

# ISO 10790:2015-04 (E)

## Measurement of fluid flow in closed conduits - Guidance to the selection, installation and use of Coriolis flowmeters (mass flow, density and volume flow measurements)

<b>Contents</b>		<b>Page</b>
Foreword .....		v
Introduction .....		vi
<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 definitions .....</b>	<b>1</b>
3.1	Definitions specific to this Coriolis flowmeter standard .....	1
3.2	Definitions from VIM, ISO/IEC Guide 99 (JCGM:2012) .....	3
3.3	Symbols .....	4
3.4	Abbreviations .....	5
<b>4</b>	<b>Coriolis flowmeter selection criteria .....</b>	<b>5</b>
4.1	General .....	5
4.2	Physical installation .....	5
4.2.1	General .....	5
4.2.2	Installation criteria .....	6
4.2.3	Full-pipe requirement for liquids .....	6
4.2.4	Orientation .....	6
4.2.5	Flow conditions and straight length requirements .....	6
4.2.6	Valves .....	6
4.2.7	Cleaning .....	6
4.2.8	Hydraulic and mechanical vibrations .....	7
4.2.9	Pipe stress and torsion .....	7
4.2.10	Crosstalk between sensors .....	7
4.3	Effects due to process conditions and fluid properties .....	7
4.3.1	General .....	7
4.3.2	Application and fluid properties .....	7
4.3.3	Multiphase flow .....	8
4.3.4	Influence of process fluid .....	8
4.3.5	Temperature effects .....	8
4.3.6	Pressure effects .....	9
4.3.7	Pulsating flow effects .....	9
4.3.8	Viscosity effects .....	9
4.3.9	Flashing and/or cavitation .....	9
4.4	Pressure loss .....	9
4.5	Safety .....	9
4.5.1	General .....	9
4.5.2	Hydrostatic pressure test .....	9
4.5.3	Mechanical stress .....	10
4.5.4	Erosion .....	10
4.5.5	Corrosion .....	10
4.5.6	Housing design .....	10
4.5.7	Cleaning .....	10
4.6	Transmitter (secondary device) .....	10
4.7	Diagnostics .....	11
<b>5</b>	<b>Inspection and compliance .....</b>	<b>11</b>

<b>6</b>	<b>Mass flow measurement</b> .....	<b>12</b>
<b>6.1</b>	<b>Apparatus</b> .....	<b>12</b>
<b>6.1.1</b>	<b>Principle of operation</b> .....	<b>12</b>
<b>6.1.2</b>	<b>Coriolis sensor</b> .....	<b>14</b>
<b>6.1.3</b>	<b>Coriolis transmitter</b> .....	<b>15</b>
<b>6.2</b>	<b>Mass flow measurement</b> .....	<b>15</b>
<b>6.3</b>	<b>Factors affecting mass flow measurement</b> .....	<b>17</b>
<b>6.3.1</b>	<b>Density and viscosity</b> .....	<b>17</b>
<b>6.3.2</b>	<b>Multiphase flow</b> .....	<b>17</b>
<b>6.3.3</b>	<b>Temperature</b> .....	<b>18</b>
<b>6.3.4</b>	<b>Pressure</b> .....	<b>18</b>
<b>6.3.5</b>	<b>Installation</b> .....	<b>18</b>
<b>6.4</b>	<b>Zero adjustment</b> .....	<b>18</b>
<b>6.5</b>	<b>Calibration of mass flow measurement</b> .....	<b>18</b>
<b>7</b>	<b>Density measurement</b> .....	<b>19</b>
<b>7.1</b>	<b>General</b> .....	<b>19</b>
<b>7.2</b>	<b>Principle of operation</b> .....	<b>20</b>
<b>7.3</b>	<b>Specific gravity of fluids</b> .....	<b>21</b>
<b>7.4</b>	<b>Density measurement uncertainty</b> .....	<b>21</b>
<b>7.5</b>	<b>Factors affecting density measurement</b> .....	<b>21</b>
<b>7.5.1</b>	<b>Temperature</b> .....	<b>21</b>
<b>7.5.2</b>	<b>Pressure</b> .....	<b>22</b>
<b>7.5.3</b>	<b>Multiphase (Two phase)</b> .....	<b>22</b>
<b>7.5.4</b>	<b>Flow effect</b> .....	<b>22</b>
<b>7.5.5</b>	<b>Corrosion and erosion</b> .....	<b>22</b>
<b>7.5.6</b>	<b>Coatings</b> .....	<b>22</b>
<b>7.5.7</b>	<b>Installation</b> .....	<b>22</b>
<b>7.6</b>	<b>Density calibration and adjustment</b> .....	<b>22</b>
<b>7.6.1</b>	<b>General</b> .....	<b>22</b>
<b>7.6.2</b>	<b>Manufacturer's density calibration</b> .....	<b>22</b>
<b>7.6.3</b>	<b>Field density calibration and adjustment</b> .....	<b>23</b>
<b>8</b>	<b>Volume flow measurement at metering conditions</b> .....	<b>23</b>
<b>8.1</b>	<b>General</b> .....	<b>23</b>
<b>8.2</b>	<b>Volume calculation</b> .....	<b>23</b>
<b>8.3</b>	<b>Gas as a process fluid</b> .....	<b>24</b>
<b>8.4</b>	<b>Volume measurement uncertainty</b> .....	<b>24</b>
<b>8.5</b>	<b>Special influences</b> .....	<b>24</b>
<b>8.5.1</b>	<b>General</b> .....	<b>24</b>
<b>8.5.2</b>	<b>Empty pipe effect</b> .....	<b>24</b>
<b>8.5.3</b>	<b>Multiphase fluids</b> .....	<b>24</b>
<b>8.6</b>	<b>Factory calibration</b> .....	<b>24</b>
<b>8.6.1</b>	<b>Mass flow and density</b> .....	<b>24</b>
<b>8.7</b>	<b>Volume check</b> .....	<b>25</b>
	<b>Annex A (informative) Calibration techniques</b> .....	<b>26</b>
	<b>Annex B (informative) Safety guidelines for the selection of Coriolis flowmeters</b> .....	<b>29</b>
	<b>Annex C (informative) Considerations for multi-component liquid systems</b> .....	<b>31</b>
	<b>Annex D (informative) Miscible liquids containing chemically non-interacting components</b> .....	<b>34</b>
	<b>Bibliography</b> .....	<b>37</b>