MEKA

CRUSHING, SCREENING AND MINING EQUIMENT HANDBOOK

MEKA

MEKA Global Crushing, Screening, Mining, and Concrete Plant Solutions
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We would like to express our gratitude to Mech. Eng. Suphi YAVUZ, who contributed to the preparation of this handbook.

Cover Photo: MEKA 1000 tons/hour capacity Crushing and Screening Plant / Israel

FOREWORD

Our dear Customers, Dealers, Stakeholders and Friends,

This handbook was created with our sincere desire to share with the relevant industry and academic circles the information, experience and knowledge accumulated by MEKA during a considerable period in the design and production of Crushing, Screening and Washing machines and facilities. Similar handbooks, which we have had access to and benefited from in the past with some envy, were made available by some of our well-known competitors based in advanced countries. The Turkish manufacturers in many industrial branches, especially in machinery industry, unfortunately came up short in compiling the up-to-date technologies and solutions available in the world and presenting them to the benefit of the relevant circles as a reference book which as well considers the realities of the country,

As is known, MEKA, after a short period after its incorporation started its activities in the design and manufacturing of concrete batching plants and by persevering in this regard for many years, it has managed to become one of the prominent manufacturers in this field in our country and in the world. I believe that the thousands of concrete plants currently operating in hundreds of countries on the five continents of the world continue to be a justified source of pride for me and each member of the MEKA family.

For more than ten years, our company has been striving with all its strength to reach or even surpass a similar level in the Crushing, Screening, Washing sector as well. Certainly, the engineering and production skills and know-how which contributed to our successes in the field of concrete batching plants will continue to guide MEKA in reaching the desired level much faster. On the other hand, I would like to underline with pleasure the strong contributions made by our R&D center, which we established with the valuable support we received from our state and where we currently employ nearly fifty engineers. In this context, in addition to the obtained patents, utility models and design registrations, global technology has benefited like 'salt in the soup' with the presentations made at many national and international technical events.

As a matter of fact, we successfully managed to make our MEKA brand name known to the world in a short time in this new and more comprehensive market than the concrete batching plants sector. While we currently export majority of our production, we have gained the admiration and appreciation of customers in many developed countries' markets, especially the USA, and we welcome cooperation proposals from our world-renowned competitors. In this context, our important projects that have been implemented continue smoothly, free of any problems.

We wanted to share the 'information', being the most valuable in our opinion among our achievements at this point, which we have reached in a relatively short time, with our stakeholders in our country, especially our valued customers, and make it available to their benefit. In this way, we are wishing to repay a small part of our great debt to this beautiful country that brought us to these days.

The handbook you are about to read is a product of all this journey and work and is prepared in two parts. In the first section, there is information about the main units of crushing, screening, and washing facilities, important calculations about these units, MEKA's production scope, models and technical specifications regarding these units. The second section contains detailed data about rocks and minerals and their physical properties, as well as some important engineering information. In the future, our aim is to make available to our customers and stakeholders similar handbooks with expanded scopes.

Finally, I would like to thank and express my appreciation to the author of this handbook Mr. Ekrem SAVAS – Mech. Eng. MEKA R&D Center Manager; Mr. Hakan KOSEOGLU MSc. Mech. Eng. and Mr. Necati YILDIZ MSc. Mining Eng. for their invaluable contributions; and Mr. Fehmi Soner MAZLUM for editing and preparing this handbook for print.

Our responsibility is for you to benefit from our handbook and to contribute further to the developments in the sector. Undoubtedly, we would be most grateful if you could kindly alert us about the many issues that exist at this stage and need to be corrected and added in future publications.

Yours faithfully.

Mehmet Kaybal
Meka Global Founder and CEO

▲ *Meka kırma eleme tesisi / Gürcistan*

▲ *Meka kırma eleme tesisi / Maritus*

▲ *Meka kırma eleme tesisi / Rusya*

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▲ *Wobbler and Apron Feeder equipped Meka Crushing and Screening Plant / Russia*
▼ *Mobile Washing and Screening Plant / Miami, United States of America*

SECTION 1

ABOUT MEKA GLOBAL

MEKA, Turkey's leading brand in its field, operates in the fields of mining, ready-mix concrete, and aggregate machinery and equipment production by providing research and development, manufacturing, marketing, and after-sales support services for equipment and complete facility production for concrete and aggregate production industries. MEKA has a wide range of products in the crushing, screening, mining, and recycling equipment and facilities, as well as concrete plants and concrete mixers.

With a focus on aggregate production, recycling, and the mining industry, MEKA produces crushers, screens, washers, feeders, conveyor systems, and mobile and stationary crushing and screening plants. In the field of concrete plants, MEKA manufactures fixed, mobile, and compact concrete plants, as well as fiber feeding systems, mixers, and concrete recycling equipment. The company also provides installation, facility automation software, after-sales services, and facility and product design services.

STRONG EMPLOYMENT POTENTIAL OF MEKA

With over 450 direct employees and a total employment figure exceeding 15,000 when business partners are included, MEKA has a well enhanced and strong employment potential. The company has four factories in within the Ankara Başkent Organized Industrial Zone and one factory within the Eskişehir Organized Industrial Zone, totaling five production facilities. MEKA also has offices in Algeria, Russia, and the United States, serving a global network of strong dealers and after-sales service points.

TURKEY'S EXPORT STAR MEKA

Turkey's export star has successfully secured its place as a key player in the Turkey Exporters Assembly's list of top exporters. By exporting over 95% of its products with more than 90% domestic inputs, MEKA achieved the 21st position in the sectoral ranking and the 836th position overall in the Turkey's top 1000 exporters list for the year 2021. This success is a testament to MEKA's export-oriented sustainable development potential.

In previous years on the same list, MEKA demonstrated its consistent success. In 2017, the company was ranked 26th in the sectoral ranking and 969th overall. In 2014, it secured the 17th position in the sectoral ranking and 795th overall. In 2013, MEKA was ranked 15th in the sectoral ranking and 650th overall. The year 2012 saw the company at the 19th position in the sectoral ranking and 750th overall. In 2011, MEKA achieved the 754th position in the overall ranking, reinforcing its reputation for export-focused sustainable development potential.

R&D CENTER AND STRONG REFERENCES

MEKA, possessing Turkey's most powerful R&D center approved by the Ministry of Industry and Technology, has gained significant recognition worldwide for its ability to produce custom designed and high-capacity facilities above industry standards. Construction companies undertaking major construction projects in more than 110 countries prioritize Meka Beton Santralleri İmalat Sanayi ve Ticaret A.Ş. (Meka Concrete Batching Plants Manufacturing Industry and Trade Inc.) for their concrete plants, crushing and screening plants, and mining equipment needs due to its exceptional capabilities.

The company's expertise and strong references are further strengthened through collaborations with many global giants listed in the ENR 250, a list of the world's largest 250 international contractors. MEKA has gained experience and powerful references by working on projects such as the HS2 high-speed train project in the UK, considered Europe's largest transportation project with an estimated cost of 135 billion euros, all concrete plants used in the construction of Istanbul Airport, the construction project of the Sochi Olympic Village in Russia, and the stadium construction projects for the World Cup.

Other noteworthy projects include Lafarge's contractorship in the Doha Metro construction project, the Yaşmaklı Hydroelectric Power Plant, the concrete road project in Kazakhstan, the construction project of RAF Marham Airbase in the UK, concrete plants in the London Heathrow Airport

▲ *HS2 Project Meka Concrete Plant / United Kingdom*

▲ *2 x K 110 Fixed Concrete Batching Plant / Port of Lyon, France*

▲ *From MEKA Production Facilities / Ankara, Eskişehir* expansion project, the Kursk and Hinkley Point C nuclear power plants in the UK, the construction project of the U.S. Consulate Compound in Mexico, and many other globally significant infrastructure projects realized with facilities and equipment designed and produced by Meka Beton Santralleri İmalat Sanayi ve Ticaret A.Ş. (Meka Concrete Batching Plants Manufacturing Industry and Trade Inc.)

OVER 35 YEARS OF EXPERIENCE

MEKA, founded in 1987 by young engineer Mehmet Kaybal in Ankara under the name Meka Engineering, started as an advanced engineering project development center focusing on Research and Development (R&D) and innovation. Within a year, it gained recognition by providing sophisticated solutions to highly significant global projects on a global scale. As a visionary enterprise that continuously analyzes industry dynamics and changing global conditions much in advance, MEKA quickly entered the construction and heavy machinery production sector.

Today, with the knowledge gained and the R&D capabilities inherited from its corporate genes, MEKA is a global leader in setting industry standards. The company is equipped with the infrastructure to provide the best service in determining customer needs, product design, production, sales and marketing, assembly, after-sales services, field training, and service operations.

MEKA GLOBAL PRODUCT RANGE

In the production of concrete batching plants and equipment for Ready Mix Concrete, Construction, and Precast Industries, MEKA has the capability and experience to design and produce plants and equipment for every capacity and production type. With its roots in concrete batching plant expertise and over 3000 active plants installed worldwide, MEKA is among the global leaders in this field. The company offers a wide product range covering various types of plants, including mobile, stationary, compact, on-site, RCC (Roller Compacted Concrete), and precast concrete batching plants, catering to the needs of small construction sites to large projects and spanning the entire spectrum from the ready-mix concrete industry to the precast concrete industry.

MEKA is also involved in the production of crushing, screening, and washing equipment for aggregate production, mining, and recycling industries.

Providing comprehensive and custom designed solutions for new facilities or capacity increase and revision of existing facilities for aggregate producers, recycling facilities, and investors in industrial mineral processing plants, MEKA designs and manufactures various equipment such as feeders, crushers, screens, wet process equipment, and mobile plants, meeting the special needs of the industry.

"Our Mission: To create MEKA, to be an innovative and leading entity that produces value, values science, prioritizes nature, and serves as an inspiring role model. "

Mehmet Kaybal
Founder and CEO Mechanical Engineer
Boğaziçi University

▲ *Agrega Production Facility / Belgium*

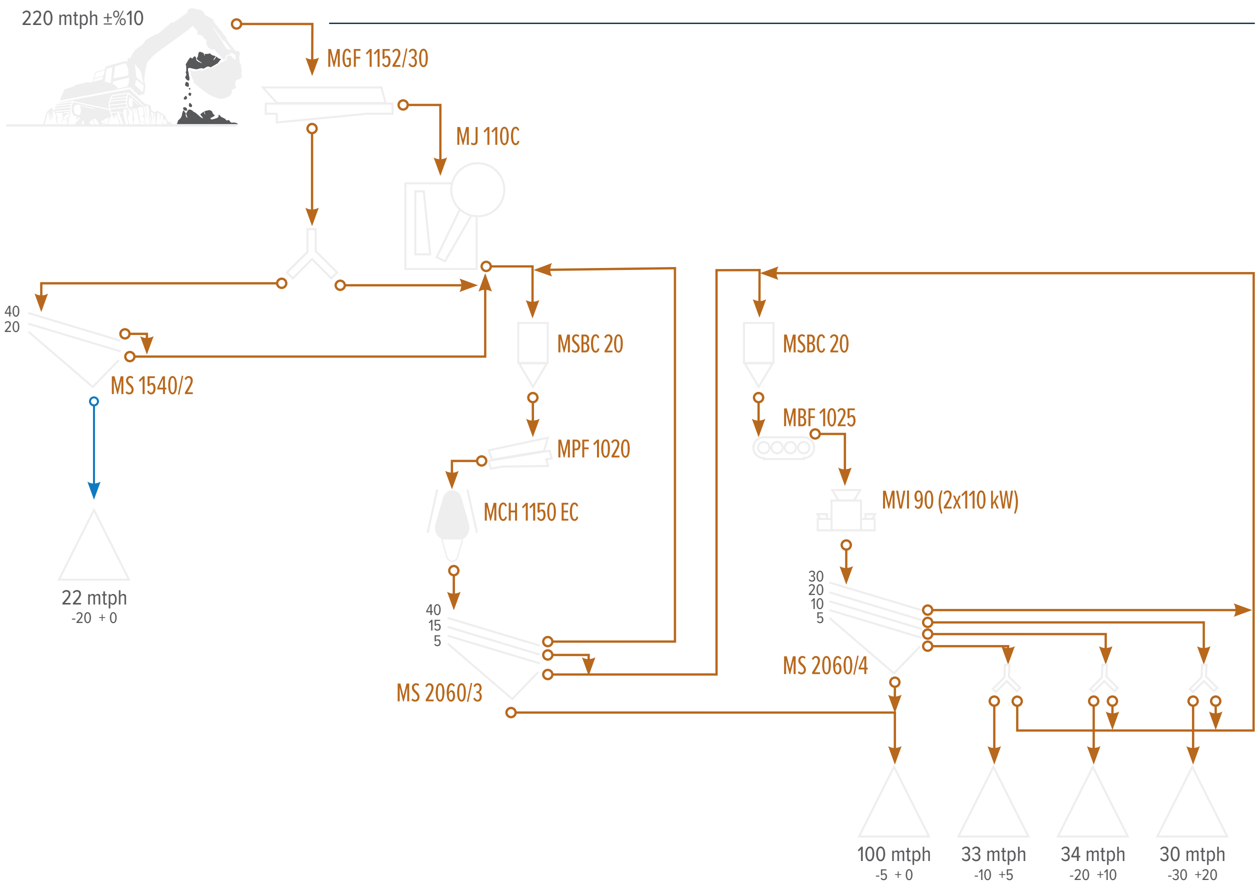
▲ *MEKA Aggregate Production Plant / Mersin, Turkey*

SECTION 2
CRUSHING, SCREENING AND WASHING PLANT UNITS

Main units of crushing-screening-washing equipment produced by MEKA are follows:

- Feeders
- Crushers
- Screens
- Washing Plants
- Mobile Crushing and Screening Plants
- Belt Conveyors.

An example of a MEKA flow sheet, which includes the main crushing-screening equipment listed above.



▲ *MEKA Aggregate Production Plant in Rwanda*

SECTION 3
FEEDERS

MEKA offers a wide range of high-quality feeders for the quarrying and mining processing industries. Whether you need a single feeder or a complete processing solution, MEKA provides you with maximum flexibility to tailor the most suitable solution for your unique conditions and specific requirements. Our precision-engineered, high-performance feeders enable you to operate with maximum efficiency and capacity. The robust design and structure mean that our equipment achieves results for you with minimal downtime and ease of maintenance, even in the most challenging applications.

The most important feeders used in crushing-screening are as follows;

3.1. Apron Feeders
3.2. Grizzly Feeders
3.3. Pan Feeder with Grizzly Scalper
3.4. Pan Feeders
3.5. Belt Feeders
3.6. Wobbler Feeders

3.1. Apron Feeders (MAF Series)

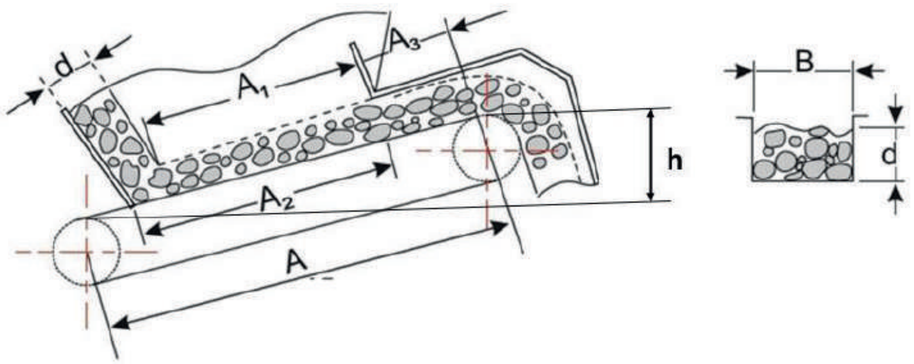
Apron feeders are widely used particularly in the mining sector. They are frequently employed in feeding high clay and high moisture ore and aggregates. Specifically designed for handling adhesive materials, apron feeders require the use of a belt conveyor beneath them. This conveyor collects the material adhering to the aprons, and at the discharge end, conveys it to the feeder discharge chute.

Apron feeders with heavy-duty construction provide reliable methods for controlling the feeding speed to prevent sudden loads on the primary crusher or other plant equipment.

▲ *MEKA Apron Feeder during the manufacturing stage.*

▲ *MEKA Apron and Wobbler Feeders / Russia*

Capacity Calculation of Apron Feeders



$\boldsymbol{Q} = 3600 \times \boldsymbol{B} \times \boldsymbol{d} \times \boldsymbol{v} \times \boldsymbol{\delta} \times \boldsymbol{\varphi}$

$\boldsymbol{Q}$: Capacity, t/h
$\boldsymbol{B}$: Feeder width, side to side, m
$\boldsymbol{d}$: Height of the conveyed material above the feeder, m
$\boldsymbol{v}$: Feeder speed, m/sec
$\boldsymbol{\delta}$: Material bulk density, t/m3
$\boldsymbol{\varphi}$: Filling ratio, 0.80 - 0.85

Resistances that the feeder must overcome:

$\boldsymbol{R1}$: Friction resistance of carrier rollers, kN
$\boldsymbol{R2}$: Friction resistance between material and hopper, kN
$\boldsymbol{R3}$: Friction resistance between moving and standing material, kN
$\boldsymbol{R4}$: Resistance for raising the material, kN
$\boldsymbol{RT}$ Total resistance, kN

$\boldsymbol{RT} = \boldsymbol{R1} + \boldsymbol{R2} + \boldsymbol{R3} + \boldsymbol{R4}$
$\boldsymbol{R1} = \mathbf{10}\mathrm{f}\ (1{,}\mathbf{2}\ \boldsymbol{B2A2\delta} + \boldsymbol{B}\mathrm{d}\boldsymbol{A3\delta} + \boldsymbol{G})$
$\boldsymbol{R2} = \boldsymbol{RSA}/100$
$\boldsymbol{R3} = \mathbf{9}\boldsymbol{B2A1\delta sf}$
$\boldsymbol{R4} = \mathbf{10}\ \boldsymbol{\delta}\ \mathrm{Bdh}$

$\boldsymbol{f}$: Friction coefficient of idlers, 0.1-0.14
$\boldsymbol{G}$: Weight of moving parts, tons
$\boldsymbol{RS}$: The friction force between the hopper and the material per meter of the feeder, daN/m
$\boldsymbol{sf}$: A correction coefficient depending on the type of material, moisture content and maximum material size. For safety reasons, $\boldsymbol{sf} = \mathbf{1}$ is taken in the first calculation.

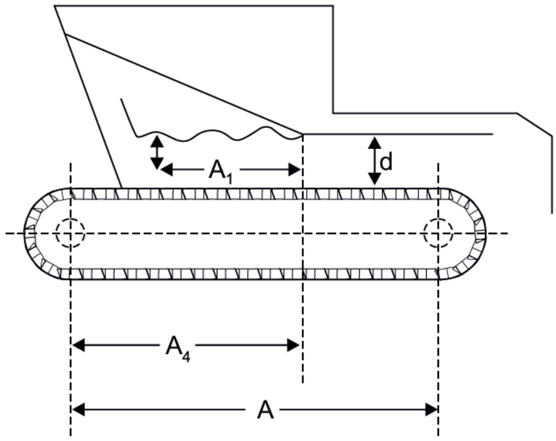
Rs VALUES, daN/m

d (m)	δ: Material bulk density			
	0,8	**1,2**	**1,6**	**2,4**
0,3	7,5	12	16,5	24
0,45	18	27	35,5	53,5
0,60	32,5	49	65,5	98
0,75	50,5	76	101	152
0,90	71	107	143	214
1	98	147	196	294
1,20	128	192	256	383
1,4	165	248	330	495
1,5	198	297	397	595
1,8	287	431	575	862

In an open hopper where large materials are fed: $A3=0$

$A1 = A4/3$

: Length of material slope inside the hopper.



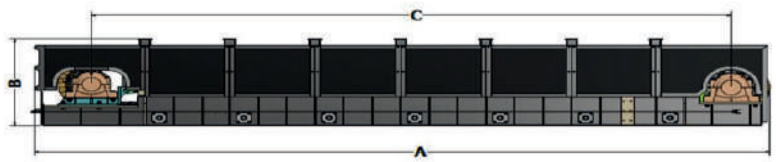
Motor power:

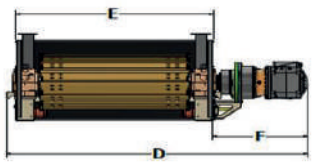
Engine power required to overcome all these resistances:

$P = RT\ v\ /\ \eta$

: Required engine power, kW
: Total resistance, kN
: Feeder speed, m/sec
η : Mechanical efficiency

Measurements of MEKA Apron Feeders





MODEL	MAF 0945	MAF 1245	MAF 1255	MAF 1260	MAF 1560	MAF 1880
A	5601	5601	6811	7155	7155	9229
B	1270	1270	1270	1270	1270	1460
C	4482	4482	5520	6008	6020	8000
D	2302	3202	3129	3202	3502	3861
E	1450	1750	1750	1750	2050	2442
F	1315	1315	1235	1320	1320	1291

MEKA Apron Feeders Technical Specifications

MODEL	WIDTH mm	SIZE m	CAPACITY mtph	MAXIMUM FEED SIZE mm	CHAIN SPEED
MAF 0945	900	4,5	110 – 350	380	0,1 – 0,30 m/s
MAF 1245	1200	4,5	230 – 680	520	0,1 – 0,30 m/s
MAF 1255	1200	5,5	230 - 680	520	0,1 – 0,30 m/s
MAF 1260	1200	6	230 – 680	520	0,1 – 0,30 m/s
MAF 1560	1500	6	350 – 1100	650	0,1 – 0,30 m/s
MAF 1880	1800	8	600 – 1750	830	0,1 – 0,30 m/s

3.2. Grizzly Feeders (MGF Series)

MEKA grizzly feeders are used for relatively clean and moderately moist quarry materials with low clay content.

The bodies of these feeders consist of two parts. The rear section includes the pan, while the front section contains one or two steps of grizzly bars. The role of the grizzly section is to screen out clay and fine materials that are not desired to enter the crusher. Grizzly bars are typically manufactured from high manganese austenitic alloy steel casting. The number of grizzly bars and the spacing between them can be adjusted according to the material size that needs to be bypassed by increasing or decreasing the number of bars. The gap between the bars is altered based on the condition of the material.

Capacity Calculation of Grizzly Feeders

Volumetric capacity formula for grizzly feeders:

$\boldsymbol{Q} = 3600 \times \boldsymbol{v} \times \boldsymbol{\delta} \times \boldsymbol{B} \times \boldsymbol{H} \times \boldsymbol{\mu}\mathrm{s} \times \boldsymbol{\mu}\mathrm{m} \times \boldsymbol{\mu\beta}$

: Capacity, t/h

: Theoretical material speed, m/sec

: Feeder internal width, m

: Material height at the feeder exit, m

$\boldsymbol{\mu}$s : Material size coefficient

$\boldsymbol{\mu}$m: Coefficient related to material moisture and pollution

: Coefficient related to vibration table inclination

: Material bulk density, t/m3

In the calculations, $\boldsymbol{H}$ is the material height value at the feeder exit, depending on experience.

It is taken based on some assumptions as follows:

$\boldsymbol{H} \leq 0.2\ \boldsymbol{B}$ For sand and fine gravel

$\boldsymbol{H} \leq 0.3\ \boldsymbol{B}$ for all-in-one material up to 150 mm

$\boldsymbol{H} \leq 0.5\ \boldsymbol{B}$ for material larger than 150 mm

$\boldsymbol{\mu}$s, Material size coefficient depending on experience as follows:

$\boldsymbol{\mu}$s =1 for sand

$\boldsymbol{\mu}$s =0.8-0.9 for material size up to 150 mm

$\boldsymbol{\mu}$s = 0.6 for material larger than 150 mm

In the calculations, the coefficient related to $\boldsymbol{\mu}$m material moisture content and pollution status as follows:

$\boldsymbol{\mu}$m = 1 for dry material

$\boldsymbol{\mu}$m = 0.8 For moist material

$\boldsymbol{\mu}$m = 0.6 For damp and clayey material

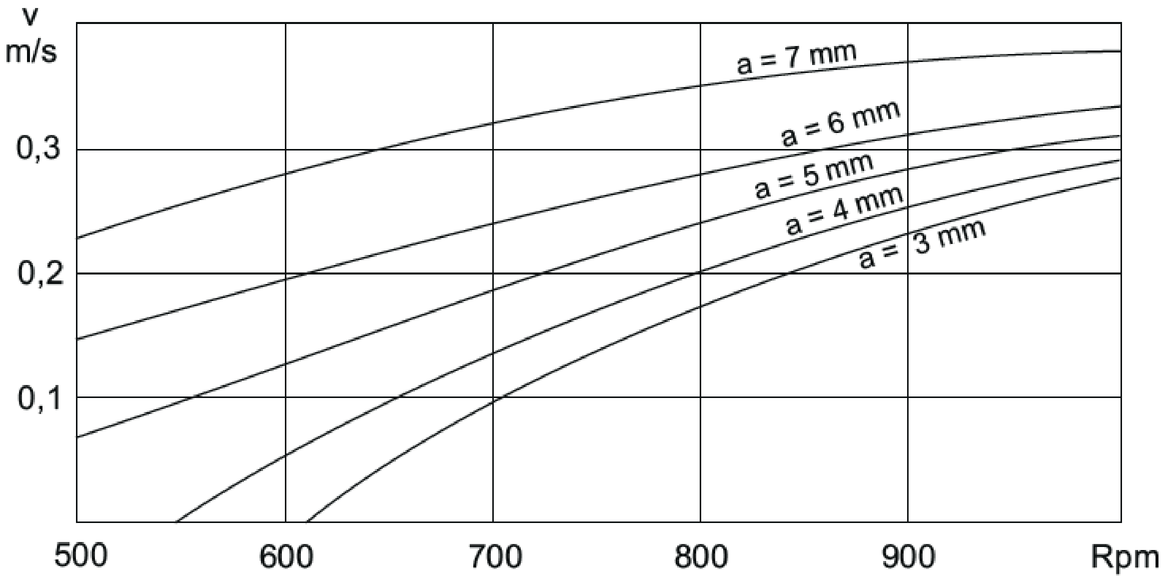
In the calculations, the vibration table inclination angle coefficient $\boldsymbol{\mu\beta}$ is based on experience as follows:

$\boldsymbol{\beta} = 30$ for = 1.15

$\boldsymbol{\beta} = 50$ for = 1.3

$\boldsymbol{\beta} = 80$ for = 1.48

$\boldsymbol{\beta} = 100$ for $\boldsymbol{\mu\beta} = 1.6$

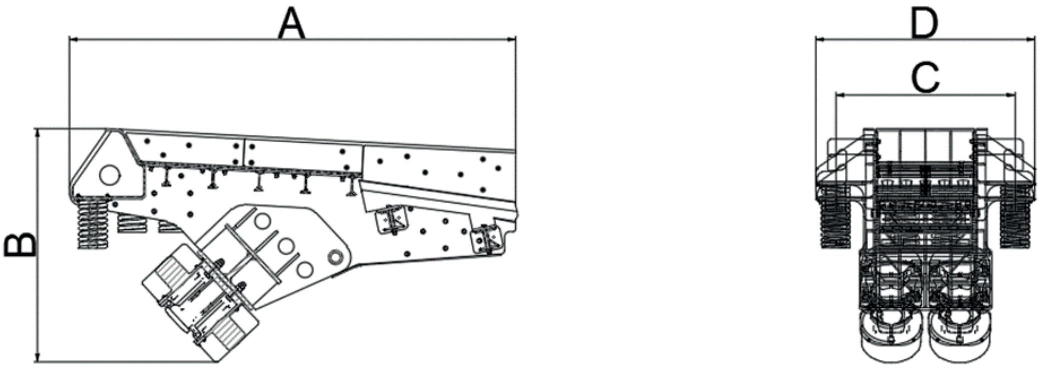


Material velocity depend on the vibration amplitude "a" and the frequency of the excitation system.

MEKA Grizzly Feeders Technical Specifications

MODEL	FEEDER SIZE Width * Length mm x mm	FEEDER'S GRIZZLY SECTION LENGTH mm	Power kW	CAPACITY mtph	MAX FEED SIZE mm
MGF 0625	650 x 2500	Tek kademe - 1000	2 x 4	100 - 200	350
MGF 0942	900 x 4200	Tek kademe - 1500	2 x 6,1	250 - 400	600
MGF 1152	1100 x 5200	Çift kademe - 2000	2 x 10,1	400 - 640	800
MGF 1260	1200 x 6000	Çift kademe - 2800	2 x 11,9	450 - 750	900
MGF 1360	1300 x 6000	Çift kademe - 2800	2 x 13,9	500 - 825	900
MGF 1460	1400 x 6000	Çift kademe - 2800	2 x 13,9	550 - 875	900
MGF 1660	1600 x 6000	Çift kademe - 2800	2 x 19	650 - 1000	1200

General Dimensions of MEKA Grizzly Feeders



Dimensions of the Feeders

Feeder Model	A (mm)	B (mm)	C (mm)	D (mm)
MGF 0625	2839	1487	1140	1396
MGF 0942	3624	1706	1400	1664
MGF 1152	5200	1876	1580	1780
MGF 1260	5129	1850	1600	1824
MGF 1360	5990	2530	1640	1951
MGF 1460	5990	1799	1880	2144
MGF 1660	5062	1886	1770	2034

3.3. Pan Feeder with Grizzly Scalper (MSF Series)

Pan feeders are the preferred equipment for more efficient separation processing when there is a high proportion of fine material within the fed material. In cases where a significant amount of fine material is present, these feeders are chosen over gridded feeders for more effective separation operations. MEKA pan feeders are used in conjunction with MEKA scalping screens or wobblers to achieve more efficient operation. This way, the fine material is efficiently pre-screened and prevented from entering the crusher.

Technical Specifications for MEKA Pan Feeders with Grizzly Scalper

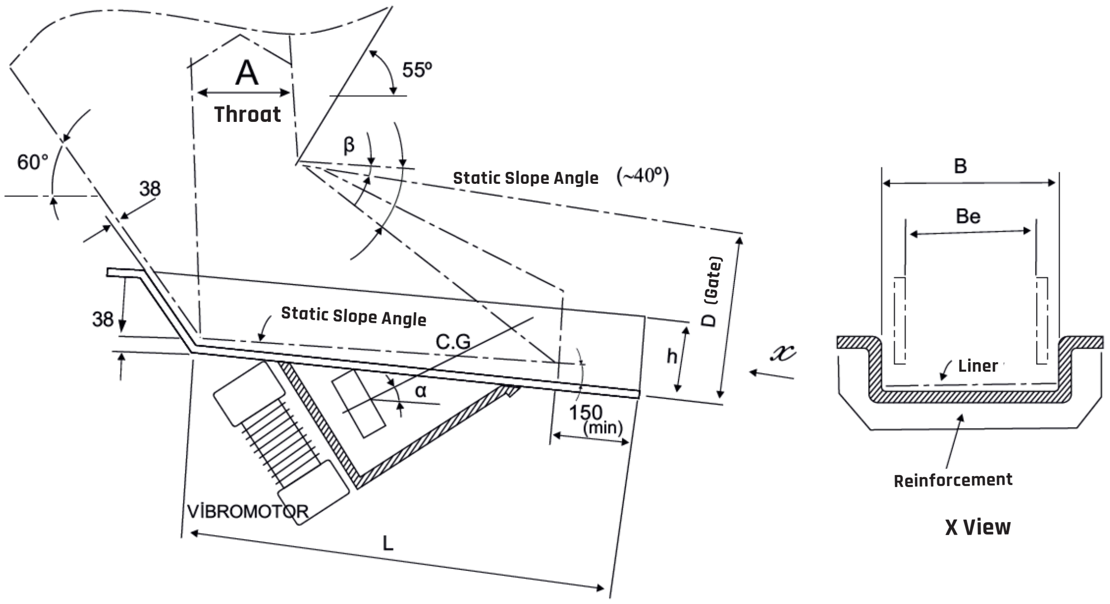
MODEL	FEEDER DIMENSIONS Width x Length mm x mm	GRIZZLY FEEDER DIMENSIONS Width x Length mm x mm	POWER kW Feeder	Screen	CAPACITY mtph	MAXIMUM FEED SIZE mm
MSF 0965	900 x 3500	1000 x 3000	2 x 6,4	2 x 6,1	250 - 400	600
MSF 1176	1100 x 4600	1200 x 3000	2 x 8	2 x 7,5	400 - 640	800
MSF 1390	1300 x 5000	1400 x 4000	2 x 13,9	2 x 12	500 - 825	900
MSF 1690	1600 x 5000	1900 x 4000	2 x 19	2 x 13,9	650 - 1000	1200
MSF 1890	1800 x 5000	1900 x 4000	2 x 24	2 x 13,9	700 - 1120	1400

3.4. Pan Feeders (MVF Series)

Pan Feeders are commonly used in crushing and screening plants to ensure consistent and uniform feeding of secondary and tertiary crushers with the required capacity. If these crushers are not fed properly, they may not operate at the desired performance level. For instance, cone crushers experience increased wear and reduced bearing life if they are not fed properly, and crushing chambers are not kept full. Vertical shaft impact crushers, on the other hand, may experience a decrease in crushing performance without proper feeding, leading to the absence of a stone box in the crushing chamber.

These pan feeders are typically installed under a surge bin with a capacity of 10-15 m3. The feeder body is either suspended from the surge with spiral springs or sits on a fixed chassis with spiral springs. This setup ensures efficient and consistent feeding to maintain the optimal performance of the crushers.

Pan Feeder Capacity



$$= 3600 \times \boldsymbol{v} \times \boldsymbol{d} \times \boldsymbol{Be} \times \boldsymbol{\delta} \times \boldsymbol{\mu\beta} \times \boldsymbol{\mu h} \times \boldsymbol{\mu s} \times \boldsymbol{\mu m}$$

: Capacity, t/h

$\boldsymbol{v}$: Material velocity, m/s

$\boldsymbol{d}$: Material thickness at the feeder outlet, m

$\boldsymbol{Be}$: Inner width of the feeder skirt, m

$\boldsymbol{\delta}$ Material bulk density, t/m^3

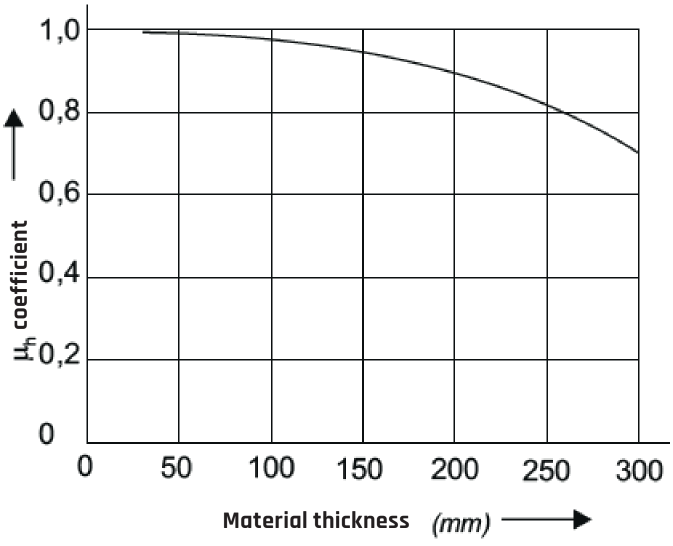
Material velocity, vibrator unit (vibro motor) revolution count, and stroke values are provided in the table below.

Material velocities based on vibrator revolution count and vibration stroke.

Vibro motor revolution count (RPM)		Stroke = 2 x amplitude mm							
1500		3,0	3,7	4,5	5,3	6,2			
1000				7,0	7,7	8,7	9,6	10,5	11,5
V	m/sn	0,10	0,15	0,20	0,25	0,30	0,35	0,40	0,45
	m/h	360	540	720	900	1080	1260	1440	1620

μh : Material thickness factor, obtained from the graph below.
μs : Friction factor, a coefficient representing the friction between the material and the trough.
$\mu s = 0.85$ is taken.
μm : Material property factor, ranging from 0.8 to 1. Small values are for light, moist, sticky materials.
$\mu\beta$: Calculated with the formula below:

$$\mu\beta = 1 + \beta \times 0{,}025$$



μ_h: Material thickness coefficient

The table below illustrates MEKA's recommended material velocity values based on the fed material size.

Material height at the feeder outlet:

$D = K F x d$

The formula is determined as follows:

D = Gate height

If the static slope angle is $\geq 35°$, then $KF = 1.3$

If the static slope angle is $\leq 35°$, then $KF = 1.5$

Material Size (mm)	Vibration Table Angle (˚)	Material Speed (m/s)
< 100mm	8˚ - 12˚	0,28
100 - 300 mm	4˚ - 8˚	0,25
> 300 mm	0˚ - 4˚	0,22

Recommended material speed values

Pan feeders are typically equipped with two counter-rotating vibro motors that produce linear vibration. Thanks to a properly calculated and designed spring system, there is no resonance, and self-synchronization is achieved. Capacity control is either done by an adjustable cover placed at the front of the feeder or by a frequency converter while the operation is ongoing. The vibro motors of the feeders are of highest quality globally brands and require minimal maintenance over an extended period.

Technical Specifications of Meka Pan Feeders

MODEL	Feeder Dimensions Width x Length mm x mm	POWER kW	CAPACITY mtph	MAX FEED SIZE mm
MVF 6515	650x 1500	2 x 0,9	100 - 180	200
MVF 8517	850 x 1700	2 x 1,96	180 -275	260
MVF 1020	1000 x 2000	2 x 1,96	220 - 400	300
MVF 1220	1200 x 2000	2 x 2,2	250 - 500	330
MVF 1520	1500 x 2000	2 x 3,2	300 - 600	400

3.5. Belt Feeders (MBF Series)

Belt feeders are commonly used for feeding granular materials stored in surge bins. Coarse and abrasive materials are not suitable for belt feeders as they can easily damage the feeder's top layer. The maximum material size for belt feeders should not exceed 50 mm. The damage caused by abrasive and sharp-edged materials to the belt top layer can be partially balanced by increasing the thickness of the cover.

It is possible to stabilize the desired feed capacity by using the adjustable gate on the front wall of the surge bin. A frequency converter can be another option for achieving the desired capacity.

MEKA belt feeders use carrier rollers manufactured with precision in steel drawing tubes, equipped with a highly effective sealing system. Self-lubricating 2RS type bearings of sufficient size and highest quality are used in the rollers. The roller intervals are kept to a minimum. All sides of the feeder are closed with bolted systems in compliance with international standards related to human safety.

Belt Feeder Capacity

$\boldsymbol{Q} = 3600 \times \boldsymbol{W} \times \boldsymbol{d} \times \boldsymbol{v} \times \boldsymbol{\delta}$

: Capacity (t/hour)

$\boldsymbol{W}$: Width between bunker side skirts (m)

$\boldsymbol{d}$: Material height on the belt at bunker outlet (m)

: Belt feeder speed (m/s)

: Material bulk density (t/m^3)

The width W between bunker skirts varies depending on the desired capacity, the nature of the material being fed, and the characteristics of the bunker. Recommended widths for the following scenarios are provided:

- $\boldsymbol{W}$ =3,40 x bmax for less abrasive materials and limited bunker heights
- $\boldsymbol{W}$ =4,25 x bmax for non-abrasive materials and higher bunker heights
- $\boldsymbol{W}$ = 4,25 x bmax for highly abrasive materials and limited bunker heights
- $\boldsymbol{W}$ = 5.00 x bmax for highly abrasive materials and higher bunker heights

bmax : Maximum particle size

The minimum value for material height at the bunker outlet is

d=0,58 w

The feeder speed is selected as 0.3 m/s for abrasive materials. For non-abrasive materials, it can be increased to a value of up to 0.5 m/s.

Belt Feeder Motor Power

The two important resistance forces that determine the feeder motor power are as follows:

1) Frictional resistance exerted on the material being conveyed:

$$F1 = C\ f\ L\ (\ Q\ /\ 3{,}6\ v)$$

F1: Frictional resistance due to material movement, daN

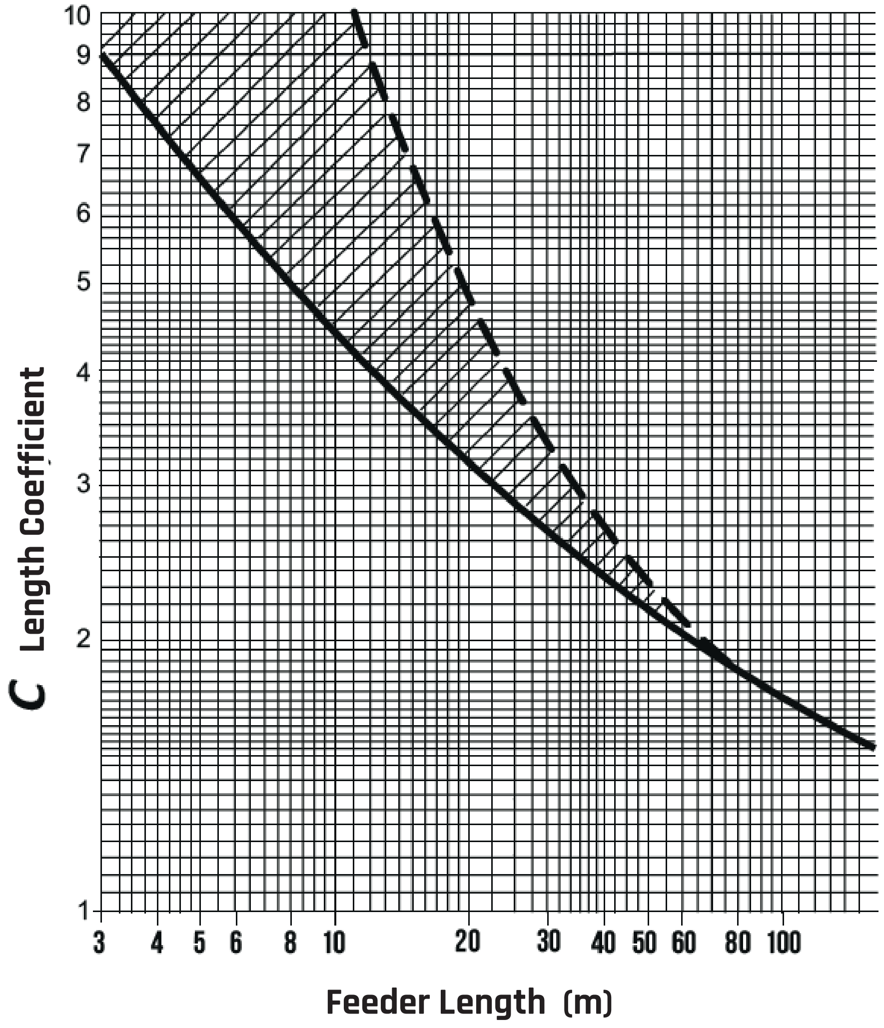
Q: Capacity, ton/hour

v: Feeder speed, m/s

C: Feeder length coefficient (obtained from the graph below)

f: Roller friction coefficient, taken between 0.020-0.022.

L: Feeder length (between drum axes), m

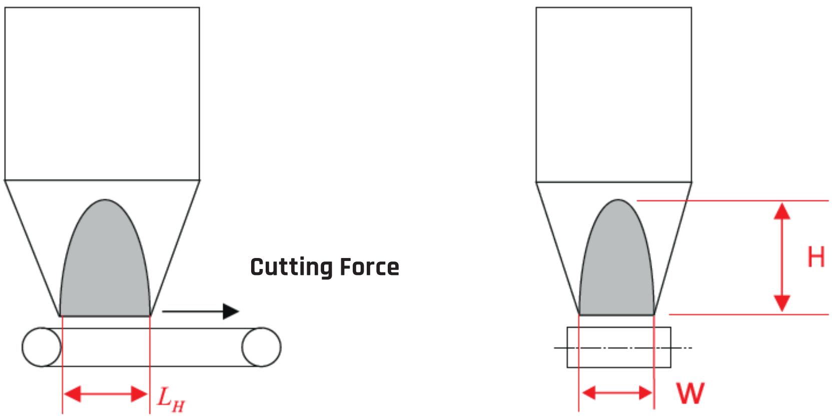


2-The cutting force exerted by the active weight on the conveyor belt in the bunker is given by the formula:

$$F2 = 1{,}5 \times LH \times W2 \times \delta$$

F2 : Cutting force required to overcome the friction resistance of the material in the bunker, daN

LH: Length of the bunker outlet, m
W: Width of the bunker outlet, m
δ: Material stacking density, ton/m^3



Therefore, the environmental force that needs to be transmitted to the drive drum by the drive system:

$F = F1 + F2$

Motor power:

$$P = \frac{F v}{102\,\eta}$$

η : Mechanical efficiency
P : Motor power, KW
v : Feeder speed, m/s
F : Total environmental force, daN

Technical Specifications of Meka Belt Feeders

MODEL	Feeder Dimensions Width x Length mm x mm	POWER kW	CAPACITY mtph	BELT FEEDER SPEED m/s	MAX FEED SIZE mm
MBF 6525	650 x 2500	3	250	0,35	100
MBF 8025	800 x 2500	4	350	0,35	150
MBF 1025	1000 x 2500	5,5	450	0,35	150
MBF 1225	1200 x 2500	7,5	550	0,35	150

3.6. Wobbler Feeders (MWF Series)

MEKA wobbler feeders are typically installed after a primary feeder, efficiently screening fine and dirty materials to reduce the load on the primary crusher. Additionally, they significantly reduce operating expenses by minimizing wear.

These feeders are manufactured in single or multiple stages. In each stage, a specific number of triangular bars are mounted on various shafts. Motion is transmitted between the shafts on the side of the feeder through chain gears and chains.

The triangular bars apply both a lifting and rolling motion to the material. This action not only removes the clay layer adhering to the material but also facilitates its passage through the opening between the shafts, allowing it to enter the by-pass system.

