A Graphic Short Form for Recording Milking System Analysis

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The Machine Milking Committee of the National Mastitis Council has recommended a new protocol for evaluating milking machine performance[1] which requires updating of current milking system analysis forms. Although several short forms are available for use[4] it was felt desirable by Goodger[3] and Buelow[5] to have a form that would be a visual graphic diagram of the system being analyzed and provide areas for recording results. This form could be used by practitioners and also as a teaching tool for students. The idea for the visual form was first presented by Buelow[5] in some visual aids developed for a scientific presentation.

Britt[6] has designed a graphic diagram (Figure 1) of a typical, midwest style barn, milking system. This design is shaded with white areas outlined in heavy black lines which point to or are the locations for making measurements. Results of these measurements are recorded in the white designated areas. The reverse side of the form (Table 1) is a description of the measurements which are made at each numbered location within the milking system. There are additional comments on the reverse side of the form that allow for optional tests not listed on the front side of the form.

The reverse side also lists the preliminary N.M.C. recommendations for milking system performance. These recommendation have not yet been adapted by 3-A milking machine manufacturers, not ASAE. Table II gives the recommended guidelines for limits of measurements within the milking system. It should be noted that for smaller systems of 4 milking units or less the new recommendations may be higher than previously used requirements, and in larger systems of 12 milking units or more the requirements may be less than previously used requirements.[7]

Measurements

Equipment needed to make the measurements include an electronic vacuum gauge* or a mercury column, an air flow meter**, and a vacuum graph*** that will allow the recording of milking and pulsator vacuum at the same time. Vacuum measures done at positions **2**, **3**, and **4**, are made at points where holes have been drilled into the pipes and either metal or plastic hose barbs have been installed by tapping holes for screw-in metal hose barbs, or gluing in plastic hose barbs. Plastic covers are placed over these hose barbs and can be removed each time tests are made. Many systems may have drain plugs or hose barbs already installed that will allow access without installing new hose barbs. Access may be accomplished by removing drain plugs and taping a plastic tube into the hole so there are no leaks, and connecting the tube to the electronic vacuum gauge.

Example use of form

A blank form (Figure I) and a system analysis guide (Table I) are included in this paper. **Permission is given by the author to copy and use this form and guide from this publication.** Figure II is a form which has been completed from data listed in the remaining section of this paper. The data is for demonstration purposes only and was not recorded from an actual operating milking system. Data is recorded in the white areas by numbers **1-11** (Figure II) located on the diagram. This system has a 5 Hp motor, with 6 units on a double slope 2" low line. Measurements are made with the system in the milking mode and all teat cups plugged.

System pressures (vacuum levels)

System pressures are measured at points **1**,**2**,**3**,**4**, and in case of a weigh jar system point **5**. These pressures differ within the system are due to friction and leakage caused by inadequate pipe sizes, elbows, gasket leaks, plumbing mistakes and possible debris blockage within the system pipes. Differences can also be caused by excess air flow within the system.

System operation vacuum (**S.O.V,**), position (**1**), was 13.8" Hg; pump inlet vacuum (**P.I.V.**), position (**2**),

Table 1.

SYSTEM ANALYSIS GUIDE - SHORT FORM

Farm Name ____________ (Follow numbers on other side) Date ______________

STEP I-Measurements should be made with the system in the **MILKING MODE**, with units plugged and all equipment operating. Use of an electronic vacuum gauge or mercury column is recommended. Please note the type of air flow meter **(A.F.M)** being used in the measurements.

POSITION (1) Measure the **System Operating Vacuum (S.O.V.)** at the receiver top, or first milk inlet on the milkline in the parlor, or at the wash manifold or at the top of a weigh jar. An alternate method is by passing a rubber or plastic tube through the drain in the bottom of the sanitary trap and threading it into the top of the receiver unit.Then tape the trap drain to prevent leakage.In weigh jar systems the **S.O.V.**should be measured at **POSITION(5)**.

STEP II-**POSITIONS (2), (3), (4)** Measure the vacuum at these points with an electronic vacuum gauge. Record the **(2)** pump inlet vacuum **(P.I.V.)**, **(3)** pulsator line vacuum, and **(4)** regulator sensing vacuum part I.

