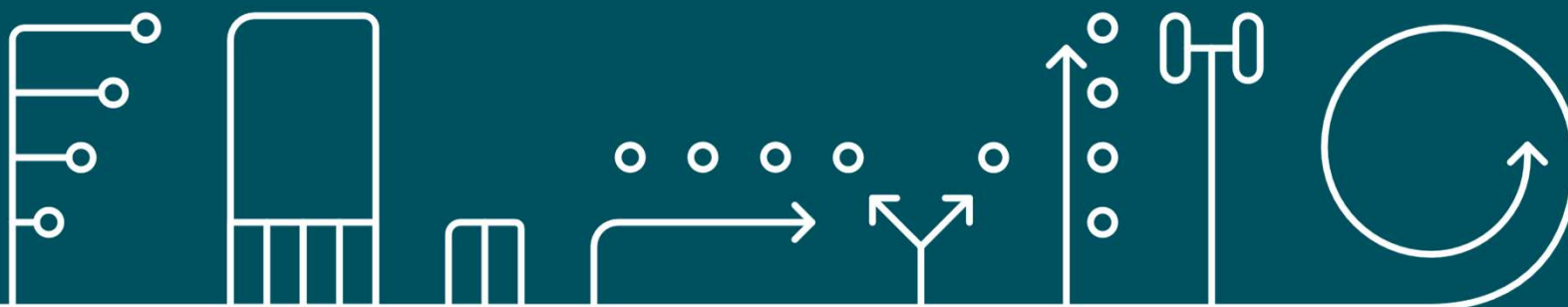




Data Networks



Field Testing Copper Links

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General Testing Guidelines

- Only use test equipment that has valid annual calibration certification
- Make sure batteries are fully charged before going to site
- Each tester shall have the latest firmware and associated test limits
- Ensure the correct test heads are utilised
- Field calibrate the tester ongoing as required during the testing phase
- Configure the tester with the correct limits
- Verify the correct testing method to be used
- Don't use worn or damaged test leads
- During the testing phase, monitor all test results for unexpected margin levels achieved – immediately investigate as appropriate
- Save test results using a unique cable ID



Authorised Testers / Systems



Certified Tester Overview			LANmark-6	LANmark-6A	LANmark-6A MPTL	LANmark-7A	LANmark-7A + 25G	LANmark-8
FLUKE NETWORKS								
DSX-5000	PL		•	•	•	×	×	×
	CH		•	•	×	•	×	×
DSX-8000	PL		•	•	•	×	×	×
	CH		•	•	×	•	•	•
TREND/IDEAL INDUSTRIES								
LANTEK III 500	PL		•	•	×	×	×	×
	CH		•	•	×	×	×	×
LANTEK III 1000	PL		•	•	×	×	×	×
	CH		•	•	×	•	×	×
VIAVI/JDSU								
Certifier 10G	PL		•	•	•	×	×	×
	CH		•	•	×	×	×	×
Certifier 40G	PL		•	•	•	×	×	×
	CH		•	•	×	•	•	•
SOFTING/PSIBER DATA								
WIREXPRT 500	PL		•	•	•	×	×	×
	CH		•	•	×	×	×	×
WIREXPRT 4500	PL		•	•	•	×	×	×
	CH		•	•	×	•	•	•
AEM								
TestPro CV100	PL		•	•	•	×	×	×
	CH		•	•	×	•	•	•



Testing Device Calibration

Calibration is an important requirement ensuring accuracy of test results obtained. All equipment used must therefore be within its calibration period.

EN 50346 states that:

"The normalisation process shall include a traceable calibration procedure for the test equipment. The test operator shall have evidence, in the form of a valid calibration certificate, to support the use of the test equipment at the time the tests are undertaken."

Field calibration (reference setting)

- Test equipment shall be "field calibrated" as prescribed by the test equipment vendor at the start of each work period. This ensures the best possible accuracy



Specific Testing Considerations For Copper Links

- Select the correct NVP value (NVP values are printed on the cables)
- Shield continuity must always be tested in screened systems
- Only use LANmark patch cords for channel testing
- Include graphical information if possible (i.e. save results with full plot information)
- GG45 based systems require specific tester / tester ancillaries. These need to be purchased via the tester vendor. Please refer to the vendor's website for more information on the correct GG45 Channel Test heads for your test-set type.

