pull-out section

A comprehensive look into the special requirements for **DathTOOMS** in section 7.1 of SANS 10142-1 Ed 3

By Anthony Schewitz, ECA(SA) Regional Director, Highveld

The ECA receives many questions about the requirements for bathrooms, which have highlighted the fact that there are many differences of opinion that cause disagreements between the contractors who have a casual approach on one side and those who maintain a hard-and-fast rule that everything must be waterproof, on the other.

What is a bathroom and where is it covered?

In 3.6 of SANS 10142-1, a bathroom is defined as a room having a bath, shower or spa installed as a fixture. A room with a toilet and handbasin is not a 'bathroom' and is treated as any other room with a water source.

3.6

bathroom

room or part of a room that contains a bath, shower or spa (or any combination of these), each installed as a fixture (see figures 7.1.1 to 7.1.5)

Understanding the zones

To understand the zoning of a bathroom and the necessity for special requirements, we must read the important note under 7.1, which states: "where the risk of shock is increased by a reduction in body resistance and contact of the body with earth potential".

7.1 Bathrooms, showers and spas

NOTE The particular requirements of this subclause apply to bathtubs, shower basins and the surrounding zones where the risk of shock is increased by a reduction in body resistance and contact of the body with earth potential.

Greater protection must be implemented according to the inherent risks in each zone and the likelihood of being electrocuted in the event of a fault. So, to understand the zones, let's first define the risks in each zone:

- **Zone 0:** In this zone, the body or a part thereof is presumed to be submerged in water and consequently, the body resistance is greatly reduced, and the risk of electric shock is greater, hence the zone itself is the inside of the bath or shower basin where water collects.
- **Zone 1:** Here, the body is perceived to be wet and/or standing (not submerged) in water thus the body resistance is reduced, and risk of electric shock is high. Here the limitations are within arm's reach from bathtub or shower floor to the edge of the bath.
- Zone 2: An example of this would be something that a person can reach/ touch while standing in water, such as reaching for a towel from within the bath or shower. In this area – where a person would dry themselves – the body is not submerged or standing in water but because the environment is damp, the body resistance is reduced and the risk is lower; hence the limitations of 600 mm from Zone 1 and a height of 2.25 m from the floor.
- Zone 3: In this area, a person would be in a moist environment and because the body's resistance is not as low as in Zone 2, the risk is reduced, and the limit is 2.4 m from zone 2 and 2.25 m from the floor.

The requirements for the zones are clear:

7.1.2 Zones

NOTE 1 For the purposes of this part of SANS 10142, bathrooms are divided into zones 0, 1, 2 and 3. The dimensions of the boundaries of these zones are measured taking account of the edge of the container, the walls and fixed partitions (see figures 7.1.1 to 7.1.5).

NOTE 2 Zones 0, 1 and 2 mentioned in 7.1.2.1, 7.1.2.2 and 7.1.2.3 bear no relationship to zones 0, 1, 2, 20, 21 and 22 mentioned in SANS 10108 for the classification of hazardous locations.

7.1.2.1 Zone 0

Zone 0 is the interior of the bathtub or shower basin (the container). 7.1.2.2 Zone 1

Zone 1 is limited by

a) the vertical plane circumscribing the outer edge or 0,20 m from the inner edge (where the ledge is too wide) of the bathtub, shower basin, or for a shower without a basin, by the vertical plane 0,60 m from the shower rose, and

b) the horizontal plane 2,5 m above the bathtub or shower floor.

7.1.2.3 Zone 2

Zone 2 is limited by

a) the volume external to zone 1 and the parallel vertical plane 0,60 m external to zone 1, and

b) the floor and the horizontal plane 2,25 m above the floor.

7.1.2.4 Zone 3

Zone 3 is limited by

a) the vertical plane external to zone 2 and the parallel vertical plane 2,40 m external to zone 2, and

b) the floor and the horizontal plane 2,25 m above the floor.

Although the drawings in SANS 10142-1 are descriptive, I usually guide students with a drawing, similar to figure 1 below and recommend that they consider dividing their own bathrooms as zones and familiarise themselves with the requirements for each zone until it becomes second nature.



