

TR-1 single separator for MQL and dry processes



**Explosive dusts from dry processes or
MQL extracted directly at the machine
and separated safely**

The innovative design system TR-1 ProVent Plus ensures that single separators with flameless pressure relief can be installed without a designated protective zone – even for processes with light metal dusts!



The new shock pressure resistant protection shaft absorbs the shock wave and the intense heat.

Dust emissions separated directly at the machine

Advantages of single separation

TR-1 for MQL and dry processing was designed as a stand-alone-system to be installed adjacent to a machine (emission source). Installation close to the machine is flexible. Due to its compact design, little space is required.

In contrast to current central separation systems this unit is very flexible and ensures a high return on investment. Transfer to another machine is easy.

Ideal for retrofitting

New and faster processes, as well as new materials require adaptability when handling explosive dusts. Stand-alone separators are particularly suitable for any modifications or retrofits.

Brief profile:

- Air flow 800 – 1200 m³/h
- Minimum space required 597 mm x 830 mm
- Integrated storage filter category H13 (separation efficiency of 99.95 % at 0.1 µm – 0.3 µm)
- Integrated flow monitoring
- Integrated temperature monitoring
- Status monitoring of the dust collection tank
- Low operating costs



TR-1 ProVent Plus with new explosion protection device.

A view of special filter cartridges.

Suitable for air recirculation

Highly efficient separation means omitting the venting of exhaust air to the outdoors. The clean air exits the system on top and is redirected into workplace in an energy efficient manner.

A clean air duct and more efficient fan can be excluded because of the direct clean air discharge.



Single separator TR-1 ProVent Plus attached to a machining center

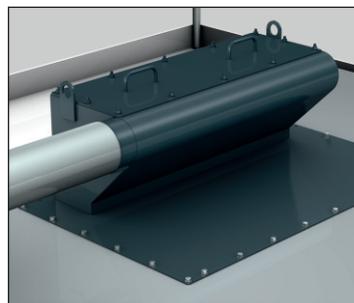
Separation of dust emissions by the ProChip collection device

Dust collection with ProChip

The housing of a machine is at the core of effective separation results.

To prevent the unwanted separation of chips we recommend using the collection device ProChip with an integrated flow lock.

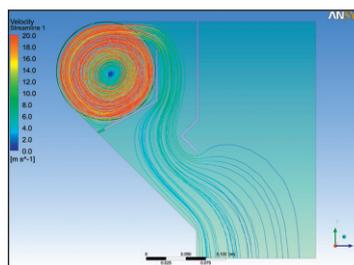
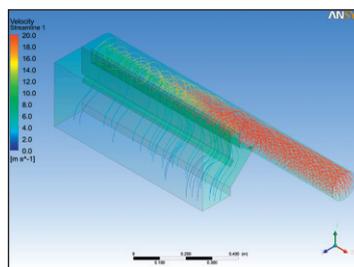
Depending on the volume of the enclosed machining area, ProChip collection can be individually adjusted for optimal separation results.



Dirty air collection with ProChip



Because of the flow lock, collected chips bounce off and fall back into the workplace. The resulting centrifugal effect further ensures that the extracted dust and coolants are partially pre-separated.



Flow simulation of the ProChip

Heavy-duty filtration

Dust extraction with maximum separation efficiency

The dust particles accumulate on the surface of the cartridge filters. Finest aerosol residues are separated by a storage filter (category H13) in the secondary filter stage. As a result, a separation efficiency of 99.95 % is achieved for suspended matter of 0.1 μm to 0.3 μm .

