Wet low intensity magnetic separators

Iron ore processing

General

Metso has produced several thousand Low Intensity magnetic separators (LIMS) both dry and wet versions to the iron ore industry.

Metso has (in close co-operation with the iron ore mining Industry) developed and designed the low intensity magnetic separators to meet the highest demands for capacity, metallurgical performance and mechanical availability.

Models and sizes

The range of wet magnetic separators is composed of the series WS1200 with drum diameters of 1200 mm with a magnetically effective drum length up to 3678 mm in increments of 613 mm. The WS1200 series includes concurrent, counter-current and counterrotation tank designs.
The wet magnetic separators are primarily used for cobbing, roughing, cleaning and finishing purposes.
Concurrent and counter-current separators are designed for both single and multistage arrangements.

Magnetic separation theory

The magnetic separation of magnetite and other magnetic minerals is a complex process.
During the separation process, each particle is subjected to a number of forces, including gravity, drag, etc.
The simplified equation below describes the magnetic force the particles are subjected to:

Magnetic force:

$F_{mag} \propto d^3 \cdot \chi \cdot B \cdot dB / dx$

d = particle diameter
χ = relative suspectibility
B = magnetising field
dB / dx = magnetic field gradient

The magnetic system produces a magnetic flux density mesaured in Tesla or Gauss and a magnetic field gradient (T/mm or G/mm). Generally, smaller pole pitches produce a lower flux density but a higher gradient. The smaller pole pitch normally has a higher magnetic attraction (expressed as B • dB / dx) close to the drum

which decreases rapidly with the distance away from the drum. Hence, the smaller pole pitch (referred to as high gradient, HG) has a greater ability to pick up finer or less magnetic particles but has a lower throughput capacity when compared to a magnetic assembly with a larger pole pitch.

Magnetic drum assembly

The heart of the magnetic separator is the magnetic drum assembly which is composed of a stationary magnetic array mounted inside of a non-magnetic drum. During operation, the drum revolves around the magnetic assembly thereby transporting magnetically attracted material on the drum to the area designated for discharge.

The drum heads are normally cast from non-magnetic aluminium alloy and the drum shell is manufactured from non-magnetic stainless steel. Drum shells are normally rubber or stainless steel covered against abrasion.

Magnetic systems

The magnetic system has alternating polarity and is comprised of six main poles and intermediate cross poles for maximising the magnetic flux. Other systems for special applications are also avalable.

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Concurrent Design (CC)

The concurrent tank features:

- Feed box with serrated weir
- Intermediate distribution chamber
- Short threshold pick-up zone
- Drum revolving concurrently with pulp flow
- Adjustable outlet spigots on tank bottom for nonmagneticeffluent
- Selection of orifices for bottom spigots to control pulp level in tank

This particular tank design is mainly used for processing of material with particle sizes up to 6 - 8 mm (3 mesh). The pulp density should be maintained from 30 to 50 % solids by weight with best results normally obtained in the mid range.

Counter-current Design (CTC)

(Steffenson type) **The counter-current tank features:**

- Full width feed channel directs pulp to feed entry slot of tank
- Feed entry at lowest point of tank
- Medium length pick-up zone for highest magnetics recovery and grade
- Drum revolving counter-current to effluent pulp flow
- Full width effluent overflow weir for control of pulp level in tank capable of tolerating rather large fluctuations in flow
- Con-current flow of magnetic particles
- Jet water furnished in feed channel (optional)

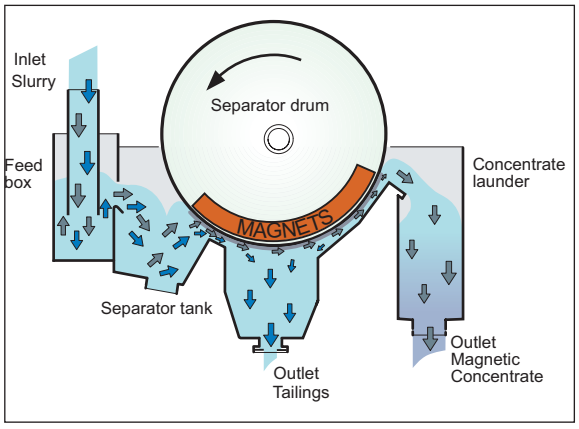
This tank design is suitable for (non-magnetic) particle sizes up to 0,8 mm (20 mesh) and is the most effective separator for cleaning and finishing. Optimum pulp density range is 25 to 35 % solids by weight.

