Submitted to:

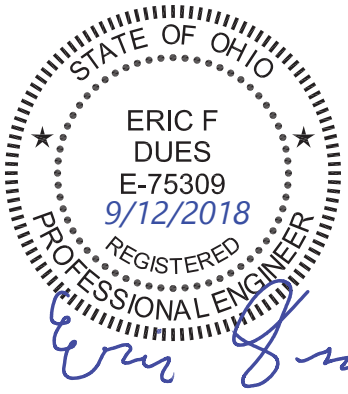
Ohio Department of Transportation, District 4
2088 S. Arlington Road
Akron, Ohio 44306

STA-077-0912

Fracture Critical Inspection Summary Report
Pier 3, Integral Steel Box Girder Cap

PID: 90973

Submitted by:



Gannett Fleming

*Excellence Delivered **As Promised***

PID No. 90973
Bridge No. STA-77-0912 over Market Ave. SW, Cleveland Ave., and 15th Street
Fracture Critical Inspection Summary Report for Pier #3, Integral Steel Box Girder Cap

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SUMMARY OF FINDINGS

The integral steel box girder pier cap is in overall fair (2) condition. This rating remains unchanged from the previous fair (2) rating based on the following conditions encountered during the inspection. Downspouts and scuppers framed between the longitudinal girders and the integral steel box girder pier cap (steel pier cap), where longitudinal girder lines 1 and 10 frame into the west face (span 4 side) of the steel pier cap, are corroded and clogged spraying water on the girders and the ends of the steel pier cap. This results in locations of severe rust with section loss to the box girder and longitudinal girder 1 and girder 10 at the splice connections. In addition, the median joint between the decks is open and enables dirt, debris and salt spray to settle on top of the steel pier cap at the center of the member between longitudinal girders 5 and 6. This results in moderate to severe rust with active section loss to the top flange and webs of the box girder. The top flange exhibits up to ¼" maximum section loss across most of the flange; the maximum recorded section loss to the web plates was ¼" near the bottom of the left (west) web. The previously discovered hole near the bottom of the web of longitudinal girder 6 where it attaches to the steel pier cap in span 3 corroded and became bigger. A new 3" diameter hole was also discovered near the bottom of the web of longitudinal girder 10 at the splice near the steel pier cap in span 4. On the interior of the steel pier cap, cracked tack welds were found. This document will summarize the general conditions that were encountered during this inspection. No critical findings were discovered that would immediately compromise the integrity of the structure, but the inspection findings did result in several maintenance and repair recommendations detailed later in this report.

INTRODUCTION

The Ohio Department of Transportation, District Four, contracted Gannett Fleming to perform another fracture critical inspection of the Pier #3 steel cap on bridge STA-77-0912 in 2018. Gannett Fleming performed the inspection on September 5th and 6th, 2018.

Description

The superstructure of Bridge STA-77-0912 consists of 10 welded plate girders with a typical transverse spacing of 9'-6" supporting a non-composite reinforced concrete deck with a longitudinal joint along the midpoint of the bridge cross section. At Pier #3, a steel pier cap supports the bridge superstructure over 15th Street, **see Photos 1 & 2**. A Location Map for the bridge is provided in **Figure 1**.

The steel pier cap is a 98'-0" long, 5'-4 ½ " deep and 3'-0" wide welded steel box girder with ten lines of longitudinal girders framing into the box girder on a 30°-19'-22" skew. The steel box girder pier cap provides an intermediate support for the entire superstructure and is fracture critical. Original structural details of the box girder are contained in the Fracture Critical Plan, see Appendix A, and the field notes are contained in Appendix B. Per the existing plans, an additional 8'-0" long cover plate was welded to the tension flange over each of the two reinforced concrete column supports during original fabrication due to a fabrication error. These additional 18" wide and ¾" thick cover plates are in a tension zone.

Photo 1 – STA-77-0912 – Integral steel box girder (Pier #3), Looking South

Photo 2 – STA-77-0912 – Integral steel box girder (Pier #3), Looking North

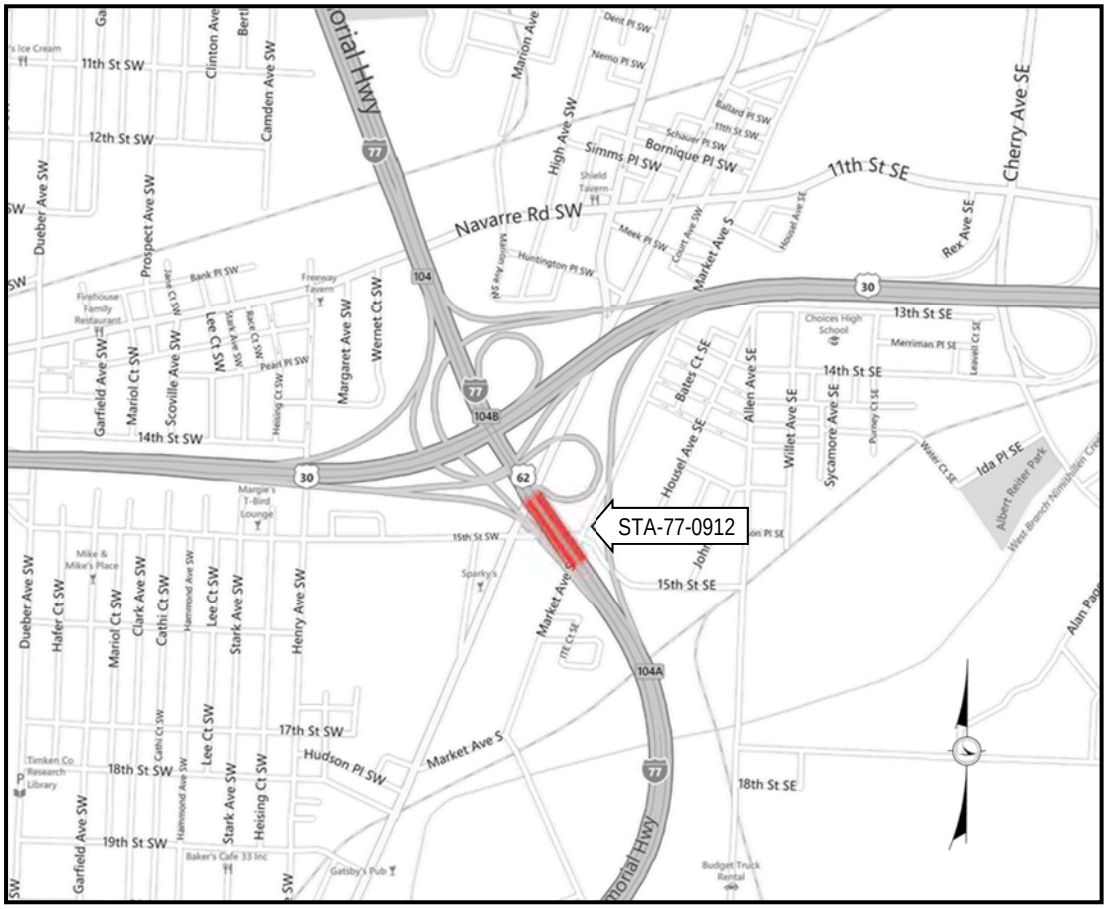


Figure 1 – STA-77-0912 – Location Map

Inspection Approach

The steel pier cap inspection in 2018 consisted of an In-Depth "Arms-Reach" inspection, performed in accordance with the guidelines of the current FHWA National Bridge Inspection Standards for Fracture Critical Members.

The fracture critical inspection of the steel pier cap was performed on September 5th and 6th, 2018 to inspect both the interior and exterior. The exterior of the cap was inspected using a manlift and the interior was inspected by entering the box girder per the procedures outlined below. A three man inspection team performed the confined space inspection. The Gannett Fleming inspection team that performed the inspection is listed below:

- Vincent D. LaCross, P.E., C.B.I. (Team Leader & Entrant)
- Robert W. Parker, (Ariel Attendant)
- Hassan Jamil, (Ground Level Attendant))

The inspection of the interior of the steel pier cap involved entering the steel box girder. Entry was performed in accordance with complete permit-required confined space entry procedures per GF Standard Operating Procedure (SOP) #10 and 29 CFR 1910.146 (both documents are included in the Fracture Critical Inspection Plan in Appendix A).

Keys were provided by ODOT to open the locks on the hinged doors that were previously installed on the pier cap for easy entry, **see Photos 3-6.**

The following six required tasks were performed during the planning and inspection of the steel pier cap.

1. Determine Resource Requirements.
   (Identify qualified inspection staff, use appropriate inspection access and inspection equipment. Refer to the Fracture Critical Inspection Plan for details)
2. Identify the Fracture Critical Members.
   (Refer to the Fracture Critical Inspection Plan for details)
3. Develop the Inspection Procedure.
   (Refer to the Fracture Critical Inspection Plan for details)
4. Prepare Follow-up Procedure.
   (Recommendations for repairs included in this document)
5. Provide Quality Control/Quality Assurance for the inspection and report.
   (Refer to the Fracture Critical Inspection Plan for details.)
6. Develop a Periodic Inspection Plan
   (Already in place with the Ohio Department of Transportation, District 4)


Photos 3 & 4 – Steel pier cap hinged doors, Pier 3, South End


Photos 5 & 6 – Steel pier cap hinged doors, Pier 3, North End

Nomenclature

The steel pier cap is oriented southwest to northeast. Nomenclature included in this inspection report shall adhere to the following conventions to provide consistency with future design/repair plans for the bridge while allowing the use of cardinal directions in field notes:

- South Opening or South Face: The southwestern opening or face
- North Opening or North Face: The northeastern opening or face
- G1 through G10: Girders and Girder diaphragms, numbered 1-10 from South to North
- D1 through D27: Intermediate diaphragms , numbered 1-27 from South to North

ODOT Coding System

The following general coding system is used to rate the condition of the bridge components according to the ODOT Bridge Inspection Manual, Revised 2014:

Table 1 – ODOT Coding Sytem

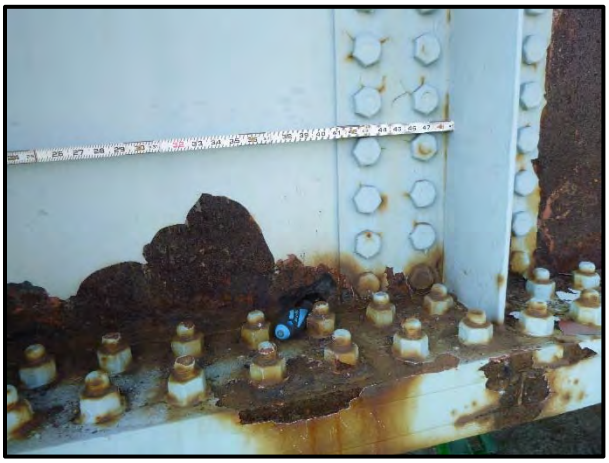
Individual Items	Summary Items
1 – Good – Element limited to only minor problems, no repairs necessary	**9 – Excellent Condition** **8 – Very Good Condition** **7 – Good Condition**
2 – Fair – All primary elements are sound but have minor section loss, deterioration, cracking, spalling or scour, minor repairs etc.	**6 – Satisfactory Condition** **5 – Fair Condition**
3 – Poor – Advanced section loss, spalling or scour, item is no longer functioning as designed (load path is significantly redistributed, fatigue cracks, wide shear cracks, local failures possible)	**4 – Poor Condition** **3 – Serious Condition**
4 – Critical – Support removed, corrective action or close monitoring necessary, consider partial or full closure, negative response (ex. crushing, bending) to the primary element due to structural loads	**2 – Critical Condition** **1 – Imminent Failure Condition** **0 – Failed Condition**

INSPECTION FINDINGS & FATIGUE PRONE CONNECTIONS

Active section loss was discovered at several locations on the outside of the steel pier cap. Where girder lines 1 and 10 frame into the west (span 4) face of the steel pier cap, downspouts and scuppers between the girder and the steel pier cap are clogged and corroded and spray water on the girders and the ends of the steel pier cap. This results in locations of severe rust with section loss to the box girder, girder 1 and girder 10 at the splice connections. **See Photos 7-10 below**. A new 3" diameter hole was also discovered near the bottom of the web of longitudinal girder 10 at the splice near the steel pier cap in span 4, **see Photos 11 & 12.**

Photos 7 & 8 – STA-77-0912 – Scupper & downspout adjacent to girder G1 connection to Pier #3 cap in span 4. Note severe rust to box girder web and girder G1 web and lower flange splice.

Photos 9 & 10 – STA-77-0912 – Scupper & downspout adjacent to girder G10 connection to Pier #3 cap in span 4. Note moderate rust to box girder web and girder G10 web (hole discovered) and lower flange splice**.**




Photos 11 & 12 – STA-77-0912 – New hole in web at bottom of longitudinal girder G10 at the splice next to Pier #3 steel pier cap, span 4.

The median joint between the northbound and southbound decks is open and enables dirt, debris and salt spray to settle on top of the steel pier cap between longitudinal girders 5 & 6. This results in severe rust with significant section loss to the top flange and moderate section loss to the webs and bottom flange. The top flange exhibits up to ¼" max. section loss across most of the flange at the center of the member, **see Photos 13 & 14**. A maximum web section loss of ¼" was recorded on the west (span 4) web near the bottom of the box girder, **see Photos 15 & 16**. A previously discovered 3" diameter hole at the bottom of the web on longitudinal girder 6 where it attaches to the steel pier cap in span 3 got bigger, **see Photos 17 & 18**.

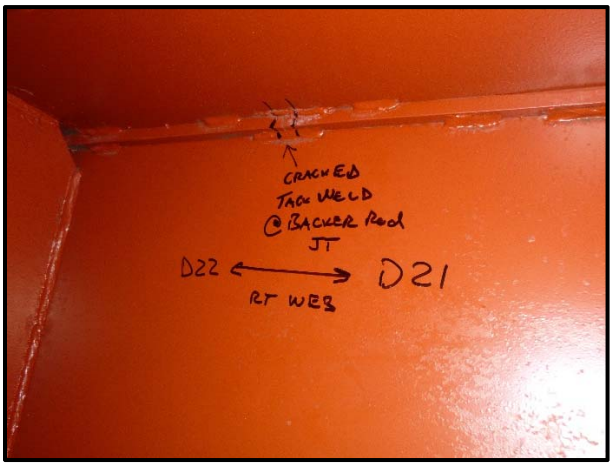

Photos 13 & 14 – STA-77-0912 – Pier #3 box girder top flange section loss at center between girders G5 & G6, note ¼" maximum section loss across top flange (looking north and south respectively).


Photos 15 & 16 – STA-77-0912 – Pier #3 steel pier cap web section loss at center between girders G5 & G6 (looking north and south respectively).


Photos 17 & 18 – STA-77-0912 – Hole in web at bottom of longitudinal girder G6 at connection to Pier #3 steel pier cap, span 3.

The fatigue prone details listed below were inspected and found to be in a similar satisfactory condition that was described in the 2016 fracture critical inspection report. Reference the attached Fracture Critical Inspection Plan for additional fatigue prone detailed information.

Fatigue Prone Detail #1 consists of the backup bars used during the welding of the web to the top and bottom flange that are held in place by intermittent fillet welds. The base metal at the ends of these intermittent welds, when located in tension and stress reversal areas, is fatigue sensitive stress Category E. The base metal of the interior of the box girder in these locations is in good condition. Cracked tack welds were noted in previous inspections between diaphragms 16 and 17 (2012 Inspection) and between diaphragms 12 and 13 (2014 Inspection). A new cracked tack weld was found between diaphragms 21 and 22 during this inspection. All are located where the ends of two backup bars come together. The vertical crack in the weld extends across the lower weld and ends directly underneath the connected ends of the backup bars. No distress was found in the box girder web at these locations, **see Photos 19 & 20**.



Photos 19 & 20 – STA-77-0912 – Fatigue Prone Detail #1, note crack in tack weld at top of web between diaphragms 16 & 17.

Fatigue Prone Detail #2 consists of locations with triaxial welds. Triaxial welds are highly susceptible to constraint induced fractures. There are four locations where triaxial (three way intersecting) welds occur at the fillet welded connection of the longitudinal girder bottom flange to the box girder web. Two of the triaxial welds occur on the interior surface at the top and bottom of the longitudinal bottom flange, and the other two triaxial welds occur on the exterior surface at the top of the longitudinal bottom flange. There are 80 locations of triaxial welds on the box girder pier cap. None of the triaxial welds were found to be in distress, **see Photos 21 & 22**.

Photo 21 – STA-77-0912 – Fatigue Prone Detail #2 and Fatigue Prone Detail #5, interior, no distress observed. Note missing paint on underside of girder bottom flange (Girder 4 bottom flange connection to south pier cap web shown)

Photo 22 – STA-77-0912 – Fatigue Prone Detail #2, exterior. Note active severe rust to triaxial weld above lower flange (Girder 10, Span 3 connection shown).

Fatigue Prone Detail #3 consists of the backup bars used during the making of the box girder web to diaphragm welds at all diaphragm locations. The backup bars are held in place using intermittent fillet welds. The base metal at the ends of these intermittent welds, when located in tension and stress reversal areas is fatigue sensitive, stress Category E. No distress was found in the welds across the interior of the pier cap, **see Photo 23**.

Photo 23 – STA-77-0912 – Fatigue Prone Detail #3, no distress observed

Fatigue Prone Detail #4 consists of the angles that were probably installed during the steel box girder assembly as web spacers. Eight angles, located between 2 and 4 inches above the bottom flange are welded to the box girder webs. The main concern is that five of the angles are located in a primary tensile zone. They are considered to be fatigue stress Category D. Broken welds on the vertical leg of the angle were previously recorded between diaphragms 1 and 2 and diaphragms 6 and 7 at the left web. They were also spotted between diaphragms 11 and 12 at the right web. **See Photo 24.**

Photo 24 – STA-77-0912 – Fatigue Prone Detail #4, note broken weld.

Fatigue Prone Detail #5 consists of the base metal of the box girder web at the end of the longitudinal beam bottom flange welded connection. It is a Category E' fatigue detail. No distress was found to the end of the base metal of the box girder web at these locations, **see Photo 21**.

Fatigue Prone Detail #6 consists of small areas of weld metal deposited at four different locations (within tension regions) on the exterior face of the box web. Welds in tension zones may be a source of developing cracks. No distress was found to any of the four locations of deposited weld metal, **see Photo 25**.

Photo 25 – STA-77-0912 – Fatigue Prone Detail #6, no distress observed (South Pier cap web adjacent to longitudinal girder G2 shown).

Fatigue Prone Detail #7 consists of the two moment plates welded to the top flange. Each of the ¾" moment plates welded to the top flange of the box girder over each of the two pier columns is Category E'. No distress was found in the top flange cover plates, **see Photos 26.**

Photo 26 – STA-77-0912 – Fatigue Prone Detail #7, no distress observed.

RETROFIT AND MAINTENANCE RECOMMENDATIONS

Immediate Action Items (Maintenance & Replacement Recommendations)

1. Clean and paint the exterior of the box girder between girders G5 & G6.
2. Clean and paint the box girder web and longitudinal girders adjacent to the scuppers and downspouts at girders G1 & G10.
3. Clean out the downspouts adjacent to girders G1 and G10. Replace heavily deteriorated drainage components as needed.
4. Clean and paint the juncture between the base of the web of longitudinal girder G6, Span 3, and the box girder.

Fatigue Retrofit Options

The pier cap has a significant number of fatigue prone details. Consideration should be given to retrofit options in advance of possible future fatigue related problems from these undesired details. Any cracks initiating from these fatigue-prone details could result in superstructure failure due to the fracture critical nature of the structure. It should be understood that access to most of the details inside of the pier cap is challenging and retrofit costs will be escalated significantly based on access constraints.

Fatigue Prone Details	Location	Recommend for Retrofit	Retrofit Method
No. 1	Backup bars used during welding of the web to the top and bottom flange held in place by intermittent fillet welds.	Yes	Remove welds and backup bar by grinding. Use extreme care during operations to not damage webs or flanges.
No. 2	Triaxial welds at the fillet welded connection of the longitudinal girder bottom flange to the box girder web, interior and exterior.	Yes	Drill through the girder webs to eliminate the intersecting weld detail. Use extreme care during operations to not damage webs or flanges.
No. 3	Backup bars used during the making of the box girder web to diaphragm welds at all intermediate diaphragm locations.	No, monitor during future inspections.	N/A
No. 4	The angles that were probably installed during the steel box girder assembly as web spacers and associated welds.	Yes	Remove eight (8) angles and grind smooth associated welds. Use extreme care during operations to not damage webs.
No. 5	Consists of the base metal of the box girder web at the end of the longitudinal beam bottom flange groove welded connection.	No, monitor during future inspections.	N/A
No. 6	Consists of small areas of weld metal deposited at four different locations (within tension regions) on the exterior face of the box web.	Yes	Remove weld metal by grinding. Use extreme care during operations to not damage webs.
No. 7	Consists of the two moment plates welded to the top flange.	Yes	Retrofit the moment plate ends with a bolted splice detail to alleviate the high stress concentrations.

