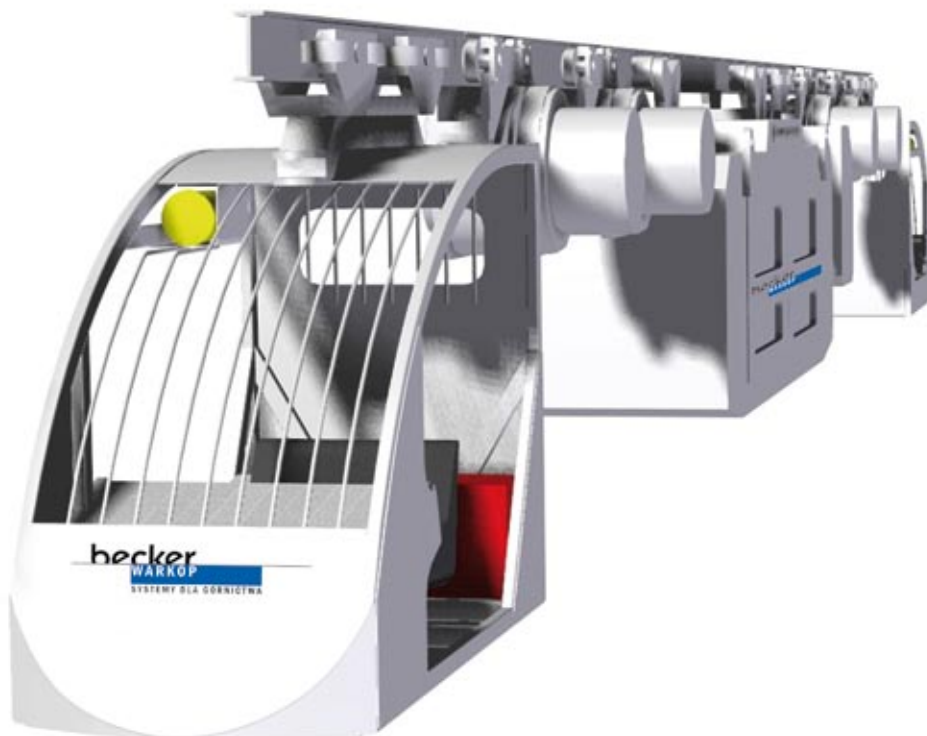




# THE SYSTEMS OF TRANSPORT





Becker Warkop Ltd. company, with its headquarters located in Swierklany, was formed in 1991 as a joint venture company based on agreement between polish partner Warkop Sp. z o. o. and Walter Becker G.m.b.H (Germany) – currently Becker Mining Systems G.m.b.H. The basic idea of the creation of Becker Warkop was cooperation in sales, manufacturing and service transport systems for mining based on floor mounted rope driven haulage gear. The specialization of the Becker Warkop Company is the manufacturing of transport hauling systems for material and people from longwalls to faces. The company still introduces and improves transport systems in underground mining.

Since 1991 the company has introduced to operation floor mounted rope driven haulage gear type KS-650/900/63/100 with rail gauges of 650 mm or 900 mm and pulling forces in rope from 63 to 100 kN. Until 2003 the company introduced and provided 95 pieces of it. In the present time the haulage gear is operated with 80 km of total railway length. Because the length of the rope reduces the length of the route, the method of the transport is changing by using combustion haulage gear or floor mounted electric cog wheel driven haulage system.

Combustion haulage gear type KSZ 650/900/30/60 is an example of the haulage gear. 39 pieces were delivered to operation. In 2002 after reaching very good exploitation results in underground mines the next step in company development is introducing combustion haulage gear instead of electric haulage gear.

Apart from the aforementioned haulage gear, the Becker Warkop company also produces floor mounted electric cog wheel driven haulage systems:

- KSZ 650/900/68 diesel drive with 68 kW power – 3 different types.
- KSZ 650/900/80 diesel drive with 80 kW power – 2 different types.
- KSZ 650/900/125 diesel drive with power over 120 kW

There are currently 42 pieces of combustion haulage gear that work in 23 mines.

Because there are no limits in configuration of the route we have many possibilities in tracking transport. These possibilities allow us to create extended transport systems begin from banking level and finishing at face or drift. Apart from all these things thanks to the above mentioned systems heavy materials like powered support can be conveyed in one part, without dismantling, while equipping the mine shaft and the liquidation of the longwalls system. One important thing that must be underlined is that by using systems of transport made by Becker Warkop work safety and its capacity is increasing. Personnel and staff can be conveyed at the same time.

