



MIE TALK – May 2016

INSPECTION OF EXPLOSION PROTECTED EQUIPMENT IN HAZARDOUS AREAS AS PER SANS 60079:17



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1. INTRODUCTION

Inspection is an action comprising careful scrutiny of an item carried out either without dismantling, or with the addition of partial dismantling as required, supplemented by means such as measurement, in order to arrive at a reliable conclusion as to the condition of an item.

Before plant or equipment in a hazardous location is brought into service, it shall be given an initial inspection and shall subsequently be re-inspected periodically to ensure that the installation is maintained in a condition that is satisfactory for continued use.

It might not be easy to accurately predict an appropriate periodic inspection interval, but it should nevertheless be done. (See table below for guidance.)

Once a periodic inspection interval has been fixed, the installation shall be subjected to interim sample inspections to support or modify the proposed interval. Similarly, the grade of inspection will have to be determined; sample inspections can be used to support or modify the proposed inspection grade. A regular review of the results of inspections will be required to justify the interval between, and grade of, inspections.

Following any replacement, repair, modification or adjustment, the items concerned should be inspected in accordance with the relevant items of the "detailed inspection" columns of tables 3, 4 and 5 found in SANS 60079:17

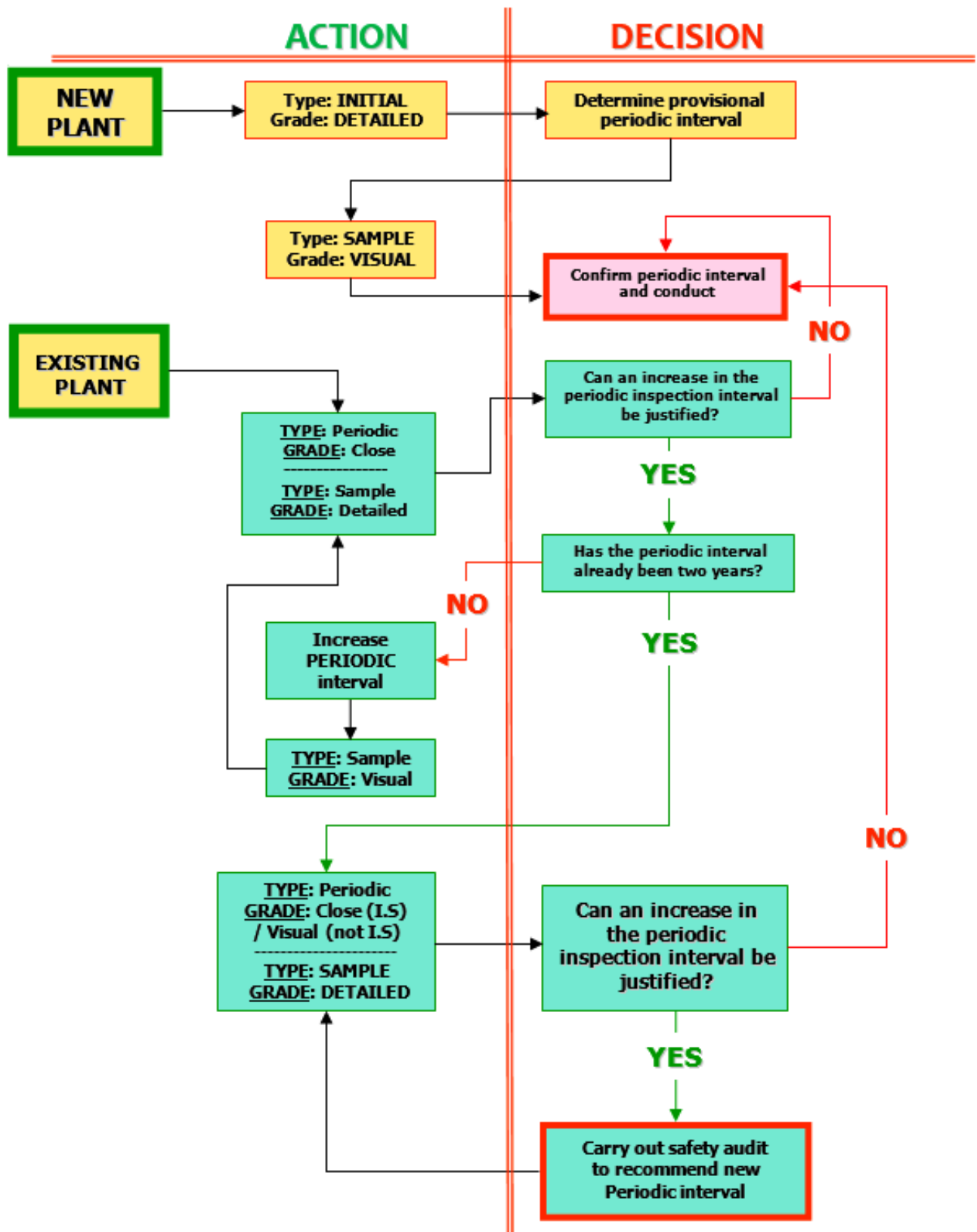
If at any time, there is a change in the location classification or if any equipment is moved from one location to another, a check shall be made to ensure that the type of protection, equipment group and temperature class, where appropriate, are suitable for the revised conditions.

