

Laminar Sciences Corp

**KaleidoFlow™ Rheoscopic Fluid  
Developer Guide**

October 2020



# Developer Guide Contents

- KaleidoFlow™ Rheoscopic Fluid Care & Handling
- Fundamentals of KaleidoFlow Fluid Use
  - Water-tight containers
  - Polarization
  - Light sources
  - Fluid movement
- How to use LSC Fluid Comparison Discs
- Investigations on 90 degree light path
- Materials Supplier Suggestions

[Abbreviations used in the document](#)

KaleidoFlow Rheoscopic Fluid: KRF, The Fluid, Fluid

Laminar Sciences Corp: LSC

# Fluid Care & Handling

## Fluid Care

- There is no known wear-out mechanism for KDF. When protected from contamination or evaporation, the streaming birefringence properties should continue in perpetuity.
  - LSC has a 10-year old tank/pump demonstration device still working as new
- KDF is sensitive to ionic contamination. Ionic contamination will cause the particles in the fluid to flocculate – irreversibly clump into fuzzy balls.
  - Salts, tap water and plumbers putty are known flocculation agents
  - Sweat and oils from human skin is a suspected flocculation agent
- KDF has been successfully mixed with acetone (in experiments to reduce viscosity). As more ‘known safe’ mix agents are discovered, they will be listed here.
- KDF, being water-based, will evaporate. If the evaporation is slight, deionized or distilled water can be used to replace the evaporated water.
- If KDF is allowed to nearly or completely dry out, the particles will adhere strongly to the whatever surface or container the fluid was in and will likely be difficult to remove. Soaking or immersing the dried particles might remove them, but there are instances where the dried residue can not be washed away. The dried residue should not be scraped or sanded away; dispose of the articles with fluid residue.

