PG-5101
Rev. 5/2021

Morehouse
THE FORCE IN CALIBRATION SINCE 1925

ISO/IEC 17025 / ANSI/NCSLI Z540.3 Accredited

Product Guide

Deadweight Calibrating Machine

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General Information

Deadweight systems provide the most accurate force calibration standards available on the market. A Morehouse Deadweight Calibrating Machine includes a set of calibrated weights at different sizes. The user can choose any combination of desired weights through the control system, and apply the determined force to the instrument under test. Some models are capable of performing the calibration automatically by applying the listed test points, and recording the instrument output for several commonly used indicators on the market.

All Morehouse deadweight calibrating machines make full use of the accuracy of deadweights, and are built using true primary standards. This means there are no multipliers (hydraulic or otherwise), levers, or flexures between the weights of the calibrator and the instrument to be calibrated. Weights are individually calibrated to primary force standards requirements, and calibrations are directly traceable to the SI through NIST. Due to the high accuracy and importance of all the details in these systems, each Morehouse Deadweight Calibrating Machine is custom designed and manufactured for the specific needs and requirements of its user. Morehouse has manufactured numerous deadweight calibrating machines at various capacities ranging from 250 lbf to 120,000 lbf, which are used by the most reputable laboratories throughout the world. These machines have a proven record of high reliability and stability, and are designed and manufactured to last for decades.

Calibration Capability

These machines are capable of calibrating force measuring devices following the requirements outlined in ISO 376 Class 00, ASTM E74 Class AA, and AS 2193 Class AA calibration procedure documents. The machine is sized to accomodate the calibration of different force measuring devices such as load cells, proving rings, crane scales, force gauges, dynamometers, and several other force measuring devices that require the utmost accuracy.

The weight of the yoke, which is the mechanism that transfers force from deadweights to the instrument, is the minimum amount of force that a Morehouse deadweight calibrating machine can apply. The available force points between the minimum force and machine capacity depends on the number and size of the weights ordered by the user. Generally, a higher number of weights provides the user with more flexibility in terms of generating test points. For instance, a deadweight calibrating machine with 10,000 lbf capacity can generate more weight combinations when built with 1,000 lbf weights than a machine with the same capacity when built with 2,000 lbf weights.

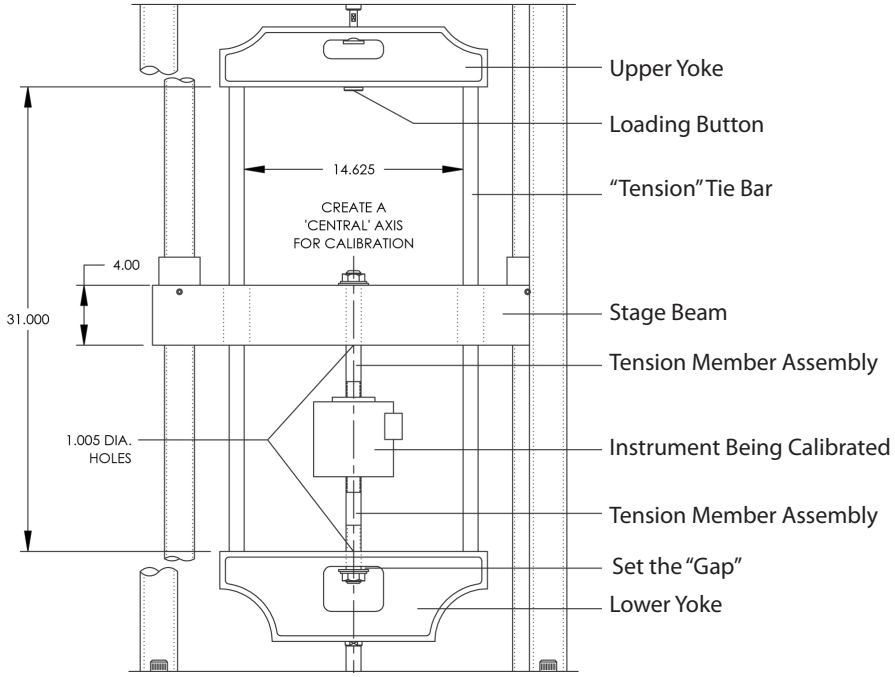
Pricing

Deadweight machines start at $70,000.00 USD. Pricing is often dependent on the size of the machine, cost of calibration of the weights, material of weights, number of weights, engineering costs, and freight. Typical pricing is around $25.00 - $50.00 per lbf for higher capacity MH machines. When the accuracy of deadweight is not required, our Morehouse Universal Calibrating Machine (UCM) with accuracies of better than 0.02 % of applied force, may be an acceptable alternative. The UCM machines of 100 Klbf and under range from $20K - $50K, depending on options.

