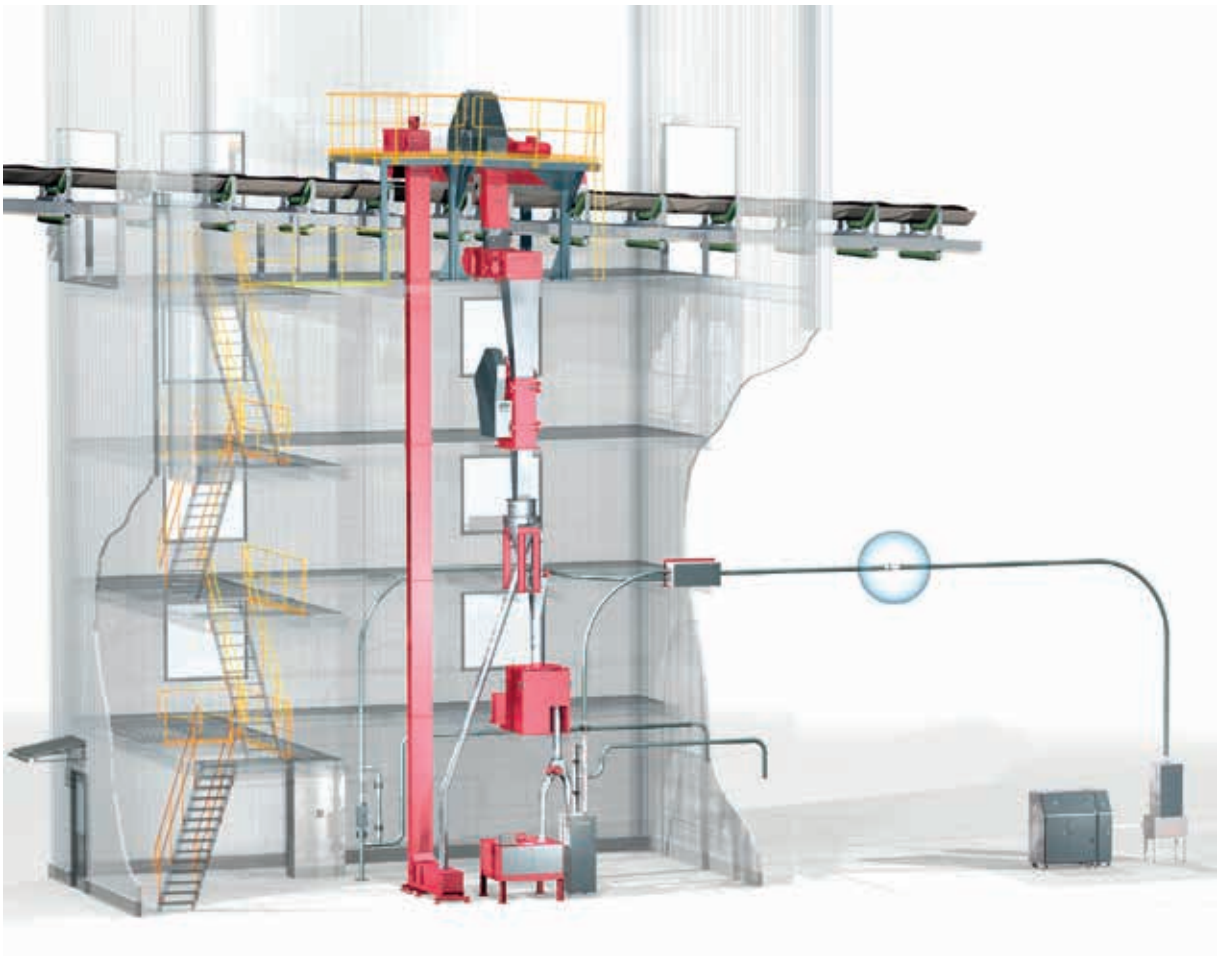
SIEBTECHNIK TEMA



Sampling and Sample Preparation

Individual units and plants

Without sampling there would be no analysis of bulk materials to maintain quality standards to which we all strive.

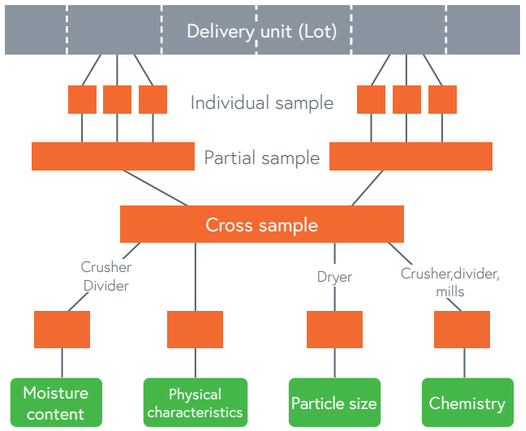
A Representative Sample is simply a sample taken from a main body of material which mirrors exactly the particle proportions of that main body in a smaller sample.

Following this principle, Siebtechnik supplies single units or complete systems for sampling, sample processing and sample analysis of bulk materials and suspensions.

