Datum Electronics Ltd

Commercial Marine Torsion Meter

1. INTRODUCTION: Datum Electronics Limited

Company Background

Datum Electronics was established in 1989. The company designs and manufactures Torsion Meter systems, Torque Sensors and other Strain Gauge based Sensors and Instrumentation. Datum's products are utilized for a wide range of applications and industries from university test rigs to shipping, heavy site machinery in steelworks and mining. The company has a wealth of expertise in providing specialist measurement solutions

Datum Electronics Limited major strengths are as a sensor manufacturer with the ability to supply sensor designs to meet a wide range of practical requirements. Synergy between the company's customer requirements has increased the pace at which product development has progressed in all market sectors.

Regarding the Marine Torsionmeters,Datum Electronics Limited have worked in partnership with a number of leading operators and OEM's to produce specific solutions to ongoing requirements. These have included:-

- Specialist Torque Sensors of the test rig applications Kingsbury, Rolls Royce, Rover, Newage, McTaggart Scott.
- Torsional Vibration Sensors for Gearbox Testing for American Axle, Dana, Daimler Chrysler, Honda and Birmingham University.
- Sensors/sensor systems for the heavy vehicle industry customers including John Deere, Caterpillar, Claas, JCB and Leibherr
- We also provide Installation, Support, Repairs at our UK base and also in conjunction with our Authorized Reseller and distributors Worldwide at strategic locations covering/including Korea, China, Australia, USA, and India etc.
- We have our own in house Research and Development function; all products are designed and built by our engineers. We are able to offer manufacturing processes in volume if required alongside more bespoke solutions for product development programs.

Example of a few of our regular customers

2. Commercial Torsion Meter Systems

2.1 Introduction to Torsion Meter systems

The Commercial Torsion Meter Systems have been developed to meet the requirements of the Commercial Marine customers to provide ongoing power monitoring data on ships including; Propulsion, Thruster and even Generator Shafts

The current usage of the systems is to provide data for fuel economy and equipment maintenance planning programs

The system is suitable for all Commercial vessels with single or multiple shaft installations with shaft diameters as standard from 150mm up to 1200mm.

The systems have the capability to provide:-

Displays of Shaft Torque, Speed, Power and Running Hours

Serial Data Outputs: RS485, (NMEA), RS232, Modbus, Ethernet, MAS etc. for the above and System Diagnostics to the Ships Systems

Optional 3 channels of Analogue outputs of Torque Speed and Power e.g. 0-10V

Local Data Output for Trials Logging and On-ship Diagnostics.

A Shaft Power and Torsionmeter System is an essential tool to help in the reduction running costs from:-

1 Fuel Saving
2 Improved Maintenance Scheduling
3 Equipment Protection

The cost of an accurate permanently installed torsionmeter is very small in comparison with potentially large savings in running costs.

Shaft Power Measurement

Shaft Power is an essential Input to Ship Performance Monitoring Systems. The data from monitoring actual power levels provides an accurate reference point to assist with assessing:

- Engine Performance Monitoring
- Hull Condition
- Propeller Condition
- Specific Fuel Consumption
- Operational Efficiency Planning
- Ship Condition Changes

The Torque and Power output from the torsionmeter system is dependent of the calculation utilising constants from the shaft these are:-

Shaft Material – either as shear modulus or Young's modulus and Poisson's ratio

Shaft Diameter – by direct measurement of the Outside Diameter and on hollow shaft also the Inside Diameter

The absolute accuracy of the system is dependent on the accuracy with which the above parameters are provided. The absolute accuracy is quoted at 0.1% + Ke where Ke is the combined error from the shaft constants. Datum Electronics Limited can conduct tests on a sample of the shaft material to determine the shear modulus. 2 samples of shaft material 20mm diameter 150mm long are required for this testing.

2.2 Commercial Torsion Meter System Description

The main objective of a Ships Shaft Power and Torsionmeter is to measure Power.

Power (KW) = Torque (KNm) x Angular Velocity (radians/sec)

or

Power (KW) = Torque (KNm) x Shaft Speed (RPM) x Π/30

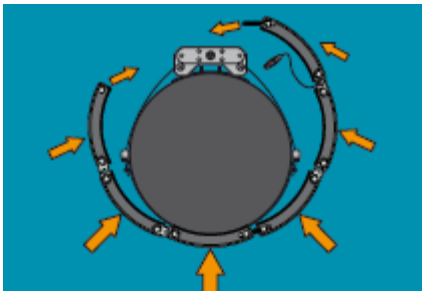
The Torsionmeter measures the shaft Torque and the Shaft RPM and hence the Power transmitted through the shaft

Torque is derived by measuring the torsional strain in the shaft caused by the twisting effect from the drive from the engine and the reaction from its load (the propeller or generator).

Measurement of the torsional strain is achieved by installing strain gauges onto the surface of the shaft. The signals from these strain gauges are amplified, conditioned and calibrated by the Datum Electronics Torsionmeter into accurate units of torque.

The Datum Electronics **Commercial Torsion Meter** system components and **Naval Marine Torsion Meters** complete the entire signal processing on shaft and transmit Serial (digital) data directly from the shaft rotor to the shaft stator. By processing the signals on shaft into a digital format the system eliminates errors from signal noise, signal drift and data transmission. This digital aspect offers a distinct advantage over a number of other manufacturers systems.

The key elements of the Torsionmeter System are:-



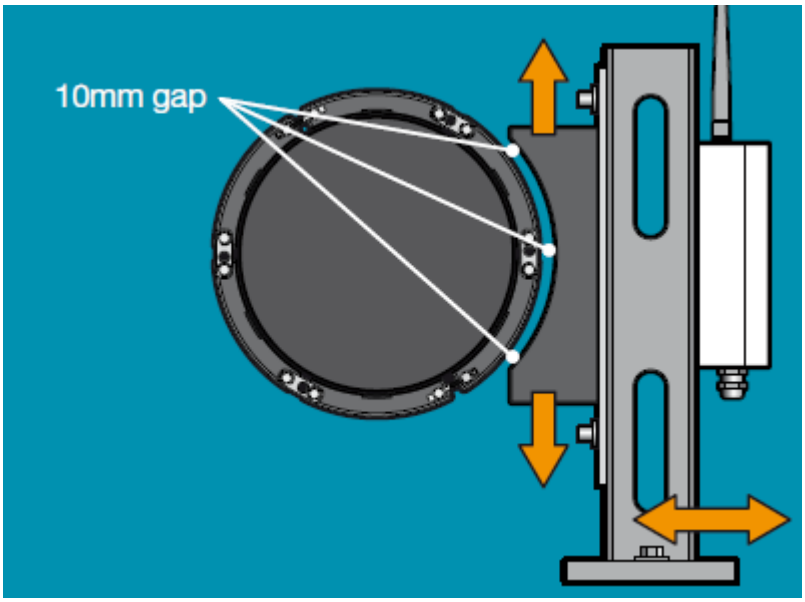
The Strain Gauge Installation
The Rotor Assembly
The Stator Assembly and display/control

THE ROTOR (See right)
The rotor, as described above, transmits the torque data from the strain gauges, it also receives power from the stator assembly and transmits a shaft speed signal to the stator. The assembly is supplied as a complete easy to install unique designed "link" assembly supplied to the nominal diameter of the shaft. The shaft tolerance is catered for within the design of the rotor links.

THE STATOR CONTROLLER UNIT

The stator/control assembly provides power to the rotor assembly and receives the data from the rotor. In the Commercial System the stator is an assembly that is situated next to the rotor.

The stator is supplied as a complete assembly; and is simply bolted into position after location adjacent to the rotor.



NOTE: This "basic" system outputs the following:

OUTPUTS: Torque, shaft RPM. Shaft Power and options for Thrust/Bending

RS485,
RS232,
USB Logging (Memory Stick)
Modbus,
4 channels of Analogues,
Ethernet

Also Optional:

Thrust, Bending and others, please enquire

DATA Rates/Speed

Torque data can be sampled at speeds to 2000 Samples per second as standard if required. Please enquire if fast data is required.

OPTIONAL display assemblies can also display the torque, speed and power data. The control unit and displays can also supply data outputs for remote use such as the ships control systems. From either the menu on the control unit or the data port a full range of built in test functions and system diagnostics functions are available.

OPTIONS:

There are a variety of options for bulkhead and panel mounted displays to be added to a system for placement around a vessel

2.3 Commercial Marine System Technical Specifications

Accuracy

Instrumentation Accuracy

Shaft Torque	0.1%
Shaft RPM	0.1%
Shaft Power	0.1%

System Accuracy

Shaft Torque	0.1% +Ke
Shaft RPM	0.1%
Shaft Power	0.1% +Ke
Ke	Total error in shaft modulus constant and shaft diameter measurement

System Repeatability

Shaft Torque	0.05%
Shaft RPM	0.05%
Shaft Power	0.05%

Data Output and Display

Power, Torque and Speed Display	The display presents average values of torque, speed and power. The time period of this average is set the application and can vary from 1 second to 15 minutes
Total Energy	The total energy is displayed in Joules from the Reset Date to Today. Previous Totals between resets can be accessed through the menu.
Average Power	Average Power for a period between resets is displayed in MW
Power Measurement Data Output	Average Values of Shaft Power, Torque and Speed are transmitted 5 times per second
Dynamic Torque Measurement(optional)	As standard Torque can be transmitted up to 800 times per second – for faster sampling discuss your requirement with sales

Environmental

Operating Temperature	-15ºC to +55ºC
Storage Temperature	-25ºC to +70ºC
Temperature Effect on readings	0.01% per degree centigrade
Instrument Stability/time drift	Less than 0.1% per annum

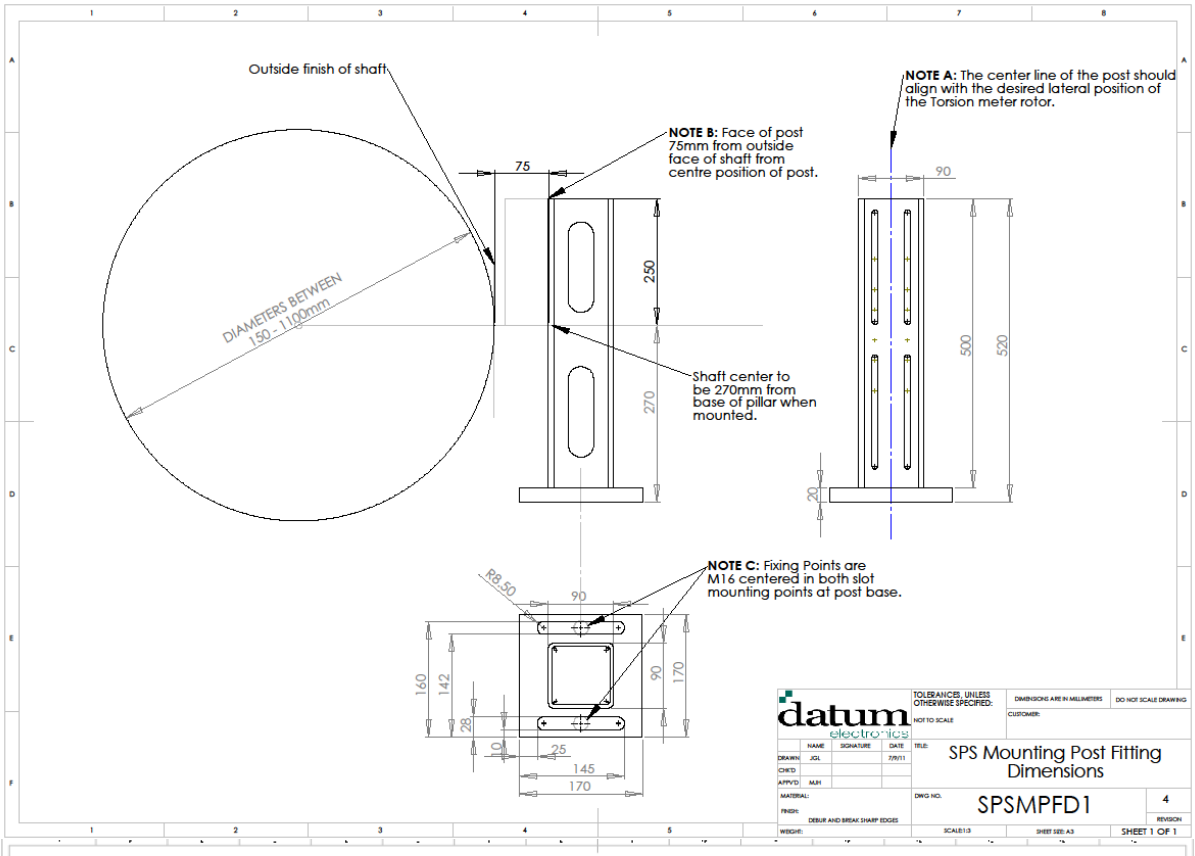
Environmental Sealing

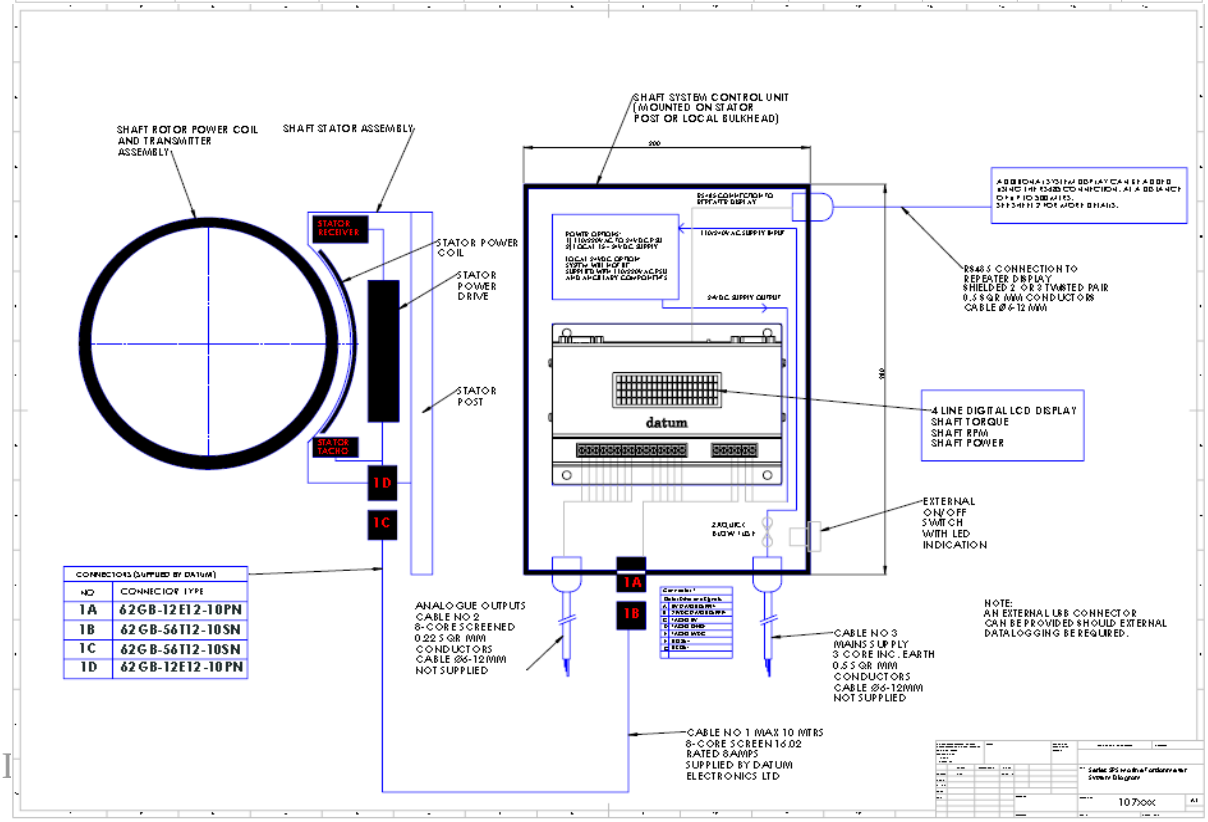
Shaft Unit 106XXX	IP67
Stator Electronics Unit	IP67
Bulkhead Control Unit	IP67
Panel Mounted Display Unit	IP67 from fascia, IP54 from rear of panel
Contamination	All materials and external components used have been tested to DefStan 08-123, contaminants include Diesel oil, Sea water, Hydraulic oil, Gear oil, Grease, Water/antifreeze
Rotor Stator Air Gap	Radial 5-10mm, lateral +/-8mm
Supply Voltage	110-230Vac, III or I, AC, or DC12-24V

Introduction of System to Ship/Shipyard personnel – to cover system operation, principle of operation, built in diagnostics functions and calibration checks.

3. Installation Drawings & Dimensions: See separate drawings if submitted

STATOR POST INSTALLATION





Major Reference/主要客户:

Sea France Flaghsip Ferry Sea France Moliere at Sea,France
SUPER Ice Class Tanker x 3 in Factorias Vulcano, S.A.,Spain
RN ARKHANGELSK x3 in Factorias Vulcano, S.A.,Spain
Sandown & Hunt Class ships in Factorias Vulcano, S.A.Spain
Havyard
Aker
Royal Australian Navy
Korean Navy
Indian Navy
Nottingham University,UK
Jaylor Fabricating Inc.
Sea King Gearbox Test Rig
Hantong Shipyard 64000dwt bulk Carrier x20 pcs, China
Dayang Shipyard 82000dwt bulk Carrier x12 pcs,China

LOGO:

香港海川国际有限公司
HK HAICHUAN IN'L LIMITED
上海市浦东新区浙桥路289号碧云公馆A楼1106室
Rm 1106,Building A, Biyun Mansion, No.289 Zheqiao Road,Pudong,Shanghai
电话: +86 21 61682673　　传真:+86 21 61682675　　邮箱:info@haichuanhk.com
上海办 Shanghai@haichuanhk.com　　武汉办: Wuhan@haichuanhk.com
广州办:Guangzhou@haichuanhk.com　　烟台办 shandong@haichuanhk.com
南京办：nanjing@haichuanhk.com

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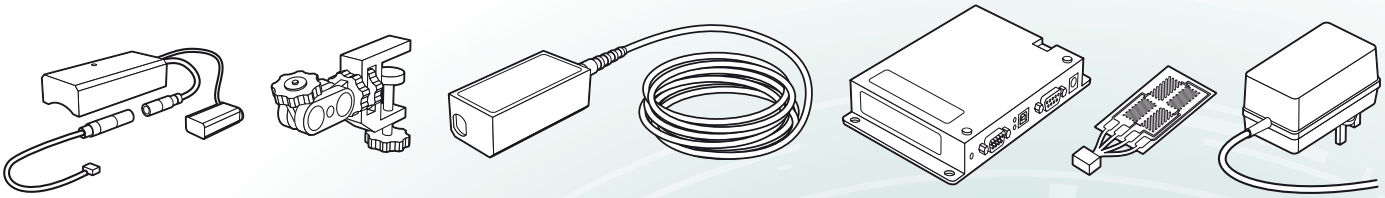
REFERENCE LIST

SHIPYARD		PROJECT	QUANTITY	REMARK
COSCO GUANZGZHOU	广州中远	4600 LIVESTORK CARRIER	4 vessels	
COSCO GUANZGZHOU	广州中远	11000DWT SHUTTLE TANKER	3 vessels	
COSCO ZHOUSHAN	舟山中远	64000DWT BULK CARRIER	4 vessels	
JINHAI HEAVY INDUSTRY	金海重工	305000DWT VLCC	4 vessels	
JINLING SHIYARD	金陵船厂	38330DWT BULK CARRIER	9 vessels	
DAYANG SHIPYARD	大洋船厂	63500DWT BULK CARRIER	4 vessels	
DAYANG SHIPYARD	大洋船厂	63500DWT BULK CARRIER	2 vessels	
DAYANG SHIPYARD	大洋船厂	63500DWT BULK CARRIER	1 vessel	
HANTONG SHIPYARD	韩通船厂	64000DWT BULK CARRIER	20 vessels	
SANFU SHIPYARD	三福船厂	34500DWT CHEMICAL TANKER	6 vessels	
GUYU SHIPYARD	国裕船厂	38800DWT BULK CARREIER	4 vessels	
GUYU SHIPYARD	国裕船厂	64000DWT BULK CARREIER	2 vessels	
CCC TIANJIN	天津航道局	12000m³ DREGER	1 vessel	4sets/vessel
CCC SHANGHAI	上海航道局	12000m³ DREGER	1 vessel	4sets/vessel
CCC YANGZI RIVER	长江航道局	2000m³ DREGER	1 vessel	4sets/vessel
JINLING SHIYARD	金陵船厂	38330DWT BULK CARRIER	4vessels	
Taizhou Catic Shipyard	口岸船厂	208000DWT BULK CARRIER	3vessels	SEEMP
Jiangsu Yangzijiang Shipyard	扬子江船厂	208000DWT BULK CARRIER	4vessels	SEEMP
New Hantong Shipyard	新韩通船厂	208000DWT BULK CARRIER	3vessels	
Qingshan Shipyard	青山船厂	64000DWT BULK CARRIER	3vessels	
Wuchang Shipyard	武昌船厂	2000m³ DREGER	1vessel	2sets/vessel
JINLING SHIYARD	金陵船厂	3800PCTC	2vessels	

SHIPYARD		PROJECT	QUANTITY	REMARK
Sanjin Shipyard	三进船厂	38300DWT BULK CARRIER	3VESSELS	
CCC Shanghai	上海航道局	海牛，海鲲	2 VESSELS	
Greenship	新船重工	冷藏船	2 vessels	
CCC Shanghai	上海航道局	新海龙	1 Vessel	
CCC TIANJIN	天津航道局	通恒，通顺	2 Vessel	
Wartsila	Wartsila	Unkown	12 vessel	
Zengzhou Shipyard	增洲船厂	中东挖泥船	2 vessel	

DATUM ELECTRONICS

COMPACT SHAFT POWER MEASURING KIT
INSTALLATION GUIDE



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CONTENTS

INTRODUCTION

Datum Electronics Shaft Power Measuring Kit is a user installable test system that measures shaft torque and shaft speed and hence shaft power.

Shaft Power (kW) =
Shaft Torque (Nm) x Shaft Speed (RPM) x $\prod$/30

Shaft Torque is measured as shaft strain by a strain gauge bonded to the surface of the shaft. The Torque is proportional to the strain for any shaft as a function of the shaft material and its diameter.

Shaft Speed is measured by an optical sensor in the receiver that is directed at reflective tape on the shaft.

The on shaft transmitter is powered by a PP3 9V battery giving a run time of approximately 30 hours. The transmitter has an input connector for the on shaft strain gauge and transmits the strain value, the battery voltage and some diagnostic data.

The static receiver combines the data from the receiver with the RPM pulse in a built-in optical sensor, and transmits this data to the test computer via USB from the universal interface.

SYSTEM OUTLINE

The system consist of four basic elements:

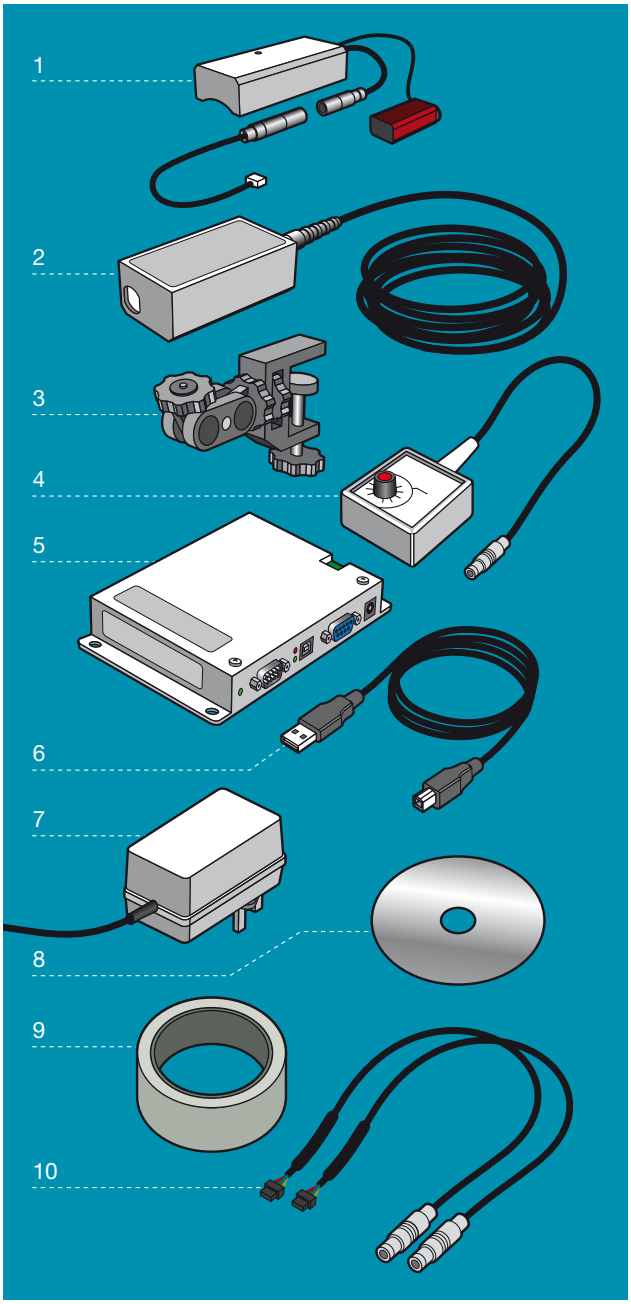
- SHAFT MOUNTED TRANSMITTER WITH THE STRAIN GAUGE
- RECEIVER WITH THE OPTICAL RPM SENSOR
- UNIVERSAL INTERFACE
- PC SOFTWARE TO DISPLAY AND LOG THE DATA

CHECK LIST

It is recommended that all hardware, consumables, tools and software are checked and present before preparation and installation commences.

HARDWARE SYSTEM SUPPLIED

DESCRIPTION	QUANTITY
• 1: Compact Transmitter 104102	1
• 2: Receiver Module 400107	1
• 3: Receiver Mounting Clamp	1
• 4: Strain Gauge Simulator	1
• 5: Instrument Interface (4000152/154 or 155)	1
• 6: USB Connection Lead	1
• 7: Interface Power Supply	1
• 8: TorqueLog Software CD	1
• 9: Strong Cross Weave Tape (roll)	1
• 10: Gauge Adapter Cables	2



STRAIN GAUGE INSTALLATION

There are four stages and components that are required for strain gauging:

1. Gauges -
   One per shaft test
2. Cleaning and Preparation -
   ensuring suitability for gauge installation
3. Adhesive -
   Temporary (up to 6 months) or Permanent (up to 10 years)
4. Protection -
   dependent on testing environment

Gauges

Gauges with connectors

Datum Electronics can supply fully encapsulated pre-wired gauges for simple installation. Other gauges can be used, please enquire with Datum Electronics.

DESCRIPTION	QUANTITY
• Datum SPMK gauges with connectors as supplied Gauges are not reusable. Please note gauges are not included in installation packs.	1

Typical consumables

Cleaning & preparation kit

Available from Datum Electronics

DESCRIPTION	QUANTITY
• M-Prep neutraliser 5A: 60ml bottle (6 shafts)	1
• M-Prep conditioner: 60ml bottle (6 shafts)	1
• 400 & 120 grit silicon carbon paper	2 pack
• Permanent marking pen: Sharpy	1
• Cotton tipper applicator:	Box of 100
• GSP-1 gauze sponges:	Box of 100
• Kimi wipe lint free tissues	1 Box

Typical adhesives kits

Temporary adhesives kit

Available from Datum Electronics

TEMPORARY ADHESIVES KIT - UP TO 5 SHAFTS
FOR UP TO 6 MONTHS INSTALLATION LIFESPAN

DESCRIPTION	QUANTITY
• Mbond 200 multi-pack	(5 x 2g containers)
• Catalyst C 200ml	1
• GSP-1 gauge tape	1

Permanent adhesives kit

Available from Datum Electronics

PERMANENT ADHESIVES KIT - UP TO 6 SHAFTS
FOR UP TO 10 YEAR INSTALLATION LIFESPAN

DESCRIPTION	QUANTITY
• Resin mixing jars (10g)	6
• Curing agent 10 Bottle (15ml)	1
• Calibrated pipettes	6
• Stirring rods	6
• Silicon gum pad	1
• 1” reel of Mylar tape	1

Typical environmental protection

M Coat-F environmental protection kit

Available from Datum Electronics

DESCRIPTION	QUANTITY
• Self adhering Teflon tape	1
• Butyl pliable rubber sealant	1
• Neoprene rubber sheets	1
• Aluminium foil tape	1
• M-Coat B: Air drying nitrile rubber coating	1

Consumables kit required

DESCRIPTION	QUANTITY
• Ballpoint pen	1
• Industrial degreaser	1
• Cable ties	6
• Cleaning rags	1
• TCW 24 tined copper wire	1
• Masking tape or marker pen	1 roll
• Banding	kit

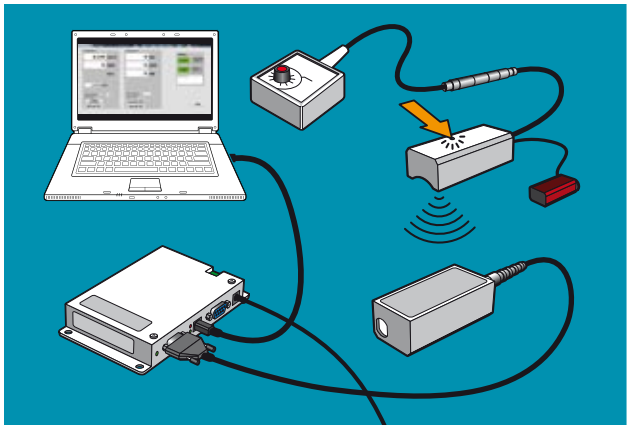
Tool kit required

DESCRIPTION	QUANTITY
• Dremel	1
• Angle marking bar	1
• Metric hex driver set	1
• Large flat head screw driver	1
• Side cutters	1
• Tin snips	1
• Tweezers	1
• Notebook PC with test software	1
• Small toughened glass plate for gauge preperation	1

EQUIPMENT PREPARATION

01

FAMILIARISE YOURSELF WITH THE SYSTEM



Testing of Transmitter and Receiver communications is vital before on-site installation commences.

Connect the interface module to the test computer with only the USB cable connected. Then install the Powerkit software and connect up the off shaft receiver and power the interface module. The red LED will show on the receiver to indicate it is working. Connect the battery to the on-shaft transmitter; the LED on top of the transmitter will blink several times to show it has power. Connect the strain gauge simulator to to the on-shaft transmitter and move the selector to the zero position.

The green LED on the off-shaft receiver should now show one green light indicating that the transmitter and receiver are connected and good data is being transmitted

Wave the speed reflector in front of the off shaft receiver's optical sensor and check that the green speed pulse LED lights to indicate the RPM counter is working correctly

Load the Powerkit software and correctly connect to the receiver/transmitter system. Once correctly connected move the strain gauge simulator through all the points and the onscreen torque value will change, wave the speed sensor in front of the off shaft receiver's optical sensor and the RPM figure will change. With no strain gauge connected the software will display approximately 3.26 mV/V.

Having completed this test you have tested the transmitter and your test receiver and gained a level of familiarity with the kit. The hardware and software checks are now complete.

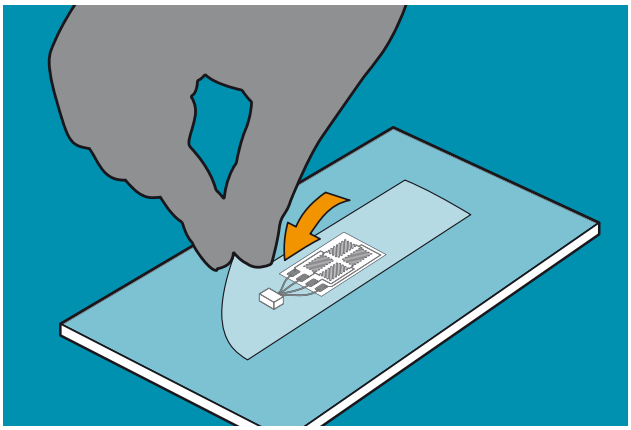
02

STRAIN GAUGE PREPARATION (GUIDANCE ONLY)

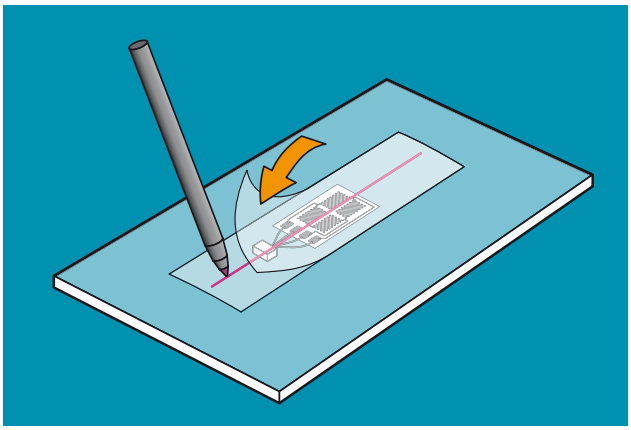
1. When mounting the strain gauge you will need to have prepared it on a glass plate with mylar tape. It is better to complete this stage in a clean room with good light before going on site.

   Thoroughly clean the surface of the glass plate using the M-Prep Conditioner first and then the M-Prep Neutraliser. This will ensure that the plate is chemically clean.

2. Using clean tweezers place the gauge on the plate with the solder/cable side uppermost. Familiarise yourself with the gauge element orientation using a magnifying glass.



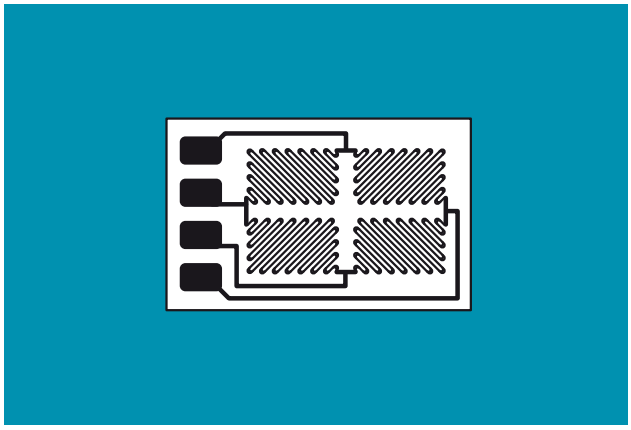
3. Cut a length of mylar tape approximately 150mm in length. Carefully offer the tape to the top side of the gauge and stick the gauge roughly in the centre of the mylar tape (see above). Stick the tape onto the glass plate with the gauge in a central position.



4. After applying the first layer of tape mark a line across the gauge (see above) using an indelible marker, parallel to the long side of the gauge. Then add a second layer of mylar tape. The second layer will stop the tape curling when applying the gauge to the shaft.

   Gently lift the two layers of tape away, with the gauge now stuck to it, ensuring that you always handle the tape and not the gauge itself.

   IF NO PREPARED CLEAN SURFACE IS AVAILABLE:
   Cut a strip of mylar tape approximately 150mm in length. Lay the tape on a flat clean surface so that the adhesive backing is facing upwards. Remove the gauge from its packaging using a pair of clean tweezers using the minimum pressure possible. Carefully place the strain gauge in the centre of the mylar tape. During all processes take great care to avoid contaminating the gauge or mylar tape.



The strain gauge supplied by Datum Electronics is a full bridge encapsulated gauge complete with a connector. These simplify the installation process and remove the need for soldering on site. The gauge has fine elements within its grid that measure strain. These elements can be seen under a magnifier and should be aligned at 45 degrees to the axis of the shaft to measure the torsional strain.

You should familiarise yourself with the gauge in a well lit environment before going to site where light may be limited.

STRAIN GAUGE PREPARATION IS NOW COMPLETE, YOU NOW NEED TO PREPARE THE SHAFT.

03

BATTERY TESTING

The PP3 9V battery should be new. Connect the battery to the Transmitter Enclosure using the supplied connectors. If the light on the top of the Transmitter Enclosure flashes, then the battery is fully charged. If the light does not flash, replace the battery with a new one.

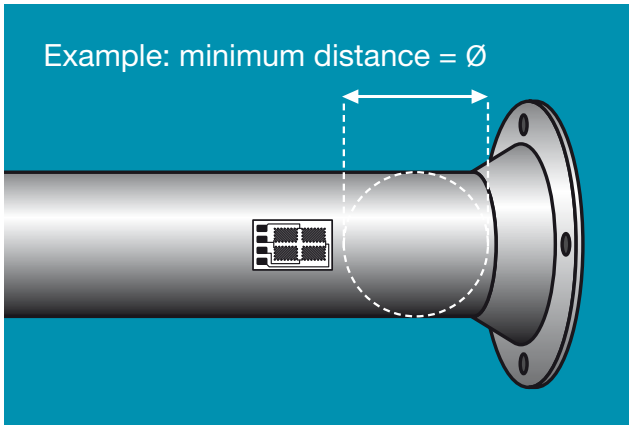
SHAFT PREPARATION

04

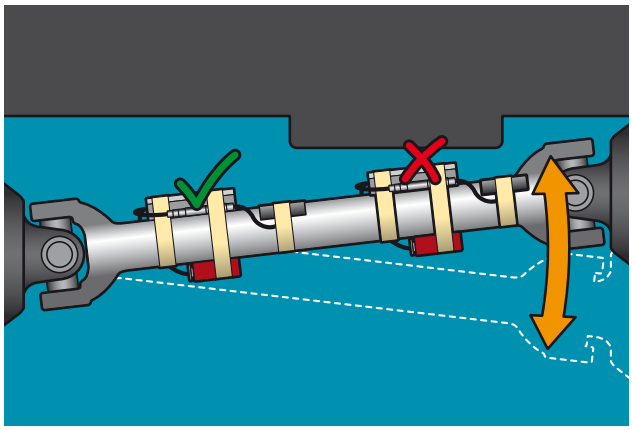
SELECTION OF INSTALLATION POSITION

The selection of a suitable area to be gauged on the drive shaft is vital to the success of the installation and data recovery. The area to be gauged should, where practicably possible, transmit the maximum level of torque/strain that is to be measured through the shaft.

1. The area should be large enough to mount the instrumentation. Look at the Transmitter unit to approximate the size of the clean gauging area that will be required.



2. Measure the diameter of the shaft. The gauging area should be no less than one shaft diameter away from any obstruction or shaft joint (see above).



3. There must not be any areas of interference once the instrumentation is mounted and the shaft is rotating. Changes in pitch/travel of the shaft during normal operation should be taken into account, with the instrumentation mounted clear of any obstructions caused by shaft pitch/travel (see above). If the instrumentation is mounted on a vehicle suspension, travel should also be accounted for.
4. If measuring shaft speed (and power) you will need to mount the receiver so that it can be directed at the shaft.
5. There should be sufficient hand and working access to enable installation of the equipment and fitting of the battery.
6. Avoid any section of the shaft that contains major pitting or excessively deep scratches.
7. Offer the complete Transmitter Assembly up to the chosen area to check clearance and also check for any rotational interferences.

Full guidance is supplied with the adhesives and cleaner preparation chemicals.

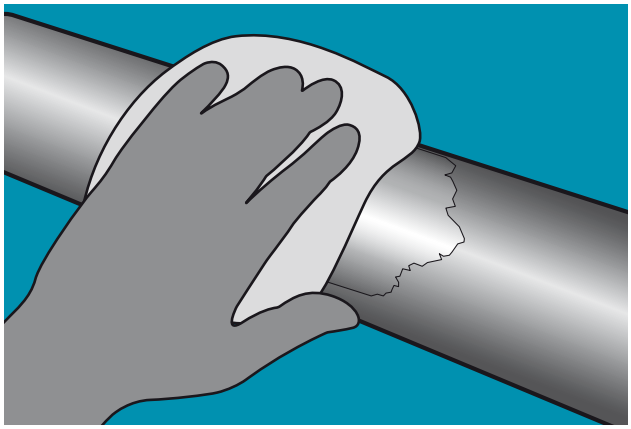
05

SURFACE PREPARATION (GUIDANCE ONLY)

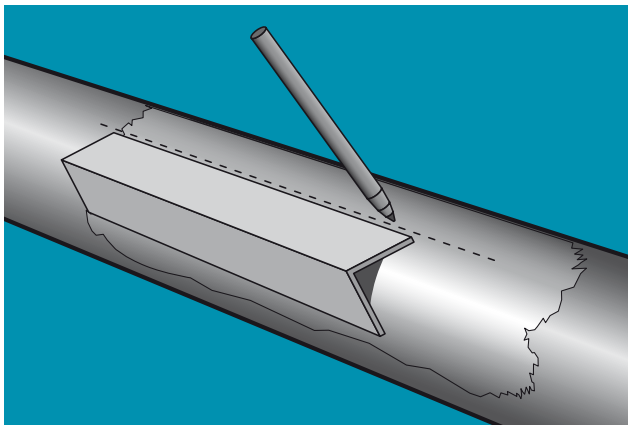
Once the installation position has been determined it is time to prepare the strain gauge area. Correct preparation of surfaces to be gauged is essential for successful equipment installation and data collection.

It is recommended that the chosen area of drive shaft is thoroughly cleaned and degreased prior to commencing strain gauging in order to prevent contaminating the gauge area.

BASIC CLEANING PREPARATION



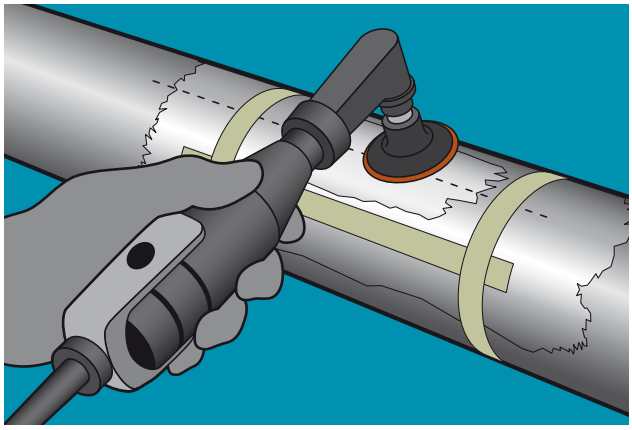
1. Clean the chosen area using rags and industrial cleaner/degreaser (see above). Remove as much dirt and grease as possible.
2. Clean area again. Once area is clean commence marking out following the steps below.



3. Place the angled bar flush to the shaft, and mark a line parallel to the shaft using a ball point pen (see above). This will act as a burnished line positioning guide to the centre line you marked on the mylar tape over the gauge in Stage 1.4.

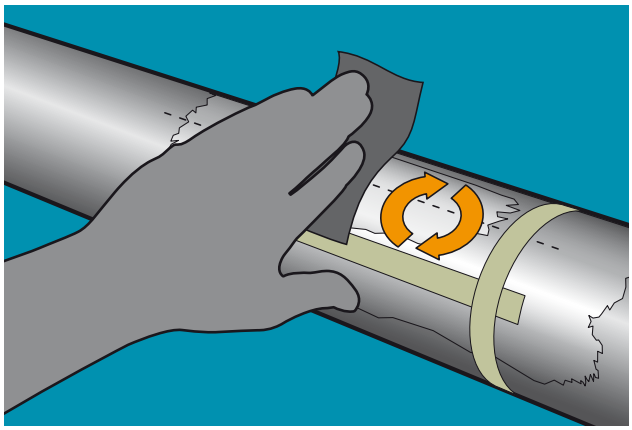
SURFACE ABRADING

The surface of the drive shaft should be abraded to remove any loosely bonded adherents such as scale, rust, paint, galvanised coatings or oxides.



4. Using the Transmitter unit as a guide, roughly indicate the area to be cleaned using masking tape (see above).

   Begin with a grinder, Dremel, disc sander or file to coarsely abrade the surface and remove any large particles such as paint, rust or any other adherents (see above). Abrade with 80-120 grit abrasive to develop a surface texture suitable for bonding.



5. Second stage abrading uses silicon carbon paper of the appropriate grit. It is recommended that abrading should start at 120 grit progressing through to 400 grit in a random pattern to attain a flat, clean, and well keyed surface (see above).

   The optimum surface finish for gauge bonding depends somewhat upon the nature and purpose of the installation. For general stress analysis applications, a relatively smooth surface is suitable.

WET ABRADING

Wet abrading is carried out using a conditioner solution. Conditioner is a mildly acidic solution which generally accelerates the cleaning process and, on some materials, acts as a gentle etchant.

6. Carry out final abrading with 400 grit paper while keeping the surface wet with conditioner solution. Use a random pattern to attain a flat, clean, and well keyed surface.

   Following cleaning the burnished line should still be visible. If working in poor light mark reference lines either side of the gauge markings to draw the eye to the burnished lines.

GAUGE LOCATION LAYOUT LINES

Gauge location layout lines should be made with a tool which burnishes, rather than scores or scribes, the surface. A scribed or scored line may raise a burr or create a stress concentration detrimental to strain gauge performance.

It is recommended that ballpoint pen is used for making alignment markings. Layout lines are ordinarily applied following the abrading operation and before final cleaning. All residues from the location marking operation should be removed by scrubbing with conditioner, as described in Stage 9 of the Surface Preparation process.

7. Mark out strain gauge location lines on the centre line you marked in step 05.3.
8. All masking tape can now be removed from the drive shaft.

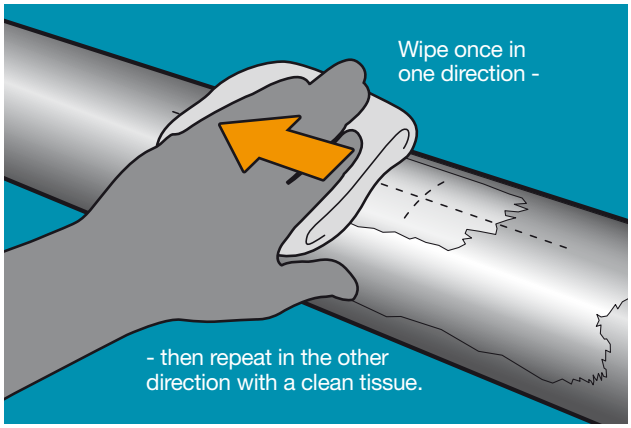
SURFACE CONDITIONING

9. Repeatedly apply conditioner and scrub the surface with cotton tipped applicators until a clean tip is no longer discoloured by the scrubbing. During this process the surface should be kept constantly wet with the conditioner until cleaning is completed. Cleaning solutions should never be allowed to dry on the surface.
10. When clean, the surface should be dried by wiping across the cleaned area with a single slow stroke of a lint free tissue. The stroke should begin from well within the cleaned area and move outwards to avoid dragging contaminants in from the boundary of the area using each tissue one only.

NEUTRALISING

The final step in surface preparation is to bring the surface condition back to an optimum alkalinity of 7.0 to 7.5 pH, which is suitable for all strain gauge adhesive systems.

11. Liberally apply neutraliser to the cleaned surface and scrub the surface with a cotton tipped applicator. The cleaned surface should be kept completely wet with neutraliser throughout this operation.



12. When neutralised, the surface should be dried by wiping across the cleaned area with a single slow stroke of a clean lint-free tissue. With a fresh lint-free tissue, a single stroke should then be made in the opposite direction, beginning within the cleaned area and moving outwards to avoid recontamination from the uncleaned boundary (see above).

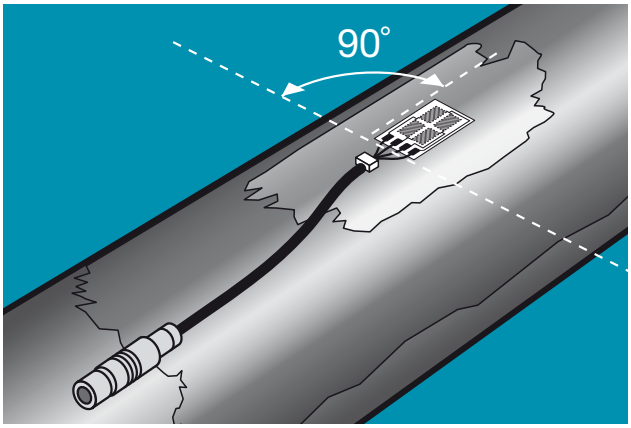
The surface is now properly prepared for gauge bonding. Gauges should be installed **as soon as possible** after this operation to prvent contamination.

PREPARATION IS NOW COMPLETE

INSTALLATION

06

GAUGE APPLICATION



You are now ready for strain gauge application.

The strain gauge supplied for this application is manufactured by Vishay Micro-Measurements Group to Datum specifications. The standard procedures for Vishay strain gauge application are described in Appendices 1 and 2 of this document.

Additional information regarding alterative adhesives can be found at: **http://www.vishaymg.co.uk/adhesives.htm**

1. The strain gauge is bonded to the shaft using one of two procedures.

   ### PROCEDURE A - Trials application

   This is recommended for short trials of 3 months in duration and where time on-site is limited. This procedure utilises a cyanoacrylate adhesive (M-Bond 200) that will cure in approximately 60 seconds by thumb pressure.

   PROCEDURE A IS LISTED IN DETAIL IN **APPENDIX 1** OF THIS DOCUMENT. THE INSTRUCTIONS IN THIS APPENDIX MUST BE FOLLOWED BEFORE MOVING TO THE NEXT STAGE.

   ### PROCEDURE B - Permanent application

   This is recommended for longer term installations where strain gauges will need operate for up to 10 years or more. This procedure utilises a two part epoxy adhesive that cures in six hours at 20˚C, reducing to one hour at 60˚C. The gauge is held by a pressure pad while curing.

   PROCEDURE B IS LISTED IN DETAIL IN **APPENDIX 2** OF THIS DOCUMENT. THE INSTRUCTIONS IN THIS APPENDIX MUST BE FOLLOWED BEFORE MOVING TO THE NEXT STAGE.

Protection from the environmental

Both strain gauge installation methods require that coatings are applied to insure that no moisture or other contamination reaches the strain gauge or the exposed wiring. The level of coatings applied will vary according to the operating conditions and the duration of the testing.

2. **After applying the strain gauge as described in the Appendices,** the gauge should be visually inspected to check that the bonds are secure, and that there are no significant air bubbles or inclusions present under the strain gauge.

The gauge, once bonded, will have an usually display a signal offset due to the distortion of the gauge around the radius and also by the action of applying hand pressure during the bonding process. The level of offset will vary from installation to installation. The offset of the gauge can be measured using a PC connected to the Receiver running the software utility. The output of the gauge, and hence the offset, will be shown in mV/V. Typically this reading will be +/-0.000mV/V to +/-0.500mV/V, the instrumentation being designed to cater for an offset of up to 1.000mV/V. If the offset is greater than this value the installation is likely to be faulty. This may be caused by an uneven or twisting pressure at installation. If the gauge offset is greater than 1.0mV/V you will need to replace the gauge. Clean the area and repeat the gauge installation.

Alternatively, this offset can be measured using a gauge indicator of some description.

3. Once the gauge is installed, and with either a handheld indicator or PC connected, you should if possible apply a twist to the shaft. Applying a small torque to the shaft by hand or by a manual lever is usually sufficient to allow you to see the readings on the display change. By applying a small force in this way you are able to gain additional confidence in your strain gauge installation.

   The value should increase/decrease slightly and then return to the start value as the twist is released (see above).

   Note the value for the gauge with no load at this stage as this will be required for future testing and diagnostics.

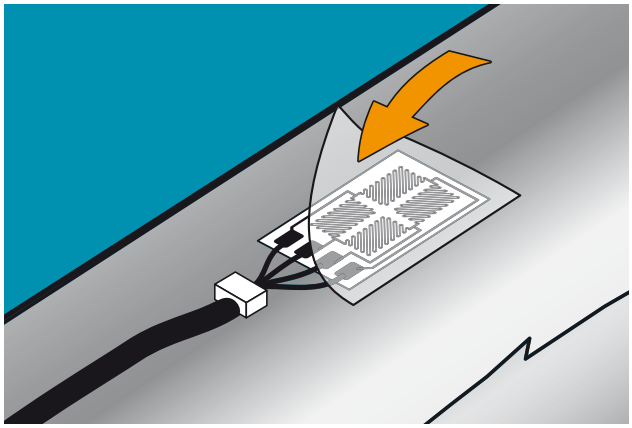
STRAIN GAUGE INSTALLATION IS NOW COMPLETE

07

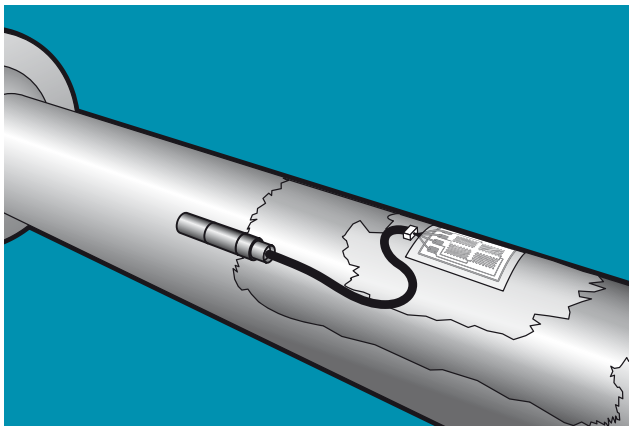
PROTECTION OF THE STRAIN GAUGE

The protection of strain gauges is vital in order to maintain good strain readings.

