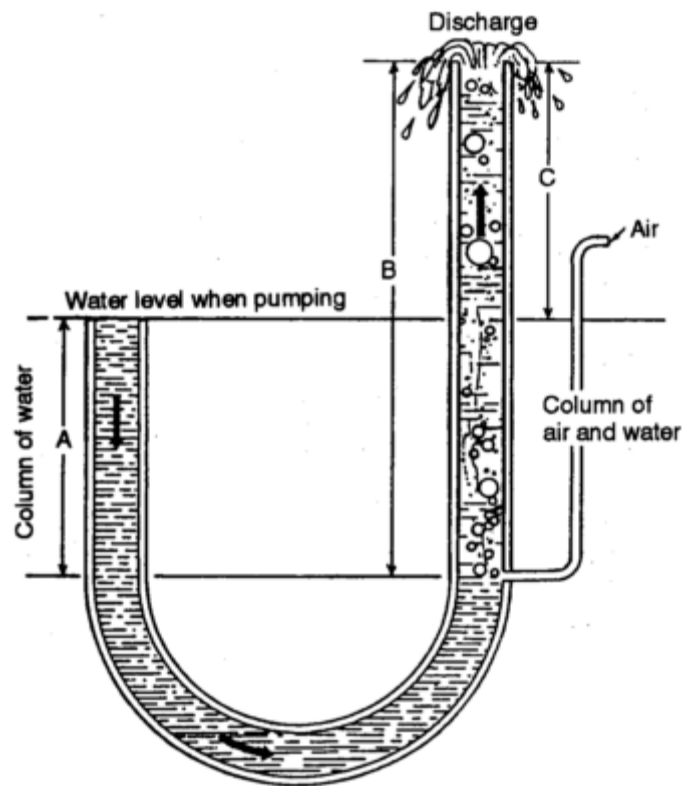


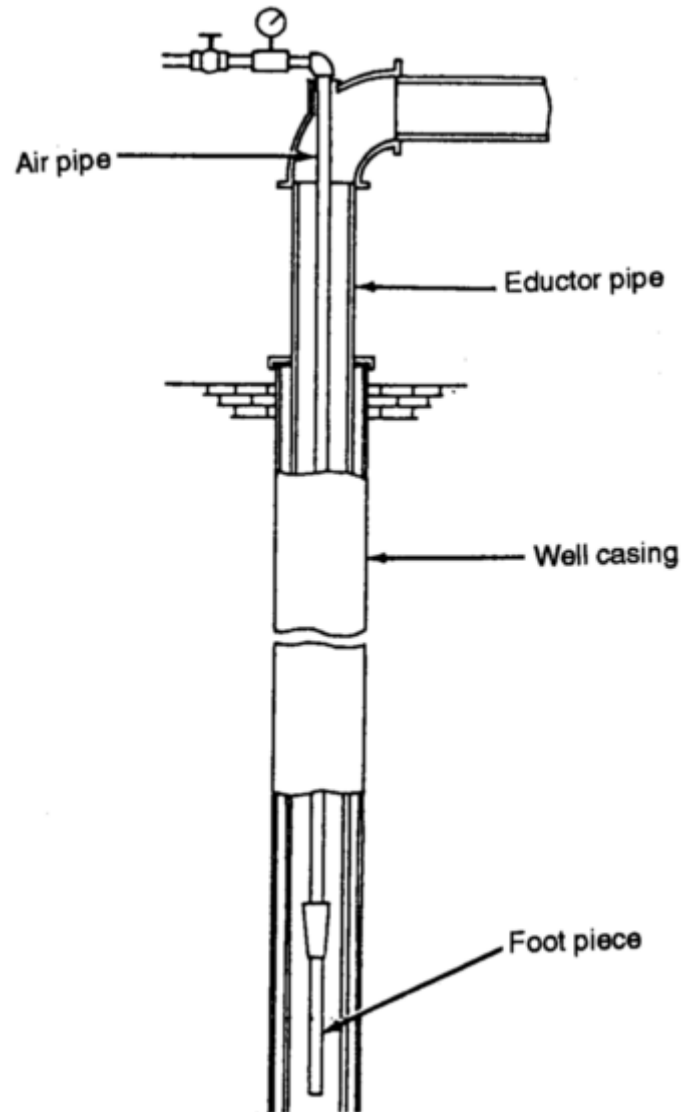
Components and working of Air Lift Pump

Principle

Water can be readily pumped from a well using an air-lift pump. There are no air-lift pumps in the Army supply system; however, in the field, you can improvise and make a pump using compressed air and the proper piping arrangement. The assembly consists of a vertical discharge (eductor) pipe and a smaller air pipe. Both pipes are submerged in the well below the pumping level for about two-thirds of the pump's length. The compressed air goes through the air pipe to within a few feet of the bottom of the eductor pipe and is then released inside the eductor pipe. A mixture of air bubbles and water forms inside the eductor pipe. This mixture flows up and out the top of the eductor pipe. The pumping action that causes water to rise as long as compressed air is supplied is the difference in hydrostatic pressure inside and outside the pipe resulting from the lowered specific gravity of the mixed column of water and air bubbles. The energy operating the air lift is contained in the compressed air and released in the form of bubbles in the water.



You should arrange an air lift with the air pipe inside the eductor pipe. You can use this arrangement for test pumping wells and for well development. You can use the well casing for the eductor pipe. However, to pump sand and mud from the bottom of a well during well development and completion, use a separate eductor pipe. This type of pump is also useful in wells that, because of faulty design, produce sand with the water. This condition will quickly create excessive wear on most pumps. By setting the educator pipe to the bottom of the screen, sand will be removed before it fills the screen.



