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CONTENTS

Page

EXECUTIVE SUMMARY 4

1. INTRODUCTION 5

2. SUPPORTING CLAUSES 5

2.1 SCOPE 5
2.1.1 Purpose 5
2.1.2 Applicability 5
2.2 NORMATIVE/INFORMATIVE REFERENCES 6
2.2.1 Normative 6
2.2.2 Informative 6
2.3 DEFINITIONS 7
2.3.1 Disclosure Classification 8
2.4 ABBREVIATIONS 8
2.5 ROLES AND RESPONSIBILITIES 9
2.6 PROCESS FOR MONITORING 9
2.7 RELATED/SUPPORTING DOCUMENTS 9

3. HIGH ENERGY PIPEWORK FOR ESKOM POWER PLANTS STANDARD 9

3.1 BASIC 9
3.2 OCCUPATIONAL, HEALTH AND SAFETY ACT (OHS ACT) 9
3.3 DESIGN 9
3.3.1 General 9
3.3.2 Design Pressures 11
3.3.3 Design Temperatures 12
3.3.4 Fluid Velocities 12
3.3.5 Pressure Drops 13
3.3.6 Stresses and Loadings 13
3.3.7 Station Axes 13
3.4 CODE OF CONSTRUCTION 13
3.5 MATERIALS 14
3.5.1 Piping 14
3.5.2 Flanges 14
3.6 WELDING 14
3.7 SUPPORTING SYSTEMS AND SUPPORTS 14
3.8 THERMAL INSULATION 14
3.9 TEMPERATURE RAMP RATES 15
3.10 WARMING OF SYSTEMS 15
3.10.1 General 15
3.10.2 Main steam warming 15
3.10.3 Warming up using drains 15
3.10.4 Warming of pipes in intermittent use 15
3.10.5 Refluxing 16
3.10.6 HP Bypass Spray Water 16
3.11 DRAINS AND DRAINAGE 16
3.11.1 Steam drains capacity 16
3.11.2 Cold reheat drains 16
3.11.3 Drainage of other systems 17
3.11.4 Pressure and Temperature ratings of drain pipes 17
3.11.5 Avoidance of water pockets 17
3.11.6 Steam traps 17
3.12 FLASHING TWO-PHASE FLOW 18
3.13 COLD PULL (COLD SPRING) 18
3.14 INSTRUMENT CONNECTIONS 18

3.15 PIPE BENDS 19
3.16 TRANSITONS 19
3.17 FORMPIECES 20
3.18 STUBS 20
3.19 RADIOGRAPH PLUGS 20
3.20 ERECTION PROCEDURES 21
3.21 KKS/AKZ CODIFICATION 21
3.22 NAME PLATES AND INDICATOR PLATES 21
3.23 ACCESS 21
3.24 DRAWING AND DESIGN PACKAGES 21
3.25 QUALITY REQUIREMENTS 22
3.25.1 Inspection authority 22
3.25.2 Contractor's quality assurance and quality control 22
3.26 DOCUMENTATION 22
3.26.1 General 22
3.26.2 Data Pack/Book 22
3.26.3 Operation and Maintenance Manuals (OEM) 23

4. AUTHORISATION 23

5. REVISIONS 23

6. DEVELOPMENT TEAM 24

7. ACKNOWLEDGEMENTS 24

APPENDIX A : BALANCED ERECTION PROCEDURE 25

APPENDIX B : VALVES 28

General 28
Drain and Vent Valves 28
Valve Bypasses 28
High Pressure Bypass Valves 28
Main Steam Warming Valves 28
Non-return Valves 28
Isolators and stop valves 29
Attemperator spray water isolation 29
Feed water valves 29

APPENDIX C : DRAWINGS 30

TABLES

Table 1: System Breakdown 5
Table 2: Design and upset conditions 12

EXECUTIVE SUMMARY

The standard has been prepared by Eskom to ensure the safety and integrity of High Energy Pipework and Pressure Parts Sections, excluding nuclear plants and internal boiler tubing, for all Eskom Power Plants.

High Energy Piping regime is defined as pipes and components in such systems for the conveyance of steam, water or water/steam mixture whose **design pressure equals or exceeds 4.0 MPa or whose design temperature equals or exceeds 250 °C.** The systems that form part of the standard are the Boiler and Turbine systems as listed under Section 2 (Table 1).

It lays down Eskom's requirements for the design, manufacture, fabrication, erection and testing, inspection, quality assurance and quality control of high energy pipework as defined herein.

The issue of this standard had become necessary because of differing requirements of the approved codes of construction, which frequently omit any reference to features essential for a successful design. It is the intent of this standard to harmonise those features, so that the quality of the pipework provided will be of a uniformly high order, regardless of the origin of the code of construction used.

This document therefore, lays down both the general principles to be followed, together with the more detailed features of design which should be investigated and be incorporated. Aspects of inspection, quality control and documentation are also included.

The enquiry document will lay down specific requirements for a particular power plant, and these are to be acted upon in conjunction with the requirements of this standard.

The safety of the pipework is subject to provisions in the Occupational Health and Safety Act and its Regulations, such as the appointment of an accredited Approved Inspection Authority to verify compliance with these requirements.

1. INTRODUCTION

Eskom recognises that national codes and standards, to which plant and equipment supplied to Eskom must conform, can specify only minimum requirements, and they do not cover fully, and in some cases omit totally, requirements which are essential for the successful long-term operation and maintenance of high energy pipework.

The high energy pipework covered by this standard operates under arduous conditions; hence the Eskom requirements are stringent and mandatory.

These requirements are generally additional to those contained in the contractually agreed code, but are deemed to be included within the contract unless agreed in writing that they may be excluded.

2. SUPPORTING CLAUSES

2.1 SCOPE

1. This standard specifies Eskom's requirements for all high energy and high temperature pipework for Eskom Power Plants.
2. The requirements of this standard are complementary to those laid down in national codes and standards. Where these requirements are more stringent than the code, this standard will apply.
3. This standard specifies pipework that complies with an operating condition whose design pressure and temperature is equal or exceeds 4.0MPa or 250°C and of the systems specified in Table 1.
4. This standard applies to new construction (design and implementation) and system replacements. It is not applicable to maintenance of the pipework.
5. These standard requirements are mandatory for application.

2.1.1 Purpose

Because of the high pressures and temperatures to which Eskom's defined high energy pipework is exposed, it is essential that the design and the quality of the materials used, the care with which fabrication, welding, non-destructive examination, erection and commissioning are carried out, must be of a high order.

2.1.2 Applicability

This document shall apply throughout Eskom Power Plants, excluding nuclear plants and internal boiler tubing.

The document is applicable for the following plant areas/systems of the Boiler and Turbine plant:

Table 1: System Breakdown

Boiler	Turbine
Auxiliary Steam	LP Bypass Valves
Attemperation system	Gland Steam
Cold Reheat	Air ejectors
Feedwater (from Feedwater pump outlet to Economizer inlet) – excluding valves	Turbine casing warming
HP Bypass	Condensate system
Hot Reheat and Bypass systems	Distillate system
Integral pipework	Turbine Loop Pipes

Main steam	Bled Steam
Sootblower Piping	All associated drain lines of the above
Spray water	
All associated drain lines of the above	

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] OHS Act - Occupational Health and Safety Act and Regulations (Act No.85 of 1993)

[3] SANS 347 – Categorization and Conformity Assessment criteria for all Pressure Equipment

[4] ASME TDP-1 - Recommended Practices for the Prevention of Water Damage to Steam Turbines Used for Electric Power Generation

[5] BS EN 13480 - Metallic Industrial Piping

[6] BS EN 10204 - Metallic Products- Types of inspection documents

[7] BS EN 10216 - Seamless steel tubes for pressure purposes

[8] BS EN 12952 - Water-tube Boilers and Auxiliary Installations

[9] ASME B31.1 - American Standard Code for Pressure Piping in Power Generation

[10] VGB-R 513 e – Internal Cleaning of Water-Tube Steam Generating Plants and Associated Pipework

[11] 240 56239133 – High Pressure Pipework Supports Standard

[12] 240-89147446 - Instrument Piping for Fossil and Hydro Power Stations

[13] 240-47560170 Process Control Manual (PCM) for Quality Management

[14] 240-55864822 - Steam and Water Sampling Guideline

[15] 240-56241933 - Control of Plant Construction Repair and Maintenance Welding Activities Standard

[16] 240-56246601 - Personnel and Entities Performing Welding Related Special Processes on Eskom Plant

[17] 240-56247788 - Weld Defect Classification and Reporting Standard

[18] 240-56355225 - Welding of High Pressure Temperature Tube and Pipework Standard

[19] 240-56247004 - Thermal Insulation Standard

[20] 240-84513751 - Material Specification and Certification Guideline

2.2.2 Informative

[21] BS EN 13445 - Unfired Pressure Vessels

[22] SANS 10227 – Criteria for the Operation of Inspection Authorities Performing Inspections in terms of the Pressure Equipment Regulation

[23] SANS 17020 – General Criteria for the Operation of Various Types of Bodies Performing Inspection

[24] 32-632 - Non-Destructive Testing Inspection Qualification

[25] 240-88300199 – Creep Remaining Life Monitoring Standard

[26] 474-303 - Life Cycle Maintenance of High Pressure and/or High Temperature Systems

[27] 474-9509 - Generation Plant Engineering Life Cycle Planning Strategy – High Pressure Piping

[28] 240-87099069 - Implementation and Calculation of the Thermal Index for Coal Fired Power Plants Standard

[29] 240-83539994 - Eskom NDT Personnel Approval for quality related special processes on Eskom Plant standard

[30] 240-83540088 – Requirement for Non-Destructive Testing (NDT) on Eskom Plant Standard

[31] 240-53113333 - Eskom Plant Codification Standard

[32] N.PSZ 45-45 - KKS Numbering System

2.3 DEFINITIONS

Definition	Description
Approved by	The accountability of the Approver of the document is equivalent to the specified role of Functional Responsible/Owner as identified in 240-53114186 and 32-6 for Documents and Records Management.
Approved Inspection Authority	An approved inspection authority approved by the Chief Inspector and is appointed to carry out the duties laid down in the code of construction, the OHS Act and its regulations, and be approved by SANAS.
Code	A collection of compatible rules, regulations and standards prepared by a standards authority, also referred to as a code of construction or a code of practice.
Cold pull	The process, also known as "cold spring", is a means of pre-stressing the system to reduce the development of secondary stresses and the forces and moments at the terminations when first put into service.
Cold start	See point 3.3.1 b)
Contract terminal point	That point at which the responsibility for the supply, erection and testing of material passes from one contractor to another.
Enquiry document	The invitation to submit a tender, issued by Eskom to selected contractors or companies. The document will make reference to this standard and lay down additional requirements specific to the plant.
High energy pipework	Pipes and fittings in such systems for the conveyance of steam, water, gases or other fluids whose design pressure equals or exceeds 4.0 MPa or whose design temperature equals or exceeds 250 °C.
Hot start	See point 3.3.1 b)
Islanding	The situation where power being exported from a station is suddenly cut off, at, or beyond, the high voltage yard, leaving the units still running but supplying only their own house load.
Pipework	The term "pipework" used herein includes pipes both straight and

Definition	Description
	bends, branches, stubs, orifice carriers, attemperators, flanges, gaskets and bolting and the pressure-bearing parts of forged or cast construction for valves or fittings, including bodies, covers and bolting.
Pipework of hazardous fluids	Pipework containing flammable or hazardous fluids, or pipework operating under arduous conditions, and definitions of dangerous media as defined in SANS 347 Fluid group 1
Regulation	The regulations forming part of the OHS Act.
Standard	The detailed requirements laid down for the supply of materials, the design of plant or equipment, the testing of materials, plant and equipment, etc. with which compliance is mandatory.
Termination	Will be defined in the works information document.
Warm start	See point 3.3.1 b)

2.3.1 Disclosure Classification

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

2.4 ABBREVIATIONS

Abbreviation	Description
ASME	American Society of Mechanical Engineers
BS	British standard prepared by the British Standards Institution
BS EN	British Standard European Norm
CoC	Certificate of Conformity
DIN	Deutsches Institut fur Normung (German Engineering Standards)
DN	The nominal internal diameter, in millimetres
ESV	Emergency Stop Valve
IP	Intellectual Property
ISO	International Organization for Standardization
K	Kelvin
KKS	Kraftwerk Kennzeichen System (power plant classification system).
MCR	Maximum continuous rating of the boiler/turbine unit
NDE	Non-Destructive Examination
NDT	Non-Destructive Testing
OEM	Original Equipment Manufacturer
OHS Act	Occupational Health and Safety Act
PER	Pressure Equipment Regulation
SANAS	South African National Accreditation System
SANS	South African National Standards
TUV	Technische Uberwachungs-Verein (The German association of technical

Abbreviation	Description
	inspectors)
VGB	Technische Vereinigung der Grosskraftwerksbetreiber (technical association of large power stations users)

2.5 ROLES AND RESPONSIBILITIES

Refer to the Design Review Procedure (240-53113685).

2.6 PROCESS FOR MONITORING

The relevant Engineering Manager is to ensure compliance of this standard.

2.7 RELATED/SUPPORTING DOCUMENTS

1. 240-88300199 – Creep Remaining Life Monitoring Standard
2. 474-303 - Life Cycle Maintenance of High Pressure and/or High Temperature Systems

3. HIGH ENERGY PIPEWORK FOR ESKOM POWER PLANTS STANDARD

3.1 BASIC

a) All the pipework and relevant components supplied in one contract and complying with this standard shall be designed, manufactured, fabricated, erected and tested to comply with the contractually defined latest edition of a single national or international code and its associated codes, and to the requirements as stipulated in SANS 347.

b) The requirements of this standard are mandatory. Departures from this standard may only be made with the prior written approval of Eskom.

3.2 OCCUPATIONAL, HEALTH AND SAFETY ACT (OHS ACT)

a) Full compliance with this Act is mandatory. Apart from the need to comply with a technical code of construction, all equipment supplied under this standard shall satisfy the requirements of the OHS Act and its Regulations. Any information required by the Inspector for Occupational Health Safety of the Department of Labour shall be supplied by the contractor on request.