Note: All personnel undertaking testing must be competent with the setup and use of the chosen tester.



Approved Test Limits

- **LANmark-6**

- ISO/IEC 11801 CLASS E
- CENELEC EN 50173 CLASS E

- **LANmark-6A**

- **ISO/IEC 11801 CLASS EA***
- **CENELEC EN 50173 CLASS EA***
- TIA/EIA 568C CAT 6A*

*Please note: for PL testing only PL2 limits are accepted

- **LANmark-6A MPTL**

- **ISO/IEC 11801 CLASS EA MPTL**
- TIA/EIA CAT 6A MPTL

- **LANmark-7A + 25G**

- ISO/IEC 11801 CLASS FA
- CENELEC EN 50173 CLASS FA
- Custom limits for 25GBASE-T in accordance with ISO/IEC 11801-9905 CAT 7A are required**

**Please note: 25G support only applicable on 30m max. LANmark-7A channel lengths

- **LANmark-8**

- ISO/IEC 11801 CLASS II

Note: Limits highlighted in blue are Aginode's preferred options - being the more stringent



Test result requirements

Please use the tester manufacturer's software to import the test results from the tester, to be saved with the appropriate file extension. Please note that test results in PDF format cannot be accepted for warranty certification.

Fluke DSX-5000 and DSX-8000 using Fluke Linkware	*.flw
Ideal LanTEK III 500 and LanTek III 1000 using Ideal DataCENTER	*.sdf
Softing WireXpert 500 and WireXpert 4500 using Softing eXport	*.prx
VIAVI Certifier 10G and Certifier 40G using VIAVI Reporter	*.prx
AEM TestPro CV100 using AEM TestDataPro	*.tpp

Reminder: It is advisable to enable and save test results with plot data on your tester, as re-certification of test results, if required, is only possible when plots are saved.



Cabling configurations and their associated test set-ups

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Testing Set-ups

The following pages describe the various installation models and associated testing set-ups in respect to Certified System Warranty submissions



Interconnect - Telecommunications Outlet (TO)

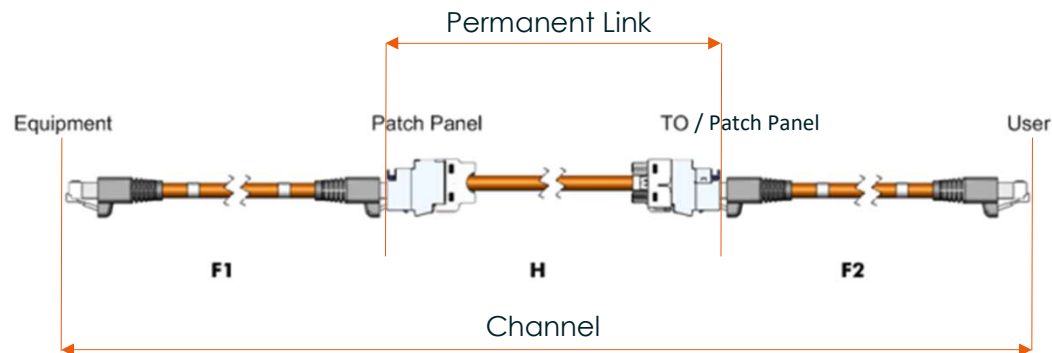
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Interconnect - TO / Panel - Panel



In these 2 connector installation models, both Channel and Permanent Link testing methods* are accepted for Certified Systems Warranty, with appropriate test limits and associated test heads. * This applies to RJ45 based systems



Interconnect - Consolidation Point (CP) - TO

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Interconnect - CP - TO

The installation includes a Consolidation Point lead consisting of a 'single ended' LANmark patch cord (which must be terminated using a stranded wire Evo Snap-In connector) connecting the CP and TO.

