

CHOOSING SPECIFICATIONS OF SEWER MAINTENANCE MACHINERY AND SAFETY EQUIPMENT



PAKISTAN WATER OPERATORS NETWORK
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PREFACE

On behalf of All water utilities in Pakistan PWON is thankful to JICA for providing Support for ***Management of Water & Sanitation Services in Punjab against Covid-19*** through which lectures / webinars were arranged January 2022, to end March 2022, for ***Better Management of Water & Sanitation Services during Outbreak*** as well as ***Awareness & Preventive Measures against Covid-19 and Preparation of in house Disinfection by Water & Sanitation Utilities.***

On demand of PWON members, lectures for capacity building of utilities in Pakistan about various important technical topics were also added along with above lectures / webinars / seminars. All these events were well participated and appreciated by all utilities

On demand of member utilities PWON has published these lectures for capacity building and references for improvement of their day to day working for the benefit of their consumers at large. This book on the topic of **CHOOSING SPECIFICATIONS OF SEWER MAINTENANCE MACHINERY AND SAFETY EQUIPMENT** is published by PWON for the benefit of all its members.

PWON is thankful to Capt. (R) Muhammad Hafeez for Preparing this valuable document.

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1. Important Specs of Suction Machines

Engine 4-cycle, water cooled, diesel engine 140KW

Gross vehicle weight 16 ton

Chassis 8 ton

Vacuum pump: Blower type, water sealing type

Vacuum pressure : Not less than -90kPa at sealing water temperature of 15C

Air flow : Not less than 30m³/min

Driving force for pump: PTO in the chassis

Tank : Stainless steel capacity not less than 4.5 M³

Thickness of tank plate : Not less than 6 mm

Interior coating : Rust proof paint

1.2 Vacuum pump

What happens when you get quotation from suction machine manufacturers in Pakistan:

They offer vacuum pump of low capacity:

Specification	Required	Normally offered
Vacuum pressure	-90 kpa minimum	200-300mm of Hg Means 26-40kpa
Air flow	More than 30m ³ /min	12-13m ³ /min
Tank capacity	6-7m ³	3.5-7m ³

So make specs without help of any quotation. Guide the manufacturer instead of being guided

1.3 Suction machine specs by Japanese manufacturers

Model Classification	Suction rate	Vacuum pressure	Power requirement
Mobile Vac 10	10 m ³ /min	-96kPa	17kW
Mobile Vac 20	18 m ³ /min	-69kPa	29kW
	20 m ³ /min	-96kPa	32kW
Mobile Vac 40	40 m ³ /min	-96kPa	58kW
Mobile Vac 50	50 m ³ /min	-96kPa	87kW
Mobile Vac 60	60 m ³ /min	-93kPa	93kW
Mobile Vac 70	70 m ³ /min	-96kPa	104kW
Mobile Vac 80	80 m ³ /min	-93kPa	118kW
Mobile Vac 100	100 m ³ /min	-87kPa	141kW

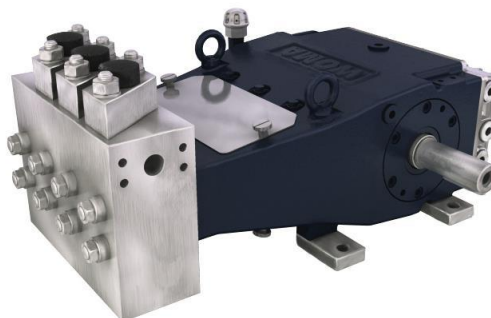
1.4 Important Specs of Jetting Machines

High pressure pump: Plunger type

- ❖ Discharge pressure : Not less than 190 bar with flow capacity 210Liter/min or 155 bar with 260 l/min.
- ❖ (260 l/min will take 30 mintues to empty 8000 liters tank and 210 l/min will take 38 minutes.