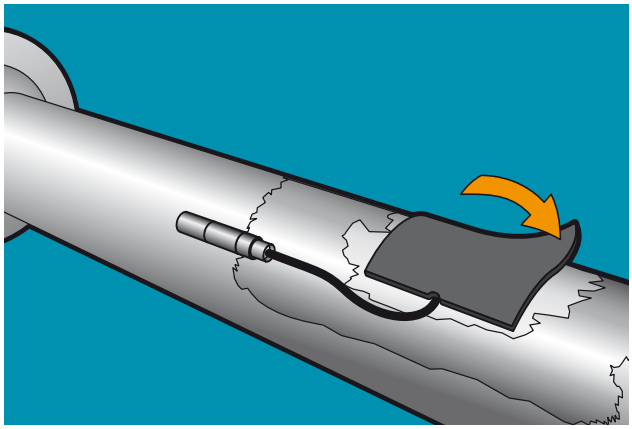
Excessive moisture or ingress of other fluids may cause a strain gauge to drift, resulting in poor or unrealistic readings. When encapsulated strain gauges are being used the following process offers a suitable level of protection.



1. Cut a piece of Teflon tape (approx 30mm long) to cover the gauge and the connector, and stick it over the strain gauge onto the cleaned area where the strain gauge is bonded to the shaft.



2. Apply pressure to the edges of the Teflon tape to provide a good seal around the gauge.

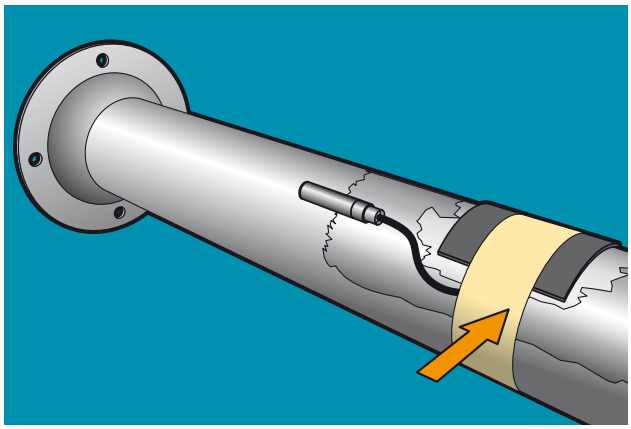


3. Cut a strip of butyl mastic large enough to cover the strain gauge and the area of Teflon, and stick over gauge onto the cleaned area where the strain gauge is bonded to the shaft (see above). Apply pressure to the edges of the mastic to provide a good seal around the gauging area but leave the cable exposed.

The shaft area needs to be chemically clean for the mastic to adhere - warming the mastic to 25-30˚C will also assist with fitting and adhesion.

Additional information regarding strain gauge coating options can be found at:

http://www.vishaymg.co.uk/protective_coatings.htm



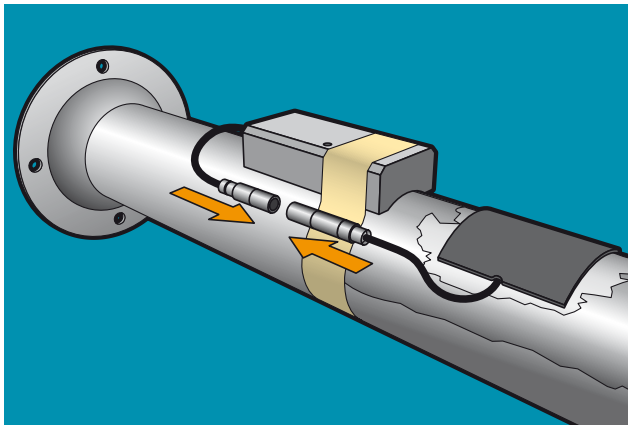
4. At higher revolutions additional layers of cross weave tape should be used to secure the mastic coatings. Suitable tapes to use are either Strong Cross Weave Tape or and Adhesive Glass Cloth Tape with a strength in excess of 25kgs per cm.

PROTECTION OF STRAIN GAUGE IS NOW COMPLETE

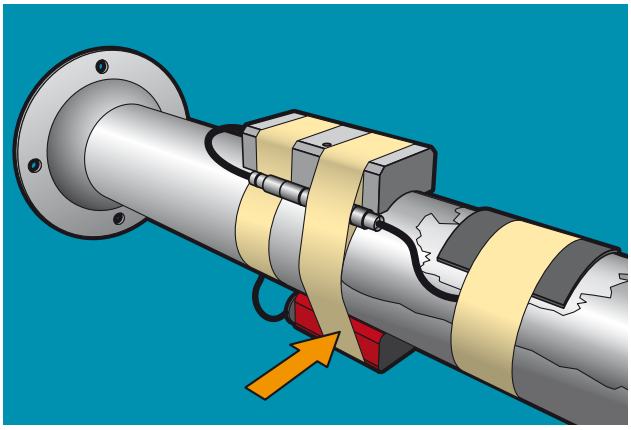
08

TRANSMITTER INSTALLATION

1. Place the Transmitter Enclosure close to the protected gauge area ensuring that the gauge cable does not become trapped in any way and allowing enough cable to plug the gauge connector to the Transmitter Enclosure. Secure the Transmitter Enclosure in place by taping to the shaft with four wraps of the cross weave tape. Take care not to cover the LED.



2. Plug the strain gauge connector into Transmitter connector. Wrap excess cable around Transmitter Enclosure.



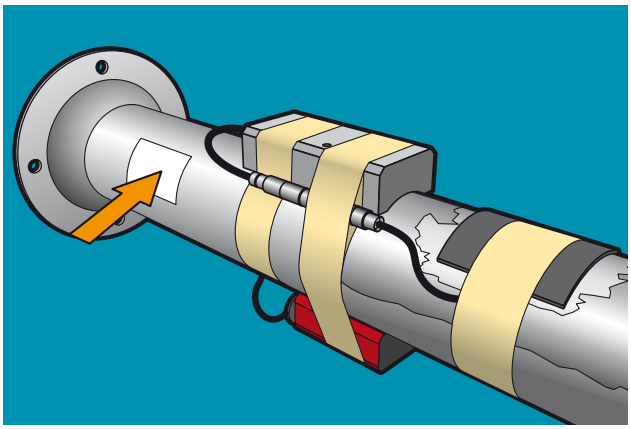
3. Position the battery on the shaft at 180deg to the transmitter on shaft up to 100mm to improve shaft balance.
4. Secure the battery in place by taping it to the shaft. Tape around the shaft and over the Transmitter Enclosure, battery and Transmitter connectors, securely fixing them all to the shaft (see above).

TRANSMITTER INSTALLATION IS NOW COMPLETE

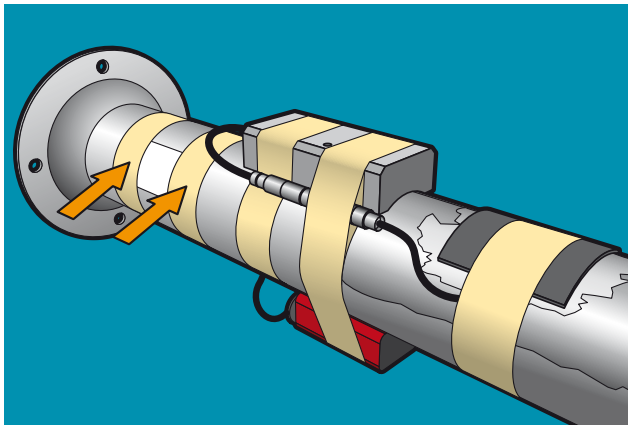
09

MEASURING RPM AND POWER – SPEED REFLECTOR INSTALLATION

1. The reflective tape that forms the target for the Optical Proximity Sensor should be positioned on the shaft so that the optical Receiver Module can be aimed at it. The Receiver Module's optical beam should be perpendicular to the sensor to ensure a good reflected signal. Avoid positioning the tape next to other highly reflective structures or surfaces that might reflect a false signal once the shaft is rotating.



2. Cut a piece of reflective tape approximately 30mm x 100mm and position it on the shaft.



3. Hold it in place by wrapping tape around the shaft at each end of the reflective tape.

SPEED REFLECTOR INSTALLATION IS NOW COMPLETE

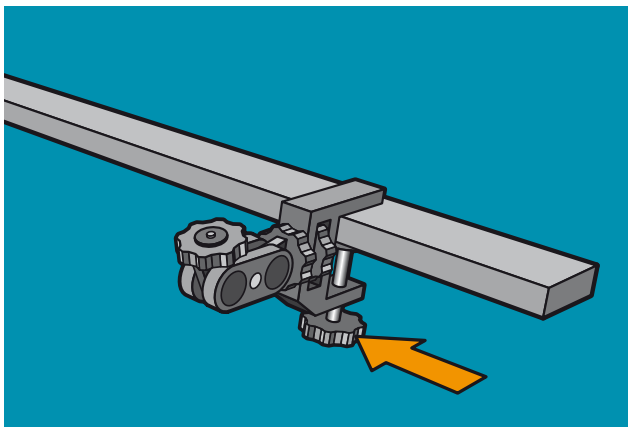
10

RECEIVER INSTALLATION

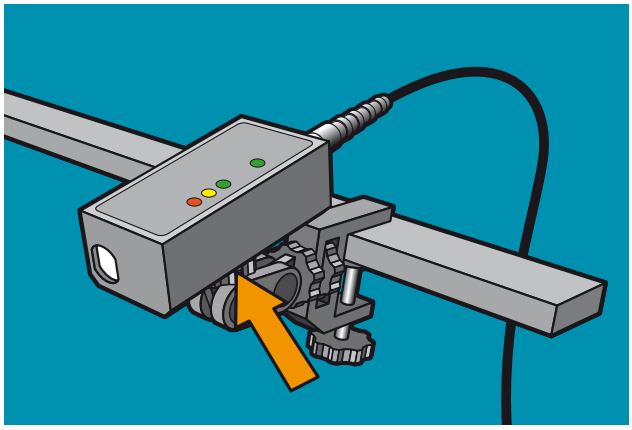
If measuring RPM/Power locate a suitable structure to mount the Receiver Module to, that also allows the receiver's speed sensor to be aligned to the Transmitter.

If only measuring torque the receiver needs to be located within 3 meter line of sight to the transmitter location but its directional alignment is not critical.

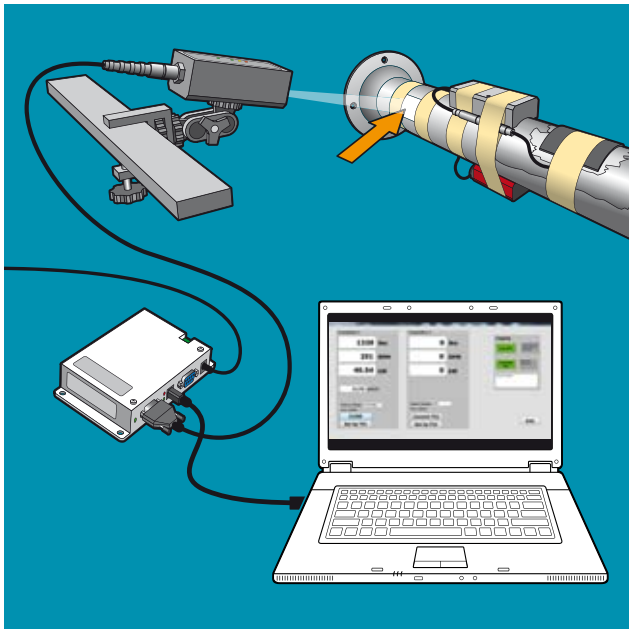
The Optical Speed Sensor on the Receiver Module should be aligned perpendicular to the reflector on the shaft to ensure the beam is reflected back to the Receiver and metered correctly.



1. Attach the Receiver Mounting Clamp to the suitable structure and tighten the locking wheels (see above).



2. Attach the Receiver Module to the Receiver Mounting Clamp by screwing it to the mounting thread and firmly tighten the locking wheel.
3. Position the optical sensor to aim at the reflector on the shaft by adjusting the locking wheels as required. Tighten all the locking wheels on the Receiver Mounting Clamp firmly.
4. Connect the Receiver Module to the Interface Unit using the 10 metre cable supplied. The cable has a RS232 connector for the Interface Unit and a connector for the Receiver. Optional extension cables are available on request.



The cable run from the Receiver to the Interface should be secured approximately every 0.5 metres so as not to become a hazard. IMPORTANT NOTE: When running cable ensure that it is not mounted in any area that may become damaged by the moving or rotational machinery. Coil up and securely tie any excess cable.

For multi-shaft installation we can provide transmitters with unique transmission channels and a multi-channel PC interface/power supply.

RECEIVER INSTALLATION IS NOW COMPLETE

APPENDIX 01

UNDERSTANDING THE RECEIVER LEDs

Understanding the LED's on Datum's 2.4GHz radio based Torque Meters and help diagnosing communication problems.

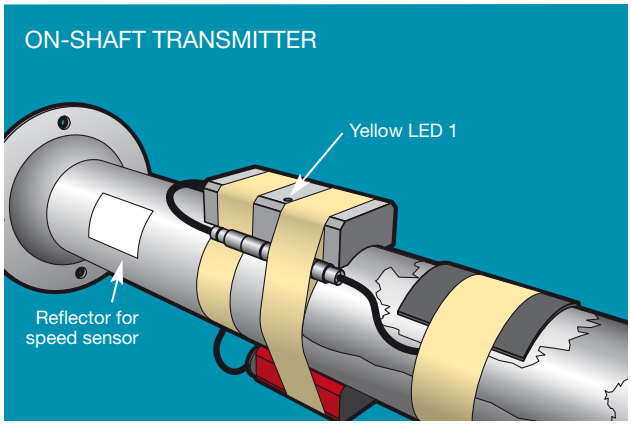
ON-SHAFT TRANSMITTER

The on-shaft transmitter has only one LED.

YELLOW LED: This LED will flash fast for up to 3 seconds whilst trying to connect to the receiver when the battery is connected.

When the transmitter has connected to the receiver, the Yellow LED will flash once a sample has been acquired, this is 10 times a seconds for the standard sample rate of 10 SPS.

If the transmitter cannot connect to the receiver the Yellow LED will flash briefly once every three seconds (power saving mode). If this happens, check the status of the off-shaft receiver LED's (oposite), check that power is supplied to the off-shaft receiver, the equipment that supplies power to the off-shaft receiver is powered on etc.



OFF-SHAFT RECEIVER

The Receiver has four LED's.

RED LED 1: Is illuminated if no data has been received from the transmitter for more than 2 seconds. It is extinguished as soon as data is received.

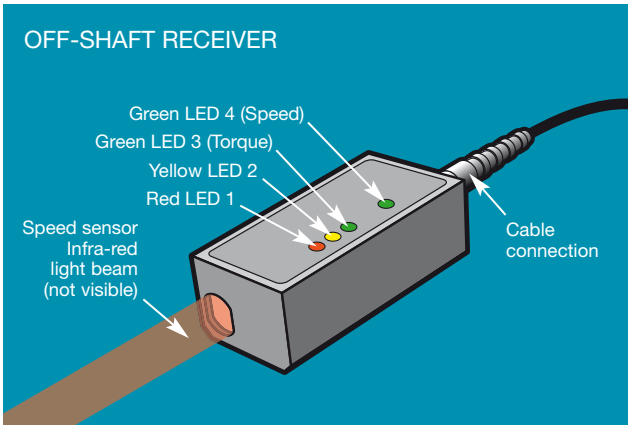
YELLOW LED 2: Flashes if data is not received when expected. It will continue to flash as long as no data is received for a period of approximately 2 seconds, after which after which it will be extinguished and the Red LED will illuminate. If data is received the Yellow LED will be extinguished.

GREEN LED 3 (Torque): Flashes briefly every time data is received from the on-shaft transmitter. In normal operation this will flash approximately 5 times per seconds, indicating reception of continuous data. Reception of data is only an indication of the integrity of the data transmission between the on-shaft transmitter and the off-shaft receiver; it does not convey any indication of the accuracy of the data received.

If no LED's are visible, check that power is supplied to the off-shaft receiver, the equipment that supplies power to the off-shaft receiver is powered on. Ensure that the circular connector to the off-shaft receiver is screwed in tight, no cables are damaged and in-line fuses are correct. Try power cycling the off-shaft receiver (undo the circular connect remove for a moment and reconnect, look at the LED's and confirm the correct operation as above.

Note: Ensure that the on-shaft transmitters Yellow LED is flashing before power cycling the off-shaft receiver to ascertain that a connection can be made.

GREN LED 4 (Speed) is illuminated whenever the speed sensor senses the reflective material on the power band segment. As such, it should flash once per revolution when the shaft is rotating.



APPENDIX 02

PROCEDURE A: STRAIN GAUGE INSTALLATION FOR SHORT TERM USAGE

THE STRAIN GAUGES SUPPLIED ARE MANUFACTURED BY **VISHAY MICRO-MEASUREMENTS GROUP** TO DATUM SPECIFICATIONS.

SHOULD MATERIALS SPECIFIED NOT BE AVAILABLE, OR THERE ARE PROCESSES WHICH REQUIRE CLARIFICATION, CONTACT YOUR **LOCAL VISHAY OFFICE** FOR ADVICE AND RECOMMENDATIONS.

INTRODUCTION

Micro-Measurements Certified M-Bond 200 is an excellent general-purpose laboratory adhesive because of its fast room-temperature cure and ease of application.

When properly handled and used with the appropriate strain gauge, M-Bond 200 can be used for high-elongation tests in excess of 60 000 microstrain, for fatigue studies, and for one-cycle proof tests to over +200 °F [+95 °C] or below -300 °F [-185°C]. The normal operating temperature range is -25° to +150°F [-30° to +65°C]. MBond 200 is compatible with all Micro-Measurements strain gauges and most common structural materials.

When bonding to plastics, it should be noted that for best performance the adhesive flowout should be kept to a minimum. For best reliability, it should be applied to surfaces between the temperatures of +70° and +85°F [+20° to +30°C], and in a relative humidity environment of 30% to 65%.

M-Bond 200 catalyst has been specially formulated to control the reactivity rate of this adhesive. The catalyst should be used sparingly for best results. Excessive catalyst can contribute many problems; e.g., poor bond strength, age-embrittlement of the adhesive, poor glueline thickness control, extended solvent evaporation time requirements, etc.

Since M-Bond 200 bonds are weakened by exposure to high humidity, adequate protective coatings are essential.

This adhesive will gradually become harder and more brittle with time, particularly if exposed to elevated temperatures. For these reasons, M-Bond 200 is not generally recommended for installations exceeding one or two years.

For proper results, the procedures and techniques presented here should be used with qualified Micro- Measurements installation accessory products (refer to Catalog A-110). Those used in this procedure are:

- CSM Degreaser or GC-6 Isopropyl Alcohol
- Silicon Carbide Paper
- M-Prep Conditioner A
- M-Prep Neutraliser 5A
- GSP-1 Gauze Sponges
- CSP-1 Cotton Applicators
- PCT- 2M Gauge Installation Tape

SHELF AND STORAGE LIFE

M-Bond 200 adhesive has a minimum shelf life of three months at +75°F [+24°C] after opening and with the cap placed back onto the bottle immediately after each use.

NOTE: To ensure the cap provides a proper seal, the bottle spout should be wiped clean and dry before replacing the cap.

Unopened M-Bond 200 adhesive may be stored up to three months at +75°F [+24°C] or six months at +40°F [+5°C].

HANDLING PRECAUTIONS

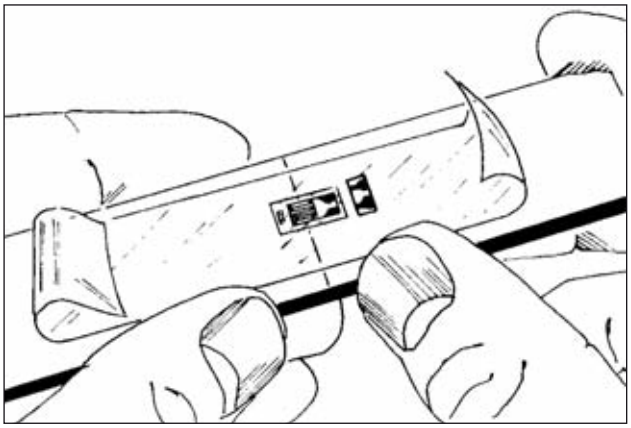
M-Bond 200 is a modified alkyl cyanoacrylate compound. Immediate bonding of eye, skin or mouth may result upon contact. Causes irritation. The user is cautioned to: (1) avoid contact with skin; (2) avoid prolonged or repeated breathing of vapors; and (3) use with adequate ventilation. For additional health and safety information, consult the Material Safety Data Sheet, which is available upon request.

NOTE: Condensation will rapidly degrade adhesive performance and shelf life; after refrigeration the adhesive must be allowed to reach room temperature before opening, and refrigeration after opening is not recommended.

GAUGE APPLICATION TECHNIQUE

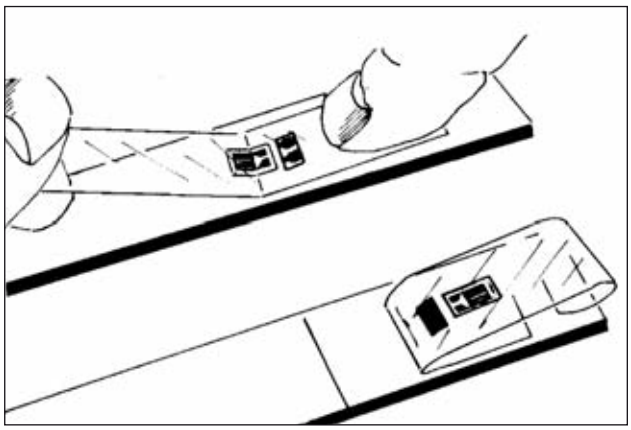
The installation procedure presented on the following pages is somewhat abbreviated and is intended only as a guide in achieving proper gauge installation with M-Bond 200. Micro-Measurements Application Note B-129 presents recommended procedures for surface preparation, and lists specific considerations which are helpful when working with most common structural materials.

STEP 01



Position the gauge/tape assembly so that the triangle alignment marks on the gauge are over the layout lines on the specimen. If the assembly appears to be misaligned, lift one end of the tape at a shallow angle until the assembly is free of the specimen. Realign properly, and firmly anchor at least one end of the tape to the specimen. Realignment can be done without fear of contamination by the tape mastic if Micro-Measurements PCT-2M gauge installation tape is used, because this tape will retain its mastic when removed.

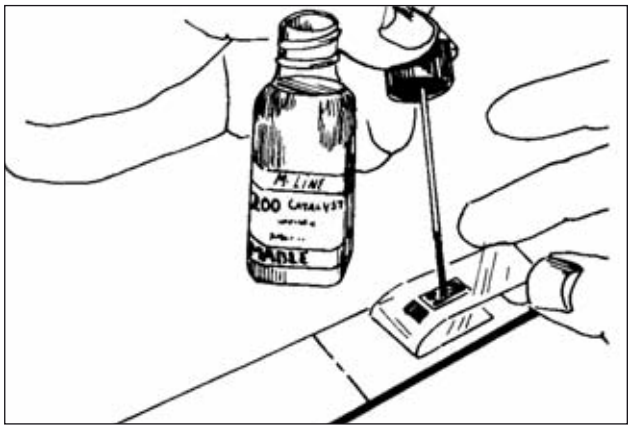
STEP 02



Lift the gauge end of the tape assembly at a shallow angle to the specimen surface (about 45 degrees) until the gauge and terminal are free of the specimen surface. Continue lifting the tape until it is free from the specimen approximately 1/2 in [10 mm] beyond the terminal. Tuck the loose end of the tape under and press to the specimen surface so that the gauge and terminal lie flat, with the bonding surface exposed.

NOTE: Micro-Measurements gauges have been treated for optimum bonding conditions and require no pre-cleaning before use unless contaminated during handling. If contaminated, the back of any gauge can be cleaned with a cotton-tipped applicator slightly moistened with M-Prep Neutraliser 5A.

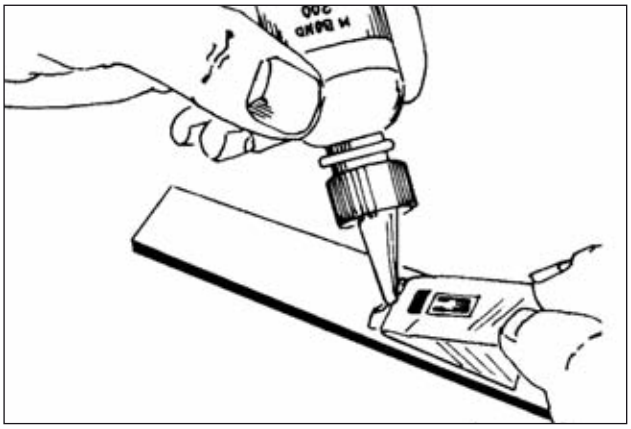
STEP 03



M-Bond 200 catalyst can now be applied to the bonding surface of the gauge and terminal. M-Bond 200 adhesive will harden without the catalyst, but less quickly and reliably. Very little catalyst is needed, and it should be applied in a thin, uniform coat. Lift the brush-cap out of the catalyst bottle and wipe the brush approximately 10 strokes against the inside of the neck of the bottle to wring out most of the catalyst. Set the brush down on the gauge and swab the gauge backing. Do not stroke the brush in a painting style, but slide the brush over the entire gauge surface and then the terminal. Move the brush to the adjacent tape area prior to lifting from the surface. Allow the catalyst to dry at least one minute under normal ambient conditions of +75°F [+24°C] and 30% to 65% relative humidity before proceeding.

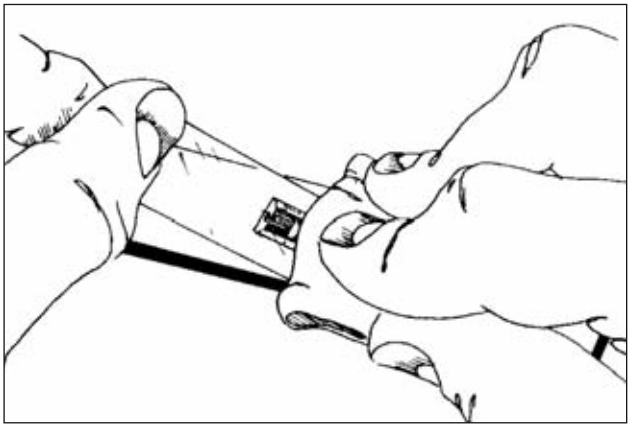
NOTE: **THE NEXT THREE STEPS MUST BE COMPLETED IN THE SEQUENCE SHOWN, WITHIN 3 TO 5 SECONDS. READ STEPS 8, 9, AND 10 BEFORE PROCEEDING.**

STEP 04



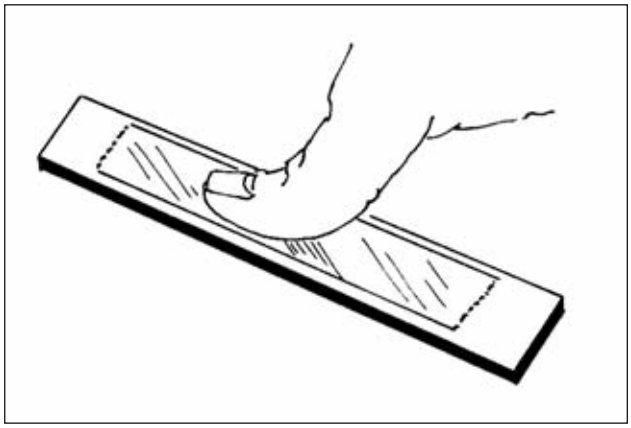
Lift the tucked-under tape end of the assembly, and, holding in the same position, apply one or two drops of MBond 200 adhesive at the fold formed by the junction of the tape and specimen surface. This adhesive application should be approximately 1/2 in [13 mm] outside the actual gauge installation area. This will insure that local polymerization that takes place when the adhesive comes in contact with the specimen surface will not cause unevenness in the gauge glueline.

STEP 05



Immediately rotate the tape to approximately a 30-degree angle so that the gauge is bridged over the installation area. While holding the tape slightly taut, slowly and firmly make a single wiping stroke over the gauge/tape assembly with a piece of gauze bringing the gauge back down over the alignment marks on the specimen. Use a firm pressure with your fingers when wiping over the gauge. A very thin, uniform layer of adhesive is desired for optimum bond performance.

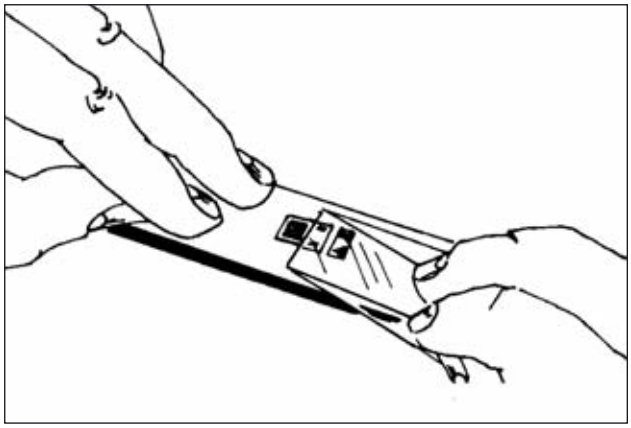
STEP 06



Immediately upon completion of wipe-out of the adhesive, firm thumb pressure must be applied to the gauge and terminal area. This pressure should be held for at least one minute. In low-humidity conditions (below 30%), or if the ambient temperature is below +70°F [+20°C], this pressure application time may have to be extended to several minutes.

Where large gauges are involved, or where curved surfaces such as fillets are encountered, it may be advantageous to use preformed pressure padding during the operation. Pressure-application time should again be extended due to the lack of "thumb heat" which helps to speed adhesive polymerization. Wait two minutes before removing tape.

STEP 07



The gauge and terminal strip are now solidly bonded in place. It is not necessary to remove the tape immediately after gauge installation. The tape will offer mechanical protection for the grid surface and may be left in place until it is removed for gauge wiring. To remove the tape, pull it back directly over itself, peeling it slowly and steadily off the surface. This technique will prevent possible lifting of the foil on open-faced gauges or other damage to the installation.

ONCE **PROCEDURE A** IS COMPLETE, PROCEED TO **SECTION 07.2** OF THIS MANUAL TO CONTINUE THE STRAIN GAUGING PROCESS.

APPENDIX 03

PROCEDURE B: STRAIN GAUGE INSTALLATION FOR LONG TERM USAGE

THE STRAIN GAUGES SUPPLIED ARE MANUFACTURED BY **VISHAY MICRO-MEASUREMENTS GROUP** TO DATUM SPECIFICATIONS.

SHOULD MATERIALS SPECIFIED NOT BE AVAILABLE, OR THERE ARE PROCESSES WHICH REQUIRE CLARIFICATION, CONTACT YOUR **LOCAL VISHAY OFFICE** FOR ADVICE AND RECOMMENDATIONS.

INTRODUCTION

The three adhesives described in this bulletin, M-Bond AE- 10, AE-15, and GA-2, are all 100%-solids epoxy systems for use with strain gauges and special-purpose sensors. The gauge installation procedure described is appropriate for each adhesive, the primary differences in the systems being in mixing instructions, pot life, cure cycles, and, to some extent, elongation properties. Each system is effective from the cryogenic region to +200°F [+95°C].

For proper results, the procedures and techniques presented in this bulletin should be used with qualified Micro-Measurements installation accessory products (refer to Micro-Measurements Accessories Catalog A-110). Accessories used in this procedure are:

- CSM Degreaser or GC-6 Isopropyl Alcohol
- CSP-1 Cotton Applicators
- PCT-2M Gauge Installation Tape
- Silicon-Carbide Paper
- MJG-2 Mylar Tape
- M-Prep Conditioner A
- HSC Spring Clamp
- M-Prep Neutraliser 5A
- GT-14 Pads and Backup Plate
- GSP-1 Gauze Sponges

HANDLING PRECAUTIONS

While these bonding agents are considered relatively safe to handle, contact with skin and inhalation of their vapors should be avoided. Immediate washing with ordinary soap and water is effective in cleansing should skin contact occur. For eye contact, rinse thoroughly with a copious amount of water and consult a physician. For additional health and safety information, consult the material safety data sheet, which is available upon request.

MIXING INSTRUCTIONS AND ADHESIVE CHARACTERISTICS

A. GENERAL

1. Each kit contains materials for mixing six batches of adhesive. Mixing instructions for M-Bond AE-10 and MBond AE-15 Bulk are included below.
2. Any resin removed from refrigeration must be allowed attain room-temperature equilibrium before being opened.
3. Mix adhesives thoroughly for five minutes according to instructions. If a room-temperature cure is used, allow the freshly mixed adhesive to stand an additional five minutes before use.
4. The pot life for Systems AE-10 and GA-2 can be prolonged by occasionally stirring to prevent localised exotherm in the center of the resin system, or by pouring it out onto a chemically clean metal plate.

NOTE: During storage, crystals may form in the Resin AE. These crystals do not affect adhesive performance, but should be reliquefied prior to mixing by warming the resin jar to +120°F [+50°C] for approximately one-half hour. Allow the resin to return to room temperature before adding curing agent; excess heat will shorten mixed pot life.

B. M-BOND AE-10 ADHESIVE KIT

AE-10 will cure at +70°F [+20°C] in 6 hours, with approximately 6% elongation capability and essentially creep-free performance. Elongation capability of approximately 10% can be obtained by extending the cure time to 24 to 48 hours at +75°F [+24°C].* To mix, fill one of the calibrated droppers with Curing Agent 10 exactly to the number 10 and dispense the contents into the center of the jar of Resin AE. Immediately cap the bottle of Curing Agent 10 to avoid moisture absorption.

Mix thoroughly for 5 minutes, using one of the plastic stirring rods. The pot life or working time after mixing is 15 to 20 minutes. Discard the dropper after use. M-Bond AE-10 Bulk is packaged with 200 grams of resin, 40 grams of Curing Agent 10, and three calibrated pipettes. The mix ratio is 10.0 parts by weight of AE

Resin to 1.5 parts by weight of Curing Agent 10. Mix thoroughly for five minutes, then allow the mixture to stand for an additional five minutes before use. When mixing quantities greater than 10 grams of AE Resin, the normal pot life of 15-20 minutes will be shortened accordingly.

*Refer to Application Notes B-129 and TT-605 for discussions of high-elongation strain measurements.

C. M-BOND AE-15 ADHESIVE KIT

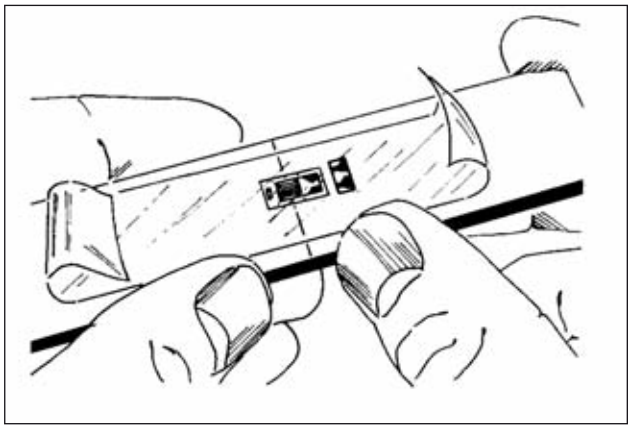
AE-15 requires moderately elevated curing temperatures, and is recommended for critical installations, such as strain gauge transducers, where zero shift and hysteresis must be minimised. The AE-15 system is also useful with high elongation strain gauges at strain levels up to approximately 10% to 15% at +70°F [+20°C], and at strain levels up to 15% at

+200°F [+95°C]. To mix, fill one of the calibrated droppers with Curing Agent 15 exactly to the number 15 and dispense the contents into the center of the jar of Resin AE. Immediately cap the bottle of Curing Agent 15 to avoid moisture absorption. Mix the Resin AE and the Curing Agent 15 thoroughly for 5 minutes, using one of the plastic stirring rods. The pot life is approximately 1-1/2 hours at +70°F [+20°C]. Discard the dropper after use. M-Bond AE-15 Bulk is packaged with 200 grams of resin, 25 grams of Curing Agent 15, and three calibrated pipettes. The mix ratio is 10.0 parts by weight of AE Resin to 0.8 parts by weight of Curing Agent 15. Mix thoroughly for five minutes, then allow the mixture to stand for an additional five minutes before use. When mixing quantities greater than 10 grams of AE Resin, the normal pot life of 15-20 minutes will be shortened accordingly.

D. M-BOND GA-2 KIT

GA-2 is a partially filled 100%-solids epoxy adhesive. Resin GA-2 with Hardener 10-A will have approximately 10% to 15% elongation capabilities when cured for 40 hours at +70°F [+20°C], and approximately 6% elongation capabilities when cured for 6 hours at +70°F [+20°C]. To mix, fill one of the calibrated droppers with Hardener 10-A exactly to the number 10, and dispense the contents into the jar of Resin GA-2. Immediately cap the bottle of Hardener 10-A to prevent moisture absorption. Mix the Resin GA-2 and the Hardener 10-A thoroughly for 5 minutes using one of the plastic stirring rods. Pot life is approximately 15 minutes at +70°F [+20°C]. Discard the dropper after use.

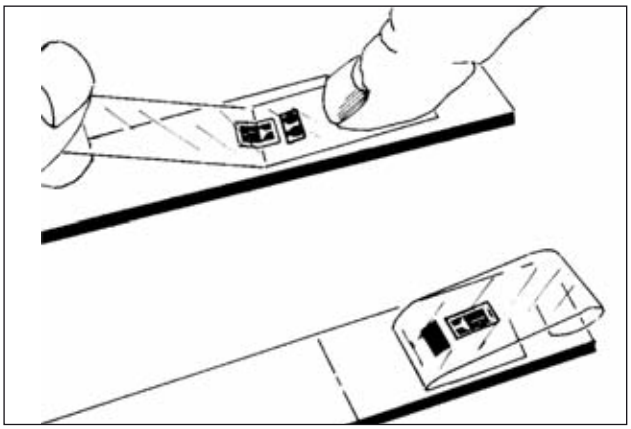
STEP 01



Position the gauge/tape assembly so the triangle alignment marks on the gauge are over the layout lines on the specimen. Holding the tape at a shallow angle, wipe the assembly onto the specimen surface. If the assembly appears to be misaligned, lift one end of the tape at a shallow angle until the assembly is free of the specimen.

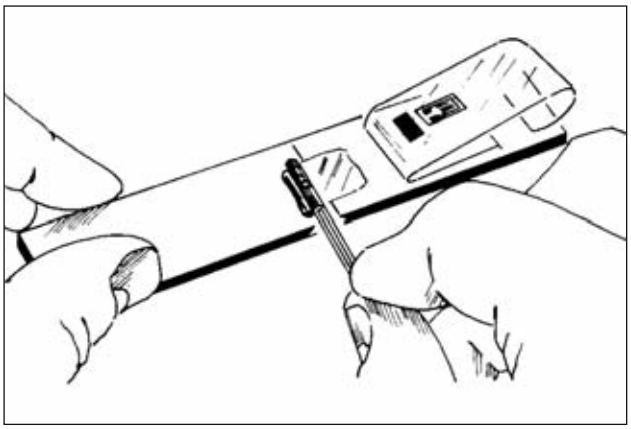
Realign properly and firmly anchor down at least one end of the tape to the specimen. This realignment can be done without fear of contamination by the tape mastic if the recommended gauge installation tape is used. This tape will retain the mastic when removed.

STEP 02



Lift one end of the tape at a shallow angle to surface (about 45 degrees) until gauge and terminal are free of specimen surface. Tuck the loose end of the tape under and press to the surface so the gauge lies flat with the bonding side exposed. In some cases this may be difficult because of space limitations. If this situation occurs, leave enough slack in the tape to allow a finger to be slipped behind the gauge to support it while applying the adhesive.

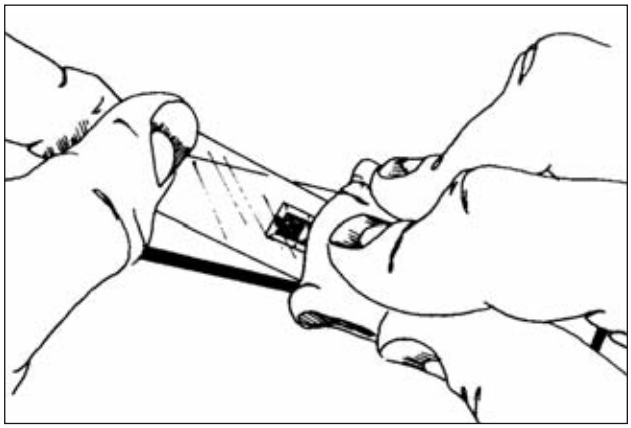
STEP 03



Coat the specimen, back of the gauge, and terminal strip with the prepared adhesive. The mixing rod can be used to apply a thin layer of adhesive over each surface. Be careful not to pick up any unmixed components of the adhesive. To ensure this, it is advisable to wipe the mixing rod clean and then pick up a very small amount of the adhesive from the center area of the adhesive jar.

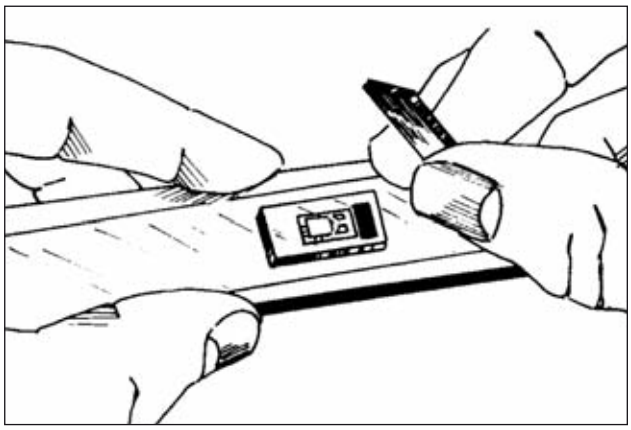
Immediately after coating the gauge and specimen with adhesive, proceed without delay to Step 8. This will limit the absorption of moisture by the uncured adhesive, and the gauge installation tape will serve as a temporary moisture barrier during curing.

STEP 04



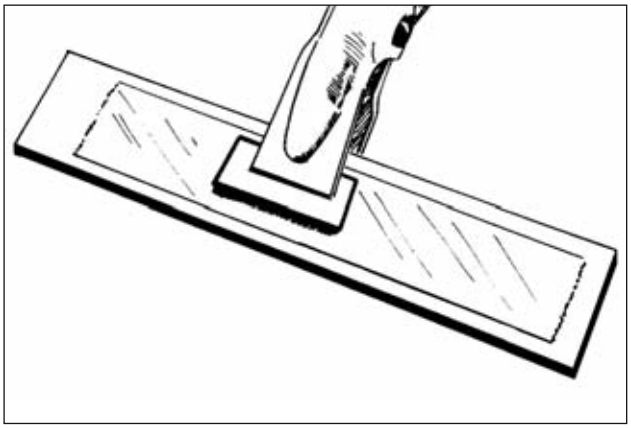
Lift the tucked-over end of tape and bridge it over the adhesive at approximately a 30-degree angle. With a piece of gauze, slowly make a single wiping stroke over the gauge/tape assembly, bringing the gauge back down over the alignment marks on the specimen. Use a firm pressure with your fingers when wiping over the gauge, since the adhesive is quite viscous. A very thin layer of adhesive is desired for optimum bond performance.

STEP 05



Place a silicone gum pad and backup plate (GT-14) over the gauge installation. The silicone gum should be soft (Durometer A40-60) and at least 3/32 in [2.5 mm] thick. This will allow the clamping force to be exerted evenly over the gauge. The area of the silicone gum pad should be used to compute the final clamping pressure.

STEP 06



Apply force by spring clamp or dead weight until a clamping pressure of 5 to 20 psi [35 to 135 kN/m2] is attained. Take special care in making sure the clamping pressure is equal over the entire gauge. Unequal clamping pressure may result in an irregular glueline. Take steps to ensure that the clamps will not slide out of position during cure. A few strips of tape to assist in holding the clamps or backup plate in place during cure may be helpful. Cure the installation in accordance with the recommended cure schedule below.

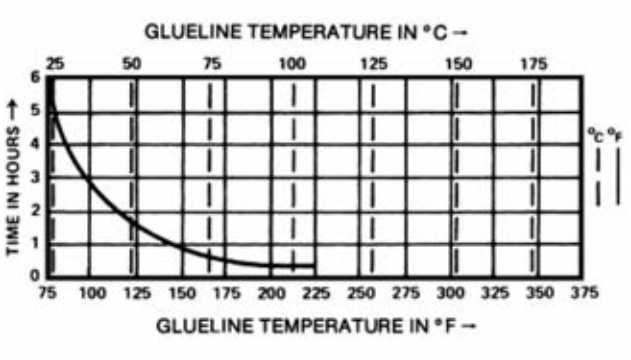
STEP 07

The gauge and terminal strip are now solidly bonded in place. To remove the tape, pull it back directly over itself, peeling it slowly and steadily off the surfaces. This technique will prevent possible lifting of the foil on openfaced gauges or otherwise damaging the installation. It is not necessary to remove this tape immediately after gauge installation. The tape will offer mechanical protection for the grid surface, and may be left in place until it is removed for gauge wiring.

ONCE **PROCEDURE B** IS COMPLETE, PROCEED TO **SECTION 07.2** OF THIS MANUAL TO CONTINUE THE STRAIN GAUGING PROCESS.

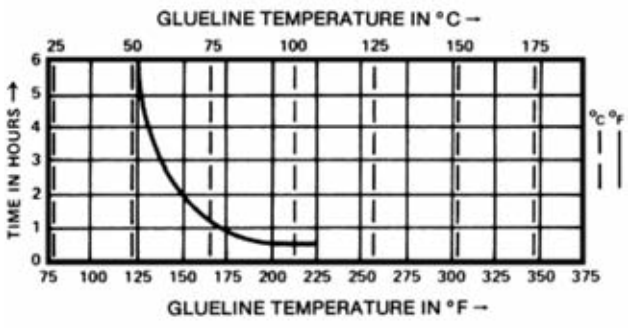
RECOMMENDED CURE SCHEDULES

M-BOND AE-10 AND GA-2



Caution: These systems may not cure properly below +70°F [+20°C]. Postcuring the installation for two hours at least +25°F [+15°C] above the maximum operating temperature with the clamping fixture removed will provide essentially creep-free performance.

M-BOND AE-15

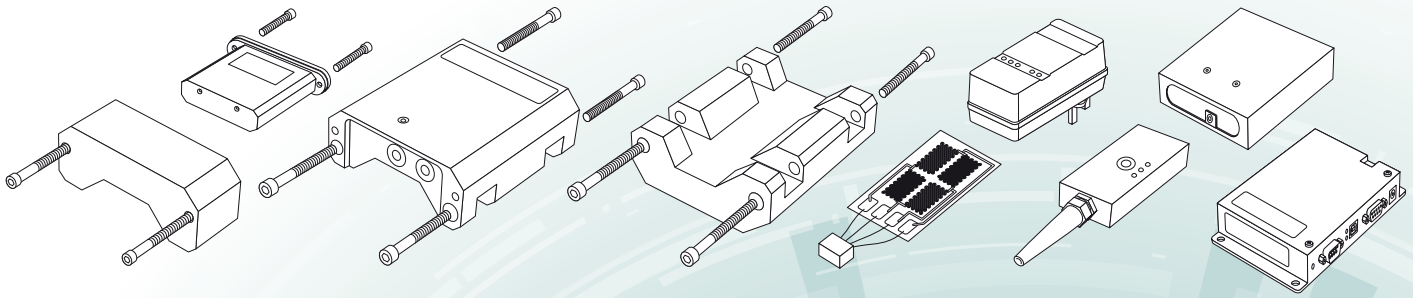


Caution: To ensure proper polymerization, the cure cycle should start within 1.5 hours after mixing.

NOTE: Do not exceed +225°F [+105°C] cure temperature.

DATUM ELECTRONICS

SHAFT POWER MONITORING KIT
INSTALLATION GUIDE



datum electronics

CONTENTS

INTRODUCTION

The Datum Shaft Power Monitoring Kit (SPMK) is a battery powered shaft-mounted transducer utilising wireless 2.4Ghz transmission for data transfer from the rotating shaft to the data receiver.

The shaft-mounted transducer is powered by a 1600mAh 4.8V NiMH battery pack. This is removable for quick replacement and charging away from the vehicle. The battery pack will give a transducer run time of approximately 30 days.

Two strain gauges can be bonded to the shaft to be measured, giving redundancy of measured data.

The data from the strain gauges is transmitted as raw mV/V. Battery voltage is also transmitted. The battery voltage can be used for monitoring the charge state and determining when battery replacement is necessary.

Measurement of shaft rotational speed is also measured by the receiver at one pulse per shaft revolution.

SYSTEM OUTLINE

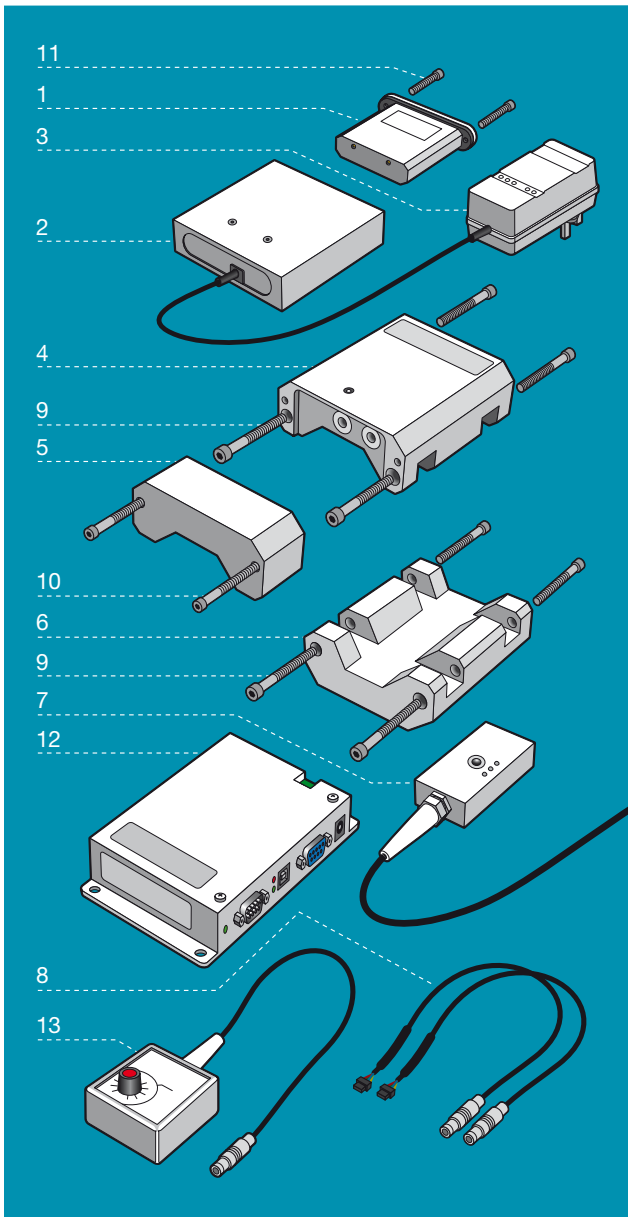
The system consists of two basic elements designed for measuring and transmitting the torque and speed of a shaft:

ON-SHAFT MOUNTED TRANSMITTER CONSISTING OF:

- TWO STRAIN GAUGES
- TRANSMITTER MODULE WITH BATTERY PACK

OFF-SHAFT MOUNTED RECEIVER CONSISTING OF:

- AS STANDARD USB AND RS232 OUTPUT FROM UNIVERSAL INTERFACE MODULE
- MAIN SUPPLY
- DIAGNOSTIC LED INDICATORS
- OPTIONAL SPEED SENSOR



CHECK LIST

It is recommended that all hardware, consumables, tools and software are checked and present before preparation and installation commences.

