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Safety Solutions

for Laboratory and Production 2016 • 17

EXTRACTION SYSTEMS

WASTE SYSTEMS

SAFETY FUNNELS

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OVER 600 PRODUCTS OF OUR OWN DEVELOPMENT

We bring you safety and comfort.

„Work in the laboratory requires a high level of concentration and is often subject to high performance pressure. Therefore it is important for colleagues to work with the best possible devices and resources.“

„THE MOST ESSENTIAL VALUE IS THE HEALTH OF HUMANS IN THE LABORATORY AND MAINTAINING HEALTH IS A SIGNIFICANT PART OF OUR STRATEGY AND WORK."

Perfect materials and simple, but absolutely safe, handling are the preconditions for safety. This is what products from S.C.A.T. provide with a guarantee you can count on. All S.C.A.T. products are developed in close collaboration with major German chemical and pharmaceutical firms. Here, chemists, engineers and technicians have deliberated, developed and manufactured for colleagues. Our company was founded to implement maximum safety standards and to guarantee them over the long term. S.C.A.T. Europe stands for Safety-Center-Analyses-Technology. We follow this idea with pleasure and success. Of course we would be happy to serve you and your colleagues as customers.

Yours sincerely
S.C.A.T. Europe GmbH

Johann Rittgasser
Owner and president

S.C.A.T. Europe - a success story.

S.C.A.T. Europe stands for Safety-Center-Analyses-Technology. The company was founded in order to protect technicians in analytical laboratories from harmful materials used in the working environment.

The impetus was a concrete requirement of a large German Chemical company. Contaminant concentrations in a laboratory where organic solvents were utilized required necessary structural alteration measures resulting in a large investment; laboratory work had to come to a halt as well.

S.C.A.T. Europe developed a safety concept which rendered these measures superfluous. With S.C.A.T. SafetyCaps, emissions were drastically reduced and structural alterations were no longer necessary. During the entire time, the laboratory continued to operate with almost no interruption. The company was able to save an amount in the upper six figures.

For us, this success was the starting shot. Since then, we have helped numerous companies throughout Europe to save costs and before all else, to protect their employees from impairment to health.

We continually develop new products in order to offer the optimal solution to each – often very specialized – requirement.

Over 600 products, developed in-house for safe handling of harmful fluids, substantiate our performance capabilities and expertise.

The current catalog offers an overview of our standard products – in addition to these, customized solutions are also realized.

We have over twenty years experience in instrumental chemical analysis and can give you professional advice for anything having to do with hazardous material safety.

S·C·A·T europe

Safety Solutions

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Safety Solutions - Made in Germany.

„The team from S.C.A.T. Europe listens, learns and develops series products based on individual solutions to problems – products that make laboratories all over the world safer and more efficient".

S.C.A.T. Europe GmbH - headquarters in Mörfelden

Development, engineering, sales and logistics - all under one roof.

From our base at Mörfelden in Germany, we at S.C.A.T. Europe make laboratories all over the world safer and more efficient. S.C.A.T. Europe's safety solutions are about much more than just delivering on a promise. Our entire company philosophy is based on finding solutions to your problems.

Stronger together!

Many of our products are originally conceived as solutions to the individual problems that you ask us to help with. Most of the standard products in this catalogue started out life in this way, and were then developed into series products. In the future, too, we'll continue to seek out the solutions to your specific laboratory, process and production issues – wherever you require assistance in ensuring the safe handling of liquid chemicals.

Let us tell you about our favourite example of an enquiry sent to us and our outstanding solution, which has since become an established global safety standard:

Our customer's HPLC system, which would easily have cost up to six figures to buy, was drawing solvents from open or improperly sealed storage bottles. As a result, air, dust and dirt particles could be drawn into capillaries that were not properly fastened into position, and subsequently make their way into the highly sensitive analysis devices. Capillaries were getting tangled during use and replacement of the storage bottles. Highly volatile substances were being lost as vapour, mixing ratios were affected and incorrect analysis results were proving time-consuming and expensive to correct. To top it off, laboratory staff were permanently exposed to health risks caused by solvent vapours escaping into the ambient air!

Suppliers of the equipment leave it up to the user to obtain the bottles which the system needs to operate. The equipment is supplied with seals for GL 45 threaded bottles, which have openings or holes for capillaries with an external diameter of

3.2 mm. Suppliers rarely or never consider the safe disposal of used eluents.

Our solution is used in laboratories across the world to ensure that hazardous liquids can be handled efficiently and safely: S.C.A.T. SafetyCaps guarantee the safe extraction of solvents from storage containers, while SafetyWasteCaps ensure that solvents can be collected safely and that waste containers are ventilated effectively.

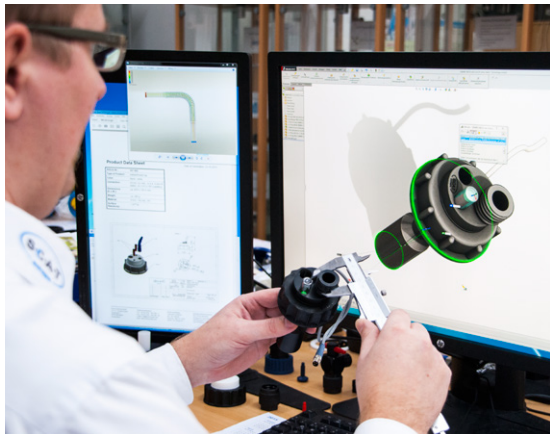
S.C.A.T. SafetyCaps – for the extraction of solvents. Made from pure PTFE and other high-quality plastics, SafetyCaps create a gas-tight seal on storage containers. Capillaries are fixed securely into place with fittings, while the rotatable core of the SafetyCap makes it easy to replace or change the storage container. The integrated air valve acts both as a valve and a filter.

This brilliantly simple – and simply brilliant – solution is completely unique in the global laboratory equipment market!

S.C.A.T. SafetyWasteCaps – for the disposal of waste liquids. This solution is made from high-quality materials and is resistant to organic solvents, acids and lyes. Capillaries and tubes are securely connected to the SafetyWasteCap using fittings and tube fittings. Waste liquids are safely directed into the containers. Exhaust filters with a multi-component granulate remove all solvent vapours from the expelled air, ensuring that your working area is kept safe and clean.

With over twenty years of experience, we make laboratories a safer place to be. For the day-to-day handling of hazardous liquids, we supply safety funnels to enable you to dispose of large and small quantities of waste liquid. We offer models with automatic closure mechanisms or shut-off valves integrated into the SafetyWasteCaps.

Our collection containers too are available in a wide range of sizes, types and materials, including electrically conductive PE-HD. From space-saving models to large waste canisters for higher volumes, with UN approval for the transport of hazardous goods on roads and industrial premises – we can offer the perfect solution for any application.

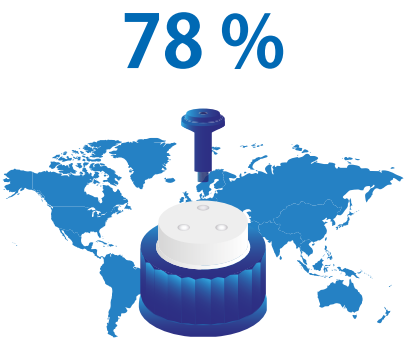


Engineering and development. Our team develops solutions for the individual challenges that our customers face.

