

Materials & Tests Unit



Standard Operating Procedures Inspection of Guardrail

Objectives:

The purpose of this SOP is to establish guidelines for the inspection, the acceptance and the reporting of Guardrail and anchor units. The SOP is designed to insure all inspectors/technicians follow the same procedures and comply with all NCDOT, ASTM and AASHTO specifications. The inspectors/technicians will insure quality control techniques, quality control records, and testing equipment are being followed.

This SOP is a quick reference guide and does not cover any specialty items. Inspection of the specialty items will require the technician to reference the project plans or contract special provisions.

Materials Inspection and Acceptance:

It is Mandatory for inspectors/technicians to follow the process of this SOP in order to establish, manage and monitor quality control, quality assurance and quality documentation. Following the proper Inspection process will ensure effectiveness and efficiency in the quality systems of the NCDOT.

1. Periodically review the Guardrail Inspection SOP.
2. Review Section 862 of the NCDOT Standard Specifications and AASHTO M 180
3. Review contract special provisions and/or plans for type of guardrail and anchor units to be inspected.
4. **No inspection will be made without Bill of Lading.**
5. All guardrail inspections will be inspected after installation.
6. Pre-Inspection Process
 - a. M&T technician will be contacted by Engineer or project inspector administrating the contract to inspect guardrail and/or anchor units.
 - b. Determine the location and amount of guardrail and/or anchor units to be inspected.
 - c. Technician will record approximate locations of rail and/or anchor to be inspected on Guardrail Field Worksheet.
 - d. Review contract special provisions and/or project plans for type of rail and anchor units to be inspected.

- Alternates for the anchor units will be listed in the contract special provisions.
 - Installation plans and parts list will be furnished by installer for each style of anchor unit.
 - FHWA approval letter will be furnished with each type of anchor unit.
- Guardrail inspections should be completed after material is installed, and when requested by the Engineer and or project inspector.
 - All materials must come from an Approved NCDOT Manufacturer and participate in the Departments Brand Registration program.
 - All materials and installation must meet [Section 862](#) of the 2012 NCDOT Standard Specifications and AASHTO M 180
 - Rail elements and terminal sections shall meet AASHTO M 180 for Class A, Type 2 unless otherwise specified.

Here is a list of units that can be installed in NC:

GRAU-350

- ET Plus – TL-3 and TL-2
- SKT-350 – TL-3 and TL-2
- X-Tension - TL-3
- X-Lite – TL-3

M-350

- FLEAT – TL-3 and TL-2
- SRT-350 – TL-3 and TL-2
- X-Tension
- X-Lite

Safety Equipment List:

Safety Shoes with ANSI Z 41 rating
 Hard Hat with ANSI Z89.1 rating
 Safety Vest
 First Aid Kit
 Safety Glasses (optional)
 Ear Plugs (optional)
 Sun Block (optional)
 Lifting Belt (optional)
 Dust Mask (optional)
 Poison Ivy Wash (optional)

Safety Concerns:

Vehicular Traffic
 Sharp Edges
 Heavy Equipment/Backing Incidents

Equipment Required for Guardrail Inspection:

Tape Measure
Magna gage (Calibrated Annually by Materials and Tests Unit Chemical Lab)
Micrometer
Calculator
Pen and Pencil
Guardrail Inspection Field Worksheets

M&T Inspector's Duties for Guardrail Inspection:

- a. Guardrail Inspection (Straight Rail)
 1. Test lot for straight rail is 25 LF for every 2000 LF or fraction thereof.
 2. Technician will randomly select a 25 LF section of rail for inspection for every 2000 LF of installed rail.
 3. Technician will perform triple spot inspection for zinc coating, gage thickness, poor workmanship, dimensions and damage. All posts, blocks, bolts and nuts will also be inspected in this section. Technician will record these readings along with heat or coil #'s on the Guardrail Field Worksheet.
 4. Technician shall then perform a random inspection along the 500 LF lot for zinc coating, gage, dimension, damage and poor workmanship. Single spot measurements for zinc coatings are allowed for this random inspection.
 5. If any failures are determined in these sections then a closer interval of the inspection is warranted.
- b. Guardrail Inspection (Shop Curve Rail)
 1. Test lot for shop curve rail is 12.5 LF for every 500 LF or fraction thereof.
 2. Technician will randomly select a 12.5 LF section of shop curve rail for every 500 LF or less of shop curve rail.
 3. Technician shall perform a triple spot inspection for zinc coating, gage thickness, poor workmanship, dimensions and damage. All posts, blocks, bolts and nuts will also be inspected at this section. Technician will record these readings along with heat/coil # on the Guardrail Field Worksheet.
 4. Technician shall then perform a random inspection along the 100 LF lot for zinc coating, gage, workmanship, dimensions and damage. Single spot measurements for zinc coatings are allowed for this random inspection.
 5. If any failures are determined with either of the inspections than a closer interval of the inspection is warranted.
- c. Guardrail Inspection (Anchor Units)
 1. Test lot for anchor units are a minimum of 50 % or fraction of for each type of anchor unit installed.
 2. Technician will randomly select anchor units for inspection.
 3. Technician will perform a triple spot inspection for zinc coating, gage thickness, poor workmanship, dimensions and damage. All posts, blocks, bolts and nuts will also be inspected at this unit. Technician will record these readings along with heat/coil # on the Guardrail Field Worksheet.
 4. Technician shall then perform a random inspection at each selected anchor unit for zinc coating, gage, workmanship, dimensions and damage. Single spot measurements for zinc coatings are allowed for this random inspection.

- If any failures are determined with the inspections than a closer interval of the inspection is warranted.

d. Inspection of Zinc Coating

- There are two methods in determining the weight of zinc coatings.
- The single spot method requires a reading with the magna gauge in the front of an item and reading again on the back in the same location.
- The triple spot method requires the identical reading as a single spot except the triple spot is an average of three readings on the back and the average of three readings on the front.
- Technician shall use a calibrated magna gauge to measure zinc coatings in the field.
- Minimum allowed zinc coating for guardrail and anchor units in oz. per sq. ft..

<u>Item</u>	<u>Single Spot</u>	<u>Triple Spot</u>
Rail	3.60 oz.	4.00 oz.
Post	1.80 oz.	2.00 oz.
Bolts & Nuts	1.00 oz.	1.25 oz.
Washers	1.00 oz.	0.85 oz.

- The magna gauge measures or reads in mils. Technician will perform a calculation to convert mils into ounces per square foot. An example of the calculations are below:

<u>Front of Rail</u>	<u>Back of Rail</u>
3.6	3.6
3.4	3.2
<u>+ 3.5</u>	<u>+ 3.3</u>
10.5 = total	10.1 = total

- Total the number of readings from both sides
Example: $10.5 + 10.1 = 20.6$
- Divide the total by the number of single spot readings to get the average.
Example: $20.6 / 3 = 6.9$ mils

Note: Technician will enter the average mils on the Hicams Guardrail FIR report for acceptance not ounces of zinc coating.

- To convert average mils to ounces square foot divide by 1.7 mils/ounces square foot
Example: $6.9 / 1.7 = 4.1$ ounces foot squared **Meets Specs.**
- Determine if each side has minimum of 40% (AASHTO M 180) of the required zinc coating by averaging the readings on each side and dividing by 1.7 mils and then compare with the required minimum of 1.6 mils

Example: Front = $(10.5 / 3) / 1.7 = 2.1$
Back = $(10.1 / 3) / 1.7 = 2.0$

- If a discrepancy arises with zinc coating on rail then slugs are to be taken randomly from the heat/coil number in question. A minimum of three slugs per heat number will be taken and sent to NCDOT Materials and Tests Chemical Lab.
- If a discrepancy arises with zinc coating on bolts, nuts or washers. A sample shall be taken with a minimum of three each and sent to Materials and Tests Chemical Lab.
- If a discrepancy arises with zinc coating on a material that cannot be slugged or sampled. The SMS and/or AME will be contacted for an investigation of the material in question.
- If zinc coating is damaged from shipping or installation then repair damaged coating in accordance with [Article 1076-7](#) of the NCDOT Standard Specifications.

