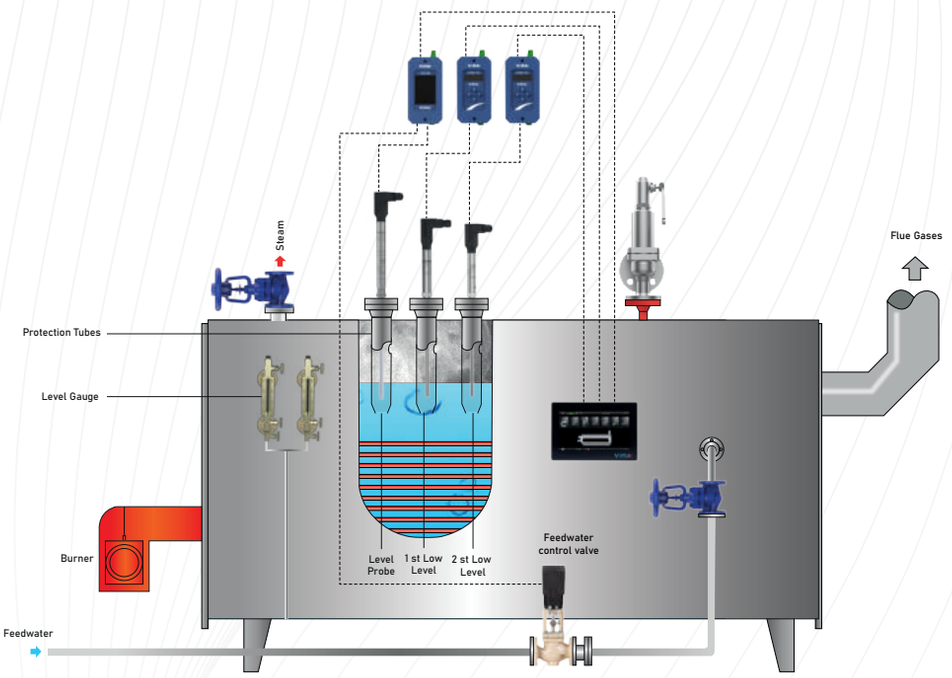
Boiler Level Control and Safety

In steam boilers, the water level decreases with the convert of the water into steam and the decreasing water is completed by the operation of the boiler feedwater pump. Depending on the amount of steam produced in the steam boiler, since the water temperature entering the boiler is lower than the boiler temperature and due to changes in steam pressure, a constant fluctuation in the water level occurs. For the efficient and safe operation of boilers, the water level must always be checked. This check may include a sound or light alarm, shutting down the feedwater supply, and shutting down the burner. It is also essential to provide an outside drum level indicator such as magnetic or reflex level gauges.



Note: Level probes can be both installed in a protection tube or a level tube. It is undesirable for the water to drop below the desired level in steam boilers. If it does, it can cause costly damage to the boilers and even fatal accidents. In case of low water level, check the following reasons.

Causes of Low Level
- Lack of feedwater
- Sudden load changes
- Feedwater pump failure
- Safety valve leaks
- Control valve malfunction
- Malfunction of boiler water level controller

