Aerospace Fiber Optics

AFO 101, Session 2

Fiber Optic Assembly

Session Learning Objectives

After completing this session you should be able to:

- Work safely with materials used for fiber optic assembly.
- Handle fiber optic material to protect the cables from damage during the assembly process.
- Insert fiber optic termini into connector / inserts.
- Remove fiber optic termini from connector / inserts.
- Assemble fiber optic cable connectors.
- Properly apply bundle ties.

Session Agenda

- **Safety**
- **Material Handling**
- **Assembly**
  - **Installation and removal of Termini from Connector / Inserts**
  - **Connectors**
- **Assembly Project**
- **Rework**
- **Review**

Warning: Personal Safety

The light from functioning optical fibers is **invisible** and ***<u>can cause damage to your eyes.</u>***

- **Do not look into the end of a connected cable.**
- Do a very through lock-out tag-out or disconnect the cable at both ends and put on clean dust caps.

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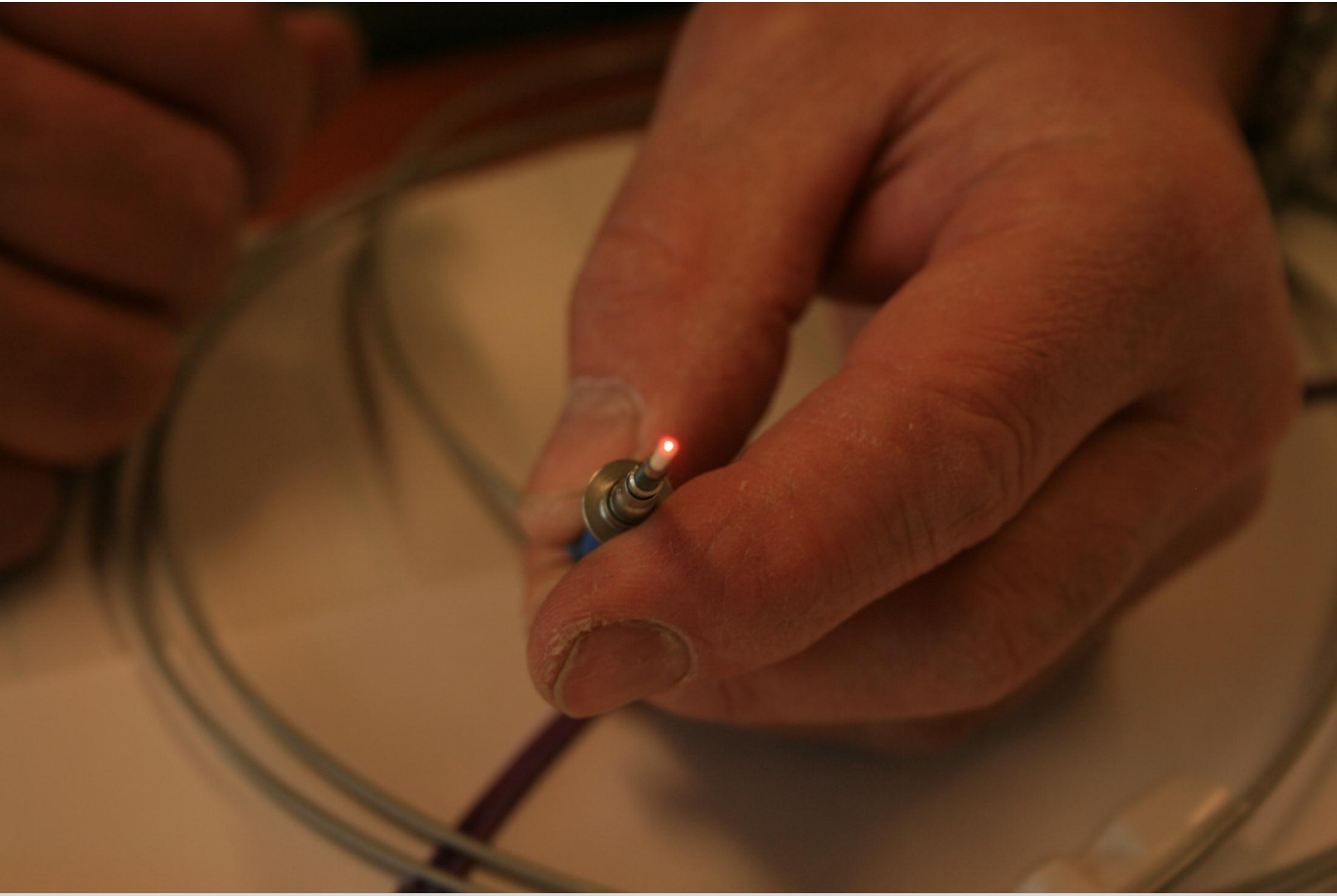

Personal Safety

- If the fiber cable gets cut, the fiber may piston out of the cut end and injure personnel.
- Fiber optic cable can cause skin punctures and may separate below the skin following puncture.
- For fiber optic cables that inadvertently get cut, place tape as flags on both cut ends to capture any fiber that may piston out.

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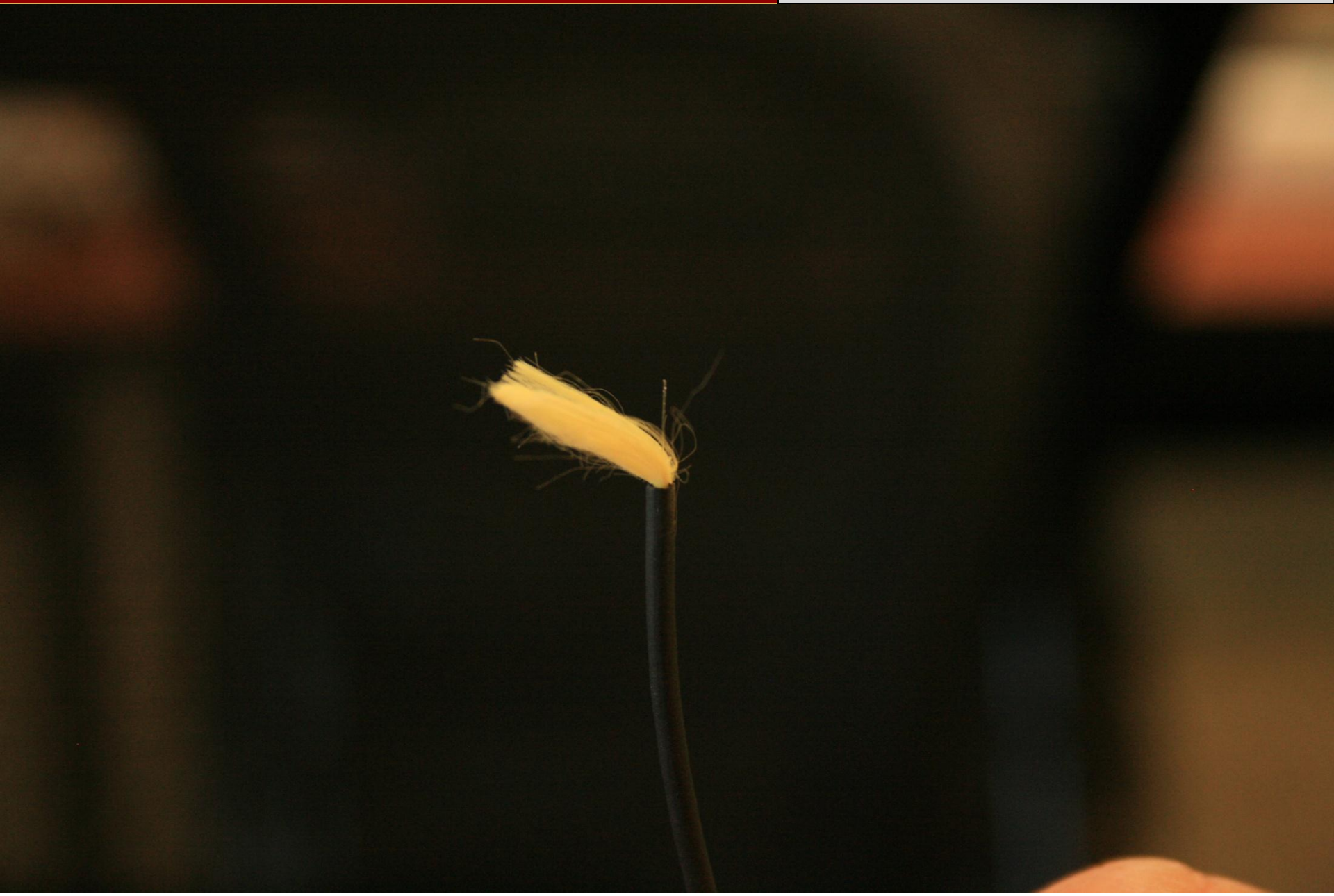

General Material Handling

- Attenuation (loss of signal strength) occurs when the end face is scratched, dirty, when the cable is damaged and at bends in the cable.
- The following guidelines help you to ensure that you prevent unnecessary causes of light loss during the routing and installation process.

Material Handling: Ensure Cleanliness

Exposure to airborne contaminates causes light loss. Protect fiber optic cables as follows:

- Ensure that the area is clean prior to opening the dust cap or protective bag.

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Material Handling: Ensure Cleanliness

Exposure to airborne contaminates causes light loss. Protect fiber optic cables as follows:

- Ensure that the area is clean prior to opening the dust cap or protective bag.
- **DO NOT** remove the dust cap from uninstalled assembly (termini) except to insert the assemblies into connectors.
- **Only** remove the dust caps from the connectors when ready to mate the connectors. Mate the connectors immediately.
- **DO NOT** touch the end face with your fingers or any tools.

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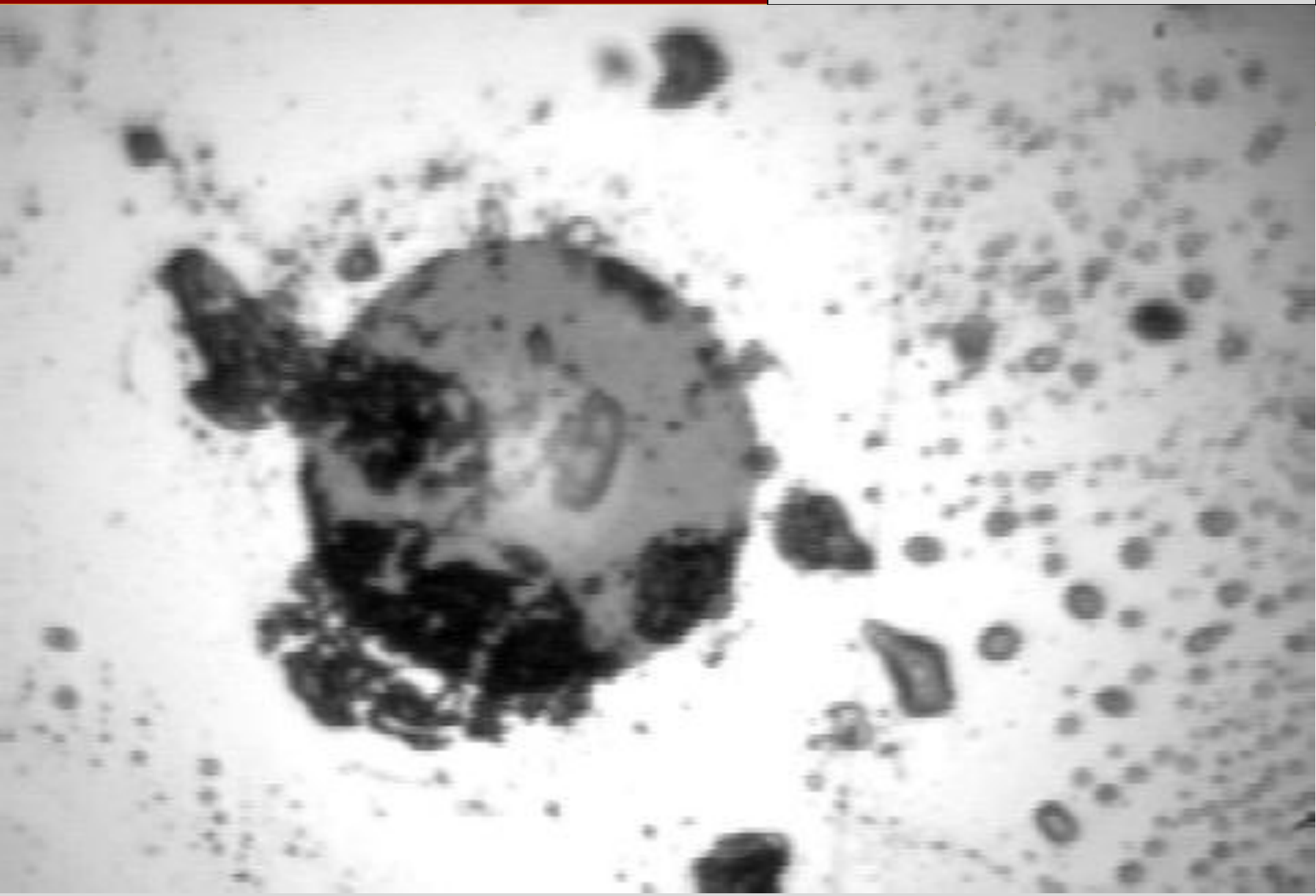