When large numbers of similar items, such as luminaries and junction boxes, are installed in a similar environment, it might be feasible to carry out periodic inspections on a sample basis, provided that the number of samples and the inspection frequency is subject to review. It is, however, strongly recommended that all items be subject to at least visual inspection.

If plant or equipment is dismantled during an inspection, precautions shall be taken during reassembly to ensure that the integrity of the type of protection is not impaired.

A typical inspection procedure is shown diagrammatically below.

Typical inspection procedure for New and Used installations



2. INSPECTORS

Entrust the maintenance of equipment used in explosive atmospheres only to experienced and suitably trained and competent persons who have received instruction in the special techniques involved in the protection concepts and inspection methods.

The inspectors must have knowledge of the relevant national standards e.g. SANS 60079:10-1; SANS 60079:10-2; SANS 60079:14 and SANS 60079:17. The inspectors shall also take into account any requirements of SANS 100142-1 that may be applicable for the installation.

Refresher training should be undertaken at regular intervals and evidence of such training should be made available. Personnel carrying out inspections should, in addition, be familiar with the requirements of the grade of inspection as they relate to installed equipment.

However, it should be impressed on inspectors that it is the duty of every person to report to his immediate superior any malfunctioning of or damage to equipment and such reports should be investigated promptly. In all cases of doubt first cut off the electrical supply.

Inspection and maintenance of installations may only be performed by experience personnel who, as part of their education are trained in:

- the different protection methods;
- installation practices;
- national rules and regulations / company regulations / standards;
- knowledge of electro-techniques and electrical installations, and
- the general principles of classification of hazardous zones.

Personnel have to take training courses or educative courses that are tailored to their working activities regularly. The experience and education in question have to be demonstrated.

The standard distinguishes three competence levels at this time, which are:

- Designers - (detailed knowledge)
- Responsible persons - (practical knowledge and insight)
- Persons operative with inspection and maintenance - (insight and familiarity)

Furthermore, personnel that are operative in explosion hazardous areas have to wear clothing that cannot generate an electrostatic charge.

3. INSPECTION

A planned scheme of regular routine inspection is the basis of effective maintenance and whilst production requirements need to be considered they shall not result in the postponement of essential inspection and remedial work.

A principal requirement of any scheme is the keeping of records which for this purpose shall as a minimum include for each plant appropriate details of:

- up-to-date area classification
- all equipment, systems and installations
- inspections carried out and faults revealed
- corrective action taken to remedy such faults.

Three forms / types of inspection which are given here under can be adopted as required by Plant Operation and Maintenance personnel:

TYPE:	Initial	Periodic	Sample	Special
LEVEL:				
Visual		All equipment to be inspected on a routine basis (within every 2 years)	Portion of the installation to be chosen of equipment (10% of installed base / type of equipment)	
Close			Size and composition determined by the purpose of the inspection.	
Detail	Pre-Commissioning after installation, before process hazards are introduced	May reveal need for further investigation	Equipment to be specially marked which was done on sample rate.	<ul style="list-style-type: none"> • Hand held • Portable Equip. • Transportable Equip.

3.1. Initial inspections

All equipment, systems and installations shall be inspected on initial installation and after modification; in accordance with the 'Initial' inspection schedules and the details shall be recorded. These should be carried out as near to commissioning of plant as possible but before flammable or explosive materials are introduced into the plant, so as to avoid any subsequent inadvertent alterations going unnoticed.

It should be noted that these are indicative and comprehensive guidelines of manufacturers should be adhered to in addition to the ones given in this editorial.

3.2. Periodic inspections

Periodic inspections are inspections of all equipment that are carried out on a routine basis. They might consist of a visual or a close inspection, as referred to in tables 3, 4 and 5, as appropriate.

A visual or close periodic inspection might reveal the need for a detailed inspection.

The grade of inspection and the interval between periodic inspections shall be determined taking into account the type of equipment, the manufacturer's recommendations, if any, the factors that govern the deterioration of equipment, the zone of use and the results of previous inspections. Where inspection grades and intervals have been established for similar equipment, plants and environments, this experience shall be used in determining the inspection strategy.

The interval between periodic inspections shall not exceed two years, and shall be shorter if the deterioration of equipment could influence explosion protection sooner.

The following major factors govern the deterioration of equipment:

- susceptibility to corrosion
- exposure to chemicals or solvents;
- accumulation of dust or dirt;
- ingress of water;
- excessive ambient temperatures;
- direct sunlight;– risk of mechanical damage;
- undue vibration;
- training and experience of personnel;
- unauthorized modifications or adjustments; and
- Inappropriate maintenance, for example not in accordance with the manufacturer's recommendations.

3.3. Sample inspections

Sample inspections are inspections of a portion of the installed equipment. They can be visual, close or detailed. The size and composition of all samples should be determined taking into account the purpose of the inspection.

