Technical University of Lodz

Department of Semiconductor of Optoelectronics Devices

Laboratory of Optoelectornics

Instruction 1

Production of optical patchcords

1. Goal

The main aim of this exercise is a fabrication of optical connectors (patchcords) of two types at the ends of the singlemode optical fibers using special kit and the optical characterization of self-made optical connectors.

2. Theory

Patchcord is an optical fibre which is ended from <u>both sides</u> with fiber optic connectors

Pigtail is an optical fiber which is ended from <u>one side</u> with fiber optic connector and from the other side it can be welded to the existing fiber network.

Among the severa; types of fiber optic connectors manufactured we have two groups of fiber connectors: one to connet the individual fibres and the second to connect paris of fibers. Due to the structure of joints of individual market the greatest popularity have: type FC (Fiber Connector), type SC (Subscriber Connector) and type ST (Straigh Tip). The latter are the basic design needed to combine several optocal fibers at the same time. Optical properies of all three types of connectors are comparable, and the losses must not exceed 0,5dB. A good connection gives losses below 0,1dB.

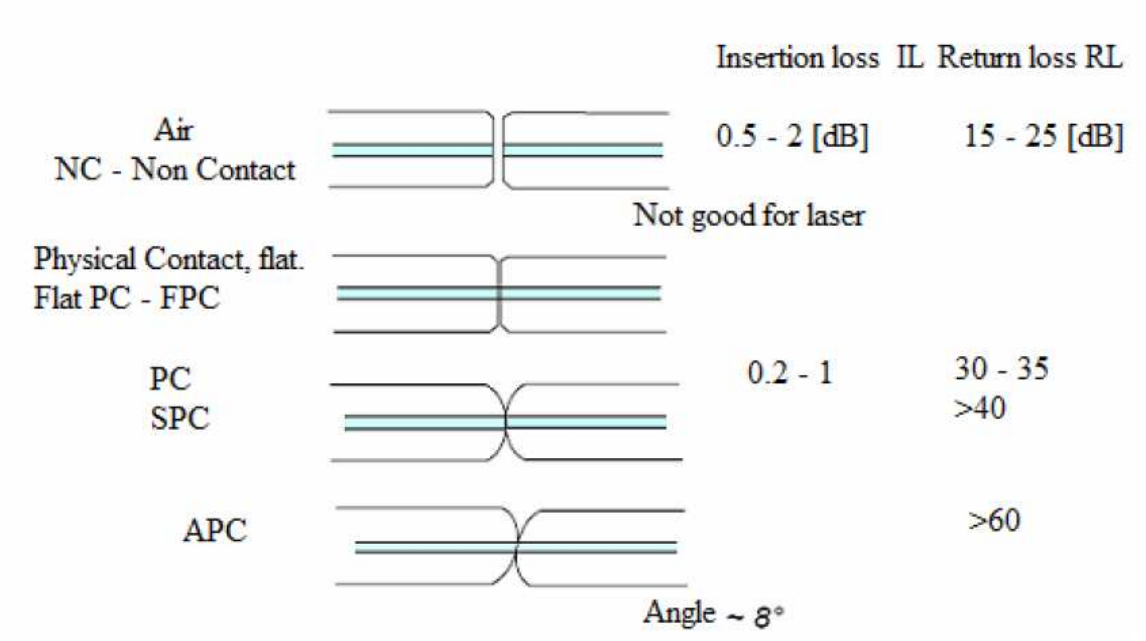


Fig.1 Types of fiber optic connectors.

To minimize losses of fiber optic connectors usually we use the optical fibers with polished contact faces in the technique of PC - Physical Contact, or at a slight angle in the technique of APC - Angled Physical Contact, to eliminate reflections. Several different types of fiber optic connectors and connecting techniques creates a combination of connectors: FC / PC, FC / APC, ST / PC, ST / APC, SC / PC, SC / APC. Another family of connectors for multimode fiber are SMA - Subminiature Assembly and a lot of double joints.