Material Handling: Protect Cables From Damage

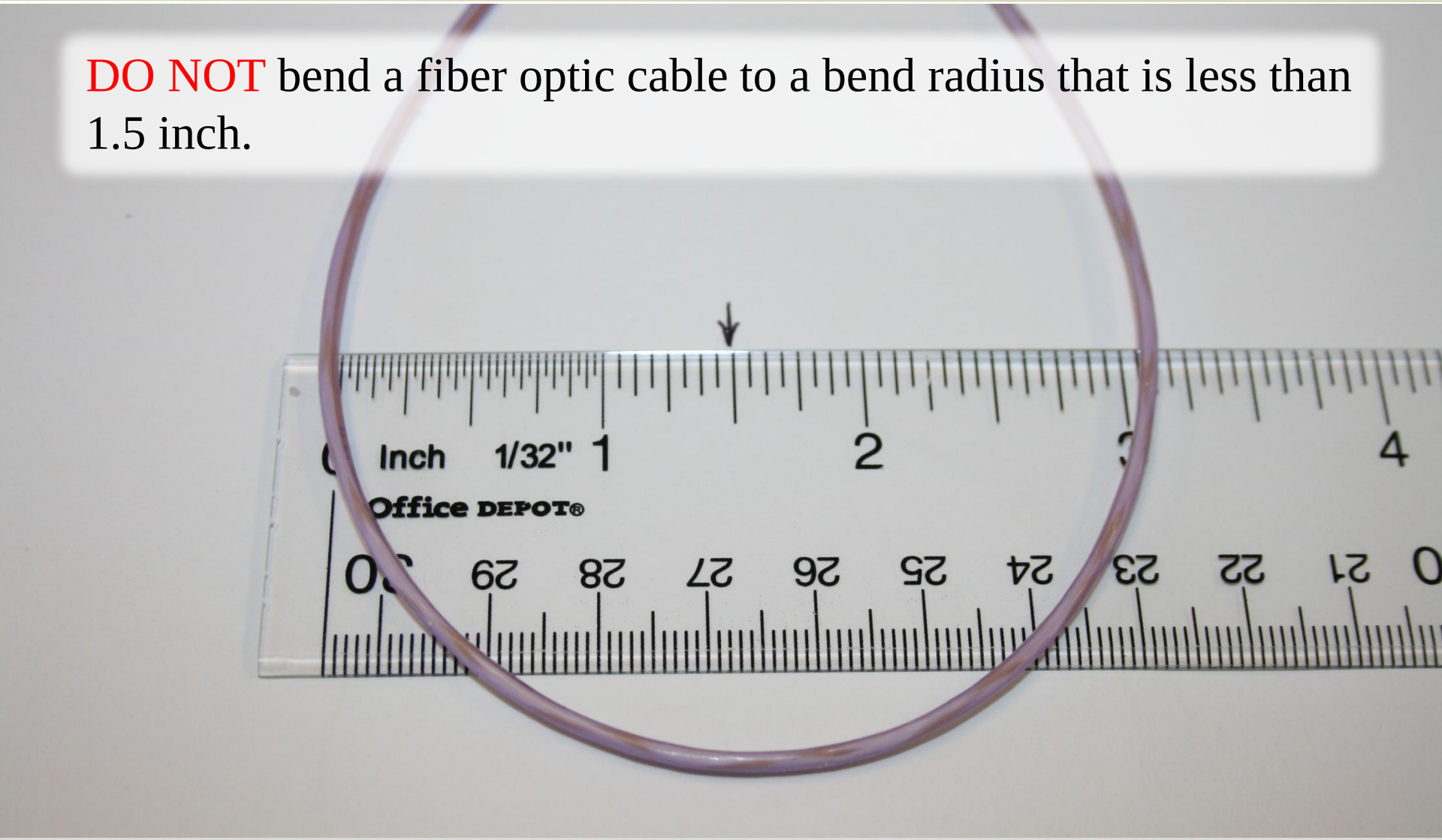
Material Handling: Protect Cables From Damage

Handle fiber optic cable assemblies carefully:

- **DO NOT** step on fiber optic cable assemblies or allow anything to fall on them.
- **DO NOT** put anything on a fiber optic cable assembly.
- **DO NOT** allow the connectors to fall on the floor or a hard surface.
- **DO NOT** hang shop lights or other equipment from a fiber optic bundle.
- **DO NOT** use fiber optic bundles as a hand hold.
- **DO NOT** stress the fiber in any way.

Bend Radius Minimum

DO NOT bend a fiber optic cable to a bend radius that is less than 1.5 inch.

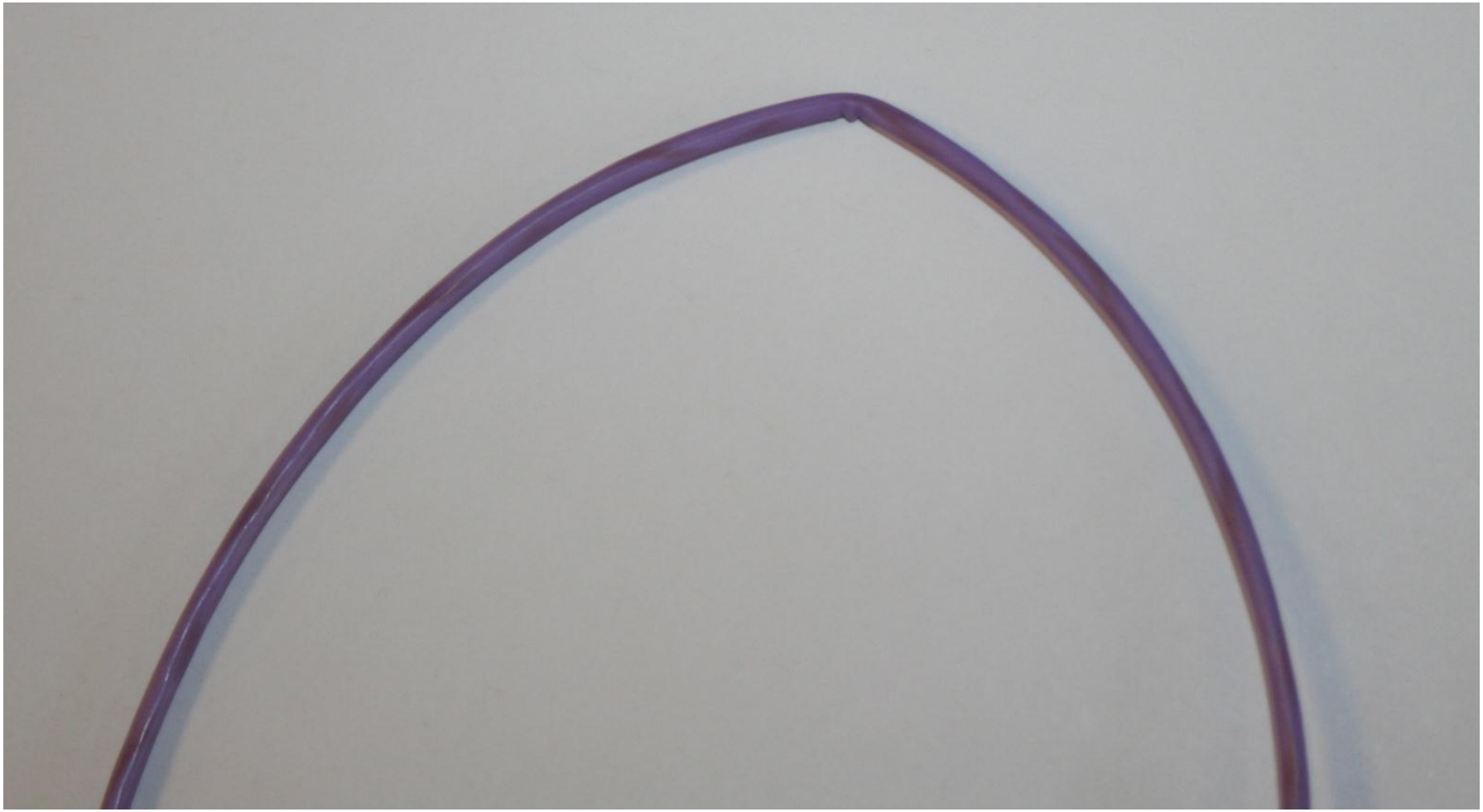


Material Handling: Bend Radius Minimum

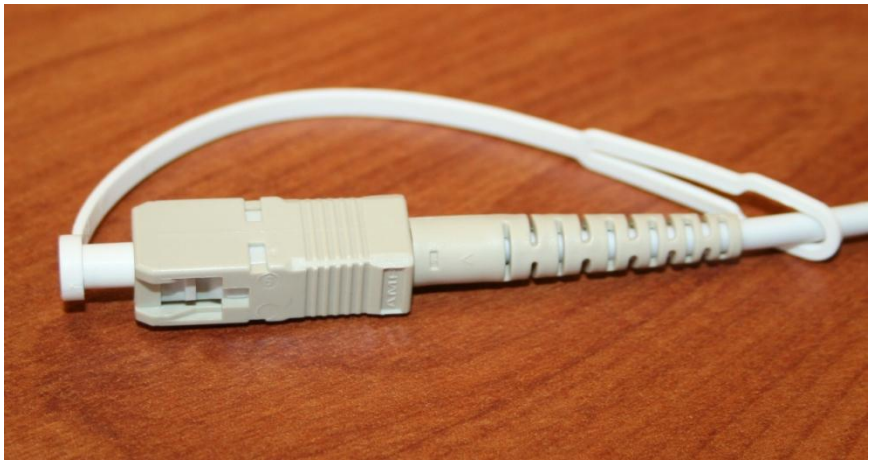
If you believe that a fiber optic cable has exceeded the bend radius:

1. Bend the cable into a loop of 3.0 to 3.5 inches in diameter with the damaged area at the top of the loop.
2. Look for possible damage.
3. Mark the damaged area with a piece of adhesive tape and record the location for action.
4. Notify quality of the damaged cable.

Bent Straw syndrome

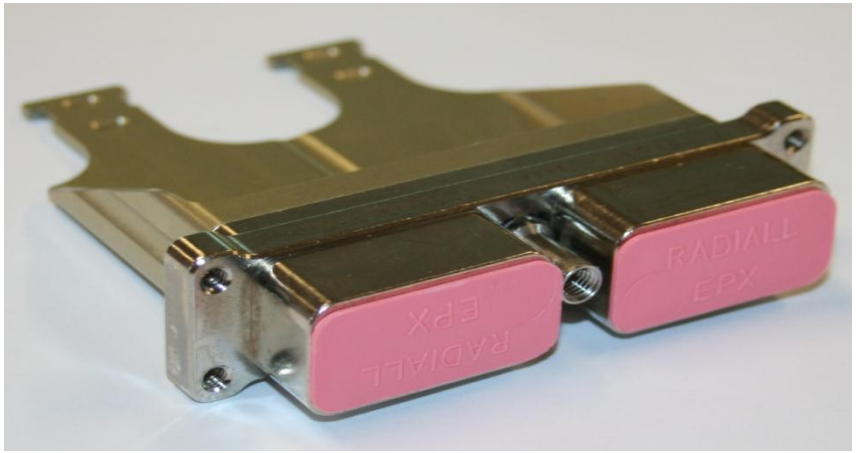


Identification: Connector Types



SC Connectors

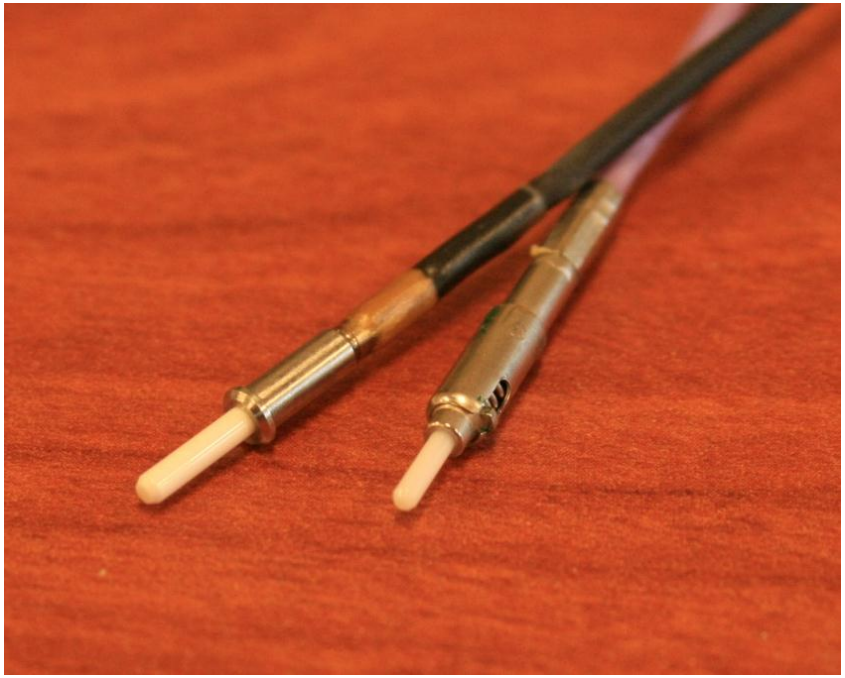
ST Connectors

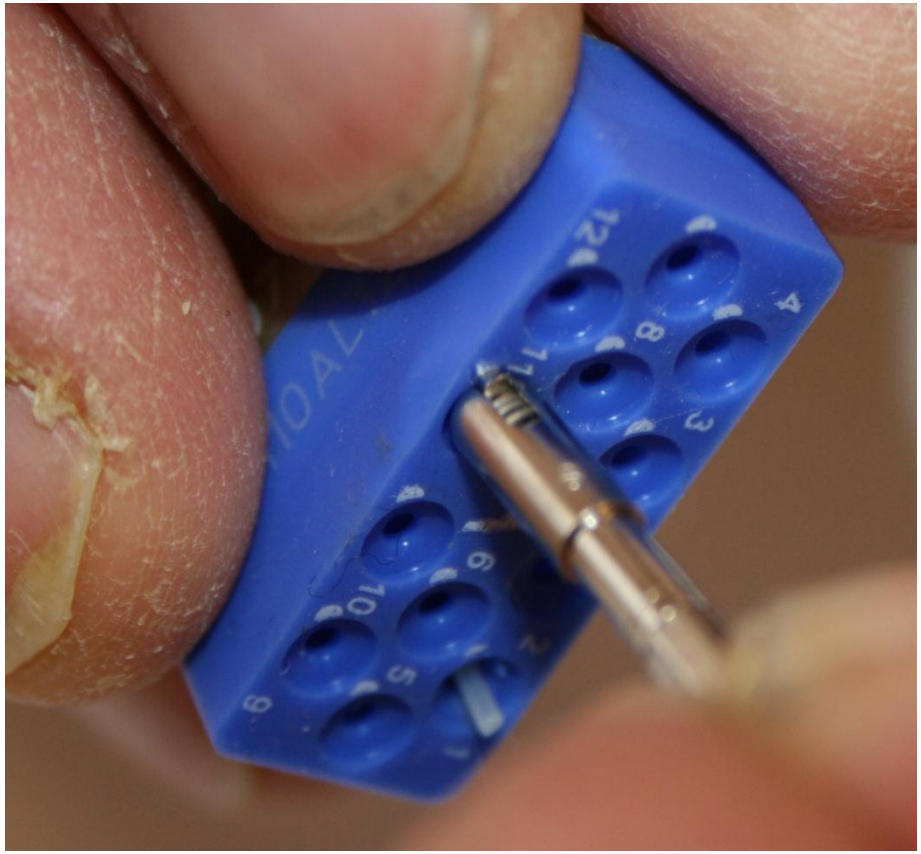


ARINC Connectors

D38999 Connectors

Assembly: Install Termini into Inserts





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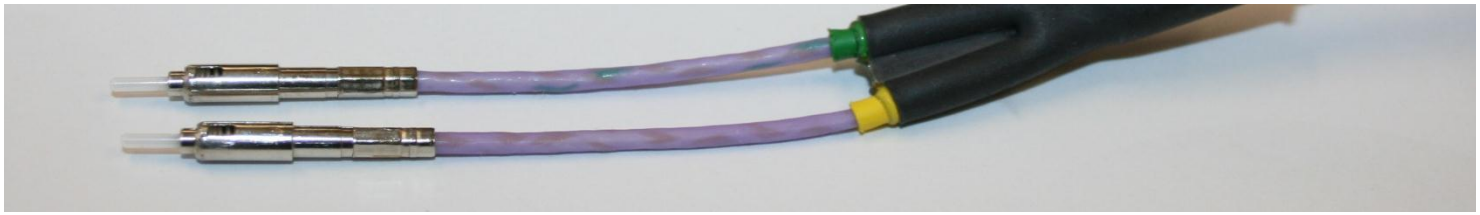
Assembly: Install Termini into Inserts

We will examine the procedures for installing the following assemblies into connectors / inserts:

1. Single fiber optic cable assembly with **un-keyed** termini.

2. Single fiber optic cable assembly with **keyed** Luxcis termini.

3. Jacketed duplex fiber optic cable assembly with **keyed** Luxcis termini.



Assembly: Install Termini Into Inserts

Insertion / Removal tools for fiber optic cable assembly with **un-keyed** or **keyed** (Luxcis) termini and M29504 (D38999) termini.

