

Colorado Procedure 10 -14

Standard Practice for

Qualification of Testing Personnel and Laboratories

1. INTRODUCTION

1.1 This procedure defines the requirements for qualification of people and laboratories. Specifically, all persons and all laboratories conducting tests used in mix design or acceptance must be qualified. Laboratories conducting Independent Assurance (IA) inspections for CDOT must be accredited and the people conducting these inspections must be certified.

2. SAMPLING AND TESTING PERSONNEL QUALIFICATIONS

2.1 All persons conducting or supervising tests used in mix design, acceptance, or IA must be qualified. The personnel conducting or supervising tests for the contractor's QC Program must be qualified. This includes mix design testing, verification testing by CDOT and designated agents (private laboratories), testing conducted by contractors and vendors and used in the acceptance decision (QC-For-Pay), and IA testing by CDOT and designated agents. The requirements to be qualified are stated below.

2.2 The person with overall responsibility for the sampling and testing on construction projects (the Project Engineer or Resident Engineer for CDOT and the Quality Control Supervisor if non-CDOT) shall be a registered Professional Engineer in the State of Colorado or possess a National Institute for Certification of Engineering Technologies (NICET) Level III Certificate in Highway Materials or Construction Materials with the soil, concrete, and asphalt sub-fields.

2.2.1 Pursuant to Section 12-25-102(10) of the Colorado Revised Statutes all mix designs shall be sealed by a registered Professional Engineer in the State of Colorado.

2.3 Persons performing sampling and testing used in the mix design, acceptance decision, QC, or IA testing shall be qualified by meeting the requirements listed in Table 10-1 and possessing current certifications.

2.3.1 To operate a nuclear device, CDOT personnel must possess a current certificate indicating that they have satisfactorily completed CDOT's School of Radiological Safety and Nuclear Gauge Operation. Non-CDOT operators of nuclear gauges must be certified as required by their company's Radioactive Materials License, issued by the Colorado Department of Public Health and Environment.

2.4 *New Employees:* New employees not qualified in accordance with Subsection 2.3 may conduct acceptance tests under the direct, day-to-day, supervision of an employee that is qualified (in accordance with Subsection 2.3) to conduct those tests. The maximum time period of supervised testing by any one non-qualified employee for each item is indicated in Subsection 2.4.2. Additional conditions that must be met are listed in Subsection 2.4.1. Note that these provisions do not apply to nuclear testing.

2.4.1 *Qualified Supervisor:* The qualified supervisor shall train the new employee, if needed, and then confirm in writing that this employee is capable of performing the tests in accordance with the standards. This written confirmation shall contain the following: identity and signature of the qualified supervisor, name and previous experience of the new employee, the time spent training the new employee, the tests for which the new employee is qualified, and the date the new employee will begin mix design or acceptance testing. The written confirmation shall be delivered to and approved by the Region Materials Engineer before the new employee performs mix design or acceptance tests. The qualified supervisor shall be present on the testing site at least once each day the new employee is conducting tests to closely oversee and check the work of the new employee. The qualified supervisor shall co-sign each test report and worksheet produced by the new employee. The close day-to-day supervision shall continue until the new employee is qualified by meeting the requirements of Subsection 2.3.

2.4.2 Time Limits for Acceptance Testing by Non-qualified New Employees:

2.4.2.1 *Soils Testing*: A maximum of 2 calendar months of continuous testing before qualification is required. Accumulation of time is not allowed.

2.4.2.2 *HMA Testing*: A maximum of two calendar months of continuous testing before qualification is required. Accumulation of time is not allowed. Inexperienced employees (less than one year of documented experience) performing testing on HMA shall successfully complete the Asphalt Construction QC/QA Technician Education course provided by the Rocky Mountain Asphalt Education Center (303-741-6148) before seeking certification.

2.4.2.3 *Concrete Testing*: A maximum of six calendar months of continuous testing before qualification is required. Accumulation of time is not allowed.

3. LABORATORY QUALIFICATION PROGRAM

3.1 The purpose of the Laboratory Qualification Program is to verify that laboratories conducting testing used in mix design or the acceptance decision are qualified. All laboratories conducting tests used in mix design or the acceptance decision must be qualified before construction of items requiring testing by that lab. Testing used in the acceptance decision includes verification testing by CDOT and designated agents of CDOT, plus QC testing by contractors and vendors.

