Eskom	Standard	Technology

Title: **Standard for Welding Requirements on Eskom Plant**

Unique Identifier:	**240-106628253**
Alternative Reference Number:	**N/A**
Area of Applicability:	**Eskom**
Documentation Type:	**Standard**
Revision:	**1**
Total Pages:	**20**
Next Review Date:	**September 2020**
Disclosure Classification:	**CONTROLLED DISCLOSURE**

APPROVED FOR AUTHORISATION
☑ TECHNOLOGY ENGINEERING
DOCUMENT CENTRE ☎ X4962

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SCOT Study Committee Number/Name: **Materials, Welding and NDT Study Committee**

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1. INTRODUCTION

This document provides mandatory requirements for welding activities on Eskom power plants.

2. SUPPORTING CLAUSES

2.1 SCOPE

The requirements contained in this standard shall apply to all welding activities performed on all Eskom power plants.

This document supersedes the following standards (which have been revoked):

- **240-56241933**: Control of Welding during Construction, Repair and Maintenance Activities Standard
- **240-56241639**: Construction and Repair Welding of Primary Air, Induced and Forced Draught Fans Standard
- **240-56246601**: Qualification, Certification and Accreditation Requirements for Personnel and Entities Performing Welding Related Work on Eskom Plant Standard
- **240-56355225**: Welding of High Pressure Temperature Tube and Pipework
- **240-77196678**: Heat Treatment of Welded Components Standard.

2.1.1 PURPOSE

The purpose of this document is to set out the welding rules and requirements for welding on Eskom power plants.

2.1.2 APPLICABILITY

This document shall apply throughout Eskom Holdings Limited Divisions.

2.2 NORMATIVE REFERENCES

Parties using this document shall use the most recent editions of the documents listed in this section.

[1] Occupational Health and Safety Act 85 of 1993 (OHS-Act)

[2] Pressure Equipment Regulations (PER)

[3] ASME Section I Rules for construction of power boilers

[4] ASME Section III Rules for construction of nuclear facility components (divisions 1, 2 and 3)

[5] ASME Section VII Recommended guidelines for the care of power boilers

[6] ASME Section VIII Rules for construction of pressure vessels (divisions 1, 2 and 3)

[7] ASME Section XI Rules for in-service inspection of nuclear power plant components

[8] ASME Piping Codes: B31.1 – Power Piping, B31.2 – Fuel Gas Piping, B31.3 – Process Piping

[9] ASME PCC-2: Repair of Pressure Equipment and Piping

[10] ASME PCC-3: Inspection Planning Using Risk-based Methods

[11] BS 1113: Design and manufacture of water-tube steam generating plant (including superheaters, reheaters and steel tube economizers)

[12] PD 5500: Specification for unfired fusion welded pressure vessels

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[13] EN 12952 (All parts) Water-tube boilers and auxiliary installations

[14] EN 12953 (All parts) Shell boilers

[15] EN 13445 Unfired pressure vessels

[16] EN 13480 (All parts) Piping

[17] AWS Structural Welding Codes

[18] AWS B2.1/B2.1M: Specification for Welding Procedure and Performance Qualification

[19] CWA 15740: Risk-based inspection and maintenance procedures for industry (RIMAP)

[20] RCC-M: Design and construction rules for mechanical components of PWR nuclear standards

[21] Technical Rules Technical rules for steam boilers (TRD), all sections

[22] AD-2000 Technical rules for pressure vessels (TRB), all sections

[23] EN 10052 – Vocabulary of heat treatment terms for ferrous products

[24] ISO 13916 - Welding — Guidance on the measurement of preheating temperature, interpass temperature and preheat maintenance temperature.

[25] EN 60584 – Thermocouples.

[26] AWS D10.10/D10.10M – Recommended Practices for Local Heating of Welds in Piping and Tubing.

[27] IIW document: IAB-252r2-14; Minimum requirements for the education, training, examination and qualification - Personnel with responsibility for welding coordination

[28] IIW document IAB-089r5-14; Minimum requirements for the education, training, examination and qualification - International Welder

[29] IIW document IAB-041r3-08; Minimum requirements for the education, training, examination and qualification; International Welding Inspection Personnel.

