

SECTION 35 12 00 – VESSEL DETECTION SYSTEMS (VDSs)

1.01 SUMMARY:

A. ^{A17}**Scope:** Scope of work shall be in accordance with Paragraph 1.01 D. of Section 01 81 26 (Communications, Control, Safety, and Security Systems), as required, for safety in parts of the Works.^{A17} This Section of the Employer's Requirements shall be read in conjunction with the Sections listed in Table 35 12 00-1.

B. **Related Sections:**

| Table 35 12 00-1: Related Sections | | |
|------------------------------------|---------------------|--|
| 1. | Section 01 81 26 | - Communications, Control, Safety, and Security Systems. |
| 2. | Section 25 11 00 | - Data Processing Equipment. |
| ^{A3} 3. | Section 27 21 00 | - Data Communications Equipment ^{A3} |
| ^{A3} 4. ^{A3} | Section 27 37 00 | - Multi-channel Mobile Radio-communication Systems. |
| ^{A3} 5. ^{A3} | Section 35 10 00 | - Waterway and Marine Signaling and Control Equipment. |
| ^{A3} 6. ^{A3} | Section 40 00 00 | - Process Systems Integration. |
| ^{A3} 7. ^{A3} | Section 40 91 00 | - Primary Process Measurement Devices. |
| ^{A3} 8. ^{A3} | Section 40 94 43 | - Programmable Logic Controllers (PLCs). |
| ^{A3} 9. ^{A3} | Section 40 95 13 | - Process Control Hardware. |
| ^{A3} 10. ^{A3} | Section 40 95 45 | - Process Control Software. |
| ^{A3} 11. ^{A3} | Section 40 96 45.13 | - Process Control Software for LMCSs. |

1.02 REFERENCES:

A. **Applicable Publications:** Refer to of Section 01 81 26 (*Communications, Control, Safety, and Security Systems*), Paragraph 1.02.

B. **Employer's Background Information:**

1. Automatic Identification System (AIS):

a. ^{A10}As of 2008,^{A10} the Employer's automatic identification system (AIS) is in accordance with ^{A10}ITU-R M.1371-3.^{A10} The Enhanced Vessel Traffic Management System's (EVTMS) old communications, tracking, and navigation (CTAN) subsystem is being phased out in favor of AIS. CTAN phase out is expected to be completed by the end of 2009, and EVTMS is expected to be improved soon.

b. AIS is known to be imprecise at low speed and not reliable for close quarters maneuvering.

2. ^{A10}**Expert Systems:** The Employer does not presently use expert systems for operation of existing locks.^{A10}

1.03 REQUIREMENTS:

A. General:

1. The Contractor shall meet all applicable requirements of Section 01 81 26 (*Communications, Control, Safety, and Security Systems*), Paragraph 1.03.
2. Vessel detection systems shall include, but not be limited to, the following:
 - a. **Vessel Presence Detection:** Shall include hardware and software as required.
 - b. **Vessel Positioning:** Shall include hardware and software to determine position, speed, and alignment of the vessel in the locks chambers.
3. VDSs shall require minimal maintenance, and shall be protected against under-voltage, over-voltage, voltage fluctuation, and over-current and current discharge conditions. Equipment shall be resistant to high humidity environment, including rain drops for equipment.
4. Vessel detection sensor output data shall be available to the machinery control station (MCS) and machinery diagnostics station (MDS) human-machine interfaces (HMIs) as specified in Section 40 96 45.13 (*Process Control Software for LMCS*). Sensor output shall be connected to the nearest LMCS input / output (I/O) concentrator, typically in each rolling gate machinery room, by means of any of the fieldbuses listed in Section 40 91 00 (*Primary Process Devices*).
5. Any other systems requiring information deriving from these sensors shall attain it through communications with the corresponding LMCS.
6. VDS manufacturers shall be [ISO 9001 certified](#). [ISO 20000 certification is preferred to ensure an ITIL style help desk](#).

B. Vessel Presence Detection:

1. MCS and MDS HMI displays shall indicate, represented on the screen as in the physical sensor location in the field, a color animated sensor icon in accordance with Table 40 96 45.13–2 (Status and Alarm Indication Animation), where open and closed states do not apply.
2. In addition to the sensor icon, a “sensing” animation shall be provided showing animated lines emanating from the sensor representing the sensing technology used by the sensor.
3. For light amplification by stimulated emission of radiation (LASER) technology, animated lines shall show a LASER sweep of the area upon vessel detection. For microwave technology, animated waves shall expand away from the sensor upon vessel detection, as illustrated on Figure 35 12 00-1.

