

PRODUCT CATALOGUE



SEC
MEASURING & MONITORING EQUIPMENT

SHOYO ENGINEERING CO., LTD.

Ensuring Marine Safety with Measurement Technology We want to build your confidence

Since its establishment in 1976, SHOYO ENGINEERING CO., LTD. has been a professional manufacturer of measuring instruments for ships.

From the beginning, we have been working on the development and manufacture of shaft horsepower meters, and have been working hard to deliver products with excellent accuracy and durability to customers at reasonable prices.

The shaft horsepower meter is used in many ships because of the confidence of our customers and it still remains our mainstay.

As the environmental regulations in the marine industry, including global warming countermeasures, are becoming stricter, marine equipment is also required to have functions that contribute to environmental countermeasures. Among them, the role of measuring and monitoring equipment including shaft horsepower meter is very important, and its importance is also increasing in the international standard ISO.

Going forward, as a specialized manufacturer of measurement equipment, we will constantly pursue measurement accuracy and safety, and will continue to strive to provide products that satisfy our customers.



in us.

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SEC Shaft Horsepower Meter

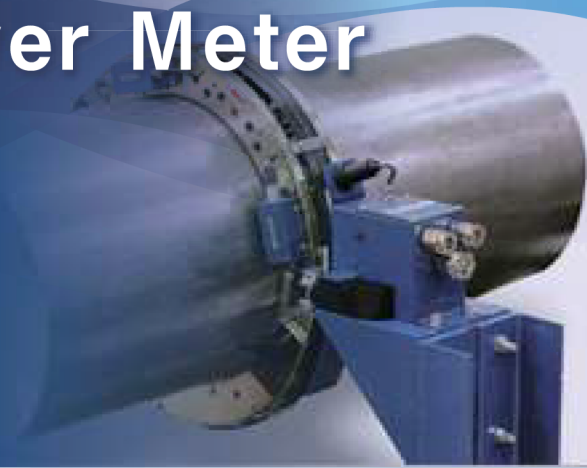
SEC Shaft Thrust Load Meter

SEC Engine Combustion Pressure Sensor

SEC Shaft Horsepower Meter

What is shaft horsepower meter? :

A shaft horsepower meter is an instrument that measures the transmitted horsepower supplied from the engine to the propeller on a vessel by measuring the torsion of the rotating shaft.



SEC Shaft Horsepower Meter

Metal strip vibration method

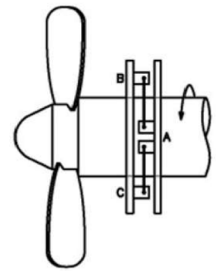
The principle of measurement is a method for detecting shaft torque using the fact that the vibration frequency changes in proportion to the change in tension.

Two sensors are installed between the detection rings mounted on the shaft, and the metal strip stretched inside the sensor changes the distance between the fulcrums due to the torsion of the shaft, increasing the tension between AB and decreasing between AC. The amount of each change is reflected in the natural frequency of the sensor strip.

The distance between the fulcrum of the sensor strip changes due to the torsion of the sensor strip

A-B → Increase A-C → Decrease

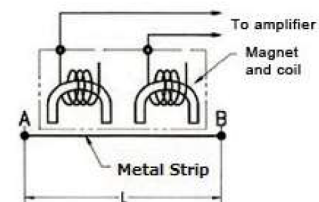
$Tension \propto \text{change amount of A-B (A-C)} \propto \text{Hz}^2$



High Sensitivity Displacement sensor

A high sensitivity displacement sensor with a minimum resolution of 0.05 microns detects the extremely small amount of shaft twist that occurs between only 70mm of the shaft.

The metal strip stretched between point A and point B continuously vibrates at the natural frequency determined by the tension of the metal strip. The vibration is caused by the excitation force of the magnet coil and the amplifier. Distance "L" between the ends A and B changes in accordance with changes in shaft torsion. Accordingly, the tension of the strip and this causes the natural frequency, which depends on the tension, to change.



High Accuracy

Sensor sensitivity determination accuracy : +/-0.15%

Perfect Reproducibility

Sensor sensitivity characteristics are semi-permanently unchanged

High Durability

Metal strip used for sensors has excellent repeated stress characteristics

Composition of SEC Shaft Horsepower Meter

SEC shaft horsepower meter is basically composed of a detector ring attached on the intermediate shaft, a contactless power supply unit that supplies the power to vibrate the metal strip of the torsion sensor and to transmit the sensor signal, and the data processing display unit that calculate and display Shaft horsepower and shaft torque based on the shaft speed signal and the sensor signal.

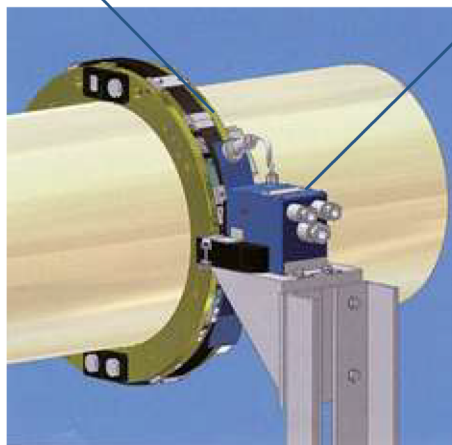
The SEC shaft horsepower meter can also be installed on the service vessel. For in-service vessels, installation at the port of call is also available.