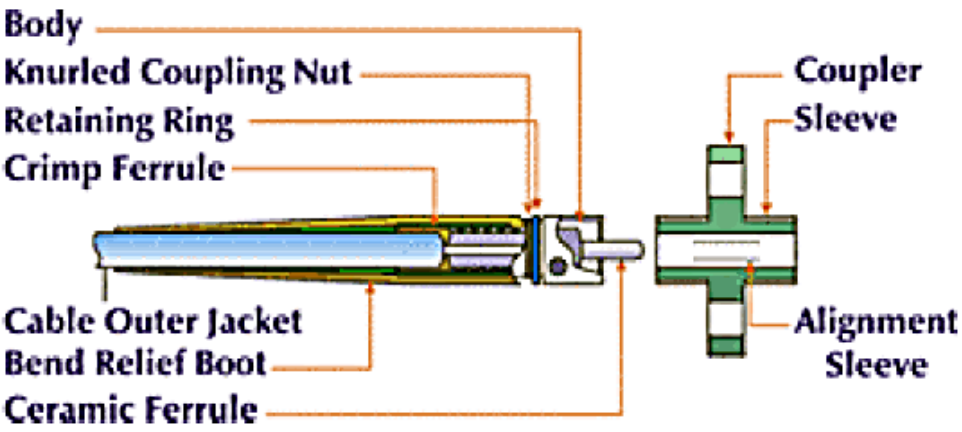


Fig.2 Optical fiber connector – structure.[http://www.fiberoptics4sale.com/wordpress/fiber-optic-connectors-basics-styles-trends/]

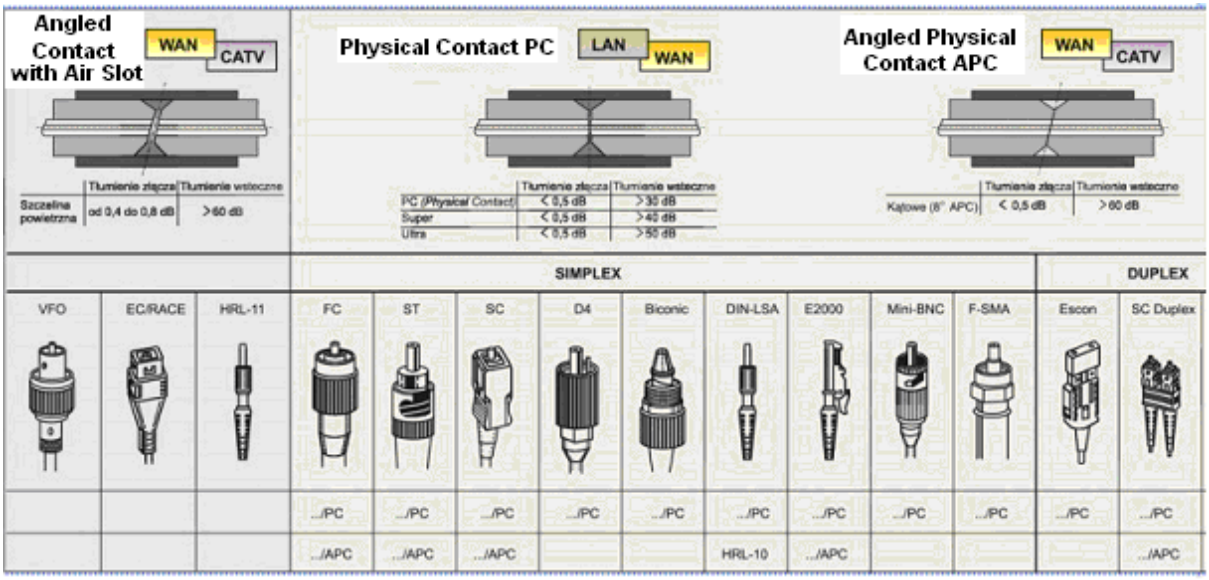


Fig. 3 Types of fiber optic connectors.

Nowaday, preferred connecting technique is the PC which allows to obtain the smallest losses while maintaining a high level of back-reflection. In this kind of connectors the back-attenuation is bigger then 40dB (40 dB for Super PC, 50 dB for Ultra PC and around 60 dB for Angled PC). Keeping these parameters requires high-precision, polishing and proper curvature of surrounding ferrule.

Geometry of the PC connectors.
To obtain the appropriate geometrical parameters we have to ensure a proper physical contact between two fibers placed in the ferrule which aims to stiffen the fiber. This effect is achieved by carefully polishing the spherical surface of the fibers to connect two surfaces in center of alignment sleeve. The elimination of the air gap we obtain by gentle pressure of connected fibers: fibers bend until the contact sleeve. Physical contact of fibers must be stable and independent of temperature changes, time, pressuer and vibration.

