

Mine Shaft Systems

Dorr-Oliver & Vecor Equipment



One Source

Competent, Responsible, Cooperative

Quality solutions delivered

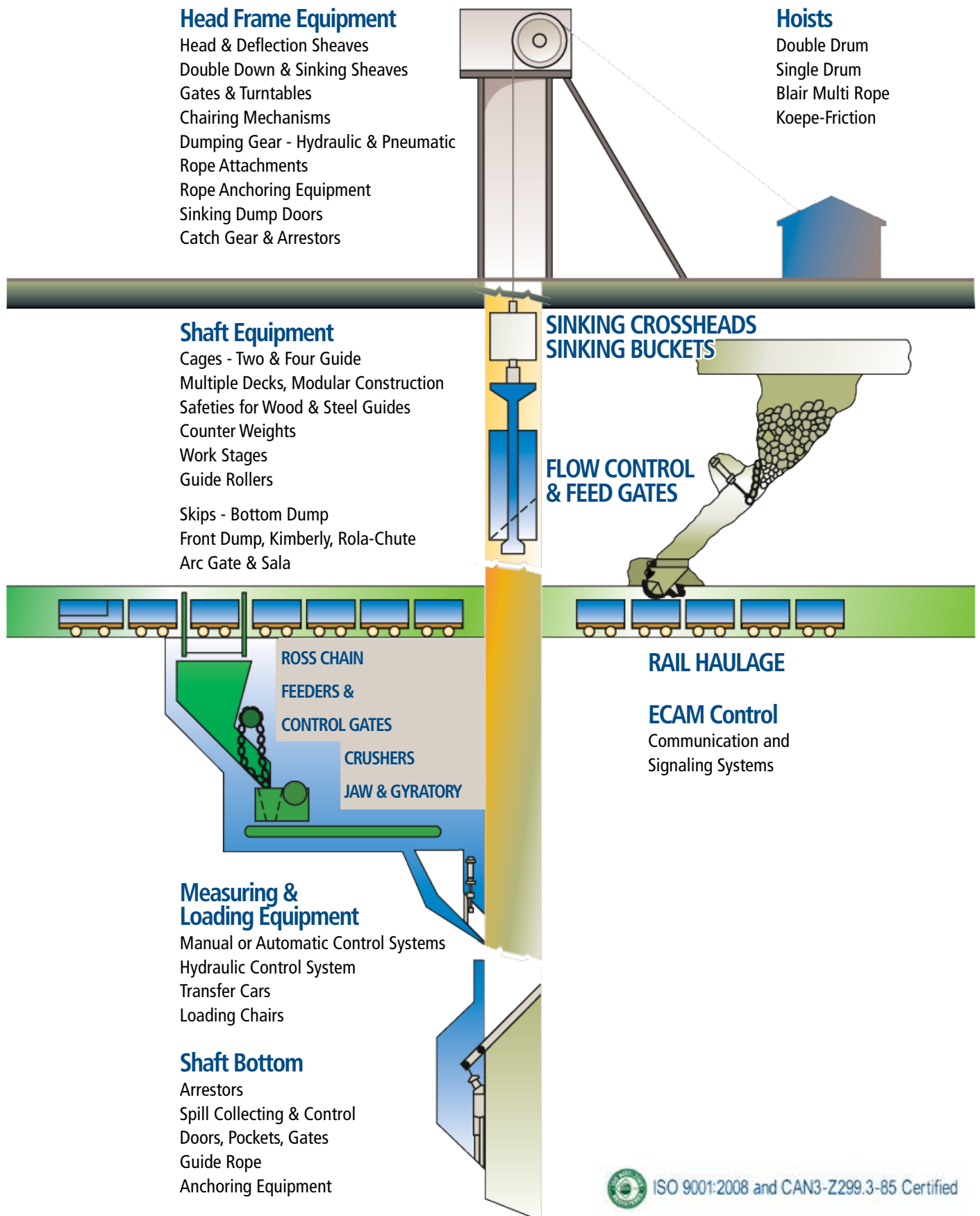


Mine shaft systems equipment

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FLSmidth offers you the highest quality products for your underground mining operation. Contact us, we will help find the best solution for your application.

Complete mine shaft systems



Ore skips



FLSmidth offers a complete range of types and sizes of Ore Skips from 1-48 m³ (40-1700 ft³). Our Skips, regardless of size or style, are designed for fast and clean dumping of ores, in all kinds of metallic and nonmetallic mines.

Rolachute Skip™
Capacity, 1200 cubic feet (34 cubic meters)

Bottom dump skip

Our Bottom Dump Skips are light and rugged for medium to large loads. They are well suited for large uncrushed muck and wet sticky fines.

- Clean dumping due to the tilt-out action of the bucket makes it particularly suited to handle sticky materials
- Fines spillage minimized by FLSmidth's Dorr-Oliver piano-type bucket hinge and the Skip door that protrudes into the dump chute
- The Bottom Dump has the largest unobstructed opening for discharge with no concern of bridging of large uncrushed material
- Simple & secure Dorr-Oliver locking and discharging mechanism minimizes maintenance.
- Discharge is activated by the dump rollers running in scrolls, mounted in the headframe. (Optional cylinder discharge in the headframe minimizes cycle time and the required headframe height.)

- Since all Bottom Dump Skips have a bail around the bucket, they are good for shafts with less than perfect guide alignment. (Note: All types of FLSmidth Skips can be supplied with a bail if so desired) FLSmidth's quick-change design allows the bail to remain in the shaft while the bucket is removed for liner replacement or exchanged with a Cage.
- Long lasting; some FLSmidth light weight aluminum Bottom Dump Skips have been in service in hardrock mines for over 30 years. FLSmidth's Bottom Dumps are the workhorse of the Hardrock Mining Industry.



The standard Dorr-Oliver Aluminum Bottom Dump skip is the workhorse of the hardrock mining industry. ▲

Kimberley skip

Lightest, Least Expensive

- Best weight to payload ratio of any Skip
- Very simple with minimal maintenance
- Cleanest possible dumping due to overturning action and no possible discharge restrictions in the bucket.
- Always the best choice for all small skip applications with volumes less than 200 cubic feet/5.7 cubic meters.
- FLSmidth has been supplying Kimberley Skips for over 80 years.

Arc-Gate skip

Lowest Maintenance, Rugged, Safest

- The FLSmidth Arc Gate is the lowest maintenance skip on the market today. This skip has only one moving part, making it the most simple and maintenance free.
- This Skip evolved from and superseded the Front Dump Skip by the elimination of the high maintenance front mounted door opening linkage.
- The Arc Gate cannot open accidentally, and when the door is open, it does not protrude outside of the compartment. Contact with shaft steel is impossible.



90 cubic foot Kimberley skip ▲

- FLSmidth's Arc-Gate Skips have been supplied to replace Front Dump Skips for increased safety and to eliminate the on-going maintenance due to costly linkage mechanisms.
- There is no requirement for heavy air actuator cylinders or air piping mounted on the skip.
- The cycle time, while relatively short, can be reduced even further to almost match the Rolachute by using a headframe mounted cylinder actuator design.
- Rugged construction results in many Arc-Gate Skips having been in service in hardrock mining for over thirty years.
- Best suited for dry, crushed material.

500 cubic foot arc gate skip ▼



Ore skips

(cont.)



Rolachute™ skip

- Fastest Cycle, Low Maintenance
- The Rolachute™ door gives this Skip the fastest cycle time of any Skip design. The absence of scrolls in the headframe means that it is not necessary to slow down to a creep while entering the scrolls.
- Simple Dump Rollers mounted in the headframe allow the door to open with minimal vertical travel.
- Low maintenance requirements; no air-cylinders, actuators or piping are required on the Skip. Best suited for dry, crushed material.

Sala front-dump, incline, cage / skips

While not as common as the skips already listed, FLSmidth also makes other types of Skips to match existing or suit special conditions and situations. If it is a special application, we have probably already supplied it or something similar to it before. Call us to find the right Skip for your requirements.

In some modern installations skips are approaching high speeds of up to 3800 fpm (19 meters/sec), making balance and alignment critical design considerations and issues to which we pay close attention.

Optimize your production by maximizing payload to tare weight ratios for improved operational efficiency by installing the Skip type and material of construction best suited to your application, as supported by our experience and vast list of installations.

Safety

All Skips are available with proven Safety Mechanisms for either wood, steel, or rope guides.