Detector Ring

- **Tolerance of dimension of detector ring** : +/-0.5mm
- Measuring shaft diameter Minimum 50mm~Max. 1000 mm
- Available to install in narrow space (Shaft length 200mm or more)
- Installation space on the shaft 160mm + Service space (About 50mm)
- Available to installed on the high-speed of shaft rotating vessel (Max 1200 min⁻¹)

Contactless Power Supply Unit

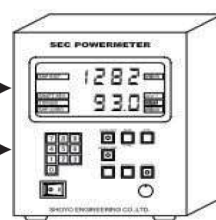
- Power supply to the sensor by the non-contact
- Transmission of the sensor signal by wireless
- Available Power supply voltage AC100~220V
- Attached Speed detector sensor (Proximity sensor or infrared photo sensor)



[Detecting parts]
Engine room

Shaft Torque

Shaft speed



[Display parts]
ECR

Data Processing Display Unit

- **LED type**: only display SHP(kW), Shaft Speed (min⁻¹), Torque(kNm)
- **LCD type**: can be display a performance curve, the related FO consumption and the other performance data
- Automatic input of zero point
- Selectable of the sampling time (20msec ~ 5sec)
- Available to communicate with the external devices
- Specification customizable upon request

Lineup of Data Processing Display Unit

LED TYPE

Shaft Horsepower Meter display for single shaft

SE002E



Dimension(mm) : W138xH98xD213
Weight (kg): 2.3

SE102E



Dimension(mm) : W138xH168xD262
Weight (kg): 2.8

SE102EV



Dimension(mm) : W138xH168xD262
Weight (kg): 2.8

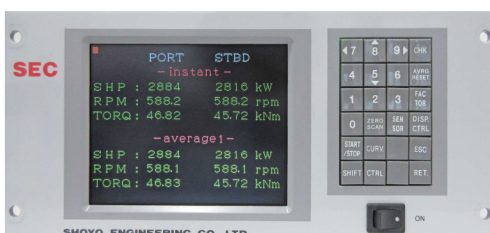


SE203E

Dimension(mm) : W252xH108xD272
Weight (kg): 4.3

LCD TYPE

Displayable Thrust Load Meter and Twin or more shaft



SE202C

Dimension(mm) : W280xH120xD343
Weight (kg) : 4.3

For the horsepower meter with twin shafts
Displayable Shaft Thrust load and FO consumption related data



SE203C

Dimension(mm) : W310xH136xD343
Weight (kg) : 6.0

For the horsepower meter up to triple shafts
Displayable Shaft Thrust load, FO consumption related data and
Engine combustion data

Specifications of Data Processing Display Unit

| Type | | SE0002E | SE102E | SE102EV | SE203E | SE202C | SE203C |
|---|--|--------------------------|--------------------------|--|--------------------------|--------------------------|--------------------------|
| Display Items | Display Type | Dual LED 4 digit | Dual LED 4 digit | Threefold LED 4 digit | Threefold LED 4 digit | 5.5 Inches TFT Color LCD | 6.5 Inches TFT Color LCD |
| | SHP(kW)5 sec ave. | Upper(constant) | Upper(constant) | Upper(constant) | Upper | ○ | ○ |
| | RPM(min ⁻¹)5 sec ave. | Lower(switch) | Lower(switch) | Middle(switch) | Middle | ○ | ○ |
| | Torque(kN)5 sec ave. | Lower(switch) | Lower(switch) | Middle(switch) | Lower | ○ | ○ |
| | SHP(kW)Auto ave.(1~240min) | Lower(switch) | Lower(switch) | Middle(switch) | Upper(switch) | ○ | ○ |
| | RPM(min ⁻¹)Auto ave.(1~240min) | - | - | - | Middle(swtich) | ○ | ○ |
| | Torque(kN)Auto ave.(1~240min) | - | - | - | Lower(switch) | ○ | ○ |
| | SHP(kW)Arbitrary ave.(max90days) | - | - | - | Upper(switch) | ○ | ○ |
| | RPM(min ⁻¹)Arbitrary ave.(max90days) | - | - | - | Middle(swtich) | ○ | ○ |
| | Torque(kN)Arbitrary ave.(max90days) | - | - | - | Lower(switch) | ○ | ○ |
| | Accumulated SHP(kWh)(max. 0.5 years) | - | - | - | - | ○ | ○ |
| | FO related data | - | - | - | - | ○ | ○ |
| | Performance data | - | - | Lower (Load rate[%]・ Δstress [MPa]swtich) | - | ○ | ○ |
| | Thrust Load data | - | - | - | - | ○ | ○ |
| | Performance curve / operating point | - | - | - | - | ○ | ○ |
| | Sensor Frequency(Hz2/Hz) | Upper(CH1) Lower(CH2) | Upper(CH1) Lower(CH2) | Upper(CH1) Middle(CH2) | Upper(CH1) Lower(CH2) | ○ ○ | ○ ○ |
| Self-checking function | | - | ○ | ○ | ○ | ○ | ○ |
| Measurement of Engine combustion Pressure | | - | - | - | - | - | ○ |
| Measurable shaft Number | | single shaft | single shaft | single shaft | single shaft | twin shafts | triple shafts |
| Output (5 sec ave) | Analog(DC4-20mA) | 3CH | 4CH | 4CH | 4CH | 4CH | 4CH |
| | Expandable Analog CH★ | × | 3CH | 3CH | 3CH | 12CH | 12CH |
| | Serial RS232C/422★ | ○ | ○ | ○ | ○ | ○ | ○ |
| Output (1Hz Instant) * | Analog(DC4-20mA) | × | ○ | ○ | ○ | ○ | ○ |
| | Serial RS232C/422★ | × | ○ | ○ | ○ | ○ | ○ |
| Input signal | Analog(DC4-20mA)★ | × | × | × | × | ○ | ○ |
| | Serial RS232C/422★ | × | × | × | × | ○ | ○ |
| | Dry contact★ | × | × | × | × | ○ | ○ |
| | NMEA★ | × | × | × | × | ○ | ○ |
| Power supply(AC100V or 220V) | | Multi | Multi | Multi | Multi | Multi | Single |
| Numeric key | | × | ○ | × | ○ | ○ | ○ |
| Dimmer switch | | ○ | ○ | ○ | ○ | × | ○ |
| Power switch | | rear | front | front | front | front | front |

*For 1Hz output specs, the dedicated module should be embedded in the display unit and it is required to modify the detector ring and contactless power supply unit.

