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1. INTRODUCTION

Need has been acknowledged for a generic specification/standard for magnetic separators and metal detectors to:

a. Assist Generation Division users to standardise their requirements and to aid them during the erection and commissioning of the separators and detectors.

b. Increase the efficiency of the current magnetic separators on all Power Stations by providing the user with the technical specification/standard.

2. SUPPORTING CLAUSES

2.1 SCOPE

This specification covers the requirements for magnetic separators and metal detectors to be installed on coal conveyor systems.

2.1.1 Purpose

The purpose of this document is to specify technical requirements for the procurement of magnetic separators and metal detectors to be installed on Eskom plant.

2.1.2 Applicability

This document applies to Eskom coal fired power stations.

2.2 NORMATIVE/INFORMATIVE REFERENCES

The following documents contain provisions that, though referenced in the text, constitute requirements of this specification. At the time of publication, the editions indicated were valid. All standards and specifications are subject to revision, and parties to agreements based on this specification are encouraged to investigate the possibility of applying the most recent editions of the documents listed below. Information on currently valid national and international standards and specifications can be obtained from the Information Centre and Technology Standardization Department at Megawatt Park or directly from the South African Bureau of Standards.

2.2.1 Normative

[1] IEC 60076-1:2011, Power transformers - Part 1: General.

[2] IEC 60076-2:2011, Power transformers - Part 2: Temperature rise for liquid- immersed transformers.

[3] IEC 60076-3:2013, Power transformers - Part 3: Insulation levels, dielectric tests and external clearances in air.

[4] SANS 780: 2009, Distribution transformers

2.2.2 Informative

[5] 240-55864503: Rev. 2, Belt Conveyor Mechanical Components Standard.

[6] 240-55864504: Rev. 1, Belt Conveyor Structural Steelwork and Welding Standard.

[7] 240-55864505: Rev. 1, Erection of Belt Conveyor Mechanical Standard.

[8] BS 292-1:1982 (1987), Rolling bearings: ball bearings, cylindrical and spherical roller bearings - Part 1: Specification for the dimensions of ball bearings, cylindrical and spherical roller bearings (metric series).

[9] BS 1486-1:1959, Lubricating nipples - Part 1: Lubricating nipples and adaptors for use on machinery and vehicles. Amendment No. 1: 1996.

[10] BS 6704:1996, Code of practice for selection, installation and maintenance of intrinsically safe electrical equipment in coal mines.

[11] BS EN 10095:1999, Heat resisting steels and nickel alloys

[12] BS EN 10250-4:2000, Open steel die forgings for general engineering purposes. Stainless steels

[13] IEC 60146:1991, Semiconductor convertors - General requirements and line commutated convertors - Part 1-1, 1-2 and 1-3.

[14] IEC 60147:1983, Essential ratings and characteristics of semiconductor devices and general principles of measuring methods - Part 1, 2 and 6.

[15] IEC 60621-3:1986, Electrical installations for outdoor sites under heavy conditions (including opencast mines and quarries) - Part 3: General requirements for equipment and ancillaries.

[16] SANS 1200-A:1986, Standardized specifications for civil engineering construction - Section A: General.

[17] SANS 1313-1:2012 Edition 4, Conveyor Belt Idlers Part 1: Troughed belt conveyor Idlers (metallic and non-metallic) for idler roller rotational speeds of up to 750 revolutions per minute.

[18] SANS 1313-2:2012, Conveyor Belt Idlers Part 2: Link suspended idlers and fixed-form suspended idlers (metallic and non-metallic) for idler rotational speeds of up to 750 revolutions per minute.

[19] SANS 1804-2:2012, Induction motors Part 2: Low-voltage three-phase standard motors.

[20] SANS 1804-4:2012, Induction motors Part 4: Single-phase induction motors.

[21] SANS 780:2009, Distribution Transformers.

[22] SANS IEC 60034: 2001, Rotating electrical machines (22 parts).

[23] SANS IEC 60034-1: 2010, Rotating electrical machines - Part 1: Rating and performance.

[24] SANS IEC 60529:1989, Degrees of Protection Provided by Enclosures (IP code).

[25] SANS ISO 9001:2000, Quality management systems - Requirements

[26] The Occupational Health and Safety Act, Act No. 85 of 1993 (OHS Act)

2.3 DEFINITIONS

Definition	Description
Cross Belt Separator	Over band Magnetic Separator for separation of ferrous metals, installed above conveyor belt perpendicular to the direction of conveyor belt movement.
In-line Separator	Over band Magnetic Separator for separation of ferrous metals, installed above conveyor belt parallel to the direction of conveyor belt movement.
Shore Hardness Test/Scleroscope Hardness Test	The determination of the hardness of metals by measuring the rebound of a diamond-tipped hammer dropped from a given height.
Tramp Iron	Pieces of iron or steel e.g. broken drills, miner's picks, crusher jaws or pieces of steel mixed with the coal, which must be removed to prevent any subsequent damage.

