

# Mechanical Force Measurement With Hydraulic Load Cells



**Pioneering  
the new standard in  
force measurement  
technology**

*The  
Instrumentation  
Company*

**NOSHOK**  
INCORPORATED

# NOSHOK

CORPORATE HEADQUARTERS



## INTRODUCTION

Established in 1967, NOSHOK was one of the first companies to offer liquid filled pressure gauges, a revolutionary concept at the time. More importantly, NOSHOK was the first company to offer an extended three year warranty on pressure gauges, raising the benchmark on quality throughout the industry. That pioneering standard has endured for over 36 years and is continually driven by our sincere desire to be the best. Our commitment to product performance and service is an enduring successful policy applied today to our mechanical force measurement products.

The same high quality and superior performance that the instrumentation industry has come to expect from all NOSHOK products is now available in precise, time tested and cost effective force measuring technology. NOSHOK hydraulic load cells are constructed utilizing the highest quality materials and craftsmanship with unsurpassed reliability. They are available with a variety of pressure gauge and transducer configurations installed on load cells varying in design and nominal dimension to provide you with a complete force measuring package.

At NOSHOK, our customer satisfaction is paramount. We fully test and calibrate all NOSHOK Transducers prior to shipment to ensure 100% "out of the box" reliability. We have the capability to provide you with the technical assistance necessary to fulfill that special requirement which is often hard to find. If it is not in our catalog, call us, we are confident we can satisfy your needs.

NOSHOK proudly backs its commitment to excellence and superior product performance. While you are viewing this catalog, I believe this commitment will become even more apparent.

Thank you for choosing NOSHOK Products.



James B. Cole  
Chief Executive Officer

### ALL FROM NOSHOK

Pressure Gauges	Pressure Switches
Differential Gauges	Needle Valves
Sanitary Instruments	Manifold Valves
Diaphragm Seals	Solenoid Valves
Transmitters/Transducers	Thermometers
Indicators	Force Measurement

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### WARRANTY

**NOSHOK'S Three Year Warranty** applies to Series 1000, 2000, 3000, 4000 and 5000 Transducers and the Series 300 and 500 liquid filled pressure gauges.

**NOSHOK** guarantees for **Three Years** the above products:

- To be free from defects in material and workmanship.
- To operate within catalogued performance specifications.
- To remain within catalogued performance specifications.
- To maintain the integrity of the hermetically sealed case, therefore preventing leakage.

**NOSHOK'S One Year Warranty** applies to Series 1000, 2000, 3000, 4000 and 5000 dry pressure gauges.

**NOSHOK** guarantees for **One Year** the above products:

- To be free from defects in material and workmanship.

In keeping with and for purpose of product and/or manufacturing process improvements, NOSHOK, INC. reserves the right to make design changes without prior notice.

**NOSHOK is a Member and Actively Supports:**





NOSHOK Series 1000 hydraulic load cells are engineered for use within the controls systems of spot welding machines, robots, printing machines and other compression force measurement applications that require a compact design.

The Series 1000 housing and piston is of an extremely durable stainless steel that provides exceptional corrosion resistance in harsh environments. A high quality NOSHOK 300 Series pressure gauge or 100, 200 or 615 Series transducer is directly mounted to the load cell for precise measurement indication. Steel jacketed flexible tubing and capillary systems are offered to accommodate applications that require remote mounting of the gauge or transmitter.

A high degree of accuracy is achievable because the load cell system is vacuum filled and sealed eliminating the error that can be caused by entrapped air. An optional liquid filled gauge dampens the effects of pulsation, vibration and shock and lubricates the gauge internals for extended service life.

## FEATURES

- Stainless steel case and piston provide exceptional corrosion resistance and extended service life
- Compact, flat body design for compression force measurement
- Ranges from 140lbs-force to 7000lbs-force
- Operates without external power supply when using a pressure gauge for indication
- Accuracy ranges are from  $\pm 0.125\%$  Full Scale (Best Fit Straight Line) to  $\pm 1.5\%$  Full Scale depending upon the measuring device
- Various output signals available in transducer models that are CE compliant
- Exclusive NOSHOK 3 year extended warranty on 100, 200 & 615 Series transducers and 300 Series liquid filled gauges.

## Applications

- Control the forces of the stamp on printing machines
- Control the forces between rollers on printing equipment
- Measure and control the forces between welding tongs on spot welding machines
- Control systems, robot equipment, production lines, testing equipment and more...

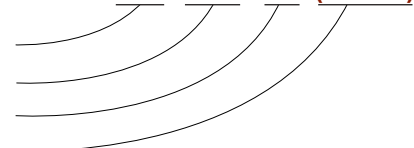
Series 1000 Hydraulic Load Cell Specification	
Nominal Diameter	ND 6
Load Cell Housing	Stainless steel
Piston	6cm <sup>2</sup> Stainless steel Optional Plastic for Welding Brackets
Connecting Line	Connecting Adapter, 50mm – STD Connecting Adapter, 100mm – Optional Flexible Tubing with Spiral Steel Jacket – Optional (max. Length 1m)
Fill Fluid	Glycerine Others Available Upon Request
Operating Temp.	14°F to 122°F (-10°C to 50°C)
Ambient Temp.	-4°F to 140°F (-20°C to 60°C)

<b>STANDARD ORDERING INFORMATION</b>	
<b>LOAD CELL</b>	<b>106S</b> 6cm <sup>2</sup> Stainless Piston <b>106P</b> 6cm <sup>2</sup> Plastic Piston
<b>MEASURING RANGE</b>	<b>150A</b> 150lbs-force <b>400A</b> 400lbs-force <b>750A</b> 750lbs-force <b>2800A</b> 2800lbs-force <b>7000A</b> 7000lbs-force (Others Ranges Available – Please Consult Factory)
<b>MEASURING INSTRUMENT</b>	<b>25-300</b> 2 1/2 Inch Pressure Gauge <b>100</b> Series 100 Transducer <b>200</b> Series 200 Transducer <b>615</b> Series 615 Transducer

**EXAMPLE**

**Load Cell** . . . . . Series1000 load cell with 6cm<sup>2</sup> plastic piston  
**Measuring Range** . . . . . 400lbs-force  
**Measuring Instrument** . . . . . 100 Series transducer  
**Options (XXX – X)** . . . . . Choose from options listed below,  
from appropriate table,  
to complete order selection

**106P 400A 100 (XXX – X)**



<b>OPTIONS for LOAD CELL WITH PRESSURE GAUGE</b>	
<b>GAUGE FILL FLUID</b>	<b>0</b> None <b>1</b> Glycerine <b>2</b> Silicone
<b>GAUGE OPTIONS</b>	<b>0</b> None <b>1</b> Maximum Indicating Pointer <b>2</b> Rubber Case Protector (Panel Mounting Features Available for Remote Installation – Please Consult Factory)
<b>OPTIONS for LOAD CELL WITH PRESSURE TRANSDUCER</b>	
<b>ACCURACY</b>	<b>1</b> ±0.50% Full Scale (B.F.S.L) – STD on 100/200 Series Transducers <b>2</b> ±0.25% Full Scale (STD on 615) – Optional on 100/200 Series Transducers <b>3</b> ±0.125% Full Scale – Option for 615 Series Transducer
<b>OUTPUT SIGNAL</b>	<b>1</b> 4mA to 20mA, 2-wire <b>3</b> 1Vdc to 5Vdc, 3-wire <b>5</b> 0Vdc to 10Vdc, 3-wire <b>2</b> 0Vdc to 5Vdc, 3-wire <b>4</b> 1Vdc to 6Vdc, 3-wire <b>6</b> 1Vdc to 11Vdc, 3-wire
<b>ELECTRICAL CONNECTION</b>	<b>1</b> 36" cable attached to option 7 or 8 <b>14</b> Hirschmann type with 1/2" NPT female conduit <b>3</b> 6-pin Bendix <b>23</b> Cable gland with internal junction box <b>6</b> 1/2" NPT conduit with 36" cable <b>25</b> M12 X 1 4-pin <b>7</b> Mini-Hirschmann (DIN 43650C) <b>29</b> 1/2" NPT female conduit with internal junction box <b>8</b> Hirschmann (DIN 43650A) <b>1800</b> Attachable Loop Powered Indicator (w/615 Transducer Only)
<b>CONNECTION TYPE FROM LOAD CELL TO PRESSURE MEASURING INSTRUMENT</b>	
<b>CONNECTING LINE</b>	<b>1</b> Connecting Adapter – 50mm – Std <b>3</b> Flexible Tubing (Specify Length) – Optional <b>2</b> Connecting Adapter – 100mm – Optional

*See Pages 14 thru 22 for Specifications,  
Dimension Drawings and Installation  
Examples*



NOSHOK Series 2000 hydraulic load cells are designed for measuring axial loads and bearing forces in turning and drilling machines, extruders and other applications requiring compression or tension force measurement. The self adapting piston is constructed of stainless steel and is available in standard or ring design.

The Series 2000 housing is an extremely durable stainless steel that provides exceptional corrosion resistance in harsh environments. A high quality NOSHOK 300 or 901 Series pressure gauge or 100, 200 or 615 Series transducer is directly mounted to the load cell for precise measurement indication. Steel jacketed flexible tubing and capillary systems are offered to accommodate applications that require remote mounting of the gauge or transmitter.

A high degree of accuracy is achievable because the load cell system is vacuum filled and sealed eliminating the error that can be caused by entrapped air. An optional liquid filled gauge dampens the effects of pulsation, vibration and shock and lubricates the gauge internals for extended service life.

