Ventilation Measurement Control Panel

Sohatsu Systems Laboratory Inc.

【Contents】

1. Overview

Ventilation measurement control panel controls tunnel ventilation based on sensor measurement data such as visibility index meter (VI meter), carbon monoxide concentration meter (CO meter), wind direction anemometer (AV meter), and image vehicle detection equipment. There are two types of ventilation control: normal ventilation control and emergency (fire) ventilation control. In normal ventilation control, FCVC (Feedforward + Feedback) control is adopted to maintain pollutant concentrations (Visibility Index (VI), Carbon Monoxide Concentration (CO)) at standard values, achieving energy efficiency.

During Emergency situations, particularly during fires, the ventilation control system utilizes speed reduction measures to maintain a low longitudinal velocity inside the tunnel which helps to ensure a safe evacuation environment for tunnel users and supports firefighting and emergency rescue efforts by the Fire department.

Additionally, it has a feature with a large touch panel (15 inch) for easy monitoring and operation.

2. Features

■ Standard Equipment with Wind Speed Reduction Control!!

In case of emergency (fire), the safety is enhanced by controlling the wind speed reduction.

■ Stabilizing Control with Wind Speed Feedback!!

In the feedback control, not only Visibility Index (VI) and carbon monoxide concentration (CO) but also wind speed is added to control to stabilize the JF operation and prevent excessive ventilation and control hunting than the conventional control. (Method of controlling wind speed changing faster than visibility index (VI) and carbon monoxide concentration (CO))

■ Large Screen Touch Panel(15 Inch) !!

Unlike the conventional ventilation control panels with many buttons on the surface, the new design uses a touchscreen for fewer buttons. This makes it easier and smoother in operation.

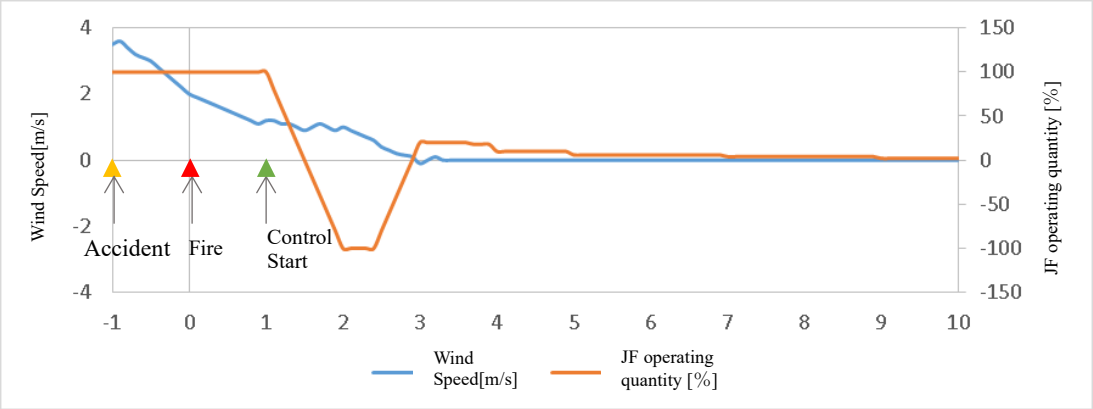
■ Integration of Ventilation Control and Measurement Panels!!

Previously, two separate units were needed for ventilation control and measurement panels, but now a single unit incorporates both functions.

