



ByMMT.com

Massachusetts Materials Technologies LLC

167 Prospect Street, Unit 4
Waltham, MA 02453
617-502-5636
HSD@ByMMT.com

REV	DATE	CHANGE	PREPARED	REVIEWED
00	180205	Initial release	PPP	BMW
01	190216	Add appendices	PPP/SDP	BMW
02	190524	Staff IA and Staff IB programs	SDP	PPP

MMT Testing Services Training Program

1. Overview

This document details the Massachusetts Materials Technologies (MMT) testing service training program for material verification. Testing services include the use of MMT instruments on projects that are conducted in laboratories, laydown yards, warehouses, or field environments.

Program Objectives: The objectives of this training program are as follows:

1. Promote general work safety and organization
2. Ensure consistency in the work performed and reliability of the data collected
3. Enable the field teams to provide quality and timely testing services

Program Components: This document describes the testing program accreditation levels, requirements, procedures, and methods for tracking technician performance. The program includes the following components, which are described in detail later in this document.

- **Accreditation Levels:** Accreditation levels are used to differentiate technicians based on their training, experience, and responsibilities during testing service projects.
- **Pre-Training Requirements:** Pre-training provides a background on general safety principles for field and laboratory work, and a technical overview of MMT instruments. Pre-training requirements should be met before attending the MMT Technician Training Class.
- **MMT Technician Training Course:** This 2-day course details the principles of MMT technologies, describes MMT field testing procedures, and provides hands-on training with all essential equipment and software. The training course is mandatory for any technician who wants to use MMT instruments on testing service projects.
- **HSD Simulation and Troubleshooting Course:** This 8-day course provides in-depth application of the HSD Tester and provides extended hours of hands-on experience. Simulated troubleshooting and field conditions are taught and exercised to mimic in-ditch scenarios. This course is required for technicians to expedite their Staff II accreditation by reducing the required supervised testing service hours.
- **Supervised Testing Services:** Supervised testing services are used to provide direct supervision of technician performance early in the training program by a more qualified and experienced technician. Supervised projects are mandatory until a technician has achieved the necessary requirements for a higher accreditation level.

- **Accreditation Exams:** Written and oral exams are used to test the competency of technicians before they can achieve each level of accreditation. Significant updates or revisions to procedures or equipment will require re-accreditation.
- **Reporting Feedback:** The reporting feedback program is intended to provide quality control and assurance of all data that is collected during testing services completed with MMT instruments. Reporting feedback provides a quantitative evaluation of technicians for each testing service project. A technician that does not meet performance requirements for their accreditation level will result in remedial actions.
- **Audits:** Audits will be periodically performed for accredited technicians to ensure consistent performance and quality.
- **In-Ditch Evaluation:** 5-day evaluation of implementation of MMT testing procedures in-ditch. Required for technicians who proceed through the Staff IB route. Evaluation performed by Staff III.

2. Accreditation Levels

The MMT accreditation levels are detailed below, and summarized in Table 1

- **Trainee:** Technicians in the process of completing the necessary pre-training requirements and MMT technician training course. Trainees cannot operate MMT equipment except under the direct supervision of a technician that is Staff II or higher.
- **Staff IA:** Technicians that have successfully completed pre-training requirements, the MMT technician training class, and passed the Staff I accreditation exam. Staff IA technicians are qualified to use MMT instruments for supervised testing services. A Staff I technician cannot complete a testing service project unless under the supervision of a technician that is Staff II or higher.
- **Staff IB:** Technicians that are certified as ASNT Level II or higher and have successfully completed pre-training requirements, the MMT technician training class, passed the Staff I accreditation exam, and completed the HSD Simulation and Troubleshooting Course. Staff IB technicians are qualified to use MMT instruments as the acting lead technician through an expedited supervised testing program consisting of 5 days of testing services that are audited by a Staff III technician.
- **Staff II:** Technicians that have met the required hours of approved supervised testing service work (300 hours for Staff I or 5 testing service days for Staff IB), received positive reviews and endorsement from their supervising technicians, and passed the Staff II accreditation exam. Staff II technicians are qualified to perform testing services independently or act as the supervisor to a Staff I technician during supervised testing services. Staff II technicians are also required to verify the quality of testing service data that is provided to the reporting group and interact with customer representatives to complete JSA and CTS documentation (if applicable). A minimum performance rating from reporting feedback must be exceeded to maintain Staff II accreditation.
- **Staff III:** Technicians that have completed at least 1000 hours of approved testing services, have exceeded the minimum performance rating requirements from reporting

