SECTION OBJECTIVE

I. Recall the requirements for balanced twisted-pair and optical fiber test equipment and proper use.

II. Recall the requirements for testing balanced twisted-pair permanent link and channel model and optical fiber permanent link model installations.

III. Understand the defined test parameters as they pertain to qualifying a Siemon Cabling System warranty.

IV. Describe the proper test parameters required for testing the warranties as defined in Annex D.

V. Identify and describe the proper registration information required for registering a Siemon Cabling System warranty.
TESTING EQUIPMENT

Approved Balanced Twisted-Pair Field Testers

▲ – 1 All transmission testing shall be performed with an approved balanced twisted-pair tester from one of the manufacturers listed in the Annex C section of this manual and as specified on the Siemon Website, www.siemon.com/ally.

Field testers from the manufacturers listed in Annex C have been approved by Siemon for use in qualifying the installed cabling in a Siemon Cabling System Warranty. Field testers need to be updated with the most recent testing parameters based on regional requirements (an example would be the United States’ tests to ANSI/TIA/EIA-568-B.1).

Tester Software

▲ – 2 All field testers shall have the latest version of software installed in order to provide the most accurate and current testing parameters and values.

Note: Verification of the version of software installed in the field testers being used, compared to the latest version available from the test equipment manufacturer, needs to be checked on a regular basis. Older versions of software in field testers may not provide the testing parameters and accuracy required by Siemon.

Proper Use

▲ – 3 Requirements and recommendations for connections, test configuration, measurement procedures and precautions that are specified in the manuals provided with the tester shall be followed.

▲ – 1 It is recommended that users receive training by the field tester manufacturer to ensure proper use of the field tester.

Note: It is important that users of these field testers are familiar with the proper setup and use of the field testers for accurate test results.

Factory Calibration

▲ – 4 All field testers shall be factory calibrated by the field tester manufacturer per the requirements in the test equipment manufacturers manual that is provided with the field tester. Proof of factory calibration for the field testers shall be provided to Siemon upon request.

Note: One method to check the field tester repeatability is to construct a reference link. This may be used to check for variations in the tester’s accuracy due to wear and tear of the Link Interface Adapters.

▲ = Normative (Shall)    ▲▲ = Informative (Should/Recommend)
Testing Options

▲ – 5 Autotest settings provided in the field tester for testing the installed cabling shall be set to the default parameters. Any autotest settings that have been modified to change testing parameters may disqualify the test results.

▲ – 6 Test settings selected from options provided in the field testers shall be compatible with the installed cabling under test.

Note: It is important to select the proper test settings based on the installed components and configuration of the cabling system to be tested. Tester settings that need to be reviewed for proper testing include Permanent Link or Channel, type of cable, NVP and performance of the class/category to be qualified.

▲ – 7 Continuity testing shall be performed using any of the approved testers in the Annex C section of this manual. The STM-8 and MT-5000 may also be used.

Note: Balanced twisted-pair multipair cables used in the Backbone are intended to support voice applications only. All Backbone copper cable channels of up to 2000 m (6550 ft) in length intended for voice applications require continuity testing only.

Test Cords/Test Adapters

▲ – 8 All balanced twisted-pair test cords used to test for Permanent Link model certification shall be approved by Siemon and supplied and verified by the test equipment manufacturer to meet or exceed the requirements of ISO/IEC 11801:2002 2nd Edition and ANSI/TIA/EIA-568-B.1 and qualified to test category 5e cabling or higher.

Note: Link adapter cables and plugs may deteriorate with use affecting the accuracy level and reliability of associated test results. The manufacturer’s guidelines of the useful life-cycle of these components should be followed.

▲ – 9 Balanced twisted-pair adapters needed to attach test cords to connecting hardware shall meet or exceed the performance category of the Permanent Link model to which they connect.
BALANCED TWISTED-PAIR TESTING

The following specifications are provided for qualification testing of installed balanced twisted-pair cabling. It should be noted that the test requirements of this section are not sufficient in themselves to qualify a system for the Siemon Cabling System Extended Warranty.

▲ – 10 Horizontal or Backbone Permanent Link model test results shall be recorded using the Permanent Link setting in the field tester.

▲ – 11 Horizontal or Backbone Channel model test results shall be recorded using the Channel setting in the field tester.

▲ = Normative (Shall) ▲▲ = Informative (Should/Recommend)
BALANCED TWISTED-PAIR TESTING MODELS (PERMANENT LINK)

General
This section covers the balanced twisted-pair testing methods and information necessary for certification of the installed cabling based on the various warranties offered by Siemon. Diagrams have been provided for clarification of the different test models.

HORIZONTAL PERMANENT LINK TEST MODEL

Horizontal Permanent Link Test \[ \leq 90 \text{ m (295 ft)} \]

\[ \Delta – 12 \]
The Horizontal Permanent Link Test consists of all of the elements of the Horizontal Permanent Link model described in the Horizontal Distribution section of this manual.

Balanced Twisted-Pair Horizontal Permanent Link Test

\[ b + c \leq 90 \text{ m (295 ft)} \]
\[ a \& d \text{ are electrically eliminated by the field tester.} \]

\[ \Delta \text{—Shows the segment under test for the Permanent Link,} \]
\[ a + d \text{ are field tester cords.} \]

BACKBONE PERMANENT LINK TEST MODEL

Backbone Permanent Link Test \[ \leq 90 \text{ m (295 ft)} \]

\[ \Delta – 13 \]
The Backbone Permanent Link consists of all of the cabling elements of the Backbone Permanent Link as described in the Backbone Distribution section of this manual.