STRENGTH OF HOSE:-

- ❖ BURST PRESSURE:- Shall be minimum of 7500psi (520 bar)
- ❖ WORKING PRESSURE:-
- ❖ Shall be minimum of 3000 psi (200 bar).
- ❖ Tank capacity: Not less than 8000 liters, mild steel sheets, which in no case shall be less than 6 mm thick.
- ❖ GVW 16ton



1.5 Plunger pumps

Model	1800 rpm (R = 1:2,417)						1500 rpm (R = 1:2,037)					
	Flow rate		Pressure		Power		Flow rate		Pressure		Power	
	l/min	Gpm	bar	psi	kW	Hp	l/min	Gpm	bar	psi	kW	Hp
MS 36	136	35,9	300	4350	78,8	107	134	35,4	300	4350	77,3	105
MS 40	168	44,4	240	3500	77,3	105	166	43,9	240	3500	76,5	104
MS 45	213	56,3	190	2750	78,0	106	210	55,5	190	2750	76,5	104
MS 50	263	69,5	155	2250	78,8	107	260	68,7	155	2250	77,3	105
MS 55	318	84,0	125	1800	76,5	104	314	83,0	125	1800	75,4	103

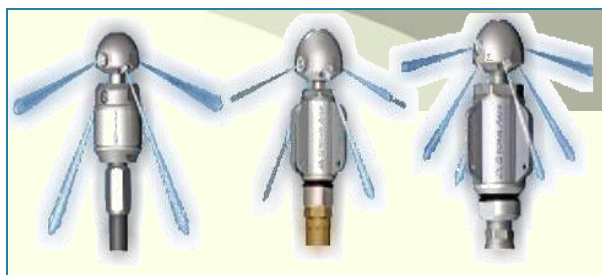
You will have to select from more pressure and less flow rate or more flow rate and less pressure

1.6 Jetting machines pump capacities by Japanese manufacturers

Specification of pump	one model	2nd model
Water Flow Rate (l / min)	230	180
Water Pressure (bar)	200	250

1.7 Choose Jetting nozzles as per requirement

- the difference in the jetting pattern is that two additional jet ports have been added at 105°. Plus, the front boring jet has been plugged to ensure maximum power is delivered to the new, scale removing jets.
- The result is enhanced removal of scale, tuberculation, corrosion products, soap and minerals.