STEP III-POSITION (6) With all teat cups plugged and in the milking mode remove the plugs from one unit and record the drop in **S.O.V.** measured at position **(1)**. Close claw vacuum, record recovery time ______,and replace plugs.

STEP IV-**POSITION (7), (4)** Now place the air flow meter **A.F.M.** at the receiver top and allow air to enter the system until vacuum measured at position **(1)** drops 0.6" Hg below the **S.O.V.** Record the air flow measured in cfm as **EFFECTIVE RESERVE (7)** and at the same time record the vacuum level the regulator is sensing at position **(4)**, part II. **In a weigh jar system the air flow meter can be placed at the end of the weigh jar vacuum supply line.**

STEP V-**POSITION (8)** Now **disable the regulator** from the system and measure cfm at the top of the receiver unit with the vacuum at 0.6" Hg below the **S.O.V.**, this is recorded as **MANUAL RESERVE (8). Optional** testing is also done with the regulator disabled.
OPTIONAL TESTING: System usage can also be measured at **POSITION (8)**, in the following order: first adjust the air flow meter until the vacuum at **POSITION (8)**, is at **S.O.V.** level,then turn off the claw, then the pulsators, then the detatchers and then any other equipment, record cfm with at each phase. No claw _________ cfm
No pulsators_________ cfm No detatchers _________ cfm All off _________cfm

STEP VI-POSITION (9) Disconnect the pump at a place between the test barb at **(2)**, and the balance tank. Place the **A.F.M.** at this position and measure cfm of the pump at Pump Inlet Vacuum **P.I.V., S.O.V., and 15"**. These are recorded at **POSITION (9)**. At the same time record the pump motor horse power at **POSITION (10)**.

STEP VII-POSITION (11) The claw or teat end vacuum are graphed on a milking cow and recorded as vacuum under load (maximum milk flow) and vacuum (at rest) at the end of milking.

STEP VIII-**Pulsator graphs** should be made at this time and all **line sizes, lengths**, and **slopes** can be recorded within the pipe being measured on the diagram. Leakage can be calculated as the difference between cfm at **P.I.V.** (STEP VI) and the **system usage** cfm from (STEP V OPTIONAL) "All off _____cfm".

Preliminary N.M.C. Recommendations for Milking System Performance Feb. '94 Update
(Not 3A or ASAE standards)

SYSTEM PUMP CAPACITY

1. Allow two cubic feet per minute (cfm) per milking unit for basic operation. If there are 16 units in the parlor this would be 32 cfm. Be sure to account for other components of the system that require higher than normal air usage.

2. Add the minimum "**effective reserve**" specified for the system. This would be 35 to 40 cfm plus 0.66 cfm for each milking unit. "**Effective reserve**" accounts for air leaks in the system due to units falling off, liner slips, or air admitted during cup changing.

3. Total the cfm from steps 1 and 2. In the case of a 16-unit system you would need (32 cfm base from step 1) plus (46-51 cfm from step 2). The total would be 32 +(46 or 51) = 78 to 83 cfm.

4. You then can multiply the total in 3 by 1.33 to compensate for leakage, regulator usage, pump wear, etc. This would give a system total of 78 x 1.33 =104 cfm. **This number could be lowered with good milking technique.**

VERSION 20AP94 UW/SVM/DMS

Figure 1.