APPENDIX A

Fracture Critical Inspection Plan for Bridge STA-77-0912 Pier #3, Steel Pier Cap

Bridge Identification:

Structural File Number: 7603576 **County-Route-SLM:** STA-077-0912 **ODOT District:** 04

Year Built: 1969 **Most Recent Fracture Critical Inspection:** September 2016

Access: Access to the end openings and exterior portions of the pier cap will be achieved utilizing a 60' manlift.

Traffic on Structure: ADT (2019): 53,000 ADT (2039): 58,000 Truck Traffic (K): 10%

Fatigue Life Study: Remaining Fatigue Life: N/A Year of Study: N/A

Load Path Redundant: No. The integral steel box girder pier cap is fracture critical; inspect FCM's every 24 months.

Structurally Redundant: No. The integral steel box girder pier cap is a simple span.

Internally Redundant: No. The integral steel box girder pier cap is a welded shape.

Figure 1 – STA-077-0912 – Elevation View, Looking West

Structure Location:

The structure is generally located at the intersection of US Route 30 and Interstate 77 southwest of Canton, Ohio as seen in Figure 3. The structure is a four lane bridge carrying I-77 over Market Avenue, Cleveland Avenue and 15th Street.

Superstructure and FCM Description:

The superstructure consists of 10 predominately welded plate girders with a typical transverse spacing of 9'-6" supporting a non-composite reinforced concrete deck with a longitudinal joint along the midpoint of the bridge cross section. At pier 3, an integral steel box girder pier cap supports the bridge superstructure over 15th Street. Figure 1 is an elevation view of the structure and Figure 2 is a general view of the integral steel box girder pier cap at pier 3.

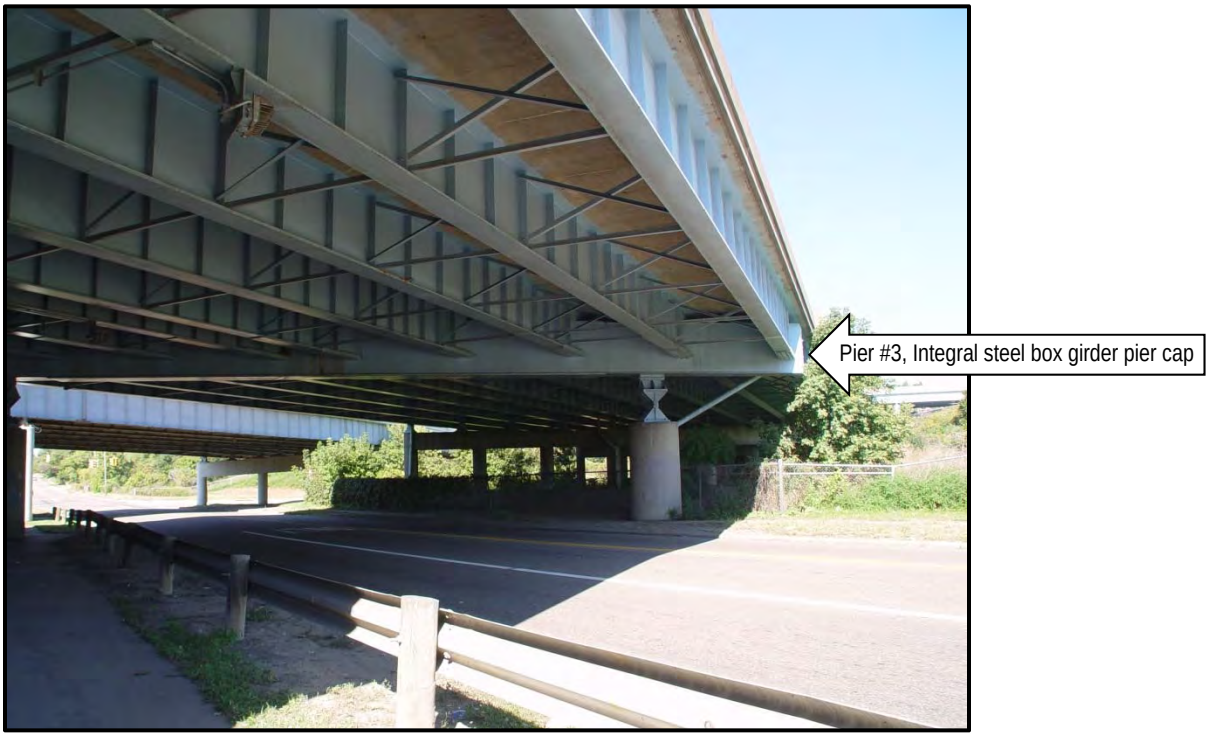


Figure 2 – STA-077-0912 – Integral steel box girder (Pier #3), Looking North

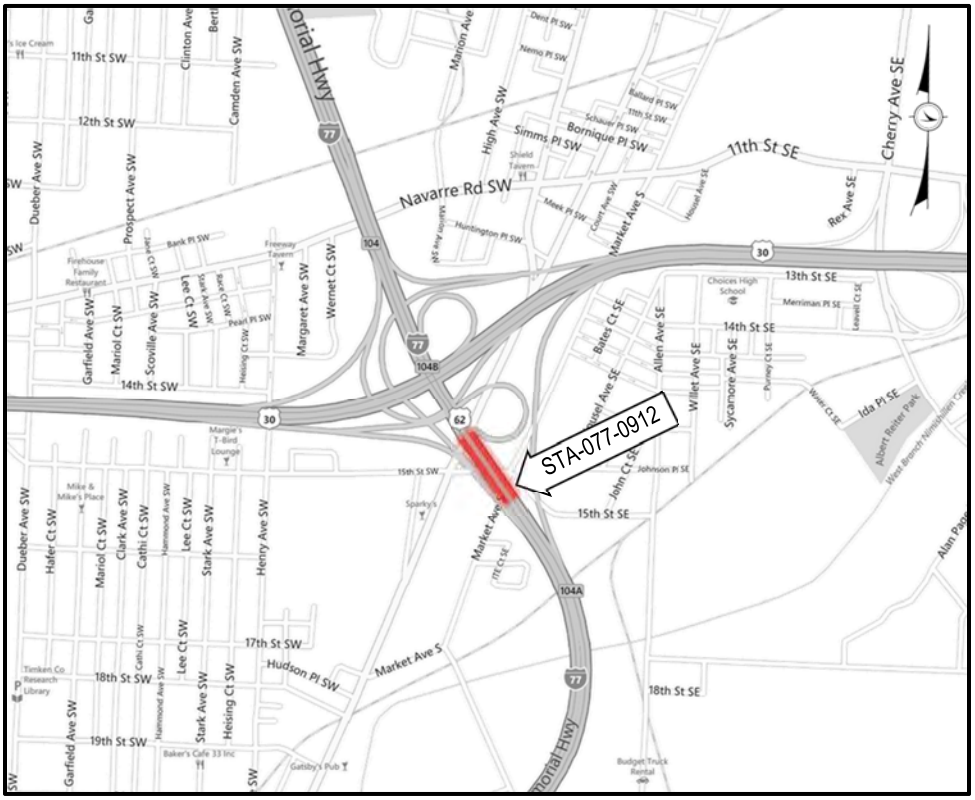


Figure 3 – STA-077-0912 – Location Map

Fracture Critical Inspection Requirements:

The inspection will consist of an In-Depth "Arms-Reach" inspection, performed in accordance with the guidelines of the current FHWA National Bridge Inspection Standards for Fracture Critical Members.

To perform an effective Fracture Critical Inspection, the following tasks must be performed. The 6 requirements are listed as follows:

1. Determine Resource Requirements.
   (Identify qualified inspection staff, use appropriate inspection access and inspection equipment).
2. Identify the Fracture Critical Members.
   (Identified in Figures 6-8 below)
3. Develop the Inspection Procedure.
   (Contained in this document)
4. Prepare Follow-up Procedure.
   (Recommendations will be made as part of this current project)
5. Provide Quality Control/Quality Assurance for the inspection and report.
   (Procedures outlined in this document)
6. Develop a Periodic Inspection Plan
   (Already in place with the Ohio Department of Transportation, District 4)

Fracture Critical Inspection Plan:

The fracture critical inspection of the integral steel box girder pier cap will involve a 2-day field effort to completely inspect both the interior and exterior. The exterior will be inspected with a manlift and the interior will be inspected by entering the box girder per the procedures outlined below. A 3-man inspection team will perform the confined space inspection. The 3-man inspection team will consist of the following Gannett Fleming personnel:

- Vince LaCross, P.E., C.B.I. (Team Leader)
- Rob Parker, C.B.I. (Inspector)
- Hassan Jamil (Ground level attendee)

The inspection of the integral steel pier cap will involve entering the steel box girder. Entry will be performed in accordance with complete permit-required confined space entry procedures per GF Standard Operating Procedure (SOP) #10 and 29 CFR 1910.146 (appended to this document). This will include the use of an entry permit system, pre-entry air monitoring, continuous air monitoring, the designation of qualified entrants, attendants, and supervisor(s), and emergency response personnel. Air monitoring for O2, %LEL, CO, and H2S will be performed prior to any entry by one designated certified entrant walking/climbing the length of the steel box girder pier cap and the certified attendant/supervisor documenting the readings every 25 feet. Radios will be used for team communications during the inspection. At the conclusion of the initial entry and air monitoring, the confined space air readings will be evaluated and if no hazards exist, the space will be designated a non-permit required confined space. Regardless of the reclassification as a non-permit required confined space, members of the inspection team entering the confined space will continuously monitor the air, and the attendant will document readings in their locations every 30 minutes for the duration of the work inside of the confined space. If the monitor alarms go off during the initial entrance and walk through, indicating that unsafe atmospheric conditions exist, the entrant will immediately exit the steel box girder. If unsafe atmospheric conditions continue to exist, further ventilation will continue, and the initial air monitoring performed again after proper ventilation. If the atmospheric hazards cannot be removed from the confined space, the box girder will NOT be entered, and the District's Project Manager will be contacted to notify and to receive further instructions.

Integral Steel Box Girder Details:

The steel pier cap is a 98′-0″ long, 5′-4 ½ ″ deep and 3′-0″ wide, double webbed, welded steel box girder with ten lines of longitudinal girders framing into the box girder. The steel box girder pier cap provides an intermediate support for the entire superstructure and is fracture critical. Original structural details of the box girder including longitudinal girder/box girder intersects are contained in Figures 4-5. Per the original plans, an additional 8′-0″ long cover plate was welded to the tension flange over each of the two supports during original fabrication due to fabrication error. These additional 18″ wide and ¾″ thick cover plates are in a tension zone and denoted in red in the Figure 4.

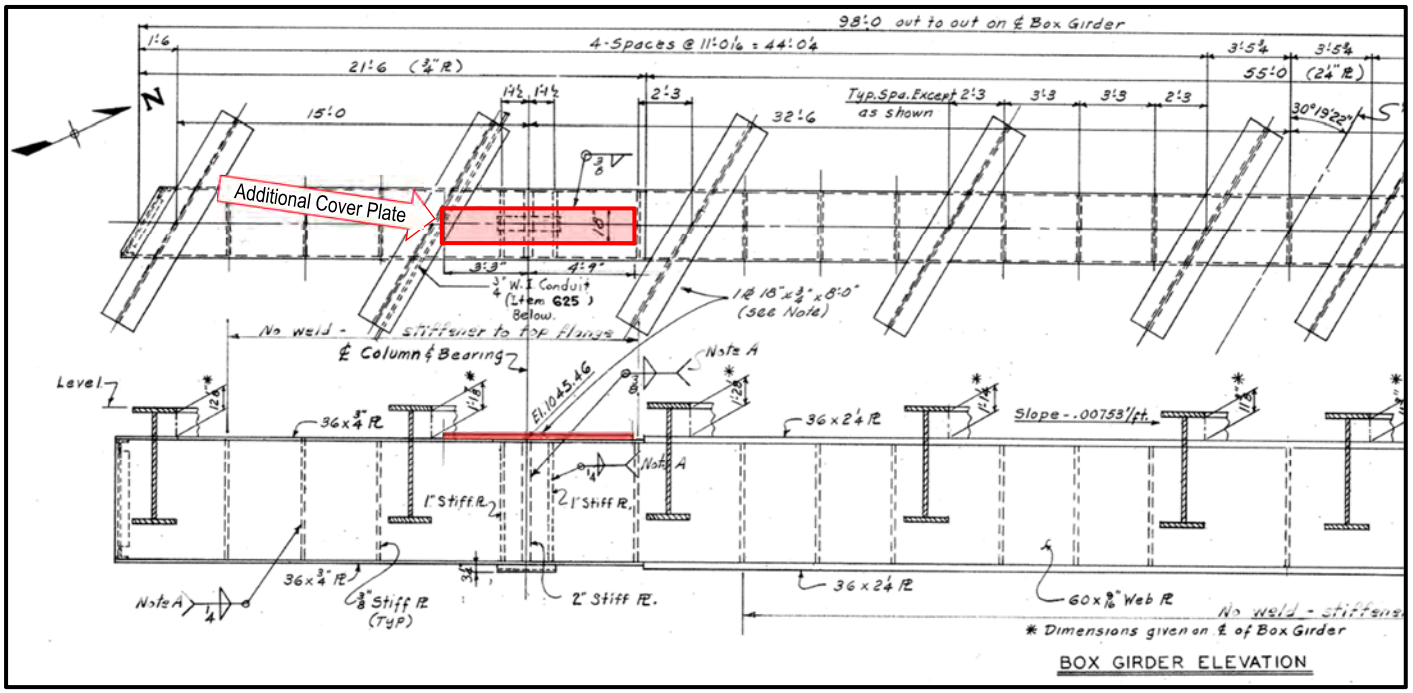


Figure 4 – STA-077-0912 – Integral steel box girder partial original plan and elevation

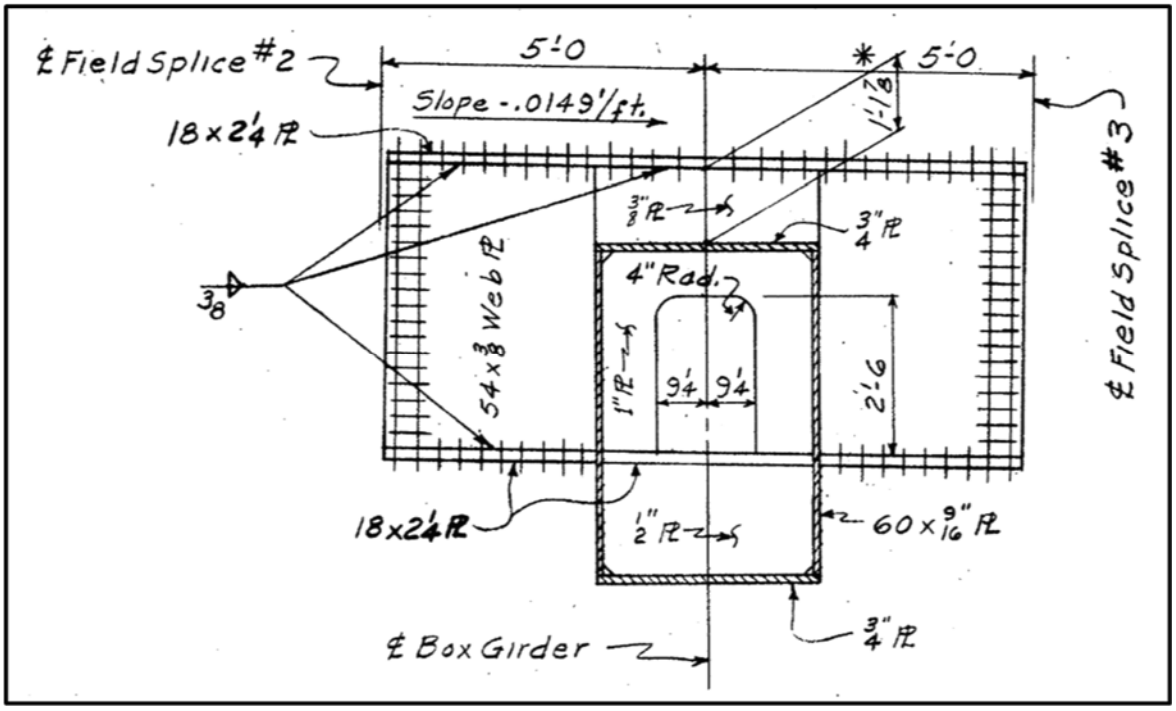


Figure 5 – STA-077-0912 – Integral steel box girder original typical section

Inspection nomenclature and orientation:

The integral steel box girder is oriented southwest to northeast. Nomenclature included in this inspection plan and subsequent inspection report shall follow the following conventions to provide consistency with the design plans for the bridge while allowing the use of cardinal directions in field notes:

- South Opening or South Face: The southwestern opening or face
- North Opening or North Face: The northeastern opening or face
- G1 through G10: Girders and Girder diaphragms, numbered 1-10 from South to North
- D1 through D27: Intermediate diaphragms , numbered 1-27 from South to North

Figure 6 of this document labels the primary elements. An 11x17" copy of a nomenclature and orientation plan will be with the inspection team for purposes of taking notes (appended to this document).

Additionally, left and right may be used to describe detailed locations. To ensure consistency, left and right directions will always be used in reference to a north facing orientation.

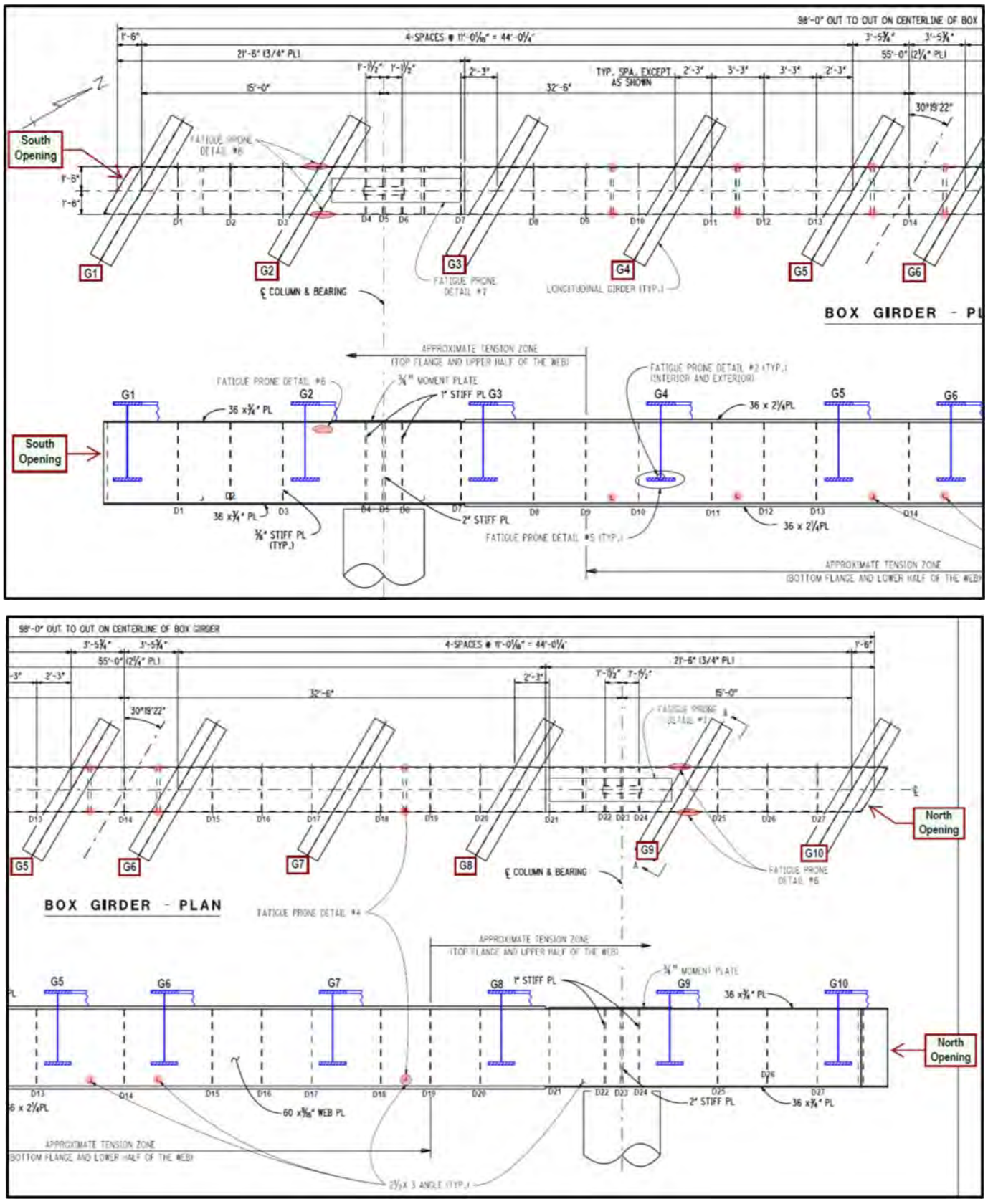


Figure 6 – STA-077-0912 – Fracture critical integral steel box girder nomenclature and orientation plan

Fracture critical member locations:

The pier cap box girder spans between two pier columns and cantilevers out approximately 17' beyond the north and south pier columns. As a result of this span configuration, the tension zones of the box girder are approximately located as follows and are shown in Figure 7.