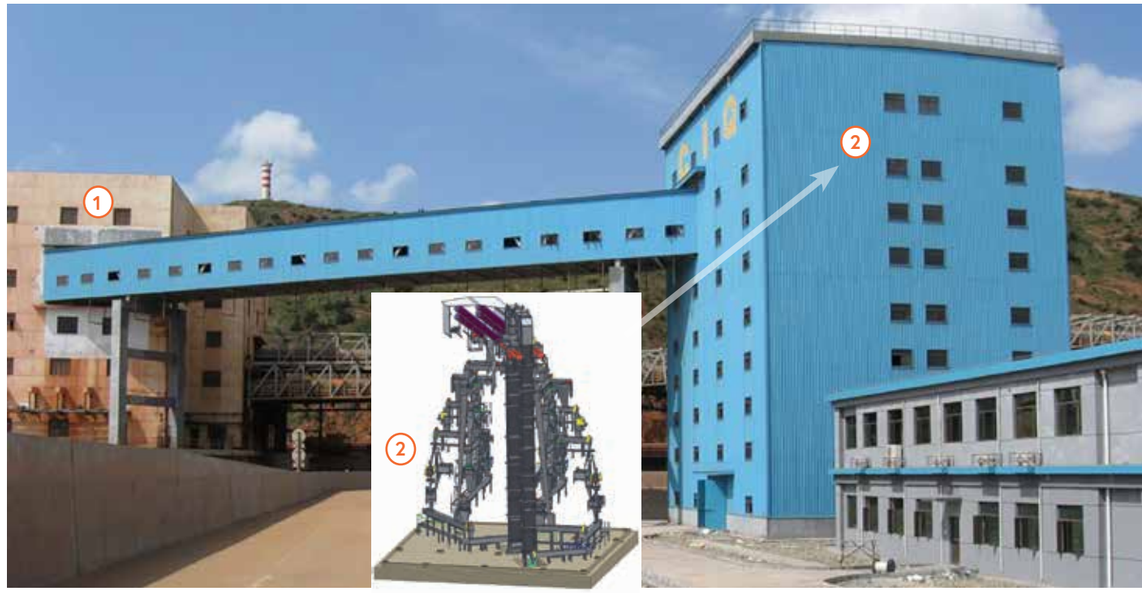
Sampling describes the process of taking samples of partial quantities (= individual samples) from the total quantity to be sampled (= delivery unit).
Sample processing includes all steps from sampling to analysis.
The requirements for sample processing are determined by the subsequent analysis, for example:

- Analytical samples for particle size and strength tests must not be altered or degraded and must be prepared as gently as possible.
- Analytical samples for an analysis of the chemical properties have to be prepared in several stages of comminution and subdivision.
- Analytical samples for moisture analysis must neither be heated nor stored open to minimize any loss of moisture.

With high value bulk materials, its imperative sampling is both accurate and efficient and more importantly relevant to the various International Standards used in each country. Siebtechnik accounts for the differing requirements of National and International Standards in force in each country.



Sampling (**1**) and sample processing (**2**) of coal during ship loading



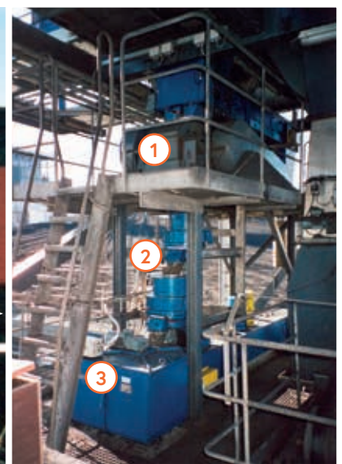
Sampling of iron ore, slot vessel sampler (**1**) and sample processing (**2**)

Fundamentals

The term 'sampling' means all operations necessary to take an individual sample from a delivery unit in such a way that it corresponds with the expected analysis of the total quantity without systematic error. The subsequent 'sample preparation' includes all operations necessary to bring the sample material into a useable state required for any subsequent examination.

During sampling, bulk goods - especially raw materials are frequently very inhomogeneous with regard to the quality characteristics relevant for evaluation.

Sampling in coal unloading crane



Double-roller mill (**1**)
Turnstile divider (**2**)
Sample collector (**3**)

The more variance in the material source, the more frequently sampling must be carried out. This is the only way to obtain a true reference with sufficient precision. The taking of a large number of individual samples inevitably leads to the processing of multiple samples and increased costs. The number of individual samples to be taken should therefore be adjusted according to the nature or value of the material being sampled and the required precision.

During the subsequent sample preparation, the sample must reflect the homogeneity of the material being sampled. In all operations, it is essential to ensure that the sample is prepared without significant loss of characteristics i.e. moisture content for example.

SIEBTECHNIK provide a high quality technical design which delivers accurate sampling sufficient to determine the material characteristics for any given application.

For example, if you consider a bulk cargo ship with 200,000 tonnes of coal on board, only a few grams of material are needed to provide a representative Ash content for the whole cargo.

Depending on the properties required from the sampled materials, we will advise a suitable sampling frequency so that a broad cross section of data can be deemed a good quality indicator for the given process.

Sampling from stationary or stockpiled material is notoriously inaccurate and unlikely to provide accurate data.

Ship cargo — 200,000 t

All individual samples — 20,000 kg

Cross sample — 20 kg

Analysis sample — 10 g

1: 10,000 · 1: 1,000 · 1: 2,000

TOTAL 1: 20,000,000,000

General Rules for Plant Design

Sampling can be carried out most easily from material on a moving belt, the head drum or from a chute or downpipe.

It must always be ensured that each sample represents a cross-sectional sample of the entire flow of material. The flow of material must therefore be recorded in its entire width and strength.

The quantity of material produced during sampling shall determine the dimensions of the sampling vessel and taking into account the sample frequency, for the design of the downstream comminution, dividing and collection equipment for the sampled materials.

The weight of an individual sample is calculated according to the following numerical value equa-

$$m_{EP} = \frac{\dot{m} \cdot SW}{v \cdot 3600}$$

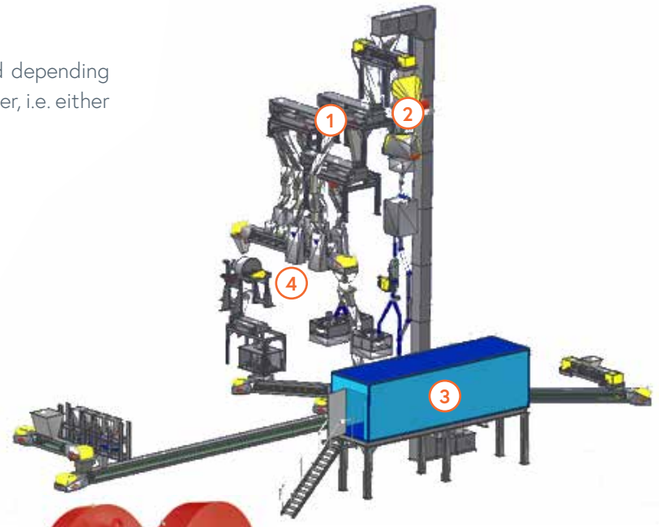
m_{EP}	Weight of the individual sample quantity in kg
$\dot{m}$	Belt load in t/h
SW	Slot width of the sampler in mm
v	Slot vessel sampler: Travelling speed of the slot vessel sampler in m/s Hammer sample taker: Belt velocity in m/s

Sampling for Sinter

Sampling can be either time or mass based depending on the individual requirements of the customer, i.e. either in equal time or mass intervals.