Figure 1

Unpacking the 'general requirements'

The general requirements clarify certain clauses and draw attention to the application of the code when there are exceptions, such as a prefabricated shower cabinet and the location of spa baths:

7.1.1 General

7.1.1.1 The requirements in this subclause do not apply to an enclosed prefabricated shower cabinet with its own shower basin and drainage system, except in the case of 7.1.4.3.4.

7.1.1.2 The requirements relating to bathrooms shall apply to a spa installed indoors. If a spa is installed outdoors, the requirements relating to swimming pools shall apply (see 7.2).

As straightforward as the requirements of 7.1.1.2 seem, it must be remembered that the location of a spa dictates its requirements – if the spa in indoors then the bathroom requirements in 7.1 must be followed and, if the spa is outdoors, the requirements in 7.2 must be applied. This means that when the location changes, the zones, IP requirements and methods of installation are different.



7.1.1.3 Electrical equipment, including appliances (although appliances are not covered by this part of SANS 10142), shall not be installed in a bathroom except under the conditions given in table 7.1. No electrical equipment shall be installed in zone 0 except in accordance with 7.1.3.2. (see also 7.1.4.4).



NOTE A volume under a bath or spa that cannot be reached without the use of a tool to remove a cover is not considered part of a bathroom.

- a Minimum height
- ^b The inner edge of a bath, shower or spa is the upper inside edge of the container (zone 0) and does not include the ledge of the bath, shower or spa.
- ^c Under certain conditions, waste pipes have to be earthed.

Figure 7.1.1 — Illustration of zones in a bathroom



Figure 7.1.2 — Plan of zone dimensions for bathrooms



Figure 7.1.3 — Elevation of zone dimensions for bathrooms

NOTE 1 A volume under a bath or indoor spa, which cannot be reached without the use of a tool to remove a cover, is not considered part of a bathroom.

NOTE 2 For locations that contain baths for medical treatment, special requirements might be necessary (see 7.7).

Clause 7.1.1.3 clarifies and refers to where the requirements for bathrooms are documented (table 7.1, which is explained later in this article). It also stipulates that no electrical appliances may be installed in zone 0, which is the *interior of the bathtub or shower*, except for a safety extra low voltage (SELV) type circuit where the control gear is located outside of Zone 0.

Clause 7.1.4.4 below reminds the installer that no other equipment may be installed in those areas.

7.1.3 Protection for safety

NOTE For the protection of socket-outlets, see 7.1.4.3.1.

7.1.3.1 Protection by safety extra low voltage (SELV)

Where safety extra low voltage is used, whatever the nominal voltage, protection against direct contact shall be provided by a) barriers or enclosures that afford at least the degree of protection IP2X, or

b) insulation capable of withstanding a test voltage of 500 V for 1 min.

Clause 7.1.3.1. specifically references SELV type systems and where these systems are used, they need protection of at least IP 2X. When referencing Annex G, the installer must limit access with the limitations of a standard test finger or ensure the device is insulated sufficiently to limit any contact.

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7.1.3.2 Protection against electric shock

7.1.3.2.1 In zone 0, only protection by safety extra low voltage at nominal voltage not exceeding 12 V is permitted, the safety source being installed outside zone 0.

The protection methods discussed in clause 7.1.3.2.1 refer to the only instance an electrical item may be installed within the interior of the bathtub or shower basin (the container), which would limit the voltage in case of an electrical fault so that a person would only feel a tingle and not receive an electric shock.

7.1.3.2.2 The measures of protection by means of obstacles and by placing equipment out of arm's reach are not permitted.

Due to the bathroom environment being damp and the possibility of a conductive surface being formed, the following clause exists to prevent the placement of obstacles in front of risks, such as placing a clothes hamper or something similar in front of an exposed joint.

7.1.3.2.3 The measures of protection by non-conducting location and earth-free equipotential bonding are not permitted.

Clause 7.1.3.2.3 covers commonly misunderstood items and, in short, it cannot be assumed that the risk of shock is minimised in a non-conductive location. In a damp environment, a non-conductive surface may become conductive if exposed to water. The exception includes utilising earth-free bonding, which simply means that the bonding doesn't have an earth return path.

