

**TURBOPLEX® AIR CLASSIFIERS
FOR HIGH PRECISION CLASSIFICATION**



HOSOKAWA ALPINE Aktiengesellschaft

Turboplex® Ultra-Fine Classifiers Type 100–1000 ATP

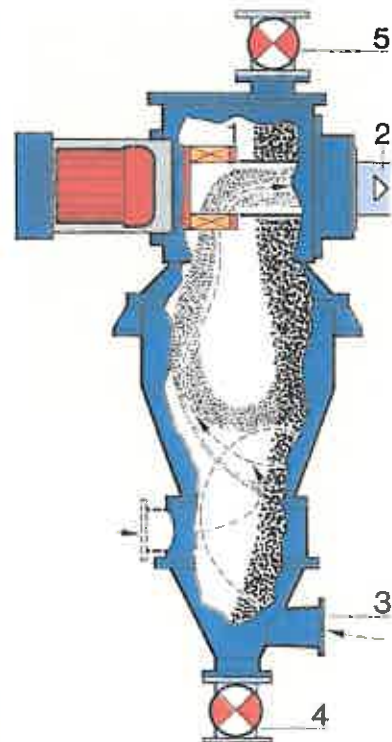
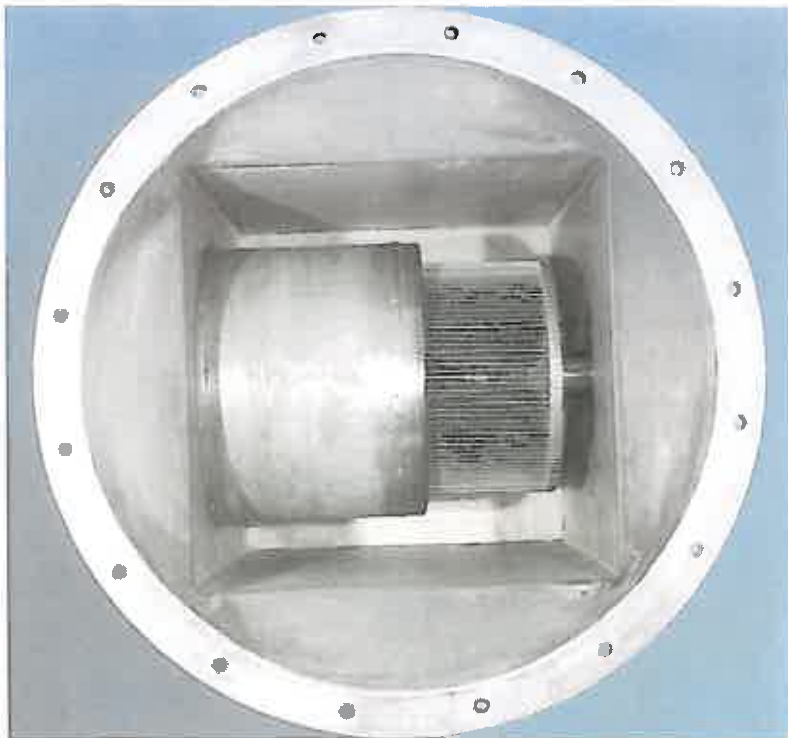
Fineness Range $d_{97} = 3\text{--}180\ \mu\text{m}$ (Depending upon the Size of Classifier)

The new generation of Turboplex® ultra-fine classifiers offers advantages: The vertical arrangement of the classifying wheel shaft has been modified to a horizontal arrangement, giving longer service life, considerable improvement in profitability, higher fines yield and improved cleanliness of the coarse material. The completely new multi-wheel classifier has been developed and patented. An air stream classifier design is available. As a result of continuous development work, Alpine succeeded in incorporating unique advantages into the new Turboplex® ultra-fine classifiers, that are not available from other classifiers. Therefore Turboplex® classifiers fundamentally differ from conventional classifiers, even those classifiers which function according to a similar separating principle.

The progress made with Turboplex® classifiers is emphasized when considering the detailed design developments. We will be pleased to explain how these affect your individual application. For example: the efficient, safe and reliable rinsing air supply between static and moving parts ensures very precise, sharp top size limitation of the fine material produced. The constant classifying behaviour additionally ensures reliability of product quality. Even when the feed rate is increased or variable, every Turboplex® produces a fine material of constant quality. Technical details concerning this classifier are available on request.

Mode of Operation and Classifying Principle

The schematic shows the design of the Turboplex® ultra-fine classifier type ATP, as a single-wheel unit. This machine mainly consists of a horizontally mounted classifying wheel (1) with fine material and classifying air outlet (2). The classifying air (3), injected into the machine base, flows inwards through the classifying wheel and discharges the fine material, whereas the coarse particles, being rejected by the classifying wheel, leave the classifier through the coarse material outlet (4). Clean coarse material is obtained by intensively rinsing this coarse material with air before it leaves the classifier; further separation of fine material is thus achieved. (The air guiding system is schematically shown in the illustration.) Product feed (5) is made from above by a rotary valve, which also acts as an air seal; when used as an air stream classifier, the product is fed directly into the classifying air flow (3). Normally, the fineness is adjusted simply by varying the classifying wheel speed.



Special Versions, Adapted to Specific Applications:

Explosion Pressure-Shock-Resistant – Wear Protected

However, significant features of the Turboplex® are as follows:

1. Contrary to previous classifier designs, the shaft of the classifying wheel is mounted horizontally, and not vertically. This design not only improves the classifying results, but also extends the service life of the classifier considerably when processing both normal and highly abrasive products, and eliminates the formation of deposits in the fine material discharge when handling materials which are sticky or tend to build up.
2. A modified version of the Turboplex® is equipped with an additional coarse material classifier (type ATP/GS). Thus the precision of cut is further improved over the whole separating range. This design offers decisive advantages, compared to conventional classifiers: a. Increased fines yield. b. Higher cleanliness of the coarse material. c. The classifier is even capable of processing products difficult to disperse in air under the same classifying conditions.
3. The new multi-wheel classifier. Never before has it been possible to produce such high quantities of ultra-fine products in such an easy and economic manner in one single classifier, because ultra-fine separation is achievable only with a small diameter classifying wheel. To obtain a high capacity, the Turboplex® is equipped with several, small diameter classifying wheels in the upper section.

