Eskom	Standard	Technology

Title: **Instrument Piping for Coal Fired Power Plants Standard**

Unique Identifier:	**240-89147446**
Alternative Reference Number:	**N/A**
Area of Applicability:	**Eskom Coal Fired Power Plants**
Documentation Type:	**Standard**
Revision:	**2**
Total Pages:	**19**
Next Review Date:	**July 2024**
Disclosure Classification:	**CONTROLLED DISCLOSURE**

APPROVED FOR AUTHORISATION
☑ TECHNOLOGY ENGINEERING
DOCUMENT CENTRE ☎ X4962

Compiled by	Approved by	Authorised by
Dr R.M. Clark	B. Naran	Prof S. Govender
Senior Consultant	Chairperson: Pressure Equipment Care Group	General Manager (Acting): Plant Engineering
Date: 22-07-2019	Date: 24/07/2019	Date: 06/08/2019

Supported by SCOT TC

M. André

Plant Engineering TC Chairperson

Date: 06/08/2019

PCM Reference : **240-53459108**

SCOT Study Committee Number/Name : **Boiler Study Committee**

CONTENTS

EXECUTIVE SUMMARY

Instrumentation piping and the effective management thereof is always an area of concern within the power generation fraternity. This pipework can, in certain instances, contain high energy process fluid that could be potentially dangerous in the event of a failure. It is therefore of paramount importance that the instrument pipework is effectively designed, controlled and managed within Eskom's coal fired power plants.

The successful implementation of this Standard will ensure that instrumentation pipework within Eskom's coal fired power plants is constructed and maintained to best international practices. Any compromise in the instrument pipework could potentially be dangerous to plant and personnel.

The Standard does not include instrumentation pipework associated with nuclear, gas, hydro, pump storage and renewable power plants.

1. INTRODUCTION

Instrumentation piping and the effective management thereof is always an area of concern within the power generation fraternity. This pipework can, in certain instances, contain high energy process fluid that could be potentially dangerous in the event of a failure. It is therefore of paramount importance that the instrument pipework is effectively designed, controlled and managed within Eskom. This pipework is furthermore governed by the OHS Act [8] and the Pressure Equipment Regulations [11], with the risk category as per SANS 347 [7].

2. SUPPORTING CLAUSES

2.1 SCOPE

The scope of this Standard is limited to the coal fired power plant instrumentation pipework. It includes the ancillary instrumentation pipework that is associated with the control and measurement of these power plants. Hydraulic control pipework does not fall within the ambit of this scope.

2.1.1 Purpose

This document sets out the minimum standards for instrumentation pipework, and the associated installation processes. The document furthermore includes suggested welding connections to join thin walled pipework.

2.1.2 Applicability

This Standard applies to instrument piping on all coal fired power stations within Eskom. Renewable, gas, hydro, pump storage and nuclear technologies are excluded from the Standard. The boundary limits are from the root valve downstream connection to the monitoring instruments for new or replacement installations.

Where modifications as per the Eskom Change Management process are made to existing instrument piping, either this Standard will be applied or the code to which the original impulse piping installation was designed. This Standard does not supersede any code requirements.

This standard excludes:

- Renewable, gas, hydro, pump storage and nuclear technologies,
- Control air and hydraulic piping,
- Sampling piping for chemistry,
- Pipework connecting specialised level measuring equipment to vessels,
- The root valve, and upstream pipework,
- Capillary tubes of commercial instruments,
- Instruments,
- Manifolds.

For design and construction purposes, the piping from the tap-off point up to and including the root valve is to be treated as part of the process line or vessel. This remains the responsibility of the process

supplier. The hazard category for this pipework will be the same as the main pipe, as defined in SANS 347 [7].

This document shall apply throughout Eskom Holdings Limited Divisions (with the exception of renewable, hydro, pump storage and nuclear technologies) where instrumentation piping is used.

2.2 NORMATIVE / INFORMATIVE REFERENCES

Parties using this document shall apply the most recent edition of the documents listed in the following paragraphs.

2.2.1 Normative

[1] ISO 9001 - Quality Management Systems.

[2] BS EN 10204 - Metallic products – Types of inspection documents.

[3] 240-72273656 - Plant classification standard.

[4] 240-106628253 – Standard for Welding Requirements on Eskom Plant.