[30] EN 1011: Welding- Recommendations for welding of metallic materials

[31] ISO 15607: Specification and qualification of welding procedures for metallic materials - General rules

[32] ISO/TR 15608: Welding – Guidelines for a metallic material grouping system

[33] ISO 15609: Specification and qualification of welding procedures for metallic materials

[34] ISO 15610: Specification and qualification of welding procedures for metallic materials. Qualification based on tested welding consumables

[35] ISO 15611: Specification and qualification of welding procedures for metallic materials. Qualification based on previous welding experience

[36] ISO 15612: Specification and qualification of welding procedures for metallic materials. Qualification by adoption of a standard welding procedure

[37] ISO 15613: Specification and qualification of welding procedures for metallic materials Qualification based on pre-production welding test

[38] ISO 15614 Specification and qualification of welding procedures for metallic materials

[39] ISO 5817: Welding - Fusion-welded joints in steel, nickel, titanium and their alloys (beam welding excluded) – Quality levels for imperfections

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[40] ISO 17663 : Welding – Quality requirements for heat treatment in connection with welding and allied processes

[41] ISO 14731: Welding co-ordination. Tasks and responsibilities

[42] EN 14732: Welding personnel. Qualification testing of welding operators and weld setters for mechanized and automatic welding of metallic materials

[43] ISO/IEC 17025: General requirements for the competence of testing and calibration laboratories

[44] ISO 9606: Approval testing of welders

[45] ISO 3834: Quality requirements for Welding

[46] ISO 14175: Welding Consumables – Gases and Gas Mixtures for Fusion Welding and Allied Processes

[47] ISO 23279: NDT of Welds – Ultrasonic testing – Characterisation of indications in welds

[48] ISO 17640: Non-destructive Testing of welds – Ultrasonic testing - Techniques, testing levels and assessment

NATIONAL STANDARDS

N/A

ESKOM STANDARDS

[49] 240-83540088 Requirements for NDT on Eskom Plant Standard

[50] 240-83539994 Eskom NDT Personnel Approval (NPA) for Quality Related Special Processes on Eskom Plant Standard

[51] 240-72273656 Power generation asset critical classification standard

[52] QM 58 Supplier Contract Quality Requirements Specification

2.3 DEFINITIONS

Definition	Description
High Pressure and Temperature Tube and Pipework	Equipment for the conveyance of steam, water, gases or other fluids whose design pressure equals or exceeds 2.0 MPa and/or whose design temperature equals or exceeds 200 °C.

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
ANB	Authorised National Body in accordance with IIW
ATB	Approved Training Body in accordance with IIW
ECSA	Engineering Council of South Africa
IIW	International Institute of Welding

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Abbreviation	Description
IWE	International Welding Engineer registered with IIW
IWP	International Welding Practitioner registered with IIW
IWS	International Welding Specialist registered with IIW
IWT	International Welding Technologist registered with IIW
SAIW	Southern African Institute of Welding
SAQA	South African Qualification Authority
HSLA	High-strength low-alloy
Q&T	Quenched and Tempered

2.5 ROLES AND RESPONSIBILITIES

The roles and responsibilities are defined in section 7 below.

2.6 PROCESS FOR MONITORING

Eskom welding care group shall conduct periodic technical assessments to ensure compliance to these requirements.

3. GENERAL REQUIREMENT

3.1 CODES, STANDARDS AND SPECIFICATIONS REQUIREMENTS

Welding procedure qualification for welds shall be in accordance with the appropriate welding standard incorporated into the relevant design and construction code. Combination or mixing of different codes shall not be permitted.

Heat treatment during procedure qualification shall simulate the actual production post weld heat treatment; for instance, where production heat treatment is (to be) performed following local post weld heat treatment procedures, the welding procedure shall be qualified using local post weld heat treatment.

A WPS supported by a valid WPQR/PQR shall be required for all welding work on Eskom plant. The WPQR/PQR shall be approved by a registered IWE or IWT with minimum qualifications as defined in section 7 below. Eskom shall reserve the right to review a WPS and associated weld maps prior to commencement of fabrication.

Weld build-ups for pressure boundary thickness restoration shall not be permitted.

Mechanical tests conducted during welding procedure qualifications shall be performed at an accredited mechanical test laboratory conforming to the requirements of ISO/IEC 17025

Welding and testing (destructive and non-destructive) of the test pieces shall be witnessed by an AIA or Notified Body.

Proximity of welds shall comply with the applicable health and safety standards and/or engineering specification, taking into account the requirements for non-destructive testing, in particular requirements for complete coverage of each weld requiring volumetric inspection by ultrasonic testing.

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The maximum hardness limit during welding procedure qualification for the materials listed below shall be 300 HV_{10}.

- 7CrMoVTiB10-10 (P/T24);
- 7CrWVMoNb9-6 (P/T23);
- X20CrMoV12-1;
- X10CrMoVNb9-1 (P/T91);
- X10CrWMoVNb9-2 (P/T92);
- VM12-SHC.

3.2 WELDER AND WELDING OPERATOR QUALIFICATION

Welders and welding operators shall be qualified in accordance with the requirements of the latest applicable construction code or engineering specification relevant to the plant.