1. The first zone is along the upper section of the box girder (top flange and upper half of the webs) from the south end of the box girder to about half way between the 3rd and 4th longitudinal girder from the south end of the pier cap.
2. The second zone is along the lower section of the box girder (bottom flange and lower half of the webs) from half way between the 3rd and 4th longitudinal girder from the south end of pier cap to half way between the 3rd and 4th longitudinal girder from the north end of the pier cap.
3. The third zone is along the upper section of the box girder (top flange and upper half of the webs) from the north end of the box girder to about half way between the 3rd and 4th longitudinal girder from the north end of the pier cap.

These zones will be the primary area for the fractural critical inspection in addition to areas that are identified as fatigue prone details and described in the next section.

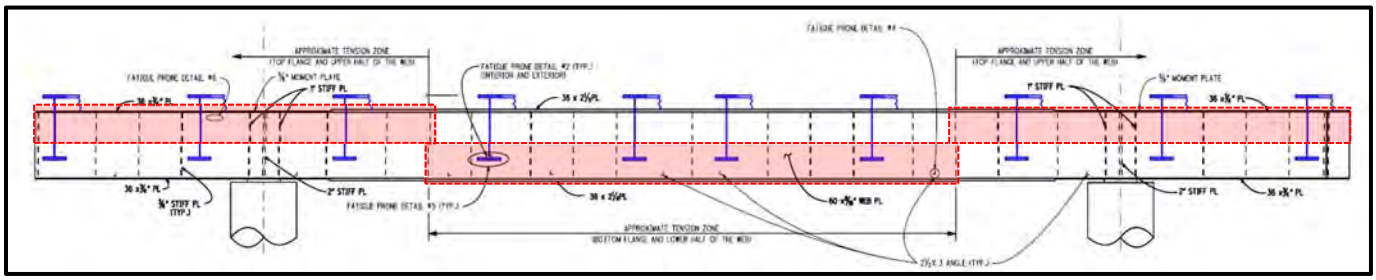


Figure 7 – STA-077-0912 – Tension zones of fracture critical integral steel box girder

Fatigue prone details:

Review of the existing pier cap box girder plans and details identified several fatigue prone details that need to be inspected and investigated. These fatigue details, which are described below, will be inspected for evidence of distress or any observed cracking. The locations of these details can be seen in Figures 6-8.

Fatigue Prone Detail # 1: The backup bars used during the welding of the web to the top and bottom flange are held in place by intermittent fillet welds. The base metal at the ends of these intermittent welds, when located in tension and stress reversal areas, is fatigue sensitive stress Category E.

Fatigue Prone Detail # 2: There are three locations where triaxial (three way intersecting) welds occur at the fillet welded connection of the longitudinal girder bottom flange to the box girder web. Two of the triaxial welds occur on the interior surface at the top and bottom of the longitudinal bottom flange, and the other triaxial weld occurs on the exterior surface at the top of the longitudinal bottom flange. Triaxial welds result in high residual stress concentrations and may be a source of developing cracks.

Fatigue Prone Detail # 3: Backup bars above and below the longitudinal girder bottom flange used during the making of the box girder web to diaphragm welds at all longitudinal girder locations were held in place using intermittent fillet

welds. Base metal at the ends of these intermittent welds, when located in tension and stress reversal areas is fatigue sensitive, stress Category E.

Fatigue Prone Detail # 4: Eight angles, located between 2 and 4 inches above the bottom flange, probably placed between the webs to act as spacers during the box girder assembly, are welded to the box girder webs. The primary concern is that five of the angles are located in a primary tensile zone as shown on Figure 7 above. They are considered to be fatigue stress Category D.

Fatigue Prone Detail # 5: The base metal of the box girder web at the end of the longitudinal beam bottom flange groove welded connection is a Category E' fatigue detail.

Fatigue Prone Detail # 6: Weld metal was deposited at four different locations (within tension regions) on the exterior face of the box web. Welds in tension zones may be a source of developing cracks.

Fatigue Prone Detail # 7: Each of the ¾" moment plates welded to the top flange of the box girder over each of the two pier columns is Category E'.

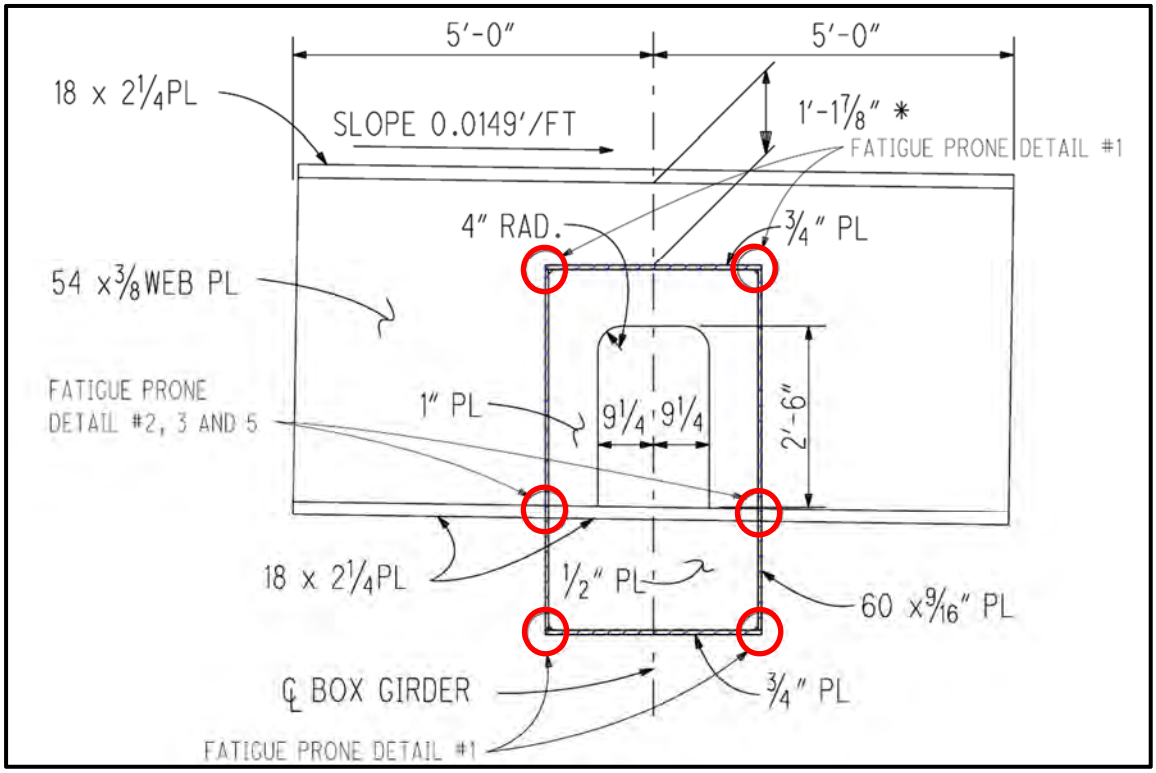


Figure 8 – STA-077-0912 – Fracture Critical integral steel box girder fatigue prone details

Inspection Methods:

Visual Inspection: Visual inspection shall be conducted in accordance with the National Bridge Inspection Standards as defined on the Code of Federal Regulations (23CFR650), the inspection procedures defined in the American Association of State Highway and Transportation Officials (AASHTO) Manual for Bridge Evaluation, and the Federal Highway Administration report (FHWA IP-86-26) covering the "Inspection of Fracture Critical Bridge Members". The inspection shall be hands on and conducted within arm's length of the inspected components. Additional lighting, mirrors, and/or magnification will be used as necessary.

Liquid Penetrant Testing: Non-destructive testing method liquid penetrant testing will be used in accordance with accepted practice as defined by the following procedure:

1. Clean the surface of the component free of dust and dirt with a piece of cloth. Brush the surface of the component to remove scale, rust, paint etc., by a soft wire brush.
2. Spray the cleaner to remove oil, grease, etc.
3. Apply the dye penetrant (by spraying) adequately to cover the area to be tested. Allow 3 to 5 minutes or more for dye to penetrate into the cracks.
4. Wipe off the excess penetrant on the surface with a rag.
5. Again spray the surface with the cleaner to remove the remnants of the red dye.
6. Spray the developer evenly on the surface to give a thin even layer. This layer absorbs the penetrant from the cracks and red spots or lines appear on the surface to give a visible indication of the flaws.
7. The crack if any will be indicated with the red dye absorbed by the white absorbent.

Follow-up procedures for inspection findings:

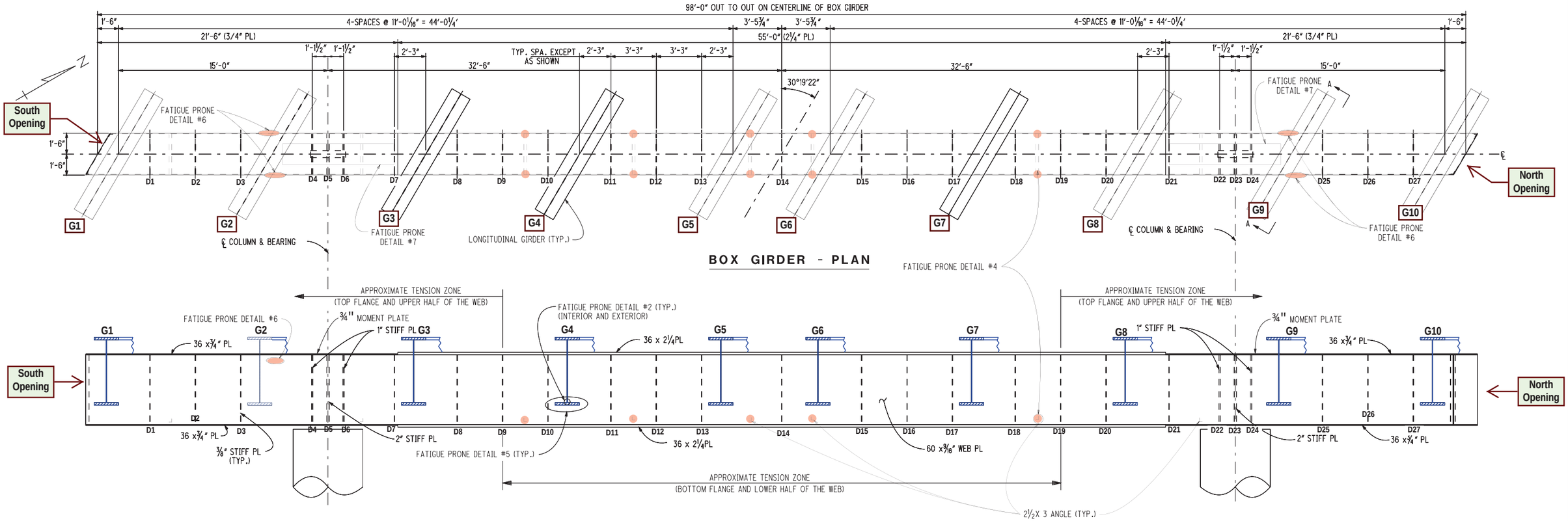
Fracture critical inspection findings shall be documented in the final inspection report. Any critical findings shall be reported to the Ohio Department of Transportation immediately. All findings (critical and typical) shall also be documented in the final fracture critical inspection report along with a copy of this inspection plan and an overall condition assessment.

Quality Control/Quality Assurance:

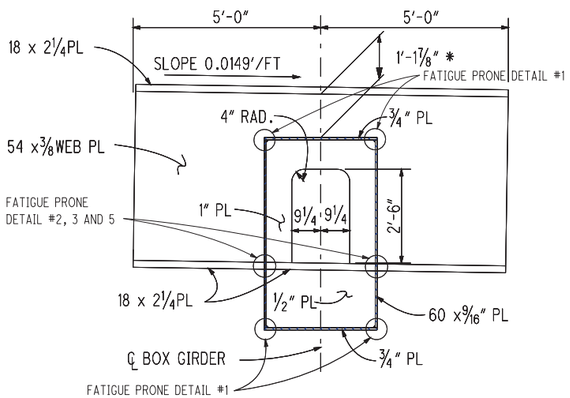
The inspection team was chosen to ensure that inspector qualifications are met, with the Team Leader having completed the course FHWA-NHI-130078, "Fracture Critical Inspection Techniques for Steel Bridges". The inspection team leader will perform quality control checks of support staff as well as monitoring of any defects that are found.

Future Inspections:

The non-redundant design of this bridge element (fracture critical integral steel pier cap) and the utilization of welded steel members coupled with regular truck load cycles provide the potential for cracks to develop. Future inspections of fracture critical elements on this structure are recommended every 24 months. If critical findings indicate the need for more frequent inspection cycles, this will be addressed in the final fracture critical inspection report and discussed with district personnel.



BOX GIRDER - ELEVATION



SECTION A-A

(FROM ORIGINAL PLANS)

THE FOLLOWING IS A LIST OF FATIGUE PRONE DETAILS AND CATEGORIES AS DISCUSSED ON PAGES 8 -14.

FATIGUE PRONE DETAIL #1 - THE BACKUP BARS FOR THE ASSEMBLY OF THE WEB TO TOP AND BOTTOM FLANGE HAVE INTERMITTENT FILLET WELDS, CATEGORY E.

FATIGUE PRONE DETAIL #2 - THREE WAY INTERSECTING FILLET WELDS OCCUR WHERE THE BOTTOM FLANGE OF THE LONGITUDINAL GIRDER CONNECTS TO THE BOX GIRDER WEB.

FATIGUE PRONE DETAIL #3 - THE BACKUP BARS ABOVE AND BELOW THE LONGITUDINAL GIRDER BOTTOM FLANGE USED DURING THE MAKING OF THE BOX GIRDER WEB TO THE DIAPHRAGM WELDS AT ALL LONGITUDINAL GIRDER LOCATIONS ARE HELD IN PLACE BY INTERMITTENT FILLET WELDS, CATEGORY E.

FATIGUE PRONE DETAIL #4 - THERE ARE EIGHT ANGLES LOCATED BETWEEN 2 AND 4 INCHES ABOVE THE BOTTOM FLANGE, CATEGORY D.

FATIGUE PRONE DETAIL #5 - THE BASE METAL OF THE BOX GIRDER WEB AT THE END OF THE LONGITUDINAL BEAM BOTTOM FLANGE GROOVE WELDED CONNECTION, CATEGORY E'

FATIGUE PRONE DETAIL #6 - WELD METAL WAS FOUND TO HAVE BEEN DEPOSITED AT FOUR DIFFERENT LOCATIONS ON THE EXTERIOR FACE OF THE BOX WEB.

FATIGUE PRONE DETAIL #7 - A 5/8 INCH MOMENT PLATE IS WELDED TO THE TOP FLANGE OF THE BOX GIRDER OVER THE PIER COLUMNS, CATEGORY E'.

FRACTURE CRITICAL MEMBER WITH FATIGUE PRONE DETAILS INDENTIFIED

STANDARD OPERATING PROCEDURE NUMBER 10
CONFINED SPACE ENTRY PROGRAM

10.0 PURPOSE

This document sets forth general confined space entry procedures for Gannett Fleming, Inc. (GFI) personnel. No personnel shall be permitted to enter a confined space until the provisions of these procedures, in accordance with the following standards and regulations, have been met.

10.1 KEY ELEMENTS

- Designation and definition of confined space entry personnel: Confined Space Supervisor, Authorized Entrant, Attendant and Rescue Team
- Identification and evaluation of confined spaces
- Confined space entry permits
- Training of personnel
- Duties of confined space entry personnel
- Lockout/tagout requirements
- Ventilation
- Electrical equipment requirements
- Compressed gas cylinders restrictions
- Specific requirements
- Emergency response

10.2 REFERENCES

- 29 CFR Part 1910.146, Permit Required Confined Spaces
- 29 CFR 1910.38, Employee Emergency and Fire Prevention Plans
- 29 CFR 1910.147, The Control of Hazardous Energy (Lockout/Tagout)
- American National Standard Safety Requirements for Confined Spaces, American National Standards Institute (ANSI) Z117.1-1989

- Gannett Fleming Safety Manual for Field Operations, Confined Space Entry

10.3 CONFINED SPACE ENTRY PERSONNEL

10.3.1 Confined Space Supervisor

The designated individual responsible for evaluating health and safety issues for confined spaces and the procedures to be performed within the confined space prior to any entry.

10.3.2 Attendant

The designated individual(s) assigned to be present at all times at the confined space entry point, to remain immediately outside the confined space, to monitor confined space conditions and to render assistance if needed, to entrants from outside of the confined space. Attendant shall not enter the confined space unless replaced by an individual equally trained in the performance of these duties.

10.3.3 Authorized Entrant

The designated individual(s) assigned to enter a confined space who has(have) been authorized by the Confined Space Supervisor.

10.3.4 Rescue Team

Those persons designated by the Confined Space Supervisor to perform rescues from confined spaces. The Rescue Team may be composed of an on-site rescue team of GFI workers or off-site emergency rescue personnel from the supporting local Fire Department or Rescue Service. Note: The training courses completed by GFI workers do not meet the requirements to serve as an on-site rescue team.

10.4 CONFINED SPACE IDENTIFICATION AND EVALUATION

10.4.1 Confined Space Identification

The Confined Space Supervisor will identify confined spaces using the following definition: A confined space is an enclosed space which has all of the following characteristics:

- Is large enough and so configured that an employee can bodily enter and perform assigned work;

- Has limited or restricted means for entry or exit (e.g., tanks, vessels, silos, manholes, storage bins, hoppers, vaults, pits and diked areas); and

- Is not designed for continuous employee occupancy.

A permit-required confined space meets the definition of a confined space and has one or more of the following characteristics:

- Contains or has a potential to contain a hazardous atmosphere;
- Contains a material with the potential to engulf an entrant;
- Has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or a floor which slopes downward and tapers to a smaller cross section; or
- Contains any other known serious safety or health hazard.

A non-permit required confined space is a confined space that does not contain or have the potential to contain any hazard capable of causing death or serious physical harm.

10.4.2 Confined Space Evaluation

Confined spaces shall be evaluated by the Confined Space Supervisor prior to each entry. The Confined Space Supervisor shall evaluate these confined spaces for potential hazards which may be involved and specify entry requirements. Evaluation will include, as a minimum, atmospheric testing for oxygen level, combustible gases and vapors, and toxic gases and vapors which are known to exist or may potentially exist in the confined space. Potential Mechanical/Electrical Hazards must also be evaluated.

The atmosphere shall be tested in the following chronological order: Oxygen Level, Combustible Gases, Toxic Gases. The atmosphere shall be tested at the lower level, middle level and upper level of the confined space. Initial test results shall be recorded on the permit.

Entry into a confined space shall only be permitted when atmospheric testing indicates the following results, except as subsequently stated:

- Oxygen levels are > 19.5 percent and < 23.5 percent
- Combustible Gas Flammability/Explosivity levels are < 10 percent of Lower Explosive Limit (LEL)
- An atmospheric concentration of a specific substance is below the listed OSHA Permissible Exposure Limit (PEL) or ACGIH Threshold Limit Value (TLV)

An Authorized Entrant may enter a confined space when the oxygen level is less than 19.5 percent or when the atmospheric concentration of a specific substance exceeds the listed OSHA PEL or ACGIH TLV ONLY IF the entrant is respirator qualified, the appropriate

respirator or breathing apparatus is worn, and the entry under these conditions is specifically authorized by the Confined Space Supervisor.

Following the evaluation of the confined space, the Confined Space Supervisor shall classify the confined space as either a permit-required confined space or a non-permit-required confined space, and specify confined space entry requirements. Entry requirements shall be recorded on the permit. A non-permit-required confined space does not require the use of an entry permit.

All confined spaces shall be continuously tested for oxygen level, flammable/explosive gases, toxic materials and other serious safety or health hazards identified by the Confined Space Supervisor throughout the duration of the confined space entry. Periodic test results shall be recorded on the permit.

10.5 CONFINED SPACE ENTRY PERMIT SYSTEM

A Confined Space Entry Permit (CSEP) system will be used by the Confined Space Supervisor to control employee entry into the permit-required confined space. Prior to each entry into any permit-required confined space, a written CSEP is required and shall be issued by the Confined Space Supervisor. Standard GFI format permits shall be used so that basic elements of information are documented.

10.5.1 Validity Period of Confined Space Entry Permit

A permit is valid for the duration of one work shift. In the event that additional time is needed, a new permit must be issued by the Confined Space Supervisor, pending reevaluation of the confined space certification for acceptable entry conditions.

10.5.2 Confined Space Entry Permit Form

The CSEP form will be completed by the Confined Space Supervisor for each permit-required confined space entry and will be specific to each entry situation. A copy of GFI's standard CSEP form is attached to this Standard Operating Procedure.

10.5.3 Posting, Maintenance, Cancellation and Filing of Confined Space Entry Permits

The CSEP shall be conspicuously posted at each confined space entry point, maintained until the entry has been completed and then canceled. Canceled CSEP forms shall be transferred to the GFI project file and maintained for a minimum period of one year.

10.6 TRAINING

10.6.1 Confined Space Supervisor

The Confined Space Supervisor shall have completed an approved course in Confined

Space Operations, or equivalent. Consult with the Corporate Safety Manager for course approval.

10.6.2 Authorized Entrants

The Authorized Entrant(s) shall have completed an approved course in Confined Space Entry, or equivalent, as a minimum. Consult with the Corporate Safety Manager for course approval.