3.2 All laboratories conducting testing used in mix design or the acceptance decision must meet the following requirements. CDOT and designated agent laboratories conducting verification testing, and contractors and vendors conducting QC testing used in the acceptance decision are included.

3.2.1 Laboratory Inspections:

3.2.1.1 *CDOT Laboratories*: The Region Materials Engineer or his designee shall conduct an inspection of each project laboratory before mix design or verification testing begins. The Central Laboratory may conduct random Field Laboratory inspections during project construction. The inspection shall be documented using the *Field Lab & Personnel Qualification Checklist* and any supplemental lists deemed necessary. The Region Materials Engineer, his designee, or the

Central Laboratory Inspection Coordinator shall indicate on the checklist whether or not the laboratory is qualified. If the laboratory has been determined to not be qualified, the deficiencies will be corrected to the satisfaction of the Region Materials Engineer. Project construction involving items subject to mix design or verification testing shall not begin until the laboratory conducting these tests is determined to be qualified. The Resident Engineer, in cooperation with the Region Materials Engineer, shall be responsible for assuring that CDOT owned project testing equipment is acceptable for mix design or verification sampling and testing.

3.2.1.2 *Designated Agent Laboratories*: All designated agent laboratories shall be part of the AASHTO accreditation program such as AASHTO Materials Reference Laboratory (AMRL) or Cement and Concrete Reference Laboratory (CCRL) in all of the tests performed. The Region Materials Engineer shall conduct or direct a designated representative to conduct an inspection of each designated agent laboratory used in verification testing before testing begins. The Central Laboratory may conduct random Field Laboratory inspections during project construction. The inspection shall be documented using the *Field Lab & Personnel Qualification Checklist* and any supplemental lists deemed necessary. The Region Materials Engineer, his designated representative, or the Central Laboratory Inspection Coordinator shall indicate on the checklist whether or not the laboratory is qualified. If the laboratory is determined to not be qualified, the deficiencies will be corrected to the satisfaction of the Region Materials Engineer. Project construction involving items subject to verification testing shall not begin until the laboratory conducting these tests is determined to be qualified. A designated agent may not conduct an inspection for qualification of its own laboratory. The laboratory shall participate in the CDOT round robin program for the required tests and achieve a score of 3.0 or better. Scores below a 3.0 will require approved corrective action and possible retesting.

3.2.1.3 *Contractor and Vendor Laboratories*: The Region Materials Engineer or his designated representative may conduct an inspection of each Contractor or vendor laboratory before QC testing used in the mix design or acceptance decision begins. If the inspection is performed it shall be documented using the *Field Lab & Personnel Qualification*

Checklist and any supplemental lists deemed necessary. The checklist shall indicate if the laboratory is qualified in all required tests. If the laboratory is determined to not be qualified, the deficiencies will be corrected to the satisfaction of the Region Materials Engineer. If the Contractor or vendor laboratory is used for mix design testing and is not AASHTO accredited, the laboratory shall participate in the CDOT round robin program for the required tests and achieve a score of 3.0 or better. Scores below a 3.0 will require approved corrective action and possible retesting. Testing conducted before the laboratory is determined to be qualified may not be used in the acceptance decision. Contractor or vendor laboratories used in QC-for-Pay projects shall be qualified in accordance with this subsection.

3.2.2 Calibration Checks: All laboratories performing mix design, verification testing, or QC testing used in acceptance shall conduct calibration checks at the minimum frequencies required by the test procedure, equipment operating guides, or Calibration Schedule included in the Field Materials Manual's Inspections (Central -> Region) Chapter. The results of these calibration checks shall be documented on the appropriate forms and retained for a period of seven years. The calibration check documentation shall be made available to the Region Materials Engineer or the Project Engineer upon request.

3.2.3 Lab Personnel Qualifications: All laboratories performing mix design, verification testing, or QC testing used in the acceptance decision shall maintain documentation of the qualification of all laboratory personnel. This documentation shall indicate that all laboratory personnel are qualified for all the tests they conduct. This documentation shall be current and available at all times for review by the Project Engineer and the Region Materials Engineer.

3.3 If the laboratory performing the mix design, verification testing, or QC used in the acceptance decision is AASHTO accredited in the tests performed, it may be exempted from the above requirements for inspection and calibration checks.