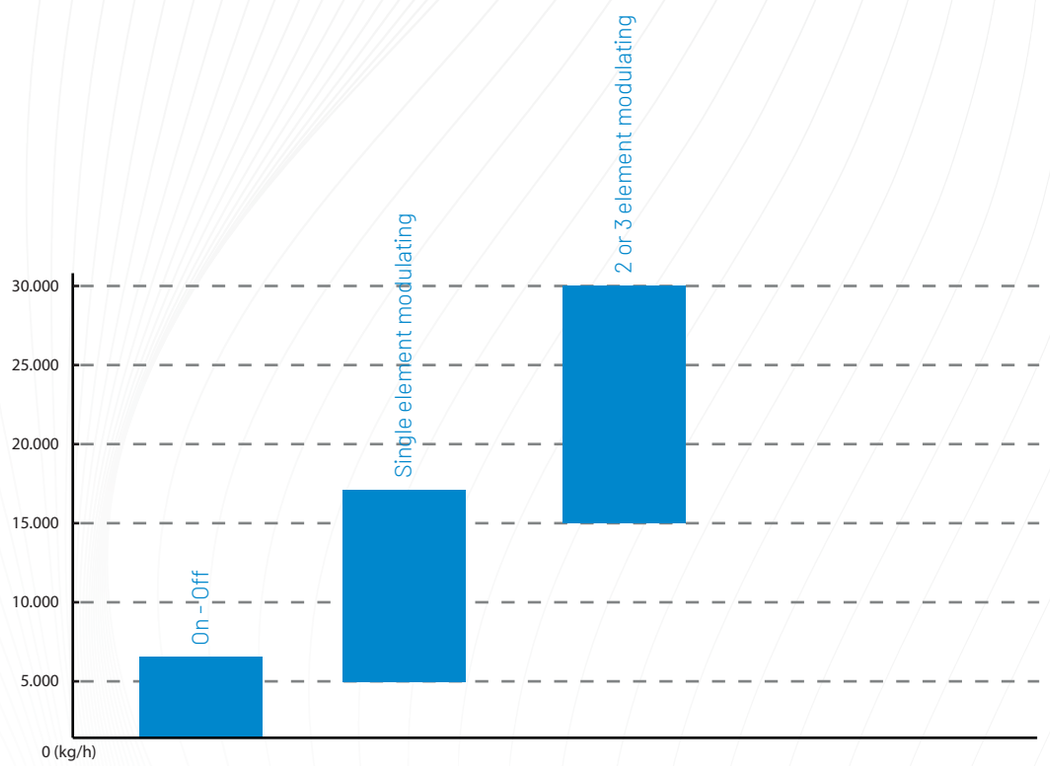
To ensure the safe operation of the boiler, all elements that affect the level control must be monitored and make sure they are working. In case of failure, the boiler operator must understand the cause of the problem and should take action most appropriately.

Boiler Water Level Control Systems

In steam boilers, feed water should be supplied to replace the water lost during steam production. Automatic level control systems are applied in steam boilers produced with modern technology. Automatic feedwater control systems have two different applications: On/Off Level control and modulating level control.

Depending on the boiler capacity; On-Off level control system should be used for the boilers with the capacity up to 5000 kg/h. for the boiler with the capacity up to 15.000 kg/h single element modulating control and higher capacity than 15.000 kg/h 2 or 3 element modulating level control systems should be used.

- **Single Element Modulating** : Modulating level control system only
- **2 Element Modulating** : Modulating level control system, steam production amount measurement with modulating level control system and steam flow meter
- **3 Element Modulating** : Modulating level control system, steam production amount measurement with steam flow meter and feed water amount measurement for the boiler with water flow meter