10.6.3 Attendants

The Attendant(s) shall have completed an approved course in Confined Space Operations, or equivalent. Consult with the Corporate Safety Manager for course approval.

10.6.3 Rescue Team

Prior to confined space entry, the Confined Space Supervisor shall contact the off-site local rescue team and make them aware of the entry and to check availability in the event of an emergency. Most GFI personnel are not trained in on-site rescue. The training of rescue team personnel shall include, as a minimum:

- Use of the equipment needed to perform rescue functions
- Emergency and rescue methods and procedures
- Additionally, at least one member of the rescue team shall hold current certification in Red Cross first aid and Red Cross CPR

10.7 DUTIES

10.7.1 Confined Space Supervisor

The duties of the Confined Space Supervisor shall be as follows:

- Know space hazards including information on the mode of exposure, signs, or symptoms and consequences of exposure
- Identify confined spaces that must be entered as part of the work
- Evaluate confined spaces for potential hazards
- Verify emergency plans and specify entry conditions such as permits, tests, procedures, and equipment before allowing entry
- Verify that equipment specified for confined space entry is available and

operational

- Designate a rescue team comprised of an off-site local Rescue Team and designate means of contacting the rescue team
- Verify training of authorized entrants, attendants and GFI rescue team
- Complete and sign permit form prior to initial entry
- Terminate entry and cancel permits when entry operations are completed or if a new condition exists that may cause death or serious physical harm
- Support Attendants in removal of unauthorized entrants
- Ensure that entry operations remain consistent with the entry permit and that acceptable entry conditions are maintained

10.7.2 Authorized Entrants

The duties of the Authorized Entrant(s) shall be as follow:

- Know space hazards, including information on the mode of exposure (e.g., inhalation or dermal absorption), signs or symptoms, and consequences of the exposure
- Use appropriate personal protective equipment properly
- Maintain communication with Attendants as necessary to enable the Attendant to monitor the Authorized Entrant's status as well as to alert the Authorized Entrant to evacuate
- Exit from permit space as soon as possible when ordered by an Attendant or other authorized person, when the Authorized Entrant recognizes the warning signs or symptoms of exposure exist, when a prohibited condition exists, or when an automatic alarm is activated
- Alert the Attendant when a prohibited condition exists or when warning signs or symptoms of exposure exist

10.7.3 Attendants

The duties of the Attendant(s) shall be as follow:

- Remain outside permit space during entry operations and maintain communications with Authorized Entrants unless relieved by another authorized Attendant

- Perform non-entry rescues when specified by employer's rescue procedure
- Know existing and potential hazards, including information on the mode of exposure, signs or symptoms, consequences of the exposure, and their physiological effects
- Keep an accurate account of those workers entering the permit-required space
- Periodically check the status of conditions in the confined space via the methods used by the Confined Space Supervisor to perform initial evaluation of the confined space
- Order evacuation of the permit space when a prohibited condition exists, when an Authorized Entrant shows signs of physiological effects of hazard exposure, when an emergency outside the confined space exists, and when the Attendant cannot effectively and safely perform required duties
- Summon rescue and other services during an emergency
- Instruct unauthorized persons to stay away from permit spaces or to exit immediately if they have entered the permit space
- Inform Authorized Entrants and Entry Supervisor of entry by unauthorized persons
- Perform no other duties that interfere with the Attendant's primary duties

10.7.4 Rescue Team

The duties of the Rescue Team shall be as follow:

- Report immediately to the confined space, when summoned
- Don the appropriate Personal Protective Equipment (PPE)
- Attempt rescue

10.8 LOCKOUT/TAGOUT

Prior to entry into any confined space, the Confined Space Supervisor shall verify that all mechanical and electrical energy sources (pipes, valves, machinery, etc.) that may pose a hazard due to accidental startup, engulfment or electrocution, have been de-energized and/or rendered in the zero mechanical state through the following methods:

- Lockout/tagout

- Blanking or blinding
- Double block and bleed
- Disconnection

10.9 VENTILATION

Adequately sized mechanical ventilation equipment should be available for confined spaces prior to initial entry and for the duration of the CSEP. The use of mechanical ventilation shall be determined by the Confined Space Supervisor. However, care should be taken to ensure that the mechanical ventilation will not pose a hazard of its own such as carbon monoxide accumulation or ignition source in the confined space or spreading contamination outside of the enclosed area.

10.10 ELECTRICAL EQUIPMENT REQUIREMENTS

When electrical or battery powered equipment is used in a confined space, it shall meet the following requirements:

- Electrical or battery powered equipment must be intrinsically safe when a flammable or potentially explosive atmosphere is present.
- Ground fault electrical circuit interrupters for electrical equipment

10.11 COMPRESSED GAS CYLINDERS

Compressed gas cylinders, except cylinders used for Self-contained Breathing Apparatus (SCBA), shall not be taken into confined spaces.

10.12 CONFINED SPACE ENTRY SPECIFIC REQUIREMENTS

Prior to entry, the Confined Space Supervisor, shall specify the air monitoring requirements and equipment requirements for the confined space entry.

10.13 EMERGENCY RESPONSE

10.13.1 Authorized Entrants

In the event that the Authorized Entrants experience an emergency situation, they shall:

- Notify Attendant of emergency situation
- Help fellow entrant, if incapacitated, and proceed immediately to the nearest escape hatch; if an emergency retrieval system is used to support entry and exit, proceed to the hatch where the emergency retrieval system is located and

attach lifeline to harness of incapacitated worker first

- Exit the confined space

10.13.2 Attendant

In the event of an emergency, the Attendant shall:

- Notify the off-site local Rescue Team by designated means of communication
- At no time is the Attendant to enter the confined space or leave the entrance unmanned
- The Attendant shall attempt rescue utilizing an emergency retrieval system without entering the space
- Upon arrival of the Rescue Team, the Attendant shall provide them with appropriate information requested to perform the rescue

10.13.3 Rescue Team

In the event of an emergency, the Rescue Team shall:

- Report immediately to the confined space.
- Don the appropriate PPE
- Attempt rescue

Gannett Fleming

CONFINED SPACE ENTRY PERMIT

Entry Date: _____

Entry Time: _____

Expiration Time: _____

CS Location: _____

_____

Description of task(s): _____

_____

Confined Space Classification* (Circle) A (Do Not Enter) B (Caution) C

Personnel Assigned

Name: _____ Duties: _____

Training**: (Circle) 1 2 3

Name: _____ Duties: _____

Training**: (Circle) 1 2 3

Name: _____ Duties: _____

Training**: (Circle) 1 2 3

Name: _____ Duties: Attendant (Required)

Training**: (Circle) 1 2 3

Name: _____ Duties: CS Supervisor

Training**: (Circle) 1 2 3

Equipment/PPE Required: (Circle) 1 2 3 4 5 6 7 8 9 10

1. Gloves
2. Hard Hat
3. Eye Protection
4. Coveralls
5. Steel Toe Shoes
6. Hearing Protection
7. Other _____
8. Other _____
9. Other _____
10. Other _____

Safety Requirements/Procedures: (Circle) 1 2 3 4 5 6

1. Constant Monitoring
2. Buddy System
3. Safety Harness
4. Tripod and Retrieval Winch
5. Other _____
6. Other _____

* A – Immediately Dangerous to Life and Health
B – Dangerous but not Immediately Dangerous to Life and Health
C – Requires no modification to standard procedures

** 1 – CPR/First Aid
2 – Confined Space Entry
3 – Respirator Qualified

Emergency Phone Nos. _____ _____ _____

EMS FIRE OTHER

Monitor No. _____ Calibrated By _____ Date _____
Monitor No. _____ Calibrated By _____ Date _____
Atmospheric Monitoring Results:

		Acceptable Limits			
Activity	Time	Oxy%	H_2S (ppm)	LEL%	Other
	19.5-23.5	0-10	0-10	0-10	
Pre-Entry					

Level of protection _____ Rescue Equipment _____
Adeq. PPE Supply _____ Ventilation _____
Isolation Complete _____ Approved Tools & Equipment _____
Tagging _____ Approved Lighting & Elec. _____
Lockout _____ Communication _____
Comments: _____

_____

_____

_____

_____

_____

Permit Prepared by : _____

Confined Space Supervisor

Appendix A — OSHA's Permit-required Confined Spaces Standard

29 CFR 1910.146, Permit-required Confined Spaces

(a) Scope and application.

This section contains requirements for practices and procedures to protect employees in general industry from the hazards of entry into permit-required confined spaces. This section does not apply to agriculture, to construction, or to shipyard employment (Parts 1928, 1926, and 1915 of this chapter, respectively).

(b) Definitions.

"Acceptable entry conditions" means the conditions that must exist in a permit space to allow entry and to ensure that employees involved with a permit-required confined space entry can safely enter into and work within the space.

"Attendant" means an individual stationed outside one or more permit spaces who monitors the authorized entrants and who performs all attendant's duties assigned in the employer's permit space program.

"Authorized entrant" means an employee who is authorized by the employer to enter a permit space.

"Blanking or blinding" means the absolute closure of a pipe, line, or duct by the fastening of a solid plate (such as a spectacle blind or a skillet blind) that completely covers the bore and that is capable of withstanding the maximum pressure of the pipe, line, or duct with no leakage beyond the plate.

"Confined space" means a space that:
(1) Is large enough and so configured that an employee can bodily enter and perform assigned work; and
(2) Has limited or restricted means for entry or exit (for example, tanks, vessels, silos, storage bins, hoppers, vaults, and pits are spaces that may have limited means of entry.); and
(3) Is not designed for continuous employee occupancy.

"Double block and bleed" means the closure of a line, duct, or pipe by closing and locking or tagging two in-line valves and by opening and locking or tagging a drain or vent valve in the line between the two closed valves.

"Emergency" means any occurrence (including any failure of hazard control or monitoring equipment) or event internal or external to the permit space that could endanger entrants.

"Engulfment" means the surrounding and effective capture of a person by a liquid or finely divided (flowable) solid substance that can be aspirated to cause death by filling or plugging the respiratory system or that can exert enough force on the body to cause death by strangulation, constriction, or crushing.

"Entry" means the action by which a person passes through an opening into a permit-required confined space. Entry includes ensuing work activities in that space and is considered to have occurred as soon as any part of the entrant's body breaks the plane of an opening into the space.

"Entry permit (permit)" means the written or printed document that is provided by the employer to allow and control entry into a permit space and that contains the information specified in paragraph (f) of this section.

"Entry supervisor" means the person (such as the employer, foreman, or crew chief) responsible for determining if acceptable entry conditions are present at a permit space where entry is planned, for authorizing entry and overseeing entry operations, and for terminating entry as required by this section.
NOTE: An entry supervisor also may serve as an attendant or as an authorized entrant, as long as that person is trained and equipped as required by this section for each role he or she fills. Also, the duties of entry supervisor may be passed from one individual to another during the course of an entry operation.

"Hazardous atmosphere" means an atmosphere that may expose employees to the risk of death, incapacitation, impairment of ability to self-rescue (that is, escape unaided from a permit space), injury, or acute illness from one or more of the following causes:
(1) Flammable gas, vapor, or mist in excess of 10 percent of its lower flammable limit (LFL);
(2) Airborne combustible dust at a concentration that meets or exceeds its LFL;

NOTE: This concentration may be approximated as a condition in which the dust obscures vision at a distance of 5 feet (1.52 m) or less.

(3) Atmospheric oxygen concentration below 19.5 percent or above 23.5 percent;

(4) Atmospheric concentration of any substance for which a dose or a permissible exposure limit is published in Subpart G, Occupational Health and Environmental Control, or in Subpart Z, Toxic and Hazardous Substances, of this Part and which could result in employee exposure in excess of its dose or permissible exposure limit;
NOTE: An atmospheric concentration of any substance that is not capable of causing death, incapacitation, impairment of ability to self-rescue, injury, or acute illness due to its health effects is not covered by this provision. (5) Any other atmospheric condition that is immediately dangerous to life or health.
NOTE: For air contaminants for which OSHA has not determined a dose or permissible exposure limit, other sources of information, such as Material Safety Data Sheets that comply with the Hazard Communication Standard, section 1910.1200 of this Part, published information, and internal documents can provide guidance in establishing acceptable atmospheric conditions.

"Hot work permit" means the employer's written authorization to perform operations (for example, riveting, welding, cutting, burning, and heating) capable of providing a source of ignition.

"Immediately dangerous to life or health (IDLH)" means any condition that poses an immediate or delayed threat to life or that would cause irreversible adverse health effects or that would interfere with an individual's ability to escape unaided from a permit space.
NOTE: Some materials -- hydrogen fluoride gas and cadmium vapor, for example -- may produce immediate transient effects that, even if severe, may pass without medical attention, but are followed by sudden, possibly fatal collapse 12-72 hours after exposure. The victim "feels normal" from recovery from transient effects until collapse. Such materials in hazardous quantities are considered to be "immediately" dangerous to life or health.

"Inerting" means the displacement of the atmosphere in a permit space by a noncombustible gas (such as nitrogen) to such an extent that the resulting atmosphere is noncombustible.
NOTE: This procedure produces an IDLH oxygen-deficient atmosphere.

"Isolation" means the process by which a permit space is removed from service and completely protected against the release of energy and material into the space by such means as: blanking or blinding; misaligning or removing sections of lines, pipes, or ducts; a double block and bleed system; lockout or tagout of all sources of energy; or blocking or disconnecting all mechanical linkages.

"Line breaking" means the intentional opening of a pipe, line, or duct that is or has been carrying flammable, corrosive, or toxic material, an inert gas, or any fluid at a volume, pressure, or temperature capable of causing injury.

"Non-permit confined space" means a confined space that does not contain or, with respect to atmospheric hazards, have the potential to contain any hazard capable of causing death or serious physical harm.

"Oxygen deficient atmosphere" means an atmosphere containing less than 19.5 percent oxygen by volume.

"Oxygen enriched atmosphere" means an atmosphere containing more than 23.5 percent oxygen by volume.

"Permit-required confined space (permit space)" means a confined space that has one or more of the following characteristics:

(1) Contains or has a potential to contain a hazardous atmosphere;

(2) Contains a material that has the potential for engulfing an entrant;

(3) Has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or by a floor which slopes downward and tapers to a smaller cross-section; or

(4) Contains any other recognized serious safety or health hazard.

"Permit-required confined space program (permit space program)" means the employer's overall program for controlling, and, where appropriate, for protecting employees from, permit space hazards and for regulating employee entry into permit spaces.

"Permit system" means the employer's written procedure for preparing and issuing permits for entry and for returning the permit space to service following termination of entry.

"Prohibited condition" means any condition in a permit space that is not allowed by the permit during the period when entry is authorized.

"Rescue service" means the personnel designated to rescue employees from permit spaces.

"Retrieval system" means the equipment (including a retrieval line, chest or full-body harness, wristlets, if appropriate, and a lifting device or anchor) used for non-entry rescue of persons from permit spaces.

"Testing" means the process by which the hazards that may confront entrants of a permit space are identified and evaluated. Testing includes specifying the tests that are to be performed in the permit space.
NOTE: Testing enables employers both to devise and implement adequate control measures for the protection of authorized entrants and to determine if acceptable entry conditions are present immediately prior to, and during, entry.

(c) General requirements.

(c)(1) The employer shall evaluate the workplace to determine if any spaces are permit-required confined spaces.
NOTE: Proper application of the decision flow chart in Appendix A to section 1910.146 would facilitate compliance with this requirement.

(c)(2) If the workplace contains permit spaces, the employer shall inform exposed employees, by posting danger signs or by any other equally effective means, of the existence and location of and the danger posed by the permit spaces.
NOTE: A sign reading DANGER -- PERMIT-REQUIRED CONFINED SPACE, DO NOT ENTER or using other similar language would satisfy the requirement for a sign.

(c)(3) If the employer decides that its employees will not enter permit spaces, the employer shall take effective measures to prevent its employees from entering the permit spaces and shall comply with paragraphs (c)(1), (c)(2), (c)(6), and (c)(8) of this section.

(c)(4) If the employer decides that its employees will enter permit spaces, the employer shall develop and implement a written permit space program that complies with this section. The written program shall be available for inspection by employees and their authorized representatives.

(c)(5) An employer may use the alternate procedures specified in paragraph (c)(5)(ii) of this section for entering a permit space under the conditions set forth in paragraph (c)(5)(i) of this section.

(c)(5)(i) An employer whose employees enter a permit space need not comply with paragraphs (d) through (f) and (h) through (k) of this section, provided that:

(c)(5)(i)(A) The employer can demonstrate that the only hazard posed by the permit space is an actual or potential hazardous atmosphere;

(c)(5)(i)(B) The employer can demonstrate that continuous forced air ventilation alone is sufficient to maintain that permit space safe for entry;

(c)(5)(i)(C) The employer develops monitoring and inspection data that supports the demonstrations required by paragraphs (c)(5)(i)(A) and (c)(5)(i)(B) of this section;

(c)(5)(i)(D) If an initial entry of the permit space is necessary to obtain the data required by paragraph (c)(5)(i)(C) of this section, the entry is performed in compliance with paragraphs (d) through (k) of this section;

(c)(5)(i)(E) The determinations and supporting data required by paragraphs (c)(5)(i)(A), (c)(5)(i)(B), and (c)(5)(i)(C) of this section are documented by the employer and are made available to each employee who enters the permit space under the terms of paragraph (c)(5) of this section or to that employee's authorized representative; and

(c)(5)(i)(F) Entry into the permit space under the terms of paragraph (c)(5)(i) of this section is performed in accordance with the requirements of paragraph (c)(5)(ii) of this section.
NOTE: See paragraph (c)(7) of this section for reclassification of a permit space after all hazards within the space have been eliminated.

(c)(5)(ii) The following requirements apply to entry into permit spaces that meet the conditions set forth in paragraph (c)(5)(i) of this section.

(c)(5)(ii)(A) Any conditions making it unsafe to remove an entrance cover shall be eliminated before the cover is removed.

(c)(5)(ii)(B) When entrance covers are removed, the opening shall be promptly guarded by a railing, temporary cover, or other temporary barrier that will prevent an accidental fall through the opening and that will protect each employee working in the space from foreign objects entering the space.

(c)(5)(ii)(C) Before an employee enters the space, the internal atmosphere shall be tested, with a calibrated direct-reading instrument, for oxygen content, for flammable gases and vapors, and for potential toxic air contaminants, in that order. Any employee, who enters the space, or that employee's authorized representative, shall be provided an opportunity to observe the pre-entry testing required by this paragraph.

(c)(5)(ii)(C)(1) Oxygen content,

(c)(5)(ii)(C)(2) Flammable gases and vapors, and

(c)(5)(ii)(C)(3) Potential toxic air contaminants.

(c)(5)(ii)(D) There may be no hazardous atmosphere within the space whenever any employee is inside the space.

(c)(5)(ii)(E) Continuous forced air ventilation shall be used, as follows:

(c)(5)(ii)(E)(1) An employee may not enter the space until the forced air ventilation has eliminated any hazardous atmosphere;

(c)(5)(ii)(E)(2) The forced air ventilation shall be so directed as to ventilate the immediate areas where an employee is or will be present within the space and shall continue until all employees have left the space;

(c)(5)(ii)(E)(3) The air supply for the forced air ventilation shall be from a clean source and may not increase the hazards in the space.

(c)(5)(ii)(F) The atmosphere within the space shall be periodically tested as necessary to ensure that the continuous forced air ventilation is preventing the accumulation of a hazardous atmosphere. Any employee who enters the space, or that employee's authorized representative, shall be provided with an opportunity to observe the periodic testing required by this paragraph.

(c)(5)(ii)(G) If a hazardous atmosphere is detected during entry:

(c)(5)(ii)(G)(1) Each employee shall leave the space immediately;

(c)(5)(ii)(G)(2) The space shall be evaluated to determine how the hazardous atmosphere developed; and

(c)(5)(ii)(G)(3) Measures shall be implemented to protect employees from the hazardous atmosphere before any subsequent entry takes place.

(c)(5)(ii)(H) The employer shall verify that the space is safe for entry and that the pre-entry measures required by paragraph (c)(5)(ii) of this section have been taken, through a written certification that contains the date, the location of the space, and the signature of the person providing the certification. The certification shall be made before entry and shall be made available to each employee entering the space or to that employee's authorized representative .

(c)(6) When there are changes in the use or configuration of a non-permit confined space that might increase the hazards to entrants, the employer shall reevaluate that space and, if necessary, reclassify it as a permit-required confined space.

(c)(7) A space classified by the employer as a permit-required confined space may be reclassified as a non-permit confined space under the following procedures:

(c)(7)(i) If the permit space poses no actual or potential atmospheric hazards and if all hazards within the space are eliminated without entry into the space, the permit space may be reclassified as a non-permit confined space for as long as the non-atmospheric hazards remain eliminated.

(c)(7)(ii) If it is necessary to enter the permit space to eliminate hazards, such entry shall be performed under paragraphs (d) through (k) of this section. If testing and inspection during that entry demonstrate that the hazards within the permit space have been eliminated, the permit space may be reclassified as a non-permit confined space for as long as the hazards remain eliminated.
NOTE: Control of atmospheric hazards through forced air ventilation does not constitute elimination of the hazards. Paragraph (c)(5) covers permit space entry where the employer can demonstrate that forced air ventilation alone will control all hazards in the space.