3. Effectiveness

■Safety Enhancement Effect of Standard Wind Speed Reduction Equipment

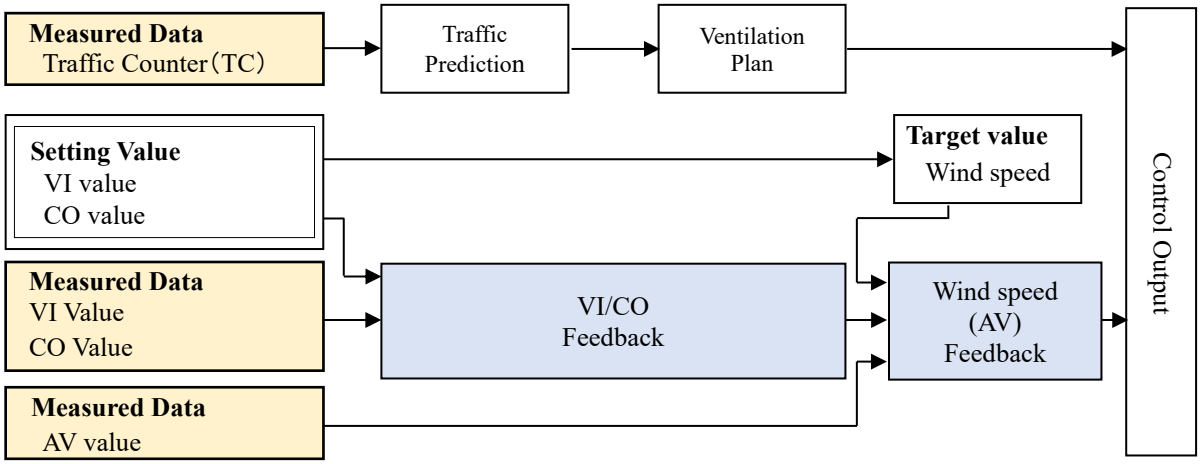
When a fire occurs, the heat and smoke from the fire flow downwind due to the main ventilation airflow. In the event of congestion in bidirectional or unidirectional tunnels, stationary vehicles may be present downstream of the fire, posing a safety concern. Therefore, in the event of a fire in the tunnel, widespread adoption of wind speed reduction control has been implemented to quickly suppress the airflow, allowing heat and smoke to be detained in the ceiling area. The figure below shows an example of wind speed reduction control using a ventilation power panel (inverter type).



This control panel is the first control panel with this wind speed reduction control as standard equipment.

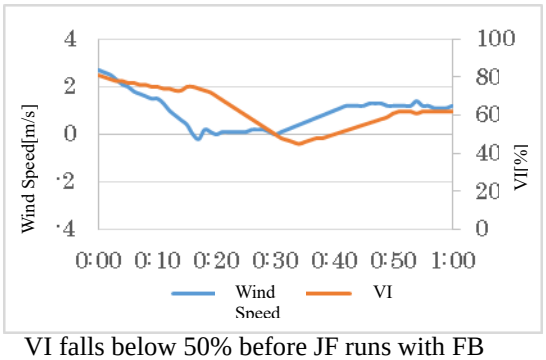
■Measurement Control Algorithm

Unlike traditional algorithms using pollutant concentration feedback, our product utilizes a cascade feedback control structure that combines feedforward (Traffic prediction and ventilation planning) with feedback from pollutant concentration and wind speed.

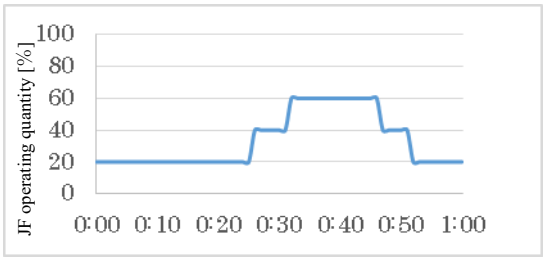


Stabilizing JF operation, our system prevents excess ventilation and control hunting by adding wind speed to feedback control for Visibility Index (VI) and carbon monoxide concentration (CO).

Without Velocity FB

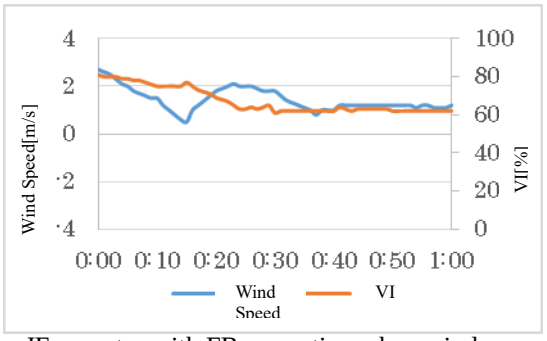


VI falls below 50% before JF runs with FB correction

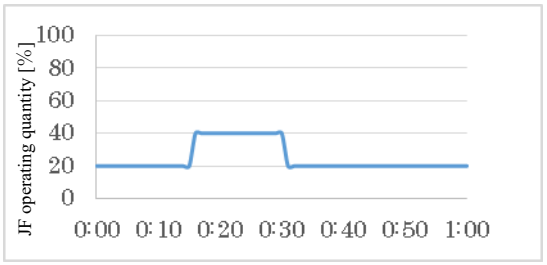


JF gradually increased to improve VI on a declining trend

With velocity FB



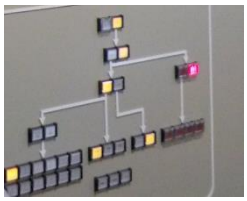
JF operates with FB correction when wind speed decreases.



JF drive is suppressed because JF is operated before VI is lowered.

