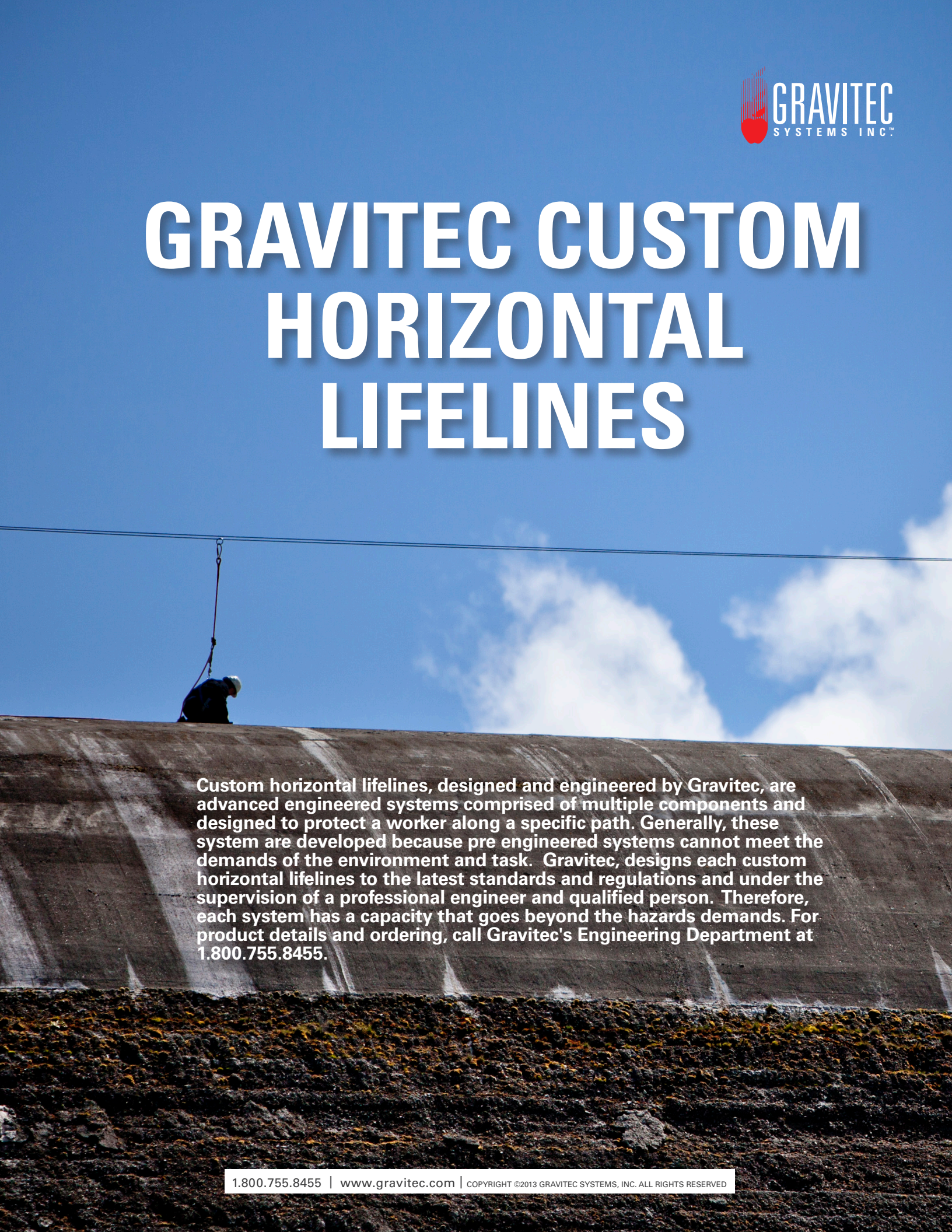

GRAVITEC SYSTEMS INC™

GRAVITEC CUSTOM HORIZONTAL LIFELINES

Custom horizontal lifelines, designed and engineered by Gravitec, are advanced engineered systems comprised of multiple components and designed to protect a worker along a specific path. Generally, these system are developed because pre engineered systems cannot meet the demands of the environment and task. Gravitec, designs each custom horizontal lifelines to the latest standards and regulations and under the supervision of a professional engineer and qualified person. Therefore, each system has a capacity that goes beyond the hazards demands. For product details and ordering, call Gravitec's Engineering Department at 1.800.755.8455.