Testing in a 3-connector model as shown in the figure is required to obtain a Certified Systems Warranty on the complete installation (= 3 connector installation)

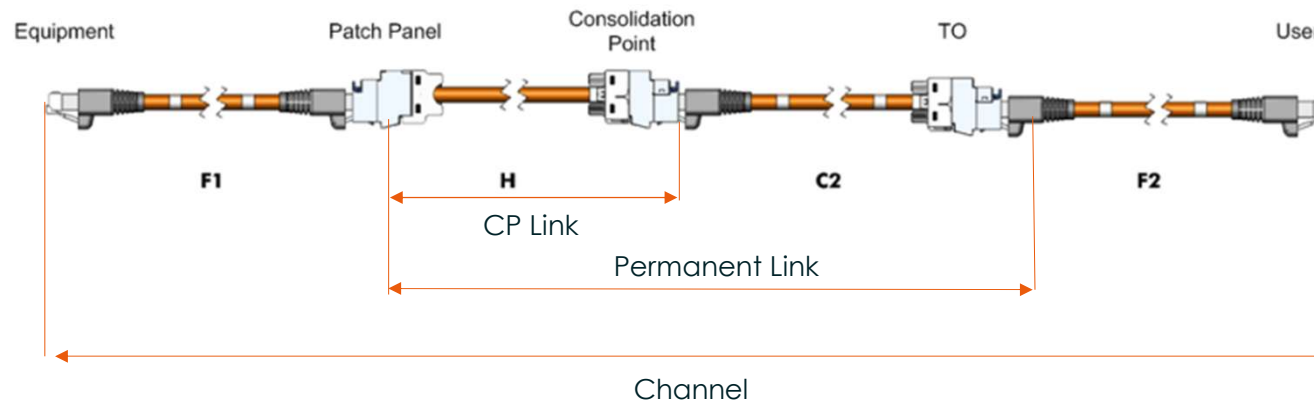
Note: Testing of each 3-connector model shall include the CP lead that will be used in the live customer configuration.



Interconnect - CP - TO: Warranty consideration

If the CP leads are not present at the time of testing, testing the 2-connector installation from the Interconnect to the CP (CP Link) is acceptable to Aginode for the issuing of a Certified Systems Warranty.

However, it must be noted that the Warranty can only be applicable to the 2-connector CP link, although system performance will be obtained with the use of compliant CP leads.