At the end of 2007 Becker Warkop began producing suspended haulage system type KPSZ with drive power 80 and 120 kW. Application of the new technical solution allow us to bring transport up to date, for example in case of very steep degrees using KPSZ80 or KPSZ120, whose drive wheels roll without slideing – a typical problem while using suspended haulage with friction drive or in mines with high air humidity.

Apart from all the kinds of floor mounted combustion cog wheel driven haulage systems the Becker Warkop company in 2007 has started produce a diesel aggregate with 125 kW power.

WE INVITE FOR A COOPERATION

# » The floor mounted cog wheel driven combustion haulage system



# » The combustion haulage gear KSZS-650/900



## Description:

The floor mounted combustion haulage gear KSZS-650/900 acts to convey personnel, materials and devices in underground mines working with arch yielding support and roof bolting.

## Construction:

### The essentials subassemblies of the haulage gear:

- Combustion tractor.
- Route.
- Transport kit.

### The haulage system was realized and designed with subassemblies of following devices:

- Combustion locomotive with power 68, 80 and over 120 kW.
- Brake vehicle of the floor mounted rope-driven haulage system type KS-650/900/63/100.
- Route of the floor mounted cog wheel driven haulage system KSZ-650/900/30/60.
- Transport kit of the floor mounted rope driven haulage system type KS-650/900/63/100.



Combustion tractor is compound of: engine part, drive vehicle, brake vehicle, main cabine and auxiliary cabine.

The engine part contains diesel-hydraulic set located on the chassis which is compatible with engine part of the suspended haulage locomotive.

Speed of the haulage system may be regulated fluently up to 4.0 m/s.

The route of the haulage system with 650 mm or 900 mm width is located on the bottom.

All subassemblies of the transport kit are combined by strands and additionally secured by emergency rope. Coveyance of material and personnel can be realized on the route with maximal lengthwise inclines  $\pm 30$  degrees and also with maximal transverse inclines  $\pm 10$  degrees.

Maximal pulling force is equal 120 kN with 68-80 kW force and 240 kN over 120 kW force.

The tractor of the haulage system can be used together with personnel cabine or without it.

The tractor can be also exploited in underground mines working – in spaces with “a”, “b”, “c” methan explosion danger.



# References list

of the currently working floor mounted cog wheel driven combustion haulage systems

Ordinal number	Mine	Company	Amount
1	COAL MINE „Brzeszcze – Silesia”	Kompania Węglowa S.A.	1
2	COAL MINE „Ziemowit”	Kompania Węglowa S.A.	1
3	COAL MINE „Szczygłowice”	Kompania Węglowa S.A.	1
4	COAL MINE „Sośnica – Makoszowy”	Kompania Węglowa S.A.	3
5	COAL MINE „Bielszowice”	Kompania Węglowa S.A.	2
6	COAL MINE „Halemba”	Kompania Węglowa S.A.	1
7	COAL MINE „Rydułtowy – Anna”	Kompania Węglowa S.A.	2
8	COAL MINE „Chwałowice”	Kompania Węglowa S.A.	2
9	COAL MINE „Marcel”	Kompania Węglowa S.A.	1
10	COAL MINE „Jankowice	Kompania Węglowa S.A.	5
11	COAL MINE „Borynia”	Jastrzębska Spółka Węglowa S.A.	1
12	COAL MINE „Jas – Mos”	Jastrzębska Spółka Węglowa S.A.	5
13	COAL MINE „Pniówek”	Jastrzębska Spółka Węglowa S.A.	2
14	COAL MINE „Zofiówka”	Jastrzębska Spółka Węglowa S.A.	4
15	COAL MINE „Krupiński”	Jastrzębska Spółka Węglowa S.A.	2
16	COAL MINE „Wujek”	Katowicki Holding Węglowy S.A.	2
17	COAL MINE „Mysłowice Wesola”	Katowicki Holding Węglowy S.A.	1
18	Zg Sobieski	PKW Jaworzno	1
19	ČSA	Czech Republik	1
20	OLŽERASSKAJA	Russia	1
21	SUEK	Russia	1
22	SALEK	Russia	2
23	ANTONOWSKAJA	Russia	1

»» The floor mounted cog wheel driven combustion haulage system



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MINING SYSTEMS

# » The floor mounted cog wheel driven haulage system with 80 kW diesel set

## Technical parameters:

**Power of diesel engine:** 80 kW by 1800 r. p. m

Number of the hydraulic engines 2 or 4

### Main dimensions and mass:

Length:  
 overall length 12 700 mm  
 engine part length 4 600 mm  
 cabine length 2 000 mm

