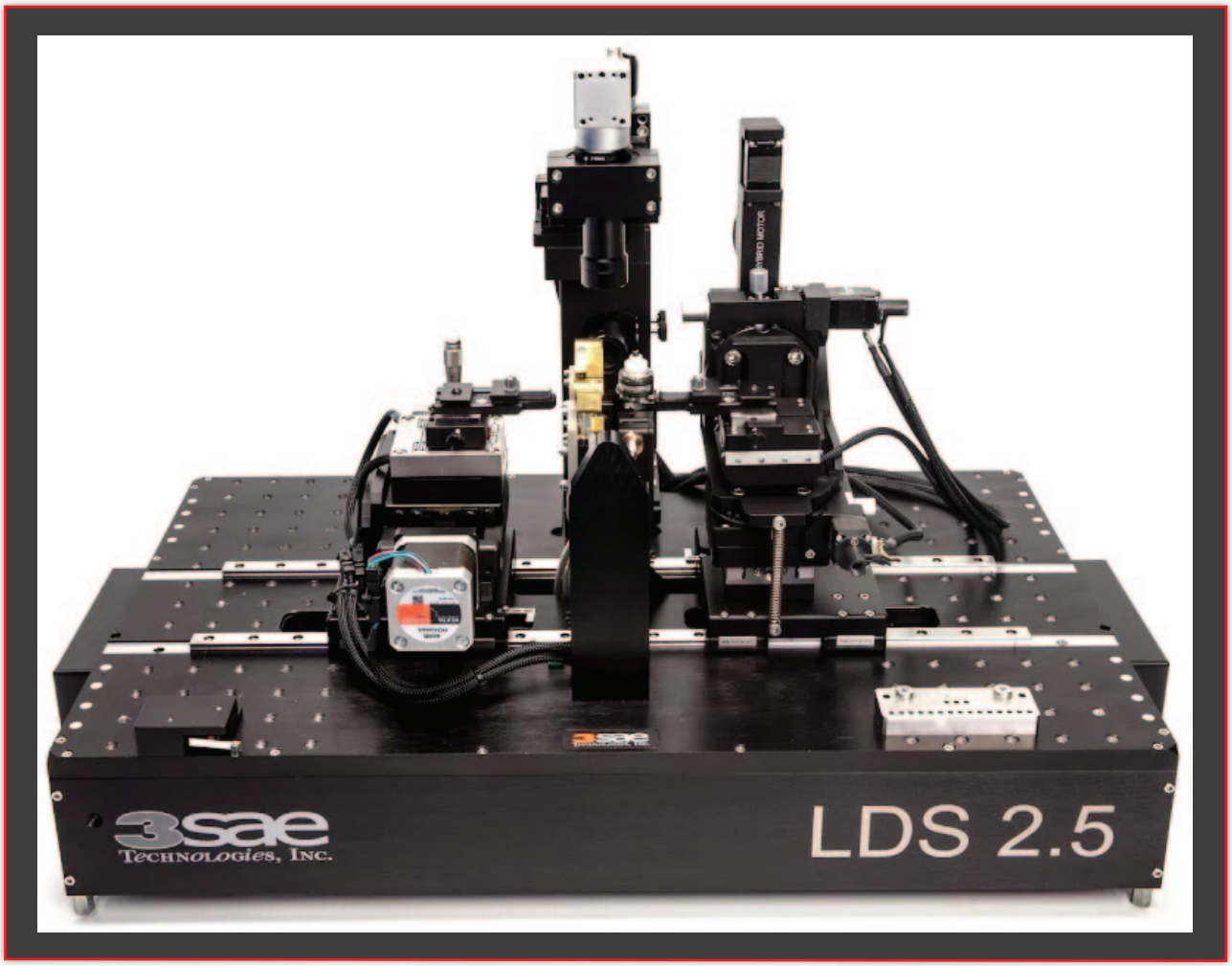
3sae Technologies, Inc.