4. INDEPENDENT ASSURANCE (IA) LABORATORY REQUIREMENTS

4.1 The CDOT Central Laboratory, the Region Materials Laboratories, and designated

agent laboratories conducting Independent Assurance (IA) inspections and testing shall conform to the following requirements.

4.1.1 Central Lab and Designated Agents: The CDOT Central Lab and designated agents conducting IA testing shall be AASHTO accredited in accordance with the requirements of Section 5.

4.1.2 Region Materials Labs: An inspection of each Region Materials Laboratory shall be made annually by personnel from the Central Materials Laboratory, as per Subsection 9.2.1.2 of the QA Procedures Chapter. Equipment Verification Checks will be made on equipment used for IA testing including ovens, scales, and balances.

4.1.3 All laboratories performing IA testing shall conduct equipment verification checks twice a year on all equipment used in IA testing during that period. The results of those checks shall be in accordance with AASHTO R 18 and documented on the appropriate forms and retained for a period of seven years.

5. ACCREDITATION

5.1 CDOT Central Laboratory and Designated Agent Inspection: The CDOT Central Lab and designated agents conducting IA testing for CDOT will be inspected periodically by National Reference Laboratories (AMRL and/or CCRL) and will maintain accreditation by the AASHTO Accreditation Program.

5.1.1 The test procedures covered by the designated agent accreditation shall include all IA tests that the designated agent will conduct or observe for CDOT.

5.1.2 AASHTO Materials Reference Laboratory (AMRL) and Cement and Concrete Reference Laboratory (CCRL) Inspection Reports:

5.1.2.1 All AMRL and CCRL inspection reports from inspections conducted on the Central Materials Laboratory will be retained and made available to the FHWA upon request.

5.1.2.2 All AMRL and CCRL inspection reports from inspections conducted on designated agents that conduct IA testing for CDOT will be retained and made available to CDOT upon request.

5.1.3 Deficiencies Identified in AMRL or CCRL Inspection Reports:

5.1.3.1 Deficiencies indicated in the AMRL or CCRL inspection reports for inspections conducted on the CDOT Central Materials Laboratory or on designated agents conducting IA testing for CDOT will be corrected at the earliest opportunity and documentation of the corrective action sent to AMRL or CCRL.

5.1.4 Proficiency Samples Ratings:

5.1.4.1 CDOT Central Laboratory or designated agent laboratory AASHTO Proficiency Samples with a rating of less than 3 (2 Standard Deviations) will be investigated to determine the cause of the low ratings and corrective action taken to prevent future occurrences. These corrections will be reported, in writing, to AMRL or CCRL within 60 days of the receipt of the deficient rating.

5.2 Local Agencies shall have IA inspections conducted by an AASHTO accredited laboratory in accordance with the conditions of Subsection 7.4 of the Quality Assurance Procedures Chapter of the Field Material Manual (FMM). The local agency must confirm that the Accredited Laboratory meets all appropriate criteria.

6. INSTRUCTIONS FOR USE OF THE – FIELD LAB & PERSONNEL QUALIFICATION CHECKLIST

GENERAL

6.1 Lab Cleanliness & Housekeeping - The field-testing lab is generally clean and organized to the point where it will not affect test results.

6.2 Equipment Cleanliness & Functionality - The field-testing equipment is clean and in good working order, with no broken or partially repaired parts that would have a detrimental effect on the test results.

6.3 Calibration Checks & Personnel Qualification - Documentation of the calibration checks must be readily available in the field-testing lab, being both complete and up-to-date. This includes calibration checks of scales, ovens, water baths (concrete & bulk), and thermometers. Equipment verification such as sieve examinations, measurements of air meters, slump cones, cylinder molds, beam

molds, etc. should also be documented. The qualifications of each person in the lab who conduct the tests are documented, being both current and available.

6.4 Scales, Accurate & Level - Verify scales have been checked with a reference weight in accordance with AASHTO M 231 and are level on the testing face.

6.5 Ovens, Accurate Temperatures (140°, 230°, 275°, & 300°F) - Verify that oven thermostats are maintaining the temperature of the 140°F ± 5° (60°C ± 2.8°) oven, 230°F ± 9° (110°C ± 5°) oven, 275°F ± 5° (135°C ± 2.8°) oven, and the 300°F ± 5° (149°C ± 2.8°) oven.

