

GUIDELINES FOR ECO-FRIENDLY HANDLING OF METAL SWARF



AN INITIATIVE OF ASSOCIATIONS REPRESENTING
PRODUCERS OF INDUSTRIAL WASTE,
HAULIERS AND FREIGHT FORWARDERS,
THE METAL-RECYCLING SECTOR
AND RECYCLERS



STEEL SWARF

ALLOY SWARF

BRASS SWARF

ALUMINIUM SWARF

GRINDING SLUDGE

IMPRINT:

These guidelines are an initiative of associations representing producers of industrial waste, hauliers and freight forwarders, the metal-recycling sector and recyclers.

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1 INTRODUCTION

These guidelines provide advice on the eco-friendly handling of metal swarf from the time it is produced through to its professional processing by a recycling company.

It has been prepared by the participants shown in the appendix in order to offer a guide for handling swarf in a responsible manner. The main issues dealt with in the guidelines are the diverse types of swarf and the consideration that has to be given to the respective characteristics to ensure safe recycling.

The related topics metalworking fluids and the leak-tightness of the units used for collection and transport are also dealt with extensively.

The present translation refers to best practices recommendations and the current situation in certain German states. Metal swarf is used for metal fillings and turnings which result from shaping and physical and mechanical surface treatment of metals, as mentioned in the EU Waste Catalogue codes 12 01 01 and 12 01 03.

2 ECONOMIC IMPORTANCE

Metal swarf is an important raw material and a valuable commodity for the steel and non-ferrous metals (NFM) processing and recycling industry. Recycling of these materials serves to close material loops, improve resource efficiency, secure the supply of raw materials and avoid negative environmental impacts, such as CO₂ emissions. These measures are part of the most important objectives of the German Federal Government with respect to environmental and resource policy (cf. German 'ProgRess' Resource Efficiency Programme).

Swarf represents a significant economic factor. For example, manufacturing had a total turnover of about 325 billion euros in 2013 in Bavaria alone. Some 66 per cent of this turnover was attributable to companies in which metal swarf is produced.

2.1 VALUE TO THE PRODUCER:

For producers, swarf and the revenues it generates are an integral part of operation costing because today the amount of scrap produced is already taken into account in the production and sales revenues for the product. Especially as the material can be transferred to the recycling company and thus returned to the material loop without difficulty.

2.2 VALUE TO THE PROCESSOR:

The amount of swarf in Germany represents a significant trade volume that makes a considerable contribution to the profitability of recycling companies. The swarf collected is sorted according to material type, treated if necessary and then made entirely available to the metal-producing industry for direct use as new products.

2.3 PROCESS-RELATED VALUE TO THE INDUSTRY:

From a production point of view it is necessary to use swarf in many melting furnaces in steelmaking and the production of other metals. Thanks to its properties, all of the swarf is usually outstandingly well suited for melting down. At the remelting plant, use is made of the chemical and physical properties of the swarf when loading the scrap baskets to obtain an efficient mixture in the charge. Swarf ensures that energy consumption during the melting process is low. Some industrial companies have arranged their production in such a way that it is based entirely on the use of metal swarf. Metal swarf is thus indispensable as a secondary raw material.

3 METAL SWARF: QUANTITY AND DIVERSITY OF TYPES

The considerably high degree of industrialisation and specialisation in the German manufacturing industry means give rise to a very large amount of metal swarf. The amount of swarf that is suitable for utilisation as a raw material in steelmaking is on average more than ten per cent of the 15 million tonnes of iron and steel scrap that is additionally purchased per year, and thus, at least adds up to 1.5 million tonnes a year.

There are no clear-cut statistical data available for non-ferrous metal (NFM) swarf. The quantity depends on the source and is also very large. For example, very large quantities of swarf arise in the production of aircraft parts because these components have to be manufactured as a whole, i.e. without any weld or blanking seams, for functional reasons. In most cases the machining unit used means the swarf is sorted according to type of alloy, which simplifies recycling.

Depending on the process used, metal swarf of different sizes, shapes and nature is produced in the machining industry. The chip size ranges from several decimetres down to fine particles.