■Improved Operation

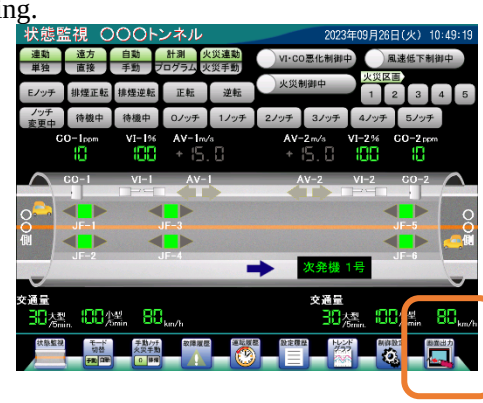
The use of a large touchscreen panel enhances visibility, allowing easy monitoring of facility status. Touchscreen controls also improve operability, preventing errors with features like confirmation screens and indicating inactive buttons.



Conventional Panel

New Control Panel

Integrating warning lights into the touchscreen monitoring screen makes it easier to understand the facility status. Plus, the 'Screen Hard Copy' feature allows saving the current facility status to a USB memory for record-keeping.



Able to save the hard copy of displayed screen to USB

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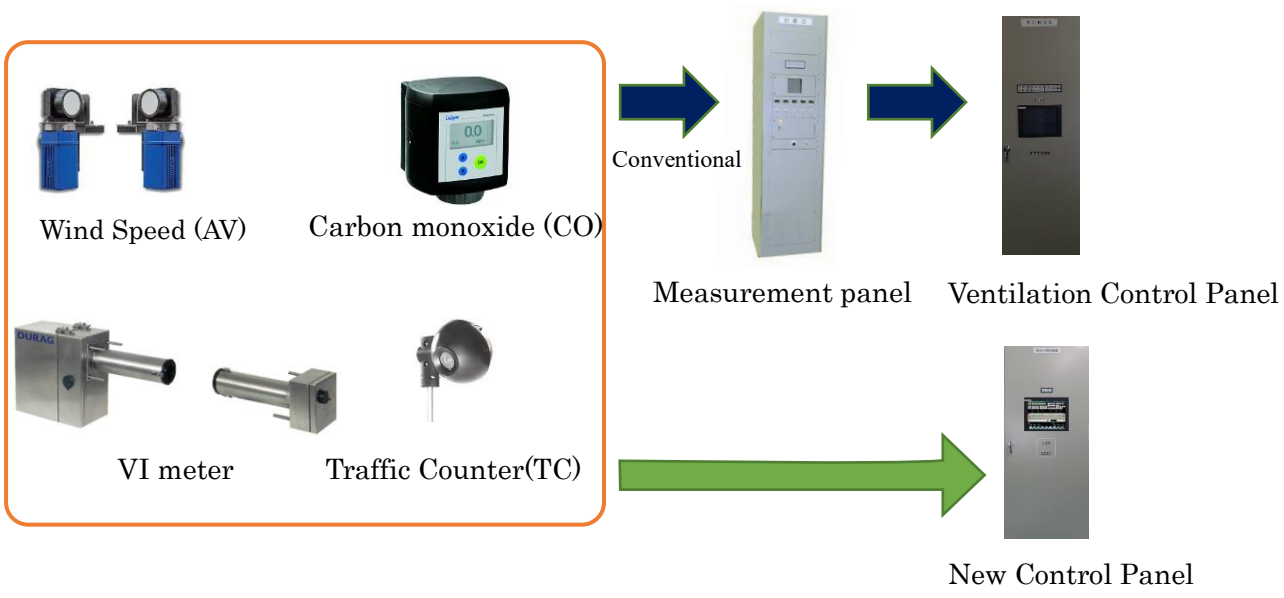
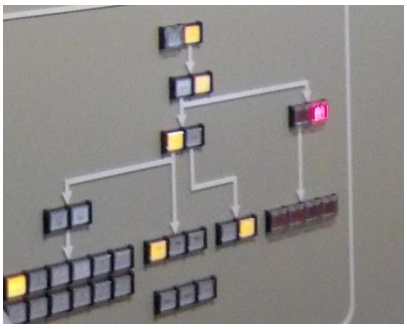
■**Space Optimization**

In conventional ventilation control panels, a separate measurement panel with a built-in measuring unit was required. In this product, the measuring unit is built-in, providing both ventilation control panel and measurement panel functions in a single unit.



4. Comparison with Conventional Technology

Below is the comparison table with conventional technology.

