WATER METERS

USET SUMMIT

MARCH 2-5, 2020

Water Meters

281

Cash register for the water system

Determine the amount of unaccounted for water loss

POSITIVE DISPLACEMENT METERS

282

- METERS USED FOR MEASURING LOW FLOW RATES ARE CALLED POSITIVE DISPLACEMENT METERS
- NUTATING DISC AND ROTAING DISC
- NOT INTENDED TO OPERATE AT FULL FLOW FOR EXTENDED PERIODS OF TIME
- A METER SHOULD BE SIZED TO OPERATE AT HALF ITS MAXIMUM RATING
- CUSTOMER WILL RECEIVE FREE WATER AT FLOW RATES THAT ARE TOO LOW TO START THE METER OPERATION
- SPECIAL METER THREADS
- HIGH WATER BILLS ARE OFTEN ACCUSED BY CUSTOMER TO BE METER RELATED.

METER INSTALLATION

SMALL METER INSTALLATION

- SMALL METERS ARE USUALLY INSTALLED WITH A CURB STOP FOR A SHUT OFF
- METER YOLKS AND SETTERS HAVE THE METER SPACEING PREDESIGNED

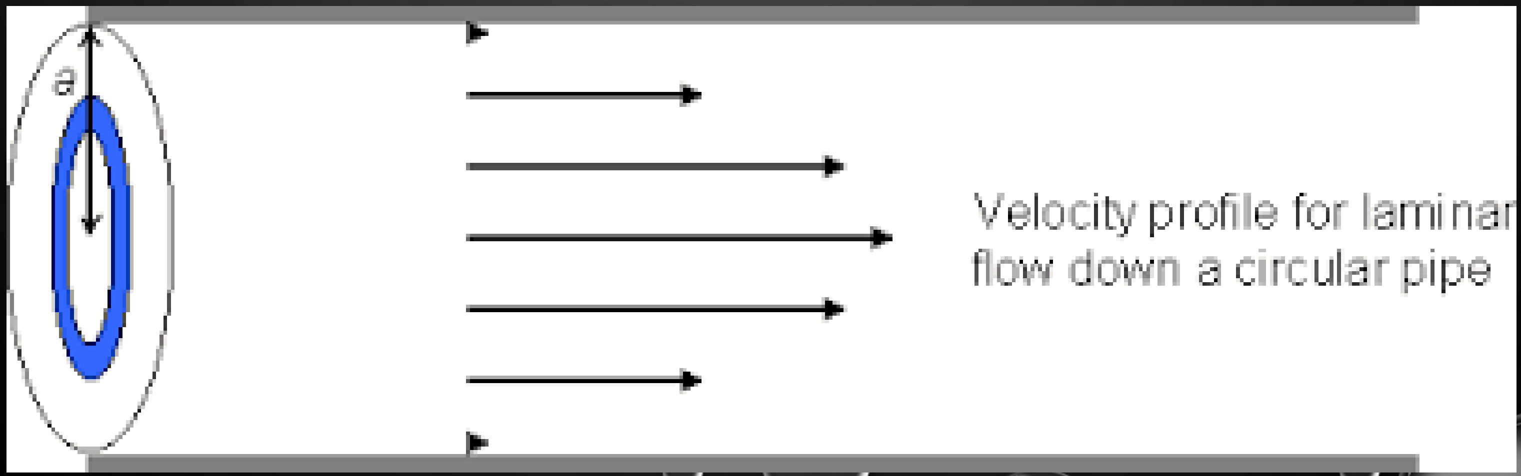
LARGE METERS

283

- TURBINE METER – ROTORS TURN BY WATER FLOW, TURBINE METERS WILL UNDER-REGISTER IF THE BLADES GET CLOGGED WITH SEDIMENT.
- MULTI JET METER – SIMILAR BUT HAS MUTIBLADE ROTOR MOUNTED ON A VERTICAL SPINDLE WITHIN THE MEASURING CHAMBER
- PROPELLER METER – PROPELLER IS TURNED BY WATER FLOW
- PROPORTIONAL METER – HAS A RESTRICTION IN THE PIPELINE THAT FORCESA PORTION OF THE FLOW TO PASS THROUGH A SMALLER METER
- VENTURI METERS – DEFINED THROAT CONSTRICTION WITHIN THE METER BODY. AS FLOW IS CONSTRICTED THE VELOCITY INCREASES. DIFFERENCE IN PRESSURE IS MEASURED
- ORIFICE METERS – THIN PLATE WITH A CIRCULAR HOLE
- MAGNETIC METERS – UNTRA SONIC FLOWMETER USES TRANSDUCERS TO GENERATE AND RECEIVE SOUND PULSES
- INSERTION METERS – PROBE WITH A SMALL ROTOR
- COMPOUND METERS – FIGURE 12-9

METER ACCURACY

- ALL METERS OPERATE ON THE PRINCIPLE OF FLOW VELOCITY
- LAMINAR FLOW
- DISTURBANCE SUCH AS PIPE BENDS AND VALVES MIGHT CREATE EDDIES IN THE WATER
- MANUFACTURERES RECOMMENDATIONS – PIPE DIAMETERS BEFORE AND AFTER



METER READING

- EARLY METERS HAD ROUND READS
- METER REGISTERS IN GALLONS OR CUBIC FEET
- MOST REGISTERS HAVE ONE OR MORE FIXED ZEROS (10X – 100X)
- DIRECT METER READING – METER READER MUST VISIT EACH SERVICE
- DOORNOLB READS – ASK CUSTOMER TO READ METER
- REMOTE METER READING – REGISTER IS LOCATED OUTSIDE THE METER BOX
- METER REGISTER SENDS A SIGNAL TO A RECEIVER
- HAND HELD PROBE
- RADIO READS

AUTOMATIC METER READING

- NEWEST TECHNOLOGY
- METER HAS A SMALL TRANSMITTER THAT SENDS A SIGNAL TO THE RECEIVER
- TELEPHONE LINES
- SOUND TRANSMISSION THROUGH WATER MAINS
- CABLE TV
- SATELLITE SYSTEMS
- WALK DOWN STREET WITH HAND HELD
- READS RECEIVED ON HOME COMPUTER
- ADVANCED METERING INFRASTRUCTURE (AMI) – MEASURE, COLLECT, AND ANALYZE ENERGY USAGE
- CUSTOMERS CAN OBTAIN AND USE INFORMATION TO HELP CONTROL USAGE

METER MAINTENANCE

- METERS ARE TESTED BEFORE SHIPPING
- METERS GRADUALLY DECREASE THEIR ACCURACY BECAUSE OF WEAR
- METER TESTING – BENCH TEST / APPLY AN ULTRASONIC
- REPLACE WORN PARTS WITH NEWS
- REPLACE METER