## FEATURES

- Stainless steel case and piston provide exceptional corrosion resistance and extended service life
- Standard or ring design suit most applications
- Ranges from 90lbs-force to 22,000lbs-force
- Operates without external power supply when using a pressure gauge for indication
- Accuracy ranges are from  $\pm 0.125\%$  Full Scale (Best Fit Straight Line) to  $\pm 1.5\%$  Full Scale depending upon the measuring device
- Exclusive NOSHOK 3 year extended warranty on 100, 200 & 615 Series transducers and 300 Series liquid filled gauges.
- Various output signals available in transducer models that are CE compliant

## Applications

- Turning and drilling machines
- Extruders
- Measuring and test equipment
- Production lines
- Overload protection
- Vices
- Control systems and machine tool

**Series 2000 Hydraulic Load Cell Specification**

<b>Nominal Diameter</b>	ND20
<b>Load Cell Housing</b>	Stainless steel
<b>Piston</b>	20cm <sup>2</sup> Stainless steel
<b>Connecting Line</b>	Direct Connection – STD Flexible Tubing with Spiral Steel Jacket – Optional (max. Length 2m) Capillary Restrictor – Optional
<b>Fill Fluid</b>	Glycerine Others Available Upon Request
<b>Operating Temp.</b>	-4°F to 140°F (-20°C to 60°C)
<b>Ambient Temp.</b>	-4°F to 140°F (-20°C to 60°C)

STANDARD ORDERING INFORMATION							
<b>LOAD CELL</b>	<b>2020</b> Standard Design	<b>2120</b> Ring Design					
<b>MEASURING RANGE</b>	<b>300A</b> 300lbs-force	<b>1200A</b> 1200lbs-force	<b>6000A</b> 6000lbs-force	<b>22000A</b> 22000lbs-force			
	<b>600A</b> 600lbs-force	<b>2500A</b> 2500lbs-force	<b>15000A</b> 15000lbs-force	<b>(Other Ranges Available – Please Consult Factory)</b>			
<b>MEASURING INSTRUMENT</b>	<b>25-300</b> 2 1/2 Inch Pressure Gauge			<b>40-901</b> 4 Inch Pressure Gauge			
	<b>100</b> Series 100 Transducer		<b>200</b> Series 200 Transducer		<b>615</b> Series 615 Transducer		

**EXAMPLE**

**Load Cell** ..... Series 2000 load cell  
**Measuring Range** ..... 2500lbs-force  
**Measuring Instrument** ..... 4 inch pressure gauge  
**Options (XXX – X)** ..... Choose from options listed below, from appropriate table, to complete order selection

**2020**   **2500A**   **40-901**   **(XXX-X)**

OPTIONS for LOAD CELL WITH PRESSURE GAUGE			
<b>GAUGE FILL FLUID</b>	<b>0</b> None	<b>1</b> Glycerine	<b>2</b> Silicone
<b>GAUGE OPTIONS</b>	<b>0</b> None	<b>1</b> Maximum Indicating Pointer	<b>2</b> Rubber Case Protector (Panel Mounting Features Available for Remote Installation – Please Consult Factory)

OPTIONS for LOAD CELL WITH PRESSURE TRANSDUCER				
<b>ACCURACY</b>	<b>1</b> ±0.50% Full Scale (B.F.S.L) – STD on 100/200 Series Transducers			
	<b>2</b> ±0.25% Full Scale (STD on 615) – Optional on 100/200 Series Transducers			
	<b>3</b> ±0.125% Full Scale – Option for 615 Series Transducer			
<b>OUTPUT SIGNAL</b>	<b>1</b> 4mA to 20mA, 2-wire	<b>3</b> 1Vdc to 5Vdc, 3-wire	<b>5</b> 0Vdc to 10Vdc, 3-wire	
	<b>2</b> 0Vdc to 5Vdc, 3-wire	<b>4</b> 1Vdc to 6Vdc, 3-wire	<b>6</b> 1Vdc to 11Vdc, 3-wire	
<b>ELECTRICAL CONNECTION</b>	<b>1</b> 36" cable attached to option 7 or 8	<b>14</b> Hirschmann type with 1/2" NPT female conduit		
	<b>3</b> 6-pin Bendix	<b>23</b> Cable gland with internal junction box		
	<b>6</b> 1/2" NPT conduit with 36" cable	<b>25</b> M12 X 1 4-pin		
	<b>7</b> Mini-Hirschmann (DIN 43650C)	<b>29</b> 1/2" NPT female conduit with internal junction box		
	<b>8</b> Hirschmann (DIN 43650A)			
	<b>1800</b> Attachable Loop Powered Indicator (w/615 Transducer Only)			

CONNECTION TYPE FROM LOAD CELL TO PRESSURE MEASURING INSTRUMENT			
<b>CONNECTING LINE</b>	<b>1</b> Direct Connection	<b>2</b> Flexible Tubing (Specify Length)	<b>3</b> Capillary Tube (Specify length)

*See Pages 14 thru 22 for Specifications, Dimension Drawings and Installation Examples*



NOSHOK Series 3000 hydraulic load cells are designed for measuring axial loads and bearing forces in turning and drilling machines, extruders and other applications requiring compression force measurement. Lateral forces with an angle of  $\pm 3^\circ$  can be regarded as negligible which allows the Series 3000 to provide the highest degree of accuracy. The self adapting piston is constructed of a high quality stainless steel for superior performance and durability to suit the most demanding applications.

The Series 3000 housing is an extremely durable stainless steel that provides exceptional corrosion resistance in harsh environments. A high quality NOSHOK 300 or 901 Series pressure gauge or 100, 200 or 615 Series transducer is directly mounted to the load cell for precise measurement indication. Steel jacketed flexible tubing and capillary systems are offered to accommodate applications that require remote mounting of the gauge or transmitter.

A high degree of accuracy is achievable because the load cell system is vacuum filled and sealed eliminating the error that can be caused by entrapped air. An optional liquid filled gauge dampens the effects of pulsation, vibration and shock and lubricates the gauge internals for extended service life.

## FEATURES

- Stainless steel case and piston provide exceptional corrosion resistance and extended service life
- Various flexible and rigid tubing options provide simple solution to challenging installation concerns
- Ranges from 360lbs-force to 70,000lbs-force
- Operates without external power supply when using a pressure gauge for indication
- Accuracy ranges are from  $\pm 0.125\%$  Full Scale (Best Fit Straight Line) to  $\pm 1.5\%$  Full Scale depending upon the measuring device
- Various output signals available in transducer models that are CE compliant
- Exclusive NOSHOK 3 year extended warranty on 100, 200 and 615 Series transducers and 300 Series liquid filled gauges.

## Applications

- Turning and drilling machines
- Extruders
- Measuring and test equipment
- Production lines
- Overload protection
- Vices
- Control systems and machine tool

**Series 3000 Hydraulic Load Cell Specification**

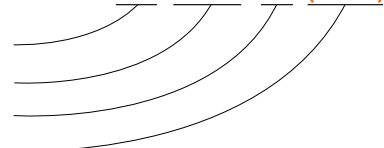
<b>Nominal Diameter</b>	ND 80
<b>Load Cell Housing</b>	Stainless steel
<b>Piston</b>	80cm <sup>2</sup> Stainless steel
<b>Connecting Line</b>	Direct Connection – STD Flexible Tubing with Spiral Steel Jacket – Optional (max. Length 2m) Capillary Restrictor – Optional
<b>Fill Fluid</b>	Glycerine Others Available Upon Request
<b>Operating Temp.</b>	-4°F to 140°F (-20°C to 60°C)
<b>Ambient Temp.</b>	-4°F to 140°F (-20°C to 60°C)

<b>STANDARD ORDERING INFORMATION</b>			
<b>LOAD CELL</b>	<b>3080</b> Standard Design		
<b>MEASURING RANGE</b>	<b>25000A</b> 25,000lbs-force	<b>60000A</b> 60,000lbs-force	<b>70000A</b> 70,000lbs-force
	(Other Ranges Available – Please Consult Factory)		
<b>MEASURING INSTRUMENT</b>	<b>25-300</b> 2 1/2 Inch Pressure Gauge <b>100</b> Series 100 Transducer	<b>40-901</b> 4 Inch Pressure Gauge <b>200</b> Series 200 Transducer	<b>615</b> Series 615 Transducer

**EXAMPLE**

**Load Cell**..... Series 3000 standard load cell  
**Measuring Range**..... 25,000lbs-force  
**Measuring Instrument**..... 200 Series transducer  
**Options (XXX – X)**..... Choose from options listed below,  
from appropriate table,  
to complete order selection

**3080 25000A 200 (XXX-X)**



<b>OPTIONS for LOAD CELL WITH PRESSURE GAUGE</b>			
<b>GAUGE FILL FLUID</b>	<b>0</b> None	<b>1</b> Glycerine	<b>2</b> Silicone
<b>GAUGE OPTIONS</b>	<b>0</b> None	<b>1</b> Maximum Indicating Pointer	<b>2</b> Set Pointer
	(Panel Mounting Features Available for Remote Installation – Please Consult Factory)		
<b>OPTIONS for LOAD CELL WITH PRESSURE TRANSDUCER</b>			
<b>ACCURACY</b>	<b>1</b> ±0.50% Full Scale (B.F.S.L) – STD on 100/200 Series Transducers <b>2</b> ±0.25% Full Scale (STD on 615) – Optional on 100/200 Series Transducers <b>3</b> ±0.125% Full Scale – Option for 615 Series Transducer		
<b>OUTPUT SIGNAL</b>	<b>1</b> 4mA to 20mA, 2-wire	<b>3</b> 1Vdc to 5Vdc, 3-wire	<b>5</b> 0Vdc to 10Vdc, 3-wire
	<b>2</b> 0Vdc to 5Vdc, 3-wire	<b>4</b> 1Vdc to 6Vdc, 3-wire	<b>6</b> 1Vdc to 11Vdc, 3-wire
<b>ELECTRICAL CONNECTION</b>	<b>1</b> 36" cable attached to option 7 or 8 <b>3</b> 6-pin Bendix <b>6</b> 1/2" NPT conduit with 36" cable <b>7</b> Mini-Hirschmann (DIN 43650C) <b>8</b> Hirschmann (DIN 43650A) <b>14</b> Hirschmann type with 1/2" NPT female conduit <b>23</b> Cable gland with internal junction box <b>25</b> M12 X 1 4-pin <b>29</b> 1/2" NPT female conduit with internal junction box <b>1800</b> Attachable Loop Powered Indicator (w/615 Transducer Only)		
<b>CONNECTION TYPE FROM LOAD CELL TO PRESSURE MEASURING INSTRUMENT</b>			
<b>CONNECTING LINE</b>	<b>1</b> Direct Connection	<b>2</b> Flexible Tubing (Specify Length)	<b>3</b> Capillary Tube (Specify length)

*See Pages 14 thru 22 for Specifications,  
Dimension Drawings and Installation  
Examples*



NOSHOK Series 4000 hydraulic load cells have been engineered and constructed for superior performance in level measurement, rope and belt tension and torque measurement, bearing support forces on lifting equipment and other compression force measurement applications .

