ENGINEERING
TOMORROW

Data sheet

Pressure operated water valve

Type WVO

Pressure operated water valve type WVO is used for regulating the flow of water in refrigeration plant with water-cooled condensers.

The pressure operated water valve gives modulating regulation of the condensing pressure and so keeps it constant during operation. When the refrigeration plant is stopped, the cooling water flow is shut off automatically.

Pressure operated water valve can be used with flammable refrigerants. Double sealing between the refrigerant and the water line ensures that in case the bellows damage and the refrigerant leak, it cannot enter into the water. This severely limits the safety implications.

It means that the valve can be used together with a double walled heat exchanger and water circuit in such a system does not need to be considered as a part of the installation for flammable refrigerants (EN378-1:2008, clause 4.4.2.2).

Features

- Compact valve
- Setting pressure done by factory (optional)
- HCFC, HFC and HC
- NPT threads on request
- Capillary tube available as option
- Stainless steel version available for request
- Suitable for flammable refrigerants
- May be used in the following EX range: Category 3 (Zone 2)

Technical data

	Water side	Refrigerant side
Max. working pressure PS / MWP	16 bar / 232 psig	26.4 bar / 383 psig
Max. test pressure PT	24 bar / 350 psig	38 bar / 551 psig
Media	Fresh water and neutral brine	R22, R1270, R134a, R290, R404A, R407A, R407C, R407F, R448A, R449A, R450A, R452A, R507A, R513A, R600, R600a
Max. differential pressure	10 bar / 145 psi	–
Temperature range	-25 – 130 °C / -13 – 266 °F	-25 – 130 °C / -13 – 266 °F

Type	Orifice size		k_v value [1]	C_v value [2]
	[mm]	[in]	[m^3 / h]	[gal / min]
WVO 10 LF	10	2/5	0.63	0.7
WVO 10	10	2/5	1.4	1.6
WVO 15	15	3/5	1.9	2.2
WVO 20	20	4/5	3.4	3.9
WVO 25	25	1	5.5	6.4

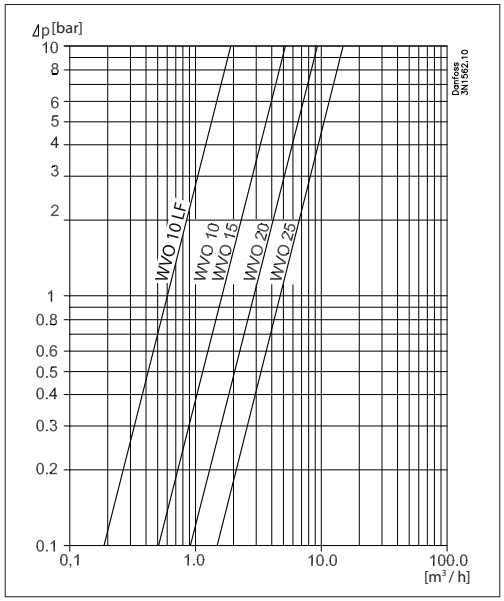
[1]) The k_v value is the flow of water in [m^3 / h] at a pressure drop across valve of 1 bar, ρ = 1000 kg / m^3
[2]) The C_v value is the flow of water in [gal / min] at a pressure drop across valve of 1 psi, ρ = 10 lbs / gal

Capacity

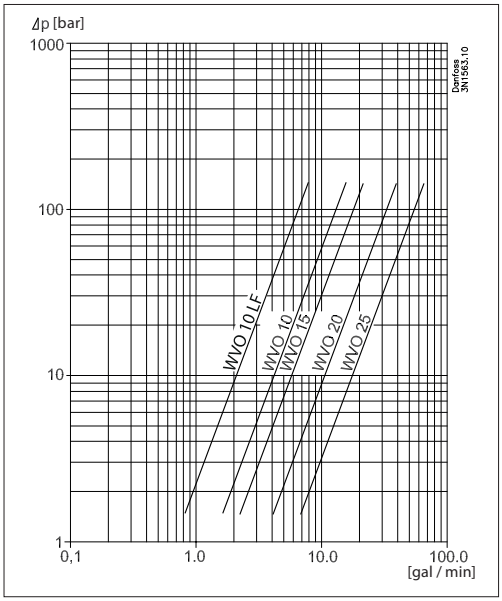
The capacity curves show the capacities of the individual valves (water quantity in [m^3 / h]) depending on the water pressure drop across the valve.

