

ISO 14955-1:2014

Machine tools - Environmental evaluation of machine tools - Part 1: Design methodology for energy-efficient machine tools

Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: [Foreword - Supplementary information](#)

The committee responsible for this document is ISO/TC 39, *Machine tools*.

ISO 14955 consists of the following parts, under the general title *Machine tools — Environmental evaluation of machine tools*:

- — *Part 1: Design methodology for energy-efficient machine tools*

The following parts are planned:

- — *Part 3: Principles for testing metal-cutting machine tools with respect to energy efficiency*
- — *Part 4: Principles for testing metal-forming machine tools with respect to energy efficiency*

Introduction

As environmental impact is a common challenge for all products and as natural resources become scarce, environmental performance criteria for machine tools have to be defined and the use of these criteria has to be specified.

Machine tools are complex products for industrial use to manufacture parts ready for use or semi-finished products. The performance of a machine tool as key data for investment is multi-dimensional regarding its economic value, its technical specification, and its operating requirements which are influenced by the specific application. Therefore, the same machine tool can show quite different energy supplied to the machine depending on the part which is being manufactured and the conditions under which the machine is operated. Therefore, the environmental evaluation of a machine tool cannot be considered in isolation from these considerations.

This part of ISO 14955 tries to overcome this deficiency by breaking down the machine tool to machine components which come closer to a functional unit for environmental evaluation. The machine components are objects of specific improvements keeping the application of the system in mind. These improvements are

subject for quantification together with the overall system design to achieve a product with an improved environmental performance. The provisions and procedures specified in this part of ISO 14955 are also intended to allow the calculation of environmental improvements on a multi-national level and across different manufacturers/suppliers and users.

Based on a list of positive environmental features, which can be built into a machine tool, the performance of this product is intended to be evaluated in order to quantify the environmental improvements achieved over a defined period.

ISO 14955 takes care of relevant environmental impacts during the use stage. Aside from the design and engineering of machine tools, the utilization of these products is also addressed.

Machine tools as manufacturing devices might have a significant influence on the environmental performance of the products being manufactured together with their final use stage. This aspect has to be treated very sensitively and might produce quite different results when an assessment is made with a broader definition of the system boundaries.

1 Scope

This part of ISO 14955 constitutes the application of eco-design standards to machine tools, mainly for metal working numerically controlled (NC) machine tools.

This part of ISO 14955 addresses the energy efficiency of machine tools during the use stage, i.e. the working life of the machine tool. Environmental relevant stages other than the use stage and relative impacts other than energy supplied to machine tools are not within the scope of this part of ISO 14955 and need a special treatment (e.g. according to [ISO/TR 14062](#)).

Elements of eco-design procedure according to [ISO/TR 14062](#) are applied to machine tools. Reporting of results to users and suppliers and monitoring of results are defined.

Evaluation of energy efficiency implies quantification of the resources used, i.e. energy supplied, and of the result achieved. This part of ISO 14955 provides guidance for a reproducible quantification of the energy supplied. It does not suggest a methodology for quantifying the result achieved due to the lack of universal criteria. The result achieved in industrial application being machined workpieces, their properties (e.g. material, shape, accuracy, surface quality), the constraints of production (e.g. minimum lot size, flexibility), and other appropriate parameters for the quantification of the result achieved are intended to be determined specifically for each application or for a set of applications.

This part of ISO 14955 defines methods for setting up a process for integrating energy-efficiency aspects into machine tool design. It does not support the comparison of machine tools. Also, this part of ISO 14955 does not deal with the effect of different user behaviours or different manufacturing strategies during the use phase.

Lists of environmentally relevant improvements and machine components, control of machine components, and combinations of machine components are given in two informative annexes, one for metal-cutting machine tools ([Annex A](#)) and one for metal-forming machine tools ([Annex B](#)). [Annex C](#) provides an example of application of the methodology. Other machine tools, e.g. laser-cutting machine tools, material additive machine tools, and woodworking machine tools are currently not covered by informative annexes.

NOTE Certain machining processes and specific machine tools can allow significant changes in the environmental impact of machined workpieces, e.g. material reduction for aluminium cans by application of special press technology, higher performance of compressors by machining on precision form grinders.^{[3][5]} The environmental impact of such processes or machine tools might be less important compared to the environmental impact of the machined workpieces and their application. These changes in the environmental impact of machined workpieces are not subject of this part of ISO 14955 but might be important if different machining processes or different machine tools have to be compared related to environmental impact of products. For instance, the accuracy of a machined workpiece might be a significant parameter for the environmental impact of the workpiece in its use stage, and any attempt to compare machine tools is intended to take this into account necessarily.

2 Normative references

- The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.
- [ISO 14021:1999](#), *Environmental labels and declarations — Self-declared environmental claims (Type II environmental labelling)*
- [ISO 14031](#), *Environmental management — Environmental performance evaluation — Guidelines*
- [ISO/TR 14062:2002](#), *Environmental management — Integrating environmental aspects into product design and development*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in [ISO/TR 14062](#) and the following apply.

3.1

design and development

set of processes that transforms requirements into specified characteristics or into the specification of a product, process, or system

Note 1 to entry: The terms “design” and “development” are sometimes used synonymously and sometimes used to define different stages of the overall process of turning an idea into a product.

Note 2 to entry: Product development is the process of taking a product idea from planning to market launch and review of the product, in which business strategies, marketing considerations, research methods, and design aspects are used to take a product to a point of practical use. It includes improvements or modifications to existing products or processes.