SECTION XXXXX

HORIZONTAL LIFELINE FALL PROTECTION SYSTEM

PART 1 GENERAL

1.1 SYSTEM DESCRIPTION

A. Type of Fall Protection system(s) required: Horizontal Lifeline (HLL)

B. System location: Roof/ Wall/ Tower/ Fixed Ladder, Misc. Structure, etc…

C. Maximum number of workers on system at one time: ##

D. Systems environmental exposure: What are the service conditions (indoors, outdoors, corrosive environment)? What materials will be required (steel, hot dip galvanizing, stainless steel, marine grade stainless etc…)?

E. Workers task while on the system: Workers will walk along edge. Occasionally, workers are required to look over the edge. While walking, workers need to carry heavy objects.

F. Type of fall protection required: Fall Restraint or Fall Arrest

G. Range of movement while on the system: Uninterrupted movement throughout the entire length of the system

H. Additional components: All attaching devices necessary for # workers.

I. Insurances required: Commercial Liability and Workers' Comp.

1.2 RELATED SECTIONS

A. Section 03300 - Cast-In-Place Concrete

B. Section 03400 - Pre-Cast Concrete

C. Section 05100 – Structural Metal Framing

D. Section 05400 – Cold Formed Metal Framing

E. Section 05310 - Metal Deck

F. Section 06100 – Rough Carpentry

G. Section 07510 - Built-Up Roofing

H. Section 07700 - Roof Specialties and Accessories

I. Section 11010 - Maintenance Equipment

1.3 REFERENCES

A. Occupational Safety & Health Administration (OSHA)

1. 29 CFR 1910.28 (b) (1) & 29 CFR 1926.501(b) (1) - Occupational Health and Safety Standards General Industry & Construction: Duty to have fall protection

2. 29 CFR 1910.140(c) (11) (i-ii) & 29 CFR 1926.502(d) (8) - Safety and Health Regulations for General Industry & Construction: Horizontal Lifeline Design Requirements.

3. 29 CFR 1910.140(c) (13) (i-ii) & 29 CFR 1926.502(d) (15) (i-ii) - Safety and Health Regulations for General Industry & Construction: Anchorage Design Requirements.

4. 29 CFR 1910.66 (e) (1) (i) - General Industry: Powered Platform Installations -Affected parts of buildings.

B. American National Standards Institute (ANSI)

1. Z359.1 [2016] – The Fall Protection Code

2. Z359.3 [2017] – Safety Requirements for Positioning and Travel Restraint Systems.

3. Z359.6 [2016] – Specifications and Design Requirements for Active Fall Protection Systems.

4. Z359.11 [2014] – Safety Requirements for Full Body Harnesses.

5. Z359.12 [2009] – Connecting Components for Personal Fall Arrest Systems.

6. Z359.13 [2013] – Personal Energy Absorbers and Energy Absorbing Lanyards.

7. Z359.14 [2014] – Safety Requirements for Self-Retracting Devices for Personal Fall Arrest and Rescue Systems.

8. Z359.15 [2014] – Safety Requirements for Single Anchor Lifelines and Fall Arrester for Personal Fall Arrest Systems.

9. Z359.18 [2017] – Safety Requirements for Anchorage Connectors for Active Fall Protection Systems.

C. Materials, Bolting, Finishing: American Society of Testing Materials (ASTM)

1. A36 - Standard Specification for Carbon Structural Steel.

2. A500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes

3. A53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

4. F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105 KSI Yield Strength.

5. A193 - Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications

6. A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

7. A666 - Standard Specification for Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.

8. A992 - Standard Specification for Structural Steel Shapes.

9. F3125 - Standard Specification for High Strength Structural Bolts, Steel and Alloy, Heat Treated, 120ksi and 150ksi Minimum Tensile Strength, Inch and Metric Dimensions.

D. American Welding Society (AWS) D1.1/D1 - Structural Welding Code – Steel

E. Design Standards

1. International Building Code (IBC) [20XX]

2. American Society of Civil Engineers (ASCE/SEI) 7-10 [20XX] – Minimum Design Loads for Buildings and Other Structures

3. American Institute of Steel Construction (AISC) 360-XX [XXth ed.] – Steel Construction Manual. In accordance with local building code and adopted standards.

