



Process Approval and Personnel Qualification for Ultrasonic Testing of Resistance Spot Welds

1 Introduction

Note: Nothing in this procedure supersedes applicable laws and regulations unless a specific exemption has been obtained.

Note: In the event of a conflict between the English and domestic language, the English language shall take precedence.

1.1 Purpose. This document provides requirements for qualification of the personnel performing ultrasonic testing and for the selection and qualification of the resistance spot-welded components that can be ultrasonically tested.

1.2 Foreword. It is recognized that the effectiveness of Ultrasonic Testing (UT) applications depends upon the capabilities of test equipment, the personnel performing the test, the specific metal combinations under test and weld process setup itself. UT may not be appropriate for certain applications, material combinations, thickness, joint geometries, weld processes, or testing environments

1.3 Applicability. This standard provides the basis for using an IRT ScanMaster Systems, swi series spot-weld inspection instrument within General Motors' assembly and metal fabricating plants. UT of resistance spot welds may only be used provided the process has been approved and the personnel have been qualified according to this standard (reference GM9621P).

1.4 Definitions. Terms included in this document are defined as follows:

Critical Accuracy. The ability to exclusively detect discrepant welds. The number of discrepant welds called discrepant divided by the total number of discrepant welds in the sample.

1.5 Overall Accuracy. The number of correct decisions divided by the total number of decisions.

1.6 Experience. Work activities accomplished in UT under the direction of qualified supervision including the performance of UT and related activities but not including time spent in organized training programs.

1.7 Ultrasonic Testing (UT). A process using ultrasonic technology that involves the inspection, testing, or evaluation of materials, components and assemblies for materials' discontinuities, properties and machine problems without further impairing or destroying the parts' serviceability.

1.8 OEM Trainer. A company or individual who represents the UT original equipment manufacturer (OEM) and provides UT training services.

1.9 UT Inspection Plan. The standardized work and ultrasonic procedure that is programmed into an automatic calling system.

2 References

Note: Only the latest approved standards are applicable unless otherwise specified.

2.1 External Standards/Specifications.

None.

2.2 GM Standards/Specifications.

GM4488M

GM9621P

3 Levels of Personnel Qualification

Note: Individuals that are in training and have not yet qualified shall be considered trainees. Trainees shall not independently conduct, interpret, evaluate, or report UT results.

3.1 UT Operator. UT Operators shall be qualified to properly perform approved UT inspection plans. In addition, they shall be able perform functional verification of UT equipment, to install or change ultrasonic probes, to make gain adjustments within prescribed limits, and to generate reports.

3.2 UT Programmer. UT Programmers shall be capable of setting up equipment, programming and qualifying UT Inspection Plans, and conducting Measure of Agreement Studies. These individuals shall be thoroughly familiar with the UT equipment. Programmers are responsible for on-the-job training of trainees and Operator support. It is the responsibility of the UT Programmer to Program UT inspection plans and to conduct the Process Approval Procedure (Section 4).

4 Process Approval Procedure

4.1 Process Selection. The UT Programmer shall select and evaluate each proposed application or component for suitability for UT. The following factors should be considered:

- a) The business case for UT on the component.
- b) The metal combinations being welded.
- c) Weld access and part orientation.
- d) Weld appearance and weld surface quality.

4.2 Develop Baseline UT Inspection Program.

The UT Programmer shall prepare and program a baseline UT inspection plan that includes basic machine setup and decision parameters for each weld. The inspection plan shall also contain the weld spot identification and order or sequence of weld checks, including graphic displays if needed.

4.3 Adjustments to UT Inspection Program.

In preparation for the Measure of Agreement Study, the UT Programmer shall study the response of the inspection program (to known discrepant welds), and make any necessary adjustments to the UT inspection plan. For this step, weld panels may be either actual production parts, weld coupons, or special parts welded under artificial process conditions.

4.4 Measure of Agreement Study (200-3000 Welds). A Measure of Agreement Study must be conducted to assure that the UT test results agree with destructive testing. The study is to be conducted on actual production parts (SAMPLED RANDOMLY, WITH NO WELD PROCESS ADJUSTMENTS OR UT PROGRAM ADJUSTMENTS). If the UT inspection program is modified at this stage the Measure of Agreement Study must be restarted. The results

of the Measure of Agreement are to be recorded using Appendix A spreadsheet.

There are two categories of process approval for spot weld UT. These are Categories A & B.

