Interim Teledyne T640 Continuous PM2.5 Local Conditions Validation Templates

NOTE: This validation template attempts to provide the critical criteria; frequency and acceptance criteria for checks, calibrations, and maintenance; and verification/calibration standards recertification frequencies and acceptable ranges for the Teledyne T640 (FEM: EQPM-0516-236). This validation template was developed specifically for the Teledyne T640 through a collaboration between EPA, Teledyne, and SLT operators. The template lists criteria considered the most important. Criteria are established to ensure that data are complete, accurate, and comparable to filter-based FRMs. The Teledyne Advanced Pollution Instrumentation Model T640 PM Mass Monitor Automatic Equivalent Method: EQPM-0516-236 states "…and operated in accordance with the Teledyne Model T640 Operations Manual"; therefore, criteria, frequency, and acceptance ranges stated in the current manual are identified by ***bold*** and ***italics*** font. Criteria stated in the FEM designation are also in ***bold*** and ***italics*** font. More detailed information on the operation of the Teledyne T640 is available in *Standard Operating Procedure Teledyne Model 640 Real-Time Continuous PM Monitor* developed by EPA.

EPA requests that regions and monitoring organizations report back to OAQPS on significant data loss resulting from implementation of this template. As a reminder, the check frequencies listed in this document are minimal requirements; checks may be completed more frequently to minimize data loss.

Where appropriate, 40 CFR Part 58 App A and 40 CFR Part 50 App L requirements (also bold and italics) apply to the Teledyne T640; however, not all FRM criteria are considered critical due to the nature of the measurement principle and design of the instrument.

1) Criteria (T640)	2) Frequency	3) Acceptable Range	Information /Action
CRITICAL CRITERIA- T640 $PM_{2.5}$ Continuous, Local Conditions			
Sampler/Monitor Designation	NA	***Meets requirements listed in FEM designation*** Confirm method designation on front panel or just inside instrument.	1) 40 CFR Part 58 App C Sec. 2.1 2) NA 3) 40 CFR Part 53 & FRM/FEM method list
Firmware of monitor	***At setup and as updated***	***1. Must be the firmware (or later version) as identified in the published method designation summary.*** ***2. Firmware settings must be set for flowrate to operate and report at "local conditions" (i.e., not STP).***	1) FEM: EQPM-0516-236 2) EPA T640 SOP 3) 1. FEM: EQPM-0516-236 2. 40 CFR Part 50 App N. sec. 1 (c)
Data Reporting Period	Report every hour	1. The calculation of an hour of data is dependent on the design of the method. ***2. A 24-hour period is calculated in AQS if 18 or more valid hours are reported for a day [1].***	See operator's manual. Hourly data are always reported as the start of the hour on local standard time 40 CFR Part 50 App N. Sec 3 (c)
Sampling Instrument			

