

Document Information	
Supplier	RhinoSensor
Title	Well Pressure Sensor User Manual
Source Part Number	PTC-0266
Printed Part Number	PTC-1373
Revision Date	01/12/09

SENSOR

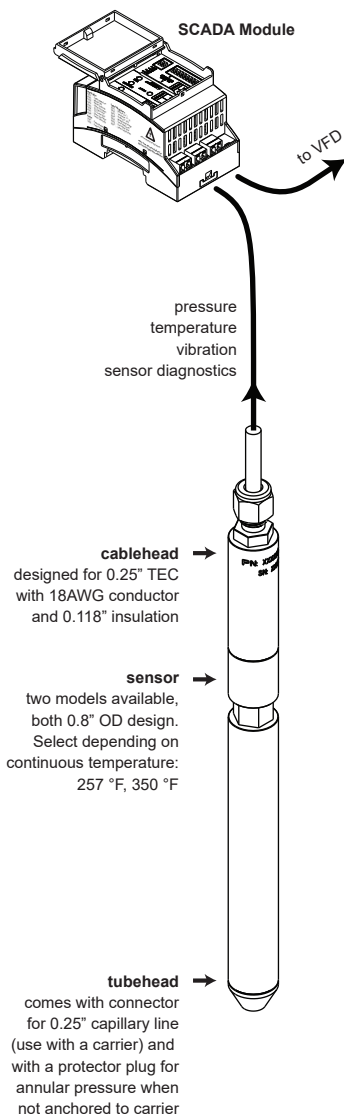
Pressure sensor designed for oil well fluid level monitoring in wells with up to 350°F ambient temperature. Robustly designed for these high ambient temperatures the sensor is suitable for artificial lift monitoring, including vibration monitoring as standard. Each sensor has an outer diameter of only 0.8", increasing its suitability to a wider range of oil wells than 1" and 1.25" OD sensors. The sensor's cablehead has been developed for 1/4" TEC (18AWG, 0.118" insulation) resulting in a multiple barrier design intended to function even when the cablehead becomes flooded

Using the latest microprocessor technology each sensor achieves its maximum performance by combining high temperature, nonvolatile memory to store the digitally mapped, silicon pressure transducer's calibration coefficient and other important manufacture data.

Communications use a digital, error-checked method with multilevel filtering to eliminate the effect of noise.

A downgraded 257°F version is available.

At surface a simple SCADA module integrates with the standard drive packages. Data logging, fluid level control and data display are all provided by the drive package.



SENSOR

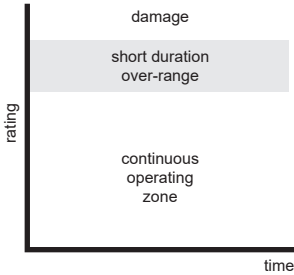
Specification

Part Number	PTC-1372
Description	RhinoSensor, 257°F and 350°F Variants
Environment	Oil and Water Wells with Downhole Pumps
Dimensions	0.8" OD, 10.0" Long (11.0" if Tubehead fitted)
Weight	1#
Supply Voltage	9VDC
Supply Current	5mA
Connections	Custom Cablehead and Tubehead
Cablehead	Custom Cablehead with 1/4" Compression Fitting and Kemlon Boot 16-B-1381-73
Tubehead	Custom Tubehead with 1/4" Compression fitting
Sensor Types	RhinoSensor Sensor Models listed
PTC-1166	Single Pressure, Temperature, Vibration Sensor, 257°F Model
PTC-1372	Single Pressure, Temperature, Vibration Sensor, 350°F Model
SCADA	Compatible with Modbus SCADA Module PTC-1371

Performance	Pressure	Temperature	Temperature	Vibration
Type	Digital Strain Gauge Technology	Internal RTD Sensor	Internal RTD Sensor	Digitally Filtered Accelerometer
Rated Range	6 000 psi	257 °F	350 °F	12.00 g
Rated Over-Range	9 000 psi	320 °F	380 °F	12.00 g
Accuracy	6 psi	0.5 °F	0.5 °F	0.10 g
Resolution	1 psi	0.1 °F	0.1 °F	0.05 g
Refresh Rate	1 sec	1 sec	1 sec	1 sec

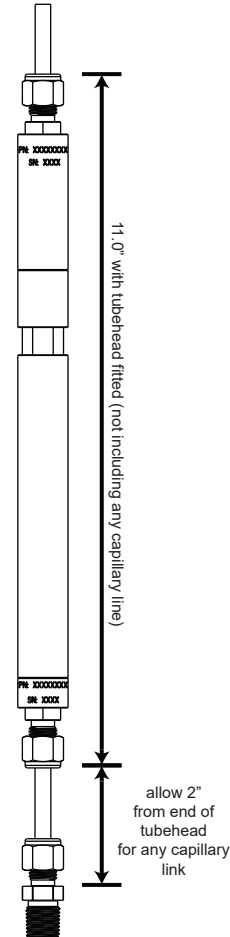
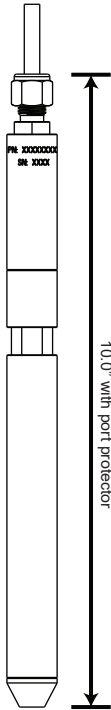
Ratings and Over-Range

All sensors have a rated (calibrated) range and a permitted over-range. The over-range limit is an absolute maximum and should never be exceeded. The sensor should not be operated for a significant period of time above the rated value.



SENSOR


Dimensions



Manufacture Testing and Certification

Each sensor is supplied with a Certificate of Conformity which details the test results as shown in the diagram below.

1. part number
2. part revision
3. serial number
4. firmware revision
5. location of manufacture
6. date of manufacture
7. test technician name
8. pressure and temperature test result matrix
9. accelerometer test result matrix
10. performance graph



ORDER
 Customer
 Customer Purchase Order
 Order Date
 End User Purchase Order
 Revision/Reference

MANUFACTURE
 Sensor ID
 Sensor Description
 Sensor Options
 Sensor Serial Number
 Sensor Firmware Revision
 Sensor Revision
 Date of Manufacture
 Manufacture Location
 Region
 Country of Origin

TESTING
 Insulation
 Sealing Test Pressure
 Vibration
 Temperature
 Function
 Calibration Check

> 100kV (250VAC, 5 mins)
 2 points (max 250kPa, 5 mins)
 Hydraulic Test Pump, 50/10 L
 - Cable Head Seal
 - connector seal
 - and pressure port
 30 g, 40 (2000)
 Batch of 1000, 1000
 1000 (250VAC) (250VAC)
 1000 (250VAC)
 Hydraulic Calibration 1000
 Temperature 100
 Date 1000
 Result Checked By: 100

