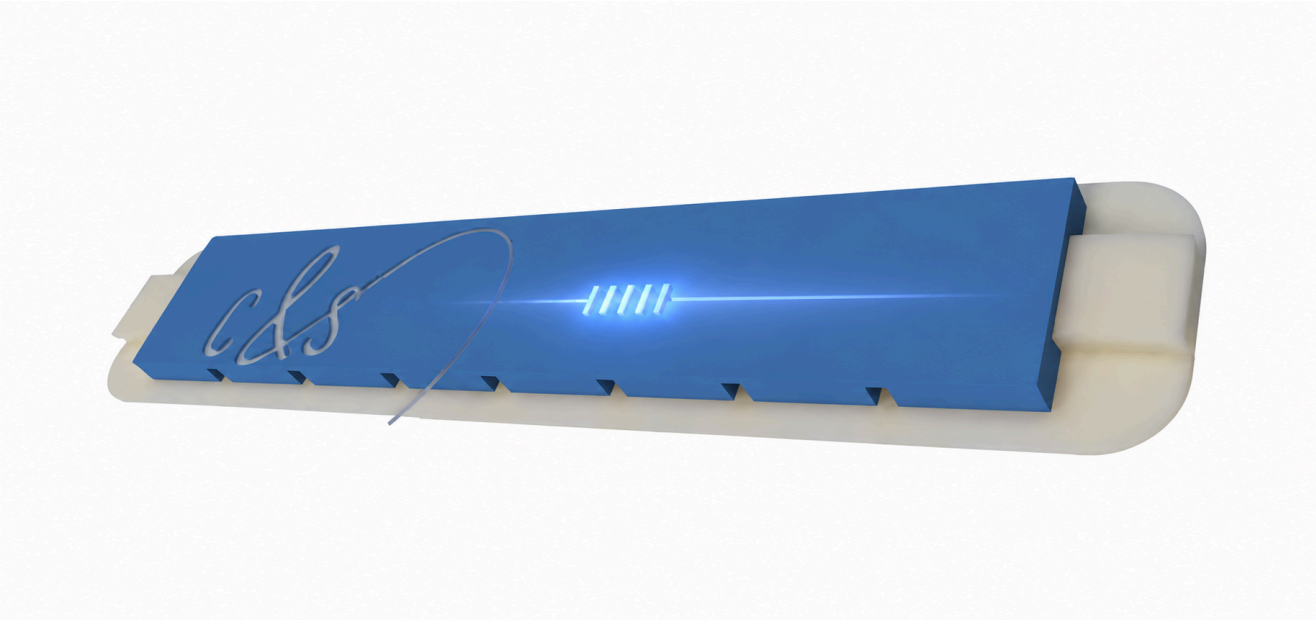
RETROFIT FBG STRAIN SENSING

CS Patch

A surface-mounted fiber Bragg grating sensor that turns an existing composite pressure vessel into a sensing asset, bonded in minutes, without touching the laminate.



1–2 min	5–10 days	UV-cured	LC/APC
install time	lead time	bonding	connector

PRINCIPLE

One FBG, used as an extensometer

The fiber is mechanically coupled to the surface before and after the grating. Deformation of the vessel is transferred into the fiber and read as a shift in Bragg wavelength, averaged over a set base length rather than concentrated on the grating itself.

COPV vessel surface	**Prep** sand + clean	**Patch** template placed	**UV bonding** CS UVACR cure	**Strain transfer** extensometer principle	**FBG** Bragg shift	**Interrogator** data out

The point isn't "an FBG glued to a tank." The value is a **repeatable integration system**, from a pre-assembled template through UV bonding to a defined strain-transfer path, so every installation behaves the same way. The CS_DUAL_PATCH template bonds two FBGs in series, axial (FBG1) and circular (FBG2), each over a base length of approximately 30 mm.

Template construction, CS_DUAL_PATCH: base template, FBG assembly, and fiber routing.

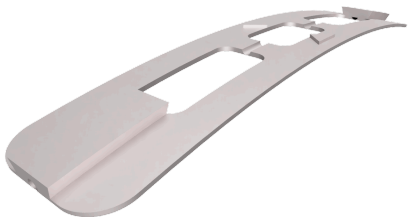
SINGLE OR DUAL

One direction, or two, on the same spot

Both share the same bonding method and installation time. The choice is about how much of the vessel's mechanical behavior you need to see.

1 FBG

CS Patch Single

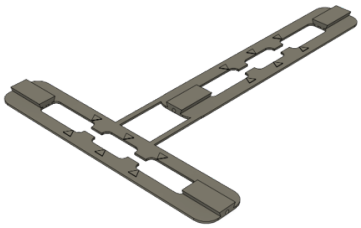


Measures strain in one chosen direction, axial or hoop. Simplest, fastest to deploy at scale.