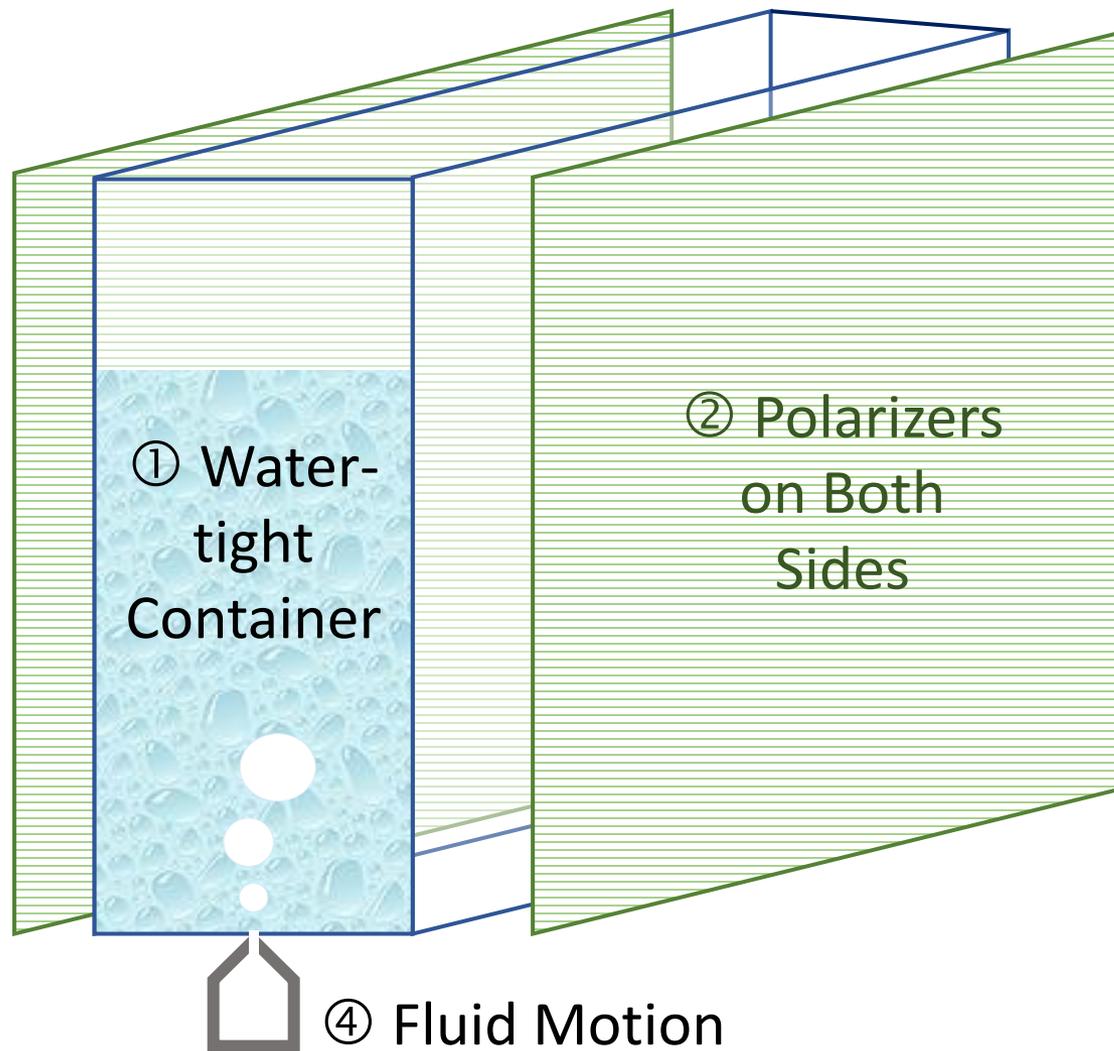
## Fluid Handling

- Rinse any fluid containers, modules, tanks, etc with distilled or de-ionized water before filling them with KRF.
- It is suggested that nitrile gloves when working on vessels for KRF so as to limit the chance that human skin salts or oils contaminate the fluid. There is also a chance that some people might find that the silicate particles in KRF irritate their skin.
- KRF is colloidal of tiny silicate particles in very pure water. As such, it is not toxic. But no testing has been done, or will be done, on ingestion by mammals. **Do not ingest KRF.**
- Do not aerosolize the KRF.
- KDF spilled on clothing or textiles may stain. Rinse out any affected clothing or textiles immediately and then machine wash them for best chance of preventing stains.
  - An experiment done by LSC indicates that cotton fabrics can be washed clean, but synthetic blends might retain a very light stain mark

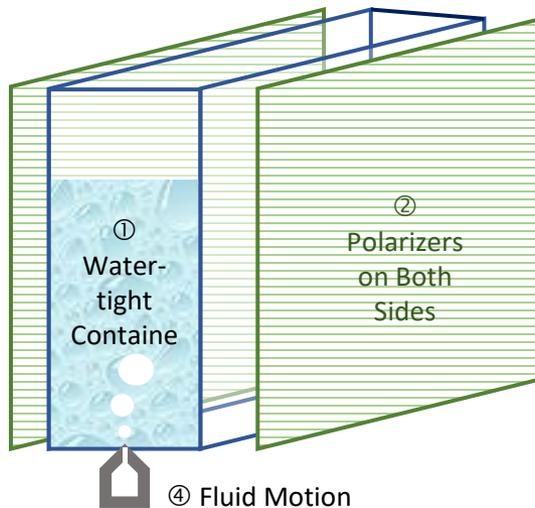
# Fundamentals of KaleidoFlow Fluid Use



③ Light Source



# Fundamentals of Fluid Use Summary

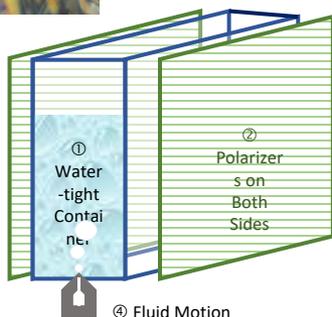


1. Water-tight container
  - Hobbyist/Educational Fluid Formulation
    - 0.125" to 1.625" effective thickness range
    - 0.25" – 1.0" thickness is sweet-spot
  - Professional Fluid Formulation
    - 0.125" to ~4.0" effective thickness range
    - 0.25" – ~2.0" thickness is sweet-spot
2. Polarizers on both sides
  - Linear polarizers: parallel, crossed or any angle
  - Circular polarizers: also work
3. Light Source
  - Full-spectrum white light
    - Warmer color temps create an amber, 'steam punk' look
    - Cooler color temps make the fluid appear clear and deliver more blues
  - Backlight uniformity versus hot spots is designer choice
4. Fluid Motion
  - Air bubbles
  - Pumped fluid
  - Objects moving in fluid
  - Fluid container motion