Screening machine (**1**)

Weighing and dosing units (**4**)



Jaw crusher (**2**)

Autom. milling and pressing system (**3**), Analysis-precise tablet

The slot width of the sampling device should be three times that of the nominal maximum particle size of the sampled material. The nominal maximum particle size indicates the particle size at which the retained material on a test sieve must not exceed 5% of the total bulk delivery. However, a slot width of 30 mm should be maintained even with finer material.

Sampling of limestone

Sampling system for copper concentrate

The speed of the sampling device must remain constant during the entire sampling procedure. When sampling from a falling flow of material, the speed of the sampling vessel should be no higher than 0.6 m/s. Otherwise, particle size selection by the sampling vessel is a possibility.

SAMPLING AND SAMPLE PREPARATION

Depending on the particle size and the possible requirement for additional processing, the sample material may now be crushed in order to be able to divide it further. When selecting the type of comminution unit, care must be taken at each comminution stage to ensure that machines are used which do not falsify the quality indicators. For example, when determining moisture content, we wouldn't use a Hammermill. As this will tend to dry the sample giving false moisture content detail.

When sub-dividing the samples, the same applies as when sampling the individual samples, i.e. each particle must have the same chance of ending up in the sample.

Otherwise, the subdivision step is not representative. Before each further sub-step, a comminution stage should always be provided for upstream, which reduces the particle size of the material and thus further homogenises it.

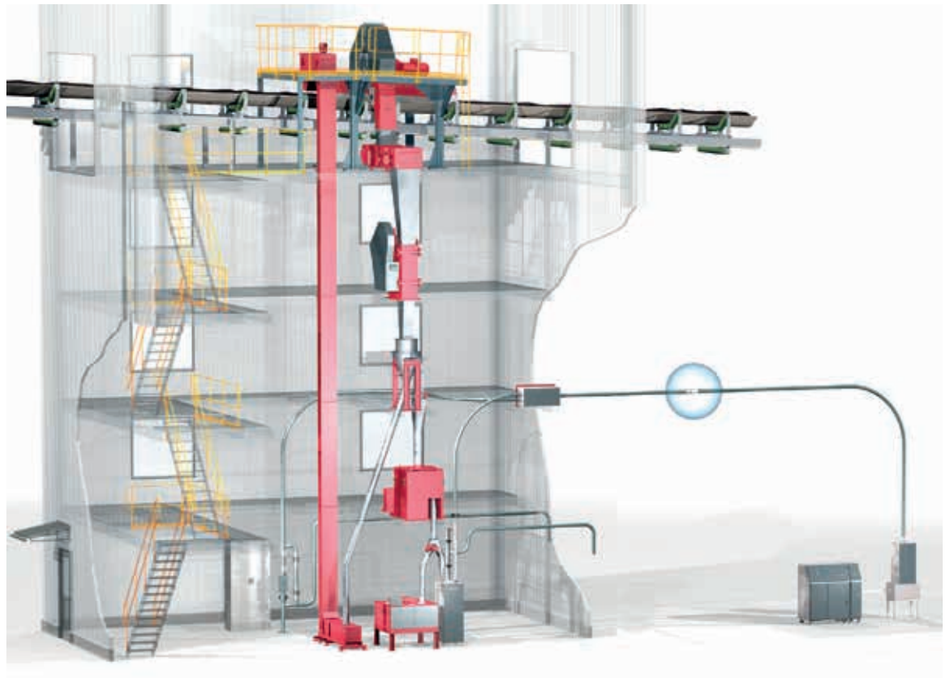
UNITS FOR SAMPLING AND SAMPLE PREPARATION

Sampler

The basic equipment for a sampling system usually consists of the sampling device and the machines for sample processing. Usually, the sampling quantities are reduced directly on site to a sample size required by the laboratory for further analysis.

This then requires at least one crushing stage and additional division, as well as the sample collector, for storing the samples for longer periods.

In order to set up a representative sampling system, the quite different products, the local conditions at the place of installation and the widely varying conveying capacities must be taken into account in addition to many normative concerns. This usually requires an individual, custom-made solution based on the units presented below.

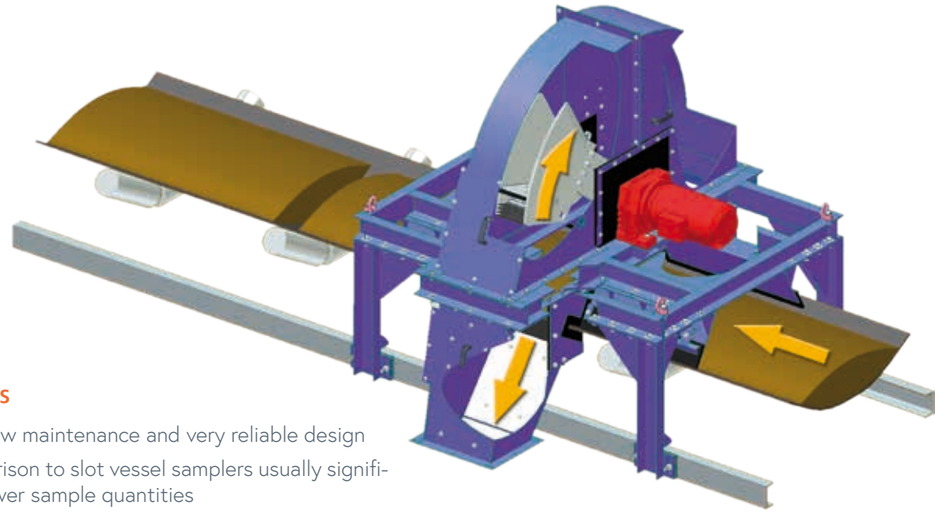


Hammer Sample Taker

The hammer sample taker is used for sampling materials from moving belt conveyors. The principle of the sampler is similar to that of sampling from a measured section of a stationary belt. The hammer sample taker guides the 'Hammer' in a circular motion through the moving material flow on the belt. It automatically takes a representative cross-sectional sample from the belt, which corresponds to that of a sampling frame. In order to ensure that the belt is not damaged and to obtain a complete and representative sample, the shape of the sampler must be adapted to the different belt cross-sections and belt trough characteristics.

