

Contents

	Foreword
	Introduction
1	Scope
2	Normative references
3	Terms and definitions
4	Symbols
5	ISO/IEC Guide 98-3 (GUM) — Basic definitions and rules
5.1	General
5.2	Uncertainty of sets of measurements
5.3	Random and systematic effects
5.4	Uncertainty models — Probability distributions
5.5	Combining uncertainties — Law of propagation of uncertainties
5.6	Expressing results
6	Open channel flow — Velocity area methods
6.1	General
6.2	Mean velocity, $V - x$
6.3	Velocity-area method for discharge calculation
6.4	Measurement of velocity
6.5	Uncertainty associated with the velocity-area method
6.5.1	General
6.5.2	Random and systematic effects
6.6	Integration uncertainties [$u^* (F y)$, $u^* (F z)$]
6.6.1	General
6.6.2	Vertical scanning uncertainties
6.6.3	Horizontal scanning uncertainties
6.7	Perimeter flow uncertainties, $u(Q p)$
7	Open channel flow — Critical depth methods
7.1	General
7.2	Head and geometry determination
7.3	Iterative calculation
7.4	Evaluating uncertainty
8	Dilution methods
8.1	General
8.2	Continuous feed
8.3	Transient mass
9	Hydrometric instrumentation
9.1	Performance specifications
9.2	Validity of uncertainty statements
9.3	Manufacturer's specifications
9.4	Performance guide for hydrometric equipment for use in technical standard examples
10	Guide for the drafting of uncertainty clauses in hydrometric standards
10.1	General
10.2	Equipment, methods and measurement systems

10.2.1	General
10.2.2	Equipment
10.2.3	Methods
10.2.4	Systems
11	Examples
11.1	General
11.2	Uncertainty in water level measurement
11.2.1	Example 1: Float/shaft encoder sensor installed in stilling well at gauging station
11.2.2	Example 2: Pressure transmitter installed in tube
11.3	Uncertainty in flow measurement using flow measurement structures
11.4	Uncertainty in flow measurement by current meter
Annex A	(informative) Introduction to hydrometric uncertainty
A.1	Basic definitions and rules
A.2	Introduction to the definitions
A.2.1	General
A.2.2	Data histograms
A.3	Measurement histograms and probability distributions
A.4	Probability models
A.4.1	General
A.4.2	Probability models — General considerations
A.5	Uncertainty for small set of data
A.6	Random and systematic effects
A.7	Summary — Type A and Type B estimation methods
A.8	Gauss probability distribution
A.9	Expanded uncertainty, $U(x)$, confidence limits and coverage factors
A.10	Examples of combined uncertainty calculation, U_c
A.11	Detection and handling of false measurements
Annex B	(informative) Introduction to Monte Carlo Simulation (MCS)
B.1	General
B.2	Flow measurement example — Hydrometric structure with air-range ultrasonic head measurement
B.3	Cautions of using the Monte Carlo method
B.3.1	General
B.3.2	Generating combinations of random variables
B.3.3	How many trials are needed when using the Monte Carlo method
Annex C	(informative) Interpolated Variance Estimation (IVE) method
C.1	Interpolated Variance Estimation method
C.2	Example
Annex D	(informative) Performance guide for hydrometric equipment for use in technical standard examples
Annex E	(informative) Uncertainty analysis of stage-discharge relation
E.1	The stage-discharge relation
E.2	Uncertainty in stage-discharge relation
E.3	Example
Annex F	(informative) Measurement of velocity
F.1	Measurement of velocity using current meters
F.1.1	Vertical segments
F.1.2	Horizontal segments
F.2	Moving boat ADCP method
F.3	Velocity-area uncertainties with moving boat ADCP method
F.3.1	Random and systematic effects
F.3.1.1	Random effects
F.3.1.2	Systematic effects
F.3.2	Determining uncertainty for moving boat ADCP