:
- Plumber training and qualification
- Cold and hot water installations, sanitary appliances and fittings, sanitary plumbing and drainage, roof drainage, use of plumbing tools
- Basic business practice for plumbers

Its also contains the list of relevant SABS standards, information on some key role players and lists some plumbing supply companies. The second edition of this book is expected in 2008.

3.4.3 Plumbing Africa

Plumbing Africa is the official journal of the following organisations (Macnamara, 2007):
- IOPSA
- Institute of Building and Drainage Control SA (IBCDSA)
- Plumbing & Sanitary ware Manufacturers Association (PLASMA)
- Polymer Hot & Cold Technology Group (PHACT)

It is a monthly magazine and claims to be the only technical one specialising in the plumbing industry. The main editorial topics cover various aspects, including new products, plumbing, legal, installation and problem solving, drainage and sanitation, by-laws, plumbing design, tools, and pricing (PTMG, 2008).

3.5 Implementation

A legal framework can only be effective if it is enforced. Thus every municipality should have a trained group of people who inspect water services and plumbing installations to ensure that these comply with national and local legislation. A visit was made to the City of Cape Town, which has a system of Water Inspectors who specifically enforce Cape Town's water bylaws. The organisational structure for the water inspectorate of Cape Town has 82 positions, although not all of them were filled at the time of our visit. Water inspectors are trained using a training manual specifically developed for this purpose.

An informal telephonic survey was done on a number of other larger municipalities in South Africa, and none except Cape Town could be found where a system of specialised water inspectors is used. Generally, building inspectors are required to also look at plumbing systems. The impression gained was that systems for enforcing water bylaws is severely lacking in most municipalities in South Africa. Further work to investigate the extent of systems to enforce water bylaws is proposed.

3.6 Discussion and Conclusions

The Water Services Act makes it illegal to install any plumbing component that does not comply with the relevant specifications listed in the latest versions of SANS 10252 and 10254. However, compliance does not mean that the component has to bear the SABS mark. WSAs have the right to impose their own requirements through bylaws and maintain their own schedules of approved products, as long as these products can also be shown to comply with SANS 10252 and 10254. JASWIC ensures compliance of non-SABS mark holders by requiring suppliers of these products to enter into a standard contract with the SABS, ensuring that regular inspections and compliance tests are carried out.

An important point is that the law does not prohibit the import and sale of non-compliant products, but only the installation thereof. The responsibility for enforcing the law is thus placed solely on the shoulders of local authorities, who should ensure compliance through measures such as maintaining a schedule of approved products, site visits, building inspections and registration of plumbers. However, it became clear throughout this project that very few municipalities actually enforce the laws on plumbing components, and that many non-compliant plumbing components are being installed in buildings. Only one local authority, that of Cape Town, was found to have a system of water inspectors whose task it is to ensure compliance to their water bylaws.

In our opinion, the main reasons for this lack of enforcement are inadequate understanding of the need for maintaining high technical standards, lack of commitment to this aim, and as a result, a severe shortage of technical staff at local government level. Lawless (2007) found that local governments in South Africa has on average three civil engineering professionals (engineers, technologists and technicians) per 100 000 population, which compares very unfavourably with around 22 civil engineering professionals per 100 000

population in developed countries. In addition around 30% of municipalities in South Africa have no civil engineering professional employed. There is no way that local government can provide even basic infrastructure services with these numbers of civil engineering professionals, and enforcing plumbing legislation is probably much lower on their priority lists. Unless this situation improves dramatically, there is little hope that the situation regarding compliance will improve substantially in future.

CHAPTER 4: COMPLIANCE OF PLUMBING COMPONENTS

4.1 Introduction

This chapter deals with work done to evaluate the level of compliance of plumbing fittings in South Africa to the legal requirements for such fittings. Plumbing fittings were assumed to be compliant if they either carried the SABS mark, were included in the JASWIC list of approved products.

Three methods were used to investigate the levels of compliance of plumbing fittings and identify problems in the plumbing industry in South Africa:

- A search was done to find as many plumbing products available on the market in South Africa as possible. These fittings were then evaluated for compliance.
- A survey was conducted on plumbers using a questionnaire.
- Interviews were conducted with a number of role-players in the plumbing industry.

These three investigations are discussed in succession. In each case the methodology is described, followed by the results and a discussion.

4.2 Plumbing Components available on the Market in South Africa

4.2.1 Introduction

Plumbing distributors have to market their products in order to sell them. This provided us with an opportunity to collect information on plumbing products on the market in South Africa, and then evaluate them for compliance.

4.2.2 Methodology

The first part of this investigation consisted of compiling a list of compliant products from the SABS and JASWIC. However, it was not possible to obtain a detailed list of products carrying the SABS mark from the SABS. Staff at the SABS referred the authors to their website, which contained a list of companies that are SABS mark holders (attached as Appendix B), but not a list of the actual products that bore the mark. Where a company thus supply some products that carry the SABS mark and some that do not, it was impossible to check this with the information supplied by the SABS. In such cases we assumed that the claims of compliance of the manufacturers were accurate.

The JASWIC list of accepted water components, updated on 25 February 2008 was downloaded from their website, and is attached as Appendix C.

The search for plumbing products consisted mainly of a web-based search for plumbing fittings, but also included searches of catalogues and visits to plumbing suppliers. The list of products found was then checked to determine whether they are SABS or JASWIC approved products, and whether the claims of compliance were accurate. The following checks were made:

- It was checked whether a particular company manufacturing or supplying plumbing fitting was included in the SABS list of mark holders (Appendix B).
- If a company was included in the SABS list, it was assumed that information supplied by the company regarding SABS compliance of specific products was accurate.
- If a company was not included in the SABS list, each product was checked against the JASWIC list to determine whether it was a compliant product.

4.2.3 Results and Discussion

The data consisted of 31 manufacturers and suppliers of 2 626 plumbing products. The results of the investigation are summarised in Table 4.1.

Table 4.1 Compliance of plumbing products found

Plumbing Components	Compliant products		Non-compliant products	
	No. of	Fraction	No. of	Fraction
Valves	6	17%	30	83%
Bidets	78	29%	194	71%
Showers	136	36%	247	64%
Cisterns	23	37%	40	63%
Geysers	13	37%	22	63%
Pipes	216	43%	281	57%
Taps	672	48%	698	52%
Total	1114	**42**%	1512	**58%**
Grand Total	2626			

Valves showed the lowest level of compliance (17%), while taps showed the highest (48%). Overall, 1 512 or 58% of the products investigated were found to be non-compliant. In addition, six companies with 269 (or 10% of) products claimed to be SABS mark holders while they were not included in the SABS list of mark holders.

4.3 Survey of Plumbers

4.3.1 Introduction

In general plumbers know the plumbing industry and the legal requirements for plumbing fittings, and were thus considered a good source of information on the state of the plumbing industry. For this reason a survey was conducted on plumbers to gain insight into practices in the industry.

4.3.2 Methodology

The plumbers survey form had to be focussed and short to ensure maximum response. The survey questions were discussed with JASWIC and other industry role-players, then discussed at a WRC Advisory Committee meeting, and finally tested on a small number of plumbers to evaluate its effectiveness. The final survey form is included in Appendix D.

Four categories of questions were included in the survey:

- Experience, background and qualifications – questions 1 to 5.
- Perception of leakage – questions 6 and 7.
- Level of compliance of plumbing products – questions 11 to 14.
- Open question inviting further comments – question 15.

A number of strategies were followed to get the questionnaires completed. In one strategy, plumbers were contacted by phone and the questionnaire faxed to them. This approach resulted in few replies and was abandoned. Plumbers were also approached at Institute of Plumbing (IOPSA) regional meetings, working via the IOPSA regional chairs and attending meetings where possible. The response at IOPSA meetings was generally good and the bulk of completed questionnaires were collected in this way.

A special effort was made to obtain responses from informal plumbers that were not part of the mainstream plumbing industry. Visits were made to stores selling plumbing fittings and informal plumbers approached when they visited the stores. Generally the merchants were not supportive and did not allow such interviews to be conducted outside their stores. Visits were then made to known areas where informal plumbers would wait to be picked up for employment. A total of ten survey forms were completed by informal plumbers. However, these informal plumbers were visibly uncomfortable with the questioning and it was clear that some of their answers reflected what they thought the answer should be.

Visits were made to four construction sites in an attempt to involve more plumbers. None of these sites had plumbers available to complete the questionnaire, and no response was received after leaving the

forms at the sites for the plumbers to send through at a later stage.

In the end a total of 100 completed survey forms were collected. The results were analysed by the Statistical Consultation Bureau of the University of Johannesburg. Their detailed report is included in Appendix D.

4.3.3 Results

A total of 100 completed survey forms were analysed. The minimum number of data points required to accept a result as a good reflection of practices in the industry was taken as 20. While the results can not always be taken as conclusive, it is believed that they provide good indications of the practices and trends in the plumbing industry in South Africa.

Experience, background and qualifications

The regional distribution of respondents is given in Table 4.2. Table 4.3 shows summarises the qualifications of the respondents: 75% of the respondents were qualified plumbers, 11% plumbers in training and the remaining 14% had no formal training. Sixty eight percent of the respondents were members of the Institute of Plumbing of South Africa (IOPSA), 30% were not members and the remaining 2% did not answer this question.

Table 4.2 Regional distribution of respondents

Place	Fraction (%)
Southern Cape (Knysna)	8
East-London (Border)	8
Rustenburg	3
Western-Cape	22
Free State (Bloemfontein)	15
Pretoria and Witbank	13
Johannesburg	29
KwaZulu-Natal Midlands	2
Total	**100**

Table 4.3 Plumbing qualification of the sample

Plumbing qualification	Fraction (%)
None	14
Plumbing trade certificate	61
National certificate in Construction at NQF/level 3	14
Plumber in training	11
Total	100

The percentage of respondents not working for a plumbing company was 14%. The remaining 86% worked for plumbing companies with 65% percent of them working for themselves. Around two third of the respondents worked for small plumbing companies (with less than 5 plumbers), and the remaining third for large and very large companies. About half of the respondents had been in the plumbing industry for less than nine years, while the other half had more than nine years experience.

Figure 4.1 shows the distribution of area where the respondents worked. Most respondents worked in suburban areas, while few worked in townships (12.5%) and informal settlements (8.3%) even though the number of people in these areas is greater than in suburban areas. Reasons for this finding may include that:

- Most IOPSA meetings took place in suburban areas and may have attracted mainly plumbers from these areas.
- The relatively high cost of plumbing work makes it less likely that generally poorer areas such as townships and informal settlements will employ qualified plumbers.
- More work in townships and informal settlements is done by informal or unqualified plumbers.

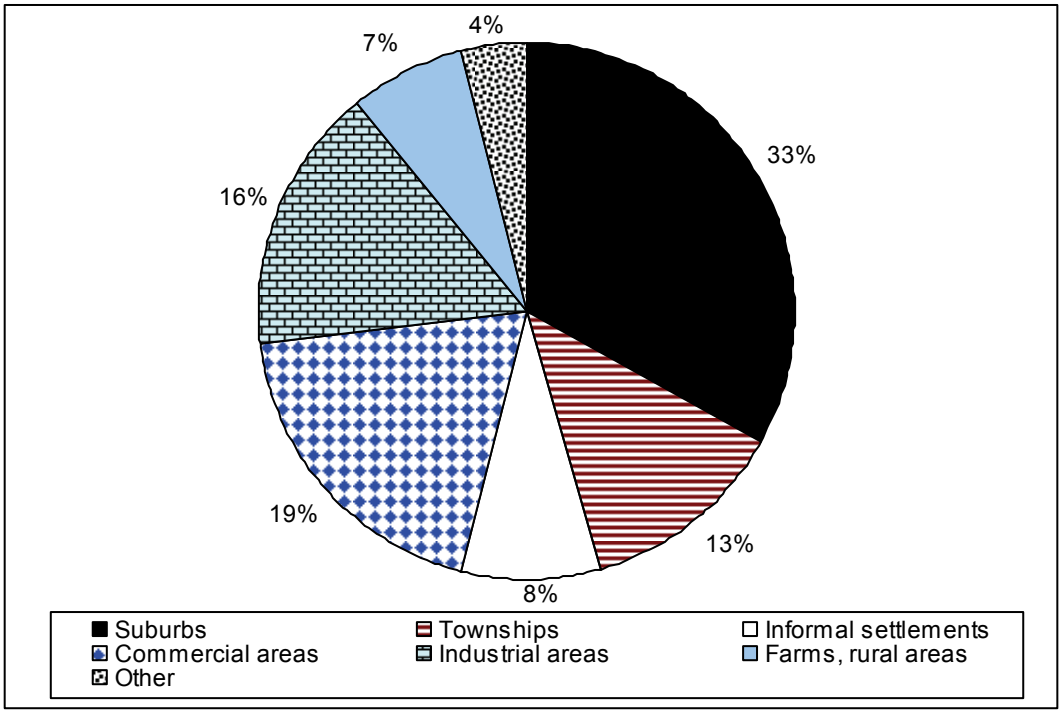


Figure 4.1 Areas where respondents performed most of their plumbing work

Figure 4.2 shows the type of buildings in which the respondents performed most of their plumbing work. Roughly half the work is conducted on business (commercial, industrial and tourism) properties, 29% in private households and 18% in public buildings.

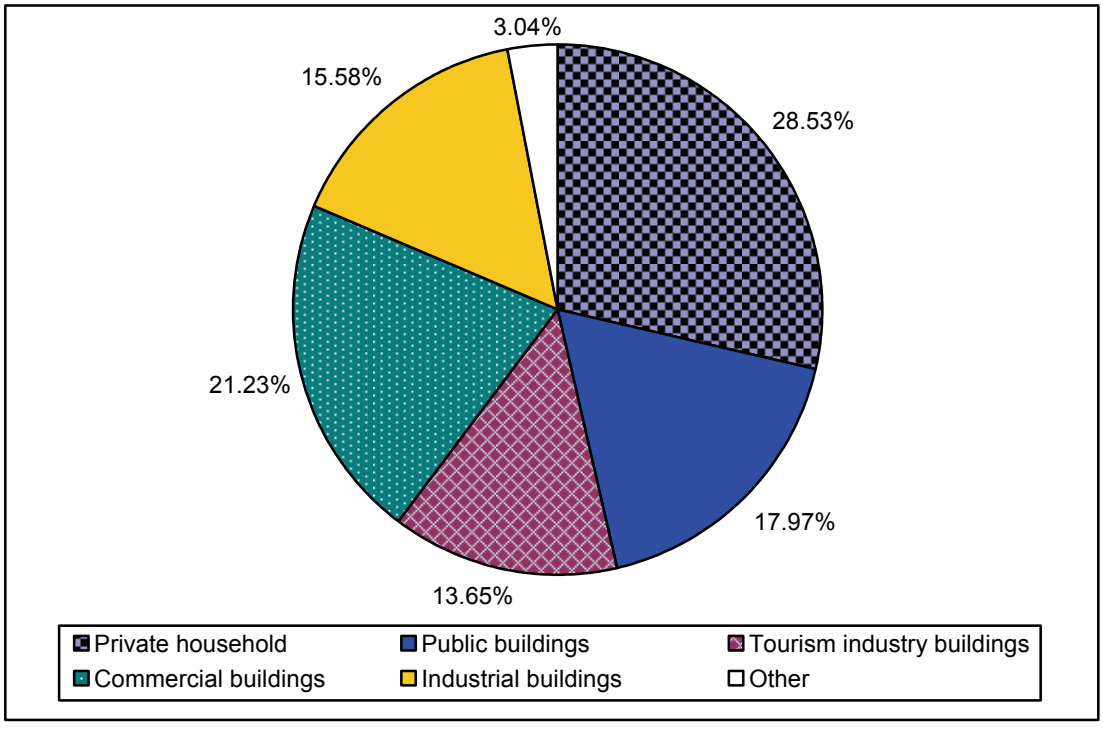


Figure 4.2 Distribution of plumbing work by type of building

Figure 4.3 shows the distribution between new plumbing installations, renovations and maintenance. These three categories make up roughly equal fractions of the work, with most of the work done on maintenance (39%) and least work done on renovations (27%).

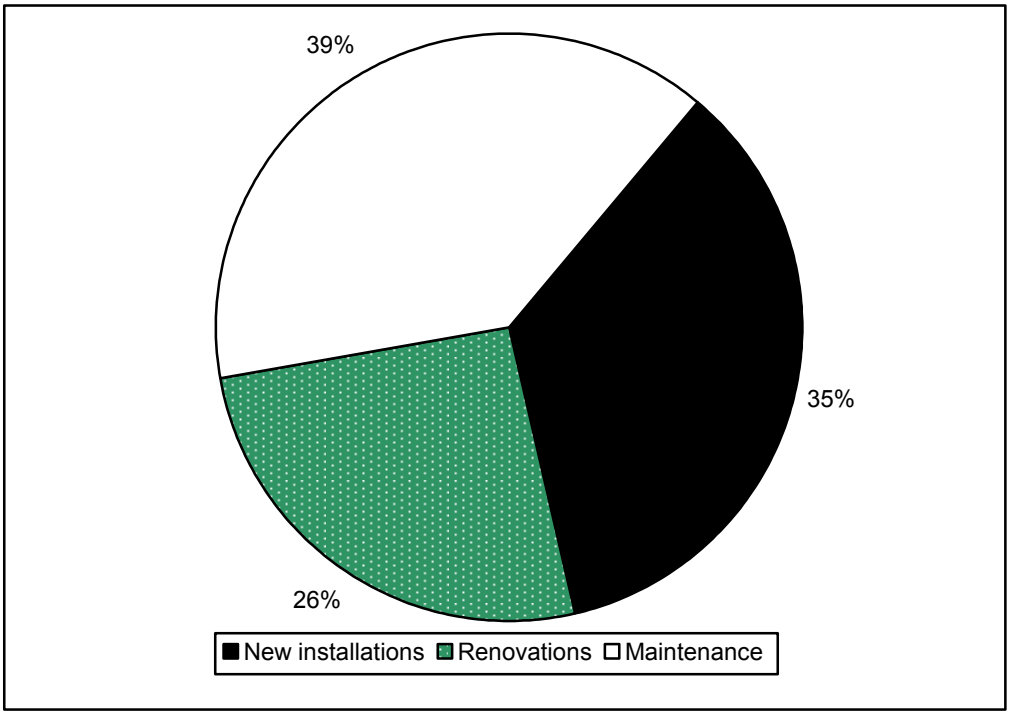


Figure 4.3 General repartition of the plumbing work done by the surveyed plumbers

Perception of leakage from plumbing components

Two questions were asked relating to the correspondents' perceptions of leakage from plumbing components. The first question asked how much of a problem leakage from plumbing components was. The results (see Figure 4.7) indicate that 39% of correspondents consider leakage from plumbing components to be a large or very large problem, while only 24% consider leakage to be a small problem or not a problem.

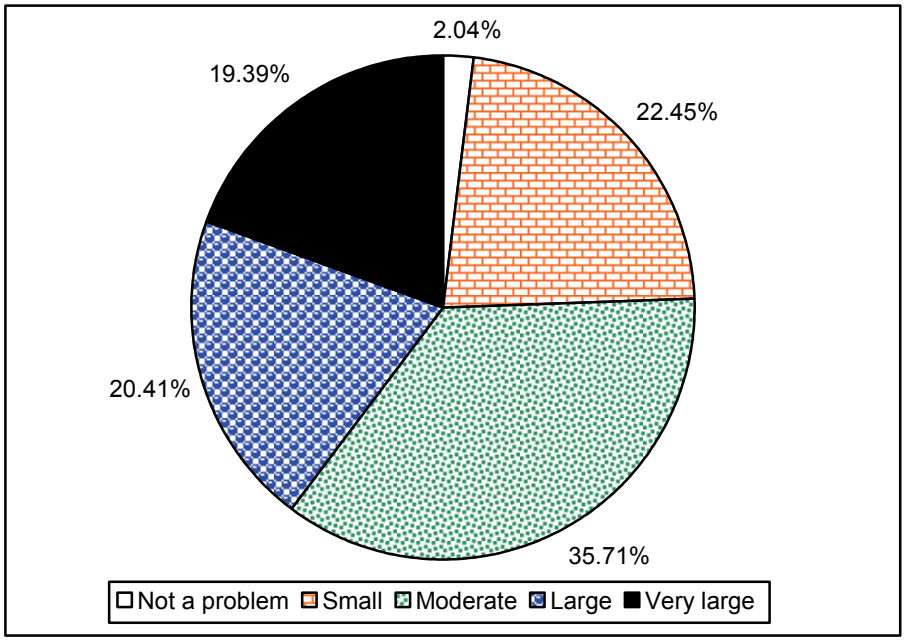


Figure 4.4 Perception of water leakage

These results were further explored through cross tabulations. Table 4.4 shows the results of a cross tabulation between questions 6 (extent of leakage) and 8 (where correspondent does most work). The results show that plumbers in all areas consider leakage from plumbing fittings to be a significant problem.

Table 4.4 Perception of water leakage per area of work

		Perception of water leakage from plumbing fittings		
		Small / Not a problem	Moderate	Large / Very large
Area of work	**Suburbs**	23.7%	36.5%	38.8%
	Townships	23.4%	33.8%	42.9%
	Informal settlements	26.7%	36.0%	37.3%
	Commercial areas	24.4%	34.6%	41.0%
	Industrial areas	22.9%	41.4%	35.7%
	Farms and rural areas	23.2%	37.7%	39.1%

The results of a cross tabulation between questions 6 (extent of leakage from plumbing fittings) and 9 (type of building where most work is done) is shown in Table 4.5. The results show that the problem of leakage is perceived to be significant and roughly the same in different types of buildings.

Table 4.5 Perception of water leakage per building

Type of building	Perception of water leakage from plumbing fittings		
	Small / Not a problem	Moderate	Large / Very large
Private households	21.5%	40.5%	38.0%
Public buildings (Schools, churches, municipal, etc)	22.8%	36.7%	40.5%
Tourism industry (Hotels, hostels, guesthouses, etc)	21.8%	37.2%	41.0%
Commercial Buildings (Shops, offices, etc)	21.5%	38.0%	40.5%
Industrial buildings	19.4%	40.3%	40.3%

The second question on leakage asked respondents to rate different plumbing components according to their contribution to leakage. The average rating for the different components is shown in Table 4.6. Note that a lower rating means a higher contribution to leakage. The rankings of the different components are remarkably similar, but toilet cisterns are identified as the main contributor, followed by taps, geysers, pipes and other valves.

Table 4.6 Rating of plumbing components according to their contribution to leakage

Component	Average rating	Rank
Toilet cisterns and accessories	2.69	1
Taps	2.72	2
Geysers and accessories	2.75	3
Pipes and accessories	2.82	4
Other valves	2.94	5

Level of compliance of plumbing products

Two questions on the level of compliance of plumbing products installed in South Africa were asked. In the first question (Question 11), respondents were asked what fraction of the plumbing products he/she installed were compliant products. In the second question (Question 12), respondents were asked what percentage of compliant plumbing products they believed are installed in South Africa. The first question about the respondents' own practices indicated very good practices with 96% compliant plumbing products

being installed (46% SABS approved, 35% JASWIC approved and 15% approved by municipalities) (see Figure 4.4). However, it should be considered that the most respondents were qualified plumbers and members of IOPSA, and were fully aware of the fact that they are not legally or through the IOPSA rules allowed to install non-compliant products. In addition, most of the surveys were completed at IOPSA meetings and it is thus unlikely that plumbers would have admitted to installing any non-compliant products even if this was the case.

A more realistic result is obtained when considering the responses to the question on practices in the plumbing industry in general (Question 12). The results shown in Figure 4.5 paint a dramatically different picture. Only 37% of respondents believe that all or most plumbing components installed are compliant, while 17% of respondents believe that few or no compliant products are installed. Most respondents (45%) believed that roughly equal quantities of compliant and non-compliant plumbing products are installed. If a weighed average of the answers is taken, 57% of fittings installed are compliant, while 43% are not.

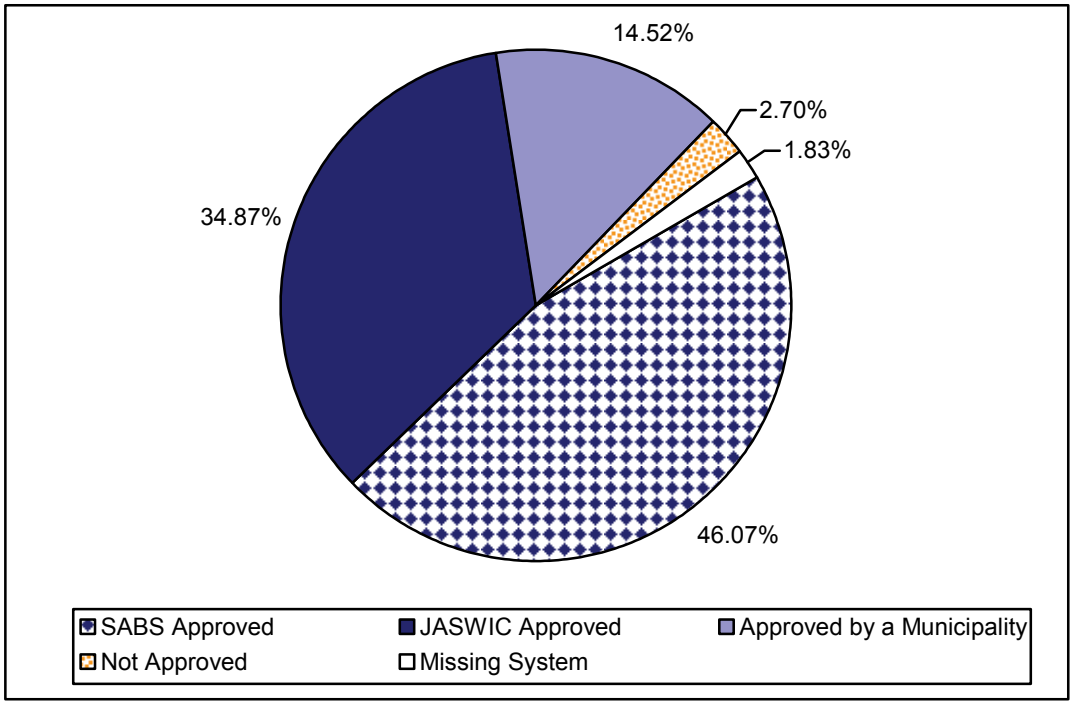


Figure 4.5 Quality of plumbing products installed by plumbers surveyed

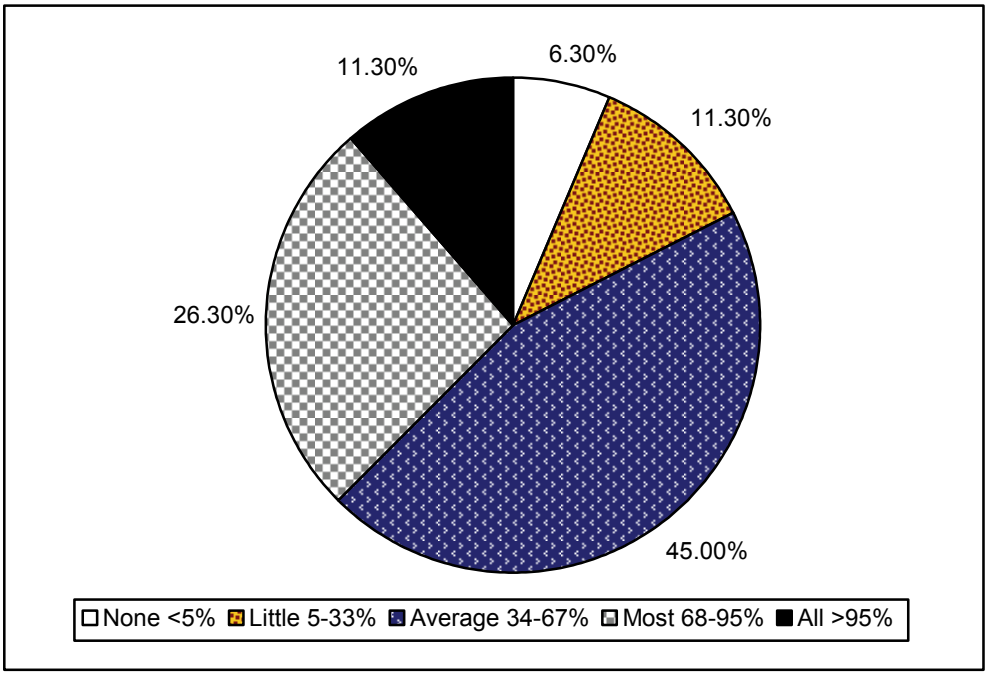


Figure 4.6 Extent of approved plumbing products installed in SA

The results of survey question 12 (compliance of plumbing products installed in industry) were further explored by performing a cross tabulation with the results of question 10 (type of installation). The significant results of the cross tabulation are shown in Table 4.4. The table indicates that non-compliant products are in particular a problem in new installations, but less of a problem in renovations and maintenance.

Table 4.7 Results of a cross tabulation between questions 10 and 12

	Plumbing work	Fraction of compliant products installed		
		Little <34%	Average 34 – 67%	Most >67%
Percentage of plumbers	**New installations**	48.6%	30.0%	-
	Renovations	-	42.6%	38.2%
	Maintenance	-	43.1%	38.9%

Figure 4.6 shows where respondents purchased most of their plumbing components. The results show that 50% of plumbing products are bought from specialised plumbing merchants and distributors, 29% directly from local plumbing manufacturers and 10% directly imported. Other sources such as hardware stores make up the remaining 11%.

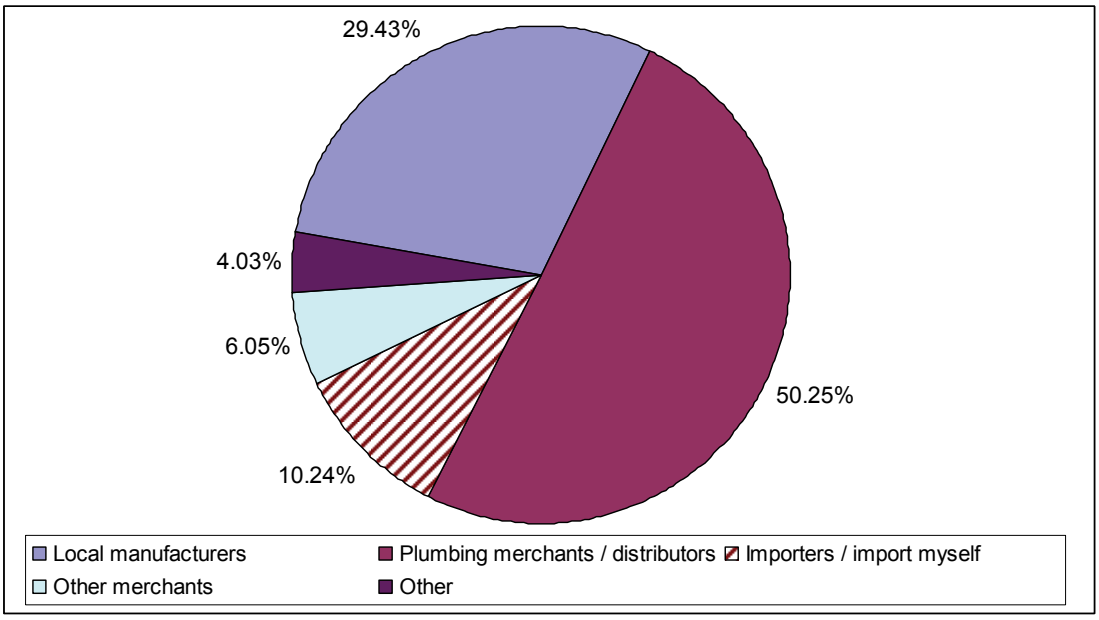


Figure 4.7 Sources of plumbing components

Question 13 investigated compliance in another way by asking what fraction of plumbers the respondent believed installs non-compliant products. The results showed that 28% of respondents believed that most or all plumbers install non-compliant products, 39 believed that roughly half of plumbers install non-compliant products, and that 34% believed few or no plumbers installed non-compliant products. A weighed average of the answers indicates that 47% of plumbers install non-compliant products, which supports the findings of the previous question (question 12).

Open question inviting further comments

Finally, an open question in the survey invited plumbers to offer suggestions on how the plumbing industry in South Africa can be improved or better regulated. Seventy one percent of respondents answered this question. A summary of the replies is given in Table 4.5.

Table 4.8 Suggestions for improving the plumbing industry

Proposition	Number of answers
Better training / more qualified plumbers	22
Qualified plumber doing all work / get rid of chancers	11
Better / more inspection (Water/Building/Plumbing inspectors)	9
One central body that has the power to control plumbers	7
Better policing / regulating of industry	7
Plumber registration / licensing	6
All products sold should be SABS approved	4
Stop importing cheap products	2

Teach the end user how to maintain fittings	2
Safe water	1
Sales to plumber logs	1
Regulate copper price	1
Keep government out of CETA. Allow industry to regulate itself	1
More discussion with city council and plumbers.	1
Certificate of plumbing work should be compulsory	1
Working harder	1

4.4 Survey of Plumbing Manufacturers

4.4.1 Introduction and Methodology

Fourteen plumbing manufacturers were identified and approached to gather information in the form of an interview based on a pre-prepared questionnaire (included in Appendix E). However, due to various reasons interviews were only conducted with four manufacturers, i.e. Sensus Metering Systems, Walker Crosweller, Dutton Plastics Engineering and Cobra Watertech.

The questions included in the survey can be placed in three categories:

- Perceptions of the quality of the products that is available on the local market, the extent of compliant and non-compliant products - questions 1 to 5.
- Identification of problems in the plumbing industry - questions 6 and 7.
- An open question asking for suggestions to improve the situation.

4.4.2 Results

It was clear that the import of bad quality products affects local manufacturers negatively. This is due to the fact that these products are often cheap as a result of the use of inferior materials and manufacturing methods, and not having to carry the costs involved with maintaining the SABS mark. As a result the local plumbing industry suffers lower sales, tighter profit margins and the loss of local jobs.

