

# ISO 3354:2008-07 (E)

## Measurement of clean water flow in closed conduits - Velocity-area method using current-meters in full conduits and under regular flow conditions

---

<b>Contents</b>		<b>Page</b>
Foreword .....		v
<b>1</b>	<b>Scope .....</b>	<b>1</b>
<b>2</b>	<b>Normative references .....</b>	<b>1</b>
<b>3</b>	<b>Terms and symbols .....</b>	<b>2</b>
<b>3.1</b>	<b>Terms .....</b>	<b>2</b>
<b>3.2</b>	<b>Symbols .....</b>	<b>3</b>
<b>4</b>	<b>Principle .....</b>	<b>4</b>
<b>4.1</b>	<b>General .....</b>	<b>4</b>
<b>4.2</b>	<b>Measurement of the measuring cross-section .....</b>	<b>5</b>
<b>4.3</b>	<b>Measurement of local velocities .....</b>	<b>6</b>
<b>4.4</b>	<b>Location and number of measuring points in the cross-section .....</b>	<b>7</b>
<b>5</b>	<b>Description of the current-meter .....</b>	<b>9</b>
<b>6</b>	<b>Requirements for the use of current-meters .....</b>	<b>9</b>
<b>6.1</b>	<b>Selection of the measuring cross-section .....</b>	<b>9</b>
<b>6.2</b>	<b>Devices for improving flow conditions .....</b>	<b>10</b>
<b>6.3</b>	<b>Calibration of the current-meter .....</b>	<b>11</b>
<b>6.4</b>	<b>Limits of use .....</b>	<b>11</b>
<b>6.5</b>	<b>Inspection and maintenance of current-meters .....</b>	<b>13</b>
<b>7</b>	<b>Setting of current-meters into the conduit .....</b>	<b>13</b>
<b>7.1</b>	<b>Setting of current-meters .....</b>	<b>13</b>
<b>7.2</b>	<b>Mounting in a circular cross-section .....</b>	<b>13</b>
<b>7.3</b>	<b>Mounting in a rectangular cross-section .....</b>	<b>14</b>
<b>8</b>	<b>Determination of the mean axial fluid velocity by graphical integration of the velocity area .....</b>	<b>16</b>
<b>8.1</b>	<b>General .....</b>	<b>16</b>
<b>8.2</b>	<b>Circular cross-sections .....</b>	<b>16</b>
<b>8.3</b>	<b>Rectangular cross-sections .....</b>	<b>18</b>
<b>9</b>	<b>Determination of the mean axial fluid velocity by numerical integration of the velocity area .....</b>	<b>20</b>
<b>9.1</b>	<b>General .....</b>	<b>20</b>
<b>9.2</b>	<b>Circular cross-sections .....</b>	<b>21</b>
<b>9.3</b>	<b>Rectangular cross-sections .....</b>	<b>22</b>
<b>10</b>	<b>Determination of the mean axial fluid velocity by arithmetical methods .....</b>	<b>23</b>
<b>10.1</b>	<b>General .....</b>	<b>23</b>
<b>10.2</b>	<b>Log-linear method .....</b>	<b>23</b>
<b>10.3</b>	<b>Log-Chebyshev method .....</b>	<b>25</b>
<b>11</b>	<b>Uncertainty in the measurement of flow-rate .....</b>	<b>27</b>
<b>11.1</b>	<b>General .....</b>	<b>27</b>
<b>11.2</b>	<b>Sources of error in local velocity measurements .....</b>	<b>27</b>
<b>11.3</b>	<b>Sources of error in estimation of flow-rate .....</b>	<b>28</b>
<b>11.4</b>	<b>Propagation of errors .....</b>	<b>29</b>

11.5	Presentation of results .....	29
11.6	Calculation of uncertainty .....	30
Annex A (normative) Measuring sections other than circular or rectangular sections .....		33
Annex B (normative) Corrections for blockage effect .....		38
Annex C (normative) Recommendations for the selection of the type of current-meter and mounting strut .....		39
Annex D (normative) Example of measuring point distribution along a radius for velocity measurement in a conduit of circular cross-section in the case of the graphical and numerical methods .....		41
Annex E (normative) Determination of boundary layer coefficient, $m$ , for extrapolation near the wall .....		43
Annex F (normative) Definition of terms and procedures used in the uncertainty calculation .....		45
Annex G (normative) Student's $t$ distribution .....		48
Annex H (informative) Examples of values of component uncertainties .....		49
Annex J (informative) Example of calculation of the uncertainty in the flow-rate measurement using current-meters .....		51