[5] 240-83539994 - Standard for Non-Destructive Testing (NDT) on Eskom Plant.

[6] 240-56241288 - Fossil Fired Boiler Protection Functions Standard.

[7] SANS 347 - Categorisation and Conformity Assessment Criteria for all Pressurised Equipment.

[8] The Occupational Health and Safety Act and Regulations (Act No 85 of 1993).

[9] 240-105658000 – Supplier Quality Management Specification.

[10] 240-112287980 – Works instructions for the application of standards for Engineering Work.

[11] The Occupational Health and Safety Act (Act No 85 of 1993) Pressure Equipment Regulation 15 July 2009.

[12] 240-84513751 Material specifications and certification guideline.

2.2.2 Informative

[13] 240-56239129 - High Pressure Pipework for Fossil Fired Power Stations Standard.

[14] BS EN 13480 - Metallic industrial piping, Parts 1 to 7.

[15] BS EN 12952 - Water tube boilers and auxiliary installations, Parts 1 to 6.

2.3 DEFINITIONS

Definition	Description
Anchor	A reliable permanent support that fastens the impulse line in place and prevents movement in all directions.
Approved Inspection Authority	An Inspection Authority as specified by the OHS Act [8].
Blowdown line	The pipe or tubing located below the instrument connection for draining the process fluids to a safe location.
Blowdown Valve	The valve in the impulse line used to discharge undesirable fluids.
Breakable Fitting	A fitting that is easily removed without damaging the tubing, pipe or instrument to allow the connection to be broken and remade successfully without replacement of components.
Capillary	A small diameter tube used for final connection to the Instrument, and is treated as part of the Instrument.
Classification	The allocation of Classification Level 1, 2 or 3 to a process system or component as per 240-72273656 Power Generation Asset Criticality Classification Standard [3].
Condensate pot	Reservoirs that are used in the measurement of steam or other vapours to condense the liquid at ambient temperature.
Control piping	Piping not connected to the process, that is used to interconnect pneumatically or hydraulically operated control apparatus, as well as signal transmission systems used to interconnect instruments.
Hazardous category	The hazard category as defined in SANS 347 [7] for all pressure systems above and including 50 kPa.
Hazardous fluid groups	Process fluids as aligned with SANS 347 [7].
High duty	As defined in the high pressure pipework standard for Eskom power plants 240-56239129 [13].
Impulse line	The line, tubing or pipe that connects the root valve to the primary measuring element of the instrument loop and includes all valves, fittings, tubing and piping used to connect the primary instrument to other instruments, apparatus, or measuring equipment.
Installation details	Installation documentation in the form of standards, specifications, procedures, drawings, line diagrams, quality control plans and erection manuals. Details of primary connections, impulse line layout, instrument location, access platforms, ladders and supports shall be included.
Instrument	A mechanical, electrical, pneumatic or hydraulic device used to measure a process variable.
Instrument isolation valve	The valve or valve manifold in the impulse line that is nearest to the instrument.

Definition	Description
Low duty	Pipework at a pressure or temperature that falls outside of the ambit for pipework as defined in the high pressure pipework standard for Eskom power plants 240-56239129 [13].
Manifold	An assembly of two or more valves, often in one package, used to facilitate calibration and maintenance. It also includes the header used for level measurement.
Modification	A permanent or temporary change to an impulse line including the replacement of tubing, valves and fittings. Any modification shall be managed within the Eskom Engineering Change Management (ECM) process and Works instructions for the application of standards for Engineering Work 240-112287980 [10].
Normal access	Means that the mechanism or plant item can be reached from a walkway, platform or fixed ladder.
Primary connection	The primary connection comprises the process tap, the piping between the process tap and the root valve, and the root valve.
Process tap	The connection into the process line or vessel.
Root valve	The first valve located on the instrument piping after it taps off the process line or vessel. The root valve may also be known as the first isolating valve, shutoff valve, or primary cut-off valve.
Slide	A device that supports the dead weight of the impulse line but allows axial movement.

2.3.1 Disclosure Classification

Controlled disclosure: controlled disclosure to external parties (either enforced by law, or discretionary).

