HIGH STRAIN RATE TESTING EQUIPMENT

CUTTING EDGE WORLD LEADER

REL, Inc. is a world leader in the design and manufacture of High Strain Rate Testing Equipment. REL distributes High Strain Rate Testing Systems worldwide for companies and researchers who are on the cutting edge of material development and property investigation in strain rate ranges from 100-10,000 s-1. REL High Strain Rate Testing Equipment allows the user to tailor the strain rate during testing to match actual in-service operating conditions.

CONDITIONS THAT ARE MODELED WITH REL HIGH STRAIN RATE TESTING PLATFORMS INCLUDE:

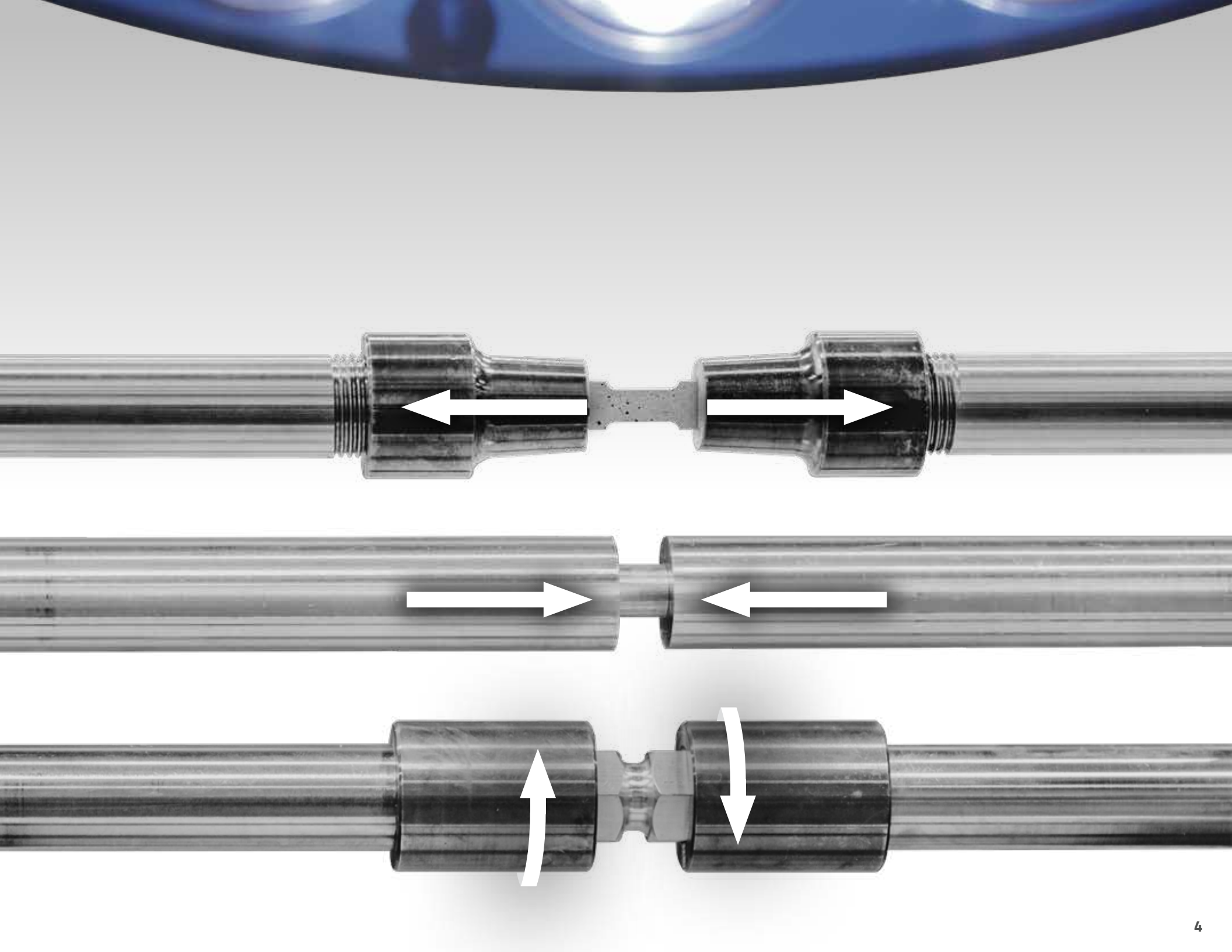
- Energy absorption & deformation
- Material forming manufacturing
- Visco-elastic material response

REL High Strain Rate Testing Equipment incorporates modules that have been refined during the relentless pursuit of experimental precision. Precision Accelerators, Ground Platforms, Stands, and Bar Sets lead to high configurability in a short time frame, and repeatable results for material response. High Speed Cameras, temperature control, and data collection are also preconfigures to be able to be integrated into the modular equipment seamlessly.

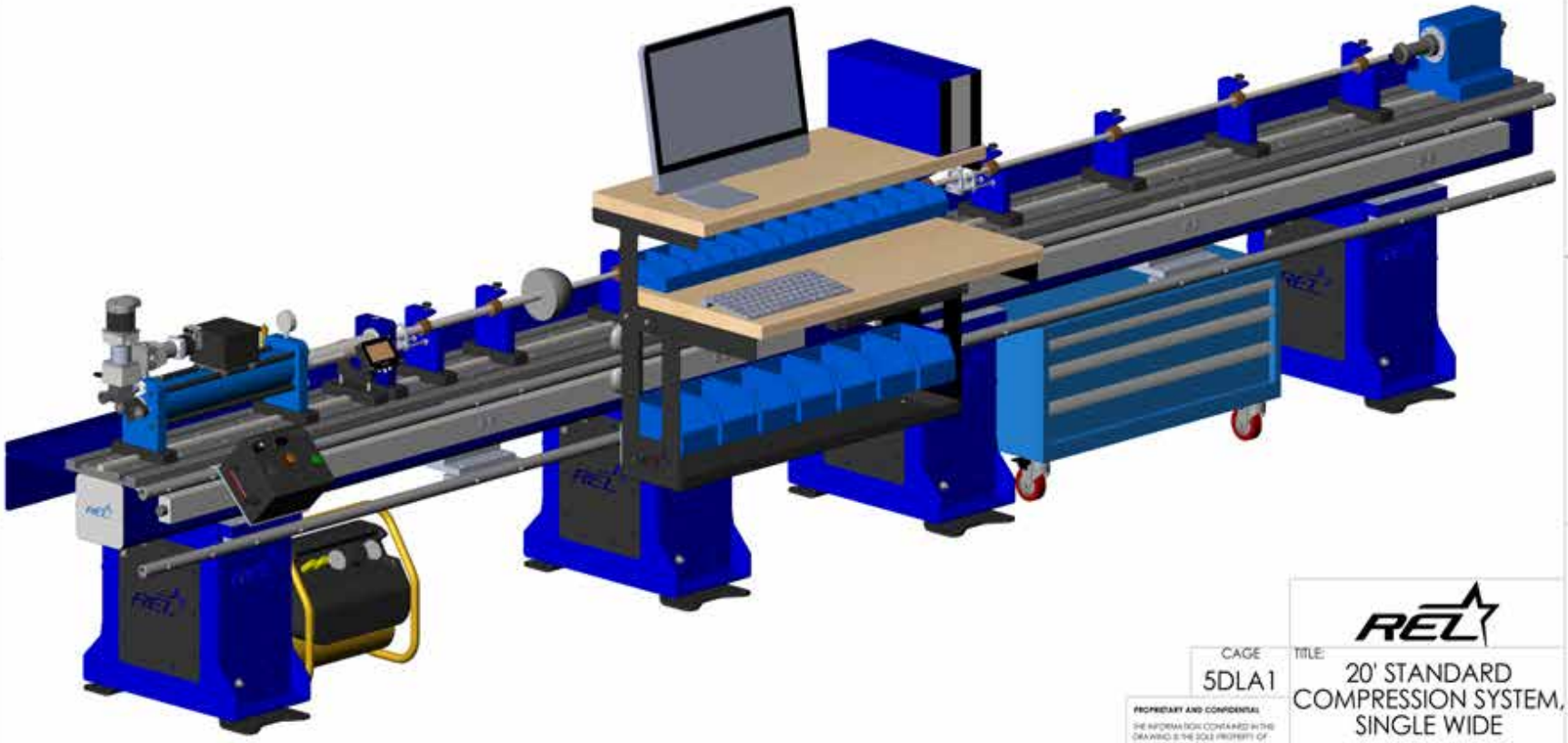
REL developed and is deploying SURE-Pulse software as a culmination of all of the High Strain Rate test studies that have been performed in house. This is a user friendly software to enable rapid adoption of test results for demanding testing applications.

Visit relinc.com/high-strain-rate-testing to view all of REL's products.

TENSION, COMPRESSION, & TORSION TESTING



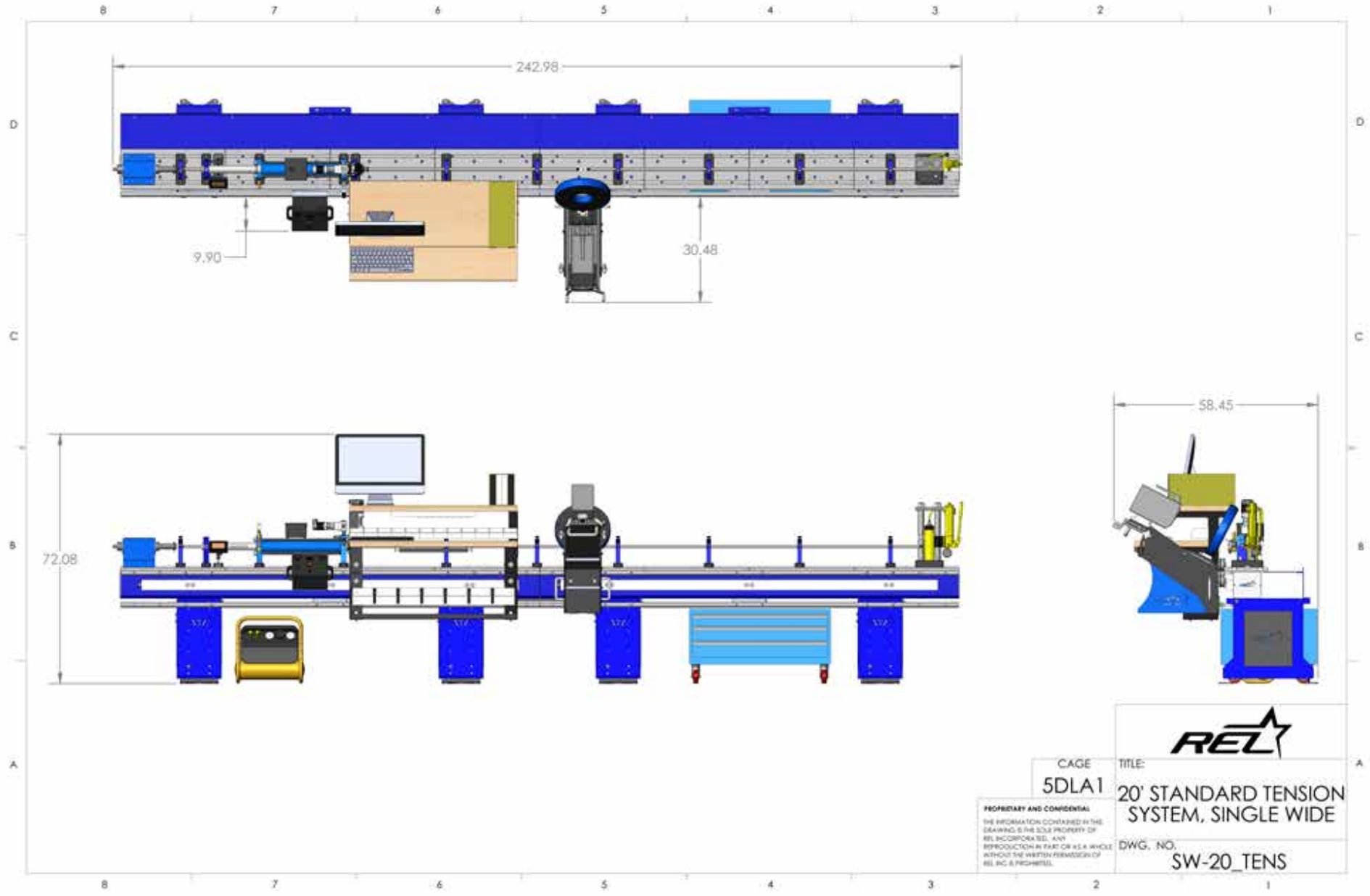
ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	G3SW-20	TESTING PLATFORM SINGLE WIDE	1
2	LAU-1000-ACS	AUTOMATED 1" COMPRESSION ACCELERATOR WITH 36" BARREL,SURE SPEED MODULE	1
3	COMP-M350-6-96-72-SET	3/4" C350 COMPRESSION BAR SET WITH STRIKERS AND MOMENTUM TRAP	1
4	DAQ-1000	DATA ACQUISITION PACKAGE	1
5	STOP-1000-HYD	STOP STAND WITH HYDRAULIC ENERGY ABSORPTION	1
6	FACL-1000	200 PSI AIR COMPRESSOR	1



CAGE 5DLA1

TITLE: 20' STANDARD COMPRESSION SYSTEM, SINGLE WIDE

DWG. NO. SW-20_COMP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72.08
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CAGE
5DLA1
TITLE:
20' STANDARD TENSION SYSTEM, SINGLE WIDE
DWG. NO.
SW-20_TENS
PROPRIETARY AND CONFIDENTIAL

DYNAMIC MATERIAL TESTING STARTS HERE.

Compression SHPB testing is the baseline for dynamic material property characterization. A controlled impact of bars and specimen in a perfectly aligned system imparts a known amount of energy into materials tested in microseconds.

Years of engineering has perfected a 100+ year old technique to extract material properties from samples tested at various strain rates. REL's SHPB acquisition system captures the compression event to process material response to a sudden dynamic event.

The compression test can be configured to allow for single or multiple hit events through the use of an impedance matched momentum trap.

EQUIPMENT HIGHLIGHTS

- Keyed alignment of launcher, striker, incident bar, and transmission bar
- Bar sizes from ⅛" - 3" diameter to test multiple size samples
- Bird-mouth bar stands allow for efficient test setups
- Repeatable tests at bar speeds up to nearly 400 ft/sec and strain rates > 10,000/sec

INTERFACES WITH

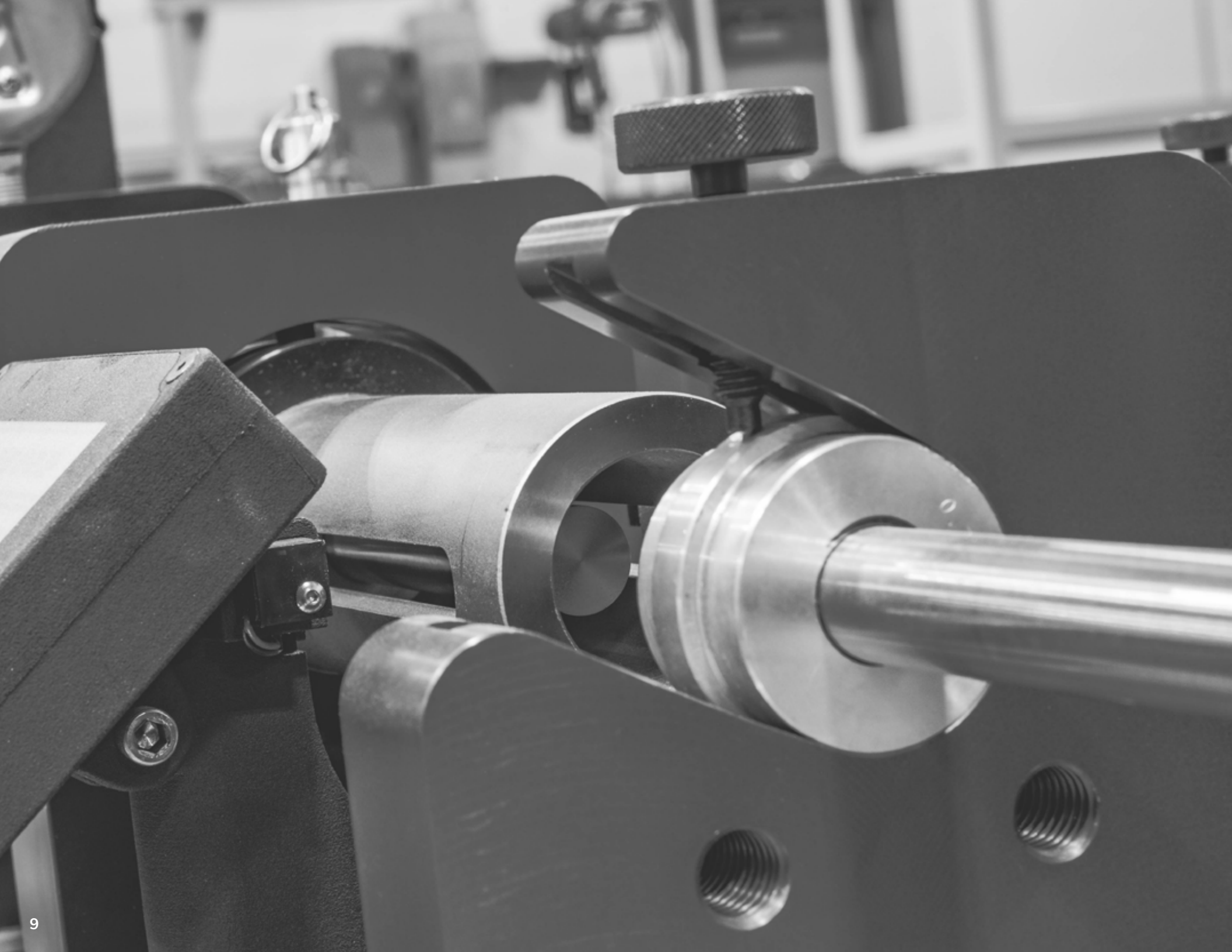
- Flat Base
- Speed Sensor
- Data Acquisition System (DAQ)
- Camera Mount