Item Name	Conventional Ventilation Panel	Modern Panel
Normal Ventilation	In bidirectional traffic tunnels, the ventilation power of vehicle traffic and the JF (Jet Fan) ventilation power offset each other, resulting in an increase in ventilation energy.	
	FB control of VI and CO only.	Feedforward control and VI, CO, AV feedback control. JF operation becomes stable and excessive ventilation and control hunting are prevented.
Emergency Ventilation	E-notch (All JFs Stop) only	Low Velocity Control Using Jet Fans in reverse operation rapidly reduces wind speed, effectively maintaining near-zero wind speed for improved safety.
Warning Light	Large number of Indicator lights. 	Less number of Indicator light. (Displayed on the status monitoring screen built in touch panel) 
Operation button	Large number of push buttons 	Less number of push buttons (Operation can be done by the mode-changeover/manual notch/fire manual screen built in the touch panel) 
Measuring Instrument	Visibility Index meter (VI) Wind speed meter (AV) Carbon monoxide meter (CO)	Visibility Index meter (VI) Wind speed meter (AV) Carbon monoxide meter (CO) Image type traffic counter (TC)
Measuring Unit	Built in Separate panel	Integrated in a new modern panel
Fire detector unit	Built in separate panel for fire detector unit	Built in separate panel for fire detector unit
Invertor Control (PLC)	Built in separate ventilation power panel (Invertor Type)	Built in separate ventilation power panel (Invertor Type)

5. On Site Adjustment

The test items during on-site adjustment are listed below.

- Exterior Structural Inspection
- Installation work status Inspection

  Panel mounting conditions, wiring condition, condition status, External cable connections etc.
- Functional and performance Test

  Power receiving, Panel ventilation fan operation, Panel lighting and outlet circuit test.

  Electric main circuit ground fault detection relay confirmation, control power supply circuit test.

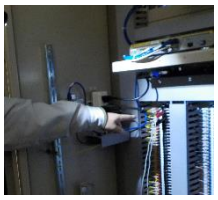
  Sequencer abnormality detection function, status display, fault display, general control function test, etc.
- External signal collection confirmation Test

  Receiving and distribution、Disaster prevention, Remote control equipment, Traffic measurement equipment
- Comprehensive operation Test

  After all tests are completed, check the operation of each function.
- Operation Test

  Operation condition setting, confirmation, measurement value recording


Installation


Inspection


Test


Operation

6. Maintenance

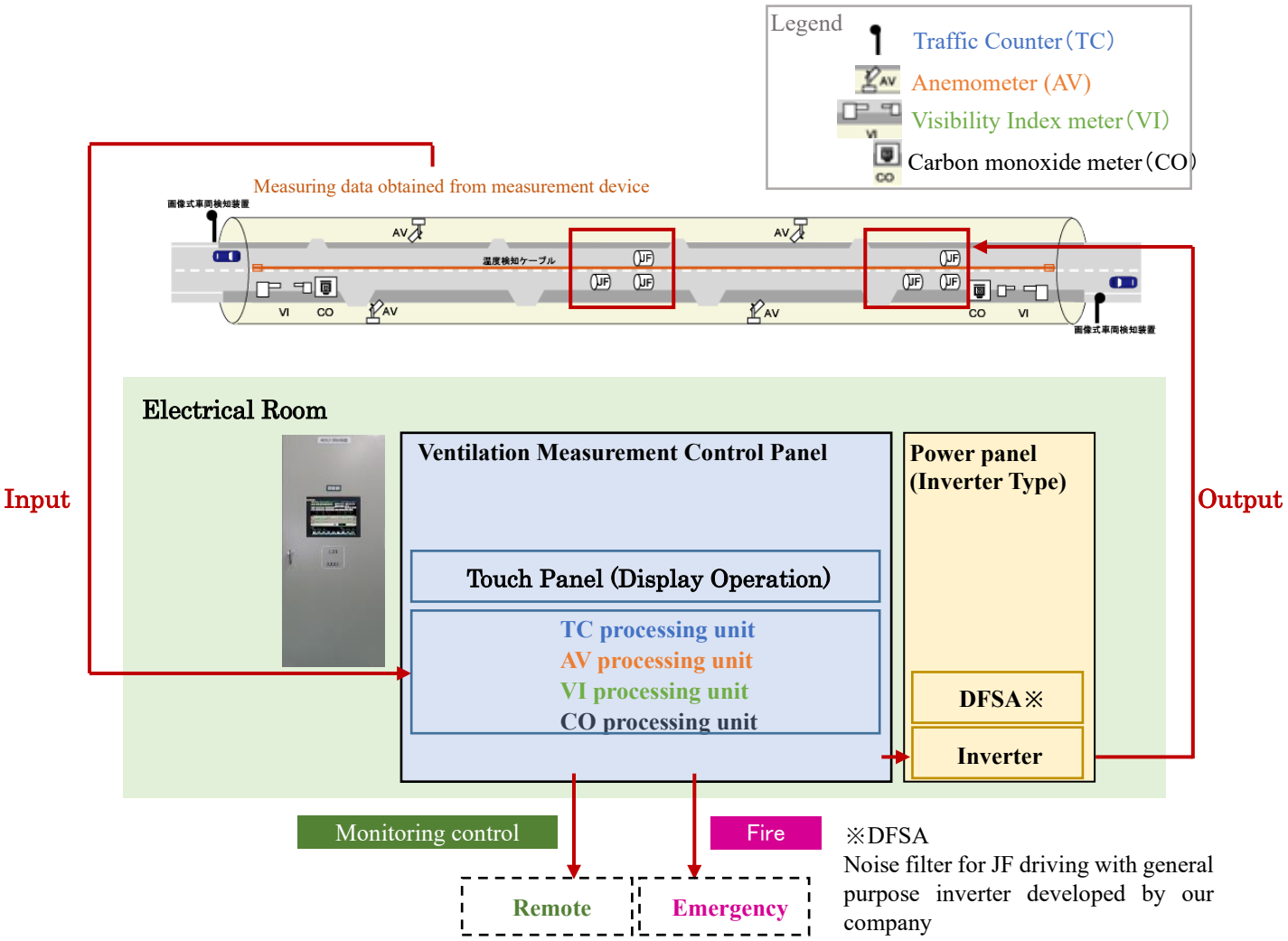
The equipment, including components with a limited lifespan, is listed below.

