

SCHEDULE 4

Regulation 20(1) and (2)

METHODS OF ANALYSIS

1.—(1) The enforcing authority must ensure that the methods of analysis used for the purposes of monitoring and demonstrating compliance with these Regulations are validated and documented in accordance with European standard EN ISO/IEC 17025:2005 entitled “*General requirements for the competence of testing and calibration laboratories (ISO/IEC 17025:2005)*”(1), or other equivalent standards accepted at international level.

(2) The enforcing authority must ensure that laboratories or parties contracted by laboratories apply quality management system practices in accordance with European standard EN ISO/IEC 17025:2005 entitled “*General requirements for the competence of testing and calibration laboratories (ISO/IEC 17025:2005)*”, or other equivalent standards accepted at international level.

2. In the absence of an analytical method meeting the minimum performance criteria set out in Part B of this schedule, the enforcing authority must ensure that monitoring is carried out using best available techniques not entailing excessive costs.

PART A

Microbiological parameters

1.—(1) Subject to sub-paragraph (2), the methods in paragraph 2 are given for reference.

(2) The enforcing authority may use other methods, providing the provisions of regulation 20 are met.

2. The methods for microbiological parameters are—

(a) for *Escherichia coli* and coliform bacteria—

(i) European standard EN ISO 9308-1:2014 entitled “*Water quality - Enumeration of Escherichia coli and coliform bacteria - Part 1: Membrane filtration method for waters with low bacterial background flora (ISO 9308-1:2014)*”(2); or

(ii) European standard EN ISO 9308-2:2014 entitled “*Water quality - Enumeration of Escherichia coli and coliform bacteria - Part 2: Most probable number method (ISO 9308-2:2012)*”(3);

(b) for enterococci, European standard EN ISO 7899-2:2000 entitled “*Water quality - Detection and enumeration of intestinal enterococci - Part 2: Membrane filtration method (ISO 7899-2:2000)*”(4);

(c) for *Pseudomonas aeruginosa*, European standard EN ISO 16266:2008 entitled “*Water quality - Detection and enumeration of Pseudomonas aeruginosa - Method by membrane filtration (ISO 16266:2006)*”(5);

(1) This standard was approved by the European Committee for Standardization (CEN) on 15th March 2005. Under reference BS EN ISO/IEC 17025:2005, it is published as a UK standard by the British Standards Institution (ISBN 0 580 46330 3).

(2) This standard was approved by the European Committee for Standardization (CEN) on 18th January 2017. Under reference BS EN ISO 9308-1:2014+A1:2017, it is published as a UK standard by the British Standards Institution (ISBN 978 0 580 92379 1).

(3) This standard was approved by the European Committee for Standardization (CEN) on 11th April 2014. Under reference BS EN ISO 9308-2:2014, it is published as a UK standard by the British Standards Institution (ISBN 978 0 580 84023 4).

(4) This standard was approved by the European Committee for Standardization (CEN) on 11th April 2014. Under reference BS EN ISO 7899-2:2000, it is published as a UK standard by the British Standards Institution (ISBN 0 580 34953 5).

(5) This standard was approved by the European Committee for Standardization (CEN) on 11th January 2008. Under reference BS EN ISO 16266:2008, it is published as a UK standard by the British Standards Institution (ISBN 978 0 580 59736 7).

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- (d) for colony count 22 °C (the enumeration of culturable microorganisms — colony count after aerobic incubation at 22 °C), European standard EN ISO 6222:1999 entitled “*Water quality - Enumeration of culturable micro-organisms - Colony count by inoculation in a nutrient agar culture medium (ISO 6222:1999)*”(6); and
- (e) for *Clostridium perfringens* including spores, European standard EN ISO 14189:2016 entitled “*Water quality - Enumeration of Clostridium perfringens - Method using membrane filtration (ISO 14189:2013)*”(7).

PART B

Chemical and indicator parameters

1.—(1) Subject to paragraph 3, for a parameter in Table 1, the method of analysis used must, as a minimum, be capable of measuring concentrations equal to the parametric value for the parameter with—

- (a) a limit of quantification of 30 % or less of the parametric value; and
(b) an uncertainty of measurement as specified in Table 1.

(2) The result of the analysis for a parameter in Table B or Table C must be expressed using at least the same number of significant figures as the parametric value for the parameter in the table.

2. The uncertainty of measurement specified in Table 1 must not be used as an additional tolerance to the parametric values.

3. Until 31st December 2019, the enforcing authority may, for a parameter in Table 2, use the corresponding ‘trueness’, ‘precision’ and ‘limit of detection’ in that table as an alternative set of performance characteristics (instead of using the limit of quantification and the uncertainty of measurement referred to in paragraph 1(1)).