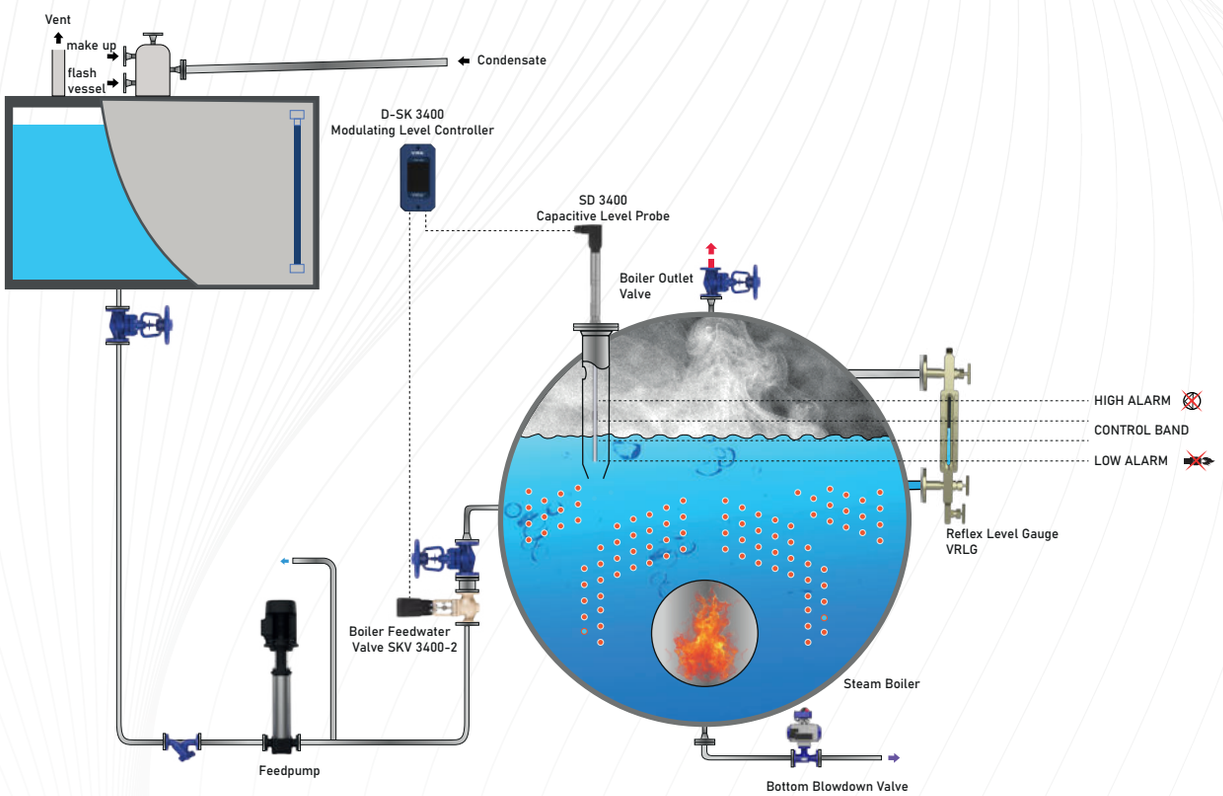


It is not sufficient to decide which level control system to use only by considering the boiler capacity. In practice, factors such as the steam consumption behavior of the plant, the variability of process loads, and the feedwater conditions are equally important. For example, an on-off level control system may not be adequate even in a low-capacity boiler if there are sudden or frequent load fluctuations. In such cases, modulating level control is preferred to ensure stable operation.

Another major reason to use a modulating level control system is energy efficiency. At higher flow rates, adding large amounts of cooler water instead of evaporated water can lead to both energy loss and thermal stress on the boiler. By adding water proportionally to the steam consumption, the boiler can operate more smoothly, reducing thermal shocks and improving fuel efficiency. Therefore, modulating control systems are often selected not only for larger capacity boilers but also for medium or even smaller boilers where load variations are significant or energy efficiency is a priority.

MODULATING LEVEL CONTROL & ALARM SYSTEM

Modulating level control system consists of a capacitive probe, a level controller and a 2 or 3-way valve. The water level, which varies with the phase change of the water in the boiler, is determined by the capacitive level probe and is continuously compared with the previously set value by the level controller. In any determined deviation, it sends a signal to the feedwater valve in order to take the required feedwater amount into the boiler.
The probe used in the modulating level control system works according to the capacitance principle. Capacitance value is measured according to the amount of water. The controller opens and closes the proportional control valve through signals from the capacitive probe and the water level is kept at the desired level. Thus, the flow rate and pressure of the steam obtained are constant. It also has a low moisture content.



Note: The control valve can be either a 2-way or a 3-way valve, depending on the boiler feedwater system design.

For safe operation, all steam boilers must be equipped with independent low and high level limiting devices. The modulating level control system is designed for water level regulation only and should not be considered a substitute for safety-related level limiting systems.

Modulating level control and alarm system can be used;
- Boilers with a capacity above 5,000 kg/h
- Applications with frequent steam load or pressure fluctuations
- Installations where energy efficiency and fuel savings are important
- Processes requiring stable and continuous steam supply