The creation of individual solutions, development, engineering and production all go hand-in-hand – under one roof.

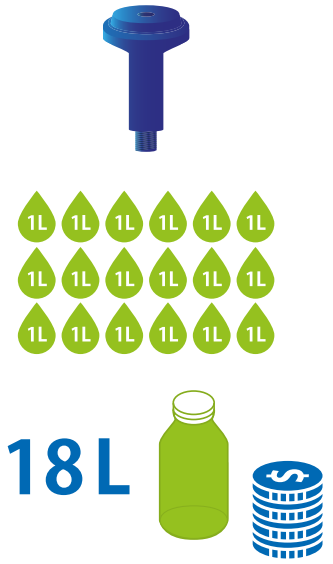
High-quality materials, devices and precision manufacture. The S.C.A.T. Europe quality promise.

Info graphic & facts



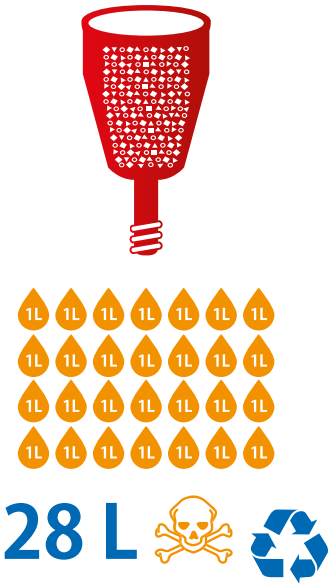
Global trust

80 % of HPLC users in Europe place their trust in us as a market leader and developer of S.C.A.T. SafetyCaps. In more than 150 countries (of 192 worldwide, equivalent to 78%), our products are contributing to increased safety in laboratories and production.



Air valves

A S.C.A.T. Europe air valve will prevent the evaporation of up to 750 ml of solvent over its service life of six months. In an HPLC system with four storage bottles, that adds up to a volume of three litres every six months. In a laboratory with six HPLC systems, the air valves prevent the evaporation of around 18 litres of liquid in a six-month period.



Exhaust filters

A S.C.A.T. Europe SafetyWasteCap with an exhaust filter fitted to a 10-litre waste canister will, compared to an open canister in an enclosed space, prevent the wastage of around 28 litres of solvent, which can be redirected back into the disposal cycle.

More than 600 products developed in-house.
Made in Germany - ready to dispatch!

All of our products are compatible with our SafetyWasteCaps and the rest of the S.C.A.T. Europe System.

The fill level control system that we've already mentioned is another key component of our portfolio. This solution is included as part of our SafetyWasteCaps with integrated fill level control. SafetyWasteCaps with electronic fill level control or disc sensors on the exterior walls of containers can be connected to our electronic signal boxes.

S.C.A.T. Europe disposal units can be earthed. Our electrically conductive PE-HD products offer the best protection against fire in the laboratory if you are working with ignitable or flammable liquids.

Electrostatic risks in your laboratory?

S.C.A.T. Europe is the market leader in solutions for reducing the risk of fire in laboratories.

Turn to page XVIII of this catalogue to read a specialist article on this topic.

Our large range of accessories and consumables, including air valves and exhaust filters, thread adapters, earthing equipment and much more, guarantees continuous and long-lasting protection and makes it simple and safe to retrofit safety solutions to existing systems in your laboratory.

With S.C.A.T. Europe, you can ensure equipment is safe right from the start! S.C.A.T. Europe's safety solutions can also be integrated directly into your laboratory installations. In 2015, we created the SymLine® – Chemical Waste Systems product line from our „Laboratory installation" product range. Early on in the planning of new laboratories, leading laboratory fitters incorporate SymLine® into their designs.
The modular and flexible system is easy to integrate into existing laboratory installations too.

As you can see, you'd have a hard job to miss us in the laboratory equipment market. Our distinctive „Professor" greets customers at trade fairs all over the world, at our own stands or those of our distributor partners. Looking for a distributor near you?
Visit **www.scat-europe.com** and **„Find a distributor"**. We'll then contact you with more information.

We hope you enjoy this catalogue.

- Your team at S.C.A.T. Europe -

More than 600 products developed in-house – Made in Germany – Ready to pack and dispatch to you.

S.C.A.T. is known as the „good brand". Rather than GHS hazard symbols, we supply safety products with a GH smile ;-).

You can't miss us. Our „Professor" greets customers at trade fairs across the world.

Safety Solutions Contents

Pages

Everything revolves around safety.

„In the chemical laboratory, safety isn't self-evident. S.C.A.T. Europe helps its customers to achieve and maintain a very high degree of safety."

Herbert Heidfeldt
Consultant for Environment, Health & Safety, Darmstadt, Germany

Herbert Heidfeldt began his career over 40 years ago in Research & Development at Merck KGaA. Since 2006, he has worked as a certified auditor, trainer and consultant for Corporate Environment, Health & Safety.

Working in the laboratory means managing complex tasks routinely and reliably. Therefore, this work demands placing a great deal of confidence in the facilities and in their own competence. More and more, supervisors and employees of chemical laboratories have to struggle with the growing occupational safety and legal requirements.

Along with the abundance of requirements, the need for professional help in order to provide competent and practical solutions for the user is also increasing.

Even as early as planning a laboratory, future risks can be reduced to a minimum by, for example, properly collecting hazardous materials that must be properly disposed of after use. Here, planners, managers and employees often focus on known safety facilities such as emergency exits and routes, signage, emergency showers and eye washes and fire fighting. However, these are only to emergency facilities designed to limit damage.

What about preventing these same emergencies from happening in the first place? The entire process chain of using chemicals is replete with dangers, especially their disposal.

Do you know how to handle all your materials properly and safely? Have you planned and tested emergency measures? Do employees receive regular training instruction? Is each next job (or the next upcoming experiment) thoroughly discussed and approved? Have you thought of everything? Or have you just been lucky so far?

Only one thing is certain: safety has many faces.

Especially in our workplaces in chemical laboratories, many sensible solutions help us handle materials properly. Information about chemicals can be found on labels, MSDSs or databases like the GESTIS database. So that practical implementation also goes smoothly, qualified equipment and tools are indispensable in today's workplace, especially when using hazardous substan-

„Working safely and efficiently in the laboratory is a constantly growing challenge."

ces such as flammable solvents - reliably grounded work equipment is an absolute must. Here, you can't rely on your proverbial guardian angel. Work safety is always a system of interlocking work regulations and facilities. A grounded hopper also includes the right label, the right storage space for materials and the employee's dissipative safety shoes.

But the most dangerous hazards are invisible. An explosive atmosphere, for example, isn't recognizable at first glance. That's understandable, because humans just don't have innate senses to detect many situations. A suitable seal, a hose connection or the right packaging material help minimize these dangers.

Working safely and efficiently in the laboratory is a constantly growing challenge. Laboratories have to manufacture high-quality products and guarantee reliable, reproducible results.
That's why laboratory safety solutions are not limited to personal protective equipment and adequate ventilation of the laboratory environment, but affect all areas of modern laboratory work - especially areas we generally rarely pay attention to in everyday life.

Author: Herbert Heidfeldt

Safe handling of solvents in the laboratory.

„Avoiding contamination in the laboratory is absolutely necessary to protect employees against health hazards."

Michael Baldus
Product manager,
NOVIA Chromatographie- und Messverfahren GmbH

NOVIA is a company owned by Provadis Partner für Bildung und Beratung GmbH.