Iron, steel, non-ferrous metal or alloy swarf can be produced in the form of coarse, broken, woolly or fine chips. The type of swarf produced determines the waste legislation classification as well as the steps that need to be taken at the point of origin.

Different examples of swarf will be presented in section 6 in the form of photos and labelled with the corresponding number from the European List of Waste, the so-called LoW number.

4 SUGGESTIONS FOR PROPER HANDLING OF WET/OILY SWARF

During machining, different amounts and types of metalworking fluid are often used. Metalworking fluid can therefore often contaminate the swarf from machining operations, although this is not necessarily the case. Metalworking fluid can also be removed using a suitable treatment (see also 4.2). Over the years, the substances used as metalworking fluids in machining have changed. Formerly Oils with additives were used earlier of oils with additives, some of which contained chlorinated hydrocarbons; because of the effects on the environment that have since been recognised, alternatives have been developed and these are equally effective.

The proper handling of wet/oily swarf adhered with metalworking fluid starts at the point of origin and is the responsibility of the producer. Metalworking fluids are recirculated in many plants for economic and ecological reasons. The recycling and/or reclamation of the metalworking fluid used is becoming increasingly more important, particularly as the waste producer now has to obtain the necessary emission permits. Both, the waste producer and the waste management company, have to pay particular attention to the recirculation of the metalworking fluid. The respective approach depends on the commercial agreements between the contractual partners.

4.1 METALWORKING FLUID USED

Normally, metalworking fluids are indispensable during metal machining. Depending on the specific application, they are also referred to as cutting oils, compounds, coolants or lubricants.

They have diverse functions that are described briefly below:

- they lubricate the tool and the metal and thus ensure lower tool wear,
- they cool the material and the tool; this reduces wear and tear and reduces thermal effects that impair the precision of the cutting operation or have a negative influence on the quality of the workpiece,
- depending on the composition, they provide (temporary) corrosion protection,
- they flush away swarf and particles from the machining area and thus allow high machining speeds to be used,
- they inhibit metal dust or emissions being released into the air, as it occasionally occurs, when dry machining is used.

Metalworking fluids are divided into water-miscible and non-water-miscible.

Non-water-miscible metalworking fluids usually contain 90/100% mineral oils and esters or synthetic oils that additionally contain specific additives (0-10%). As far as legislation about hazardous substances is concerned, these products are generally classified as 'non-hazardous'. Products classified as non-hazardous are clearly preferred for reasons of occupational health and safety, and storage. Unfortunately, mineral oils are still classified as 'hazardous' in many registers of hazardous materials because they previously often contained larger quantities of polycyclic aromatic hydrocarbons (PAHs), which are deemed to be carcinogenic. It is easy to see from current safety data sheets that this is no longer the case.

Water-miscible metalworking fluids are sold in concentrated form. This comprises 30-90% esters or highly refined mineral oil or synthetic base fluids (e.g. glycol derivatives) and various additives. To a large extent the use of components, that are designated hazardous is impeded or prevented to a large extent by industry agreements and subordinate legislation in the form of rules and standards.

Note: see also TRGS-611, BGR 143, VDI Richtlinie 3397 or the VSI-VKIS-IGM list of substances for constituents in metalworking fluids.

Nevertheless, some additive concentrates are classified as being hazardous because of the high additive concentration. The reason is often a high amine content, which leads to the designation 'corrosive' or 'irritant'. Many concentrates, however, do not require any special labelling. Although these partly contain hazardous substances, which could lead to them being designated, for example, as 'acute toxicity category 4' and 'irritating to eyes', the hazardous substances are dosed in such small quantities that in most cases the concentrate as a whole is exempt from any labelling requirements. This is also often desirable because most customers prefer products that are exempt from any labelling requirements for reasons of industrial safety and storage.

Concentrates are used, for example, as a 5% mixture with water (as an emulsion or a solution), in other words diluted 1:20 prior to use with the machine tool. The concentration of hazardous constituents in the resultant emulsion/solution is much lower than in the concentrate. Thus, for example, 5-10% of a substance that is classified as being hazardous in the concentrate only contains 0.25-0.5% in the emulsion. The criteria of § 3 Para. 2 German List of Waste (G-LoW) are not met and the emulsion or solution is thus considered to be non-hazardous, even when the concentrate would be classified as hazardous.