HARDWARE SYSTEM SUPPLIED

DESCRIPTION	QUANTITY
• 1: Battery pack 400105	1
• 2: Battery charger adaptor 400104	1
• 3: Battery charger Ansmann ASC110	1
• 4: Transmitter 400101	1
• 5: Transmitter cover	1
• 6: Balance weight 400104	1
• 7: Receiver module 400113	1
• 8: Gauge adaptor cables	2
• 9: Banding M6x40 securing bolts	8
• 10: Transmitter cover M5x45 securing bolts	2
• 11: Battery M5x20 securing bolts	2
• 12: Instrument interface 400152	1
• 13: Dummy transducer starain gauge simulator	1

STRAIN GAUGE INSTALLATION

There are four stages and components that are required for strain gauging:

1. Gauges -
   One per shaft test
2. Cleaning and Preparation -
   ensuring suitability for gauge installation
3. Adhesive -
   Temporary (up to 6 months) or Permanent (up to 10 years)
4. Protection -
   dependent on testing environment

Gauges

Gauges with connectors

Datum Electronics can supply fully encapsulated pre-wired gauges for simple installation. Other gauges can be used, please enquire with Datum Electronics.

DESCRIPTION	QUANTITY
• Datum SPMK gauges with connectors as supplied Gauges are not reusable. Please note gauges are not included in installation packs.	1

Typical consumables

Cleaning & preparation kit

Available from Datum Electronics

DESCRIPTION	QUANTITY
• M-Prep neutraliser 5A: 60ml bottle (6 shafts)	1
• M-Prep conditioner: 60ml bottle (6 shafts)	1
• 400 & 120 grit silicon carbon paper	2 pack
• Permanent marking pen: Sharpy	1
• Cotton tipper applicator:	Box of 100
• GSP-1 gauze sponges:	Box of 100
• Kimi wipe lint free tissues	1 Box

Typical adhesives kits

Temporary adhesives kit

Available from Datum Electronics

TEMPORARY ADHESIVES KIT - UP TO 5 SHAFTS
FOR UP TO 6 MONTHS INSTALLATION LIFESPAN

DESCRIPTION	QUANTITY
• Mbond 200 multi-pack	(5 x 2g containers)
• Catalyst C 200ml	1
• GSP-1 gauge tape	1

Permanent adhesives kit

Available from Datum Electronics

PERMANENT ADHESIVES KIT - UP TO 6 SHAFTS
FOR UP TO 10 YEAR INSTALLATION LIFESPAN

DESCRIPTION	QUANTITY
• Resin mixing jars (10g)	6
• Curing agent 10 Bottle (15ml)	1
• Calibrated pipettes	6
• Stirring rods	6
• Silicon gum pad	1
• 1” reel of Mylar tape	1

Typical environmental protection

M Coat-F environmental protection kit

Available from Datum Electronics

DESCRIPTION	QUANTITY
• Self adhering Teflon tape	1
• Butyl pliable rubber sealant	1
• Neoprene rubber sheets	1
• Aluminium foil tape	1
• M-Coat B: Air drying nitrile rubber coating	1

Consumables kit required

DESCRIPTION	QUANTITY
• Ballpoint pen	1
• Industrial degreaser	1
• Cable ties	6
• Cleaning rags	1
• TCW 24 tined copper wire	1
• Masking tape or marker pen	1 roll
• Banding	kit

Tool kit required

DESCRIPTION	QUANTITY
• Dremel	1
• Angle marking bar	1
• Metric hex driver set	1
• Large flat head screw driver	1
• Side cutters	1
• Tin snips	1
• Tweezers	1
• Notebook PC with test software	1
• Small toughened glass plate for gauge preperation	1

EQUIPMENT PREPARATION

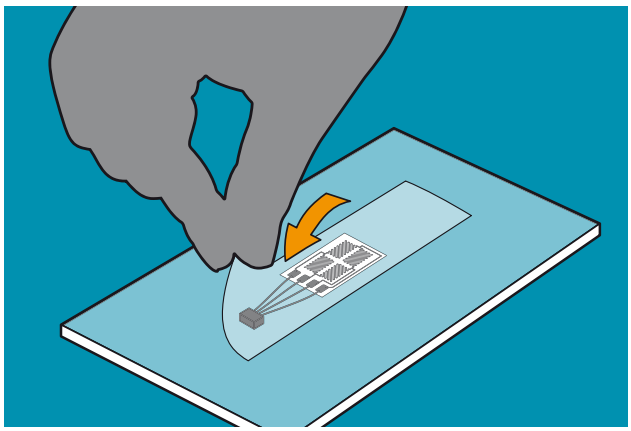
01

STRAIN GAUGE PREPARATION

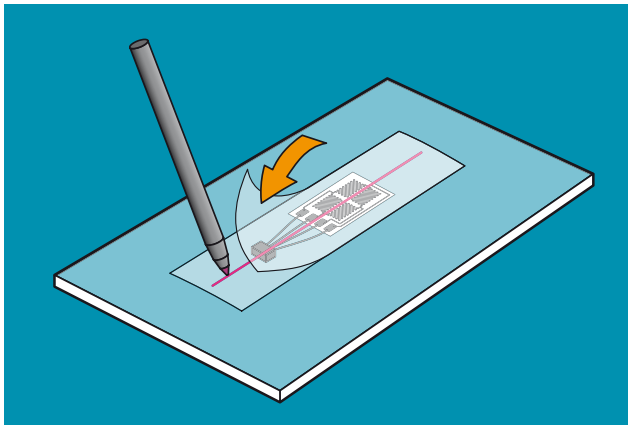
1. When mounting the strain gauge you will need to have prepared it on a glass plate with mylar tape. It is better to complete this stage in a clean room with good light before going on site.

   Clean the surface of the glass plate using the M-Prep Conditioner first and then the M-Prep Neutraliser. This will ensure that the plate is chemically clean.

2. Using tweezers place the gauge on the plate with the solder/cable side uppermost. Familiarise yourself with the gauge element orientation using a magnifying glass.



3. Cut a length of mylar tape approximately 150mm in length. Carefully offer the tape to the top side of the gauge and stick the gauge roughly in the centre of the mylar tape (see above).

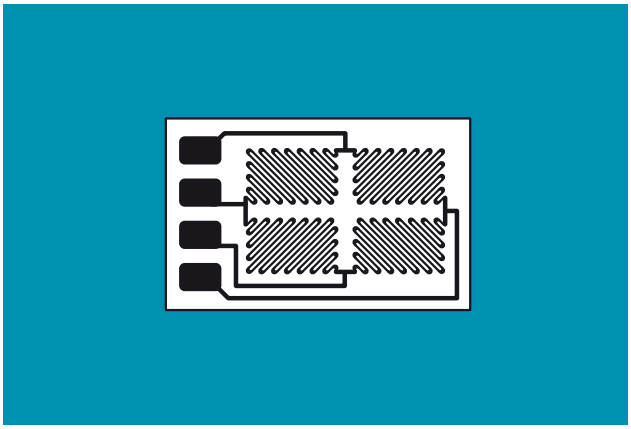


4. After applying the first layer of tape mark a line across the gauge (picture) using an indelible marker, parallel to the long side of the gauge. Then add a second layer of mylar tape. The second layer will stop the tape curling when applying the gauge.

   Lift the tape away, with the gauge now stuck to it, ensuring that you always handle the tape and not the gauge itself.

   IF NO PREPARED CLEAN SURFACE IS AVAILABLE:
   Cut a strip of mylar tape approximately 150mm in length. Lay the tape on a flat clean surface so that the adhesive backing is facing upwards. Remove the gauge from its packaging using a pair of clean tweezers using the minimum pressure possible. Carefully place the strain gauge in the centre of the mylar tape. During all processes take great care to avoid contaminating the gauge or mylar tape.

The strain gauge supplied is a full bridge encapsulated gauge complete with a connector. These simplify the installation process and remove the need for soldering on site.



The gauge has fine elements within it's grid that measure strain. These elements can be seen under a magnifier and should be aligned at 45 degrees to the axis of the shaft to measure the torsional strain.

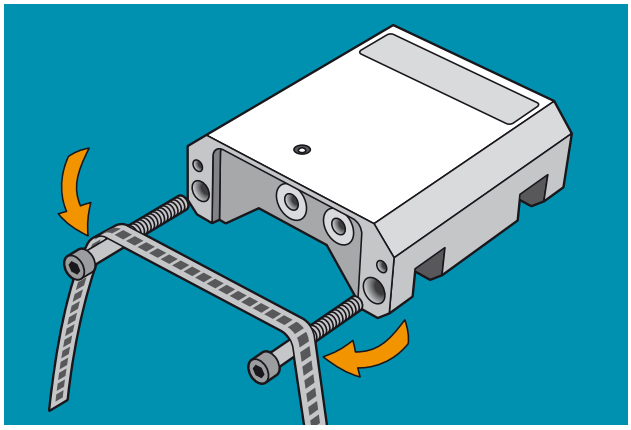
As these grid lines are difficult to see on site the gauges are supplied pre marked to show the alignment with the shaft. You should familiarise yourself with the gauge in a well lit environment before going to site where light may be limited.

STRAIN GAUGE PREPARATION IS NOW COMPLETE

02

TRANSMITTER ENCLOSURE PREPARATION

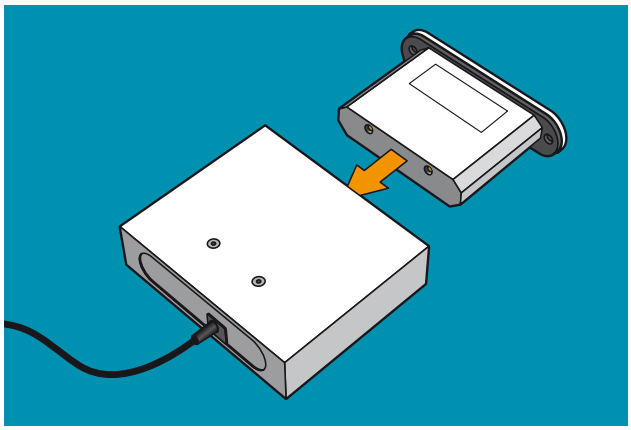
1. Remove Transmitter Enclosure Cover from Transmitter Assembly.
2. Measure drive shaft diameter and make a record.
3. Cut jubilee band to required length using tin snips. This length will be approx three times the diameter of the drive shaft.



4. Pre-form a jubilee band into a “U” shape by bending the band over the two cap head bolts in the Transmitter Enclosure (see above). This will give the jubilee band the correct shape to insert into the Transmitter Enclosure.
5. Feed jubilee band through slots in the Transmitter Enclosure.
6. Fit cap head bolts to Transmitter Enclosure to secure shaped jubilee bands in place. Tighten with hex driver.
7. Repeat steps 4 and 5 with jubilee bands and slots in the Balance Weight.
8. Fit cap head bolts to Balance Weight to secure shaped jubilee bands in place. Tighten with hex driver.

03

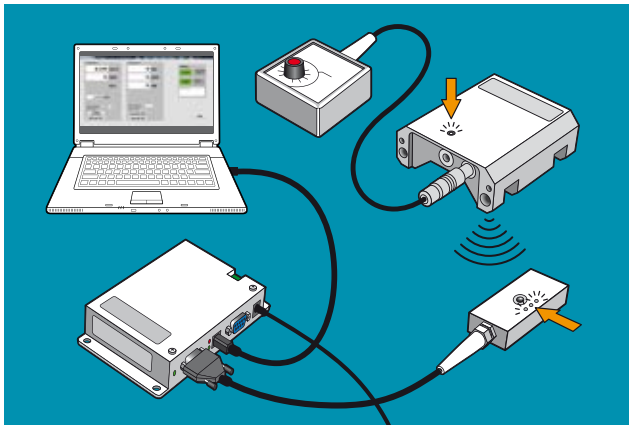
BATTERY TESTING AND INSTALLATION



1. Batteries should be received fully charged. Insert battery into slot in Transmitter Enclosure. Ensure that the battery is inserted the correct way up. If the light on the top of the Transmitter Enclosure flashes, then the battery is fully charged. If the light does not flash, place the battery in the battery charger (see above) until fully charged. When fully charged the green LED on the charger unit will light.

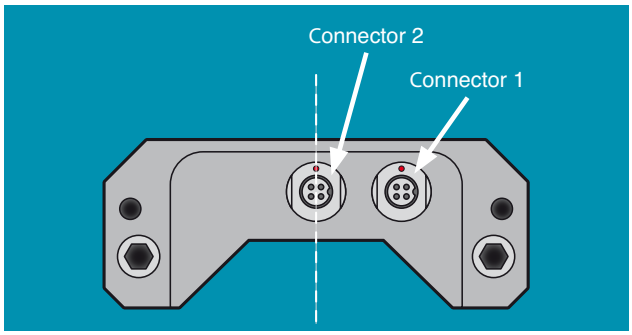
04

TRANSMITTER AND RECEIVER TESTING



Testing of Transmitter and Receiver communications is vital before on-site installation commences.

Connect the interface module to the test computer with only the USB cable connected. Then install the Powerkit software and connect up the off shaft receiver and power the interface module. The red LED will show on the receiver to indicate it is working. Place the battery in the on-shaft transmitter in the correct position; the LED on top of the transmitter will blink several times to show it has power. Connect the strain gauge simulator to connector port 1 (see below) on the on-shaft transmitter and move the selector to the zero position.



The green LED on the off-shaft receiver should now show one green light indicating that the transmitter and receiver are connected and good data is being transmitted

Wave the speed reflector in front of the off shaft receiver’s optical sensor and check that the green speed pulse LED lights to indicate the RPM counter is working correctly

Load the Powerkit software and correctly connect to the receiver/transmitter system. Once correctly connected move the strain gauge simulator through all the points and the onscreen torque value will change, wave the speed sensor in front of the off shaft receiver’s optical sensor and the RPM figure will change.

With no strain gauge connected the software will display approximately 3.26 mV/V for each channel. Now move the plug to the outside connector 2 and repeat the test.

Having completed this test you have tested the transmitter and your test receiver and gained a level of familiarity with the kit. The hardware and software checks are now complete.

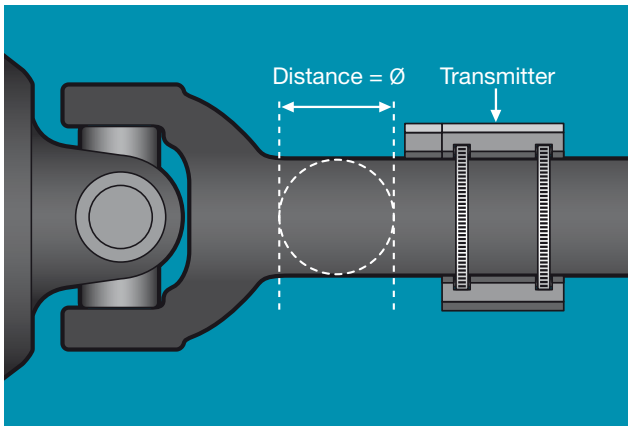
DRIVE SHAFT PREPARATION

05

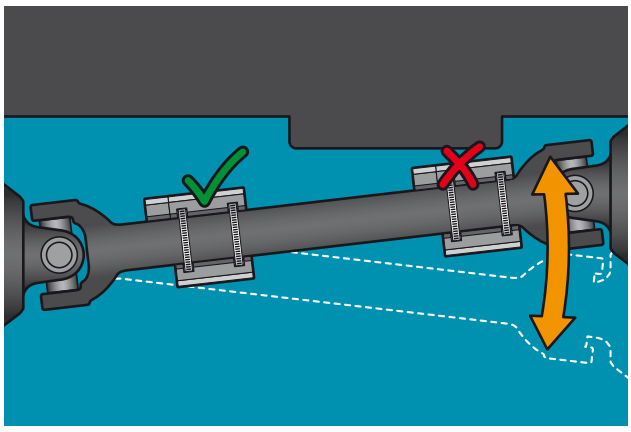
SELECTION OF INSTALLATION POSITION

The selection of a suitable area to be gauged on the shaft is vital to the success of the installation and data recovery. The area to be gauged should, where practicably possible, transmit the maximum level of torque/strain that is to be measured through the shaft.

1. The area should be large enough to mount the instrumentation. The dimensions of the on-shaft transmitter assembly can be used to indicate the size of the clean gauging area that will be required.



2. The gauging area should be no less than one shaft diameter away from any obstruction or shaft joint (see above).



3. There must not be any areas of interference once the instrumentation is mounted and the shaft is rotating. Changes in pitch/travel of the shaft during normal operation should be taken into account, with the instrumentation mounted clear of any obstructions caused by shaft pitch/travel (see above). If the instrumentation is mounted on a vehicle, suspension travel should also be accounted for.

   A suitable structure to mount the Receiver Module to should also be considered at this stage that allows the receiver's speed sensor to be aligned to the Transmitter. This will help to avoid complications later in the install process (review the location guide under 10.1).

4. There should be sufficient hand and working access to enable installation of the equipment and fitting of the battery.
5. Avoid any section of the shaft that contains major pitting or excessively deep scratches.
6. Offer complete Transmitter Assembly up to the chosen area to check clearance and also check for any rotational interferences.

06

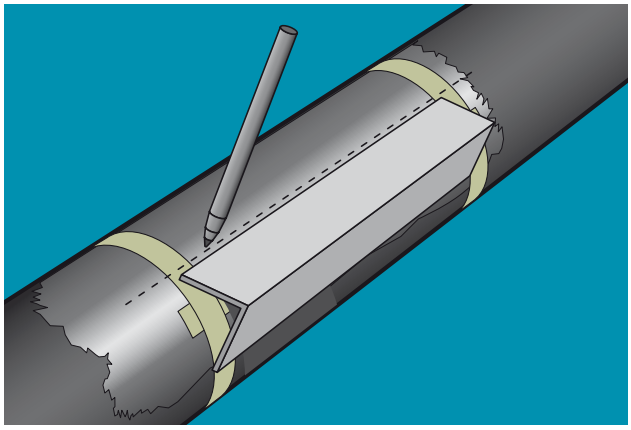
SURFACE PREPARATION

Once the installation position has been determined it is time to prepare the strain gauge area. Correct preparation of surfaces to be gauged is essential for successful equipment installation and data collection.

It is recommended that the chosen area of drive shaft is thoroughly cleaned and degreased prior to commencing strain gauging in order to prevent contaminating the gauge area.

BASIC CLEANING PREPARATION

1. Clean the chosen area using rags and industrial cleaner/degreaser (see above). Remove as much dirt and grease as possible.
2. Clean area again. Once area is clean commence marking out following the following steps.

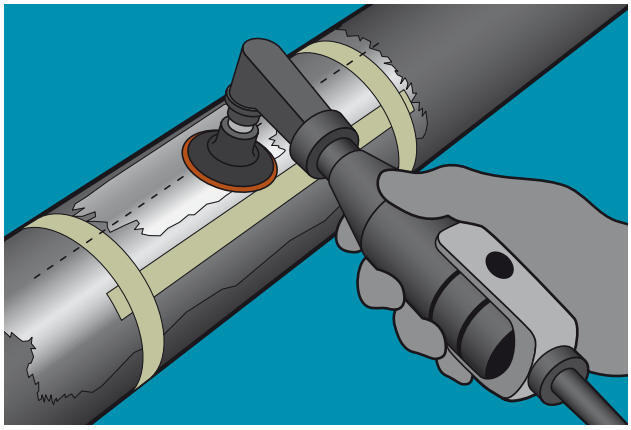


3. Place the angled bar flush to the shaft, and mark a line parallel to the shaft (see above) using a ball point pen.

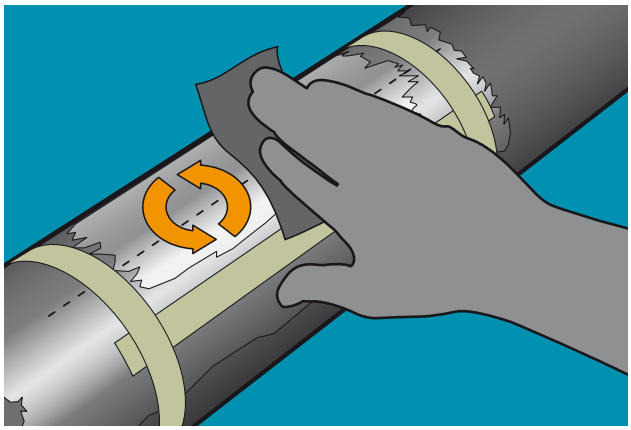
   Using the on-shaft transmitter assembly as a guide, roughly indicate the area to be cleaned using masking tape or permanent marker (see above).

SURFACE ABRADING

The surface of the drive shaft should be abraded to remove any loosely bonded adherents such as scale, rust, paint, galvanised coatings or oxides.



4. Begin with a grinder, Dremel, disc sander or file to coarsely abrade the surface and remove any large particles such as paint, rust or any other adherents (see above). Abrade with 80-120 grit abrasive to develop a surface texture suitable for bonding.



5. Second stage abrading uses silicon carbon paper of the appropriate grit. It is recommended that abrading should start at 120 grit progressing through to 400 grit in a random pattern to attain a flat, clean, and well keyed surface. (see previous picture).

The optimum surface finish for gauge bonding depends somewhat upon the nature and purpose of the installation. For general stress analysis applications, a relatively smooth surface is suitable.

WET ABRADING

Wet abrading is carried out using a conditioner solution. Conditioner is a mildly acidic solution which generally accelerates the cleaning process and, on some materials, acts as a gentle etchant.

6. Carry out final abrading with 400 grit paper while keeping the surface wet with conditioner solution. Use a random pattern to attain a flat, clean, and well keyed surface.

   Following cleaning the burnished line should still be visible. If working in poor light mark reference lines either side of the gauge markings to draw the eye to the burnished lines.

GAUGE LOCATION LAYOUT LINES

Gauge location layout lines should be made with a tool which burnishes, rather than scores or scribes, the surface. A scribed or scored line may raise a burr or create a stress concentration detrimental to strain gauge performance.

It is recommended that ballpoint pen is used for making alignment markings. Layout lines are ordinarily applied following the abrading operation and before final cleaning. All residues from the location marking operation should be removed by scrubbing with conditioner, as described in Stage 9 of the Surface Preparation process.

7. Mark out the strain gauge location layout lines for one or two gauges depending on your installation requirements. The gauges should be positioned in alignment with the burnished line. Once the protective covering is in place later in the install process the gauges should be within the base area of the on-shaft transmitter assembly so that it covers and protects them.

8. All masking tape can now be removed from the drive shaft.

SURFACE CONDITIONING

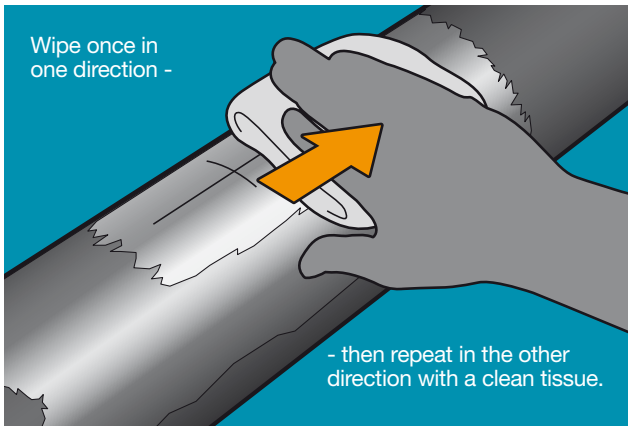
9. Repeatedly apply conditioner and scrub the surface with cotton tipped applicators until a clean tip is no longer discoloured by the scrubbing. During this process the surface should be kept constantly wet with the conditioner until cleaning is completed. Cleaning solutions should never be allowed to dry on the surface.

10. When clean, the surface should be dried by wiping across the cleaned area with a single slow stroke of a lint free tissue. The stroke should begin from well within the cleaned area and move outwards to avoid dragging contaminants in from the boundary of the area.

NEUTRALISING

The final step in surface preparation is to bring the surface condition back to an optimum alkalinity of 7.0 to 7.5 pH, which is suitable for all strain gauge adhesive systems.

11. Liberally apply neutraliser to the cleaned surface and scrub the surface with a cotton tipped applicator. The cleaned surface should be kept completely wet with neutraliser throughout this operation.



12. When neutralised, the surface should be dried by wiping across the cleaned area with a single slow stroke of a clean lint-free tissue. With a fresh lint-free tissue, a single stroke should then be made in the opposite direction, beginning within the cleaned area and moving outwards to avoid recontamination from the uncleaned boundary (see above).

The surface is now properly prepared for gauge bonding. Gauges should be installed as soon as possible after this operation.

PREPARATION IS NOW COMPLETE

INSTALLATION

07

GAUGE APPLICATION

You are now ready for strain gauge application.

The strain gauge supplied for this application is manufactured by Vishay Micro-Measurements Group to Datum specifications. The standard procedures for Vishay strain gauge application are described in Appendices 1 and 2 of this document.

1. The strain gauge is bonded to the shaft using one of two procedures.

PROCEDURE A

This is recommended for short trials of 4-8 weeks in duration and where time on-site is limited. This procedure utilises a cyanoacrylate adhesive (M-Bond 200) that will cure in approximately 60 seconds by thumb pressure.

PROCEDURE A IS LISTED IN DETAIL IN **APPENDIX 1** OF THIS DOCUMENT. THE INSTRUCTIONS IN THIS APPENDIX MUST BE FOLLOWED BEFORE MOVING TO THE NEXT STAGE.

PROCEDURE B

This is recommended for longer term installations where strain gauges will need operate for upto 10 years. This procedure utilises a two part epoxy adhesive that cures in six hours at 20˚C, reducing to one hour at 60˚C. The gauge is held by a pressure pad while curing.

PROCEDURE B IS LISTED IN DETAIL IN **APPENDIX 2** OF THIS DOCUMENT. THE INSTRUCTIONS IN THIS APPENDIX MUST BE FOLLOWED BEFORE MOVING TO THE NEXT STAGE.

2. **After applying the strain gauges as described in the Appendices,** the gauges should be visually inspected to check that the bonds are secure, and that there are no significant air bubbles or inclusions present under the strain gauge.

The gauge, once bonded, will have an offset due to the distortion of the gauge around the radius and also by the action of applying hand pressure during the bonding process. The level of offset will vary from installation to installation. The offset of the gauge can be measured using a PC connected to the Receiver running the software utility. The output of the gauge, and hence the offset, will be shown in mV/V. Typically this reading will be +/-0.000mV/V to +/-0.500mV/V, the instrumentation being designed to cater for an offset of up to 1.000mV/V. If the offset is greater than this value the installation is likely to be faulty. This may be caused by an uneven or twisting pressure at installation. If the gauge offset is greater than 1.0mV/V you will need to replace the gauge. Clean the area and repeat the gauge installation.

Alternatively, this offset can be measured using the handheld indicator Datum Type 324.

3. Once the gauge is installed, and with either a handheld indicator or PC connected, you should apply a twist to the shaft. As you twist the shaft you should see the strain gauge registering an increase or decrease. Applying about +/-30Nm force by hand will be sufficient, for example, by rotating the shaft with a small bar through the axle joint if the equipment is installed on a vehicle. The value should increase/decrease slightly and then return to the start value as the twist is released (see above).

   Note the value for the gauge with no load at this stage as this will be required for future testing and diagnostics.

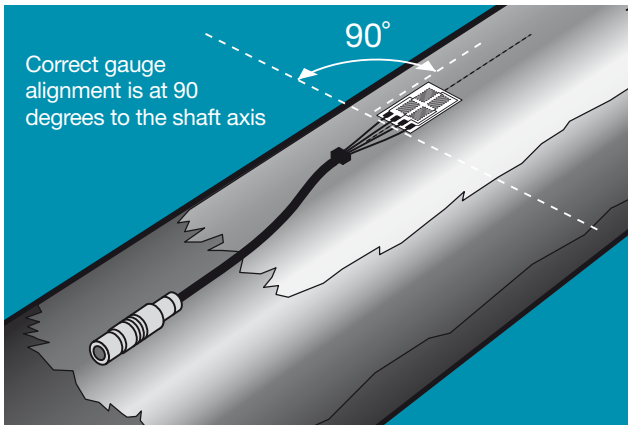
STRAIN GAUGE INSTALLATION IS NOW COMPLETE

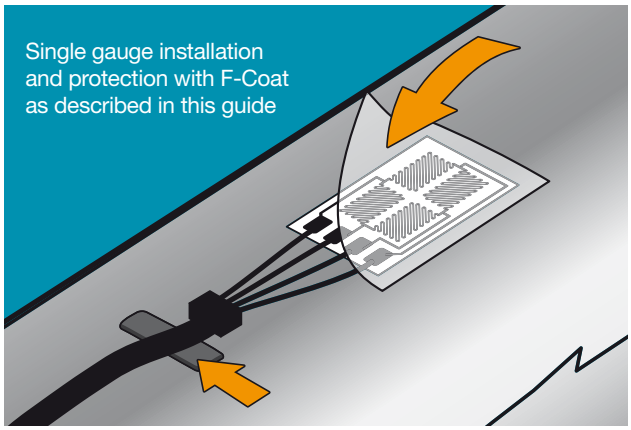
08

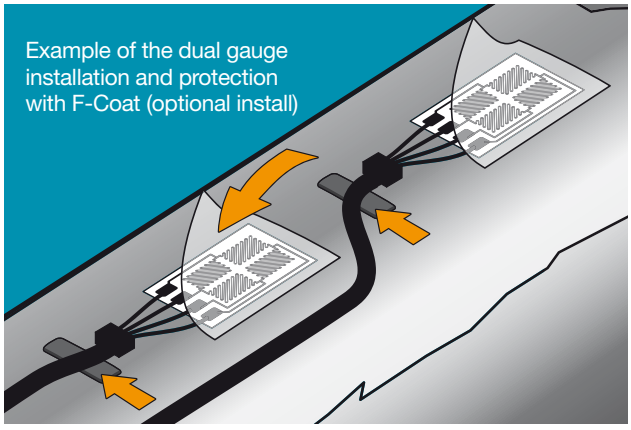
RECOMMENDED PROTECTION OF THE STRAIN GAUGE

The protection of strain gauges is vital in order to maintain good strain readings.

Excessive moisture or ingress of other fluids may cause a strain gauge to drift, resulting in poor or unrealistic readings. When encapsulated strain gauges are being used the following process offers a suitable level of protection.

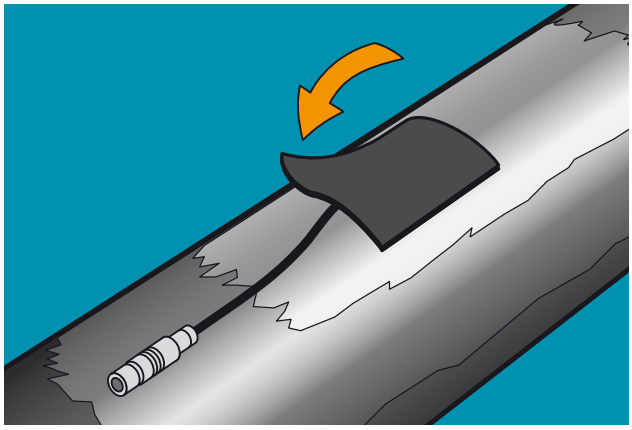




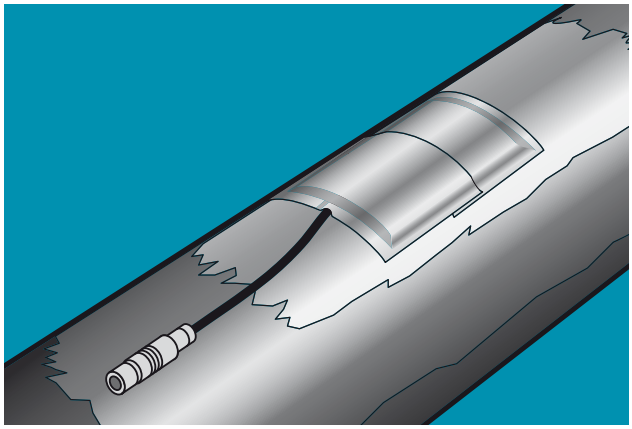


1. Cut a strip of F-Coat, approximately 5mm x 15mm and position under the connecting wires of the strain guage.
2. Cut a piece of Teflon tape to cover the gauge and the connector approx 30mm, and stick over the strain gauge onto the cleaned area where the strain gauge is bonded to the shaft, but not over the F-Coat you have just applied (see previous single gauge diagram).

   Apply pressure to the edges of the Teflon tape to provide a good seal around the gauge.

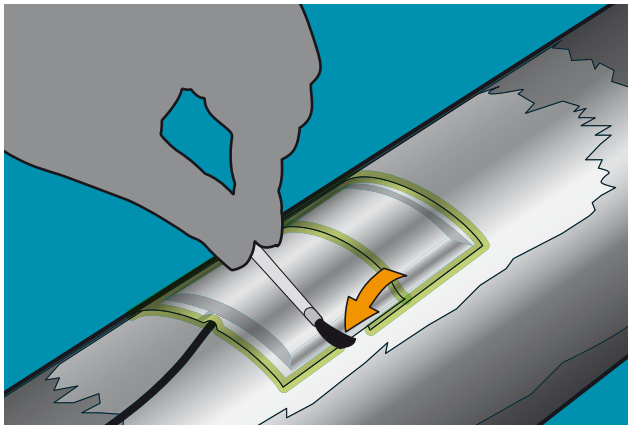


3. Cut another larger strip of F-Coat, large enough to cover the strain gauge and the area of Teflon, and stick over gauge onto the cleaned area where the strain gauge is bonded to the shaft (see above). Apply pressure to the edges of the F-Coat to provide a good seal around the gauging area.

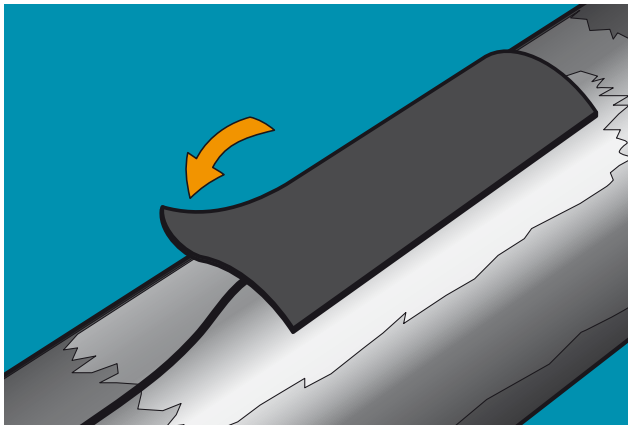


4. Cut two pieces of 10- foil from the F-Coat Kit large enough to overlap each other by approximately 10mm and to cover the F-Coat area by at least 10mm to allow bonding to the cleaned shaft area. Place the first piece of foil down over half of the F-Coat covered area at the opposite end to the connector cables. Press and smooth the edges down to form a good seal to the cleaned shaft area.

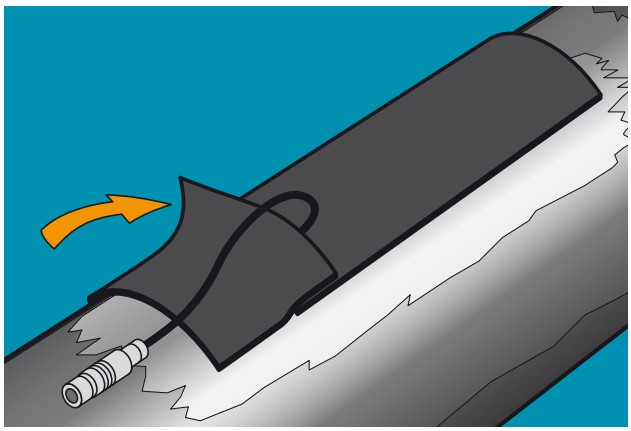
   Now place the second piece of foil covering the opposite end of the F-Coat covered area, overlapping the first piece of foil and the F-Coat. Press and smooth down the foil to the shaft to form tightly around the cables and produce a good seal.



5. Use the applicator brush to paint M-Coat B arround the edges of the foil where it meets the shaft surface to give a good seal (see above). Also paint the M-Coat B along the join of the two foil pieces where they overlap each other. Pay particular attention around the area where the cables exit the foil.



6. Cut a strip of GAK 7 butyl mastic protective covering, approximately 50 x 100mm. This should be large enough to cover the foiled area and stick onto cleaned shaft area. Carefully press the mastic firmly over the strain gauge cable but leaving it exposed. (see above).



7. Cut a second strip of GAK 7 butyl mastic protective covering approximately 50 x 40mm.

   Press a second patch of GAK 7 butyl mastic half onto the cleaned shaft area and half overlapping the patch from Step 6, leaving the strain gauge cable exposed (see above). Gently press down to form a good seal on all edges.

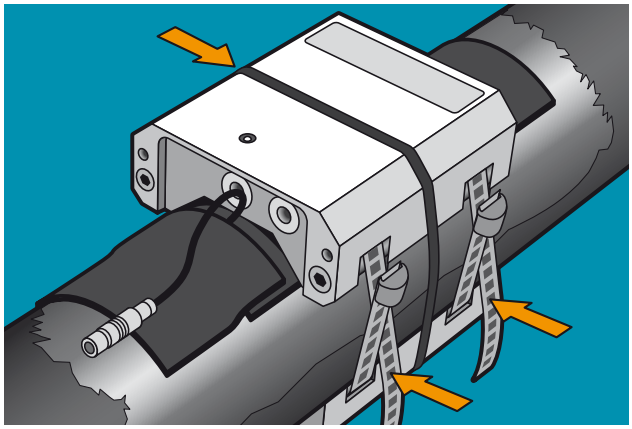
   The shaft area needs to be chemically clean for the mastic to adhere - warming the mastic to 25-30C will also assist with fitting and adhesion.

PROTECTION OF STRAIN GAUGE IS COMPLETE

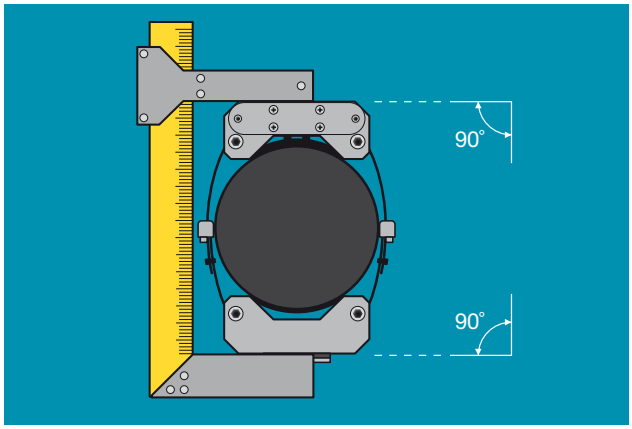
09

TRANSMITTER INSTALLATION

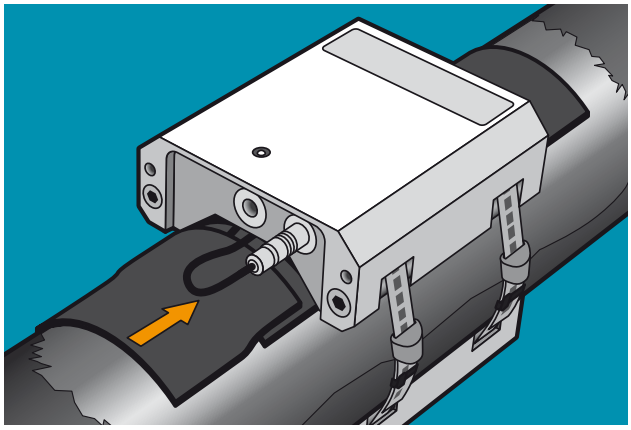
1. Place Transmitter Enclosure over the protected gauge area ensuring that the gauge wire does not become trapped in any way.



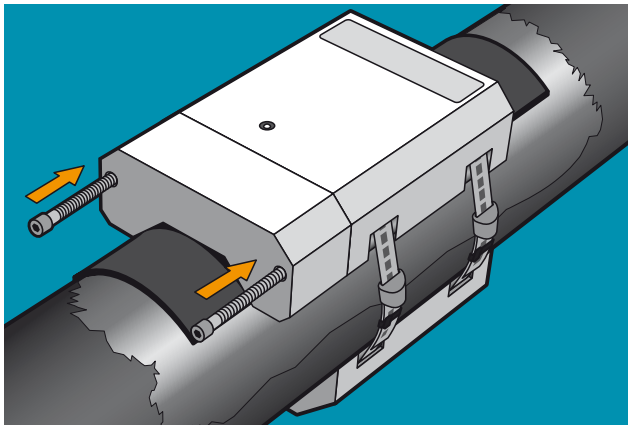
2. Position Balance Weight beneath shaft and temporarily secure Balance Weight and Transmitter in position using a cable tie (see above).



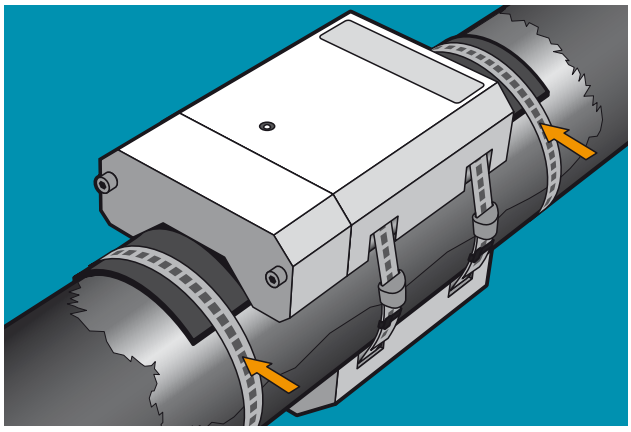
3. Tighten screws in jubilee bands until the Transmitter and Balance Weight are secured together and securely fixed to the shaft. Take care to ensure that the Transmitter and Balance Weight are equally spaced and at 180 degrees to each other (see above).
4. To secure jubilee cable straps, firstly cut a length of tinned copper wire 100mm in length. Wrap the copper wire around the jubilee straps, through the screw slot, and twist together. Trim away any excess.
5. Cable tie the jubilee band ends together.



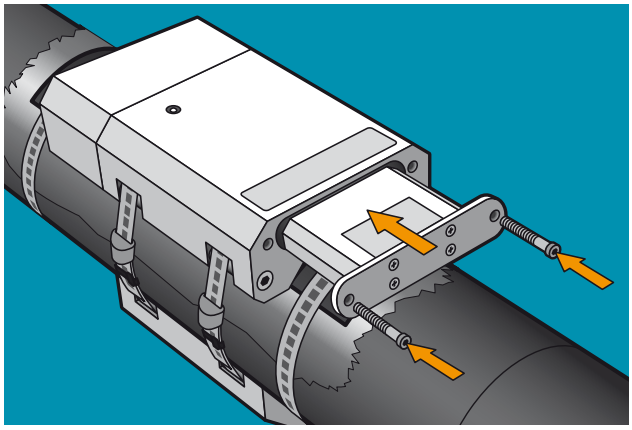
6. Plug the strain gauge connector into Transmitter socket (see above). Wrap excess cable around the connector.



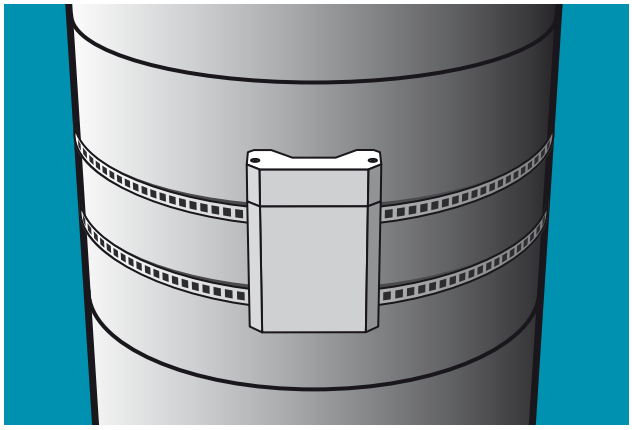
7. Secure the Transmitter Enclosure Cover onto the Transmitter using two M5 x 40 cap head screws.



For higher speed shafts any exposed patches of mastic will require a mechanical constraint from nylon tape or a mechanical strapping such as jubilee bands (see above).



8. Insert Battery Pack and secure in position using two M5 x 40 cap head screws (see above).

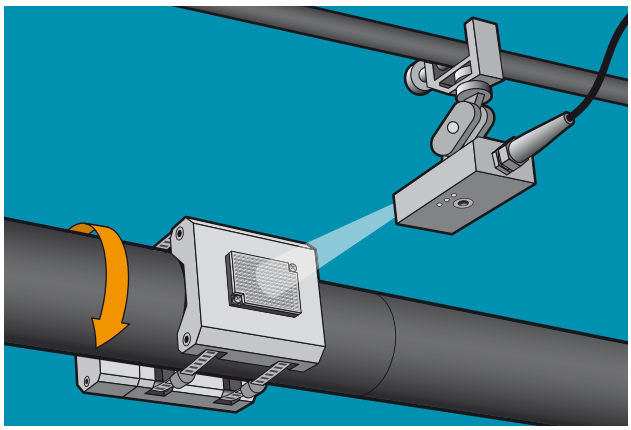


Installation of the equipment on large diameter shafts can easily be catered for by adjusting the length of the jubilee bands (see example above).

TRANSMITTER INSTALLATION IS NOW COMPLETE

10

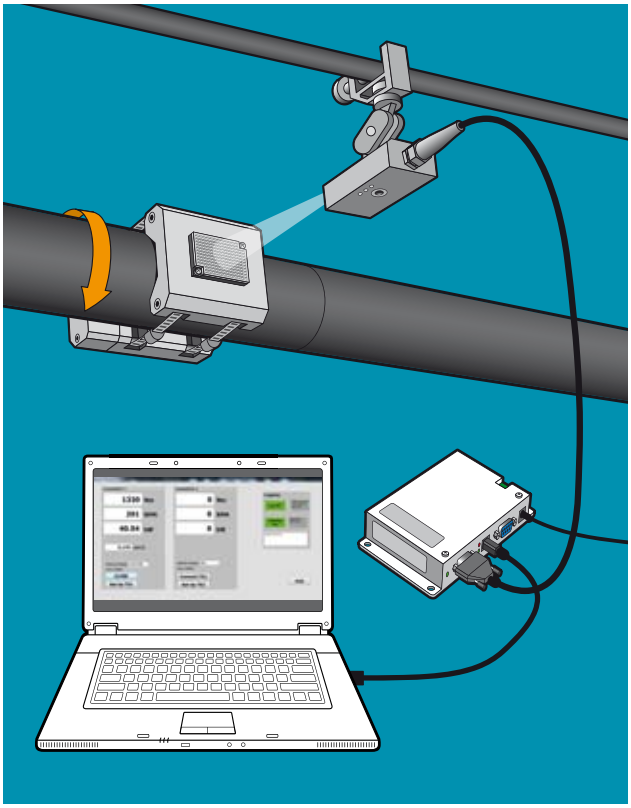
RECEIVER INSTALLATION



1. The Receiver Module should be located as close as practicably possible to the Transmitter Assembly, ideally within 0.2 - 0.5 metres distance from the Transmitter, and a maximum distance of 1 metre. Locate a suitable structure to mount the Receiver Module to, within this range that also allows the receiver's speed sensor to be aligned to the Transmitter.

   The optical speed sensor on the Receiver Module should be aligned perpendicular to the reflector on the counter weight to ensure the beam is reflected back to the Receiver and metered correctly (see illustration above).

   Attach the multi-position mounting bracket to the Receiver Module by screwing it to the mounting thread and firmly tighten the locking wheel. Clamp the multi-position mounting bracket to the structure and position the optical sensor to aim at the reflector on the counter weight as described above. Tighten all the locking wheels on the multi-position mounting bracket firmly.



2. Connect the cable from the Receiver to the Instrumentation using the RS232 connector.

   The cable run from the Receiver to the Instrumentation should be cable tied approximately every 0.5 metres.

   IMPORTANT NOTE: When running cable ensure that it is not mounted in any area that may become damaged by the moving or rotational machinery, for example vehicle suspension.

   Coil up and securely tie any excess cable.

   If necessary trim the cable to length and wire into the 5-way terminal block, colour matched to RTL equipment terminations.

RECEIVER INSTALLATION IS NOW COMPLETE

APPENDIX 01

UNDERSTANDING THE TRANSMITTER AND RECEIVER LEDs

Understanding the LED's on Datum's 2.4GHz radio based Torque Meters and help diagnosing communication problems.

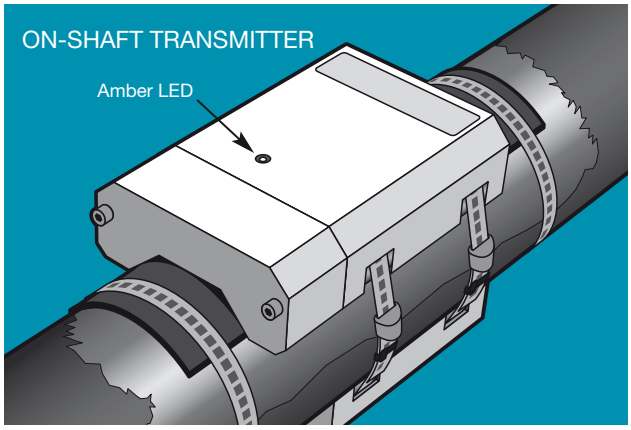
ON-SHAFT TRANSMITTER

The on-shaft transmitter has only one LED mounted in the Transmitter assembly.

AMBER LED 1: This LED will flash fast for up to 3 seconds whilst trying to connect to the receiver when the power is first applied to the Stator Assembly. If the LED doesn't flash at all, check the Stator Assembly is powered ON, ensure that the Rotor Assembly is correctly aligned with the Stator Assembly and the correct air-gap has been set (according to the installation instructions - 10mm nominally).

When the transmitter has connected to the receiver, the AMBER LED will flash once a sample has been acquired; this sample rate is 10 times a second for the standard sample rate of 10 SPS.

If the transmitter cannot connect to the receiver the AMBER LED will flash briefly once every three seconds (power saving mode). If this happens, check the status of the PSU Interconnection Box LED's (see the LED guide below); check that power is supplied to the off-shaft receiver; the equipment that supplies power to the off-shaft receiver is powered on, etc.



OFF-SHAFT RECEIVER

The Receiver has four LED's.

RED LED 1: Is illuminated if no data has been received from the transmitter for more than 2 seconds. It is extinguished as soon as data is received.

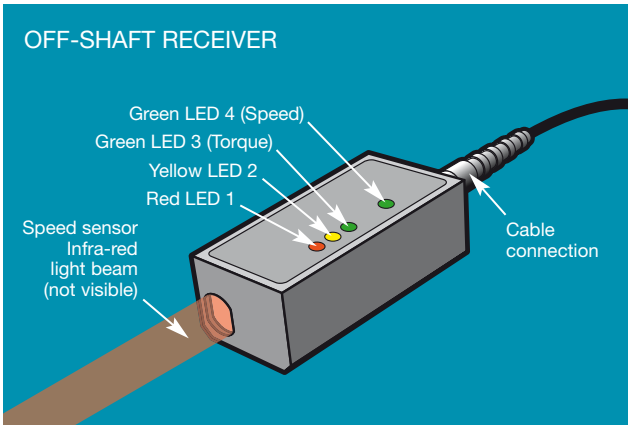
YELLOW LED 2: Flashes if data is not received when expected. It will continue to flash as long as no data is received for a period of approximately 2 seconds, after which after which it will be extinguished and the Red LED will illuminate. If data is received the Yellow LED will be extinguished.

GREEN LED 3 (Torque): Flashes briefly every time data is received from the on-shaft transmitter. In normal operation this will flash approximately 5 times per seconds, indicating reception of continuous data. Reception of data is only an indication of the integrity of the data transmission between the on-shaft transmitter and the off-shaft receiver; it does not convey any indication of the accuracy of the data received.

If no LED's are visible, check that power is supplied to the off-shaft receiver, the equipment that supplies power to the off-shaft receiver is powered on. Ensure that the circular connector to the off-shaft receiver is screwed in tight, no cables are damaged and in-line fuses are correct. Try power cycling the off-shaft receiver (undo the circular connect remove for a moment and reconnect, look at the LED's and confirm the correct operation as above.

Note: Ensure that the on-shaft transmitters Yellow LED is flashing before power cycling the off-shaft receiver to ascertain that a connection can be made.

GREN LED 4 (Speed) is illuminated whenever the speed sensor senses the reflective material on the power band segment. As such, it should flash once per revolution when the shaft is rotating.



APPENDIX 02

PROCEDURE A: STRAIN GAUGE INSTALLATION FOR SHORT TERM USAGE

THE STRAIN GAUGES SUPPLIED ARE MANUFACTURED BY **VISHAY MICRO-MEASUREMENTS GROUP** TO DATUM SPECIFICATIONS.

