NEX1

NEX1 Technologies Co., Ltd

Reliability Test Report of Armored FC Pigtails/ Patch cords

Prepared by	Checked by	Approved by

NEX1 Technologies Co., Ltd

Contents

Chapter 1   Introduction

Fiber pigtails / patchcords are one of the most essential optical passive components in the fiber optical telecommunication system. It is used to interconnect optic fibers, components , modules or systems. The optical characteristics of fiber pigtails/patchcords contain insertion loss and return loss. To ensure long-term stable & low loss fiber connection, besides basic measurement for insertion loss & return loss, it also includes reliability test of fiber pigtails/patchcords. The reliability tests identify possible weaknesses in connector design or materials ,and provide tangible assurance that the connector is capable of functioning reliably over a number of years in a wide variety of service environments.

The qualification test program for armored single mode fiber patchcord of NEX1 Technologies Co.,Ltd. is according to Telcordia GR-326-CORE, Issue 3,September 1999, "Generic Requirements for Single mode Optical Connectors and Jumper Assemblies" All fiber pigtails/patchcords under test are randomly sampled from NEX1's production line. The optical performance is measured before and after the tests. This Report summarizes the test results and all test conditions, including the equipments and methods, are also described in detailed.

Chapter 2　Test Scope

In this chapter , we describe the specification of samples and definitions of all test conditions.

2-1　Specification of samples.

The definition and optical performance　requirements of testing samples described in the following sections.

2-1-1 Definition of test samples

There are two types of test samples: Pigtail and jumper cable assembly .

◆ Pigtail assembly, consists of two connector plugs mated with and adapter with unterminated leads as shown in Figure 2-1.
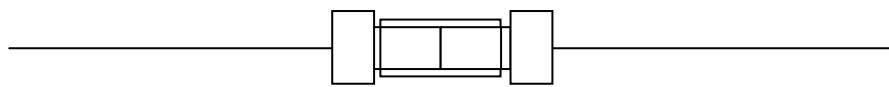
Fig. 2-1 Pigtail Assembly

◆ Jumper cable assembly, consists of a jumper cable terminated with plugs on each end connected with adapters to two additional connector plugs with unterminated leads on either end as shown in Figure 2-2.
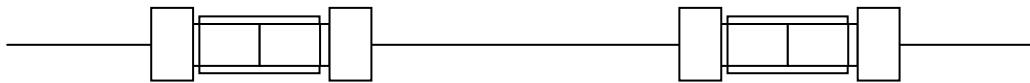
Fig. 2-2 Jumper Cable Assembly

2-1-2 Optical Performance Requirements

The test specifications come from GR-326-CORE.   The criteria apply at both 1310nm and 1550nm wavelengths. Refer to GR-326 Table 4-2 & 4-3, the pass/fail specifications are summarized in the following table:

Table 2-1 Summary of Optical Performance Criteria: Loss

Test	Maximum Loss		Mean Loss		Loss Increase	
	(R)	(O)	(R)	(O)	(R)	(O)
New Product	0.40	0.20	0.20	0.15	- - -	- - -
During Test, Not Under Load	0.50	0.30	0.30	0.20	0.30	0.20
End of Test	0.50	0.30	0.30	0.20	- - -	- - -

Table 2-2 Summary of Optical Performance Criteria: Return Loss

Test	Return Loss	Increase in Return Loss	
	(R)	(R)	(O)
New Product	40	- - -	- - -
During Test, Not Under Load	40	5	2
End of Test	40	5	2

Note :　R : Requirement , O : Objective

2-2 Test Item

The reliability tests according to Telcordia GR-326-CORE can be classified into two groups: environmental and mechanical tests .All applied tests are listed in the following tables:

Table 2-3　Environmental Test

Category	Test Item	Condition	Pass/Fail Criteria
Environmental Test	Thermal Age Test	Temp. : 85±2℃, Humidity : uncontrolled Duration:168hrs	ΔI.L.<0.2db, R.L.>40db
	Thermal Cycle Test	Temp. :-40 ~ 75℃, Humidity : uncontrolled Duration:168hrs	ΔI.L.<0.2db, R.L.>40db
	Humidity Aging Test	Temp. : 75±2℃, Humidity : 95% Duration:168hrs	ΔI.L.<0.2db, R.L.>40db
	Humidity/Condensati-on Cycling Test	Temp. :-10 ~ +65℃, Humidity: 90~100% Duration:168hrs	ΔI.L.<0.2db, R.L.>40db
	Dry-out	Temp. : 75±2℃, Humidity : 95% Duration:24hrs	ΔI.L.<0.2db, R.L.>40db
	Post-Condensation Thermal Cycle Test	Temp. :-40 ~ 75℃, Humidity : uncontrolled Duration:1hrs	ΔI.L.<0.2db, R.L.>40db

Note :　For cable jumper assembly, it only need to do thermal age and thermal cycle test .

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Table2-4　Mechanical Test

Category	Test Item	Condition	Pass/Fail Criteria
Mechanical Test	Vibration Test	10~55Hz/2hrs Amplitude1.5mm Rate:45Hz/min	ΔI.L.<0.2db, R.L.>40db
	Flex Test	Load:0.9Kg Rotate $0^0,90^0,0^0,-90^0,0^0$ 100 cycles	ΔI.L.<0.2db, R.L.>40db
	Twist Test	Load:1.35kg 2.5turns	ΔI.L.<0.2db, R.L.>40db
	Proof Test	Straight Pull: 4.5kg(5sec) then 6.8kg（5sec） Side Pull: 2.3Kg(5sec) 　　　　3.4Kg(5sec)	ΔI.L.<0.2db, R.L.>40db
	Impact Test	1.5m drop 8 times	ΔI.L.<0.2db, R.L.>40db

2-3 Test Instruments

The optical characteristics of all pigtails/patchcords under test were measured using JDSU RM-3 Backreflection Meter(Made by Canada). The other testing instruments including, Norland AC-3000 automated non-contact interferometric microscope (USA), GIANT FORCE programmable temperature and humidity control chamber (Taiwan), SHENKO ELECTRIC vibration shaker (Japan), mechanical

tension
tester (Made by NEX1) etc. as shown in the figure 2-3 to2-7.

Fig.2-3 JDSU RM-3
Backreflection Meter
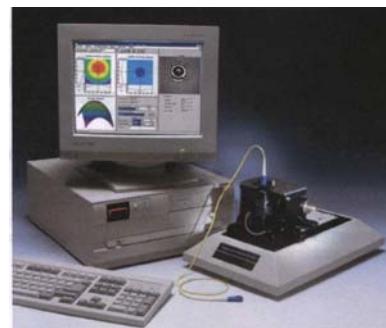
Fig.2-4 Interferometric
Microscope

Fig.2-5 Temp.& Humidity
Controller

Fig.2-6 Mechanical Tension Tester

Fig.2-7 Vibration Shaker

Chapter 3 Test Condition and Results

The tests description and results are presented in this chapter.

3-1 Thermal Age Test

a. Testing Method

To leave the fiber pigtails/patchcords in a constant temperature chamber with temperature of $85\pm2℃$ and uncontrolled humidity for 168hrs,After testing, measure the I.L. and R.L. of testing samples ,the variation of I.L.
should be less than 0.2db and the R.L. larger than 40db.
(ΔI.L.<0.2db,R.L.>40db).

b. Apparatus

(b-1) GIANT FORCE programmable temperature and humidity control chamber (Taiwan)
    Model: GTH099-40-1P   Serial No: GF-97700-1

(b-2) JDSU Backreflection Meter RM-3 (Canada)
    Model:RM3750+1FA7   Serial No: GF-97700-1

c. Results

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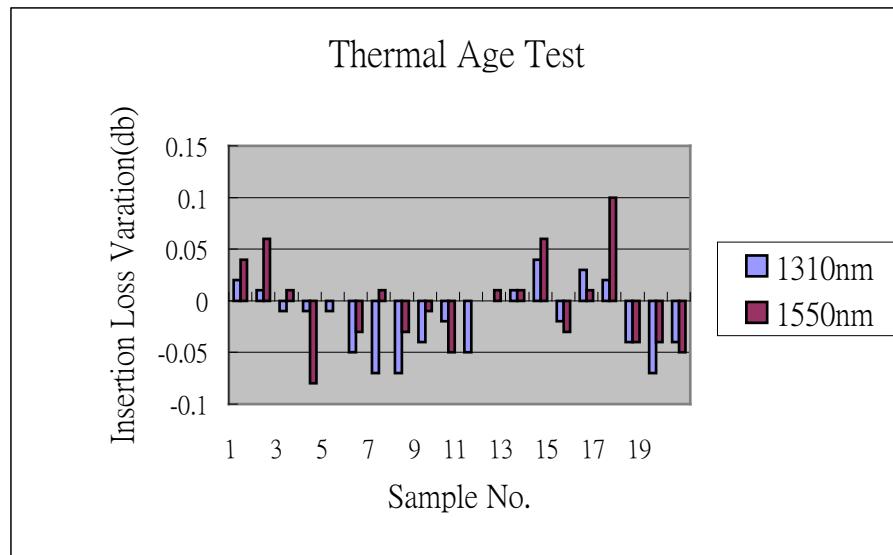
Fig.3-1 Insertion Loss Variation of Thermal Age Test
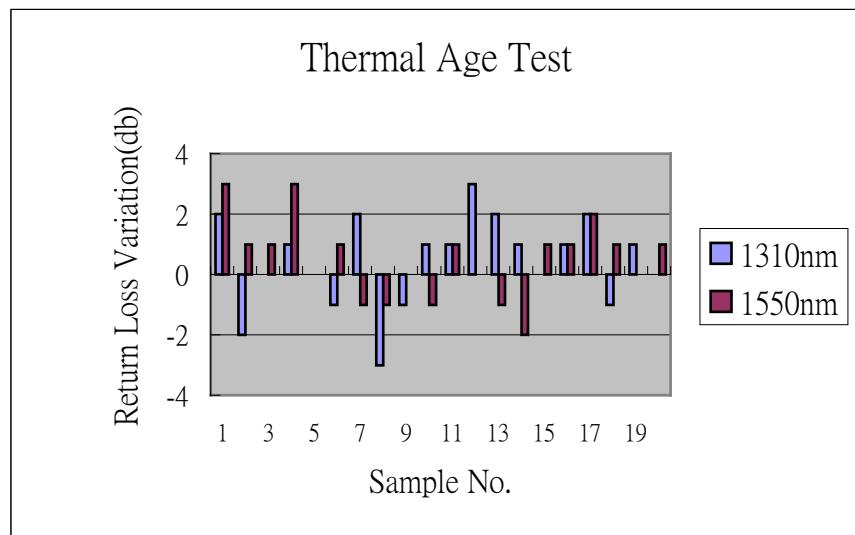
Fig.3-2 Return Loss Variation of Thermal Age Test

3-2 Thermal Cycle Test

a. Testing Method

(a) Temperature Cycle:-40~+75℃
(b) Humidity: Uncontrolled
(c) Duration: 21cycles, 168hrs
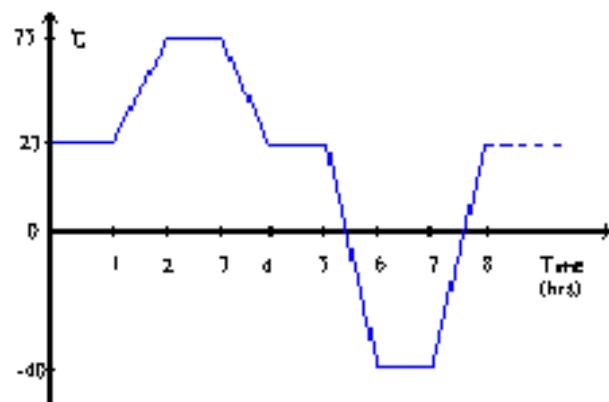
The temperature profile is as shown in figure 3-3.