There is then also no need to classify metal swarf resulting from the production and which is contaminated with fluid residues/waste as hazardous without prior case-by-case examination.

The concentration of a metalworking fluid can be determined quite easily with a handheld refractometer; this is the usual practice for monitoring the metalworking fluid.

Even if a metalworking fluid concentrate is classified as being 'hazardous', it is so strongly diluted in an emulsion or solution that one can no longer assume that it is dangerous. **Viewed individually, swarf and metalworking fluid can thus each be classified as being non-hazardous. The combination of both is therefore also non-hazardous.**

4.2 DIFFERING METHODS OF COLLECTION AT THE POINT OF ORIGIN

The diversity of the swarf products requires collection methods that have been adapted accordingly, especially in view of the differing moisture contents. The methods are also geared to the quantity of swarf produced in a company (see also section 4.3).



1 TILTABLE COLLECTION CONTAINER WITH DISCHARGE

It is important to undertake an initial gravity separation at the point of origin to separate the fluids in order to be able to feed the wet/oily swarf in particular to another eco-friendly treatment.

Suitable containers with suction or discharge devices are available. Depending on the nature of the swarf, the technical requirements and the respective amounts of swarf produced by a company, certain kinds of swarf can additionally be compressed, spun and/or centrifuged for reasons of efficiency. This not only reclaims the metalworking fluid used during production but also reduces the weight and volume of the swarf to be transported. The type of collection and any possible treatment carried out should be coordinated with subsequent recycling.



2 TIPPING CONTAINER



3 TIPPING CONTAINER WITH DRAIN OUTLET

4.3 LOGISTICS

The specific circumstances at the waste producer's plant require an individually tailored **logistics concept** not only with respect to the type but also the amount of swarf produced. Waste management may be required seven days a week in the case of a plant operating on a three-shift basis, whereas the containers located at another plant may only need to be emptied once a month. The economic diversity of the waste producers together with the different company sizes in the machining and metalworking industry requires an agreed approach by the business partners (waste producer and recycler) that is economic and geared to the individual needs in practice.

Tipping containers, for example, **can be used to collect the swarf** where it is produced; they are available in all sizes and equipped with an outlet valve or a hose connection to recirculate emulsions or cutting oils (Figs. 1-4). **Particular attention must be given to the leak-tightness of the containers.** The double-wall design of the container base can be helpful here.



4 COLLECTION CONTAINER WITH DOUBLE-WALLED BASE, SWARF FILTER AND DISCHARGE DEVICE FOR EMULSIONS



5 DRIP PAN

Depending on the terms of the agreement between the waste producer and the recycler, one has to ensure that depending on its nature the swarf is not exposed to rainwater during the collection process. Depending on the location and feasibility, the company should adapt suitable measures such as canopies or covers for the container (e.g. using a lid or tarpaulin on containers/dump boxes).



6 EXAMPLE OF A COVERED CONTAINER

The **leak-tightness** of the collection containers is particularly important with wet/oily swarf when the base area is not sealed in accordance with the relevant regulations. In view of the metalworking fluids adhering to the swarf, the containers have to be **leakproof** during storage and transport. There are **different** types available depending on the swarf produced.

- Single-wall containers/dump boxes with swing doors should have fixed, wedge-shaped barriers to ensure optimal tipping into the swarf store.
- Containers with a lid and/or double wall on the under side may be needed so the transportation can be carried out in an eco-friendly manner.

- Containers that are firmly anchored in the ground and conform to the requirements of VAUwS/AwSV are also in use. This depends on national legislation.

Leak-free transport can also be ensured using a suitable lining in the shipping space.

The following examples demonstrate their practical suitability daily:



7 LIDDED DUMP BOX

Fig. 8 shows a swarf transport container with a single-leaf container door. There is a rubber seal in between the door and the container. The door is screwed down in three places.

In addition, there is a side lock so that the door cannot open if the three screws on the side are undone.