2.3.1 Classification

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

2.4 ABBREVIATIONS

Abbreviation	Description
AC	Alternating Current
BS	British Standard
CSIR	Council for Scientific and Industrial Research
DC	Direct Current
IEC	International Electrotechnical Commission
IP	Ingress Protection
OHS	Occupational Health and Safety
SANS	South African National Standards

2.5 ROLES AND RESPONSIBILITIES

Compiler: Responsible to compile the document and to ensure that the content is integrated to reflect the requirements of every stakeholder forming part of this project.

Functional Responsible: The Functional Responsible person is responsible to approve the content of the document and assure its correctness before the document is submitted for authorisation.

Authoriser: The document Authoriser is responsible to ensure that the correct processes were followed in developing this document and that the relevant stakeholders have been involved. The Authoriser also reviews the document for alignment to business strategy, policy, objectives and requirements. He/she shall authorise the release and application of the document.

2.6 PROCESS FOR MONITORING

This document will be maintained and reviewed as per the Document and Record Management Procedure.

2.7 RELATED/SUPPORTING DOCUMENTS

None

3. SPECIFICATION FOR MAGNETIC SEPARATORS

3.1 REQUIREMENTS

Magnetic separators shall be suspended over conveyors. Suspended magnets can be either permanent magnets or electromagnetic separators. This specification applies to electromagnetic separators.

3.1.1 Suspended self-cleaning cross belt magnetic separators

a. Cross belt magnetic separators shall clear the burden depth of a fully loaded belt with the material load extending to the edge of the belt.

b. Where cross belt magnetic separators are installed over belts, the distance between the face of the magnet and the conveying belt shall allow for a normal depth of burden and the clearance on top of the burden shall be according to the manufacturer recommendation.

c. Surge guards shall be provided to prevent material becoming trapped between the magnet belt and the pulleys.

d. Tramp iron discharge chutes shall be fitted at the discharge end of the magnet, leading into a tramp iron discharge box. The chute lip shall be of a non-magnetic material (e.g. manganese or stainless steel).

e. The discharge box shall be of robust construction and suitably braced. It shall be mounted on wheels and have lifting lugs welded on for easy removal of the box. In addition the discharge box shall have an easily removable grid fitted half way up the box to separate smaller pieces of broken metal and rods and other small items from larger tramp iron pieces.

f. Idlers and decking plates mounted directly beneath the magnets shall be made of non-magnetic materials.

3.1.2 Suspended self-cleaning in-line magnetic separators

a. In addition to the requirements for cross belt magnetic separators, the design for in-line magnetic separators shall allow for horizontal and vertical adjustment.

3.1.3 Suspended manual cleaning magnets (magnets without self-cleaning belts)

a. All magnets shall be marked clearly, indelibly and permanently with arrows and "direction of the conveyor belt" inscriptions to prevent incorrect installation.

b. Provision shall be made for limit switches to be mounted at the end of the crawl beams from which the magnet is suspended. The magnet shall only be de-energized when the magnet is moved against the terminal switch at the end of the crawl beams.

c. It shall be ensured that fins are provided on the outside of the suspended magnets for additional heat dissipation.

d. The magnet face shall have replaceable stainless steel bumper/wear plates to absorb metal impact.

e. The magnet shall be interlocked with the corresponding conveyor by means of an operated contactor.

f. Tramp iron discharge boxes as specified in paragraphs 3.1.1 (d) and (e) shall be provided for each suspended magnet.

3.2 MECHANICAL REQUIREMENTS FOR MAGNETIC SEPARATOR

3.2.1 Belt

3.2.1.1 Belt Tension

The tensioning of the belt shall be sufficient to prevent slip at the drive pulley.

3.2.1.2 Belt Fasteners

Non-magnetic fasteners shall be used for joining the belt.

3.2.1.3 Belt Rating

The belt class will be specified and shall be selected for a tension incorporating standard belt safety factors.

3.2.1.4 Belt Type

The number of plies and top - and bottom covers in conjunction with the type, method of fixing and number of slats across the belting shall be specified by the supplier. The number of plies shall be limited to prevent separation of the plies due to the high duty cycle of the belt.