1

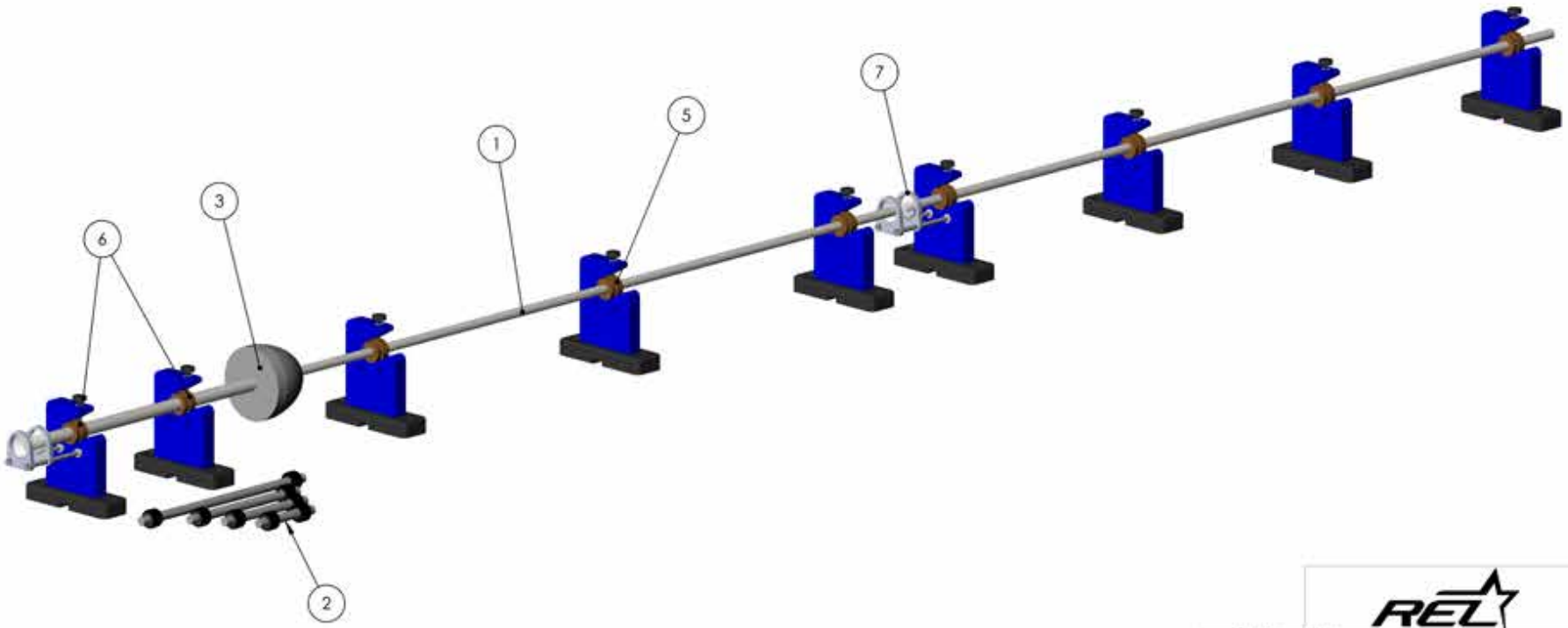
2

3

1. System bars sitting in aligned 'bird-mouth' stands
2. Impact zone of striker and incident bar at end of bar accelerator
3. Specimen mounted for testing with movable protective shield



ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	CBS-M350-6-96-72	.750" DIA. C350 COMPRESSION BAR SET, 96" INCIDENT, 72" TRANSMISSION	1
2	SBC-M350-6-SET	.75" COMPRESSION STRIKER SET (6",9",12",18")	1
3	MT-1001-ST	3/4" STEEL MOMENTUM TRAP WITH SLEEVE	1
4	SHPB1-11211	1" BAR SUPPORT	9
5	SHPB1-11211B-6	BAR SUPPORT BUSHING 0.75"	7
6	SHPB1-11211B-8.5	BAR SUPPORT BUSHING 1.062	2
7	SFG3-16-06	IMPACT GUARD ASSEMBLY	2



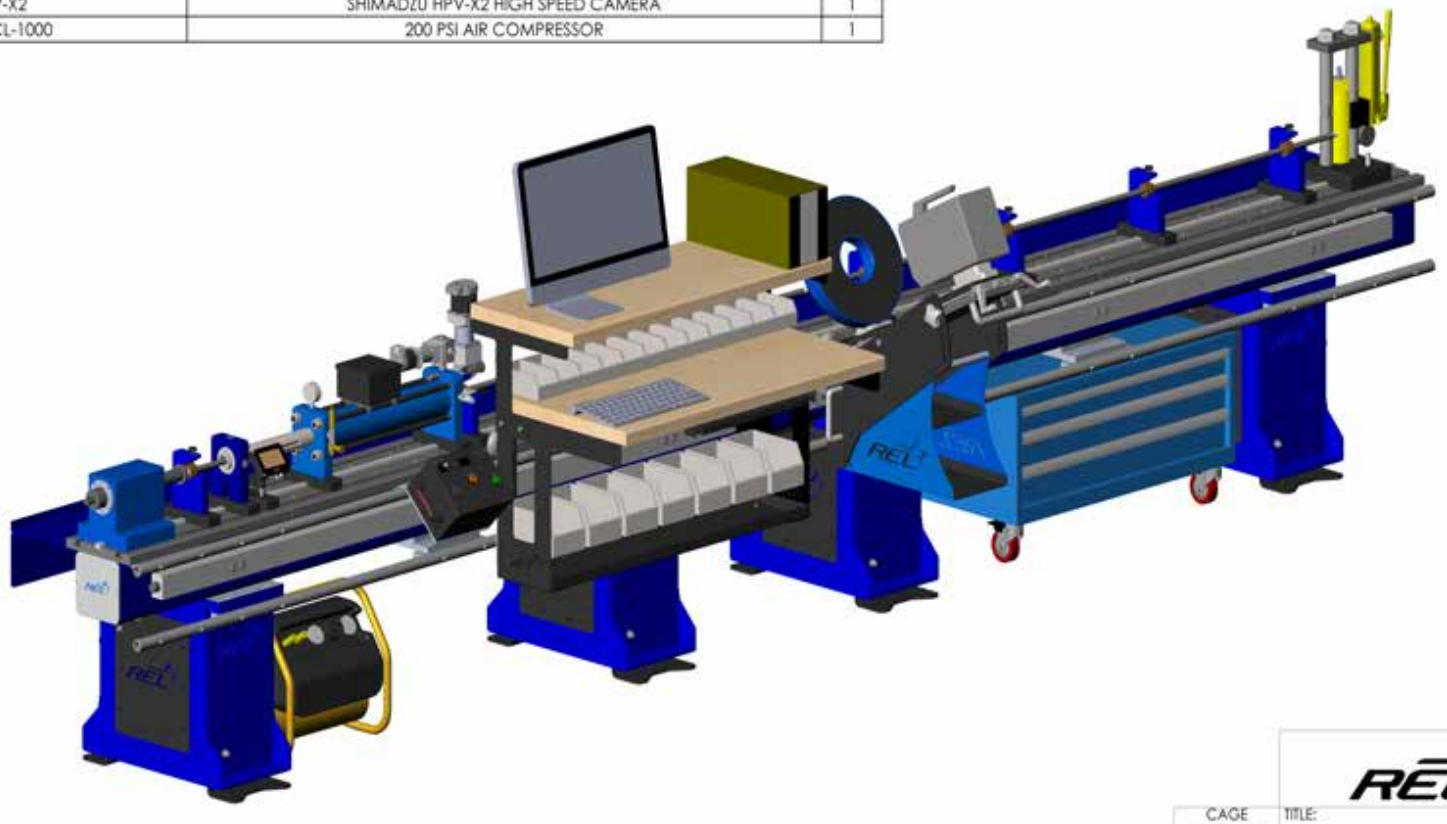
REL

CAGE
5DLA1

TITLE:
3/4" C350 COMPRESSION BAR SET WITH STRIKERS AND MOMENTUM TRAP

DWG. NO.
COMP-M350-6-96-72-SET

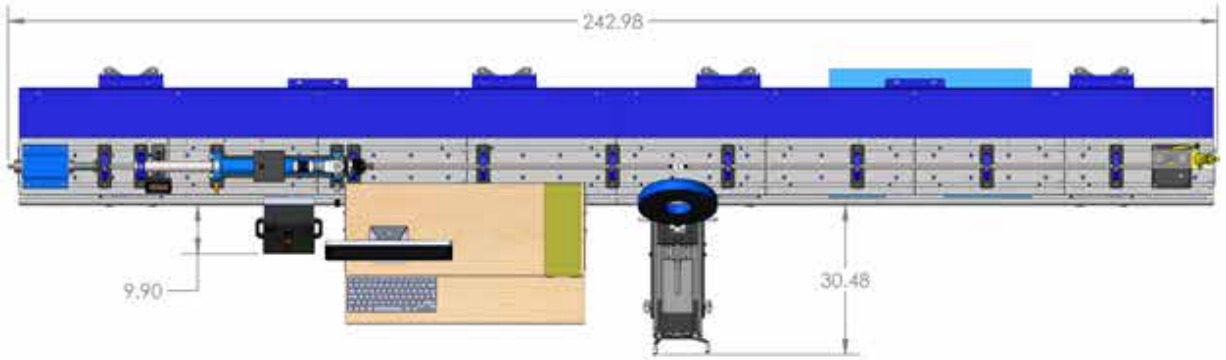
ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	G3SW-20	SURE FLAT SINGLE WIDE BASE SYSTEM	1
2	LAU-1000-ATS	AUTOMATED 1" TENSION ACCELERATOR WITH 36" BARREL,SURE-SPEED MODULE	1
3	TENS-M350-6-114-96-SET	3/4" C350 TENSION BAR SET WITH STRIKERS,GRIPSET AND SETTING TOOL	1
4	DAQ-1000	DATA ACQUISITION PACKAGE	1
5	STOP-1000-HYD	STOP STAND WITH HYDRAULIC ENERGY ABSORPTION	1
6	FBL-1000	MOUNTING CARRIAGE ,CAMERA/LIGHTNG	1
7	FBL-1100	HIGH INTENSITY LED RING LIGHT	1
8	HPV-X2	SHIMADZU HPV-X2 HIGH SPEED CAMERA	1
9	FACL-1000	200 PSI AIR COMPRESSOR	1

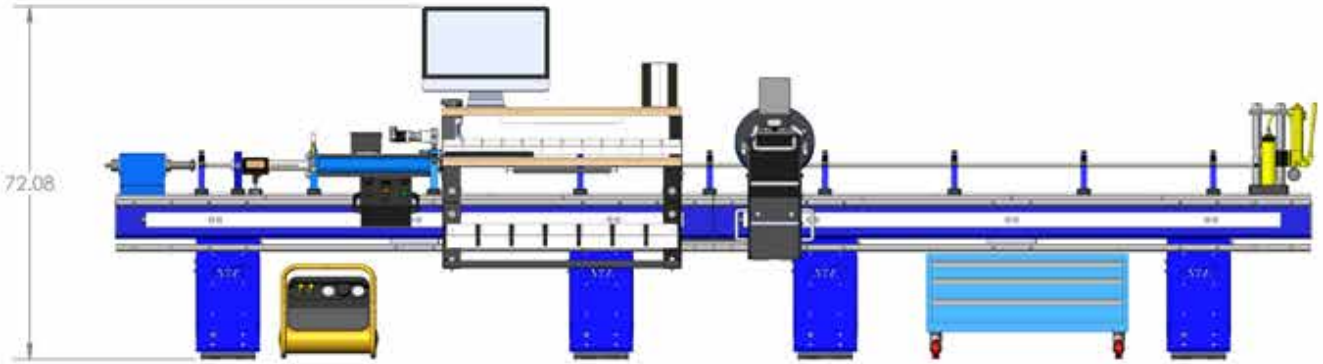


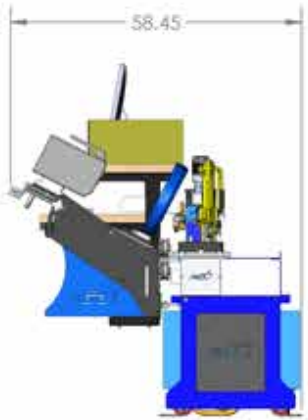
CAGE 5DLA1

TITLE: 20' STANDARD TENSION SYSTEM, SINGLE WIDE

DWG. NO. SW-20_TENS







REL

CAGE	TITLE:
5DLA1	20' STANDARD TENSION SYSTEM, SINGLE WIDE
	DWG. NO. SW-20_TENS

MATERIAL TENSION RESPONSE IS THE BACKBONE OF STRUCTURAL DESIGN.

Tension failure criteria is critical to structural and fracture-based design applications. Characterizing materials in tension at high rates is a non-trivial task that requires precision equipment and processes.

REL has developed and tuned our tension system modules to address a variety of issues encountered during tension SHPB testing. Carefully machined collets, hardened grips, and precision ground bars ensure impedance matching and maximum loading rates. While gun drilled, concentric striker tubes provide uniform load profiles in a compact package using common launchers.

The entire tension module setup is configured to simplify data acquisition which often includes Digital Image Correlation equipment and processing steps to acquire strain data.

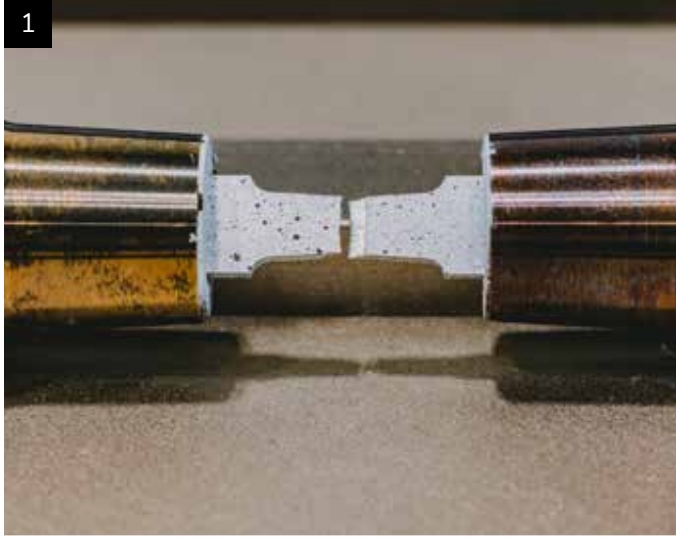
EQUIPMENT HIGHLIGHTS

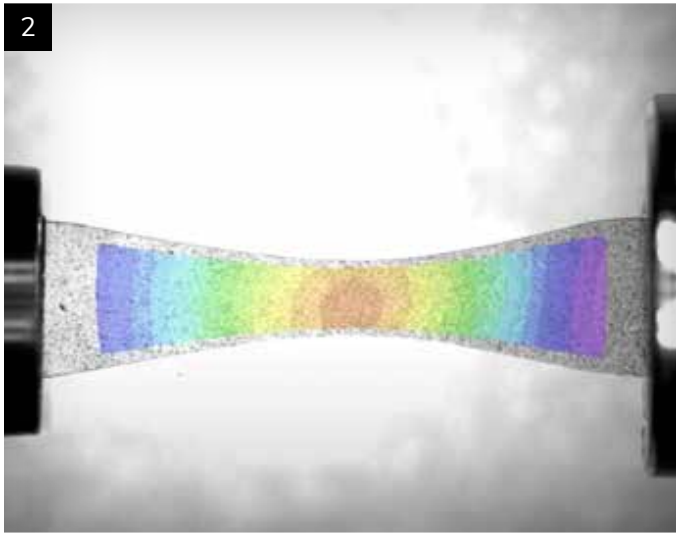
- Impedance matched collets and grips calibrated for each bar material and size
- Flat or threaded sample options
- Concentric tube strikers provide direct tension and balanced load profiles
- Common launchers between compression and tension (with use of specific adapters)

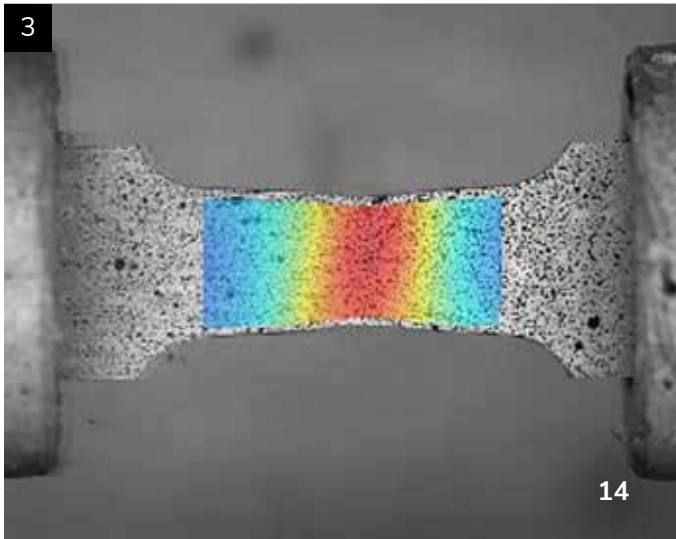
INTERFACES WITH

- Flat Base
- Speed Sensor
- DAQ
- Camera Mount
- Lighting
- Heating Systems

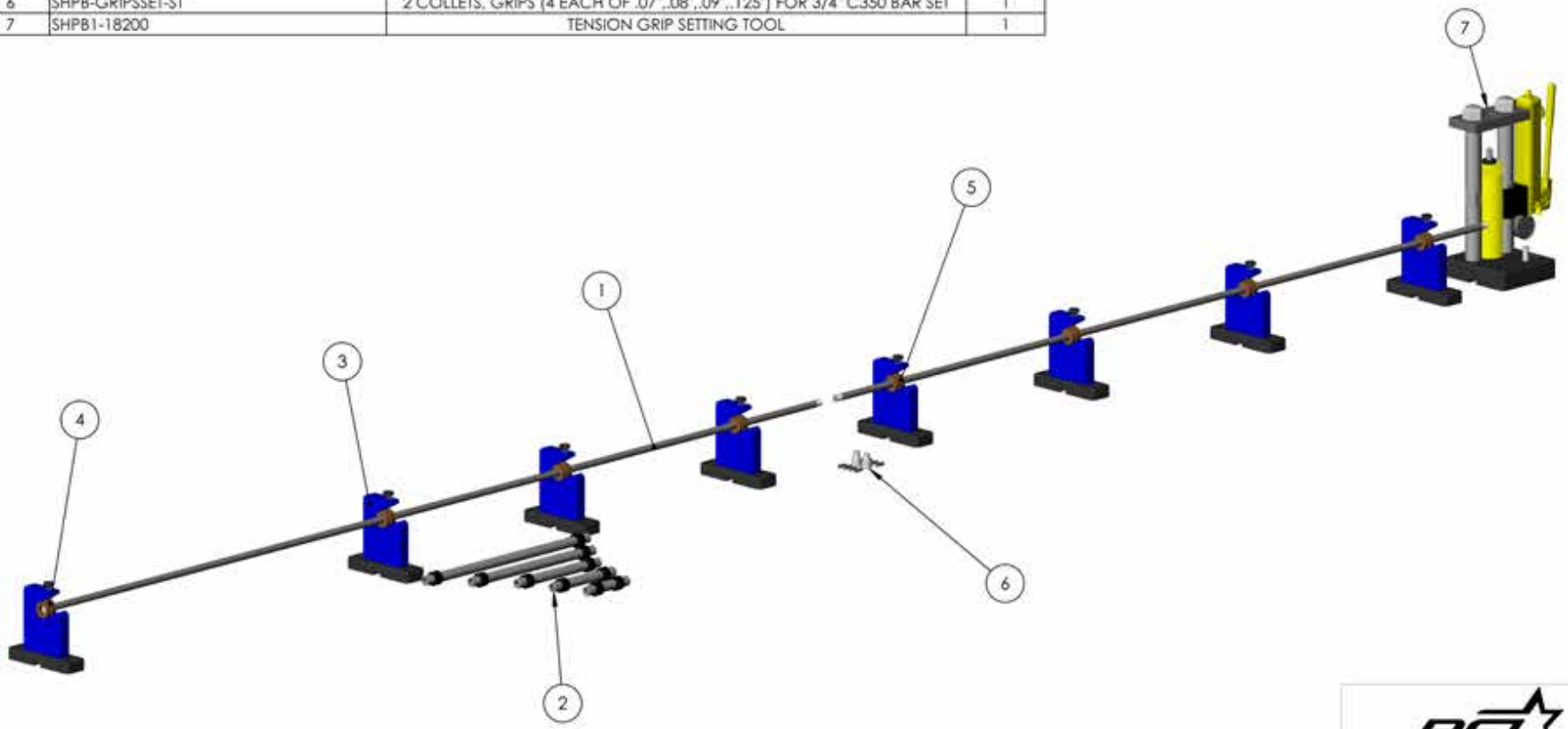
1. Fractured flat tension sample with grips
2. Highly elastic, transparent polymer film sample during test with 2D strain overlay
3. Ductile metallic sample during test with 2D strain overlay