3.3 DESIGN

3.3.1 General

Apart from mandatory compliance with the design code, the piping systems conforming to this standard shall incorporate the following features:

a) A minimum design life, for new systems, of 200 000 hours at design conditions of pressure and temperature, for piping whose design stresses are time-dependant.

b) The following is defined as Hot, Warm and Cold starts:

Type of start	Shut down duration - hours
Cold	>36
Warm	>8 <36
Hot	<8

c) A design capable of withstanding the following minimum number of starts and stops; these requirements are applicable for new plants only.

i. 300 cold starts

ii. 1050 warm starts

iii. 4000 hot starts

d) The contractor shall demonstrate with a fatigue analysis that the pipework can withstand the above number of starts and trips. Dynamic analysis shall also be performed to evaluate effects like steam and water hammer and rapid valve operation. Any restraints, dampers, etc. required to satisfy those conditions shall be included. The design shall minimise stress-intensified areas such as abrupt changes of thicknesses. The ten highest stressed components in each piping system shall be identified in the executive summary of the stress analysis report. This is applicable to the following systems; Main Steam, Hot Reheat, Cold Reheat and Feedwater.

e) A design incorporating a vertical stop in each of the major steam systems at about the level of the turbine shaft in order to stabilize the system.

f) The provision of bypass systems.

f) Provision for warming the major steam systems at a rate that will not compromise the boiler and turbine start up times.

g) Provision for maintaining in the hot condition, sections of steam piping which are in intermittent use, e.g. piping to and from bypass valves, at not less than 50°C below the main connected system temperature and at least 20°C above saturation temperature, and at loads of 40 % MCR and greater.

h) An efficient heat insulation system provided with easily removable sections of lagging to give access to areas of the pipes, components and butt welds for life cycle management. Refer to the Eskom standard 240-56247004 - Thermal Insulation Standard.

i) Balanced erection, including the installation of cold pull, during construction to an agreed procedure. Refer to Annex B for details of the generic erection procedure.

j) A design able to accept deterioration in the load-supporting capability and hysteresis of the constant load and variable spring hangers of at least ± 10 %, without exceeding code-allowable stresses in the pipe systems and allowable terminal point loadings, or reducing the drainage slope below the specified minimum.

k) Access platforms to all constant load hangers and variable spring hangers for checking of their position and condition, and to permit adjustment.

l) The design, supply, erection, operation and dismantling from each unit in turn, of temporary piping, components and valves for chemical cleaning, flushing and steam blowing, provided in order to ensure the internal cleanliness of the boiler and HP piping. The scope of this standard includes 100 % NDE, including volumetric and surface testing, as defined in the scope of work of welds and bends of the temporary piping and refurbishing of any valves, after use and before re-erection on another unit.

m) Provision of all isolating valves, drain valves, control valves and actuators forming part of the scope of supply for HP pipework, together with dummy trim and spindles for use during flushing, chemical cleaning and steam blow-through operations, hydrostatic testing (should an agreement be reached between Eskom and the AIA this test could be dispositioned) and spares adequate for their refurbishment to “as new” condition by the HP pipework contractor before take-over by Eskom.

3.3.2 Design Pressures

a) The design pressure of the main steam pipework shall be the highest set-point of the superheater safety valves for a drum boiler, or the safety functions of set-point of the HP bypass valves (including pressure loses between the superheater outlet headers and HP bypass valves) for a once-through boiler.

b) The design pressure for the hot reheat pipework shall be the highest set-point pressure of the hot reheat safety valves (including pressure losses between reheater outlet headers and safety valves).

c) The design pressure for the cold reheat piping shall be that of the highest hot reheat safety valve set-point, plus the maximum pressure drop through the reheater under conditions of boiler MCR flow through the HP bypass valves, plus the necessary spray water, plus the pressure drop in the piping between cold reheater non-return valves and the cold reheat inlet headers at turbine MCR conditions.

d) The design pressure of feed water piping between the feed pumps and the last possible point of isolation before the economiser must be as follows:

   i. If a fixed speed feedwater pump is installed, the shut off head of the pump, with cold water (20°C) discharging against a closed valve.

   ii. If a variable speed feedwater pump is installed, the highest discharge pressure of the pump at over-speed conditions.

e) The design pressure of the feedwater system after the last point of isolation as mentioned above shall be the set-point of the protection of the boiler, plus the friction and hydrostatic heads where applicable.

f) The design pressure shall not be lower than the set-point pressure of any relief valve, plus friction and hydrostatic heads where applicable.

3.3.3 Design Temperatures

a) The design temperature for the main steam and hot reheat pipework shall be the boiler steam outlet design temperature plus 5°C.

b) The cold reheat system shall be designed for the following conditions:

  i. 30 °C above the highest expected HP turbine exhaust temperature during all modes of continuous turbine operation,

  ii. 5°C above the highest expected HP turbine exhaust temperature during transient conditions such as house load, idle mode or turbine trip from only operating condition. This transient design conditions shall be calculated for 10 000 hours

  iii. The highest expected temperature resulting from failure of the HP bypass spray water system at the minimum boiler operating pressure conditions. This design condition will be calculated for 10 000 hours.

c) The design temperature of the feed system shall be 10°C above the maximum HP heater outlet temperature.

3.3.4 Fluid Velocities

a) Pipe sizes shall be selected so that the following maximum permitted velocities are not exceeded at design, or maximum upset conditions. Refer to Table 2 for maximum design and maximum upset condition values.

Table 2: Design and upset conditions

System	Design Condition (Maximum)	Upset Condition (Maximum)
Main Steam	60 m/s	100 m/s
Cold Reheat	35 m/s	60 m/s
Hot Reheat	55 m/s	100 m/s
Auxiliary Steam ≤ 1,2 MPa	30 m/s	30 m/s
Auxiliary Steam >1,2 MPa, but <5,0 MPa	35 m/s	35 m/s
Feed Water	5 m/s	6 m/s

3.3.5 Pressure Drops

a) The contractual inlet pressure at the HP ESV and IP ESV shall conform to the turbine contractor requirements.

b) The pressure drop in the auxiliary steam range and piping shall not drop below the operating pressure when passing between three adjacent units.

3.3.6 Stresses and Loadings

a) The stresses on the high energy pipework shall be designed on the basis of the following:

  i. The calculated primary stresses due to internal pressure, mass, support reaction loading, cold pull, etc., where applicable are within those allowed under the agreed code of construction for the specified life,

  ii. The calculated secondary stresses due to restrained thermal expansion shall be within the allowable stress range as defined by the agreed code of construction for the specified life,

  iii. The analysis methodology for any dynamic event shall be in compliance with the agreed code of construction,

  iv. The stress intensifications due to changes of shape, geometry, material and/or positions of weldments shall be minimized by the use of transition pieces,

  v. Occasional stresses (rapid valve operation, seismic, wind loading, etc.).

b) The Terminal point loading of the high energy pipework shall be designed on the basis of the following:

  i. The calculated forces and moments acting on the terminal points shall be in compliance to the connecting equipment's OEM requirements.

3.3.7 Station Axes

a) The piping systems shall use the boiler island axes. These axes are defined as follows and this concept shall be used in all drawings and documentations, and in identifying the directions of displacements, forces and moments, etc.:

  i. "X" axis - the centre line of the turbine shaft, the positive direction being from the last unit towards unit 1, the zero position being at the intersection with the "Y" axis ,

  ii. "Y" axis - the boiler centre line, the positive direction being from the turbine towards the boiler, the zero position being at the intersection with the "X" axis , and

  iii. "Z" axis - the vertical axis, the positive direction being upwards measured from the station zero level.

Note: Moments are positive when they act clockwise, when looking in the positive direction of an axis.

3.4 CODE OF CONSTRUCTION

a) The following is applicable to systems as defined in Table 1:

  i. The code of construction to be used for the design, procurement, manufacture, and fabrication, erection, materials specifications, commissioning and testing of the piping system and all relevant components shall follow a uniform suite of codes.

  ii. Eskom preference is to follow European Standards (EN).

iii. Materials from other suite of codes that are permitted under the code of construction, is subject to ***prior approval*** from Eskom.

3.5 MATERIALS

All materials shall comply with the relevant code and the Eskom Standard, 240-84513751 - Material Specification and Certification Guideline.

3.5.1 Piping

a) All pipes and bends shall be seamless, hot finished shall be cylindrical and of uniform bore and thickness within the tolerances given by the relevant code. The finishing of the bend will depend on the application and dimensions.

b) After any fabrication procedure such as bending, or welding, requiring the application of heat, the pipes or component shall be heat treated to the standard required by the code of construction.

3.5.2 Flanges

a) In the unlikely event that flanges are the only engineering solution the necessary engineering justification shall be provided for review and acceptance by Eskom. This is applicable to Boiler systems as defined in Table 1.

3.6 WELDING

a) For all welding requirements of the following Eskom standards shall apply:

   i. 240-56355225 - Welding of High Pressure Temperature Tube and Pipework Standard,

   ii. 240-56241933 - Control of Plant Construction Repair and Maintenance Welding Activities Standard

   iii. 240-56246601 - Personnel and Entities Performing Welding Related Special Processes on Eskom Plant

   iv. 240-77196678 - Heat Treatment of Welded Components

   v. 240-83539994 - Eskom NDT Personnel Approval (NPA) for Quality Related Special Processes on Eskom Plant Standard

   vi. 240-83540088 - Requirements for Non-Destructive Testing (NDT) on Eskom Plant Standard

3.7 SUPPORTING SYSTEMS AND SUPPORTS

a) All high energy pipework shall be adequately supported to allow it to expand and contract in a controlled manner, to minimise vibration and to limit stresses within the systems and at the terminations.

b) Details of Eskom requirements for supports are given in Eskom specification 240-56239133.

3.8 THERMAL INSULATION

a) All pipework shall be insulated to satisfy the requirements of Eskom 240-56247004 - Thermal Insulation Standard.

b) All lagging and cladding shall be installed prior to commissioning the Boiler or Turbine.

3.9 TEMPERATURE RAMP RATES

a) The contractor shall provide, with the final flexibility analysis, information on the maximum allowable rates of temperature change for all thick walled components in his supply, and confirm that these will not impose a limitation on the unit start-up times.

b) The contractor shall propose methods to control the temperature ramp rates in all thick-walled components

3.10 WARMING OF SYSTEMS

3.10.1 General

a) Steam pipe systems which are hot when in operation shall be fitted with warming pipes, valves, etc. to enable the components to be heated up or be maintained in the hot condition as required. The warming system shall be capable of heating the metal of the main system under controlled conditions, at a rate less than that which will lead to overstress of the thickest components. Thermocouples shall be used for temperature monitoring. This is applicable to the Main Steam, Hot Reheat and Cold Reheat systems.

3.10.2 Main steam warming

a) The main steam system shall be fitted with a warming system which takes steam from just before the emergency stop valves (ESVs) and discharges the steam into the cold reheat system immediately downstream of the non-return valves. Steam conditioning may be required prior to discharging into the cold reheat system. Where possible, this system should also take steam from the inlet chambers of the ESVs to promote warming of these heavy-wall components.

b) The capacity of this warming system shall be sufficient to achieve the temperature the inlet to the ESVs, as required by the turbine contractor. Control of the rate of warming shall be obtained from monitoring of the temperatures in the thickest components in the main steam system.

3.10.3 Warming up using drains

a) The drains fitted to the main steam and hot reheat pipes, apart from being able to remove all water condensed at the maximum rate, shall also be large enough to allow sufficient flow of steam during start-up conditions.

3.10.4 Warming of pipes in intermittent use

a) Systems and Pipes such as the following have no flow in them during steady state operation:

   i. HP Bypass System
   ii. LP bypass pipes from the hot reheat system to the LP bypass valves.
   iii. Reheater safety valves and piping legs.
   iv. Auxiliary steam range, both self-supply and common range.
   v. Steam supply to steam driven quick start air ejector.
   vi. Gland steam supply.

b) Provision for maintaining in the hot condition, sections of steam piping which are in intermittent use, e.g. piping to and from bypass valves, at not less than 50°C below the connected system temperature and at least 20°C above saturation temperature, and at loads of 40 % MCR and greater.

c) Continuous warming shall be performed without the use of valves or any form of leak-off to atmosphere or to waste. It may be achieved by circulating steam from the main system through the otherwise dead branch, using the pressure difference created by the flow in the main pipe (see Appendix C Sheet 13), or otherwise.

d) Care shall be taken in the routing of warming pipes to ensure that they have, and maintain, a continuous drainage slope to avoid them becoming plugged with water, and that they will not reflux into the hot main pipe.

3.10.5 Refluxing

a) No reflux shall occur in the design of smaller pipe systems which have no flow of steam or are only used intermittently e.g., warming maintaining lines, sootblower supplies etc., to avoid the risk of condensation running back (refluxing) into the main pipe.

b) The design of instrument pressure tapping points to be used is shown in Appendix C Sheet 8.

c) Larger offtakes, such as those for sootblower steam, installed close to the main pipe from which steam is taken, so that the valve and the short connecting pipe remain well above saturation temperature, approximately 20°C above. A drain immediately upstream of this isolating valve may be required to remove any condensate formed while the system is shut down, and before opening the isolating valve. The sequencing of operation of valves should not result in refluxing.

3.10.6 HP Bypass Spray Water

a) The HP Bypass system shall be adequately designed, taking into the effects of any thermal shock that might occur when in operation.

3.11 DRAINS AND DRAINAGE

3.11.1 Steam drains capacity

a) The capacity of the steam drain systems shall be calculated on the maximum rate of production of condensate during a cold start or whatever is the most arduous condition. The drain system shall also be capable of providing an adequate flow of steam in order to warm up the system at a rate commensurate with the requirements of the start-up diagrams. Adequate drainage should be provided to remove all condensate under all modes of operation and during start up and shut down.

3.11.2 Cold reheat drains

a) For cold reheat pipes, fully compensated set-on drain pockets sufficiently size for the envisage condensate shall be provided at the low points. Set-through branches, and branches reinforced by welded pads, are not acceptable.

b) The cold reheat system must have sufficient drainage in the system and must conform to ASME TDP 1.

3.11.3 Drainage of other systems

a) The drainage slope for feed water drains and other fluid drain systems shall be not less than 1%.