★Optional

SEC Shaft Horsepower Meter

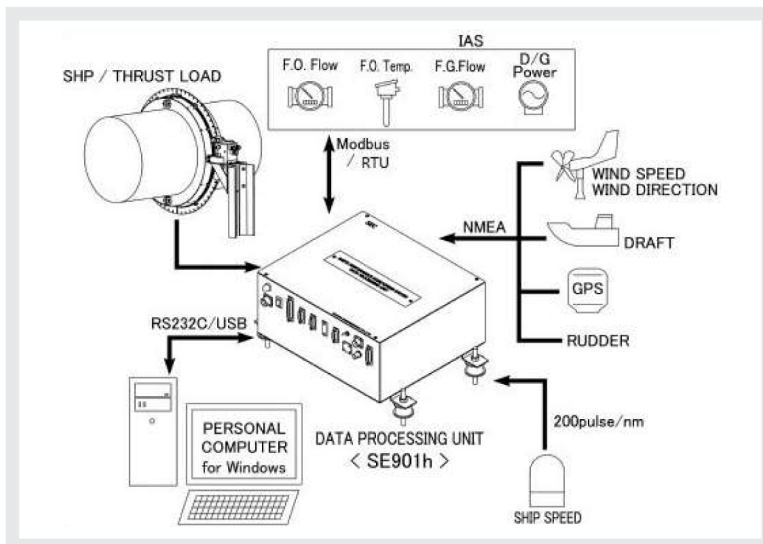
SEC Shaft Thrust Load Meter

SEC Engine Combustion Pressure Sensor

SEC Ship Performance Monitor

The shaft horsepower meter and shaft thrust load meter data and various operation data are integrated and managed collectively. The SEC has a data processing unit SE901h that does not have a display monitor, and a PC monitor is used for all data display. PC dedicated software that can log and analyze the performance data is installed. Among our display unit, SE203C has the same function.

System configuration of the use for Data processing unit SE901h



SEC Shaft Horsepower Meter Signal

- ☐ Shaft Horsepower
- ☐ Shaft Thrust Load
- ☐ Shaft Speed
- ☐ Shaft Torque

Input signal from external devices

- 1) Modbus : FO Flow, FO Temp, FG Flow, G/E output
- 2) NMEA : Wind direction/speed, Draft, GPS, Rudder angle
- 3) Pulse : Ship speed

Output signal to external devices

- 1) To IAS by Modbus
- 2) To PC by RS232C or RS422

Dedicated Logging software for PC

Install the dedicated software on PC and connect the PC to the data processing unit with a USB converter cable. Data is sent from the data processing unit every 5 seconds. A single file is saved in CSV file format from the start to the end of measurement, and a folder is created for each date. It is possible to output Daily Report and Noon Report for 24 hours from any specified time.

| SEC PERFORMANCE MONITOR | | | | | | |
|-----------------------------------|---------|-----------------------------------|--------------|--------------|--------------|--------------|
| | PORT | | | STARBOARD | | |
| | Instant | Auto average | Man. average | Instant | Auto average | Man. average |
| Shaft Power(kW) | 10372 | 10359 | 10313 | 10745 | 10765 | 10774 |
| Shaft Speed(rpm) | 69.3 | 69.3 | 69.3 | 68.7 | 69.0 | 69.1 |
| Torque(kNm) | 1430 | 1429 | 1422 | 1494 | 1489 | 1489 |
| Thrust(kN) | 906 | 903 | 899 | 994 | 982 | 983 |
| Reset Auto Ave. | | | | | | |
| | No.1 | No.2 | No.3 | No.4 | | |
| Electric Power(kW) | 6205 | 6202 | 6201 | 6199 | | |
| FO Flow(ltr/h) | 1367 | 1370 | 1354 | 1364 | | |
| FO consumption(Kg/h) | 1259 | 1262 | 1243 | 1255 | | |
| FG consumption(Kg/h) | 0 | 1 | 0 | 0 | | |
| FO Temperature(deg) | 117 | 117 | 121 | 118 | | |
| Total Equivalent Fuel Flow (kg/h) | 5020 | FO Corrected Density(kg/dm3) | | 0.920 | | |
| Plant Performance(g/kW.h) | 233.8 | Hydro Dynamic Performance(m/kW.h) | | 1.780 | | |
| Overall Ship Performance(Nm/ton) | 4.04 | FG Flow to GCU(kg/h) | | 1 | | |
| Ship Speed(knot) | | | | | | |
| | Log | 20.30 | GPS | 20.66 | | |
| Draft(m) | Forward | 9.54 | After | 8.54 | Trim | F1.00 |
| Depth of Water(m) | 125.6 | Latitude | | N 34.13.566 | | |
| Rudder Angle STBD(deg.) | P1.8 | Longitude | | E 128.58.806 | | |
| Rudder Angle PORT(deg.) | P1.2 | Heading(deg.) | | 20.1 | | |

PC System requirements

- OS :
Windows 10/8.1 / 7
(Japanese or English version)
- Memory:
2GB (64 bit) 1GB (32bit) or over
- Hard Disk:
400MB or over

SEC Shaft Horsepower Meter for temporary use

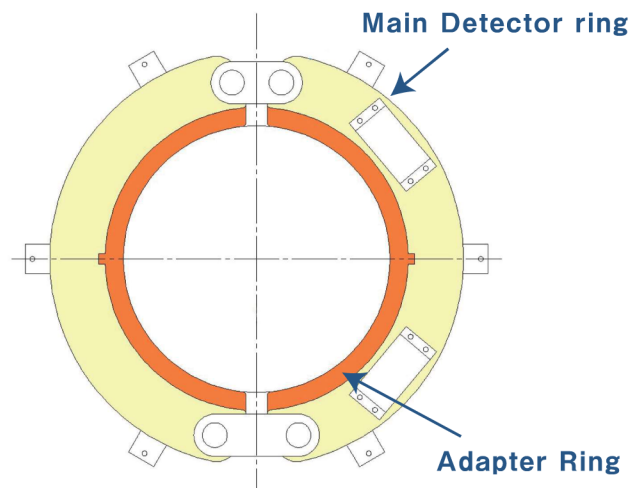
SEC shaft horsepower meter can be used for the temporarily measurement at sea trial.