# Water-tight Containers



© Light Source

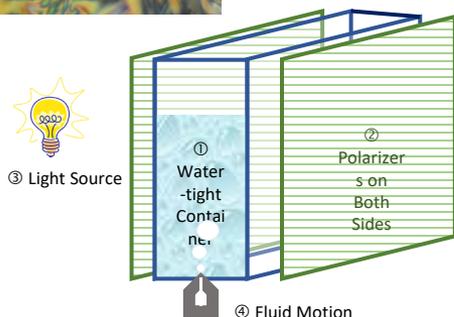


### • Fluid Depth Suggestions

- “depth” means the dimension parallel to light path through the fluid
- Professional Fluid Formulation
  - “Pro” formulation transmits ~40% more light than the “H/E” formulation
  - 0.25” – ~2.0” is sweet-spot of fluid depth
  - Depths below 0.25” have not been adequately explored by LSC. Given the microscopic size of the particles in the fluid, however, it is reasonable to assume the streaming birefringent will occur at smaller depths.
  - LSC has built fluid tanks up to 4.0” deep. Between depths of 2” to 4”, colors generated in the back of the fluid can be obscured by colors closer to the viewer. It is suggested that depths between 2-4” are best used in artistic designs, not fluid flow visualization designs.
- Hobbyist/Educational Fluid Formulation
  - 0.25” – 1.0” is sweet-spot of fluid depth
  - LSC has seen acceptable results up to 1.625” depth

# Fundamentals of Fluid Use

## Water-tight Containers



- Container Construction
  - LSC has used primarily cast and extruded acrylic (Poly(methyl methacrylate) (PMMA)) plastic sheets
  - Acrylic is slightly hydroscopic. In some LSC designs the acrylic panes will convex inward as they absorb water, making the fluid depth smaller in the center of the container
  - Glass or any other non-stressed plastic should work fine
  - Stressed plastic (e.g. blow mold plastic bottles) will introduce other colors as the stresses become birefringent in polarized light
- Glues and Cements
  - TAP Plastics acrylic cement
- Gaskets
  - Plumbers putty has caused flocculation (after several weeks)



# How to use LSC “Comp” Discs

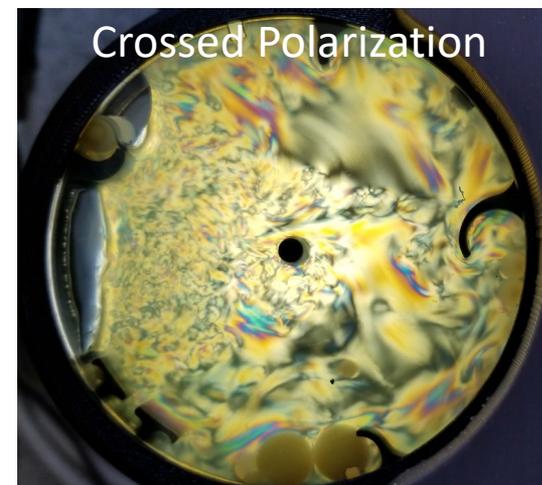
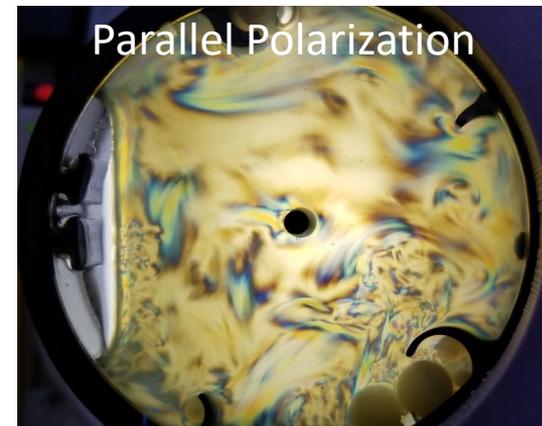


Fluid Type      Disc Manufacture  
Date Code



Rotating the front polarizer allows the developer to see how KaleidoFlow Rheoscopic Fluid shows different aspects of the flow conditions based on the orientation between the back and front polarizers.

