DESCRIBE THE OPERATION OF A SAFETY CIRCUIT

Winder safety circuit
Back-up safety circuit
Winder lockout circuit

3. WINDER SAFETY CIRCUIT

The Safety Circuit is a collection of protective devices, connected in series. Therefore, if any one of the monitored units, or conditions is not in the desired condition, the Safety Circuit will be in a tripped condition.

If the safety Circuit is tripped, the Winder Brakes will automatically apply, therefore winding can only take place when the Safety Circuit is reset, or in a healthy condition. In this way one ensures that no winding takes place should a fault condition exists.

The Safety Circuit can be divided into 3 main sections

1. Winder Safety Circuit
2. Back-up Safety Circuit
3. Winder Lockout Circuit

The Safety Circuits are usually fed by a 110 V Supply. This supply flows through the Safety Circuit contacts in series, which will be closed when in the healthy condition, and thus close the Safety Circuit contractors, thus enabling other Winder circuits to operate, e.g. Brakes to be lifted, power to be applied.

The prime function of the Winder Safety Circuit is to apply the mechanical brakes, isolate the AC motor control in the case of a AC Winders and suicide the field current in the case of DC generators. The Safety Circuit is controlled by two contractors connected in series for Safety back up. When the Back-up Safety Circuit trips the main AC breaker is tripped to isolate the AC supply to the motor and control panels.

On DC Winders the DC loop Breaker Safety Circuit has some of the more serious protection devices. Tripping of this circuit cause the mechanical brakes to apply and the DC loop breaker to be tripped. The DC generator set is not stopped in this case but the main loop is opened so that no current can flow.
The Winder Lockout Circuit will not trip the Winder whilst it is in motion. It will however, when a fault is detected, allow the wind in progress to finish until the brakes are applied.
The Winder will the " Lockout", thus not allowing the brakes to be lifted until the fault is corrected and the Winder Lockout Circuit is rest. Whilst the Winder is locked out, power cannot be applied to the motor and neither can the brakes be lifted.

Safety Circuits vary considerably from Winder to Winder, due to age and with the new Winders being more comprehensively protected to ensure reliable safe operation at all times.

A brief description will be given to typical Safety Circuit units, and conditions that are monitored, is listed below, but these items are not specific to any particular Winder.

3.1 MAIN SAFETY CIRCUIT

Emergency Stop
Slack Rope
Overspeed protection
Programmable Logic Control safety- (Only Winders with PLC's)
Motor Vacuum Circuit Breaker Tripped
Signal Interlocking
No Start Interlock
Auxiliary Drive Monitor Trip
Brake Oil Pump Tripped
Brake Safety Circuit
Men/Rock Change over
ESCORT PLC Safety
Bearing Lubrication Trip
Stator Overload - Alternating Current
Rotor Overload - AC
Resistor Fan Trip - AC
Potential Interlocking - AC
Electrolyte Temperature Trip - AC
Dynamic Braking Main Circuit Breaker Tripped - AC
Cooling Water Temperature Trip - AC
Overwind / Underwind Protection

Conveyance Monitoring Safety Circuit - (Slack / tight rope, pole, door, emergency stop etc.)
Marshall Device- (incline shafts only)

3.2 BACKUP SAFETY CIRCUIT

Emergency Stop
Headgear Overwind/Underwind
Camgear Overwind/Underwind
Motor VCB Push-button Trip
VCB Trip
DC Circuit Breaker
Motor Field Failure
3.3 LOCKOUT SAFETY CIRCUIT
Brake Oil Temp
Brake Oil Level
Broken spring
ESCORT Brake Failure
Brake Wear
Brake Oil Filters Blocked
Bearing Temperature
Motor Temperature
Motor Fan
3.4 DESCRITTION OF WINDER SAFETY DEVICES

3.4.1 EMERGENCY STOP

If any emergency stop push- button is activated the Safety Circuit will trip

3.4.2 STATIC SLACK ROPE DEVICE

This device is normally mounted in the Winder house at the rope opening. It consists of a roller mounted across the rope hole just below the winding rope with a weight and limit switch actuator to trip the Winder should the winding rope come into contact with the roller which is normally pivoted on two bearings. The disadvantage of this slack rope device is that it would only detect slack rope in the first 30 to 50 meter of the shaft, thereafter it is normally inoperable as the weight the rope from the sheaves wheel to the drum, compared to the weight of the rope in the shaft which will be greater then, thus no sag will appear to operate the static slack rope device.