The Series 4000 housing is an extremely rugged galvanized and chrome plated steel, with a high grade stainless steel piston that provides exceptional durability and extended service life. A high quality NOSHOK pressure measuring instrument is directly mounted to the load cell for precise measurement indication. The pressure gauge is available in the 400/500 series all stainless steel model in dry or liquid filled form or the proven 901 Series with stainless steel housing, brass internals and liquid fill. The 100, 200 or 615 Series transducer provide the highest quality form of electronic measurement utilizing advanced diffused semiconductor or proven sputtered thin film sensor technology for maximum stability.

A variety of rigid, flexible and capillary tubing is available in several lengths to suit most installation requirements for remote mounting of the gauge or transmitter.

**FEATURES**

- Various measuring ranges from 2,200lbs-force to 220,000lbs-force suit most applications
- Galvanized and chrome plated steel housing with high grade stainless steel piston provide exceptional durability and extended service life
- Rigid, flexible or capillary tubing connections combine versatility and strength to meet demanding installation needs
- Accuracy ranges are from ±0.125% Full Scale (Best Fit Straight Line) to ±1.5% Full Scale depending upon the measuring device
- Various output signals available in transducer models that are CE compliant
- Exclusive NOSHOK 3 year extended warranty on 500 Series gauges and all transducer models

**Applications**

- Weight and Level Measurement:  
Content indication based on weight measurement for vertical and horizontal tanks and bulk containers
- Measurement of bearing and support forces for bridges, supporting framework and lifting gear
- Load measurement under railroad tracks
- Monitoring contents of bunkers and silos

<b>Series 4000 Hydraulic Load Cell Specification</b>	
<b>Nominal Diameter</b>	ND100
<b>Load Cell Housing</b>	Galvanized and chrome plated steel
<b>Piston</b>	100cm <sup>2</sup> High grade stainless steel
<b>Diaphragm</b>	Rubber
<b>Connecting Line</b> Standard Lengths: 1m, 2m, 3m, 4m, 6m Maximum: 16m	Rigid right angle tube, zinc plated and chromated steel Rigid angled tube, zinc plated and chromated steel Flexible tubing with 7mm diameter spiral steel jacket Flexible tubing with 7mm diameter spiral steel jacket and polyethylene jacket Capillary restrictor Bend with glands on the load cell
<b>Mounting</b>	Threaded borings in base of case – STD Square flange fastening - Optional
<b>Fill Fluid</b>	Glycerine Others Available Upon Request
<b>Accessories</b>	Ball and socket Round form load plate
<b>Operating Temp.</b>	-13°F to 194°F (-25°C to 90°C)
<b>Ambient Temp.</b>	-13°F to 194°F (-25°C to 90°C)

STANDARD ORDERING INFORMATION			
<b>LOAD CELL</b>	4100 Standard Design		
<b>MEASURING RANGE</b>	45F 45 tons-force (short ton)	75F 75 tons-force (short ton)	110F 110 tons-force (short ton)
<b>MEASURING INSTRUMENT</b>	40-400 4 Inch Pressure Gauge 100 Series 100 Transducer	60-400 6 Inch Pressure Gauge 200 Series 200 Transducer	615 Series 615 Transducer

*Other piston diameters and ranges available on special request*

**EXAMPLE**

**Load Cell** ..... Series 4000 standard load cell  
**Measuring Range** ..... 75 tons-force (short tons)  
**Measuring Instrument** ..... 615 Series transducer  
**Options (XXX – X)** ..... Choose from options listed below, from appropriate table, to complete order selection

OPTIONS for LOAD CELL WITH PRESSURE GAUGE			
<b>GAUGE FILL FLUID</b>	0 None	1 Glycerine	2 Silicone
<b>GAUGE OPTIONS</b>	0 None	1 Maximum Indicating Pointer	2 Set Pointer (Panel Mounting Features Available for Remote Installation – Please Consult Factory)
OPTIONS for LOAD CELL WITH PRESSURE TRANSDUCER			
<b>ACCURACY</b>	1 ±0.50% Full Scale (B.F.S.L) – STD on 100/200 Series Transducers 2 ±0.25% Full Scale (STD on 615) – Optional on 100/200 Series Transducers 3 ±0.125% Full Scale – Option for 615 Series Transducer		
<b>OUTPUT SIGNAL</b>	1 4mA to 20mA, 2-wire	3 1Vdc to 5Vdc, 3-wire	5 0Vdc to 10Vdc, 3-wire
	2 0Vdc to 5Vdc, 3-wire	4 1Vdc to 6Vdc, 3-wire	6 1Vdc to 11Vdc, 3-wire
<b>ELECTRICAL CONNECTION</b>	1 36" cable attached to option 7 or 8 3 6-pin Bendix 6 1/2" NPT conduit with 36" cable 7 Mini-Hirschmann (DIN 43650C) 8 Hirschmann (DIN 43650A)	14 Hirschmann type with 1/2" NPT female conduit 23 Cable gland with internal junction box 25 M12 X 1 4-pin 29 1/2" NPT female conduit with internal junction box	1800 Attachable Loop Powered Indicator (w/615 Transducer Only)
CONNECTION TYPE FROM LOAD CELL TO PRESSURE MEASURING INSTRUMENT			
<b>CONNECTING LINE:</b> 1m, 2m, 3m, 4m, 6m Maximum: 16m	1 Rigid Right Angle 2 Rigid Angled Tube 3 Capillary Tubing	4 Flexible Tubing with 7mm spiral steel jacket 5 Flexible Tubing with Spiral Steel Jacket and Polyethylene Jacket	

*See Pages 14 thru 22 for Specifications, Dimension Drawings and Installation Examples*



NOSHOK Series 5000 hydraulic load cells are designed in a distinctive ring shaped form to provide superior performance in compression or tension force measurement applications such as injection molding machine screws, tailstock spindles, propeller shafts, rope and torque measurement and more.

The Series 5000 housing and piston are constructed from a high grade stainless steel that provides exceptional durability and corrosion resistance while contributing to the extended service life of the load cell. A high quality NOSHOK pressure measuring instrument is directly mounted to the load cell for precise measurement indication. The pressure gauge is available in the 400/500 series all stainless steel model in dry or liquid filled form or the proven 901 Series with stainless steel housing, brass internals and liquid fill. The 100, 200 or 615 Series transducer provide the highest quality form of electronic measurement utilizing advanced diffused semiconductor or proven sputtered thin film sensor technology for maximum stability. A variety of rigid, flexible and capillary tubing is available in several lengths to suit most installation requirements for remote mounting of the gauge or transducer.

**FEATURES**

- Various measuring ranges from 3800lbs-force to 250,000lbs-force suit most applications
- High grade stainless steel housing and piston provide exceptional durability and extended service life
- Rigid, flexible or capillary tubing connections combine versatility and strength to meet demanding installation needs
- Accuracy ranges are from  $\pm 0.125\%$  Full Scale (Best Fit Straight Line) to  $\pm 1.5\%$  full scale
- Various output signals available in transducer models that are CE compliant
- Exclusive NOSHOK 3 year extended warranty on 500 Series gauges and all transducer models

**Applications**

- **Material Handling and Hoisting Technology:**  
Measurement of tension force in cables and ropes on brown coal excavators and supervision of steel rope tension on cable railway
- Adjustment and monitoring of compression forces at rolling frames. Mounted underneath the screw-down gear of the roller bearing
- Adjustment and monitoring at turning, milling and deep-hole boring machines. Forward feed force measurement and overload detection (i.e. at tool breakage)
- Rock thrust measurement in fore poles in mines and tunnel construction

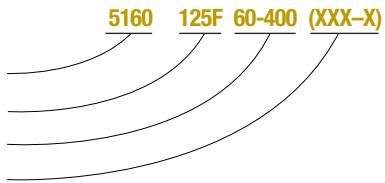
<b>Series 5000 Hydraulic Load Cell Specification</b>	
<b>Nominal Diameter</b>	ND160
<b>Load Cell Housing</b>	160cm <sup>2</sup> High grade stainless steel
<b>Piston</b>	High grade stainless steel
<b>Connecting Line</b> Standard Lengths: 1m, 2m, 3m, 4m, 6m Maximum: 16m	Rigid right angle tube, zinc plated and chromated steel Rigid angled tube, zinc plated and chromated steel Flexible tubing with 7mm diameter spiral steel jacket Flexible tubing with 7mm diameter spiral steel jacket and polyethylene jacket Capillary restrictor Bend with glands on the load cell
<b>Mounting</b>	Threaded borings in base of case – STD
<b>Fill Fluid</b>	Glycerine Others Available Upon Request
<b>Accessories</b>	Ball and socket Round form load plate
<b>Operating Temp.</b>	-13°F to 194°F (-25°C to 90°C)
<b>Ambient Temp.</b>	-13°F to 194°F (-25°C to 90°C)

