

Oscillation Flow Meter

For Wet and Dry Gases

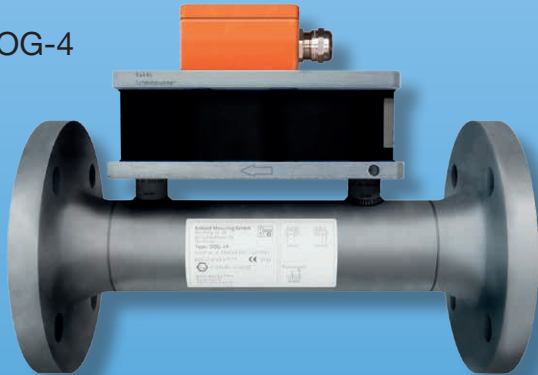


measuring
•
monitoring
•
analyzing

DOG



DOG-4



- Measuring Ranges:
0.07-7 ... 35-3500 CFM (Air)
- p_{\max} : 360 PSI; t_{\max} : 248 °F
- Connection:
1" ... 8" ANSI Flange
- Material: Stainless Steel
- Accuracy:
 $\pm 1.5\%$ of Reading
- No Moving Parts
- Long-term Stability
- Options: Flow Computer,
Analog and Pulse Outputs

DOG-6



KOBOLD companies worldwide:

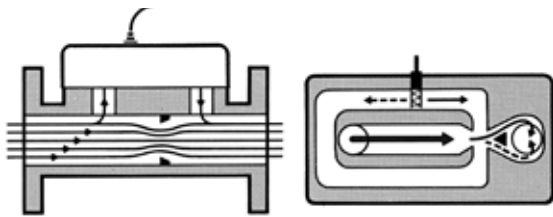
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Description

KOBOLD DOG flow meters are designed for measuring gas flow. The DOG-4 is designed specifically for use with dry gases. The DOG-6 incorporates a design feature that allows it to excel in accurate measurement of wetter gases. It features a special sensor construction and an angled measuring head. This angled measuring chamber allows any condensate to drain easily when wet gases, like biogas, are being measured.

The unique principle of operation is as follows. The gas flows through an orifice in a tube. Bypass bores are located at the sides of the main flow body. The dynamic pressure at the orifice causes part of the gas volumetric flow to move into the bypass. The division ratio remains constant over the whole measuring range.



The bypass channel contains the Oscillator which is the element used for measurement. When the gas flows through the measuring cell, a gas column oscillates in a U-shaped channel, moving from the left and right. This oscillation frequency is proportional to the flow velocity and to the total volume flow. The oscillation frequency is sensed with a platinum sensor. An alternating electrical signal is generated that is processed through the integral electronics.

Application

The connected flow channels are large enough that the constant changes of direction of the flow in the channels produce a self-cleaning effect. As a result, the DOG flow meters are extremely dirt resistant and have no consumables.

The mounting position can be chosen at will. When condensate forms in the gas, the horizontal mounting position with the sensing element pointing upwards is the recommended installation orientation.

The gas flow velocity anywhere upstream of the flow meter should not exceed the sound velocity. Pressure drops above critical and pulsating streams must also be avoided. The recommended straight run is 10x the pipe diameter upstream and 5x the pipe diameter downstream.

The model with the bypass ball valves installed between the measuring head and the housing enables easy sensor replacement and cleaning of the measuring head without flow interruption in the main line or the flow meter body. The bypass valves also protect against mechanical damage during start-up.