Insertion Tools

Insertion Tool Part Number	Color
M81969/14-03	Blue
DAK83-16	Blue

Removal Tools

Removal Tool Part Number	Color
M81969/14-03	White
DRK83-16	Blue/White

Assembly: Install Keyed Luxcis Termini

Partially insert the terminus by hand prior to using the insertion tool to prevent the terminus from rotating during installation.

Insertion Tools

Insertion Tool Part Number	Color
M81969/14-03	Blue
DAK83-16	Blue

In areas of limited space, the DAK83-16 may be easier to use.

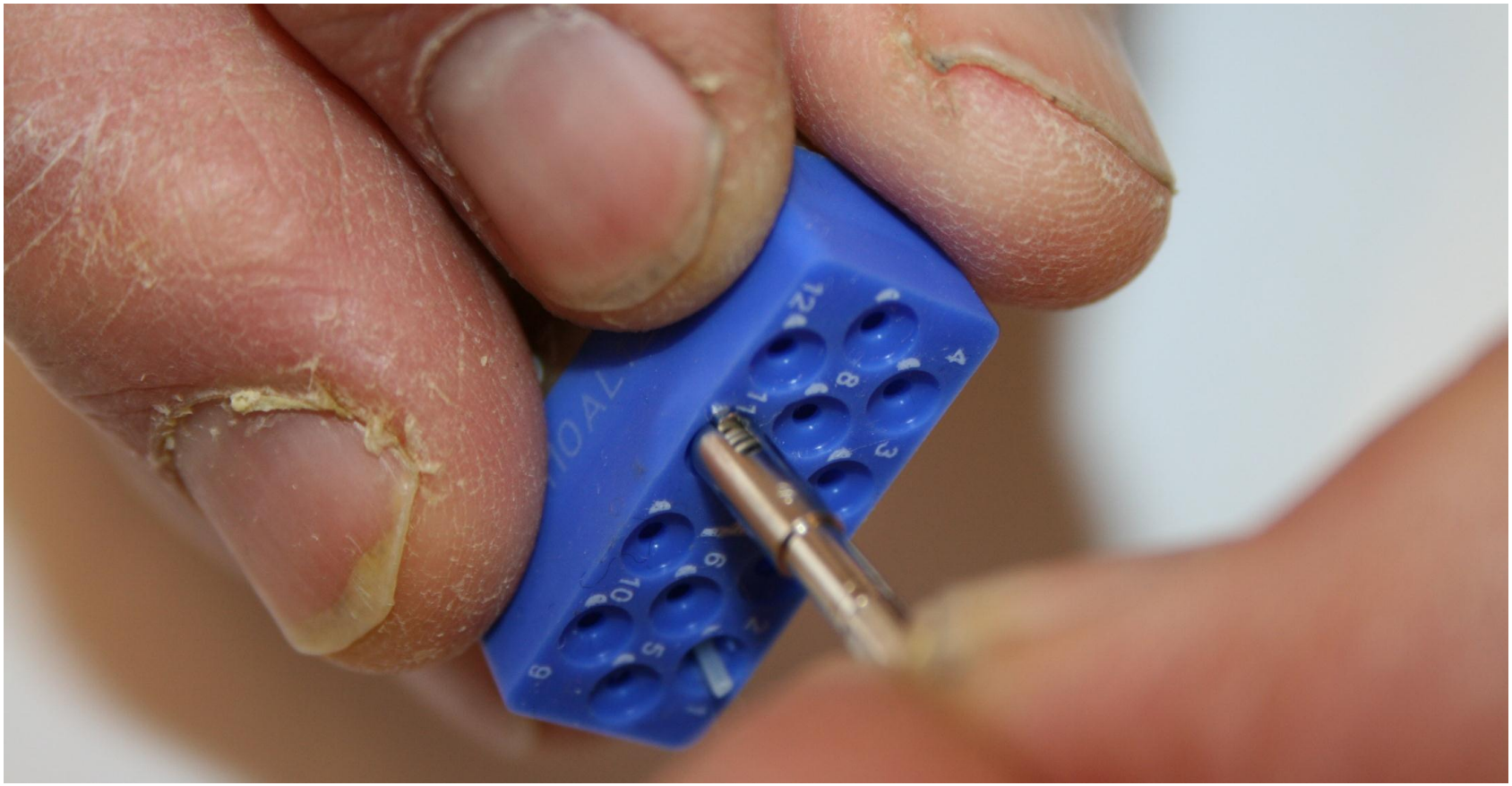
Removal Tools

Removal Tool Part Number	Color
M81969/14-03	White
DRK83-16	Blue/White

In areas of limited space, the DRK83-16 may be easier to use.

Fiber optic cable assembly with keyed termini.

1. Align the key on the terminus with the keyway-orientation marking on the rear face of the connector grommet.



Fiber optic cable assembly with keyed termini.

1. Align the key on the terminus with the keyway-orientation marking on the rear face of the connector grommet.
2. Carefully insert each terminus of a duplex fiber cable assembly ***by hand*** into the appropriate cavity until the key of the terminus is just inside the key way.
3. Carefully put an undamaged insertion tool on the fiber and push the insertion tool into the grommet.
4. Remove the insertion tool from the fibers and carefully pull it off of the fiber.
5. Gently pull on the cables with your finger and thumb to make sure that the termini are locked in place.
6. When doing a duplex cable assembly the steps above must be performed simultaneously.

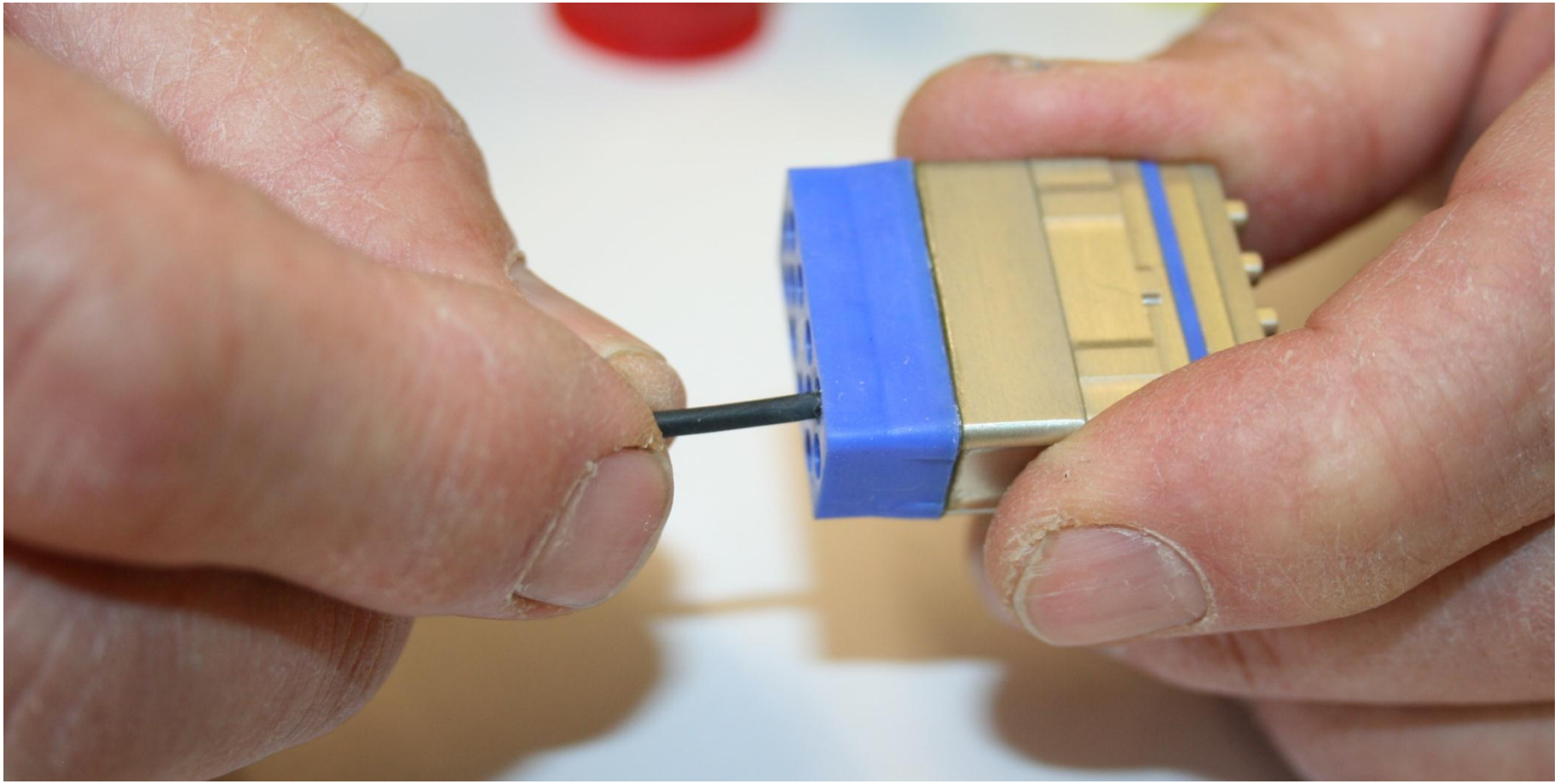
CAUTION: If you pull too hard, you will damage the cable.

DO NOT pull with your fingernails.

General Assembly Process

Fiber optic assembly generally includes the following:

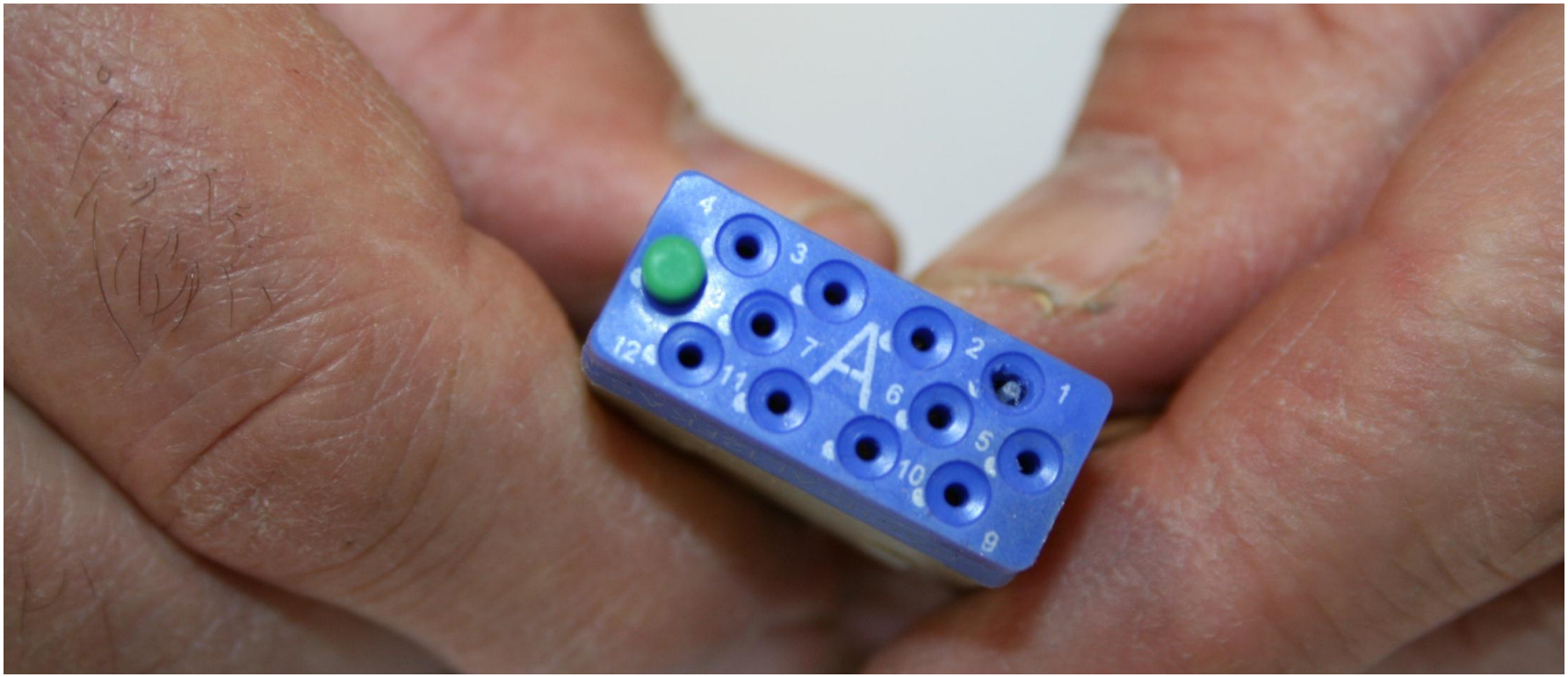
1. Insertion of cable termini into connector inserts.



