



VQ - Oracle



## Transforming Facility Maintenance

IoT, AI, Big Data

Continuing advances in information technology are transforming maintenance.

A human-managed age, in which people performed inspections and managed maintenance information, is transitioning to an age of AI management in which information is transmitted by things themselves and managed by AI.

OKANO VALVE's Industry 4.0 developments realize VQ (VALVIQUITOUS) and ORCL (VQ-ORCL) as the advancing products that continue to be updated.

ORCL embodies all the facility maintenance know-how, diagnostic technologies, and the latest in information technologies accumulated by OKANO VALVE over the course of a century.

It transforms the precision and efficiency of facility maintenance.





# Technology

## Analyzing the Health of Electrically Powered Equipment Based on Precise Information

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The technology underlying ORCL grasps the state of a motorized equipment by measuring, converting, and analyzing current and voltage in the equipment as it operates.

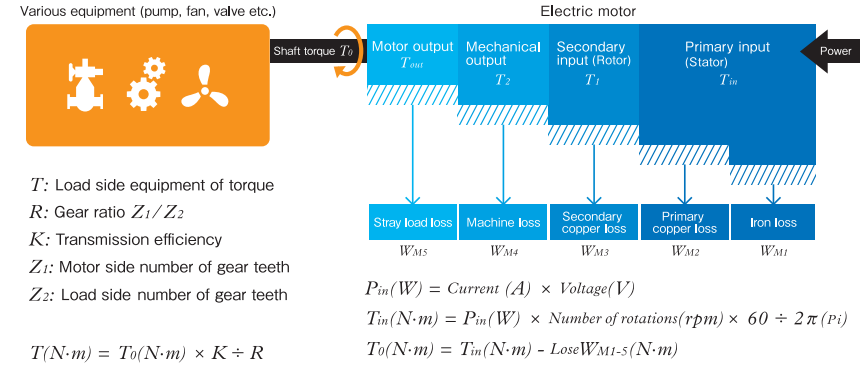
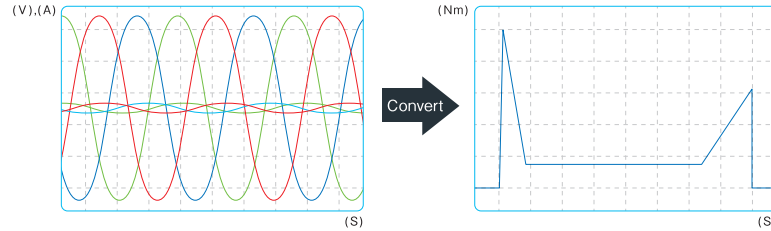
This approach, which seeks to tune into the “inner voice” of the equipment, allows the acquisition of precise information on equipment health.

Two types of analysis, torque analysis and FFT analysis, constitute the core analysis of the acquired information.

## 1. Torque analysis

Torque analysis converts the current and voltage in the equipment as it operates into generated torque.

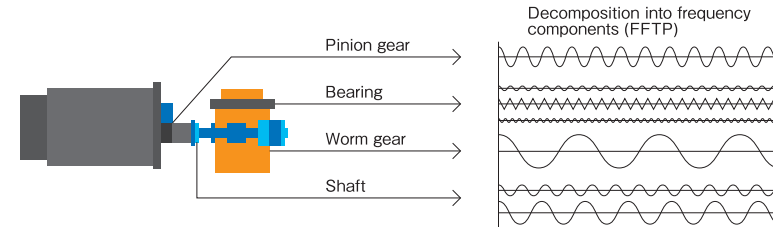
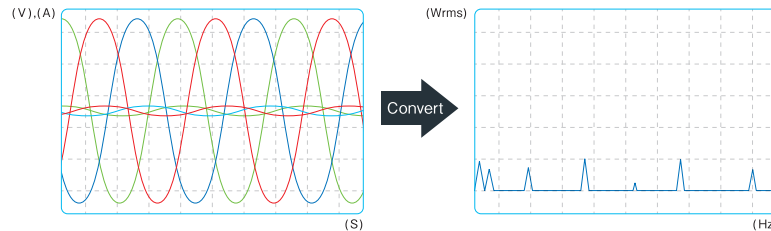
The behavior of the torque generated is analyzed to grasp of the loads generated in the equipment and determine whether the equipment has defects.



## 2. FFT analysis

Equipment's power consumption is driven from the measured current and voltage. Using Fast Fourier Transform, the time waveform of the power consumption is converted to FFT spectrum.

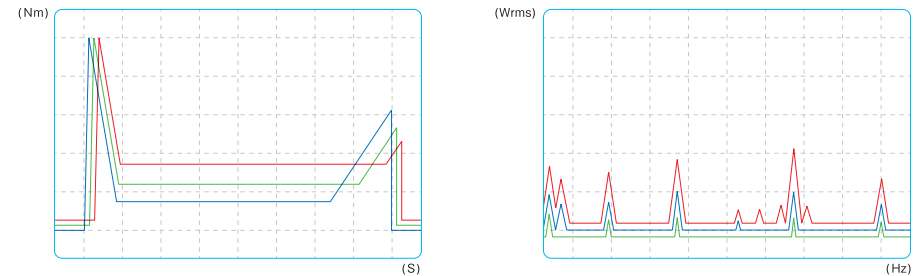
Each component in the equipment have an associated frequency, by analyzing the FFT spectrum, abnormalities and defects can be identified.



$$F(t) = \sum_{x=0}^{N-1} f(x) e^{-j \frac{2\pi t x}{N}}$$

## 3. Trend monitoring

ORCL allows quantitative single-diagnosis analysis of equipment health. Comparisons of the latest information to a history of information obtained through periodic diagnostics makes it possible to identify even minor changes in equipment tendencies and further enhances maintainability.