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International References

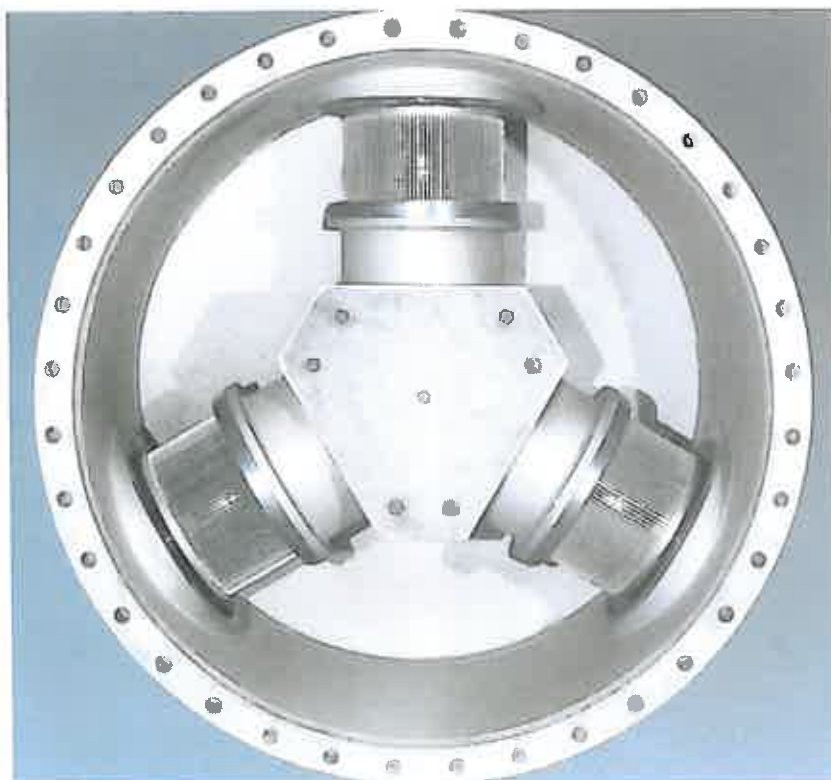
Turboplex® ultra-fine classifiers are successfully used for many different products and applications in numerous countries throughout the world.

Every machine supplied is backed up by an efficient contractual representation or associated company of Alpine who – assisted by specialists from the parent company – provide advice on all questions related to process technology and who are always at your disposal, to ensure first-class after-sales service.

Key to Illustrations

Fig. 1 Single wheel classifier 100 ATP/GS

Fig. 2 Turboplex® multi wheel classifier type 315/3 ATP/GS



Turboplex® Single Wheel Classifiers

Turboplex®:

The New Generation of Ultra-Fine Classifiers

Alpine's standard in the development of efficient ultra-fine classifiers is unexcelled, a fact which is again proven by the new Turboplex® classifier series.

□ Illustration 1: This diagram shows the basic design of the standard, i.e. single wheel classifier type ATP. The classifying wheel has been optimised by Alpine and various other classifying parameters improved, and this guarantees excellent classification with high precision of cut.

□ Illustration 2: As an alternative to the standard version, a modified design with optimized coarse material classifying section and altered classifying air supply is available.

Type description: ATP/GS.

This version allows a considerable improvement of the precision of cut over the whole separating range, which means: 1. Even higher fines yield and optimum cleanliness of the coarse material! 2. Even products which are difficult to disperse in air are classified with optimum results.

New Technique

The performance of Turboplex® ultra-fine classifiers in practical operation and technical progress incorporated into the design can hardly be compared with any other classifier type. Some advantages of the new Turboplex® classifiers which have been demonstrated by actual machines operating in numerous factories over a considerable time period, are:

The simple construction and solid design, which meet customers' requirements for reduced costs for maintenance and repair, are impressive. Furthermore, Turboplex® classifiers are subject to minimum wear only (even when processing abrasive products), due to the horizontally mounted classifying wheel. To process extremely abrasive materials, the classifier is equipped with an additional, wear-resistant lining (Ill. 1: red areas — wear protection — to order). In short: Turboplex® classifiers reduce the operating costs and spare part expenditure. Therefore profitability is considerably increased.

The low overall construction height and the small space requirement are addi-

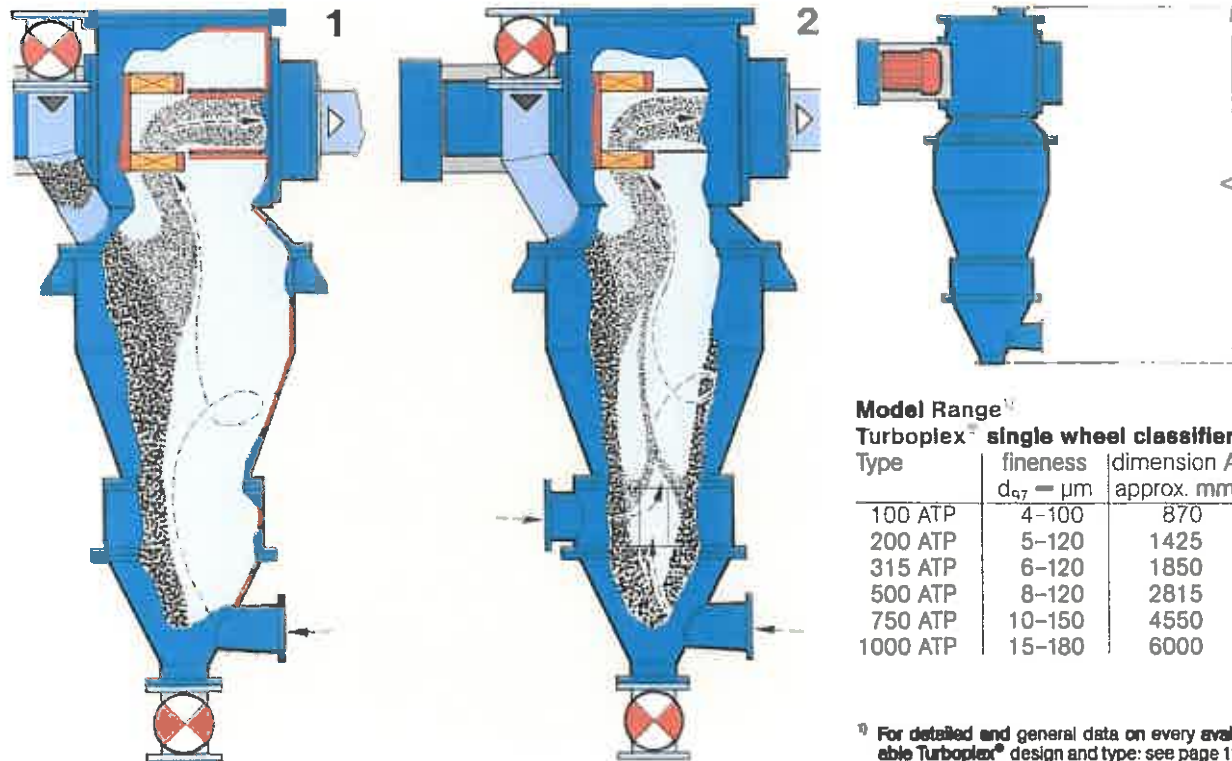
onal advantages of this machine. In this respect, too, the Turboplex® is normally most favourable, compared to classifiers with a similar throughput rate. Therefore the space available is optimally used, or new buildings can be erected at lower expense.

