# VACUUM STABILITY IN MILKING CLAWS WITH 5/8, 6/8, OR 7/8 INCH ID MILK OUTLET UNDER VARYING CONDITIONS OF FLOW AND LIFT

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Recently, new claws with increased outlet sizes have been developed and marketed. Studies were conducted by the University of California-Davis, Milk Technology Laboratory at the Veterinary Medicine Teaching and Research Center in Tulare (Photo 1) to measure and compare vacuum in four claws with differing outlet inner diameters (ID) under controlled conditions of flow and lift on the milking machine test bench.

Four representative claws were tested from a group of 15 at the Milk Technology Laboratory developed by Dr. Brazil (Photo 2). All of the 5/8 claws had similar characteristics and two were chosen for further evaluation. Of the four selected, two claws had milk outlets with ID of 5/8 inches; one had 6/8 inches and another had 7/8 inches. Each claw was fitted with 70 inches of milk hose that matched the claw outlet internal diameter to which it was attached. Hoses were connected to the milk line through inlets matching the size of the hose. Each claw was assembled with a set of identical liners and teat cups. Claw vacuum measurements were obtained by inserting a 12 gauge needle into one short milk tube of each claw assembly (Photo 3). Milk line vacuum measurements were obtained from identical needles placed into milk line inlets.

All tests were performed using a simulated udder. Water was substituted for milk on the test bench. The simulated udder allowed for control of water flow to represent various levels of milk production. Claw vacuum stability was observed under varying conditions of lift (0, 6, and 12 inches) and flow (1 and 1.5 gallons/minute) The experiment was conducted on three consecutive days. Each day, the four claws were tested under all combinations of lift and flow for a total of 72 tests.

Overall, the most stable vacuum was delivered by 6/8 inch and 7/8 inch claws at zero lift. Increasing lift of the milk degraded the performance of all four claws, with the larger claws and particularly 7/8 inch, still maintaining some advantage (Figure 1). The milk flow rate also altered the claw vacuum levels (Figure 2). Mean claw vacuum was highest in the larger internal diameter outlet claws compared to the smaller diameter outlet claws.

Under simulated milking conditions, a cow would give milk a varying flow rates with an increase to the peak flow and thereafter decreasing until the milking machine is detached. The 7/8 inch inlet claw maintained a narrow range of vacuum at the claw as compared to the 5/8 inch inlet claw (Figure 3). To maintain the same average claw vacuum level in the 5/8 inch inlet claw as in the 7/8 inch inlet claw, the system vacuum had to be raised almost 1.5 inches Hg (Figure 4). At the same time vacuum range in the 5/8 inch inlet claw increased significantly over that of the 7/8 inch inlet claw.

More stable vacuum contributed to higher mean claw vacuum for larger claws in this experiment. The majority of the dairies after conversion to larger capacity claws have observed increased milking speed due in part to higher average claw vacuum. Higher claw vacuum could also reduce liner slips and provide more persistent teat end vacuum in both the open and closed phase of pulsation which could improve milking efficiency. It should be noted that vacuum stability range varied between claws. With 0 inches lift and 1 gallon/minute flow, the 7/8 inch claw had a range of about 5 mm Hg; the 6/8 inch claw range was about 10 mm Hg, and the 5/8 inch claws had ranges of about 25 and 30 mm Hg. Improving vacuum stability within these ranges may have subtle benefits that enable more rapid, gentle and complete milk out.

For more detailed information, contact Lionel Brazil at the Milk Technology Laboratory (559-688-1731).

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Photo 1. Dr. Lionel Brazil in the Milking Machine Technology Laboratory at the University of California-Davis, Veterinary Medical Teaching and Research Laboratory in Tulare. Data from milking machines is captured by the computer seen in front of Dr. Brazil.