2.4 ABBREVIATIONS

Abbreviation	Description
AIA	Approved Inspection Authority
BSP	British Standard Pipe
CoE	Centre of Excellence
ECM	Engineering Change Management
EDWL	Engineering Design Work Lead
FTR	Free Text Retrieval
IWE	International Welding Engineer
IWT	International Welding Technologist
OD	Outside Diameter
OHS	Occupational Health and Safety[8]

Abbreviation	Description
PER	Pressure Equipment Regulations as defined in the OHS Act [11]
P&ID	Piping and Instrumentation Diagram
SANAS	South African National Accreditation System
SANS	South African National Standard

2.5 ROLES AND RESPONSIBILITIES

It is the responsibility of the Engineering Design Work Lead to ensure that this Standard is complied with in full when designing instrument pipework.

The relevant installer and maintainer of the pipework shall comply with the requirements of this Standard. Any deviations to this Standard will be managed according to Eskom Document 240-112287980 Works Instruction for the application of Standards for engineering work [10].

2.6 PROCESS FOR MONITORING

The Engineering Design Work Lead (EDWL) shall ensure that this Standard is adhered to in full during the design, installation and maintenance of the instrument pipework.

2.7 RELATED / SUPPORTING DOCUMENTS

The document supersedes GGSS 1427 “Instrument piping for fossil and hydro power plants”.

3. STANDARD FOR INSTRUMENT PIPING

3.1 DESIGN APPROVAL

The installation detail for the proposed piping shall be approved by an appropriate ECSA registered person before submission to the Eskom approval authority. No installation work may take place before approval is obtained from the relevant authorities.

3.1.1 Classification

All impulse lines shall be classified as per the Plant classification standard [3] according to the plant on which they connect.

3.1.2 Duty categories of impulse lines

Two duty categories are stipulated, as defined in this document:

- High Duty
- Low Duty

3.1.3 Temperature concession

The design temperature for impulse lines shall be the same as the maximum operating temperature of the process fluid.

3.1.4 Plant identification and coding

The appropriate plant identification code shall be applied to the installation detail and shall refer to the related plant measurement device, valve or equipment. The coding of plant will be in line with the respective codification standard used on the respective power station. The primary element as well as the root isolation valve will appear on the respective Piping and Instrumentation diagram (P&ID).

3.1.5 Documentation

Documentation to be compiled and retained shall comply with the relevant statutory and safety stipulations.

3.2 MECHANICAL DESIGN

3.2.1 Primary connection

The primary connection shall comply with the design code for the process line or vessel. The root valve shall be located as close as possible to the process tap connection. All connections should be located so that normal access to the process tap and the root valve is possible.

3.2.2 Process tap

The process tap shall be correctly positioned to ensure the functionality of the instrument system. The process tap shall be located as near as possible to a pipe support to limit the effects of vibration.

If the process tap design allows for a fitting as a connection, it shall be ½ BSP tapered female thread. This is only applicable to low duty applications.

3.2.3 Tube specification

The selected pipework material and thickness for low and high duty applications shall be based on the designer's discretion, and sound engineering practices.

3.2.4 Tube joints and connections

Joints or connections between the root valve and the instrument shall be limited to as few joints as possible.

Impulse lines connected to the following services shall have welded connections:

- High duty impulse lines.
- Low duty impulse lines connected to hazardous fluids.
- Low duty impulse lines connected to vacuum installations.
- Low duty impulse lines located where access for maintenance and inspections is restricted or difficult, regardless of pressure, temperature and process fluid.

Any deviation from butt welded connections shall be sanctioned by the Eskom IWE/IWT welding specialist on site. The deviation will be recorded and managed according to Eskom Standard 240-112287980 Works Instruction for the application of Standards for engineering work [10].

Low duty non-welded impulse lines are connected with compression fittings. Connections to instruments and manifolds after the root valve downstream connection shall be made with breakable fittings. Bends

rather than fittings should be used to change the direction of impulse lines. Fittings shall be positioned at least three tube diameters away from a bend.

3.2.5 Weld transition pieces

Where it is necessary to connect dissimilar tube materials on welded impulse lines, transition pieces of compatible material and dimensions shall be provided. These connections shall be welded with the associated welding procedure. The material, design and welding procedure for the transition pieces shall be accepted by an Eskom IWE/IWT. The approval by an Approved Inspection Authority is dependent on the categorisation of the instrument line.