Order	Calibration	0	10
(°C)	(°C)	(°C)	(°C)
10.0	10.0	10.0	10.0
10.0	10.0	10.0	10.0
10.0	10.0	10.0	10.0
10.0	10.0	10.0	10.0

SENSOR

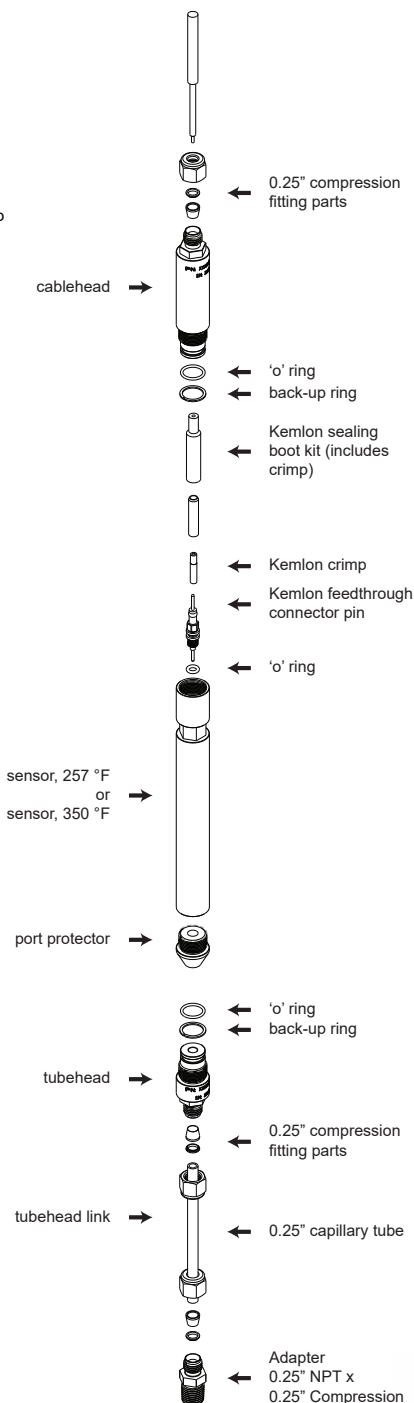


FAMILIARISATION

Before using the sensor you should become familiar with it's various parts.

Cablehead, sensor, port protector, tubehead and all the compression nuts are 9/16" AF. You will need two open end 9/16" wrenches to work with the sensor.

Kemlon crimp is a specialist item and is fitted to the TEC conductor using a DMC crimp tool with TP700 turret. Make sure to have this tool before starting the job.



Cablehead

On the top (downstream end) of the sensor is a cablehead.

The function of the cablehead is to connect the TEC to the sensor. Fitted correctly it is a reliable connection and will continue to ensure sensor function even if the cablehead becomes flooded

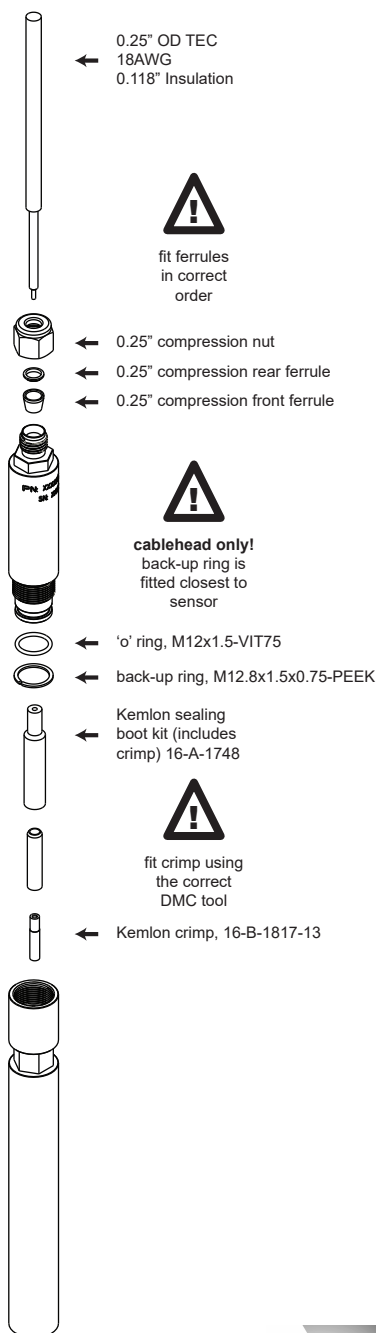
This cablehead is only for 316SS, 0.25" OD Tubing Encapsulated Cable. Inside the cablehead a sealing rubber boot is fitted to the TEC inner conductor. The standard boot is for 18AWG conductor with 0.118" OD insulation.

If you use a different TEC then consult RhinoSensor. The supplied boot kit may need replaced with one compatible with your TEC and the sensor connector pin (Kemlon 16-A-1748).

Replacement cablehead and boot kit are supplied as part of the Re-Install Kit.

We recommend replacing the 'o' ring (M12x1.5-VIT75) and back-up ring (M12.8x1.5x0.75-PEEK) when you re-run the sensor. You will need to replace the boot kit when you re-run the sensor. All parts (cablehead, compression fitting parts, O ring, boot kit) come in the Re-Install Kit which can be ordered separately (PTC-1102).

You may manufacture a replacement or a custom cablehead. Download the manufacture drawing and model from the web site.



TEC Suitability

The sensor is compatible with a wide variety of tubing encapsulated cable. However, the installation kit which comes with a new sensor (and a replacement re-installation kit) is specific to TEC with this specification

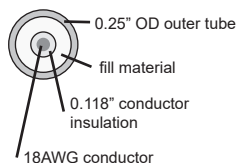
- 0.25" OD Tube
- 0.118" Insulation Over Conductor
- 18AWG Conductor

If you choose to use a different cable you need to check compatibility. Contact RhinoSensor for support.



check the
supplied boot
kit is compatible
with your TEC

DRAKA TEC 029112
is compatible with supplied
boot kit:
Kemlon 16-B-1381-73



using
different TEC?



boot kit compatibility check

boot hole must be sized
for the TEC conductor
insulation to ensure a
reliable seal in case of
fluid ingress



insulator hole must be sized
for the TEC conductor
insulation to allow it to
pass through



conductor AWG size
must be correct to ensure
proper crimping



Tubehead

At the upstream end of the sensor is the pressure port. This may remain open to the well (to measure annulus pressure) or can be fitted with a special tubehead to connect the sensor to a capillary line (the capillary line would connect into a ported carrier to measure tubing pressure).