NOTE: Sample inspections should not be expected to reveal faults of a random nature (for example, loose connections), but should be used to monitor the effects of, for example, environmental, vibration and inherent design weaknesses.

3.4. Special inspections (for moveable equipment)

Moveable and portable equipment can be used in an explosion hazardous area temporarily.

Examples of such equipment are: emergency generators, electrical arc welding tools, industrial forklifts, compressors, power ventilators or blowers, portable electric driven hand tools and certain types of equipment for testing and inspection.

Portable, moveable and hand tools are particular sensitive to damage or improper use. It can therefore be necessary to shorten the intervals between periodical inspections. This electrical equipment has to be inspected by means of a close inspection at least every 12 months. Lids that are regularly opened are subject to a detailed inspection every 6 months. Additionally, the equipment has to be visually inspected by the user before use so as to guarantee that the equipment is not damaged visibly.

When connecting cables to electrical equipment, the relevant protection method with respect to explosion protection has to be maintained. If a cable gland is provided with the symbol "X", than it may only be used in fixed installations. In case of portable equipment only glands without the symbol "X" may be used. (SANS 60079:14 stip. 9.3.10)

3.5 External visual inspection (Visual & Close)

The equipment carries the correct circuit (installation) identification. All installed equipment / enclosures must be tagged so that they are uniquely identified to trace them at a later date so as to either ensure or cross-check for correct selection and installation information.

This is termed as the inspection or conformance of the individual installation with respect to what has been envisaged at the design stage.

- a)
- b) Match the protection concept as labelled on the equipment with the area classification of its location.
- c) Match the sub-group (in case the protection concept is subject to a sub-group) as labelled on equipment with the area classification of its location.
- d) Match the surface temperature class as labelled on the equipment with the appropriate explosive gas, liquid or vapour present in the area classification of its location.

The initial external visual inspection to ensure that the equipment is free of corrosion and or undue dust accumulation or material (corrosion agents) which could lead to corrosion at a later date.

To ensure that all cable glands, stoppers and their fastening nuts and bolts are secure. The integrity of the earth connection including its proper tightness to the enclosure/ equipment needs to be ensured.

To ensure that all cable trays, external special guards around the equipment, if any, are properly secure and undamaged.

The cables and conduits are not damaged. In the case where cables are led to the enclosure through sand filled trenches it is not necessary to remove the sand until physical evidence of any abnormality is noticed.

To ensure that the electrical protection is set properly. This is to include checks of fuses, circuit breakers, protection relays etc. Proper labelling of these devices needs to be ensured such that they are clearly identifiable without the need to touch the devices or the need to remove any devices such as fuses etc.

To ensure that an external application to prevent corrosion is properly applied, such as grease applied to gaskets and joints; tape to glands etc.

3.6 Internal Inspection (Detail)

To inspect for undue accumulation of dust, dirt or corrosion agents inside the enclosure. To check for any damages to gaskets, tightness of electrical connections (to guard against the sparking etc.). Being an internal inspection will require proper electrical isolation of equipment and removal of covers as per requirements. Use of proper tools is a pre-requisite for checking the tightness.

Another internal inspection is for checking of the correct installation of lamps / bulbs as per the design. This also necessitates removal of the cover and isolation of electrical equipment from service and supply.

In the case where encapsulating material is used in equipment / enclosures, cable boxes and stoppers, it should be ensured that the filling is proper. The covers need to be removed for a visual inspection inside the enclosure and requisite isolation done. Generally a visual inspection is sufficient as long as no deterioration or abnormality is observed.

Either by internal or external inspections the motor air-gaps and other radial and axial clearances of motors need to be checked against the manufacturer's design data sheet.

This record will help to determine undue wear and tear or distortion, which could be indicative of impending failure in terms of, sparks due to rubbing between rotating parts (such as fan blades, bearing grease guards, rotor body etc.) or any other abnormality.

The integrity of the equipment with respect to design parameters needs to be confirmed with respect to a hazardous dossier and it should be ensured that there are no "unauthorized" modifications. This can be done through internal and external inspections.

- To ensure by inspection and checking that:
- Potential equalizer system connections are secure and undamaged
- Earthing connections are undamaged and secure
- All enclosure fittings are properly bonded to earth and are secure and undamaged

The initial inspection should also include in addition to the above checks certain other checks, which are specific to the protection concepts in question.

3.7 Inspection after equipment repair

In the case of repair, adjustment or replacement carried out on any equipment system or installation, it shall be checked in accordance with the relevant items as per the 'Initial' inspection schedule. These checks may be carried out by the person doing the work and need not be recorded.

It has to be ensured that any repair does not change the integrity of the equipment, vis-à-vis the protection concept as approved and / or certified and documented in the Hazardous Location System of the Plant / Site.

a) Inspection after change in area classification, sub-group or surface temperature classification.

This inspection should ensure that the installation, equipment and equipment are in conformance to the new classification and are appropriate. This needs to be in particularly checked for sub-group and temperature classification.

b) Periodic / Routine Inspection

All equipment, systems and installations shall be inspected in accordance with the 'Periodic / Routine' inspection schedules and the details shall be recorded. These inspections are required to be done to identify the deterioration in installation conditions due to operating conditions or environment or unauthorized modifications.