3.2.1.5 Belt Width

For in-line magnetic separators and conveyor belt widths of up to 1 500 mm the tramp iron belt shall be 150 mm wider than the conveyor belt. For conveyor belts of a width exceeding 1 650 mm the tramp iron belt shall be of the same width as the conveyor belt.

3.2.1.6 Belt Speed

For in-line magnetic separators the tramp iron belt shall travel at the same speed as the conveyor belt, not less, and not more than 20% faster than the speed of the conveyor belt. For cross belt magnetic separators, the tramp iron belt shall travel at a nominal speed of 2.0 m/s.

3.2.1.7 Belt Alignment

The belt tensioning device shall be of robust construction and shall be mounted on the framework of the separator. Positive alignment of the belt is essential as the magnetic separators may be tilted slightly.

3.2.2 Magnetic separator belt idler and pulley bearings

3.2.2.1 Bearings

a. The selection of bearings, which shall comply with the requirements of BS 292-1 shall be based on continuous service as dependability is of the utmost importance. The bearings shall be selected to carry all radial and end thrusts.

b. Bearings shall be firmly secured to their respective shafts using point-type set screws. The point-type set screws shall be designed for accurate, non-slip and tight fitting to the shafts. They shall not become loosened whilst running under any operating conditions.

c. All bearings shall be fully adjustable. At the top pulleys, sole plates with jacking screws and locknuts shall be provided.

3.2.2.2 Seals

The bearings shall be sealed against the ingress of dust, grit and moisture. The seals shall be designed for arduous service in a fine abrasive dust-laden atmosphere. Felt or fibre packing shall not be used as dynamic seals.

3.2.2.3 Lubrication

All bearing housings shall be provided with button-headed nipples in accordance with BS 1486-1, clearly identified with red paint. The housing shall be completely filled with grease in order to keep dust out. The grease nipples shall be readily accessible.

3.2.3 Magnetic separator belt pulleys

3.2.3.1 Construction

All pulleys shall be manufactured from grade EN3 material in accordance with BS 970. All stress concentrations in the shell and the disc shall be reduced to a minimum. All pulleys shall be provided with guards according to the requirements of 240-55864503.

3.2.3.2 Crowning

The drive and non-drive pulleys shall be crowned. The crowning of the pulleys shall have a profile formed by three straight lines: two thirds of the face width shall be parallel. NOTE: It is not necessary for the two top pulleys to be crowned.

3.2.3.3 Balancing

The pulleys shall be accurately manufactured and then dynamically balanced before installation to ensure maximum bearing life and minimum vibration.

3.2.3.4 Diameter

The pulleys shall be conservatively sized. The diameter of the pulleys shall not be less than the largest diameter given in accordance with any belt manufacturer's recommendations.

3.2.3.5 Pulley Face Width

The pulley face width shall be larger than the belt width by not less than 200 mm.

3.2.3.6 Pulley Shaft

a. All shafts shall be made of accurately machined, high quality axle steel to grade EN3A of BS 970.

b. All contact connections shall be machined concentrically with a surface texture of not less than 0.8 µm. The shaft shall be machined to the bearing manufacturer's recommended tolerance.

c. The pulley shafts shall be of adequate diameter to limit the amount of twist and so eliminate vibration. The maximum allowable angle of twist shall not exceed 1° on a length equal to 20 times the shaft diameter. The deflected angle of the shaft shall not exceed 1:2 500.

d. The pulley shaft diameter shall be stepped down to prevent wandering of the pulley within the bearing centres. The maximum stepdown for a bearing shall be limited to 10% of the nominal shaft diameter. The shaft reduction shall be polished. The radius of the curve of the stepdown shall be at least three (3) times the step height difference in accordance with the "Peterson" curves for stress concentration.

e. Shafts shall be easily removable from the pulley and the pulley shall be securely fitted to the shaft with friction based releasable clamping assemblies. The tightening torque of the shaft to hub connection shall be clearly stencilled on the pulley end discs.

3.2.3.7 Electro-Magnetic Pulleys

Electro-magnetic pulleys shall not be supplied to Eskom.

3.2.4 Drives

3.2.4.1 Type

The drive shall be shaft mounted and shall comply with the requirements of IP 65 of IEC 60529.

3.2.4.2 Drive Cooling

The motor shall be air cooled and shall comply with the requirements of SANS IEC 60034-1.

3.3 ELECTRICAL REQUIREMENTS FOR MAGNETIC SEPARATORS

Code of practice for the selection, installation and maintenance of intrinsically safe electrical equipment in coal mines shall be according to SANS 10086-1. All electrical equipment shall comply with the SANS standard for hazardous areas.