6.6 Thermometer(s) Accurate - Conforming to the requirements of ASTM. The thermometers shall be capable of reading 77°F by 0.2°F (25°C by 0.1°C), 140°F by 0.2°F (60°C by 0.1°C), 230°F by 1°F (110°C by 0.5°C), 275°F by 2°F (135°C by 1°C), and 300°F by 2°F (149°C by 1°C).

6.7 Sieves - In good repair, and checked with comparator. Sieves conform to ASTM E 11 and have been checked with a certified comparator in accordance with ASTM E 11. Verify that there are no visible holes, dents, wire marks, etc. in the sieves or any sagging of the sieve.

6.8 Current and Updated CDOT Materials Forms. CDOT Form #250 (Materials Documentation Record) and Form #379 (Project Independent Assurance Sampling Schedule) are filled out and complete as of the date of the inspection.

6.9 Equipment and Lab Facility supplied by the Contractor meet the M Standards (M-620-11 or M-620-12) or the specification for the project for which the lab is being supplied.

6.10 Aggregate splitter complies with ASTM C 702 for the correct number of opening and the size of openings. Splitter does not have visible signs of excessive wear, i.e., splitter openings broken, dented, welds detached, etc.

6.11 Shaker - Sieving Adequacy Test Performed. Verify the correct aggregate sieving time by running the sieving adequacy test defined in CP 31, ASTM C 136, and AASHTO T 27. Verify that the sieve shaker can hold an entire set of sieves, (10 + catch pan).

CONCRETE

6.12 Curing tanks for concrete cylinders and beams contains lime-water at the correct temperature, $73^{\circ}\text{F} \pm 1.8^{\circ}$ ($23^{\circ}\text{C} \pm 1^{\circ}\text{C}$) in accordance with ASTM C 31. Verify the recording thermometer is present and is correct in accordance with ASTM C 31.

6.13 Verify that all Concrete Testing Equipment meets the appropriate requirements: Air meter (ASTM C 231), Slump Cone (ASTM C 143), Unit Weight (ASTM C 138), Cylinder Molds (ASTM C 31), and Beam Molds (ASTM C 78).

6.14 Verify that the Concrete Compression Machine has been calibrated for concrete cylinders, ASTM C 39, and for beams (if tested), ASTM C 78, and has a current (yearly) certified calibration sticker on the machine. Verify that the neoprene pads meet ASTM C 1231 and have been checked for wear and logged for the number of breaks on each pair of pads (maximum of 100 uses per pad). Verify the loading rate of the Concrete Compression Machine and that it meets the ASTM C 39. Verify that calibration records for the Concrete Compression Machine are available and up to date in accordance with ASTM E 4.

ASPHALT

6.15 Verify that a square splitting pan and square sided scoop are being used for asphalt sampling and splitting in accordance with CP 55.

6.16 Verify that CP 51 is being followed for determination of Maximum Specific Gravity (Rice). Verify that manometer is free of air bubbles, vacuum pump oil is free of water, desiccating crystals are free of moisture, flasks have been calibrated in accordance with CP 51 and "D" weights have been logged. Verify that vacuum pump pressure can be maintained at 28 ± 2 mm of mercury.

6.17 Verify that CP 44 is being followed for determination of Bulk Specific Gravity. Bulk tank is at the correct temperature, $77^{\circ}\text{F} \pm 1.8^{\circ}$ ($25^{\circ}\text{C} \pm 1^{\circ}$). Suspension line is of the smallest possible diameter at the water surface (and there are no knots at the surface).

NUCLEAR

6.18 Verify that nuclear gauges are stored and secured properly as required by the Radioactive Materials License. Verify that the Caution Radioactive Materials placard, the Notice to Employees document, and the Nuclear Incident Procedure sheet (filled out with responsible individual(s) names and phone numbers) are posted correctly. That the daily gauge logs are filled out and current, and the Moisture / Density Gauge has been calibrated as specified. Consultant M/D Gauges will be certified within the last 12 months and CDOT M/D Gauges will be calibrated within the last 24 months. Verify that Statistical Stability and Drift tests have been run before the start of the project and whenever requested by the Project Engineer.