# Advantage

## Efficiency & Functionality

OKANO VALVE has been active  
in the field of machinery maintenance for a century.  
ORCL's development is characterized  
by the pursuit of ultimate in usability.

ORCL meets user needs in every phase:  
planning, measurement, diagnosis, and management.

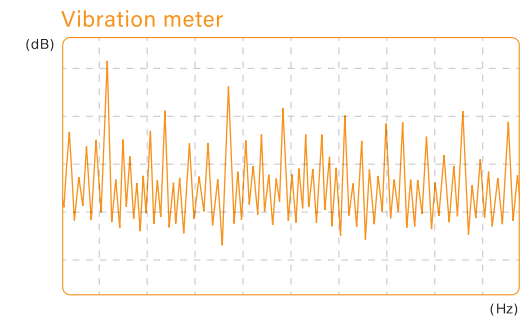
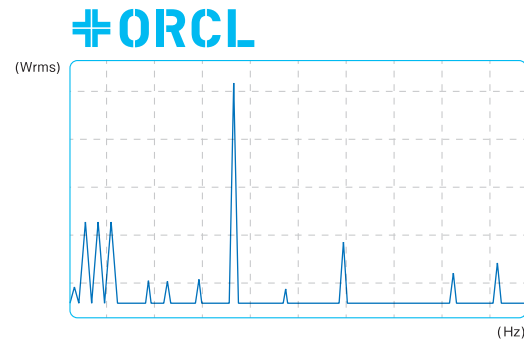
Experience the innovative world of ORCL.  
Open the door to the next generation in maintenance technologies.

## Advantage

### 1. Measurement that doesn't require expertise

The vibration measurements typically used for machine diagnostics are hard to perform for unskilled personnel without workmanship / know-how.

In contrast, ORCL requires no measurement skills and allows the reliable collection of precise diagnostic information.



### 2. Automated analysis

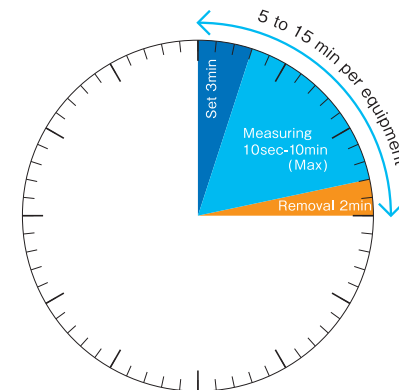
ORCL software converts measurements into information an analyst can understand.

Nearly all analytical processes are automated, minimizing errors associated with human operators and inconsistencies in analytical conclusions and ensuring consistent, high-quality, diagnostic information.



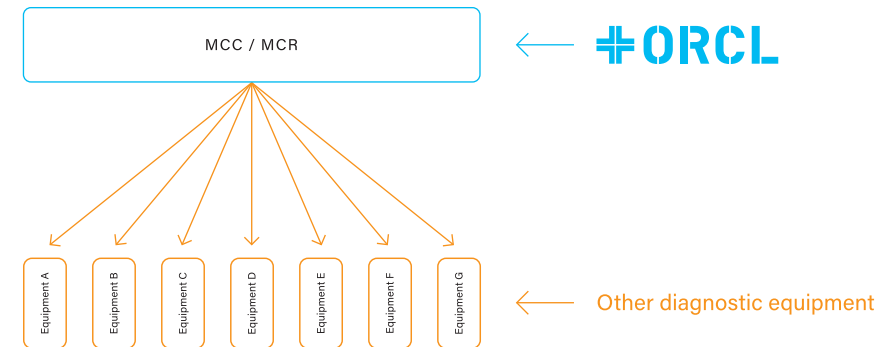
### 3. Simple, time-efficient measurements (5 to 15 minutes per equipment)

To deploy ORCL, simply connect a few terminals. ORCL quickly gathers current and voltage data. Measurement time per equipment is approximately 5 to 15 minutes — significantly faster than other diagnostic technologies or inspections involving disassembly.



### 4. Remote measurement for enhanced safety and efficiency

ORCL doesn't require a local operator. Operators can perform measurements at any location where equipment current and voltage can be monitored, for example, a Motor Control Center (MCC) or Main Control Room (MCR). An operator working at a central hub for electrical wiring information — an MCC or an MCR — can measure multiple equipment simultaneously in safe environment.