STANDARD ORDERING INFORMATION				
<b>LOAD CELL</b>	5160 Ring Design			
<b>MEASURING RANGE</b>	38F 38 tons-force (short tons)	75F 75 tons-force (short tons)	125F 125 tons-force (short tons)	
<b>MEASURING INSTRUMENT</b>	40-400 4 Inch Pressure Gauge 100 Series 100 Transducer	60-400 6 Inch Pressure Gauge 200 Series 200 Transducer	615 Series 615 Transducer	

*Other piston diameters and ranges available on special request*

**EXAMPLE**

**Load Cell** . . . . . Series 5000 standard load cell  
**Measuring Range** . . . . . 125 tons-force (short tons)  
**Measuring Instrument** . . . . . 6 inch pressure gauge  
**Options (XXX-X)** . . . . . Choose from options listed below,  
 from appropriate table,  
 to complete order selection



OPTIONS for LOAD CELL WITH PRESSURE GAUGE			
<b>GAUGE FILL FLUID</b>	0 None	1 Glycerine	2 Silicone
<b>GAUGE OPTIONS</b>	0 None	1 Maximum Indicating Pointer	2 Rubber Case Protector
(Panel Mounting Features Available for Remote Installation – Please Consult Factory)			

OPTIONS for LOAD CELL WITH PRESSURE TRANSDUCER			
<b>ACCURACY</b>	1 ±0.50% Full Scale (B.F.S.L.) – STD on 100/200 Series Transducers		
	2 ±0.25% Full Scale (STD on 615) – Optional on 100/200 Series Transducers		
	3 ±0.125% Full Scale – Option for 615 Series Transducer		
<b>OUTPUT SIGNAL</b>	1 4mA to 20mA, 2-wire	3 1Vdc to 5Vdc, 3-wire	5 0Vdc to 10Vdc, 3-wire
	2 0Vdc to 5Vdc, 3-wire	4 1Vdc to 6Vdc, 3-wire	6 1Vdc to 11Vdc, 3-wire
<b>ELECTRICAL CONNECTION</b>	1 36" cable attached to option 7 or 8	14 Hirschmann type with 1/2" NPT female conduit	
	3 6-pin Bendix	23 Cable gland with internal junction box	
	6 1/2" NPT conduit with 36" cable	25 M12 X 1 4-pin	
	7 Mini-Hirschmann (DIN 43650C)	29 1/2" NPT female conduit with internal junction box	
	8 Hirschmann (DIN 43650A)		
	1800 Attachable Loop Powered Indicator (w/615 Transducer Only)		

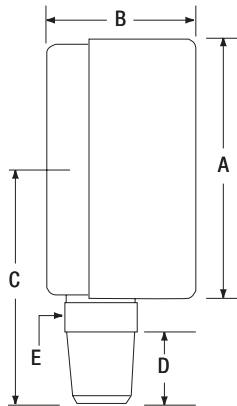
CONNECTION TYPE FROM LOAD CELL TO PRESSURE MEASURING INSTRUMENT			
<b>CONNECTING LINE:</b> 1m, 2m, 3m, 4m, 6m Maximum: 16m	1 Rigid Right Angle	4 Flexible Tubing with 7mm spiral steel jacket	
	2 Rigid Angled Tube	5 Flexible Tubing with Spiral Steel Jacket and Polyethylene Jacket	
	3 Capillary Tubing		

*See Pages 14 thru 22 for Specifications,  
Dimension Drawings and Installation  
Examples*

# Pressure Measuring Instrument Specifications

	<b>25-300 SERIES</b>	<b>40-901 SERIES</b>
<b>Gauge Housing</b>	2 1/2 inch one-piece, die cast brass	4" SS Housing, Dry or Liquid Filled
<b>Cover Ring or Bayonet Ring</b>	Brass Cover Ring – STD Panel Mount Options Available for Remote Installation	Stainless steel bayonet ring – STD Panel Mount Options Available for Remote Installation
<b>Lens</b>	Plexiglass	Instrument Glass
<b>Accuracy</b>	±1.5% full scale, ASME Grade A	±1% full scale ASME Grade IA
<b>Safety Relief</b>	Safety relief disc on top of case	Safety relief disc on top of case
<b>Pointer</b>	Balanced aluminum, black finish	Balanced aluminum, black finish
<b>Dial</b>	Aluminum, white finish with black markings	Aluminum, white finish with black markings
<b>Fill Fluid</b>	Glycerine Others Available Upon Request	Glycerine Others Available Upon Request
<b>Operating Temp.</b>	14°F to 122°F (-10°C to 50°C)	14°F to 122°F (-10°C to 50°C)
<b>Ambient Temp.</b>	-4°F to 140°F (-20°C to 60°C)	-4°F to 140°F (-20°C to 60°C)

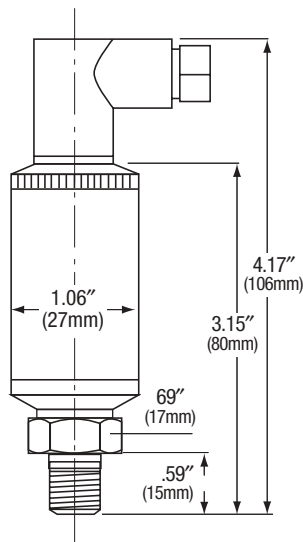
	<b>60-400 SERIES All SS PRESSURE GAUGE</b>	<b>60-500 SERIES ALL SS PRESSURE GAUGE</b>
<b>Gauge Housing</b>	6 Inch 304SS	6 Inch 304SS
<b>Bayonet Ring</b>	Polished stainless steel bayonet ring	Polished stainless steel bayonet ring
<b>Lens</b>	Laminated Safety Glass	Laminated Safety Glass
<b>Accuracy</b>	±1% full scale, ANSI Grade 1A	±1% full scale, ANSI Grade 1A
<b>Safety Relief</b>	Safety relief disc on top of case	Safety relief disc on top of case
<b>Pointer</b>	Balanced aluminum, black finish	Balanced aluminum, black finish
<b>Dial</b>	Aluminum, white finish with black markings	Aluminum, white finish with black markings
<b>Fill Fluid</b>	None – Dry Case Gauge	Glycerine Others Available Upon Request
<b>Operating Temp.</b>	14°F to 122°F (-10°C to 50°C)	14°F to 122°F (-10°C to 50°C)
<b>Ambient Temp.</b>	-40°F to 260°F (-40°C to 127°C)	0°F to 160°F (-18°C to 71°C)



Series		A	B	C	D	E
25-300	in	2.48	1.34	2.13	0.55	0.55
	mm	63.0	34.0	54.0	14.0	14.0
40-901	in	3.98	2.01	3.43	0.55	0.87
	mm	101.0	51.0	87.0	14.0	22.0
60-400/ 60-500	in	6.30	2.36	4.65	0.79	0.87
	mm	160.0	60.0	118.0	20.0	22.0

# Pressure Measuring Instrument Specifications

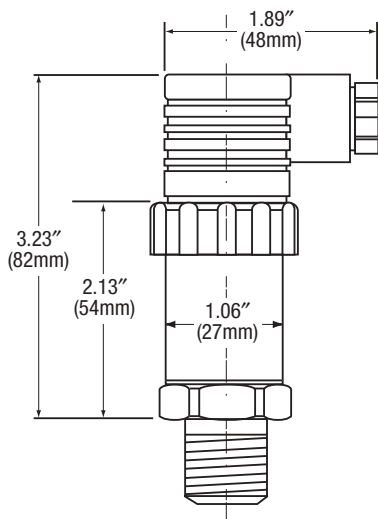
		<b>100 and 200 SERIES TRANSDUCER SPECIFICATIONS</b>	
<b>Output Signal:</b>	<b>100 Series</b> <b>200 Series</b>	4mA to 20mA, 2-wire 0Vdc to 5Vdc, 0Vdc to 10Vdc, 1Vdc to 5Vdc, 1Vdc to 6Vdc, 1Vdc to 11Vdc, 3-wire	
<b>Accuracy</b>		±0.5% Full Scale (B.F.S.L.) – STD Includes the combined effects of linearity, hysteresis and repeatability ±0.25% Full Scale – Optional	
<b>Repeatability</b>		≤±0.05% Full Scale	
<b>Hysteresis</b>		≤±0.1% Full Scale	
<b>Stability</b>		≤±0.2% Full Scale for 1 year, non accumulating	
<b>Power Supply</b>		10Vdc to 30Vdc, 4mA to 20mA, 0Vdc to 5Vdc, 1Vdc to 5Vdc and 1Vdc to 6Vdc 14Vdc to 30Vdc for 1Vdc to 11Vdc and 0Vdc to 10Vdc unregulated	
<b>Load Limitations:</b>	<b>100 Series</b> <b>200 Series</b>	≤(Vpower supply – 10)/.020 Amp for 100 Series ≥ 10,000 Ω for 0Vdc to 10Vdc, 3-wire and 1Vdc to 11Vdc outputs ≥ 5,000 Ω for 0Vdc to 5Vdc, 3-wire, 1Vdc to 5Vdc and 1Vdc to 6Vdc outputs. Current consumption 8mA	
<b>Housing Material</b>		316 stainless steel	
<b>Temperature Ranges</b>		Compensated 32° F to 176° F/0° C to 80° C Effect ±0.017% Full Scale/°F for zero and span Storage -40° F to 212° F/-40° C to 100° C	Medium -22° F to 212°F/-30° C to 100°C Ambient -40° F to 185° F/-10°C to 85° C
<b>Adjustment</b>		±10% Full scale for zero and span	
<b>Environmental Rating</b>		NEMA 4X, IP65 (IEC 529)	
<b>Electromagnetic Rating</b>		CE compliant to EMC norm EN61326: 1997/A1: 1998 RFI,EMI,ESD protection	
<b>Electrical Protection</b>		Reverse Polarity, over-voltage and short circuit protection	
<b>Shock</b>		1000 g's per IEC 770	
<b>Vibration</b>		30 g's per IEC 770	