Areas of Application

- Compressed Air
- Natural gas, Biogas, Fermentation gas
- Propane
- Hydrogen Gas
- Nitrogen
- Argon

Technical Details

Measuring Accuracy: $\pm 1.5\%$ of reading (at $Q_t \leq MV \leq 100\%$ *)
 $\pm 5\%$ of reading (at $1\% \leq MV < Q_t^*$)

*The lower limit Q_t depends on the density

$Q_t = 8\%$ at density 1 kg/m^3

$Q_t = 4\%$ at density 2 kg/m^3

$Q_t = 2\%$ at density 4 kg/m^3

$Q_t = 1\%$ at density $\geq 8 \text{ kg/m}^3$

Repeatability: 0.1% of reading

Media Temp: -4 ... 248 °F (non ATEX version)

-4 ... 140 °F (ATEX version)

Ambient Temp: -4 ... 176 °F (non ATEX version)

-4 ... 140 °F (ATEX version)

Operating Pressure: Max. 360 PSI

Span: DOG-4 1:100, DOG-6 Max. 1:75

Hot Wire Sensor: Platinum sensor

Protection: IP 65

Materials (Sensor)

Housing: 316L Satinless Steel

Orifice: 316L Stainless steel

Measuring Head: Polyphenylene Sulfide (PPS)

Hot Wire Sensor: Platinum/PEEK/Ceramic

Gaskets: Klinger SIL® C-4265, NBR

Ball valves: Stainless Steel

Note:

Sponsored by the Federal Ministry of Economics and Technology on the basis of a resolution of the German Bundestag.



Electronics DOG-...A/B/C/D/E/F/R
(Sensor with/without ATEX/IECEX Certification)

Power supply:

- A:** 230 V_{AC} ±10%, 50...60 Hz (with ATEX/IECEX)
- B:** 230 V_{AC} ±10%, 50...60 Hz (without ATEX/IECEX)
- C:** 110 V_{AC} ±10%, 50...60 Hz (without ATEX/IECEX)
- D:** 110 V_{AC} ±10%, 50...60 Hz (with ATEX/IECEX)
- E:** 24 V_{AC} ±10%, 50...60 Hz (without ATEX/IECEX)
- F:** 24 V_{AC} ±10%, 50...60 Hz (with ATEX/IECEX)
- R:** 24 V_{DC} ±20%, (without ATEX/IECEX)

Input: Platinum Sensor (Allowed Distance: Max. 50 m to Sensor)

Output: Opto Coupler, Frequency Linear to Flow (See graph below)
V_{CE}: 12 - 24 V (Recommended), Max. 30 V
I_C: Max. 50 mA
P_{tot}: 100 mW at 77 °F
Derating: 0.91 mW/34 °F

Ambient Temperature: -13... 140°F

Protection: IP20

Ex Version (A/D/F):

ATEX

Transducer: II (1)G [Ex ia Ga] IIC
Sensor: II 1 G Ex ia IIC T4 Ga

IECEX

Transducer: [Ex ia Ga] IIC
Sensor: Ex ia IIC T4 Ga

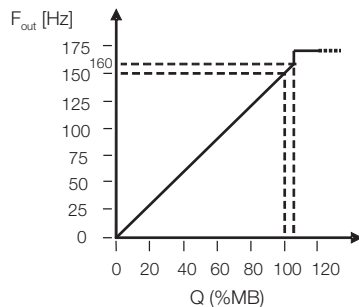
Transducer

Mounting: DIN Rail

Dimensions:

- Width:** 1.77"
- Height:** 4.16"
- Depth:** 4.47"
- Weight:** Approx. 0.44 lbs.

Frequency/Flow Linearity



Electronics DOG-...G/H/I/K/L
(Sensor without/with ATEX/IECEX Certification and Flow Rate/Unit Counter, with Current/Pulse Output)

Display: Alphanumeric LCD, UV-Resistant with Displayed Functions:
Flow Rate:
7 Digits, 17 mm High
Total (Resettable):
7 Digits, 17 mm High
Accumulated Total (Not Resettable):
11 Digits, 8 mm High

Units: Flow: m³, cf, scf, Nm³
Time Units: /sec, /min, /hr, /day
Total: m³
Accumulated Total: m³

Decimal Places: Flow: 0, 1, 2 or 3
Total: 0, 1, 2 or 3
Accumulated Total: According to Selection for Total