The nominated person(s) shall determine the frequency of 'Periodic / routine' inspections. Experience has shown that there is a point beyond which increasing the frequency of inspection does not decrease the significant fault rate. The nominated person may extend the interval between 'Periodic' inspections if the significant fault rate is not increased consequently.

In extremely adverse conditions, the interval between 'periodic' inspections may be as low as three months but should not normally exceed two years. However in extremely good, stable environmental conditions, the interval between inspections

may be extended to four years. Where the interval between 'Periodic' inspections exceeds two years, 'Visual' inspections shall be carried out as defined below.

It should be noted that a 'significant fault' is one in which the certified integrity of the equipment or system (in so far as it affects safety in flammable atmosphere) is impaired and the significant fault rate is the number of items having significant faults expressed as a percentage of the total number of items inspected.

c) Visual Inspection from Floor Level

The majority of faults on equipment, systems and installations, which remain undisturbed, are caused by environmental factors and most of these are detectable by a 'Visual' inspection from floor level.

Where the 'Periodic' inspection interval exceeds two years all equipment, systems and installations shall be inspected in accordance with the 'Visual' inspection schedules and at an interval not exceeding half that determined for the 'Periodic' inspection. The details shall be recorded.

Following a major shutdown in hazardous locations all equipment, systems and installations in that area should be inspected in accordance with the visual inspection schedules. The details should be recorded.

3.8 Guideline for Routine or Visual Inspection

The following can act as guidelines for the routine or periodic or visual inspections of installations:

- To check for deterioration in enclosures, fittings, conduits, cable glands, cable boxes due to corrosion effect.
- To check for undue accumulation of dust and dirt in cable trays, enclosures, conduits etc. Because these can contain corrosive liquids and solvents.
- To check for any physical damages to enclosures, conduits, cables, cable trays etc.
- To check for any leakage of oil, powder, sand from equipment having moving parts.
- To check for looseness in enclosure fittings, mountings, glands, stoppers etc.
- To check for any deteriorating gaskets thus exposing the components housed in enclosure to harsh environment.
- To check for any excessive vibrations at the point of mounting, this may lead to loosening of cable or conduit connections in enclosures and rotating equipment.
- To check for the condition of bearings to ensure that no overheating, rubbing or seizing occurs.
- To check for any abnormal leakage or loss in level of oil or powder or sand indicating that the protection is deteriorating.
- To check for proper functioning of relays & protection, safety devices used to ensure safety of equipment, equipment and plant installation.
- To check for any loose electrical connection in particular with equipotential bonding.
- To check for any unauthorized changes, such as – in fuse rating or bulbs / lamps.

3.9 Inspection procedure

Generally dividing the installations or plant in a geographical manner and then carrying out the appropriate inspections has been found to be more economical than based on a system approach. In checking the installation by systems, it can be time consuming as each system often occupies more than one physical location.

The format of the procedure should be devised such that positive reporting is done. This means compliance of all systems and the full installation with the requirements is ensured. In negative reporting, only non-compliances are reported and a doubt can linger as to whether the full installation has been inspected from every aspect of safety or not.

A suggested method could be:

- Divide the Plant / Site into proper logical locations.
- Detail all parts of the electrical installation in sheets of inspection.
 - These sheets should detail type of inspection to be carried out on each equipment or system or installations in the area identified.
 - The sheets should clearly specify the method of reporting so that no ambiguity remains in the recording. Record compliance and non-compliance separately. This will ensure quick generation of a punch list and its rectification and subsequent re-inspection for compliance.

A procedure to integrate all such reports and linking them to each part of installation to allow for verification of the completeness of the inspection process.

4. MAINTENANCE OF Ex db, Ex eb AND Ex nA/ec INSTALLATIONS

Electric material is negatively influenced by the environmental circumstances under which it is used, such as:

- corrosion,
- ambient temperature,
- ultraviolet radiation,
- penetration of water,
- accumulation of dust and sand,
- mechanical effects and
- Chemical deterioration.

Corrosion of metals or the influence of chemicals, especially of solvents on synthetic materials or elastomeric parts, can affect the protection method and the degree of protection of the material, and deteriorate it. If lids or cover plates are badly corroded, they have to be replaced.

Plastic lids (or covers made of other synthetic materials) can exhibit surface cracks that can compromise the integrity of the lid. Where necessary, metal lids need to be treated with a suitable protective layer against corrosion, as a precaution; the frequency and nature of this treatment are determined through environmental circumstances.

5. INSPECTION EX db, Ex eb AND Ex ec MATERIAL AND INSTALLATIONS

The standard SANS 60079:17 has the following Grades of inspection:

- Visual
- Close
- Detailed

Periodical inspections are generally visual or close inspections. As a consequence of a periodically held visual or close inspection, a further more detailed inspection can turn out to be necessary. In determining the inspection classification and the period of time between periodical inspections, the type of material, possible instructions from the manufacturer, factors regarding diminishing quality, zone of use, and the results of past inspections all need to be taken into account.