Technical Specifications of Meka Wobbler Feeders

MODEL	Feeder Dimensions Width x Length mm x mm	POWER kW	CAPACITY mtph	MAXIMUM FEED SIZE mm
MWF 1035	1000 x 3500	22	200 - 300	600
MWF 1235	1200 x 3500	22	300 - 400	700
MWF 1440	1400 x 4000	30	350 - 450	800
MWF 1640	1600 x 4000	37	400 - 600	900
MWF 1660	1600 x 6000	2 x 37	500 - 650	900
MWF 1860	1800 x 6000	2 x 37	650 - 1000	1000

▲ *Meka Apron ve Wobbler Besleyici Ünitesi / Rusya*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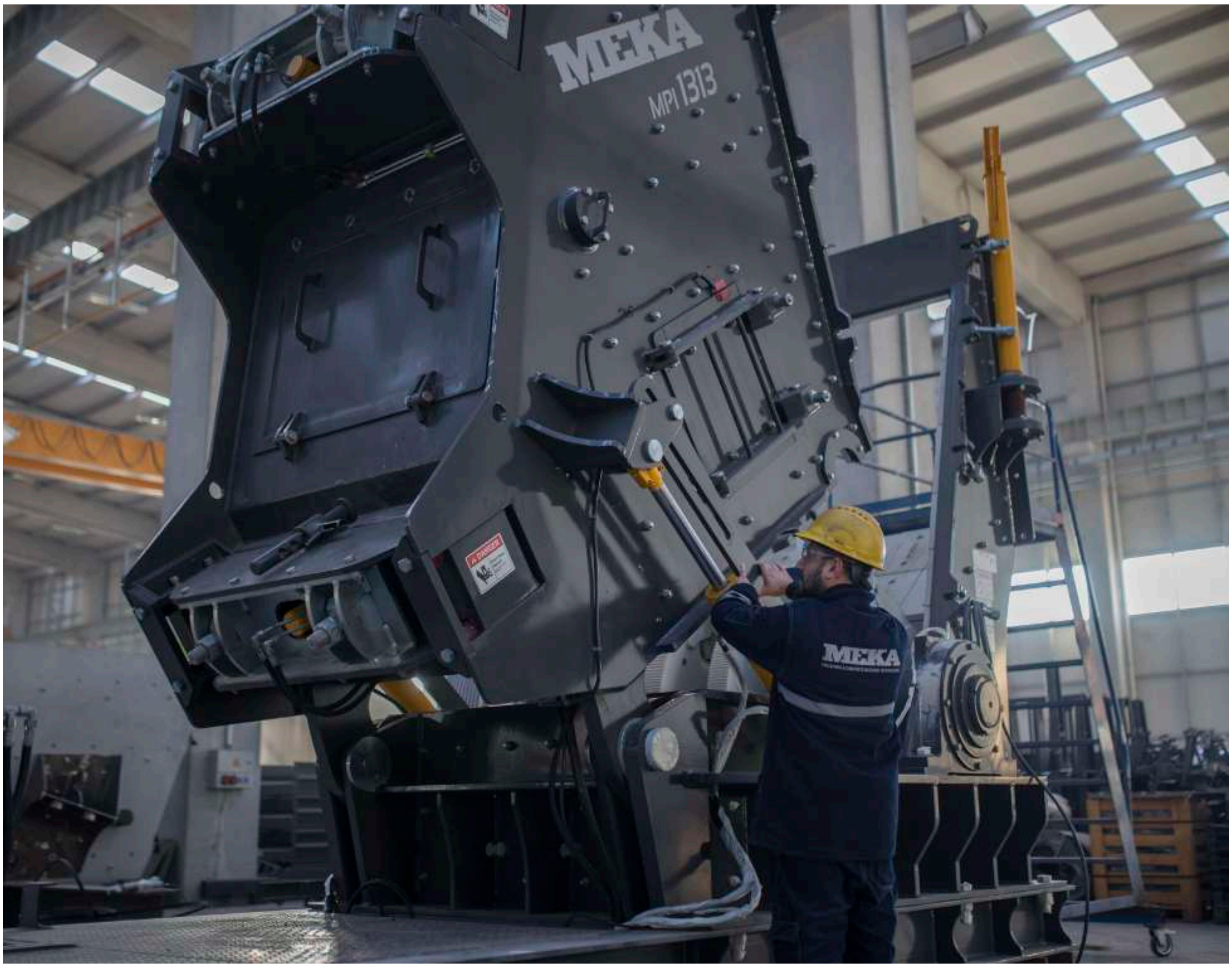
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SECTION 4
CRUSHERS

Mining and construction sectors require the reduction of the rock or ore obtained after drilling and blasting at the quarry to a smaller size for their use in different applications. This process is called size reduction or crushing. Depending on the size of the usable material, the crushing process is generally carried out in three stages.

a- Primary Crushing:

It is the first stage of crushing. In the primary crushing stage, the ore or rock obtained from drilling and blasting at the quarry, with the maximum size of approximately 800 – 1500 mm, is reduced to below 150 – 300 mm. This is often referred to as Primary Crushing Stage.

b- Secondary Crushing

It is the second stage of crushing. In the secondary crushing stage, the rock or ore obtained from the primary crushing process, with the maximum size of approximately 150 – 300 mm, is reduced to below 50 – 80 mm. This is often referred to as the Secondary Crushing Stage.

c- Tertiary Crushing

It is the third stage of crushing. In the tertiary crushing stage, the ore or rock obtained from the secondary crushing process, with the maximum size of approximately 50 – 80 mm, is reduced to below 5 – 12 mm. This is often referred to as the Tertiary Crushing Stage.

Machines performing size reduction or crushing are referred to as crushing machines or simply crushers.

Classification of Crushers

MEKA offers a very extensive crusher production portfolio. Crushers in MEKA's production portfolio can be classified based on the stage they are used and the crushing principle.

Classification Based on the Stage of the Crushers

In this classification, crushers are named based on the stage they are used in.

a- Primary Crushers

Crushers used in the primary crushing stage, reducing the ore or rock with the maximum size of 800 – 1500 mm to below 150 – 300 mm.

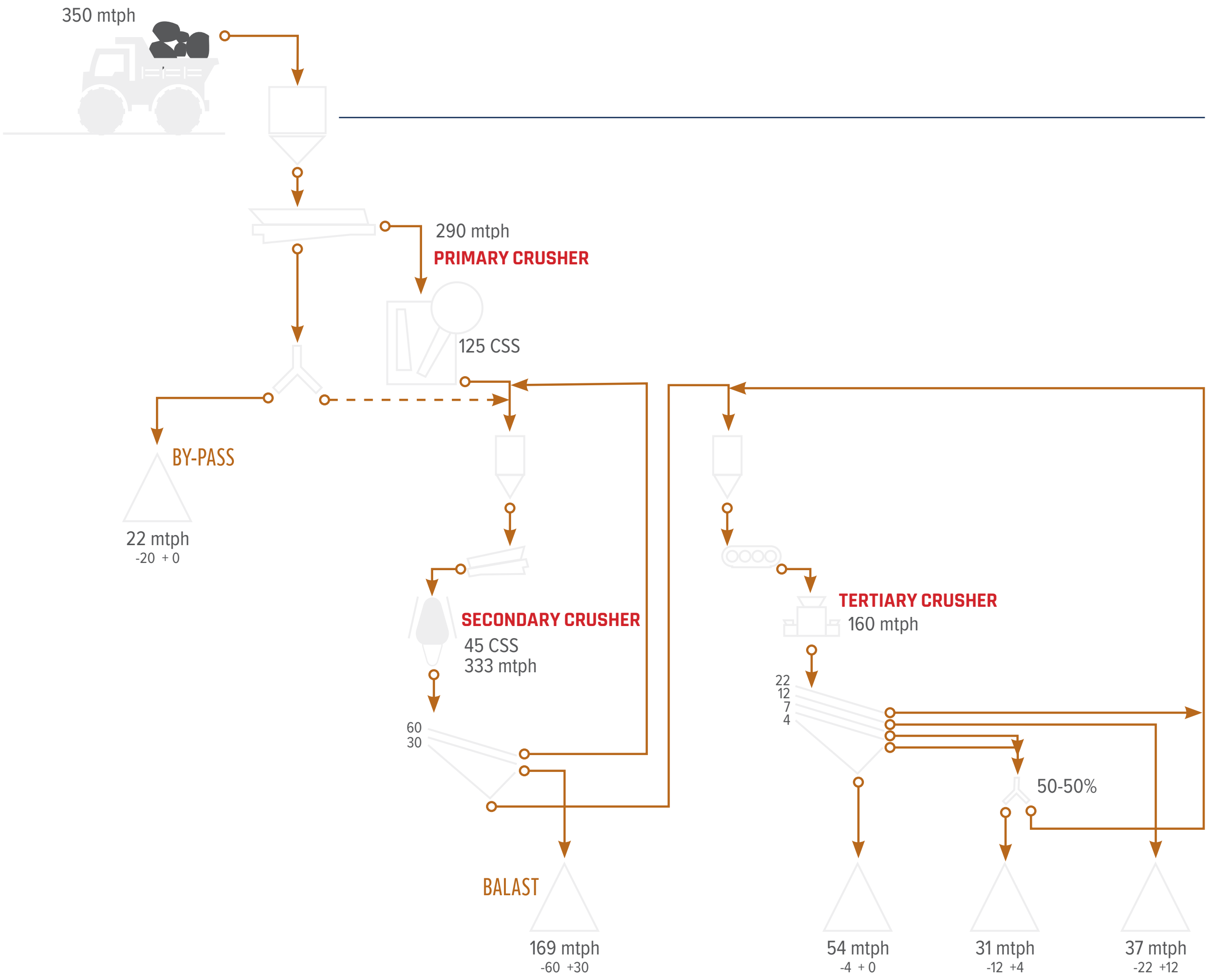
b- Secondary Crushers

Crushers used in the secondary crushing stage, reducing the ore or rock with the maximum size of 150 – 300 mm to below 50 – 80 mm.

c- Tertiary Crushers

Tertiary crushers are used in the tertiary crushing stage, reducing the ore or rock with the maximum size of 50 – 80 mm to below 5 – 12 mm

The locations of the crushers in a crushing-screening plant are shown in the below flow sheet.



Classification Based on the Size Reduction Method Applied by the Crusher

There are four main methods of mechanical size reduction. These are:

- Compression
- Impact
- Cutting
- Abrasion

Crushers perform the crushing process by applying only one of these methods or by applying several of them together. It is possible to categorize crushers into three groups based on the methods they apply.

a- Compression Crushers

These crushers primarily break the material by applying pressure. Some of these crushers also apply cutting and abrasion in addition to pressure. The crushers in MEKA's production portfolio under this category include

- **Jaw Crushers**
- **Cone Crushers**
- **Cylinder Crushers**

b- Impact Crushers

These crushers primarily break the material by applying impact force. The crushers in MEKA's production portfolio under this category include:

- **Horizontal Shaft Impact Crushers (HSI)**
- **Vertical Shaft Impact Crushers (VSI)**

c - Impact and Abrasion Crushers

These crushers break the material by applying both impact and abrasion. Grate hammer crushers, three-stage impact crushers, and tertiary impact crushers fall into this category. The crushers in MEKA's production portfolio under this category include:

- **MSIH Series Secondary Impact Crushers**
- **Tertiary Impact Crushers**
- **Hammer Crushers**

4.1. Jaw Crushers (MJ and MJS Series)

Jaw crushers are a type of crusher that has two vertical jaw dies, one fixed and the other movable, with an angle called the nip angle between them. These crushers break and cut the fed material by applying pressure with the movement of the movable jaw towards and away from the fixed jaw. Jaw crushers are divided into two main groups based on the movement mechanism of the movable jaw:

- **Single toggle plate jaw crushers**
- **Double toggle plate jaw crusher**

While single toggle jaw crushers are commonly used in the aggregate sector, double toggle jaw crushers are generally used for crushing very hard ores.

Single toggle jaw crushers have the following important parameters:

b = (0.8-0.9) x G

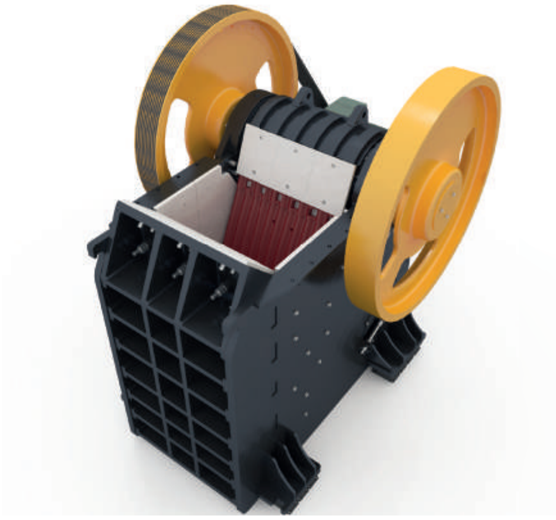
- Maximum feed size, b
- Width of the crushing chamber entrance, G

L ≅ 2 x G

- Height of the crushing chamber, L

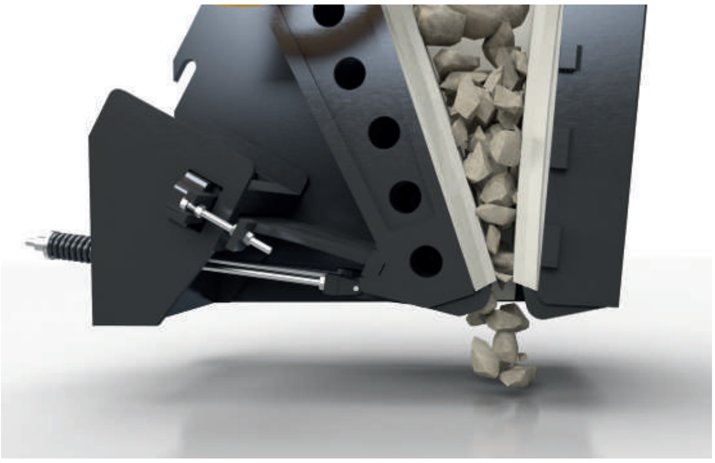
1,3 x G < W < 3,0 x G

- Length of the crushing chamber, W
- LT = LMAX - LMİN
- LMAX : OSS (Open Side Setting)
- LMİN : CSS (Closed Side Setting)
- LT : Stroke

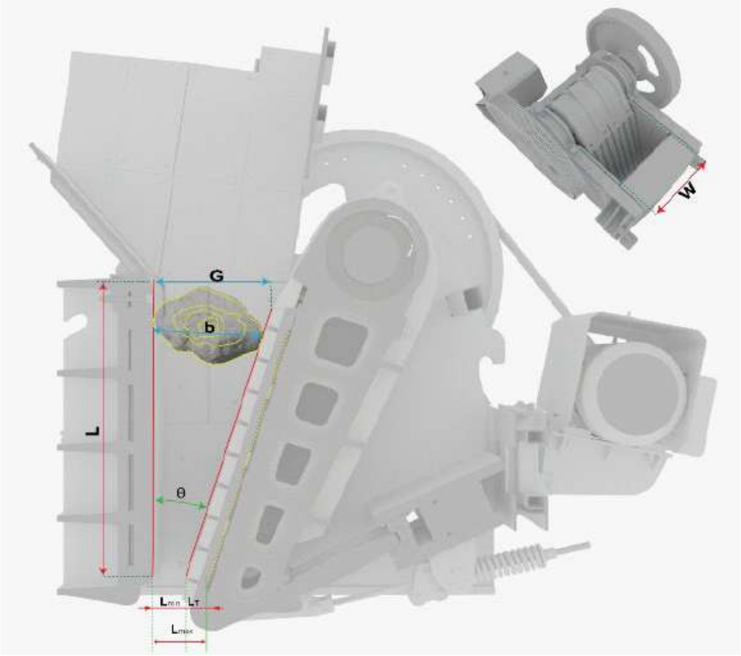


R = G / LMİN

- ***n*** : Number of strokes per minute (Varies between 100 - 359 rpm depending on the crusher size.)
- ***θ*** : Nip (Grip) angle
- ***R*** : Size reduction ratio



The parameters are schematically represented as shown below.



Capacity in Jaw Crushers

Critical Speed:

nC = 47 x [1 / (LT) 0,5] x [(R-1) /R] 0.5

Rose-English Formula:

Capacity at Critical Speed:

QM = 2820 x (L T)0,5 x W x (2 x LMİN +LT) x [R /(R-1)] 0.5 x $\boldsymbol{\rho S}$ x f (PK) X f(β)SC

QM: Capacity, (tons/hour)

LT: Stroke, m

n: Strokes per minute, rpm

W: Length of the crushing chamber, m

LMIN: Minimum set value of the crusher output, m

R: Size reduction ratio, ($R = G$ / LMİN)

$\boldsymbol{\rho S}$: Specific gravity of the crushed ore (t/m3)

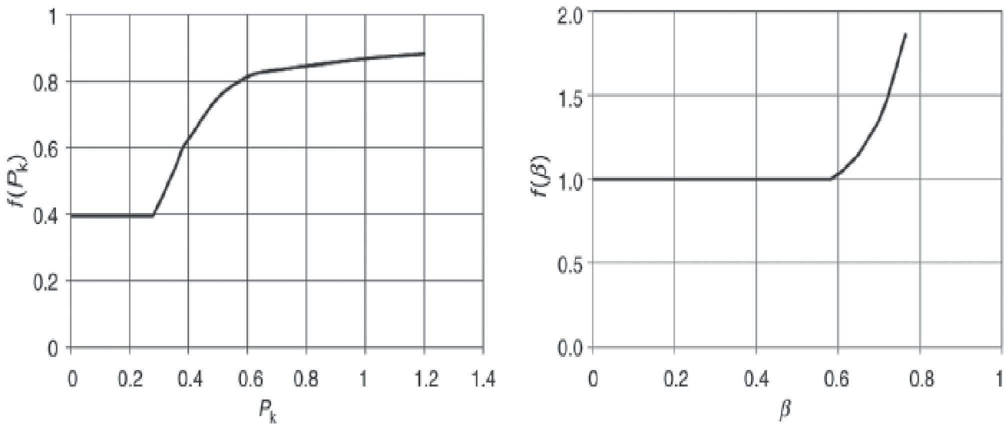
$$P_K = ((d_{MAX} - d_{MIN})/d_{MEAN})$$

dMAX: Maximum particle size in the fed material

dMIN: Minimum particle size in the fed material

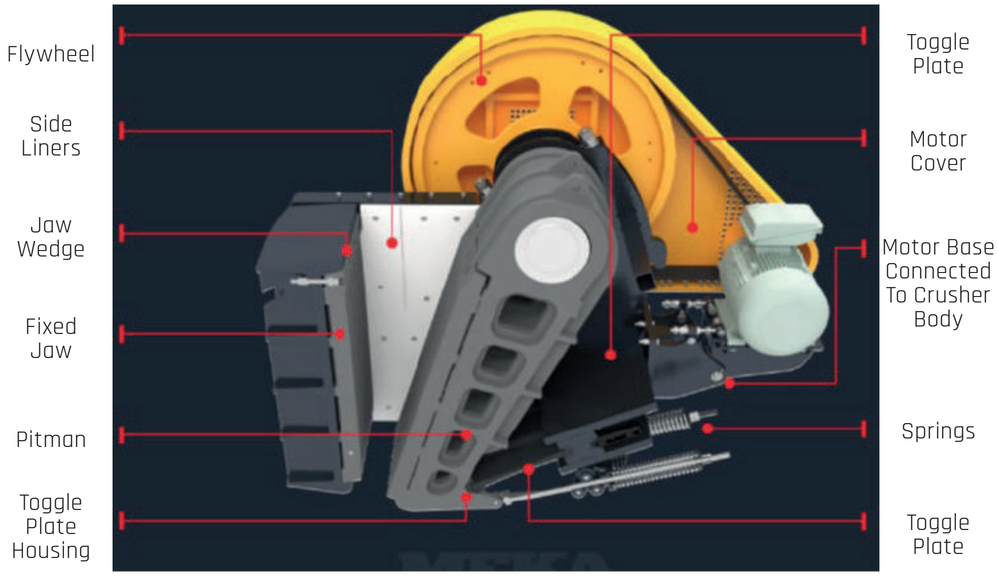
dMEAN: Mean particle size of the fed material

PK is a size distribution function that influences the capacity with the coefficient $f(pk)$.



The values of f(PK) and f(β) depending on PK and β

MEKA jaw crushers are designed to crush the hardest, least breakable, and highly abrasive materials.



The crusher body is manufactured either by welding construction or bolted construction, depending on its model. The front plate to which the fixed jaw is attached, the steel support plate, and the rear block where the jaw adjustment system sits are also made of cast steel.

In the case of the body being manufactured with welded construction, low-carbon side plates and reinforcements, front plate, rear block, side bearings, and chassis seating flanges are welded by expert welders. Afterward, the entire body undergoes stress relief annealing and sandblasting before painting.

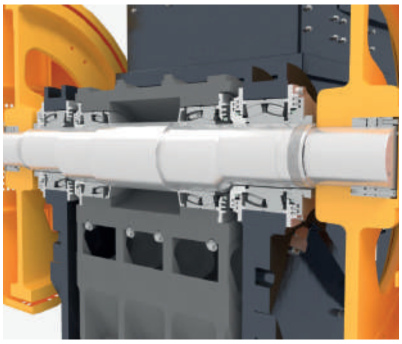
Pitman is manufactured from high-quality cast steel. Bearing slots are processed on CNC machines.

Flywheels are made of high-quality white cast iron. The diameter and width of the flywheel are significantly large to provide high inertia. The main shaft is made of hardened and tempered alloy forged steel. It is precisely processed on CNC machines, and the areas where bearings sit are delicately grinded. Heavy-duty top-quality double-row spherical roller bearings are used. An effective labyrinth-type sealing system is used to ensure the best performance of the jaw crusher.

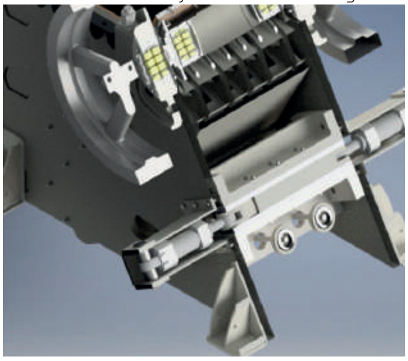
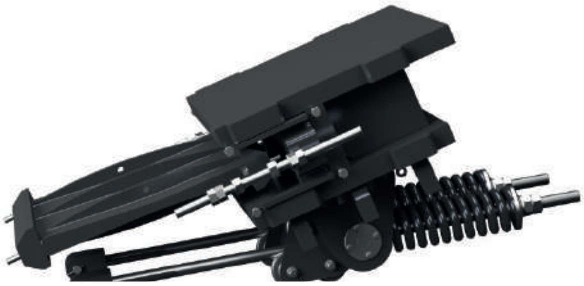
The general appearance of the crusher body and pitman group

The hydraulic-assisted jaw adjustment system used in jaw crushers has been replaced by a dual wedge hydraulic adjustment system.

Crusher jaws and side liners are typically made from high manganese Headfield steel (GX120 Mn Cr 18-2). This austenitic alloy steel casting material contains 16-19% Mn and 1.5-2.5% Cr."

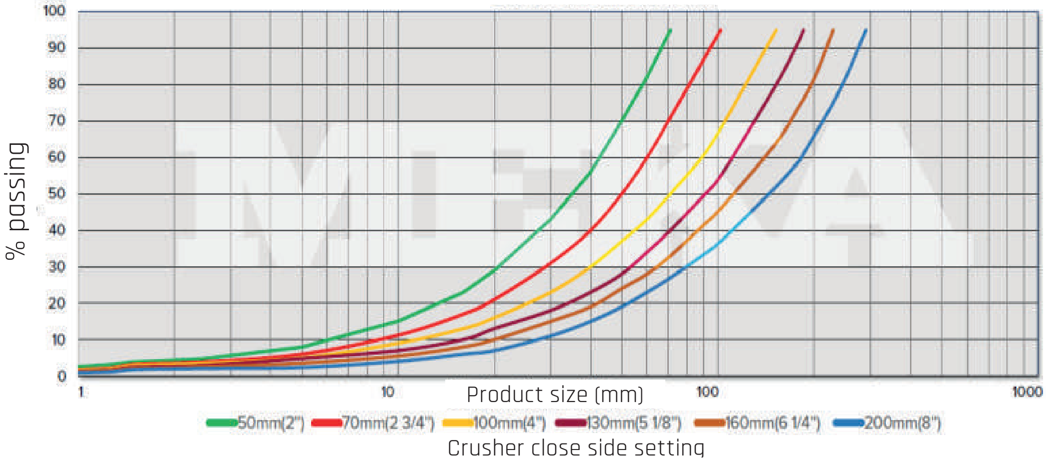


General view of the jaw crusher bearing housing system.

Double-toggle hydraulic jaw adjustment system.

Jaw crusher product curve based on the jaw opening.



Jaw crusher product curve based on the jaw opening.

General Technical Specifications of MEKA Jaw Crushers

MODEL	OPENING mm	CLOSED SIDE SETTING MIN-MAX OPENING mm	CAPACITY mtph	POWER kW	WEIGHT kg
MJ 60	610 * 380	40 - 150	20 - 80	30	6000
MJ 65	650 * 500	40 - 150	25 - 100	45	7000
MJ 70	700 * 400	30 - 100	25 - 110	45	4200
MJ 90	900 * 650	60 - 150	50 - 200	75	11400
MJ 110	1100 * 850	100 - 200	100 - 300	132	33000
MJ 130	1300 * 1000	125 - 250	275 - 600	160	43000
MJ 110C	1070 * 770	75 - 210	135 - 340	110	19000
MJ 120C	1200 * 870	70 - 175	175 - 595	160	27990
MJ 150C	1400 * 1200	125 - 250	340 - 970	200	50950
MJS 90	900 * 200	25 - 75	10 - 80	30	6000
MJS 110	1100 * 350	25 - 100	40 - 200	75	11000

Capacities According to Jaw Opening for MEKA Primary and Secondary Jaw Crushers

CAPACITIES ACCORDING TO JAW OPENING FOR MEKA PRIMARY JAW CRUSHERS, mtph

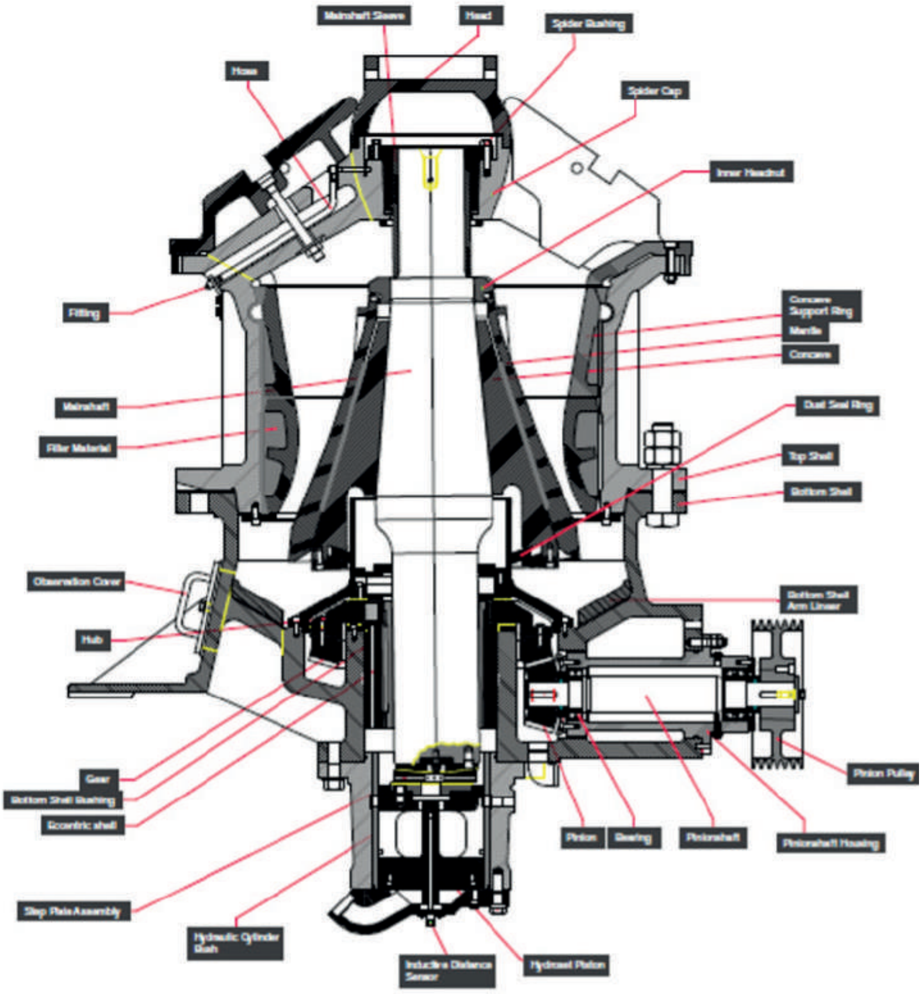
OPENING mm	**CRUSHER MODEL**							
	MJ 60	*MJ 70*	*MJ 90*	*MJ 110*	*MJ 130*	*MJ 110C*	*MJ 120C*	*MJ 150C*
40	*20-33*	*25-38*						
50	*24-38*	*28-42*						
60	*30-45*	*35-55*	*50-78*					
70	*36-52*	*40-65*	*60-80*				*175-240*	
80	*42-60*	*50-75*	*65-90*			*145-170*	*195-270*	
90	*48-68*	*65-85*	*72-100*			*175-185*	*210-305*	
100	*55-75*	*70-100*	*78-110*	*100-125*		*190-205*	*235-325*	
125	*60-85*		*90-130*	*140-175*	*275-330*	*235-260*	*285-395*	*340-470*
150	*80-110*		*105-160*	*175-220*	*325-390*	*275-310*	*340-475*	*400-555*
175			*135-200*	*210-265*	*370-445*	*325-360*	*385-540*	*460-635*
200			*175-240*	*250-310*	*415-500*	*365-390*		*520-720*
250					*510-610*			*640-880*

CAPACITIES ACCORDING TO JAW OPENING FOR MEKA SECONDERY JAW CRUSHERS, mtph

JAW OPENING mm	CRUSHER MODEL	
	MJS 90	*MJS 110*
20	*9-16*	*30-50*
25	*13-22*	*40-60*
30	*12-28*	*50-75*
40	*20-40*	*75-100*
50	*32-44*	*80-125*
60	*40-59*	*95-150*
70	*50-65*	*110-175*
80	*56-75*	*125-200*

4.2. Cone Crushers (MCH and MCS Series)

Cone crushers are used in the aggregate industry particularly for the secondary crushing of various ores in the mining sector, especially for volcanic and metamorphic rocks with high SiO2 content such as basalt, granite, and quartzite. A cross-section of a cone crusher and its main components is shown below.



Components of Hydrocone Type Cone Crushers

Capacity and Power in Cone Crushers
Gauldie's Formula for Gyration Speed:
N ≥ 665 (Sinα -μCosα) / d0,5
N: Gyration speed, revolutions per minute
μ: Coefficient of friction between the material and the crushing cone or concave, typically ranging between 0.2 and 0.3.
d: Maximum product size, cm
α: Angle of the crushing cone surface with the horizontal"

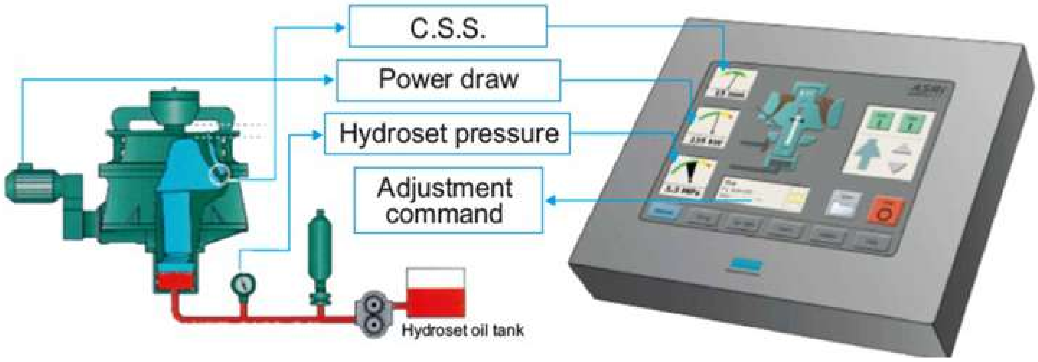
Capacity Formula for Cone Crushers
Rose and English Capacity Formula:
Q = { [Wi x D x ρS x (LMAX + L MİN)0.5] / [2 x (R / R-1)0.5] } x (LMAX + L MİN) x K
Q: Capacity, t/h
Wİ : Bond Work Index, kWh/ton
D: Diameter of the bowl (fixed crusher jaw group), cm
LMAX : Open-side setting value (OSS), m
LMİN: Closed-side setting value (CSS), m
R: Reduction ratio
K: Statistical factor
ρS: Specific gravity of the crushed material
For soft materials such as coal and coke, ***K*** is taken as 0.5, while for hard materials like quartz and granite, ***K*** is taken as 1.
Cone Crusher Power Formula
To calculate power loss in cone crushers, the Bond Work Index (***Wi***) of the material to be crushed and the capacity (Q) of the crusher must be known.

Power
P = Wİ x Q x [1- (P80/ F80)0.5] x (100/P80)0.5
P = Power, kW
Wi = Bond Work Index, kWh/t
Q = Capacity, t/h
F80: The particle size at which 80% of the ore carrying the attribute assigned to you has passed, in microns.
P80: Particle size at which 80% of the product has passed, in microns

MEKA gives great importance to the production of cone crushers, which play a crucial role in crushing of volcanic and metamorphic rocks and important ores. Presently, MEKA's portfolio includes three crucial cone crushers: MCH 900, MCH 1150, and MCS 900. MEKA continues to enhance this portfolio.

The main shaft is manufactured from quench and tempered steels such as SAE/AISI 4140 (DIN 42CrMo4) or SAE/AISI 4340 (DIN 34CrNiMo6). The lower and upper housing are made from special alloy steel castings.

Eccentric bushing, lower housing bushing, eccentric wear plate, main shaft step, piston wear plate is manufactured from special alloy high leaded bronze. The material quality and manufacturing precision in these parts are crucial. MEKA takes great pride in prioritizing these precision requirements.



MEKA's cone crusher automation system continuously monitors the wear condition of crusher jaws, keeping the CSS value consistently at the same level. This ensures longer lifespan for the crusher jaws and stable product distribution.

The automation system also ensures the safety of the crusher. When foreign metallic material enters the crusher, the hydroset pressure increases. The pressure relief valve opens, allowing an increase in jaw opening and the removal of foreign material from the crushing area.

MEKA Cone Crusher Technical Specifications

Crusher Model	MCS900	MCH900	MCH1150
Capacity, mtph	60 - 214	60 - 165	80 - 340
Power, kW	110	110	200
Max. Feed Size, mm	160 - 240	85 - 130	80 - 210
Concave	EC, C, MC	EC, C, MC	EC, C, MC, MF
CSS, (Min-Max), mm	22 - 38	13 - 35	13 - 44
Eccentric Range, mm	13 - 25	16 - 32	13 - 40
Weight, kg	14200	11200	18200

CRUSHER MODEL	Max feed size, mm		Revolutions/ minute		Motor power KW	ECC Stroke KW	CSS mm							
	CSS	SH	ECC	Pinion	KW	mm	13	16	19	22	25	29	32	35
MCH 900 EC	80-100	130	355	1160	75	16			85	90	95	100	105	110
					90	19			100	110	115	120	125	130
					90	22					135	140	145	150
					110	25					155	160	165	
					110	29						180	185	
MCH 900 C	70-80	110	355	1160	75	16		80	85	85	90	95	100	
					90	19		95	100	105	110	115	120	
					90	22				125	130	135	140	
					110	25				140	145	150		
					110	29					180	165		
MCH 900 MC	60-70	85	355	1160	55	16	60	70	75	80	85			
					75	19	70	80	90	100	105			
					75	22		90	100	110	125			
					90	25		100	106	115	135			
					110	29		110	115	125				
					110	32				135				

MCS 900 MEKA Cone Crusher Capacity Values. Capacities are for a bulk density of 1.6 t/m3

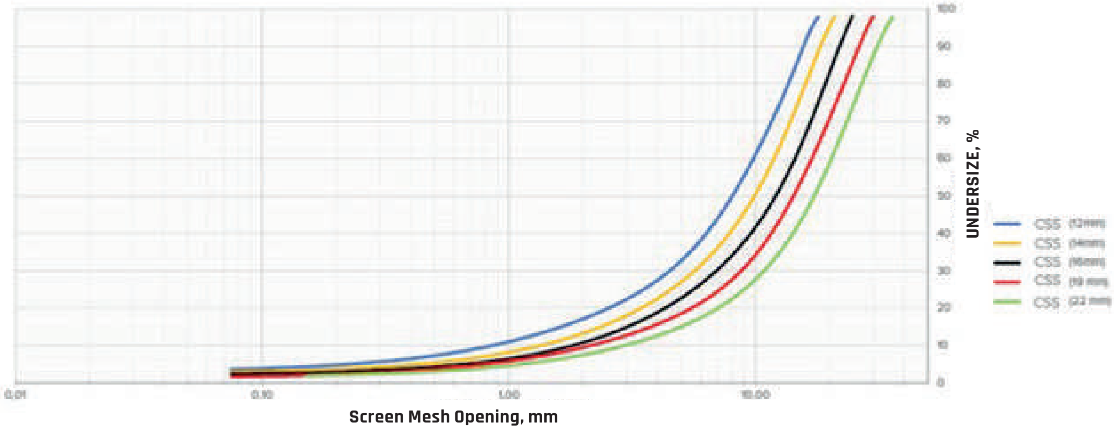
CRUSHER MODEL	Motor power KW	Crushing chamber type	Max feed size, mm	Ton/hour capacities depending on CSS (mm)				
				38	42	46	50	55
MCS 900	90-110	EC	240				175	195
	90-110	C	200			155	165	
	90-110	M	160		120	150		

MCS 900 MEKA Cone Crusher Capacity Values. Capacities are for a bulk density of 1.6 t/m3

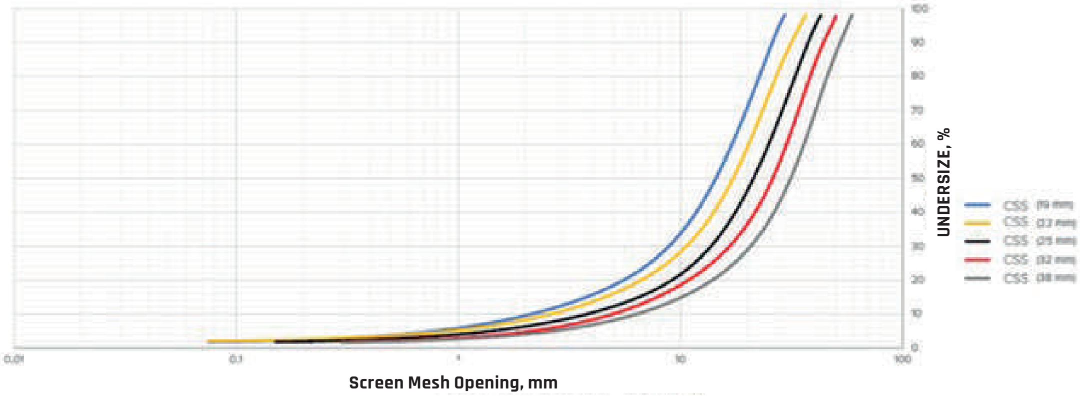
CRUSHER MODEL	Motor power KW	Crushing chamber type	Max feed size, mm	Ton/hour capacities depending on CSS (mm)											
				10	13	16	19	22	25	29	32	35	38	41	44
MCH 1150	200	EC	215			80-190	90-260	95-280	100-290	110-310	120-340	130-340	135-350	140-320	150-300
	200	C	175		70-120	80-230	90-260	100-280	110-300	120-320	125-340	130-300	140-280	150-220	155-190
	200	MC	140		75-175	80-250	85-260	90-280	95-320	110-340	120-300	130-280	140-220	150-190	
	200	MF	85	50-120	55-200	60-210	65-220	70-235	75-250	105-240	110-230	120-180	125-160		

MCS 1150 MEKA Cone Crusher Capacity Values. Capacities are for a bulk density of 1.6 t/m3

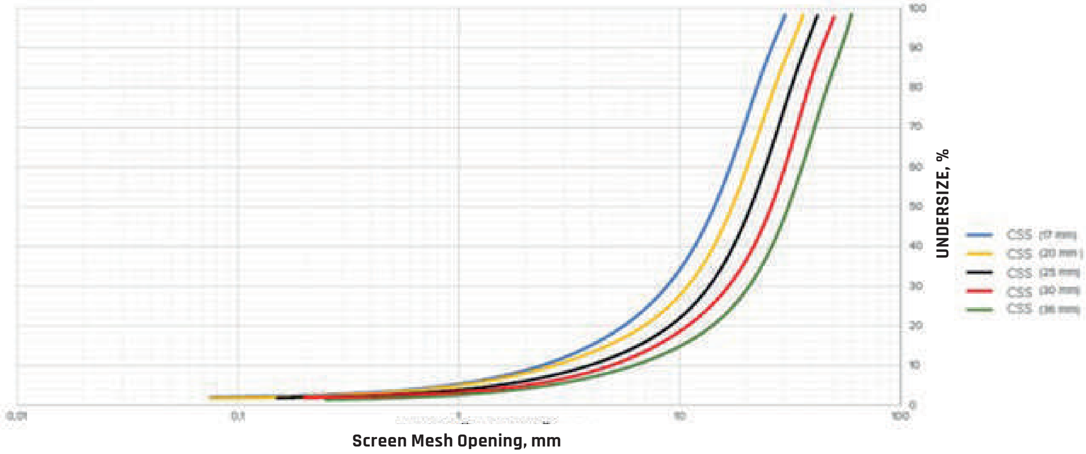
MCS 1150 MF Crusher Product Curve



MCS 1150 MC Crusher Product Curve

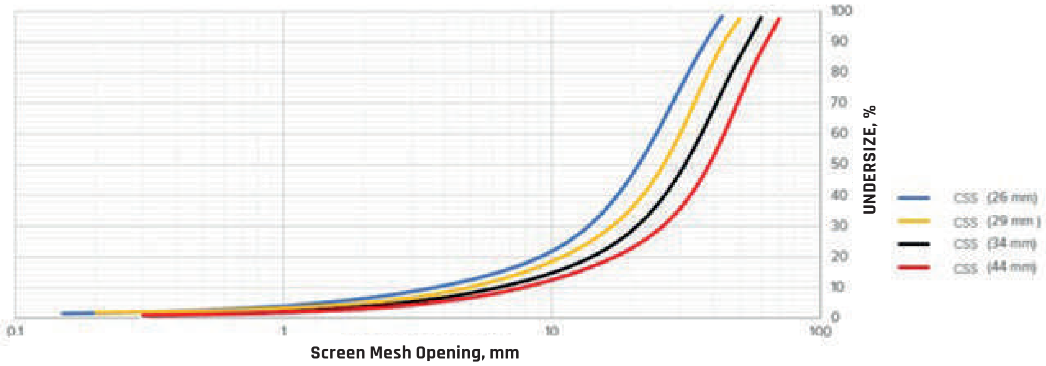


MCS 1150 C Crusher Product Curve



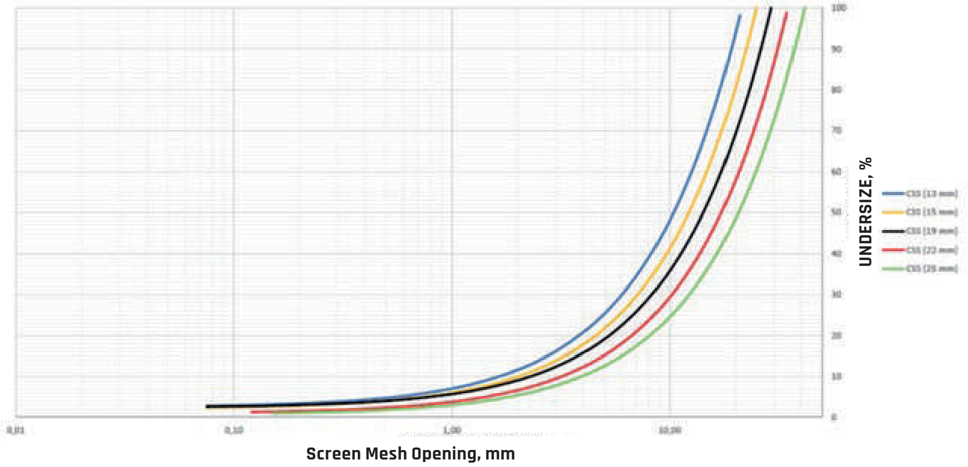
MEKA

MCS MF EC Crusher product Curve

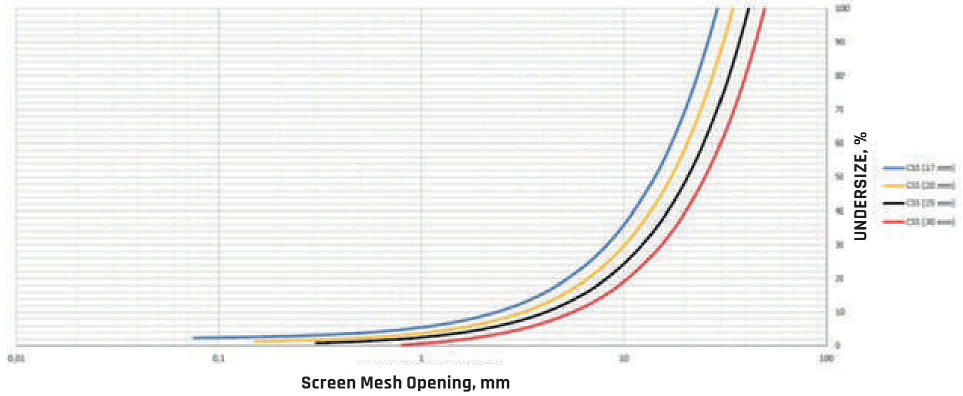


MEKA MCH 1150 cone crusher product curves based on crushing type

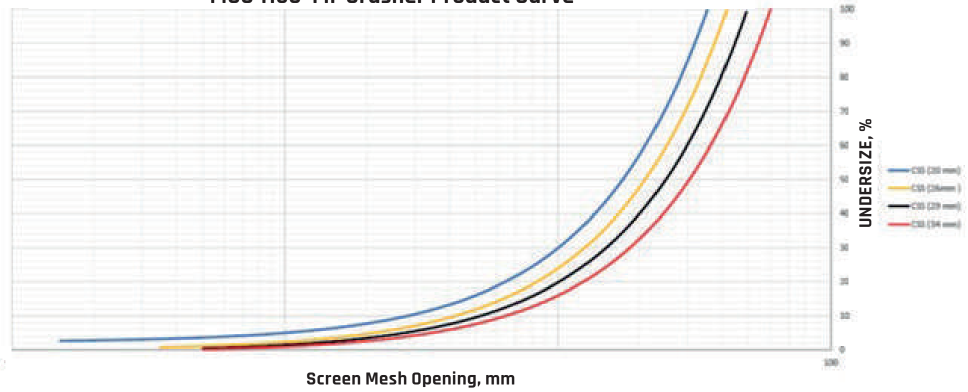
MCS 900 MC Crusher Product Curve



MCS 900 C Crusher Product Curve



MCS 1150 MF Crusher Product Curve



MEKA MCH 900 cone crusher product curves based on crushing type

4.3. HORIZONTAL SHAFT IMPACT CRUSHERS

MEKA horizontal shaft impact crushers convey a significant portion of the kinetic energy from the blow bars on the rotor spinning at a minimum speed of 27 m/s to the material entering the crusher through the feed inlet. This results in the creation of internal stresses in the material, causing it to break.

MEKA's horizontal shaft impact crushers are available in primary, secondary, and tertiary types. A rotor with a high moment of inertia has at least 4 crusher hammers attached to it. These blow bars are made of high Mn steel (16-18% Mn, 1.5-2.5% Cr) austenitic cast steel (Hadfield steel) or high-chromium white cast iron containing 15-22% Cr for more abrasive materials. The blow bars are connected to the rotor through a bolted and cam system, allowing for easy removal and installation. On the opposite side of the rotor, there are at least 2, sometimes 3, crushing plates connected to the main body via hinged joints, also made of Hadfield steel. These plates can be easily attached and detached using a bolted system designed for heavy-duty breaker plates.

The gap between the crushing plates and rotor blow bars is adjusted by a spring-loaded mechanical or hydraulic system. This allows for easy modification of the gradation distribution of the product discharged from the crusher.

MEKA primary horizontal shaft impact crushers are capable of crushing materials up to 1000-1200 mm in size. They have a heavier-duty rotor and body compared to secondary types. MEKA secondary horizontal shaft impact crushers, on the other hand, can crush materials up to around 500-600 mm and have a relatively lighter-duty rotor and body compared to primary impact crushers.

Crusher Types	Reduction Ratios
Jaw Crusher	*2-3*
Primary Gyratory Crusher	*3-4*
Cone Crusher	*3-5*
HSI (Horizontal Shaft Impact) Crusher	*7-10*
VSI (Vertical Shaft Impact) Crusher	*4-6*

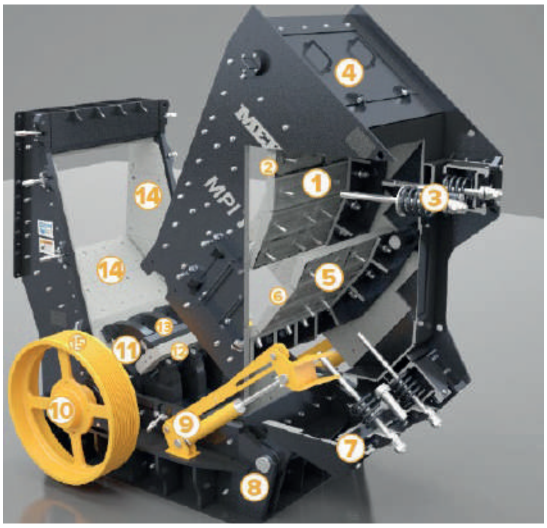
Size Reduction Ratios Based on Crusher Types

The most significant advantage of impact crushers is their high Reduction Ratio (RR), which is the ratio of the size reduction compared to pressure crushers. This can be seen in the table below.