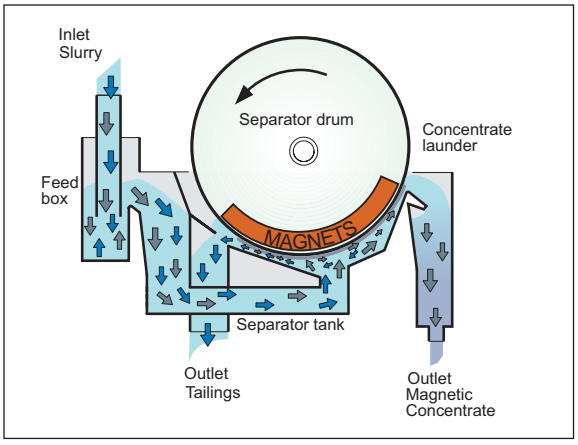
Counter-rotation Design (CR)

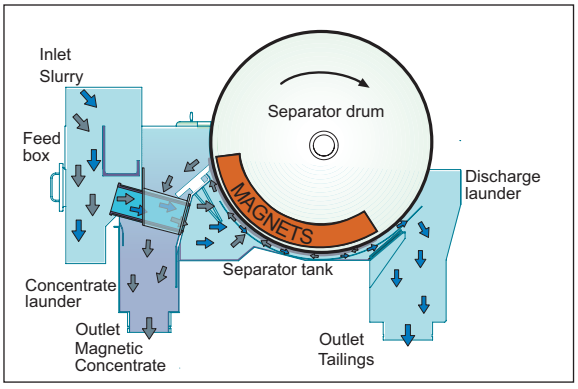
The counter-rotation tank features:

- Full width feed chamber directs pulp to drum
- Feed entry near magnetic concentrate discharge
- Extra long pick-up zone for highest magnetics recovery
- Drum revolving counter-current to effluent pulp flow
- Full width effluent overflow weir for control pulp level in tank, hence tolerating rather large fluctuations in flow
- Level control by weir bars at tailings discharge

This tank design is particulary suitable for cobbing and roughing of fine to coarse particles up to 3-8 mm (4 mesh) at medium to high densities (30 to 50% solids).. It is excellent for capacity and recovery, but should not be used as a single unit when highest concentrate grade is required.







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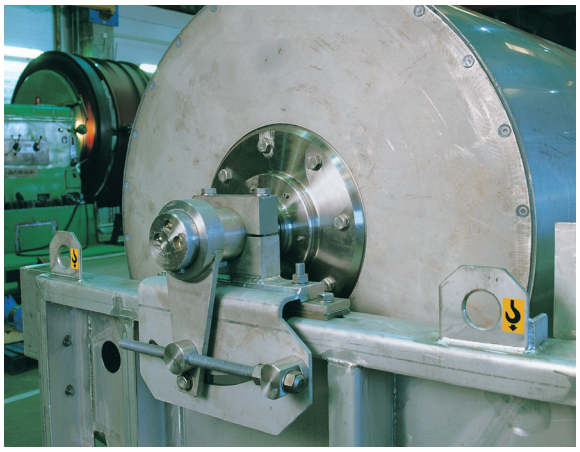
Adjustment of magnet and drum position

The magnetic drum and magnetic assembly can easily be adjusted to obtain the best process performance. The adjustment possibilities include:

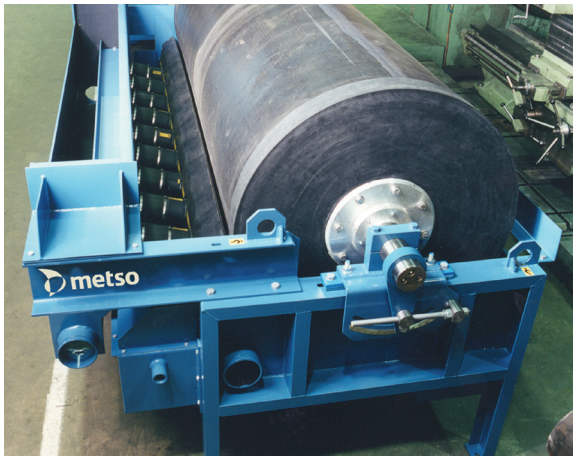
- Magnet assembly positioning in relation to concentrate discharge weir.
- Horizontal positioning of drum
- Vertical positioning of drum



Feedboxes

- The feed boxes designed for CR, CC and CTC magnetic separators are normally made of mild steel and rubber-lined against abrasion.
- The CC and CTC feed boxes have serrated weirs for even pulp distribution across the entire magnetic drum width.
- The CR tank feed box discharges through a number of tubes into the feed chamber of the tank.

The primary distribution of the feed to the magnetic separator feed boxes is normally not included in the magnetic separator delivery.



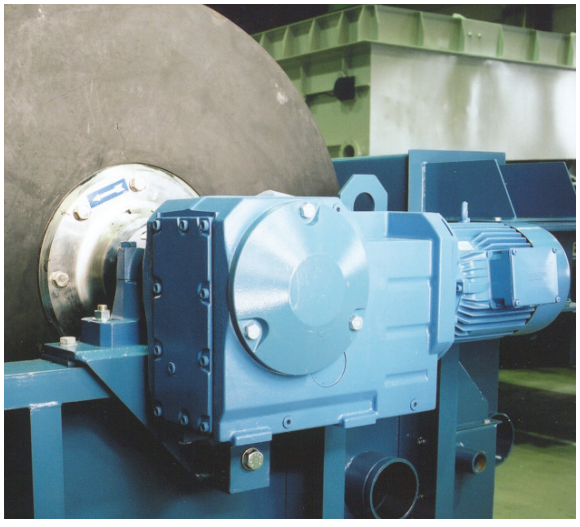
Drive system

The standard drive system consists of a right-angled gear box with a direct-coupled electric motor. The advantage with this system is the reduced maintenance requirement, higher efficiency, lower noise and cleaner installation.

The alternative drive features a shaft-mounted gear box with V-belt drive and fully enclosed drive guard.

The advantage of the alternative drive is the possibility of more easily altering the drum speed by changing Vbelt sheaves and belts.

The drum peripheral speed is normally set at about 1,2 m/s.



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Concentrate discharge and launder arrangement

For control of the concentrate disharge an easily adjustable overflow weir in high density polyethylene (HDPE) is provided with the CC and CTC models and is optional with the CR.

Concentrate collection launders are available in several designs with and without rubber lining.

Effluent discharge

The separator effluent is normally discharged into a suitably designed trough under the machine. The trough, in steel or concrete, is not supplied with the separator.

Application guide lines

Absolute guide lines for sizing of the equipment are not available; thus the machine sizes selected by the use of the table below needs to be verified by testing, preferably by using full size machines. Sizing of equipment based on results from tests using a Davis Tube Tester or small diameter laboratory LIMS is not recommended.