LARGE DIAMETER SPLICING SYSTEM
LDS 2.5



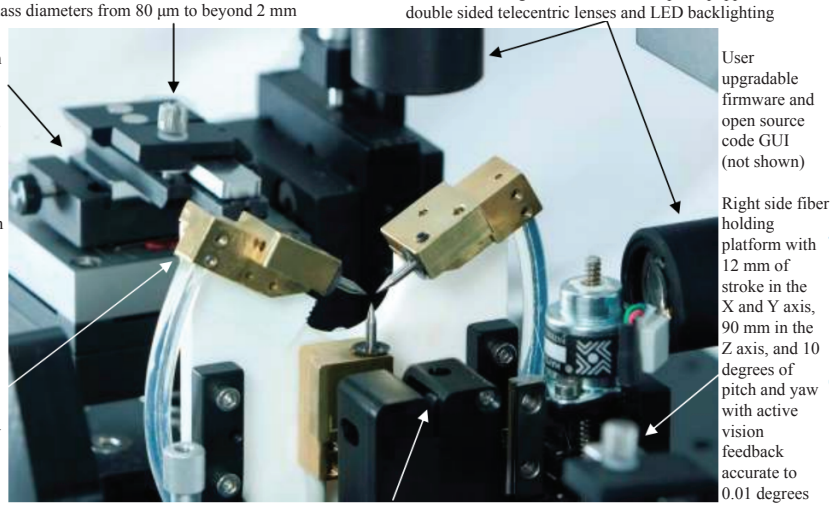
LARGE DIAMETER SPLICING SYSTEM 2.5

3SAE Large Diameter Splicing System 2.5

The rapid development of photonic technologies has created the need for sophisticated optical products well outside the "telecom standards". Requirements for these photonic components are both increasingly diverse and technically challenging; often they cannot be realized due to the limitations in the glass processing and/or fiber splicing technology.

Utilizing precision engineering, over 20 years of fiber splicing and glass processing experience 3SAE Technologies developed the LDS 2.5, glass processing system. Whether the application is splicing of fiber end caps, tapering, high power fiber laser component fabrication (such as mode field adapters, pump combiners and pump/signal combiners), the LDS 2.5 provides capabilities that overcome the hurdles of current fiber component fabrication processes to meet the most demanding requirements. Designed for reproducibility, precision, and user-friendly operation, the LDS 2.5 provides the user a manufacturing approach to optical component product development. Its extreme flexibility enables customers to realize current and future glass processing and fusion splicing possibilities.

Precision mechanical design, high contrast optics, and absolute control of positional and angular fiber alignment sets the LDS 2.5 apart from competing technologies.

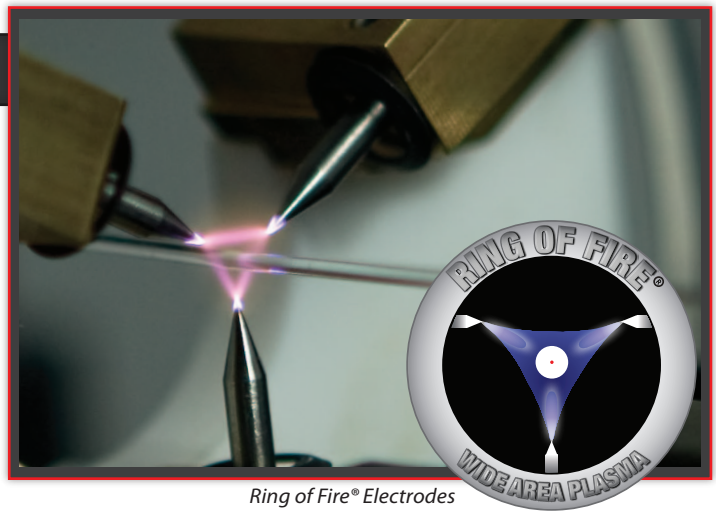


A sophisticated image processing software package allows the user to view, in real time, the progress of a splice or taper. The system handles fiber diameters from 125 to 2.5mm, as well as optics such as prisms, end caps, and lenses, with alignment and fusion of unsurpassed quality. 3SAE Technologies has the ability to offer customized LDS 2.5 systems to meet very specific customer requirements. Please inquire about your specific application.

LDS 2.5 NEW FEATURES: (IMPROVEMENTS FROM LDS 2.0)

- *New Focus Motor and upgraded mechanics, improving focus motor longevity and reliability and improving Focus Motor serviceability.*
- *New X/Y motion mechanics, improving smoothness in motion, stage rigidity alignment accuracy and repeatability.*
- *New Load Cell mechanics providing enhanced stability and reliability. Better than 10x improvement in tension resolution at low tension.*
- *5MP High Speed camera up to 30fps.*
- *Includes end cap splicing package.*
- *New Computer with faster processer, increased RAM, etc…*
- *Completely new control software: 100% new architecture based on five years of customer feedback.*
- *Streamlined production friendly GUI and features significantly improved responsiveness.*
- *Improved automated splicing, all without sacrificing complete discreet control.*
- *New hybrid motor control.*
- *Updated tapering software featuring new intuitive programming interface and expanded table based tapering capabilities. (Requires tapering package)*
- *LDS 2.5 upgrade is available to existing LDS 2.0 customers! Please contact 3SAE for details and eligibility.*