Balanced Twisted-Pair Backbone Permanent Link Test

\[ b \leq 90 \text{ m (295 ft)} \] for class D, E, E\text{A}, F and F\text{A}/category 5e, 6, 6\text{A}, 7 or 7\text{A} certification
\[ a \& c \text{ are electrically eliminated by the field tester.} \]

\[ \Delta \text{—Shows the segment under test for the Permanent Link,} \]
\[ a + c \text{ are field tester cords.} \]

\[ \Delta = \text{Normative (Shall)} \]
\[ \Delta = \text{Informative (Should/Recommend)} \]
BALANCED TWISTED-PAIR TESTING MODELS (CHANNEL)

Horizontal Channel Test \( \leq 100 \text{ m (328 ft)} \)

\( \Delta - 14 \) The Horizontal Channel Test consists of all the cabling elements of the Horizontal Channel model described in the Horizontal Distribution section of this manual, where the total combined length of equipment cables, patch cords or jumpers shall not exceed 25 m (82 ft) for UTP/ScTP/S/FTP, based on the open office cabling formula in the Horizontal Distribution section of this manual.

\[ \begin{align*}
\text{a} + \text{c} + \text{d} + \text{e} \leq 90 \text{ m (295 ft)} \\
\text{a} \leq 5 \text{ m (16 ft)} - \text{top diagram} \\
\text{a} + \text{b} \leq 5 \text{ m (16 ft)} - \text{bottom diagram} \\
\end{align*} \]

---

Balanced Twisted-Pair Horizontal Channel Test

\[ \begin{align*}
\text{c} + \text{d} & \leq 90 \text{ m (295 ft)} \\
\text{e} & \leq 20 \text{ m (66 ft)/MuTOA} \\
\text{a} & \leq 5 \text{ m (16 ft)} - \text{top diagram} \\
\text{a} + \text{b} + \text{e} & \leq 25 \text{ m (82 ft)} \\
\text{a} + \text{b} + \text{c} + \text{d} + \text{e} & \leq 100 \text{ m (328 ft)}
\end{align*} \]

---

Shows the segment under test for the Channel, a + e are equipment cables and are covered by warranty.

Note: The rounding of meters to feet does reflect a slight difference in the example above.
BALANCED TWISTED-PAIR TESTING MODELS (CHANNEL)

**Backbone Channel Test (≤ 100 m (328 ft))**

▲ – 15 The Backbone Channel Test consists of all the cabling elements of the Backbone Channel model described in the Backbone Distribution section of this manual, where the total combined length of equipment cables, patch cords or jumpers shall not exceed 25 m (82 ft) for balanced twisted-pair.

\[ a + b + d + e \leq 25 \text{ m (82 ft)} \]
\[ a + b + c + d + e \leq 100 \text{ m (328 ft)} \]

---

**Balanced Twisted-Pair Backbone Channel Test**

\[ c \leq 90 \text{ m (295 ft)} \] for class D, E, E\text{A}, F and F\text{A}/category 5e, 6, 6\text{A}, 7 and 7\text{A} certification

\[ a + b + d + e \leq 25 \text{ m (82 ft)} \]
\[ a + b + c + d + e \leq 100 \text{ m (328 ft)} \]

---

▲ = Normative (Shall)   ▲▲ = Informative (Should/Recommend)
BALANCED TWISTED-PAIR CABLING PARAMETERS DEFINED

The following transmission parameters for field testing of the installed cabling have been defined to better understand the test results provided by the field tester and as a tool to take corrective action if any of the test parameters fail. The performance parameters listed below are based on the requirements as defined in industry standards. Additional test requirements based on higher performance cabling systems may be more severe than those listed in this section and are further defined in the Annex D section of this manual.

Wire Map

The Wire Map test verifies pin to pin termination at each end of a Horizontal or Backbone cable for an acceptable wiring scheme. Each of the eight conductors in the cable is checked for continuity, shorts, crossed pairs, reversed pairs, split pairs, and other mis-wires.

Shield Continuity

Shield continuity is determined during the wire map testing. If using shielded cable and shielded connecting hardware it is important to verify if the shield of the cable is properly terminated to the connecting hardware.

Length

The maximum physical length of the Permanent Link is 90 m (295 ft). The maximum physical length of the Channel is 100 m (328 ft), which includes equipment and patch cords.

▲ – 16 All testers shall have the Nominal Velocity of Propagation (NVP) properly set for the type of cable being tested.

Note: Properly setting the NVP or selecting the cable under test in the field tester database will provide more accurate length measurements.

Insertion Loss (Attenuation)

Insertion Loss is a measure of signal loss in the Permanent Link or Channel. Total insertion loss includes the cumulative insertion loss of each of the following elements: connecting hardware, fixed cable, patch cords, jumpers, and equipment cables.
Crosstalk Parameters

NEXT Loss (pair-to-pair)

Near-end crosstalk is a measure of the unwanted signal coupling from a transmitter at the near-end into an adjacent pair measured at the near-end.

Pair-to-pair NEXT testing provides results for six (6) (pair-to-pair) combinations for a 4-pair cable.

Since telecommunications systems transmit from both ends of the cabling, it is necessary to provide NEXT results for both ends of the cabling. All approved testers provide NEXT results for both ends with one test. These test devices have bi-directional remotes to perform these measurements.

NEXT Loss (power sum)

Power sum near-end crosstalk is a computation of the unwanted signal coupling from multiple transmitters at the near-end into a pair measured at the near-end.

Power sum NEXT testing provides results as one (1) computation per cable pair.

Since telecommunications systems transmit from both ends of the cabling and may use all 4-pairs of a cable (Full-Duplex), it is necessary to provide power sum NEXT results for both ends of the cabling. All qualified testers provide NEXT results for both ends with one test. These test devices have bi-directional remotes to perform these measurements.

