

COMPOSITES TEST FIXTURES - COMPRESSION

Unsupported Gage Section

Compression testing of composites without anti-buckling guide plates, is often preferred as the free unsupported length is more representative of true compression behavior. This method relies on the accuracy of the alignment between the upper fixture and the lower fixture while introducing the compression load. In addition, the natural failure process of the specimen will induce high lateral forces that must be resisted to ensure that forces remain in true compression. In these principles, the IITRI, Wyoming Modified Celanese and Combined Loading Compression fixtures are the same.

Their differences lie in the way the compression load is introduced – either by shear transfer from jaw faces to specimen, end loading or a combination of both. In the CLC fixture, the shear load component is from the tightening of the screws which is combined with end loads introduced directly. In contrast, the IITRI and Celanese rely on the self-tightening effect from the wedge jaw faces. The Celanese fixture also allows for preloading the jaw faces by manual screws when the specimen is being installed, while the IITRI also includes end bars that could be used to introduce end loads to the specimen.

In terms of usability, the IITRI allows the largest specimens, up to 38 mm wide, but is the heaviest of the fixtures. The CLC is conceptually the simplest but care must be exercised to ensure the specimen is properly located and improper or uneven tightening of the clamping screws can affect results. The Celanese is a neat compact fixture but is limited to only 12.7 mm (0.5 in.) wide specimens.

IITRI COMPRESSION FIXTURE

The IITRI fixture is designed according to ASTM D3410 with features for ease of use. The fixture sits between two compression platens. Alternatively, the upper fixture may be directly connected to a load cell via the standard clevis connection which allows it to be easily raised and lowered to install the specimen. The design incorporates two stiff columns with linear bearings for high lateral stiffness and alignment. It includes one set of wedge jaw faces and spacers suitable for specimens up to 38 mm wide and a fixture to assist in the alignment of the specimen within the wedge jaw faces.



S4690A IITRI Compression Fixture

WYOMING MODIFIED CELANESE FIXTURE

This fixture is derived from the Celanese compression fixture previously included in ASTM D3410 and using the similar sized specimen. Unlike the original Celanese fixture with its conical wedge jaw faces that has a limited thickness range, this modified version uses tapered cylindrical wedge jaw faces. In effect, the construction is conceptually similar to IITRI with guide posts and wedges, but is much more compact design and is ideal for 12.7 mm (0.5 in) wide specimens. Also it is much easier to handle being lighter in weight and does not require a specimen alignment fixture.



CP105787 Wyoming Modified Celanese Compression Test Fixture

COMBINED LOADING COMPRESSION FIXTURE

The CLC fixture was designed to use both shear transfer of axial load to the specimen as well as end loading the specimen. Shear force is introduced by tightening four clamping screws, while the specimens are positioned so that the specimen ends are exposed flush with the top and bottom blocks of the fixture. The upper and lower parts of the fixture are maintained in alignment by guidance columns and linear bearings to ensure minimal friction. This fixture design is therefore significantly different to IITRI and Modified Celanese suggesting less damage to the specimen at the jaw face.



CP104483 Combined Loading Compression Fixture

IITRI COMPRESSION FIXTURE

FEATURES

- Meets ASTM D3410 and ISO 14126 Method 1
- Wedge jaw faces with spacers to accommodate different specimen thickness
- Includes precision specimen alignment fixture
- Ergonomic design allows for easy set up and ease of use
- High strength stainless steel construction for corrosion resistance and durability