Does this situation sound familiar?

You're in the laboratory preparing your samples, but you're still thinking about the parallel analysis you just ran and also have to remember to equilibrate your HPLC system. You lose focus for a moment and you've spilled the solvent you wanted to pour straight into the flask.

In my own experience, that's part of a normal workday in the laboratory.

This loss of attention is followed by contamination with hazardous chemicals, particularly solvents. But it isn't just inattention like this; it's also incorrect handling by insufficiently qualified and thus unsuitable laboratory equipment that leads to health and environmental hazards.

Avoiding contamination in the laboratory is absolutely necessary to protect employees against health hazards. The greatest danger for employees is to be unknowingly exposed to risk.

In order to avoid undesired physical contact with hazardous materials, laboratory personnel should observe the basic safety rules for working in the laboratory.

But they can only do so if suitable technical solutions for handling solvents are available and can be implemented.

In our experience, both the SafetyCaps for solvent extraction and the SafetyWasteCaps for safe disposal fulfil these requirements ideally.

Responsible activities in the laboratory require well-trained personnel. In doing so, the pure knowledge of occupational health and safety plays a role, especially so-called „awareness". Only employees who are familiar with the contexts and risks contained in their work and have developed an awareness of security can act appropriately - but only if they know the necessary correct technical solutions and are able to use them.

As a company engaged in the education and training of laboratory staff, we have a high responsibility towards people to inform them about correct practices,

„S.C.A.T. Europe systems are demonstrably easy and safe to use“

necessary expertise and the correct, optimum technical solutions in theory and in practice.

We realize this by making health, safety and environmental protection an integral part of our qualification measures - whether in training, continuing education or programs of study.

All the S.C.A.T. Europe systems we implement have proven themselves to be easy and safe to use - whether it‘s the simple replacement of ventilation valves, the secure closure of the safety funnel with a ball valve or the flexibility provided by the multiple sizes of threaded connections and additional components.

Maximum security is always combined with user-friendliness and easy handling.

Conclusion:

In order to ensure the safe handling of solvents in the laboratory, facilities must include easily usable and reliable tools and systems, as these contribute significantly to occupational health and safety - all systems by S.C.A.T. Europe meet these requirements. They also ensure that „clean“, reproducible analysis results are obtained, since the systems avoid contamination of the solvent, even with outside impurities.

Author: Michael Baldus

Safety every day in the laboratory.

„This clearly documents that with the S.C.A.T. SafetyCap an evident reduction in the methanol concentration in the test chamber to nearly 0 was achieved, so the workplace limit value of 270 mg/m³ specified by TRGS 900 was fallen well below."

SGS Institut Fresenius was commissioned to investigate reduction of emissions achieved by use of S.C.A.T. SafetyCaps.

In this respect, 1000 ml solvent bottles with and without SafetyCaps were used and the emissions over a period of 28 days compared.

Then test chamber tests were conducted over a period of 7 days, during which the level of emissions in atmosphere were regularly monitored.

The solvent components tested as examples were the tested compounds methanol/water (ratio: 80/20), acetonitrile and methanol.

Additional test reports attendant to efficiency of S.C.A.T. Europe SafetyCaps can be downloaded at www.scat-europe.com

Determining the changes in density and volume

SGS Institut Fresenius GmbH was commissioned by S.C.A.T. Europe GmbH to evaluate the effectiveness of their S.C.A.T. SafetyCaps in comparison to a solvent bottle without S.C.A.T. SafetyCaps. Changes in density of a methanol/water mixture were examined to determine if use of the S.C.A.T. SafetyCap could prevent a change in the mixture over an longer time of 8 days. A comparison of the measured results shows that in a bottle fitted with the S.C.A.T. SafetyCap no change in density occurs, the initial density of 0.855 g/cm³ stayed constant throughout the entire 8 days of the test.

In contrast to this, the solvent bottle without a S.C.A.T. SafetyCap displayed a demonstrable change in density so that the initial value of 0.855 g/cm³ of the solvent mixture rose to a density of 0.858 g/cm³ (Fig.1). An increase in density indicates that there has been a greater loss of methanol than of water from the mixture. This loss did not occur in the same mixture ratio. Therefore a change in the composition of the methanol/water mixture can be assumed, which then could result in errors in measured values under laboratory conditions.
In contrast to this, in the solvent bottle with the S.C.A.T. SafetyCap, no change in the mixture ratio was found so that errors in measured values due to a change in the solvent mixture can be excluded.

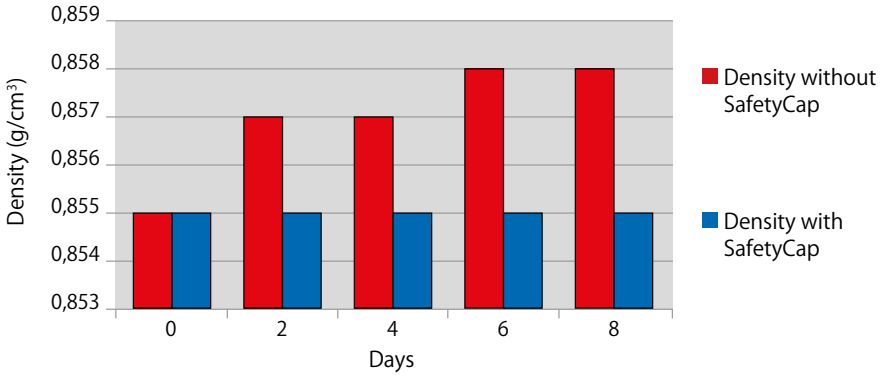


Fig. 1 Changes in the density of a methanol/water mixture

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Characterization of the change in volume in methanol and acetonitrile

The first step in this test was to determine change in volume by means of differential weighing over the 28 day pilot study in which both acetonitrile and methanol were specified as solvents. These two solvents were used to generate the best possible comparison with real on-site conditions in a HPLC laboratory. Based on the measurement results it is evident that in both series of trials with the S.C.A.T. SafetyCap, scarcely any change in volume over the period of 28 days was observed. In comparison to this, without the S.C.A.T. SafetyCap, a significant reduction in the given volume of 1 liter was found within the period of the trial (Fig. 2).

In the acetonitrile bottle without a SafetyCap, a reduction in volume of almost 10 % occurred so that after 28 days, only 90 % of the initial volume remained in the solvent bottle. Consequently, after 4 weeks, almost 10 % of the solvent quantity was lost, having escaped unfiltered into the atmosphere. During differential weighting to determine the change in volume of methanol, it was evident that an even more significant reduction had occurred in the solvent bottle not fitted with a S.C.A.T. SafetyCap: After 28 days, only 87.8 % of the initial volume remained in the open solvent bottle, compared with 100 % of the initial volume remaining in the solvent bottle equipped with the S.C.A.T. SafetyCap. It is obvious that almost 13 % of the solvent quantity used are lost, having escaped into the atmosphere from the solvent bottle not fitted with a S.C.A.T. SafetyCap.

Characterization of the atmospheric concentration by test chamber investigations

In order to investigate the atmospheric emissions caused by open solvent bottles in comparison to a solvent bottle with S.C.A.T. SafetyCap, one of each solvent bottles were placed in a test chamber and their respective methanol or acetonitrile emissions were tested after 1, 3 and 7 days (fig. 3).