The general arrangement of the slack rope device is basically identical on all the Winder. The operation of the device is acceptable but subject to limitation depth, wiring to Safety Circuit etc.

Testing in most cases is done by pulling the device down by hand, which is practical way for doing daily checks. Slack rope simulation by sprigging should be done when practical, for example when cutting front ends.

The arrangement is typical of most shafts with the supporting steel being dependent on the building arrangement. The distance of the roller from the rope and the size of the balancing weights are dependent on site conditions. The slack rope trip is initiated by a lever arm limit switch and fine setting is achieved by turning a threaded stud.

If a slack rope is detected, the Winder is tripped. When the Winder is moved thereafter, it can only be moved in conjunction with the backing out switch, in the direction that will rectify the slack rope.

3.4.3 OVERSPEED PROTECTION

The overspeed alarm is a warning device that will give the driver an alarm if the maximum allowed speed is exceeded, if this is then further exceeded it will result in the Winder being tripped.

3.4.4 PLC SAFETY (only Winder with PLC's)

Run Back Protection - (New Cegelec Winder)
Overcurrent , overspeed etc.

3.4.5 MOTOR VCB TRIPPED

Electrical faults will trip the motor breaker that in turn will trip the Safety Circuit.

3.4.6 SIGNAL INTERLOCKING

During men winding the lock bell shaft System is interlocked with the Safety Circuit. This is to ensure that the correct procedure is followed whilst men are being conveyed. After the signals have been completed, there is a ten second delay before the Signal Interlock Trip Relay closes.
If the driver attempts to move the Winder before this period has lapsed, the Safety Circuit will trip. This interlock is overridden when the brake lever is in the on position and the power lever in the off position, to allow for Auto wind materials to take place.

Some of the older Winders use the Broomfield Dixon device that mechanically interlock with the levers.

3.4.6 NO START INTERLOCK

If the power has been applied for approximately 10 seconds, without the brakes being released then the Safety Circuit will trip.

3.4.8 AUXILIARY DRIVE MONITOR TRIP

This system consists of a microprocessor, which can handle four-shaft encoder's. These encoders are mounted on each of the Lilly drive shafts and the other encoders each on the drive shafts to the mechanical Camgear. The system is set up automatically for a keypad by running the machine to initialise the encoders. Once the system is set up it will do monitoring in both the clutched and unclutched condition, i.e. During the clutched condition the monitoring takes place between the two Lilly drive shafts and the two Mechanical Camgear drives, in the unclutched condition the monitoring will take place between the Lilly drive shaft and the mechanical Camgear.

If a faulty condition has been detected, the Safety Circuit will trip.

3.4.9 BRAKE OIL PUMP TRIPPED.

Any failure of brake oil pumps trips the Safety Circuit

3.4.10 BRAKE SAFETY CIRCUIT

Brake Oil Temp
Oil over temperature trips the Lockout Circuit
Brake Oil Level
Oil level low trips the Lockout Circuit
Broken Spring
Any failure of a brake spring trips the Lockout Circuit
Brake Wear
Any brake wear trips the Lockout Circuit
Brake Rubbing
The brake rubbing circuit checks that the brakes have been fully lifted or should the brakes tend to creep on due to a fall in brake oil pressure.
Brake Oil Filters Blocked
Any failure of a filter trips the Lockout Circuit.

3.4.11 MEN/ROCK CHANGE OVER

This system is used on Rock Winders to move the overwind position from the bank to the tip. If a changeover from men to rock or vice versa is attempted whilst the Winder is in motion, it will cause the Safety Circuit to trip.

3.4.12 ESCORT PLC SAFETY

Emergency trip valve failure will trip the Safety Circuit and if an ESCORT failure signal is detected, the Lockout Circuit will be tripped.

3.4.13 BEARING LUBRICATION TRIP.

If any of the required lubricating pumps are not running, the Lockout system is activated and the Winder will then trip after is has come to rest normally and the brakes have been applied and control lever in neutral position.

3.4.14 STATOR OVERLOAD

If an overload in the AC Winder motor is detected the Safety Circuit will trip.

3.4.15 ROTOR OVERLOAD

If an overload in the AC Winder motor is detected the Safety Circuit will trip.