ATTENUATION TO CROSSTALK RATIO (ACR) (pair-to-pair)

ACR requirements are applicable to class D, E, and F only. Pair-to-pair ACR is a computation of the difference between the pair-to-pair NEXT and the Insertion Loss (IL) of the cabling measured in dB.

Since telecommunications systems transmit from both ends of the cabling and may use all four pairs of a cable (Full-Duplex), it is necessary to provide pair-to-pair ACR results for both ends of the cabling. All qualified testers provide pair-to-pair ACR results for both ends of the cable under test.

ATTENUATION TO CROSSTALK RATIO (power sum ACR)

Power Sum Attenuation to Crosstalk Ratio (PS ACR) is a computation of the difference between PS NEXT and the Insertion Loss (IL) of each pair of a channel.
Since telecommunications systems transmit from both ends of the cabling and may use all four pairs of a cable (Full-Duplex), it is necessary to provide Power Sum ACR results for both ends of the cabling. All qualified testers provide PS ACR results for both ends of the cable under test.

**FEXT and ELFEXT**

Far-end crosstalk is a measure of the unwanted signal coupling from a transmitter at the near-end into an adjacent pair measured at the far-end.

Equal level far-end cross talk is expressed in dB as the difference between the measured FEXT loss and the insertion loss of the disturbed pair.

\[ ELFEXT = FEXT - \text{INSERTION LOSS} \]

**ELFEXT Loss (pair-to-pair)**

Pair-to-pair ELFEXT testing provides results for six (6) (pair-to-pair) combinations for a 4-pair cable.

Since telecommunications systems transmit from both ends of the cabling, it is necessary to provide ELFEXT results for both ends of the cabling. All approved testers provide ELFEXT results for both ends with one test. These test devices have bi-directional remotes to perform these measurements.

**ELFEXT Loss (power sum)**

Power sum equal level far-end crosstalk is a computation of the unwanted signal coupling from multiple transmitters at the near-end into a pair measured at the far-end relative to the received signal level measured on that same pair.

Power sum ELFEXT testing provides results as one (1) computation per cable pair.

Since telecommunications systems transmit from both ends of the cabling system and may use all four pairs of a cable (Full-Duplex), it is necessary to provide power sum ELFEXT results for both ends of the cabling. All qualified testers provide ELFEXT results for both ends with one test. These test devices have bi-directional remotes to perform these measurements.

**Return Loss**

Return loss is a measure of reflected signals caused by impedance mismatches in the cabling Permanent Link or Channel. Return loss is especially important for applications that use simultaneous bi-directional transmission.
Propagation Delay

Propagation delay is a measure in time of 100 Ω 4-pair cable. It is the difference in time between when a signal is transmitted and when it is received across a 100 Ω 4-pair cable.

Delay Skew

Delay skew is the difference in the propagation delay between any two pairs within the same cable sheath. It is the measure in time of the difference in propagation delay between the fastest and slowest transmission paths in a Permanent Link or Channel. Delay skew is required for applications that use multiple pairs for parallel transmission.

D.C. Loop Resistance

D.C. loop resistance is applicable to class D, E, and F only. The d.c. loop resistance is a measure of the sum total of the d.c. resistance of the wires of a wire pair. The tester measures the loop resistances of each wire pair separately.

TEST REQUIREMENTS

▲ – 17 All Horizontal and Backbone balanced twisted-pair Permanent Link models with fixed cable lengths of no more than 90 m (295 ft) and balanced twisted-pair Channel models with total cable lengths, including patch cords/cross-connect jumpers and equipment cables, of no more than 100 m (328 ft) shall be 100% tested.

▲ – 18 Test performance requirements for category 3 multi-pair or spliced balanced twisted-pair cabling are intended to support voice applications only and shall be tested for continuity.
SYSTEM TEST & REGISTRATION

▲ – 19 Test performance requirements for class D, E, and F/category 5e, 6, 6A and 7 cabling Permanent Link or Channel models shall include the following parameters as required by ISO/IEC 11801:2002 2nd Ed. or in ANSI/TIA/EIA-568-B.1 and ANSI/TIA/EIA-568-B.1-2:

- WIRE MAP plus Shield Continuity (when present)
- LENGTH
- INSERTION LOSS
- NEXT Loss (pair-to-pair)
- NEXT Loss (power sum)
- ACR* (pair-to-pair)
- ACR* (power sum)
- ELFEXT (pair-to-pair)
- ELFEXT (power sum)
- RETURN Loss
- PROPAGATION DELAY
- DELAY SKEW
- D.C. LOOP RESISTANCE*

*Note: Test is not a required test parameter by The Siemon Company

▲ – 20 Field testers that report a PASS result for each of the parameters defined in requirements ▲– 18 and ▲– 19 based on the appropriate test requirements, shall be saved into the field tester memory and submitted for warranty.

▲ – 21 Field testers that report a PASS*, FAIL*, or FAIL result for any of the parameters defined in requirements ▲– 18 and ▲– 19 shall not be recorded into field tester memory and shall not be submitted for warranty.

Note 1: Test results that contain an asterisk are within the accuracy range of the field tester. Any results reported with an asterisk may be used to inform the installer to take corrective actions.

Note 2: When experiencing marginal results on links that have had corrective action performed, contact a Siemon Company technical representative for resolution.

DOWNLOADING TEST RESULTS

▲ – 22 All PASS test results shall be downloaded into the database software that has been provided from the manufacturer of the field tester. Test results that are not submitted in the software format compatible with the field tester will not be accepted.
OPTICAL FIBER TESTING

General

This section specifies the minimum performance requirements for the field testing of optical fiber cabling systems. The objective of this section is to provide the test procedures and acceptance values for 62.5/125 µm, 50/125 µm multimode Horizontal link performance requirements as well as 62.5/125 µm and 50/125 µm multimode and singlemode Backbone link performance requirements.