Chairing

All Skips can be supplied with optional Chairing Pads for use with Dorr-Oliver shaft-mounted Skip Loading Chairs, which eliminate excessive rope stretch when loading at great depth.

Material

All Skips can be constructed of Steel, Aluminum, Stainless Steel or strategically placed combinations. Advanced protective coatings & insulation barriers are used to resist galvanic and chemical corrosion.

Liners

All Skips have many Liner options available including abrasion-resistant steels, cast high manganese, or rubber strategically placed in high impact and high wear areas, designed for ease of replacement.

Design

All Skips are designed based on over 85 years of experience supplying thousands of Skips to every application, from Gold, Silver, Iron, and Lead to Potash, Coal, Salt, Copper, Zinc, Uranium, and others. Documented experience, methods and standards are coupled with the latest engineering design technology and FLSmidth Quality Assurance Systems to produce efficient, safe, long-lasting Skips.

Skip / cage combinations

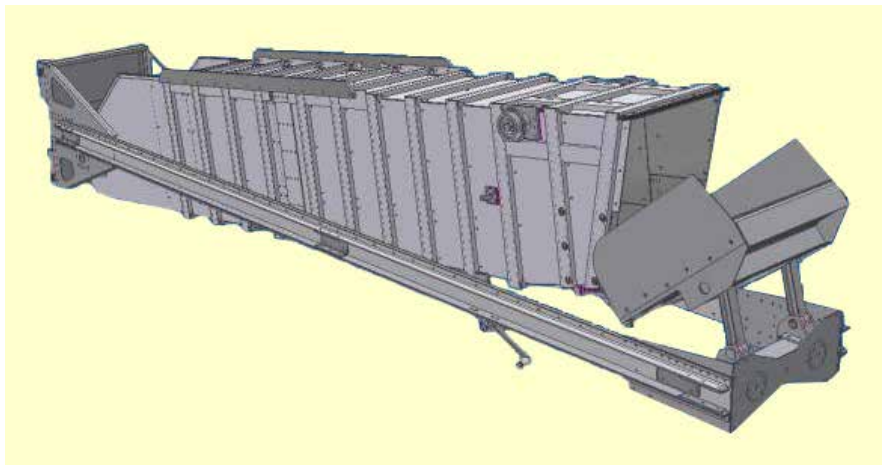
All Skips are available with integral man cages, or with accommodation for Trailer Cages. Our 3H Quick-Change System allows for very quick installation and removal of the Trailer Cage.

Guide rollers

All Skips can be fitted with a full range of FLSmidth Guiding systems to suit all applications and conditions ranging from economical long lasting Heavy-Ply, fixed rollers for slower speed to High Speed Aircraft tires with spring coil over gas-charged Cylinder suspension. Several sizes and types of tires including Pneumatic, Solid Rubber, Foam-Filled, and solid Polyurethane are available. The wheels are mounted on Steel, Aluminum, or Stainless hubs and brackets with either fixed, serrated, or eccentric axle adjustments.

Selection

Contact us and advise us of your operating conditions and we will help you pick the best Skip type, Material, Guiding System, and Safety Mechanism to economically suit your application.



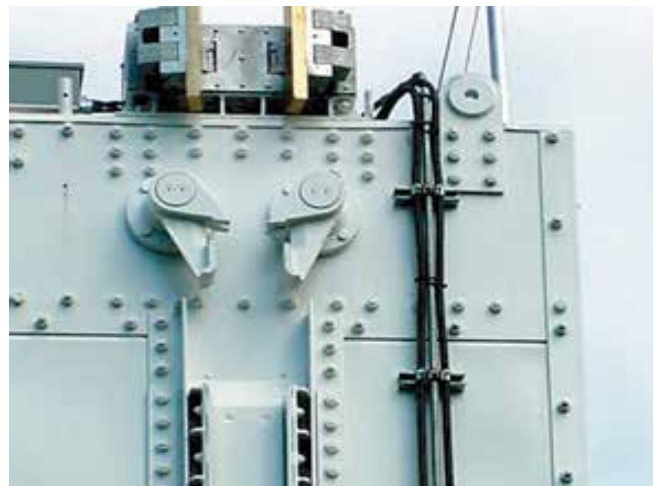
Solid modeling ensures all clearances and interferences are considered at the "design" stage.



Cages



Our cages range from very small Two-Man Auxiliary Cages and Trailer Cages to Multi-Deck Cages handling 300 men or more, or internal loads of trucks, equipment, and material of 50 tons or more.



Guide Slippers service-able from inside the Cage, Safety Dogs and FLSmidth installed Customer's Hydraulic Chairing Device.

Custom designed

Varying conditions found at installations throughout the world dictate that each cage is a custom design, tailored to the client's specific requirements. All types, Service Cages, Auxiliary and Trailer Cages, each with many options and alternatives, such as various designs of cage floors, doors, roofs, removable intermediate decks, and removable counterweights are available.

Cages are usually designed with significant amounts of aluminum to maximize payloads. However materials of construction can include mild steel, stainless steel, and strategically placed combinations of these materials, depending on the application and service conditions.

Safety

For cages operating with single rope drum hoists, we provide Safety Mechanisms for either wood, or steel shaft guides. The safety mechanism, which is activated by a slack rope condition, brings the cage to a controlled safe stop. cages are also designed to operate with a multi-rope Koepe hoist. We also provide rope attachments and Safety equipment such as Arrestor Frames for the head frame and shaft sump. These devices are designed to create a predictable deceleration and bring the conveyance to a stop in the event of a hoist problem.

Suspension

Traveling at high speeds, these large conveyances also require proper suspension. We offer several types of heavy-duty Guide Rollers and Suspension Systems to suit all conditions.

Stainless steel cage

Shown to the right (top) is a BMR cage with 112 man capacity. The cage shown to the right is stainless steel construction with an aluminum roller door on the bottom deck. The top deck is equipped with an aluminum guillotine door. The Aluminum Roller Door can be supplied with a spring or segmented counterweight.

Design

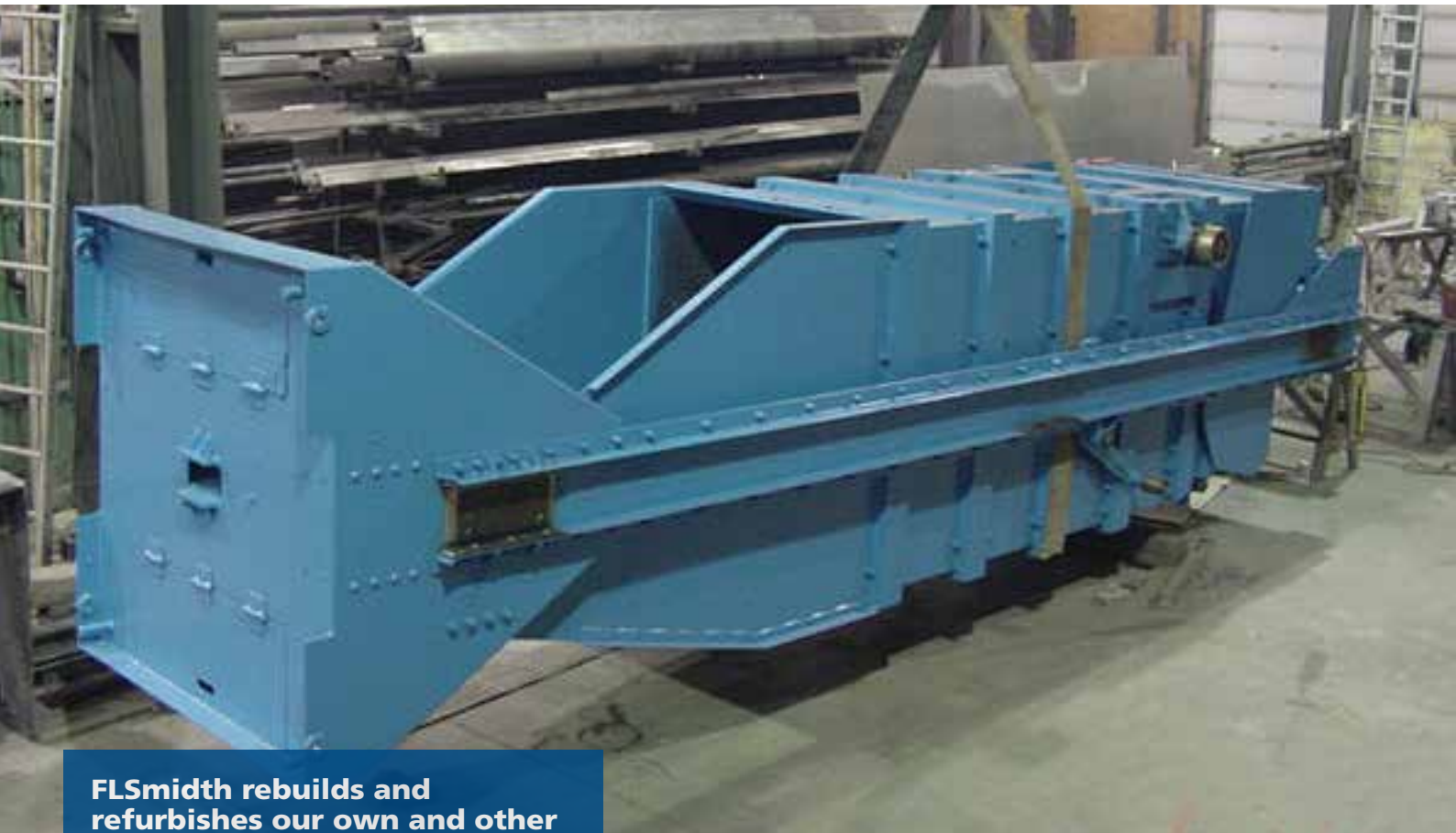
All cage designs are based on over 85 years of experience of supplying thousands of cages. With that documented experience, our methods and standards are coupled with the latest technology engineering design methods and Quality Assurance Systems to produce a Certified Safe and long-lasting cage.

