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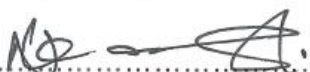
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Compiled by



Mlondi Nkambule

C&I Plant CoE

Senior Technologist

Date: **02/07/2018**

Approved by



Mapula Majola

C&I Plant CoE

Manager (Acting)

Date: **2018-07-06**

Authorised by



Prudence Madiba

E, C&I CoE

Senior Manager

Date: **2018-07-10**

Supported by SCOT SC



Dr. Craig Boesack

SCOT SC Chairperson

Date: **05/07/2018**

PCM Reference : **240-53458811**

SCOT Study Committee Number/Name : **C&I Plant CoE SC**

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## 1. INTRODUCTION

In process systems three of the most important process variables to measure are temperature, flow and pressure. The common pressures measured are the hydrostatic pressure of a liquid column and the atmospheric pressure. Most particularly in pneumatic, hydraulics measurement and control of the system, pressure is the most important prerequisite for safe and economic operation. All pressure meter technologies have recommended installation and engineering practices to ensure they meet their published specifications and for optimal performance, accuracy and repeatability. Pressure meter users are frequently challenged with wide variations in their actual field conditions and installation constraints that are much different from the ideal conditions under which their pressure meter was calibrated.

## 2. SUPPORTING CLAUSES

### 2.1 SCOPE

This document captures the installation, operation and maintenance of pressure measuring devices on equipment at Eskom's coal fired power stations. The document further covers the minimum requirements for the installation of all pressure transmitters and associated pressure devices. This document also presents the most common types of electronic pressure measuring instruments and gives an overview of their design in respect of a long service life. Subsequently, functional safety under environmental influences will be addressed and how it can be ensured through product testing. The document also elaborates on the application of electronic pressure measurement technology which can generally be assigned to one of three areas: to the monitoring of critical system pressure, to the control of pressure or to the indirect measurement of process values.

#### 2.1.1 Purpose

The purpose of this document is to provide the user with a comprehensive overview of the system components, installation requirements, operation, maintenance requirements and standard application capability of the pressure measurement equipment at Eskom's coal fired power stations.

To detail Eskom's requirements and apply a standard for indoor and outdoor pressure transducer installations for power stations. This document also gives guidance to the use of the different instrument types such as pressure transmitters, pressure switches and process pressure transmitters. Basically, these electronic pressure measuring instruments consist of a pressure connection, a pressure sensor, electronics, an electrical connection and in addition to those mentioned above, there are also simpler instrument types known as pressure sensor modules; often consisting of no more than a pressure sensor and simple mechanical and electrical interfaces. These types are particularly suitable for complete integration into users' systems.

#### 2.1.2 Applicability

This document shall apply throughout Eskom Holdings Limited Divisions. The document is applicable to all Eskom power stations equipped and that used uses pressure measuring devices to measure pressure.

### 2.2 NORMATIVE/INFORMATIVE REFERENCES

Where specific references are made to specifications this shall imply the latest revision of that specification and also 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.

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- [2] Process Measurement Instrumentation, American Petroleum Institute Recommended Practice 551, 1993.
- [3] [240-89147446](#) Instrument Piping for Fossil and Hydro Power Plants
- [4] [240-56355754](#) Field Instrument Installation Standard
- [5] [240-56355815](#) Junction Boxes and Cable Termination Installation Standard
- [6] [240-56355535](#) Process Calibration Equipment Standard