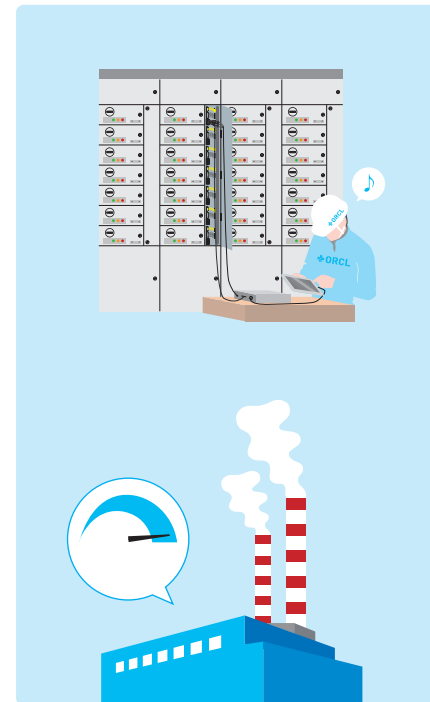


### 5. Minimizing the need for disassembly enhances efficiency and reduces risk

ORCL makes it possible to grasp the state of an equipment to an extent that previously required disassembly. Compared to health checks involving disassembly and inspection, ORCL offers significant time and cost savings. And minimizing the need for disassembly eliminates the risk of damage due to the disassembly process itself.

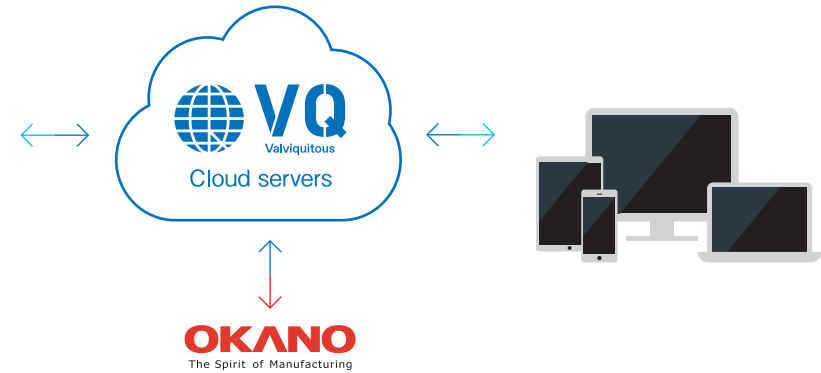
### 6. Diagnostics without shutting down the plant or the equipment

This streamlined approach to remote measurement allows plant and equipment diagnosis without shutting down the plant or turning off an equipment. Investigating potential defects and condition monitoring no longer means shutting down a plant or switching off an equipment. That, in turn, means higher productivity.



### 7. Next-generation maintenance with connections to VQ

Synchronizing information stored in ORCL with the VQ ( VALVIQUITOUS ) information management system developed by OKANO VALVE allows detailed analysis, ubiquitous information management, and many other services.



### 8. Hardware and software, results of pursuit of functionality and exterior appearance

ORCL measures 330 mm (Width) × 204 mm (Depth) × 66 mm (Height) and weighs 1.7 kg. Its portability adds to its ease of use.

A tablet interface and a sophisticated software package make ORCL ideal for use by anyone, including analysts, managers, and technicians.

An attractive exterior design, an aspect typically neglected in the field of industrial instruments, further enhances the functional appeal of ORCL.



# Operation

## A Wide Range of Service Lineups

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ORCL isn't just a diagnostic instrument.

It's part of an overall maintenance system based on the ORCL diagnostic instrument.

Users have different outsourcing needs and practices.

ORCL offers service lineups tailored to user needs.

This gives customers the flexibility to choose the services they need.

### Packaged plan

#### Comprehensive service plan

The customer contracts with OKANO VALVE to handle all maintenance for an equipment or a group of equipment.

The customer simply determines whether to accept specific proposals.

This approach can minimize management costs associated with facility maintenance.

#### Total service plan

The customer contracts with OKANO VALVE to handle ORCLbased facility diagnostics.

This eliminates the need to purchase diagnostic instruments.

OKANO VALVE recommends this plan if the customer is considering introducing ORCL or for trial use of ORCL.