Another important advantage of MEKA impact crushers is that the product is cubic and free from internal stresses. This feature is a significant preference for using the product obtained from impact crushers in concrete and road aggregates.

4.4. MEKA PRIMARY IMPACT CRUSHERS (MPI SERIES)

The rotor of the MEKA Primary Impact Crusher is the most crucial component in the crushing process, forming the core of the crusher along with the main shaft, bearings, and housing. Considering the impact and stresses generated by a rock mass with a volume of up to $1m^3$, the rotor is designed with a highly rigid and robust structure. It is manufactured as a complete steel casting with heavy-duty type discs. The main shaft is made of forged steel alloy, either SAE 4140 or SAE 4340. The bearings used are of the highest quality, being double-row spherical roller types.



PART NUMBER	COMPONENTS
1	First Breaker Plate
2	Liners
3	Breaker Plate Adjustment Cylinder
4	Access Door
5	Second Breaker Plate
6	Liners
7	Breaker Plate Adjustment Mechanism
8	Body Hinge
9	Hydraulic Cylinder and Safety Arm
10	Rotor Shaft
11	Rotor
12	Blow Bar
13	Blow Bar Locking Wedge
14	Liners
15	Drive Pulley

Heavy-duty blow bars (16-18% Mn, 1.5-2.5% Cr) are manufactured from austenitic cast steel (Hadfield steel) and are attached to the crusher rotor with a simple, cam system. The crusher body is made of low-carbon structural steel. The crushing chamber is coated with wear-resistant steel cast liners made of high manganese (12-16% Mn). These liners are attached to the body plate with bolts and can be easily replaced.

Sensors in the body prevent operation during maintenance procedures, ensuring safe procedures.

The upper part that carries the crusher's breaker plates and adjustment systems is hinged to the upper body. For easy maintenance, the upper body can be tilted by two heavy-duty hydraulic cylinders and secured with a mechanical arm.

The crusher has two breaker plates, and it is designed to accommodate an additional third breaker plate when needed. A hydraulic-assisted mechanical-spring modular adjustment mechanism is used for gap adjustment between the breaker plates and the rotor. The springs protect against stress on the breaker plates, preventing excessive movement in the gap during operation and maintaining stability in production.

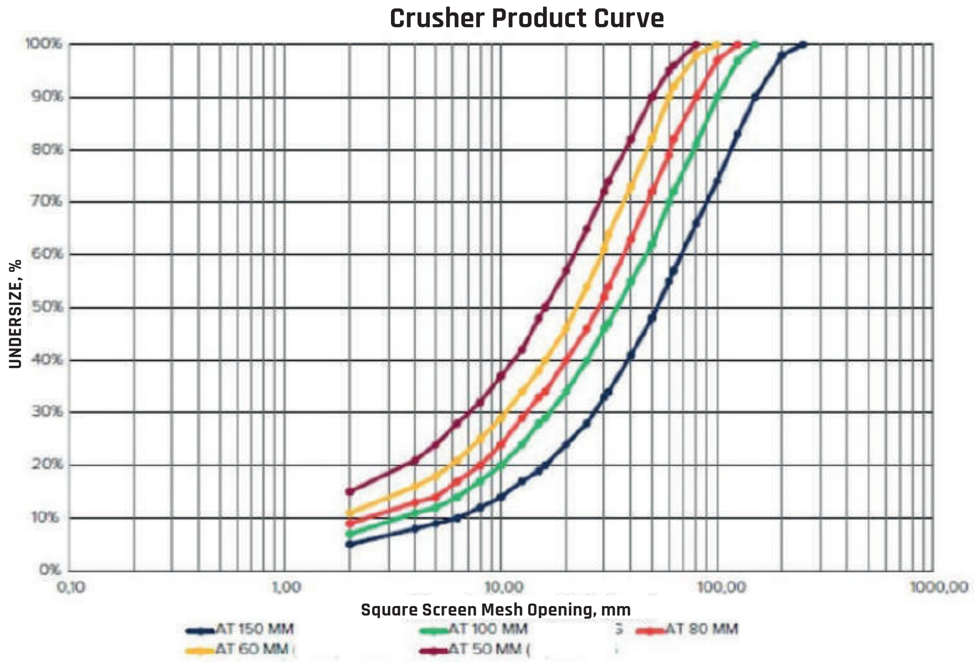
MEKA Primary Impact Crusher Technical Specifications are provided in the table below. The following considerations were considered while preparing this table:

- Minimum capacities are for a feed size of 800 mm and a product size of 100 mm.
- Maximum capacities are for a feed size of 600 mm and a product size of 200 mm.
- Capacities are for a bulk density of 1.6 t/m□.
- Weights do not include the motor group, support legs, and maintenance platform.

CRUSHER TECHNICAL SPECIFICATIONS	**PRIMARY IMPACT CRUSHER MODEL**				
	MPI 1111	*MPI 1114*	*MPI 1313*	*MPI 1515*	*MPI 1620*
Rotor Dimensions Diameter * Length mm x mm	*1100 * 1070*	*1100 * 1400*	*1300 * 1300*	*1500 * 1500*	*1600 * 2000*
Feed Opening mm * mm	*1110 * 924*	*1000 * 1400*	*1320 * 1200*	*1540 * 1360*	*2040 * 1630*
Maximum Feed Size mm	*600*	*600*	*900*	*1000*	*1300*
Motor Power kW	*160*	*200*	*250*	*315*	*500*
Capacity mtph	*150 - 200*	*250 - 350*	*300 - 500*	*400 - 600*	*600 - 950*
Weight kg	*15100*	*16800*	*22400*	*26800*	*40500*

MEKA Primary Impact Crusher Technical Specifications

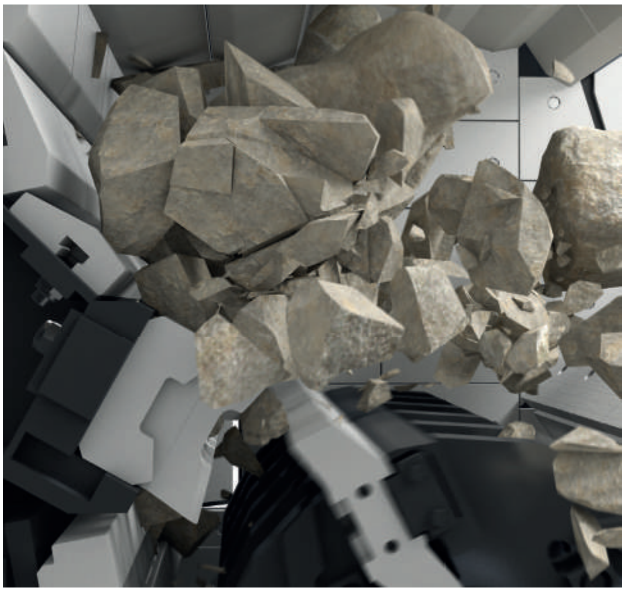
The product curves for Meka Primary Impact Crushers, arranged according to different rotor clearances, are provided in the graph below.



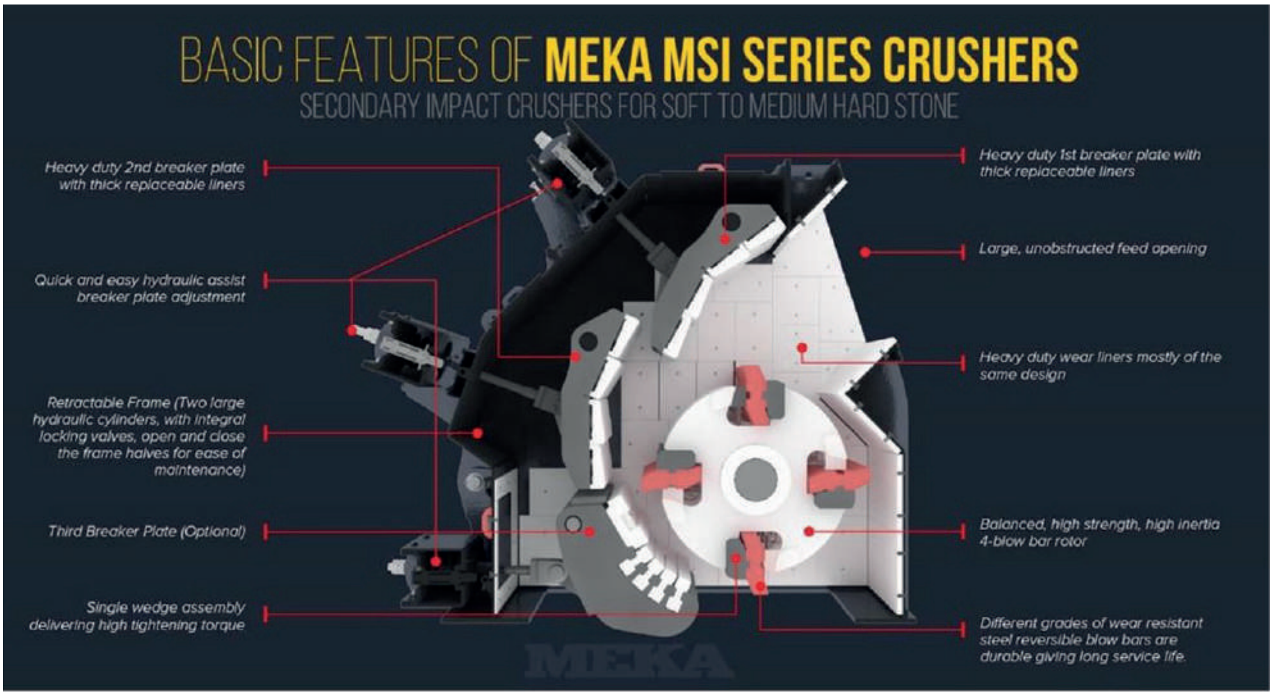
/Product curve of Meka Primary Impact Crusher

4.5. MEKA SECONDARY IMPACT CRUSHERS (MSI Series)

MEKA MSI series secondary impact crushers are typically secondary impact crushers used to crush materials with low or medium hardness, producing products in the range of 0-80 mm. On the other hand, the MEKA MSIH series crushers are designed for medium or hard materials, and with the help of three-stage crushing plates, a product of 0-50 mm can be obtained in a single pass.



Meka MSI ve MSIH serisi sekonder darbeli kırıcılar.



MEKA MSI series secondary impact crushers have a main body made of high-yield strength material, featuring a sufficiently reinforced structure. The body consists of upper and lower bodies connected to each other by hinged joints. The body, to which the first and second crushing plates are attached, can be tilted with heavy-duty hydraulic cylinders. This facilitates maintenance and allows for easy replacement of blow bars and crushing plate liners. The portions of the body in contact with material are covered with crushing liners, most of which are of the same dimensions with a thickness of 30 mm.

The rotor of MEKA MSI series secondary impact crushers is stress-relieved, dynamically balanced with a high moment of inertia. The discs are made of cast steel and are thick, welded to a specially alloyed tube by skilled welders, and subjected to stress relief annealing after welding.

The main shaft is made of forged steel alloy, either SAE 4140 or SAE 4340. The bearings are of the highest quality, being double-row spherical roller bearings.

Heavy-duty blow bars (16-18% Mn, 1.5-2.5% Cr) are made of austenitic cast steel (Hadfield steel) and are attached to the crusher rotor with a simple cam system.

MEKA MSI Type Secondary Impact Crusher Rotor

The first and second crushing plates of MEKA MSI series secondary impact crushers are connected to the upper body from their upper sides and can be easily adjusted for crusher opening with a hydraulic-assisted mechanical system attached to their lower sides. The crushing liners, made of high-manganese Hadfield steel and attached to the crushing plates, are considerably thick and designed for easy replacement.

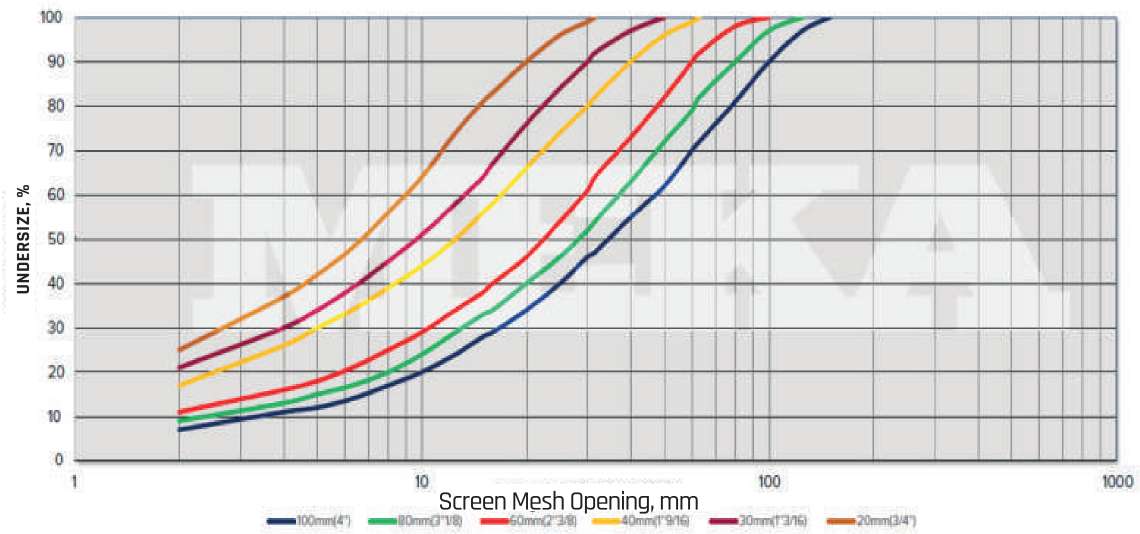
When finer material is required, a third crushing plate, hinged to the lower body, is added. In this group, grinding grates made of special pass-through high-manganese austenitic cast steel are used. This significantly increases the crusher's reduction ratio.

MEKA MSI Series Secondary Impact Crusher Technical Specifications are provided in the table below.

- Capacities are for a bulk density of 1.6 t/m³.
- Weights do not include the motor group, support legs, and maintenance platform.

CRUSHER TECHNICAL SPECIFICATIONS	*MSI 1210*	*MSI 1312*	*MSI 1315*
Rotor Dimensions Diameter * Length mm x mm	*1150 * 1000*	*1300 * 1250*	*1300 * 1500*
Feed Opening mm * mm	*1080 * 825*	*1310 * 800*	*1510 * 800*
Maximum Feed Size mm	*250*	*350*	*350*
Motor Power kW	*132 - 160*	*200*	*250 - 315*
Capacity mtph	*100 - 150*	*150 - 250*	*250 - 350*
Weight kg	*12400*	*18000*	*22600*

MEKA MSI Series Secondary Impact Crusher Technical Specifications

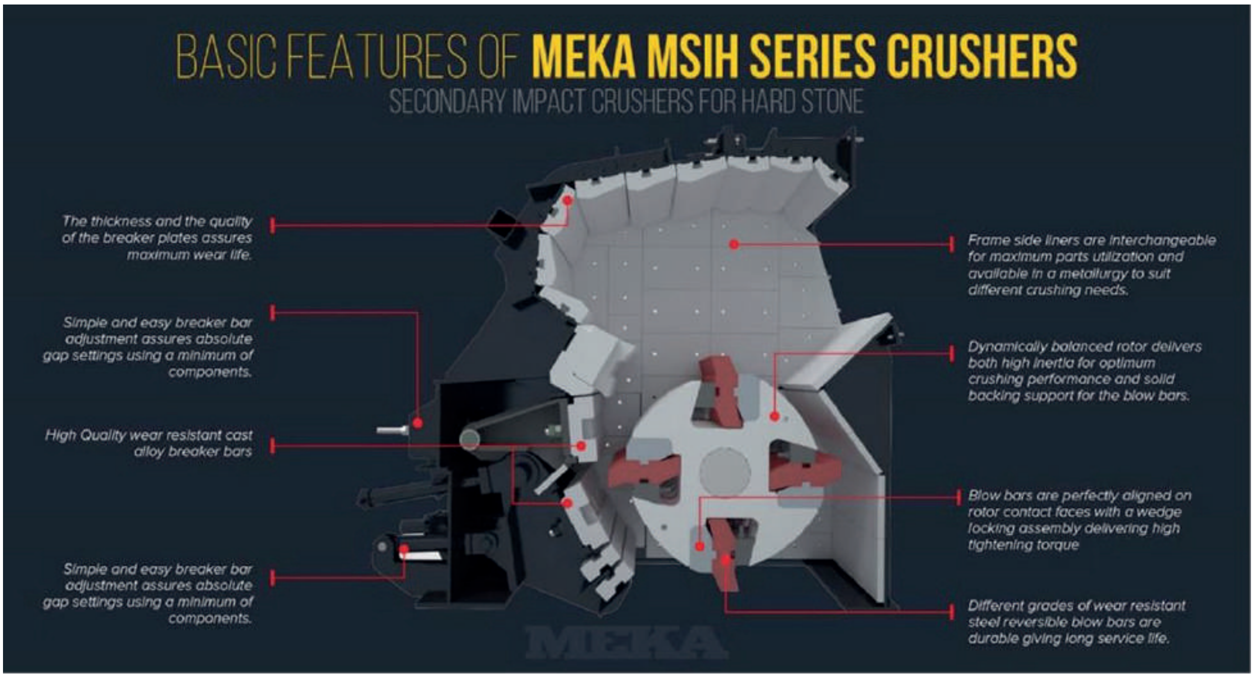


Meka MSI Series Secondary Impact Crusher Product Curve.

4.6. MEKA SECONDARY IMPACT CRUSHERS (MSIH Series)

MEKA MSIH crushers are specifically designed to crush hard and abrasive rocks. Therefore they have highly reinforced and rigid body structures.

Crusher blow bars, crushing plates, and grinding grates are made of special white cast iron containing 15-22% Cr, and their wear resistance is significantly higher than high Mn Hadfield steel.



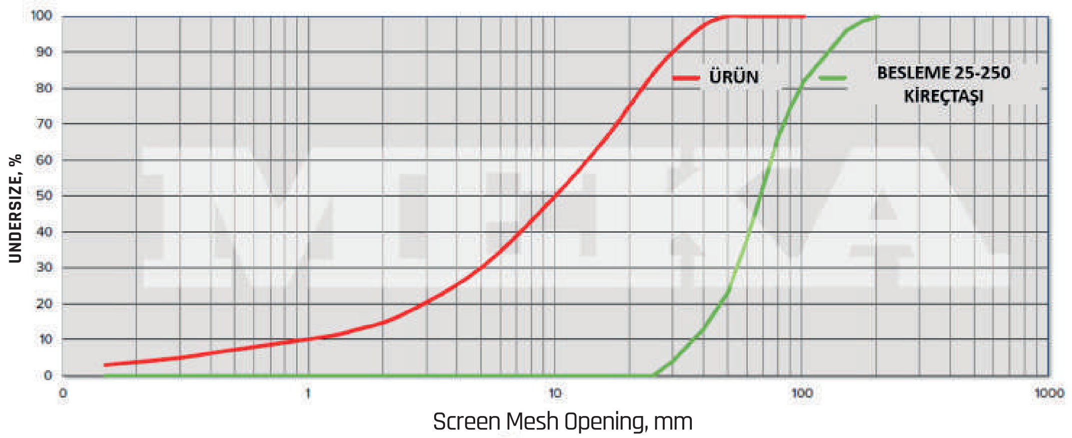
The Main Components of the Meka MSIH Series Secondary Crushers

MEKA MSIH Series secondary impact crushers' technical specifications are provided in the table below.

- Capacities are for 1.6 t/m^3 bulk density.
- Weights do not include the motor group, support legs, and maintenance platform.

TECHNICAL SPECIFICATIONS	MSI 1110H	MSI 1112H	MSI 1115H	MSI 1415H	MSH 1420H
Rotor Dimensions Diameter * Length mm x mm	1120 * 1000	1120 * 1200	1120 * 1500	1400 * 1500	1400 * 2000
Feed Opening mm * mm	1040 * 550	1320 * 550	1560 * 550	1530 * 1000	2030 * 1000
Maximum Feed Size mm	300	300	300	350	350
Motor Power kW	160	200	250 - 315	400	500
Capacity mtph	130 - 200	170 - 250	250 - 350	350 - 450	380 - 600
Weight kg	12280	14320	18800	28760	35000

Technical Specifications of MSIH Series Secondary Impact Crusher



Product Curve of Meka MSIH Series Secondary Impact Crusher

4.7. MEKA TERTIARY IMPACT CRUSHERS (MTI Series)

MEKA tertiary crushers are designed typically to crush the oversize aggregates from the secondary crusher output, as well as to break down the material on the top deck of the screen and the undesired amount of screened material. These crushers are symmetrically designed and feature a bi-directional operation. This allows utilizing both sides of the crusher blow bars evenly and, at the same time, flipping the blow bars to use the other side, ensuring a uniform wear. These crushers break the material through impact and friction.

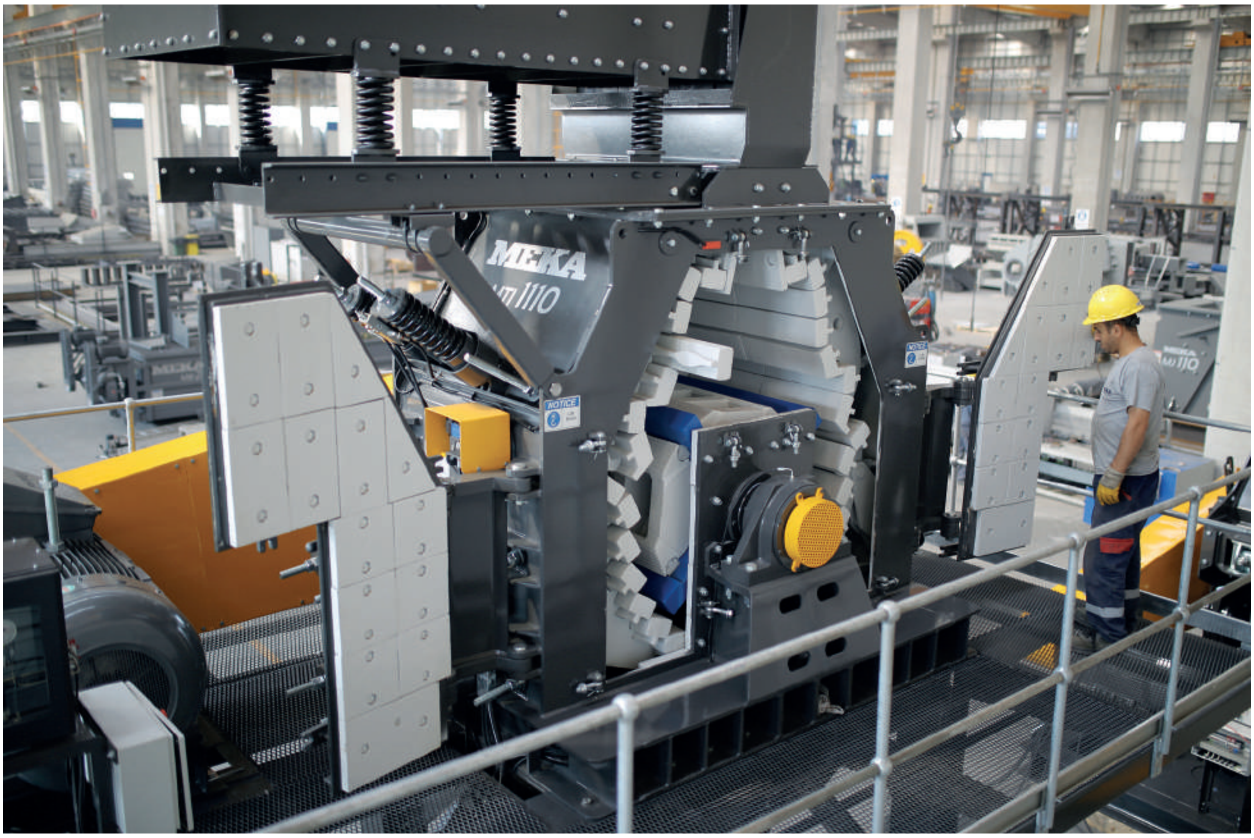
The gap between the crushing plates and the crusher blow bars is easily adjusted with a hydraulic-assisted, spring-loaded mechanical system.

The materials for the crusher blow bars and crushing plate liners are generally made of high Mn Hadfield steel based on the characteristics of the crushed material. Alternatively, they can be made from white cast iron with high Cr content for abrasive materials.

For easy maintenance and replacement of worn parts, the crusher is equipped with maintenance covers on both sides that can be easily opened manually in two pieces.

The heavy-duty bearings of the crusher are lubricated with an automatic lubrication system.

MEKA tertiary impact crushers are typically fed with a vibrating feeder placed beneath a small-volume surge bin to ensure the even distribution of the fed material along the width of the rotor. This approach promotes uniform wear in the crusher and enhances its crushing performance.



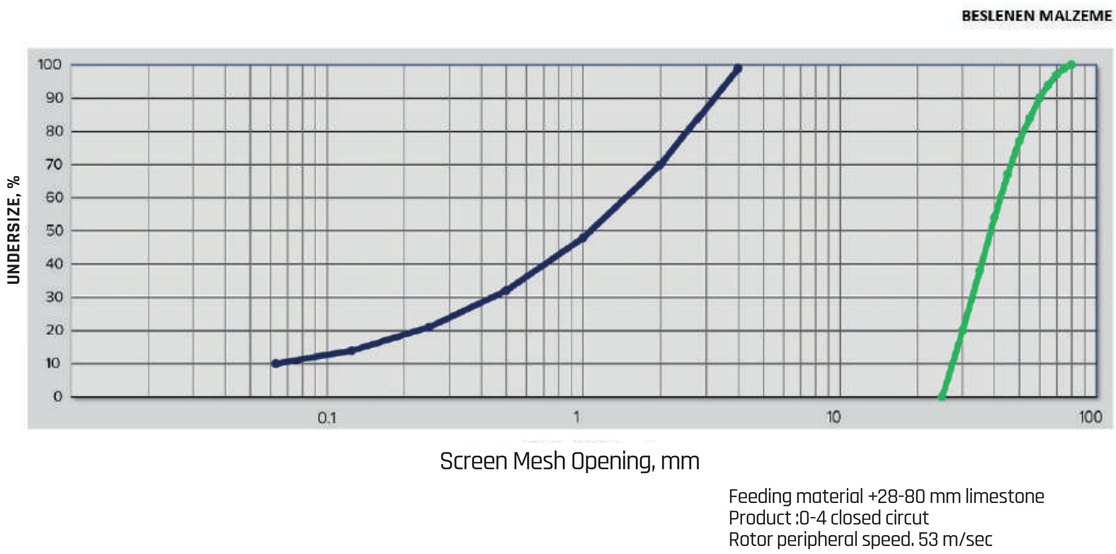
Feeding of MEKA Tertiary Impact Crusher with a Vibrating Feeder

The technical specifications of Meka Tertiary Impact Crushers are provided in the table below.

- Capacities are for a bulk density of 1.6 t/m3
- Weights do not include the motor group, legs, and maintenance platform.

TECHNICAL SPECIFICATIONS	MTI 1105	MTI 1110	MTI 1115	MTI 1307	MTI 1314
Rotor Dimensions Diameter * Length mm x mm	1100 * 500	1100 * 1000	1100 * 1500	1286 * 655	1286 * 1355
Feed Opening mm * mm	520 * 310	1020 * 310	1520 * 310	1040 * 550	1390 * 210
Maximum Feed Size mm	150	150	150	90	90
Motor Power kW	110	200 - 250	315	90 - 132	160 - 250
Capacity mtph	100 - 120	220 - 250	280 - 320	100 - 120	220 - 250
Weight kg	8750	14000	17470	8400	13480

The Technical Specifications of Meka Tertiary Impact Crushers

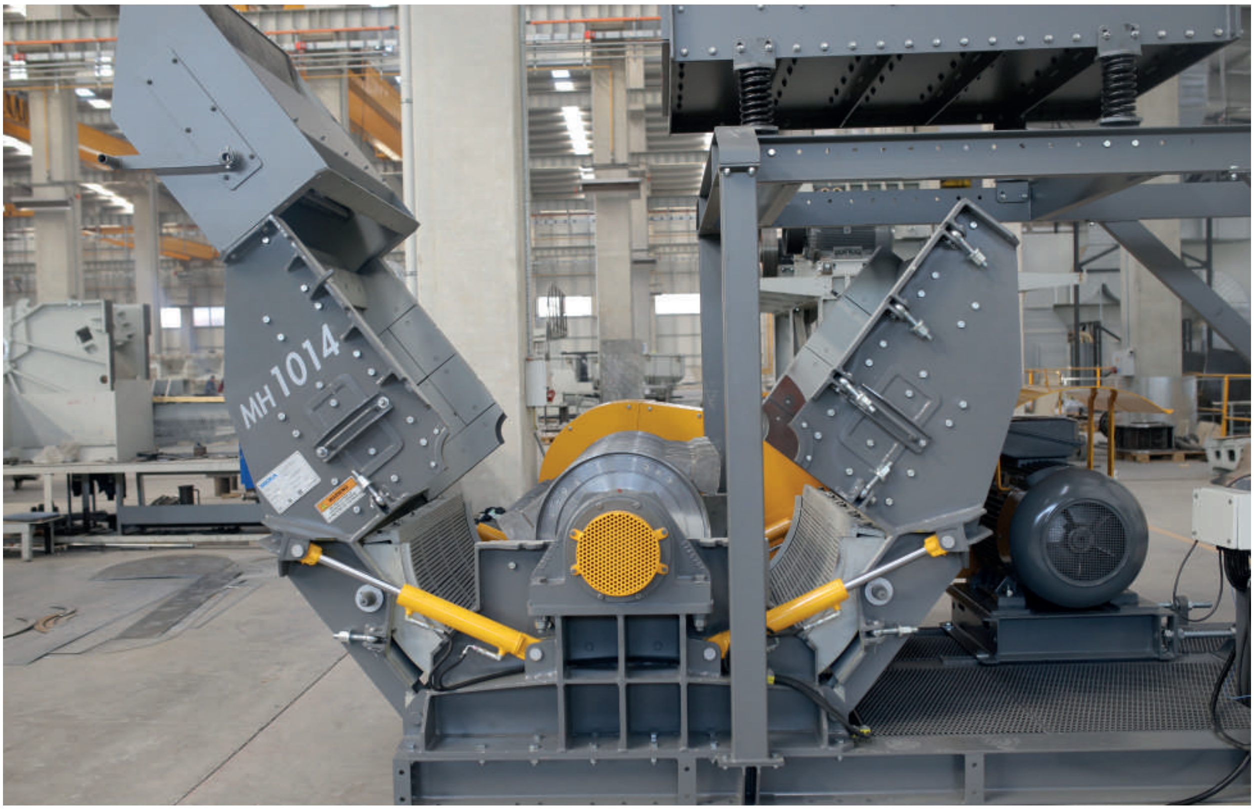


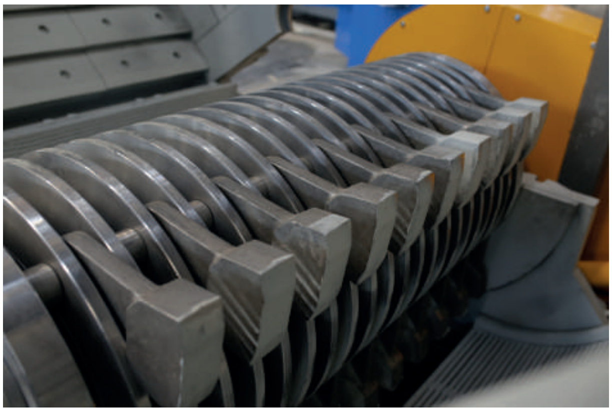
Product Curve of MEKA MTI Series Tertiary Impact Crushers

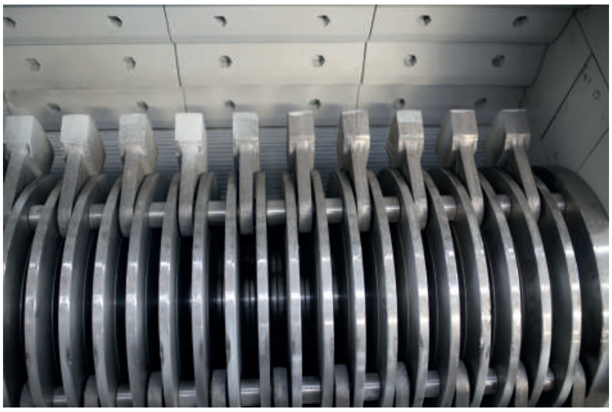
4.8. MEKA HAMMER CRUSHERS (MH Series)

MEKA hammer crushers are typically used for the tertiary crushing of soft or medium-hard materials. Grates are placed at various intervals at the crusher outlet, allowing sized material to be obtained without the need for screening the material discharged from the crusher.

In hammer crushers, instead of fixed hammers, hammers which are connected to a certain number of shafts with joints are used. These shafts are placed around the discs connected to the main shaft with cams.







Hammer crushers have a symmetrical structure, like tertiary impact crushers, and can rotate in both directions. This ensures uniform wear of crusher hammers and liners, providing longevity.

The crusher hammers, crushing liners, and grates are made of high Mn Hadfield steel. The parts of the crusher body in contact with the material are also covered with bolted high Mn liners.

The crusher body is designed in two parts, allowing these parts to be opened in both directions by hydraulic cylinders for easy maintenance.

MEKA hammer crushers are typically fed with a vibrating feeder placed beneath a small-volume surge bin to ensure the even distribution of the fed material along the width of the rotor. This approach ensures uniform wear in the crusher, enhancing its crushing performance.

The technical specifications of MEKA Hammer Crushers are provided in the table below.

- Capacities are for a bulk density of 1.6 t/m3
- Weights do not include the motor group, carrier legs, and maintenance platform.

TECHNICAL SPECIFICATIONS	MHC 1014	MHC 1214
Rotor Dimensions Diameter * Length mm x mm	1000 * 1400	1200 * 1400
Maximum Feed Size mm	125	200
Feed Opening mm * mm	1420 * 250	1420 * 410
Motor Power kW	90 - 132	132 - 160
Capacity mtph	50 - 100	100 - 170
Weight kg	7940	9690

MEKA Hammer Crushers Technical Specifications

4.9. MEKA VERTICAL SHAFT IMPACT CRUSHERS

Vertical shaft impact crushers are particularly used for the tertiary crushing of hard volcanic rocks such as basalt and granite. They are crucial crushers for producing fine material in the desired gradation and cubic structure in concrete and road aggregates.

MEKA's vertical shaft impact crushers are divided into two main groups.

- MV-G Series Vertical Shaft Impact Crushers
- MVI-L Series Vertical Shaft Impact Crushers

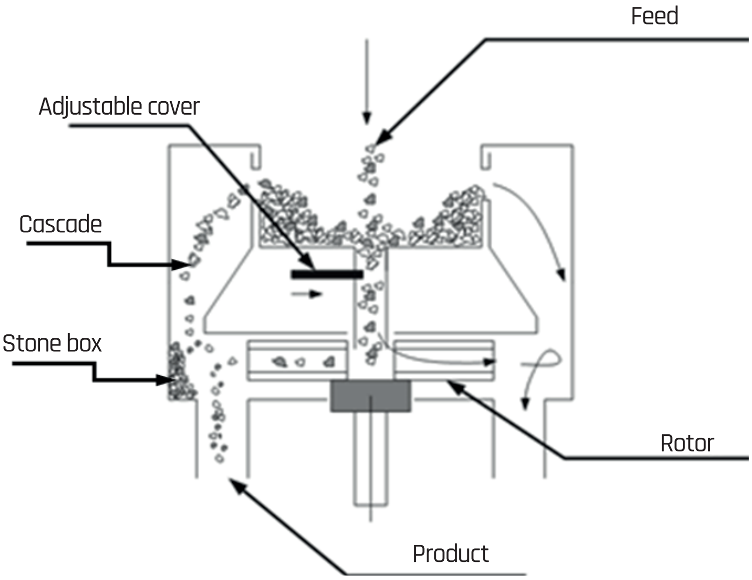
4.9.1. MEKA MVI-G SERIES VERTICAL SHAFT IMPACT CRUSHERS

MEKA MVI-G Series Vertical Shaft Impact Crushers are generally designed based on the closed rotor/stone box system, i.e., the ROR (Rock-on-Rock) and ROS (Rock-on-Steel) systems.

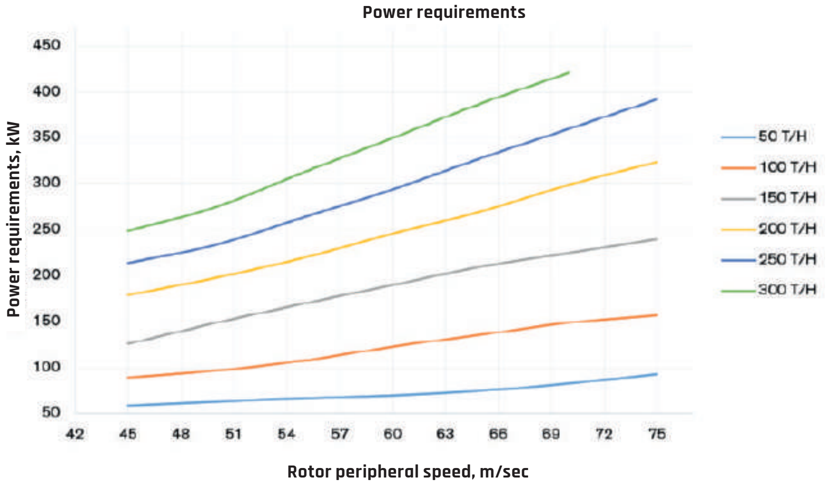
However, as with MVI-L Series Vertical Shaft Crushers, ROR (Rock-on-Rock) ROS (Rock-on-Steel) and (Steel-On-Steel) SOS systems can also be applied to these vertical shaft crushers. This application is detailed in the MVI-L Series Vertical Shaft Crushers section..

Most of the aggregates, up to a maximum size of 50 mm, are directed into the rotating rotor at high speed in the horizontal plane, while a smaller portion, whose quantity can be adjusted with a hydraulic cover, is directed to outside the rotor. The material passing through the rotor and gaining high-speed motion is directed to the stone box attached to the inner body in the horizontal plane. The material is crushed by impacting the stone box and the material passing outside the rotor. In these crushers, wear is minimal as the material breaks by impacting each other. Tungsten carbide rotor tips are placed in areas of the rotor where the material is thrown horizontally at high speed.

Similar to other tertiary impact crushers, to achieve the desired performance from vertical shaft crushers, it is necessary to feed them with a vibro feeder placed under a small surge bin.



The operating principle of Meka MVI series vertical shaft impact crushers



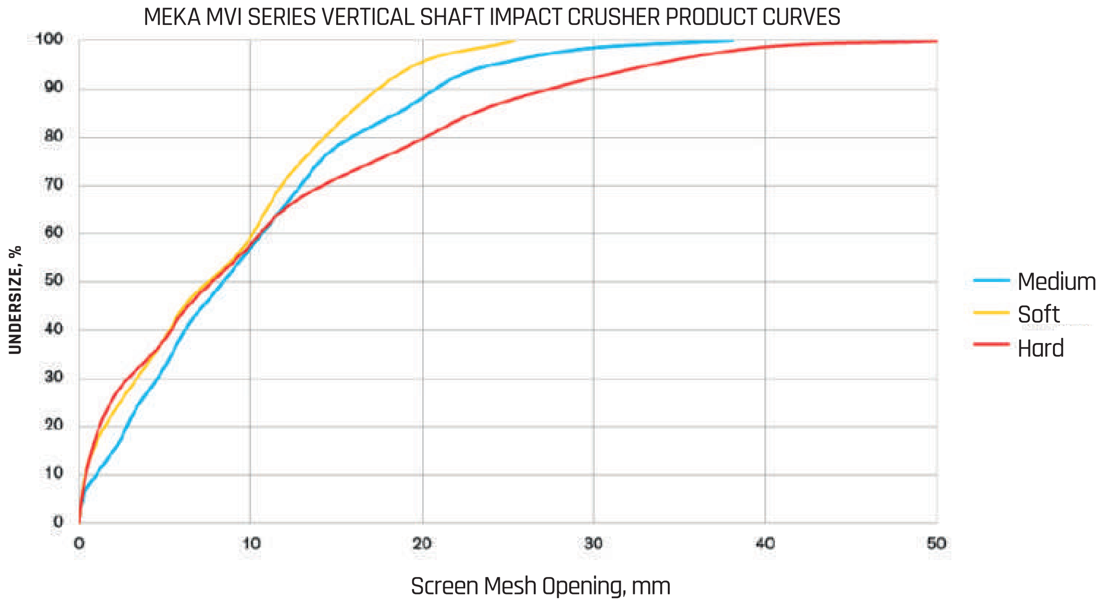
Power requirements in Meka MVI series vertical shaft impact crushers

The technical specifications of MEKA MVI Series Vertical Shaft Impact Crushers are given in the table below.

- Capacities are for 1.6 t/m3 bulk density.
- Weights do not include the motor group, carrier legs, and maintenance platform.

CRUSHER MODEL	Maximum Feed Size mm	Capacity mtph	Motor Power kW	Weight kg
MVI 90L (ROR SD)	50	200	200 - 250	10160 – 10525
MVI 90L (ROR DD)	50	300	2 * 110 - 160	11730 – 11930
MVI 90L (ROS SD)	50	250	200 - 250	12000 – 12370
MVI 90L (ROS DD)	50	300	2 * 110 – 160	13580 – 13775
MVI 90L (SOS SD)	75	250	200 – 250	12500 – 12865
MVI 90L (SOS DD)	75	400	2 * 200	15095
MVI 90G (ROR SD)	50	200	200 – 250	9180 – 9540
MVI 90G (ROR DD)	50	300	2 * 110 – 200	11090 – 11550
MVI 90G (ROS SD)	50	200	200 – 250	11660 – 12060
MVI 90G (ROS DD)	50	300	2 * 110 – 200	13240 – 14060
MVI 70G (ROR SD)	35	120	110 – 160	5595 – 5695
MVI 70G (ROR DD)	35	160	2 * 110	7100
MVI 70G (ROS SD)	35	120	110 – 160	7020 – 7120
MVI 70G (ROS DD)	35	160	2 * 110	8525

Technical Specifications of MEKA MVI Series Vertical Shaft Impact Crushers

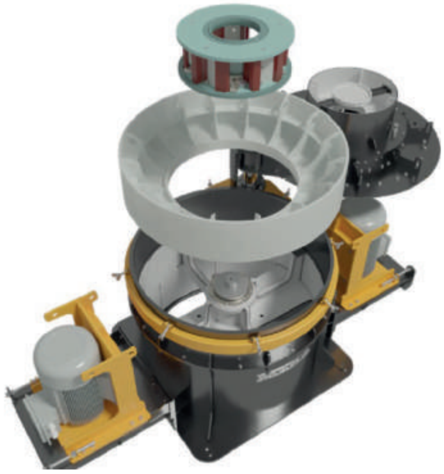


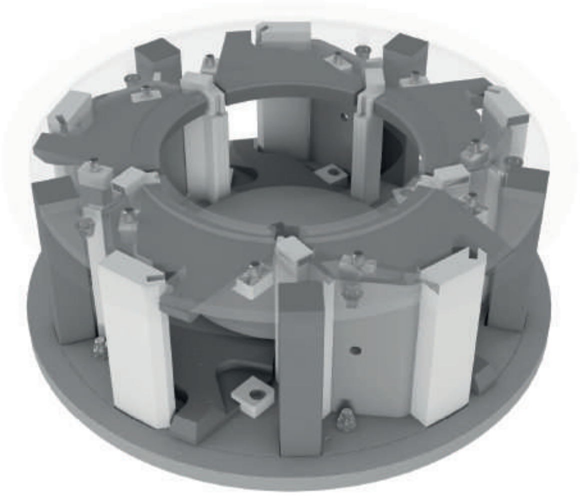
Meka MVI Series Vertical Shaft Impact Crushers Product Curve (For ROR Application)

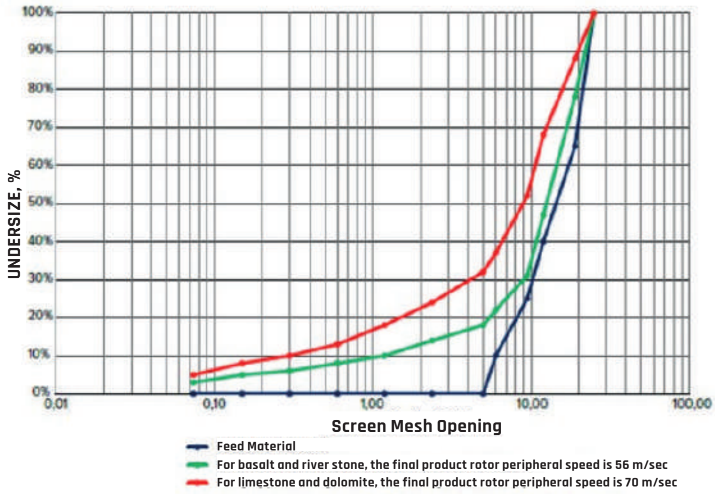
4.9.2. MEKA MVI-L SERIES VERTICAL SHAFT IMPACT CRUSHERS

- These crushers can be easily configured in three different setups according to the desired product gradation and the type of material being crushed. These setups are:
    - ROR Closed rotor, stone box
    - ROS Closed rotor, anvil ring
    - SOS Open rotor, anvil ring
- The top cover and feed chute can be easily lifted and rotated with a hydraulic system, providing easy maintenance and quick replacement of wear parts.
- Low energy and wear costs.
- Provide high cubicity to the product.
- Eliminate soft stones.
- The product curve is stable.
- High capacities.
- Product curves obtained from MVI-L series vertical shaft impact crushers, depending on the application, are provided below.