3.4.16 RESISTOR FAN TRIP

If a fan trips in the AC Winder resistor panels, the Safety Circuit will trip.

3.4.17 POTENTIAL INTERLOCKING

This is used on AC Winders to protect the stator reverse contractors and motor from short circuits and will trip the Safety Circuit if this condition occurs.

3.4.18 ELECTROLYTE TEMPERATURE TRIP

This is used on AC Winders to prevent the liquid controller form overheating and will trip the Safety Circuit if this condition occurs.

3.4.19 DYNAMIC BRAKING MAIN CIRCUIT BREAKER TRIPPED.

This is used on AC Winders to protect the thyristor stacks or dynamic braking generators and will trip the Safety circuit if this condition occurs.

3.4.20 COOLING WATER TEMPERATURE TRIP

This is used on AC Winders to prevent the liquid controller from overheating and will trip the Safety Circuit if this condition occurs.

3.4.21 LILLY OVERWIND/UNDERWIND

Overwind/Underwind switches are provided on the Mine Winder Controller of any Winder. Once the Winder has been tripped by one of these conditions, the driver can only recover from this condition by using the backing out switch.

The backing out switch permits the Safety Circuit to reset, but if the brakes are lifted before power is applied in the correct direction. If power is applied in the wrong direction, it will cause the Winder to trip again.

3.4.22 CAMGEAR OVERWIND/UNDERWIND

Overwind/underwind switches are provided on the Camgear if a Winder. Once the Winder has been tripped by one of these conditions, the driver can only recover from this condition if the Safety Circuit bridged out.

3.4.23 MOTOR VACUUM CIRCUIT BREAKER PUSH-BUTTON TRIP

This is used for manual shutdown.

3.4.24 VACUUM CIRCUIT BREAKER TRIP

Electrical faults etc. causes the VCB to trip

3.4.25 BEARING TEMPERATURE

If the pre-set temperature on a bearing is exceeded, it will then operate an alarm and trip the Lockout Safety Circuit.

3.4.26 MOTOR TEMPERATURE

If a pre-set temperature on a motor winding is exceeded, it will then operate an alarm and trip the Lockout Safety Circuit.

3.4.27 PHILLIPS PROTECTION DEVICE-WRONG DIRECTION

The Phillips Protection Device provides a warning to the driver if the conveyance is in the bank area and power is applied in the wrong direction. The wrong direction would be that, the conveyance could move further ups the headgear towards overwinds trips, rather than downs the shaft.

3.4.28 THREE TURN WARNING

The Driver is warned of the arrival of the ascending cage, skip, r other means of conveyance at not less than three turns of the drum below the bank and there must be a warning signal, which is usually audible.

3.4.29 TACHO FAILURE

If there is a loss of electrical output from the tacho generators that is used for control and ESCORT system, it will trip the Winder Safety Circuit.

If however, one drum is unclutched provision is made to prevent the Winder from being tripped, because there is no output from the tacho on the stationary drum.

3.4.30 ELECTRICAL SUICIDE TRIP - (DC GENERATOR SETS)

The DC loop Breaker will trip within one second after the Winder Safety Circuit has tripped, if current is still detected within the Armature loop.

3.4.31 LEVERS INTERLOCK

For both automatic winding and before clutching, levers must be in specific positions. Any subsequent movement of the levers will result in the Safety Circuit being tripped.

3.4.32 STALL PROTECTION

The DC loop Breaker trips if current flows in the motor armature loop for approximately 40 seconds, or more without motor movement being detected.

3.5 SHAFT SAFETY DEVICES

3.5.1 SPEED/DISTANCE ENVELOPE PROTECTION

3.5.1.1 OVERSPEED PROTECTION

Every Winder must be fitted with at least one effective automatic overwind prevention device as well as an effective automatic overspeed prevention device.

Overspeed protection is not merely designed to protect the equipment from travelling at too high a speed in the shaft, but also to prevent the possible occurrence of an overwind and may accordingly be regarded as a form of overwind protection. The degree of protection required from the overspeed protection is academic and cannot be generalised.

The various methods of detecting overspeed condition are:-

1. Mechanical Lilly, Arid, RDC
2. Tacho Generator

The mechanical overspeeds detection device, driven by the drum shaft, operates a switch when a predetermined speed is attained and will sound an audible warning. If the speed increases more the Safety Circuit will trip.