When incorporated into grinding/classifying plants working in circuit (see illustrations on page 5), Turboplex® classifiers considerably reduce the total energy consumption because the fine material is optimally separated due to the high sharpness of cut. Thus undesirable over-grinding is prevented, and the grinding process is made easier. Turboplex® classifiers present significant advantages, but no disadvantages. Despite the excellent, reliable classifying results, low space requirement, low energy consumption and low costs for wear parts, Turboplex® ultra-fine classifiers are available at a very competitive price.

Key to Illustrations (page 5)

Fig. 1 Processing plant for mineral powders.
1 — Alpine ball mill; 2 — Turboplex® single wheel classifier; 3 — Turboplex® multi wheel classifier; 4 — Alpine Ventoplex® classifier.

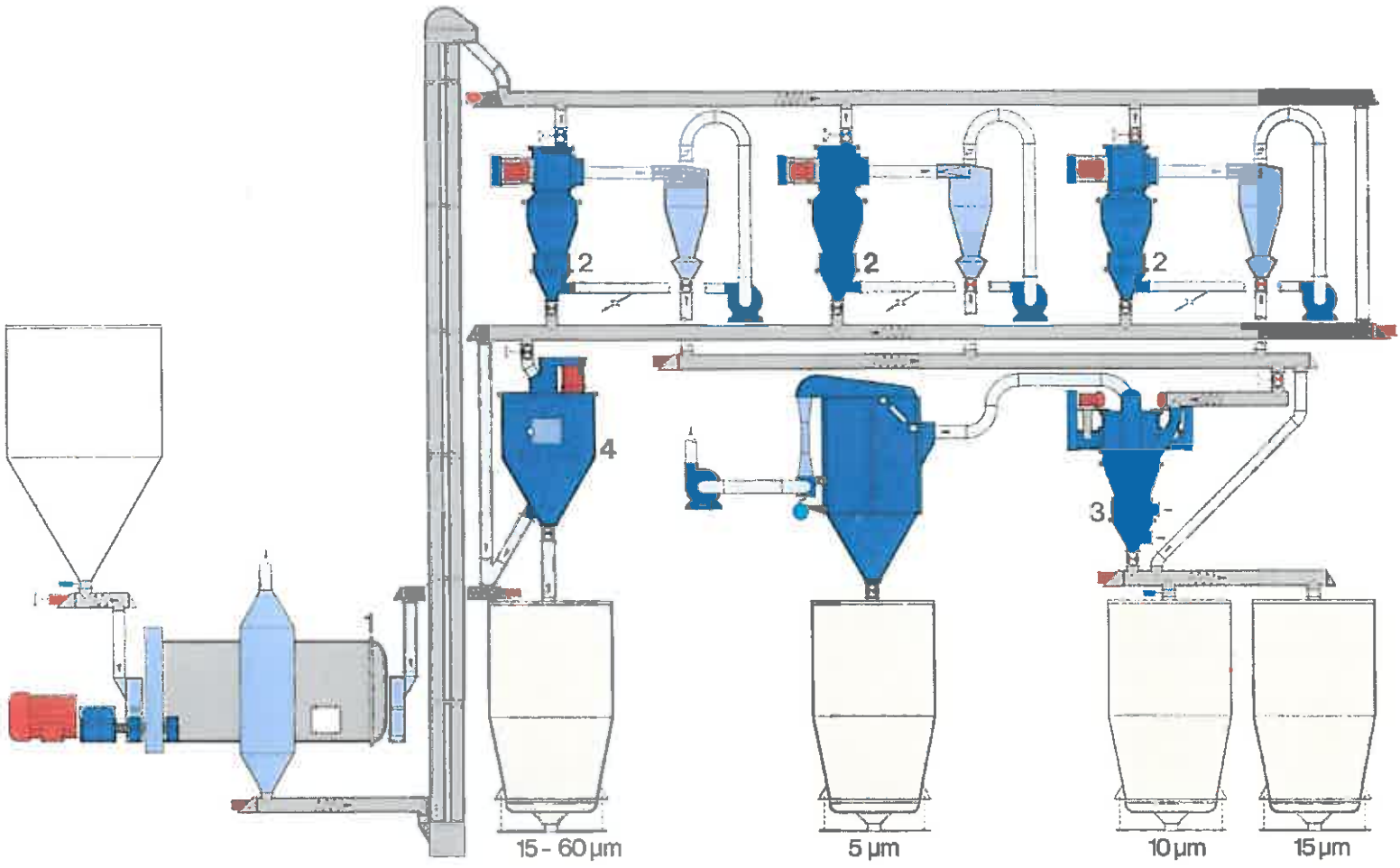
Fig. 2 Type 315 ATP, Fig. 3 Type 200 ATP



Model Range¹⁾

Turboplex® single wheel classifier Type	fineness $d_{97} = \mu\text{m}$	dimension A approx. mm
100 ATP	4-100	870
200 ATP	5-120	1425
315 ATP	6-120	1850
500 ATP	8-120	2815
750 ATP	10-150	4550
1000 ATP	15-180	6000

¹⁾ For detailed and general data on every available Turboplex® design and type: see page 11.



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3

Turboplex® Multi Wheel Classifiers

The new multi-wheel classifying principle

sets new standards! The multi-wheel classifier design used for the first time by Alpine for Turboplex® classifiers provides the following advantages in practical operation:

□ Super-fine products – particularly in the range of 3–6 µm – can now be produced very economically with very high fines yield and optimum sharpness of cut, using one single classifier.