<b>100 Series Wiring Diagram</b>				
	<b>Mini-Hirschmann</b>	<b>Cable</b>	<b>M12</b>	<b>Bendix 6-pin</b>
+ Supply	1	Red	1	A
+ Output	2	Black	3	B
<b>200 Series Wiring Diagram</b>				
	<b>Mini-Hirschmann</b>	<b>Cable</b>	<b>M12</b>	<b>Bendix 4-pin or 6-pin</b>
+ Supply	1	Red	1	A
+ Output	3	White	4	C
Common	2	Black	3	B

# Pressure Measuring Instrument Specifications

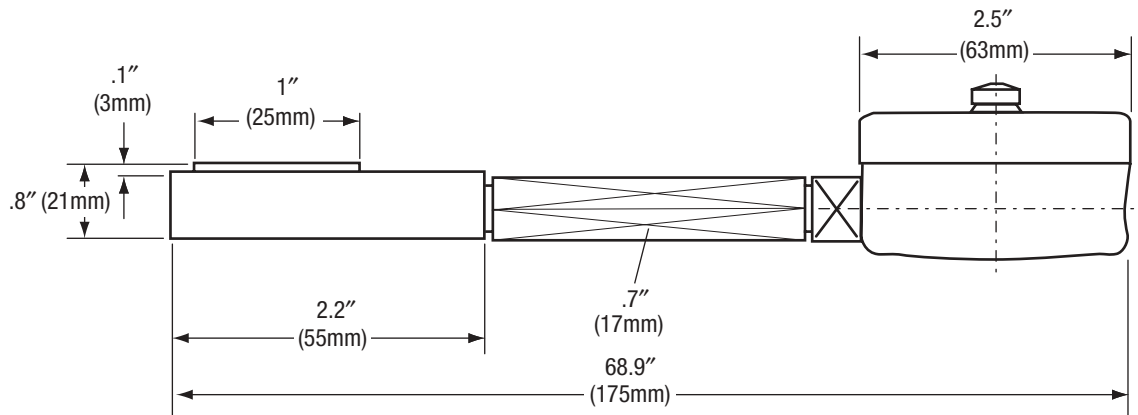
<b>615 SERIES TRANSDUCER SPECIFICATIONS</b>	
<b>Output Signal:</b>	615 Series 4mA to 20mA, 2-wire 0Vdc to 5Vdc, 0Vdc to 10Vdc, 1Vdc to 5Vdc, 1Vdc to 6Vdc, 1Vdc to 11Vdc, 3-wire
<b>Accuracy</b>	±0.25% Full Scale (B.F.S.L) – STD Includes the combined effects of linearity, hysteresis and repeatability ±0.125% Full Scale – Optional
<b>Repeatability</b>	≤±0.05% Full Scale
<b>Hysteresis</b>	≤±0.1% Full Scale
<b>Stability</b>	≤±0.2% Full Scale for 1 year, non accumulating
<b>Power Supply</b>	10Vdc to 30Vdc, 4mA to 20mA, 0Vdc to 5Vdc, 1Vdc to 5Vdc and 1Vdc to 6Vdc 14Vdc to 30Vdc for 1Vdc to 11Vdc and 0Vdc to 10Vdc unregulated
<b>Load Limitations</b>	≤ (Vpower supply – 10)/.020 Amp for 100 Series ≥ 10,000 Ω for 0Vdc to 10Vdc, 3-wire and 1Vdc to 11Vdc outputs ≥ 5,000 Ω for 0Vdc to 5Vdc, 3-wire, 1Vdc to 5Vdc and 1Vdc to 6Vdc outputs. Current consumption 8mA
<b>Housing Material</b>	316 stainless steel
<b>Temperature Ranges</b>	Compensated 32° F to 175° F/0° C to 80° C Effect ±0.01%/°F for zero and span Storage -40° F to 212° F/-40° C to 100° C Medium -20° F to 212°F/-30° C to 100° C Ambient -15° F to 175° F/-10° C to 80° C
<b>Adjustment</b>	±10% Full scale for zero and span
<b>Environmental Rating</b>	NEMA 4X, IP65 (IEC 529)
<b>Electromagnetic Rating</b>	CE compliant to EMC norm EN61326: 1997/A1: 1998 RFI,EMI,ESD protection
<b>Electrical Protection</b>	Reverse Polarity, over-voltage and short circuit protection
<b>Shock</b>	Less than ±0.05% Full Scale effect or 1000 g's @ 20 ms on any axis
<b>Vibration</b>	Less than ±0.01% Full Scale effect or 15 g's @ 0 Hz to 2000 Hz on any axis



<b>Current 2-Wire Wiring Diagram</b>					
	Hirschmann	Cable	M12	Bendix 6-Pin	Internal Junction Box
+ Supply	1	Red	1	A	1
+ Output	2	Black	3	B	2
<b>Voltage, 3-Wire Wiring Diagram</b>					
	Hirschmann	Cable	M12	Bendix 6-Pin	Internal Junction Box
+ Supply	1	Red	1	A	1
+ Output	3	White	4	C	3
Common	2	Black	3	B	2