3.11.4 Pressure and Temperature ratings of drain pipes

a) The minimum design pressure of drain pipes shall be the same as that of the pipes they are draining, up to and including the last valve or control device (e.g. an orifice).

b) The design pressure of drain pipes downstream of the last valve or control device shall be half that of the pipes that are being drained or that of the downstream system to which they discharge whichever is the higher.

c) The design temperature of steam drain piping shall be the same as that of the pipes that are being drained.

3.11.5 Avoidance of water pockets

a) The design of the steam pipework formed pieces shall be such that all water pockets are avoided, so that changes in the internal diameter do not reduce the drainage slope below the minimum specified nor create water pockets.

b) The following fittings shall not be installed in horizontal runs of steam piping:

   i. Concentric reducers. Only eccentric reducers designed to maintain a continuous drainage slope on the bottom of the pipe shall be used.

   ii. Swaged or widen T-pieces, the bodies of which are larger in diameter than the main pipe. These T-pieces may however be used in vertical pipes. By agreement, this type of T-piece may be used in horizontal runs of piping if fitted with a drain.

Note: Appendix C Sheet *4 shows typical acceptable and unacceptable installations*.

3.11.6 Steam traps

a) For all Boiler systems steam traps shall be used only to drain steam systems whose design pressure is less than 4.0MPa. Steam traps can be used at higher pressure for the Turbine system provided that the requirements below are adhered to.

b) If failure of a steam trap occurs, in either the open or closed position, it must not affect the safety of the system, under steady state conditions.

c) The discharge from the trap shall be led to the appropriate blow-down vessel or flash box.

d) The installation of the steam trap shall incorporate the following features (see Appendix C Sheet 5):

   i. An isolating valve close to the pipe being drained,

   ii. Lockable Isolating valves at the inlet and outlet of the steam trap,

   iii. A bypass line fitted with a suitable valve connected as shown in Appendix C Sheet 5,

   iv. A witness valve between the steam trap and its downstream isolating valve for checking the operation of the steam trap unless discharge is to an open tundish,

   v. A strainer at the inlet to the steam trap, and

vi. The trap and all valves shall be easily accessible for operation and maintenance.

e) All valves shall be adequately supported.

3.12 FLASHING TWO-PHASE FLOW

a) Due care should be taken where two-phase flow may occur to eliminate or minimize the effect on the material.

b) Due care should be taken in the process design of two-phase lines to ensure that two-phase slug does not occur under any possible operating conditions.

3.13 COLD PULL (COLD SPRING)

a) Cold pull (cold spring) shall be used to reduce reactions at terminations and anchors, but no credit will be allowed in reduction of the secondary stress range. Refer to the Generic Erection Procedure in Appendix A for details.

b) The amount of cold pull shall be 85% of the full calculated thermal expansion of the system.

c) This is applicable to Main Steam, Hot Reheat and Cold Reheat Systems.

d) See Appendix A for details of cold pull installation.

3.14 INSTRUMENT CONNECTIONS

a) This standard includes all instrument connections from the main piping to the first double isolation valve.

b) The technical aspects for instrument pipework are covered by the Eskom standard 240-89147446 Instrument Piping for Fossil and Hydro Power Stations.

c) Pressure tapping points:

i. Each one shall include the stub connection to the main pipe, a length of pipe and two isolating devices, of DN15.

ii. For steam pipes this arrangement is acceptable where the impulse pipe runs downwards so that refluxing cannot occur. Where the impulse pipe must run upwards, it shall be arranged to be in contact with the main pipe for a distance of not less than 2,5 m under the lagging before emerging, at which point the DN15 globe valve shall be fitted as shown in Appendix C Sheet 8.

d) Thermocouple pockets:

i. The stub and pocket shall be supplied and installed under this standard. Thermocouple pockets details and design are to be submitted to Eskom for approval.

ii. Through-wall and mid-wall temperature thermocouples shall be installed in all thick walled components as shown in Appendix C Sheet 12.

e) Tapping and dossing points:

i. Differential pressure tappings shall include the stubs connected to the main pipe together with DN15 globe isolating valves, installed outside the lagging as shown in Appendix C Sheet 9. The condensate pots will be installed under the Eskom standard, 240-89147446 - Instrument piping for fossil and hydro power stations.

ii. Sampling points shall be installed typically as shown in Appendix C Sheets 10 and 11, and include the installation of stubs on the pipes, complying with the following Eskom standards; 240-55864822 – Steam and Water Sampling and 240-89147446 – Instrument Piping for Fossil and Hydro Power Stations Standard.

3.15 PIPE BENDS

a) Seamless bends made by induction bending or seamless butt welded fittings are only permitted.

b) Segmental bends, corrugated bends, ripple bends and longitudinal welded bends are not acceptable for HP piping.

c) In order to avoid the creation of water pockets the bore diameter of pipe bends shall be the same as that of the straight pipes which they join.

3.16 TRANSITONS

a) To reduce stress intensifications at positions where changes of thickness occur, and to provide improved geometry for non-destructive examination during construction and subsequent in-service inspection, transition pieces shall be fitted to valves and components whose internal diameter is 150mm or greater.

b) Transition pieces shall be welded (as far as practicable) to the valves in the manufacturer's shop. Transition pieces of other components shall be welded (as far as practical) in the manufacturing workshop. Full facilities for heat treatment and non-destructive examination, both internally and externally shall be available.

c) Other components shall be designed with a transition piece to eliminate butt welds.

d) The material for the transition pieces shall be selected to ensure that sound welding compatibility is kept between the materials. An appropriate welding procedure shall be qualified.

e) The connections to boiler terminal point interfaces and turbine terminal point interfaces are to be governed by this standard.

f) Suitable proportions for the design of transition pieces are given in Appendix C,Sheet 1 and are based on the following:

i. The maximum slope of any outside conical portion of the transition piece shall not exceed 15° (1:4).

ii. The maximum angle between the inner and outer surfaces of the valve body shall not exceed 20°, after match boring.

iii. The outer surface of the transition piece adjacent to the weld onto the valve shall be cylindrical for a distance not less than twice the thickness at that point plus 25 mm, and of the same diameter as the end of the valve.

iv. The outer surface of the transition piece adjacent to the pipe shall be cylindrical for a distance of twice the thickness of the pipe plus 25 mm, and of the same diameter as the outside of the pipe.

v. The amount of counter boring and subsequent wall thickness reduction should be limited.

vi. All sharp edges on transition pieces to be broken.

vii. The pipe and valve bores of less than DN150 (see Appendix C Sheet 2) shall be matched to the dimensions and tolerances allowed by the code, and the counterbore in the pipe shall extend for a distance not less than the thickness at that point plus 20 mm. The weld cap may be sloped at an angle not exceeding 15°, and shall be ground smooth before heat treatment, NDE being carried out afterwards.

Note: Appendix C Sheet *3 shows the required dimensions for butt joints to help to extend life and to allow for meaningful in-service ultrasonic inspection.*

3.17 FORMPIECES

a) Eskom preference is to have formpieces of a forged non-welded design. As an alternative Eskom will consider a fabricated construction with the branches set-on subject to prior approval.

b) None of the following features are acceptable for formpieces:

i. Set-through branches, and

ii. Reinforcement by means of welded-on pads and trifom shoes.

c) The bodies and branches of formpieces shall preferably be of the same material as the pipes to which they are connected, the thickness transition from body to pipes being as shown in Appendix C Sheet 3.

d) Welded formpieces shall be fully normalised and tempered after construction.

e) All main steam and hot reheat formpieces shall be fitted with through-wall and mid-wall differential thermocouples and stubs. Detail design, location and type of thermocouple shall be approved by Eskom.

3.18 STUBS

a) The welding of small bore pipes directly to main pipes, formpieces, etc. without an intervening stub is not acceptable.

3.19 RADIOGRAPH PLUGS

a) Radiograph plugs, if needed to satisfy code NDE requirements, or if the geometrical shape of a joint makes this method desirable, shall be of the type illustrated in Appendix C Sheet 7.

3.20 ERECTION PROCEDURES

a) Before any erection work is carried out a comprehensive erection procedure methodology shall be approved by Eskom. This erection procedure shall be in compliance with the Generic Erection Procedure in Appendix A.

b) This document(s) shall include the following, although not limited to, to ensure that the piping is in a fit condition to be put into service:

i. The methodology for High Velocity Flushing and Chemical Cleaning,

ii. Construction and Balanced Erection Procedure, including installation of cold pull,

iii. Methodology for the requirements of Blow Through,

iv. The methodology for Hydrostatic Testing,

v. The reinstatement of the system.

Note: The above list is not necessarily comprehensive.

3.21 KKS/AKZ CODIFICATION

a) KKS codification applies to new plants and for current plants the existing codification will apply.

b) KKS coding shall be according to N.PSZ 45-45.

c) Before the erection starts, the HP pipework contractor shall supply to Eskom complete drawings and documentation of the KKS/AKZ codification for the equipment in his scope.

d) The KKS/AKZ codification shall be used on all drawings and OEM manuals.

3.22 NAME PLATES AND INDICATOR PLATES

a) Labelling and coding shall be done in accordance with the Eskom Plant Codification Standard (240-53113333) and KKS numbering system (N.PSZ 45-45).

b) If there is a pressure vessel the name plate is to be done according to the PER.

3.23 ACCESS

a) This standard specifies the provision of permanent safe and easy access for operation and maintenance of all valves, variable spring and constant load hangers and snubbers. The responsibility for the provision of supporting steelwork for the access points shall lay with the HP pipework contractor.

b) The design of access points shall comply with applicable specifications and standards.

3.24 DRAWING AND DESIGN PACKAGES

a) The contractor shall submit drawings and design packages that contain sufficient information to carry out a detailed review of the design and construction methodology.

b) The drawings, designs and any other analysis performed under this scope of work shall become the property of Eskom.

c) The drawings and package should be of a nature to allow life cycle management of the system.

d) All drawings, detail designs and stress models shall be submitted in an electronic format and in its native source, to enable Eskom to edit when and where required, without any IP limitations.

e) All software and design packages that are used should be commercially available. Prior to the use of any software packages agreement is to be reached with Eskom to satisfy the requirements of this standard.

3.25 QUALITY REQUIREMENTS

3.25.1 Inspection authority

a) An Approved Inspection Authority, as defined in SANS 10227 and SANS 17020, shall be appointed to monitor and verify that the design, material procurement, construction, erection and testing of high energy pipework complies with the construction code and this standard. And to ensure compliance with the issuing of Certificate of Manufacture.

3.25.2 Contractor’s quality assurance and quality control

a) The contractor is entirely accountable for the quality and integrity of the HP Pipework that the contractor is supplying and installing for Eskom.

b) The contractor shall comply with Eskom “240-47560170 Process Control Manual (PCM) for Quality Management” and associated documents and any other applicable statutory requirements.

c) Eskom are to review the contractor’s quality control plan, prior to the commencement of any work.

3.26 DOCUMENTATION

3.26.1 General

a) The contractor shall prepare the documentation and certificates in the form of data books which shall be countersigned and stamped by the inspection authority. For category II and higher the data book will also be reviewed and endorsed by the inspection authority as defined in SANS 347.

b) Before any contractor discards any documentation of work done for Eskom, they are to notify Eskom. Certain documentation is to be kept by contractor as a legal requirement, which will be specified in the enquiry. On expiry of those documents, if the contractor wishes to discard, Eskom has to be notified.

c) Before any commissioning of the plant occurs, a CoC signed by all the relevant parties is to be issued to Eskom.

3.26.2 Data Pack/Book

a) Documentation to be compiled and retained shall be the details of the instrumentation, the pipework design and support details, material certification, as-built drawings, test and inspection data, welding procedures, AIA acceptance and any other documentation needed to comply with statutory and safety stipulations.

b) Information shall be provided on the following:

   i. A comprehensive list of all codes of construction and amendments and the dates of their validity.

   ii. Copies of a material certificates used for all pipes, fittings, valves.

iii. Weld procedures, weld consumables, heat treatment charts, etc.
iv. Register of the baseline replicas that have been lifted and issued to Eskom.
v. Full design package including flexibility models,
vi. Hydrostatic records and procedure.
vii. Maintenance procedure
viii. Suggested spares to be kept (Such as hanger or support spares).
ix. Certificate of manufacture in terms of PER.
x. NDT records.
xi. Post weld heat treatment records
xii. Full isometric set drawings before and after construction.

3.26.3 Operation and Maintenance Manuals (OEM)

a) Within three months of the completion of the final flexibility analysis, the contractor shall submit to Eskom for approval, three preliminary copies of a handbook which gives information necessary for the safe operation, in-service inspection, maintenance and repair of the high energy pipe systems. Diagrammatic drawings of the systems and isometric arrangements shall be included.

4. AUTHORISATION

This document has been seen and accepted by:

Name & Surname	Designation
Bhavesh Naran	Senior Engineer: Boiler Pressure Parts and HP Piping
Erick Van Zyl	Corporate Specialist: Boiler Pressure Parts and HP Piping
Rob Clark	Chief Engineer: Boiler
SCOT Boiler Study Committee	All Members
SCOT Turbine Study Committee	All Members
SCOT Gas Study Committee	All Members
SCOT Auxiliary Plant Study Committee	All Members

5. REVISIONS

Date	Rev.	Compiler	Remarks
November 2012	0.1	E van Zyl	Draft document for review created from 46-223
August 2013	1	E van Zyl	Final Document for Authorisation by ROD TDAC 16 July 2013
February 2015	1.1	Muhammad Laher	Updated Draft prepared
February 2105	1.2	Muhammad Laher	Final draft for Comments Review Process
March 2015	1.3	Muhammad Laher	Final Draft Document for Authorisation and Publication not published, retracted for updates

Date	Rev.	Compiler	Remarks
November 2015	1.4	Muhammad Laher	Document amended on comments received from Turbine, final Draft for second comments Review process
March 2016	1.5	Muhammad Laher	Updated Final Draft after Comments Review Process, small change to document title
March 2016	2	Muhammad Laher	Final Rev 2 for Authorisation and Publciation

6. DEVELOPMENT TEAM

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

- Bhavesh Naran
- Erick Van Zyl
- Muhammad Laher
- Rob Clark

7. ACKNOWLEDGEMENTS

- None

APPENDIX A: BALANCED ERECTION PROCEDURE

Generic Methodology for Pipework Balanced Erection

Eskom's requirements for the erection of the main services piping (feedwater, main steam, hot and cold reheat and any associated bypasses) is that a balanced erection procedure be used, followed by a neutral float and, for all systems operating in the creep regime, cold pull. In the following descriptions, "spools" are understood to mean a section of pipe between welds, and containing no intermediate butt welds, whereas a "sub-assembly" is considered to be an assemblage of spools welded together to form a contiguous part of the system. The erection procedure may involve the use of spools, subassemblies or a mixture of the two. A leg is defined as that half of the system between a terminal point and the final closure weld. Each spool shall be weighed and that weight recorded. In addition, permanent records shall have been made of thickness measurements at ninety degree intervals around each spool, at locations approximately 200mm from each end prior to erection being started. Data sheets shall be prepared for recording the load and elevation data achieved: 1) during neutral floats, 2) after cold pull, 3) in the hot condition. These data sheets shall include target elevations, at the permanent support locations for each of the three conditions. The target elevation data shall be backed up with the input and results of the computer runs supplied in machine readable format. All measured elevation shall be made relative to permanently installed datum's on structural steel.