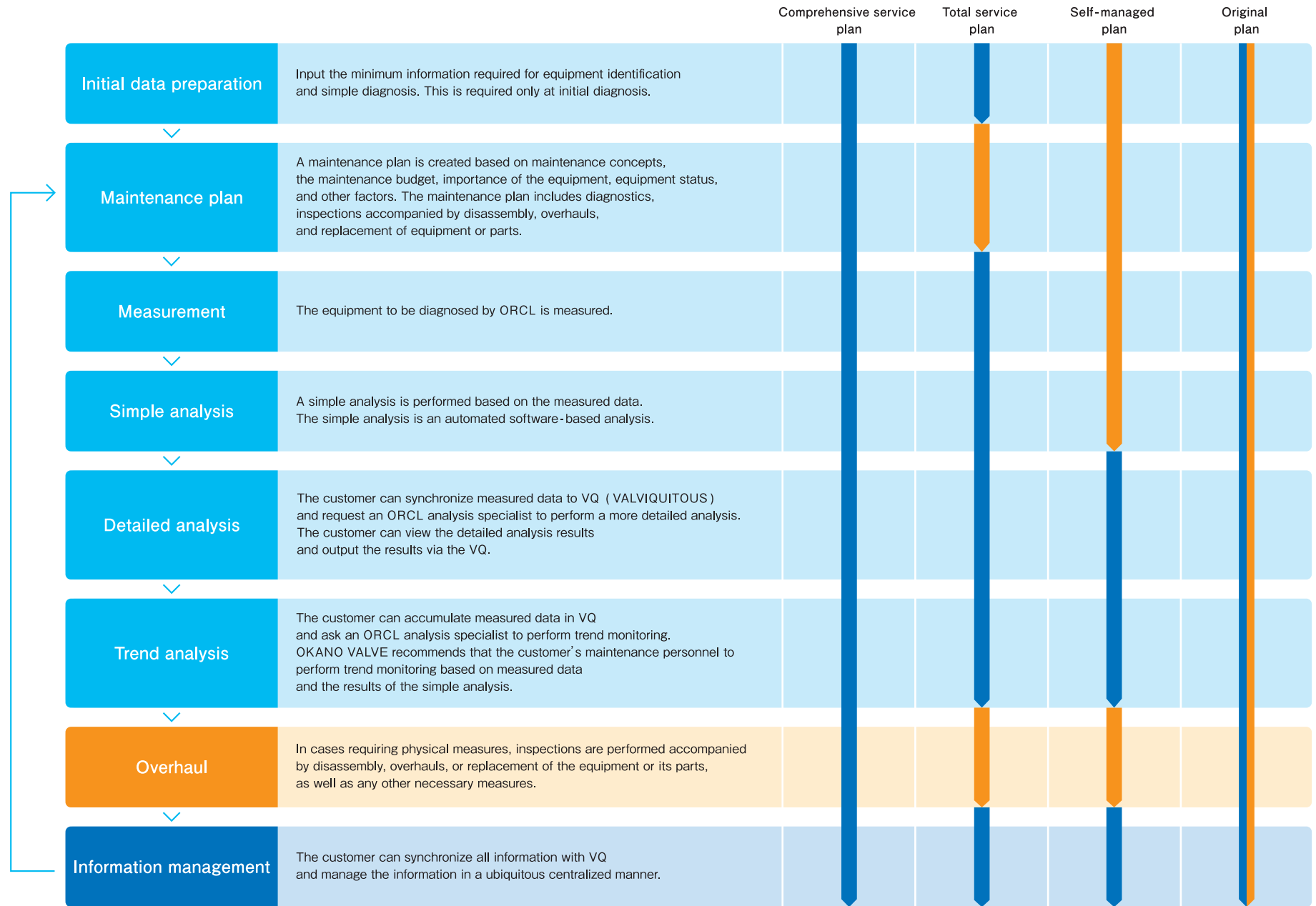
#### Self-managed plan

Under this plan, the customer is responsible for measurements and simple analysis using ORCL, leaving only detailed analysis and trend analysis to OKANO VALVE.

This plan gives the customer flexibility and choice in using ORCL diagnostic technologies based on the customer's current maintenance cycle.



## Operation



Carried by OKANO Carried by Customer

# Operation

## Initial data preparation

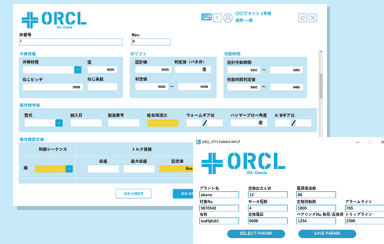
### Step1.

Power on the tablet terminal, activate the ORCL application, and proceed to the equipment information input screen.



### Step2.

Referring to the equipment specifications, enter each required item and save.



\*Of the required inputs, 13 involve the motorized valve (ORCL\_MOV.app), while 8 involve other equipment (ORCL\_FFT3.app, ORCL\_FFT1.app).

### Step3.

Synchronize the ORCL application with VQ (VALVIQUITOUS) to complete the initial data preparation.

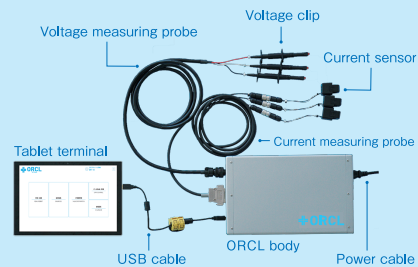


\*VQ synchronization allows the customer to back up all equipment information and diagnostic information; receive various types of additional services; and view information on various IT devices.  
\*ORCL users can access certain VQ functions at no charge.

## Measurement

### Step1.

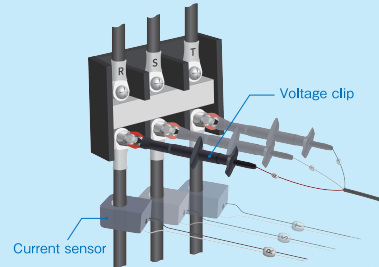
Carry ORCL in its carry case to an MCC or an MCR, and connect the ORCL hardware main body to the targeted equipment.



\*ORCL-1 requires an AC 100 to 240 V power supply.  
\*No voltage measuring probe is required for FFT3 or FFT1.

### Step2.

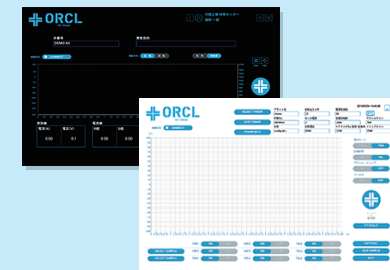
Attach the ORCL sensors and clips to the power cable of the targeted equipment (e.g. at the MCC).



\*For the ORCL-2, attach just the current sensor to the power cable.

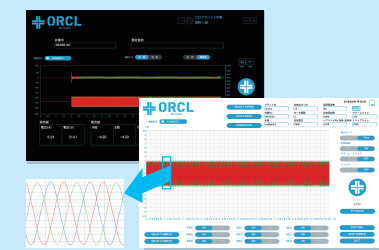
### Step3.