ROR - Closed Rotor/Stone Box APPLICATION

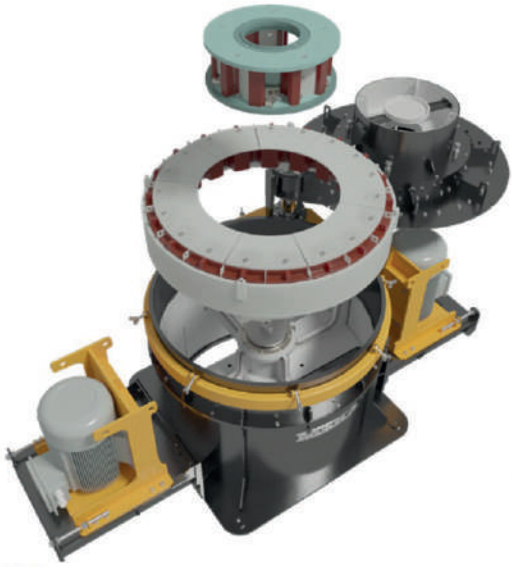


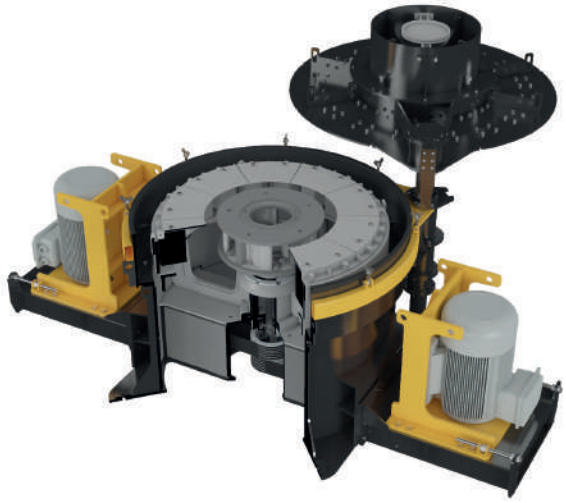


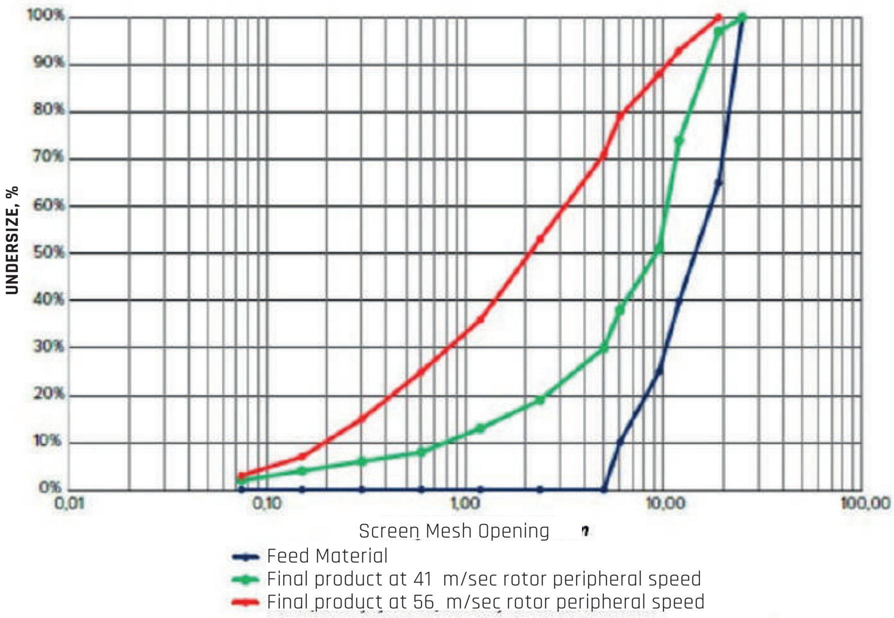


Product Curves for ROR Application

ROS - Closed Rotor/Anvil Ring APPLICATION

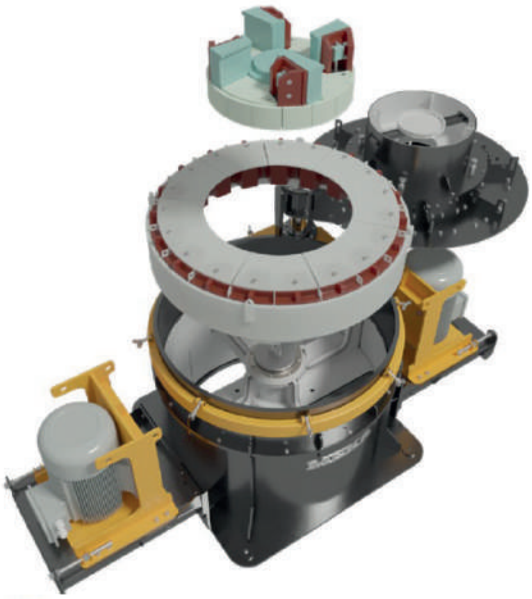


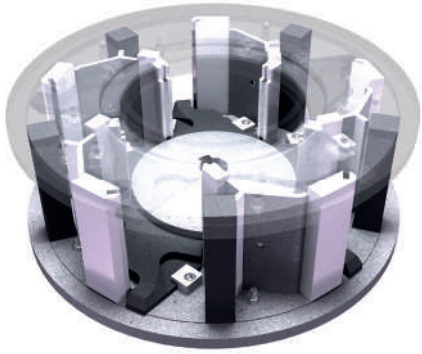


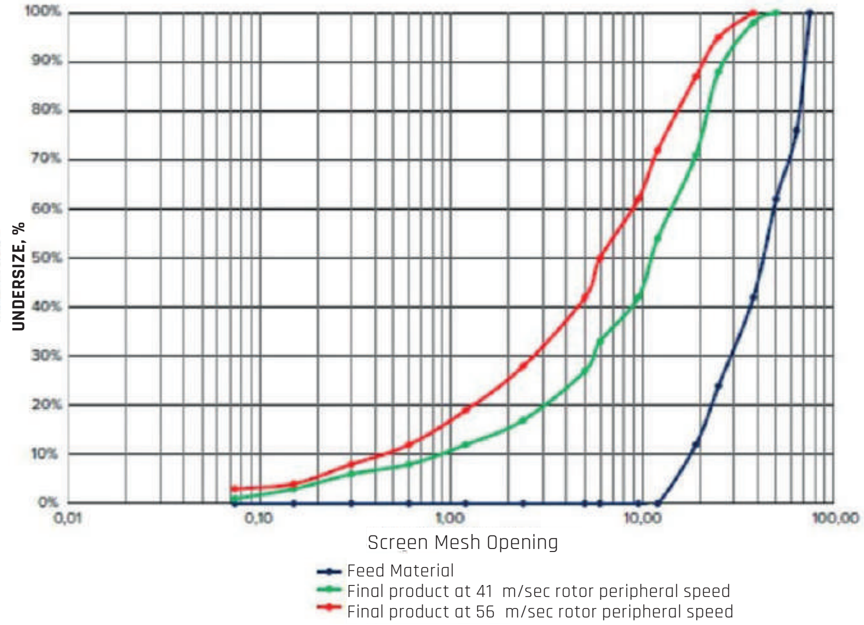


Product Curves for ROR Application

SOS - Open Rotor/Anvil Ring APPLICATION

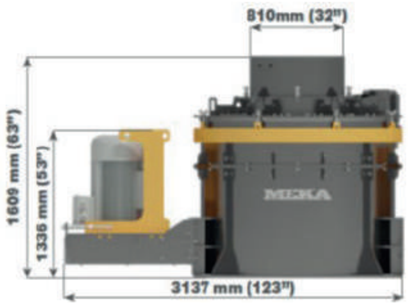


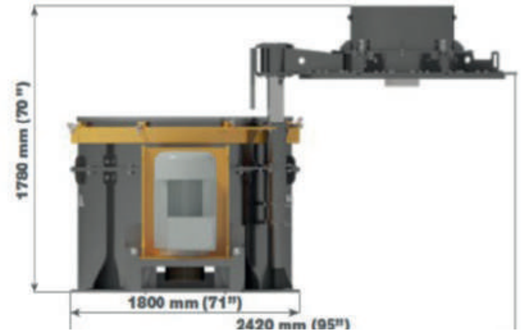




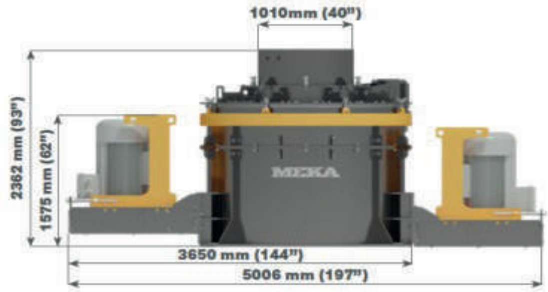
SOS Application Product Curves (Material: Dolomite, Feed Size: 12 - 75 mm)

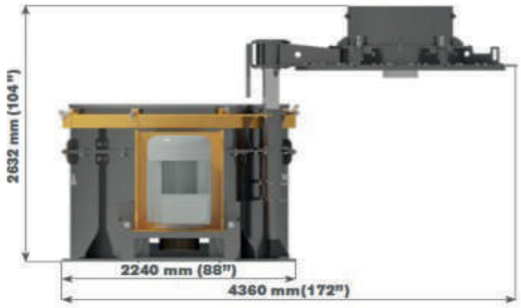
General dimensions for MEKA MVI-L Series MVI-L-65 and MVI-L-90 Vertical Shaft Impact Crushers and technical specifications for the MVI-L-90 type vertical shaft impact crushers are provided below.





General Dimensions of MV 65 Vertical Shaft Impact Crusher





Technical Specifications of MEKA MVI 90L Series Vertical Shaft Impact Crusher

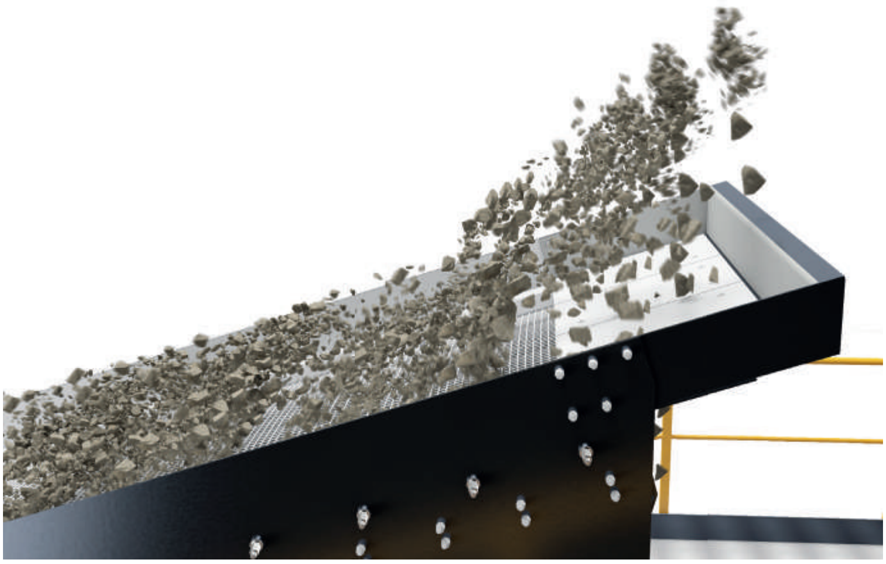
Crusher model	Max feed size mm	Capacity mtph	MOTOR kW / rpm	Weight kg
MVI 90L ROR SD	50	200	200 – 250 / 800 – 1700	9330
MVI 90L ROR DD	50	300	2 * 110 – 160 / 800 – 1700	10170
MVI 90L ROS SD	50	250	200 – 250 / 800 – 1600	11170
MVI 90L ROS DD	50	300	2 * 110 – 160 / 800 – 1600	12010
MVI 90L SOS SD	75	250	200 – 250 / 800 – 1400	11665
MVI 90L SOS DD	75	400	2 * 200 / 800 – 1400	13070

Technical Specifications of MEKA MVI 90L Series Vertical Shaft Impact Crusher

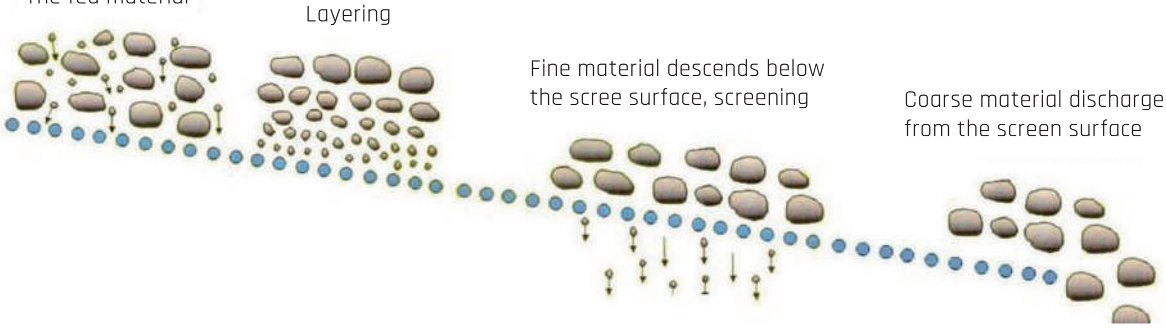
SECTION 5
SCREENS

VIBRATING SECREENS

Vibrating screens are one of the most crucial units in crushing and screening plants. To obtain the desired product from the plant, the screening must be carried out with the desired performance. For this, it is essential to choose the correct screen type and determine the screen size accurately. The determination of the screens size in vibrating screens operating according to conventional screening systems will be explained below.



This principle is based on the 'LAYERING' of the material on the screen panel. As a result of this layering, coarse materials are positioned at the top of the layer, while fine materials move towards the screen panel. For layering to occur, the material needs to move slowly on the screen panel.



Determining the Screen Size

The determination of the screen size involves establishing the screen width and screening area.

Screen area calculation

$$E_a = \frac{Q_{ea}}{Q_{birim}} * \eta$$

EA : Screen area, m2

QEA : Feed material undersize capacity, t/h

QUNİT: Unit screening capacity

□: Safety factor

This factor represents the definition ratio of the material to be screened at the Aggregate plants.

If the physical properties of the material in the plant are well-defined, if the gradation curve is well-determined, if the gradation curve is definite, and the capacity is reliable, taking □ =1 will be is safe.

QUNIT : Unit Screening Capacity (ton/ (m2 * hour)

QUNIT : A * B * C * D * E * F * G * H * I * J * K * L

A: For the material size to be screened, the basic capacity value which 1 m□ of the screen area can screen.

B: Coefficient related to the material quantity larger than the size to be screened (over size); screen oversize percentage factor.

C: Coefficient related to the quantity of material passing through half the size of the screened size (half size).

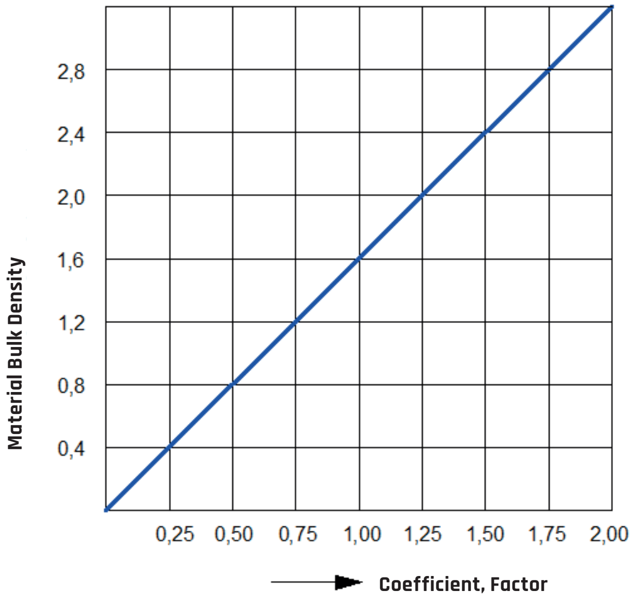
D: Coefficient related to the screen deck position.

Number of Screen Decks	1	2	3	4
Coefficient D	1	0,9	0,8	0,77

E : Washing screen factor

Size of the material to be screened	1-6	6-12	12-25	26-40	41-50	51-75	+75
Coefficient E	1,4	1,3	1,25	1,2	1,15	1,1	1

F : Material bulk density coefficient

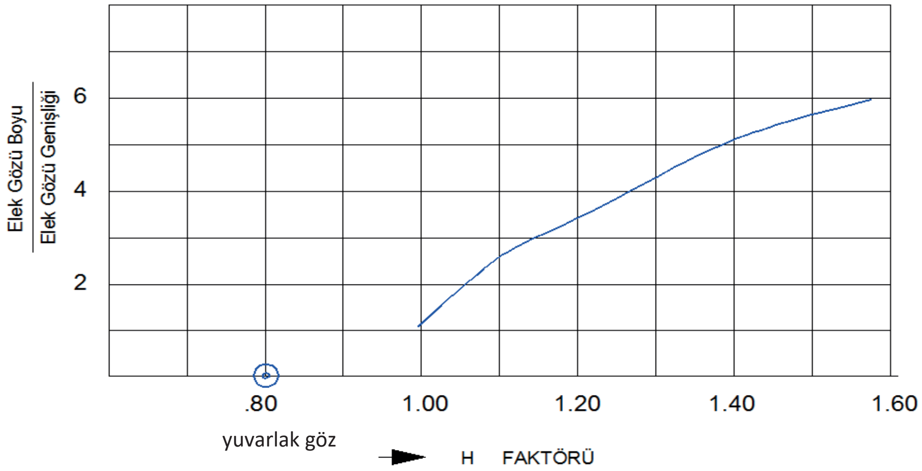


G: Open area coefficient

G = Actual open area (%) / 50 (%)

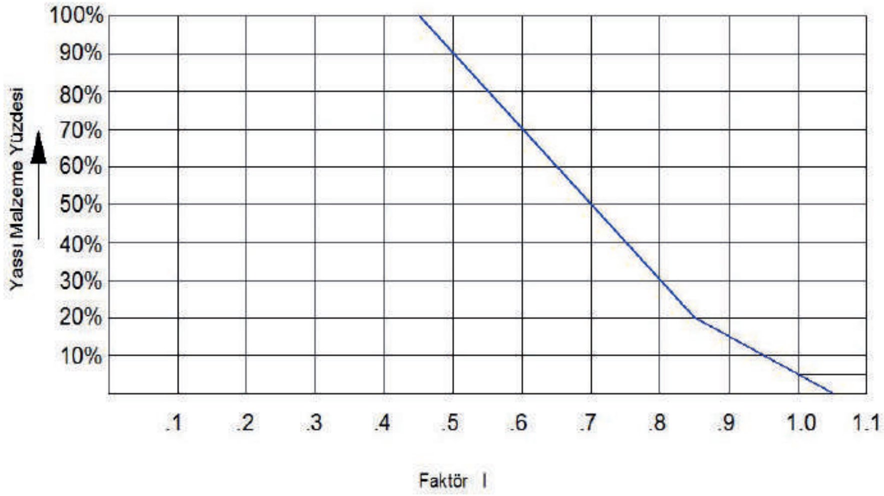
G : Open area coefficient.

H : Screen mesh opening shape coefficient

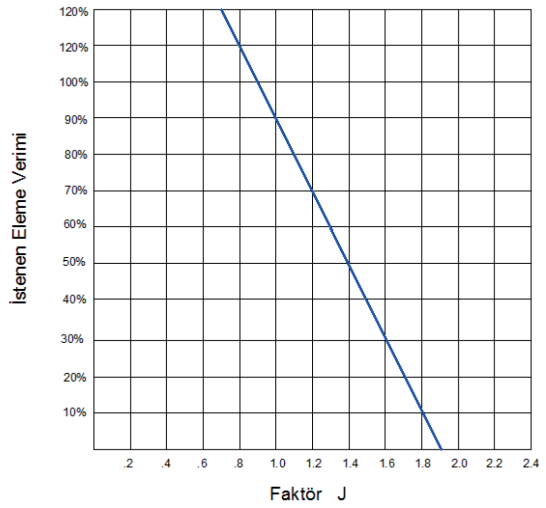


I : Shape coefficient" of the material to be screened

The fact that the material which is not cubic or spherical but rather flat is a factor that affects the screening capacity. In the aggregate industry, flat material is defined as material with a thickness three times or more its width.



J: Shape coefficient of the material to be screened

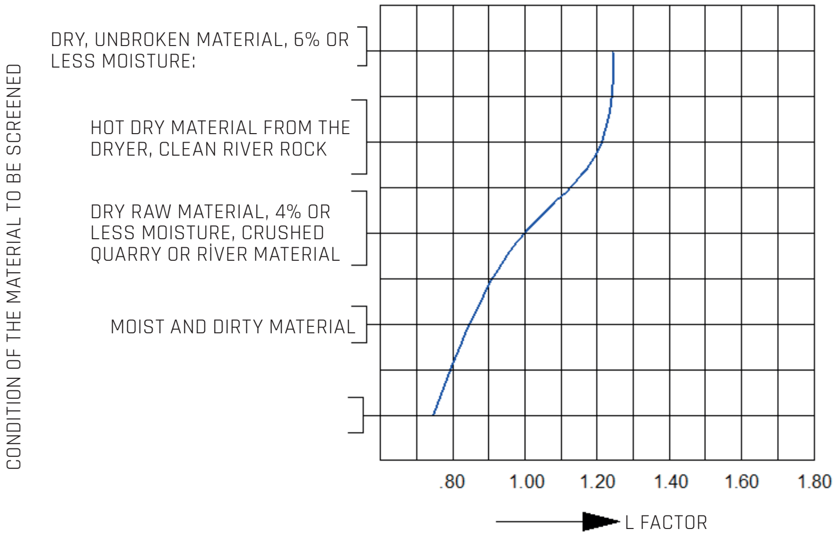


K: Screen type and motion coefficient

K: Screen type and motion coefficient

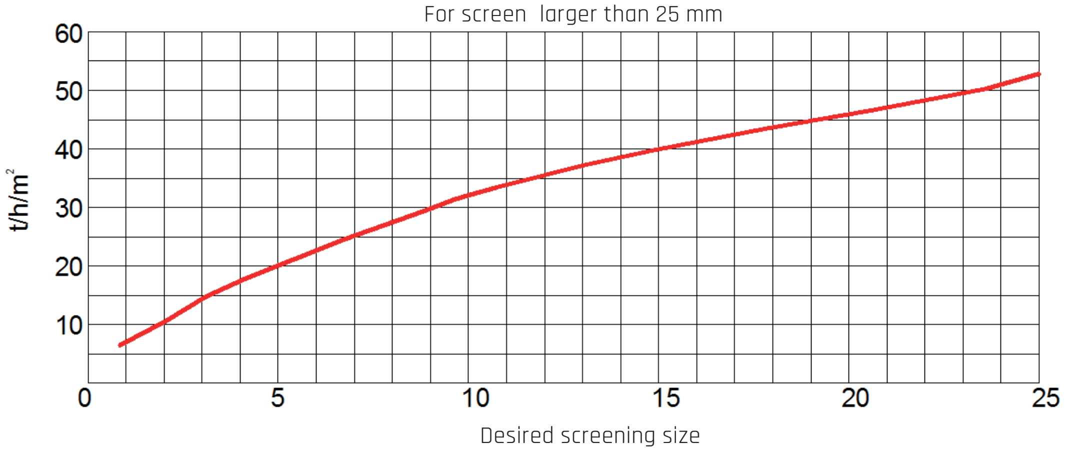
	Horizontal		Inclined			Multi-stage			
Screen Deck	Flat	Flat	Flat	Flat	Flat	Multi-stage	3 Stage	2 Stage	2 Stage
Vibration	Linear	Fixed Elliptical	Circular	Variable Elliptical	Linear	Linear	Variable Elliptical	Linear	Variable Elliptical
Coefficient K	0,9	1,1	1	1,1	1	1,3	1,4	1,1	1,3

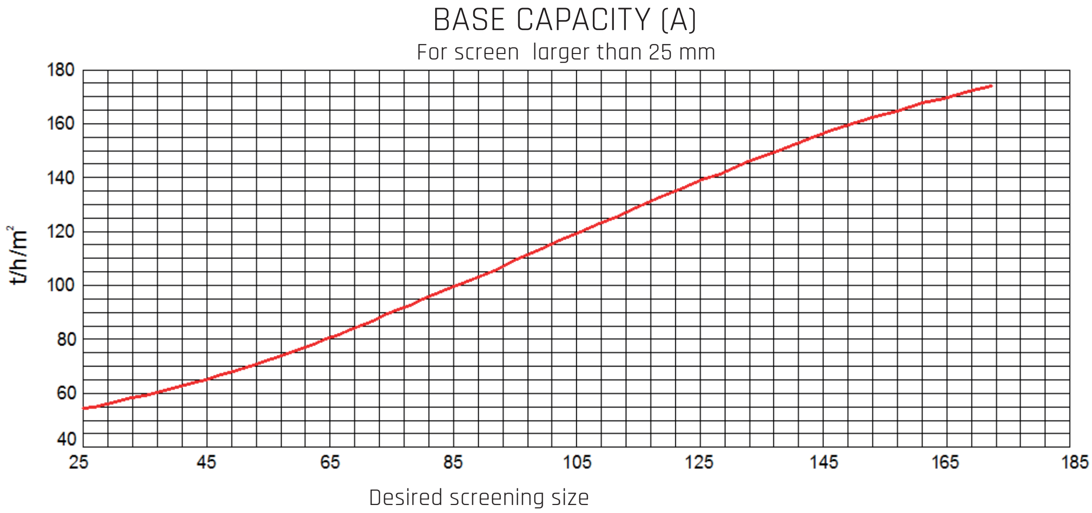
L: Material condition Coefficient

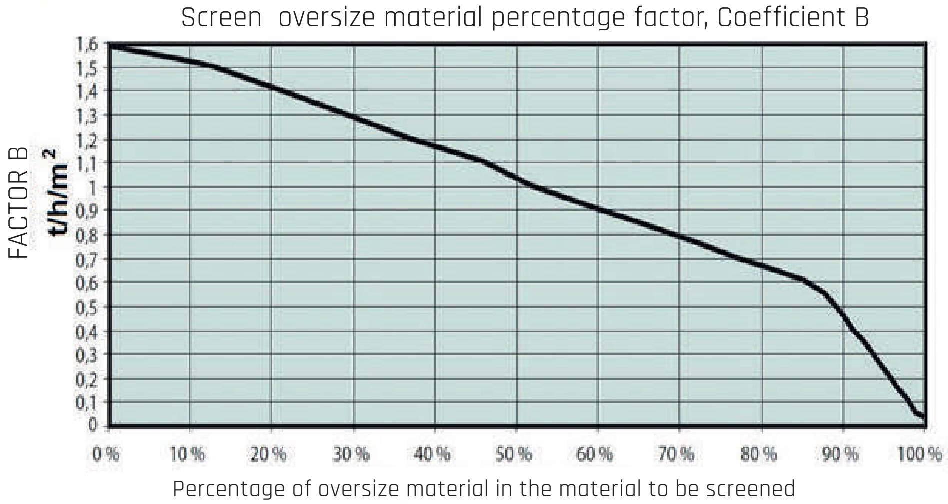


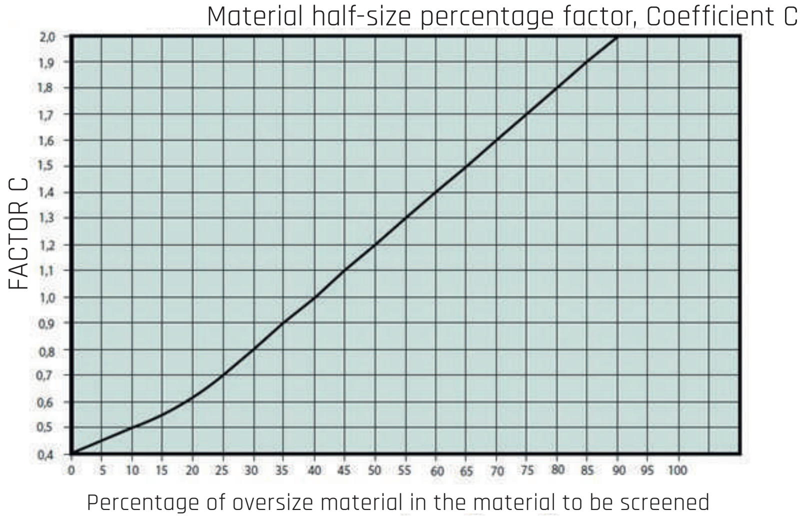
BASE CAPACITY (A)

For screen larger than 25 mm




BASE CAPACITY (A)
For screen larger than 25 mm
t/h/m²
180
160
140
120
100
80
60
40
25
45
65
85
105
125
145
165
185
Desired screening size


Screen oversize material percentage factor, Coefficient B
FACTOR B
t/h/m 2
1,6
1,5
1,4
1,3
1,2
1,1
1
0,9
0,8
0,7
0,6
0,5
0,4
0,3
0,2
0,1
0
0 %
10 %
20 %
30 %
40 %
50 %
60 %
70 %
80 %
90 %
100 %
Percentage of oversize material in the material to be screened


Material half-size percentage factor, Coefficient C
FACTOR C
2,0
1,9
1,8
1,7
1,6
1,5
1,4
1,3
1,2
1,1
1,0
0,9
0,8
0,7
0,6
0,5
0,4
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
90
95
100
Percentage of oversize material in the material to be screened

Approximate capacity values for screening based on mesh size and area

Screen area calculation is a time-consuming process. To quickly get an idea about the mesh size concerning the material capacity to be screened, the table below is used.

SIZE OF SCREENED MATERIAL	Material Capacity Passing Through the Screen MTPH			
	Screen size $m \times m$			
	$1,5 \times 3,6$	$1,8 \times 4,2$	$2,1 \times 4,8$	$2,4 \times 6$
Screen area, m2	$5,4$	$7,6$	10	$14,4$
2	20	30	45	65
5	50	70	95	135
8	75	105	140	180
12	100	145	200	230
16	125	180	230	270
25	175	250	300	350
32	200	290	350	400
50	220	370	430	500
90	370	460	550	600

Material Capacity Passing Through the Screen MTPH

Minimum screen width determination

The primary factor in determining the screen width is the material thickness (d) at the screen discharge point.

d(mm) = (Q /□) / [3.6 * v * (B-0,15)]

B : Screen width (m)

v : Material velocity (m/s)

Q : Screen capacity (TPH)

δ : Bulk density (t/m3)

d : Material thickness at the screen discharge point has a maximum value of 4 x screen opening size. If this value exceeds, proper stratification does not occur, and there is no full contact between the material to be screened and the mesh.

d : Material depth at the screen discharge point has a minimum value of 1 x screen opening size.

Wet Screening

Wet screening involves washing the material by spraying it with pressurized water as it progresses over the material screen panel, particularly when the material to be screened is dirty. This allows the material to pass through the screen. Equipment such as a washing screw is used to separate the dirty water passing through the screen bottom channel along with fine material.

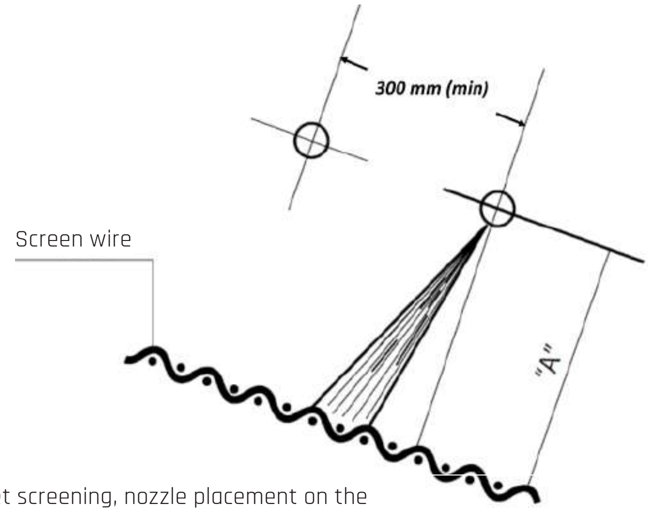
Water flow: Depending on the contamination level of the material to be screened, a water flow of 0.5 to 3 times the material flow to be screened is required. For instance**;**

For relatively clean material, if clay and foreign substances have not penetrated the material structure, the capacity of the material to be screened is sufficient (e.g., materials from flowing rivers).

For dirty material, if clay and foreign substances have penetrated the material structure to some extent, more than the capacity of the material to be screened may be required.

Water pressure: The water pressure in the sprays should be between 1.5 and 3 bar.

Spray connection pipes: Should be a minimum of 1 1/2" (38 mm). Pipe intervals should be approximately 300 mm. The pipes should be connected to the main collector pipe of at least 2 □" on one side, and the other sides should be closed.

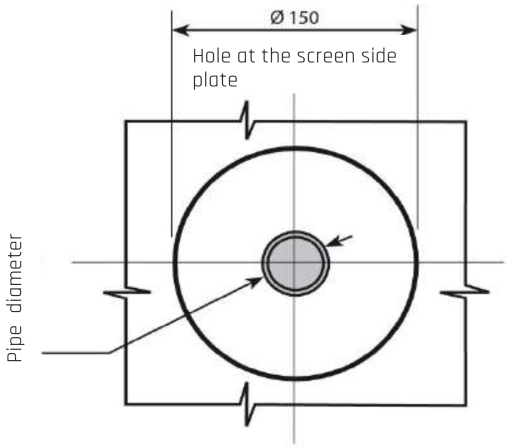


A = 350 mm Recommended

A = 200 mm Minumum

In wet screening, nozzle placement on the screens

Nozzles are connected to 3/4" sleeves, approximately 300 mm apart on the pipes. For intermediate screen washings, holes with a diameter of 150 mm should be drilled on the side plate of the screen at pipe transitions.

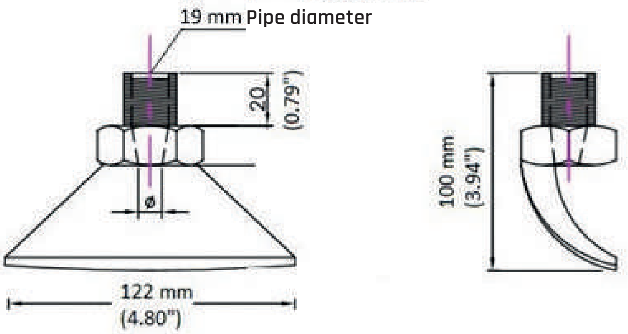


Side Plate Hole Size in Wet Screens

To prevent material-water splashing from these holes, special rubber bellows are used. Connections from the pipes where nozzles are attached to the main collector should be made with rubber hoses, and it is preferable to have a valve in each pipe line. Pipes should not be connected to the screen body in any way; they should be connected to profiles attached to the main frame with U-clamps.

Spray nozzles: Spray nozzles are elements that create a sharp, fan-shaped water jet.

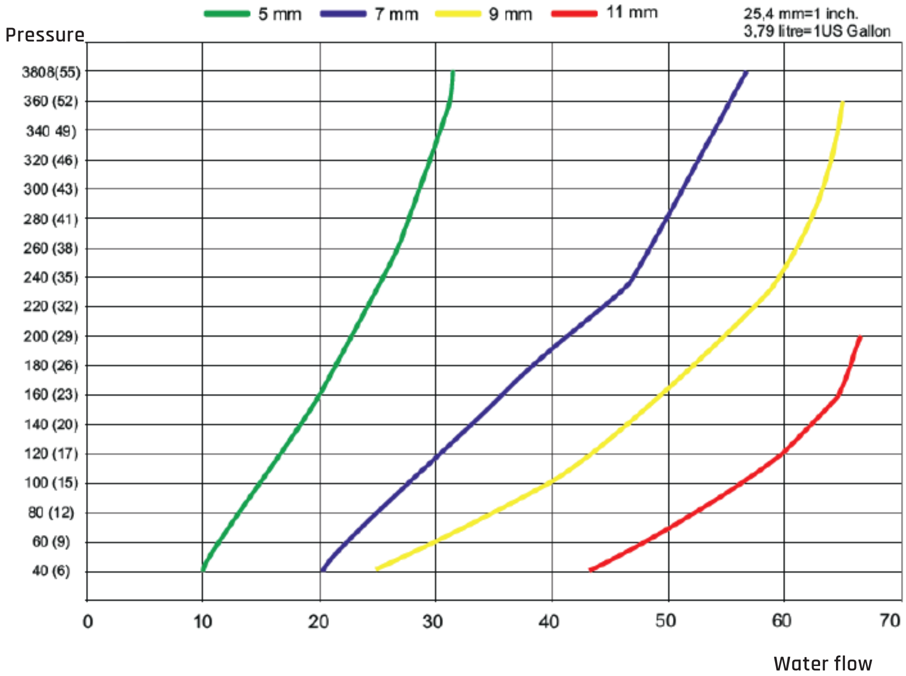
They should be resistant to wear, corrosion, and economical. The water pressure in the nozzle should be between 1.5 - 3 bar. Nozzles are made of polyurethane to be resistant to both wear and corrosion.



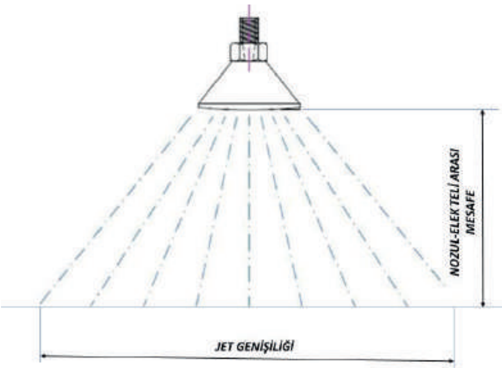
Nozzle dimensions

The nozzle hole diameters range from 5 to 11 mm. The water capacity of the nozzle, based on water pressure and hole diameter, is also shown in the graph below.

Note: 1 bar equals 100 kPa.



Nozzle Water Flow Based on Nozzle Hole Diameter and Pressure



,Nozzle Placement

Jet Width (mm)

Distance between nozzle and screen wire (mm)	Nozzle Hole Diameter, Ø	5 mm		7 mm		9 mm		11 mm	
	Pressure bar	1,5	2,5	1,5	2,5	1,5	2,5	1,5	2,5
200	Jet Width mm	600	700	600	800	600	800	600	800
300		750	850	800	1000	600	800	600	800
400		900	1000	1000	1200	1000	1200	1000	1200

Jet Width Based on Water Pressure and Nozzle Type

The water jets must be positioned in a way that they intersect, and the distance between the nozzles should be determined accordingly. Additionally, in consecutive pipes, the nozzles should not be on the same axis; they should be placed in a zigzag pattern. In other words, the nozzle in the next pipe should be placed between the two nozzles in the previous pipe. Nozzles should not be placed from the front of the screen to 2 meters behind it. Otherwise, the material will be conveyed with water to the front chute and, consequently, to the equipment in front of it. This can cause issues with material conveyance and breakage.

Once the number of nozzles and, consequently, the number of pipes are determined, distributing the nozzles and pipes equally to each level is the most suitable method. Starting the pipes on the lower levels from where the pipes on the upper levels end is also the most accurate approach.

Washing System Calculation

$V(m3/h) = K * Q(m3/h)$
V : Required water flow rate(m3/h)
Q: Screen capacity(m3/h)
K : Contamination factor
K : 0.5−1.5 for relatively clean material
K : 1.5−3.0 if there is a high clay content

Number of nozzles in a pipe:
If we set the nozzle intervals to 300 mm,
$NNOZZLE = B / 0.3$
B : Screen width(m)

Water capacity of a nozzle:
VNOZUL : lt/min

Water capacity of a pipe:
$VBORU = NNOZUL * VNOZUL(lt/min)$
NNOZUL : Number of nozzles in a pipe

Number of pipes:
$NBORU = V(lt/dk) / VBORU (lt/min)$
V: Required water flow rate(lt/min)
VBORU: Water capacity of a pipe(lt/min)

Water Flow:

MEKA has a very wide range of vibrating screens. In the design of vibrating screens, FEM (Finite Element Method) and DEM (Discrete Element Method) analyses are conducted and based on the results, the design is implemented using high-quality materials and advanced production methods. The screen body is manufactured entirely with bolts, and huck-bolt technology is used in connections. S690 QL quality steel, highly resistant to vibration, is used in the side plates of all screens.

MEKA'nın ürettiği belli başlı elek tipleri:

- Circular vibrating inclined screens
- Oval vibrating horizontal screens
- Grizzly pre-screens
- Grizzly scalper primary feeder pre-screens
- Dewatering screens

5.1. MEKA MS SERIES INCLINED VIBRATING SCREENS

MEKA MS series inclined vibrating screens are classic circular vibrating screens. They are manufactured with a 15□ - 20□ slope to provide the desired flow speed for the material. These screens feature a modular drive system, which is bolted to the screen body. It can be easily disassembled during transportation for convenient packaging.

The screen body is constructed with highly resistant top-quality side plates of sufficient thickness for durability against vibration. With specially designed screen wire support frames, the body has a very rigid structure and is resistant even to extreme amplitude vibrations.

A specially designed feed chute and an oval tensioned screen panel ensure that the material spreads evenly on the screen mesh, maximizing the utilization of the screen area.

In relatively large screens, the front chute is moved with a rail system for easy replacement of the screen mesh. These screens use self-tensioning special motor bases, preventing the vibration from affecting the electric motor and V-belts. Properly designed, high-quality coil springs are used as an elastic system. Special rubber blocks are used to prevent excessive movement during starts and stops. Specially designed front chutes are employed, and the rotating part of the chutes ensures easy compatibility with the conveyors in front of the chute. The wide space between screen layers allows for easy replacement of screen mesh.

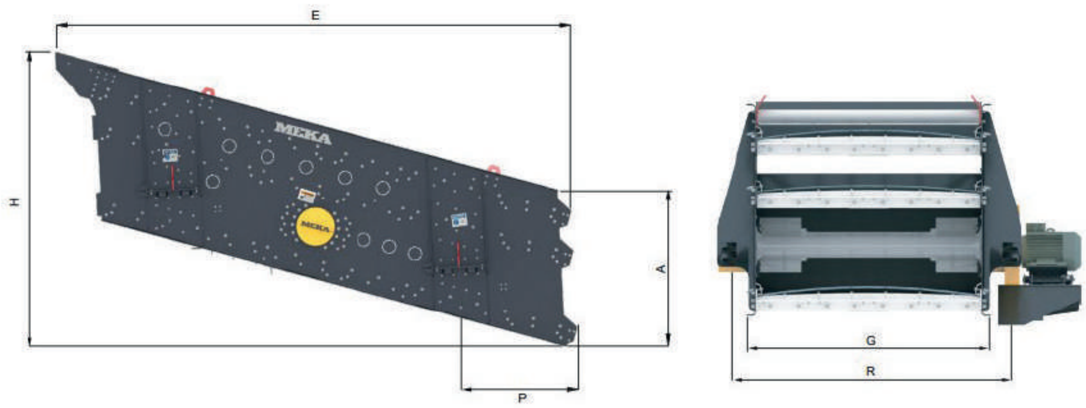



Various vibrating screen pictures from MEKA

5.1.1. MEKA 2-DECK INCLINED VIBRATING SCREENS

SCREEN MODEL	WIDTH MM	LENGTH MM	WEIGHT (excluding screen mesh) kg	MOTOR POWER KW
MS 1540/2	1500	4000	3631	15
MS 1650/2	1600	5000	4225	15
MS 2050/2	2000	5000	4600	15
MS 2060/2	2000	6000	5592	18,5
MS 2460/2	2400	6000	6111	22

MEKA Two-Deck Inclined Screens Technical Specifications

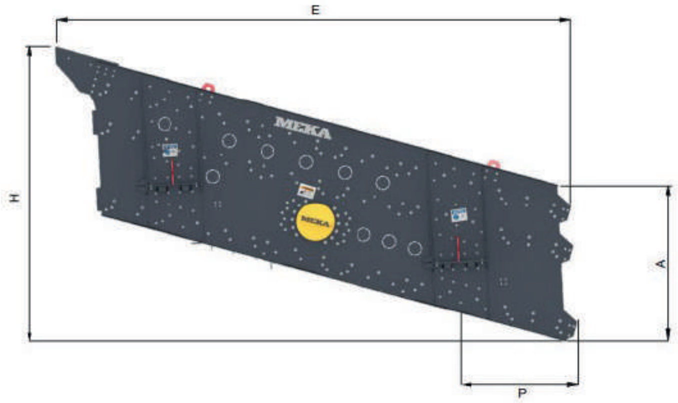


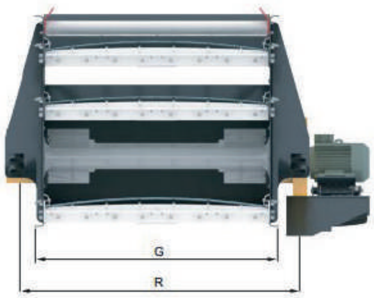
SCREEN MODEL	A	E	G	H	P	R
MS 1540/2	1353	4445	1670	2766	833	2012
MS 1650/2	1353	5413	1770	3067	1064	2112
MS 2050/2	1353	5413	2170	3067	1064	2512
MS 2060/2	1418	6365	2170	3463	1438	2512
MS 2460/2	1418	6365	2570	3463	1438	2912

5.1.2. MEKA 4-DECK INCLINED VIBRATING SCREENS

SCREEN MODEL	WIDTH MM	LENGTH MM	WEIGHT (excluding screen mesh) kg	MOTOR POWER KW
MS 1540/3	1500	4000	4610	15
MS 1650/3	1600	5000	6220	18,5
MS 2050/3	2000	5000	6731	18,5
MS 2060/3	2000	6000	7468	22
MS 2460/3	2400	6000	8158	30

MEKA three-deck inclined screens





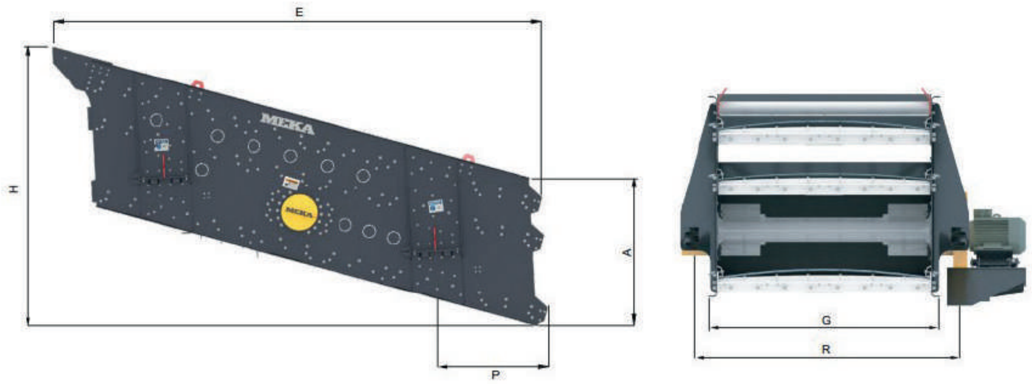
SCREEN MODEL	A	E	G	H	P	R
MS 1540/3	1850	4445	1670	3260	833	2012
MS 1650/3	1959	5403	1770	3704	1039	2112
MS 2050/3	1959	5413	2170	3704	1039	2512
MS 2060/3	1967	6365	2170	4012	1439	2512
MS 2460/3	1967	6365	2570	4012	1439	2912

General Dimensions of MEKA Three-Deck Inclined Screens

5.1.3. MEKA 4-DECK INCLINED VIBRATING SCREENS

SCREEN MODEL	WIDTH MM	LENGTH MM	WEIGHT (excluding screen mesh) kg	MOTOR POWER KW
MS 1540/4	*1500*	*4000*	*6176*	*18,5*
MS 1650/4	*1600*	*5000*	*7534*	*18,5*
MS 2050/4	*2000*	*5000*	*8750*	*22*
MS 2060/4	*2000*	*6000*	*9289*	*22*
MS 2460/4	*2400*	*6000*	*9943*	*30*

Meka dört katlı eğimli eleklerin teknik özellikleri



SCREEN MODEL	*A*	*E*	*G*	*H*	*P*	*R*
MS 1540/4	*2430*	*4457*	*1670*	*3849*	*833*	*2012*
MS 1650/4	*2459*	*5408*	*1770*	*4138*	*1078*	*2112*
MS 2050/4	*2459*	*5408*	*2170*	*4138*	*1078*	*2512*
MS 2060/4	*2483*	*6359*	*2170*	*4532*	*1415*	*2512*
MS 2460/4	*2483*	*6359*	*2570*	*4532*	*1415*	*2912*

MEKA Four-Deck Inclined Screens General Dimensions

5.2. MEKA MGS SERIES GRIZZLY SCREENS

MEKA grizzly screens are used in front of crushers to screen out material smaller than the crusher's set value and convey it to the crusher discharge conveyor without entering the crusher. They are generally manufactured as 2-deck screens. Adjustable grizzlies with 2 or more stages are usually placed on the upper deck of the crusher. Grizzlies are bolted to heavy-duty profile carriers. Grizzlies are typically made of austenitic steel castings containing high Mn.

A standard screen panel is connected to the lower deck of the screen.