Manufacturers were hesitant to speculate on the market share of compliant and non-compliant products, but generally agreed that with the plumber survey results that roughly half of the products sold in South Africa do not comply with legislation.

The largest problem in the plumbing industry was considered a lack of enforcement of legislation, mainly due to a lack of inspectors trained to do this job. Qualified plumbing inspectors should be employed by municipalities throughout South Africa to ensure that legislation is complied to.

The above result did not fully match the ranking of problems put to the interviewees as shown in Table 4.6 (lowest rank indicates largest problem). This ranking showed the quality of staff and insufficient control of imports and plumbers to be more important, although the latter two are linked to enforcement of legislation

Table 4.9 Ranking of the problems in Plumbing Industry

Problem	Average Rank
Quality level of staff (Plumbers)	2.0
Insufficient control over imports	2.8
Insufficient control over plumbers	3.8
Insufficient enforcement of the legislation	4.0
Insufficient legislation	4.8
Pirate / grey products	5.0
Insufficient control over distributors / merchants	5.5
Manufacturers	7.3

Replies to question "*What would you like to see done by the following parties in order to improve the state of the plumbing industry in South Africa?"* are summarised below for different institutions mentioned.

DWAF

- Understanding legislation.
- Implementation of stricter water conservation controls and regulations.
- Continue with proposed "Draft Water Regulation Act".
- Register plumbers and enforce legislation.
- Assist Local Authorities to inspect and enforce compliance to standards.
- Legislate against import / sale / manufacture of non-compliant products.
- Have open discussions with all bodies in the plumbing industry in South Africa.

DTI

- Enforce legislation.
- Tighter regulation of imports.
- Improve on import control.
- Have open discussions with all bodies in the plumbing industry in South Africa.

DoL

- Accrediting training without corruption.
- Assists with registration of plumbers.
- To go back to a trade system for training plumbers

- Legislate compulsory annual licensing of responsible plumbers
- Quality assure curriculums and qualification processes of plumbers

DoE

- Improve plumber training.
- To start at grass roots with all trainees
- Align FET college curriculums with DoL plumber qualifications

Local Authorities

- Apply highest standard available.
- Enforce Bylaws.
- All to be adherent to the same specific body.
- Operate a plumbing inspector section to ensure compliance to water supply bylaws.

SABS

- Enforce legislation.
- Maintain quality standards of local manufacturers.
- Involved all parties in discussions, including importers and not only local manufacturers.
- Rewrite the standards to be in line with international standards.

JASWIC

- Apply and enforce measurable standards.
- Continue with their good work.

IOPSA

- Report on failing products.
- More involvement with plumber training and regulation (continue work with DWAF and also plumber registration.)

CETA

- CETA was criticised for the low output levels and poor quality of newly qualified plumbers. CETA's very complex administrative procedures are held responsible for the low intakes of trainees and learnerships in the plumbing industry, especially in small and medium enterprises.

Insurance Industry

- The insurance industry can play a large role in addressing the problem of sub-standard plumbing fittings by making compliance a requirement of their policies and ensuring that only approved fittings are installed when honouring insurance claims.

Plumbing Industry in General

- Plumber training is the responsibility of the entire industry.
- Local manufacturers must stand together to ensure imports are properly legislated.
- Should be run only by plumbers and not the manufacturers or importers.

4.5 Conclusions

An analysis of 2 626 plumbing from 31 manufacturers and suppliers identified through a search of products being marketed in South Africa showed that:

- 58% of the products did not comply with legislation.
- 10% of the companies that claimed to supply SABS approved products were not included in the SABS list of mark holders.

The following findings were made in a survey of a hundred plumbers distributed throughout South Africa and doing plumbing work in different areas and types of buildings:

- Roughly half of plumbing work is conducted inn business (commercial, industrial and tourism) properties, 29% in private households and 18% in public buildings.
- New plumbing installations, renovations and maintenance make up roughly equal fractions of plumbing work, with most of the work done on maintenance (39%) and least work done on renovations (27%).
- Most (76%) of plumbers consider leakage from plumbing fittings to be a problem. Plumbers considered leakage to be a problem all areas and types of buildings.
- While plumbers were not willing to admit that they install non-compliant plumbing products themselves, a weighed average of their responses regarding the plumbing industry in general indicated that 47% of plumbers install non-compliant products and 43% of plumbing fittings installed are non-compliant. The installation of non-compliant plumbing products seems to be a particular problem in new installations and less of a problem in renovations and maintenance.
- A request for suggestions to improve the plumbing industry in South Africa was dominated by the suggestion of better training and more qualified plumbers, followed by the suggestion that only qualified plumbers should be allowed to do plumbing work and a suggestion for better enforcement through water inspectors.

Interviews conducted with a number of local manufacturers in the plumbing industry highlighted the negative impact cheap and low quality imported plumbing products have on the local manufacturing industry in terms of market share, profitability and provision of local employment. Specific problems that were highlighted include the quality and control over plumbers, insufficient controls over imports and insufficient enforcement of legislation. A number of suggestions are made to improve the situation.

CHAPTER 5: ON-SITE LEAKAGE

5.1 Introduction

This chapter describes an investigation to determine the extent of on-site leakage in certain areas in Johannesburg through physical inspection of 182 randomly selected properties. Leakage rates were measured with the municipal water meters used to measure normal water consumption. To ensure that the meters used were as accurate as possible, only meters not older than five years were used.

5.2 Water meters

Municipal water meters are used to measure consumption on different types of properties. In this study the municipal water meters were also used to estimate leakage, and it is thus necessary to provide background on the characteristics and accuracy of these meters.

5.2.1 Metrological Characteristics

The following parameters are directly related to the primary function of a meter that is to adequately measure the volume of water that has moved through it:

- *Actual volume*: Volume of water circulated trough the meter in a predefined lapse of time, regardless of its duration. *The actual flow rate* is defined as the ratio between the actual volume and the predefined time.
- *Indicated volume*: Reading of the meter corresponding to the actual volume. The *indicated flow rate* is defined as the ratio between the indicated volume and the predefined time.
- *Indication error*: Difference between the indicated and the actual volume. The volume difference may be positive or negative.
- *Relative error*: Defined as the ratio between the indication error and the actual volume. It is a non-dimensional parameter that is usually expressed in percentage. Like the indication error, the relative error may also be positive or negative.
- *Error curve*: The relative error of a meter is not constant or independent of the operating conditions, and changes with flow rate. The error curve is the graphical representation of the evolution of the relative error with flow rate.

5.2.2 Meter Accuracy

Detailed knowledge of the error curve of a meter is critical for any evaluation of its reliability. To a great

extent, the quality of a meter is the quality of its error curve and its evolution with time.

The turbine type water meters used for measuring municipal water demand are sized according to the usage pattern of a particular user, and are normally least accurate under low flow rate conditions. Since leakage from a property will often be small, it was necessary to study the accuracy of the meters used and compensate the readings to ensure that realistic estimates of the leakage rates could be made.

Figure 5.1 shows a typical accuracy curve for a municipal water meter with an accuracy envelope that the meter has to comply to. The parameters shown on the curve are defined as follows:

- Starting flow rate (Q_s): The minimum flow rate required to get any reading from the flow meter.
- Minimum flow rate (Q_{min}): The flow rate at which the accuracy of the flow meter enters the 5% envelope.
- Transitional flow rate (Q_t): The flow rate at which the flow meter enters the 2% accuracy envelope and then stays within this envelope
- Normal flow rate (Q_n): The design flow rate of the meter.
- Maximum flow rate (Q_{max}): The maximum flow rate that the meter can handle for short periods without sustaining damage.

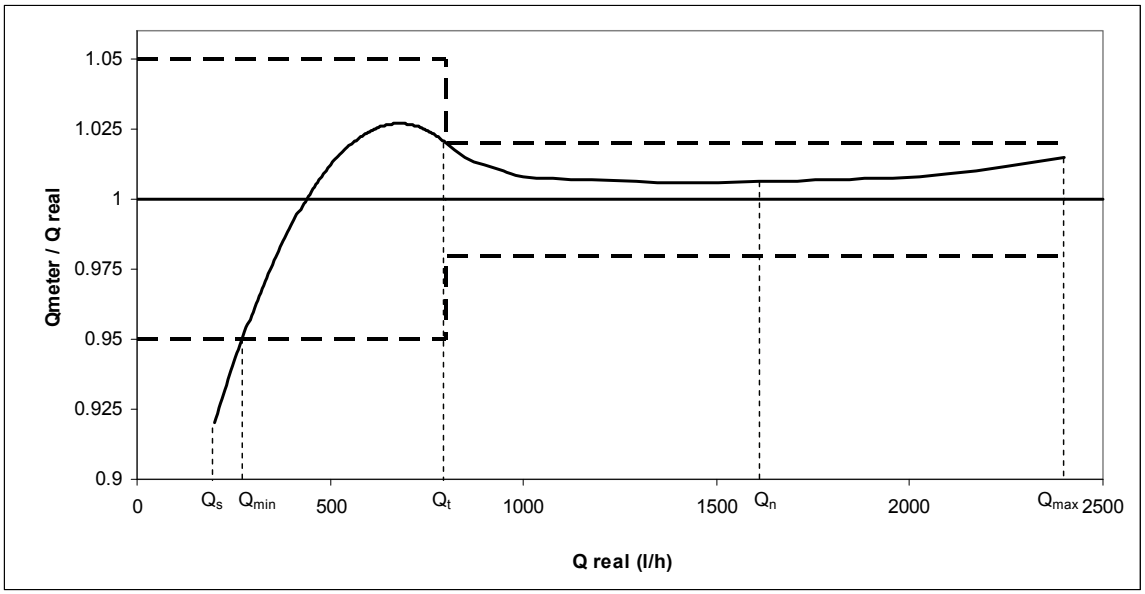


Figure 5.1 Typical accuracy curve for a turbine water meter

To ensure that the minimum losses are incurred through under-registration of the water meter, a design engineer will aim to ensure that the minimum expected demand of a user is greater than the Q_{min} of the meter. However, leakage often starts with a small flow rate and then increases over time. Leakage less than Q_s will not be registered at all on the meter, and leakage between Q_s and Q_{min} will be significantly under registered. Even between Q_s and Q_t the error in a leakage reading can be as much as 5%.Specifications for some commonly used municipal water meters are given in Tables 5.1 to 5.4.

All water meters with a nominal bore not exceeding 100 mm are calibrated for compliance with South African Bureau of Standards (SABS 1529-1, 1994), and are metrologically classified as A, B, C or D depending on the level of accuracy required for the meter. The least accurate is a class A meter, which should not be used for billing purposes. The most accurately calibrated meter is a class D meter which has also the largest range although for purpose of billing the use of classes B and C have tended to dominate with the former being commonly used by both domestic and commercial users.

Table 5.1 Kent volumetric rotary piston water meters ABB models V 110 and V 100 T, complying to BS 5728 and ISO 4064 Class C (Source: Manufacturer Catalogue)

Size of Meter		mm	15	20	25
Meter thread size		inches	G¾B	G1B	G¼B
Permanent flow rate	qp±2%	m³/h	1.5	2.5	3.5
Overload flow rate	qs±2%	m³/h	3.0	5.0	7.0
Transitional flow rate	qt±2%	l/h	22.5	37.5	52.5
Minimum flow rate	qmin±5%	l/h	15.0	25.0	35.0
Starting flow approximately		l/h	5.7	9.5	13.2
Head loss at qs		bar	1.0	1.0	1.0
Head loss at qt		bar	0.25	0.25	0.25
Meter reset to zero at		m³	10000	10000	10000
Minimum indicated digit value		litre	0.1	0.1	0.1
Output pulse		litre/pulse	5	5	n/a

Table 5.2 Kent multijet inferential water meters ABB M 100 Optima: (Source: DPI-Incledon SA)

Size of Meter		mm	15	20	25
Max flow rate	qs±2%	m³/h	3.0	5.0	7.0
Permanent flow rate	qp±2%(Actual)	m³/h	2.1	3.5	4.9
Transitional flow rate	qt±2%	l/h	22.5	37.5	52.5
Minimum flow rate	qmin±5%(Actual)	l/h	12.0	20.0	20.0
Starting flow approximately		l/h	6.0	6.0	10.0
Maximum Working Pressure		kPa	1600	1600	1600
Meter reset to zero at		m³	100000	100000	100000
Minimum indicated digit value		litre	0.1	0.1	0.1

Table 5.3 Meinecke Water meters ML 3000e (Source: Manufacturer Catalogue)

Size of Meter		mm	20	25	80
Max flow rate	qs±2%	m³/h	5	12	200
Permanent flow rate	qp±2%(Actual)	m³/h	2.5	6	120
Transitional flow rate	qt±2%	l/h	37.5	90	800
Minimum flow rate	qmin±5%(Actual)	l/h	20	25	500
Starting flow approximately		l/h	?	?	250

Table 5.4 Actaris/Schlumberger-Flostar water meters (Source: Manufacturer Catalogue)

Size of Meter		mm	40	50
Max flow rate	qs±2%	m³/h	20	30
Permanent flow rate	qp±2% (Actual)	m³/h	10	15
Transitional flow rate	qt±2%	l/h	150	225
Minimum flow rate	qmin±5% (Actual)	l/h	100	90
Starting flow approximately		l/h	22	32
Maximum Working Pressure		bar	16	16
Indicating range		m³	999999.99	999999.99
Minimum indicated digit value		litre	0.5	0.5

5.2.3 Technical Parameters

These parameters are referred to technical aspects of the meter, and also to the conditions in which the meter operates. The main ones are:

- Pressure
- Working temperature
- Pressure loss
- Operating conditions
- Flow direction
- Indicating device
- Designation, dimensions and design

Information related to these parameters is also given in Tables 5.1 to 5.4.

5.2.4 Meter age

Age is a good parameter to define wear in a meter. However, very often meter age data is difficult to obtain or is not reliable. On the other hand, the accumulated volume is usually an up-to-date parameter

which is carefully controlled by the utility since it is used for billing purposes (Arregui et al., 2006).

The same authors suggest how to group meters by age when dealing with the determination of the performance of different meters present in a utility: “When meters are classified by age, the group can span 2 or 3 years. If the groups depend on the accumulated volume, they should be separated every 300-500 m³ (which would be equivalent to 2-3 years average residential consumption depending on the user). In both cases they found an important correlation between the wear at different flow rates and age.

5.3 Study area

Johannesburg Water supplied the project with a list of 233 properties with flow metres not older than five years. The identified properties include different user types in 36 suburbs as listed in Table 5.5. Johannesburg currently replaces meters as they become aware of serious problems (e.g. metres not working) or receive complaints about meters. Thus it was assumed that the properties identified were randomly selected.

Table 5.5 Properties identified for investigation

Suburb	No of Properties Identified
Kenilworth	10
Turffontein	11
Towerby, Forest Hill, Townview	10
Oakdene	11
Linmeyer	11
La Rochelle, The Hill (Ext 1)	11
Glenesk, New Centre, Village Main	4
City and Suburban	5
Johannesburg	11
Marshalls Town	8
Newtown	9
Fordsburg	5
Park Town, Braamfontein, Hillbrow	6
Berea	11
Yeoville	10
Bellevue	10
Bellevue East	10
Observatory	8
Doornfontein	10
New Doornfontein, Troyeville, Fairview	12

Jeppestown	11
Bertrams	10
Kensington	11
Auckland Park, Brixton	9
Melville, Triomf	9
Total	**233**

5.4 Metering errors

For the purpose of this study, it has been possible to obtain from Johannesburg Water the date of installation of each water meter even also the cumulated usage. All water meters on the inspected stands have been installed from 2005 to 2007 and were thus less than 3 years old. From this point of view, they could be considered as a homogenous group having the same average rate of decay and therefore the same average accuracy in first approximation.

To make allowances for errors in the meter readings taken in the study, it was necessary to investigate the accuracy of the various makes and models of water meters were encountered in the study. The numbers and starting, minimum and transitional flow rates of the water meters encountered in this study are given in Table 5.6. The numbers of meters shown in the last column of Table 5.6 are the actual numbers of meters where readings could be taken and is explained later in this section.

Table 5.6. Types of water meters under study

Supplier	Model	Size (mm)	Qs (l/h)	Qmin (l/h)	Qt (l/h)	No. of meters
Elster Kent	ABB Castle	15	6	12	22.5	14
		20	6	20	37.5	4
		25	10	20	52.5	3
Elster Kent	PSM, KSM	15	5.7	15	22.5	130
		20	9.5	25	37.5	17
		25	13.2	35	52.5	4
Sensys	Meinecke	20	8*	20	37.5	1
		25	10*	25	90	1
		80	250	500	800	2
Actaris	Schlumberger&Flostar	40	22	100	150	5
		50	32	90	225	1
Total						**182**

Note: * Q_s not specified. Assumed to be 40% of Q_{min}.

To model meter accuracy, a parabolic curve was fitted for the section of the accuracy curve between Q_s

and Q_t (see Figure 5.1). The accuracy of the water meters at Qs is not specified, and this value was selected to create an accuracy curve that stays within the accuracy envelope in Figure 5.1, and has a maximum value of around 1.03 to 1.04. Typical fitted accuracy curves are shown in Figure 5.2, and the parameters of the parabolic equation fitted to the data in Table 5.6. The equation is written as:

$$\frac{Q_{meter}}{Q_{real}} = aQ_{real}^2 + bQ_{real} + c$$

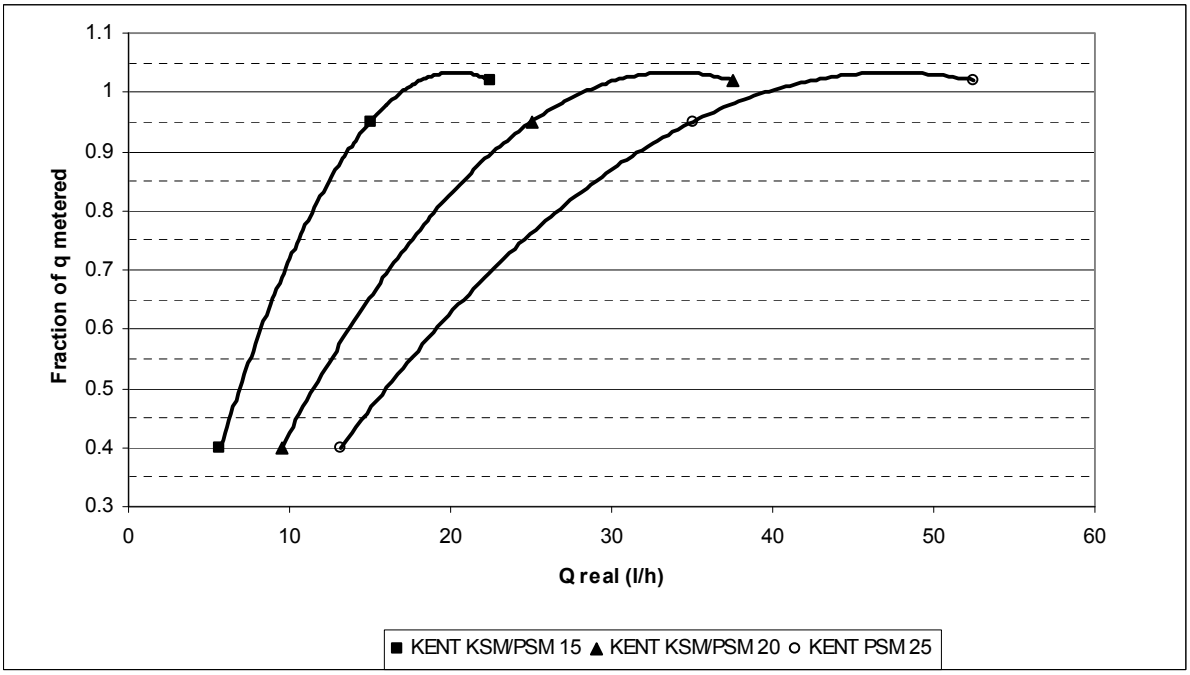


Figure 5.2 Accuracy curves used for Kent KSM and PSM water meters. The three data points shown are Q_s, Q_{min} and Q_t respectively.

Table 5.7 Parameters for parabolic curve used to model meter accuracies

Meter	Size (mm)	a	b	c
Kent ABB Castle	15	-1.6162E-03	0.0624	0.4336
Kent ABB Castle	20	-5.5329E-04	0.0358	0.4550
Kent ABB Castle	25	-1.8462E-04	0.0155	0.7131
Kent KSM/PSM	15	-2.9647E-03	0.1205	-0.1906
Kent KSM/PSM	20	-1.0673E-03	0.0723	-0.1906
Kent PSM	25	-5.4019E-04	0.0513	-0.1826
Meinecke(Spanner-Pollux)/XNP	20	-5.7062E-04	0.0368	0.4420
Meinecke Cosmos	80	-2.1212E-06	0.0030	-0.0152
Schlumberger Flostar	40	-7.4199E-05	0.0200	-0.3030

In order to convert metered flow rates to actual flow rates, a graph of the actual flow rate (Q_{real}) against the meter flow rate (Q_{meter}) was drawn based on the accuracy curves described above. Where the meter flow rate was zero, the real flow rate was assumed to be zero too (the effect of leakage below the starting flow rate is investigated later on in this chapter). Where a flow rate was obtained from the meter that was less than the starting meter flow rate (calculated from Q_s and the meter accuracy), the actual flow was assumed to be Q_s. Between the starting and transitional meter flow rates (calculated from Q_s, Q_t and the meter accuracies), a third order polynomial curve, obtained through a curve fit on the data points, was used. Finally, for meter flow rates above the transitional meter flow rate (calculated from Q_t and the meter accuracy), the meter flow rate was not modified. A typical curve (for the Kent KSM/PSM 15 mm diameter meter) is shown in Figure 5.3. The parameters of the third order polynomial function giving the real flow rate as a function of the meter flow rate is given in Table 5.7. The equation is written as:

$$Q_{real} = aQ_{meter}^3 + bQ_{meter}^2 + cQ_{meter} + d$$

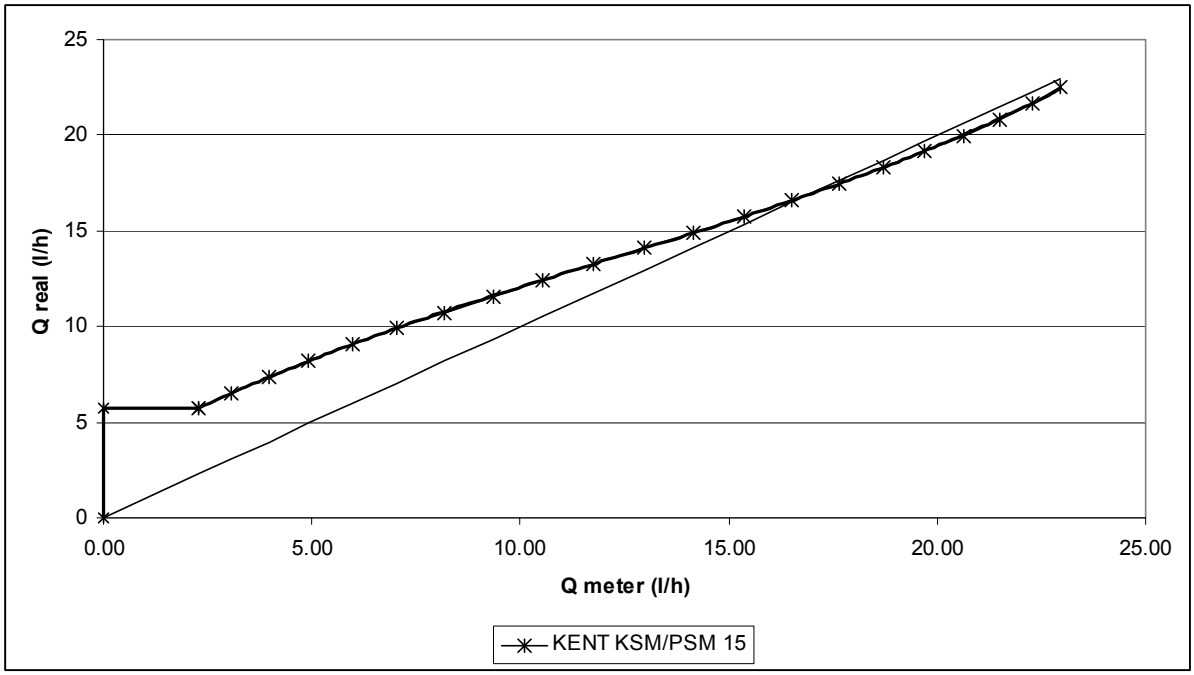


Figure 5.3 Relationship between Q_{meter} and Q_{real} for the Kent KSM/PSM 15 mm diameter flow meter.

Table 5.8 Parameters for third order polynomial function giving Q_{real} as a function of Q_{meter}

Meter	Size (mm)	a	b	c	d
Kent ABB Castle	15	1.0341E-03	-3.8451E-02	1.2751	0.9336
Kent ABB Castle	20	3.7099E-04	-2.3271E-02	1.2906	1.3518
Kent ABB Castle	25	1.4564E-04	-1.2277E-02	1.2062	0.5241
Kent KSM/PSM	15	1.2112E-03	-4.3821E-02	1.2046	3.1879
Kent KSM/PSM	20	4.3610E-04	-2.6296E-02	1.2047	5.3131
Kent PSM	25	2.2205E-04	-1.8777E-02	1.2071	7.3715
Meinecke(Spanner-Pollux)/XNP	20	3.6719E-04	-2.2811E-02	1.2737	1.5240
Meinecke Cosmos	80	1.0021E-06	-1.2917E-03	1.2566	86.1100
Schlumberger Flostar	40	3.4265E-05	-8.2947E-03	1.3068	20.9710

5.5 Methodology

The following precautions have been taken in using reading water meters to determine the leakage rate on-site:

1. Water meters should be accurate : age < 5 years.
2. Measurements have been taken during a period where no legitimate consumption was taking place. To ensure this, the following steps were taken:

a. The customer was given advance notice of the leakage reading to be made.
b. On the day of the leakage reading, the doorbell was rung and the customer asked to close all fixtures if he/she was present on the property.
c. If a leak flow was measured, the above procedure was repeated on a different day and at a different time of the day. The flow reading (if any) was then assumed to be a leak if the different readings taken on the different visits were similar.
d. If the first visit shows zero leakage, no further visits were required.

3. To ensure that leakage readings were accurate:
    a. Volume readings were taken at at least 5 minutes intervals.
    b. At least two readings were taken at each visit. Readings could only be accepted as leakage if they were similar.

The methodology followed in the study included the following steps:

1. Identify stands to investigate: Johannesburg Water identified stands with new flow meters (< 5 years).
2. Identify users to visit in a given week.
3. Announcement letters in post boxes.
4. Perform visits after 9:00 and before 13:00.
5. Ring doorbell – if answered, ask to turn off all fittings for half an hour.
6. Take required number of water meter readings at 5 minutes intervals.
7. Note details of property and water meter.
8. Move to the next property.

The steps to record the information were as follows:

1. Reset the stopwatch.
2. Record the initial reading on water meter (displayed index of the meter).
3. Start the stopwatch.
4. After the interval of 5 minutes, record the first reading (displayed index of the meter).
5. After 10 minutes, record the second reading.
6. Calculate the volume of the flow for the two intervals by subtracting the first reading from the initial and the second from the first, and record these values.
7. Convert these readings into an hourly flow rate.
8. Adjust measured flow rates for metering errors.
9. Analyse the results.

5.6 Results

It was not possible to obtain readings for all the properties identified, mainly due to meters not being found or not being accessible. Leakage readings could be taken on 183 (79%) of the 233 meters identified. Of the meters read, it was found that 59% (108) of the properties had a measurable on-site leakage, and 41% showed no leakage. Table 5.9 summarises the above information and provide more detail on the reasons why meters could not be read.

Table 5.9 Summary of results

Details	Number of Properties	% of Sub-total	% of Total
Properties investigated			
With leaks	108	59%	46%
Without leaks	74	41%	32%
Sub-total	**182**	**100%**	**78%**
Properties not investigated			
Meters not located	19	40%	8%
Meters on Block of Flats and Complex	15	31%	6%
Meters unreadable	4	8%	2%
Meters within locked premises	3	6%	1%
Meters boxes locked	3	6%	1%
Meters removed	3	6%	1%
Meter buried under a pile of sand	1	2%	0%
Faulty meters	3	2%	1%
Sub-total	**51**	**100%**	**21%**
Total	**233**		

The 108 properties with on-site leakage had a minimum leakage rate of 5.7 l/h, a maximum leakage rate of 456 l/h, an average leakage rate of 40.7 l/h, and a median leakage rate of 12.6 l/h. The large difference between the average and median leakage rates is an indication that most leaks are relatively small, but that a few properties have much larger leaks. The average leakage rate found translates into a monthly leakage volume of 30 kl, which is equal to the typical monthly consumption of a residential property. If the properties where no leakages were found are taken into consideration, the average leakage rate drops to 24.2 l/h, or 17 kl/month.

Table 5.10 summarises the number of properties investigated and leakage occurrence per suburb.

Table 5.10 Properties investigated and leakage found per suburb

Suburb	No of Visited Properties	% Leaking Properties
Auckland Park, Brixton	9	56%
Bellevue	7	86%
Bellevue East	8	75%
Berea	6	67%
Bertrams	16	75%
City and Suburban	2	100%
Doornfontein	3	67%
Fordsburg	4	75%
Glenesk, New Centre, Village Main	4	75%
Jeppestown	11	45%
Johannesburg	1	0%
Kenilworth	8	75%
Kensington	17	47%
La Rochelle, The Hill (Ext 1)	9	78%
Linmeyer	9	56%
Marshalls Town	3	67%
Melville, Triomf	9	44%
New Doornfontein, Troyeville, Fairview	16	50%
Newtown	3	0%
Oakdene	5	60%
Observatory	10	70%
Park Town, Braamfontein, Hillbrow	4	50%
Towerby, Forest Hill, Townview	7	29%
Turffontein	8	38%
Yeoville	4	75%
Total / Average	**183**	**58%**

To investigate leakage rates further, two categories of properties were defined, i.e. a Residential category consisting of houses on individual stands, and an Other category, consisting of non-domestic users and bulk domestic users such as blocks of flats. Table 5.11 provides an analysis of the results for these two categories.

Table 5.11 Leakage per property type

Category	User type	No. of properties	Fraction with on-site leaks	Ave leakage rate (l/h)
Residential	Houses on individual properties	128	60%	25.7
	Total	**128**	**60%**	**25.7**
Other	Offices and office blocks	7	29%	5.4*
	Blocks of flats	20	81%	60.1*
	Shops	5	0%	0.0
	Hotel and guest houses	2	100%	4.2*
	Schools	3	67%	256.2*
	Churches	8	50%	14.8*
	Other	9	44%	69.9*
	Total	**55**	**56%**	**77.7**
All		**182**	**59%**	**40.7**

Note: * uncorrected values

Table 5.11 shows that the fractions of properties with on-site leakage are similar for the two categories, with 60% of residential and 56% of other properties showing on-site leakage. However, there is a clear difference between the average leakage rates of 25.7 l/h and 77.7 l/h for residential and other properties respectively. Blocks of flats are particularly problematic with both a large frequency of leakage and large leakage rates. It is not possible to make similar conclusions for other users in the Other category due to the few data points available. The reason for Other properties to have higher average leakage rates is likely to be that they would typically have more extensive on-site plumbing systems and thus a larger potential for leakage to occur. An additional reason might be that the cost of water is of less significance to other users, or that water consumption is not monitored by these users.

The frequency distribution graphs of leakage rates on Residential and Other properties are shown in Figures 5.4 and 5.5 respectively. In both cases the leakage rates display an exponential frequency distribution with most leaks occurring in the lowest flow rate category, and the number of leaks reducing exponentially as the leakage rate increases. The lack of on-site leaks is below 10 l/h on Residential properties, and below 25 l/h for Other properties is as a result of the starting flow rates of the municipal flow meters used. The distributions seem to indicate that these categories should contain the highest frequency of leaks, and thus that the properties where no leakage was detected, would most likely have leaks that are too small to register on the flow meters.