General Assembly Process

Fiber optic assembly generally includes the following:

1. Insertion of cable termini into connector inserts.
2. Insertion of seal plugs into unused cavities.



General Assembly Process

Fiber optic assembly generally includes the following:

1. Insertion of cable termini into connector inserts.
2. Insertion of seal plugs into unused cavities.
3. Installation of assembled inserts into connector shells (receptacles and plugs).

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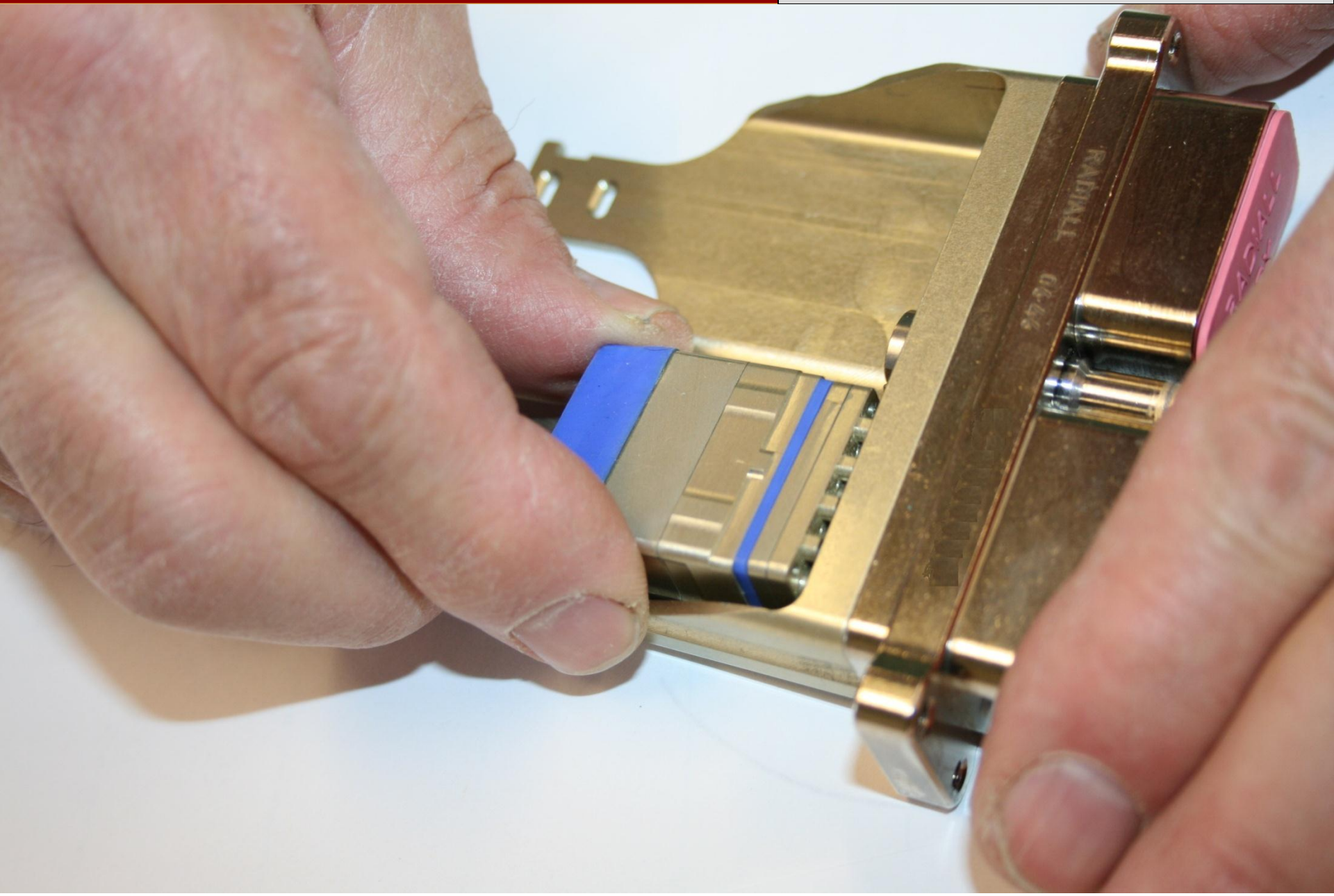

General Assembly Process

Fiber optic assembly generally includes the following:

1. Insertion of cable termini into connector inserts.
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4. Installation of polarization keys and keyways.

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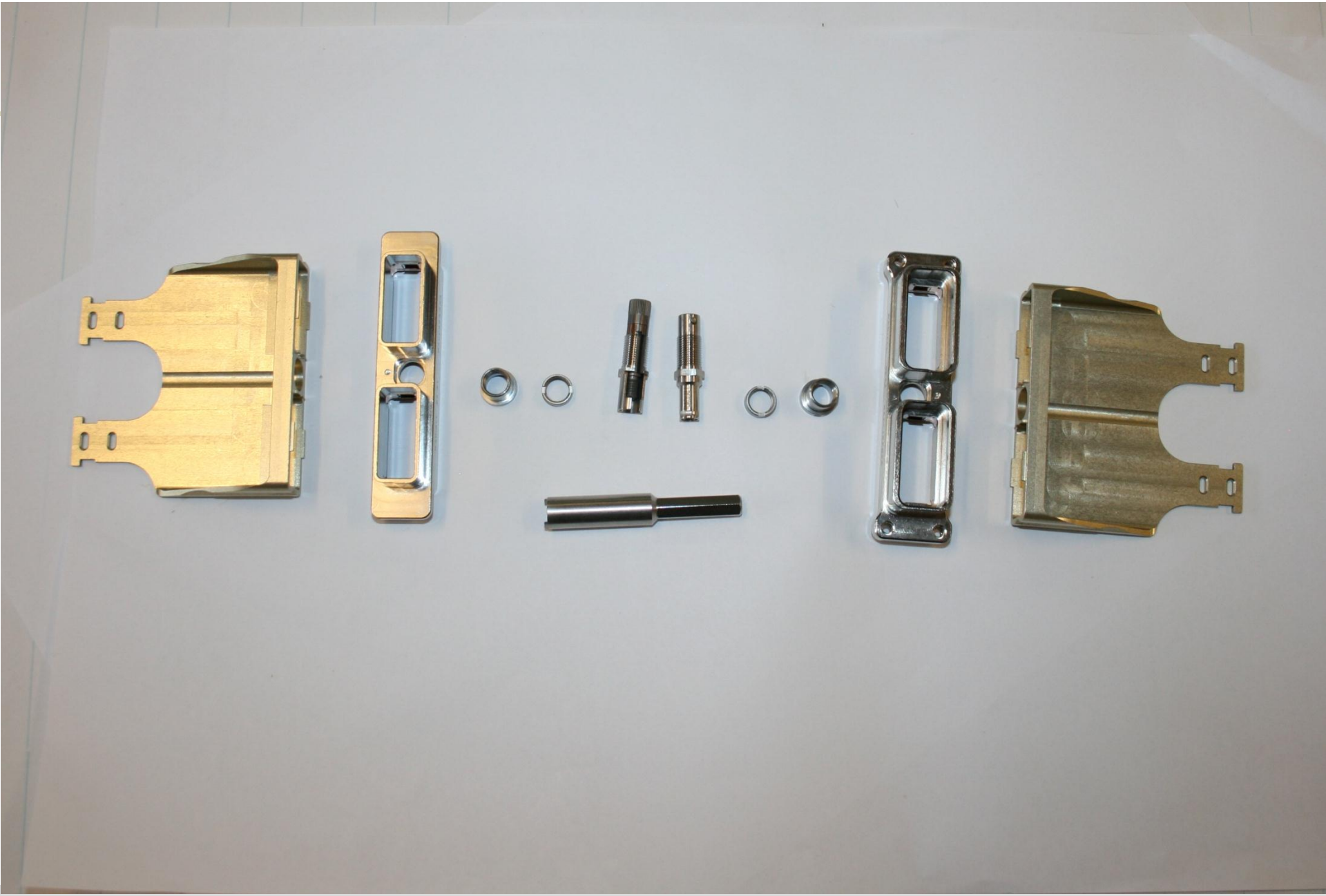

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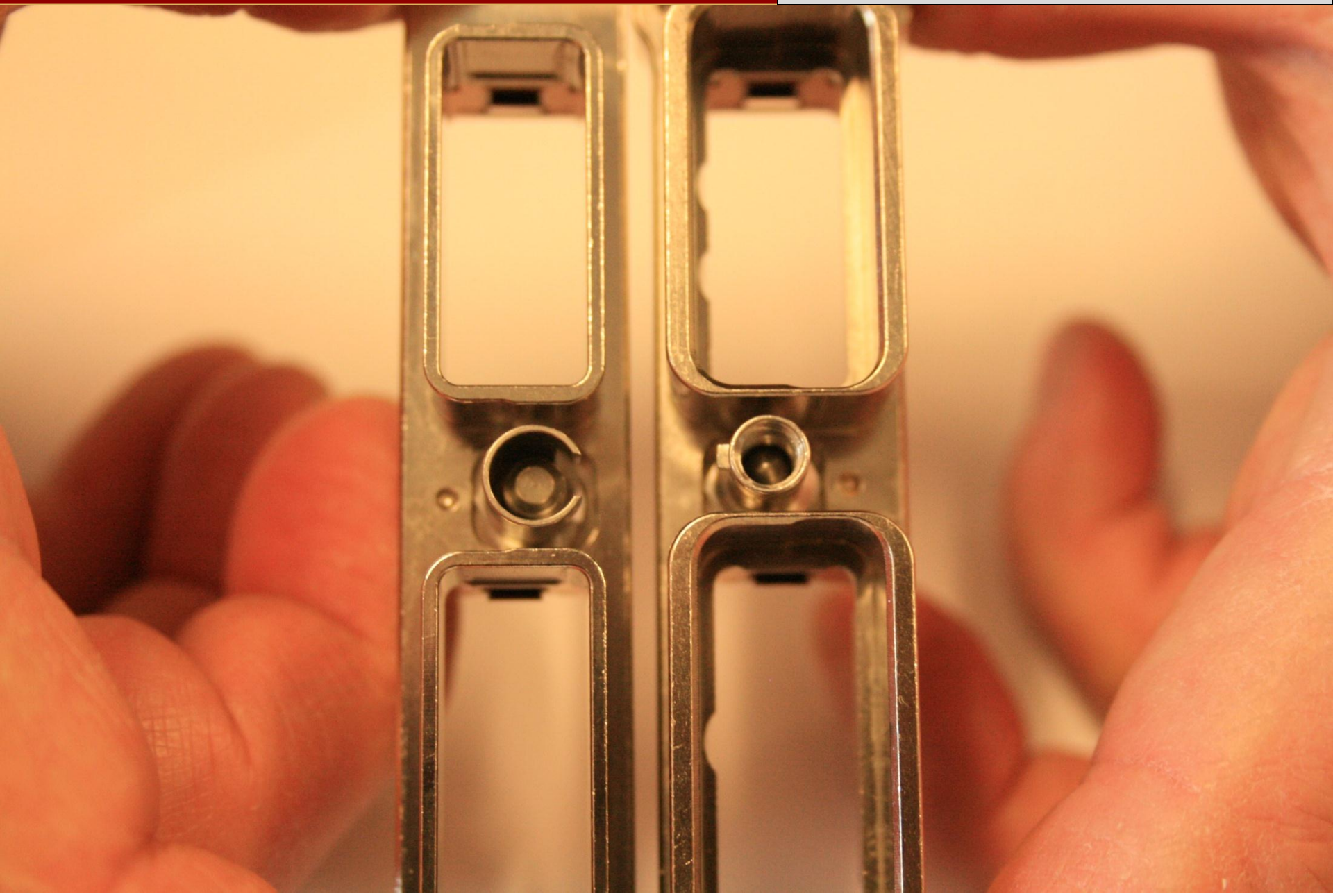

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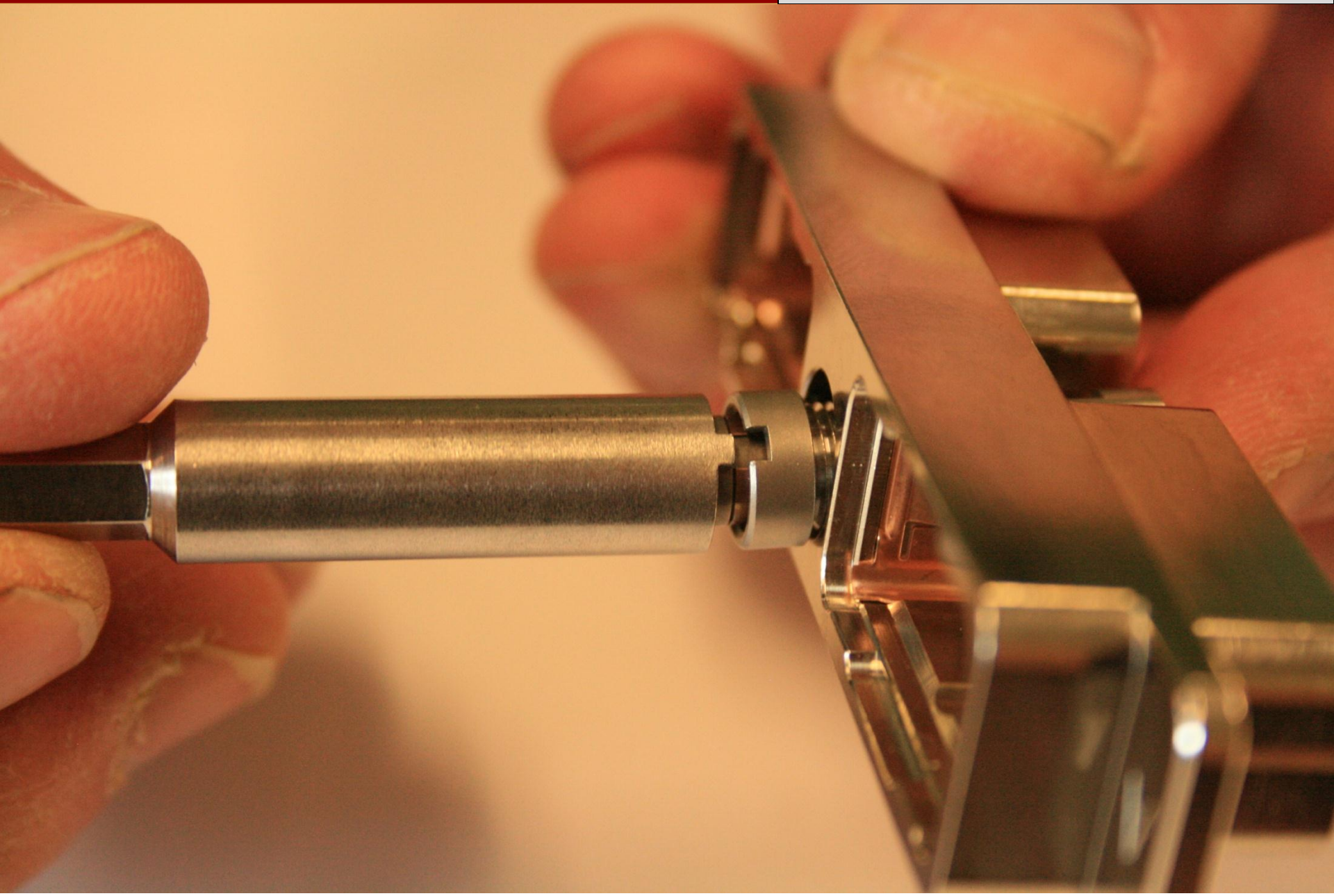

General Assembly Process

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1. Insertion of cable termini into connector inserts.
2. Insertion of seal plugs into unused cavities.
3. Installation of assembled inserts into connector shells (receptacles and plugs).
4. Installation of polarization keys and keyways.
5. Installation of cable clamps (backshells).