Backlighting: Yes

Signal input: Flow: Sensor

Power Supply:

- G:** 230 V_{AC} ± 10%, 50...60 Hz (without ATEX/IECEX)
- H:** 230 V_{AC} ± 10%, 50...60 Hz (with ATEX/IECEX)
- I:** 110 V_{AC} ± 10%, 50...60 Hz (without ATEX/IECEX)
- K:** 110 V_{AC} ± 10%, 50...60 Hz (with ATEX/IECEX)
- L:** 24 V_{DC} ± 20%, (without ATEX/IECEX)

Electrical Connection: 4 x M16x1.5 Cable Gland

Housing Material: ABS with PC Cover

Weight: Approx. 3.97 lbs.

Analog Output: 4...20 mA (Active), 10-Bit Resolution, 3-wire

Pulse Output: PNP, 24 V_{DC} Active, Max. 50 mA, Scaled According to Linearized Accumulated Total (e. g. Pulse every 12 Litres)
Pulse Duration: User Defined
0.008 s...2 s
Max. Frequency 64 Hz

Protection: IP65

Mounting: Wall Mounting

Data Protection: EEPROM Backup, Backup of Running Totals Every Minute, Data Retention at Least 10 Years

Communication: Modbus RTU RS485 2-wire (Optional other Modbus Versions)



Electronic Options (continuation)

Ex Version (K):

ATEX

Transducer:

II (1)G [Ex ia Ga] IIC

Sensor:

II 1 G Ex ia IIC T4 Ga

IECEX

Transducer:

[Ex ia Ga] IIC

Sensor:

Ex ia IIC T4 Ga

Electronics DOG-...M/N/O/P

(Sensor without/with ATEX/IECEX Certification and Flow Computer)

Display:

Alphanumeric LCD, UV-Resistant with Displayed Functions: Compensated Flow Rate: 7 Digits, 17 mm High Compensated Total (Resettable): 7 Digits, 17 mm High Accumulated Total (Not Resettable) 11 Digits, 8 mm High Actual Line Temperature: 6 Digits Actual Line Pressure: 6 Digits

Units:

Flow: m³, cf, scf, Nm³ Time Units: /sec, /min, /hr, /day Total: m³ Accumulated Total: m³ Temperature: °C, °F or °K Pressure: mbar, bar, PSI

Decimal Places:

Flow: 0, 1, 2 or 3 Total: 0, 1, 2 or 3 Accumulated Total: According to Selection for Total Temperature/Pressure: 1

Backlighting:

Yes

Signal Input:

Flow: sensor Temperature: PT100, 2- or 3-wire Pressure: 4...20 mA (Passive), 14-Bit Resolution, 2- or 3-wire

Power Supply:

- M: 230 VAC ± 10%, 50...60 Hz (without ATEX/IECEX) N: 230 VAC ± 10%, 50...60 Hz (with ATEX/IECEX) O: 110 VAC ± 10%, 50...60 Hz (without ATEX/IECEX) P: 110 VAC ± 10%, 50...60 Hz (with ATEX/IECEX)

Electrical Connection: 5 x M 16x1.5 Cable Gland

Housing Material: ABS with PC Cover

Weight: Approx. 4 lbs.

Analog Output: 4...20 mA (Active), 10-Bit Resolution, 3-wire

Pulse Output:

PNP, 24 VDC Active, Max. 50 mA, Scaled According to Linearized Accumulated Total (e. g. Pulse every 12 Litres) Pulse Duration: User Defined 0.001 s... 10 s Max. Frequency 500Hz

Protection:

IP 65

Mounting:

Wall mounting

Data Protection:

EEPROM Backup, Backup of Running Totals Every Minute, Data Retention at Least 10 Years

Communication:

Modbus RTU RS485 2-wire (Optional other Modbus vVersions on Request)

Ex Version (P):

ATEX

Transducer:

II (1)G [Ex ia Ga] IIC

Sensor:

II 1 G Ex ia IIC T4 Ga

IECEX

Transducer:

[Ex ia Ga] IIC

Sensor:

Ex ia IIC T4 Ga

Display



Note: Temperature and pressure sensors are not included in scope of delivery.