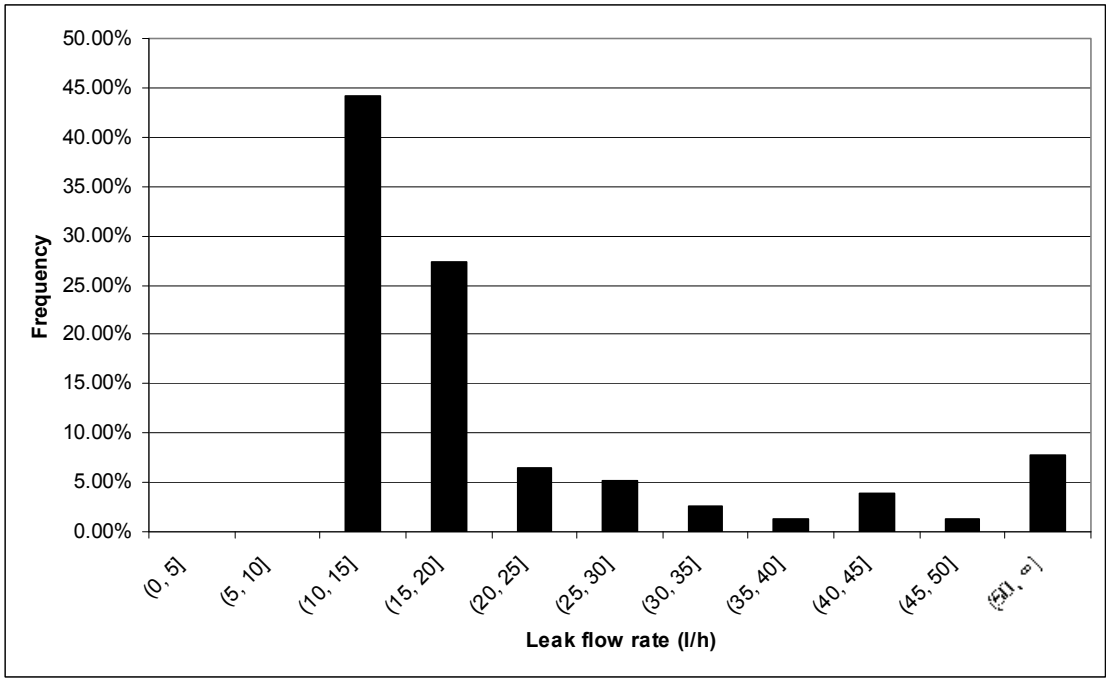


Figure 5.4 Distribution of leak flow rates for residential properties with on-site leaks

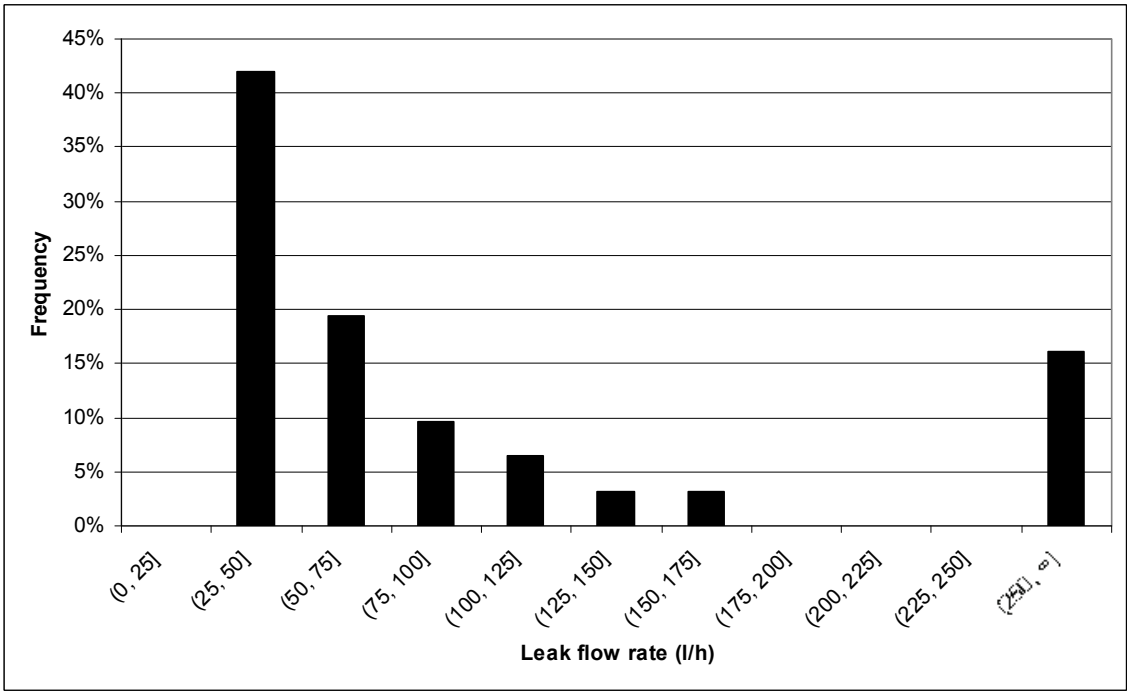


Figure 5.5 Distribution of leak flow rates for other properties with on-site leaks

Figure 5.6 shows the cumulative frequency distributions for Residential and Other properties with on-site leakage. The graphs show similar trends with most leaks relatively small, and a few large leaks causing the extended 'tails' of the graphs. This means that the average on-site leakage can be reduced significantly by fixing the leaks on the few properties with very large leaks.

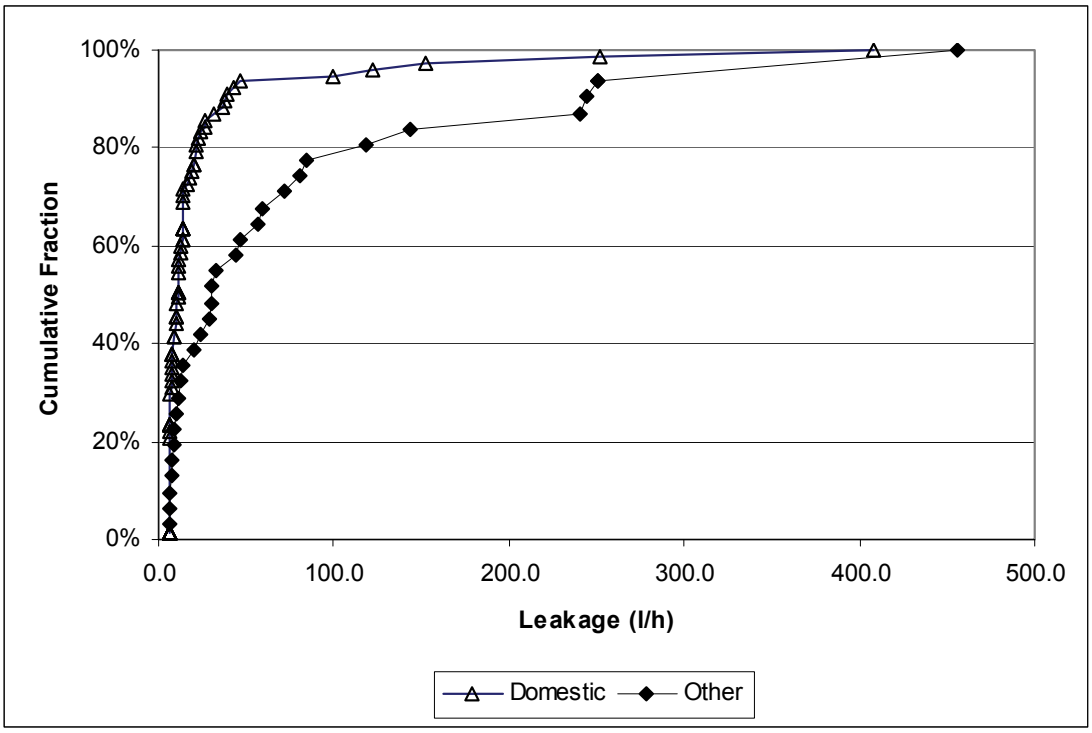


Figure 5.6 Cumulative frequency distributions of leak flow rates on residential and other properties with on-site leaks

5.7 The impact of meter accuracy

Municipal water meters are sized for typical consumption flow rates and are least accurate when measuring small flows such as leaks. This means that the smallest leaks will not be measured at all, and that larger leaks will frequently be under-registered, resulting in a loss of income for the municipality. An estimate of the under-registration loss can be made by comparing the leakage rates before and after corrections for meter accuracy where on-site leakage was found, and considering the starting flow rate of meters where no on-site leakage was found.

Under-registration of water meters is regarded as an apparent loss, since it is normally a component of consumption that is not measured. In the case of on-site leakage, the under-registration of the leakage rate can also be seen as an apparent loss from the municipality's point of view, since it represents a loss of revenue for them. However, from a more holistic viewpoint, both the registered and under-registered on-site leakage are still leakage, and should be identified and repaired to ensure that the minimum water is wasted.

The average corrected leakage rate on Residential properties was 25.7 l/h compared to the uncorrected average leakage rate of 23.3 l/h. This means an average under-registration of leakage of 2.4 l/h, or 1.7 kl/month per Residential property. Assuming an average residential consumption of 30 kl/month, this represents (from a municipality's point of view) an apparent loss of approximately 6%. If the leakage on properties where no on-site leakage was recorded was assumed equal to the starting flow rate of the

meter, the average leakage on these Residential properties can be as high as 6.1 l/h (4.4 kl/month) per property, which represents a maximum apparent loss of 15%.

The average corrected and uncorrected flow rates for Other properties were 77.7 and 61.0 l/h respectively. This is equivalent to an under-registration of 6.7 l/h or 4.8 kl/month. If the leakage on properties where no on-site leakage was recorded was assumed equal to the starting flow rate of the meter, the average leakage on these Other properties can be as high as 19.7 l/h, or 14.2 kl/month per property.

In both cases, the frequency distribution of leakage rates indicated that leakage rates lower than the starting flow rates of the meters will follow an exponential distribution, with most leaks being very small and the number of leaks reducing rapidly with increasing leakage rates. If it is assumed that the average on-site leakage rate in properties where no leaks were registered is one third of the starting flow of the meters, the average under-registration of leakage on Residential properties is estimated as 3.9 l/h (2.8 kl/month) per property, and the average under-registration on Other properties as 12.4 l/h (8.9 kl/month) per property.

5.8 Conclusions

A study of 182 randomly selected properties in Johannesburg showed that 59% of the properties had on-site leaks present. The average leakage rate of leaking properties was found to be 40.7 l/h, or 30 kl/month. The average leakage rate for all properties was 24.2 l/h, or 17 kl/month.

On-site leakage rates were found to follow an exponential frequency distribution with most leaks being small, meaning that the leakage rate will frequently be lower than the starting flow of a municipal water meter (and will thus not be measured), or in the range of least accuracy of the meter (and thus be under-registered). A rough estimate based on the survey conducted showed that the apparent losses for a municipality due to on-site leakage is 3.9 l/h (2.8 kl/month) per Residential (houses on single stands in suburbs) property, and 12.4 l/h (8.9 kl/month) per Other (non-domestic and large domestic) property.

CHAPTER 6: CASE STUDIES

6.1 Introduction

A number of case studies were investigated to illustrate specific issues in plumbing systems.

6.2 Rural water supply scheme in Venda

A study on rural water supply was done by Haarhoff and Rietveld 2008) in 21 villages with 9 000 inhabitants in the Upper Nwanedi Basin in Venda during October 2007. The area was served by 108 public standpipes (with one or two taps) serving between four and 30 households each. The area has a dedicated maintenance officer responsible for repairing or replacing broken taps, even though it was found that he lacked some basic tools to perform his work.

Various problems with taps were observed, including broken handles, stripped threads on valve spindles, leaking gland seals and worn washers. The first two problems render a standpipe unusable, while the latter two cause intermittent or continuous leakage from the tap.

Of the 108 standpipes supplying the area, 45% had SABS approved taps, 41% had non-compliant taps and 13% did not have any taps at all. Only 4% and 9% of the standpipes with taps were found to be leaking and broken respectively. This relatively low fraction is probably due to a dedicated maintenance officer looking after the taps in the area. However, this officer does not purchase taps or tap components himself, and thus the local water supply authority that is directly responsible for the supply of the large fraction of non-compliant fittings.

The authors found that the tap is the most important component of a standpipe installation and has to be exceptionally robust to withstand the high wear and tear due to frequent use, occasional abuse and some vandalism. Even the best taps would have a considerably lower working life than other components in the supply system, and the authors stress the importance of a systematic procedure for maintenance and replacement of taps in rural supply systems.

It is recommended that special specifications and maintenance requirements are developed and enforced for standpipes to ensure that these often marginalised communities are provided with an adequate water supply and that water leakage is minimised. Even if this means a substantial increase in the cost of the taps, the additional cost is likely to be negligible compared to the cost of the whole supply system and the consequences of not supplying rural people with a sustained and adequate level of service.

6.3 Urban system - Munsieville

A project to address leakage on private properties was done by the Alliance to Save Energy in Munsieville Proper and Extension 1, suburbs of the Mogale City Local Municipality (formerly Krugersdorp) (Alliance to Save Energy, 2007). This area served is an old part of the Municipality of Mogale City and the existing infrastructure was found to consist mostly of old galvanized pipes in a corroded state. The project covered 1 371 units, housing approximately 5 200 people.

The main objective of the project was to develop replace plumbing fittings (cisterns, taps, pipes, etc) on private properties in a previously disadvantaged community in order to reduce the identified high level of wastage. This simultaneously addressed municipal cost recovery for the provision of the basic services. In addition, the project aimed at creating jobs and skills, empowering the local community, community awareness and upliftment and energy and cost savings.

The project consisted of a thorough inspection and audit of properties in Munsieville to determine the state of plumbing and leakage from plumbing components. The minimum night flow of the area was determined to estimate the total leakage from the system. After replacing plumbing fittings, the audit and minimum night flow measurements were repeated to estimate the impact of the project on leakage. Since the project only focussed on fixing plumbing components, the improvement in leakage from the area provides a good indication of the on-site leakage prior to the project.

The main result of the project was a 38% reduction in leakage based on minimum night flow measurements. Since repairs were only done on plumbing fittings in private properties and excluded leaks on pipes, it may be concluded that the level of on-site leakage in Munsieville was significantly higher than 40%. The Project concluded that toilet cisterns were the main source of leakage in the area.

The total saving in water used in Munsieville was 155 784 kl per year, representing an annual savings in municipal bulk water purchases of R351 962.

6.4 Components Supplied by Plumbing Retailers

An investigation was done to determine the availability and price of SABS approved and non-approved products on the market. Ten suppliers of plumbing fittings in the Johannesburg area were visited to obtain the retail prices for the following five components:

- Angle valve. This valve is installed in a wall to connect the flexible pipe leading to a toilet cistern to the plumbing system.
- Standard 20 mm (¾ “) garden tap
- Single 15 mm (½ “) kitchen sink tap

- Kitchen sink mixer tap
- Toilet cistern components. This included all the components that regulate the filling and flushing mechanisms inside a toilet cistern.

For each component the prices for the cheapest SABS approved and non-approved fittings were obtained. In some cases an employee of the supplier assisted with the investigation, and the possibility of such a person hiding the fact that non-compliant fittings are sold should not be disregarded. Thus the results of this investigation are likely to underestimate the prevalence of non-compliant fittings. The suppliers visited fall in three broad categories, i.e.:

- Building suppliers
    - Build it (Edenvale, Van Riebeeck avenue)
    - Builders Warehouse (Edenvale)
    - Cashbuild (Protea gardens, Old Potchefstroom road)
- Hardware stores
    - I.B Hardware (Alexandra, 1st avenue)
    - Kliptown Timber and Hardware (Walter Sisulu Square, Union road)
    - Mega Mica Eastgate (Eastgate Mall)
    - Protea Hardware (Old Potchefstroom road)
    - Takolias hardware (Kliptown, Walter Sisulu Square)
- Plumbing suppliers
    - Build Plumb and Tile (Cresta, Beyers Naude)
    - On-tap Plumbing and Hardware Supplies (254 Northriding)

The results of the analysis show that a mix of SABS approved and non-approved plumbing fittings are sold. Hardware stores seem to present the largest problem with only 40% of the products investigated carrying the SABS mark. In 16% of cases hardware stores had both compliant and non-compliant products available. In these cases the non-compliant product was always the same price or cheaper than the compliant product, giving an incentive to the consumer to buy the non-compliant product. On average the approved product was 50% more expensive than the approved product, and ranged between 0% and 135%.

Building suppliers generally supplied either an SABS approved or non-approved product, but had significantly fewer non-compliant products than hardware stores. Plumbing suppliers had the best performance, although some non-compliant products were found.

6.5 RDP Housing

South Africa has a large housing backlog amongst poorer communities and the Government has various programmes aimed at rectifying this situation. These houses are commonly knows as RDP houses.

To investigate the quality of plumbing fittings in RDP housing developments, a visit was made to a randomly selected RDP house in each of ten different RDP developments in Johannesburg and Tshwane. The house owner was approached and the plumbing fittings were inspected with his or her permission. The inspection focussed on three fittings: outside tap, inside tap and toilet flushing mechanism, and specifically checked for an SABS mark and problems with the fittings. It was also checked if the toilet was supplied with an angle or shut-off valve, and whether it was leaking. The main findings of the investigation are as follows:

- The average age of the houses inspected was less than 1.5 years.
- 40% of the houses had no tap inside the house.
- 80% of the houses had no angle or shut-off valve installed for the toilet.
- 50% of the houses had leaking toilets.
- Of the 26 fittings inspected, only two (8%) displayed the SABS mark.
- Of the 26 fittings inspected, 14 (53%) were broken or had a problem such as a leak.

The complete results with pictures of some of the fittings are included in Appendix F.

The data show that the plumbing fittings being installed in RDP housing are inadequate. Less than 10% of the fittings displayed the SABS mark. Forty percent of the houses did not even have a tap inside the house, meaning that the inhabitants have to go outside to wash their hands after using the bathroom or fetch water for cooking and washing. This is a severe inconvenience and does not promote healthy living conditions.

The lack of quality fittings installed is clearly reflected in the fact that more than 50% of the fittings were broken or leaking, and that 50% of the toilets were leaking. The severity of the problem is highlighted by the fact that the average house at the time of inspection age was less than 1.5 years.

RDP housing is supplied to poor and vulnerable people, who can often not afford to replace faulty plumbing fittings or large water accounts due to leakage. It is thus of the greatest importance that RDP houses are fitted with high quality plumbing fittings that will operate with minimum maintenance for many (say in excess of 20) years. The investigation of RDP units showed that this requirement is not being met in the least. In addition, the legal requirements for plumbing fittings are largely being ignored, resulting in fittings failing after short periods of time and a very negative outlook for leakage in RDP developments.

We recommend that a thorough study is conducted to ascertain the state of plumbing fittings in RDP developments in South Africa, and action is taken to rectify this problem in current and future housing developments.

CHAPTER 7: CONCLUSIONS AND RECOMMENDATIONS

7.1 Introduction

The main goals of this project were to investigate the level of compliance of plumbing fittings installed in South Africa, as well as the extent of leakage from plumbing fittings (on-site leakage). This chapter gives a summary of the main findings of the project, considers the implications for future water demand, and finally makes some recommendations for action or further research.

7.2 Main findings

The Water Services Act makes it illegal to install any plumbing component that does not comply with the relevant specifications listed in the latest versions of SANS 10252 and 10254. However, compliance does not mean that the component has to bear the SABS mark. WSAs have the right to impose their own requirements through bylaws and maintain their own schedules of approved products, as long as these products can also be shown to comply with SANS 10252 and 10254. JASWIC ensures compliance of non-SABS mark holders by requiring suppliers of these products to enter into a standard contract with the SABS, ensuring that regular inspections and compliance tests are carried out.

An important point is that the law does not prohibit the import and sale of non-compliant products, but only the installation thereof. The responsibility for enforcing the law is thus placed solely on the shoulders of local authorities, who should ensure compliance through measures such as maintaining a schedule of approved products, site visits, building inspections and registration of plumbers. However, it became clear throughout this project that very few municipalities actually enforce the laws on plumbing components, and that many non-compliant plumbing components are being installed in buildings. Only one local authority, that of Cape Town, was found to have a system of water inspectors whose task it is to ensure compliance to their water bylaws.

In our opinion, the main reasons for this lack of enforcement are inadequate understanding of the need for maintaining high technical standards, lack of commitment to this aim, and as a result, a severe shortage of technical staff at local government level. Lawless (2007) found that local governments in South Africa have on average three civil engineering professionals (engineers, technologists and technicians) per 100 000 population, which compares very unfavourably with around 22 civil engineering professionals per 100 000 population in developed countries. In addition around 30% of municipalities in South Africa have no civil engineering professional employed. There is no way that local government can provide even basic infrastructure services with these numbers of civil engineering professionals, and enforcing plumbing legislation is probably much lower on their priority lists. Unless this situation improves dramatically, there is

little hope that the situation regarding compliance will improve substantially in future.

Specific findings of this study are listed below under general, compliance of plumbing fittings and on-site leakage.

General

- High quality plumbing systems are essential to ensure that water supplied is used effectively, and leakage is minimised.

- While South Africa arguably has sufficient national legislation governing plumbing installations, this is not always the case at local government level.

- South African law is clear that only plumbing components that comply with SANS 10252 and 10254 are allowed to be installed in South Africa. However, a number of worrying trends were found in this study that do not support the provision of high quality plumbing systems, and may have severe implications for future water demands and leakage in South Africa.

- Few Water Services Authorities have effective systems to enforce national and local legislation.

Compliance of Plumbing Fittings

It was found that a substantial fraction, approximately 50%, of plumbing components installed do not comply with the legal requirements. This is evident from the following findings:

- 58% of the plumbing components available on the market were found to be non-compliant.
- According to a survey of plumbers, 43% of products installed are non-compliant and 52% of plumbers install non-compliant products.
- In interviews with representatives of local manufacturers, the representatives agreed that around 50% of products installed are non-compliant.
- A preliminary investigation into plumbing components installed in RDP houses indicated that more than 90% of components are non-compliant.
- A study of rural villages in Venda showed that only 45% of standpipes had compliant taps, 41% had non-compliant taps and 13% had no taps installed.
- An investigation into the availability of plumbing fittings at a number of retailers in the Johannesburg area showed that non-SABS compliant fittings are commonly sold, with hardware stores being the main culprits. On average, fittings bearing the SABS mark were 50% more expensive than those that do not, providing a strong incentive for consumers to purchase the non-compliant product.

The main reasons for the high level of non-compliance are the lack of enforcement of the legislation at

local government level, and the fact that there is no prohibition on the import and sale of non-compliant products. In some instances where national and local government play leading roles in service provision to the poor (in particular RDP housing and a rural water supply), the problem of non-compliance was found to be particularly bad and even caused by government purchasing non-compliant products.

The consequences of such a high fraction of non-compliant plumbing products are dire and include:

- Undermining authority of government and the law if government do not comply to own rules.
- Potential negative health impacts by contamination of the drinking water through failed components or leaching of chemicals such as lead, iron, arsenic, copper from plumbing components made from sub-standard materials.
- Higher fail frequencies and shorter life-spans and of plumbing components, resulting in greater future damage to property and higher water losses. This was evident in the investigation of RDP houses, where the majority of non-compliant products failed in a very short period of time (less than 1.5 years) and 50% toilets were found to be already leaking.
- Undermining of local plumbing manufacturing industry, resulting in closure of manufacturers and job losses, since they are not able to compete in a fair manner with imported poor quality and non-compliant products.

On-site Leakage

- A study of 182 randomly selected properties in Johannesburg showed that at least 59% of the properties had on-site leaks present. The average leakage rate on properties where leaks could be measured was found to be 40.7 l/h, or 30 kl/month. The average leakage rate for all properties (those where leaks could be measured and those where any leaks were too small to be measured) was 24.2 l/h, or 17 kl/month. The implication is that almost a significant fraction of municipal water consumption is made up of on-site leakage.

- Residential (houses on single stands in suburbs) and Other (non-domestic and large domestic) properties showed similar frequencies of on-site leakage occurring. However, there was a significant difference between the average leakage rates of 25.7 l/h and 77.7 l/h for Residential and Other properties respectively.

- Blocks of flats were found particularly to be problematic with both a large frequency of leakage and large leakage rates.

- On-site leakage rates were found to follow an exponential frequency distribution with the smallest leaks having the highest rate of occurrence. This indicates that on-site leakage rates will frequently be lower than the starting flows of municipal water meters (and will thus not be measured), or in the range of least accuracy of the meter (and thus be under-registered). An estimate based on the survey conducted

showed that the apparent losses for a municipality due to on-site leakage is 3.9 l/h (2.8 kl/month) on residential (houses on single stands in suburbs) properties, and 12.4 l/h (8.9 kl/month) on other (non-domestic and large domestic) properties.

- Significant on-site leakage is present in township areas as shown in a study in Mohale City's Munsieville Township, where the on-site leakage was found to be in excess of 40% of total consumption.

7.3 Implications for future water demand

High quality plumbing systems are essential to ensure that water supplied is used effectively, and leakage is minimised. A number of worrying trends were found in this project that do not support the provision of high quality plumbing systems, and may have severe implications for future water demands and leakage in South Africa.

Not all municipalities have water bylaws or systems in place to enforce these bylaws. This means that inferior products can be installed, resulting in inefficient water use and high leakage levels.

There is clearly a problem with leakage in certain township areas and this problem is likely to continue and increase unless action is taken to find a sustainable solution to the problem. It is likely that many areas where water is not billed by volume consumed, or where payment for water is low, will experience similar levels of on-site leakage to Munsieville (in excess of 40%).

The investigation on the state of plumbing fittings in ten RDP houses showed large problems with the quality of fittings used and leakage even in recently constructed houses. This problem can be expected to increase in future and needs to be addressed urgently to stop and reverse this trend.

7.4 Recommendations

Government Departments and Institutions

- National legislation should be developed to stop or restrict suppliers of plumbing fittings to distribute non-compliant products.

- National Departments (including DWAF, DTI, DoL, and DoE) should be made aware of the critical importance of enforcing current laws and national standards for plumbing materials, fittings, and workers.

- The SABS should make information on specific approved products available to the public, and not only give the names of companies who are mark holders.

- The SABS should take stronger action against companies using their mark incorrectly.

- CETA should address problems currently restricting adequate numbers of plumbers to be trained in practice.

- The insurance industry should be encouraged through legal or other means to make compliance of plumbing fittings a requirement of their policies and to ensure that only compliant fittings are installed when honouring insurance claims.

- Special specifications and maintenance requirements should be developed and enforced for standpipes to ensure that these often marginalised communities are provided with an adequate water supply and that water leakage is minimised. Even if this means a substantial increase in the cost of the taps, the additional cost is likely to be negligible compared to the cost of the whole supply system and the consequences of not supplying rural people with a sustained and adequate level of service

- Serious consideration should be given to national legislation to encourage the use of 'leak free' toilet systems and external cistern overflows.

- Legislation should be passed that a property requires a certificate of compliance for its plumbing system when transferring ownership, similar to that currently required for electrical systems.

Local Authorities

- Local Authorities should be made aware of the critical importance of enforcing current laws and national standards for plumbing materials, fittings, and workers.

- Local authorities should be required to enforce water bylaws through a system of specialised and trained water inspectors empowered to enforce the bylaws.

- Public awareness campaigns should be launched to make property owners and tenants aware of the prevalence and implications of on-site leakage and ways to check and control these losses.

- Certain relatively small actions, such as only high quality washers to be sold and requiring external overflows for toilets can make a large difference in on-site leakage and should be considered.

Plumbing Industry

- A Government recognised national register of qualified plumbers should be considered as a way to

control the quality of plumbing work done.

- JASWIC should develop a stronger framework of requirements, rules and tests for the adoption of plumbing fittings in its list of approved products. It should also consider stronger measures to encourage manufacturers included in its list to get the SABS mark for their products.

- A workshop involving Government, Local Authorities, plumbing manufacturers and suppliers, the SABS and representatives of plumbers should be held to discuss solutions to the problems highlighted in this report.

Research Institutions

- Further research should be conducted on water bylaws and their enforcement at the different water services providers in South Africa.

- A study should be commissioned to ascertain the level of on-site leakage in all areas where water consumption is not individually metered, or where payment levels are low. This study should propose a systematic method whereby the problem of on-site leakage in these areas is addressed in a sustainable way.

- A thorough study should be commissioned to ascertain the state of plumbing fittings in RDP developments in South Africa, and action is taken to rectify this problem in current and future housing developments.

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APPENDIX A: SABS STANDARDS RELEVANT TO THE PLUMBING INDUSTRY

Standard	Year	Title	Notes
SANS 11	2001	Unplasticised polyvinyl chloride (UPVC) components for external rainwater systems	
SANS 22	1975	Glazed ceramic wall tiles and fittings	
SANS 32	1997	Internal and/or external protective coatings for steel tubes - Specification for hot dip galvanized coatings applied in automatic plants	
SANS 62-(1 & 2)	2001	Steel pipes.	
SANS 151	2002	Fixed electric storage water heaters	
SANS 191	2000	Cast steel gate valves	
SANS 198	2001	Functional-control valves and safety valves for domestic hot and cold water	
SANS 226	1987	Water taps (metallic)	
SANS 242	1973	Stainless sinks with draining boards (for domestic use)	
SANS 460	1985	Copper tubes for domestic plumbing services	
SANS 497	1991	Glazed ceramic sanitaryware	
SANS 514	1999	Immersion heaters for electric storage water heaters	
SANS 533-(1 to 3)	1982, 1982 & 1985	Black polyethylene pipes for the conveyance of liquids	
SANS 546	1977	cast iron fittings for asbestos cement pressure pipes	
SANS 559	1970	Vitrified clay sewer pipes and fittings	
SANS 664	1973	Rubber insertion sheeting	
SANS 665	2000	Cast iron gate valves for general purposes	
SANS 676	1986	Reinforced concrete pressure pipes	
SANS 677	1986	Concrete non-pressure pipes	
SANS 746	1976	Cast-iron pipes and pipe fittings or use above ground in drainage installations	
SANS 776	2000	Copper alloy gate valves - Heavy duty	
SANS 791	2002	Unplasticised polyvinyl chloride (PVC-U) sewer and drain pipes and pipe fittings	
SANS 815	1978	Shouldered-end pipes and fittings and couplings	

SANS 815-1	2002	Shoulder-ended and groove-ended piping systems. Part 1: Shoulder ended steel pipes, fittings and couplings	
SANS 819	1999	Fibre-cement pipes, couplings and fittings for sewerage, drainage and low-pressure irrigation	
SANS 821	2002	WC flashing cisterns	
SANS 921	1994	Pitch-impregnated fibre pipes fittings and jointing.	
SANS 924	1972	Stainless steel stall urinals	
SANS 966-(1 & 2)	2000 & 2002	Components of pressure pipes systems	
SANS 967	1999	Unplasticised poly(vinyl chloride) (PVC-U) soil, waste and vent pipes and pipe fittings	
SANS 974-1	1986	Rubber joints rings (non-cellular) Part 1: Joint rings for use in water, sewer and drainage systems	
SANS 975	1970	Pressed concrete pipes	
SANS 986	2000	Pre-cast reinforced concrete culverts	
SANS 988	1971	Braided reinforced rubber hose for air and water	
SANS 1021	2002	Water taps (plastic bodies)	
SANS 1028	1975	Pipe wrenches	
SANS 1067-(1 & 2)	2000	Copper based fittings for copper tubes	
SANS 1086	1976	Flexible polyvinyl chloride (PVC) pressure hose	
SANS 1109-1	1990	Pipes threads where pressure-tight joints are made on the threads Part 1: designation, dimensions and tolerances	
SANS 1115	1976	Cast iron gratings for gullies and stormwater drains	
SANS 1117	1977	Plastics wrappings for the protection	
SANS 1123	2000	Pipe flanges	
SANS 1125	2001	Room air conditioners and heat pumps	
SANS 1200 (AD,DB,DE,L,LB,LD,LE,LF & MK)	1982 -1989	Standardised specification for civil engineering construction	
SANS 1209	1984	Pipe holderbats	
SANS 1223	2000	Fibre-cement pressure pipes and couplings	
SANS 1240	2002	Automatic shut-off flush valves for water closets and urinals	

SANS 1283	2002	Modified poly(vinyl chloride) (PVC-M) pressure pipe and couplings for cold water services in underground mining	
SANS 1306-1	1990	Pipe threads where pressure-tight joints are not made on the threads Part 1: Designation, dimensions and tolerances	
SANS 1307	1992	Domestic solar heaters	
SANS 1315	2002	Polypropylene pressure pipes	
SANS 1321-(1 & 2)	1981 & 1982	Non-metallic waste traps	
SANS 1356	1982	Fixed electric instantaneous water heaters	
SANS 1476	1989	Fabricated flanged steel pipeworks	
SANS 1480	2000	Single control mixer taps	
SANS 1509	2002	Flush valves for WC flushing cisterns	
SANS 1532	1991	Vent valves for drainage installations	
SANS 1551-(1 & 2)	2000	Check valves (flanges and water types)	
SANS 1601	1994	Structured wall pipes and fittings of uPVC for buried drainage sewerage systems	
SANS 1733	2000	WC flashing systems (low-flushing capacity) that operate with flushing cisterns	
SANS 1748-1	1998	Glass-fibre-reinforced thermosetting plastics (GRP) pipes Part 1: Pipes for water supply, sewerage or drainage	
SANS 1808-(2,5,8,9,10,13,16,18,24,30,31,32,35,37,44,45,58 & 66)	1998 - 2001	Water supply and distribution systems components	
SANS 1847-1	1999	Glass-fibre-reinforced plastics (GRP) cistern for the storage of water Part 1: One piece cisterns of nominal capacity up to and including 500 litres	
SANS BS 7491-(2 & 3)	1992 & 1994	Glass-fibre-reinforced plastics cistern BS 7491-2: 1994 IDT and BS 7491-3: 1994 IDT cold-water storage	
SANS 4427	1996	Polyethylene (PE) pipes for water supply - Specifications	
SANS 5828	1983	Resistance welding equipment - Secondary connecting cables with terminals connected to water-cooled lugs - Dimensions and characteristics	

SANS 50295-(1 & 3)	1994 & 1991	Vitrified clay pipes and fittings and pipe joints for drains and sewers	
SANS 50545	1994	Ductile iron pipes, fittings, accessories and their joints for water pipelines - Requirements and test methods	
SANS 50598	1994	Ductile iron pipes, fittings, accessories and their joints for sewerage applications - Requirements and test methods	
SANS 10106	1972	Solar water heaters	
SANS 10120-(2AD,2LB,2LD, 2LE,2LF,2MK,3AD,3DE,3L,3LB,3LD,3LE,3LF,3MK,4AD,4DE,4L,4LB,4LD,4LE,4LF,4MK,5AD,5D,5L,5LB,5LD,5LE,5LF & 5MK	1982 - 1986	Code of practice for use with standardized specifications for civil engineering construction and contract documents	
SANS 10125	1976	The installation of flexible membrane linings in earth embankment reservoirs	
SANS 10252-(1 & 2)	1994 &1993	Water supply and drainage for buildings	
SANS 10254	2000	The installation, maintenance, replacement and repair of fixed electric storage water heating systems	Geysers' work have to comply with this standard. It is specified that a plumber is obliged to inform a building owner by writing a report if the building's plumbing system is not compliant.
SANS 10306	1999	The management of potable water in distribution systems	
SANS 10400	1990	The application of the National Building Regulations	It defines a "trained plumber". A trained plumber is the people who obtains a "Plumbing trade test certificate" or a "National certificate in construction plumbing at NQF/Level 3"

APPENDIX B: SABS LIST OF APPROVED COMPONENTS

SABS MARK HOLDERS

(Adapted from SABS Website. Accessed 17 March 2008)