1) Criteria (T640)	2) Frequency	3) Acceptable Range	Information /Action
TSP Sampling Inlet	***At Setup***	***TAPI 5-Lpm sample inlet (P/N: 081050000)***	1) FEM: EQPM-0516-236 2) EPA T640 SOP 3) 1. FEM: EQPM-0516-236
One-point Flow Rate Verification	***every 30 days each separated by 14 days***	< ± 4.1% of ±5.0 LPM design flowrate	1, 2 and 3) 40 CFR Part 50, App.L, Sec. 9.2.5, 40 CFR Part 58, Appendix A Sec. 3.2.1
PMT verification	every 90 days	≤ ± 1.5 of SpanDust™ value stated on bottle	1) Teledyne T640 manual 2) EPA T640 SOP 3) To meet DQO set forth in 40 CFR Part 58, Appendix A Sec. 2.3.1.1
OPERATIONAL CRITERIA- T640 $PM_{2.5}$ Continuous, Local Conditions			
One-point Temp Verification	every 30 days	***< ± 2.1°C***	1) Teledyne T640 manual 2) EPA T640 SOP 3) Teledyne T640 manual
Pressure Verification	every 30 days	***< ± 10.1 mm Hg***	1) Teledyne T640 manual 2) EPA T640 SOP 3) Teledyne T640 manual
Leak Check (Zero Test)	every 30 days	***≤ 0.2 µg/m³***	1) Teledyne T640 manual 2) EPA T640 SOP 3) Teledyne T640 manual
Span Deviation Tracker	Daily	If flagged	1, 2 and 3) Recommended. Teledyne representatives suggest monitoring this metric as a leading indicator of potential instrument malfunction.
Signal Length	Daily	Logged	1, 2 and 3) Recommended. Teledyne representatives suggest monitoring this metric because it is useful when diagnosing instrument malfunction (e.g., deviation from design flow rate).
Annual Multi-point Verifications/Calibrations			
Pressure Verification/Calibration	on installation, then every 365 days and 1/calendar year	***< ± 10.1 mm Hg***	1) Teledyne T640 manual 2) Method 2.12 Sec. 6.5 3) Teledyne T640 manual
Flow Rate single-point Verification/ Calibration	***Electromechanical maintenance or transport or*** Every 365 days and 1/ calendar year	< ± 2.1% of transfer standard	1) 40 CFR Part 50, App.L, Sec. 9.2. 2) 40 CFR Part 50, App.L, Sec. 9.1.3, Method 2.12 Sec. 6.3 & Table 6-1 3) Recommendation
Precision			

1) Criteria (T640)	2) Frequency	3) Acceptable Range	Information /Action
Collocated Samples	***every 12 days for 15% of sites by method designation***	CV < 10.1% of samples ≥ 3 µg/m^3	1) and 2) 40 CFR Part 58 App A Sec. 3.2.3 3 Recommendation based on DQO in 40 CFR Part 58 App A Sec. 2.3.1.1
Accuracy			
Temperature Audit	every 180 days and at time of flow rate audit	< ± 2.1ºC	1, 2 and 3) Method 2.12 Sec. 11.2.2
Pressure Audit	every 180 days and at time of flow rate audit	< ±10.1 mm Hg	1, 2 and 3) Method 2.12 Sec. 11.2.3
Semi Annual Flow Rate Audit	***Twice a calendar year and 5-7 months apart***	< ± 4.1% of 5.0 LPM design flowrate	1 and 2) 40 CFR Part 58, App A, Sec. 3.2.2 3) Method 2.12 Sec. 11.2.1
Shelter Temperature			
Temperature range	during operation	**0 - 50°C**	1) Teledyne T640 manual 2) Recommendation 3) Teledyne T640 manual
Temperature Control	Daily (hourly values)	< 2.1º C SD over 24 hours	1, 2 and 3) QA Handbook Volume 2 Sec. 7.2.2
Temperature Device Check	every 180 days and twice a calendar year	< ± 2.1º C	1, 2 and 3) QA Handbook Volume 2 Sec. 7.2.2
Monitor Maintenance			
Inlet Cleaning	***every 30 days***	***cleaned***	1,2 and 3) Teledyne T640 manual
Downtube Cleaning	every 90 days	cleaned	1) Teledyne T640 manual 2 and 3) Method 2.12 Sec. 8.4
Inspect and clean optical chamber and relative humidity/temperature (RH/T) sensors	every 180 days and twice a calendar year. More frequently with high loading	cleaned	1) Teledyne T640 manual 2) EPA T640 SOP 3) EPA T640 SOP
Change Disposable Filter Unit	Annually or when Pump PWM value approaches 80%.	cleaned/changed	1) Teledyne T640 manual 2) EPA T640 SOP 3) EPA T640 SOP
Inspect Downtube and ASC to ensure vertically plumbed	every 90 days	***Plumb (90° from instrument horizontal axis)***	1) Teledyne T640 manual 2) Recommendation 3) Teledyne T640 manual
Check Pump Performance	every 30 days	***PWM value 30 < 80%***	1) Teledyne T640 manual 2) EPA T640 SOP 3) Teledyne T640 manual
Inspect inner and outer sample tubes	***every 30 days***	***Inspected Cleaned as needed***	1,2 and 3) Teledyne T640 manual
Manufacturer-Recommended Maintenance	per manufacturers' manual	per manufacturers' manual	
SYSTEMATIC CRITERIA- T640 $PM_{2.5}$ Continuous, Local Conditions			