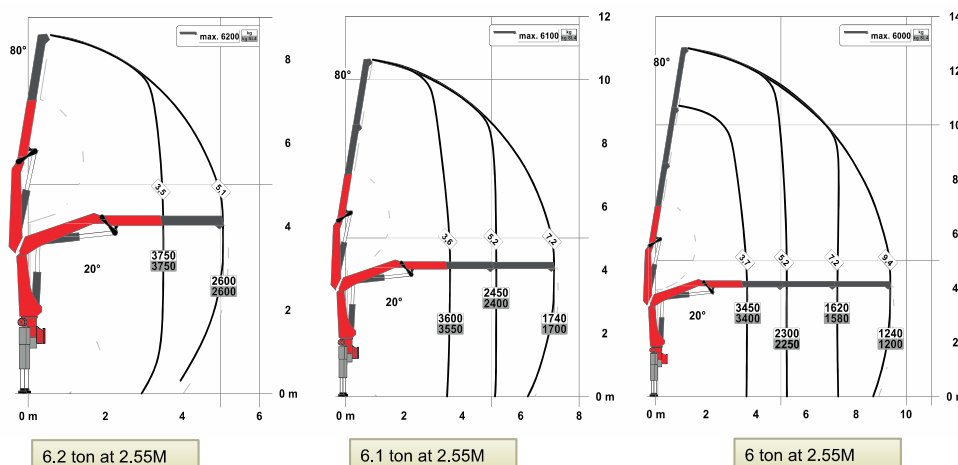


1.8 Optional heads for max. cleaning

Sewer Jetting Nozzle

WARTHOG® - 5 Models to Fit Your Pumps and Lines					
	WT-3/8-C	WS-1/2	WH-1/2 & 3/4	WG-1	WD 1-1/4
Maximum Pressure	4000 PSI	4000 PSI	8000 PSI	3000 PSI	3000 PSI
Operating Pressure	1500-4000 PSI	1500-4000 PSI	1500-8000 PSI	1500-3000 PSI	1500-3000 PSI
Rotating Speed	300-500 RPM	200-500 RPM	150-300 RPM	150-300 RPM	150-300 RPM
Flow	5-12 GPM	8-20 GPM	10-45 GPM	50-80 GPM	80-120 GPM
Flow Rating	0.75Cv	1.3Cv	3.0Cv	4.6Cv	7.6Cv
Pulling Force	5-20 lb	9.27 lb	18-50 lb	70-100 lb	130-190 lb
Inlet Port	3/8 NPT or BSPP	1/2 NPT or BSPP	1/2, 3/4 NPT or BSPP	1 NPT or BSPP	1-1/4 NPT or BSPP
Tool Diam. (Incl. Skid)	1.9 in.	1.9 in.	3.4 in.	4.8 in.	4.8 in.
Suitable For Pipe Diameter	76-152 mm	102-204 mm	152-457 mm	203-914 mm	203-914 mm
Length	3.0 in.	4.4 in.	7.5 in.	9.1 in.	9.1 in.
Nozzle Ports	3 x 1/8 NPT	3 x 1/8 NPT	3 x 1/8 NPT	5 x 1/8 NPT	7 x 1/8 NPT
Weight Complete	544 Grams.	1338 Grams.	2131 Grams.	4944 Grams.	4989 Grams.

2.Truck Mounted Cranes

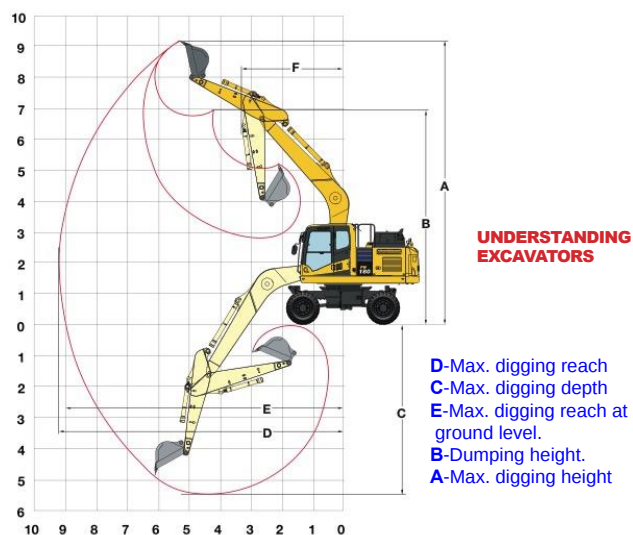


Max. lifting capacity 6200 Kg At 2.55m & at 2M may be 5000Kg

2.1 Truck Mounted Cranes

PK 15500 Performance A			
hydraulic			
Outreach		Capacity	
2.3 m	6100 kg	7' 7"	13450 lbs
4.5 m	3140 kg	14' 9"	6920 lbs
6.1 m	2250 kg	20' 0"	4960 lbs
8.0 m	1690 kg	26' 3"	3730 lbs

PK 15500 Performance B			
hydraulic			
Outreach		Capacity	
2.0 m	6000 kg	6' 7"	13230 lbs
4.5 m	3040 kg	14' 9"	6700 lbs
6.1 m	2140 kg	20' 0"	4720 lbs
8.0 m	1570 kg	26' 3"	3460 lbs
10.1 m	1230 kg	33' 2"	2710 lbs
manual			
12.3 m	930 kg	40' 4"	2050 lbs
14.4 m	740 kg	47' 3"	1630 lbs
16.6 m	600 kg	54' 6"	1320 lbs