Artistically:  
Parallel polarizers allow more light to pass through the disc and the fluid produces lighter colors. When the polarizers are 90 degrees crossed, the fluid produces large fields of dark ‘haze’ and more intense colors around the ‘haze’. Crossed polarizers also allow less light to come through (although the pictures to the right don’t show it because the camera employed auto exposure)

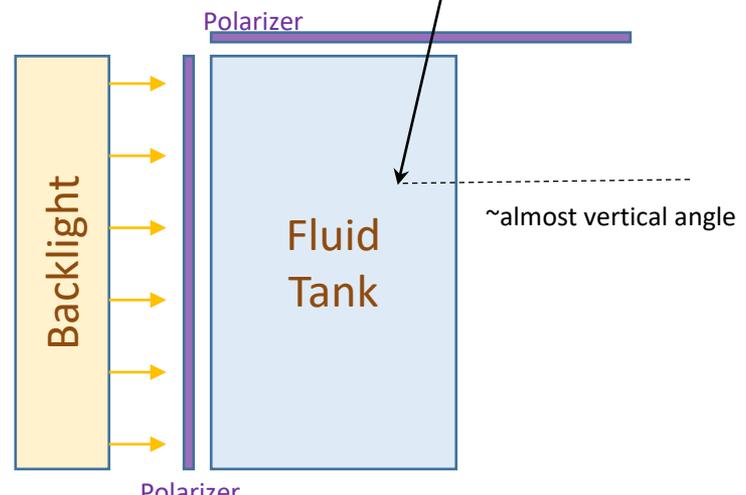
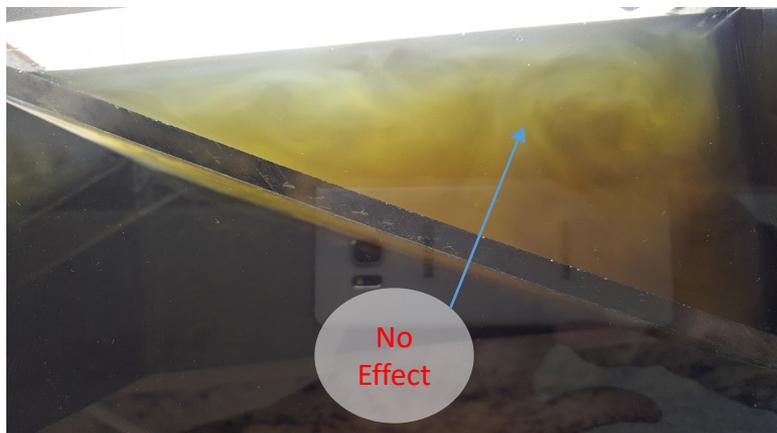
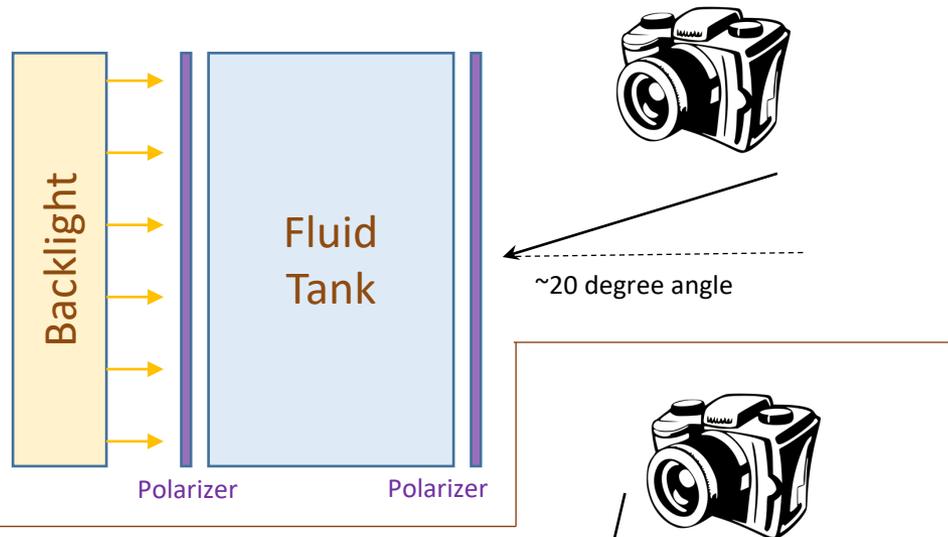
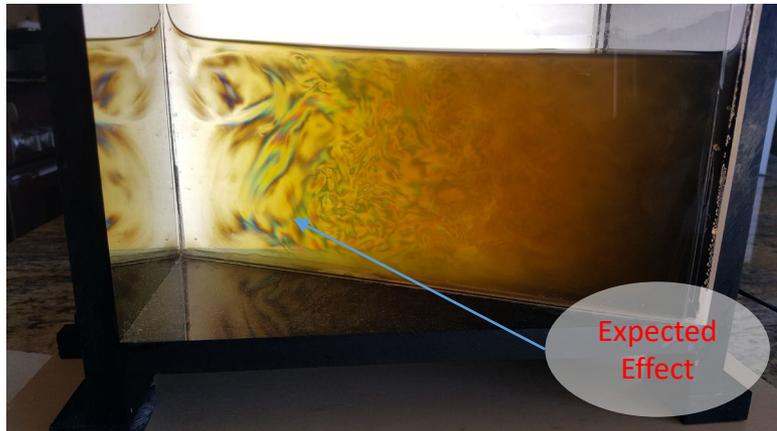


