

WEEE: Recommendations on ReUse for the concerned parties – The guideline VDI 2343

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Abstract

Speaking in terms of figure skating, by now the electronic industry has done its short programme under the WEEE- and RoHS Directives [1], [2] with registering their electrical and electronic equipment (EEE) put on the EU markets with the national clearing houses, setting up take-back and disposal schemes for waste electrical and electronic equipment (WEEE) as well as by replacing lead in EEE. This releases energies for the freestyle part, including a broader implementation of ReUse for EEE as foreseen by the WEEE Directive. ReUse entails a particular potential for cost-saving, innovation and ecological benefits in the life-cycle of EEE and is, therefore, often called “the ultimate and most comprehensive form of recycling” [3].

Germany has implemented the WEEE- and RoHS Directives in the Act on Electrical and Electronic Equipment (**ElektroG**) [6] In order to support the parties subject to the obligations under the ElektroG in their implementation, the Verein Deutscher Ingenieure e.V. (German Association of Engineers, VDI [4]) established a specific Guideline Committee on the Recycling of WEEE. The committee elaborates and codifies practice-tailored and state of the art recommendations for the parties concerned laid down in the guideline VDI 2343. Given the importance of ReUse a specific section of the guideline is dedicated to this topic With the intention of further deploying ReUse, the guideline gives recommendations for the ReUse of WEEE and their components. It explores the technological, economical, ecological, legal and social preconditions and implications of ReUse, which, in contrast to the automotive applications, is still rarely supported in the electronic industry [5]. The ReUse section also includes definitions of basic standards and further sets out different ways of ReUse in order to support small and medium-sized enterprises in establishing ReUse activities properly.

1 Facts about the VDI and VDI guidelines

The Verein Deutscher Ingenieure e. V. (“The Association of German Engineers”) is a charitable, commercially and politically independent technical and scientific association of engineers and scientists. With more than 135,000 full members, it is one of the largest associations of engineers in Europe and the leading spokesman for technology and engineering in Germany [4]. Established in 1856, it has initiated many major developments for technology, for instance in the area of technical monitoring, technical regulations and standardisation, working studies, industrial right protection and patent matters.

The VDI has systematically built up a set of technical regulations, which today contains more than 1,700 valid VDI guidelines extensively covering the broad field of technology. In line with technical developments, the existing guidelines are updated regularly. Each year about 190 new VDI guidelines are published. This enables the VDI to fulfil its primary function: the transfer of technical knowledge as a service. VDI guidelines are trend-setting working documents for daily use. With regard to their assessment and evaluation criteria they provide well-founded bases for decision taking processes and represent benchmarks for unobjectionable technical proceeding. Therewith, VDI guidelines provide practising engineers with the security to be in line with approved technical regulations. VDI guidelines have particular legal importance at the national level, for example by their inclusion in acts, ordinances, decrees or regulations. VDI guidelines also constitute a practical supplement to European and international rules or serve as national position during the development of these regulations.

2 The term “ReUse”

“ReUse” is defined under the ElektroG as “any operation by which WEEE or components thereof are used for the purpose for which they were conceived or placed on the market” [6]. Although the secondary uses of EEE before they become waste (e.g. after repair or resale or for a purpose other than the one they were originally designed for) may be considered to be examples of ReUse, the ElektroG limits the obligations to equipment that has already become waste (WEEE).

3 ReUse: Conserving value instead of disposing of WEEE

In specific product areas ReUse promises huge economic as well as ecologic advantages, because during ReUse, also metaphorically described as “the ultimate

and most comprehensive form of recycling” [3], [7], the added value of previous production processes will be conserved. Depending on age and condition of WEEE, it may be reasonable to ReUse either the whole appliance or only single components.

To assess the possibilities for the ReUse of a product precisely, different aspects have to be taken into account and evaluated. In this evaluation a broad range of factors will influence the pros and cons of ReUse, which have to be considered on a technical, economical and ecological level. The following criteria should be examined and evaluated [3]:

- **Technical criteria** (kind and variety of parts and materials used, suitability for disassembly, cleaning, testing, reconditioning);
- **Quantitative criteria** (amount of returning products, timely and regional availability, ...);
- **Value criteria** (value added from material/production/assembly);
- **Time criteria** (planned product life time, single use cycle time, ...);
- **Innovation criteria** (technical progress regarding new products versus remanufactured products, ...);
- **Disposal criteria** (efforts and cost of alternative processes to recycle the products and possible hazardous components, ...);
- Criteria regarding compatibility of reused devices with a modify standards of newly EEE (competing or cooperation with OEMs, ...); and
- **Other criteria** (market behaviour, liabilities, patents, intellectual property rights, ...).

Whereas the ReUse of automotive components in an industrial way is state of the art, the ReUse of WEEE is less common [9]. Yet, studying industrial activities attentively, there are, in fact, some actors distributing remanufactured¹ or refurbished products in the following industrial sectors:

- Refurbishment of Medical equipment to make sure that they are safe and effective as when they were new (e.g. diagnostic systems like CTs or MRT's) [11].;
- Energy generation (e.g., exciter rotors);
- Electronic entertainment (e.g. satellite receiver's and set top boxes);

¹ This term might be defined differently in local legislations (e.g. USA....).

- Household appliances (e.g. washing machines);
- IT equipment (e.g. PC's and Server Hardware) or
- ...