The capacity given apply at 85% valve opening and are obtained with the offset shown on page 4.

SI unit



US unit



Ordering

Type	Connection type	Connection standard	Pressure range		Code no.
			[bar]	[psig]	
WVO 10 LF	G 3/8	ISO 228–1	8 – 12	115 – 175	**003N8053** [2]
WVO 10 LF	G 3/8	ISO 228–1	14 – 18	200 – 260	**003N8054** [2]
WVO 10	G 3/8	ISO 228–1	8 – 12	115 – 175	**003N5203**
WVO 10	G 3/8	ISO 228–1	14 – 18	200 – 260	**003N5206**
WVO 10	G 3/8	ISO 228–1	16 – 20	232 – 290	**003N5207**
WVO 10	G 3/8	ISO 228–1	16 – 22	232 – 320	**003N6220** [1]
WVO 15	G 1/2	ISO 228–1	Available on request		
WVO 20	G 3/4	ISO 228–1	Available on request		
WVO 25	G 1	ISO 228–1	Available on request		
WVO 10	NPT 3/8	ANSI/ASME B1.20.1	6 – 10	85 – 145	**003N8052**
WVO 10	NPT 3/8	ANSI/ASME B1.20.1	14 – 18	200 – 260	**003N8056**
WVO 15	NPT 1/2	ANSI/ASME B1.20.1	6 – 10	85 – 145	**003N8062**
WVO 15	NPT 1/2	ANSI/ASME B1.20.1	14 – 18	200 – 260	**003N8066**
WVO 20	NPT 3/4	ANSI/ASME B1.20.1	14 – 18	200 – 260	**003N8076**
WVO 25	NPT 1	ANSI/ASME B1.20.1	Available on request		

[1]) with 0.8 m capillary tube and valve opener
[2]) WVO 10 low flow version with k_v value: 0,63 m^3/h

Codes for valve with prefabricated factory setting, other sizes and pressure ranges are available on request.

Accessories

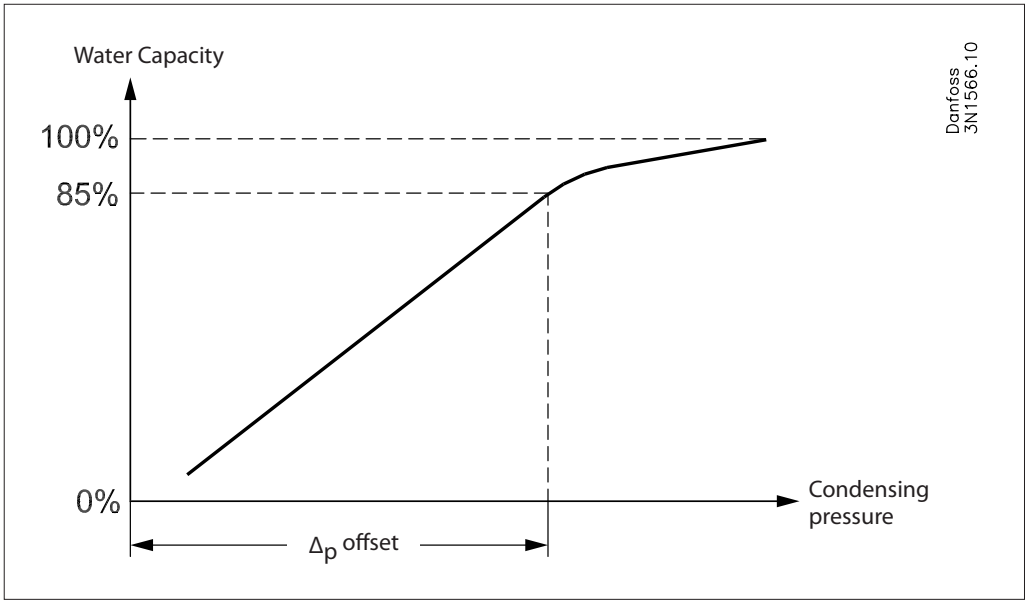
Description	Code no.
1 m (39 in) capillary tube ¼ in. (6 mm) flare coupling nuts at each end	**060-007166**
Bracket	**003N0388**

Sizing

When sizing and selecting water regulating valves it is most important to ensure that the valve at any time is able to give the necessary quantity of cooling water.
To select a suitable size of valve it is necessary to know the precise amount of cooling required. On the other hand, to avoid the risk of unstable regulation (hunting) the valve should not be oversized. In general, the aim should be to select the smallest valve capable of giving the required flow .
To obtain a precise control it can be recommended to only use 85% of the capacity.