Launch the ORCL application on the tablet, select to measure the targeted equipment, and proceed to the measurement standby screen.



### Step4.

Operate the equipment to begin the measurement. Press the Stop button on the screen when the measurement is finished.

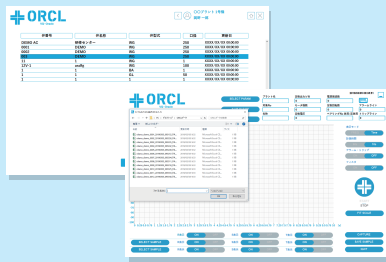


\*The measured data is saved automatically.  
\*Note that measurement procedures vary slightly depending on the ORCL application.

## Simple analysis

### Step1.

Launch the ORCL application on the tablet terminal and select a simple analysis for the targeted equipment.



\*In a case where the simple analysis is performed immediately after the measurement, the step 1 is not carried out.

### Step2.

Check the results of the analysis provided by the AI (algorithm-based) based on the measured data and equipment information data.



\*The ORCL\_FFT3 and ORCL\_FFT1 lack this function.  
\*The analysis results can be output to a report.

### Step3.

Specific details are checked and the customer's own analysis performed based on torque waveforms, FFT data, and other quantitative measured data.



### Step4.

Synchronize the ORCL application with VQ to complete the simple analysis.



\*VQ synchronization allow the customer to back up all the equipment information and diagnostic information; receive various additional services; and view information on various IT devices.  
\*ORCL users can access certain VQ functions at no charge.

## Detailed analysis

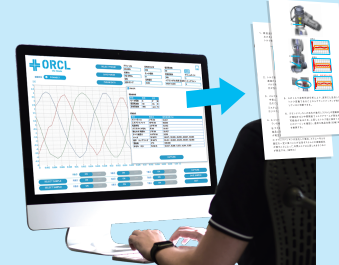
### Step1.

Access VQ via the tablet terminal or other IT terminal and request a detailed analysis.



### Step2.

An ORCL analysis specialist at OKANO VALVE will perform a detailed analysis and send a completion notification when the detailed analysis is complete.



### Step3.

Check the results of the detailed analysis uploaded to VQ.



### Step4.

Call OKANO VALVE for any other services, including a review of details and consultations on approaches to maintenance.



**OKANO**  
The Spirit of Manufacturing

# Future Expandability

## From Intermittent Condition Monitoring to True Condition Monitoring

Diagnosis performed periodically or diagnosis that begins after an equipment defect risk is identified isn't condition monitoring in the true sense.

True condition monitoring means that the equipment itself continues to transmit condition information around the clock, while AI manages the condition information thus transmitted. ORCL has realized the technical basics required for true condition monitoring.

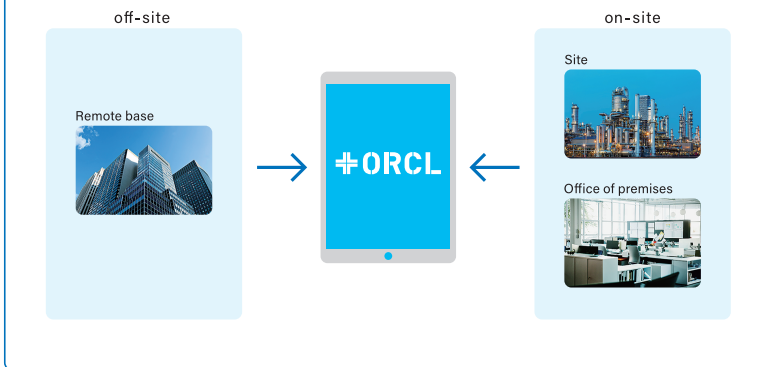
This is the culmination of technologies often discussed to date and already realized in certain other industries.

## ORCL - on line

Deploying permanent ORCL (ORCL-on line) makes it possible to build leading-edge maintenance environments. Various approaches are available for introducing ORCL-on line, ranging from deploying ORCL as an embedded component in newly built plants, when replacing equipment, or adding ORCL to an existing equipment.