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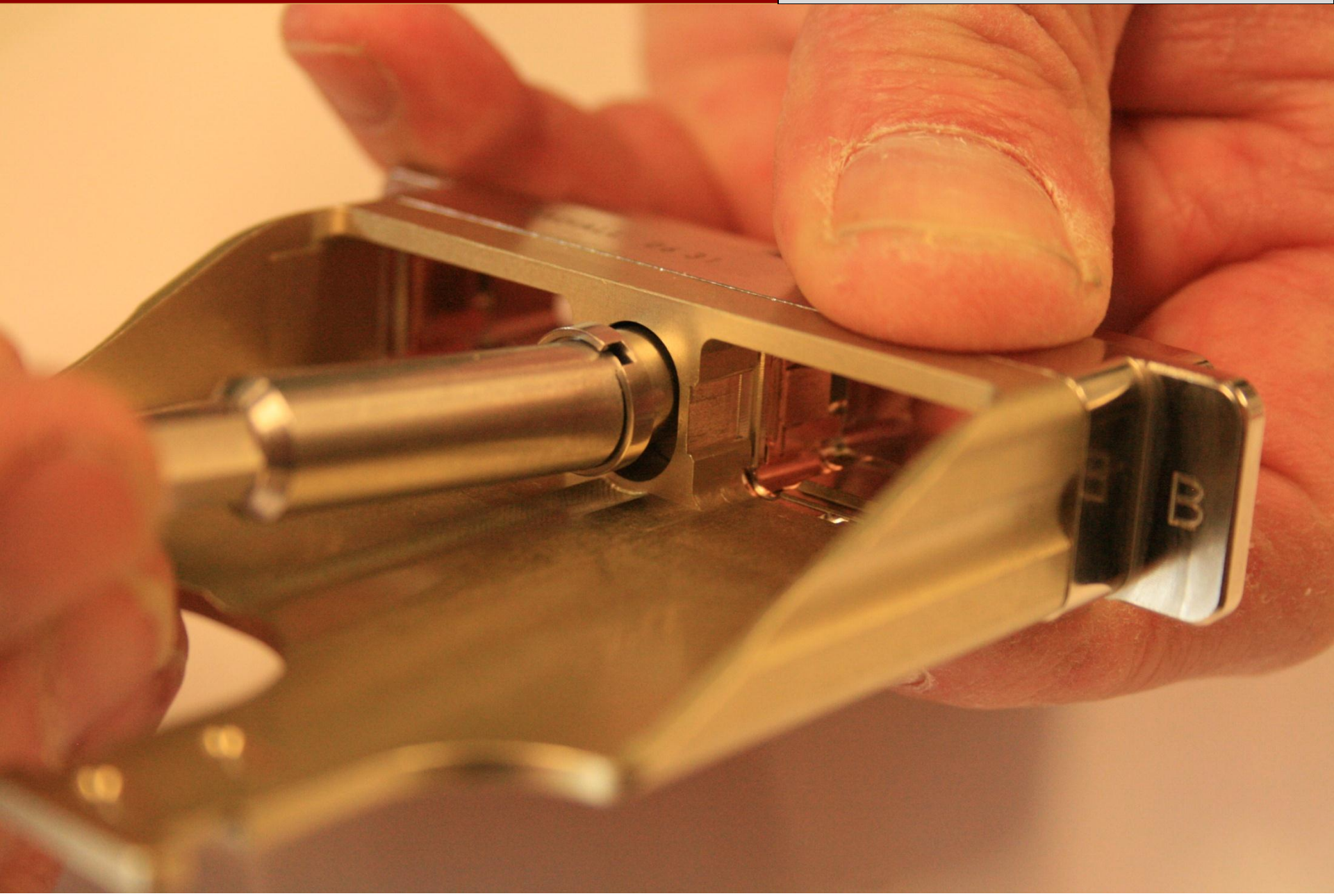

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2. Insertion of seal plugs into unused cavities.
3. Installation of assembled inserts into connector shells (receptacles and plugs).
4. Installation of polarization keys and keyways.
5. Installation of cable clamps (backshells).
6. Bundle tying.

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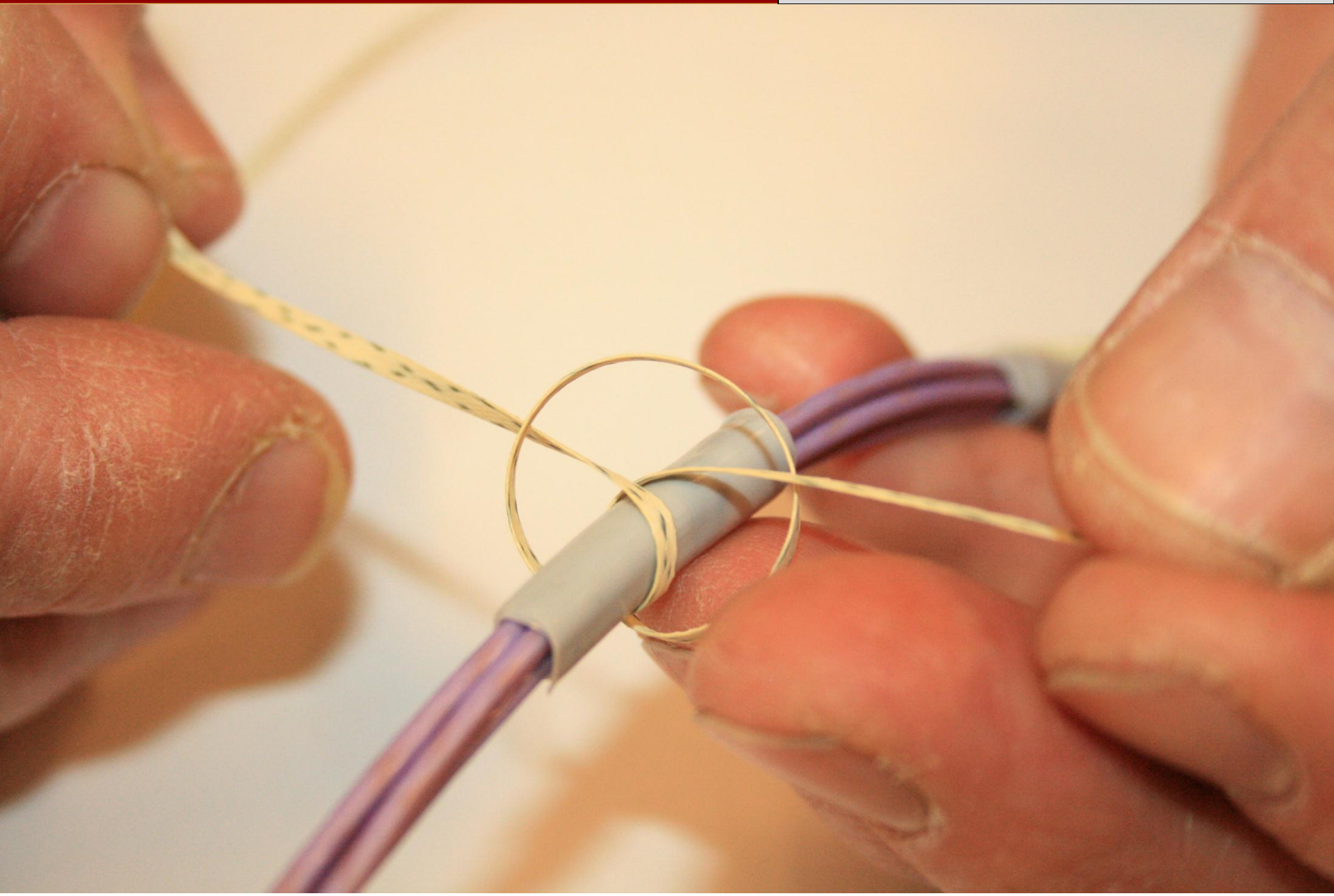

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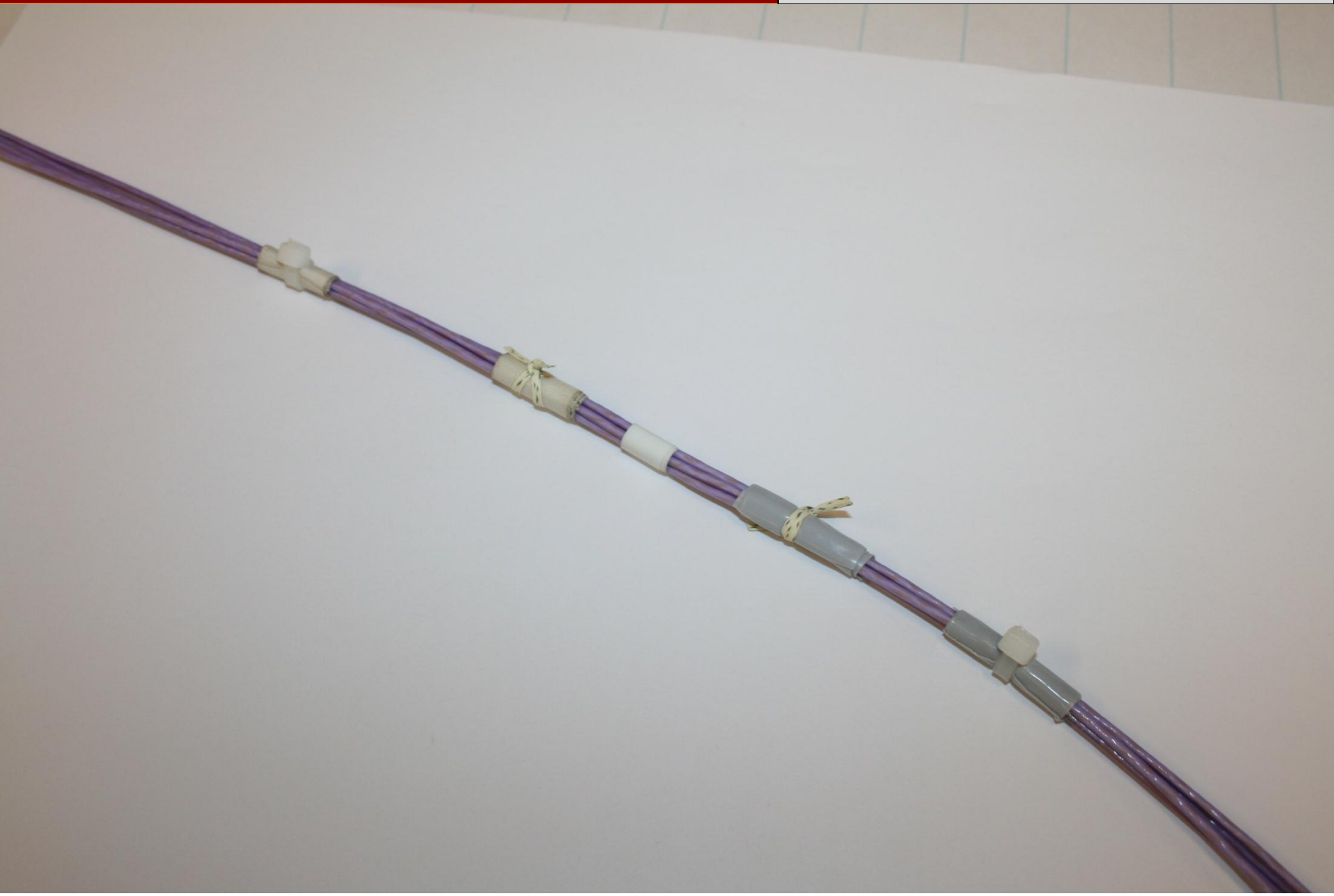

General Assembly Process

Fiber optic assembly generally includes the following:

1. Insertion of cable termini into connector inserts.
2. Insertion of seal plugs into unused cavities.
3. Installation of assembled inserts into connector shells (receptacles and plugs).
4. Installation of polarization keys and keyways.
5. Installation of cable clamps (backshells).
6. Bundle tying.
7. Connector mating.

Note: Some of these steps are not required for all connector types. For example, circular connectors are obtained from the vendors with the inserts pre-installed and the termini are inserted into the connector inserts inside of the connectors.