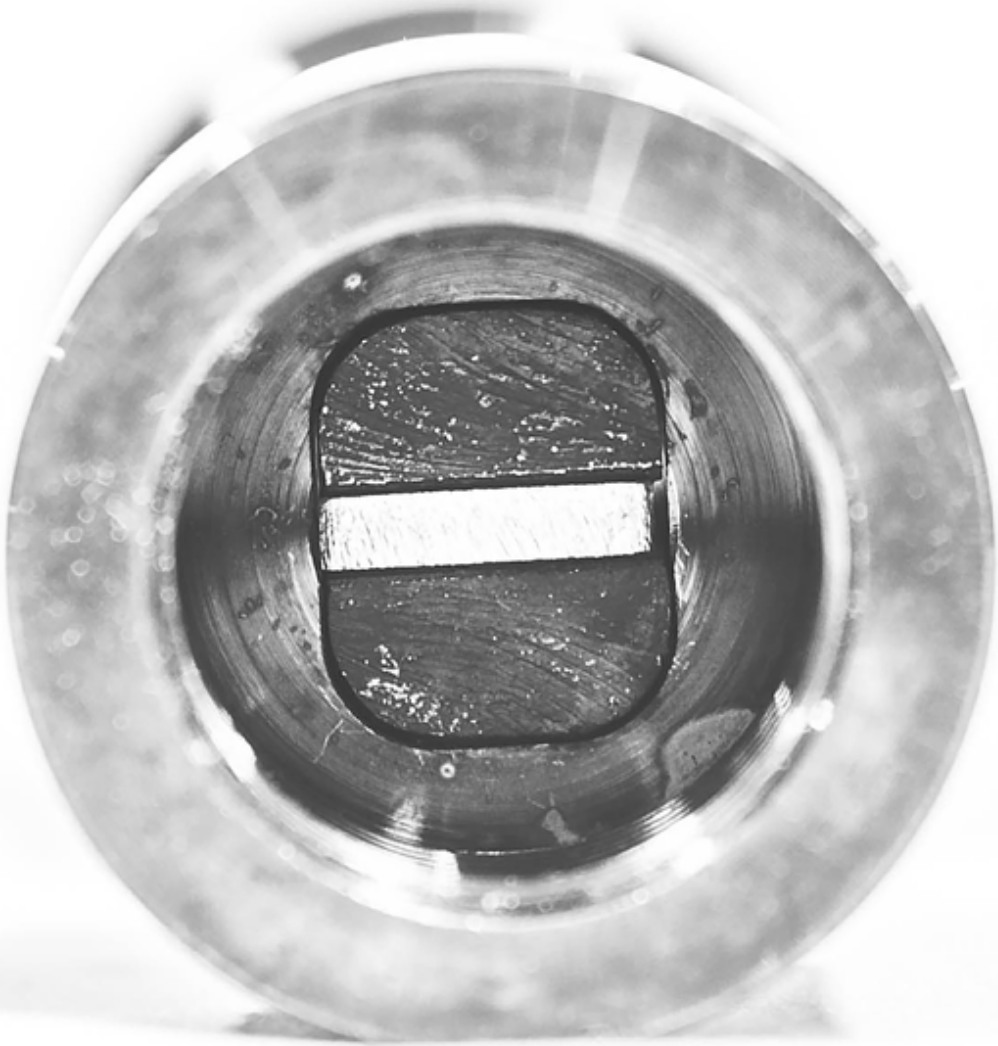
ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	TBS-M350-6-114-96	.750" DIA. C350 TENSION BAR SET, 114" INCIDENT,96" TRANSMISISON	1
2	SBT-M350-6-SET	3/4" TENSION STRIKER BAR SET (6",9",12",18")	1
3	SHPB1-11211	1" BAR SUPPORT	8
4	SHPB1-11211B-8.5	BAR SUPPORT BUSHING 1.062"	1
5	SHPB1-11211B-6	BAR SUPPORT BUSHING 0.75"	7
6	SHPB-GRIPSSET-ST	2 COLLETS, GRIPS (4 EACH OF .07",.08",.09"..125") FOR 3/4" C350 BAR SET	1
7	SHPB1-18200	TENSION GRIP SETTING TOOL	1

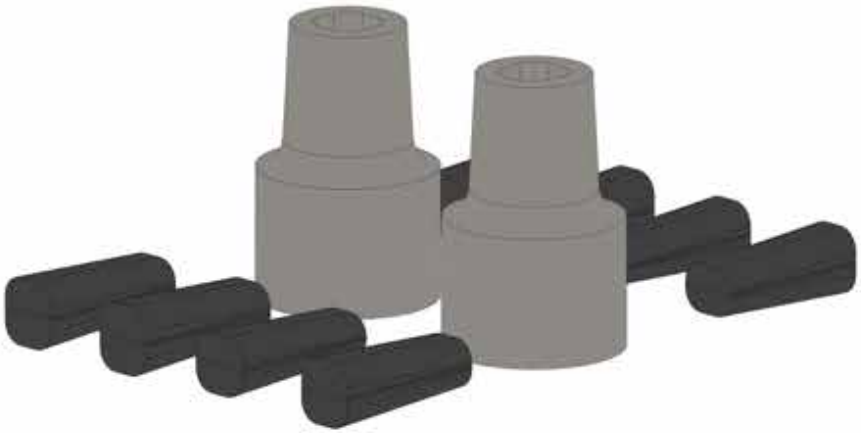


CAGE
5DLA1

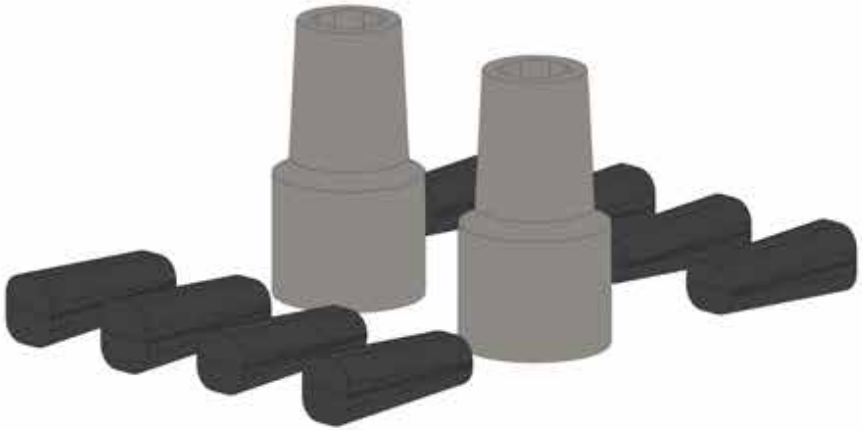
TITLE:
3/4" C350 TENSION BAR SET WITH STRIKERS, GRIPSET,SETTING TOOL

DWG. NO.
TENS-M350-6-114-96-SET





SHPB-GRIPPSET-ST



SHPB-GRIPPSET-AL

SHPB-GRIPSSET-X

-X- MATERIAL	
ST	FOR STEEL TENSION BAR SETS
AL	FOR ALUMINUM TENSION BAR SETS

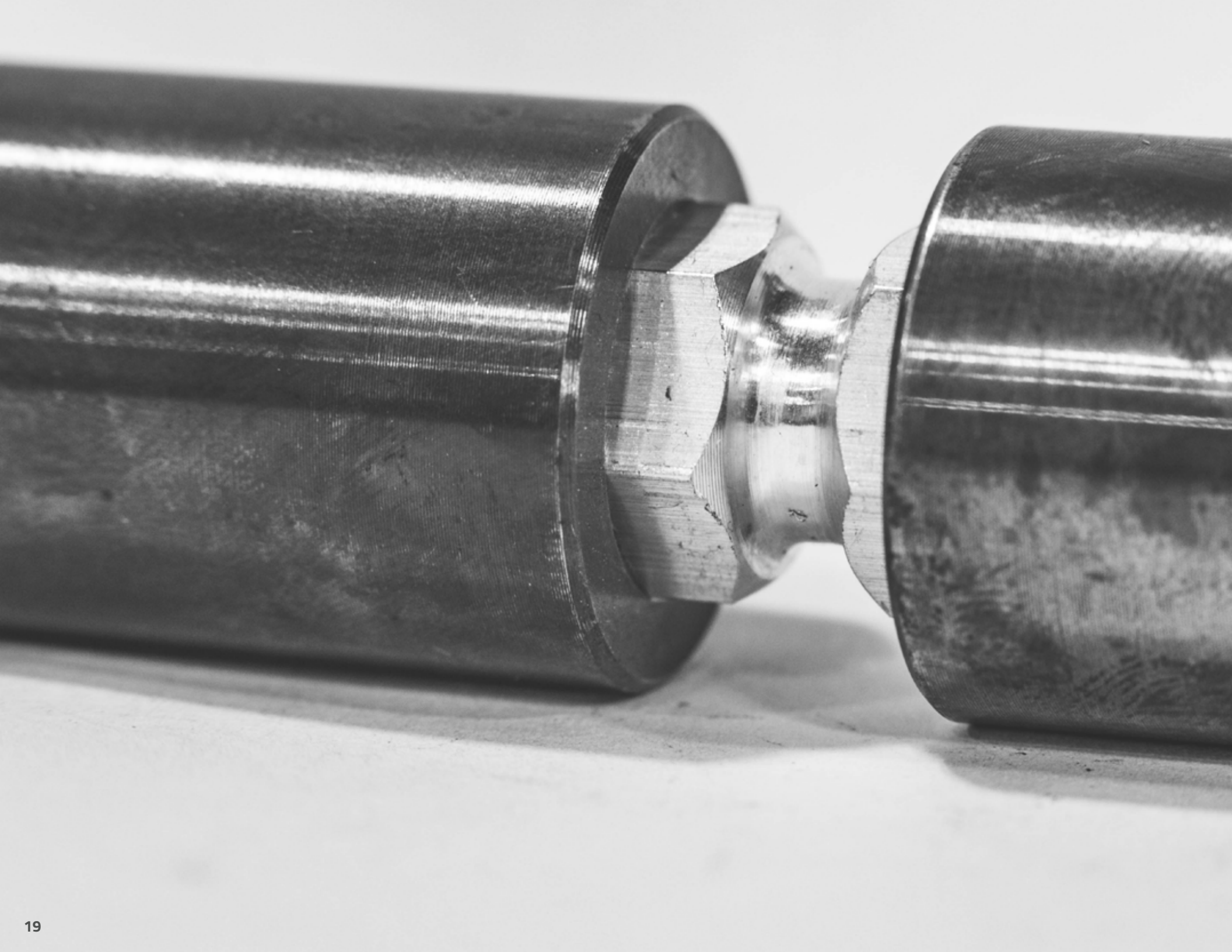
SETS INCLUDE 2 COLLETS AND 2 SETS OF JAWS FOR
.07", .08", .09", .125" THICKNESS MATERIALS

REL

CAGE
5DLA1

TITLE:
TENSION GRIP SET

DWG. NO.
SHPB-GRIPSSET-X



HIGH RATE SHEAR LOADING ON THE SAME GREAT PLATFORM.

The high strain rate torsion module utilizes common stands, frame and support hardware as the rest of REL SHPB modules. This plug and play option allows high rate torsional shear loading of solid or hollow sample sections with DIC strain analysis.

Utilizing maraging steel loading bars with a split clamp and direct torque actuator ensures simple setup and repeatable pulse profiles.

EQUIPMENT HIGHLIGHTS

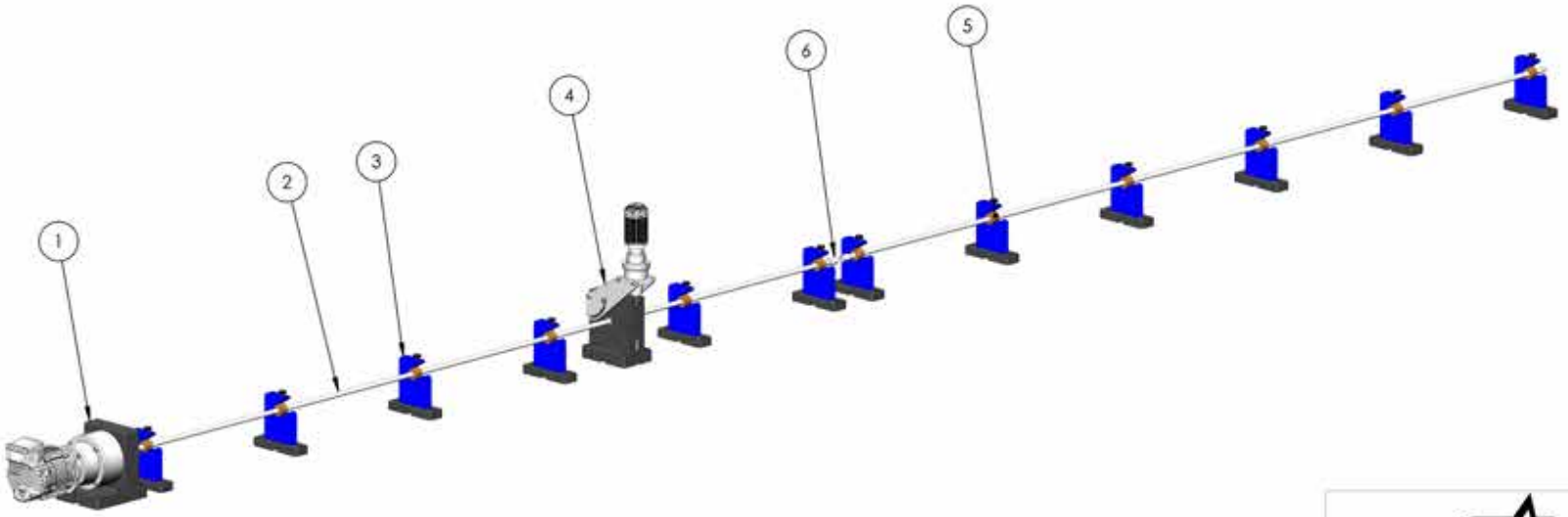
- Drop in module works on any REL flat base platform
- Direct torque loading
- Clamp and release firing sequence requires no projectiles
- Preloads up to 600 ft-lb and 90 deg deflections on ¾" C350 bars

INTERFACES WITH

- Flat Base
- DAQ
- Camera Mount
- REL WS1 16” LED Ring Light

1. Torsion preload actuator
2. Rapid release clamp assembly
3. Standard tubular torsion samples

ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	TORQ-1100	TORQUE MOTOR/GEARBOX ASSEMBLY	1
2	TORQ-1003	TORQ BAR	2
3	SHPB1-11211	1" BAR SUPPORT	12
4	TORQ-1200	CLAMP MODULE	1
5	SHPB1-11211B-6	BAR SUPPORT BUSHING 0.75"	12
6	TORQ-1012	TORQUE SAMPLE HOLDER	2



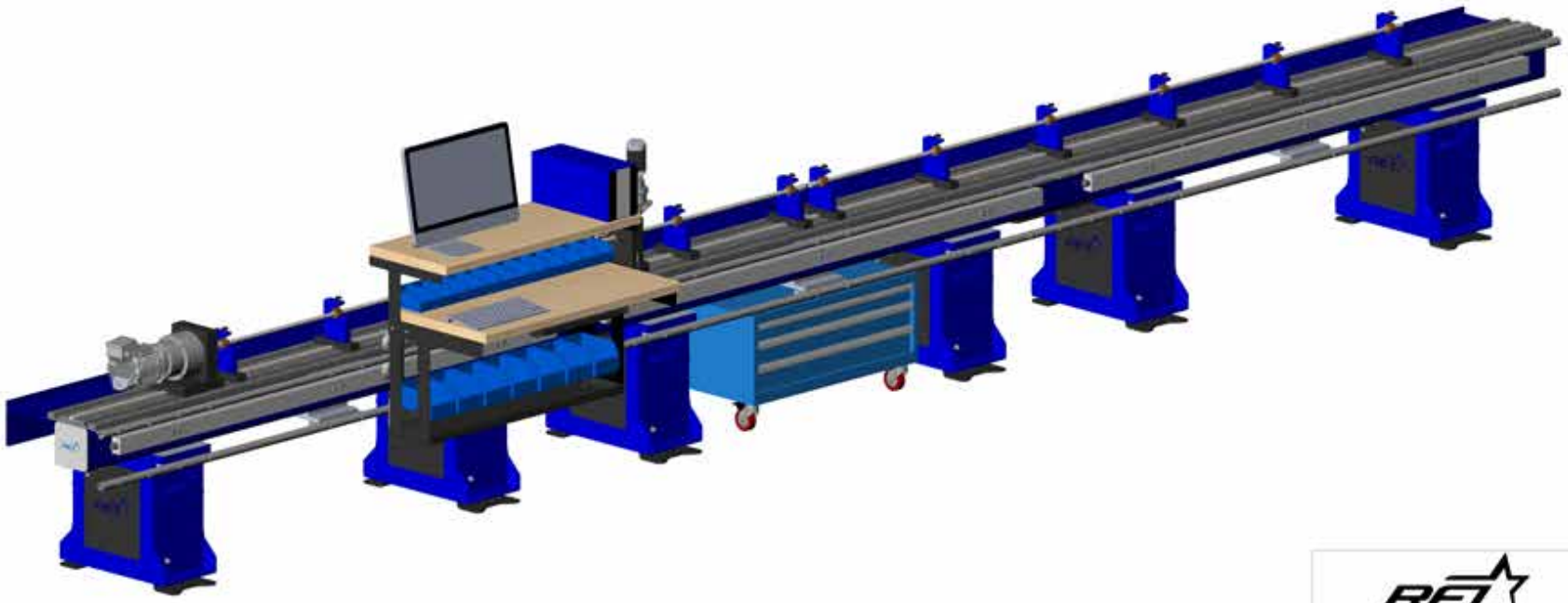
REL

CAGE 5DLA1

TITLE: TORSION TESTING SYSTEM

DWG. NO. TORQ-1000

ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	G3SW-30	TESTING PLATFORM SINGLE WIDE	1
2	TORQ-1000	SURE-TORQUE ASSEMBLY	1
3	DAQ-1000	DATA ACQUISITION PACKAGE	1



REL

CAGE 5DLA1

TITLE: STANDARD TORQUE SYSTEM, 30' SINGLE WIDE

DWG. NO. SW-30_TRQ

DIRECT IMPACT TESTING

PRECISE IMPACT TAILORED FOR ANY TEST REQUIRED.

Direct impact tests and momentum transfer test fall out of the conventional test setups developed for SHPB testing. The REL system can be configured in many different ways and the same are required to generate impact events. The bar accelerator, speed sensor, camera integration, and test setups mounted on the REL Flat Base open the possibilities for various dynamic test setups.