D-SK 3000-3 Modulating Level Control and Alarm System

NEW

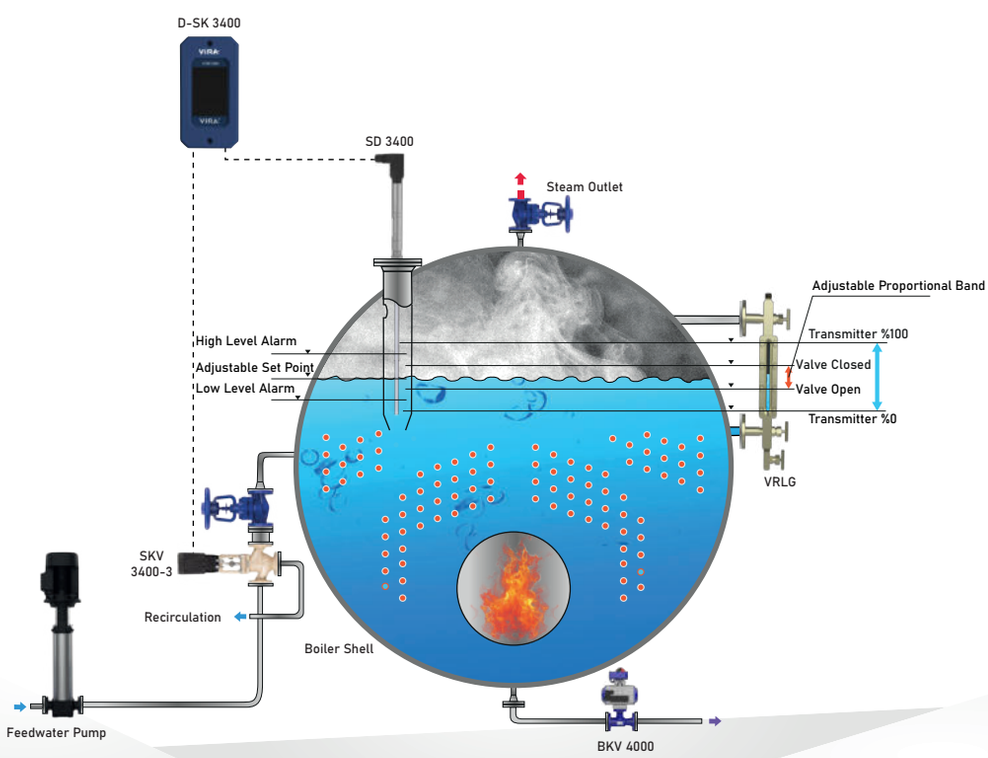
Modulating Level Controller

Type	: D-SK 3400
Supply Voltage	: 24VDC
Enclosure	: Panel-mount and Din Rail Type
Functions	: Modulating / On–Off Level Control, High & Low Level Alarms, 4-20 mA Analogue Input, Touch Screen Adjustable Control Parameters (e.g. proportional band, set point, alarm delay)
Outputs	: 4–20 mA Analog Level Signal, 4–20 mA Analog Control Output (Control/Drive), 1 Valve Control Relay, 2 Alarm Relays, RS 485 Modbus, 0-1k Ohm Potentiometer Feedback
Max. Ambient Temp.	: 55 °C
Compliance	: CE (EMC 2014/30/EU, LVD 2014/35/EU), EN 12952 & EN 12953, Type Approval (Module B + D)

Modulating Level Control Probe (Capacitive Level Probe)

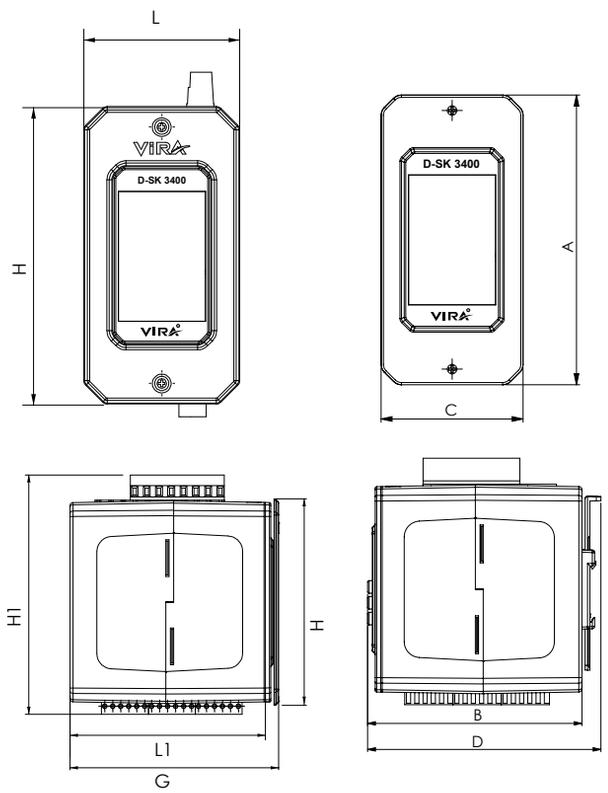
Type	: SD 3400
Nominal Pressure	: PN 40
Max. Operat. Temp.	: 239 °C
Max. Operat. Press.	: 32 Bar g
Connection	: G 1/2" BSPT (Optional NPT)
Length	: 300-1500 mm
Max. Ambient Temp.	: 75 °C
Compliance	: CE (PED 2014/68/EU), EN 12952 & EN 12953, Type Approval (Module B + D)

