Designation: D7725 – 17 (Reapproved 2023)

Standard Test Method for the Continuous Measurement of Turbidity Above 1 Turbidity Unit (TU)[1]

This standard is issued under the fixed designation D7725; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This test method covers the on-line and in-line determination of high-level turbidity in water that is greater than 1.0 turbidity units (TU) in municipal, industrial and environmental usage.

1.2 In principle, there are three basic applications for on-line measurement set ups. This first is the slipstream (bypass) sample technique. For the slipstream sample technique a portion of sample is transported out of the process and through the measurement apparatus. It is then either transported back to the process or to waste. The second is the in-line measurement where the sensor is brought directly into the process (see Fig. 8). The third basic method is for in-situ monitoring of sample waters. This principle is based on the insertion of a sensor into the sample itself as the sample is being processed. The in-situ use in this test method is intended for the monitoring of water during any step within a processing train, including immediately before or after the process itself.

1.3 This test method is applicable to the measurement of turbidities greater than 1.0 TU. The absolute range is dictated by the technology that is employed.

1.4 The upper end of the measurement range is left undefined because different technologies described in this test method can cover very different ranges of turbidity.

1.5 Many of the turbidity units and instrument designs covered in this test method are numerically equivalent in calibration when a common calibration standard is applied across those designs listed in Table 1. Measurement of a common calibration standard of a defined value will also produce equivalent results across these technologies. This test method prescribes the assignment of a determined turbidity values to the technology used to determine those values. Numerical equivalence to turbidity standards is observed between different technologies but is not expected across a common sample. Improved traceability beyond the scope of this test method may be practiced and would include the listing of the make and model number of the instrument used to determine the turbidity values.

1.5.1 In this test method, calibration standards are often defined in NTU values, but the other assigned turbidity units, such as those in Table 1 are equivalent. For example, a 1 NTU formazin standard is also a 1 FNU, a 1 FAU, a 1 BU, and so forth.

1.6 This test method does not purport to cover all available technologies for high-level turbidity measurement.

1.7 This test method was tested on different waters, and with standards that will serve as surrogates to samples. It is the user's responsibility to ensure the validity of this test method for waters of untested matrices.

1.8 Those samples with the highest particle densities typically prove to be the most difficult to measure. In these cases, the process monitoring method can be considered with adequate measurement protocols installed.

1.9 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.10 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.* Refer to the MSDSs for all chemicals used in this procedure.

1.11 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

[1] This test method is under the jurisdiction of ASTM Committee D19 on Water and is the direct responsibility of Subcommittee D19.03 on Sampling Water and Water-Formed Deposits, Analysis of Water for Power Generation and Process Use, On-Line Water Analysis, and Surveillance of Water.

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TABLE 1 Technologies for Measuring Turbidity Greater Than 1 TU That Can be Used for In-Line or On-Line Applications

Design and Reporting Unit	Prominent Application	Key Design Features	Typical Instrument Range	Suggested Application
Nephelometric Non-Tatio (NTU)	White light turbidimeters comply with EPA 180.1 for low-level turbidity monitoring.	Detector centered at 90 degrees relative to the incident light beam. Uses a white light spectral source.	0.012 to 40 NTU	Regulatory reporting of clean water
Ratio White Light Turbidimeters (NTRU)	Complies with Interim Enhanced Surface Water Treatment Rule (ISWTR) regulations and Standard Method 2130B. Can be used for both low- and high-level measurement.	Used a white light spectral source. Primary detector centered at 90°. Other detectors located at other angles. An instrument algorithm uses a combination of detector readings to generate the turbidity reading.	0.012–10 000 NTRU	Regulatory reporting of clean water
Formazin Nephelometric, Near-IR Turbidimeters, Non-Ratiometric (FNU)	Complies with ISO 7027. The wavelengthis less susceptible to color interferences. Applicable for samples with color and good for low-level monitoring.	Detector centered at 90 degrees relative to the incident light beam. Uses a near-IR (780–900 nm) monochromatic light source.	0.012–1 000 FNU	0–40 FNU ISO 7027 regulatory reporting
Formazin Nephelometric Near-IR Turbidimeters, Ratio Metric (FNRU)	Complies with ISO 7027. Applicable for samples with high levels of color and for monitoring to high turbidity levels.	Uses a near-IR monochromatic light source (780–900 nm). Primary detector centered at 90°. Other detectors located at other angles. An instrument algorithm uses a combination of detector readings to generate the turbidity reading.	0.012–1 000 FNU	0–40 FNRU ISO 7027 regulatory reporting
Surface Scatter Turbidimeters (SSU)	Turbidity is determined through light scatter from a defined volume beneath the surface of a sample. Applicable for reporting for EPA compliance monitoring.	Detector centered at 90 degrees relative to the incident light beam. Uses a “white light” spectral source.	0.012–10 000 FNRU	10–10 000 SSU
Formazin Nephelometric Turbidity Multibeam unit (FNMU)	Is applicable to EPA regulatory method GLI Method 2. Applicable to drinking water and wastewater monitoring applications.	Detectors are geometrically centered at 0° and 90°. An instrument algorithm uses a combination of detector readings, which may differ for turbidities varying magnitude.	0.012 to 4000 NTMU	0 to 40 NTMU Reporting for EPA and ISO compliane
Formazin Attenuation Unit (FAU)	Compliance Reporting for ISO 7027 for samples that exceed 40 units.	Uses a near-IR light source at 860 ± 30 nm and the detector is 0 degrees relative to the centerline of the incident light beam. The measurement is an attenuation measurement.	10–10 000+ FAU	100–10 000+ FAU Reporting for ISO 7027 for levels in excess of 40 units
Attenuation Unit (AU)	Not applicable for regulatory purposes. Best applied for samples with high-level turbidity.	Uses a white light spectral source (400–680 nm range). Detector geometry is 0° relative to the incident light beam.	10–10 000+ AU	100–10 000+ AU
Formazin Back Scatter (FBU)	Not applicable for regulatory purposes. Best applied to high turbidity samples. Backscatter is common probe technology and is best applied in higher turbidity samples.	Uses a near-IR monochromatic light source in the 780–900 nm range. Detector geometry is between 90 and 180° relative to the incident light beam.	10 000+ FBU	10 000 FBU
Forward Scatter Ratio Unit (FSRU)	The technology encompasses a single, light source and two detectors. Light sources can vary from single wavelength to polychromatic sources. The detection angle for the forward scatter detector is between 0 and 90–degrees relative to the centerline of the incident light beam.	The technology is sensitive to turbidities as low as 1 TU. The ratio technology helps to compensate for color interference and fouling.	The measurement of ambient waters such as streams, lakes, and rivers. The range is typically from about 1–800 FSRU, depending on the manufacturer.	Forward Scatter Ratio Unit (FSRU)