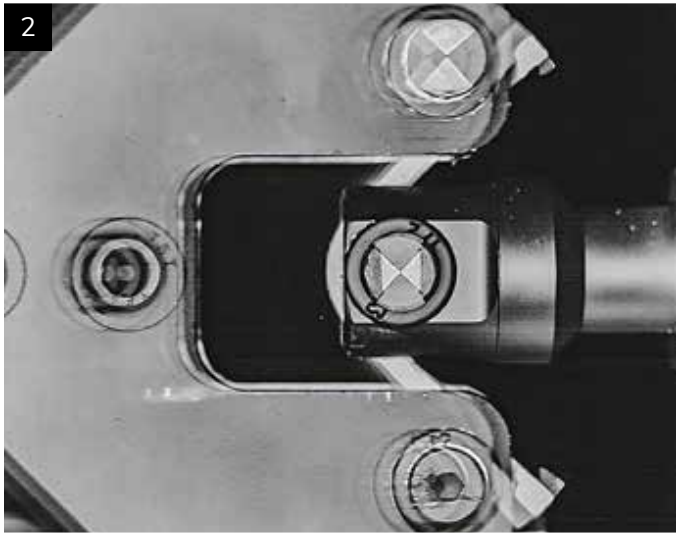
Direct Impact, Momentum Transfer, 3-Point Bend Testing, Dynamic Pipe Burst Testing, Sled Impact, Simulated Drop Tests, 50G inertia loading, and Battery Pierce Testing are several tested that have been configured on REL's Direct Impact Testing System.

EQUIPMENT HIGHLIGHTS

- Aligned test configurations
- REL Flat Base for fixture setup
- SHPB system components are for multiple purposes
- REL Bar Accelerators supply known energy for impact events

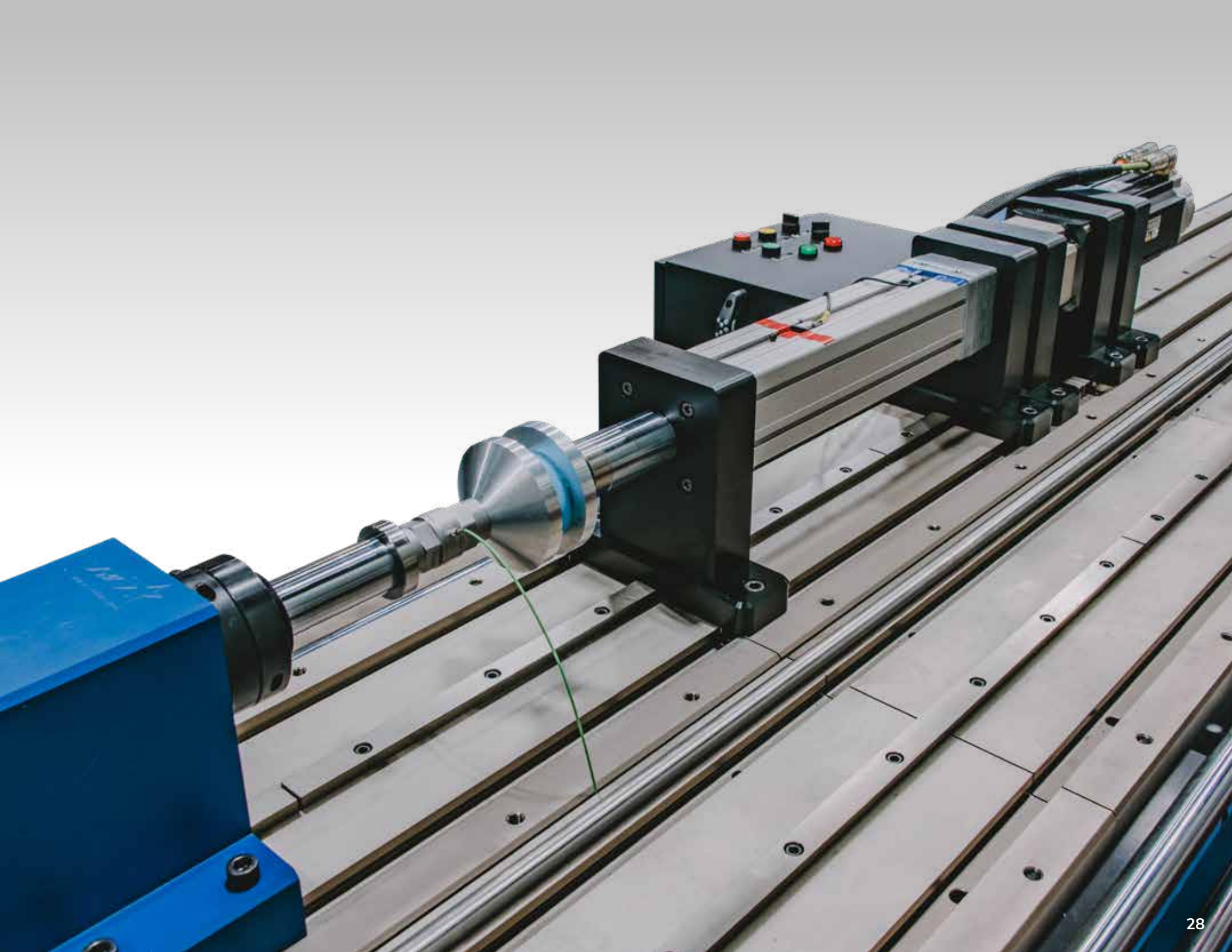
INTERFACES WITH

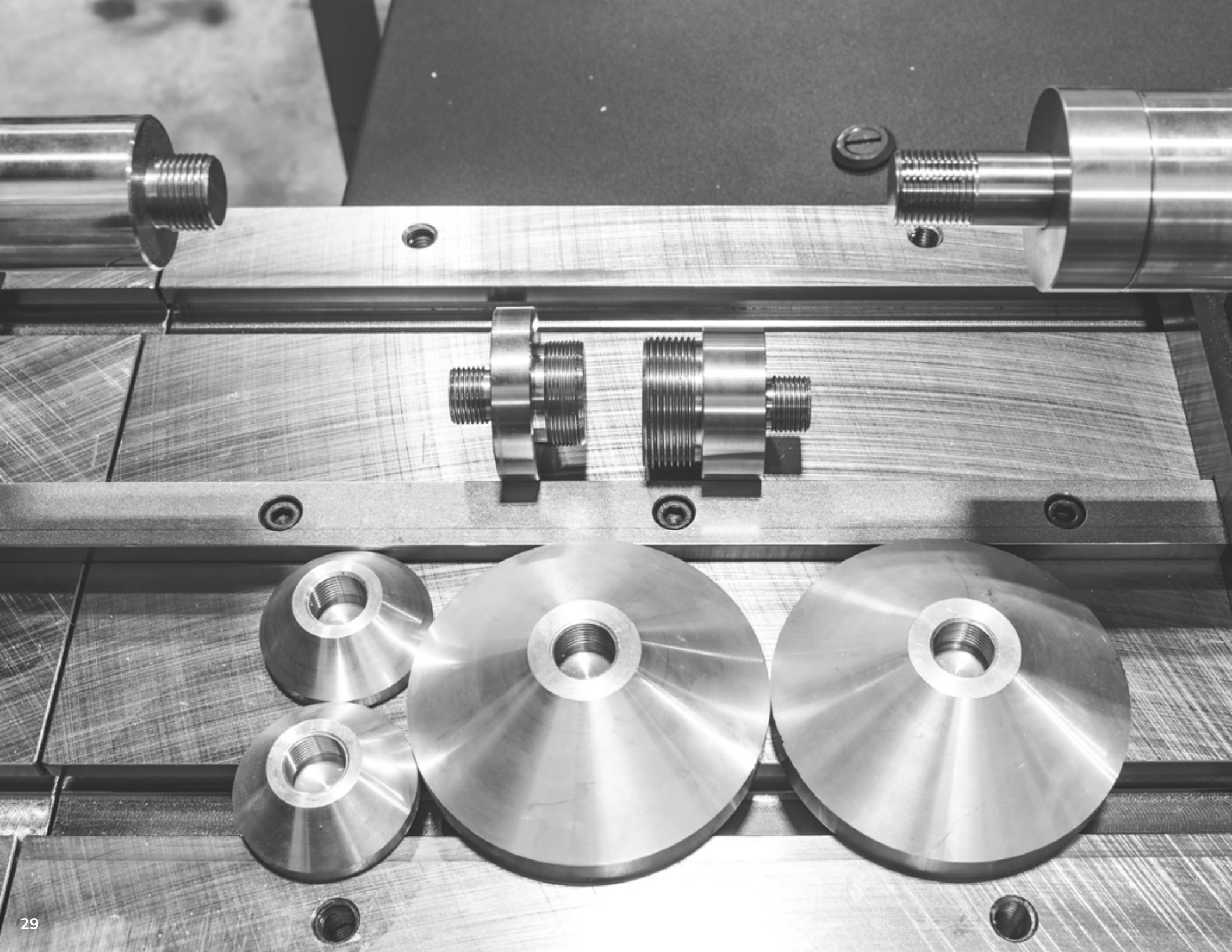
- Flat Base
- Speed Sensor
- DAQ & Load Cells
- Camera Mount
- Lighting



1. Direct Impact of a 3D printed foam
2. 3 point bend captured with high speed camera for point tracking in SURE-Pulse
3. Unique battery pierce testing setup in safety enclosure

SERVO MECHANICAL TESTING SYSTEM





SPECIFY YOUR TESTING SPEED.

REL's Servo Mechanical Testing unit has been designed to provide material response data from quasi-static to strain rates up to 50/second. Mounted on the same REL Flat Base, it is intended to fill the gap of strain rated that cannot be achieved by conventional test frames or conventional SHPB techniques.

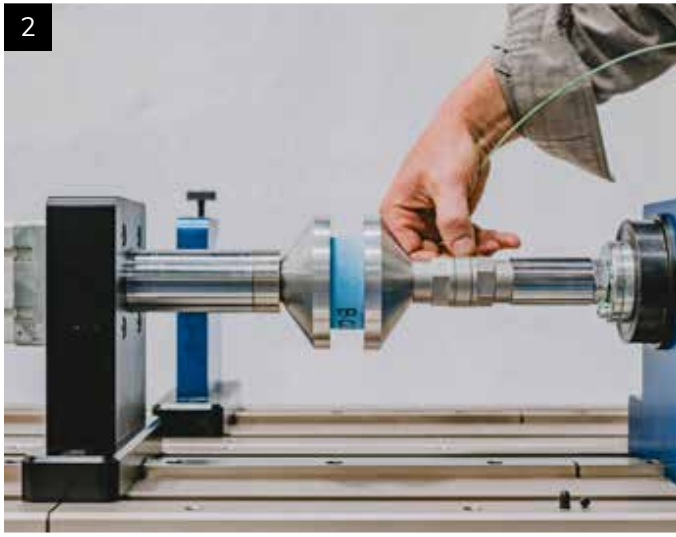
The module integrates with other REL High Strain Rate Testing modules - in REL Flat Base, lighting and camera systems, SURE-Pulse, Load Cells, and Stop Stands.

EQUIPMENT HIGHLIGHTS

- Up to 60 inches per second transverse speeds
- Configurable for tension and compression
- 6000 lb capacity (up to 6 inches per second)
- Programmable and integrates with cameras and DAQ

INTERFACES WITH

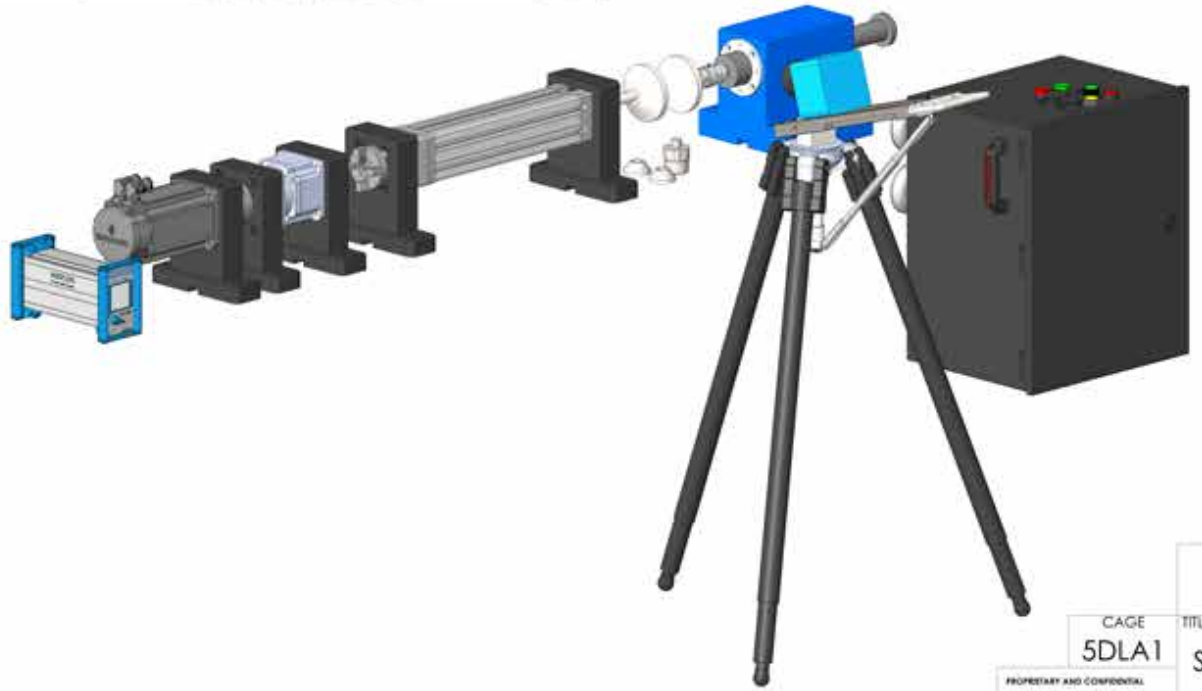
- Flat Base
- Tension Grip System
- DAQ
- Camera Mount
- Lighting
- SURE-Pulse Software for digital image correlation (DIC)



1. Charge amplifier setup with piezo load cell
2. Memory foam test setup
3. Servo Mechanical Tensile Testing of metallic sample


Air-Opaque
READY-TO-USE
OPAQUE
AIRBRUSH COLORS
Air-Opaque
READY-TO-USE
OPAQUE
AIRBRUSH COLORS

ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	QSTM-1500	LINEAR ACTUATOR ASSEMBLY	1
2	QSTM-1100	QSTM SERVO ASSEMBLY	1
3	QSTM-1200	QSTM GEARBOX ASSEMBLY	1
4	QSTM-4000	QSTM SERVO CONTROL ASSEMBLY	1
5	SHPB-2017	QSTM THREADED ADAPTER	1
6	SHPB-2005-M350	SHPB BAR CAP	1
7	STOP-1000-HYD	STOP STAND WITH HYDRAULIC ENERGY ABSORPTION	1
8	SHPB-2002	4.25" SPECIMEN PLATTEN	2
9	SHPB-2006	2" SPECIMEN PLATTEN	2
10	TRIPOD_528XB_ASSY	CAMERA TRIPOD	1
11	KISTLER_9352A	HIGH FREQUENCY LOAD CELL	1
13	KISTLER TYPE 5018A1010	CHARGE AMPLIFIER	1
14	EDGE-SC2X	HIGH SPEED CAMERA	1
15	SHPB-2016	ACUATOR TENSION ADAPTER	1



REL

CAGE 5DLA1

TITLE: SERVO MECHANICAL TESTING SYSTEM

DWG. NO. QSTM-1000

BARS

PREMIUM MATERIALS, PRECISION MANUFACTURING, AND ACCURATE DATA.

REL's certified and serialized bar sets are subject to an elaborate set of manufacturing operations before they qualify for high strain rate testing. The highest strength raw materials are selected which must go through several heat treatments, straightening, grinding, and machining operations.

The result is a near perfect set of bars and strikers that become the backbone of any high strain rate test setup. This precision is critical to capturing reliable and repeatable pulses for high strain rate events.

EQUIPMENT HIGHLIGHTS

- Maraging C350 and Al7075-T6 standard (other material options on request)
- Precision centerless ground to +/- .0005 inch
- Standard bar lengths up to 12 ft
- Straightness .001 in/ft

INTERFACES WITH

- Flat Base
- Bar Accelerator
- Speed Sensor
- DAQ
- Heating Systems

1. 1.5" compression strikers with taper lock bushings
2. Strain gauge application
3. Various striker bar types, materials, and diameters

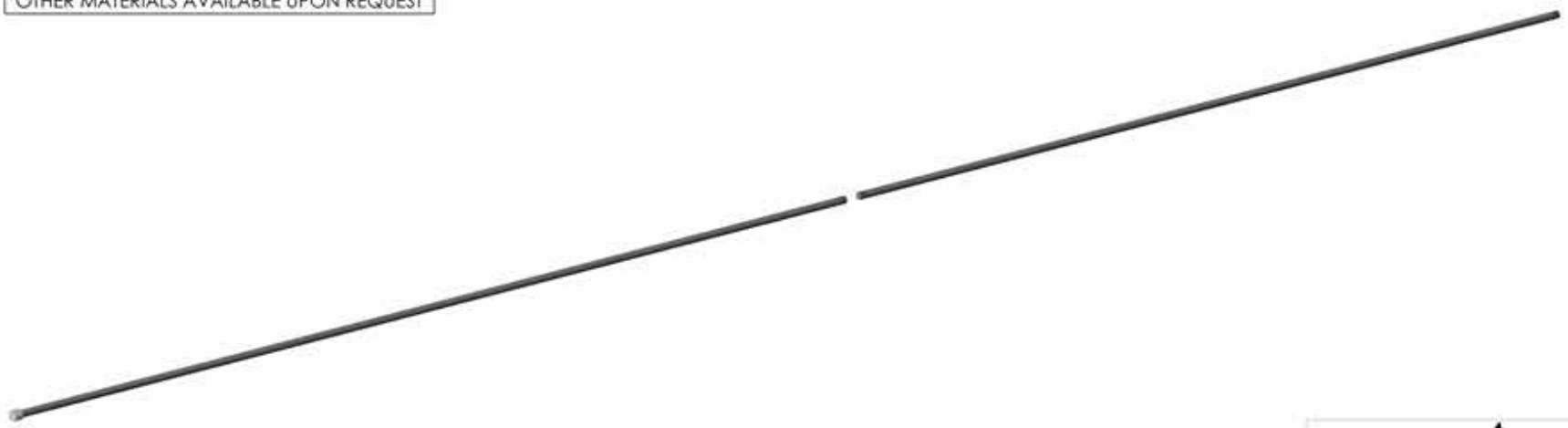
TBS-XXXX-D-L1-L2

-D- DIAMETER	
3	.375"
6	.750"
12	1.500"
OTHER DIAMETERS AVAILABLE UPON REQUEST	

-XXXX- MATERIAL	
M350	MARAGING STEEL C350
7075	ALUMINUM 7075
N718	NICKEL 718
OTHER MATERIALS AVAILABLE UPON REQUEST	

-L1- LENGTH
LENGTH OF INCIDENT BAR IN INCHES

-L2- LENGTH
LENGTH OF TRANSMISSION BAR IN INCHES



BAR DIAMETER GROUND TO +/- .0005"
BARS STRAIGHTENED TO .001"/FT.

