

# WATO EX-35

## Anesthesia Machine

### Physical Specifications

#### Dimensions and Weight

Height	1410 mm
Width	780 mm (not including breathing system)
	945 mm (including breathing system)
Depth	690 mm
Weight	<145 kg (without vaporizers and cylinders)

#### Top Shelf

Weight limit	30 kg
Width	630 mm
Depth	315 mm

#### Work Surface

Height	850 mm
Width	545 mm
Depth	310 mm

#### Drawer (Internal Dimension)

Height	130 mm
Width	415 mm
Depth	325 mm

#### Bag Arm

Height	1150 mm
Length	312 mm
Connection	ISO 22mm OD, 15mm ID

#### Casters

Diameter	125 mm
Brakes	All four casters with brakes

### Ventilator Specifications

#### Modes of Ventilation

Manual/Spontaneous Ventilation/Bypass  
Volume Control Ventilation (VCV) with PLV function  
Pressure Control Ventilation (PCV)  
Synchronized Intermittent Mandatory Ventilation (SIMV-Volume Controlled and SIMV-Pressure Controlled)  
Pressure Support Ventilation (PS) with apnea backup

#### Compensation

Circuit gas leakage compensation and automatic compliance compensation

#### Ventilation Parameters Range

Patient Size	Adult, Pediatric, Infant
Tidal volume	20~1500 mL (Volume Mode) (increments of 1 mL)
	5~1500 mL (Pressure Mode)
Pinsp	5~60 cmH <sub>2</sub> O (increments of 1 cmH <sub>2</sub> O)
Plimit	10~100 cmH <sub>2</sub> O (increments of 1 cmH <sub>2</sub> O)
ΔPsupp	3~60 cmH <sub>2</sub> O (increments of 1 cmH <sub>2</sub> O)
Rate	4~100 bpm (increments of 1 bpm)
I:E	4:1 - 1:8 (increments of 0.5)
Inspiratory pause (Tip:Ti)	OFF, 5% - 60% (increments of 1%)
Inspiratory time (Tinsp)	0.2 - 5.0 s (increments of 0.1 s)



Trigger window	5% - 90% (increments of 5%)
Flow trigger	0.5 ~ 15 L/min (increments of 0.5L/min)
Pressure trigger	-20 ~ -1 cmH <sub>2</sub> O (increments of 1 cmH <sub>2</sub> O)
Expiration termination level	5% - 60% (increments of 5%)
Min Rate	2 - 60 bpm (increments of 1 bpm)
Tslope	0.0 - 2.0 s (increments of 0.1 s)
Apnea I: E	4:1~1:8 (increments of 0.5)
ΔPapnea	3 - 30 cmH <sub>2</sub> O (increments of 1 cmH <sub>2</sub> O)

#### Positive End Expiratory Pressure (PEEP)

Type	Integrated, electronic controlled
Range	OFF, 3~30 cmH <sub>2</sub> O (increments of 1 cm H <sub>2</sub> O)

#### Ventilator Performance

Driving pressure	280 kPa to 600 kPa
Peak gas flow	120 L/min + Fresh Gas Flow

#### Monitoring Parameters

Minute volume	0 ~ 100 L/min
Tidal volume	0~2500 ml
Inspired oxygen (FiO <sub>2</sub> )	18% ~ 100%
Peak airway pressure	-20 ~ 120 cmH <sub>2</sub> O
Mean pressure	-20 ~ 120 cmH <sub>2</sub> O
Plateau pressure	-20 ~ 120 cmH <sub>2</sub> O
I:E	8:1 ~ 1:10
Rate	0 ~ 120 bpm
PEEP	0 ~ 70 cmH <sub>2</sub> O
Resistance (R)	0 ~ 600 cmH <sub>2</sub> O/(L/s)
Compliance (C)	0 ~ 300 ml/ cmH <sub>2</sub> O

#### Control Accuracy

Volume delivery	< 75 ml: ± 15 ml ≥75 ml: ± 15 ml or ± 10% of the set value, whichever is greater
Pressure delivery	± 3.0 cmH <sub>2</sub> O or ± 8% of the set value, whichever is greater
PEEP delivery	OFF: ≤4.0 cmH <sub>2</sub> O 3 to 30 cmH <sub>2</sub> O: ± 2.0 cmH <sub>2</sub> O or ±8% of the set value, whichever is greater