When the end of the wind is approached, a specially profiled cam provides a speed reference in the deceleration zone, which reduces the maximum possible speed to an acceptable value.

A tacho generator overspeed detection system is also driven by the drum shaft and has a voltage output proportional to its speed. If a predetermined value is reached the Safety Circuit will trip.

3.5.1.2 OVERWIND PROTECTION

The various overwind prevention devices in a shaft, used or as a back-up system, are as follow:

Controlled retardation at the end of the wind by:

1. Automatic control of power
2. Braking

Controlled retardation at the end of wind by control of power is only possible if the Safety Circuit is healthy and if the power source has not been interrupted.

The method of retardation of an AC Motor or DC motor is a technical subject on its own and will not dealt with in this paper.

The method used to achieve braking in an AC motor is called dynamic braking in which the AC supply is removed from the terminals and DC connected to two stator phases.

The Ward Leonard system provides good speed and its simplicity is decided advantage. The speed attained by the motor is very nearly proportional to the position of the driver's level.

The mechanical Lilly, Ardic RDC position, referred to a profiled cam, monitors the speed of the Winder during the deceleration period. If the driver exceeds a set speed a predetermined distance from the end of wind, a warning is sounded and the Safety Circuit is tripped.

The Winder brake system must respond accurately and quickly, especially under an emergency application, but smut also provide accurate control of rate of build-up of the brake force and hence the rate of retardation.
The Electronic Sensing and Control of Retardation (ESCORT) system fulfils these requirements however, modern large deep level winders are now looking at a full closed loop brake control system.
3.4.2 SKIP STUCK IN TIP DEVICE

This is a way of detecting slack rope with a skip in the tip position. This is purely an electrical circuit based on the direction in which the Winder is to travel when the brakes are released out of the tip and timing circuit to detect that the skip has reached a pre-determined position in a pre-determined time. Should the skip no trip this position in the time set, The Safety Circuit will trip.

3.4.3 STATION GATE INTERLOCK

This device is used to ensure that all the station gates are closed before the Winder can move off. This comprises of hard-wired series connection of all the bank and underground station gate limit switches. If the shaft gates are closed the Winder is permitted to start wind but is not in operation while the winder is in motion.

A gate override facility for the bank and underground are wired via the key switch on the lockbell system, to facilitate the loading and unloading of cars and long material. This override is connected to the spring return to centre side of the switch to prevent the operator from permanently overriding the station gates.

With the station gate interlock being connected in series, it makes it very difficult to detect which gate open, and therefore, the telemetry system is used to show the status of the shaft gates and is used purely as an indication system, for fault finding purpose. Other information such as dam-levels, pressures etc. is also brought to surface via the telemetry system.

Some shafts have the latch fitted the standard gate latch on the left-hand side with a slightly modified latch to the right.
In most cases fitting of the standard latch to existing gates would require new gates completely, therefore various latch systems are used.

3.4.4 ULTIMATE LIMIT -TARZAN WIRE IN HEADGEAR

All the shafts are fit with the normal steel wire stretched across the winding compartments. The wire is sometimes stretched across individual compartments or when two compartments of the same Winder are adjacent then the wire is tetched across them both. In all cases the wire is fixed to the headgear steelwork on one side and to the limit switch on the other side via a series of pulleys.

In some cases the final limit is a large limit switch with a wheel attached to the lever arm which will strike a cam attached to the conveyance.

The main reason for choosing it over the Tarzan wire is to simplify the resetting of the system in the event of an overwind past the final limit, as it is normally difficult to pull a new wire across the compartments.

3.4.5 SKIP PROTRUDING DEVICE AT LOADING BOX AREAS

This device is normally installed just below the lip of the loading box chute. The device consists of a wire tensioned across the winding compartment and the front side of the skip plus minus 150 mm below the loading box chute. The
device will operate if material protrudes from the skip and should be positioned such that it should trip the machine at the loading box at a very low speed to prevent damage to shaft steelwork. This circuit will trip the Safety Circuit.

3.4.6 SPECTACLE PLATES

This is a mechanical device mounted in the headgear to arrest the conveyance should an overwind occur. This device will ensure that the rope is detached when the humble hook passes through the spectacle plate and the scissors action of the humble hook will ensure that the conveyance is supported in the spectacle plate.