3 Comparison of specs: the biggest Wheeled Excavators available world wide

Specs	Hitachi	Doosan	Hyundai	Komatsu
Max. digging reach(meters)	10.28	10.00	9.96	9.929
Max. digging depth(meters)	6.31	6.255	6.38	5.966
Engine HP	164	170	174	165

3.1 Mini excavators

Specs	capacity
Max. digging reach	4.1 to 7.39
Max. digging depth	2.4 to 4.62
Engine	13.3HP to 67HP
Bucket	0.014m3 to 0.28m3



3.2 Suitable for small road side drains and pipe laying



4 Auto priming & Self-priming Dewatering sets



4.1 Dewatering sets

Capacity available from 1 cusec to 15 cusec

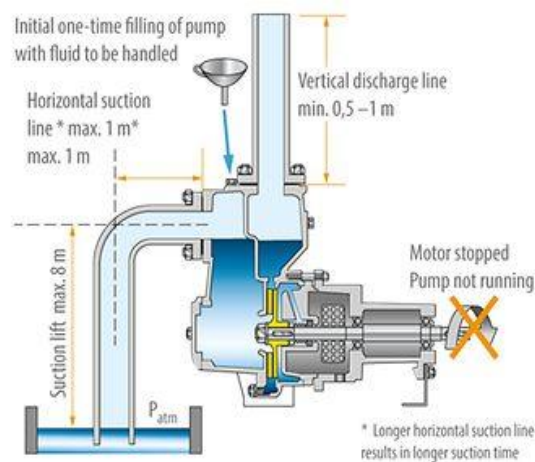
Suction Pipe size from 2 inch to 20 inch

Solids passing size from 38mm to 80mm

Types of self-priming pumps

- Dry prime centrifugal pumps: The pump system consists of a centrifugal pump and a separator, which enables air to be separated from the liquid and be sucked by a vacuum pump – making automatic priming possible.
- Wet prime pumps: : It uses an air-water mixture to reach a fully-primed pumping condition.

4.2 Wet prime pumps



- The impeller and volute casing is essentially surrounded by a tank so that it can always be immersed in a liquid sufficient to get the pump started.

- It is important that a self-priming centrifugal pump's reservoir is filled correctly with liquid after installation. “ Even a ‘self-priming’ centrifugal pump will not operate when dry.
- In its priming mode, the pump essentially acts as a liquid-ring pump. The rotating impeller generates a vacuum at the impeller's ‘eye’ which draws air into the pump from the suction line.
- At the same time, it also creates a cylindrical ring of liquid on the inside of the pump casing. **This effectively forms a gas-tight seal, stopping air returning from the discharge line to the suction line.** Air bubbles are trapped in the liquid within the impeller's vanes and transported to the discharge port. There, the air is expelled and the liquid returns under gravity to the reservoir in the pump housing.
- Gradually, liquid rises up the suction line as it is evacuated. This process continues until liquid replaces all the air in the suction piping and the pump. At this stage, the normal pumping mode commences, and liquid is discharged.

4.3 Auto prime or Dry prime pumps

- The main difference in a [dry-prime pump](#) is its ability to prime without the need to add fluid.
- Prime is maintained by a vacuum unit, diaphragm, compressor or other priming device. An integral compressor creates vacuum through a venturi educator to achieve proper suction prime.
- A dry-prime pump's rapid priming coupled with higher volumes results in a great efficient compared to wet-prime pumps. With the improved efficiency and performance comes a higher price tag, usually about 40% more than a wet-prime unit.