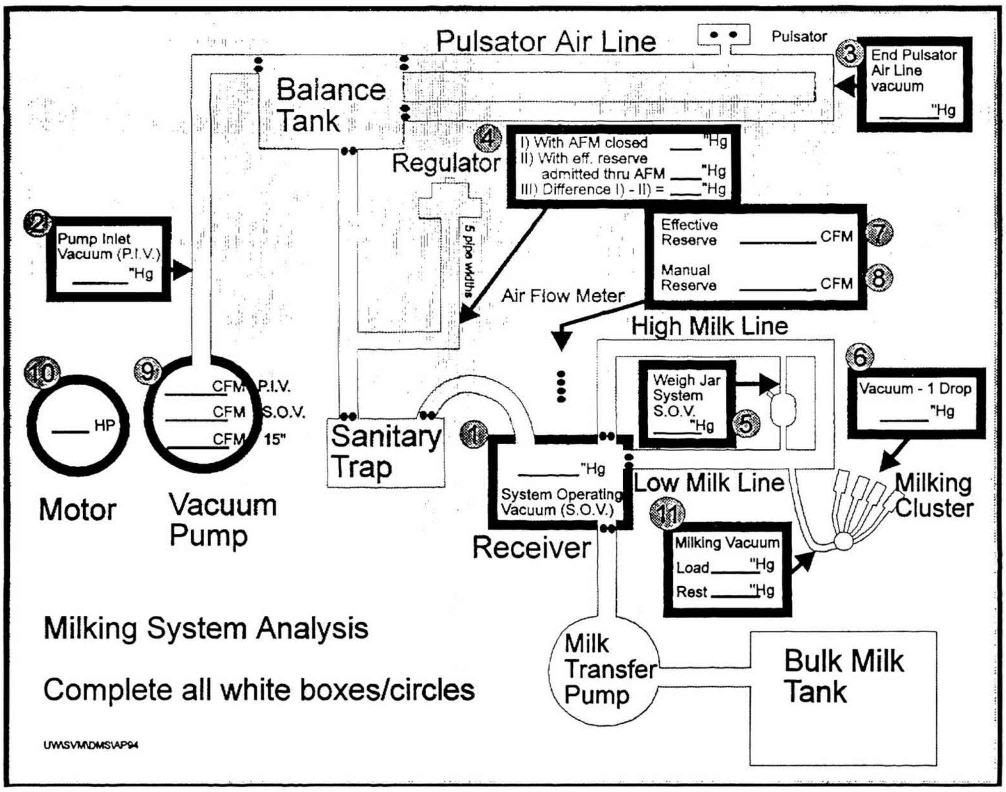

Figure 2.

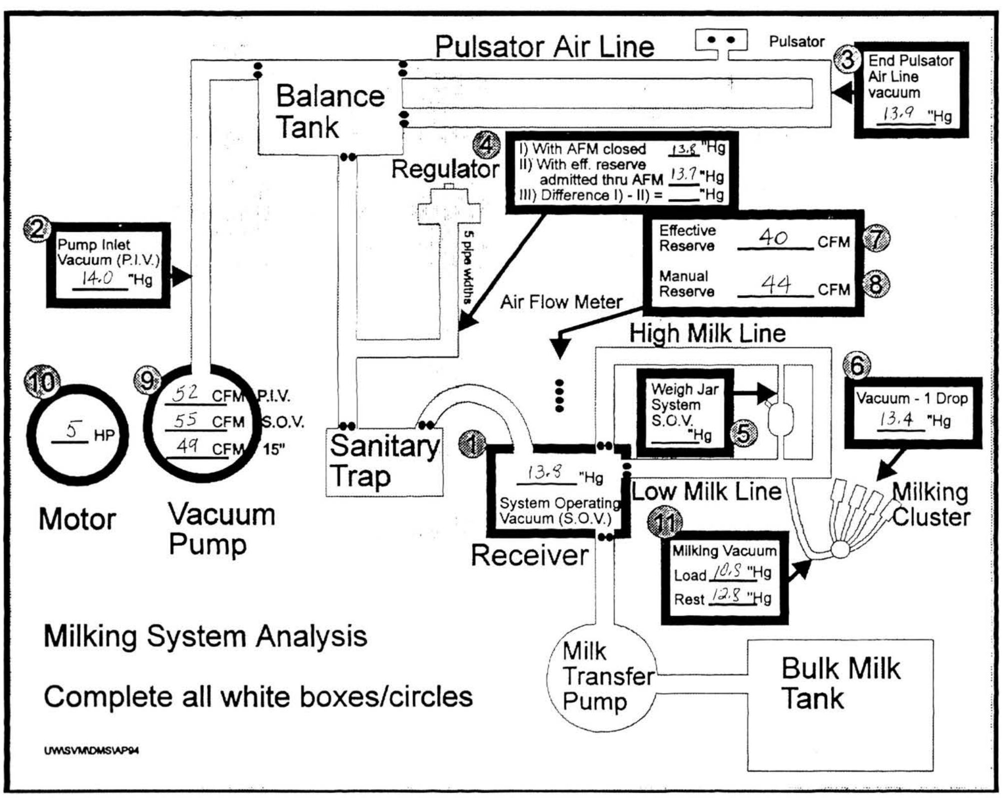

Table 2.