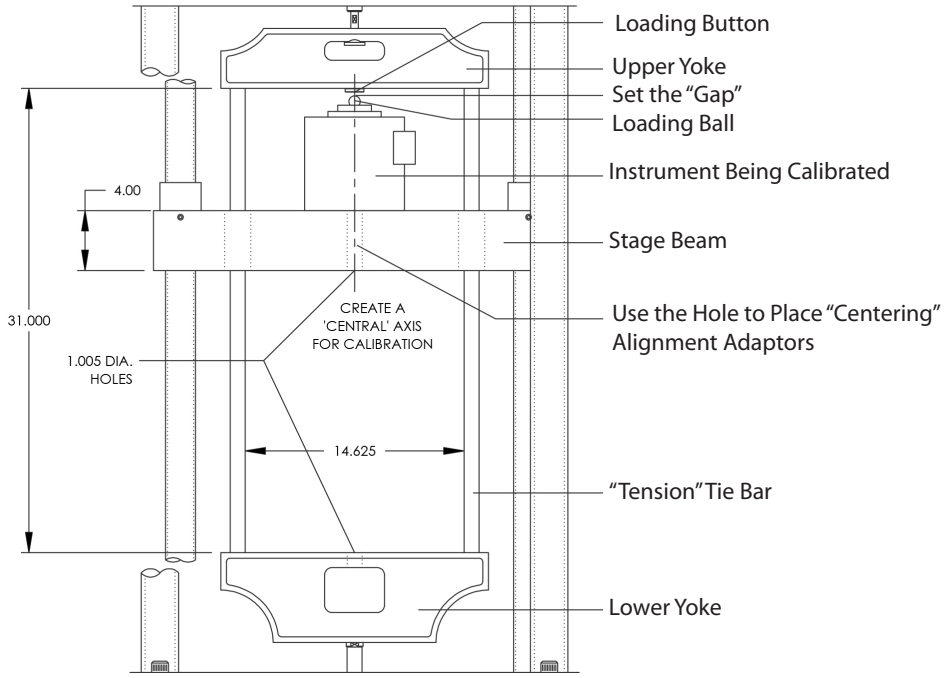
Modes of Operation

Morehouse deadweight calibrating machines are designed with the capability to apply force to the unit under test in both compression and tension modes. Each machine is equipped with an adjustable stage beam powered by an electric motor. By moving the position of the stage beam, the opening needed for positioning the unit under test is adjusted for compression or tension calibration. For compression calibration, the instrument under test is placed on top of the stage beam and the position of the stage beam is adjusted by the operator. Then the yoke is lowered on the instrument and the desired weight combination is applied to the yoke. For calibration in tension mode, the instrument is mounted underneath the stage beam on one side, and to the lower part of the yoke from the other side. Then the yoke is lowered to be hanging from the instrument and the desired test points are applied by choosing the proper weight combination.

Typical Setup



Typical Tension Setup



Typical Compression Setup

Weights

All primary standard weights are adjusted to better than 0.002 % of their nominal value and are calibrated and certified either directly traceable to SI units through an ISO/IEC 17025 accredited lab or directly by the United States National Institute of Standards and Technology (NIST). Weights are also adjusted for the local gravity and air buoyancy as well as material density to produce true mass values.

All weights with capacities less than 10,000 lbf (50 kN) can be machined from stainless steel. Stainless steel is used because of its resistance to corrosion and long-term stability. Additionally, an austenitic grade of stainless steel is used because of its resistance to magnetism. Studies have shown the effects of magnetism can cause slight errors in weights. Larger weights are often machined from steel and nickel plated for resistance to corrosion. The large weights can be supplied machined from stainless steel at an additional cost.

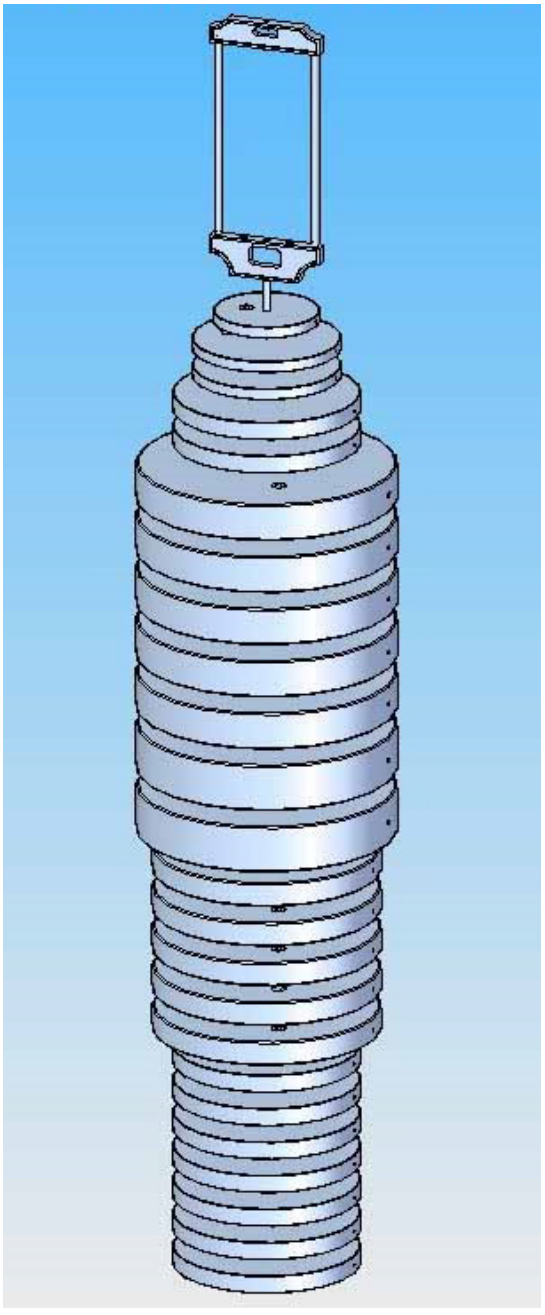
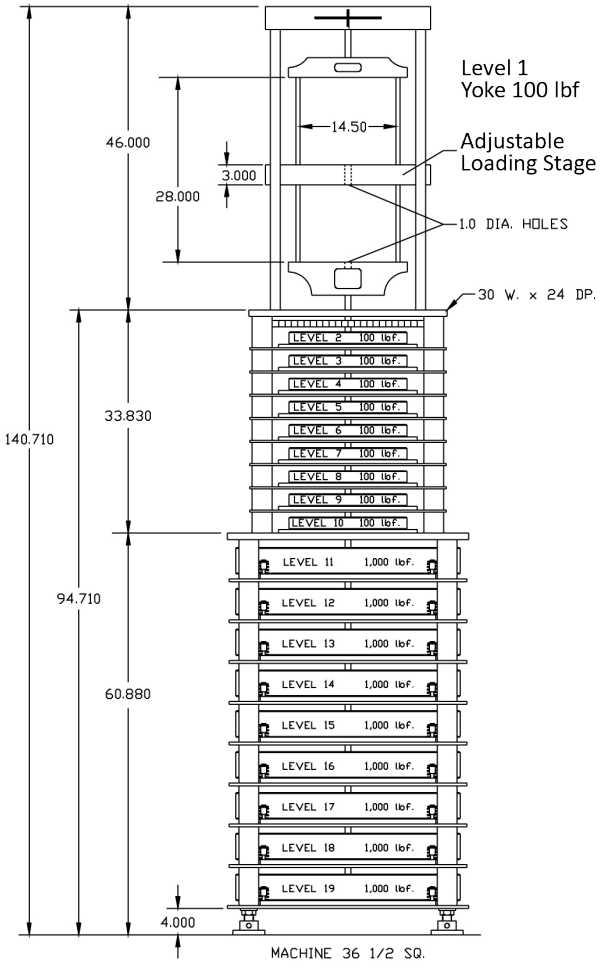