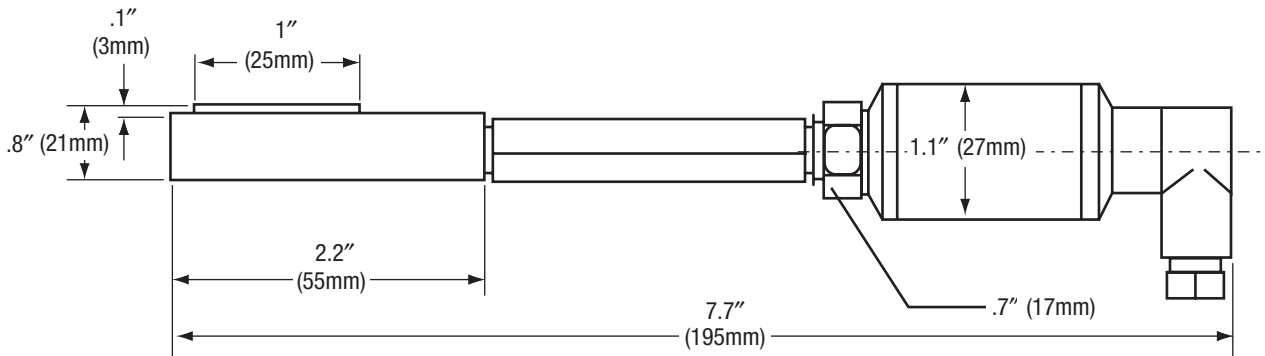
**DIMENSIONS**

Series 1000 with 25-300 Series Pressure Gauge



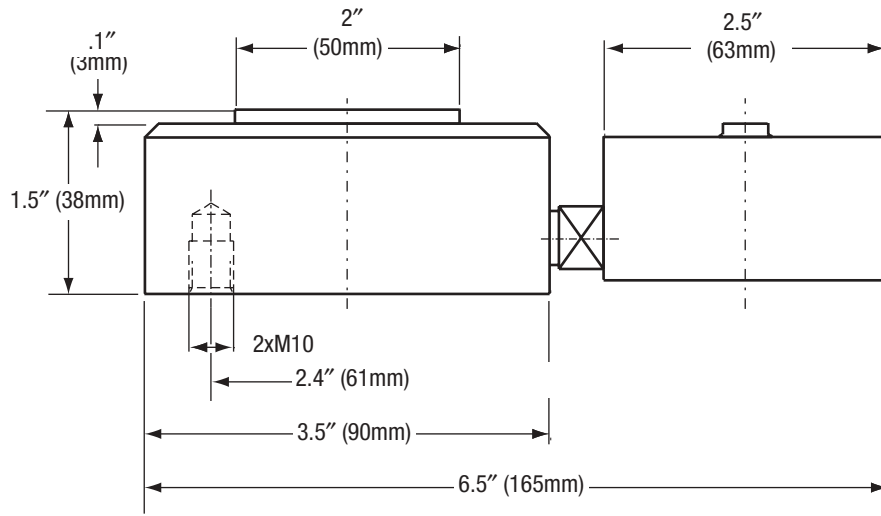
**DIMENSIONS**

Series 1000 with 100/200 Series Transducer



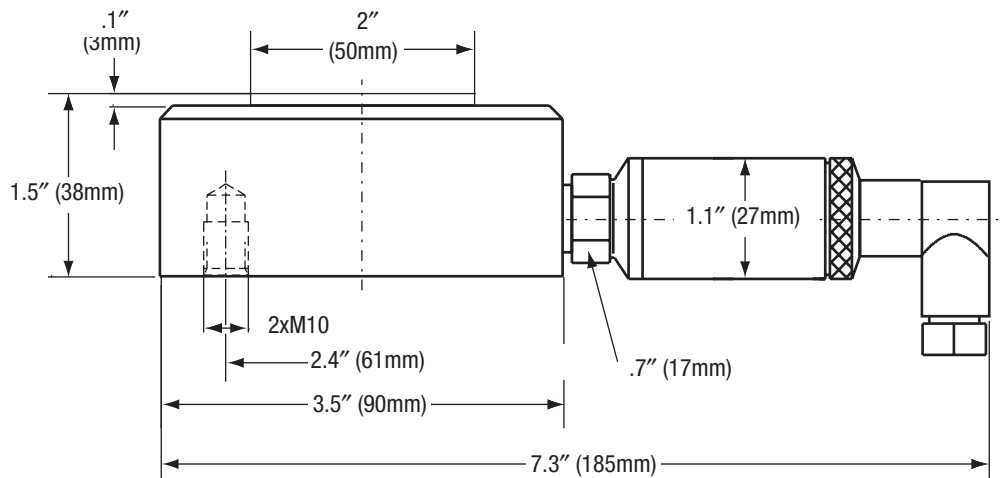
**DIMENSIONS**

Series 2000 with 25-300 Series Pressure Gauge



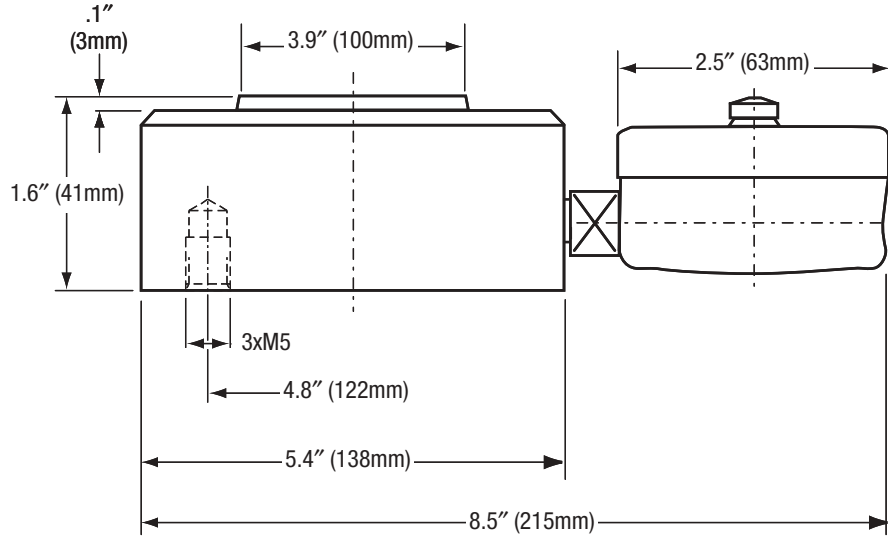
**DIMENSIONS**

Series 2000 with 100/200 Series Transducer



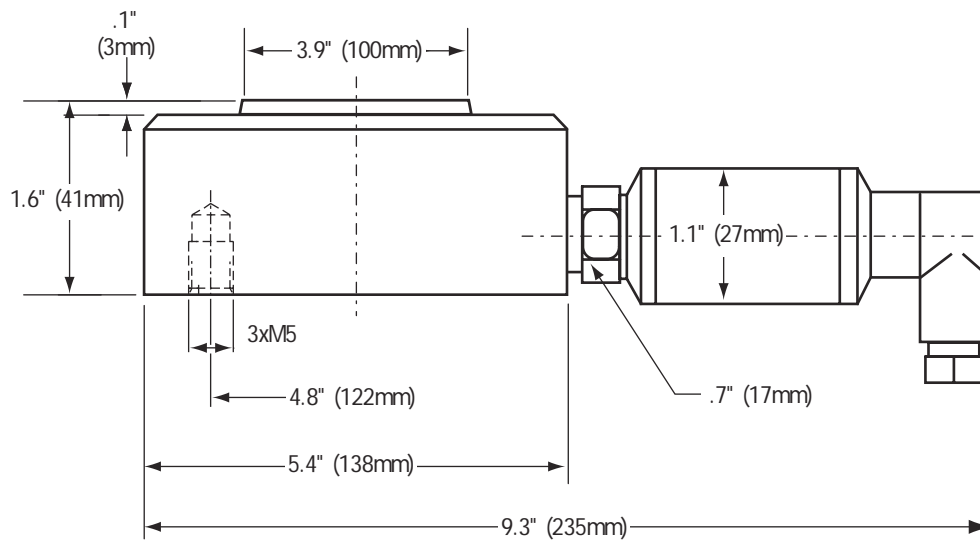
**DIMENSIONS**

Series 3000 with 25-300 Series Pressure Gauge



**DIMENSIONS**

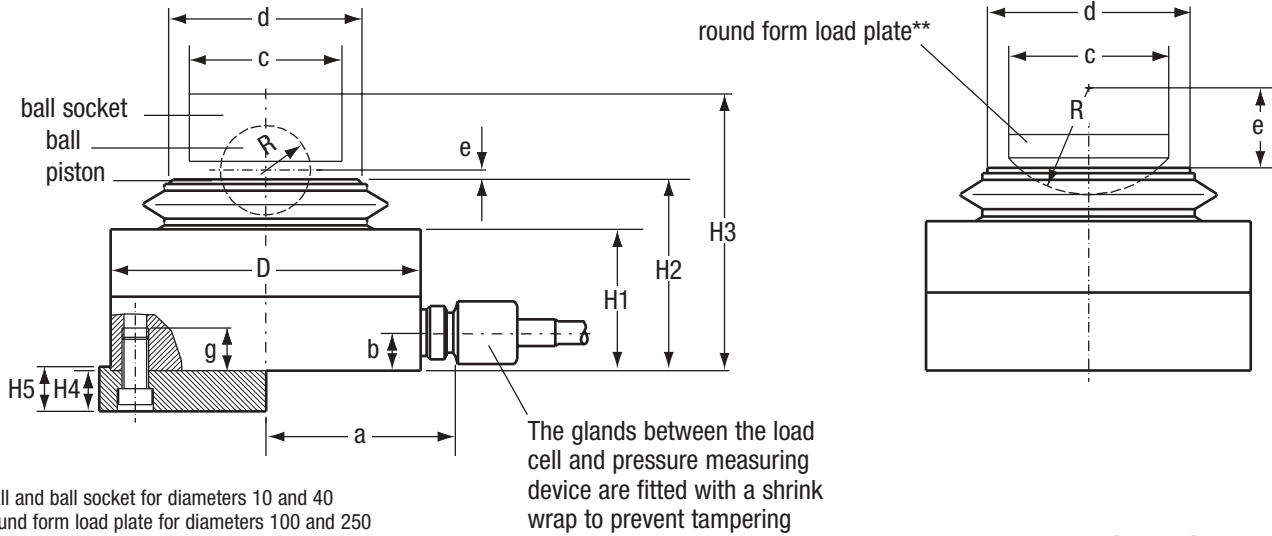
Series 3000 with 100/200 Series Transducer



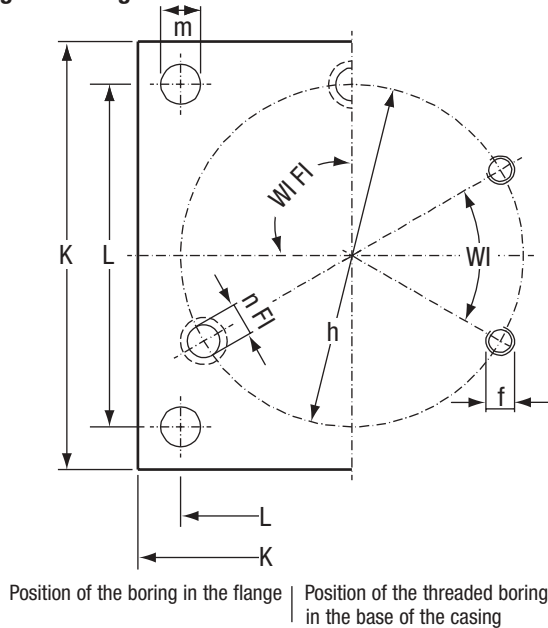
# SERIES 4000/5000

## Load Cell Dimensions and Installation Examples

### 4000 Series Load cell



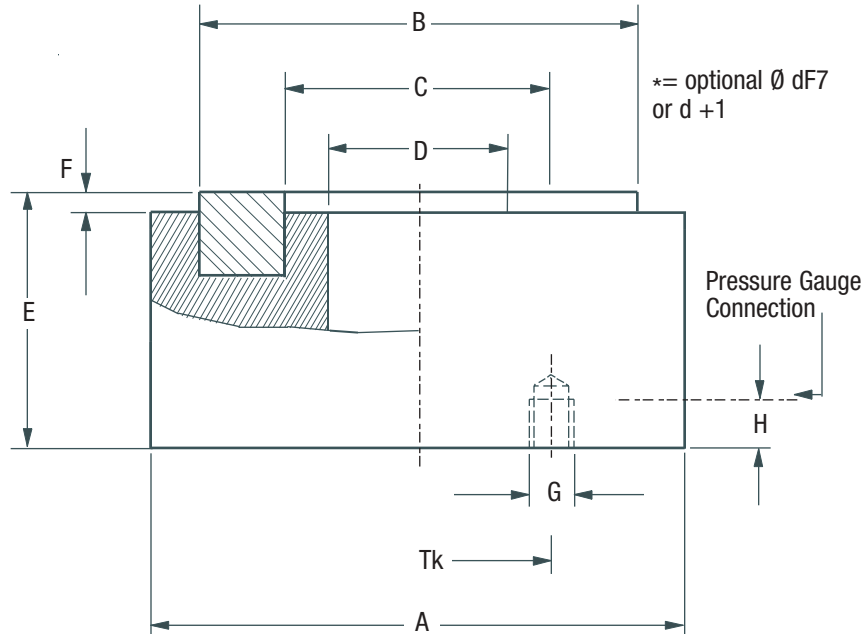
### 4000 Series Flange fastening



### Dimensions

	mm	inches
Dim.	100	3.9
a	109	4.3
b	17	.7
c	76	3
d	128	5
D	192	7.6
R	45	1.8
e	33.5	1.3
f	M 12	
g	17	.7
h	165	6.5
n	6	.2
H1	72	2.8
H2	98.5	3.9
H3	117.8	4.6
WI	60°	60°
H4	18	.7
H5	20	.8
L	200	7.9
l	160	6.3
m	14	.6
n fl.	6	.2
WI. fl.	60°	60°