Order Details for DOG-4 for Dry Gases (Example: DOG-4 2 S1 A50 0 R0 0)

Model	Material	Measuring Range Air (CFM)	Process Connection ¹⁾	Ball Valves	Electronics	Options
DOG-4..	..2.. = 316L SS	..S1.. = 0.07 ... 7	..A25.. = ANSI 1" Class 150	..0.. = without Ball Valves ..1.. = with 2x Ball Valves	..C0.. = Frequency Output, 110 V _{AC} ..D0.. = as 'C0', with ATEX/IECEX ..R0.. = Frequency Output, 24 V _{DC} ..I0.. = Unit Counter, Pulse Output, Analog Output, 110 V _{AC} ..K0.. = as 'I0', with ATEX/IECEX ..L0.. = Unit Counter, Pulse Output, Analog Output, 24 V _{DC} ..O0.. = Flow Computer, Pulse Output, Analog Output, 110 V _{AC} ..P0.. = as 'O0', with ATEX/IECEX	..0 = without ..Y = Special Option (Specify in Clear Text)
		..01.. = 0.12 ... 12				
		..51.. = 0.21 ... 21	..B25.. = ANSI 1" Class 300			
		..A1.. = 0.41 ... 41				
		..S1.. = 0.07 ... 7	..A40.. = ANSI 1 1/2" Class 150			
		..01.. = 0.12 ... 12				
		..A6.. = 0.53 ... 53	..B40.. = ANSI 1 1/2" Class 300			
		..C1.. = 1.2 ... 120				
		..S1.. = 0.07 ... 7	..A50.. = ANSI 2" Class 150			
		..01.. = 0.12 ... 12				
		..B1.. = 0.65 ... 65	..B50.. = ANSI 2" Class 300			
		..C6.. = 1.5 ... 150				
		..B6.. = 0.82 ... 82	..A80.. = ANSI 3" Class 150			
		..D6.. = 2.7 ... 270				
		..F1.. = 4.7 ... 470	..B80.. = ANSI 3" Class 300			
		..D1.. = 1.6 ... 160				
		..E6.. = 3.8 ... 380	..A1H.. = ANSI 4" Class 150			
		..F6.. = 5.9 ... 590				
		..E1.. = 3.5 ... 350	..B1H.. = ANSI 4" Class 300			
		..G1.. = 7.1 ... 710				
..H1.. = 18 ... 1800	..A1F.. = ANSI 6" Class 150					
..G1.. = 7.1 ... 710						
..G6.. = 15 ... 1500	..A2H.. = ANSI 8" Class 150					
..H6.. = 35 ... 3500 ²⁾						

¹⁾ Max. pressure rating limited to 230 PSI for ANSI Class 150 and 360 PSI for ANSI Class 300

²⁾ Calibrated up to 2400 CFM. Higher flow rate calibration on request.