Figure 1: Typical 25,000 lbf Deadweight Stack and Yoke used in a Morehosue Deadweight Calibrating Machine

Design

Since the 1950s Morehouse has been designing and installing deadweight calibrators for Government, National Metrology Institutes (NMIs), and commercial businesses interested in the most accurate method to calibrate force devices. Morehouse deadweight calibrating machines are designed to allow any weight to be applied independently of any other weight in the calibrator. This is a great advantage over designs where weights are chain loaded and can only be applied in a fixed, predetermined sequence. With chain loading systems one weight generally cannot be applied unless the one above it is applied first. Independent weight control makes the calibrator more versatile, faster, and easier to operate. Independent weight control also allows the weights to be inter-compared without the expense of machine disassembly. Figure 2 demonstrates the typical design of a deadweight calibrating machine.



Shown without corner covers nor plexiglass view panels

Figure 2: Morehouse Deadweight Calibrating Machine (Model: MH; Capacity: 10,000 lbf)

Models

Morehouse has two different models of deadweight calibrating machines available: Model MH and Model L.

Model MH

The MH model is available in several capacities and weight complements standard capacities being 2,000 lbf, 5,000 lbf, 10,000 (shown in Figure 2), 20,000 lbf, 25,000 lbf, 50,000 lbf and 120,000 lbf, or the approximate equivalent in kgf/Newton. Based on the user requirements, model MH machines can be designed for capacities as low as 50 lbf (250 N) through capacities up to 250,000 lbf (1 MN). In a model MH deadweight calibrating machine, primary standard weights are applied and removed using a pneumatic system of weight lifter assemblies and pneumatic solenoid valves connected to a manifold, which is distributing air to all the weight levels. The pneumatic system needs an operating air pressure of 10-15 psi. The pneumatic solenoid valves open and close to apply or remove the weights force to the test instrument. The valves are controlled by a PLC unit connected to a tablet or computer. A software program and a screen interface allows the operator of the machine to control the force application or removal to the test instrument when performing the calibration. A model MH machine with 10,000 lbf capacity is shown in Figure 2.

Model L

The model L is available only in capacities from 100 through 1,100 lbf, standard capacities being 500 lbf and 1,000 lbf, or the approximate equivalent in kgf or N. It is available with stainless steel or nickel-plated steel weights. Weights are applied and removed through a system of manually operated levers as shown in Figure 3.

Figure 3: Morehouse Deadweight Calibrating Machine (Model: L, Capacity: 1,000 lbf)

Custom Designs

Morehouse can design machines to fit your force laboratory requirements and limitations. The Morehouse Engineering department can layout a machine or several machines in your existing laboratory or help with the layout of a new laboratory. Depicted in Figure 4 is a layout consisting of a 2 Klbf, 25 Klbf, and 100 Klbf model MH machines in a force measurement laboratory. Engineering put the layout together in an existing building and created the support structures, steps, and decking. Higher capacities or custom machines are available upon request.