3.3.1 Transformer-Rectifier

3.3.1.1 General

a. The transformer-rectifiers shall be sealed and oil cooled. They shall be conservatively sized to limit the heat rise of the cooling oil.

b. The DC output shall be electrically isolated from the tank and from earth. The unit shall consist of the double wound rectifier-transformer.

c. The transformer and tank shall comply in general with the requirements of SANS 780 except where otherwise detailed in this specification.

d. The diode and power rectifier shall be chosen so that their current, voltage and thermal ratings, both surge and continuous, are not exceeded under any working conditions or fault conditions external to the device and thereby selecting appropriate or matching high speed semiconductor fuses.

e. Testing shall be in accordance with SANS 780, IEC 60076.

f. A list of spares or critical spares shall be provided.

3.3.1.2 Voltage Changes and Surges

a. A minimum of three sets of taps for various voltage changes shall be incorporated in the transformer-rectifiers, to optimize the magnet's performance.

b. The rectifier circuit shall comprise solid state silicon diodes with suitable individual protection from voltage surge.

3.3.1.3 Enclosures

a. The transformer-rectifier shall be enclosed in a large suitable enclosure complying with the requirements of IP 65 of IEC 60529. The enclosure shall be supplied with double doors.

b. The calibrated voltmeter and ammeter constructed to the requirements IP 65 of IEC 60529 shall be mounted on the outside of the door of the enclosure. The voltmeter and ammeter shall display the output of the rectifier.

c. An emergency stop button to the requirements of IP 65 shall be mounted on the outside of the door of the enclosure. The circuit shall be equipment with correctly sized short circuit protective devices and 3-phase voltage detection relay.

d. The enclosure shall be free standing and shall be provided with robust lifting lugs.

e. All circuit diagram components shall be permanently mounted inside the enclosure and all items inside the enclosure shall be properly labelled to Eskom standard. The wiring terminations shall be labelled as shown on the circuit diagram. The wording shall be in English.

3.3.2 Starter Panels

Suitable starter panels designed and constructed to the requirements of IP 65 of IEC 60529 shall ensure that failure of the belt drive motor, or loss of one or two phases of the electric power supply, or of the DC supply, shall cause the belt to trip.

3.3.3 Electro- Magnet

3.3.3.1 Core

The electro-magnet shall have a high-permeability steel core. The core shall be machined for good continuity and conductivity of the flux and shall be solid or it shall be laminated vertically. The

description of the core (i.e. round, rectangular or square and solid or laminated) and the core dimensions shall be provided by the supplier. Core losses shall be limited to the minimum.

3.3.3.2 Casing

All casing components shall be machined for good conductivity of the flux. The thickness of all casing components shall be specified by the supplier.

3.3.3.3 Coils

The coil conductors shall be insulated to Class "H" of SANS IEC 60034-1 with Class "F" temperature rise. The current density in the coil shall be conservatively rated to ensure minimum ampere-turns losses when the magnetic separator is operating at high temperatures. The magnetic field shall be of sufficient strength and shall be effective over the length of the magnet to provide the most efficient magnetic exposure time to the tramp iron.

NOTE: A high strength but short length of magnetic field may not allow sufficient time for any metal to be drawn through the burden.

3.3.4 Magnetic Separator Supporting Frame

a. The frame shall be designed and constructed to comply with the requirements of 240-55864504 [6] and shall be of robust channel construction to prevent distortion and vibration in service. Robust suspension brackets shall be mounted directly on the supporting frame. Dual holes on each suspension bracket shall be provided for rigging purposes and for using a safety chain.

b. A minimum of four (4) steel spacers shall be mounted directly under the magnetic separators to prevent the separators from coming into direct contact with the ground when they are stored.

c. Two (2) crawl beams and four trolleys shall be mounted above each magnetic separator. The supplier shall allow sufficient space for cables and/or chains and turnbuckles for each magnetic separator.

3.3.5 Oil-Cooled Magnetic Separators

a. The supplier shall be responsible for the supply and filling of the first oil fill of the magnet. The type of oil shall be as per the Eskom standard.

b. Oil filled magnetic separators shall be fitted with a combined oil level, temperature and pressure alarm to indicate at the control room when a fault condition exists.

c. Oil-cooled magnetic separators shall be sealed. Adequate provision shall be made for expansion of the oil. Arrangements to accommodate this expansion shall be clearly described in an offer.

d. When oil-cooled magnetic separators are offered, the casing shall be pressure tested with compressed air to not less than 500 Pa above atmospheric pressure and the test pressure shall be maintained for not less than 30 min without any leakage occurring.