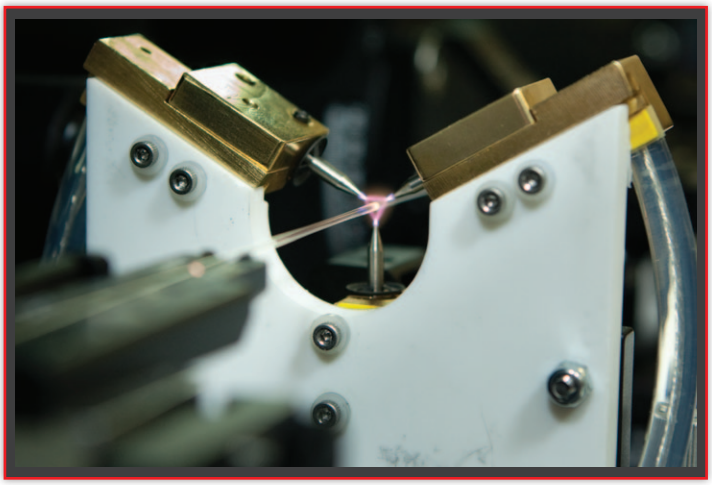
RING OF FIRE® TECHNOLOGY



Ring of Fire® Electrodes

Conventional arc fusion machines utilize a high voltage glow discharge between two electrodes, forming a heat source in the shape of a narrow cylinder perpendicular to the fiber. Such heat sources are inadequate for larger fibers, because of the inability to heat evenly.

Flame and filament machines can be optimized to provide circumferential heating, but they also extend the heat zone along the fiber axis. This is advantageous for some applications, such as Thermally Expanded Core splicing (TEC), but causes substantial limitations in the geometries that can be processed. For example, these heat sources are poorly suited for splicing a small diameter fiber to a much larger fiber or optical device (end cap, lens, prism). The heat required to splice the larger object will typically destroy the smaller fiber. A multi-electrode plasma discharge is advantageous for these applications, as the resulting heat zone is isothermic around the circumference of the fiber, but remains relatively narrow. This allows for precise heating of larger or higher temperature materials. With this system, accurately aligned, high strength splices can be performed without difficulty.

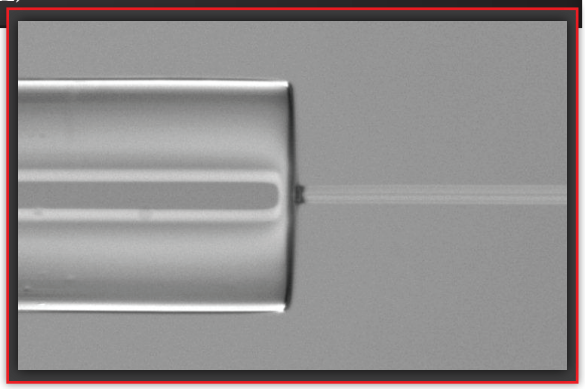


Fiber in the Ring of Fire®

Ring of Fire® Heat Source: Attributes and Capabilities

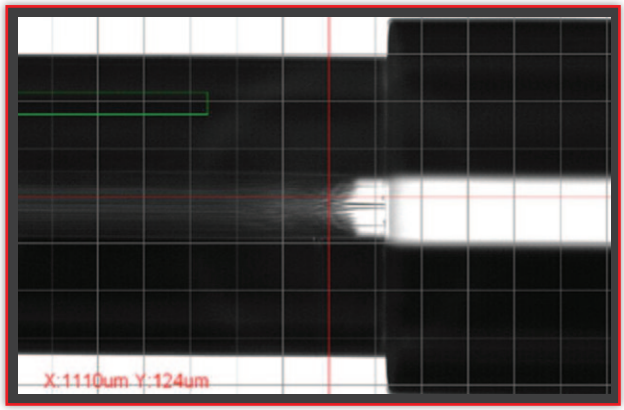
- Three Electrode system design combines proven manufacturing ready technology with R&D flexibility.
- Isothermic plasma field (triangular two-dimensional plane) up to 100 times larger than that of a standard two-electrode system.
- Proprietary alloy electrodes coupling extended life, high thermal power generation, and low maintenance/cost.
- Generates negligible tungsten deposits and requires no specialized gas environment for operation.
- Ideally suited for difficult or developmental applications.