SANS 151 / SABS 151
FIXED ELECTRIC STORAGE WATER HEATERS

Permit No	Company	Specification No	Telephone	Region	Industry
163/530	Kwikot (Pty) Ltd	SANS 151 / SABS 151	(011) 914-2300	Gauteng	Electrotechnical
3569/5183	City Heat Geysers CC	SANS 151 / SABS 151	(031) 461-3555	KwaZulu-Natal	Electrotechnical
5676/8232	Xstream Geysers	SANS 151 / SABS 151	(021) 872-0900	Western Cape	Electrotechnical
6730/9988	Franke Water Heating Systems (Pty) Ltd	SANS 151 / SABS 151	(011) 357-3442	Gauteng	Electrotechnical
6802/10101	W.E. Geysers (Pty) Ltd	SANS 151 / SABS 151	(011) 769-1387	Gauteng	Electrotechnical
7723/12383	Geyser Allied Products (Pty) Ltd	SANS 151 / SABS 151	(011) 392-3059	Gauteng	Electrotechnical
5717/8382	Tecron Water Heating (Pty) Ltd	SANS 151 / SABS 151	(021) 5350137	Western Cape	Electrotechnical

SANS 191 / SABS 191
CAST STEEL GATE VALVES

Permit No	Company	Specification No	Telephone	Region	Industry
539/1065	Ainsworth Engineering (Pty) Ltd	SANS 191 / SABS 191	(011) 433-3968	Gauteng	Mechanical, Metallurgical

SANS 198 / SABS 198
SAFETY VALVES

Permit No	Company	Specification No	Telephone	Region	Industry
1182/4020	Dutton Plastics Engineering (Pty) Ltd	SANS 198 / SABS 198	(011) 617-5000	Gauteng	Mechanical, Metallurgical
1085/2076	Cobra Watertech (Pty) Ltd - Coppinger Street	SANS 198 / SABS 198	(011) 9515059	Gauteng	Mechanical, Metallurgical
1141/2227	Marley Pipe Systems (Pty) Ltd	SANS 198 / SABS 198	(011) 8266228	Gauteng	Mechanical, Metallurgical
5279/13074	Parker Manufacturing (Pty) Ltd	SANS 198 / SABS 198	(011) 474-1989	Gauteng	Mechanical, Metallurgical
6332/9321	Caleffi S.p.A	SANS 198 / SABS 198	(09390) 322-8491	Italy	Mechanical, Metallurgical
6336/9327	Hans Sasserath & Co KG	SANS 198 / SABS 198	(094921) 616-1050	Germany	Mechanical, Metallurgical
6365/9378	Apex Valves South Africa (Pty) Ltd	SANS 198 / SABS 198	(012) 6640588	Gauteng	Mechanical, Metallurgical

SANS 226 / SABS 226
WATER TAPS (METALLIC BODIES)

Permit No	Company	Specification No	Telephone	Region	Industry
4491/6335	ISCA	SANS 226 / SABS 226	(011) 8829100	Gauteng	Mechanical, Metallurgical
6033/8816	Hans Grohe GmbH & Co KG	SANS 226 / SABS 226	(0949) 78365130	Germany	Mechanical, Metallurgical
757/673	Cobra Watertech (Pty) Ltd - Wright Street	SANS 226 / SABS 226	(011) 951 5134	Gauteng	Mechanical, Metallurgical
7793/12470	Grohe Water Technology AG & Co KG	SANS 226 / SABS 226	(09492372) 931604	Germany	Mechanical, Metallurgical
8187/12995	Guangdong Huayi Plumbing Fittings Industry Co Ltd	SANS 226 / SABS 226	(0986750) 271-2519	China	Mechanical, Metallurgical
8275/13127	Taizhou Fenghwa Brassworks Co Ltd	SANS 226 / SABS 226	(011) 483-3882	China	Mechanical, Metallurgical

SANS 460 / SABS 460
PLAIN-ENDED SOLID DRAWN COPPER TUBES FOR POTABLE WATER

Permit No	Company	Specification No	Telephone	Region	Industry
2684/5315	Maksal Tubes (Pty) Ltd	SANS 460 / SABS 460	(011) 8131240	Gauteng	Mechanical, Metallurgical
4394/6510	Copper Tubing Africa (Pty) Ltd	SANS 460 / SABS 460	(011) 615-7193	Gauteng	Mechanical, Metallurgical
8021/12789	Mueller Europe Limited	SANS 460 / SABS 460	(09441902) 499700	United Kingdom	Mechanical, Metallurgical

SANS 664 / SABS 664
CAST IRON GATE VALVES FOR WATERWORKS

Permit No	Company	Specification No	Telephone	Region	Industry
432/790	Dynamic Fluid Control (Pty) Ltd	SANS 664 / SABS 664	(011) 748-0200	Gauteng	Mechanical, Metallurgical
539/1065	Ainsworth Engineering (Pty) Ltd	SANS 664 / SABS 664	(011) 433-3968	Gauteng	Mechanical, Metallurgical
6864/10195	AVK International A/S	SANS 664 / SABS 664	(094586) 946999	Denmark	Mechanical, Metallurgical
7383/10951	Feixian Dae Ryuk Machinery Co Ltd/Sanspar Engineering Sales (Pty) Ltd	SANS 664 / SABS 664	(0986532) 57-8120	China	Mechanical, Metallurgical
7735/12399	Shanghai Johnson Valve Industries Co Ltd	SANS 664 / SABS 664	(0986215) 480-7903	China	Mechanical, Metallurgical
8335/13231	Qindao Huaguan Valve Company Limited/EPNS Engineering (Pty) Ltd	SANS 664 / SABS 664	(011) 452-7771	China	Mechanical, Metallurgical

SANS 665 / SABS 665
CAST IRON GATE VALVES FOR GENERAL PURPOSES

Permit No	Company	Specification No	Telephone	Region	Industry
432/790	Dynamic Fluid Control (Pty) Ltd	SANS 665 / SABS 665	(011) 748-0200	Gauteng	Mechanical, Metallurgical
539/1065	Ainsworth Engineering (Pty) Ltd	SANS 665 / SABS 665	(011) 433-3968	Gauteng	Mechanical, Metallurgical

SANS 752 / SABS 752
FLOAT VALVES

Permit No	Company	Specification No	Telephone	Region	Industry
1182/2262	Dutton Plastics Engineering (Pty) Ltd	SANS 752 / SABS 752	(011) 617-5000	Gauteng	Mechanical, Metallurgical
3612/1360	Cobra Watertech (Pty) Ltd - Springs	SANS 752 / SABS 752	(011) 8131110	Gauteng	Mechanical, Metallurgical
5279/7700	Parker Manufacturing (Pty) Ltd	SANS 752 / SABS 752	(011) 474-1989	Gauteng	Mechanical, Metallurgical
5795/13227	Geberit Technik AG/Geberit Southern Africa (Pty) Ltd	SANS 752 / SABS 752	(094155) 221-6373	Switzerland	Mechanical, Metallurgical
8251/13086	Wisa BV	SANS 752 / SABS 752	(09003126) 362-9020	Netherlands	Mechanical, Metallurgical
8274/13124	K & P Precision Tools	SANS 752 / SABS 752	(011) 882-6006	Gauteng	Mechanical, Metallurgical

SANS 776 / SABS 776
COPPER ALLOY GATE VALVES – HEAVY DUTY

Permit No	Company	Specification No	Telephone	Region	Industry
3612/1690	Cobra Watertech (Pty) Ltd - Springs	SANS 776 / SABS 776	(011) 8131110	Gauteng	Mechanical, Metallurgical

SANS 815-1 / SABS 815-1
SHOULDER-ENDED AND GROOVE-ENDED PIPING SYSTEMS PART 1: SHOULDER-ENDED STEEL PIPES, FITTINGS AND COUPLINGS

Permit No	Company	Specification No	Telephone	Region	Industry
5000/12439	Macsteel Tube and Pipe (Pty) Ltd	SANS 815-1 / SABS 815-1	(011) 897-2179	Gauteng	Mechanical, Metallurgical
7840/12535	Protea Engineering (Pty) Ltd	SANS 815-1 / SABS 815-1	(011) 914-2144	Gauteng	Mechanical, Metallurgical

SANS 815-2
SHOULDER-ENDED AND GROOVE-ENDED PIPE SYSTEMS PART 2: GROOVE-ENDED STEEL PIPES, FITTINGS AND COUPLINGS

Permit No	Company	Specification No	Telephone	Region	Industry
5000/12439	Macsteel Tube and Pipe (Pty) Ltd	SANS 815-2	(011) 897-2179	Gauteng	Mechanical, Metallurgical

SANS 821 / SABS 821
WC FLUSHING CISTERNS

Permit No	Company	Specification No	Telephone	Region	Industry
1182/2512	Dutton Plastics Engineering (Pty) Ltd	SANS 821 / SABS 821	(011) 617-5000	Gauteng	Mechanical, Metallurgical
5279/8184	Parker Manufacturing (Pty) Ltd	SANS 821 / SABS 821	(011) 474-1989	Gauteng	Mechanical, Metallurgical
5795/13228	Geberit Technik AG/Geberit Southern Africa (Pty) Ltd	SANS 821 / SABS 821	(094155) 221-6373	Switzerland	Mechanical, Metallurgical
5795/8468	Geberit Technik AG/Geberit Southern Africa (Pty) Ltd	SANS 821 / SABS 821	(094155) 221-6373	Switzerland	Mechanical, Metallurgical
8251/13087	Wisa BV	SANS 821 / SABS 821	(09003126) 362-9020	Netherlands	Mechanical, Metallurgical
8274/13125	K & P Precision Tools	SANS 821 / SABS 821	(011) 882-6006	Gauteng	Mechanical, Metallurgical

SANS 1056-2 /SABS 1056-2
BALLVALVES PART2: HEAVY DUTY VALVES (NOT FIRE-SAFE)

Permit No	Company	Specification No	Telephone	Region	Industry
3612/5154	Cobra Watertech (Pty) Ltd - Springs	SANS 1056-2 / SABS 1056-2	(011) 8131110	Gauteng	Mechanical, Metallurgical

SANS 1056-3 / SABS 1056-3
BALLVALVES PART 3: LIGHT DUTY VALVES (NOT FIRE-SAFE)

Permit No	Company	Specification No	Telephone	Region	Industry
3612/5154	Cobra Watertech (Pty) Ltd - Springs	SANS 1056-3 / SABS 1056-3	(011) 8131110	Gauteng	Mechanical, Metallurgical

SANS 1067-1 / SABS 1067-1
COPPER-BASED FITTINGS FOR COPPER TUBES PART 1: COMPRESSION FITTINGS

Permit No	Company	Specification No	Telephone	Region	Industry
3612/4768	Cobra Watertech (Pty) Ltd - Springs	SANS 1067-1 / SABS 1067-1	(011) 8131110	Gauteng	Mechanical, Metallurgical
4394/8412	Copper Tubing Africa (Pty) Ltd	SANS 1067-1 / SABS 1067-1	(011) 615-7193	Gauteng	Mechanical, Metallurgical

SANS 1067-2 / SABS 1067-2
COPPER-BASED FITTINGS FOR COPPER TUBES PART 2: CAPILLARY SOLDER FITTINGS

Permit No	Company	Specification No	Telephone	Region	Industry
2684/7124	Maksal Tubes (Pty) Ltd	SANS 1067-2 / SABS 1067-2	(011) 8131240	Gauteng	Mechanical, Metallurgical
3612/4768	Cobra Watertech (Pty) Ltd - Springs	SANS 1067-2 / SABS 1067-2	(011) 8131110	Gauteng	Mechanical, Metallurgical

SANS 1240 / SABS 1240
AUTOMATIC SHUT-OFF FLUSH VALVES FOR WATER CLOSETS AND URINALS

Permit No	Company	Specification No	Telephone	Region	Industry
1085/4966	Cobra Watertech (Pty) Ltd - Coppinger Street	SANS 1240 / SABS 1240	(011) 9515059	Gauteng	Mechanical, Metallurgical
7171/10637	Walker Crosweller (Pty) Ltd	SANS 1240 / SABS 1240	(011) 7931031	Gauteng	Mechanical, Metallurgical

SANS 1480 / SABS 1480
SINGLE CONTROL MIXER TAPS

Permit No	Company	Specification No	Telephone	Region	Industry
4491/6336	ISCA	SANS 1480 / SABS 1480	(011) 8829100	Gauteng	Mechanical, Metallurgical
5279/13075	Parker Manufacturing (Pty) Ltd	SANS 1480 / SABS 1480	(011) 474-1989	Gauteng	Mechanical, Metallurgical
5671/8221	Hansa Metallwerke AG	SANS 1480 / SABS 1480	(09497111) 614196	Germany	Mechanical, Metallurgical
6033/9408	Hans Grohe GmbH & Co KG	SANS 1480 / SABS 1480	(0949) 78365130	Germany	Mechanical, Metallurgical
757/5986	Cobra Watertech (Pty) Ltd - Wright Street	SANS 1480 / SABS 1480	(011) 951 5134	Gauteng	Mechanical, Metallurgical
7793/12471	Grohe Water Technology AG & Co KG	SANS 1480 / SABS 1480	(09492372) 931604	Germany	Mechanical, Metallurgical
8187/12996	Guangdong Huayi Plumbing Fittings Industry Co Ltd	SANS 1480 / SABS 1480	(0986750) 271-2519	China	Mechanical, Metallurgical
8275/13128	Taizhou Fenghwa Brassworks Co Ltd	SANS 1480 / SABS 1480	(011) 483-3882	China	Mechanical, Metallurgical

SANS 1509 / SABS 1509
FLUSHING DEVICES FOR WC FLUSHING CISTERNS

Permit No	Company	Specification No	Telephone	Region	Industry
1182/6922	Dutton Plastics Engineering (Pty) Ltd	SANS 1509 / SABS 1509	(011) 617-5000	Gauteng	Mechanical, Metallurgical

SANS 1532 / SABS 1532
VENT VALVES FOR DRAINAGE INSTALLATIONS

Permit No	Company	Specification No	Telephone	Region	Industry
1141/6923	Marley Pipe Systems (Pty) Ltd	SANS 1532 / SABS 1532	(011) 8266228	Gauteng	Mechanical, Metallurgical
4907/7081	Brix Enterprises	SANS 1532 / SABS 1532	(011) 682-2698	Gauteng	Mechanical, Metallurgical

SANS 1551-1 / SABS 1551-1
CHECK VALVES (FLANGED AND WAFER TYPES) PART 1: PN SERIES

Permit No	Company	Specification No	Telephone	Region	Industry
432/10831	Dynamic Fluid Control (Pty) Ltd	SANS 1551-1 / SABS 1551-1	(011) 748-0200	Gauteng	Mechanical, Metallurgical

SANS 1808-5 / SABS 1808-5
WATER SUPPLY AND DISTRIBUTION SYSTEM COMPONENTS PART 5: FLEXIBLE CONNECTORS

Permit No	Company	Specification No	Telephone	Region	Industry
6333/9322	Industrias Mateu SA	SANS 1808-5 / SABS 1808-5	(09003493) 564-7111	Spain	Mechanical, Metallurgical
7836/12528	Neoperl GmbH	SANS 1808-5 / SABS 1808-5	(09497631) 1880/9	Denmark	Mechanical, Metallurgical
8197/13008	Ningbo Tucai Flexible Pipe Co Limited	SANS 1808-5 / SABS 1808-5	(09865746) 248-1989	China	Mechanical, Metallurgical
8276/13129	Yuyao Shenlong Water-Heating Equipment Factory	SANS 1808-5 / SABS 1808-5	(011) 483-3882	China	Mechanical, Metallurgical
8446/13378	Taizhou Delibao Pipe Industry Co Ltd/Splashworks	SANS 1808-5 / SABS 1808-5	(0086576) 87371978	China	Mechanical, Metallurgical

SANS 1808-9 / SABS 1808-9
WATER SUPPLY AND DISTRIBUTION SYSTEM COMPONENTS PART 9: METERING TAPS AND VALVES (METALLIC BODIES)

Permit No	Company	Specification No	Telephone	Region	Industry
7171/10638	Walker Crosweller (Pty) Ltd	SANS 1808-9 / SABS 1808-9	(011) 7931031	Gauteng	Mechanical, Metallurgical

SANS 1808-16 / SABS 1808-16
WATER SUPPLY AND DISTRIBUTION SYSTEM COMPONENTS PART 16: DRINKING FOUNTAINS

Permit No	Company	Specification No	Telephone	Region	Industry
7171/10638	Walker Crosweller (Pty) Ltd	SANS 1808-16 / SABS 1808-16	(011) 7931031	Gauteng	Mechanical, Metallurgical

SANS 1808-35 / SABS 1808-35
WATER SUPPLY AND DISTRIBUTION SYSTEM COMPONENTS PART 35: ELECTRONICALLY OPERATED TAPS

Permit No	Company	Specification No	Telephone	Region	Industry
4491/12050	ISCA	SANS 1808-35 / SABS 1808-35	(011) 8829100	Gauteng	Mechanical, Metallurgical

SANS 1808-44 / SABS 1808-44
WATER SUPPLY AND DISTRIBUTION SYSTEM COMPONENTS PART 44: PIPE SADDLES

Permit No	Company	Specification No	Telephone	Region	Industry
393/12853	Marley Pipe Systems (Pty) Ltd	SANS 1808-44 / SABS 1808-44	(011) 7398600	Mpumalanga	Mechanical, Metallurgical
7746/12412	Plastica Alfa Srl	SANS 1808-44 / SABS 1808-44	(09390933) 51973	Italy	Mechanical, Metallurgical
8022/12790	Georg Fischer Alprene S.r.l./Alprene Plastics Products (Pty) Ltd	SANS 1808-44 / SABS 1808-44	(0939051) 632-4211	Italy	Mechanical, Metallurgical
8198/13011	Jenfit (Pty) Ltd	SANS 1808-44 / SABS 1808-44	(012) 804-4436	Gauteng	Mechanical, Metallurgical

SANS 1806-66 / SABS 1808-66
WATER SUPPLY AND DISTRIBUTION SYEMTEM COMPONENTS PART66: DEMAND TYPE WATER TAPS

Permit No	Company	Specification No	Telephone	Region	Industry
7171/10638	Walker Crosweller (Pty) Ltd	SANS 1808-66 / SABS 1808-66	(011) 7931031	Gauteng	Mechanical, Metallurgical

SANS 1808-85
WATER SUPPLY AND DISTRIBUTION SYSTEMS PART 85: ORIENTED POLYVINYL CHLORIDE (PVC-O) PRESSURE PIPES FOR UNDERGROUND USE

Permit No	Company	Specification No	Telephone	Region	Industry
3890/12115	DPI Plastics (Pty) Ltd - Roodekop	SANS 1808-85	(011) 345-5600	Gauteng	Mechanical, Metallurgical

SANS 1848 / SABS 1848
GEYSER DRIP TRAYS

Permit No	Company	Specification No	Telephone	Region	Industry
163/10993	Kwikot (Pty) Ltd	SANS 1848 / SABS 1848	(011) 914-2300	Gauteng	Rubber, Plastics, Glass
6802/10253	W.E. Geysers (Pty) Ltd	SANS 1848 / SABS 1848	(011) 769-1387	Gauteng	Rubber, Plastics, Glass
7114/10554	Heunis Rainwater Goods (Pty) Ltd	SANS 1848 / SABS 1848	(012) 3720021	Gauteng	Rubber, Plastics, Glass
7098/10534	NW Plastics CC	SANS 1848 / SABS 1848	(011) 968-1679	Gauteng	Rubber, Plastics, Glass

SANS 4427 / SABS ISO 4427
POLYETHYLENE (PE) PIPES FOR WATER SUPPLY - SPECIFICATIONS

Permit No	Company	Specification No	Telephone	Region	Industry
1106/13311	Reef Plastics & Chemicals (Pty) Ltd	SANS 4427 / SABS ISO 4427	(011) 762-5581	Gauteng	Rubber, Plastics, Glass
3092/1994	Namibia Plastic Converters (Pty) Ltd	SANS 4427 / SABS ISO 4427	(09264) 62-501171	Namibia	Rubber, Plastics, Glass
3890/11064	DPI Plastics (Pty) Ltd - Roodekop	SANS 4427 / SABS ISO 4427	(011) 345-5600	Gauteng	Rubber, Plastics, Glass
4775/6877	Pace Plastics (Pty) Ltd	SANS 4427 / SABS ISO 4427	(031) 763-4111	KwaZulu-Natal	Rubber, Plastics, Glass
5140/11004	Proplastics (Pvt) Ltd	SANS 4427 / SABS ISO 4427	(092634) 621-6515	Zimbabwe	Rubber, Plastics, Glass
5220/7675	Marley Pipe Systems (Pty) Ltd	SANS 4427 / SABS ISO 4427	(039) 682-6212	KwaZulu-Natal	Rubber, Plastics, Glass
5795/13230	Geberit Technik AG/Geberit Southern Africa (Pty) Ltd	SANS 4427 / SABS ISO 4427	(094155) 221-6373	Switzerland	Rubber, Plastics, Glass
6517/12296	Flo-Tek Pipes and Irrigation	SANS 4427 / SABS ISO 4427	(09267) 533-2180	Botswana	Rubber, Plastics, Glass
6536/9642	Sangio Pipe	SANS 4427 / SABS ISO 4427	(031) 782-3781	KwaZulu-Natal	Rubber, Plastics, Glass

Permit No	Company	Specification No	Telephone	Region	Industry
6783/10075	Gazelle Plastics	SANS 4427 / SABS ISO 4427	(011) 955-3551	Gauteng	Rubber, Plastics, Glass
7639/12257	Firat Plastik, Kaucuk San. Ve Tic A.S.	SANS 4427 / SABS ISO 4427	(090212) 859-0404	Turkey	Rubber, Plastics, Glass
8029/13294	Eurocelt (Durban) CC	SANS 4427 / SABS ISO 4427	(031) 916-6949	KwaZulu-Natal	Rubber, Plastics, Glass
8331/13223	Lamasat International Limited	SANS 4427 / SABS ISO 4427	(002601) 273142	Zambia	Rubber, Plastics, Glass
8372/13277	Flotek Pipes and Irrigation (Pty) Ltd	SANS 4427 / SABS ISO 4427	(011) 316-6891	Gauteng	Rubber, Plastics, Glass
8403/13321	Screenex Pipe Manufacturing CC	SANS 4427 / SABS ISO 4427	(011) 864-2773	Gauteng	Rubber, Plastics, Glass
8487/13438	Forceflo Plant and Machinery	SANS 4427 / SABS ISO 4427	(056) 931-0949	Free State	Rubber, Plastics, Glass
88/2658	DPI Plastics (Pty) Ltd - Bellville	SANS 4427 / SABS ISO 4427	(021) 9453656	Western Cape	Rubber, Plastics, Glass
892/1779	Petzetakis Africa (Pty) Ltd	SANS 4427 / SABS ISO 4427	(012) 541-1080	Gauteng	Rubber, Plastics, Glass

SANS 10508 / SABS ISO 10508
THERMOPLASTICS PIPES AND FITTINGS FOR HOT AND COLD WATER SYSTEMS

Permit No	Company	Specification No	Telephone	Region	Industry
5220/12786	Marley Pipe Systems (Pty) Ltd	SANS 10508 / SABS ISO 10508	(039) 682-6212	KwaZulu-Natal	Rubber, Plastics, Glass

SANS 14236
PLASTICS PIPES AND FITTINGS - MECHANICAL-JOINT COMPRESSION FITTINGS FOR USE WITH POLYETHYLENE PRESSURE PIPES IN WATER SUPPLY SYSTEMS

Permit No	Company	Specification No	Telephone	Region	Industry
7746/12413	Plastica Alfa Srl	SANS 14236	(09390933) 51973	Italy	Rubber, Plastics, Glass
8022/12791	Georg Fischer Alprene S.r.l./Alprene Plastics Products (Pty) Ltd	SANS 14236	(0939051) 632-4211	Italy	Rubber, Plastics, Glass
8198/13010	Jenfit (Pty) Ltd	SANS 14236	(012) 804-4436	Gauteng	Rubber, Plastics, Glass
8242/13076	Unidelta PSA	SANS 14236	(090356) 878-011	Italy	Rubber, Plastics, Glass
8283/13142	Servicios Logisticos Intergrates Holdings STP, SL	SANS 14236	(011) 477-8332	Spain	Rubber, Plastics, Glass
8357/13262	Irritec S.r.l.	SANS 14236	(00390941) 922111	Italy	Rubber, Plastics, Glass

SANS 15874-1
PLASTICS PIPING SYSTEMS FOR HOT AND COLD WATER INSTALLATIONS - POLYPROPYLENE (PP) PART 1: GENERAL

Permit No	Company	Specification No	Telephone	Region	Industry
8367/13272	Coprax - Comercio e Industria do Plastico, Lda	SANS 15874-1	(00351256) 579-480	Italy	Rubber, Plastics, Glass

SANS 15874-2
PLASTICS PIPING SYSTEMS FOR HOT AND COLD WATER INSTALLATIONS - POLYPROPYLENE (PP) PART 2: PIPES

Permit No	Company	Specification No	Telephone	Region	Industry
8367/13272	Coprax - Comercio e Industria do Plastico, Lda	SANS 15874-2	(00351256) 579-480	Italy	Rubber, Plastics, Glass

SANS 15874-3
PLASTICS PIPING SYSTEMS FOR HOT AND COLD WATER INSTALLATIONS - POLYPROPYLENE (PP) PART 3: FITTINGS

Permit No	Company	Specification No	Telephone	Region	Industry
8367/13272	Coprax - Comercio e Industria do Plastico, Lda	SANS 15874-3	(00351256) 579-480	Italy	Rubber, Plastics, Glass

SANS 15874-5
PLASTICS PIPING SYSTEMS FOR HOT AND COLD WATER INSTALLATIONS - POLYPROPYLENE (PP) PART 5: FITNESS FOR PURPOSE OF THE SYSTEM

Permit No	Company	Specification No	Telephone	Region	Industry
8367/13272	Coprax - Comercio e Industria do Plastico, Lda	SANS 15874-5	(00351256) 579-480	Italy	Rubber, Plastics, Glass

SANS 15875-1
PLASTICS PIPING SYSTEMS FOR HOT AND COLD WATER INSTALLATIONS - CROSSLINKED POLYETHYLENE (PE-X) PART 1: GENERAL

Permit No	Company	Specification No	Telephone	Region	Industry
7948/12688	Uponor Wirsbo AB	SANS 15875-1	(0946233) 38000	Sweden	Rubber, Plastics, Glass
8508/13464	Marley Plumbing and Drainage	SANS 15875-1	(00441622) 858-888	United Kingdom	Rubber, Plastics, Glass
8527/13494	John Guest Limited	SANS 15875-1	(00441895) 44-9233	United Kingdom	Rubber, Plastics, Glass
8541/13514	Golan Plastic Products Ltd/MD Distribution CC	SANS 15875-1	(011) 704-5127	Israel	Rubber, Plastics, Glass

SANS 15875-2
PLASTICS PIPING SYSTEMS FOR HOT AND COLD WATER INSTALLATIONS - CROSSLINKED POLYETHYLENE (PE-X) PART 2: PIPES

Permit No	Company	Specification No	Telephone	Region	Industry
7948/12688	Uponor Wirsbo AB	SANS 15875-2	(0946233) 38000	Sweden	Rubber, Plastics, Glass
8508/13464	Marley Plumbing and Drainage	SANS 15875-2	(00441622) 858-888	United Kingdom	Rubber, Plastics, Glass
8527/13494	John Guest Limited	SANS 15875-2	(00441895) 44-9233	United Kingdom	Rubber, Plastics, Glass
8541/13514	Golan Plastic Products Ltd/MD Distribution CC	SANS 15875-2	(011) 704-5127	Israel	Rubber, Plastics, Glass

SANS 15875-3
PLASTICS PIPING SYSTEMS FOR HOT AND COLD WATER INSTALLATIONS - CROSSLINKED POLYETHYLENE (PE-X) PART 3: FITTINGS

Permit No	Company	Specification No	Telephone	Region	Industry
7948/12688	Uponor Wirsbo AB	SANS 15875-3	(0946233) 38000	Sweden	Chemicals, Petroleum, Paints, Pharmaceuticals
8508/13464	Marley Plumbing and Drainage	SANS 15875-3	(00441622) 858-888	United Kingdom	Chemicals, Petroleum, Paints, Pharmaceuticals
8527/13494	John Guest Limited	SANS 15875-3	(00441895) 44-9233	United Kingdom	Chemicals, Petroleum, Paints, Pharmaceuticals
8541/13514	Golan Plastic Products Ltd/MD Distribution CC	SANS 15875-3	(011) 704-5127	Israel	Chemicals, Petroleum, Paints, Pharmaceuticals

SANS 15875-5
PLASTICS PIPING SYSTEMS FOR HOT AND COLD WATER INSTALLATIONS - CROSSLINKED POLYETHYLENE (PE-X) PART 5: FITNESS FOR PURPOSE OF THE SYSTEM

Permit No	Company	Specification No	Telephone	Region	Industry
7948/12688	Uponor Wirsbo AB	SANS 15875-5	(0946233) 38000	Sweden	Chemicals, Petroleum, Paints, Pharmaceuticals
8508/13464	Marley Plumbing and Drainage	SANS 15875-5	(00441622) 858-888	United Kingdom	Chemicals, Petroleum, Paints, Pharmaceuticals
8527/13494	John Guest Limited	SANS 15875-5	(00441895) 44-9233	United Kingdom	Chemicals, Petroleum, Paints, Pharmaceuticals
8541/13514	Golan Plastic Products Ltd/MD Distribution CC	SANS 15875-5	(011) 704-5127	Israel	Chemicals, Petroleum, Paints, Pharmaceuticals

SANS 15876-1
PLASTICS PIPING SYSTEMS FOR HOT AND COLD WATER INSTALLATIONS - POLYBUTYLENE (PB) PART 1: GENERAL

Permit No	Company	Specification No	Telephone	Region	Industry
8284/13143	Hepworth Building Products - Doncaster Site	SANS 15876-1	(00441709) 856300	United Kingdom	Rubber, Plastics, Glass
8285/13144	Hepworth Building Products - Brandon Site	SANS 15876-1	(00441709) 856300	United Kingdom	Rubber, Plastics, Glass

SANS 15876-2
PLASTICS PIPING SYSTEMS FOR HOT AND COLD WATER INSTALLATIONS - POLYBUTYLENE (PB) PART 2: PIPES

Permit No	Company	Specification No	Telephone	Region	Industry
8284/13143	Hepworth Building Products - Doncaster Site	SANS 15876-2	(00441709) 856300	United Kingdom	Rubber, Plastics, Glass
8285/13144	Hepworth Building Products - Brandon Site	SANS 15876-2	(00441709) 856300	United Kingdom	Rubber, Plastics, Glass

SANS 15876-3
PLASTICS PIPING SYSTEMS FOR HOT AND COLD WATER INSTALLATIONS - POLYBUTYLENE (PB) PART 3: FITTINGS

Permit No	Company	Specification No	Telephone	Region	Industry
8284/13143	Hepworth Building Products - Doncaster Site	SANS 15876-3	(00441709) 856300	United Kingdom	Rubber, Plastics, Glass
8285/13144	Hepworth Building Products - Brandon Site	SANS 15876-3	(00441709) 856300	United Kingdom	Rubber, Plastics, Glass

SANS 15876-5
PLASTICS PIPING SYSTEMS FOR HOT AND COLD WATER INSTALLATIONS - POLYBUTYLENE (PB) PART 5: FITNESS FOR PURPOSE OF THE SYSTEM

Permit No	Company	Specification No	Telephone	Region	Industry
8284/13143	Hepworth Building Products - Doncaster Site	SANS 15876-5	(00441709) 856300	United Kingdom	Rubber, Plastics, Glass
8285/13144	Hepworth Building Products - Brandon Site	SANS 15876-5	(00441709) 856300	United Kingdom	Rubber, Plastics, Glass

APPENDIX C: JASWIC LIST OF APPROVED COMPONENTS

JASWIC ACCEPTANCE COMMITTEE WORKING LIST: ACCEPTED WATER COMPONENTS

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Line	Product description	Manufacturer	Catalog reference	Specification	Mark/ comply	Serial	Special conditions
1	Cistern (close coupled)	Vaal Sanitaryware	Protea (11,4 litre)	SABS 821	Mark	705 / 1	Method I overflow only
2	Cistern (close coupled)	Vaal Sanitaryware	Lotus 710013	SABS 821	Mark	475 / 1	Method I overflow only
3	Cistern (close coupled)	Vaal Sanitaryware	Hibiscus 710031	SABS 821	Mark	476 / 2	Method I overflow only
4	Cistern (concealed)	Geberit International AG	110.845	SABS 821	Mark	537 / 1	Method I overflow only
5	Cistern (high level)	Dutton Plastics Eng	Elf (11 litre)	SABS 821	Mark	629 / 1	Method I overflow only
6	Cistern (high level)	Dutton Plastics Eng	Lux (11 litre)	SABS 821	Mark	673 / 1	Method I overflow only
7	Cistern (high level)	Parker Manufacturing	Manx (13 litre)	SABS 821	Mark	680 / 1	Method I overflow only
8	Cistern (high level)	Parker Manufacturing	Puma (9 litre)	SABS 821	Mark	449 / 1	Method I overflow only
9	Cistern (high level)	Parker Manufacturing	Lynx (9 litre & 11 litre)	SABS 821	Mark	439 / 1	Method I overflow only
10	Cistern (high level)	Vaal Sanitaryware	Protea (11,4 litre)	SABS 821	Mark	813 / 1	Method I 0verflow only
11	Cistern (low level)	Dutton Plastics Eng	Elf (11 litre)	SABS 821	Mark	630 / 1	Method I overflow only
12	Cistern (low level)	Dutton Plastics Eng	Lux (11 litre)	SABS 821	Mark	674 / 1	Method I overflow only
13	Cistern (low level)	Parker Manufacturing	Manx (11 litre)	SABS 821	Mark	677 / 1	Method I overflow only
14	Cistern (low level)	Vaal Sanitaryware	Protea (9 & 11,4 litre)	SABS 821	Mark	706 / 1	Method I overflow only
15	Cistern (low level)	Parker Manufacturing	Puma (9 litre)	SABS 821	Mark	448 / 1	Method I overflow only
16	Cistern (low level)	Parker Manufacturing	Lynx (9 litre & 11 litre)	SABS 821	Mark	438 / 1	Method I overflow only
17	Cistern (low level)	Dutton Plastics Eng	Alpha (9 litre)	SABS 821	Mark	52 / 1	Method I overflow only
18	Cistern (low level)	Dutton Plastics Eng	National 9 litre Syphonic	SABS 821	Mark	254 / 1	Method I overflow only
19	Cistern (low level)	Dutton Plastics Eng	Superior	SABS 821	Mark	410 / 1	Method I overflow only
20	Cistern (low level)	Vaal Sanitaryware	Hibiscus	SABS 821	Mark	476 / 3	Method I overflow only
21	Cistern (semi-high level)	Vaal Sanitaryware	Protea (11,4 litre)	SABS 821	Mark	814 / 1	Method I overflow only
22	Cistern (semi-high level)	Vaal Sanitaryware	Hibiscus	SABS 821	Mark	476 / 1	Method I overflow only
23	Coupling (VJ)	TMP Water Engineering Services	100mm-315mm range	SANS 1808-2	Comply	1512 / 1	
24	Fitting (brass)	Rifeng	Press Fittings, 16 & 25mm	JASWIC R41	Comply	1496 / 1	
25	Fitting (compression)	Unidelta	Unidelta	SANS 14236	Mark	1503 / 1	
26	Fitting (copper alloy)	Cobra Watertech (Pty) Ltd	Cobra DZR Series	SABS 1067/1	Mark	792 / 1	
27	Fitting (copper alloy)	Cobra Watertech (Pty) Ltd	Copcal	SABS 1067/2	Mark	530 / 1	Not to be brazed - Must be used with accepted solder and flux
28	Fitting (copper alloy)	Maksal Tubes	Maksal Compression	SABS 1067/1	Mark	1415 / 1	
29	Fitting (copper)	Zhejiang Wenling Dingwin	Eezi Solder ES0 series	SANS 1067-2	Comply	1507 / 1	Copper fittings, excluding copper alloys
30	Fitting (plastic saddle)	Alprene Plastic Products	150150, 154154,	SANS 1808/44	Mark	595 / 1	
31	Fitting (plastic)	D P I Plastics (Pty) Ltd	Duroflo	SABS 966/1	Mark	624 / 1	Not to be built in, solvent welded, used in fire or combined installations above ground