Below 85% the ratio between flow and condensing difference pressure is linear. Above 85% the ratio is no longer linear. To reach a 100% capacity the WVO needs significant increase of condensing pressure. See table at the bottom of the page.

Offset



Type	Δ_p offset	
	[bar]	[psi]
WVO 10 LF	1.6	23
WVO 10	2.0	30
WVO 15	2.5	35
WVO 20	3.0	43
WVO 25	3.5	50

Valve size

The following data is used when selecting the size of WVO:

- Cooling capacity of condenser,
- Temperature rise in cooling media,
- Differential pressure across valve,
- Condensing temperature,
- Specific heat capacity of cooling media,
- Refrigerant.

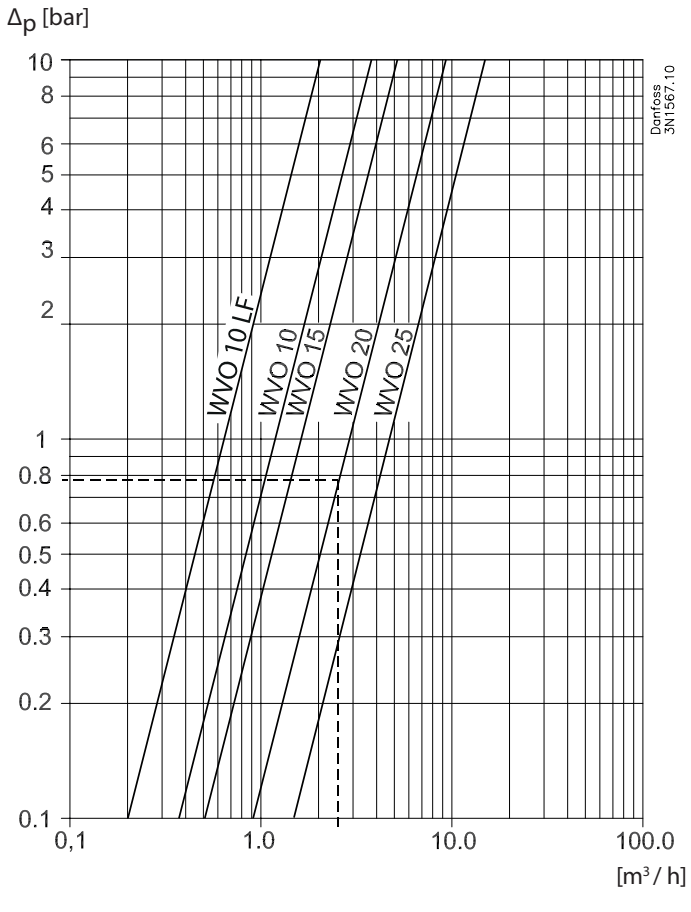
Calculating size in SI Unit

Example 1:

- Condenser capacity Q_0: 30 kW
- Condensing temperature t_0: 35 °C
- Refrigerant: R404A
- Cooling media: water
- Specific heat capacity of water C_p: 4.19 kj / (kg*K)
- Water inlet temperature t_1: 15 °C
- Water outlet temperature t_2: 25 °C
- Pressure drop across valve Δ_p: max. 1.0 bar

Necessary mass flow	$\dot{m} = \frac{Q_c}{C_p \cdot (t_2 - t_1)} \cdot 3600 = \frac{30}{4.19 \cdot (25 - 15)} \cdot 3600 = 2577 \text{ kg / h}$
Volume flow	$\dot{V} = \frac{\dot{m}}{\rho} = \frac{2577}{1000} \approx 2.6 \text{ m}^3\text{/ h}$

Selecting size



Selecting WVO 20 code number

The saturated pressure for R404A
T_c = 35 °C ⇒ P_c = 7.9 barg

Choose a WVO 20 with 6 – 10 barg range

Calculating size in SI Unit
(continue)

Example 2:

- Condenser capacity Q_c: 20 kW
- Condensing temperature t_c: 35 °C
- Refrigerant: R134a
- Cooling media: Brine
- Density of brine ρ: 1015 kg / m³
- Specific heat capacity of brine C_p: 4.35 kj (kg*K)
- Brine inlet temperature t_1: 20 °C
- Brine outlet temperature t_2: 25 °C
- Pressure drop across valve Δp: max. 2.0 bar

Necessary mass flow	$\dot{m} = \frac{Q_c}{C_p \cdot (t_2 - t_1)} \cdot 3600 = \frac{20}{4.35 \cdot (25 - 20)} \cdot 3600 = 3310 \text{ kg / h}$
Volume flow	$\dot{V} = \frac{\dot{m}}{\rho} = \frac{3310}{1015} \approx 3.26 \text{ m}^3\text{ / h}$
k_v value	$k_v \geq \frac{\dot{V}}{\sqrt{\frac{1000 \cdot \Delta p}{\rho}}} = \frac{3.26}{\sqrt{\frac{1000 \cdot 2.0}{1015}}} = 2{,}32 \text{ m}^3\text{ / h}$

Selecting size of WVO 20

$k_v \geq 2.32$ m³ / h ⇒ **WVO 20**
WVO 20 has $k_v = 3.4$ m³ / h and the necessary capacity is below 85% of full capacity.