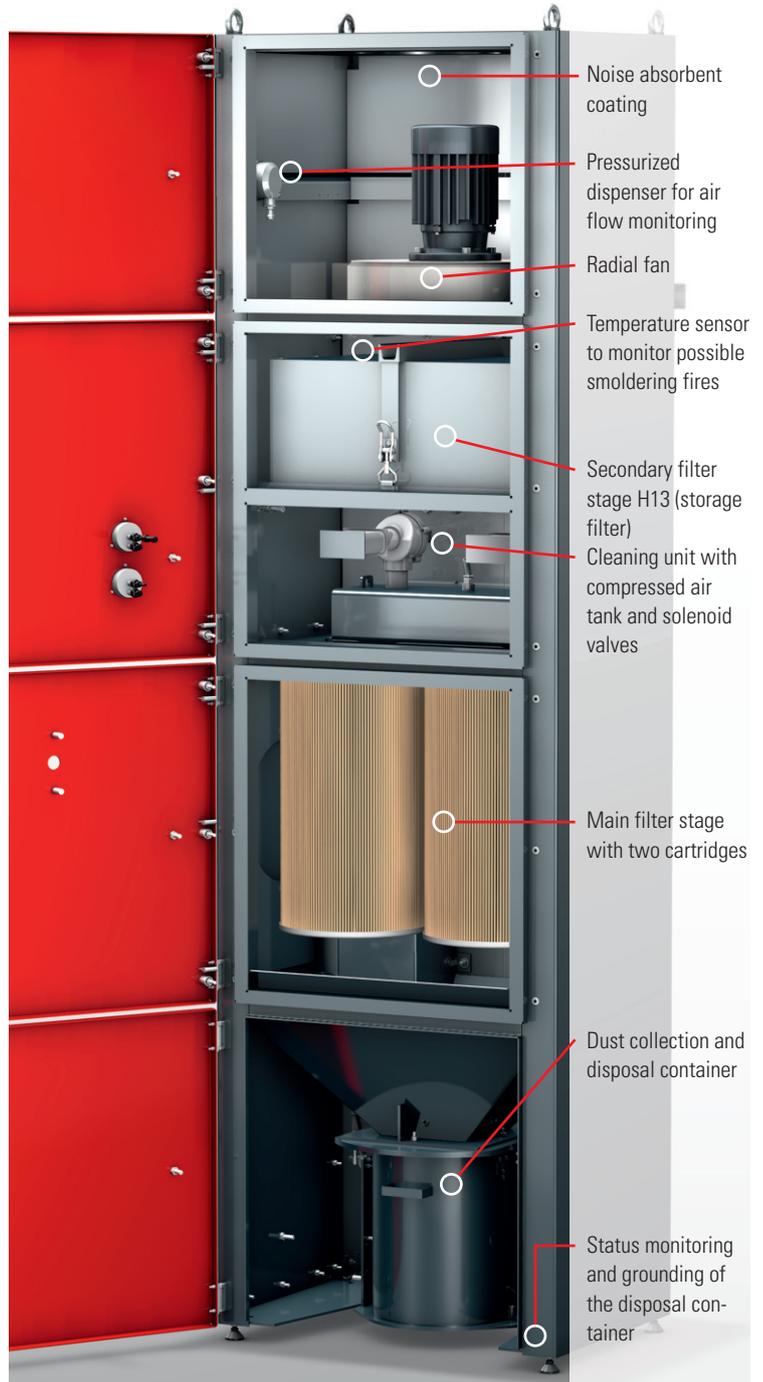
The filter cartridges in the main filter stage



The filter cartridges for TR's main filter stage offer high separation efficiency with optimal energy consumption due to their large surface.

Filter cleaning without interruption

Compressed air cleaning of the filter cartridges in most designs can be achieved without process interruptions at preset intervals or as required.



TR-1 single separator for MQL and dry processing (opened)
Standard design for non-combustible dusts (e. g. processing grey cast)
Air flow from 800 to 1200 m^3/h

How dust explosions are created



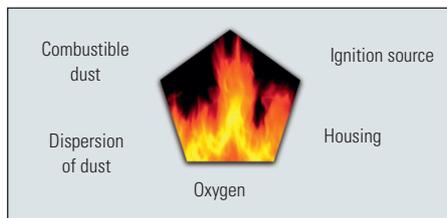
Explosive conditions

During every compressed air pulse cleaning of the filter cartridges, an explosive atmosphere is created which only exists for a few seconds.

Pulse cleaning, disperses dust. If all other elements (as described below) are present in sufficient quantity, there basically exists the risk of explosion.

This risk is limited by the lower and upper explosion limit of the explosion atmosphere.

A mere mixture of generally $< 60 \text{ g/m}^3$, falls below the lower explosion limit (LEL). The upper explosion limit (UEL) is exceeded at a sizeable mixture of $> 1 \text{ to } 6 \text{ kg/m}^3$. The dust-air mixture in both cases becomes inert.



Explosion pentagon

By the removal or deterrence of one component, explosions can be reliably prevented.



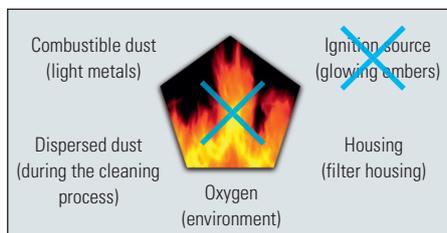
During compressed air pulse cleaning of the filter cartridges, the dust is dispersed, becoming explosive

Strategies for avoiding dust explosions

Dust explosions "require" an explosive environment that is created during the cleaning of filter cartridges.