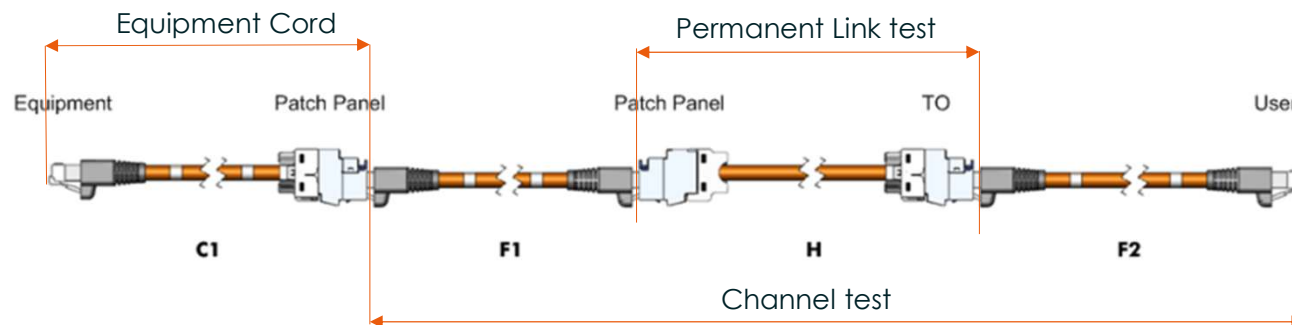
CrossConnect - TO

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CrossConnect - TO

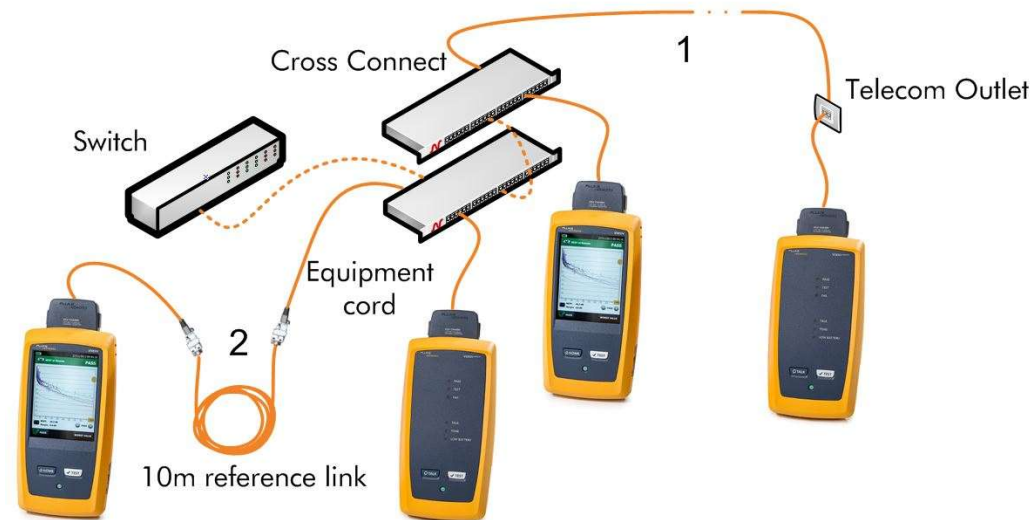
The installation includes an Equipment Cord consisting of a 'single ended' LANmark patch cord (which must be terminated using a stranded wire Evo Snap-In connector) used to connect the active equipment ports.



CrossConnect - TO: Testing Set-up

In order to obtain a Certified Systems Warranty for the 3-connector installation, this configuration needs to be tested in two parts.

- 1) 2 connector panel to outlet model
- 2) Equipment Cord in combination with a 10m (minimum) reference link



CrossConnect - TO: Reference link requirements

The 10m (minimum) reference link must be used to obtain an accurate measurement of the equipment cord performance.

The reference link needs to be constructed using the infrastructure cable and 2 jacks, as used in the PL installation.

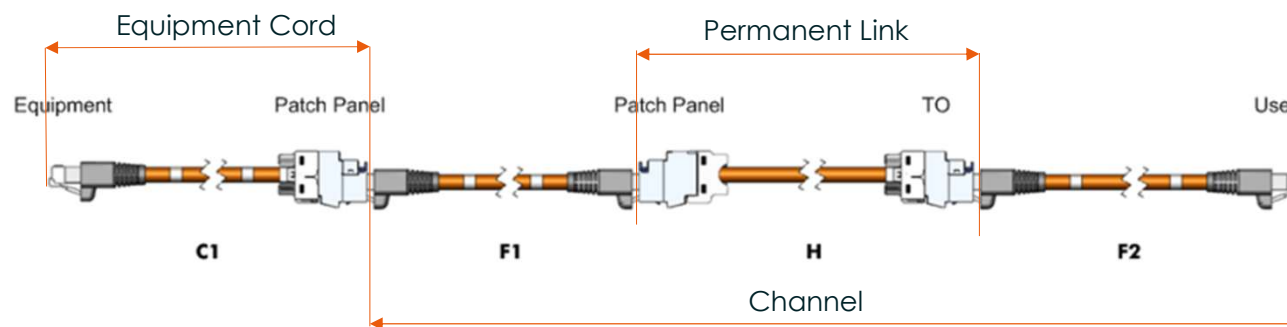
The reference link needs to be tested prior to use and a clear PASS using the applicable CLASS/CAT PL limit must be obtained.

The test result is required to be included in the final test file submission, being clearly labelled "reference link".



CrossConnect - TO: Warranty consideration

If the Equipment Cords are not present at the time of testing, testing the 2-connector installation from the Panel to the TO is acceptable to Aginode for the issuing of a Certified Systems Warranty. However, it must be noted that the Warranty can only be applicable to the 2 connector PL link, although system performance will be obtained with the use of compliant Equipment Cords.