Inside this port on the sensor is a protector which will remain in place during operation. Do not attempt to remove this as you may damage the transducer.

The tubehead connector is designed only for 316SS, 0.25" OD Capillary Tube.

Replacement tubehead are available. These are supplied as part of a Re-Install Kit.

We recommend replacing the O ring (M12x1.5-VIT75) and back-up ring (M12.8x1.5x0.75-PEEK) when you re-run the sensor. All parts (tubehead, compression fitting parts, O ring) come in the Re Installation Kit. This kit comes with the sensor and may be ordered separately as a service item.

You may manufacture a replacement or a custom tubehead (possibly to anchor sensor to a carrier or clamp). Download the manufacture drawing and model from the web site.



tubehead only!
'o' ring is
fitted closest to
sensor

← 'o' ring, M12x1.5-VIT75

← back-up ring, M12.8x1.5x0.75-PEEK



fit ferrules
in correct
order

← 0.25" compression front ferrule

← 0.25" compression rear ferrule

← 0.25" compression nut



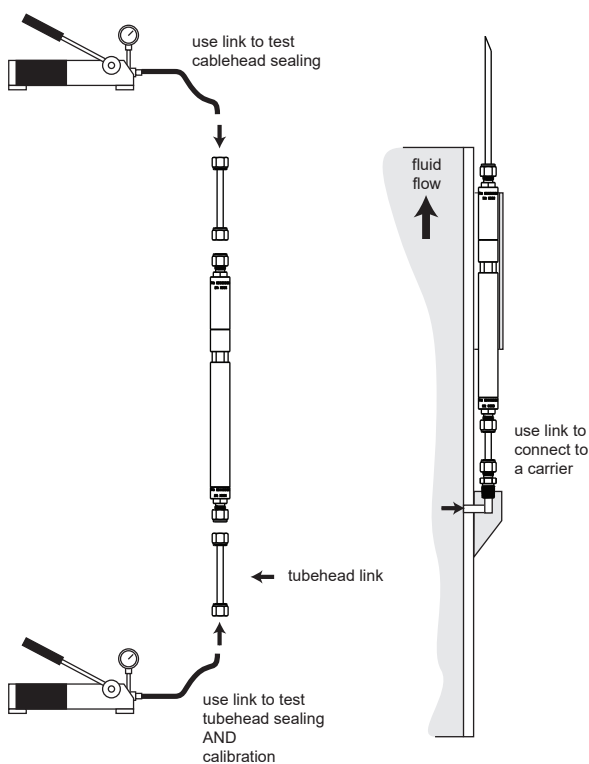
fit
port protector
if not using
a tubehead



Tubehead Link

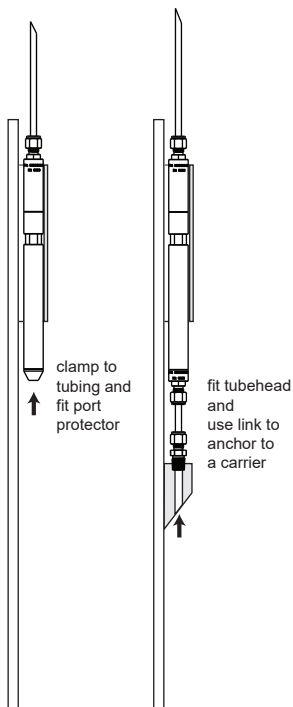
This small sub-assembly is supplied with the tubehead as part of the Re-Install Kit (supplied with every new sensor and also available as a service item).

The link is pre-assembled and pressure tested and can be used to (a) apply a test pressure to the sensor pressure port, and (b) connect the sensor to a carrier.



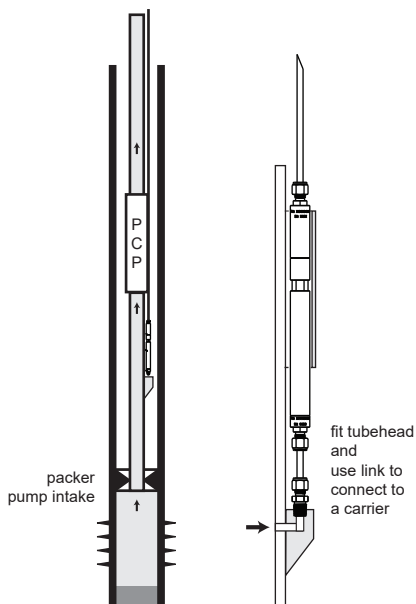
Carrier Selection

You may choose to use either a tubing carrier or clamp. If you are to measure tubing ID pressure then you will require a tubing carrier. The tubing carrier may port directly to the upstream connection on the sensor or use a tubehead link.



OPTION A: Open End

When measuring annulus pressure you do not need to fit the tubehead and can simply leave the protector in place.

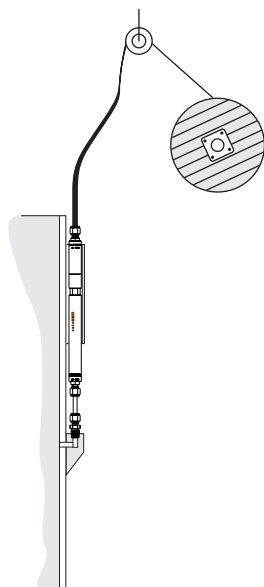


OPTION B: Use Link

If your annulus is sealed from the production fluid you will need to port the sensor to a carrier. Use either the supplied link or a new length of 0.25" capillary tube

INSTALLATION

Now that you are familiar with the different parts of the sensor you are ready to install it. First, you should start with a field test making sure your sensor has not been subject to transit damage.



