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Machine tools — Environmental evaluation of machine tools —

Part 4: Principles for measuring metal-forming machine tools and laser processing machine tools with respect to energy efficiency

Machines-outils — Évaluation environnementale des machines-outils —

Partie 4: Principes de mesurage de l'efficacité énergétique des machines-outils de formage des métaux et des machines-outils à laser

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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).

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This document was prepared by Technical Committee ISO/TC 39, *Machine tools*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

A list of all parts in the ISO 14955 series can be found on the ISO website.

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Introduction

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

Machine tools are complex products for used by industry to manufacture workpieces ready for use or semi-finished products. Their environmental impact includes waste raw material, use of auxiliary substances such as lubricants and other material flows as well as the conversion of electrical energy into heat, the dissipation of heat to the atmosphere or heat exchange by fluids and eventually the use of other resources such as compressed air.

Based on relevance considerations, the ISO 14955 series is focussed on environmental impacts during the use phase.

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. The energy supplied to the same machine tool can vary depending on the workpiece manufactured and the conditions under which the machine tool is operated. Therefore, the environmental evaluation of a machine tool cannot be performed without considering of these aspects.

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Machine tools — Environmental evaluation of machine tools —

Part 4:
Principles for measuring metal-forming machine tools and laser processing machine tools with respect to energy efficiency

1 Scope

This document specifies technical requirements and measures for testing procedures for evaluation of energy required to be adopted by persons undertaking the design, manufacture and supply of metal forming and laser processing machine tools in order to achieve reproducible data about the energy supplied under specified conditions. Furthermore, it provides methods for quantifying the energy supplied to components in order to assign their share to generalized machine tool functions as described in ISO 14955-1.

Along with ISO 14955-1 and ISO 14955-2, it covers all significant energy requirements relevant to hydraulic (servo) and mechanical (servo) presses, turret punch presses and press brakes, pipe benders, laser processing machine tools, when they are used as intended and under the conditions foreseen by the manufacturer. Examples of how to perform energy evaluation on metal-forming machine tools are given in the annexes.

This document is applicable to machine tools which transmit force mechanically or transmit energy by laser light to cut, form, or work metal or other materials by means of dies attached to or operated by slides, punches or beams as well as to lasers ranging in size from small high speed machine tools producing small work-pieces to large relatively slow speed machine tools and large work-pieces. This document covers machine tools whose primary intended use is to work metal, but which can be used in the same way to work other materials (e.g. cardboard, plastic, rubber, leather, etc.).

It also applies to auxiliary devices supplied as an integral part of the machine tool and to machine tools which are part of an integrated manufacturing system where the energy required is comparable to those of machine tools working separately.

This document does not give test procedures for the energy requirements of tools or dies attached to the machine tools.

It is not applicable to machine tools whose principal designed purpose is:

— metal-cutting by milling, drilling or turning;

— metal-cutting by oxygen or water cutting;

— attaching a fastener, e.g. riveting, stapling or stitching;

— bending or folding by folding machine tools;

— straightening;

— extruding;

— drop forging or drop stamping;

— compaction of metal powder;

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— single purpose punching machine tools designed exclusively for profiles, e.g. used in the construction industry;

— working by pneumatic hammer;

— working by pneumatic presses.

NOTE Mechanical servo presses are also known as servo electric presses.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 14955-1, *Machine tools — Environmental evaluation of machine tools — Part 1: Design methodology for energy-efficient machine tools*

ISO 14955-2:2018, *Machine tools — Environmental evaluation of machine tools — Part 2: Methods for measuring energy supplied to machine tools and machine tool components*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 14955-1 and ISO 14955-2 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1
press
machine tool designed or intended to transmit energy to a tool/punch for the purpose of the working (e.g. forming or shaping) of metal or other material worked in the same way between the tools

3.2
hydraulic press
hydraulic servo press
press (3.1) designed or intended to transmit energy by linear movement between closing tools by hydraulic means

[SOURCE: ISO 16092-1:2017, 3.1.4, modified — The Note 1 to entry has been deleted.]