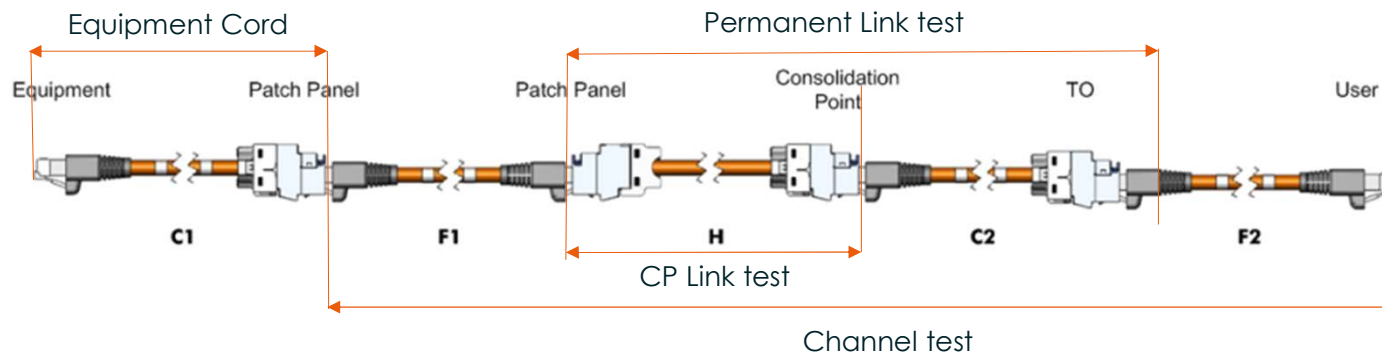
CrossConnect - CP - TO

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CrossConnect - CP - TO

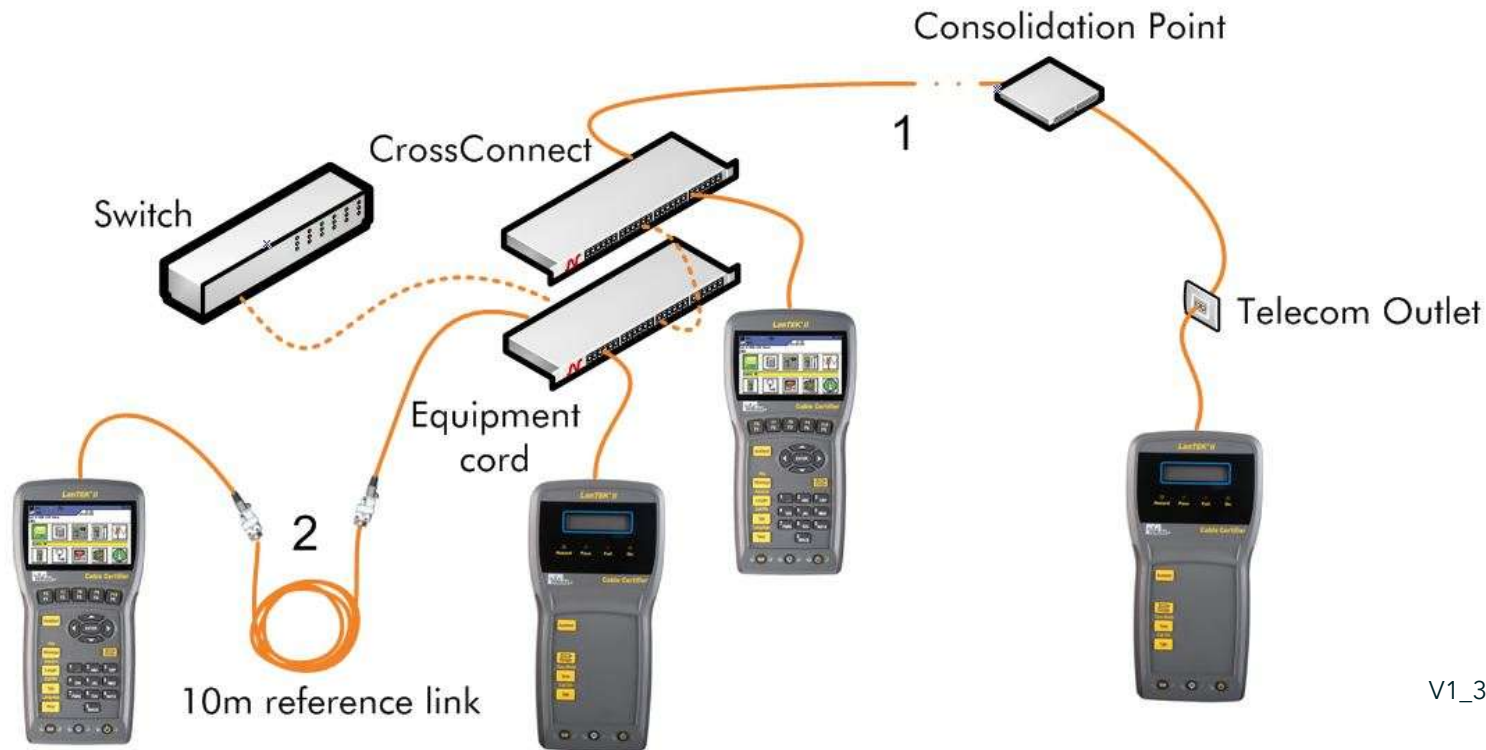
The installation includes an Equipment Cord and CP lead, both consisting of a 'single ended' LANmark patch cord (which must be terminated using a stranded wire Evo Snap-In connector) used to respectively connect the active equipment ports and CP - TO.