TABLE 1

Minimum performance characteristic: uncertainty of measurement

<i>Parameter</i>	<i>Uncertainty of measurement</i> <i>(% of parametric value, except pH) (Note 1)</i>	<i>Notes(8)</i>
Aluminium	25	
Ammonium	40	
Antimony	40	
Arsenic	30	
Benzo(a)pyrene	50	Note 5
Benzene	40	
Boron	25	

(6) This standard was approved by the European Committee for Standardization (CEN) on 16th March 1999. Under reference BS EN ISO 6222:1999, it is published as a UK standard by the British Standards Institution (ISBN 0 580 32495 8).

(7) This standard was approved by the European Committee for Standardization (CEN) on 15th July 2016. Under reference BS EN ISO 14189:2016, it is published as a UK standard by the British Standards Institution (ISBN 978 0 580 92184 1).

(8) Acrylamide, epichlorohydrin and vinyl chloride to be controlled by product specification.

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<i>Parameter</i>	<i>Uncertainty of measurement</i> <i>(% of parametric value, except pH) (Note 1)</i>	<i>Notes(8)</i>
Bromate	40	
Cadmium	25	
Chloride	15	
Chromium	30	
Conductivity	20	
Copper	25	
Cyanide	30	Note 6
1,2-dichloroethane	40	
Fluoride	20	
Hydrogen ion concentration (in pH)	0.2	Note 7
Iron	30	
Lead	25	
Manganese	30	
Mercury	30	
Nickel	25	
Nitrate	15	
Nitrite	20	
Oxidisability	50	Note 8
Pesticides	30	Note 9
Polycyclic aromatic hydrocarbons	30	Note 10
Selenium	40	
Sodium	15	
Sulphate	15	
Tetrachloroethene	30	Note 11
Trichloroethene	40	Note 11
Trihalomethanes: total	40	Note 10
Total organic carbon	30	Note 12
Turbidity	30	Note 13

(8)

Acrylamide, epichlorohydrin and vinyl chloride to be controlled by product specification.

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TABLE 2**Minimum performance characteristics: trueness, precision and limit of detection**

<i>Parameter</i>	<i>Trueness</i> <i>(% of parametric value, except for pH) (Note 2)</i>	<i>Precision</i> <i>(% of parametric value, except for pH) (Note 3)</i>	<i>Limit of detection</i> <i>(% of parametric value, except for pH) (Note 4)</i>	<i>Notes(9)</i>
Aluminium	10	10	10	
Ammonium	10	10	10	
Antimony	25	25	25	
Arsenic	10	10	10	
Benzo(a)pyrene	25	25	25	
Benzene	25	25	25	
Boron	10	10	10	
Bromate	25	25	25	
Cadmium	10	10	10	
Chloride	10	10	10	
Chromium	10	10	10	
Conductivity	10	10	10	
Copper	10	10	10	
Cyanide	10	10	10	Note 6
1,2-dichloroethane	25	25	10	
Fluoride	10	10	10	
Hydrogen ion concentration (in pH)	0.2	0.2		Note 7
Iron	10	10	10	
Lead	10	10	10	
Manganese	10	10	10	
Mercury	20	10	20	
Nickel	10	10	10	
Nitrate	10	10	10	
Nitrite	10	10	10	
Oxidisability	25	25	25	Note 8

(9)

Acrylamide, epichlorohydrin and vinyl chloride to be controlled by product specification.

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<i>Parameter</i>	<i>Trueness</i> <i>(% of parametric value, except for pH) (Note 2)</i>	<i>Precision</i> <i>(% of parametric value, except for pH) (Note 3)</i>	<i>Limit of detection</i> <i>(% of parametric value, except for pH) (Note 4)</i>	<i>Notes(9)</i>
Pesticides	25	25	25	Note 9
Polycyclic aromatic hydrocarbons	25	25	25	Note 10
Selenium	10	10	10	
Sodium	10	10	10	
Sulphate	10	10	10	
Tetrachloroethene	25	25	10	Note 11
Trichloroethene	25	25	10	Note 11
Trihalomethanes: total	25	25	10	Note 10
Turbidity	25	25	25	

Notes to Table 1 and Table 2

Note 1: Uncertainty of measurement is a non-negative parameter characterising the dispersion of the quantity values being attributed to a measurand, based on the information used. The performance criterion for measurement uncertainty ($k = 2$) is the percentage of the parametric value stated in the table or better. Measurement uncertainty must be estimated at the level of the parametric value, unless otherwise specified.

Note 2: Trueness is a measure of systematic error, i.e. the difference between the mean value of the large number of repeated measurements and the true value. Further specifications are those set out in international standard ISO 5725 entitled “*Accuracy (trueness and precision) of measurement methods and results*”(10).

Note 3: Precision is a measure of random error and is usually expressed as the standard deviation (within and between batches) of the spread of results from the mean. Acceptable precision is twice the relative standard deviation. This term is further specified in international standard ISO 5725 entitled partly “*Accuracy (trueness and precision) of measurement methods and results*”.

Note 4: Limit of detection is either three times the standard deviation within a batch of a natural sample containing a low concentration of the parameter, or five times the standard deviation of a blank sample (within a batch).