COMPOUND METER

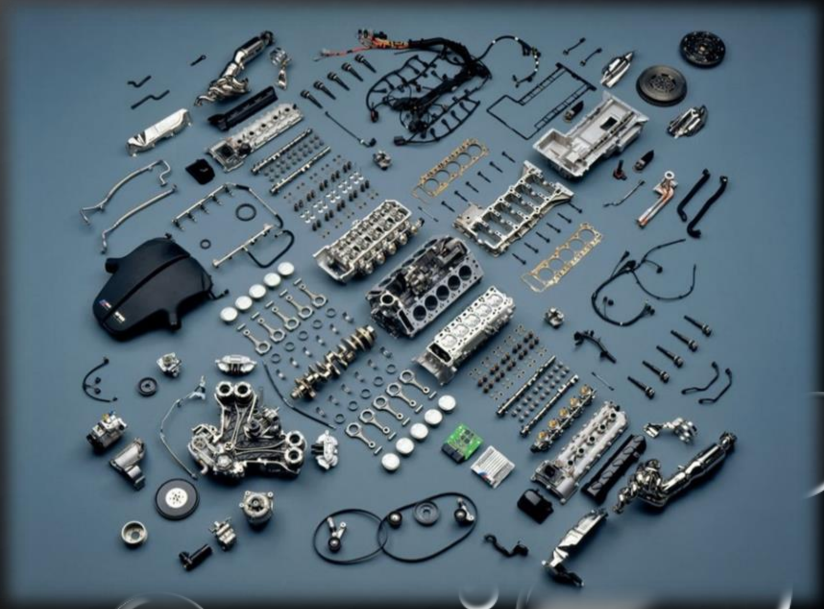
LOW FLOW – All water passes through the nutating disc / PD

CROSSOVER – As water flow increase control valve opens, water passes through both chambers until throttling down begins on the PD side

FULL FLOW – high flows the control valve is fully opened , bulk of the water passe through the turbine meter side.

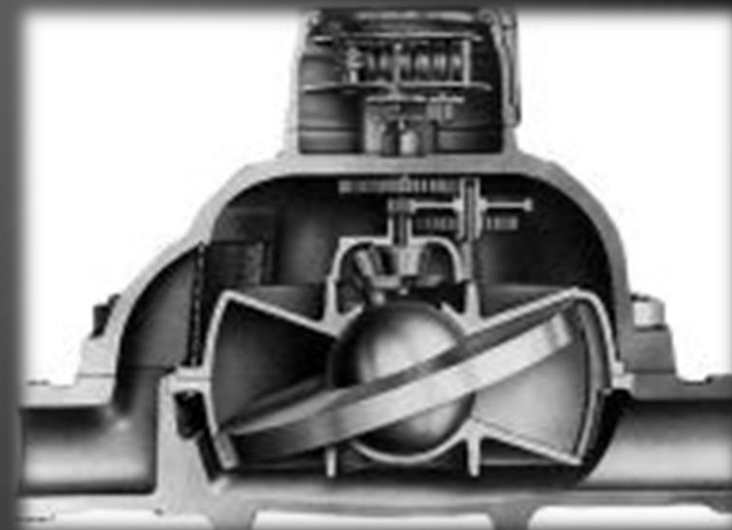
METER CHARACTERISTICS

- ACCURACY WITHIN THE RANGE OF ANTICIPATED FLOWS
- MINIMAL HEAD LOSS
- DURABILITY
- EASE OF REPAIR
- AVAILABILITY OF SPARE PARTS
- QUIET OPERATION
- REASONABLE COST



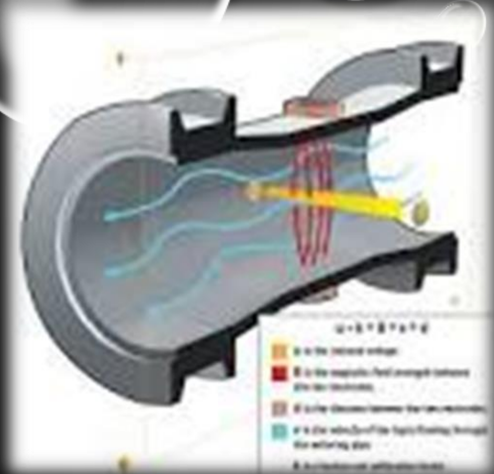
POSITIVE DISPLACEMENT METERS

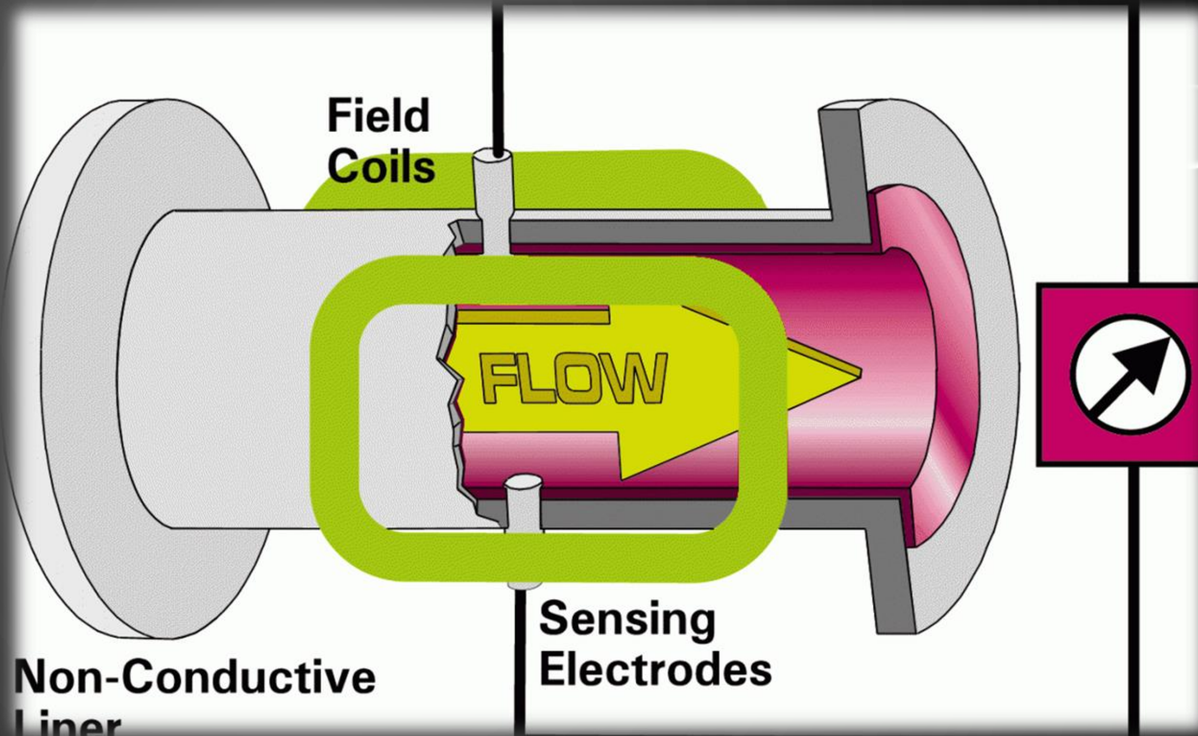
Customer water meters



NUTATING DISC

PISTON METER





Magnetic meters

Meter Testing

- **Volumetric**
  - Calibrated tank
  - Calibrate volumetric tanks annually
  - Wet the tanks prior to conducting initial tests
- **Gravimetric**
  - Weigh Scale
  - Calibrate scale annually
  - Wet tank procedure not required
- **Master Meter**
  - Known good meters
  - Volume to volume comparison
  - Correct flow profile using strainer and flow straighteners