The Hammer utilises a flexible rubber blade and brushes, which ensures that any remaining fine material is removed from the belt to the discharge sample chute.

Hammer sample taker		HPN
Belt width	mm	400 - 2,400
Weight	kg	350 - 5,000



Advantages

- Simple, low maintenance and very reliable design
- In comparison to slot vessel samplers usually significantly lower sample quantities
- Hardly any changes required to existing belt systems for subsequent installation

Slot Vessel Sampler

The slot vessel sampler is used to sample materials at the belt head drum or from an unpressurised vertical chute or downpipe.
The principle is based on a slotted vessel with a defined inlet slot width open to the falling material that covers the entire cross-section within the chute.
The sampler then passes through the flow of material from its parked position, with the bottom flap open, after traversing through the material with its flap open, the return leg closes the flap and collects the representative sample for discharging as the flap re-opens on reaching the parked position slot vessel.

When the vessel returns to the parked position, the bottom flap is opened and the contents discharged via a collection chute. The parked position of the sampler is always outside the flow of material, which minimizes unit wear.

Advantages

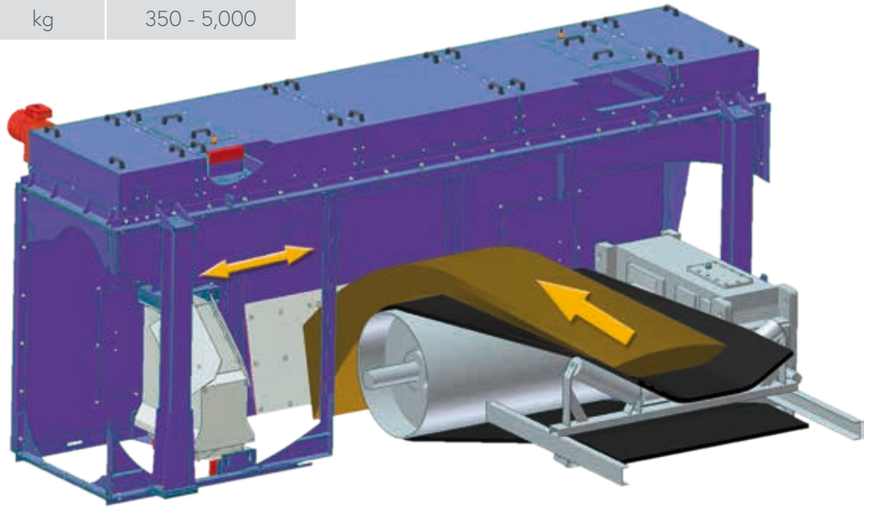
- A versatile design, which is also very adaptable to an array of different applications
- The flexible design affords the user representative sampling even in the most inaccessible places

Slot Vessel Samplers in Suspended Applications

As its name suggests, this version can be supplied with the traversing track at the top instead of the normal lower mount.
Other options also exist, such as a circular path traversing vessel.

- Swivel arm sampler
- Swivel sampler

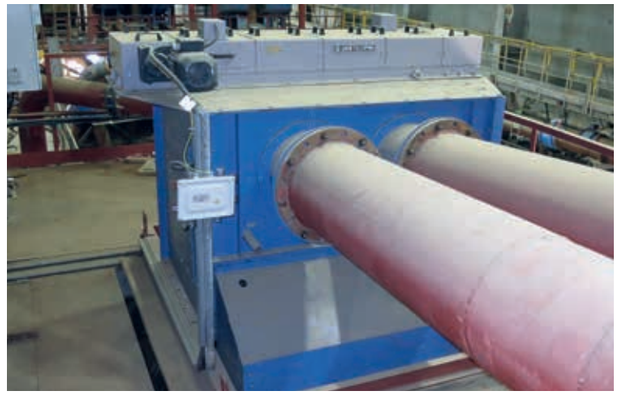
Slot vessel samlper / Swivel sampler / Swivel arm sampler		LPN / SwPN / SAPN
Belt width	mm	400 - 2,400
Weight	kg	350 - 5,000

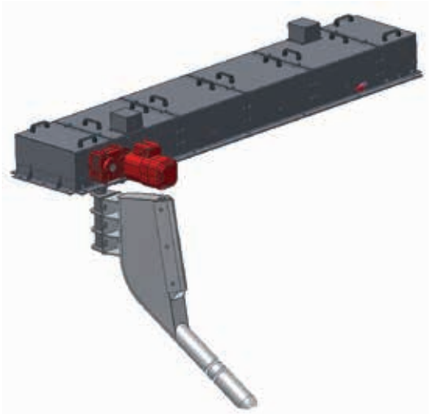


Slurry Sampler

Representative sampling of slurries is carried out by a sampling spoon, which is guided through the material flow in a linear movement at constant speed. While the sampling spoon travels through the suspension flow, a partial flow is continuously separated and discharged via the outlet pipe. The sample material obtained in this way can be collected and further processed via a collection drain channel. The parked position of the sampling spoon between two samples being taken is inside the material space but outside the main product flow, so that any direct contact between the sampling spoon and the material flow is avoided and wear on the sampling spoon is reduced.

Slurry sampler		LPN-T
Pipe diameter/ cross section of chute	mm	100 - 3,000
Weight	kg	250 - 1,000





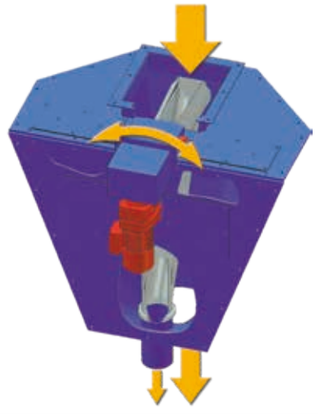
Downpipe / Slurry Sampler

Representative sampling is carried out by a sample chute, which is guided in a circular motion through the material flow at a constant speed. While the sample chute is rotated through the material flow, a partial flow is continuously separated and routed to the outside. The sample material obtained in this way can be collected and further processed via a pipe socket.

