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Pneumatic fluid power — Application notes for the improvement of the energy efficiency of pneumatic systems

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Contents

Page

Foreword .... **iv**
Introduction .... **v**
1 Scope **1**
2 Normative references **1**
3 Terms and definitions **1**
4 General **1**
Bibliography **3**

Foreword

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This document was prepared by Technical Committee ISO/TC 131, *Fluid power systems*, Subcommittee SC 9, *Installations and systems*.

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.

Introduction

The energy consumption of a stationary machine is not only defined by the type of machine (e.g. turning machine, injection moulding machine) but significantly by the requirements of the machine manufacturer and the mode of use of the machine. Only if the machine is optimally adapted to need (e.g. working cycle, precision, grade of automatisation), can the energy concept developed for it work.

It follows that the pneumatic part in a drive system of a machine and the energy portion needed for its operation depend on the tasks and requirements the pneumatics has to fulfil in the machine.

Typical applications for pneumatics in stationary machines are:

— Movements (linear, rotary);

— Clamping, pressing, moving, separating, positioning and orienting of workpieces;

— Packing, filling, dosing, locking, opening.

Pneumatic fluid power — Application notes for the improvement of the energy efficiency of pneumatic systems

1 Scope

This document gives advice on how to conceive pneumatic systems, which under consideration of functionality and economic efficiency, can be operated with increased energy efficiency. It does not focus on compressed air generation and distribution.

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 5598, *Fluid power systems and components — Vocabulary*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 5598 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/

4 General

The more precise the specifications on forces, cycle times, precision, life time etc. are, the more economically (also from an energetic point of view) machines can be designed, and drive concepts using, e.g. pneumatics, hydraulics, electrics or combinations of these technologies, can be developed.

Thus, when setting up an energy concept, the respective tasks as well as the interaction of the drive components in particular should be considered. It is also necessary to take the requested mode of operation into account.

Examples of measures are listed below, through which a pneumatic system can be optimally adapted to the demand. In this context it should be considered that some of the listed measures exclude each other and that they should be selected according to their requested functionality.

When determining measures, the general rules and safety requirements for pneumatic systems according to ISO 4414 should be considered.

The more precisely the requirements, with regard to function and economic efficiency, are specified, the more efficiently the pneumatics can be designed.

NOTE It is not possible to give a general statement on the energy saving potential, as no reference value exists.

— Creating awareness of energy efficiency among employees and users:

  — continuous training of employees and strengthening of internal communications activities on energy efficiency (training, flyers);

— Design of the compressed air system:

  — Selection, dimensioning and coordinated interaction of compressors (including consideration of, e.g. central heat recuperation or rotation speed control of compressors);

  — Avoiding suboptimal dimensioning, e.g. by using too many filters;

  — Use of efficient drying technologies (e.g. less loss of cleaning air);

  — Reducing pressure losses via optimal dimensioning and selection of filters or adjustment of the pressure regulator, respectively;

  — Determination of maintenance intervals for regular pressure difference monitoring at the filter element;

  — Selection of the optimum pressure level in the network; if necessary several pressure zones or pressure amplifiers can be used in order to locally satisfy higher pressure requirements. In doing so, it should be considered that the requested performance characteristics of the functions as well as the process safety are ensured.

  — An optimally designed network infrastructure as piping systems (e.g. piping arrangement and diameter, minimum pipe length, few cross-sectional modifications, use of smooth hoses and tubes) as well as the use of connectors with a low flow resistance;

  — Considering the incorporation of sensor systems for leakage level monitoring of the system in operation (e.g. condition monitoring via flow rate sensors);

  — Determination of maintenance intervals to regularly monitor the leakage level (e.g. regular spotting of leakages, control of pressure loss before system start up);

  — Use of assessment matrices and simulation software for an application specific optimisation of the pneumatic system;

  — Enabling shutdown of the complete system, of the single aggregates or of the components (ON/OFF respectively stand-by mode), with consideration of safety criteria and machine requirements (e.g. by using brake holding devices, ball valves, unlockable non-return valves);

  — Avoiding of oversized drives (e.g. select safety factors and brake systems according to requirements, insertion of an external guide to increase mechanical stability, reduction of moved masses, consideration of friction forces);

  — Selection of the appropriate drive type for the application (e.g. single-acting cylinder, pressure reduced back stroke);

  — Minimizing of pressure loss by sufficient dimensioning of the components in the control loop system (e.g. valves, hoses, push-in connectors);

  — Insertion of actuators which, if switched on, only need a reduced/no control energy (e.g. valves with reduction of holding current, bistable valves);

  — Putting in place energy saving controls for vacuum generators (e.g. compact ejectors with energy saving function, air saving circuits);

  — Vacuum generation as close as possible to the point of use;

  — Minimizing the hose volume in vacuum technology.

Bibliography

[1] ISO 4414, *Pneumatic fluid power — General rules and safety requirements for systems and their components*

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