Balanced Erection

Balanced erection is intended to result in a system such that:

- Piping connected to rotating equipment shall be supported in such a manner that no self-weight effects are transferred across the terminal points.
- Loading at boiler and turbine terminal will be as designed. Designed limitations shall be defined as defined by the boiler and turbine supplier.
- Pipe support load setting will be in compliance with design.
- No stress will exist with the piping other than those designed.

The erection of each piping leg shall always start from the terminal point and proceed toward the final closure weld approximately in the centre of the piping leg. This will be preferably in a vertical section and will be the location of any cold pull that is required.

Neutral Float

Neutral floats are performed to demonstrate that the balanced erection procedure has been successful and that required cold pull off-sets, if applicable, have been achieved. It also demonstrates that the contract supports are supporting the individual legs effectively. A neutral float is performed separately on each leg of the system, from its terminal point to the cold pull location, to demonstrate that both legs of the piping system, as built, are in balance, while floating on their permanent supports, with the calculated loads and with the terminal points aligned.

Cold Pull

Cold pull is imposed to minimize expansion stresses in the operating conditions so that those stresses don't have to be considered as primary to avoid detrimental long term effect. Its use avoids relying on the assumption that expansion stresses will relax sufficiently with under the influence of creep. Such assumptions is unreliable, particularly with the use of the newer creep strength enhanced ferritic alloys. The opportunity arose to impose cold pull is created by the intentional misalignment of the piping spool at the location of the final closure weld erection. The careful closure of the pull gap, after the neutral floats and the completion of the terminal welds, creates prestresses in the cold condition and ensures that there are minimal expansion stresses when the system, heats up to operating conditions.

For cold pull to be effective, the following precautions shall be observed:

- The location of the cold pull gap must be at a point where torsional movements are minimal and installed in a vertical pipe leg;
- Pipes either side of the cold pull gap must be in a stress-free condition, balanced on their hangers and welded to their terminal points, and anchor points must be firmly secured to prevent movement;
- The cold pull gap must be accurately measured and recorded. The closing of the gap must not introduce additional forces and moments into the system. The forces required to close the gap shall be recorded and be compared by the designer to those calculated by him. Only if the designer is satisfied that the applied forces meet his design, may the joint be welded;
- Restraints used for closing the cold pull gap must remain in place during the welding and subsequent post-weld heat treatment
- The flexibility analysis may only take account of the effect of cold pull as it can be applied i.e. without torsion.

Basic Erection Methodology

Each piping system will be erected as follows:

- Assembly of the spools to achieve sub-assemblies, where necessary. Generally individual spools shall be balanced-erected shall be considered as “sub-assemblies” in the following paragraphs. However, occasionally it may be necessary to pre-assemble 2 or more spools in a sub-assembly. Such exceptions shall be pre-approved by the customer. When such approval has been given, such sub-assemblies may be constructed without any balancing or the usage of load cells. The spools making up these sub-assemblies shall be supported on sufficient lifting gear and aligned to the specified neutral float elevations and horizontal co-ordinates. The first spool should also be closely aligned to the terminal point as if it were to be welded to the terminal. All the rigid supports on the spools shall be locked in their vertical positions after the spools are aligned. Welding and PWHT will follow.
- Sub-assemblies are aligned to form the piping leg, while supported on rigid supports containing load cells. The intermediate butt weld between the first and second sub-assembly will be made and stress relieved. The rigid supports on these two sub-assemblies will be adjusted to restore the load cells to their pre-welding values while maintaining the alignment of the first spool with the terminal point. The supports will then be locked. The third sub-assembly will then be aligned for the next intermediate butt weld, with its far end at its specified neutral elevation. Its load cell readings will be recorded and the weld made and heat treated. Its supports will be adjusted to restore the load cell readings to the recorded readings and locked. Any additional sub-assemblies will be installed in a similar way to the third.
- The piping will be transferred to the locked supports, installed in their neutral float locations.
- The system shall then be insulated and clad as much as possible. The weight of any missing insulation and cladding shall be compensated for by temporarily installing equivalent weights, by means of sandbags or similar, at appropriate locations.
- The permanent supports shall be unlocked and the supports adjusted so that their cursors align with the neutral float indicators on their scales – ensuring that, during any adjustments, it is the appropriate portion of the support which moves and that the elevation of the pipe does not change. All the supports should be hanging plumb at this stage.

- The alignment of each end of the system shall be confirmed and the neutral float elevations recorded on the data sheet.
- Welding and PWHT of terminal points is completed.
- The cold pull gap shall be verified and recorded. (The gap will be marked with four vertical and one horizontal scribe line on each pipe at the terminal interface. Centre pop marks will be made where the scribe lines cross and the elevation of the centre pop marks will be recorded.) The cold pull gap shall then be closed (vertical scribe lines will be in line to ensure no axial differential rotation, centre pop differential distances to be maintained to ensure no lateral differential rotation, measurement of lateral distances between pipes in the horizontal planes to ensure correct lateral closure and distance between centre pops to ensure correct axial amount of cold pull gap in the vertical direction). Final welding and PWHT shall then be performed.
- Rigging used to close the cold pull gap shall be removed; the permanent supports shall be blocked and moved to their design locations, (set rod angulations), compensating weights removed and insulation completed. Unblock supports.
- Cold elevation and hanger readings survey
- Perform cold commissioning
- During hot commissioning, after first heating up to approximately operating temperature, and again cooling down, all hanger positions shall be recorded, and shall be reset as required by the contractor’s experienced piping design engineer. This procedure shall be repeated until the system is accepted by Eskom.

Full results of the elevations, settings, weights, adjustments, etc., made shall be supplied to Eskom immediately after the exercise is completed, for acceptance. The contractor shall ensure that the work in this section is supervised by specialized piping personnel.

APPENDIX B: VALVES

General

a) The valves as specified in this section are applicable to Boiler systems as defined in Table 1. For Turbine systems the valves will be specified in the enquiry.

b) For high pressure feed water and steam systems above DN 150, only parallel slide valves shall be used for isolation where there is no control function.

Drain and Vent Valves

a) Drain and Vent Systems that falls within this standard shall have double isolation, with the valves installed in a master / slave configuration.

b) Steam pipe drains shall be provided with a thermocouple upstream of the first isolating valve (see Appendix C Sheet 6) to provide indication or control for the drain system valves.

c) All valves which are required to be opened or closed during normal start-ups, shut downs and other operations, the master valve shall be provided with power operation, but the slave valve can be manual operation.

d) All operational drains from HP Steam pipework shall be led to the appropriate blow-down vessel with a non-return valve and a hand-operated parallel slide type isolating valve at the blow-down vessel manifold. The lifting disc type non-return valves fitted in the main steam pipe drains may create a hydrostatic head of up to one metre, and account shall be taken of this in designing the system.

Valve Bypasses

a) Parallel slide isolating valves of DN 150 or greater, shall be provided with bypasses with their associated isolating valves. The size of the bypass shall be calculated by the designer to permit an adequate flow under transient conditions to warm the downstream system and to equalize the pressure differential across the valve station before opening the main valve.

High Pressure Bypass Valves

a) The piping immediately downstream of valves, for a distance not less than 10 diameters, shall be designed to the worst local upset conditions.

b) The piping contractor is responsible to ensure that the valve is kept hot under all operating conditions. The downstream piping and the spray water piping shall be kept hot by warming.

Main Steam Warming Valves

a) In reheat units, main steam warming control and conditioning valves shall be supplied under this standard and shall be installed, one on each leg to the HP turbine, together with isolating valves. This system shall be connected from the main steam pipes immediately before the turbine emergency stop valves to the cold reheat system immediately downstream of the non-return valves. This system is provided to accelerate the warming of the main steam and cold reheat pipework during cold starts, and to assist with matching of steam to metal temperatures during warm and hot re-starts and other transient conditions.

Non-return Valves

a) Note: Two types of non-return valves are recognised for use in high pressure systems:

i. Lifting disc type

ii. Tilting disc type

b) The tilting disc non-return valve shall be used for main steam and feed water conditions.

c) Tilting disc non-return valves shall be of a design which has no gland on the spindle.

d) Internal spring assistance for closing non-return valves is not acceptable; except for the feedwater line NRV's.

e) If lifting disc type non-return valves are used in the drain system from the main steam pipes to the boiler blow-down vessel, the designer shall take account of the hydrostatic head of water required to start flow, and which may reach one metre head of water gauge.

f) Non-return lifting valves shall be installed on all lines discharging into the boiler blow-down vessel. The pressure/temperature rating of these valves shall be that of the design conditions for the drain systems.

g) Screw down NRV's is not permitted and all NRV's shall be installed in horizontal lines only. This is applicable to Main Steam and Feedwater systems.

Isolators and stop valves

a) Main steam, cold and hot reheat lines shall be provided with isolating devices close to the boiler headers for use during pressure testing. Vent and drain connections shall be provided in or close to the isolating devices, together with arrangements for filling.

b) Pressure test isolating devices bodies shall be treated as valve bodies.

Attemperator spray water isolation

a) Each attemperator spray water system shall be provided with an additional power operated isolating (block) valve to be operated by the control logic of the boiler.

b) All attemperator spray water systems shall be provided with hand operated isolating valves and non-return valves at their respective feed supply points.

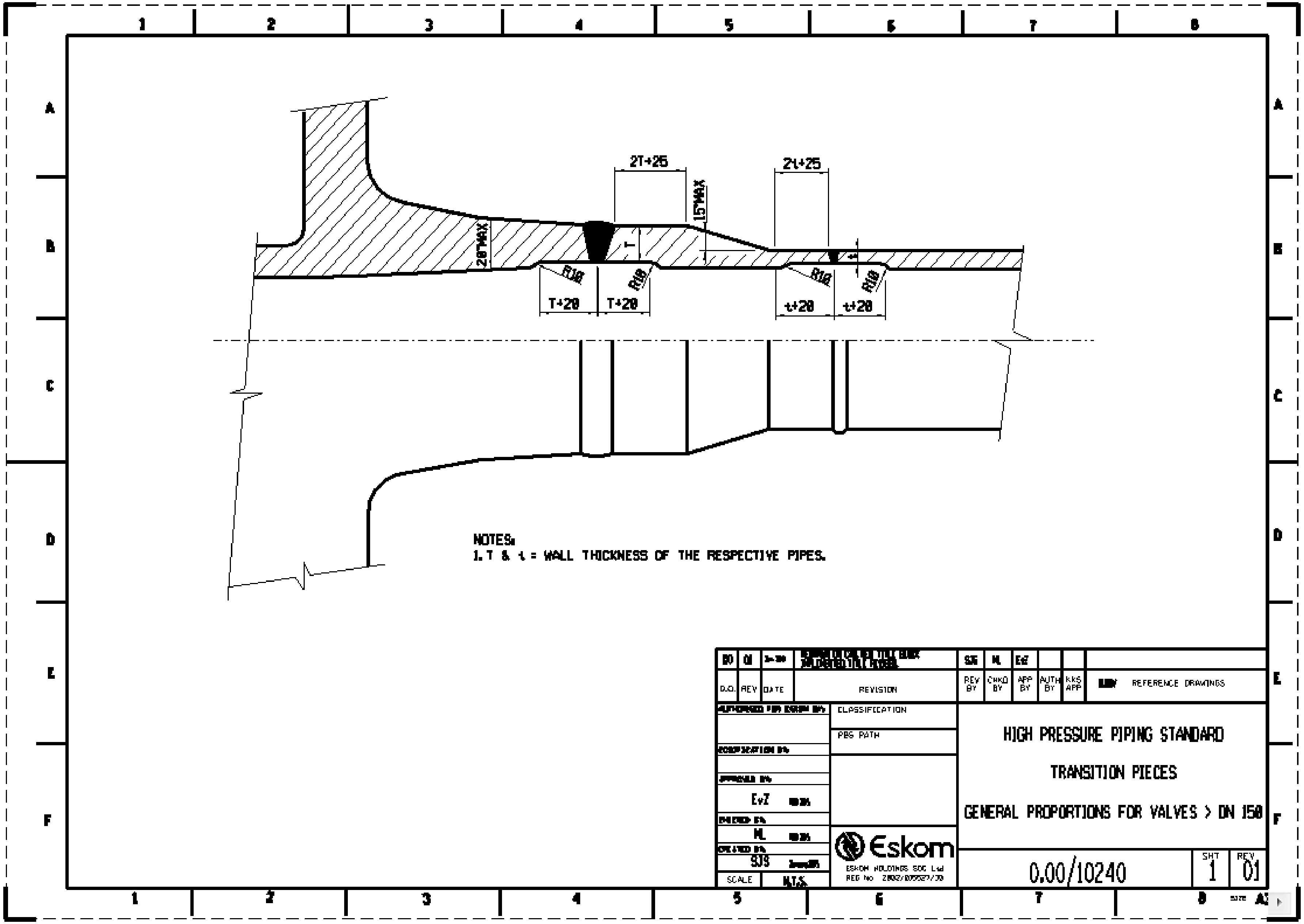
Feed water valves

a) Valves relating to the feed water system will be specified in the Turbine enquiry/ works information.