Height:  
 overall height 1 995 mm  
 to rail 1 750 mm

Overall width 1 460 mm

Number of cabins 2

Shipment mass 11 400 kg

### Traction merits:

Maximal pulling force	240 kN ±5%
Maximal drive speed	3.4 m/s
Minimal turning radius in the horizontal plane	4 m
Minimal turning radius in the vertical plane	22 m
Maximal inclination of the route	30°
Latitude of the route	650 or 900 mm
Route shape type	Shape type C180, BW I 140

### Brakes:

Emergency and parking brake spring disk brake  
 Strength of governor of the brake vehicle min. 360 kN  
 Brake trolley min. 380 kN  
 Start operate speed of the emergency brake 4.0 ± 0.2 m/s  
 Start operate speed of the centrifugal breaker switch 4.5 ± 0.2 m/s

### Route:

Length of the route unlimited  
 Lengthwise inclination of the route ± 30°  
 Transverse inclination of the route ± 10°  
 Gauge of the rails 650 or 900 mm  
 Length of the straight rails from 1500 do 3000 mm  
 Turning radius in the horizontal plane min. 4 m  
 Turning radius in the vertical plane min. 22 m  
 The route shape type Shape C180, BW I 140

**By inclines over 10 degrees the conveyance should be realized with two hydraulic engines switch on.**



# » The floor mounted cog wheel driven haulage system with over 120 kW diesel set

## Technical parameters:

**Power of diesel engine** 125 kW by 2200 r. p. m

Number of the hydraulic engines 2 or 4

### Main dimensions and mass:

#### Length:

overall length 13 600 mm  
engine part length 3 700 mm  
cabine length 1 900 mm

#### Height:

overall height 1 835 mm  
to rail 1 560 mm

Overall width 1 460 mm

Number of cabins 2

Shipment mass 13 600 kg

### Traction merits:

Maximal pulling force	240 kN $\pm$ 5%
Maximal drive speed	4.0 m/s
Minimal turning radius in the horizontal plane	4 m
Minimal turning radius in the vertical plane	22 m
Maximal inclination of the route	30 °
Latitude of the route	650 or 900 mm
Route shape type	Shape type C180, BW I 140

### Brakes:

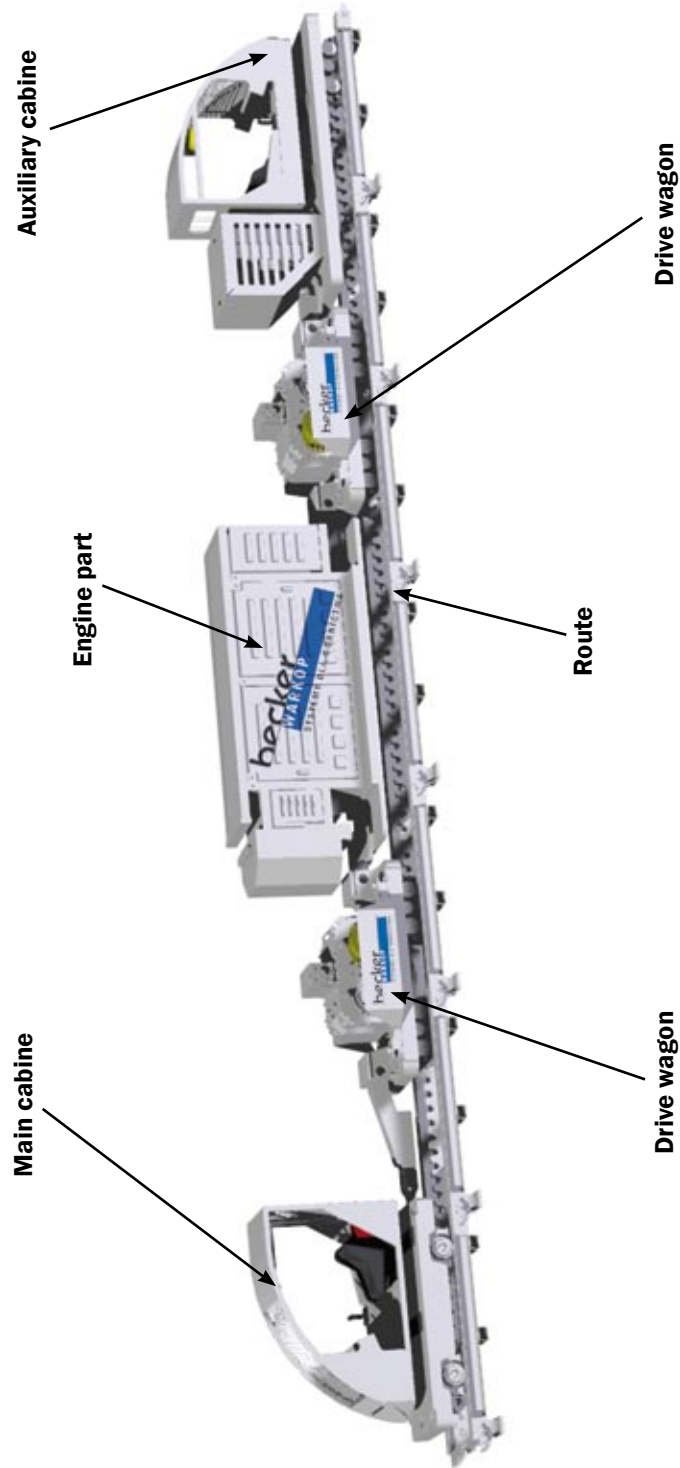
Emergency and parking brake spring disk brake  
Strenght of governor of the brake vehicle min. 360 kN  
Brake trolley min. 380 kN  
Start operate speed of the emergency brake 4.5  $\pm$  0.2 m/s  
Start operate speed of the centrifugal breaker switch 5.0  $\pm$  0.2 m/s