Fig.3-3 Thermal Cycle Temperature Profile

After repeat above conditions for 21 cycles , measuring the I.L. and R.L. of testing samples, the variation of I.L. should be less than 0.2db and the R.L. larger than 40db (ΔI.L.<0.2db,R.L.>40db).

b. Apparatus
   The same as 3-1

c. Results
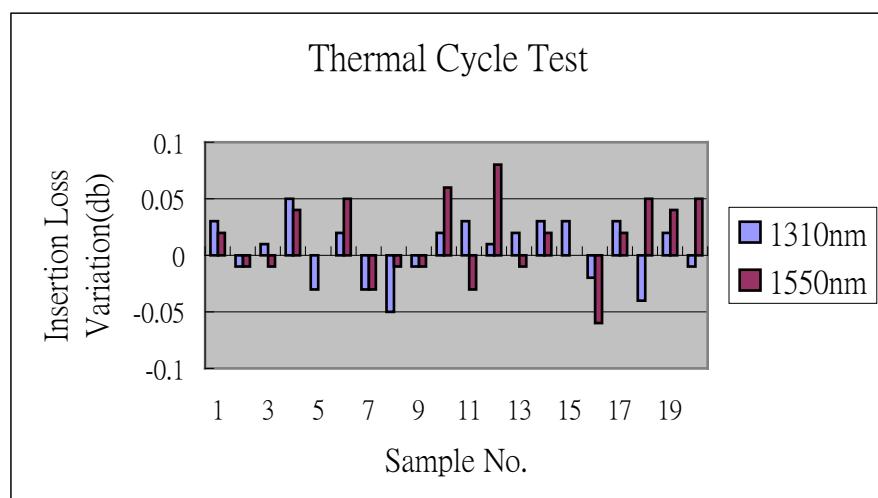
Fig.3-4 Insertion Loss Variation of Thermal Cycle Test
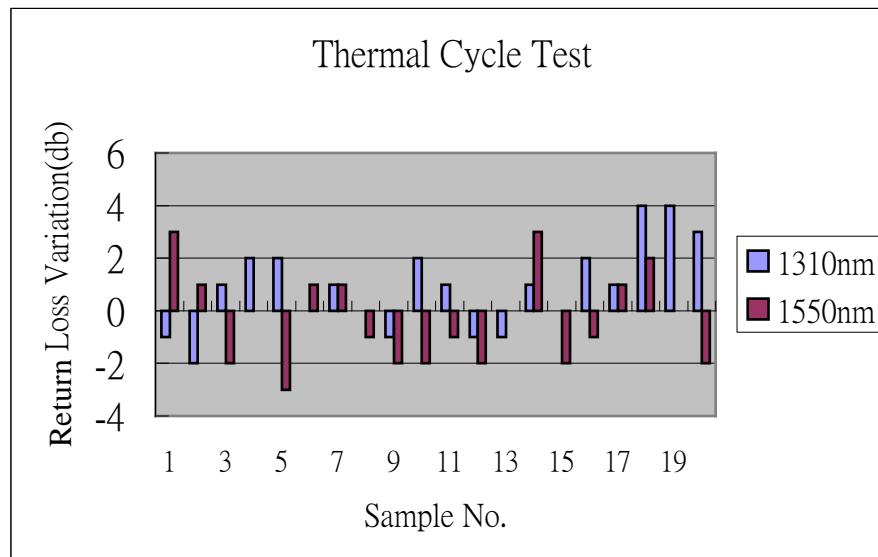
Fig.3-5 Return Loss Variation of Thermal Cycle Test

3-3 Humidity Aging Test

a. Testing Method

To leave the fiber pigtails/ patchcords in a constant temperature chamber with temperature of 75$\pm$2℃ and 95% relative humidity for 168hrs. After testing , measure the I.L. and R.L. of testing samples , the variation of I.L. should be less than 0.2db and the R.L. larger than 40db (ΔI.L.<0.2db,R.L.>40db).

b. Apparatus
   The same as 3-1

c. Results

Humidity Aging Test

Fig.3-6 Insertion Loss Variation of Humidity Aging Test

Humidity Aging Test
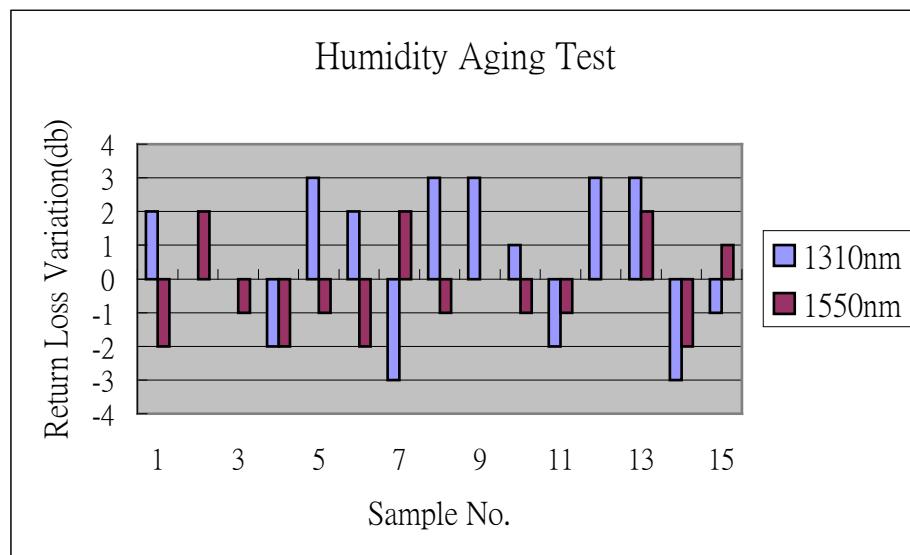
Fig.3-7 Return Loss Variation of Humidity Aging Test

3-4 Humidity/Condensation Test

a.Testing Method
(a). Temperature Cycle   : -10~+65℃.
(b). Relative Humidity: 90-100%
(c).Duration :14 cycles,168hrs
The temperature profile is as shown in figure 3-8
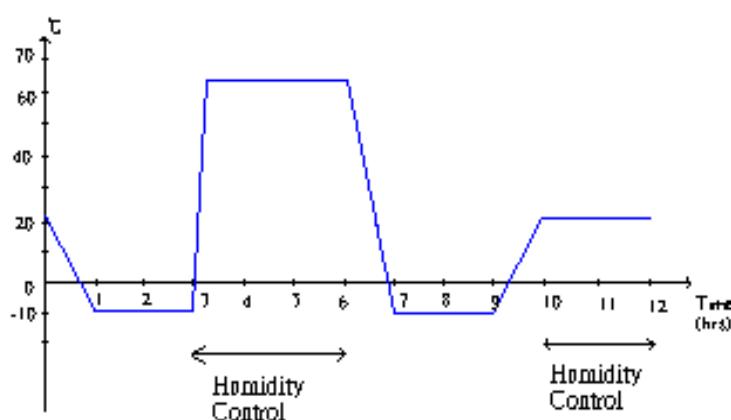
Fig.3-8 Humidity Condensation Temperature Profile

After repeat above conditions for 14 cycles, measuring the I.L. and R.L. of testing samples, the variation of I.L. should be less than 0.2db and the R.L. larger than 40db(ΔI.L.<0.2db,R.L.>40db).

b. Apparatus
The same as 3-1

c. Results

Fig.3-9 Insertion Loss Variation of Humidity-Condensation Test
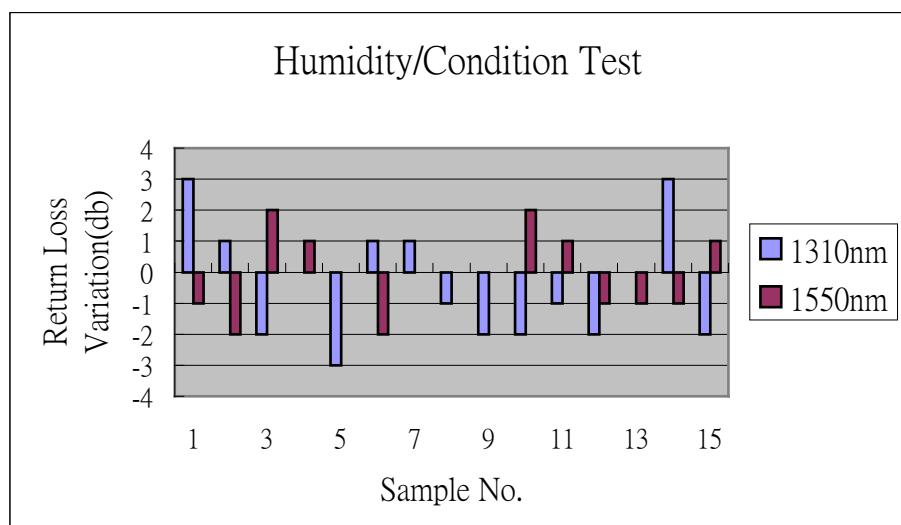
Fig.3-10 Return Loss Variation of umidity-Condensation Test

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3-5 Dry-out Test

a. Testing Method
  To leave the fiber patchcords in a constant temperature chamber with temperature of 75±2℃ and uncontrolled humidity for 24hrs. After testing , measure the I.L. and R.L. of testing samples , the variation of
  I.L. should be less than 0.2db and the R.L. larger than 40db (ΔI.L.<0.2db,R.L.>40db).

b. Apparatus
The same as 3-1

c. Results

Fig.3-11 Insertion Loss Variation of Dry-out Test
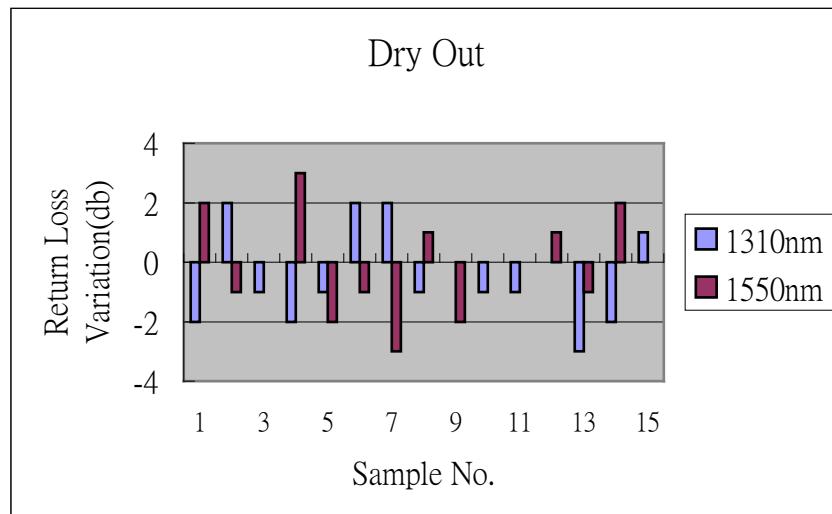
Fig.3-12 Return Loss Variation of Dry-out Test