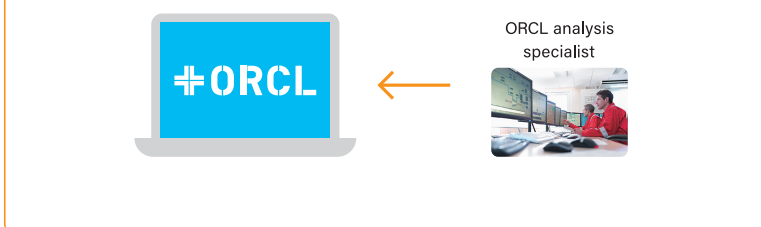
## User

### Condition monitoring

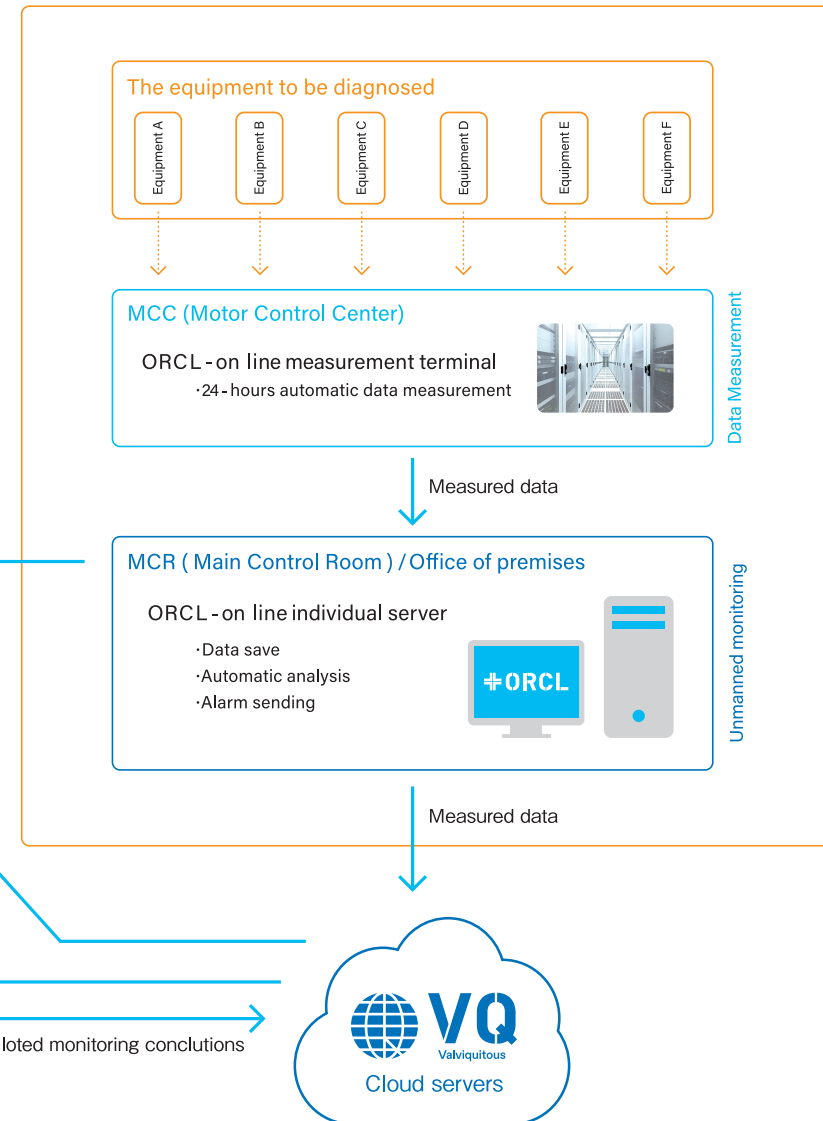


## OKANO

### Piloted monitoring



## Plant(Factory)



## Hardware

### ORCL-1

Flagship model capable of torque and FFT measurements

● Silver ● Black ○ White



### ORCL-2

Light-duty model that focuses on FFT measurements in a compact unit and at a lower price point

\*Under development



## Software

### ORCL\_MOV.app

This motorized-valve-dedicated application is equipped with measurement functions based on ORCL-1. It features a torque data display; FFT data display; data management; and simple, automatic AI-based diagnostic functions.



### ORCL\_FFT3.app

Intended for use with fully electrically-powered equipment, this application enables measurement operation functions based on ORCL-1. It features an FFT data display and data management functions (lacks torque data display and automatic diagnostic functions).



### ORCL\_FFT1.app

Intended for use with fully electrically-powered equipment, this application enables measurement operation functions based on ORCL-2. It features an FFT data display and data management functions (lacks torque data display and automatic diagnostic functions).  
\*Under development



\*Software functionality can be expanded based on customer and diagnostic needs in the future.

## Data information

### ORCL-1

Flagship model

Hardware	
Size	W330mm × D204mm × H66mm
Mass	1.7kg
Measuring range	Voltage MAX : AC484V Current MAX : AC100A
Measurement accuracy	Full scale(Effective value) less than $\pm 1\%$
Sampling rate	1kS/s
Data reduction technique	6CH simultaneous counting in real time Fast signal processing
Condition	Ambient temperature 0-50°C Relative humidity 85 (%) or less (No dewing)
Power source	AC100-240V

Supplied peripherals and accessories		
Tablet terminal	Windows Tablet [ ORCL_MOV.app / ORCL_FFT.app installed ]	1
Sensor	Current sensor (Small clamp type)	3
Clip	Voltage clip Hook type Pincer type Alligator type	3 each
L type plug	Voltage clip direction change plug	3
Cable	Voltage probe L 2150mm Current probe L 2150mm Power cable L 3000mm USB cable L 1500mm (For data communication)	1 each
Storage case	Attache case (Size : W420mm×D218mm×H375mm)	1
Carry case	Polyester tool bag	1

\*Windows is a registered trademark of Microsoft corporation in the United States and other countries.