“Comp” discs will be available soon in the LSC Store



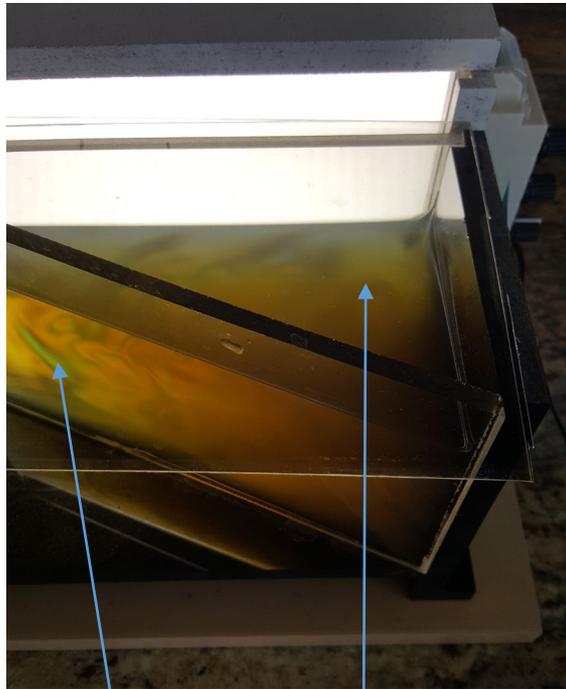
# 90 Degree Light Path Investigations

Customers often ask if they need a linear light path - the answer (so far) is unfortunately "yes"



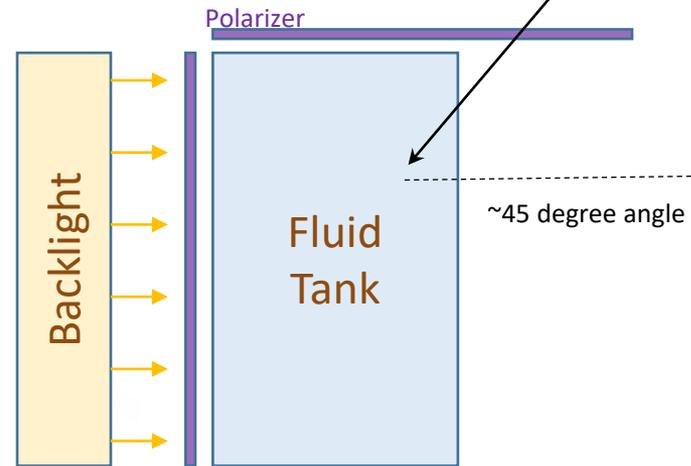
# Unexplained Phenomena

*OTOH, maybe there is yet more physics of streaming birefringence to be discovered*



Little  
Effect

Expected  
Effect



*Somehow, after the light passes through the front acrylic pane, the effect is visible even from above – but not when the light dose not pass thru the acrylic pane???*



## Supplier Options

Tank	Polarizer	Backlight	Motion	Supplier Name
✓				TAP Plastics <a href="http://www.tapplastics.com/">http://www.tapplastics.com/</a>
✓		✓		Evonik / Acrylite <a href="https://www.acrylite-shop.com/US/us/index.htm">https://www.acrylite-shop.com/US/us/index.htm</a>
	✓			Alight Polarizers <a href="http://polarization.com/">http://polarization.com/</a>
	✓			American Polarizers Inc <a href="http://www.apioptics.com/">http://www.apioptics.com/</a>
		✓		Super Bright LEDs <a href="https://www.superbrightleds.com/">https://www.superbrightleds.com/</a>
		✓		DCL Lumisheet <a href="http://www.dlc-lumisheet.com/">http://www.dlc-lumisheet.com/</a>
			✓	Greylor Pumps <a href="http://www.greylor.com/">http://www.greylor.com/</a>

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Listed suppliers are examples only; many other suppliers likely exist