feedback, and have passed the Staff III accreditation exam. In addition to the Staff II qualifications, Staff III technicians are qualified to maintain and repair MMT instruments, lead the MMT Technician Training Class, audit other technicians on testing service projects, and conduct remedial training for a technician that has failed to meet performance requirements from reporting feedback. Staff III technicians must exceed a minimum performance rating from reporting feedback to maintain Staff III accreditation.

Table 1: Summary of the requirements and qualifications for MMT accreditation levels

Level	Requirements to Complete	Qualifications
Trainee	None	- Learn fundamentals of technology and procedures
Staff IA	- Pre-training - MMT Technician Training Course - Pass Staff I Accreditation Exam	- Assist technicians that are Staff II or higher during supervised testing services
Staff IB	- Pre-training + ASNT Level II or higher certification - MMT Technician Training Course - Pass Staff I Accreditation Exam - HSD Simulation and Troubleshooting course	- Work as lead technician for at least 5 field testing service jobs that are audited by Staff III technician
Staff II	- Staff IA: 300 hours of approved supervised testing services - Staff IB: 5 testing service jobs as acting lead technician with Staff III supervision - Endorsement and positive reviews of performance from supervising technicians - Pass Staff II Accreditation Exam	- Supervise Staff I during testing services - Verify testing service data quality and provide to MMT reporting group - Complete JSA and CTS documents - Perform independent testing services
Staff III	- 1000 hours of approved testing services - Meet minimum performance requirements through reporting feedback - Pass Staff III Accreditation Exam - Formally receive certification from existing Staff III	- All Staff II responsibilities - Repair and maintain MMT instruments - Lead MMT Technician Training Class - Administer Accreditation Exams - Conduct remedial training or audits

3. Pre-training Requirements

Pre-training requirements provide general information on safety and MMT technologies. Before attending the MMT Technician Training Class, the items below must be completed. Some of this information will be part of accreditation examinations that must be passed before using MMT instruments for testing services.

- OSHA 10 hour training
- Review MMT safety manual
- Review MMT technology primer
- Review MMT testing procedures (MMT001-006)
- Review MMT employee handbook (if full-time MMT employee)
- ASNT Level II or higher certification (**REQUIRED for Staff IB Program**)

4. MMT Training Courses

4.1 MMT Technician Training Course (MANDATORY)

The MMT Technician Training Class educates technicians on all the essentials for implementing MMT instruments for testing services. Prior to attending the course, the technician must complete all pre-training requirements. After the successful completion of the class and the passing of a written examination, the technician will achieve Staff I accreditation for the use of MMT instruments through Supervised Testing Services. The 2-day curriculum will cover the items below. A detailed description is provided in Appendix A.

- Principles of MMT technologies like the Hardness, Strength, and Ductility (HSD) Tester for material verification of steel pipelines
- Principles of longitudinal seam determination for flash-welded, submerged-arc-welded (SAW), and electric-resistance-welded (ERW) pipe joints
- Principles of steel metallography to examine heat-affected-zones near welded connections and grains of microstructure
- Use of grinding tools to prepare an initially corroded surface to a 2000 grit mirror finish, and additional surface preparation steps for metallographic examination.
- Use of etching solution to measure size of heat-affected-regions near welds and to expose grains in a steel microstructure
- Use of portable microscope for recording high magnification images of the steel microstructure
- Use of ultrasonic thickness (UT) gauges for informational wall thickness measurements that can be used to locate longitudinal seams or identify a seamless pipe joint
- Implementation of the Visible Wet Contrast magnetic particle examination technique for detection of defects and discontinuities that is used to qualify testing locations
- Use of die grinder to remove burrs or shavings of steel material that are sent to a laboratory for chemical analysis.
- Use of MMT software for data acquisition and data processing
- Use of HSD tests for calibration, base metal testing, and seam determination
- Application of MMT testing service procedures