LDS 2.5 ATTRIBUTES & CAPABILITIES (BASE PACKAGE)



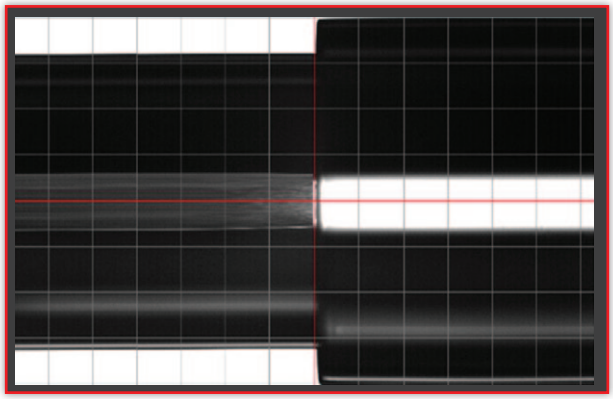
2 mm to SMS splice

- Powerful, positionable Ring of Fire® heat source provides even heating for fiber splicing, fiber end-capping, Photonic Crystal Fiber (PCF) splicing and many other applications including tapering, collapsing, and fusing.
- Splicing of 125µm – 2.5mm diameter fibers can all be accomplished using one machine.
- System capable of splicing materials with high melting temperatures.
- Ability to splice dissimilar fiber diameters or materials surpasses capabilities of existing splice technologies.
- Provides unique capability to fuse pre-made End Caps having vastly dissimilar diameters than that of the input fibers.
- Automatic Pitch and yaw alignment that aligns the pitch and yaw axes of the right stage to 0.01 degrees.
- Improved Graphical User Interface (GUI) is intuitive, clearly marked and easy to use and features configurable operator levels for production environments.



Large diameter PCF with short collapse

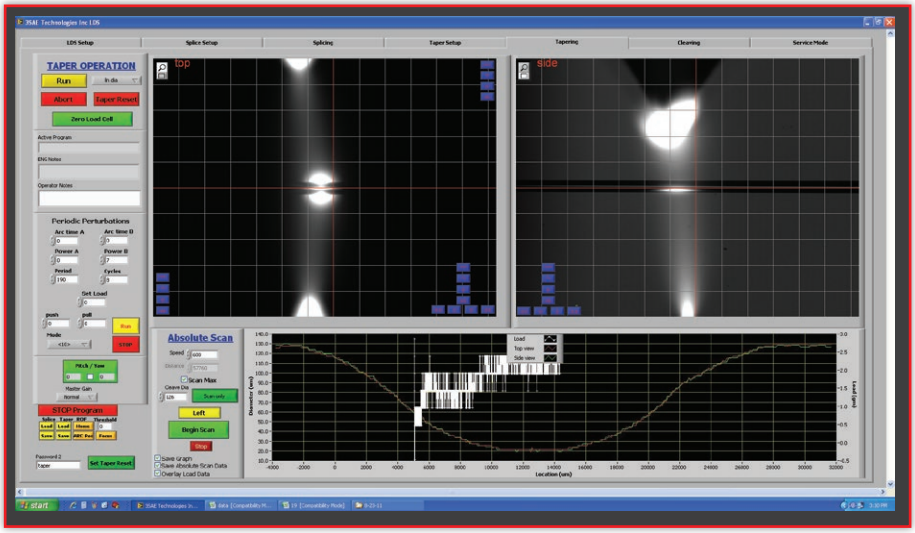
- Scanning software scans fiber diameters before or after splice or taper.
- Real time data and high quality images (before, during, and after splice or other process) can be captured and automatically saved.
- "Hot" imaging provided simultaneously using two independent, orthogonally mounted cameras, enables the user to view fiber processes in real time.
- Many Photonic Crystal Fibers (PCF) can be spliced with little or no air hole collapse.
- Capability of uniformly collapsing Photonic Crystal Fiber (PCF) allows for positional cleaving, ultrasonic cleaning (no liquid wicking into air holes), and achievement of excellent splice losses. (Cleaving requires cleaving package).
- "Ionic Ablation" fiber cleaning provides a secondary cleaning of optical fibers.
- Extremely high splice strengths are achievable without repetitive passes of the plasma field.
- Up to 10 axes of alignment.
- Pitch and yaw axes provide +/- 5° range of motion with 0.01° adjustability
- Piezo-driven flexure stage and software package providing 130µm of vibration-free z-axis motion with 0.25 µm theoretical resolution.
- Fiber splicing to End Caps or other shorter-length optical elements that cannot be held using traditional fusion splicer fiber-holding mounts using a vacuum system for stable, precise control of hard-to-handle optical components.
- Mechanical platform is easily interchangeable with optional 16mm standard fiber holder platform and offers the same axes of motion.