### Route:

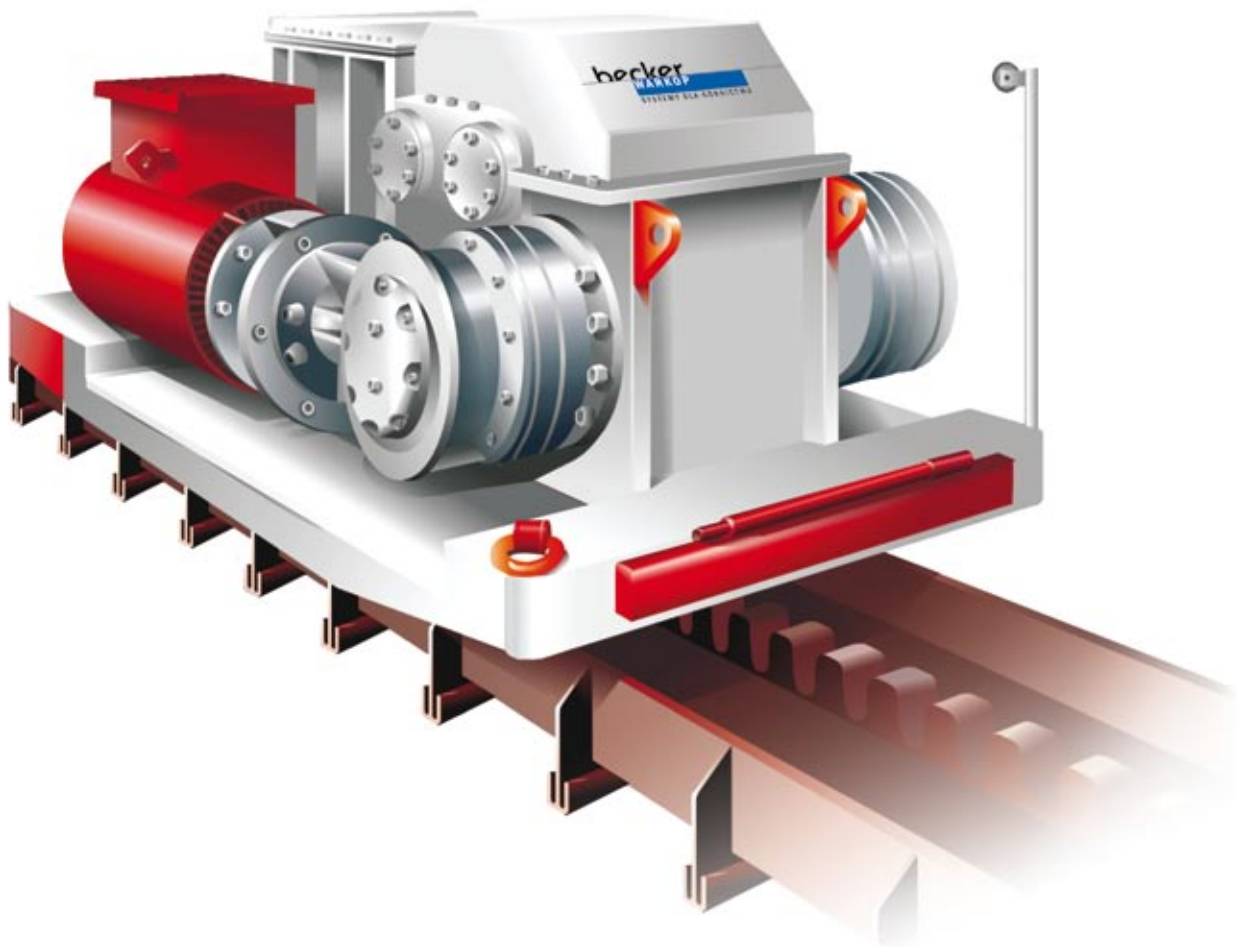
Length of the route unlimited  
Lengthwise inclination of the route  $\pm$  30°  
Transverse inclination of the route  $\pm$  10°  
Gauge of the rails 650 or 900 mm  
Length of the straight rails from 1500 to 3000 mm  
Turning radius in the horizontal plane min. 4 m  
Turning radius in the vertical plane min. 22 m  
Route shape type Shape type C180, BW I 140