CAGE 5DLA1

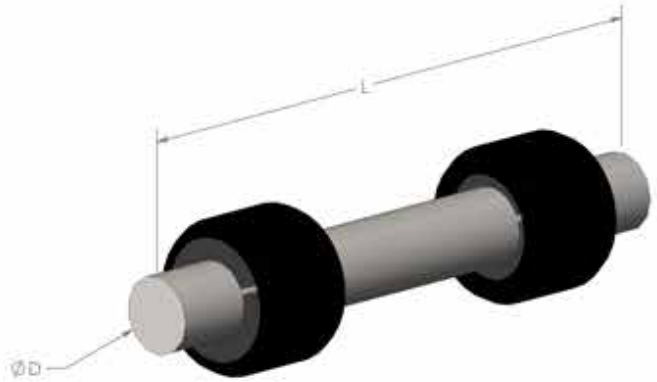
TITLE: TENSION BAR SET

DWG. NO. TBS-XXXX-D-L1-L2

-L- LENGTH	
L	LENGTH OF STRIKER BAR IN INCHES
SET	SET INCLUDES 6",9",12",18" LONG STRIKERS

SBC-XXXX-D-L

-D- DIAMETER	
3	.375"
6	.750"
12	1.500"
OTHER DIAMETERS AVAILABLE UPON REQUEST	



-XXXX- MATERIAL	
M350	MARAGING STEEL C350
7075	ALUMINUM 7075
N718	NICKEL 718
OTHER MATERIALS AVAILABLE UPON REQUEST	

BAR DIAMETER GROUND TO +/- .0005"
BARS STRAIGHTENED TO .001"/FT.

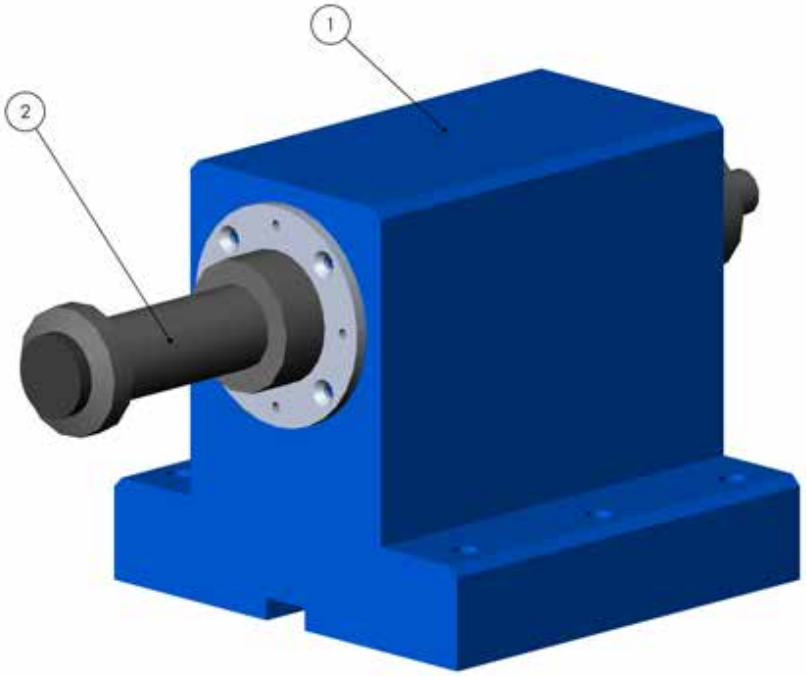
REL

CAGE 5DLA1

TITLE: STANDARD COMPRESSION STRIKER ASSEMBLY

DWG. NO. SBC-XXXX-D-L

ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	SFG3-09-02	STOP STAND	1
2	SFG3-09-02-HYD	HYDRAULIC ENERGY ABSORPTION	1

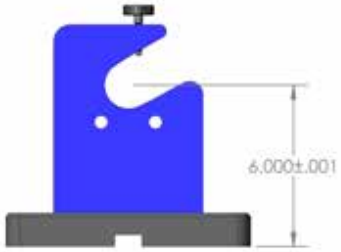


REL

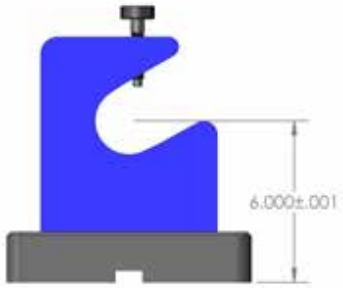
CAGE 5DLA1

TITLE: STOP STAND WITH HYDRAULIC ENERGY ABSORPTION

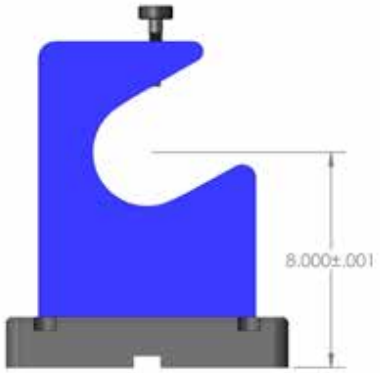
DWG. NO. STOP-1000-HYD



SHPB1-11211
BAR SUPPORT FOR 1" SYSTEMS



SHPB2-11211
BAR SUPPORT FOR 2" SYSTEMS



SHPB3-11211
BAR SUPPORT FOR 3" SYSTEMS

REL

CAGE
5DLA1

TITLE:
BAR SUPPORT

DWG. NO.
SHPB-11211

FLAT BASE

THE MOST IMPORTANT PART OF ANY STRUCTURE IS THE FOUNDATION ON WHICH IT IS BUILT.

REL's testing platform design is centered on the Flat Base. The REL Flat Base is the core of precision for every REL high strain rate testing system.

EQUIPMENT HIGHLIGHTS

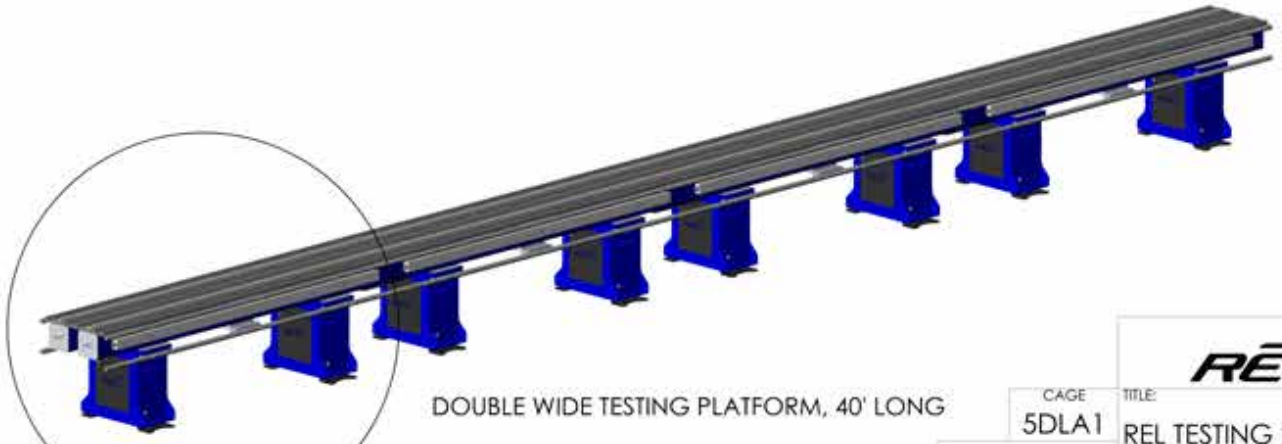
- T-Slot Table is precision ground steel mounted on high section modulus square beams
- Accurately assembled to within 0.001"/foot
- Corrosion resistant nickel plating for non-climate controlled spaces
- 10' sections configure to any lab space
- Integral power strips to power system modules (20 amps, 120VAC)
- Integral chrome rod guide system for precision module motion and repeatable setups

INTERFACES WITH

- Bar Accelerator
- Bar End Conditioner
- REL Heating Systems
- REL Bars
- ALL REL System Elements—now and future!

1. Precision ground T-Slot table with t-slot nut fasteners for system modules
2. REL double wide testing platform—scalable in 10' length increments
3. Integral on-board system power

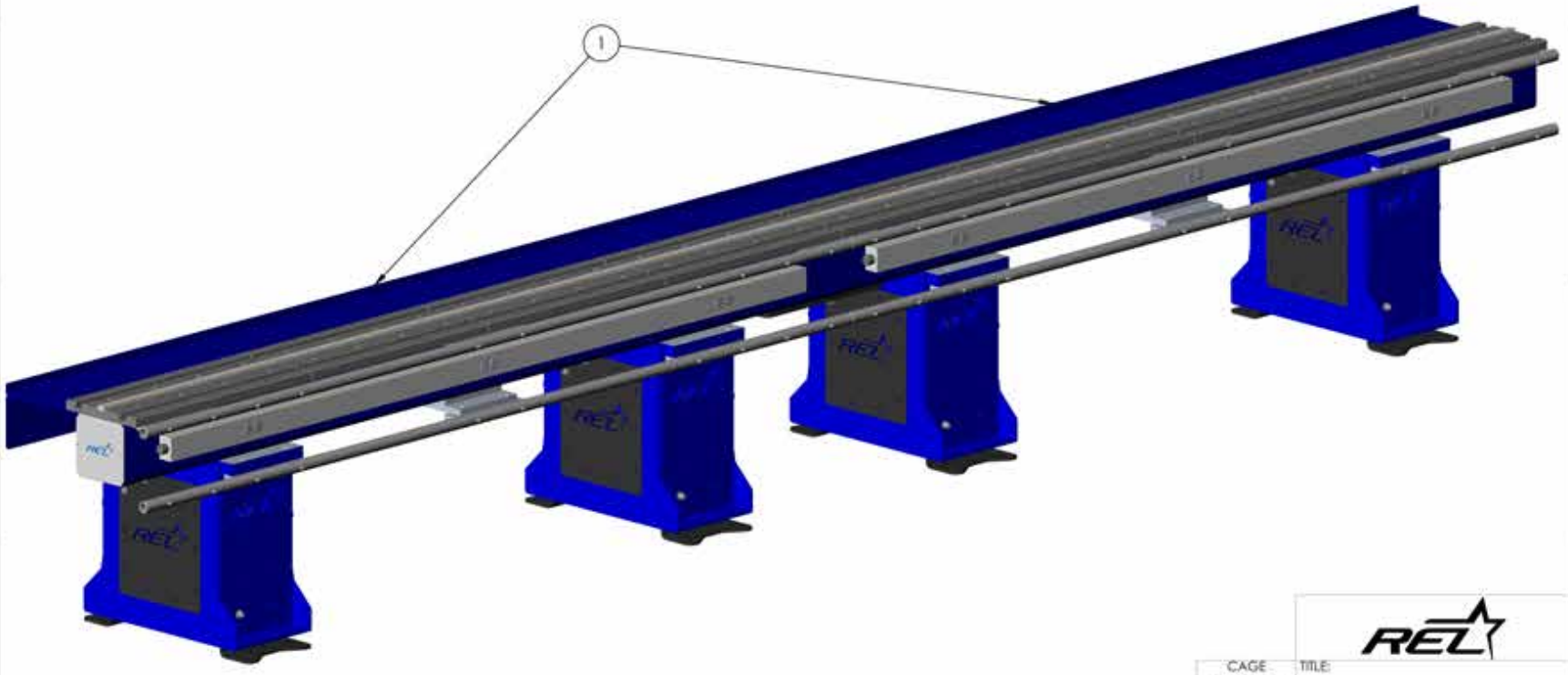
MULTIPLE 10' PLATFORM SECTIONS
CAN BE COMBINED TO CREATE
ANY LENGTH SYSTEM



DOUBLE WIDE TESTING PLATFORM, 40' LONG

CAGE	5DLA1
TITLE:	REL TESTING PLATFORM DOUBLE WIDE
DWG. NO.	G3DW

ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	G3SW	REL TESTING PLATFORM, 10'	2

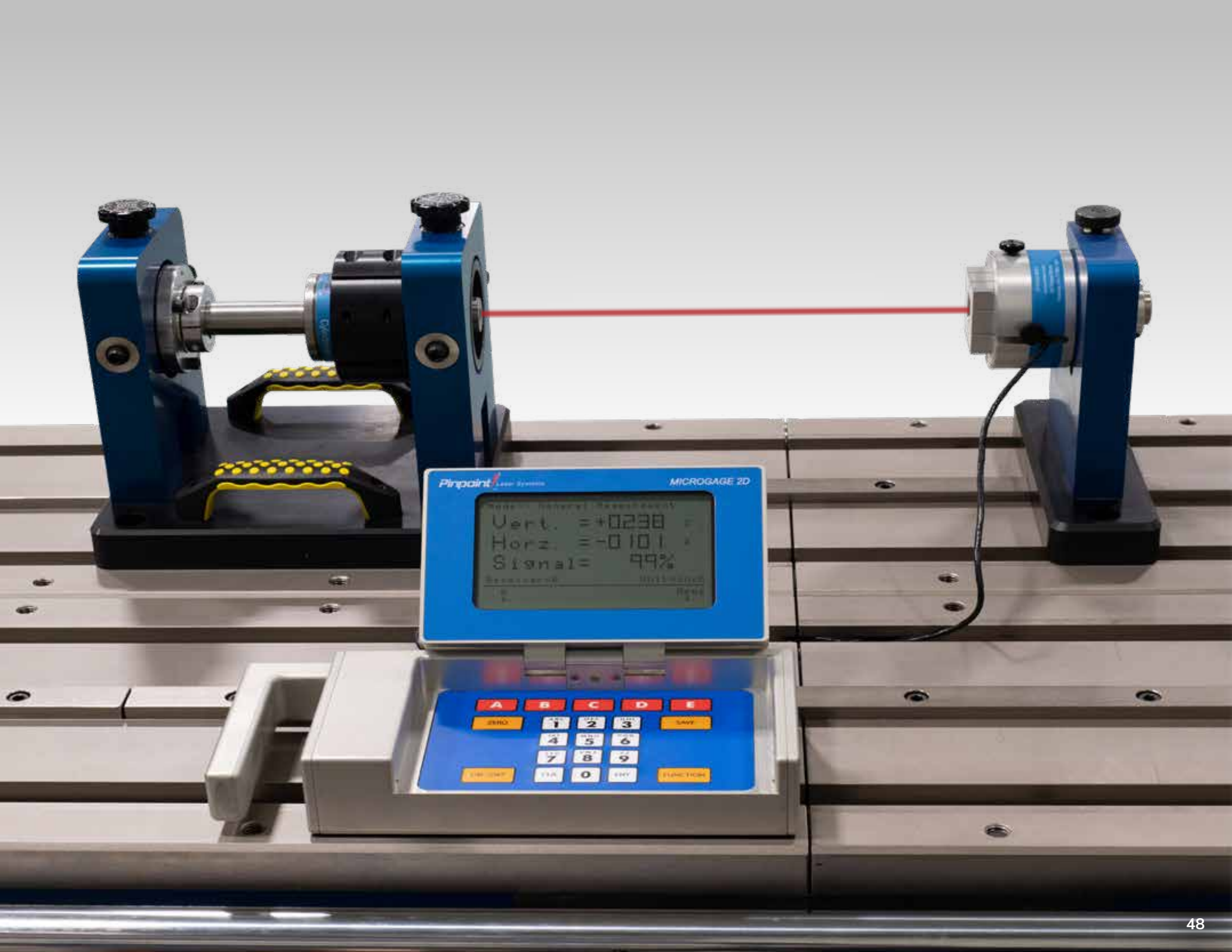


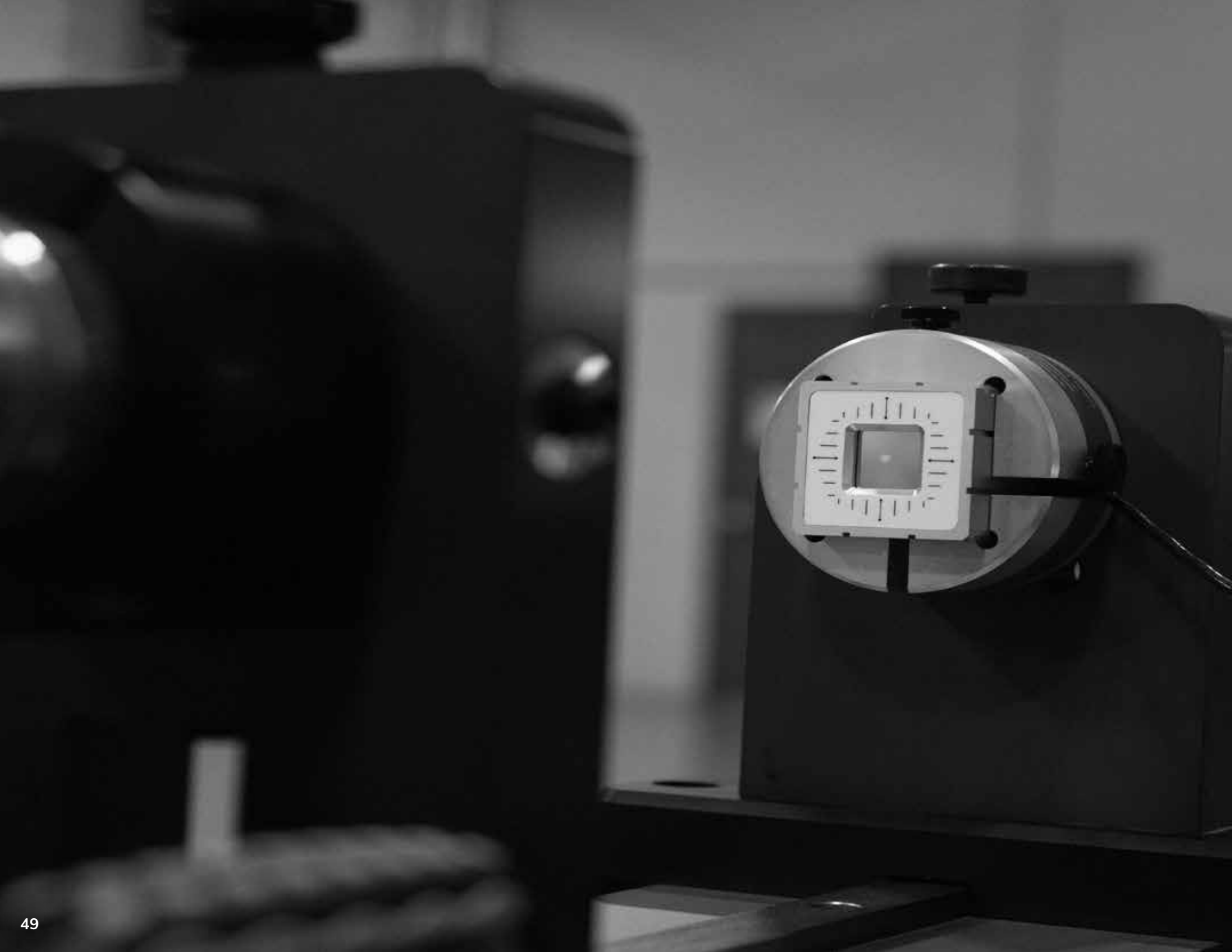
CAGE
5DLA1

TITLE:
TESTING PLATFORM
SINGLE WIDE, 20'

DWG. NO.
G3SW-20

LASER ALIGNMENT TOOL


Pinpoint
MICROGAGE 2D
Vert. =+0230
Horz. =-0101
Signal= 99%
A
B
C
D
E
ZERO
SAVE
FUNCTION



FLATNESS-STRAIGHTNESS VERIFIED.

REL's Laser Alignment Tool provides precision feedback on system flatness and straightness. Two dimensional postitioning can be measured to within .001" over the length of a standard SHPB frame. This capability is useful in quantifying straightness during system installation or during special test setups. The Laser Alignment Tool operation is simple and easy with a standard Flat Base interface, micro adjustment screws, push button zeroing, and a digital readout for vertical and horizontal error.