Testing should be based more on meters consumption history

----- Perform at least 3 flows per meter -----

- Start at the low flow
- A minimum of one sweep hand
- A poor test result should be repeatable
- In field calibration can be performed on
  some meters +/- 3% to 5%
- Spare Measuring Elements will allow for minimal customer disruption.
- Verify isolation valve closure
- Use calibration certificate of tester
  Clean Strainer

MAINTENANCE AND REPAIR

- DISMANTLE THE METER
- THOROUGHLY CLEAN THE PARTS
- INSPECT ALL PARTS FOR WEAR, PITTING AND DISTORTION
- REPLACE OR REPAIR PARTS AS NECESSARY
- REASSEMBLE THE METER
- RETEST THE METER

STUDY QUESTION 68 288

WHICH OF THE FOLLOWING IS NOT A METER TYPE COMMONLY USED ON WATER SYSTEMS

a. PROPORTIONAL

b. CURRENT

c. MAGNETIC

d. INVERSE

STUDY QUESTION 69

POSITVE-DISPLACEMENT METERS _____ WHEN THEY ARE EXCESSIVELY WORN

a. DO NOT REGISTER

b. UNDER REGISTER

c. OVER REGISTER

d. REGISTER INTERMITTENTLY

STUDY QUESTION 70

WHEN USING TUBINE METERS, CLOGGING OF THE WHEEL'S BLADES CAN BE PREVENTED BY INSTALLING A(N) AHEAD OF THE METER

a. VENTURI DEVICE

b. IMPELLER

c. STRAINER

d. RESTRICTOR

STUDY QUESTION 71

WHAT TYPE OF METER IS USED FOR SERVICE WHERE DAILY USE IS RELATIVELY LOW BUT WHERE HIGH FLOW RATES MAY BE REQUIRED IN AN EMERGENCY

a. MAGNETIC METER

b. DETECTOR-CHECK METER

c. VENTURI METER

d. COMPOUND METER

STUDY QUESTION 72

WHAT TYPE OF METER IS USED FOR CUTOMERS THAT HAVE WIDE VARIATIONS IN WATER USE

a. MAGNETIC

b. DETECTOR-CHECK

c. VENTURI METER

d. COMPUND METER

Water Meters Q & A

Q-1:
What are two reasons for metering water customers?

A-1:

- To help a water utility account for water pumped to the system
- To equitably charge customers for the water they use

Water Meters Q & A

Q-2:
Name the two types of positive displacement meters commonly used on customer water services.

A-2:

- Piston meters
- Nutating-dish meters

Water Meters Q & A

Q-3:
Compound meters are generally used under what conditions?

A-3:
Compound meters are generally used where there is a considerable variation between low-flow and high-flow requirements for the customer.

Water Meters Q & A

Q-4:
List four factors that must be considered to select the correct size of meter.

A-4:

- The expected maximum customer demand for water
- The normal pressure in the system at the point of connection
- Friction losses in the service line, meter, and customer plumbing
- The range of flow rates that are expected

Water Meters Q & A

Q-5:
List 10 requirements for an acceptable meter installation.

Water Meters Q & A

A-5:

- The installation should not be subject to flooding with non-potable water.
- Valves should be provided on each side of the meter to isolate the meter for repair.
- The meter should preferably be mounted horizontally.
- The meter should e reasonably accessible for service and inspection.
- Provisions should be made either to have the meter easily accessible for reading or to have it provided with a remote reading device.

Water Meters Q & A

A-5:

- The meter should be protected from freezing and from mechanical damage.
- The installation should not create a safety hazard.
- The meter should e sealed o prevent tampering.
- Large meters should be properly supported to prevent excessive stress on the service pipe.
- Large-meter installations should have either a bypass line or multiple meters so that water service does not have to be discontinued while the meter is tested or replaced.

Water Meters Q & A

Q-8:
List three basic elements in a meter test.

A-8:

- Running a number of different rates of flow over the operating range of the meter to determine overall meter efficiency.
- Passing known quantities of water through the meter at various test rates to provide a reasonable determination of meter registration.
- Meeting accuracy limits on different rates for acceptable use.

Water Meters Q & A

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List three basic elements in a meter test.

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- Meeting accuracy limits on different rates for acceptable use.

PUMPS AND MOTORS CHAPTER 14

TYPES OF PUMPS

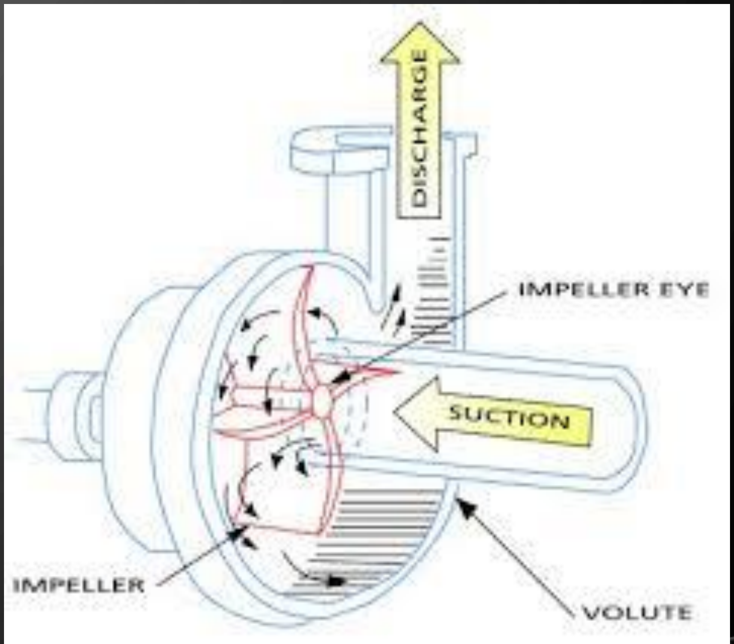
251

- MOST PUMPS ON A PUBLIC WATER SYSTEM ARE CALLED VELOCITY PUMPS
- PUMPS MOVE WATER BY A SPINNING IMPELLER
- S – CH

CENTRIFUGAL PUMPS

251

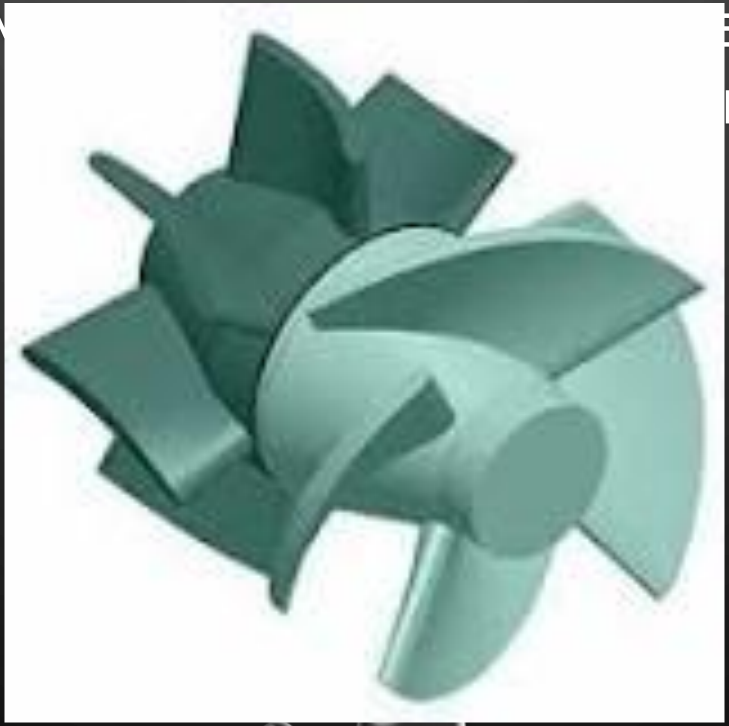
- CENTRIFUGAL PUMPS HAVE A ROTATING IMPELLER WITHIN A PUMP CASE
- WATER IS DRAWN FROM THE CENTER AND THROWN OUTWARD
- VOLUTE DESIGN
- SINGLE SUCTION
- DOUBLE SUCTION – HORIZONTAL SPLIT CASE
- THEORETICAL SUCTION LIFT 34 FEET AT SEA LEVEL
- PRACTICAL IS 15-25 FEET
- CENTRIFUGAL PUMP ADVANTAGES
  - SIMPLE CONSTRUCTION
  - MODERATE COSTS
  - SMALL SPACE REQUIREMENTS
  - LOW MAINTENANCE
  - ABILITY TO OPERATE AGAINST CLOSED HEAD FOR SHORT TIME PERIODS
-