(c)(7)(iii) The employer shall document the basis for determining that all hazards in a permit space have been eliminated, through a certification that contains the date, the location of the space, and the signature of the person making the determination. The certification shall be made available to each employee entering the space or to that employee's authorized representative.

(c)(7)(iv) If hazards arise within a permit space that has been declassified to a non-permit space under paragraph (c)(7) of this section, each employee in the space shall exit the space. The employer shall then reevaluate the space and determine whether it must be reclassified as a permit space, in accordance with other applicable provisions of this section.

(c)(8) When an employer (host employer) arranges to have employees of another employer (contractor) perform work that involves permit space entry, the host employer shall:

(c)(8)(i) Inform the contractor that the workplace contains permit spaces and that permit space entry is allowed only through compliance with a permit space program meeting the requirements of this section;

(c)(8)(ii) Apprise the contractor of the elements, including the hazards identified and the host employer's experience with the space, that make the space in question a permit space;

(c)(8)(iii) Apprise the contractor of any precautions or procedures that the host employer has implemented for the protection of employees in or near permit spaces where contractor personnel will be working;

(c)(8)(iv) Coordinate entry operations with the contractor, when both host employer personnel and contractor personnel will be working in or near permit spaces, as required by paragraph (d)(11) of this section; and

(c)(8)(v) Debrief the contractor at the conclusion of the entry operations regarding the permit space program followed and regarding any hazards confronted or created in permit spaces during entry operations.

(c)(9) In addition to complying with the permit space requirements that apply to all employers, each contractor who is retained to perform permit space entry operations shall:

(c)(9)(i) Obtain any available information regarding permit space hazards and entry operations from the host employer;

(c)(9)(ii) Coordinate entry operations with the host employer, when both host employer personnel and contractor personnel will be working in or near permit spaces, as required by paragraph (d)(11) of this section; and

(c)(9)(iii) Inform the host employer of the permit space program that the contractor will follow and of any hazards confronted or created in permit spaces, either through a debriefing or during the entry operation.

(d) Permit-required confined space program (permit space program).

Under the permit space program required by paragraph (c)(4) of this section, the employer shall:

(d)(1) Implement the measures necessary to prevent unauthorized entry;

(d)(2) Identify and evaluate the hazards of permit spaces before employees enter them;

(d)(3) Develop and implement the means, procedures, and practices necessary for safe permit space entry operations, including, but not limited to, the following:

(d)(3)(i) Specifying acceptable entry conditions;

(d)(3)(ii) Providing each authorized entrant or that employee's authorized representative with the opportunity to observe any monitoring or testing of permit spaces;

(d)(3)(iii) Isolating the permit space;

(d)(3)(iv) Purging, inerting, flushing, or ventilating the permit space as necessary to eliminate or control atmospheric hazards;

(d)(3)(v) Providing pedestrian, vehicle, or other barriers as necessary to protect entrants from external hazards; and

(d)(3)(vi) Verifying that conditions in the permit space are acceptable for entry throughout the duration of an authorized entry.

(d)(4) Provide the following equipment (specified in paragraphs (d)(4)(i) through (d)(4)(ix) of this section) at no cost to employees, maintain that equipment properly, and ensure that employees use that equipment properly:

(d)(4)(i) Testing and monitoring equipment needed to comply with paragraph (d)(5) of this section;

(d)(4)(ii) Ventilating equipment needed to obtain acceptable entry conditions;

(d)(4)(iii) Communications equipment necessary for compliance with paragraphs (h)(3) and (i)(5) of this section;

(d)(4)(iv) Personal protective equipment insofar as feasible engineering and work practice controls do not adequately protect employees;

(d)(4)(v) Lighting equipment needed to enable employees to see well enough to work safely and to exit the space quickly in an emergency;

(d)(4)(vi) Barriers and shields as required by paragraph (d)(3)(iv) of this section;

(d)(4)(vii) Equipment, such as ladders, needed for safe ingress and egress by authorized entrants;

(d)(4)(viii) Rescue and emergency equipment needed to comply with paragraph (d)(9) of this section, except to the extent that the equipment is provided by rescue services; and

(d)(4)(ix) Any other equipment necessary for safe entry into and rescue from permit spaces.

(d)(5) Evaluate permit space conditions as follows when entry operations are conducted:

(d)(5)(i) Test conditions in the permit space to determine if acceptable entry conditions exist before entry is authorized to begin, except that, if isolation of the space is infeasible because the space is large or is part of a continuous system (such as a sewer), pre-entry testing shall be performed to the extent feasible before entry is authorized and, if entry is authorized, entry conditions shall be continuously monitored in the areas where authorized entrants are working;

(d)(5)(ii) Test or monitor the permit space as necessary to determine if acceptable entry conditions are being maintained during the course of entry operations; and

(d)(5)(iii) When testing for atmospheric hazards, test first for oxygen, then for combustible gases and vapors, and then for toxic gases and vapors.

(d)(5)(iv) Provide each authorized entrant or that employee's authorized representative an opportunity to observe the pre-entry and any subsequent testing or monitoring of permit spaces;

(d)(5)(v) Reevaluate the permit space in the presence of any authorized entrant or that employee's authorized representative who requests that the employer conduct such reevaluation because the entrant or representative has reason to believe that the evaluation of that space may not have been adequate;

(d)(5)(vi) Immediately provide each authorized entrant or that employee's authorized representative with the results of any testing conducted in accord with paragraph (d) of this section.
NOTE: Atmospheric testing conducted in accordance with Appendix B to section 1910.146 would be considered as satisfying the requirements of this paragraph. For permit space operations in sewers, atmospheric testing conducted in accordance with Appendix B, as supplemented by Appendix E to section 1910.146, would be considered as satisfying the requirements of this paragraph.

(d)(6) Provide at least one attendant outside the permit space into which entry is authorized for the duration of entry operations;
NOTE: Attendants may be assigned to monitor more than one permit space provided the duties described in paragraph (i) of this section can be effectively performed for each permit space that is monitored. Likewise, attendants may be stationed at any location outside the permit space to be monitored as long as the duties described in paragraph (i) of this section can be effectively performed for each permit space that is monitored.

(d)(7) If multiple spaces are to be monitored by a single attendant, include in the permit program the means and procedures to enable the attendant to respond to an emergency affecting one or more of the permit spaces being monitored without distraction from the attendant's responsibilities under paragraph (i) of this section;

(d)(8) Designate the persons who are to have active roles (as, for example, authorized entrants, attendants, entry supervisors, or persons who test or monitor the atmosphere in a permit space) in entry operations, identify the duties of each such employee, and provide each such employee with the training required by paragraph (g) of this section;

(d)(9) Develop and implement procedures for summoning rescue and emergency services, for rescuing entrants from permit spaces, for providing necessary emergency services to rescued employees, and for preventing unauthorized personnel from attempting a rescue;

(d)(10) Develop and implement a system for the preparation, issuance, use, and cancellation of entry permits as required by this section;

(d)(11) Develop and implement procedures to coordinate entry operations when employees of more than one employer are working simultaneously as authorized entrants in a permit space, so that employees of one employer do not endanger the employees of any other employer;

(d)(12) Develop and implement procedures (such as closing off a permit space and canceling the permit) necessary for concluding the entry after entry operations have been completed;

(d)(13) Review entry operations when the employer has reason to believe that the measures taken under the permit space program may not protect employees and revise the program to correct deficiencies found to exist before subsequent entries are authorized; and
NOTE: Examples of circumstances requiring the review of the permit space program are: any unauthorized entry of a permit space, the detection of a permit space hazard not covered by the permit, the detection of a condition prohibited by the permit, the occurrence of an injury or near-miss during entry, a change in the use or configuration of a permit space, and employee complaints about the effectiveness of the program.

(d)(14) Review the permit space program, using the canceled permits retained under paragraph (e)(6) of this section within 1 year after each entry and revise the program as necessary, to ensure that employees participating in entry operations are protected from permit space hazards.
NOTE: Employers may perform a single annual review covering all entries performed during a 12-month period. If no entry is performed during a 12-month period, no review is necessary. Appendix C to section 1910.146 presents examples of permit space programs that are considered to comply with the requirements of paragraph (d) of this section.

(e) Permit system.

(e)(1) Before entry is authorized, the employer shall document the completion of measures required by paragraph (d)(3) of this section by preparing an entry permit.
NOTE: Appendix D to section 1910.146 presents examples of permits whose elements are considered to comply with the requirements of this section.

(e)(2) Before entry begins, the entry supervisor identified on the permit shall sign the entry permit to authorize entry.

(e)(3) The completed permit shall be made available at the time of entry to all authorized entrants or their authorized representatives, by posting it at the entry portal or by any other equally effective means, so that the entrants can confirm that pre-entry preparations have been completed.

(e)(4) The duration of the permit may not exceed the time required to complete the assigned task or job identified on the permit in accordance with paragraph (f)(2) of this section.

(e)(5) The entry supervisor shall terminate entry and cancel the entry permit when:

(e)(5)(i) The entry operations covered by the entry permit have been completed; or

(e)(5)(ii) A condition that is not allowed under the entry permit arises in or near the permit space.

(e)(6) The employer shall retain each canceled entry permit for at least 1 year to facilitate the review of the permit-required confined space program required by paragraph (d)(14) of this section. Any problems encountered during an entry operation shall be noted on the pertinent permit so that appropriate revisions to the permit space program can be made.

(f) Entry permit.

The entry permit that documents compliance with this section and authorizes entry to a permit space shall identify:

(f)(1) The permit space to be entered;

(f)(2) The purpose of the entry;

(f)(3) The date and the authorized duration of the entry permit;

(f)(4) The authorized entrants within the permit space, by name or by such other means (for example, through the use of rosters or tracking systems) as will enable the attendant to determine quickly and accurately, for the duration of the permit, which authorized entrants are inside the permit space;
NOTE: This requirement may be met by inserting a reference on the entry permit as to the means used, such as a roster or tracking system, to keep track of the authorized entrants within the permit space.

(f)(5) The personnel, by name, currently serving as attendants;

(f)(6) The individual, by name, currently serving as entry supervisor, with a space for the signature or initials of the entry supervisor who originally authorized entry;

(f)(7) The hazards of the permit space to be entered;

(f)(8) The measures used to isolate the permit space and to eliminate or control permit space hazards before entry;
NOTE: Those measures can include the lockout or tagging of equipment and procedures for purging, inerting, ventilating, and flushing permit spaces.

(f)(9) The acceptable entry conditions;

(f)(10) The results of initial and periodic tests performed under paragraph (d)(5) of this section, accompanied by the names or initials of the testers and by an indication of when the tests were performed;

(f)(11) The rescue and emergency services that can be summoned and the means (such as the equipment to use and the numbers to call) for summoning those services;

(f)(12) The communication procedures used by authorized entrants and attendants to maintain contact during the entry;

(f)(13) Equipment, such as personal protective equipment, testing equipment, communications equipment, alarm systems, and rescue equipment, to be provided for compliance with this section;

(f)(14) Any other information whose inclusion is necessary, given the circumstances of the particular confined space, in order to ensure employee safety; and (15) Any additional permits, such as for hot work, that have been issued to authorize work in the permit space.

(g) Training.

(g)(1) The employer shall provide training so that all employees whose work is regulated by this section acquire the understanding, knowledge, and skills necessary for the safe performance of the duties assigned under this section.

(g)(2) Training shall be provided to each affected employee:

(g)(2)(i) Before the employee is first assigned duties under this section;

(g)(2)(ii) Before there is a change in assigned duties;

(g)(2)(iii) Whenever there is a change in permit space operations that presents a hazard about which an employee has not previously been trained;

(g)(2)(iv) Whenever the employer has reason to believe either that there are deviations from the permit space entry procedures required by paragraph (d)(3) of this section or that there are inadequacies in the employee's knowledge or use of these procedures.

(g)(3) The training shall establish employee proficiency in the duties required by this section and shall introduce new or revised procedures, as necessary, for compliance with this section.

(g)(4) The employer shall certify that the training required by paragraphs (g)(1) through (g)(3) of this section has been accomplished. The certification shall contain each employee's name, the signatures or initials of the trainers, and the dates of training. The certification shall be available for inspection by employees and their authorized representatives.

(h) Duties of authorized entrants.

The employer shall ensure that all authorized entrants:

(h)(1) Know the hazards that may be faced during entry, including information on the mode, signs or symptoms, and consequences of the exposure;

(h)(2) Properly use equipment as required by paragraph (d)(4) of this section;

(h)(3) Communicate with the attendant as necessary to enable the attendant to monitor entrant status and to enable the attendant to alert entrants of the need to evacuate the space as required by paragraph (i)(6) of this section;

(h)(4) Alert the attendant whenever:

(h)(4)(i) The entrant recognizes any warning sign or symptom of exposure to a dangerous situation, or

(h)(4)(ii) The entrant detects a prohibited condition; and

(h)(5) Exit from the permit space as quickly as possible whenever:

(h)(5)(i) An order to evacuate is given by the attendant or the entry supervisor,

(h)(5)(ii) The entrant recognizes any warning sign or symptom of exposure to a dangerous situation,

(h)(5)(iii) The entrant detects a prohibited condition, or

(h)(5)(iv) An evacuation alarm is activated.

(i) Duties of attendants.

The employer shall ensure that each attendant:

(i)(1) Knows the hazards that may be faced during entry, including information on the mode, signs or symptoms, and consequences of the exposure;

(i)(2) Is aware of possible behavioral effects of hazard exposure in authorized entrants;

(i)(3) Continuously maintains an accurate count of authorized entrants in the permit space and ensures that the means used to identify authorized entrants under paragraph (f)(4) of this section accurately identifies who is in the permit space;

(i)(4) Remains outside the permit space during entry operations until relieved by another attendant;
NOTE: When the employer's permit entry program allows attendant entry for rescue, attendants may enter a permit space to attempt a rescue if they have been trained and equipped for rescue operations as required by paragraph (k)(1) of this section and if they have been relieved as required by paragraph (i)(4) of this section.

(i)(5) Communicates with authorized entrants as necessary to monitor entrant status and to alert entrants of the need to evacuate the space under paragraph (i)(6) of this section;

(i)(6) Monitors activities inside and outside the space to determine if it is safe for entrants to remain in the space and orders the authorized entrants to evacuate the permit space immediately under any of the following conditions;

(i)(6)(i) If the attendant detects a prohibited condition;

(i)(6)(ii) If the attendant detects the behavioral effects of hazard exposure in an authorized entrant;

(i)(6)(iii) If the attendant detects a situation outside the space that could endanger the authorized entrants; or

(i)(6)(iv) If the attendant cannot effectively and safely perform all the duties required under paragraph (i) of this section;

(i)(7) Summon rescue and other emergency services as soon as the attendant determines that authorized entrants may need assistance to escape from permit space hazards;

(i)(8) Takes the following actions when unauthorized persons approach or enter a permit space while entry is underway:

(i)(8)(i)
Warn the unauthorized persons that they must stay away from the permit space;

(i)(8)(ii) Advise the unauthorized persons that they must exit immediately if they have entered the permit space; and

(i)(8)(iii) Inform the authorized entrants and the entry supervisor if unauthorized persons have entered the permit space;

(i)(9) Performs non-entry rescues as specified by the employer's rescue procedure; and

(i)(10) Performs no duties that might interfere with the attendant's primary duty to monitor and protect the authorized entrants.

(j) Duties of entry supervisors.

The employer shall ensure that each entry supervisor:

(j)(1) Knows the hazards that may be faced during entry, including information on the mode, signs or symptoms, and consequences of the exposure;

(j)(2) Verifies, by checking that the appropriate entries have been made on the permit, that all tests specified by the permit have been conducted and that all procedures and equipment specified by the permit are in place before endorsing the permit and allowing entry to begin;

(j)(3) Terminates the entry and cancels the permit as required by paragraph (e)(5) of this section;

(j)(4) Verifies that rescue services are available and that the means for summoning them are operable;

(j)(5) Removes unauthorized individuals who enter or who attempt to enter the permit space during entry operations; and

(j)(6) Determines, whenever responsibility for a permit space entry operation is transferred and at intervals dictated by the hazards and operations performed within the space, that entry operations remain consistent with terms of the entry permit and that acceptable entry conditions are maintained.

(k) Rescue and emergency services.

(k)(1) An employer who designates rescue and emergency services, pursuant to paragraph (d)(9) of this section, shall:

(k)(1)(i) Evaluate a prospective rescuer's ability to respond to a rescue summons in a timely manner, considering the hazard(s) identified; Note to paragraph (k)(l)(i): What will be considered timely will vary according to the specific hazards involved in each entry. For example, §1910.134, Respiratory Protection, requires that employers provide a standby person or persons capable of immediate action to rescue employee(s) wearing respiratory protection while in work areas defined as IDLH atmospheres.

(k)(1)(ii) Evaluate a prospective rescue service's ability, in terms of proficiency with rescue-related tasks and equipment, to function appropriately while rescuing entrants from the particular permit space or types of permit spaces identified;

(k)(1)(iii) Select a rescue team or service from those evaluated that:

(k)(1)(iii)(A) Has the capability to reach the victim(s) within a time frame that is appropriate for the permit space hazard(s) identified;

(k)(1)(iii)(B) Is equipped for and proficient in performing the needed rescue services;

(k)(1)(iv) Inform each rescue team or service of the hazards they may confront when called on to perform rescue at the site; and

(k)(1)(v) Provide the rescue team or service selected with access to all permit spaces from which rescue may be necessary so that the rescue service can develop appropriate rescue plans and practice rescue operations. Note to paragraph (k)(1): Non-mandatory Appendix F contains examples of criteria which employers can use in evaluating prospective rescuers as required by paragraph (k)(l) of this section.

(k)(2) An employer whose employees have been designated to provide permit space rescue and emergency services shall take the following measures:

(k)(2)(i) Provide affected employees with the personal protective equipment (PPE) needed to conduct permit space rescues safely and train affected employees so they are proficient in the use of that PPE, at no cost to those employees;

(k)(2)(ii) Train affected employees to perform assigned rescue duties. The employer must ensure that such employees successfully complete the training required to establish proficiency as an authorized entrant, as provided by paragraphs (g) and (h) of this section;

(k)(2)(iii) Train affected employees in basic first-aid and cardiopulmonary resuscitation (CPR). The employer shall ensure that at least one member of the rescue team or service holding a current certification in first aid and CPR is available; and

(k)(2)(iv) Ensure that affected employees practice making permit space rescues at least once every 12 months, by means of simulated rescue operations in which they remove dummies, manikins, or actual persons from the actual permit spaces or from representative permit spaces. Representative permit spaces shall, with respect to opening size, configuration, and accessibility, simulate the types of permit spaces from which rescue is to be performed.

(k)(3) To facilitate non-entry rescue, retrieval systems or methods shall be used whenever an authorized entrant enters a permit space, unless the retrieval equipment would increase the overall risk of entry or would not contribute to the rescue of the entrant. Retrieval systems shall meet the following requirements.

(k)(3)(i) Each authorized entrant shall use a chest or full body harness, with a retrieval line attached at the center of the entrant's back near shoulder level, above the entrant's head, or at another point which the employer can establish presents a profile small enough for the successful removal of the entrant. Wristlets may be used in lieu of the chest or full body harness if the employer can demonstrate that the use of a chest or full body harness is infeasible or creates a greater hazard and that the use of wristlets is the safest and most effective alternative.

(k)(3)(ii) The other end of the retrieval line shall be attached to a mechanical device or fixed point outside the permit space in such a manner that rescue can begin as soon as the rescuer becomes aware that rescue is necessary. A mechanical device shall be available to retrieve personnel from vertical type permit spaces more than 5 feet (1.52 m) deep

(k)(4) If an injured entrant is exposed to a substance for which a Material Safety Data Sheet (MSDS) or other similar written information is required to be kept at the worksite, that MSDS or written information shall be made available to the medical facility treating the exposed entrant.