3-6 Post Condensation Test

a. Testing Method

The same testing condition as 3-2 (Thermal Cycle Test). After repeat above conditions for 21 cycles, measure the I.L. and R.L. of testing samples, the variation of I.L. should be less than 0.2db and the R.L. larger than 40db(∆I.L.<0.2db,R.L.>40db).

b. Apparatus
The same as 3-1

c. Results
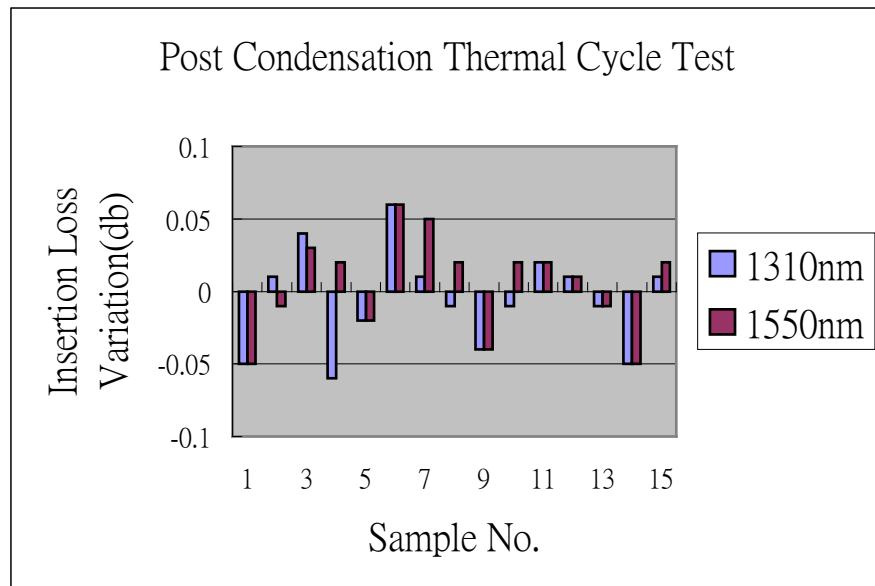
Fig.3-13 Insertion Loss Variation of Post-Condensation Thermal Cycle Test
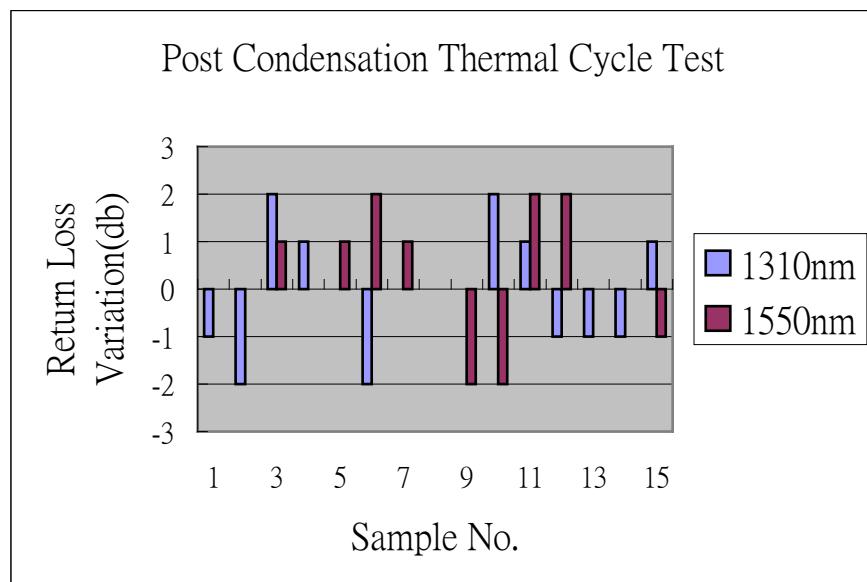
Fig.3-14 Return Loss Variation of Post-Condensation Thermal Cycle Test

3-7 Vibration Test

a. Testing Method
      (a).Frequency:10~55Hz
      (b).XYZ direction:
          (b-1):Maximum Amplitude:1.5mm
          (b-2):Duration:2hrs

Applying the above frequency and amplitude to the fiber pigtails/ patchcords . After testing , measure the I.L. and R.L. of testing samples. The variation of I.L. should be less than 0.2db and the R.L. larger than 40db . (ΔI.L.<0.2db,R.L.>40db)

  b. Apparatus

  SHINKO ELECTRIC Vibratory Packer

  c. Results
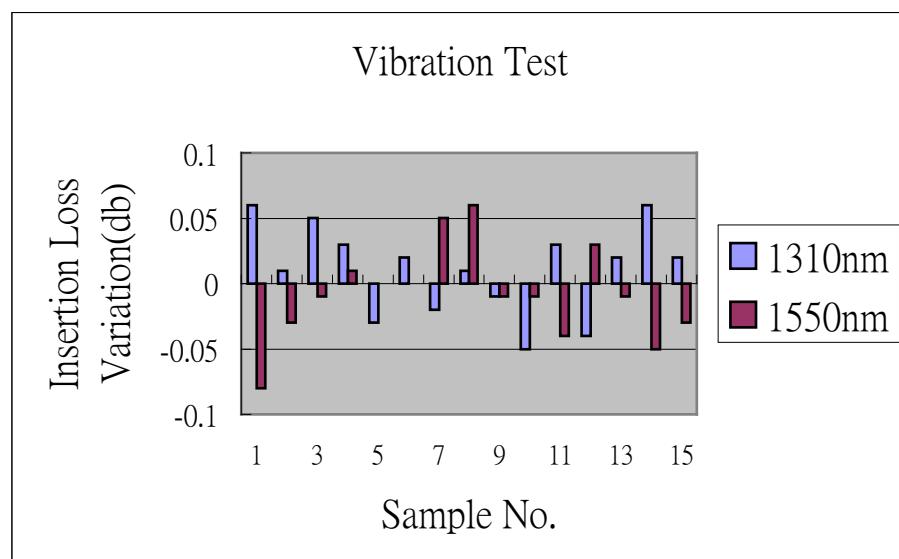
Fig.3-15 Insertion Loss Variation of Vibration Test
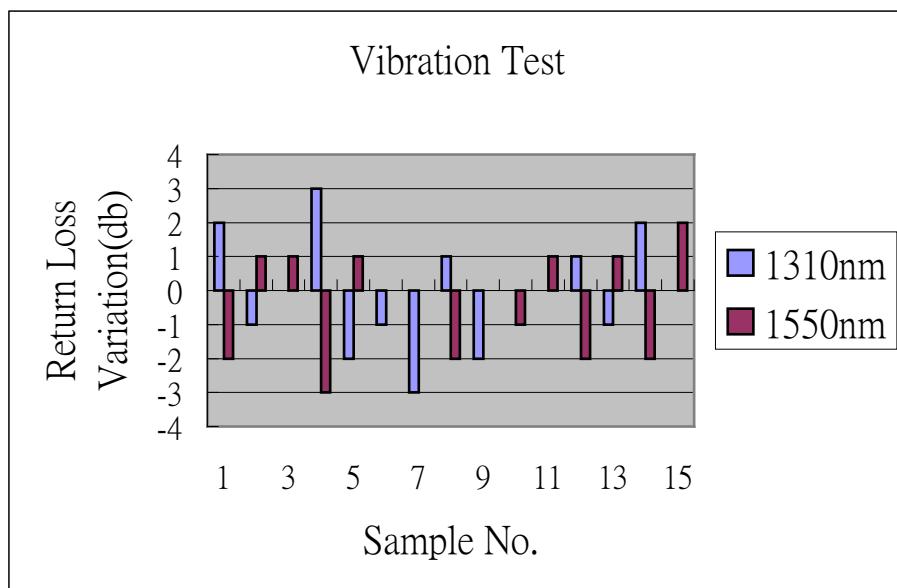
Fig.3-16 Return Loss Variation of Vibration Test

3-8 Flex Test

a. Testing Method

Applying 0.9Kg load on one end of patchcord and rotate the other end through the following cycle: $0^0, 90^0, 0^0, -90^0, 0^0$ as shown in figure 3-17.
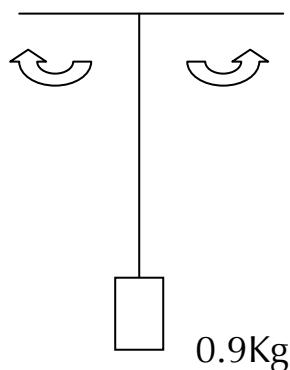
Fig.3-17 Flex Test

b. Apparatus

Mechanical Tester

c. Results
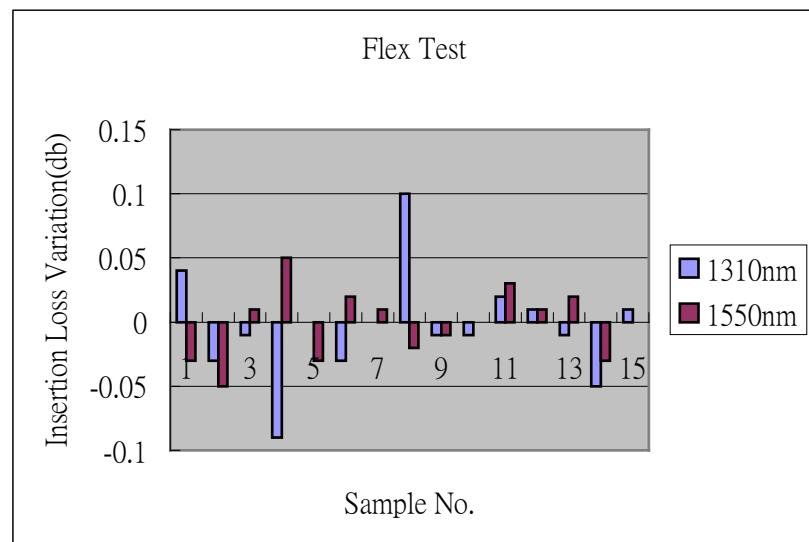
Fig.3-18 Insertion Loss Variation of Flex Test
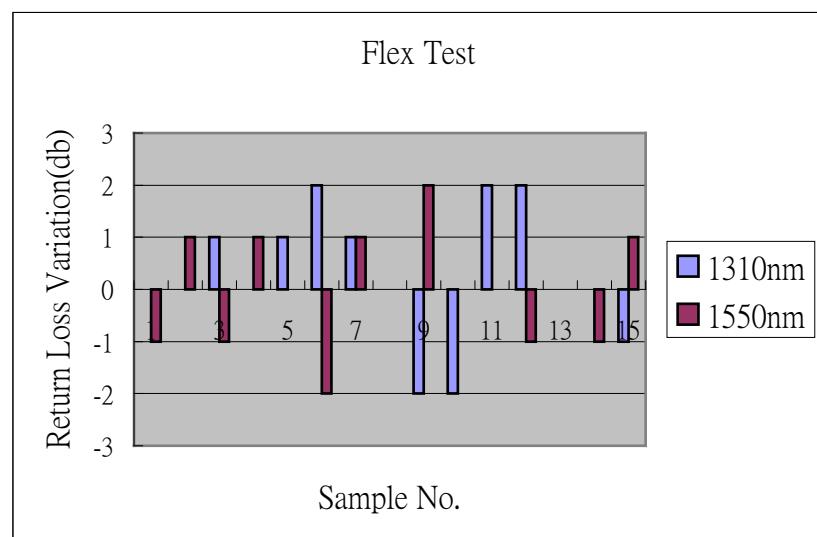
Fig.3-19 Return Loss Variation of Flex Test