4.2 HSD Simulation and Troubleshooting Course (OPTIONAL)

The HSD Simulation and Troubleshooting course provides extended education on all aspects of implementing MMT instruments for testing services. Prior to taking this course, it is required that the technician has already been certified as ASNT Level II or higher, completed the MMT Technician Training Course and passed the Staff I accreditation exam. The 8-day curriculum will cover all the items covered in the Staff I accreditation course and implement them through simulated in-ditch testing and data collection with the HSD and associated equipment. The course will include independent use of the HSD Tester, including testing on pipe diameters ranging from 8 to 30 inches, grain imaging and burr sampling, and data uploading and organization. The course will incorporate troubleshooting scenarios and technicians will accumulate more than 50 hours of supervised testing through this program. Once the course is complete, supervisors will provide

feedback on the technician's performance and ultimately decided whether to endorse the technician for the Staff IB certification.

5. Supervised Testing Services

Supervised testing services are intended to allow the Staff I technician to gain competency with MMT instruments and field procedures under the supervision of a technician that is Staff II or higher. The extent of supervised testing services required to reach Staff II eligibility is dependent on whether the technician is a Staff IA or Staff IB, as described below:

- **Staff IA requirements:** To increase from a Staff IA to Staff II, 300 total hours of supervised testing services is required, with at least 100 hours as the "acting" lead technician on testing service projects. As an acting lead, the Staff I technician will handle the responsibilities of a Staff II technician by verifying the quality of testing service data that is provided to the reporting group and interacting with customer representatives to complete JSA and CTS documentation at the site. The supervising Staff II or Staff III technician will intervene if improper or inadequate procedures are followed during this time.
- **Staff IB requirements:** To increase from a Staff IB to Staff II, the technician must complete 5 days of testing services as the lead technician. These days will be audited by a Staff III technician who will intervene if improper or inadequate procedures are followed during this time.

When the requirements for supervised testing services are reached, the supervisors over this time period will provide feedback on the technician's performance during this period and ultimately decided whether to endorse the technician for the Staff II level. All supervisor feedback will be evaluated on a case-by-case basis prior to administering the Staff II accreditation exam. Negative feedback and lack of endorsement may result in an increase in the number of supervised testing service hours required to be eligible for taking the Staff II accreditation examination.

6. Accreditation Exams

The following describes topics to be included in the accreditation level exams.

- **Staff I:** 45 questions, multiple choice. The test is administered at the end of the MMT Technician Training Class. The test will cover basics from each MMT procedure learned.
- **Staff II:** 45 questions, multiple choice. The test is administered after the technician has reached at least 300 hours of approved supervised testing services or has completed the HSD simulation and troubleshooting course. The Staff II test is more detailed than the Staff I exam, and includes questions related to basic HSD troubleshooting, data processing, and data reporting. An oral exam is also performed by a Staff III.
- **Staff III:** 100 questions, multiple choice with a hands-on component. The test is administered after the technician has reached at least 1000 hours of approved testing services while exceeding the necessary minimum performance rating from Reporting Feedback for a Staff II. The test will contain advanced questions regarding theory, HSD operation, and troubleshooting.

Significant updates or revisions to procedures or equipment will require re-accreditation. The scope of the re-accreditation process will depend on the update or revision.

7. Reporting Feedback

The reporting feedback program is intended to provide quality control and assurance of all data that is collected during field testing services with the HSD Tester. This information will be used to track the performance of individual technicians. Performance data will then be used to ensure that technicians meet a minimum expectation on testing service projects related to, (1) documentation and procedures, (2) HSD base metal tests, (3) welded seam characterization, (4) removal of burr samples for chemical analysis, (5) surface metallography for grain structure, and (6) overall performance. Reporting feedback is applied to Staff II and Staff III technicians who are qualified to review the data that is collected and provided to the MMT reporting team. These Staff II and Staff III technicians are responsible for the performance of any Staff I technician. If a technician's performance rating falls below the minimum for a given accreditation level, they will need to be re-trained for any deficient categories and will then enter a probationary period to maintain their accreditation. If the technician fails to maintain performance during the probation period, they will have their certification level downgraded or revoked. Reporting feedback is considered before the promotion of a Staff II technician to a Staff III technician. An example of reporting feedback is provided in Appendix B.