#### Monitoring Accuracy

Volume monitoring	< 75 ml: ± 15 ml ≥75 ml: ± 15 ml or ± 10% of the reading, whichever is greater
Pressure monitoring	± 2.0 cmH <sub>2</sub> O
PEEP monitoring	± 2.0 cmH <sub>2</sub> O or ± 10% of the reading, whichever is greater
MV monitoring	±15% of the reading

#### Trend Graph

Continuous trend information with time discrete events for the latest 48 hours

## Trend Table

Continuous trend information together with time discrete events for the latest 48 hours

## Alarm Log Book

500 events storage, first in first out

## Alarm Setting

Tidal volume	Low: 0 ~ 1595 ml High: 5 ~ 1600 ml
Minute volume	Low: 0 ~ 99 L/min High: 0.2 ~ 100 L/min
Inspired oxygen	Low: 18% ~ 98% High: OFF, 20% ~ 100%
Apnea alarm	VTe < 10ml measured in 20s Paw < (PEEP + 3) cmH <sub>2</sub> O in 20s
Airway pressure low	0 ~ 98 cmH <sub>2</sub> O
Airway pressure high	2 ~ 100 cmH <sub>2</sub> O
Sustained airway pressure alarm:	15s
Subatmospheric pressure alarm:	Paw < -10 cmH <sub>2</sub> O
Alarm silence countdown timer:	120 to 0 seconds

## Ventilator Components

### Flow Sensor

Type	Variable orifice flow sensor
Location	Inspiratory and expiratory port

### Oxygen Sensor

Type	Galvanic fuel cell
FiO <sub>2</sub> displayed	18% to 100%
Accuracy	± (volume fraction of 2.5 % + 2.5 % gas level)
Response Time	≤ 20 seconds

## Ventilator Screen

Display type	Color active matrix TFT touch screen
Display size	10.4 in diagonal
Pixel format	1024 x 768
Brightness	Adjustable
Screen display	configurable
Display parameters	All setting and alarm parameters (including Breath rate, I/E ratio, Tidal volume, Minute volume, PEEP, MEAN, PEAK, PLAT, and O <sub>2</sub> concentration, EtCO <sub>2</sub> , N <sub>2</sub> O, Anesthesia gas concentration)
Display waveforms	P-T, F-T, V-T, CO <sub>2</sub> , O <sub>2</sub> , Anesthetic gas, N <sub>2</sub> O
Spirometry loops	P-V, F-V and F-P
Timer	On screen timer

## Communication Ports

One RS-232C connector and one DB9 connector  
Ethernet (RJ-45)  
USB

## Vaporizers

Vaporizer	Mindray V60 Anesthetic Vaporizer or Penlon Sigma Delta Anesthetic Vaporizer
Support agents	Halothane, Enflurane, Isoflurane, Sevoflurane
Position	MAX.2
Mounting mode	Selectatec®, with interlocking function Plug-in®, with interlocking function

## Modules

### Anesthesia Gas (AG) Module

Measurement mode	Side-stream
Monitor gases	CO <sub>2</sub> , N <sub>2</sub> O, Halothane, Enflurane, Isoflurane,

Sevoflurane, Desflurane, MAC, Paramagnetic O<sub>2</sub> (optional)  
45 s (ISO accuracy mode)  
10min (full accuracy mode)  
Adu/Ped: 150, 180, 200 ml/min  
Neo: 100, 110, 120 ml/min  
± 10 mL/min or ± 10% of the set value, whichever is greater  
CO<sub>2</sub>: 0% ~ 10%  
Des: 0% ~ 18 %  
Sev: 0% ~ 8%  
Enf, Iso, Hal: 0% ~ 5%  
O<sub>2</sub>/N<sub>2</sub>O: 0% ~ 100%  
2 ~ 100 bpm  
2 bpm ~ 60 bpm: ± 1 bpm  
61 bpm ~ 100 bpm: ± 2 bpm

Warm-up time

Sample rate

Accuracy

Range

AwRR range

AwRR accuracy

## Carbon Dioxide (CO<sub>2</sub>) Modules

Method	Infrared absorption
Module type	Mindray side-stream Capnostat mainstream Oridion micro-stream (optional)
Work mode	Standby or measurement
Displayed numerics	EtCO <sub>2</sub> , FiCO <sub>2</sub>
Waveform	Capnography