8 SPECIAL SWARF-TRANSPORT CONTAINER

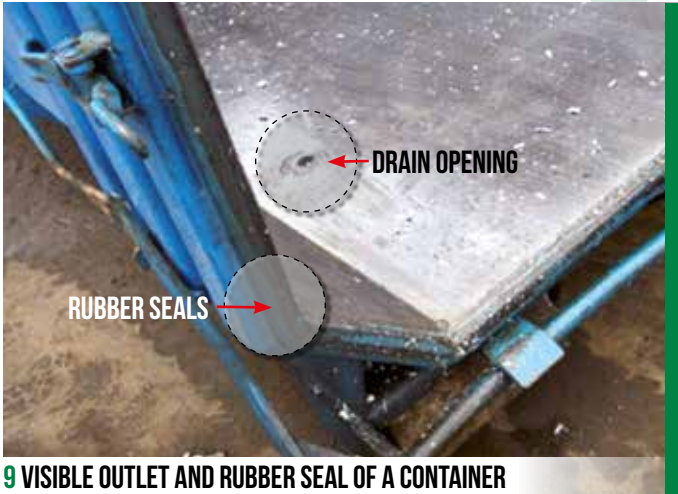
STEEL SWARF

ALLOY SWARF

BRASS SWARF

UNIDENTIFIED SWARF

HEAVY METAL SLUDGE



9 VISIBLE OUTLET AND RUBBER SEAL OF A CONTAINER

The rubber seals are wearing parts and therefore have to be replaced when necessary (see Fig. 9). Depending on the type of swarf produced, the leak-tightness of a container can also be ensured using special plastic mats or in some other way.

In addition, attention has to be given to other damage that could also lead to leaks (e.g. deformation or perforation). Such containers have to be repaired or taken out of service.

4.4 PROPER HANDLING AT THE SWARF STORE OF THE RECYCLER

After being recorded, the pretreated swarf is taken to plants with Federal Immission Control Act (BImSchG) approval that are monitored by the authorities.

Recyclers must have appropriately approved and prepared treatment areas. Stringent requirements are imposed on the proper storage and treatment of the swarf.

To avoid chemical reactions (e.g. oxidation), which can occur in particular with very fine swarf, it is absolutely necessary to separate the swarf in accordance with the LoW classifications for swarf types, e.g. brass swarf or magnesium swarf, from the time it is produced until the time it is shipped, including during storage. The different types of swarf should also be kept separate from the time they are produced until the time they are shipped, including during storage to ensure high quality recycling.



10 TIPPING CONTAINER VEHICLE WITH THROUGH-WELDED FLOOR PLATE AND CHAMFERING FOR LEAKPROOF TRANSPORTATION OF SWARF

5 LEGAL FUNDAMENTALS

5.1 CLASSIFICATION OF METAL SWARF FROM SURFACE TREATMENT OPERATIONS IN ACCORDANCE WITH WASTE LEGISLATION CURRENTLY VALID IN GERMANY AND THE EU.

In Germany the Abfallverzeichnisverordnung (Waste Catalogue Ordinance, German List of Waste = G-LoW) defines which waste has to be assigned to which type of waste shown in the waste catalogue and labelled with a six-digit waste code. The waste producer or owner is strictly responsible for the correct classification of the waste.

The G-LoW is based the EU List of Waste. This waste catalogue is harmonised under EU law and is regularly reviewed on the basis of new findings and new research results and revised if necessary. The problem of the oil content in metal swarf was taken fully into consideration during the discussions on the compilation of the G-LoW in 2000. Nevertheless, based on these discussions the LoW-legislator knowingly classified it as non-hazardous waste.

The Waste Catalogue is based on the principle of origin, i.e. waste is primarily assigned the waste code whose wording best describes the waste. Based on this system the regulatory authority has laid down that metal swarf is deemed to be non-hazardous and does not have a mirror entry provided it is assigned to the waste codes 120101 to 120103. This classification will not be altered according to the proposal of the EU Commission for a revised waste catalogue.

On the other hand, some German states (e.g. Bavaria and Baden-Württemberg) take a different view in this respect and regard a classification as non-hazardous waste to be technically unjustifiable.

Metal swarf contaminated with metalworking fluid could still continue to be classified as non-hazardous waste from a Bavarian legal point of view provided it is 'practically drip-free'.