**By inclines over 10 degrees the conveyance should be realized with two hydraulic engines switch on.**

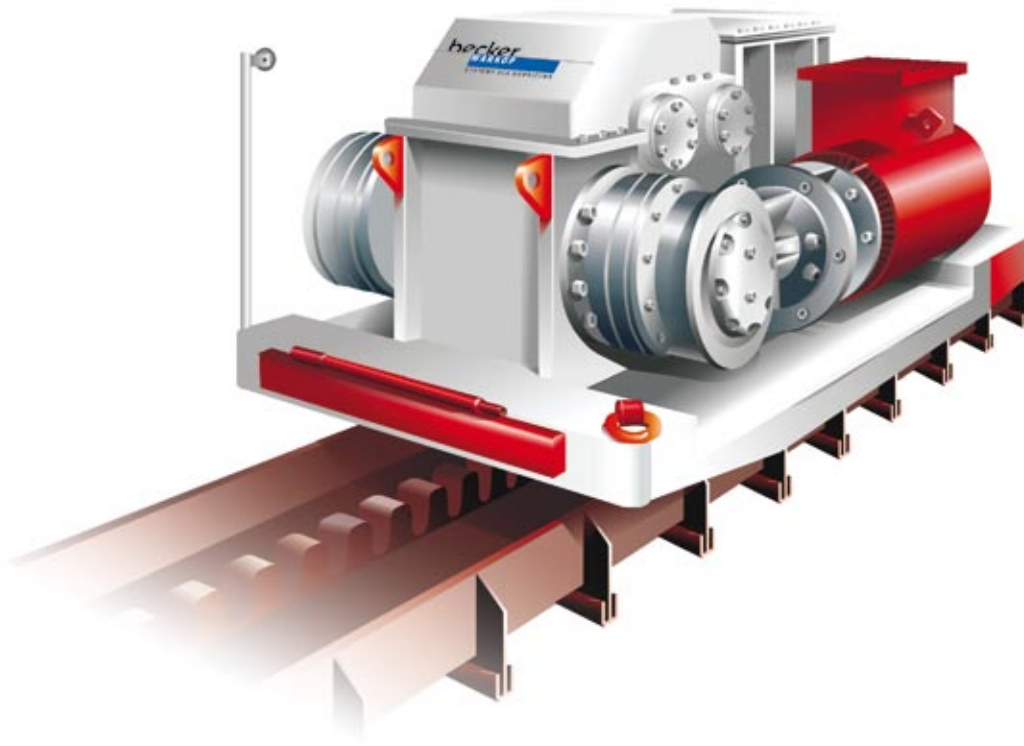
» The floor mounted cog wheel driven combustion haulage system type  
**KSZS-650/900/125**



# » The floor mounted cog wheel driven electric haulage system



# » The floor-mounted cog wheel driven electric haulage system type KSZ-650/900/30/60



## Description

The floor-mounted cog wheel-driven system is built to convey powered support units, elements of the continuous miners and elements of the face conveyor during reinforcement and liquidation of the face. Floor-mounted cog wheel-driven system may be use as an independent means of transport or as extension of the transport that is executed by the floor-mounted cog wheel-driven system or the floor mounted rope-driven haulage system, suspended haulage system from bottom road or top road to the face.