Oscillation Flow Meter for Wet and Dry Gases Model DOG

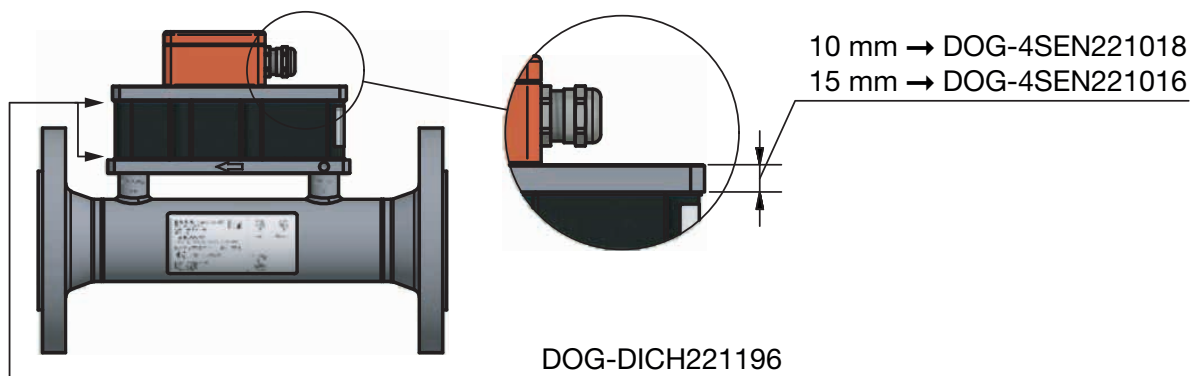
Order Details for DOG-6 for Wet Gases (Example: DOG-6 2 S1 A50 0 R0 0)

Model	Material	Measuring Range Air (CFM)	Process Connection ¹⁾	Ball Valves	Electronics	Options
DOG-6..	..2.. = 316L SS	..S1.. = 0.07 ... 5	..A25.. = ANSI 1" Class 150	..0.. = without Ball Valves ..1.. = with 2x Ball Valves	..CO.. = Frequency Output, 110 V _{AC} ..DO.. = as 'C0', with ATEX/IECEX ..RO.. = Frequency Output, 24 V _{DC} ..IO.. = Unit Counter, Pulse Output, Analog Output, 110 V _{AC} ..K0.. = as 'I0', with ATEX/IECEX ..L0.. = Unit Counter, Pulse Output, Analog Output, 24 V _{DC} ..O0.. = Flow Computer, Pulse Output, Analog Output, 110 V _{AC} ..P0.. = as 'O0', with ATEX/IECEX	..0 = without ..Y = Special Option (Specify in Clear Text)
		..01.. = 0.12 ... 9				
		..51.. = 0.21 ... 16	..B25.. = ANSI 1" Class 300			
		..A1.. = 0.41 ... 32				
		..S1.. = 0.07 ... 5	..A40.. = ANSI 1 1/2" Class 150			
		..01.. = 0.12 ... 9				
		..A6.. = 0.53 ... 41	..B40.. = ANSI 1 1/2" Class 300			
		..C1.. = 1.2 ... 88				
		..S1.. = 0.07 ... 5	..A50.. = ANSI 2" Class 150			
		..01.. = 0.12 ... 9				
		..B1.. = 0.65 ... 50	..B50.. = ANSI 2" Class 300			
		..C6.. = 1.5 ... 110				
		..B6.. = 0.82 ... 62	..A80.. = ANSI 3" Class 150			
		..D6.. = 2.7 ... 200				
		..F1.. = 4.7 ... 350	..B80.. = ANSI 3" Class 300			
		..D1.. = 1.6 ... 120				
		..E6.. = 3.8 ... 290	..A1H.. = ANSI 4" Class 150			
		..F6.. = 5.9 ... 440				
		..E1.. = 3.5 ... 270	..B1H.. = ANSI 4" Class 300			
		..G1.. = 7.1 ... 530				
		..H1.. = 18 ... 1300	..A1F.. = ANSI 6" Class 150			
		..G1.. = 7.1 ... 530				
		..G6.. = 15 ... 1100	..A2H.. = ANSI 8" Class 150			
		..H6.. = 35 ... 2400				

¹⁾ Max. pressure rating limited to 230 PSI for ANSI Class 150 and 360 PSI for ANSI Class 300