The spherical polishing process is very improtant and we have to remeber to do it properly - not too long because it causes the undercuts effect which means that we are dealing with air gap and hence the increase of the back-reflection effect of the connection – and not too short because the forces during connection fibers causes the regression effect.

International standards specify three physical quantities that allow determine the quality of polished surfaces: radius of curvature (radius of the sphere formed on the polished Alignment sleeve), the amount of fiber (distance issue or relief after polishing fiber in relation to aligning sleeve) and the highest peak shift (shift polishing and peak,)

3. Exercise

The kit includes:

- Cutter
- Stripper Miller for 900um and 250um buffer
- Clauss Kevlar Shears
- Glue Hysol
- Knife to scribe fiber Dual Sapphire Scribe
- Oven MultiCureII 24 ports ST/SMA/FC/LC/SC
- Metal casing on the Tubes 2,5mm, 3mm and 1,25mm (24 pieces)
- Stainless Steel Polishing Puck to ST, SC, FC, LC connectors
- Glass polishing pad connectors
- Crimper
- Syringes with needles in the resin (10 pieces)
- Wire ferrulr clearing
- Polishing paper film 0,3um, 3um and 30um (5 pieces)
- Isopropyl Alcohol IPA 1l
- Feeder IPA wipes dust-free KimWipes (250 pieces in one package)
- Container waste fiber
- FIS 400x Fiber Optic Inspector Scope
- Locator of damage
- Suitcase

WARNING! Before this exercise, see the instructional movie placed on your computer!

WARNING! During this exercise you have to wear safety goggles!

a. Slide the connector cover on the fiber optic cable as shown in Figure 4.

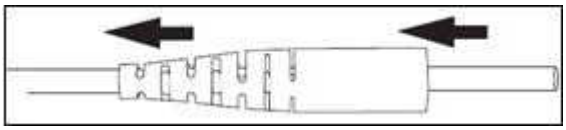


Fig.4 (http://theeraj1986.hpage.co.in/sc_pc_12756543.html)

b. Remove around 35mm (ST) / 30mm (SC) of cabel outer jacket, leave 10mm (ST) / 8mm (SC) of kevlar and using scissor cut off the rest. See Figure 5.

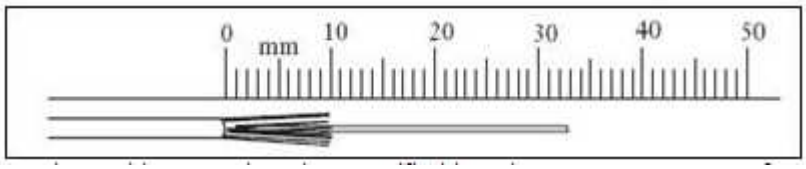


Fig.5 (http://theeraj1986.hpage.co.in/sc_pc_12756543.html)

c. Remove the kevlar at the cabel outer jacket and slide the ferrule and push kevlar back.
d. Remove around 18mm (ST / SC) of fiber cover - using the middle hole of stripper. Then using the smallest hole of stripper remove the acrylic.

Fig.6 Stripper – used to remove the fiber covers and acrylic.
(http://theeraj1986.hpage.co.in/sc_pc_12756543.html)

e. Prepare two-components epoxide glue , mixing small amounts of ingredients. The resulting mixture places in the syringe.
f. Clean the optical connector using tissue, then injected into the mixture of epoxy glue A / B, as shown in Fig.7. WARNING! Too much glue may causes impurity at the fiber front.

Rys.7 (http://theeraj1986.hpage.co.in/sc_pc_12756543.html)

g. Slide the fiber optic connector ST / SC, until you feel resistance (see Figure 8). Remove glue from the jutting out part of optical fiber.