By combining an adapter ring with the main ring, the measurements can be made on multiple ships with different shaft diameters.

Rental is also available for measurement only during sea trial.

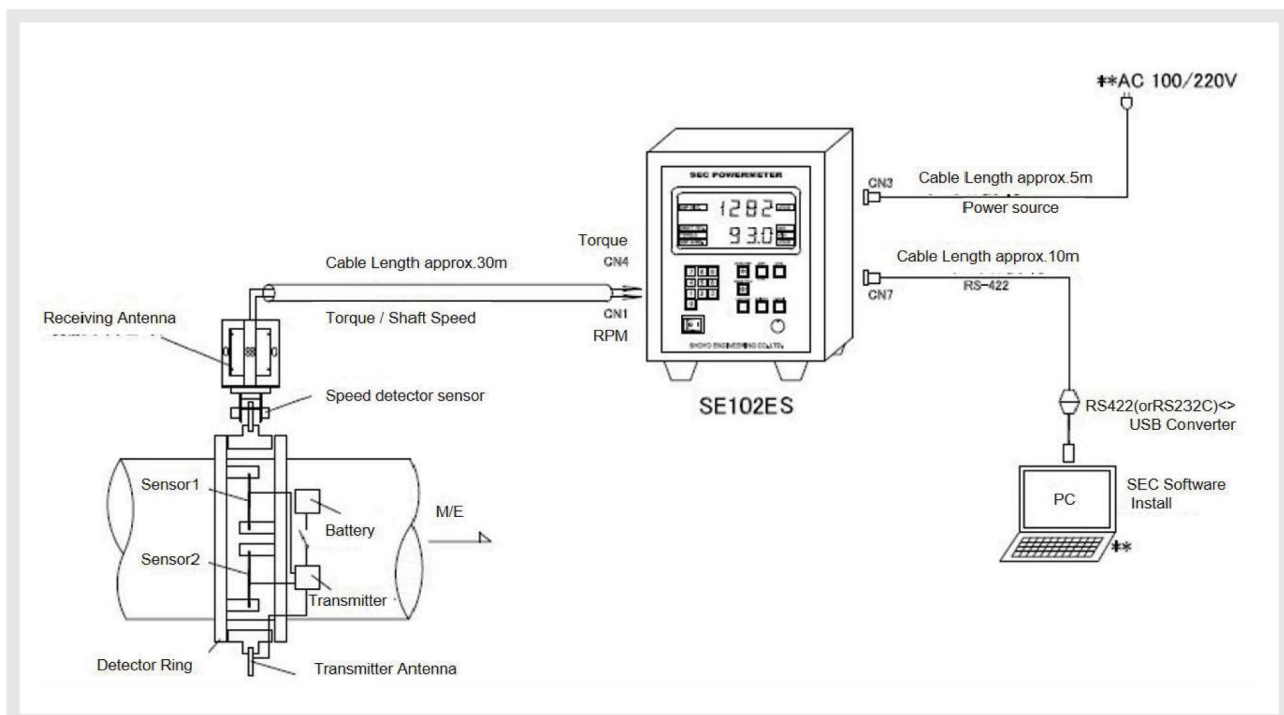
Feature of temporary use

- ▶ Measurable on multiple ships by changing the adapter ring in the range of shaft diameter $\pm 35\text{mm}$
- ▶ Sensor driven by battery (9V battery)
- ▶ Easy mounting of antenna unit
- ▶ Data logging is possible with SEC dedicated software
- ▶ Data sampling according to ISO15016: 2015 (1 second instant) is possible



Shaft Horsepower Meter for temporary use

System configuration sample



SEC Shaft Thrust Load Meter

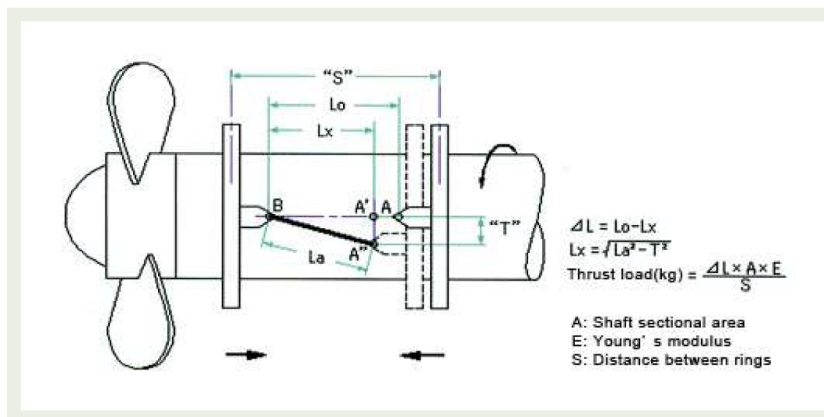
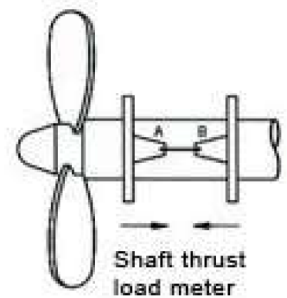
What is shaft thrust load meter? :

The shaft thrust load meter measures the shaft compression (longitudinal) strain caused by propeller propulsion.

SEC Shaft Thrust Load Meter

SEC shaft thrust load meter can detect extremely subtle compression strain of the shaft with a high sensitivity displacement sensor which has a minimum resolution of 0.025 microns.

The shaft thrust load can be measured with high accuracy by correcting shaft torsion based on torque data obtained from the SEC shaft horsepower meter.