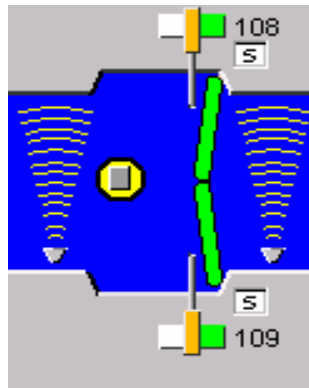


Figure 35 12 00-1: Vessel Presence Detection Animation Example from Existing Locks

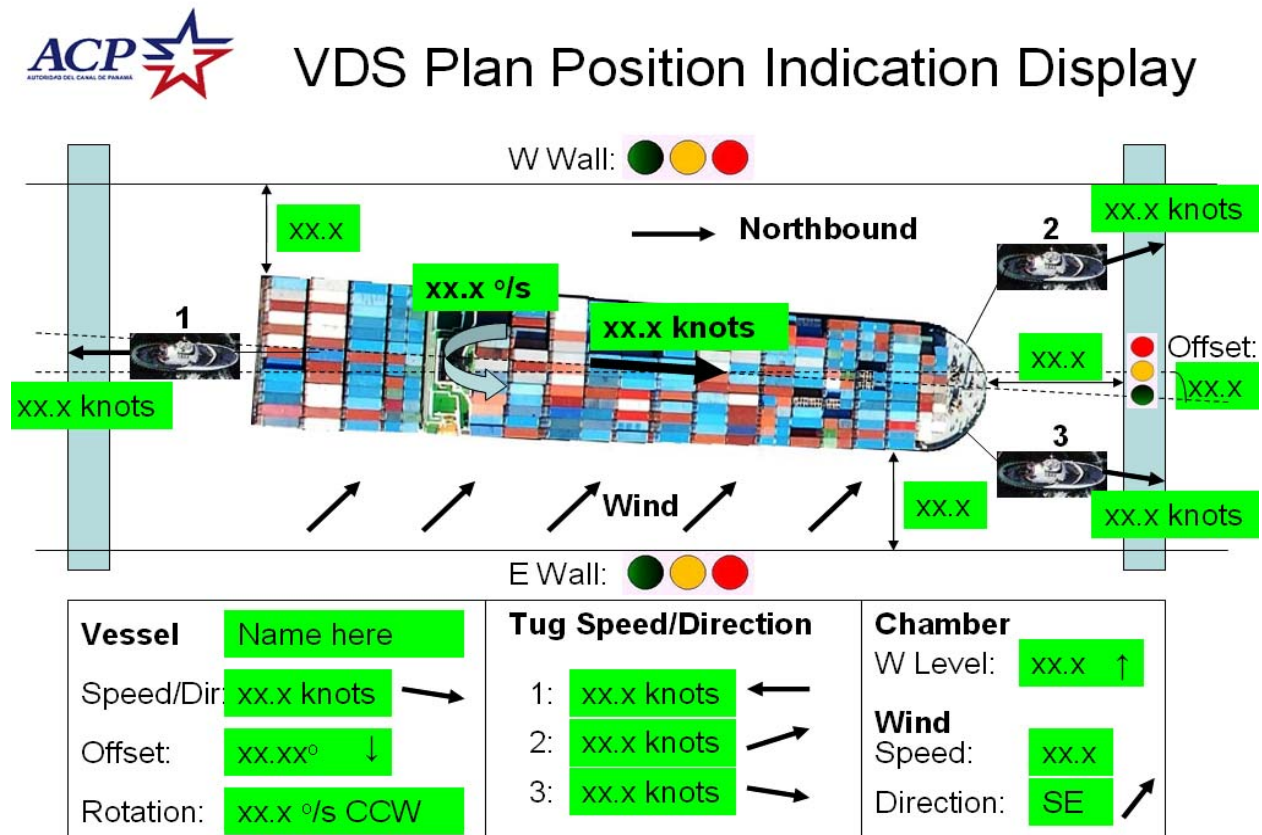
C. Vessel Position Indication:

1. ^{A17}The Works shall include a chamber-distance marking/signaling system as a common situational awareness tool. ^{A17} This shall allow the Employer's Personnel (lockmaster, tugboat pilots and vessel pilots) to know the position of the transiting vessel within each lock chamber at all times.
2. Several technologies may be considered for this system. ^{A16}If using LASER or light detection and ranging (LIDAR) sweep detection / distance sensing, microwave array, or similar technology, multiple sensors shall be embedded along the lock walls as required to meet these requirements. Use of radio frequency identification (RFID) technology is acceptable if it can reach the required distances and if feasible to meet these requirements at the time of installation. ^{A16}
3. Indication shall be made available at multiple sections of the locks so that the pilot can correct the vessel position if required. The indication shall be provided by means of a semaphore installed flush on both lock walls facing up, near the sensor position and on portable terminals, or other suitable method to convey the indication to the pilot.
4. At a particular sensing location on locks side walls, the Contractor shall provide semaphores, which shall be visible to the Employer's Personnel (pilots). These semaphores shall indicate transiting vessel characteristics to the pilots. Transiting vessel characteristics shall be indicated using light colors according to distance to lock wall, offset angle, and velocity conditions as follows:
 - a. **Distance-Based Indication:** A green light if wall-vessel distance is greater than 400 mm (16"), yellow if between 400 mm (16") and 200 cm (8"), and blinking red if less than 200 mm (8").
 - b. **Offset Angle-Based Indication:** Green, yellow, and red rules shall depend on the transiting vessel size, as coordinated with and reviewed by the Employer's Representative.

- c. **Velocity Based Indication:** Green, yellow, and red rules shall depend on the transiting vessel size as well as bow and stern velocities, as coordinated with and reviewed by the Employer's Representative.
5. At a particular sensing location just ahead and near the rolling gate's upper center, the Contractor shall provide semaphores, which shall be visible to the Employer's Personnel (including pilots whenever possible). These semaphores shall use green, red, and yellow lights to indicate transiting vessel distance to RG to the pilots. Light color correspondence to distance ranges shall be as coordinated with and reviewed by the Employer's Representative.
6. ^{A3}Wireless transmission subsystem shall be WiMax (first choice) or WiFi (second choice) in accordance with Section 27 21 00 (*Data Communications Equipment*), and suitable for relaying vessel position and velocity data, as well as wind speed and direction information to the Employer's Personnel (lockmaster, as well as tug and vessel pilots).^{A3}
7. HMI shall be adequate for use under the working circumstances of the Employer's Personnel (pilot). HMI shall be intuitive, and user friendly. HMI displays shall include, but not be limited to, the following:
 - a. Color for adjacent VDS semaphores on both lock side walls and the rolling gate (RG) just ahead.
 - b. RG position.
 - c. Distance to the RG just ahead (when RG is closed).
 - d. Locks chambers, tugs, and vessels shown to scale.
 - e. Lock center line.
 - f. Smallest distance to locks walls on both sides of the vessel.
 - g. Vessel center line.
 - h. Vessel direction (north or south bound).
 - i. Vessel displacement speed (value and vector), including indications of bow and stern velocity to the wall.
 - j. Vessel offset heading (angle between lock chamber and vessel center lines).
 - k. Vessel position in relation to lock walls and in the display center.
 - l. Wind speed and direction (value, text, and multiple vectors).
8. Distance to wall data shall be presented in steady green when normal, steady yellow when in warning, and flashing red when in alarm, corresponding to indications specified in Subparagraph 1.03 C.4.a., above.
9. Figures 35 12 00-2 and ^{A8-3}^{A8} illustrate conceptual HMI displays. Figure 35 12 00-4 illustrates the ^{A8}wireless^{A8} network.

D. (deleted)

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Figure 35 12 00-2: Conceptual Plan Position Indication Mode Display for LMCS HMI. Note that a) vessel^{A8} center line deviation angle from locks center line has been exaggerated for illustration purposes, and b) illustration shows required and some desirable (not required) features.

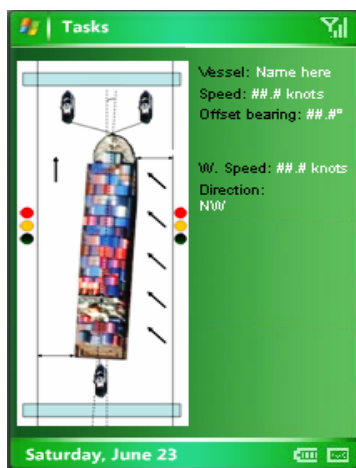


Figure 35 12 00-3: Alternative Conceptual PPI Mode Display for Portable Terminals.