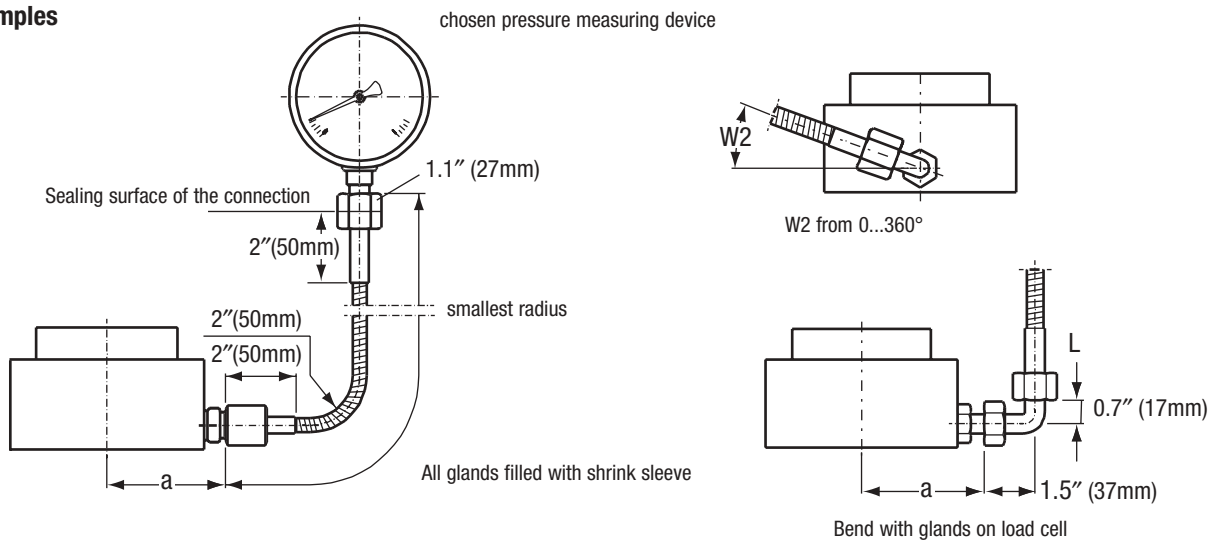
**5000 Series Load Cell**



Load cell	size	A	B	C	D	Tk	G	E	F	H
ND 160	(mm)	210	180	120	100	170	4xM10	70	5	22.5
	inches	8.3	7.1	4.7	3.9	6.7	4xM10	2.8	.2	.9

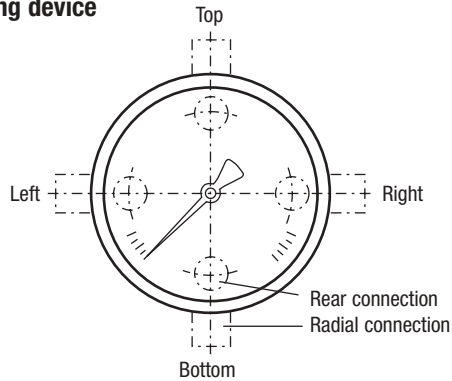
**Installation examples**

**A: Flexible tube**

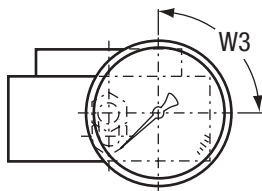


### Installation examples

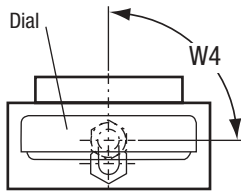
#### B: Rigid tube with pressure gauge as measuring device



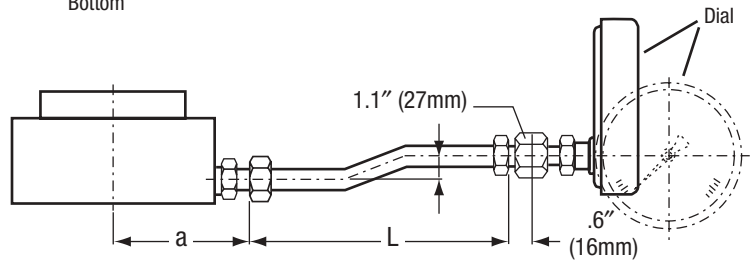
#### C: Rigid tube with angled bend



Pressure gauge, rear connection  
W3 from 0...360°

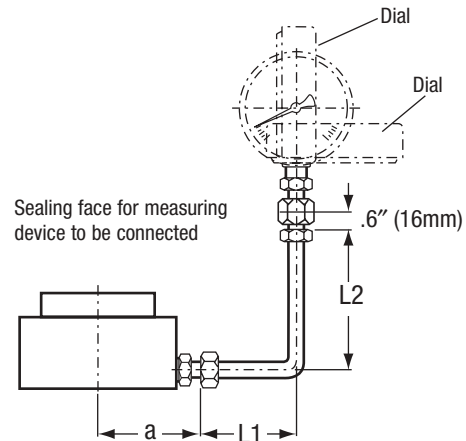


Pressure gauge, radial connection  
W4 from 0...360°



L as desired 3.9"–9.8"  
(100–250mm)

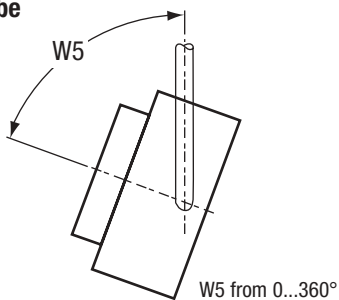
Sealing surface for pressure measuring device



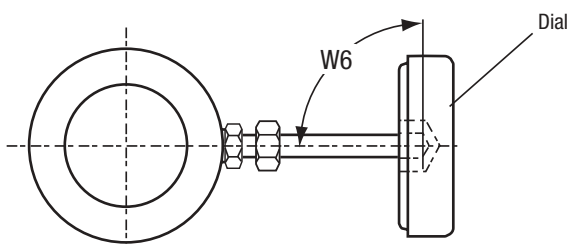
L1 and L2 as desired 2.4"–9.8"  
(60–250mm)

Sealing face for measuring device to be connected

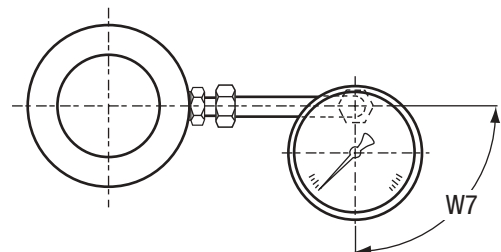
#### D: Rigid angled tube



W5 from 0...360°



Pressure gauge, radial connection, W6 from 0...360°



Pressure gauge, rear connection, W7 from 0...360°

# NOSHOK Hydraulic Load Cell

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NOSHOK hydraulic load cells measure force in a direct, simple and cost effective manner without the need for an external power source. The load cells are available in a variety of shapes and sizes with standard measuring ranges suited for most force applications.

Regardless of the external dimensions of the unit, NOSHOK hydraulic load cells operate under the hydraulic principle. The load, when applied to the surface area of the piston, causes a pressure increase in the hydraulic fluid and from there is transferred to the attached high quality NOSHOK pressure gauge or transducer for measurement indication. They are designed for static and quasi static loads (i.e. the rise time of the force should not exceed 1 second, since faster changes in force could damage the attached gauge). Capillary restrictors are available to dampen pressure spikes generated by loading and unloading the load cell. NOSHOK load cells can be used for weight measurement or force measurement.

Mounting conditions of the load cell does influence the accuracy of the entire unit as well as the service life and reliability. The mounting should always ensure an axial and central introduction of the force to be measured for the highest degree of accuracy. Side forces, bending or torque should be avoided through proper installation to prevent false indications and maintain load cell service life.

NOSHOK hydraulic load cells are manufactured to the highest quality standards proven technologies that require little or no maintenance while providing excellent value. In addition to the outstanding features in the basic design, NOSHOK offers such options as maximum indicating pointers to measure maximum pressure/force loads in the system, attachable loop powered indicators for local indication, custom dials and scales, custom connections including direct connection, flexible and rigid tubing, various fill fluids and more to help provide a complete and suitable package for all of your force measurement needs.

NOSHOK proudly backs its quality with our exclusive 3 year extended warranty on all 100,200 & 615 Series transducers along with the 300 Series liquid filled pressure gauges. Final calibration tests performed on all hydraulic load cells ensuring 100% “out of the box” reliability.

## *Applications for Your NOSHOK Hydraulic Load Cell*

NOSHOK hydraulic load cells have been engineered to meet customers growing demands for a high quality force measurement product in markets such as machine and plant construction, agricultural and construction equipment, welding machines, testing and control equipment and more.

### ■ Material handling and lifting gear

- Bearing and support forces on lifting tools

### ■ Agricultural and construction equipment

- On carriers and presses
- Torque measurement through lifting gears
- Excavators in brown coal mining equipment

### ■ Testing and control equipment

- Clamping force measurement on vices
- Tailstock spindles
- Brake test beds

### ■ Machine construction and operation

- Injection molding machine screws
- Rope and belt tension measurements as well as torque measurements
- Jug and special machine construction

### ■ Weight Measurement and level measurement in bunkers, silos and tanks

### ■ Welding & Printing Machines

- Measuring the force between tongs on spot welding machines
- Control forces between rollers on printing equipment
- Control of pressure stamp



# ADDITIONAL INFORMATION REQUIRED for LEVEL MEASUREMENT

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## Level Measurement:

- Standing/hanging container: (hanging container up to 60 ton total weight)  
The measuring unit is applicable for evenly distributed amounts (liquids)  
The dimensions in the distance have to be equal to each other and equal to the center

- 3 point seating**, shape of container; symmetric

**1 force measuring unit**, 2 fixed bearings  
1/3 is measured  
The indicated value is 3 times the measured value  
**3 force measuring units**  
Values are measured under each container foot

- 3 point seating, shape of container; symmetric**

- 4 point seating**, shape of container; symmetric

**4 measuring units**  
Values are measured under each container foot

**Weight of Container:** \_\_\_\_\_ **Nominal capacity, nominal load:** \_\_\_\_\_

**Filling material:** \_\_\_\_\_ **Weight density:** \_\_\_\_\_

- Lying containers:**  
The measuring unit is applicable for evenly distributed amounts (liquids)  
Important: the containers must have a symmetric shape