TECHNICAL SPECIFICATIONS

MODEL	MGS 1440	MGS 1640	MGS 1845
Number of Decks	2	2	2
Screen Width, mm	1400	1600	1800
Screen Length, mm	4000	4000	4500
Motor Power, KW	22	30	37
Weight, kg	8700	9400	12124

The Technical Specifications of MEKA MGS Series Grizzly Screens

5.3. MEKA MSS SERIES SCALPER SCREENS

MEKA scalper screens are used in front of vibrating feeders, apron feeders or reciprocating feeders for materials that are dirty, have a high clay content or are moist. The upper deck typically consists of three-stage grizzly groups. Grizzlies are bolted to heavy-duty profile carriers. Grizzlies are usually made of austenitic steel castings containing high Mn. Depending on the abrasive nature of the material, either regular steel medwire mesh or polyurethane screen panels are used at the lower deck. The mesh size varies according to the material size to be bypassed. These screens are heavy-duty with thicker body side plate thicknesses compared to other screens, and additional reinforcements are present attached to the body.

Similar to vibrating grizzly feeders, double vibro-motors are used in the drive systems. The connection chassis of the vibro-motor is heavy-duty and bolted to the main body.

There are Hardox liners bolted to the side plates of the grizzly deck, minimizing wear and tear.

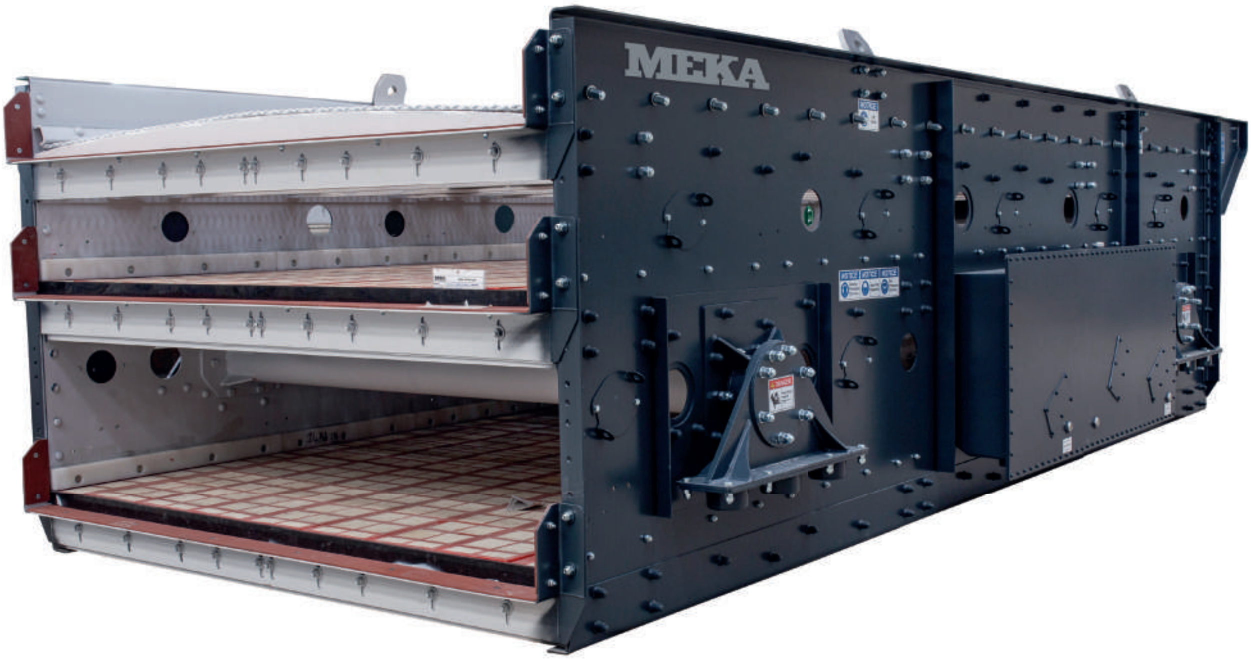
TECHNICAL SPECIFICATIONS	MSS 1030	MSS 1230	MSS 1530	MSS 1440	MSS 1640	MGS 1940
Number of Decks	2	2	2	2	2	2
Screen Width, mm	1000	1200	1500	1400	1600	1900
Screen Length, mm	3000	3000	3000	4000	4000	4000
Motor Power, KW	2*6,1	2*7,5	2*10,1	2*12	2*13,9	2*13,9
Weight, kg	2600	5470	6750	9000	9650	12500

The Technical Specifications of MEKA MGS Series Grizzly Screens

5.4. MEKA MHS SERIES OVAL VIBRATING HORIZONTAL SCREENS

The most significant feature of MEKA MHS series oval vibrating screens is that every point on the screen body produces an elliptical vibration of the same characteristics. Thanks to the special drive system, both the vibration amplitude and the vibration angle can be controlled based on the properties of the screened material.

MEKA MHS series oval vibrating screens have a considerable robust body construction with no welding used in the body manufacturing. Special vibration bolts (huck bolts) are employed, and the side walls are made of a minimum of 8 mm thick ASTM A 36 (EN S275) plate. Considering the intense stress in the drive area and the drive box, there are three levels of plates, including additional reinforcement plates. The screen frame, made of sturdy H profiles and box profiles, is highly resistant to high G-force values.



In the elastic system, just as coil springs are used, Marsh Mellow type rubber springs are also employed. Excessive movements during start-up and shutdown are prevented by lateral rubber wedges.

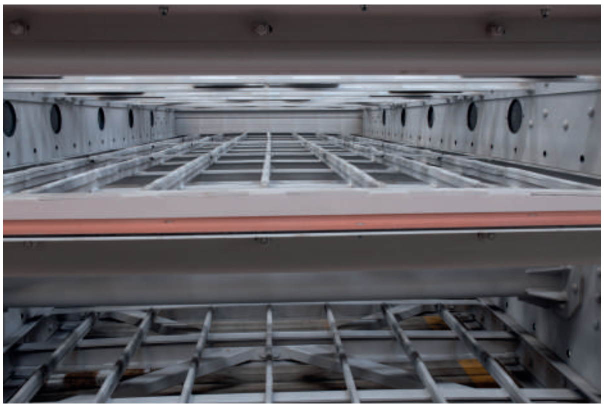
MEKA MHS series vibrating screens are designed with three shafts, and the motion transfer between the shafts is achieved using gears. The gears and the discs on the opposite side of the gears are securely connected to the screen side walls and mounted on bushings. The bearings have a tapered hub and sit on the tapered surfaces of the bushings. Consequently, unlike other vibrating screens, the inner race of the bearings remains stationary while the outer race rotates. This bearing arrangement allows the load to be carried by a wider surface. The motion, obtained from the motor through a belt pulley system, is transmitted to the drive gear with a tapered locking hub attached to the drive shaft.

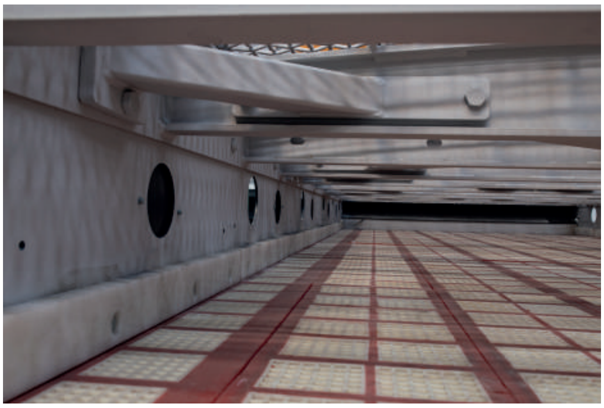
Weights that produce the semi-circular vibration are connected to the discs on the drive side where the gears are attached and to the discs on the opposite side where there are no gears. The gear transmission between the drive shaft and the other two shafts, as described, allows the adjustment of the screen's vibration angle. By removing the locking mechanism on the middle gear, the weight group on the middle

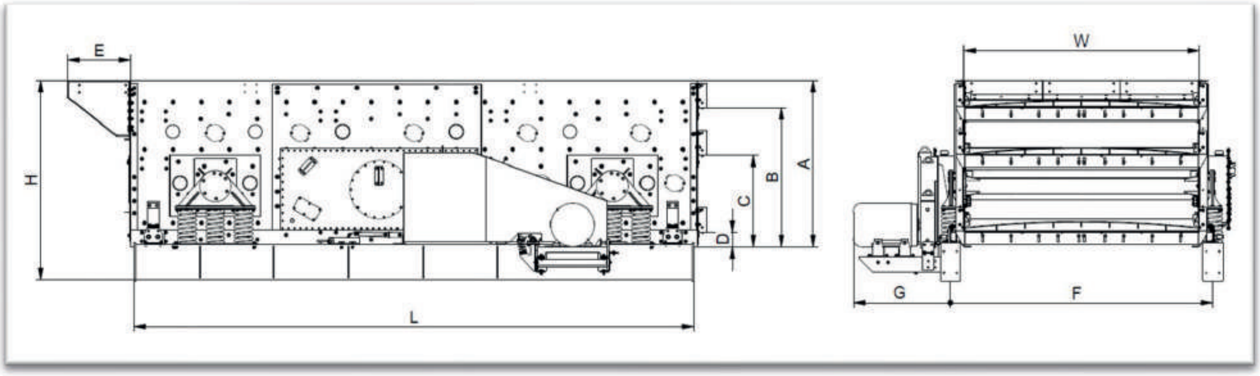
shaft can be rotated to achieve the desired vibration angle, and this position is fixed with the locking mechanism. This way, it is possible to adjust the vibration angle in increments of 5 degrees within the range of 30 to 60 degrees.

SCREEN MODEL	Screen Width, mm	Screen Length	Number of decks	Revolution Count, rpm	Motor Power, kW	Weight kg
MHS 5163	1562	4877	3	730 – 870	30	8781
MHS 6162	1930	4877	2	730 – 870	30	7781
MHS 6163	1930	4877	3	730 – 870	30	9275
MHS 6202	1930	6096	2	730 – 870	30	8850
MHS 6203	1930	6096	3	730 – 870	30	10588
MHS 8202	2540	6096	2	730 – 870	37	12517
MHS 8203	2540	6096	3	730 – 870	37	14267

Technical Specifications of MEKA MHS Series Horizontal Screens







SCREEN MODEL	*A*	*B*	*C*	*D*	*E*	*F*	*G*	*H*	*L*	*W*
MHS 5163	1590	1320	860	180	675	1854	978	1970	4780	1562
MHS 6162	1203	902	-	180	675	2222	1000	1583	4780	1930
MHS 6163	1590	1320	860	180	675	2222	1000	1970	4780	1930
MHS 6202	1203	902	-	170	675	2222	1000	1583	5980	1930
MHS 6203	1630	1312	900	156	675	2222	1000	1983	5980	1930
MHS 8202	1283	987	-	158	675	2832	1045	1636	6010	2540
MHS 8203	1794	1498	986	158	675	2832	1045	2147	6010	2540

General Dimensions of MEKA MHS Series Horizontal Screens

SECTION 6
WASHING UNITS

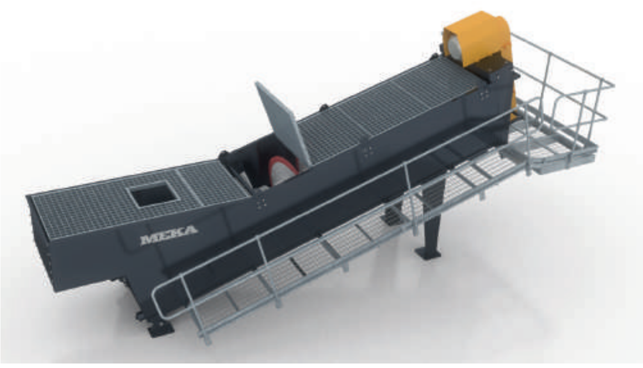
MEKA is the leading crushing and screening plant manufacturer in Turkey. In addition to dry crushing and screening machinery and equipment production, MEKA is also the leading producer of Türkiye in washing and dewatering systems for the aggregate and mining industries. The main equipment for washing plants produced by MEKA includes the following:

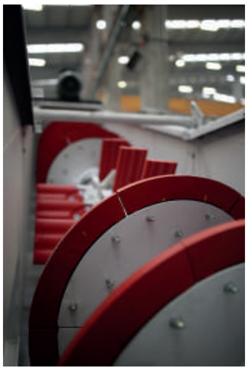
- Coarse material washing and dewatering screws
- Fine material washing and dewatering screws
- Log washers
- Dewatering screens
- Compact sand plants
- Fine material recovery units
- Bucket washers

6.1. MEKA COARSE MATERIAL WASHING AND DEWATERING SPIRAL CLASSIFIERS

MEKA 's coarse material washing and dewatering spiral classifiers remove materials such as silt, clay, and organic particles from coarse aggregate through a washing process, separating to a certain degree, the washed aggregate from dirty water. Instead of a spiral classifier, corrugated paddles are used in the trough section of the washer. These paddles enable the removal of adhered dirty material from the aggregate surface through scrubbing. Water, provided from the bottom of the trough, rises to the surface and leaves the washer along with the dirty water over adjustable weirs. These washers are capable of washing aggregates up to a size of 75 mm and can be manufactured with single or double screws configurations.

The spiral classifier body and spirals are coated with polyurethane or high manganese austenitic steel casting lining. The spiral shaft bearing is located outside the basin, providing easy maintenance. Heavy-duty, liquid-oil type reducers are used.





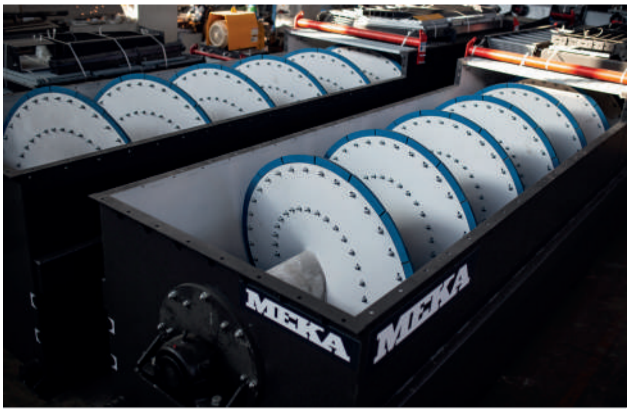
WASHER MODEL	SIZE diameter x length mm x mm	CAPACITY t/h	MAX PIECE SIZE, mm	MOTOR POWER, kW	SPIRAL CLASSİFİER SPEED rev/min	WEIGHT kg	WATER m3/min
MCWS 0954	928*5450	130-160	65	30	16-32	6500	90-135
MCWS 1163	1118*6350	180-230	75	37	13-26	9000	110-170
MCWD 0954	928*5450	270-320	65	2x30	16-32	10800	160-220
MCWD 1163	1118*6350	360-450	75	2x37	13-26	15500	200-250

MEKA coarse material washing and dewatering spiral classifiers technical specifications

6.2. FINE MATERIAL WASHING AND DEWATERING SPIRAL CLASSIFIER

Fine material washing and dewatering spiral classifiers are typically positioned beneath washing screens. They wash a portion of fine aggregate, up to 10 mm, together with water under the screen, separating it from the settled fine aggregate at the bottom of the trough and convey it to the equipment in front of it. The aggregate leaving the fine material spiral classifiers still contain approximately 20-25% water. Additional equipment, such as dewatering screens, is needed to further reduce this ratio. The dirty water is directed through adjustable weirs at the back of the to trough the dirty water channel and is removed from the environment through a pipe.

The spiral classifier body and spirals are coated with polyurethane or high manganese steel casting lining. The spiral shaft bearing is located outside the trough, providing ease of maintenance. Liquid-oil heavy-duty reducers are used.

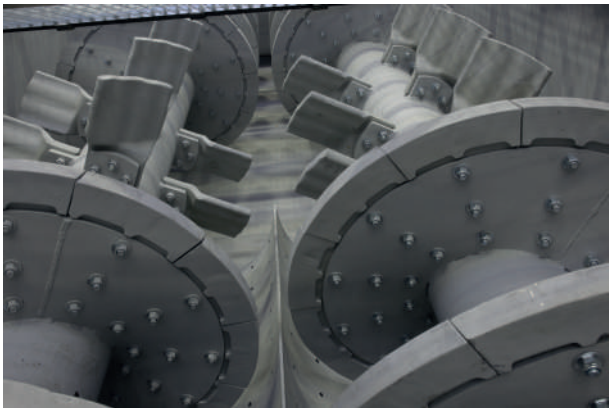


	WASHER MODEL	SIZE diameter x length mm x mm	CAPACITY t/h	MAX PIECE SIZE, mm	MOTOR POWER, kW	SPIRAL CLASSİFİER SPEED rev/min	WEIGHT kg
Single spiral	**MFWS 0976**	917*7620	23-90	10	15	10-21	6500
	MFWS 1197	1120*9700	35-160	10	18,5	8-17	10500
	MFWS 1310	1370*10300	60-250	10	30	7-14	13950
	MFWS 1610	1675*10500	90-360	10	45	5-11	22000
Double spiral	**MFWD 0976**	917*7620	45-180	10	2x15	10-21	11700
	MFWD 1197	1120*9700	70-315	10	2x18,5	8-17	18850
	MFWD 1310	1370*10300	125-500	10	2x30	7-14	25000
	MFWD 1610	1675*10500	180-725	10	2x45	5-11	40250

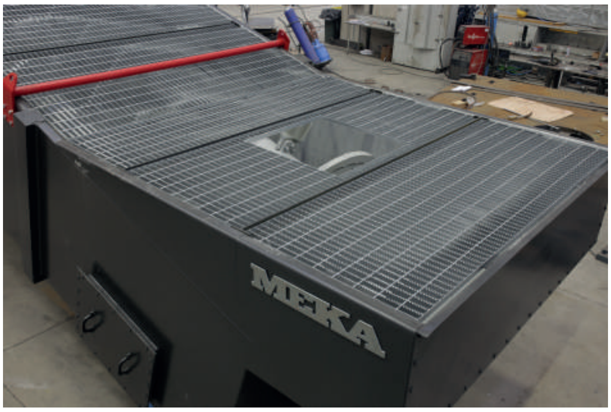
Technical specifications of MEKA fine material washing and dewatering spiral classifier

6.3. LOG WASHER

MEKA's log washers convey clay and similar plastic clay materials adhered to aggregates up to 150 mm in size upward at a certain angle by using paddles placed on two shafts in a helical style. During this process, the material adhered to the surface of the aggregate is broken and removed from the log washer with water directed from top to bottom.







MEKA Log Washer's Standard Specifications:

- Easily replaceable Ni-Hard paddles
- Highly rigid reinforced body structure
- Processed single-piece shaft with significantly thick wall thickness
- Specially designed gearbox for the log washer, resistant to high shock loads
- Adjustable angle body structure
- Specially positioned bearing system outside the body

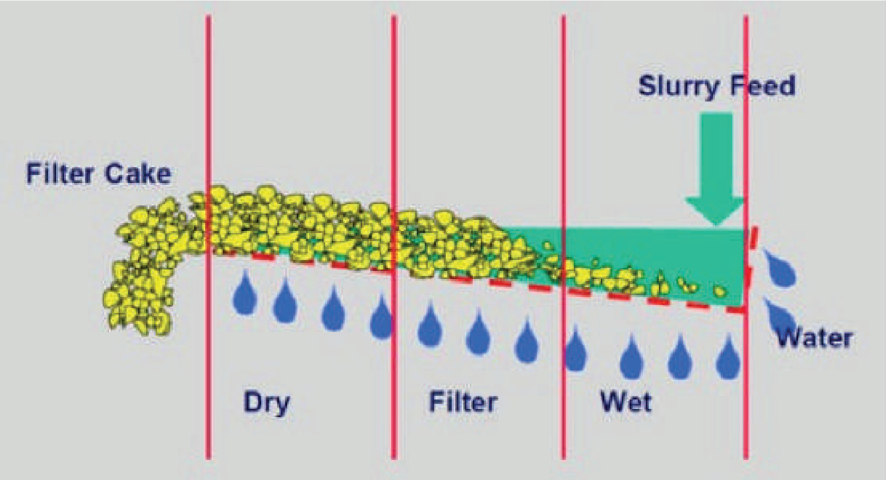
WASHER MODEL	SIZE diameter x length mm x mm	CAPACITY t/h	MAX PIECE SIZE, mm	MOTOR POWER, kW	WEIGHT kg
MLW 3630	905 * 9000	50 – 125	75	90 – 110	26407
MLW 4430	1120 * 9000	75 – 175	100	110 – 160	32275
MLW 4435	1120 * 10500	75 - 175	100	160	37150

MEKA Log Washer Technical Specifications

6.4. DEWATERING SCREENS

Dewatering screens are used to reduce the moisture content of washed aggregates to a level of 10-15%. This way the washed aggregates are easily conveyed and stocked with belt conveyors. These screens are manufactured with an approximate 5◻ upward inclination. They are single-deck screens. The screen media and the rear wall is made of polyurethane panels with rectangular shape opening. Opening width of the screen media is around 250 microns.

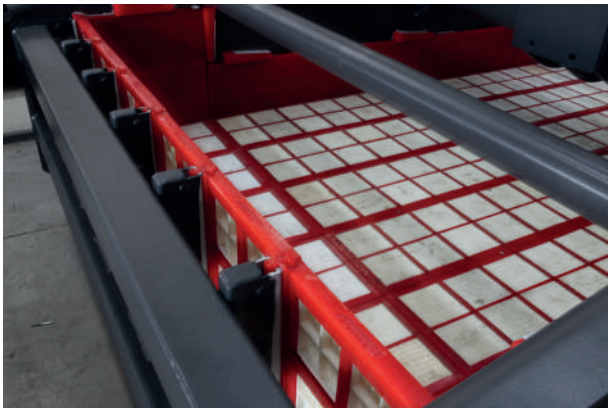
These linear vibrating screens are driven by double vibro motors or double exciters, depending on the screen size. The upward movement speed of the material is approximately 0.12-0.15 m/s, which is quite low. This ensures a higher degree of water drainage. In some cases, channel-type drainage beams are used to increase the filtration efficiency.



Dewatering Screen Working Principle

	Specific Gravity 1,5			Specific Gravity 2,7			Specific Gravity 4,0		
SCREEN WIDTH mm	**(-)300 µm +38 µm**	**(-)600 µm +150 µm**	**(-)4,750 µm +150 µm**	**(-)300 µm +38 µm**	**(-)600 µm +150 µm**	**(-)4,750 µm +150 µm**	**(-)300 µm +38 µm**	**(-)600 µm +150 µm**	**(-)4,750 µm +150 µm**
600	7	13	22	12	24	39	17	35	58
900	15	30	49	27	53	59	39	79	131
1200	22	44	73	39	79	131	58	117	194
1500	33	66	109	59	118	197	87	175	292
1800	39	79	131	71	142	236	105	210	350
2100	54	107	179	96	193	321	143	286	476

Dewatering screen approximate capacity values depending on material specific gravity and size range.



SCREEN MODEL	SCREEN SIZE Width*Length mm*mm	SCREENING AREA m2	MOTOR POWER, kW	MAXIMUM CAPACITY Ton/hour	WEIGHT kg	INCLINATION ANGLE ADJUSTMENT RANGE (0)
MDS 1224	1200*2400	2,88	2x2,88	90	1900	-5/+5
MDS 1824	1800*2400	4,32	2x7,35	150	2750	-5/+5
MDS 1840	1800*4000	7,2	2x6,1	210	4300	-5/+5

MEKA dewatering screens technical specifications

6.5. COMPACT SAND UNITS (SAND WASHING UNITS)

MEKA compact sand units are generally used to obtain washed and moisture-reduced sand in compliance with concrete standards in the range of 0-5 mm (0-4 mesh). Apart from this general application, MEKA compact sand units are also used in industrial sand production and in the rehabilitation processes of polluted rivers and ports.

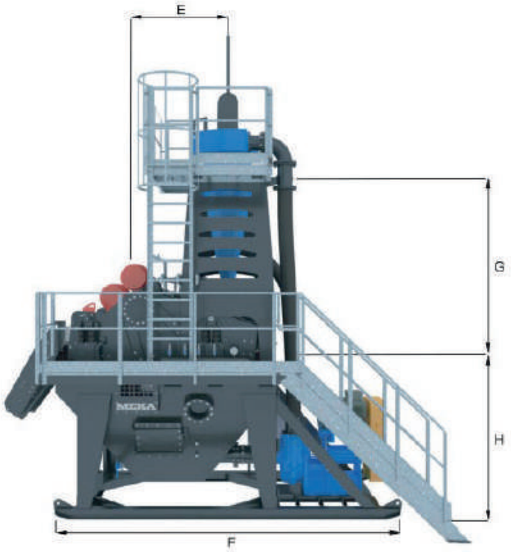
Designed for easy disassembly, the complete unit can fit into a single container.

- Dewatering screen with a polyurethane screen panel that reduces the moisture content of fine material to a level of 10-15%, allowing it to be conveyed by belt conveyors.
- Hydrocyclone capable of separating particles down to 70 microns with replaceable rubber linings.
- Highly durable slurry pump with replaceable linings.
- Hydro cyclone tank with an automatic float system that requires minimal maintenance.

MEKA Compact Sand Unit Working Principle

TECHNICAL SPECIFICATIONS	MCSP 90	MCSP 150	MCSP 210
Capacity, t/h	90	150	210
Water Requirement, m3/hour	270	450	630
Cyclone Diameter, mm	500	660	2*660
Dewatering Screen Size, mm*mm	1200*2400	1800*2400	1800*4000
Dewatering Screen Motor Power, kW	2*2,88	2*7,35	2*6,1
Pump Size, mm	200*150	200*150	250*200
Pump Motor Power, KW	45	55	75
Pump Motor Power, KW	7475	10900	16750

MEKA Compact Sand Unit Technical Specifications



MODEL	A	B	C	D	E	F	G	H
MCSP 90	860	1460	7043	5342	1382	5020	2908	2250
MCSP 150	1059	1922	7649	5418	1435	4820	2901	2250
MCSP 210	1019	1240	8135	5905	1930	6646	3180	2260

MEKA Compact Sand Unit General Dimensions

6.6. BUCKET WASHING AND WATER SEPARATION SYSTEMS

Bucket washing and water separation systems are used to separate the sand and dirty water mixture incoming from washing screens. By using a twin bucket system, it is possible to obtain two different qualities of sand. The mixture of dirty water and material taken from the bottom discharge of the washing screen is directed to the bucket washer's bucket group. The majority of the sand is captured by the bucket group. The sand that cannot be captured and settles at the bottom of the tank is conveyed towards the bucket by the spiral conveyor on the side of the bucket group, captured by the bucket, and conveyed to the bucket group. The bucket group then removes the sand, dewatering it, and conveys it to the conveyor in front of it.

Meka Bucket Washing and Water Separation System Key Features:

- High capacity
- 1 or 2 product groups can be obtained.
- Clean sand can be obtained by separating impurities below 75 microns.
- Very dry sand can be obtained by separating the water in the sand at a level of 10-15%.
- Very low operating cost

BUCKET WASHER MODEL	CAPACITY Tons/hour	WATER CONSUMPTION m3/hour	MOTOR POWER kW	BUCKET REVOLUTION COUNT rev/min
MBW 60	40-60	50-75	5,5	2-5
MBW 100	60-100	75-100	7,5	2-5
MBW 150	100-150	100-125	11	2-5

Bucket Washer Technical Specifications


MEKA
MS 2460

SECTION 7
MEKA PORTABLE UNITS

MEKA Portable Units consist of feeders, crushers, and screen groups placed on a semi-trailer unit transported by rubber-wheeled axle groups. The number of axles and tires varies according to the weight of the unit. Semi-trailers and chassis are heavy-duty type and have a considerable rigid structure. The axles are supplied by well-known companies in the country and have a heavy-duty structure.

Some of these units include:

- MPJ series portable primary jaw crushers
- MPPI series portable primary impact crushers
- MPSI series portable secondary impact crushers
- MPIS series portable secondary impact crusher-screen units
- MPVI series portable vertical shaft impact crushers
- MPTI series portable tertiary impact crushers
- MPSU series portable inclined screen units
- MPWP series portable screening-washing units
- MPD series portable multi-stage plants
- MPSP series portable screening unit

7.1. PRIMARY JAW CRUSHER UNITS

MPJ PRIMARY JAW CRUSHER UNITS TECHNICAL SPECIFICATIONS

	MP 60	MP 90	MP 110C
FEEDER			
Model	MGF 0625	MGF 0942	MGF 1152
Width	0,6 m	0,9 m	1,1 m
Length	2,5 m	4,2 m	5,2 m
Grid Length	1 m	1,5 m	1 m x 2
Grid Spacing Settings	40 - 50 - 60 mm	55 - 75 mm	40 - 50 - 65 mm
Motor Power	2 x 4.3 kW	2 x 6.1 kW	2 x 10.1 kW
Hopper Volume	6 m^3	8 m^3	10 m^3
CRUSHER			
Model	MJ 60	MJ 90	MJ 110C
Feed Opening	610 x 380 mm	900 x 650 mm	1,070 x 810 mm
Maximum Feed Size	340 mm	580 mm	810 mm
Capacity	110 t/h'e kadar	250 t/h'e kadar	430 t/h'e kadar
Jaw Outlet Width	40 -150 mm	60 - 200 mm	75 - 210 mm
Motor Power	45 kW (50 Hz)	75 kW (50 Hz)	110 kW (50 Hz)
DISCHARGE BELT CONVEYOR			
Belt Width	650 mm	800 mm	1,000 mm
Length	7 m	7 m	7 m
Motor Power	5.5 kW	7.5 kW	11 kW
TRANSPORTATION DIMENSIONS			
Length	9,5 m	12,1 m	13,2 m
Width	2,3 m	2,5 m	2,9 m
Height	3,6 m	3,7 m	4,2 m
Weight	20,500 kg	33,000 kg	43,200 kg
OPERATING DIMENSIONS			
Length	9,5 m	12,1 m	13,2 m
Width	3,3 m	3,7 m	4 m
Height	4,2 m	4,5 m	5,1 m

7.2. PRIMARY IMPACT CRUSHER UNITS

MP PRIMARY IMPACT CRUSHER UNITS TECHNICAL SPECIFICATIONS

	MP 1111	MP 1114	MP 1515
FEEDER			
Model	MGF 1152	MGF 1360	MGF 1460
Width	1,1 m	1,4 m	1,4 m
Length	5,2 m	6 m	6 m
Grid Length	1 m x 2	1,4 m x 2	1,4 m x 2
Grid Spacing Settings	40 - 50 - 65 mm	55 - 65 - 95 mm	55 - 65 - 95 mm
Motor Power	2 x 10.1 kW	2 x 12 kW	2 x 13.95 kW
Hopper Volume	10 m^3	11 m^3	12 m^3
CRUSHER			
Model	MPI 1111	MPI 1114	MPI 1515
Feed Opening	Ø1,100 x 1,070 mm	Ø1,100 x 1,400 mm	Ø1,500 x 1,500 mm
Maximum Feed Size	600 mm	600 mm	900 mm
Capacity	200 t/h'e kadar	350 t/h'e kadar	600 t/h'e kadar
Motor Power	160 kW (50 Hz)	200 kW (50 Hz)	315 kW (50 Hz)
DISCHARGE BELT CONVEYOR			
Belt Width	800 mm	1200 mm	1,200 mm
Length	9 m	9 m	9 m
Motor Power	11 kW	15 kW	18.5 kW
TRANSPORTATION DIMENSIONS			
Length	16,4 m	16,8 m	18,4 m
Width	2,6 m	2,9 m	3,1 m
Height	4,3 m	4,3 m	4,3 m
Weight	33,000 kg	38,000 kg	44,000 kg
OPERATING DIMENSIONS			
Length	16,4 m	16,8 m	18,4 m
Width	3,7 m	4 m	4,2 m
Height	5,6 m	5,6 m	5,6 m

7.3. SECONDARY IMPACT CRUSHER UNITS

MP-SI SECONDARY IMPACT CRUSHER UNITS TECHNICAL SPECIFICATIONS

	MP 1210SI	MP 1312SI	MP 1315SI
FEEDER			
Model	MBF 0850	MBF 1050	MBF 1250
Width	800 mm	1000 mm	1200 mm
Length	5 m	5 m	5 m
Motor Power	2 x 4 kW	2 x 5.5 kW	2 x 5,5 kW
Hopper Volume	5 m^3	5 m^3	7 m^3
CRUSHER			
Model	MSI 1210	MSI 1312	MSI 1315
Rotor Dimensions	Ø1,200 x 1,000 mm	Ø1,300 x 1,200 mm	Ø1,300 x 1,500 mm
Maximum Feed Size	250 mm	350 mm	350 mm
Capacity	150 t/h'e kadar	250 t/h'e kadar	350 t/h'e kadar
Motor Power	160 kW (50 Hz)	200 kW (50 Hz)	315 kW (50 Hz)
DISCHARGE BELT CONVEYOR			
Belt Width	800 mm	1000 mm	1,200 mm
Length	7 m	9 m	9 m
Motor Power	7.5 kW	11 kW	15 kW
TRANSPORTATION DIMENSIONS			
Length	13,5 m	15,5 m	15,5 m
Width	2,4 m	2,7 m	3,1 m
Height	4,3 m	4,3 m	4,3 m
Weight	30,000 kg	37,000 kg	40,000 kg
OPERATING DIMENSIONS			
Length	13,6 m	15,6 m	15,6 m
Width	3,7 m	3.9	4,2 m
Height	5,2 m	5,2 m	5,2 m

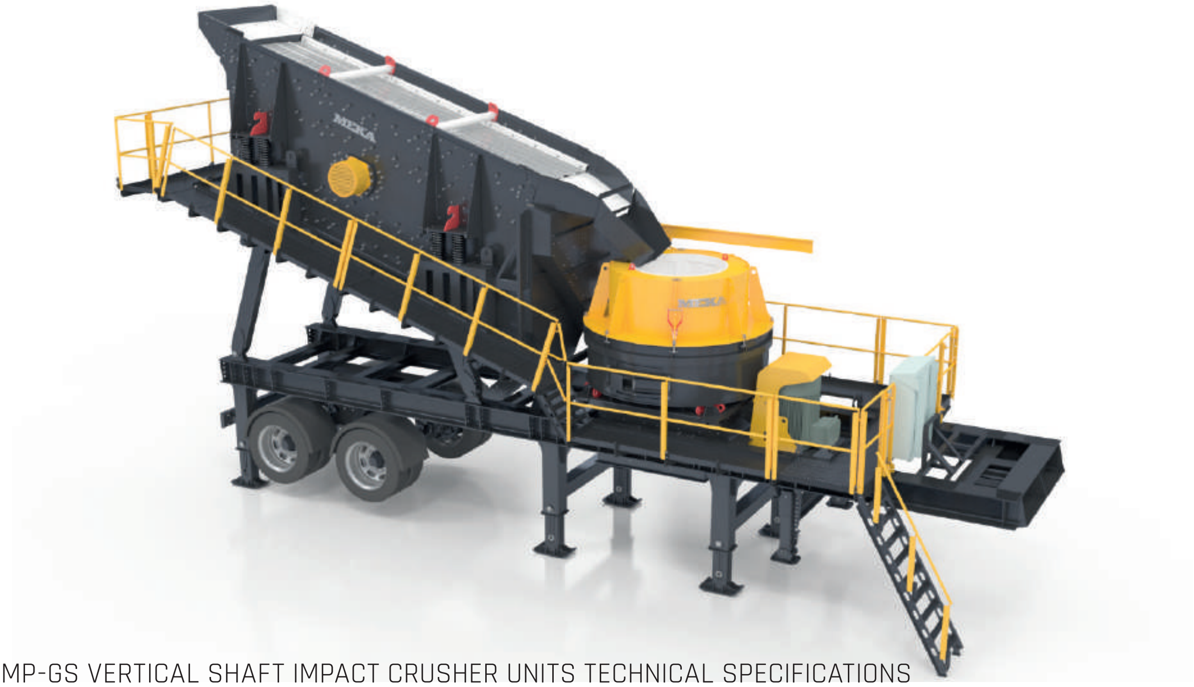
7.4. SECONDARY IMPACT CRUSHER WITH SCREEN UNITS

MP-SI SECONDARY IMPACT CRUSHER UNITS TECHNICAL SPECIFICATIONS

	MP 1111-S	MPIS 1114-S
FEEDER		
Model	MGF 1152	MGF 1460
Width	1,1 m	1,4 m
Length	5,2 m	6 m
Grizzly Length	1 m x 2	1,4 m x 2
Grizzly Gap	40 - 50 - 65 mm	55 - 65 - 95 mm
Motor Power	2 x 10.1 kW	2 x 13.95 kW
Bunker Hacmi	10 m^3	12 m^3
CRUSHER		
Model	MPI 1111	MPI 1114
Rotor Dimensions	Ø1,100 x 1,070 mm	Ø1,100 x 1,400 mm
Maximum Feed Size	600 mm	600 mm
Capacity	200 t/h	350 t/h
Motor Power	160 kW (50 Hz)	200 kW (50 Hz)
SCREEN		
Model	MS 1650 x 2	MS 2050 x 2
Width	1,6 m	2 m
Length	5 m	5 m
Kat Sayısı	2	2
Motor Power	15 kW	18.5 kW
FEEDING BELT CONVEYOR		
Belt Width	800 mm	1200 mm
Length	14 m	14 m
Motor Power	15 kW	18,5 kW

BELT CONVEYOR UNDER SCREEN		
Belt Width	1400 mm	1600 mm
Length	5 m	5 m
Motor Power	2 x 4 kW	2 x 5.5 kW
DISCHARGE BELT CONVEYOR		
Belt Width	650 mm	800 mm
Length	2,5 m	3 m
Motor Power	4 kW	5.5 kW
TRANSPORTATION DIMENSIONS		
Length	20,8 m	21,2 m
Width	3,4 m	3,6 m
Height	4,3 m	4,3 m
Weight	56,000 kg	65,000 kg
OPERATING DIMENSIONS		
Length	20,6 m	21 m
Width	5,2 m	5,6 m
Height	5,8 m	5,8 m

7.5. VERTICAL SHAFT IMPACT CRUSHER UNITS



MP-GS VERTICAL SHAFT IMPACT CRUSHER UNITS TECHNICAL SPECIFICATIONS

	MP 70G-S	MP 90G-S
SCREEN		
Model	MS 1540 x 3	MS 1650 x 3
Width	1,5 m	1,6 m
Length	4 m	5 m
Kat Sayısı	3	3
Motor Power	15 kW	18.5 kW
CRUSHER		
Model	MVI 70	MVI 90
Rotor Dimensions	Ø700 mm	Ø900 mm
Maximum Feed Size	35 mm	45 mm
Capacity	150 t/h'e kadar	300 t/h'e kadar
Motor Power	185 kW (50 Hz)	250 kW (50 Hz)
TRANSPORTATION DIMENSIONS		
Length	10,5 m	14,1 m
Width	2,8 m	3 m
Height	3,9 m	4,3 m
Weight	27,500 kg	34,000 kg
OPERATING DIMENSIONS		
Length	10,1 m	13,1 m
Width	3,7 m	3,9 m
Height	6 m	6,8 m

7.6. TERTIARY CRUSHER UNITS

MP-TI TERTIARY CRUSHER UNITS TECHNICAL SPECIFICATIONS

	MP 1110TI	MP 1115TI
FEEDER		
Model	MBF 0860	MBF 1260
Width	800 mm	1200 mm
Length	6 m	6 m
Motor Power	2 x 4 kW	2 x 5,5 kW
Hopper Volume	5 m^3	7 m^3
CRUSHER		
Model	MTI 1110	MTI 1115
Rotor Dimensions	Ø1,100 x 1,000 mm	Ø1,100 x 1,500 mm
Maximum Feed Size	150 mm	150 mm
Capacity	250 t/h	320 t/h
Motor Power	250 kW (50 Hz)	315 kW (50 Hz)
DISCHARGE BELT CONVEYOR		
Belt Width	800 mm	1,200 mm
Length	7 m	7 m
Motor Gücü	11 kW	15 kW
TRANSPORTATION DIMENSIONS		
Length	15,5 m	15,5 m
Width	2,4 m	3,0 m
Height	4,3 m	4,3 m
Weight	32,000 kg	38,000 kg
OPERATING DIMENSIONS		
Length	13,6 m	13,6 m
Width	3,9 m	4,5 m
Height	5,1 m	5,1 m

7.7. SCREEN UNITS

TECHNICAL SPECIFICATIONS OF INCLINED MP SCREENING UNITS

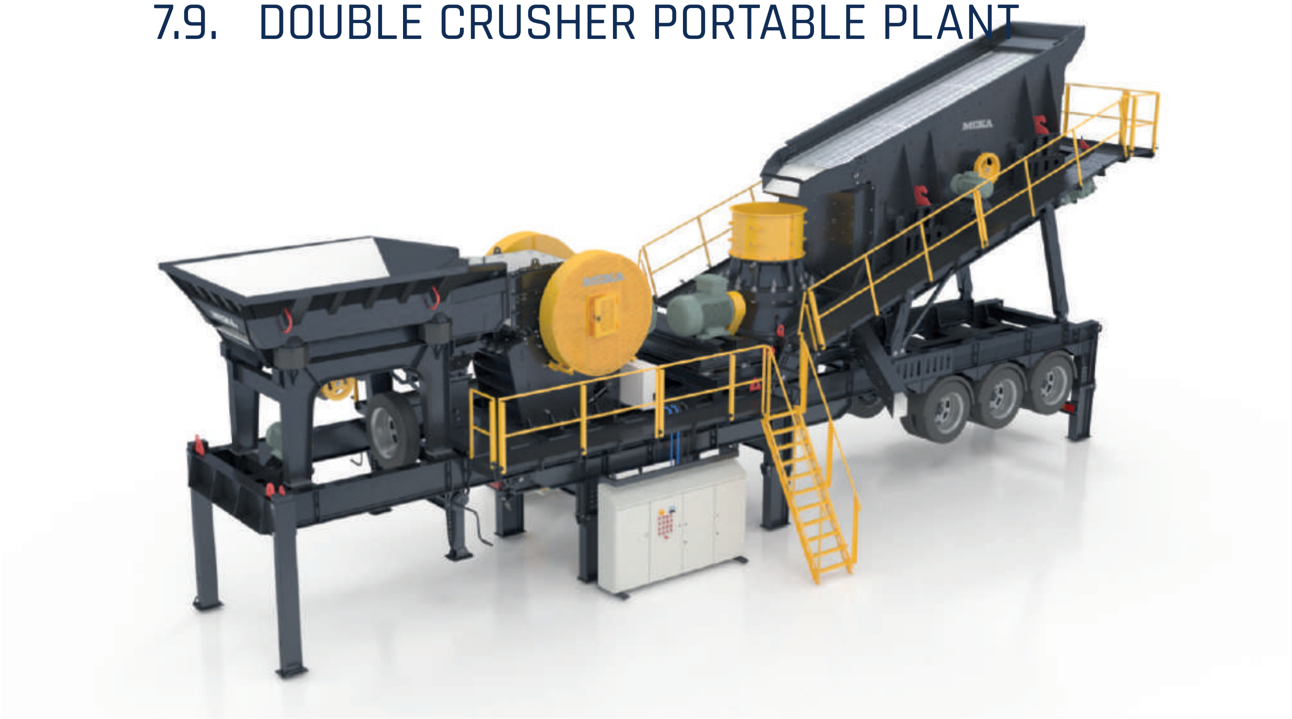
	MP 1650X3	MP 2050X3	MPS 2060X3
SCREEN			
Model	MS 1650 x 3	MS 2050 x 3	MS 2060 x 3
Width	1,6 m	2 m	2 m
Length	5 m	5 m	6 m
Number of Decks	3	3	3
Motor Power	15 kW	18.5 kW	22 kW
BELT CONVEYOR UNDER SCREEN			
Belt Width	1200 mm	1600 mm	1600 mm
Length	5 m	5 m	6 m
Motor Power	2 x 4 kW	2 x 5.5 kW	2 x 5.5 kW
DISCHARGE BELT CONVEYOR			
Belt Width	650 mm	800 mm	800 mm
Length	2,5 m	3 m	3 m
Motor Power	4 kW	5.5 kW	5.5 kW
TRANSPORTATION DIMENSIONS			
Length	10,2 m	10,2 m	11,4 m
Width	2,8 m	3,2 m	3,2 m
Height	4,3 m	4,3 m	4,3 m
Weight	21,900 kg	23,500 kg	25,000 kg
OPERATING DIMENSIONS			
Length	10,1 m	10,1 m	10,8 m
Width	4 m	4,4 m	4,4 m
Height	7,2 m	7,2 m	7,6 m

7.8. 7.8. SCREENING-WASHING UNITS

TECHNICAL SPECIFICATIONS OF MPWP SCREENING-WASHING UNITS

	MPWP
SCREEN	
Model	MHS 6203
Width	1,93 m
Length	6,1 m
Number of Decks	3
Motor Power	30 kW
WASHING UNITS	
Diameter	Ø900 mm
Length	7,6 m
Material Size	10 mm
Speed	21 dev/dak
Motor Power	2 x 15 kW
DISCHARGE BELT CONVEYOR	
Belt Width	800 mm
Length	3 m
Motor Power	5,5 kW
TRANSPORTATION DIMENSIONS	
Length	14,2 m
Width	3,6 m
Height	4,4 m
Weight	38,500 kg
OPERATING DIMENSIONS	
Length	14,6 m
Width	3,9 m
Height	5,3 m

7.9. DOUBLE CRUSHER PORTABLE PLANT



TECHNICAL SPECIFICATIONS OF MPD DOUBLE CRUSHER PLANT

	MPWP
FEEDER	
Model	MGF 1036
Width	1 m
Length	3,6 m
Grizzly Length	2 x 0,9 m
Grizzly Açıklığı	Minimum 45 mm / Ayarlanabilir
Motor Power	15 kW
Hopper Volume	4,5 m^3
CRUSHER	
Model	MJ 90
Feed Opening	900 x 650 mm
Maximum Feed Size	580 mm
Capacity	250 t/h'e kadar
Jaw Outlet Width	60 - 200 mm
Motor Power	75 kW (50 Hz)
SCREEN	
Model	MS 1650 x 3
Width	1,6 m
Length	5 m
Number of Decks	3
Motor Power	15 kW

MEKA

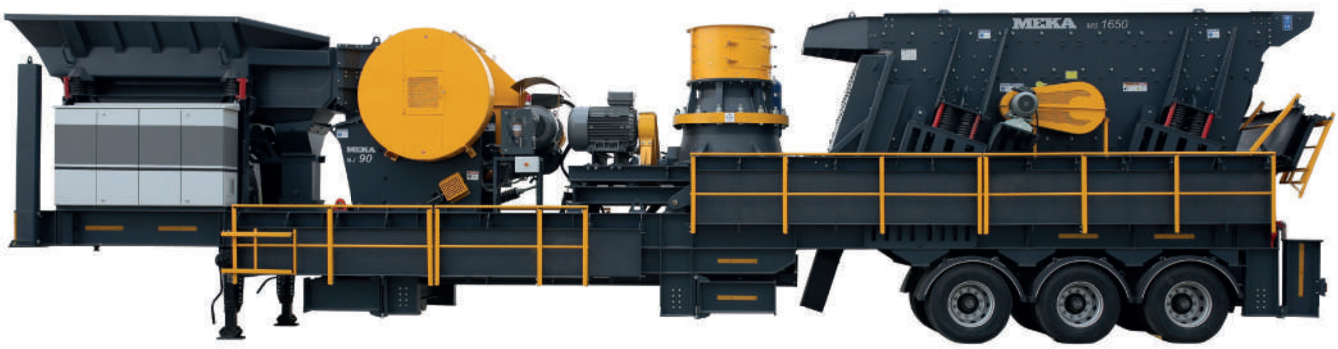
CONE CRUSHER	
Model	MCH 900
Maximum Feed Size	130 mm
Capacity	130 mtph'a kadar
Motor Power	110 kW (50 Hz)

BELT CONVEYOR UNDER CRUSHER	
Belt Width	1000 mm
Length	6 m
Motor Power	7.5 kW

BELT CONVEYOR UNDER SCREEN	
Belt Width	1400 mm
Length	5 m
Motor Power	7.5 kW

TRANSPORTATION DIMENSIONS	
Length	17 m
Width	2,9 m
Height	4,3 m
Weight	52,500 kg

OPERATING DIMENSIONS	
Length	16,5 m
Width	3,8 m
Height	6,4 m



7.10. SCREENING UNITS

TECHNICAL SPECIFICATIONS OF MP-F PORTABLE SCREENING UNIT

	MP 1650X3-F	MP 2050X3-F	MP 2060X3-F
HOPPER			
Volume	10 m^3	10 m^3	10 m^3
BELT FEEDER			
Belt Width	800 mm	1000 mm	1000 mm
Length	2 m	2 m	2 m
Motor Power	5.5 kW	5.5 kW	5.5 kW
SCREEN FEED BELT CONVEYOR			
Belt Width	800 mm	1000 mm	1000 mm
Length	11 m	11 m	12 m
Motor Power	2 x 5.5 kW	2 x 7.5 kW	2 x 7.5 kW
SCREEN			
Model	MS 1650 x 3	MS 2050 x 3	MS 2060 x 3
Width	1,6 m	2 m	2 m
Length	5 m	5 m	6 m
Number of Decks	3	3	3
Motor Power	15 kW	18.5 kW	22 kW
PRODUCT BELT CONVEYOR UNDER SCREEN			
Belt Width	1200 mm	1600 mm	1600 mm
Length	5 m	5 m	6 m
Motor Power	2 x 4 kW	2 x 5.5 kW	2 x 5.5 kW
DISCHARGE BELT CONVEYOR			
Belt Width	650 mm	800 mm	800 mm
Length	8 m	8 m	8 m
Motor Power	5.5 kW	7.5 kW	7.5 kW

TRANSPORTATION DIMENSIONS			
Length	15 m	15 m	16,4 m
Width	2,8 m	3,2 m	3,2 m
Height	4,3 m	4,3 m	4,3 m
Weight	34,000 kg	36,000 kg	38,000 kg

OPERATING DIMENSIONS			
Length	15 m	15 m	16,4 m
Width	15 m	15,6 m	15,6 m
Height	7,2 m	7,2 m	7,6 m

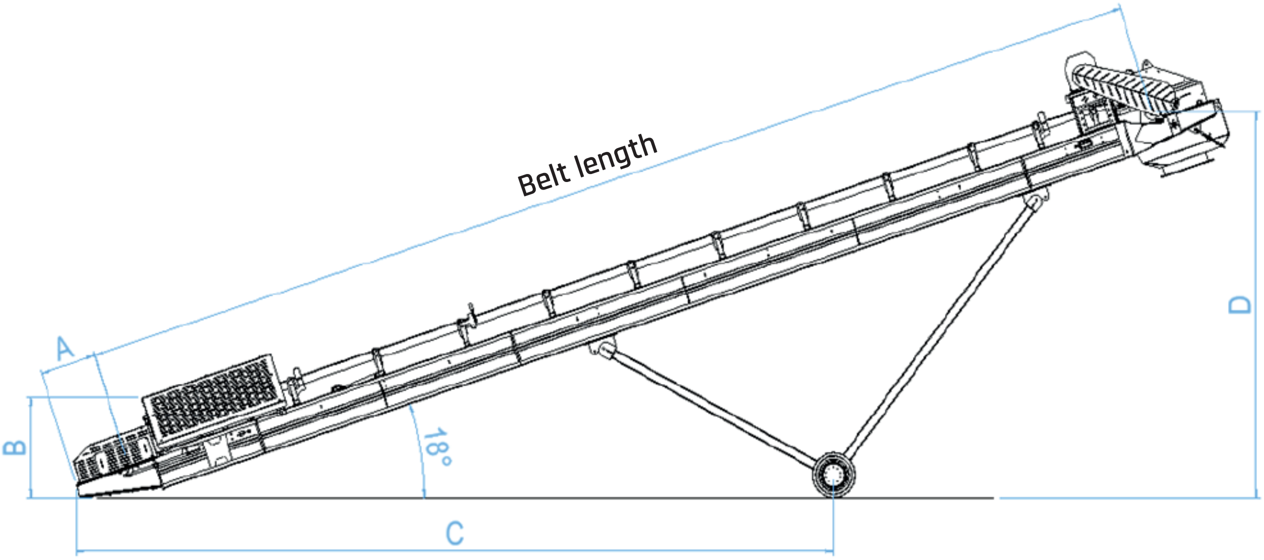
SECTION 8
BELT CONVEYORS

Belt conveyors are one of the essential components of crushing and screening plants. Material is conveyed from crushers to other crushers, screens, or stockpiles through belt conveyors. These conveyors exhibit different features depending on the location where they are used.

