

Subject: Fall Protection Surveillance Assessment, Causal Analyses for P2 findings

Objective: Complete causal analyses for Fall Protection items P2-001 through P2-008 by February 28, 2009.

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Methodology: The causal analysis effort was divided into two events. The facilitator hoped to maximize the teams' time together by focusing on commonalities between the items, thus similar findings were grouped together.

The first event focused on items P2-001 and P2-002 (Chains) as well as P2-008 (Anchor Point Engineering Review). The second event focused on items P2-003 through 006 (Ladders and Ladder Programs) as well as P2-007 (Scaffolding Components).

Due to the differing circumstances concerning the findings, the group elected to modify our approach and evaluate the Ladder / Ladder Program items individually.

Findings and Causal Analyses:

P2-001 – Chains being used in lieu of swinging gates or offset access for ladderway in the TJNAF Test Laboratory do not meet the requirements of 29CFR1910.23(a)(2) or the standard OSHA interpretation for the use of chains.

Background: Chains were being used that did not the code requirements, including strength values. Although chains are allowed in the proper configuration, discussion revealed that there are no / few maintenance or design records and no established inspection criteria for chains; it was then revealed that there is confusion on “ownership” and thus no tracking or planning for these types of items.

Causal Analysis Determination: There is no data or awareness that chain maintenance needs to occur, nor is there any consistent understanding of “ownership”.

Note: after this event, it was discovered that Test lab personnel had been told of this one particular issue and how to correct it. The suggested corrective actions were not carried out; why is unknown.

P2-002 – Chains being used in lieu of a standard guardrail in the TJNAF Test Laboratory do not meet the requirements for a guardrail as defined in 29CFR1910.23(a)(2) or (e).

Background: P2-002 was grouped with P2-001. See P2-001 above.

Causal Analysis Determination: P2-002 was grouped with P2-001. See P2-001 above.

P2-003 – Use of a mobile ladder stand as a fixed industrial stair does not meet the requirements of 29CFR1910.24 for fixed industrial stairs

Background: The mobile ladder had long been used as a fixed stair, mostly for convenience. The users were unaware of the defect and code violation, or else did not communicate the issue to the proper personnel. See “Ladder Program Commonalities” at the end of the document for quantifiable information on this.

Causal Analysis Determination: The users did not understand or communicate to the proper personnel that use of the mobile ladder as a fixed industrial stair was a significant problem.

P2-004 – Modification of mobile ladder stands and other portable ladders results in ladders that may no longer conform to standard specifications of strength to safely support the design working load (29CFR1910.29(a)(2)(iii) and ES&H Manual 6132 paragraph 3.1)

Background: These items involved multiple locations, including the Test Lab and “several facilities” (ref p4 of report). In the case of the Test Lab, the addition of a spreader bar, as well as the lack of an Engineering analysis, in a stepladder caused the ladder to be out of compliance. The item referencing “several facilities” dealt with handrail modification on mobile ladder stands.

The handrail modifications had been in place for a significant amount of time, and were thought to be necessary for work access. The team’s input was that the handrails had met the code requirements when originally installed, but had not been changed when the code changed. See “Ladder Program Commonalities” at the end of the document for more quantifiable information on this.

Causal Analysis Determination: The users did not understand or communicate to the proper personnel that the modifications were significant problems.

P2-005 – Defective ladders shall be removed from service as required by ES&H Manual Section 6132 paragraph 3.1 “Withdraw ladders from service that have developed defects. Destroy any defective ladder or tag it “Dangerous, Do Not Use,” and send it to Facilities Management for repair...”

Background: This item centered on rust / deformation of a support caster on a mobile ladder stand. See “Ladder Program Commonalities” at the end of the document for more quantifiable information on this.

Causal Analysis Determination: The users did not understand or communicate to the proper personnel that the degree of rust / deformation prevented safe use of the ladder.

P2-006 – There is no definitive program to implement a continuing fixed ladder maintenance program to ensure all ladders shall be inspected regularly, with the intervals between inspections being determined by use and exposure (29CFR1910.27(f)).

Background: Approximately two years ago, FML had conducted a “Condition Assessment” on all fixed ladders across the site. This assessment was not ladder-specific and did not have the rigidity of a formal continuing program, i.e., intervals and scheduling were not planned. It was originally thought that this assessment met requirements. See “Ladder Program Commonalities” at the end of the document for more quantifiable information on this.

Causal Analysis Determination: The “Condition Assessment” did not define the rigidity of a formal continuing program.

P2-007 – There is no identifiable means to verify that the scaffold system components acquired by Facilities Management are traceable to a given manufacturer or matched product line or that if they had been designed and constructed in accordance with a recognized standard.

Background: P-cards were used for these particular transactions; these cards do not have the verification or traceability requirements of purchase requisitions.