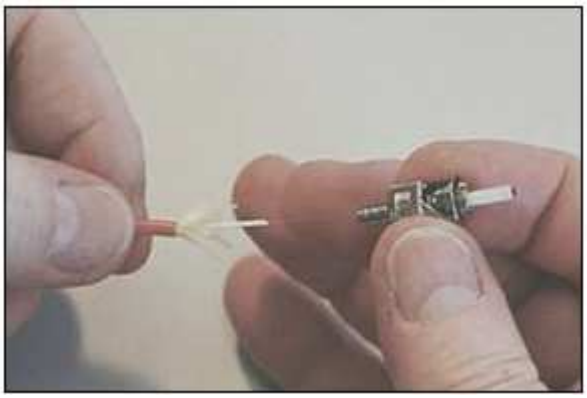


Fig.8 (http://theeraj1986.hpage.co.in/sc_pc_12756543.html)

h. Hold the cable and slide the ferrule with kevlar. Impose kevlar on the connector. Holding the connector, slide the ferrule back on kevlar. Using crimper - crimp theferrule at the connector as on Fig.9.

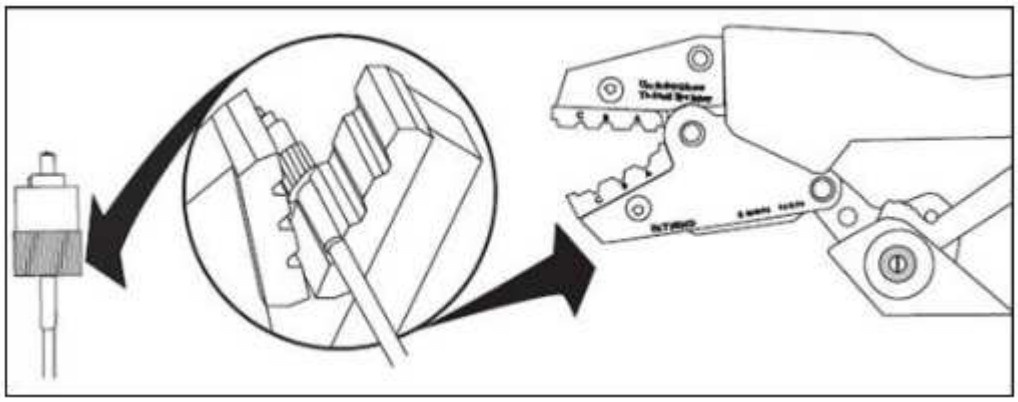


Fig.9 (http://theeraj1986.hpage.co.in/sc_pc_12756543.html)

i. Put same glue on the connector in place of clamp and slide the connector cover.
j. Put prepared connector into the oven and hold it. Then wait for few minutes until the connector will be cold.

Fig.10 Oven used for heating the connectors (http://theeraj1986.hpage.co.in/sc_pc_12756543.html)

k. After the glue solidified cut projecting fiber from the connector using the stylus.
l. Fasten the connector polishing disks. Put the paper on the polishing pad and polish the tip of the connector. To accurately polish the connector do about twenty "eights". Repeat the same thing on paper of less grain.
m. After each polishing the surface of connector should be examined under a microscope. The effect of polishing is shown as Fig.14.

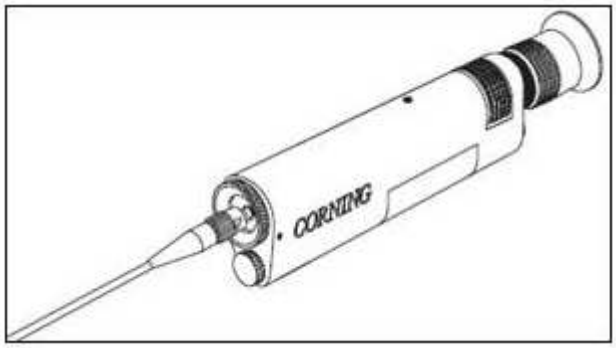
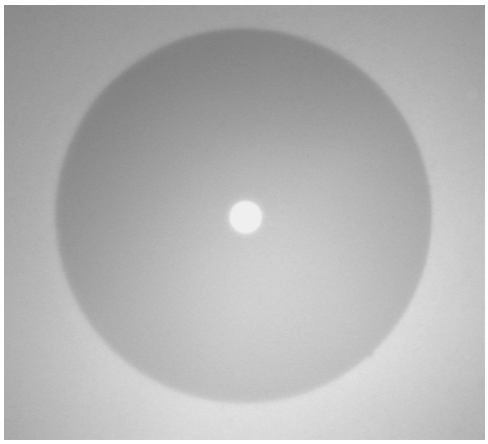


Fig.13 Examinationof optical fiber surface under the microscope. (http://theeraj1986.hpage.co.in/sc_pc_12756543.html)



Rys.14(http://fca.com.pl/s/29/pol/52,Geometria_zlaczy_i_jakosc_produkcji)

n. Clean the connector surfaces using the alcohol, then install the cover which protect from dust.
o. See the effect of work using the OTDR probe. To do this, ask teacher. Photo taken by OTDR'a include to the report.