ITEM MEASURED	GUIDELINES
Vacuum level at receiver (S.O.V.) (System Operating Vacuum)	14"-15" high line 12"-13.5" low line
Weigh jar system (S.O.V.)	12.5" - 13.5" Hg
Vacuum level near the regulator	Within 0.2 " Hg of the (S.O.V.)
Vacuum level near the vacuum pump	Within 0.5" Hg of the (S.O.V.)
Vacuum level at far end pulsator line	Within 0.2" Hg of (S.O.V.)
Regulator sensing vacuum	Within 0.2" Hg
Effective reserve	At least 40 cfm per system
Manual reserve / Regulator efficiency	Effective reserve should be at least 90% of manual reserve
Vacuum at receiver with 1 unit open	Maximum drop not more than 0.6" Hg
Recovery time	Less than 3 seconds
Air usage by regulator	Not over 10 cfm - best under 5 cfm
Air use by each milking cluster	0.3 - 0.5 cfm per cluster
Air use by pulsators	1 - 2 cfm per pulsator
Air use by detatchers	Less than 1 cfm per detatcher
System leakage	Less than 5 cfm per system

was 14.0" Hg; vacuum at the end of the pulsator line, position (**3**), was 13.9" Hg; and regulator sensing vacuum, position (**4**), part I was 13.8" Hg. If this had been a weigh jar system, the system operating vacuum (**S.O.V.**) would have been measured at position (**5**).

Regulator function

With the system operating in the milking mode, all teat-cup plugs are pulled from one milking cluster, vacuum at position (**1**) drops to 13.4" Hg, which is then recorded at position (**6**). It would be desirable if a system would have enough pump capacity and sufficient regulator function to prevent any loss of system vacuum levels if a unit fall off occurred during milking.

The air flow meter is then placed at the receiver top and air is allowed to enter the system until vacuum at the receiver drops 0.6" Hg below the **S.O.V.** Air flow is recorded as 40 cfm, position (**7**), and regulator sensing part II is measured as 13.7" Hg, and noted at position (**4**) **part II**. The measurement recorded in position (**7**) is called **effective reserve**. These measurements demonstrate; a) the ability of the vacuum regulator to maintain stable vacuum within the milking system, b) and how pipe size, plumbing, and pipe length affect what vacuum level the regulator senses in relation to the other measured points within the system. The ability of the regulator to sense vacuum levels is also dependent on the location of the regulator or regulator sensing device. Regulator function is sometimes reduced in systems with excessive air flow.

The regulator is then disabled and **manual reserve** is measured by allowing air to enter the system through the air flow meter until the vacuum at position (**1**) drops 0.6" Hg below the **S.O.V.** This measurement is 44 cfm and is recorded in position (**8**). The difference between manual reserve and effective reserve is the amount of air used to operate the vacuum regulator. Regulator air use may be due to direct use of air to operate the regulator or by indirect use of air due to location, pipe size, and pipe length from the regulator to the sanitary trap and vacuum pump.

Air usage

Optional Testing (Table 1 Step V) includes measuring air use by the milking cluster, pulsators, detatchers, and any other equipment. The air flow meter is now adjusted in order for the system vacuum level to return to the original **S.O.V.** Components of the milking system are then disabled by first shutting off vacuum to the claw (milking cluster), then the pulsators, then the detatchers followed by any other equipment within the system that uses air. As each of these components are shut off, the cfm will increase from each previous measurement. These cfm changes are due to the amount of air needed to operate these different components within the system.

Vacuum pump

The vacuum pump is isolated from the rest of the system and air use at position (**9**), is measured at **pump inlet vacuum** which was 14" Hg, which gave a reading of 52 cfm. Air flow is then measured at position (**9**) at **system operating vacuum** of 13.8" Hg, and is found to be 55 cfm. Air flow at position (**9**) is then measured at 15" Hg, and is found to be 49 cfm. Measuring pump air flows at these vacuum levels show; a) when measured at the **P.I.V.** level it shows the actual cfm produced at the pump during milking; b) if measured at the **S. O.V.** level it shows what the pump air flow would be if there were no leaks or friction in the system between the sanitary trap and the vacuum pump; c) when measured at 15" Hg, the pump is operating at the manufacture's recommended level and a comparison can be made as to pump wear in relation to the original cfm rating at 15" Hg.

