



## ENVIRONMENTAL QUALITY OF IMPACT DRILLS

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### Abstract:

*Environmental performance of each product is defined already at the stage of its design - in its pre-production stage. Environmental quality of the product is one of the most important factors of environmental performance of a product. Environmental quality includes a range of criteria that indicate the nature of the product and its environmental impact throughout its life cycle. The comparative analysis method is one of the ways to assess the environmental quality of the product. The article gives a specific example of the assessments carried out on the impact drills (of one specific brand) with different technical parameters.*

### Key words:

*Environmental product quality, Impact drill, Comparative analysis*

### INTRODUCTION

The increasing interest in the environmental protection and the deteriorating state of the environment gave rise to eco-friendly designs. In the eighties of the twentieth century the environmental protection was carried out in several ways. Their analysis, however, showed that the most economical and most effective way to protect the environment is prevention, namely finding and removing the causes of environmental damage [1]

The approach of designing products with special consideration for the environmental impacts, also known "ecodesign", is vastly different from all other approaches that tried to solve environmental issues, particularly in the industry. Ecodesign focuses on the elimination of causes, not consequences, and it tries to incorporate its principles to the initial stages of the development and design of the product. [6] Ecodesign, which is one of the tools of environmental management, looks at the whole situation from the other side – from the point of view of causes. Its aim is to remove the adverse effects products have on the environment already at the stage of their product design. This approach should be implemented in the following stages as well - production, distribution, use and disposal. That is why ecodesign should become an integral part of the design phase regardless of whether we are talking about enterprises developing new products or those innovating already existing products.

The main objective of the article is to carry out the comparative analysis in order to determine the environmental quality of the selected types of impact drills. Based on the selected requirements, whether of specific or zero levels, the article aims to carry out an environmental assessment of the selected devices. On the basis of partial outcomes the article aims to choose the product with the highest environmental quality level.

## 1 PRODUCT CHARACTERISTICS

For the purpose of the comparative analysis we used BOSCH impact drills with different technical parameters. Their specific technical parameters are shown in Fig. 1, 2, 3 and 4.

<b>Rated wattage</b>	<b>600 W</b>
<b>Idle speed</b>	0-2800 min <sup>-1</sup>
<b>Performance</b>	301W
<b>Weight</b>	1,8 kg
<b>Torque</b>	10,8 Nm
<b>Nominal torque</b>	1,8 Nm
<b>Clamping range</b>	1,5 – 13 mm
<b>Length</b>	266,0 mm
<b>Height</b>	180,0 mm

*Fig. 1 Technical parameters of BOSCH GSB 13 RE Professional [2]*

<b>Rated wattage</b>	<b>750 W</b>
<b>Idle speed</b>	0-2800 min <sup>-1</sup>
<b>Performance</b>	380 W
<b>Weight</b>	2,2 kg
<b>Torque</b>	18,0 Nm
<b>Nominal torque</b>	2,3 Nm
<b>Clamping range</b>	1,5 – 13 mm
<b>Length</b>	285,0 mm
<b>Height</b>	214,0 mm

*Fig. 2 Technical parameters of BOSCH GSB 16 RE Professional [3]*

<b>Rated wattage</b>	<b>701 W</b>
<b>Idle speed</b>	0-3000 min <sup>-1</sup>
<b>Performance</b>	351 W
<b>Weight</b>	1,9 kg
<b>Torque</b>	-
<b>Nominal torque</b>	-
<b>Clamping range</b>	2 - 13 mm
<b>Length</b>	270,0 mm
<b>Height</b>	210,0 mm

*Fig. 3 Technical parameters of BOSCH GSB 1600 RE Professional [4]*

<b>Rated wattage</b>	<b>750 W</b>
<b>Idle speed</b>	50-3000 min <sup>-1</sup>
<b>Performance</b>	400 W
<b>Weight</b>	1,8 kg
<b>Torque</b>	10,0 Nm
<b>Nominal torque</b>	-
<b>Clamping range</b>	2 - 13 mm
<b>Length</b>	268,0 mm
<b>Height</b>	208,0 mm

*Fig. 4 Technical parameters of BOSCH PSB 750 RCE [5]*

## 2 COMPARATIVE ANALYSIS

This method was first published in the eighties of the twentieth century. It was successfully applied in grant projects and was internationally accepted in various fora. Leading car manufacturers such as Ford, Nissan, Volkswagen or Fiat have successfully applied this method when assessing the environmental impact of some of their products. [6]

The principle of this method lies in the fact that the assessed object is assigned the evaluation number  $ZCi$ , where  $i$  is equal to 1,2, ...,  $n$ , where  $n$  is the total number of assessed objects. [6]

The evaluation number is a dimensionless number of the complex nature.