Code number

The saturated pressure for 134a
$T_c = 35$ °C $P_c = 7.9$ barg

Choose a WVO 20 with 6 – 10 barg range

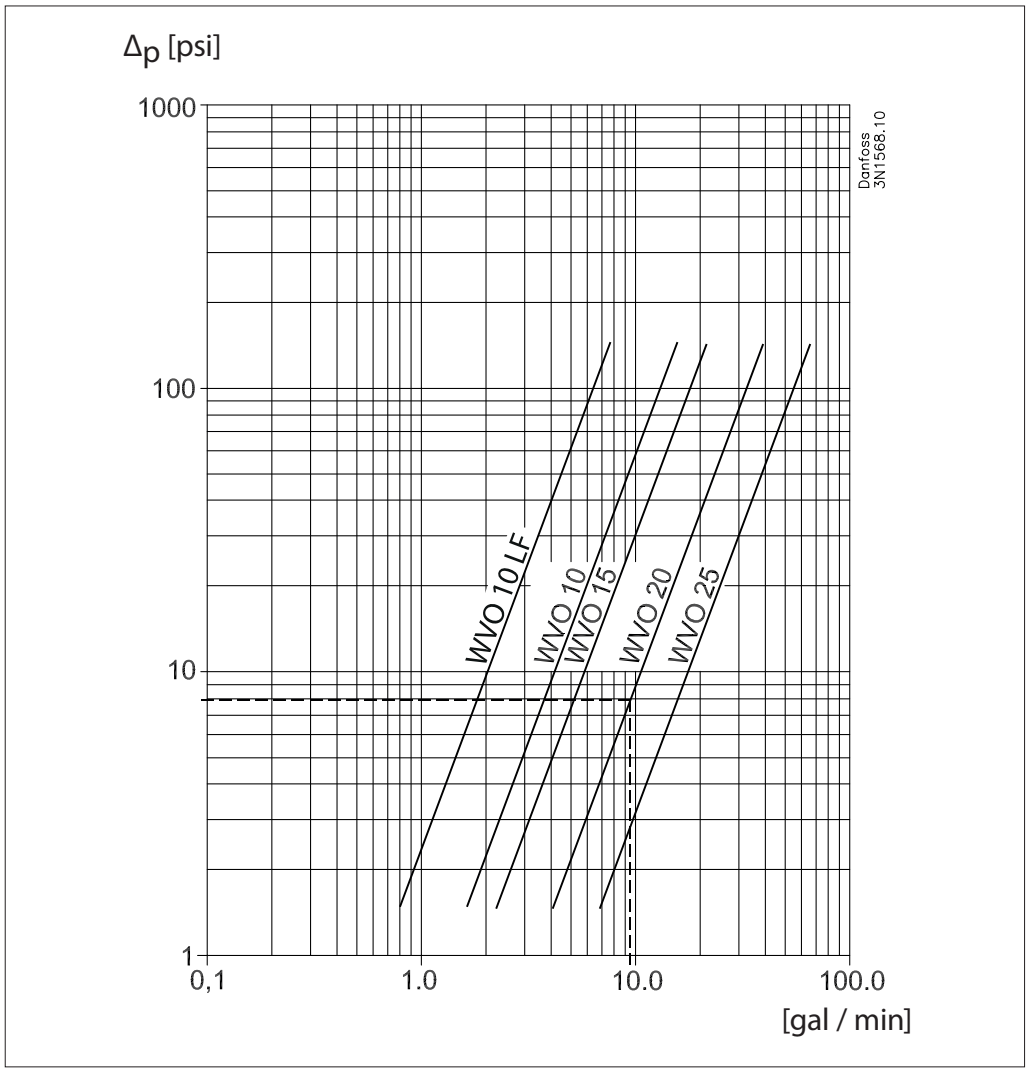
Calculating size in US Unit

Example 1:

- Condenser capacity Q_c: 5 TR
- Condensing temperature t_c: 95 °F
- Refrigerant: R404A
- Cooling media: water
- Water inlet temperature t_1: 60 °F
- Water outlet temperature t_2: 75 °F
- Pressure drop across valve Δ_p: max. 15 psi

Necessary water flow	$V = \frac{Q_c \cdot 15000}{500 \cdot (t_2 - t_1)} = \frac{5 \cdot 15000}{500 \cdot (75 - 60)} = 10$ GPM

Selecting size

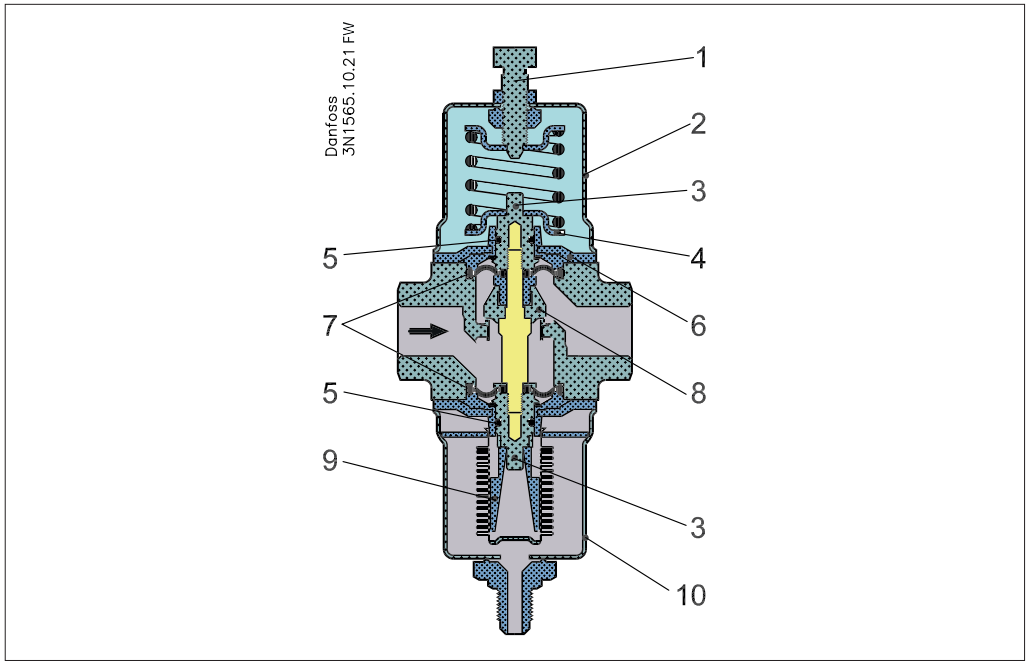


Selecting WVO 20 code number

The saturated pressure for R404A
$T_c = 95$ °F $\Rightarrow P_C = 115$ psig

Choose a WVO 20 with 85 – 145 psig range

Design / Function



1. Screw for setting pressure
2. Spring housing
3. Spindle retainer
4. Spring retainer
5. O-ring
6. Guide bush
7. Diaphragm
8. Valve plate
9. Thrust pad
10. Bellows element

Condensing pressure impulses are transmitted via the bellows element to the valve cone so that the valve - even at very small pressure variations - is able to adapt the quantity of water required by the condenser.
If fluorinated refrigerants are to be used a capillary tube connection is required, 1 m capillary tube with ¼ in. / 6 mm flared union nuts at either end can be supplied.
The valves are pressure-relieved in such a way that a variation in the water pressure will not affect their setting.
To protect the refrigeration plant against high head pressures - in the event that the water supply to the condenser should fail - a safety switch type KP or RT should be fitted on the high pressure side.