7.1.3.3 Supplementary equipotential bonding

All accessible conductive parts in zones 1, 2 and 3 that may become alive accidentally, though not normally forming part of the electrical circuit, shall be bonded with a local supplementary equipotential bonding conductor, except where the conductive parts are protected by insulating covering or is otherwise enclosed. The resistance of the earth continuity circuit to earth shall not exceed $0,2 \Omega$.

Clause 7.1.3.3 is an important principle, yet it is often forgotten that conductive parts can inadvertently become live, so it is better to always keep the worst-case scenario in mind and bond and connect all accessible parts to earth.

Equipment selection and erection

Some of the most common misconceptions about bathrooms are that everything must be waterproof, that no sockets are allowed, that downlights are illegal and that heaters may not be installed in a bathroom.

The following requirements are clear: 7.1.4 Selection and erection of electrical equipment 7.1.4.1 Degrees of protection Electrical equipment shall have at least the following degrees of protection against ingress of water: a) in zone 0: IPX7; b) in zone 1: IPX5; c) in zone 2: IPX4; d) in zone 3: IP21; and e) outside zone 3 in the same room: IP21, except for a distribution board: IPX5 (see 7.1.4.3.6).

Clause 7.1.4 compels the installer to address the water or moisture ingress according to the requirements and the inherent risks involved – so not everything has to be 'waterproof' *per se* – it all depends on the location in the bathroom.

When we specifically look at the degrees of protection employed along with the requirements specified for each zone and the inherent risks involved in each Zone, the IP ratings would make sense when location is taken into account.

Let's break them down further:

7.1.4.1. a) Zone 0 - IP X7 - which allows temporary immersion to a maximum of 1 m, hence the inside of the bathtub or shower basin has a risk of immersion and protection must be installed.

7.1.4.1.b) Zone 1 - IP X5 - which protects against ingress of low-pressure jets from all angles, and which fits into the environment as it protects against the normal vertical or diagonal shower stream, even showers with side bottom and top outlets would be protected against ingress of water.

7.1.4.1.c) Zone 2 – IP X4 – which protects against splashing from all angles, given the location with the inadvertent risk of water splashing on devices during the process of cleansing oneself, the equipment would be protected.

7.1.4.1.d) Zone 3 - IP 21 - which protects against the penetration of the standard test finger when referring to the physical ingress and vertical dripping with the water ingress and ensures that the user cannot touch any live parts even if the person is still wet and water is dripping off them because the ingress protection would be sufficient.

7.1.4.1.e) Outside Zone 3 - IP 21 - which protects the same as zone 3 and has the additional specification for DBs being IP X5 as the requirement in Zone 1 that protects the DB against any potential low-pressure spray, such as a leaking tap. It is vitally important to remember the IP rating for equipment outside, such as lights, sockets and appliances and to verify the required rating with the supplier before installing them.

Many claims have arisen out of a perceived contradiction between clause 7.1.4.1.e) and clause 6.15.6.1, but if you read the clauses carefully, they are both specific to their environments: 6.15.6.1 is specific to sockets exposed to the weather and 7.1.4.1.e) is specific to equipment installed in bathrooms. Where they are installed is as important as the requirements for each as the location defines the specific requirements.

6.15.6.1 A socket-outlet that is exposed to the weather (or to the condensation, dripping, splashing or accumulation of water) shall have a rating of at least IP44 in accordance with SANS 60529. The rating applies whether a plug is in or out.

NOTE The IP ratings are explained in annex G.

An important note around IP ratings is that a higher degree of protection does not necessarily mean it is better suited for other environments that require lower IP ratings. The methods of testing differ vastly, and it is always best to match as far as reasonable the IP required for the risk at hand.

7.1.4.2 Wiring systems

7.1.4.2.1 In zones 0, 1 and 2, wiring systems shall be limited to those necessary for the supply of appliances situated in these zones. **7.1.4.2.2** Junction boxes are not permitted in zones 0, 1 and 2.

Clause 7.1.4.2.1 means that only the cables supplying appliances are allowed within 600 mm of the shower, and you are not allowed to run the entire house's power cables within this area. Clause 7.1.4.2.2 limits the areas where water can collect to minimise potential contact when the shower is being used.