Test Equipment (Optical Fiber)

Approved Field Testers

▲ – 23 Testing of the optical fiber shall be performed with a qualified power meter and light source. Balanced twisted-pair test equipment listed in Annex C and defined on the Siemon Website that uses fiber test adapters is acceptable for qualifying the optical fiber cabling.

Additional power meter and light sources which are not listed in Annex C may be approved for use. Please call your local Siemon Company office for guidance in selecting “qualified test equipment.”

Proper Use

▲ – 24 Guidelines and requirements for connections, test configuration and measurement procedures specified in the manuals provided with the optical fiber tester(s) shall be followed.

Note: It is important that users of the power meters and light sources be familiar with the proper set-up and use of the field testers for obtaining accurate test results.

Factory Calibration

▲ – 25 All power meters and light sources shall be factory calibrated by the field tester manufacturer per the requirements in the tester manufacturers manual provided with the field tester. Proof of factory calibration for the field testers shall be provided to Siemon upon request.

Test Cords

▲ – 26 Optical fiber test cords used to access connecting hardware at the cross-connect facilities and Telecommunications Outlet shall be compatible with the cabling to which it connects.

▲ – 27 All optical fiber test cords used to test for certification shall be supplied by the test equipment manufacturer, or provided by Siemon.
Test Requirements (Optical Fiber)

▲ – 28 All Horizontal and Backbone optical fiber Links shall be 100% tested for attenuation and length.

▲ – 29 All Horizontal and Backbone optical fiber Links shall be tested for attenuation using the 1-jumper reference method.

Note: Bandwidth (multimode) and Dispersion (singlemode) are important performance parameters, but because installation practices can not adversely affect them, they are only tested in the factory.

The following diagrams and steps have been provided in this manual to explain the proper reference requirements used when testing an Optical Fiber Link using the 1-jumper reference method.

Figure A shows the Optical Fiber Link under test as well as the optical fiber equipment cables (fiber jumpers) that will be introduced to connect to active equipment.
**Step 1**

Connect light source and power meter with Test Cord No. 1 (see Figure B). Measure the power value and record it as P₁. P₁ is the reference launch power.

![Figure B](image)

**Step 2**

Remove Test Cord No.1 from the power meter. Connect to the power meter Test Cord No. 2. With the help of an appropriate connecting hardware (adapter), connect Test Cord No. 1 with Test Cord No. 2 (see Figure C).

![Figure C](image)

**Step 3**

Measure the power value and record it as P₁₋₂. Disconnect the test cords from each other, then connect them and measure the power value again. Repeat this procedure several times (3-5). All the measured values shall be less than 0.75 dB (P₁₋₂ - P₁) and differ very slightly from each other. The measured values above 0.75 dB mean that one or both of the test cords are defective.

Note: While performing all measurements do not disconnect Test Cord No. 1 from the light source and Test Cord No. 2 from the power meter, and do not switch off the light source and power meter. When occasionally one of these actions takes place, repeat the steps 1 through 3.
**SYSTEM TEST & REGISTRATION**

**Step 4**
Disconnect the test cords from each other. Connect Test Cords No. 1 & No. 2 to the corresponding end of the optical fiber Link to be tested (see Figure D).

Measure and record the power value as \( P_2 \).

Optical power loss (dB) = \( P_1 - P_2 \).

![Figure D](image)

Note 1: The information on the 1-jumper reference method provides verification of the test cords used for testing the optical fiber link. The use of qualified optical fiber test cords and a power meter and light source that contains a reference button feature can eliminate some of the qualification steps.

Note 2: When using the field testers from the Annex C section of this manual for measuring length and attenuation, refer to test equipment manufacturers instructions for test set up.

**Field Testing of MT-RJ Cabling Systems Using Dual-Port Testers**

**Materials**
1. Duplex ST to MT-RJ Fiber Jumper (w/o Pins)
2. Duplex ST to MT-RJ Fiber Jumper (w/ Pins)
3. Duplex MT-RJ to MT-RJ Fiber Jumper (w/o Pins)
4. MT-RJ Adapter

Note 1: The following example uses an ST equipment interface for illustration purposes only.

Note 2: These Components (sometimes know as reference kits) are available directly from handheld tester manufacturers.

**Precautions**
Proper cleaning of the connectors is essential to obtain accurate, consistent test results. The Siemon Company recommends the use of isopropyl alcohol in conjunction with cleaning sticks (Siemon P/N: FTCS) to remove any airborne contaminants on the faces of the connectors.
**Obtaining Reference Data**

Reference measurements must be taken to eliminate the insertion loss introduced by the fiber jumpers used to connect to the system under test. In case of the MT-RJ, the use of both pinned and non-pinned MT-RJ connectors must be used to ensure proper alignment. This requirement, which introduces an additional connection during the test procedure, is accounted for by its inclusion during the reference procedure.

Note: These procedures may differ slightly for each individual tester. Please contact the tester manufacturer directly or reference the documentation included with the tester for specific test procedures.

![Figure 1](image1)

**Figure 1**

The procedures for establishing the reference are shown above in Figure 1:

1. Connect the ST to MT-RJ fiber jumper (w/Pins) to the main unit
2. Connect the ST to MT-RJ fiber jumper (w/o Pins) to the remote unit
3. Mate the MT-RJ connectors using the MT-RJ adapter
4. Perform reference measurement

**Test Procedures**

Pinned MT-RJs are used to terminate the fiber in a Horizontal or Backbone system. Therefore, in order to test, the MT-RJ connectors used must both be without pins. As a result, another (non-pinned) jumper must be added to the existing reference jumpers as illustrated in Figure 2.