3.3 INSPECTION AND NON DESTRUCTIVE TESTING (NDT)

NDT on welds shall be performed according to the requirements of the relevant design and construction codes, applicable (additional) engineering or product specifications and Eskom standards 240-83539994 and 240-83540088.

3.4 WELDING CONSUMABLES CONTROL

Consumables requiring strict control of and protection from moisture shall be stored in a clean and dry atmosphere at a minimum temperature of 80°C. Consumables not used during any one shift shall be returned to the consumable storage area for re-baking as per the maximum allowable re-baking works procedure.

All consumables showing signs of damage to coatings, rust or contamination by any carbonaceous (paint, oil, polymers etc.) substance shall be promptly removed from storage or circulation and properly disposed of. There shall be no mixing of different class/grade of consumables in one container.

4. SPECIFIC REQUIRMENTS FOR WELDING ON HIGH PRESSURE AND TEMPERATURE TUBE AND PIPEWORK

4.1 WELDING CONSUMABLES

Welding consumables for use in the creep range shall comply with the applicable consumable standard for creep resistant steels. For commonly used welding processes the following standards are normally applicable:

- MMA: ISO 3580 **OR** AWS A5.5M
- SAW wire: ISO 24598 **OR** AWS A5.23M/A5.17M
- SAW flux: ISO 14174 **OR** AWS A5.23M/A5.17M
- TIG: 1SO 21952 **OR** AWS A5.28M
- GMAW: ISO 14343 **OR** AWS A5.28M
- FCAW ISO 17634 **OR** AWS A5.36M

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4.2 THERMAL CUTTING

Where thermal cutting by plasma arc or by the oxy-fuel technique is required for these materials:

- 14MoV6-3 (660);
- 15NiCuMoNb5-6-4 (WB 36);
- 7CrMoVTiB10-10 (P24);
- 7CrWVMoNb9-6 (P23);
- X20CrMoV12-1;
- X10CrMoVNb9-1 (P91);
- X10CrWMoVNb9-2 (92)
- VM12-SHC;

the procedure specifying the following minimum critical parameters shall be submitted to Eskom for approval:

- Pre-heat temperature
- Cutting travel speed,
- Process gas type,
- Type of flame: neutral, oxidising or reducing
- Gas pressure
- Gas supply rate
- In the case of plasma cutting: the voltage and amperage settings.

4.3 GAS PREHEATING

Preheating by gas shall be permitted under the following conditions:

- Only propane or butane or mixtures thereof shall be permitted as fuel gas on ring burners or torches of the “rosebud” type.
- When temperature indicating crayons are used, at least three ranges shall be employed while heating to give progressive warning as the correct temperature is approached.
- For carbon steel and 16Mo3, gas preheating may be used without restrictions.
- Where PHWT is not required, gas preheating of the materials listed below is allowed:
  - 13CrMo4-4 (P/T21);
  - 10CrMo9-10 (P/T22);
  - 14MoV6-3;
  - 15NiCuMoNb5-6-4;
  - 7CrMoVTiB10-10 (P/T24);
  - 7CrWVMoNb9-6 (P/T23);
  - X20CrMoV12-1;
  - X10CrMoVNb9-1 (P/T91);

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- X10CrWMoVNb9-2 (P/T92);
- VM12-SHC.

4.4 WELD REPAIRS

4.4.1 REMOVAL OF DEFECTS

- All gouged surfaces of welds, prior to repair, shall have a minimum of 2 mm of metal ground out in order to ensure complete removal of any oxidised material before re-welding commences
- Carbon arc air gouging shall not be permitted on 14MoV6-3 (660); X20CrMoV12-1; X10CrMoVNb9-1 (P91); X10CrWMoVNb9-2 (P92) and VM12-SHC materials. On all other materials, an appropriate preheat shall be used if carbon arc air gouging is to be carried out.
- The excavated area shall be subjected to suitable surface examination to ensure complete removal of the defect. A test record attesting to this shall be generated for piping and header components.

4.4.2 WELD REPAIRS

- The repaired areas shall be re-examined using the same inspection procedures by which the defects were originally detected.
- Repair after PWHT shall not be permitted unless prior written approval is granted by the Eskom-appointed welding coordinator.
- Weld repairs shall be appropriately mapped on the relevant drawings for all components except for tubes.