(Top) BMR Cage

(Bottom) FLSmidth's stainless steel cages.

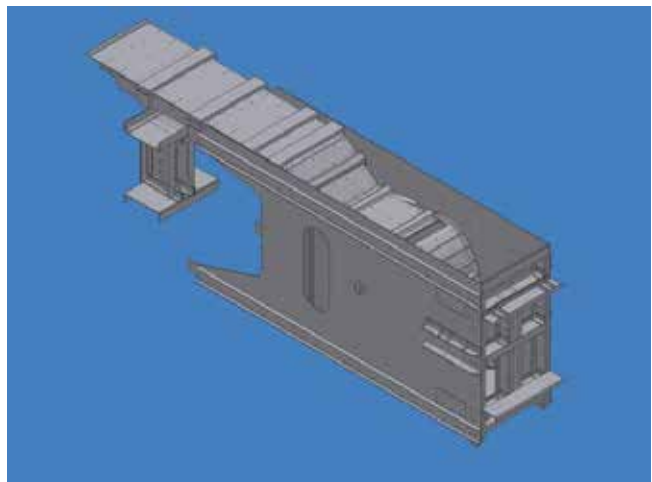


Rebuild / Refurbish skips and cages



FLSmidth rebuilds and refurbishes our own and other manufacturers' Skips and Cages to a functionally new condition.

The solid model above was used to check clearances on the ultimate skip rebuild; a front dump skip that had been manufactured by others and was still relatively new was converted to an FLSmidth Dorr-Oliver Arc-Gate Skip to eliminate the Front Dump maintenance issues. The bottom quarter of the skip, which is the working section, was removed and replaced with this new section.



Conveyances often come back to us in a condition that some people would consider to be at the end of their useful life. The conveyances have suffered through corrosive environments (salt brine and acidic shaft water) and have withstood abrasion and impact from hard rock and be scrapped or remanufactured.

The skip or cage is methodically re-built to a functionally new condition, re-certified by a professional engineer and returned to the mine to serve another complete tour of duty. Many skips have been rebuilt and served additional campaigns many times. Skips that have undergone a regular preventative maintenance series of rebuilds, in the end cost less because they serve more tours.

The same personnel that build FLSmidth's new Dorr-Oliver Skips and Cages perform the rebuild and implement the same methods and quality criteria. FLSmidth quality standards, systems and procedures, and an engineering rebuild package specific for each skip or cage are used. The engineering package consists of "to-do" lists including critical items that require NDT ultrasonic testing, magnetic particle and liquid penetrant inspection, original detail and modification drawings, quality assurance check lists, painting and special client requests for modifications.

Ready to return to work, and functionally the same as a new skip. (See light blue skip to the left) Typically, the equipment has been blast cleaned, straightened, any damage repaired, or corroded sections replaced, cracked welds repaired, any areas where problems have occurred were redesigned and made stronger, worn guide slippers replaced, all bearings, seals and bushings replaced, safety spring replaced, all safety device pins, shackles, shafts and dogs and drawbars were NDT tested and replaced as necessary, hinge pins and liners replaced. It was painted with two coats of High Build Epoxy and given a new load certificate and OEM warranty. Ready for another campaign equal in length to the previous one.

Why not just use a local shop?

An FLSmidth rebuild is not just putting on a patch and replacing liners. The integrity of the rebuilt conveyance is assured and it can be trusted to safely and efficiently perform like new.

- Grit blast cleaned
- Completely dismantled & inspected
- NDT tested, repair or replace
- Replace bearings, bushings and wear items
- Re-Design problem areas, stronger
- Ensure integrity & straightness of structure
- Ensure smooth operation of mechanical
- Painted & Certified with new OEM Warranty



Material handling cars/cages



Material handling car

Material Handling Cars are available to transport material of any specified length, for slinging inside cages or Counterweights. Designs for track or trackless operations.

Fully enclosed with expanded metal for trash removal from underground. Floor can be either live to transport packaged timber or pipe or may have a flat floor.

Zimmerman materials cage

The Zimmerman Timber Cage has proven itself as a time & labor saving mine conveyance, especially in installations where hoisting capacity is limited. It requires only a few minutes to swing the cage in or out of the shaft using the shaft hoist and permanently fixed slings.

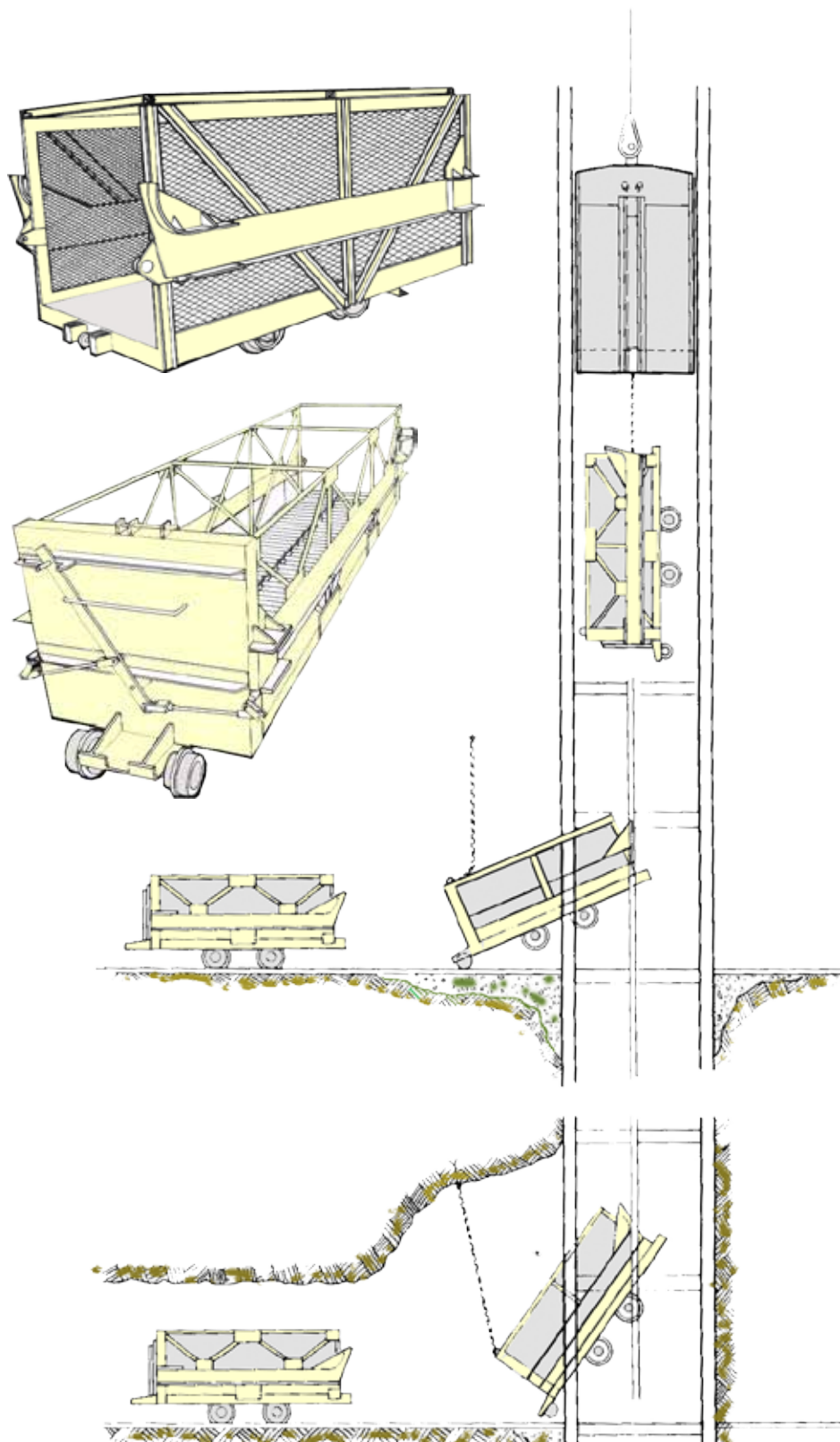
We will design to suit any compartment or guide size and Cages are available for either track or trackless operations.