Note 5: If the value of uncertainty of measurement cannot be met, the best available technique should be selected (up to 60 %).

Note 6: The method determines total cyanide in all forms.

Note 7: Values for trueness, precision and uncertainty of measurement are expressed in pH units.

(9) Acrylamide, epichlorohydrin and vinyl chloride to be controlled by product specification.

(10) This standard has been approved by the International Organization for Standardization (ISO). Under reference BS ISO 5725-1 to BS ISO 5725-6, these are published as UK standards by the British Standards Institution.

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Note 8: Reference method European standard EN ISO 8467:1995 entitled “*Water quality - Determination of permanganate index (ISO 8467:1993)*”(11).

Note 9: The performance characteristics for individual pesticides are given as an indication. Values for the uncertainty of measurement as low as 30 % can be achieved for several pesticides, higher values up to 80 % may be allowed for a number of pesticides.

Note 10: The performance characteristics apply to individual substances, specified at 25 % of the parametric value in Table B.

Note 11: The performance characteristics apply to individual substances, specified at 50 % of the parametric value in Table B.

Note 12: The uncertainty of measurement should be estimated at the level of 3 mg/l of the total organic carbon in accordance with European standard EN 1484:1997 entitled “*Water analysis - Guidelines for the determination of total organic carbon and dissolved organic carbon*”(12).

Note 13: The uncertainty of measurement must be estimated at the level of 1.0 nephelometric turbidity units in accordance with European standard EN ISO 7027-1:2016 entitled “*Water quality - Determination of turbidity - Part 1: Quantitative methods (ISO 7027-1:2016)*”(13).

PART C

Indicative dose

For each parameter in Table 3, the method of analysis used must be capable of measuring activity concentrations with at least the limit of detection specified for that parameter in the second column of that table.

TABLE 3

Minimum performance characteristics: limit of detection

<i>Parameter</i>	<i>Limit of detection (in Bq/l) (Notes 1 and 2)</i>	<i>Notes</i>
Tritium	10	Note 3
Radon	10	Note 3
gross alpha activity	0.04	Note 4
gross beta activity	0.4	Note 4
U-238	0.02	
U-234	0.02	
Ra-226	0.04	
Ra-228	0.02	Note 5
Pb-210	0.02	
Po-210	0.01	

(11) This standard was approved by the European Committee for Standardization (CEN) on 3rd November 1994. Under reference EN ISO 8467:1995, it is published as a UK standard by the British Standards Institution (ISBN 0 580 23435 5).

(12) This standard was approved by the European Committee for Standardization (CEN) on 6th April 1997. Under reference BS EN 1484:1997, it is published as a UK standard by the British Standards Institution (ISBN 0 580 28372 0).

(13) This standard was approved by the European Committee for Standardization (CEN) on 15th April 2016. Under reference BS EN ISO 7027-1:2016, it is published as a UK standard by the British Standards Institution (ISBN 978 0 580 81961 2).

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<i>Parameter</i>	<i>Limit of detection (in Bq/l) (Notes 1 and 2)</i>	<i>Notes</i>
C-14	20	
Sr-90	0.4	
Pu-239 / Pu-240	0.04	
Am-241	0.06	
Co-60	0.5	
Cs-134	0.5	
Cs-137	0.5	
I-131	0.5	

Notes to Table 3

Note 1: The limit of detection must be calculated in accordance with the international standard ISO 11929:2010 entitled “*Determination of the characteristic limits (decision threshold, detection limit and limits of the confidence interval) for measurements of ionising radiation - Fundamentals and application*”(14), with probabilities of errors of 1st and 2nd kind of 0.05 each.

Note 2: Measurement uncertainties must be calculated and reported as complete standard uncertainties, or as expanded standard uncertainties with an expansion factor of 1.96, in accordance with international standard ISO/IEC Guide 98-3:2008 entitled “*Guide to the expression of uncertainty in measurement*”(15).

Note 3: The limit of detection for tritium and for radon is 10% of the corresponding parametric value for the parameter.

Note 4: The limit of detection for gross alpha activity and gross beta activities is 40% of the screening values of 0.1 Bq/l and 1.0 Bq/l respectively.

Note 5: This limit of detection applies only to initial screening for indicative dose for a new water source. If initial checking indicates that it is unlikely that Ra-228 exceeds 20% of the derived concentration, the limit of detection may be increased to 0.08 Bq/l for routine Ra-228 nuclide specific measurements, until a subsequent re-check is required.

(14) This standard has been approved by the International Organization for Standardization (ISO). Under reference BS ISO 11929:2010, it is published as a UK standard by the British Standards Institution (ISBN 978 0 580 59044 3).

(15) This standard has been approved by the International Organization for Standardization (ISO). Under reference ISO/IEC Guide 98-3:2008 Ed 1, it is published as a UK standard by the British Standards Institution.