The replacement cycle for equipment and components varies depending on usage and environmental conditions, but the general guidelines are as follows

No.	Parts Name	Replacement Cycle	Remarks
1	Touch Panel (Main body)	10 Years	
2	Battery (Touch Panel and PLC)	5 Years	
3	Touch Panel (Backlight)	7 Years	Usage 60000 hours
4	UPS (Battery and Fan)	5 Years（Ambient Temp 20℃ 2.5 Years（Ambient Temp 30℃）	(If required)

7. System Configuration

■Overall Configuration



The values measured by measuring instruments like traffic counter (TC), Wind speed meter (AV), and carbon monoxide (CO), Visibility index (VI) is sent to the respective processing unit integrated into the ventilation control panel installed in electrical room. Subsequently, the processed data is input into the PLC.

The values of the measuring instruments input into the PLC are displayed on the touch panel. The internal processing calculates the JF operating quantity based on measured value, which is then sent to the inverter to control the operation of the JF within the tunnel. Additionally, the values from the measuring instruments input into the PLC are further transmitted to remote control facilities and disaster prevention equipment.

8. Specifications Monitoring operations (Touch Panel)

- **Hard copy of all Screen can be taken and can be printed！！**
- **In single screen operation mode, Fire, Tunnel status can be monitored！！**
- **Easy-to-understand screen design with color-coded buttons！！**