![Figure 2](image2)

**Figure 2**

1. Disconnect remote ST to MT-RJ jumper (w/o Pins) from the MT-RJ adapter
2. Connect MT-RJ jumper (w/o Pins) to the MT-RJ adapter

▲ = Normative (Shall)  ▲▲ = Informative (Should/Recommend)
There are now non-pinned MTRJ connectors extending from both the main and remote units, which can properly interface with the system under test as illustrated in Figure 3.

**Figure 3**

3. Connect to system under test  
4. Test system and record results

**Optical Fiber Field Testing Using A MT-RJ Field Tester**

▲ – 30 All MT-RJ optical fiber links shall be tested using the same requirements as provided in ▲ – 28 and ▲ – 29 if the power meter and light source is provided with an MT-RJ interface port on the tester.

**Figure 1**

The procedures for establishing the reference are shown above in Figure 1:  
1. Connect one of the MTRJ to MTRJ fiber jumpers between the main and remote units.  
2. Perform reference measurement.
Test Procedures
In order to access both ends of the DUT (device under test), another jumper must now be introduced. disconnect the original fiber jumper from the remote end and connect the second jumper to the remote as illustrated in Figure 2.

![Figure 2](image)

There are now MTRJ connectors (w/o pins) extending from both the main and remote units which can properly interface with the DUT as illustrated in Figure 3.

![Figure 3](image)

1. Connect the fiber jumpers to the DUT.
2. Test system and record results.

Note: When using a power meter and light source that does not contain MT-RJ interface ports to test MT-RJ optical fiber links, refer to The Siemon Company website (www.siemon.com) for the most current Field Bulletin for proper testing requirements, or the process on pages 12-16.

▲ – 31 All Horizontal 62.5/125 µm or 50/125µm multimode optical fiber Links shall be 100% tested for attenuation at either 850 nm or1300 nm in at least one direction with a power meter and light source. The attenuation test results shall be 2.0 dB or less. If a Consolidation Point is used, test results shall be 2.75 dB or less.

▲ – 32 All Backbone 62.5/125 µm, 50/125µm multimode or singlemode optical fiber Links shall be 100% tested for attenuation at both 850 nm and 1300 nm for multimode or 1310 nm and 1550 nm for the appropriate singlemode in at least one direction with a power meter and light source. The acceptable attenuation values for Backbone optical fiber Links shall be determined using the link attenuation equation in normative 33.

▲ = Normative (Shall)    △ = Informative (Should/Recommend)
Performance Limits

Attenuation

\[\text{Link attenuation} = \text{cable attenuation} + \text{connector insertion loss} + \text{splice insertion loss}.\]

Cable attenuation, connector attenuation, and splice attenuation are determined by each of the following formulas:

- \[\text{Cable attn. (dB)} = \text{Att. Coefficient (dB/km)} \times \text{Length (km)}\]

**Attenuation Coefficient**

- 3.5 dB/km @ 850 nm for 62.5/125 µm or 50/125µm
- 1.5 dB/km @ 1300 nm for 62.5/125 µm or 50/125µm
- 1.0 dB/km @ 1310 nm for singlemode inside plant cable
- 1.0 dB/km @ 1550 nm for singlemode inside plant cable
- 0.5 dB/km @ 1310 nm for singlemode outside plant cable
- 0.5 dB/km @ 1550 nm for singlemode outside plant cable

- \[\text{Connector attn. (dB)} = \text{number of connector pairs} \times \text{connector loss}\]
  \[= 2 \times 0.75 \text{ dB}\]
  \[= 1.5 \text{ dB}\]

- \[\text{Splice Attn. (dB)} = \text{number of splices (S)} \times \text{splice loss (dB)}\]
  \[= S \times 0.3 \text{ dB}\]

\[\triangle - 34 \text{ All centralized optical fiber links shall be 100\% tested for attenuation at either 850 nm or 1300 nm in at least one direction with a power meter and light source. The attenuation test results shall be 3.3 dB or less. If a Consolidation Point is used, test results shall be 4.1 dB or less}\]

Note: This value for centralized cabling is based on the loss of 3 connector pairs.
## OPTICAL FIBER WORKSHEET

### Formulas to Determine Acceptable Link Attenuation

<table>
<thead>
<tr>
<th>Description</th>
<th>Formula</th>
<th>Calculated Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cable Attenuation Coefficient (dB/km)</td>
<td>[times] Cable length x</td>
<td></td>
</tr>
<tr>
<td></td>
<td>[equals] Cable Attenuation</td>
<td></td>
</tr>
<tr>
<td>Number of Connector Pairs</td>
<td>[times] Connector Loss (per mated pair) x</td>
<td></td>
</tr>
<tr>
<td></td>
<td>[equals] Connector Insertion Loss (dB)</td>
<td></td>
</tr>
<tr>
<td>Number of Splice Pairs</td>
<td>[times] Splice Loss x</td>
<td></td>
</tr>
<tr>
<td></td>
<td>[equals] Splice Insertion Loss</td>
<td></td>
</tr>
<tr>
<td>Cable Attenuation</td>
<td>[plus] Connector Insertion Loss +</td>
<td></td>
</tr>
<tr>
<td></td>
<td>[plus] Splice Insertion Loss +</td>
<td></td>
</tr>
<tr>
<td></td>
<td>[equals] Link Attenuation</td>
<td></td>
</tr>
</tbody>
</table>

▲ = Normative (Shall)  △ = Informative (Should/Recommend)
**SYSTEM TEST & REGISTRATION**

**Length**

▲ – 35 All Horizontal and Backbone optical fiber Links shall be 100% tested for length using one of the following:

- An OTDR,
- Optical test measurement device capable of providing length,
- Sequential measurement markings provided on the optical fiber cables.