- The sample chute can be driven either by a geared motor or by pneumatic means.
- The distinction between downpipe and slurry-sampler refers to the material flow to be sampled and has an influence on the discharge angle of the sample chute

The waiting position of the sample chute between two samplings is inside the material space but outside the main product flow, so that any direct contact between the sample chute and the material flow is avoided and wear on the sample chute is reduced.

Downpipe / slurry sampler		FPN / TPN
Nominal diameter of the downpipe	mm	200 - 800
Installation height	mm	500 - 3,000
Weight	kg	80 - 3,000



Downpipe Slot Vessel Sampler

Representative sampling occurs by means of a slotted vessel, which is guided by a pneumatic linear drive and push rod at constant speed through the complete chute cross section. Due to clever sealing of the push rod and drive assembly, the drive is not exposed to the product. The vessel traverse speed can be adapted to individual requirements by means of adjustable valves on the drive.

Material collection occurs on the return leg after having traversed the material cross section. In its parked position the sampler is not exposed to the material flow and is not subject to wear.

The sampling 'spoon' is rotated above the sample discharge chute and thus emptied after it has passed through the product flow. Centrifugal motion is initiated mechanically via adjustable stops and therefore requires no further drive.

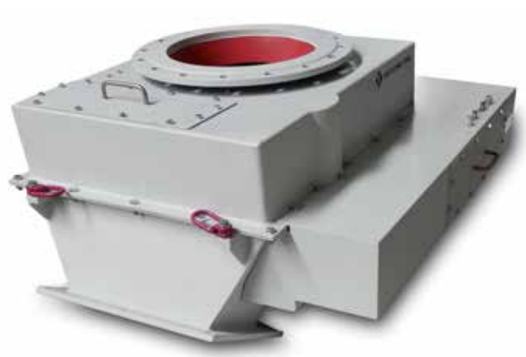
Downpipe slot vessel sampler		FLPN 100 - 300
Nominal diameter of the downpipe	mm	100 - 300
Installation height	mm	450
Weight	kg	75 - 110

Downpipe Swivel Sampler

Representative sampling is carried out here through a slotted vessel, which actuates in a circular motion at a constant speed, through the flow of material.

While the collector is rotated through the material cross section, a sample is taken and collected. This is then emptied over the sample collection chute. Following a complete discharge, the slotted vessel swings back into the parked position.

As with other samplers the parked position is positioned away from the material flow to protect it from wear. The actuation can be either pneumatic or 3ph electric-motor.



Downpipe swivel sampler		FSPN
Nominal diameter of the downpipe	mm	400 - 800
Installation height	mm	500 - 700
Weight	kg	150 - 600

Screw Sampler

The screw sampler takes a non-representative point sample from the material flow where it remains positioned.

Ideal for silo discharge chutes the material must ideally be a fine powder and be homogeneous across the particle size distribution.

Sampling is carried out via a sample collection tube positioned within the material flow, which has openings on the leading face into which material will fall.

When sampling, an auger rotates within the collection tube drawing the sample towards a discharge tube and into a collection flask.

Screw sampler		SPN 50 / 480
Diameter of the sample collection pipe	mm	Ø 50
Sample volume approx.	dm^3/h	130
Weight	kg	20

Piston Sampler

Piston Samplers take a non-representative sample from the material flow. The material should be homogeneous across the particle size distribution.

Sampling is carried out via a sample collection tube positioned in the material flow, with openings on the leading edge into which material falls. When sampling, a pneumatically actuated piston is pushed through the sample collection pipe from its parked position towards the material flow.

This is used to empty the sample collection pipe and then to take the newly collected sample material on the return journey. The sample material discharges into a suitable collection vessel or flask.

Piston sampler		KoPN 50 / 250
Diameter of the collection pipe	mm	Ø 50
Sample volume approx.	cm^3	250
Weight	kg	15

Clinker Sampler

Like the piston sampler, the clinker sampler takes a non-representative sample from the material flow. For this purpose, a sampling "spoon", collects clinker from the stream over a defined period of time, it is actuated pneumatically. On sample collection, a piston inside the sampler housing ejects the sample material via a pre-classified fixed grate.

The fine material obtained in this way can be discharged to a collection vessel or flask. for further analysis. The coarse fraction discharged to another outlet for return to the main product stream.

Clinker sampler		KPN 130x600
Diameter of the sampling spoon	mm	Ø 80
Sample volume approx.	dm^3	3
Weight	kg	280

Air Slide Sampler

Air Slide Sampler takes a non-representative point sample from the material flow of an air slide. The material should be homogeneous across the particle size distribution and across the conveying width.

Sampling is via collection pipe positioned into the material flow, with openings that are normally turned away from the material flow and sealed closed. At the point of sampling, the sample collection pipe with its openings is rotated into the material flow and a sample is collected.

The collected sample is ejected via the sample collection pipe to a suitable container or flask.

Air slide sampler		RPN 50 / 480
Diameter of the collection pipe	mm	Ø 50
Sample volume approx.	mm	250
Weight	kg	20

Crushers and Mills

A number of size reduction machines are available suitable for varying degrees of size reduction and material hardness: hammer mills, double-roller mills and single-roller mills, jaw crushers, cone crushers, continuously operating vibrating-disc mills and eccentric vibrating mills for grinding to the degree of fineness required for laboratory analysis. The selection of the most suitable comminution unit is based on the product and the quality characteristics required.

Single-roller mill
EW 30/40-L

Jaw crusher EB 30/25

Hammer mill HM 6a

Dividing Equipment

A wide range of equipment is available for subdivision of samples. Respective International Standards must also be carefully observed for sample dividers: These include minimum gap widths, speeds below 0.6 m/s, the taking of a sufficient number of individual samples (cuts) whilst the minimum quantity is being observed, no segregation, etc.

The number of the 'division ratio 1 : x', which is important for the dividing units, can be calculated for our products as follows:

$$x = \frac{d_T \cdot \pi}{SW}$$

x	Division number
d_T	Diameter of dividing circuit
SW	Slot width of the material outlet opening for the sample

Turnstile Divider

The flexible turnstile divider, divides a myriad of bulk material streams using a series of spiral radial sweep arms and feed cones. It can be used for almost all products, from coarse coke to finely ground quicklime.