SOILS

6.19 Verify that soils and base course equipment meet the corresponding AASHTO requirements and that the correct hammers and molds, designated in AASHTO T 99 and T 180, are used. Verify that the atterberg limit equipment is calibrated properly and is within specification in accordance with AASHTO T 89 and T 99. Verify that the #4 riddle meets the AASHTO E 11 standards by using a comparator, micrometer, or other calibrated measuring device. Verify that the compaction base is of sufficient mass (> 90 kg) and that a suitable area for compaction is available in accordance with AASHTO T 99 and T 180.

AASTHO Test Designation	ASTM Test Designation	CDOT Test Designation	Test Description	ACI Concrete Field Testing Technician Grade I	ACI Aggregate Testing Technician - Level 1	ACI Aggregate Testing Technician - Level 2	ACI Concrete Lab. Testing Tech. Grade I (G) - Level 1 (L) – Both (B)	ACI Concrete Lab. Testing Tech. Grade II (G) - Level 2 (L) – Both (B)	ACI Concrete Strength Testing Technician	WAQTC Embankment & Base Excavation & Embankment – Soil s Inspector	LABCAT A	LABCAT B	LABCAT C	LABCAT E
T 246		CPL 5106	Hveem Stability										X	
T 283		CPL 5109	Resistance to Moisture Induced Damage										X	
	C 1231		Unbonded Caps for Concrete Cylinders				B		X					
	C 39		Compressive Strength of Cylindrical Concrete Specimens				B		X					
	C 617		Capping Cylindrical Concrete Specimens				B		X					
	C 1064		Temperature of Freshly Mixed Hydraulic-Cement Concrete	X										
	C 172		Sampling Freshly Mixed Concrete	X										
	C 143		Slump of Hydraulic-Cement Concrete	X										
	C 138		Density, Yield and Air Content (Gravimetric) of Concrete	X										
	C 231		Air Content of Freshly Mixed Concrete by Pressure Method	X										
	C 31		Making and Curing Concrete Test Specimens in the Field	X										
	C 42		Obtaining and Testing Drilled Cores and Sawed Beams					B						
	C 78		Flexural Strength of Concrete (Using Simple Method with Third-Point Loading)				L	G	X					
T 224		CP-23	Correction for Coarse Particles in the Soil Compaction Test							X				
T 310		CP 80	In-Place Density and Moisture Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)							X				
T 89			Determining the Liquid Limits of Soils							X *				
T 90			Determining the Plastic Limit and Plasticity Index of Soils							X *				
T 99 T 180			Moisture Density Relations of Soils							X				

* Those only seeking an inspection certification need only pass the excavation and embankment exam.

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Field Lab & Personnel Qualification Checklist – 13

Project No. _____ Project Code _____

Project Location: _____

Consultant/Field Tester _____ Project Engineer _____

Qualified Laboratory? Yes No General Impression _____

Region Inspection of Project Field Lab Region Inspection of Contractor Lab

Region Inspection of Consultant Lab

GENERAL

- 6.1 Lab Cleanliness & Housekeeping. (Good/Fair/Poor) _____
- 6.2 Equipment Cleanliness & Functionality. (Good/Fair/Poor)..... _____
- 6.3 Calibration Checks & Personnel Qualification, Documents present & complete.(Y/N/NA) _____
- 6.4 Scales-Accurate & Level. (Y/N/NA)..... _____
- 6.5 Ovens-Accurate Temperatures (140°, 230°, 275°, 300EF). (Y/N/NA) _____
- 6.6 Thermometer(s)-Accurate. (Y/N/NA)..... _____
- 6.7 Sieves - Good repair, and checked w/ comparator. (Y/N/NA) _____
- 6.8 Current CDOT Materials Forms. (Y/N/NA)..... _____
Forms up-to-date (# 250 & # 379, and all others). (Y/N/NA)..... _____
- 6.9 Equipment & Lab facility supplied by Contractor meet Specifications. (Y/N/NA)..... _____
- 6.10 Aggregate Splitter - Correct # of openings. (Y/N/NA) _____
Correct size openings. (Y/N/NA) _____
- 6.11 Shaker-sieving adequacy performed. (Y/N/NA)..... _____
Holds full set of sieves (10 + catch pan). (Y/N/NA)..... _____