It was evident that within the test chamber, despite continuous air exchange a methanol concentration of 630 – 660 mg/m³ could be determined for the solvent bottle without SafetyCap, whereas a concentration of 1 – 2 mg/m³ was analyzed for a solvent bottle with S.C.A.T. SafetyCap.

This clearly documents that with the S.C.A.T. SafetyCap an evident reduction in the methanol concentration in the test chamber to nearly 0 was achieved, so the workplace limit value of 270 mg/m³ specified by TRGS 900 was fallen well below.

In contrast to this, without SafetyCap the concentration of 630 – 660 mg/m³ clearly exceeds the workplace limit value to constitute a background exposure which can lead to impairment of employees‘ health in the laboratory.

A similar picture also results from the test chamber investigation with acetonitrile, in which a concentration of 1 – 5 mg/m³ was determined with SafetyCap, as opposed to an atmospheric concentration of 730 – 800 mg/m³ without the S.C.A.T. SafetyCap, despite continuous air exchange (Fig. 3).

Comparison of the detected test chamber emissions with the acetonitrile limit values of 34 mg/m³ specified by TRGS 900 showed that without the S.C.A.T. SafetyCap, the workplace limit value was evidently exceeded. In contrast to this, with the S.C.A.T. on the bottle a distinct minimization of the acetonitrile concentration was determined, which was well below the workplace limit value of 34 mg/m³ specified by TRGS 900 (fig. 4).

Conclusion

In conclusion, it is evident that solvent emissions could be significantly reduced by the S.C.A.T. SafetyCaps. In this respect, the use of S.C.A.T. SafetyCaps can be expected to lead to a clear reduction of the exposure to solvents in the air in a laboratory.

In this connection the reduction in the solvent concentration in the air can be assumed to be of a similar proportion as was described previously, leading to significantly lower health risk for the employees concerned.

Furthermore, S.C.A.T. technology significantly minimizes the risk of contamination of solvent-free blank samples in laboratories, so the use of S.C.A.T. SafetyCaps can also be considered a measure of quality assurance.

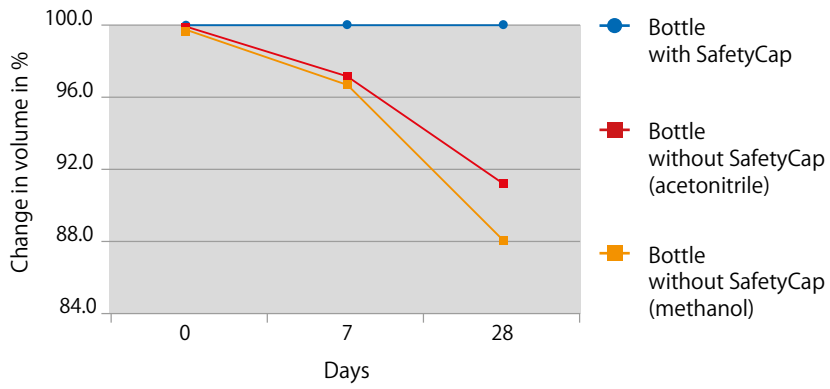


Fig. 2 Changes in volume of methanol and acetonitrile

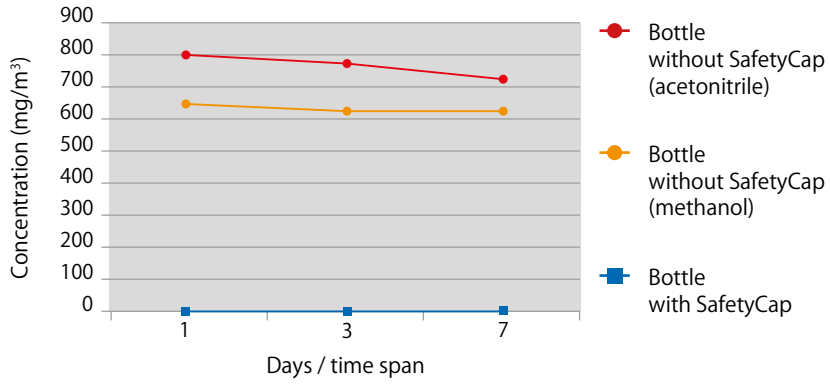


Fig. 3 Methanol emissions and acetonitrile emissions in the test chamber

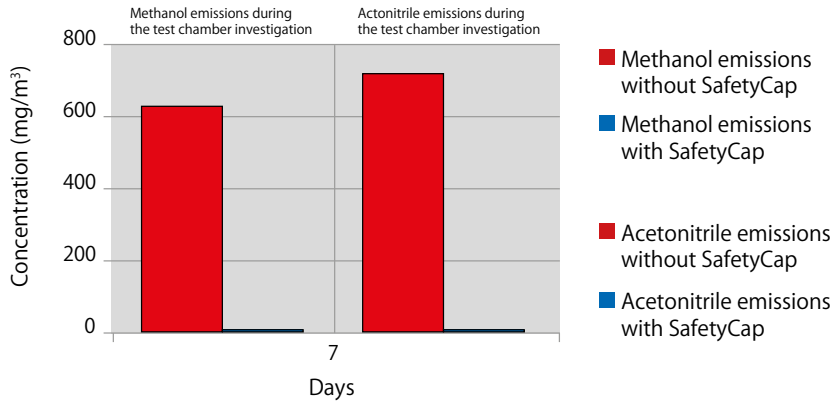


Fig. 4 Methanol emissions & acetonitrile emissions in the test chamber

When handling flammable liquids: Electrostatic risks of ignition in your laboratory?

„Alternately, the use of conductive or dissipative materials is recommended, as they can uncritically discharge their charges when grounded. This means that the prerequisite for brush discharges, the charged insulating material surfaces, is not present."

Author: Kurt Moritz

Kurt Moritz is the specialist in charge of electrostatics and mechanical explosion protection for the technical plant safety of ***Merck KGaA, Darmstadt.***

Contrary to popular belief, electrostatics - often called static electricity - is not produced by rubbing surfaces together but by separating surfaces which were previously in intensive contact. In this context, intensive means that a contact surface, a dwell time (even if short) and a distance between the surface of max. 10 mm must all be present.

Depending on the conductivity and position in the triboelectric series, materials tend to pick up charged particles on their surfaces or transmit charged particles to the adjacent surface. In this case, conductive materials serve as electron suppliers (donator), while insulating materials absorb charged particles (acceptor).

If the surfaces are separated quickly after such a charge transfer, and if at least one of these materials is a poor conductor of electricity, the charge transferred can no longer flow back to the surface from which it originated. These charged particles which cannot be transferred back remain on the one surface and form a charge excess, while they are absent on the other surface, leading to a charge deficiency on that surface. When separated, voltage is generated that can rapidly reach the kV range.

Therefore, electrostatics is always a surface effect and occurs on the surface on a molecular or atomic level.

When working with solids, it is easy to recognize separation processes that may lead to charges. In general, visible movements are always present. Removing films, pouring a product out of a container, removing synthetic pieces of clothing (fleece, polyester) that are separated from the body - all these things lead to tangible and sometimes visible charges and discharges.

However, a prerequisite for charge separation is, as previously explained, that at least one of the materials involved must bee a poor conductor of electricity.

Poor conductors (or „insulators") include most plastics like PE, PVC, PVDF, PTFE, etc. However, solids are not classified by conductivity (unit: S/m) but by resistance (unit: Ωm). Siemens/metre is the reciprocal value of the ohmmeter, so the numerical values are directly comparable. Therefore, low conductivity corresponds to high resistance.