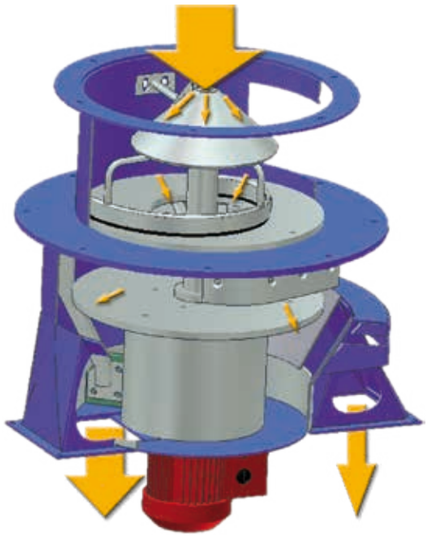
The sampled materials can usually be fed directly, without prior dosing, into the feeding area of the divider, homogenisation is assured by spiral sweep arms mixing and dosing before the actual dividing stage.

The material fed to the centre of the divider plate via the first inward spiral arm is now uniformly transported by a second discharge arm in a spiral movement outwards over the edge of the plate. There it falls onto a conically shaped enclosure, which is partially recessed. The product that falls into this recess is the 'sample'. The material, which slides over the cone to the centre of the divider, is discharged as 'reject material' via the reject material chute.

Advantages

- Due to the spiral rake arm design, even materials with an elevated moisture content can be handled without issues.
- To aid cleaning, some units are fitted with inspection apertures to facilitate this.
- The division ratio can be fully varied in the range from 1:4 to well over 1:1,000 by internal adjustments, depending on the divider size and design.

Turnstile divider		DKT
Diameter of the dividing circiut	mm	200 - 1,600



UNITS FOR SAMPLING AND SAMPLE PREPARATION

Turnstile divider with manual
or motor-driven adjustment of the division ratio

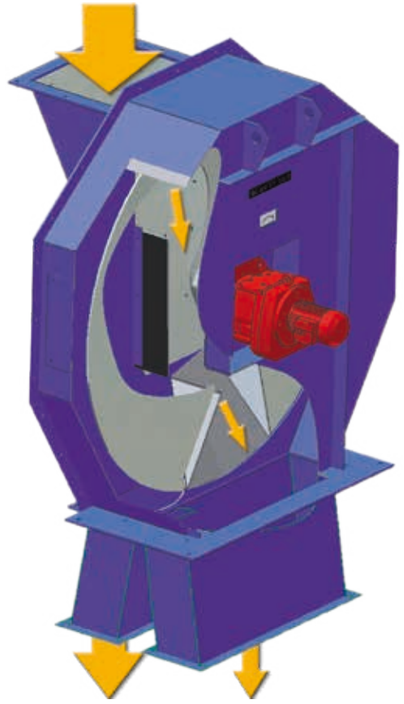
Rotary Divider

The vertically arranged disc of the rotary divider has an aperture through which the sample material flows, driven by a 3ph electric-motor. The material is fed uniformly to the dividing unit via a dosing unit and directed onto the rotating disc. It passes through the aperture in the disc as a 'sample' or is rejected by the disc as 'reject material'.

Due to the simple design, however, the division ratio (1:2 to 1:130 depending on type) is fixed and cannot be changed readily after delivery.

The divider is used for dividing continuously fed, free flowing materials.

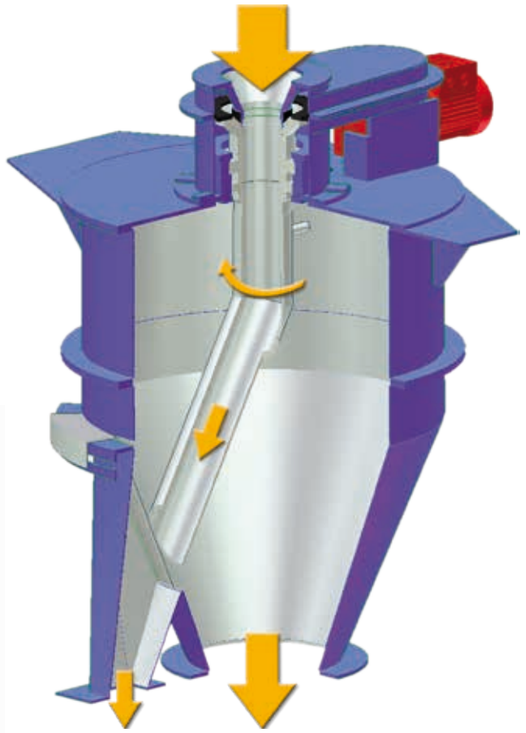
Rotary divider		ROT
Diameter of the dividing circuit	mm	400 - 1,250



Revolving Tube Divider

In the revolving tube divider, uniformly flowing material is divided via an inclined rotating tube onto a funnel-shaped cone. This cone has recess in for sample collection. The product that passes through this recess is the sample and the material collected by the funnel is the rejected material. The openings for the sample can be varied by means of slide gates, whereby a variably adjustable division ratio can be achieved.

The revolving tube divider can only be used with free flowing, low moisture content material. Large inspection openings make this unit easy to clean.



Revolving tube divider		DRT
Diameter of the dividing circiut	mm	200 - 1,000

Dryer

In our dryer, bulk material samples are dried gently so that at the end of the process a dry, free flowing sample material is available. This sample can be used to determine the PSD or for further grinding to analytical levels.

The drying process is based on contact drying on a vibrating hot plate, which permanently turns the sample. In combination with circulated heating oil, samples can be reliably dried in a very short time, reversal of the vibro-motors starts the discharge of the sample from the dryer.

Sample Collectors, Sample Transport and Laboratory Equipment

If samples can only be collected at longer intervals, we offer the possibility of storing them in so-called sample collectors of various sizes until collection.

Our sample collectors are available in the following versions:

- As sample collectors with one or two sample containers
- As a carousel version with 4 to 20 and more sample containers
- Or as a conveyor version with 4 to 20 and more sample containers

The sample containers can hold from 100ml to 10 litres of sample material and are optionally made of plastic or stainless steel.

In our wider product portfolio you will see equipment for the transportation of samples, such as space-saving, fully encapsulated belts, fully automated pneumatic transportation systems, sieve analysis screens, drum tests and a myriad of other items for sample testing and processing.