e. Gage

1. Technician will take gage readings with a micrometer.
2. All measurements will be recorded on the Guardrail Field Worksheet.
3. Below is a list of common guardrail items used in the NCDOT. Some of the materials listed may have to be inspected per AASHTO M 180, installation plans, project plans or special provisions.
 - Rail= 12 gage (.109" with minimum thickness of .100")
 - Shop Curve Rail= 12 gage (.109" with minimum thickness of .100")
 - Transitions= 12 gage (.109" with minimum thickness of .100")
 - Bridge/End Shoes= 10 gage (.138" with minimum thickness of .100")

f. Dimensions

1. Technician will take measurements with a tape measure.
2. All measurements will be recorded on the Guardrail Field Worksheet.
3. Below is a list of common rail items used in the NCDOT. Some of the materials may have to be inspected per AASHTO M 180, installation plans, project plans or special provisions.
 - "W" beam rail = 12-1/4" width (+- 1/4")
 - Thrie or Triple corrugated beam rail = 20" width (+- 1/4")
 - W Posts = W6 x 8.5 or W6 x 9.0 (8.5 & 9.0 represents lbs. per LF)
 - C-shape Posts = 4.5" x 6.0"
 - Anchor Units = Check dimensions with installation plans (These will be furnished by installer)

Standards:

NCDOT Standard Specifications Section 862
AASHTO M 180

Sample Prep and Submittal:

All inspections must be entered into Hicams under Field Inspection Report (FIR) within two working days. Listed below are screen shots on Hicams concerning entry of a Guardrail Field Inspection Report.

Filter

Contract: Material Type: (All)

Report Name: Guardrail Inspected By:

Report ID: Section: 11 Inspection Date: 00/00/0000

Report Status: In Process Inspection Result: (All)

Test Category: (All)