Materials Handling Car slung inside Counterweight



Zimmerman Material Handling Cage with flat floor and enclosed with expanded metal for trash removal.
Zimmerman Material Handling Cage with live Roller Floor for Timber or Pipe Handling.





Guide rollers



Guide roller selection is specific to conditions at each shaft. Correct application helps maintain guide alignment and minimize maintenance.



Minimize shaft maintenance and extend equipment life

FLSmidth has developed over many years a complete range of Guide Rollers to suit every condition and application.

FLSmidth's Dorr-Oliver Guide Rollers operate on timber or hollow structural steel shaft guides at speeds as high as 40 miles per hour. With an improperly designed or miss-applied Guide Roller any slight misalignment of the guides can cause the conveyance to impact the guides at as much as 2G's. These impacts eventually cause further misalignment of the guides and the problem compounds until the guides must be re-aligned. The use of FLSmidth's Dorr-Oliver Guide Roller results in reduced shaft maintenance and roller adjustment and prolonged roller life.

Sizes

Range from 9" to 16-1/2" diameter.

Tires

Include Heavy Duty Pneumatic-tube, Solid Rubber, Foam Filled, Solid Polyurethane and the Pneumatic Aircraft tire.

Materials

Options for the Hub and Brackets include pressed steel, aluminum and stainless steel.

Mountings

Include Fixed Bracket, Compression Suspension and the Coil Over Shock Absorber.

Set of solid rubber tires on aluminum hubs with urethane compression suspension. The suspension unit consists of a swing arm with urethane compression springs. The suspension maintains pressure against the guides. Light and heavy-duty suspensions are available.



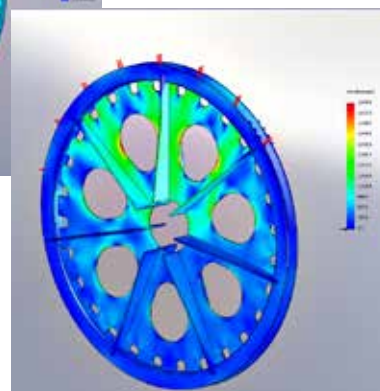
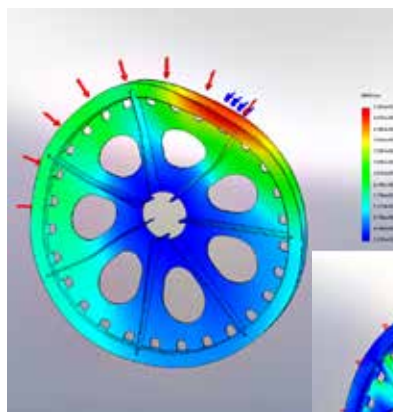
Set of solid rubber tires on cast aluminum rims. Coarse adjustment via eccentric axle or serrated plates is available. Fine adjustment via the threaded suspension rod.

Rope sheaves



The success of our Sheaves is due to high quality manufacturing and design practices. The Dorr-Oliver sheave is widely recognized as the best available.

Solid modeling and finite element analysis are standard design procedures and the designs exceed all applicable codes. Raw materials and the final product are subjected to extensive non-destructive testing.



Head & deflection sheaves

FLSmidth's Dorr-Oliver Head Sheaves and Deflection Sheaves are available in a variety of all types with sizes ranging from 3 ft. diameter to 25 ft. diameter or larger as required.

All sheaves are designed to withstand a load equal to the rope breaking strength.

Our Sheaves can be designed with split type or segmented construction for ease of handling and installation in limited space.

Designs include unlined, steel-lined, and split wedge-type polyurethane liners to satisfy all applications and conditions.

FLSmidth Sheaves typically outlast the mineshaft that they were installed in because they are built to last, FLSmidth's Dorr-Oliver Sheaves are often recycled and reused in a new shaft. We have replaced sheaves that were manufactured by others that had not lasted even to the life of the first shaft.

Compensating sheaves

The Blair arrangement uses two sheaves side by side, for two connections to the skip or cage. This provides deep hoisting capability with two ropes, thus eliminating the requirement for a safety mechanism and wooden guides. Economical rope guides can instead be used. Our Compensating Sheaves ensure hoist rope tensions and lengths are equally maintained via our supply of load cells and hydraulic power package.

Sinking sheaves

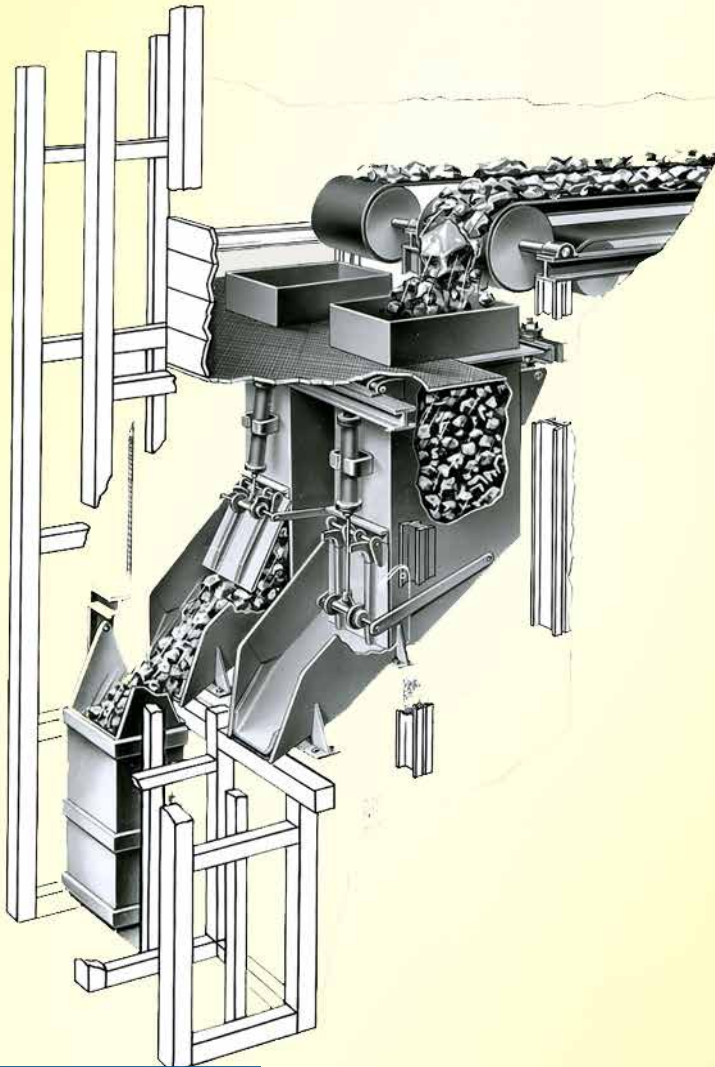
Standard sizes of 36, 48, 60 and 72 inch point diameter, complete with shaft and bearing assemblies. Customer specific sizes also available.