In MEKA belt conveyors, each equipment and part comply with international standards. All the necessary precautions are taken for human health and safety. Impact roller groups are placed at loading points with at least 4 units at short intervals. Drive drums must be rubber-coated and equipped with suitable grooves for water drainage.

THE APPROXIMATE DIMENSIONS AND TECHNICAL SPECIFICATIONS OF BELT CONVEYORS

8.1. RADIAL STACKER BELT CONVEYORS



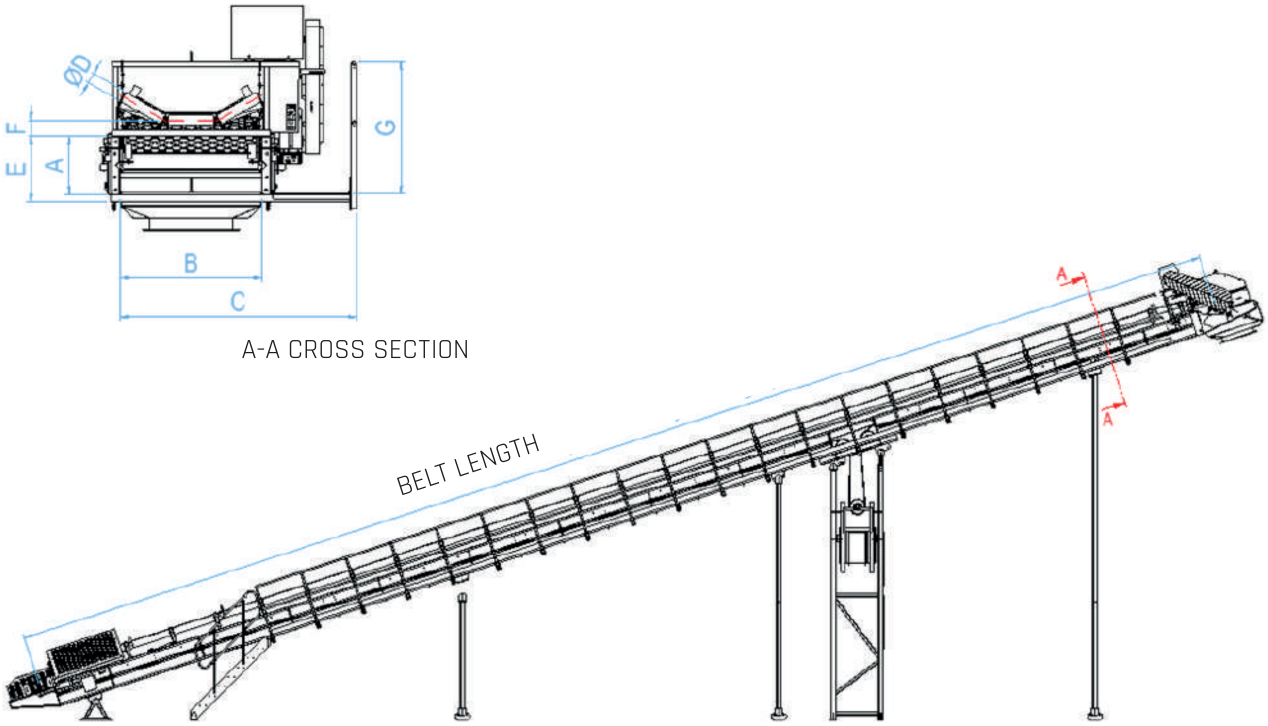
The General Dimensions of MEKA Radial Stacker Belt Conveyors

Belt conveyor length (m)	Belt conveyor width (mm)	A	B	C	D
10	650	620	1064	7421	3465
	800	620	1064	7421	3465
	1000	808	1169	7421	3523
	1200	808	1169	7421	3523
12	650	620	1064	8840	4083
	800	620	1064	8840	4083
	1000	808	1169	8840	4141
	1200	808	1169	8840	4141
15	650	620	1064	10982	5010
	800	620	1064	10982	5010
	1000	808	1169	10982	5068
	1200	808	1169	10982	5068
16	650	620	1064	11680	5319
	800	620	1064	11680	5319
	1000	808	1169	11680	5377
	1200	808	1169	11680	5377
17	650	620	1064	12388	5628
	800	620	1064	12388	5628
	1000	808	1169	12388	5686
	1200	808	1169	12388	5686
18	650	620	5937	13100	382
	800	620	5937	13100	382
	1000	808	5995	13100	495
	1200	808	5995	13100	495
19	650	620	6246	13820	382
	800	620	6246	13820	382
	1000	808	6304	13820	495
	1200	808	6304	13820	495
20	650	620	6555	14530	382
	800	620	6555	14530	382
	1000	808	6613	14530	495
	1200	808	6613	14530	495
21	650	620	6864	15226	382
	800	620	6864	15226	382
	1000	808	6922	15226	495
	1200	808	6922	15226	495
22	650	620	7173	15935	382
	800	620	7173	15935	382
	1000	808	7231	15935	495
	1200	808	7231	15935	495
23	650	620	7482	16645	382
	800	620	7482	16645	382
	1000	808	7540	16645	495
	1200	808	7540	16645	495
24	650	620	7791	17354	382
	800	620	7791	17354	382
	1000	808	7850	17354	495
	1200	808	7850	17354	495
25	650	620	8100	18065	382
	800	620	8100	18065	382
	1000	808	8158	18065	495
	1200	808	8158	18065	495
26	650	620	8409	18773	382
	800	620	8409	18773	382
	1000	808	8467	18773	495
	1200	808	8467	18773	495
27	650	620	8409	19482	382
	800	620	8409	19482	382
	1000	808	8467	19482	495
	1200	808	8467	19482	495
28	650	620	9027	20205	382
	800	620	9027	20205	382
	1000	808	9085	20205	495
	1200	808	9085	20205	495
29	650	620	9394	20900	382
	800	620	9394	20900	382
	1000	808	9336	20900	495
	1200	808	9336	20900	495
30	650	620	9665	21624	382
	800	620	9665	21624	382
	1000	808	9703	21624	495
	1200	808	9703	21624	495

Technical Specifications of MEKA Radial Stacker Belt Conveyors

Belt conveyor length (m)	Belt conveyor width (mm)	Motor Power (KW)	Belt conveyor speed (m/s)	Belt conveyor angle (X0)	Belt conveyor length (m)	Belt conveyor width (mm)	Motor Power (KW)	Belt conveyor speed (m/s)	Belt conveyor angle (X0)
10	650	5,5	1,5	18	**22**	650	11	1,5	18
	800	7,5	1,5	18		800	15	1,5	18
	1000	11	1,5	18		1000	15	1,5	18
	1200	15	1,5	18		1200	22	1,5	18
12	650	5,5	1,5	18	**23**	650	11	1,5	18
	800	7,5	1,5	18		800	15	1,5	18
	1000	11	1,5	18		1000	18,5	1,5	18
	1200	15	1,5	18		1200	22	1,5	18
15	650	7,5	1,5	18	**24**	650	11	1,5	18
	800	11	1,5	18		800	15	1,5	18
	1000	15	1,5	18		1000	18,5	1,5	18
	1200	18,5	1,5	18		1200	22	1,5	18
16	650	7,5	1,5	18	**25**	650	11	1,5	18
	800	11	1,5	18		800	15	1,5	18
	1000	15	1,5	18		1000	18,5	1,5	18
	1200	18,5	1,5	18		1200	22	1,5	18
17	650	7,5	1,5	18	**26**	650	11	1,5	18
	800	15	1,5	18		800	15	1,5	18
	1000	15	1,5	18		1000	18,5	1,5	18
	1200	18,5	1,5	18		1200	22	1,5	18
18	650	7,5	1,5	18	**27**	650	11	1,5	18
	800	15	1,5	18		800	15	1,5	18
	1000	15	1,5	18		1000	18,5	1,5	18
	1200	18,5	1,5	18		1200	22	1,5	18
19	650	7,5	1,5	18	**28**	650	11	1,5	18
	800	15	1,5	18		800	15	1,5	18
	1000	15	1,5	18		1000	18,5	1,5	18
	1200	18,5	1,5	18		1200	22	1,5	18
20	650	7,5	1,5	18	**29**	650	11	1,5	18
	800	15	1,5	18		800	18,5	1,5	18
	1000	15	1,5	18		1000	18,5	1,5	18
	1200	18,5	1,5	18		1200	22	1,5	18
21	650	11	1,5	18	**30**	650	11	1,5	18
	800	15	1,5	18		800	18,5	1,5	18
	1000	15	1,5	18		1000	18,5	1,5	18
	1200	18,5	1,5	18		1200	22	1,5	18

8.2. FIXED BELT CONVEYORS



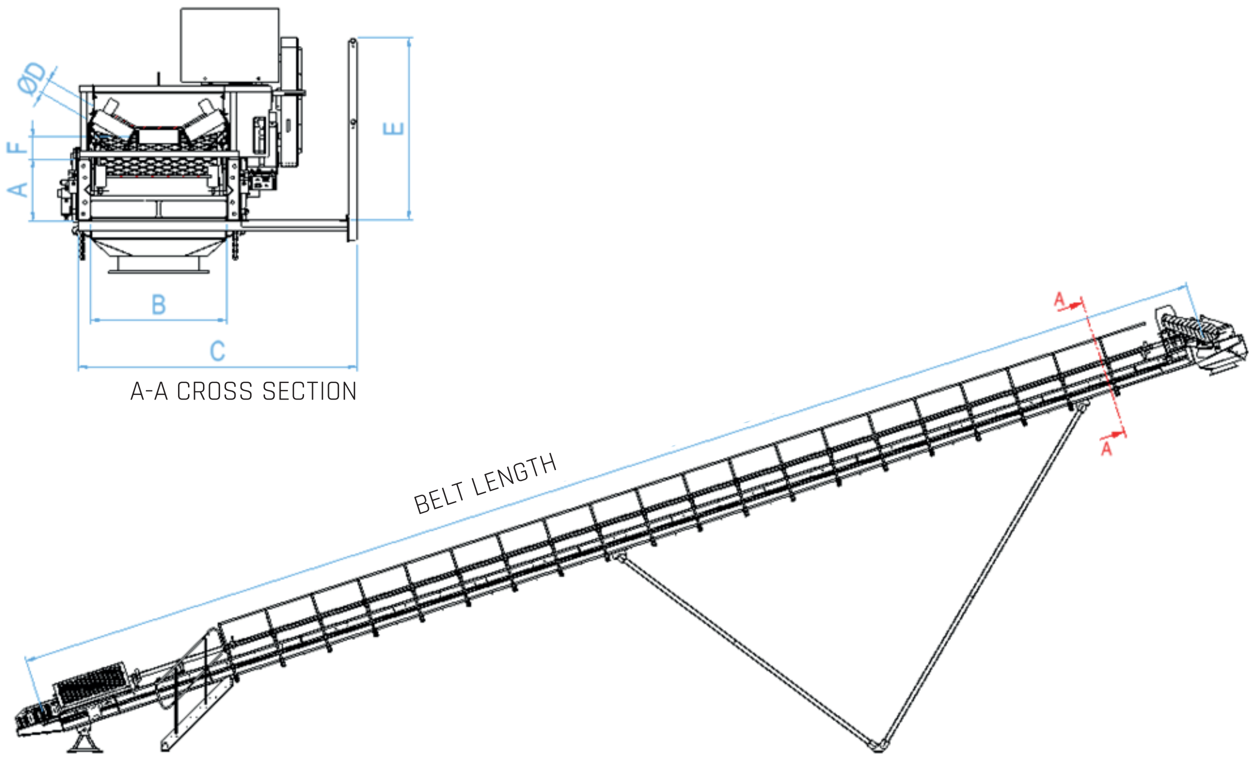
MEKA Fixed Belt Conveyor Cross-sectional Dimensions

Belt width mm	DIMENSIONS						
	A	B	C	D	E	F	G
650	382	840	1174	89	442	135	1080
800	382	1000	1800	89	442	135	1080
1000	495	1200	2074	89	555	135	1080
1200	495	1450	2323	108	555	135	1080

MEKA Fixed Belt Conveyor Technical Specifications

Belt conveyor length (m)	Belt conveyor width (mm)	Motor Power (KW)	Belt conveyor speed (m/s)	Belt conveyor angle (X0)
650	26-30	11	1,5	18
	31-40	15	1,5	18
	41-48	15	1,5	18
	49-66	18,5	1,5	18
	67-90	22	1,5	18
800	26-30	15	1,5	18
	31-42	18,5	1,5	18
	43-54	22	1,5	18
	55-66	30	1,5	18
	67-90	37	1,5	18
1000	26-28	18,5	1,5	18
	29-40	22	1,5	18
	41-52	30	1,5	18
	53-62	30	1,5	18
	63-90	37	1,5	18
1200	26-32	22	1,5	18
	33-40	37	1,5	18
	41-50	37	1,5	18
	51-70	45	1,5	18

8.3. V-LEG FIXED BELT CONVEYORS



MEKA V-Leg Fixed Belt Conveyor Cross-sectional Dimensions

Belt width mm	DIMENSIONS					
	A	B	C	D	E	F
650	382	840	1174	89	1080	135
800	382	1000	1800	89	1080	135
1000	495	1200	2074	89	1080	135
1200	495	1450	2323	108	1080	135

SECTION 9
STANDARDS AND IMPORTANT TECHNICAL INFORMATION

BELT CONVEYOR CALCULATIONS

Belt Width and Belt Conveyor Speed

Table 4 is used as a reference for belt width selection, while Table 5 is used as a reference for conveyor speed selection.

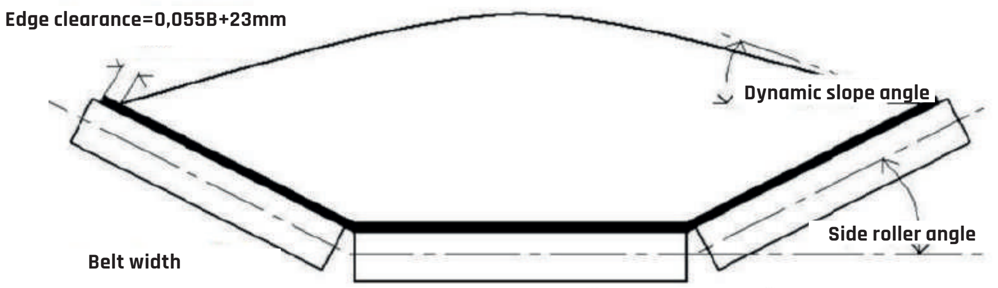
Capacity

Volumetric capacity values (V) for belt conveyors are provided in Table 1 in m^3/h. These values are given for belt conveyors operating with a dynamic slope angle of 20°, side roller angle of 35°, and in a horizontal position. Thus, the capacity of the belt conveyor is calculated by using the following formula

$$Q = V * \rho * \cos\alpha * CF$$

Where:
Q: Capacity, t/h
V: Volumetric capacity, m^3/h (Table 1)
ρ: Material heap density, t/m^3
cosα : Cosine of the belt incline angle (Table 2)
CF : Capacity factor (Table 3)

3-roller belt conveyor section



Capacity of the belt conveyor
Material heap density
Dynamic slope angle 20°
Side roller angle 35°

Belt width	Bant speed, m/sec											
	0.5	0.75	1	1.25	1.5	2	2.5	3	3.5	4	4.5	5
400mm	26	39	52	65	78	104	130	156	182	209	235	261
450mm	34	51	69	86	103	137	172	206	240	274	309	343
500mm	44	65	87	109	131	175	218	262	306	349	393	437
600mm	66	99	131	164	197	263	329	394	460	526	592	657
650mm	78	118	157	196	235	314	392	471	549	628	706	785
750mm	107	161	215	268	322	429	536	644	751	858	965	1073
800mm	123	185	247	308	370	493	617	740	863	987	1110	1233
900mm	159	238	318	397	477	635	794	953	1112	1271	1430	1589
1000mm	199	298	398	497	597	795	994	1193	1392	1591	1790	1989
1050mm	221	331	441	551	662	882	1103	1323	1544	1764	1985	2206
1200mm	292	438	585	731	877	1169	1462	1754	2046	2339	2631	2923
1350mm	374	561	748	936	1123	1497	1871	2245	2619	2994	3368	3742
1400mm	404	606	807	1009	1211	1615	2019	2422	2826	3230	3634	4037
1500mm	466	699	932	1165	1398	1865	2331	2797	3263	3729	4195	4662
1600mm	533	800	1066	1333	1599	2132	2665	3198	3731	4265	4798	5331
1800mm	680	1020	1361	1701	2041	2721	3402	4082	4762	5443	6123	6803
2000mm	846	1268	1691	2114	2537	3382	4228	5073	5919	6764	7610	8455
2200mm	1029	1543	2057	2572	3086	4115	5143	6172	7201	8229	9258	10287

Table 1 : Volumetric capacity values for belt conveyors according to belt width, V

Consines

Slope angle	0°	5°	10°	15°	17.5°	20°	22.5°	25°
Cos	1.000	0.996	0.985	0.966	0.954	0.940	0.924	0.906

Table 2: Cosine values of the incline angle

CF : Capacity Factor

DİNAMİK ŞEV AÇISI	*YAN RULO AÇISI*				
	20°	25°	30°	35°	45°
0°	0.43	0.53	0.61	0.69	0.81
5°	0.52	0.61	0.69	0.77	0.88
10°	0.61	0.70	0.77	0.84	0.94
15°	0.70	0.78	0.86	0.92	1.04
20°	0.79	0.87	0.94	1.00	1.08
25°	0.88	0.96	1.03	1.08	1.15

Table 3 Capacity factor values for different dynamic slope angles and different side roller angles

Allowed maximum particle sizes for belt widths

Belt width mm	Uniform particle sizes	If approximately 80% fine material is mixed
400	75	125
450	100	150
500	100	175
600	125	200
650	125	250
750	150	300
800	150	300
900	175	325
1000	200	375
1050	200	375
1200	300	450
1350	300	500
1400	300	600
1500	350	600
1600	375	600
1800	450	600
2000	450	600
2200	475	650

Table 4 Allowed maximum particle sizes for belt widths

Recommended typical belt speeds (m/sec)

Belt width mm	Granular material and free-flowing materials	Quarry materials, crus-hed coal, and soil	Hard ore and stone
400	2.0	1.5	-
450	2.5	2.25	1.75
500	3.0	2.25	1.75
600	3.0	2.5	2.25
650	3.25	2.75	2.50
750	3.5	3.0 - 3.5	2.75
800	3.75	3.0 - 3.5	2.75
900	4.0	3.0 - 3.5	3.0
1000	4.0	3.0 - 3.5	3.0
1050	4.0	3.0 - 3.5	3.0
1200	4.0	3.25 - 4.0	3.0 - 3.5
1350	4.5	3.25 - 4.0	3.0 - 3.5
1400	4.5	3.25 - 4.0	3.0 - 3.5
1500	4.5	3.25 - 4.0	3.0 - 3.5
1600	5.0	3.75 - 4.25	3.25 - 4.0
1800	5.0	3.75 - 4.25	3.25 - 4.0
2000	-	3.75 - 4.25	3.25 - 4.0
2200	-	3.75 - 4.25	-

Forces to be transmitted to the Conveyor Belt by the Drive Drum:

The conveyor drive system should transmit the following forces to the conveyor belt:

- **F1,** the force required to set the empty conveyor belt and conveyor rollers in motion
- **F2,** the force required to convey the material along the conveyor
- **F3,** the force required to elevate the material
- **F4,** the frictional forces applied by additional elements of the belt conveyor (belt scrapers, side skirt scrapers, etc.)

F1, The formula for the force required to move an empty conveyor belt and its rollers is as follows:

F1 =C * f * L * [2q* (B/1000) * Cosβ +(qr'/a') + (qr"/a")]

F1: kg.

C: Length coefficient, obtained from Graph 1

f: Roller friction coefficient. Depending on roller design varies between 0.017-0.04. Standard value f=0.020-0.025 . In extremely dusty environments and low temperatures should be taken as 0.035-0.04.

L: Distance between conveyor drum axes, m

B: Belt width, m

β: Conveyor inclination angle (^{0})

q: Belt weight per unit area, kg/m^2

qr′ and qr′′: Weight of the rotating parts of the carrying and return roller groups kg, obtained from Table 11.

a′ and a′′: In order, distance between the carrying and return roller groups, m

F2, Force Required to Move Material Along the Conveyor:

F2 =C * f * L * [Q / (3,6 * v)] * Cosβ

F2: Force required to move material along the conveyor, kg

Q: Capacity, tons per hour

v: Conveyor speed, m/sec

F3, Force Required to Lift Material:

F3 = (Q * H) / (3,6 * v)

F3: Force required to lift material, kg

H: Height the material needs to be lifted, m

F4, Force Required to Overcome Resistance from Loading Hoppers or Side Skirts:

F4 = 2 * fS * lS * hS2

F4: Force required to overcome resistance from loading hoppers or side skirts, kg

fS: Friction coefficient between material and side skirts (obtained from Table 11)

lS: Length of the loading chute or skirt, m

hS: Height of the material , m

hS = 0,1 * B

B: Belt width, m

NOTE: If there is rubber under the side skirts or loading chute, an additional force of 4.5 kg/m is added for each meter of rubber.

Total Force F required for the Conveyor Drive System:

F=F1+F2+F3+F4

Required Motor Power:

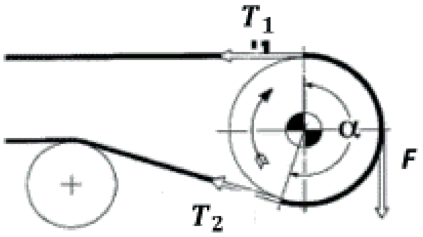
$$P = \frac{Fv}{102\eta}$$

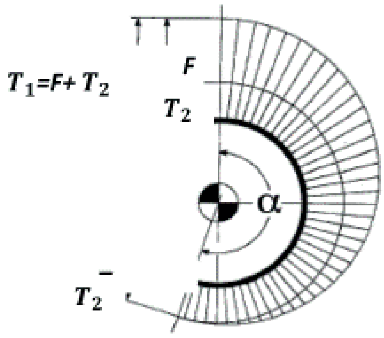
F : Total force required for the conveyor drive system, daN

v : Conveyor speed, m/s

η : Mechanical efficiency, it is appropriate to use η=0.90

Stresses in the Conveyor Belt:





Equations Used for Stresses:

$$T_1 = F + T_2$$

$$\frac{T_1}{T_2} = e^{\mu\alpha}$$

$$K = \frac{1}{e^{\mu\alpha} - 1}$$
$$T_2 = KF$$
$$T_1 = (K+1)F$$

μ: Coefficient of friction between the drum and conveyor belt.

For uncoated drums, μ =0.25, for rubber-coated drums, μ=0.35;

α: Wrap angle of the belt on the drum, in radians.

$$D = C_{T_r} * s_k$$

Conveyor Drum Diameter Calculation:

Drive drum diameter

D = sk * CTr

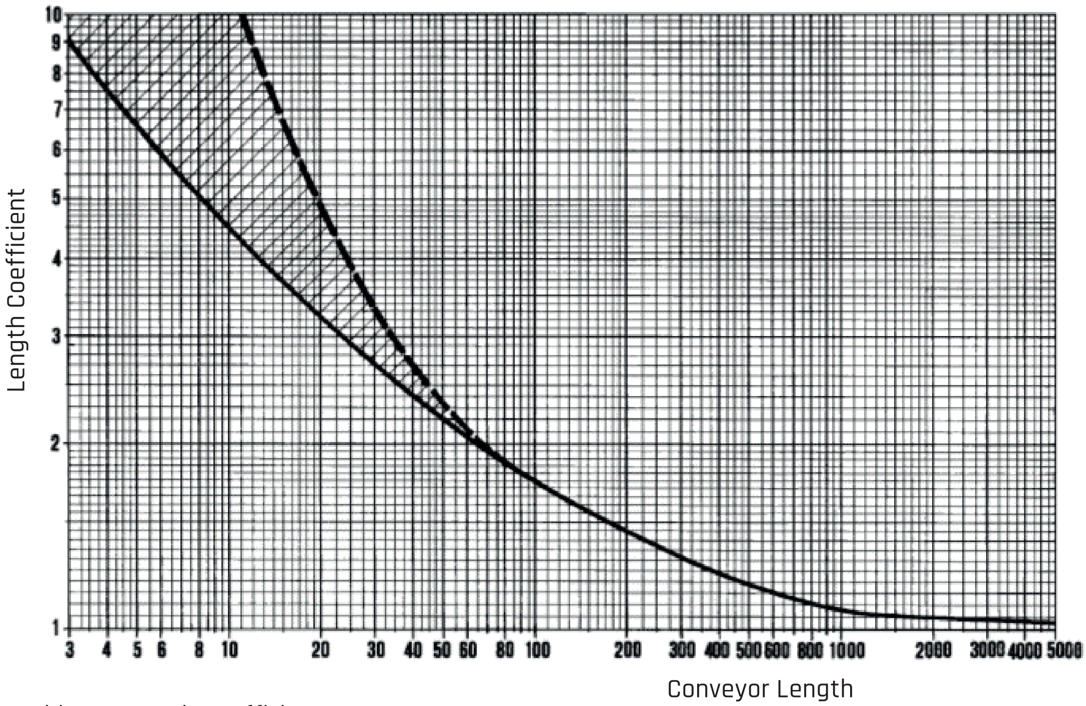
D: Minimum drum diameter, mm.

sk: Carcass thickness (Table 8), in the case of steel-corded belts, it is the cord diameter, mm.

CTr: Coefficient

Carcass reinforcement material	C_{T_r}
B (cotton)	80
P (polyamide)	90
E (polyester)	108
St (steel)	145

Tables and Charts Used in Conveyor Calculations:



Graphic 1 C Length Coefficient

Roller Diameter	Number of Rollers	Belt Width (mm)											
		300	400	500	650	800	1000	1200	1400	1600	1800	2000	2200
63	Single	2,2	2,7	3,3	4,0	4,8	–	–	–	–	–	–	–
	Double	3,5	3,7	4,1	4,8	5,7	–	–	–	–	–	–	–
	Triple	–	4,4	4,7	5,5	6,5	–	–	–	–	–	–	–
89	Single	–	–	5,5	6,2	6,9	7,8	–	–	–	–	–	–
	Double	–	–	8,4	9,2	9,9	10,8	–	–	–	–	–	–
	Triple	–	–	11,1	11,8	12,5	13,4	–	–	–	–	–	–
108	Single	–	–	7,2	8,2	9,2	10,4	16,7	–	–	–	–	–
	Double	–	–	11,4	12,4	13,4	14,5	19,5	–	–	–	–	–
	Triple	–	–	15,2	16,2	17,2	18,5	21,6	–	–	–	–	–
133	Single	–	–	–	10,0	11,3	18,8	23,3	26,2	27,8	–	–	–
	Double	–	–	–	15,3	16,7	22,3	26,9	31,0	34,5	–	–	–
	Triple	–	–	–	20,0	21,3	25,0	30,3	34,6	39,8	–	–	–
159	Single	–	–	–	–	–	–	30,2	33,4	37,4	41,2	44,7	–
	Double	–	–	–	–	–	–	35,5	35,2	43,2	46,7	50,7	–
	Triple	–	–	–	–	–	–	39,9	44,3	47,7	51,2	55,8	–
191	Single	–	–	–	–	–	–	–	–	–	58,0	63,0	68,5
	Double	–	–	–	–	–	–	–	–	–	63,2	69,5	75,0
	Triple	–	–	–	–	–	–	–	–	–	75,5	80,5	86,5

Table 6 roller weights

Carcass style	Carcass weight kg/m²	Carcass style	Carcass weight kg/m²	Carcass style	Carcass weight kg/m²	Carcass style	Carcass weight kg/m²	Carcass style	Carcass weight kg/m²
250/2	2,2	630/3	4,9	1000/3	7,1	1250/5	10,0	2000/6	13,9
315/2	2,7	630/4	5,4	1000/4	8,0	1600/4	11,9	2500/4	17,0
400/3	3,3	800/3	6,0	1000/5	8,1	1600/5	11,8	2500/5	18,7
500/3	4,1	800/4	6,5	1250/3	9,0	2000/4	15,0	3150/5	22,3
500/4	4,4	800/5	6,7	1250/4	9,5	2000/5	15,0	3150/6	22,0

Table Carcass weight

NOT: The weight of 1 square meter of rubber coating with a thickness of 1 mm is 1.2 kg.

Material Conditions		Top coating thickness, mm	Bottom coating thickness, mm
Light	Very fine coal, sawdust, chimney dust	2,0	0,8 - 1,0
Slightly abrasive	Sand, bituminous coal, stones and coal smaller than 75 mm	2,0 - 3,0	0,8 - 1,0
Abrasive	Anthracite coal, coke, sinter, ores smaller than 250 mm, stone	2,5 - 6,0	1,6 - 2,0
Heavy and abrasive	Stones larger than 250 mm, heavy and sharp-edged ores	6,0 - 12,0	2,0

, Table 8 Coating Thicknesses of Belts According to Material Type.

Belt Style Tensile Strength, KN/m	Number of carcasses KN/m	Maximum Tensile Strength		Carcass		Carcass Strength N/min
		Vulcanized N/mm	Added N/mm	Carcass Weight Kg/m2	Carcass Thickness, mm	
250/2	2	25	20	2,2	1,9	125
315/2	2	32	25	2,7	2,3	160
400/3	3	40	32	3,3	2,9	125
500/3	3	50	40	4,1	3,5	160
500/4	4	50	40	4,4	3,8	125
630/3	3	63	50	4,9	4,0	200
630/4	4	63	50	5,4	4,6	160
800/3	3	80	63	6,0	4,9	250
800/4	4	80	63	6,5	5,4	200
1000/3	3	100	80	7,1	5,7	315
1000/4	4	100	80	8,0	6,4	250
1000/5	5	100	80	8,1	6,8	200
1250/3	3	125	–	9,0	6,9	400
1250/4	4	125	–	9,5	7,6	315
1250/5	5	125	–	10,0	8,0	250
1600/4	4	160	–	11,9	9,2	400
1600/5	5	160	–	11,9	9,5	315
2000/4	4	200	–	15,0	11,4	500
2000/5	5	200	–	15,0	11,4	400
2500/5	5	250	–	18,7	14,2	500
3150/6	6	315	–	22,3	17,4	500

Table 9 Recommended Belt Series and Technical Specifications for Textile Reinforced Belts.

Belt style	Maximum belt force utilization rate, %								
	%60-%100			%30-%60			Up to %30		
	A	B	C	A	B	C	A	B	C
250/2	250	200	160	200	160	125	160	160	125
315/2	250	200	160	200	160	125	160	160	125
400/3	315	250	200	250	200	160	200	200	160
500/3	400	315	250	315	250	200	250	250	200
500/4	500	400	315	400	315	250	315	315	250
630/3	500	400	315	400	315	250	315	315	250
630/4	500	400	315	400	315	250	315	315	250
800/3	630	500	400	500	400	315	400	400	315
800/4	630	500	400	500	400	315	400	400	315
1000/3	630	500	400	500	400	315	400	400	315
1000/4	800	630	500	630	500	400	500	500	400
1000/5	800	630	500	630	500	400	500	500	400
1250/3	800	630	500	630	500	400	500	500	400
1250/4	1000	800	630	800	630	500	630	630	500
1250/5	1000	800	630	800	630	500	630	630	500
1600/4	1000	800	630	800	630	500	630	630	500
1600/5	1250	1000	800	1000	800	630	800	800	630
2000/4	1250	1000	800	1000	800	630	800	800	630
2000/5	1250	1000	800	1000	800	630	800	800	630
2500/5	1600	1250	1000	1250	1000	800	1000	1000	800
3150/6	2000	1600	1250	1600	1250	1000	1250	1250	1000

A: Drive drum, tripper drum
B: Tail, return, tail drum
C: Deflection drum

MATERIAL TYPE	Side skirt friction coefficient, fs	MATERIAL TYPE	Side skirt friction coefficient, fs
Gypsum, -12mm	10	Kaolin, dry	11
Bauxite, Ground	216	Lime, unslaked	134
Glass shards	96	Lime, slaked	56
Raw stone, crushed stone	132	Limestone, fine	147
Cement	244	Clinker	141
Iron ore	318	Coke, fine	52
Phosphate rock	125	Coke, coarse	21
Coal, anthracite	62	Coal, bituminous	87
Sand, dry	158	Grain	50

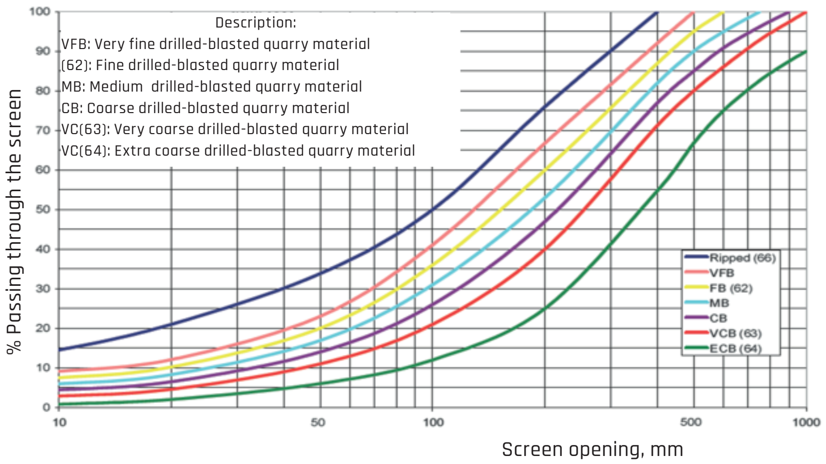
Table 11 Friction coefficients between some materials and side skirts.

SIZE DISTRIBUTION CURVES OF AGGREGATES EXTRACTED FROM QUARRIES

STANDARDS FOR MOST COMMON AGGREGATE APPLICATIONS

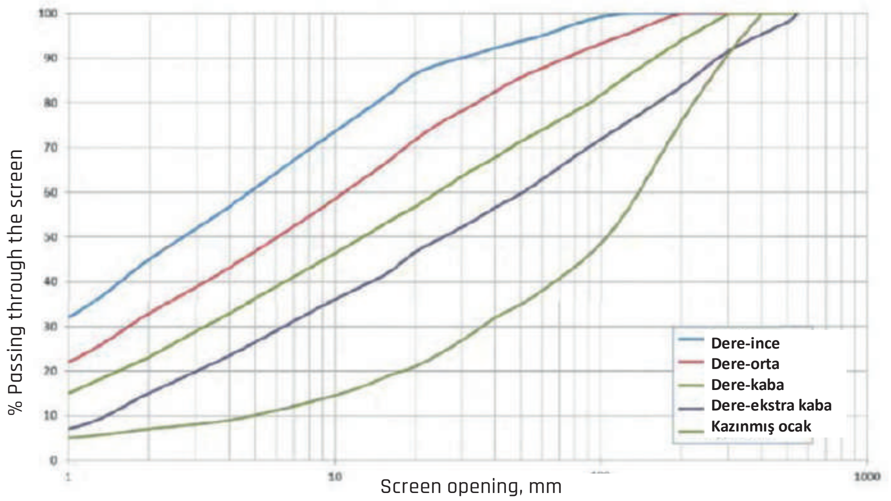
COUNTRY	STANDARD	CONCRETE AGGREGATE	ASPHALT AGGREGATE	RAILWAY BALLAST
EUROPEAN UNION	EN	EN 12620	EN 13043	EN 13450
ENGLAND	BS	BS 882	BS 63	
U.S.A.	ASTM	C 33	D 692	AREMA/C33
RUSSIAN FEDERATION	GOST	GOST 8287-93	GOST 8287-93	GOST 7392-85
JAPAN	JIS	JIS A 5005-1987		

SIZE DISTRIBUTION CURVES OF AGGREGATES EXTRACTED FROM QUARRIES



Size distribution curves of quarry materials obtained by drilling and blasting

Size distribution curves of various structured river materials



Size distribution curves of various structured river materials

ROCK TYPES

Main types of rocks:

a- Volcanic Rocks (Igneous Rocks)

b- Sedimentary Rocks (Sedimentary Rocks)

c- Metamorphic Rocks (Metamorphic Rocks)

d- Ores

Volcanic Rocks

EThese rocks form when molten material (magma) cools on the surface or within the depths of the Earth's crust. They consist of Quartz, Feldspar, Pyroxene, Amphiboles, Mica, and Olivine crystals, primarily derived from silicate melt.

They are classified into three subgroups based on the region of formation.

- Surface Rocks: Glass-like, fine-grained (grain size <0.1 mm)
- Intrusive Rocks: Medium-grained (grain size 0.1-2 mm)
- Deep Rocks: Coarse-grained (grain size > 2 mm)

Significant Volcanic Rocks

SİO2 RATIO	DEEP ROCKS	INTRUSIVE ROCKS	SURFACE ROCKS
< 52% (bazik)	GABBRO	DIABASE	BASALT
52 - 62% (or-ta)	DIORITE	PORPHYRY	ANDESITE
> 62% (asidik)	GRANİTE	QUARTZ PORPHYRY	RHYOLİTE

Sedimentary Rocks

Sedimentary rocks are formed through physical erosion on the Earth's surface and deposition resulting from chemical dissolution.

They are categorized into 3 groups based on their formation:

- **Clastic Sedimentary Rocks:** Formed as a result of mechanical erosion caused by wind, rain, and ice. Examples include Breccia, Sandstone, Siltstone.
- **Chemical Sedimentary Rocks:** Formed by the chemical dissolution and precipitation of materials. Examples include Limestone, Dolomite, Rock Salt, Gypsum.
- **Organic Sedimentary Rocks:** Formed from the remains of plants and animals. Examples include certain limestones, coal, some dolomites.

Metamorphic Rocks

Metamorphic rocks are formed in the earth's crust through the transformation of volcanic and sedimentary rocks under the influence of pressure and temperature.

They are divided into two main groups:

- **Regional Metamorphism:** Metamorphism resulting from pressure.
- **Contact Metamorphism:** Metamorphism resulting from temperature.

Important Metamorphic Rocks

Original Rock	**Regional Metamorphism**			
Low Grade	**Medium Grade**	**High grade**	**Contact Metamorphism**	
Granite	Phylite	Schist	Gneiss	Hornfels
Basalt	Schist	Amphilbolite	Amphilbolite	Hornfels
Limestone	Marble	Marble	Marble	Marble
Sandstone	Schist	Quartzite	Quartzite	Quartzite

PHYSICAL PROPERTIES OF ROCKS

Hardness (Mohs Scale): The relative resistance of a mineral to scratching, expressed on the Mohs Scale, established by German mineralogist Friedrich Mohs in 1812.

Specific Gravity (Solid Density): Density of the rock material, expressed in t/m□.

Bulk Density: Density of the compacted rock material, expressed in t/m□.

CR (Crushability): The percentage indicating how easily a rock can be crushed.

ABR (Abrasiveness): The abrasion resistance of the rock, expressed in g/t.

Ai (Abrasion Index): The abrasion index of the rock material.

LA (Los Angeles Abrasion Loss): The loss of material due to Los Angeles abrasion testing.

Wi (Work Index): The work input required in kilowatt-hours per ton for reducing a particular rock from a specific size to the desired product size.

UCS (Uniaxial Compressive Strength): The maximum compressive stress a rock can sustain, expressed in N/mm□.

IF, IE (Flakiness Index and Elongation Index): Indices indicating the cubicity and flatness of the rock material.

These properties, especially hardness measured on the Mohs Scale, provide a standardized way to assess the physical characteristics of rocks.

Hardness, Mohs Hardness Scale

The hardness of rocks is typically expressed using the Mohs Scale. This scale was established in 1812 by the German mineralogist Friedrich Mohs and has been universally accepted. It represents the relative resistance of a mineral to scratching, expressed as the mineral's resistance to being scratched by a material of known hardness.

Mohs Hardness Scale and Some Objects Used for Scratching For the purpose of scratching, some objects and their hardness are as follows:

- Fingernail Hardness = 2.5
- Copper Coin Hardness = 3
- Steel Blade or Glass Plate Hardness = 5.5
- Steel File or Steel Nail Hardness = 6

MOHS HARDNESS SCALE

MINERAL	HARDNESS
TALC	1
GYPSUM	2
CALCITE	3
FLUORITE	4
APATITE	5
ORTHOCLASE	6
QUARTZ	7
TOPAZ	8
CORONDUM	9
DIAMOND	10

Density: t/m^3

Density is the ratio of the weight of a solid to its volume. In other words, it is the specific gravity of a solid.

Bulk Density: t/m^3

Bulk density is the weight of a unit volume of aggregate. For accurate measurement, unsegregated aggregate is baked at 110°C. A dry and clean container with volume V is filled to the brim, and the excess is scraped off with a straight-edged board.

Bulk density is the ratio of the weight of the aggregate heap to the volume V of the container.

ABR (Abrasiveness) and CR (Crushability) Indices

These indices indicate the abrasiveness and crushability values of the rock. The test is based on the French standard P18-579 and was developed by the Laboratoire Central des Ponts et Chausées (LCPC).

The testing apparatus consists of a rotor that holds a plate approximately 25 mm x 50 mm in size and 5 mm in thickness, with a Brinell Hardness of approximately 60-75. This plate is used for measuring abrasiveness and friability. The material to be tested is placed in a container measuring Ø90 x 100 mm.

Within the container, 500 grams of material within the size range of 4 - 6.3 mm is placed.

The test plate is rotated at a speed of 4500 rpm for 5 minutes. After this duration, the material inside the container is emptied and sieved through a test sieve with a gap of 1.6 mm. The test piece and the material sieved through 1.6 mm are then weighed.

$$ABR = \frac{(m_0 - m)}{M}$$

ABR: LCPC Abrasivity Coefficient, g/t

mo: Weight of the test plate before the test, grams

m: Weight of the test plate after the test, grams

M:Weight of the material subjected to the test, 0.00005 tons

CR : Friability (%)

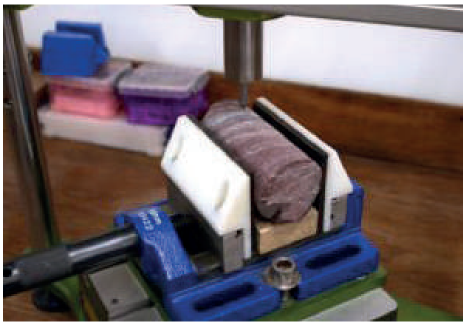
M1.6: Weight of material sieved through a 1.6 mm sieve, grams

M: Weight of material subjected to the test, grams

Friability	Friability class
0-25	Low
25-50	Medium
50-75	High
75-100	Very high

Friability Classification

Cerchar Abrasivity Index (CAI) (ASTM D 7625-10)



Schematic Principle of the CERCHAR Abrasivity Index Detection Device.

The CERCHAR Abrasivity Index is determined by fixing the rock sample tightly in a clamp. A heat-treated alloy steel tip, with a 7 kg dead weight on a 900 conical needle-shaped pin, is lowered onto the sample. The needle is moved 10 mm over the sample within a 1,5 second period.

The diameter of the worn tip is measured precisely under a microscope in terms of 1/10th of mm.