4.4 WHY YOUR SELF-PRIMING PUMP WON'T PRIME

- Air leak in suction line
- Debris in the impeller
- Pump is air bound

- Plugged recirculation port
- Lift too high for pump speed or impeller diameter

5. Dump trucks

- Tipping system is the most important.
- Selection of right truck for required pay load



Optional bodies



▲U-section body with high hinge



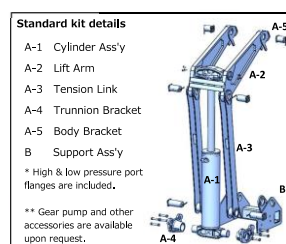
▲Refuse dump body



▲Scoop end type
(for rock and heavy material)

5.1 Hoist specification

Cylinder bore x stroke	160 x 584 mm
Rod diameter	70 mm
Retracted Cylinder Length	1,008mm (Eye to Eye)
Max. pressure	13.7 MPa (140 kgf/cm ²)
Mass (Support Ass'y included)	262 kg



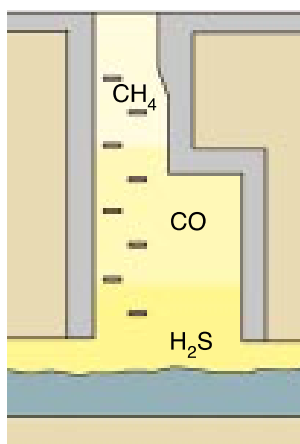
Rated Lifting Capacity(kg)	Recommended Truck G.V.W.(kg)	Body length L(mm)	Designed Maximum Lifting Capacity(kg)		
			50°	55°	60°
6-8ton	11-17ton	4.5m		16ton	

6. Safety Equipment

6.1 Highly toxic components of sewer gas

- Hydrogen sulfide, methane, carbon dioxide, sulfur dioxide & Carbon mono oxide.
- Symptoms of headache, nausea, dizziness, or drowsiness may indicate exposure to an odorless gas like methane or carbon monoxide, or to hydrogen sulfide, which smells of rotten eggs.
- Anyone experiencing severe symptoms should seek immediate medical care.

6.2 Gases of main concern



6.3 How these gases are formed

- The end products of anaerobic decomposition include gases like hydrogen sulphide, ammonia, methane, etc. $C_6H_{12}O_6 \rightarrow 3CO_2 + 3CH_4$
- Aerobic decomposition is caused in the presence of air or oxygen which is available in sewage in the dissolved form. During this process, organic matter is broken up and oxidized to form stable and non-objectionable end products such as carbon dioxide, nitrates, sulphates, etc.

6.4 H₂S and CO

Hydrogen sulphide (H₂S)

Hydrogen sulfide has been reported as the leading cause of sudden death in the work place. At concentrations in air of approximately 300 ppm, H₂S can be immediately deadly.

At concentrations above 100 ppm, hydrogen sulphide has a paralysing effect on the sense of smell.

It is absorbed primarily through the lungs, but can also be adsorbed to a limited extent through the skin and mucous membranes(eyes, ears, nose, mouth etc).

Carbon monoxide (CO)

The lethal colorless and odorless gas – carbon monoxide

Exposure to carbon monoxide at concentrations over 350 ppm can cause confusion, fainting on exertion and collapse. An airborne concentration of carbon monoxide above 1,200 ppm is immediately dangerous to life or health.

6.5 Methane (CH₄) & CO₂

- ❖ Methane is a simple minimally toxic [gas](#) and displaces oxygen, but does not itself cause significant physiological responses.
- ❖ It is a colorless, extremely flammable and explosive gas that can cause fire and explosion.
- ❖ Carbon dioxide is a simple asphyxiant (displaces oxygen) and a stimulant for the respiratory system. A concentration of 5% may produce headaches and shortness of breath. Background concentrations of carbon dioxide in air range from 300 to 400 ppm.

6.6 Choose easy operated Four gas detectors



6.7 Breathing equipment & Full body harness

■ Respirators and/or self-contained breathing apparatus



6.8 Tripod and ventilating arrangement



6.9 Ventilation eqpt. protective clothing



Fresh air should be supplied to the working location and the blower fan must be carefully located to avoid sucking in contaminated air.

6.10 PPE

There are four primary types of disease-causing organisms that can affect humans and are found in sewage — bacteria, protozoa, viruses and parasitic worms. PPE can help ensure that these contaminants are kept off of the human body and keep the worker free from scrapes, cuts, scratches and other bodily harm.

PPE



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