EQUIPMENT HIGHLIGHTS

- Measuring Resolution: .0001"
- Measuring accuracy: +/- .0002" or 1% of alignment error
- Measuring distance up to 150ft
- Micro adjustment calibration knobs for mechanical zeroing
- Battery powered display with 2D readout
- Optional computer control for data logging

INTERFACES WITH

- Flat Base
- Bars

1. Laser output module
2. Positional readout with zeroing feature
3. Precise beam adjustment

BAR ACCELERATOR


REL
REL
REL

PRECISE AND REPEATABLE SHOT SPEEDS FOR ALL IMPACT-TYPE TESTING.

The REL series of accelerators comprises of several different barrel diameters, lengths, and pressure ratings for various test scenarios including SHPB and direct impact. Accelerators can be configured with manual controls or with remote push-button charge, vent and fire operation.

REL Accelerators can be operated in both tension and compression with minimal changeover time and can repeatedly launch SHPB strikers or impact projectiles to within 1% accuracy.

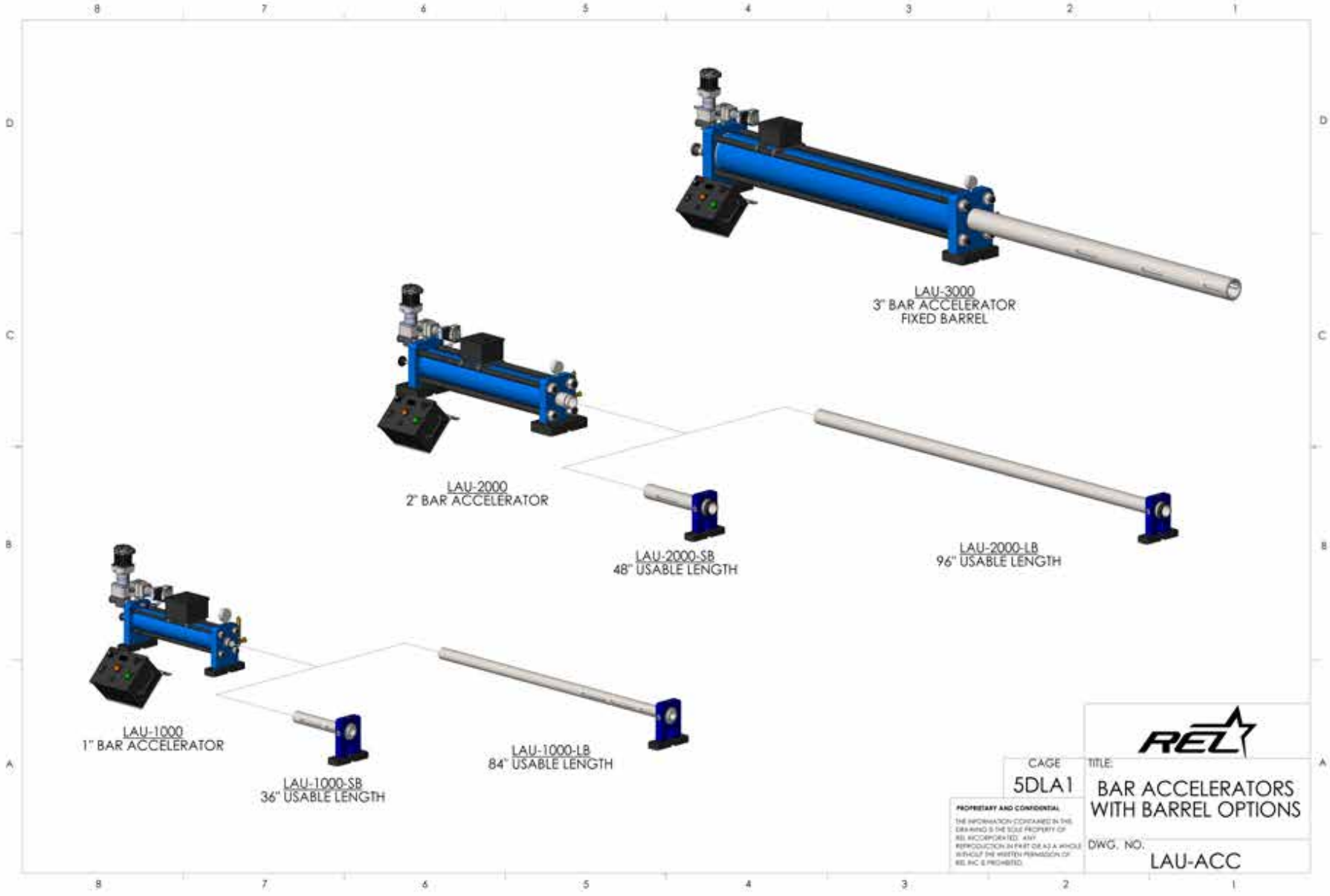
EQUIPMENT HIGHLIGHTS

- Standard barrel options for 1", 2", and 3" strikers (1.5", 2.25", 3.25" respective bore diameter)
- Sleeved barrel options for special bore diameters down to .125"
- Operates on compressed air, nitrogen, or helium up to 300 psi (high pressure versions also available)
- Swappable barrel extensions for higher velocity or long length strikers
- Auto-fire option adds servo operated control valves for all functions
- Auto-fire control box can be located up to 500' from launcher with tethered remote cable

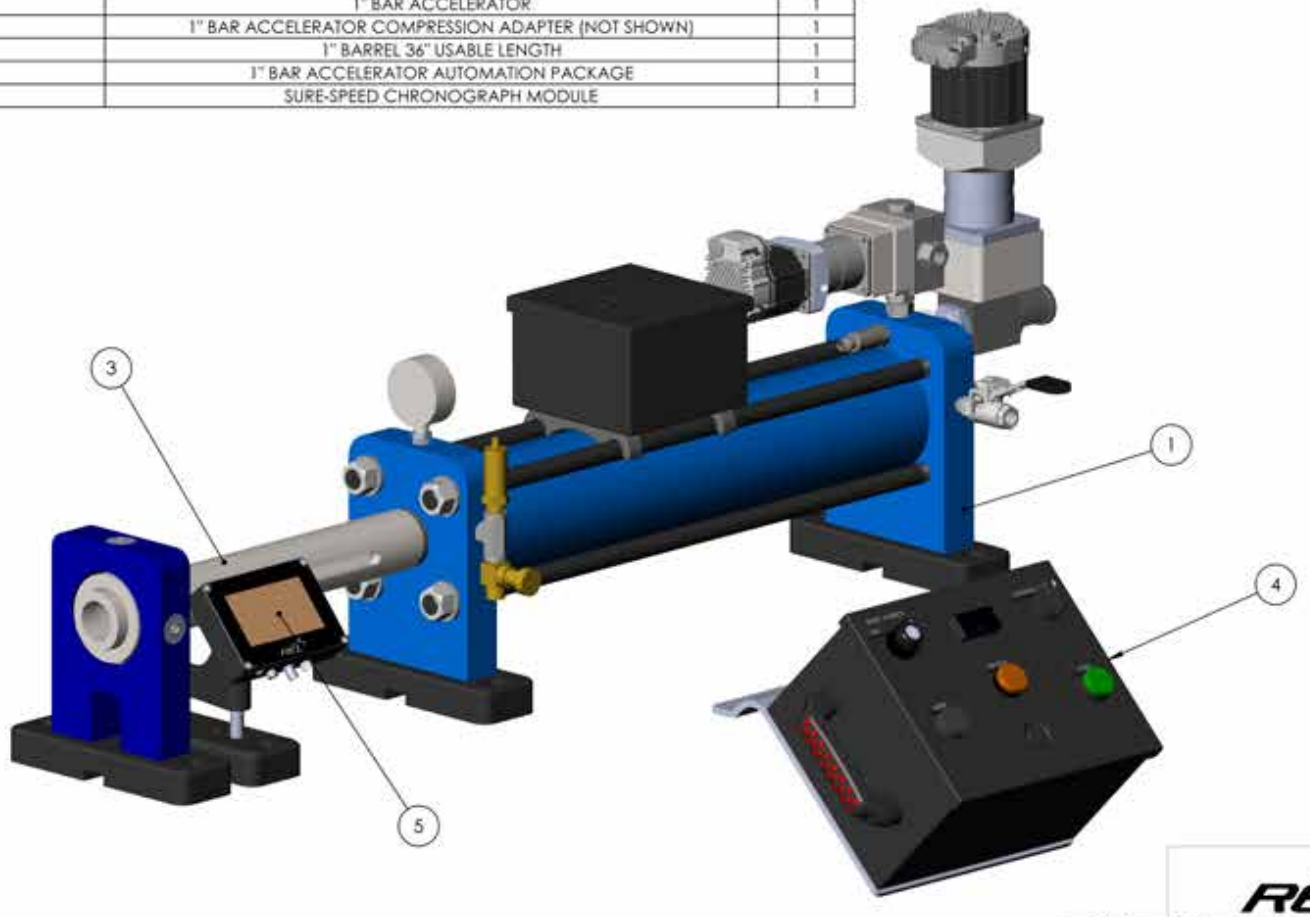
INTERFACES WITH

- Flat Base
- Bars
- Speed Sensor
- Direct Impact Module

1. Standard 1" bar accelerator with auto-launch option
2. Auto-launch control panel with safety interlock circuits
3. Servo operated charge/vent control valve


LAU-3000
3" BAR ACCELERATOR
FIXED BARREL
LAU-2000
2" BAR ACCELERATOR
LAU-2000-SB
48" USABLE LENGTH
LAU-2000-LB
96" USABLE LENGTH
LAU-1000
1" BAR ACCELERATOR
LAU-1000-SB
36" USABLE LENGTH
LAU-1000-LB
84" USABLE LENGTH
REL
CAGE
5DLA1
TITLE:
BAR ACCELERATORS
WITH BARREL OPTIONS
DWG. NO.
LAU-ACC
PROPRIETARY AND CONFIDENTIAL

ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	LAU-1000	1" BAR ACCELERATOR	1
2	LAU-1000-CA	1" BAR ACCELERATOR COMPRESSION ADAPTER (NOT SHOWN)	1
3	LAU-1000-SB	1" BARREL 36" USABLE LENGTH	1
4	LAU-1000-AP	1" BAR ACCELERATOR AUTOMATION PACKAGE	1
5	SS-320	SURE-SPEED CHRONOGRAPH MODULE	1



CAGE 5DLA1

PROPRIETARY AND CONFIDENTIAL

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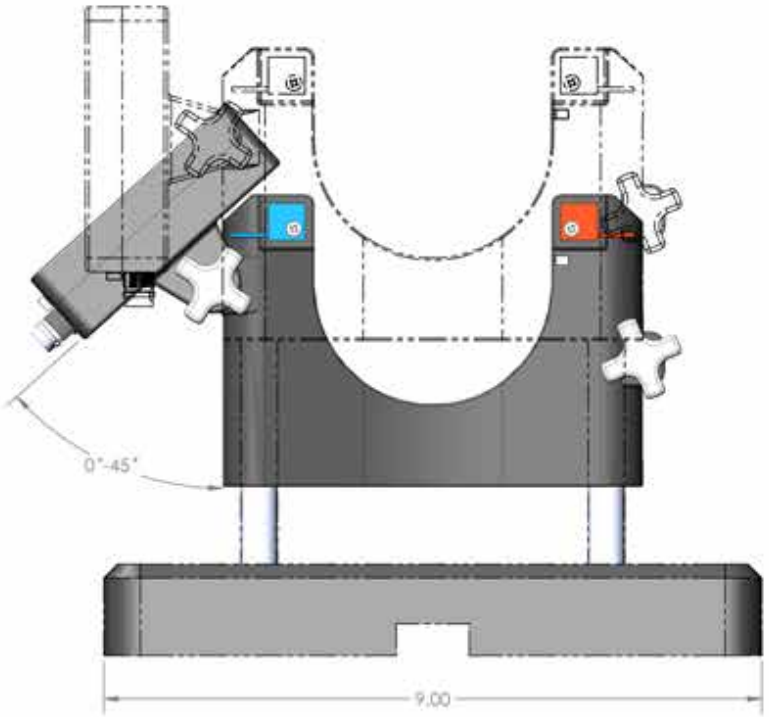
TITLE: AUTOMATED 1" COMPRESSION ACCELERATOR WITH 36" BARREL,SURE SPEED MODULE

DWG. NO. LAU-1000-ACS

SURE-SPEED SENSOR


SURE-speed
254.8
FPS
RESET
REL



CAGE
5DLA1

TITLE:
SPEED SENSOR

DWG. NO.
SS-320

SURE-SPEED FOR EVENTS UP TO 3000FT/SEC.

The speed of any impact event on REL's testing platform is captured with REL's SURE-Speed unit. The integrated optical gates measure the velocity of any object passing through. It is configurable for multiple setups, English and SI units and can be used to trigger system lighting and camera and other data acquisition modules for event capture.

This module is keyed to integrate on the flat base and align with sight windows on the bar accelerator to acquire speed of any striker bar or projectile passing by. This allows researchers to know the input energy prior to the impact event.

EQUIPMENT HIGHLIGHTS

- Calibrated accurate up to 3000 ft/sec
- English and SI units
- Battery powered for remote applications
- Adjustable and durable base andenclosure

INTERFACES WITH

- REL Flat Base
- Bar Accelerator
- DAQ
- Camera Mount
- Lighting

1. Resetting speed sensor prior to testing
2. Speed sensor ready and waiting for test
3. SURE-Speed positioned near impact zone

1

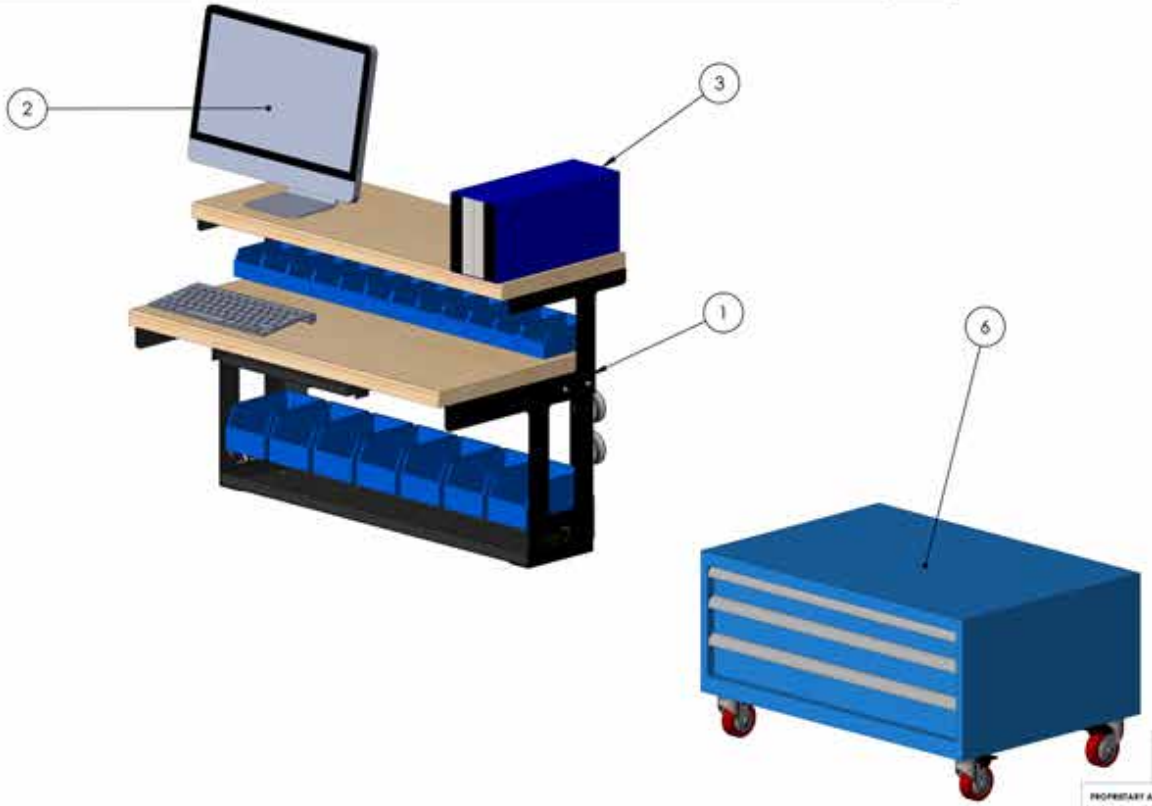
2

3

DAQ


SURE-PULSE
APC

ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	SFG3-CC-000	RAIL MOUNTED COMPUTING CENTER	1
2	COMPUTER	SYSTEM COMPUTER WITH LATEST VERSION OF SURE-PULSE SOFTWARE	1
3	VISHAY-2310B	180KHZ SIGNAL CONDITIONING AMPLIFIER WITH CABLES	2
4	PICOSCOPE 4824	OSCILLISCOPE WITH CABLES (NOT SHOWN)	1
5	STRAIN GAUGE	STRAIN GAUGE (NOT SHOWN)	10
6	LISTA28X40_WHEELED	3 DRAWER WHEELED TOOLBOX	1



CAGE 5DLA1

TITLE: DATA ACQUISITION PACKAGE

DWG. NO. DAQ-1000

ACQUIRE DATA AT SPEED.

The system response of REL's data acquisition system is able to capture up to 8 channels of data at 10 million points per second with 12-16 bit precision.

REL's DAQ system integrates and captures test information from strain gages, signal amplifiers, oscilloscopes, and camera and lighting triggers, to high speed camera imagery and speed sensors. This information captures the dynamic event and is processed in the SURE-Pulse Software to give valuable insight into material response subjected to high rate loading.

Fast, easy-to-use setup for multiple dynamic events works seamlessly together or can be configured for standalone use.