Below are examples of defects in optical fiber surfaces. These defects make that the signal transmission is difficult or even impossible. Figure 15, 16, 17

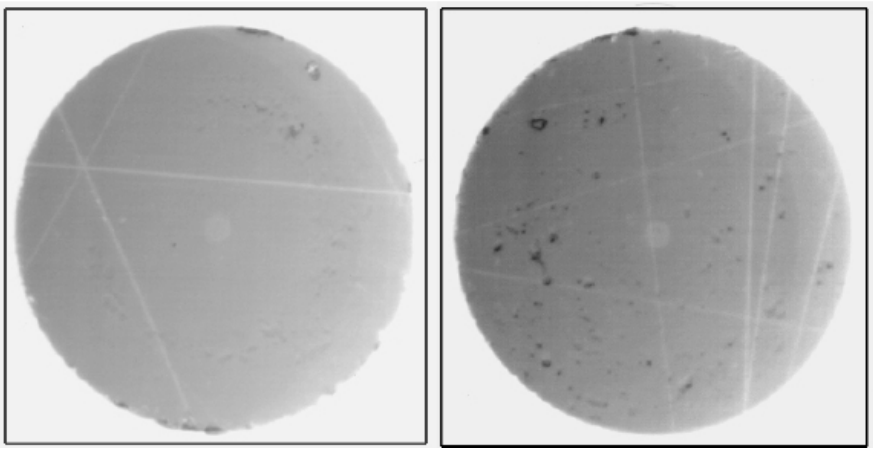


Fig. 15 Badly polished fiber surfaces. Indication - continue polishing.

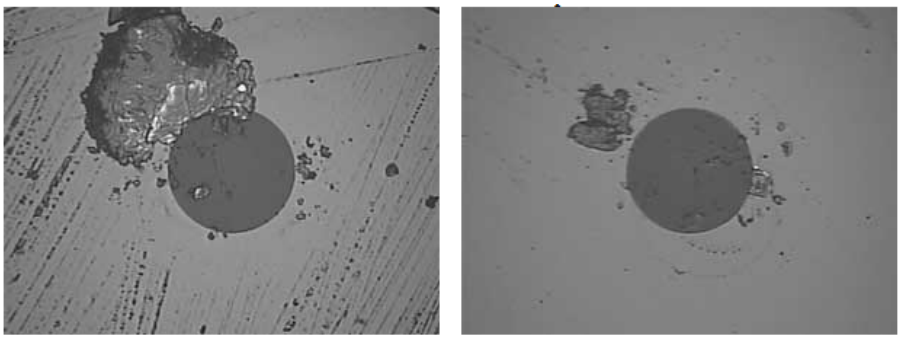


Fig. 16 Dirty fiber surfaces. Indication – continue cleaning using alcohol.

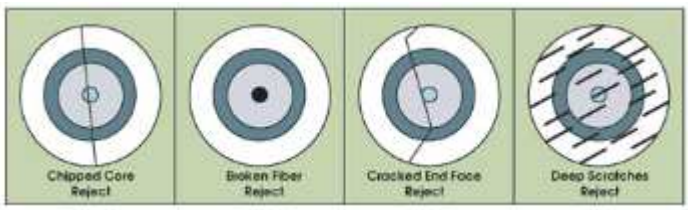


Fig. 17 Mechanical damages which disqualify connectors From left: nicked core, cracked core, crack fibers tip, deep scratches impossible to be polished (http://www.photonics.com/Article.aspx?AID=17379)

4. Raport

The report should include:

- Description of each step of procedure
- Conclusions and obervations from the effects of made patch cord
- Photo of the made connectors (surface of connectors)
- Comparison of made connectors and the optical fiber from telecomunication.