All our sample containers can be fitted with RFID chips for better tracking and clear identification of the samples. If a sample container is equipped with this chip, this can be overwritten in a contactless fashion with the desired sample information in the sample collector. These can be easily read out in the laboratory using an appropriate device.

Robot-based Systems for Sample Processing and Analysis

With our 'state of the art' automated sample processing plant and analysis system, we free your laboratory personnel from repetitive tasks.

With robotic systems, sample processing can be made more flexible with greater repeatability. Robotics are also future proof, with ongoing real-time up-gradeability.

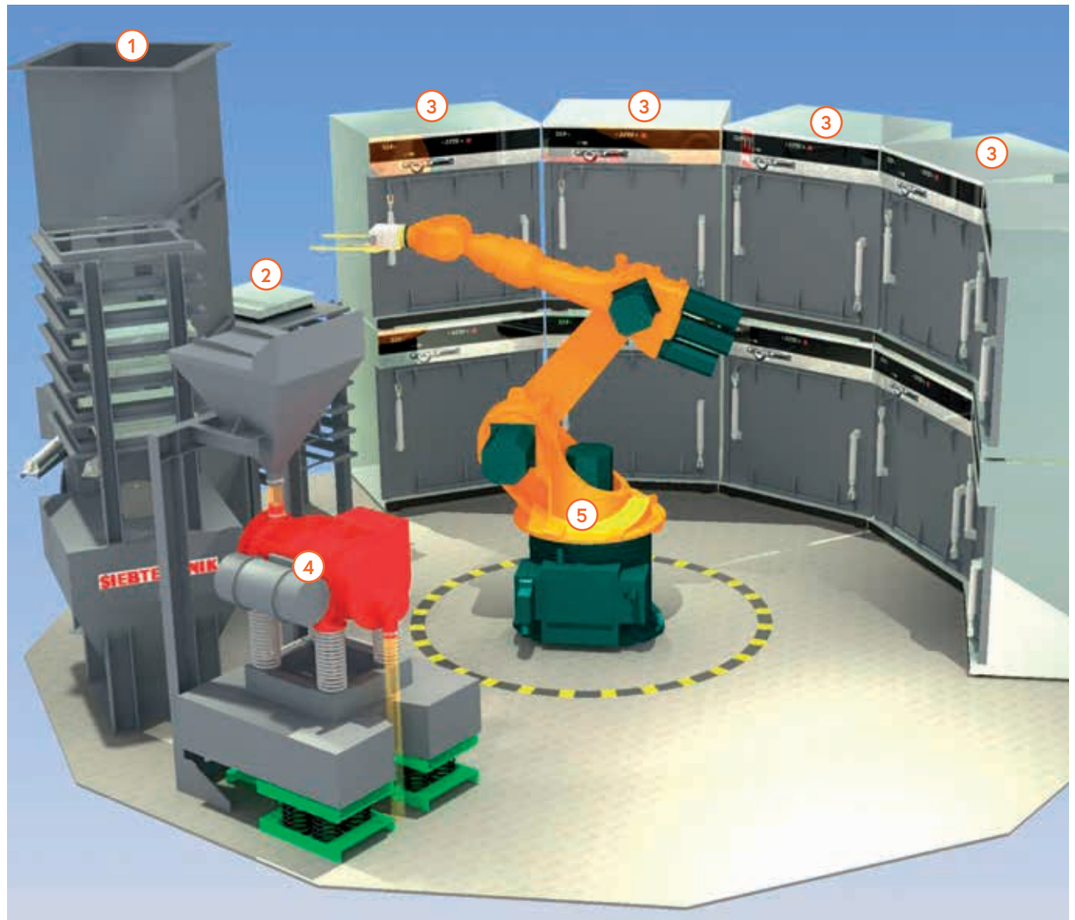
AMAS (Automatic Moisture Analyser System)

With this fully automated system, the moisture content of bulk material samples of up to 6 kg can be determined. For this purpose, AMAS can be integrated into an existing automatic sampling system, so that analysis is also carried out promptly after sampling.

The process in the AMAS begins with the filling of the drying tray with the moist bulk material sample, which is then uniformly distributed and weighed in the tray. After a defined drying time, the tray is removed from the oven, weighed and put back into the oven.

This last step is repeated until the material is dried and two successive weight checks show constancy. After emptying and cleaning the tray, it can be refilled.

In the illustration shown, AMAS is supplemented with an eccentric vibrating mill for ultra-fine milling, so that the sampled material is subsequently prepared ready for analysis.

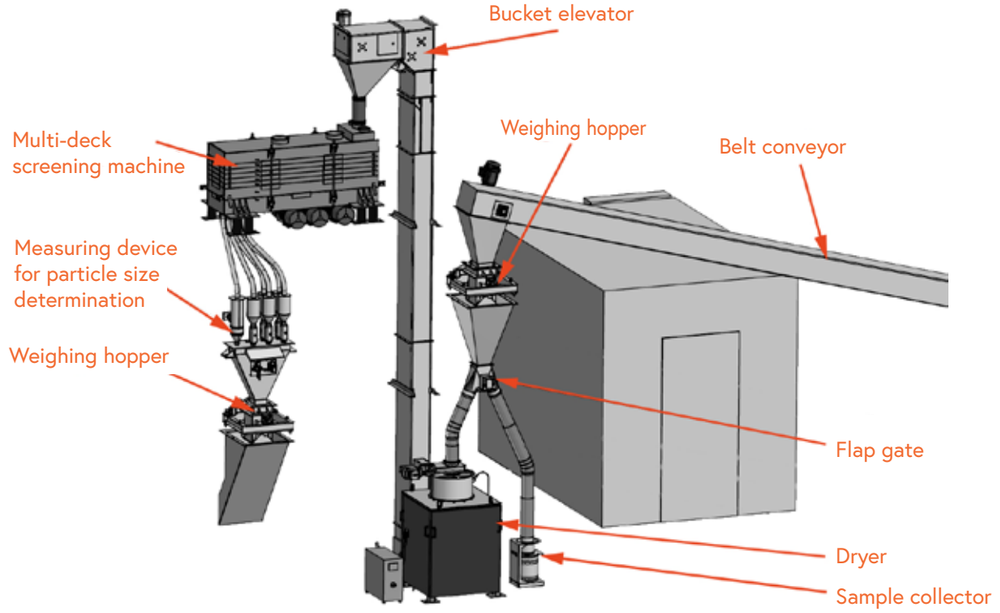


Material feed (**1**), scale (**2**), drying ovens (**3**), ultra-fine comminution (**4**), handling device (**5**)

Sampling of Bulk Materials with Automatic Particle Size Determination

Automated sample preparation systems integrated with analytical sieves, allow the user a fully automated process to determine a samples PSD or chemical analysis with the minimum effort.