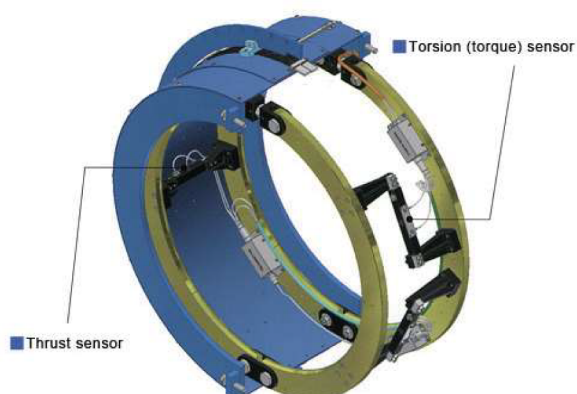
As shown in the above figure, the rotating shaft contains both compression strain proportional to the propulsive force and torsion generated proportionally to the torque. In order to measure the true compressive strain (ΔL), it is necessary to know the torsional component "T". "T" is calculated from the torque data of the shaft horsepower meter. Therefore, a shaft horsepower meter is indispensable for the SEC shaft thrust load meter.

Type of Shaft Thrust Load Meter

There are three types of SEC Shaft thrust load meter: **Combined type** that measures the torsion and compressive strain on the shaft using a single detector ring, **Separate type** that measures shaft horsepower and shaft thrust with separate rings, and **Temperature correction type** that added a temperature correction feature to the separate type.

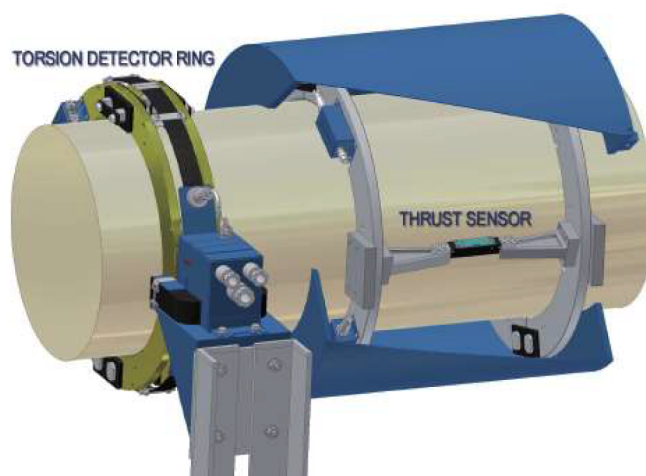
Combined type

Measure the torsion and compressive strain on a single detector ring



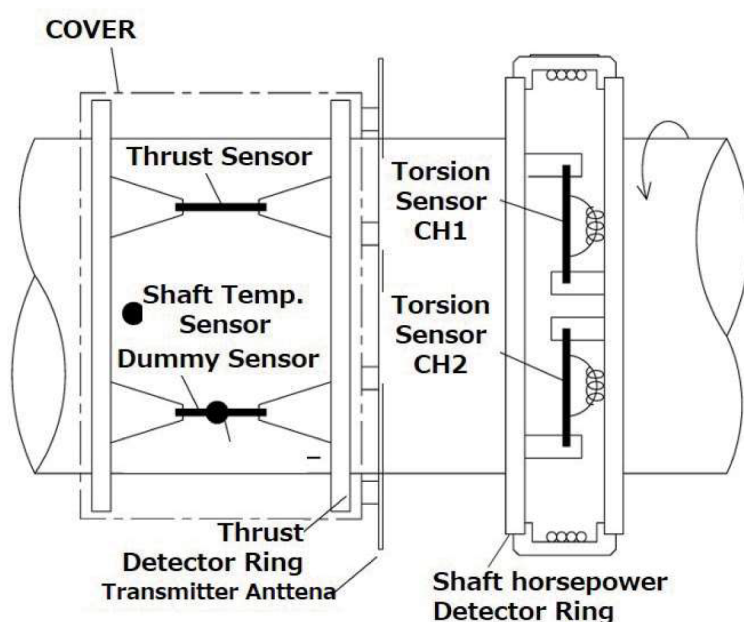
Separate type

Measure the shaft horsepower and shaft thrust load with the separate detector ring.



Temperature correction type

Add the temperature correction feature to the separate type and measure with the higher accuracy.



The linear expansion coefficient between the metal strip of the thrust sensor and the shaft is very similar, but if there is a temperature difference between them, a measurement error will occur. Therefore, a temperature sensor is equipped each on the shaft and the sensor strip, and the sensor strip vibration frequency is corrected from the resulting temperature difference.

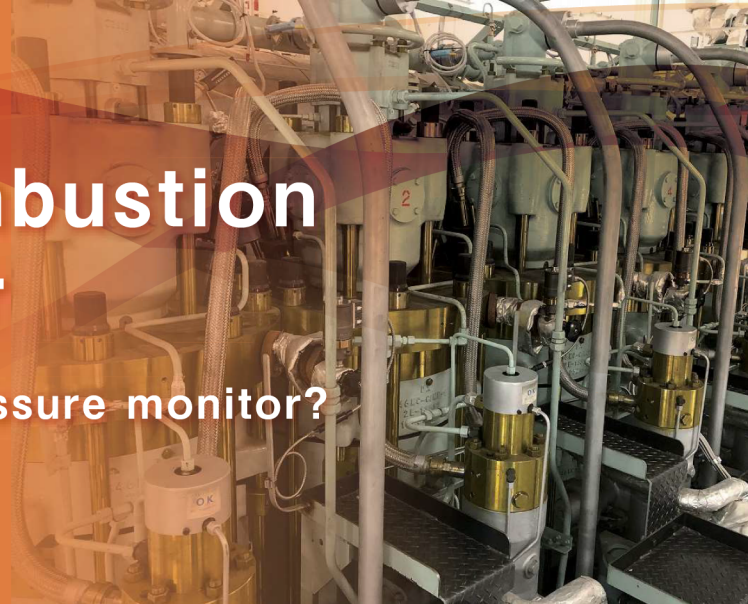
Measuring accuracy and Installation space

| Type | Measuring accuracy | Installation space |
|-----------------------------|-----------------------|---|
| Combine type | +0.5%, -2.5% or under | 500~600mm (incl. service space) |
| Separate type | +0.5%, -1.5% or under | 1,100~1,200mm (incl. detector ring of shaft horsepower meter and service space) |
| Temperature correction type | +0.5%, -0.5% or under | 1,100~1,200mm (incl. detector ring of shaft horsepower meter and service space) |

SEC Engine Combustion Pressure Monitor

What is engine combustion pressure monitor?