AXIAL-FLOW PUMPS

253

- PROPELLER PUMPS
- THEY DO NOT HAV… …ES AND ACHIEVE FLOW BY LIFTING … …D IMPELLER



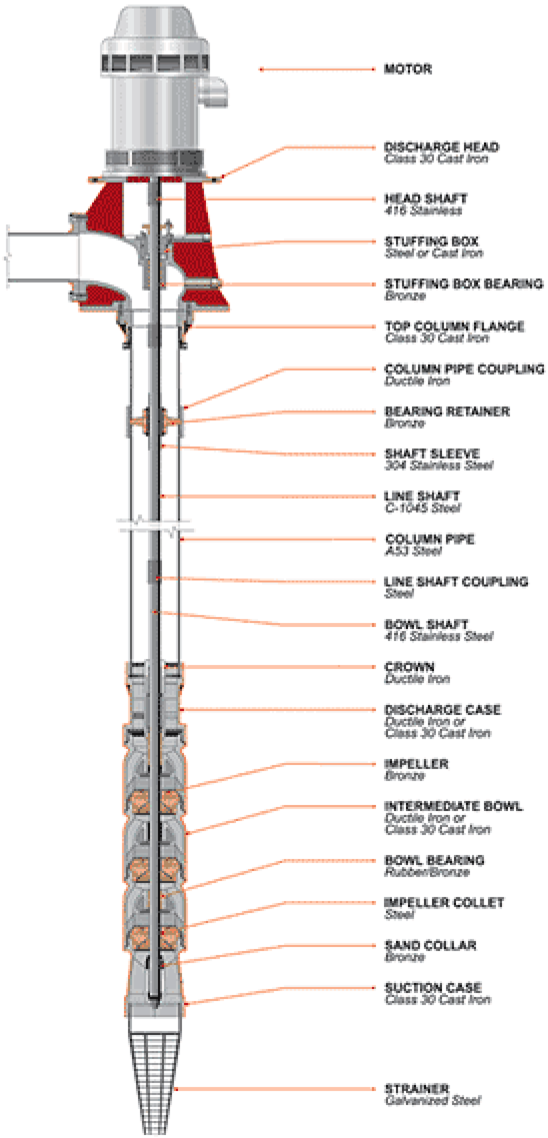
VERTICAL TURBINE PUMP

254

- TYPE OF CENTRIFUGAL PUMP
- MULTIPLE STAGES PRODUCE HIGH PRESSURE AT HIGH EFFICIENCIES (90-95%)
- CLOSE IMPELLER / VOLUTE HOUSING – SAND AND SILT CAN WEAR AWAY IMPELLERS
- PUMP IS DRIVEN BY A LARGE SHAFT
- CAN BE INSTALLED AT MORE THAN 2000 FEET
- SUBMERSIBLE PUMPS ARE TURBINE AND SUBMERSIBLE MOTOR COMBOS
- SUBMERSIBLE PUMPS ELIMINATE THE LONG DRIVE SHAFT

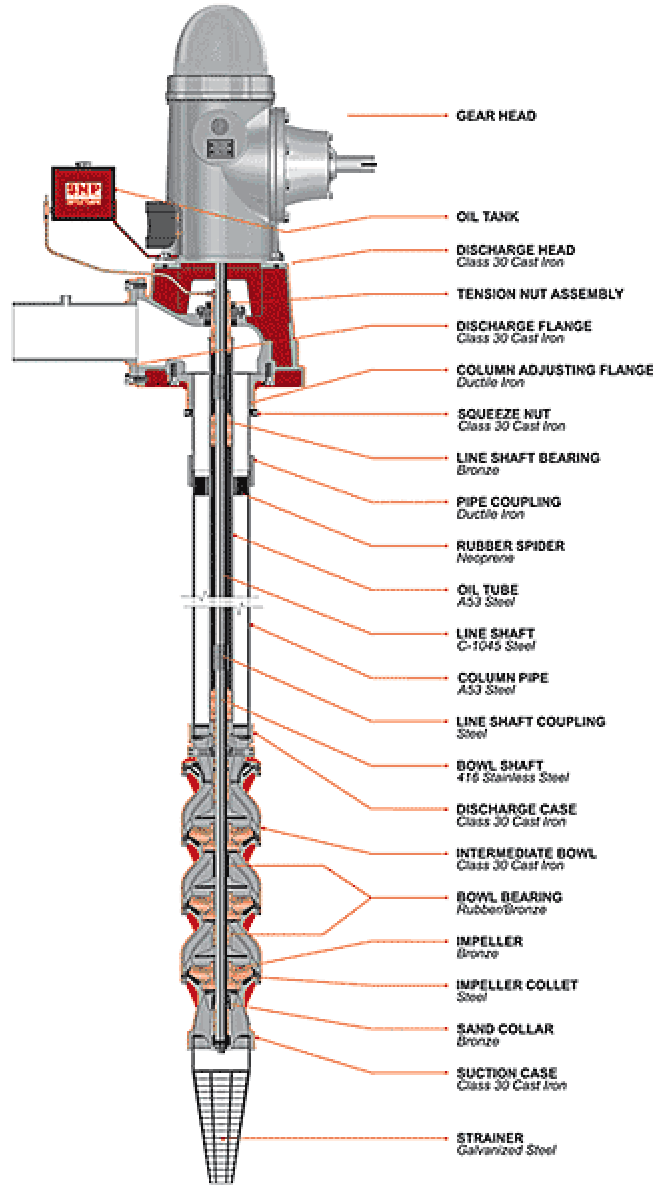
VERTICAL TURBINE PUMPS

WATER LUBRICATED



VERTICAL TURBINE PUMPS (*Water Lubricated*)

OIL LUBRICATED



VERTICAL TURBINE PUMPS (*Oil Lubricated*)