3.2.6 Material compatibility

The material for the labels, fittings, compression fittings, anchors, slides, clamps, tools and any materials that will be in temporary or permanent contact with the impulse pipework shall be of a material that will not render itself to damage the pipework. Such damage mechanisms include chemical, metallurgical (welding) or other damaging effects to the impulse pipework.

3.2.7 Compression fittings

Compression fittings manufactured and installed to a recognised international standard may be used, except where welded or other connections are specified.

These fittings shall be installed in strict accordance with the manufacturer's instructions, which shall form part of the quality control plan.

3.2.8 Isolating valves

Impulse lines for high duty and hazardous fluids shall have a minimum of two root isolating valves. The root valve shall be located as close as possible to the process tap. The root valve shall ensure a minimum class five shut-off isolation up to the design parameters of the pipework.

For low duty services, only one root valve is required. Additional valves shall be provided as needed.

Bi-directional valves shall be installed, where possible. Directional valves shall be installed with the flow arrow pointing in the direction of flow.

3.2.9 Instrument isolating valves

The instrument isolation valve or valve manifold shall be accessible to personnel during normal plant operation to isolate the instrument from the process. The instrument isolation valve shall be ergonomically located and within easy reach of the instrument. The instrument is to be clearly visible from the instrument isolation valve.

Instrument isolation valves shall be supported in such a manner that they remain in place when disconnected from instruments or impulse lines.

3.2.10 Environmental and ambient conditions

Where environmental and ambient conditions along the location of the impulse lines may affect the accuracy of measurements, adequate provisions shall be made to eliminate the effect of these conditions. Examples of these provisions include trace-heating and / or thermal insulation.

3.3 INSTALLATION

3.3.1 Tube configuration and routing

Impulse lines shall be kept as short as possible, with as few joints and directional changes. The installation shall allow for the appropriate compensation for differential movement or expansion, as per the design requirements.

Impulse lines shall run together wherever possible. Lines running in parallel groups shall not cross each other and the sequence of impulse lines shall be maintained through each successive set of clamps, bends, connections, penetrations or barriers.

Impulse lines shall not be installed in walkways, near stairways or where they will obstruct maintenance or operational activities. The minimum clearances shall be:

- 2.2 metres over walkways,
- 3 metres in open areas.

3.3.2 Tube cutting

Tubing shall be cut with a fine-tooth saw using a cutting guide, or the correct sized tube cutter. The cutting wheel shall be sharp and in good condition to prevent damage to the tubing. The tube ends shall be lightly de-burred internally and externally without causing damage to, or scratching the tubing. After cutting and de-burring, all foreign matter on the inside and outside of the tube shall be cleared. A tube cutter shall be used when an automatic welding process is utilised.

3.3.3 Tube bending

Bends, rather than fittings should be used to change direction of impulse lines.

Tubing shall be bent at ambient temperature using a suitable bending device. When bending austenitic tubing, the formers, slide rails and other parts of the device that come into direct contact with the tubing shall be made from an austenitic material.

All tube bends shall be free from deformation, kinks, flat spots and scoring, or as determined within the limits of the applicable design code.

Fittings shall be positioned at least three tube diameters away from a bend. Free hand bending is not permitted.

3.3.4 Connections to instruments

Breakable fittings shall be used for connections to instruments. Parallel threads (constant diameter) shall be used if the connection is threaded.

3.3.5 Welding

All welding of pipework shall comply with the latest requirements of the Standard for welding requirements on Eskom plant [4].

3.3.6 Passivation

The post-weld passivation process shall be included as part of the weld procedure specifications.

3.3.7 Tube slope and instrument positioning

The minimum slope on all impulse lines shall be 8% (80 mm per 1 meter length of line). Where this minimum slope cannot be achieved due to structural or physical constraints, the proposed solution shall be set out in the instrument detail and supplemented by a formal application for a concession.

The route of impulse lines shall ensure that the function of these lines is not affected by the inappropriate entrapment of gas or liquid, unless the manifold or termination connection allows for draining and / or venting. High point vents or low point drains, or both, shall be provided to ensure that all the entrapped gas or liquid can be purged from the impulse line.

Condensate pots shall be fitted where necessary to ensure accurate measurements.