4. American Concrete Institute (ACI) 318-XX Building Code Requirements for Structural Concrete.

5. National Design Specification (ANSI/NDS) [20XX] – Wood Construction Manual

F. Definitions

1. Anchorage – per ANSI Z359.0 – A secure connecting point or a terminating component of a fall protection system capable of supporting impact forces applied by a fall protection system.

2. Anchorage Connector – per ANSI Z359.0 – A component or subsystem that functions as an interface between the anchorage and a fall protection, work positioning, rope access or rescue system for the purpose of coupling the system to the anchorage.

3. Clearance – per ANSI Z359.0 – The distance below an authorized person that must remain clear of obstructions in order to ensure that the authorized person does not make contact with any objects that would cause injury in the event of a fall.

4. Continuous Fall Protection – per ANSI Z359.0 – One or more fall protection systems that provide fall protection without interruption.

5. Fall Arrest – per ANSI Z359.0 – The action or event of stopping a free fall or the instant where the downward free fall has been stopped.

6. Fall Hazard – per ANSI Z359.0 – Any location where a person is exposed to a potential free fall.

7. Fall Restraint/Travel Restraint – per ANSI Z359.0 – A combination of anchorage, anchorage connector, lanyard (or other means of connection) and body support (full body harness) that limits travel in such a manner that the user is not exposed to a fall hazard.

8. Qualified Person – per ANSI Z359.0 – A person with a recognized degree or professional certificate and with extensive knowledge, training and experience in the fall protection and rescue field who is capable of designing, analyzing, evaluating and specifying fall protection and rescue systems to the extent required by the Z359 standards.

1.4 PERFORMANCE

A. System shall comply with Section 1.1 System Description

B. Performance Requirements

1. System Performance

a. The Fall Protection Horizontal Lifeline System shall be designed to allow users to walk the entire length of the system without having to disconnect from the system to pass through intermediate supports. The system shall be designed to support required number of users in case of a fall and to prevent the users from free falling more than 6 feet. All components shall be designed by the fall protection system supplier and shall meet the applicable fall protection ANSI standards and applicable OSHA regulations.

b. The Fall Protection Horizontal Lifeline System shall be designed to control swing fall at corners and other locations in accordance with Z359.6.

2. Structural Performance:

a. Structure supporting the Horizontal Lifeline system must be capable of withstanding design loads based on the maximum specified number of users as required by governing regulations and codes. Where component design loads are specified herein, they represent design minimum requirements.

b. All fall protection components and systems shall be designed with a minimum 2:1 safety factor per section reference 1.3.A.2. In addition, structure supporting fall protection components and systems shall be designed for combined loading conditions in accordance with section reference 1.3.B.3.

1.5 DESIGN

A. Horizontal Lifeline Design Requirements

1. Fall protection horizontal lifelines shall comply with current applicable OSHA, ANSI, and state regulations and standards.

2. The fall protection system and any supporting structure shall be designed by:

Gravitec Systems Inc.	Phone:	1-800-755-8455
21291 Urdahl Road NW,	Website:	www.gravitec.com
Poulsbo, WA 98370-7124	E-mail:	solutions@gravitec.com.

3. General Requirements:

a. Horizontal lifelines shall be designed and installed, under the supervision of a Qualified Person (see section definition 1.3.F.8), as part of a complete personal Fall Protection system. The Qualified Person shall be a licensed professional engineer in the state having jurisdiction.

b. The horizontal lifeline must be level (less than a 5% grade).

c. Engineers shall, at minimum, determine the performance of the system when a fall occurs on the shortest span (largest forces) and the longest span (largest total fall distance) in the system.

d. Tip over posts and/or energy absorbers shall not be used to limit the maximum arrest force of the worker. The tip over posts and/or energy absorbers shall be used only to control or reduce the maximum arrest load (cable tension loading) on the structure.

e. Anchorages for horizontal lifelines systems shall be verified and designed, prior to use, by a Qualified Person with experience and training in the design and use of horizontal lifelines systems.

f. HLL(s) shall satisfy the seismic conditions for nonstructural components as described by ASCE/SEI 7 and IBC, editions appropriate for the jurisdiction. No exceptions can be taken if the system is required to function for life-safety purposes after an earthquake.

g. The fall arrest system shall consist of a steel safety cable attached to the structure. The cable shall be single span or shall have intermediate supports, which allow the user to pass without disconnecting from the system.

h. Brackets and supports shall be attached to the structure with appropriate anchors of proper size to adequately support the intended loaded.

i. The HLL(s) shall comply with the manufacturer's design requirements.