Comments: _____

CONCRETE Applicable. (Y/N) _____

- 6.12 Concrete curing water at correct temperature. (Y/N/NA) _____
Recording thermometer present and operating. (Y/N/NA)..... _____
- 6.13 Concrete Testing Equipment:
 - Air Meter Calibrated. (Y/N/NA) _____
 - Slump Cone Dimensions are accurate. (Y/N/NA)..... _____
 - Strike off plate for Unit Wts is accurate. (Y/N/NA)..... _____
 - Approved Cylinder/Beam Molds. (Y/N/NA)..... _____
- 6.14 Concrete Compression Machine:
 - Calibrated for Cylinders/Beams. (Y/N/NA) _____
 - Neoprene Pads checked/logged. (Y/N/NA)..... _____
 - Correct Loading Rate. (Y/N/NA)..... _____
 - Calibration records present. (Y/N/NA)..... _____

Comments: _____

ASPHALT Applicable. (Y/N)

- 6.15 Square Splitting Pan for Asphalt. (Y/N/NA).....
- Square Sided Scoop for Asphalt. (Y/N/NA).....
- 6.16 Maximum Specific Gravity (RICE) set up. (Y/N/NA)
- Manometer free of air. (Y/N/NA)
- Pump oil free of water. (Y/N/NA).....
- Desiccating crystals free of water. (Y/N/NA)
- Flasks calibrated and logged. (Y/N/NA)
- Vacuum Pump Pressure at 28 ± 2 mm Hg. (Y/N/NA)
- 6.17 Bulk Specific Gravity Equipment:
 - Tank at Correct Temperature. (Y/N/NA).....
 - Suspension line of smallest diameter. (Y/N/NA).....

Comments:

NUCLEAR Applicable. (Y/N)

- 6.18 Nuclear Gauge Stored Properly & Secured. (Y/N/NA).....
- Caution Radioactive Materials placard posted correctly. (Y/N/NA).....
- Nuclear Incident Procedures filled out. (Y/N/NA)
- Daily Gauge Logs filled out. (Y/N/NA)
- M/D Gauge Certified. (Y/N/NA)
- Stat & Drift Test performed. (Y/N/NA)

Comments:

SOILS Applicable. (Y/N).....

- 6.19 Soils & Base Equipment:
 - Hammers & Molds within specification. (Y/N/NA).....
 - Atterburg equipment within specification. (Y/N/NA).....
 - #4 Riddle within specification. (Y/N/NA)
 - Compaction base of sufficient mass (>90 Kg). (Y/N/NA)

Comments:

PERSONNEL

Tester 1 (Name / Title)	Required (Y or N)	Certification	Expiration MM-DD-YY
		ACI Concrete Field Testing Technician Grade I	
		ACI Aggregate Testing Technician – Level 1	
		ACI Aggregate Testing Technician – Level 2	
		ACI Concrete Laboratory Testing Technician Grade I or ACI Concrete Lab. Testing Tech. Level 1	
		ACI Concrete Laboratory Testing Technician Grade II or ACI Concrete Lab. Testing Tech. Level 2	
		ACI Concrete Strength Testing Technician	
		WAQTC Embankment & Base Excavation & Embankment – Soils Inspector	
		LabCAT A	
		LabCAT B	
		LabCAT C	
		LabCAT E	

Tester 2 (Name / Title)	Required (Y or N)	Certification	Expiration MM-DD-YY
		ACI Concrete Field Testing Technician Grade I	
		ACI Aggregate Testing Technician – Level 1	
		ACI Aggregate Testing Technician – Level 2	
		ACI Concrete Laboratory Testing Technician Grade I or ACI Concrete Lab. Testing Tech. Level 1	
		ACI Concrete Laboratory Testing Technician Grade II or ACI Concrete Lab. Testing Tech. Level 2	
		ACI Concrete Strength Testing Technician	
		WAQTC Embankment & Base Excavation & Embankment – Soils Inspector	
		LabCAT A	
		LabCAT B	
		LabCAT C	
		LabCAT E	

Comments: _____

Inspected by: _____ **Date** _____ **Region** _____ **Materials Lab**

Approved by: _____ **Date** _____
 Project Engineer

- Distribution: () Region Materials Engineer - Original
 () Resident Engineer
 () Project Engineer
 () Field Lab Tester

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