With its integrated dryer, any damp or moist materials can also be processed and subsequently fed to the analyser without difficulties.



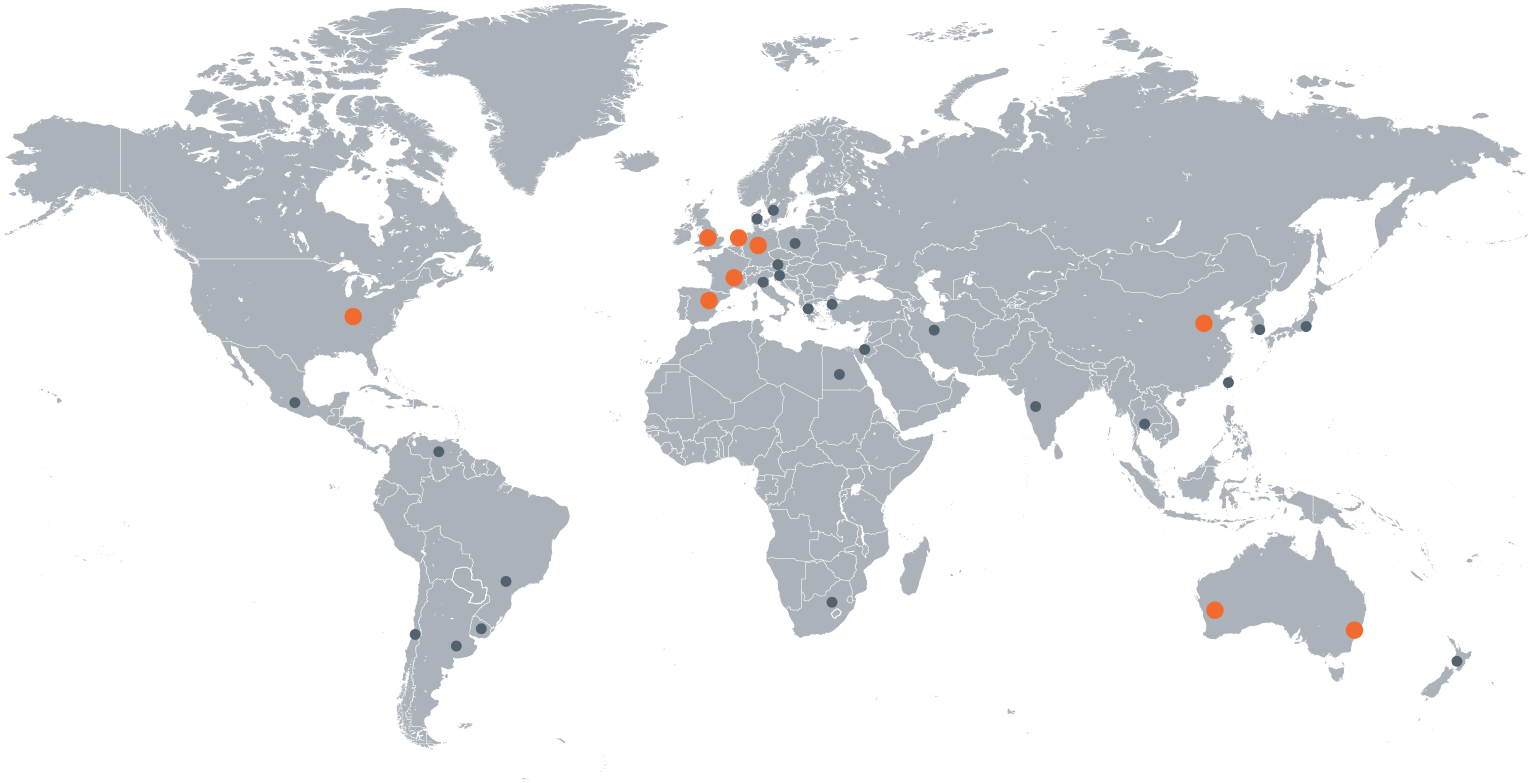
Testing of Sampling and Sample Preparation Equipment

Testing a sampling system for systematic errors is very time-consuming and personnel-intensive and is usually carried out on the basis of comparative sampling.

Samples obtained by an automated system are usually compared with those obtained by some form of reference procedure i.e. manual sampling from the stopped belt, for example.

Our experienced team of engineers and technicians, design automatic sampling systems, integrating specific items so that reliably accurate samples are collected with the necessary care and technical knowledge to produce exactly what our clients require and in accordance with local or International Specifications where required.

One Solution. Worldwide.



SIEBTECHNIK TEMA provides more than 50 local support offices worldwide as well as main sites located in:

Mülheim an der Ruhr, Germany | Rijswijk / The Hague, The Netherlands | Madrid, Spain
Daventry, Great Britain | Mundolsheim, France | Sydney & Perth, Australia | Cincinnati, USA
Tianjin, China

We are experts in the field of solid-liquid separation and the processing of bulk materials

Automation | Channel conveyors | Crushing & Milling Equipment | Control Screening Machines
Decanter | Dryers | Laboratory Equipment | Pneumatic Tube Systems | Preparation Systems
Process Equipment | Pulsator Jigs | Pusher Centrifuges | Sampling Systems | Screening
Machines | Screen Worm Centrifuges | Sliding Centrifuges | Vibrating Centrifuges

Copyright information: All drawings, images and registered trademarks in this document are protected by copyright. Any reproduction or partial use without the explicit permission of us as copyright and trademark owner is prohibited. Violations of copyright or trademarks will be legally pursued.

SIEBTECHNIK TEMA

SIEBTECHNIK GmbH | Platanenallee 46 | 45478 Mülheim a.d. Ruhr
GERMANY | www.siebtechnik-tema.com | sales@siebtechnik.com

WB240e | 07/2025