3-9 Twist Test

a. Testing Method

Applying a 1.35Kg load to fiber patchcord , and rotate the fiber patchcord in the direction about the axis of fiber 2.5 turns then rotate reverse direction 5 turns again as shown in figure 3-20. Repeat the above steps 9 times. After testing , measure the I.L. and R.L. of testing samples ,the variation of I.L. should be less than 0.2db and the R.L. larger than 40db .
(ΔI.L.<0.2db,R.L.>40db)

1.35Kg

Fig.3-20 Twist Test

b. Apparatus

Mechanical Tester

c Results
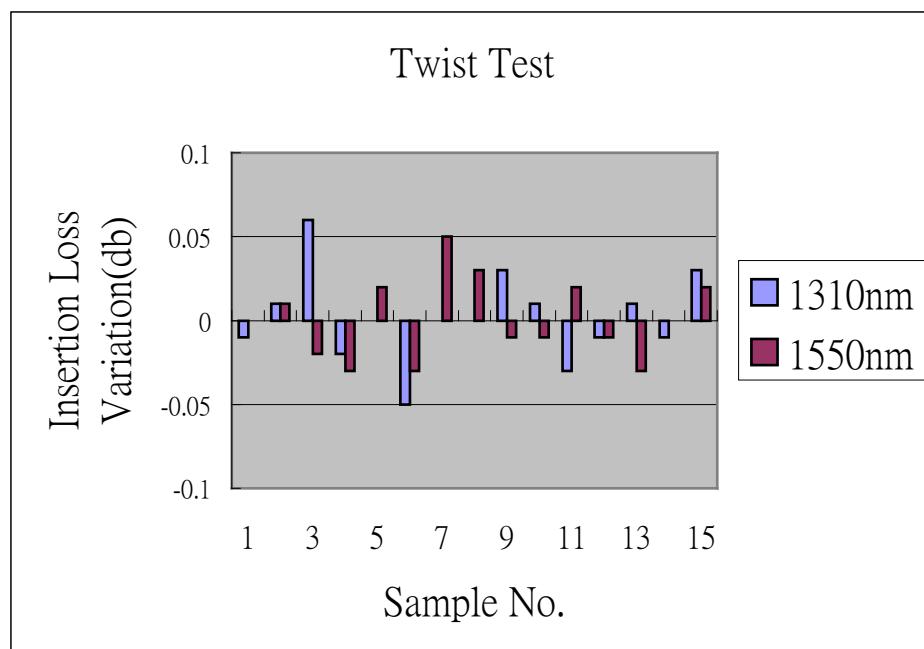
Fig.3-21 Insertion Loss Variation of Twist Test
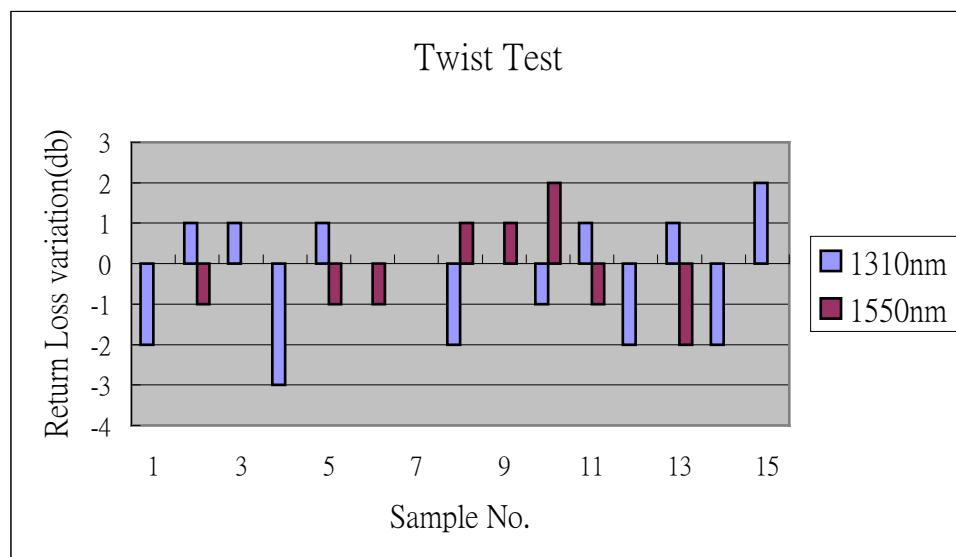
Fig.3-22 Return Loss Variation of Twist Test

3-10 Proof Test

Proof Test can be classified into two type of testing: Straight Pull and 90^0 Side Pull.

(a).Straight Pull:

By loading4.5kg weight to fiber patchcord for 5 seconds directly, then 6.8kg weight to fiber patchcord for 5 seconds, After testing , measure the I.L. and R.L. of testing samples , the variation of I.L. should be less than 0.2db and the R.L. larger than 40db . (ΔI.L.<0.2db,R.L.>40db)

(b).90^0 Side Pull:

By loading2.3kg weight to fiber patchcord for 5 seconds ,then 3.4kg weight to fiber patchcord for 5 seconds, After testing , measure the I.L. and R.L. of testing samples , the variation of I.L. should be less than 0.2db and the R.L. larger than 40db . (ΔI.L.<0.2db,R.L.>40db)
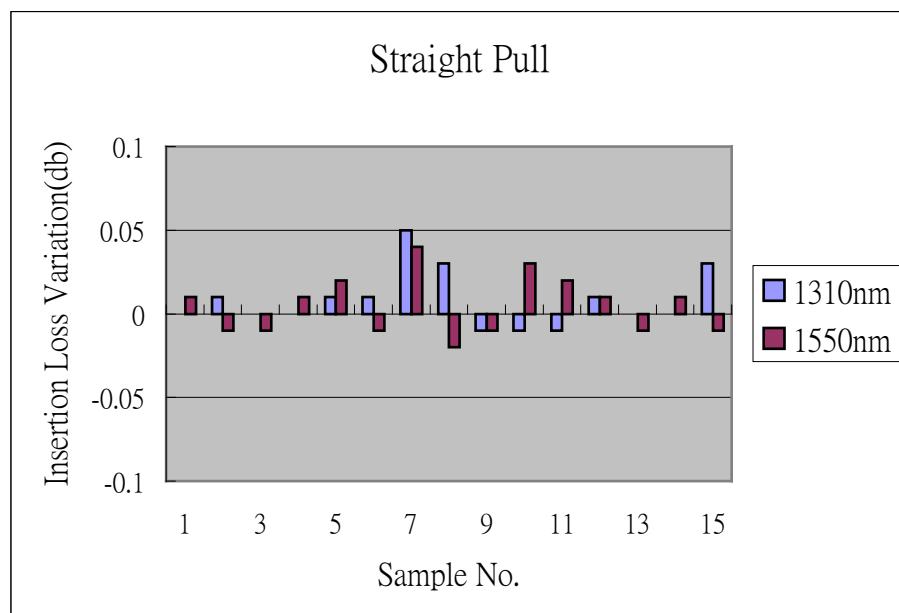
Fig.3-23 Insertion Loss Variation of Straight Pull Test
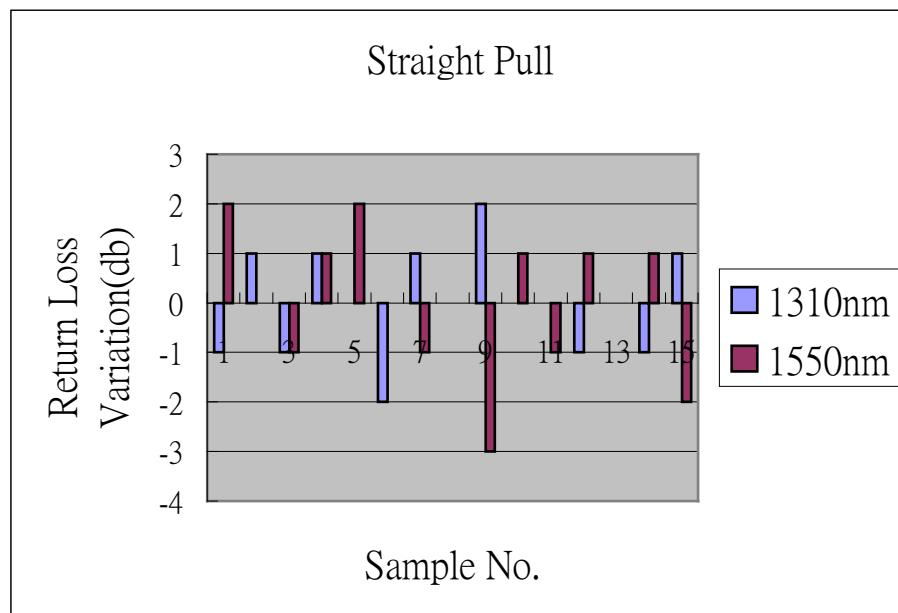
Fig.3-24 Return Loss Variation of Straight Pull Test
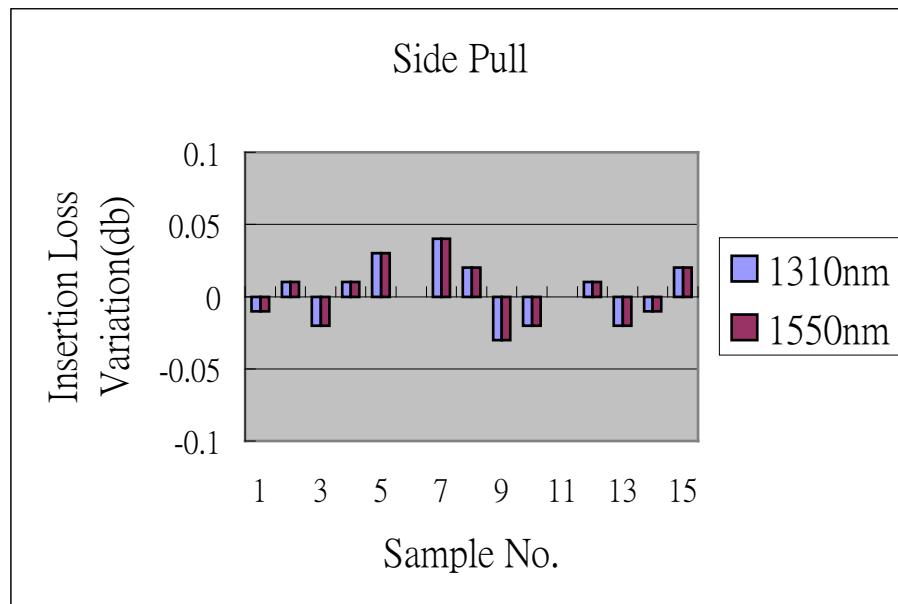
Fig.3-25 Insertion Loss Variation of Side Pull Test
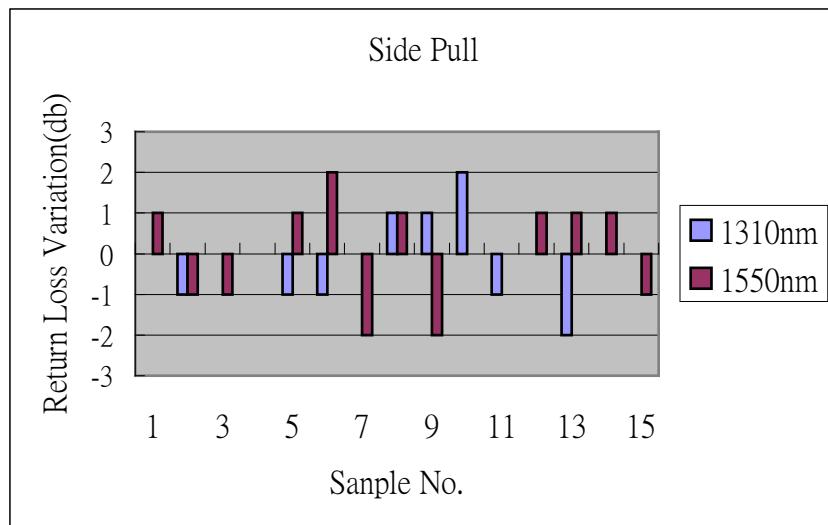
Fig.3-26 Return Loss Variation of Side Pull Test