Large diameter PCF with no collapse

LDS 2.5 SYSTEM UPGRADE PACKAGES

The following add-on packages target specific needs of the user. They can be added to the LDS 2.5 at any time.



Large Diameter Splicing (LDS) System Taper GUI

Tapering Package

• Large Diameter Splicing (LDS) System Taper GUI

• Automated software providing precise motor speed and load cell control, enables reproducible fabrication of low loss and high ratio tapers up to 85mm in length.

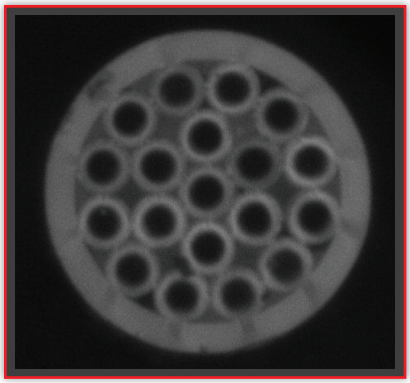
• Taper scanning function, exclusive to the LDS 2.5, allows for immediate process feedback by measuring diameter over length.

• Proprietary Power-Ramp Technology, unique to the LDS 2.5, can compensate for thermal mass changes along the length of a taper via controlled power adjustments to the plasma field during the tapering process.

• Versatile GUI is detailed enough to allow the user unprecedented control, yet can be as simple as one button operation.

• Single direction tapering for pulling tapers through the stationary Ring of Fire heat source. This is utilized for tapering symmetric and asymmetric linear tapers. This function is generally used for taper ratio's equal to or less than 10:1.

• Bidirectional tapering method is created by pulling both left and right stages outward as the Ring of Fire sweeps left to right. This method is used for producing adiabatic tapers with the ability to alter the exponential shape of the taper. One major advantage of bidirectional tapering is that this method is not taper ratio limited allowing the user to produce adiabatic tapers such as 500 micron fiber tapered down to 10 microns. In addition to the taper ratio advantages, the default exponentially shaped taper performance allows for tapering 125um single mode (SMF) down to less than 10 microns (O.D.) while only inducing <0.05dB insertion loss.



19 to 1 pump combiner endface

Capillary Speed Loader

Bundling Convenience Package (*Tapering Package Required*)

• Package supports capillary-based pump and pump combiners

• Includes Capillary Speed Loader which allows easy, high-yield loading of fiber into capillaries (load times generally less than 1 minute).

• Adjustable fusion level can be applied along length of bundle.

• Integrated imaging system easily captures end face images of bundle without the need to realign the LDS 2.5. (PM Splicing and Cleaving System Packages Required)

• Bundle handling fixtures and tooling included.

LDS 2.5 SYSTEM UPGRADE PACKAGES

Polarization Maintaining (PM) Splicing Package

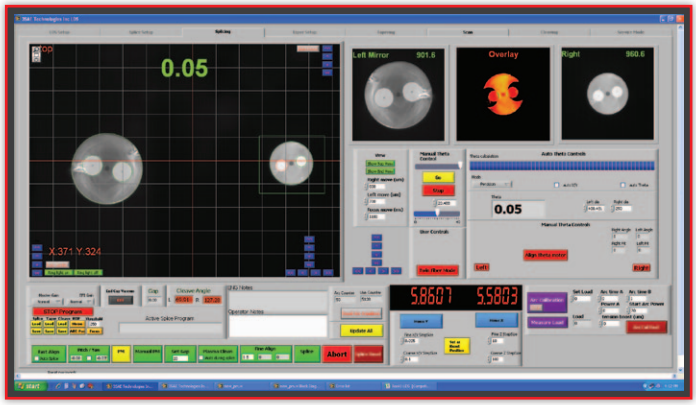
• PM Mirror Bracket assembly provides simultaneous end viewing of both the left and right stages.

• Provides rotational accuracy to +/- 0.1° for Panda type PM fiber.

• Alignment using Image Analysis Software allows independent alignment of PM fibers regardless of fiber shape, fiber diameter, or fiber material; thus eliminating the need for factory intervention when optimizing splices for new PM fibers.