Monitoring

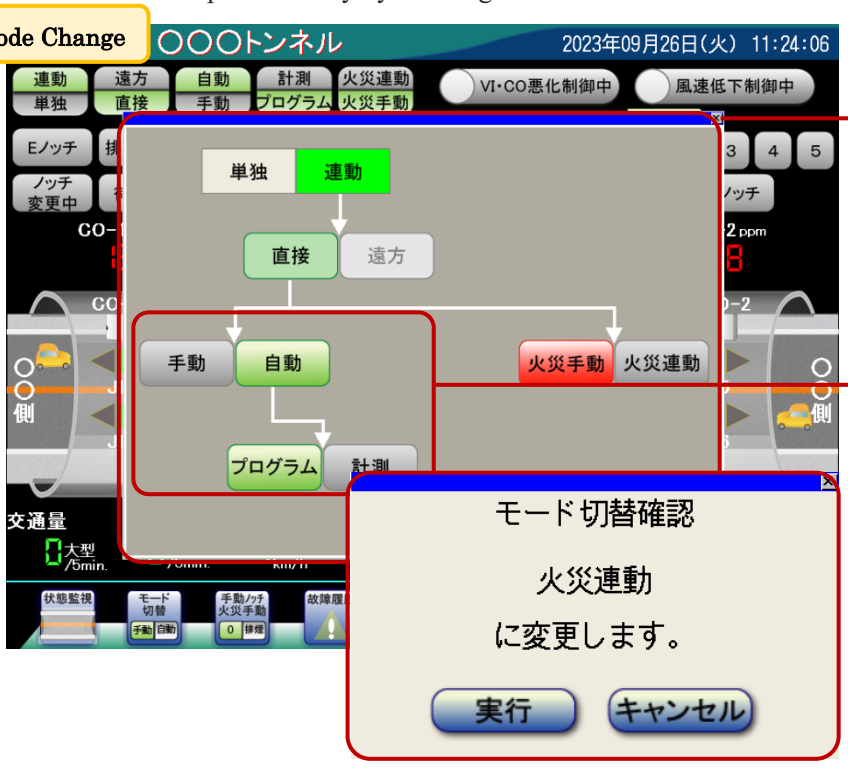
Operation Mode
Fire Status

While monitoring the status of instruments and ventilation equipment inside the tunnel, you can view the operating mode and the status of any potential fire.

Common Screen
Outputs a hard copy of the displayed screen to a USB memory in bitmap format.

- During mode switches, a confirmation screen is displayed to prevent wrong operations.
- Make operation easy by showing which buttons can be clicked and which cannot.

Mode Change



Press the mode switch button and a pop-up will appear.
Mode Change screen

Display inactive buttons that cannot be operated。

When you press the button to change the mode, a confirmation button will appear to confirm the change.

■ **Simple Operation History！！**

Operation History

Display of past 3000 operation histories in descending order of occurrence of a date and time.

■ **Low speed wind control can be observed in graph！！**

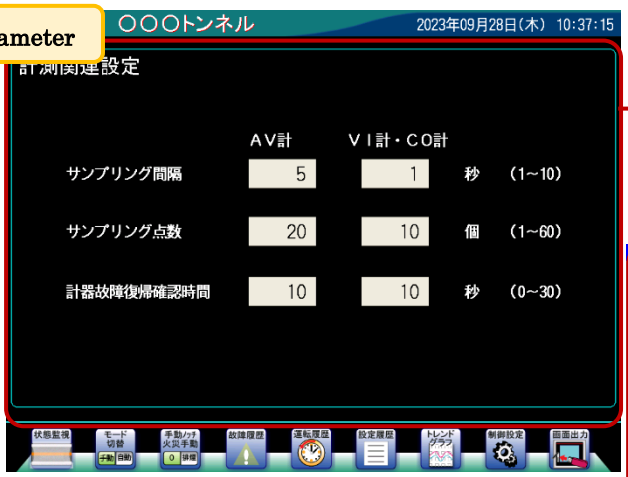
Trend

Display graphs for JF's number of operation and AV measurements values.

Wind speed reduction control can be observed in same graph.