PRINCIPLE OF OPERATION

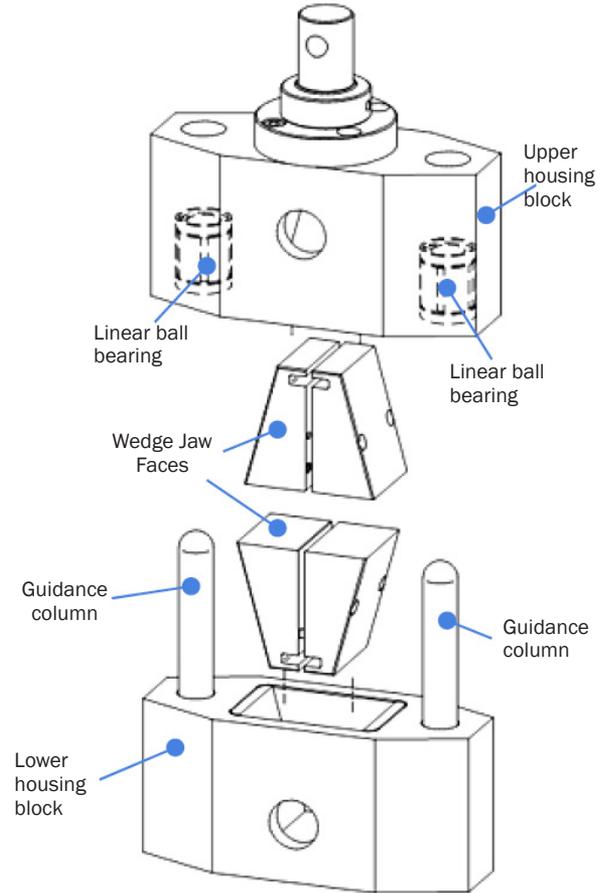
The IITRI Compression fixture allows compression forces to be imparted to the specimen via pure shear loading by means of rectangular wedges within housing blocks. The faces of the wedges are surfalloy coated with tungsten carbide to provide optimal gripping performance. The wedges have slots to accommodate end bars. These ensure an equal length of specimen is engaged within each pair of wedges. The end bars may be removed before the test or left in place to impart an additional degree of end-loading to the specimen.

The upper housing block may be compressed with a compression platen or attached directly to the load cell while the lower housing block sits on a compression platen. The guidance columns and linear bearings ensure complete alignment between the upper and lower blocks.

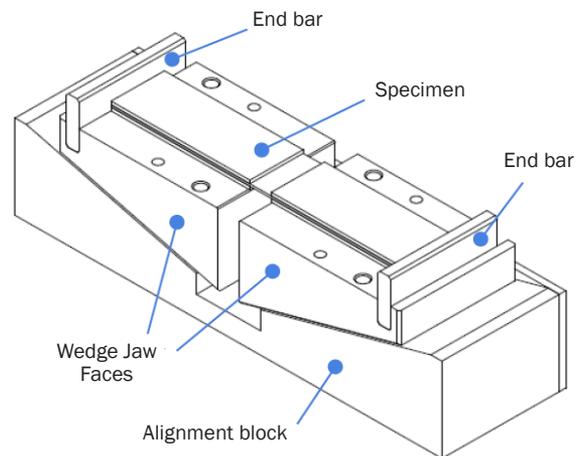
A specimen alignment fixture is included, which allows consistent and precise alignment of specimen with respect to the longitudinal axis of the wedges in the test fixture. Holes are incorporated in the housing block to aid in removal of the test specimen after the test is complete.

APPLICATION RANGE

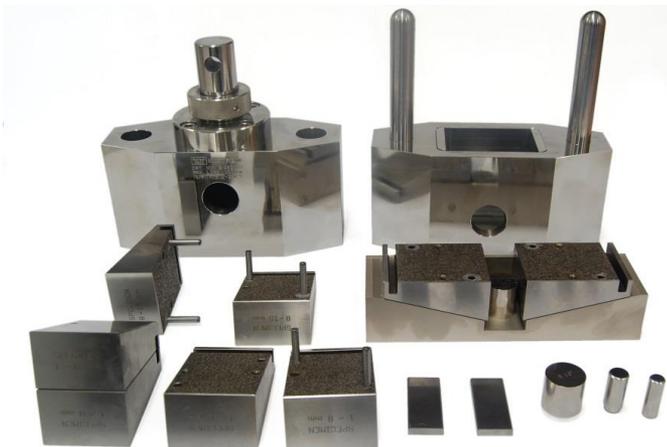
- Type of loading: Compression
- Specimen material: Polymer matrix composite materials
- Specimen shapes: Tabbed or un-tabbed flat specimens per ASTM D3410 and ISO 14126 Method 1



Exploded view of IITRI Fixture



Specimen Alignment Fixture



Disassembled IITRI Fixture including Specimen Alignment Fixture and Gage Blocks

WYOMING MODIFIED CELANESE

FEATURES

- Compact and lightweight design allows for easy set up and ease of use
- High strength stainless steel construction for corrosion resistance and durability

