

Application Note: Crack Tip Opening Displacement (CTOD)

What is CTOD Test?

CTOD test is a measure of the resistance of a material to the propagation of a crack. Essential CTOD quantifies how much a crack can open before a catastrophic failure is seen. Cracks can form in materials due to a multitude of reasons including but not limited to manufacturing defects, impact, service fatigue etc. Understanding CTOD is extremely important for

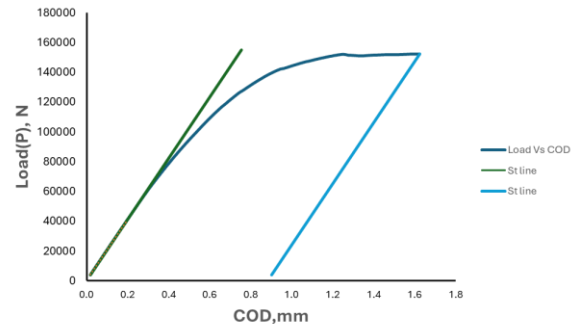
- Predicting failure of materials by understanding load/stress conditions under which crack can propagate
- Choice of materials suitable for specific applications based on required toughness
- Designing structures that can withstand potential crack propagation
- Evaluating safety of structures with existing cracks to predict life cycle

CTOD is widely used in various industries like Aerospace, Automotive, Pipelines, Naval etc. Instron systems support CTOD testing across a range of materials and loading conditions to meet relevant testing standards.

How is CTOD measured?

There are three basic steps involved in CTOD Testing

1. **Sample Preparation:** Standard specimen is prepared with a pre cracked notch. Most commonly used standard is ASTM1820 but there are other industry specific standards as well. Preparing sample with the suitable notch geometry, size is key towards getting reliable CTOD results. Instron Fracture Software gives additional information on sample preparation complying to ASTM1820
2. **Pre-cracking:** Fatigue loading is applied on the specimen for pre-cracking. This is a commonly used step and can be easily performed on an Instron Dynamic load frame.
3. **Loading and Crack Measurement:** The specimen is subjected to load to allow opening of the crack. Crack opening gauges are used to measure the crack tip opening displacement.
4. **Data Analysis:** The CTOD value is determined from the load displacement curve



Instron Dynamic Systems for CTOD Testing

Instron offers a wide range of dynamic testing for CTOD Testing

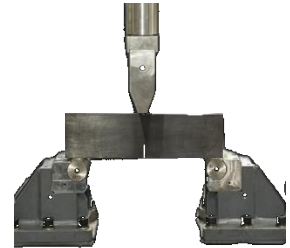
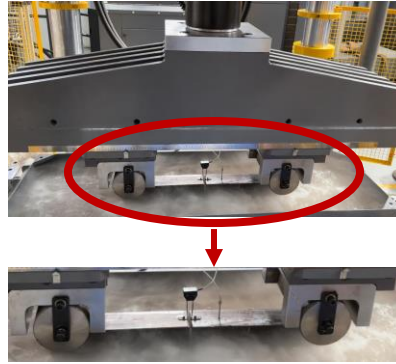
Model No.	Unit	BI-7000	BI-7004	BI-7020	BI-7030
Dynamic Load Capacity	kN	25	50	100-600	600-3000
Actuator Stroke (Total)	mm	50	100	150	
No. of Columns		2			4
Actuator Position		Bottom		Bottom/Top	Top
Frame Stiffness	MN/m	100	160	500/1000	2500-10000
Loadcell Accuracy		±0.3% of full scale			±0.5% of reading down to 1/500 of load cell capacity
Cycling Frequency	Hz	0-65		0-100	0-35
Column Clearance	mm	400	600		800/1000 & 1000/2000*
*Daylight Opening	mm	700	900	1200	
Electric Supply		200-240V, 15 A single Phase Supply		380/400/415 VAC, 3 Ph, 50/60 Hz	

*(Maximum Between Load Cell and Actuator at zero position) 1000/1200 column clearance for 2000 & 3000kN systems

Typical CTOD Test Setup

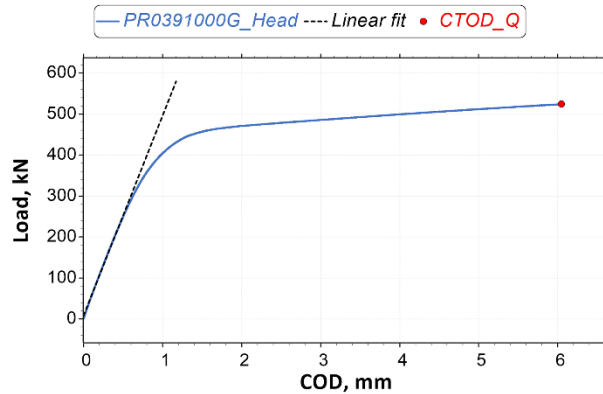
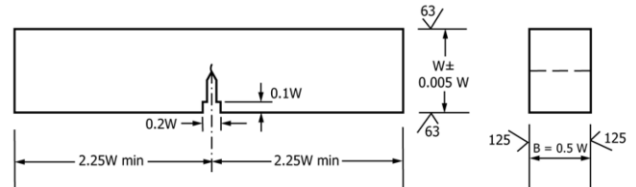


BI-7035 2000kN Dynamic Test system is used for conducting CTOD test on metallic specimens. The 4 column, highly stiff dynamic rated loadframe with a bottom T slotted base is equipped with a low temperature bath for testing at subzero temperature. Typical setup with the grips is as shown in the below images



Specimen details

Specimen type	SE(B) - Straight Through Wide		
Width, mm	160.000	Thickness, mm	80.000
Span, mm	640.000	Precrack length	0.496
Modulus, GPa	210.000	Yield Strength, MPa	480.000
Tensile Strength, MPa	600.000	Poisson's Ratio	0.300



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