3-11 Impact Test

Applying a sudden shock of maximum 10G load to fiber
patchcord ,
as shown in Fig.3-27 .After testing , measure the I.L. and R.L. of
testing samples the variation of I.L. should be less than 0.2db and
the R.L. larger than 40db .
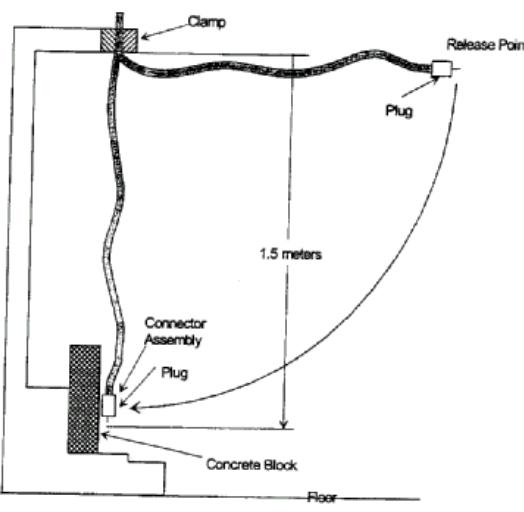
Figure 5-7. Impact Test Facility

Fig.3-27 Impact Test

Impact Test

Insertion Loss Variation(db)

0.06
0.04
0.02
0
-0.02
-0.04
-0.06

1 3 5 7 9 11 13 15

□ 1310nm
■ 1550nm

Sample No.

Fig.3-28 Insertion Loss Variation of Impact Test

Impact Test

Return Loss Variation (db)

4
2
0
-2
-4

1 3 5 7 9 11 13 15

□ 1310nm
■ 1550nm
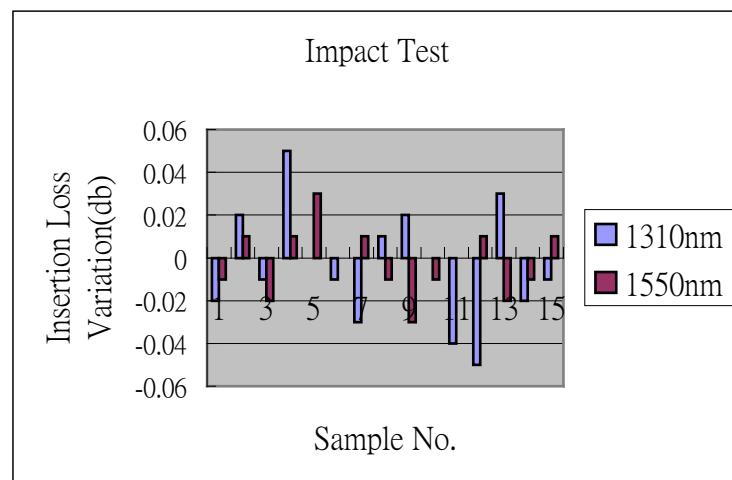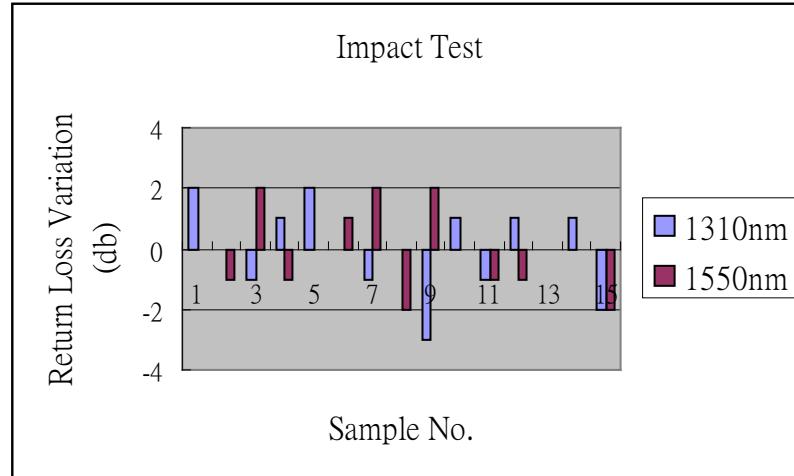
Sample No.

Fig.3-29 Return Loss Variation of Impact Test

Chapter 4 Conclusion

According to the performance criteria mentioned in section 2-2 .,all samples passed the test successfully. The result is summarized in Table
4-1&4-2.

Table 4-1. Environmental Test Results Summary for GR—326-CORE

	Environmental Test	Number of Samples	Date Completed	Number Passed	Number Failed
1	Thermal Age Test	15/5	1 /14 2002	15/5	0/0
2	Thermal Cycle Test	15/5	1/ 22 2002	15/5	0/0
3	Humidity Aging Test	15	1/ 29 2002	15	0
4	Humidity-CondensationCycling Test	15	2/7 2002	15	0
5	Dry-out	15	2/8 2002	15	0
6	Post-Condensation Thermal Cycle Test	15	2/15 2002	15	0

Table 4-2. Mechanical Test Results Summary for GR—326-CORE

	Mechanical Test	Number of Samples	Date Completed	Number Passed	Number Failed
1	Vibration Test	15	2/18 2002	15	0
2	Flex Test	15	2/19 2002	15	0
3	Twist Test	15	2/19 2002	15	0
4	Proof Test	15	2/22 2002	15	0
5	Impact Test	15	2/25 2002	15	0

Chapter 5   Reference

1. GR-326-CORE Issue3 "Generic Requirements for Singlemode Optical Connectors and Jumper Assemblies"1999,Telcordia.

Appendix A

Table A-1　New Product Test Data

Item	Insertion Loss		Return Loss	
Sample	1310nm	1550nm	1310nm	1550nm
#1	0.07	0.03	53	54
#2	0.12	0.09	59	59
#3	0.13	0.11	60	58
#4	0.14	0.16	58	54
#5	0.13	0.12	58	58
#6	0.13	0.08	57	59
#7	0.17	0.10	58	60
#8	0.17	0.08	60	58
#9	0.11	0.09	58	59
#10	0.15	0.13	55	60
#11	0.17	0.09	59	59
#12	0.12	0.17	55	59
#13	0.15	0.14	59	60
#14	0.10	0.07	59	58
#15	0.12	0.10	58	58
#16	0.09	0.12	57	59
#17	0.08	0.07	57	59
#18	0.16	0.17	58	58
#19	0.14	0.13	55	58
#20	0.15	0.15	54	57
Maximum Loss	0.17	0.17	- - -	- - -
Mean Loss	0.13	0.11	- - -	- - -

#1 ~ #15: Pigtail Assembly

#16~#20: Jumper Cable Assembly

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Table A-2-1   Thermal Age Test Data   [1310nm wavelength]

Item	Insertion Loss			Return Loss		
Sample	Before Test	After Test	Increase	Before Test	After Test	Increase
#1	0.07	0.09	0.02	53	55	2
#2	0.12	0.13	0.01	59	57	-2
#3	0.13	0.12	-0.01	60	60	0
#4	0.14	0.13	-0.01	58	59	1
#5	0.13	0.12	-0.01	58	58	0
#6	0.13	0.08	-0.05	57	56	-1
#7	0.17	0.10	-0.07	58	60	2
#8	0.17	0.10	-0.07	60	57	-3
#9	0.11	0.07	-0.04	58	57	-1
#10	0.15	0.13	-0.02	55	56	1
#11	0.17	0.12	-0.05	59	60	1
#12	0.12	0.12	0.00	55	58	3
#13	0.15	0.16	0.01	59	61	2
#14	0.10	0.14	0.04	59	60	1
#15	0.12	0.10	-0.02	58	58	0
#16	0.09	0.12	0.03	57	58	1
#17	0.08	0.10	0.02	57	59	2
#18	0.16	0.12	-0.04	58	57	-1
#19	0.14	0.07	-0.07	55	56	1
#20	0.15	0.11	-0.04	54	54	0
Maximum Loss	0.17	0.16	- - -	- - -	- - -	- - -
Mean Loss	0.13	0.11	- - -	- - -	- - -	- - -

#1 ~ #15: Pigtail Assembly

#16~#20: Jumper Cable Assembly

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Table A-2-2   Thermal Age Test Data [1550nm wavelength]

