Horizontal mills
Technology at work for you
Horizontal mills
Horizontal mills

Introduction

Metso is the world’s largest supplier of grinding mills, related accessories, and specialty applications wherever size reduction is required.

Our grinding mills are the workhorses of the comminution process, maximizing results in many applications:

- Metallic minerals
- Industrial minerals
- Solid fuels
- Limestone for flue gas desulfurization (FGD) reagent preparation

Since 1896, Metso has sold over 12,000 mills
# Horizontal mills

## Product range

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
<th>Dimensions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rod</td>
<td></td>
<td>10' x 15'</td>
</tr>
<tr>
<td>Ball (geared)</td>
<td></td>
<td>5' x 27'</td>
</tr>
<tr>
<td>Ball (GMD)</td>
<td></td>
<td>25' x 30'</td>
</tr>
<tr>
<td>AG/SAG (geared)</td>
<td></td>
<td>12’–38’</td>
</tr>
<tr>
<td>Large SAG (GMD)</td>
<td></td>
<td>36’–44’</td>
</tr>
</tbody>
</table>
Horizontal mills

Product role

• Crushing and grinding processes liberate valuable minerals from ores through a series of size reductions

- Grinding materials in horizontal mills with or without media dates back to the late 1800's
- Since that time, Metso has designed and manufactured more than 12,000 grinding mills
Horizontal mills

Design objectives

With every mill design, we strive to meet our customer’s specifications. Our goal is to achieve:

• Long life (>25 year fatigue life)
• Low risk (for customer and Metso)
• High quality (fit for purpose)
• High availability
• Minimum maintenance
• Customer satisfaction
Horizontal mills

Driving customer success

With over 100 years of milling experience, Metso’s advanced design and quality assurance techniques have kept us at the forefront of mill sales, while providing:

• No structural problems for over 20 years using these techniques
• Highest reliability, lowest unplanned downtime
• Proven failsafe mill support systems
Horizontal mills

Metso personnel – putting knowledge into action

Our highly trained and widely experienced people are what makes the difference in:

• Application engineering
• Computer-aided design
• Process design
• Contract management
• Manufacturing
• Quality assurance
• Erection supervision
• Maintenance training
• Customer service
Horizontal mills

Features and benefits
Horizontal mills

Rod mills

• 10' to 15' Diameters
• 75 to 2,000 HP
• Application
  - 4 to 35 mesh product
• Types
  - Wet trunnion overflow
  - Dry peripheral discharge
  - Dry center discharge
Horizontal mills

Rod mills

• 1st conventional grinding step, grinds crushed ore, max. 1.25" (mining)

• Grinding media: rods of Ø2' to Ø4"

• Coarse grinding, where close control is required, either of top size or fines

• Grinds the largest particles more efficiently,
  - Produces product with a relatively narrow size distribution

• Speed: 60 to 70% of critical

• Various discharging arrangements
  - Overflow: wet grinding, the most common type (mining)
  - End peripheral discharge: dry grinding, produces a relatively fine rod mill product
  - Center peripheral discharge: operates dry, has a high gradient, high tonnage, produces fewer fines
Horizontal mills

Rod mills – 10.5' Dia x 14' Lg Rod Mills – Quebec, Canada

- 800 hp motor
- 64 x 16 hydrodynamic bearings
Horizontal mills

Ball mills

• Tumbling mill
• Steel media
• 5' to 27' diameters (geared)
• 25' to 30' diameters (gearless)
• 100 to 25,000 HP
• Minus 1/2" feed
• Minus 35 mesh to micron sized products
Horizontal mills

Ball mills

• Primary ball mill
  - 1st grinding step
  - Grinds crushed material
  - Used in cement and some mining applications

• Secondary ball mill
  - 2nd grinding step
  - Grinds product from: AG/SAG, primary ball mill and rod mills

• Regrind ball mill
  - 2nd/3rd grinding step
  - Or regrinding of concentrated ore

• Overflow discharge design
  - Most common type
  - Operates wet
  - Gives a finer grind

• Grate discharge design
  - Operates wet or dry
  - Gives a higher gradient, a more rapid flow, less fines
  - Can carry a higher ball charge, draws about 10% more power than an overflow ball mill of the same size, with higher throughput
Horizontal mills

Ball mills – dual pinion drive
Horizontal mills

Ball mills – dual pinion drive – Boddington Gold Mine, Australia

- (4) 26' dia x 44.5' long
- 2 x 7500 kW
- Geared - wound rotor induction motors
- 150" pad bearings
- Dual pinion drive
Horizontal mills

Ball mills – gearless motor drive
Horizontal mills

Ball mills – gearless motor drive – Conga Project, Peru

- (2x) 26' dia x 42' long
- 16 MW
- Gearless motor drive
- 150" pad bearings
Horizontal mills