5. SPECIFIC REQUIRMENTS FOR WELDING PRIMARY AIR, INDUCED AND FORCED DRAUGHT FANS

5.1 REMOVAL OF WEAR PLATES AND LINERS

Removal of the liners with the fan in-situ is not generally recommended other than in the exceptional circumstances where an individual wear plate or liner needs replacement, in which case the following shall be observed:

- Prior to any preheating being applied for gouging or welding purposes, a small hole of 3 mm diameter must be drilled near the blade trailing edge weld (minimum 20 mm from the weld). The hole must enter the air space between the blade plates. All holes shall be closed by welding after completion of the work.
- Preheating before gouging or welding is essential and must conform to the applicable WPS.
- Liners to liner welds may be removed by argon arc air gouging. All other liner to fan impeller welds shall be removed by abrasive grinding where practically possible.
- Once all the required wear plates are removed, the previously welded areas shall be ground to a smooth profile.
- 100% MPI inspection shall be carried out on all the ground areas as well as the adjacent material

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5.2 INSPECTION OF WELDMENTS

Final inspection of welds on HSLA and Q&T steels shall be delayed and performed at least 48 hours after cooling down from welding and PWHT. The time between completing the weld or PWHT (if applicable) and performing final inspection shall be as long as possible within the time constraints of the outage.

Exemption for delayed inspection may be considered provided the following conditions are met:

- Approval is granted in writing by the Eskom-appointed welding coordinator.
- Only the balancing weights to the side plate attachment welds shall be considered for exemption from the minimum of 48 hours waiting time.
- When conditions specified in Section 5.3 below are met.

5.3 WELDING OF BALANCING WEIGHT TO THE SIDE PLATE WHERE DELAYED INSPECTION IS (TO BE) WAIVED

For preheating and bake-out heat treatment, resistance heating mats shall be applied. A gas heating technique may be considered for applications where resistance heating methods are found to be impractical.

A pre-weld hydrogen bake-out shall be performed in the area of welding, using heating pads (covered with insulation material) to a temperature of between 200ºC and 250 ºC and a dwell time of 3 hours.

100% MPI inspection must be carried out after welding and/or PHWT where applicable.

Where the WPS does not require PWHT the following conditions shall also apply:

- Stringer bead welds shall be applied when using the high/upper end of the allowed heat input range as specified in the WPS.
- Only SMAW and/or GTAW welding process shall be allowed. A minimum of two weld layers shall be required to fill the butt weld or complete a fillet weld to provide for some tempering on the first layer by the subsequent layer.
- A post-weld hydrogen bake-out shall be performed in the area of welding, using heating pads (covered with insulation material) to a temperature of between 200ºC and 250 ºC and a dwell time of 3 hours.
- Metallographic replication of the final weldment should be performed for further evaluation and assessment of future risk mitigation, as may be necessary.

6. HEAT TREATMENT OF WELDED COMPONENTS

6.1 PREHEAT AND INTERPASS TEMPERATURE

When temperature indicating crayons are used for measuring preheat and interpass temperatures, crayons rated for both minimum preheat and maximum interpass temperatures shall be used.

The measured preheat, interpass and preheat maintenance temperatures shall be recorded as part of the final report that shall be included in the data book.

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6.2 HEATING AND COOLING RATES DURING LOCAL PWHT

For local post weld heat treatment, maximum heating and cooling rates for temperatures ≥300°C shall be as indicated below:

- 220 °C/h – for component thicknesses *e* ≤ 25 mm;
- 5 500/*e* °C/h – for component thicknesses within the range 25 mm < *e* ≤ 100 mm;
- 55 °C/h – for component thicknesses *e* > 100 mm.