1) Criteria (T640)	2) Frequency	3) Acceptable Range	Information /Action
Siting	every 365 days and once a calendar year	***Meets siting criteria or waiver documented***	1) 40 CFR Part 58 App E, Sec. 2-6 2) Recommendation 3) 40 CFR Part 58 App E, Sec. 2-6
Data Completeness	***Annual Standard***	***≥ 75% scheduled sampling days in each quarter***	1, 2 and 3) 40 CFR Part 50, App. N, Sec. 4.1 (a)(b)
	24- Hour Standard	***≥ 75% scheduled sampling days in each quarter***	1, 2 and 3) 40 CFR Part 50, App. N, Sec. 4.2 (a)(b)
Reporting Units	***all data***	***µg/m^3 at ambient temp/pressure (PM$_{2.5}$)***	1. 2 and 3) 40 CFR Part 50 App N Sec. 3.0 (b)
Rounding convention for data reported to AQS	***all concentrations***	***to one decimal place or as reported by instrument***	1. 2 and 3) 40 CFR Part 50 App N Sec. 3.0 (b)
Annual 3-yr average	***all concentrations***	***nearest 0.1 µg/m^3*** (≥ 0.05 round up)	1,2 and 3) 40 CFR Part 50, App. N Sec. 3 and 4 Rounding convention for data reported to AQS is a recommendation
24-hour, 3-year average	***all concentrations***	***nearest 1 µg/m^3*** (≥ 0.5 round up)	1,2 and 3) 40 CFR Part 50, App. N Sec. 3 and 4 Rounding convention for data reported to AQS is a recommendation
Verification/Calibration Standards Recertifications - All standards should have multi-point certifications against NIST Traceable standards			
Flow Rate Transfer Std.	every 365 days and once a calendar year	***< ± 2.1% of NIST Traceable Std.***	1) 40 CFR Part 50, App.L Sec. 9.1 & 9.2 2) Method 2.12 Sec. 4.2.3 & 6.3.3 3) 40 CFR Part 50, App.L Sec. 9.1 & 9.2
Field Thermometer	every 365 days and once a calendar year	± 0.1° C resolution, ± 0.5° C accuracy	1, 2 and 3) Method 2.12 Sec. 4.2.2
Field Barometer	every 365 days and once a calendar year	± 1 mm Hg resolution, ± 5 mm Hg accuracy	1, 2 and 3) Method 2.12 Sec. 4.2.2
Clock/timer Verification	Every 30 days	±5 min/mo**	1 and 2) Method 2.12 Sec. 4.2.1 3) Recommendation
Precision			
Single analyzer (collocated monitors)	every 90 days	Coefficient of variation (CV) < 10.1% for values ≥ 3.0 µg/m^3	1,2 and 3) Recommendation in order to provide early (quarterly) evaluation of achievement of DQOs.
Primary Quality Assurance Org.	***Annual and 3-year estimates***	***90% CL of CV < 10.1 % for values ≥ 3.0 µg/m^3***	1,2 and 3) 40 CFR Part 58, App A, Sec. 4.2.1 and 2.3.1.1
Bias			
Performance Evaluation Program (PEP)	***5 audits for PQAOs with ≤ 5 sites 8 audits for PQAOs with > 5 sites***	***< ±10.1% for values ≥ 3 µg/m^3***	1,2 and 3) 40 CFR Part 58, App A, Sec. 3.2.4, 4.2.5 and 2.3.1.1

SD= standard deviation , CV= coefficient of variation

**** = need to ensure data system stamps appropriate time period with reported sample value**