For a visual inspection, only the eyes are used. No tools are allowed to be used and this also applies to climbing tools such as ladders. Basically, nothing in the installation is touched. Typical points of inspection are: missing bolts, wrongly applied tape (Denso tape), missing stopping plugs, obstruction of Ex d gaps, damaged enclosure.

For a close inspection, climbing tools are used as well as both hands, in order to feel whether or not certain things are fastened tightly and correctly. Basically no tools are used, and housings are not opened. Typical points of inspection are: loose cable gland, incorrect cable gland, loose bolt and Ex d gap too wide.

For a detailed inspection, tools are used and the housings are opened. This means it is also necessary to turn off the power and work with a working permit. Typical points of inspection are: earthing incorrectly connected, corroded or damaged Ex d gaps, loose or badly attached conductors, damaged seals.

The standard SANS 60079:17 contains an appendix in which the points of inspection are mentioned. Here it is also mentioned whether these belong to the visual, close or detailed inspection.

It is good to ask one's self why a certain item is a point of inspection. The result of inspections needs to be recorded in written form.

When putting an installation (or part of an installation) into use, it needs to be inspected in detail; we call this the initial inspection.

To enable to carry-out inspection and maintenance, up to date documentation has to be present such as:

- Zone drawings and other relevant data such as EPL requirements;
- Equipment group classifications (IIA, IIB or IIC) and temperature classification;
- Current time characteristics of thermal overloads protecting Ex e motors;
- Protection method, IP-grade, corrosion resistance of equipment;
- Information such as a list of equipment, spare parts, certificates, technical information;
- Copies of earlier inspection information.

6. MARKING OF EQUIPMENT

If the nameplate or tag plate is illegible due to corrosion or damage of the plate alternative methods may be applied to trace the details of the indications on these plates. One could think of supplementary identification labels like tag numbers having a reference to a database file regarding the installation.

7. MECHANICAL INSPECTIONS.

The following deserve special attention:

- Examine the equipment closely for faults such as cracks in the metal, cracked or broken glasses, and defects in the cement.
- Examine all cables and cable entries for defects, paying particular attention to the condition of flexible cables used with portable equipment.
- Check the clamping of the armouring of cables to ensure that the lead sheath is not subject to strains that may cause fracture and that the armouring is firmly earthed to ensure the flow of capacitive currents to earth.
- Examine all conduit runs and fittings for possible slackness of joints.
- Pay attention to the general condition of the equipment and arrange for appropriate remedial measures where required.
- At such intervals as are shown necessary by experience, or as required by the Approving Authority (whichever are shorter) take the equipment apart and examine it for possible defects resulting from corrosion, erosion, or other causes.

8. CHECK LISTS

8.1 Suggested check list for the inspection of explosion protected metal enclosures "db" type Flameproof, "eb" type Increased Safety enclosures, Zone 2 Non-sparking "ec" enclosures and Dust Ignition Proof dip / tD enclosures.

These enclosures all have machined lids and matching surfaces for their protection i.e. metal to metal flame paths and can also be used in Zone 1 & Zone 2 hazardous locations provided they have constructional requirements for the explosion protection.

Regular visual inspection of flameproof enclosures.

- Paintwork must be clean and in good condition - check for corrosion.
- Check enclosure for any cracks or structural defects. If found repair immediately.
- Are all locknuts tight? If bolts are missing, isolate the device and replace immediately.
- Are all cable entries and glands tight and in good condition?
- If enclosure volume are more than 2 litre and certified as Gas Group IIC, then a compound / barrier gland must have been used to terminate cables.
- Any worn operators, i.e. isolator handles, pushbutton shafts, should be replaced at the end of a shift in a safe location.

- At a pre-determined time, remove enclosures and check the correct functions of equipment. Tighten all terminals and connections to obviate electrical faults. When flame paths on machined surfaces have been checked for scoring or scratching, smear light grease on these surfaces to protect against corrosion.
- Check that the flame path degree of protection identification labels and all instructions for electrical operation are clear to operators.
- Most important; cables to the devices must be in good condition. Avoid joints and where joints are necessary a record should be kept of all work done on such cables.

In the event of any such devices having to undergo a major overhaul, either leave this to an approved SANS repair mark holder, or, if that is not possible, get your closest Inspector or testing authority to examine and approve the equipment. Always get written approval.

Finally, ask the Original Equipment Manufacturer (OEM) for their recommendations on inspection and maintenance routines and embody into any scheduled forms you may set up to assist your personnel.

8.2 Check list and maintenance of Increased Safety "eb" & "ec" type equipment either in polyester, aluminium or metal alloy enclosures.