APPENDIX C: DRAWINGS

The following list of drawings is attached:

Sheet 1	Transition Pieces - General Proportions for Valves > DN 150
Sheet 2	Dimensions of Butt Weld Joints =< DN 150
Sheet 3	Connection of Forged or Forged/Fabricated Valve or Formpiece to Pipe
Sheet 4	Widened T-Pieces and Reducing Pieces
Sheet 5	Arrangement of Steam Traps
Sheet 6	T-piece for Steam Pipe Drain Thermocouples
Sheet 7	Typical Radiograph Boss and Plug
Sheet 8	Pressure Tapping Points DN15 on Main Pipes
Sheet 9	Differential Pressure Tapping Points for Steam Pipes
Sheet 10	Transition Stub for Steam Sampling
Sheet 11	Transition Stub for H.P. Water Fast Sampling Probe
Sheet 12	Inner and Mid-Wall Thermocouple Pockets
Sheet 13	Typical system for warming pipes in intermittent use


2T+25
2t+25
15°MAX
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NOTES:
1. T & t = WALL THICKNESS OF THE RESPECTIVE PIPES.
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REVISION
REV BY
CHKD BY
APP BY
AUTH BY
KKS APP
REFERENCE DRAWINGS
CLASSIFICATION
PBS PATH
EvZ
ML
SJS
SCALE
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Eskom
ESKOM HOLDINGS SOC Ltd
HIGH PRESSURE PIPING STANDARD
TRANSITION PIECES
GENERAL PROPORTIONS FOR VALVES > DN 150
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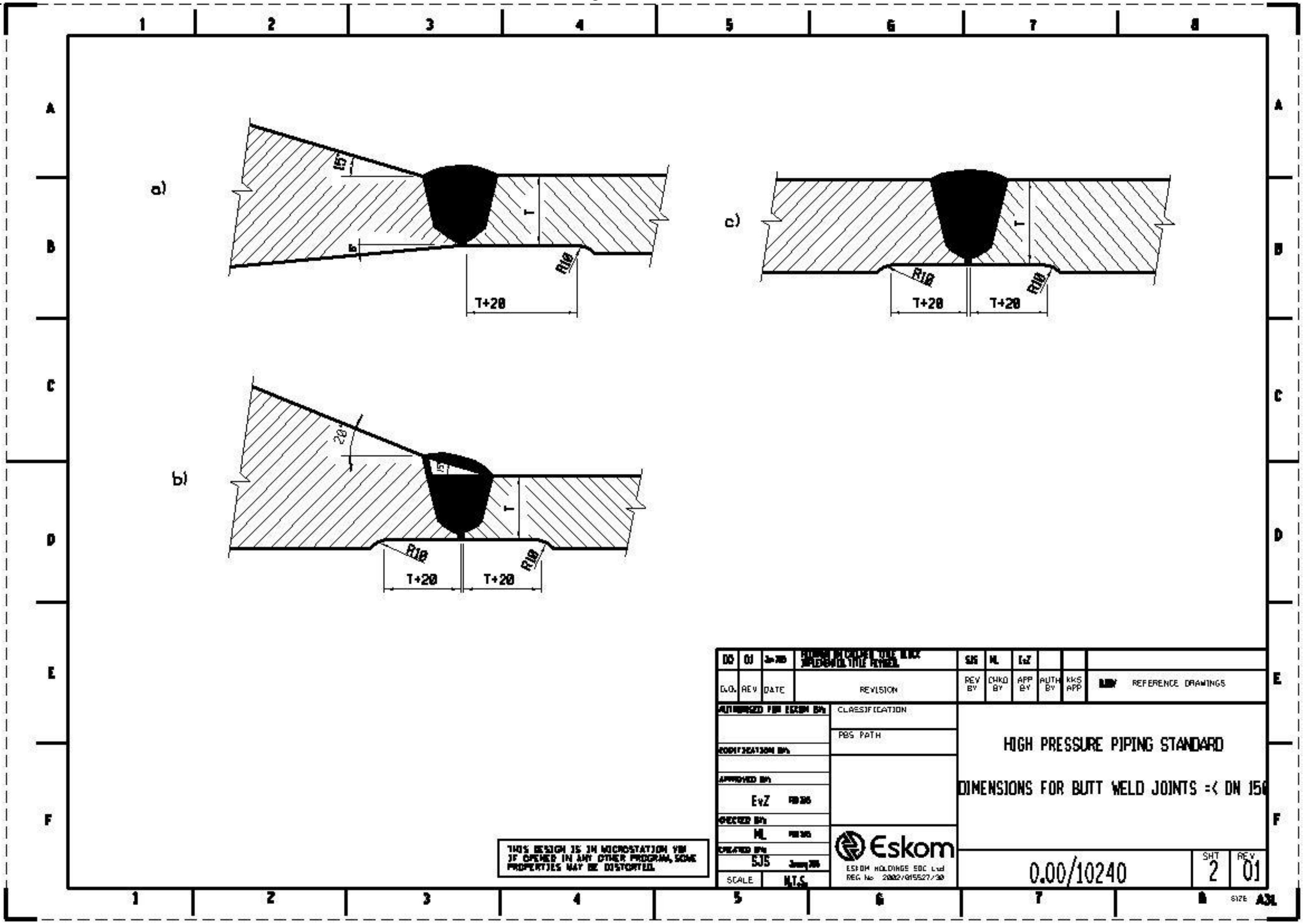
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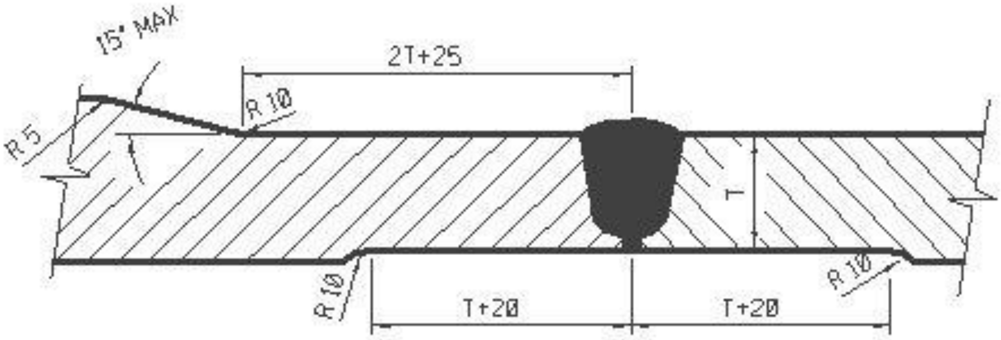


NOTES:
1) T= THICKNESS OF CONNECTED PIPE WALL.

D.O.	REV	DATE	REVISION	REV BY	CHKD BY	APP BY	AUTH BY	KKS APP
00	01	Jan 2015	REDRAWN ON CAD. NEW TITLE BLOCK IMPLEMENTED. TITLE REVISED.	SJS	ML	EvZ		

REFERENCE DRAWINGS

AUTHORISED FOR ESKOM BY:

CERTIFICATION BY:

APPROVED BY: EvZ FEB 2015

CHECKED BY: ML FEB 2015

CREATED BY: SJS 30 JAN 2015

SCALE: N.T.S.