CrossConnect - CP - TO: Testing Set-up

In order to obtain a Certified Systems Warranty for the 4-connector installation, this configuration needs to be tested in two parts.

- 1) 3 connector Panel - CP - TO model
- 2) Equipment Cord in combination with a 10m (minimum) reference link



CrossConnect - CP - TO: Reference link requirements

The 10m (minimum) reference link must be used to obtain an accurate measurement of the Equipment Cord performance.
The reference link needs to be constructed using the infrastructure cable and 2 jacks, as used in the PL installation.

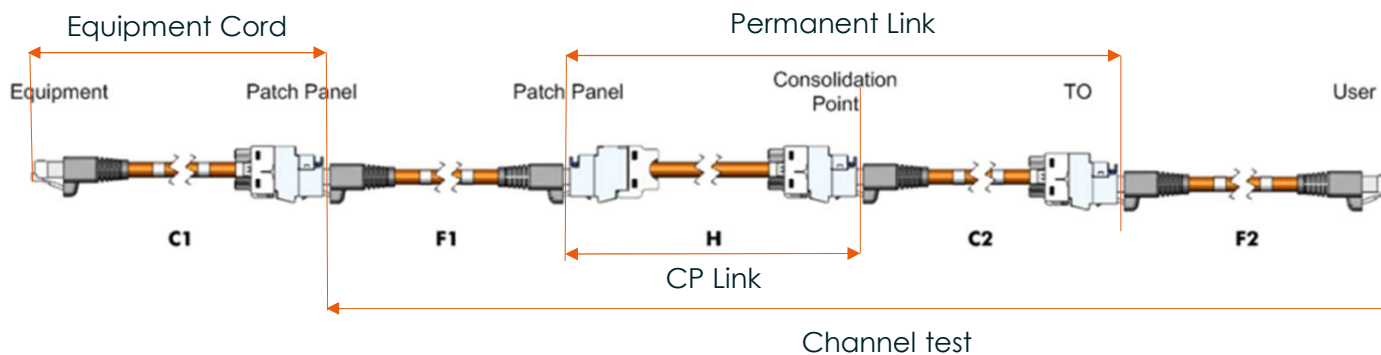
The reference link needs to be tested prior to use and a clear PASS using the applicable CLASS/CAT PL limit must be obtained.
The test result is required to be included in the final test file submission, being clearly labelled "reference link".



CrossConnect - CP - TO: Warranty consideration

If the Equipment Cords and CP leads are not present at the time of testing, testing the 2-connector installation from the Interconnect to the CP (CP Link) is acceptable to Aginode for the issuing of a Certified Systems Warranty.

However, it must be noted that the Warranty can only be applicable to the 2 connector CP link, although system performance will be obtained with the use of compliant Equipment Cords and CP leads.