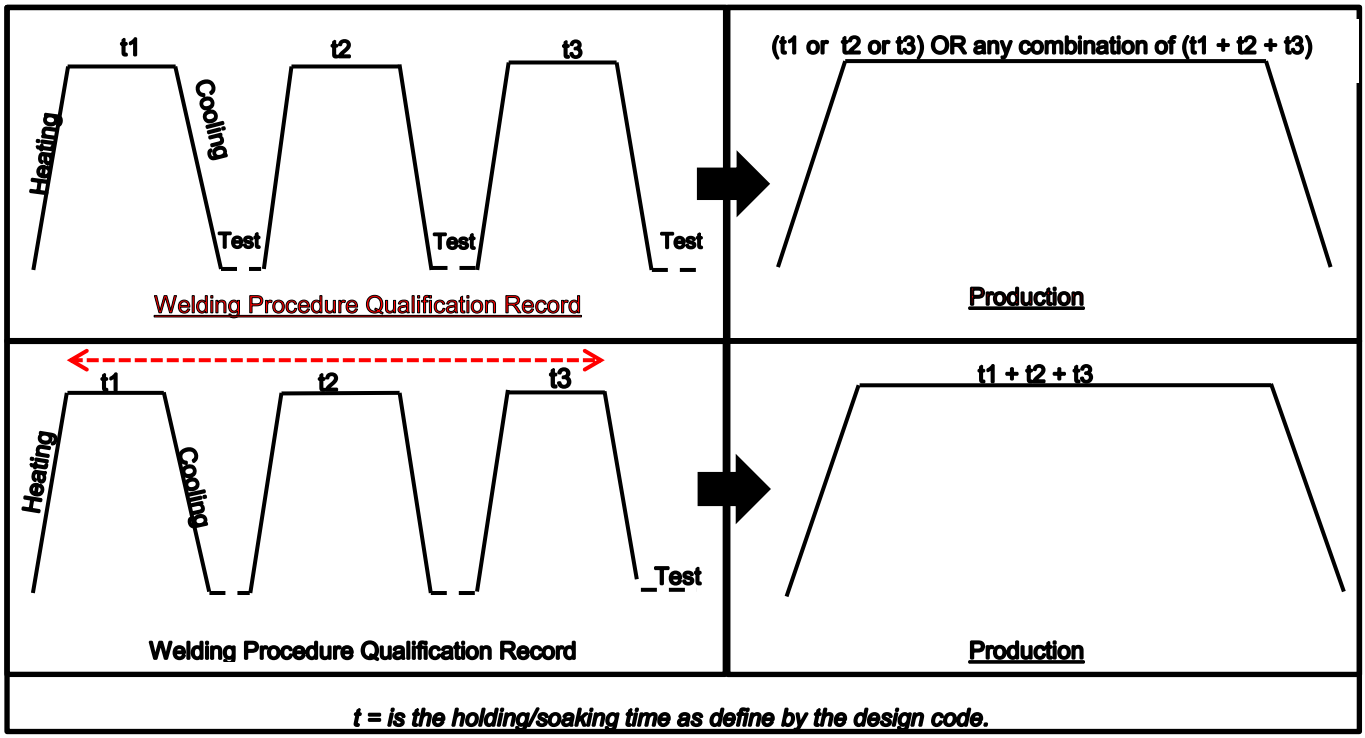
Where *e* is the components thickness in *mm*

When welding is performed on material that has exceeded its creep design life, post-weld heat treatment parameters (in particular the heating and cooling rates) shall be specified having regard to the material condition and component configuration in accordance with international best practice to ensure that the integrity of the final welded component is not impaired.

6.3 POST WELD HEAT TREATMENT

Post weld heat treatment procedures shall be demonstrated to be adequate for the component geometry in production.

Production heat treatment cycles and/or cumulative heat treatment soaking times shall be limited to the number of heat treatment cycles and/or cumulative heat treatment soaking times simulated during the welding procedure qualification test (refer to the figure below for illustration). When full mechanical testing in accordance with code requirements has been performed for each cycle, each cycle may be considered as a stand-alone production cycle.



Prior to PWHT, welded joints involving ferritic/martensitic steel grades [such as X20CrMoV12-1; X10CrMoVNb9-1 (P91); X10CrWMoVNb9-2 (P92) and VM12-SHC] shall be cooled down from interpass temperature to a temperature below 80 degrees over the full thickness of the component.

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6.4 INTERUPTION DURING POST WELD HEAT TREATMENT

When heat treatment is interrupted during heating, the heat treatment shall be restarted (as per the heat treatment procedure) from any temperature and heating rate in accordance with the applicable codes and Section 6.2 of this standard.

When heat treatment interruption occurs during soaking, the remaining soaking time as per the heat treatment procedure shall be implemented upon resumption of the heat treatment from a temperature and rate appropriate for the component. Where there is reasonable technical justification for exemption against this requirement, a written motivation shall be submitted to the Eskom-appointed welding coordinator for evaluation and approval.

NOTE: *If the interruption violates the specified cooling rates, the incident shall be reported to the Eskom-appointed Welding Coordinator for resolution.*

In the event of heat treatment interruption during cooling, the heat treatment shall be considered completed unless the interruption violates the cooling rates specified in Section 6.2 above, in which case the incident shall be reported to the Eskom-appointed Welding Coordinator for resolution.

7. QUALIFICATION AND ACCREDITATION REQUIREMENTS FOR PERSONNEL AND ENTITIES PERFORMING WELDING RELATED WORK ON ESKOM PLANT

7.1 PERSONNEL PERFORMING WELDING RELATED ACTIVITIES

The authorization for the following tasks and responsibilities for each site, project and manufacturing shall be accorded to the person in writing and accepted by signature. Appointment shall be made via the relevant managers and/or the Eskom Welding Care Group delegate.

Any qualification, other than that specified in this standard, such as from another country/entity that is considered to be equivalent shall be evaluated by the Eskom Welding Care Group for relevance and/or applicability.

7.2 WELDERS

7.2.1 CONSTRUCTION CODE QUALIFICATION

Welders and welding operators working on Eskom plant shall be qualified in accordance with the latest applicable health and safety standard.