• Compatible for use with Large Mode Area (LMA) and Photonic Crystal (PC) fibers.

• Includes Left and Right 250um Lighted PM fiber holders.



Large Diameter Splicing (LDS) System PM GUI

Integrated Piezo LDF Cleaving System Package

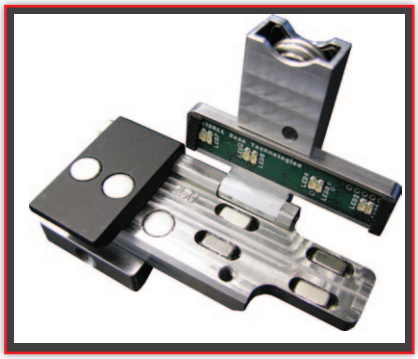
• Provides an in-the-box cleaving solution for production of end caps, tapers, mode-field adapters (MFAs) and optical fiber combiners up to 500µm in diameter. (Tapering package required for manufacturing tapers and optical combiners).

• High quality diamond-tipped ultrasonic blade with piezo-based frequency/amplitude control as well as a fiber-deflection control mechanism.

• Real time scanning and image feedback capabilities provide reproducible reference and cleave location control.

• Cleave location precise to +/- 1µm

• Improves yields of delicate assemblies by eliminating excess handling needed to transfer to an external cleaver.



LDS Light Injecting PM Fiber Holders

LDS 2.5 SYSTEM PACKAGES AND COMPONENTS

LDS-01-0550 - Large Diameter Splicing System LDS 2.5 Standard Package

LDS 2.5 Wide Area Plasma glass processing station with the following capabilities:

- Semi-automatic alignment and splicing including pitch/yaw for 125um to 2.5mm
- Two orthogonal 5MP cameras with precision double telecentric lenses providing 3.7 x 2.8mm field of view
- Vacuum based end cap holding system for supporting end caps during splicing, 2000um Fiber Holder (Right)
- PC with all necessary software and accessories
- Accessory kit including 250um fiber holders, 400um fiber holders, user manual, (2) spare electrode sets, all necessary PC and LDS interconnect cables. (No substitutions for fiber holder sizes.)
- 3SAE Automatic Electrode Cleaner (AEC)

Includes manufacturer's 1-year parts and labor warranty

LDS-01-0103 - Polarization Maintaining (PM) Splicing Package

Includes the following: Theta fiber alignment; End-face inspection alignment software package; Integrated mirror for end-face alignment; 250 µm light injecting fiber holders (pr) supports up to 600um coating

LDS-01-0104 - Tapering Package

Includes the following: Fully automatic adiabatic taper creation up to 85mm and load cell feedback system

LDS-01-0108 - Integrated Piezo LDF Cleaving System Package

Includes the following:

- Semi-automated cleaving of fibers up to 500um
- Adjustable precision cleaving location via image feedback
- Cleaver software package

LDS-01-0177 - Bundling Convenience Package

Includes the following: LDS Capillary Speed Loader; Fixturing for 700 µm and 870 µm OD capillaries (custom sizes available for purchase); Power supply; User's manual; 700 µm fiber holders (pr); 1000 µm fiber holders (pr)

TRN-01-0012 - Training

Training-3SAE LDS system Multi-day On-site Installation, Operational Training & Travel Expenses

Optional Components

LDS Capillary Speed Loader	LDS-01-0125
Facilitates rapid loading (less than 1 minute of seven (7) fibers into pre-tapered capillaries; Fixturing for 700 µm and 870 µm OD capillaries (other sizes available); Power supply; User's manual	
Electrodes ROF (Sold Individually)	SPT-10-1638
LDS Fiber Holders - 250 µm (pr)	LDS-01-0120
LDS Fiber Holders - 400 µm (pr)	LDS-01-0121
LDS Fiber Holders - 700 µm (pr)	LDS-01-0122
LDS Fiber Holders - 1000 µm (pr)	LDS-01-0123
LDS Fiber Holders - 2000 µm (pr)	LDS-01-0124
LDS Light Injecting PM Fiber Holders - 250 µm (pr)	LDS-01-0178
Electrode Sharpening Wheel (Pack of 25)	SPT-10-0761
Diamond Tip Replacement Blade	SPT-10-1570
Magnetic Brass Electrode Holders (Set of 3) for ROF	LDS-01-0094
Automatic Electrode Cleaner, (AEC)	ACC-01-0143