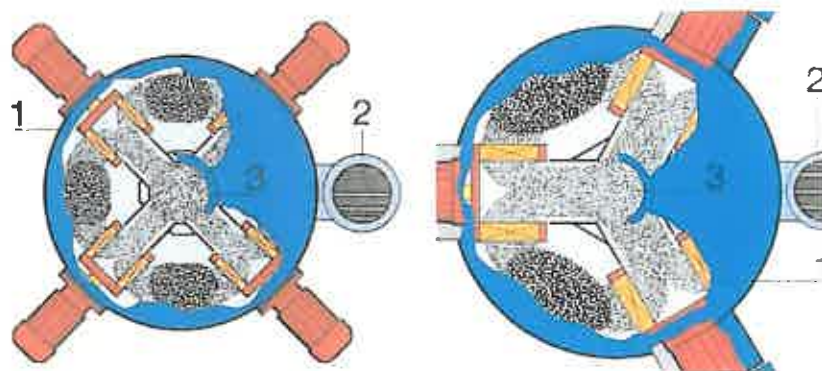
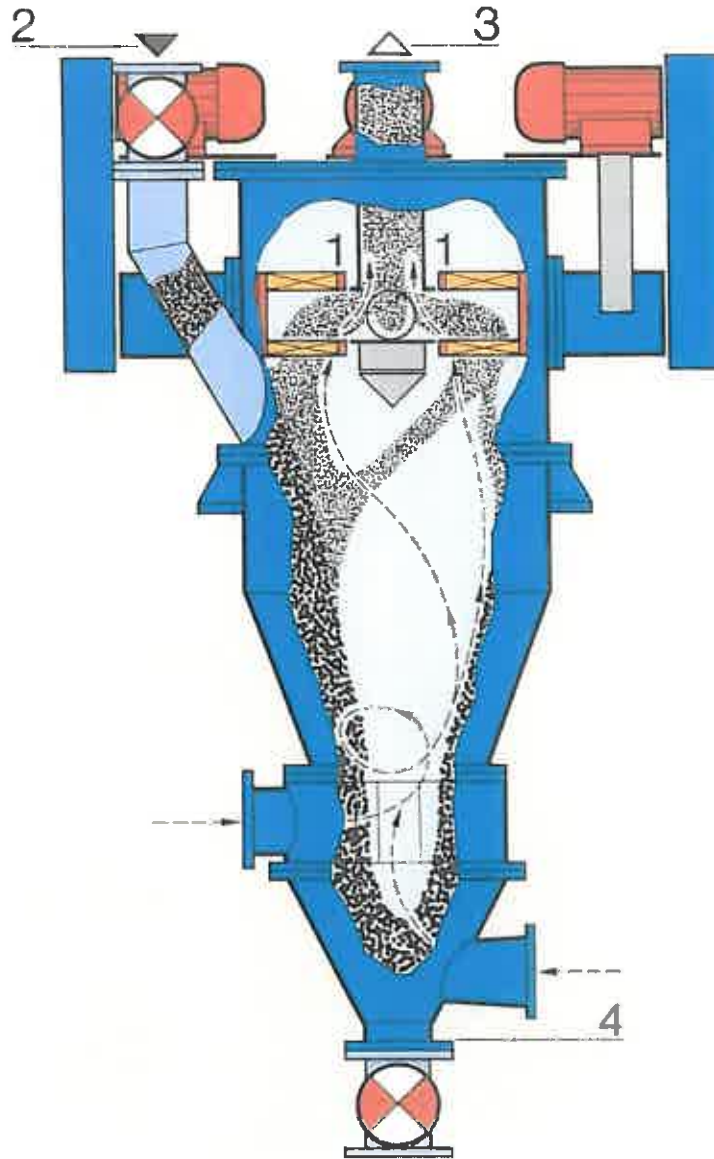
The particular advantages of the Turboplex® multi-wheel classifier series are evident when considering the basic, physical properties which have to be observed for classifiers used for ultra-fine separation:

With increasing classifier size, the cut point and precision of cut usually change, as a function of the higher throughput rate. This means: Super-fine end products are normally obtainable only on relatively small classifiers – i.e. laboratory or pilot classifiers – with correspondingly low throughput. When using a larger, production-scale machine, the required ultra-fine separation could no longer be obtained!

Now Alpine have met the requirements for the dry production of ultra-fine end products with high throughput rate in practical operation in an uncomplicated and unique way by installing several, small, equal-sized classifying wheels in the classifier head of the Turboplex® multi-wheel classifiers.

The positive classifying properties of the single-wheel classifiers – and particularly the excellent precision of cut – are directly transferable to the multi-wheel classifiers.

The feed rate for Turboplex® multi-wheel classifiers ranges from approx. 150–7500 kg/h, depending upon the end product fineness, product to be classified and classifier size.



Sectional Drawing

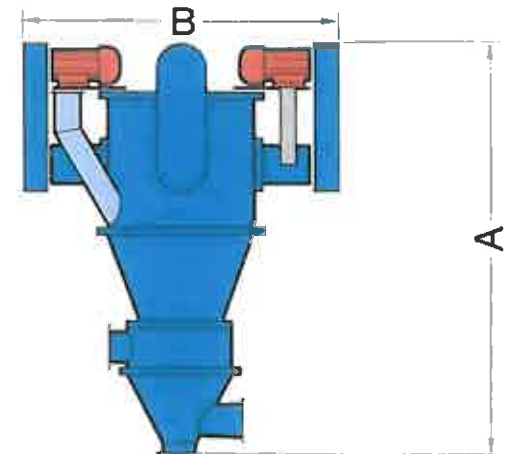
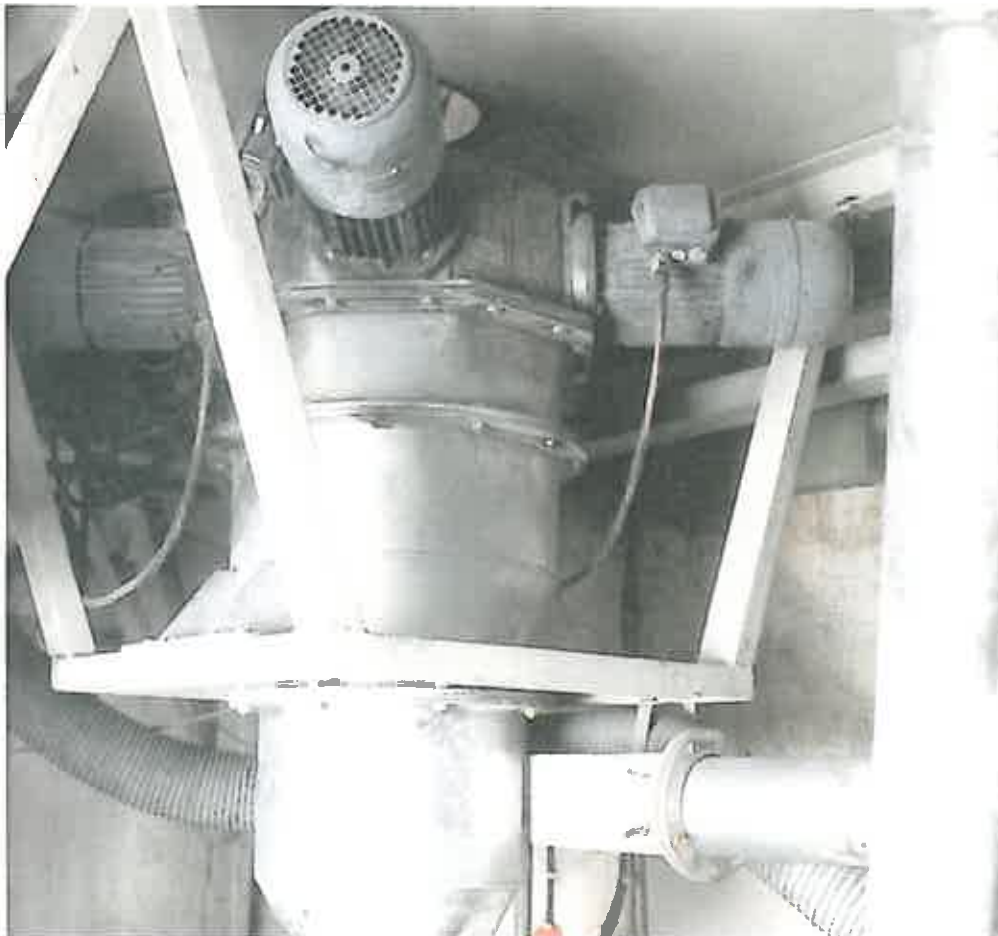
- 1 – Several, horizontally mounted classifying wheels each with a separate drive. Common speed control is made via one adjustable, electrical frequency inverter.
- 2 – Product feed: Product is introduced either by an airtight feeder (fill) or directly into the classifying air flow (air stream classifier).
- 3 – Common fine material discharge.
- 4 – Coarse material discharge with optimized coarse material classifying section.