7.2.2 INTERNATIONAL WELDER QUALIFICATION

In addition to the mandatory qualifications required in section 3.2 and 7.2.1 above, welders working on Eskom Levels One and Two Plant shall have at least one of the following requirements and only conduct welding for the type of welding qualified; e.g. tube welding shall require an International Tube Welder qualification for the specific welding process being used.

- International Tube Welder.
- International Plate Welder.
- International Fillet Welder.

This welder training shall be based on IIW documents IAB-089r5-14 Parts 1 and 2

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7.3 WELDING COORDINATOR

Welding coordinators shall have one of the following minimum requirements for education, examination and qualification:

- International Welding Engineer (IWE) in line with IIW document IAB-252R2-14.
- International Welding Technologist (IWT) in line with IIW document IAB-252R2-14.

In addition the Welding Engineer/Technologist shall be registered with ECSA as Professional Engineer/Technologist. Registration with other professional bodies shall be subject to approval by the Eskom Welding Care group.

The minimum tasks and responsibilities assigned to the welding coordinator shall be as follows:

- Review the product standard to be used, together with any supplementary requirements.
- Ensure that all welding and related activities are performed in accordance with all applicable Eskom standards.
- Maintain a register of all WPSs and WPQRs and maintain their validity.
- Identify need for new WPSs and arrange compilation and qualification.
- Welding problem investigation.
- Provide technical advice to supervisory and inspection staff.
- Ensure all welders performing welding operations are correctly qualified to the applicable code.
- Maintain and update a register of welder's qualifications using a separate identification number for each welder (this function can be delegated to an IWS by an IWE/IWT)
- Select the appropriate WPS and qualified welder for each welding operation.
- Ensure conformance to approved WPS's for all welding operations.
- Coordinate training of welders to meet site/workshop specific conditions.
- Coordinate refresher training programs for welders and arrange requalification tests.
- Test new welders. (this function can be delegated to an IWS by an IWE/IWT)
- Ensure that all welding work is inspected by competent and qualified personnel.
- Review and approve all heat treatment procedures prior to heat treatment commencing.
- Witness the execution of WQR activities if qualification activities are not witnessed by AIA.
- Witness the execution of WPQR activities if qualification activities are not witnessed by AIA.
- Approval of WPQR
- Verify that the information on the WPS accurately reflects the parameters reported on the WPQR before use on Eskom equipment/plant.
- Review the capacity of the site, project or manufacturer to meet the prescribed welding requirements.
- Enforce SANS ISO 3834 philosophies and practices, as required.
- Conduct regular audits to ensure that welding management systems are operating correctly.

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- Investigate any welding activity that could affect Eskom plant in a detrimental way.
- Compile and implement repair procedures.
- Compilation of weld maps
- Compilation of the heat treatment procedure.
- Enforce and maintain all legislative requirements related to welding.
- Specify welding sequences, should it be necessary.
- Technical review of:
  - The parent material(s) specification and welded joint properties.
  - The joint location in relation to design requirements.
  - Quality and acceptance requirements for welds.
  - The location, accessibility and sequence of welds, including accessibility for inspection and non-destructive testing
  - Other welding requirements, e.g. batch testing of consumables, ferrite content of weld metal, ageing, hydrogen content, permanent backing, use of peening, surface finish, weld profile.
  - The dimensions and details of joint preparation and completed weld.
- Review the suitability of any sub-contractor for intended welding operations.
- Review the compatibility, delivery conditions, storage and handling of welding consumables
- Review materials for:
  - Any supplementary requirements in the material purchasing specifications.
  - The storage and handling of parent material.
  - Traceability.

7.4 WELDING SUPERVISOR

Welding supervisors shall have at least one of the following minimum requirements for education, examination and qualification:

- International Welding Specialist (IWS) in line with IIW document IAB-252R2-14
- International Welding Practitioner (IWP) in line with IIW document IAB-252R2-14

The minimum tasks and responsibilities assigned to the welding supervisor shall be as follows:

- Plan, organise and control the work load of welders.
- Review and approve all quality control plans related to welding activities.
- Maintain appropriate records of all welding work.
- Exercise general control over all welders and welding operations.
- Ensure conformance to approved WPS's for all welding operations.
- Ensure that the environment is conducive to welding.