The properties of the objects are given by their parameters. If we change a parameter, the properties of the object will change as well, ranging from acceptable to unacceptable limits. What is acceptable and what is not is set by the authority and it depends on the given requirements.

### 2.1 Assessment methodology

The aim of the article was to determine the environmental impact of the selected impact drills.

Before carrying out the comparative analysis itself it was necessary to identify major requirements with regard to their environmental impact. These requirements are based on standards laid down for given environmental characteristics.

After determining the most favorable  $P_j$  values for each requirement we began with calculations based on the relationships outlined for the comparative analysis.

Testing four types of impact drills (made by the same manufacturer but with different technical parameters, class and price) we compared their environmental impact using the comparative analysis.

Impact drills and their technical parameters are shown in Figure 1,2,3 and 4.

Baseline data for calculations are given in Tab. 1.

For some values from Table 1 we provide brief descriptions.

Line no. 1 states the weight of the product. The lower the weight, the higher the possibility of finding plastic parts inside the product, and thus the better chance for their recycling. Line no. 2 states power consumption. The lower the power consumption the lower the energy demand on electricity supply. Lines no. 3 and 4 show dimensions of products. The smaller the product, the lower the amount of material used for its manufacture. Lines no. 5 and 6 show vibration emission values. The vibration emission level given in these instructions has been measured according to measurement procedures specified in EN 60745. Moreover, it can be used to compare different types of power tools against each other as well as predict the vibration emission level.

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Tab.1 Baseline data for the assessment of the environmental impact of selected types of impact drills

No.	Name of the request	Request value	Factor of significance	Rated objects			
				1 GSB13 RE Professional	2 GSB16 RE Professional	3 GSB1600 RE Professional	4 PSB 750 RCE
Value properties							
Requirements with zero level							
1	weight	1,8	0,5	1,8	2,2	1,9	1,8
2	rated wattage	600	0,75	600	750	701	750
3	length	266	1	266	285	295	283
4	height	188	1	188	214	195	201
5	vibration from screwdriving	2,5	0,75	2,5	2,5	2,5	2,5
6	vibration from drilling	15	0,75	26	15	23	35
7	noise	93	0,75	93	96	98	100
Requirements with a certain level							
8	color	3	0,25	3	3	2	2
9	performance	380	0,5	301	380	351	380
10	material	3	0,75	3	2	2	2

## 2.2 Interpretation of results

Thanks to our calculations we achieved the following results:

- Bosch GSB 13 RE Professional reached the value of 16.9
- Bosch GSB 16 RE Professional reached the value of – 26.3
- Bosch 1600 RE Professional reached the value of – 38.3
- Bosch PSB 750 RCE reached the value of – 47.9

The environmental impact of the assessed product is more favorable when the evaluation number is higher. Therefore, the higher the evaluation number, the lower the environmental impact of the product.

In this case, **Bosch GSB 13 RE Professional**, showed the lowest environmental impact – 16.9.



Fig. 5 Figures achieved using the comparative analysis (The results of the comparative analysis)

All studies cases showed negative numbers. This means that environmental impact of all evaluated drills differ from values that are deemed ideal. The nature of this method implies that the higher the value (positive), the better the environmental impact of the object. As for the presented evaluation, the closer the number is to zero, the more favorable environmental impact the drill has.

## CONCLUSION

The main aim of article was to determine the environmental impact of impact drills. The analysis was carried out using the method of comparative analysis. The comparative analysis suited our purpose the best because it works with specific data that is available from the manuals or on the Internet websites of manufacturers. Such data is necessary for the calculation of dimensionless evaluation numbers  $ZC_i$ , which are also the result of the evaluation method. The advantage of this method is the speed it can be implemented with when evaluating the environmental impact of the product. This method has a predefined formula, thus facilitating the process of evaluating and minimizes the possibility of mistakes. Clear results can convince readers - potential consumers to buy Bosch impact drill GSB 13 RE Professional.

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