| Improvement actions: Fluid system<br>according to ISO/DIS 14955-1 | | | | |
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| **No.** | **Requirements on** | **Description** | **Relevant for machine type** | **Estimated Energy savings** |
| 1 | Selection of optimal drive subsystem (motor-pump system) | - Different function sequences create the need for pump system which match the requirements profile;- Power on demand depending on the load cycle;- Select the correct size and type of motor and pump to avoid over-dimensioning and operate the pump in the optimal efficiency range;- Temporary storage of hydraulic energy (e.g. accumulator charging operation) to achieve the best possible match between the pump drive and the load cycle and to compensate for demand peaks (potential downsizing);- Speed controlled pumps allow pressure control with variable speed instead of control valves;- Use switching valves with optimized technology;-(e.g. alternative control via Pulse Width Modulation or use of low power solenoids when applicable). | Metal cutting | 3,7 – 4,5% |
| 2 | Selection of the optimal drive subsystem (motor-pump system) | Different functions sequences create the need for pump systems which match the requirements profile (pump combinations, e.g. high pressure/low pressure, variable or fixed-displacement pumps).<br>Power on demand depending on the load cycle (constant speed in intermittent operation, variable speed (pole change, speed control/regulation with servo motors or asynchronous motors)<br>Select the correct size pump to avoid over-dimensioning, and operate the pump in the optimal efficiency range.<br>Temporary storage of hydraulic energy to achieve the best possible match between the pump drive (e.g. accumulator charging circuits) and the load cycle, and to compensate for demand peaks (so that drives and pumps with a lower output rating can be used). | Mechanical Press; Servo Press; Hydraulic Press | |
| 3 | Oil cooling | Use water cooling instead of air cooling. Water cooling is more efficient and water may be used in facillity for other purposes. Recovering cooling energy can be used for e.g. floor heating or warm water supply. | Mechanical Press; Servo Press; Hydraulic Press | 3,1 – 3,6% |
| 4 | ISO 4413 shall be applied | | Mechanical Press; Servo Press; Hydraulic Press | |
| 5 | Reduce hydraulic losses/leakage | - Use displacement control systems instead of throttle control systems;- Reduce internal leakage (e.g. seat valves in the accumulator charging unit or the clamping hydraulics);- Consider distributed supply strategies;- Apply leakage monitoring. | Metal cutting | 3,1 – 3,6% |

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| 6 | Match the pressure level to the load cycle and to the different actuators on the machine | Pressure adjustment using adjustable pressure relief valves or zero-pressure circulation.<br>Use actuators which are designed to operate at the same pressure level (no pressure reduction losses).<br>Pressure adjustment using pressure-controlled drive systems (e.g. variable speed drives, adjustable-pressure variable capacity pumps).<br>Use pressure intensifiers for individual actuators which require higher pressure.<br>On/Off or stand-by mode, giving due consideration to safety criteria. | Mechanical Press; Servo Press; Hydraulic Press | |
| 7 | Match the pressure level to the load cycle and to the different actuators on the machine | - Pressure adjustment using adjustable pressure relief valves or zero-pressure circulation;- Use actuators which are designed to operate at the same pressure level (less losses);- Pressure adjustment using pressure-controlled drive systems (e.g. variable speed drives, ...);- Use pressure intensifiers for individual actuators which requires higher pressure;- On/Off or stand-by mode giving due consideration to safety criteria. | Metal cutting | |
| 8 | Reduce hydraulic losses | Use displacement control systems in place of throttle control systems.<br>Reduce internal leakage, for example through the use of seat valves in the accumulator charging circuit or the clamping hydraulics.<br>Optimize the design of the hydraulic lines and reduce hydraulic resistance.<br>Consider distributed supply strategies<br>Use of pilot operated valves with low pilot oil consumption | Mechanical Press; Servo Press; Hydraulic Press | |
| 9 | Reduce power consumption on solenoid operated valves | Reduce power consumption for valve actuation; Reduce power consumption by using valves with 8 W solenoids when applicable.The possible use of low Watt solenoids is depending on the function, because of reduced switching forces.Reduce power consumption by using valve connectors with built-in automatic reduction of holding current Use pulse valves (with detent) which only draw power during switching.<br>Use pulse valves (with detent) which only draw power during switching (Hydraulik press)<br>Reduce power consumption by using valve connectors with built-in automatic reduction of holding current (Hydraulik press)<br>Reduce power consumption for valve actuation; | Mechanical Press; Servo Press; Hydraulic Press | |