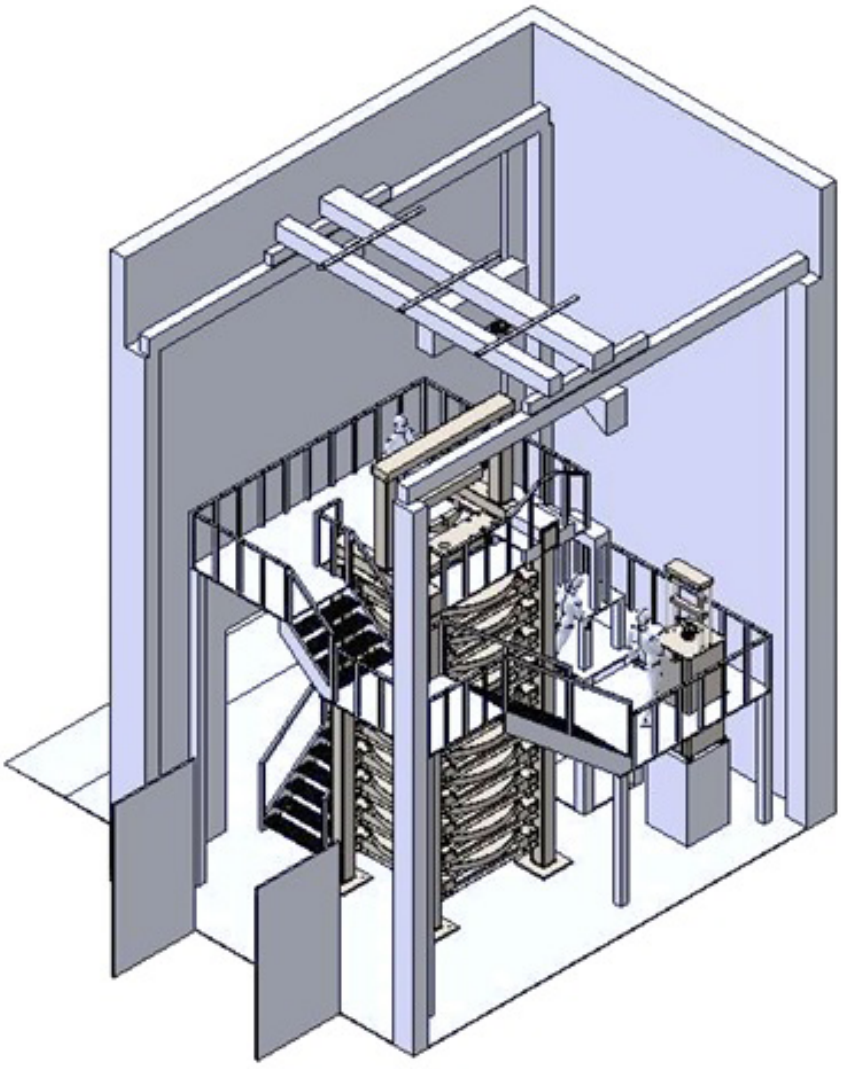
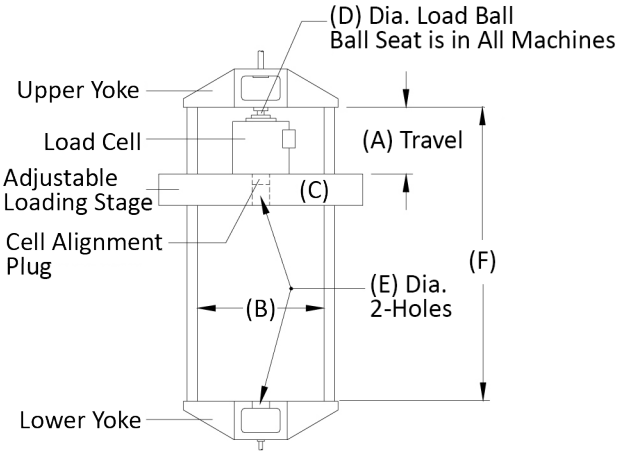
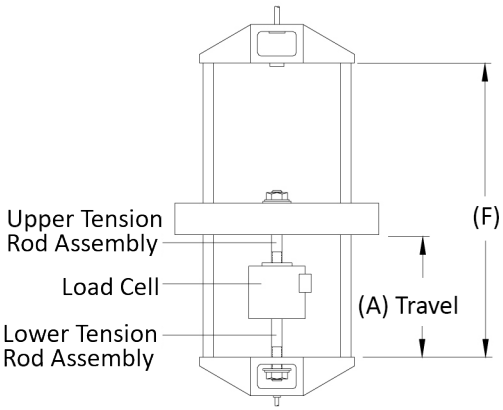