A practically drip-free condition can be achieved, for example, by suitable storage or by centrifuging or pressing the respective swarf. According to the legal interpretation in Bavaria, any accumulations of metalworking fluid in the bottom of the collection containers that form during transport are not in themselves a reason for swarf being classified as practically drip-free.

Note: The disposal of used metalworking fluid or fluids that have been used to treat swarf contaminated with metalworking fluid is not part of these guidelines. For the sake of completeness it should be pointed out that the applicable statutory regulations (e.g. WFD or VAUwS/AwSV) should be observed. Furthermore, attention is drawn to VDI Richtlinie 3397 that deals with the disposal of metalworking fluid that has been collected.

According to § 3 Para. 2(1) G-LoW it is assumed that waste that exhibits one or more of the properties listed there and exceeds certain threshold values is classified as hazardous. The responsible authority may classify 'non-hazardous' waste as 'hazardous' waste on a case-by-case basis if the waste satisfies one or more hazard criteria. The burden of proof in such cases lies strictly with the authority (§ 3 Para. 3 G-LoW).

In contrast to metal sludge therefore metal swarf generally should not be classified as hazardous waste. This would be contrary to the waste classification system and violate existing legislation.

5.2 DIFFERENT CONCEPTS OF HAZARDOUS IN THE LEGAL REQUIREMENTS

Legislation on waste and dangerous goods are fields of law in which the focus of the regulations differs. In waste legislation, healthy and eco-friendly recycling and disposal of waste is of primary importance. In dangerous goods legislation, the focus is on safe transport and the handling of hazardous substances associated with the shipment. Provided the waste has a waste code in accordance with the LoW, waste legislation and not the legislation on substances, applies exclusively. With regards to transport, traffic law additionally has the objective of ensuring that traffic moves smoothly and safely and attempts to prevent any negative effects on traffic due to the transport.

5.3 LEGAL/TECHNICAL INFORMATION ON PROPER HANDLING OF METAL SWARF BY THE PRODUCER, THE HAULIER AND THE RECYCLING COMPANY

5.3.1 Responsibility of the swarf producer

On the basis of its specialist technical knowledge the swarf producer has to assign the appropriate waste code to the swarf produced. After being recorded (see Sections 4.2 to 4.4), wet/oily swarf has to be transported to the recycling company for further treatment in a leakproof manner, e.g. using appropriate containers or linings in the vehicles.

If the necessary transport is carried out directly by a haulier or freight forwarder or a trading or recycling company, the swarf producer has to vouch for the swarf being packaged in a leakproof manner before

handing it over to the subsequent business partner.

The producer has to choose a haulier conscientiously and carefully. One criterion, for example, is that the metal swarf being stored and treated at the recycling company in an eco-friendly manner. This is not necessary when handing over to a certified waste management company that has the respective waste code listed in its permit. One can assume, that handling by such companies will be professional and done properly. If the producer transports the swarf from the point of origin to the recycling company, the point of origin has to be equipped with suitable containers as well as with vehicles and suitably trained drivers.

5.3.2 Responsibility of the recycling company

The storage and treatment of the metal swarf has to be carried out in accordance with requirements that, as a general rule require approval in accordance with the Federal Immission Control Act. If the recycling company transports the swarf to its swarf yard, the same responsibilities apply here as to the point of origin (cf. 4.4).

STEEL SWARF

6 EXAMPLES OF SWARF AND METAL SLUDGE WITH THE CORRESPONDING LoW NUMBERS

ALLOY SWARF

BRASS SWARF

UM SWARF

ARF

UDGE



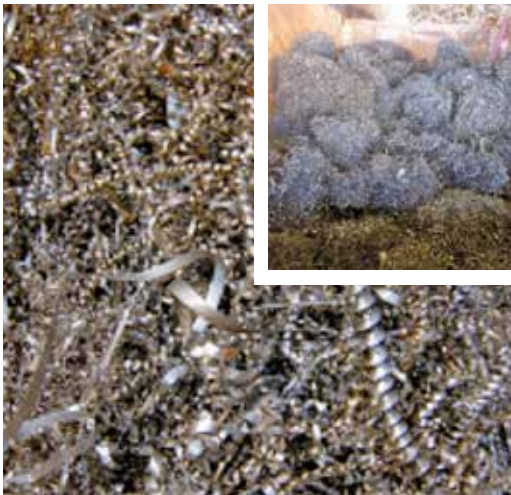
6.1 STEEL SWARF

- a) Designation: steel swarf, type E5H or E5M
- b) LoW No.: 12 01 01 'ferrous metal filings and turnings'
- c) Source: e.g. steel processing plants, especially for mechanical or plant engineering