Extended drive distance compliance

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Parameter requirements for extended drive distance compliance

Application Drive Distance without PoE (m)	LANmark Unscreened		LANmark Screened			
	Cat.5e	Cat.6	Cat.5e	Cat.6	Cat.6A	Cat.7 & 7A
10base-T (Ethernet)	177	177	177	177	177	177
100Base-T (Fast Ethernet)	140	140	140	140	140	140
1000Base-T (Gigabit Ethernet)	100	100	100	115	115	130
10GBase-T (10 Gigabit Ethernet)	n/a	n/a	n/a	n/a	100	120**
Class E applications	n/a	100	n/a	100	100	100
Class EA applications	n/a	n/a	n/a	n/a	100	100
Class F and FA applications	n/a	n/a	n/a	n/a	n/a	100

Application Drive Distance with PoE (m)	LANmark Unscreened		LANmark Screened					
	Cat.5e	Cat.6	Cat.5e	Cat.6	Cat.6A	Cat.7	Cat.7A AWG 23	Cat.7A AWG 22
10base-T (Ethernet)	125	130	125	130	140	150	165	177
100Base-T (Fast Ethernet)	125	130	125	130	140	140	140	140
1000Base-T (Gigabit Ethernet)	100	100	100	115	115	130	130	130
10GBase-T (10 Gigabit Ethernet)	n/a	n/a	n/a	n/a	100	120**	120**	120**



Extended drive distance compliance

For permanent link lengths in excess of 90m that FAIL test, these will need to be investigated prior to warranty submission to ensure that the overall results are in line with expected characteristics.

For example, the IL test limit is related to the 90m link length.

Therefore, links in excess of 90m are likely to FAIL the IL and overall test parameter requirements, however, in relationship to other parameters such as NEXT, it would not necessarily cause a failure of the ACR-N requirement.

As previously mentioned, given ACR-N is a key parameter for the support of applications (IEEE 802.3), if IL fails but ACR-N passes, then the channel may still be able to support specific applications.



Extended drive distance compliance

Parameters that should **NOT** FAIL >90m are wire map, NEXT, PSNEXT, RL, FEXT, PSFEXT, ACR-F, PSACR-F.

Parameters that may FAIL >90m are propagation delay, delay skew, IL, ACR-N, PSACR-N, DC-loop resistance, length (TIA).

At the point of testing, in order to verify that extended drive distances can be supported, the ACR-N value at the given application frequency is required to be 4dB or higher (e.g. 10BASE-T at 10MHz).

For higher speed applications (e.g. 1000BASE-T), delay skew also needs to be considered.

See next slide for overall parameter requirements for extended drive distance application support.



Parameter requirements for extended drive distance compliance

- IL: ok to fail
- ACR-N/PSACR-N: ok to fail, however, >4dB (value) at given application frequency
- Propagation delay: ok to fail
- Delay skew: <50ns for 1Gb and higher applications
- DC-loop resistance: <25 Ohm required for PoE support
- Length: ok to fail

Application Drive Distance without PoE (m)	LANmark Unscreened		LANmark Screened			
	Cat.5e	Cat.6	Cat.5e	Cat.6	Cat.6A	Cat.7 & 7A
10base-T (Ethernet)	177	177	177	177	177	177
100Base-T (Fast Ethernet)	140	140	140	140	140	140
1000Base-T (Gigabit Ethernet)	100	100	100	115	115	130
10GBase-T (10 Gigabit Ethernet)	n/a	n/a	n/a	n/a	100	120**
Class E applications	n/a	100	n/a	100	100	100
Class EA applications	n/a	n/a	n/a	n/a	100	100
Classe F and FA applications	n/a	n/a	n/a	n/a	n/a	100

Application Drive Distance with PoE (m)	LANmark Unscreened		LANmark Screened					
	Cat.5e	Cat.6	Cat.5e	Cat.6	Cat.6A	Cat.7	Cat.7A AWG 23	Cat.7A AWG 22
10base-T (Ethernet)	125	130	125	130	140	150	165	177
100Base-T (Fast Ethernet)	125	130	125	130	140	140	140	140
1000Base-T (Gigabit Ethernet)	100	100	100	115	115	130	130	130
10GBase-T (10 Gigabit Ethernet)	n/a	n/a	n/a	n/a	100	120**	120**	120**



Modular Plug Terminated Link (MPTL)

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Modular Plug Terminated Link (Direct Attach)

Connectivity for IP devices, such as security cameras, differ from typical data and voice outlets. Often the installation environment can not accommodate an outlet termination with a jack.

