ScreenMaster RVG200
Paperless recorder

Programming the RVG200 to monitor the energy loss between the supply and condensate sides of the system

Measurement made easy

Introduction

This document describes how to configure the RVG200 paperless recorder to perform the steam power balance calculations \((qv, P, Ts, Tc)\) and \((qv, qc, P, Ts, Tc)\). These calculations are included as part of the predetermined equations available in the Math & Logic functionality, under Energy Equations.

The energy equations are used to calculate the amount of energy (power) produced within a water or steam flow system that is heated in order to perform a heating role for another process. Often these calculations are used to produce a total energy value that is used for the purpose of billing and is commonly found in interdepartmental district heating and cooling systems.

RVG200 software requirements

To use the energy calculations, the following RVG200 software options must be enabled:

- Math & Logic
- Energy Calculations
- Totalizers
  (if total energy, total mass and total condensate required)
Calculating the system power balance

A system’s power balance is the difference between the power contained within the steam flow at the system’s input, compared with the power remaining within the steam after the process has been undertaken. The power balance calculates the steam energy that has been absorbed by the process by subtracting these values from one another.

Changes to the system’s water or steam pressure change the temperature at which it boils. This in turn changes the amount of energy that is required to produce steam and, more importantly, to keep it as steam.

The first calculation required is the amount of energy that is needed to create and keep the steam at the correct temperature. This is called the specific enthalpy and is a function of the temperature and pressure of the steam. Specific enthalpy is defined as the energy (in kJ) used to turn 1 kg of water into 1 kg of steam at a given temperature and pressure and is expressed in kJ/kg. Once the specific enthalpy has been determined, the power in the system can be calculated using the equation:

\[ \text{Power} = \text{Mass} \times \text{Enthalpy} \]

...where the mass is derived from the volume flow of the steam through the pipe.

The power calculation is performed twice; once for the steam flow into the system and once for the steam flow out of the system. The system’s power balance is then calculated using the equation:

\[ \text{Power Balance} = \text{Input Power} - \text{Output Power} \]

The RVG200 contains steam tables internally that are necessary to calculate the enthalpy of the steam based on its temperature and pressure.

Steam power balance (qv, qc, P, Ts, Tc,) overview

To calculate the steam power balance, the values of the volume flow (qv), pressure (P) and the temperature (Ts) in the supply and the volume flow (qc) and temperature (Tc) in the return or condensate side of the system are needed.

Although it is possible to calculate steam power balance without the return (condensate) volume flow (qc) measurement, best results are obtained using all 5 measurements.

The ScreenMaster RVG200 enables calculation of steam power balance using both methods:

(qv, P, Ts, Tc)
(qv, qc, P, Ts, Tc)

However, this document describes the calculation of steam power using all 5 variables (qv, qc, P, Ts, Tc).
Configuring the RVG200

Configuring the math block

To configure the math block:

1. Enter the configuration level as described in Section 7.3 of the Operating Instruction (OI/RVG200-EN) and touch the math equations icon (\(\mathbb{E}\)) in the main configuration menu.

2. Touch a Math tab to edit, touch \(\mathbb{E}\) to edit the Block Type parameter, select Energy Equations and touch \(\mathbb{V}\).

3. Touch \(\mathbb{E}\) to edit the Equation parameter, select Steam Pwr Bal\((qv,qc,P,T_s,T_c)\) and touch \(\mathbb{V}\).

4. Touch \(\mathbb{E}\) to edit the Flow setup \((qv)\) parameter then touch \(\mathbb{E}\) to edit the Flow source \((qv)\) parameter. A list of inputs is displayed that can be used as a flow input source.

5. Select the required flow input source then touch \(\mathbb{E}\) to edit the Min/max flow limit parameter.

6. Repeat steps 4 and 5 to edit the Flow setup \((qc)\), Flow source \((qc)\) and Min/max flow limit parameters.

7. Touch \(\mathbb{E}\) to edit the Pressure setup \((P)\) parameter. A list of inputs is displayed that can be used as a pressure source.