An explosion cannot be prevented by switching-off the machine during the cleaning process, since there is no guarantee that an ignition source won't enter the separator shortly before the cleaning process.

We offer reliable alternatives to this common practice: the modular design TR-1 series is suitable for individually adjusted explosion protection measures which can be retrofitted.



Explosion pentagon

Example: Despite an explosive dust-air mixture, an explosion can be avoided with the prevention of a single ignition source

TR-1 explosion protection series

Explosive dusts can be controlled

As an add-on to the basic design, the TR-1 series offers various configurations for applications involving explosive dusts.

In addition to non-combustible dusts, the explosive dusts from the treatment of light metals such as aluminum,

magnesium and modern metal compounds can be extracted and separated safely with corresponding safety measures.

Even organic dusts from processing plastics can become explosive.

TR-1 series with various protective devices



The “customization” of modular components fulfills specific requirements and ensures individualized solutions ready for installation.

As a basis for decision-making Keller prepares a hazard analysis for each separator containing all possible protective measures.

Preventive or constructive explosion protection in one system

	Explosion prevention	Constructive explosion protection
Combustible dusts without ignition sources	TR-1 AS	–
Combustible organic dusts with potential ignition sources e. g. plastic	TR-1 ProSens	TR-1 ProVent Plus
Combustible metal dusts (MQL) with potential ignition sources e. g. aluminum processing	TR-1 ProSens	TR-1 ProVent Plus

Tested protective devices for hazard-free operation

The prerequisite testing of the flameless pressure relief for metal dust explosions was performed according to DIN EN 14460 for ProVent Plus.

The German Association for Technical Inspection (TÜV Süd Industrie Service) issued a detailed hazard analysis for ProSens. In addition, an expert report from the referenced FSA Institute confirmed the suitability of the protection devices for all applications involving dry dust.



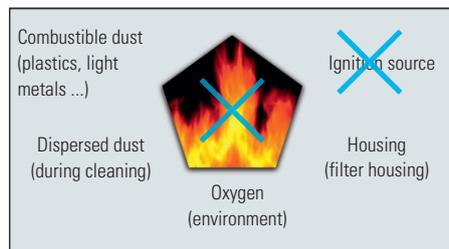
TR-1 AS

For ignition source free operation

The antistatic design TR-1 AS is ideally suited for the processing of organic materials such as plastics and shall an entry of ignition sources through the separation be excluded.

During filter cartridge cleaning, an explosive atmosphere is present, however it has no impact since there is no ignition source.

All components are grounded to avoid the creation of antistatic charges.



TR-1 AS (antistatic design) Preventive explosion protection

The presence of an ignition source is safely eliminated

Cleaning the filter cartridges



The compressed air pulse for filter cartridge cleaning is generated by compressed air stored by electromagnetic solenoid valves inside any configuration of the TR-1 single separator.



Single separator TR-1 AS

Safe metal dust explosions

TR-1 ProSens

With ignition source monitoring by ProSens

patented



Single separator TR-1 ProSens
Suitable for dry processing and MQL

Cleaning of the filter cartridges is performed when the system is shut off for which the antistatic design of the TR-1 AS is ideally suitable (offline cleaning) at the TR-1 ProSens.

Since sparks can be created during the processing of light metals, especially of aluminum, the extraction system is monitored by a spark sensor.

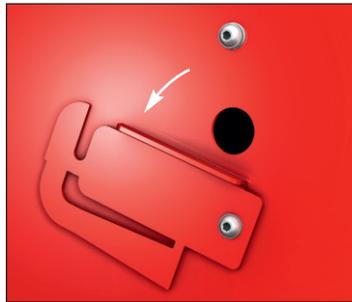
The entry of an ignition source is detected by the sensor which automatically prevents the subsequent cleaning process.

In fact, although there exists an ignition source inside the separator, an explosive environment cannot be prevented by shutting down the cleaning process.

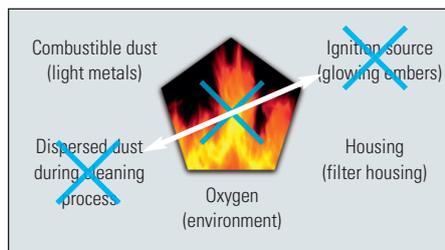
The machine and filter system shut down at the end of the process cycle. After approx. 3 minutes, a visual inspection can be performed of the dirty air zone (for smoldering particles).

The process can continue provided that no smoke is created by ignition sources.

In the event of smoke or fumes, a suitable extinguishing powder is supplied through the fire extinguisher opening.