- 3 point seating**, shape of container; symmetric

**1 force measuring unit**, 2 fixed bearing  
1/2 is measured  
The load is distributed 50/50

- 4 point seating**, shape of container; symmetric

**4 force measuring units**  
Values are measured under each container foot

**Weight of Container:** \_\_\_\_\_ **Nominal capacity, nominal load:** \_\_\_\_\_

**Filling material:** \_\_\_\_\_ **Weight density:** \_\_\_\_\_

- Standing/lying containers for bulk material:**  
The value indicated is calculated using 3 or 4 measuring values without a fixed bearing. The measuring values are transferred to a processing unit with tara/zero suppression. All load cells are linked to an indicator with the output corresponding to the sum of all measuring values and being displayed

- 3 point seating**

**Container with 3 force measuring units**  
Values are measured under each container foot

- 4 point seating**

**Container with 4 force measuring units**  
Values are measured under each container foot

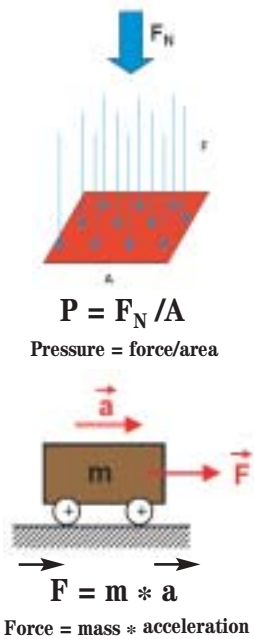
**Weight of Container:** \_\_\_\_\_ **Nominal capacity, nominal load:** \_\_\_\_\_

**Filling material:** \_\_\_\_\_ **Weight density:** \_\_\_\_\_

**Additional features required:** \_\_\_\_\_

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# Reference Material



## DEFINITIONS

**Pressure** – the force acting on a surface divided by the area over which it acts. *Symbol p*

**Force** – a physical influence that tends to change the position of an object with mass, equal to the rate of change in momentum of the object. *Symbol F*; Defined  $F = m \cdot a$

**Area** - the extent of a planar region or of the surface of a solid measured in square units.

**Gravity** – A force attracting massive bodies towards each other that is proportional to the product of their masses and inversely proportional to the square of their separation.

**Newton** - an SI unit of force equivalent to the force that produces an acceleration of one meter per second per second on a mass of one kilogram *Symbol N*

**Ton** - an imperial unit of weight, equal to (2,000 lb) in the United States (a.k.a. *short ton*)

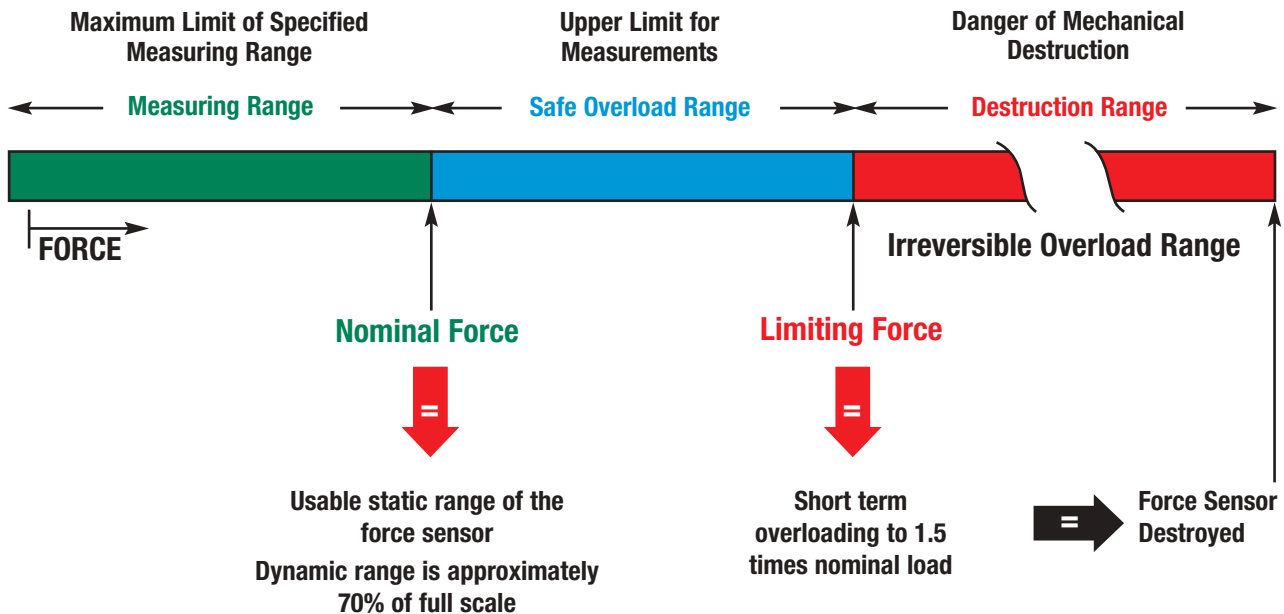
*Metric ton* – a unit of weight equal to 1000 kg

*Long ton* – an imperial unit of weight, equal to 1016 kg (2,240 lb) in the United Kingdom

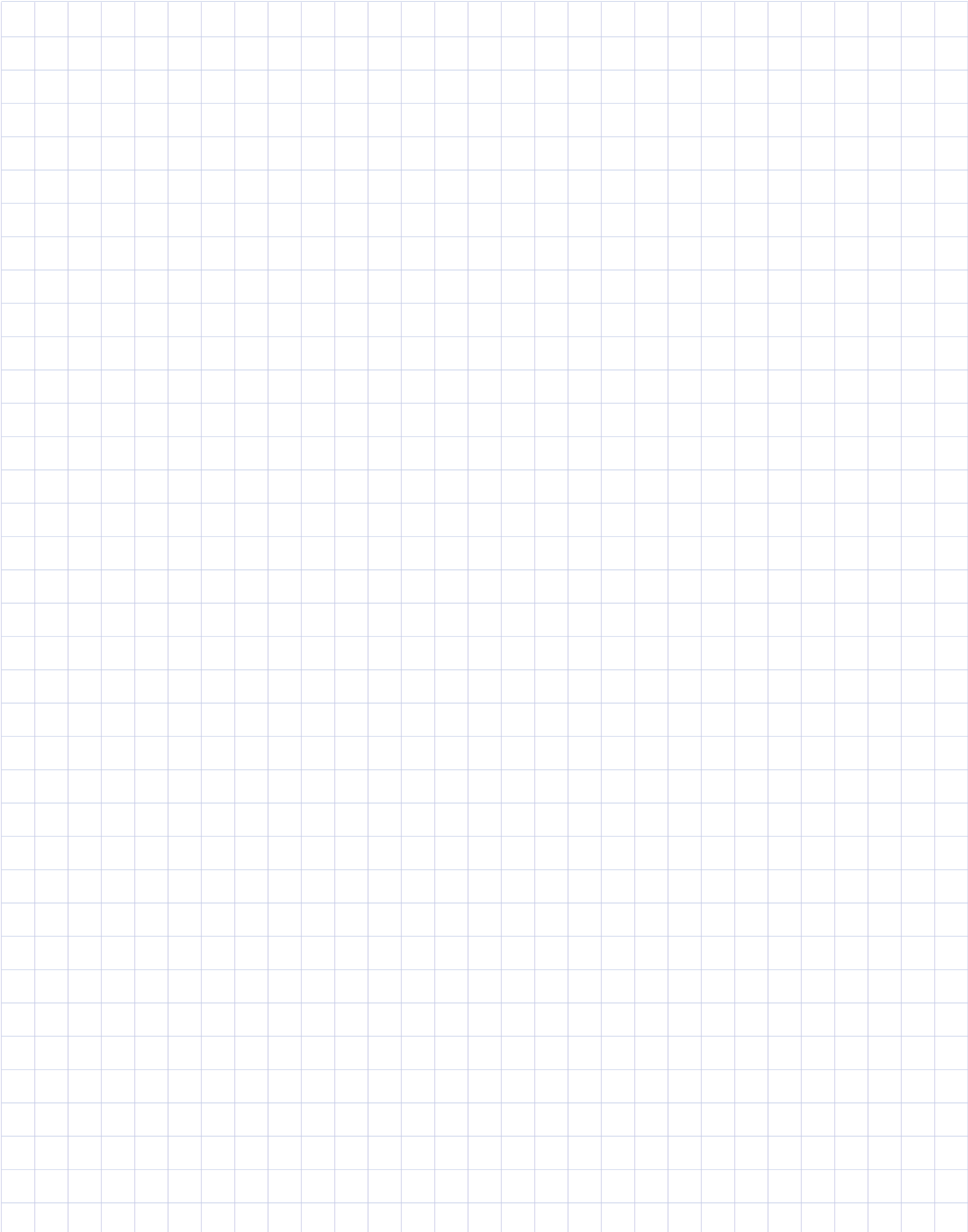
**Nominal Load** – The load/force that the load cell is constructed for

**Nominal Temperature Range** – The temperature range where the measuring instrument complies with its specifications

FORCE UNITS CROSS REFERENCE CHART							
lbs-force	newton	kg-force	kN (kilonewtons)	ounce-force	tons-force (short)	tons-force (long)	tons-force (metric)
<b>1</b>	4.4482	0.4535	0.0044	16.0000	0.0005	0.0004	0.0004
0.2248	<b>1</b>	0.1019	0.001	3.5969	0.0001	0.0001	0.0001
2.2046	9.8066	<b>1</b>	0.0098	35.2739	0.0011	0.0009	0.001
224.8089	1000	101.9716	<b>1</b>	3596.9431	0.1124	0.1003	0.1019
0.0625	0.2780	0.0283	0.0002	<b>1</b>	0.00003	0.00002	0.00002
2000	8896.4432	907.1847	8.8964	32000	<b>1</b>	0.8928	0.9071
2204.6226	9806.65	1000	9.8066	35273.962	1.1023	<b>1</b>	1.0160
2204.6226	9806.65	1000	9.806	35273.962	1.1023	0.9842	<b>1</b>



**Notes**



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