Economically Priced Plant Design
 Turboplex® multi-wheel classifiers do not only produce excellent classifying results. The capital investment required for this classifier is very reasonable, and the following technical and operational advantages are offered:

1. Super-fine end products are obtainable at high output rates, with only one classifier, instead of several small classifiers, installed in parallel.
2. The product is fed to the machine through one feed opening. Therefore only one feeding device is necessary.
3. The fine material is discharged through one common fine material duct, allowing the air conditions to be controlled easily.
4. The classified coarse material is discharged through one discharge opening.
5. Due to the high throughput rate of Turboplex® multi-wheel classifiers, these machines can be combined with mills of corresponding, large size.

Key to Illustrations
 Fig. 1 Type 100/4 ATP/GS
 Fig. 2 Type 200/4 ATP/GS



Model Range¹⁾

Turboplex® Multi Wheel Classifiers			
Type	fineness $d_{97} - \mu\text{m}$	dimensions approx. mm	
		A	B
100/4 ATP	3- 60	1225	1300Ø
200/4 ATP	4- 70	2350	2000Ø
315/3 ATP	6-120	3000	2500Ø

¹⁾ For detailed and general data on every available Turboplex® design and type: see page 11.

Turboplex® Air Stream Classifiers

Special Feature: Product Is Fed in Together with the Air Stream

Classifying Principle and Mode of Operation

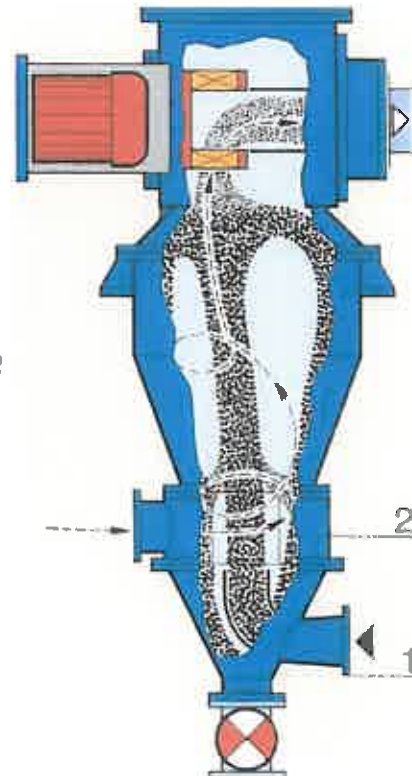
The product to be classified (1) is directly fed into the classifier with a partial flow of the classifying air. Preliminary separation of the product from the air flow is not necessary. Therefore Turboplex® air stream classifiers can be operated for example, directly in-line with pneumatically discharging mills, spray driers etc.

Optimum Classifying Results

regarding sharpness of cut, fines yield and coarse material cleanliness are obtained on Turboplex® air stream classifiers – even at very fine cut points. Therefore Turboplex® air stream classifiers are, apart from other applications, also ideally suited to solve problems where optimum coarse material cleanliness is required.

In general, the poor cleanliness of the coarse material, resulting from low sharpness of cut, represents a disadvantage of conventional air stream classifiers. Therefore they are practically not suitable for the production of materials of prime quality, e.g. if a narrow, steep particle size distribution is required.

On the other hand, Turboplex® air stream classifiers ensure a maximum precision of cut over the whole fineness range. This is made possible by the optimized Turboplex® classifying wheel and by the fact that the coarse material is intensively rinsed with clean air in a counter flow in the coarse material classifying section (2). On the other hand, in conventional classifiers the coarse material is only rinsed with air laden with feed material.



Model Range air stream classifiers	fineness $d_{97} - \mu\text{m}$	dim. A approx. mm
100/4 ATP-S/GS	3- 60	1225
200 ATP-S/GS	5-120	1425
200/4 ATP-S/GS	4- 70	2350
315 ATP-S/GS	6-120	1850
315/3 ATP-S/GS	6-120	3000
500 ATP-S/GS	8-120	2815
750 ATP-S/GS	10-150	4960
1000 ATP-S/GS	15-180	6600

Key to Illustrations

Fig. 1 Type 100/4 ATP-S/GS;
explosion pressure-shock-proof for 10 bar (over-
pressure)

Fig. 2 Type 315 ATP-S/GS

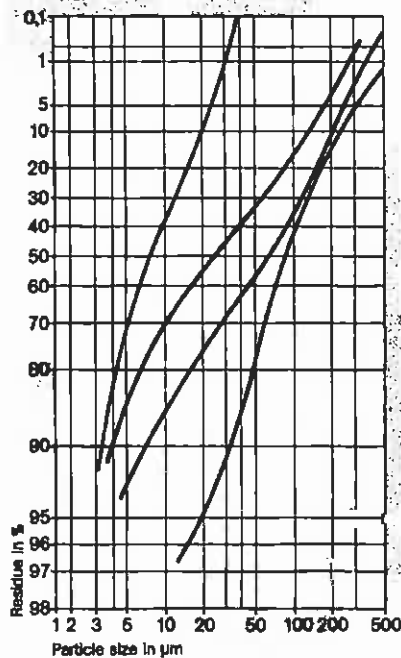
Examples of Application and Classifying Performance

Widest Field of Application

Turboplex® ultra-fine classifiers are not only suitable for the separation of dry, easily flowing materials. Turboplex® classifiers are also designed to process materials with difficult classification behaviour and materials which are difficult to disagglomerate.