Application and particle size classification	Typical particle size, top size, µm Amount finer than 74 µm	Typical feed rate, dry basis, tph per meter of drum width	Typical slurry feed rate , m^3 per hour per meter of drum width	Recommended tank design
Iron ore separation Coarse (Cobbing)	8 000 – (15 000) 0 – 10%	100 – 160	200 – 350	Concurrent Counter-rotation
Iron ore separation Medium to coarse (Rougher)	2 000 – 5 000 20 – 25%	80 – 120	200 – 350	Counter-rotation Counter-current
Iron ore separation Fine to medium	1 000 40 – 50%	40 – 80	150 – 250	Counter-rotation Counter-current
Iron ore separation Fine (Finishing)	100 60 – 100	10 – 60	100 – 200	Counter-current

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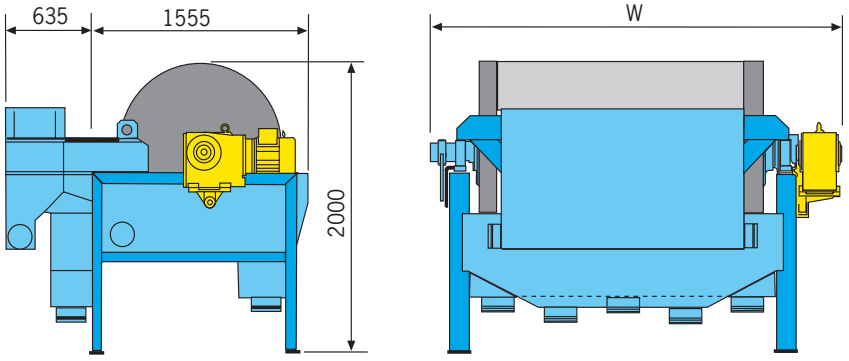
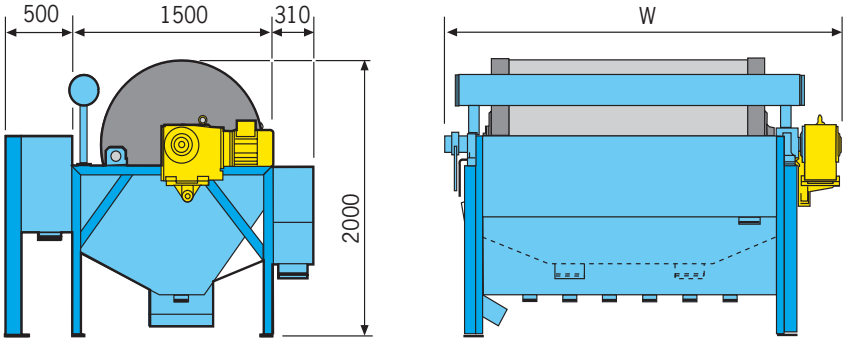
Types WS1200CC, WS1200CTC, WS1200CR

Model and size	Drum effective magnet length, mm	Motor size, kW	Dimensions W, mm	Machine unit weight, kg
WS 1206	600	3,0	1 771	2 400
WS 1212	1 200	4,0	2 371	3 300
WS 1218	1 800	5,5	2 971	4 000
WS 1224	2 400	5,5	3 571	4 800
WS 1230	3 000	7,5	4 218	5 700
WS 1236	3 600	11	4 818	6 600

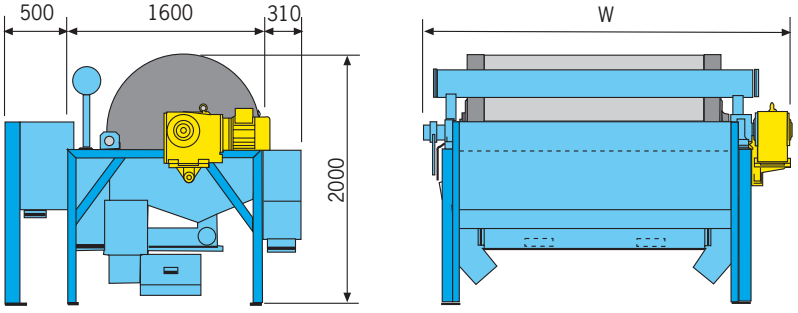
WS 1200CR



WS 1200CC



WS 1200CTC



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