4. Restraint HLL(s) shall be designed per ANSI Z359.6:

a. The HLL(s) shall prevent workers from reaching and falling into any open hole or off the edge of a working surface.

b. The horizontal lifeline shall comply with the requirements for fall arrest horizontal lifelines as indicated in this document.

c. Where a worker is using a full body harness the force on the worker's body shall not exceed 400 lbs.

d. Tip over posts and/or energy absorbers may be used in travel restraint systems; provided that the engineer has determined that the restraint forces will not cause the tip over posts and/or energy absorbers to deploy and ensures that the deflection of the wire rope in combination with other deformations of the restraint system will not permit the worker(s) to reach the fall hazard.

e. The use of fall restraint systems shall be limited to surfaces less than a slope of 4:12 from the horizontal. This is so a fall will not result in dynamic loading on the fall restraint system or where the authorized person could end up being suspended vertically from the system.

5. Fall Arrest HLL(s) shall be designed per ANSI Z359.6:

   a. The selection, design, and installation of fall arrest horizontal lifelines shall be performed under the supervision of a Qualified Person.

   b. Fall arrest horizontal lifelines and all components shall have the strength capable of sustaining static loads applied to the wire rope of at least two times the maximum arresting force.

   c. When more than one user is attached to a horizontal lifeline, the load on the lifeline can be determined using either lumped mass or sequential fall as described in ANSI Z359.6 [4.6.7]

   d. The swing fall shall comply with ANSI Z359.6 [4.6.9]

   e. The clearance safety margin shall comply with ANSI Z359.6 [7.6.2]

B. Sub-System Requirements

   1. Harnesses used with the system shall comply with ANSI Z359.11.

   2. Vertical Lifelines (VLLs) used with the system shall comply with ANSI Z359.15.

   3. Connecting Components (carabiners and snap hooks) used with the system shall comply with ANSI Z359.12.

   4. Energy Absorbing Lanyards (EALs) used with the system shall comply with ANSI Z359.13.

   5. Self-Retracting Lifelines (SRLs) used with the system shall comply with ANSI Z359.14.

C. Horizontal lifelines shall be used exclusively for their designed use and shall be marked to prevent other uses.

D. The design shall take into consideration the potential uses of, and loads on, the horizontal lifeline in order to facilitate the prompt rescue of workers who may fall while attached to the system.

1.6 SUBMITTALS

A. Submit under provisions of Section ##### – Submittal Procedures

B. Product Data: Provide data sheets on each product to be used, including:

   1. Preparation instructions and recommendations.

2. Storage and handling requirements and recommendations.

3. Installation methods.

C. Drawings and Calculations:

1. Drawings:

a. Show the layout of the system including where the system is located and the complete assembly of all components. And how the system is to be accessed.

b. Include a specification of the number, location, and qualifications of workers using the system.

c. Clearly specify the type of system, (restraint or arrest), maximum and average arrest force of PFAS equipment, type of equipment to be used (lanyard, self-retracting device, etc.), equipment dimensions, materials, fabrication details, hardware, and installation instructions. And additional information as indicated in Z359.6 Section 3.2.

d. Clearly specify the required clearance for each system and location.

2. Calculations:

a. Calculations shall be prepared by a Qualified Person under the supervision of a registered Professional Engineer who is also a Qualified Person.

b. Include a statement defining the type of system and indicating that the design is in accordance with the requirements of ANSI Z359.6.

3. The Professional Engineer who oversaw the design of the system shall affix their professional seal to each drawing and calculation package issued in accordance with state law.

D. Operation and Maintenance Data shall be prepared per Z359.2 & ANSI Z359.6:

1. Include complete list of equipment replacement parts; identify each entry with the equipment description and part numbers.