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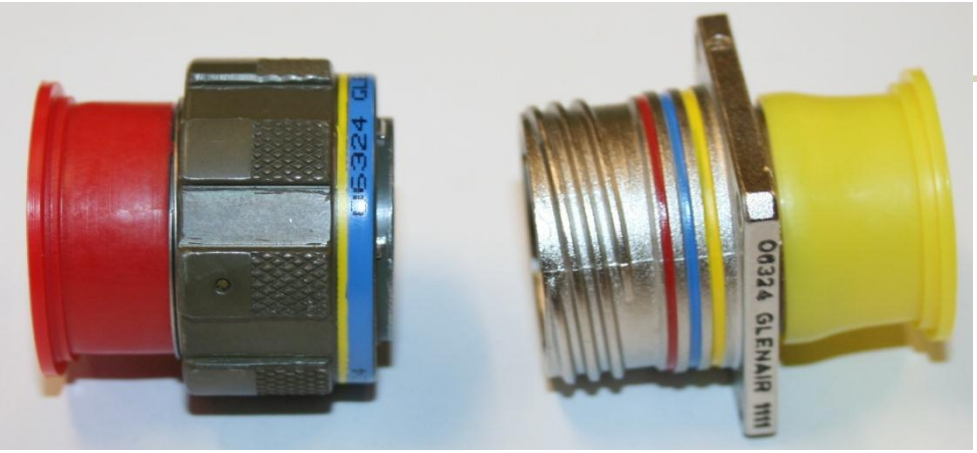

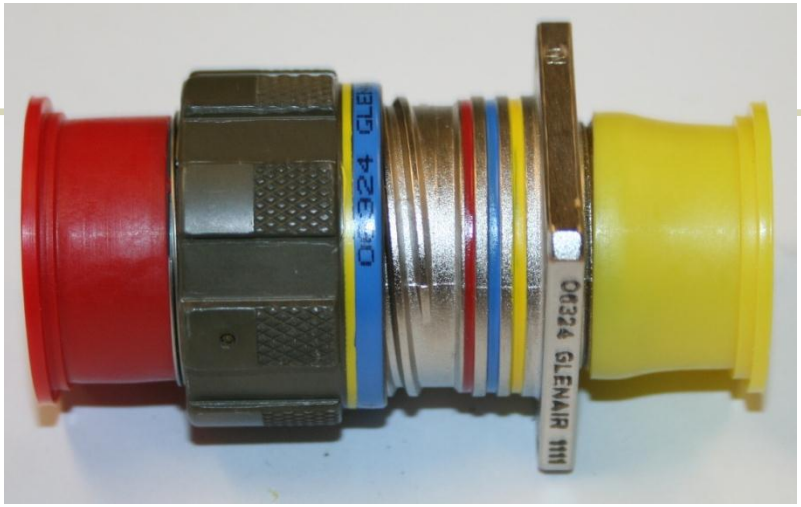

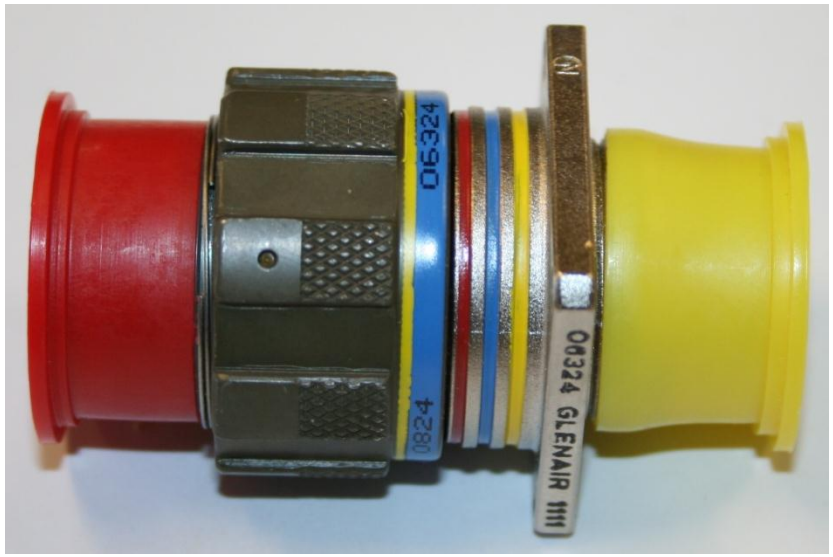

Break

Please return in 10 minutes.

Assembly: Circular Connectors

Note: D38999 connectors have pre-installed inserts.

1. Slide backshell onto cable assembly.
2. Insert termini into contact cavity per previous instruction.
3. Insert seal plugs until the plug butts against the end of the grommet.
4. Install backshell onto connector.
5. Add protection.
6. Close.

Assembly: LC & SC Connectors

- The only assembly required for the LC and SC assemblies is attaching cable assemblies to the alignment sleeves.

- It clicks into place.

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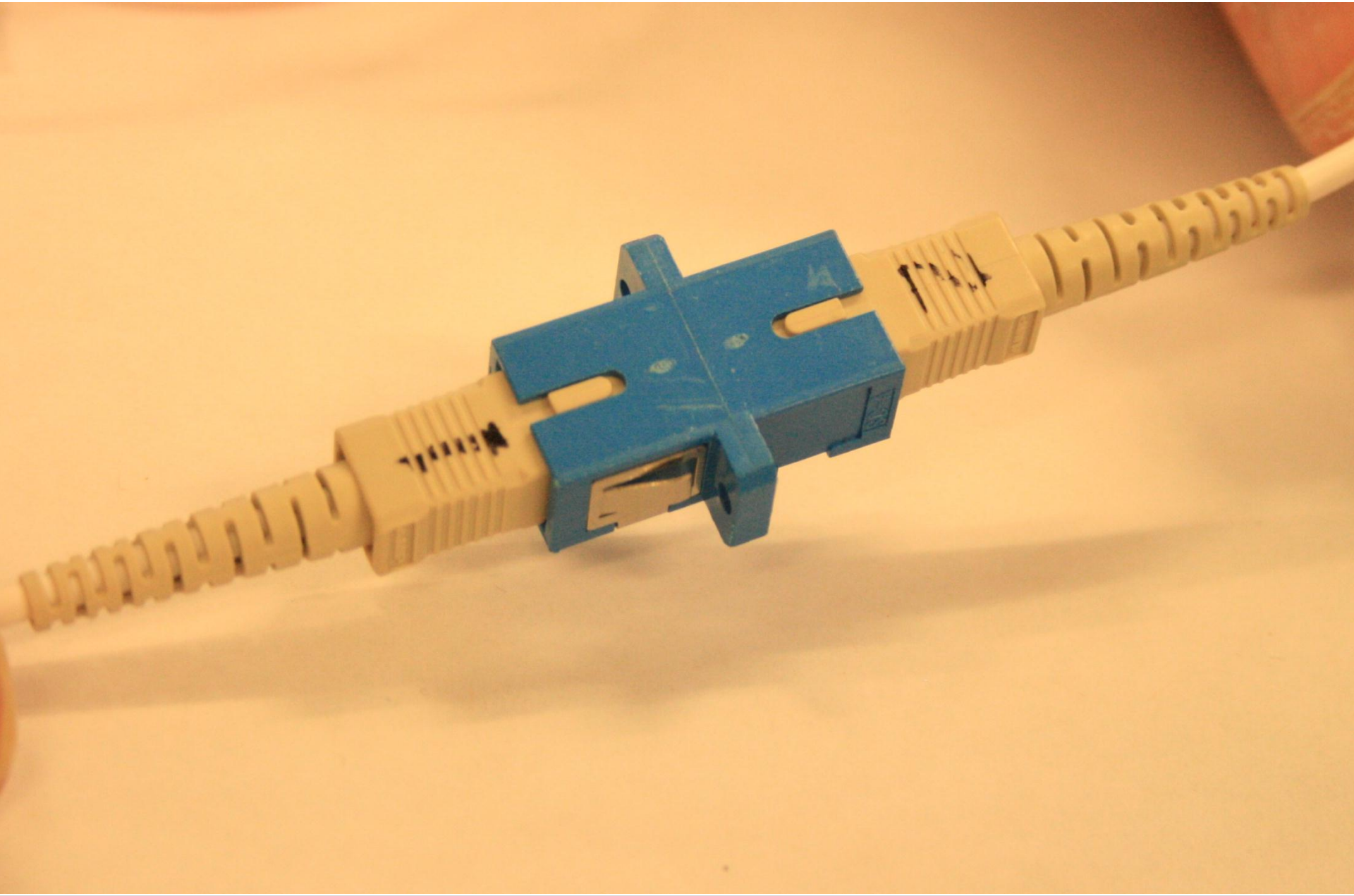
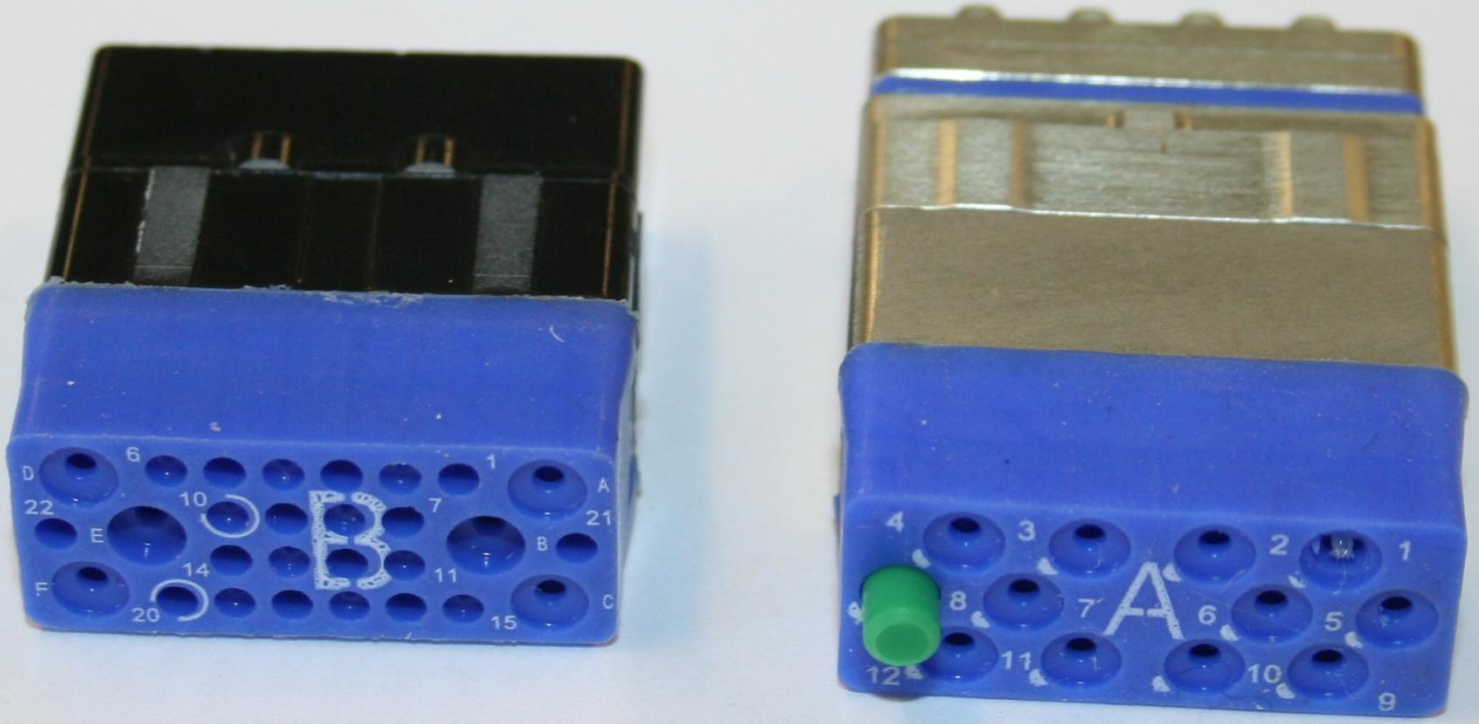


Assembly: Assemble ARINC Connectors

Note: A inserts have one polarization key and B inserts have two polarization keys.

1. Be sure to use one A insert and one B insert in the insert cavity of each connector.
2. Be sure to use an opposite insert as it's mating connector. Match the arraignment pattern with a pin insert for each corresponding receptacle insert.



Assembly: Assemble ARINC Connectors

Install the inserts into the connector shells:

1. Be sure to slide any rear-end components on the cable prior to installing the insert into the connector.
2. Install the inserts into the receptacle and the plug shells as follows:
   a. Align the A insert polarization key with the A cavity keyway in the back surface of the connector shell and gently push the insert into the connector shell until it locks.
   b. Align the B insert polarization key with the B cavity keyway in the back surface of the connector shell and gently push the insert in the cavity until it stops.

CAUTION: Do not use force to overcome obstructions. If an obstruction occurs, remove the insert and start over.

Assembly: Assemble ARINC Connectors

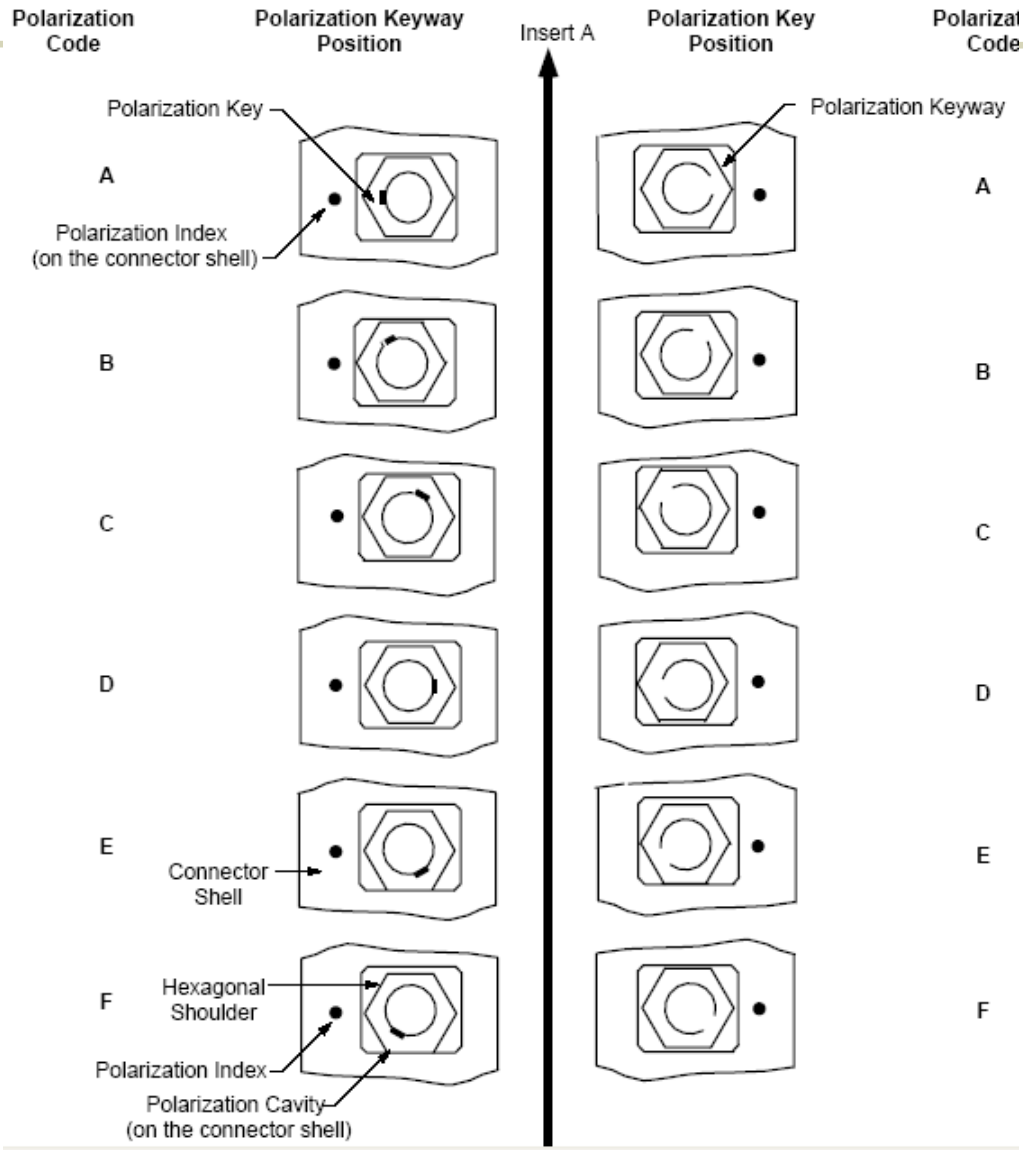
Install the connector shell polarization keys and keyways:

1. Obtain the correct polarization code from the engineering drawing.
2. Orient the jackscrew to align with the correct polarization code and push it into the connector.