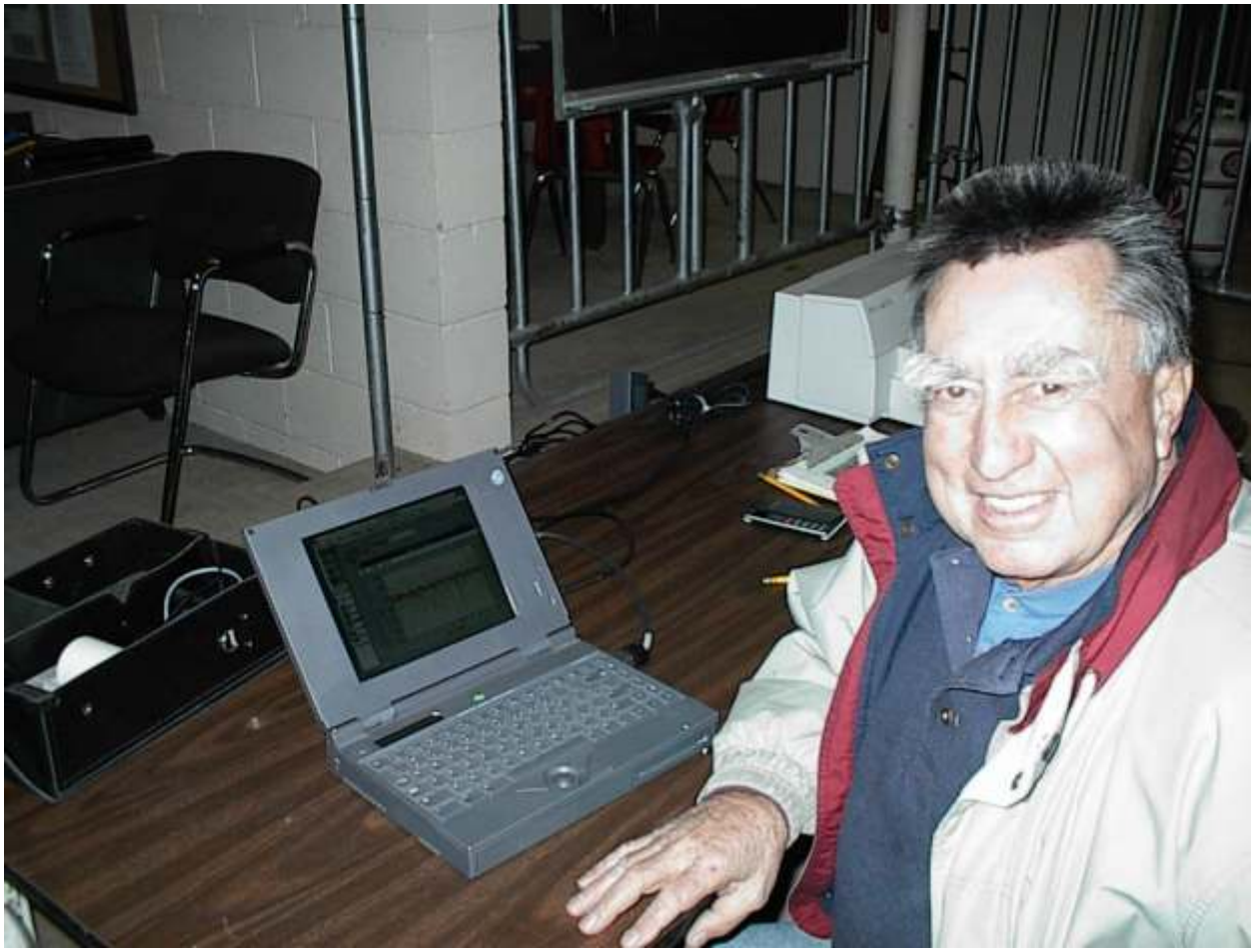


Photo 2. Laboratory setup for studying milking machine function at the University of California-Davis, Veterinary Medical Teaching and Research Center in Tulare. Water is used to simulate milk. The flow rate can be varied to simulate various levels of milk production. Vacuum levels can be monitored at several locations and recorded into the computer system.

Photo 3. Closeup view of milking claw on the milking machine test bench at the University of California-Davis, Veterinary Medical Teaching and Research Laboratory in Tulare. The arrow points to the vacuum monitoring port which measures the vacuum within the milking claw chamber.