CAI=10.d

CAI: CERCHAR abrasion index

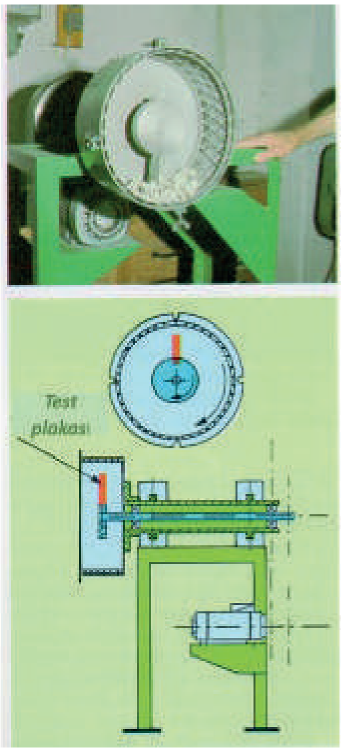
d: Diameter of the wear flat, mm

The hardness of the pin should be 54-56 Rockwell C.

For accurate measurements, 5 measurements should be taken with 5 pins.

Material Type	Abrasion Resistance Level	Friability class	Friability class
Wood	Non-abrasive	0,0 - 0,3	0 - 50
Clay, Siltstone	Very slightly abrasive	0,3 - 0,5	50 - 100
Pure Marble	Slightly abrasive	0,5 - 1,0	100 - 250
Limestone, Marble with SiO2	Abrasive	1,0 - 2,0	250 - 500
Quartz, Sandstone, Basalt	Highly abrasive	2,0 - 4,0	500 - 1250
Quartz, Granite, Gneiss	Very highly abrasive	4,0 - 6,0	1250 - 2000

CAI and ABR Abrasiveness Indices for Some Materials
Ai: Abrasion Index
This index is an indicator of the rock's abrasion strength.



A_i Abrasion Index Detection Device

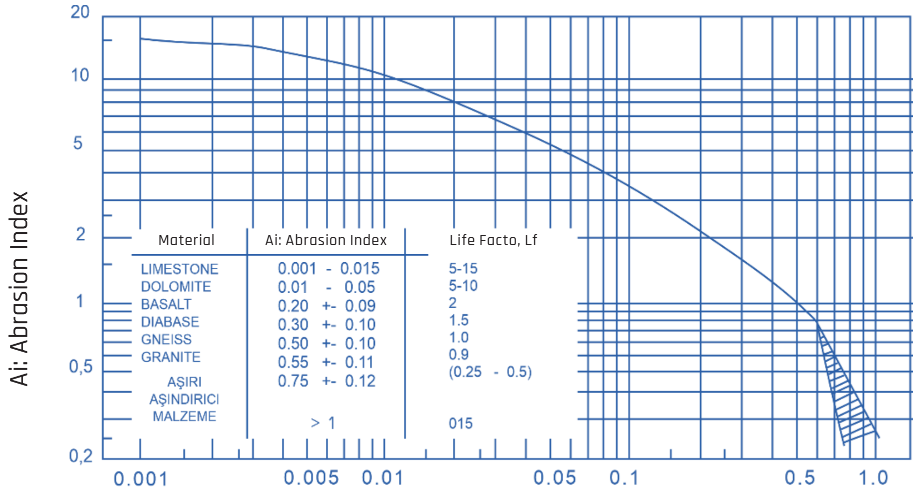
This index is an indicator of the rock's abrasion strength. In the abrasion index detection device, there is a rotor and a cylindrical drum rotating in the same direction. The inner diameter of the cylindrical drum is 205 mm. There are 12 short shelves on the inner walls of the drum, which are designed to lift the test material during rotation.

The weight of the test material is 400 g, with 200 g in the 12-16 mm fraction and 200 g in the 16-19 mm fraction. The test material is used in 4 periods.

The test plate is attached to the rotor. The rotor rotates 10 times faster than the drum. Each period lasts for 15 minutes, and in each period, a new amount of test material, 4 x 400 g, is used.

At the end of one hour of operation, the weight difference on the test plate is determined. The weight difference in grams is the AI Abrasion Index.

For a more accurate calculation of the worn jaw and side liner lifespans in jaw and cone crushers, there is a lifespan factor L1 = 1 for a lifespan of 0.5 based on the abrasion index.



Relationship between Abrasion Index and Life Factor

LA, Los Angeles Abrasion Loss

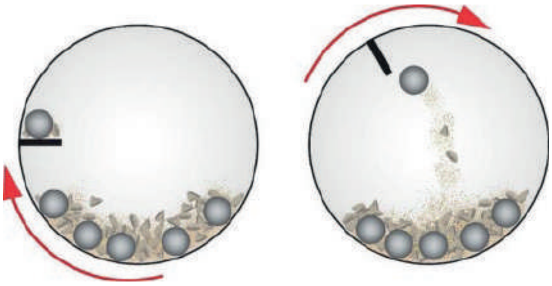
This test method applied to rocks is determined by ASTM C131 and EN 1097-2.

The test device consists of a cylinder with an inner diameter of Ø 711 mm and a length of 508 mm, rotating at a speed of 30 - 33 rpm. The axis of the cylinder is in a horizontal position. Inside the cylinder, there is one shelf with a thickness of 25 mm and a height of 90 mm. The purpose of this shelf is to lift the material and steel balls to a certain height, ensuring their fall.

Inside the cylinder, steel balls with a diameter of Ø 48 mm and a quantity ranging from 6 to 12, depending on the gradation of the test material, are charged with 5000 g of test material. After rotating the cylinder 500 times, the contents are emptied into a tray. After separating the balls, the test material is sieved through a sieve with an opening of 1.70 mm. The material remaining on the sieve is dried and weighed.

$$LA = \frac{5000 - G}{50}$$

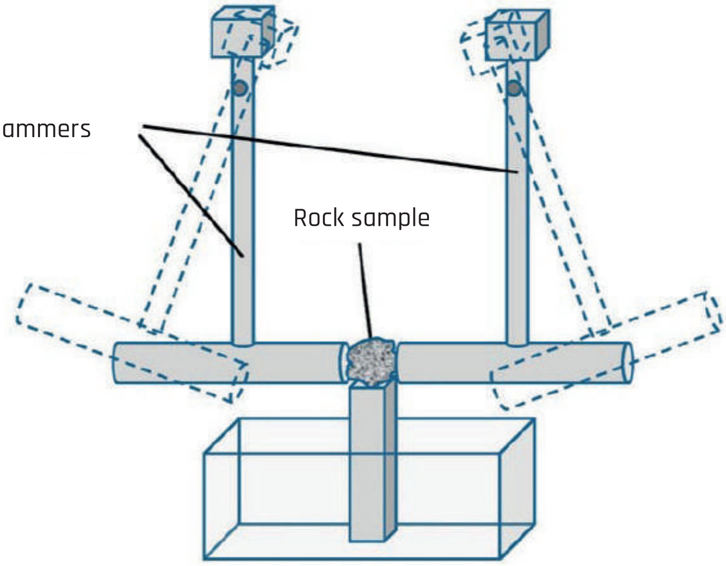
G: Weight of rocks remaining above 1.7 mm, measured in grams.

Los Angeles Abrasion Test Equipment

W_i Work Index

This test has been developed by Fred C. Bond at the Allis Chalmers test center and has been widely accepted worldwide. This index is an indicator showing the energy required to perform a crushing operation.



Wi test device schematic diagram

$$a = \frac{2Gh}{c}$$

Where;

G: Weight of each hammer, kg

h: Lifting distance of hammers at the moment when the material is broken, m

c: Smallest dimension of the test material, cm

a: Impact strength, kgm/cm

Wi is calculated as follow;

$$W_i = 47,6\frac{a}{d}$$

a = Impact strength, kgm/cm

d = specific gravity of the rock, gr/cm3

30 cubically shaped rocks are needed for the test. These rocks will pass through a 70 x 70 mm square mesh but will not pass through a 55 x 55 mm square mesh.

The Work Index (Wi) is an indicator of the rock's breakability. It is also used in calculating the energy required for breaking, employing the Bond Formula.

$$W = 11W_i\left(\frac{1}{\sqrt{P}} - \frac{1}{\sqrt{F}}\right)$$

W = 11 Wİ * { [1/(P80)0,5] – [1 / (F80)0,5]}

W: Approximate specific energy requirement for crushing, Kwh/t

Wi: Work index

P80: Square mesh size through which 80% of the product (material from the crusher) passes, in microns

F80: Square mesh size through which 80% of the material fed to the crusher passes, in microns (fine material should be screened out from the fed material)

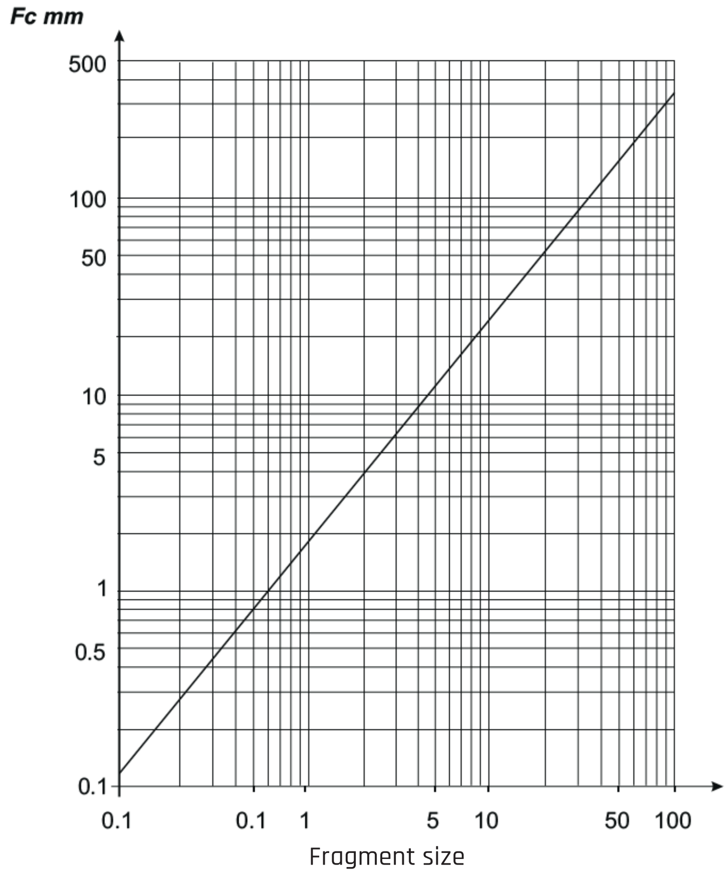
If the fine material has not been screened out from the fed material, the corrected F value should be considered. The corrected F value is calculated as follows:

$$F = \frac{F_{cüst} + F_{calt}}{2} \times 1000$$

Fmax : Maximum size of the fed material, mm

Fmin : Minimum size of the fed material, mm

FC: Corrected feed size, microns



FC values according to the fragment size

The Bond formula is used for both the impact work index and the grinding work index.

UCS, Compressive Strength

Cylindrical rock samples with a length at least 2 times the diameter are used to determine the compressive strength of the rock. The sample is subjected to low-speed pressure, and the breaking load is determined.

UCS=F/A

F: Breaking force of the sample, N

A: Cross-sectional area of the sample, mm2

UCS: Compressive strength, N/mm2

I_F, I_E , Length index and IF Flatness index

These indices are crucial for the usability of crushed and screened aggregates in concrete and road construction. These indices are applicable.

In the tables below, we can see sample aggregate size ranges and the predicted weight values for the flatness index and these intervals. First, these sample aggregates are prepared.

Below are tables for determining the flatness index and length index. For determining the flatness index, each element of the aggregate prepared for the purpose of determining the length index is separated from the corresponding passers and non-passers through the relevant window of the determination table.

If the total sample aggregate weight M2, the weight of samples not passing through the pin intervals of the relevant length index determination table, and the weight of sample aggregate passing through the window intervals M4 are, therefore;

IL = Length index % = M4 / M2 x 100

IF = Flatness index % = M3 / M2 x 100

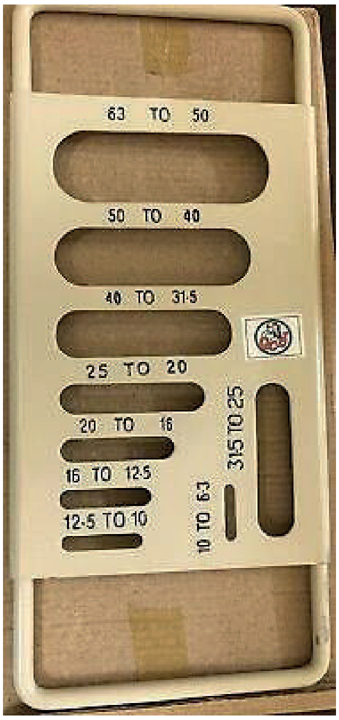
An aggregate with a flatness and length index exceeding 10-15% is never desirable in either concrete or road aggregates.

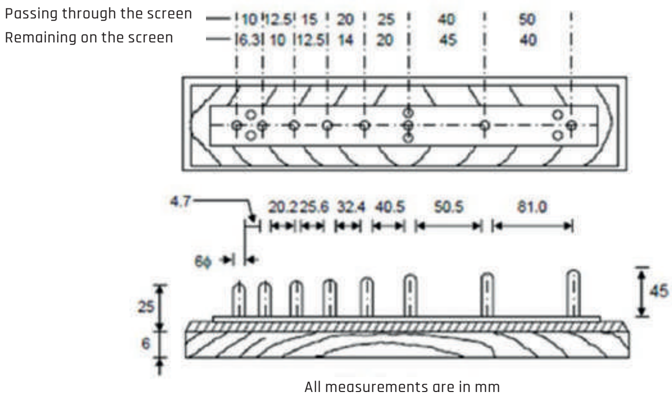
100% passing size (mm)	100% retained size (mm)	Flat index scale slot gap, (mm)	Minimum quantity (kg)
63	50	33,9	50
50	37,5	26,3	35
37,5	28	19,7	15
28	20	14,4	5
20	14	10,2	2
14	10	7,2	1
10	6,3	4,9	0,5

Sample aggregate size ranges and quantities for the flatness index

100% passing size (mm)	100% retained size (mm)	Length index gauge between pins, (mm)	Minimum quantity (kg)
50	37,5	78,7	35
37,5	28	59	15
28	20	43,2	5
20	14	30,6	2
14	10	21,6	1
10	6,3	14,7	0,5

Sample aggregate size ranges and quantities for the length index





Flatness index and length index determination tables

I_S, Shape Index EN 933-4

It is an index that indicates whether the coarse aggregate is cubic. It is determined with a special caliper as seen below.

The upper opening of the caliper is one-third of the lower opening. The lower opening of the caliper is adjusted according to the length of the stone piece. If the thickness of this stone piece is exceeded, it is not cubic. It is determined with aggregates ranging in size from 4 mm to 63 mm. In this way, each stone piece is classified as cubic or non-cubic.

The shape index is the percentage of the non-cubic piece weight to the total weight.

Shape index determination caliper

Tables related to the physical properties of rocks

Rock Name	SiO2 (%)	Wi Work Index	Breakability or crushability percentage CR (%)	LA Abrasion Loss	ABR (Abrasiveness g/t)
Amphibolite	–	16-19	25-46	–	300-1600
Basalt	20-50	10-20	20-44	8-21	500-2300
Diabase	45-5	14 -22	18-44	7-34	450-2300
Diorite	55-70	10-22	20-36	14-30	400 -1700
Dolomite	0-10	6-12	30-56	15-55	20-450
Gabbro	40-55	8-22	27-34	14-30	800-1700
Gneiss	55-75	11-18	30-67	15-28	600-1600
Granite	65-75	10-20	28-90	17-35	900-1900
Gravel	–	–	30-55	–	300-2500
Limestone	0-30	6-15	30-62	30-45	0-500
Rhyolite	–	–	16-56	–	200-1900
Sandstone	–	8-16	32-60	15-55	300-2200
Quartzite	90-99	9-17	22-65	17-30	1400-2400

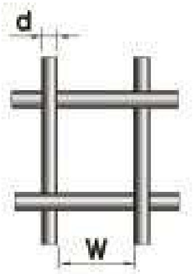
The physical properties of various rocks

Rock Name	Rock Type	Wi Work Index	Density t/m3	Bulk Densityt/ m3	Abrasion Index Ai	Compressive Strength, MPa
Andesite	Volcanic	16±2	2,6–2,8	1,6	0,5	170–300
Amhibole	Metamorphic	16±3	2,8 –3,0	1,7	0,2–0,45	–
Sandstone	Sedimentary	10±3	2,7	1,6	0,1–0,9	30–180
Basalt	Volcanic	20±4	2,9 –3,0	1,8	0,2±0,1	300–400
Limestone	Sedimentary	12±3	2,7	1,6	0,001-0,03	80–180
Karbon	Sedimentary	14±4	1,0 –1,8	0,8	–	–
Klinker	–	–	–	1,2	–	–
Kok	–	–	–	0,6	–	–
Diabase	Volcanic	19±4	2,8 –2,9	1,7	0,3±0,1	250–350
Diorite	Volcanic	19±4	2,7 –2,8	1,6	0,4	170–300
Dolomite	Sedimentary	12±3	2,7	1,6	0,01–0,05	50–200
Gabbro	Volcanic	20±3	2,9 –3,0	1,8	0,4	170–300
Gneiss	Metamorphic	16±4	2,7	1,6	0,5±0,1	200–300
Granite	Volcanic	16±6	2,7	1,6	0,55±0,1	200–300
Hematite	Sedimentary	–	5,1	2,2 –2,4	0,35±0,2	–
Magnetite	Sedimentary	–	5,7	2,2 –2,4	0,50±0,2	–
Mermer	Metamorphic	12±3	2,7	1,6	0,001–0,03	80–180
Porphyry	Volcanic	18	2,7	1,6	0,1–0,9	180–300
Quartzite	Metamorphic	16±3	2,7	1,6	0,75±0,1	150–300
Syenite	Volcanic	19±4	2,7 –2,8	1,6	0,4	170–300
Silex (Hornfels)	Metamorphic	18±3	2,8	1,65	0,7	150–300

The physical properties of some important rocks

IMPORTANT TECHNICAL INFORMATION

STANDARD ELECTRICAL WIRE DIMENSIONS



Screen Opening W (mm)	Screen Wire Diameter D (mm)	Screen Unit Weight (Kg/m2)	Screen Open Area Ratio (%)
1x1	0,75	4,2	33
1,25x1,25	1	5,8	31
1,5x1,5	1	5,2	36
1,75x1,75	1	4,8	40
2x2	1	4,4	44
	1,2	5,9	39
	1,5	8,4	33
2,5x2,5	1,2	5,1	46
	1,5	7,4	39
3x3	1,5	6,5	44
	1,8	8,8	39
	2	10,5	36
3,5x3,5	1,5	5,9	49
	1,8	8,0	44
	2	9,5	40
4x4	1,5	5,4	53
	2	8,7	44
	2,2	10,2	42
	2,5	12,5	38
4,5x4,5	1,5	4,9	56
	2	8,0	48
	2,5	11,7	41
5x5	1,5	4,5	59
	2	7,5	51
	2,2	8,8	48
	2,5	10,9	44
	3	14,7	39
5,5x5,5	2	7,0	54
	2,5	10,2	47
	3	13,9	42
6x6	2	6,5	56
	2,5	9,6	50
	3	13,1	44
	3,5	16,8	40
7x7	2,5	8,6	54
	3	11,8	49
	3,5	15,3	44
8x8	2	5,2	64
	2,5	7,8	58
	3	10,7	53
	3,5	13,9	48
	4	17,4	44
9x9	2,5	7,1	61
	3	9,8	56
	3,5	12,8	52
	4	16,1	48
10x10	2,5	6,5	64
	3	9,1	59
	3,5	11,9	55
	4	14,9	51
	5	21,8	44

Screen Opening, W (mm)	Screen Wire Diameter, D (mm)	Screen Unit Weight (Kg/m2)	Screen Open Area Ratio (%)
11x11	3	8,4	62
	4	14,0	54
	5	0,4	47
12x12	3	7,8	64
	4	13,1	56
	5	19,2	50
13x13	3	7,4	66
	4	12,3	58
	5	18,2	52
14x14	3,5	9,2	64
	4	11,6	60
	5	17,2	54
15x15	3,5	8,7	66
	4	11,0	62
	5	16,4	56
	6	22,4	51
16x16	3,5	8,2	67
	4,5	12,9	61
	5	15,6	58
	6	21,4	53
17x17	4	10,0	66
	5	14,9	60
	6	20,5	55
18x18	4	9,5	67
	4,5	11,8	64
	5	14,2	61
	6	19,6	56
19x19	5	13,6	63
	6	18,8	58
20x20	4	8,7	69
	5	13,1	64
	6	18,1	59
	7	23,7	55
21x21	5	12,6	65
	6	17,4	60
22x22	5	12,1	66
	6	16,8	62
	7	22,1	58
23x23	5	11,7	67
	6	16,2	63
24x24	5	11,3	68
	6	15,7	64
	7	20,7	60
25x25	4	7,2	74
	5	10,9	69
	6	15,2	65
	7	20,0	61
	8	25,4	57

Screen Opening, W (mm)	Screen Wire Diameter, D (mm)	Screen Unit Weight (Kg/m2)	Screen Open Area Ratio (%)
26x26	6	14,7	66
	7	19,4	62
	8	24,6	58
27x27	6	14,3	67
	7	18,9	63
	8	23,9	60
28x28	6	13,9	68
	7	18,3	64
	8	23,3	60
30x30	5	9,3	73
	6	13,1	69
	7	17,3	66
	8	22,0	62
	10	32,7	56
32x32	6	12,4	71
	8	20,9	64
	10	31,1	58
35x35	6	11,5	73
	8	19,5	66
	10	29,1	60
38x38	8	18,2	68
	10	27,3	63
40x40	7	13,6	72
	8	17,4	69
	10	26,2	64
45x45	8	15,8	72
	10	23,8	67
50x50	8	14,4	74
	10	21,8	69
	12	30,4	65
55x55	8	13,3	76
	10	20,1	72
60x60	8	12,3	78
	10	18,7	73
	12	26,2	69
65x65	10	17,4	75
	12	24,5	71
70x70	10	16,4	77
	12	23,0	73
75x75	10	15,4	78
	12	21,7	74
80x80	10	14,5	79
	12	20,5	76
90x90	10	13,1	81
	12	18,5	78
100x100	10	11,9	83
	12	16,8	80
120x120	10	10,1	85
	12	14,3	83

STEEL WATER AND GAS PIPE STANDARDS

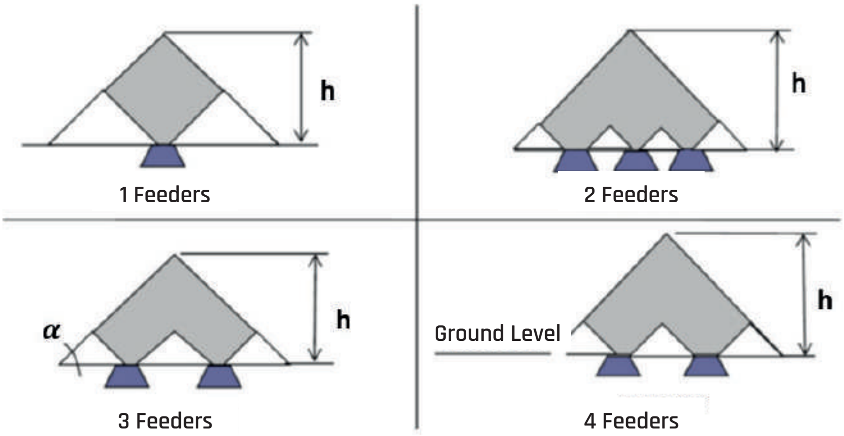
DIN 2440 Steel Water and Gas Pipe Standards				
Internal Nominal Diameter		External Diameter mm	Thickness of Wall mm	Pipe Weight kg/m
in	*mm*	*mm*	*mm*	*kg/m*
1/2	*15*	*21,25*	*2,75*	*1,25*
3/4	*20*	*26,75*	*2,75*	*1,63*
1	*25*	*33,50*	*3,25*	*2,42*
1 1/2	*40*	*48,25*	*3,50*	*3,86*
2	*50*	*60,00*	*3,75*	*5,20*
2 1/2	*65*	*75,50*	*3,75*	*6,64*
3	*80*	*88,25*	*4,00*	*8,31*
4	*100*	*113,50*	*4,25*	*11,50*
5	*125*	*139,00*	*4,50*	*14,90*
6	*150*	*164,50*	*4,50*	*17,80*
8	*200*	*216,00*	*6,50*	*33,60*

DIN 2441 Steel Pipe Standards

DIN 2441 Steel Pipe Standards				
Internal Nominal Diameter		External Diameter mm	Thickness of Wall mm	Pipe Weight kg/m
in	*mm*	*mm*	*mm*	*kg/m*
1/2	*15*	*21,25*	*3,25*	*1,44*
3/4	*20*	*26,75*	*3,50*	*2,01*
1	*25*	*33,50*	*4,00*	*2,91*
$1^{1/2}$	*40*	*48,25*	*4,25*	*4,61*
2	*50*	*60,00*	*4,50*	*6,16*
$2^{1/2}$	*65*	*75,50*	*4,50*	*7,88*
3	*80*	*88,25*	*4,75*	*9,78*
4	*100*	*113,50*	*5,00*	*13,40*
5	*125*	*139,00*	*5,50*	*18,10*
6	*150*	*164,50*	*5,50*	*21,60*
8	*200*	*216,00*	*7,50*	*38,60*

CONICAL STOCK DIMENSIONS

Tunnels are Below Ground Level



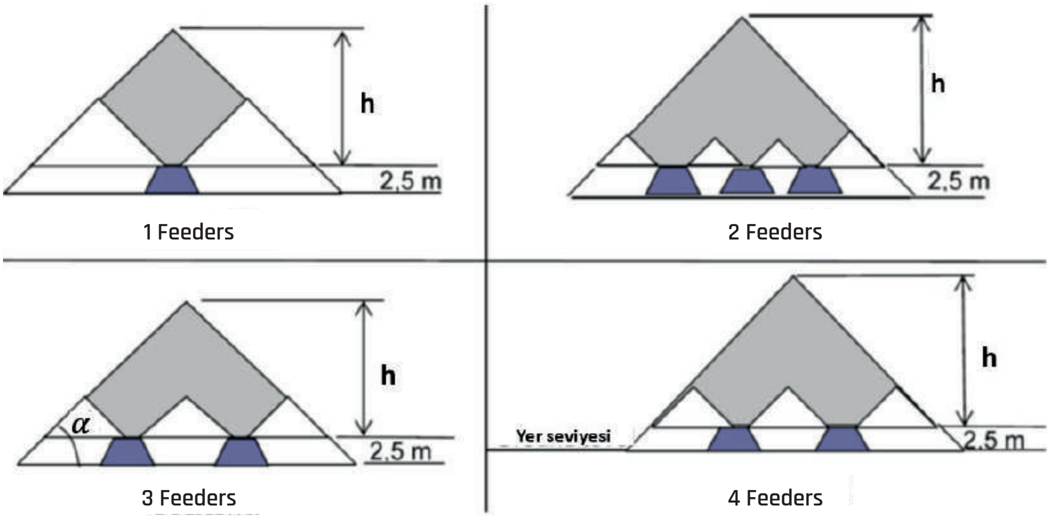
Feeder Conveyor Length m	Feeder Conveyor Angle degree	h m	Gross Volume m3 %100	Net Volume m3 1 Feeder %25	Net Volume m3 2 Feeders %30	Net Volume m3 3 Feeders %35	Net Volume m3 4 Feeders %38
18	18	5,6	256	64	77	89	97
20	18	6,2	351	88	105	123	133
22	18	6,8	467	117	140	163	177
25	18	7,7	685	171	205	240	260
28	18	8,6	962	241	289	337	366
30	18	9,3	1183	296	355	414	450
35	18	10,8	1879	470	564	658	714
40	18	12,4	2805	701	841	982	1066
45	18	13,9	3993	998	1198	1398	1517
50	18	15,4	5478	1369	1643	1917	2082
55	16	15,2	5174	1294	1552	1811	1966
60	16	16,5	6718	1679	2015	2351	2553
65	16	17,9	8541	2135	2562	2989	3246
70	16	19,3	10668	2667	3200	3734	4054
80	16	22,0	15924	3981	4777	5573	6051
90	16	24,8	22672	5668	6802	7935	8616
100	16	27,6	31101	7775	9330	10885	11818

NOTE:

- The values provided above are applicable for □ = 400 static slope angle.
- Gross Volume = 1.4873 * h^3

CONICAL STOCK DIMENSIONS

21Tunnels are Above Ground Level



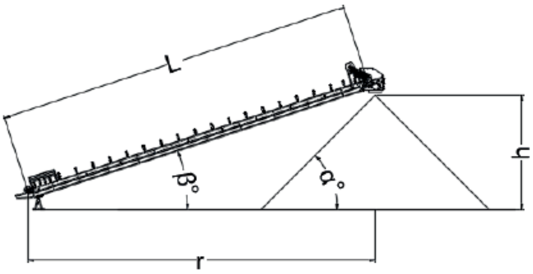
Stockpile Feeder Conveyor Length m	Stockpile Feeder Conveyor Angle Degree	h m	Gross Volume m3 %100	Gross Volume Above tunnel m3	Net Volume m3 1 Feeder %25	Net Volume m3 2 Feeders %30	Net Volume m3 3 Feeders %35	Net Volume m3 4 Feeders %38
18	18	3,1	256	43	11	13	15	16
20	18	3,7	351	74	18	22	26	28
22	18	4,3	467	118	29	35	41	45
25	18	5,2	685	212	53	64	74	80
28	18	6,1	962	346	86	104	121	131
30	18	6,8	1183	461	115	138	161	175
35	18	8,3	1879	854	213	256	299	324
40	18	9,9	2805	1423	356	427	498	541
45	18	11,4	3993	2203	551	661	771	837
50	18	12,9	5478	3225	806	968	1129	1226
55	16	12,7	5174	3013	753	904	1054	1145
60	16	14,0	6718	4108	1027	1232	1438	1561
65	16	15,4	8541	5440	1360	1632	1904	2067
70	16	16,8	10668	7033	1758	2110	2462	2673
80	16	19,5	15924	11096	2774	3329	3884	4217
90	16	22,3	22672	16483	4121	4945	5769	6263
100	16	25,1	31101	23379	5845	7014	8183	8884

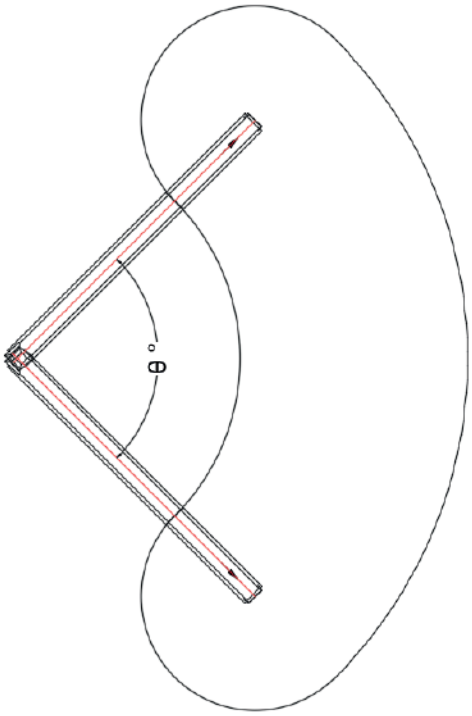
NOTE:

The values provided above are valid for α = 400 static slope angle.

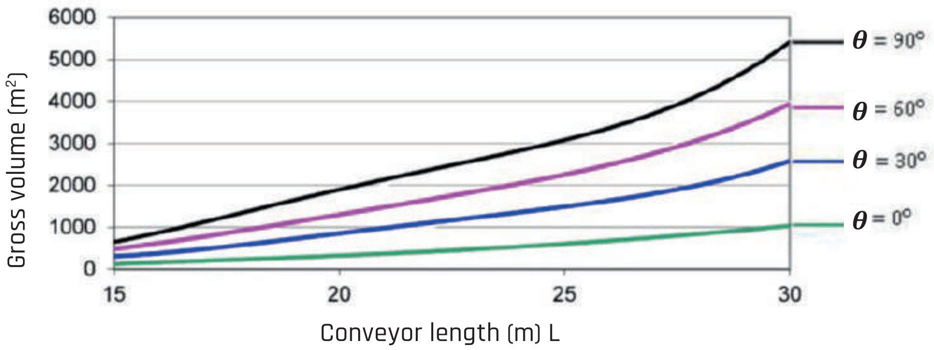
Gross Volume = 1.4873 * (h + 2.5)2

ROTARY CONVEYOR STOCKS





STOCK VOLUMES

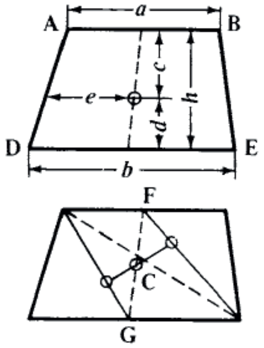
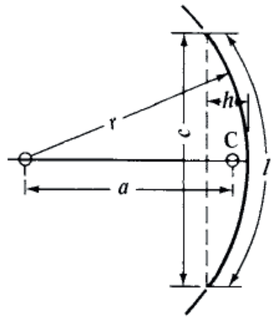
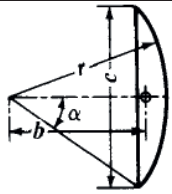
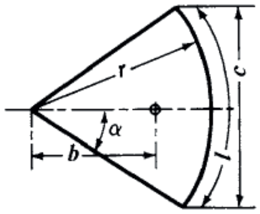
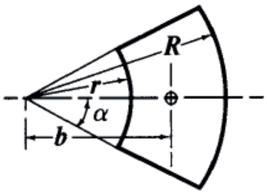


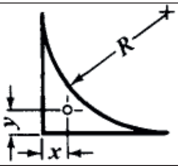
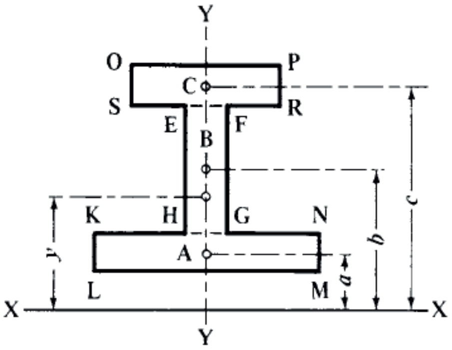
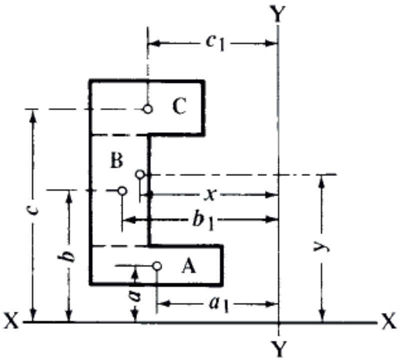
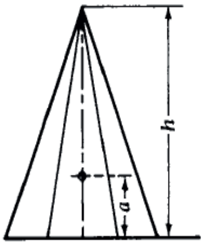
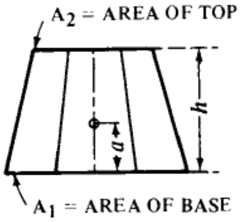
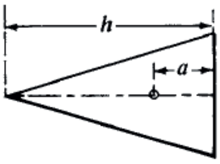
NOTE:

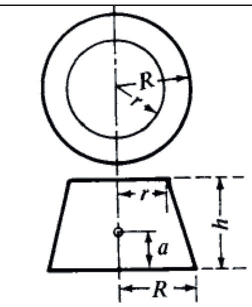
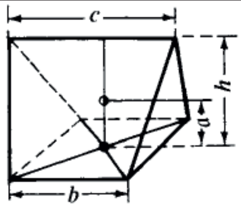
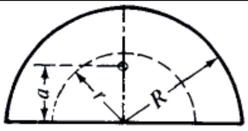
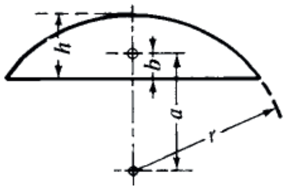
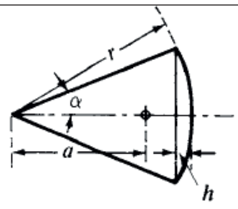
The values given in the above chart are for □ = 400 static slope angle.

Total stock volume: $V = 1,4873 * h^3 + (\frac{2\pi r h^2}{\tan \alpha} * \frac{\theta^0}{360^0})$

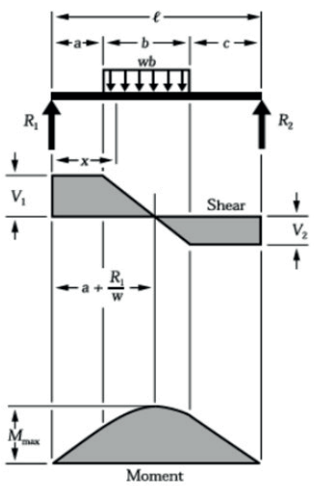
CENTERS OF GRAVITY FOR SOME SURFACES AND SOLID OBJECTS

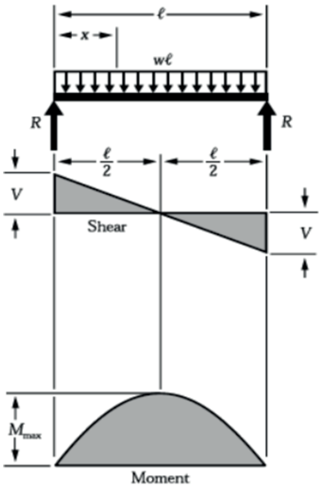
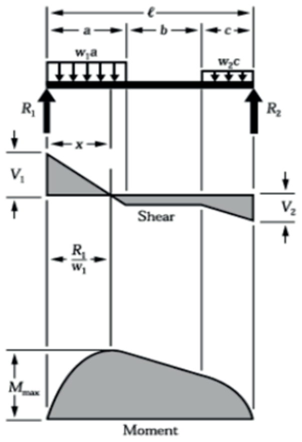
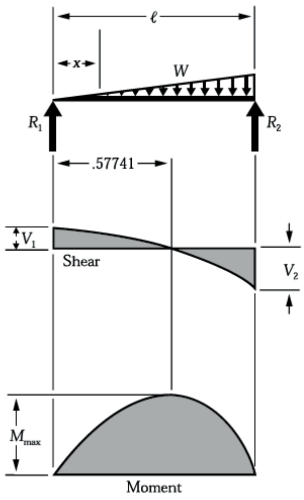
	$c = \frac{h(a+2b)}{3(a+b)}$ $d = \frac{h(2a+b)}{3(a+b)}$ $e = \frac{a^2+ab+b^2}{3(a+b)}$
	$a = \frac{r*c}{l} = \frac{c(c^2+4h^2)}{8lh}$
	$b = \frac{c^3}{12A} = \frac{2}{3} * \frac{r^3 sin^3 \alpha}{A}$
	$b = \frac{2rc}{3l} = \frac{r^2c}{3A} = 38,197\frac{r sin\alpha}{\alpha}$
	$b = 38,197\frac{(R^3-r^3)sin\alpha}{(R^2-r^2)\alpha}$

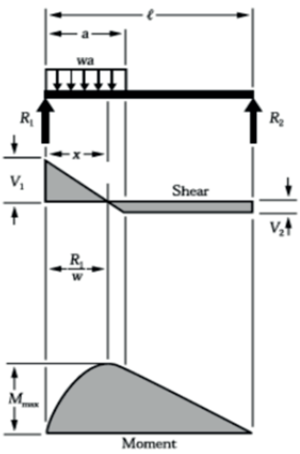
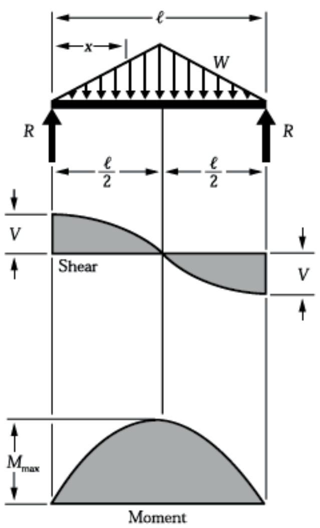
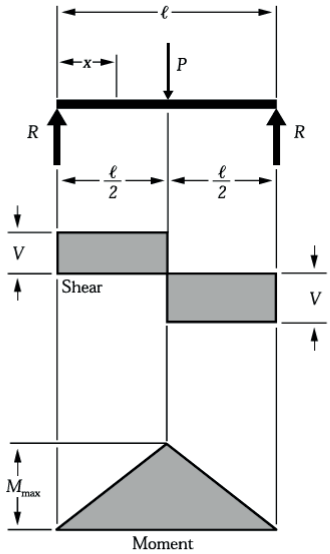
	$Alan = 0,2146R^2$ $x = 0,2234R$ $y = 0,2234R$
	$y = \dfrac{Aa + Bb + Cc}{A + B + C}$
	$x = \dfrac{Aa_1 + Bb_1 + Cc_1}{A + B + C}$ $y = \dfrac{Aa + Bb + Cc}{A + B + C}$
 *Katı piramit*	$a = \frac{1}{4}h$
 *Kesik piramit*	$a = \dfrac{h(A_1 + 2\sqrt{A_1 * A_2} + 3A_2}{4(A_1 + \sqrt{A_1 * A_2} + A_2}$
 *Katı koni*	$a = \dfrac{1}{4}h$

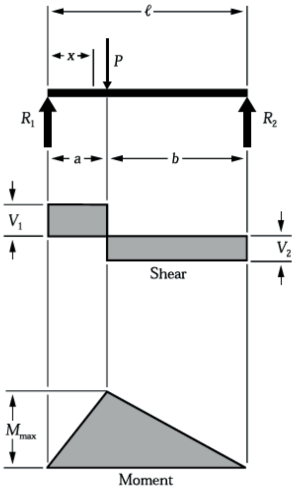
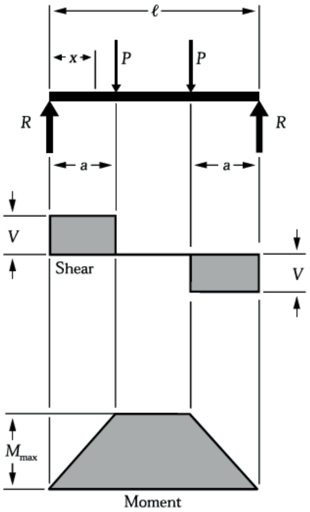
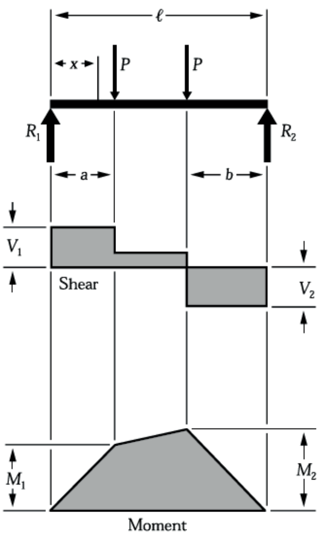
 Kesik koni	$a = \dfrac{h(R^2 + 2Rr + 3r^2)}{4(R^2 + Rr + r^2)}$
 Kama	$a = \dfrac{h(b + c)}{2(2b + c)}$
 İçi oyuk yarım küre	$a = \dfrac{3(R^4 - r^4)}{8(R^3 - r^3)}$
 Küre segmenti	$a = \dfrac{3(2r - h)^2}{4(3r - h)}$ $b = \dfrac{h(4r - h)}{4(3r - h)}$
 Küresel segment	$a = \dfrac{3}{8}(1 + cos\alpha)r = \dfrac{3}{8}(2r - h)$

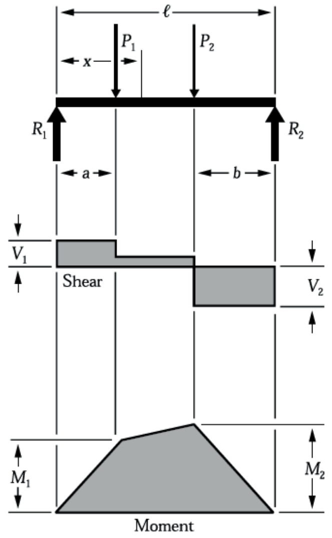
KİRİŞLERİN DİZAYN FORMÜLLERİ

	$R_1 = V_1\ (a < c\ iken\ max) = \dfrac{wb}{2l}(2c + b)$ $R_2 = V_2\ (a > c\ iken\ max) = \dfrac{wb}{2l}(2a + b)$ $V_x\ (a < x < (a + b)\ iken) = R_1 - w(x - a)$ $M_{max}\left(at\ x = a + \dfrac{R_1}{w}\right) = R_1\left(a + \dfrac{R_1}{2w}\right)$ $M_x\ (x < a\ iken) = R_1 x$ $M_x\ (a < x < (a + b)\ iken) = R_1 x - \dfrac{w}{2}(x - a)^2$ $M_x\ (x > (a + b)\ iken) = R_2(l - x)$

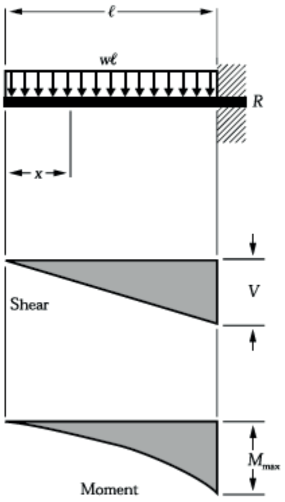
	$R = V = \frac{wl}{2}$ $V_x = w\left(\frac{l}{2} - x\right)$ $M_{max}\ (merkezde) = \frac{wl^2}{8}$ $M_x = \frac{wx}{2}(l - x)$ $\Delta_{max}\ (merkezde) = \frac{5wl^4}{384EI}$ $\Delta_x = \frac{wx}{24EI}(l^3 - 2lx^2 + x^3)$
	$R_1 = V_1 = \frac{w_1 a(2l - a) + w_2 c^2}{2l}$ $R_2 = V_2 = \frac{w_2 c(2l - c) + w_1 a^2}{2l}$ $V_x\ (x < a\ iken) = R_1 - w_1 x$ $V_x\ (a < x < (a + b)\ iken) = R_1 - w_1 a$ $V_x\ (x > (a + b)\ iken) = R_2 - w_2(l - x)$ $M_{max}\left(R_1 < w_1 a\ iken\ x = \frac{R_1}{w_1}\ olduğunda\right) = \frac{{R_1}^2}{2w_1}$ $M_{max}\left(R_2 < w_2 c\ iken\ x = l - \frac{R_2}{w_2}\ olduğunda\right) = \frac{{R_2}^2}{2w_2}$ $M_x\ (x < a\ iken) = R_1 x - \frac{w_1 x^2}{2}$ $M_x\ (a < x < (a + b)\ iken) = R_1 x - \frac{w_1 a}{2}(2x - a)$ $M_x\ (x > (a + b)\ iken) = R_2(l - x) - \frac{w_2(l - x)^2}{2}$
	$R_1 = V_1 = \frac{W}{3}$ $R_2 = V_2 = \frac{2W}{3}$ $V_x = \frac{W}{3} - \frac{Wx^2}{l^2}$ $M_{max}\left(x = \frac{l}{\sqrt{3}} =,5774l\ olduğunda\right) = \frac{2Wl}{9\sqrt{3}} =,1283Wl$ $M_x = \frac{W_x}{3l^2}(l^2 - x^2)$ $\Delta_{max}\left(x = l\sqrt{1 - \sqrt{\frac{8}{15}}} =,5193l\ olduğunda\right) =,01304\frac{Wl^3}{EI}$ $\Delta_x = \frac{Wx}{180EIl^2}(3x^4 - 10l^2x^2 + 7l^4)$