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- Ensure all welders welding in his/her area of responsibility are correctly qualified to execute the work assigned to them.
- Train welders to meet site/workshop conditions.
- Exercise control of materials and consumables for welding operations in accordance with the applicable codes and standards.
- Ensure the correct handling and storage of all welding consumables in accordance with the applicable codes and standards.
- Ensure that all consumables used conform to the relevant WPS used.
- Ensure all equipment used in welding operations is calibrated in accordance with the applicable requirements.
- Ensure that all welding equipment is adequately maintained and the maintenance records are kept updated.
- Control of equipment as follows:
  - The suitability of welding associated equipment.
  - Auxiliaries and equipment supply, identification and handling.
  - Personal protective equipment and other safety equipment directly associated with the applicable welding process.
  - Equipment verification and validation.
- Execute effective production planning as follows:
  - The allocation of qualified personnel.
  - Plan for adequate equipment for preheating and post-heat treatment, including temperature indicators and power sources.
  - The arrangement for any production test.
  - Evaluate the issuing and use of work instructions.
- Ensure identification and traceability as follows:
  - The identification of production plans.
  - The identification of routing cards.
  - The identification of weld locations in construction.
  - The identification of the location of repairs.
  - The identification of the location of temporary attachments.
  - Traceability for fully mechanized and automatic welding units to specific welds.
  - Traceability of welder and welding operators to specific welds.
  - Traceability of welding procedure specifications to specific welds.

7.5 WELDING INSPECTOR

Welding inspectors shall have at least one of the following minimum requirements for education, examination and qualification.

Minimum requirements for welding inspection on Eskom level 1 and 2 plant:

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- SAIW Welding and Fabrication Inspector Level 2.
- IIW International Welding Inspector: Comprehensive (IWI- C)
- IIW International Welding Inspector: Standard (IWI- S)

Minimum requirements for welding inspection on Eskom level 3 Eskom plant:

- SAIW Welding and Fabrication Inspector Level I.
- IIW International Welding Inspector: Basic (IWI- B)

The minimum tasks and responsibilities assigned to the welding inspector shall be as follows:

Verification of parent material identity by correlation of hard Inspection and testing before welding:

- The validity of welders' and welding operators' qualification certificates.
- The validity of the welding procedure specification.
- Stamping and/or related product markings to parent material certificates.
- The identity and traceability of welding consumables.
- Verification of joint preparation (e.g. shape and dimensions), in relation to that specified in the design, drawing and/or WPS.
- Fit-up, jigging and tacking.
- Any special requirements in the welding procedures specification (e.g. prevention of distortion).
- The suitability of working conditions for welding, including environment.
- The calibration and validity of measuring, inspection and testing equipment.
- Confirming the training/competency of heat treatment technicians as per section 7.8 below.
- Review of quality control plans for completeness and relevance to the intended scope of work.
- Correct storage of welding consumables.
- The identification and traceability of the welding consumables (e.g. designation, trade name, manufacturer of consumables and batch or cast numbers).
- The identification and traceability of parent material (e.g. type, cast number).
- Verification of minimum requirements by signing of the heat treatment chart and QCP's at critical intervention points.
- Review suitability of NDT techniques to be used.
- Review of NDT technician certifications and qualifications in line with Eskom requirements.
- Review of relevant drawings to ensure welding compliance to design requirements.

Inspection and testing during welding:

- Verification of essential welding parameters (e.g. welding current, arc voltage and travel speed), as defined in the approved WPS.
- Verification and control of preheating/inter-pass temperatures as defined in the approved WPS.
- The cleaning of runs and layers of weld metal.

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- Back gouging.
- The welding sequence as defined in the approved WPS.
- The correct use and handling of welding consumables.
- Verify control of distortion.
- Any intermediate examination (e.g. checking dimensions).
- Updating of quality control plan.

Inspection and testing after welding:

- Visual inspection (for completeness of welding, weld dimensions, shape).
- The use of correct NDT processes as per the quality control plan.
- The use of correct destructive testing processes as per the quality control plan.
- The form, shape, tolerance and dimensions of the construction against the acceptance criteria detailed in the quality control plan.
- The results and records of post-operations (e.g. post-weld heat treatment, ageing), as per the quality control plan.
- Verification by inspection that Post-Weld Heat Treatment (PWHT) activities are being performed in accordance with the specification/s, as per the quality control plan.
- Issuing of Non-Conformance and track the closing of the Non-Conformance.
- Ensure that the necessary measures and actions (e.g. weld repairs, re-assessment of repaired welds, corrective actions) are implemented.
- Ensure that all quality records including data books are prepared and maintained as per applicable specifications.

7.6 WELDING INSTRUCTOR

Welding instructors shall have the following minimum requirements for education, examination and qualification:

For practical training:

- International Welding Practitioner (IWP) in line with IIW document IAB-252R2-14.

For theoretical training:

- International Welding Specialist (IWS) in line with document IAB-252R2-14.

The minimum tasks and responsibilities assigned to the welding instructor are as follows:

- Present Welder Training (both theory and practical).
- Maintain Welding Facilities and Equipment.
- Facilitating the Training needs analysis.
- Administer the practical training of the trainees.
- Administer the on-job training of the trainees.