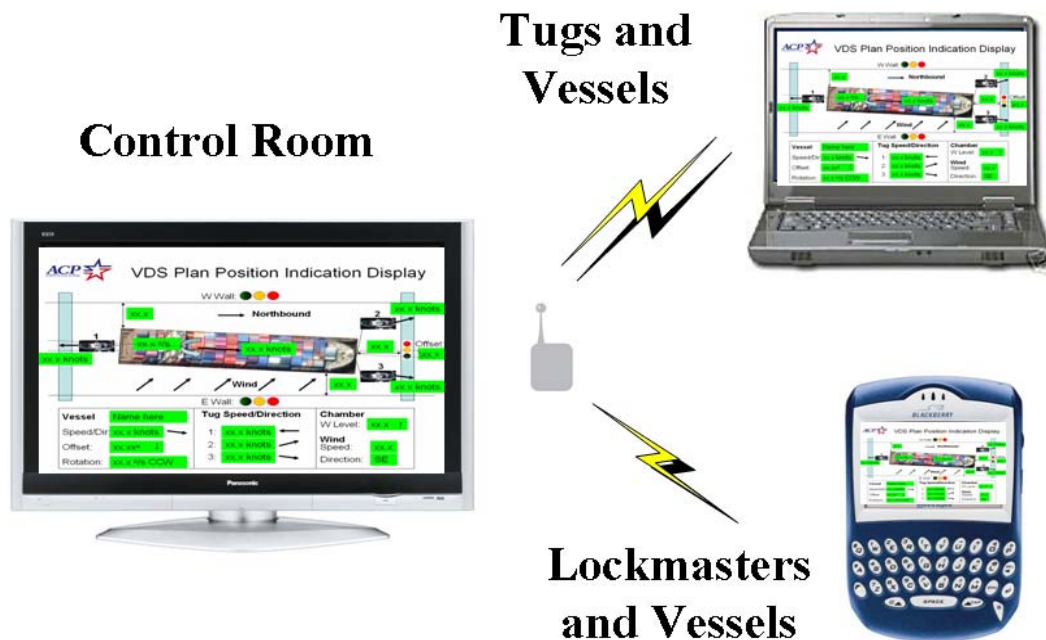


Figure 35 12 00-4: ^{A8}Conceptual wireless network.^{A8}

E. Interoperability:

1. VDSs shall interoperate with AIS to share data and avoid duplication of efforts whenever obtaining accurate data is feasible.
2. VDSs shall interoperate with LMCS for the following:
 - a. To enable opening a rolling gate when a transiting vessel is approaching,
 - b. To display vessel animations and position in LMCS’s HMI,
 - c. To disable closing rolling gates when a transiting vessel is crossing, and
 - d. To bypass VDS status information.
3. ^{A8}Should wind direction/speed sensors not be connected to VDSs, these shall interoperate with the Employer’s “Sección de Recursos Hídricos” (EACR) ALERT (or successor system) in order to relay wind direction and speed information.^{A8}

F. Equipment and Materials:

1. **Input/Output Concentrators:** Shall be in accordance with Section 40 94 43 (*Programmable Logic Controllers*).
2. **Portable Terminal Equipment:**
 - a. Ruggedized wireless units shall be in accordance with Section 25 11 00 (*Data Processing Equipment*).
 - b. The Contractor shall furnish no less than seventy units for transiting vessels and tugboats. Note that more than one unit per vessel may be required depending on the number of high ranking boarding officers.
3. **Semaphores:** Traffic light like units shall be in accordance with Section 35 10 00 (*Waterway and Marine Signaling and Control Equipment*).
4. **Sensors:** Shall be in accordance with Section 40 91 00 (*Primary Process Measurement Devices*). Rating shall be IP68 or better.
5. **Servers:** Shall be in accordance with Section 25 11 00 (*Data Processing Equipment*).
6. **Other Hardware and Software:** Shall be as required.