▲ – 36 The measured length of the fixed cable portion of any optical fiber link shall not exceed the lengths specified for Horizontal or Backbone cabling in the Horizontal Distribution and the Backbone Distribution sections of this manual.

This length may be based on the physical length of the cable as identified by the factory-labeled markings in uninterrupted segments.

**Cable Verification**

▲ ▲ – 2 All optical fiber cable should be tested for length, on the reel prior to installation, to determine if there are any breaks in the optical fiber cable.

**SYSTEM REGISTRATION**

**GENERAL**

The following guidelines are provided for cabling system registration for the Siemon Cabling System Extended Warranty.

▲ – 37 All registration procedures specified in the Certified Installer Agreement shall be followed.

This section is not intended to replace or supersede the Certified Installer Agreement. In case of conflict, the Certified Installer Agreement takes precedence over the requirements specified in this manual.

▲ – 38 Installations shall only qualify for system registration under the extended warranty program if at least one CI designer and at least one CI installer (not the same person) were directly involved with the design and installation of the system.

▲ = Normative (Shall) ▲▲ = Informative (Should/Recommend)
Pre-Registration —

PRIOR TO INSTALLATION

▲ – 39 A warranty Commitment Statement/Pre-Registration Form is required to be provided to the Customer/End-User at the time of sale/contract for a warranted system. The authorized CI (Designer or Installer) shall ensure that the Warranty Commitment Statement/Pre-Registration Form is completed and returned to The Siemon Company prior to the start of the installation.

The Siemon Company will then provide the appropriate Warranty document to the Customer/End-User along with notification to the authorized CI (Designer or Installer) as to the agreement between them and The Siemon Company.

**No warranted work shall commence until the appropriate Warranty document is conveyed.**

▲ – 40 Permission to use non-Siemon products for registered installations shall be received in writing from The Siemon Company prior to installation.

Installations may only use connecting hardware that is manufactured or approved by Siemon. Approval of non-Siemon product for use in a registered system, may be obtained by submitting a Request for Exception (Form 1).

Note: Non-Siemon Company connecting hardware is not covered under a Siemon Company product warranty. Links having non-Siemon connecting hardware are covered under the applications warranty only, provided that the non-Siemon connectors continue to meet the applicable reliability and transmission performance requirements.

▲ – 41 Permission to use non-qualified cable for registered installations shall be received in writing from Siemon prior to installation.

▲ = Normative (Shall)    ▲▲ = Informative (Should/Recommend)
Installations may only use cable that is manufactured by a cable ally or is approved by Siemon. Approval of non-qualified cable for use in a registered system, may be obtained by submitting a Request for Exception (Form 1).

\[\triangle - 42\] Permission to design and install a cabling system which is in violation of a Siemon Cabling System manual normative for a registered installation shall be received in writing from Siemon prior to installation.

Registration Package —

INSTALLATION COMPLETED

\[\triangle - 43\] The Certified Installer (company) shall send as-installed information to Siemon for review. This information shall be accompanied by a Cabling System Registration Form (Form 2), which shall be completed and signed by both the CI designer and the CI installer prior to submittal.

\[\triangle - 44\] The Certified Installer (company) shall obtain a customer completed Customer Satisfaction Questionnaire Form (Form 3), which shall be included in the registration package. This form must be received by Siemon prior to the warranty being conveyed.

\[\triangle - 45\] The registration package shall also include a Horizontal and/or Backbone Permanent Link/Channel details. Forms 10 and 11 shall be used for Horizontal and Backbone details for all subsystems to be registered.

Test Data

\[\triangle - 46\] The balanced twisted-pair test data for each warranted Permanent Link/Channel shall be provided in an electronic media format. Optical fiber test data may be provided in electronic media format or hard copy. Consult your local Siemon Company Training or Technical Support Representative for details on the types of acceptable electronic media.

\[\triangle - 47\] The completed registration package shall be sent to the applicable Siemon Company office.

Records of this correspondence will be maintained by Siemon, as well as any corrective measures to be taken by the Certified Installer (company) to allow registration.

Once all of the registration information is in order and the customer survey is found to be satisfactory, Siemon will assign an installation number and send photocopies of the Extended Warranty Agreement and the Certificate of Registration (Form 4) to the Certified Installer (company). The Extended Warranty Agreement and Certificate of Registration will be sent directly to the Certified Installer by Siemon.

\[\triangle = \text{Normative (Shall)}\] \[\triangle\triangle = \text{Informative (Should/Recommend)}\]
Building Drawing

▲ – 3 A detailed building drawing or blue print / floor plan should be provided.

▲ – 48 The Certified Installer (company) shall retain all documents and drawings related to each installation for the duration of the extended warranty which begins with the certificate of registration date of issue. This documentation shall be made available to Siemon and the customer as required.

System Changes

▲ – 49 The addition or relocation of cross-connect facilities/spaces shall be registered by submitting forms 5, 10 & 11 plus the balanced twisted-pair and optical fiber test data as specified in this section. Changes or additions to existing installations that do not include the addition of cross-connect facilities/spaces shall be registered by submitting the appropriate test documentation. The change requests are initiated using the Change of Registration Form (Form 5).

Note: Changes or additions to a registered installation shall fall under the terms and conditions of the original warranty registration document. Rearrangements of equipment cables, jumpers/patch cords are not considered to be cabling system changes and do not require a Change of Registration Form.