8. Select the required pressure input source then touch \(\mathbb{E}\) to edit each of the displayed parameters.

IMPORTANT (NOTE)

The RVG200 displays only sources configured with units applicable to that particular variable type. For example, for Flow source \((qv)\), only inputs assigned supported flow units (for example, l/s) are displayed.

Set Min/max flow limit within the engineering range limits. If the flow rate exceeds the set limits by 5 % (or more) of the engineering range, a flow diagnostic message is displayed.

Set Min/max pressure limit within the engineering range limits. If the measured pressure exceeds the set limits by 5 % (or more) of the engineering range, a pressure diagnostic message is displayed.

Set Pressure type to Gauge or Absolute. If set to Gauge, an Atmos Pressure constant parameter is displayed – set a pressure constant value.
## Configuring the RVG200

9. Touch to edit the **Temp. steam setup (Ts)** parameter. A list of inputs is displayed that can be used as a temperature source.

<table>
<thead>
<tr>
<th>Math</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Steam Pwr Bal (qv, qg, P, Ts, Tc)</td>
<td></td>
</tr>
<tr>
<td>Flow setup (qv)</td>
<td>None</td>
</tr>
<tr>
<td>Flow setup (qg)</td>
<td>None</td>
</tr>
<tr>
<td>Pressure setup (P)</td>
<td>None</td>
</tr>
<tr>
<td>Temp. steam setup (Ts)</td>
<td>None</td>
</tr>
<tr>
<td>Temp. cond. setup (Tc)</td>
<td>None</td>
</tr>
</tbody>
</table>

10. Select the required temperature input source then touch to edit each of the displayed parameters.

When set to On, **Default enable** enables a default temperature value to be used in the event that the measured temperature falls outside of the operator-configured minimum and maximum temperature limits.

Set **Min/max temp. limit** within the engineering range limits. If the measured temperature exceeds the set limits, a temperature diagnostic message is displayed.

Set the **Minimum steam temp.**

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### Displaying and recording the values

The configured math block must be assigned to a recording channel to enable the result of the calculation to be displayed and recorded.

1. Select a recording channel to display the energy calculation result and select the math block as the source ID:

   ![Recording Channel](image)

2. Touch the **Maths block x** tab. The math block engineering range and units are displayed:

   ![Maths Block](image)

   **IMPORTANT (NOTE)**
   
   The parameters displayed are read only. Changes may only be made in the math block configuration level.

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11. Repeat steps 9 and 10 to edit the **Temp. cond setup (Tc)**, **Temp. cond source (Tc)**, **Default enable**, **Min/max temp. limit**, and **Abs. pressure cond. pipe** parameters.
Totalizing the values

The energy calculation provides an instant reading of the power output of the steam system. To calculate the total energy used a totalizer must be configured and can be assigned to a recording channel to enable the total energy to be displayed and recorded.

1. Configure a standard 7 digit totalizer on the recording channel that the math block is assigned to:

   Touch ‹ to edit the Tag/Units parameter and select the units to totalize in.

   Touch ‹ to edit the Count Range parameter and set the range to count across.

   The RVG200 calculates the count rate automatically if a relationship exists between the math block units and the totalizer units selected.

2. Select a recording channel to display the totalizer result and select the totalizer as the source ID:

   IMPORTANT (NOTE)
   The totalizer parameters displayed are read only. Changes may only be made on the totalizer tab for the math block recording channel.

Displaying and recording associated variables

When an energy calculation math block has been configured, other associated variables are produced (for example, mass flow and steam enthalpy). These variables can be selected and assigned as the source ID for other recording channels if required.
Completion

Make any other changes to the recorder’s configuration as required and exit the configuration level as described in Section 7.6 of the Operating Instruction (OI/RVG200-EN).

If the configuration is to be used immediately, touch the Apply Changes button on the configuration exit dialog.

To save the configuration for later use, touch the Export configuration button and select a location to save the configuration (either to internal storage or external media).

When the configuration is loaded into the recorder, the energy data collection for the steam system can begin.
Notes