3.4 TESTING MAGNETIC SEPARATORS

3.4.1 Gauss meter to be used for testing

a. Prior to any testing of the magnetic separators, the Gauss meter used to measure the magnetic flux shall be checked against a calibrated test meter to be supplied by the manufacturer of the magnetic separators.

b. At ambient temperature the gauss reading should be 800.

c. When operating at 80°C the gauss reading should be between 650 and 700. For both cases the gauss meter should be placed at the centre of the magnet and at a maximum allowable working gap (the gap between the magnet and the bottom of the material).

d. This calibrated test meter shall be certified by the SANS or CSIR.

e. Gauss test shall be performed once a year and the efficiency of the magnetic separators shall be at least 90%.

3.4.2 In the manufacturer's works

a. Flash testing shall be conducted prior to the mounting of the magnet into the casing. The magnetic separators shall be energized for a continuous period of not less than 24 hours in an ambient temperature of not less than 20°C.

b. The maximum operating temperature of the magnetic separator on the surface of any part of the external casing shall not be greater than 85°C at an ambient air temperature corrected to 20°C.

c. To evaluate the magnet's characteristics, a saturation temperature curve shall be plotted and compared with the original design details and any subsequent tests. The current consumption shall also be recorded.

d. The flux density shall be measured and plotted at the specified distances across both axes of the magnets in 200 mm steps and compared with the original guaranteed flux densities given in Tables 1 to 8.

e. The flux density shall be equal to or better than the flux density quoted in the tender. In the event of the performance test not matching the tendered values the manufacturer shall carry out modifications to achieve the tendered performance prior to the dispatch of the separators to site.

f. A static test of the magnetic separators shall be done as follows:

- A template manufactured from stainless steel plate and of the same profile as the conveyor belt to be protected, shall be used for static testing of the magnetic separator;
- Unwanted tramp iron of the sizes described in Appendix B, shall be buried under a burden of the profile of the material carried by the conveyor, and the template shall be moved under the magnetic separator. The coal shall be supplied by the manufacturer of the magnetic separators. The coal shall have the following size characteristics, in order to test the magnetic separator under similar conditions to those encountered on site:
- 100% of 25 mm or less,
- 50% of 6 mm or less; and
- The distance between the template and the face of the magnet shall be adjusted to the working gaps stated in Appendix A.

g. The static test shall only be considered successful when the guaranteed percentages of extraction of the unwanted tramp iron pieces are achieved.

h. The magnetic separator units that have passed the flux density and the static tests successfully shall then be considered acceptable for dispatch to site.

3.5 SITE TESTING

a. The test before completion shall demonstrate that the extraction as tested in the factory is achieved under site conditions.

b. After 11 months of operation following take-over and prior to the end of the maintenance period, the supplier and Eskom shall jointly repeat the tests undertaken prior to dispatch. The records of the tests in the workshop shall be used for comparative purposes to determine any changes in magnetic performance.

c. An item of equipment will be considered to have passed the test if the magnetic performance is within 2.5% of the original result. For oil cooled magnets, the current density should be 1.3 or less and for air cooled magnets, the current density should be 0.8 or less.

d. Parameters that have to be considered when evaluating the performance of magnetic separators are:

- Voltage
- Absorbed power (20°C)
- Resistance when cold
- Operating temperature
- Current absorption during operation
- Resistance during operation
- Flux produced at operating gap
- The distance between the magnet and the bottom of the material (operating gap) v/s maximum allowable working gap as specified by the supplier.

3.6 SPECIFYING A MAGNETIC SEPARATOR

a. The following factors shall be specified when purchasing a magnetic separator:

- Belt width
- Belt speed
- Trough angle
- Belt capacity
- Material profile
- Incline angle
- Material conveyed
- Bulk density
- Maximum lump size
- Maximum burden depth
- Calculated burden depth
- Type and size of tramp iron to be extracted

b. Should any of the above factors be altered the responsible person shall consult with the manufacturer for recommendations.