For steam, water and liquid process fluids, the instruments shall be located below the root valve. The downward slope of the impulse line from the process tap to the instrument shall be 80 mm or more per metre run. This arrangement is to limit the penetration of gas bubbles into the system, which could negatively impact the temperature at the instrument.

For air, gas and vacuum processes, the instruments shall be located above the process tap. The upward slope from the process tap to the instrument shall be 80 mm or more per metre run. This arrangement will allow condensed liquid to drain back into the process rather than into the instrument, which could cause errors in measurement. Exceptions to this rule are to be discussed with the relevant CoE discipline. Where this cannot be achieved due to structural or physical constraints, the instruments can be located below the process tap, provided a drain tank is installed. The drain tank shall have a minimum capacity of 0.5 litre, with a blowdown valve installed at the lowest possible point to collect condensate. The design and location of the drain tanks shall be included in the installation detail.

3.3.8 Condensate pots

Condensate pots or weirs are used in the measurement of steam and other vapours. They condense the vapour to a liquid state to minimise errors due to gas entrapment within the impulse lines. Condensate pots installed in vertical positions are used to collect liquids drained from an impulse line. The design and test procedure and the location of the condensate pots shall be included in the installation detail.

Condensate pots, regardless of their orientation, shall be protected from excessive vibration.

Condensate pots shall be categorised as vessels according to SANS 347 [7], and designed accordingly.

3.3.9 Routing through barriers and penetrations

Impulse lines routed through penetrations, walls or other barriers where visual contact is lost or impaired shall be labelled with permanent tags that clearly show the identity of the impulse line. The tags shall be securely attached on either side of the barrier. Material for the tags shall be compatible with the material of the impulse line. Labels removed for any reason shall be replaced without delay.

Openings shall be large enough to ensure that there is no possibility of damage to the impulse lines. Anchors, slides or other means shall be applied to ensure the integrity of the impulse lines through the barrier or penetration.

3.3.10 Instrument installation and location

Instruments shall be installed with easy access to all connections so that servicing, calibration or replacement can be made with minimum disassembly.

Local instruments, other than direct mounted indicators such as pressure gauges, should be mounted at an accessible location on floor-mounted instrument stands or racks. They shall not be mounted on process piping or vessels, handrails, walkways or main building support structures.

The mounting height to the centre-line of the instruments shall be approximately 1.4 metres from the floor, or permanent access platform.

Instruments shall be located where normal access is available but should not obstruct walkways or operating areas. High point vents and low point drains shall be within reach from normal access walkways or platforms.

Protective fixed barriers or shields shall be provided where instruments or impulse lines are located in a position where damage could occur.

Connecting lines between the instrument isolating valves or manifolds and the instrument or instrument rack shall be neatly arranged with sufficient flexibility to avoid undue stress on the instrument or pipework.

3.3.11 Manifolds

Manifolds shall be supported in such a manner that they remain in place when disconnected from the instrument, or impulse lines. The selected material for manifolds shall take cognisance of the following points:

- The impulse line material.
- The design parameters from the instrument suppliers.
- The process conditions.
- Process vessel / piping material.

3.3.12 Capillary tubes

If the capillary tubes are supplied sealed to the instrument by the manufacturer, they shall not be opened or cut. The Manufacturer's installation instructions shall be meticulously followed. Racks, supports and shields shall be provided to protect capillary tubes, which should be clamped to racks or supports at frequent intervals.

3.3.13 Supports, slides, anchors and clamps

Supports and racks shall be of adequate strength and spacing to bear the total mass of the piping. This shall include the process fluid, insulation and any barriers or protection. The design shall take account of environmental and operational factors to which the installation will be exposed.

Supports and racks for impulse lines and instruments shall be constructed and mounted in a manner that limits the transfer of vibrations. The supports and racks shall not be attached to process lines, vessels, equipment, handrails, walkways or main building support structures. The spacing between supports shall not exceed 1.5 metres.

Anchors shall be placed in each straight run of tubing that requires a support, as per the design. Connections to root valves, instrument isolating valves, manifolds and clamps are regarded as anchors. Connections to instruments are classified as termination points. Impulse lines shall be supported with

slides where axial movement along the line may occur due to temperature and vibration. Such slides shall allow adjacent impulse lines to move independently of each other.

Tube clips and clamps shall be rigid enough to secure, but not to damage the impulse lines. The material selected for supports and clamps shall be compatible with, and circumvent damage to impulse lines.