Figure 4. Comparisons of vacuum level at the claw with 0 to 2 gallons per minute flowrate for 7/8 and 5/8 claw inlet diameter. These flowrate approximate the flow during milking for a high producing cow. The system vacuum level for the 7/8 claw was held at 12.5 inches Hg. To maintain a similar average claw vacuum with the 5/8 claw inlet, the vacuum was raised to 13.9 inches Hg. Note the wide vacuum variation with the 5/8 claw inlet.

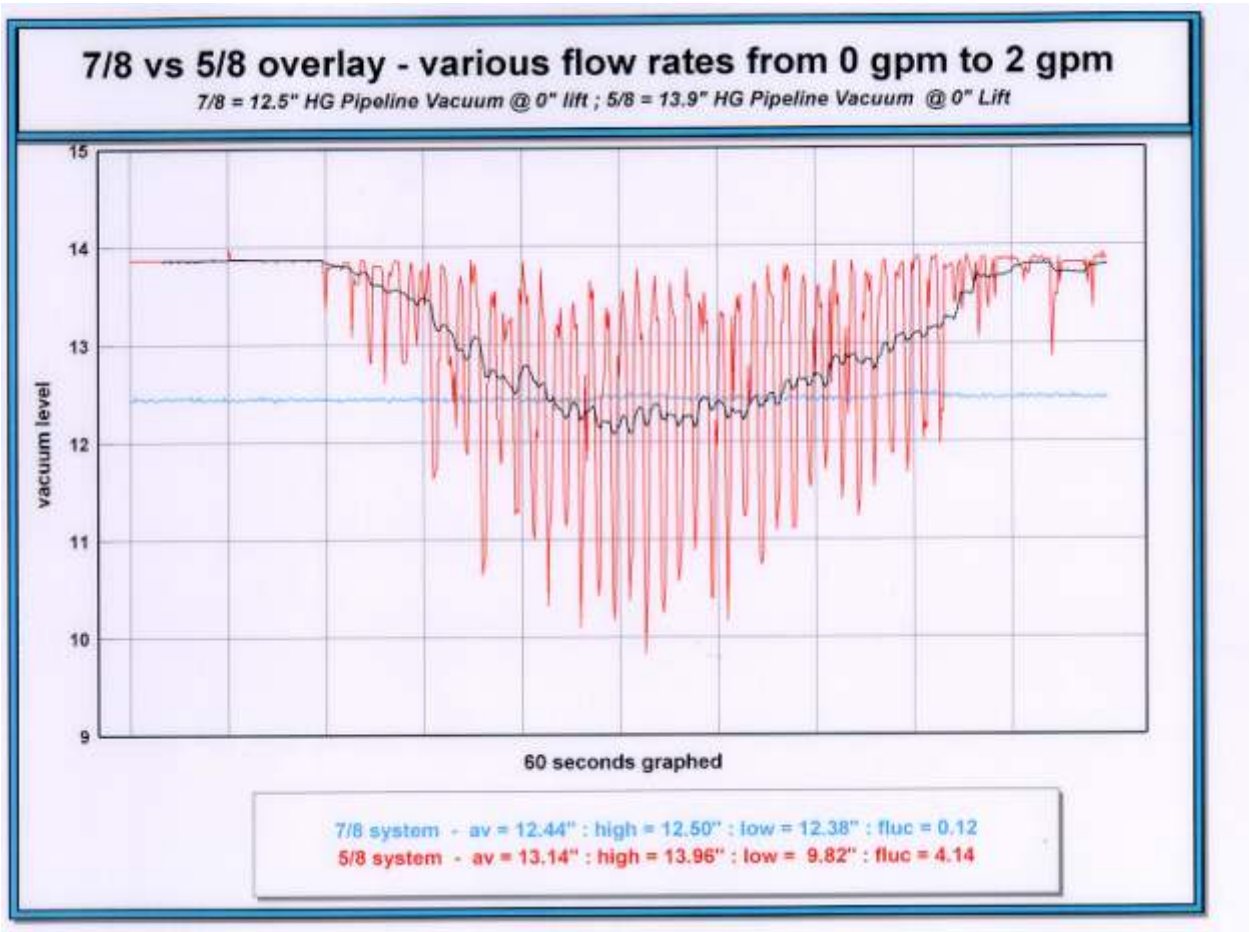


Figure 3. Simulated milk flow from 0 to 2 gallons per minute at 13.0 inches of Hg vacuum. To maintain the same average vacuum level as in the 7/8 simulation, the vacuum would have to be raised to 13.9 inches of vacuum for the 5/8 simulation.