Furthermore these difficult separation problems are solved at extremely fine cut points and with a high output rate. The fields of application are determined by the excellent classification results.

- high fines yield, even with separations between 3 and 10 µm;
- extremely high separation sharpness and disagglomerating capacity, even with ultra-fine classification below 10 µm;
- wide, variable range of separation and the typical operating characteristics of the Turboplex® classifiers, such as:
 - production of constant, closely sized fine materials, free of oversize particles, even when the feed rate varies;
 - wear-resistant classification and largely insensitive to foreign material.



Practical Applications

□ Production of ultra-fine materials of prime quality, with steep particle size distribution and absolutely exact, maximum top size limit. These products, "free of oversize particles", are obtained in the range of $d_{97} = 3-180 \mu\text{m}$, depending upon the classifier size.

□ "Fines milking" in the mineral powder industry. This means the extraction of a quantity of first-class fine material from a very large feed material flow; depending upon the sales purpose and application, the coarse material still has to retain a certain amount of fines in it.

□ Dedusting of products or separation of a small quantity of oversized particles (or foreign matter) to improve the properties for further treatment. Typical product example: toner, i.e. copying powder.

□ Increased profitability of grinding/classifying plants. Due to the fact that Turboplex® classifiers separate very precisely, the undesirable, excessive grinding in grinding/classifying plants operated in circuit is avoided, and a considerable amount of energy is saved.

□ Mineral powders

In addition to producing materials of medium fineness, Turboplex® classifiers are frequently operated in the ultra-fine product range of 3-5 µm and for the production of fillers. Product examples: Limestone - calcite - chalk - dolomite - feldspar - talcum - quartz - kieselguhr - gypsum - graphite - wollastonite etc.

□ Abrasive materials

Turboplex® classifiers are used for the production of "F" and "P" granulations of abrasive powders. This is evident proof of optimum classifying quality and maximum wear resistance.

□ Toner, copying powder

Used for dedusting at approx. 5-8 µm, Turboplex® classifiers yield coarse materials practically free from dust, with minimum loss of product, due to the excellent separation sharpness.

□ Heavy metal powders, pigments.

The high disagglomeration capacity allows extremely precise separation, even when processing products with very high density or colours and pigments which have a high tendency to agglomerate.

□ Food and feedstuff,

such as soya flour, protein enrichment in flours, starch, lactose etc.

Testwork

Alpine attach great importance to customer service. One part of customer service is the qualified conducting of classifying trials in our test centre under conditions comparable to practical operation, using production-scale classifiers. We determine the data for your product, on which you can base calculations of profitability and effectiveness. We welcome customers' presence to witness testwork. We submit a guarantee for production quality and capacity.

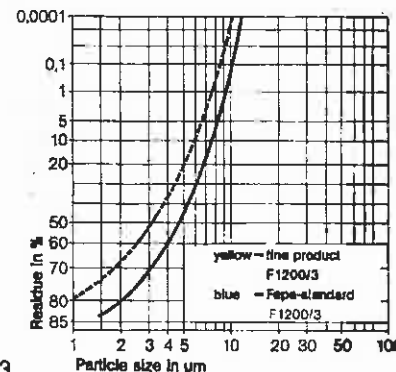
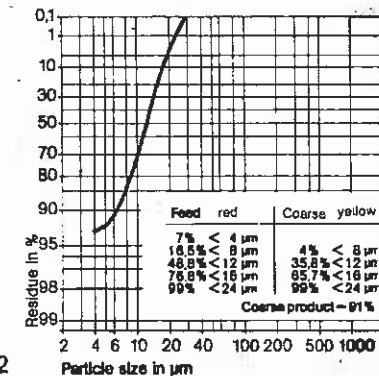
Key to Illustrations

Fig. 1 Independent of the feed rate, Turboplex® classifiers produce fine materials of constant quality; only the cleanliness of the coarse material varies. 3 classifications, effected with different feed rates, show this relationship in general.

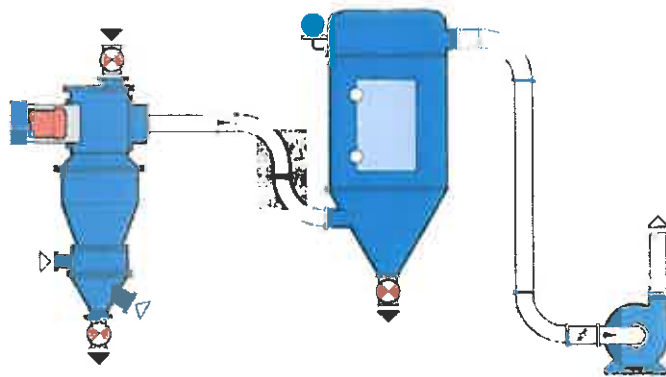
Feed rate	2.3 t/h	9.1 t/h	14 t/h
Fines yield: approx.	52%	36%	31%
Feed material: curve	red	red	red
Fine product: curve	orange	orange	orange
Coarse product: curve	blue	blue	blue

Fig. 2 Example for a precise classification. Problem specification: Dedusting of toner powder. Feed material - red; dedusted coarse product - yellow.

Fig. 3 Classification of abrasives. Feed material - red; fine product - yellow.



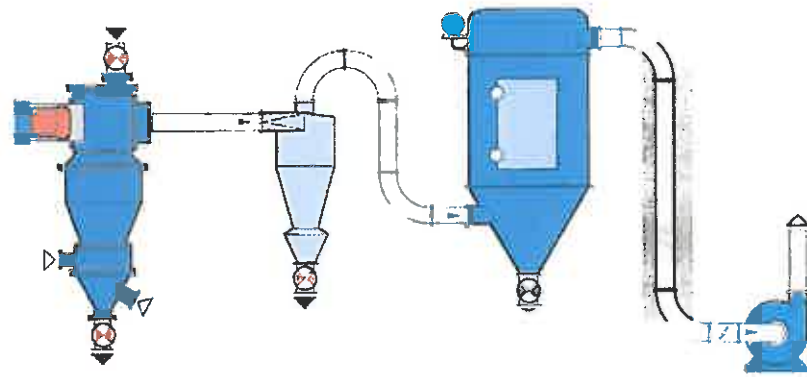
Pneumatic Standard Plants/Technical Data



Typical Standard Plants

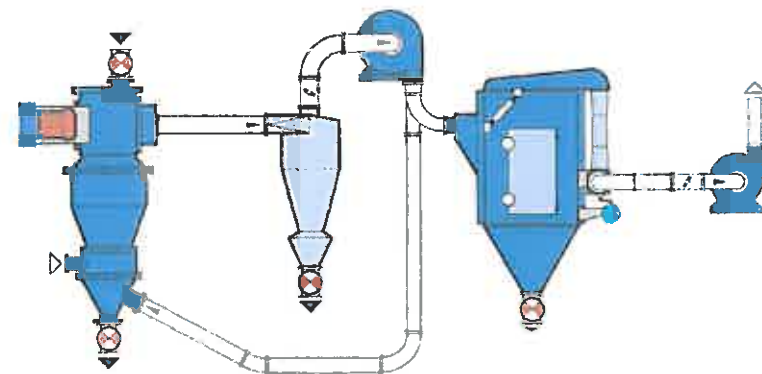
with pneumatic operation, which are most frequently used in production, are shown in the flow diagrams (fig. 1–5). Furthermore the technical table (page 11) includes additional information on the classifier sizes and necessary accessories for pneumatic operation.

