STRAUB

Excerpt

EXPERTISE FOR EVALUATION OF THE EGO CONTROL ACTUATOR

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Prof. Oschatz – Prof. Hartmann – Prof. Werdin

„The system considered here carries out the hydraulic balancing on the transfer systems automatically in a dynamic-adaptive manner. In contrast to the conventional hydraulic balancing, which is only dimensioned for the design of the heating system, the Straub system automatically adapts to the respective operating condition - so will it, amongst other, not only be dynamically regulated to maintain a setpoint of the temperature spread, but this setpoint also varies depending on the specific load.“

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Excerpt

Expertise for evaluation of suitability of the *STRAUB EGO control actuator* for automatic hydraulic balancing

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Content

Summary

With the EGO model, the STRAUB company offers electro-thermal actuators for operating the valves in underfloor heating manifolds. Since the actuators – as explained in more detail below - go beyond simple control elements in their functionality, Straub talks about control actuators.

The control actuators are intended to be controlled by a two-point room temperature control. Each actuator has contact temperature sensors for recording the flow and return temperature of the supplied underfloor heating circuit. They contain functions for limiting the medium flow on the supplied underfloor heating circuits, which should achieve an effect that is at least comparable to conventional hydraulic balancing. The present report examines and evaluates the suitability/functionality of the actuators for automatic temperature-based hydraulic balancing of underfloor heating circuits.

When using the Straub system, the valves are cyclically - following the binary control signal of the temperature control - opened and closed by the actuator. When the valve is open, the valve stroke is limited in order to avoid hydraulic over-/undersupplies of the underfloor heating circuits. The valve stroke limitation is essentially based on an evaluation of the temperature spread between the flow and the return, as measured by the actuators themselves, and of other heating-circuit-specific parameters that the actuators determine in a self-learning manner.

In the context of the present expertise, the suitability of the Straub system for automatic balancing of flow rates, directly on the supplied underfloor heating circuits, was demonstrated by an extensive series of measurements. The system's effect in this regard satisfies the requirements for a conventional hydraulic balancing of the transfer systems (underfloor heating circuits) and goes partly even further due to its adaptive character. In potentially hydraulic oversupplied circuits, the flow is restricted by a variable valve stroke limitation of the open valve. It primarily considers the flow and return temperature measured on the contact sensors as well as any other through self-learning identified parameters. On this basis, the actuators work both dynamically and indirectly thermal-load adaptively: it is controlled to maintain the setpoint of the temperature spread; and at the same time, this setpoint is varied depending on the operating/load situation (primarily due to flow temperature control). Thus, in contrast to conventional balancing, which is only dimensioned for the design case, a balancing can be achieved for almost any operating condition.

The system considered here carries out the hydraulic balancing on the transfer systems automatically in a dynamic-adaptive manner. Calculations, which would otherwise be necessary for this balancing, are therefore only to be performed to the extent that they are required for further measures/calculations (e.g. pump design, checking the boiler-heating curve, etc.; see also VdZ-Technical Rule [1])) as well as for the documentation of the balancing.

The present expertise is valid, as long as there are no recognized technical rules, that contain explicit specifications for an adaptive hydraulic balancing of underfloor heating systems based on temperature measurements.

3.3 Evaluation of the balancing function

The control algorithm of the examined control actuators for automatic balancing is generally based on a control of the temperature spread between flow and return by varying the open valve stroke and thus the volume mass flow. However, the algorithm was not disclosed in detail (see 2.2) and, in this respect, it could not be examined with regard to compliance with the targeted detail-characteristics. The evaluation is limited to an analysis of the measurements, especially regarding to relevant balancing phenomena.

From the perspective of hydraulic balancing, it must be possible to limit the flow rate appropriately in all regular operating conditions - unregulated operating conditions should be avoided if they lead to significant hydraulic over-/under-supplies and thus will have a negative impact on comfort and energy consumption. Since the examined control actuators are designed for cyclic valve operation in conjunction with a two-point room controller, a high number of daily opening/closing operations in heating mode must be assumed. For an evaluation with regard to hydraulic balancing, it must be taken into account, how the actuators behave over the entire period of time of the valve opening (open time) of each switching cycle. The following two conditions in particular must be taken into account:

- **Start phase: (hydraulic) dead time immediately after valve opening**

  Almost immediately after opening the valve, the flow of underfloor heating circuit already indicates the central flow temperature. At the same time, the "fresh" heating water has not yet completely flowed through the circuit.[4] The measurable return flow temperature is lower or significantly lower than that which would result from a steady flow. Within this phase, a change of the valve stroke has no great influence on the temperature spread, but primarily on the length of the dead time itself. A sole regulation of the temperature spread by adjusting the valve stroke can therefore lead to little or no limitation of the mass flow. Hydraulic advantaged circuits can be hydraulically oversupplied within the hydraulic dead time, if no measures are taken in this respect.