3.4.7 JACK CATCHES

This is a mechanical arresting device situated in the top headgear below the spectacle plate. The device is designed such that it will arrest the conveyance when an overwind has occurred should the spectacle plate a humble hook fail to arrest the conveyance.

Important factors to be checked with mechanical overwind arrangements to ensure safe operation is listed below.

1. Must be adequate design
2. The critical dimensions must be correct.
3. Alignment of humble hook with spectacle plate.
4. Alignment of cage lugs and jack catches

3.5 SHAFT CONVEYANCE SAFETY DEVICES

This has been the major area of development due to the latest requirements envisaged in the new Mines Occupational Safety and Health act. Various systems have been tested and are being installed at Rustenburg, Union and Amandelbult.

3.5.1 MINIMUM REQUIREMENTS FOR A SHAFT CONVEYANCE MONITORING

. Continuos Slack rope measured by means of Loadcells or strain gauges.
. Continuos Tightrope measured by means of Loadcells or strain gauges.
. Slack rope (Thimble switch)
. Speech and signalling facilities for each conveyance
. Speech and signalling facilities for each inspection conveyance with remote handset facilities.
. Cage /Skip door monitoring
. Pole in position monitoring
. Conveyance signal interlocking facility.
. Emergency/shaft inspection lockout facility.
. Optional requirements.
. XYZ Accelerometers for the monitoring of shaft conditions.
. Decking Facilities

3.5.2 THIMBLE SLACK ROPE DEVICE (TRADITIONAL JCI DEVICE)

This device monitors slack rope condition throughout the length of the shaft. The thimble switch is set in such a fashion that it would detect a no load condition on the thimble due to the small movement of the rope around the thimble. In no load condition a small micro limit opens and this contact will then be fed into the cage interface card which in turn will transmit the status of the switch to the transistorised output card on surfaces. The output card will turn energise or de - energise the logic relays for the left and right conveyances which will form part of the logic to create forward and reverse slack and tight rope conditions.

Reports from the mines indicate that the reliable operation of the device is dependent more on a trial and error setting than on an exact science. The areas that affect this are:

. Tightness of splice
. Setting of device
. Corrosion
. Dirt Ingress

In essence the device is too dependent on the individuals flair to maintain it to be considered a fail-safe Safety device.

Test simulations on surface, for most shafts, invariable test the operation of the Static Slack rope device, due to the sagging effect of the rope between the Winder drum and the sheaves. In order to stimulate slack rope on the continuous device it is necessary to go below bank level, which is not really practical.

It should be noted that for the above reason both the Static and Continuous devices are required and should not be considered as back-ups for each other. (The static device will not operate at depths greater than plus minus 50 meters below the bank).

3.5.3 THE LOADCELL/STRAIN GAUGE SLACK AND TIGHT ROPE DEVICE

These devices will monitor slack and tight rope by means of mounting loadcells or strain gauges below or into the transom of the conveyance. This has been made simpler with the design of the loadcell in the MK 3 link. The loadcells/ strain gauges will physically measure the load in the conveyance and encode their measurement by means of an electronic card. The loadcell interface card Incorporates an upper and lower limit threshold which can be adjusted to give a relay output at these pre-set limits. The loadcell interface acrd relay contacts are connected as digital inputs to the conveyance interface card.
This will then via transmission medium duplicate these signals to a transistorised relay output card in the Winder room conveyance-monitoring panel on surface. The outputs are connected to logic relays for left and right hand conveyances, in such a fashion that it would trip the conveyance monitoring Safety Circuit should a slack or tight rope occur.

3.5.4 CONTINUOUS SKIP DOOR MONITORING

This limit or magnetic switch is mounted on the skip door. The switch is connected to the cage interface unit, which will transmit the status of the contact via the transmission medium to surface, where this is converted to a digital output via a transistorised output relay card. This output is connected to the left and right relay logic relays and the circuit is shown in the Drivers reset safety relay logic diagram. This will trip the conveyance monitoring Safety Circuit.

There are various methods, being used to confirm that the skip body has returned to the correct position in the bridle.

The interlocking is done using a magnetic switch fixed to the Bridle with a magnet attached to the skip body. Due to the nature of the locking system it is highly unlikely that the skip can come out of position after leaving the tipping area.