Liquids shall also be distinguished from an electrostatic standpoint, and even liquids have a high resistance - in other words, poor electrical conductivity.

These include, for example, aliphatic/aromatic hydrocarbons, such as ethers, as well as widely used solvents such as toluene, n-heptane, n-hexane, xylenes, etc.

Some nitrites (such as acetonitrile) and some esters play a special part, as they lead to unexpectedly high supercharges despite having relatively good conductivity - a previously little-known and rarely-investigated effect. This means that electrostatic

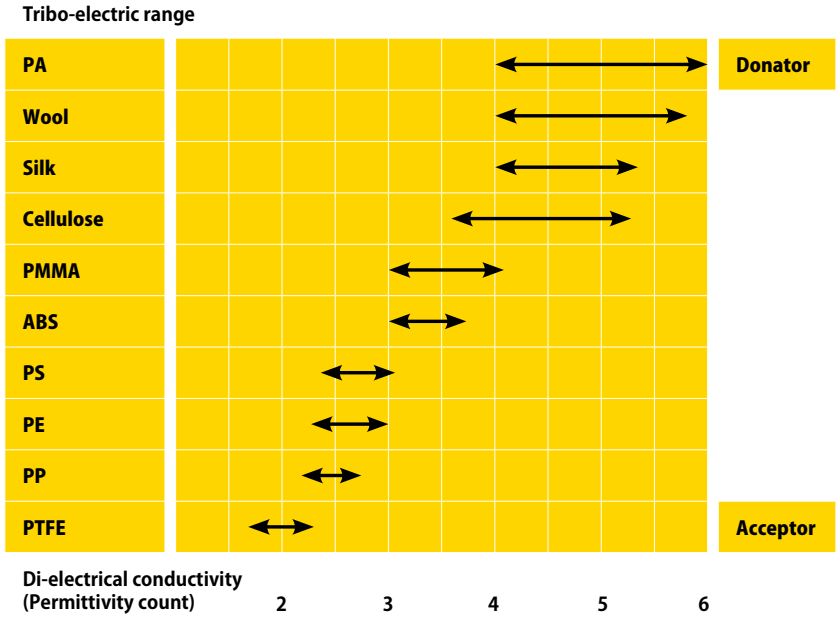
protection is especially important for such substances.

Now, unlike the solids, a surface separation process is not always recognizable as such with liquids.

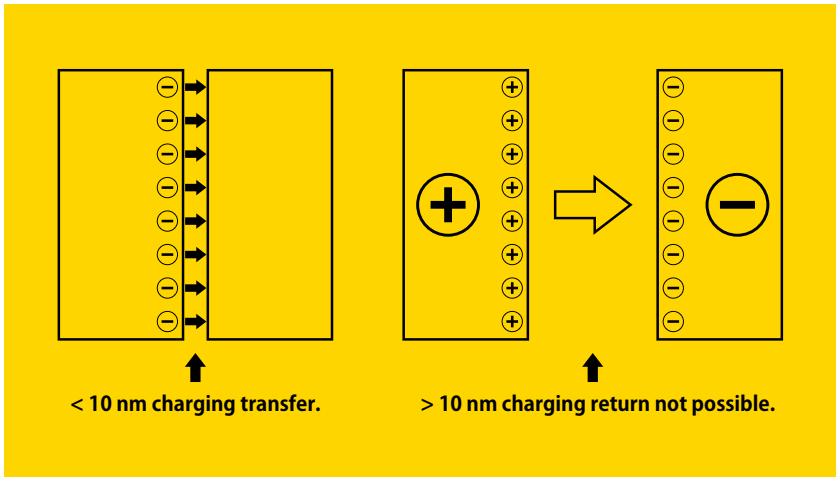
The fluid-filled glass pipeline or the semi-transparent HPLC hose with its still medium is optically barely distinguishable from the pipeline with flowing medium.

And even if it is: the liquid column remains completely in contact with the inner wall of the hose/tube. **But no surfaces are separated in this process, are they?**

A common misconception, because, unlike solids, a so-called electrochemical double layer (also called a Helmholz double layer) forms in the liquid on the container or pipeline wall with electrically charged separated layers. When the liquid flows, the charge layer that is primarily situated in the liquid is carried along.



Materials with higher permittivity serve as electron suppliers (donors). Those with lower permittivity tend to accept charged particles (acceptors).



Charge transfer upon contact, charge separation by surface separation.

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Most frequent type of discharge: **the spark discharge**

Surface roughness, flow-inhibiting installations and cross-sectional changes also favour these effects, increasing the charging for the system.

Of course certain quantities and (separating) speeds are necessary in order to generate a charging process.

When promoting in closed systems, for example, a speed of <1 m/s is designated critical because an equilibrium between charge transfer and charge reflux sets in up to this value. However, this limit is not applicable to free pouring, because different volume-to-surface conditions are present in this instance and a charge reflux is excluded by the removal of the liquid.

Therefore, filling a test tube from a laboratory spray bottle certainly does not meet the criteria that lead to critical electrostatic charges, even though the spray bottle is also made of insulating material (generally LDPE or HDPE).

However, charges can be generated if a larger quantity is conveyed at a higher speed. **This situation may occur in capillaries and hoses in HPLC systems**, for example, especially when several of these hoses are combined, concentrating and increasing the flow of waste solvents. The associated separation or charging processes can be so strong that an electrostatic field forms around the promoting hoses. Now, if conductive, non-grounded components (such as metal parts) are present within the effective range of this field, they are subject to a charge polarisation. This means that the opposing polarity increases towards the field; the like-minded polarity is repelled. This polarisation effect of charged particles in ungrounded conductive components can be so strong that a discharge of the excess charge or - depending on polarity - an equalisation of the charge defect until the next „grounding“ takes place. Both generally manifest in the form of sparks.

A classic example for charges via induction are metallic components such as couplings or brackets connected to liquid promotional hoses made of insulating material.

Even when pouring liquids which flow over surfaces and subsequently collect in containers (e.g. waste solvents that are poured through a funnel into a collection thank), charges may accumulate. Initially, the funnel may charge in one polarity due to the separation process between liquid and funnel.

The oppositely charged liquid collects in the container and transmits its charge to the container. If the funnel and container are not electrically/electrostatically connected to each other, a different electric potential forms on both components, i.e. a charge that can be discharged in the form of sparks. This creates an ignition hazard.

Damaging incidents due to electrostatic charges and discharges when transferring liquids and waste solvents are well-known and documented.

How do you avoid electrostatic ignition hazards when handling solvents in laboratories?

There are three different types of electrostatic discharge that are relevant in laboratories. A risk assessment that takes into account these three types of discharge, evaluates them and specifies safeguards protects against electrostatic hazards.

The most common type of discharge is the spark discharge, which always occurs when conductive materials are charged by separating their surfaces from insulating materials or by „induction".

These charged, conductive objects may include

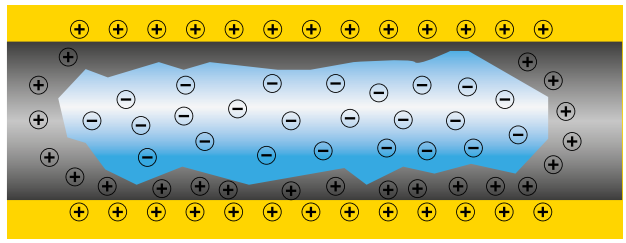
- packaging materials such as canisters, alloy bottles, metal containers
- persons
- tools such as funnels, pipeline components, sieves and filters
- as well as flammable solvents with high conductivity (alcohols, ketones)

if their charges cannot be discharged.