Item	Insertion Loss			Return Loss		
Sample	Before Test	After Test	Increase	Before Test	After Test	Increase
#1	0.03	0.07	0.04	54	57	3
#2	0.09	0.15	0.06	59	60	1
#3	0.11	0.12	0.01	58	59	1
#4	0.16	0.08	-0.08	54	57	3
#5	0.12	0.12	0.00	58	58	0
#6	0.08	0.05	-0.03	59	60	1
#7	0.10	0.11	0.01	60	59	-1
#8	0.08	0.05	-0.03	58	57	-1
#9	0.09	0.08	-0.01	59	59	0
#10	0.13	0.08	-0.05	60	59	-1
#11	0.09	0.09	0.00	59	60	1
#12	0.17	0.18	0.01	59	59	0
#13	0.14	0.15	0.01	60	59	-1
#14	0.07	0.13	0.06	58	56	-2
#15	0.10	0.07	-0.03	58	59	1
#16	0.12	0.13	0.01	59	60	1
#17	0.07	0.17	0.10	59	61	2
#18	0.17	0.13	-0.04	58	59	1
#19	0.13	0.09	-0.04	58	58	0
#20	0.15	0.10	-0.05	57	58	1
Maximum Loss	0.17	0.18	- - -	- - -	- - -	- - -
Mean Loss	0.11	0.11	- - -	- - -	- - -	- - -

#1 ~ #15: Pigtail Assembly

#16~#20: Jumper Cable Assembly

NEX1 Technologies Co., Ltd

Table A-3-1 Thermal Cycle Test Data [1310nm wavelength]

Item	Insertion Loss			Return Loss		
Sample	Before Test	After Test	Increase	Before Test	After Test	Increase
#1	0.09	0.12	0.03	55	54	-1
#2	0.13	0.12	-0.01	57	55	-2
#3	0.12	0.13	0.01	60	61	1
#4	0.13	0.18	0.05	59	61	2
#5	0.12	0.09	-0.03	58	60	2
#6	0.08	0.10	0.02	56	56	0
#7	0.10	0.07	-0.03	60	61	1
#8	0.10	0.05	-0.05	57	57	0
#9	0.07	0.06	-0.01	57	56	-1
#10	0.13	0.15	0.02	56	58	2
#11	0.12	0.15	0.03	60	61	1
#12	0.12	0.13	0.01	58	57	-1
#13	0.16	0.18	0.02	61	60	-1
#14	0.14	0.17	0.03	60	61	1
#15	0.10	0.13	0.03	58	58	0
#16	0.12	0.10	-0.02	58	60	2
#17	0.10	0.13	0.03	59	60	1
#18	0.12	0.08	-0.04	57	61	4
#19	0.07	0.09	0.02	56	60	4
#20	0.11	0.10	-0.01	54	57	3
Maximum Loss	0.16	0.18	- - -	- - -	- - -	- - -
Mean Loss	0.11	0.12	- - -	- - -	- - -	- - -

#1 ~ #15: Pigtail Assembly

#16~#20: Jumper Cable Assembly

NEX1 Technologies Co., Ltd

Table A-3-2 Thermal Cycle Test Data [1550nm wavelength]

Item	Insertion Loss			Return Loss		
Sample	Before Test	After Test	Increase	Before Test	After Test	Increase
#1	0.07	0.09	0.02	57	60	3
#2	0.15	0.14	-0.01	60	61	1
#3	0.12	0.11	-0.01	59	57	-2
#4	0.08	0.12	0.04	57	57	0
#5	0.12	0.12	0.00	58	55	-3
#6	0.05	0.10	0.05	60	61	1
#7	0.11	0.08	-0.03	59	60	1
#8	0.05	0.04	-0.01	57	56	-1
#9	0.08	0.07	-0.01	59	57	-2
#10	0.08	0.14	0.06	59	57	-2
#11	0.09	0.06	-0.03	60	59	-1
#12	0.18	0.26	0.08	59	57	-2
#13	0.15	0.14	-0.01	59	59	0
#14	0.13	0.15	0.02	56	59	3
#15	0.07	0.07	0.00	59	57	-2
#16	0.13	0.07	-0.06	60	59	-1
#17	0.17	0.19	0.02	61	62	1
#18	0.13	0.18	0.05	59	61	2
#19	0.09	0.13	0.04	58	58	0
#20	0.10	0.15	0.05	58	56	-2
Maximum Loss	0.18	0.26	- - -	- - -	- - -	- - -
Mean Loss	0.11	0.12	- - -	- - -	- - -	- - -

#1 ~ #15: Pigtail Assembly

#16~#20: Jumper Cable Assembly

Table A-4-1 Humidity Aging Test Data [1310nm wavelength]

Item	Insertion Loss			Return Loss		
Sample	Before Test	After Test	Increase	Before Test	After Test	Increase
#1	0.12	0.17	0.05	54	56	2
#2	0.12	0.13	0.01	55	55	0
#3	0.13	0.17	0.04	61	61	0
#4	0.18	0.12	-0.06	61	59	-2
#5	0.09	0.14	0.05	60	63	3
#6	0.10	0.07	-0.03	56	58	2
#7	0.07	0.10	0.03	61	58	-3
#8	0.05	0.07	0.02	57	60	3
#9	0.06	0.10	0.04	56	59	3
#10	0.15	0.17	0.02	58	59	1
#11	0.15	0.17	0.02	61	59	-2
#12	0.13	0.14	0.01	57	60	3
#13	0.18	0.25	0.07	60	63	3
#14	0.17	0.22	0.05	61	58	-3
#15	0.13	0.12	-0.01	58	57	-1
Maximum Loss	0.18	0.25	- - -	- - -	- - -	- - -
Mean Loss	0.12	0.14	- - -	- - -	- - -	- - -

#1 ~ #15: Pigtail Assembly

NEX1
NEX1 Technologies Co., Ltd

Table A-4-2 Humidity Aging Test Data [1550nm wavelength]

Item	Insertion Loss			Return Loss		
Sample	Before Test	After Test	Increase	Before Test	After Test	Increase
#1	0.09	0.13	0.04	60	58	-2
#2	0.14	0.21	0.07	61	63	2
#3	0.11	0.15	0.04	57	56	-1
#4	0.12	0.06	-0.06	57	55	-2
#5	0.12	0.17	0.05	55	54	-1
#6	0.10	0.07	-0.03	61	59	-2
#7	0.08	0.08	0.00	60	62	2
#8	0.04	0.05	0.01	56	55	-1
#9	0.07	0.11	0.04	57	57	0
#10	0.14	0.12	-0.02	57	56	-1
#11	0.06	0.08	0.02	59	58	-1
#12	0.26	0.27	0.01	57	57	0
#13	0.14	0.21	0.07	59	61	2
#14	0.15	0.19	0.04	59	57	-2
#15	0.07	0.08	0.01	57	58	1
Maximum Loss	0.26	0.27	- - -	- - -	- - -	- - -
Mean Loss	0.11	0.13	- - -	- - -	- - -	- - -

#1 ~ #15: Pigtail Assembly

NEX1

NEX1 Technologies Co., Ltd

Table A-5-1 Humidity-Condensation Cycling Test Data [1310nm wavelength]

Item	Insertion Loss			Return Loss		
Sample	Before Test	After Test	Increase	Before Test	After Test	Increase
#1	0.17	0.09	-0.08	56	59	3
#2	0.13	0.10	-0.03	55	56	1
#3	0.17	0.16	-0.01	61	59	-2
#4	0.12	0.13	0.01	59	59	0
#5	0.14	0.14	0.00	63	60	-3
#6	0.07	0.07	0.00	58	59	1
#7	0.10	0.15	0.05	58	59	1
#8	0.07	0.13	0.06	60	59	-1
#9	0.10	0.09	-0.01	59	57	-2
#10	0.17	0.16	-0.01	59	57	-2
#11	0.17	0.13	-0.04	59	58	-1
#12	0.14	0.17	0.03	60	58	-2
#13	0.25	0.24	-0.01	63	63	0
#14	0.22	0.17	-0.05	58	61	3
#15	0.12	0.09	-0.03	57	55	-2
Maximum Loss	0.25	0.24	- - -	- - -	- - -	- - -
Mean Loss	0.14	0.13	- - -	- - -	- - -	- - -

#1 ~ #15: Pigtail Assembly

NEX1 Technologies Co., Ltd

Table A-5-2 Humidity-Condensation Cycling Test Data [1550nm wavelength]

Item	Insertion Loss			Return Loss		
Sample	Before Test	After Test	Increase	Before Test	After Test	Increase
#1	0.13	0.15	0.02	58	57	-1
#2	0.21	0.22	0.01	63	61	-2
#3	0.15	0.21	0.06	56	58	2
#4	0.06	0.04	-0.02	55	56	1
#5	0.17	0.17	0.00	54	54	0
#6	0.07	0.02	-0.05	59	57	-2
#7	0.08	0.05	-0.03	62	62	0
#8	0.05	0.02	-0.03	55	55	0
#9	0.11	0.14	0.03	57	57	0
#10	0.12	0.09	-0.03	56	58	2
#11	0.08	0.05	-0.03	58	59	1
#12	0.27	0.26	-0.01	57	56	-1
#13	0.21	0.22	0.01	61	60	-1
#14	0.19	0.21	0.02	57	56	-1
#15	0.08	0.11	0.03	58	59	1
Maximum Loss	0.27	0.26	- - -	- - -	- - -	- - -
Mean Loss	0.13	0.13	- - -	- - -	- - -	- - -

#1 ~ #15: Pigtail Assembly

NEX1 Technologies Co., Ltd

Table A-6-1 Dry-out Test Data [1310nm wavelength]

Item	Insertion Loss			Return Loss		
Sample	Before Test	After Test	Increase	Before Test	After Test	Increase
#1	0.09	0.11	0.02	59	57	-2
#2	0.10	0.09	-0.01	56	58	2
#3	0.16	0.15	-0.01	59	58	-1
#4	0.13	0.17	0.04	59	57	-2
#5	0.14	0.14	0.00	60	59	-1
#6	0.07	0.12	0.05	59	61	2
#7	0.15	0.09	-0.06	59	61	2
#8	0.13	0.12	-0.01	59	58	-1
#9	0.09	0.08	-0.01	57	57	0
#10	0.16	0.22	0.06	57	56	-1
#11	0.13	0.06	-0.07	58	57	-1
#12	0.17	0.25	0.08	58	58	0
#13	0.24	0.23	-0.01	63	60	-3
#14	0.17	0.19	0.02	61	59	-2
#15	0.09	0.09	0.00	55	56	1

#1 ~ #15: Pigtail Assembly

NEX1 Technologies Co., Ltd

Table A-6-2 Dry-out Test Data [1550nm wavelength]

Item	Insertion Loss			Return Loss		
Sample	Before Test	After Test	Increase	Before Test	After Test	Increase
#1	0.15	0.21	0.06	57	59	2
#2	0.22	0.23	0.01	61	60	-1
#3	0.21	0.26	0.05	58	58	0
#4	0.04	0.07	0.03	56	59	3
#5	0.17	0.14	-0.03	54	52	-2
#6	0.02	0.04	0.02	57	56	-1
#7	0.05	0.07	0.02	62	59	-3
#8	0.02	0.03	0.01	55	56	1
#9	0.14	0.13	-0.01	57	55	-2
#10	0.09	0.04	-0.05	58	58	0
#11	0.05	0.08	0.03	59	59	0
#12	0.26	0.22	-0.04	56	57	1
#13	0.22	0.24	0.02	60	59	-1
#14	0.21	0.27	0.06	56	58	2
#15	0.11	0.08	-0.03	59	59	0

#1 ~ #15: Pigtail Assembly

NEX1 Technologies Co., Ltd

Table A-7-1 Post –Condensation Thermal Cycle Test Data [1310nm wavelength]