EQUIPMENT HIGHLIGHTS

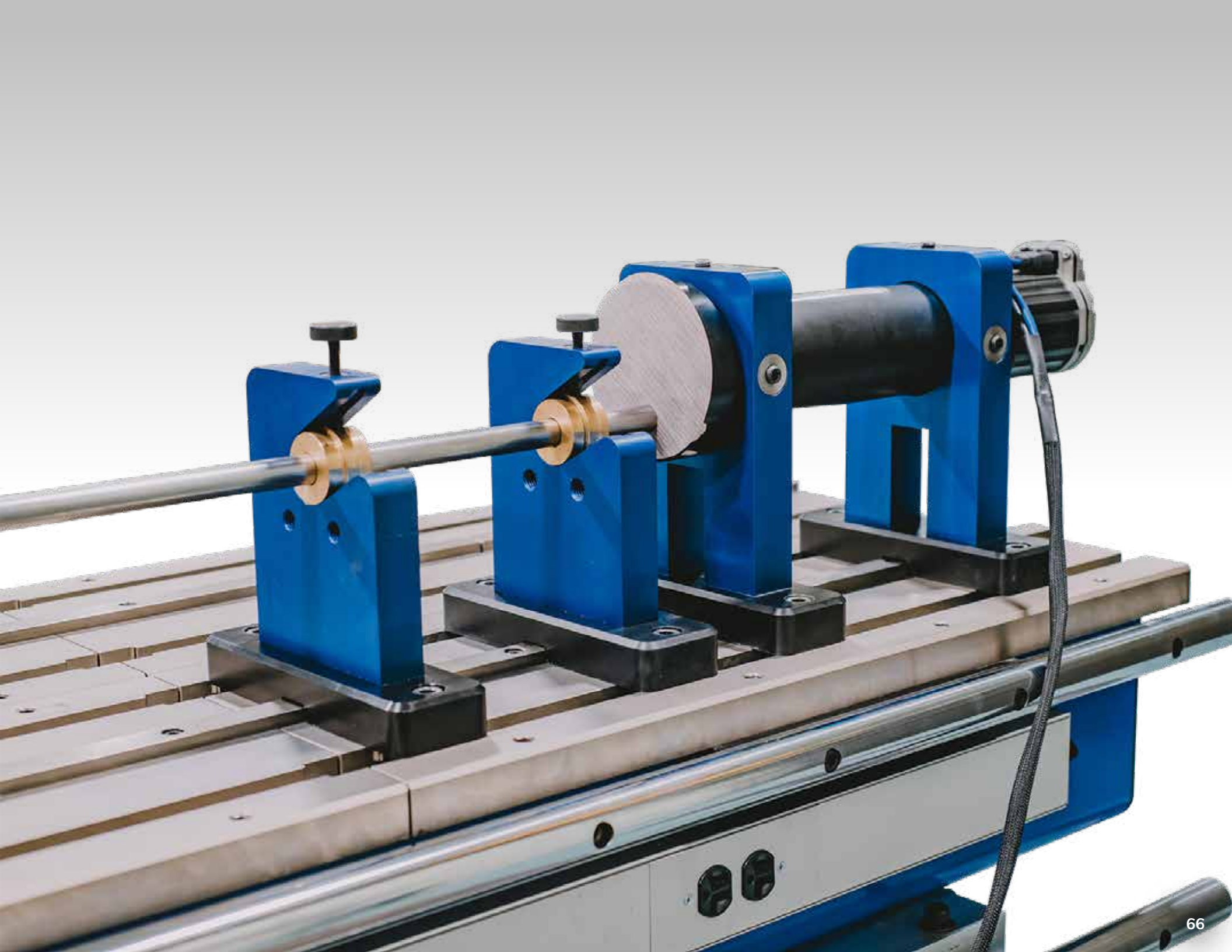
- 10Mhz data acquisition rate, up to 16 bit precision
- Integrated system trigger to capture events up to 5 million frames per second
- Mounted on system rails to move locations as needed
- Modules link together with shielded connection to limit noise

INTERFACES WITH

- SURE-Pulse
- Bar Accelerator
- REL Flat Base
- Servo Mechanical Testing System
- Camera Mount
- Lighting

1. Shielded M8 connections for strain gages
2. Strain conditioners and amplifiers for four channels
3. Base mounted power strips allow for multiple power ports

BAR END CONDITIONER



LIKE A FRESH SET OF BARS FOR EVERY TEST.

REL's Bar End Conditioner allows every user the option to regrind their SHPB bars ends as often as needed without ever removing them from the system. In many cases this eliminates the need for bar insert protectors when testing hard materials.

The bar end conditioner is supplied as a kit with a grind module, drive module, and controller. The drive and grind modules mount right to the flat base frame on either end of a bar. The conditioner also works for tension and compression striker bars.

EQUIPMENT HIGHLIGHTS

- Synchronized rotation, servo driven power heads
- Micro-adjustment screws for grind head alignment
- Peel and stick sanding discs allow quick grit change or replacement
- Abrasive discs are compatible with all bar materials
- Simple on/off control with 3 user selectable speeds

INTERFACES WITH

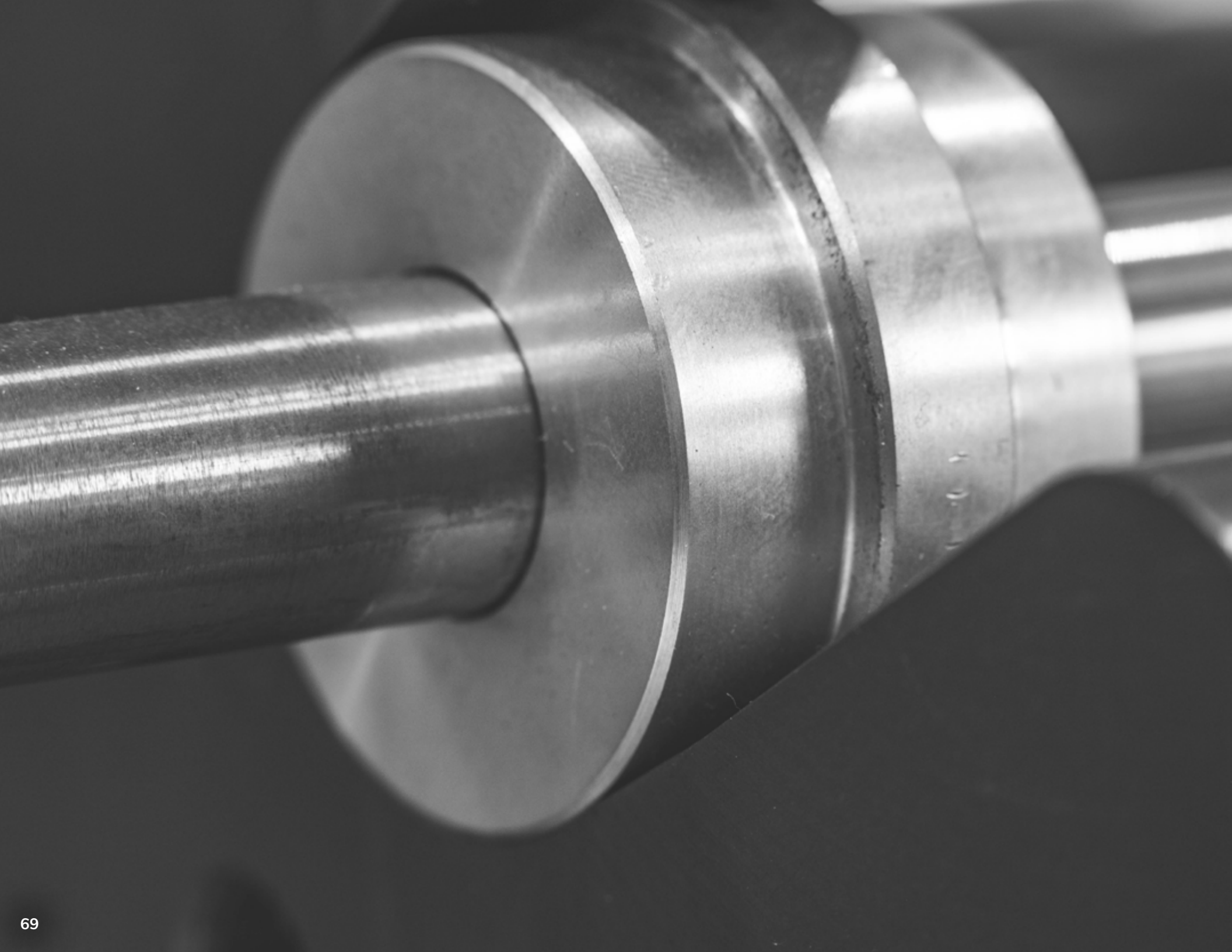
- Flat Base
- Bars

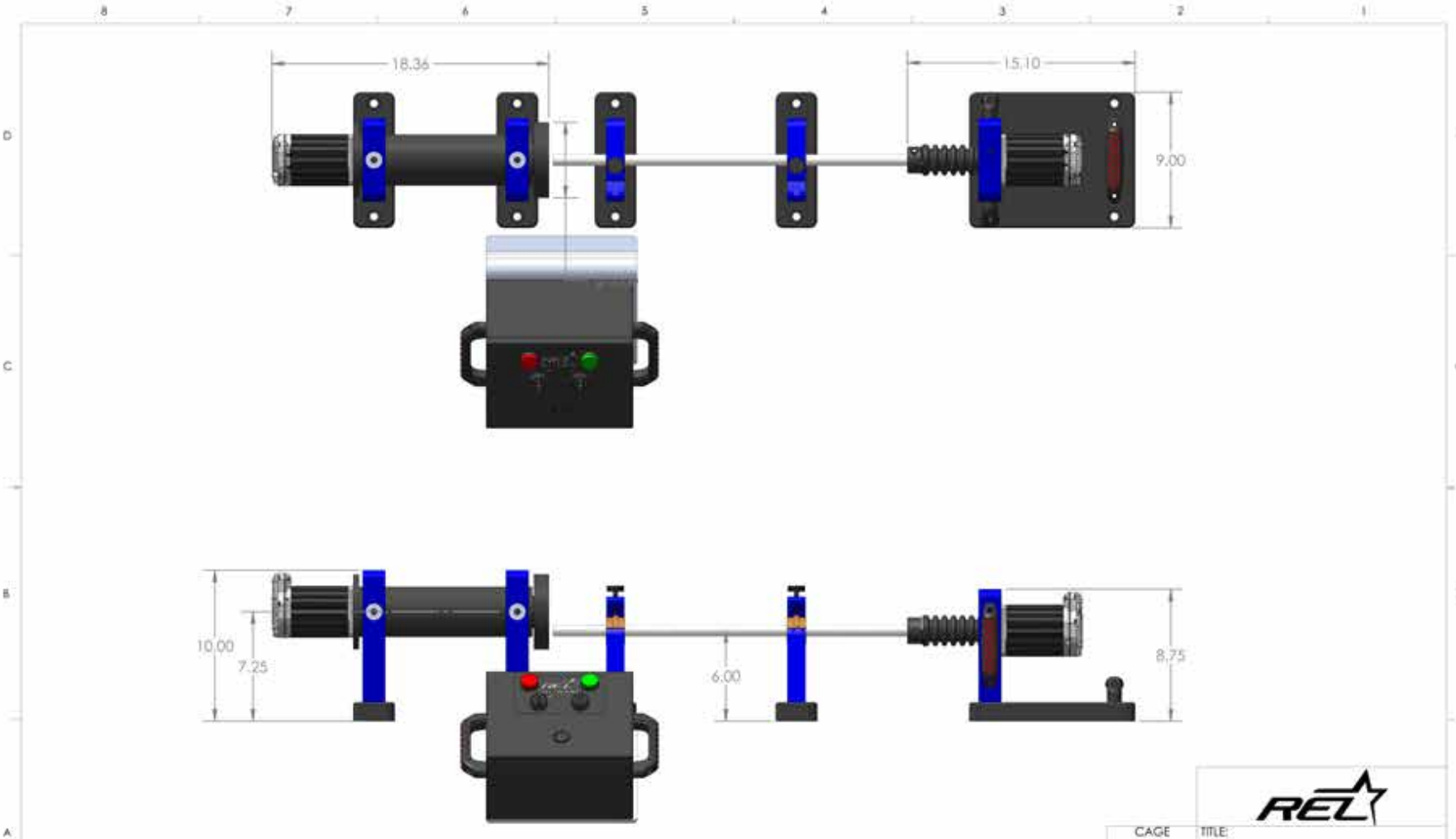

1


2


3

1. Bar conditioner drive head
2. Bar conditioner grind head
3. Freshly ground bar ends





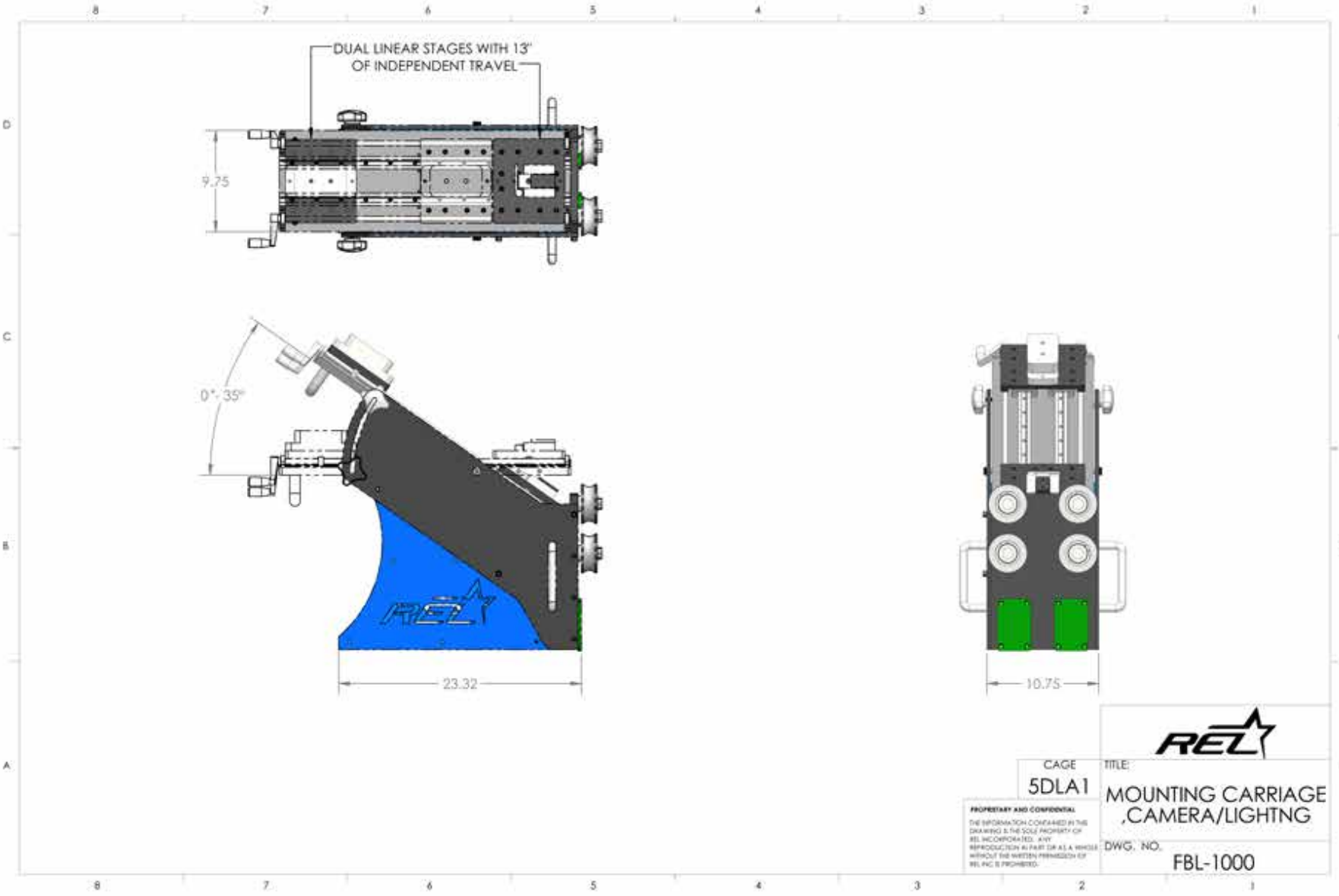
GRINDER CAN BE CONFIGURED TO GRIND
BARS FROM .250" UP TO 3.00" DIAMETER

CAGE
5DLA1

TITLE:
BAR END
CONDITIONER

DWG. NO.
SG-1000

CAMERA MOUNT


DUAL LINEAR STAGES WITH 13"
OF INDEPENDENT TRAVEL
9.75
0°-35°
23.32
10.75
CAGE
5DLA1
TITLE:
MOUNTING CARRIAGE
,CAMERA/LIGHTNG
DWG. NO.
FBL-1000
PROPRIETARY AND CONFIDENTIAL

SEEING IS BELIEVING.

REL designed a camera mounting module with an integral shadow free lighting system that is integral to REL's High Strain Rate Testing platform. Built on precision stainless steel rollers this module mounts and rolls on the chrome guide rails to wherever the testing action is.

EQUIPMENT HIGHLIGHTS

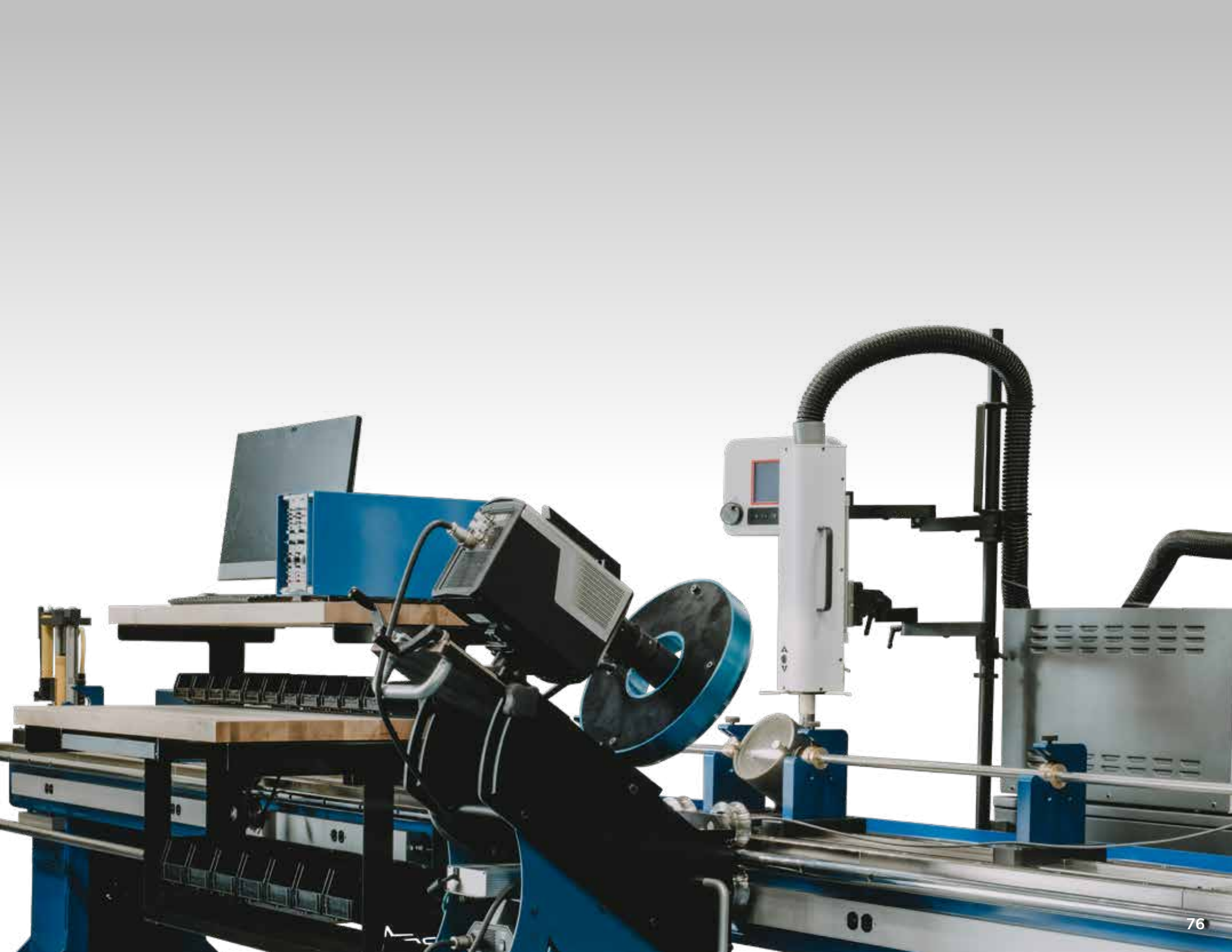
- Mounts are available for all high speed video and framing cameras
- Power supply shelf allows for effective cable management
- REL's camera mount can adjust 6" axially—this motion is controlled on bearing slides with individual lead screws to adjust lighting and camera focal axes independently
- Tilt feature allows for optimal frame centering
- Precision stainless steel rollers allow for camera placement along the total system length

INTERFACES WITH

- Flat Base
- Kirana, Shimatzu, Phantom, etc., Ultra High-Speed Cameras
- REL WS1 16" LED Ring Light

1. Camera rear view showing power supplies on integral shelves
2. Camera mounted through shadow free ring light
3. Camera in action during tension test

AIR TEMPERATURE CONTROL



TEMPERATURE AND ENVIRONMENTAL CONTROL IS PARAMOUNT TO SPECIFIC MATERIAL TESTING.