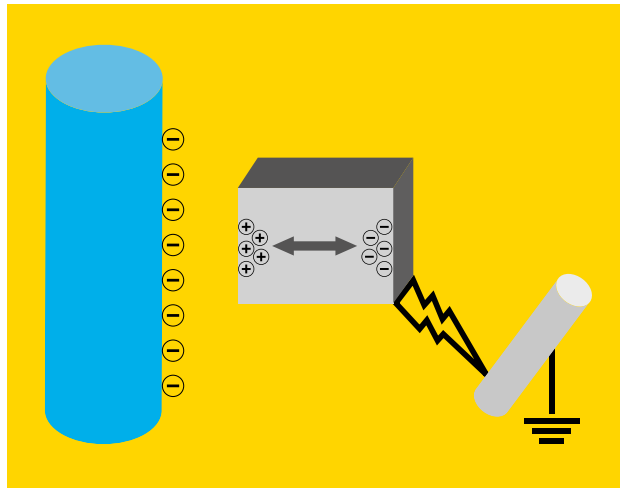
The charge accumulates as if in a capacitor. If the potential is high enough, the charge is equalized with another conductive object to other potentials (generally to the grounding).

The use of conductive or dissipative grounding materials prevents spark discharges.

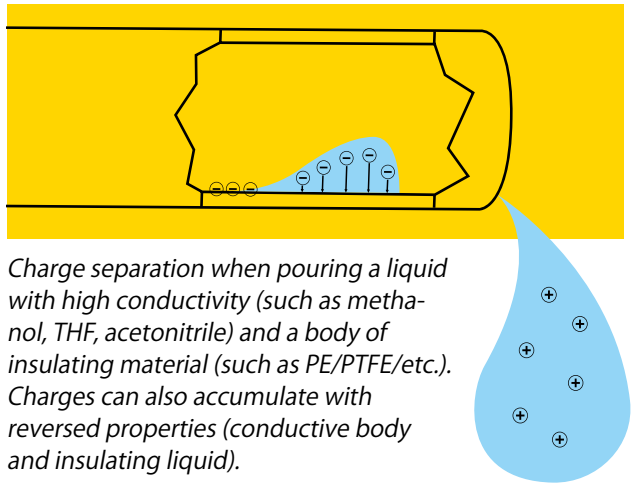
The charge is equalized via the ground connection and a possible charge is harmlessly discharged. At the same time, conductive, grounded containers are capable of grounding the conductive liquids they hold.



Charge separation on a molecular basis while being promoted.



Polarisation of conductive, ungrounded parts through „induction". This may lead to a charge equalisation via a spark discharge.



Charge separation when pouring a liquid with high conductivity (such as methanol, THF, acetonitrile) and a body of insulating material (such as PE/PTFE/etc.). Charges can also accumulate with reversed properties (conductive body and insulating liquid).

Continued on next page >

Prevent spark discharges?
By using dissipative materials!

The second relevant type of discharge is the brush discharge.

This occurs on insulating surfaces which have been charged by separating operations such as rubbing, wiping, the removal of protective films, etc., or by spraying.

Insulating solid surfaces can only be charged by such surface processes. Charging via induction does not occur in insulating materials, as the poor conductivity does not allow the charged particles in the material to be moved/polarised.

If a charged insulating surface is given a grounding conductor, such as by the approach of a metal object or a person, the electrostatic field concentrates towards this grounding and develops into a spark manifesting on the surface - the brushing discharge.

Brushing discharges are lower in energy than spark discharges and cannot ignite flammable dust-air mixtures with a minimum ignition energy of > 1 mJ. However, the energy of the brush discharge is sufficient to ignite flammable solvent vapours or combustible gases.

Depending on the combustible material (e.g. the explosion group IIC) and the probability of occurrence of ignitable solvent vapour-air mixtures (such as „occasional" / Zone 1), an insulating material surfaces >20 cm^2 may be evaluated as critical.

Containers such as cans, bottles, etc., or tools made of insulating materials may sometimes have a manufacturer release for use with flammable solvents; however, the operator must be aware of this hazard and must observe the manufacturer specifications and conditions of use (such as „Dry wiping prohibited", „...only for designated use", etc.).

To protect against brush discharges, insulating surfaces cannot be charged by rubbing, wiping, or similar operations in the simultaneous presence of flammable vapours.

Alternately, the use of conductive or dissipative materials is recommended, as they can uncritically discharge their charges when grounded. This means that the prerequisite for brush discharges, the charged insulating material surfaces, is not present.

The third type of discharge observed in laboratories is the propagating bush discharge.

This mainly occurs inside plants and on insulating surfaces if so-called „strong charge-generating processes" take place simultaneously. For example, these conditions are present in insulating hoses through which aerosols or solid particles are promoted at high speed.

A hose affected in this manner and in which a propagating brush discharge has occurred generally has a dark mark, several centimetres long, with a central concentration, which caused a perforation in the wall due to the discharge breakdown.
A propagating brush discharge contains enough energy to ignite fuel-air mixtures of any kind. However, as several conditions are required for the creation of this type of discharge, the probability of occurrence is relatively low. If in doubt, seek an expert opinion.

Since propagating brush discharges only occur on insulating surfaces, the use of conductive or dissipative transport or conveyor systems is also an adequate safeguard in this situation.

Electrostatics and their ignition risk is a very complex issue. The requirements for components and parts used in so-called hazardous areas, i.e. zones defined as hazardous-relevant because flammable atmospheres occur frequently and to a greater extent in these areas, are heavily regulated.

But even in areas with high air exchange and lower solvent volumes which are not defined as hazardous zones, care must be taken to ensure that no electrostatic ignition source is created near emission sites or near the open handling of solvents. An electrostatic discharge occurring in this area would inevitably cause the mixture to ignite and, in a worst-case scenario, would cause the container to explode.

This emission should initially be avoided by use of suitable filtration systems, for example. If this is not possible, care must be taken to ensure that no electrostatic hazards can be created near solvent emission sites or in areas in which these substances are handled openly (i.e. waste solvent collection points).

To this end, the previously specified safeguards for solvent systems as well as additional measures, such as the grounding of persons via dissipative flooring and appropriate footwear, must be maintained. Electrostatic requirements for the hazardous areas listed above are regulated differently depending on national regulations.

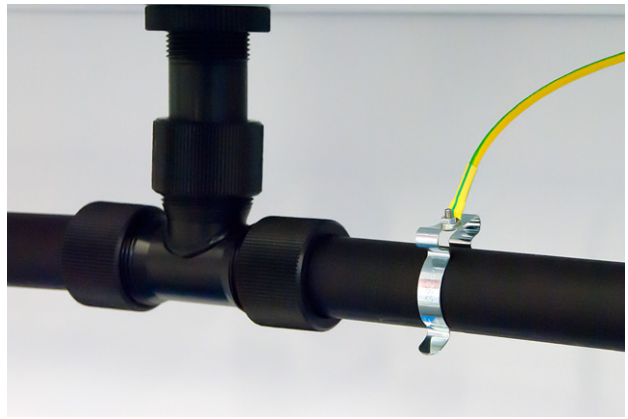
In Germany, the „Technical Regulations for Hazardous Substances“, or TRGS 727 (formerly TRBS 2153), delineates electrostatic requirements in hazardous areas under the title „Prevention of ignition hazards due to electrostatic charge“.