AG/SAG mills

• 12' to 38' diameters (geared)
• 36' to 44' diameters (gearless)
• 10 to 40,000 HP
• Application
  - Primary grinding
• Types
  - Wet
  - Dry – airswept
Horizontal mills

Autogenous grinding (AG mills)

• 1st grinding step, grinds run of mine ore (7.8" to 15.7") or crushed ore (5.9" to 9.8")
• Grinding media consists of rocks in the ore itself
• The feed must contain a sufficient amount of coarse grinding stones
• Carries out both crushing and grinding
  - Replaces fine crushing and rod mill grinding
• Ability to use high chrome steel liners
• Uses more energy (kWh/ton) as compared to rod mill grinding
  - A result of the coarser AG mill feed and the finer AG mill product
• Capacity and grind are very dependent on ore
Horizontal mills

AG mill – Boliden Aitik Project, Sweden

- (2x) 38' dia x 45' long AG mill
- 22.5 MW
- Gearless motor drive
- 166" hydrostatic pad bearings
Horizontal mills

Semi-Autogenous grinding (SAG mills)

- 1st grinding step, grinds run of mine ore (8" to 16") or crushed ore (6" to 10")
- Grinding media consists of rocks (same as AG grinding), and typically a 4 to 12% ball charge (up to 20% in some cases)
- Balls are added to avoid build up of critical size material and to improve grindability/capacity
  - Most common ball size: Ø4" to Ø5"
- Aspect ratios (L/D) ranging from 0.2 to 3
- Higher capacity than AG grinding
- Demands less space than AG grinding
- Less vulnerable to ore changes
Horizontal mills
AG/SAG mills – TISCO Project, Taiyuan, China

• 34' dia x 18' long
• 11 MW dual pinion drive
• GE synchronous quadramatic drive
• 132" hydrostatic sleeve bearings
Horizontal mills
AG/SAG mills – Conga Project, Peru

• 42' dia x 25' long
• 28 MW
• Gearless motor drive
• 166" pad bearings
Horizontal mills

Pebble mills

• Secondary grinding
  - Grinds product from primary grinding step (rod mills, AG/SAG mills)

• Grinding media is pebbles that consist of:
  - Screened out fractions of the ore itself, synthetic pebbles, or manufactured $\text{Al}_2\text{O}_3$
  - 1.9" to 3.5" in size

• Grate discharge

• Lower charge and pulp density than ball mills

• Pebble mills are larger than ball mills running at the same horse power draw

• Pebble consumption normally between 5 to 20% of the ore quantity

• Speed: 75 to 85% of critical

• No metal contamination
Horizontal mills

Pebble mill – Boliden Aitik Project, Sweden

• (2) 30’ dia. X 37’ long pebble mill
• 10 MW dual pinion drive
• ABB HSIM drive
• 124” hydrostatic sleeve bearings
Horizontal mills

Information required for sizing/selection
Horizontal mills

Metso test centers

Our engineers conduct extensive testing and research to ensure that your grinding mill is running at maximum capacity.

Tests performed

- JKSimMet (BRGM/Herbst)
- Batch (AG/SAG/ball)
- MinnovEX SPI (Starkey test)
- MacPherson autogenous work index
- Discrete element modeling
- Drop weight
- Bond work index (ball/rod mill)
- Continuous closed circuit (ball/pebble/rod)
- Hardgrove grindability index
- Vibrating (ball)
Metso services business line

Services and benefits
Advanced technology

- Research and testing
- Process simulation
- High fidelity simulation
- Optimization software
- Plant optimization

Optimizing process using simulation software creates predictive flowcharts for crushing circuits

Reliable grinding mill performance simulation enables liner and kinematics optimization
Metso services portfolio

Services
- Advanced technologies
- Automation solutions
- Performance contracts
- Spare and wear parts supply
- Training
- Equipment refurbishing
- Field services
- Plant diagnostics and upgrades

Benefits
- Better process performance
- Improved productivity
- Maximum plant availability and reduced downtime
- Reliable equipment performance
- Effective preventive maintenance
- Improved safety
Wear protection and spare parts

• Rubber
• Polyurethane
• Ceramics
• Combinations
• Mills, crushers, wear surfaces, etc.
• OEM parts for all Metso equipment
Life cycle services

• Routine service support
• Maintenance contracts
• Operation contracts
• $/t production contracts

Metso service personnel are trained and operate locally
Process technology

- Instrumentation
- Laboratory services
- Training
- Upgrading
- Optimization
- Blast design
Horizontal mills

Conclusion

Metso’s reputation is founded on over a century of dependability, integrity, and results

• Repeat customers can attest to our rugged, long-lasting equipment
• Professionally trained personnel provide mill designs and service that drive customer success and satisfaction
Thank you