SHOULD MATERIALS SPECIFIED NOT BE AVAILABLE, OR THERE ARE PROCESSES WHICH REQUIRE CLARIFICATION, CONTACT YOUR **LOCAL VISHAY OFFICE** FOR ADVICE AND RECOMMENDATIONS.

INTRODUCTION

Micro-Measurements Certified M-Bond 200 is an excellent general-purpose laboratory adhesive because of its fast room-temperature cure and ease of application.

When properly handled and used with the appropriate strain gauge, M-Bond 200 can be used for high-elongation tests in excess of 60 000 microstrain, for fatigue studies, and for one-cycle proof tests to over +200 °F [+95 °C] or below -300 °F [-185°C]. The normal operating temperature range is -25° to +150°F [-30° to +65°C]. MBond 200 is compatible with all Micro-Measurements strain gauges and most common structural materials.

When bonding to plastics, it should be noted that for best performance the adhesive flowout should be kept to a minimum. For best reliability, it should be applied to surfaces between the temperatures of +70° and +85°F [+20° to +30°C], and in a relative humidity environment of 30% to 65%.

M-Bond 200 catalyst has been specially formulated to control the reactivity rate of this adhesive. The catalyst should be used sparingly for best results. Excessive catalyst can contribute many problems; e.g., poor bond strength, age-embrittlement of the adhesive, poor glueline thickness control, extended solvent evaporation time requirements, etc.

Since M-Bond 200 bonds are weakened by exposure to high humidity, adequate protective coatings are essential.

This adhesive will gradually become harder and more brittle with time, particularly if exposed to elevated temperatures. For these reasons, M-Bond 200 is not generally recommended for installations exceeding one or two years.

For proper results, the procedures and techniques presented here should be used with qualified Micro- Measurements installation accessory products (refer to Catalog A-110). Those used in this procedure are:

- CSM Degreaser or GC-6 Isopropyl Alcohol
- Silicon Carbide Paper
- M-Prep Conditioner A
- M-Prep Neutraliser 5A
- GSP-1 Gauze Sponges
- CSP-1 Cotton Applicators
- PCT- 2M Gauge Installation Tape

SHELF AND STORAGE LIFE

M-Bond 200 adhesive has a minimum shelf life of three months at +75°F [+24°C] after opening and with the cap placed back onto the bottle immediately after each use.

NOTE: To ensure the cap provides a proper seal, the bottle spout should be wiped clean and dry before replacing the cap.

Unopened M-Bond 200 adhesive may be stored up to three months at +75°F [+24°C] or six months at +40°F [+5°C].

HANDLING PRECAUTIONS

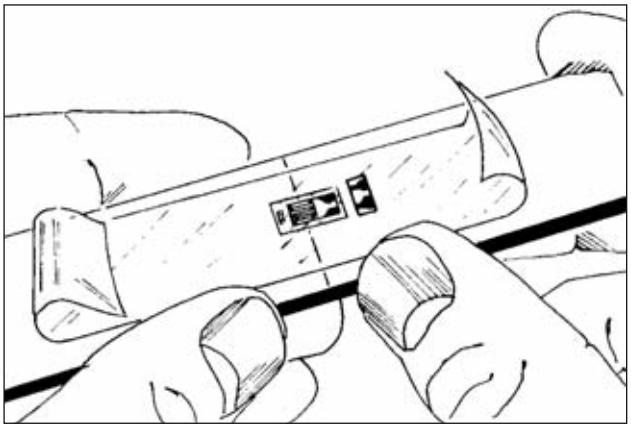
M-Bond 200 is a modified alkyl cyanoacrylate compound. Immediate bonding of eye, skin or mouth may result upon contact. Causes irritation. The user is cautioned to: (1) avoid contact with skin; (2) avoid prolonged or repeated breathing of vapors; and (3) use with adequate ventilation. For additional health and safety information, consult the Material Safety Data Sheet, which is available upon request.

NOTE: Condensation will rapidly degrade adhesive performance and shelf life; after refrigeration the adhesive must be allowed to reach room temperature before opening, and refrigeration after opening is not recommended.

GAUGE APPLICATION TECHNIQUE

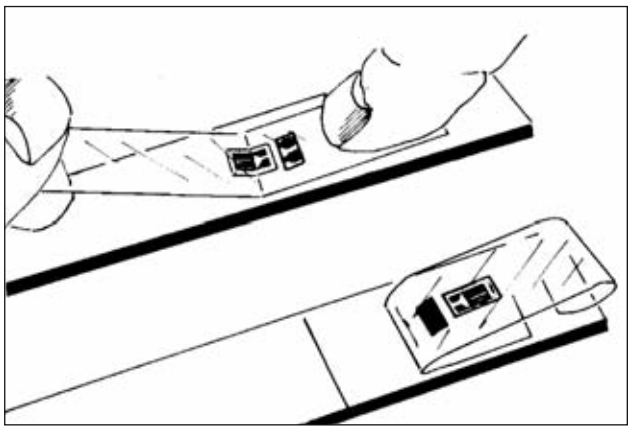
The installation procedure presented on the following pages is somewhat abbreviated and is intended only as a guide in achieving proper gauge installation with M-Bond 200. Micro-Measurements Application Note B-129 presents recommended procedures for surface preparation, and lists specific considerations which are helpful when working with most common structural materials.

STEP 01



Position the gauge/tape assembly so that the triangle alignment marks on the gauge are over the layout lines on the specimen. If the assembly appears to be misaligned, lift one end of the tape at a shallow angle until the assembly is free of the specimen. Realign properly, and firmly anchor at least one end of the tape to the specimen. Realignment can be done without fear of contamination by the tape mastic if Micro-Measurements PCT-2M gauge installation tape is used, because this tape will retain its mastic when removed.

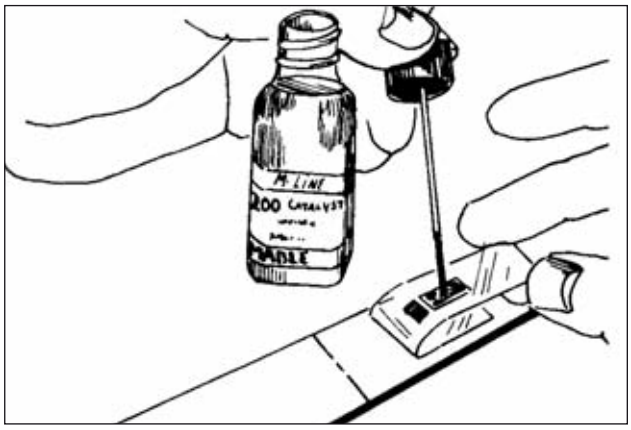
STEP 02



Lift the gauge end of the tape assembly at a shallow angle to the specimen surface (about 45 degrees) until the gauge and terminal are free of the specimen surface. Continue lifting the tape until it is free from the specimen approximately 1/2 in [10 mm] beyond the terminal. Tuck the loose end of the tape under and press to the specimen surface so that the gauge and terminal lie flat, with the bonding surface exposed.

NOTE: Micro-Measurements gauges have been treated for optimum bonding conditions and require no pre-cleaning before use unless contaminated during handling. If contaminated, the back of any gauge can be cleaned with a cotton-tipped applicator slightly moistened with M-Prep Neutraliser 5A.

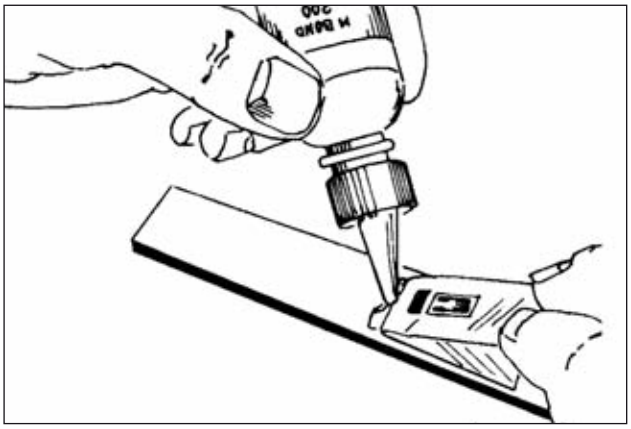
STEP 03



M-Bond 200 catalyst can now be applied to the bonding surface of the gauge and terminal. M-Bond 200 adhesive will harden without the catalyst, but less quickly and reliably. Very little catalyst is needed, and it should be applied in a thin, uniform coat. Lift the brush-cap out of the catalyst bottle and wipe the brush approximately 10 strokes against the inside of the neck of the bottle to wring out most of the catalyst. Set the brush down on the gauge and swab the gauge backing. Do not stroke the brush in a painting style, but slide the brush over the entire gauge surface and then the terminal. Move the brush to the adjacent tape area prior to lifting from the surface. Allow the catalyst to dry at least one minute under normal ambient conditions of +75°F [+24°C] and 30% to 65% relative humidity before proceeding.

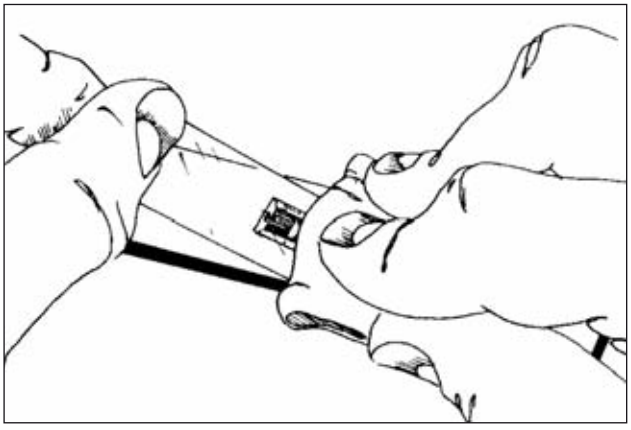
NOTE: **THE NEXT THREE STEPS MUST BE COMPLETED IN THE SEQUENCE SHOWN, WITHIN 3 TO 5 SECONDS. READ STEPS 8, 9, AND 10 BEFORE PROCEEDING.**

STEP 04



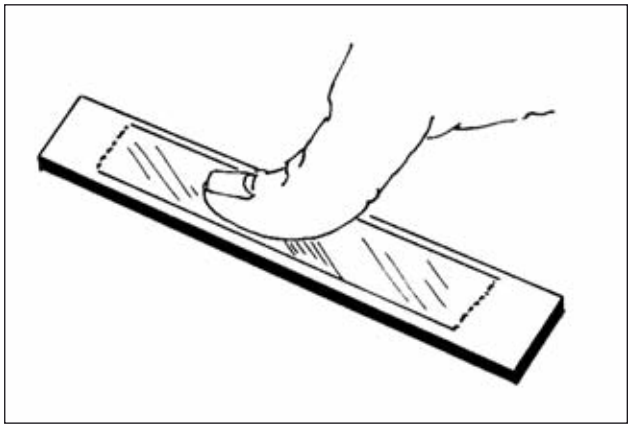
Lift the tucked-under tape end of the assembly, and, holding in the same position, apply one or two drops of MBond 200 adhesive at the fold formed by the junction of the tape and specimen surface. This adhesive application should be approximately 1/2 in [13 mm] outside the actual gauge installation area. This will insure that local polymerization that takes place when the adhesive comes in contact with the specimen surface will not cause unevenness in the gauge glueline.

STEP 05



Immediately rotate the tape to approximately a 30-degree angle so that the gauge is bridged over the installation area. While holding the tape slightly taut, slowly and firmly make a single wiping stroke over the gauge/tape assembly with a piece of gauze bringing the gauge back down over the alignment marks on the specimen. Use a firm pressure with your fingers when wiping over the gauge. A very thin, uniform layer of adhesive is desired for optimum bond performance.

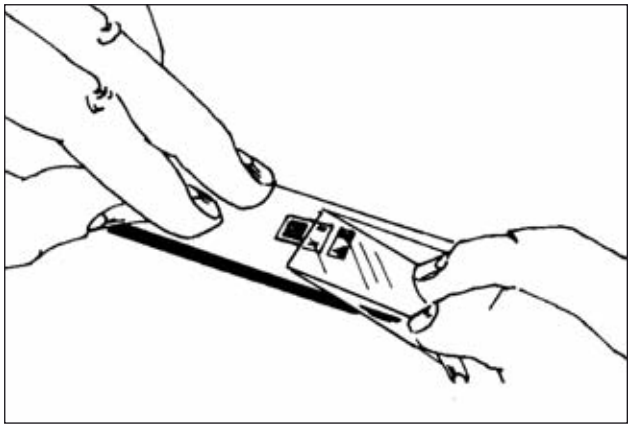
STEP 06



Immediately upon completion of wipe-out of the adhesive, firm thumb pressure must be applied to the gauge and terminal area. This pressure should be held for at least one minute. In low-humidity conditions (below 30%), or if the ambient temperature is below +70°F [+20°C], this pressure application time may have to be extended to several minutes.

Where large gauges are involved, or where curved surfaces such as fillets are encountered, it may be advantageous to use preformed pressure padding during the operation. Pressure-application time should again be extended due to the lack of "thumb heat" which helps to speed adhesive polymerization. Wait two minutes before removing tape.

STEP 07



The gauge and terminal strip are now solidly bonded in place. It is not necessary to remove the tape immediately after gauge installation. The tape will offer mechanical protection for the grid surface and may be left in place until it is removed for gauge wiring. To remove the tape, pull it back directly over itself, peeling it slowly and steadily off the surface. This technique will prevent possible lifting of the foil on open-faced gauges or other damage to the installation.

ONCE **PROCEDURE A** IS COMPLETE, PROCEED TO **SECTION 07.2** OF THIS MANUAL TO CONTINUE THE STRAIN GAUGING PROCESS.

APPENDIX 03

PROCEDURE B: STRAIN GAUGE INSTALLATION FOR LONG TERM USAGE

THE STRAIN GAUGES SUPPLIED ARE MANUFACTURED BY **VISHAY MICRO-MEASUREMENTS GROUP** TO DATUM SPECIFICATIONS.

SHOULD MATERIALS SPECIFIED NOT BE AVAILABLE, OR THERE ARE PROCESSES WHICH REQUIRE CLARIFICATION, CONTACT YOUR **LOCAL VISHAY OFFICE** FOR ADVICE AND RECOMMENDATIONS.

INTRODUCTION

The three adhesives described in this bulletin, M-Bond AE- 10, AE-15, and GA-2, are all 100%-solids epoxy systems for use with strain gauges and special-purpose sensors. The gauge installation procedure described is appropriate for each adhesive, the primary differences in the systems being in mixing instructions, pot life, cure cycles, and, to some extent, elongation properties. Each system is effective from the cryogenic region to +200°F [+95°C].

For proper results, the procedures and techniques presented in this bulletin should be used with qualified Micro-Measurements installation accessory products (refer to Micro-Measurements Accessories Catalog A-110). Accessories used in this procedure are:

- CSM Degreaser or GC-6 Isopropyl Alcohol
- CSP-1 Cotton Applicators
- PCT-2M Gauge Installation Tape
- Silicon-Carbide Paper
- MJG-2 Mylar Tape
- M-Prep Conditioner A
- HSC Spring Clamp
- M-Prep Neutraliser 5A
- GT-14 Pads and Backup Plate
- GSP-1 Gauze Sponges

HANDLING PRECAUTIONS

While these bonding agents are considered relatively safe to handle, contact with skin and inhalation of their vapors should be avoided. Immediate washing with ordinary soap and water is effective in cleansing should skin contact occur. For eye contact, rinse thoroughly with a copious amount of water and consult a physician. For additional health and safety information, consult the material safety data sheet, which is available upon request.

MIXING INSTRUCTIONS AND ADHESIVE CHARACTERISTICS

A. GENERAL

1. Each kit contains materials for mixing six batches of adhesive. Mixing instructions for M-Bond AE-10 and MBond AE-15 Bulk are included below.
2. Any resin removed from refrigeration must be allowed attain room-temperature equilibrium before being opened.
3. Mix adhesives thoroughly for five minutes according to instructions. If a room-temperature cure is used, allow the freshly mixed adhesive to stand an additional five minutes before use.
4. The pot life for Systems AE-10 and GA-2 can be prolonged by occasionally stirring to prevent localised exotherm in the center of the resin system, or by pouring it out onto a chemically clean metal plate.

NOTE: During storage, crystals may form in the Resin AE. These crystals do not affect adhesive performance, but should be reliquefied prior to mixing by warming the resin jar to +120°F [+50°C] for approximately one-half hour. Allow the resin to return to room temperature before adding curing agent; excess heat will shorten mixed pot life.

B. M-BOND AE-10 ADHESIVE KIT

AE-10 will cure at +70°F [+20°C] in 6 hours, with approximately 6% elongation capability and essentially creep-free performance. Elongation capability of approximately 10% can be obtained by extending the cure time to 24 to 48 hours at +75°F [+24°C].* To mix, fill one of the calibrated droppers with Curing Agent 10 exactly to the number 10 and dispense the contents into the center of the jar of Resin AE. Immediately cap the bottle of Curing Agent 10 to avoid moisture absorption.

Mix thoroughly for 5 minutes, using one of the plastic stirring rods. The pot life or working time after mixing is 15 to 20 minutes. Discard the dropper after use. M-Bond AE-10 Bulk is packaged with 200 grams of resin, 40 grams of Curing Agent 10, and three calibrated pipettes. The mix ratio is 10.0 parts by weight of AE

Resin to 1.5 parts by weight of Curing Agent 10. Mix thoroughly for five minutes, then allow the mixture to stand for an additional five minutes before use. When mixing quantities greater than 10 grams of AE Resin, the normal pot life of 15-20 minutes will be shortened accordingly.

*Refer to Application Notes B-129 and TT-605 for discussions of high-elongation strain measurements.

C. M-BOND AE-15 ADHESIVE KIT

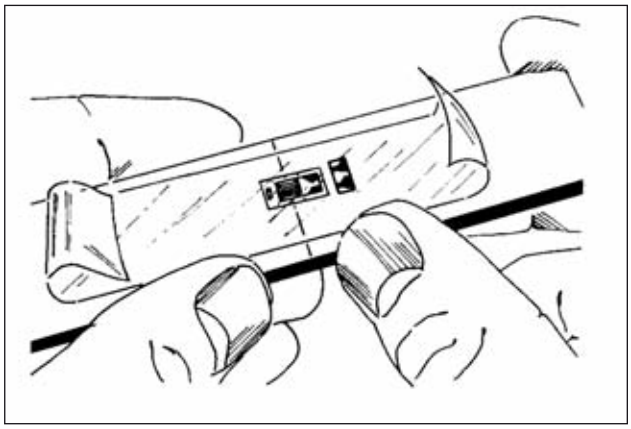
AE-15 requires moderately elevated curing temperatures, and is recommended for critical installations, such as strain gauge transducers, where zero shift and hysteresis must be minimised. The AE-15 system is also useful with high elongation strain gauges at strain levels up to approximately 10% to 15% at +70°F [+20°C], and at strain levels up to 15% at

+200°F [+95°C]. To mix, fill one of the calibrated droppers with Curing Agent 15 exactly to the number 15 and dispense the contents into the center of the jar of Resin AE. Immediately cap the bottle of Curing Agent 15 to avoid moisture absorption. Mix the Resin AE and the Curing Agent 15 thoroughly for 5 minutes, using one of the plastic stirring rods. The pot life is approximately 1-1/2 hours at +70°F [+20°C]. Discard the dropper after use. M-Bond AE-15 Bulk is packaged with 200 grams of resin, 25 grams of Curing Agent 15, and three calibrated pipettes. The mix ratio is 10.0 parts by weight of AE Resin to 0.8 parts by weight of Curing Agent 15. Mix thoroughly for five minutes, then allow the mixture to stand for an additional five minutes before use. When mixing quantities greater than 10 grams of AE Resin, the normal pot life of 15-20 minutes will be shortened accordingly.

D. M-BOND GA-2 KIT

GA-2 is a partially filled 100%-solids epoxy adhesive. Resin GA-2 with Hardener 10-A will have approximately 10% to 15% elongation capabilities when cured for 40 hours at +70°F [+20°C], and approximately 6% elongation capabilities when cured for 6 hours at +70°F [+20°C]. To mix, fill one of the calibrated droppers with Hardener 10-A exactly to the number 10, and dispense the contents into the jar of Resin GA-2. Immediately cap the bottle of Hardener 10-A to prevent moisture absorption. Mix the Resin GA-2 and the Hardener 10-A thoroughly for 5 minutes using one of the plastic stirring rods. Pot life is approximately 15 minutes at +70°F [+20°C]. Discard the dropper after use.

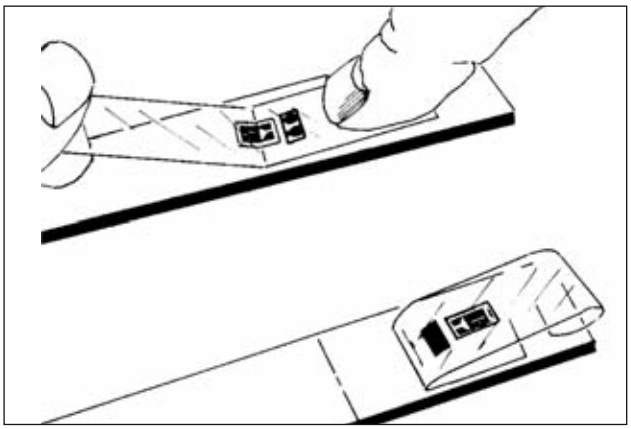
STEP 01



Position the gauge/tape assembly so the triangle alignment marks on the gauge are over the layout lines on the specimen. Holding the tape at a shallow angle, wipe the assembly onto the specimen surface. If the assembly appears to be misaligned, lift one end of the tape at a shallow angle until the assembly is free of the specimen.

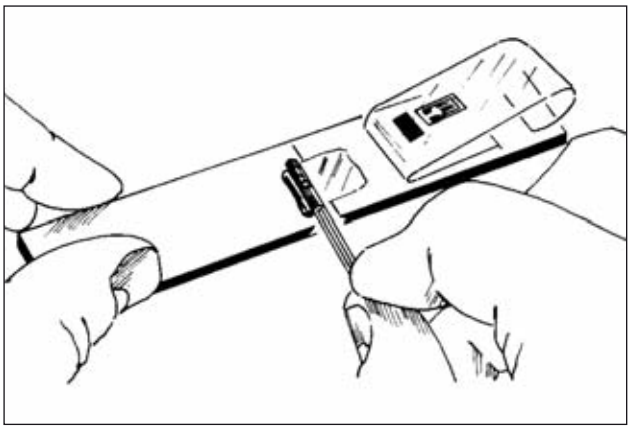
Realign properly and firmly anchor down at least one end of the tape to the specimen. This realignment can be done without fear of contamination by the tape mastic if the recommended gauge installation tape is used. This tape will retain the mastic when removed.

STEP 02



Lift one end of the tape at a shallow angle to surface (about 45 degrees) until gauge and terminal are free of specimen surface. Tuck the loose end of the tape under and press to the surface so the gauge lies flat with the bonding side exposed. In some cases this may be difficult because of space limitations. If this situation occurs, leave enough slack in the tape to allow a finger to be slipped behind the gauge to support it while applying the adhesive.

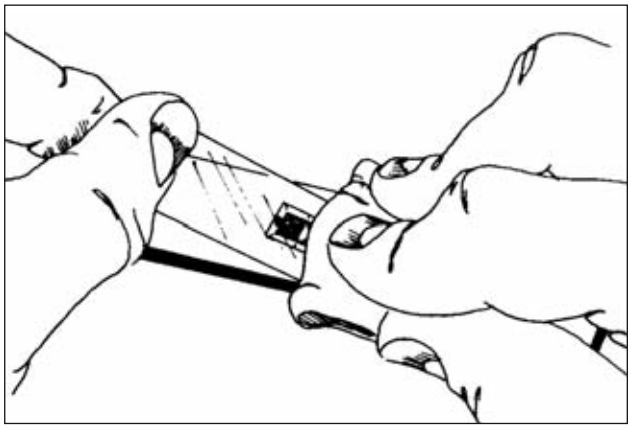
STEP 03



Coat the specimen, back of the gauge, and terminal strip with the prepared adhesive. The mixing rod can be used to apply a thin layer of adhesive over each surface. Be careful not to pick up any unmixed components of the adhesive. To ensure this, it is advisable to wipe the mixing rod clean and then pick up a very small amount of the adhesive from the center area of the adhesive jar.

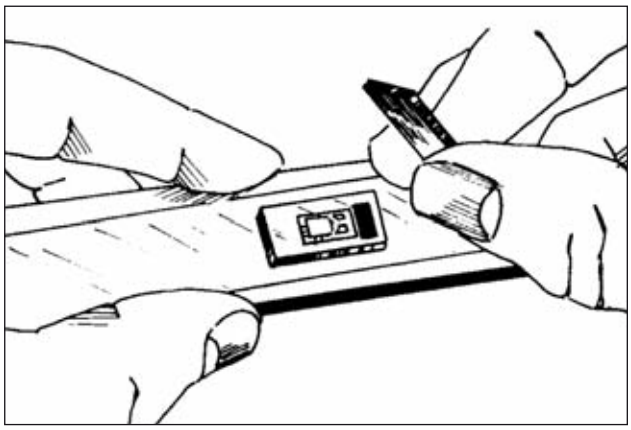
Immediately after coating the gauge and specimen with adhesive, proceed without delay to Step 8. This will limit the absorption of moisture by the uncured adhesive, and the gauge installation tape will serve as a temporary moisture barrier during curing.

STEP 04



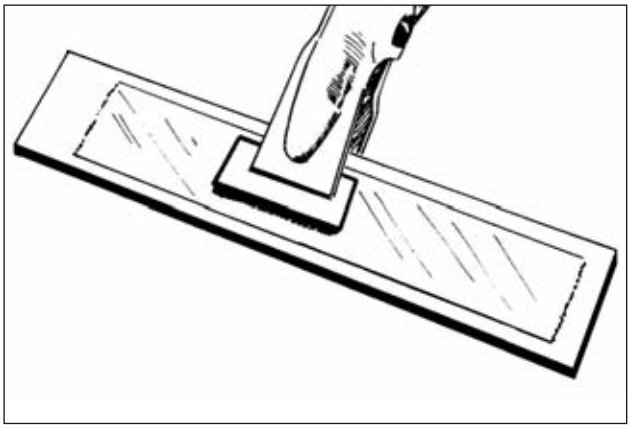
Lift the tucked-over end of tape and bridge it over the adhesive at approximately a 30-degree angle. With a piece of gauze, slowly make a single wiping stroke over the gauge/tape assembly, bringing the gauge back down over the alignment marks on the specimen. Use a firm pressure with your fingers when wiping over the gauge, since the adhesive is quite viscous. A very thin layer of adhesive is desired for optimum bond performance.

STEP 05



Place a silicone gum pad and backup plate (GT-14) over the gauge installation. The silicone gum should be soft (Durometer A40-60) and at least 3/32 in [2.5 mm] thick. This will allow the clamping force to be exerted evenly over the gauge. The area of the silicone gum pad should be used to compute the final clamping pressure.

STEP 06



Apply force by spring clamp or dead weight until a clamping pressure of 5 to 20 psi [35 to 135 kN/m2] is attained. Take special care in making sure the clamping pressure is equal over the entire gauge. Unequal clamping pressure may result in an irregular glueline. Take steps to ensure that the clamps will not slide out of position during cure. A few strips of tape to assist in holding the clamps or backup plate in place during cure may be helpful. Cure the installation in accordance with the recommended cure schedule below.

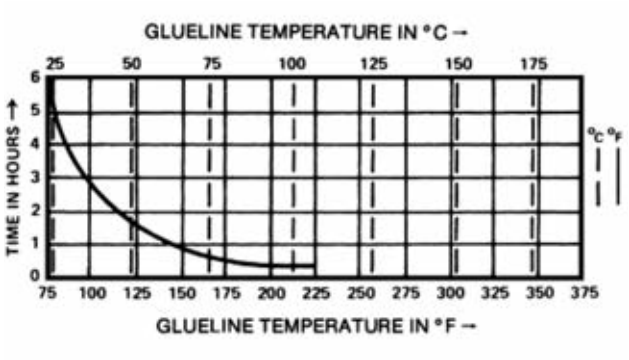
STEP 07

The gauge and terminal strip are now solidly bonded in place. To remove the tape, pull it back directly over itself, peeling it slowly and steadily off the surfaces. This technique will prevent possible lifting of the foil on openfaced gauges or otherwise damaging the installation. It is not necessary to remove this tape immediately after gauge installation. The tape will offer mechanical protection for the grid surface, and may be left in place until it is removed for gauge wiring.

ONCE **PROCEDURE B** IS COMPLETE, PROCEED TO **SECTION 07.2** OF THIS MANUAL TO CONTINUE THE STRAIN GAUGING PROCESS.

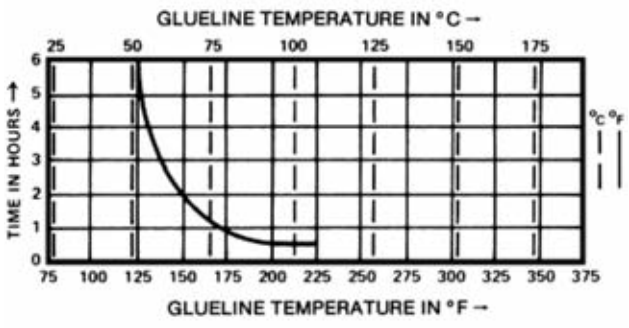
RECOMMENDED CURE SCHEDULES

M-BOND AE-10 AND GA-2



Caution: These systems may not cure properly below +70°F [+20°C]. Postcuring the installation for two hours at least +25°F [+15°C] above the maximum operating temperature with the clamping fixture removed will provide essentially creep-free performance.

M-BOND AE-15



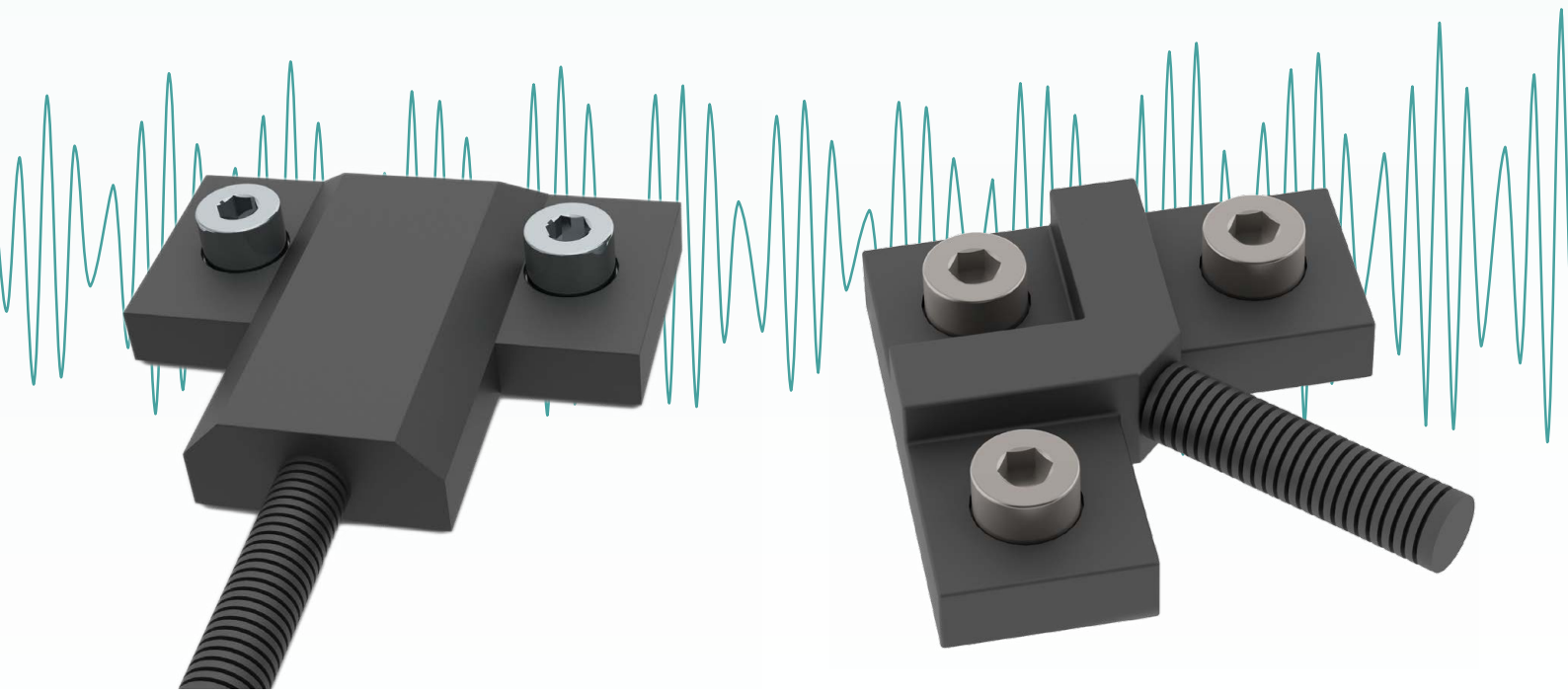
Caution: To ensure proper polymerization, the cure cycle should start within 1.5 hours after mixing.

NOTE: Do not exceed +225°F [+105°C] cure temperature.

DATUM ELECTRONICS

SERIES 460

BOLT-ON STRAIN GAUGE SENSORS



datum electronics

THE DATUM BOLT-ON STRAIN GAUGE

Datum Electronics offer many types of bolt-on strain sensor that have been developed to provide rugged and robust production sensor.

They have been designed to measure tensile, compressive and bending stresses ranging from 50 to 1,100 micro-strain. The gauges have been desinged for use in applications including on:

vehicles, civil engineering structures, silos, hoppers and specialist engineering projects.

They can also be used for other applications including bridges, oil rigs, ship hulls and building roofs to evaluate tensile and compressive strain.

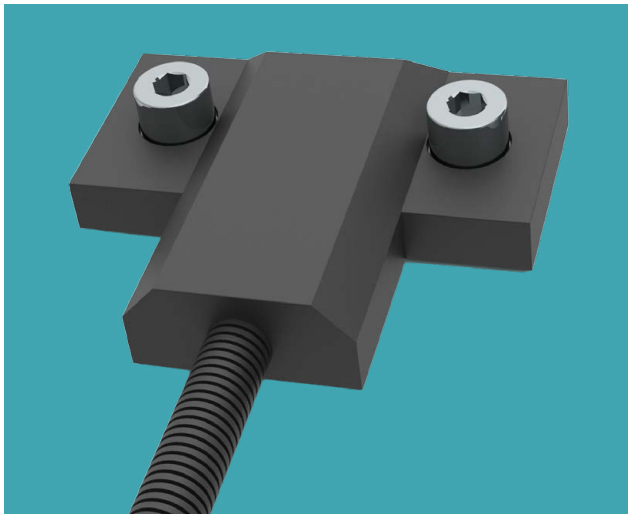
Datum Electronics also specialises in volume OEM solutions for customers who need an application specific product. Talk to our sales team to discuss at web@datum-electronics.co.uk or 01983 282834.

SPECIFICATIONS

Our Bolt-on strain sensors are quick and easy to install without any fine wiring or soldering. Its practical robust design allows the sensor to work in almost any environment, in any weather and even underwater if required. Rated to IP68 this is a truly universal product that will give you reliable accurate strain indication whatever the application or environmental condition. All sensors are pre-tested and checked during final assembly ensuring the reliability and quality of all our sensors.

DIVERSITY

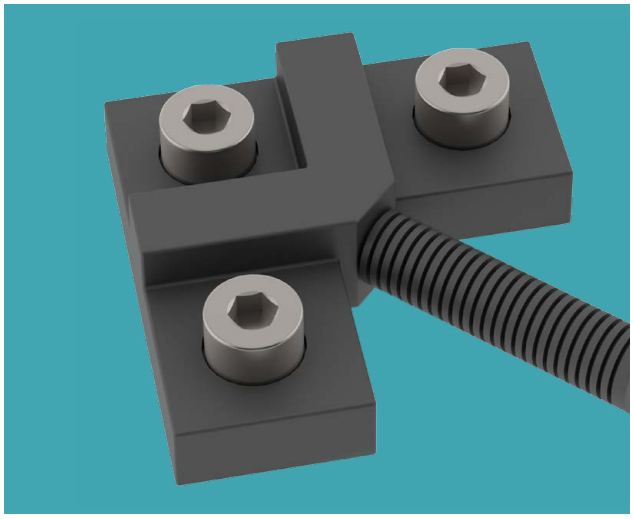
Using the latest strain gauge techniques and techologies it gives you the accurate and reliable data you require in a number of challenging environments. The sensors are fully compatible with our wide range of load and strain indicators and amplifiers allowing you to operate any number of sensors in parallel for your pplication. A direct serial link to a PC, or an analogue input to a data logger or PLC, is also an option and also very easy to achieve. The Series 460 Bolt-on strain sensor is not only an essential product for measuring micro-strain, but it can also become an integral part of a strain monitoring system.



2-HOLE BOLT-ON SENSOR

The standard 2-Hole sensor can be bolted direct to the structure for use in a range of applications and environments. We recommend that the structure on to which sensor is to be bolted should be at least 10 times larger than the sensor, for accurate and reliable measurement data.

The 2-Hole sensor has a standard hole size of 10.2mm. There is an option for a sensor with a hole size of 8.2mm if required in addition to the 10.2mm option.



3-HOLE BOLT-ON SENSOR

The 3-Hole bolt-on strain sensor is a dual element sensor that corrects any differential temperature between the sensor and the structure. Typically, a vehicle axle can be 5 degrees hotter than the sensor as the axle heats due to braking and drive loads, in this case the surface strain of the axle due to temperature can be 60 micro-strain greater than the sensor.

The 3-Hole bolt-on sensor has been designed to eliminate this potential strain difference. Highly sensitive with effective temperature compensation built in, this product makes an incredibly useful and cost-effective method of measuring strain.

Document: 1011 Issue: 2 Date: 07/02/2017

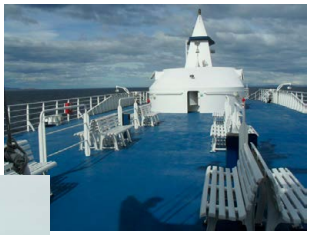
FULL SPECIFICATIONS FOR BASIC STANDARDS

SPECIFICATION	
Rated Strain Range	10 - 1,100 micro-strain **OEM can be catered to your requirements*
Maximum Strain (single operation)	1,500 micro-strain
Rated Output	1.5mV/V for 1,000 micro-strain
Linearity & Repeatability	0.1% of rated output (FSD)
Hysteresis	0.1% of rated output (FSD)
Temperature Effect on Output	0.005 of applied load
Temperature Effect on Zero	0.005 of rated load
Bridge Resistance	350ohm (nominal)
Electrical Connection	3 meter, 4-core integral cable
Excitation Voltage	10VDC
Excitation (max)	15VDC
Environmental Protection	IP68
Operating Temperature	-20C to +80C
Storage Temperature	-40C to +100C
Humidity	0% - 100%
Chemical Splash	Resistant to chemicals including: Dust, Water, Salt Stray, Urine, Paint, Dilute Acid Fuels: Diesel, Gasoline, Bio Diesel Oils: Lubricating, Hydraulic Coolant: Ethylene Glycol, Coolant Conditioner, Freon
Acceptable Bolt Down Error	+/-40% of scaled measurement range
Connections	Red Excitation positive (ex+ve) Blue Excitation negative (ex-ve) Green Signal positive (sig+ve) Yellow Signal negative (sig-ve)

APPLICATION EXAMPLES

VEHICLES

SILOS



SHIP HULLS

OIL RIGS

HOPPERS

TYPICAL SENSOR INSTALLATION

SURFACE PREPARATION

The sensor mounting surface must be flat and clean. The sensor has two pads or three pads, which are bolted to the strucure; if the bolting procedure twists or sretches the sensor elements due to the machined unevenness of the surface it will apply an offset to the sensor. The system has been designed to accept a small amount of zero offset however this should be kept to a minimum.

FLATNESS

The sensor can be fixed to the structure using an adhesive; the adhesive greatly reduces long term movement of the sensor relative to the structure. The better the bond to the structure the better the systems performance. The adhesives used to bond sensors, will be affected by dirt, grease or any other contamination on the surface. We strongly recommend that the surface is degreased in two phases. Phase one would be using a simple degreasing agent to remove obvious debris and the second phase would be to repeat this with a clean application of the degreasing agent and the use of a clean wipe. The second wipe should be inspected, to assess the level of any residual contamination. The degreasing agent itself can contain substances which will reduce adhesion. Therefore the cleaning agent itself should not be flooded on to the surface, and any remaining residue must be cleaned away thoroughly.

Level of Contamination
Clean to the naked eye

Cleaning Agents
Loctite 7063 degreasing agent or equivalent

The lower faces of the sensor should also be inspected for contamination before application and cleaned if required.

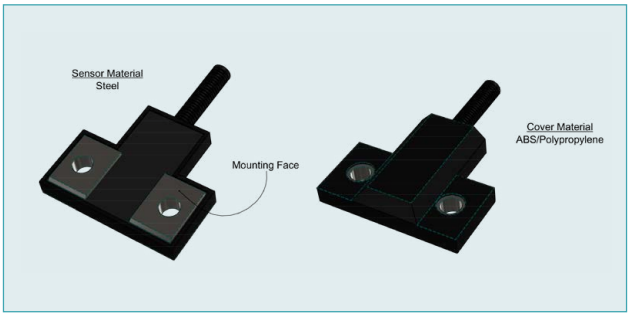
TYPICAL APPLICATION

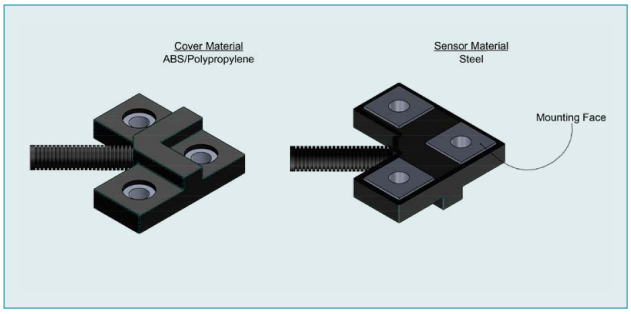
Present the sensor to the structure and check alignment of the fixing holes, loose bolt the sensor to the axle to check that the sensor is not pre-stressed by the bolts.

Remove the bolts/
Apply adhesive to either
(a) Both surfaces or

(b) One surface and catalyst to the other as directed.

Present the sensor to the structure and loose bolt it. Tighten alternatively to achieve an even torque for each of the bolts. The bolt tightening should be carried out in a minimum of three even steps. The glue line should be thin and even but will vary according to the instructions of the specified adhesive.

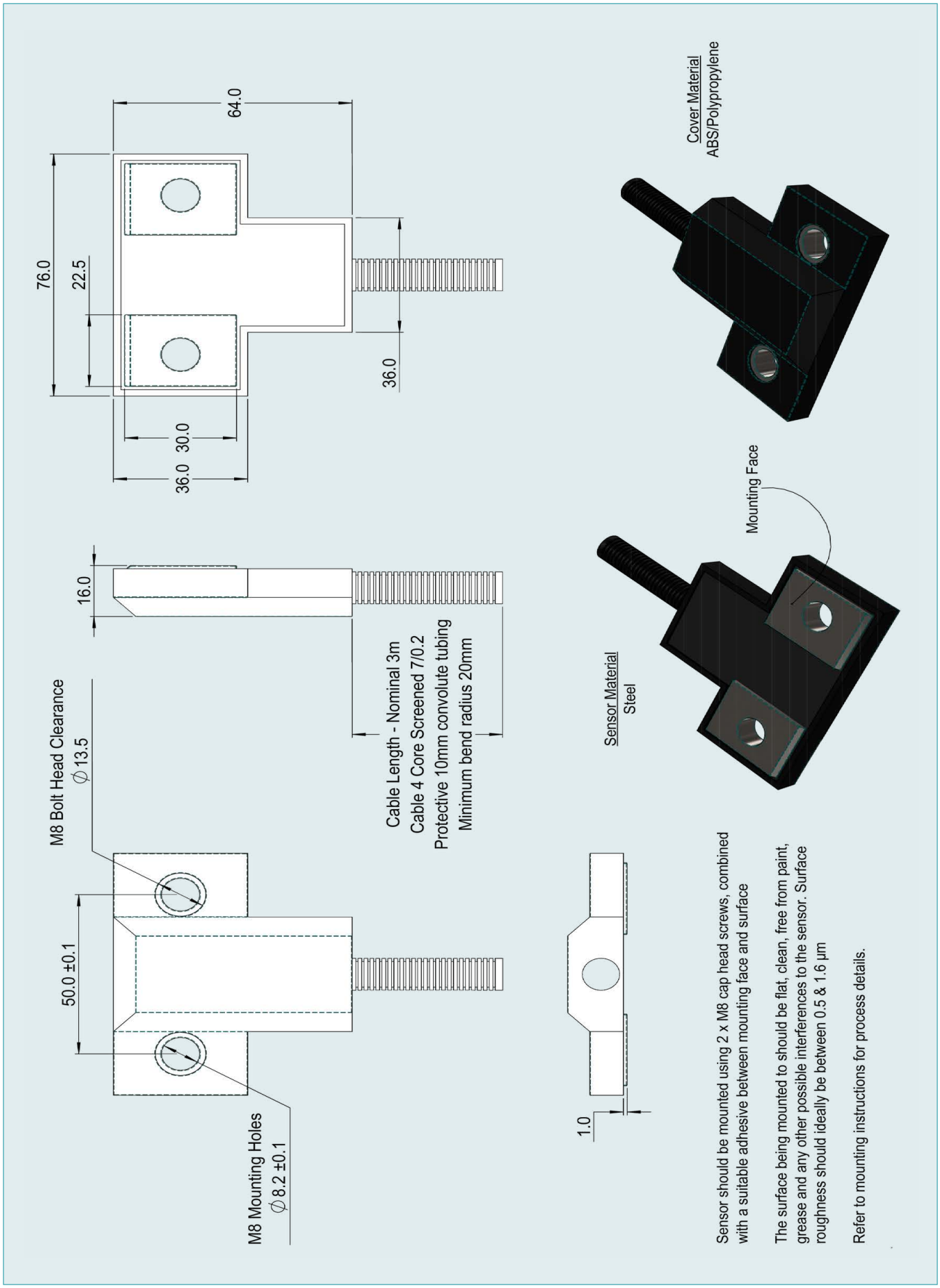


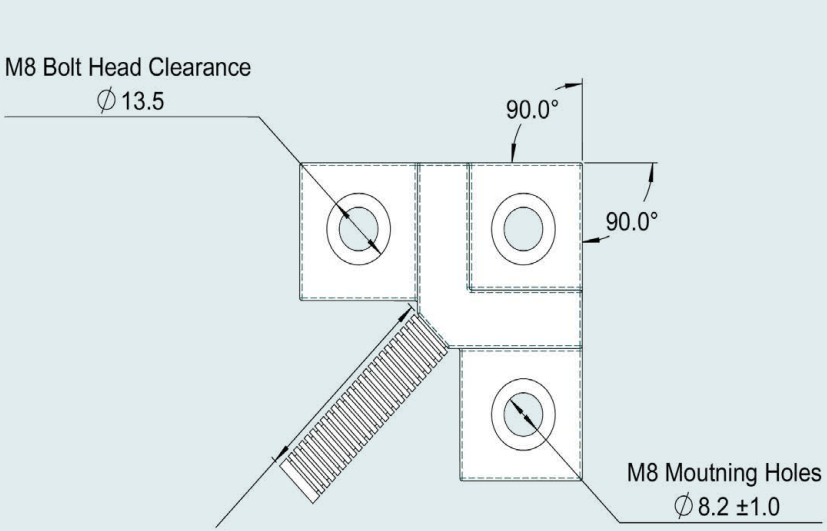


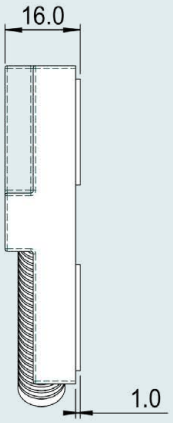
ACCEPTABLE ADHESIVE & FITTINGS

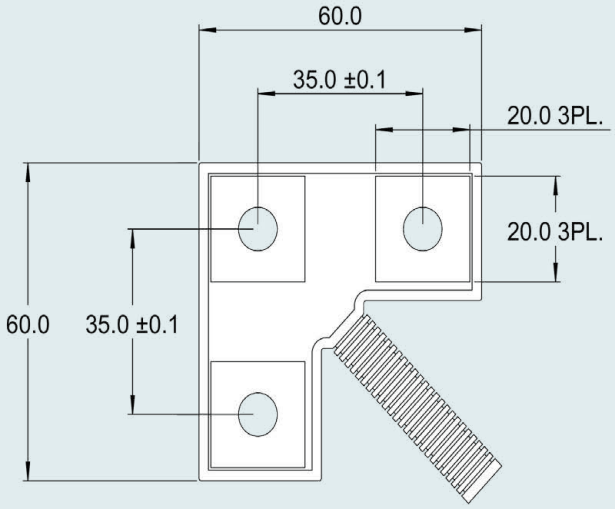
Loctite Retaining Compound 638 or equivalent

Loctite 330 with 737 activator or equivalent


64.0
76.0
22.5
36.0
30.0
36.0
16.0
M8 Bolt Head Clearance
⌀13.5
50.0 ±0.1
M8 Mounting Holes
⌀8.2 ±0.1
Cable Length - Nominal 3m
Cable 4 Core Screened 7/0.2
Protective 10mm convolute tubing
Minimum bend radius 20mm
1.0
Sensor Material
Steel
Mounting Face
Cover Material
ABS/Polypropylene
Sensor should be mounted using 2 x M8 cap head screws, combined with a suitable adhesive between mounting face and surface
The surface being mounted to should be flat, clean, free from paint, grease and any other possible interferences to the sensor. Surface roughness should ideally be between 0.5 & 1.6 µm
Refer to mounting instructions for process details.



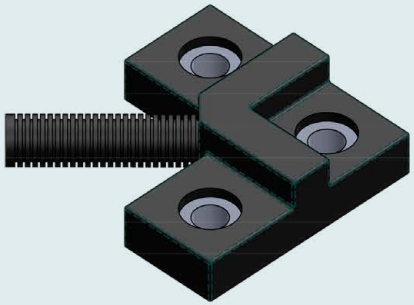


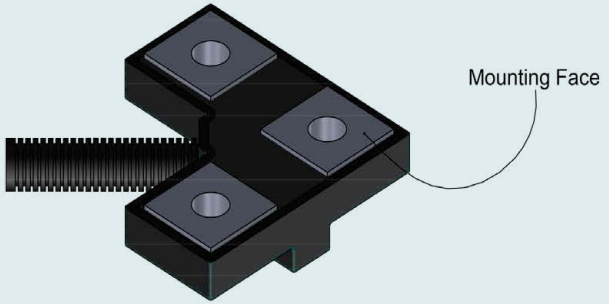


Cable Length - Nominal 3m
Cable 4 Core Screened 7/0.2
Protective 10mm convolute tubing
Minimum bend radius 20mm

Cover Material
ABS/Polypropylene

Sensor Material
Steel





Sensor should be mounted using 2 x M8 cap head screws, combinedwith a suitable adhesive between mounting face and surface

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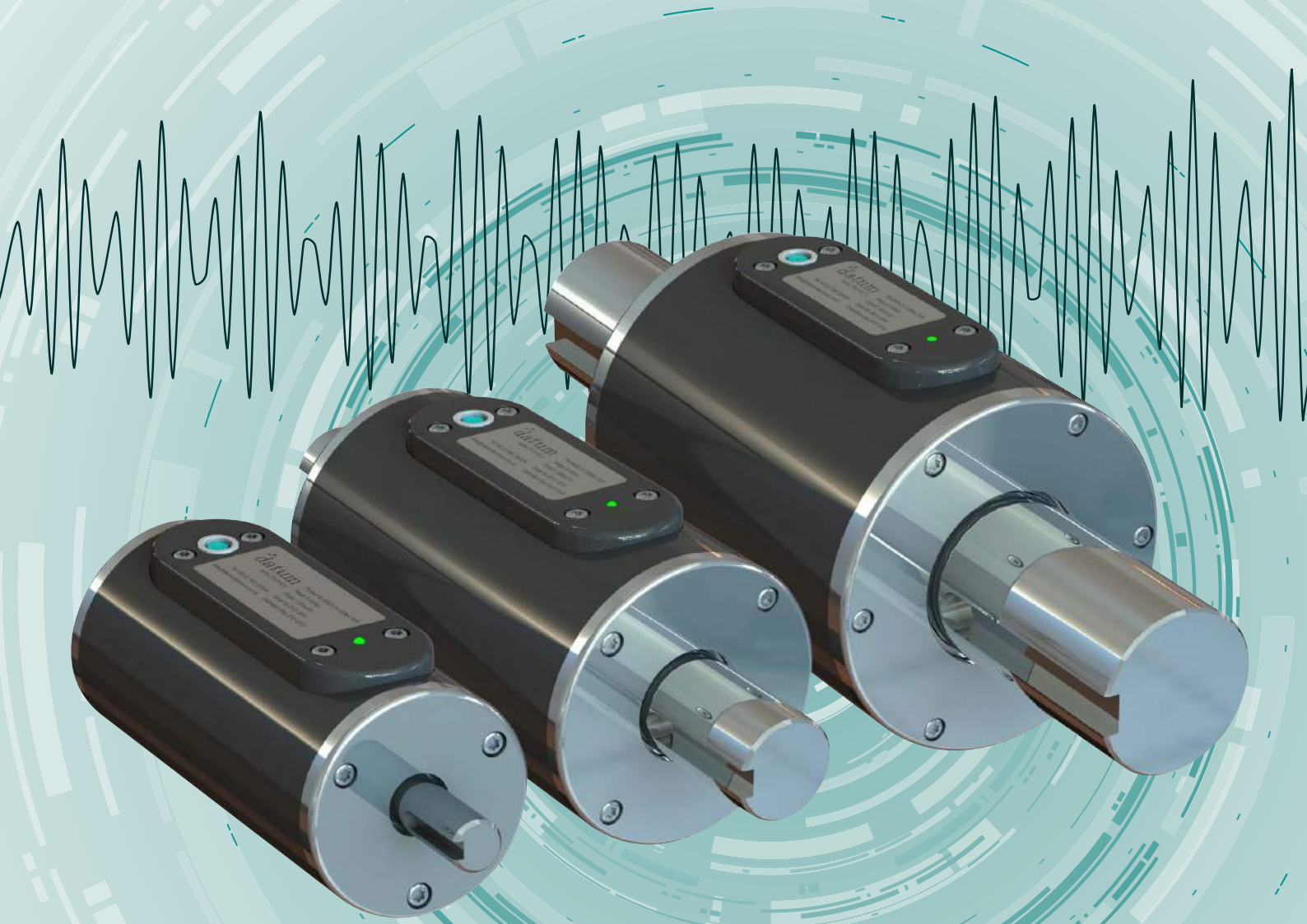
Refer to mounting instructions for process details.