- Follow strain / pressure response
- Instrument many tanks at controlled cost
- Cycling, proof testing, burst testing

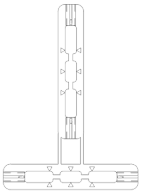
2 FBG, in series

CS Patch Dual



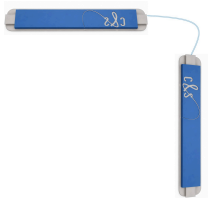
Axial and hoop, measured together at one location, for a biaxial view of the vessel's local mechanical behavior.

- Compare hoop / axial strain directly
- Stiffness changes, local anomalies
- R&D, qualification, characterization



Fixed jig, 0° / 90°

One pre-assembled T-shaped template, the two FBGs locked perpendicular. This is the CS_DUAL_PATCH from the installation manual: axial and circumferential, always at a fixed 90°, cured as a single piece.



Free jig, single templates in series

Two independent Single templates placed one after the other rather than locked into one rigid piece. Orientation and spacing between the two FBGs are free, not constrained to 90°.

TECHNICAL SPECIFICATIONS

Specifications

Values marked TBC are not yet confirmed. Testing is in progress.

Parameter	Specification	Status
Technology	Fiber Bragg Grating (FBG), extensometer principle	Confirmed
Mounting	Surface-mounted, retrofit on existing vessels	Confirmed
Footprint	Approx. 120 mm × 20 mm	Confirmed
Base length	Approx. 30 mm per FBG (axial and circular)	Confirmed
Fiber	Silica, approx. 120 µm, optional 900 µm protective tubing	Confirmed
FBG length	Approx. 4 mm	Confirmed
Connector	LC/APC	Confirmed
Bonding	CS UVACR01/02/03, one-component UV-curing adhesive, solvent-free	Confirmed
Installation time	1–2 minutes once the surface is prepared	Confirmed
Dual jig options	Fixed template (0°/90°), or free, two Single templates in series	Confirmed
Readout	FBG interrogator, static or dynamic depending on the DAQ used	Confirmed
Operating strain range	TBC	TBC
Strain accuracy / repeatability	TBC	TBC
Operating temperature	TBC	TBC
Environmental protection / IP rating	TBC	TBC
Fatigue / cycle life	TBC	TBC

UV bonding kit (adhesives, UV lamp, lamp support, protective glasses) sold separately.

Values marked TBC are not yet confirmed; testing is in progress. Specifications are subject to change without notice.

INSTALLATION

Bonded in place, glued in six moves

CS_DUAL_PATCH, template before cure and finished install with protective covers.

01
Prepare
Mark, sand or scuff, clean the substrate.

02
Verify
Check the FBG signal on the interrogator.

03
Position
Clean the patch, apply UVACR02, place the template.

04
Cure template
Approx. 30s per area, axial then circumferential.

05
Bond FBG
UVACR01 in the outer bonding openings only.

06
Cure FBG
Minimum 120s for each filled bonding area.

07
Protect
Slide covers over both FBGs, fix one side only.

08
Route
Secure fiber, tubing, connector with small UVACR02 dots.

09
Check
Verify signal and installation before use.

WHAT'S NEEDED

- CS Patch, Single or Dual
- CS UV Bonding Kit
- Surface preparation materials
- FO connector cleaner recommended
- Compatible FBG interrogator
- UV eye protection
- Isopropanol and clean wiping tissue

APPLICATIONS

Three places this gets used

A

Development & testing

- Pressure cycling, hydrostatic testing
- Proof pressure, burst testing
- Fatigue testing, prototype comparison
- No specially instrumented tank needed

B

Production & quality

- Production validation
- Batch-to-batch comparison
- Instrumented proof testing
- Flag a tank that drifts from reference

C

In-service monitoring

- Instrument a vessel not "born smart"
- Cycle counting, usage history
- Anomaly and degradation monitoring
- Entry point to condition-based maintenance

ADVANTAGES

Key characteristics

Retrofit
No new tank needed.

Non-invasive
Composite structure untouched.

Fast
Minutes, not a project.

Standardized
Less dependency on an expert.

Repeatable
Compare several tanks reliably.

Scalable
Prototype to full fleet.

Optical
Passive, EMI-immune, multiplexable.

CS Patch Single

€265 / unit, tax excl.

Lead time 5 to 10 days.

CS Patch Dual

On request

Lead time 5 to 10 days.