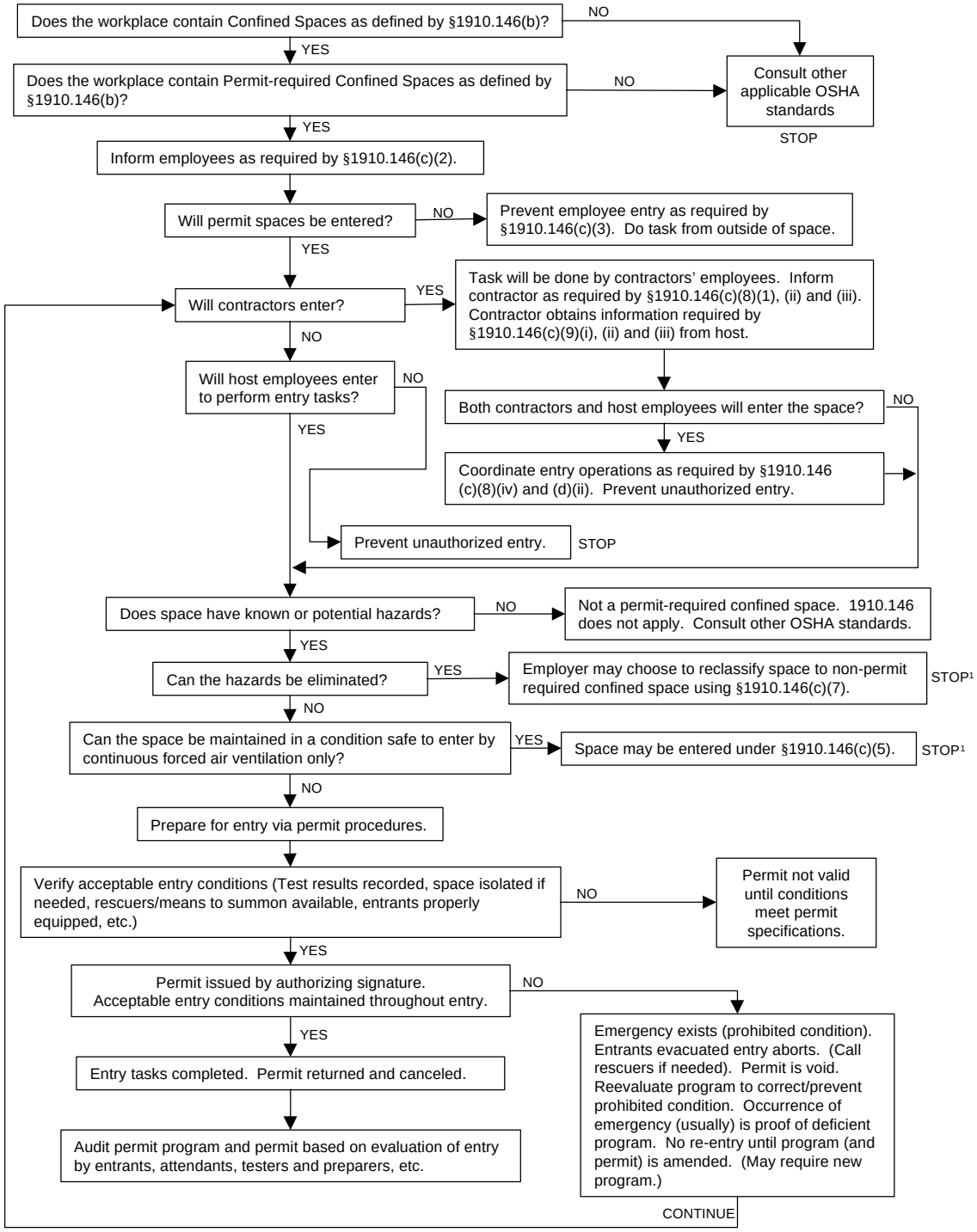
(l) Employee participation.

(l)(1) Employers shall consult with affected employees and their authorized representatives on the development and implementation of all aspects of the permit space program required by paragraph (c) of this section.

(l)(2) Employers shall make available to affected employees and their authorized representatives all information required to be developed by this section.

Appendix A: 29 CFR 1910.146, Permit-required confined spaces standard

Appendix A, Permit-required Confined Space Decision Flow Chart



[1]Spaces may have to be evacuated and re-evaluated if hazards arise during entry

Appendix B, Procedures for Atmospheric Testing

Atmospheric testing is required for two distinct purposes: evaluation of the hazards of the permit space and verification that acceptable entry conditions for entry into that space exist.

(1) Evaluation testing. The atmosphere of a confined space should be analyzed using equipment of sufficient sensitivity and specificity to identify and evaluate any hazardous atmospheres that may exist or arise, so that appropriate permit entry procedures can be developed and acceptable entry conditions stipulated for that space. Evaluation and interpretation of these data, and development of the entry procedure, should be done by, or reviewed by, a technically qualified professional (e.g., OSHA consultation service, or certified industrial hygienist, registered safety engineer, certified safety professional, certified marine chemist, etc.) based on evaluation of all serious hazards.

(2) Verification testing. The atmosphere of a permit space which may contain a hazardous atmosphere should be tested for residues of all contaminants identified by evaluation testing using permit specified equipment to determine that residual concentrations at the time of testing and entry are within the range of acceptable entry conditions. Results of testing (i.e., actual concentration, etc.) should be recorded on the permit in the space provided adjacent to the stipulated acceptable entry condition.

(3) Duration of testing. Measurement of values for each atmospheric parameter should be made for at least the minimum response time of the test instrument specified by the manufacturer.

(4) Testing stratified atmospheres. When monitoring for entries involving a descent into atmospheres that may be stratified, the atmospheric envelope should be tested a distance of approximately 4 feet (1.22 m) in the direction of travel and to each side. If a sampling probe is used, the entrant's rate of progress should be slowed to accommodate the sampling speed and detector response.

(5) Order of testing. A test for oxygen is performed first because most combustible gas meters are oxygen dependent and will not provide reliable readings in an oxygen deficient atmosphere. Combustible gases are tested for next because the threat of fire or explosion is both more immediate and more life threatening, in most cases, than exposure to toxic gases and vapors. If tests for toxic gases and vapors are necessary, they are performed last.

Appendix C, Examples of Permit-required Confined Space Programs

Example 1.

Workplace. Sewer entry.

Potential hazards. The employees could be exposed to the following:

Engulfment.

Presence of toxic gases. Equal to or more than 10 ppm hydrogen sulfide measured as an 8-hour time-weighted average. If the presence of other toxic contaminants is suspected, specific monitoring programs will be developed.

Presence of explosive/flammable gases. Equal to or greater than 10% of the lower flammable limit (LFL).

Oxygen Deficiency. A concentration of oxygen in the atmosphere equal to or less than 19.5% by volume.

A. ENTRY WITHOUT PERMIT/ATTENDANT

Certification. Confined spaces may be entered without the need for a written permit or attendant provided that the space can be maintained in a safe condition for entry by mechanical ventilation alone, as provided in 1910.146(c)(5). All spaces shall be considered permit-required confined spaces until the pre-entry procedures demonstrate otherwise. Any employee required or permitted to pre-check or enter an enclosed/confined space shall have successfully completed, as a minimum, the training as required by the following sections of these procedures. *A written copy of operating and rescue procedures as required by these procedures shall be at the work site for the duration of the job.* The Confined Space Pre-Entry Check List must be completed by the LEAD WORKER before entry into a confined space. This list verifies completion of items listed below. This check list shall be kept at the job site for duration of the job. If circumstances dictate an interruption in the work, the permit space must be re-evaluated and a new check list must be completed.

Control of atmospheric and engulfment hazards.

Pumps and Lines. All pumps and lines which may reasonably cause contaminants to flow into the space shall be disconnected, blinded and locked out, or effectively isolated by other means to prevent development of dangerous air contamination or engulfment. Not all laterals to sewers or storm drains require blocking. However, where experience or knowledge of industrial use indicates there is a reasonable potential for contamination of air or engulfment into an occupied sewer, then all affected laterals shall be blocked. If blocking and/or isolation requires entry into the space the provisions for entry into a permit-required confined space must be implemented.

Surveillance. The surrounding area shall be surveyed to avoid hazards such as drifting vapors from the tanks, piping, or sewers.

Testing. The atmosphere within the space will be tested to determine whether dangerous air contamination and/or oxygen deficiency exists. Detector tubes, alarm only gas monitors and explosion meters are examples of monitoring equipment that may be used to test permit space atmospheres. Testing shall be performed by the LEAD WORKER who has successfully completed the Gas Detector training for the monitor he will use. The minimum parameters to be monitored are oxygen deficiency, LFL, and hydrogen sulfide concentration. A written record of the pre-entry test results shall be made and kept at the work site for the duration of the job. The supervisor will certify in writing, based upon the results of the pre-entry testing, that all hazards have been eliminated. Affected employees shall be able to review the testing results. The most hazardous conditions shall govern when work is being performed in two adjoining, connecting spaces.

Entry Procedures. If there are no non-atmospheric hazards present and if the pre-entry tests show there is no dangerous air contamination and/or oxygen deficiency within the space and there is no reason to believe that any is likely to develop, entry into and work within may proceed. Continuous testing of the atmosphere in the immediate vicinity of the workers within the space shall be accomplished. The workers will immediately leave the permit space when any of the gas monitor alarm set points are reached as defined. Workers will not return to the area until a SUPERVISOR who has completed the gas detector training has used a direct reading gas detector to evaluate the situation and has determined that it is safe to enter.

Rescue. Arrangements for rescue services are not required where there is no attendant. See the rescue portion of section B., below, for instructions regarding rescue planning where an entry permit is required.

B. ENTRY PERMIT REQUIRED

Permits. Confined Space Entry Permit. All spaces shall be considered permit-required confined spaces until the pre-entry procedures demonstrate otherwise. Any employee required or permitted to pre-check or enter a permit-required confined space shall have successfully completed, as a minimum, the training as required by the following sections of these procedures. *A written copy of operating and rescue procedures as required by these procedures shall be at the work site for the duration of the job.* The Confined Space Entry Permit must be completed before approval can be given to enter a permit-required confined space. This permit verifies completion of items listed below. This permit shall be kept at the job site for the duration of the job. If circumstances cause an interruption in the work or a change in the alarm conditions for which entry was approved, a new Confined Space Entry Permit must be completed.

Control of atmospheric and engulfment hazards.

Surveillance. The surrounding area shall be surveyed to avoid hazards such as drifting vapors from tanks, piping or sewers.

Testing. The confined space atmosphere shall be tested to determine whether dangerous air contamination and/or oxygen deficiency exists. A direct reading gas monitor shall be used. Testing shall be performed by the SUPERVISOR who has successfully completed the gas detector training for the monitor he will use. The minimum parameters to be monitored are oxygen deficiency, LFL and hydrogen sulfide concentration. A written record of the pre-entry test results shall be made and kept at the work site for the duration of the job. Affected employees shall be able to review the testing results. The most hazardous conditions shall govern when work is being performed in two adjoining, connected spaces.

Space Ventilation. Mechanical ventilation systems, where applicable, shall be set at 100% outside air. Where possible, open additional manholes to increase air circulation. Use portable blowers to augment natural circulation if needed. After a suitable ventilating period, repeat the testing. Entry may not begin until testing has demonstrated that the hazardous atmosphere has been eliminated.

Entry Procedures. The following procedure shall be observed under any of the following conditions: 1.) Testing demonstrates the existence of dangerous or deficient conditions and additional ventilation cannot reduce concentrations to safe levels; 2.) The atmosphere tests as safe but unsafe conditions can reasonably be expected to develop; 3.) It is not feasible to provide for ready exit from spaces equipped with automatic fire suppression systems and it is not practical or safe to deactivate such systems; or 4.) An emergency exists and it is not feasible to wait for pre-entry
procedures to take effect.

All personnel must be trained. A self contained breathing apparatus shall be worn by any person entering the space. At least one worker shall stand by the outside of the space ready to give assistance in case of emergency. The standby worker shall have a self contained breathing apparatus available for immediate use. There shall be at least one additional worker within sight or call of the standby worker. Continuous powered communications shall be maintained between the worker within the confined space and standby personnel.

If at any time there is any questionable action or non-movement by the worker inside, a verbal check will be made. If there is no response, the worker will be moved immediately. *Exception:* If the worker is disabled due to falling or impact, he/she shall not be removed from the confined space unless there is immediate danger to his/her life. Local fire department rescue personnel shall be notified immediately. The standby worker may only enter the confined space in case of an emergency (wearing the self contained breathing apparatus) and only after being relieved by another worker. Safety belt or harness with attached lifeline shall be used by all workers entering the space with the free end of the line secured outside the entry opening. The standby worker shall attempt to remove a disabled worker via his lifeline before entering the space.

When practical, these spaces shall be entered through side openings -- those within 3 1/2 feet (1.07 m) of the bottom. When entry must be through a top opening, the safety belt shall be of the harness type that suspends a person upright and a hoisting device or similar apparatus shall be available for lifting workers out of the space.

In any situation where their use may endanger the worker, use of a hoisting device or safety belt and attached lifeline may be discontinued.

When dangerous air contamination is attributable to flammable and/or explosive substances, lighting and electrical equipment shall be Class 1, Division 1 rated per National Electrical Code and no ignition sources shall be introduced into the area.

Continuous gas monitoring shall be performed during all confined space operations. If alarm conditions change adversely, entry personnel shall exit the confined space and a new confined space permit issued.

Rescue. Call the fire department services for rescue. Where immediate hazards to injured personnel are present, workers at the site shall implement emergency procedures to fit the situation.

Example 2.

Workplace. Meat and poultry rendering plants.

Cookers and dryers are either batch or continuous in their operation. Multiple batch cookers are operated in parallel. When one unit of a multiple set is shut down for repairs, means are available to isolate that unit from the others which remain in operation.

Cookers and dryers are horizontal, cylindrical vessels equipped with a center, rotating shaft and agitator paddles or discs. If the inner shell is jacketed, it is usually heated with steam at pressures up to 150 psig (1034.25 kPa). The rotating shaft assembly of the continuous cooker or dryer is also steam heated.

Potential Hazards. The recognized hazards associated with cookers and dryers are the risk that employees could be:

1. Struck or caught by rotating agitator;
2. Engulfed in raw material or hot, recycled fat;
3. Burned by steam from leaks into the cooker/dryer steam jacket or the condenser duct system if steam valves are not properly closed and locked out;
4. Burned by contact with hot metal surfaces, such as the agitator shaft assembly, or inner shell of the cooker/dryer;
5. Heat stress caused by warm atmosphere inside cooker/dryer;
6. Slipping and falling on grease in the cooker/dryer;
7. Electrically shocked by faulty equipment taken into the cooker/dryer;
8. Burned or overcome by fire or products of combustion; or
9. Overcome by fumes generated by welding or cutting done on grease covered surfaces.

Permits. The supervisor in this case is always present at the cooker/dryer or other permit entry confined space when entry is made. The supervisor must follow the pre-entry isolation procedures described in the entry permit in preparing for entry, and ensure that the protective clothing, ventilating equipment and any other equipment required by the permit are at the entry site.

Control of hazards. Mechanical. Lock out main power switch to agitator motor at main power panel. Affix tag to the lock to inform others that a permit entry confined space entry is in progress.

Engulfment. Close all valves in the raw material blow line. Secure each valve in its closed position using chain and lock. Attach a tag to the valve and chain warning that a permit entry confined space entry is in progress. The same procedure shall be used for securing the fat recycle valve.

Burns and heat stress. Close steam supply valves to jacket and secure with chains and tags. Insert solid blank at flange in cooker vent line to condenser manifold duct system. Vent cooker/dryer by opening access door at discharge end and top center door to allow natural ventilation throughout the entry. If faster cooling is needed, use an portable ventilation fan to increase ventilation. Cooling water may be circulated through the jacket to reduce both outer and inner surface temperatures of cooker/dryers faster. Check air and inner surface temperatures in cooker/dryer to
assure they are within acceptable limits before entering, or use proper protective
clothing.

Fire and fume hazards. Careful site preparation, such as cleaning the area within 4 inches (10.16 cm) of all welding or torch cutting operations, and proper ventilation are the preferred controls. All welding and cutting operations shall be done in accordance with the requirements of 29 CFR Part 1910, Subpart Q, OSHA's welding standard. Proper ventilation may be achieved by local exhaust ventilation, or the use of portable ventilation fans, or a combination of the two practices.

Electrical shock. Electrical equipment used in cooker/dryers shall be in serviceable condition.

Slips and falls. Remove residual grease before entering cooker/dryer.

Attendant. The supervisor shall be the attendant for employees entering cooker/dryers.

Permit. The permit shall specify how isolation shall be done and any other preparations needed before making entry. This is especially important in parallel arrangements of cooker/dryers so that the entire operation need not be shut down to allow safe entry into one unit.

Rescue. When necessary, the attendant shall call the fire department as previously arranged.

Example 3.

Workplace. Workplaces where tank cars, trucks, and trailers, dry bulk tanks and trailers, railroad tank cars, and similar portable tanks are fabricated or serviced.

A. During fabrication. These tanks and dry-bulk carriers are entered repeatedly throughout the fabrication process. These products are not configured identically, but the manufacturing processes by which they are made are very similar.

Sources of hazards. In addition to the mechanical hazards arising from the risks that an entrant would be injured due to contact with components of the tank or the tools being used, there is also the risk that a worker could be injured by breathing fumes from welding materials or mists or vapors from materials used to coat the tank interior. In addition, many of these vapors and mists are flammable, so the failure to properly ventilate a tank could lead to a fire or explosion.

Control of hazards.

Welding. Local exhaust ventilation shall be used to remove welding fumes once the tank or carrier is completed to the point that workers may enter and exit only through a manhole. (Follow the requirements of 29 CFR 1910, Subpart Q, OSHA's welding standard, at all times.) Welding gas tanks may never be brought into a tank or carrier that is a permit entry confined space.

Application of interior coatings/linings. Atmospheric hazards shall be controlled by forced air ventilation sufficient to keep the atmospheric concentration of flammable materials below 10% of the lower flammable limit (LFL) (or lower explosive limit (LEL), whichever term is used locally). The appropriate respirators are provided and shall be used in addition to providing forced ventilation if the forced ventilation does not maintain acceptable respiratory conditions.

Permits. Because of the repetitive nature of the entries in these operations, an "Area Entry Permit" will be issued for a 1 month period to cover those production areas where tanks are fabricated to the point that entry and exit are made using manholes.

Authorization. Only the area supervisor may authorize an employee to enter a tank within the permit area. The area supervisor must determine that conditions in the tank trailer, dry bulk trailer or truck, etc. meet permit requirements before authorizing entry.

Attendant. The area supervisor shall designate an employee to maintain communication by employer specified means with employees working in tanks to ensure their safety. The attendant may not enter any permit entry confined space to rescue an entrant or for any other reason, unless authorized by the rescue procedure and, even then, only after calling the rescue team and being relieved by an attendant or another worker.

Communications and observation. Communications between attendant and entrant(s) shall be maintained throughout entry. Methods of communication that may be specified by the permit include voice, voice powered radio, tapping or rapping codes on tank walls, signalling tugs on a rope, and the attendant's observation that work activities such as chipping, grinding, welding, spraying, etc., which require deliberate operator control continue normally. These activities often generate so much noise that the necessary hearing protection makes communication by voice difficult.

Rescue procedures. Acceptable rescue procedures include entry by a team of employee-rescuers, use of public emergency services, and procedures for breaching the tank. The area permit specifies which procedures are available, but the area supervisor makes the final decision based on circumstances. (Certain injuries may make it necessary to breach the tank to remove a person rather than risk additional injury by removal through an existing manhole. However, the supervisor must ensure that no breaching procedure used for rescue would violate terms of the entry permit. For instance, if the tank must be breached by cutting with a torch, the tank surfaces to be cut must be free of volatile or combustible coatings within 4 inches (10.16 cm) of the cutting line and the atmosphere within the tank must be below the LFL.

Retrieval line and harnesses. The retrieval lines and harnesses generally required under this standard are usually impractical for use in tanks because the internal configuration of the tanks and their interior baffles and other structures would prevent rescuers

from hauling out injured entrants. However, unless the rescue procedure calls for breaching the tank for rescue, the rescue team shall be trained in the use of retrieval lines and harnesses for removing injured employees through manholes.

B. Repair or service of "used" tanks and bulk trailers.

Sources of hazards. In addition to facing the potential hazards encountered in fabrication or manufacturing, tanks or trailers which have been in service may contain residues of dangerous materials, whether left over from the transportation of hazardous cargoes or generated by chemical or bacterial action on residues of non-hazardous cargoes.

Control of atmospheric hazards. A "used" tank shall be brought into areas where tank entry is authorized only after the tank has been emptied, cleansed (without employee entry) of any residues, and purged of any potential atmospheric hazards.

Welding. In addition to tank cleaning for control of atmospheric hazards, coating and surface materials shall be removed 4 inches (10.16 cm) or more from any surface area where welding or other torch work will be done and care taken that the atmosphere within the tank remains well below the LFL. (Follow the requirements of 29 CFR 1910, Subpart Q, OSHA's welding standard, at all times.)

Permits. An entry permit valid for up to 1 year shall be issued prior to authorization of entry into used tank trailers, dry bulk trailers or trucks. In addition to the pre-entry cleaning requirement, this permit shall require the employee safeguards specified for new tank fabrication or construction permit areas.

Authorization. Only the area supervisor may authorize an employee to enter a tank trailer, dry bulk trailer or truck within the permit area. The area supervisor must determine that the entry permit requirements have been met before authorizing entry.