Retrieve
Reset
ins
in
New

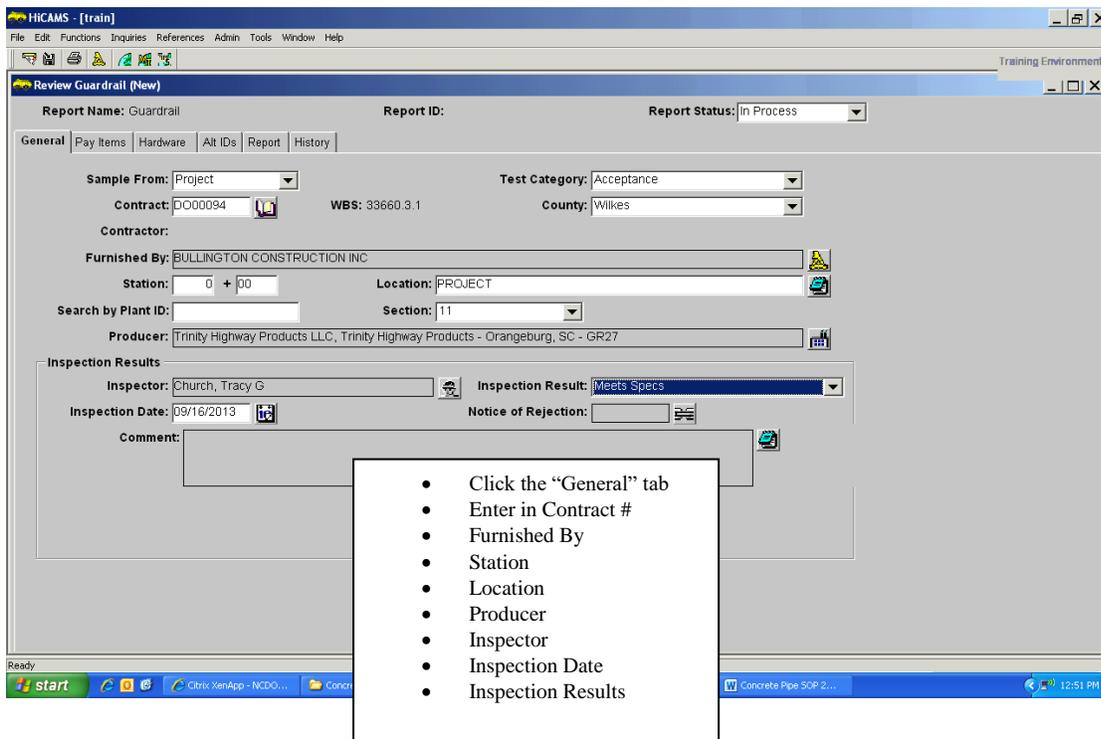
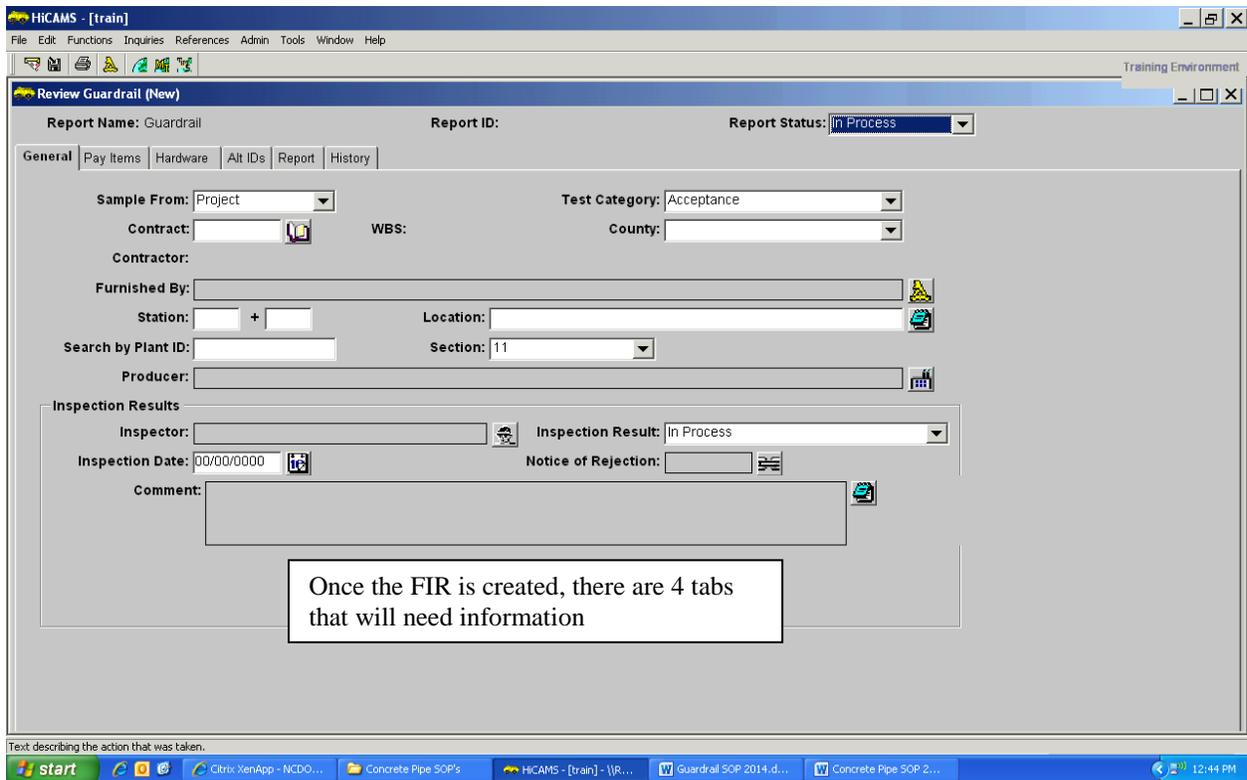
Report Name	Report ID	Contract	Material Type	Inspector	Inspection Date	Section	Inspection Result	Report Status	Test Category
Guardrail	49140	C202810		Whitley, Christop	10/31/2013	11	Meets Specs	In Process	Acceptance
Guardrail	41623	C202729		McLain Jr, Raefor	08/17/2012	11	Meets Specs	Unauthorized	Acceptance