### 2.2.2 Informative

None

## 2.3 DEFINITIONS

Definition	Description
Acceptability Criteria	The characteristics of the system that shall allow evaluation for acceptance of that system.
Accuracy of measurement	Closeness of the agreement between the result of a measurement and a true value of the pressure. Note: accuracy is a qualitative concept.
Calibration	a set of operations that establish, under specified conditions, the relationship between the values of quantities indicated by a measuring instrument or measuring system
Controlled Disclosure	Controlled disclosure to external parties (either enforced by law, or discretionary)
Differential	The value of the difference between two pressures.
Employer	Persons that authorize modifications to the existing wiring system or persons that authorize the installation of new wiring systems.
Gauge	The value of a pressure measured with respect to atmospheric pressure
Hysteresis	Property of a measuring instrument whereby its response to a given stimulus depends of the sequence of preceding stimuli, eg dependence of reading on whether pressure is rising or falling.
ISO	International Organisation for Standardisation.
Sensor	Element of a measuring instrument or measuring chain that is directly or indirectly affected by the measured.
Termination	In electrical wiring termination is the process of connecting one cable to another at the point at which it ends.
The Installation Contractor	Responsible for the termination of all C&I cabling and associated equipment and for the development of the Termination Schedules.
Transducer	Device that provides an output quantity having a determined relationship to the pressure. <i>Commonly used in pressure measurement to refer to pressure transducers with voltage outputs.</i>

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### 2.3.1 Disclosure Classification

**Controlled Disclosure:** Controlled Disclosure to external parties (either enforced by law, or discretionary).

## 2.4 ABBREVIATIONS

Abbreviation	Description
BSP	British Standard Pipe
C&I	Control And Instrumentation
EMC	Electromagnetic Compatibility
FMEA	Failure Mode and Effects Analysis
GT	Group Technology
HART	Highway Addressable Remote Transducer
I/O	Input / Output
IP	Ingress Protection
mA	Milliamp
MTTF	Mean Time To Failure
SI	Système Internationale
SIL	Safety Integrity Level
V	Volt

## 2.5 ROLES AND RESPONSIBILITIES

### 2.5.1 Installation Contractor

The installation contractor is responsible for the termination of all C&I cabling and associated equipment and for the development of the Termination Schedules and associated documentation, which shall be signed off together with the employer.

Only once the appropriate acceptance documentation has been signed off can the system be commissioned.

### 2.5.2 Employer

The employer is responsible for the evaluation and acceptance of the cable termination and associated documentation and together with the installation contractor shall signoff the appropriate documents.

### 2.5.3 Operation

Operation is being responsible for the monitoring and responds to malfunctioning pressure devices. They are also responsible for the initial response to alarms and routine system operational.

### 2.5.4 Maintenance

Maintenance is responsible for the on-load system verification and off-loads system calibration including inspections and system diagnostics.

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### **2.5.5 C&I Engineering**

C&I Engineering is responsible for the life cycle management of the system, regular audits, response procedures and the maintenance base of the system.

### **2.5.6 Boiler Engineering**

Boiler Engineering is responsible for defining the measurement requirements (sensor positions) and to do final confirmation for device functioning.

## **2.6 PROCESS FOR MONITORING**

This document will be reviewed as per the next review date or earlier if warranted.

## **2.7 RELATED/SUPPORTING DOCUMENTS**

None

# **3. PRESSURE MEASUREMENT SYSTEM INSTALLATION STANDARD**

## **3.1 INSTALLATION REQUIREMENTS**

### **3.1.1 General**

During the installation and commissioning phase, all manufacturers' specifications should be adhered to for providing power or other utility sources and for installing, connecting, programming, operating and maintaining the devices. All aspects of the installation, design and operation should be carefully and accurately documented and completed by competent personnel.

All pressure installations shall have isolation valves. All instruments, gauges and switches shall be bottom-entry. A gauge or switch may be supported by its piping, unless vibration is present where remote support shall be done. All transmitters shall have independent support.

Siphons or 'pigtailed' shall be used for steam and other hot condensable vapours when the pressure gauge is mounted above the process connection allowing condensate drainage to the process.

### **3.1.2 Installation Location**

The pressure meter installation shall be aesthetically pleasing and conform to the best practices.

The mounting location of pressure meters and installation thereof shall comply with Field Instrument Installation Standard: 240-56355754, and to this specification.

The location and configuration of the pressure meter installation shall take into consideration environmental aspect such as temperature, vibration, magnetic fields, hazardous zoning classification, or any other special requirements.