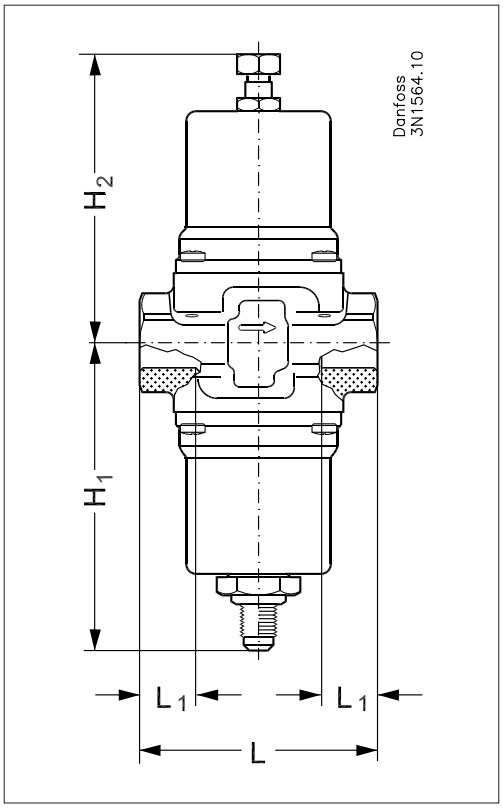
The valve plate (8) is a brass plate with a vulcanized layer of special rubber to form an elastic seal against the valve seat. The valve is externally sealed by the diaphragms (7).
The top and bottom of the valve plate holder is extended by a guide that is fitted with O-rings (5) to ensure the internal operating parts move correctly. These O-rings, fitted in conjunction with the diaphragms, also provide extra protection against external leakage.
The valve seat is made of stainless steel and is swaged to the valve body.

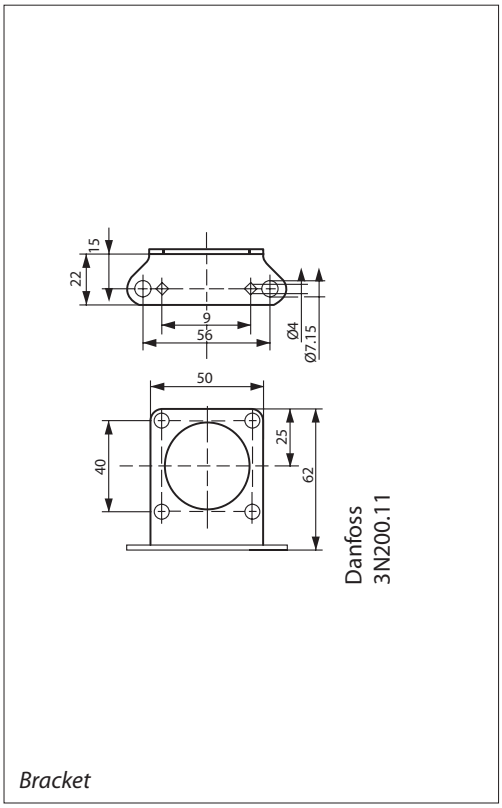
Installation

Between the flare connection of the pressure operated water valve and the pipe line / compressor Danfoss recommends to use capillary tube to avoid fatigue error due to the vibration from the compressor.

The installation of an MESH 40 filter ahead of the valve is recommended.
If a mounting bracket is used it must always be between valve body and setting section.

Dimensions and weights





Bracket

Type	H_1		H_2		L		L_1		Net weight	
	[mm]	[in]	[mm]	[in]	[mm]	[in]	[mm]	[in]	[kg]	[lbs]
WVO 10	91	3.58	89	3.50	72	2.83	11	0.43	1.0	2.20
WVO 15	91	3.58	89	3.50	72	2.83	14	0.55	1.0	2.20
WVO 20	91	3.58	89	3.50	90	3.54	16	0.63	2.0	4.40
WVO 25	96	3.78	94	3.70	96	3.74	19	0.75	2.0	4.40