Accurate determination of sample teat temperature at at the point of dynamic load application is technology that REL has integrated into the high strain rate teat platform. There are several modules that have been developed for different temperature testing.

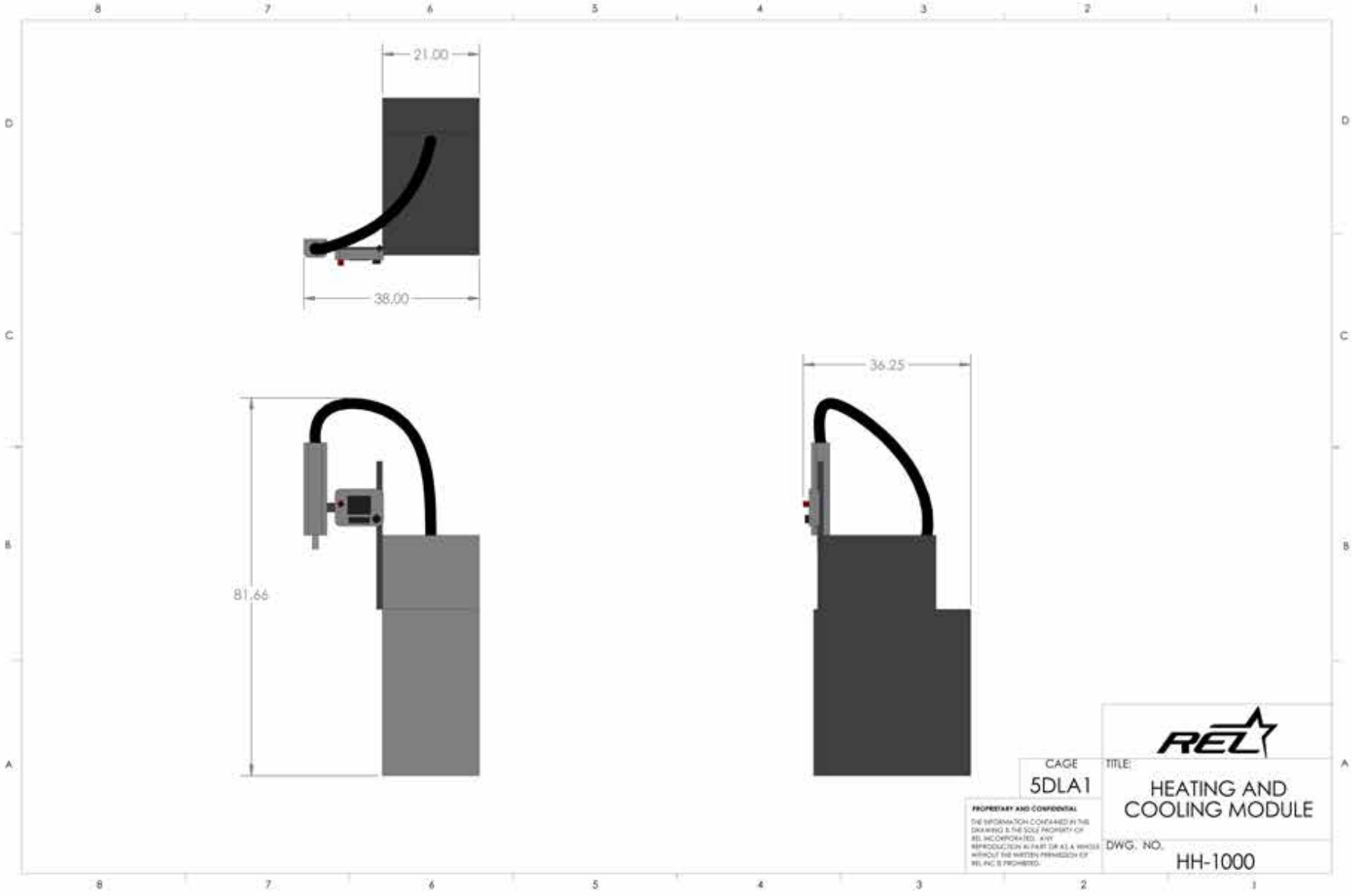
EQUIPMENT HIGHLIGHTS

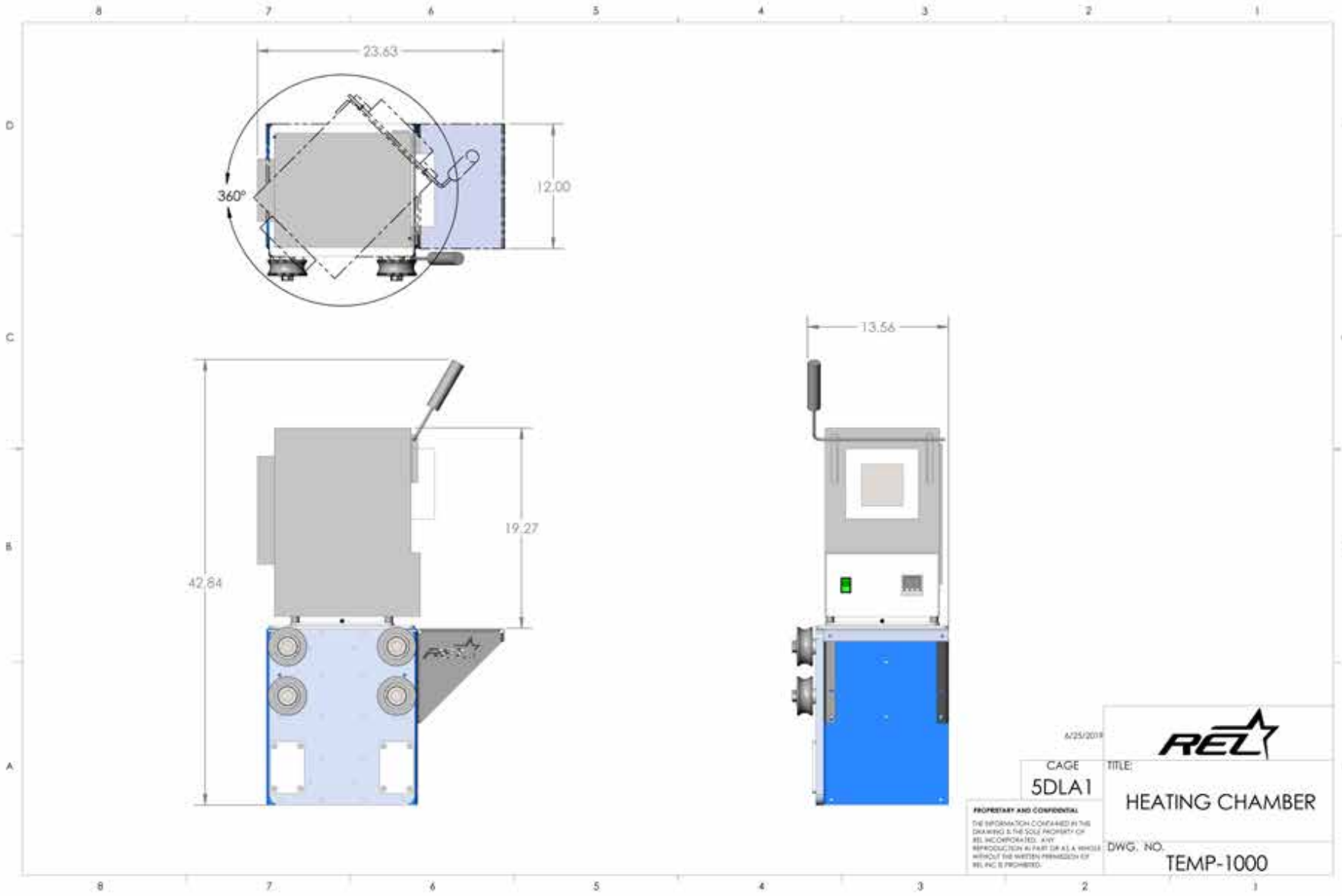
- The Air Temperature Control medical grade temperature module provides temperature control for the most stringent testing requirements from -60 Degrees Centigrade to 225 degrees Centigrade. This houses the sample for Tension, Compression, and Torsion testing at a select-able temperature. This applies the selected temperature air to the test chamber.
- Direct Flame Heating is a precise torch for heating metallic samples in tension experiments. This is coupled with the FLMR-EYE for 1ms temperature time resolution during testing.
- The Heat Chamber is a kiln solution for all material types. Care must be exercised, especially for low specific heat materials, in reporting the sample temperature during testing.

INTERFACES WITH

- Bars
- Flat Base

1. Direct Flame Heater in action during a tension test
2. High temperature adjustable compression sample holder
3. Tension test utilizing the Air Temperature Control module in conjunction with the environmental chamber

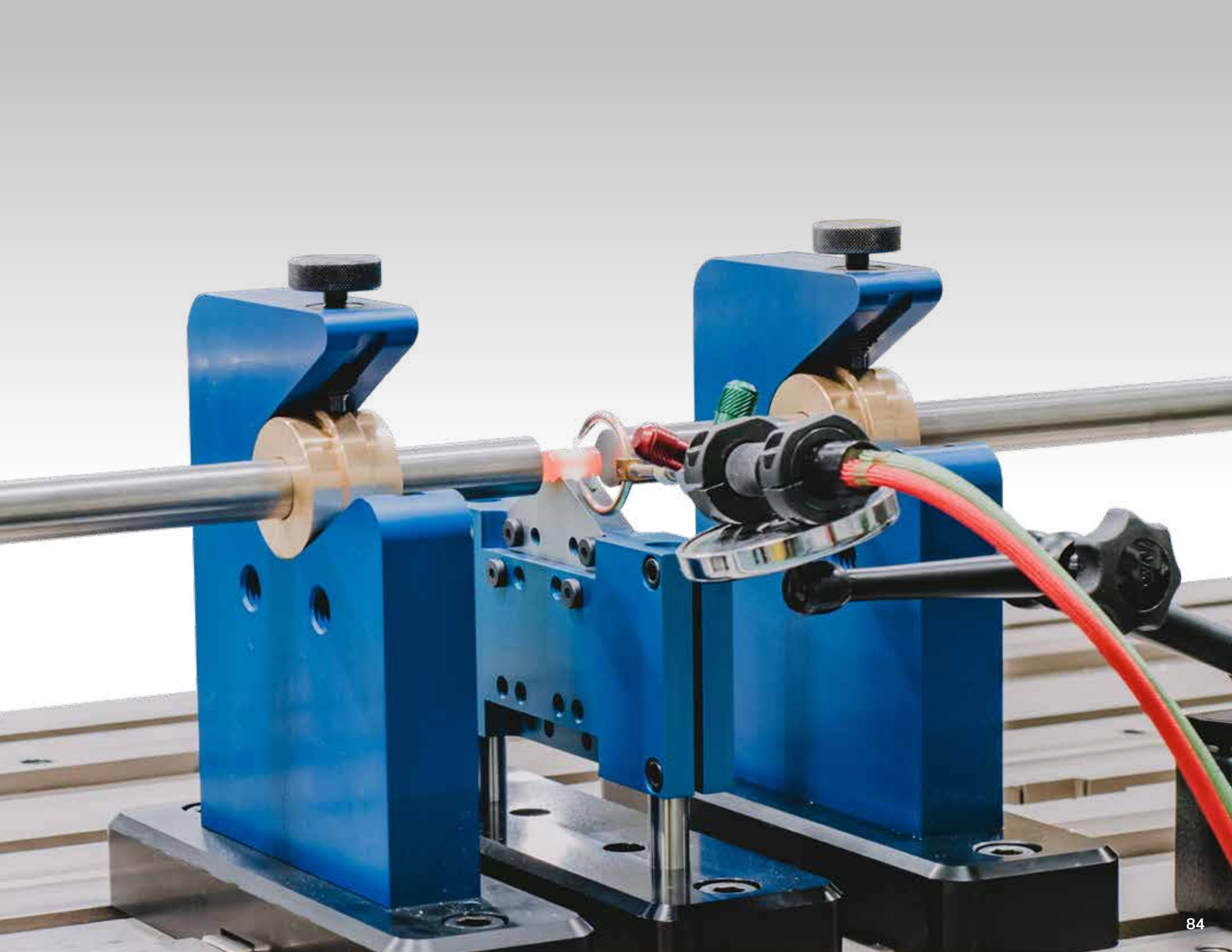

21.00
38.00
81.66
36.25
CAGE
5DLA1
TITLE:
HEATING AND
COOLING MODULE
DWG. NO.
HH-1000
PROPRIETARY AND CONFIDENTIAL


23.63
360°
12.00
42.64
19.27
13.56
6/25/2019
CAGE
5DLA1
TITLE:
HEATING CHAMBER
DWG. NO.
TEMP-1000
PROPRIETARY AND CONFIDENTIAL

HEAT CHAMBER


POWER

DIRECT FLAME HEATING



SURE-PULSE


SURE-pulse
DATA PROCESSOR
Stress Vs Strain
Stress Vs Time
Strain Vs Time
Strain Rate Vs Time


SURE-CURE
APC

A PURPOSE BUILT ANALYSIS TOOL DESIGNED FROM THE GROUND UP FOR HIGH STRAIN RATE TESTING.

REL's SURE-Pulse software package is a complete solution for processing and analyzing high strain rate data collected during SHPB or impact events. It streamlines the data input process and allows for a wide variety of signal types and sources.

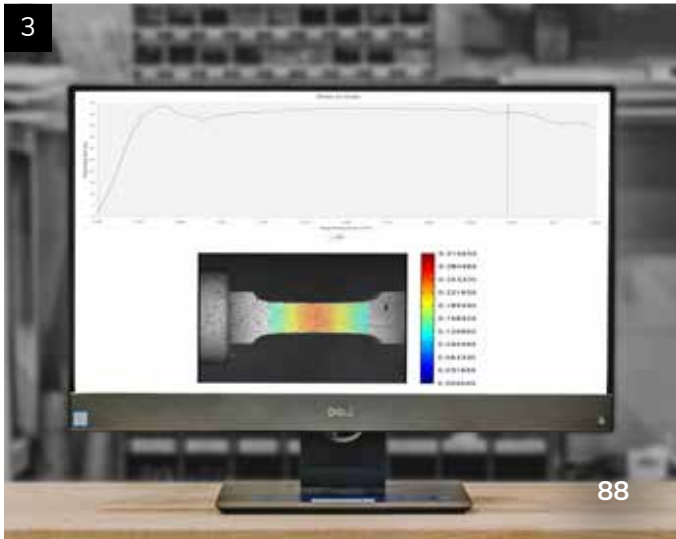
SURE-Pulse gives the user an assortment of post processing tools such as filters, trimming and statistics while providing a high contrast graphic interface. These features allow large data sets to be easily managed, displayed, and reported.

EQUIPMENT HIGHLIGHTS

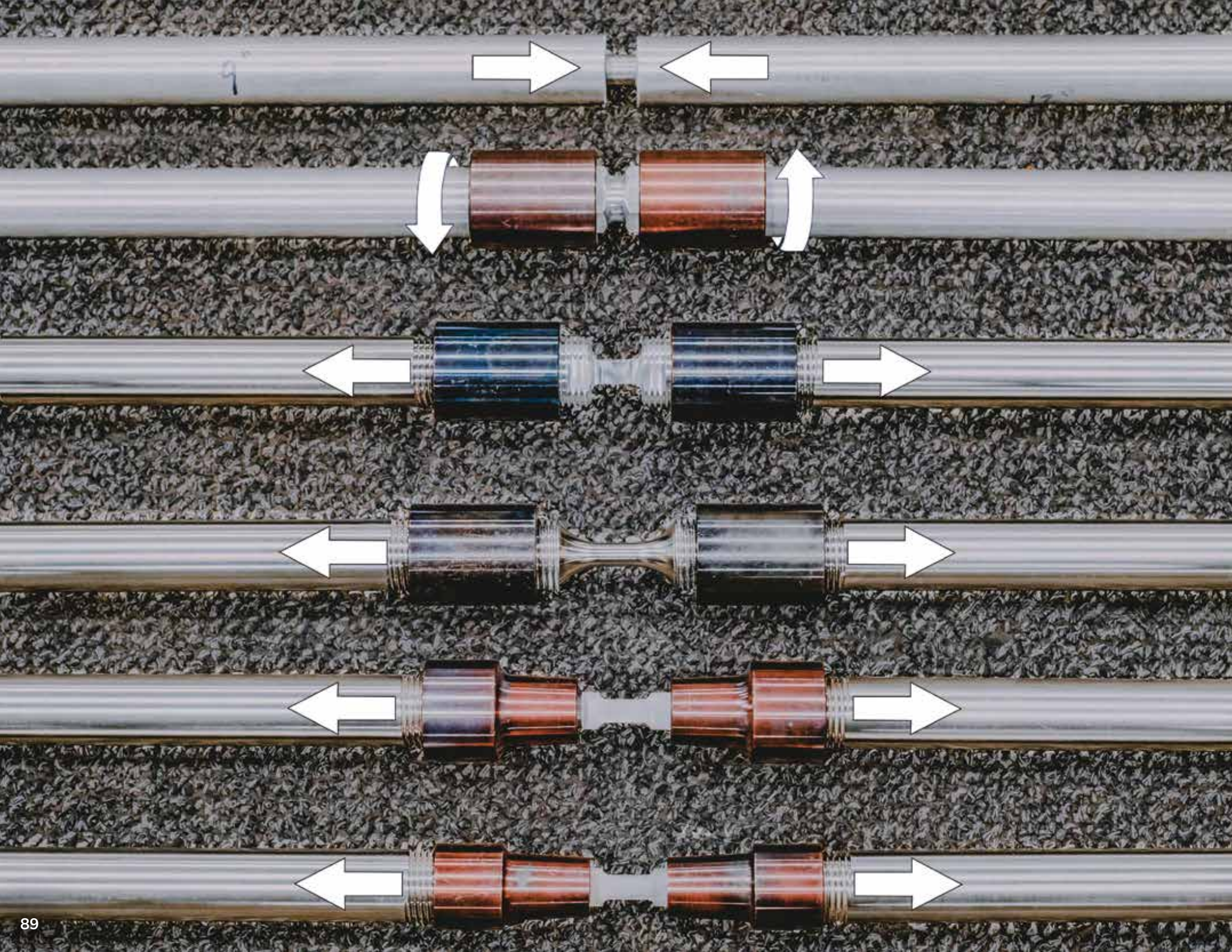
- Intuitive graphical interface
- Configurable results, reports, and reference data
- Simplified filtering, statistical, and data selection tools
- Built in 2D digital image correlation and target tracking
- Complete data workspace solution for high and low rate testing
- No cost and open source

INTERFACES WITH

- DAQ
- Camera Mount
- Lighting



1. Typical high-rate analysis plots (stress-strain, stress-time, strain-time, and strain rate-time)
2. Pulse selection tool for SHPB tests
3. 2D DIC strain map synced with stress-strain curve



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