Warranty Issues

▲ – 50 If problems are identified, the Certified Designer and/or Installer shall resolve any questions or missing information.

Warranty Claims

▲ – 51 All warranty claims shall be processed according to the Cabling System Warranty and the Certified Installer agreement using the Customer Claim Form (Form 6) and the Corrective Action Claim Form (Form 7).
Applicable Forms

The following forms may be used in the process of cabling system installation and registration.

- Warranty Commitment Statement/Pre-Registration Form
- Form 1 Request for Exception (Double sided)
- Form 2 Registration Form (Double sided & signed)
- Form 3 Customer Satisfaction Questionnaire
- Form 4 Certificate of Registration
- Form 5 Change Registration Form
- Form 6 Customer Claim Form
- Form 7 Corrective Action Claim Form
- Form 10 Horizontal Distribution Details
- Form 11 Backbone Distribution Details

Note: These forms are located on the www.siemon.com/ally website under the Warranty tab.

Forms Diagram

PRIOR TO INSTALL
- Pre Registration
- Exceptions (Form 1)

POST INSTALL REGISTRATION
- Registration (Form 2)
- Customer Satisfaction (Form 3)
- Horizontal Details (Form 10)
- Backbone Details (Form 11)
- Test Data:
  - Copper—Tester Format
  - Fiber—Hard Copy

MAC WORK
- Change Registration (Form 5)
- Horizontal Details (Form 10)
- Backbone Details (Form 11)
- Test Data:
  - Copper—Tester Format
  - Fiber—Hard Copy

WARRANTY CLAIMS
- Claim (Form 6)
- Correction (Form 7)
NORMATIVE SUMMARY

Testing

▲ – 1 All transmission testing shall be performed with an approved balanced twisted-pair tester from one of the manufacturers listed in the Annex C section of this manual and as specified on the Siemon Website, www.siemon.com.

▲ – 2 All field testers shall have the latest version of software installed in order to provide the most accurate and current testing parameters and values.

▲ – 3 Requirements and recommendations for connections, test configuration, measurement procedures and precautions that are specified in the manuals provided with the tester shall be followed.

▲ – 4 All field testers shall be factory calibrated by the field tester manufacturer per the requirements in the test equipment manufacturers manual that is provided with the field tester. Proof of factory calibration for the field testers shall be provided to Siemon upon request.

▲ – 5 Autotest settings provided in the field tester for testing the installed cabling shall be set to the default parameters. Any autotest settings that have been modified to change testing parameters may disqualify the test results.

▲ – 6 Test settings selected from options provided in the field testers shall be compatible with the installed cabling under test.

▲ – 7 Continuity testing shall be performed using any of the approved testers in the Annex C section of this manual. The STM-8 and MT-5000 may also be used.

▲ – 8 All balanced twisted-pair test cords used to test for Permanent Link model certification shall be approved by Siemon and supplied and verified by the test equipment manufacturer to meet or exceed the requirements of ISO/IEC 11801:2002 2nd Edition and ANSI/TIA/EIA-568-B.1 and qualified to test category 5e cabling or higher.

▲ – 9 Balanced twisted-pair adapters needed to attach test cords to connecting hardware shall meet or exceed the performance category of the Permanent Link model to which they connect.

▲ – 10 Horizontal or Backbone Permanent Link model test results shall be recorded using the Permanent Link setting in the field tester.

▲ – 11 Horizontal or Backbone Channel model test results shall be recorded using the Channel setting in the field tester.

▲ – 12 The Horizontal Permanent Link Test consists of all of the elements of the Horizontal Permanent Link model described in the Horizontal Distribution section of this manual.

▲ = Normative (Shall) ▲▲ = Informative (Should/Recommend)
- 13 The Backbone Permanent Link consists of all of the cabling elements of the Backbone Permanent Link as described in the Backbone Distribution section of this manual.

- 14 The Horizontal Channel Test consists of all the cabling elements of the Horizontal Channel model described in the Horizontal Distribution section of this manual, where the total combined length of equipment cables, patch cords or jumpers shall not exceed 25 m (82 ft) for UTP/ScTP/S/FTP, based on the open office cabling formula in the Horizontal Distribution section of this manual.

- 15 The Backbone Channel Test consists of all the cabling elements of the Backbone Channel model described in the Backbone Distribution section of this manual, where the total combined length of equipment cables, patch cords or jumpers shall not exceed 25 m (82 ft) for balanced twisted-pair.

- 16 All testers shall have the Nominal Velocity of Propagation (NVP) properly set for the type of cable being tested.

- 17 All Horizontal and Backbone balanced twisted-pair Permanent Link models with fixed cable lengths of no more than 90 m (295 ft) and balanced twisted-pair Channel models with total cable lengths, including patch cords/cross-connect jumpers and equipment cables, of no more than 100 m (328 ft) shall be 100% tested.

- 18 Test performance requirements for category 3 multi-pair or spliced balanced twisted-pair cabling are intended to support voice applications only and shall be tested for continuity.

- 19 Test performance requirements for class D, E, and F/category 5e, 6, 6A and 7 cabling Permanent Link or Channel models shall include the following parameters as required by ISO/IEC 11801:2002 or in ANSI/TIA/EIA-568-B.1 and ANSI/TIA/EIA-568-B.1-2:

  - Wire Map plus Shield Continuity (when present)
  - Length
  - Insertion Loss
  - NEXT Loss (pair-to-pair)
  - NEXT Loss (power sum)
  - ACR* (pair-to-pair)
  - ACR* (power sum)
  - ELFEXT (pair-to-pair)
  - ELFEXT (power sum)
  - RETURN Loss
  - Propagation Delay
  - Delay Skew
  - D.C. Loop Resistance*

= Normative (Shall)  ▲ = Informative (Should/Recommend)
*Note: Test is not a required test parameter by Siemon.