To monitor all processes of engine cylinder pressure and combustion pressure.



SEC Engine Combustion Pressure Monitor

SEC engine combustion pressure monitor detects with the pressure sensor which is replaced the engine cylinder presser with the change in the natural frequency of the metal strip.

It is possible to monitor visibly by displaying the drawing such as P-Theta or P-V drawing. It is also possible to measure all the cylinder simultaneously and constantly and can be monitored by every cylinder and every hours.

System configuration of Engine Combustion Pressure Monitor

SEC pressure monitor presents two type of configuration.

One is that all cylinder are equipped with a pressure sensor that can operate continuously, measuring the internal pressure of all cylinders simultaneously.

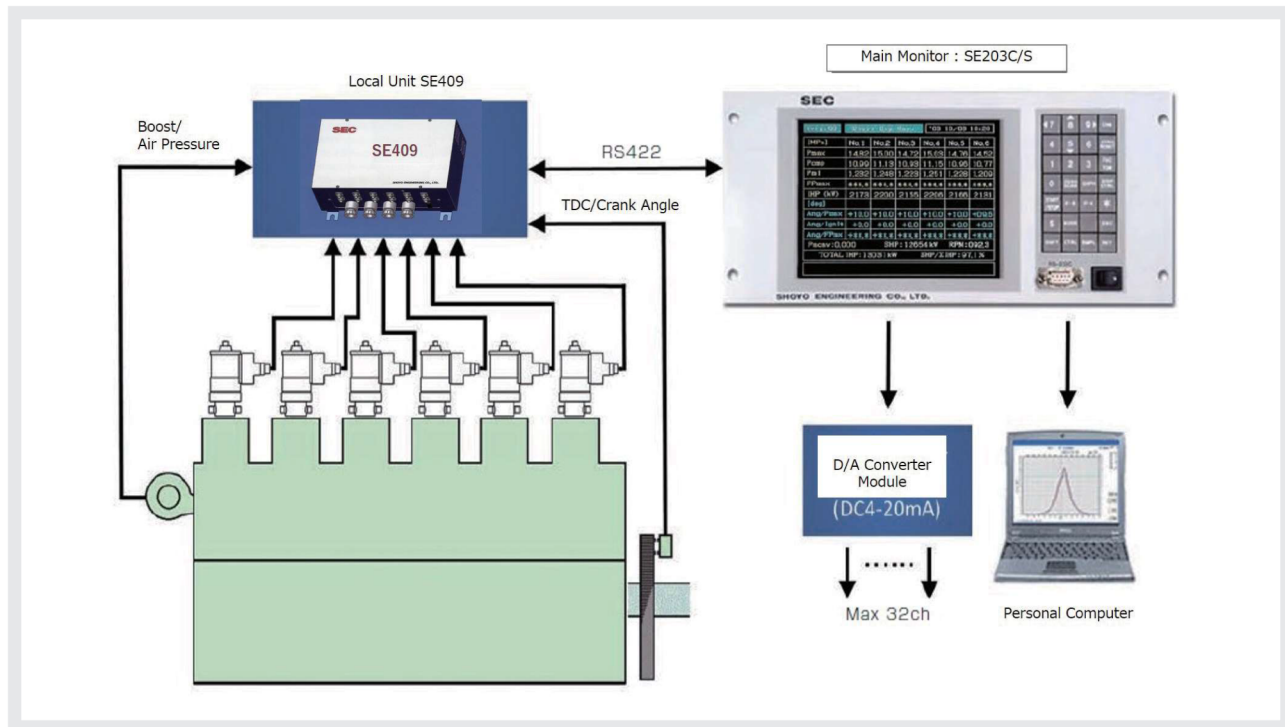
Another is that to measure each cylinder sequentially with a single pressure sensor.

SEC system consists of a combustion pressure sensor mounted on each cylinder, a local unit (SE409) near the engine and a main monitor (SE203C/S) located in the engine control room.