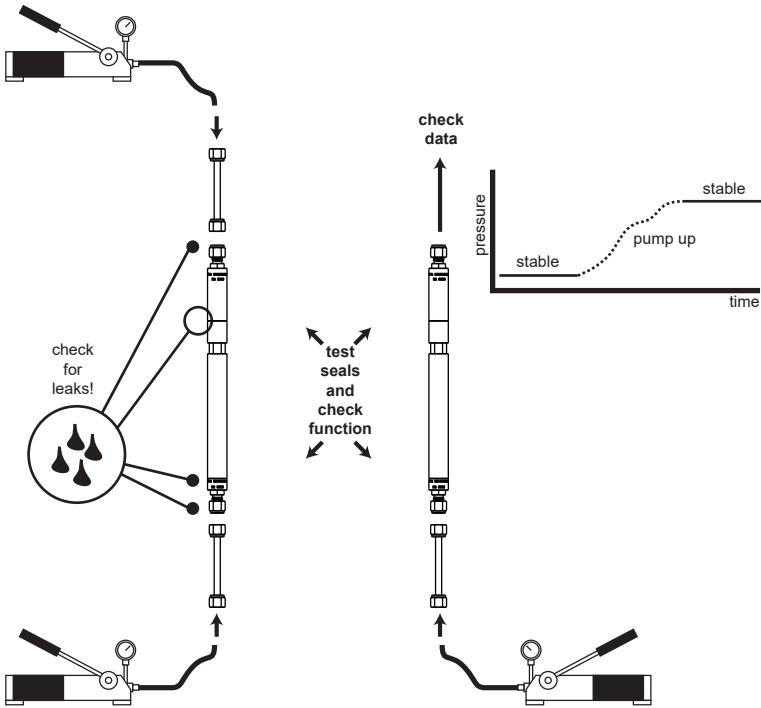
SENSOR

Field Testing

Every sensor should be tested before installation.

The simplest test is a function check, ensuring you have zero data errors. Simply connect the sensor to the SCADA module and wait for the SENSOR LED to illuminate indicating a message has been successfully received.

You can also apply pressure to the port and check the sensor reading matches the pressure applied.



Tubehead Fitting

You may choose to fit the tubehead to the tube first or fit the tube to the sensor with a tubehead attached, as is described below:

1. remove the tubehead
2. remove old 'o' ring and back up ring
3. clean the tubehead
4. grease the thread and 'o' ring groove
5. fit the 'o' ring and back up ring
6. attach tubehead to the sensor
7. fit compression fitting ferrul
8. lightly attach compression fitting nu
9. cut capillary line
10. insert into tubehead
11. tighten compression fitting nu

If you wish you can attach a pressure pump to the other end of the capillary line and pressure test for leaks at the compression fitting or 'o' ring seal. You can also check the calibration on the sensor.



tubehead only!
'o' ring is fitted closest to sensor



- ← 'o' ring, M12x1.5-VIT75
- ← back-up ring, M12.8x1.5x0.75-PEEK



fit ferrules in correct order



- ← 0.25" compression front ferrule
- ← 0.25" compression rear ferrule



- ← 0.25" compression nut

Cablehead Fitting

It is recommended that you practice fitting of the cablehead to make sure you are comfortable with the process. A badly fitted cablehead may work for a time but can result in a failure later in the installations life.

When practicing fitting of the cablehead you will need replacement crimps (see Servicing part list). All other parts are reusable.

Step 1: Prepare Cablehead

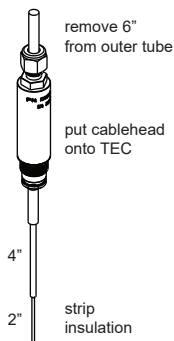
- remove the cablehead
- remove the old 'o' ring and backup ring
- clean the cablehead
- clean inside the sensor cablehead connection
- fit the compression ferrules and nut (loosely) to the cablehead
- put aside for now

Step 2: Strip TEC End

- cut the TEC
- remove 6" of outer tube
- remove the fill material which is over the insulation
- strip 2" of insulation
- twist the conductor to make it easier to work with

Step 3: Fit Cablehead to TEC

- put the cablehead over the TEC
- move it along the TEC, out of the way

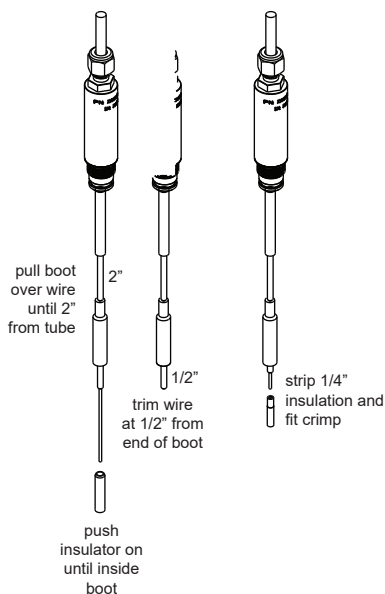


Step 4: Fit the Sealing Boot

- thread the bare conductor through the boot
- using the conductor pull the insulated wire through the boot
- pull until there is a 2" gap from the cut end of the TEC outer tube to the boot
- put the white insulator over the conductor
- push the insulator up into the boot until the end is flush with the boot's open end

Step 5: Fit Crimp

- cut the conductor at the end of the boot
- push the boot up 1/2"
- remove 1/4" insulation
- attach a crimp using the DMC crimp tool with TP700 turret set to 18AWG



Step 6: Assemble Boot

- pull the boot down, locking the crimp into the insulator
- keep pulling the boot down until the insulator moves up and locks into the boot



pull boot down
until crimp and
insulator click
into place

Step 7: Re-Inspect Cablehead

- inspect (clean if required) the cablehead thread and 'o' ring groove
- grease the thread and groove

Step 8: Connect to Sensor

- plug the boot onto the sensor connector
- push firmly until it locks on the connector
- screw on the cablehead, folding the insulated wire to the side of the boot
- keep screwing down, keeping the insulated wire inside the cablehead

Step 9: Tighten Compression Fitting

- push the TEC into the cablehead
- secure the compression nut

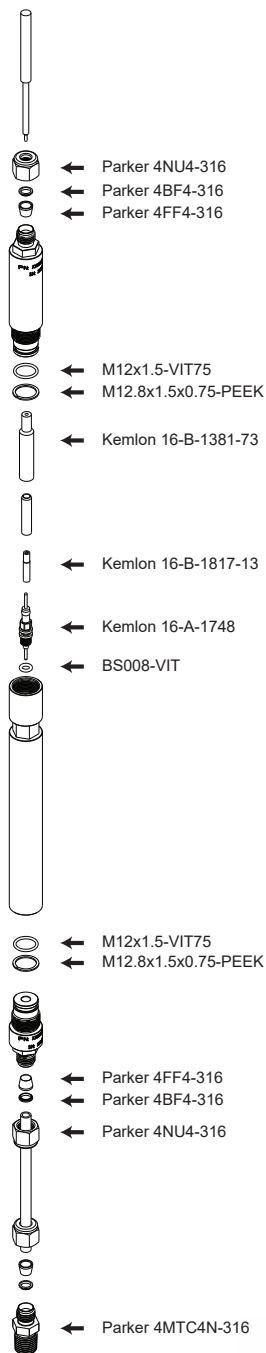
Step 10: Function Test

Servicing

The tubehead and cablehead can be replaced. A service item, Re-Install Kit, is available.