JASWIC ACCEPTANCE COMMITTEE WORKING LIST: ACCEPTED WATER COMPONENTS

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Line	Product description	Manufacturer	Catalog reference	Specification	Mark/ comply	Serial	Special conditions
32	Fitting (plastic)	Alprene Plastic Products	AZ & A16	SABS 14236	Mark	594 / 1	Not to be used in fire or combined installations above ground
33	Fitting (plastic)	Irritec	Irritec range	SABS 14236	Comply	840 / 1	Not to be used in fire or combined installations above ground
34	Fitting (plastic)	Plastica Alfa	Alpha Cepex Astral Plastica	SANS 14326	Mark	1407 / 1	
35	Fitting (plastic)	Plastica Alfa	Blackline	SANS 14326	Mark	1412 / 1	
36	Fitting (plastic)	Revi D.O.O. Druzba ZA Proizvod	REVI PPSU	SABS/IS 19508	Mark	1446 / 1	
37	Fitting (plastic)	Uponor	Uponor Unipipe	JASWIC R41	Comply	1492 / 1	
38	Fitting (plastic)	John Guest Speedfit Ltd		SANS 15875-3	Comply	1501 / 1	
39	Fitting (Polybutylene)	Nueva Terrain Spain	Nueva Terrain	SANS 15876	Comply	1505 / 1	Not for use in fire or combined above ground installations
40	Fitting (polypropylene)	Ctando Plastics (Pty) Ltd	Threaded /Fusion fittings	SANS 15874-3	Comply	1495 / 1	Not for use in fire or combined installations above ground
41	Fitting(Saddle)(stainless)	Cascade Control (Pty) Ltd	CSS range	SANS 1804-44	Comply	1402 / 1	
42	Pipe (AC)(CID)	Turnall Fibre Cement	S.A.2	SABS 1223	Mark	1002 / 2	
43	Pipe (AC)(COD)	Turnall Fibre Cement	S.A.2	SABS 1223	Mark	1002 / 1	
44	Pipe (braided connector)	Industrias Mateu SA	IM98 & IM99	SABS 1808/5	Mark	1057 / 1	
45	Pipe (braided connector)	Comap Pty	SA29, SA30	SANS 1808-5	Comply	1386 / 1	
46	Pipe (copper)	MaksalTubes	460/0	SABS 460	Mark	450 / 1	Not to be bent, brazed, or used underground
47	Pipe (copper)	MaksalTubes	460/1	SABS 460	Mark	450 / 2	Not to be brazed or used underground
48	Pipe (copper)	MaksalTubes	460/2, 460/3	SABS 460	Mark	450 / 3	Not to be brazed
49	Pipe (copper)	Copper Tubing Africa (Pty) Ltd	460/0	SABS 460	Mark	898 / 1	Not to be bent, brazed, or used underground
50	Pipe (copper)	Copper Tubing Africa (Pty) Ltd	460/1	SABS 460	Mark	898 / 2	Not to be brazed or used underground
51	Pipe (copper)	Copper Tubing Africa (Pty) Ltd	460/2	SABS 460	Mark	898 / 3	Not to be brazed
52	Pipe (HDPE)	Petzatakis	Megathene	SABS/ISO 4427	Mark	659 / 1	Not to be used in fire or combined installations above ground
53	Pipe (HDPE)	DPI Plastics (Pty) Ltd	Poly HDPE Type IV	SABS/ISO 4427	Mark	698 / 1	Not to be used in fire or combined installations above ground
54	Pipe (HDPE)	Petzatakis	Type IV	SABS/ISO 4427	Mark	542 / 1	Not to be used in fire or combined installations above ground
55	Pipe (LDPE)	DPI Plastics (Pty) Ltd	Poly LDPE Type I	SABS/ISO 533	Mark	699 / 1	For irrigation systems only
56	Pipe (LDPE)	Petzatakis	Type IV	SABS/ISO 533	Mark	756 / 1	For irrigation systems only
57	Pipe (multi-layer)	Ginde Pipes SA (Pty) Ltd	Yr472A Yr472B	JASWIC R56	Comply	1482 / 1	Not to be used in fire or combined installations above ground
58	Pipe (multi-layer)	Uponor	Pipes PERT/AL/PERT	JASWIC R56	Comply	1490 / 1	Not for use in fire or combined installations above ground
59	Pipe (multi-layer)	Mingshi Piping Systems	Pipes PEX/AL/PEX M-1216	JASWIC R56	Comply	1491 / 1	Not for use in fire or combined installations above ground
60	Pipe (PE-X)	Marley Extrusions Ltd	Mac-Flo (PE-X) Pipes, Fittings	SANS 15875	Comply	1453 / 1	Not to be used in fire or combined installations above ground
61	Pipe (PE-X)	John Guest Speedfit Ltd		SANS 15875	Comply	1500 / 1	
62	Pipe (polybutylene)	Hepworth Building Products Ltd	YR 65C	SANS 15876	Mark	1462 / 1	Not to be used in fire or combined installations above ground

Line	Product description	Manufacturer	Catalog reference	Specification	Mark/ comply	Serial	Special conditions
63	Pipe (polybutylene)	Nueva Terrain Spain	Nueva Terrain	SANS 15876	Comply	1504 / 1	Not for use in fire or above ground combined installations
64	Pipe (polypropylene)	Pace Plastics	Alcop	SABS 1315	Mark	899 / 1	Not for use in fire or combined installations above ground
65	Pipe (polypropylene)	Eurocelt Durban cc	Polycop 2000	SABS 1315	Comply	930 / 1	Not for use in fire or combined installations above ground
66	Pipe (polypropylene)	Pace Plastics	Pace IPS	SABS 1315	Mark	1031 / 2	Not for use in fire or combined installations above ground
67	Pipe (polypropylene)	Pace Plastics	IPS	SABS 1315	Mark	1421 / 1	Not to be used in fire or combined installations above ground
68	Pipe (polypropylene)	Ctando Plastics (Pty) Ltd	PP screwed pipe	SABS 1315	Mark	1455 / 1	Not to be used in fire or combined installations above ground
69	Pipe (pvc)M	DPI Plastics (Pty) Ltd	Ultraflo	SABS 966/2	Mark	941 / 1	Not for use in fire or combined installations above ground
70	Pipe (pvc)M	Marley SA (Pty) Ltd	Aqua-Wall - PPM	SABS 966/2	Mark	1062 / 2	Not to be used in fire or combined installations above ground
71	Pipe (pvc)U	D P I Plastics (Pty) Ltd	Duroflo	SABS 966/1	Mark	625 / 1	Not to be built in, solvent welded or used in fire or combined installations above ground
72	Pipe (pvc)U	Petzatakis	Supradur	SABS 966/1	Mark	730 / 1	Not to be built in, solvent welded or used in fire or combined installations above ground
73	Pipe (pvc)U	Petzatakis	Supratuff	SABS 966/1	Mark	956 / 1	Not to be built in, solvent welded or used in fire or combined installations above ground
74	Pipe (pvc)U	Marley SA (Pty) Ltd	Hydro-Wall - PPU	SABS 966/1	Mark	1062 / 1	Not be built in, solvent welded or used in fire or combined installations above ground
75	Pipe (steel)(black)	Trident Sterling	Type and size	SABS 62 & 719	Mark	754 / 1	For underground use refer to local authority
76	Pipe (steel)(black)	Robor Tube	Type and size	SABS 62 & 719	Mark	762 / 1	For underground use refer to local authority
77	Pipe(steel)(galvanised)	Robor Ltd	Type and size	SABS 62 & 719	Mark	752 / 1	refer to local authority for use in their area
78	Pipe(steel)(galvanised)	Trident Sterling	Type and size	SABS 62 & 719	Mark	759 / 1	refer to local authority for use in their area
79	Pipe(steel)(galvanised)	Robor Tube	Type and size	SABS 62 & 719	Mark	760 / 1	refer to local authority for use in their area
80	Pipe and Fitting (System)	Aquatherm Gmbh	70708-70726	SANS 15874-2/3/5	Comply	1508 / 1	
81	Repair Clamp (Stainless steel)	Cascade Control (Pty) Ltd	CR1, CR2	SABS 1808-45	Comply	1401 / 1	
82	Repair Clamp (Stainless steel)	PPD Engineering & Hardware cc	Celaclampfit	SABS 1808-45	Comply	1442 / 1	
83	Tap (bib)	Cobra Watertech (Pty) Ltd	Bib taps plain and hose	SABS 226/2	Mark	793 / 1	
84	Tap (bib)	Cobra Watertech (Pty) Ltd	Bib tap	SABS 226/2	Mark	946 / 1	
85	Tap (Hose bib)	Cobra Watertech (Pty) Ltd	Hose Bibtap	SABS 226/2	Mark	946 / 5	
86	Tap (Hose bib)(Stop tap)	Cobra Watertech (Pty) Ltd	121lk-15, 121lk-20, 121lk1-15	SABS 226/2	Mark	793 / 3	
87	Tap (Hose bib)(Stop tap)	Cobra Watertech (Pty) Ltd	131-15, 131-22, 131,28, 131-15	SABS 226/2	Mark	793 / 4	
88	Tap (medical)	Cobra Watertech (Pty) Ltd	508, 510-21, 511-21, 511-21/S	SABS 226/2	Mark	572 / 2	
89	Tap (metering)	WalkerCrosweller(Pty)Ltd	WALCRO100	SABS 1808/9	Mark	835 / 1	
90	Tap (metering)	WalkerCrosweller(Pty)Ltd	WALCRO101	SABS 1808/9	Mark	834 / 1	
91	Tap (mixing)	Cobra Watertech (Pty) Ltd	Image Series	SABS 226/2	Mark	398 / 1	
92	Tap (mixing)	ISCA (Pty) Ltd	Iscamix81,82,83,84	SANS 1480	Mark	1387 / 1	
93	Tap (mixing)	ISCA (Pty) Ltd	Iscamix 85,88,89	SANS 1480	Mark	1387 / 2	

Line	Product description	Manufacturer	Catalog reference	Specification	Mark/ comply	Serial	Special conditions
94	Tap (mixing)	ISCA (Pty) Ltd	BETA-Chloe, Gio, Zara, Toscana	SANS 1480	Mark	1427 / 1	
95	Tap (mixing)	ISCA (Pty) Ltd	BETA-Castello	SANS 1480	Mark	1428 / 1	
96	Tap (mixing)	Cobra Watertech (Pty) Ltd	Mixer	SABS 226	Mark	572 / 4	
97	Tap (mixing)	Hansgrohe Bathrooms	Tallis	SANS 1480	Mark	1463 / 1	
98	Tap (mixing)	GROHE	Tenso 3 hole bath combination	SANS 1480	Mark	1471 / 4	
99	Tap (mixing)	GROHE	Chiara mixers	SANS 1480	Mark	1473 / 2	
100	Tap (mixing)	GROHE	Atrio mixers	SANS 1480	Mark	1474 / 1	
101	Tap (mixing)	Kaiping Europea Plmb Appartus	Molini	SABS 1480	Comply	1477 / 1	
102	Tap (mixing) (single lever)	Cobra Watertech (Pty) Ltd	Trend Series	SANS 1480	Mark	969 / 1	
103	Tap (mixing) (single lever)	GROHE	Tenso basin mixer single lever	SABS 226	Mark	1470 / 1	
104	Tap (mixing) (single lever)	GROHE	Ectos single lever bath mixer	SANS 1480	Mark	1470 / 5	
105	Tap (mixing) (single lever)	GROHE	Ectos single lever concealed	SANS 1480	Mark	1470 /11	
106	Tap (mixing) (single lever)	GROHE	Tenso single lever basin mixer	SANS 1480	Mark	1471 / 1	
107	Tap (mixing) (single lever)	GROHE	Tenso single lever bath mixer	SANS 1480	Mark	1471 / 5	
108	Tap (mixing) (single lever)	GROHE	Tenso single lever shower	SANS 1480	Mark	1471 / 6	
109	Tap (mixing) (single lever)	GROHE	Taron single lever mixers	SANS 1480	Mark	1472 / 1	
110	Tap (mixing) (single lever)	GROHE	Chiara single lever mixers	SANS 1480	Mark	1473 / 1	
111	Tap (mixing) (single lever)	Caizhou	Single lever mixing taps	SANS 1480	Comply	1494 / 1	
112	Tap (mixing) (single lever)	Main Plan Limited	Delong Nobile range	SANS 1480	Comply	1509 / 1	
113	Tap (mixing) (single lever)	Main Plan Limited	Delong Mystical range	SANS 1480	Comply	1510 / 1	
114	Tap (mixing) (single lever)	Main Plan Limited	Delong Prego range	SANS 1480	Comply	1511 / 1	
115	Tap (mixing)(bath)	GROHE	Ectos single lever mixer	SANS 1480	Mark	1470 / 3	
116	Tap (mixing)(bath)	GROHE	Bath mixer single lever	SANS 1480	Mark	1470 / 6	
117	Tap (mixing)(bath)	GROHE	Ectos 3 hole bath combination	SANS 1480	Mark	1470 / 7	
118	Tap (mixing)(bidet)	Hansa Metallwerke	106	SANS 1480	Mark	1014 / 3	
119	Tap (mixing)(single lever)	Cobra Watertech (Pty) Ltd	Focus Series	SANS 1480	Mark	555 / 1	
120	Tap (mixing)(single lever)	GROHE	Ectos single lever bidet mixer	SABS 1480	Mark	1470 / 2	
121	Tap (mixing)(single lever)	GROHE	Ectos single lever shower mixe	SANS 1480	Mark	1470 /10	
122	Tap (mixing)(single lever)	GROHE	Tenso single lever bidet mixer	SANS 1480	Mark	1471 / 2	
123	Tap (mixing)(single lever)	GROHE	Tenso single lever bath mixer	SANS 1480	Mark	1471 / 3	
124	Tap (pillar)	Cobra Watertech (Pty) Ltd	Medical Series	SABS 226/2	Mark	572 / 1	

Line	Product description	Manufacturer	Catalog reference	Specification	Mark/ comply	Serial	Special conditions
125	Tap (single lever)	HansaMetallwerke	100 101 109 209 309 701	SANS 1480	Mark	1014 / 2	
126	Tap (stop)	Cobra Watertech (Pty) Ltd	Stoptaps	SABS 226/2	Mark	793 / 2	
127	Tap (various)	Cobra Watertech (Pty) Ltd	Aquila Series	SABS 226/1&2	Mark	64 / 1	
128	Tap (various)	Cobra Watertech (Pty) Ltd	Carina Series	SABS 226/1&2	Mark	73 / 1	
129	Tap (various)	Cobra Watertech (Pty) Ltd	Crutch Series	SABS 226/1&2	Mark	81 / 1	
130	Tap (various)	Cobra Watertech (Pty) Ltd	Star Series	SABS 226/!&2	Mark	1051 / 1	
131	Tap (various)	ISCA (Pty) Ltd	Crystal Clear	SABS 226/2	Mark	425 / 1	
132	Tap (various)	ISCA (Pty) Ltd	Hawaii, Crystal Clear	SABS 226/2	Mark	435 / 1	
133	Tap (various)	Cobra Watertech (Pty) Ltd	Tudor Series	SABS 226/2	Mark	562 / 1	
134	Tap (various)	Cobra Watertech (Pty) ltd	Stella Bright Series	SABS 226/2	Mark	563 / 1	
135	Tap (various)	Cobra Watertech (Pty) Ltd	Stella Series	SABS 226/1/2	Mark	563 / 2	
136	Tap (various)	ISCA (Pty) Ltd	Alpha, Beta, Gamma	SABS 226/2	Mark	435 / 2	
137	Tap (various)	ISCA (Pty) Ltd	ALPI	SABS 226/2	Mark	943 / 1	
138	Tap (various)	ISCA (Pty) Ltd	V-tap	SABS 226/2	Mark	943 / 2	
139	Tap (various)	ISCA (Pty) Ltd	Antica	SABS 226/2	Mark	943 / 3	
140	Tap (various)	ISCA (Pty) Ltd	Windsor	SABS 226/2	Mark	943 / 4	
141	Tap (various)	ISCA (Pty) Ltd	Palesa	SABS 226/2	Mark	943 / 5	
142	Tap (various)	ISCA (Pty) Ltd	Classic	SABS 226/2	Mark	943 / 6	
143	Tap (various)	Cobra Watertech (Pty) Ltd	Matt Chrome 800 Series	SABS 226/2	Mark	946 / 2	
144	Tap (various)	Cobra Watertech (Pty) Ltd	Victoriana Series	SABS 226/1/2	Mark	968 / 1	
145	Tap (various)	ISCA (Pty) Ltd	BETA TRI, ROMA, ORACLE	SABS 226-2	Mark	1429 / 1	
146	Tap (various)	ISCA (Pty) Ltd	BETASUPERO	SABS 226-2	Mark	1429 / 2	
147	Vacuum breaker	Cobra Watertech (Pty) Ltd	Vacubreak PB1.10	SABS 198	Mark	83 / 1	
148	Vacuum breaker	Parker Manufacturing	OCTA	SABS 198	Mark	544 / 1	
149	Vacuum breaker	Marley SA (Pty) Ltd	LAT24	SABS 198	Mark	215 / 4	
150	Vacuum breaker	Caleffi SA (Pty) Ltd	300 series 15 &20mm	SABS 198	Mark	926 / 4	
151	Vacuum breaker	Apex Valves S A (Pty)Ltd	VRV 15	SABS 198	Mark	1019 / 4	
152	Valve (ball)	Cobra Watertech (Pty) Ltd	Isolating Ball Valve Series	SABS 1056/3	Mark	518 / 1	
153	Valve (control)	Valve Technology	Rapid 400 kPa, moderate 100 kPa	SABS 198	Comply	1404 / 1	
154	Valve (float)	Dutton Plastics Eng	15mm HP	SABS 752/1	Mark	35 / 1	
155	Valve (float)	Cobra Watertech (Pty) Ltd	700SP-4	SABS 752/1	Mark	49 / 1	

Line	Product description	Manufacturer	Catalog reference	Specification	Mark/ comply	Serial	Special conditions
156	Valve (float)	Cobra Watertech (Pty) Ltd	724-15 Bottom inlet	SABS 752/1	Mark	68 / 1	
157	Valve (float)	Cobra Watertech (Pty) Ltd	725-15 Bottom inlet	SABS 752/1	Mark	69 / 1	
158	Valve (float)	Dutton PLastics Eng	Kleenflo	SABS 752/1	Mark	664 / 1	
159	Valve (float)	Dutton Plastics Eng	Stilflo	SABS 752/2	Mark	725 / 1	
160	Valve (float)	Dutton Plastics Eng	SBA 11	SABS 752/1	Mark	290 / 1	
161	Valve (float)	Dutton Plastics Eng	SBA 10	SABS 752/1	Mark	291 / 1	
162	Valve (float)	Parker Manufacturing	CV61 and CV63	SABS 752/1	Mark	312 / 1	
163	Valve (float)	Dutton Plastics Eng	15mm MOH	SABS 752/1	Mark	424 / 1	
164	Valve (float)(high pressure)	Cobra Watertech (Pty) Ltd	Float Valve High Press Series	SABS 752/1	Mark	796 / 1	
165	Valve (float)(high pressure)	Cobra Watertech (Pty) Ltd	High pressure 715	SABS 752/1	Mark	797 / 1	
166	Valve (float)(high pressure)	Cobra Watertech (Pty) Ltd	High pressure 701	SABS 752/1	Mark	798 / 1	
167	Valve (float)(low pressure)	Cobra Watertech (Pty) Ltd	Low Pressure 710	SABS 752/1	Mark	803 / 1	
168	Valve (float)(low pressure)	Cobra Watertech (Pty) Ltd	Low Pressure 720	SABS 752/1	Mark	804 / 1	
169	Valve (flush)	Cobra Watertech (Pty) Ltd	Flushmaster Std FM/KF Series	SABS 1240	Mark	644 / 1	
170	Valve (flush)	Cobra Watertech (Pty) Ltd	Flushmaster Junior FJ/KF Serie	SABS 1240	Mark	645 / 1	
171	Valve (flush)	WalkerCrosweller(Pty)Ltd	WALCRO Flush Major Series	SABS 1240	Mark	422 / 1	
172	Valve (flush)	WalkerCrosweller(Pty)Ltd	WALCRO103	SABS 1240	Mark	833 / 1	
173	Valve (flush)	Cobra Watertech (Pty) Ltd	Econoflush	SABS 1240	Mark	482 / 1	
174	Valve (flush)(cistern)	Dutton Plastics Eng	DPE flat washer valve	SABS 1509	Mark	304 / 1	
175	Valve (flush)(cistern)	Dutton Plastics Eng	Maxi-Flush MKII	SABS 1509	Mark	367 / 1	
176	Valve (flush)(cistern)	Dutton Plastics Eng	Thru-flush PF1-8, PF50-57	SABS 1509	Mark	224 / 1	
177	Valve (flush)(cistern)	Dutton Plastics Eng	Thru-flush PF64-70	SABS 1509	Mark	224 / 2	
178	Valve (flush)(cistern)	Parker Manufacturing	CV74	SABS 1509	Mark	929 / 1	
179	Valve (flush)(cistern)	Dutton Plastics Eng	Supa flush	SABS 1509	Mark	931 / 1	
180	Valve (gate)	Cobra Watertech (Pty) Ltd	1001, 1003, 1006 Series	SANS 776	Mark	292 / 1	
181	Valve (gate) (resilient seal)	Quingdao Pipeking Machinery Co	EPNS	SABS 664	Mark	1484 / 1	
182	Valve (gate)(cast iron)	AinsworthEngineering	AIV	SABS 664	Mark	878 / 1	
183	Valve (gate)(cast steel)	AinsworthEngineering	AIV	SABS 191	Mark	879 / 1	
184	Valve (gate)(resilient seal)	AinsworthEngineering	104-,110-,120-,& 130-000	SABS 664	Mark	30 / 1	
185	Valve (gate)(resilient seal)	Dynamic Fluid Control	Elypso RSV	SABS 664	Mark	632 / 1	
186	Valve (gate)(resilient seal)	Shanghai Johnson Valve Industy	BV-05-47	SABS 664	Mark	1046 / 1	

Line	Product description	Manufacturer	Catalog reference	Specification	Mark/ comply	Serial	Special conditions
187	Valve (hydrant) underground	AinsworthEngineering	400000 R S V	SABS 1128/I	Mark	935 / 1	
188	Valve(metering)	WalkerCrosweller(Pty)Ltd	WALCRO 150 (was RADA 50)	SABS 1808/9	Mark	423 / 1	
189	Valve (press. operated relief)	Marley SA (Pty) Ltd	LAT11, 14, 17, 28 & 29	SABS 198	Mark	670 / 1	
190	Valve (press. operated relief)	Caleffi SA (Pty) Ltd	312 - 2/4/6	SABS 198	Mark	1052 / 1	
191	Valve (press. operated relief)	WattsIndustries	Watts	SABS 198	Comply	1479 / 1	
192	Valve (pressure)(control)	Cobra Watertech (Pty) Ltd	Closy PA1 Series	SABS 198	Mark	75 / 1	
193	Valve (pressure)(control)	DuttonPlasticsEng	Feenix 100, 200, 300, 400	SABS 198	Mark	637 / 1	
194	Valve (pressure)(control)	DuttonPlasticsEng	Feenix 100, 200, 300, 400	SABS 198	Mark	638 / 1	
195	Valve (pressure)(control)	Cobra Watertech (Pty) Ltd	KwikfloSeries	SABS 198	Mark	666 / 1	
196	Valve (pressure)(control)	Marley SA (Pty) Ltd	LAT10, LAT13 & LAT16	SABS 198	Mark	669 / 1	
197	Valve (pressure)(control)	Cobra Watertech (Pty) Ltd	Masterflo I PA3 Series	SABS 198	Mark	683 / 1	
198	Valve (pressure)(control)	Cobra Watertech (Pty) Ltd	Masterflo II PA4.---	SABS 198	Mark	86 / 1	
199	Valve (pressure)(control)	Cobra Watertech (Pty) Ltd	Masterbox II PA4 Series	SABS 198	Mark	483 / 1	
200	Valve (pressure)(control)	Cobra Watertech (Pty) Ltd	PA4.612, PA4.622 PA4.632	SABS 198	Mark	492 / 1	
201	Valve (pressure)(control)	Cobra Watertech (Pty) Ltd	PB1.312, PB1.322, PB1.342	SABS 198	Mark	507 / 1	
202	Valve (pressure)(control)	Marley SA (Pty) Ltd	Quadro 100, 200 & 400kPa	SABS 198	Mark	573 / 1	
203	Valve (pressure)(control)	Marley SA (Pty) Ltd	LAT21, 34, 35, 36, 37	SABS 198	Mark	215 / 2	
204	Valve (pressure)(control)	Marley SA (Pty) Ltd	LAT22 & LAT23	SABS 198	Mark	215 / 3	
205	Valve (pressure)(control)	Caleffi SA (Pty) Ltd	533Calvalve	SABS 198	Mark	926 / 1	
206	Valve (pressure)(control)	Caleffi SA (Pty) Ltd	533Doublebloc	SABS 198	Mark	926 / 2	
207	Valve (pressure)(control)	Caleffi SA (Pty) Ltd	533Multibloc	SABS 198	Mark	926 / 3	
208	Valve (pressure)(control)	Hans Sasserath & Co	KH3.124	SABS 198	Mark	1035 / 1	
209	Valve (pressure)(control)	Hans Sasserath & Co	KH3.104 KH3.106 KH3.124	SABS 198	Mark	1040 / 1	
210	Valve (pressure)(control)	Hans Sasserath & Co	KH3.114 KH3.116 KH3.126	SABS 198	Mark	1040 / 2	
211	Valve (safety)	Cobra Watertech (Pty) Ltd	Master PB1.12 and PB1.22	SABS 198	Mark	481 / 1	
212	Valve (safety)	Cobra Watertech (Pty) Ltd	Master PB1.42	SABS 198	Mark	481 / 2	
213	Valve (safety)	Caleffi SA (Pty) Ltd	310-1/2/4/6	SABS 198	Mark	926 / 5	
214	Valve (vacuum breaker)	WattsIndustries	Watts	SABS 198	Comply	1480 / 1	
215	Valve kit (PRV + relief valve)	WattsIndustries	Watts N45-Z8 400 kPa	SABS 198	Comply	1481 / 1	
216	Water heater (gravity)	W E Geysers	Combitherm	SABS 151	Mark	1454 / 1	
217	Water heater (storage)	Kwikot - Jhb	Econoflo 400kPa type 3	SABS 151	Mark	626 / 1	

Line	Product description	Manufacturer	Catalog reference	Specification	Mark/ comply	Serial	Special conditions
218	Water heater (storage)	Kwikot - Jhb	Electrasol 400kPa type 3	SABS 151	Mark	628 / 1	
219	Water heater (storage)	Kwikot - Jhb	K Series 100kPa type 3	SABS 151	Mark	661 / 1	
220	Water heater (storage)	Kwikot - Jhb	Displacem't 100kPa type 3	SABS 151	Mark	622 / 1	
221	Water heater (storage)	Kwikot - Jhb	Displ.100kPa Slim type 3	SABS 151	Mark	635 / 1	
222	Water heater (storage)	Kwikot - Jhb	Displacem't 200kPa type 3	SABS 151	Mark	647 / 1	
223	Water heater (storage)	Kwikot - Jhb	Combination LP type 2	SABS 151	Mark	668 / 1	
224	Water heater (storage)	Kwikot - Jhb	Megaflo type 3 (400 kPa)	SABS 151	Mark	685 / 1	
225	Water heater (storage)	Kwikot - Jhb	OVWBE type 1	SABS 151	Mark	693 / 1	
226	Water heater (storage)	Kwikot - Jhb	Kwikot 2000 type 3	SABS 151	Mark	801 / 1	
227	Water heater (storage)	Kwikot - Jhb	400kPa type 3	SABS 151	Mark	206 / 1	
228	Water heater (storage)	Kwikot - Jhb	Kwikot 200kPa type 3	SABS 151	Mark	277 / 1	
229	Water heater (storage)	City Heat Geysers CC	type 1 & 3	SABS 151	Mark	472 / 1	
230	Water heater (storage)	City Heat Geysers CC	type 2	SABS 151	Mark	472 / 2	
231	Water heater (storage)	Kwikot - Jhb	S500	SABS 151	Mark	502 / 1	
232	Water heater (storage)	W E Geysers	100L, 150L, 200L	SABS 151	Mark	1048 / 1	
233	Water heater (storage)	Franke Water Heating Systems	Megahot	SABS 151	Mark	1051 / 2	
234	Water heater (storage)	Kwikot - Jhb	Econohot 1000 100L & 150L	SABS 151	Mark	1082 / 1	
235	Water heater (storage)	KwikotLimited	Kwikot 600 Dual 100 & 150	SABS 151	Mark	1403 / 1	
236	Water heater (storage)	Geyser Allied Products	GAP 100, GAP 150, GAP 200	SANS 151	Mark	1459 / 1	
237	Water heater (storage)	Franke Water Heating Systems	Horizontal and Vertical geyser	SANS151/SABS151	Mark	1485 / 1	
238	Water heater (storage)	Copperline Geysers cc	400, 125, H200, 100, H150, 50	SABS 151	Mark	1488 / 1	
239	Water heater drip tray	GRPSolutions	Floodbuster drip tray	SANS 1848	Comply	1506 / 1	
240	Water meter (combination)	Elster Kent Metering (Pty) Ltd	3000V	SABS 1529	Mark	445 / 1	
241	Water meter (combination)	Sensys	ML 3701 e, ML 3750 e	SABS 1529	Mark	1098 / 1	
242	Water meter (multi-jet)	Elster Kent Metering (Pty) Ltd	Optima2000MNRF,MNR,MNRS	SABS 1529	Mark	478 / 1	
243	Water meter (multi-jet)	Elster Kent Metering (Pty) Ltd	AT000	SABS 1529	Mark	970 / 1	
244	Water meter (multi-jet)	Sensys	W 121.14/E, MML 1000/11.00(1)	SABS 1529	Mark	1097 / 1	
245	Water meter (multi-jet)	Actaris	Wolmag,woltex,FlostarMultimag	SABS 1529	Mark	1109 / 1	
246	Water meter (multi-jet)	Zenner Meters (PTY) Ltd	MNK1.5,CIB&C,MNK2.5,MNK3.5	SABS 1529	Mark	1391 / 1	
247	Water meter (multi-jet)	Zenner Meters (PTY) Ltd	CIB,MNK-N1.5,CIB,MNK1.5PlstCB	SABS 1529	Mark	1391 / 2	
248	Water meter (multi-jet)	Aqua-Loc SA (Pty) Ltd	Aqua-loc WDMS	SANS 1529	Mark	1469 / 1	

JASWIC ACCEPTANCE COMMITTEE WORKING LIST: ACCEPTED WATER COMPONENTS

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Line	Product description	Manufacturer	Catalog reference	Specification	Mark/ comply	Serial	Special conditions
249	Water meter (rotary piston)	Elster Kent Metering (Pty) Ltd	PSM	SABS 1529	Mark	444 / 1	
250	Water meter (vert. spindle)	Sensys	ML 3400 e	SABS 1529	Mark	1099 / 1	
251	Watermeter(woltman)	Elster Kent Metering (Pty) Ltd	Helix3000	SABS 1529	Mark	447 / 1	
252	Watermeter(woltman)	Elster Kent Metering (Pty) Ltd	HelixWP4000	SABS 1529	Mark	991 / 1	
253	Watermeter(woltman)	Sensys	ML 3000 e, ML 3100 e	SABS 1529	Mark	1100 / 1	
254	Watermeter(woltman)	Actaris	HorizontalWoltman	SABS 1529	Mark	1418 / 1	

APPENDIX D: PLUMBERS SURVEY FORM AND RESULTS

Questionnaire for Plumbers

We would like to request a few minutes of your time to assist this research done by the University of Johannesburg. The result of this research will help us understand the current state of the plumbing industry in South Africa. Your contact details are not required and your answers will be treated confidentially.