Largest Sheave in North America 21.5 ft ~ 6.6 m diameter



Measuring & loading stations



FLSmidth Skip Loading Systems will move your ore and/or waste from your ore passes or storage-surge bins to your skip and control your hoisting plant automatically and unattended.

The heart of the Loading System is the proven load-sensing device between the measuring capsule and its supporting structure, which controls the feeders or conveyors and the gates or transfer hoppers on two compartment systems.

The arrival of the empty skip at the loading position discharges the appropriate measuring capsule, initiates the hoisting plant and re-cycles the feeding and conveying function. Multiple level and manual operation are available on all loading systems.

FLSmdith can supply the system to feed the Loading Station as a Loading System Package. Items like the conveyor, vibratory pan or Ross Chain Feeders and the belt magnet are included. The cylinders, conveyor, feeders, measuring boxes and skips can all be interlocked with proximity switches and hoist controls via PLC. The entire loading and hoisting system can be fully automated.

The illustration on the left shows a typical but basic two-compartment loading station with each compartment fed by a separate conveyor and the Wedged Lock splash-proof doors that are particularly well suited for sticky muck and rapid discharge applications. Modern high speed hoisting systems must be kept in motion as much of the time as possible. Therefore you cannot afford to have a skip waiting for a slow loading arrangement. Many types of arrangements are available and almost any arrangement and capacity has already been supplied.



FLSmdith's Dorr-Oliver Loading Stations are custom designed to suit each situation. Designs include swing out directional chutes and air operated transfer hoppers/cars to direct the ore to the proper measuring capsule from a single conveyor.

The images to the right were part of a skip loading station supplied in 2005. Also included were two guillotine gate feed chutes, abrasion resistant liners, support structure, access platforms, pneumatic cylinders & controls. Hydraulic cylinders and optional power packs are also available.



These photographs show a Measuring Flask with an ARC GATE door discharge chute that is particularly well suited in limited space and where very accurate flow control is required.



Chairing



All skips can be supplied with Chairing Mechanisms to eliminate excessive rope stretch when loading at depth. FLSmidth offers multiple designs, depending on the configuration of the shaft.

Our traditional Skip Loading Chairs extend into the shaft compartment to allow the Skip Bucket to be supported while loading. In addition this style mechanism can also be fitted with chairing bumpers or hydraulic buffers.

Another available option is our FLSmidth Chairing Pawl which pneumatically activates a resting pawl that engages with a receiver mounted to the skip body. This system accommodates shafts with smaller excavation areas as well limits the protrusion into the shaft compartment.



Ross chain feeders

Application

Ross Chain Feeders are handling every known granular material on five continents. They have proven their efficiency in handling the heaviest rock and ore feeds to primary crushers, bin storage feeds to secondary crushers, and as hopper, bin and chute control feeds to conveyors and skips.

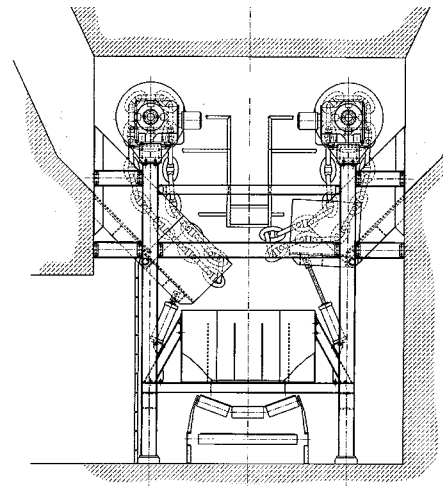
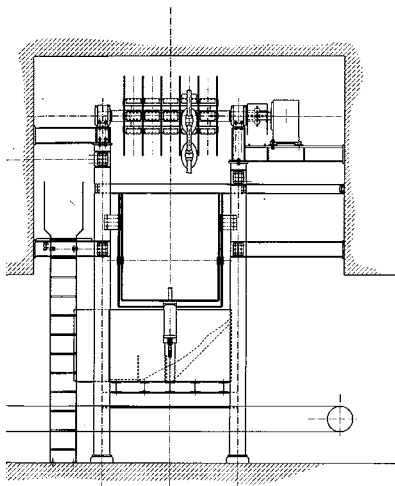
The Yielding Top Control Principle of operation ensures remarkably long life to the equipment and minimum power consumption. It guards the outlets of 2000-ton vertical ore pockets and in other installations; 35-ton loads are being dumped straight at the feeder.

Pivot chute

For precise control of feed, the Ross Pivot Chute Lip is a valuable addition. No other change in the feeder is required. Raising or lowering the lip changes the tonnage flow over a range as great as 3.5 to 1 on small or crushed material or 1.5 to 1 on very large rock.

Operation

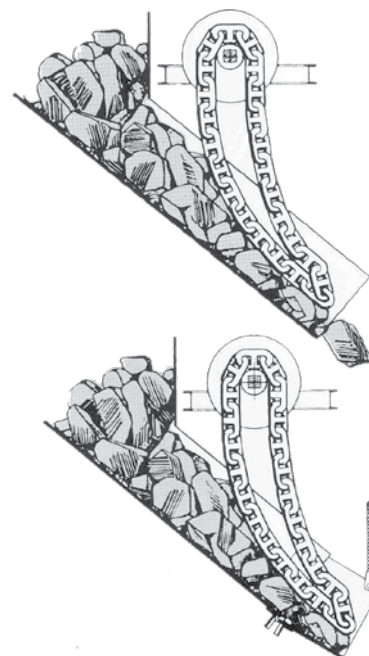
The Ross Chain Feeder is much more effective than a stationary chain curtain. The Feeder provides the restraining effect of an endless



curtain, which lies on the material. The feeder rotates moving the material into a steady "single-ply" stream and feeds it down a chute at a controlled rate. Ross Feeders are available in a large range of Drive and Chain sizes to handle a full range of size from large uncrushed rock to crushed granular materials.

Variable speed drive

The flow range can be further increased several times by including a variable speed drive on the Feeder. This makes it ideal for feeding crushers, pulverizers, dryers, Kilns, mixers, conveyors and screens. Drive options include variable frequency AC drives and Hydraulic drives.



(Top) Standard Ross Chain Feeder
(Bottom) Ross Chain Feeder with Pivot Chute Lip



Mine Haulage



Mine cars for all your underground mining needs

Arc-Flow bottom dump cars

FLSmidth's Dorr-Oliver Arc-Flow Cars are available in capacities from 70ft³ to 350ft³ and for track gauges for 30" up to standard rail gauge of 4' 8-1/2". When arranged with overlapping ends for continuous loading and ramp dumping, the Arc-Flow car train becomes an ideal application for semi or fully automatic haulage systems.

Granby cars

FLSmidth has manufactured over 2500 Granby Type Mine Cars ranging from 40 to 300 cubic foot capacity. Most of these cars are still in operation today handling the bulk of the Canadian underground mining production, waste haulage, and in some cases, backfill. FLSmidth's Granby Cars are practically all custom designed to fit our customer's

requirements. Standard proven components and methods of construction are combined with FLSmidth's long experience in underground haulage and mine operations to produce the best mine car value available in North America.

Gable bottom cars

Muck that has proven impossible to discharge from conventional mine cars can be handled efficiently in FLSmidth's Dorr-Oliver Double Door Gable Bottom mine cars.

Tipple cars

FLSmidth's Dorr-Oliver Tipple Cars are available in capacities from 100ft³ up and designs can range from simple tub-like construction to literal battleships.

Grangesberg cars

FLSmidth's Grangesberg cars with overlapping ends and remote locomotive control at the loading chutes have proven to be very efficient one man high capacity haulage system. The locomotive and cars are carried over the dump station by a series of rollers engaging a track on both sides of the locomotive and the car bodies. The bottoms of the cars drop away on the contoured single dump rail permitting unrestricted material discharge.



Rock dump cars

FLSmidth's Dorr-Oliver Rock Dump Cars are the best known type of mine car in the world. FLSmidth has manufactured well over 3,000 Rock Dump Cars in capacities ranging from 10 to 60ft³ and these have included all possible conditions of track gauge and cage sizes, etc. The Rock Dump Car is still very popular for development and production haulage underground.

have tremendous possibilities for handling ore, waste, back fill or other material underground, and almost any free flowing material in surface processing plants. Potential is limited only by the working space available.