7.1.4.3 Switchgear and controlgear

7.1.4.3.1 In zones 0, 1 and 2, no switchgear and accessories shall be installed except that emergency push buttons, which operate at a safety extra low voltage at nominal voltage not exceeding 12 V, are permitted in zones 1 and 2

This clause is self-explanatory in that the control gear for the pumps, lights and any fixed appliances shall not be installed in the potentially wet environments. The intention is that switches can be in the zones as required but the control equipment must be outside the zoned area, for example, spa baths where the push buttons are within reach of the person in the basin (container). However, the control gear is in the volume below the actual spa bath; or a bell switch (for someone to call for assistance) where the related controlgear in another room.

7.1.4.3.2 Insulating cords of cord-operated switches are permitted in zones 1 and 2, provided that the cord-operated switch complies with the requirements for switches (see table 4.1).

This is similar to the applications stipulated in clause 7.1.4.3.1 above, except that this clause is specific to pull switches when they are used in a bathroom to switch lights, heaters, etc according to the requirements in table 4.1.

7.1.4.3.3 In zone 3, socket-outlets are permitted only if they are a) supplied individually by an isolating transformer that complies with SANS 61558-2-6, or

b) supplied by safety extra low voltage (SELV) (see 5.8), or

c) protected by an earth leakage protection device with a rated earth leakage tripping current (rated residual current) IAn not exceeding 30 mA.

Clause 7.1.4.3.3 clearly outlines the options with regards to protection when installing a socket outlet anywhere from 600 mm from the shower or bath. It is important to note that there are three protection methods that are acceptable when socket outlets are used in zone 3 of a bathroom.

7.1.4.3.4 Any switches and socket-outlets shall be at a distance of at least 0,60 m from the door opening of the prefabricated shower cabinet (see figures 7.1.4 and 7.1.5).

Clause 7.1.4.3.4 reminds us as that socket outlets and switches must be placed in zone 3 or outside the zoned area.

7.1.4.3.5 Where heating elements are installed in the water circulating system of a bath or a spa, the supply to the elements shall be interlocked with the circulating pump.

Clause 7.1.4.3.5 mentions that you should not be able to connect the heating elements if the pump is not running and vice versa. This can be achieved by means of an interlock (electrical or mechanical) between these two devices such as if water flow ceases, the elements would be deenergised.

7.1.4.3.6 If a distribution board is installed in a room that contains a fixed bath or a shower, it shall be outside zone 3 and the enclosure shall have a degree of protection of IPX5 (see 6.6.1.7(a)).

Clause 7.1.4.3.6 simply reminds the installer to be aware of the IP requirements when installing a DB in a bathroom.

7.1.4.4 Other fixed equipment and heated towel rails

NOTE Other fixed equipment includes heated tower rails and heating units embedded on the floor.

7.1.4.4.1 except in the case of safety extra low voltage, subject to the conditions of 5.8, 7.1.3.2 and 7.9, the following requirements apply: a) in zone 0, no fixed electrical equipment shall be installed; b) in zone 1 and 2, only equipment as indicated in table 7.1 may be installed.

Heated towel rails were dealt with extensively in an article, 'Installing heated towel rails according to SANS 10142-1', by Highveld Regional Director, Chris Koen in the September-October 2020 issue of SA Electrical Contractor magazine and the article is available on the ECA's website.

Clause 7.1.4.4 reminds the installer that no fixed electrical equipment is allowed in Zone 0 and that if such equipment is installed in Zone 1 and 2 (above the bath or in close proximity) then the device must comply with the requirements in Table 7.1 (below) and the current-carrying parts must not be accessible to the standard test finger and must incorporate earth leakage protection if the devices are of phase voltage (230v) or fed from an extra low voltage safety supply.

7.1.4.4.2 Heating units embedded in the floor and intended for heating the location may be installed in zones 1, 2 or 3 provided a) the heating elements are covered by a metallic sheath (screened), or b) a metallic grid is installed above the heating elements, and c) the sheath or grid is connected to the equipotential bonding specified in 7.1.3.3. Terminations shall comply with 6.16.4.2. d) the circuit that supplies underfloor heating is protected by an earth leakage protection device, with a rated earth leakage tripping current (rated residual current) I∆n not exceeding 30 mA.

