– Notes to the functional specification –

Regulations for reducing the energy consumption of new - and replaced equipment worldwide

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The following described requirements for new and replaced equipment are representing the minimum requirements. The supplier is halted to propose extending beyond economic energy efficiency measures.

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1. Electric Drives

1.1. **Configuration:** For engines > 2 kW correct sizing has to be proved.

1.2. **Efficiency classes:** IE3 efficiency class is the standard for asynchronous motors with a nominal power from 0.75 to 375 kW. For motors <7.5 kW with a low duty cycle of <1500 h efficiency class IE2 (previously EFF1) can be used.
The use of synchronous motors (corresponds approximately to IE4) has to be preferred to asynchronous motors, if the application allows it.

1.3. **RPM Control:** Motors with an efficiency class IE2 have to be generally equipped with a RPM control over frequency converters. For motors of higher efficiency classes and part load amount > 10% the economy of an RPM control with frequency converter has to be checked. Frequency converters with reduced harmonic content have to be used, i.e. with Active Line Modules or for larger drives with 12-pulse circuits, so that the THD (Total Harmonic Distortion) in each case is <8%. The frequency converter input has to be dimensioned capacitively.

1.4. **Cooling**: For motors >50 kW the profitability of direct water cooling (cooling jacket) has to be assessed. For motors >200 kW it has to be provided.

1.5. **Brakes and stopping functions** are to be realized – to the extent possible – by means of mechanical brakes, self-locking devices or energy recovery. If feasible, the flow of current to a motor should be cut-off (by cancelling the controller clearance) rather than by specifying that the frequency converter rpm be set to 0.

1.6. **Recuperation (Energy Recovery):** Regenerative braking, as cited under point 1.5, is to be realized preferably by means of a dual converter or load sharing.

2. Controls

2.1. **Demand mode:** For automated or predictable processes, a switching off function has to be provided control-sided. This turns off components which are not needed in the chain of steps for a prolonged period. Unless otherwise agreed, the following recommended values apply in this case:

Component	**Shutdown by inactivity for**
Simple drive motors	> 5 s
Pumps	> 1 min
Lighting	> 1 min
Frequency converter	> 1 min
Exhausts	> 3 min
Heating/Cooling	> 5 min

Components not cited here are to be switched off as seen fit. The reactivation is to be taken within the chain of steps to ensure that components are running on time to exclude any impairment of the proper functioning of the machine as a whole.
During downtime for individual assemblies – due to a lack of material or an interruption – the aforementioned assemblies are likewise to be shut off as it seems wise to do so.

2.2. **Sleep-Function:** A sleep function is to be provided for the whole system. This function is to allow for a power-saving idle state and a reliable restart.

The following are to be shut off:

- motors and converters
- heating / cooling, incl. steam supply
- pumps
- measurement data logger
- lighting
- suction devices
- screens & displays
- power packs
- media (compressed air, steam, water...), with appropriate central shut-off valves provided for this purpose.
- The specific PCs for the system are to be put in the energy-saving mode and the screens shut off

The following are NOT to be shut off:

- at least one PLC for reliable restart
- any safety devices as may be needed (e.g. photoelectric barrier to prevent automatic restart, pollution monitoring devices...)
- pump components whose operation is process-relevant even in the sleep mode or those that it is unwise to shut off.

Two push-buttons, “Sleep” and “Start”, are to be used for shut-off and activation. The total system is to be configured to automatically switch into “sleep mode” if not used for a prolonged period (see 2.1.). Dependable restart of the system in 15 s or less must be ensured. For this reason, absolute displacement sensors should be given preference over incremental sensors.

2.3. **Energy Saving Mode for PC’s:**
The energy-saving function of the systems' PCs should be integrated into the sleep function as per point 2.2. The following configuration is to be implemented:

Process	**after…**
Reduce screen brightness to 10%	1 min
Turn off display	5 min
Turn off hard disk	10 min

3. Pneumatics / Vacuum:

Pneumatics-Replacement: If possible, use an electric drive instead of a pneumatic drive.

3.1. **Configuration:** The configuration of double acting pneumatic cylinders with diameters >100 mm is principally to be demonstrated. For smaller cylinders, that have a significant degree of air consumption due to their operating frequency, the following values apply:

Configuration of cylinders if …	
Diameter Ø	**Loads/min**
≤ 20mm	> 5
> 20mm	> 3
> 50mm	> 0,5
> 100mm	always

The configuration of the pneumatic cylinders is to be documented in accordance with the following criteria:

- dimensioning of cylinder and feed line cross-section
- positioning of valve as close as possible to cylinder
- in the case of end-position damping configuration, use of a smaller cylinder in combination with a supplementary damper is to be considered

Assistance:
http://www.boschrexroth.com/computation/energy/energy_computation.jsp?language=de

3.2. **Operation mode**: If the application allows it, operate pneumatic cylinders single acted.
3.3. **Compressed air motors** are not to be used.
3.4. **Blast functions** are not to be assigned for cleaning or cooling purposes, if there is no need to use especially the relaxation cooling effect of compressed air.
3.5. **Ejectors** ("venturi tubes") are not to be used to create a vacuum without air-saving and shut-off function.

4. Steam

4.1. **Configuration:** The configuration of fittings, lines and power consumers is to be documented in all cases. The following apply in this case:

- dimensioning of the lines
- minimization of line lengths and number of fittings (e.g. by means of harness control, joint shut-off of heater circuits or joint drainage after the dissipaters)
- energetic properties should be taken into account in selecting fitting types.