G. Software:

1. Intuitive software shall be furnished as required for system management and operation, and shall meet the applicable requirements of Sections 01 81 26 (*Communications, Control, Safety, and Security Systems*) and 40 96 45 (*Process Control Software*).
2. ^{A17}Operation software shall include software for WiFi/WiMax compliant laptops or workstations at transiting vessels, tugboats, and WiFi/WiMax terminals. ^{A17}

H. Installation:

1. **Sensors:** Shall be installed in accordance with Section 40 91 23 (*Primary Process Measurement Devices*).
2. **Servers:** Shall be rack mounted in the corresponding main control building.
3. **Wireless Transmission Subsystem:** Shall use a combination of the most effective IT security techniques in accordance with Section 01 81 26 (*Communications, Control, Safety, and Security Systems*).
- ^{A8}4. ^{A17}**Wind Vector Displays:** HMI shall be configured to show wind vectors on one of four sides of a vessel, depending on the push direction, in accordance with Figure 35 12 00-5. However, vector directions shall show anywhere within 360°

and shall not be limited to 0, 90, 180, 270 degrees as shown in the example below.^{A17}

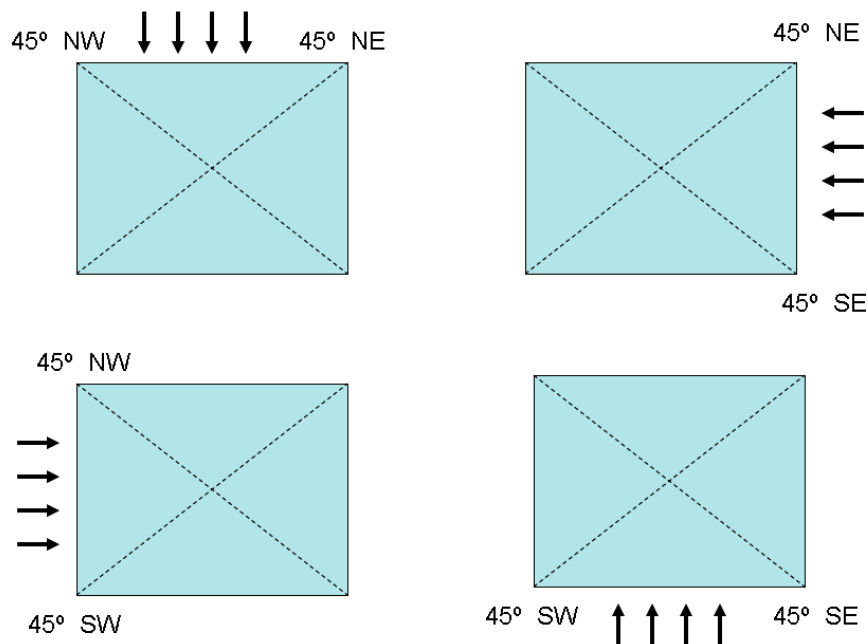


Figure 35 12 00-5: Wind vector display^{A8}

^{A10}5. (Deleted)

1.04 DESIGN CRITERIA/SYSTEM PERFORMANCE:

A. General:

1. **Problem to be Solved:** VDSs are required to solve the following business needs:
 - a. Detect vessel presence in operational areas of rolling gates to avoid accidentally closing it when a vessel is crossing locks chambers.
 - b. Detect vessel position and velocity in the horizontal plane and relay information to the Employer’s Personnel (lockmaster as well as pilots in tugs and transiting vessels). The reference shall be the locks chamber center line, not the side walls.
 - c. ^{A3}Generate automatic warnings as required for collision avoidance.^{A3}
 - ^{A19}d. Lower operational costs by reducing vessel transit times.^{A19}

2. **Restrictions to be Considered:**

- a. None of the selected technologies shall interfere with electronics onboard tugs and transiting vessels.

B. **Design Criteria:**

- 1. VDSs shall be safety enhancement systems suitable for operations at all times under all local weather conditions, and shall comply with the applicable International Maritime Organization (IMO) and Permanent International Association of Navigation Congresses (PIANC) recommendations, requirements, and standards.
- 2. HMI displays shall be designed considering the input of Employer's Personnel (pilots) as end users.