Assembly: Assemble ARINC Connectors

Receptacle

Jackpost



Plug

Jackscrew

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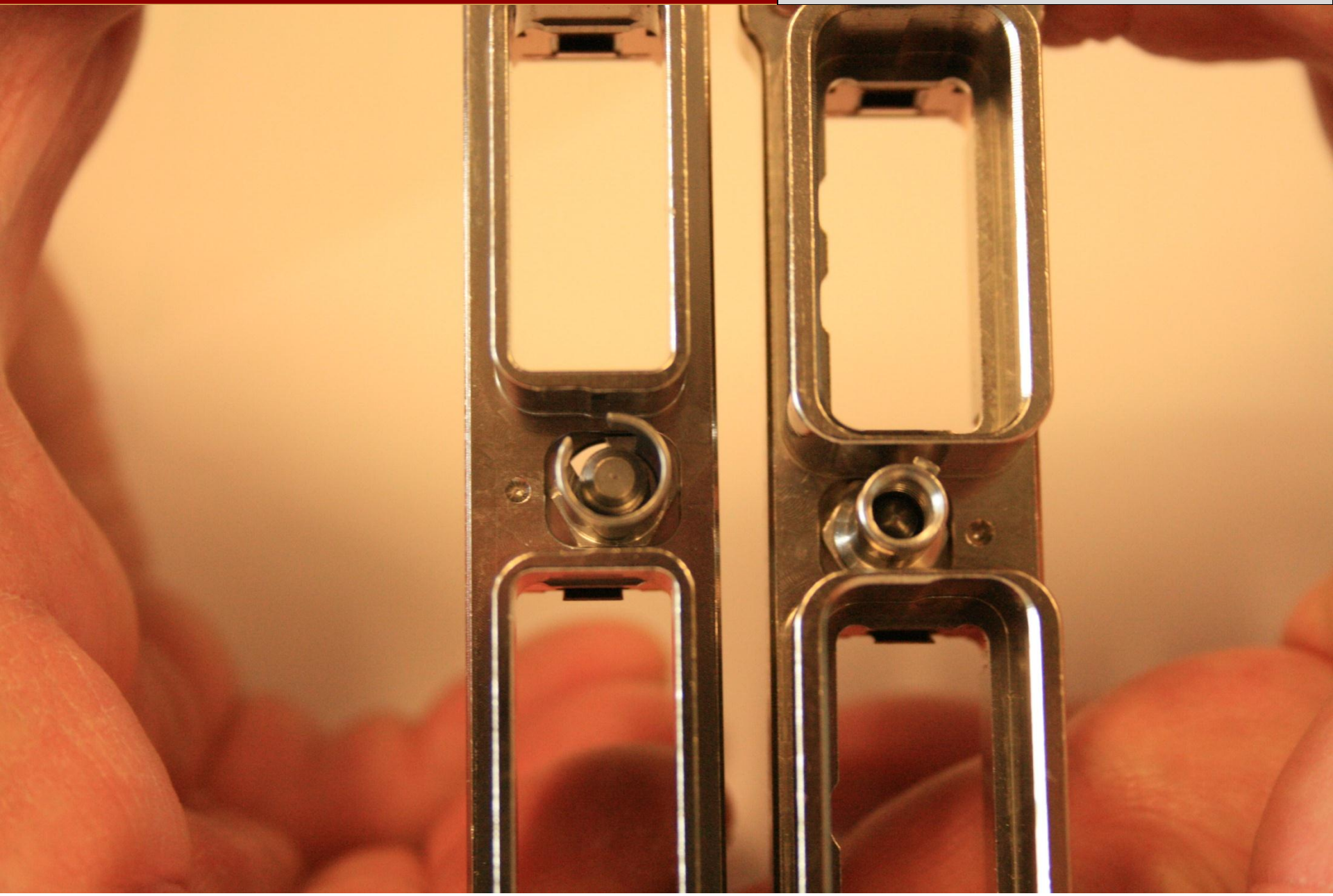

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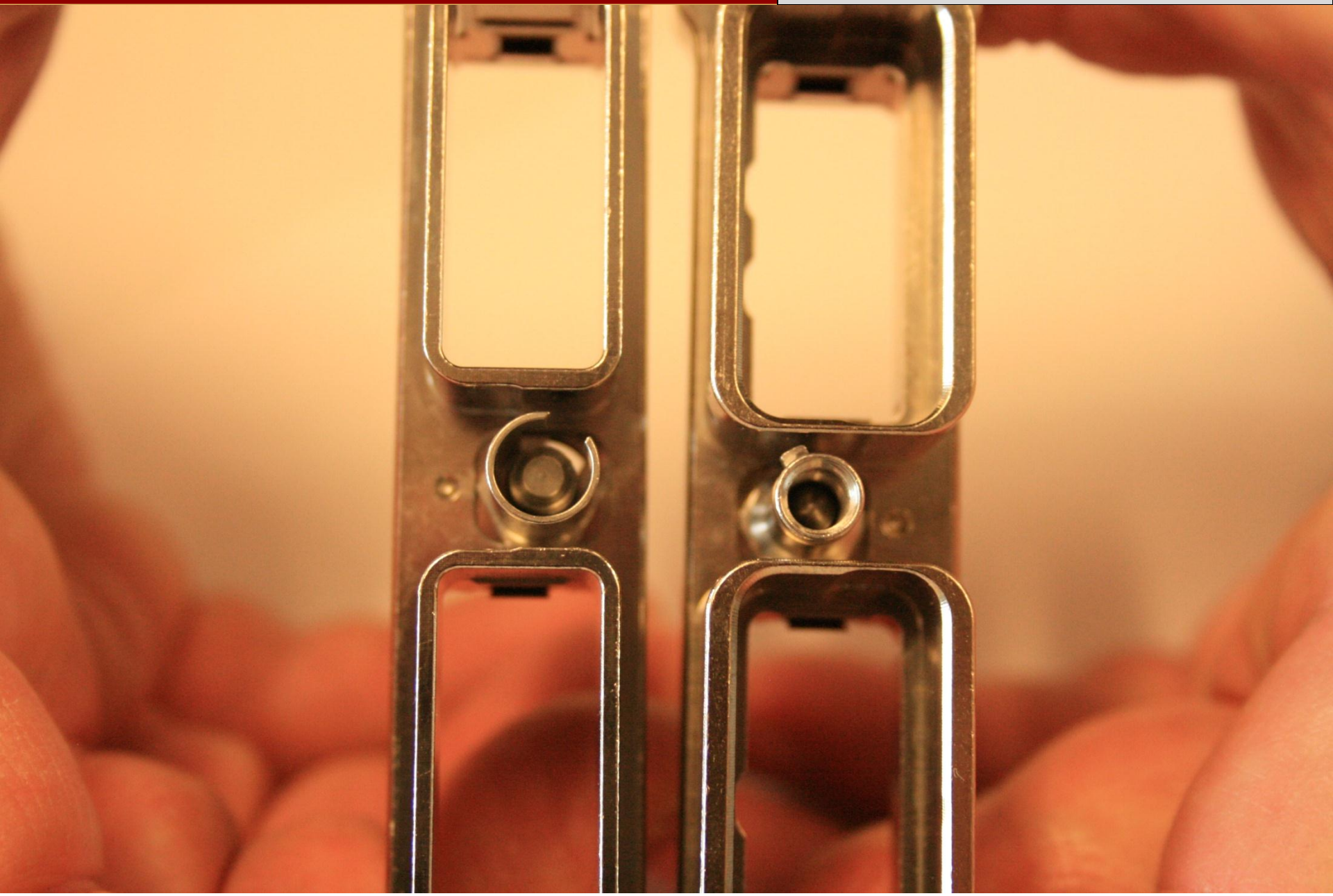

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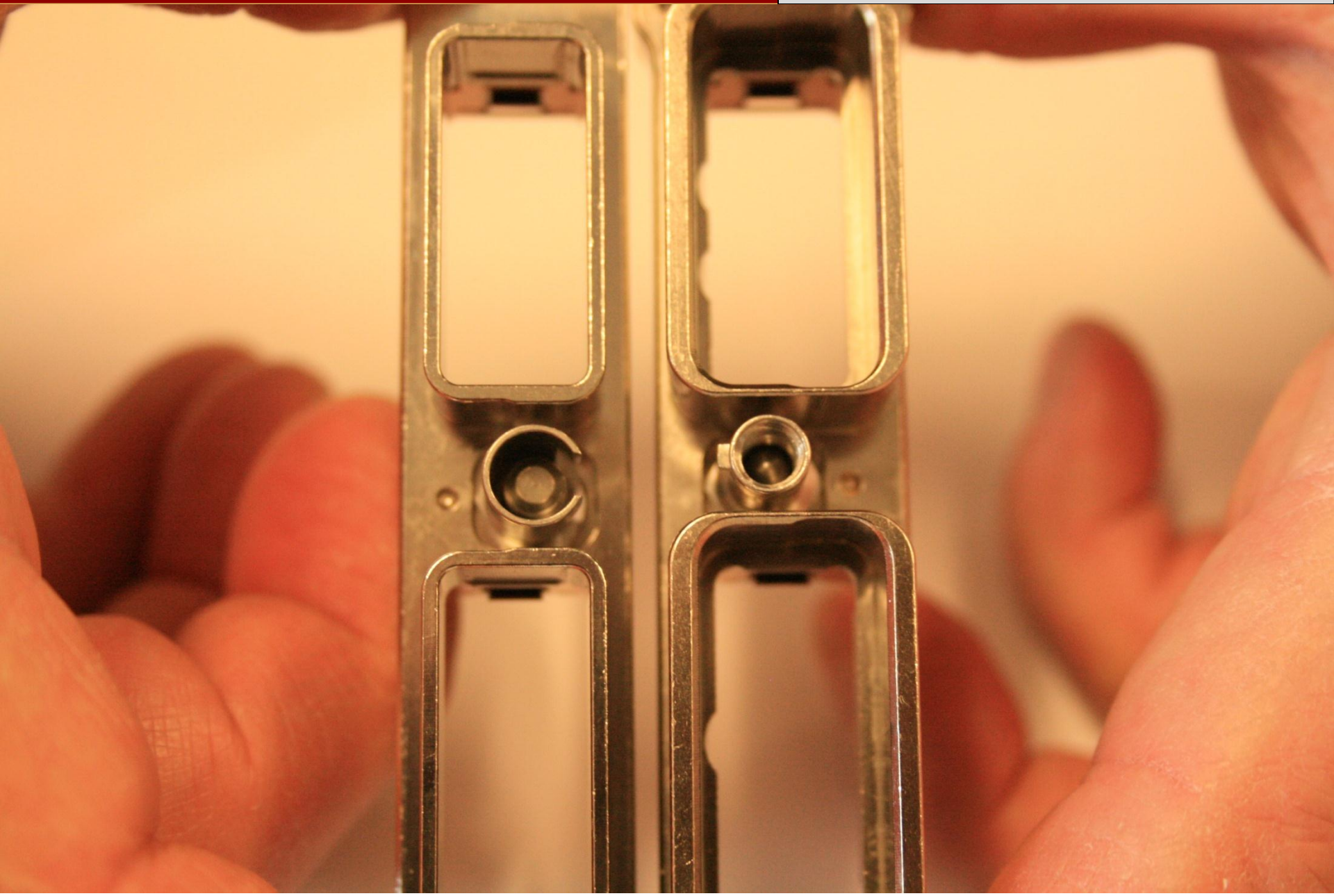

Assembly: Assemble ARINC Connectors

Install the connector shell polarization keys and keyways:

1. Obtain the correct polarization code from the engineering drawing.
2. Orient the jackscrew to align with the correct polarization code and push it into the connector.
3. Put a drop of Loctite 222 on the screw threads and push the jackscrew retention nut over the knurled end of the jackscrew.
4. Use the 282 664 retention nut wrench to torque the jackscrew retention nut to 7.0 +/- 1.0 in. lb.