1. Who do you work for?

Myself ☐ Plumbing Company ☐ Non-plumbing company ☐ Other (Please specify) ☐

2. How big is a company where you work?

Small (1–5 teams) ☐ Large (5–10 teams) ☐ Very large (More than 10 teams) ☐

3. How long have you been in the plumbing industry?

Less than 3 years ☐ 4 - 9 years ☐ 10 – 20 years ☐ More than 20 years ☐

4. What plumbing qualification do you have?

None ☐ Plumbing trade certificate ☐ National certificate in Construction at NQF/level 3 ☐ Plumber in training ☐

5. Are you a member of IOPSA? Yes ☐ No ☐

6. How serious do you think is the problem of water leakage from plumbing fittings in the area that you serve?

Not a problem ☐ Small ☐ Moderate ☐ Large ☐ Very large ☐

7. Rate each plumbing component according to how much water leakage they are responsible for, in your opinion. (From 1 = most to 5 = least)

Geysers and accessories	
Pipes and accessories	
Toilet cisterns and accessories	
Taps	
Other valves	

Thanks for your participation! If you want more information, please contact

K Paul Lobanga
Tel: 011 559 2931
E-mail: lobanga1@hotmail.com
Fax: 011 559 2532
or
Prof JE Kobus Van Zyl
Tel: 011 559 2345
E-mail: kobusvz@uj.ac.za

Frequencies of Recorded Variables for Lobanga

New Question 1: Who do you work for?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Myself	56	56.0	56.0	56.0
	Plumbing Company	30	30.0	30.0	86.0
	Non-plumbing Company & Other	14	14.0	14.0	100.0
	Total	100	100.0	100.0	

New Question 3: How long have you been in the plumbing industry?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Less than 9 years	46	46.0	46.5	46.5
	More than 9 years	53	53.0	53.5	100.0
	Total	99	99.0	100.0	
Missing	System	1	1.0		
Total		100	100.0		

New Question 6: How serious do you think is the problem of water leakage from plumbing fittings in the area that you serve?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Small / Not a problem	24	24.0	24.5	24.5
	Moderate	35	35.0	35.7	60.2
	Large	20	20.0	20.4	80.6
	Very large	19	19.0	19.4	100.0
	Total	98	98.0	100.0	
Missing	System	2	2.0		
Total		100	100.0		

New Question 12: Considering all plumbing components installed in South Africa, what fraction do you believe to be approved by SABS, JASWIC or a local authority?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Little & None <33%	14	14.0	17.5	17.5
	Average 34-67%	36	36.0	45.0	62.5
	Most 68-95%	21	21.0	26.3	88.8
	All >95%	9	9.0	11.3	100.0
	Total	80	80.0	100.0	
Missing	System	20	20.0		
Total		100	100.0		

New Question 13: In your opinion, what is the percentage of plumbers who install non-approved products?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Little & None <33%	27	27.0	33.8	33.8
	Average 34-67%	31	31.0	38.8	72.5
	Most & All >67%	22	22.0	27.5	100.0
	Total	80	80.0	100.0	
Missing	System	20	20.0		
Total		100	100.0		

Crosstabs For Lobanga

New Question 6 (How serious do you think is the problem of water leakage from plumbing fittings in the area that you serve?) VS Question 8.1 Suburbs

Crosstab								
			Question 8.1 Suburbs					Total
			None <5%	Little 5-33%	Average 34-67%	Most 68-95%	All >95%	None <5%
New Question 6: How serious do you think is the problem of water leakage from plumbing fittings in the area that you serve?	Small / Not a problem	Count	3	2	2	10	4	21
		% within New Question 6	14.3%	9.5%	9.5%	47.6%	19.0%	100.0%
		% within Question 8.1 Suburbs	50.0%	20.0%	15.4%	27.8%	20.0%	24.7%
	Moderate	Count	2	4	5	13	7	31
		% within New Question 6	6.5%	12.9%	16.1%	41.9%	22.6%	100.0%
		% within Question 8.1 Suburbs	33.3%	40.0%	38.5%	36.1%	35.0%	36.5%
	Large	Count	0	3	4	6	3	16
		% within New Question 6	.0%	18.8%	25.0%	37.5%	18.8%	100.0%
		% within Question 8.1 Suburbs	.0%	30.0%	30.8%	16.7%	15.0%	18.8%
	Very large	Count	1	1	2	7	6	17
		% within New Question 6	5.9%	5.9%	11.8%	41.2%	35.3%	100.0%
		% within Question 8.1 Suburbs	16.7%	10.0%	15.4%	19.4%	30.0%	20.0%
Total		Count	6	10	13	36	20	85
		% within New Question 6	7.1%	11.8%	15.3%	42.4%	23.5%	100.0%
		% within Question 8.1 Suburbs	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	7.195(a)	12	.844
Likelihood Ratio	7.796	12	.801
Linear-by-Linear Association	1.207	1	.272
N of Valid Cases	85		
a 15 cells (75.0%) have expected count less than 5. The minimum expected count is 1.13.			

New Question 6 (How serious do you think is the problem of water leakage from plumbing fittings in the area that you serve?) VS Question 8.2 Townships

Crosstab								
			Question 8.2 Townships					Total
			None <5%	Little 5-33%	Average 34-67%	Most 68-95%	All >95%	None <5%
New Question 6: How serious do you think is the problem of water leakage from plumbing fittings in the area that you serve?	Small / Not a problem	Count	7	7	0	3	1	18
		% within New Question 6	38.9%	38.9%	.0%	16.7%	5.6%	100.0%
		% within q8.2 Townships	19.4%	35.0%	.0%	33.3%	12.5%	23.4%
	Moderate	Count	19	4	1	2	0	26
		% within New Question 6	73.1%	15.4%	3.8%	7.7%	.0%	100.0%
		% within q8.2 Townships	52.8%	20.0%	25.0%	22.2%	.0%	33.8%
	Large	Count	6	6	2	1	1	16
		% within New Question 6	37.5%	37.5%	12.5%	6.3%	6.3%	100.0%
		% within q8.2 Townships	16.7%	30.0%	50.0%	11.1%	12.5%	20.8%
	Very large	Count	4	3	1	3	6	17
		% within New Question 6	23.5%	17.6%	5.9%	17.6%	35.3%	100.0%
		% within q8.2 Townships	11.1%	15.0%	25.0%	33.3%	75.0%	22.1%
Total		Count	36	20	4	9	8	77
		% within New Question 6	46.8%	26.0%	5.2%	11.7%	10.4%	100.0%
		% within q8.2 Townships	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	27.758(a)	12	.006
Likelihood Ratio	27.044	12	.008
Linear-by-Linear Association	7.928	1	.005
N of Valid Cases	77		
a 15 cells (75.0%) have expected count less than 5. The minimum expected count is .83.			

New Question 6 (How serious do you think is the problem of water leakage from plumbing fittings in the area that you serve?) VS Question 8.3 Informal settlements

Crosstab								
			Question 8.3 Informal settlements					Total
			None <5%	Little 5-33%	Average 34-67%	Most 68-95%	All >95%	None <5%
New Question 6: How serious do you think is the problem of water leakage from plumbing fittings in the area that you serve?	Small / Not a problem	Count	14	0	3	2	1	20
		% within New Question 6	70.0%	.0%	15.0%	10.0%	5.0%	100.0%
		% within Question 8.3 Informal settlements	26.9%	.0%	60.0%	50.0%	16.7%	26.7%
	Moderate	Count	22	2	2	0	1	27
		% within New Question 6	81.5%	7.4%	7.4%	.0%	3.7%	100.0%
		% within Question 8.3 Informal settlements	42.3%	25.0%	40.0%	.0%	16.7%	36.0%
	Large	Count	9	4	0	0	1	14
		% within New Question 6	64.3%	28.6%	.0%	.0%	7.1%	100.0%
		% within Question 8.3 Informal settlements	17.3%	50.0%	.0%	.0%	16.7%	18.7%
	Very large	Count	7	2	0	2	3	14
		% within New Question 6	50.0%	14.3%	.0%	14.3%	21.4%	100.0%
		% within Question 8.3 Informal settlements	13.5%	25.0%	.0%	50.0%	50.0%	18.7%
Total		Count	52	8	5	4	6	75
		% within New Question 6	69.3%	10.7%	6.7%	5.3%	8.0%	100.0%
		% within Question 8.3 Informal settlements	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	21.260(a)	12	.047
Likelihood Ratio	23.974	12	.021
Linear-by-Linear Association	1.910	1	.167
N of Valid Cases	75		
a 16 cells (80.0%) have expected count less than 5. The minimum expected count is .75.			

New Question 6 (How serious do you think is the problem of water leakage from plumbing fittings in the area that you serve?) VS Question 8.4 Commercial areas

Crosstab								
			Question 8.4 Commercial areas					Total
			None <5%	Little 5-33%	Average 34-67%	Most 68-95%	All >95%	None <5%
New Question 6: How serious do you think is the problem of water leakage from plumbing fittings in the area that you serve?	Small / Not a problem	Count	6	5	3	5	0	19
		% within New Question 6	31.6%	26.3%	15.8%	26.3%	.0%	100.0%
		% within Question 8.4 Commercial areas	40.0%	22.7%	18.8%	23.8%	.0%	24.4%
	Moderate	Count	5	9	9	4	0	27
		% within New Question 6	18.5%	33.3%	33.3%	14.8%	.0%	100.0%
		% within Question 8.4 Commercial areas	33.3%	40.9%	56.3%	19.0%	.0%	34.6%
	Large	Count	2	3	2	7	2	16
		% within New Question 6	12.5%	18.8%	12.5%	43.8%	12.5%	100.0%
		% within Question 8.4 Commercial areas	13.3%	13.6%	12.5%	33.3%	50.0%	20.5%
	Very large	Count	2	5	2	5	2	16
		% within New Question 6	12.5%	31.3%	12.5%	31.3%	12.5%	100.0%
		% within Question 8.4 Commercial areas	13.3%	22.7%	12.5%	23.8%	50.0%	20.5%
Total		Count	15	22	16	21	4	78
		% within New Question 6	19.2%	28.2%	20.5%	26.9%	5.1%	100.0%
		% within Question 8.4 Commercial areas	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	15.492(a)	12	.216
Likelihood Ratio	16.632	12	.164
Linear-by-Linear Association	4.688	1	.030
N of Valid Cases	78		
a 14 cells (70.0%) have expected count less than 5. The minimum expected count is .82.			

New Question 6 (How serious do you think is the problem of water leakage from plumbing fittings in the area that you serve?) VS Question 8.5 Industrial areas

Crosstab								
			Question 8.5 Industrial areas					Total
			None <5%	Little 5-33%	Average 34-67%	Most 68-95%	All >95%	None <5%
New Question 6: How serious do you think is the problem of water leakage from plumbing fittings in the area that you serve?	Small / Not a problem	Count	6	4	2	4	0	16
		% within New Question 6	37.5%	25.0%	12.5%	25.0%	.0%	100.0%
		% within Question 8.5 Industrial areas	46.2%	16.7%	15.4%	23.5%	.0%	22.9%
	Moderate	Count	4	13	7	4	1	29
		% within New Question 6	13.8%	44.8%	24.1%	13.8%	3.4%	100.0%
		% within Question 8.5 Industrial areas	30.8%	54.2%	53.8%	23.5%	33.3%	41.4%
	Large	Count	2	3	3	4	2	14
		% within New Question 6	14.3%	21.4%	21.4%	28.6%	14.3%	100.0%
		% within Question 8.5 Industrial areas	15.4%	12.5%	23.1%	23.5%	66.7%	20.0%
	Very large	Count	1	4	1	5	0	11
		% within New Question 6	9.1%	36.4%	9.1%	45.5%	.0%	100.0%
		% within Question 8.5 Industrial areas	7.7%	16.7%	7.7%	29.4%	.0%	15.7%
Total		Count	13	24	13	17	3	70
		% within New Question 6	18.6%	34.3%	18.6%	24.3%	4.3%	100.0%
		% within Question 8.5 Industrial areas	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	15.466(a)	12	.217
Likelihood Ratio	14.841	12	.250
Linear-by-Linear Association	3.741	1	.053
N of Valid Cases	70		
a 15 cells (75.0%) have expected count less than 5. The minimum expected count is .47.			

New Question 6 (How serious do you think is the problem of water leakage from plumbing fittings in the area that you serve?) VS Question 8.6 Farms, rural areas

Crosstab								
			Question 8.6 Farms, rural areas					Total
			None <5%	Little 5-33%	Average 34-67%	Most 68-95%	All >95%	None <5%
New Question 6: How serious do you think is the problem of water leakage from plumbing fittings in the area that you serve?	Small / Not a problem	Count	7	6	2	1	0	16
		% within New Question 6	43.8%	37.5%	12.5%	6.3%	.0%	100.0%
		% within Question 8.6 Farms, rural areas	20.0%	25.0%	33.3%	33.3%	.0%	23.2%
	Moderate	Count	14	10	1	1	0	26
		% within New Question 6	53.8%	38.5%	3.8%	3.8%	.0%	100.0%
		% within Question 8.6 Farms, rural areas	40.0%	41.7%	16.7%	33.3%	.0%	37.7%
	Large	Count	8	3	2	0	1	14
		% within New Question 6	57.1%	21.4%	14.3%	.0%	7.1%	100.0%
		% within Question 8.6 Farms, rural areas	22.9%	12.5%	33.3%	.0%	100.0%	20.3%
	Very large	Count	6	5	1	1	0	13
		% within New Question 6	46.2%	38.5%	7.7%	7.7%	.0%	100.0%
		% within Question 8.6 Farms, rural areas	17.1%	20.8%	16.7%	33.3%	.0%	18.8%

Crosstab								
			Question 8.6 Farms, rural areas					Total
			None <5%	Little 5-33%	Average 34-67%	Most 68-95%	All >95%	None <5%
Total		Count	35	24	6	3	1	69
		% within New Question 6	50.7%	34.8%	8.7%	4.3%	1.4%	100.0%
		% within Question 8.6 Farms, rural areas	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	7.782(a)	12	.802
Likelihood Ratio	7.759	12	.804
Linear-by-Linear Association	.015	1	.902
N of Valid Cases	69		
a 14 cells (70.0%) have expected count less than 5. The minimum expected count is .19.			

New Question 6 (How serious do you think is the problem of water leakage from plumbing fittings in the area that you serve?) VS Question 9.1 Private households

Crosstab								
			Question 9.1 Private households					Total
			None <5%	Little 5-33%	Average 34-67%	Most 68-95%	All >95%	None <5%
New Question 6: How serious do you think is the problem of water leakage from plumbing fittings in the area that you serve?	Small / Not a problem	Count	3	2	4	5	3	17
		% within New Question 6	17.6%	11.8%	23.5%	29.4%	17.6%	100.0%
		% within Question 9.1 Private households	42.9%	16.7%	23.5%	20.0%	16.7%	21.5%
	Moderate	Count	3	4	4	13	8	32
		% within New Question 6	9.4%	12.5%	12.5%	40.6%	25.0%	100.0%
		% within Question 9.1 Private households	42.9%	33.3%	23.5%	52.0%	44.4%	40.5%

Crosstab								
			Question 9.1 Private households					Total
			None <5%	Little 5-33%	Average 34-67%	Most 68-95%	All >95%	None <5%
New Question 6: How serious do you think is the problem of water leakage from plumbing fittings in the area that you serve?	Large	Count	0	3	5	3	3	14
		% within New Question 6	.0%	21.4%	35.7%	21.4%	21.4%	100.0%
		% within Question 9.1 Private households	.0%	25.0%	29.4%	12.0%	16.7%	17.7%
	Very large	Count	1	3	4	4	4	16
		% within New Question 6	6.3%	18.8%	25.0%	25.0%	25.0%	100.0%
		% within Question 9.1 Private households	14.3%	25.0%	23.5%	16.0%	22.2%	20.3%
Total		Count	7	12	17	25	18	79
		% within New Question 6	8.9%	15.2%	21.5%	31.6%	22.8%	100.0%
		% within Question 9.1 Private households	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	8.112(a)	12	.776
Likelihood Ratio	9.018	12	.701
Linear-by-Linear Association	.131	1	.717
N of Valid Cases	79		
a 15 cells (75.0%) have expected count less than 5. The minimum expected count is 1.24.			

New Question 6 (How serious do you think is the problem of water leakage from plumbing fittings in the area that you serve?) VS Question 9.2 Public buildings (schools, churches, municipal, etc.)

Crosstab								
			Question 9.2 Public buildings (Schools, churches, municipal, etc.)					Total
			None <5%	Little 5-33%	Average 34-67%	Most 68-95%	All >95%	None <5%
New Question 6: How serious do you think is the problem of water leakage from plumbing fittings in the area that you serve?	Small / Not a problem	Count	5	4	3	4	2	18
		% within New Question 6	27.8%	22.2%	16.7%	22.2%	11.1%	100.0%
		% within Question 9.2 Public buildings	26.3%	16.0%	23.1%	26.7%	28.6%	22.8%
	Moderate	Count	11	9	8	1	0	29
		% within New Question 6	37.9%	31.0%	27.6%	3.4%	.0%	100.0%
		% within Question 9.2 Public buildings	57.9%	36.0%	61.5%	6.7%	.0%	36.7%
	Large	Count	1	7	1	5	3	17
		% within New Question 6	5.9%	41.2%	5.9%	29.4%	17.6%	100.0%
		% within Question 9.2 Public buildings	5.3%	28.0%	7.7%	33.3%	42.9%	21.5%
	Very large	Count	2	5	1	5	2	15
		% within New Question 6	13.3%	33.3%	6.7%	33.3%	13.3%	100.0%
		% within Question 9.2 Public buildings	10.5%	20.0%	7.7%	33.3%	28.6%	19.0%
Total		Count	19	25	13	15	7	79
		% within New Question 6	24.1%	31.6%	16.5%	19.0%	8.9%	100.0%
		% within Question 9.2 Public buildings	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	21.577(a)	12	.043
Likelihood Ratio	26.317	12	.010
Linear-by-Linear Association	2.998	1	.083
N of Valid Cases	79		
a 15 cells (75.0%) have expected count less than 5. The minimum expected count is 1.33.			

New Question 6 (How serious do you think is the problem of water leakage from plumbing fittings in the area that you serve?) VS Question 9.3 Tourism industry (Hotels, hostels, guesthouses, etc.)

Crosstab								
			Question 9.3 Tourism industry (Hotels, hostels, guesthouses, etc.)					Total
			None <5%	Little 5-33%	Average 34-67%	Most 68-95%	All >95%	None <5%
New Question 6: How serious do you think is the problem of water leakage from plumbing fittings in the area that you serve?	Small / Not a problem	Count	5	5	3	3	1	17
		% within New Question 6	29.4%	29.4%	17.6%	17.6%	5.9%	100.0%
		% within Question 9.3 Tourism industry	23.8%	15.2%	27.3%	30.0%	33.3%	21.8%
	Moderate	Count	9	16	3	1	0	29
		% within New Question 6	31.0%	55.2%	10.3%	3.4%	.0%	100.0%
		% within Question 9.3 Tourism industry	42.9%	48.5%	27.3%	10.0%	.0%	37.2%
	Large	Count	2	7	2	3	2	16
		% within New Question 6	12.5%	43.8%	12.5%	18.8%	12.5%	100.0%
		% within Question 9.3 Tourism industry	9.5%	21.2%	18.2%	30.0%	66.7%	20.5%
	Very large	Count	5	5	3	3	0	16
		% within New Question 6	31.3%	31.3%	18.8%	18.8%	.0%	100.0%
		% within Question 9.3 Tourism industry	23.8%	15.2%	27.3%	30.0%	.0%	20.5%

Crosstab								
			Question 9.3 Tourism industry (Hotels, hostels, guesthouses, etc.)					Total
			None <5%	Little 5-33%	Average 34-67%	Most 68-95%	All >95%	None <5%
Total		Count	21	33	11	10	3	78
		% within New Question 6	26.9%	42.3%	14.1%	12.8%	3.8%	100.0%
		% within Question 9.3 Tourism industry	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	12.760(a)	12	.387
Likelihood Ratio	14.293	12	.282
Linear-by-Linear Association	.286	1	.593
N of Valid Cases	78		
a 15 cells (75.0%) have expected count less than 5. The minimum expected count is .62.			

New Question 6 (How serious do you think is the problem of water leakage from plumbing fittings in the area that you serve?) VS Question 9.4 Commercial buildings (Shops, offices, etc.)

Crosstab								
			Question 9.4 Commercial buildings (Shops, offices, etc.)					Total
			None <5%	Little 5-33%	Average 34-67%	Most 68-95%	All >95%	None <5%
New Question 6: How serious do you think is the problem of water leakage from plumbing fittings in the area that you serve?	Small / Not a problem	Count	1	9	4	2	1	17
		% within New Question 6	5.9%	52.9%	23.5%	11.8%	5.9%	100.0%
		% within Question 9.4 Commercial buildings	16.7%	30.0%	23.5%	9.5%	20.0%	21.5%
	Moderate	Count	2	16	5	6	1	30
		% within New Question 6	6.7%	53.3%	16.7%	20.0%	3.3%	100.0%
		% within Question 9.4 Commercial buildings	33.3%	53.3%	29.4%	28.6%	20.0%	38.0%

Crosstab								
			Question 9.4 Commercial buildings (Shops, offices, etc.)					Total
			None <5%	Little 5-33%	Average 34-67%	Most 68-95%	All >95%	None <5%
New Question 6: How serious do you think is the problem of water leakage from plumbing fittings in the area that you serve?	Large	Count	1	1	5	6	3	16
		% within New Question 6	6.3%	6.3%	31.3%	37.5%	18.8%	100.0%
		% within Question 9.4 Commercial buildings	16.7%	3.3%	29.4%	28.6%	60.0%	20.3%
	Very large	Count	2	4	3	7	0	16
		% within New Question 6	12.5%	25.0%	18.8%	43.8%	.0%	100.0%
		% within Question 9.4 Commercial buildings	33.3%	13.3%	17.6%	33.3%	.0%	20.3%
Total		Count	6	30	17	21	5	79
		% within New Question 6	7.6%	38.0%	21.5%	26.6%	6.3%	100.0%
		% within Question 9.4 Commercial buildings	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	19.310(a)	12	.081
Likelihood Ratio	21.048	12	.050
Linear-by-Linear Association	3.300	1	.069
N of Valid Cases	79		
a 14 cells (70.0%) have expected count less than 5. The minimum expected count is 1.01.			

New Question 6 (How serious do you think is the problem of water leakage from plumbing fittings in the area that you serve?) VS Question 9.5 Industrial buildings

Crosstab								
			Question 9.5 Industrial buildings					Total
			None <5%	Little 5-33%	Average 34-67%	Most 68-95%	All >95%	None <5%
New Question 6: How serious do you think is the problem of water leakage from plumbing fittings in the area that you serve?	Small / Not a problem	Count	3	5	3	2	0	13
		% within New Question 6	23.1%	38.5%	23.1%	15.4%	.0%	100.0%
		% within Question 9.5 Industrial buildings	23.1%	22.7%	20.0%	16.7%	.0%	19.4%
	Moderate	Count	4	9	8	3	3	27
		% within New Question 6	14.8%	33.3%	29.6%	11.1%	11.1%	100.0%
		% within Question 9.5 Industrial buildings	30.8%	40.9%	53.3%	25.0%	60.0%	40.3%
	Large	Count	1	4	0	6	2	13
		% within New Question 6	7.7%	30.8%	.0%	46.2%	15.4%	100.0%
		% within Question 9.5 Industrial buildings	7.7%	18.2%	.0%	50.0%	40.0%	19.4%
	Very large	Count	5	4	4	1	0	14
		% within New Question 6	35.7%	28.6%	28.6%	7.1%	.0%	100.0%
		% within Question 9.5 Industrial buildings	38.5%	18.2%	26.7%	8.3%	.0%	20.9%
Total		Count	13	22	15	12	5	67
		% within New Question 6	19.4%	32.8%	22.4%	17.9%	7.5%	100.0%
		% within Question 9.5 Industrial buildings	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	18.258(a)	12	.108
Likelihood Ratio	21.299	12	.046
Linear-by-Linear Association	.045	1	.833
N of Valid Cases	67		
a 17 cells (85.0%) have expected count less than 5. The minimum expected count is .97.			

New Question 1 (Who do you work for?) VS Question 11.1 SABS approved

Crosstab								
			Question 11.1 SABS approved					Total
			None <5%	Little 5-33%	Average 34-67%	Most 68-95%	All >95%	None <5%
New Question 1: Who do you work for?	Myself	Count	0	1	5	8	27	41
		% within New Question 1	.0%	2.4%	12.2%	19.5%	65.9%	100.0%
		% within Question 11.1 SABS approved	.0%	100.0%	62.5%	47.1%	55.1%	53.2%
	Plumbing Company	Count	2	0	2	7	15	26
		% within New Question 1	7.7%	.0%	7.7%	26.9%	57.7%	100.0%
		% within Question 11.1 SABS approved	100.0%	.0%	25.0%	41.2%	30.6%	33.8%
	Non-plumbing Company & Other	Count	0	0	1	2	7	10
		% within New Question 1	.0%	.0%	10.0%	20.0%	70.0%	100.0%
		% within Question 11.1 SABS approved	.0%	.0%	12.5%	11.8%	14.3%	13.0%
Total		Count	2	1	8	17	49	77
		% within New Question 1	2.6%	1.3%	10.4%	22.1%	63.6%	100.0%
		% within Question 11.1 SABS approved	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	5.771(a)	8	.673
Likelihood Ratio	6.574	8	.583
Linear-by-Linear Association	.016	1	.901
N of Valid Cases	77		
a 10 cells (66.7%) have expected count less than 5. The minimum expected count is .13.			

New Question 1 (Who do you work for?) VS Question 11.2 JASWIC approved

Crosstab								
			Question 11.2 JASWIC approved					Total
			None <5%	Little 5-33%	Average 34-67%	Most 68-95%	All >95%	None <5%
New Question 1: Who do you work for?	Myself	Count	4	2	5	14	17	42
		% within New Question 1	9.5%	4.8%	11.9%	33.3%	40.5%	100.0%
		% within Question 11.2 JASWIC approved	50.0%	22.2%	55.6%	66.7%	63.0%	56.8%
	Plumbing Company	Count	4	7	3	4	5	23
		% within New Question 1	17.4%	30.4%	13.0%	17.4%	21.7%	100.0%
		% within Question 11.2 JASWIC approved	50.0%	77.8%	33.3%	19.0%	18.5%	31.1%
	Non-plumbing Company & Other	Count	0	0	1	3	5	9
		% within New Question 1	.0%	.0%	11.1%	33.3%	55.6%	100.0%
		% within Question 11.2 JASWIC approved	.0%	.0%	11.1%	14.3%	18.5%	12.2%
Total		Count	8	9	9	21	27	74
		% within New Question 1	10.8%	12.2%	12.2%	28.4%	36.5%	100.0%
		% within Question 11.2 JASWIC approved	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	15.154(a)	8	.056
Likelihood Ratio	16.014	8	.042
Linear-by-Linear Association	.108	1	.743
N of Valid Cases	74		
a 9 cells (60.0%) have expected count less than 5. The minimum expected count is .97.			

New Question 1 (Who do you work for?) VS Question 11.3 Approved by local authority (but not JASWIC or SABS)

Crosstab								
			Question 11.3 Approved by local authority (but not JASWIC or SABS)					Total
			None <5%	Little 5-33%	Average 34-67%	Most 68-95%	All >95%	None <5%
New Question 1: Who do you work for?	Myself	Count	13	5	4	2	7	31
		% within New Question 1	41.9%	16.1%	12.9%	6.5%	22.6%	100.0%
		% within Question 11.3 Approved by local authority	56.5%	50.0%	80.0%	40.0%	58.3%	56.4%
	Plumbing Company	Count	8	5	0	2	3	18
		% within New Question 1	44.4%	27.8%	.0%	11.1%	16.7%	100.0%
		% within Question 11.3 Approved by local authority	34.8%	50.0%	.0%	40.0%	25.0%	32.7%
	Non-plumbing Company & Other	Count	2	0	1	1	2	6
		% within New Question 1	33.3%	.0%	16.7%	16.7%	33.3%	100.0%
		% within Question 11.3 Approved by local authority	8.7%	.0%	20.0%	20.0%	16.7%	10.9%
Total		Count	23	10	5	5	12	55
		% within New Question 1	41.8%	18.2%	9.1%	9.1%	21.8%	100.0%
		% within Question 11.3 Approved by local authority	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	6.007(a)	8	.646
Likelihood Ratio	8.398	8	.396
Linear-by-Linear Association	.206	1	.650
N of Valid Cases	55		
a 11 cells (73.3%) have expected count less than 5. The minimum expected count is .55.			

New Question 1 (Who do you work for?) VS Question 11.4 Not approved

Crosstab							
			Question 11.4 Not approved				Total
			None <5%	Little 5-33%	Average 34-67%	Most 68-95%	None <5%
New Question 1: Who do you work for?	Myself	Count	20	4	1	0	25
		% within New Question 1	80.0%	16.0%	4.0%	.0%	100.0%
		% within Question 11.4 Not approved	55.6%	66.7%	50.0%	.0%	55.6%
	Plumbing Company	Count	13	1	0	0	14
		% within New Question 1	92.9%	7.1%	.0%	.0%	100.0%
		% within Question 11.4 Not approved	36.1%	16.7%	.0%	.0%	31.1%
	Non-plumbing Company & Other	Count	3	1	1	1	6
		% within New Question 1	50.0%	16.7%	16.7%	16.7%	100.0%
		% within Question 11.4 Not approved	8.3%	16.7%	50.0%	100.0%	13.3%
Total		Count	36	6	2	1	45
		% within New Question 1	80.0%	13.3%	4.4%	2.2%	100.0%
		% within Question 11.4 Not approved	100.0%	100.0%	100.0%	100.0%	100.0%

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	10.700(a)	6	.098
Likelihood Ratio	8.174	6	.226
Linear-by-Linear Association	2.998	1	.083
N of Valid Cases	45		
a 10 cells (83.3%) have expected count less than 5. The minimum expected count is .13.			

New Question 1 (Who do you work for?) VS Question 11.5 Don't know

Crosstab							
			Question 11.5 Don't know				Total
			None <5%	Little 5-33%	Average 34-67%	All >95%	None <5%
New Question 1: Who do you work for?	Myself	Count	10	1	2	0	13
		% within New Question 1	76.9%	7.7%	15.4%	.0%	100.0%
		% within Question 11.5 Don't know	55.6%	100.0%	100.0%	.0%	59.1%
	Plumbing Company	Count	5	0	0	1	6
		% within New Question 1	83.3%	.0%	.0%	16.7%	100.0%
		% within Question 11.5 Don't know	27.8%	.0%	.0%	100.0%	27.3%
	Non-plumbing Company & Other	Count	3	0	0	0	3
		% within New Question 1	100.0%	.0%	.0%	.0%	100.0%
		% within Question 11.5 Don't know	16.7%	.0%	.0%	.0%	13.6%
Total		Count	18	1	2	1	22
		% within New Question 1	81.8%	4.5%	9.1%	4.5%	100.0%
		% within Question 11.5 Don't know	100.0%	100.0%	100.0%	100.0%	100.0%

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	4.905(a)	6	.556
Likelihood Ratio	5.909	6	.433
Linear-by-Linear Association	.071	1	.790
N of Valid Cases	22		
a 11 cells (91.7%) have expected count less than 5. The minimum expected count is .14.			

New Question 1 (Who do you work for?) VS New Question 12 (Considering all plumbing components installed in South Africa, what fraction do you believe to be approved by SABS, JASWIC or a local authority?)

Crosstab							
			New Question 12: Considering all plumbing components installed in South Africa, what fraction do you believe to be approved by SABS, JASWIC or a local authority?				Total
			Little & None <33%	Average 34-67%	Most 68-95%	All >95%	Little & None <33%
New Question 1: Who do you work for?	Myself	Count	9	18	12	6	45
		% within New Question 1	20.0%	40.0%	26.7%	13.3%	100.0%
		% within New Question 12	64.3%	50.0%	57.1%	66.7%	56.3%
	Plumbing Company	Count	3	13	8	3	27
		% within New Question 1	11.1%	48.1%	29.6%	11.1%	100.0%
		% within New Question 12	21.4%	36.1%	38.1%	33.3%	33.8%
	Non-plumbing Company & Other	Count	2	5	1	0	8
		% within New Question 1	25.0%	62.5%	12.5%	.0%	100.0%
		% within New Question 12	14.3%	13.9%	4.8%	.0%	10.0%
Total		Count	14	36	21	9	80
		% within New Question 1	17.5%	45.0%	26.3%	11.3%	100.0%
		% within New Question 12	100.0%	100.0%	100.0%	100.0%	100.0%

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	3.672(a)	6	.721
Likelihood Ratio	4.704	6	.582
Linear-by-Linear Association	.302	1	.582
N of Valid Cases	80		
a 6 cells (50.0%) have expected count less than 5. The minimum expected count is .90.			

New Question 1 (Who do you work for?) VS New Question 13 (In your opinion, what is the percentage of plumbers who install non-approved products?)

Crosstab						
			New Question 13: In your opinion, what is the percentage of plumbers who install non-approved products?			Total
			Little & None <33%	Average 34-67%	Most & All >67%	Little & None <33%
New Question 1: Who do you work for?	Myself	Count	14	19	13	46
		% within New Question 1	30.4%	41.3%	28.3%	100.0%
		% within New Question 13	51.9%	61.3%	59.1%	57.5%
	Plumbing Company	Count	8	11	7	26
		% within New Question 1	30.8%	42.3%	26.9%	100.0%
		% within New Question 13	29.6%	35.5%	31.8%	32.5%
	Non-plumbing Company & Other	Count	5	1	2	8
		% within New Question 1	62.5%	12.5%	25.0%	100.0%
		% within New Question 13	18.5%	3.2%	9.1%	10.0%
Total		Count	27	31	22	80
		% within New Question 1	33.8%	38.8%	27.5%	100.0%
		% within New Question 13	100.0%	100.0%	100.0%	100.0%

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	3.793(a)	4	.435
Likelihood Ratio	3.914	4	.418
Linear-by-Linear Association	1.261	1	.262
N of Valid Cases	80		
a 3 cells (33.3%) have expected count less than 5. The minimum expected count is 2.20.			