JET PUMPS

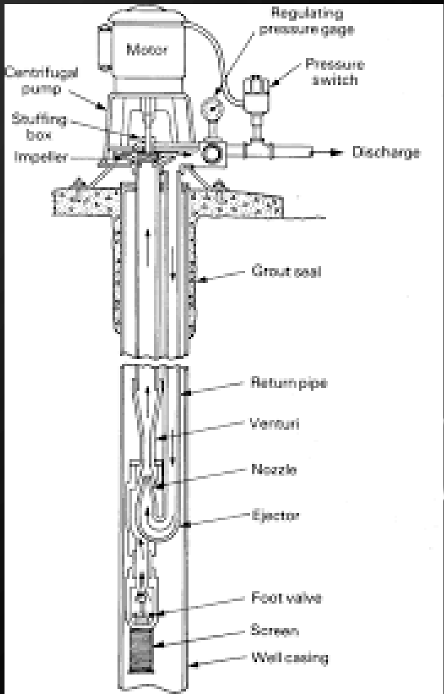
255-

- FIGURE 14-10
- CENTRIFUGAL PUMP AT THE GROUND SURFACE GENERATES HIGH VELOCITY WATER THAT IS DIRECTED DOWN THE WELL TO AN EJECTOR
- PARTIAL VACUUM IS CREATED THAT RAISES ADDITIONAL WATER TO THE SURFACE
- THE DISCHARGE OF THE PUMP IS SPLIT PART OF THE WATER

  GOES TO DISTRIBUTION WHILE THE OTHER PART BACK TO

  THE EJECTOR
- JET PUMPS USED MAINLY FOR SMALL HOUSEHOLD

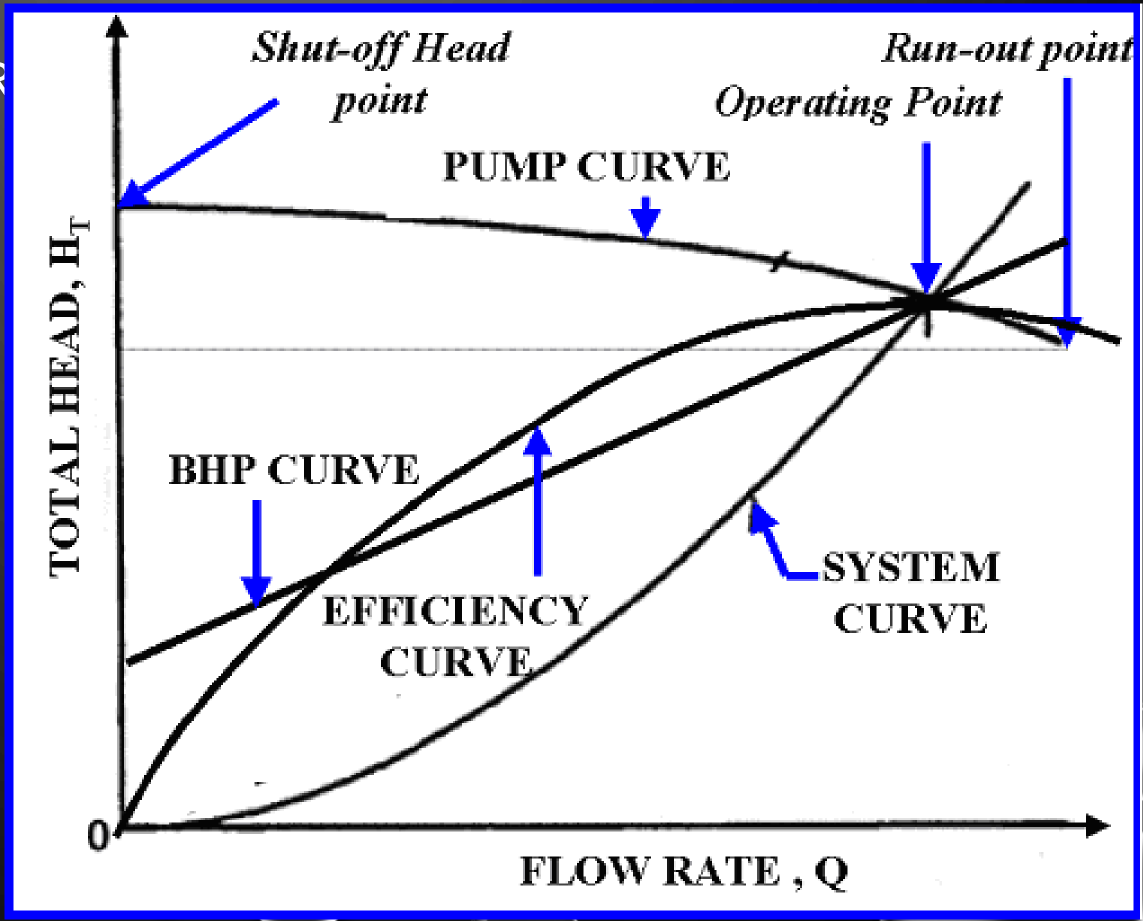
  APPLICATIONS - LOW EFFICIENCY / LOW COST / LOW MAINT.