Man coaches

As underground workings spread out, the time required to place men in the working areas becomes a major problem. FLSmidth has manufactured and supplied a considerable quantity of man coaches with capacities ranging from four to forty men for various mines across the world. All designs provide maximum protection and as much comfort as possible with wood slat seats, rubber cushioned wheels and couplers, and optional, sprayed on lining for sound proofing.



Scraper trains

Some development drives and tunnel projects are well suited for the application of Scraper and Slusher Trains. FLSmidth has supplied several Slusher Train Installations for development work, all of which have completed their designed projects and since then converted to regular haulage.

Double door bottom dump cars

FLSmidth's Double Door Bottom Dump Cars are high capacity main haulage cars designed for continuous bottom dumping and continuous loading. This type of car is well suited for high production haulage of primary crushed muck.

Self-Propelled transfer cars

FLSmidth has designed and manufactured a number of air and electrically driven transfer cars for both underground and surface applications. These can be operated manually from the unit, or remotely from a control station. Transfer cars

Zimmerman timber cage cars

FLSmidth's Zimmerman Timber Cage Cars are enclosed with expanded metal for trash removal from underground operations. Zimmerman Timber Cage Cars are available to handle the materials from 8 to 22 ft. long and to suit any compartment or guide size with special designs for slinging inside cages or for trackless mining operations.

Transfer cars

Head Frame Transfer Cars are another specialty of FLSmidth. Designs are available to direct the flow of ore or waste in as many as four different directions.



Shuttle cars

Drifting and development work always presents the problem of getting the loaded car away from the face and an empty car in its place. FLSmidth's Dorr-Oliver Shuttle Car is an accepted and proven method of passing cars up to the face in most mines.

Service cars

Transporting supplies and equipment both on surface and underground is always a costly and difficult procedure. FLSmidth has not neglected this phase of haulage and have designs available for almost any type of Service Car. If you have a service car problem, call us to find out how we can help you.



Vecor mine hoists



Ø 6.0 m 4-Rope Koepe Hoist - Lonmin K4.

FLSmidth has a proven history in the design, manufacture and supply of robust, reliable Vecor Mine Hoists. Our office based in Johannesburg, South Africa is the center of excellence for hoisting technology within the FLSmidth.

FLSmidth has a hoist reference list that exceeds 500 installations worldwide over a period spanning more than 100 years.

We have extensive experience in the supply of hoists in the three principle categories, namely:

- Friction/Koepe Hoists
- Drum Hoists (Single and Double Drum)
- Blair Multi-Rope (BMR) Hoists



We also design and supply hoists for specialized applications such as stage hoists for shaft sinking operations.

FLSmidth has supplied hoists with drum diameters ranging from less than 1.0 meter to greater than 6.0 meters. The majority of these hoists have been of the double drum configuration with dual clutched drums and diameters greater than 5.0 meters.

Design & braking systems

The FLSmidth design team has pioneered and perfected many hoisting configurations particularly in the field of deep level hoisting. FLSmidth has designed, manufactured and supplied more BMR hoists than any other hoist supplier. We are also the first company to successfully supply a hoist operating over a single winding depth in excess of 3000 meters.

The hoist design process makes extensive use of our in-house finite element analysis (FEA) facilities. Modern software allows for all geometric details to be modelled and fully analyzed, ensuring reputed robust and reliable designs. Our designs have been proven over many years in the field, with performance being backed by field strain gauge testing.

Drum design is a crucial component for all hoists. Drums are exposed to heavy loads of a cyclical nature and are therefore designed in accordance with recognised international standards for fatigue design.

Various drive configurations can be offered including geared, direct drive with overhung motors and Integral. Motors can be AC Induction, AC Synchronous or DC and would be supplied through a preferred supplier.

For the purposes of cost competitiveness, FLSmidth employs concepts of “designed for manufacture” and make use of their global network for material and component sourcing in order to provide hoists of the finest quality with unparalleled levels of reliability and production availability.

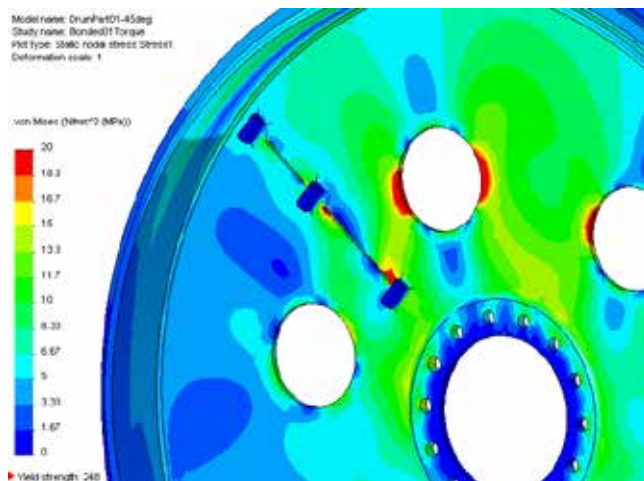
FLSmidth is able to offer fully customised designs to suit individual client needs and requirements. These customised designs make use of commonly used standard components such as bearings and clutches.

FLSmidth as an international leader in hoisting technology, has developed hydraulic systems for Escort and Closed-Loop brake control. The developments in Closed Loop control were stimulated by the need to reduce dynamic rope loads under emergency braking conditions.

The resultant reduction in peak rope loads has facilitated deep shaft hoisting. Sophisticated hydraulic systems are employed to ensure rapid speed of response and repeatable control accuracy.

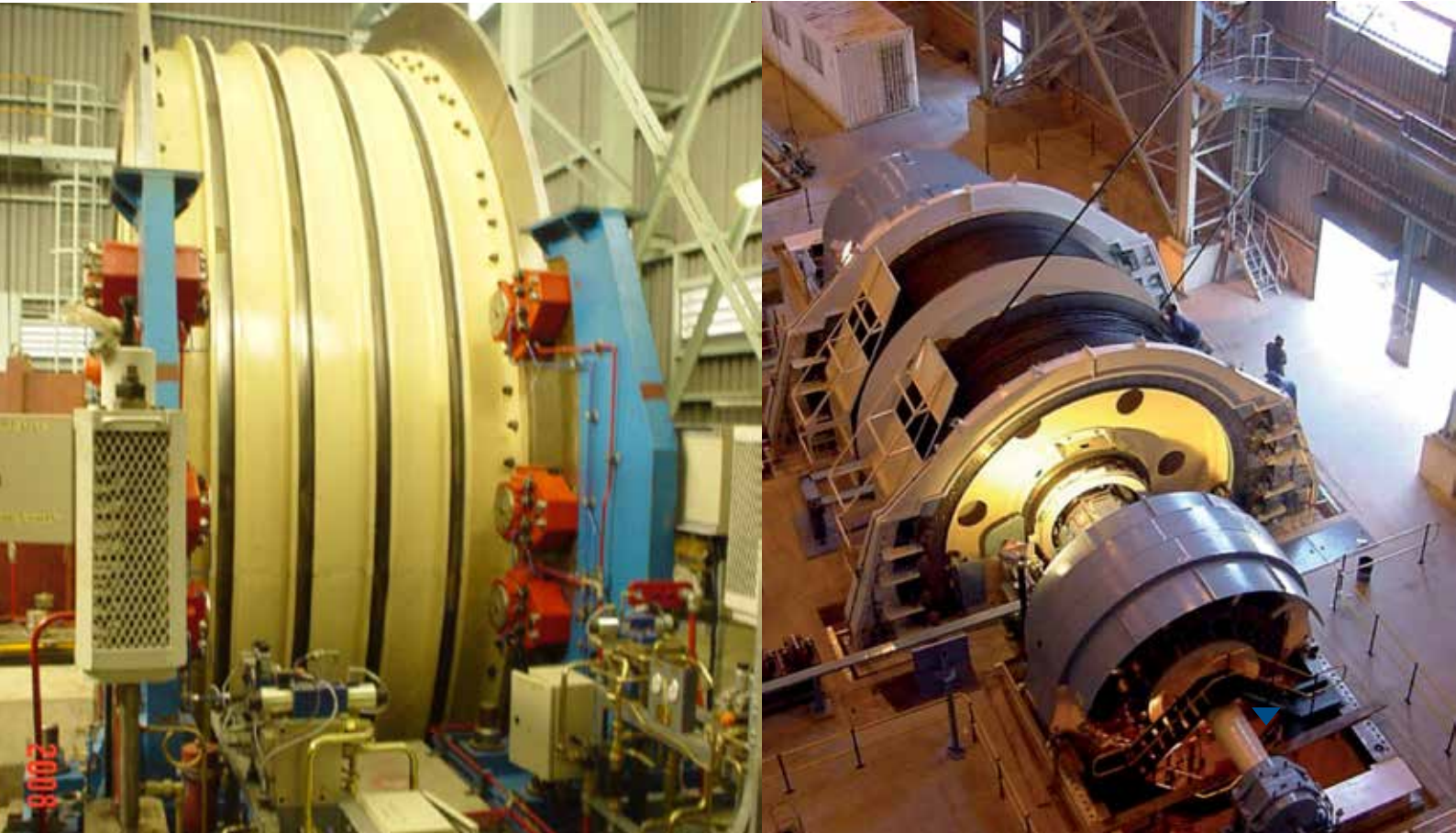
Disc braking systems are the preferred arrangement for current hoists. The design of the brake path or brake disc ensures minimum deflection under rope loading and high stability under thermal loading.