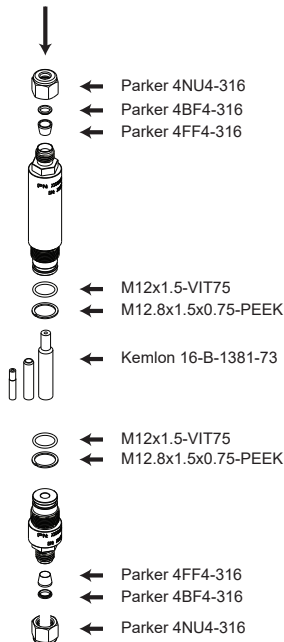
Calibration of the sensor may be checked by connecting a pressure source to the tubehead and pressuring the sensor. Any sensor which requires recalibration or repair should be returned to RhinoSensor with a purchase order for PTC-1302 Recalibration and PTC-1303 Repair.

There are no user serviceable items within the sensor. Any sensors which have been disassembled will not be accepted for PTC-1302 Recalibration and PTC-1303 Repair and will have to be replaced.

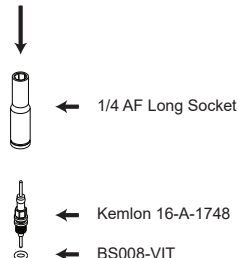


Service Items	Part Number	Alternate Supplier Part Numbers
Replacement Sensor, 257 °F	PTC-1393	--
Replacement Sensor, 350 °F	PTC-1394	--
Sensor, Re-Install Kit	PTC-1102	WARNING: Not a complete list Rear Ferrule: Parker 4BF4-316 Front Ferrule: Parker 4FF4-316 Nut: Parker 4NU4-316 Boot Kit: Kemlon 16-B-1381-73 O-Ring: Metric M12x1.5-VIT75 Backup Ring: Metric M12.8x1.5x0.75-PEEK
Sensor, Pin Replacement Kit	PTC-1100	Pin: Kemlon 16-A-1748 Tool: Long Socket 1/4" AF O-Ring: BS008-VIT75
Sensor, Recalibration	PTC-1302	--
Sensor, Repair	PTC-1303	--
DMC Crimp Tool with Turret	PTC-1101	DMC-AF8 M22520/1-01 (Crimp Tool) DMC-TP700 (Turret)
Replacement Crimps, 18AWG	PTC-1187	Kemlon 16-B-1817-13

Re-Install Kit Included Items

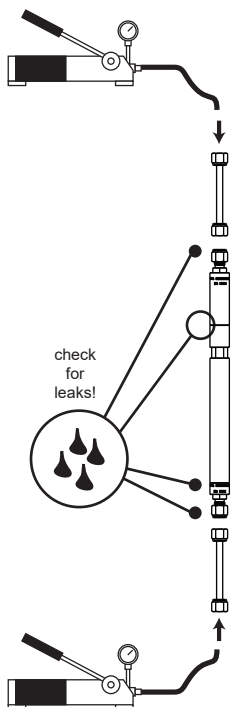


Pin Replacement Kit Included Items



Pressure Testing

Each sensor can be fully pressure tested using just a hand pump and tubehead. Connect the tubehead to the pressure port of the sensor and pump up to the test pressure, and then repeat the test on the cablehead end of the sensor.



Connector Replacement

Broken or damaged cable connector pins can be replaced. Order a PTC-1100 Pin Replacement Kit. The kit which you will be supplied includes the tools to remove the old pin and fit the supplied replacement. Instruction describe the actions required to keep the area clean and ensure a good fit of the pin. After fitting the sensor cablehead end must be pressure tested to ensure the pin seal is holding pressure and can withstand a cablehead flood at pressure



← long socket, 1/4 AF

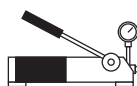
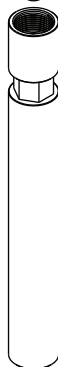


protect from
dirt or moisture
entering the
sensor during
pin replacement



← Kemlon Feedthrough
Connector 16-A-1748

← 'o' ring, BS008-VIT75



after replacing
check
for leaks!



SCADA MODULE

SCADA module to communicate with the RhinoSensor downhole sensor and provide visual and SCADA diagnostics on the module, cable and sensor performance. Module is independent of the sensor and you can freely move a module from one well to another. A bus connection system is available to stack multiple modules together in a test or well-cluster location.

Although normally powered by 24VDC from your SCADA system the module is designed to allow operation from a 12V battery source, allowing you to power from a truck power point, battery or solar array.

The module is triple isolated:

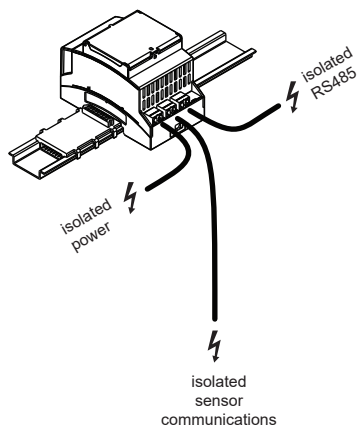
- Incoming supply power
- Modbus RTU 485 port
- Sensor communications port

Filtering is employed on the communications port to ensure trouble-free operation even in the noisiest environments. The filtering is proven to eliminate the noise coupled from running the sensor surface cable alongside the drivehead power cables originating from a variable speed drive.

Modbus RTU is available on an 2-wire RS485 link.

The port is isolated. Registers, input bits and coils are implemented to access sensor data, diagnostics, test functions and the status of the sensor and module. RTU Address (1-255) and BAUD (38.4, 19.2, 9.6, 4.8) are changed using switches on the front of the module.

LEDs are used to show the status of the system. A troubleshooting guide is provided.