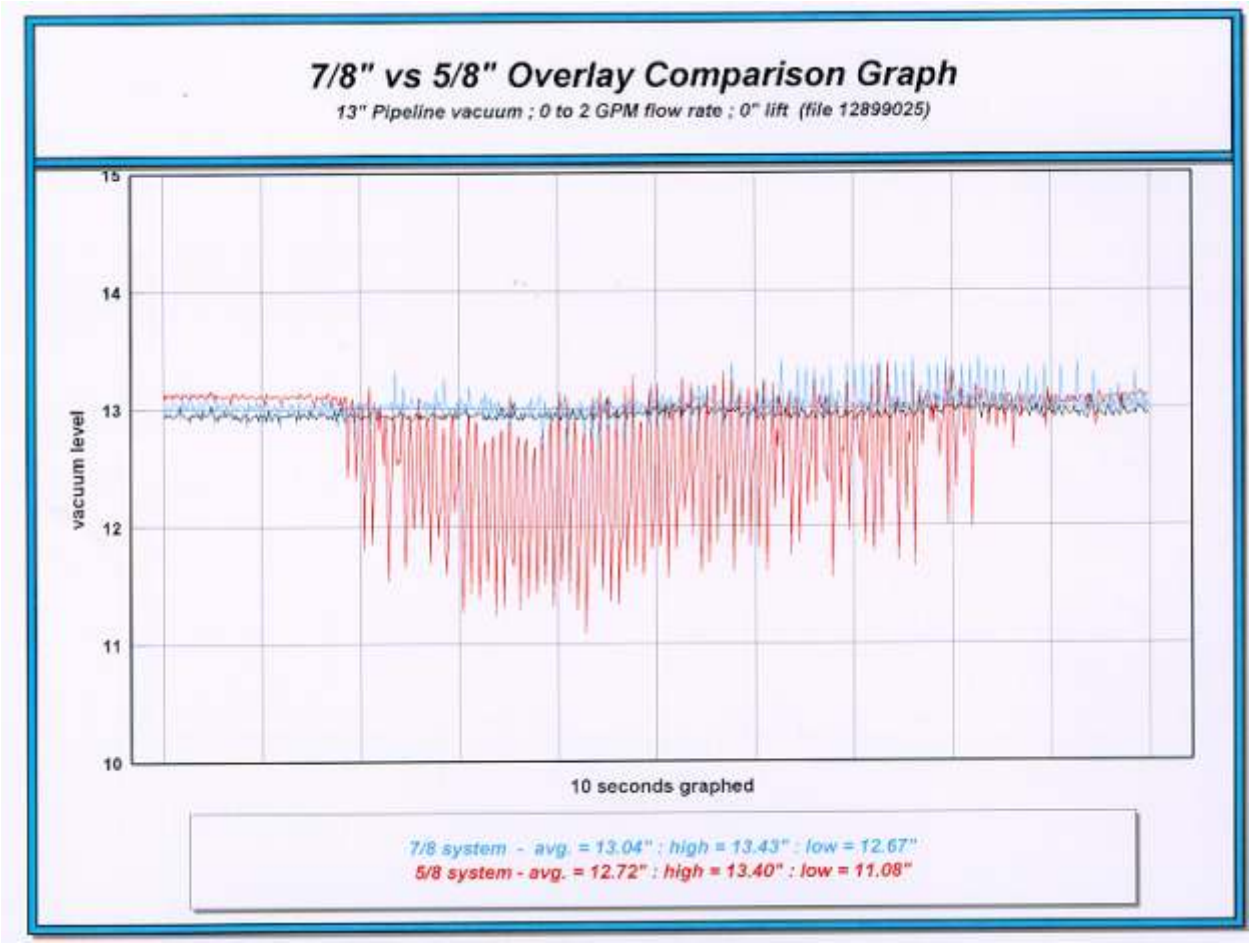
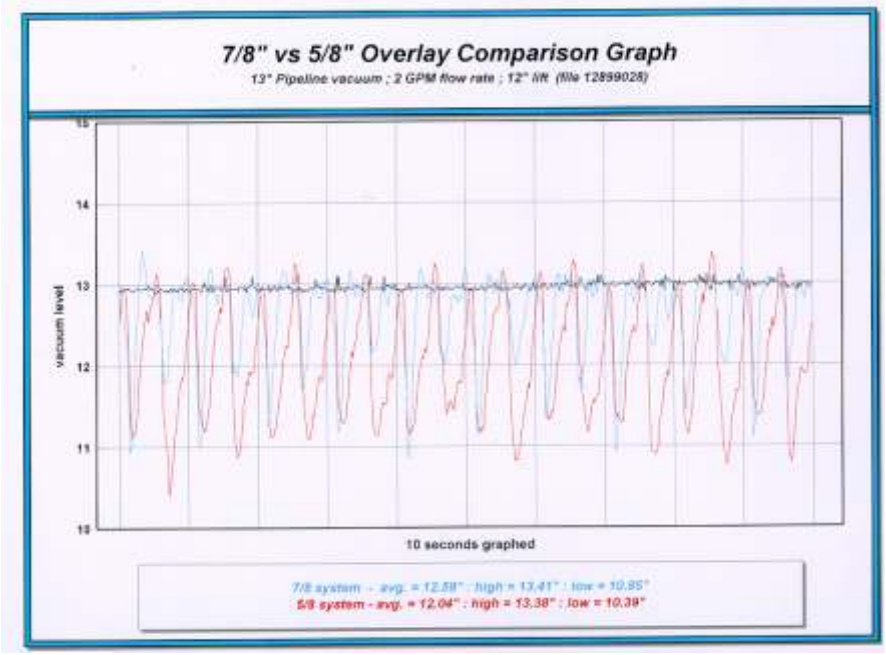