▲ – 20 Field testers that report a PASS result for each of the parameters defined in requirements ▲ – 18 and ▲ – 19 based on the appropriate test requirements, shall be saved into the field tester memory and submitted for warranty.

▲ – 21 Field testers that report a PASS*, FAIL*, or FAIL result for any of the parameters defined in requirements ▲ – 18 and ▲ – 19 shall not be recorded into field tester memory and shall not be submitted for warranty.

▲ – 22 All PASS test results shall be downloaded into the database software that has been provided from the manufacturer of the field tester. Test results that are not submitted in the software format compatible with the field tester may not be accepted.

Optical Fiber Testing

▲ – 23 Testing of the optical fiber shall be performed with a qualified power meter and light source. Balanced twisted-pair test equipment listed in Annex C and defined on the Siemon Website that uses fiber test adapters is acceptable for qualifying the optical fiber cabling.

▲ – 24 Guidelines and requirements for connections, test configuration and measurement procedures specified in the manuals provided with the optical fiber tester(s) shall be followed.

▲ – 25 All power meters and light sources shall be factory calibrated by the field tester manufacturer per the requirements in the tester manufacturers manual provided with the field tester. Proof of factory calibration for the field testers shall be provided to Siemon upon request.

▲ – 26 Optical fiber test cords used to access connecting hardware at the cross-connect facilities and Telecommunications Outlet shall be compatible with the cabling to which it connects.

▲ – 27 All optical fiber test cords used to test for certification shall be supplied by the test equipment manufacturer, or provided by Siemon.

▲ – 28 All Horizontal and Backbone optical fiber links shall be 100% tested for attenuation and length.

▲ – 29 All Horizontal and Backbone optical fiber links shall be tested for attenuation using the 1-jumper reference method.

▲ – 30 All MT-RJ optical fiber links shall be tested using the same requirements as provided in ▲ – 28 and ▲ – 29 if the power meter and light source is provided with an MT-RJ interface port on the tester.

▲ – 31 All Horizontal 62.5/125 µm or 50/125µm multimode optical fiber links shall be 100% tested for attenuation at either 850 nm or 1300 nm in at least one direction with a power meter and light source. The attenuation test results shall be 2.0 dB or less. If a Consolidation Point is used, test results shall be 2.75 dB or less.
**SYSTEM TEST & REGISTRATION**

▲ – 32 All Backbone 62.5/125 μm, 50/125μm multimode or singlemode optical fiber Links shall be 100% tested for attenuation at both 850 nm and 1300 nm for multimode or 1310 nm and 1550 nm for the appropriate singlemode in at least one direction with a power meter and light source. The acceptable attenuation values for Backbone optical fiber Links shall be determined using the link attenuation equation in normative 33.

▲ – 33 Backbone links or links greater than 90 m (295 ft), shall have the attenuation acceptance based on the calculation provided below:

\[
\text{Link attenuation} = \text{cable attenuation} + \text{connector insertion loss} + \text{splice insertion loss}
\]

▲ – 34 All centralized optical fiber links shall be 100% tested for attenuation at either 850 nm or 1300 nm in at least one direction with a power meter and light source. The attenuation test results shall be 3.3 dB or less. If a Consolidation Point is used, test results shall be 4.1 dB or less.

▲ – 35 All Horizontal and Backbone optical fiber Basic Link models shall be 100% tested for length using one of the following:

- An OTDR
- Optical test measurement device capable of providing length
- Sequential measurement markings provided on the optical fiber cables.

▲ – 36 The measured length of the fixed cable portion of any optical fiber link shall not exceed the lengths specified for Horizontal or Backbone cabling in the Horizontal Distribution and the Backbone Distribution sections of this manual.

System Registration

▲ – 37 All registration procedures specified in the Certified Installer Agreement shall be followed.

▲ – 38 Installations shall only qualify for system registration under the extended warranty program if at least one CI designer and at least one CI installer (not the same person) were directly involved with the design and installation of the system.

▲ – 39 A warranty Commitment Statement/Pre-Registration Form is required to be provided to the Customer/End-User at the time of sale/contract for a warranted system. The authorized CI (Designer or Installer) shall ensure that the Warranty Commitment Statement/Pre-Registration Form is completed and returned to Siemon prior to the start of the installation.

**No warranted work shall commence until the appropriate Warranty document is conveyed.**

▲ – 40 Permission to use non-Siemon products for registered installations shall be received in writing from Siemon prior to installation.

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SYSTEM TEST & REGISTRATION

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▲ – 43 The Certified Installer (company) shall send as-installed information to Siemon for review. This information shall be accompanied by a Cabling System Registration Form (Form 2), which shall be completed and signed by both the CI designer and the CI installer prior to submittal.

▲ – 44 The Certified Installer (company) shall obtain a customer completed Customer Satisfaction Questionnaire Form (Form 3), which shall be included in the registration package. This form must be received by Siemon prior to the warranty being conveyed.

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▲ – 49 The addition or relocation of cross-connect facilities/spaces shall be registered by submitting forms 5, 10 & 11 plus the balanced twisted-pair and optical fiber test data as specified in this section. Changes or additions to existing installations that do not include the addition of cross-connect facilities/spaces shall be registered by submitting the appropriate test documentation. The change requests are initiated using the Change of Registration Form (Form 5).

▲ – 50 If problems are identified, the Certified Designer and/or Installer shall resolve any questions or missing information.

▲ – 51 All warranty claims shall be processed according to the Cabling System Warranty and the Certified Installer agreement using the Customer Claim Form (Form 6) and the Corrective Action Claim Form (Form 7).

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