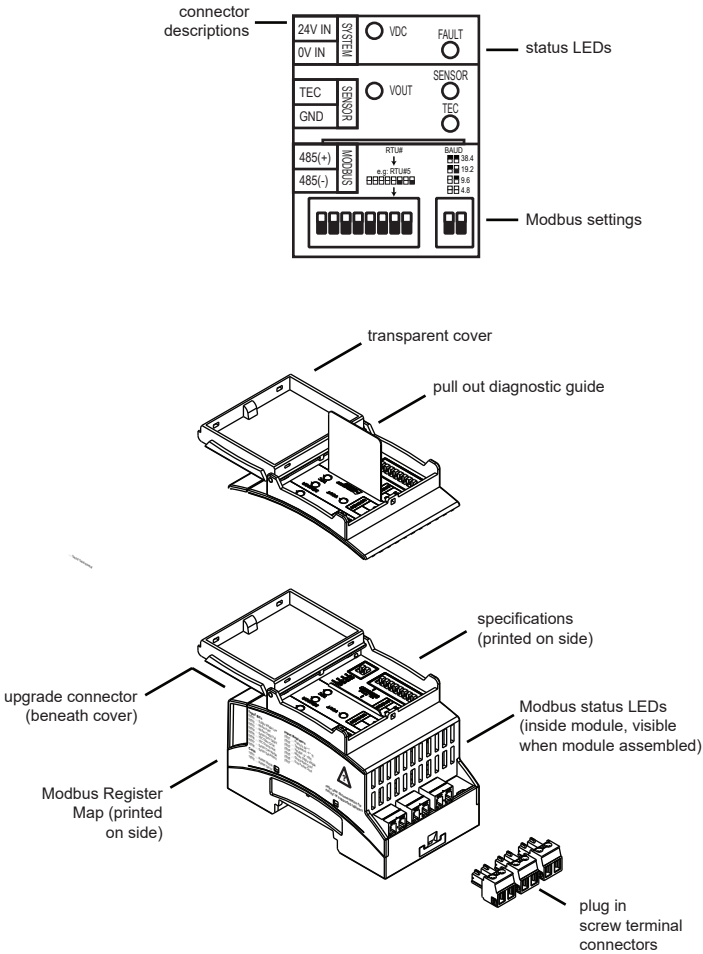
Specification

Part Number	PTC-1371
Description	RhinoSensor Sensor SCADA Module
Environment	To be located within a protective host enclosure only
Temperature	-40 °F to +170 °F
Humidity	95%
Dimensions	54mm (width on rail) x 90mm (symmetrical on rail) x 60mm (height from rail)
Weight	0.5#
Supply Voltage	24VDC
Supply Current	150mA
Connections	Removable Screw Terminals, 0.2" Pitch
Power Supply	1000V Isolated, 2 Way Connector, Phoenix Contact 1836189
Sensor	1000V Isolated, 2 Way Connector, Phoenix Contact 1836189
Modbus	1000V Isolated, 2 Way Connector, Phoenix Contact 1836189
Sensor Types	compatible with RhinoSensor Sensor Models listed
PTC-1166	Single Pressure, Temperature, Vibration Sensor, 257°F Model
PTC-1372	Single Pressure, Temperature, Vibration Sensor, 350°F Model
SCADA	Isolated RS485 2-Wire Port
Protocol	Modbus RTU
Address Range	1-255 (0 for broadcast)
BAUD Rates	38.4 - 19.2 - 9.6 4.8 kbps
Registers	Standard Modbus Register Ranges
0XXXX	Coils (Control Commands)
1XXXX	Status Bits (Live Status)
3XXXX	Input Registers (Live Data)
4XXXX	Holding Registers (Factory Settings)

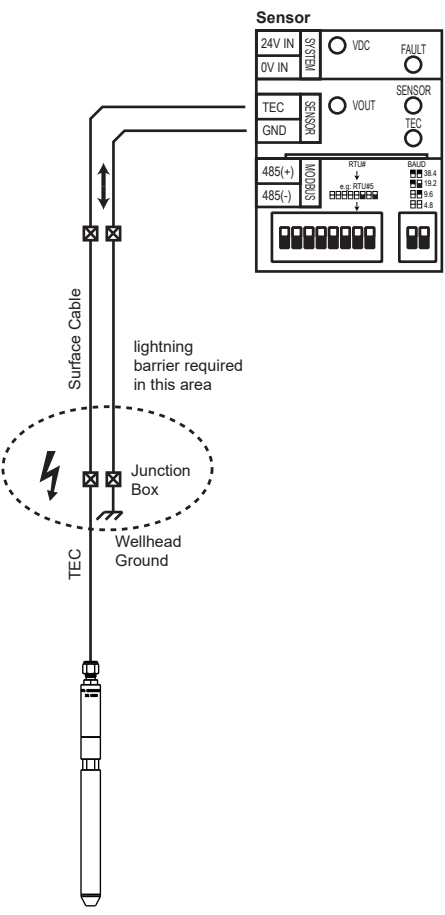
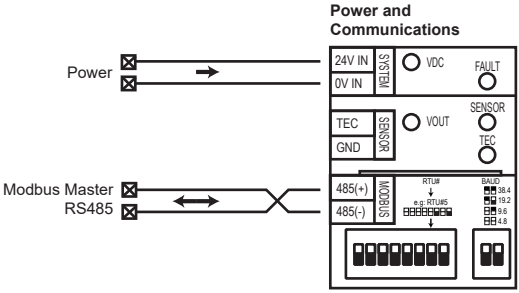
SCADA



Functional Parts



Module Wiring

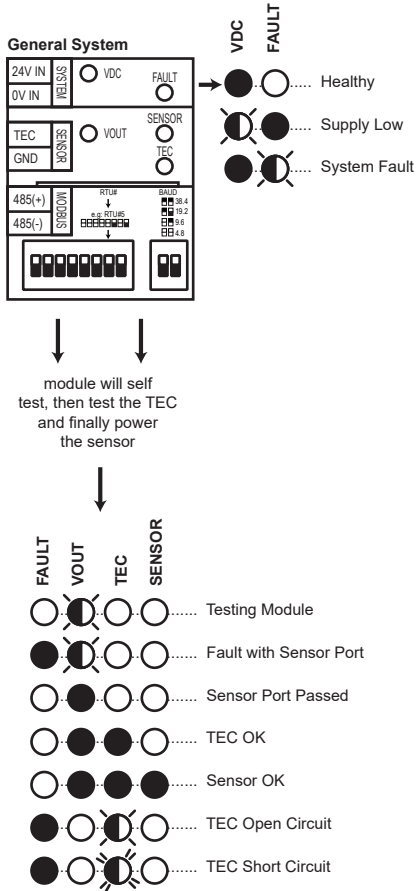


LED Function

There are 7 LED on the module:

LED	Description
Modbus RX	will flash when data is received on the 485 port. RX and TX will flash together rapidly (4 times per second) when the new switch settings for RTU# and BAUD have not yet been stored.
Modbus TX	will flash when data is transmitted on the 485 port. Occurs if the Master request is accepted and a response is sent.
VDC	will be solid on when power is OK. If power is low then the VDC LED will flash and the FAULT LED will light. The module will shutdown all functions.
FAULT	this will light to indicate a general FAULT within the module. It will flash together with another LED to indicate a FAULT with that particular function.
VOUT	lights to state the sensor connection is powered. Flashing indicates it is restarting. Flashing with a FAULT flash indicates a fault with the sensor connection circuit (this is self tested during every start and restart of the module)
SENSOR	lights solid when the sensor is found. If the sensor is faulty the FAULT and SENSOR LEDs will both flash

LED	Description
TEC	lights solid to show the cable is good (i.e. not open circuit, not short circuit). A flashing TEC LED with FAULT on indicates a cable fault. To identify between a short and open the TEC LED will flash differently during these fault conditions: single flash is OPEN, double flash is SHORT.