DATUM ELECTRONICS

M425 TORQUE TRANSDUCER
HANDBOOK AND INSTALLATION GUIDE



datum electronics

CONTENTS

Document: 1010 Issue: 6 Date: 01/10/2016

M425 INTRODUCTION

What is it designed to do?

The latest technology Datum Electronics Series M425 non-contact rotary Torque Transducers have been designed to fit with most applications and solutions requiring rotary torque measurement. The Torque Transducer fits in line with the drive train or test bed, using standard keyway shafts.

A non-contact transmission system provides data directly proportional to torque. In this variant it is supplied as a complete transducer with bearings to support the stator unit on the rotating shaft. It is suitable for most general test rig applications.

The M425 Torque Transducer utilises a strain gauged shaft for accurate and reliable torque measurement and a set of rotating on-shaft conditioning electronics. The digital signals are transmitted to the non-rotating part of the system or stator providing a reliable and highly accurate torque measurement solution.

The M425 has a torque measuring element design with an optimum length to maximise overall accuracy and give a high degree of tolerance to mounting offset.

The M425 also has a legacy mode so that it can be used as a direct replacement for the previous M420 Transducer.

SYSTEM ADVANTAGES

M425 system performance and benefits:

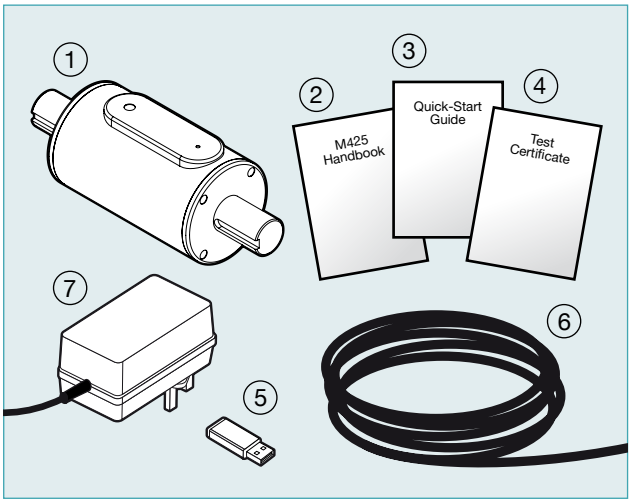
- Accuracy and resolution options
- High data rate
- Static and rotary torque measurement
- Operational stability
- Non-contact data transmission
- Magnetic speed sensor - not effected by dirt
- Simple to integrate
- Robust construction
- Torque transducer sensor
- Ranges 0-5Nm up to 0-60,000Nm
- High resolution torque sampling
- Sample rate selection 1-4000 samples per second
- Low power consumption

SYSTEM OUTLINE

The key features of the M425 system are:

- Complete torque transducer
- Designed to be mounted in line with the drivetrain
- Torque transducer body supported on rotary shaft with bearings
- Ideal for test rig applications
- Keyway shaft for easy fit and rig design
- Torque measurement available up to 60,000Nm in a range of model sizes
- Analogue output options

SYSTEM ITEMS SUPPLIED



It is recommended that all hardware, consumables, tools and software are checked and present before preparation and installation commences.

CHECK LIST

Included as standard with the M425 Torque Transducer:

DESCRIPTION	QUANTITY
1 - M425 Torque Transducer	1
2 - M425 handbook	1
3 - Quick-start guide	1
4 - Test certificate	1
5 - Datum software	1
6 - Transducer cable	1
7 - Power supply	1

Optional extras available from Datum Electronics:

DESCRIPTION
Universal Interface
Versatile bulkhead mounted indicator
M425 Transducer to universal interface data cable

FAMILIARISATION

SIMPLE DIAGNOSTICS, TESTING AND CONNECTION

Before installing your M425 Transducer into the rig or machine we would advise you to familiarise yourself with its connections and operation by performing a bench test.

By connecting the Transducer directly to a Datum Universal Interface (example A below), or to a PC via the Datum Universal Interface (example B opposite), you will be able to rotate the shaft to generate an output signal of RPM.
By applying a small torque by hand to the shaft you will also be able see the change in the torque signal output on the Universal Interface display or in the Datum Data Logging PC software.

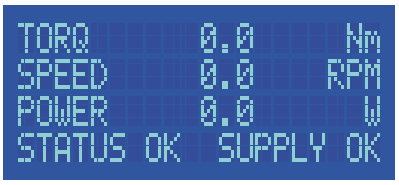
If you are connecting to a PC without a Datum Universal Interface and using your own instrumentation (example C opposite) you will be able to test your instrumentation in the same way by simulating a signal to the interface or indicator model you are using. The M425 supports a variety of universal interface models.

Once you are familiar with the transducer and its outputs continue to install as normal. If any questions arise at this stage please call our product support team for advice.

The Datum Universal Interface display

The Datum Universal Interface has a built-in display which you can use for familiarisation with a direct connection to the M425 Torque Transducer (diagram A below).

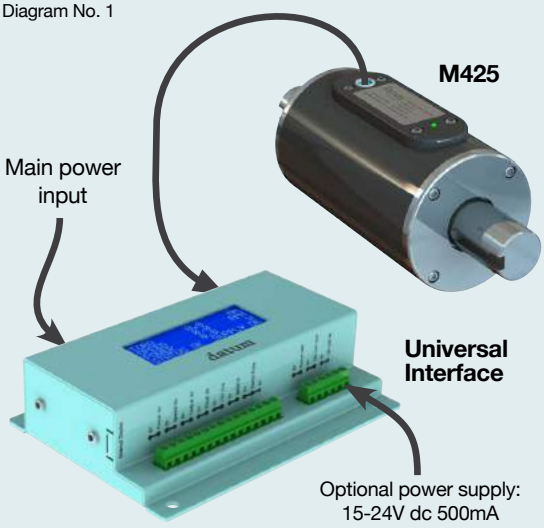
The Universal Interface display can show the following data from the M425 Torque Transducer:



Connection example (A)

M425 to the Datum Universal Interface.

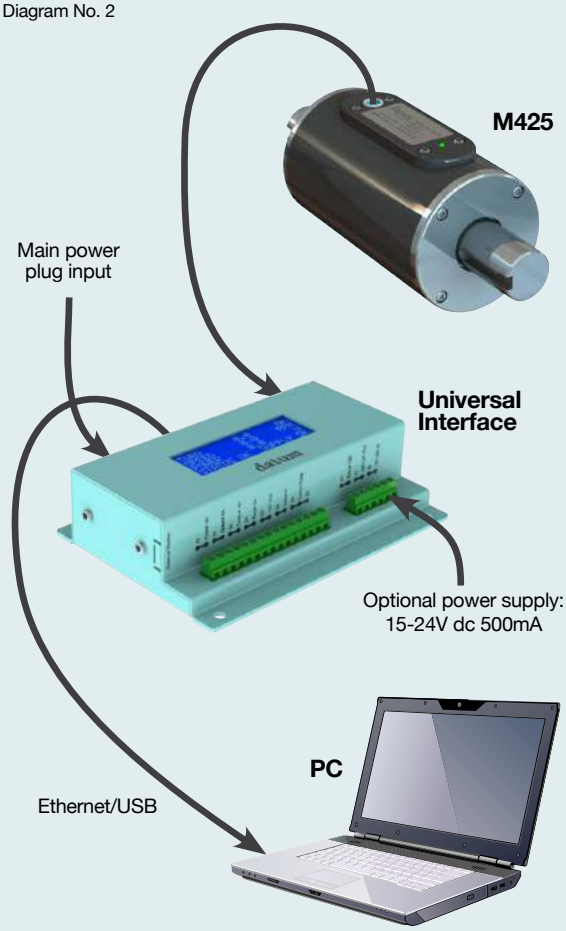
Diagram No. 1



Connection example (B)

M425 to PC via the Datum Universal Interface.

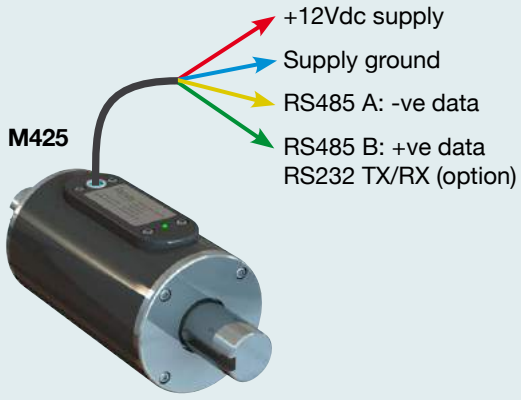
Diagram No. 2



Connection example (C)

Direct connection from M425 to an alternative interface or indicator.

Diagram No. 3



See electrical connection guide on page 7 for further information on connecting your own instrumentation.

MECHANICAL INSTALLATION

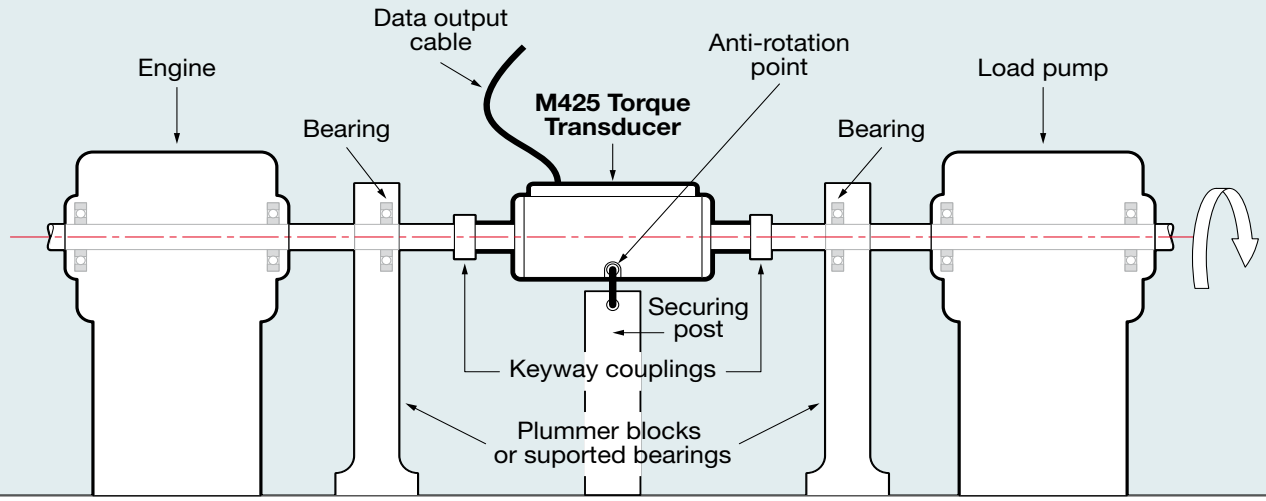
OBJECTIVE OF THE MOUNTING

The objective is to align the shaft of the M425 Torque Transducer (sensor) with the torque. The torque should where possible be driven through the centre line of the shaft.

Unlike Disk Transducers that require very fine alignment tolerances when mounting, the M425's longer shaft allows a greater degree of flexibility in terms of alignment.

Diagram No. 4

Typical installation with bearing block each side



THINGS TO AVOID

The series M425 Torque Transducers are designed to withstand a level of overload.

The load levels quoted within tolerances (see table 8 on page 16) should not have any effect on the calibration or zero setting of the Transducers. Each Transducer has been subjected to the proof load level within its testing cycle.

Loading the Transducer above the proof level will offset the Transducer zero and will damage the Transducer. Regular loading beyond the proof level will start to show progressive zero movement and may effect both the gain and the hysteresis of the Transducer. The shaft absolute load is the maximum before the shaft will yield.

You should avoid any side loads or bending loads across the shaft. As the M425 Transducer series have relatively long shafts they are more tolerant to a small degree of misalignment than short flange transducers (sensors), however misalignment can change the loading on the internal bearings of the device and should be avoided where possible.

Consider large dynamic or transient torques when designing your test system.

When designing the test rig or test system that will use the M425 Transducer you should consider the effect of any large inertial / kinetic loads such as flywheels or brakes. If the system is to drive to a high level of torque, and then a brake is applied, the dynamic torque in the test rig can be much higher than that of the output of the drive motor. The fast deceleration torque may exceed the limits above causing damage.

Overload = 150% the rating of the transducer. Loads at this level should be avoided as they will decrease the fatigue life of the Transducer. If you are likely to see large overloads at the same time as wishing to see high resolution data for much smaller torques please consult our sales team.

Ultimate Load = at the ultimate loads quoted for the Transducer shaft (see table 8, page 16) the sensing element will be damaged and large offsets will occur. At this level the shaft will be well beyond its design limits and may mechanically fail. If you have loaded a Transducer above the Proof Load/Overload level it should be checked before continued use.

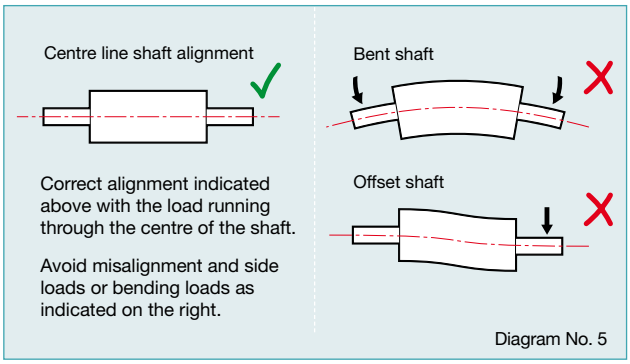


Diagram No. 5

Where the installation will see a larger degree of misalignment you should consider the use of flexible couplings in the drive line. If misalignment is very likely consider the Datum Electronics RS and FF ranges which are bearing-less transducers (see page 18). Talk with our sales team who can advise on this type of installation.

WHICH WAY ROUND TO MOUNT?

The M425 Transducer will operate in both a clockwise or anti-clockwise direction.

The M425 Transducer is calibrated to give a positive output for clockwise torque and a negative output for counter clockwise torque. The M425 Transducer will also output torque data while static.

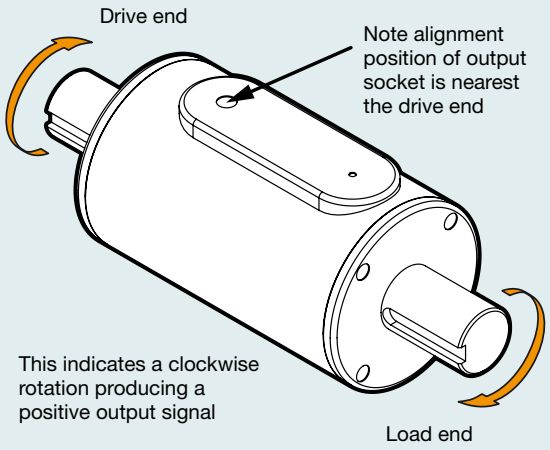


Diagram No. 6

KEYWAY FIT SIZE

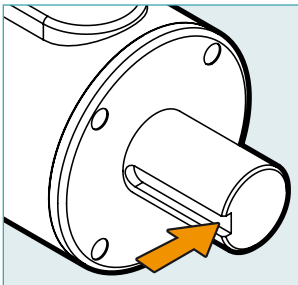


Diagram No. 7

Keyway sizes are generally in accordance with BS4235-2:1977.

See table No. 9 on page 17 for the keyway size options available on the M425 model range.

ANTI-ROTATION POINT

The M425 Transducers have an anti-rotation anchor point on the underside of their casing. This is to be used to secure the static body of the Transducer and prevent rotation during operation.

Pass a strong cable or tie through the hole in the anti-rotation anchor point and secure the tie to a solid structure on the test rig, ensuring the tie has clearance from the rotating drive shaft and moving parts to avoid snagging.

You should use the anti-rotation anchor point for this rather than the data cable as using the data cable may damage the connection. The data cable is not designed to take a load.

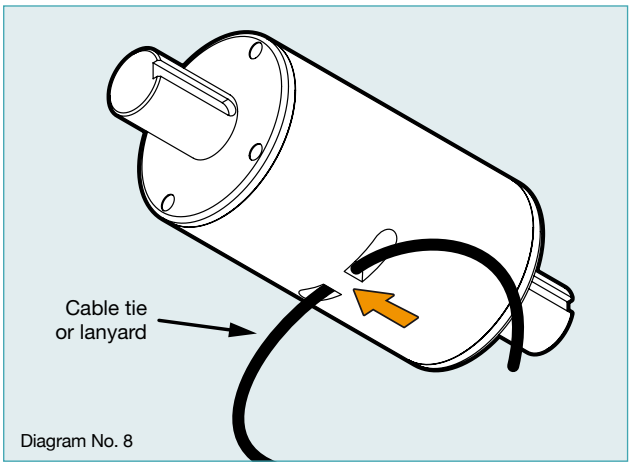


Diagram No. 8

ELECTRICAL CONNECTION

CABLE AND SOCKET CONNECTORS WIRING GUIDE

The M425 Transducer is supplied with a standard 3 metre signal cable. This cable is terminated with a standard 9-way D connector to interface to any of the Datum Electronics Signal Interfaces or Indicators.

The connections within this cable are detailed below should you wish to connect the M425 Transducer directly into your own instrumentation and software.

The default signal output from the Transducer is RS485 Serial Data (see protocol section for data output details on page 11).

We have also provided the Triad 4-way plug wiring arrangement in diagram No. 10 below for the Transducer end of the cable. On some occasions a cable may need to be assembled after laying through tight bulkhead access which may require the removal of the connectors.

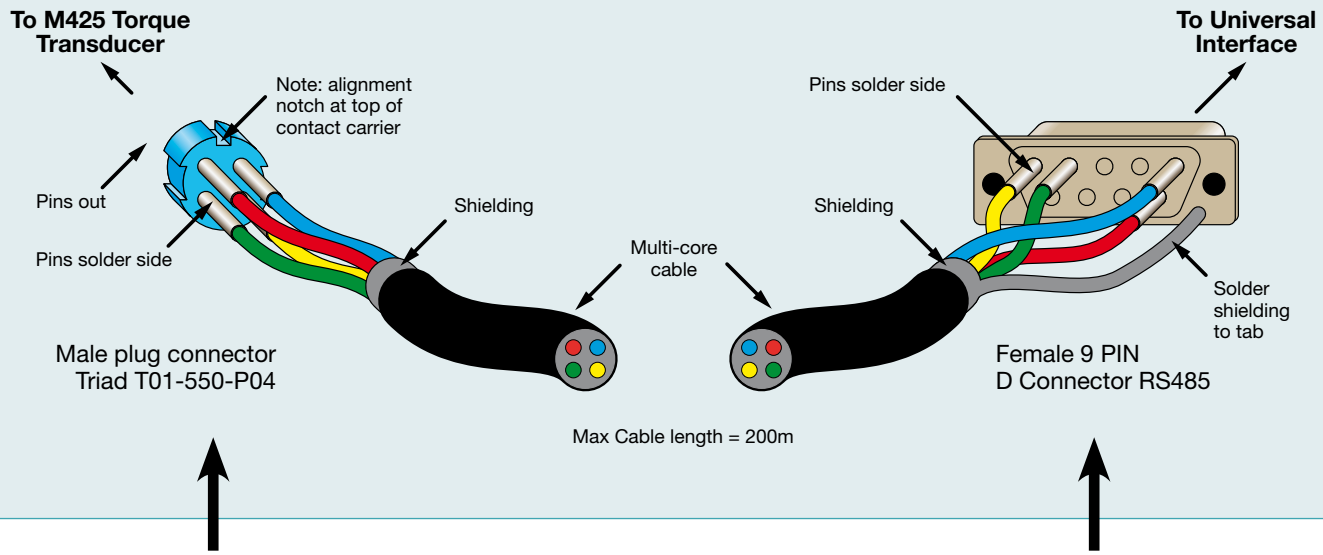
The maximum cable length for the M425 Transducer is normally 200 metres. For special applications with the right cable conditions this can increase to 500 metres depending on the sample rate and baud rate.

The data cable from the M425 Transducer to an interface must meet the following specification: **4 core wire, braided, screened, 7/02mm PVC Sheathed cable or equivalent.**

The M425 Transducer current consumption is less than 250mA with a 12Vdc supply. The M425 Transducer complete with its Universal Signal Interface will consume below 450mA.

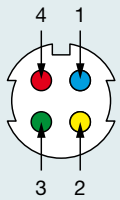
Diagram No. 9

Transducer signal cable wiring guide



Triad 4-way Plug T01-550-P04 wiring guide

Pin Out	Function	Cable Colour
Pin 1	Supply ground	BLUE
Pin 2	RS485 A: -ve data	YELLOW
Pin 3	RS485 B: +ve data RS232 TX/RX (option)	GREEN
Pin 4	+12Vdc supply to Transducer	RED

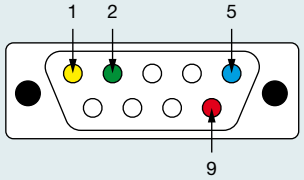


PIN numbering viewed from solder/cable side of the connector

Diagram No. 10

9-way D connector RS485 wiring guide

Pin Out	Function	Cable Colour
Pin 1	RS485 A: -ve data	YELLOW
Pin 2	RS485 B: +ve data RS232 TX/RX (option)	GREEN
Pin 5	Supply ground	BLUE
Pin 9	+12Vdc supply to Transducer	RED



PIN numbering viewed from solder/cable side of the connector

Diagram No. 11

SYSTEM CONNECTIONS

When supplied with the Universal Transducer Interface the Datum M425 Torque Transducers provide simple connections to logging, monitoring and control system through both analogue and serial interfaces. Software is provided to access the primary Ethernet setup interface for the M425.

M425 Transducer, Universal Interface and PC connections guide

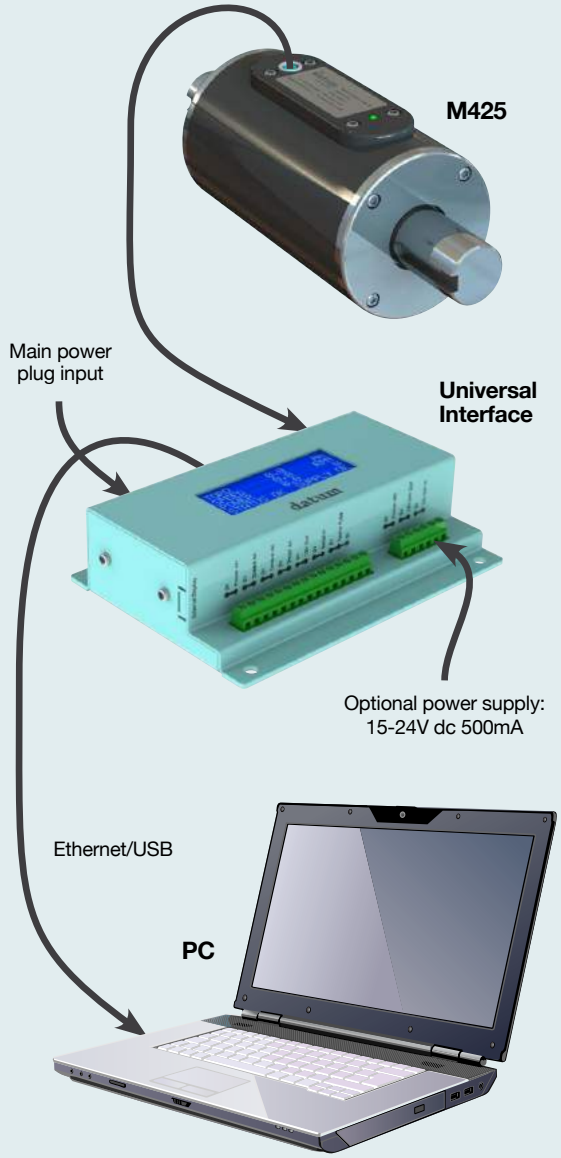
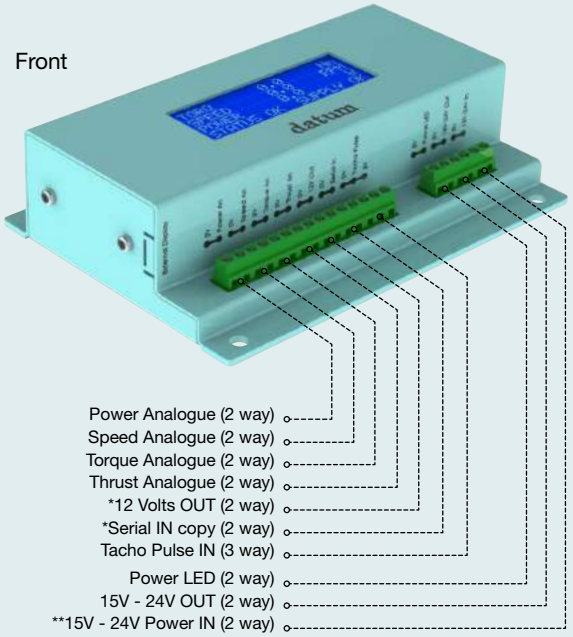


Diagram No. 12

Universal Interface connections guide

Front



*The **12V Output** and the **Serial IN Copy** are screw terminals that duplicate the connections for the serial torque sensor 'D' connector.

**Alternative power input terminal.

Back

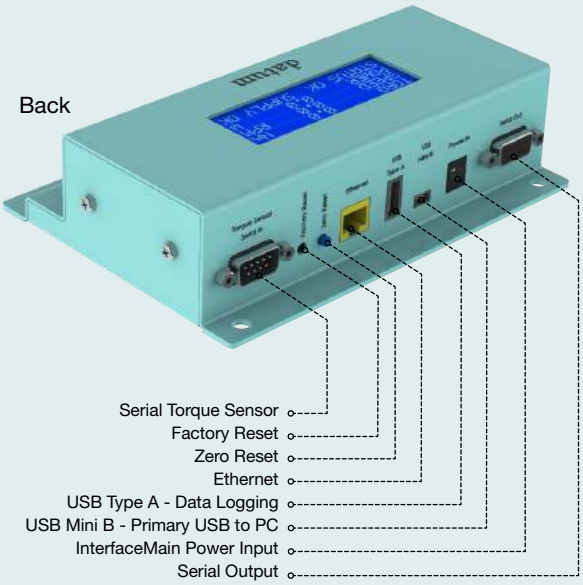
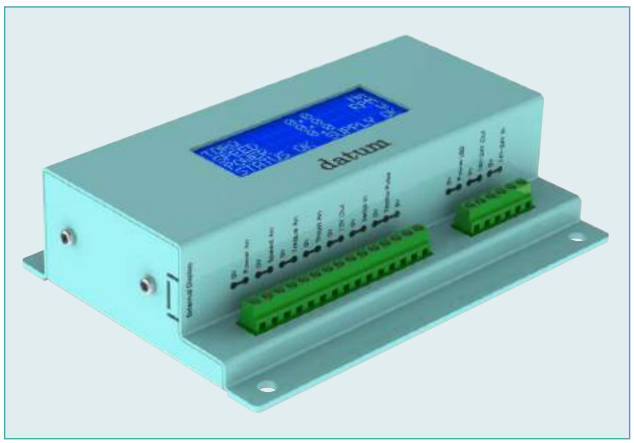


Diagram No. 13

USER INTERFACES

Datum Electronic's Universal Interface provides options for different operating environments.

Datum Electronics can provide the universal interface package for either control enclosure application or heavy industrial applications.



UNIVERSAL INTERFACE

The universal interface will connect directly to the M425 Torque Transducer. It supplies 12Vdc to power the Transducer and converts the torque and RPM signal into the outputs you require.

The outputs that can be configured are:

4 analogue outputs as either 4-20mA (4-12-20mA): +/-10Vdc, +/-5Vdc, 0-10Vdc or 0-5Vdc, for shaft torque, RPM, Power and Spare

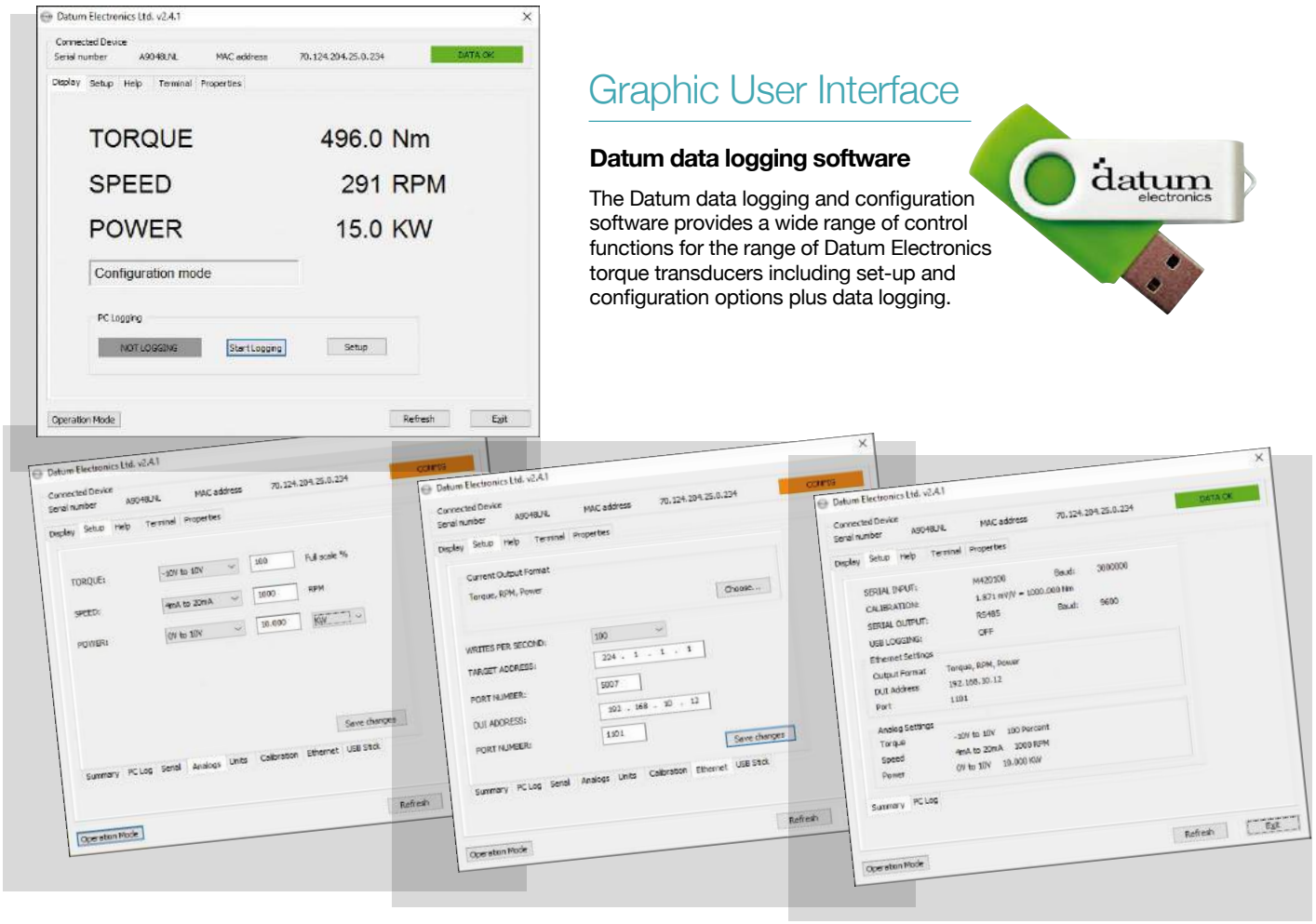
RS485/RS232 serial data

Ethernet

MODBUS

USB Type Mini B

The interface will also accept an input from an external tachometer sensor, the output from this sensor can be directly linked into the torque and power data.



Graphic User Interface

Datum data logging software

The Datum data logging and configuration software provides a wide range of control functions for the range of Datum Electronics torque transducers including set-up and configuration options plus data logging.

VERSATILE (400260) BULKHEAD MOUNTED INDICATOR

Designed for use in industrial and marine environments the Heavy Duty Indicator provides all of the facilities of the Universal Indicator plus an extended graphical display.

It is housed in a weatherproof enclosure with waterproof protector glands & connector and is designed to meet IP67 ingress protection standard.

ALTERNATE CONNECTION OPTIONS

The M425 is compatible with a variety of other universal interfaces or indicators by correct cable and PIN configuration. This allows direct connection to their user software and customers own software. See page 7 for a guide to wiring connector configuration.

The M425 will also accept configuration commands to enable connection to legacy Datum Electronics interfaces and indicators. When set in compatibility mode the M425 can be used with Torque Log Software, the Datum Electronics type 300 and Type 370 Indicators and the Type 400150 USB / analogue or 400152 USB interfaces.

DATA OUTPUT

Data output from the Datum M425 series is available is either readable ASCII or Hex formats. This allows a wide range of interface options using either the Datum Interfaces or Software or even simple terminal programs to read the data.

THE M425 TRANSDUCER HAS THREE OPERATIONAL MODES:

MODE 1: In this mode the Transducer will transmit Zeroed data in the format of the $ZR strings below.

$ZR,0.0002,0.0002,0.0002,0.0002,0.0002,0.44,CS

The number of torque values per second (resolution) can be varied by setting the baud rate either through the Datum PowerKit software or by using the "baud" command if using your own software.

MODE 2: Mode 2 is a non-transmit mode and will only respond to commands. Sending a "help" command in this mode will list the commands available.

MODE 3: This is a legacy binary mode in which the transducer will transmit the 6-byte binary format used in earlier Datum products and the M420. The mode can be set using the Datum PowerKit software or the command "mode" when using your own software. See the following section for more information on command options.

DATA OUTPUT FORMAT:

The Series M425 Transducer can provide data either as an individual reading or as parts of data packets. These can be configured using the interface software to suit most applications.

The following two standard formats (String type A and String type B) are provided as a guide:

String type A

$ZR,0.0492,25.6,CS

Where:

$ZR is the string identifier,
0.0492 is the mV/V value from the sensor,
25.6 is the RPM,
CS is the data checksum

This type of string containing multiple mV/V signal value is used where the baud rate of the receiving device is limited and a higher data rate is required.

String type B:

$ZR,0.0492,0.0492,0.0492,0.0492,0.0492,0.0492,0.0492,0.0492, 0.0492,0.0492,24.1, 21.6,CS

Where:

$ZR is the string identifier,
0.0492 are the last 10 signal values in mV/V from the sensor,
25.6 is the RPM,
21.6 is the shaft temperature indication,
CS is the data checksum.

This type of string containing multiple mV/V signal value is used where the baud rate of the receiving device is limited and a higher data rate is required.

RAW DATA TORQUE CALCULATION:

i.e. 1.7560 mV/V = 500Nm (see calibration certificate for this value) the torque will be [0.0492 ÷ 1.7650 x 500] Nm = 14.00Nm.

SOFTWARE COMMANDS DIRECT TO THE M425 STATOR:

The following commands can be used with your own software to configure the M425 Transducer and set the data output.

"Detail" returns the following string format:

$DT, 0.0001,-0.0015,0.0015,0.00, 21.132, 4.995,0.175,CS

The string format is made of the following data elements:

$DT is the identifier,
0.0001 is the zeroed strain,
-0.0015 is the raw strain mV/V,
0.00 is the RPM,
21.312 is the rotor temperature deg C,
4.995 is the rotor voltage,
0.175 is the power supply current,
CS is the checksum.

"Baud" sets the host baud rate and reboots the system.

"Offset" signed offset in nV/V applied to the rotor output.

"Gain" signed gain in pV/V/quanta.

"Mode" **1** = Normal.
2 = Command mode.
3 = Compatibility mode.

"Normal" start Transmission of rotor data string $RZ.

"Help" lists the commands available in this mode.

"Reset" resets the Transducer to a default setting of (56700 baud, 1 torque value, 1 RPM value, 128 samples per second, mode 2 [awaiting a command]).

HOW CHECKSUM IS CALCULATED:

The checksum is calculated and implements the CCITT 16-bit CRC used by IEEE 802.15.4, using a Modulo 256 calculation.

A detailed description and software examples are available in Technical Bulletin 1007.

SAMPLE RATES AND RESOLUTION

The M425 can output torque data at sample rates from 4 up to 4000 samples per second. The lower data rates provide resolution up to 1:560,000, at highest data rates the noise free resolution reduces 1:11,000. See table 3 on page 13.

The sample rates that can be transmitted from the stator to your instrumentation or computer are listed in tables 1 and 2 on page 13. These table show the rates for a range of standard output strings.

PC PORT LIMITATIONS:

Note: the M425 Transducer is capable of transmitting at the rates above. Some PC's have limited port configurations that may not be able to cater for data rates at this level.

The maximum data rate at a given baud rate can be calculated as: The basic string with a single torque value and an RPM value has 22 characters, each character is 10 bits. Therefore running serial communications at 9600 baud you are limited to 43 samples per second (9600 ÷ (22 x 10).

By running at 115,200 baud this is increased to 525 samples per second [115,200 ÷ (22 x 10)].

By sending the data in packets containing 10 torque values the message becomes 94 characters long [115,200 ÷ (94 x 10)] as each packet contains 10 samples. The data rate becomes 1225 samples per second.

OUTPUT PERFORMANCE

MAXIMUM SAMPLE RATES FOR TYPICAL OUTPUT DATA STRING INCLUDING RPM

When the interface is transmitting a standard data packet containing one torque sample per packet the minimum baud rates required to transmit/receive the data are shown below.

Samples per second	100	1000	2000	4000
Minimum Baud Rate	38400	256000	460800	921600

Lower baud rates can be used if the data is combined in data packets containing more than one torque reading (see the table below which outline the maximum sample rates at given baud rates)

Based on 24bit strain/torque samples, resolution of 1:2,000 (inc. RPM) Table No. 1

At a Baud rate of:										
	9600	**19200**	**38400**	**57600**	**115200**	**256000**	**460800**	**921600**	**3000000**	
Number of torque values:	**Torque readings per second:**									**Example of the output string:**
Type 1 = 1 per packet	43	87	174	260	525	1100	2000	4000	4000	$ZR,T,R,C,V,CS
Type 2 = 5 per packet	88	177	355	533	1066	2000	4000	4000	4000	$ZR,T,T,T,T,T,R,C,V,CS
Type 3 = 10 per packet	102	204	408	612	1225	2000	4000	4000	4000	$ZR,T,T,T,T,T,T,T,T,T,T,R,C,V,CS
Type 4 = 16 per packet	108	216	432	649	1250	2000	4000	4000	4000	$ZR,T,T,T,T,T,T,T,T,T,T,T,T,T,T,T,T,R,C,V,CS

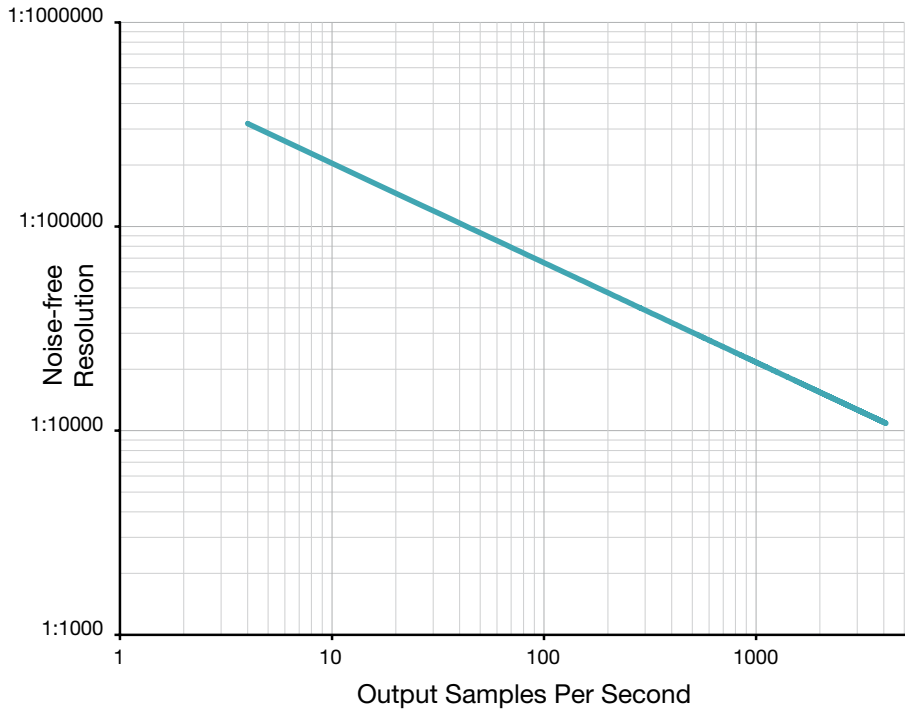
Based on 16bit strain/torque samples, resolution of 1:20,000 (inc. RPM) Table No. 2

At a Baud rate of:										
	9600	**19200**	**38400**	**57600**	**115200**	**256000**	**460800**	**921600**	**3000000**	
Number of torque values:	**Torque readings per second:**									**Example of the output string:**
Type 1 = 1 per packet	45	91	182	274	548	1219	2000	4000	4000	$ZR,T,R,C,V,CS
Type 2 = 5 per packet	97	195	391	587	1175	2000	4000	4000	4000	$ZR,T,T,T,T,T,R,V,CS
Type 3 = 10 per packet	114	228	457	685	1250	2000	4000	4000	4000	$ZR,T,T,T,T,T,T,T,T,T,T,R,V,CS
Type 4 = 16 per packet	121	243	487	731	1250	2000	4000	4000	4000	$ZR,T,T,T,T,T,T,T,T,T,T,T,T,T,T,T,T,R,V,CS

Table No. 3

Resolution table

This graph show the noise-free resolution attainable at different output data rates.



Key to a Zeroed Data MODE1 example output data string

(for 10 torque readings per data packet)

$ZR,T,T,T,T,T,T,T,T,T,T,R,V,CS

$ZR = String type identifier (Zeroed Torque in mV/V)

T = Torque, raw strain data readings in mV/V

R = Rotor shaft RPM

CS = Checksum

PC Port Limitations

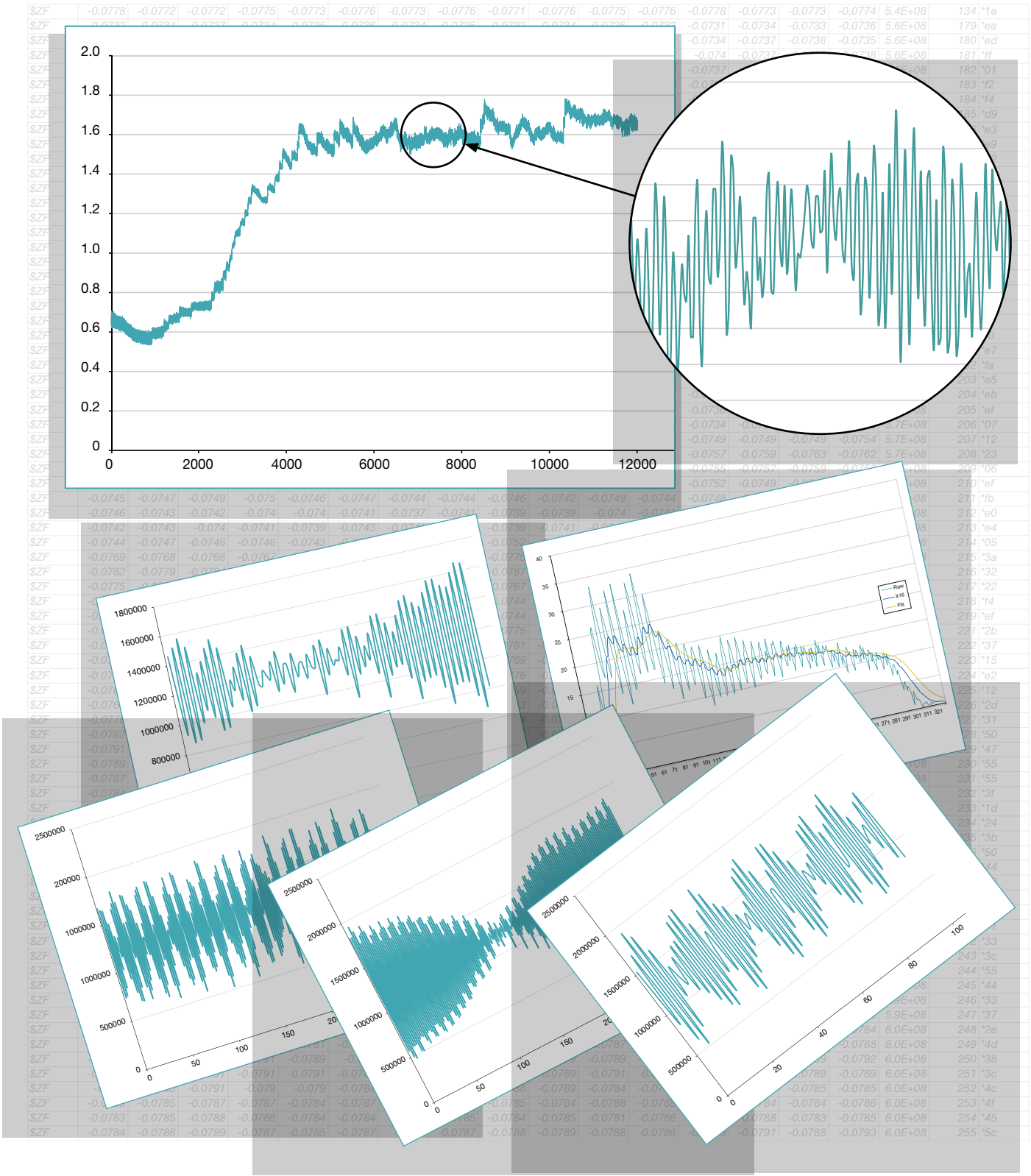
Note: the M425 Transducer is capable of transmitting at the rates above. Some PC's have limited port configurations that may not be able to cater for data rates at this level.

OUTPUT DATA

READ MORE FROM YOUR DATA

The M425 will provide you with accurate torque data. The following graphs show examples of some data output possibilities of the M425 Torque Transducer.

Within this data we can often see valuable characteristics at higher sample rates that show Torsional information that will indicate system wear, vibration and changes in efficiency. The raw data can also be viewed in a spreadsheet as columns.



SPECIFICATIONS

M425 performance information

PERFORMANCE	Table No. 4
Non-Linearity	+/-0.1% FSD
Non-Repeatability	+/-0.05% FSD
Noise-free Resolution	20 bit to 13.5 bit (dependent on sample rate)
Sample Rate	1 to 4000 samples per second
Output Baud Rate	9600 to 3Mbaud (see table 13)

RPM:	
Size 1 to 6	30 pulses per rev

Transducer output interfaces:	
Serial data via RS485	
RS232 (option)	

Transducer output data:			
Torque	Shaft RPM	Shaft Temp.	Diagnostics

POWER SUPPLY	Table No. 5
Transducer	10-24Vdc 250mA
Transducer and Interface	15-24Vdc 400mA

SIGNAL INTERFACE OUTPUTS	Table No. 6
Digital:	
RS485	Serial data
RS232	Serial data
Ethernet	Data and configuration
MODBUS UDP	Serial data
USB Type Mini B	Serial data
USB Type A	Data logging

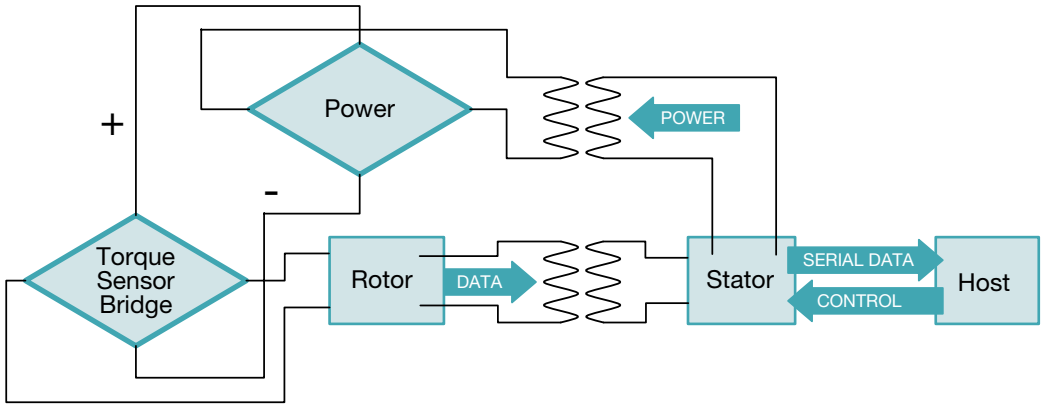
Analogues:	
All four of the M425 Transducer's analogue output channels can be configured for any of the following settings by the user: 4-20mA configured 4-20mA (4-12-20mA): +/-10Vdc, +/-5Vdc, 0-10Vdc or 0-5Vdc	
A typical configuration arrangement would be as follows:	
Channel 1 - Torque	from 0-500Nm as 4-20mA
Channel 2 - Speed RPM	from 0-100-rpm as 0-5Vdc
Channel 3 - Power	from 0-5000W as 4-20mA
Channel 4 - Spare	

Display:			
Torque	Speed RPM	Power	Status

ENVIRONMENT	Table No. 7
Thermal Stability of Gain per 10˚C	0.02%
Thermal Stability of Zero per 10˚C	0.02%
Normal Specification Range	10 to 60˚C
Operating Range	-10 to +70˚C
Storage Range	-35 to +75˚C
Environmental Protection	IP54 (see RS425 for IP67/68)
Electromagnetic Compatibility	EN61326-1:2006 (IEC61000-4), IEC60945)

M425 block diagram

Diagram No. 14



SPECIFICATIONS continued

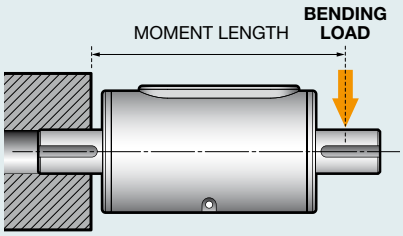
M425 shaft stiffness and load parameters

Table No. 8

M425 model size	Rated load (Nm)	Rated load (Lbft)	Standard max RPM	Overall length (mm)	Moment length	Bending loads at the moment length (N)	Shaft proof load (Nm)	Shaft ultimate (breaking) load (Nm)	Axial loads (N)	Total stiffness (Rad/Nm)	Total stiffness (Nm/Rad)
Size 1 - A	10	7.4	0-10000	184	154	8	18	32	442	2.06E-03	485
Size 1 - B	20	14.8	0-10000	184	154	14	31	55	636	1.12E-03	891
Size 1 - C	50	36.9	0-10,000	184	154	33	74	131	1,131	5.25E-04	1,904
Size 1 - D	100	73.8	0-10,000	184	154	65	144	257	1,767	3.62E-04	2,761
Size 2 - A	250	184	0-8,000	240	175.5	153	389	694	3,431	6.09E-05	16,418
Size 2 - B	500	369	0-8,000	240	175.5	330	838	1,497	5,726	3.74E-05	26,749
Size 3 - A	1,000	738	0-6,000	315	132.75	797	1,530	2,732	8,553	1.07E-05	93,458
Size 3 - B	2,000	1,475.1	0-6,000	315	132.75	1,644	3,155	5,633	13,854	4.99E-06	200,573
Size 4 - A	5,000	3,687.9	0-5,000	425	218.75	2,364	7,477	13,353	24,630	2.22E-06	450,056
Size 4 - B	10,000	7,375.7	0-5,000	425	218.75	4,618	14,604	26,079	38,485	1.27E-06	789,591
Size 5 - A	15,000	11,064	0-2,000	416	191	8,502	23,477	41,922	52,810	3.82E-07	2614,430
Size 5 - B	20,000	14,751	0-2,000	416	191	11,241	31,040	55,428	63,617	2.95E-07	3390,520
Size 5 - C	25,000	18,439	0-2,000	416	191	14,513	40,075	71,562	75,430	2.39E-07	4185,528
Size 5 - D	30,000	22,127	0-2,000	416	191	17,851	49,290	88,018	86,590	2.06E-07	4863,152
Size 6 - A	40,000	29,503	0-1,500	410	185	21,190	56,672	101,200	95,033	1.67E-07	5986,531
Size 6 - B	60,000	44,254	0-1,500	410	185	34,977	93,545	167,045	132,732	1.25E-07	8021,991

Bending loads

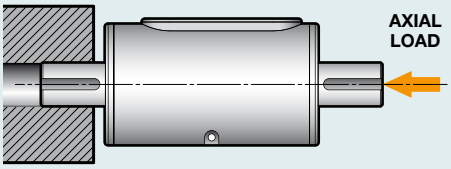
Diagram No. 15



Where possible moments at the end on the shaft should be avoided. The table contains values for the moments that can be exerted without damage with the transducer not rotating. These values should be reduced if the shaft is rotating.