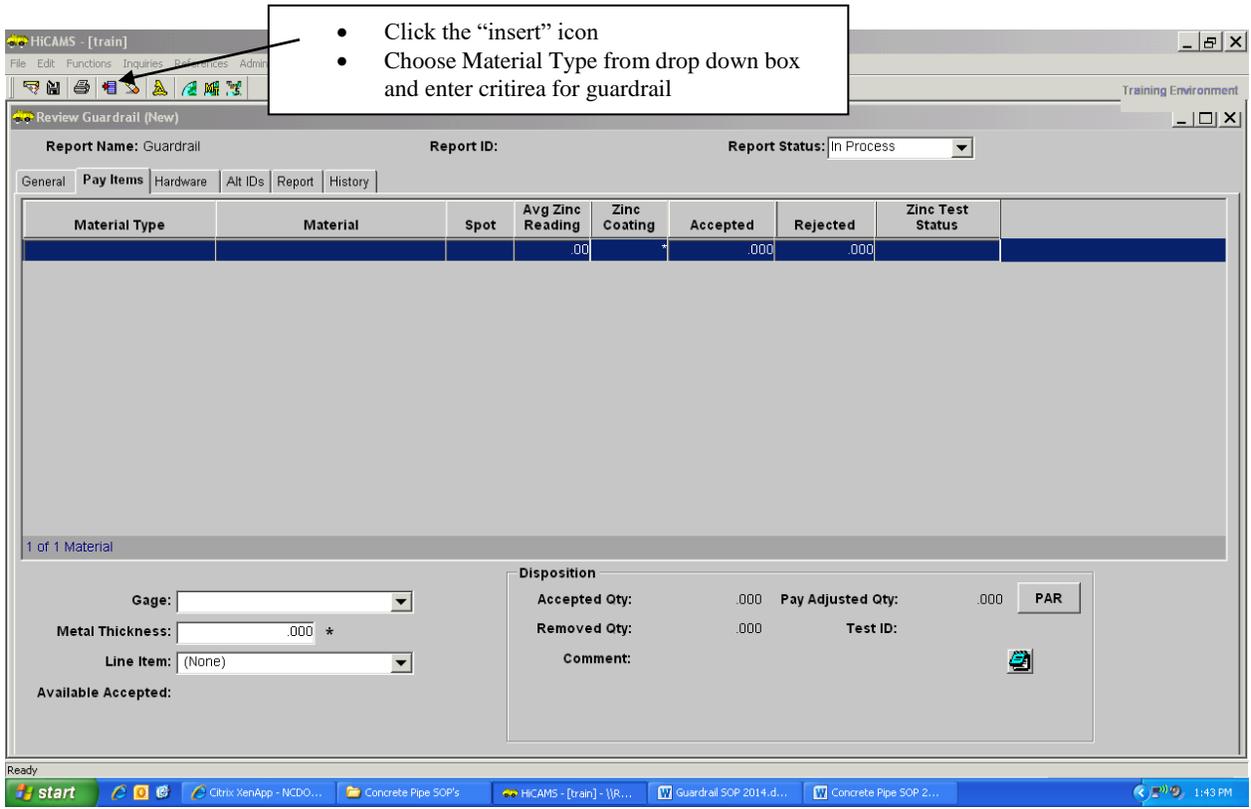
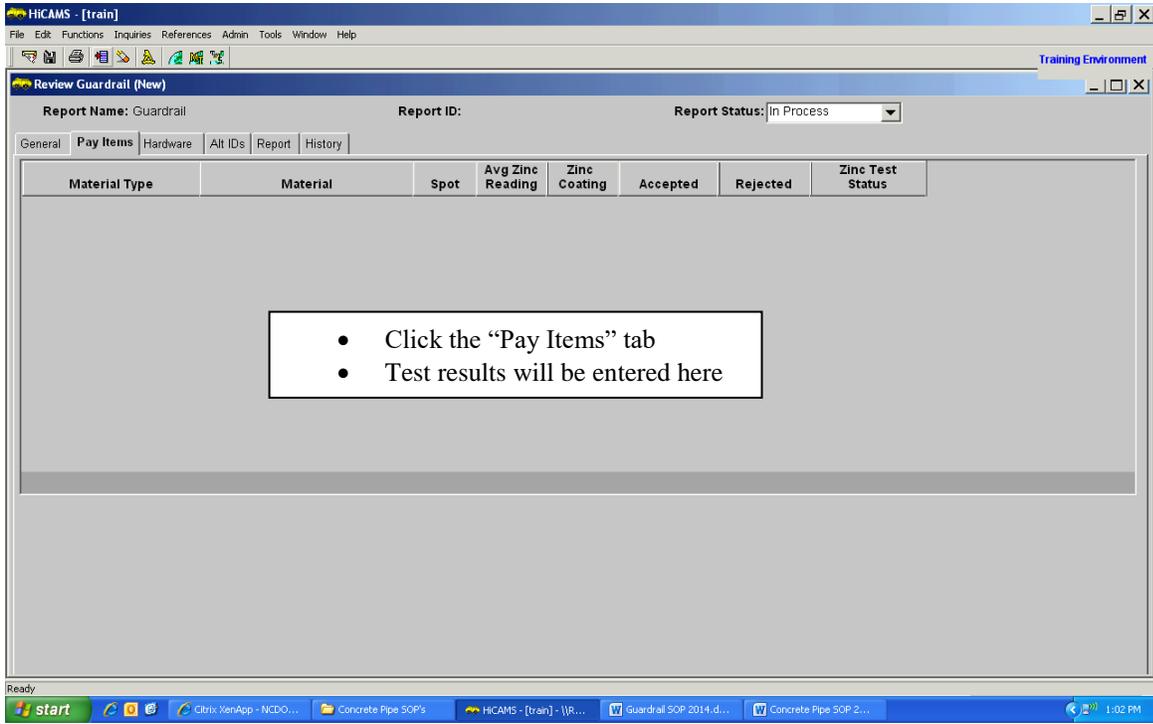
1 of 2 FIR