2. Include technical information for servicing equipment.

3. Include legible “as-constructed” drawings of the installed system.

4. Include installation date and system owner’s name and address.

5. Include detailed operating procedures:

    a. Written by a Qualified or Competent Person.

    b. Identifying the fall protection system locations.

    c. Stating any safety precautions that shall be followed during access and egress.

    d. Describing the limitation on use of system: maximum load, designated equipment, required clearance and maximum number of persons permitted to be attached to the system at one time.

    e. Instructions for inspection, maintenance, and retirement of the system and all of its components, including how often inspection and maintenance are to be performed and a description of the qualifications required for persons performing these tasks.

    f. Procedure for inspection:

        I. Required or recommended inspection intervals.

        II. Detailed instruction for inspecting each component of the system.

        III. Description of acceptance or rejection criteria, including retirement criteria, of each component of the system.

        IV. Fall protection procedures shall include a requirement that any incidents, including accidents or near misses, be investigated to determine if procedures can be improved.

6. Provide or direct the owner of the system or the employer of the workers using the system to develop and implement a rescue plan before the system is used.

1.7 QUALITY ASSURANCE

A. Single Source: Obtain all materials and equipment required under this section from a single supplier.

B. Designer/Installer Qualifications: Engage a single firm to assume undivided responsibility for the design and fabrication of all fall protection system components. Firm shall have a minimum of 5 years documented experience in the fabrication of such components similar to that required for this project. Additionally, the firm shall have a minimum of 5 years documented experience in the installation of such components and who offers a regular inspection and maintenance service on such systems.

C. Design Engineer: Employ a firm with a minimum of 10 years' experience designing fall protection systems with a minimum of 5 systems installed in the previous 12 months. Who employs a registered Professional Engineer (PE), with evidence of being the principal PE on at least 3 fall arrest systems which have been in use for no less than 1 year prior to bid closing date.

D. Professional Engineer who is a Fall Protection Qualified Person: Shall oversee the fall protection systems' design, such that all component items meet the "Structural Performance" requirements, including sizing and spacing of all attachments to the building structure and verify the design is compliant with all applicable OSHA regulations and ANSI standards. Additionally, they must prepare, stamp and sign all required calculations.

E. All welding to be executed by certified welders in accordance with AWS requirements.

1.8 DELIVERY, STORAGE & HANDLING

A. Material delivery shall be coordinated with all effected entities.

B. Storage and Protection:

1. Store originally packaged materials in a cool, dry, and protected location.

2. Materials shall be in new condition and show no signs of damage.

1.9 SEQUENCING

A. Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress.

1.10 WARRANTY

A. Manufacturer's standard warranty for materials and workmanship.

B. Installer's standard one (1) year warranty for materials and workmanship.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers shall comply with the *Quality Assurance* section of this documentation.

B. All supporting structure which connects the horizontal lifeline to the super structure shall be designed by:

3M, Latchways PLC 15401 Vantage Parkway West Suite 120 Houston, TX, 77032	Phone: Website: E-mail:	011-44-1380-732700 www.latchways.com info@latchways.com
Capital Safety 3833 Sala Way Red Wing, MN 55066	Phone: Website: E-mail:	1-800-328-6146 www.capitalsafety.com info@capitalsafety.com
Honeywell Miller Fall Protection 1345 15th Street PO Box 271 Franklin, PA 16323	Phone: Website: E-mail:	1-800-873-5242 www.millerfallprotection.com Contact on website
Kee Safety 100 Stradtman St, Buffalo, NY 14206	Phone: Website: E-mail:	1-800-851-5181 www.keesafety.com info@keesafety.com
XSPlatforms 21 Bellarmine Court, Chico, CA 95928	Phone: Website: E-mail:	1-530-343-1400 www.xsplatforms.com info@xsplatforms.com
Gravitec Systems Inc. 21291 Urdahl Road NW, Poulsbo, WA 98370-7124	Phone: Website: E-mail:	1-800-755-8455 www.gravitec.com solutions@gravitec.com

2.2 DESIGNERS

A. Gravitec Systems Inc.
21291 Urdahl Road NW,
Poulsbo, WA 98370-7124

2.3 MATERIALS

A. Product

1. The system shall be a complete and turnkey complying with the performance and design criteria of this document.

2. Component Materials:

   a. Mild Steel

   b. 304 Stainless Steel

   c. 316 Stainless Steel

3. Post Base Plate Connectors: Provide complete with required components for weatherproof mounting to the following surfaces:

   a. Standing Seam Roof Type.

b. Composite Ribbed Roofing Type.

c. Metal Roofing Type.

d. Insulated Roof Deck Type.

e. Concrete Deck Type.

f. Timber Deck Type.

g. Non-Penetrating.