3.7 INSTALLATION, OPERATION AND MAINTENANCE OF ELECTROMAGNETIC SEPARATORS

3.7.1 General description

a. Cross belt electromagnetic separators are all custom designed to suit each particular application. The magnet designs and choice of material can be updated to improve the quality of performance. The magnet consists of a heavy casing which contains the cooled coil.

b. The coil insulation permits a temperature rise of approximately 80°C maximum regardless of ambient temperature, and although a higher temperature may not cause any damage, it will reduce the magnets performance. The magnets are designed to suit the ambient temperature where they are installed.

c. The casing temperature is generally approximately 70°C on top of the magnet casing. The latest magnets have a convection cooling system which reduces temperature by allowing increased heat dissipation.

d. The magnet has eight (8) plummer block bearings for pulleys and these require regular greasing only. Pulleys are crowned for good belt tracking, which is always achieved initially by steering the belt with the two top idlers, then using the take-up pulley for tension and finer tracking.

e. Pulley hubs should be checked for security within the first ten days of continuous running. The foot gear motor needs very little maintenance apart from occasional oil level checks.

f. If the magnet is suspended "in line" with the conveyor, it must have sufficient back, front, up and down adjustment to basically follow the material trajectory.

g. If the magnet is suspended across the conveyor, it must have its centreline corresponding to the centreline of the conveyor and must have sufficient up and down adjustment to achieve the correct operation gap for which it was designed.

h. Magnets shall be suspended at an angle with the entry side higher than the exit side to reduce the risks of objects getting stuck at the front of the magnet and damaging the belt. This angle shall be specified by the suppliers.

i. The older magnets have an oil level dipstick and the more recent units have an oil level sight glass. The magnets have a water drain plug and this should be checked over at least 6 months intervals to ensure that no water accumulates.

j. The magnet belt has special combined joint/slats to wipe off tramp metal.

k. With proper installation and reasonable care the magnet will give reliable service over years and perform the duty for which it was intended.

3.7.2 Do's and Don'ts

Do:

a. Ensure adequate adjustment for magnet position and angle for gap on cross belt installation or good following of trajectory angle at discharge point for in-line installations.

b. Set belt tension for equal sag on each side of magnet. Do initial training of belt by steering the belt with small adjustment to the bottom idlers and then control tension/training with the take-up adjusting screws.

c. Set the magnet operation gap to a minimum for best results. Check the nameplate stating "Magnet Operating Gap". Note that increasing the gap only 5% can result in 15% performance loss. Each cross belt magnet has an angle iron surge guard. It must be mounted on the incoming side of the magnet to prevent material entering between the belt and the magnet (Cross magnets only).

d. Grease the pulley bearings regularly and replace when damaged. Bearings are actually overrated and will give exceptional life with reasonable care.

e. Check the gearbox oil regularly and top up when necessary with the correct grade of gearbox oil.

f. Order the recommended maintenance spares to prevent excessive magnet "down time" resulting in possible damage with high cost. The magnet was installed for insurance against damage so it is essential to keep it in operation.

g. Check the rectifier/transformer output voltage to see that it is the same as the nameplate voltage on the magnet. If the magnet appears to be cooler than normal then suspected diode failure could have occurred on one of the phases resulting in much reduced performance (blown fuse could also be the cause).

h. Keep the magnet casing clean to prevent reduced heat release from the surface, especially on the top of the casing.

i. Maintain the oil level in the circulation tank sight glass so that it is always higher than the top coil circulation pipe where it enters the circulation tank, this is essential to ensure proper oil circulation. Oil level may drop in the first few months of operation as the stainless steel magnet wear plate tends to sag slightly, especially on large magnets.

Don’t:

j. Use extra heavy belting.

k. Change voltage taps without consulting the supplier.

l. Install conveyor idlers and deck plate directly under the magnet. Pulls can occur on the sides of the magnets affecting its performance.

m. Ever operate the magnet without its belt running continuously as excessive tramp metal build up will stall motor, resulting in a motor burn out. Metal build up causes a loss in separation efficiency as well. An over band magnet's belt movement assists cooling. The belt can also be "spiked" by metal if it is not running.

n. Use incorrectly rated fuses for AC and DC.

o. Operate the magnet without oil in the rectifier tank. Fill with transformer oil to cover the transformer/rectifier. Use normal transformer oil.

p. Operate without a chute on cross belt installation as metal could be extracted and then pulled under.

3.7.3 General

a. Every 12 months perform a resistance test to ensure that the coil is sound and no leakage to the ground occurs.

b. If the magnet is stored for extended periods of time, particularly outdoors, then drying out may become necessary.

c. Check occasionally for pulley side movement, hub security, belt damage and gearbox wear.

d. It is good practice to always interlock the magnet with the main conveyor. The magnet belt motor should also be interlocked to ensure that it runs before the magnet is energised.

4. METAL DETECTORS

The purpose of the metal detector is to detect metals present in the conveyor belt. This equipment is useful in testing the efficiency of the magnetic separators. This is done by installing metal detectors between the magnetic separators and the head discharge pulley, or after the discharge point where magnetic pulleys are used. Metal detectors shall record any tramp iron not removed by the magnetic

separators. The metal detectors shall have a counter and shall be capable of detecting a specified size of metal, or a layer, and shall be adjustable to detect magnetic or non-magnetic materials, or a combination of these.