Feature of SEC Engine Combustion Pressure Monitor

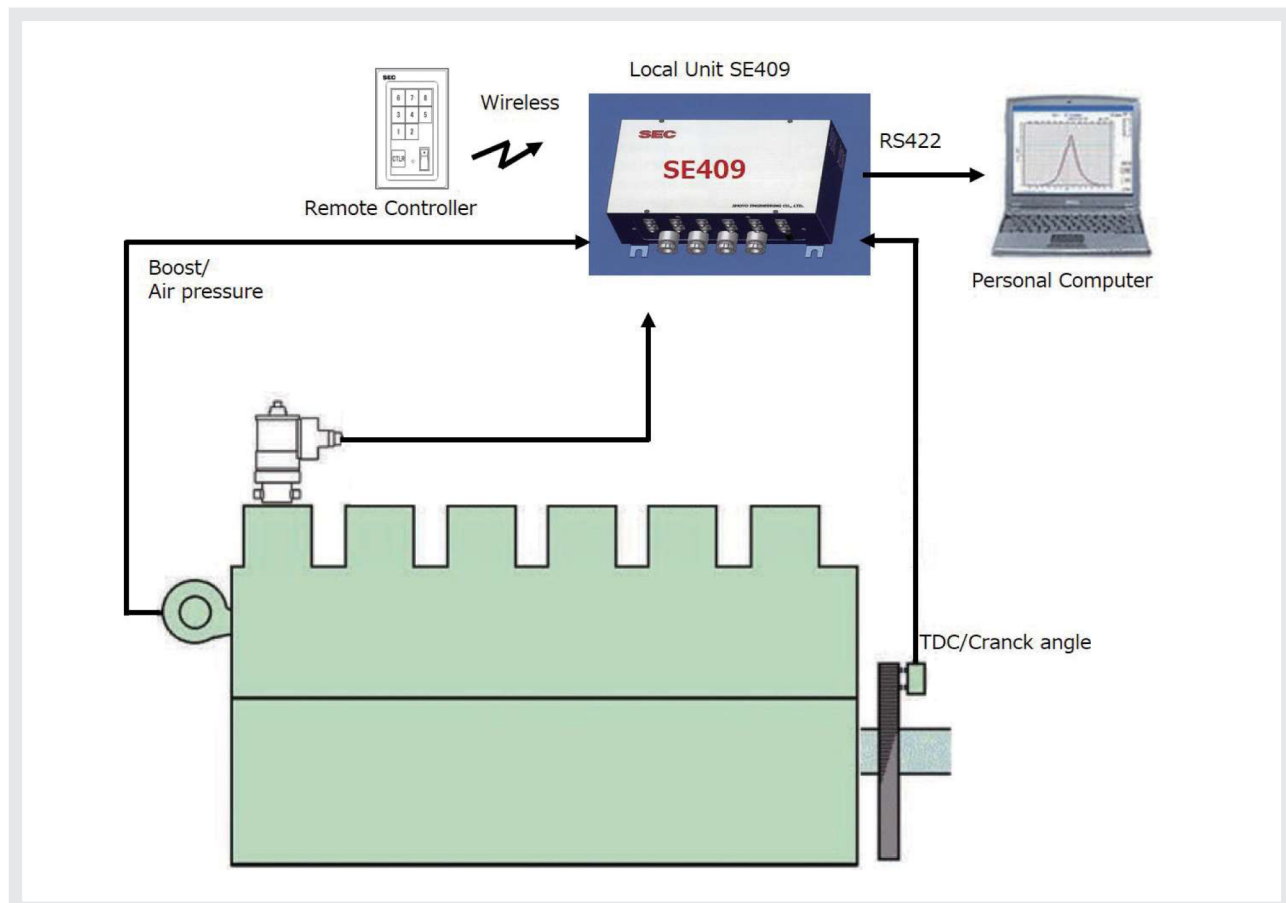
- ▶ Can be installed on Diesel or GAS engine (2 or 4 cycle)
- ▶ Simultaneous measurement up to 18 cylinders
- ▶ Crank Shaft Speed: up to 1,000rpm
- ▶ Sampling of Crank Angle: 2 cycle every 0.25 degree / 4 cycle every 0.5 degree
- ▶ Measuring accuracy: +1.2%, -0.5%

Configuration of all cylinder measurement type



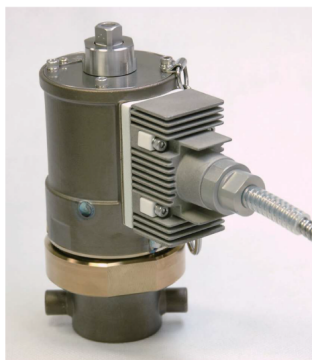
※The local unit can be connected to PC directly without interfacing with the main monitor SE203C/S

Configuration of individual cylinder measurement type



※To measure each cylinder sequentially to specify the cylinder number with the wireless remote controller. The distance between the local unit and the remote controller is allowed up to 30m.

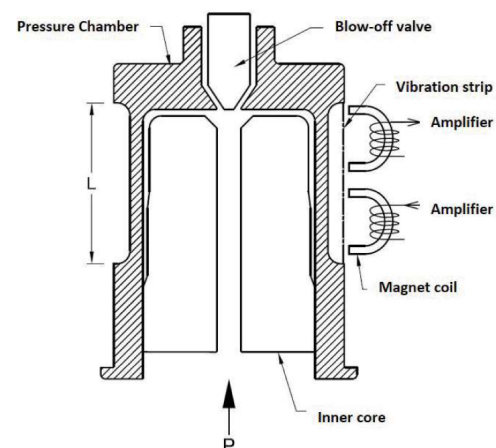
Combustion Pressure Sensor



The pressure receiving part of the SEC combustion pressure sensor is not a diaphragm structure, but a pipe structure that is closed at the top. A thin metal strip is attached a certain tension to the external surface of the pipe. The tension of the metal strip changes in accordance with pipe length (L), which changes under pressure. The metal strip vibrates under the excitement generated by the coil unit and the amplifier connected to the cable. Its vibration frequency is the natural frequency determined by the tension on the metal strip. As the length of the pipe (L) increase under pressure (P), the tension on the metal strip increases, thus causing the natural frequency to increase. Because there is a proportional relationship between the applied pressure and the natural frequency of the strip, it is possible to determined the pressure by measuring changes in the frequency of the strip's vibration.

Feature of Combustion pressure sensor

- ▶ Minimize the electrical component configuration used for the pressure sensor and increase reliability.
- ▶ The coil unit is mounted on a housing with cooling fins. The housing is fixed to the outer cylinder via a heat insulating material. This suppresses the temperature rise of the housing body and operates stably.
- ▶ Super stainless steel is used for the pressure-receiving cylinder and inner core to improve durability.
- ▶ By opening the valve on the top of the cylinder, it is possible to blow off the internal deposits, and it can be used semi-permanently by regular maintenance.



Local unit SE409

All actual measurements of engine combustion pressure are managed and performed by the local unit SE409. The unit is located in the engine room and the pressure sensor is connected to the unit directly.



Built-in modules and functions

Amplifier Module

Excite the each sensor's vibration strip

Measuring Module

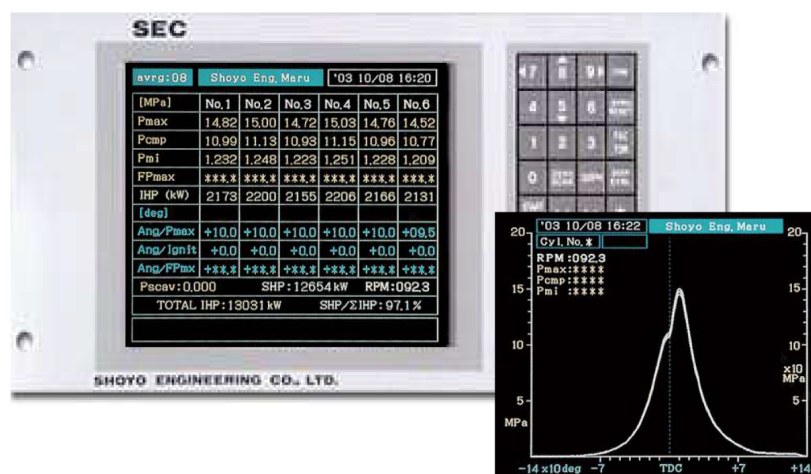
Scan sensor signal at every crank angle of 0.25/0.5 degree

Management Module

Collect and send all pressure data to the main monitor

Main monitor SE203C/S

Installed in the engine control room and connected to the local unit via RS422. Integrated with shaft horsepower meter, thrust load meter and other operational data, can be displayed in a batch.