The mounting location and positioning for the transmitter shall take into consideration sufficient space for secure mounting, full opening of the transmitter covers, and the local indicator should be visible and legible to the observer from permanent walkways. The transmitter should be mounted in a manner that prevents moisture from collecting in the transmitter.

The pressure meter should be located in a location accessible from a permanent walkway for ease of cleaning and servicing, but shall take into consideration maintenance activities and particular the removal of large objects of plant in the area.

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### **3.1.3 Labelling**

- All labelling shall be on permanent structures that remain when the instrument is replaced according to the site specific labelling standard.
- Labelling must not be affected by maintenance activities and should facilitate the ease of maintenance.

### **3.1.4 Material**

Eskom Power Stations shall use stainless steel wherever possible, minimum grade being 3CR12 powder coated for enclosures e.g. Junction box and 304 for associated field instruments e.g. Manifolds.

### **3.1.5 Impulse Piping**

Impulse piping shall be short as possible. Refer to relevant standard on impulse piping [2]. Unless otherwise required for specific meters, a general straight-run pipe allowance of 10 pipe diameters upstream and 10 pipe diameters downstream shall be made. In this portion of the pipe, no pipe beds, branches, valves, or pipe size changes are allowed.

If this is unattainable, pressure straighteners must be installed at least 5 Pipe diameters upstream of the meter. If this cannot be done, a pipe modification must be made to accommodate the meter.

### **3.1.6 Cleaning**

All piping must be deburred after cutting and purged of cuttings and other foreign material. This includes impulse piping, process taps and flanges.

### **3.1.7 Sealing**

When viscous liquids or pressures of corrosive fluids are measured, or when plugging is possible, an instrument shall be sealed or protected by a diaphragm seal or protector. Diaphragm seals with capillary leads shall be used when required. Care should be taken to isolate the capillary from any heat source such as process piping. Pressure differential sensing instruments shall use a pair of capillary leads that are of equal length and follow the same path to minimise error. Leads should also be kept short as possible.

### **3.1.8 Pulsating**

Instruments that measure the pulsating pressures of reciprocating pumps and compressors should be equipped with pulsating dampers to prevent failure of the pressure elements. Indication gauges filled with liquid shall be used for local indication.

### **3.1.9 Vibration**

If any part of the pressure system or equipment is subject to vibration, the instrument shall be mounted on a vibration-free remote support. Coiled tubing or capillary system should be provided between the pressure source and instrument.

### **3.1.10 SIL Rating**

All transmitters shall be certified for installation in a SIL1 / SIL2 system, unless otherwise specified.

### **3.1.11 Measurement**

The standard transmission shall be 2-wire HART enabled 4 – 20 mA signal.

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### **3.1.12 Connection Types**

Pressure transmitters shall have 1/2 inch BSP parallel thread connections with suitable breakable seals. The pressure connection, also frequently referred to as the process connection, is used to channel the pressure medium to the sensor. Almost all pressure connections have a standard thread and can therefore be screwed in at the measuring point without problems. Leading manufacturers often provide a multitude of different pressure connections for their pressure measuring instruments in order to meet the various requirements of the widest range of industries and applications, as well as regional and national standards.

### **3.1.13 Ingress Protection**

All transmitters inside/outside a power station shall use an IP 67 rating. The electronic components and electrical connections must be protected against the ingress of any foreign objects or water in order to ensure they continue to operate. The IP ratings defined in the DIN EN 60529 standard specify what level of protection is provided by an electrical or electronic instrument at room temperature against contact with and intrusion of foreign objects (first digit) as well as against ingress of water (second digit). A higher IP rating does not automatically imply an improvement in protection. For example, IP67 (total dust ingress protection, protection against temporary immersion) does not necessarily cover IP65 (total dust ingress protection, spray water protected), since the load due to spray water can be significantly higher than the load during temporary immersion. For the IP68 rating (total dust ingress protection, protection against permanent submersion).