PRINCIPLE OF OPERATION

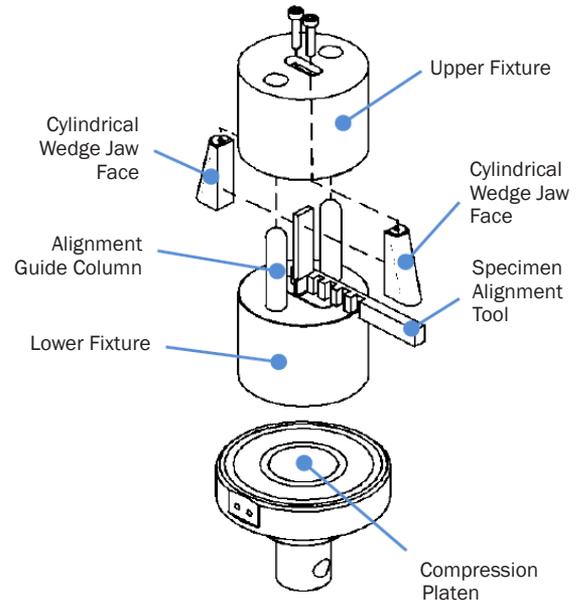
The Wyoming Modified Celanese (WMC) Fixture incorporates several design improvements over the original Celanese fixture. The original Celanese fixture adopts a conical wedge design which requires the specimen to be fabricated to a very specific thickness with very precise tolerances to maintain full surface contact of the wedges with their mating conical cavity. In contrast, the WMC fixture adopts a cylindrical wedge design which maintains full surface contact with the mating cavity regardless of the specimen thickness.

Initial clamping of the specimen is achieved via screws at the end of each wedge face. A specimen alignment tool is provided to aid in setup ensuring the wedge jaw faces are symmetrical with respect to the specimen.

By sitting on a compression platen, the lower fixture is laterally unconstrained thereby ensuring complete alignment with the upper fixture via the guide columns and linear bearings.

APPLICATION RANGE

- Type of loading: Compression
- Specimen material: Polymer matrix composite materials
- Specimen shapes: Tabbed or un-tabbed flat specimens



Exploded View of Wyoming Modified Celanese Fixture

COMBINED LOADING COMPRESSION

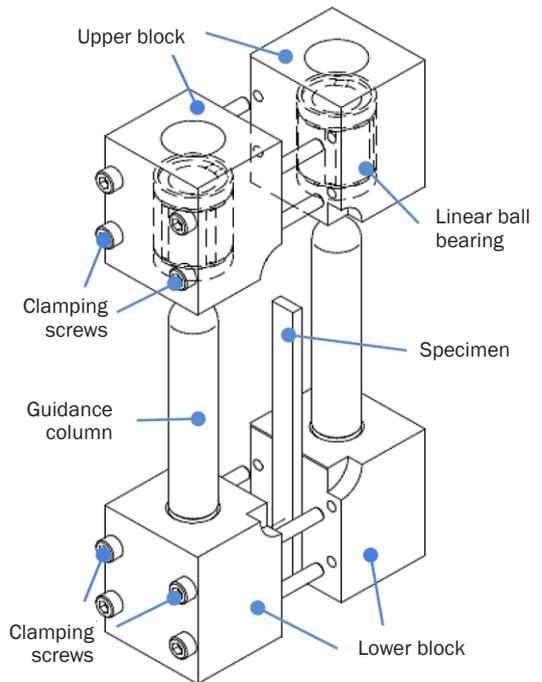
FEATURES

- Complies fully to ASTM D6641
- Compact and lightweight design allows for easy set up and ease of use
- High strength stainless steel construction for corrosion resistance and durability

PRINCIPLE OF OPERATION

The Combined Loading Compression (CLC) fixture allows application of compressive force onto the specimen by a combination of shear loading and end loading. The specimen is clamped between two pairs of blocks with its ends flush with the ends of the blocks and the assembled fixture is then placed between compression platens. Because the specimen ends are flush with the ends of the blocks, end loading is applied directly by the compression platens, while the shear loading is applied via the blocks.