Figure 4: Custom Design of Morehouse Deadweight Calibrating Machines

Model MH Specifications



Compression Mode

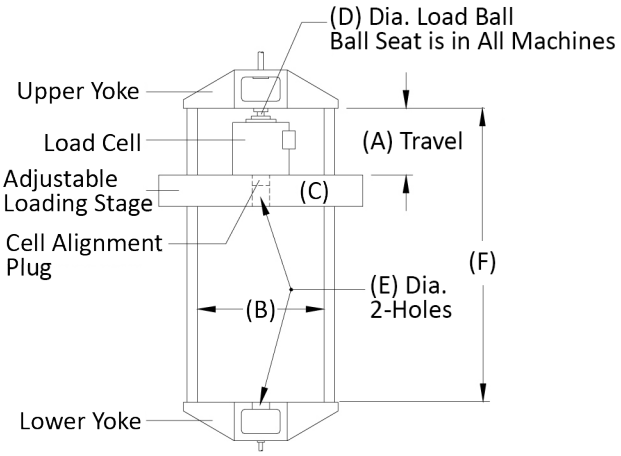


Tension Mode

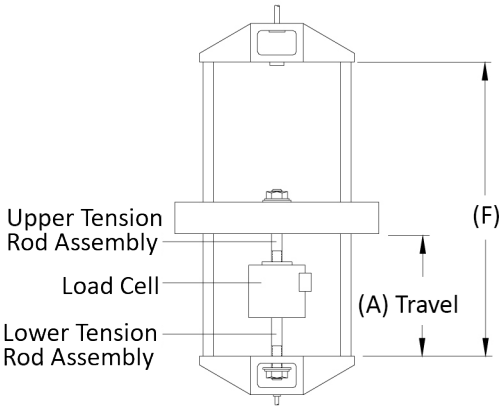
		Machine Capacity (lbf)									
		100		1,000		2,000		5,000		10,000	
Yoke Assembly	Dimension A	10 in		18 in		19.5 in		21.5 in		24.5 in	
	Dimension B	4.5 in		8 in		10 in		14.5 in		14.5 in	
	Dimension C	1.5 in		1.8 in		3.0 in		4.0 in		4.0 in	
	Dimension D	0.38 in		0.44 in		0.44 in		0.44 in		0.44 in	
	Dimension E	0.375 in		0.75 in		0.75 in		1.00 in		1.00 in	
	Dimension F	11.5 in		19.8 in		22.5 in		25.5 in		28.5 in	
Full Machine	Height	70 in		82 in		92 in		150 in		150 in	
	Base	18 x 18 in		22 x 18 in		24 x 24 in		32 x 32 in		37 x 37 in	
	Total Weight	700 lb		2,100 lb		3,400 lb		7,700 lb		14,000 lb	
	Standard Weight Complements	Qty	lbf	Qty	lbf	Qty	lbf	Qty	lbf	Qty	lbf
		Yoke	2.5	Yoke	10	Yoke	20	Yoke	50	Yoke	100
		1	2.5	2	10	9	20	9	50	9	100
		7	5	1	20	9	200	9	500	9	1,000
		6	10	9	50						
				5	100						

The dimensions of the machine's yoke assembly may be varied to accommodate individual requirements with respect to overall dimensions of load cells or other instruments to be calibrated in both tension and compression.

Model MH Specifications (cont.)



Compression Mode



Tension Mode

		Machine Capacity (lbf)									
		20,000		30,000		50,000		100,000		120,000	
Yoke Assembly	Dimension A	21.5 in		29.5 in		23 in		36 in		36 in	
	Dimension B	12.6 in		14.7 in		14.7 in		20 in		20 in	
	Dimension C	4.0 in		6.0 in		4.0 in		6.0 in		6.0 in	
	Dimension D	0.44 in		0.44 in		0.63 in		0.88 in		0.88 in	
	Dimension E	1.00 in		1.00 in		1.50 in		1.50 in		1.50 in	
	Dimension F	25.5 in		35.5 in		27.5 in		42 in		42 in	
Full Machine	Height	180 in		204 in		210 in		280 in		280 in	
	Base	43 x 43 in		57 x 57 in		60 x 60 in		110 x 110 in		110 x 110 in	
	Total Weight	33,000 lb		40,000 lb		67,000 lb		130,000 lb		155,000 lb	
	Standard Weight Complements	Qty	lbf	Qty	lbf	Qty	lbf	Qty	lbf	Qty	lbf
		Yoke	100	Yoke	200	Yoke	1,000	Yoke	1,000	Yoke	1,000
		5	100	2	100	4	1,000	1	1,000	1	1,000
		2	200	8	200	5	2,000	4	2,000	4	2,000
		2	500	14	2,000	5	3,000	5	4,000	6	5,000
		8	1,000			5	4,000	5	6,000	10	8,000
		5	2,000					5	8,000		

The dimensions of the machine's yoke assembly may be varied to accommodate individual requirements with respect to overall dimensions of load cells or other instruments to be calibrated in both tension and compression.