Details NOR Save As

Click to add a new Field Inspection Report

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Review Guardrail (New)

Report Name: Guardrail Report ID: Report Status: In Process

General | **Pay Items** | Hardware | Alt IDs | Report | History

Material Type	Material	Spot	Avg Zinc Reading	Zinc Coating	Accepted	Rejected	Zinc Test Status
Guardrail, Steel Beam - English	Guardrail, Steel Beam- Linear Feet	Triple	7.23	4.25	325.000	.000	Meets Specs
Guardrail, Steel Beam - English	Guardrail, Steel Beam, Shop Curved-	Triple	7.08	4.16	25.000	.000	Meets Specs
Guardrail Anchor Unit - Both	Guardrail Anchor Units, Type 350- Ea	Triple	7.67	4.51	3.000	.000	Meets Specs
Guardrail Anchor Unit - Both	Guardrail Anchor Units, Type AT-1- E	Triple	7.52	4.42	1.000	.000	Meets Specs
Guardrail Anchor Unit - Both	Guardrail Anchor Units, Type B-77- E	Triple	7.43	4.37	4.000	.000	Meets Specs

5 of 5 Material

Gage: 12 - English

Metal Thickness: .109

Line Item: 17 - GR ANCHOR TYPE B-

Available Accepted:

The “Pay Item” tab is used for materials that have a line item in the contact. For example: guardrail, guardrail shop curve, anchor units and extra length posts. All other items inspected that do not have a dedicated line item will be placed during the next step under the “Hardware” tab.

- Entry for “Material Type” will be guardrail steel beam or anchor unit
- Entry for “Material” will be what type of guardrail or anchor units that was inspected.
- Entry for “Spot” is referring to a triple or single spot reading for zinc coating. When applicable triple spots tests should be first test administered.
- Entry for “Avg. Zinc Reading” is referring to the average mils read and calculated by the magna gage. Hicams will convert the average mils into ounces per square foot of zinc.
- Entry for “Accepted” will be the approved quantity.
- Entry for “Rejected” will be the rejected quantity.
- Entry for “Zinc Test Status” will determine if zinc coatings meet the minimum requirements.

Review Guardrail (New)

Report Name: Guardrail Report ID: Report Status: In Process

General | Pay Items | **Hardware** | Alt IDs | Report | History

Material Type	Material	Accepted	Rejected	Pass/Fail
Guardrail, Steel Post & Block - Both	Post, Guardrail, Steel- Each	53.000	.000	Pass
Guardrail, Steel Post & Block - Both	Post, Guardrail, Steel- Each	5.000	.000	Pass
Guardrail, Plastic Block - Both	Block, Guardrail, Plastic- Each	53.000	.000	Pass
Guardrail, Plastic Block - Both	Block, Guardrail, Plastic- Each	5.000	.000	Pass