## Technical parameters:

### Route:

Maximal lengthwise inclination	$\pm 35^\circ$
Maximal transverse inclination	$\pm 10^\circ$
Width of the route	650 or 900 mm
Length of the straight rails	from 1500 to 3000 mm
Turning radius of the arc rails	4000 mm
Length of the route (for 300 m long feeder cable)	max. 600 m

**Drive part (electric drive)**

Pulling force	max. 180 kN
Speed of the transport	13.8 up to 20.4 m/min
Installed force	30 up to 60 kW
Dimensions:	
Length	2900 mm
Width	1630 mm

**Load platform 320 kN**

Load capacity	320 kN
Dimensions:	
Length	3800 mm
Width	1550 mm
Height	326 mm
Mass	3698 kg

**Construction:**

**The main subassemblies of the floor-mounted cog wheel-driven system:**

**Route** – Is made of rails (width 650mm or 900 mm) that the haulage system and transport kit are translocating on. The route consists of: straight rails, arc rails, inspection rail, guard rail, stays.

**Drive part (Electric drive)** – acts to translocate the transport kit on the bottom route. The main subassemblies of the bottom route are: drive, chassis, hydraulic brake failure system and electric switch EH-dw-5 or EVV2K.

**Transport kit** – is made of drive part, linking strands and transport-platforms 50, 100, 220, 320, 350 kN.

**Principle of operation:**

In the floor-mounted cog wheel-driven system the electric drive transmits turning movement from electric motor (or 2 electric motors) by intersecting axis planetary gear with toothed wheel. Spindle wheel rolls on the rack and at the same time the spindle wheel puts in motion the drive part together with the transport kit.

The induction tri phase electric motor with self locking system is equipped with a friction brake, which is activated by spring and switch off by electromagnet.

The spindle wheel may be stopped by locking pawl.

To switch on the electrical motors and to assure their correct mutual running the fireproof braker switch type EH-dw-5 or EVV2K has been used.

# » References list

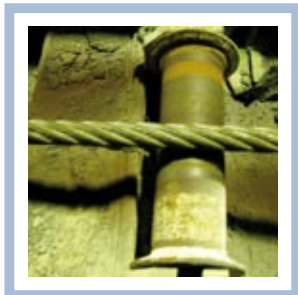
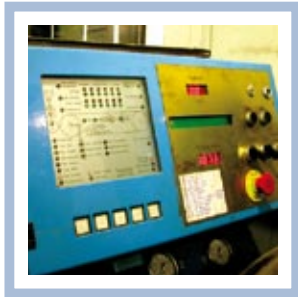
of the currently working floor mounted rope driven rail haulage systems  
**KSZ-650/900/63/100**

Ordinal number	Mine	Company	Amount
1	COAL MINE „Szczygłowiec”	Kompania Węglowa S.A.	2
2	COAL MINE „Sośnica-Makoszowy”	Kompania Węglowa S.A.	1
3	COAL MINE „Rydułtowy-Anna”	Kompania Węglowa S.A.	12
4	COAL MINE „Chwałowice”	Kompania Węglowa S.A.	5
5	COAL MINE „Marcel”	Kompania Węglowa S.A.	7
6	COAL MINE „Jankowice”	Kompania Węglowa S.A.	6
7	COAL MINE „Brzeszcze-Silesia”	Kompania Węglowa S.A.	2
8	COAL MINE „Wieczorek”	Katowicki Holding Węglowy S.A.	2
9	COAL MINE „Wujek”	Katowicki Holding Węglowy S.A.	12
10	COAL MINE „Mysłowice-Wesoła”	Katowicki Holding Węglowy S.A.	2
11	COAL MINE „Borynia”	Jastrzębska Spółka Węglowa S.A.	2
12	COAL MINE „Jas-Mos”	Jastrzębska Spółka Węglowa S.A.	6
13	COAL MINE „Krupiński”	Jastrzębska Spółka Węglowa S.A.	3
14	COAL MINE „Zofiówka”	Jastrzębska Spółka Węglowa S.A.	3

# » The floor mounted rope driven haulage system



# » The floor mounted rope-driven rail haulage system type KS-650/900/63/100



## Description

The floor mounted rope-driven rail haulage systems type KS-650/900/63/100 with route gauge 650 or 900 mm and pulling force in rope 63 to 100 kN are able to convey heavy materials in underground mines working such as:

- Transport of materials directly on the platforms or containers (for example loose material) long materials to 7.5 m long and also large size loads like machines and devices elements, in particular powered support units in underground mines working with inclines up to  $\pm 30$  degrees.
- Transport of personnel in cabins located on load platforms and haul-load platforms, brake trolleys, also in special passengers cabins in horizontal underground mines working with inclines up to 25 degrees.
- Contemporary transport of materials and personnel in passenger cabine located on brake trolley in horizontal underground mines working with inclines up to 25 degrees.

Floor mounted rope-driven rail haulage system is put in motion by "closed" rope – "rope without an end", with rope guides in different block set, which allow it to convey in underground mines working with variable inclines.