Axial loads

Diagram No. 16



Direct Axial loads will have little effect on performance, however offset Axial loads that apply a cross moment to the shaft will have an effect on the smaller size 1 transducers below 50Nm and should be avoided.

M425 Specifications continued

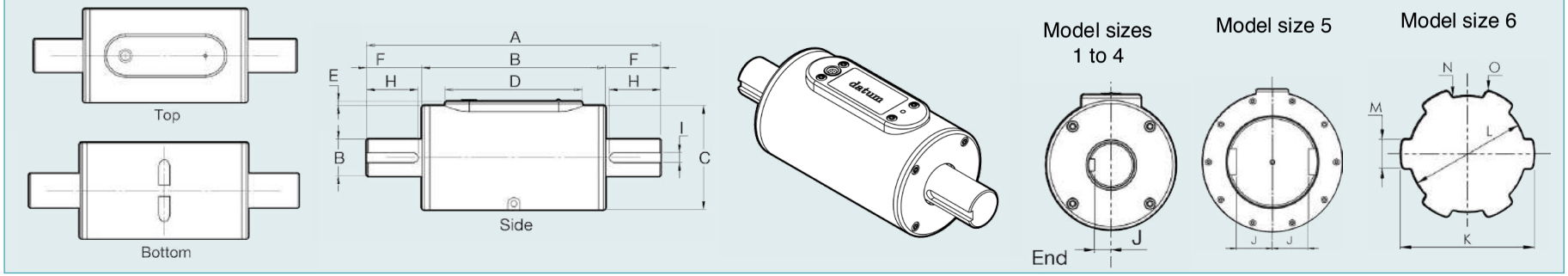
M425 mass and dimensions (mm)

Table No.9

						A	B	C	D	E	F	G		H	I	J
M425 model size	**Rated load (Nm)**	**Rated load (lb ft)**	**Rotational speed (RPM)**	**Body mass Kgs**	**Total mass Kgs**	**Overall length**	**Body length**	**Body dia.**	**Output module length**	**Output module height**	**Exposed shaft length**	**Shaft dia. g6 fit**	**Numer of keyways**	**Keyway length (BS 4235-1: 1972)**	**Keyway width (BS 4235-1: 1972)**	**Keyway depth off centre**
Size 1 - A	0-10	7.4	0-10,000	1.057	1.030	184	130	66	112	3.5	27	15	1 keyway	22.5	5	4.3
Size 1 - B	0-20	14.8	0-10,000	1.057	1.041	184	130	66	112	3.5	27	15	1 keyway	22.5	5	4.3
Size 1 - C	0-50	36.9	0-10,000	1.057	1.058	184	130	66	112	3.5	27	15	1 keyway	22.5	5	4.3
Size 1 - D	0-100	73.8	0-10,000	1.057	1.081	184	130	66	112	3.5	27	15	1 keyway	22.5	5	4.3
Size 2 - A	0-250	184	0-8,000	1.057	2.617	240	150	85	112	3.5	45	30	1 keyway	44	8	11
Size 2 - B	0-500	369	0-8,000	1.057	2.721	240	150	85	112	3.5	45	30	1 keyway	44	8	11
Size 3 - A	0-1,000	738	0-6,000	1.057	6.729	315	150	110	112	5.5	82.5	50	1 keyway	78.5	12*	20
Size 3 - B	0-2,000	1475.1	0-6,000	1.057	6.930	315	150	110	112	5.5	82.5	50	1 keyway	78.5	12*	20
Size 4 - A	0-5,000	3687.9	0-5,000	1.152	14.702	425	150	135	112	5.5	137.5	75	1 keyway	78.5	20	30
Size 4 - B	0-10,000	7375.7	0-5,000	1.152	15.254	425	150	135	112	5.5	137.5	75	1 keyway	78.5	20	30
Size 5 - A	0-15,000	11064	0-2,000	2.138	28.595	416	168	170	112	5.5	124	110	2 keyway	116	32	44
Size 5 - B	0-20,000	14751	0-2,000	2.138	31.366	416	168	170	112	5.5	124	110	2 keyway	116	32	44
Size 5 - C	0-25,000	18439	0-2,000	2.138	33.875	416	168	170	112	5.5	124	110	2 keyway	116	32	44
Size 5 - D	0-30,000	22127	0-2,000	2.138	35.246	416	168	170	112	5.5	124	110	2 keyway	116	32	44

Model size	**Rated load (Nm)**	**Rated load (lb ft)**	**Rotation-al speed (RPM)**	**Total mass Kgs**	**Rotor mass Kgs**	**Overall length**	**Body length**	**Body dia.**	**Output module length**	**Output module height**	**Exposed shaft length**	**Spline outer dia.**	**Spline no.**	**Spline inner dia.**	**Spline width**	**Chamfer and radius**
Size 6 - A	0-40,000	29503	0-1,500	44.93	31.842	416	155	228.6	112	5.5	101.6	152.4	6 spline	137	38	N = 0.5 - 1, O = 1.1- 1.3
Size 6 - B	0-60,000	44254	0-1,500	44.93	34.669	416	155	228.6	112	5.5	101.6	152.4	6 spline	137	38	N = 0.5 - 1, O = 1.1 - 1.3

Alphabet key for M425



*Does not comply with (BS 4235-1: 1972)

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PRE-CALIBRATED AND TESTED

TEST CERTIFICATE

The M425 Series Torque Transducer is calibrated on test rigs traceable to UK National Standards

The Transducers will be subjected to a series of test cycles starting with a proof load cycle(s) and then followed by a series of calibration cycles.

Loads are applied from zero torque to the maximum working torque of the Transducer.

The data shown on the test certificate:

- The test equipment used
- Calibration date
- A table of the actual loads applied against the output
- The output is described in either:

  mV/V - this is the raw strain signal from the torque shaft

  Nm/Lbft - this is the calibrated output of the transducer

Some Transducers are supplied with a raw output that is processed and displayed in the instrumentation or user software.

Other Transducers store their calibration settings and have an output in the units required, Nm/Lbft. These Transducers can also output the raw mv/V values where required.

- Example of cal sheet annotated
- RPM - Calibration

The Interfaces and Indicators

Where supplied with an indicator or a signal interface the outputs of the interface and the Transducer will both be calibrated and detailed on a systems test certificate.

The outputs calibrated will be the +/-10Vdc, +/-5Vdc and the 4-20mA signals.

The indicators and serial data outputs for the Ethernet, USB and MODBUS ports are directly sent from the Transducer. Interface options allow a scaling factor(s) for these signals to be entered into the Interface.

ALTERNATIVE SOLUTIONS

THE DATUM RS & FF425 RANGES

In addition to the M425 range Datum Electronics Limited manufacture a wide range of complimentary torque sensors.

The RS and FF425 ranges are non-contact and non-bearing sensors that can be tailored to fit a test rig or drive application.

Within these ranges the Series 425 Electronics are engineered to fit a shaft coupling of a section of an existing drive shaft. These are fitted by Datum Electronics in the factory. They have advantages where space is at a premium and a standard transducer cannot replace an existing component without major engineering work. They have further advantages in that they can operate at higher speeds for longer duty cycles. When used in harsh environments the RS/FF425 ranges can be supplied full encapsulated.

With the sensor added to an existing shaft the dynamics of the drive line will remain substantially the same.

FF Series Transducer

RS425 Series Transducer

DIAGNOSTICS

GUIDE TO STATUS CODES

INCORRECT TORQUE

Check the scaling of the output device.

If using the user software on a PC look at the torque calibration tab.

The certificate issued with the transducer will have a value for its output signal in mV/V at a given torque.The software set up should match this (i.e. 1.756mV/V = 250Nm)

If using the Universal Interface use the GUI interface connected via the USB port and check the same tab.

Check the torque reading with no torque applied. If the Transducer output is showing a torque reading at zero this will be added to all readings. The torque calibration tab of the software has an option to zero the torque reading. The Universal Interface also has a torque zero button. Pressing and holding this for 10 seconds will take the current torque reading as zero.

When checking or setting the zero check to see if any torque is locked into the transducer by the machine or rig on which it is used. It is ideal to check the zero with the transducer disconnected from the rig.

SIGNAL NOISE

The M425 Transducer is designed to be a sensitive device and will show any variation in torque applied. The noise level on the data from your Transducer should be very low but will vary with sampling rates and averaging. The faster the Transducer reads the torque data the more signal noise you will see. (See table 3 on page 13). This table assumes that no averaging has been applied in the instrument or software interface. From the table you will see that at 4 samples per second the noise levels are very low at less than 1 part in 120,000 and at 4000 samples per second they are below 1 part in 10,000.

To differentiate between signal noise and mechanical input it is worth plotting the output data. At times the minor fluctuations in torque will show valuable diagnostics data and element of torsional vibration.

If you conclude that the noise is a true mechanical reading but you require a steady display, either increase the damping level of the display software or decrease the sampling rate.

Although designed to reject electrical noise, and designed/tested to EMC Standards, the Transducer may be affected by large varying electrical fields. Review all local switching, generating or drive machinery.

If unsure of the status of the data we may be able to assist if you send a log file and a brief description of any effects you are seeing to: **support@datum-electronics.co.uk**

ZERO OFFSET

The factory zero of the M425 Transducer will be declared on the calibration sheet. If the reading you have at zero differs from this value, look at the raw signal value from the Transducer (either using the user interface software or the detail command). Small offsets can be removed using the zero command on the software interface or the zero button on the Universal Interface. If the offsets continue to appear refer back to the original offset value on your certificate to check that you are not applying an ongoing series of small offsets.

If the offset is large (greater than 0.2mV/V) it is likely that the Transducer has been subjected to a significant torque overload and has a permanent offset. If this is the case and repeated overloads are applied, the Transducer will become inaccurate and may ultimately mechanically fail. You should review your application and consider a higher rating of Transducer.

If the keyways of the Transducer are visually out of line this is a very good indicator that the Transducer has suffered a significant and damaging overload.

NO DATA

If you have no data being transmitted from the Transducer check the LED on top of the Transducer at the opposite end to the cable exit. This LED should be green and on.

LED STATUS

ON: Good signal and good power.

Flashing: Good power but no data.
(Please note that when you power your transducer for the first time you may see the LED flashing for up to a minute then change to ON, This is normal for first time use).

OFF: No power and no signal.

If the LED is **OFF** check all connections and ensure that you are supplying the correct power to the transducer either directly or from the Datum Universal Interface. Checking the power supply and connection cables (see page 7) will confirm this.

If this LED is on and you have no data check the output:

(1) **Universal Interface** - this will show a STATUS on line 4 of the display.

(2) **(No Serial Data out from the Universal Interface to your device)** - if the display on the Universal Interface is reading and showing changing torque and speed values as you apply loads to the Transducer, check the Interface to your system.

- **2A Baud Rate** - the baud rate requested for output can be seen and changed using the software provided.
- **2B Signal Reversal** - some communications over RS485 are described differently and may be reversed.

(3) **Bad Data** - if you are seeing data from either the Transducer or the Interface that appears invalid, check the connections to your system and the baud rate. The data when streaming in Mode 1 should appear on a simple terminal programme.

MAINTENANCE

SERVICEABLE ITEMS: BEARINGS

The bearings are the only component on the M425 that may require servicing depending on operating conditions. The following provides information on the bearing life under load conditions.

The M425 Transducer has a balanced rotor running between your couplings. The body of the Transducer is supported by two bearings. The life of the bearings at normal running RPM of half the rated RPM is 10 years continuous use.

If you have requirements for high duty sensors where bearing life may be a concern due to other external loads, ask our support team for additional information on our bearing less RS425 and FF425 ranges. These RS/FF designs provide a high degree of flexibility with regard to mounting tolerances and maintenance free operation.

If the shaft of the Transducer is bent the balance of the Transducer will be disturbed and the bearing life will be greatly reduced. Excessive load or mounting misalignment will also effect the life of the bearings. Bearings can be service by return to Datum Electronics.

GLOSSARY OF TERMS

Engineering Units

The transducers/sensors are calibrated in engineering units of either Nm or Lbft.

Full Scale Output

The mV/V is the output from the transducer when the rated load in applied.

mV/V

To measure torque we use a bridge network of resistive strain gauges. These change resistance with the applied strain. The output they give is a ratio of the voltage applied and the mV change in signal from the bridge.

This mV/V ratio is normally quoted in the form 1.55mV/V = 1000Nm. The mV/V value is established at calibration by applying a known torque to the shaft. This ratio will remain constant for the life of the transducer/sensor unless damaged.

Noise

Irregular fluctuations that accompany a transmitted electrical signal but are not part of the data generated from the sensor.

Proof Load

The proof load is the load to which the transducer/sensor has been tested - occasional loading to this level should not damage the transducer. Repeated loading to this level will reduce the fatigue life of the transducer and may cause small zero offset over time (usually measured in either Nm or lbft).

Rated Load

The Rated Load is the design full load of the transducer/sensor (measured in either Nm or lbft).

Raw Data

Raw data is the raw strain level from the torque shaft. It will include any zero offset.

The scaling of the raw data will require:

Torque [Nm] = (raw data [mV/V] - zero offset [mV/V]) x (rated torque [Nm]) ÷ (full scale output [mV/V]).

Sensor

A sensor measures a physical quantity and converts this into a signal. The physical quantity is torque or torsional strain, this is converted into serial data.

NOTE: The words transducer and sensor are often used in this context to mean the same thing.

Span

This is the value of output at the rated load. Either given in terms of mV/V signal or Nm or lbft when in engineering units.

STEP files

A STEP file is a widely adopted CAD file format used to share 3D models between users with different CAD systems.

Torque

The twisting force on the shaft created by the driving force (motor) and the resisting force (brake or gear).

Transducer

A transducer is defined as a device that converts one form of energy to another. In terms of the M425 Torque Transducer the transducer converts torque into serial data.

NOTE: The words transducer and sensor are often used in this context to mean the same thing.

Zero

This is the value of the signal when the shaft is completely unloaded. Normally quoted in mV/V.

DATUM ELECTRONICS

M425 TORQUE TRANSDUCER PRODUCT OVERVIEW

datum electronics

THE DATUM M425 TORQUE TRANSDUCER

The latest technology Datum Electronics Series M425 non-contact rotary Torque Transducers have been designed to fit with most applications and solutions requiring rotary torque measurement. The Torque Transducer fits in line with the drive train or test bed, using standard keyway shafts.

A non-contact transmission system provides data directly proportional to torque. In this variant it is supplied as a complete transducer with bearings to support the stator unit on the rotating shaft. It is suitable for most general test rig applications.

The M425 Torque Transducer utilises a strain gauged shaft for accurate and reliable torque measurement and a set of rotating on-shaft conditioning electronics. The digital signals are transmitted to the non-rotating part of the system or stator providing a reliable and highly accurate torque measurement solution.

The M425 has a torque measuring element design with an optimum length to maximise overall accuracy and give a high degree of tolerance to mounting offset.

The M425 also has a legacy mode so that it can be used as a direct replacement for the previous M420 Transducer.

M425 SYSTEM PERFORMANCE AND BENEFITS:

- Ranges 0-10Nm up to 0-60,000Nm
- High resolution torque sampling
- High data rate
- Accuracy and resolution options
- Non-contact data transmission
- Static and rotary torque measurement
- Operational stability
- Magnetic speed sensor - not effected by dirt
- Simple to integrate
- Robust construction
- Sample rate selection 1-4000 samples per second
- Low power consumption

SPECIFICATIONS

M425 PERFORMANCE INFORMATION

PERFORMANCE	
Non-Linearity	+/-0.1% FSD
Non-Repeatability	+/-0.05% FSD
Noise-free Resolution	20 bit to 13.5 bit (dependent on sample rate)
Sample Rate	1 to 4000 samples per second
Output Baud Rate	9600 to 3Mbaud

RPM:	
Size 1 to 6	30 pulses per rev

Transducer output interfaces:
Serial data via RS485
RS232 (option)

Transducer output data:			
Torque	Shaft RPM	Shaft Temp.	Diagnostics

POWER SUPPLY	
Transducer	10-24Vdc 250mA
Transducer and Interface	15-24Vdc 400mA

ENVIRONMENT	
Thermal Stability of Gain per 10˚C	0.02%
Thermal Stability of Zero per 10˚C	0.02%
Normal Specification Range	10 to 60˚C
Operating Range	-10 to +70˚C
Storage Range	-35 to +75˚C
Environmental Protection	IP54 (see RS425 for IP67/68 options)
Electromagnetic Compatibility	EN61326-1:2006 (IEC61000-4), IEC60945)

For signal output options including Ethernet, MODBUS, USB, RS485/232 and 4 analogue channels configured 4-20mA (4-12-20mA): +/-10Vdc, +/-5Vdc, 0-10Vdc or 0-5Vdc, refer to Document 1013 Daum Universal Transducer Interface.

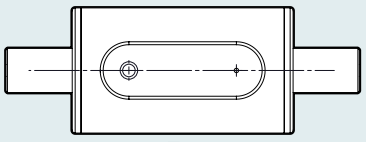
Document: 1012 Issue: 5 Date: 03/08/2016

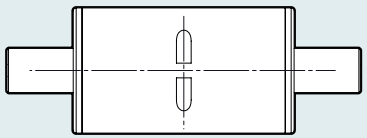
M425 Specifications

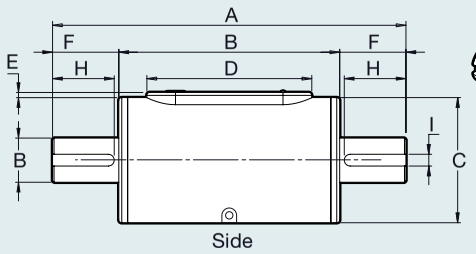
						A	B	C	D	E	F	G		H	I	J
M425 model size	**Rated load (Nm)**	**Rated load (lb ft)**	**Rotational speed (RPM)**	**Body mass Kgs**	**Total mass Kgs**	**Overall length**	**Body length**	**Body dia.**	**Output module length**	**Output module height**	**Exposed shaft length**	**Shaft dia. G6 fit**	**Numer of keyways**	**Keyway length (BS 4235-1: 1972)**	**Keyway width (BS 4235-1: 1972)**	**Keyway depth off centre**
Size 1 - A	0-10	7.4	0-10,000	1.057	1.030	184	130	66	112	3.5	27	15	1 keyway	22.5	5	4.3
Size 1 - B	0-20	14.8	0-10,000	1.057	1.041	184	130	66	112	3.5	27	15	1 keyway	22.5	5	4.3
Size 1 - C	0-50	36.9	0-10,000	1.057	1.058	184	130	66	112	3.5	27	15	1 keyway	22.5	5	4.3
Size 1 - D	0-100	73.8	0-10,000	1.057	1.081	184	130	66	112	3.5	27	15	1 keyway	22.5	5	4.3
Size 2 - A	0-250	184	0-8,000	1.057	2.617	240	150	85	112	3.5	45	30	1 keyway	44	8	11
Size 2 - B	0-500	369	0-8,000	1.057	2.721	240	150	85	112	3.5	45	30	1 keyway	44	8	11
Size 3 - A	0-1,000	738	0-6,000	1.057	6.729	315	150	110	112	5.5	82.5	50	1 keyway	78.5	12*	20
Size 3 - B	0-2,000	1475.1	0-6,000	1.057	6.930	315	150	110	112	5.5	82.5	50	1 keyway	78.5	12*	20
Size 4 - A	0-5,000	3687.9	0-5,000	1.152	14.702	425	150	135	112	5.5	137.5	75	1 keyway	78.5	20	30
Size 4 - B	0-10,000	7375.7	0-5,000	1.152	15.254	425	150	135	112	5.5	137.5	75	1 keyway	78.5	20	30
Size 5 - A	0-15,000	11064	0-2,000	2.138	28.595	416	168	170	112	5.5	124	110	2 keyway	116	32	44
Size 5 - B	0-20,000	14751	0-2,000	2.138	31.366	416	168	170	112	5.5	124	110	2 keyway	116	32	44
Size 5 - C	0-25,000	18439	0-2,000	2.138	33.875	416	168	170	112	5.5	124	110	2 keyway	116	32	44
Size 5 - D	0-30,000	22127	0-2,000	2.138	35.246	416	168	170	112	5.5	124	110	2 keyway	116	32	44

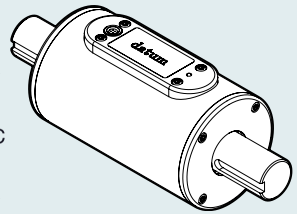
Alphabet key for M425

			A	B	C	D	E	F	K		L	M	N & O
Model size	**Total mass Kgs**	**Rotor mass Kgs**	**Overall length**	**Body length**	**Body dia.**	**Output module length**	**Output module height**	**Exposed shaft length**	**Spline outer dia.**	**Spline no.**	**Spline inner dia.**	**Spline width**	**Chamfer and radius**
Size 6 - A	44.93	31.842	416	155	228.6	112	5.5	101.6	152.4	6 spline	137	38	N = 0.5 - 1, O = 1.1 - 1.3
Size 6 - B	44.93	34.669	416	155	228.6	112	5.5	101.6	152.4	6 spline	137	38	N = 0.5 - 1, O = 1.1 - 1.3

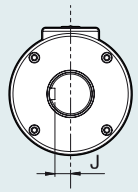




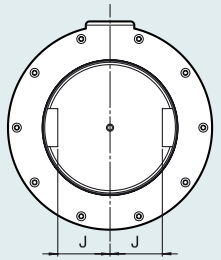




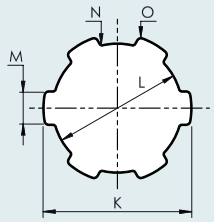
Model sizes 1 to 4



Model size 5



Model size 6



*Does not comply with (BS 4235-1: 1972)

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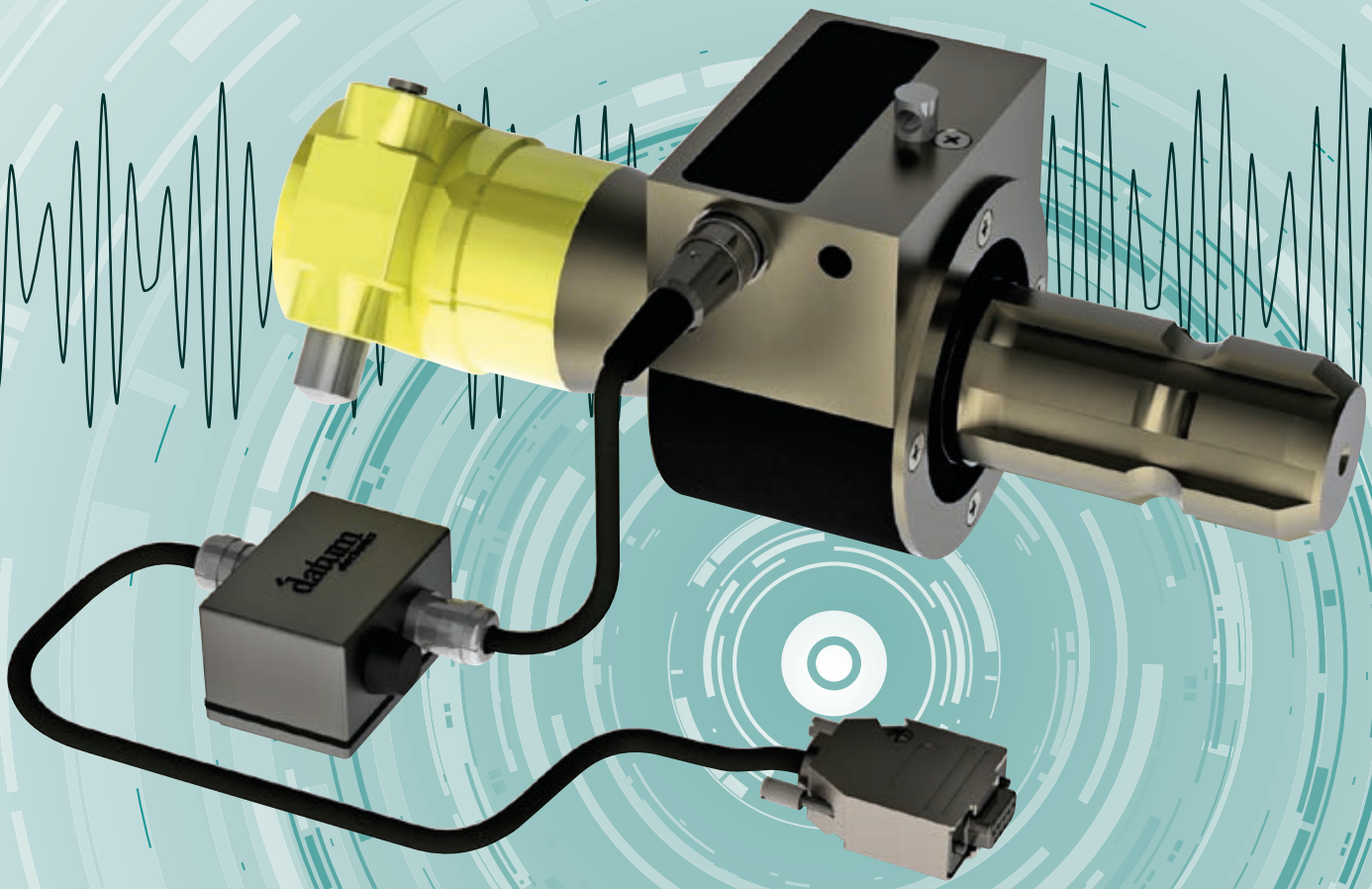
DATUM ELECTRONICS

PTO 420 SERIES SHAFT TORQUE & POWER MONITORING SYSTEM
HANDBOOK AND INSTALLATION GUIDE



datum electronics

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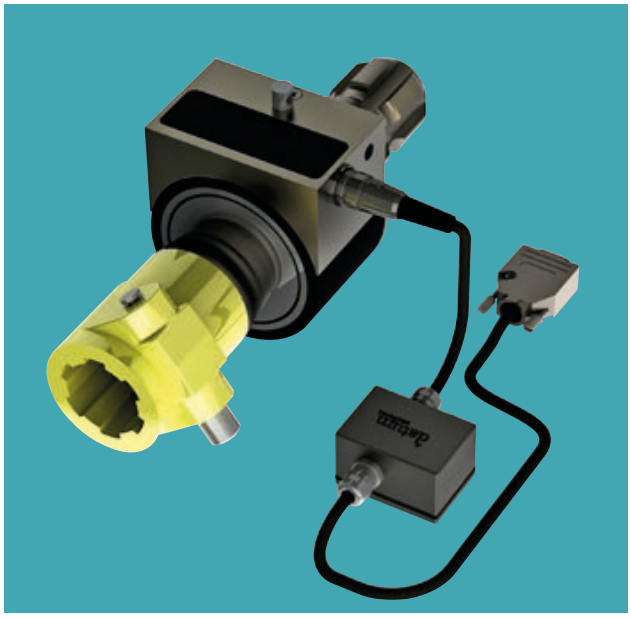
PTO 420 SERIES SHAFT TORQUE AND POWER MONITORING SYSTEM



What is it designed to do?

Datum Electronics Series 420 PTO (Power Take Off) Shaft Torque and Power Monitoring System will monitor and log the torque, shaft speed and transmitted power accurately when testing new systems driven from all standard PTO Shafts.

The tractor's PTO or stub shaft transfers power from the tractor to the PTO-driven machine or implement. Power transfer is accomplished by connecting a drive shaft from the machinery to the tractor's PTO stub shaft. Common examples include elevators, grain augers and silage blowers. The PTO and drive shaft rotates at 540 rpm (9 times/sec.) or 1,000 rpm (16.6 times/sec.) when operating at full recommended speed. At all speeds, they rotate in proportion to the speed of the tractor engine.

Measurement and Monitoring

Efficient measurement and monitoring of this power can be a useful tool in research and analysis into the performance of a tractor transmission. It highlights efficiency savings measurement and control.

SYSTEM ADVANTAGES

PTO series 420 system performance and benefits:

Power Monitoring
Robust Design for use in field applications
IP 65
Easy Installation
Accurate Results (0.5% Accuracy)
Direct USB Interface into PC or laptop

SYSTEM OUTLINE

Non-contact transmission

The PTO series 420 is a contactless rotary torque transducer. The transducer measures torque strain in the shaft via an on-shaft microprocessor circuit, which also measures shaft rotational speed.

The torque and speed data is transmitted to the stationary part via a contactless method and is transmitted to the control unit. The control unit has an RS232 data connection which can be connected to a Laptop or PC running Datum Electronics test software which allows the display and logging of Torque, Speed and Power data.

The Series 420 PTO System has a non-contact transmissions system that provides a digital output directly proportional to Torque. Supplied as a complete transducer with bearings to support the stator unit, this robust design gives performance data by actual measurement on the rotating drive shaft. It is suitable for most power take off applications.

The PTO system has a female coupling on one end and a male fitting on the opposite end. The female end is coupled to the male end of the application. The PTO system acts like an extension adaptor, with the male end replicating the male end of the application. The torque and speed signals are transmitted from the shaft to a static cover assembly.

Clockwise/Anti-Clockwise Measurement

Measuring torque in both directions, clockwise and anti-clockwise the system provides accurate readings of Power, Torque and Speed logged to a Datum Universal Indicator. If required, the system can also be adapted to record and analyse the data onto a PC or laptop with our TorqueLog software.

SYSTEM ITEMS SUPPLIED

Included as standard with the PTO Transducer:

DESCRIPTION	QUANTITY
PTO Transducer	**1**
PTO Transducer connection cable	**1**
Datum Universal Interface - Optional	**1**
Universal Interface USB cable - Optional	**1**
Universal Interface Power Supply - 110-230Vac if req.	**1**
Universal Interface power lead 2mts with open cable ends for connection to a 24Vdc Aux supply. - Optional	**1**
Calibration **Test Certificate**	**1**

FAMILIARISATION

SIMPLE DIAGNOSTICS, TESTING AND CONNECTION

Before installing your PTO Transducer into the rig or vehicle we would advise you to familiarise yourself with its connections and operation by performing a bench test.

By connecting the Transducer directly to a Datum Universal Interface (example A below), or to a PC via the Datum Universal Interface (example B opposite), you will be able to rotate the shaft to generate an output signal of RPM. By applying a small torque by hand to the shaft you will also be able see the change in the torque signal output on the Universal Interface display or in the Datum PC software.

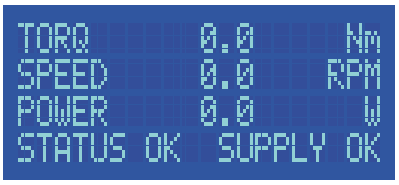
If you are connecting to a PC without a Datum Universal Interface and using your own instrumentation (example C opposite) you will be able to test your instrumentation in the same way by simulating a signal to the interface or indicator model you are using. The PTO Transducer supports a variety of universal interface models.

Once you are familiar with the PTO transducer and its outputs, continue to install as normal. If any questions arise at this stage please call our product support team for advice.

The Datum Universal Interface display

The Datum Universal Interface has a built-in display which you can use for familiarisation with a direct connection to the PTO Transducer (diagram A below).

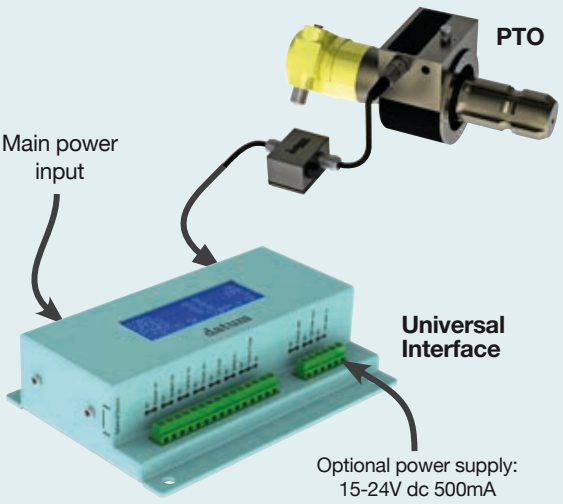
The Universal Interface display can show the following data from the PTO Transducer:



Connection example (A)

PTO Transducer to the Datum Universal Interface.

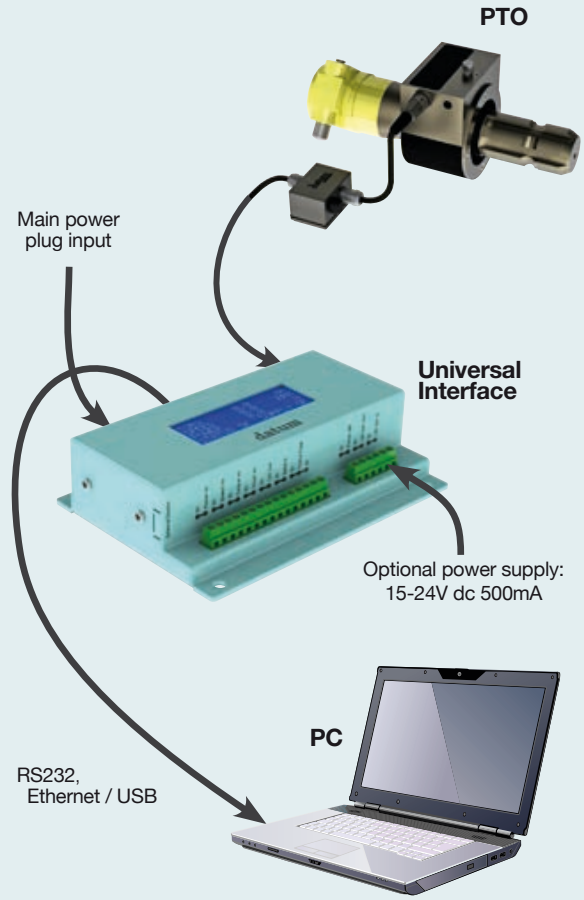
Diagram No. 1



Connection example (B)

PTO Transducer to PC via the Datum Universal Interface.

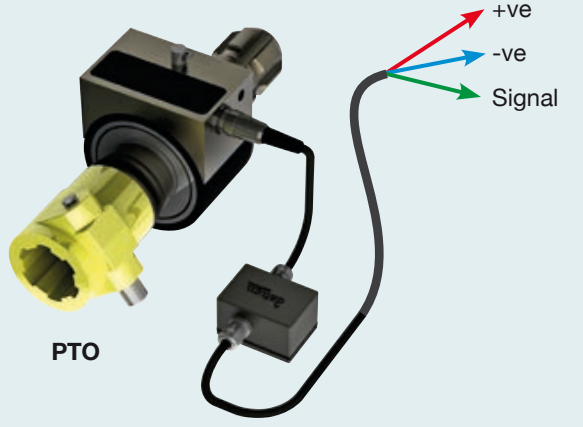
Diagram No. 2



Connection example (C)

Direct connection from PTO Transducer to an alternative interface or indicator.

Diagram No. 3



See electrical connection guide on pages 6-9 for further information on connecting your own instrumentation.

MECHANICAL INSTALLATION

ANTI-ROTATION POINT

The body of the PTO transducer is suspended on bearings on the rotating shaft. An anti-rotation tether point is provided on the top of the body, adjacent to the cable connection, to prevent the transducer body from rotating with the shaft.

The bearings in the transducer are intended for supporting the body of the transducer only and should not be used to support the shaft or assembly to which the transducer is mounted.

INSTALLATION

The Transducer should be attached to the PTO shaft output of the vehicle and a suitable tether arranged to a stationary part of the vehicle to prevent the outer body from rotating when the PTO shaft rotates. The connecting cable must NOT be used for this purpose. The connecting cable should be connected between the Transducer and Universal Interface if supplied, which should be mounted in a convenient location, away from rotating parts and protected from dirt and moisture.

The power cable (if supplied) should be connected (via a suitable connector) to the vehicle's battery supply. A DC supply in the voltage range 12.5 to 15V with a supply current capability of 1A is required for correct operation.

Correct Polarity Must be Observed:

Red = +ve (Positive)
Blue = -ve (Negative)

The RS232 output can be connected either to the Datum Universal Indicator (supplied) for a local display of Torque, Speed and Power, or can be connected to Laptop or PC (Windows) running the test software supplied.

SAFETY - ENSURE THE PTO SHAFT IS GUARDED

A tractor power take-off (PTO) and the power take-off drive shaft of a machine are very dangerous if used and not correctly guarded. Every year people are killed or seriously injured in accidents involving PTOs and PTO drive shafts. Most of these accidents are preventable if the PTO and PTO drive shaft are fitted with guards of good design which are properly used and maintained.

Note: Broken, damaged or badly fitting guards can be just as dangerous as no guard at all.

Protect the tractor PTO with a shield covering the top and both sides of the PTO so that it stops anyone making contact with it, either with parts of their body or their clothes. Make sure this shield is well constructed and capable of supporting a downward load of at least 120 kg. When the PTO is not in use, it may be covered by a fixed cap. Guard PTO drive shafts by enclosing them along their full length, from the tractor to the first bearing on the machine.

Take care to route all the PTO Transducer cables safely away from the rotating PTO shaft and any moving mechanical components. Secure them with cable ties to ensure there is no possibility of fouling on the rotating shaft.

Further advice on guarding the PTO shaft is available from in the form of a PDF document on the Health and Safety Executive website at the following link:

www.hse.gov.uk/pubns/ais40.pdf

CALIBRATION

The Transducer is supplied with a calibration certificate for reference purposes. The output from the transducer is described in mV/V and related to the data transmitted via the RS232 output from the transducer.

If The Universal Interface is supplied pre-set to the transducer's calibration values and should not need to be adjusted other than a possible re-setting of the Transducer Zero Point.

The Datum software software, once installed, may need calibration values to be entered from the calibration certificate before correct values will be displayed.

(Both of these require a zero offset to be reset separately, see the relevant sections).

OPERATION

The Datum Universal Indicator and Datum test software should show the Torque, Speed and Power measured by the transducer.

If the indicator shoes "No Data from Transducer", or the Software shows '---' instead of a torque value, this indicates that no data is being received from the transducer. In this case check the connectors and cable between control unit and transducer, and between control unit and indicator or PC.

INPUT ELECTRICAL CONNECTION
(Universal Interface to PTO)

CABLE AND SOCKET CONNECTORS WIRING GUIDE

The supplied cable length for the PTO Transducer is 4 metres, longer cables up to 10 meters can be supplied on request. This cable is terminated with a standard 9-way D connector to interface to any of the Datum Electronics Signal Interfaces or Indicators.

The connections within this cable are detailed below should you wish to connect the 420 series PTO Transducer directly into your own instrumentation and software.

The default signal output from the PTO Transducer is RS232 Serial Data. An In-line fuse is housed in the cable as additional protection from vehicle supplies (as there tends to be the occasional spike in current).

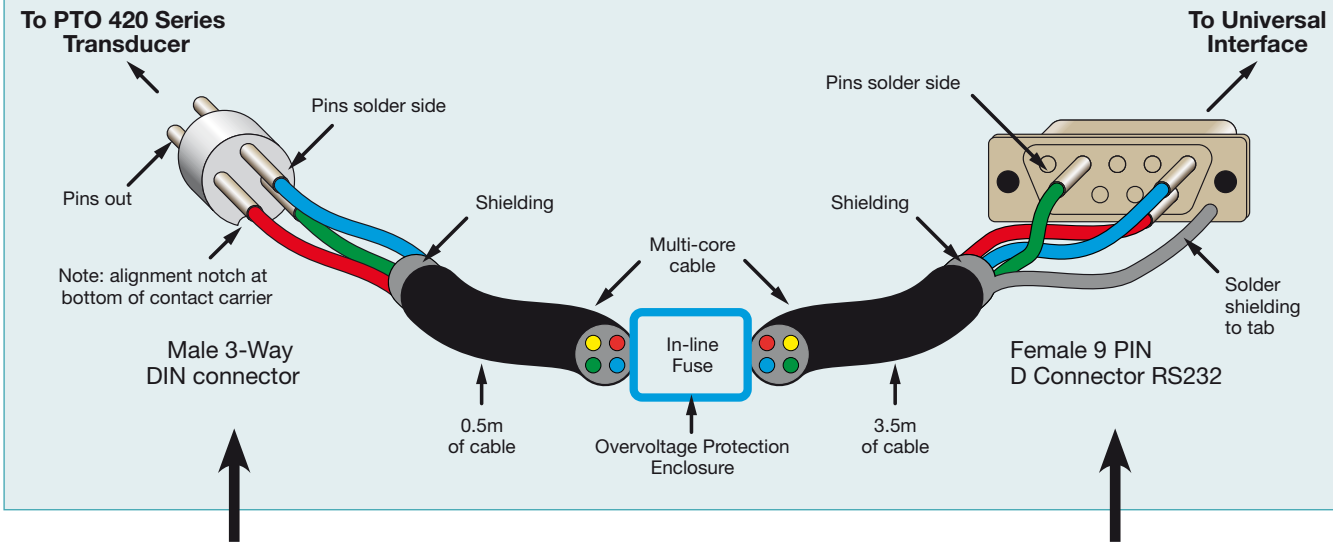
We have also provided the 3-way DIN and 9-way D plug wiring arrangement in diagram No. 4 below for the PTO Transducer end of the cable. On some occasions a cable may need to be assembled after laying through tight bulkhead access which may require the removal of the connectors. The maximum cable length for the PTO Transducer is normally 10 metres.

The data cable from the 420 series PTO Transducer to an interface must meet the following specification: **4 core wire, braided, screened, 7/02mm PVC Sheathed cable or equivalent.**

The 420 series PTO Transducer current consumption is less than 250mA with a 12Vdc supply. The 420 series PTO Transducer complete with its Universal Interface will consume below 450mA.

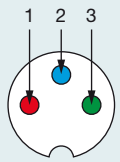
Diagram No. 4

Universal Interface to PTO Transducer signal cable wiring guide



3-way DIN connector wiring guide

Pin Out	Function	Cable Colour
Pin 1	+ve	RED
Pin 2	-ve	BLUE
Pin 3	Signal	Green

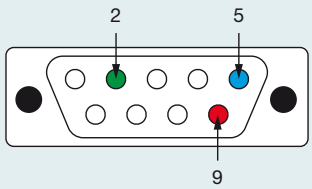


PIN numbering viewed from solder/cable side of the connector

Diagram No. 5

9-way D connector RS232 wiring guide

Pin Out	Function	Cable Colour
Pin 2	Signal	GREEN
Pin 5	Supply ground	BLUE
Pin 9	+ve	RED



PIN numbering viewed from solder/cable side of the connector

Diagram No. 6

OUTPUT ELECTRICAL **RS485** CONNECTION
(Universal Interface to Laptop PC)

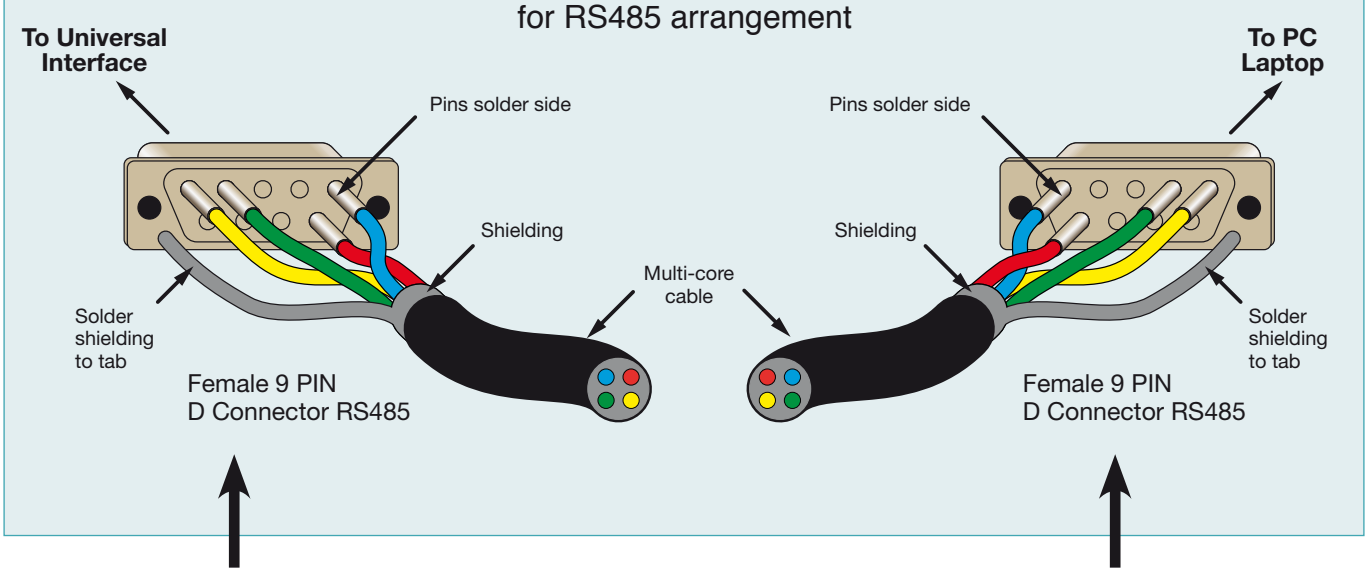
CABLE AND SOCKET CONNECTORS WIRING GUIDE

The Datum Universal Interface can also be connect to a Laptop or PC by USB or 9 way RS485 or RS232 serial D connector.

The connections for a RS485 serial D connector are detailed below should you wish to assemble your own cable to connect the 420 series PTO Transducer. Please note these are not supplied with the trasnducer

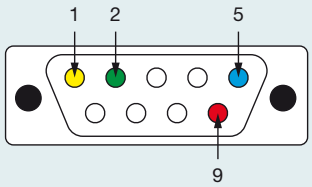
Diagram No. 7

Universal Interface to Laptop PC signal cable wiring guide for RS485 arrangement



9-way D connector RS485 wiring guide

Pin Out	Function	Cable Colour
Pin 1	RS485A	YELLOW
Pin 2	RS485B	GREEN
Pin 5	Supply ground	BLUE
Pin 9	12V Output (disabled when the Serial Output is being used for connection to a PC)	RED

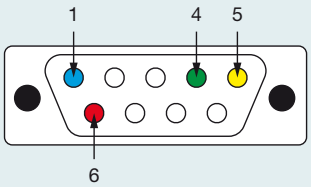


PIN numbering viewed from solder/cable side of the connector

Diagram No. 8

9-way D connector RS485 wiring guide

Pin Out	Function	Cable Colour
Pin 1	Supply ground	BLUE
Pin 4	RS485B	GREEN
Pin 5	RS485A	YELLOW
Pin 6	12V Output (disabled when the Serial Output is being used for connection to a PC)	RED



PIN numbering viewed from solder/cable side of the connector

Diagram No. 9

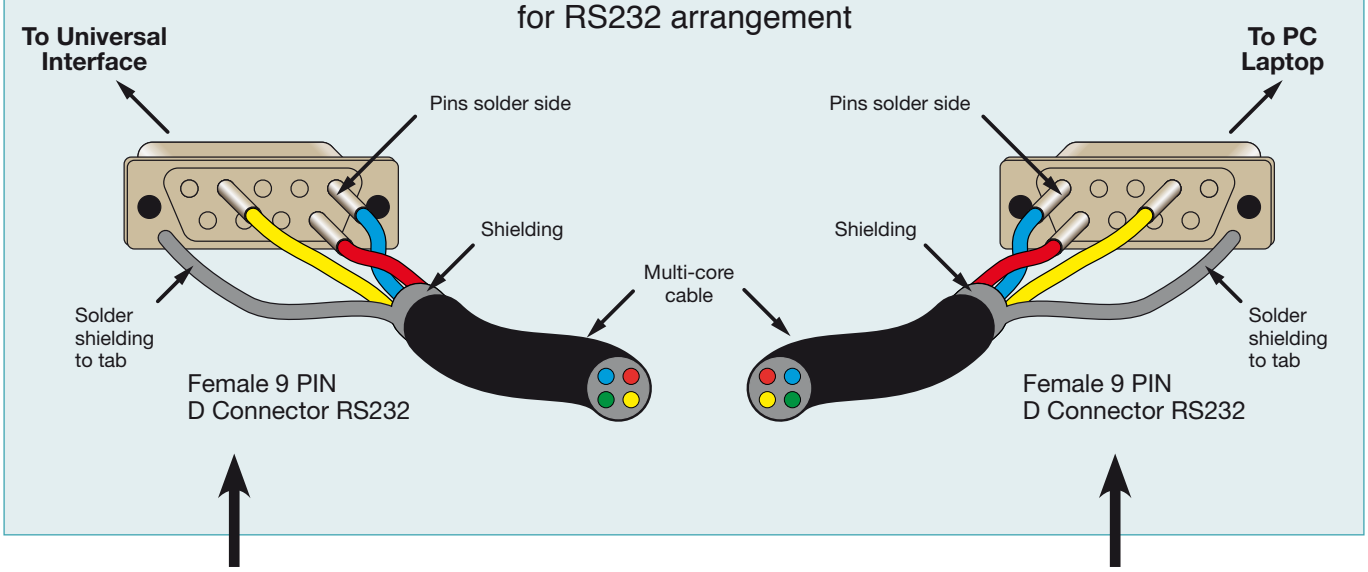
OUTPUT ELECTRICAL **RS232** CONNECTION
(Universal Interface to Laptop PC)

Unless requested the standard output from the Datum Universal Interface module is RS232, this can be changed in the Datum Software

The connections for a RS232 serial D connector are detailed below should you wish to assemble your own cable to connect the 420 series PTO Transducer.