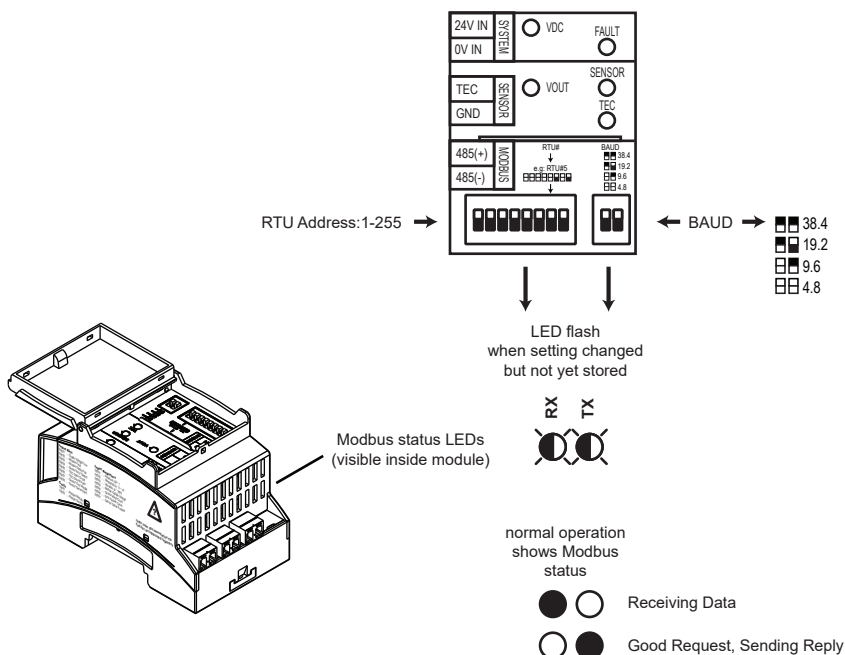


Modbus

All data, status and remote functions (e.g. restart) are available across Modbus. The module implements Modbus RTU protocol with address range 1-255 (0 reserved for broadcast). The physical connection is RS485 2-Wire Connection. This physical link is isolated to prevent ground loops.

Setting RTU and BAUD

These are set using the switches on the front of the module. You do not need to cycle the power to the module for the changes to take effect. Any new setting takes effect 5 seconds after any switch has been changed. During this 5 second period the Modbus status LEDs flash rapidly.



Coils

Register	Description	
00001	Restart Module	1=Restart (resets to 0)
00002	Restart Sensor	1=Restart (resets to 0)

Status Bits

Register	Description	
10001	Supply Voltage Low	Set=Low
10002	Module Fault	Set =Fault
10003	Module Output Fail	Set =Fail
10004	Sensor Error Detect	Set =Error
10005	TEC Open Circuit	Set =Open
10006	TEC Ground Fault	Set =Short
10007	Sensor Over-Range	Set =Over-Range
10008	Sensor Self-Protect	Set =Self-Protect

Input Registers

Register	Description	
30001	Intake Pressure	psi *10
30002	Discharge Pressure	psi*10
30003	Intake Temperature	C*10
30004	Discharge Temperature	C*10
30005	Circuit Temperature	C*10
30006	Vibration on X Axis	g*1000
30007	Vibration on Y Axis	g*1000
30008	Vibration on Z Axis	g*1000
30009	Azimuth	deg*100
30010	Zenith	deg*100
30011	Intake Transducer Temperature	C*10
30012	Discharge Transducer Temperature	C*10
31000	Motor Temperature	C*10
31001	Motor Oil Temperature	C*10
32000	Module Supply Voltage	V*1000
32001	Module Output Current	mA*10
32002	Sensor Packets Count	0 - 65535
32003	Sensor Good Packets Count	0 - 65535
32004	Sensor Bad Packets Count	0 - 65535

39000	Sensor Serial Number	0 - 65535
39001	Sensor Part Number	0 - 65535
39002	Sensor Temperature Range	C*1
39003	Sensor Intake Pressure Range	psi*1
39004	Sensor Discharge Pressure Range	psi*1
39005	Sensor Firmware Revision	value *100
39006	Sensor Service TAG Char 1	ASCII Char Value
39007	Sensor Service TAG Char 2	ASCII Char Value
39008	Sensor Service TAG Char 3	ASCII Char Value
39009	Sensor Service TAG Char 4	ASCII Char Value
39010	Fault Status Word	b0: Supply Voltage Low, Set =Low b1: Module Fault, Set =Fault b2: Module Output Fail, Set =Fail b3: Sensor Error Detect, Set =Error b4: TEC Open Circuit, Set =Open b5: TEC Ground Fault, Set =Short b6: Sensor Over-Range, Set =Over-Range b7: Sensor Self-Protect, Set =Self-Protect b8 - b15: not used

Holding Registers

Register	Description	
40001	Module Part Number	0 - 65535
40002	Module Revision	0 - 65535
40003	Module Serial Number	0 - 65535
40004	Module Firmware Revision	value *100
40005	Module Service TAG Char 1	ASCII Char value
40006	Module Service TAG Char 2	ASCII Char value
40007	Module Service TAG Char 3	ASCII Char value
40008	Module Service TAG Char 4	ASCII Char value
40099	Reserved - Do Not Write	

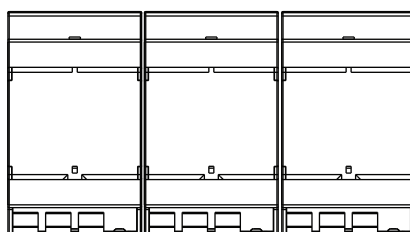
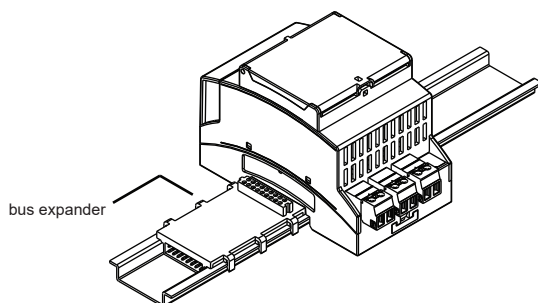
Servicing

There are no user serviceable functions inside the module. The only service item available is an Installation Kit which comes with replacement connectors and programming port cover.