■ **Keypad input for clear limits, preventing errors！！**

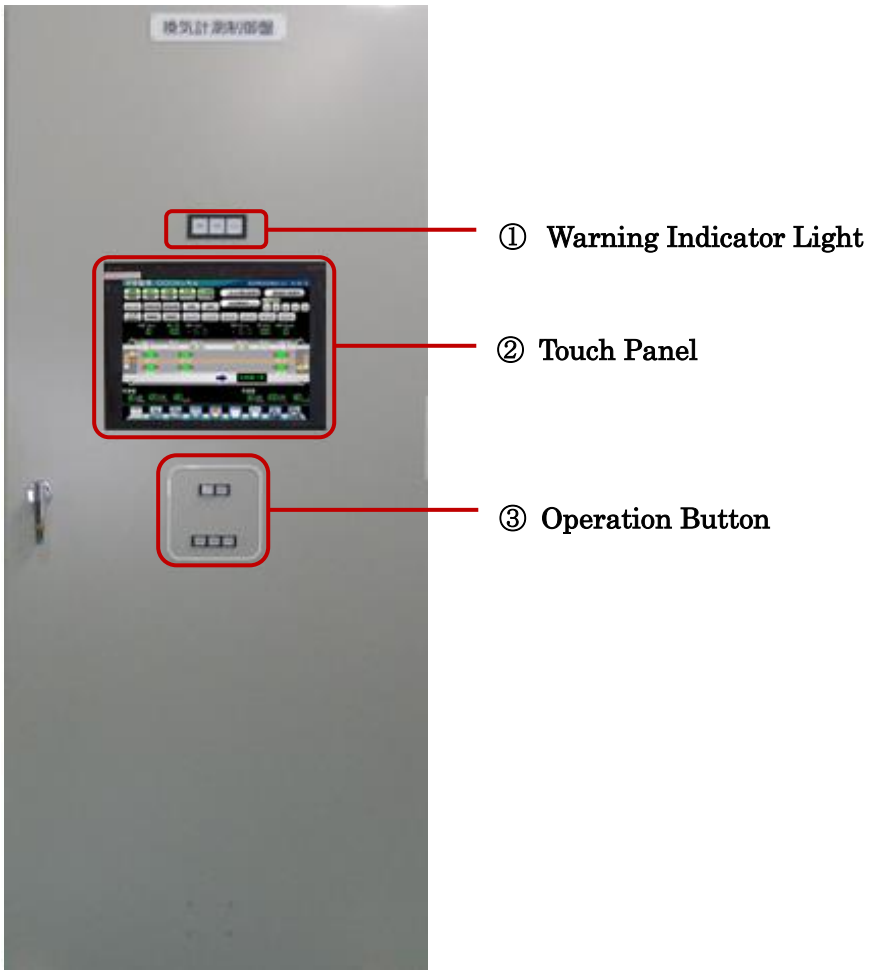
Parameter



Parameters related to measurements devices AV, VI, CO.
When the numeric value is pressed, the numeric keypad is displayed, and the numeric keypad is used to set the value.

Input values within the displayed range on the numeric keypad and set them using the Write button.

9. Panel Specification



① Warning Display light

Display warning with a red lamp indicator.

～Examples of warning light indicators～

Major failure, Minor failure, Door Open etc.

② Touch Panel

Displays and perform operations.

Screen displays the operating mode, fire status, status of measuring devices and ventilation equipment inside the tunnel, displaying the driving history, and configuring parameters.

～Examples～

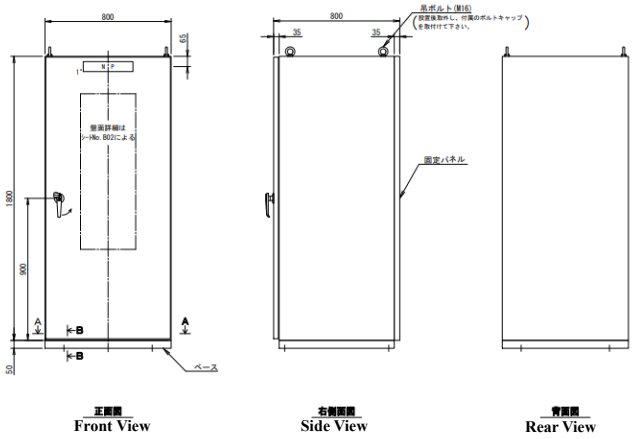
Monitoring Status, Mode change, Failure History, Trend graph screens etc.

③ Operation Button

Convenient button operations on the panel are performed using push-button switches. When turned on, they will be indicated in red.

～Examples～

Independent, Interlocking, Alarm return, Failure return, Lamp test etc.

<table>
<tr><th colspan="2">Item</th><th>Contents</th></tr>
<tr><td colspan="2">Target Tunnel</td><td>Two-way traffic tunnel</td></tr>
<tr><td colspan="2">Ventilation Method</td><td>Longitudinal ventilation method</td></tr>
<tr><td colspan="3"> 
</td></tr>
<tr><td rowspan="4">Specifications</td><td>Dimensions</td><td>W800×H1800×D800mm</td></tr>
<tr><td>Model</td><td>Indoor Independent closed type</td></tr>
<tr><td>Electrical Type</td><td>Control circuit: Single phase 100V 50/60Hz</td></tr>
<tr><td>Usage conditions</td><td>Ambient temperature - 5 ~ 40 °C (24-hour average below 35 °C)
Altitude 1000m, Humidity 30～80%</td></tr>
<tr><td rowspan="2">Structure</td><td>Protection class</td><td>Protection class is the general indoor class and is as follows.
<table>
<tr><th>Item</th><th>Specifications</th></tr>
<tr><td>Door packing</td><td>NA</td></tr>
<tr><td>Ventilation filter</td><td>NA</td></tr>
<tr><td>JEM1267 IP code</td><td>IP20</td></tr>
</table>
The charging section protection for the internal panel and door-mounted devices will be as follows: structures preventing direct contact or those with no danger below 24V, and exposed charging terminals within easy reach will have electric shock prevention measures like acrylic covers, terminal covers, caps, etc.</td></tr>
<tr><td>Main Steel plate thickness</td><td>If it is made of steel plate, the plate thickness should be less than or equal to (Unit: mm).
<table>
<tr><th>Plate Type</th><th>Door</th><th>Celling</th><th>Side</th><th>Floor</th></tr>
<tr><td>Field Operational panel(Self-standing)</td><td>3.2</td><td>2.3</td><td>2.3</td><td>2.3</td></tr>
</table>
・Post shaped support will be made of steel pipe.
・Post-shaped pillar foundation base will be made of 6mm steel plate.</td></tr>
<tr><td colspan="2">Paint Color</td><td>Outside：5Y7/1 Inside：5Y7/1</td></tr>
<tr><td colspan="2">Paint Gloss</td><td>Semi-gloss</td></tr>
<tr><td colspan="2">Painting Specifications</td><td>Melamine baking coating</td></tr>
<tr><td colspan="2">Film thickness</td><td>Outside：60μm　Inside：40μm</td></tr>
</table>