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7.7 SENIOR WELDING INSTRUCTOR/HEAD OF WELDING SCHOOL

Courses leading to IIW qualifications are closely related to industrial practice, and it is essential for teaching staff to have continuing contact with industry. With this in mind teaching staff need to combine the following elements:

- Teaching ability – evidence of training in lecturing, public speaking or verbal communication.
- Competence in the subjects being taught.
- Knowledge and experience of current industrial practice in the subjects being taught.
- Practical skills in the demonstration of welding practice.

Senior Welding Instructor/Head of Welding School shall have one of the following as the minimum requirements for education, examination and qualification:

- International Welding Engineer (IWE) in line with document IAB-252R2-14.
- International Welding Technologist (IWT) in line with document IAB-252R2-14.
- International Welding Specialist (IWS) in line with document IAB-252R2-14.

The minimum tasks and responsibilities assigned to the welding training specialist are as follows:

- Supervise the welding training staff.
- Conduct learner assessments.
- Develop training material and programs.
- Administer the assessments and examinations in line with International Institute of Welding requirements.
- Administer the testing of trainees.
- Execute continuous assessment of the training programs to ensure relevance and effectiveness.
- Updating of the syllabus as required.
- Maintain the current industrial best practice.

7.8 HEAT TREATMENT OPERATORS

Heat-treatment operators shall have the following minimum requirements for education, examination and qualification:

- Internal training (in-house training) manuals must be submitted and approved by Eskom-appointed welding coordinator or independently verified.
- External training, manuals must be submitted and approved by Eskom-appointed welding coordinator or independently verified.

The minimum tasks and responsibilities assigned to the Heat Treatment Operator are as follows:

- Verification of equipment calibration.
- Set up of heat treatment equipment.

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- Attachment of thermocouples in accordance with the method statement and the applicable health and safety code
- Execution of heat treatment in accordance with approved method statement.
- Record and report all deviation from the heat treatment chart
- Compilation of all records pertinent to the heat treatment process.
- Execute heat treatment activities in accordance with Eskom's standard

7.9 WELDING TRAINING SCHOOL FACILITIES

The ATB shall provide an appropriate complement of teaching staff which has, collectively, the knowledge and skills necessary to deliver the course in an effective manner. The number of such staff shall be sufficient to ensure that the essential specialist knowledge and industrial experience to cover the syllabus is adequately represented in the team of teachers and visiting lecturers. In order to effectively deliver the course, one instructor is required for each 10 trainees.

The facilities should be clean, well lit and comfortable. For practical work each student should have ample bench space and good access to test specimens. Classrooms should have adequate desks or tables, and be equipped with suitable teaching aids, such as blackboards, overhead projectors, closed circuit television, slide projectors and video equipment, as appropriate to the course.

The lectures must be supported by good quality visual aids, for example: slides, physical samples and/or videos.

The ATB shall maintain a reference library of key material available to students for background study. This library shall include a comprehensive collection of standards relevant to welding.

A full set of good quality course notes should be maintained in order to ensure consistency between courses and in the event of any change of staff. Lectures should be supported by good quality handbooks issued to students containing key information for reference.

A final examination to assess student performance, in accordance with the relevant IIW guideline will be conducted by a Board of Examiners appointed by the Governing Board of the ANB. This examination is mandatory, and is independent of any assessment procedure conducted by the ATB.

The training facilities for all welding personnel shall be accredited by IIW and use the IIW training programme as the basis for its training and qualification programme.

7.10 ACCREDITATION OF COMPANIES PERFORMING WELDING ON ESKOM PLANT

All companies performing welding related activities on Eskom plant shall have accreditation to ISO 3834 as follows.

Equipment Group	Minimum Quality Level	Type
Eskom Level 1 Plant	IS0 3834 Part 2	Comprehensive
Eskom Level 2 Plant	IS0 3834 Part 3	Standard
Eskom Level 3 Plant	IS0 3834 Part 4	Elementary

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8. RECORDS AND DATA PACKAGES

Records pertaining to any manufacture, repairs or modifications shall be compiled as per the requirements of QM 58.

9. AUTHORISATION

This document has been seen and accepted by:

Name & Surname	Designation	DIVISION
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10. REVISIONS

Date	Rev.	Compiler	Remarks
July 2016	0	Prince Dlamini	First Draft for Internal Review and comments
August 2016	0.1	Prince Dlamini	Final Draft for Formal Comments Review Process
September 2016	1	Prince Dlamini	Final Document for Authorisation and Publication

11. DEVELOPMENT TEAM

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

- Morris Maroga
- Prince Dlamini
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