Item	Insertion Loss			Return Loss		
Sample	Before Test	After Test	Increase	Before Test	After Test	Increase
#1	0.11	0.06	-0.05	57	56	-1
#2	0.09	0.10	0.01	58	56	-2
#3	0.15	0.19	0.04	58	60	2
#4	0.17	0.11	-0.06	57	58	1
#5	0.14	0.12	-0.02	59	59	0
#6	0.12	0.18	0.06	61	59	-2
#7	0.09	0.10	0.01	61	61	0
#8	0.12	0.11	-0.01	58	58	0
#9	0.08	0.04	-0.04	57	57	0
#10	0.22	0.21	-0.01	56	58	2
#11	0.06	0.08	0.02	57	58	1
#12	0.25	0.26	0.01	58	57	-1
#13	0.23	0.22	-0.01	60	59	-1
#14	0.19	0.14	-0.05	59	58	-1
#15	0.09	0.10	0.01	56	57	1
Maximum Loss	0.25	0.26	- - -	- - -	- - -	- - -
Mean Loss	0.14	0.13	- - -	- - -	- - -	- - -

#1 ~ #15: Pigtail Assembly

NEX1 Technologies Co., Ltd

Table A-7-2 Post-Condensation Thermal Cycle Test Data [1550nm wavelength]

Item	Insertion Loss			Return Loss		
Sample	Before Test	After Test	Increase	Before Test	After Test	Increase
#1	0.21	0.16	-0.05	59	59	0
#2	0.23	0.22	-0.01	60	60	0
#3	0.26	0.29	0.03	58	59	1
#4	0.07	0.09	0.02	59	59	0
#5	0.14	0.12	-0.02	52	53	1
#6	0.04	0.10	0.06	56	58	2
#7	0.07	0.12	0.05	59	60	1
#8	0.03	0.05	0.02	56	56	0
#9	0.13	0.09	-0.04	55	53	-2
#10	0.04	0.06	0.02	58	56	-2
#11	0.08	0.10	0.02	59	61	2
#12	0.22	0.23	0.01	57	59	2
#13	0.24	0.23	-0.01	59	59	0
#14	0.27	0.22	-0.05	58	58	0
#15	0.08	0.10	0.02	59	58	-1
Maximum Loss	0.27	0.29	- - -	- - -	- - -	- - -
Mean Loss	0.14	0.15	- - -	- - -	- - -	- - -

#1 ~ #15: Pigtail Assembly

NEX1

NEX1 Technologies Co., Ltd

Table A-8-1 Vibration Test Data [1310nm wavelength]

Item	Insertion Loss			Return Loss		
Sample	Before Test	After Test	Increase	Before Test	After Test	Increase
#1	0.06	0.12	0.06	56	58	2
#2	0.10	0.11	0.01	56	55	-1
#3	0.19	0.24	0.05	60	60	0
#4	0.11	0.14	0.03	58	61	3
#5	0.12	0.09	-0.03	59	57	-2
#6	0.18	0.20	0.02	59	58	-1
#7	0.10	0.08	-0.02	61	58	-3
#8	0.11	0.12	0.01	58	59	1
#9	0.04	0.03	-0.01	57	55	-2
#10	0.21	0.16	-0.05	58	58	0
#11	0.08	0.11	0.03	58	58	0
#12	0.26	0.22	-0.04	57	58	1
#13	0.22	0.24	0.02	59	58	-1
#14	0.14	0.20	0.06	58	60	2
#15	0.10	0.12	0.02	57	57	0
Maximum Loss	0.26	0.24	- - -	- - -	- - -	- - -
Mean Loss	0.13	0.15	- - -	- - -	- - -	- - -

#1 ~ #15: Pigtail Assembly

Table A-8-2 Vibration Test Data [1550nm wavelength]

NEX1 Technologies Co., Ltd

Item	Insertion Loss			Return Loss		
Sample	Before Test	After Test	Increase	Before Test	After Test	Increase
#1	0.16	0.08	-0.08	59	57	-2
#2	0.22	0.19	-0.03	60	61	1
#3	0.29	0.28	-0.01	59	60	1
#4	0.09	0.10	0.01	59	56	-3
#5	0.12	0.12	0.00	53	54	1
#6	0.10	0.10	0.00	58	58	0
#7	0.12	0.17	0.05	60	60	0
#8	0.05	0.11	0.06	56	54	-2
#9	0.09	0.08	-0.01	53	53	0
#10	0.06	0.05	-0.01	56	55	-1
#11	0.10	0.06	-0.04	61	62	1
#12	0.23	0.26	0.03	59	57	-2
#13	0.23	0.22	-0.01	59	60	1
#14	0.22	0.17	-0.05	58	56	-2
#15	0.10	0.07	-0.03	58	60	2
Maximum Loss	0.29	0.28	- - -	- - -	- - -	- - -
Mean Loss	0.15	0.14	- - -	- - -	- - -	- - -

#1 ~ #15: Pigtail Assembly

Table A-9-1 Flex Test Data [1310nm wavelength]

NEX1 Technologies Co., Ltd

Item	Insertion Loss			Return Loss		
Sample	Before Test	After Test	Increase	Before Test	After Test	Increase
#1	0.12	0.16	0.04	58	58	0
#2	0.11	0.08	-0.03	55	55	0
#3	0.24	0.23	-0.01	60	61	1
#4	0.14	0.05	-0.09	61	61	0
#5	0.09	0.09	0.00	57	58	1
#6	0.20	0.17	-0.03	58	60	2
#7	0.08	0.08	0.00	58	59	1
#8	0.12	0.22	0.10	59	59	0
#9	0.03	0.02	-0.01	55	53	-2
#10	0.16	0.15	-0.01	58	56	-2
#11	0.11	0.13	0.02	58	60	2
#12	0.22	0.23	0.01	58	60	2
#13	0.24	0.23	-0.01	58	58	0
#14	0.20	0.15	-0.05	60	60	0
#15	0.12	0.13	0.01	57	56	-1
Maximum Loss	0.24	0.23	- - -	- - -	- - -	- - -
Mean Loss	0.15	0.14	- - -	- - -	- - -	- - -

#1 ~ #15: Pigtail Assembly

Table A-9-2 Flex Test Data [1550nm wavelength]

NEX1

NEX1 Technologies Co., Ltd

Item	Insertion Loss			Return Loss		
Sample	Before Test	After Test	Increase	Before Test	After Test	Increase
#1	0.08	0.05	-0.03	57	56	-1
#2	0.19	0.14	-0.05	61	62	1
#3	0.28	0.29	0.01	60	59	-1
#4	0.10	0.15	0.05	56	57	1
#5	0.12	0.09	-0.03	54	54	0
#6	0.10	0.12	0.02	58	56	-2
#7	0.17	0.18	0.01	60	61	1
#8	0.11	0.09	-0.02	54	54	0
#9	0.08	0.07	-0.01	53	55	2
#10	0.05	0.05	0.00	55	55	0
#11	0.06	0.09	0.03	62	62	0
#12	0.26	0.27	0.01	57	56	-1
#13	0.22	0.24	0.02	60	60	0
#14	0.17	0.14	-0.03	56	55	-1
#15	0.07	0.07	0.00	60	61	1
Maximum Loss	0.28	0.29	- - -	- - -	- - -	- - -
Mean Loss	0.14	0.14	- - -	- - -	- - -	- - -

#1 ~ #15: Pigtail Assembly

Table A-10-1 Twist Test Data [1310nm wavelength]

NEX1

NEX1 Technologies Co., Ltd

Item	Insertion Loss			Return Loss		
Sample	Before Test	After Test	Increase	Before Test	After Test	Increase
#1	0.16	0.15	-0.01	58	56	-2
#2	0.08	0.09	0.01	55	56	1
#3	0.23	0.29	0.06	61	62	1
#4	0.05	0.03	-0.02	61	58	-3
#5	0.09	0.09	0.00	58	59	1
#6	0.17	0.12	-0.05	60	60	0
#7	0.08	0.08	0.00	59	59	0
#8	0.22	0.22	0.00	59	57	-2
#9	0.02	0.05	0.03	53	53	0
#10	0.15	0.16	0.01	56	55	-1
#11	0.13	0.10	-0.03	60	61	1
#12	0.23	0.22	-0.01	60	58	-2
#13	0.23	0.24	0.01	58	59	1
#14	0.15	0.14	-0.01	60	58	-2
#15	0.13	0.16	0.03	56	58	2
Maximum Loss	0.23	0.29	- - -	- - -	- - -	- - -
Mean Loss	0.14	0.14	- - -	- - -	- - -	- - -

#1 ~ #15: Pigtail Assembly

Table A-10-2 Twist Test Data [1550nm wavelength]

NEX1
NEX1 Technologies Co., Ltd

Item	Insertion Loss			Return Loss		
Sample	Before Test	After Test	Increase	Before Test	After Test	Increase
#1	0.05	0.05	0.00	56	56	0
#2	0.14	0.15	0.01	62	61	-1
#3	0.29	0.27	-0.02	59	59	0
#4	0.15	0.12	-0.03	57	57	0
#5	0.09	0.11	0.02	54	53	-1
#6	0.12	0.09	-0.03	56	55	-1
#7	0.18	0.23	0.05	61	61	0
#8	0.09	0.12	0.03	54	55	1
#9	0.07	0.06	-0.01	55	56	1
#10	0.05	0.04	-0.01	55	57	2
#11	0.09	0.11	0.02	62	61	-1
#12	0.27	0.26	-0.01	56	56	0
#13	0.24	0.21	-0.03	60	58	-2
#14	0.14	0.14	0.00	55	55	0
#15	0.07	0.09	0.02	61	61	0
Maximum Loss	0.29	0.27	- - -	- - -	- - -	- - -
Mean Loss	0.14	0.14	- - -	- - -	- - -	- - -

#1 ~ #15: Pigtail Assembly

Table A-11-1 Straight Pull Test Data   [1310nm wavelength]

NEX1 Technologies Co., Ltd

Item	Insertion Loss			Return Loss		
Sample	Before Test	After Test	Increase	Before Test	After Test	Increase
#1	0.15	0.15	0.00	56	55	-1
#2	0.09	0.10	0.01	56	57	1
#3	0.29	0.29	0.00	62	61	-1
#4	0.03	0.03	0.00	58	59	1
#5	0.09	0.10	0.01	59	59	0
#6	0.12	0.13	0.01	60	58	-2
#7	0.08	0.13	0.05	59	60	1
#8	0.22	0.25	0.03	57	57	0
#9	0.05	0.04	-0.01	53	55	2
#10	0.16	0.15	-0.01	55	55	0
#11	0.10	0.09	-0.01	61	61	0
#12	0.22	0.23	0.01	58	57	-1
#13	0.24	0.24	0.00	59	59	0
#14	0.14	0.14	0.00	58	57	-1
#15	0.16	0.19	0.03	58	59	1
Maximum Loss	0.29	0.29	- - -	- - -	- - -	- - -
Mean Loss	0.14	0.15	- - -	- - -	- - -	- - -