8. Audits and Evaluations

Periodic audits will be conducted for all technician accreditation levels to ensure consistent data collection, procedure compliance, and quality assurance. Audits can only be conducted by a Staff III technician. Remedial action resulting from a nonconformance identified during an audit will be promptly implemented. The results of the audit will be recorded and maintained for each technician. For Staff IB technicians, audits are mandatory for 5 days of testing service projects to meet the supervised testing service requirements for Staff II accreditation.

Appendix A – MMT Technician Training Class Curriculum

A detailed description of the course is described below:

Day 1

- **Field procedure and documentation:** Instructor and trainee review in-ditch procedures relating to measurements and documentation and discuss issues and notable items encountered in field situations. Instructor provides an overview on how to find a longitudinal seam weld and how to organize data for collection and reporting.
- **Surface prep:** Instructor demonstrates proper surface prep. Trainee successfully preps 3 pipes including one with substantial pitting. Surface prep is evaluated by trainer.
- **Microstructure etching:** Instructor demonstrates surface polish and metallographic imaging procedure on pipes tested on Day 1. Trainee successfully prepares the grain microstructure of 3 regions and evaluates with field microscope.
- **Chemistry:** Instructor demonstrates how to use die grinder. Employee removes enough material for each test location on 3 pipes from day 1.
- **HSD introduction and calibration test:** Overview of HSD Tester is presenter. Instructor walks trainee through completing calibration test.

Day 2

- **Review of all procedures:** Instructor recaps all procedures from previous day.
- **HSD testing:** Detailed overview of HSD tester, tensile testing, and methodology presented. Instructor walks trainee through completing pipe test. Once walk through is complete trainee will assist instructor on testing 2 pipes of various sizes (from surface prep training) and then will test the third pipe from Day 1 with assistance from the instructor. All tests must pass the pass/fail criteria.
- **In-ditch testing simulation evaluation:** Trainee will perform all MMT procedures to complete testing on a pipe with known properties to demonstrate competency in main tasks learned on prior days. Instructor will evaluate trainee on all MMT procedures.
- **Staff I Exam:** Written test for Staff I accreditation

Appendix B – Reporting Feedback

The reporting feedback program is intended to provide quality control and assurance of all data that is collected during field testing services with the HSD Tester. This information will be used to track the performance of individual technicians. Reporting feedback is also used to document issues with specific HSD units or software on different projects to track the frequency and severity of problems.

Procedures

After a report has been prepared and reviewed by the reporting group for a testing service project, the “Testing Service Project Feedback Form” is completed by the reviewer of the project. This document contains the following.

Technician Evaluation: The reporting feedback provides a quantitative evaluation and constructive comments to the field technicians in the following areas:

- *Documentation and General Procedures:* All necessary data was collected and promptly uploaded to Google Drive. Field notes were fully completed and accurate. HSD calibration and other field procedures were correctly followed.
- *HSD Base Metal Tests:* The appropriate number of reliable HSD tests on the pipe surface were collected. Additional tests were performed if required, such as due to a failed test or adjacent base metal tests that differed by more than 5 ksi in strength prediction.
- *Welded Seam Characterization:* For flash-welded, submerged-arc-welded (SAW), or double-submerged-arc-welded (DSAW) samples, the characteristic weld reinforcement was documented with field images. For electric-resistance-welded (ERW) samples, a reliable HSD test across the weld was performed with notes defining the distance from the start of the test to the bondline. ERW samples also require reliable images of the etched surface on the welded seam so that the size and features of the apparent heat-affected-zone can be documented.
- *Chemical Composition:* If shavings were used, the correct procedures were followed to obtain the required mass of material for laboratory testing, and the samples were shipped within the required amount of time after the project was completed. For Spark Optical Emission Spectroscopy (OES), the unit was calibrated before testing, and the proper procedures were followed.
- *Surface Metallography:* The required number of reliable images of the steel microstructure were obtained, with quality lighting, contrast, etching time, and minimal surface scratches.
- *Overall Rating:* The overall rating is an unweighted average of each category above.