In hard operating conditions where high pulling force of the kit is required, it can be put in motion by double rope.

The rope is put in motion by electric drive. Floor mounted rope-driven rail haulage system is equipped in steering stand with indicators that ensure correct work of the drive.

The route of the floor mounted rope-driven rail haulage system together with blocks complete that put the rope in motion is compound of repetitive straight and arc rails for leading the route and junction. Maximal weight of the conveying materials is 22 tons. The additional accessories are: platforms, protection panels, front grip and support plates. These platforms are combined by special strands and security ropes.



Straight rails have special mechanical connections that allow for deflection in horizontal plane up to 4 degrees.

Floor mounted rope-driven rail haulage system type KS-650/900/63/100 is adjusted for passengers conveyance in special passenger cars or cabins located on platforms or brake trolley.

Floor mounted rope-driven rail haulage system may be equipped with different kinds of rope drives prepared for running in underground mines working. Each transport kit should have its own brake trolley which has built up double brake operator sytem.

## Technical parameters:

### Route:

	<b>KS-650</b>	<b>KS-900</b>
Width of the rail	650 mm	900 mm
Maximal length of the rail	3000 m	3000 m
Maximal lengthwise inclination:		
for personnel conveyance	± 25°	± 25°
for material conveyance	± 30°	± 30°
For contemporary conveyance of perssonel and material	± 25°	± 25°
Maximal transverse inclination	± 15°	± 15°
Transport speed	0÷2 m/s	0÷2 m/s
Turning radius in the horizontal plane	min. 4 m	min. 4 m
Turning radius in the vertical plane	min. 22 m	min. 22 m
Tractive force:		
HNK – 2	63 kN	63 kN or 2x63 kN
HNK – 3	100 kN	100 kN
ECKER E-SR-100	100 kN	100 kN
ECKER E-SP-100	100 kN	100 kN
GOLLNER GP8500/PL	85-100 kN	85-100 kN
GOLLNER GR8500/PL	85-100 kN	85-100 kN
Maximal duty of the load platform	100 kN	100 kN
Braking force of the brake trolley	60, 90, 120, 180 kN	60, 90, 120, 180 kN
Load capacity of the load platform	100, 150, 220 kN	100, 150, 220 kN
Amount of persons conveying in cabins located:		
On the brake trolley	6 persons	12 persons
On the haul-load platform	14 persons	14 persons
On the load platform	14 persons	14 persons

## Construction:

### The subassemblies of the floor mounted rope-driven rail haulage system:

- Drive
- Rope
- Route with track rollers and junction
- Stretching station
- Transport kit
- Electrical equipment

# » References list

of the currently working floor mounted cog wheel driven electric haulage systems

Ordinal number	Mine	Company	Amount
1	COAL MINE „Sośnica - Makoszowy”	Kompania Węglowa S.A.	3
2	COAL MINE „Chwałowice”	Kompania Węglowa S.A.	4
3	COAL MINE „Marcel”	Kompania Węglowa S.A.	1
4	COAL MINE „Jankowice”	Kompania Węglowa S.A.	1
5	COAL MINE „Szczygłowice”	Kompania Węglowa S.A.	2
6	COAL MINE „Ziemowit”	Kompania Węglowa S.A.	1
7	COAL MINE „Murcki”	Katowicki Holding Węglowy S.A.	2
8	COAL MINE „Mysłowice – Wesola”	Katowicki Holding Węglowy S.A.	1
9	COAL MINE „Staszic”	Katowicki Holding Węglowy S.A.	1
10	COAL MINE „Borynia”	Jastrzębska Spółka Węglowa S.A.	1
11	COAL MINE „Jas – Mos”	Jastrzębska Spółka Węglowa S.A.	1
12	COAL MINE „Krupiński”	Jastrzębska Spółka Węglowa S.A.	1
13	COAL MINE „Zofiówka”	Jastrzębska Spółka Węglowa S.A.	3
14	COAL MINE „Bogdanka”	Lubelski Węgiel S.A.	1
15	ČSA	Czech Republik	1
16	LAZY	Czech Republik	1
17	DARKOV	Czech Republik	1
18	KYRGAJSKAJA	Russia	1
19	JUZKUZBASSUGOL	Russia	2
20	TABAS	Iran	2
21	Donetsksteel	Ukraine	2

»» The suspended cog wheel driven combustion haulage system



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Rough calculations which concern maximum loads of the diesel monorail (suspended) rack-and-pinion drive KPZS – 80.