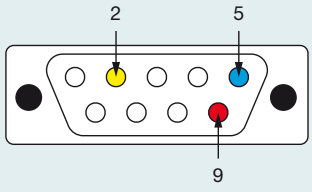
Diagram No. 10

Universal Interface to Laptop PC signal cable wiring guide for RS232 arrangement



9-way D connector RS232 wiring guide

Pin Out	Function	Cable Colour
Pin 2	Rx / Tx	YELLOW
Pin 5	Supply ground	BLUE
Pin 9	12V Output (disabled when the Serial Output is being used for connection to a PC)	RED

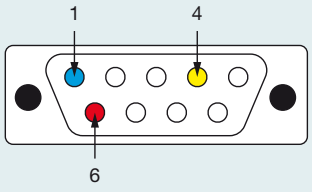


PIN numbering viewed from solder/cable side of the connector

Diagram No. 11

9-way D connector RS232 wiring guide

Pin Out	Function	Cable Colour
Pin 1	Supply ground	BLUE
Pin 4	Rx / Tx	YELLOW
Pin 6	12V Output (disabled when the Serial Output is being used for connection to a PC)	RED



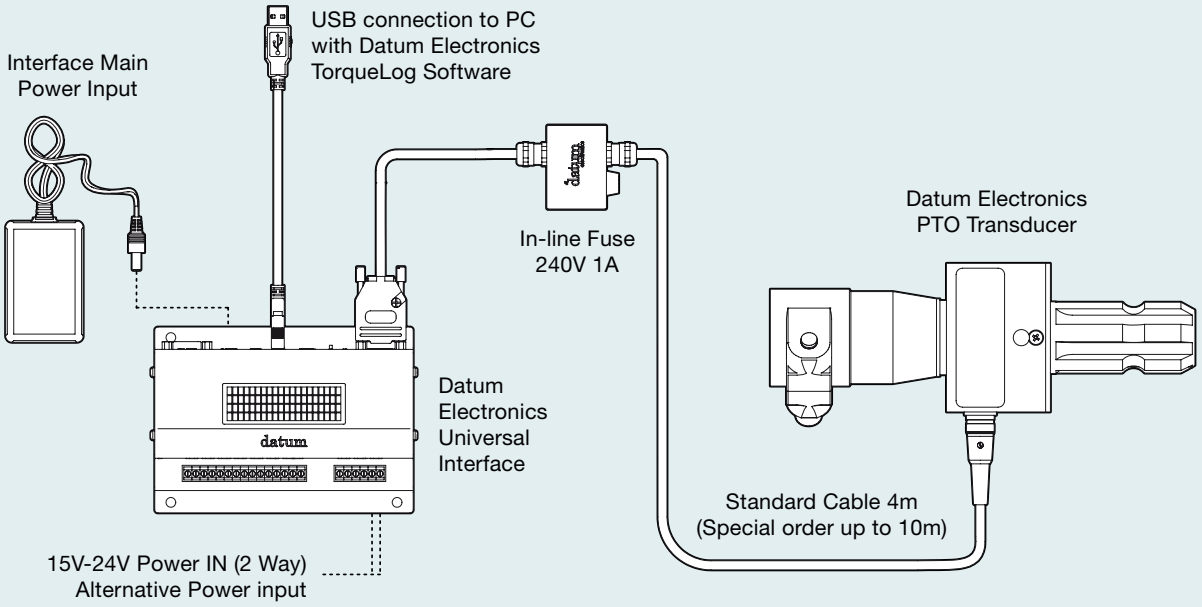
PIN numbering viewed from solder/cable side of the connector

Diagram No. 12

SYSTEM CONNECTIONS

Series 420 PTO Transducer connections guide

Diagram No. 13



For information on connecting up rechargeable battery block supplied as an optional extra please contact **web@datum-electronics.co.uk**

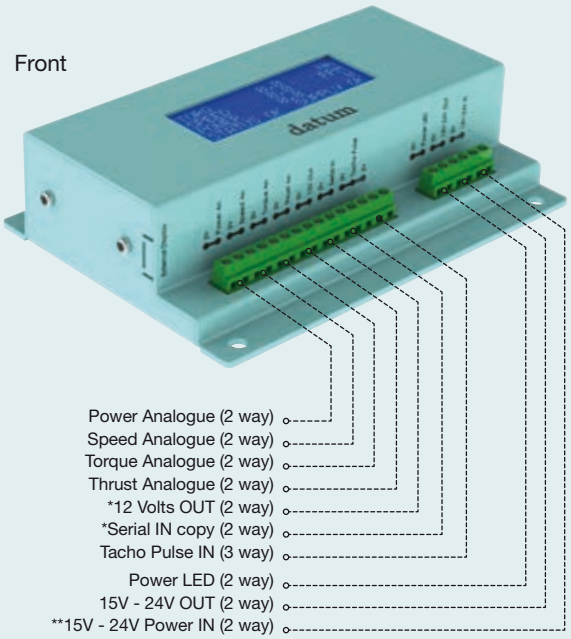
Universal Interface connections guide

When supplied with the Universal Transducer Interface the Datum PTO Transducers provide simple connections to logging, monitoring and control system through both analogue and serial interfaces. Software is provided to access the primary Ethernet setup interface for the PTO Transducer.

*The **12V Output** and the **Serial IN Copy** are screw terminals that duplicate the connections for the serial torque sensor 'D' connector.

**Alternative power input terminal.

Front



Back

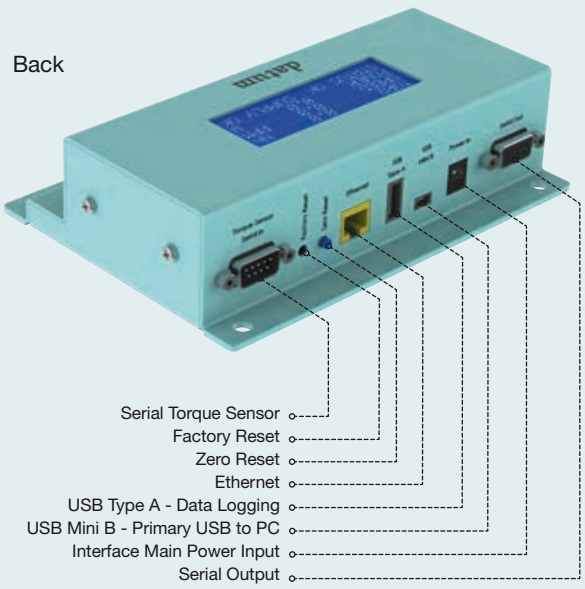
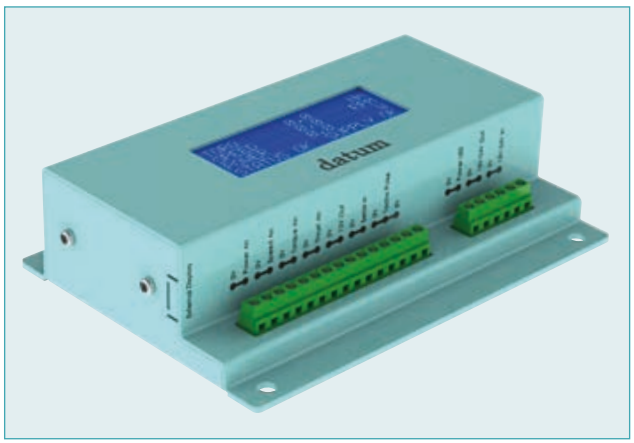


Diagram No. 14

USER INTERFACES

Datum Electronic's Universal Interface provides options for different operating environments.

Datum Electronics can provide the universal interface package for either control enclosure application or heavy industrial applications.



UNIVERSAL INTERFACE

The universal interface will connect directly to the PTO Torque Transducer. It supplies 12Vdc to power the Transducer and converts the torque and RPM signal into the outputs you require.

The outputs that can be configured are:

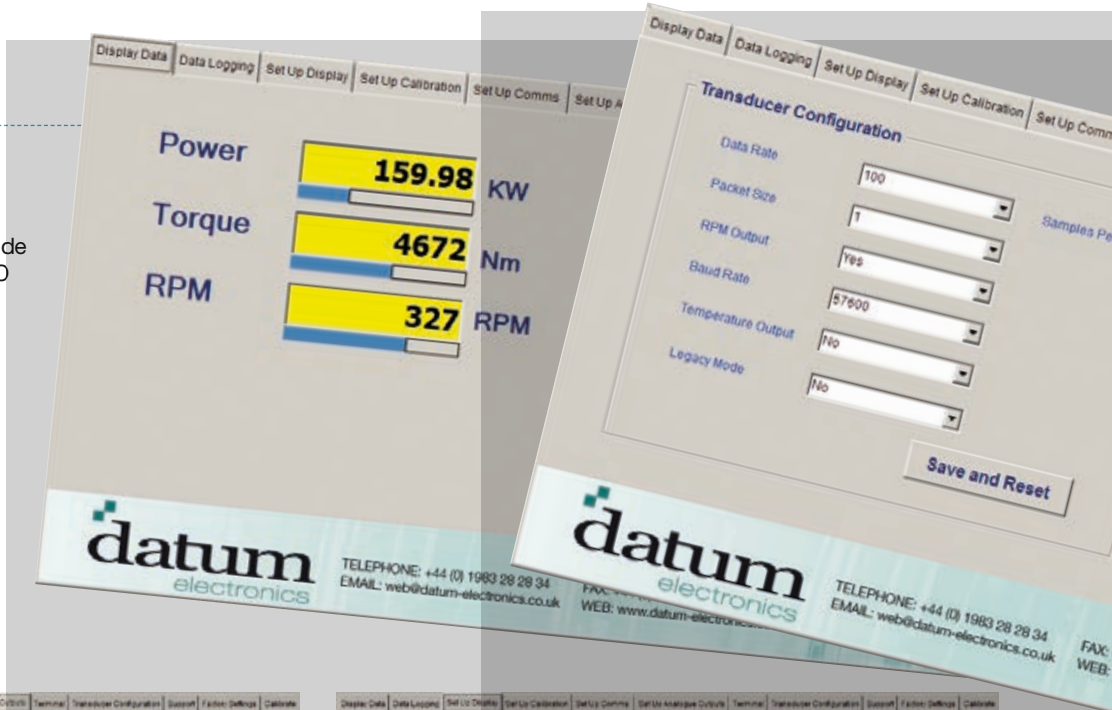
- 4 analogue outputs as either 4-20mA (4-12-20mA): +/-10Vdc, +/-5Vdc, 0-10Vdc or 0-5Vdc, for shaft torque, RPM, Power and Spare
- RS485/RS232 serial data
- Ethernet
- MODBUS
- USB Type Mini B

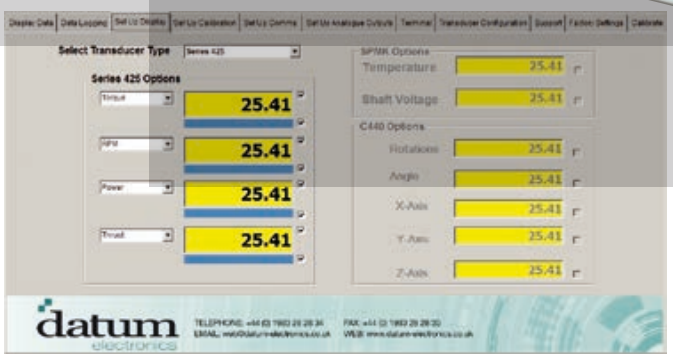
The interface will also accept an input from an external tachometer sensor. The output from this sensor can be directly linked into the torque and power data.

GRAPHIC USER INTERFACE

Datum data logging software

The Datum data logging and configuration software provides a wide range of control functions of the PTO including set-up and configuration options plus data logging.





DATUM UNIVERSAL INTERFACE USB LOGGING GUIDE

If the USB memory stick logging functionality is required please ensure that you discuss your requirement with Sales prior to dispatch to ensure that the DUI is sent with the correct funcitonality

The Datum Universal Interface Module can log the basic test data direct onto a USB memory stick as a .CSV File - see example below.

The DUI can use USB memory sticks up to 64GB memory capacity.

To log test data to a USB stick please ensure you insert the memory stick before you power the DUI. If your USB stick has a data connection LED this will pulse quickly to show that the memory stick is logging. Please note if you insert USB Stick into the DUI after this then the system will not log. Once this is confirmed and you are ready to log test data please insert the USB memory stick into the USB port on the

DUI and the system will immediately start to log. You do not have to press any buttons etc. it is automatic. When you are ready to finish logging please remove the USB stick and the

log file will be automatically closed.

Please note that the log file will not have the headers as seen below these are for guidance purposes only.

LOGGED FILE EXAMPLE

UNIX TIME	Torque Nm	Speed RPM	mV/V
1421414333	1.96787	0	0.00155
1421414333	0.96787	0	0.00155
1421414333	0.57154	0	0.00045
1421414333	0.31767	0	0.00025
1421414333	-0.0632	0	-0.00005
1421414333	1.20624	0	0.00095
1421414333	-2.2211	0	-0.00175
1421414333	-1.3325	0	-0.00105
1421414333	-0.5709	0	-0.00045
1421414333	0.4446	0	0.00035
1421414333	-0.317	0	-0.00025
1421414333	-1.714	0	0.00135
1421414333	-1.8403	0	-0.00145
1421414333	-0.0632	0	-0.00005
1421414333	-0.6978	0	-0.00055
1421414334	1.96787	0	0.00155
1421414334	-0.1901	0	-0.00015
1421414334	0.82542	0	0.00065

UNIX TIME CONVERSION

Explanation/Methodology

Unix time is the number of seconds since January 1, 1970.

Excel doesn't contain built-in functions for working with Unix dates so they must be calculated.

Excel allows you to add a number of days to a date by using the "+" operator.

First convert the number of seconds to number of days (by dividing by 60*60*24) and then add the result to the date "1/1/1970".

The formula will look like:

=CELL/(60*60*24)+"1/1/1970"

The quotes around the date are required. If they are not present, Excel will treat 1/1/1970 as an expression. On Linux (or any other OS that uses coreutils), you can type:

date +%s

- to see the current unix time.

Summary =CELL/(60*60*24)+"1/1/1970"

POWER CALCULATION

To calculate the power in Watts, you will need to use the Torque in Nm and the Speed in RPM values.

The formulae is below:

Torque = Power / Shaft RPM (radians/sec = RPM * 2 * pi / 60) Power in W, Shaft speed in radians/sec, torque in Nm. radians/sec = RPM * 2 * pi / 60

Excel Formulae is: **Nm*RPM*2*PI()/60**

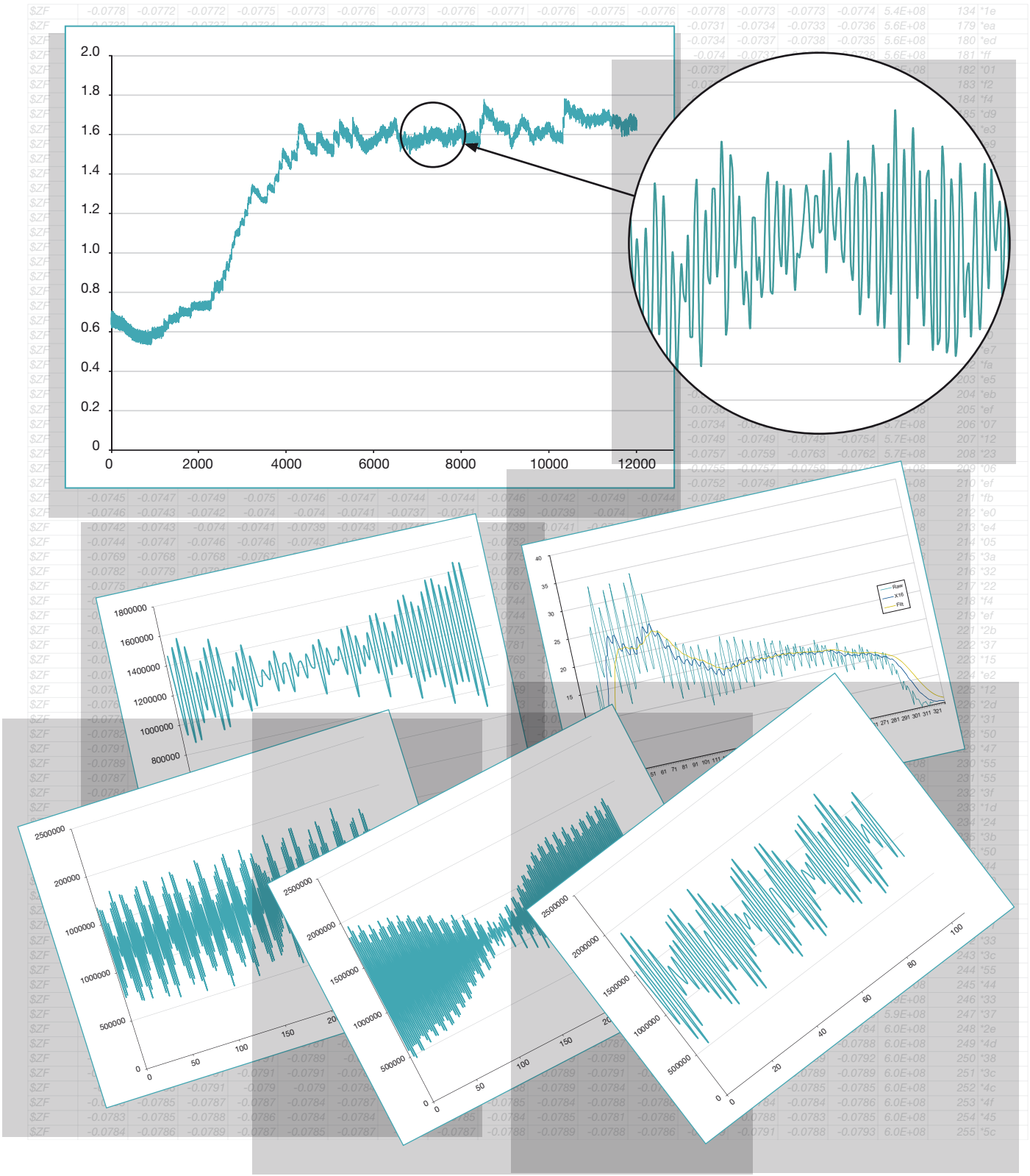
For anymore questions about your Datum products please contact support: **support@datum-electronics.co.uk** or call **+44 (0) 1983 282834**

OUTPUT DATA

READ MORE FROM YOUR DATA

The 420 Series PTO will provide you with accurate torque data. The following graphs show examples of some data output possibilities of the 420 Series PTO's Transducer.

Within this data we can often see valuable characteristics at higher sample rates that show Torsional information that will indicate system wear, vibration and changes in efficiency. The raw data can also be viewed in a spreadsheet as columns.



SPECIFICATIONS

STANDARD SPLINE CONFIGURATIONS	Table No. 1
Male / Female	1" 3/8 x 6 spline
Male / Female	1" 3/8 x 21 spline
Male / Female	1" 3/4 x 6 spline
Male / Female	1" 3/4 x 20 spline

OPERATING SPEED	Table No. 2
540 / 1,000 rpm as standard (up to 3,000rpm if required)	

POWER RATING (MIN)	
Standard 1"3/8 shaft configurations	Table No. 3
Measures Power 135HP or 101kW at 540rpm	
Measures Power 253HP or 188kW at 1000rpm	

Standard 1"3/4 shaft configurations	Table No. 4
Measures Power: 190HP or 141kW at 540rpm	
Measures Power: 350HP or 261kW at 1000rpm	

PERFORMANCE	Table No. 5
Non-Linearity	+/-0.1% FSD
Non-Repeatability	+/-0.05% FSD
Sample Rate	1 to 100 samples per second
Output Baud Rate	9600 baud

Transducer output interfaces:	Table No. 6
Serial data via RS232	

Transducer output data:			Table No. 7
Torque	Shaft RPM	Shaft Temp.	Diagnostics

POWER SUPPLY	Table No. 8
Transducer	10-24Vdc 250mA
Transducer and Interface	15-24Vdc 400mA

TORQUE RATING	Table No. 9
Measures Torque up to a maximum of 1,800Nm on all standard 1"3/8 shafts	
Measures Torque up to a maximum of 2,500Nm on all standard 1"3/4 shafts	

SIGNAL INTERFACE OUTPUTS WITH DUI	
Digital:	Table No. 10
RS485	Serial data
RS232	Serial data
Ethernet	Data and configuration
MODBUS UDP	Serial data
USB Type Mini B	Serial data
USB Type A	Data logging

Analogues:	Table No. 11
All four of the PTO Transducer's analogue output channels can be configured for any of the following settings by the user: 4-20mA configured 4-20mA (4-12-20mA): +/-10Vdc, +/-5Vdc, 0-10Vdc or 0-5Vdc	
A typical configuration arrangement would be as follows:	
Channel 1 - Torque	from 0-500Nm as 4-20mA
Channel 2 - Speed RPM	from 0-100-rpm as 0-5Vdc
Channel 3 - Power	from 0-5000W as 4-20mA
Channel 4 - Spare	

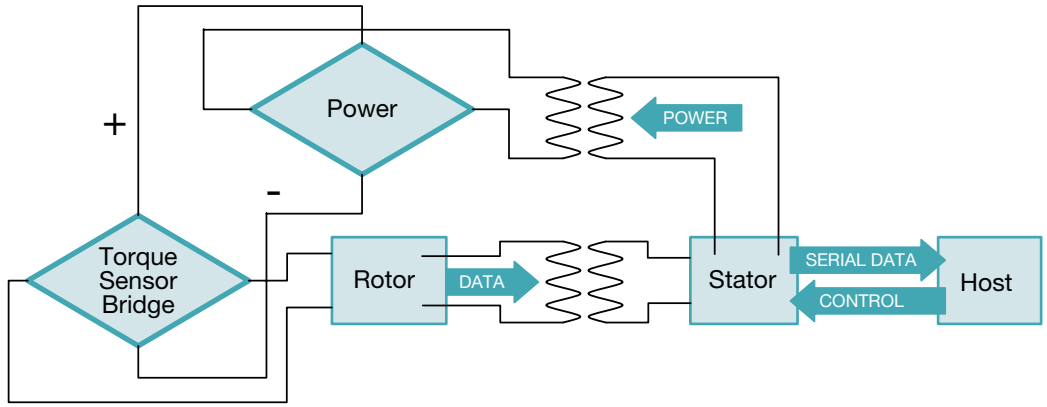
Display:		Table No. 12
Torque	Speed RPM	Power

ENVIRONMENT	Table No. 13
Thermal Stability of Gain per 10°C	0.02%
Thermal Stability of Zero per 10°C	0.02%
Normal Specification Range	10 to 60°C
Operating Range	-10 to +70°C
Storage Range	-35 to +75°C
Transducer Environmental Protection	IP65 (see RS425 for IP67/68)
Electromagnetic Compatibility	EN61326-1:2006 (IEC61000-4), IEC60945)

SPECIFICATIONS

PTO 420 series block diagram

Diagram No. 15



MECHANICAL INTERFACE SPECIFICATIONS

420 Series PTO Transducer compatible spline configurations.

Splined Power Take Off Shaft Profiles:

A - Male / Female 1” 3/8 x 6 spline
B - Male / Female 1” 3/8 x 21 spline
C - Male / Female 1” 3/4 x 20 spline
D - Male / Female 1” 3/4 x 6 spline

3D models and STEP files are available from Datum Electronics to assist project planning.
Please contact Datum Electronics for more information.

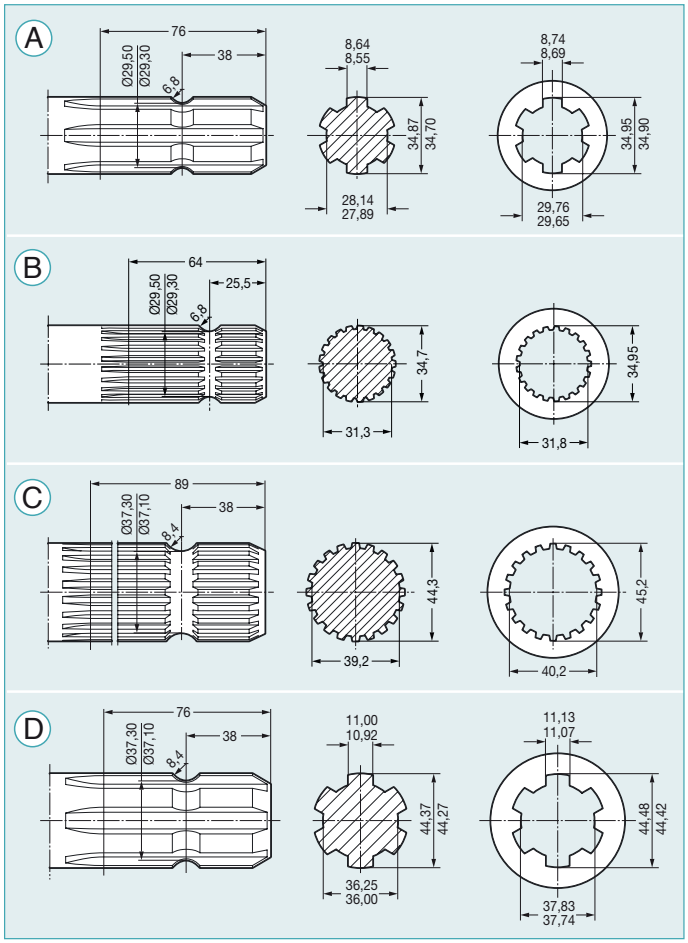


Diagram No. 16

PRE-CALIBRATED AND TESTED

TEST CERTIFICATE

The 420 Series PTO Shaft Torque and Power Monitoring System is calibrated on test rigs traceable to UK National Standards

The PTO Transducers will be subjected to a series of test cycles starting with a proof load cycle(s) and then followed by a series of calibration cycles.

Loads are applied from zero torque to the maximum working torque of the Transducer.

The data shown on the test certificate:

- The test equipment used
- Calibration date
- A table of the actual loads applied against the output
- The output is described in either:

  mV/V - this is the raw strain signal from the torque shaft

  Nm/Lbft - this is the calibrated output of the transducer

Some PTO Transducers are supplied with a raw output that is processed and displayed in the instrumentation or user software.

Other Transducers store their calibration settings and have an output in the units required, Nm/Lbft. These Transducers can also output the raw mv/V values where required.

- Example of cal sheet annotated
- RPM - Calibration

The Interfaces and Indicators

Where supplied with an indicator or a signal interface the outputs of the interface and the PTO's Transducer will both be calibrated and detailed on a systems test certificate.

The outputs calibrated will be the +/-10Vdc, +/-5Vdc and the 4-20mA signals.

The indicators and serial data outputs for the Ethernet, USB and MODBUS ports are directly sent from the Transducer. Interface options allow a scaling factor(s) for these signals to be entered into the Interface. For MODBUS and Ethernet ouptut please ensure that you discuss your requirement prior to order.

DIAGNOSTICS & SUPPORT

INCORRECT TORQUE

Check the scaling of the output device.

If using the user software on a PC look at the torque calibration tab.

The certificate issued with the transducer will have a value for its output signal in mV/V at a given torque. The software set up should match this (i.e. 1.756mV/V = 250Nm).

IIf supplied with the DUI then you can connect this to a PC and check in the supplied test softare that the calibration values match your test certificate.

Check the torque reading with no torque applied. If the Transducer output is showing a torque reading at zero this will be added to all readings. The torque calibration tab of the software has an option to zero the torque reading. The Universal Interface also has a torque zero button. Pressing and holding this for 10 seconds will take the current torque reading as zero.

When checking or setting the zero check to see if any torque is locked into the transducer by the machine or rig on which it is used. It is ideal to check the zero with the transducer disconnected from the rig.

ZERO OFFSET

The factory zero of the PTO Power Monitoring System will be declared on the calibration sheet. If the reading you have at zero differs from this value, look at the raw signal value from the PTO's Transducer (either using the user interface software or the detail command). Small offsets can be removed using the zero command on the software interface or the zero button on the Universal Interface. If the offsets continue to appear refer back to the original offset value on your certificate to check that you are not applying an ongoing series of small offsets.

If the offset is large (greater than 0.2mV/V) it is likely that the Transducer has been subjected to a significant torque overload and has a permanent offset. If this is the case and repeated overloads are applied, the Transducer will become inaccurate and may ultimately mechanically fail. You should review your application and consider a higher rating of Transducer.

If the keyways of the Transducer are visually out of line this is a very good indicator that the Transducer has suffered a significant and damaging overload.

MAINTENANCE

It is recomended that your PTO transducer is calibrated regulary to ensure that the Torque signal is accurate. Datum Electronics recomend that transducers are calibrated at least once every 12 months. Regular calibration also allows for maintenance checks to be made on the condition of your transducer to ensure longevity.

MAINTENANCE

SERVICEABLE ITEMS: BEARINGS

The bearings are the only component on the 420 series PTO Power Monitoring System that may require servicing depending on operating conditions. The following provides information on the bearing life under load conditions.

The body of the Transducer is supported by one bearing. The life of the bearings at normal running RPM of half the rated RPM is 10 years continuous use.

If you have requirements for high duty sensors where bearing life may be a concern due to other external loads, ask our support team for additional information on our bearing less RS425 and FF425 ranges. These RS/FF designs provide a high degree of flexibility with regard to mounting tolerances and maintenance free operation.

If the shaft of the Transducer is bent the balance of the Transducer will be disturbed and the bearing life will be greatly reduced. Excessive load or mounting misalignment will also effect the life of the bearings. Bearings can be serviced by return to Datum Electronics.

GLOSSARY OF TERMS

Engineering Units

The transducers/sensors are calibrated in engineering units of either Nm or Lbft.

Full Scale Output

The mV/V is the output from the transducer when the rated load in applied.

mV/V

To measure torque we use a bridge network of resistive strain gauges. These change resistance with the applied strain. The output they give is a ratio of the voltage applied and the mV change in signal from the bridge.

This mV/V ratio is normally quoted in the form 1.55mV/V = 1000Nm. The mV/V value is established at calibration by applying a known torque to the shaft. This ratio will remain constant for the life of the transducer/sensor unless damaged.

Noise

Irregular fluctuations that accompany a transmitted electrical signal but are not part of the data generated from the sensor.

Proof Load

The proof load is the load to which the transducer/sensor has been tested - occasional loading to this level should not damage the transducer. Repeated loading to this level will reduce the fatigue life of the transducer and may cause small zero offset over time (usually measured in either Nm or lbft).

Rated Load

The Rated Load is the designed full load of the transducer/sensor (measured in either Nm or lbft).

Raw Data

Raw data is the raw strain level from the torque shaft. It will include any zero offset.

The scaling of the raw data will require:

Torque [Nm] = (raw data [mV/V] - zero offset [mV/V]) x (rated torque [Nm]) ÷ (full scale output [mV/V]).

Sensor

A sensor measures a physical quantity and converts this into a signal. The physical quantity is torque or torsional strain, this is converted into serial data.

NOTE: The words transducer and sensor are often used in this context to mean the same thing.

Span

This is the value of output at the rated load. Either given in terms of mV/V signal or Nm or lbft when in engineering units.

STEP files

A STEP file is a widely adopted CAD file format used to share 3D models between users with different CAD systems.

Torque

The twisting force on the shaft created by the driving force (motor) and the resisting force (brake or gear).

Transducer

A transducer is defined as a device that converts one form of energy to another. In terms of the PTO Power Monitoring System the transducer converts torque into serial data.

NOTE: The words transducer and sensor are often used in this context to mean the same thing.

Zero

This is the value of the signal when the shaft is completely unloaded. Normally quoted in mV/V.

ALTERNATIVE SOLUTIONS

THE DATUM M425, RS & FF425 RANGES

In addition to the PTO range Datum Electronics Limited manufacture a wide range of complimentary torque sensors.

The M425, RS and FF425 ranges are non-contact and non-bearing sensors that can be tailored to fit a test rig or drive application.

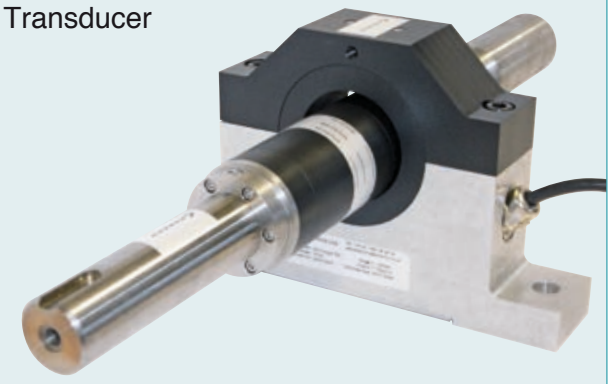
Within these ranges the Series 425 Electronics are engineered to fit a shaft coupling of a section of an existing drive shaft. These are fitted by Datum Electronics in the factory. They have advantages where space is at a premium and a standard transducer cannot replace an existing component without major engineering work. They have further advantages in that they can operate at higher speeds for longer duty cycles. When used in harsh environments the RS/FF425 ranges can be supplied full encapsulated.

With the sensor added to an existing shaft the dynamics of the drive line will remain substantially the same.

M425 Series
Transducer

FF 425 Series
Transducer

RS425 Series
Transducer



FF410 Static Torque Transducer

DESCRIPTION

The Datum Electronics Series 410 Static torque sensor was developed following demand from our customers for an effective and competitively priced product. Developed from our FF420 rotary torque transducers, the same technology and design principles have been applied to our FF410 reaction transducer range providing a competitive option which is simple and effective.

SPECIFICATIONS

The Series FF410 Reaction Torque Transducer design utilises full bridge strain gauge principles. Using the same principles and knowledge gained in the rotary market, the reaction torque range provides the following specifications with an optional high torsional stiffness model.

Accurate On Shaft Torque Measurement
Flexible Rig/Drivetrain fittings (Din Size Flange)
Modular System Assembly
Proven Technology
Low Maintenance
Simple Linear Calibration included as standard
Engineered to fit most drive components
Static Torque Measurement
Full Bridge Strain Gauge Output

EASY FIT INTO RIG

The FF410 Static Sensor easily fits into your existing test rig or drive train. Using standard DIN flanges, fitting and coupling the static transducer into your rig is made more efficient than other manufacturing options. The minimum operating envelope of the Series 410 reaction torque transducer starts from as little as 100mm and will increase depending upon torque measurement requirements.

TORQUE RATINGS

The Series 410 Reaction Torque Transducers have been designed with nominal rated torque levels in Nm. We can modify the torque range to include lb/ft, in/lbs or similar based upon your requirements. Nominally rated torque levels include:

250Nm
500Nm
1,000Nm
2,000Nm
5,000Nm
10,000Nm

FEATURES

Flange Mounted static transducer

Flange torque transducer to match standard DIN Flanges

Ideal design for easy fitting to test rigs and drive systems

No bearings for lightweight applications

Unique design offers high torsional stiffness model

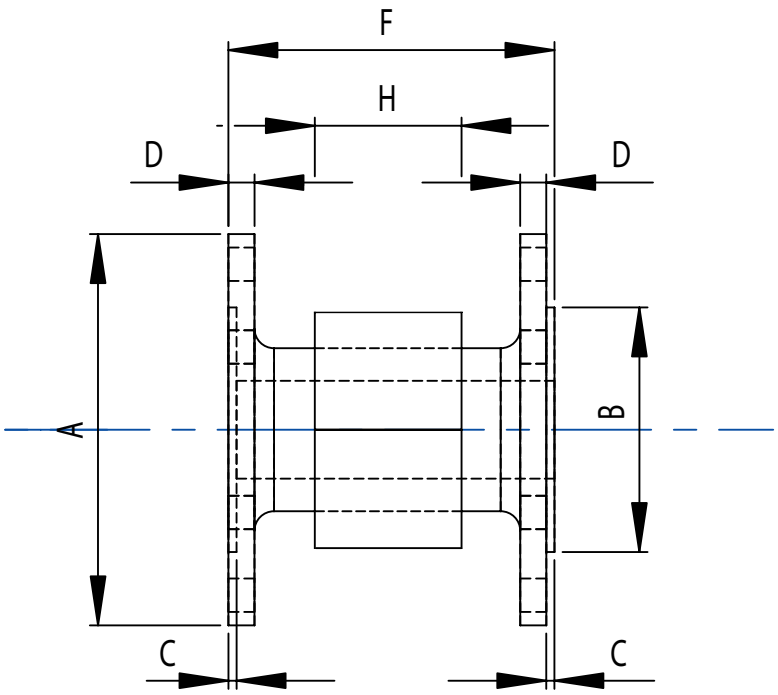
Standard FF410 reaction torque sensor range available from 250Nm-10,000Nm

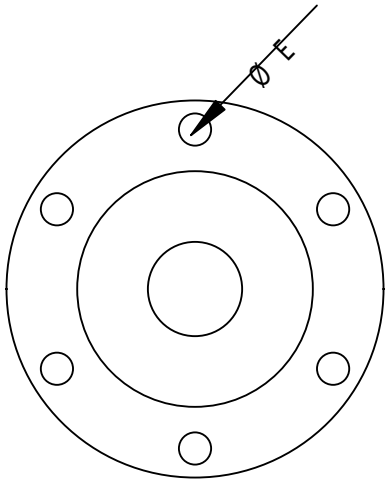
Full Bridge strain gauge output compatible with Datum Type310, Type324, Type 300 Indicators.

Please enquire for more details of our full static range of torque transducer

FF410 SPECIFICATIONS & DIMENSIONS

TORQUE	A	B	C	D	No. OF HOLES	E (+0.2mm)	E (PCD)
250Nm	100mm	57mm	2.5mm	8.0mm	6	8.25mm	84mm
500Nm	100mm	57mm	2.5mm	8.0mm	6	8.25mm	84mm
700Nm	100mm	57mm	2.5mm	8.0mm	6	8.25mm	84mm
1,000Nm	120mm	75mm	2.5mm	8.0mm	8	10.25mm	101.5mm
1,600Nm	120mm	75mm	2.5mm	8.0mm	8	10.25mm	101.5mm
1,900Nm	120mm	75mm	2.5mm	8.0mm	8	10.25mm	101.5mm
2,900Nm	150mm	90mm	3.0mm	10.0mm	8	12.1mm	130mm
4,400Nm	150mm	90mm	3.0mm	10.0mm	8	12.1mm	130mm
5,100Nm	180mm	110mm	3.0mm	12.0mm	8	14.1mm	155.5mm
7,300Nm	180mm	110mm	3.0mm	15.0mm	10	16.1mm	155.5mm
13,000Nm	225mm	140mm	4.4mm	20.0mm	8	16.1mm	196mm





TECHNICAL DATA

Operating Temperature
0 to + 70C

Storage Temperature
- 40 to + 85C

Temperature Effect on Span
0.001% per C

Temperature Effect on Zero
0.002% per C

Calibration Temperature
22C

Environmental Protection
IP54 IP65 to order if required)

Cable Length
4 metres (standard) longer if required

Combined Error
0.2% of FSD

Sensitivity
1.8mV/V (nominal)

Hysteresis / Repeatability
0.15% of FSD

Excitation Voltage
5 - 15VDC

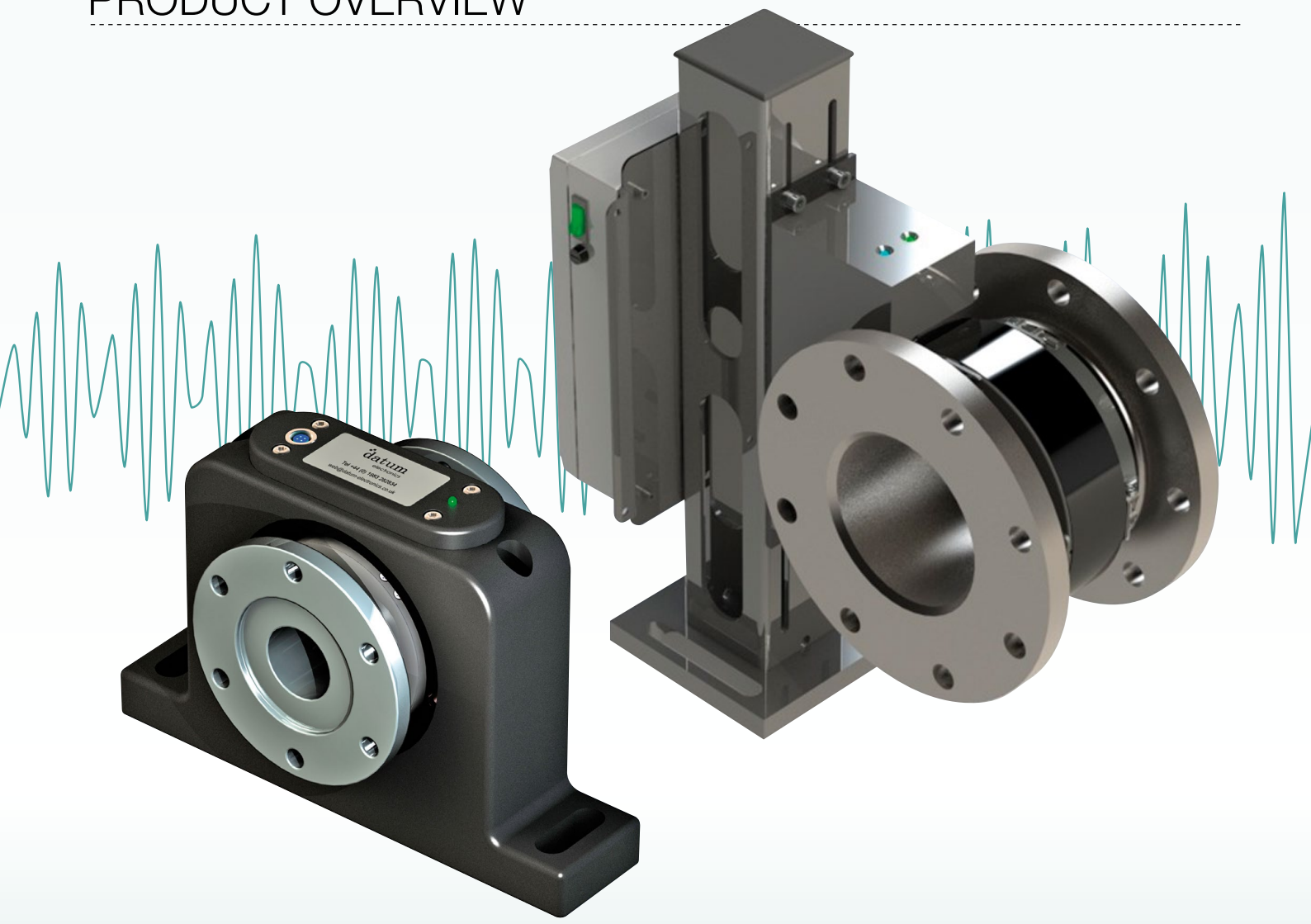
Max Overload capacity
150% of full load

Bridge Resistance
700ohms (nominal)

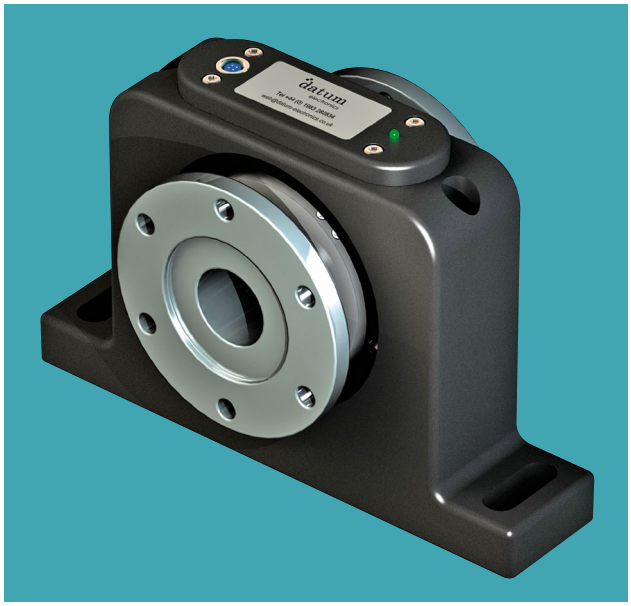
FF410 Static Torque Transducer

DATUM ELECTRONICS

FF425 NON-CONTACT FLANGED TORQUE TRANSDUCER PRODUCT OVERVIEW



datum electronics



THE DATUM FF425 NON-CONTACT FLANGED TORQUE TRANSDUCER

Using the latest technology manufactured and designed by Datum Electronics the Series FF425 non-contact rotary Flanged Torque Transducers fit directly as replacement drive line spacers and couplings. The transducer utilises the Datum 425 Series state of the art electronics, offering very high accuracy, operational stability, high signal resolution and a wide range of signal output options.

The Torque Transducer can either be supplied from our standard range with DIN flanges up to 30KNm or as custom units up to any size with the flange and length dimension designed to fit an existing coupling spacer design. With the custom option drive lines can have a torque transducer integrated with a minimum of cost and disruption or need to find additional space.

The FF425 is a true non-contact torque transducer, the rotor runs inside the stator with a 2 to 5mm air gap. This ensures no long-term wear of bearings or frictional loads on the rotating drive shaft.

The FF425 Torque Transducers are ideal for test rigs and permanent machinery applications.

FF425 SYSTEM PERFORMANCE AND BENEFITS:

Ranges from 0-100Nm up to 30KNm as standard

For larger ranges up to any size, please contact Datum sales team

High Accuracy

High Torque Resolution

Fully Non-Contact Transmission and Hardware

Can be Supplied Custom to Your Driveline

Fast Data Sampling Rates

Robust Construction

Low Power Consumption

Researched Design and Built in the UK

SPECIFICATIONS

FF425 PERFORMANCE INFORMATION

PERFORMANCE	
Non-Linearity	+/-0.1% FSD
Non-Repeatability	+/-0.05% FSD
Noise-free Resolution	20 bit to 13.5 bit (dependent on sample rate)
Sample Rate	1 to 4000 samples per second
Output Baud Rate	9600 to 3Mbaud

Transducer output:
Serial data via RS485 see Datum Universal Interface Specification for standard options including 4-20mA, +/-10Vdc, Ethernet, RS485, USB.

Transducer output data:			
Torque	Shaft RPM*	Shaft Temp.	Diagnostics
*Output of RPM based on 1 input pulse per revolution as standard			

POWER SUPPLY	
Transducer	10-24Vdc 250mA
Transducer and Interface	15-24Vdc 400mA

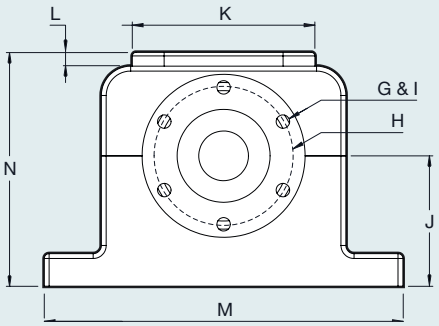
ENVIRONMENT	
Thermal Stability of Gain per 10˚C	0.02%
Thermal Stability of Zero per 10˚C	0.02%
Normal Specification Range	10 to 60˚C
Operating Range	-10 to +70˚C
Storage Range	-35 to +75˚C
Environmental Protection	IP54 (or IP67 with Option ET)
Electromagnetic Compatibility	EN61326-1:2006 (IEC61000-4), IEC60945)

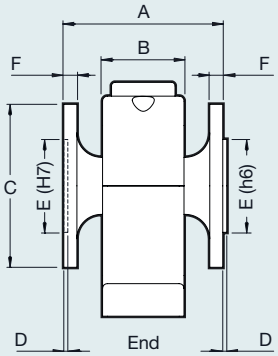
FOR SIGNAL OUTPUT OPTIONS INCLUDING:
Ethernet, MODBUS, USB, RS485/232 and 4 analogue channels configured 4-20mA (4-12-20mA): +/-10Vdc, +/-5Vdc, 0-10Vdc or 0-5Vdc, **refer to Document 1023 Datum Universal Transducer Interface.**

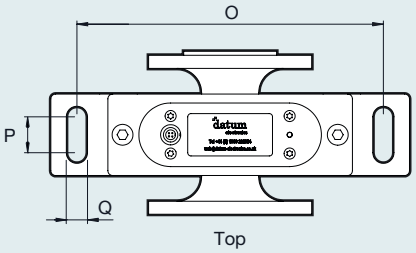
SPECIFICATIONS FF425 dimensions (mm)

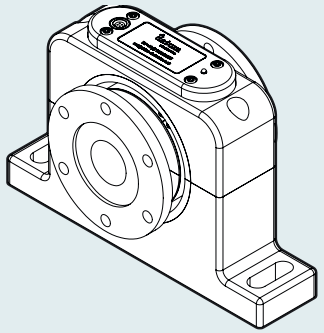
						A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
FF425 Model Size	Rated load (Nm)	Rated load (lb ft)	Standard Rotational speed (RPM)	Body mass (Kgs)	Rotor mass (Kgs)	Shaft length face to face (mm)	Body width (mm)	Flange Ø (mm)	Male/Female flange coupling extrusion/ depth (mm)	Male/Female flange coupling Ø H7/ h6 TOL (mm) (ISO 286)	Flange thickness (mm)	Number of holes	PCD (mm)	Hole Specification (ISO 4017 / DIN 933 / ISO 273)	Base to shaft centre (mm)	Output module length (mm)	Output module height (mm)	Base length (mm)	Overall height (mm)	Base fixing slot. Centre to centre (mm)	Fixing slot length (mm)	Slot width (mm)
Size 1	**0-100**	73.8	10,000	1.057	0.560	97.5	50	100	2.5	57	8	8	84	M8	80	112	8.5	220	143.5	188	22	13
Size 2 - A	**0-250**	184	10,000	1.057	1.201	97.5	50	100	2.5	57	8	8	84	M8	80	112	8.5	220	143.5	188	22	13
Size 2 - B	**0-500**	369	10,000	1.057	1.276	97.5	50	100	2.5	57	8	8	84	M8	80	112	8.5	220	143.5	188	22	13
Size 3 - A	**0-1000**	738	10,000	1.057	1.668	97.5	50	120	2.5	75	8	8	155.5	M10	80	112	8.5	220	143.5	188	22	13
Size 3 - B	**0-2000**	1475.1	10,000	1.057	2.149	107.5	50	120	2.5	75	8	8	155.5	M10	80	112	8.5	220	143.5	188	22	13
Size 4 - A	**0-5000**	3687.9	8000	1.152	6.112	137	50	180	3	110	12	8	155.5	M14	100	112	8.5	220	172.5	188	22	13
Size 4 - B	**0-10,000**	7375.7	8000	1.152	12.162	157	60	185	3	110	15	8	155.5	M14	100	112	8.5	220	172.5	188	22	13
Size 5 - A	**0-15,000**	11064	6000	2.138	20.499	216	60	250	5.5	140	20	8	217	M16	100	112	8.5	300	212.5	266	22	13
Size 5 - B	**0-20,000**	14751	6000	2.138	22.318	216	60	250	5.5	140	20	8	217	M16	100	112	8.5	300	212.5	266	22	13
Size 5 - C	**0-25,000**	18439	6000	2.138	34.608	216	60	285	6	175	20	8	247	M18	100	112	8.5	300	212.5	266	22	13
Size 5 - D	**0-30,000**	22127	6000	2.138	40.969	216	60	315	6	190	22	8	275	M20	100	112	8.5	300	212.5	266	22	13

Alphabet key for FF425 model sizes 1 to 5









3D models and STEP files are available from Datum Electronics to assist project planning. Please contact Datum Electronics for more information.

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M420 Rotary Torque Transducer

Series M420 Non-Contact Rotary Torque Transducer

STANDARD RANGE INCLUDES:

- Digital Torque Data (USB)
- Range from 5Nm — 100,000Nm
- Keyway shaft
- Rotational / Static measurement
- Bi-Directional measurement
- 100 samples per second
- 15-24VDC (power supply) supplied
- Calibration Certificate
- 1 years warranty
- 1 meter transducer cable
- 2 meter USB cable
- User manual/handbook

ADDITIONAL OPTIONS AVAILABLE:

- RS232 Digital Data
- Speed & Power Output
- Analogue Output Options
  - 4-20mA ~ 0-10VDC ~ +/-10VDC
  - 12+/-8mA ~ 0-5VDC ~ +/-5VDC
- RS485 (transmission only)
- Fast sample rates up to 20,000 samples per second
- Additional cable lengths available both USB & Transducer
- Local Display Option

DESCRIPTION

Suitable for general test rig applications, the Datum Series M420 non-contact rotary torque transducers have been designed to fit in-line with most applications and solutions within the field of rotary measurement. The transducer is compatible with common drive trains or test beds, using standard keyway shaft specifications for fixing and alignment into your rig/drivetrain. A non-contact transmission system provides a digital output directly proportional to torque; in this variant it is supplied as a complete transducer with bearings to support the stator unit on the rotating shaft.

Strong robust industrial measurement equipment designed to fit inline with most test rig and driveline applications

The Series M420 transducer uses the very latest strain gauge technology for accurate and reliable torque measurement. The Series M420 has a central element and on-shaft rotating conditioning electronics. Digital signals are transmitted to the non-rotating part of the system or stator. The standard output for all Series 420 torque transducers is digital data (torque) as this is more reliable than other commercially available products with reduced signal interference from external sources.