### ORCL-2

Light model \*Under development

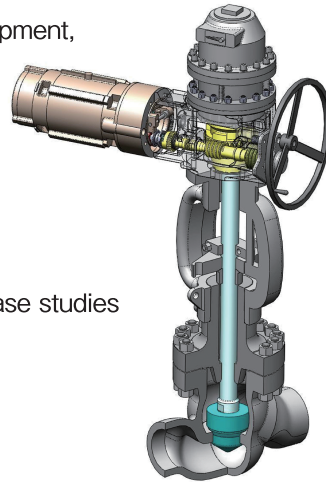
Hardware	
Size	*Under development
Mass	*Under development
Measuring range	*Under development
Measurement accuracy	Full scale(Effective value) less than $\pm 1\%$
Sampling rate	1kS/s
Data reduction technique	1CH measurement fast signal processing
Condition	*Under development
Power source	Supplied by the USB cable from the tablet terminal

Supplied peripherals and accessories		
Tablet terminal	Windows Tablet [ ORCL_FFT1.app installed ]	1
Sensor	Current sensor (Small clamp type)	1
Cable	Current probe USB cable (For data communication and power supply)	1 each
Storage case	*Under development	1
Carry case	*Under development	1

# Valve & Actuator diagnosis

Applicable to the maintenance of every motorized equipment, the ORCL technology originated from the need for more sophisticated maintenance of critical motorized valves at power plants.

ORCL technologies will be discussed by presenting case studies of the diagnosis of a motorized valve (MOV).



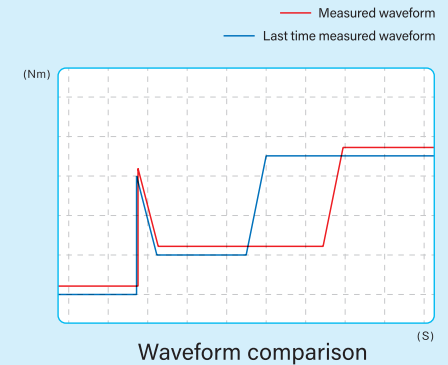
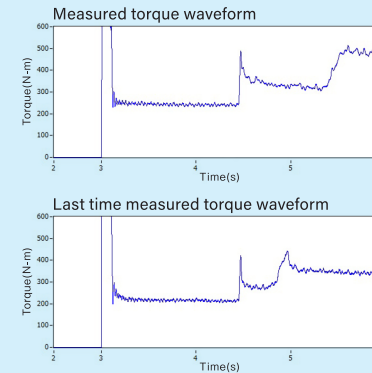
## Diagnostic items

In general, ORCL can diagnose any state required to maintain a MOV.

- Body defects
- Seat defects
- Stem defects
- Gland packing defects
- Stem nut defects
- Operating time/Stem lift defects
- Vibration defects
- Gear defects
- Motor defects
- Pillow defects
- Torque switch malfunction
- Limit switch malfunction
- Setting torque error
- Opening and closing torque defects

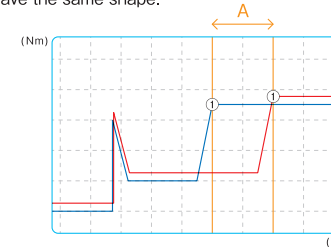
## Case 1. Wear of stem nut

### Measurement



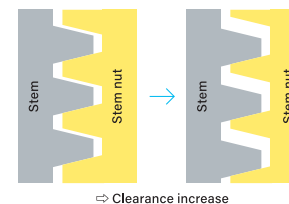
### Analysis

1. Comparing the current waveform and the preceding waveform makes it possible to identify any increase in the length of portion A, even if the two waveforms have the same shape.

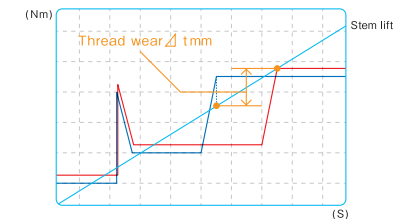


- 2.

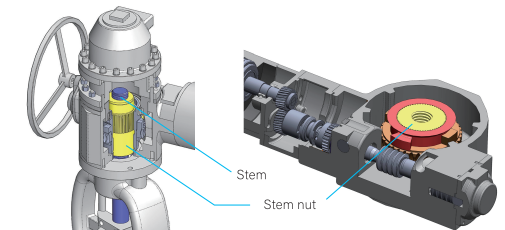
3. Analysis indicates this delay is attributable to wear in the threads of the stem nut (made of copper alloy of low hardness). This is the component abraded by the repeated open/close action.



4. We can calculate the quantitative thread wear based on the increase in A and stem lift.



5. As wear advances, threads undergo shearing and the stem nut idles, resulting in a nonfunctional valve.

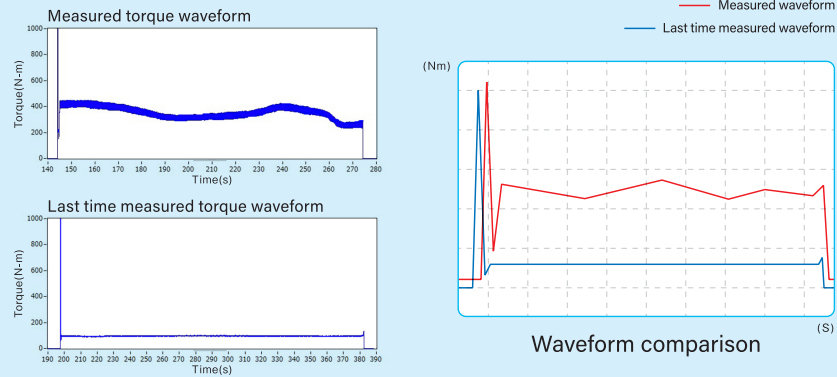


6. The system calculates the estimated remaining service life of the stem nut, recommending replacement of the stem nut when appropriate.