Note 3 to entry: The integration of environmental aspects into product design and development may also be termed Design for Environment (DFE), eco-design, the environmental part of product stewardship, etc.

[SOURCE: ISO 9000:2005, 3.4.4]

3.2

environment

surroundings in which an organization operates, including air, water, land, natural resources, flora, fauna, humans, and their interrelation

Note 1 to entry: Surroundings in this context extend from within an organization to the global system.

[SOURCE: ISO 14001:2004, 3.5]

3.3

environmental aspect

element of an organization's activities, products, or services that can interact with the environment

Note 1 to entry: A significant environmental aspect is an environmental aspect that has or can have significant environmental impact.

[SOURCE: ISO 14001:2004, 3.6]

3.4

environmental impact

any change to the environment, whether adverse or beneficial, wholly or partially resulting from an organization's environmental aspects

[SOURCE: ISO 14001:2004, 3.7]

3.5

life cycle

consecutive and interlinked stages of a product system, from raw material acquisition or generation from natural resources to the final disposal

Note 1 to entry: The stages of a product's life cycle are raw material acquisition, manufacture, distribution, use, and disposal (Introduction of ISO/TR 14062 based on 5.2.3 of ISO 14040:2006).

[SOURCE: ISO 14040:2006, 3.1]

3.6

mode of operation

type of operating and controlling a machine tool, whereby different modes of operation are defined by safety standards for machine tools

Note 1 to entry: Examples for modes of operation are manual mode, automatic mode, and setting mode.

Note 2 to entry: Different machine activities require certain modes of operation as laid down in safety standards for machine tools.

3.7

operating state

defined combination of ON, HOLD, OFF, etc., states of mains, peripheral units, machine control, machine processing unit, and machine motion unit including machine activities when operating state is other than OFF

Note 1 to entry: Peripheral units are for example units for machine cooling, process cooling, workpiece and tool handling, recyclables, and waste handling.

Note 2 to entry: Machine processing units are for example main spindle of a turning machine, tool spindle of a machining centre, generator for electro-discharge machine, slide of a press, and draw cushions of a press.

Note 3 to entry: Machine motion units are for example linear axes of a turning machine, linear and rotary axes of a machining centre, and linear axes of a wire electro-discharge machine.

Note 4 to entry: For measurement and testing energy efficiency of machine tools, operating states such as OFF, STANDBY, EXTENDED STANDBY, WARM UP, READY FOR OPERATION, PROCESSING, and CYCLING, have to be defined. An example for such a definition for a metal-cutting machine tool is given in [Table D.1](#).

Note 5 to entry: Examples for machine activities are tool loading, workpiece loading, axes movements, waiting, machining or cycling, or complete test cycles.

Note 6 to entry: Depending on the operating state and the machine activities, a mode of operation is selected as defined by relevant safety standards of machine tools.

3.8

environmental claim

statement, symbol or graphic that indicates an environmental aspect of a product, a component or packaging

Note 1 to entry: An environmental claim may be made on product or packaging labels through product literature, technical bulletins, advertising, publicity, telemarketing, as well as through digital or electronic media such as the Internet.

[SOURCE: ISO 14021:1999, 3.1.3]

3.9

environmental claim verification

confirmation of the validity of an environmental claim using specific predetermined criteria and procedures with assurance of data reliability

[SOURCE: ISO 14021:1999, 3.1.4]

3.10

explanatory statement

any explanation which is needed or given so that an environmental claim can be properly understood by a purchaser, potential purchaser, or user of the product

[SOURCE: ISO 14021:1999, 3.1.6]

3.11

functional unit

quantified performance of a product system for use as a reference unit in a life cycle assessment study

[SOURCE: ISO 14021:1999, 3.1.7]

3.12

machine tool function

machine operation (machining process, motion and control), process conditioning and cooling, workpiece handling, tool handling or die change, recyclables and waste handling, machine cooling/heating

Note 1 to entry: Any machine tool function may be realized by one machine component or by a combination of machine components. Some machine components may realize more than one machine tool function.

Note 2 to entry: [Figure 7](#) shows an example relation between machine components and machine tool functions.

Note 3 to entry: Machine tool functions may be used for identifying machine components ([3.13](#)) relevant for energy supplied to the machine tool.

3.13

machine component

mechanical, electrical, hydraulic, or pneumatic device of a machine tool, or a combination thereof

3.14

qualified environmental claim

environmental claim which is accompanied by an explanatory statement that describes the limits of the claim

[SOURCE: ISO 14021:1999, 3.1.12]

3.15

self-declared environmental claim

environmental claim that is made, without independent third-party certification, by manufacturers, importers, distributors, retailers, or anyone else likely to benefit from such a claim

[SOURCE: ISO 14021:1999, 3.1.13]

3.16

machine tool

mechanical device which is fixed (i.e. not mobile) and powered (typically by electricity and compressed air), typically used to fabricate metal components by the selective removal or mechanical deformation
 Note 1 to entry: Machine tools operation can be mechanical, controlled by humans or by computers.
 Machine tools have also a number of peripherals used for feeding, safety, waste and chip removal, lubrication, and other tasks connected to their main activities.

3.17

energy efficiency

relationship between the result achieved and the resources used, where resources are limited to energy input

Note 1 to entry: Efficiency is defined as the relationship between the result achieved and the resources used (ISO 9000:2005, 3.2.15).

Note 2 to entry: Statements of energy efficiency can be given e.g. in cycle per total energy supplied, in workpiece per energy supplied. If machining of test pieces is involved, specification of workpiece machining and quality of workpiece are part of the definition of the result.

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