Weight of the load M (kg) during lift conveyance, depending on speed of the transport V (m/s) and inclination angle  $\alpha$  (°).

V (m/s) for 4 drives	$\alpha$ (°)									
	2.5	5.0	7.5	10.0	12.5	15.0	17.5	20.0	25.0	30.0
0.4				47914	39953	34317	30124	26890	22245	19093
0.5			48517	38757	32318	27758	24367	21751	17994	15444
0.6		50000	40431	32298	26931	23132	20306	18126	14995	12870
0.7		46438	34655	27684	23084	19827	17405	15536	12853	11031
0.8		40633	30323	24223	20199	17349	15229	13594	11246	9652
0.9	50000	36118	26954	21532	17954	15421	13537	12084	9997	8580
1.0	49394	32507	24259	19379	16159	13879	12184	10876	8997	
1.1	44904	29551	22053	17617	14690	12617	11076	9887	8179	
1.2	41162	27089	20216	16149	13466	11566	10153	9063		
1.3	37996	25005	18661	14907	12430	10676	9372	8366		
1.4	35282	23219	17328	13842	11542	9914	8703			
1.5	32930	21671	16172	12919	10773	9253	8122			

V (m/s) for 3 drives	$\alpha$ (°)									
	2.5	5.0	7.5	10.0	12.5	15.0	17.5	20.0	25.0	30.0
0.5			44985	35936	29965	25737	22593	20168	16684	14319
0.6		50000	40431	32298	26931	23132	20306	18126	14995	12870
0.7		46438	34655	27684	23084	19827	17405	15536	12853	11031
0.8		40633	30323	24223	20199	17349	15229	13594	11246	9652
0.9	50000	36118	26954	21532	17954	15421	13537	12084	9997	8580
1.0	49394	32507	24259	19379	16159	13879	12184	10876	8997	7722
1.1	44904	29551	22053	17617	14690	12617	11076	9887	8179	
1.2	41162	27089	20216	16149	13466	11566	10153	9063		
1.3	37996	25005	18661	14907	12430	10676	9372	8366		
1.4	35282	23219	17328	13842	11542	9914	8703	7768		
1.5	32930	21671	16172	12919	10773	9253	8122			
1.6	30871	20317	15162	12112	10099	8674				
1.7	29055	19121	14270	11399	9505	8164				
1.8	27441	18059	13477	10766	8977	7711				
1.9	25997	17109	12768	10199	8505					
2.0	24697	16253	12129	9689	8079					

# » The suspended pneumatic cog wheel driven light rail motor tractor type DZK

The pneumatic cog wheel driven light rail tractor is used in the underground mines working with lengthwise inclines up to 30 degrees. Light rail tractor is built for materials transport on short distances – maximal up to 300 m. Most often used in assembly chambers, shunting device or as cooperative device with other means of transport. Tractor is able to use in the underground mines working with “a”, “b”, “c” methane explosion danger category (2% methane concentration) also A and B coal dust explosion danger.

## Technical parameters:

### Tractor:

Maximal supply pressure 0.6 MPa

Maximal pulling force DZK drive by pressure:  
6 bar 33 ± 5% kN  
4 bar 22 ± 5% kN

Maximal drive speed 0.6 m/s

Consumption of compressed air by:  
V = 0,2 m/s 6 m<sup>3</sup>/min  
V = 0,6 m/s 10 m<sup>3</sup>/min

Nominal diameter of armoured hose connector with compressed air 40 mm ( 1 ¼” )

Maximal length of the fedder cable 50 m

### Brakes:

Strenght of governor of the drive brake 60 kN  
Brake safety factor 1.82

### Route:

Route shape type I 155 – route shape type BW-50/65 for suspended cog wheel haulage system  
Lenght of the route unlimited  
Machine run without feeding change over maximal 100 m  
Lengthwise inclination of the route ± 30°  
Lenght of the straight rails up to 2000 mm  
Turning radius in the horizontal plane 4.0 m  
Turning radius in the vertical plane 10 m

### Dymensions of the DZK tractor:

lenght: 1 200 mm  
widht: 860 mm  
height: 700 mm

### Weight:

Tractor DZK 1 200 kg

### Maximal netto loading of the transport kit

Inclination	Feeding air pressure	Mass of the load (netto)
up to 10°	0.4 MPa	11 000 kg
	0.6 MPa	18 500 kg
10 ÷ 20°	0.4 MPa	5 100 kg
	0.6 MPa	8 600 kg
20 ÷ 30°	0.4 MPa	3 200 kg
	0.6 MPa	6 100 kg



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WARKOP

MINING SYSTEMS

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