Recently, heaters and underfloor heating in bathrooms have become more prevalent in upmarket properties. To clarify, a heater may be installed in a bathroom, if required, provided it is screened or it has a metallic grid, which is bonded and covers the elements. Open, accessible elements and conductive parts are forbidden in the provisions. When underfloor heating is installed in a bathroom, clause 7.1.4.4.2.d makes a special requirement that underfloor heating in a bathroom must have earth leakage protection.

Next, we will investigate the requirements specifically listed on Table 7.1.

Table 7.1 — Conditions under which electrical equipment may be installed in a bathroom

1	2	3	4		
Electrical equipment	Conditions that apply in				
	Zone 1	Zone 2	Zone 3		
Distribution and control	x	×	Normal provisions SANS 10142-1	of	
Bell push	B1 and C1	B1 and C1	Normal provisions SANS 10142-1	of	
Socket-outlet	x	C2	Normal provisions SANS 10142-1	of	
Wall switch	x	x	Normal provisions SANS 10142-1	of	
Pull switch	Normal provisions of SANS 10142-1				
Distribution boards	x	x	x		
Fixed appliances (e.g. luminaires, underfloor heating, mirror heating, towel heaters)	(A and B1) or (B2)	(A and B1) or (B2)	Normal provisions SANS 10142-1	of	

ting material that it is not

- A denotes that earth leakage protection shall be provided;
 B1 denotes that the equipment shall be so enclosed in insulating material that possible to touch current-carrying parts with the standard test finger;
 B2 denotes that class II appliances shall be used;
 B1 denotes that the equipment shall be supplied from a safety supply with a servicitage not exceeding 25 %;
 C2 denotes that the meanment shall be a supplied from a safety supply used to the superior of the target supply that the equipment shall be a supplied from a safety supply with a servicitage not exceeding 25 %;
- C2 denotes that the equipment shall be supplied from a safety supply that has a maximum rating of 50 VA. Shaver supply units shall comply with SANS 61:558-2-5 X denotes that the equipment shall not be installed.

Table 7.1 is a concise summary of the requirements and, when teamed with a zoning drawing and the relevant IP requirements as well as any special requirements, we can summarise the table even further.

It is important to understand the meaning of the symbols in the above table:

A - means that earth leakage protection must be provided

B1 – means that the possibility of touching carrying parts is mitigated by enclosing them with insulating material that cannot be accessed with the standard test finger. (See article, '*What is a standard test finger*?' by Chris Koen, ECA(SA) Regional Director, Highveld Region, in the January-February 2021 issue of *SA Electrical Contractor*.)

B2 – Class II type protection on appliances is specific to the insulation type (either double insulation or reinforced insulation). Many appliances such as lights, heated towel rails, extraction fans, etc fall into this category, so it is always best to verify with the manufacturer and/or consult the product specifications.

Definitions

3.3.2

class II appliance

appliance that has double insulation or reinforced insulation (or both) throughout, and that is without provision for earthing

3.83.2

class II transformer

transformer in which protection against electric shock does not rely on basic insulation only, but in which additional safety precautions such as double insulation or reinforced insulation are provided, there being no provision for protective earthing or reliance upon installation conditions

C1 – Equipment must be fed from a safety supply being of the ELV type, meaning low voltage and isolated in the simplest terms limited to 25V. Typically, in this setting you would have

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safety supply

supply of electricity that is obtained from

a) the unearthed secondary circuit of an isolating transformer with limited output voltage, specified by the manufacturer, or

 b) any other isolating device that provides equivalent safety and the same degree of separation between the primary and secondary circuits, or
 d) an isolated generator or a battery that provides a non-earthed supply

C2 – as per C1 except that the voltage limitation is lifted and a power limitation added of 50 VA. Devices will still have a degree of separation as well as having the power limitation which would limit current flow would mean that safety is achieved through alternative means. Typically, this is used for sockets designed as shaver outlets.

 \mathbf{X} – This symbol is self-explanatory – such equipment is not allowed in this environment.