HSD Tester Problem Indicators: Another component of the reporting feedback is to identify HSD Tester or software problems to document issues. These should be logged on the field notes by

the technicians during the project and will be used to track the prevalence and severity of issues with the HSD Tester or software. The feedback form includes the following problem indicators:

- *Contact styluses*: Indications of stylus wear, a stylus that did not fall within the expected range during calibration tests, or a stylus that consistently showed a poor fit during testing.
- *Profilometer assembly*: Profilometer issues will affect the groove dimensions for the two styluses that it profiles during testing. Issues could be related to the motor, wiring, or profilometer stylus wear which may be diagnosed by seeing 2 styluses on the same profilometer falling outside the expected range during calibration tests.
- *Load cells*: Load cell problems could be related to improper load cell zeroing, wiring, or sensor problems.
- *EB unit*: EB unit areas could be related to loose connections or damaged components.
- *Software*: Software problems include errors or warnings that are observed while using the data acquisition or data processing software.
- *Other*: Any other system or component, such as mounting, drive motors, ratchet straps, and more.

Implementation

Performance data will be periodically collected and summarized in the “Testing Service Performance Log”. The performance log includes a tab that provides details for every project completed, including basic job information, field technician performance, and HSD Tester problem indicators. The other tab in the performance log is a summary of the performance ratings for individual field technicians which averages the scores over all projects for a given reporting period.



Massachusetts Materials Technologies LLC
 167 Prospect Street, Unit 4
 Waltham, MA 02453
 617-502-5636
 HSD@byMMT.com

MMT Testing Service Feedback

Instructions:

This document is completed at the end of every testing service project, and is distributed to the field crew members and reporting group when final reports are submitted to the customer.

Ratings are calculated for each component of the field testing program and range from 0% (unacceptable) to 100% (perfect)

The final performance evaluation is an equally weighted average of each testing service component rating

HSD Tester problem indicators are not scored, but indicate maintenance to the unit that may be required

Job Information (Lead technician is boxed)						
MMT Project ID:	NAT18050		Lead tech:	RP	Field tech:	DB
Customer:	National Grid		Site location(s):	Hanscom AFB, MA, 01731		
Start Date:	10/23/2018	End Date:	10/24/2018			
Testing Service Feedback						
Reviewed by:		Parth Patel and Steven Palkovic		Note: "S" Indicates Satisfactory, "U" Indicates unsatisfactory		
1. Documentation and General Procedures						
U	Field data was promptly and completely uploaded to Team Drive\Data\01_Active				50%	Rating
S	All necessary field images were collected (site overview, dig overview, test quadrants, weld images)					
U	Field notes were fully completed and accurate					
S	All calibration and field procedures were followed correctly					
Reviewer comments:	GPS coordinates were not accurate, and one of the field notes was partially completed. Field data was uploaded more than 1 week after testing was completed.					
2. HSD Base Metal (BM) Tests						
4	Number of samples tested	0	Number of improper/incomplete	100%	Rating	
Reviewer comments:						
3. Welded Seam (WD) Characterization						
3	Number of welded seams tested	0	Number of improper/incomplete	100%	Rating	
Reviewer comments: Only 1 seam HSD test was completed, but there was insufficient room or seam indications for the remaining 2 samples. These issues were properly communicated to the reporting group during field testing. Provide more etched seam images.						
4. Chemical Composition (Burr Samples or Spark OES)						
S	Burrs properly collected & shipped	N/A	Spark OES properly collected	100%	Rating	
Reviewer comments:						
5. Surface Metallography for Grain Size						
4	Number of samples tested	0	Number of improper/incomplete	100%	Rating	
Reviewer comments: Images were slightly under-etched, but lighting was perfect.						
Final Performance Summary						
		1	2	3	4	5
		50%	100%	100%	100%	100%
						90%
HSD Tester and Software Problem Indicators						
U	Contact styluses	S	Profilometer assembly	S	Load cells	
S	EB unit	S	Software	S	Other	
Reviewer comments: Stylus 3 had a poor fit throughout testing. This was correctly discussed with reporting group, but needs to be looked at.						
General Comments						

Figure 1: Example of the MMT Testing Service Feedback Form