2 of 4 Material

Line Item: 14 - SBGR SHOP CURVED

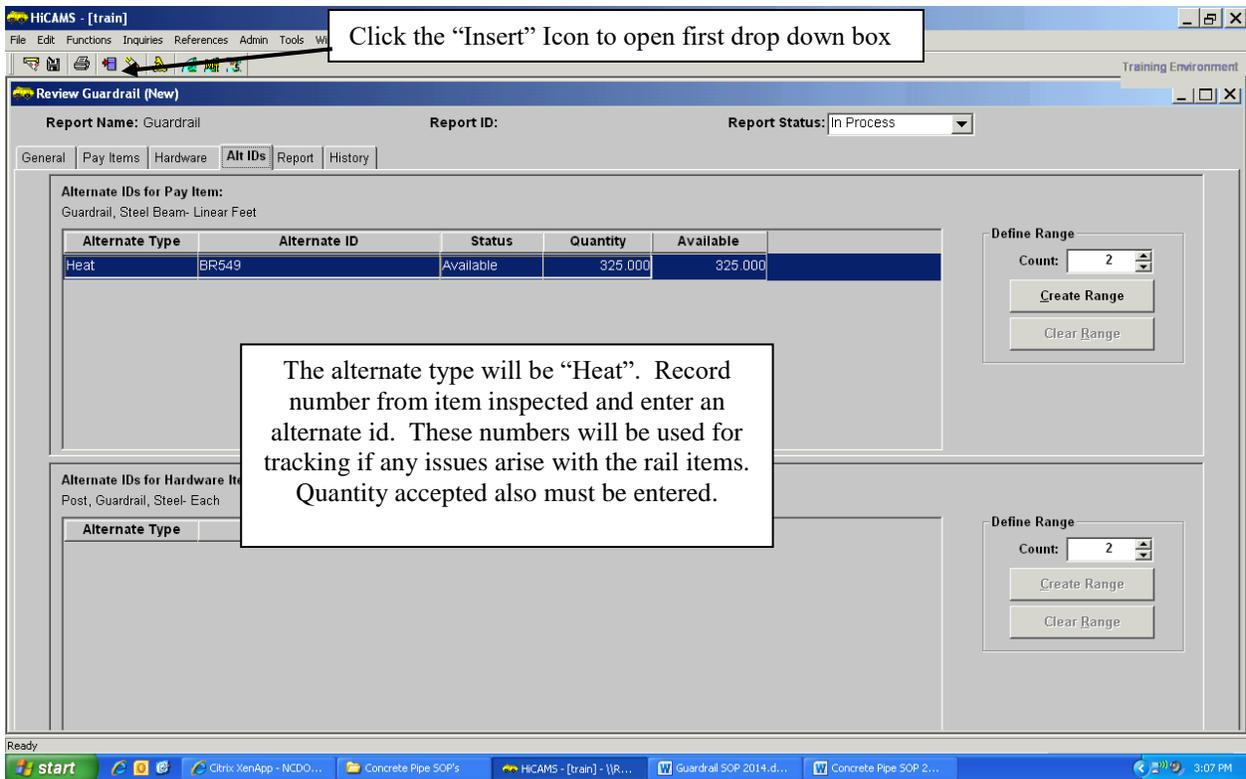
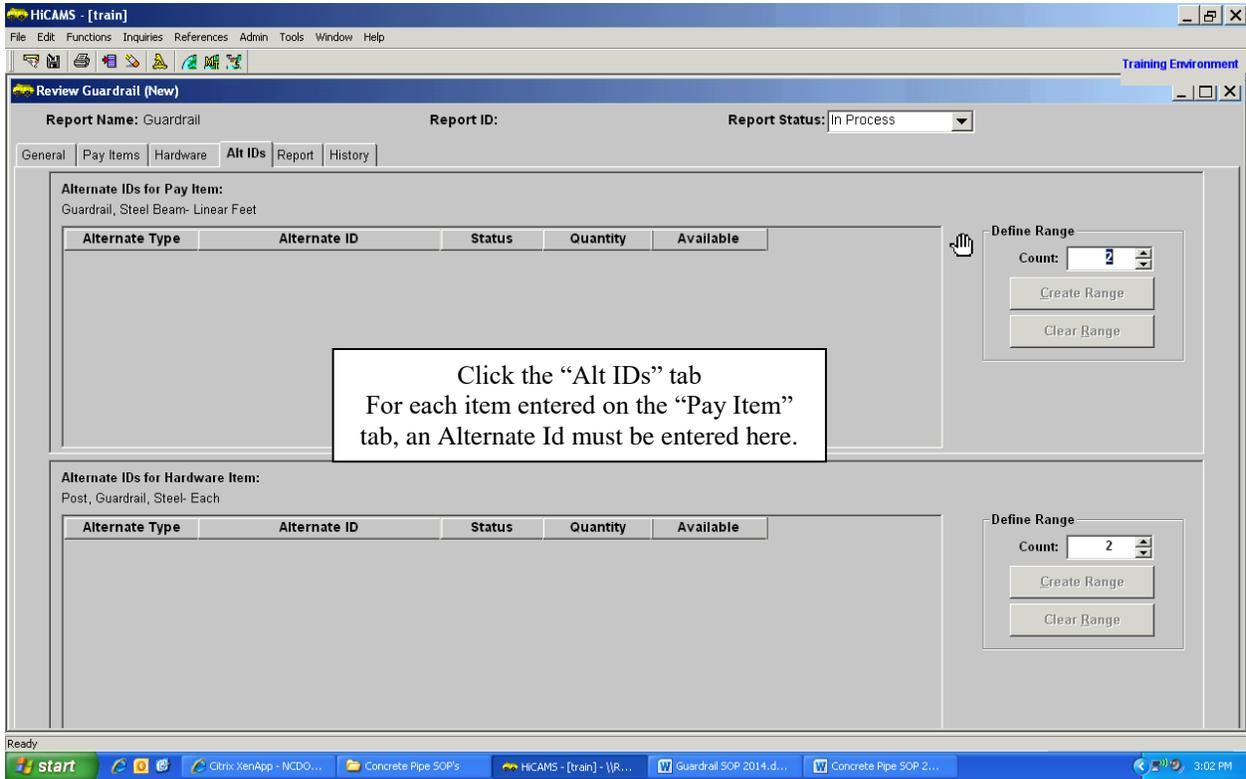
Available Accepted: 5.000