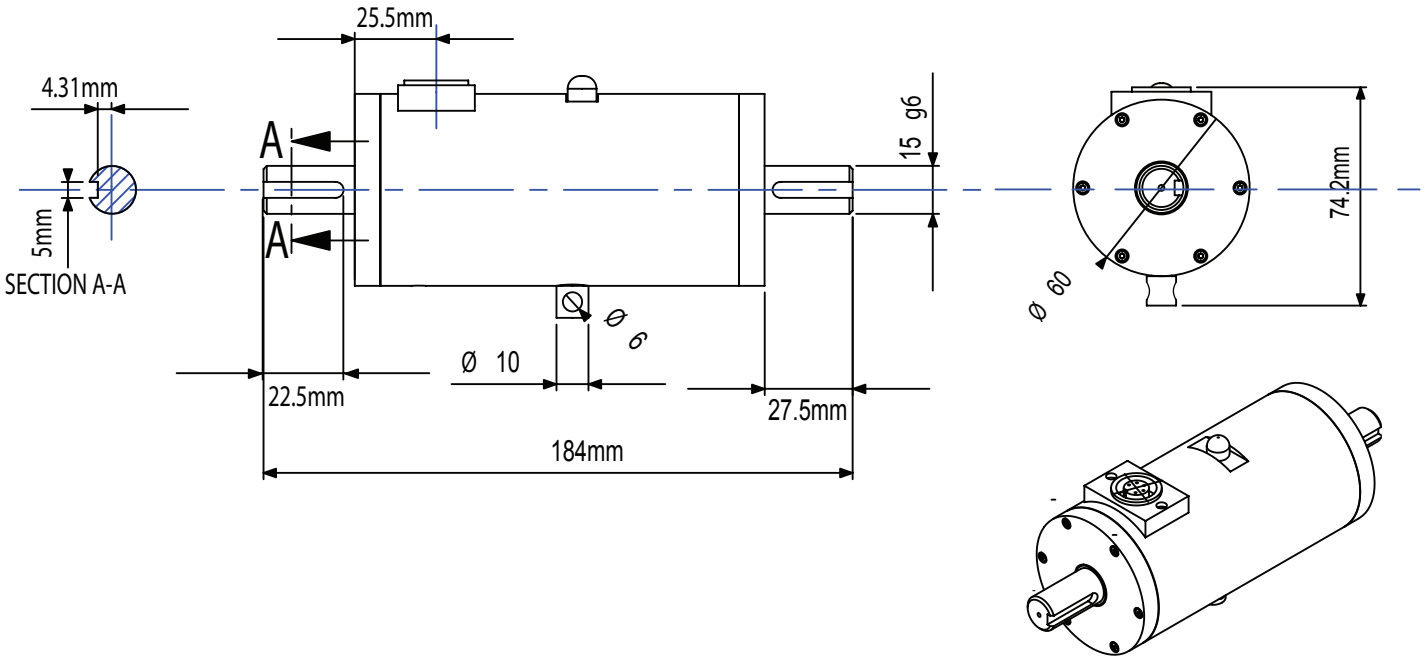
M420 (BASIC & STANDARD RATINGS)

MODEL	TORQUE RATING	SPEED	ACCURACY	SAMPLING RATE
M420-S1	100Nm (75 lb/fts)	10,000rpm	0.1%	100sps
M420-S2	500Nm (370 lb/fts)	6,000rpm	0.1%	100sps
M420-S3	2,000Nm (1,475 lb/fts)	3,000rpm	0.1%	100sps
M420-S4	10kNm (7,375 lb/fts)	2,000rpm	0.1%	100sps

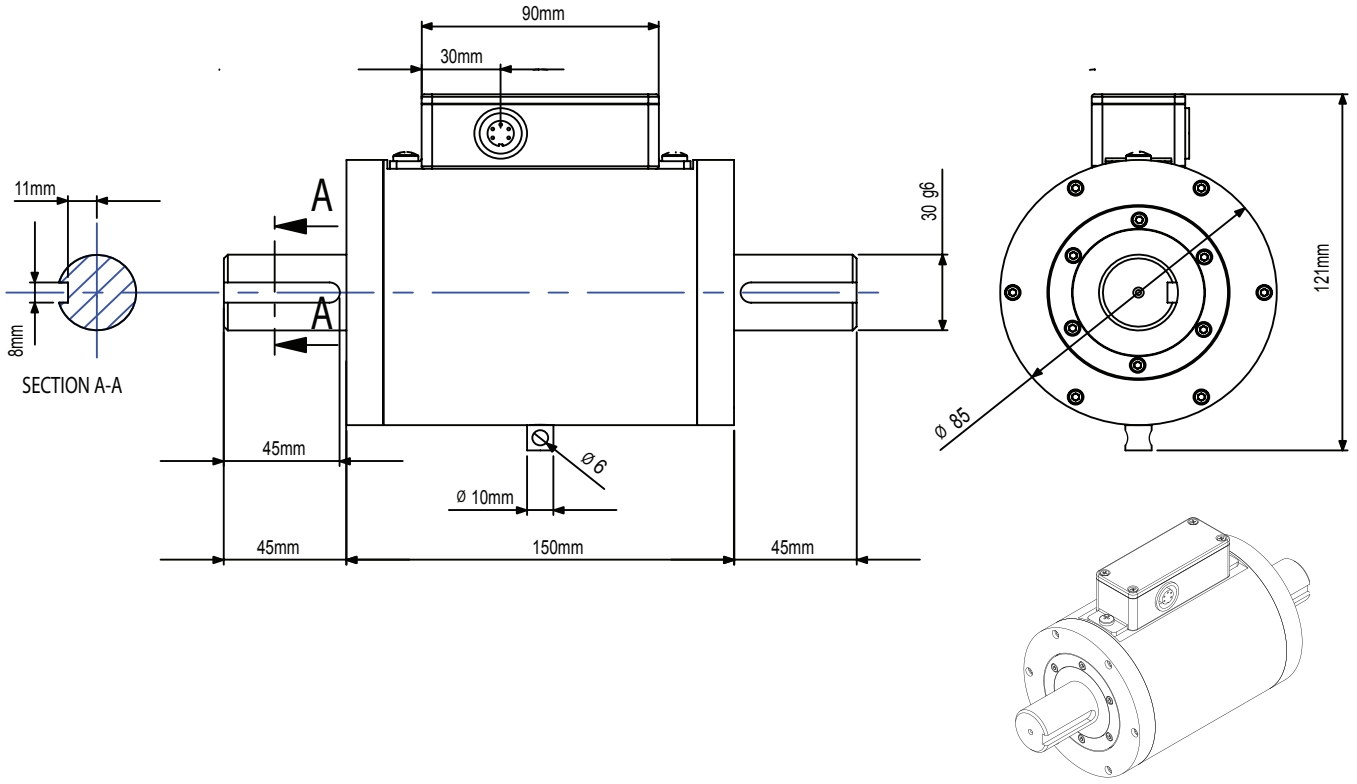
If you require anything above our standard transducer range of 10,000Nm we can and have engineered torque measurement transducers up to 500,000Nm.

The Series M420 transducer provides a simple, compact and reliable method of accurately measuring torque on a rotating shaft. The standard range of housings cater for torque ranges from 5Nm up to 10kNm, the same modular elements have been applied to bespoke transducers for use down as low as 1Nm and up to 500kNm.

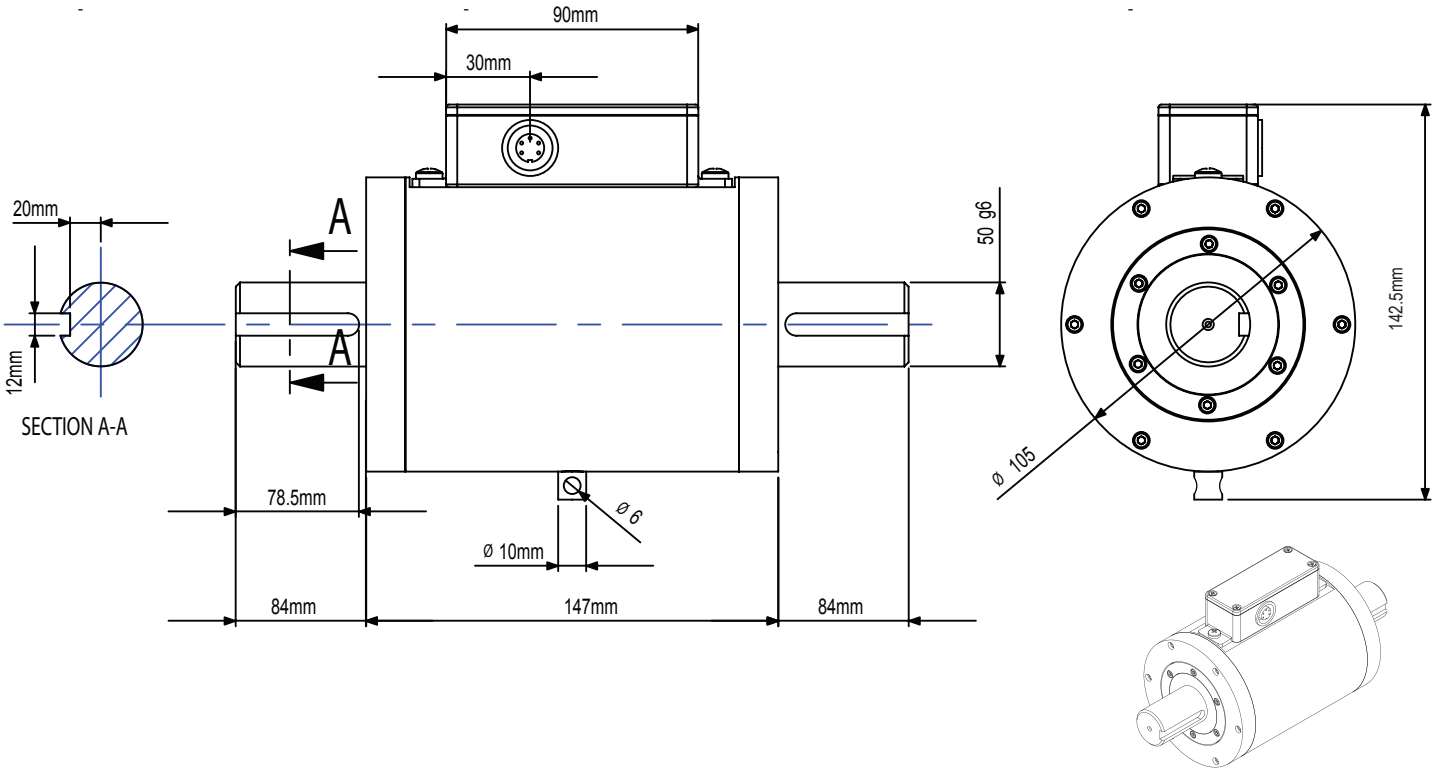
M420-S1 (0 - 100Nm)
SPECIFICATIONS & DIMENSIONS



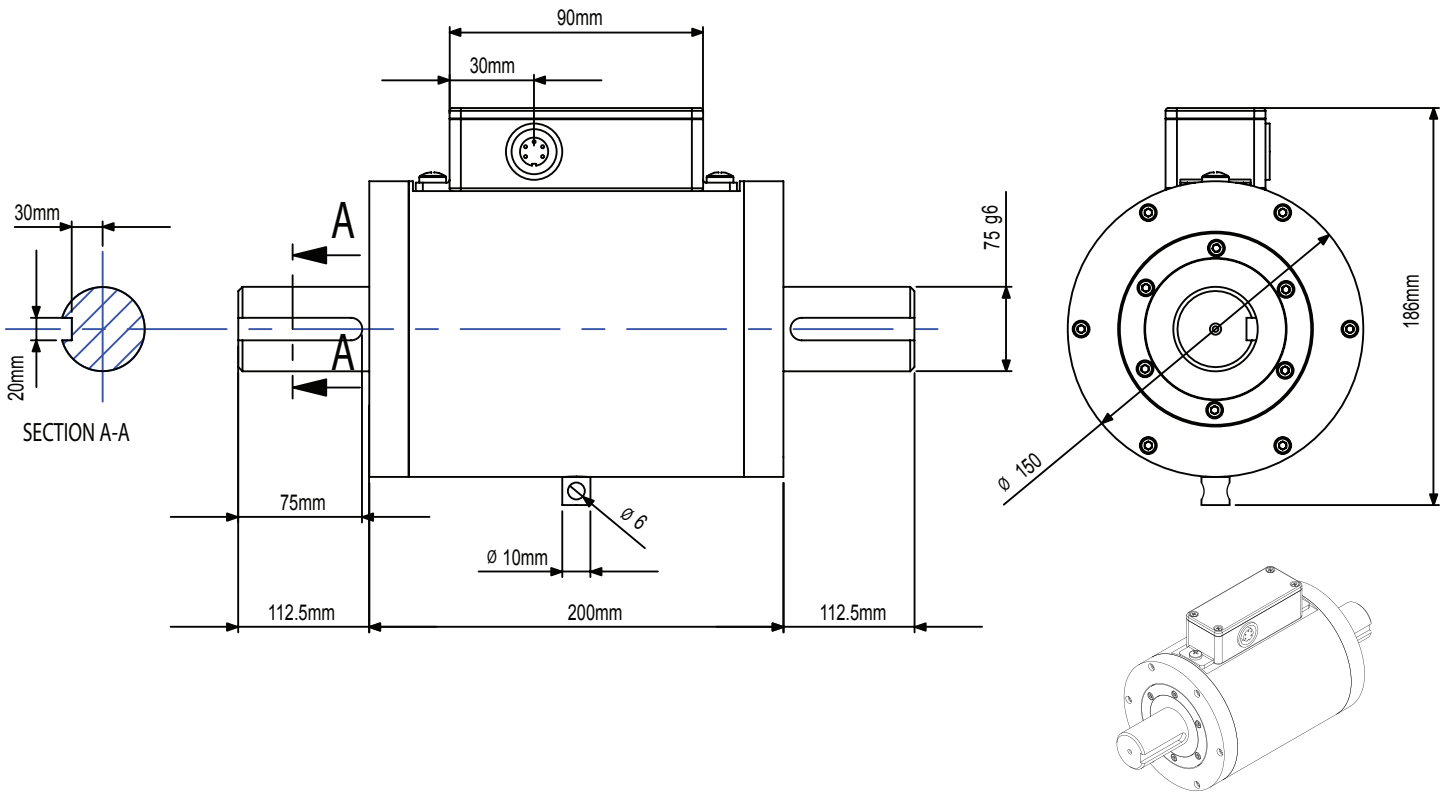
M420-S2 (0 - 500Nm)
SPECIFICATIONS & DIMENSIONS



M420-S3 (0 - 2,000Nm)
SPECIFICATIONS & DIMENSIONS



M420-S4 (0 - 10,000Nm)
SPECIFICATIONS & DIMENSIONS



TECHNICAL DATA:

Operating Temperature
0 to + 70C

Storage Temperature
- 40 to + 85C

Temperature Effect on Span
0.001% per C

Temperature Effect on Zero
0.002% per C

Calibration Temperature
22C

Environmental Protection
IP54 (IP65 to order if required)

Cable Length
3 metres (standard) longer if required

Signal Convention
+ ve clockwise / - ve anti-clockwise

Power Supply
15 - 24VDC

Speed Measurement:
Hall-Affect Speed Sensor

THE COMPETITIVE EDGE

The Series M420 transmits calibrated digital data as this is a cleaner and more defined method of transmitting data. The on-shaft signal from the strain gauge is converted to a digital signal and amplified on shaft. It is this signal that is taken off the shaft and processed by either an indicator or by TorqueLog, providing the end user with clean and definitive data transmission.

ANALOGUE OPTIONS

If an analogue signal is required, our Series 420 torque transducers are able to provide either 4-20mA or 0-10VDC output by converting the digital data signal from the torque transducer to an analogue signal. However, the effect of external or electrical noise can impact upon signal strength and definition in this instance. Other commercial applications may use slip rings or analogue signals to transmit data, but the Datum Electronics series 420 outputs digital as standard.

M420 SYSTEM CONFIGURATIONS

The M420 Rotary Torque transducer has been specifically designed with standard keyway shafts for easy installation with any drivetrain set up. Our basic non-contact transmission system provides a digital output directly proportional to torque with additional options including Speed and Power. However we have a range of system configurations including options for analogue output as either 0-10VDC or 4-20mA. We also have number instrumentation devices which can log, record and display the torque, speed and power signals direct from the M420 transducer, without the need for any additional processing electronics.

SENSOR APPLICATIONS

Torque measuring devices can and have been used in a number of different environments and applications. Our M420 series of torque measuring instrumentation is incredibly robust and can be used across a whole genre of industries for very different reasons. If you have the capability to measure and control torque in rotating machinery the opportunity is there to either increase efficiency and therefore save money, or control the equipment so that it increases longevity and can reduce maintenance costs.

Our products have been used in a number of different applications, and every day there are new enquires offering fresh new challenges for our torque measuring devices and other associated products and services. Typical applications include heavy industry, motor sport, marine, power generation, heavy vehicles, agricultural and industrial tools.

SPECIFICATIONS

Accurate On Shaft Torque Measurement
Flexible shaft fittings (Keyway)
Modular System Assembly
Non-contact Signal Transmission
Proven Technology
Low Maintenance
Simple Linear Calibration
Engineered to fit most drive components
Rotary and Static Torque Measurement
Optional Analogue Data Output
Optional Speed / Power Output

torque LOG

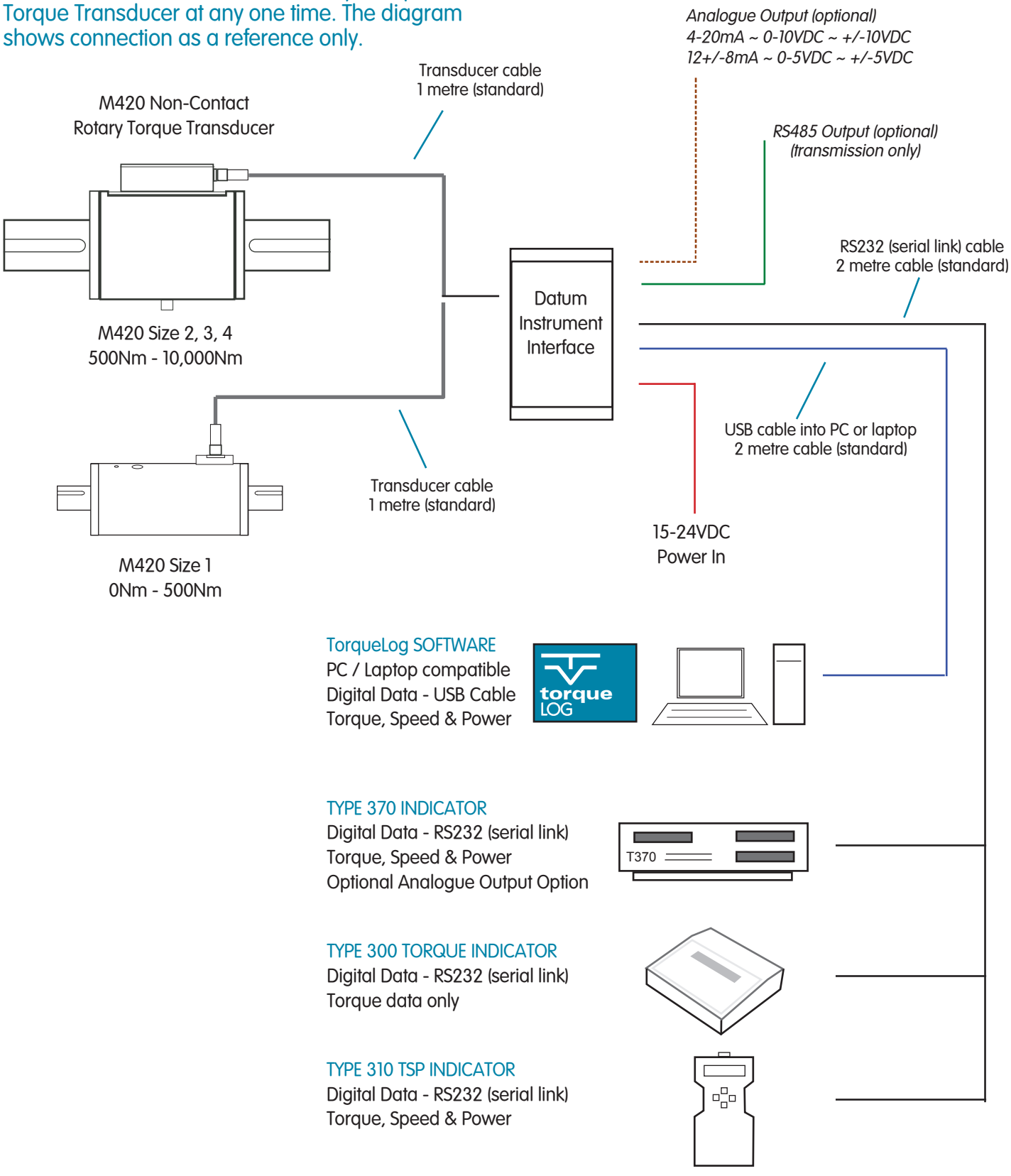
Datum Electronics TorqueLog software is an easy and convenient way of collecting data. TorqueLog software provides a direct readout of Torque, Speed and Power on a PC with additional facilities to read peak torque, log data to Excel and provide data for other applications. The enhanced features of this software include:

Calibrated Display of Torque in Nm or lb/ft
Display of Speed (rpm)
Display of Power in kW or HP
Peak Torque, Speed and Power Capture Facility
Data logging of Torque (or Torque Speed and Power)

The TorqueLog software is easy to use and easy to install, and provides the user with data access at the touch of a button.

M420 SYSTEM OUTLINE

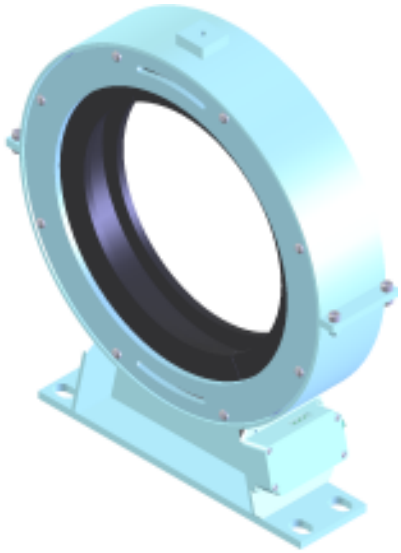
Transducer Interface module will only accept 1 M420 Torque Transducer at any one time. The diagram shows connection as a reference only.



The M420 Non-Contact Rotary Torque Transducer comes complete with transducer cables that interface direct into Datum Transducer Interface Module. The 15-24VDC supply powers the module and provides power on and off the shaft M420 Torque Transducer. Depending upon the instrumentation options will determine which cable is supplied. If you have requested our Torque logging software 'TorqueView we will supply a USB cable for interface into a PC or laptop. If the transducer is to be supplied with any other instrumentation options, then a RS232 serial cable will be supplied.

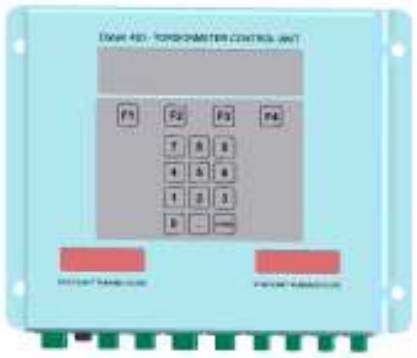
We also have an option from the Transducer Interface Module that can supply an analogue signal, popular options include 4-20mA or 0-10VDC. For analogue applications, data protocols will be provided on the analogue output from the module for interfacing for the end user.

Naval Marine Torsionmeter



- Accurate Shaft Power and Torque Measurement
- Tested to Military Standards
- Simple Installation
- Minimal Service Requirements
- Ship Control System Data and Control Inputs

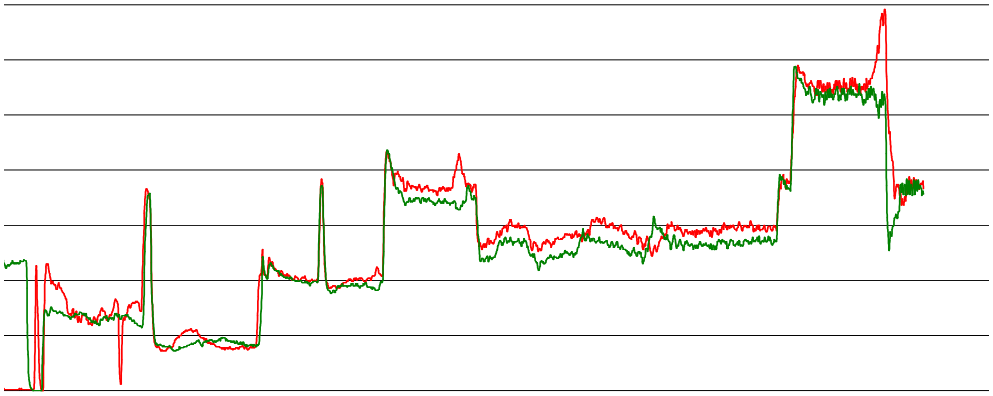
The Datum Electronics Limited Series 420 Naval Marine Torsionmeters have been designed to meet the needs of the world's Navies to improve propulsion efficiency and operating reliability.



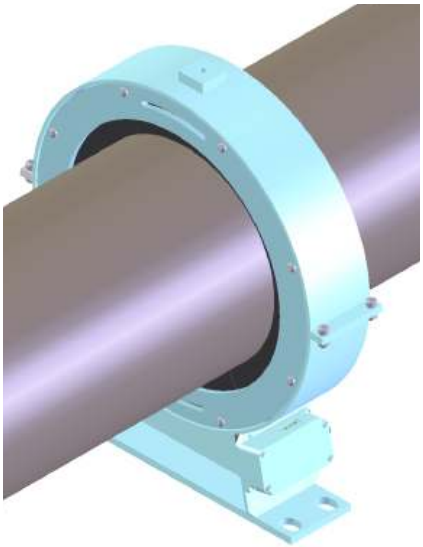
The Series 420 Torsionmeters provide both accurate and reliable data on the shaft power and torque but can also provide dynamic data showing the operational characteristics of the shaft system. The systems offer the latest technology and the flexibility to meet future requirements.

Designed to operate in challenging environments encountered in a naval fleet, each part of the system has been tested to military standards for shock, vibration, EMC (Electro Magnetic Compatibility), Contamination (Oil, Grease, Glycol, Diesel, Salt Spray), Temperature and Humidity.

The dynamic data options are a key tool providing information on shaft bending and misalignment, shaft vibration, and propulsion system condition.



Typical Dynamic Torque Data from Sea Trials

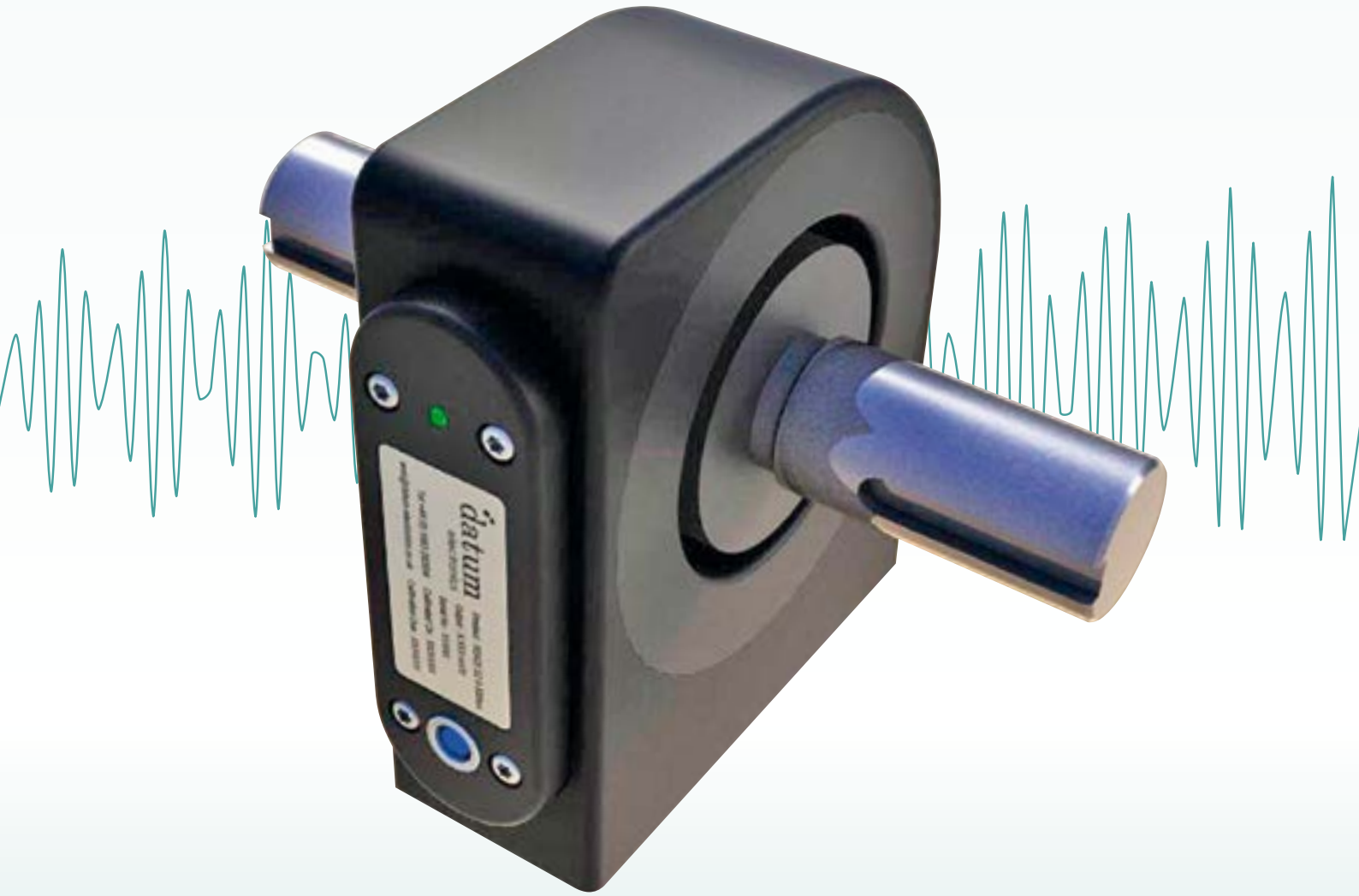


Naval Marine System Specification

Accuracy	
Instrumentation Accuracy	
Shaft Torque	0.1%
Shaft RPM	0.1%
Shaft Power	0.1%
System Accuracy	
Shaft Torque	0.1% +Ke
Shaft RPM	0.1%
Shaft Power	0.1% +Ke
Ke	Total error in shaft modulus constant and shaft diameter measurement
System Repeatability	
Shaft Torque	0.05%
Shaft RPM	0.05%
Shaft Power	0.05%
Data Output and Display	
Power, Torque and Speed Display	The display presents average values of torque, speed and power. The time period of this average is set the application and can vary from 1 second to 15 minutes
Power Measurement Data Output	Average Values of Shaft Torque and Speed are transmitted 5 times per second
Dynamic Torque Measurement (optional)	Torque is transmitted 5000 times per second
Environmental	
Operating Temperature	-15°C to +55°C
Storage Temperature	-25°C to +70°C
Temperature Effect on readings	0.01% per degree centigrade
Instrument Stability /Time Drift	Less than 0.1% per annum
Humidity	Temperature Cycled at RH 93%
Vibration	Tested to DefStan 08-123
Shock	Tested to DefStan 08-123 MIL 901 D
Underwater Shock	Design and approved to meet captive requirements of UK MOD
Salt Atmosphere	28 day Salt Spray and Humidity Test to Def Stan 08-123
EMC	Tested to Def Stan 59-41 and Def Stan 61-5
Environmental Sealing	
Shaft Unit 106100/106-420 Generic	IP67
Stator Electronics Unit 106115	IP67
Bulkhead Control Unit 106200	IP67
Remote Display 106300	IP67
Contamination	All materials and external components used have been tested to DefStan 08-123, contaminants include Diesel oil, Sea water, Hydraulic oil, Gear oil, Grease, Water/antifreeze
Rotor Stator Air Gap	+/-13mm radial, +/-8mm Lateral
Power Supplies	
Supply Voltage main Control Unit	110-230V AC or DC12-24V
Supply Voltage Stator	Supplied from control unit
Remote Display	11-230Vac
Cables (Lengths)	
Stator to Control Unit	Up to 20 meters – supplied
Control Unit to Remote Display	Up to 1500 meters – not supplied
Data Cables	Up to 1500 meters – not supplied
Supply Cables	Not supplied
Dimensions	
Shaft Unit 420 Series	See Series 420 GA
Shaft Unit 106000 Minehunter Small Shaft	See 106100
Control Unit 106200	See 106200
Remote Display 106300	See 106300

DATUM ELECTRONICS

RS425 NON-CONTACT TORQUE TRANSDUCER
PRODUCT OVERVIEW



datum electronics

THE **RS425** NON-CONTACT TORQUE TRANSDUCER

Bearing-less Torque Sensor with completely separate rotor and stator

The Datum Electronics Series RS425 non-contact rotary torque transducers have been designed to fit easily in line with any drivetrain or test bed using either a spline or keyway shaft.

We are able to modify the ends of the transducer to best suit your requirements, and can even design bespoke ends to fit. This type of transducer has many advantages over other torque systems including: zero bearing friction, high speed and high torque applications.

RS425 System Performance and Benefits:

Lightweight Torque transducer with completely separate rotor and stator set

No mechanical friction, long-term operation reduced maintenance

Ideal keyway shaft for easy fitting to test rigs and drive systems

Spline shafts are also available as an alternative to a keyway shaft

No bearings – ideal for high speed applications

Standard RS425 torque transducer range available from 0-10Nm to 0-30,000Nm

Analogue Output available & compatible with LABVIEW software

Ideal for fully sealed or underwater applications (IP 68) system upgrade

The RS425 Torque Sensor Range

The RS425 torque transducer utilises a strain gauged shaft for accurate and reliable torque measurement and a set of rotating on shaft conditioning electronics, the digital signals are transmitted to the non-rotating part of the system or stator providing a reliable and highly accurate torque measurement solution. The rotor is continuously powered enabling static torque measurement to be made. Not only does the RS425 Series offer great technical advantages but the range of torque sensors are competitively priced.

The RS425 series torque transducer is not limited by bearings; therefore it can be used at higher speeds, and places no bearings loads on to the shaft. The stator needs to be mounted in relation to the shaft within an operating envelope of +/- 3 to 5mm. The standard range can measure torque ranges from 0-10Nm up to 30kNm, the same modular elements have been applied to bespoke torque transducers for use down as low as 3Nm and up to 500kNm and above.

Using our new generation of electronics as found in our industry standard M425 Torque transducer, the RS425 gives customers the ability to choose the sample rate that they need from 1 up to 4000sps, with higher resolution using up to 24bit technology.

In many cases higher RPM ratings can be attained - please call our engineering team to discuss you applications

The Competitive Edge

The Series RS425 transmits calibrated digital data as this is a cleaner and more defined method of transmitting data. The on-shaft signal from the strain gauge is converted to a digital signal and amplified on shaft. It is this signal that is taken off the shaft and processed by either with our DUI; Datum Universal Interface, or with our free of charge GUI software, providing the end user with clean and definitive data transmission.

RS425 Analogue Options

If an analogue signal is required, our Series 425 torque transducers are able to provide either 4-20mA or 0-10VDC output with our DUI; by converting the digital data signal from the torque transducer to an analogue signal. However, the effect of external or electrical noise can impact upon signal strength and definition in this instance. Other commercial applications may use slip rings or analogue signals to transmit data, but the Datum Electronics series 425 outputs digital as standard.

If your requirements dictate anything above our standard torque sensor range of 30,000Nm we can and have engineered torque measurement transducers up to 500,000Nm for the RS425. Please discuss your requirements with our sales team.

Document: 1027 Issue: 2 Date: 03/8/2016

Instrumentation

The Series RS425 transducer is compatible with our new DUI; Datum Universal interface which gives a range of digital and analogue outputs as well as a digital display of the torque speed and power. It can also be set in a legacy mode to work with our older range of indicators and displays

A popular option is to view data from the transducer on a PC or laptop for torque data analysis. Our GUI software has been developed to allow the user to view the torque data in real time with optional data analysis for performance monitoring and control. Using a simple USB interface, or Ethernet connection the transducer data can be displayed and logged at the touch of a button with our GUI.

RS425 System Advantages

- **Accurate On Shaft Torque Measurement**
- **Flexible shaft fittings (Spline or keyway shaft)**
- **Modular System Assembly**
- **Non-contact Signal Transmission**
- **Proven Technology**
- **Low Maintenance**
- **Simple Linear Calibration**
- **Engineered to fit most drive components**
- **Rotary and Static Torque Measurement**
- **Optional Analogue Data Output**
- **LABVIEW compatible**

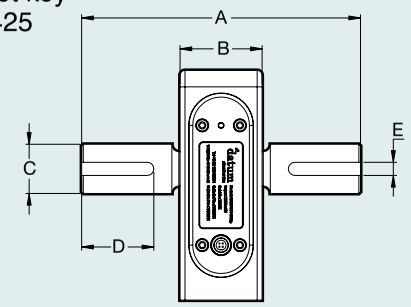
RS425 Performance Information

RS425 SERIES	Size 1	Size 2	Size 3	Size 4	Size 5
Torque range	0-100Nm	0-500Nm	0-2,000Nm	0-10,000Nm	0-30,000Nm
Accuracy class	0.1%FSD	0.1%FSD	0.1%FSD	0.1%FSD	0.1%FSD
Mechanical connection	Keyway or Spline Shaft				
Signal outputs	RS485 as standard				
Optional outputs with DUI	DIGITAL: USB, Ethernet, RS485/232 and USB memory logging. ANALOGUE: 3 Channels of Torque, Speed and Power as 0-10V/4-20mA.				
Transmission	Strain gauge signal, digital on-shaft with inductive loop				
Standard speed (rpm)	10,000rpm	10,000rpm	6,000rpm	5,000rpm	2,000rpm
Max speed (rpm)	30,000rpm	20,000rpm	16,000rpm	10,000rpm	5,000rpm
Output data	1-4000sps				

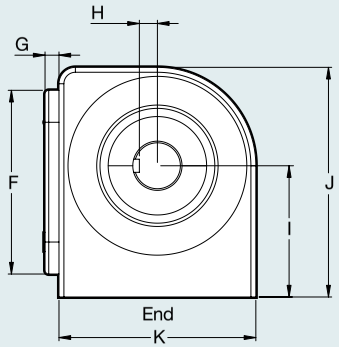
RS425 Specifications

						A	B	C	D	E	F	G	H	I	J	K	L	M
RS425 Model Size	Rated load (Nm)	Rated load (lb ft)	Standard Rotational speed (RPM)*	*Stator mass (Kgs)	Rotor mass (Kgs)	Shaft length face to face (mm)	Body width (mm)	Shaft Ø g6 TOL (ISO 286-2)	Keyway length (BS 4235-1 : 1972)	Keyway width (BS 4235-1 : 1972)	Output module length (mm)	Output module height (mm)	Keyway depth off axial centre (BS 4235-1 : 1972)	Base to shaft axial centre (mm)	Overall height (mm)	Base length (mm)	Base fixing holes. Centre to centre (mm)	Fixing holes (DIN 933)
Size 1 - A	0-10	7.4	10,000	1.057	0.401	150	50	15	22.5	5	112	8.5	4.3	80	140	120	100	M8
Size 1 - B	0-20	14.8	10,000	1.057	0.421	150	50	15	22.5	5	112	8.5	4.3	80	140	120	100	M8
Size 1 - C	0-50	36.9	10,000	1.057	0.462	150	50	15	22.5	5	112	8.5	4.3	80	140	120	100	M8
Size 1 - D	0-100	73.8	10,000	1.057	0.560	150	50	15	22.5	5	112	8.5	4.3	80	140	120	100	M8
Size 2 - A	0-250	184	10,000	1.057	1.201	170	50	30	44	8	112	8.5	11	80	140	120	100	M8
Size 2 - B	0-500	369	10,000	1.057	1.276	170	50	30	44	8	112	8.5	11	80	140	120	100	M8
Size 3 - A	0-1000	738	6,000	1.057	1.668	240	50	50	78.5	12	112	8.5	20	80	140	120	100	M8
Size 3 - B	0-2000	1,475.1	6,000	1.057	2.149	240	50	50	78.5	12	112	8.5	20	80	140	120	100	M8
Size 4 - A	0-5000	3,687.9	5,000	1.152	6.112	240	50	75	78.5	20	112	8.5	30	80	140	120	100	M8
Size 4 - B	0-10,000	7,375.7	5,000	1.152	12.162	240	50	75	78.5	20	112	8.5	30	80	140	120	100	M8
Size 5 - A	0-15,000	11,064	2,000	2.138	20.499	292	60	110	116	32	112	8.5	44	120	220	200	180	M10
Size 5 - B	0-20,000	14,751	2,000	2.138	22.318	292	60	110	116	32	112	8.5	44	120	220	200	180	M10
Size 5 - C	0-25,000	18,439	2,000	2.138	34.608	292	60	110	116	32	112	8.5	44	120	220	200	180	M10
Size 5 - D	0-30,000	22,127	2,000	2.138	40.969	292	60	110	116	32	112	8.5	44	120	220	200	180	M10

Alphabet key for RS425



Side



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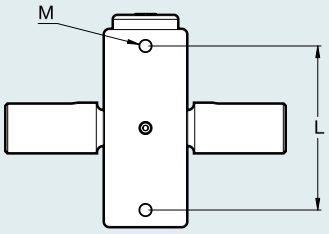
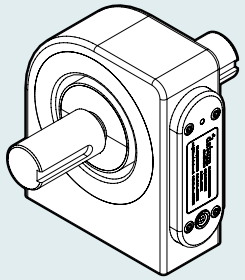


Bottom



3D models and STEP files are available from Datum Electronics to assist project planning. Please contact Datum Electronics for more information.

*For higher speed requirements please discuss your requirements with our sales team

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Series 430 Shaft Power Measurement Kit

Simple to Use ● Easy to Install ● Portable and Lightweight

To Fit Shafts From 30mm – 1100mm

The Datum Electronics Series 430 Shaft Power Measurement kit is designed to measure the on-shaft torque for trials applications on rotating shafts. It can be used of simple testing of power levels or as a key tool within extended trials to assess fuel efficiency or performance improvements

The system is designed for measuring power and torque on drive shafts, applications including marine ship shafts, prop shafts and vehicle drive shafts. The trials kit measures the on-shaft torque and wirelessly sends this data to the off shaft receiver which is also the optic speed sensor. The data is outputted via USB to a laptop/netbook to our free software, PowerKit. The Torque, Speed and Power can then be viewed or logged as required

Datum Electronics is a leader in the design and manufacture of torque and power measurement products and systems. The Shaft Power Measurement Kit is one of a number of standard solutions available; the companies also manufactures modular and custom solutions and are always pleased to discuss these options with you

SPMK Specifications

	Compact	Standard
Shaft Fit Dimensions	30 - 500mm	90 - 1100mm
Electronics Accuracy	0.1%	0.1%
IP Rating	IP67	IP67
Operating Temperature	0-70°C	0-70°C
Data Sampling Rate	10 SPS as standard For faster rates please discuss	10 SPS as standard For faster rates please discuss
Data Output	RS485 & USB for Torque and Speed Analogue available as an extra	RS485 & USB for Torque and Speed Analogue available as an extra
Battery Life **Battery Type**	4 Days as Standard PP3 N.B faster sample rate reduces battery life	30 Days as Standard Rechargeable Hot Swap N.B faster sample rate reduces battery life
Cable Length	4m as Standard	4m as Standard

Measurement & Analysis

The Datum Electronics Shaft Power Measurement Kit does more than just measure Torque; it can be used to verify power outputs from engines and motors. The following data can also be measured and analyzed

- Power Transmission
- Torque Trials
- Vibration and Torsional Acceleration
- Power Transients
- Peak Torque Levels
- Power Delivery
- Shaft Vibration

System Advantages

The main advantage of the Shaft Power Measurement Kit is the simple and easy installation process and ease of operation. The Kit comes in three main components making this application easy enough install, set up, test and operate and re-use where necessary.

With the aid of its installation disk; the software can be simply installed onto all modern Microsoft operating systems. The free software that is supplied provides live Torque, Speed and Power as standard which can be imported into Microsoft programs such as Excel for future date logging.

- Measures Shaft Power, Shaft Torque & Shaft Speed as a basic function
- Easy to install with a step-by-step guide
- Logs, records and displays 'real time' data
- Portable & lightweight design
- User Friendly software which is included free of charge
- Compatible with 2 data channels and shaft speed

Type 131 Load Cell Amplifiers

DESCRIPTION

The Type 131 Load Cell Amplifier's basic function is to amplify the signal from any load cell with full bridge connection. Amplifying this signal allows the user to use the data from the load cell in a more efficient and productive way. Reading its signal is difficult, but with an amplifier the job is made simpler, easier and more efficient.

FEATURES

The Type 131 Amplifier is designed to interface to a full bridge strain gauge based load cell or similar sensor. It can be calibrated to provide a 4-20mA output for a fixed load range from the sensor. The new design is now RoHS compliant to required industry standards with enhanced features including:

- Bridge Resistance between 120 - 2,000ohms
- 4 wire connection to Load Cell
- 12V - 24V power supply
- - 20°C to 50°C operating Temperature
- Provides Bridge Excitation Voltage 8.0V
- Linearity 1:4000
- Bipolar Output is an optional configuration
- Bandwith 20Hz at 3dB

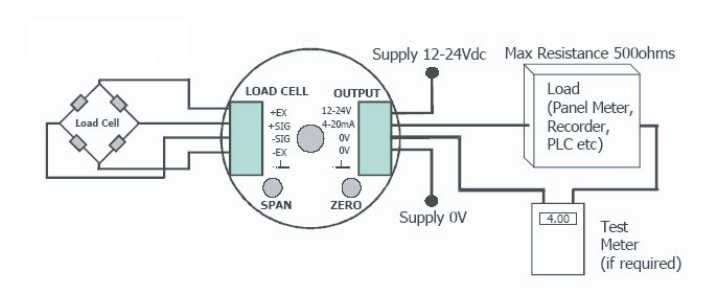
The amplifier is housed in an ABS enclosure allowing easy installation or mounting to a suitable surface with a single screw.

BRIEF SETUP SPECIFICATION TABLE

SETUP VALUE	MIN	TYP	MAX	UNITS
Bridge Resistance (12V supply)	120	350	2000	Ohms
Bridge Resistance (15V supply)	150*	350	2000	Ohms
Bridge Resistance (18V supply)	180*	350	2000	Ohms
Bridge Resistance (24V supply)	350*	-	2000	Ohms
4-20mA Load impedance	0	-	500	Ohms
Supply current (Load Variable)	-	35-50	-	mA

** To limit thermal dissipation, minimum bridge resistances are limit at higher voltages.*

CONNECTIONS



SPECIFICATIONS

The Type 131 sensor amplifier is available in 4 ranges to suit most applications

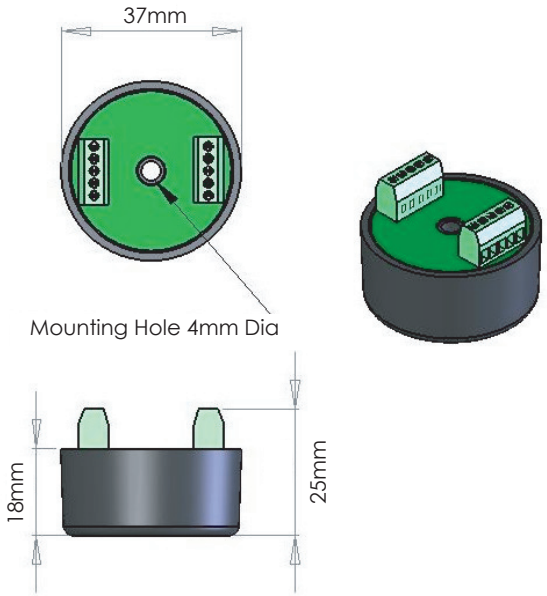
PRODUCT	FULL SCALE INPUT RANGE
Type 131 (A)	0.25mV/V - 0.85mV/V
Type 131 (B)	0.65mV/V - 1.65mV/V
Type 131 (C)	1.5mV/V - 2.5mV/V
Type 131 (D)	2.25mV/V - 3.25mV/V

Alternative Output Options and Custom Ranges can be provided

OUTPUT TYPE	AMPLIFIER
4 - 20mA	Type 131 (standard)
12 +/- 8mA*	Type 131M (non-standard)
0 - 10VDC	Type 132 (standard)
5 +/- 5VDC*	Type 132M (non-standard)

**This output also allows for Bipolar load ranges (custom specification)*

SENSOR DIMENSIONS



Type 132 Load Cell Amplifier

DESCRIPTION

The Type 132 Load Cell Amplifier's basic function is to amplify the signal from any load cell with full bridge connection. Amplifying this signal allows the user to use the data from the load cell in a more efficient and productive way. Reading its signal is difficult, but with an amplifier the job is made simpler, easier and more efficient.

FEATURES

The Type 132 Amplifier is designed to interface to a full bridge strain gauge based load cell or similar sensor. It can be calibrated to provide a 0-10VDC output for a fixed load range from the sensor. The new design is now RoHS compliant to required industry standards with enhanced features including:

- Bridge Resistance between 120 - 2,000ohms
- 4 wire connection to Load Cell
- 12V - 24V power supply
- - 20°C to 50°C operating Temperature
- Provides Bridge Excitation Voltage 8.0V
- Linearity 1:4000
- Bipolar Output is an optional configuration
- Bandwith 20Hz at 3dB

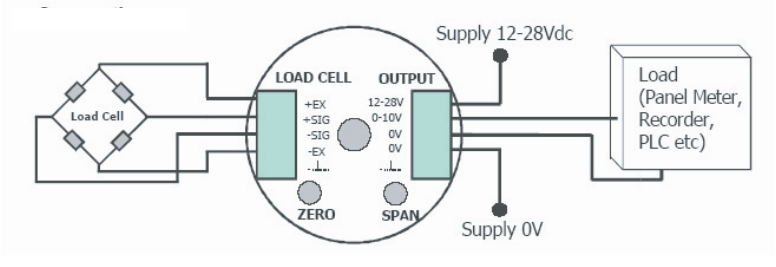
The amplifier is housed in an ABS enclosure allowing easy installation or mounting to a suitable surface with a single screw.

BRIEF SETUP SPECIFICATION TABLE

SETUP VALUE	MIN	TYP	MAX	UNITS
Bridge Resistance (12V supply)	120	350	2000	Ohms
Bridge Resistance (15V supply)	150*	350	2000	Ohms
Bridge Resistance (18V supply)	180*	350	2000	Ohms
Bridge Resistance (24V supply)	350*	-	2000	Ohms
0-10V Load impedance	1K0	-	-	Ohms
Supply current (Load Variable)	-	30	-	mA

** To limit thermal dissipation, minimum bridge resistances are limit at higher voltages.*

CONNECTIONS



Note: The 0V (supply) is internally connected to the 0V (signal)

SPECIFICATIONS

The Type 132 sensor amplifier is available in 4 ranges to suit most applications

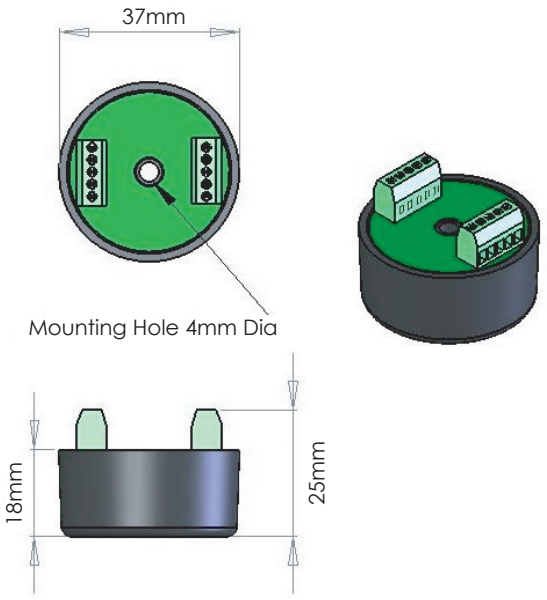
PRODUCT	FULL SCALE INPUT RANGE
Type 132 (A)	0.25mV/V - 0.85mV/V
Type 132 (B)	0.65mV/V - 1.65mV/V
Type 132 (C)	1.5mV/V - 2.5mV/V
Type 132 (D)	2.25mV/V - 3.25mV/V

Alternative Output Options and Custom Ranges can be provided

OUTPUT TYPE	AMPLIFIER
0 - 10VDC	Type 132 (standard)
5 +/- 5VDC*	Type 132M (non-standard)
4 - 20mA	Type 131 (standard)
12 +/- 8mA*	Type 131M (non-standard)

**This output also allows for Bipolar load ranges (custom specification)*

SENSOR DIMENSIONS



香港海川国际有限公司
HK HAICHUAN IN'L LIMITED
上海市浦东新区浙桥路289号碧云公馆A楼1106室
Rm 1106,Building A, Biyun Mansion, No.289 Zheqiao Road,Pudong,Shanghai
电话: +86 21 61682673　　传真:+86 21 61682675　　邮箱:info@haichuanhk.com
上海办 Shanghai@haichuanhk.com　　武汉办: Wuhan@haichuanhk.com
广州办:Guangzhou@haichuanhk.com　　烟台办 shandong@haichuanhk.com
南京办：nanjing@haichuanhk.com