6.3 BRASS SWARF

- a) Designation: brass swarf
- b) LoW No.: 12 01 03 'non-ferrous metal filings and turnings'
- c) Source: metal processing plants, e.g. for mechanical engineering or the manufacture of fittings



6.2 ALLOY SWARF

- a) Designation: alloy swarf, especially V2A swarf
- b) LoW No.: mostly LoW No. 12 01 01 'ferrous metal filings and turnings'; also in part LoW No. 12 01 03 'non-ferrous metal filings and turnings' depending on the alloy composition
- c) Source: e.g. (stainless) steel processing plants, especially for mechanical or plant engineering



6.4 ALUMINIUM SWARF

- a) Designation: aluminium swarf
- b) LoW No.: 12 01 03 'non-ferrous metal filings and turnings'
- c) Source: metal processing plants, e.g. for mechanical engineering or vehicle manufacture, or of automotive component suppliers

STEEL SWARF

ALLOY SWARF

BRASS SWARF

ALUMINIUM SWARF

An explicit distinction should be made in between metal swarf and metal grinding sludge.

Grinding sludge is the term used to describe process waste, that results from the machining and processing of metal by grinding, honing, lapping, vibratory grinding or electrical discharge machining. The extremely fine particles, that result from machining (turning, milling, drilling etc.) are also regarded as grinding sludge. The consistency and composition of the grinding sludge differs, accordingly to the metal being machined and the machining process and metalworking fluids used. In addition to fine and extremely fine particles of the metal machined (10-80 wt%) and particles of abrasive medium (2-75 wt%), the grinding sludge can possibly also still contain up to 50 wt% filter aids.

Together with abrasives, both water-miscible and non-water-miscible metalworking fluids are used.

For economic and ecological reasons, the fraction of the sludge that is attributable to grinding using an emulsion is over 90 per cent nationwide today.



6.5 GRINDING SLUDGE

- a) Designation: grinding sludge
- b) LoW No. 12 01 18* 'metal sludge (grinding, honing and lapping sludge) containing oil'
- c) Source: metal processing plants, e.g. for surface treatment or mechanical engineering
- d) Electronic consignment-note procedure necessary



6.6 GRINDING SLUDGE

- a) Designation: grinding sludge
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- c) Source: metal processing plants, e.g. for surface treatment or mechanical engineering
- d) An electronic consignment-note procedure is necessary

7 SUMMARY

STEEL SWARF

ALLOY SWARF

BRASS SWARF

Specific smaller swarf points of origin are often not able to ensure drip-free conditions for all of the waste produced for practical reasons (small amounts of swarf produces or small factory premises without special storage opportunities, etc.). In this case it is particularly important to ensure that suitable collection containers are available.

With these guidelines, the initiative of the associations offers advice on the eco-friendly handling of metal swarf contaminated with metalworking fluids. It describes possible solutions that cover the period from the generation of the swarf at the producer through to its proper treatment in the approved swarf store of the recycling company. In addition, it provides possible solutions for problems that can arise when dealing with metal swarf.

The editors have placed importance on making all participants more aware of the diversity of swarf and of the numerous different points of origin and the different disposal requirements associated with them.

The importance of the different metalworking fluids used in the machining process is emphasized in a section of its own. This is complemented by the ever-recurring reference to the need for the collection and transport containers to be leakproof. The classification as production waste in current waste legislation is described as well as opinions that deviate from this. Examples of the classification of the common types of swarf round off the guidelines.



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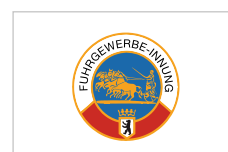
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