4.1.1 Construction

The metal detector shall be of robust construction to withstand the rigours of mining installations. The metal detector shall be fully dustproof and waterproof. Lifting lugs or holes shall be provided.

4.1.2 Location

The metal detector shall be located mid-way between the idler assemblies and away from head/tail pulleys or any other sources of vibration.

4.1.3 Safety equipment

An automatic crash bar operating independently of the metal detector and protecting the metal detector from damage caused by lumps of coal on the burden of coal shall be supplied and installed by the supplier. The crash bar shall be designed so that any lump of coal, or any object protruding from the material conveyed, striking the bar will trip the conveyor belt and allow the belt to stop before the lump of coal reaches the metal detector.

4.1.4 Ancillary Equipment

The metal detector shall be supplied with powder marking and a detection warning lamp. Both the powder marker and the signal detection warning lamp shall be designed to withstand the rigours of mining installations, without damage.

4.1.5 Belt Splice and Steel Core Belting

The metal detectors shall be fitted with a splice detector control device. This device shall allow adjustment of the sensitivity to compensate cords in steel cord belting or for metal splices in ply belting.

4.1.6 Belt anti-rip devices

When anti-rip devices such as loops are built into the conveyor belt, it shall also be possible to adjust the sensitivity to compensate for these loops.

4.1.7 Operating Temperature Range

The metal detector shall be designed to operate at an ambient temperature of up to 50°C.

4.1.8 Sensitivity

It shall be possible to discriminate between pieces of metal by size; pieces larger than that specified shall be detectable whilst smaller/harmless pieces shall be overlooked.

4.1.9 Control Unit

The control unit shall be mounted outside the stream of material. The control unit enclosure shall comply with IP 65 of IEC 60529. The enclosure shall be of robust construction, and shall be fitted with double doors. The internal door shall consist of a glass panel. The displays of the instruments inside the control unit shall be clearly visible and shall be aided by lighting provided inside the control unit.

4.1.10 Outside Interference

Outside interference from welding machines or two way radios shall not affect the efficient operation of the metal detector.

4.1.11 Metal Detector Counter

a. The metal detector counter shall have a maximum warning period of 8 sec.

b. The counter shall have an adjustable sensitivity, so that items of less than a given size are not counted.

4.2 RECORDING EQUIPMENT

The automatic electric detection counter shall have a minimum of five large digits and provision shall be made for relaying the readings to a central control room. The digits shall be visible from the outside as well as the counter, which shall be sealed against ingress of dirt and moisture. The manual reset knob shall not cancel the readings in the control room.

5. AUTHORISATION

This document has been seen and accepted by:

Name	Designation
	This document has been approved by SCOT
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6. REVISIONS

Date	Rev	Compiler	Remarks
November 2012	0.3		Draft Document for review created from GGSS 0410
May 2013	1		Final Document for Publication
November 2017	1.2	A. Matlala	Draft Document for Comments Review
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- Tiaan Adlem
- Andre Laas

8. GUARANTEED COLD FLUX DENSITY OF MAGNETIC SEPARATOR

Table 1: Guaranteed cold flux density of magnetic separator at 200 mm working gap

1	2	3	4	5	6
Distance normal to the belt (mm)	Distance parallel to the belt (mm)				
	0	200	400	600	800
0					
200					
400					
600					
800					

Table 2: Guaranteed cold flux density of magnetic separator at 300 mm working gap

1	2	3	4	5	6
Distance normal to the belt (mm)	Distance parallel to the belt (mm)				
	0	200	400	600	800
0					
200					
400					
600					
800					

Table 3: Guaranteed cold flux density of magnetic separator at 400 mm working gap

1	2	3	4	5	6
Distance normal to the belt (mm)	Distance parallel to the belt (mm)				
	0	200	400	600	800
0					
200					
400					
600					
800					

Table 4: Guaranteed cold flux density of magnetic separator at 500 mm working gap

1	2	3	4	5	6
Distance normal to the belt (mm)	Distance parallel to the belt (mm)				
	0	200	400	600	800
0					
200					
400					
600					
800					

9. GUARANTEED HOT FLUX DENSITY OF MAGNETIC SEPARATOR

Table 5: Guaranteed hot flux density of magnetic separator at 200 mm working gap

1	2	3	4	5	6
Distance normal to the belt (mm)	Distance parallel to the belt (mm)				
	0	200	400	600	800
0					
200					
400					
600					
800					