These devices are enclosures with lids, which have gaskets, which house explosion protected electrical elements. The electrical elements themselves have flame paths similar to the protection described in Flameproof Metal Enclosures, and the elements (such as pilot lights and transformers of so called "s", "q" or "m" special protection), are devices that have been encapsulated to prevent ingress of a hazard or designed in such a way as to contain a possible ignition. The elements are certificated and marked in the coding of testing stations with normal certificate numbers but with most important exceptions – a suffix letter either "U" or "X" . is placed after the certificate number. These elements can only be used in a further enclosure, which is an increased degree of protection for the device, hence the term "Increased Safety". The gasket enclosure housing certificated explosion protected switching elements must be of at least *IP54 Degree of Protection to IEC144 to prevent ingress of dust and moisture and will have a further certificate number on the outside without a letter suffix.

An inspection schedule for Increased Safety Push button Stations, Custom Built control stations and Increased Safety Terminal boxes used for termination into flameproof enclosures follows: -

- Visually inspect, once per week, and check that stations and equipment are clean.
- Check that cable glands for cable entries are all in good condition.
- Are labels giving flameproof degree of protection fixed securely to devices and are the devices suitable for the hazardous environment in which they are installed.
- Are all screws tightened down on covers? Missing screws must be replaced immediately.
- If a station is cracked or has any part of it chipped on a polyester type enclosure, it must be replaced immediately.
- Cracked glasses on light indicators must be replaced immediately.

At an annual inspection of at least one-year intervals, isolate the supply to these "e" type devices and check the following: -

If there is an abnormal amount of dust or moisture present, investigate the cause of such phenomena. This could be due to perish gaskets on the cover or that the cable gland is not providing sufficient seal. Quite often a hairline crack in polyester material, not discernible to the human eye, will allow moisture or water to penetrate the enclosure. It is recommended that cable glands are used both an inner seal and outer seal on to the cable. Shrouds used in the past with cable glands gives practically no sealing properties and the ultra violet rays of the sun and normal weathering in conjunction with chemical atmospheres very rapidly deteriorate the sealing properties of such shrouds. What has to be achieved is the preclusion of all moisture and dust to prevent tracking of electrical potential on the certified electrical explosion protected elements. The terminals on these devices are part of the protection certificate and any missing or damaged locking devices or lock washers must be replaced immediately.

In the case of terminal boxes or marshalling boxes, terminals of "e" type certification with a certificate number with "u" or "x" suffix number (or certified approved terminals) must be used internally and the terminal box will have a certificate number without letter suffix to complete the increased safety protection. Gland entries into all "e" increased equipment must be by means of a certified "e" type gland for the type of cable being used.

8.3 Check schedule for the inspection of switch plugs

- Visually inspect that incoming cables to these devices are sound and that correct cable glands in relation to types of cables are correct.
- Check and ensure that there are no cracks or any damage to the plugs and sockets. If any damage is observed replace the unit immediately.
- Ensure that the gland used is correct and is correctly installed.
- Ensure that the labels are correct and are visual.
- Check that the plug top operates correctly when inserted in the plug.
- Ensure that the markings are correct and visual and that the certificate is still valid.

8.4 Inspect once per year or at maintenance shutdowns

- After isolation of power to socket outlets, remove covers to entries and inspect electrical connections. If not in first class condition, make off again and make sure that all-locking devices, washers and nuts are securely tightened.
- Inspect all electrical insulating material if it is charred or shows signs of breaking down, it must be replaced with OEM parts.
- If pins or contacts have excessive wear, replace with new parts. Never replace new parts to fit mating old parts.
- In case of metal flameproof mating surfaces, check for corrosion and/or excessive wear. When reassembling, use light layer of grease. Flame paths must not be closed by paint.
- If unit is painted and re-labelled etc. After maintenance, it will be easier to keep clean.
- Make sure that labels giving flameproof degree of protection are fixed to the socket outlets and that the protection is adequate for the hazardous environment. Electrical rating plates must also be clearly displayed.

8.5 Schedule for equipment inspections

8.5.1. Daily inspection

- Visually inspect all equipment for any obvious defects or damage.
- Check all cables and cable entries for damage or mechanical stress.
- Ensure that all indication lights are in working order.
- Ensure that all labels are intact and are correct.
- Ensure that all pushbuttons are in working order and are not damaged.
- Ensure that Emergency stops are not damaged and are in working order.
- Ensure that drawings are available and are correct.
- Inspect motors for any signs of damage.
- Check motor temperature by hand.
- Check motor bearing temperatures by ear, hand or by means of a stethoscope.
- Check motors for any signs of vibrations.
- Check lighting levels.
- Check lights for damage.

All defects that are found must be noted and brought to the attention of the responsible person, and defects must be attended to promptly.

8.5.2. Three monthly inspection

- Isolate the electrical supply.
- Check main isolators for any damage or signs of wear.
- Check all timers, counters, relays, isolators and contactors for damage or wear.
- Check all wires for loose connections or any other defects.
- Switch on control supply and ensure that the controls are operating correctly.
- Switch on mains and start up system and ensure that it is operating correctly.
- Check temperature switches for correct operation.
- Check pressure switches for correct operation.
- Check and measure earth resistance, earth loop impedance and insulation of system.
- Hand over equipment to operator.