A specimen alignment tool is provided to ensure the specimen is centered with respect to the blocks. In addition, a graduated scale is engraved on the lower block to assist in centering the specimen in the test fixture.

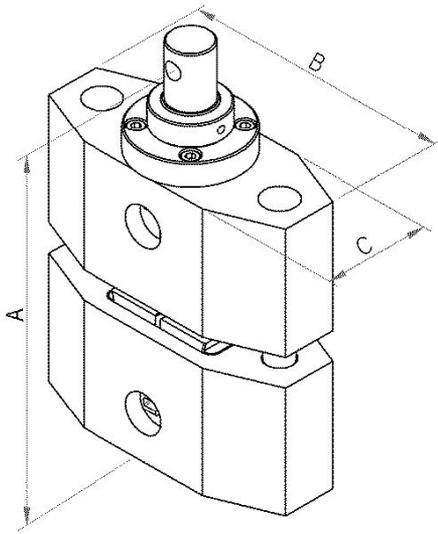


Exploded View of Combined Loading Compression Fixture

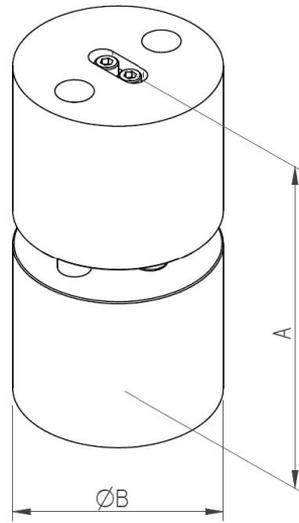
APPLICATION RANGE

- Type of loading: Compression
- Specimen material: Polymer matrix composite materials
- Specimen shapes: Un-tabbed flat specimens per ASTM D6641

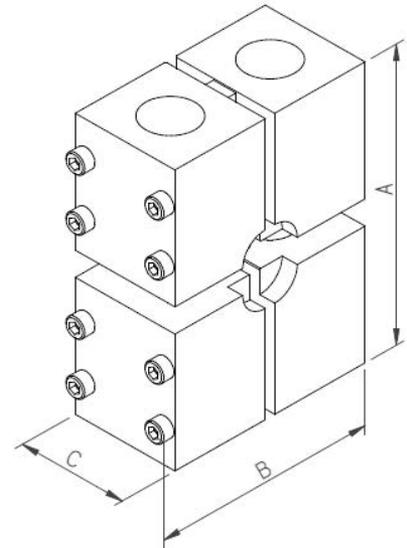
SPECIFICATIONS



S4690A



CP105787



CP104483

Test Standard		ASTM D3410	NA	ASTM D6641
Maximum Load	kN	100 (with Type Dm adapter) 300 (loaded between platens)	100	100
Temperature Range	°C °F	-70 to +200 -94 to +392	-70 to +200 -94 to +392	-70 to +200 -94 to +392
Specimen Thickness	mm in	1 - 15 0.04 - 0.59	3.8 - 6.35 0.15 - 0.25	1 - 15 0.04 - 0.59
Jaw Face Length	mm in	75 (clamped length 65) 2.95 (clamped length 2.56)	50.8 2	64 2.52
Specimen Width	mm in	12 - 38.1 0.5 - 1.5	12.7 0.5	12 - 30 0.5 - 1.18
Mass	kg lb	23 50.7	5.3 11.7	5.1 11.2
Upper Interface ¹		Type Dm or Compression Platen (>100 mm dia.)	Compression Platen (>100 mm dia.)	Compression Platen (>100 mm dia.)
Lower Interface		Compression Platen (>100 mm dia.)	Compression Platen (>100 mm dia.)	Compression Platen (>100 mm dia.)
Effective Length (A)	mm	310 (with Type Dm adapter) ² 244 (without Type Dm adapter)	142	154
	in	12.2 (with Type Dm adapter) 9.6 (without Type Dm adapter)	5.6	6.1
Overall Width (B)	mm	200	75	116
	in	7.9	3.0	4.6
Depth (C)	mm	80	-	53
	in	3.15	-	2.1

Notes:

1. It is recommended that the upper platen incorporates a lockable spherical seat.
2. For specimens with 25 mm gage length and 15 mm thickness

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