Installation Design

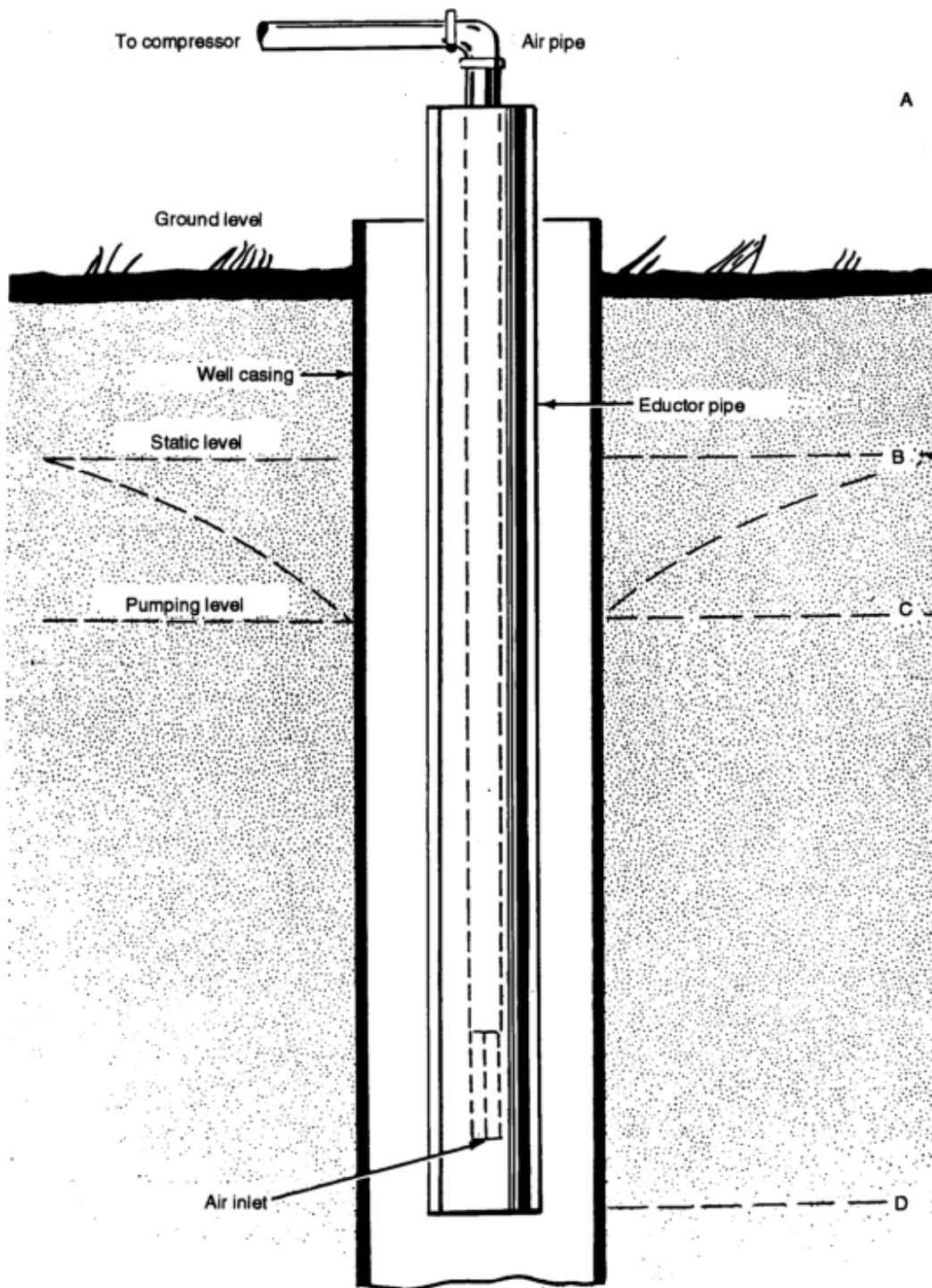
Submergence: Submergence is the proportion (percentage) of the length of the air pipe that is submerged below the pumping level. Use the following formula to determine submergence percentage:

$$\%submergence = \frac{x}{y} \times 100$$

where—

x = vertical distance from A to C.

y = vertical distance from C to D.



Air Pressure: To calculate the required air pressure to start the air lift, you must know the length of air pipe submerged below the static level. Area from point B to point D, for the starting air pressure. Divide the area from point C to D by 2.31 (constant/conversion factor) to get the required air pressure (psi).

Compressors: The 350 cubic feet per minute (cfm) compressor on military drilling rigs, such as the LP-12, is sufficient for operating an air lift. With a submergence of 60 percent, a lift not exceeding 50 feet and the compressor delivering 350 cfm of air, a well can be pumped at over 200 GPM. If you need more air, use another compressor in parallel. The maximum pressure that the compressor will produce is 200 psi, which is enough to start an airlift with about 420 feet of air pipe submerged.

Correct Air Amounts: For efficiency, the compressor must deliver the correct amount of air. Too much air causes excessive friction in the pipe lines and waste of air from incomplete expansion in the discharge pipe. Too little air results in a reduced yield and a surging, intermittent discharge.

Performance and Efficiency: The performance and efficiency of an air lift vary greatly with the percent of submergence and the amount of lift. Generally, a submergence of 60 percent or more is desirable. If a well has a considerable pumping-level depth, you will have to use a lesser submergence percent. However, if the submergence is too low, the air lift will not operate. See Table 1 for performance data for air-lift pumps corresponding to different submergence conditions and lifts.

Total Depth (feet)	Submergence (percent)
Up to 50	66 to 70
50 to 100	55 to 66
100 to 200	50 to 55
200 to 300	43 to 50
300 to 400	40 to 43
400 to 500	33 to 40

Table 1

The values are for properly proportioned air and eductor pipes with minimum frictional losses. The efficiencies indicated in terms of gallons of water per cubic foot of air probably cannot be fully attained in military field operations.