8.6 Maintenance and inspection of Ex ia, ib & ic installations

Points of attention when working with intrinsic safe installations:

- To switch off the voltage is not necessary.
- The tools to be used should not spark and should not have a temperature that is too high.
- An intrinsic safe enclosure is allowed to be opened while energized.
- Opening and closing of housings needs to be done carefully.
- A proper ingress protection class for this equipment is IP54.
- Also for Ex I equipment and installations, there is an inspection list in the standard SANS 60079:17.

An intrinsic safe enclosure may be opened while in operation. However, you have to realise that it is possible to influence the process if you e.g. disconnect a wire accidentally. This is why generally these kinds of activities fall under a "Work permit".

When opening and closing housings, the same kind of care needs to be taken as for Ex e equipment. That is to say, using silicon grease on the screws and gasket in order to ensure that, in time, the enclosure can be opened again without any damage being done. The default minimum ingress protection class (IP-degree) for this equipment is IP54, but certain specific circumstances may demand higher requirements.

9. INSPECTION GUIDANCE FORMS

In the standard SANS 60079:17, an inspection list is included for "Ex" equipment and installations. This list needs to be followed when inspecting the specified explosion protection method installed in question. Remember that this is the minimum requirement and additional items can be added to individual inspection list as per user / company requirement.

Below are the minimum required inspection checkpoints as listed in SANS 60079:17.

SANS 60079:17 Table 1 – Inspection schedule for Ex'eb' & Ex'ec'				
A)	Equipment	V	C	D
1)	Equipment is appropriate to area classification	X	X	X
2)	Equipment group is correct		X	X
3)	Equipment temperature class is correct		X	X
4)	Equipment circuit identification is correct			X
5)	Equipment circuit identification is available	X	X	X
6)	Enclosure glass parts & glass to metal sealing gaskets and/or compounds are satisfactory	X	X	X
7)	There are no unauthorized modifications			X
8)	There are no visible unauthorized modifications	X	X	
9)	Bolts, cable entry devices (direct & indirect) & blanking elements are of the correct type and are complete and tight			
	- Physical check		X	X
	- Visual check	X		
10)	Lamp rating, type and position are correct			X
11)	Electrical connections are tight			X
12)	Conditions of closure gaskets is satisfactory			X
13)	Enclosed break and hermetically sealed devices are undamaged (Ex'n' only)			X
14)	Restricted breathing enclosure is satisfactory (Ex'n' only)			X
15)	Motor fans have sufficient clearance to enclosure and/or covers			X
16)	Breathing and draining devices are satisfactory		X	X
B)	Installation			
1)	Type of cable is appropriate			X
2)	There is no obvious damage to cables	X	X	X
3)	Sealing of trunking, ducts, pipes and/or conduit is satisfactory	X	X	X
4)	Integrity of conduit systems and interfaces with mixed systems is maintained			X
5)	Earthing connections, including any supplementary earthing bonding connections are satisfactory (e.g. connections are tight and conductors are of sufficient cross section)			
	- Physical check			X
	- Visual check	X	X	
6)	Fault loop impedance (TN systems) or earthing resistance (IT systems) is satisfactory			X
7)	Insulation resistance is satisfactory			X
8)	Automatic electrical protective devices operate within permitted limits			X
9)	Automatic electrical protective devices are set correctly (Auto reset not possible)			X
10)	Special conditions of use (if applicable) are complied with			X
11)	Cables not in use are correctly terminated			X
12)	Variable voltage/frequency installation in accordance with documentation		X	X
C)	Environment			
1)	Equipment is adequately protected against corrosion, weather, vibration and other adverse effects	X	X	X
2)	No undue accumulation	X	X	X
3)	Electrical insulation is clean and dry			X

SANS 60079:17 Table 2 – Inspection schedule for Ex'ia', "ib" & "ic"				
A)	Equipment	V	C	D
1)	Circuit and/or equipment documentation is appropriate to are classification	X	X	X
2)	Equipment installed is that specified in the documentation		X	X
3)	Circuit and/or equipment category and group is correct		X	X
4)	Equipment temperature class is correct		X	X
5)	Installation is clearly labelled		X	X
6)	There are no unauthorized alterations			X
7)	There are no visible unauthorized modifications	X	X	
8)	Safety barrier units, relays and other energy limiting devices are of the approved type, installed in accordance with the certification requirements and securely earthed where required	X	X	X
9)	Electrical connections are tight			X
10)	Printed circuit boards are clean and undamaged			X
B)	Installation			
1)	Cables are installed in accordance with documentation			X
2)	Cable screens are earthed in accordance with the documentation			X
3)	There is no obvious damage to cables	X	X	X
4)	Sealing of trunking, ducts, pipes and/or conduits is satisfactory	X	X	X
5)	Point to point connections are all correct			X
6)	Earth continuity is satisfactory (e.g. connections are tight and conductors of sufficient cross sections)			X
7)	Earth connections maintain the integrity of the type of protection	X	X	X
8)	The I.S circuit is isolated from earth or earthed at one point only (refer to documentation)			X
9)	Separation is maintained between I.S and non-I.S circuits in common distribution boxes or relay cubicles			X
10)	As applicable, short circuit protection of the power supply is in accordance with documentation			X
11)	Special conditions of use (if applicable) are complied with			X
12)	Cable not in use are correctly terminated	X	X	X
C)	Environment			
1)	Equipment is adequately protected against corrosion, weather, vibration and any other averse factors	X	X	X
2)	No undue accumulation of dust and dirt is present	X	X	X