3.3
mechanical press
press (3.1) designed or intended to transmit energy from a prime mover to a tool/punch by mechanical means using a clutch mechanism which transmits torque to impart motion of the flywheel to the slide

[SOURCE: ISO 16092-1:2017, 3.1.2, modified — The Note 1 to entry has been deleted.]

3.4
mechanical servo press
press (3.1) designed or intended to transmit energy to a tool/punch by mechanical means using a servo drive mechanism without clutch mechanism to generate torque to impart motion to the slide

[SOURCE: ISO 16092-1:2017, 3.1.3, modified — The Note 1 to entry has been deleted.]

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3.5
double action press
press (3.1) containing a die cushion for deep drawing purposes

3.6
press brake
machine tool designed or intended to transmit energy to the moving part of the tools by hydraulic means and/or mechanical means with or without using a servo drive mechanism, principally for the purpose of bending between narrow forming tools along straight lines

3.7
pipe bender
machine tool designed or intended to transmit energy to constrain or strain to tension by bending pipes

3.8
turret punch press
type of *press* (3.1) used to cut holes in material, which can be small and manually operated holding one simple die set, or very large and NC controlled with a single or multi-station turret holding a much larger and complex die set

3.9
laser processing machine tool
machine tool in which (an) embedded laser(s) provide(s) sufficient energy/power to melt, evaporate, or cause a phase transition in at least a part of the workpiece, and which has the functional and safety completeness to be ready-to-use

[SOURCE: ISO 11553-1:2005, 3.2 modified — "machine" is substituted by "machine tool"]

3.10
slide/ram
main reciprocating *press* (3.1) member which holds the tool/punch

[SOURCE: ISO 16092-1:2017, 3.2.12]

3.11
beam
main reciprocating press brake member which normally holds the punch on a down-stroking press brake, and which normally holds the die on an up-stroking press brake

[SOURCE: EN 12622:2009, 3.1.1]

3.12
die cushion
accessory for a die which accumulates and releases, or absorbs, force as required in some *press* (3.1) operations

[SOURCE: ISO 16092-1:2017, 3.2.6]

3.13
tool/die
device for imparting a desired shape, form, or finish to a material

EXAMPLE Hardened steel forms for producing the patterns on coins and medals by pressure, and the hollow moulds into which metal or plastic is forced.

3.14
moving bolster
movable plate carrying the *tools or dies* (3.13) and moving during tool change

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3.15
automation system
system for loading and/or unloading of workpieces by highly automatic means, reducing human process intervention to a minimum

3.16
spacer
device to hold a space open [e.g. between slide and moving bolster or between slide and *die cushion* (3.12)] on hydraulic or mechanical presses

3.17
regenerative circuit
shaft side of a double action cylinder connected to the head side, so that fluid exiting the shaft side is added to the fluid entering the head side

3.18
total power
power applied to a machine tool component at the feeding point of the machine tool component

3.19
power loss
loss of power applied to a machine tool component, mostly transferred to heat (e.g. due to friction or throttle losses)

3.20
inverter system
system generating variable frequency to energize electric motors for variable speed, consisting of line reactor and/or line filter and the inverter itself

3.21
dead centre
point at which the tool/punch, during its travel, is:

— either nearest/closest to the die (generally, it corresponds to the end of the closing stroke), known as bottom dead centre (BDC);

— or furthest from the die (generally, it corresponds to the end of the opening stroke), known as top dead centre (TDC)

[SOURCE: ISO 16092-1:2017, 3.2.4]

4 Operating states for measurement procedure

4.1 Operating state OFF

The main switch shall be turned off during measurement.

4.2 Operating state MAIN SWITCH ON

Main switch and control voltage are turned on. The power measured is mainly the power applied to the control system and includes the power applied in operating state OFF.

The power needed for air conditioning of the control cabinets depends on ambient conditions during measurement.

4.3 Operating state AUXILIARY DRIVES ON

The auxiliary drives shall be turned on and the average power shall be measured over a time of at least 15 min. If auxiliary drives are used to charge accumulators for control pressure and an on/off-charging

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