C. **System Performance:**

- 1. **General:** VDSs shall do, but not be limited to, the following:
 - a. Enhance LMCS displays by showing vessel position in locks chambers.
 - b. Perform adequately regardless of vessel hull color and shape, as well as Employer's Personnel (pilot) preferences for locks entry. Note that some vessels will enter the first chamber aligned with the approach structures, i.e. sliding on it and not nearly aligned.
 - c. Ignore objects in locks chambers with areas smaller than 2 m x 2 m.
 - d. Provide historical playback of events to assist in the investigation of incidents.
 - e. Consider the presence of one or more tugs and vessels in a lock chamber, and not be affected by this fact.
 - f. Make VDS information available to the Employer's Personnel (lockmaster and the corresponding pilots) via wireless transmission.
 - g. ^{A3}Allow system users to select which vessel to display whenever there is more than one vessel in the same lock complex, and
 - h. ^{A19}Use color coding (i.e., green, yellow and red) and steady/blinking attributes for vessel position and speed data, depending on warning and alarm limits defined by the system manager. ^{A19}
- 2. **Interlocks:**
 - a. VDSs shall determine when a vessel is crossing a RG threshold so that closing it is temporarily disabled by the LMCS.

- b. Positive detection shall disable gate closing if open, and stop and open a closing gate.
 - c. A sensor bypass shall also be available. Bypass activation/deactivation shall be via the corresponding LMCS.
- 3. **System Reliability:** Shall be 99.99% or better.
- 4. **Vessel Presence Detection:** VDSs shall detect the presence of a vessel and major floating objects in the path of each RG, regardless of the water level in lock chambers.
- 5. **Vessel Positioning:**
 - a. VDS shall detect vessel position in chambers (distance to walls). Distance measurements shall be accurate to 100 mm or better.
 - b. VDSs shall determine vessel's normal (green) / warning (yellow) / alarm (red) status depending on user defined range of shortest distance to locks chamber wall.
 - c. VDSs shall aid the Employer's Personnel (pilots) in determining their vessels location in relation to the centerline and walls of the lock chambers, within a range of 600 mm (24").
 - d. VDSs shall increase locks throughput and safety of the lockage operations, by allowing the Employer's Personnel (pilots) to know at all times the position of the vessel with respect to the chamber, especially when entering the locks.
 - e. VDSs shall get vessel velocity from own devices or calculations. Speed from the automatic identification system (AIS) may be used for validation or backup.
 - f. VDSs shall get tugs position and speed from AIS or own devices.
 - g. VDSs shall animate LMCS HMI by including vessel display.

1.05 SUBMITTALS: The following shall be submitted for substantiation purposes:

- A. **Design:** The following shall be in accordance with Section 01 81 26 (*Communications, Control, Safety, and Security Systems*), Paragraph 1.05 D:
 - 1. Calculations, including system availability.
 - 2. Critical path method (CPM) diagram, with monthly updates.
 - 3. Descriptive literature.
 - 4. Drawings.

5. HMI displays.
 6. IT security methods.
 7. Protection methods for corrosion, electrostatic discharge (ESD), fungus/humidity, lightning/surge, power distortion and harmonics, radio frequency interference/electromagnetic interference (RFI/EMI), thermal, and vibration.
 8. Quality assurance and control plans.
 9. Specifications.
 10. Strengths, weaknesses, opportunities, and threats (SWOT) analysis.
 11. Any other data required for review.
- B. **Re-Submittals Just Prior to Purchasing Materials:** All items in Subparagraph A., above, that have changed from original submittal shall be resubmitted in a Design Conference in accordance with Section 01 81 26 (*Communications, Control, Safety, and Security Systems*), Paragraph 1.05.
- C. **Right After Factory Quality Control Tests (FQCT) and Factory Inspection Tests (FIT):**
1. Test reports.
- D. **Upon Receipt of Shipped Items in Panama:**
1. Instruction manuals for administration, installation, maintenance, and operation.
 2. Packing lists.
- E. **Prior to Issuance of Taking Over Certificate:**
1. As-built drawings.
 2. List of recommended spare parts.
 3. Software licenses.
 4. Test reports.
 5. Training services.
- 1.06 QUALITY ASSURANCE:** Shall include the following in accordance with Section 01 81 26 (*Communications, Control, Safety, and Security Systems*), Paragraph 1.06:
- A. Factory quality control tests (FQCT).
 - B. Factory inspection tests (FIT).
 - C. Final field inspection tests (FFIT).
 - D. Training services for no less than ten persons.

E. Warranty.

END OF SECTION