Special insulation may be required for impulse lines connected to certain services.

For multiple impulse lines, simple saddles consisting of a corrugated clamp bolted to a flat bar shall not be acceptable.

3.3.14 Syphon's and loops

Pressure instruments for steam or hot fluid service shall have a loop (pigtail) or other suitable isolator between the instrument and the source of pressure when mounted on process piping. This isolator protects the instrument from excessive temperature. Syphons shall not be used on differential pressure instruments.

3.3.15 Pre-commissioning cleaning

All lines shall be cleaned after installation, before testing or before being placed into service. Cleanliness of all impulse lines shall be consistent with the requirements of the main process. Cleanliness may be achieved by pneumatic blowdown with compressed air or inert gas, or by flushing with a liquid compatible with the process fluid and of sufficient purity to minimise corrosion of the impulse lines and fittings.

3.3.16 Coating of piping

Coating of impulse lines is not permitted.

3.4 QUALITY ASSURANCE

The quality of suppliers and components delivered to Eskom is of vital importance, seeing that the reliability of Eskom plant is of national importance to the economy. In this regard, Eskom has put a Supplier Quality Management Specification (240-105658000) [9] in place. All suppliers doing business with Eskom are required to comply with the requirements of this Specification.

3.4.1 Receipt of materials

Prior to material acceptance, a visual inspection shall be carried out. Each shipment shall be examined, as appropriate for:

- Compliance with the purchaser's specifications,
- Physical damage,
- Adequate storage protection,
- Conformance to dimensional and material property specifications,
- Proper identification and marking,
- Compliant documentation, such as material certification (mechanical testing and chemical composition).

Materials found deficient during this inspection shall be identified and segregated from acceptable materials. Rejected materials should be quarantined and returned to the vendor.

3.4.2 Handling

Handling of materials shall be controlled to prevent damage, and contamination with peripheral harmful matter or substances such as oil, grease or dirt. Tubing and fittings shall be carefully handled during receipt, storage and installation to prevent any scratching, gouging and nicking that may affect the integrity of the pipework.

Tubing should not be dragged across hard surfaces, sharp edges of steelwork, concrete and gravel.

3.4.3 Storage

Tubing, fittings, materials or assemblies shall be stored in a dry space and protected from contamination and physical damage. Containers or stacks shall be clearly marked with their contents, material designation and if applicable, plant identification codes.

3.4.4 Cleanliness

The interior of all tubing, valves and fittings shall be clean and free from foreign material. Tube ends, valves and fittings should be sealed at all times until positioned for installation. The cleanliness, appropriate to the process application of all impulse lines shall be proved prior to pressure testing or commissioning.

3.4.5 Pre-test inspection

Each installation shall be visually inspected prior to testing. This inspection shall ensure compliance with the installation details. All joints shall be left un-insulated and exposed for examination during pressure testing. The pre-test inspection shall verify that:

- Correct materials have been used.
- The specified installation details have been followed.
- Specified slopes have been maintained.
- Supports are adequate and vibration has been mitigated.
- Connections have been correctly made.
- Welded connections have been non-destructively inspected in accordance with the Standard for Non-Destructive Testing (NDT) on Eskom Plant [5]. The extent and nature of non-destructive testing shall be agreed upon between the Contractor, the EDWL, the IWE and the Approved Inspection Authority.
- Valves and instruments have been correctly labelled.
- High-point vents and low-point drains have been provided for, as required by the design.
- Documentation demonstrating compliance with this Standard has been provided.
- All quality control and non-destructive testing reports have been signed and accepted by the relevant approval authorities.

- All non-conformances have been identified, and concessions have been approved.

3.4.6 Pressure tests

Pressure tests shall be conducted to ensure the pressure integrity of the impulse lines.

When it is not practical to perform a pressure test, the Pipework Engineer on site may waiver this requirement provided the Pipework Engineer, in conjunction with the Approved Inspection Authority are satisfied that all of the points below are satisfied, as a minimum requirement:

- All design requirements have been achieved and the installation is as per the design.
- The correct materials and thicknesses were used for the pipework system.
- The correct welding procedures and consumables were used, and the welds were performed by a qualified welder.
- All non-destructive testing has been carried out to prove that there are no defects in the system. This includes surface and sub-surface defects.
- All data books are signed off by the Pipework Engineer and Approved Inspection Authority.
- The contents of the data books are in compliance with the standards governing the pipework system.