D-SK 3000-3 Typical Installation



TECHNICAL SPECIFICATION

D-SK 3400 Modulating Level Controller



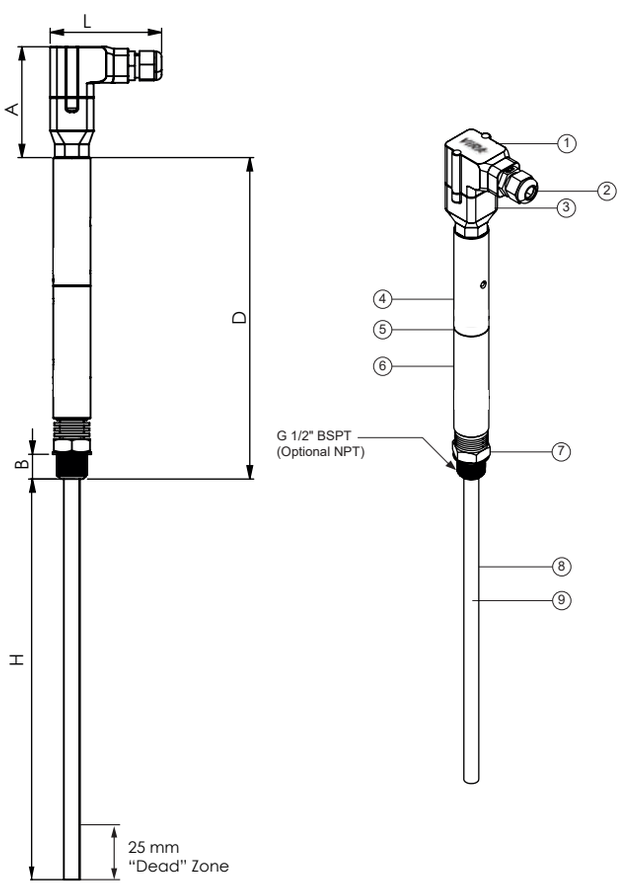
Technical Data

Type	D-SK 3400
Supply Voltage	24VDC
Functions	Modulating / On–Off Level Control, High & Low Level Alarms, Touch Screen, Adjustable Control Parameters (e.g. proportional band, set point, alarm delay)
Inputs	Level Probe Input, Ground, 0-1k Ohm Potentiometer Feedback, 4-20 mA Analogue Input
Outputs	1 Valve Modulation Relay, 2 Alarm Relays, RS 485 Modbus, 4–20 mA Analog Level Signal, 4–20 mA Analog Control Output
Display	Touch Screen
Label	Silicone Rubber
Max. Ambient Temp.	55℃
Enclosure	PC (Polycarbonate)
Type	Panel-mount and Din Rail
Protection Class	IP40

Dimensions

H (mm)	H1 (mm)	L (mm)	L1 (mm)	C (mm)	D (mm)	B (mm)	G (mm)	A (mm)
134,6	156	72	130	64	148	136	136	130

SD 3400 Capacitive Level Probe



No	Part	Material
1	Upper Connector Housing	GF-PP (Glass Fiber Reinforced Polypropylene)
2	PG 11 Cable Gland	PA6 (Polyamide)
3	Lower Connector Housing	GF-PP (Glass Fiber Reinforced Polypropylene)
4	Preamplifier Body	Austenitic Stainless Steel 304
5	Preamplifer Connector	Austenitic Stainless Steel 316L
6	Cover Assembly	Austenitic Stainless Steel 304
7	Probe Body	Austenitic Stainless Steel 316L
8	Probe Sheathing	Polytetrafluoroethylene (PTFE)
9	Probe (Sheated)	Austenitic Stainless Steel 316L

Dimensions

H (mm)	L (mm)	A (mm)	B (mm)	D (mm)	Dead zone (mm)
300-1500	83,5	83	18,5	240,5	25

Note: The capacitive level probe is manufactured to the specified length and cannot be shortened afterwards. The required probe length must be clearly stated at the time of order.