Table 2

Lift (feet)	Submergence (percent)	Lift (percent)	Rating	Submergence (feet)	Starting Air Pressure (psi)	Gallons of Water (per cubic foot of air)	Cubic Feet of Air (per gallon of water)	Total Length of Air Line (feet)
25	54	46	Minimum	29	13	4.55	0.22	54
	68	32	Best	53	23	8.34	0.12	78
	76	24	Maximum	79	34	14.30	0.07	104
50	51	49	Minimum	52	23	2.50	0.40	102
	65	35	Best	93	40	4.35	0.23	143
	72	28	Maximum	129	56	6.57	0.15	179
100	47	53	Minimum	89	38	1.43	0.70	189
	60	40	Best	150	65	2.70	0.37	250
	67	33	Maximum	203	88	3.70	0.27	303
150	43	57	Minimum	113	49	1.05	0.95	263
	55	45	Best	183	79	2.04	0.49	333
	62	38	Maximum	245	106	2.70	0.37	395
200	41	59	Minimum	139	60	0.85	1.18	339
	52	48	Best	216	94	1.54	0.65	416
	59	41	Maximum	288	125	1.89	0.53	488
250	39	61	Minimum	160	69	0.71	1.41	410
	49	51	Best	240	104	1.21	0.83	490
	56	44	Maximum	318	138	1.45	0.69	568
300	37	63	Minimum	176	76	0.60	1.67	476
	47	53	Best	266	115	0.96	1.04	566
	53	47	Maximum	339	147	1.18	0.85	639
350	36	64	Minimum	197	85	0.53	1.88	547
	46	55	Best	287	124	0.80	1.25	637
	50	50	Maximum	350	151	0.94	1.06	700
400	35	65	Minimum	215	93	0.48	2.07	615
	43	57	Best	302	130	0.69	1.45	702
	48	52	Maximum	369	160	0.79	1.26	769
450	34	66	Minimum	232	100	0.44	2.27	682
	42	58	Best	326	141	0.61	1.65	776
	47	53	Maximum	399	173	0.68	1.48	849
500	34	66	Minimum	258	112	0.41	2.46	758
	41	59	Best	348	150	0.54	1.85	848
	46	54	Maximum	426	184	0.60	1.66	926
550	34	66	Minimum	283	123	0.38	2.65	833
	40	60	Best	367	159	0.49	2.05	917
	45	55	Maximum	450	195	0.54	1.86	1,000
600	33	67	Minimum	296	128	0.36	2.81	896
	40	60	Best	400	173	0.45	2.25	1,000
	44	56	Maximum	471	204	0.49	2.06	1,071
650	33	67	Minimum	320	139	0.34	2.94	962
	39	61	Best	416	180	0.42	2.40	1,066
	43	57	Maximum	490	212	0.44	2.26	1,140
700	33	67	Minimum	345	149	0.33	3.00	1,045
	39	61	Best	448	194	0.39	2.55	1,148
	43	57	Maximum	528	228	0.42	2.40	1,228

Foot Piece: For best efficiency, the end of the air pipe should have a foot piece. This device breaks the air into small streams so that the bubbles formed will be as small as possible. You can make a foot piece by drilling numerous small holes in a short section of pipe.

Discharge Pipe: You can approximate the discharge-pipe length from Table 2. Lower submergence than those shown result in a lower pumping efficiency. The planned pumping rate must not cause an excessive drop in the water level, reducing the submergence. The two chief losses in the discharge pipe are air slipping through the water and the water friction in the discharge line. As the velocity of discharge increases, slippage decreases and friction increases. Eductor intake loss occurs at the lower end of the pipe due to friction and to the energy required to accelerate the flow of water into the pipe.

Reference:

<http://www.globalsecurity.org/military/library/policy/army/fm/5-484/Ch4.htm>