New Question 3 (How long have you been in the plumbing industry?) VS Question 11.1 SABS approved

Crosstab								
			Question 11.1 SABS approved					Total
			None <5%	Little 5-33%	Average 34-67%	Most 68-95%	All >95%	None <5%
New Question 3: How long have you been in the plumbing industry?	Less than 9 years	Count	2	1	4	8	22	37
		% within New Question 3	5.4%	2.7%	10.8%	21.6%	59.5%	100.0%
		% within Question 11.1 SABS approved	100.0%	100.0%	50.0%	47.1%	44.9%	48.1%
	More than 9 years	Count	0	0	4	9	27	40
		% within New Question 3	.0%	.0%	10.0%	22.5%	67.5%	100.0%
		% within Question 11.1 SABS approved	.0%	.0%	50.0%	52.9%	55.1%	51.9%
Total		Count	2	1	8	17	49	77
		% within New Question 3	2.6%	1.3%	10.4%	22.1%	63.6%	100.0%
		% within Question 11.1 SABS approved	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	3.457(a)	4	.484
Likelihood Ratio	4.612	4	.329
Linear-by-Linear Association	2.091	1	.148
N of Valid Cases	77		
a 6 cells (60.0%) have expected count less than 5. The minimum expected count is .48.			

New Question 3 (How long have you been in the plumbing industry?) VS Question 11.2 JASWIC approved

Crosstab								
			Question 11.2 JASWIC approved					Total
			None <5%	Little 5-33%	Average 34-67%	Most 68-95%	All >95%	None <5%
New Question 3: How long have you been in the plumbing industry?	Less than 9 years	Count	7	5	6	6	8	32
		% within New Question 3	21.9%	15.6%	18.8%	18.8%	25.0%	100.0%
		% within Question 11.2 JASWIC approved	87.5%	55.6%	66.7%	28.6%	29.6%	43.2%
	More than 9 years	Count	1	4	3	15	19	42
		% within New Question 3	2.4%	9.5%	7.1%	35.7%	45.2%	100.0%
		% within Question 11.2 JASWIC approved	12.5%	44.4%	33.3%	71.4%	70.4%	56.8%
Total		Count	8	9	9	21	27	74
		% within New Question 3	10.8%	12.2%	12.2%	28.4%	36.5%	100.0%
		% within Question 11.2 JASWIC approved	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	12.833(a)	4	.012
Likelihood Ratio	13.437	4	.009
Linear-by-Linear Association	10.232	1	.001
N of Valid Cases	74		
a 4 cells (40.0%) have expected count less than 5. The minimum expected count is 3.46.			

New Question 3 (How long have you been in the plumbing industry?) VS Question 11.3 Approved by local authority (but not JASWIC or SABS)

Crosstab								
			Question 11.3 Approved by local authority (but not JASWIC or SABS)					Total
			None <5%	Little 5-33%	Average 34-67%	Most 68-95%	All >95%	None <5%
New Question 3: How long have you been in the plumbing industry?	Less than 9 years	Count	12	4	3	3	3	25
		% within New Question 3	48.0%	16.0%	12.0%	12.0%	12.0%	100.0%
		% within Question 11.3 Approved by local authority	52.2%	40.0%	60.0%	60.0%	25.0%	45.5%
	More than 9 years	Count	11	6	2	2	9	30
		% within New Question 3	36.7%	20.0%	6.7%	6.7%	30.0%	100.0%
		% within Question 11.3 Approved by local authority	47.8%	60.0%	40.0%	40.0%	75.0%	54.5%
Total		Count	23	10	5	5	12	55
		% within New Question 3	41.8%	18.2%	9.1%	9.1%	21.8%	100.0%
		% within Question 11.3 Approved by local authority	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	3.417(a)	4	.491
Likelihood Ratio	3.533	4	.473
Linear-by-Linear Association	1.264	1	.261
N of Valid Cases	55		
a 5 cells (50.0%) have expected count less than 5. The minimum expected count is 2.27.			

New Question 3 (How long have you been in the plumbing industry?) VS Question 11.4 Not approved

Crosstab							
			Question 11.4 Not approved				Total
			None <5%	Little 5-33%	Average 34-67%	Most 68-95%	None <5%
New Question 3: How long have you been in the plumbing industry?	Less than 9 years	Count	18	3	0	0	21
		% within New Question 3	85.7%	14.3%	.0%	.0%	100.0%
		% within Question 11.4 Not approved	50.0%	50.0%	.0%	.0%	46.7%
	More than 9 years	Count	18	3	2	1	24
		% within New Question 3	75.0%	12.5%	8.3%	4.2%	100.0%
		% within Question 11.4 Not approved	50.0%	50.0%	100.0%	100.0%	53.3%
Total		Count	36	6	2	1	45
		% within New Question 3	80.0%	13.3%	4.4%	2.2%	100.0%
		% within Question 11.4 Not approved	100.0%	100.0%	100.0%	100.0%	100.0%

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	2.813(a)	3	.421
Likelihood Ratio	3.959	3	.266
Linear-by-Linear Association	1.920	1	.166
N of Valid Cases	45		
a 6 cells (75.0%) have expected count less than 5. The minimum expected count is .47.			

New Question 3 (How long have you been in the plumbing industry?) VS Question 11.5 Don't know

Crosstab							
			Question 11.5 Don't know				Total
			None <5%	Little 5-33%	Average 34-67%	All >95%	None <5%
New Question 3: How long have you been in the plumbing industry?	Less than 9 years	Count	8	0	1	0	9
		% within New Question 3	88.9%	.0%	11.1%	.0%	100.0%
		% within Question 11.5 Don't know	44.4%	.0%	50.0%	.0%	40.9%
	More than 9 years	Count	10	1	1	1	13
		% within New Question 3	76.9%	7.7%	7.7%	7.7%	100.0%
		% within Question 11.5 Don't know	55.6%	100.0%	50.0%	100.0%	59.1%
Total		Count	18	1	2	1	22
		% within New Question 3	81.8%	4.5%	9.1%	4.5%	100.0%
		% within Question 11.5 Don't know	100.0%	100.0%	100.0%	100.0%	100.0%

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	1.546(a)	3	.672
Likelihood Ratio	2.264	3	.519
Linear-by-Linear Association	.524	1	.469
N of Valid Cases	22		
a 6 cells (75.0%) have expected count less than 5. The minimum expected count is .41.			

New Question 3 (How long have you been in the plumbing industry?) VS New Question 12 (Considering all plumbing components installed in South Africa, what fraction do you believe to be approved by SABS, JASWIC or a local authority?)

Crosstab							
			New Question 12: Considering all plumbing components installed in South Africa, what fraction do you believe to be approved by SABS, JASWIC or a local authority?				Total
			Little & None <33%	Average 34-67%	Most 68-95%	All >95%	Little & None <33%
New Question 3: How long have you been in the plumbing industry?	Less than 9 years	Count	7	17	11	1	36
		% within New Question 3	19.4%	47.2%	30.6%	2.8%	100.0%
		% within New Question 12	50.0%	47.2%	52.4%	11.1%	45.0%
	More than 9 years	Count	7	19	10	8	44
		% within New Question 3	15.9%	43.2%	22.7%	18.2%	100.0%
		% within New Question 12	50.0%	52.8%	47.6%	88.9%	55.0%
Total		Count	14	36	21	9	80
		% within New Question 3	17.5%	45.0%	26.3%	11.3%	100.0%
		% within New Question 12	100.0%	100.0%	100.0%	100.0%	100.0%

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	4.852(a)	3	.183
Likelihood Ratio	5.555	3	.135
Linear-by-Linear Association	1.267	1	.260
N of Valid Cases	80		
a 2 cells (25.0%) have expected count less than 5. The minimum expected count is 4.05.			

New Question 3 (How long have you been in the plumbing industry?) VS New Question 13 (In your opinion, what is the percentage of plumbers who install non-approved products?)

Crosstab						
			New Question 13: In your opinion, what is the percentage of plumbers who install non-approved products?			Total
			Little & None <33%	Average 34-67%	Most & All >67%	Little & None <33%
New Question 3: How long have you been in the plumbing industry?	Less than 9 years	Count	11	15	8	34
		% within New Question 3	32.4%	44.1%	23.5%	100.0%
		% within New Question 13	40.7%	48.4%	36.4%	42.5%
	More than 9 years	Count	16	16	14	46
		% within New Question 3	34.8%	34.8%	30.4%	100.0%
		% within New Question 13	59.3%	51.6%	63.6%	57.5%
Total		Count	27	31	22	80
		% within New Question 3	33.8%	38.8%	27.5%	100.0%
		% within New Question 13	100.0%	100.0%	100.0%	100.0%

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	.813(a)	2	.666
Likelihood Ratio	.814	2	.666
Linear-by-Linear Association	.006	1	.941
N of Valid Cases	80		
a 0 cells (.0%) have expected count less than 5. The minimum expected count is 9.35.			

Question 5 (Are you a member of IOPSA?) VS Question 11.1 SABS approved

Crosstab								
			Question 11.1 SABS approved					Total
			None <5%	Little 5-33%	Average 34-67%	Most 68-95%	All >95%	None <5%
Question 5: Are you a member of IOPSA?	Yes	Count	1	1	6	11	34	53
		% within Question 5	1.9%	1.9%	11.3%	20.8%	64.2%	100.0%
		% within Question 11.1 SABS approved	50.0%	100.0%	75.0%	64.7%	70.8%	69.7%
	No	Count	1	0	2	6	14	23
		% within Question 5	4.3%	.0%	8.7%	26.1%	60.9%	100.0%
		% within Question 11.1 SABS approved	50.0%	.0%	25.0%	35.3%	29.2%	30.3%
Total		Count	2	1	8	17	48	76
		% within Question 5	2.6%	1.3%	10.5%	22.4%	63.2%	100.0%
		% within Question 11.1 SABS approved	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	1.139(a)	4	.888
Likelihood Ratio	1.394	4	.845
Linear-by-Linear Association	.034	1	.854
N of Valid Cases	76		
a 5 cells (50.0%) have expected count less than 5. The minimum expected count is .30.			

Question 5 (Are you a member of IOPSA?) VS Question 11.2 JASWIC approved

Crosstab								
			Question 11.2 JASWIC approved					Total
			None <5%	Little 5-33%	Average 34-67%	Most 68-95%	All >95%	None <5%
Question 5: Are you a member of IOPSA?	Yes	Count	5	3	7	16	22	53
		% within Question 5	9.4%	5.7%	13.2%	30.2%	41.5%	100.0%
		% within Question 11.2 JASWIC approved	62.5%	33.3%	77.8%	80.0%	84.6%	73.6%
	No	Count	3	6	2	4	4	19
		% within Question 5	15.8%	31.6%	10.5%	21.1%	21.1%	100.0%
		% within Question 11.2 JASWIC approved	37.5%	66.7%	22.2%	20.0%	15.4%	26.4%
Total		Count	8	9	9	20	26	72
		% within Question 5	11.1%	12.5%	12.5%	27.8%	36.1%	100.0%
		% within Question 11.2 JASWIC approved	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	10.146(a)	4	.038
Likelihood Ratio	9.182	4	.057
Linear-by-Linear Association	5.814	1	.016
N of Valid Cases	72		
a 3 cells (30.0%) have expected count less than 5. The minimum expected count is 2.11.			

Question 5 (Are you a member of IOPSA?) VS Question 11.3 Approved by local authority (but not JASWIC or SABS)

Crosstab								
			Question 11.3 Approved by local authority (but not JASWIC or SABS)					Total
			None <5%	Little 5-33%	Average 34-67%	Most 68-95%	All >95%	None <5%
Question 5: Are you a member of IOPSA?	Yes	Count	17	6	4	5	9	41
		% within Question 5	41.5%	14.6%	9.8%	12.2%	22.0%	100.0%
		% within Question 11.3 Approved by local authority	73.9%	66.7%	80.0%	100.0%	81.8%	77.4%
	No	Count	6	3	1	0	2	12
		% within Question 5	50.0%	25.0%	8.3%	.0%	16.7%	100.0%
		% within Question 11.3 Approved by local authority	26.1%	33.3%	20.0%	.0%	18.2%	22.6%
Total		Count	23	9	5	5	11	53
		% within Question 5	43.4%	17.0%	9.4%	9.4%	20.8%	100.0%
		% within Question 11.3 Approved by local authority	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	2.352(a)	4	.671
Likelihood Ratio	3.406	4	.492
Linear-by-Linear Association	.900	1	.343
N of Valid Cases	53		
a 6 cells (60.0%) have expected count less than 5. The minimum expected count is 1.13.			

Question 5 (Are you a member of IOPSA?) VS Question 11.4 Not approved

Crosstab							
			Question 11.4 Not approved				Total
			None <5%	Little 5-33%	Average 34-67%	Most 68-95%	None <5%
Question 5: Are you a member of IOPSA?	Yes	Count	24	5	1	1	31
		% within Question 5	77.4%	16.1%	3.2%	3.2%	100.0%
		% within Question 11.4 Not approved	70.6%	83.3%	50.0%	100.0%	72.1%
	No	Count	10	1	1	0	12
		% within Question 5	83.3%	8.3%	8.3%	.0%	100.0%
		% within Question 11.4 Not approved	29.4%	16.7%	50.0%	.0%	27.9%
Total		Count	34	6	2	1	43
		% within Question 5	79.1%	14.0%	4.7%	2.3%	100.0%
		% within Question 11.4 Not approved	100.0%	100.0%	100.0%	100.0%	100.0%

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	1.287(a)	3	.732
Likelihood Ratio	1.545	3	.672
Linear-by-Linear Association	.100	1	.751
N of Valid Cases	43		
a 6 cells (75.0%) have expected count less than 5. The minimum expected count is .28.			

Question 5 (Are you a member of IOPSA?) VS Question 11.5 Don't know

Crosstab							
			Question 11.5 Don't know				Total
			None <5%	Little 5-33%	Average 34-67%	All >95%	None <5%
Question 5: Are you a member of IOPSA?	Yes	Count	12	1	2	0	15
		% within Question 5	80.0%	6.7%	13.3%	.0%	100.0%
		% within Question 11.5 Don't know	75.0%	100.0%	100.0%	.0%	75.0%

Crosstab							
			Question 11.5 Don't know				Total
			None <5%	Little 5-33%	Average 34-67%	All >95%	None <5%
Question 5: Are you a member of IOPSA?	No	Count	4	0	0	1	5
		% within Question 5	80.0%	.0%	.0%	20.0%	100.0%
		% within Question 11.5 Don't know	25.0%	.0%	.0%	100.0%	25.0%
Total		Count	16	1	2	1	20
		% within Question 5	80.0%	5.0%	10.0%	5.0%	100.0%
		% within Question 11.5 Don't know	100.0%	100.0%	100.0%	100.0%	100.0%

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	4.000(a)	3	.261
Likelihood Ratio	4.499	3	.212
Linear-by-Linear Association	.741	1	.389
N of Valid Cases	20		
a 7 cells (87.5%) have expected count less than 5. The minimum expected count is .25.			

Question 5 (Are you a member of IOPSA?) VS New Question 12 (Considering all plumbing components installed in South Africa, what fraction do you believe to be approved by SABS, JASWIC or a local authority?)

Crosstab							
			New Question 12: Considering all plumbing components installed in South Africa, what fraction do you believe to be approved by SABS, JASWIC or a local authority?				Total
			Little & None <33%	Average 34-67%	Most 68-95%	All >95%	Little & None <33%
Question 5: Are you a member of IOPSA?	Yes	Count	12	26	11	6	55
		% within Question 5	21.8%	47.3%	20.0%	10.9%	100.0%
		% within New Question 12	92.3%	72.2%	52.4%	75.0%	70.5%

Crosstab							
			New Question 12: Considering all plumbing components installed in South Africa, what fraction do you believe to be approved by SABS, JASWIC or a local authority?				Total
			Little & None <33%	Average 34-67%	Most 68-95%	All >95%	Little & None <33%
Question 5: Are you a member of IOPSA?	No	Count	1	10	10	2	23
		% within Question 5	4.3%	43.5%	43.5%	8.7%	100.0%
		% within New Question 12	7.7%	27.8%	47.6%	25.0%	29.5%
Total		Count	13	36	21	8	78
		% within Question 5	16.7%	46.2%	26.9%	10.3%	100.0%
		% within New Question 12	100.0%	100.0%	100.0%	100.0%	100.0%

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	6.419(a)	3	.093
Likelihood Ratio	6.954	3	.073
Linear-by-Linear Association	3.519	1	.061
N of Valid Cases	78		
a 2 cells (25.0%) have expected count less than 5. The minimum expected count is 2.36.			

Question 5 (Are you a member of IOPSA?) VS New Question 13 (In your opinion, what is the percentage of plumbers who install non-approved products?)

Crosstab						
			New Question 13: In your opinion, what is the percentage of plumbers who install non-approved products?			Total
			Little & None <33%	Average 34-67%	Most & All >67%	Little & None <33%
Question 5: Are you a member of IOPSA?	Yes	Count	15	21	19	55
		% within Question 5	27.3%	38.2%	34.5%	100.0%
		% within New Question 13	55.6%	70.0%	90.5%	70.5%
	No	Count	12	9	2	23
		% within Question 5	52.2%	39.1%	8.7%	100.0%
		% within New Question 13	44.4%	30.0%	9.5%	29.5%
Total		Count	27	30	21	78
		% within Question 5	34.6%	38.5%	26.9%	100.0%
		% within New Question 13	100.0%	100.0%	100.0%	100.0%

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	6.934(a)	2	.031
Likelihood Ratio	7.651	2	.022
Linear-by-Linear Association	6.213	1	.013
N of Valid Cases	78		
a 0 cells (.0%) have expected count less than 5. The minimum expected count is 6.19.			

Question 10.1 New installations VS Question 11.1 SABS approved

Crosstab								
			Question 11.1 SABS approved					Total
			None <5%	Little 5-33%	Average 34-67%	Most 68-95%	All >95%	None <5%
Question 10.1 New installations	None <5%	Count	0	0	0	1	6	7
		% within Question 10.1 New installations	.0%	.0%	.0%	14.3%	85.7%	100.0%
		% within Question 11.1 SABS approved	.0%	.0%	.0%	7.1%	14.6%	10.8%
	Little 5-33%	Count	0	1	2	4	7	14
		% within Question 10.1 New installations	.0%	7.1%	14.3%	28.6%	50.0%	100.0%
		% within Question 11.1 SABS approved	.0%	100.0%	28.6%	28.6%	17.1%	21.5%
	Average 34-67%	Count	0	0	1	1	5	7
		% within Question 10.1 New installations	.0%	.0%	14.3%	14.3%	71.4%	100.0%
		% within Question 11.1 SABS approved	.0%	.0%	14.3%	7.1%	12.2%	10.8%
	Most 68-95%	Count	2	0	3	6	9	20
		% within Question 10.1 New installations	10.0%	.0%	15.0%	30.0%	45.0%	100.0%
		% within Question 11.1 SABS approved	100.0%	.0%	42.9%	42.9%	22.0%	30.8%
	All >95%	Count	0	0	1	2	14	17
		% within Question 10.1 New installations	.0%	.0%	5.9%	11.8%	82.4%	100.0%
		% within Question 11.1 SABS approved	.0%	.0%	14.3%	14.3%	34.1%	26.2%
Total		Count	2	1	7	14	41	65
		% within Question 10.1 New installations	3.1%	1.5%	10.8%	21.5%	63.1%	100.0%
		% within Question 11.1 SABS approved	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	14.993(a)	16	.525
Likelihood Ratio	15.494	16	.489
Linear-by-Linear Association	.003	1	.955
N of Valid Cases	65		
a 22 cells (88.0%) have expected count less than 5. The minimum expected count is .11.			

Question 10.1 New installations VS Question 11.2 JASWIC approved

Crosstab								
			Question 11.2 JASWIC approved					Total
			None <5%	Little 5-33%	Average 34-67%	Most 68-95%	All >95%	None <5%
Question 10.1 New installations	None <5%	Count	3	1	0	1	2	7
		% within Question 10.1 New installations	42.9%	14.3%	.0%	14.3%	28.6%	100.0%
		% within Question 11.2 JASWIC approved	37.5%	12.5%	.0%	4.8%	9.5%	10.6%
	Little 5-33%	Count	2	2	2	5	3	14
		% within Question 10.1 New installations	14.3%	14.3%	14.3%	35.7%	21.4%	100.0%
		% within Question 11.2 JASWIC approved	25.0%	25.0%	25.0%	23.8%	14.3%	21.2%
	Average 34-67%	Count	1	0	3	1	1	6
		% within Question 10.1 New installations	16.7%	.0%	50.0%	16.7%	16.7%	100.0%
		% within Question 11.2 JASWIC approved	12.5%	.0%	37.5%	4.8%	4.8%	9.1%
	Most 68-95%	Count	1	5	2	9	5	22
		% within Question 10.1 New installations	4.5%	22.7%	9.1%	40.9%	22.7%	100.0%
		% within Question 11.2 JASWIC approved	12.5%	62.5%	25.0%	42.9%	23.8%	33.3%

Crosstab								
			Question 11.2 JASWIC approved					Total
			None <5%	Little 5-33%	Average 34-67%	Most 68-95%	All >95%	None <5%
Question 10.1 New installations	All >95%	Count	1	0	1	5	10	17
		% within Question 10.1 New installations	5.9%	.0%	5.9%	29.4%	58.8%	100.0%
		% within Question 11.2 JASWIC approved	12.5%	.0%	12.5%	23.8%	47.6%	25.8%
Total		Count	8	8	8	21	21	66
		% within Question 10.1 New installations	12.1%	12.1%	12.1%	31.8%	31.8%	100.0%
		% within Question 11.2 JASWIC approved	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	28.005(a)	16	.032
Likelihood Ratio	26.126	16	.052
Linear-by-Linear Association	7.262	1	.007
N of Valid Cases	66		
a 21 cells (84.0%) have expected count less than 5. The minimum expected count is .73.			

Question 10.1 New installations VS Question 11.3 Approved by local authority (but not JASWIC or SABS)

Crosstab								
			Question 11.3 Approved by local authority (but not JASWIC or SABS)					Total
			None <5%	Little 5-33%	Average 34-67%	Most 68-95%	All >95%	None <5%
Question 10.1 New installations	None <5%	Count	4	1	0	0	0	5
		% within Question 10.1 New installations	80.0%	20.0%	.0%	.0%	.0%	100.0%
		% within Question 11.3 Approved by local authority	18.2%	11.1%	.0%	.0%	.0%	10.2%

Crosstab								
			Question 11.3 Approved by local authority (but not JASWIC or SABS)					Total
			None <5%	Little 5-33%	Average 34-67%	Most 68-95%	All >95%	None <5%
Question 10.1 New installations	Little 5-33%	Count	6	4	0	0	2	12
		% within Question 10.1 New installations	50.0%	33.3%	.0%	.0%	16.7%	100.0%
		% within Question 11.3 Approved by local authority	27.3%	44.4%	.0%	.0%	20.0%	24.5%
	Average 34-67%	Count	3	1	1	0	1	6
		% within Question 10.1 New installations	50.0%	16.7%	16.7%	.0%	16.7%	100.0%
		% within Question 11.3 Approved by local authority	13.6%	11.1%	20.0%	.0%	10.0%	12.2%
	Most 68-95%	Count	5	2	1	1	1	10
		% within Question 10.1 New installations	50.0%	20.0%	10.0%	10.0%	10.0%	100.0%
		% within Question 11.3 Approved by local authority	22.7%	22.2%	20.0%	33.3%	10.0%	20.4%
	All >95%	Count	4	1	3	2	6	16
		% within Question 10.1 New installations	25.0%	6.3%	18.8%	12.5%	37.5%	100.0%
		% within Question 11.3 Approved by local authority	18.2%	11.1%	60.0%	66.7%	60.0%	32.7%
Total		Count	22	9	5	3	10	49
		% within Question 10.1 New installations	44.9%	18.4%	10.2%	6.1%	20.4%	100.0%
		% within Question 11.3 Approved by local authority	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	15.527(a)	16	.486
Likelihood Ratio	18.966	16	.270
Linear-by-Linear Association	7.543	1	.006
N of Valid Cases	49		
a 23 cells (92.0%) have expected count less than 5. The minimum expected count is .31.			

Question 10.1 New installations VS Question 11.4 Not approved

Crosstab							
			Question 11.4 Not approved				Total
			None <5%	Little 5-33%	Average 34-67%	Most 68-95%	None <5%
Question 10.1 New installations	None <5%	Count	5	0	1	0	6
		% within Question 10.1 New installations	83.3%	.0%	16.7%	.0%	100.0%
		% within Question 11.4 Not approved	14.7%	.0%	50.0%	.0%	14.3%
	Little 5-33%	Count	9	0	0	0	9
		% within Question 10.1 New installations	100.0%	.0%	.0%	.0%	100.0%
		% within Question 11.4 Not approved	26.5%	.0%	.0%	.0%	21.4%
	Average 34-67%	Count	4	1	0	0	5
		% within Question 10.1 New installations	80.0%	20.0%	.0%	.0%	100.0%
		% within Question 11.4 Not approved	11.8%	20.0%	.0%	.0%	11.9%
	Most 68-95%	Count	7	3	1	0	11
		% within Question 10.1 New installations	63.6%	27.3%	9.1%	.0%	100.0%
		% within Question 11.4 Not approved	20.6%	60.0%	50.0%	.0%	26.2%

Crosstab							
			Question 11.4 Not approved				Total
			None <5%	Little 5-33%	Average 34-67%	Most 68-95%	None <5%
Question 10.1 New installations	All >95%	Count	9	1	0	1	11
		% within Question 10.1 New installations	81.8%	9.1%	.0%	9.1%	100.0%
		% within Question 11.4 Not approved	26.5%	20.0%	.0%	100.0%	26.2%
Total		Count	34	5	2	1	42
		% within Question 10.1 New installations	81.0%	11.9%	4.8%	2.4%	100.0%
		% within Question 11.4 Not approved	100.0%	100.0%	100.0%	100.0%	100.0%

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	11.360(a)	12	.498
Likelihood Ratio	12.771	12	.386
Linear-by-Linear Association	.810	1	.368
N of Valid Cases	42		
a 17 cells (85.0%) have expected count less than 5. The minimum expected count is .12.			

Question 10.1 New installations VS Question 11.5 Don't know

Crosstab							
			Question 11.5 Don't know				Total
			None <5%	Little 5-33%	Average 34-67%	All >95%	None <5%
Question 10.1 New installations	None <5%	Count	3	0	1	0	4
		% within Question 10.1 New installations	75.0%	.0%	25.0%	.0%	100.0%
		% within Question 11.5 Don't know	18.8%	.0%	50.0%	.0%	20.0%

Crosstab							
			Question 11.5 Don't know				Total
			None <5%	Little 5-33%	Average 34-67%	All >95%	None <5%
Question 10.1 New installations	Little 5-33%	Count	1	1	0	0	2
		% within Question 10.1 New installations	50.0%	50.0%	.0%	.0%	100.0%
		% within Question 11.5 Don't know	6.3%	100.0%	.0%	.0%	10.0%
	Average 34-67%	Count	1	0	0	0	1
		% within Question 10.1 New installations	100.0%	.0%	.0%	.0%	100.0%
		% within Question 11.5 Don't know	6.3%	.0%	.0%	.0%	5.0%
	Most 68-95%	Count	4	0	1	1	6
		% within Question 10.1 New installations	66.7%	.0%	16.7%	16.7%	100.0%
		% within Question 11.5 Don't know	25.0%	.0%	50.0%	100.0%	30.0%
	All >95%	Count	7	0	0	0	7
		% within Question 10.1 New installations	100.0%	.0%	.0%	.0%	100.0%
		% within Question 11.5 Don't know	43.8%	.0%	.0%	.0%	35.0%
Total		Count	16	1	2	1	20
		% within Question 10.1 New installations	80.0%	5.0%	10.0%	5.0%	100.0%
		% within Question 11.5 Don't know	100.0%	100.0%	100.0%	100.0%	100.0%

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	14.271(a)	12	.284
Likelihood Ratio	10.652	12	.559
Linear-by-Linear Association	.236	1	.627
N of Valid Cases	20		
a 19 cells (95.0%) have expected count less than 5. The minimum expected count is .05.			

Question 10.1 New installations VS New Question 12 (Considering all plumbing components installed in South Africa, what fraction do you believe to be approved by SABS, JASWIC or a local authority?)

Crosstab							
			New Question 12: Considering all plumbing components installed in South Africa, what fraction do you believe to be approved by SABS, JASWIC or a local authority?				Total
			Little & None <33%	Average 34-67%	Most 68-95%	All >95%	Little & None <33%
Question 10.1 New installations	None <5%	Count	3	2	2	0	7
		% within Question 10.1 New installations	42.9%	28.6%	28.6%	.0%	100.0%
		% within New Question 12	25.0%	5.9%	11.8%	.0%	10.0%
	Little 5-33%	Count	3	9	2	2	16
		% within Question 10.1 New installations	18.8%	56.3%	12.5%	12.5%	100.0%
		% within New Question 12	25.0%	26.5%	11.8%	28.6%	22.9%
	Average 34-67%	Count	1	1	4	2	8
		% within Question 10.1 New installations	12.5%	12.5%	50.0%	25.0%	100.0%
		% within New Question 12	8.3%	2.9%	23.5%	28.6%	11.4%
	Most 68-95%	Count	3	11	5	1	20
		% within Question 10.1 New installations	15.0%	55.0%	25.0%	5.0%	100.0%
		% within New Question 12	25.0%	32.4%	29.4%	14.3%	28.6%

Crosstab							
			New Question 12: Considering all plumbing components installed in South Africa, what fraction do you believe to be approved by SABS, JASWIC or a local authority?				Total
			Little & None <33%	Average 34-67%	Most 68-95%	All >95%	Little & None <33%
Question 10.1 New installations	All >95%	Count	2	11	4	2	19
		% within Question 10.1 New installations	10.5%	57.9%	21.1%	10.5%	100.0%
		% within New Question 12	16.7%	32.4%	23.5%	28.6%	27.1%
Total		Count	12	34	17	7	70
		% within Question 10.1 New installations	17.1%	48.6%	24.3%	10.0%	100.0%
		% within New Question 12	100.0%	100.0%	100.0%	100.0%	100.0%

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	13.125(a)	12	.360
Likelihood Ratio	13.348	12	.344
Linear-by-Linear Association	1.170	1	.279
N of Valid Cases	70		
a 17 cells (85.0%) have expected count less than 5. The minimum expected count is .70.			

Question 10.1 New installations VS New Question 13 (In your opinion, what is the percentage of plumbers who install non-approved products?)

Crosstab						
			New Question 13 In your opinion, what is the percentage of plumbers who install non-approved products?			Total
			Little & None <33%	Average 34-67%	Most & All >67%	Little & None <33%
Question 10.1 New installations	None <5%	Count	2	2	3	7
		% within Question 10.1 New installations	28.6%	28.6%	42.9%	100.0%
		% within New Question 13	9.1%	6.9%	16.7%	10.1%

Crosstab						
			New Question 13 In your opinion, what is the percentage of plumbers who install non-approved products?			Total
			Little & None <33%	Average 34-67%	Most & All >67%	Little & None <33%
Question 10.1 New installations	Little 5-33%	Count	5	3	6	14
		% within Question 10.1 New installations	35.7%	21.4%	42.9%	100.0%
		% within New Question 13	22.7%	10.3%	33.3%	20.3%
	Average 34-67%	Count	4	3	1	8
		% within Question 10.1 New installations	50.0%	37.5%	12.5%	100.0%
		% within New Question 13	18.2%	10.3%	5.6%	11.6%
	Most 68-95%	Count	4	11	6	21
		% within Question 10.1 New installations	19.0%	52.4%	28.6%	100.0%
		% within New Question 13	18.2%	37.9%	33.3%	30.4%
	All >95%	Count	7	10	2	19
		% within Question 10.1 New installations	36.8%	52.6%	10.5%	100.0%
		% within New Question 13	31.8%	34.5%	11.1%	27.5%
Total		Count	22	29	18	69
		% within Question 10.1 New installations	31.9%	42.0%	26.1%	100.0%
		% within New Question 13	100.0%	100.0%	100.0%	100.0%

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	9.585(a)	8	.295
Likelihood Ratio	10.196	8	.252
Linear-by-Linear Association	.391	1	.532
N of Valid Cases	69		
a 9 cells (60.0%) have expected count less than 5. The minimum expected count is 1.83.			

Question 10.2 Renovations VS Question 11.1 SABS approved

Crosstab								
			Question 11.1 SABS approved					Total
			None <5%	Little 5-33%	Average 34-67%	Most 68-95%	All >95%	None <5%
Question 10.2 Renovations	None <5%	Count	0	1	1	1	5	8
		% within Question 10.2 Renovations	.0%	12.5%	12.5%	12.5%	62.5%	100.0%
		% within Question 11.1 SABS approved	.0%	100.0%	20.0%	7.1%	12.8%	13.1%
	Little 5-33%	Count	0	0	2	7	9	18
		% within Question 10.2 Renovations	.0%	.0%	11.1%	38.9%	50.0%	100.0%
		% within Question 11.1 SABS approved	.0%	.0%	40.0%	50.0%	23.1%	29.5%
	Average 34-67%	Count	1	0	2	5	15	23
		% within Question 10.2 Renovations	4.3%	.0%	8.7%	21.7%	65.2%	100.0%
		% within Question 11.1 SABS approved	50.0%	.0%	40.0%	35.7%	38.5%	37.7%
	Most 68-95%	Count	0	0	0	1	6	7
		% within Question 10.2 Renovations	.0%	.0%	.0%	14.3%	85.7%	100.0%
		% within Question 11.1 SABS approved	.0%	.0%	.0%	7.1%	15.4%	11.5%
	All >95%	Count	1	0	0	0	4	5
		% within Question 10.2 Renovations	20.0%	.0%	.0%	.0%	80.0%	100.0%
		% within Question 11.1 SABS approved	50.0%	.0%	.0%	.0%	10.3%	8.2%
Total		Count	2	1	5	14	39	61
		% within Question 10.2 Renovations	3.3%	1.6%	8.2%	23.0%	63.9%	100.0%
		% within Question 11.1 SABS approved	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	18.450(a)	16	.298
Likelihood Ratio	16.474	16	.420
Linear-by-Linear Association	.273	1	.602
N of Valid Cases	61		
a 21 cells (84.0%) have expected count less than 5. The minimum expected count is .08.			