CLASSIFICATION

PBS PATH

Eskom
ESKOM HOLDINGS SOC Ltd
REG No. 2002/015527/30

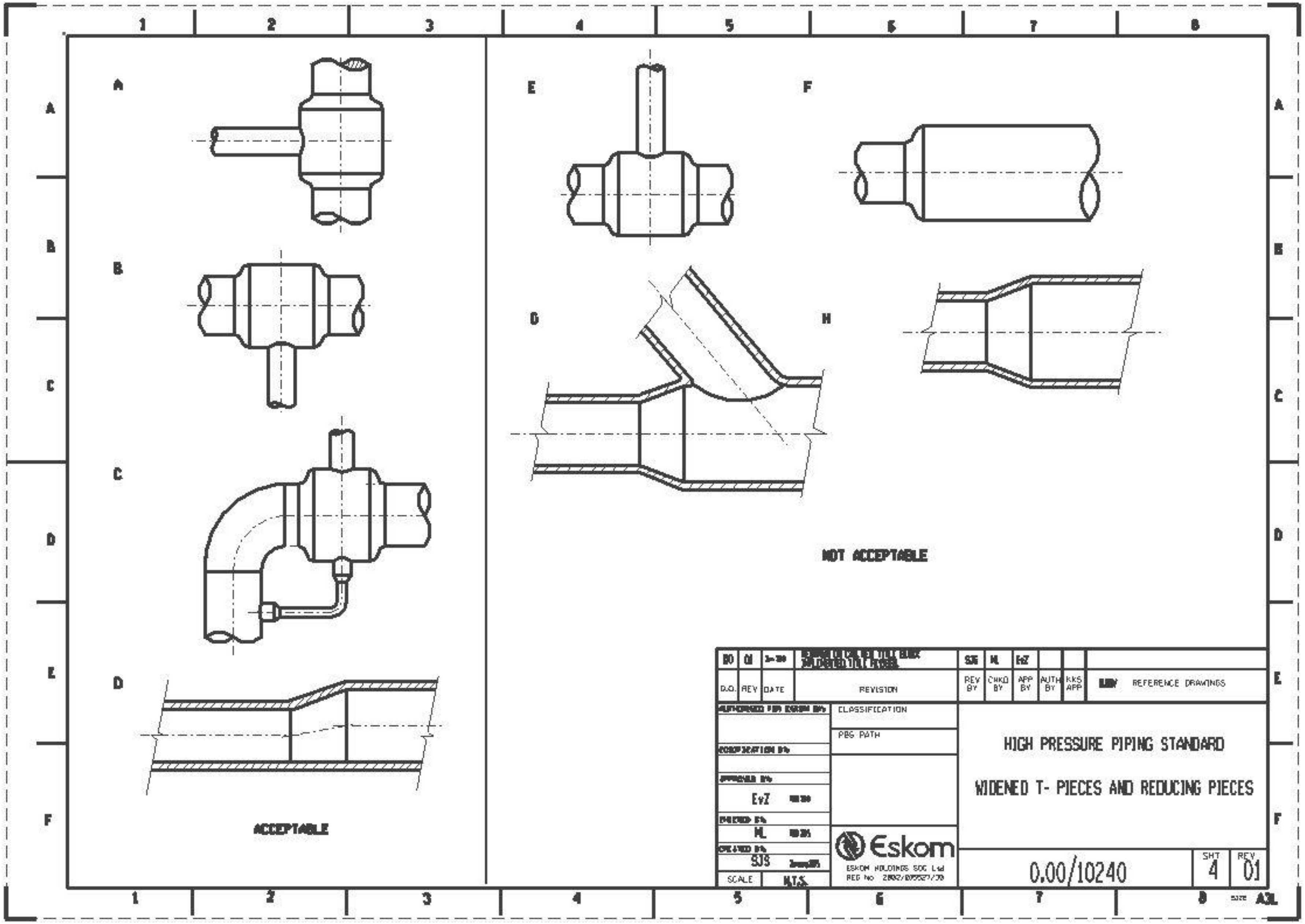
HIGH PRESSURE PIPING STANDARD

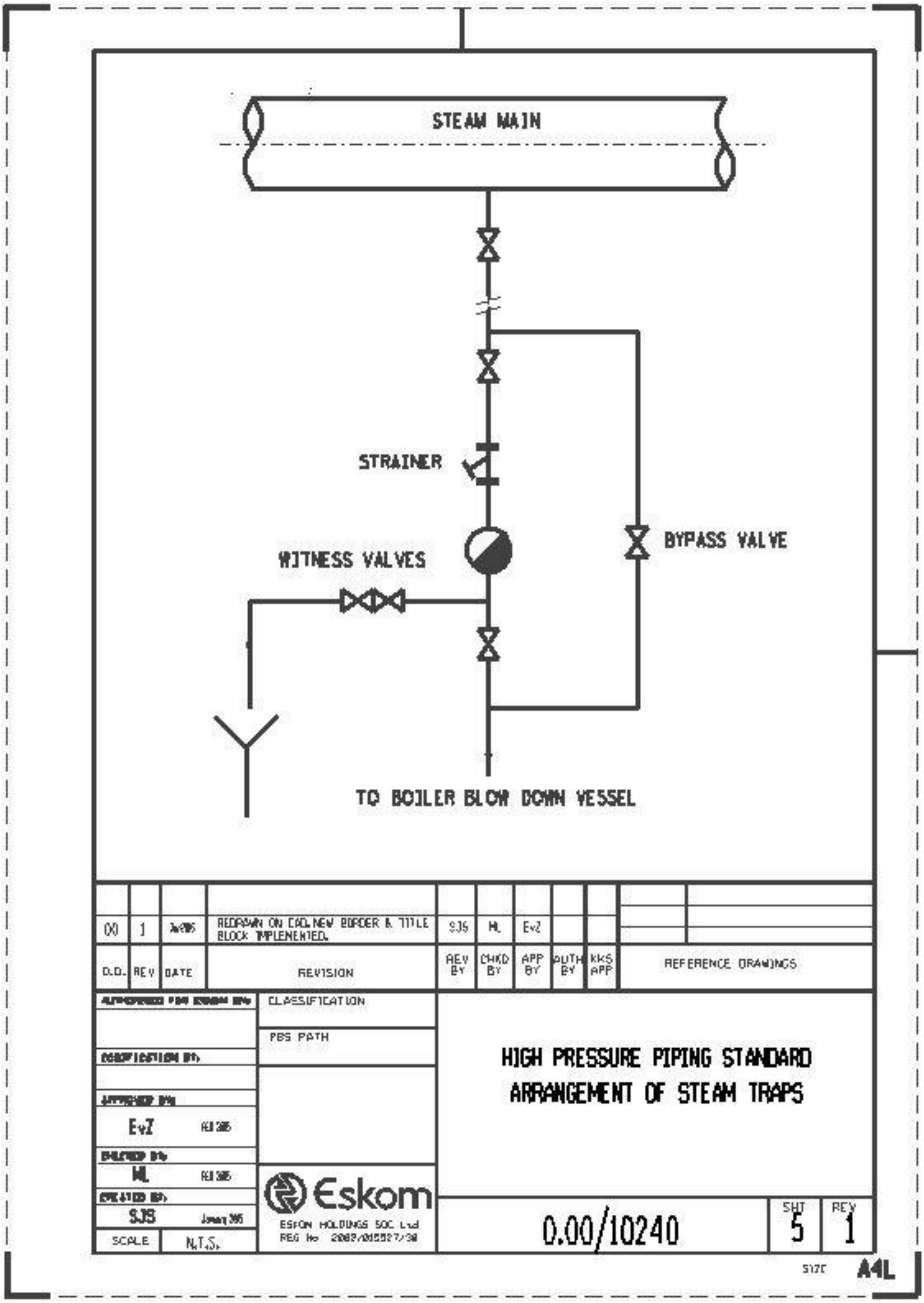
CONNECTION OF FORGED OR FORGED/FABRICATED VALVE OR FORM PIECE TO VALVE

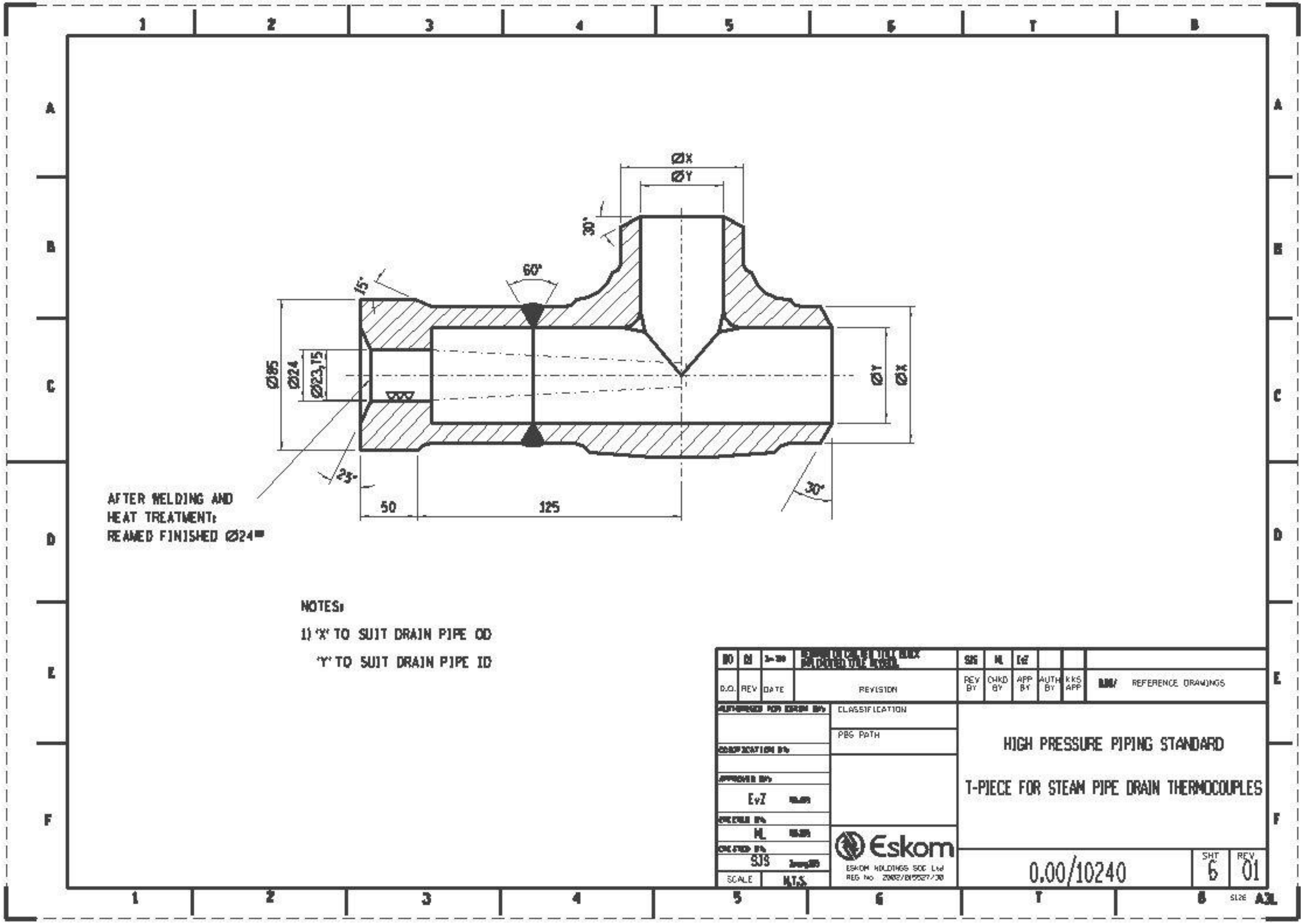
0.00/10240

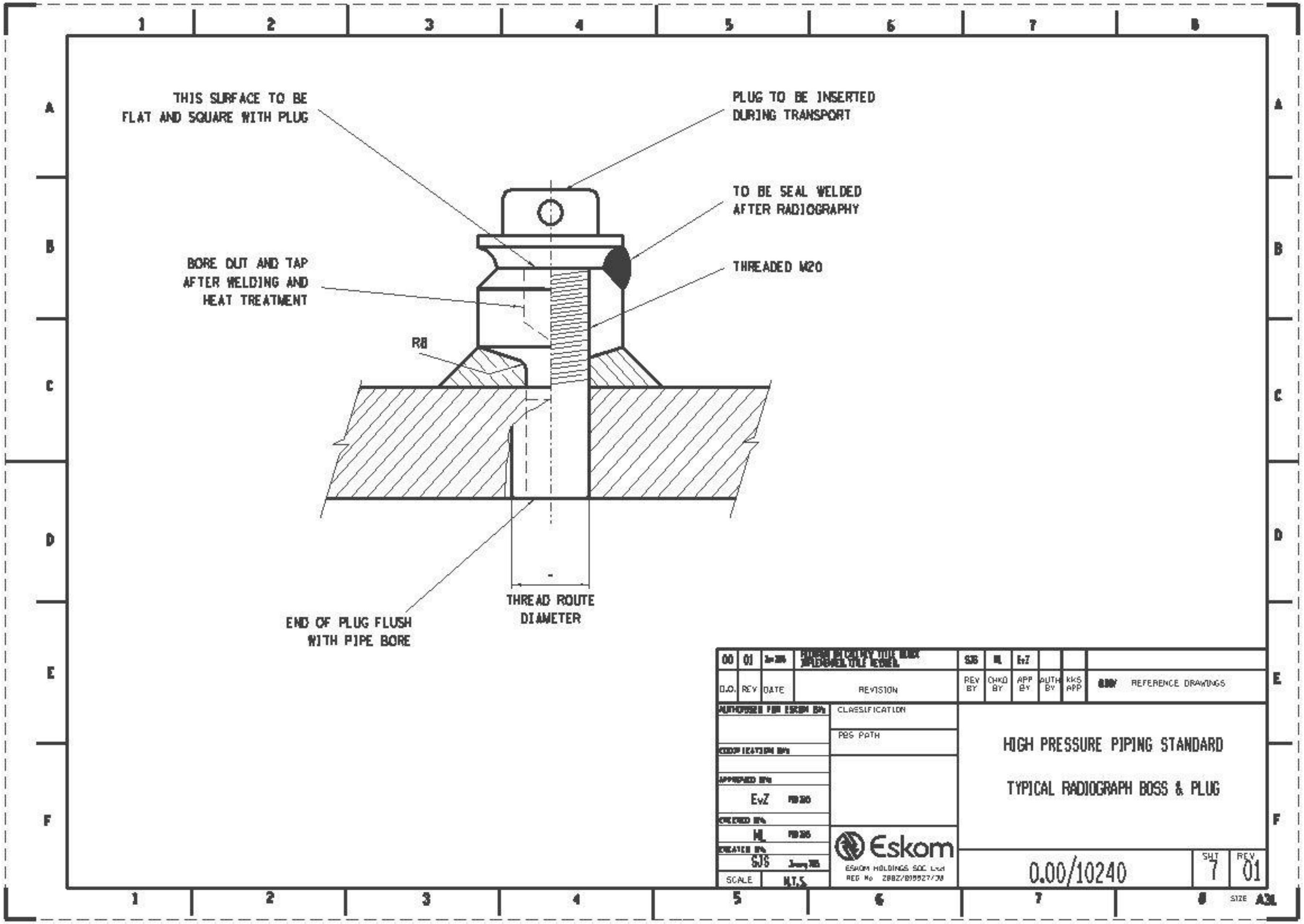
SHT 3 REV 01

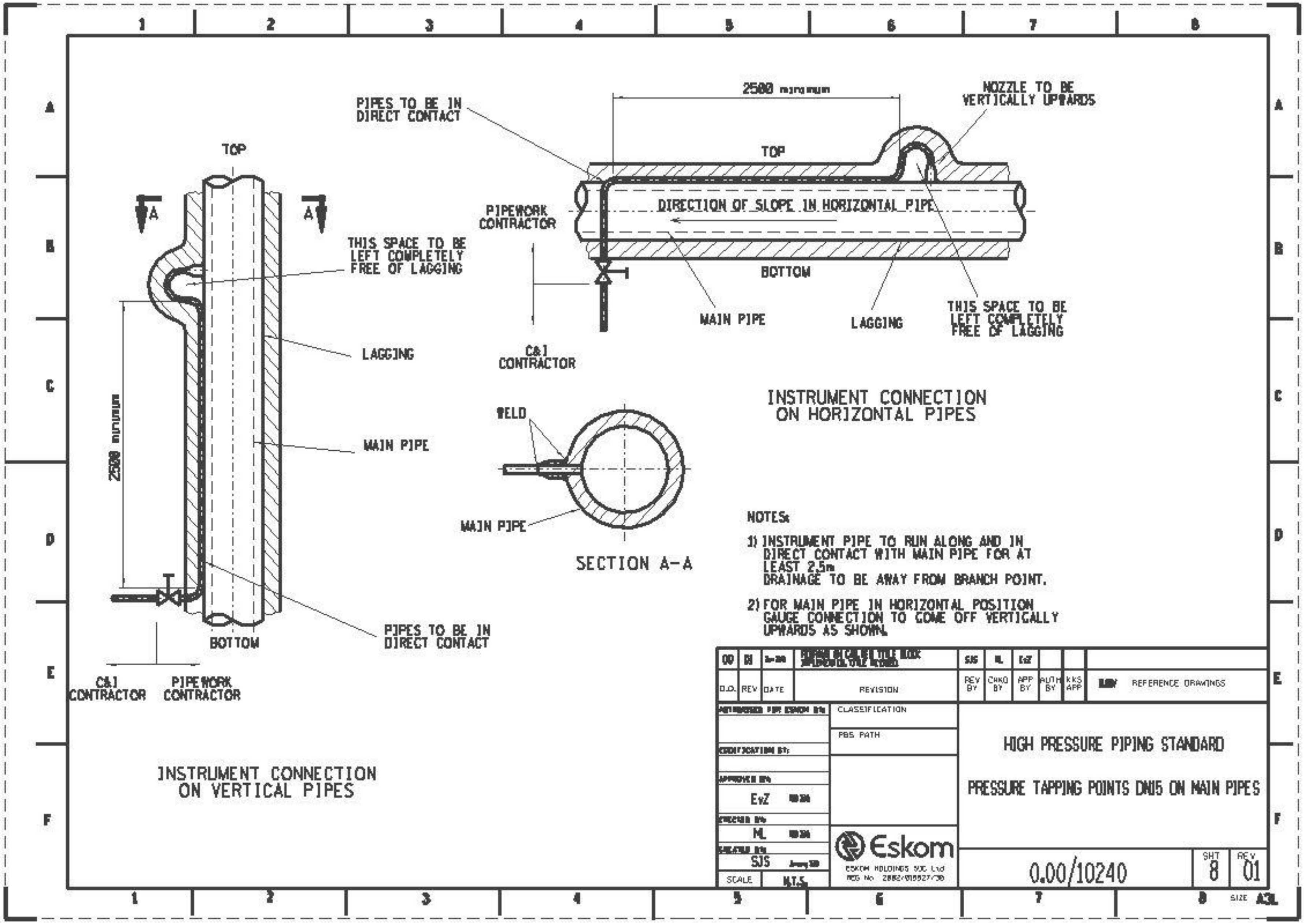
SIZE A4L

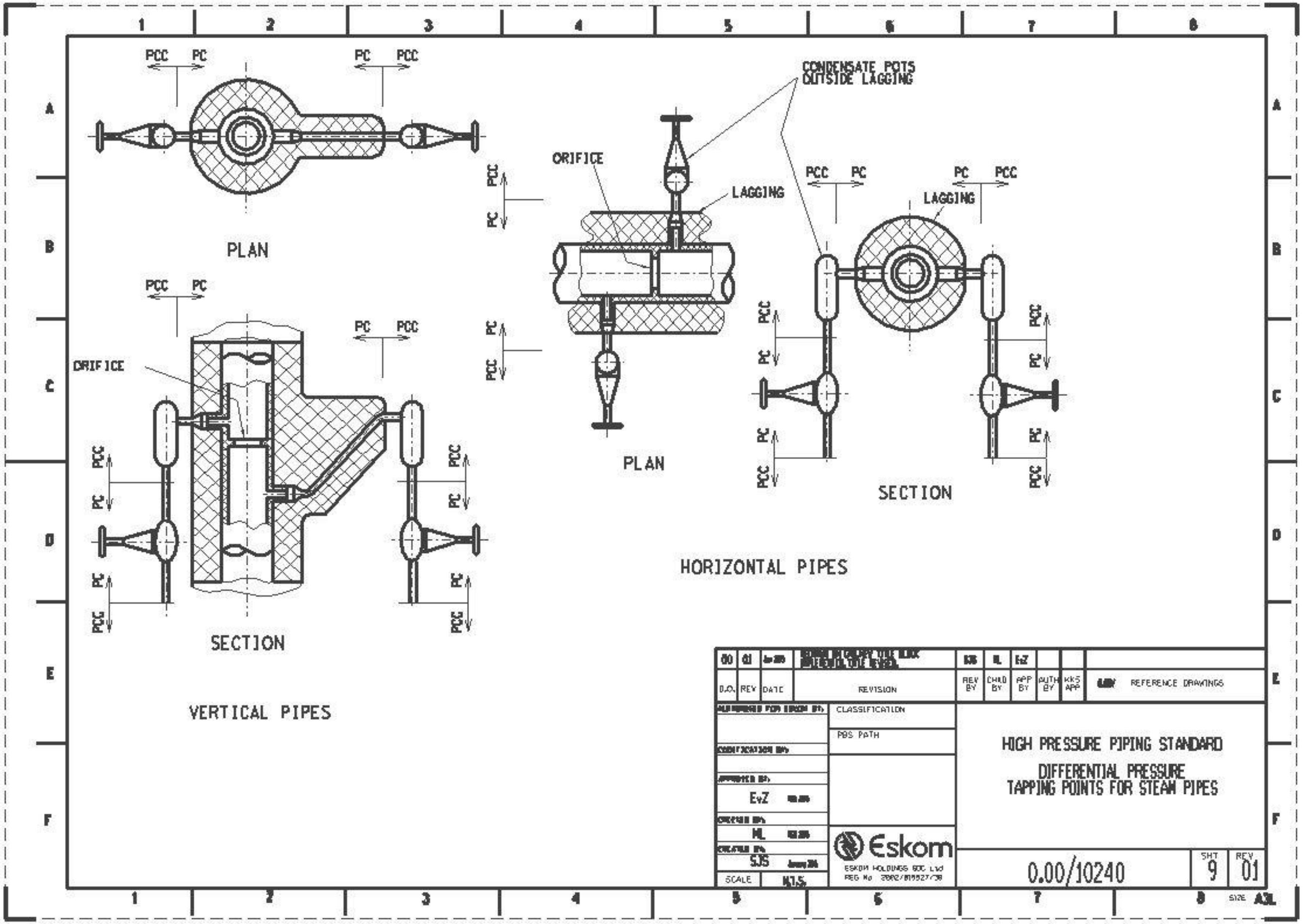

A
B
C
D
E
F
G
H
ACCEPTABLE
NOT ACCEPTABLE
D.O.
REV
DATE
REVISION
REV BY
CHKD BY
APP BY
AUTH BY
KKS APP
REFERENCE DRAWINGS
CLASSIFICATION
PBS PATH
EvZ
ML
SJS
SCALE
N.T.S.
Eskom
ESKOM HOLDINGS SOC Ltd
HIGH PRESSURE PIPING STANDARD
WIDENED T- PIECES AND REDUCING PIECES
0.00/10240
SHT
4
REV
01
A3L

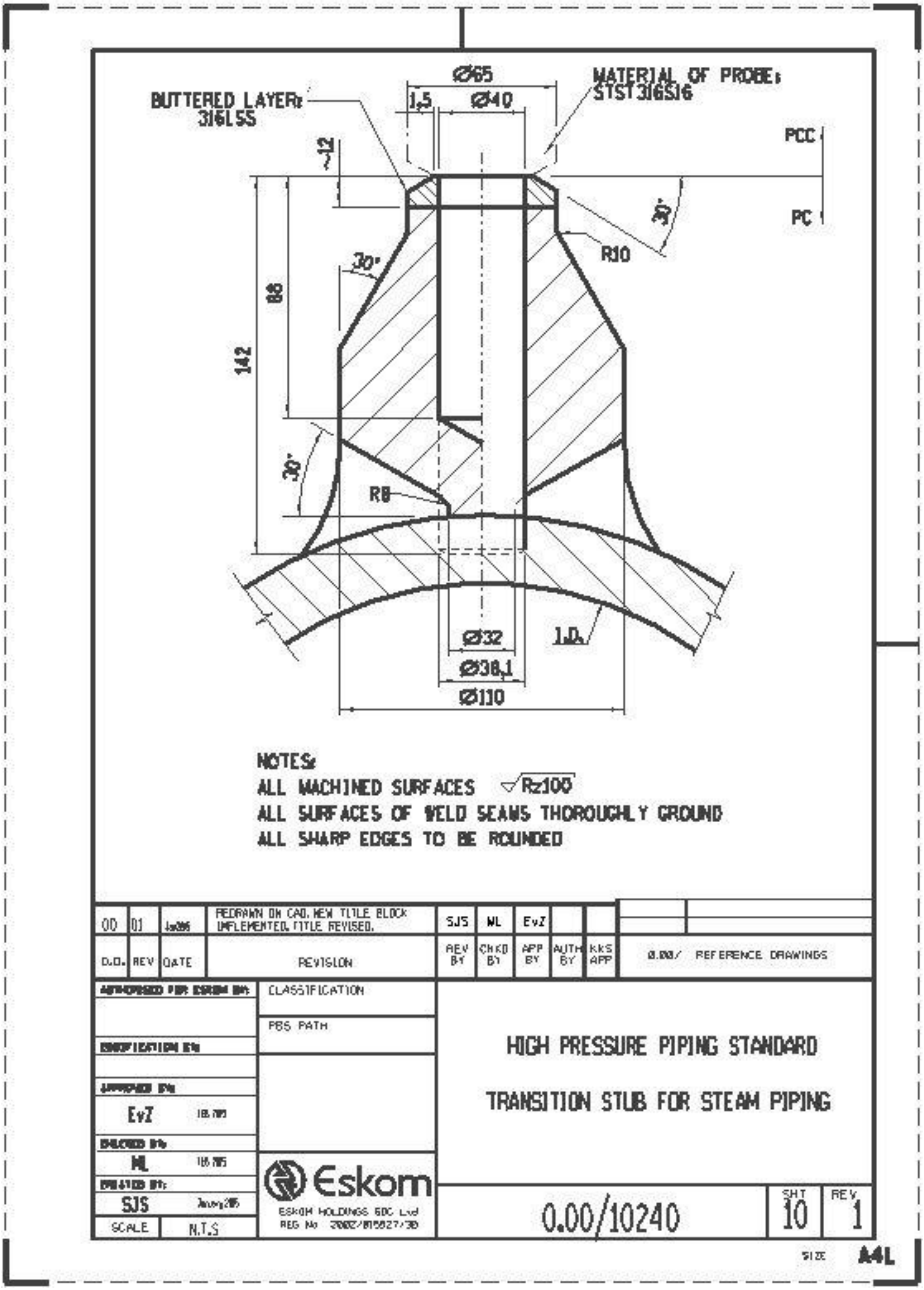

STEAM MAIN
STRAINER
BYPASS VALVE