Figure 2. Comparison of 7/8" vs 5/8" at a two gallon per minute flow rate and 0" or 12" lift with a pipeline vacuum level at 13" Hg.



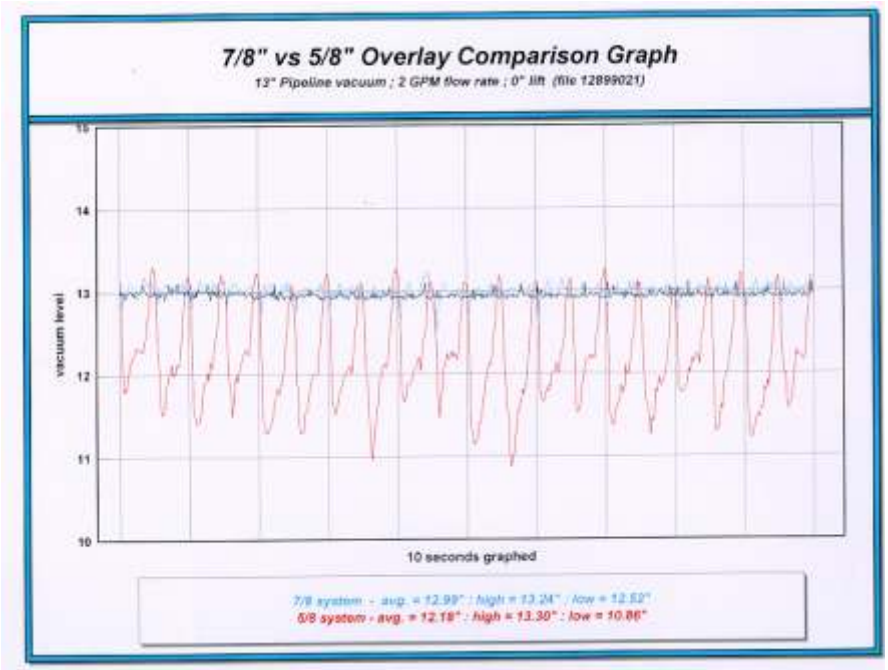



Figure 1. Comparison of 7/8" vs 5/8" at a one gallon per minute flow rate and 0" or 12" lift with a pipeline vacuum level at 13" Hg.