The implementation of ReUse activities differ in a broad range from industrial operations at big companies to single operations at social organizations.

4 Guideline VDI 2343 – Part ReUse

To support the players regulated by the ElektroG, producing and handling (W)EEE, in the remanufacture and ReUse, a section of the guidelines comprises recommendations concerning the question “In which cases and in which way WEEE can be remanufactured?”. In this context, the guideline addresses the following aspects:

- Technical Aspects;
- Legal aspects;
- Economical aspects;
- Ecological aspects; and
- Social aspects.

5 Legal framework for ReUse

The legal framework for ReUse is mainly laid down in the ElektroG as binding Public Law, but the Civil and Criminal Law also impose certain legal obligations on the producers of EEE in relation to ReUse.

ReUse is one of the objectives of the **ElektroG** in order to implement an integrated waste management in Germany: “*The ElektroG aims primarily at preventing waste from EEE and further to promote reuse, recycling and other forms of recovery to reduce both, the volume of waste disposal and the inclusion in waste an harmful substances from WEEE*”. The ElektroG mainly provides for four kinds of obligations relating to ReUse. Compliance with these obligations can generally be enforced by the competent authorities.

(1) **The Design Obligations:** EEE must, wherever possible, be designed in a way providing for and facilitating their ReUse as such or of their components or materials. The producers are further obliged not to prevent ReUse through specific design features or certain manufacturing processes unless such features or processes are required by law or present overriding advantages [9].

(2) **Safe Take-back Obligations:** The ElektroG also obliges public waste management authorities, distributors and producers to collect and take back WEEE in a way that does not prevent their subsequent ReUse, i.e. without further damages [9].

(3) **The ReUse-check Obligations:** The waste treatment facilities must check prior to the disposal or treatment of the waste whether the WEEE or its components can be reused provided that such check is technically and financially feasible. The latter will significantly depend on the information made available to the operators of treatment facilities by the producers [9].

(4) **The Reporting Obligations:** Finally, the registered producers have to inform the German Clearing House (*Stiftung Elektro-Altgeräte-Register*) about the number of devices that have been reused in order to enable the Clearing House to monitor the waste stream and attainment of the recycling quota [9].

Under **Civil Law** a liability of the producer, that cannot be excluded contractually, may arise from injuries and damages to persons or goods caused by defective products under the Act on Product Liability. In this context the question arises, whether the party refurbishing (e.g. upgrading) the device incurs liability for such a damage and when or whether the original producer remains liable. **Criminal Product Liability** may apply to the producers of EEE and the parties refurbishing WEEE with regard to defective products causing bodily injuries by negligence [9].

The Legal Section of the VDI guideline on ReUse aims to summarise the most important legal terms, obligations and liabilities of the producers, parties taking back, refurbishing or treating WEEE and to describe possibilities to facilitate the handling the legal obligations.

6 Technical processes prior ReUse

ReUse describes in a closed view the technical [oriented] processes prior to distribution and reapplication of WEEE. It serves the maintaining or reconditioning of the product function and quality. It aims carrying used products over to use the whole product or components again and to extend their useful life.

ReUse covers the necessary process steps, which are appropriate to distribute old appliances or their components again by considering different requirements like quality, reliability and safety. Usually ReUse is carried out in five basic process steps – disassembly, diagnostic, cleaning, reconditioning and/or replenishment and product assembly –. In specific cases further steps or special operations may be required, e.g. for medical appliances it is necessary to do a disinfection process.

During the ReUse process usually only the wearing parts are reconditioned or replaced whereas the high value components can be reused. Thereby it can be

ensured that remanufactured products have a comparable quality to the newly manufactured products.

Different ways of ReUse can be distinguished.

Figure 1: Different ways of preparing product ReUse.

	characteristic disassembly level	quality level	product change
Direct reuse	product	used	same as before
repairing	product	able to work	parts changed or repaired
Refurbishing	product or component	specified quality level	parts changed or repaired
Refabrication	component	like new	recombined components ¹
Upgrade	component	specified quality level	upgraded product
Cannibalization	component	depending from further use	parts partly reused

¹ upgrade is possible if applicable

7 Prospects: Are economy and ecology benefits corresponding?

ReUse of used appliances offers the highest value creation within the different ways of recycling, because always created value of existing parts will be obtained. Accordingly only defect parts or operational substrates has to be manufactured again or has to be reconditioned by additional ReUse processes.

From the ecological point of view, ReUse preserves most of the initial value of a equipment. Compared to the new production of EEE, ReUse causes considerably less new ecological impacts as only further shipment and, if so, only the new manufacturing of a few components are necessary. Compared to the new manufacturing of a product up to 90% of material and energy resources can be saved [3].

However, the question “Is economically and ecologically making sense?” cannot be answered in general [10]. Taking into account the possible energy savings in the use phase of EEE (e.g. household appliances) on one hand it can be reasonable to replace the appliances after an average period of use. From the user's economical point of view on the other hand it may be more profitable to keep an EEE for a longer period of time. Finally, the recycling companies' decision for or against the ReUse of WEEE is essentially based on an economical evaluation. In principle, ReUse seems to be preferable, because only a small number of EEE or their components have to be newly manufactured.

The guideline VDI 2343 – part “ReUse” addresses a comprehensive assistance concerning ReUse of WEEE and their components. In particular, questions of brand image, selling and distribution strategies and

market development for remanufactured products are considered.

8 Literature

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