#1 ~ #15: Pigtail Assembly

Table A-11-2 Straight Pull Test Data [1550nm wavelength]

NEX1

NEX1 Technologies Co., Ltd

Item	Insertion Loss			Return Loss		
Sample	Before Test	After Test	Increase	Before Test	After Test	Increase
#1	0.05	0.06	0.01	56	58	2
#2	0.15	0.14	-0.01	61	61	0
#3	0.27	0.26	-0.01	59	58	-1
#4	0.12	0.13	0.01	57	58	1
#5	0.11	0.13	0.02	53	55	2
#6	0.09	0.08	-0.01	55	55	0
#7	0.23	0.27	0.04	61	60	-1
#8	0.12	0.10	-0.02	55	55	0
#9	0.06	0.05	-0.01	56	53	-3
#10	0.04	0.07	0.03	57	58	1
#11	0.11	0.13	0.02	61	60	-1
#12	0.26	0.27	0.01	56	57	1
#13	0.21	0.20	-0.01	58	58	0
#14	0.14	0.15	0.01	55	56	1
#15	0.09	0.08	-0.01	61	59	-2
Maximum Loss	0.27	0.27	- - -	- - -	- - -	- - -
Mean Loss	0.14	0.14	- - -	- - -	- - -	- - -

#1 ~ #15: Pigtail Assembly

Table A-11-3 Straight Pull Test Data [1310nm wavelength]

NEX1 Technologies Co., Ltd

Item	Insertion Loss			Return Loss		
Sample	Before Test	After Test	Increase	Before Test	After Test	Increase
#1	0.15	0.14	-0.01	55	55	0
#2	0.10	0.11	0.01	57	56	-1
#3	0.29	0.27	-0.02	61	61	0
#4	0.03	0.04	0.01	59	59	0
#5	0.10	0.13	0.03	59	58	-1
#6	0.13	0.13	0.00	58	57	-1
#7	0.13	0.17	0.04	60	60	0
#8	0.25	0.27	0.02	57	58	1
#9	0.04	0.01	-0.03	55	56	1
#10	0.15	0.13	-0.02	55	57	2
#11	0.09	0.09	0.00	61	60	-1
#12	0.23	0.24	0.01	57	57	0
#13	0.24	0.22	-0.02	59	57	-2
#14	0.14	0.13	-0.01	57	57	0
#15	0.19	0.21	0.02	59	59	0
Maximum Loss	0.29	0.27	- - -	- - -	- - -	- - -
Mean Loss	0.15	0.15	- - -	- - -	- - -	- - -

#1 ~ #15: Pigtail Assembly

Table A-11-4 Straight Pull Test Data [1550nm wavelength]

Item	Insertion Loss	Return Loss

NEX1 Technologies Co., Ltd

Sample	Before Test	After Test	Increase	Before Test	After Test	Increase
#1	0.06	0.05	-0.01	58	59	1
#2	0.14	0.16	0.02	61	60	-1
#3	0.26	0.25	-0.01	58	57	-1
#4	0.13	0.18	0.05	58	58	0
#5	0.13	0.13	0.00	55	56	1
#6	0.08	0.07	-0.01	55	57	2
#7	0.27	0.27	0.00	60	58	-2
#8	0.10	0.10	0.00	55	56	1
#9	0.05	0.07	0.02	53	51	-2
#10	0.07	0.08	0.01	58	58	0
#11	0.13	0.09	-0.04	60	60	0
#12	0.27	0.22	-0.05	57	58	1
#13	0.20	0.23	0.03	58	59	1
#14	0.15	0.14	-0.01	56	57	1
#15	0.08	0.06	-0.02	59	58	-1
Maximum Loss	0.27	0.27	- - -	- - -	- - -	- - -
Mean Loss	0.14	0.14	- - -	- - -	- - -	- - -

#1 ~ #15: Pigtail Assembly

Table A-11-5 Side Pull Test Data [1310nm wavelength]

Item	Insertion Loss	Return Loss

NEX1 Technologies Co., Ltd

Sample	Before Test	After Test	Increase	Before Test	After Test	Increase
#1	0.14	0.12	-0.02	55	57	2
#2	0.11	0.13	0.02	56	56	0
#3	0.27	0.26	-0.01	61	60	-1
#4	0.04	0.09	0.05	59	60	1
#5	0.13	0.13	0.00	58	60	2
#6	0.13	0.12	-0.01	57	57	0
#7	0.17	0.14	-0.03	60	59	-1
#8	0.27	0.28	0.01	58	58	0
#9	0.01	0.03	0.02	56	53	-3
#10	0.13	0.13	0.00	57	58	1
#11	0.09	0.05	-0.04	60	59	-1
#12	0.24	0.19	-0.05	57	58	1
#13	0.22	0.25	0.03	57	57	0
#14	0.13	0.11	-0.02	57	58	1
#15	0.21	0.20	-0.01	59	57	-2
Maximum Loss	0.27	0.28	- - -	- - -	- - -	- - -
Mean Loss	0.15	0.15	- - -	- - -	- - -	- - -

#1 ~ #15: Pigtail Assembly

Table A-11-6 Side Pull Test Data [1550nm wavelength]

Item	Insertion Loss	Return Loss

Sample	Before Test	After Test	Increase	Before Test	After Test	Increase
#1	0.05	0.04	-0.01	59	59	0
#2	0.16	0.17	0.01	60	59	-1
#3	0.25	0.23	-0.02	57	59	2
#4	0.18	0.19	0.01	58	57	-1
#5	0.13	0.16	0.03	56	56	0
#6	0.07	0.07	0.00	57	58	1
#7	0.27	0.28	0.01	58	60	2
#8	0.10	0.09	-0.01	56	54	-2
#9	0.07	0.04	-0.03	51	53	2
#10	0.08	0.07	-0.01	58	58	0
#11	0.09	0.09	0.00	60	59	-1
#12	0.22	0.23	0.01	58	57	-1
#13	0.23	0.21	-0.02	59	59	0
#14	0.14	0.13	-0.01	57	57	0
#15	0.06	0.07	0.01	58	56	-2
Maximum Loss	0.27	0.28	- - -	- - -	- - -	- - -
Mean Loss	0.14	0.14	- - -	- - -	- - -	- - -

#1 ~ #15: Pigtail Assembly

Table A-11-7 Side Pull Test Data [1310nm wavelength]

Item	Insertion Loss	Return Loss

NEX1 Technologies Co., Ltd

Sample	Before Test	After Test	Increase	Before Test	After Test	Increase
#1	0.12	0.13	0.01	57	58	1
#2	0.13	0.08	-0.05	56	55	-1
#3	0.26	0.25	-0.01	60	59	-1
#4	0.09	0.10	0.01	60	60	0
#5	0.13	0.15	0.02	60	61	1
#6	0.12	0.11	-0.01	57	59	2
#7	0.14	0.15	0.01	59	57	-2
#8	0.28	0.26	-0.02	58	59	1
#9	0.03	0.02	-0.01	53	51	-2
#10	0.13	0.13	0.00	58	58	0
#11	0.05	0.07	0.02	59	59	0
#12	0.19	0.20	0.01	58	59	1
#13	0.25	0.24	-0.01	57	58	1
#14	0.11	0.12	0.01	58	59	1
#15	0.20	0.20	0.00	57	56	-1
Maximum Loss	0.28	0.26	- - -	- - -	- - -	- - -
Mean Loss	0.15	0.15	- - -	- - -	- - -	- - -

#1 ~ #15: Pigtail Assembly

Table A-11-8 Side Pull Test Data [1550nm wavelength]

Item	Insertion Loss	Return Loss

NEX1 Technologies Co., Ltd

Sample	Before Test	After Test	Increase	Before Test	After Test	Increase
#1	0.04	0.06	0.02	59	60	1
#2	0.17	0.16	-0.01	59	59	0
#3	0.23	0.23	0.00	59	60	1
#4	0.19	0.19	0.00	57	55	-2
#5	0.16	0.17	0.01	56	54	-2
#6	0.07	0.08	0.01	58	58	0
#7	0.28	0.27	-0.01	60	61	1
#8	0.09	0.11	0.02	54	53	-1
#9	0.04	0.03	-0.01	53	54	1
#10	0.07	0.06	-0.01	58	57	-1
#11	0.09	0.08	-0.01	59	60	1
#12	0.23	0.24	0.01	57	57	0
#13	0.21	0.21	0.00	59	60	1
#14	0.13	0.10	-0.03	57	55	-2
#15	0.07	0.09	0.02	56	58	2
Maximum Loss	0.28	0.27	- - -	- - -	- - -	- - -
Mean Loss	0.14	0.14	- - -	- - -	- - -	- - -

#1 ~ #15: Pigtail Assembly

Table A-12-1 Impact Test Data [1310nm wavelength]

Item	Insertion Loss	Return Loss

Sample	Before Test	After Test	Increase	Before Test	After Test	Increase
#1	0.13	0.13	0.00	58	58	0
#2	0.08	0.07	-0.01	55	54	-1
#3	0.25	0.27	0.02	59	61	2
#4	0.10	0.14	0.04	60	59	-1
#5	0.15	0.13	-0.02	61	61	0
#6	0.11	0.08	-0.03	59	60	1
#7	0.15	0.11	-0.04	57	59	2
#8	0.26	0.23	-0.03	59	57	-2
#9	0.02	0.03	0.01	51	53	2
#10	0.13	0.12	-0.01	58	58	0
#11	0.07	0.08	0.01	59	58	-1
#12	0.20	0.22	0.02	59	58	-1
#13	0.24	0.22	-0.02	58	58	0
#14	0.12	0.14	0.02	59	59	0
#15	0.20	0.21	0.01	56	54	-2
Maximum Loss	0.26	0.27	- - -	- - -	- - -	- - -
Mean Loss	0.15	0.15	- - -	- - -	- - -	- - -

#1 ~ #15: Pigtail Assembly

Table A-12-2   Impact Test Data [1550nm wavelength]

Item	Insertion Loss	Return Loss

NEX1

NEX1 Technologies Co., Ltd

Sample	Before Test	After Test	Increase	Before Test	After Test	Increase
#1	0.06	0.06	0.00	60	59	-1
#2	0.16	0.18	0.02	59	57	-2
#3	0.23	0.24	0.01	60	61	1
#4	0.19	0.21	0.02	55	57	2
#5	0.17	0.21	0.04	54	56	2
#6	0.08	0.11	0.03	58	58	0
#7	0.27	0.26	-0.01	61	62	1
#8	0.11	0.10	-0.01	53	53	0
#9	0.03	0.03	0.00	54	53	-1
#10	0.06	0.08	0.02	57	59	2
#11	0.08	0.10	0.02	60	61	1
#12	0.24	0.27	0.03	57	56	-1
#13	0.21	0.22	0.01	60	59	-1
#14	0.10	0.11	0.01	55	56	1
#15	0.09	0.06	-0.03	58	58	0
Maximum Loss	0.27	0.27	- - -	- - -	- - -	- - -
Mean Loss	0.14	0.15	- - -	- - -	- - -	- - -

#1 ~ #15: Pigtail Assembly