Through-air operation without preliminary fine material separation via cyclone (fig. 1). This is the most economic design for type 100–315 ATP.



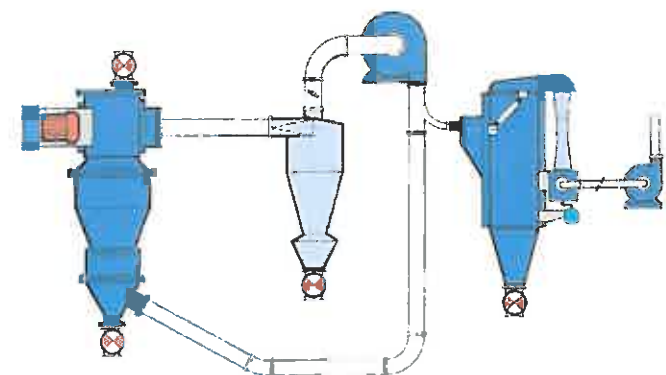
Through-Air Operation with Preliminary Fine Material Separation via Cyclone

(fig. 2) Turboplex® classifiers type 100–315 ATP are frequently used to produce a variety of different grades in practical operation, i.e. different product size distributions have to be produced or various different materials have to be classified in these classifying plants. The preliminary fine material separation with a cyclone offers a possibility for easy, rapid and thorough cleaning. Practical examples: toner, epoxy powder, heavy metal powder, abrasive materials etc.



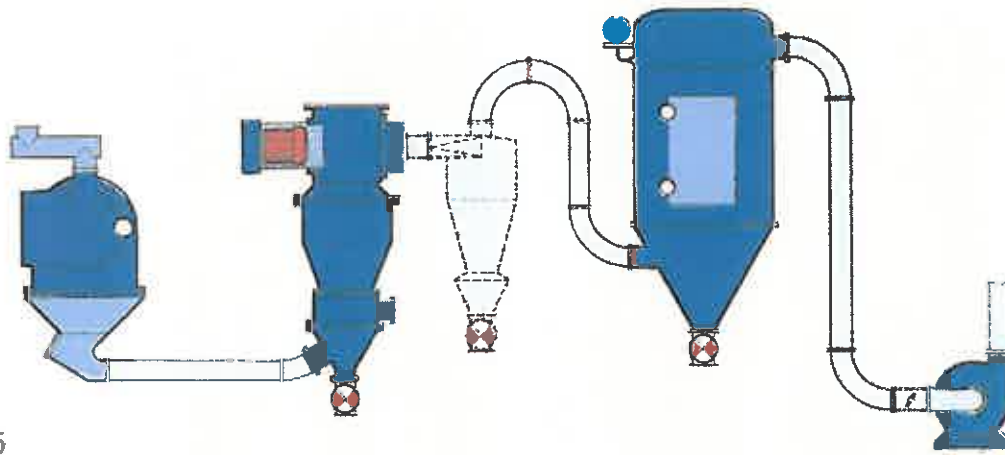
Operation in a Partly Closed Circuit

(fig. 3) With operation in a partly closed circuit, 50% of the classifying air is recirculated back into the classifier after separation from the fine material in the cyclone. The costs for final dust collection are very favourable with this mode of operation: The Alpine high efficiency cyclone used for fine material collection is available at a reasonable cost; furthermore a budget-priced bag-house type filter, specifically sized for 50% of the total air flow, can be used to dedust the exhaust air.



Closed Circuit Operation

(fig. 4) Depending on the classifier size, a comparison between the pneumatic standard plants often shows that the investment costs are most favourable for closed circuit operation. With this system, it is only necessary to take a small air bleed from the closed air circuit. To dedust this bleed air, a relatively small and budget-priced bag-house filter is sufficient. Even this cost can often be eliminated by ducting the bleed air into a central dedusting system.



5

Turboplex® Air Stream Classifiers ATP-S

When using the air stream classifier, a preliminary separation of the product from the air flow is not necessary. The product being classified is directly fed into the classifier with a partial flow of the classifying air. Therefore Turboplex® air stream classifiers can be operated directly coupled to pneumatically discharging mills, spray driers etc. The standard mode of operation is through-air operation; if necessary, the product can be pre-separated in a cyclone.

Type and Output Survey

Turboplex® ATP		type	100	100/4	200	200/4	315	315/3	500	750	1000
Fineness ¹⁾	d_{97} — μm		4–100	3–60	5–120	4–70	6–120	6–120	8–120	10–150	15–180
Feed rate ²⁾	approx. kg/h		50–200	150–400	200–1000	600–3000	500–2500	1500–7500	1250–8000	2800–19000	5000–35000
Scale-up factor ³⁾	F — approx.		0,25	1	1	4	2,5	7,5	6,25	13,5	25
Classifying wheel											
number	no.		1	4	1	4	1	3	1	1	1
diameter	mm		100	100	200	200	315	315	500	750	1000
speed	rp.m.		1150–11500	1150–11500	600–6000	600–6000	400–4000	400–4000	240–2400	160–1600	120–1200
drive power, total	kW		4	16	5,5	22	11	33	15	30	45
type of drive — direct — V-belts			●	●		●	●	●	●	●	●
Classifier designs											
single wheel classifier	type ATP		●		●		●		●	●	●
multi-wheel classifier	type ATP/			●		●		●		●	●
air stream classifier	type ATP/S			●	●	●	●	●	●	●	●
Construction variants ⁴⁾											
standard designs			●	●	●	●	●	●	●	●	●
explosion pressure-shock-resistant			●	●	●	●	●	●	●	—	—
wear protected			—	●	●	●	●	●	●	●	●
Plant accessories — guide only —											
Fig. 1: through-air operation											
Alpine round filter	type		M 4 R	M 18 R	M 18 R	G 40 R	M 28 R				
fan	kW		11	15	15	37	30				
Fig. 2: through-air operation cyclone											
Alpine cyclone	type		MAZ 224	MAZ 450	MAZ 450	KAZ 710	KAZ 560				
Alpine cylindrical filter	type		M 4 R	M 10 R	M 10 R	G 28 R	M 28 R				
fan	kW		11	15	15	37	30				
Fig. 3: partly closed circuit operation:											
Alpine cyclone	type					KAZ 710		KAZ 900	KAZ 900	KAZ 1400	KAZ 2000
fan	kW					37		55	55	110	200
Alpine bag-house filter	type					G 16		G 25	G 25	G 56	G 104
fan	kW					4		7,5	7,5	15	22
Fig. 4: Closed circuit operation:											
Alpine cyclone	type					KAZ 710	KAZ 560	KAZ 900	KAZ 900	KAZ 1400	KAZ 2000
fan	kW					37	30	55	55	110	200
Alpine bag-house filter	type					K 9	K 9	M 9	M 9	G 16	G 25
fan	kW					1,1	1,1	2,2	2,2	4	5,5