Drawings

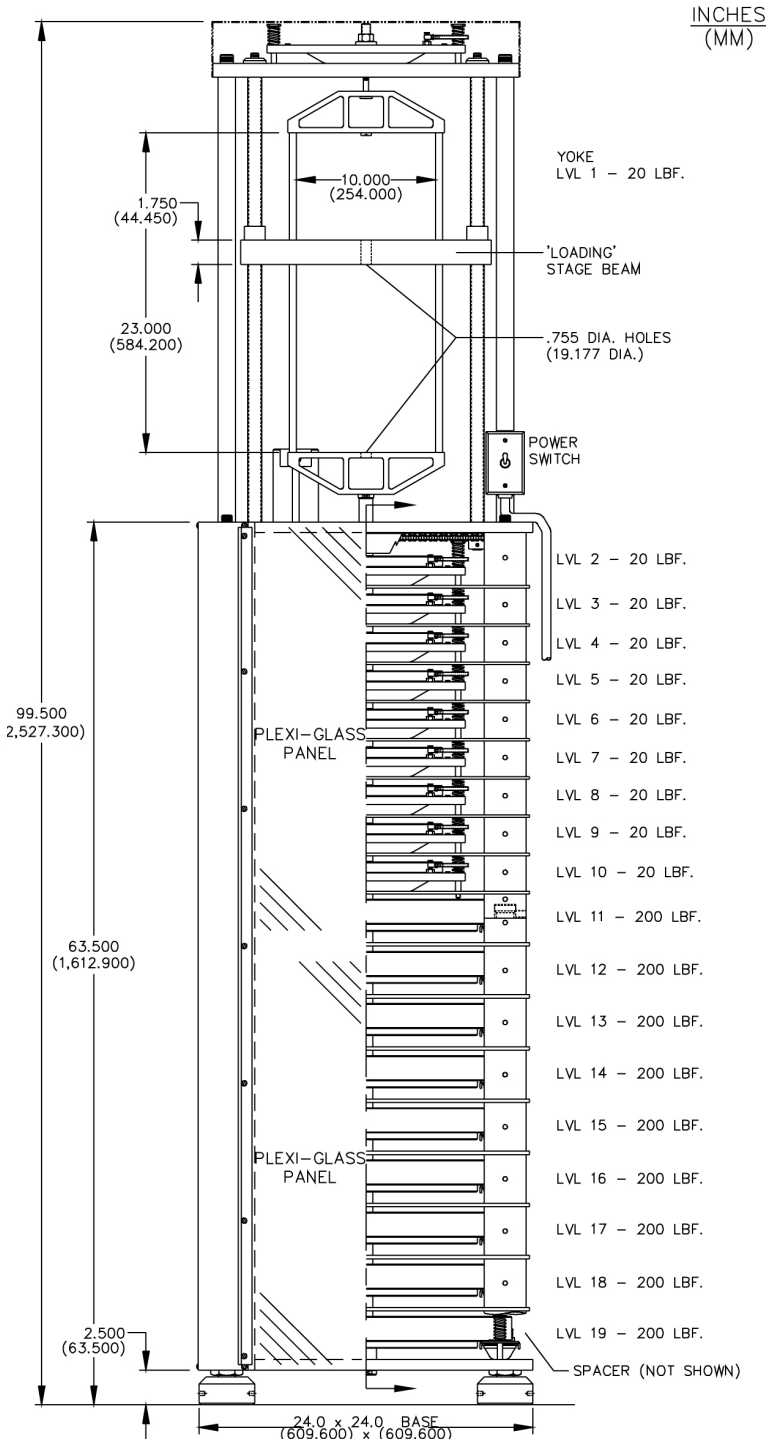


Figure 5: Deadweight Calibrating Machine; Capacity: 2,000 lbf (Drawing 808000-01)

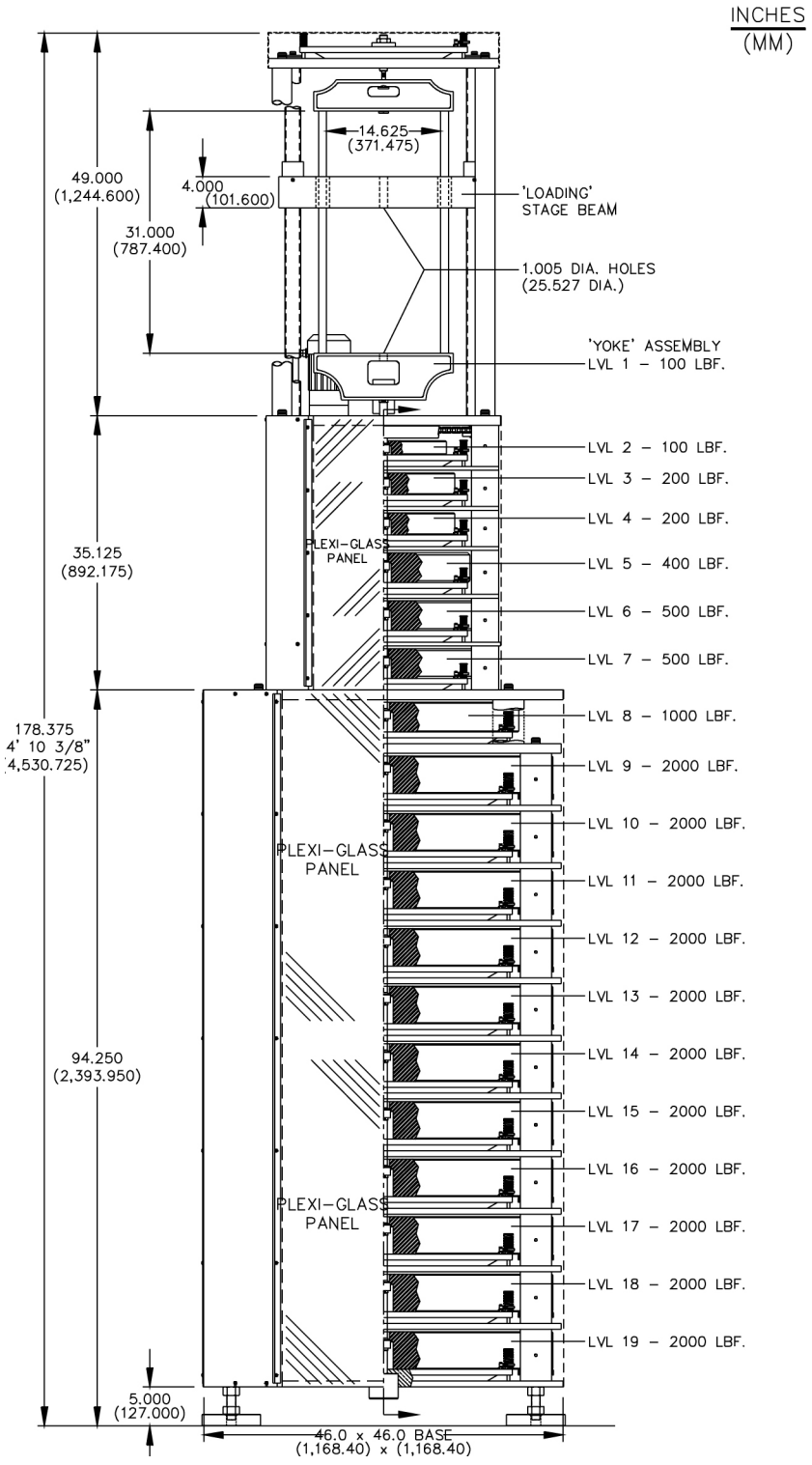


Figure 6: Deadweight Calibrating Machine; Capacity: 25,000 lbf (Drawing 809000-01)