Causal Analysis Determination: Use of P-cards for a transaction that required traceability.

Note: The ESH&Q subject matter expert for ladders and scaffolding recently implemented a solution with Procurement. P-cards are no longer allowed for scaffolding transactions; requisitions will be used. Requisitions have scaffolding “codes” that are tagged for verification by both FML and ESHQ prior to site use.

P2-008 – An employee was concerned about the adequacy of an anchor point for the Hall C HVAC System, and no engineering review had been conducted in this area to verify that the anchor point being used meets the minimum requirements as specified in 29CFR1926 502(d)(15).

Background: A tie-off point (technically not an anchor point) was being used that is inadequate per the current engineering calculations. An engineered platform solution has been designed, proposed and communicated. According to the team it is awaiting funding. This maintenance is critical to beam delivery and must occur a minimum of twice per year at this height and location. In the interim, solutions such as manlifts, masonry anchors and ceiling rods are being evaluated.

However, while the need for a permanent or interim solution was known and communicated, the inadequate tie-off point remained in use.

Causal Analysis Determination: Given the issues with the engineered platform solution, an appropriate interim solution had not yet been implemented.

References

1910.23(a)(2)

Every ladderway floor opening or platform shall be guarded by a standard railing with standard toeboard on all exposed sides (except at entrance to opening), with the passage through the railing either provided with a swinging gate or so offset that a person cannot walk directly into the opening.

1926.502(d)(15)

Anchorage used for attachment of personal fall arrest equipment shall be independent of any anchorage being used to support or suspend platforms and capable of supporting at least 5,000 pounds (22.2 kN) per employee attached, or shall be designed, installed, and used as follows:

1926.502(d)(15)(i)

as part of a complete personal fall arrest system which maintains a safety factor of at least two; and

1926.502(d)(15)(ii)

under the supervision of a qualified person.

Fixed industrial stairs. - 1910.24

 [Regulations \(Standards - 29 CFR\) - Table of Contents](#)

● Part Number:	1910
● Part Title:	Occupational Safety and Health Standards
● Subpart:	D
● Subpart Title:	Walking-Working Surfaces
● Standard Number:	<u>1910.24</u>
● Title:	Fixed industrial stairs.

1910.24(a)

"Application of requirements." This section contains specifications for the safe design and construction of fixed general industrial stairs. This classification includes interior and exterior stairs around machinery, tanks, and other equipment, and stairs leading to or from floors, platforms, or pits. This section does not apply to stairs used for fire exit purposes, to construction operations to private residences, or to articulated stairs, such as may be installed on floating roof tanks or on dock facilities, the angle of which changes with the rise and fall of the base support.

..1910.24(b)

1910.24(b)

"Where fixed stairs are required." Fixed stairs shall be provided for access from one structure level to another where operations necessitate regular travel between levels, and for access to operating platforms at any equipment which requires attention routinely during operations. Fixed stairs shall also be provided where access to elevations is daily or at each shift for such purposes as gauging, inspection, regular maintenance, etc., where such work may expose employees to acids, caustics, gases, or other harmful substances, or for which purposes the carrying of tools or equipment by hand is normally required. (It is not the intent of this section to preclude the use of fixed ladders for access to elevated tanks, towers, and similar structures, overhead traveling cranes, etc., where the use of fixed ladders is common practice.) Spiral stairways shall not be permitted except for special limited usage and secondary access situations where it is not practical to provide a conventional stairway. Winding stairways may be installed on tanks and similar round structures where the diameter of the structure is not less than five (5) feet.

1910.24(c)

"Stair strength." Fixed stairways shall be designed and constructed to carry a load of five times the normal live load anticipated but never of less strength than to carry safely a moving concentrated load of 1,000 pounds.

1910.24(d)

"Stair width." Fixed stairways shall have a minimum width of 22 inches.

1910.24(e)

"Angle of stairway rise." Fixed stairs shall be installed at angles to the horizontal of between 30 deg. and 50 deg. Any uniform combination of rise/tread dimensions may be used that will result in a stairway at an angle to the horizontal within the permissible range. Table D-1 gives rise/tread dimensions which will produce a stairway within the permissible range, stating the angle to the horizontal produced by each combination. However, the rise/tread combinations are not limited to those given in Table D-1.

Table D-1

Angle to horizontal	Rise (in inches)	Tread run (in inches)
30 deg. 35'	6 1/2	11
32 deg. 08'	6 3/4	10 3/4
33 deg. 41'	7	10 1/2
35 deg. 16'	7 1/4	10 1/4
36 deg. 52'	7 1/2	10
38 deg. 29'	7 3/4	9 3/4
40 deg. 08'	8	9 1/2
41 deg. 44'	8 1/4	9 1/4
43 deg. 22'	8 1/2	9
45 deg. 00'	8 3/4	8 3/4
46 deg. 38'	9	8 1/2
48 deg. 16'	9 1/4	8 1/4
49 deg. 54'	9 1/2	8

1910.24(f)

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"Stair treads." All treads shall be reasonably slip-resistant and the nosings shall be of nonslip finish. Welded bar grating treads without nosings are acceptable providing the leading edge can be readily identified by personnel descending the stairway and provided the tread is serrated or is of definite nonslip design. Rise height and tread width shall be uniform throughout any flight of stairs including any foundation structure used as one or more treads of the stairs.