Table 6: Guaranteed hot flux density of magnetic separator at 300 mm working gap

1	2	3	4	5	6
Distance normal to the belt (mm)	Distance parallel to the belt (mm)				
	0	200	400	600	800
0					
200					
400					
600					
800					

Table 7: Guaranteed hot flux density of magnetic separator at 400 mm working gap

1	2	3	4	5	6
Distance normal to the belt (mm)	Distance parallel to the belt (mm)				
	0	200	400	600	800
0					
200					
400					
600					
800					

Table 8: Guaranteed hot flux density of magnetic separator at 500 mm working gap

1	2	3	4	5	6
Distance normal to the belt (mm)	Distance parallel to the belt (mm)				
	0	200	400	600	800
0					
200					
400					
600					
800					

APPENDIX A

(Normative)

10. DATA SHEET OF MAGNETIC SEPARATORS OFFERED

A.1

Supplier.....

Make and model .....

Overall mass (kg).....

Maximum mass of largest component in kg .....……

Overall dimensions:..... length (mm) .....…

width (mm)..... ……..

height (mm).... ……..

Transformer type ..... ……

Transformer oil immersed (yes or no)..... ….

Type of oil ..... ….

Rectifier type.....

A.2

Magnet details..... ……

Magnet DC power consumption - hot (kW) .....…….

Magnet DC power consumption - cold (kW) .....

Max. AC power consumption (kW)……..

Transformer type.....

Rectifier type.....

Current density – cold (A/mm^2)……

Material of conductor.....

Conductor cross-sectional area (mm^2) .....

Conductor shape.....

Total ampere-turns - cold (no.). ……

Mass of winding (kg) ……

Insulation class for conductor to SANS IEC 60034-1……..

Insulation class for Side insulation to SANS IEC 60034-1 ……

Coil temperature rise (°C)……..

A.3

Type In-line/cross belt

Magnet box size: length (mm)……

width (mm)……..

height (mm).. ..... ……..

Magnet core cross-sectional area (mm^2) ..... …..

Height (mm)…….

Core shape and construction .....

Mass of core (kg)……

A.4

Collection system

Reduction gear unit type .....

Belt drive motor size (kW)…….

Belt make.....

Belt description .....

Belt class .....

Belt width (mm)……..

No. of plies.....

Belt cover : Top.....

: Bottom ……

A.5

Permanent magnetic pulley

Supplier.....

Make and model……

Mass (kg) ..... ……

Diameter without lagging (mm).. ……

Face width (mm) ..... …….

Shaft material…….

Shaft diameter (mm) ..... ……..

Bearing base.....

Lagging thickness (mm) ..... ……

Construction design (vertical pole type/alternate pole type)……

Polarity style (across the width or other) of the drum.....……..

(around circumference of the drum or other)... ..... …….

Magnetic core type……

Diameter (mm) ..... ……

Flux rating (Wb/m^2) at: 50 mm from face……

75 mm from face…….

100 mm from face……...

APPENDIX B

(Normative)

11. GUARANTEED PERCENTAGE OF EXTRACTION OF TRAMP IRON

B.1

Burden depth of 250 mm and working gap of 350 mm between conveyor belt and magnet face (quantity/number)

Percentage extracted

Tramp iron items of mass 10 kg to 50 kg .....

Tramp iron items of mass 5 kg to 10 kg .....

Tramp iron items of mass 0.5 kg to 5 kg .....

B.2

Burden depth of 300 mm and working gap of 400 mm between conveyor belt and magnet face (quantity/number)

Percentage extracted

Tramp iron items of mass 10 kg to 50 kg .....

Tramp iron items of mass 5 kg to 10 kg .....

Tramp iron items of mass 0.5 kg to 5 kg .....

B.3

Burden depth of 350 mm and working gap of 450 mm between conveyor belt and magnet face (quantity/number)

Percentage extracted

Tramp iron items of mass 10 kg to 50 kg .....

Tramp iron items of mass 5 kg to 10 kg .....

Tramp iron items of mass 0.5 kg to 5 kg .....

B.4

Description of test pieces less than 5 kg

For the tramp iron of mass 0.5 to 5 kg the following test metal sizes shall be used:

16 mm diameter x 300 mm long 10 off

30 mm diameter x 130 mm long 10 off

40 mm diameter x 300 mm long 10 off

50 mm diameter x 300 mm long 10 off

These pieces shall be supplied free of charge by the manufacturer of the magnetic separator.
The test pieces shall be randomly placed in the burden depth.