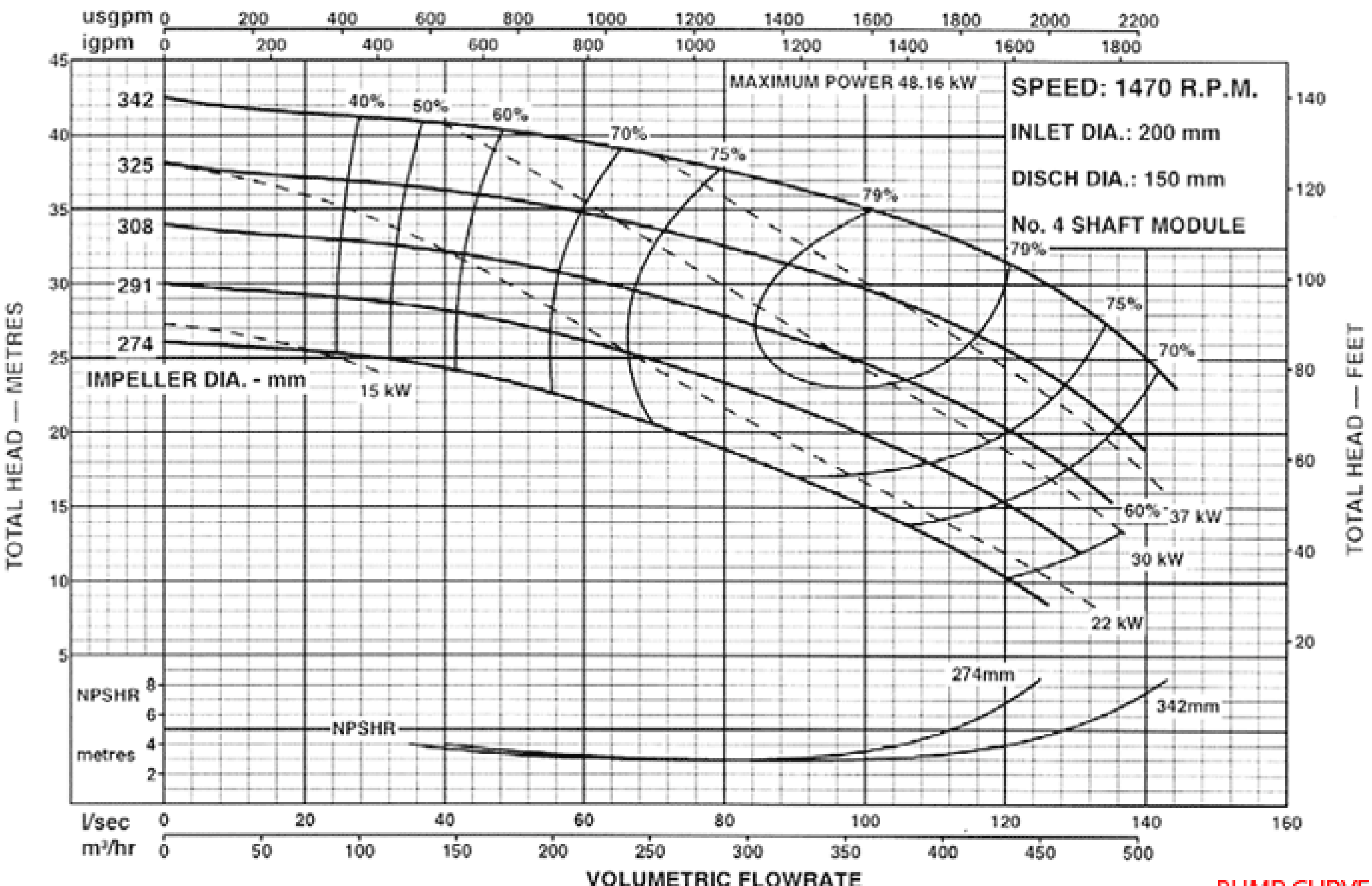


READING A PUMP CURVE

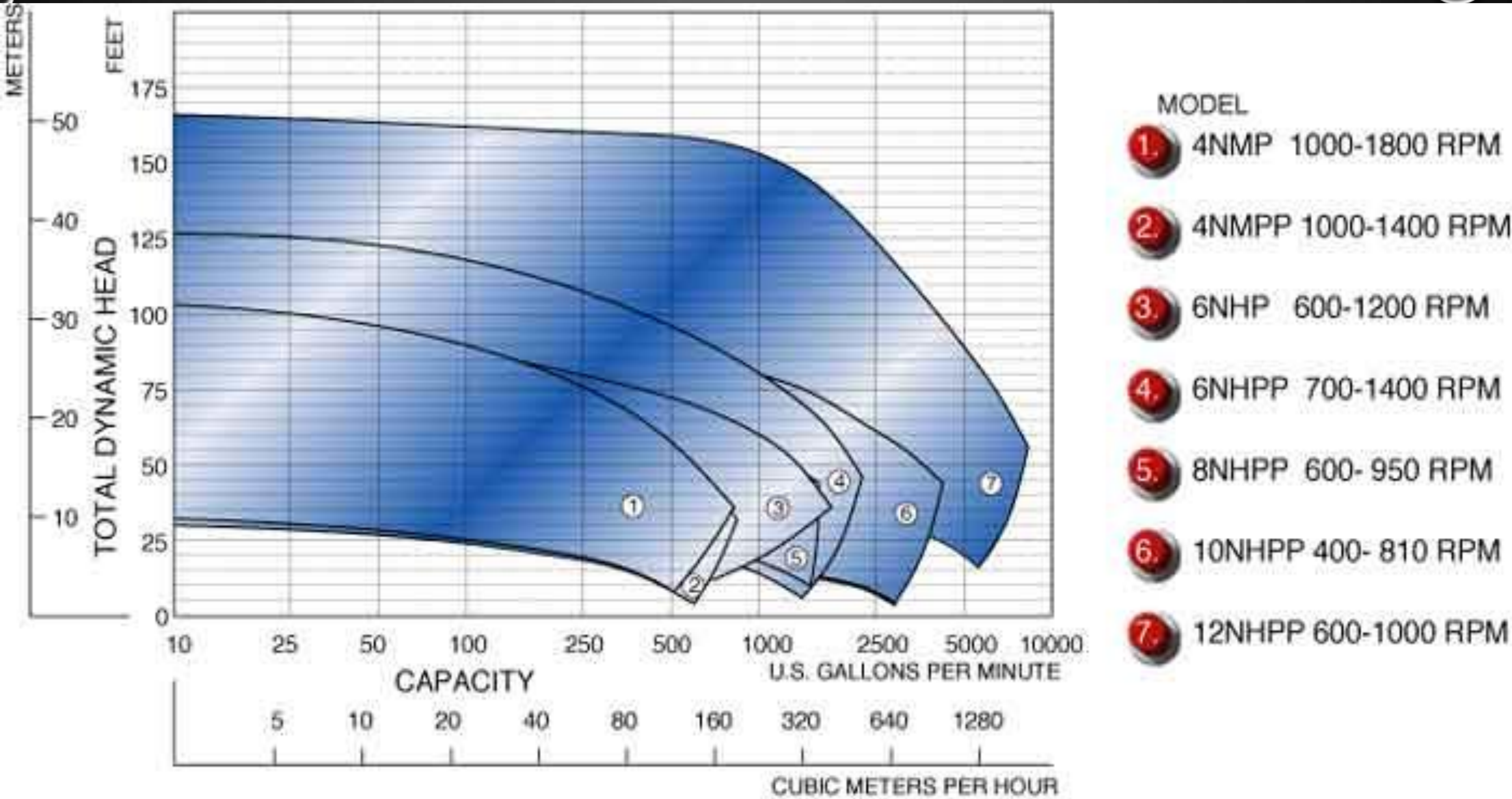
256-257

- A PUMP CURVE IS A GR
- CAPACITY
- HEAD
- REQUIRIED POWER
- EFFICIENCY




usgpm
igpm
MAXIMUM POWER 48.16 kW
SPEED: 1470 R.P.M.
INLET DIA.: 200 mm
DISCH DIA.: 150 mm
No. 4 SHAFT MODULE
IMPELLER DIA. - mm
342
325
308
291
274
15 kW
22 kW
30 kW
37 kW
NPSHR
metres
274mm
342mm
TOTAL HEAD — METRES
TOTAL HEAD — FEET
l/sec
m³/hr
VOLUMETRIC FLOWRATE

PUMP CURVE


METERS
FEET
TOTAL DYNAMIC HEAD
175
150
125
100
75
50
25
0
50
40
30
20
10
10
25
50
100
250
500
1000
2500
5000
10000
U.S. GALLONS PER MINUTE
CAPACITY
5
10
20
40
80
160
320
640
1280
CUBIC METERS PER HOUR
MODEL
1. 4NMP 1000-1800 RPM
2. 4NMPP 1000-1400 RPM
3. 6NHP 600-1200 RPM
4. 6NHPP 700-1400 RPM
5. 8NHPP 600- 950 RPM
6. 10NHPP 400- 810 RPM
7. 12NHPP 600-1000 RPM

READING A PUMP CURVE

256-258

- H-Q CURVE – RELATIONSHIP BETWEEN THE HEAD (FEET) AND THE CAPACITY (Q) IN GALLON PER MINUTE
- P-Q – RELATIONSHIP BETWEEN POWER REQUIRED AND CAPACITY (Q) POWER IS IN BRAKE HORSEPOWER, MOTOR EFFICIENCY MUST BE KNOWN
- E-Q – RELATIONSHIP BETWEEN PUMP EFFICIENCY (E) PERCENT AND CAPACITY
- SIZING A PUMP A MODEL SHOULD BE SELECTED THAT PROVIDES THE DESIRED FLOW RATE NEAR PEAK EFFICIENCY
- EFFICIENCY OF THE ELECTRIC MOTOR
- WIRE TO WATER EFFICIENCY