(Top) FEA model for hoist drum
(Bottom) Disc braking arrangement



Vecor mine hoists

(cont.)



(left) Koepe Hoist - Lonmin K4
(right) Ø 6.0 m Double Drum Hoist -
Impala 14#.

Friction & drum hoists

Friction hoists, commonly referred to as “Koepe” hoists, provide an economical solution to many hoisting applications. These hoists typically have lower capital costs when compared to drum hoists due to characteristic lighter, single-drum constructions and lower installed power requirements.

Koepe drums are subjected to high cyclic fatigue loads, typically reversed during every drum revolution. Design is of necessity for infinite fatigue life.

The head ropes of a Koepe hoist are subjected to cyclic variations in

operating loads due to the required use of tail, or balancing ropes. For adequate rope life, the static load range should be limited to approximately 12 % of the rope breaking strength. Regular rope maintenance and replacement is essential on these hoists.

Koepe hoists are not normally favored for depths of wind greater than 1800 m. However, for depths within the 1800 m range, very large payloads can be handled by increasing the number of head ropes. Koepe hoists frequently find application as service hoists for men and materials using a cage and

counterweight arrangement. These are often configured for use with push button cage control.

Drum hoists, both single drum and double drum, are the most frequently used type of hoisting system. With multi-layer coiling the double drum hoist is frequently used for lengths of wind to 2500 metres, but can be used for lengths of wind greater than 3000 metres.

Although normally winding in balance, the range of brake torque required during emergency braking requires some form of brake control system to provide acceptable retardation levels under all winding conditions. The control of emergency braking retardation for single drum hoists is particularly problematic due to the high out of balance loads and great variation in the natural rates of retardation for different hoisting conditions. FLSmidth has extensive experience in the design of suitable brake control systems.

Blair multi-rope hoist

The conventional double drum hoist underwent a major development in 1957 when Robert Blair introduced the concept of combining the load carrying capacity of multiple ropes in the friction hoist system with the simplicity and flexibility of drum hoists. Each drum of a BMR hoist is divided into two (or more) compartments with a single rope per compartment - each rope on the drum being attached to the same conveyance. Systems are incorporated to ensure load sharing between ropes and protection against miscoiling.



The BMR system significantly increases the hoisting capacity of a drum hoist. Hoists with end loads of 32 tonnes at depths of 2500 meters are common. The Moab Khotsong BMR winder, supplied by FLSmidth to AngloGold Vaal River Operations, was the first hoist to operate to a depth of 3150 m in a single wind with an end-load of 23 tonnes.

The most frequently encountered problem with a BMR hoisting system is that of Fleet angle control because of the wide drums inherent in BMR hoists.

A number of solutions are employed:

- Arranging the drums in tandem and mechanically coupling through gears.
- Arranging the drums in tandem, or side by side, but inclined at an angle, and coupling electrically.
- In-line arrangement of drums where the shaft system allows for conveyances at large centre distances, for example using the outer compartments of a shaft.
- Arranging the drums inclined to each other, but mechanically coupled through a Hookes Joint.



Ø 5.1m BMR Hoist with Hookes Joint Coupling - South Deep

Rope attachments, catch gears, and arrestors



Fine adjustment hydraulic linkage

Fine adjustment Linkage is primarily used in friction hoisting setups. The linkage allows fine adjustment so all ropes in a multi-rope arrangement are equally tensioned and therefore working together which in turn greatly extends rope life.

Sockets

Sockets are used on a variety of applications including Hoist, Balance, Guide and Sinking Ropes. The Socket attachment offers a safe, economical connection and can be installed with either the quick and efficient Wirelock Resin or Zinc.

With special Threaded STT and STJ Type Sockets, a wide range of Jaw or Tang ends can be made to suit most required connections without a Link Plate. Our standard SJ (non-threaded) Sockets normally require an Adapter Link Plate, adding both cost and bulk but are preferred in some installations.

All Sockets are designed with a minimum of 10:1 Factor of Safety, Proof Load Tested to 2 ½ times Safe Working Load, Ultrasonically and Wet Magnetic Particle Inspected. All meet or exceed National Coal Board Standards. Sockets are customer designed to suit customer needs.

Thimble type cappel

Thimble Cappels are used in single and multi-hoist applications.

Solid thimble & clamps

Solid Thimble and U-Bolt Clamps are used with either Round Strand Hoist or Balance Rope connections.

Dorr-Oliver catch gear

- Pawl configuration custom designed to suit load case and space constraints
- (single or multiple pawl columns, double sided designs for tight clearances between compartments).
- Pawl box with guides and guide shoes mounted to support post and base.
- Hydraulic buffers to reduce impact loading on components and headframe structure.
- Manual or hydraulic pawl retraction for maintenance checks.



(Bottom) Ultra Heavy Duty Catch Gear for North America's Largest Ore Skips. Shown is part of a set designed for an impact loading of 1,400,000 lbs.

Swivel & swivel hooks

Swivels are used to provide rotation, primarily in Balance or Sinking Stage Ropes, to alleviate torque buildup, which is damaging to ropes. A variety of styles are available ranging in capacities from 1 ½ to 100 tons.

Glands

Glands are used for the maneuvering, lifting and suspension of Round Strand or Locked Coil Ropes.

The Gland design is similar to that of a Wedge Cappel, utilizing interlocking wedges inside the two part gland body.

All Glands are manufactured from high quality steel, Proof load tested to 2 times safe working load, ultrasonically and wet magnetic particle inspected.

Maneuvering & suspension glands

This type of gland is commonly used for manoeuvring ropes into position or anchoring permanently where rotation is not required.

Spherically seated glands

The Spherically Seated Gland can be used similar to the non-spherical type but in addition, has a spherical brass



(Bottom Left) Standard Thimble Cappel, shown with thimble removal tool
(Bottom Right) Hydraulic Linkage

base unit to facilitate rotation of the Guide Ropes, thereby evenly distributing wear over the rope surface.

Guide rope tensioning

Where shaft Guide Rope systems are used in lieu of rigid type guides, several attachment assemblies are available. Arrangements are offered with bottom weight tensioning (most common), bottom spring tensioning or top spring tensioning.

The upper attachment includes a Spherically Seated Gland, while the bottom end can be fitted with a socket or glands. The socket or gland is then connected to a Triangular Link Plate which facilitates load transfer for rope changes.

With bottom weight tensioning, cheeseweights are mounted on a rod and platform thereby keeping guideropes tensioned. As mentioned, rather than cheeseweights, spring tensioning can be employed at either top or bottom.

Tension Weights (Cheeseweights)
The dimensions of the cast iron tension weights are generally determined by the shaft layout and position of the guide and rubbing ropes.

Lead cheeseweights can be used when height restraints become an issue.

Friction (Koepe) hoisting ropes

FLSmidth offers solutions for tower and ground mounted Friction (Koepe) Hoists which have a long standing reputation for providing ropes for deep shaft and difficult friction hoist installations.