10. Quality

■Patent

Patent No.4898732 Tunnel ventilation control system using jet fan in two-way traffic tunnel

Patent No.5335550 Ventilation control system for long distance road tunnel

Patent No.5300775 Induction electric motor with variable drive system for jet fans in road tunnels driven through long cables

■Quality Management

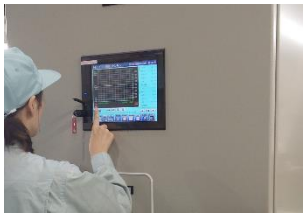
ISO 9001 Quality Management system Certified

ISO 27001 Information Security Management System Certified

The Sohatsu Systems Laboratory Inc. establishes quality and information security policies and endeavors to achieve proper quality management by acquiring various management systems, setting quality policies, and establishing information security policies.

■Factory Test

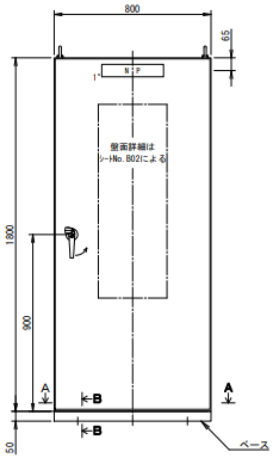
The test items during factory testing are shown below.



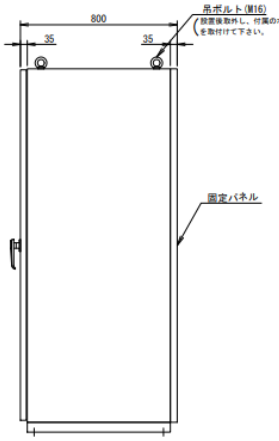
- Quantity Inspection
- Visual Structural Inspection
- Film thickness Inspection
- Dimensional Inspection
- Functional Performance
- Power supply inspection
- Insulation Resistance test
- Withstand Voltage test
- Functional Test
- Touch Panel Functional test
- Input/Output Signal test

11. Standard Drawings

■Standard outline drawing

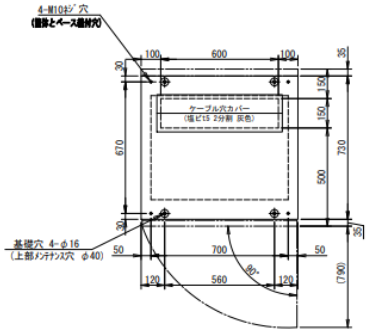


Front View

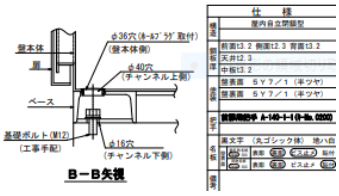


Side View

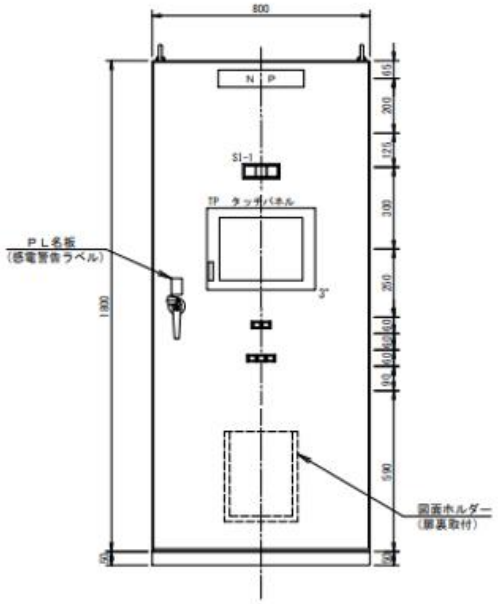
Rear View



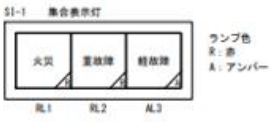
A－A矢視



B－B矢視



Front View



Operation Switch

Website and Inquiry

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