1910.24(g)

"Stairway platforms." Stairway platforms shall be no less than the width of a stairway and a minimum of 30 inches in length measured in the direction of travel.

1910.24(h)

"Railings and handrails." Standard railings shall be provided on the open sides of all exposed stairways and stair platforms. Handrails shall be provided on at least one side of closed stairways preferably on the right side descending. Stair railings and handrails shall be installed in accordance with the provisions of 1910.23.

1910.24(i)

"Vertical clearance." Vertical clearance above any stair tread to an overhead obstruction shall be at least 7 feet measured from the leading edge of the tread.

[39 FR 23502, June 27, 1974, as amended at 43 FR 49744, Oct. 24, 1978; 49 FR 5321, Feb. 10, 1984]

1910.29(a)(2)(iii)

The materials used in mobile ladder stands and scaffolds shall be of standard manufacture and conform to standard specifications of strength, dimensions, and weights, and shall be selected to safely support the design working load.

1910.27(f)

"Maintenance." All ladders shall be maintained in a safe condition. All ladders shall be inspected regularly, with the intervals between inspections being determined by use and exposure.

ESH&Q Manual Chapter 6132

3.1 Ladders

Maintain ladders in usable condition. Withdraw ladders from service that have developed defects. Destroy any defective ladder or tag it “Dangerous, Do Not Use,” and send it to Facilities Management for repair with parts available from the manufacturer. **Do not improvise your own repair of a ladder.**

Use only the following types of portable step and extension ladders:

- Type I, IA Industrial, for heavy duty: 250/300 lbs.
- Type II Commercial, for medium duty: 225 lbs.
- Type II Folding ladder/stools for office use only—these must be equipped with grab rails
- Do not splice two short ladders together to produce a long ladder
- Do not stand above the second step from the top of a ladder
- Do not place a ladder in front of a door which opens towards the ladder unless the door is blocked open, locked, or guarded
- Do not place ladders on boxes, barrels, or other unstable bases to obtain additional height
- Do not purchase or use Type III — household/light duty — ladders at Jefferson Lab

3.1.1 Ladder setup and use

- Do not carry a ladder upright near electric power lines. Contact can be lethal. Use only fiberglass ladders near electrical hazards.
- Fully extend a step ladder prior to use. Do not use it folded or propped up against a vertical surface.
- Place the extension ladder base a distance from the vertical wall equal to one-fourth the working length of the ladder.
- Face the ladder when ascending or descending.
- Do not carry anything in your hands when ascending or descending. Use a hand line to raise or lower equipment or tools.
- Store portable ladders in protected places so that they do not become hazards.

- When using a ladder to gain access to a roof or elevated platform, tie it off or secure it in place.
 - Ensure that the ladder extends at least 1 meter (3 ft.) beyond the point of support (roof line).
 - The first person going up the ladder needs a safety spotter who will keep the ladder stable at the base.
 - No more than one person shall be on a ladder at a time except for specially constructed, double-sided step ladders.

Ladder Program Commonalities

- Ladder issues were documented in four areas of the Lab – the Test Lab, Hall C, the Experimental Equipment Lab (EEL) and “several facilities” (ref p4 of report).
- It is Lab precedent that all ladders are to be inspected by Users before work. (ESH&Q 6132)

In order to fully determine ladder responsibilities, the grid below was developed by the team:

<u>Type of Ladder</u>	<u>Ownership</u>	<u>Tag / Inspect</u>	<u>Maintains / Sends for Repair</u>
Fixed to Building	FML	FML or User	FML
Mobile	User	User	User
Step & Extension	User	User	User

As can be seen, FML has the majority of responsibility for fixed ladders, while Users have all responsibilities for mobile, step and extension ladders.

There are approximately 640 non-FML employees on site; of these approximately 33%, or about 215 personnel, have the potential to use some type of ladder. Thus, in order for the current organization structure to exist, i.e., Users maintaining ownership, it is logical that this group would need to be trained and well versed on JLab’s ladder safety inspection / acceptable maintenance requirements in order to minimize incidents.

Parking Lot

- Establish an interim solution for Hall C HVAC work that requires fall protection. (see P2-008)
- Establish acceptability criteria for openings where chains are used. Prioritize the use of chains across the site, aligned with the operating budget.
- Communicate distribution issues concerning the original Fall Protection document factual accuracy check.