### **3.1.14 Hazardous Locations**

All hazardous locations installations shall be issued with Certificate of Compliance by a person registered as a Master Installation Electrician in terms of regulation 11(2) of Electrical Installation Regulations in OHS Act.

Any additional requirements for equipment in hazardous area systems shall take precedence over this specification and be in accordance with the zone classification but should be indicated so in the deviation list of this specification.

### **3.1.15 Signal Measurement**

The standard transmission shall be 2-wire HART enabled 4 – 20 mA signal.

## **3.2 DOCUMENTATION OF INSTALLATION**

Environmental information critical to meter maintenance and calibration will be captured during installation, documented, and handed over to the client. This critical information includes details such as

- Pipe inner diameter
- Pipe wall thickness
- Pipe material
- Coating type and thickness

## **3.3 MEASUREMENT AND VERIFICATION**

### **3.3.1 Pre-Installation Verification**

Pressure measurement devices should be shipped to the user after having undergone factory acceptance testing by qualified personnel. The shipment should include documented certification reports and operation and maintenance manuals.

All information provided with the pressure measurement equipment should be kept and filed, and form part of the documentation of a quality management and preventive maintenance program.

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### 3.3.2 Post Installation Verification

The manufacturer's recommended installation practices shall be used as the measure for the pressure meter installation acceptance. Any deviations from the manufacturer's recommended installation practices shall be listed in the Deviation List.

In the event of the manufacturer's installation practices being contrary to this specification, the manufacturer's specification shall take precedence but be indicated as such in the Deviation List.

All pressure measurement systems should be calibrated in situ as part of the commissioning phase.

In situ calibrations are necessary to establish and confirm conformance with the specified requirements for pressure measurement accuracy. The Pressure Meter Installation Checklist shall be used to determine acceptability of the pressure meter installation.

## 4. AUTHORISATION

This document has been seen and accepted by:

Name & Surname	Designation
Johan Geustyn	C&I Plant CoE Senior Technician
Silibaziso Gwafa	C&I Design Application CoE Senior Technologist
Khaya Sobuwa	C&I PEI
Xolelwa Sibozza	C&I Design Application CoE Manager
Mapula Majola	C&I Plant CoE Manager (Acting)
Paul du Plessis	C&I PEI
Eugene Motsoatsoe	C&I Design Application CoE Manager
Nomatshawe Gantsho	C&I Design Application CoE Manager
Thokozani Msibi	C&I Design Application CoE Manager (Acting)
Prudence Madiba	E,C&I CoE Senior Manager

## 5. REVISIONS

Date	Rev.	Compiler	Remarks
May 2008	0	C&I Engineer	Original document, FHS 6.
January 2013	0.1	E. Motsoatsoe	EED_GTD_C&I_002
October 2013	1	E. Motsoatsoe	Final document Authorised for Publication
October 2017	1.4	M. Nkambule	Final Document for Comments Review
November 2017	1.8	M. Nkambule	Final Draft for SCOT Comments Review
January 2018	1.9	M. Nkambule	Final Updated Draft after SCOT Review Process
June 2018	2	M. Nkambule	Final Rev 2 Document for Authorisation and Publication

## 6. DEVELOPMENT TEAM

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

- C&I Field Devices & Loop Design Care Group (SC08-03-C-05)

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## **7. ACKNOWLEDGEMENTS**

- C&I Field Devices & Loop Design Care Group (SC08-03-C-05)

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**APPENDIX A: PRESSURE INSTALLATION ACCEPTANCE CERTIFICATE**

ACCEPTED

☐

NOT ACCEPTED

☐

Customer			
Project		Project No	
Plant/Unit			
		Finished on	

**PERSON IN CHARGE**

Customer		Dep.	
Vendor		Dep.	

<b>Special Requirements:</b>			
Defect Items were Found	Yes / No		
Recheck necessary		Not necessary	
<b>List Defects:</b>			

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