Zone 1

This is the volume above the bath or shower that can house various objects – and this disproves the common misconception that 'no electrical equipment may be above the bath'. To clarify it further, a pull switch (given the normal provisions of SANS 10142-1) would ensure the correct IP Rating conducive to the zone and that conductive parts are not accessible.

Bell presses are also allowed in this area as long as you cannot touch the current-carrying parts; and the secondary provision is that the bell press is

fed from a safety supply. Lastly, in zone 1, fixed appliances are allowed with the following provisions when they are either of class II type construction, or they must have enclosed current-carrying parts and be protected by earth leakage protection.

Zone 2

In zone 2 you may install all the components in zone 1 with the with the addition that a socket may be installed in this zone provided it is through a safety supply of 50 VA – usually a shaving socket.

Zone 3

This zone takes the requirements in zone 1 and zone 2 and decreases the requirements even further, essentially making it a 'normal environment' as you would be assessing items in this area, such as lights, fixed appliances and sockets as you would in other environments that have a risk of water ingress. As in zones 1 and 2, zone 3 prohibits the installation of distribution boards, which can only be installed outside Zone 3.

Expanding on the special earthing requirements in bathrooms

There are not too many special earthing requirements in a bathroom and mainly offer guidance with some of the unique isolated components.

7.1.5 Earthing

7.1.5.1 Except in the case of isolated supplies, an earth continuity conductor shall be connected to the earthing terminal of class 1 fixed appliances in a bathroom.

There are many appliances that would conform to the above clause, which basically reiterates that if there is a fixed appliance that is not fed from a safety supply, then the earth must be connected to the earthing terminal.

7.1.5.2 If the following are electrically isolated from earth, they need not be earthed:

a) metallic baths and basins;

b) metallic waste fittings in baths or shower trays; and

c) other isolated metallic parts.

NOTE A bath or basin is said to be isolated from earth if the waste pipes are nonmetallic and the taps are

a) wall mounted, or

b) bath or basin mounted and supplied by non-metallic piping.

Clause 7.1.5.2 assists in an area that is no longer really necessary as few baths and basins are metallic and are mainly fibreglass and ceramic. Consider that a metal bath would not necessarily need earthing as it could be holding an isolated body of water. As we learnt with protection practices in bathrooms, a common practice is separation by isolating. An example of this would be a plastic shower drain with a steel grid. In this case the metal grid could then be considered isolated from the earth.





Figure 2

Older requirements said it better.

Looking at the drawing above (figure 2), which is from the 1981 revision of SABS 0142-1, there was a lot more detail in the image and is probably the reason the zoning on sinks, plugs and switches in bathrooms weren't problematic back then. In the new standard, the drawing is simpler and cleaner but the layout of the older specifications and in table 9 showed the exact requirements whereas the new layout means you have to refer to the drawing, the specific clauses and table 7.1.

Figure 2 shows a simple placement of 'contentious' items such as:

- A light installed above the bathtub.
- A water heater installed in zone 1.
- A bell press installed in zone 1.
- A shaver socket in zone 2, a heater in zone 2/3.
- A light above the hand basin.
- An instantaneous water heater by the hand basin.
- A heated towel-rail.
- And even a socket, push button and switch in the bathroom.

Existing installations

Existing installations often come up in arguments, but the code is not retrospective (and if it was, each installation would have to be upgraded to the current specifications and it would not only be expensive but policing it would be a nightmare) so this means that bathrooms must be tackled in the same way that we tackle existing installations in general.

The requirements in the Electrical Installation Regulations clearly state in subregulation 9(2)b the installation must follow the general safety principles and be assessed as either reasonably safe or unsafe. The safety requirements in relation to the environment would be assessed using the guidelines in section 5 of SANS 10142-1.

Conclusion

The rules for bathrooms have been adapted over the years but are essentially the same rules and not much has changed since SABS 0142-1: 1993. On the whole, the requirements (bar a few additions and safety requirements), follow the IEC requirements and perhaps if the IEC 60364-7-701 document was adopted, it would make alignment easier.

Interestingly, IEC 60364-7-701 ends with zone 2 and, if you look at our requirements, there is very little that differentiates our zone 3 from anywhere else, which makes me wonder why the zones have stayed the same for so long.

More info:

anthony@ecasa.co.za



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