PUMP STARTING AND STOPPING

258-259

- SUCTION SIDE OF PUMP WATER IS ALWAYS SUPPLIED UNDER PRESSURE THE PUMP WILL ALWAYS BE PRIMED AND READY FOR IMMEDIATE USE
- SMALL PUMPS ARE USUALLY PROVIDED WITH A CHECK VALVE ON THE DISCHARGE SIDE WHICH WILL OPEN WHEN PUMP IS RUNNING AND CLOSE WHEN PUMP IS OFF
- WATER HAMMER PUMPS MAY NEED A PRESSURE RELIEF VALVE OR SURGE CHAMBER/TANK
- LARGE PUMPS POWER ACTIVATED DISCHARGE VAVES ARE NEEDED
- SPECIAL PROVISIONS MUST BE MADE FOR CLOSING THE DISCHARGE VALVE IN THE EVENT OF A POWER FAILURE

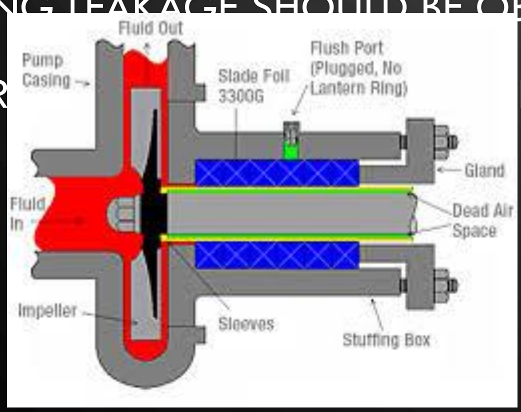
FLOW CONTROL

- MOST PUMPS USED IN WATER INDUSTRY ARE CONSTANT SPEED
- VARYING DEMANDS ARE MET BY TURNING THE PUMPS ON AND OFF
- FLOW CAN BE TEMPORAILY CONTROLLED BY THROTTLING A VALVE
- GATE VALVES WILL EVENTUALLY BE DAMAGED
- BUTTERFLY VALVES NOT AS CRITICAL
- CONTINUAL VARYING PUMP DISCHARGE – VARIABLE FREQUENCY SPEED (VFD)

MONITORING PUMP OPERATION

261

- SUCTION AND DISCHARGE SHOULD BE MONITORED BY READING GAUGES
- BEARINGS AND MOTOR TEMPERATURES SHOULD BE MONITORED REGUARLY
- EXPERIENCED OPERATORS LEARN NORMAL AND
- VIBRATION
- PUMP DISCHARGE CAN BE METERED
- PACKING LEAKAGE SHOULD BE OBSERVED
- AMPER [illegible] HECKED



PUMP MAINTENANCE

262

- MAINTENCE PROGRAM
- SEASONAL MAINTENANCE SCHEDULE
- CONDIT ALIGNMENT
- PUMP M NTENANCE ITEMS

Preventive Maintenance Check list

Period	Periodical PM tests
Daily	Monitoring Water level in Tanks
Daily	Monitoring Noise & Vibration
Daily	Monitoring water leakage
Monthly	Pets control service
Monthly	Check pressure gauges & Pressure Tank
Monthly	Monitoring Pressure Switch
Monthly	Check float valve and float switch
Monthly	Monitoring oil or grease leakage from bearing box
Monthly	Monitoring pump parts temp. (Bearing temp.)
Monthly	Clean the pump and pump room
Monthly	Make sure that motor performance is matching pump duty point
Monthly	Monitoring electrical motor temp.
Monthly	Check automatic operating mode circuit +operate stand by pump 5 minutes.
Monthly	Check valves throttling position degree

BEARING MAINTENANCE

262-263

- PUMP BEARINGS ARE EITHER GREASE OR OIL LUBRICATED
- USE MANUFACTURERS RECOMMENDED LUBRICANT
- CHANGE OIL EVERY 6-12 MONTHS
- GREASE – NEVER OVER LUBRICATE

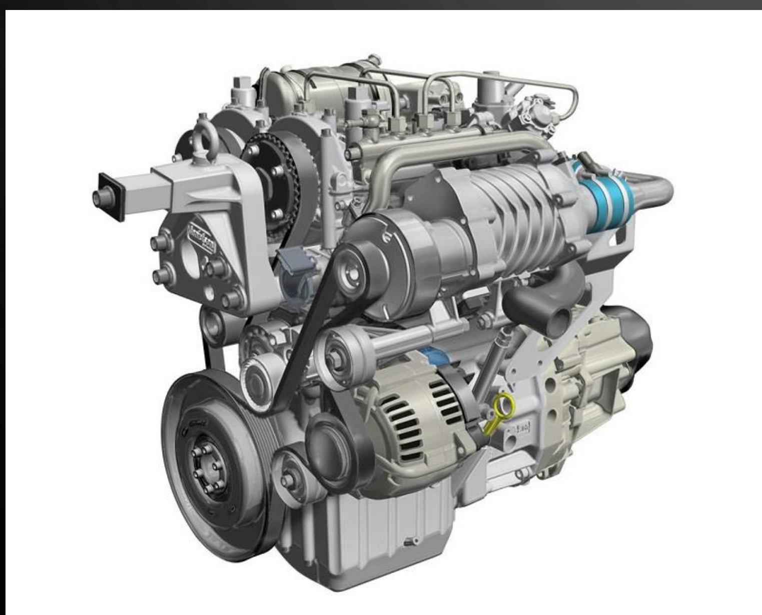
BEARING GREASE PROCEDURES

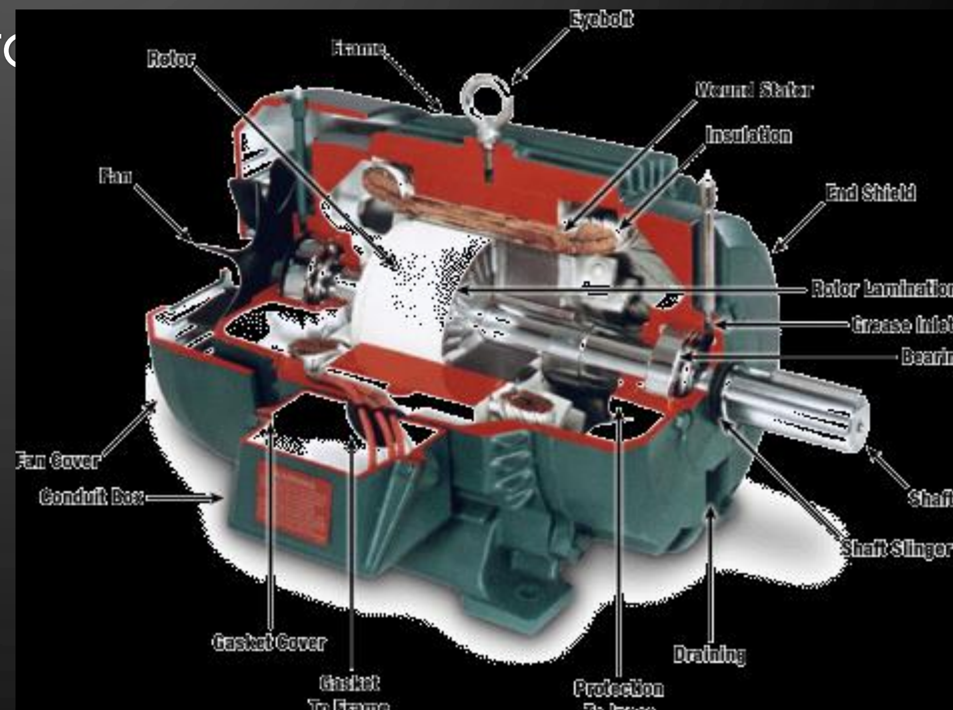
- OPEN GREASE PLUG
- FILL BEARING WITH GREASE UNTIL GREASE FLOWS FROM GREASE PLUG
- RUN PUMP WITH GREASE PLUG OPEN UNTIL GREASE IS WARM
- REPLACE DRAIN PLUG