¹⁾ Fineness range d_{97} = particle size through which 97 % of the product passes. Data is based on a material with a density of 2.7 g/cm³ (limestone).

²⁾ The feed rate depends upon the fineness d_{97} and the fine material capacity. Data is based on classification with very high separation sharpness.

³⁾ The scale-up factor F serves as informative value where fineness range is common to two types.

⁴⁾ Construction variants: ● available standard design; — design not planned. (Special designs to order, depending upon the application).

For Pilot Operation and Small-Scale Production:

Turboplex® Classifying Plant 50 ATP



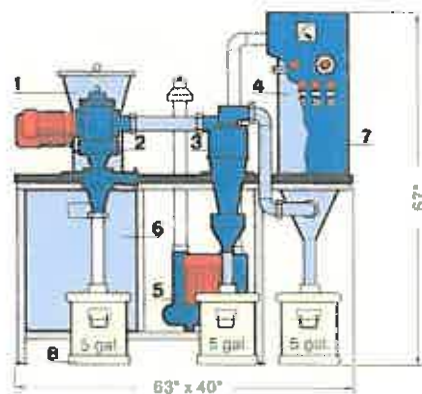
Compact Classifying Plant

The Turboplex® ultra-fine classifier 50 ATP is an extraordinarily efficient, precisely separating, and wear-resistant classifier. It produces fine materials with a sharply defined maximum particle size, which can be considered as "free of oversize particles". A further, outstanding feature of this machine is the extremely wide range of separation which is variable between $d_{97} = 2.5-120 \mu\text{m}$.

The throughput rate of this classifying plant makes it suitable for use in pilot plants and for small-scale production. As regards to both cleaning, and also to adjustment of the operating parameters, the plant is easily accessible and simple for anyone to operate. It achieves perfectly reproducible classifying results, which are not dependent on any particular operating personnel. The plant is supplied as a complete unit. Only the compressed air and power supply need to be provided on site. Special leaflet no. 370/1.

Technical Data: Type 50 ATP

Fineness ¹⁾ $d_{97} - \mu\text{m}$	2.5-120
Feed rate ²⁾ approx. kg/h	4-100
Classifying wheel	
diameter	mm 50
drive	kW 1
speed	r.p.m. 1500-22000
Fan	kW 1
Feed screw	kW 0.3
Filter	
cleaning air consumption	approx. Nm ³ /h 1.5



¹⁾ Fineness data referring to a material with density = 2.7 g/cm³.

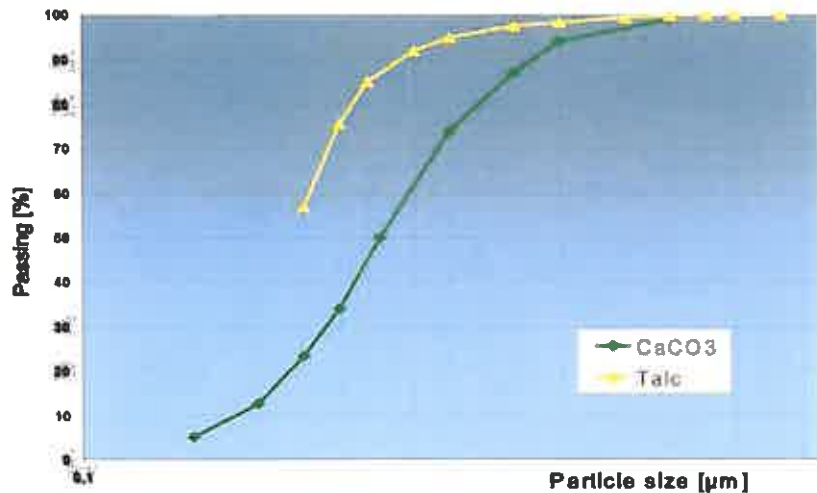
²⁾ depending upon fineness.

The New Generation Classifier Wheel NG for Alpine Turboplex ATP

Alpine Turboplex classifiers—both in single-wheel and multi-wheel design—have become the standard classifiers worldwide for the ultrafine range. This type of classifier has been sold a few thousand times in a great variety of versions, either as a stand-alone classifier or in combination with a mill.

Development of the New Generation

Our main aim was to reduce the production costs by drastically reducing the energy consumption. Normally when classifying in the $d_{50} < 2 \mu\text{m}$ range, the energy costs for the classification process rise disproportionate to the energy costs for the grinding process.

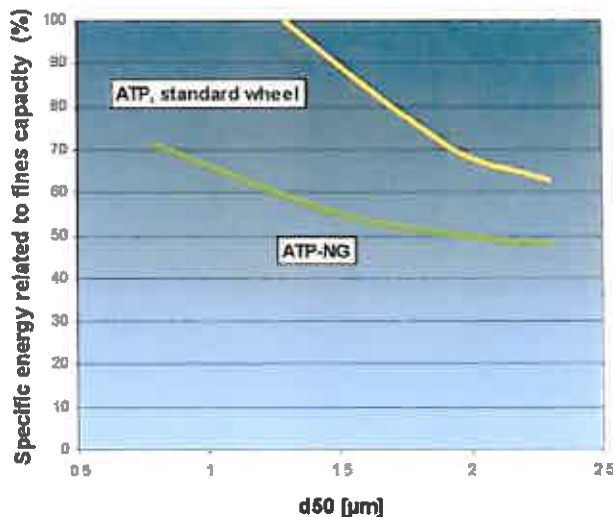


As additional target we succeeded in shifting the fineness into the submicron range.

Advantages of the new classifier wheel NG

- Low energy consumption up to 30% and 50% compared with the standard Turboplex classifier.
- Classification up to $d_{50} = 0,5 \mu\text{m}$
- High yield of fines
- Retrofitting

Existing Turboplex classifiers can easily be upgraded by simply exchanging the classifying wheel drive unit.



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MICRON POWDER SYSTEMS

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