Appendix D, Confined Space Pre-Entry Check List

Appendix D-1

Confined Space Entry Permit

Date and Time Issued: _____ Date and Time Expires: _____

Job site/Space I.D.: _____ Job Supervisor:_____

Equipment to be worked on: _____ Work to be performed: _____

Stand-by personnel: _____ _____ _____

1. Atmospheric Checks:
   - Time _____
   - Oxygen _____%
   - Explosive _____% L.F.L.
   - Toxic _____PPM

2. Tester's signature: _____

3. Source isolation (No Entry):

	N/A	Yes	No
Pumps or lines blinded,	( )	( )	( )
disconnected, or blocked	( )	( )	( )

4. Ventilation Modification:

	N/A	Yes	No
Mechanical	( )	( )	( )
Natural Ventilation only	( )	( )	( )

5. Atmospheric check after isolation and Ventilation:

Oxygen _____%	>	19.5	%
Explosive _____% L.F.L.	<	10	%
Toxic _____PPM	<	10	PPM H_2S

Time _____

Tester's signature _____

6. Communication procedures: _____
_____

7. Rescue procedures: _____
_____
_____
_____
_____
_____

8. Entry, standby, and back up persons:

	Yes	No
Successfully completed required training?	( )	( )
Is it current?	( )	( )

9. Equipment:

	N/A	Yes	No
Direct reading gas monitor - tested	( )	( )	( )
Safety harnesses and lifelines for entry and standby persons	( )	( )	( )
Hoisting equipment	( )	( )	( )
Powered communications	( )	( )	( )
SCBA's for entry and standby persons	( )	( )	( )
Protective Clothing	( )	( )	( )
All electric equipment listed Class I, Division I, Group D and Non-sparking tools	( )	( )	( )

10. Periodic atmospheric tests:

Oxygen ____% Time ____	Oxygen ____% Time ____	Oxygen ____% Time ____	Oxygen ____% Time ____
Explosive ____% Time ____	Explosive ____% Time ____	Explosive ____% Time ____	Explosive ____% Time ____
Toxic ____% Time ____	Toxic ____% Time ____	Toxic ____% Time ____	Toxic ____% Time ____

We have reviewed the work authorized by this permit and the information contained here-in. Written instructions and safety procedures have been received and are understood. Entry cannot be approved if any squares are marked in the "No" column. This permit is not valid unless all appropriate items are completed.

Permit Prepared By: (Supervisor) _____ _____

Approved By: (Unit Supervisor) _____ _____

Reviewed By (Cs Operations Personnel): _____ _____

(printed name) (signature)

This permit to be kept at job site. Return job site copy to Safety Office following job completion.

Copies: White Original (Safety Office) Yellow (Unit Supervisor) Hard(Job site)

Appendix D — Confined Space Pre-Entry Check List (cont.)

Appendix D-2

ENTRY PERMIT

PERMIT VALID FOR 8 HOURS ONLY. ALL COPIES OF PERMIT WILL REMAIN AT JOB SITE UNTIL JOB IS COMPLETED

DATE: _____ SITE LOCATION and DESCRIPTION _____
PURPOSE OF ENTRY _____
SUPERVISOR(S) in charge of crews Type of Crew Phone #
_____
_____
COMMUNICATION PROCEDURES _____
RESCUE PROCEDURES (PHONE NUMBERS AT BOTTOM) _____
_____

*** BOLD DENOTES MINIMUM REQUIREMENTS TO BE COMPLETED AND REVIEWED PRIOR TO ENTRY ***

REQUIREMENTS COMPLETED	DATE	TIME	REQUIREMENTS COMPLETED	DATE	TIME
Lock Out/De-energize/Try-out	_____	_____	**Full Body Harness w/"D" ring**	_____	_____
Line(s) Broken-Capped-Blanked	_____	_____	**Emergency Escape Retrieval Equip**	_____	_____
Purge-Flush and Vent	_____	_____	**Lifelines**	_____	_____
Ventilation	_____	_____	Fire Extinguishers	_____	_____
Secure Area (Post and Flag)	_____	_____	Lighting (Explosive Proof)	_____	_____
Breathing Apparatus	_____	_____	Protective Clothing	_____	_____
Resuscitator - Inhalator	_____	_____	Respirator(s) (Air Purifying)	_____	_____
Standby Safety Personnel	_____	_____	Burning and Welding Permit	_____	_____

Note: Items that do not apply enter N/A in the blank.

			**RECORD CONTINUOUS MONITORING RESULTS EVERY 2 HOURS								
CONTINUOUS MONITORING**	Permissible		____	____	____	____	____	____	____	____	____
TEST(S) TO BE TAKEN	Entry Level		____	____	____	____	____	____	____	____	____
PERCENT OF OXYGEN	**19.5% to 23.5%**		____	____	____	____	____	____	____	____	____
LOWER FLAMMABLE LIMIT	**Under 10%**		____	____	____	____	____	____	____	____	____
CARBON MONOXIDE	**+35 PPM**		____	____	____	____	____	____	____	____	____
Aromatic Hydrocarbon	+ 1 PPM	* 5PPM	____	____	____	____	____	____	____	____	____
Hydrogen Cyanide	(Skin)	* 4PPM	____	____	____	____	____	____	____	____	____
Hydrogen Sulfide	+10 PPM	*15PPM	____	____	____	____	____	____	____	____	____
Sulfur Dioxide	+ 2 PPM	* 5PPM	____	____	____	____	____	____	____	____	____
Ammonia		*35PPM	____	____	____	____	____	____	____	____	____

* Short-term exposure limit: Employee can work in the area up to 15 minutes.
\+ 8 hr. Time Weighted Avg.: Employee can work in area 8 hrs (longer with appropriate respiratory protection).

REMARKS:_____

GAS TESTER NAME & CHECK #	INSTRUMENT(S) USED	MODEL &/OR TYPE	SERIAL &/OR UNIT #
_____	_____	_____	_____
_____	_____	_____	_____

SAFETY STANDBY PERSON IS REQUIRED FOR ALL CONFINED SPACE WORK

SAFETY STANDBY PERSON(S)	CHECK #	CONFINED SPACE ENTRANT(S)	CHECK #	CONFINED SPACE ENTRANT(S)	CHECK #
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____

SUPERVISOR AUTHORIZING - ALL CONDITIONS SATISFIED _____ DEPARTMENT/PHONE _____

AMBULANCE 2800 FIRE 2900 Safety 4901 Gas Coordinator 4529/5387

Appendix E, Sewer System Entry

Sewer entry differs in three vital respects from other permit entries; first, there rarely exists any way to completely isolate the space (a section of a continuous system) to be entered; second, because isolation is not complete, the atmosphere may suddenly and unpredictably become lethally hazardous (toxic, flammable or explosive) from causes beyond the control of the entrant or employer, and third, experienced sewer workers are especially knowledgeable in entry and work in their permit spaces because of their frequent entries. Unlike other employments where permit space entry is a rare and exceptional event, sewer workers' usual work environment is a permit space.

(1) Adherence to procedure. The employer should designate as entrants only employees who are thoroughly trained in the employer's sewer entry procedures and who demonstrate that they follow these entry procedures exactly as prescribed when performing sewer entries.

(2) Atmospheric monitoring. Entrants should be trained in the use of, and be equipped with, atmospheric monitoring equipment which sounds an audible alarm, in addition to its visual readout, whenever one of the following conditions are encountered: Oxygen concentration less than 19.5 percent; flammable gas or vapor at 10 percent or more of the lower flammable limit (LFL); or hydrogen sulfide or carbon monoxide at or above 10 ppm or 35 ppm, respectively, measured as an 8-hour time-weighted average. Atmospheric monitoring equipment needs to be calibrated according to the manufacturer's instructions. The oxygen sensor/broad range sensor is best suited for initial use in situations where the actual or potential contaminants have not been identified, because broad range sensors, unlike substance-specific sensors, enable employers to obtain an overall reading of the hydrocarbons (flammables) present in the space. However, such sensors only indicate that a hazardous threshold of a class of chemicals has been exceeded. They do not measure the levels of contamination of specific substances. Therefore, substance-specific devices, which measure the actual levels of specific substances, are best suited for use where actual and potential contaminants have been identified. The measurements obtained with substance-specific devices are of vital importance to the employer when decisions are made concerning the measures necessary to protect entrants (such as ventilation or personal protective equipment) and the setting and attainment of appropriate entry conditions. However, the sewer environment may suddenly and unpredictably change, and the substance-specific devices may not detect the potentially lethal atmospheric hazards which may enter the sewer environment.

Although OSHA considers the information and guidance provided above to be appropriate and useful in most sewer entry situations, the Agency emphasizes that each employer must consider the unique circumstances, including the predictability of the atmosphere, of the sewer permit spaces in the employer's workplace in preparing for entry. Only the employer can decide, based upon his or her knowledge of, and experience with permit spaces in sewer systems, what the best type of testing instrument may be for any specific entry operation.

The selected testing instrument should be carried and used by the entrant in sewer line work to monitor the atmosphere in the entrant's environment, and in advance of the entrant's direction of movement, to warn the entrant of any deterioration in atmospheric conditions. Where several entrants are working together in the same immediate location, one instrument, used by the lead entrant, is acceptable.

(3) Surge flow and flooding. Sewer crews should develop and maintain liaison, to the extent possible, with the local weather bureau and fire and emergency services in their area so that sewer work may be delayed or interrupted and entrants withdrawn whenever sewer lines might be suddenly flooded by rain or fire suppression activities, or whenever flammable or other hazardous materials are released into sewers during emergencies by industrial or transportation accidents.

(4) Special Equipment. Entry into large bore sewers may require the use of special equipment. Such equipment might include such items as atmosphere monitoring devices with automatic audible alarms, escape self-contained breathing apparatus (ESCBA) with at least 10 minute air supply (or other NIOSH approved self-rescuer), and waterproof flashlights, and may also include boats and rafts, radios and rope stand-offs for pulling around bends and corners as needed.

Non-Mandatory Appendix F, Rescue Team or Rescue Service Evaluation Criteria

(1) This appendix provides guidance to employers in choosing an appropriate rescue service. It contains criteria that may be used to evaluate the capabilities both of prospective and current rescue teams. Before a rescue team can be trained or chosen, however, a satisfactory permit program, including an analysis of all permit- required confined spaces to identify all potential hazards in those spaces, must be completed. OSHA believes that compliance with all the provisions of §1910.146 will enable employers to conduct permit space operations without recourse to rescue services in nearly all cases. However, experience indicates that circumstances will arise where entrants will need to be rescued from permit spaces. It is therefore important for employers to select rescue services or teams, either on-site or off-site, that are equipped and capable of minimizing harm to both entrants and rescuers if the need arises.

(2) For all rescue teams or services, the employer's evaluation should consist of two components: an initial evaluation, in which employers decide whether a potential rescue service or team is adequately trained and equipped to perform permit space rescues of the kind needed at the facility and whether such rescuers can respond in a timely manner, and a performance evaluation, in which employers measure the performance of the team or service during an actual or practice rescue. For example, based on the initial evaluation, an employer may determine that maintaining an on-site rescue team will be more expensive than obtaining the services of an off-site team, without being significantly more effective, and decide to hire a rescue service. During a performance evaluation, the employer could decide, after observing the rescue service perform a practice rescue, that the service's training or preparedness was not adequate to effect a timely or effective rescue at his or her facility and decide to select another rescue service, or to form an internal rescue team.

A. Initial Evaluation

I. The employer should meet with the prospective rescue service to facilitate the evaluations required by §1910.146(k)(1)(i) and §1910.146(k)(1)(ii). At a minimum, if an off-site rescue service is being considered, the employer must contact the service to plan and coordinate the evaluations required by the standard. Merely posting the service's number or planning to rely on the 911 emergency phone number to obtain these services at the time of a permit space emergency would not comply with paragraph (k)(1) of the standard.

II. The capabilities required of a rescue service vary with the type of permit spaces from which rescue may be necessary and the hazards likely to be encountered in those spaces. Answering the questions below will assist employers in determining whether the rescue service is capable of performing rescues in the permit spaces present at the employer's workplace.

1. What are the needs of the employer with regard to response time (time for the rescue service to receive notification, arrive at the scene, and set up and be ready for entry)? For example, if entry is to be made into an IDLH atmosphere, or into a space that can quickly develop an IDLH atmosphere (if ventilation fails or for other reasons), the rescue team or service would need to be standing by at the permit space. On the other hand, if the danger to entrants is restricted to mechanical hazards that would cause injuries (e.g., broken bones, abrasions) a response time of 10 or 15 minutes might be adequate.

2. How quickly can the rescue team or service get from its location to the permit spaces from which rescue may be necessary? Relevant factors to consider would include: the location of the rescue team or service relative to the employer's workplace, the quality of roads and highways to be traveled, potential bottlenecks or traffic congestion that might be encountered in transit, the reliability of the rescuer's vehicles, and the training and skill of its drivers.

3. What is the availability of the rescue service? Is it unavailable at certain times of the day or in certain situations? What is the likelihood that key personnel of the rescue service might be unavailable at times? If the rescue service becomes unavailable while an entry is underway, does it have the capability of notifying the employer so that the employer can instruct the attendant to abort the entry immediately?

4. Does the rescue service meet all the requirements of paragraph (k)(2) of the standard? If not, has it developed a plan that will enable it to meet those requirements in the future? If so, how soon can the plan be implemented?

5. For off-site services, is the service willing to perform rescues at the employer's workplace? (An employer may not rely on a rescuer who declines, for whatever reason, to provide rescue services.)

6. Is an adequate method for communications between the attendant, employer and prospective rescuer available so that a rescue request can be transmitted to the rescuer without delay? How soon after notification can a prospective rescuer dispatch a rescue team to the entry site?

7. For rescues into spaces that may pose significant atmospheric hazards and from which rescue entry, patient packaging and retrieval cannot be safely accomplished in a relatively short time (15-20 minutes), employers should consider using airline

respirators (with escape bottles) for the rescuers and to supply rescue air to the patient. If the employer decides to use SCBA, does the prospective rescue service have an ample supply of replacement cylinders and procedures for rescuers to enter and exit (or be retrieved) well within the SCBA's air supply limits?

8. If the space has a vertical entry over 5 feet in depth, can the prospective rescue service properly perform entry rescues? Does the service have the technical knowledge and equipment to perform rope work or elevated rescue, if needed?

9. Does the rescue service have the necessary skills in medical evaluation, patient packaging and emergency response?

10. Does the rescue service have the necessary equipment to perform rescues, or must the equipment be provided by the employer or another source?

B. Performance Evaluation

Rescue services are required by paragraph (k)(2)(iv) of the standard to practice rescues at least once every 12 months, provided that the team or service has not successfully performed a permit space rescue within that time. As part of each practice session, the service should perform a critique of the practice rescue, or have another qualified party perform the critique, so that deficiencies in procedures, equipment, training, or number of personnel can be identified and corrected. The results of the critique, and the corrections made to respond to the deficiencies identified, should be given to the employer to enable it to determine whether the rescue service can quickly be upgraded to meet the employer's rescue needs or whether another service must be selected. The following questions will assist employers and rescue teams and services evaluate their performance.

1. Have all members of the service been trained as permit space entrants, at a minimum, including training in the potential hazards of all permit spaces, or of representative permit spaces, from which rescue may be needed? Can team members recognize the signs, symptoms, and consequences of exposure to any hazardous atmospheres that may be present in those permit spaces?

2. Is every team member provided with, and properly trained in, the use and need for PPE, such as SCBA or fall arrest equipment, which may be required to perform permit space rescues in the facility? Is every team member properly trained to perform his or her functions and make rescues, and to use any rescue equipment, such as ropes and backboards, that may be needed in a rescue attempt?

3. Are team members trained in the first aid and medical skills needed to treat victims overcome or injured by the types of hazards that may be encountered in the permit spaces at the facility?

4. Do all team members perform their functions safely and efficiently? Do rescue service personnel focus on their own safety before considering the safety of the victim?

5. If necessary, can the rescue service properly test the atmosphere to determine if it is IDLH?

6. Can the rescue personnel identify information pertinent to the rescue from entry permits, hot work permits, and MSDSs?

7. Has the rescue service been informed of any hazards to personnel that may arise from outside the space, such as those that may be caused by future work near the space?

8. If necessary, can the rescue service properly package and retrieve victims from a permit space that has a limited size opening (less than 24 inches (60.9 cm) in diameter), limited internal space, or internal obstacles or hazards?

9. If necessary, can the rescue service safely perform an elevated (high angle) rescue?

10. Does the rescue service have a plan for each of the kinds of permit space rescue operations at the facility? Is the plan adequate for all types of rescue operations that may be needed at the facility? Teams may practice in representative spaces, or in spaces that are "worst-case" or most restrictive with respect to internal configuration, elevation, and portal size. The following characteristics of a practice space should be considered when deciding whether a space is truly representative of an actual permit space:

(1) Internal configuration.

(a) Open -- there are no obstacles, barriers, or obstructions within the space. One example is a water tank.

(b) Obstructed -- the permit space contains some type of obstruction that a rescuer would need to maneuver around. An example would be a baffle or mixing blade. Large equipment, such as a ladder or scaffold, brought into a space for work purposes would be considered an obstruction if the positioning or size of the equipment would make rescue more difficult.

(2) Elevation.

(a) Elevated -- a permit space where the entrance portal or opening is above grade by 4 feet or more. This type of space usually requires knowledge of high angle rescue procedures because of the difficulty in packaging and transporting a patient to the ground from the portal.

(b) Non-elevated -- a permit space with the entrance portal located less than 4 feet above grade. This type of space will allow the rescue team to transport an injured employee normally.

(3) Portal size.

(a) Restricted -- A portal of 24 inches or less in the least dimension. Portals of this size are too small to allow a rescuer to simply enter the space while using SCBA. The portal size is also too small to allow normal spinal immobilization of an injured employee.

(b) Unrestricted -- A portal of greater than 24 inches in the least dimension. These portals allow relatively free movement into and out of the permit space.

(4) Space access.

(a) Horizontal -- The portal is located on the side of the permit space. Use of retrieval lines could be difficult.

(b) Vertical -- The portal is located on the top of the permit space, so that rescuers must climb down, or the bottom of the permit space, so that rescuers must climb up to enter the space. Vertical portals may require knowledge of rope techniques, or special patient packaging to safely retrieve a downed entrant.

Appendix B — Web Addresses for Confined Spaces Resources

Resource	URL
General Industry Standards	
1910.146 - Permit-Required Confined Spaces	http://www.osha-slc.gov/OshStd_data/1910_0146.html
Appendix A - Permit-required Confined Space Decision Flow Chart	http://www.osha-slc.gov/OshStd_data/1910_0146_APP_A.html
Appendix B - Procedures for Atmospheric Testing	http://www.osha-slc.gov/OshStd_data/1910_0146_APP_B.html
Appendix C - Examples of Permit-required Confined Space Programs	http://www.osha-slc.gov/OshStd_data/1910_0146_APP_C.html
Appendix D - Confined Space Pre-Entry Check List	http://www.osha-slc.gov/OshStd_data/1910_0146_APP_D.html
Appendix E - Sewer System Entry	http://www.osha-slc.gov/OshStd_data/1910_0146_APP_E.html
Shipyard Employment Standards	
Part 1915 Subpart B - Confined and Enclosed Spaces and Other Dangerous Atmospheres in Shipyard Employment.	http://www.osha-slc.gov/OshStd_toc/OSHA_Std_toc_1915_SUBPART_B.html
Preambles	
Permit-required Confined Spaces, Final Rule (01/14/93)	http://www.osha-slc.gov/Preamble/ConSpaces_toc/ConSpaces_toc_by_sect.html
Permit-required Confined Spaces, Final Rule; Revisions (12/01/98)	http://www.osha-slc.gov/Preamble/CS_toc/Confined_toc_by_sect.html
Directives	
CPL 2.100 - Application of the Permit-Required Confined Spaces (PRCS) Standards, 29 CFR 1910.146. (05/05/95)	http://www.osha-slc.gov/OshDoc/Directive_data/CPL_2_100.html
STD 2-4.1 - 29 CFR 1915 Subpart B, Confined and Enclosed Spaces and Other Dangerous Atmospheres in Shipyard Employment -- Inspection Procedures and Interpretive Guidance. (06/23/95)	http://www.osha-slc.gov/OshDoc/Directive_data/STD_2-4_1.html
Additional Compliance Assistance Resources	
FAQs - Frequently Asked Questions (FAQs) about Permit-Required Confined Spaces Standard.	http://www.osha-slc.gov/html/faq-confinedspaces.html
Confined Space Hazards - Small Business Outreach Training Program Instructional Guide, OSHA Training Institute, (1997).	http://www.osha-slc.gov/SLTC/smallbusiness/sec12.html
Permit-required Confined Spaces - Small Business Outreach Training Program Instructional Guide, OSHA Training Institute, (1997). - Provides links to numerous resources concerning confined spaces.	http://www.osha-slc.gov/SLTC/smallbusiness/sec13.html
O SHA Interpretations - You may search the OSHA on-line database of interpretations.	http://www.osha-slc.gov/OshDoc/toc_interps.html
Department of Energy	
Technical Reference (OTR): Confined Space Entry - Contains elements of the DOE confined spaces program.	http://scripts.osha-slc.gov/cgi-bin/redirect?url=http://tis-hq.eh.doe.gov/docs/osh_tr/ch4.html?
Health and Safety Plan Guidelines: Confined Space Entry - Contains guidelines on establishing a site specific confined spaces program.	http://scripts.osha-slc.gov/cgi-bin/redirect?url=http://tis-hq.eh.doe.gov/docs/hasp/ch13/links.html

APPENDIX B

Structural Inspection Notes

Gannett Fleming

CONFINED SPACE ENTRY PERMIT

Entry Date: 9/5/18

Entry Time: 0910

Expiration Time: _____

CS Location: STA-077-0912 (SFN 7603576)

Description of task(s): Inspection of fracture critical integral steel box girder