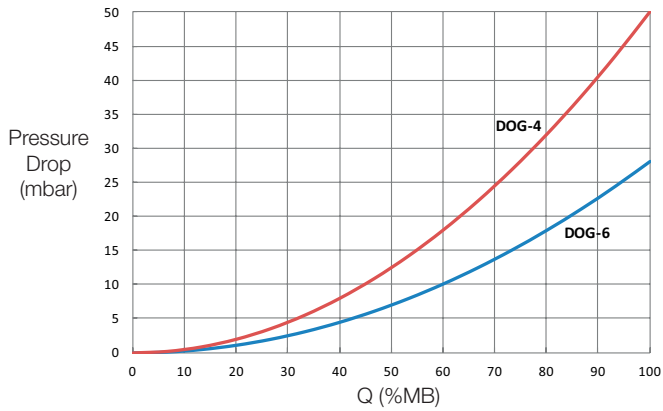
Order Details Accessories/Spare Parts for DOG-4/-6

Order Code	Description	Image
DOG-4SEN221018	DOG-4 spare sensor with transport sleeve, 10 mm plate	
DOG-4SEN221016	DOG-4 spare sensor with transport sleeve, 15 mm plate	
DOG-6SEN221195	DOG-6 spare sensor with transport sleeve	
DOG-4KAL01	DOG-4/ -6 calibration software with PC interface with USB connection	
DOG-DICH221196	DOG-4/-6 sealing set for oscillator	





Pressure Loss/Flow



The diagram applies for gases with a density of air at NPT (0°C and 1013.25 mbar). The pressure loss is always proportional to the density of the gas. For example, the pressure loss doubles at 100% higher operating pressure.

Calculating the Actual Density

The actual density can be calculated with the following formula:

$$D = \frac{D_0 * P * T_0}{T}$$

D_0 = Density at 1 bar abs. and 0°C (= 273 °K)

T = Temperature in °K = °C + 273

(for example 20 °C = 273 + 20 = 293 °K)

T_0 = 273 °K

P = Operating pressure in bar (Absolute pressure)

Calculating the Norm Flow

$$Q_N = Q \cdot \frac{P * 273}{1.013 * T}$$

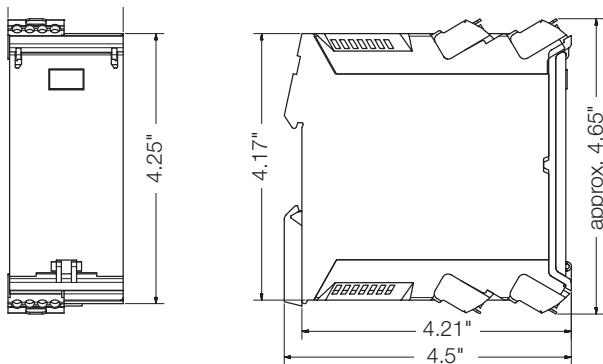
Q_N = Norm flow at 1.013 bar abs. and 0°C

Q = Operating Flow

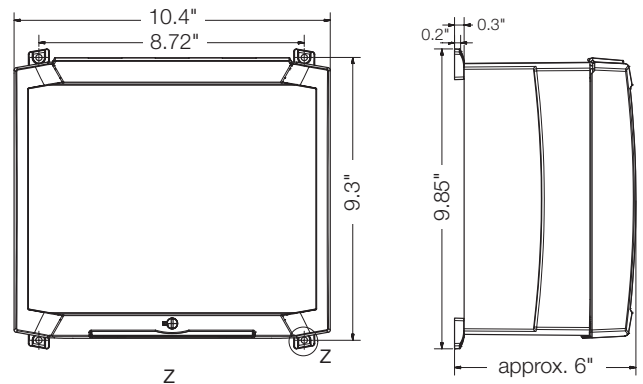
P = Operating Pressure in bar (Absolute Pressure)