At the European level, CENELEC (EUROPEAN COMMITTEE FOR ELECTROTECHNICAL STANDARDIZATION) CLC/TR 50404:2003 superseded by CLC/TR 60079-32-1:2015 Electrostatics - Code of practice for the avoidance of hazards due to static electricity is applied.

These regulations describe hazards and specify safety measures. Therefore, their contents can also be applied here as a source of useful information and can be used in the event of questions.

Kurt Moritz
Kurt Moritz is the specialist in charge of electrostatics and mechanical explosion protection for the technical plant safety of **Merck KGaA, Darmstadt**.

The safe grounding of conductive components prevents spark discharges. Conductive materials must also be grounded.



Using conductive or dissipative grounding materials avoids creating insulating surfaces. This removes the prerequisite for brush discharges.

Protect your health.

Hazardous vapours may arise while working with solvents and other hazardous liquids. Inadequate sealing of supply or waste containers creates health risks. Numerous statutory guidelines apply. Always put your own health first.

In addition to the Chemicals Act, the Hazardous Substances Act is based on the Occupational Health and Safety Act. The employer is responsible for protecting all workers against risks to health through inhalation, skin contact and the physico-chemical effects of hazardous substances.

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In January 2009, regulation (EC) no. 1272/2008 – the CLP Regulation - entered into effect.

It regulates the classification, labelling and packaging of substances and mixtures (Regulation on classification, labelling and packaging of substances and mixtures, or CLP) and replaced the European Dangerous Substances Directive and the Dangerous Preparations Directive in 2015.

The CLP Regulation is based on a UN recommendation to introduce a uniform system for the classification and labelling of chemicals (Globally Harmonised System, UN GHS), which dates back to the 1992 Sustainability Conference in Rio de Janeiro. This represents a compromise between established systems, primarily between North America, the EU and the regulations on hazardous goods.

Source:
Bundesanstalt für Arbeitsschutz und Arbeitsmedizin (BAuA)

For more information, please visit:
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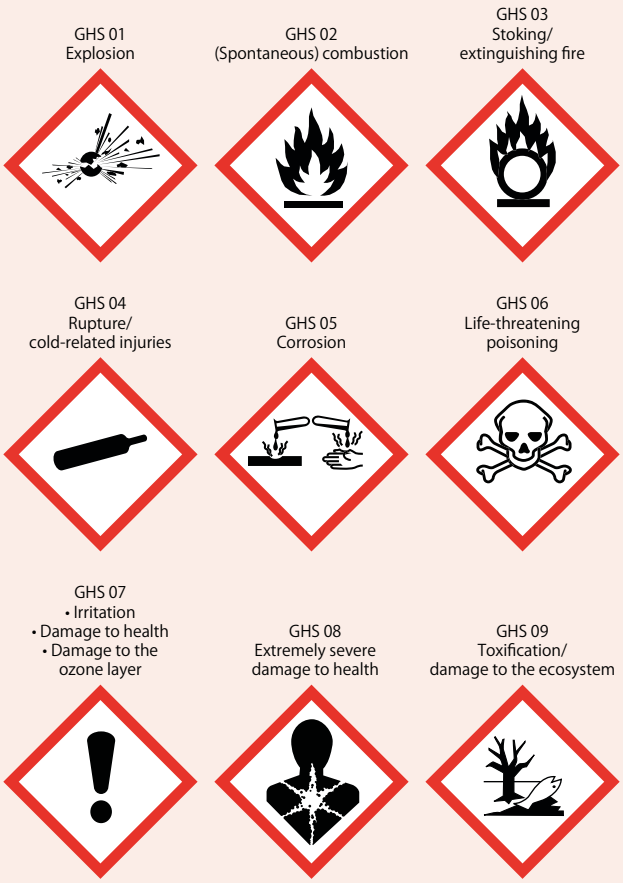

European list of agents that trigger (occupational) diseases (Extract from BKV Annex 1, December 2014. Source: BAuA)

Lead or its compounds • mercury or its compounds • chromium or its compounds • cadmium or its compounds • manganese or its compounds • thallium or its compounds • vanadium or its compounds • arsenic or its compounds • phosphorus or its inorganic compounds • beryllium or its compounds • carbon monoxide • hydrogen sulphide • mucosal lesions, cancer or other neoplasms of the urinary tract by aromatic amines • halocarbons • benzene, its homologues or styrene • nitro or amino compounds of benzene or its homologues • carbon disulfide • methyl alcohol (methanol) • organic phosphorus compounds • fluorine or its compounds • nitric esters • halogenated alkyl, aryl or alkylaryl oxide • halogenated alkyl, aryl or alkyl aryl sulphide• diseases of the teeth by acids • corneal damage to the eye by benzoquinone • para-tertiary butyl phenol • isocyanate • liver disease by dimethylformamide • polyneuropathy or encephalopathy caused by organic solvents or mixtures thereof • diseases of the blood, the blood-forming and the lymphatic system by benzene • cancer of the larynx by sulphuric acid-containing aerosols (...)

TRGS 526 „Laboratories“ (Technical regulations for hazardous substances)

2 / General information:

Laboratories must (...) be designed and operated according to prior art standards.

3.1 / Risk assessment - Procedure:

Measures to protect against hazardous substances shall be set so that (...) the employees are not exposed to any hazards or loads. If this is not possible, the activity should be designed so that the overall risk to workers is minimized after reviewing alternate measures.

3.3.1 / Exposure assessment:

The employer can generally assume that no unacceptably high exposure to hazardous substances is present if expert (...) personnel is acting in accordance with relevant regulations and prior art (...).

3.7 / Employment restrictions:

Employment restrictions for minors, women of childbearing age, and pregnant and lactating women must be observed (Young Persons Employment Act, Maternity Protection Act and the regulation for the protection of mothers in the workplace).

4.3.1 / Avoiding hazards:

The employer shall design the workplace to avoid hazards or reduce them to a minimum. The duration and extent of exposure to hazardous substances must be limited, (...).

4.11.1 / Release of gases and vapours:

Outside of fume hoods, activities in which gases and vapours may form in hazardous concentrations or quantities may only be performed if suitable safeguards (...) ensure that a threat (...) is excluded.

4.16.1 / Handling waste:

When preparing and filling storage tanks (of waste), no hazardous gases or vapours (...) may leak or otherwise enter into the laboratory air.

5.2.23 / Chromatography (HPLC):

If the system cannot be operated with a fume hood, the released solvent vapours must be vented/ dissipated safely.

6.1 / Technical protective measures:

Hazards in laboratories are primarily avoided by ensuring that workplaces are appropriately designed and equipped. These include (...) the nature of the equipment, instruments and (...).

TRBS 2153 - Avoiding ignition hazards due to electrostatic charges (Technical regulations for operating safety) (See also TRGS 727)

4.5 Electrostatic charges when handling liquids - small containers

(...) Dangerous charges can be generated by friction, fluid flow or ungrounded persons. In these cases, hazardous discharges to insulated metal components, such as handles, locks, barrel pumps or solid/liquid surfaces, should be expected.