## Side-Stream Carbon Dioxide (CO<sub>2</sub>) Module

Measurement range	0 ~ 99 mmHg
Accuracy	± 2 mmHg (0 ~ 40 mmHg) ± 5% of the reading (41 ~ 76 mmHg) ± 10% of the reading (77 ~ 99 mmHg)
Resolution	1 mmHg
Sampling rate	Neonatal: 100 mL/min and 120 mL/min optional Adult/children: 120 mL/min and 150 mL/min optional
Sampling rate accuracy	± 15% of the set value or ± 15 mL/min, whichever is greater
Warming-up time	< 1 min, enter the ISO accuracy mode After 1 min, enters the full accuracy mode
Response time	< 4.5 s @ 100 mL/min < 4.5 s @ 120 mL/min Measured by using neonatal watertrap and 2.5 m neonatal sampling line < 5.5 s @ 120 mL/min < 5 s @ 150 mL/min Measured by using adult watertrap and 2.5 m adult sampling line

## Capnostat Mainstream CO<sub>2</sub> Module

Measurement range	0 ~ 150 mmHg
Accuracy	± 2 mmHg (0 ~ 40 mmHg) ± 5% of the reading (41 ~ 70 mmHg) ± 8% of the reading (71 ~ 100 mmHg) ± 10% of the reading (101 ~ 150 mmHg)
Resolution	1 mmHg
Rise time	< 60 ms
Response time	< 2 s
Alarm limit	EtCO <sub>2</sub> High: OFF, 2 ~ 150 mmHg EtCO <sub>2</sub> Low: OFF, 0 ~ 148 mmHg FiCO <sub>2</sub> High: OFF, 1 ~ 150 mmHg

## Micro-stream CO<sub>2</sub> Module

Measurement range	0 ~ 99 mmHg
Accuracy	0 ~ 38 mmHg: ± 2 mmHg

	39 ~ 99 mmHg: $\pm$ (5 % of the reading + 0.08 % of (the reading minus 38 mmHg))
Sampling rate	50 ml/min
Sampling accuracy	-7.5 ml/min ~ + 15 ml/min
Initialization time	30s
Response time	2.9s
Rising time	< 190 ms
Delay time	2.7s
Alarm range	EtCO <sub>2</sub> High: OFF, 2 ~ 99 mmHg EtCO <sub>2</sub> Low: OFF, 0 ~ 97 mmHg FiCO <sub>2</sub> High: OFF, 1 ~ 99 mmHg

## Electrical Specifications

### Current Leakage

100 ~ 240V	< 500 $\mu$ A
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### Power And Battery Backup

Power input	220-240 Vac, 50/60 Hz, 6A 100-120 Vac, 50/60 Hz, 7A 100-240 Vac, 50/60 Hz, 7A
Auxiliary electrical outlets	Up to 4 outlets (3A for each, total 5A)
Battery backup	90 min for 1 piece battery (powered by new fully-charged batteries with 25°C ambient temperature) 240 min for 2 pieces battery (powered by new fully-charged batteries with 25°C ambient temperature)
Battery type	Build-in Li-ion battery, 11.1 VDC, 4500 mAh
Safety feature	In case of electricity and battery failure, manual ventilation, gas delivery and agent delivery are possible

## Pneumatic Specifications

### ACGO (Auxiliary Common Gas Outlet)

Connector	ISO 22 mm OD and 15 mm ID
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### Pipeline Supply

Gas type	O <sub>2</sub> , N <sub>2</sub> O and Air
Pipeline input range	280 to 600 kPa
Pipeline connections	DISS or NIST

### Pipeline Supply Pressure Gauges

Display type	Mechanical
Ranges	0 to 1000kPa
Accuracy	$\pm$ (4% of the full scale reading + 8% of the actual reading)

### Cylinder Supply

Cylinder Supply	E Cylinder (American style or UK style)
O <sub>2</sub> Input Range	6.9 to 20 MPa
N <sub>2</sub> O Input Range	4.2 to 6 MPa
Air Input Range	6.9 to 20 MPa
Cylinder Connections	Pin-Index Safety System (PISS)
Yoke Configuration	O <sub>2</sub> , N <sub>2</sub> O, Air

### Cylinder Supply Pressure Gauges

Display type	Mechanical
Air Range	0 to 25 MPa
O <sub>2</sub> Range	0 to 25 MPa
N <sub>2</sub> O Range	0 to 10 MPa
Accuracy	$\pm$ (4% of the full scale reading+8% of the actual reading)

### O<sub>2</sub> Controls

Method	N <sub>2</sub> O shut off with loss of O <sub>2</sub> pressure
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Supply failure alarm	$\leq$ 220.6 kPa
O <sub>2</sub> Flush	25 ~ 75 L/min