SANS 60079:17 Table 3– Inspection schedule for Ex "db" & "dc"				
A)	Equipment	V	C	D
1)	Equipment is appropriate to area classification	X	X	X
2)	Equipment group is correct		X	X
3)	Equipment temperature class is correct		X	X
4)	Equipment circuit identification is correct			X
5)	Equipment circuit information is available	X	X	X
6)	Enclosure glass parts & glass to metal sealing gaskets and/or compounds are satisfactory	X	X	X
7)	There are no unauthorized modifications			X
8)	There are no visible unauthorized modifications	X	X	
9)	Bolts, cable entry devices (direct or indirect) & blanking elements are of the correct type and are complete and tight			
	Physical check		X	X
	Visual check			X
10)	Flange faces are clean and undamaged and gaskets, if any are satisfactory			X
11)	Flange gap dimensions are within max permitted values		X	X
12)	Lamp rating, type and condition are correct			X
13)	Motor fans have sufficient clearance to enclosure and/or covers			X
14)	Breathing and draining devices are satisfactory		X	X
B)	Installation			
1)	Type of cable is appropriate			X
2)	There is no obvious damage to cables	X	X	X
3)	Sealing of trunking, ducts, pipes and/or conduits is satisfactory	X	X	X
4)	Stopper boxes & cable boxes are correctly filled			X
5)	Integrity of conduit systems and interfaces with mixed systems is maintained			X
6)	Earthing connections, including any supplementary earthing bonding connections are satisfactory (e.g. connections are tight and conductors are sufficient cross section)			
	Physical check			X
	Visual check			X
7)	Fault loop impedance (TN systems) or earthing resistance (IT systems) is satisfactory			X
8)	Insulation resistance is satisfactory			X
9)	Automatic electrical protective devices operate within limits			X
10)	Automatic electrical protective devices are set correctly (Auto reset not possible)			X
11)	Special conditions of use (if applicable) are complied with			X
12)	Cables not in use are correctly terminated			X
13)	Obstructions adjacent to flameproof flanged joints are in accordance with IEC 60079-14	X	X	X
14)	Variable voltage/frequency installation in accordance with documentation		X	X
C)	Environment			
1)	Equipment is adequately protected against corrosion, weather, vibrations and other adverse factors	X	X	X
2)	No undue accumulation of dust and dirt	X	X	X

SANS 60079:17 Table 4 – Inspection schedule for equipment protected by enclosure Type 'tD'				
A)	Equipment	V	C	D
1)	Enclosure is appropriate to area classification	X	X	X
2)	IP grade of equipment is appropriate to conductivity of dust	X	X	X
3)	Equipment maximum surface temperature is correct		X	X
4)	Equipment circuit identification is correct			X
5)	Equipment circuit identification is available	X	X	X
6)	Enclosure gaskets and gas to metal sealing gaskets and/or compound are satisfactory	X	X	X
7)	There are no unauthorized modifications			X
8)	There are no visible unauthorized modification	X	X	
9)	Bolts, cable entry devices and blanking elements are of the correct type and are complete and tight			
	- Physical check		X	X
	- Visual check	X		
10)	Lamp rating, type and position are correct			X
11)	Electrical connections are tight			X
12)	Condition of enclosure gaskets are satisfactory			X
13)	Motor fans have sufficient clearance to enclosure and/or covers			X
B)	Installation			
1)	The installation is such as to minimize the risk of dust accumulation	X	X	X
2)	Sealing of trunking, ducts, pipes and/or conduit is satisfactory	X	X	X
3)	Type of cable is appropriate			X
4)	There is no obvious damage to cables	X	X	X
5)	Cables not in use are correctly terminated		X	X
6)	Earthing connections, including any supplementary earthing bonding connections are satisfactory			
	- Physical check			X
	- Visual check	X	X	
7)	Fault loop impedance (TN system) or earthing resistance (IT system) is satisfactory			X
8)	Insulation resistance is satisfactory			X
9)	Automatic electrical protective devices operate within permitted limits			X
10)	Automatic electrical protective devices are set correctly (Auto reset is not possible)			X
11)	Special conditions of use (if applicable) are complied with			X
C)	Environment			
1)	Equipment is adequately protected against corrosion, weather, vibration and any other adverse effect	X	X	X
2)	No undue accumulation of dust and dirt	X	X	X

10. Applicable Standards

- **SANS 60079-0:** Explosive atmospheres Part 0 - General requirements
- **SANS 60079-17:** Explosive atmospheres Part 17 - Electrical installations, inspections and maintenance
- **ARP 0108:** Regulatory requirements for explosion-protected equipment
- **SANS 10108:** The classification of hazardous locations and the selection of equipment for use in such locations