4.5.1 Conductive or dissipative containers

While filling and emptying the container, all conductive or dissipative parts of the system must be electrically connected and grounded.

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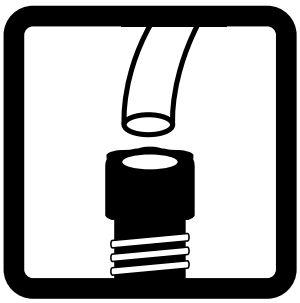
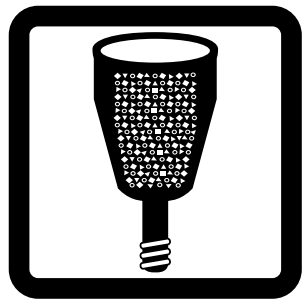
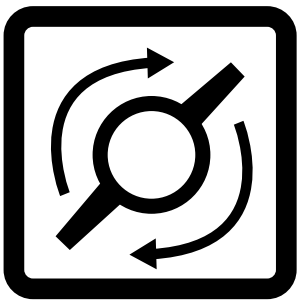


Connection options for HPLC capillaries

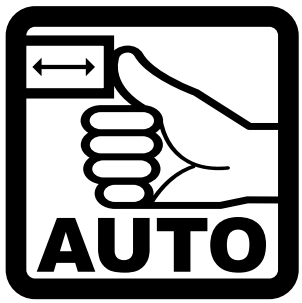
Connection options for tubing



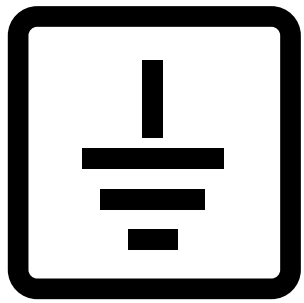
Connection options for S.C.A.T. Exhaust filters



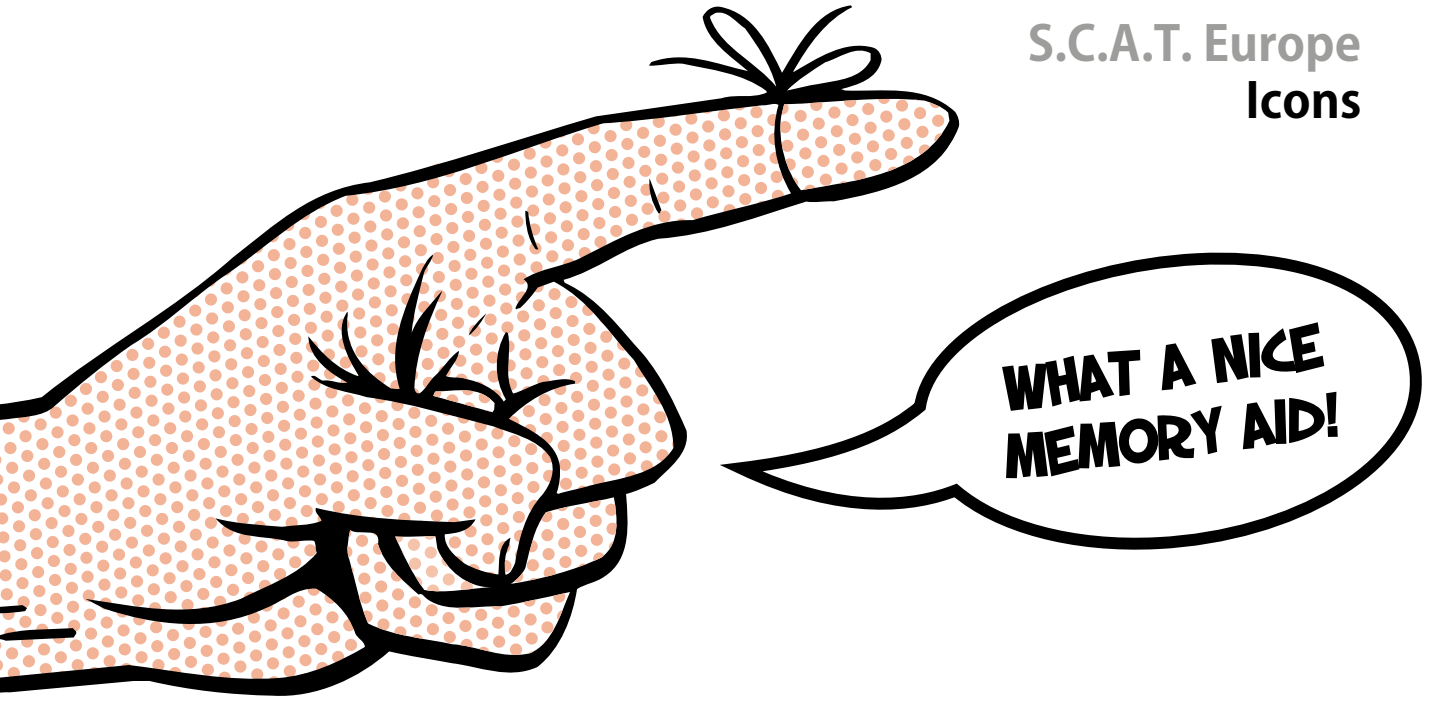
Integrated safety funnels with shut-off

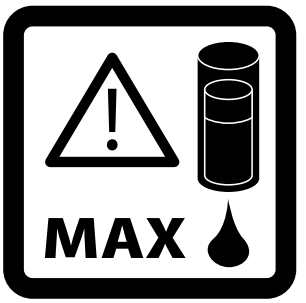


Integrated safety funnels with automatic closure

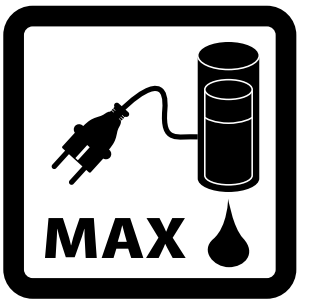


Connection options for ground cables

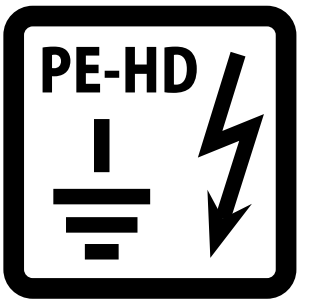




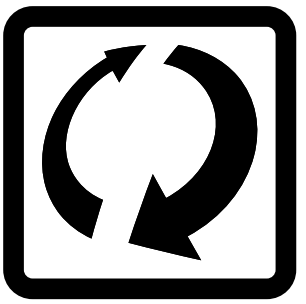
Integrated floater for level warning



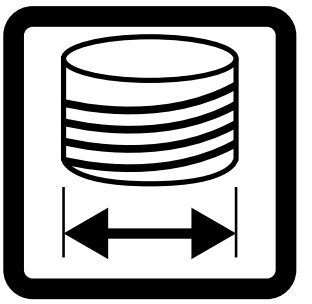
Connection options for electronic level control



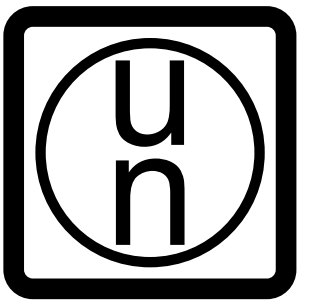
Electrostatic conducti-ve PE-HD to prevent from ignition risks



Service life / lifespan for consumables



Thread size



UN approval for the transport of hazardous goods on roads and plant premises

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