This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.

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An American National Standard

Standard Specification for Switch, Position Proximity (Noncontact) or Limit (Mechanical Contact), Fiber-Optic[1]

This standard is issued under the fixed designation F2071; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This specification covers the requirements for fiber-optic position switches (proximity and limit). This specification does not include switches that transfer an optical signal from one path to another by an external force or energy applied to the switch.

1.2 Special requirements for naval shipboard applications are included in the Supplement.

1.3 The values stated in SI units are to be regarded as standard. The values given in parentheses are mathematical conversions to inch-pound units that are provided for information only and are not considered standard. Where information is to be specified, it shall be stated in SI units.

1.4 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.5 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D3951 Practice for Commercial Packaging

2.2 *ISO Standards:*[3]

ISO 9001 Quality System—Model for Quality Assurance in Design/Development, Production, Installation, and Servicing

3. Terminology

3.1 *Definitions:*

3.1.1 *closed switch, n*—the light path is complete; signal from transmitter to receiver is complete.

3.1.2 *closed switch with positive alarm, n*—the light path is complete. Signal level indicates that the end faces of the sensing element are dirty and require maintenance for continued proper operation.

3.1.3 *fiber-optic position switch, n*—a device that converts measured position, via changes in fiber-optic properties, to an output that is a function of the applied measurand. The fiber-optic position switch normally consists of a sensor head, optoelectronics module, and connectorized fiber-optic cable.

3.1.4 *limit switch, n*—a switch that senses a change in position via mechanical contact.

3.1.5 *open switch, n*—the light path is blocked; signal from transmitter to receiver is not complete.

3.1.6 *optical transmittance change, n*—the change in optical power level introduced by an environmental, mechanical, or other induced stress.

3.1.7 *optoelectronics module, n*—unit of the fiber-optic position switch that contains the optical transmitter and receiver, and signal conditioning electronics, necessary to convert the sensed position to the specified output signal. The optoelectronics module may be an expansion card for a microprocessor-based system, or a stand-alone unit.

3.1.8 *proximity switch, n*—a switch that senses a change in position via noncontact means.

3.1.9 *sensor head, n*—unit of the fiber-optic position switch that detects position via changes in optical properties. The

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] Available from International Organization for Standardization (ISO), ISO Central Secretariat, BIBC II, Chemin de Blandonnet 8, CP 401, 1214 Vernier, Geneva, Switzerland, http://www.iso.org.

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optoelectronics module interrogates the sensor head to determine the position of the measurand. An optical signal is transmitted from the optoelectronics module to the sensor head. The optical path is either complete or blocked, depending on the status of the item being measured, giving an indication of the position or status of the item back to the optoelectronics module.

3.1.10 *steady-state supply voltage, n*—an input voltage that does not deviate from a specified nominal tolerance (for example, ±5 %).

3.1.11 *tether valve limit switch, n*—a limit switch used to detect valve position via a tether line connected to the valve handle.

3.1.12 *transient supply voltage, n*—a voltage superimposed on the steady-state supply voltage that is greater than the specified steady-state tolerance and has a very rapid rise and fall.

4. Classification

4.1 *Designation*—Most switch manufacturers use designations, systematic numbering or identifying codes. Once understood, these designations could aid the purchaser in quickly identifying the switch type, electrical power ratings, and other characteristics.

4.2 *Design*—Fiber-optic position switches typically consist of an assembly with three major components: optical sensor head, fiber-optic cables, and optoelectronics module. The optoelectronics module shall be interchangeable between any of the sensor types.

4.3 *Types*—The following are common types of fiber-optic position switches:

Proximity
Limit, pin actuated
Limit, lever actuated
Limit, lever and roller
Limit, tether valve

4.3.1 *Fiber-Optic Proximity Switches*—The fiber-optic proximity switch sensor head receives the light beam from the light source in the optoelectronics module via a fiber-optic cable. The sensor head emits the light beam to detect an object in a specific location. The sensor head also receives the light beam reflection from the object, typically via a wide angle receiving lens, and is detected by the light beam receiving device in the optoelectronics module. When the object moves into the sensing site, the light beam is reflected into the receiving lens completing the fiber-optic light path. It is important to consider contrasting light levels between reflections from background objects when no object to be detected is present and reflections from the object to be detected, when selecting a fiber-optic proximity switch.

4.3.2 *Fiber-Optic Limit Switches*—The fiber-optic limit switch sensor head houses the mechanical contact device that senses the position of the object to be detected. The mechanical contact device is typically a pin or plunger, lever, roller, lever and roller, or tether valve. The fiber-optic limit switch sensor head receives the light beam from the light source in the optoelectronics module via a fiber-optic cable. The same fiber-optic cable allows completion of the light path to a fiber-optic receiver in the optoelectronics module. Dependent upon the configuration of the switch, the mechanical contact device either completes or breaks the light path upon detection of the object.

5. Ordering Information

5.1 The purchaser should provide the manufacturer with all of the pertinent application data. Recommended data is shown in 5.2. If special application operating conditions exist that are not shown in the acquisition requirements, they should also be described.

5.2 *Acquisition Requirements*—Acquisition documents should specify the following:

(1) Title, number, and date of this specification,
(2) Manufacturer's part number,
(3) Switch type required (see 4.3),
(4) Unique or special enclosure requirements (see 7.1),
(5) Type of optoelectronics module (see 7.2). If control enclosure or console mounted, specify requirements,
(6) Length of fiber-optic cable required,
(7) Type of electrical connection (see 7.4),
(8) When the electrical connection mating plug is not to be provided (see 7.4),
(9) System operating characteristics,
(10) Materials,
(11) Environmental requirements,
(12) Quantity of switches required,
(13) Size and weight restrictions (see 7.5),
(14) Critical service life requirements (see 8.1),
(15) Performance requirements (see 8.2),
(16) Special surface finish requirements (see 9.1),
(17) Special workmanship requirements (see 9.2),
(18) When certification is required (see 13),
(19) Special marking requirements (see 14),
(20) Special packaging or package marking requirements (see 15),
(21) When ISO 9001 quality assurance system is not required (see 16.1), and
(22) Special warranty requirements (see 16.1).

6. Materials and Manufacture

6.1 *Position Switches*—Materials for the fiber-optic position switches shall be corrosion resistant and noncombustible or fire retardant.

7. Physical Properties

7.1 *Enclosure*—If case sealing is required, the mechanism, materials, and process shall be described. The same should apply to the electrical connector. Resistance to cleaning solvents should likewise be stated. Unique or special enclosure requirements shall be specified in the acquisition requirements (see 5.2).

7.2 *Optoelectronics Module*—The optoelectronics module shall contain the optical and signal conditioner devices necessary to convert the sensor head output to the specified electrical