Service Items	Part Number	Supplier Part Number
Replacement SCADA Module	PTC-1395	--
Module Install Kit	PTC-1111	Phoenix Contact 1836189 (3 req'd) Phoenix Contact 2896225
Module, Bussing Kit	PTC-1222	Phoenix Contact 2896458
Module, Exchange & Repair	PTC-1227	--

Bussing

Modules can be bussed together. Order PTC-1222 Bus Kit (Single). The bus distributes power and Modbus communications from one module to all the other modules without external wiring. It is suitable for workshops and well clusters.



→ power and modbus signals are distributed on the bus to the other modules

only one module should be wired with power and Modbus



Power

Sensor Well A

Modbus Master RS485



Sensor Well B

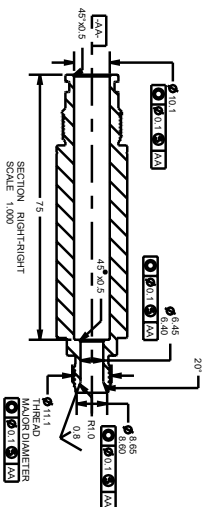
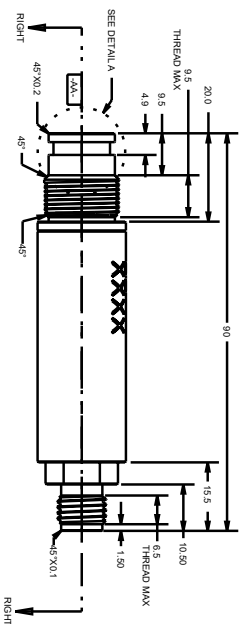
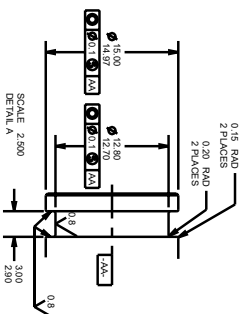
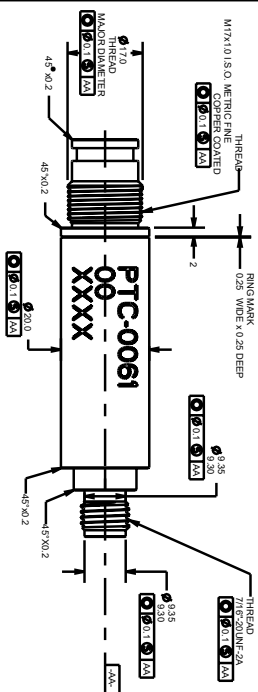


Sensor Well C



Part Drawings	
M17 TEC Cable Head	PTC-0061-00x02
M17 Tube Head	PTC-0062-00x01
Thread Protector, 20.13mm tube,M17x1	PTC-0109-00x01

PTC-0061-00X02



UNLESS OTHERWISE STATED

1. DIMS IN MM
2. DIAMETERS CONCENTRIC TO 0.05 TIR

SURFACE FINISH 32 MICRONS

4. 1ST ANGLE PROJECTION

DEFAULT TOLERANCES

0.XX +/- 0.005

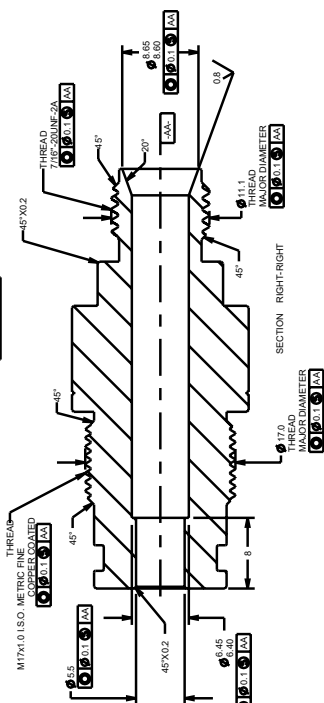
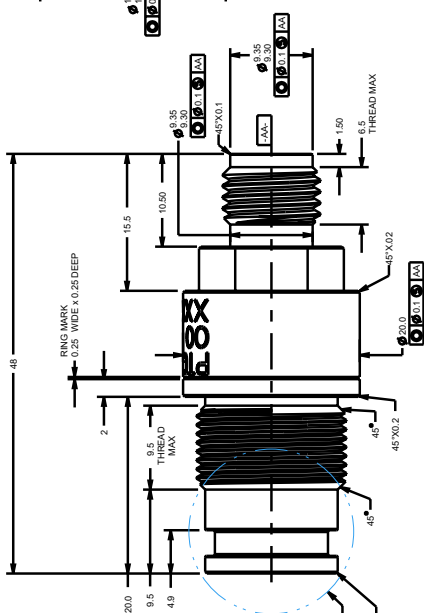
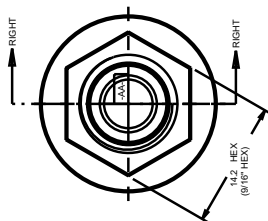
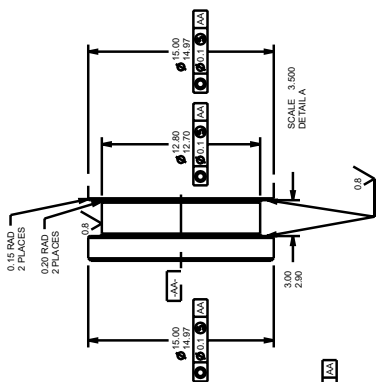
0.X +/- 0.005

X +/- 0.5



MATL 316SS	DESCRIPTION M17 TEC Cable Head
DESIGNER: N SOLIS	PTC-0061-00X02
SHEET 1 OF 2	
SCALE: 1/200	
	DATE: 11-Sep-09

PTC-0062-00X01



UNLESS OTHERWISE STATED
1. DIMS IN MM
2. DIAMETERS CONCENTRIC TO 0.05 TIR
SURFACE FINISH 32 MICRONS
4. 1ST ANGLE PROJECTION
5. ALL BURRS AND SHARP EDGES REMOVED

DEFAULT TOLERANCES
0.XX +/- 0.005
0.X +/- 0.05
X +/- 0.5

MATL 316SS	DESCRIPTION M17 Tube Head
DESIGNER: N SOUS	PTC-0062-00X01
SHEET 1 OF 2	
SCALE: 2:500	DATE: 14-Sep-09



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