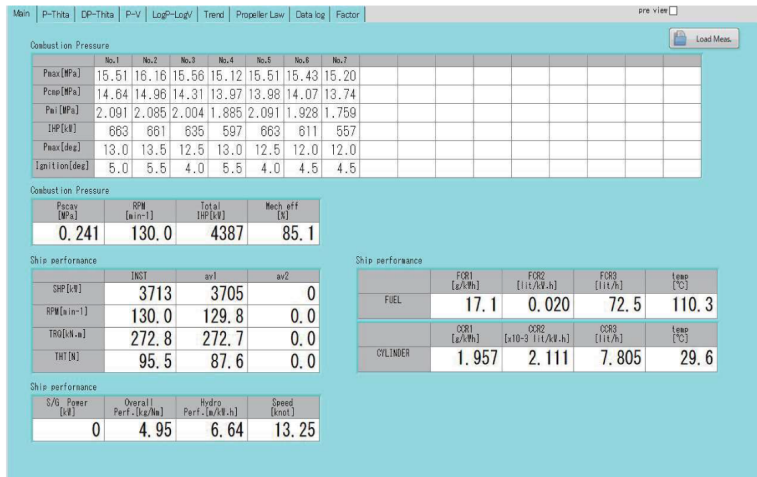


Data Logging Analysis Software

The display unit SE203C/S in the engine control room is connected to a personal computer, and combustion data can be logged and analyzed using dedicated software.

In the case of simultaneous measurement for all cylinders, the interval for continuous automatic measurement can be selected from 30 to 600 seconds. One measurement data file is created in CSV format for each measurement, and a folder is created for each date.

Screen sample of Software



PC System requirement

OS:

Windows 10/8.1 / 7

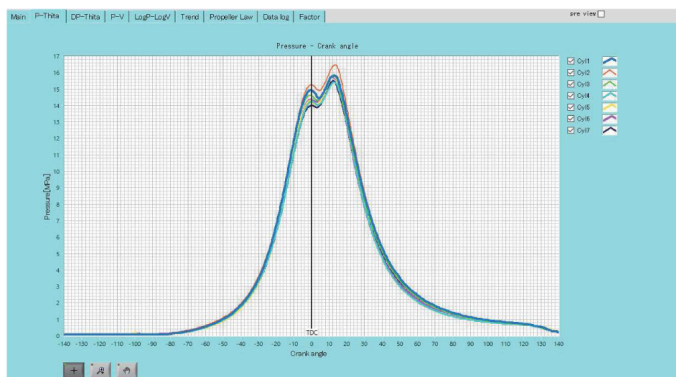
(Japanese or English version)

Memory :

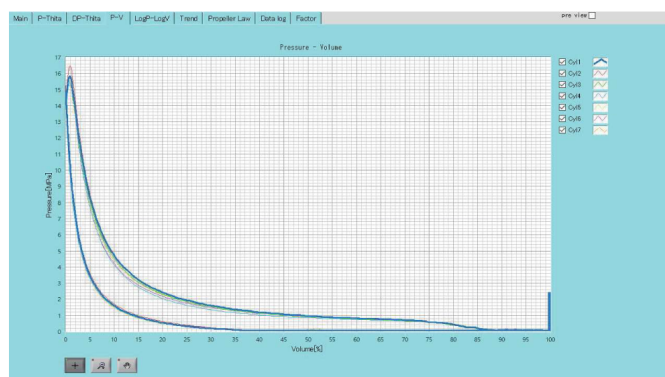
2GB(64bit) 、1GB(32bit) or over

Hard Disk :

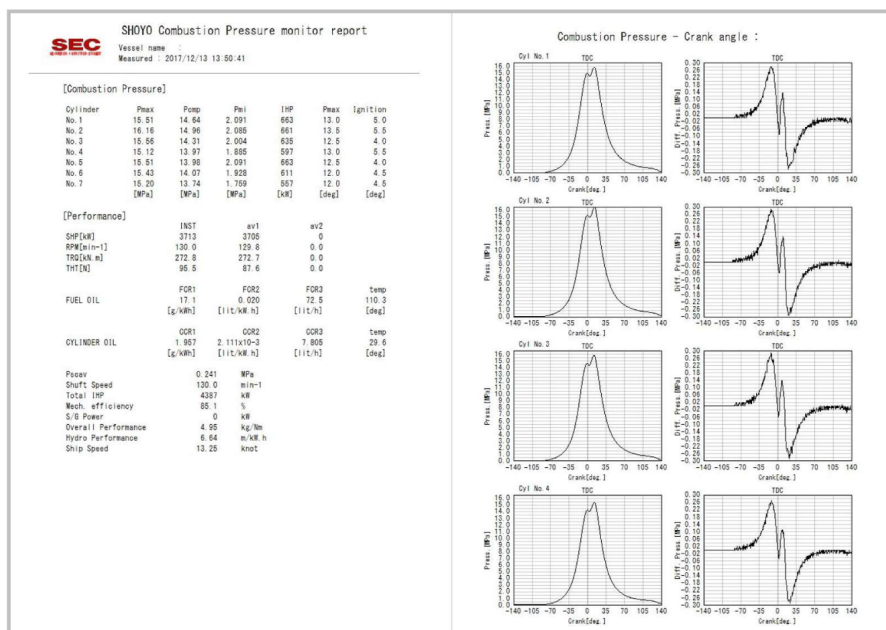
400MB or over



P-θ drawing



P-V drawing



Report



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