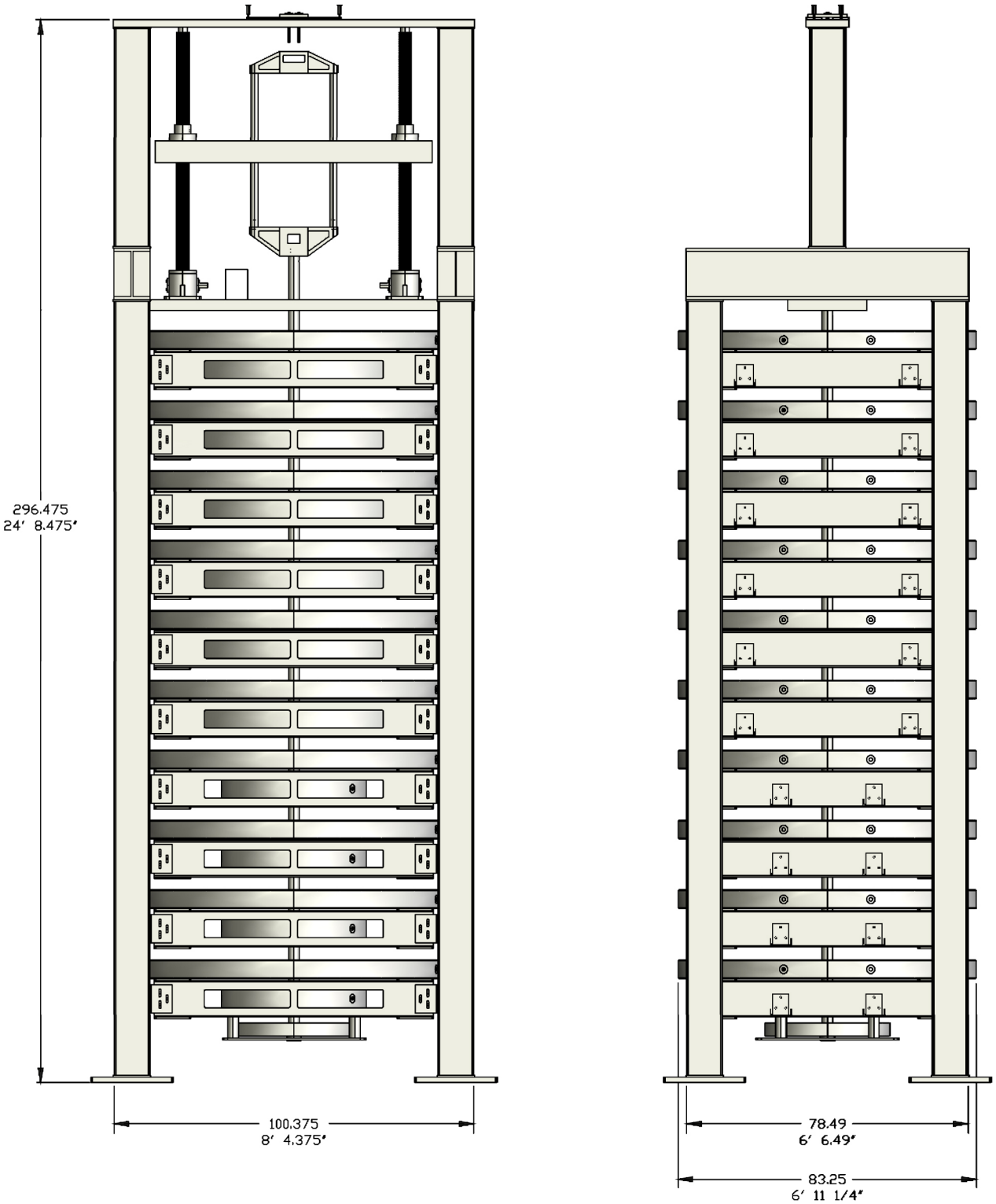
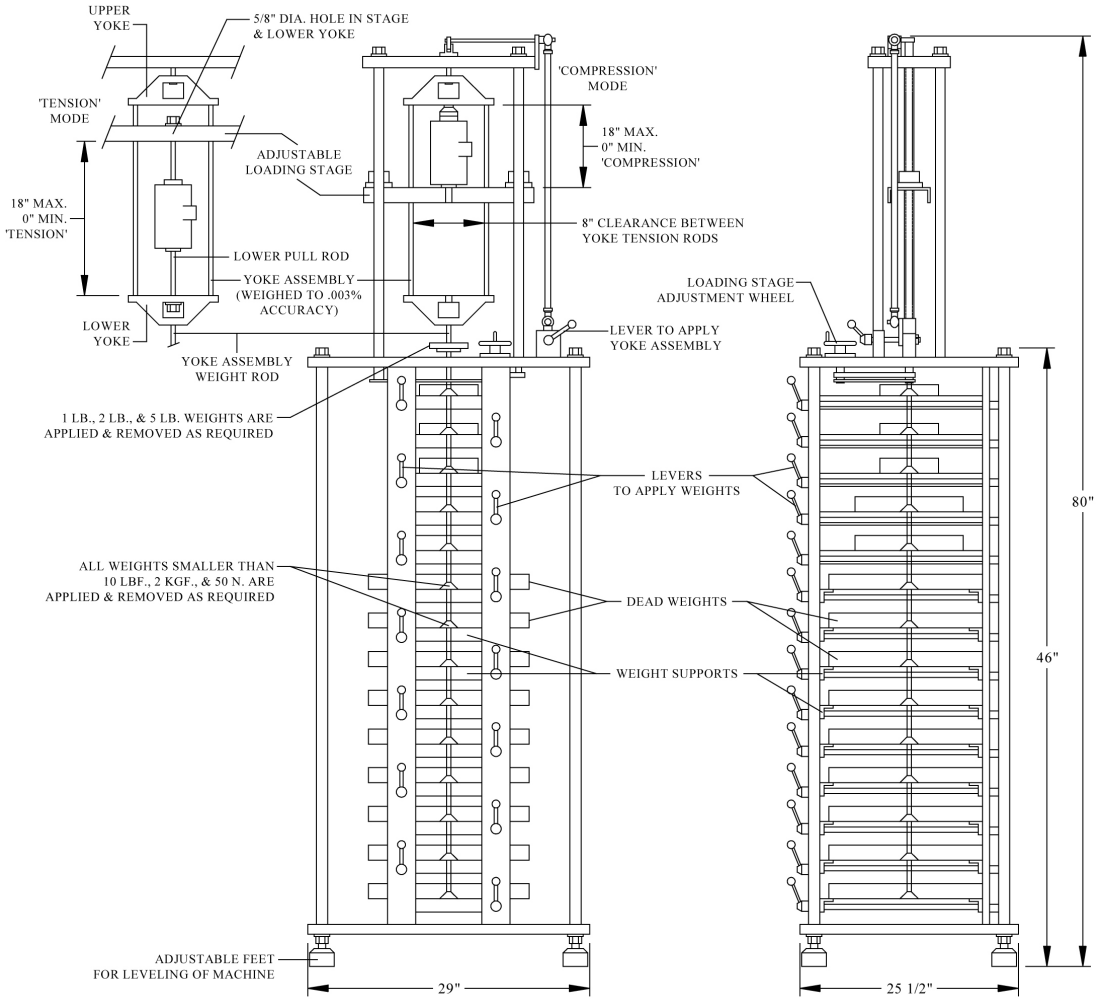