Fire extinguisher opening



TR-1 ProSens

Preventive explosion protection

Avoids a coincidence of ignition source and dispersed dust



ProSens – Extraction monitoring for the presence of ignition sources or flying sparks

Consists of a sensor and digital switching with interface to SPS

Infrared daylight sensor

- Detects ignition sources from 400 °C
- Tests its functionality every four hours automatically
- Is kept clean by means of compressed air rinsing

TR-1 ProVent Plus

With shock pressure resistant protection shaft

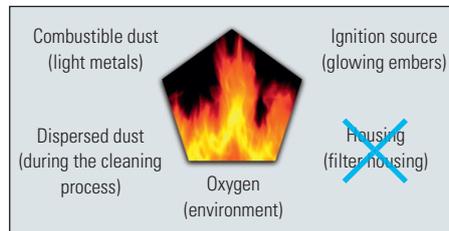
patented

The further development of constructive explosion protection offers Keller the possibility to separate explosive metal dusts from dry applicatons or MQL directly at the corresponding machine without any hazard and to clean the filter cartridges at the same time without interrupting the process. This ensures a highly efficient shift operation for MQL processes.

TR-1 ProVent Plus

Constructive explosion protection

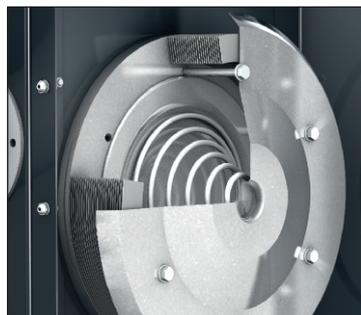
Explosion pressure is derieved without any hazard (explosion pressure relief)



Suitable for explosive, metallic dusts

The new series TR-1 PV+ was designed for higher tempertures of explosive mixtures such as occurring with aluminum dusts.

- 1 The pressure relief valve avoids an excessively pressure increase in the filter housing.
- 2 Shock pressure resistant protection shaft absorbs the shock wave and hot gases are vented upwards.
- 3 Heat energy and possible remaining particles are retained and absorbed by two additional stainless stell mesh filters.



Cross-section: pressure relief valve



TR-1 ProVent Plus single separator

With new shock pressure resistant protection shaft absorbs the shock wave and the intense heat.

No hazard for metal dust explosions

TR-1 ProVent Plus

No safety zone required

TR-1 ProVent Plus single separator no longer requires a safety zone due to its new shock pressure resistant shaft. The shock wave and hot gases are largely absorbed and vented upwards.

A metal dust explosion is no longer a hazard for the operator and the environment.

A testing for the flameless pressure relief of metals according to EN 14460 was performed successfully. We will be pleased to provide you with the test certificate upon request.



Back pressure flap ProFlap

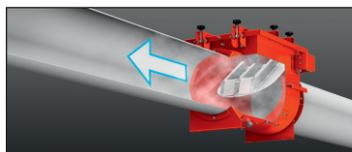
Single separator TR-1 ProVent Plus

With new, pressure-resistant protective shaft for hazard-free discharge of explosion pressure (safety zone unnecessary).

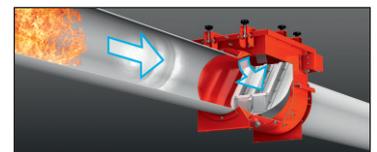
ProFlap prevents the spread of explosion flames into the workplace

In the event of a dust explosion during the cleaning of filter cartridges, the shock wave and flames could spread into the machine's workspace through the suction duct.

The locking function of the ProFlap is based on an automatic back pressure flap.



The back pressure flap opens during the extraction of dirty air from the machine



The shock-wave closes the back pressure flap

Comprehensive system solutions available

TR-1 for MQL and dry processing is part of the newly designed, energy-efficient, and flow-optimized separation solution to keep air clean during metal treatment processes.

We will be pleased to present you with detailed information on our technologies and solutions.

Consulting service

Do not hesitate to contact us for detailed information on the TR-1's application possibilities in the treatment of metal and plastics. We are pleased to offer you a consultation without obligation as a dialog partner in the assessment phase of your project.

To assist in decision-making for advance planning, Keller always prepares a hazard analysis with information regarding the necessary protection measures.

You will benefit from our experience!



TR-1 ProVent Plus as a single separator of a machine tool for manufacturing motor blocks and motor heads

TR-1 single separator for MQL and dry processing



With GREEN BALANCE Keller Lufttechnik GmbH + Co. KG commits to reliable, far-sighted treatment of all resources – to bring into line technological progress, operational issues and social targets in order to protect the environment.

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