MOTORS

263

- ELECTRIC MOTORS ARE USED IN 95% OF ALL PUMPS
- INTERNAL COMBUSTION USED AS STANDBY – 38% EFFICIENT
- AC CURRENT USED TO POWER MOTORS – 3 PHASE
- SINGLE PHASE FOR SMALLER MOTO

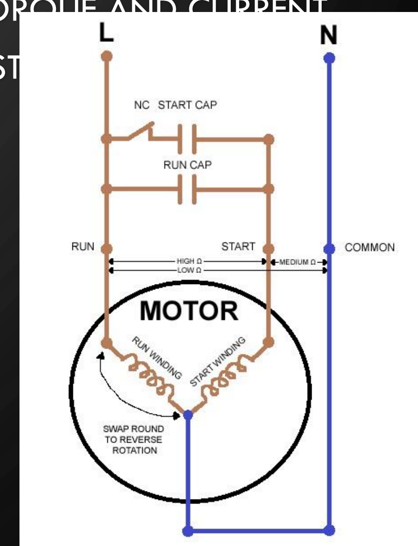




SINGLE PHASE MOTORS

264

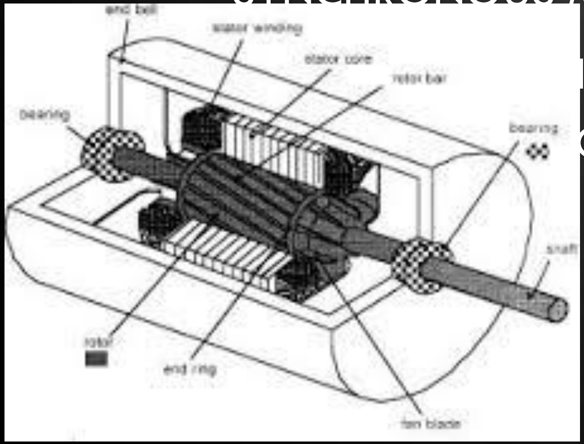
- MOTORS ARE USED FOR FRACTIONAL HP SIZES
- 10 HP AT 120-240V
- S-PH PUMPS HAVE NO POWER TO BRING IT UP TO SPEED (STARTING TORQUE)
- **<u>3 BASIC TYPES</u>**
  - SPLIT CASE MOTORS – ROTOR WITH NO WINDINGS. LOW STARTING TOR
  - REPULSION-INDUCTION MOTORS – COMPLEX AND EXPENSIVE, HIGHER ST
  - CAPACITOR START MOTORS – HIGH STARTING TORQUE AND CURRENT.
  - USED WHERE THE LOAD CAN BE BROUGHT UP TO SPEED QUICKLY AND INFREQUENT STARTING IS REQUIRED

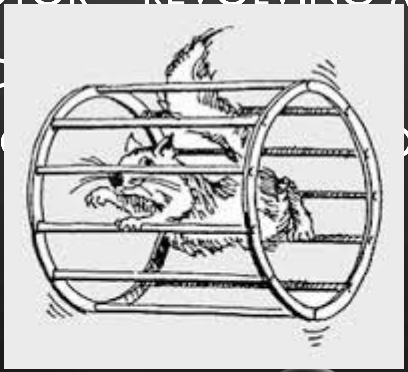


THREE PHASE MOTORS

264-265

- MOTORS ABOVE 1/2 HP
- 230. 460, 2300, 4000 VOLTS
- **<u>3 CLASSES </u>** - READ DEFINITIONS ON PAGE 264
  - SQUIRREL-CAGE INDUCTION MOTOR – SI
  - SYNCHRONOUS MOTOR – REVOLVING M





MOTOR TEMPERATURE

265

- MOTORS CONVERT ELECTRICAL ENERGY INTO MECHANICAL ENERGY AND HEAT
- 5% IS LOST IN HEAT
- AMBIENT TEM
- HIGH OPERA
- MOTORS NEE

MECHANICAL PROTECTION

265

- HOUSING TO LOCATION RELATIONSHIP
- OUTSIDE MOTORS MUST BE PROTECTED
- MOTOR HOUSING DESIGNS
  - OPEN
  - DRIP PROOF
  - SPLASH-PROOF
  - GUARDED
  - TOTALLY ENCLOSED WITH FAN COOLING

MOTOR STARTERS

265

- SMALL MOTORS ARE STARTED BY DIRECTLY CONNECTING LINE VOLTAGE TO THE MOTOR
- LARGER MOTORS A MOTOR STARTER
- MOTOR STARTER INCLUDES A MAIN DISCONNECT SWITCH
- FUSES
-
- N BY NITO

REDUCED-VOLTAGE CONTROLLERS

265

- HIGH STARTER CURRENT PROTECTION
- REDUCED VOLTAGE SUPPLIED TO MOTOR

MOTOR CONTROL SYSTEMS

266

- REMOTE AND AUTOMATIC CONTROLS ELIMINATE THE NEED FOR AN OPERATOR
- SYSTEM ALS

INTERNAL COMBUSTION ENGINES

266-267

INTERNAL COMBUSTION ENGINES POWER PUMPS DURING EMERGENCIES

ELECTRIC GENERATORS ARE POWERED BY THESE ENGINES

TYPES OF ENGINES

- GASOLINE ENGINES
- DIESEL ENGINES
- HANE

OPERATIONS AND MAINTENANCE

268

START UP OPERATING PROCEDURES

- SERVICE PRIOR TO OPERATION – INSPECT BEFORE STARTING –FLUIDS, BELTS, HOSES
- INITIAL OPERATION SERVICE – AFTER STARTING – CHECK IDLE, PRESSURES, TEMPS
- SERVICE DURING OPERATION – CHECK GAUGES, FUEL LEVELS
- SERVICE AFTER O ... ED
- ROUTINE PREVEN ... RGENCY SERVICE SHOULD

PUMP, MOTOR, AND ENGINE RECORDS

268-269

- DETAILED RECORDS SHOULD MAINTAINED ON ALL EQUIPMENT

TYPICAL INFORMATION

- MAKE, MODEL, CAPACITY, TYPE, SERIAL NUMBER, WARRANTY INFORMATION
- DATE AND LOCATION
- PART NUMBERS
- TEST RESULTS
- MANUFACTURERS SUGGESTED INSPECTION AND MAINT. SCHEDULES
- NAMES, ADDRESSES, PHONE NUMBERS OF THE MANUFACTURERS

INSTRUMENTATION AND CONTROL

CHAPTER 18