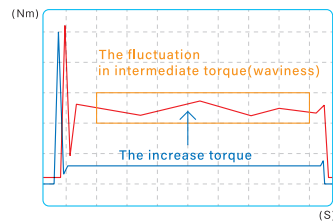
## Case2. Degradation of gland packing

### Measurement



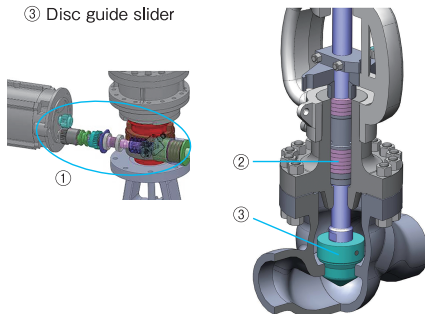
### Analysis

1. Comparing the current waveform and the preceding waveform indicates that torque value fluctuates during the valve operation (at intermediate opening).

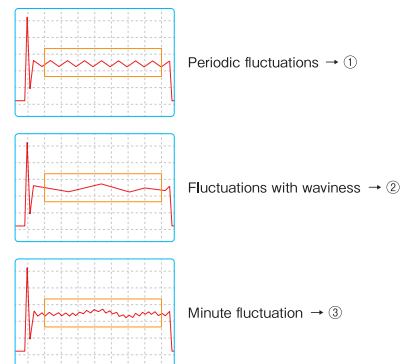


2. The fluctuations occur continuously.  
Analysis indicates a defective part at which resistance arises during the operation of the valve

- ① Gear in actuator
- ② Part where the stem (valve stem) and packing slide against each other
- ③ Disc guide slider

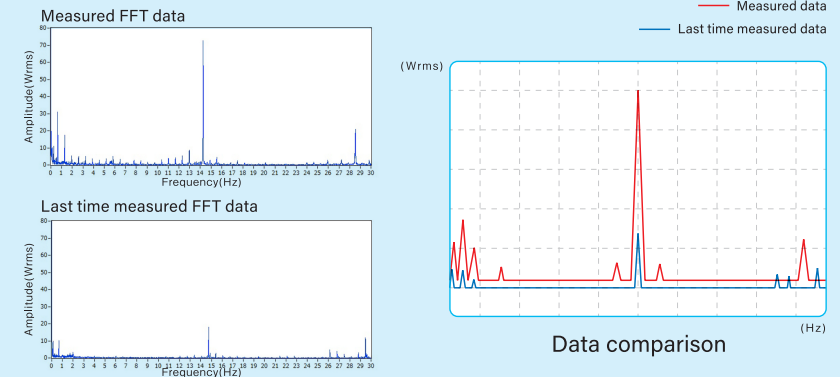


3. In the case of ①, a defective rotary part causes periodic fluctuations. In the case of ③, surface roughness or scale adhesion causes minute fluctuation.
4. In the case of ②, the resistance that arises at the sliding portion is unstable, resulting in fluctuations with waviness. The defective portion in question is caused by ②. Degradation of the gland packing appears to be the cause of the defect.
5. In cases in which the degradation of the gland packing boosts intermediate torque to the torque alarm value or above, the valve is nonfunctional.
6. Whether the gland packing can continue to be used is determined based on the increase in intermediate torque. Replacement of the gland packing is recommended where appropriate.



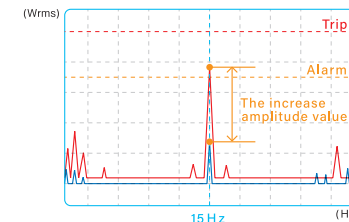
## Case3. Defective gear

### Measurement



### Analysis

1. Comparing the current waveform and the preceding waveform indicates that the amplitude of the electrical power has increased - specifically, that the amplitude of electrical power in the vicinity of 15 Hz has increased significantly beyond the alarm value.



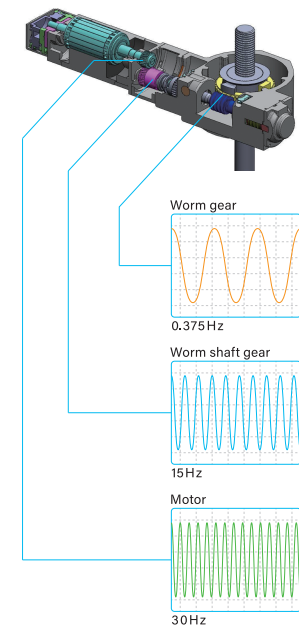
2. The FFT analysis allows sensing of defective rotary parts and indicates the nature of the defect.

3. Each of the rotary parts has a rotating frequency that can be calculated based on design information.

[Motor rotation speed: 1800rpm, Total reduction ratio, 80, Worm gear ratio 1/40]

- Rotating frequency of the motor / 1800rpm ÷ 60sec = 30Hz
- Rotating frequency of the worm gear / 30Hz ÷ 80 = 0.375Hz
- Rotating frequency of the worm shaft gear / 0.375Hz × 40 = 15Hz

4. The amplitude of the electrical power exceeds the alarm value at 15 Hz. Since this coincides with the rotating frequency of the worm shaft gear, the worm shaft gear can be identified as the cause of the defect.



5. Failure of any of the rotary parts can result in a nonfunctional valve.

6. We recommend actuator inspection and replacement of the worm shaft gear. In addition, a detailed analysis is performed based on identification of amplitude generation / growth of electrical power.