4.4.1 Category A Chisel Test Substitution, GM9621P. A component or application and the corresponding UT Inspection Plan is considered an approved method for In-Process Inspection, provided a Measure of Agreement Study has been completed and the following criteria have been met:

- a) Critical Accuracy equal to or greater than 80%
- b) Overall Accuracy equal to or greater than 90%.
- c) Measure of Agreement Study contains a total weld sample size of 200-3000 welds (or 50 assemblies) and a minimum of 20 undersize or breaking welds (refer GM4488M, section 4).

4.4.2 Category B - Peel Test Substitution, GM9621P. A component or application and the corresponding UT Inspection Plan is considered an approved substitute for Weld Destruct Test provided a Measure of Agreement Study has been completed and the following criteria have been met:

- a) Critical Accuracy equal to or greater than 95%
- b) Overall Accuracy equal to or greater than 90%.
- c) Measure of Agreement Study contains a total weld sample size of 200-3000 welds (or 50 assemblies) containing a minimum of 20 welds discrepant for size (refer GM4488M section 4).

4.5 Deviation For Highly Robust Weld Processes. If random production sampling of 3000 welds does not capture at least 20 welds discrepant for size, then the following deviation may be applied in order to complete the Measure of Agreement Study (CONDUCTED PER PARAGRAPH 4.4):

DEVIATION: "The quantity of study welds may be supplemented using a random portion of welds from step 4.3, in order to bring the discrepant quantity to a minimum of 20."

5 Personnel Qualification Procedure

5.1 Qualification Record. Candidates for qualification in UT shall have sufficient training and work experience to ensure qualification. The fulfillment of these requirements is to be documented for all UT personnel, using the form in Appendix B or an equivalent qualification record.

Note: Successful completion of UT training includes passing grades on written and hands-on examinations.

5.2 UT Operator Training and Work Experience.

- Successful completion of GM-approved training for UT Operators.
- 100 hours work experience in UT within a 2-month period.
- Demonstrated hands-on proficiency with the UT instrument, (refer to paragraph 3.1).

5.3 UT Programmer Training and Work Experience.

- Successful completion of GM approved training for UT Operators.
- Successful completion of GM approved OEM training for UT Programmers.
- 500 hours work experience in UT within a 12-month period, or ASNT Level II certification.
- Demonstrated hands-on proficiency with the UT instrument, (refer to paragraph 3.2).

5.4 Examination Criteria

5.4.1 UT Operator Examinations Operator Examinations shall be administered by either the UT Trainer, or by a qualified UT Programmer. Written Examinations shall cover basic UT theory and practice as it relates to the job elements described in paragraph 3.1. Written Examinations shall also cover the GM specification for spot weld acceptance criteria (GM4488M), and the GM procedure for welding process control (GM9621P).

Written Examinations shall be closed book except that data, such as graphs, tables, specifications, or procedures, may be provided with the examination. Questions using such reference materials shall require an understanding of the information rather than merely locating the appropriate answer.

Hands-on Examinations shall address the equipment, procedures and UT techniques that the individual may encounter during specific work assignments and the job elements described in paragraph 3.1.

Those failing to attain passing grades (70% minimum) may receive suitable additional training as determined by the UT Trainer before re-examination.

5.4.2 UT Programmer Examinations. UT Programmer Examinations shall be administered by the GM-approved OEM Trainer.

Written Examinations shall cover basic UT theory and practice as it relates to the job elements described in paragraph 3.2.

Written Examinations shall be closed book except that data, such as graphs, tables, specifications, or procedures, may be provided with the examination. Questions using such reference materials shall require an understanding of the information rather than merely locating the appropriate answer.

Hands-On Examinations shall address the equipment, setup and programming procedures and Measure of Agreement Studies and required record keeping.

Those failing to attain passing grades (70% minimum) may receive suitable additional training as determined by the OEM Trainer before re-examination.

5.5 Performance Re-evaluations. UT personnel may be reexamined any time at the discretion of GM management and have their qualification extended or revoked.

5.6 Interrupted Service. A qualified UT Operator, whose UT use is interrupted by three months or longer, shall have his/her qualification status revoked, pending re-orientation and re-qualification through a hands-on examination administered by the UT Trainer or plant UT Programmer.

A qualified UT Programmer, whose UT use is interrupted by twelve months or longer, shall have his/her qualification status revoked, pending re-orientation and re-qualification through a hands-on examination administered by the UT Trainer or another plant UT Programmer.

6 Release and Revisions