WITNESS VALVES
TO BOILER BLOW DOWN VESSEL
REDRAWN ON CAD, NEW BORDER & TITLE BLOCK IMPLEMENTED.
SJS
ML
EvZ
D.O.
REV
DATE
REVISION
REV BY
CHKD BY
APP BY
AUTH BY
KKS APP
REFERENCE DRAWINGS
CLASSIFICATION
PBS PATH
EvZ
ML
SJS
SCALE
N.T.S.
ESKOM HOLDINGS SOC Ltd
HIGH PRESSURE PIPING STANDARD
ARRANGEMENT OF STEAM TRAPS
0.00/10240
SHT
5
REV
1
SIZE
A4L

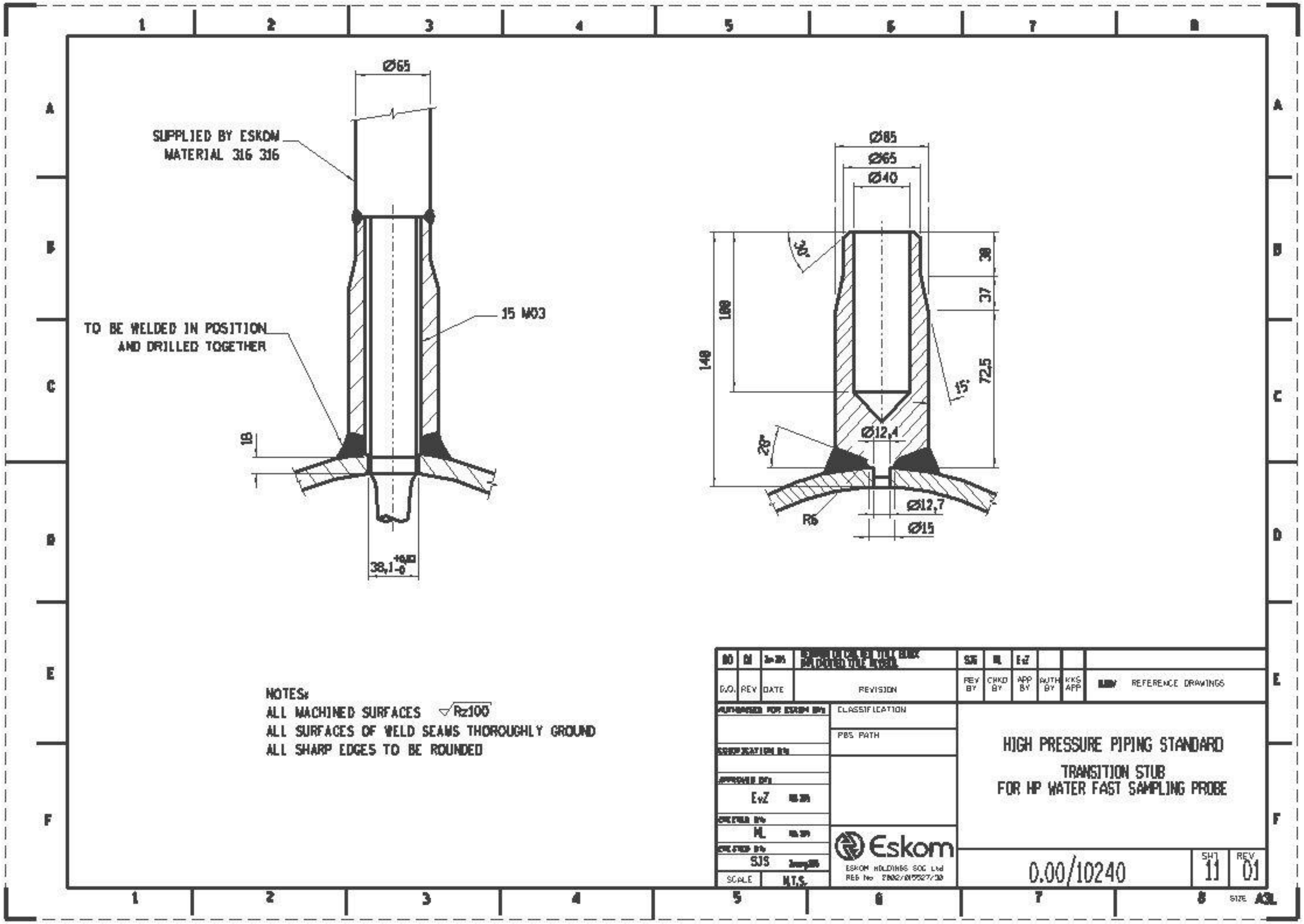

ØX
ØY
30°
60°
15°
Ø85
Ø24
Ø23,15
ØY
ØX
25°
30°
50
125
AFTER WELDING AND
HEAT TREATMENT:
REAMED FINISHED Ø24
NOTES:
1) 'X' TO SUIT DRAIN PIPE OD
'Y' TO SUIT DRAIN PIPE ID
D.O. REV DATE
REVISION
REV BY
CHKD BY
APP BY
AUTH BY
KKS APP
REFERENCE DRAWINGS
CLASSIFICATION
PBS PATH
HIGH PRESSURE PIPING STANDARD
T-PIECE FOR STEAM PIPE DRAIN THERMOCOUPLES
EvZ
NL
SJS
SCALE
N.T.S.
Eskom
ESKOM HOLDINGS SOC Ltd
0.00/10240
SHT
6
REV
01
SIZE A3L