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| 10 | Dimensioning of tubes and pipes | - Optimize the design of piping (length, diameter, … ) and reduce flow resistance;Tubes and pipes cause friction losses and thus energy losses. Finally the tube or pipe causes a pressure drop which effects negatively to the energy balance of the machine tool. Length, inner diameter, flowrate and installation radius of tubes, pipes and fittings shall be optimised to the application;Functions shall be identified and described where this requirement is applicable. | Metal cutting | |
| 11 | Overall system | Optimization of total hydraulic system | Metal cutting | |
| 12 | Leakage monitoring | Internal leakage (e. g. loose fittings in reservoir, worn valves or pumps) leads to energy losses. Leakage monitoring detects exceeding flow. | Mechanical Press; Servo Press; Hydraulic Press | 3,1 – 3,6% |
| 13 | Low flow resistance | Avoid losses caused by flow resistance e.g. by choosing valve dimension and spring characteristics in respect to optimized pressure drop. | Mechanical Press; Servo Press; Hydraulic Press | 3,1 – 3,6% |
| 14 | High efficient auxilliary pressure generation | Avoid pressure relief valves or pressure reducing valves for pressure adjustment, generate pressure at propriate level e.g. by speed controlled pumps, pumps with variable flow, discontinuosly operating pumps (see 3-1). | Mechanical Press; Servo Press; Hydraulic Press | 3,1 – 3,6% |
| 15 | Warm-up cycle | End warm-up cycle as soon as possible, use actual oil temperature to control warmup. If applicable change to hydraulic heating instead of electical heaters in respect to start temperature. | Mechanical Press; Servo Press; Hydraulic Press | 3,1 – 3,6% |
| 16 | Oil temperature | Operate in optimal temperature range. Select oil viscosity grade suitable for the the expected ambient temperature range. | Mechanical Press; Servo Press; Hydraulic Press | 3,1 – 3,6% |
| 17 | Discontinous operating pumps, adjustable pressure for cooling lubrication, controlled flow rate | Active mode of cooling lubricant system depends on demand | Metal cutting | 3,7 – 4,5% |

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| 18 | Minimal quantity lubrication (MQL) when advantage | Consider energy consumption of compressed air | Metal cutting | 4,6 – 5,5% |
| 19 | Thermal management of machine tool and all components (e.g. cooling devices, ...) | Optimized concept for thermal management of all machine tool components regarding:;1. Minimization of thermal power losses;2. If thermal power loss is not avoidable, it has to be dissipated by air or water cooling; for reuse of thermal energy water is given a preference compared to air; further reuse of thermal energy has to be checked/discussed with customer (e.g. via standardized interface);3. Controlled ventilation (fan) | Metal cutting | 4,6 – 5,5% |
| 20 | Lubrication flow depending on demand | Active mode of cooling and lubrication system. E. g.;- discontinuous operating pumps;- controlled flow rate;- adjustable pressure. | Mechanical Press; Servo Press; Hydraulic Press | 3,7 – 4,5% |
| 21 | Apply direct cooling of components depending on process (cooling at the source) | Temperature controlled | Metal cutting | 3,7 – 4,5% |
| 22 | Low flow rate for lubrication pump | Install not more than sufficient pump flow and distributor instead of orifices | Mechanical Press; Servo Press; Hydraulic Press | 3,1 – 3,6% |
| 23 | Demand dependend cooling | E.g. substituting line connected motors by inverter motors | Metal cutting | 3,7 – 4,5% |
| 24 | Consideration of applied sub-systems with regard to synergies | To obtain the maximum possible energy savings it is often not sufficient to only look at the individual components and modules that are used for the individual functions. In addition it must be checked if it possible to extend the use of a supply unit (e.g. hydraulic), particularly during idle periods where other machine functions could be supplied or driven by it. In addition to the increase in the total efficiency of the supply unit due to the improved utilisation, a complete drive unit can be omitted (e.g. generation of high pressure coolant) and a large part of the previous energy requirement saved (avoidance of electrical, mechanical and volumetric losses). | Metal cutting | |
| 25 | Demand depending controlled peripherals (..devices like mist extraction, chip conveyor, etc) | Active mode of oil mist exhaust system, depends on operating mode | Metal cutting | 3,7 – 4,5% |