- **Remaining open time after the expiry of the dead time**

  After the hydraulic dead time has expired, the temperature spread between the flow and return of the circuit allows a certain conclusion to be drawn from its supply situation. In this operating condition, the mass flow can be sensibly limited by controlling the temperature spread by means of varying the valve stroke.

The measurement results show an appropriate limitation of the flow rates at all times - both in the hydraulic dead time of the underfloor heating circuits and in the remaining open time. Due to the integrated control of the actuators, the volume flow distribution between the two test rooms is plausible and reasonable with regard to the respective installation distances or specific outputs - a basically similar distribution would also be sought in a conventional hydraulic balancing. In contrast to the conventional hydraulic balancing, which is only dimensioned for the design of the heating system, the Straub system automatically adapts to the respective operating condition - so will it, amongst other, not only be dynamically regulated to maintain a setpoint of the temperature spread, but this setpoint also varies depending on the specific load.

[4] The time behaviour in this respect is influenced by the concrete boundary conditions of the individual case.
(e.g. ambient temperature, thermal protection and cooling time of the pipelines)

The balancing function of the examined control actuators meets the requirements for hydraulic balancing that can be derived from the applicable technical rules, insofar as they can be transferred to temperature-based electronic systems such as this one. Due to the adaptive character of the system, the balancing adapts to the current operating condition - the automatic hydraulic balancing of the actuators considered here goes beyond the possibilities of a conventional hydraulic balancing, which is only dimensioned for the design of the heating system.

4 Information on using the system in the context of hydraulic balancing in accordance with the VdZ- technical rule [1]

The system considered here carries out the hydraulic balancing on the transfer systems automatically in a dynamic-adaptive manner. Calculations, which would otherwise be necessary for this balancing, are therefore only to be performed to the extent that they are required for further measures/calculations (e.g. pump design) as well as for the documentation.

Additional requirements of the VDZ technical rule - e.g. control/correction of the boiler-heating curve, control of pressure maintenance and pipe insulation, possibly further balancing measures for extended networks, etc. - are not affected by this.

Sources and further literature references

[1] VdZ -- Forum für Energieeffizienz in der Gebäudetechnik e.V., VdZ-Fachregel Optimierung von Heizungsanlagen im Bestand, Stand Juli 2016 -- Version 1.2, 07/2016.

[2] BVF Bundesverband Flächenheizung und Flächenkühlung e.V., Überschlägiger hydraulischer Abgleich bestehender Fußbodenheizkreise; Ausgabe 10/2019, 10/2019.

[3] Kati Jagnow und Dieter Wolff für die OPTIMUS-Gruppe, OPTIMUS Umweltkommunikation in der mittelständigen Wirtschaft am Beispiel der Optimierung von Heizungssystemen durch Information und Qualifikation zur nachhaltigen Nutzung von Energieeinsparpotenzialen.

[4] DIN Deutsches Institut für Normung e.V., DIN EN 1264-3:2009-11 Raumflächenintegrierte Heiz- und Kühlsysteme mit Wasserdurchströmung -- Teil 3: Auslegung; Deutsche Fassung EN 1264-3:2009, 11/2009.

[5] DIN Deutsches Institut für Normung e.V., DIN EN 12831:2003-08 Heizungsanlagen in Gebäuden, Verfahren zur Berechnung der Norm-Heizlast, August 2003.

[6] DIN Deutsches Institut für Normung e.V., DIN EN 12831 Beiblatt 3:2016-12 Heizsysteme in Gebäuden -- Verfahren zur Berechnung der Norm-Heizlast: Vereinfachtes Verfahren zur Ermittlung der Raum-Heizlast, 12/2016.

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[8] DIN Deutsches Institut für Normung e.V., DIN EN 12831-1:2017-09 Energetische Bewertung von Gebäuden -- Verfahren zur Berechnung der Norm-Heizlast -- Teil 1: Raumheizlast, Modul M3-3; Deutsche Fassung EN 12831-1:2017, 09/2017.

[9] DIN Deutsches Institut für Normung e.V., E DIN SPEC 12831-1:2018-10 Verfahren zur Berechnung der Raumheizlast -- Teil 1: Nationale Ergänzung zur DIN EN 12831-1, 10/2018.

[10] Bundesinstitut für Bau-, Stadt- und Raumforschung (BBSR), Bundesministerium für Wirtschaft und Energie (BMWi), Bundesministerium für Umwelt, Naturschutz, Bau und Reaktorsicherheit (BMUB), Bekanntmachung der Regeln zur Datenaufnahme und Datenvewendung im Wohngebäudebestand, 07.04.2015.