### O<sub>2</sub>-N<sub>2</sub>O Link system

Type	Mechanical
Range	O <sub>2</sub> concentration not lower than 25%

### Auxiliary O<sub>2</sub> Flowmeter (optional)

Range	0 ~ 15 L/min
Indicator	Flow tube

### Mechanical Control Flow Meters

O <sub>2</sub> flow range	Two flow tubes with the ranges of 0 ~ 1 L/Min and 1 ~ 15 L/min
Air flow range	Two flow tubes with the ranges of 0 ~ 1 L/Min and 1 ~ 15 L/min
N <sub>2</sub> O flow range	Two flow tubes with the ranges of 0 ~ 1 L/Min and 1 ~ 10 L/min
Accuracy	between -10% and +10% of the indicated value (under 20°C and 101.3 kPa, for flow between 10% and 100% of full scale)

## Environmental Specifications

### Operating

Temperature	10 ~ 40°C
Relative humidity	15% ~ 95% (noncondensing)
Barometric (Kpa)	70 ~ 106 kPa

### Storage

Temperature	-20 ~ 60°C for main unit, -20 ~ 50°C for O <sub>2</sub> sensor
Relative humidity	10% ~ 95% (noncondensing)
Barometric	50 ~ 106 kPa

### Electromagnetic Compatibility

Immunity	Complies with all requirements of IEC 60601-1-2
Emissions	Complies with all requirements of IEC 60601-1-2

### Breathing System Specification

#### Breathing system volume (Pre-pak)

Automatic ventilation	2850 ml
Manual ventilation	1800 ml

#### Breathing system volume (Non Pre-pak)

Automatic ventilation	2600 ml
Manual ventilation	1800 ml

### Carbon dioxide absorbent canister

Absorbent capacity	1500 mL
Integrated expiratory limb water trap	Capacity: 6 mL

### Breathing Circuit Parameters

Compliance	$\leq$ 4 mL/100Pa (bag mode) Automatically compensates for compression losses within the breathing circuit in mechanical mode
Expiration resistance	< 6.0 cm H <sub>2</sub> O @60 L/min
Inspiration resistance	< 6.0 cm H <sub>2</sub> O @60 L/min

### System Pressure Gauge

Range	-20 ~ 100 cmH <sub>2</sub> O
Accuracy	$\pm$ (2% of the full scale reading + 4% of the actual reading)

## Ports And Connectors

Exhalation	22 mm OD / 15 mm ID conical
Inhalation	22 mm OD / 15 mm ID conical
Manual bag port	22 mm OD / 15 mm ID conical

## Bag-to-Ventilator Switch

Type	Bi-stable
Control	Switch between manual and mechanical ventilation

## Integrated Adjustable Pressure Limiting (APL) Valve

Range	1 ~ 75 cmH <sub>2</sub> O
Tactile knob indication at above 30 cmH <sub>2</sub> O	
Accuracy	± 10 cmH <sub>2</sub> O or ± 15% of the setting value, which is greater

## Anesthetic Gas Scavenging System (AGSS)

Size (H x W x D)	430 x 132 x 114 mm
Type of disposal system	Active: High-flow or Low-flow Passive
Applicable standard	ISO 80601-2-13
Pump rate	75 ~ 105 L/min (High-flow)

25 ~ 50 L/min (Low-flow)

Pressure relief device: Pressure compensation opening to the air  
State indication of the disposal system: The float falls below the "MIN" mark on the sight glass when the disposal system does not work or the pump rate is lower than 25 L/min (Low-flow) or 75 L/min (high-flow).

Filter	Stainless screen with hole diameter of 140 ~ 150 μm
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Connector of the disposal system: ISO 9170-2

## Materials

All materials in contact with exhaled patient gases are autoclavable, except flow sensors (being not capable of being autoclaved), O<sub>2</sub> sensor, and mechanical pressure Gauge.

All materials in contact with patient gas are latex free.

## Suction Device

### Venturi Suction Regulator

Gas source	Air, from system gas source
Minimum flow	20 L/min
Maximum vacuum	≥72 kPa at supply gas pressure of 280 kPa; ≥73 kPa at supply gas pressure of 600 kPa

### Continuous Suction Regulator

Supply	Negative Pressure Suction
Maximum vacuum	517.5 mmHg to 540 mmHg (69 kPa to 72 kPa) with external vacuum applied of 540 mmHg and 40 L/min free flow
Maximum flow	39 L/min to 40 L/min with external vacuum applied of 540mmHg and 40 L/min free flow
Minimum flow	20 L/min

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Please contact your local Mindray sales representative for the most current information.

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