Confined Space Classification* (Circle) A (Do Not Enter) B (Caution) C

Personnel Assigned

Name: _____ Duties: _____

Training**: (Circle) 1 2 3

Name: _____ Duties: _____

Training**: (Circle) 1 2 3

Name: Vince LaCross Duties: Entrant

Training**: (Circle) 1 (2) 3

Name: Rob Parker Duties: Attendant (Required)

Training**: (Circle) (1) (2) (3)

Name: Rob Parker Duties: CS Supervisor

Training**: (Circle) (1) (2) (3)

Equipment/PPE Required: (Circle) (1) (2) (3) 4 5 6 (7) 8 9 10

1. Gloves
2. Hard Hat
3. Eye Protection
4. Coveralls
5. Steel Toe Shoes
6. Hearing Protection
7. Other Air Monitor
8. Other _____
9. Other _____
10. Other _____

Safety Requirements/Procedures: (Circle) (1) (2) (3) 4 5 6

1. Constant Monitoring
2. Buddy System
3. Safety Harness
4. Tripod and Retrieval Winch
5. Other _____
6. Other _____

* A – Immediately Dangerous to Life and Health
B – Dangerous but not Immediately Dangerous to Life and Health
C – Requires no modification to standard procedures

** 1 – CPR/First Aid
2 – Confined Space Entry
3 – Respirator Qualified

Gannett Fleming

Emergency Phone Nos. _____ _____ Tech. Rescue 330-489-3256

EMS FIRE OTHER

Monitor No. 477232 Calibrated By RWP Date 09/4/18
Monitor No. 477384 Calibrated By RWP Date 09/04/18
Atmospheric Monitoring Results:

Activity	Time	Oxy%	H_2S (ppm)	LEL%	Other CO (ppm)
		Acceptable Limits 19.5-23.5	19.5-27.5	0-10	0-10	0-35
Pre-Entry	0900	20.8	0	0	0
20 ft / 40 ft	0910/0915	20.8/20.8	0/0	0/0	0/0
60 ft / 80 ft	0920/0925	20.8/20.8	0/0	0/0	0/0
Inspection	0930/0940	20.8/20.8	0/0	0/0	0/0
	0950/1000	20.8/20.8	0/0	0/0	0/0
	1010/1020	20.8/20.8	0/0	0/0	0/0
	1030/1040	20.8/20.8	0/0	0/0	0/0
	1050/1100	20.8/20.8	0/0	0/0	0/0
Vince out for break ←	1210/1220	20.8/20.8	0/0	0/0	0/0
	1230/1240	20.8/20.8	0/0	0/0	0/0
	1250/1300	20.8/20.8	0/0	0/0	0/0
	1310/1320	20.8/20.8	0/0	0/0	0/0
Exit at 1320 (confined space work complete for today)					

Level of protection	_____	Rescue Equipment	_____
Adeq. PPE Supply	_____	Ventilation	Open doors to ventilate (30 min vent before entry)
Isolation Complete	_____	Approved Tools & Equipment	_____
Tagging	_____	Approved Lighting & Elec.	Approved lights (intrinsically safe)
Lockout	_____	Communication	Phone

Comments: No issues

Permit Prepared by : _____ Rob Parker

Confined Space Supervisor

VDL/RWP 9/5/18

ITEM 101 = BURN MARK (PIC #4)

~~102 = GOUGES 3 - 3"×1/8" (PIC #4)~~

103 = MISSING PAINT ON UNDERSIDE OF BOTTOM FLANGE (PIC #15-16)

ITEM 104 = CRACK IN TACK WELD NEAR BACKER ROD "BUTTING" (PIC #19-20)

105 = BURN MARK (PIC #21)

ITEM 107 = BROKEN WELD, ANGLE @ RIGHT WEB (PIC # ~~28-31~~)

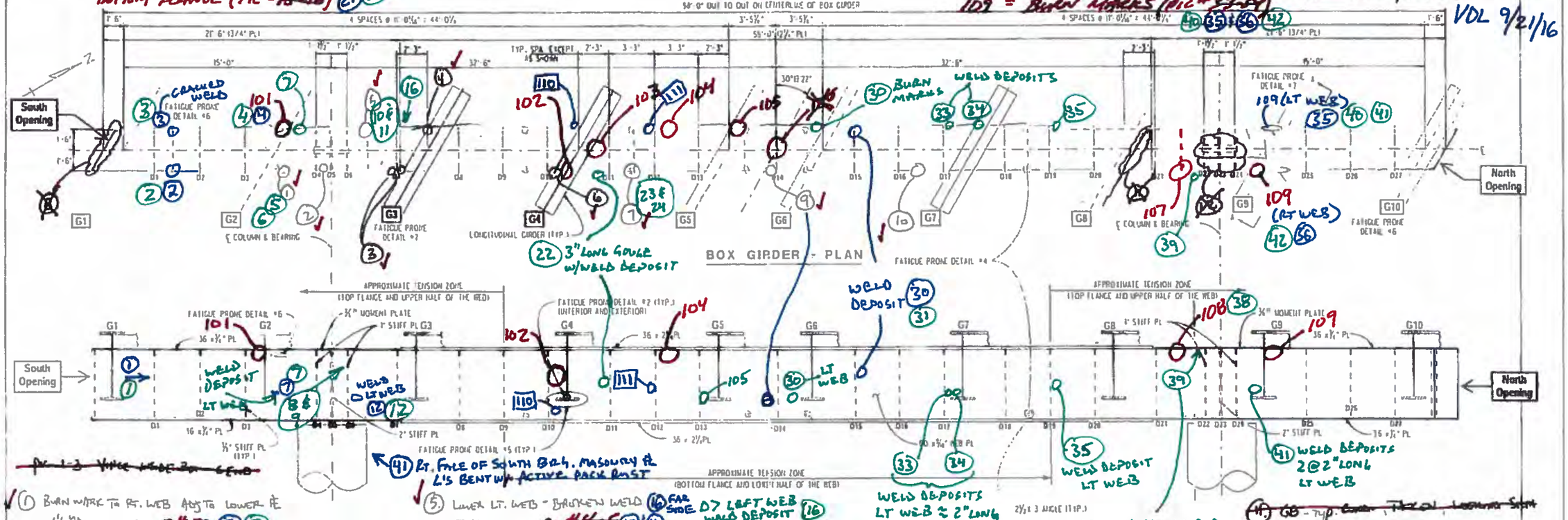
108 = LONGITUDINAL BURN ON TOP OF BFK (PIC # 32)

109 = BURN MARKS (PIC # ~~32-34~~)

DIER 3 INTERLOK

PIPED Loc. CTM 7/23/14

VDL 9/21/16



(1) BURN MARK TO RT. WEB ADJ TO LOWER FL 1½" DIA. - PIC ~~3~~ #2 (5)(5)

TOP OF WEB BURN MARK - 4" × 2", 4" FROM TOP FL - PIC 8 (6)(6)

(2) LONGIT. BURN MARKS 6" FROM WEB 18 x 2¼ PL FL, NEAR BOTH WEBS PIC ~~#1~~ #3 (8)(9)(8)(9)

(3) 2" × 1/16" GOUGES, NEAR WEB @ D7, RT. WEB 18 x 2¼ PL PIC ~~#8~~ #8-10 (15) FAR SIDE (13)(14)(13)(14)

(4) SIGN. WELD DISCONTINUITY LOWER FL BOTTOM, S. END PIC ~~#11~~ #6-7

(5) LOWER LT. WEB - BROKEN WELD OF 4. PIC ~~#4~~ #4-5 (10)(11)(10)(11) (12) FAR SIDE D7 LEFT WEB WELD DEPOSIT (16)

(6) UNDERSIDE OF BOTTOM FL + CORNER MISSING PAINT W/LT. AUST 3" @ CORNER + 12" TAUNUS CENTER PIC ~~#11~~ #11-13 (20)(20)

(7) LOWER 4, RT. WEB, CRACKED WELD PIC ~~#17~~ #17-18 (23)(23) REPAIRED

(8) S. END OF PL LOWER FL W/BROKEN WELD PIC 16

(9) 1¼" × 1/16" GOUGE TO RT. WEB NEAR MIDPOINT, 2½" FROM DM PIC ~~#22~~ #22-23 (28)(29)(29)

(10) CRACK TO TACK WELD, RT. WEB AT TOP, AT ENDS OF BACKER RODS PIC ~~#26~~ #26-27 (31)(32)

~~(11) GOUGE - TYP. EACH, TACK W/ LONGITUDINAL STIFF PIC #3~~

~~(12) BRG. SHAFT - TYPICAL CONDITION, EXISTING DEPTH PIC #3~~

THE FOLLOWING IS A LIST OF FATIGUE PRONE DETAILS AND CATEGORIES AS DISCUSSED ON PAGES 8 -14.

FATIGUE PRONE DETAIL #1 - THE BACKUP BARS FOR THE ASSEMBLY OF THE WEB TO TOP AND BOTTOM FLANGE HAVE INTERMITTENT FILLET WELDS. CATEGORY E.

FATIGUE PRONE DETAIL #2 - THREE WAY INTERSECTING FILLET WELDS OCCUR WHERE THE BOTTOM FLANGE OF THE LONGITUDINAL GIRDER CONNECTS TO THE BOX GIRDER WEB.

FATIGUE PRONE DETAIL #3 - THE BACKUP BARS ABOVE AND BELOW THE LONGITUDINAL GIRDER BOTTOM FLANGE USED DURING THE MAKING OF THE BOX GIRDER WEB TO THE DIAPHRAGM WELDS AT ALL LONGITUDINAL GIRDER LOCATIONS ARE HELD IN PLACE BY INTERMITTENT FILLET WELDS, CATEGORY E.

FATIGUE PRONE DETAIL #4 - THERE ARE EIGHT ANGLES LOCATED BETWEEN 2 AND 4 INCHES ABOVE THE BOTTOM FLANGE, CATEGORY D.

FATIGUE PRONE DETAIL #5 - THE BASE METAL OF THE BOX GIRDER WEB AT THE END OF THE LONGITUDINAL BEAM BOTTOM FLANGE GROOVE WELDED CONNECTION. CATEGORY E'.

FATIGUE PRONE DETAIL #6 - WELD METAL WAS FOUND TO HAVE BEEN DEPOSITED AT FOUR DIFFERENT LOCATIONS ON THE EXTERIOR FACE OF THE BOX WEB.

FATIGUE PRONE DETAIL #7 - A 5/8 INCH MOMENT PLATE IS WELDED TO THE TOP FLANGE OF THE BOX GIRDER OVER THE PIER COLUMNS. CATEGORY E'.

110 1" ϕ WELD DEPOSIT BELOW G4, LEFT WEB (18)(19)(18)(19)

111 D12, LT WEB WELD DEPOSIT (24)(25) (26)(26)

(#) = 2016 PHOTO NUMBER VDL 9/21/16

(##) = 2018 PHOTO NUMBER VDL 9/5/18

EXHIBIT 3
FRACTURE CRITICAL MEMBER WITH FATIGUE PRONE DETAILS INDENTIFIED

FATIGUE PRONE DETAIL LOCATIONS

(#) = 2016 PHOTO # VDL 9/22/16

(#) = 2018 PHOTO # VDL 9/5 & 9/6

BY: VDL/DEC 6/21/12

BY: VDL/RWP 9/5/18
VDL/RWP 9/6/18

BRIDGE NUMBER: STA-77-0911

EXTERIOR FIELD NOTES

- 58-63, 57-62 SEE NOTES
- GEN PHOTO #002A & 002C
- GEN PHOTO #003 & 003
- 95, 98, 99, 72, 75, 76 WEB 1/16" TO 1/8" LOSS FULL HT. MAX. 1/4" LOSS
- 82-87 SEE NOTES
- (104-110) PHOTO 1 of 15
- PHOTO 1 of 15 SUPERSTRUCTURE & SUBSTRUCTURE DEMAND SHEAR POINT (ATC)
- 111-117
- 118-120 INTERIOR G10 @ SPLICE PL (WEST SIDE) 100% SECN. LOSS
- 88-92 SEE NOTES
- 57 DETAIL #5
- 58, 59 SEE DETAIL
- 71 MINOR SCALE TO BOT OF PIPE CAP
- RUST TOP OF G5
- 96 TOP
- PHOTO #33 & 34
- 14, 97, 79, 101 G6 BOT FE
- 103 (TOP), 81
- 90, 67 COVER PL
- DETAIL #2
- 68 (BOT)
- 72, 94 G4 BOT FL @ BOX, MINOR PEEL & SURFACE RUST
- 73 DETAIL #4
- 74 & 75 TYP
- HAIRLINE CRACK FOUND IN PAINT PHOTO #41 & 42
- 100, 78 1/8" LOSS BOT. OF BOT FE BOX GDR
- G5 WELD 24" EAST
- G6 7"
- 82 EAST ~1/16" LOSS
- 63, 64, 83, 84 PHOTO #36 & 37
- 66, 86
- 76, 77
- BOX GIRDER - PLAN
- 85, 65 TOP OF BOX GDR
- PHOTO #35 & 36 - PICTURE OF TOP OF BEAM SHOWING RUST SCALE UNDER JOINT (3/16" LOSS OF SECTION)
- 44, 81
- 81 TOP
- PHOTO #33 - BEFORE REMOVING OFF ANT
- PHOTO #34 - AFTER REMOVING (NORTH SIDE) ≤ 1/8" LOSS EAST
- 43, 80 TO 3/16"
- 87-89 NORTH BRG SOUTH FACE
- SOME RUST SCALE & SECTION LOSS TO WEB OF GIRDER, WEST OF BOTH SPLICE PLATES (PHOTO #21 & 22)
- 70 & 71, 92 & 93
- 1/16" TO 1/4" LOSS TO BOT 4" G10 OUTSIDE FACE (WEB) ATTACHMENT TO BOX GDR (EAST SIDE)
- 1/16" TO 1/4" LOSS TO BOT 3" OF GIRDER WEB & ADJACENT PIECE OF WEB (ACTIVE PART)
- 45 - INTERIOR G1 @ EAST FACE OF PIER
- 46 - SOUTH BEARING, SOUTH FACE
- PHOTO #45 (EASTSIDE) - MINOR SCALE & LOOSE RUST IN CREVICE
- PHOTO #50 (EASTSIDE)
- PHOTO #46 & 48 (WESTSIDE)
- 47-56 SEE NOTES
- WESTSIDE - RUST SCALE & SECTION LOSS TO WEB OF PIER CAP & GIRDER. 1/8" - 1/4" THIS AREA VERY RUSTY PHOTO #49
- 64-67 SOUTH BRG, NORTH FACE
- LONGITUDINAL GIRDER
- TOP FLANGE
- 2" (TO CENTER OF WELDING MATERIAL)
- 1 1/2"
- 4 1/2"
- 70 SCRAPES ON BOT & BTWN G4 & G5
- 72 EAST SIDE
- 76 & 77
- EASTSIDES PHOTO #37 - BEFORE
- PHOTO #38 AFTER
- PAINT PEELING IN CORNER AT WEB OF GIRDER & PIER CAP
- 100% LOSS BOT. 6" GDR. WEB ≤ 1/4" LOSS TO TOP OF G6 BOT FE & BOX GDR WEB
- 42, 45
- 78 & 79 UP TO 3/8" LOSS TO PIER BOX WEB ADJ TO G6 BOT FE
- 68 BRG
- EASTSIDE SEE DETAIL
- PHOTO #4 & 5 - LOWER PART OF WEB SCALE LOSS
- 38, 44
- 37, 43
- 18 x 2 1/4 PL
- SLOPE 0.0149"/FT
- 5'-8"
- 1'-1 3/8" IRON 1
- 4" RAD.
- 3/4" PL
- 54 x 3/8 WEB PL
- 1" PL
- IRON 2.3 AND 5
- 2 1/2"
- 2 1/4"
- 5 1/2"
- 18 x 2 1/4 PL
- 1/2" PL
- 68 x 1/2" PL
- 3/4" PL
- ℄ BOX GIRDER
- IRON 1
- ACTIVE CRACK AT OUTSIDE EDGE OF PL @ FASCIA GIRDER
- SECTION A-A (FROM ORIGINAL PLANS)
- BOX GIRDER - ELEVATION
- 5/8" PLATE
- 6"
- 3"
- TOP FLANGE
- WEB
- SECTION A-A
- DETAIL #5 PHOTO #47 46 57
- 2 1/4" PLATE
- TOP FLANGE OF BOX GIRDER
- 10"
- 18"
- 3"
- A
- PHOTO #18 to 20
- 74 & 75 EAST SIDE
- 68 & 69
- 39
- 3/4" PLATE
- 5/8" PLATE
- 5/8" PLATE BETWEEN LONG. GIRDER 2 PL WELDED TO TOP FLANGE OF BOX GIRDER
- LONGITUDINAL GIRDER
- TOP FLANGE OF BOX GIRDER
- 1'-6"
- 5 1/2"
- 3 1/2"
- 80
- 102
- DETAIL 1 PHOTO #16 & 17
- TOP FLANGE (BOX)
- LONGITUDINAL GIRDER
- 1 1/2"
- 11 1/2"
- 4 1/2"
- 40
- 73
- WELD MATERIAL (TYP, ALL DETAILS)
- DETAIL #4 PHOTO #39 & 40
- LONGITUDINAL GIRDER
- 1/2" GAP
- BOX GIRDER
- PAINT WAS REMOVED AROUND CRACK AND CRACK WAS JUST IN THE PAINT
- DETAIL #3 (PHOTO #30 to 32)
- LONGITUDINAL GIRDER
- TOP FLANGE OF BOX GIRDER
- 1"
- 3"
- 4 1/2"
- 3 3/4"
- 1 1/4"
- 69
- 91
- DETAIL 2 (PHOTO #27 to 29)

NOTE #1 - SCUPPER IS PLUGGED → ALSO SEE GEN PHOTO #002A to 002C

MAJOR PAINT PEELING & SCALING OCCURRING WITH SECTION LOSS AROUND THE LONGITUDINAL GIRDER BOTTOM FLANGE (PHOTO #44 & 45) 47-56 SEE NOTES 47-56

APPENDIX B
B-1 (EXTERIOR)

STA-77-0912, Pier #3 FC Steel Pier Cap Notes, Exterior

by VDL 9/22/16

VDL 9/5 & 9/6 / 2018

Photos 47 – 56: 47-56 – MINIMAL CHANGE SINCE 2016 INSPECTION

- Interior face of G1 @ Box Girder (West Side)
- 1/8" (+/-) loss to bottom ¼ of G1 web & bottom ½ of box girder web
- 1/16" to 1/8" loss to top of G1 bot flange splice plate
- 100% to knife edge section loss to bot 6" of 1st stiffener (G1) from box girder, 50% loss to bot 6" of 2nd stiffener
- 50% loss to splice nuts from box girder to 1st stiffener (top plate of bot flange splice and bot 6" of web splice (G1))
- PVC repair to drain, but drain is clogged

Photos 57-62: 58-63 – MINIMAL CHANGE SINCE 2016 INSPECTION

- Exterior face (G1) @ box girder, west side
- ≤ ¼" loss to bot 6" of G1 web & box girder web above G1 bot flange
- ≤ 1/8" loss to top of G1 bot flange @ face of box girder
- ≤ 1/8" loss to bot 6" of G1 web from box girder to 1st stiffener
- ≤ 50% loss to bot 3" of 1st stiffener
- Splice plates / bolts good condition w/ minimal deterioration

Photos 82-87: 104-110

- G10 @ box girder (west side), interior
- PVC repair to drainage OK
- Drain appears to be open ← PARTIALLY
- 1/16" to 1/8" loss to box girder web behind drain pipe
- 1/16" loss to bot 3" of G10 web from box girder to 1st stiffener
- Paint peeling off G10 web between 1st and 2nd stiffener

Photos 88-92 111-117

1/8" LOSS TO 100% LOSS x 3" HIGH @ SPLICE & ABOVE BOT FL

- G10 outside face, west side of box girder
- 1/16" loss to bot 3" of G10 web from box girder to 2nd stiffener
  - Max 3/16" loss adjacent to box girder side of web splice (G10)
- Minor section loss & pain peeled off G10 web full height between 1st and 2nd stiffener
- Minor to 1/16" loss to top of top splice plate, G10 bot flange
- 1/16" to 1/8" loss to G10 bot flange (outer half) between end of top splice plate & 2nd stiffener

100% } 118-120 INTERIOR G10 WEST SIDE (HOLE @ SPLICE IN BOT OF WEB

Photo 93: General Elevation (East Side)

Photo 94: General Elevation (West Side)

STA-77-0912, Pier #3 FC Steel Pier Cap Exterior Photos by Hassan Jamil 09/10/18

Photo 150 – Wide view of pier cap looking south (perpendicular to the pier cap)

Photo 151 – Wide view of pier cap looking south (parallel to the deck)

Photo 152 – Wide view of pier cap looking north (parallel to the deck)

Photo 153 – Pier cap opening with door open (Southwest)

Photo 154 – Southwest scupper close up

Photo 155 – Southwest scupper faraway

Photo 156 – Pier cap below median looking south

Photo 157 – Southwest scupper close up

Photo 158 – Pier cap below median looking north

Photo 159 – Southeast scupper close up

Photo 160 – Southeast scupper faraway

Photo 161 – Pier cap opening with door open (Northeast)

Photo 162 – Pier cap opening with door closed (Southwest)

Photo 163 – Pier cap opening with door closed (Northeast)

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