4.2. **Valves:** In the case of small rated widths (up to 2"), suitable ball valves are preferable for shut-off purposes.
4.3. **Insulation:** Mineral wool in the following thicknesses is preferable as insulation for steam lines to 220° C:

Tube nominal size	**Insulation thickness* [mm]**
DN 6…20	30
DN 25…40	60
DN 50…100	80
DN 125...250	100
DN 300...500	120

** The calculation was based on a thermal conductivity value at 220°C of λ=0,09 W/mK.*

Flexible tubes, valves and fittings have to be insulated too. For this purpose, up to DN80 e.g. Conti® Thermo-Protect and beyond mineral wool are used.

It is important to ensure that the insulation is not compressed when mounted. A reflective covering (e.g. aluminum, sheet metal) reduces heat losses by radiation. A contact between the lining and the hot lines has to be avoided.

Please note:
The use of other insulation materials is in compliance with the operating field: temperature, humidity, chemicals etc. The thermal conductivity of the insulating material at 220 °C is at maximum of λ = 0.1 W/mK. In large-scale applications, materials of fire protection class A1 (non-flammable) have to be used in principle. The use of other materials takes place only upon consultation with the responsible fire protection engineer.

4.4. **Steam traps:** The steam trap function should be continuously monitored inside the system.

5. Hydraulics

Hydraulics replacement: If possible, use an electric drive instead of a hydraulic drive.

5.1. **Configuration**: The configuration of the hydraulic system is fundamentally to be proven. The following criteria have to be observed:
- Dimensioning of lines and cylinders
- optimum pump type for each operating range (axial, gear, radial piston, rotary vane pump)
- optimum pumping system for each load profile (variable displacement or fixed constant pump, combination high pressure/low pressure)
- Dimensioning of the pump power and the drive motor
- Selection of the hydraulic fluid/viscosity class based on the operating conditions
- Minimization of the pressure level

5.2. **Control system:** With a variable load profile, RPM control or a cascaded structure with shut off function has to be provided.

5.3. **Reservoir:** The suitability of a hydraulic reservoir to cover peak loads or to cover short turn-offs has to be considered.

5.4. **Control**: Throttle controls have to be avoided.

6. Cooling

6.1. **Cooling of switch cabinets**: If at all possible, it is best to forgo active cooling of switch cabinets, in borderline cases, the possibility of a reduction in heat input should be considered. Where active cooling is needed, fluid cooling should be considered. If fluid cooling is not possible, air conditioning equipment with Rittal "blue e"-labeling is to be used. The temperature specification for switch cabinet cooling is not to be set at under 38 °C.

6.2. **Cooling water control**: Control of the cooling water flow rate on the temperature difference between supply and return has to be provided. For this, a control valve type 5724-8 or type 5725-8 of the company Samson can be used.

7. Other

7.1. **Lighting:** LED bulbs with a light output of > 100 lm/W and a service life L80Bx > 50,000 hours have preferably to be provided. Due lighting selection pay attention on vendor-independent quality certificates such as CE or ENEC certificate.
7.2. **Demand mode:** Other components not cited under points 1 to 6 are to be integrated, wherever possible, into the shut-offs cited under points 2.2 and 2.3.
7.3. **Components:** Energy consumption is always to be taken into consideration when selecting components not cited under points 1 to 6.

8. Documentation and recording of energy consumption

8.1. **Consumption estimation and recording:** The energy consumption of the entire system has to be predicted with the purchaser to an agreed load condition and inspected for acceptance and to be documented. In consultation with ContiTech the supplier has to ensure that the energy consumption of the system can be monitored for all major forms of energy according to the plant infrastructure.
The consumption measurement can be performed on request by ContiTech Engineering. For documentation of energy consumption, a template is available from ContiTech Engineering.
8.2. **Measuring instruments** have to be installed, that can be connected to the appropriate structures (e.g. M-bus, Mod-Bus, ...) or controls (PLC, Profibus, LAN) and read out, processed and evaluated with the energy monitoring software.
8.3. For detection of the **steam consumption** of the machine, an outlet tap for each heating unit between steam traps and shut-off valve has to be provided. When selecting and installing a steam flow meter the guideline of ContiTech Engineering is to be taken into account.
8.4. For detection of the **compressed air consumption** a flow measuring point is necessary to provide, recommendation: Ball valve for receiving a calorimetric measurement system of the company Metes KG.
8.5. For detection of the **cooling water consumption**, a piston flow meter from the company Sensus is recommended.
8.6. For detection of the **electricity consumption** a 3-phase multifunction meter is recommended.

Please Note:
1. In the event that statutory or contractual obligations or terms and conditions for a specific project, as agreed upon (written form) with the procuring business unit, deviate from the stipulations contained in this directive, they are to be complied with.
2. If the regulations cannot be fulfilled by other reasons, this has to be pointed out in the quotation including an explanation for the deviation.

Revision History

Nr.	Date	What was changed?	Signature
0	17.09.2009	Compilation oft he regulations	Czaja, Fleck, Füchsel, Kerstan
1	22.09.2009	Detailed changings of point 3.1., 3.3., 3.5., 4.1., 4.4., 5, 7.1., notice 2 added	Fleck
2	02.02.2015	Total revision of version 2009	Horn
3	12.08.2015	Point 8.3. notice concerning recommendation for steam flow meter selection and installation added	Horn

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