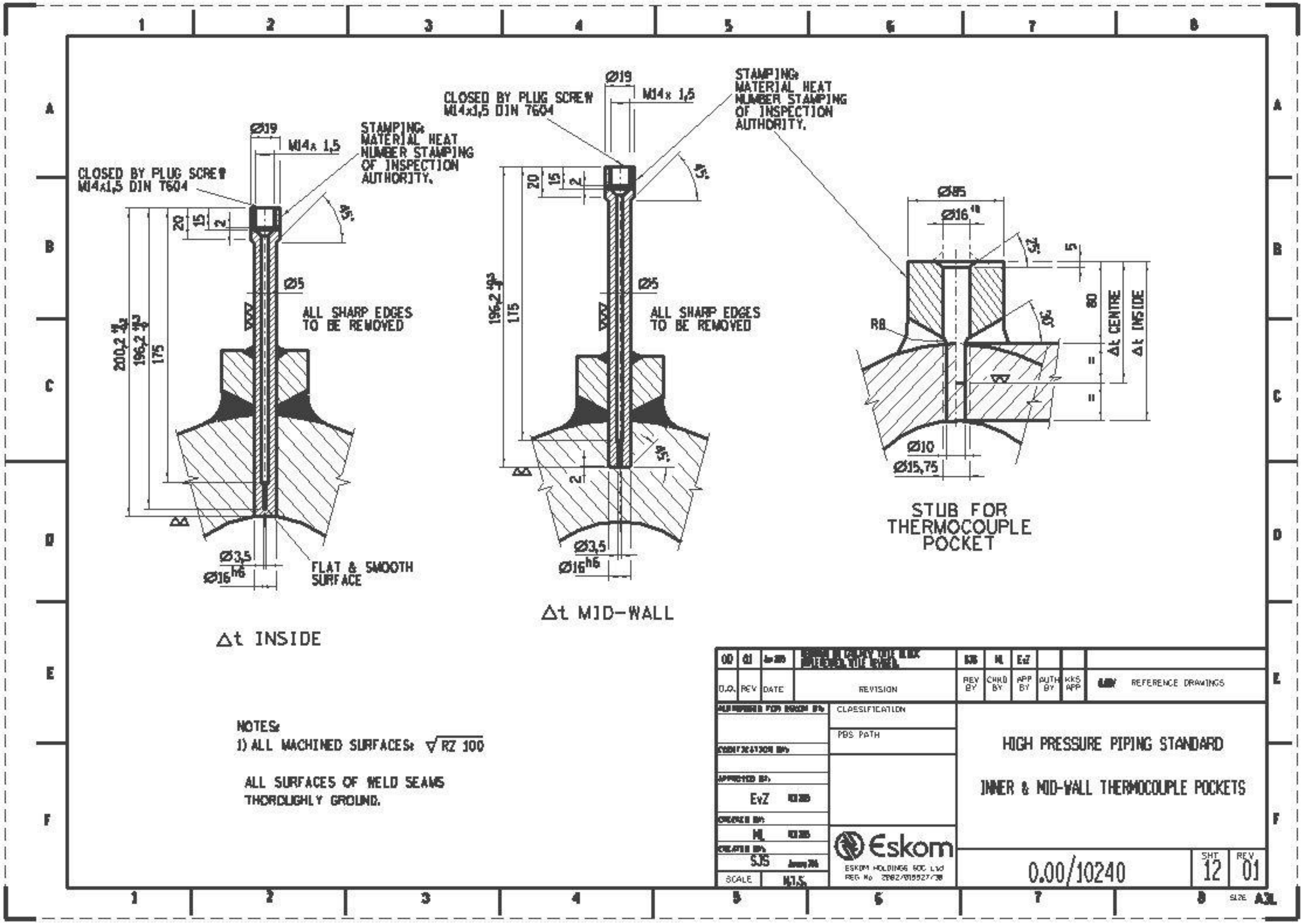

THIS SURFACE TO BE FLAT AND SQUARE WITH PLUG
PLUG TO BE INSERTED DURING TRANSPORT
TO BE SEAL WELDED AFTER RADIOGRAPHY
THREADED M20
BORE OUT AND TAP AFTER WELDING AND HEAT TREATMENT
R8
END OF PLUG FLUSH WITH PIPE BORE
THREAD ROUTE DIAMETER
D.O.
REV
DATE
REVISION
REV BY
CHKD BY
APP BY
AUTH BY
KKS APP
REFERENCE DRAWINGS
CLASSIFICATION
PBS PATH
EvZ
ML
SJS
SCALE
N.T.S.
Eskom
ESKOM HOLDINGS SOC Ltd
HIGH PRESSURE PIPING STANDARD
TYPICAL RADIOGRAPH BOSS & PLUG
0.00/10240
SHT
7
REV
01
SIZE
A3L

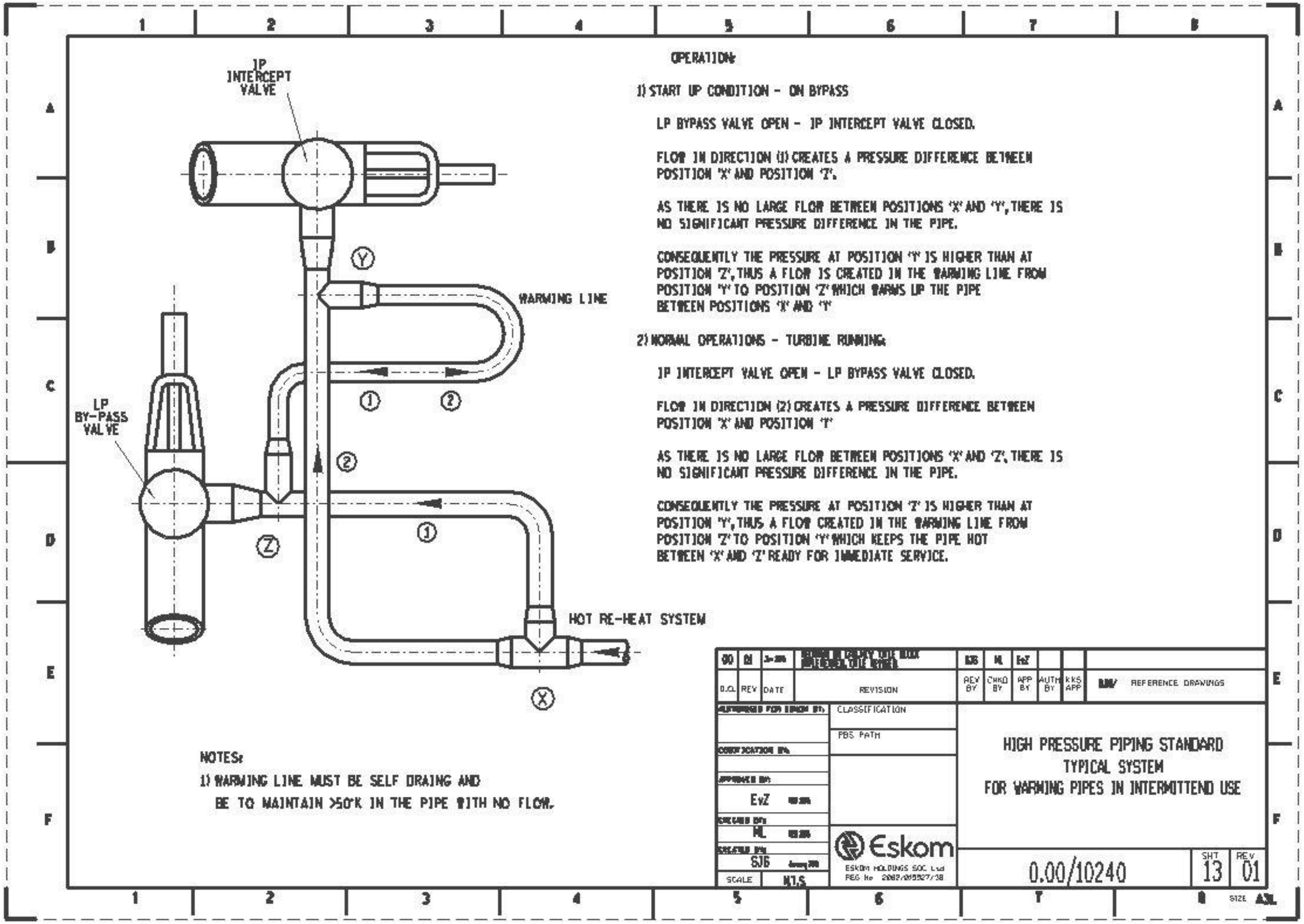

PIPES TO BE IN DIRECT CONTACT
TOP
A
A
THIS SPACE TO BE LEFT COMPLETELY FREE OF LAGGING
LAGGING
MAIN PIPE
2500 minimum
PIPES TO BE IN DIRECT CONTACT
BOTTOM
C&I CONTRACTOR
PIPEWORK CONTRACTOR
INSTRUMENT CONNECTION ON VERTICAL PIPES
2500 minimum
NOZZLE TO BE VERTICALLY UPWARDS
TOP
DIRECTION OF SLOPE IN HORIZONTAL PIPE
PIPEWORK CONTRACTOR
BOTTOM
MAIN PIPE
LAGGING
THIS SPACE TO BE LEFT COMPLETELY FREE OF LAGGING
C&I CONTRACTOR
INSTRUMENT CONNECTION ON HORIZONTAL PIPES
WELD
MAIN PIPE
SECTION A-A
NOTES:
1) INSTRUMENT PIPE TO RUN ALONG AND IN DIRECT CONTACT WITH MAIN PIPE FOR AT LEAST 2.5m
DRAINAGE TO BE AWAY FROM BRANCH POINT.
2) FOR MAIN PIPE IN HORIZONTAL POSITION GAUGE CONNECTION TO COME OFF VERTICALLY UPWARDS AS SHOWN.
D.O. REV DATE REVISION
REV BY CHKD BY APP BY AUTH BY KKS APP
REFERENCE DRAWINGS
CLASSIFICATION
PBS PATH
EvZ
ML
SJS
SCALE N.T.S.
Eskom
ESKOM HOLDINGS SOC Ltd
HIGH PRESSURE PIPING STANDARD
PRESSURE TAPPING POINTS DN15 ON MAIN PIPES
0.00/10240
SHT 8
REV 01
SIZE A3L


PCC
PC
PLAN
ORIFICE
SECTION
VERTICAL PIPES
CONDENSATE POTS OUTSIDE LAGGING
LAGGING
PLAN
SECTION
HORIZONTAL PIPES
D.O.
REV
DATE
REVISION
REV BY
CHKD BY
APP BY
AUTH BY
KKS APP
REFERENCE DRAWINGS
CLASSIFICATION
PBS PATH
EvZ
ML
SJS
SCALE
N.T.S.
Eskom
ESKOM HOLDINGS SOC Ltd
HIGH PRESSURE PIPING STANDARD
DIFFERENTIAL PRESSURE
TAPPING POINTS FOR STEAM PIPES
0.00/10240
SHT
9
REV
01
SIZE A3L


Ø65
1,5
Ø40
BUTTERED LAYER:
316L SS
MATERIAL OF PROBE:
STST 316S16
PCC
PC
30°
R10
30°
88
142
30°
R8
Ø32
Ø38,1
Ø110
I.D.
NOTES:
ALL MACHINED SURFACES Rz100
ALL SURFACES OF WELD SEAMS THOROUGHLY GROUND
ALL SHARP EDGES TO BE ROUNDED
00 01 REDRAWN ON CAD, NEW TITLE BLOCK IMPLEMENTED, TITLE REVISED. SJS WL EvZ
D.O. REV DATE REVISION REV BY CHKD BY APP BY AUTH BY KKS APP
0.00/ REFERENCE DRAWINGS
CLASSIFICATION
PBS PATH
EvZ
WL
SJS
SCALE N.T.S
HIGH PRESSURE PIPING STANDARD
TRANSITION STUB FOR STEAM PIPING
Eskom
ESKOM HOLDINGS SOC Ltd
0.00/10240
SHT 10
REV 1
SIZE A4L


Ø65
SUPPLIED BY ESKOM
MATERIAL 316 316
15 MO3
TO BE WELDED IN POSITION
AND DRILLED TOGETHER
18
38,1
Ø85
Ø65
Ø40
30°
38
37
100
140
72,5
15°
Ø12,4
28°
Ø12,7
R6
Ø15
NOTES:
ALL MACHINED SURFACES Rz100
ALL SURFACES OF WELD SEAMS THOROUGHLY GROUND
ALL SHARP EDGES TO BE ROUNDED
D.O. REV DATE REVISION
REV BY CHKD BY APP BY AUTH BY KKS APP
REFERENCE DRAWINGS
CLASSIFICATION
PBS PATH
EvZ
ML
SJS
SCALE N.T.S.
Eskom
ESKOM HOLDINGS SOC Ltd
HIGH PRESSURE PIPING STANDARD
TRANSITION STUB
FOR HP WATER FAST SAMPLING PROBE
0.00/10240
SHT 11
REV 01
SIZE A3L


CLOSED BY PLUG SCREW
M14x1,5 DIN 7604
Ø19
M14x 1,5
STAMPING:
MATERIAL HEAT
NUMBER STAMPING
OF INSPECTION
AUTHORITY.
45°
Ø5
ALL SHARP EDGES
TO BE REMOVED
200,2
196,2
175
20
15
2
Ø3,5
Ø16 h6
FLAT & SMOOTH
SURFACE
Δt INSIDE
Δt MID-WALL
Ø85
Ø16
R8
Ø10
Ø15,75
80
Δt CENTRE
Δt INSIDE
STUB FOR
THERMOCOUPLE
POCKET
NOTES:
1) ALL MACHINED SURFACES: √RZ 100
ALL SURFACES OF WELD SEAMS
THOROUGHLY GROUND.
D.O.
REV
DATE
REVISION
REV BY
CHKD BY
APP BY
AUTH BY
KKS APP
REFERENCE DRAWINGS
CLASSIFICATION
PBS PATH
HIGH PRESSURE PIPING STANDARD
INNER & MID-WALL THERMOCOUPLE POCKETS
EvZ
ML
SJS
SCALE
N.T.S.
Eskom
ESKOM HOLDINGS SOC Ltd
0.00/10240
SHT
12
REV
01
SIZE A3L


OPERATION:
1) START UP CONDITION - ON BYPASS
LP BYPASS VALVE OPEN - IP INTERCEPT VALVE CLOSED.
FLOW IN DIRECTION (1) CREATES A PRESSURE DIFFERENCE BETWEEN POSITION 'X' AND POSITION 'Z'.
AS THERE IS NO LARGE FLOW BETWEEN POSITIONS 'X' AND 'Y', THERE IS NO SIGNIFICANT PRESSURE DIFFERENCE IN THE PIPE.
CONSEQUENTLY THE PRESSURE AT POSITION 'Y' IS HIGHER THAN AT POSITION 'Z', THUS A FLOW IS CREATED IN THE WARMING LINE FROM POSITION 'Y' TO POSITION 'Z' WHICH WARMS UP THE PIPE BETWEEN POSITIONS 'X' AND 'Y'
2) NORMAL OPERATIONS - TURBINE RUNNING.
IP INTERCEPT VALVE OPEN - LP BYPASS VALVE CLOSED.
FLOW IN DIRECTION (2) CREATES A PRESSURE DIFFERENCE BETWEEN POSITION 'X' AND POSITION 'Y'
AS THERE IS NO LARGE FLOW BETWEEN POSITIONS 'X' AND 'Z', THERE IS NO SIGNIFICANT PRESSURE DIFFERENCE IN THE PIPE.
CONSEQUENTLY THE PRESSURE AT POSITION 'Z' IS HIGHER THAN AT POSITION 'Y', THUS A FLOW CREATED IN THE WARMING LINE FROM POSITION 'Z' TO POSITION 'Y' WHICH KEEPS THE PIPE HOT BETWEEN 'X' AND 'Z' READY FOR IMMEDIATE SERVICE.
IP INTERCEPT VALVE
WARMING LINE
LP BY-PASS VALVE
HOT RE-HEAT SYSTEM
Y
Z
X
NOTES:
1) WARMING LINE MUST BE SELF DRAING AND BE TO MAINTAIN >50°K IN THE PIPE WITH NO FLOW.
REVISION
REFERENCE DRAWINGS
CLASSIFICATION
PBS PATH
EvZ
ML
SJG
SCALE N.T.S
Eskom
HIGH PRESSURE PIPING STANDARD
TYPICAL SYSTEM
FOR WARMING PIPES IN INTERMITTEND USE
0.00/10240
SHT 13
REV 01
SIZE A3L