The “Hardware” tab shall be used for the materials that do not have a dedicated line item in the contract. For example: Posts, Blocks, Nuts, Bolts, Washers, End Shoes and etc.

Posts and plastic blocks must be assigned to the line item with guardrail & guardrail shop curve (As seen on the lower left of the above screen shot). Technician shall determine how many posts and blocks were used. Below is a calculation used to determine this.

$$\text{LF of guardrail} \times 0.16 = \# \text{ of posts or block}$$

*Note: Some guardrail items will not be required to be entered onto a FIR for Hicams. However this does not elevate the technician from performing the inspection and recording their findings on the “Guardrail Field Inspection Worksheet”.



HICAMS - [train] Training Environment

File Edit Functions Inquiries References Admin Tools Window Help

Review Guardrail (Report ID: 49185)

Report Name: Guardrail Report ID: 49185 Report Status: Complete

General | Pay Items | Hardware | Alt IDs | Report | History

Sample From: Project Test Category: Acceptance
 Contract: DO00094 WBS: 33660.3.1 County: Wilkes
 Contractor:
 Furnished By: BULLINGTON CONSTRUCTION INC
 Station: 0 + 00 Location: PROJECT
 Search by Plant ID: Section: 11
 Producer: Trinity Highway Products LLC, Trinity Highway Products - Oran
 Inspection Results
 Inspector: Church, Tracy G
 Inspection Date: 09/16/2013
 Comment:

Once all information is entered, than the report status can be change to complete & report saved. A report id # will be assigned to the FIR

Ready

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HICAMS - [train] Training Environment

File Edit Functions Inquiries References Admin Tools Window Help

Review Notice of Rejection (New)

Filter
 Related Field Inspection Report ID: 49185 Report Name: Guardrail
 Retrieve
 Select

General | Materials | Report

Inspection Result: Meets Specs
 Inspector: Church, Tracy G
 Producer: Trinity Highway Products LLC, Trinity Highway Products
 Purchase Order:
 Contract: DO00094
 Contractor: DAVIE GRADING, INC.
 Description: BRIDGE REPLACEMENT.
 Station: 0 + 00 Location: PROJECT
 Source:
 Reason:
 Comment:

Notice of Rejection must be completed and saved if any items are rejected.

Ready

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Documentation Submittal:

1. The Engineer administering the contract will be notified immediately of inspection results.
2. The technicians will complete FIR on Hicams within two working days of the inspection. FIR will be reviewed and authorized by the Section Materials Specialist within two working days after being completed.
3. A hard copy of the Guardrail Field Inspection Worksheet, BOL and copy of FIR will be filled by the technician.