4. The Fall Protection System shall be attached to the supporting structure with appropriate fasteners. The fasteners shall be designed to support a load on the fall protection system of 2 times the maximum design load without failure.

5. Provide all designed sub-system items per Section 1.5 (B) of this document.

B. Supporting Structure

1. Structural Components shall comply with the applicable standards:

a. Structural Steel: ASTM A992.

b. Structural Tubing: ASTM A500 Grade B.

c. Structural Bars, Plates, Shapes, and Sheet Piling: ASTM A36.

d. Piping: ASTM A53.Grade B

2. Fasteners shall comply with the applicable standards:

a. Structural Bolts: ASTM F3125.

b. Alloy-Steel and Stainless Steel Bolting: ASTM A193 B7.

3. Flashing and Sealing Material shall comply with the applicable standards.

4. Material substitutions shall be better than or equal to the requirements found in this section.

5 Fabrication

a. Fabricate work true to dimension, square, plumb, level, and free from distortion or defects detrimental to performance.

b. Coordinate the system with supporting structure.

c. Welding:

I. AWS D 1.1 as applicable.

II. If Butt welds are used, then surplus welding material shall be ground off to ensure exposed surfaces are smooth. Fillet welds shall not be ground.

III. Slag shall be removed from the materials surface.

6 Finishes

a. Hot Dip Galvanized: Comply with ASTM A123.

b. Powder Coat: 1. Prepare raw steel pieces by blast abrasive to a white metal blast cleaned surface. 2. Provide conversion coating process with iron-phosphate pretreatment. 3. Powder coat finish = 3-5 mil powder color coat approved by xxxxxx.

2.4 HORIZONTAL LIFELINE DESIGN

A. Horizontal lifeline design shall comply with the *Design Requirement* section of this document.

B. Steel design shall comply with AISC 360 edition as required by jurisdiction.

C. Wood design shall comply with ANSI/NDS [20XX].

D. Concrete design shall comply with ACI 318-XX.

E. Fall protection systems attached onto an existing or new structure shall comply with IBC and ASCE/SEI as required by jurisdiction.

PART 3 EXECUTION

3.1 INSTALLATION

A. Installation shall be performed by:

Gravitec Systems Inc.
21291 Urdahl Road NW,
Poulsbo, WA 98370-7124

Phone: 1-800-755-8455
Website: www.gravitec.com
E-mail: solutions@gravitec.com.

B. Install in accordance with approved drawings, shop drawings and manufacturer's instructions.

C. The Fall Protection System shall be installed under the direction of manufacturer's authorized trained personnel and under the supervision of a Qualified Person.

D. Install anchorages and fasteners in accordance with their manufacturer's recommendations to obtain the allowable working loads published in the product literature and in accordance with this specification.

E. Do not load or stress the Fall Protection System until all materials and fasteners are properly installed and ready for service.

F. Where bolting is used for fastening, no fewer than three threads are to be exposed and the nut shall be positively locked using a thread-locking fluid or the double nutting technique.

G. Dissimilar materials with greater than 0.15V shall be separated by a faying surface.

3.2 FIELD QUALITY CONTROL

A. After the Fall Protection System is installed and properly tensioned, the approved Qualified or Competent Person shall inspect and operate the system and shall make all final adjustments for proper operation.

3.3 ADJUSTMENTS AND FINAL INSPECTION

A. Verify that all manufactured units have been installed in accordance with specifications and details and will function as intended. Adjust any items where necessary to ensure proper operation.

B. Provide a complete drawing set with any revisions to the design or layout of the fall protection systems during installation.

3.4 OPERATOR SYSTEM ORIENTATION

A Provide a minimum of 2 hours of operator orientation after system has been installed. Orientation shall be for the users of the system conducted at the installation site. Mininum requirements for orientation; system type, clearance requirements, maximum number of users, pre-use inspection, yearly inspection requirement, system use and use of personal equipment specified to be used with the system.

3.5 MAINTENANCE, INSPECTION AND TESTING

A. Provide xx copies of the manufacturer's maintenance, inspection and testing instructions.

B. Provide documentation that is consistent with applicable OSHA and ANSI standards.

C. Provide system placards at access points providing system information including, but not limited to; maximum number of users, system type (restraint or arrest), clearance requirement, manufacturer, installer, date of installation, inspection list, and any other specific limitations of the system.

END OF SECTION