Hoist (head) ropes

- High Performance Non-Rotating
- Full Locked Coil
- Round Strand
- Flattened Strand



(Above) Spherically Seated Glands and Manoeuvring & Suspension Gland

Balance (tail) ropes

- 34x7 & 34x17
- Plastic Enhanced
- Special Small Loop Construction

Guide ropes

- Half Locked Coil

Drum hoisting ropes

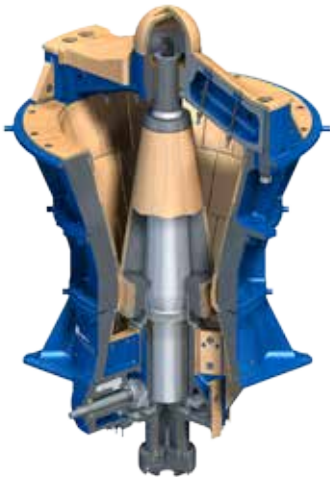
FLSmidth's capabilities range from simple single drum to deep shaft installations.

- High Performance Non-Rotating
- Flattened Strand





Crushers, sizers & feeder breakers



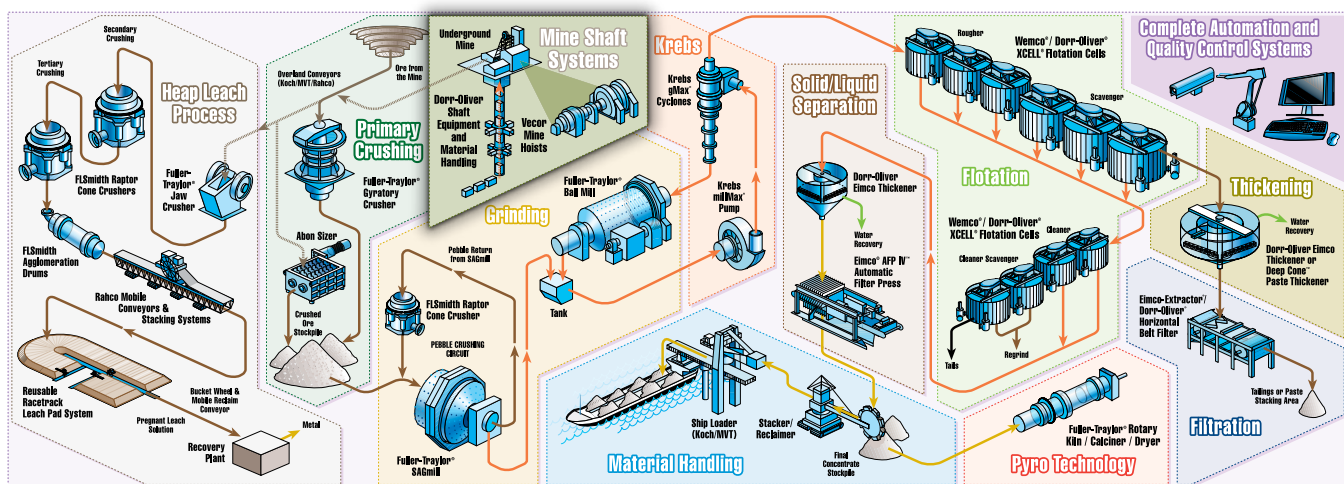
FLSmidth has over a century of experience in crushing and is known as a world-class supplier of crushing equipment for the mining, cement and aggregate industries. This expertise is supported by more than 1,700 installed crushers, feeder-breakers and sizers.

All of our crushing and sizing equipment is available for surface or underground installation, for stationary or mobile applications, and for climatic conditions that range from tropical to arctic.

Crushing products

- Gyratory Crushers
- Cone Crushers
- Low Speed Sizers
- Roll Crushers
- Jaw Crushers
- Feeder-Breakers
- Hammermills
- Vertical Shaft Impactors
- Plants & Systems
- Crusher Gears

Mine shaft systems flow sheet



Customer services



FLSmidth provides the service and maintenance to keep your application safe and operational.



FLSmidth is your one source for spare parts, services, maintenance and operational services. Our customer services group provides a wide range of services from installation, troubleshooting, mechanical analysis, recertification and commissioning of FLS equipment. Customers are our most important assets. Indeed, everyone promises it, we deliver it.

We work closely with our customers from project inception to help best incorporate most current designs for safety, production and ease of maintenance

Rebuilds

FLSmidth can rebuild your existing mining equipment with quality and reliable OEM parts providing the



After many hours of operation equipment needs to be rebuilt/upgraded to maintain safety. Our rebuild shops ensure the highest quality and safest rebuilds available.



services required to engineer, procure and rebuild to OEM quality and standards while updating to the current design standards and incorporating any upgrades required by the customer, a cut above the competition.

Original OEM spares;

- Hoists, Drum, Koepe, BMR , Tensioning Reels
- Sheaves, Head, Deflection. BMR Compensating, Sinking, Double Down
- Skips, Bottom Dump, Kimberly, Rola Chute, Arc Gate, Front Dump, Incline
- Cages, Single/Double/Triple Deck, Two Guide and Four Guide.
- Counter Weights/Frame & Pipe Types
- Guide Rollers
- Haulage Equipment, Mine Cars, Arc-Flow Bottom Dump. Granby, Grangesberg
- Ross Chain Feeders
- Gates and Chutes
- Measuring and Loading Stations

Rope attachments and rope handling equipment:

Sockets, Hoist, Balance and Guide Rope. Hoist Rope thimble Cappsels, Solid Thimble & Clamps, Fine Adjusting Hydraulic Linkage, Swivels, Glands, Sinking Attachments, Chaseblocks, Buckets, Load Cells, Cheeseweights

Consulting, recertification, design and modification services, mine hoisting seminars;

Rope Installation, Hoisting System Design, Socketing Seminars, Rigging Seminars, Mine Hoisting Seminars, Maintenance Procedures, Testing/ Recertification, Attachments Inspections, Attachment Recertification, All Rope Installation, Removal, Maintenance & Service Needs, Rentals and Site Services

Additional products;

Rope installation and removal equipment, Tensioners, Reel Winders, Lubricators, Socketing Stands, Tuggers/Winchers, Reaving Sheaves, Goosenecks, Reaving sheaves, Rope Unwinders, Rope Transporters, Grooving Tools, Rope Cleaners.

One Source, many solutions



In addition to underground mining solutions FLSmidth brings together the experience and reliability of global leading brands and services to provide complete systems and solutions for your application.

As a One Source supplier, FLSmidth integrates testing, detailed design engineering, global procurement, expert process control, and localized services to deliver a complete flowsheet of products and process support for the minerals processing industries.



FLSmidth is your One Source for the world's largest installed base of original equipment, enhanced products, technologies, and services unmatched in the mining and minerals processing industries. FLSmidth offers a broad range of equipment and processes including: testing, design, engineering, crushing, grinding, classifying, flotation, thickening and clarifying, vacuum and pressure filtration, pyroprocessing, material handling, slurry handling, automation, along with OEM quality replacement parts, modernization services and other after-sale services.

To successfully compete in today's challenging world economy, companies often require innovative solutions to make their plant operating systems function at peak efficiency. Utilizing the latest in equipment technology, resources, and materials, we deliver the optimum design, equipment, and process support needed. When you select FLSmidth as your partner, you also bring this solid foundation and over a century of experienced support to your business.



FLSmidth offers engineering, field services and process control systems needed to keep your plant running smoothly and efficiently.



Product brands:

- ABON - feeding, sizing, crushing and screening equipment since the 1920s.
- Buffalo - feeding and crushing equipment for mining and general industries since 1975.
- Dawson Metallurgical Laboratories metallurgical testing for ore amenability, process development, flowsheet layout and plant design since the 1930's.
- Dorr-Oliver and EIMCO - over 100 years of technical innovation in liquid/solid separation solutions and underground mining including product offerings from WEMCO and Shriver.
- Fuller-Traylor/FFE - dating back to 1903, Fuller-Traylor mills, crushers and pumps have a reputation for ruggedness and reliability.
- Raptor® Cone Crushers - These well-designed, robust and durable machines offer outstanding productivity.
- FLSmidth KREBS - hydrocyclone separation and severe-duty slurry pumping solutions since 1952. Krebs also supplies Technequip Valves.
- FLSmidth Material Handling Brands – Koch, MVT, RAHCO, and Conveyor Engineering combine to design, manufacture, and service bulk handling systems including mobile conveyors, radial stackers, portable conveyors, fixed/overland conveyors, and at-the-face mining conveyors, as well as supplying coke oven plant technology, rolling mill systems, and steel construction for hydraulic engineering.
- Möller - design, engineering, procurement, erection, and commissioning of pneumatic conveying systems and silos equipped with pneumatic facilities.
- VECOR - mine hoist technology.
- FLSmidth Automation - automation and quality control systems and total electrifications projects

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