	$R_1 = V_1 = \frac{wa}{2l}(2l - a)$ $R_2 = V_2 = \frac{wa^2}{2l}$ $V_x\ (x < a\ iken) = R_1 - wx$ $M_{max}\left(x = \frac{R_1}{w}\ iken\right) = \frac{{R_1}^2}{2w}$ $M_x\ (x < a\ iken) = R_1 x - \frac{wx^2}{2}$ $M_x\ (x > a\ iken) = R_2(l - x)$ $\Delta_x\ (x < a\ iken) = \frac{wx}{24EIl}(a^2(2l-a)^2 - 2ax^2(2l-a) + lx^3)$ $\Delta_x\ (x > a\ iken) = \frac{wa^2(l-x)}{24EIl}(4xl - 2x^2 - a^2)$
	$R = V = \frac{W}{2}$ $V_x\left(x < \frac{l}{2}\ iken\right) = \frac{W}{2l^2}(l^2 - 4x^2)$ $M_{max}\ (merkezde) = \frac{Wl}{6}$ $M_x\left(x < \frac{l}{2}\ iken\right) = Wx\left(\frac{1}{2} - \frac{2x^2}{3l^2}\right)$ $\Delta_{max}\ (merkezde) = \frac{Wl^3}{60EI}$ $\Delta_x = \frac{Wx}{480EIl^2}(5l^2 - 4x^2)^2$
	$R = V = \frac{P}{2}$ $M_{max}\ (\text{yükün olduğu noktada}) = \frac{Pl}{4}$ $M_x\left(x < \frac{l}{2}\ iken\right) = \frac{Px}{2}$ $\Delta_{max}\ (\text{yükün olduğu noktada}) = \frac{Pl^3}{48EI}$ $\Delta_x\left(x < \frac{l}{2}\ iken\right) = \frac{Px}{48EI}(3l^2 - 4x^2)$
	$R_1 = V_1\ (a < b\ \text{olduğunda max}) = \frac{Pb}{l}$ $R_2 = V_2\ (a > b\ \text{olduğunda max}) = \frac{Pa}{l}$

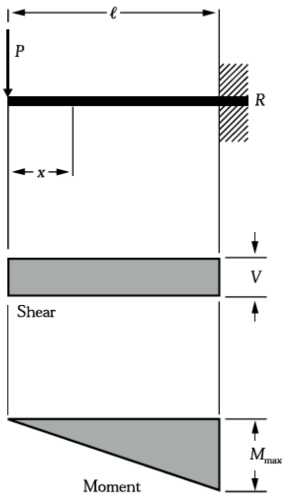
	M_{max} (yükün olduğu noktada) $= \frac{Pab}{l}$ $M_x\ (x < a\ iken) = \frac{Pbx}{l}$ $\Delta_{max}\left(a > b\ iken\ ve\ x = \sqrt{\frac{a(a+2b)}{3}}\ olduğu\ noktada\right)$ $= \frac{Pab(a+2b)\sqrt{3a(a+2b)}}{27EIl}$ Δ_a (yükün olduğu noktada) $= \frac{Pa^2b^2}{3EIl}$ $\Delta_x\ (x < a\ iken) = \frac{Pbx}{6EIl}(l^2 - b^2 - x^2)$ $\Delta_x\ (x > a\ iken) = \frac{Pa(l-x)}{6EIl}(2lx - x^2 - a^2)$
	$R = V = P$ M_{max} (yüklerin arasındaki bir noktada) $= Pa$ $M_x\ (x < a\ iken) = Px$ Δ_{max} (merkezde) $= \frac{Pa}{24EI}(3l^2 - 4a^2)$ $\Delta_x\ (x < a\ iken) = \frac{Px}{6EI}(3la - 3a^2 - x^2)$ $\Delta_x\ (a < x < (l-a)\ iken) = \frac{Pa}{6EI}(3lx - 3x^2 - a^2)$
	$R_1 = V_1\ (a < b\ iken\ max) = \frac{P}{l}(l - a + b)$ $R_2 = V_2\ (a > b\ iken\ max) = \frac{P}{l}(l - b + a)$ $V_x\ (a < x < (l-b)\ olduğunda) = \frac{P}{l}(b - a)$ $M_1\ (a > b\ iken\ max) = R_1 a$ $M_2\ (a < b\ iken\ max) = R_2 b$ $M_x\ (x > a\ iken) = R_1 x$ $M_x\ (a < x < (l-b)\ iken) = R_1 x - P(x - a)$



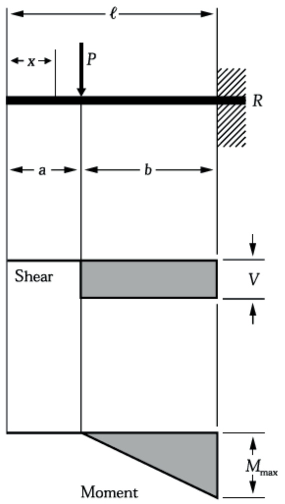
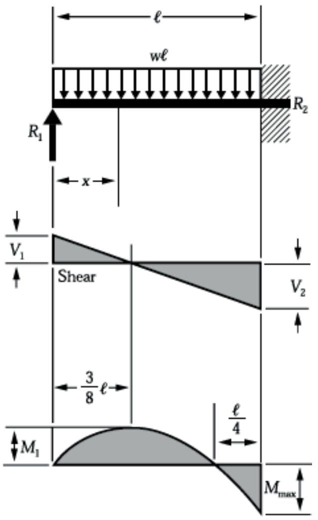
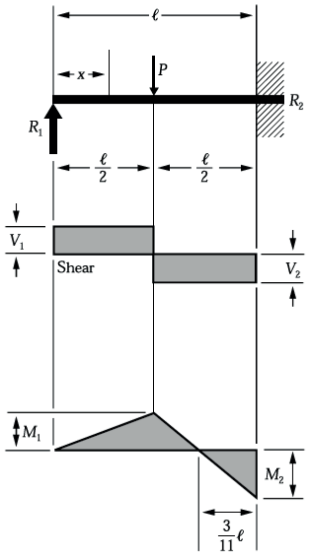
$$R_1 = V_1 = \frac{P_1(l-a) + P_2 b}{l}$$
$$R_2 = V_2 = \frac{P_1 a + P_2(l-b)}{l}$$
$$V_x\ (a < x < (l-b)\ olduğunda) = R_1 - P_1$$
$$M_1\ (R_1 < P_1\ iken\ max) = R_1 a$$
$$M_2\ (R_2 < P_2\ iken\ max) = R_2 b$$
$$M_x\ (x < a\ iken) = R_1 x$$
$$M_x\ (a < x < (l-b)\ olduğunda) = R_1 x - P_1(x-a)$$

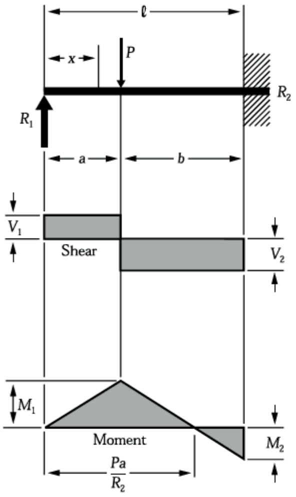
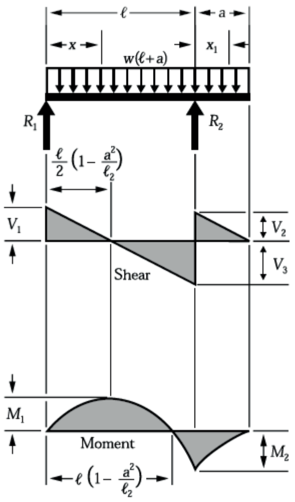


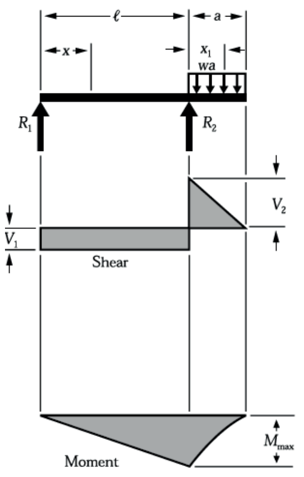
$$R = V = wl$$
$$V_x = wx$$
$$M_{max}\ (sabit\ uçta) = \frac{wl^2}{2}$$
$$M_x = \frac{wx^2}{2}$$
$$\Delta_{max}\ (serbest\ uçta) = \frac{wl^4}{8EI}$$
$$\Delta_x = \frac{w}{24EI}(x^4 - 4l^3x + 3l^4)$$



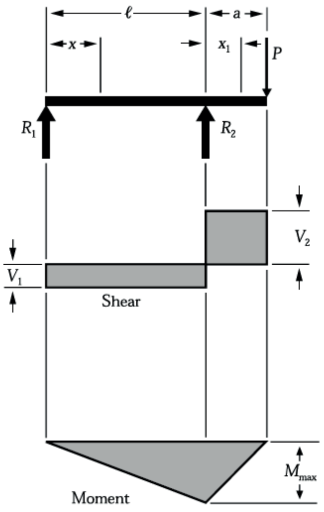
$$R = V = P$$
$$M_{max}\ (sabit\ uçta) = Pl$$
$$M_x = Px$$
$$\Delta_{max}\ (serbest\ uçta) = \frac{Pl^3}{3EI}$$
$$\Delta_x = \frac{P}{6EI}(2l^3 - 3l^2x + x^3)$$

	$R = V = P$ $M_{max}\ (sabit\ uçta) = Pb$ $M_x\ (x > a\ iken) = P(x-a)$ $\Delta_{max}\ (serbest\ uçta) = \frac{Pb^2}{6EI}(3l-b)$ $\Delta_a\ (yükün\ olduğu\ noktada) = \frac{Pb^3}{3EI}$ $\Delta_x\ (x < a\ iken) = \frac{Pb^2}{6EI}(3l-3x-b)$ $\Delta_x\ (x > a\ iken) = \frac{P(l-x)^2}{6EI}(3b-l+x)$
	$R_1 = V_1 = \frac{3wl}{8}$ $R_2 = V_2 = \frac{5wl}{8}$ $V_x = R_1 - wx$ $M_{max} = \frac{wl^2}{8}$ $M_1\left(x = \frac{3}{8}l\ iken\right) = \frac{9}{128}wl^2$ $M_x = R_1 x - \frac{wx^2}{2}$ $\Delta_{max}\left(x = \frac{l}{16}(1+\sqrt{33}) = ,4215l\ iken\right) = \frac{wl^4}{185EI}$ $\Delta_x = \frac{wx}{48EI}(l^3 - 3lx^2 + 2x^3)$
	$R_1 = V_1 = \frac{5P}{16}$ $R_2 = V_2 = \frac{11P}{16}$ $M_{max}\ (sabit\ uçta) = \frac{3Pl}{16}$ $M_1\ (yükün\ olduğu\ noktada) = \frac{5Pl}{32}$ $M_x\left(x < \frac{l}{2}\ iken\right) = \frac{5Px}{16}$ $M_x\left(x > \frac{l}{2}\ iken\right) = P\left(\frac{l}{2} - \frac{11x}{16}\right)$ $\Delta_{max}\left(x = l\sqrt{\frac{1}{5}} = ,4472l\ iken\right) = \frac{Pl^3}{48EI\sqrt{5}} = ,009317\frac{Pl^3}{EI}$ $\Delta_x\ (yükün\ olduğu\ noktada) = \frac{7Pl^3}{768EI}$ $\Delta_x\left(x < \frac{l}{2}\ iken\right) = \frac{Px}{96EI}(3l^2 - 5x^2)$ $\Delta_x\left(x > \frac{l}{2}\ iken\right) = \frac{P}{96EI}(x-l)^2(11x-2l)$

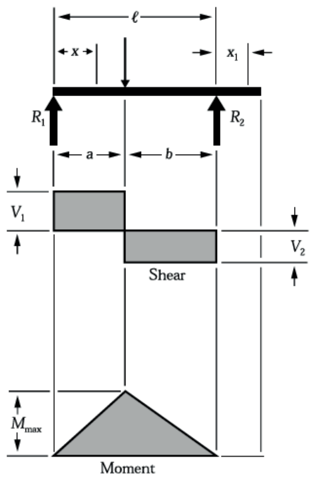
	$R_1 = V_1 = \frac{Pb^2}{2l^3}(a+2l)$ $R_2 = V_2 = \frac{Pa}{2l^3}(3l^2 - a^2)$ $M_1\ (\text{yükün olduğu noktada}) = R_1 a$ $M_2\ (\text{sabit uçta}) = \frac{Pab}{2l^2}(a+l)$ $M_x\ (x < a\ \text{iken}) = R_1 x$ $M_x\ (x > a\ \text{iken}) = R_1 x - P(x-a)$ $\Delta_{max}\left(x = l\frac{l^2+a^2}{3l^2-a^2}\ \text{iken}\ a <,414l\ \text{olduğunda}\right)$ $= \frac{Pa}{3EI}\frac{(l^2-a^2)^3}{(3l^2-a^2)^2}$ $\Delta_{max}\left(x = l\sqrt{\frac{a}{2l+a}}\ \text{iken}\ a >,414l\ \text{olduğunda}\right)$ $= \frac{Pab^2}{6EI}\sqrt{\frac{a}{2l+a}}$ $\Delta_a\ (\text{yükün olduğu noktada}) = \frac{Pa^2b^3}{12EIl^3}(3l+a)$ $\Delta_x\ (x < a\ \text{iken}) = \frac{Pb^2x}{12EIl^3}(3al^2 - 2lx^2 - ax^2)$ $\Delta_x\ (x > a\ \text{iken}) = \frac{Pa}{12EIl^3}(l-x)^2(3l^2x - a^2x - 2a^2l)$
	$R_1 = V_1 = \frac{w}{2l}(l^2 - a^2)$ $R_2 = V_2 + V_3 = \frac{w}{2l}(l+a)^2$ $V_2 = wa$ $V_3 = \frac{w}{2l}(l^2 - a^2)$ $V_x\ (\text{destekler arasında}) = R_1 - wx$ $V_{x_1}\ (\text{sarkma için}) = w(a - x_1)$ $M_1\left(x = \frac{l}{2}\left[1 - \frac{a^2}{l^2}\right]\ \text{iken}\right) = \frac{w}{8l^2}(l+a)^2(l-a)^2$ $M_2\ (R_2\ \text{üzerinde}) = \frac{wa^2}{2}$ $M_x\ (\text{destekler arasında}) = \frac{wx}{2l}(l^2 - a^2 - xl)$ $M_{x_1}\ (\text{sarkma için}) = \frac{w}{2}(a - x_1)^2$ $\Delta_x\ (\text{destekler arasında})$ $= \frac{wx}{24EIl}(l^4 - 2l^2x^2 + lx^3 - 2a^2l^2 + 2a^2x^2)$ $\Delta_{x_1}\ (\text{sarkma için}) = \frac{wx_1}{24EI}(4a^2l - l^3 + 6a^2x_1 - 4ax_1^2 + x_1^3)$



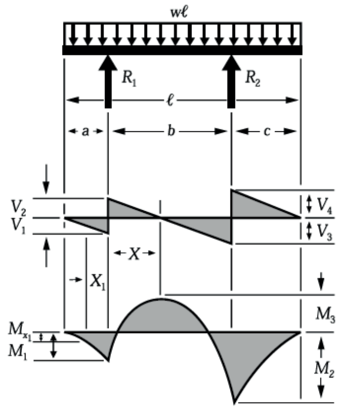
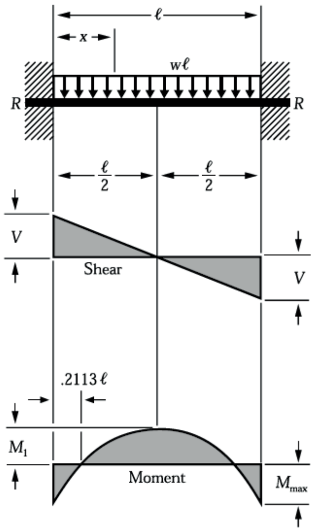
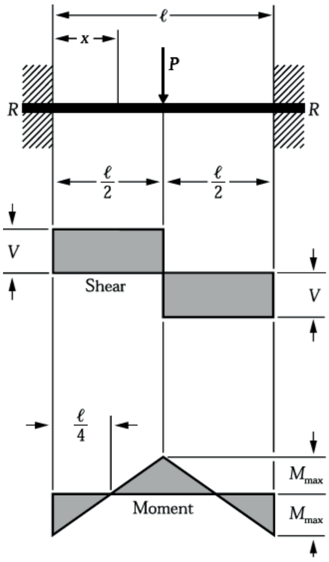
$$R_1 = V_1 = \frac{wa^2}{2l}$$
$$R_2 = V_1 + V_2 = \frac{wa}{2l}(2l + a)$$
$$V_2 = wa$$
$$V_{x_1}\ (sarkma\ için) = w(a - x_1)$$
$$M_{max}\ (R_2\ noktasında) = \frac{wa^2}{2}$$
$$M_x\ (destekler\ arasında) = \frac{wa^2x}{2l}$$
$$M_{x_1}\ (sarkma\ için) = \frac{w}{2}(a - x_1)^2$$
$$\Delta_{max}\left(desteklerin\ arasında\ x = \frac{l}{\sqrt{3}}\ noktasında\right) = \frac{wa^2l^2}{18\sqrt{3}EI} = ,03208\frac{wa^2l^2}{EI}$$
$$\Delta_{max}\ (x_1 = a\ noktasındaki\ sarkmada) = \frac{wa^3}{24EI}(4l + 3a)$$
$$\Delta_x\ (destekler\ arasında) = \frac{wa^2x}{12EIl}(l^2 - x^2)$$
$$\Delta_{x_1}\ (sarkma\ için) = \frac{wx_1}{24EI}(4a^2l + 6a^2x_1 - 4ax_1{}^2 + x_1{}^3)$$

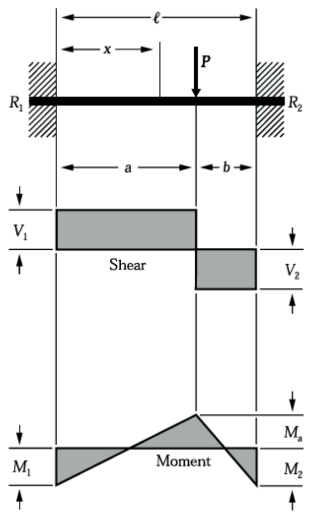


$$R_1 = V_1 = \frac{Pa}{l}$$
$$R_2 = V_1 + V_2 = \frac{P}{l}(l + a)$$
$$V_2 = P$$
$$M_{max}\ (R2\ noktasında) = Pa$$
$$M_x\ (destekler\ arasında) = \frac{Pax}{l}$$
$$M_{x_1}\ (sarkma\ için) = P(a - x_1)$$
$$\Delta_{max}\left(desteklerin\ arasında\ x = \frac{l}{\sqrt{3}}\ iken\right) = \frac{Pal^2}{9\sqrt{3}EI} = ,06415\frac{Pal^2}{EI}$$
$$\Delta_{max}\ (x_1 = a\ noktasında\ sarkma\ için) = \frac{Pa^2}{3EI}(l + a)$$
$$\Delta_x\ (destekler\ arasında) = \frac{Pax}{6EIl}(l^2 - x^2)$$
$$\Delta_{x_1}\ (sarkma\ için) = \frac{Px_1}{6EI}(2al + 3ax_1 - x_1{}^2)$$



$$R_1 = V_1\ (a < b\ iken\ max) = \frac{Pb}{l}$$
$$R_2 = V_2\ (a > b\ iken\ max) = \frac{Pa}{l}$$
$$M_{max}\ (yükün\ olduğu\ noktada) = \frac{Pab}{l}$$
$$M_x\ (x < a\ iken) = \frac{Pbx}{l}$$
$$\Delta_{max}\left(a > b\ iken\ x = \sqrt{\frac{a(a+2b)}{3}}\ olduğunda\right) = \frac{Pab(a+2b)\sqrt{3a(a+2b)}}{27EIl}$$
$$\Delta_a\ (yükün\ olduğu\ noktada) = \frac{Pa^2b^2}{3EIl}$$
$$\Delta_x\ (x < a\ iken) = \frac{Pbx}{6EIl}(l^2 - b^2 - x^2)$$
$$\Delta_x\ (x > a\ iken) = \frac{Pa(l-x)}{6EIl}(2lx - x^2 - a^2)$$
$$\Delta_{x_1} = \frac{Pabx_1}{6EIl}(l + a)$$

	$R_1 = \frac{wl(l-2c)}{2b}$ $R_2 = \frac{wl(l-2a)}{2b}$ $V_1 = wa$ $V_2 = R_1 - V_1$ $V_3 = R_2 - V_4$ $V_4 = wc$ $V_{x_1} = V_1 - wx_1$ $V_x\ (x < l\ iken) = R_1 - w(a + x_1)$ $V_m\ (a < c\ iken) = R_2 - wc$ $M_1 = -\frac{wa^2}{2}$ $M_2 = -\frac{wc^2}{2}$ $M_3 = R_1\left(\frac{R_1}{2w} - a\right)$ $M_x\left(x = \frac{R_1}{w} - a\ iken\ max\right) = R_1 x - \frac{w(a+x)^2}{2}$
	$R = V = \frac{wl}{2}$ $V_x = w\left(\frac{l}{2} - x\right)$ $M_{max}\ (kenarlarda) = \frac{wl^2}{12}$ $M_1\ (merkezde) = \frac{wl^2}{24}$ $M_x = \frac{w}{12}(6lx - l^2 - 6x^2)$ $\Delta_{max}\ (merkezde) = \frac{wl^4}{384EI}$ $\Delta_x = \frac{wx^2}{24EI}(l-x)^2$
	$R = V = \frac{P}{2}$ $M_{max}\ (merkez\ ve\ kenarlarda) = \frac{Pl}{8}$ $M_x\left(x < \frac{l}{2}\ iken\right) = \frac{P}{8}(4x - l)$ $\Delta_{max}\ (merkezde) = \frac{Pl^3}{192EI}$ $\Delta_x\left(x < \frac{l}{2}\ iken\right) = \frac{Px^2}{48EI}(3l - 4x)$



$$R_1 = V_1\ (a < b \text{ iken } max) = \frac{Pb^2}{l^3}(3a+b)$$

$$R_2 = V_2\ (a > b \text{ iken } max) = \frac{Pa^2}{l^3}(a+3b)$$

$$M_1\ (a < b \text{ iken } max) = \frac{Pab^2}{l^2}$$

$$M_2\ (a > b \text{ iken } max) = \frac{Pa^2b}{l^2}$$

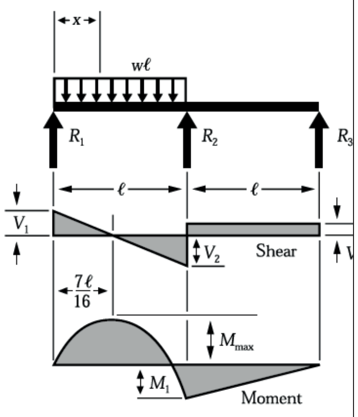
$$M_a\ (\text{yükün olduğu noktada}) = \frac{2Pa^2b^2}{l^3}$$

$$M_x\ (x < a \text{ iken}) = R_1x - \frac{Pab^2}{l^2}$$

$$\Delta_{max}\left(x = \frac{2al}{3a+b} \text{ noktasında } a > b \text{ iken}\right) = \frac{2Pa^3b^2}{3EI(3a+b)^2}$$

$$\Delta_a\ (\text{yükün olduğu noktada}) = \frac{Pa^3b^3}{3EIl^3}$$

$$\Delta_x\ (x < a \text{ iken}) = \frac{Pb^2x^2}{6EIl^3}(3al - 3ax - bx)$$



$$R_1 = V_1 = \frac{7}{16}wl$$

$$R_2 = V_2 + V_3 = \frac{5}{8}wl$$

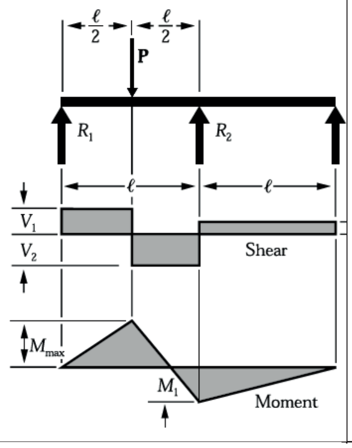
$$R_3 = V_3 = -\frac{1}{16}wl$$

$$V_2 = \frac{9}{16}wl$$

$$M_{max}\left(x = \frac{7}{16}l \text{ iken}\right) = \frac{49}{512}wl^2$$

$$M_1\ (R_2 \text{ destek noktasında}) = \frac{1}{16}wl^2$$

$$M_x\ (x < l \text{ iken}) = \frac{wx}{16}(7l - 8x)$$



$$R_1 = V_1 = \frac{13}{32}P$$

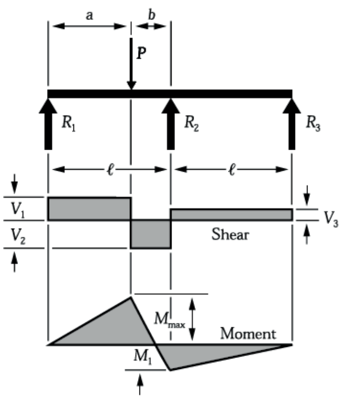
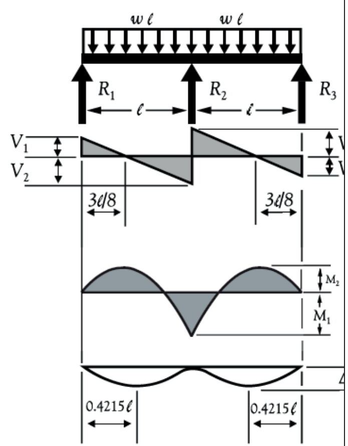
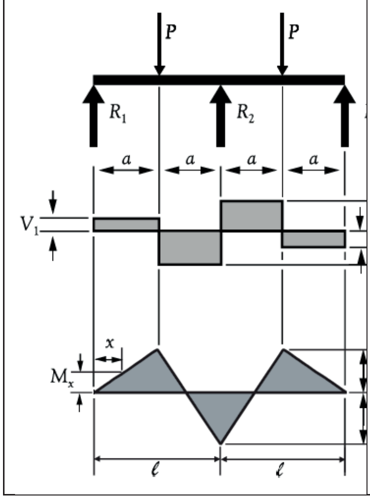
$$R_2 = V_2 + V_3 = \frac{11}{16}P$$

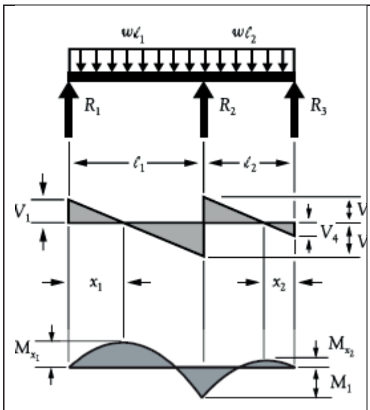
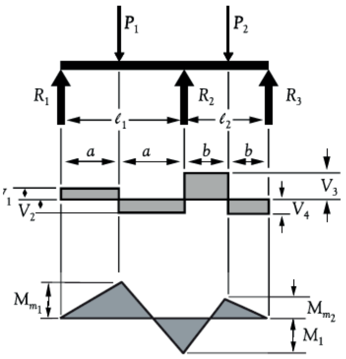
$$R_3 = V_3 = -\frac{3}{32}P$$

$$V_2 = \frac{19}{32}P$$

$$M_{max}\ (\text{yükün olduğu noktada}) = \frac{13}{64}Pl$$

$$M_1\ (R_2 \text{ destek boktasında}) = \frac{3}{32}Pl$$

	$R_1 = V_1 = \frac{Pb}{4l^3}\left(4l^2 - a(l+a)\right)$ $R_2 = V_2 + V_3 = \frac{Pa}{2l^3}\left(2l^2 + b(l+a)\right)$ $R_3 = V_3 = -\frac{Pab}{4l^3}(l+a)$ $V_2 = \frac{Pa}{4l^3}(4l^2 + b(l+a)$ M_{max} (yükün olduğu noktada) $= \frac{Pab}{4l^3}\left(4l^2 - a(l+a)\right)$ M_1 (R_2 destek noktasında) $= \frac{Pab}{4l^2}(l+a)$
	$R_1 = V_1 = R_3 = V_3 = \frac{3wl}{8}$ $R_2 = \frac{10wl}{8}$ $V_2 = V_{max} = \frac{5wl}{8}$ $M_1 = \frac{wl^2}{8}$ $M_2 \left(\frac{3l}{8}\ \text{noktasında}\right) = \frac{9wl^2}{128}$ Δ_{max} (R_1 ve R_3'ten ortalama $0,4215l$ kadar uzakta) $= \frac{wl^4}{185EI}$
	$R_1 = V_1 = R_3 = V_3 = \frac{5P}{16}$ $R_2 = 2V_2 = \frac{11P}{8}$ $V_2 = P - R_1 = \frac{11P}{16}$ $V_{max} = V_2$ $M_1 = -\frac{3pl}{16}$ $M_2 = \frac{5Pl}{32}$ M_x ($x < a$ iken) $= R_1 x$

	$R_1 = \frac{M_1}{l_1} + \frac{wl_1}{2}$ $R_2 = wl_1 + wl_2 - R_1 - R_3$ $R_3 = V_4 = \frac{M_1}{l_2} + \frac{wl_2}{2}$ $V_1 = R_1$ $V_2 = wl_1 - R_1$ $V_3 = wl_2 - R_3$ $V_4 = R_3$ $M_1 = -\frac{wl_2^3 + wl_1^3}{8(l_1 + l_2)}$ $M_{x_1}\left(x_1 = \frac{R_1}{w}\ iken\right) = R_1x_1 - \frac{wx_1^2}{2}$ $M_{x_2}\left(x_2 = \frac{R_3}{w} iken\right) = R_3x_2 - \frac{wx_2^2}{2}$
	$R_1 = \frac{M_1}{l_1} + \frac{P_1}{2}$ $R_2 = P_1 + P_2 - R_1 - R_3$ $R_3 = \frac{M_1}{l_2} + \frac{P_2}{2}$ $V_1 = R_1$ $V_2 = P_1 - R_1$ $V_3 = P_2 - R_3$ $V_4 = R_3$ $M_1 = -\frac{3}{16}\left(\frac{P_1l_1^2 + P_2l_2^2}{l_1 + l_2}\right)$ $M_{m_1} = R_1a$ $M_{m_2} = R_3b$

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VSMA Selection of screen size and type

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C. Erdem İmrak, M. Loray Kesikçi, Sürekli Transport Sistemler

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Evolution of design and applicatios of apron feeders, Bulk material handling Division, Pgh. PA USA

A.W. Roberts, Australia, An overview of Feeder Design Focusing on Belt and Apron Feeders

Table: Measurement conversion tables

Length	1 inch	1 foot	1 yard	1 mile	1 cm	1 meter	1 km
1 inch	1	$8.33*10^{-2}$	$2.778*10^{-2}$	$1.578*10^{-5}$	2.54	$2.54*10^{-2}$	$2.54*10^{-5}$
1 foot	12	1	0.3333	$1.894*10^{-4}$	30.48	0.3048	$3.048*10^{-4}$
1 yard	36	3	1	$5.682*10^{-4}$	91.44	0.9144	$9.144*10^{-4}$
1 mile	$6.336*10^{4}$	5280	1760	1	$1.609*10^{5}$	1609	1.609
1 cm	0.3937	$3.281*10^{-2}$	$1.09*10^{-2}$	$6.21*10^{6}$	1	10^{-2}	10^{-5}
1 meter	39.37	3.281	1.094	$6.21*10^{-4}$	100	1	10^{-3}
1 km	$3.937*10^{4}$	3281	1094	0.621	10^{5}	1000	1

Area	1 $inch^2$	1 $foot^2$	1 $yard^2$	1 $mile^2$	1 cm^2	1 m^2	1 hectar	1 km^2
1 $inch^2$	1	$6.944*10^{3}$	$7.716*10^{4}$	$0.249*10^{9}$	6.452	$6.452*10^{4}$	$6.452*10^{8}$	$6.452*10^{10}$
1 $foot^2$	144	1	0.111	$0.359*10^{7}$	929	$9.290*10^{2}$	$9.290*10^{6}$	$9.290*10^{8}$
1 $yard^2$	1296	9	1	-	8361	0.8361	-	-
1 $mile^2$	$4.014*10^{9}$	$2.788*10^{7}$	$3.098*10^{6}$	1	$2.589*10^{10}$	$2.590*10^{6}$	259	2.59
1 cm^2	0.155	$1.076*10^{3}$	$1.196*10^{4}$	$0.386*10^{10}$	1	10^{4}	10^{8}	10^{10}
1 $meter^2$	1550	10.76	1.196	$0.386*10^{6}$	10^{4}	1	10^{4}	10^{6}
1 hectare	$1.55*10^{7}$	$1.076*10^{5}$	2.47	$0.386*10^{2}$	10^{8}	10^{4}	1	10^{2}
1 $kilometer^2$	$1.550*10^{9}$	$1.076*10^{7}$	$1.196*10^{6}$	0.3861	10^{10}	10^{6}	100	1

Volume	1 $inch^3$	1 $foot^3$	1 $yard^3$	1 US galon	1 IMP galon	1 cm^3	1 dm^3 (litre)	1 m^3
1 $inch^3$	1	$5.787*10^{-4}$	$2.143*10^{-5}$	$4.329*10^{-3}$	-	16.39	$1.639*10^{-2}$	$1.639*10^{-5}$
1 $foot^3$	1728	1	0.0370	7.481	6.232	$2.832*10^{4}$	28.32	$2.832*10^{-2}$
1 $yard^3$	46656	27	1	202	168.2	-	764.6	0.07646
1 US gallon	231	0.1337	-	1	0.8327	$3.786*10^{3}$	3.785	$3.786*10^{-3}$
1 Imperial gallon	277.4	0.1603	-	1.201	1	4546	4.546	0.00456
1 cubic $centimeter^3$	$6.102*10^{-2}$	$3.531*10^{-5}$	$1.308*10^{-6}$	$2.642*10^{-4}$	-	1	10^{-3}	10^{-6}
1 $decimeter^3$ or liter	61.02	$3.531*10^{-2}$	-	0.2642	0.22	1000	1	10^{-3}
1 $meter^3$	$6.102*10^{4}$	35.31	1.308	264.2	220	10^{6}	1000	1

Density	1 kg/m^3	1 $lb/inch^3$	1 lb/ft^3	1 ton/m^3
1 kg/m^3	1	$3.61*10^{-5}$	$6.242*10^{-2}$	10^{-3}
1 $lb/inch^3$	27.680	1	1.728	27.6814
1 lb/ft^3	16.0184	$5.787*10^{-4}$	1	0.016018
1 ton/m^3	1000	0.03613	62.428	1

Weight	1 ounce	1 pound (lb)	1US short ton	1 IMP	1 gram	1 kg	1 ton
1 ounce	1	$6.250*10^{-2}$	-	$3.125*10^{-5}$	28.35	$2.835*10^{-2}$	$2.835*10^{-5}$
1 pound (lb)	16	1	0.0005	-	453.6	0.454	$4.536*10^{-4}$
1 US ton	32000	2000	1	0.8929	907190	907.20	0.907
1 Imperial ton	35840	2240	1.120	1	1016050	1016	1.016
1 gram	$3.527*10^{-2}$	$2.205*10^{-3}$	$1.102*10^{-6}$	-	1	10^{-3}	10^{-6}
1 kilogram	35.27	2.205	0.0011	0.00098	1000	1	10^{-3}
1 ton	$3.527*10^{4}$	2204.6	1.1023	0.9842	10^{6}	10^{3}	1

Power	1 kW (kilowatt)	1 PS	1 HP	1 m kg/s	1 kcal/s	1 BTU/s	1 ftlb/s
1 kW (kilowatt)	1	1.36	1.34	102	0.239	0.948	737.54
1 PS	0.735	1	0.986	75	0.176	0.697	542.46
1 HP	0.746	1.014	1	76.1	0.178	0.707	550.20
1 m kg/s	$9.981*10^{-3}$	$1.33*10^{-2}$	$1.31*10^{-2}$	1	$2.34*10^{-3}$	$9.39*10^{-3}$	7.23
1 kcal/s	4.19	5.69	5.61	427	1	3.97	3087
1 BTU/s	1.06	1.43	1.41	108	0.252	1	778
1 ftlb/s	$1.36*10^{-3}$	$1.84*10^{-3}$	$1.82*10^{-3}$	0.138	$3.24*10^{-4}$	$1.29*10^{-3}$	1

Work	1 Joule - 107 erg	1 kilowatt-second (kWs)	1 PSh (petasatt)	1 meter-kilogram (mkg)	1 kilocalorie (kcal)
1 Joule - 10^{7} erg	1	$0.278*10^{-6}$	$0.378*10^{-6}$	0.102	$0.239*10^{-3}$
1 kilowatt-second (kWs)	$3.6*10^{6}$	1	1.36	$0.367*10^{1}$	860
1 PSh (petasatt)	$2.65*10^{6}$	0.736	1	$0.270*10^{1}$	632
1 meter-kilogram (mkg)	9.81	$2.72*10^{-6}$	$3.70*10^{-6}$	1	$2.345*10^{-3}$
1 kilocalorie (kcal)	4186	$1.16*10^{-3}$	$1.58*10^{-3}$	426.9	1

Presure	1 atm (760 mm Hg)	1 atm (1 kg/cm^2)	1 PSI (pound/inch^2)	1 torr (1mm Hg)	1 bar (104dyn/cm^2)
1 atm (760 mm Hg)	1	1.0332	14.7	760	1.0133
1 atm (1 kg/cm^2)	0.9678	1	14.2	735.56	0.9807
1 PSI (pound/inch^2	0.068	0.07	1	-	-
1 torr (1mm Hg)	$1.316*10^{-3}$	$1.3595*10^{-3}$	-	1	$1.333*10^{-3}$
1 bar (10^4dyn/cm^2)	0.9869	1.0197	-	750.06	1

Table: Net Usable Screen Area, m²

Screen width * length, m	Upper curtain	Middle	Lower	Screen width * length, m	Upper curtain	Middle	Lower
0.6 * 1.2	0.55	0.50	0.45	1.8 * 2.4	4.10	3.68	3.30
0.6 * 1.8	0.84	0.75	0.68	1.8 * 3.0	5.11	4.60	4.14
0.9 * 1.8	1.40	1.25	1.12	1.8 * 3.6	6.13	5.50	4.97
0.9 * 2.4	1.85	1.67	1.50	1.8 * 4.2	7.15	6.44	5.80
0.9 * 3.0	2.30	2.10	1.85	1.8 * 4.8	8.18	7.36	6.62
0.9 * 3.6	2.80	2.50	2.25	1.8 * 6.1	10.20	9.20	8.28
0.9 * 4.2	3.25	2.90	2.64	2.1 * 3.6	7.24	6.52	5.87
0.9 * 4.8	3.70	3.35	3.00	2.1 * 4.2	8.45	7.60	6.85
1.2 * 1.8	1.95	1.75	1.58	2.1 * 4.8	9.66	8.70	7.80
1.2 * 2.4	2.60	2.34	2.10	2.1 * 6.1	12.08	10.87	9.78
1.2 * 3.0	3.25	2.92	2.64	2.4 * 4.2	10.69	9.62	8.66
1.2 * 3.6	3.90	3.50	3.15	2.4 * 4.8	11.15	10.03	9.03
1.2 * 4.2	4.55	4.10	3.69	2.4 * 6.1	13.94	12.55	11.29
1.2 * 4.8	5.20	4.68	4.20	2.4 * 7.3	16.42	14.78	13.30
1.5 * 1.8	3.35	3.00	2.70	3.0 * 4.8	13.68	12.3	11.08
1.5 * 2.4	4.20	3.76	3.40	3.0 * 6.1	17.38	15.65	14.08
1.5 * 3.0	5.00	4.50	4.06	3.0 * 7.3	20.80	18.72	16.85
1.5 * 3.6	5.85	5.27	4.74	3.6 * 4.8	16.56	14.90	13.40
1.5 * 4.2	6.70	6.02	5.40	3.6 * 6.1	21.04	18.94	17.04
1.5 * 4.8	8.36	7.53	6.77	3.6 * 7.3	25.18	22.66	20.39

Table: Density and Work Index

Ore	Density	Work Index	Ore	Density	Work Index
Andesite	2.84	22.13	Lead ore	3.44	11.40
Barite	4.28	6.24	Lead-zinc ore	3.37	11.30
Basalt	2.89	20.41	Limestone	2.69	11.61
Bauxite	2.38	9.45	Limestone for cement	2.68	10.18
Cement clinker	3.15	13.49	Manganese ore	3.74	12.46
Cement raw material	2.67	10.57	Calcined magnesite	5.22	16.80
Chrome ore	4.06	9.60	Mica	2.89	134.50
Clay	2.23	7.10	Molybdenum ore	2.70	12.97
Gypsum	2.69	8.16	Nickel ore	3.32	11.88
Coal	1.63	11.37	Oil shale	1.76	18.10
Bituminous coal	1.51	20.70	Phosphate fertilizer	2.65	13.03
Petroleum coke	1.78	73.80	Phosphate rock	2.66	10.13
Copper ore	3.02	13.13	Potash ore	2.37	8.88
Gold ore	2.86	14.83	Potash salt	2.18	8.23
Diorite	2.78	19.40	Pumice	1.96	11.93
Dolomite	2.82	11.31	Pyrite ore	3.48	8.90
Sand	3.48	58.18	Pyrrhotite ore	4.04	9.58
Feldspar	2.59	11.67	Quartz	2.64	12.77
Ferrochrome	6.75	8.87	Quartzite	2.71	12.18
Ferromanganese	5.91	7.77	Rutile ore	2.84	12.12
Ferrosilicon	4.91	12.83	Sandstone	2.68	11.53
Flint	2.65	26.16	Shale	2.58	16.40
Fluorspar	2.98	9.76	Silica	2.71	13.53
Gabbro	2.83	18.45	Silica sand	2.65	16.46
Galena	5.39	10.19	Silicon carbide	2.73	26.17
Garnet	3.30	12.37	Silver ore	2.72	17.30
Glass	2.58	3.08	Sinter	3.00	8.77
Gneiss	2.71	20.13	Smelting slag	2.93	15.76
Granite	2.68	14.39	Blast furnace slag	2.39	12.16
Graphite	1.75	45.03	Slate	2.48	13.83
Gravel	2.70	25.17	Sodium silicate	2.10	13.00
Ilmenite	4.27	13.11	Spodumene ore	2.75	13.70
Iron ore	3.96	15.44	Syenite	2.73	14.90
Hematite	3.76	12.68	Kyanite	3.23	18.87
Specular hematite	3.29	15.40	Tin ore	3.94	10.81
Olitic	3.32	11.33	Titanium ore	4.23	11.88
Limonite	2.53	8.45	Volcanic rock	2.85	21.10
Magnetite	3.88	10.21	Uranium ore	2.70	17.93
Taconite	3.52	14.87	Zinc ore	3.68	12.42

Table: Screen standards

United States (1)		TYLER (2)	Canada (3)		English (4)		France (5)		German (6)
Metric	Imperial System	Mesh	Metric	Imperial System	mm	Mesh	mm	No	mm
125 mm	5"		125 mm	5"					
106 mm	4 ¼		106 mm	4 ¼					
100 mm	4"		100 mm	4"					
90 mm	3 ½		90 mm	3 ½					
75 mm	3"		75 mm	3"					
63 mm	2 ½"		63 mm	2 ½"					
53 mm	2 ½"		53 mm	2 ½"					
50 mm	2"		50 mm	2"					
45 mm	1 ¾"		45 mm	1 ¾"					
37.5 mm	1 1/3"		37.5 mm	1 ¾"					
31.5 mm	1 ¼"		31.5 mm	1 ¼"					
26.5 mm	1.06"	1.05"	26.5 mm	1.06"					
25.0 mm	1"		25.0 mm	1"					25.0 mm
22.4 mm	7/9"	0.883"	22.4 mm	7/9"					
19.0 mm	¾"	0.742"	19.0 mm	¾"					20.0 mm
									18.0 mm
16.0 mm	5/8"	0.624"	16.0 mm	5/8"					16.0 mm
13.2 mm	0.530"	0.525"	13.2 mm	0.530"					
12.5 mm	½"		12.5 mm	½"					12.5 mm
11.2 mm	7/16"	0.441"	11.2 mm	7/16"					
			9.5 mm	3/8"					10.0 mm
9.5 mm	3/9"	0.371"	8.0 mm	5/16"					
8.0 mm	5/16"	2 ½"	6.7 mm	0.265"					8.0 mm
6.7 mm	0.265"	3"	6.3 mm	¼"					
6.3 mm	¼"								6.3 mm
5.6 mm	No: 3 ½	3 ½	5.6 mm	No: 3 ½					
		4					5.000	38	5.0 mm
4.75 mm	4	5	4.75 mm	4					
4.00 mm	5	6	4.00 mm	5			4.000	37	4.0 mm
3.35 mm	6		3.35 mm	6	3.35 mm	5			
							3.150	36	3.15 mm
2.80 mm	7	7	2.80 mm	7	2.80 mm	6			
2.36 mm	8	8	2.36 mm	8	2.40 mm	7	2.500	35	2.5 mm
2.00 mm	10	9	2.00 mm	10	2.00 mm	8	2.000	34	2.0 mm
1.70 mm	12	10	1.70 mm	12	1.63 mm	10	1.600	33	1.6 mm
1.40 mm	14	12	1.40 mm	14	1.40 mm	12			
							1.250	32	1.25 mm
1.18 mm	16	14	1.18 mm	16	1.20 mm	14			
1.00 mm	18	16	1.00 mm	18	1.00 mm	16	1.000	31	1.0 mm

(1) USA Sieve Series-ASTM Specification E-11-70
(2) Tyler Standard Screen Scale Sieve Series
(3) Canadian Standard Sieve Series 8-Gp-1d
(4) British Standards Institution; London BS-410-62
(5) French Standard Specifications AFNOR X-11-501
(6) German Standard Specification DIN 4188

850 μ	20	20	850 μ	20	850 μ	18			
							0.800	30	800 μ
710 μ	25	24	710 μ	25	710 μ	22			
							0.630	29	630 μ
600 μ	30	28	600 μ	30	600 μ	25			
500 μ	35	32	500 μ	35	500 μ	30	0.500	28	500 μ
425 μ	40	35	425 μ	40	420 μ	36			
							0.400	27	400 μ
355 μ	45	42	355 μ	45	355 μ	44			
							0.315	26	315 μ
300 μ	50	48	300 μ	50	300 μ	52			
250 μ	60	60	250 μ	60	250 μ	60	0.250	25	250 μ
212 μ	70	65	212 μ	70	210 μ	72			
							0.200	24	200 μ
180 μ	80	80	180 μ	80	180 μ	85			
							0.160	23	160 μ
150 μ	100	100	150 μ	100	150 μ	100			
125 μ	120	115	125 μ	120	125 μ	120	0.125	22	125 μ
106 μ	140	150	106 μ	140	105 μ	150			
							0.100	21	100 μ
90 μ	170	170	90 μ	170	90 μ	170			90 μ
75 μ	200	200	75 μ	200	75 μ	200	0.080	20	80 μ
									71 μ
63 μ	230	250	63 μ	230	63 μ	240	0.063	19	63 μ
									56 μ
53 μ	270	270	53 μ	270	53 μ	300			
							0.050	18	50 μ
45 μ	325	325	45 μ	325	45 μ	350			45 μ
							0.040	17	40 μ
38 μ	400	400	38 μ	400	38 μ	400	0.036		
32 μ	450				32 μ	440	0.032		
25 μ	500						0.025		
20 μ	635						0.010		


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