The probability of both stop brackets coming loose or braking simultaneously is remote, therefore the magnetic switch is probably no required, but ensures that the system is electrically interlocked to stop the winder should this occur.
The bottom discharge skips do require some method of confirming skip back in bridle. Various methods are used:-

- Cats whiskers at tip position
- Magnetic switches on the locking levers.
- Magnetic switches on the skip body.
- Magnetic switches on the skip pan.
- Limit switches on the skip Pan.

The best method would seem to be the Magnetic switch on the skip. The magnet is fixed to the underside of the skip pan and the switch is fixed to the bottom transom of the bridle. This gives positive indication that the skip is properly positioned in the bridle, during normal winding in the shaft.

This is a similar device as described in the skip protruding section which consists of a tensioned wire or roller across the winding compartment plus minus 25-30 mm away from the skip door ensure that the skip door is position before it moves down the shaft. Should the wire/roller be struck by the skip a limit switch is operated to trip the conveyance monitoring Safety Circuit.

3.5.5 CAGE/POLE DOOR INTERLOCK DEVICE

With regard to the type of devices used and the manner of fitting, the variations are numerous. Limit and magnetic switches are used in various positions, some inside the cage, some on the outside. Development is ongoing on a large percentage of the shafts with the type of equipment fitted usually dependent on the shaft conditions (wet etc.) and the cage configuration.

Cage door interlock using limit switch on the outside of the cage. A steel pin attached to the sliding door protrudes through a hole in the cage and operates the limit switch lever. Having switch outside deters tampering.

Cage door interlock using a magnetic switch. The switch is fixed to the cage structure with magnet fixed to the sliding door.

The physical appearance of the device is reasonable standard using a limit switch attached to a steel flap. When the pole is pushed through the hole it operates the limit switch. There is some minor variation of the hardware which are required due to cage configuration.

This device is operated via the conveyance monitoring units, which detect the signal from the cage doors or pole switch and via a transmission medium is converted to a transistorised relay output on surface. The logic relays are wire as a parallel circuit with the pole in position switches to from the basis for the cage door Safety relay logic incorporating the cage door override circuit and speed detector. This will trip the conveyance monitoring Safety Circuit.

3.5.6 CAGE DOOR OVERRIDE

The cage door override facility must be incorporated in the circuit via the lock bell key switch to override the cage doors, when material cars or long material is loaded or unloaded on the bank or underground. The override is linked with a speed detector circuit and is connected to the spring return to off position side of the lockbell key switch, and is cross-interlocked with cage door/pole in position switches to prevent operators and drivers from permanently overriding the system.

3.6 INCLINE SHAFT SAFETY DEVICES

In addition to overspeed, overwind and most of the Safety devices discussed under vertical shafts the following safety precautions had to be added to the incline Winders. This came mostly from the low gradient shafts that developed a new control and brake philosophy for the Winder.

3.6.1 MARSHALL DEVICE

The Marshall device is used on incline shafts for the detection of derailment of the skip or conveyance on either on or two tracks. The detection of derailment is achieved by running a wire, mounted on brackets down either side of the track/tracks, so that in the event of a derailment, the conveyance either touches (earth) or breaks (open circuit the wire.

The unit also monitors short-circuiting of the conductors and provides indication of the operation of dropsets on either side.

This device has tow independent trip conditions namely;

1. Earth fault
2. Broken wire

Both conditions will trip the Winder Safety Circuit.

Should any rock or material foul the rail and one of the conductors it would cause an earth fault and thereby operate the Safety Circuit, the broken wire operates a relay which is connected to the Safety Circuit should any of the wires be broken in the shaft.

3.6.2 DROP SETS

This purely indication to the driver as there is no Safety device or interlock to the Winder Safety Circuit.

3.6.3 HOPPER CLOSED DEVICE

This Safety device is a wire tensioned across the winding compartments just above an empty hopper plus minus 10 to 15 meters from the hopper-tipping path. Should the hopper not close the wire will detect this condition and trip the Winder.

This device is not installed underground at the loading points, but could be incorporated as a Safety feature to prevent overloading or material protruding from cars when the conveyance is brought to surface.

3.6.4 BLAIR DEVICE.

This is a mechanical safety device mounted to the last hopper and connected to the Winder rope by means of a 16-mm sling. This device automatically operate should the rope break and will arrest the hopper when the Blair device is activated.