Figure 7: Deadweight Calibrating Machine; Capacity: 100,000 lbf (Dimensions in inches)



WEIGHT COMPLEMENT TABLE

QUANTITY SUPPLIED	MACHINE CAPACITY 500 LBF. (POUNDS)	250 KGF. (KILOGRAMS)	2500 N. (NEWTONS)
YOKE ASS'Y.	10	5	50
1	1	1	5
2	2	2	10
1	5	---	25
1	10	5	50
1	20	10	100
1	40	20	200
9	50	25	250
TOTAL WT.	540 LBF.	270 KGF.	2700 N.

YOKE ASSEMBLY IS THE MINIMUM WEIGHT THAT CAN BE APPLIED.

WEIGHT COMPLEMENT TABLE

QUANTITY SUPPLIED	MACHINE CAPACITY 1000 LBF. (POUNDS)	500 KGF. (KILOGRAMS)	5000 N. (NEWTONS)
YOKE ASS'Y.	10	5	50
1	1	1	5
2	2	2	10
1	5	---	25
1	10	5	50
1	20	10	100
1	40	20	200
1	50	25	250
9	100	50	500
TOTAL WT.	1040 LBF.	520 KGF.	5200 N.

YOKE ASSEMBLY IS THE MINIMUM WEIGHT THAT CAN BE APPLIED.

EXAMPLE OF LOADING AND UNLOADING PROCEDURE ON 500 LBS. CAP. MACHINE

LOADS ARE APPLIED IN AN ASCENDING OR DESCENDING ORDER WITHIN THE WEIGHT COMPLEMENT OF THE MACHINE. FOR EXAMPLE, THE WEIGHT APPLICATION SEQUENCE FOR A (5) POINT CALIBRATION ON A 500 LBS. CAPACITY LOAD CELL WOULD BE AS FOLLOWS.

POINT	WEIGHTS APPLIED	TOTAL LOAD
1	YOKE ASS'Y. (10 LBS.) + 40 LBS. + 50 LBS.	100 LBS.
2	50 LBS. + 50 LBS.	200 LBS.
3	50 LBS. + 50 LBS.	300 LBS.
4	50 LBS. + 50 LBS.	400 LBS.
5	50 LBS. + 50 LBS.	500 LBS.

UNLOADING THE INSTRUMENT BEING CALIBRATED WOULD BE THE REVERSE ORDER OF THE ABOVE.

EQUIVALENT TABLE:

1 LB. = 4.448222 N. 1 KG. = 9.806650 N. 1 N. = 0.101972 KG.
1 LB. = 0.453597 KG. 1 KG. = 2.204600 LB. 1 N. = 0.224809 LB.

Figure 7: Deadweight Calibrating Machine; Capacity: Model L