T = Operating Temperature in °K

Dimensions Electronics DOG-...A/B/C/E/R



Dimensions Electronics DOG-...G/H/I/L/M/N/O

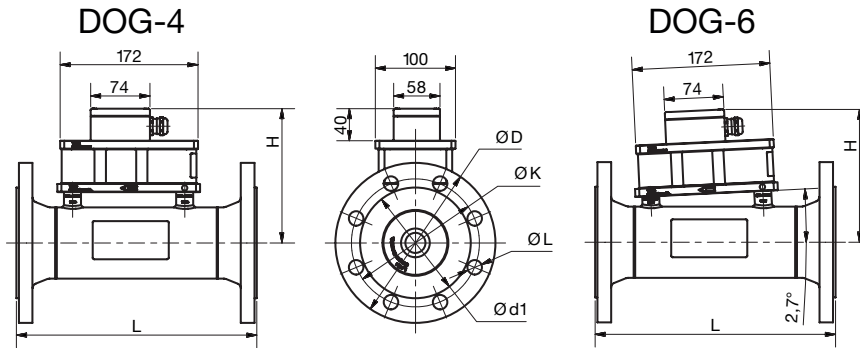


Accessories (Optional)

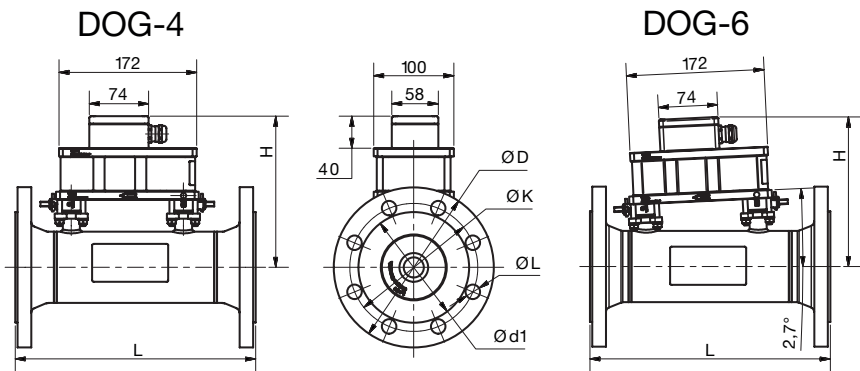
- Replacement sensor
- Sealing for oscillator
- Recalibration tool for transmitter

Dimensions (mm) and Weights DOG-4/-6

Without Ball Valves



With Ball Valves



Dimensional Details, ASME Flanges Class 150

NPS	L Length mm/inch	H Height without Valves (mm)	H Height with Valves (mm)	ØD Outer Ø (mm)	ØK Pitch Circle (mm)	ØL Hole Ø (mm)	Ød1 Sealing Surface Ø (mm)	No. of Holes	Hole Size	Weight (lbs)
1	317.5/12.5"	140	166	110	79.4	15.9	50.8	4	M14	14.0
1½	317.5/12.5"	148	174	125	98.4	15.9	73	4	M14	18.0
2	317.5/12.5"	154	180	150	120.7	19.1	92	4	M16	22.5
3	355.7/14"	168	194	190	152.4	19.1	127	4	M16	34.0
4	355.7/14"	181	207	230	190.5	19.1	157.2	8	M16	44.3
6	381/15"	208	234	280	241.3	22.2	216	8	M20	65.5
8	381/15"	233	260	345	298.5	22.2	270	8	M20	104.3

Dimensional Details, ASME Flanges Class 300

NPS	L Length mm/inch	H Height without Valves (mm)	H Height with Valves (mm)	ØD Outer Ø (mm)	ØK Pitch Circle (mm)	ØL Hole Ø (mm)	Ød1 Sealing Surface Ø (mm)	No. of Holes	Hole Size	Weight (lbs)
1	317.5/12.5"	140	166	124	88.9	19.1	50.8	4	M16	16.1
1½	317.5/12.5"	148	174	155	114.3	22.2	73	4	M20	22.5
2	317.5/12.5"	154	180	165	127	19.1	92	8	M16	25.4
3	355.7/14"	168	194	210	168.3	22.2	127	8	M20	41.7
4	355.7/14"	181	207	255	200	22.2	157.2	8	M20	62.8