As a result, a direct attach method, which is a modular plug terminated to solid conductor horizontal cable, is accepted by industry Standards when implementing these devices through structured cabling.



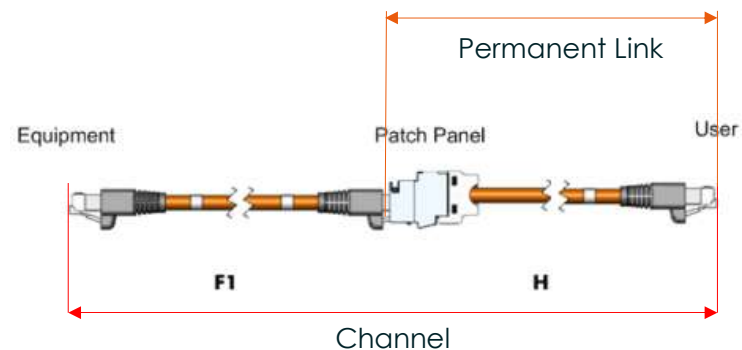
**LANmark-6A Field Terminable
Modular Screened Plug
N490.001**



Testing MPTL Links

The ISO 11801 and TIA-862A Standards recognise that the workstation outlet and patch cord at the device end may be removed, if deemed inappropriate.

Testing of MPTL links can only be achieved in a Permanent Link configuration using a **PL test head in combination with a patch cord test head**.






***PASS acceptance**



*PASS Acceptance for Warranty Certification

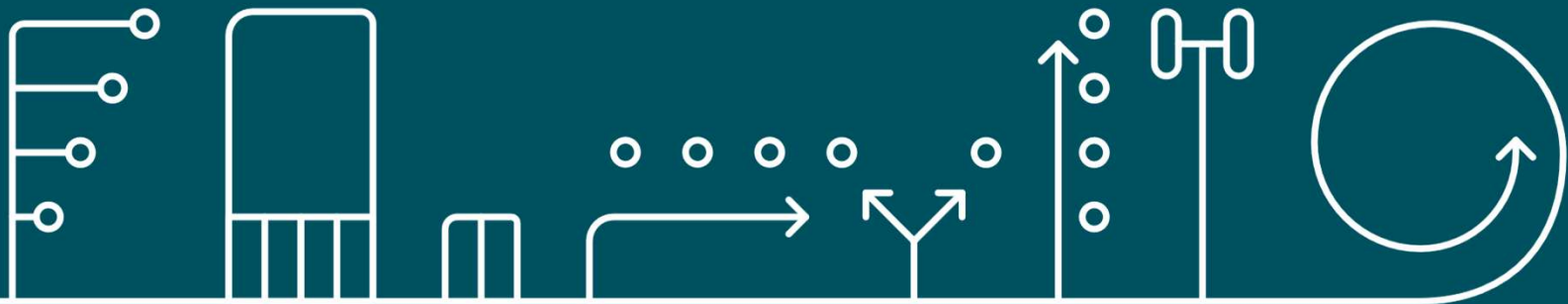
Warranty Module requested	Channel limits	Permanent link limits
LANmark-6	CLASS E	CLASS E
LANmark-6A	CLASS EA / CAT 6A	CLASS EA / CAT 6A Only if length >5m and <15m
LANmark-6A MPTL	Not Supported	ISO 11801 CLASS EA TIA CAT 6A MPTL
LANmark-7A	CLASS FA >15m PL length	Not supported
LANmark-8	CLASS II	Not Supported

	Only PASS test results accepted
	*PASS possible, conditions noted
	Test configuration not supported





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Field Testing Copper Links