Question 10.2 Renovations VS Question 11.2 JASWIC approved

Crosstab								
			Question 11.2 JASWIC approved					Total
			None <5%	Little 5-33%	Average 34-67%	Most 68-95%	All >95%	None <5%
Question 10.2 Renovations	None <5%	Count	3	1	1	3	1	9
		% within Question 10.2 Renovations	33.3%	11.1%	11.1%	33.3%	11.1%	100.0%
		% within Question 11.2 JASWIC approved	37.5%	11.1%	14.3%	15.8%	4.8%	14.1%
	Little 5-33%	Count	2	5	1	4	5	17
		% within Question 10.2 Renovations	11.8%	29.4%	5.9%	23.5%	29.4%	100.0%
		% within Question 11.2 JASWIC approved	25.0%	55.6%	14.3%	21.1%	23.8%	26.6%
	Average 34-67%	Count	2	2	4	7	7	22
		% within Question 10.2 Renovations	9.1%	9.1%	18.2%	31.8%	31.8%	100.0%
		% within Question 11.2 JASWIC approved	25.0%	22.2%	57.1%	36.8%	33.3%	34.4%
	Most 68-95%	Count	0	0	1	4	5	10
		% within Question 10.2 Renovations	.0%	.0%	10.0%	40.0%	50.0%	100.0%
		% within Question 11.2 JASWIC approved	.0%	.0%	14.3%	21.1%	23.8%	15.6%

Crosstab								
			Question 11.2 JASWIC approved					Total
			None <5%	Little 5-33%	Average 34-67%	Most 68-95%	All >95%	None <5%
Question 10.2 Renovations	All >95%	Count	1	1	0	1	3	6
		% within Question 10.2 Renovations	16.7%	16.7%	.0%	16.7%	50.0%	100.0%
		% within Question 11.2 JASWIC approved	12.5%	11.1%	.0%	5.3%	14.3%	9.4%
Total		Count	8	9	7	19	21	64
		% within Question 10.2 Renovations	12.5%	14.1%	10.9%	29.7%	32.8%	100.0%
		% within Question 11.2 JASWIC approved	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	15.304(a)	16	.502
Likelihood Ratio	17.209	16	.372
Linear-by-Linear Association	4.837	1	.028
N of Valid Cases	64		
a 21 cells (84.0%) have expected count less than 5. The minimum expected count is .66.			

Question 10.2 Renovations VS Question 11.3 Approved by local authority (but not JASWIC or SABS)

Crosstab								
			Question 11.3 Approved by local authority (but not JASWIC or SABS)					Total
			None <5%	Little 5-33%	Average 34-67%	Most 68-95%	All >95%	None <5%
Question 10.2 Renovations	None <5%	Count	3	2	1	0	1	7
		% within Question 10.2 Renovations	42.9%	28.6%	14.3%	.0%	14.3%	100.0%
		% within Question 11.3 Approved by local authority	14.3%	20.0%	20.0%	.0%	10.0%	14.3%

Crosstab								
			Question 11.3 Approved by local authority (but not JASWIC or SABS)					Total
			None <5%	Little 5-33%	Average 34-67%	Most 68-95%	All >95%	None <5%
Question 10.2 Renovations	Little 5-33%	Count	4	6	2	0	2	14
		% within Question 10.2 Renovations	28.6%	42.9%	14.3%	.0%	14.3%	100.0%
		% within Question 11.3 Approved by local authority	19.0%	60.0%	40.0%	.0%	20.0%	28.6%
	Average 34-67%	Count	8	1	2	1	5	17
		% within Question 10.2 Renovations	47.1%	5.9%	11.8%	5.9%	29.4%	100.0%
		% within Question 11.3 Approved by local authority	38.1%	10.0%	40.0%	33.3%	50.0%	34.7%
	Most 68-95%	Count	4	1	0	0	0	5
		% within Question 10.2 Renovations	80.0%	20.0%	.0%	.0%	.0%	100.0%
		% within Question 11.3 Approved by local authority	19.0%	10.0%	.0%	.0%	.0%	10.2%
	All >95%	Count	2	0	0	2	2	6
		% within Question 10.2 Renovations	33.3%	.0%	.0%	33.3%	33.3%	100.0%
		% within Question 11.3 Approved by local authority	9.5%	.0%	.0%	66.7%	20.0%	12.2%
Total		Count	21	10	5	3	10	49
		% within Question 10.2 Renovations	42.9%	20.4%	10.2%	6.1%	20.4%	100.0%
		% within Question 11.3 Approved by local authority	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	22.070(a)	16	.141
Likelihood Ratio	22.725	16	.121
Linear-by-Linear Association	.643	1	.423
N of Valid Cases	49		
a 23 cells (92.0%) have expected count less than 5. The minimum expected count is .31.			

Question 10.2 Renovations VS Question 11.4 Not approved

Crosstab							
			Question 11.4 Not approved				Total
			None <5%	Little 5-33%	Average 34-67%	Most 68-95%	None <5%
Question 10.2 Renovations	None <5%	Count	6	0	0	0	6
		% within Question 10.2 Renovations	100.0%	.0%	.0%	.0%	100.0%
		% within Question 11.4 Not approved	17.6%	.0%	.0%	.0%	14.3%
	Little 5-33%	Count	9	3	0	0	12
		% within Question 10.2 Renovations	75.0%	25.0%	.0%	.0%	100.0%
		% within Question 11.4 Not approved	26.5%	50.0%	.0%	.0%	28.6%
	Average 34-67%	Count	10	3	0	0	13
		% within Question 10.2 Renovations	76.9%	23.1%	.0%	.0%	100.0%
		% within Question 11.4 Not approved	29.4%	50.0%	.0%	.0%	31.0%
	Most 68-95%	Count	5	0	1	0	6
		% within Question 10.2 Renovations	83.3%	.0%	16.7%	.0%	100.0%
		% within Question 11.4 Not approved	14.7%	.0%	100.0%	.0%	14.3%
	All >95%	Count	4	0	0	1	5
		% within Question 10.2 Renovations	80.0%	.0%	.0%	20.0%	100.0%
		% within Question 11.4 Not approved	11.8%	.0%	.0%	100.0%	11.9%
Total		Count	34	6	1	1	42
		% within Question 10.2 Renovations	81.0%	14.3%	2.4%	2.4%	100.0%
		% within Question 11.4 Not approved	100.0%	100.0%	100.0%	100.0%	100.0%

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	17.848(a)	12	.120
Likelihood Ratio	14.719	12	.257
Linear-by-Linear Association	2.117	1	.146
N of Valid Cases	42		
a 18 cells (90.0%) have expected count less than 5. The minimum expected count is .12.			

Question 10.2 Renovations VS Question 11.5 Don't know

Crosstab							
			Question 11.5 Don't know				Total
			None <5%	Little 5-33%	Average 34-67%	All >95%	None <5%
Question 10.2 Renovations	None <5%	Count	4	0	0	0	4
		% within Question 10.2 Renovations	100.0%	.0%	.0%	.0%	100.0%
		% within Question 11.5 Don't know	23.5%	.0%	.0%	.0%	19.0%
	Little 5-33%	Count	4	1	0	0	5
		% within Question 10.2 Renovations	80.0%	20.0%	.0%	.0%	100.0%
		% within Question 11.5 Don't know	23.5%	100.0%	.0%	.0%	23.8%
	Average 34-67%	Count	2	0	1	1	4
		% within Question 10.2 Renovations	50.0%	.0%	25.0%	25.0%	100.0%
		% within Question 11.5 Don't know	11.8%	.0%	50.0%	100.0%	19.0%
	Most 68-95%	Count	4	0	1	0	5
		% within Question 10.2 Renovations	80.0%	.0%	20.0%	.0%	100.0%
		% within Question 11.5 Don't know	23.5%	.0%	50.0%	.0%	23.8%
	All >95%	Count	3	0	0	0	3
		% within Question 10.2 Renovations	100.0%	.0%	.0%	.0%	100.0%
		% within Question 11.5 Don't know	17.6%	.0%	.0%	.0%	14.3%
Total		Count	17	1	2	1	21
		% within Question 10.2 Renovations	81.0%	4.8%	9.5%	4.8%	100.0%
		% within Question 11.5 Don't know	100.0%	100.0%	100.0%	100.0%	100.0%

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	10.963(a)	12	.532
Likelihood Ratio	10.442	12	.577
Linear-by-Linear Association	.086	1	.769
N of Valid Cases	21		
a 20 cells (100.0%) have expected count less than 5. The minimum expected count is .14.			

Question 10.2 Renovations VS New Question 12 (Considering all plumbing components installed in South Africa, what fraction do you believe to be approved by SABS, JASWIC or a local authority?)

Crosstab							
			New Question 12: Considering all plumbing components installed in South Africa, what fraction do you believe to be approved by SABS, JASWIC or a local authority?				Total
			Little & None <33%	Average 34-67%	Most 68-95%	All >95%	Little & None <33%
Question 10.2 Renovations	None <5%	Count	4	3	2	1	10
		% within Question 10.2 Renovations	40.0%	30.0%	20.0%	10.0%	100.0%
		% within New Question 12	30.8%	10.3%	11.1%	12.5%	14.7%
	Little 5-33%	Count	4	7	3	2	16
		% within Question 10.2 Renovations	25.0%	43.8%	18.8%	12.5%	100.0%
		% within New Question 12	30.8%	24.1%	16.7%	25.0%	23.5%
	Average 34-67%	Count	2	12	8	2	24
		% within Question 10.2 Renovations	8.3%	50.0%	33.3%	8.3%	100.0%
		% within New Question 12	15.4%	41.4%	44.4%	25.0%	35.3%
	Most 68-95%	Count	2	4	2	1	9
		% within Question 10.2 Renovations	22.2%	44.4%	22.2%	11.1%	100.0%
		% within New Question 12	15.4%	13.8%	11.1%	12.5%	13.2%

Crosstab							
			New Question 12: Considering all plumbing components installed in South Africa, what fraction do you believe to be approved by SABS, JASWIC or a local authority?				Total
			Little & None <33%	Average 34-67%	Most 68-95%	All >95%	Little & None <33%
Question 10.2 Renovations	All >95%	Count	1	3	3	2	9
		% within Question 10.2 Renovations	11.1%	33.3%	33.3%	22.2%	100.0%
		% within New Question 12	7.7%	10.3%	16.7%	25.0%	13.2%
Total		Count	13	29	18	8	68
		% within Question 10.2 Renovations	19.1%	42.6%	26.5%	11.8%	100.0%
		% within New Question 12	100.0%	100.0%	100.0%	100.0%	100.0%

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	7.532(a)	12	.821
Likelihood Ratio	7.313	12	.836
Linear-by-Linear Association	2.673	1	.102
N of Valid Cases	68		
a 17 cells (85.0%) have expected count less than 5. The minimum expected count is 1.06.			

Question 10.2 Renovations VS New Question 13 (In your opinion, what is the percentage of plumbers who install non-approved products?)

Crosstab						
			New Question 13: In your opinion, what is the percentage of plumbers who install non-approved products?			Total
			Little & None <33%	Average 34-67%	Most & All >67%	Little & None <33%
Question 10.2 Renovations	None <5%	Count	4	3	3	10
		% within Question 10.2 Renovations	40.0%	30.0%	30.0%	100.0%
		% within New Question 13	17.4%	11.5%	16.7%	14.9%

Crosstab						
			New Question 13: In your opinion, what is the percentage of plumbers who install non-approved products?			Total
			Little & None <33%	Average 34-67%	Most & All >67%	Little & None <33%
Question 10.2 Renovations	Little 5-33%	Count	6	4	6	16
		% within Question 10.2 Renovations	37.5%	25.0%	37.5%	100.0%
		% within New Question 13	26.1%	15.4%	33.3%	23.9%
	Average 34-67%	Count	6	11	5	22
		% within Question 10.2 Renovations	27.3%	50.0%	22.7%	100.0%
		% within New Question 13	26.1%	42.3%	27.8%	32.8%
	Most 68-95%	Count	1	5	4	10
		% within Question 10.2 Renovations	10.0%	50.0%	40.0%	100.0%
		% within New Question 13	4.3%	19.2%	22.2%	14.9%
	All >95%	Count	6	3	0	9
		% within Question 10.2 Renovations	66.7%	33.3%	.0%	100.0%
		% within New Question 13	26.1%	11.5%	.0%	13.4%
Total		Count	23	26	18	67
		% within Question 10.2 Renovations	34.3%	38.8%	26.9%	100.0%
		% within New Question 13	100.0%	100.0%	100.0%	100.0%

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	10.924(a)	8	.206
Likelihood Ratio	13.333	8	.101
Linear-by-Linear Association	.580	1	.446
N of Valid Cases	67		
a 10 cells (66.7%) have expected count less than 5. The minimum expected count is 2.42.			

Question 10.3 Maintenance VS Question 11.1 SABS approved

Crosstab								
			Question 11.1 SABS approved					Total
			None <5%	Little 5-33%	Average 34-67%	Most 68-95%	All >95%	None <5%
Question 10.3 Maintenance	None <5%	Count	1	0	1	3	4	9
		% within Question 10.3 Maintenance	11.1%	.0%	11.1%	33.3%	44.4%	100.0%
		% within Question 11.1 SABS approved	50.0%	.0%	20.0%	20.0%	9.1%	13.4%
	Little 5-33%	Count	0	1	0	2	5	8
		% within Question 10.3 Maintenance	.0%	12.5%	.0%	25.0%	62.5%	100.0%
		% within Question 11.1 SABS approved	.0%	100.0%	.0%	13.3%	11.4%	11.9%
	Average 34-67%	Count	0	0	2	2	7	11
		% within Question 10.3 Maintenance	.0%	.0%	18.2%	18.2%	63.6%	100.0%
		% within Question 11.1 SABS approved	.0%	.0%	40.0%	13.3%	15.9%	16.4%
	Most 68-95%	Count	0	0	2	2	9	13
		% within Question 10.3 Maintenance	.0%	.0%	15.4%	15.4%	69.2%	100.0%
		% within Question 11.1 SABS approved	.0%	.0%	40.0%	13.3%	20.5%	19.4%
	All >95%	Count	1	0	0	6	19	26
		% within Question 10.3 Maintenance	3.8%	.0%	.0%	23.1%	73.1%	100.0%
		% within Question 11.1 SABS approved	50.0%	.0%	.0%	40.0%	43.2%	38.8%
Total		Count	2	1	5	15	44	67
		% within Question 10.3 Maintenance	3.0%	1.5%	7.5%	22.4%	65.7%	100.0%
		% within Question 11.1 SABS approved	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	17.632(a)	16	.346
Likelihood Ratio	16.449	16	.422
Linear-by-Linear Association	2.716	1	.099
N of Valid Cases	67		
a 19 cells (76.0%) have expected count less than 5. The minimum expected count is .12.			

Question 10.3 Maintenance VS Question 11.2 JASWIC approved

Crosstab								
			Question 11.2 JASWIC approved					Total
			None <5%	Little 5-33%	Average 34-67%	Most 68-95%	All >95%	None <5%
Question 10.3 Maintenance	None <5%	Count	1	1	1	3	3	9
		% within Question 10.3 Maintenance	11.1%	11.1%	11.1%	33.3%	33.3%	100.0%
		% within Question 11.2 JASWIC approved	12.5%	12.5%	14.3%	15.8%	11.5%	13.2%
	Little 5-33%	Count	1	1	0	3	5	10
		% within Question 10.3 Maintenance	10.0%	10.0%	.0%	30.0%	50.0%	100.0%
		% within Question 11.2 JASWIC approved	12.5%	12.5%	.0%	15.8%	19.2%	14.7%
	Average 34-67%	Count	1	2	2	3	3	11
		% within Question 10.3 Maintenance	9.1%	18.2%	18.2%	27.3%	27.3%	100.0%
		% within Question 11.2 JASWIC approved	12.5%	25.0%	28.6%	15.8%	11.5%	16.2%

Crosstab								
			Question 11.2 JASWIC approved					Total
			None <5%	Little 5-33%	Average 34-67%	Most 68-95%	All >95%	None <5%
Question 10.3 Maintenance	Most 68-95%	Count	1	0	3	8	4	16
		% within Question 10.3 Maintenance	6.3%	.0%	18.8%	50.0%	25.0%	100.0%
		% within Question 11.2 JASWIC approved	12.5%	.0%	42.9%	42.1%	15.4%	23.5%
	All >95%	Count	4	4	1	2	11	22
		% within Question 10.3 Maintenance	18.2%	18.2%	4.5%	9.1%	50.0%	100.0%
		% within Question 11.2 JASWIC approved	50.0%	50.0%	14.3%	10.5%	42.3%	32.4%

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	15.854(a)	16	.463
Likelihood Ratio	18.932	16	.272
Linear-by-Linear Association	.142	1	.706
N of Valid Cases	68		
a 22 cells (88.0%) have expected count less than 5. The minimum expected count is .93.			

Question 10.3 Maintenance VS Question 11.3 Approved by local authority (but not JASWIC or SABS)

Crosstab								
			Question 11.3 Approved by local authority (but not JASWIC or SABS)					Total
			None <5%	Little 5-33%	Average 34-67%	Most 68-95%	All >95%	None <5%
Question 10.3 Maintenance	None <5%	Count	4	0	1	1	2	8
		% within Question 10.3 Maintenance	50.0%	.0%	12.5%	12.5%	25.0%	100.0%
		% within Question 11.3 Approved by local authority	17.4%	.0%	20.0%	33.3%	18.2%	15.4%
	Little 5-33%	Count	2	2	0	0	3	7
		% within Question 10.3 Maintenance	28.6%	28.6%	.0%	.0%	42.9%	100.0%
		% within Question 11.3 Approved by local authority	8.7%	20.0%	.0%	.0%	27.3%	13.5%
	Average 34-67%	Count	3	1	1	1	1	7
		% within Question 10.3 Maintenance	42.9%	14.3%	14.3%	14.3%	14.3%	100.0%
		% within Question 11.3 Approved by local authority	13.0%	10.0%	20.0%	33.3%	9.1%	13.5%
	Most 68-95%	Count	8	3	2	1	0	14
		% within Question 10.3 Maintenance	57.1%	21.4%	14.3%	7.1%	.0%	100.0%
		% within Question 11.3 Approved by local authority	34.8%	30.0%	40.0%	33.3%	.0%	26.9%
	All >95%	Count	6	4	1	0	5	16
		% within Question 10.3 Maintenance	37.5%	25.0%	6.3%	.0%	31.3%	100.0%
		% within Question 11.3 Approved by local authority	26.1%	40.0%	20.0%	.0%	45.5%	30.8%
Total		Count	23	10	5	3	11	52
		% within Question 10.3 Maintenance	44.2%	19.2%	9.6%	5.8%	21.2%	100.0%
		% within Question 11.3 Approved by local authority	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	13.191(a)	16	.659
Likelihood Ratio	18.745	16	.282
Linear-by-Linear Association	.387	1	.534
N of Valid Cases	52		
a 23 cells (92.0%) have expected count less than 5. The minimum expected count is .40.			

Question 10.3 Maintenance VS Question 11.4 Not approved

Crosstab							
			Question 11.4 Not approved				Total
			None <5%	Little 5-33%	Average 34-67%	Most 68-95%	None <5%
Question 10.3 Maintenance	None <5%	Count	8	1	0	1	10
		% within Question 10.3 Maintenance	80.0%	10.0%	.0%	10.0%	100.0%
		% within Question 11.4 Not approved	22.2%	16.7%	.0%	100.0%	22.2%
	Little 5-33%	Count	4	1	0	0	5
		% within Question 10.3 Maintenance	80.0%	20.0%	.0%	.0%	100.0%
		% within Question 11.4 Not approved	11.1%	16.7%	.0%	.0%	11.1%
	Average 34-67%	Count	4	2	0	0	6
		% within Question 10.3 Maintenance	66.7%	33.3%	.0%	.0%	100.0%
		% within Question 11.4 Not approved	11.1%	33.3%	.0%	.0%	13.3%
	Most 68-95%	Count	11	1	1	0	13
		% within Question 10.3 Maintenance	84.6%	7.7%	7.7%	.0%	100.0%
		% within Question 11.4 Not approved	30.6%	16.7%	50.0%	.0%	28.9%
	All >95%	Count	9	1	1	0	11
		% within Question 10.3 Maintenance	81.8%	9.1%	9.1%	.0%	100.0%
		% within Question 11.4 Not approved	25.0%	16.7%	50.0%	.0%	24.4%
Total		Count	36	6	2	1	45
		% within Question 10.3 Maintenance	80.0%	13.3%	4.4%	2.2%	100.0%
		% within Question 11.4 Not approved	100.0%	100.0%	100.0%	100.0%	100.0%

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	7.957(a)	12	.788
Likelihood Ratio	7.751	12	.804
Linear-by-Linear Association	.191	1	.662
N of Valid Cases	45		
a 17 cells (85.0%) have expected count less than 5. The minimum expected count is .11.			

Question 10.3 Maintenance VS Question 11.5 Don't know

Crosstab						
			Question 11.5 Don't know			Total
			None <5%	Little 5-33%	Average 34-67%	None <5%
Question 10.3 Maintenance	None <5%	Count	6	0	0	6
		% within Question 10.3 Maintenance	100.0%	.0%	.0%	100.0%
		% within Question 11.5 Don't know	33.3%	.0%	.0%	28.6%
	Little 5-33%	Count	1	0	0	1
		% within Question 10.3 Maintenance	100.0%	.0%	.0%	100.0%
		% within Question 11.5 Don't know	5.6%	.0%	.0%	4.8%
	Average 34-67%	Count	2	0	1	3
		% within Question 10.3 Maintenance	66.7%	.0%	33.3%	100.0%
		% within Question 11.5 Don't know	11.1%	.0%	50.0%	14.3%
	Most 68-95%	Count	5	1	0	6
		% within Question 10.3 Maintenance	83.3%	16.7%	.0%	100.0%
		% within Question 11.5 Don't know	27.8%	100.0%	.0%	28.6%

Crosstab						
			Question 11.5 Don't know			Total
			None <5%	Little 5-33%	Average 34-67%	None <5%
Question 10.3 Maintenance	All >95%	Count	4	0	1	5
		% within Question 10.3 Maintenance	80.0%	.0%	20.0%	100.0%
		% within Question 11.5 Don't know	22.2%	.0%	50.0%	23.8%
Total		Count	18	1	2	21
		% within Question 10.3 Maintenance	85.7%	4.8%	9.5%	100.0%
		% within Question 11.5 Don't know	100.0%	100.0%	100.0%	100.0%

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	6.417(a)	8	.601
Likelihood Ratio	6.814	8	.557
Linear-by-Linear Association	.930	1	.335
N of Valid Cases	21		
a 13 cells (86.7%) have expected count less than 5. The minimum expected count is .05.			

Question 10.3 Maintenance VS New Question 12 (Considering all plumbing components installed in South Africa, what fraction do you believe to be approved by SABS, JASWIC or a local authority?)

Crosstab							
			New Question 12: Considering all plumbing components installed in South Africa, what fraction do you believe to be approved by SABS, JASWIC or a local authority?				Total
			Little & None <33%	Average 34-67%	Most 68-95%	All >95%	Little & None <33%
Question 10.3 Maintenance	None <5%	Count	1	4	4	1	10
		% within Question 10.3 Maintenance	10.0%	40.0%	40.0%	10.0%	100.0%
		% within New Question 12	7.7%	12.9%	21.1%	11.1%	13.9%

Crosstab							
			New Question 12: Considering all plumbing components installed in South Africa, what fraction do you believe to be approved by SABS, JASWIC or a local authority?				Total
			Little & None <33%	Average 34-67%	Most 68-95%	All >95%	Little & None <33%
Question 10.3 Maintenance	Little 5-33%	Count	2	3	2	1	8
		% within Question 10.3 Maintenance	25.0%	37.5%	25.0%	12.5%	100.0%
		% within New Question 12	15.4%	9.7%	10.5%	11.1%	11.1%
	Average 34-67%	Count	0	8	4	0	12
		% within Question 10.3 Maintenance	.0%	66.7%	33.3%	.0%	100.0%
		% within New Question 12	.0%	25.8%	21.1%	.0%	16.7%
	Most 68-95%	Count	4	5	6	3	18
		% within Question 10.3 Maintenance	22.2%	27.8%	33.3%	16.7%	100.0%
		% within New Question 12	30.8%	16.1%	31.6%	33.3%	25.0%
	All >95%	Count	6	11	3	4	24
		% within Question 10.3 Maintenance	25.0%	45.8%	12.5%	16.7%	100.0%
		% within New Question 12	46.2%	35.5%	15.8%	44.4%	33.3%
Total		Count	13	31	19	9	72
		% within Question 10.3 Maintenance	18.1%	43.1%	26.4%	12.5%	100.0%
		% within New Question 12	100.0%	100.0%	100.0%	100.0%	100.0%

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	11.349(a)	12	.499
Likelihood Ratio	15.138	12	.234
Linear-by-Linear Association	.662	1	.416
N of Valid Cases	72		
a 16 cells (80.0%) have expected count less than 5. The minimum expected count is 1.00.			

Question 10.3 Maintenance VS New Question 13 (In your opinion, what is the percentage of plumbers who install non-approved products?)

Crosstab						
			New Question 13: In your opinion, what is the percentage of plumbers who install non-approved products?			Total
			Little & None <33%	Average 34-67%	Most & All >67%	Little & None <33%
Question 10.3 Maintenance	None <5%	Count	2	7	2	11
		% within Question 10.3 Maintenance	18.2%	63.6%	18.2%	100.0%
		% within New Question 13	8.3%	24.1%	10.5%	15.3%
	Little 5-33%	Count	2	6	1	9
		% within Question 10.3 Maintenance	22.2%	66.7%	11.1%	100.0%
		% within New Question 13	8.3%	20.7%	5.3%	12.5%
	Average 34-67%	Count	3	6	1	10
		% within Question 10.3 Maintenance	30.0%	60.0%	10.0%	100.0%
		% within New Question 13	12.5%	20.7%	5.3%	13.9%
	Most 68-95%	Count	7	5	7	19
		% within Question 10.3 Maintenance	36.8%	26.3%	36.8%	100.0%
		% within New Question 13	29.2%	17.2%	36.8%	26.4%

Crosstab						
			New Question 13: In your opinion, what is the percentage of plumbers who install non-approved products?			Total
			Little & None <33%	Average 34-67%	Most & All >67%	Little & None <33%
Question 10.3 Maintenance	All >95%	Count	10	5	8	23
		% within Question 10.3 Maintenance	43.5%	21.7%	34.8%	100.0%
		% within New Question 13	41.7%	17.2%	42.1%	31.9%
Total		Count	24	29	19	72
		% within Question 10.3 Maintenance	33.3%	40.3%	26.4%	100.0%
		% within New Question 13	100.0%	100.0%	100.0%	100.0%

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	12.294(a)	8	.139
Likelihood Ratio	12.776	8	.120
Linear-by-Linear Association	.493	1	.482
N of Valid Cases	72		
a 9 cells (60.0%) have expected count less than 5. The minimum expected count is 2.38.			

APPENDIX E: PLUMBING MANUFACTURERS SURVEY FORM

Questionnaire for Manufacturers

We would like to request a few minutes of your time to assist this research done by the University of Johannesburg. The result of this research will help to improve the regulation relating to the Plumbing industry in South Africa.Your contact details are not required and your answers will be treated confidentially

	None <5%	Little 5–33%	Average 33–67%	Most 67–95%	All >95%
1. What, in your opinion, what is the fraction of water supply plumbing fittings in South Africa that are approved by the following bodies/marks?					
SABS					
JASWIC					
Approved by a local authority (not JASWIC)					
Other regognised quality marks: ISO, ASTM, ANSI, DIN, etc.					
Non marked or approved (grey) products					
Pirated products					
Other (please specify)					
2. What, in your opinion, what is the fraction of sewer and drainage plumbing fittings in South Africa that are approved by the following bodies/marks?					
SABS					
JASWIC					
Approved by a local authority (not JASWIC)					
Other regognised quality marks: ISO, ASTM, ANSI, DIN, etc.					
Non marked or approved (grey) products					
Pirated products					
Other (please specify)					

3. What do you think is the biggest problem in the plumbing industry in SA?
(Rate from 1 = most to 7 = least)

Pirate / grey products	
Insufficient legislation	
Insufficient enforcement of legislation	
Insufficient control over plumbers	
Insufficient control over imports	
Insufficient control over distributors	
Other (Please specify)	

4. What would you like to see done by the following parties in order to improve the state of the plumbing industry in South Africa?

Government Departments:

Local Authorities

SABS (SANS)

JASWIC

The Plumbing Industry

Thanks for your participation! If you want more information, please contact

K Paul Lobanga
University of Johannesburg - Department of Civil Engineering Science
Tel: (+2711) 489 – 2931
E-mail: lobanga1@hotmail.com
Or
Prof JE Kobus Van Zyl
Department of Civil Engineering Science - University of Johannesburg
Tel: (+2711) 489 – 2345
E-mail: kobusvz@uj.ac.za

APPENDIX F: INVESTIGATION OF PLUMBING FITTINGS IN RDP HOUSING DEVELOPMENTS

Date of visit	Name of development	Fitting	Photo	Name of fitting	Fitting has SABS mark	Problems with fitting	Construction date
2008 - 03 - 14.	Soshanguve South	Outside Tap		Cobra	Yes	No	2008 - 01 - 01.
	Extension 5	Kitchen Tap		N/A	No	No	2008 - 01 - 01.
		Toilet **Does the toilet have an angle valve?**: No		Sterling	No	Yes, there was leakage from the pipes	2008 - 01 - 01.

Date of visit	Name of development	Fitting	Photo	Name of fitting	Fitting has SABS mark	Problems with fitting	Construction date
2008 - 03 - 14.	Soshanguve South	Outside Tap		N/A	No	No	2008 - 01 - 01.
	Extension 4	Kitchen Tap		N/A	No	Tap is faulty	2008 - 01 - 01.
		Toilet **Does the toilet have an angle valve?**: No		N/A	No	The contractors never finished building the toilet	2008 - 01 - 01.

Date of visit	Name of development	Fitting	Photo	Name of fitting	Fitting has SABS mark	Problems with fitting	Construction date
2008 - 03 - 14.	Soshanguve South	Outside Tap		N/A	N/A	Plastic tap was stolen, there is no tap	2007 - 11 - 11.
	Extension 2	Kitchen Tap		No tap in the house	N/A	N/A	
		Toilet **<u>Does the toilet have an angle valve?</u>**: No		N/A	No	Yes, there was leakage from the cistern	2007 - 11 - 11.

Date of visit	Name of development	Fitting	Photo	Name of fitting	Fitting has SABS mark	Problems with fitting	Construction date
2008 - 03 - 14.	Soshanguve South	Outside Tap		N/A	N/A	The original tap was changed because of leakage	2005 - 05 - 01.
	Block TT	Kitchen Tap		No tap in the house	N/A	N/A	
		Toilet **<u>Does the toilet have an angle valve?</u>**: Yes		Sterling	No	Yes, there was leakage from the pipes	2005 - 05 - 01.

Date of visit	Name of development	Fitting	Photo	Name of fitting	Fitting has SABS mark	Problems with fitting	Construction date
2008 - 03 - 14.	Soshanguve South	Outside Tap		N/A	No	Tap is faulty	2004 - 06 - 01.
	Extension 3	Toilet **Does the toilet have an angle valve?**: No		Elf (DPE)	No	Yes, there was leakage from the pipes	2004 - 06 - 01.

Date of visit	Name of development	Fitting	Photo	Name of fitting	Fitting has SABS mark	Problems with fitting	Construction date
2008 - 03 - 14.	Soshanguve South	Outside Tap	Same tap as the kicthen 	Probrass	No	No	2007 - 09 - 01.
	Block A and B	Kitchen Tap		N/A	No	No	2007 - 09 - 01.
		Toilet **Does the toilet have an angle valve?**: No		N/A	No	No	2007 - 09 - 01.

Date of visit	Name of development	Fitting	Photo	Name of fitting	Fitting has SABS mark	Problems with fitting	Construction date
2008 - 03 - 18.	Cosmo City	Outside Tap		Plastic tap	No	No	2007 - 12 - 01.
	Extension 5	Bathroom tap		Cobra	Yes	No	2007 - 12 - 01.
		Toilet **Does the toilet have an angle valve?**: No		Betta		No	2007 - 12 - 01.

Date of visit	Name of development	Fitting	Photo	Name of fitting	Fitting has SABS mark	Problems with fitting	Construction date
2008 - 03 - 18.	Cosmo City	Outside Tap		Comap	No	The original tap was changed because of leakage	
		Kitchen Tap		Comap	No	The original tap was changed because of leakage	
		Toilet **Does the toilet have an angle valve?**: No		N/A	No	The toilet has cracked	

Date of visit	Name of development	Fitting	Photo	Name of fitting	Fitting has SABS mark	Problems with fitting	Construction date
2008 - 03 - 18.	Freedom Park	Outside Tap		N/A	No	No	2006 - 01 - 01.
	Siyaya Section	Kitchen Tap		No tap in the house	N/A	N/A	2006 - 01 - 01.
		Toilet **Does the toilet have an angle valve?**: No		N/A		No	2006 - 01 - 01.

Date of visit	Name of development	Fitting	Photo	Name of fitting	Fitting has SABS mark	Problems with fitting	Construction date
2008 - 03 - 18.	Pimville	Outside Tap		Cobra	Yes	The original tap was changed because of leakage	2006 - 01 - 01.
	Zione 6	Kitchen Tap		N/A	No	No	2006 - 01 - 01.
		Toilet		N/A	No	Yes, there is sometimes leakage from the cistern	2006 - 01 - 01.
		Does the toilet have an angle valve?: Yes				The valve is not working	