2-Way Feedwater Control Valve

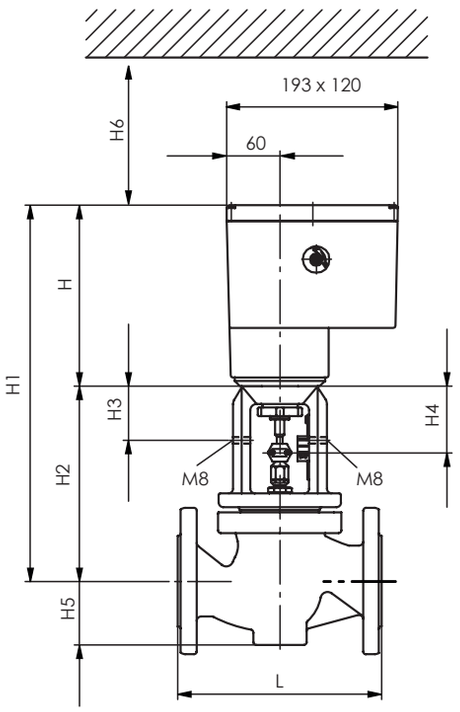
Type	: SKV 3400-2
Body Material	: ENJL 1040 PN 16, ENJS 1049 PN 25, 1.0619 PN 40
Leakage Class	: Class IV (Optional V)
Flow Characteristic	: Lineer (Equal Percentage)
Operating Temp.	: -10 - + 220°C (High Temp. on Request)
Supply	: 220VAC (optional 24VDC)
Control Signal	: 3 Step (4-20 mA Optional)
Protection Class	: IP 54
Protection Switch	: Standard 2 * Safety Limit Switch

3-Way Feedwater Control Valve

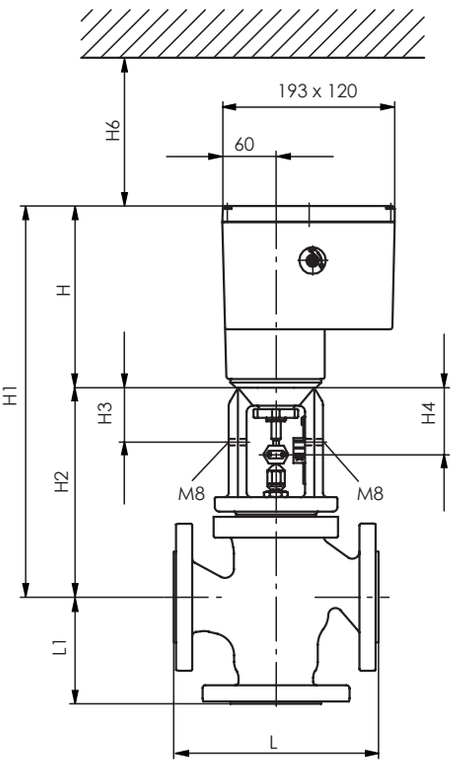
Type	: SKV 3400-3
Body Material	: ENJL 1040 PN 16, ENJS 1049 PN 25, 1.0619 PN 40
Leakage Class	: Class I
Flow Characteristic	: Lineer (Equal Percentage)
Operating Temp.	: -10 - + 220°C (High Temp. on Request)
Supply	: 220VAC (optional 24VDC)
Control Signal	: 3 Step (4-20 mA Optional)
Protection Class	: IP 54
Protection Switch	: Standard 2 * Safety Limit Switch

TECHNICAL SPECIFICATION

SKV 3400-2
2 Way Feedwater Control Valve



SKV 3400-3
3 Way Feedwater Control Valve



Technical Data

Model	SKV 3400-2, SKV 3400-3
Supply Voltage	230 V, 50 Hz
Type	Diverting Valve
Pressure Class	PN 16, PN 25, PN 40
Body Material	EN-JL1040 - PN16 EN-JS1049 - PN25 1.0619 - PN40
Operat. Temp.	-10 - +220 °C
Sealing	Metal to Metal
Actuator	Electric (Optional Pneumatic)
Protection Class	IP54
Control Options	3 Step, 4-20 mA (optional)
Feedback Signal	0-1K Potentiometer, 4-20 mA Positioner (Optional)

Dimensions

Nominal size (DN)	L (mm)	L1 (mm)	H1 (mm)	H2 (mm)	H3 (mm)	H4 (mm)	Weight (kg)
15	130	70	H2+H	235	61	75	6
20	150	80	H2+H	235	61	75	7
25	160	85	H2+H	235	61	75	8
32	180	100	H2+H	235	61	75	13
40	200	105	H2+H	235	61	75	15
50	230	120	H2+H	235	61	75	17
65	290	130	H2+H	270	61	75	31
80	310	140	H2+H	270	61	75	37
100	350	150	H2+H	360	75	90	49
125	400	200	H2+H	375	75	90	95
150	480	210	H2+H	375	75	90	135