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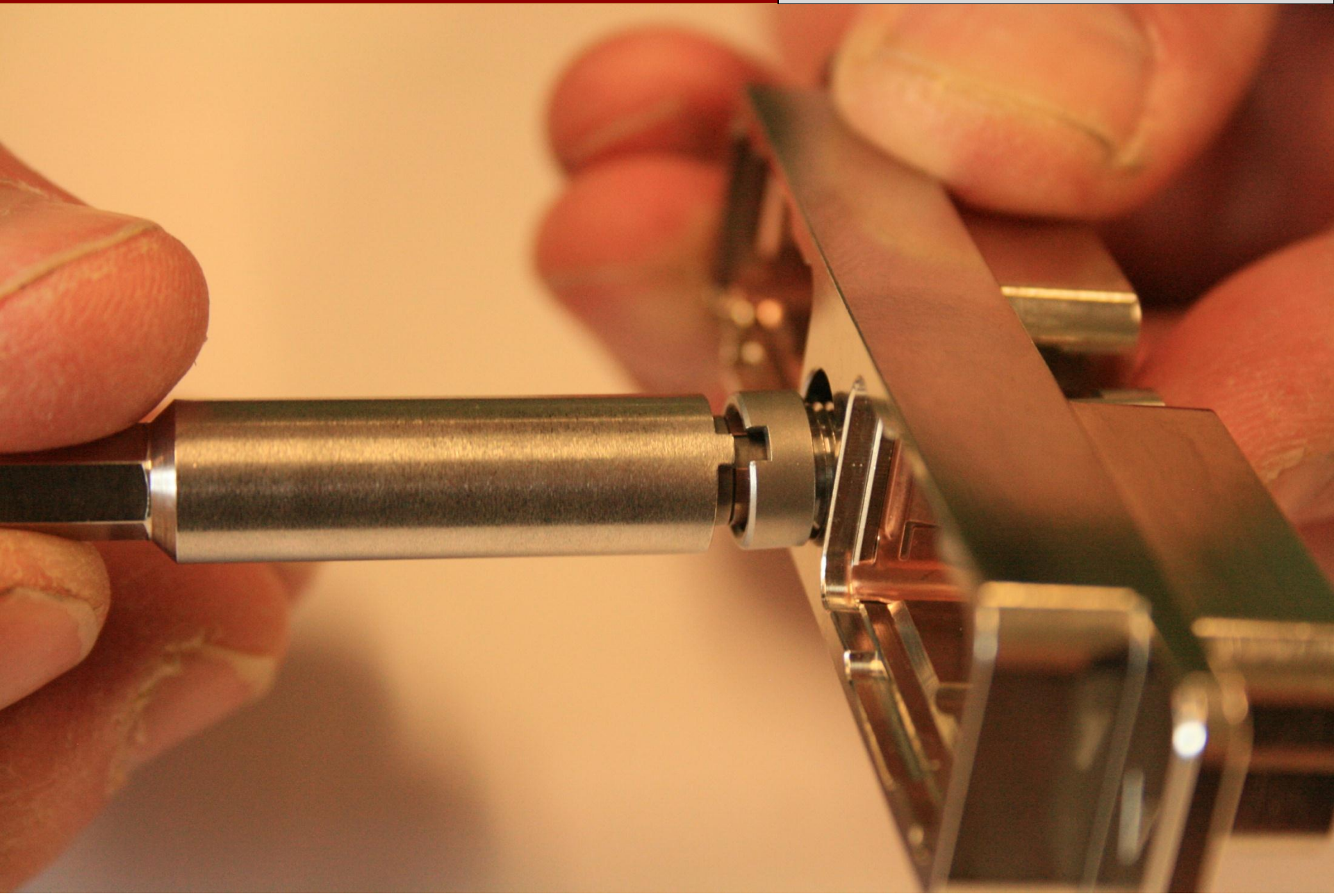

Assembly: Assemble ARINC Connectors

Install the Cable Clamp (Backshell):

1. Push the cable clamp onto the rear surface of the connector shell until the clamp touches the rear surface of the connector shell.
2. Put a drop of Loctite 222 on a minimum of two threads of the clamp retention nut.
3. Push the clamp retention nut over the end of the jackscrew until it touches the screw threads on the end of the jackscrew.
4. Use the 282 664 retention nut wrench to tighten the clamp retention screw to 7.0 +/- 1.0 in. lb

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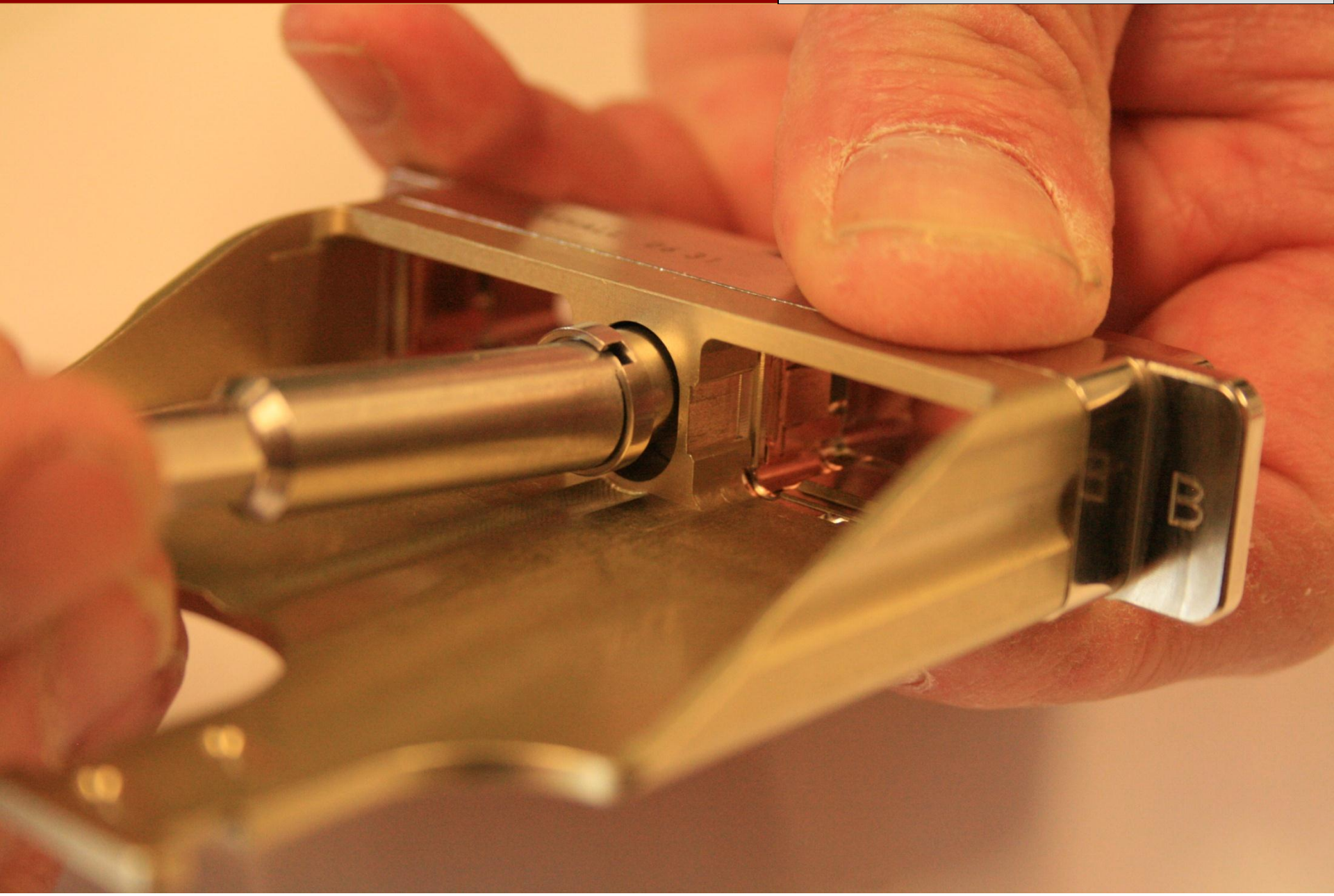


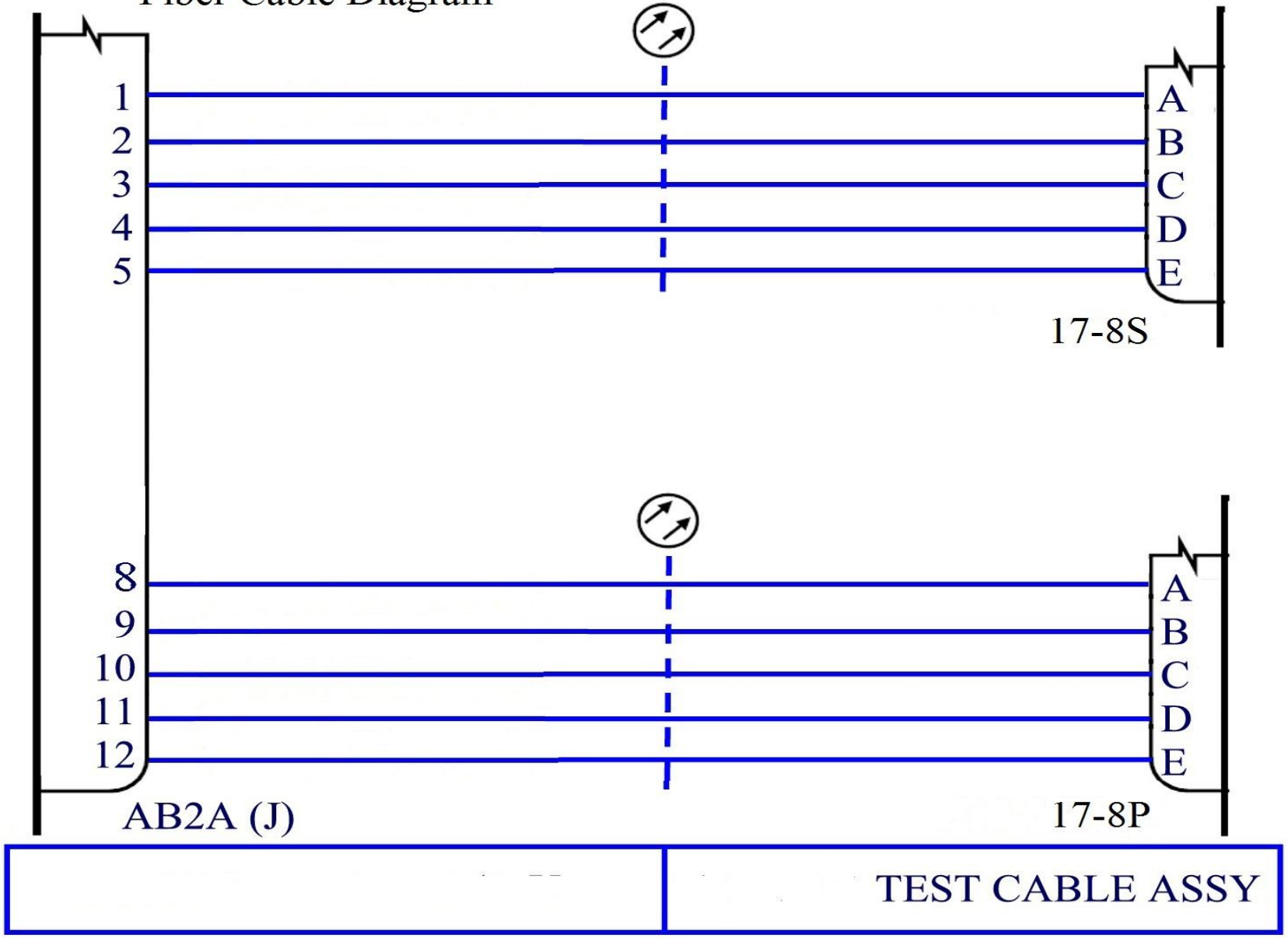
Bundle Tying: Cable Routing in the Bundle

- **Untangle the cables and route them parallel to each other as much as practical.**
- It is only acceptable to cross cables within a bundle when a cable needs to be routed for termination or to a breakout to another bundle or group.

Exercise 1: Connector Assembly Practice

- Place the backshell on the fiber optic cables.
- Install the polarization key on the connector shell.
- Use the retention nut wrench to tighten the jackscrew. Though we are not using a torque wrench in class, remember that the torque requirement is 7.0 +/- 1.0 in. lb.
- Install the backshell on the connector shell.
- Use the retention nut wrench to tighten the clamp retention screw. Remember that the torque requirement is 7.0 +/- 1.0 in. lb.
- Install termini into connector inserts per diagram.
- Install the A insert into the A insert cavity of the connector shell.
- Install second end of fibers into the appropriate D38999 connector.
- Install the dust caps over the front face of the inserts.
- When complete, ask your instructor to check your work and record the results on your checklist.

Fiber Cable Diagram



Review

How much do you remember?

By now, you should be able to:

- Safely handle fiber optic cable assemblies.
- Install termini into connector inserts.
- Remove termini from connector inserts.
- Assemble connectors used with fiber optic cables.

Review Game

Rules:

1. Divide into two teams.
2. The first team to join together with half of the number of class participants is the X team and goes first.
3. Select a spokesperson.
4. Read the question.
5. Confer with your team. State an answer.
6. If you are correct, you get a point. If not, the other team gets a chance.
7. Each team takes turns attempting to earn points.

Question:

When is it appropriate to remove dust caps during the assembly process?

Answer:

ONLY remove the dust caps from the termini when you are ready to install the termini into the inserts. Remove the dust caps from the connectors when you are ready to mate the connectors.

Question:

What is the minimum bend radius for a fiber optic cable that is tied to a bundle of other wires?

Answer:

The minimum bend radius for a fiber optic cable tied to a wire bundle is the same as a fiber by it's self 1.5" bend radius.

Question:

What type of cable assembly contains two fibers in one jacket?

Answer:

A Duplex fiber optic cable assembly.

Question:

What is the difference between the termini installation processes for keyed and un-keyed termini?

Answer:

With the keyed termini, it is necessary to align the termini key with the insert keyway.

Question:

What is the primary difference in the processes for inserting the termini of single fiber optic cable assemblies and duplex fiber optic cable assemblies into connector inserts?

Answer:

The duplex cables must be inserted simultaneously so that you don't exceed the bend radius.

Question:

True or False: It is necessary to install inserts into D38999 connectors.

Answer:

Circular connectors have the inserts pre-installed.

Question:

What is represented by the white half moon adjacent to the contact cavity on the grommet?

Answer:

The half moon is identifying the location of the key way for the terminus key.

Question:

When you remove terminus from a connector, what do you do if the terminus does not release?

Answer:

You should: Remove the removal tool, rotate it 90º, and try again.

Question:

What determines the clocking on an ARINC connector?

Answer:

This information will be on the engineering drawing.

Conclusion

How can we prepare for the next session?