3.4.7 Pressure test boundaries

The impulse lines shall be pressure tested from the root valve to the instrument isolation valve or manifold.

3.4.8 Hydrostatic testing

The following shall be observed when planning a hydrostatic test programme:

- A calibrated test pressure gauge shall be visible at all times to the operator controlling the applied pressure. The gauge must have a valid calibration certificate, indicating that the gauge has been calibrated by a SANAS approved laboratory.
- For impulse lines, testing should be performed with demineralised water or the process liquid.

The applied test pressure shall be determined by the applicable design code or Act. The pressure shall be applied with water or process liquid at a temperature not less than 10ºC. As an example, when the pipework is designed to BS EN 13480-2 [14], Section B5.5 shall apply.

3.4.9 Pneumatic testing

Pneumatic testing may be deemed to be appropriate for some impulse lines. Commercial leak-testing fluids shall be used for leak-testing.

The test pressure applied shall be determined by the applicable design code or Act. This pressure shall be applied with non-flammable gas, and shall be held for 30 minutes.

Pneumatic testing shall only be used in exceptional cases, due to the risks associated with pneumatic testing. Pneumatic testing must comply with the requirements as stipulated in the OHS Act Pressure Equipment Regulation [11].

3.5 MATERIAL CERTIFICATION

3.5.1 Material of construction

All materials used in the manufacture of tubing and components shall be certified by the manufacturer. The manufacturer shall have a quality assurance programme for material control and verification. The certificate shall include the mechanical and chemical tests performed.

The quality management system shall comply with ISO 9001- Quality Management Systems requirements [1].

3.5.2 Certificates of compliance

All materials used under the ambit of this Standard for high pressure applications shall comply with the Eskom Standard 240-84513751 Material specifications and certification guideline [12].

3.5.3 Tube identification

Tubing shall be marked with the outer diameter (OD), alloy, wall thickness, code of manufacture and other information required. The marking of tubes shall be unambiguous. The marking method and materials applied shall not affect the integrity of the tube material.

3.5.4 Inspection and test plans

Inspection and test plans shall be developed that clearly stipulate the work to be performed in a logical order. This shall include all hold, witness, review and surveillance points required for inspection and verification. The inspection and test plans shall be submitted as part of the installation detail.

4. AUTHORISATION

This document has been seen and accepted by:

Name & Surname	Designation
Alton Naidoo	Middle Manager, Boiler Auxiliary
Yokesh Singh	General Manager
Morris Maroga	Corporate Specialist
Erick van Zyl	Corporate Specialist
Andrew Downes	Senior Consultant
Johan Geustyn	Senior Engineer
Lebo Serekwa	Senior Consultant
Bhavesh Naran	Chairman. Pressure Equipment Care Group
George Mthimkhulu	Senior Engineer
Balin Naicker	Middle Manager Engineering
Dr Robert Clark	Senior Consultant

5. REVISIONS

Date	Rev.	Compiler	Remarks
June 2014	0	RM Clark	Initial revision of document to comply with Eskom standards. First Draft
January 2015	0.1	RM Clark	Final Draft for comments and review process
October 2015	0.2	RM Clark	Updated Draft after Comments Process
October 2015	1	RM Clark	Final Document for Authorisation and Publication
November 2018	1.1	RM Clark	Waiver of pressure test included under item 3.4.6, final Draft after Review Process
December 2018	1.2	RM Clark	Final Draft ready for Publication
July 2019	1.3	RM Clark	Updated Final Draft to incorporate comments from M. Andre
July 2019	2	RM Clark	Final Rev 2 Document for Authorisation and Publication

6. DEVELOPMENT TEAM

The following people were involved in the development of this document:

- A Downes
- E van Zyl
- N Hallet
- M Laher
- A Naidoo
- J Geustyn
- H van Niekerk

7. ACKNOWLEDGEMENTS

- All members of the Boiler Care group.
- The valuable inputs from Boiler Pressure Parts CoE.
- The valuable inputs from Turbine CoE.
- The valuable inputs from C&I CoE.
- The valuable inputs from Marlize Andre.