Pulsators

A graph recorder is then used at position (**11**) to graph milking and pulsator vacuum under load. The milking vacuum averages 10.8" Hg, under load and 12.8" Hg at the end of milking. These two measurements are recorded at position (**11**). Graphing each pulsator would be recommended at this time. From these graphs pulsation ratio and milk rest ratio can be determined.

Pipe size

System pipe size can be noted by writing in the pipe size within the pipes on the diagram. Pipe slope, elbows, gaskets, inlets, etc. can be listed if desired.

Acknowledgment should be given to Joe Pelletier, Martha Mealy, Chris Eisele, John Dahl, Graeme Mein, Ken Buelow, Ken Nordlund, and Bill Goodger for their ideas, expertise, and input into this project.

* Surge Digital Vacuum Gauge, Babson Bros. Co., Naperville, IL 60563

** Boumatic, Dairy Equipment Co., Madison, WI Surge, Babson Bros. Co., Naperville, IL 60563 AlfaLaval, Kansas City, MO.

*** Dairy Test Equipment Co. 14058 Euclid Ave., Chino, CA 91710 Western Dairy Research, (digital, no paper) "Digimet", 122 North M St., Tulare, CA 93274

Permission is given by the author to copy and use Figure I and Table I from this paper. This form and recommended levels do not replace any recommendations made by milking machine manufacturers.

References

1. Johnson, Andrew: *Evaluation Procedures for Milking Systems* 1/94 NMC Machine Milking Committee 1992-1993. Copy 2/4/94. 2. Britt, J.S., Eisele, C.: *Production Medicine II Teaching Form for System Design and System Performance,* UW/School of Veterinary Medicine, April 1994. 3. Goodger, W., *et. el.*: *An Integrated Quality Control System,* Proceedings of the American Association of Bovine Practitioners, Albuquerque, NM September 1993, P-169. 4. Timms, L.: N.M.C. Machine Milking Committee, Personal Communication. 5. Buelow, K.: Personal Communication, 1994. 6. Britt, J.S.: *A Graphic Short Form for Recording Milking System Analysis, Food Animal Production Medicine Section,* UW/School of Veterinary Medicine, Madison, WI, April 1994. 7. Milking Machine Manufactures Council: *Maximizing the Milk Harvest,* April 1993.

Reproductive performances of Marchigiana cows.

C. Pieramati, C. Renieri, M. Silvestrelli, and P. Spina.
XLIII Convegno Nazionale SISVet., 1989.

The authors examine the reproductive careers of 533 Marchigiana cows, considering only the animals registered between 1958 and 1968, in the area of Pescara. Mean age at first and last calving was found to be 1026.5 +/-156 and 3211 +/- 290 days respectively. The calving interval was 431 +/- 110 days and mean calving number was 6.0 +/- 1.9 per cow. Reproductive efficiency was measured using the ratio between days of pregnancy in a year and pregnancy length and between reproductive life length and days of pregnancy in a career. The authors also examine the heritability of these parameters.

The chromosomes of early clevage stage bovine embryos.

Supplizi A. Verini, W.A. King, and K.P. Xu.
8th European Colloquium on Cytogenetics of Domestic Animals, 1988.

There are very few observations on the chromosomes of early clevage stage bovine embryos. This study, involving 11 superovulated (FSH, 40 mg) Holstein heifers inseminated 8 to 12 and 24 to 36 h after the onset of estrus (Day=0), was undertaken to complement existing data on preattachment embryos. Genital tracts were flushed on Day 2 (n=5), Day 3 (n=5) and Day 4 (n=1). A total of 155 ova/embryos (24 one-cell, 40 two cell, 25 four-cell, 64 eight- to 16-cell and 2 16-cell) were cultured 4 to 18 h in medium containing colcemide and fixed on slides. Metaphase spreads were obtained from 71 (46%). In all, 20 were 60XY, 14 were 60XX, 19 had either incomplete or poorly spread metaphases, 8 had abnormal complements and 10 one-cell stage were unfertilized and had meiotic chromosomes. The abnormal embryos included one 30X/62XX, one 30Y/60XX, and one multi-pronuclear ovum in the one-cell group, two 3n, one 30Y/60XX and 30X/60XY in the two-cell group and one 8 to 16-cell embryo with two haploid and no diploid metaphases. The results show a decreasing incidence of abnormal chromosome complements in one-cell (3/7), two-cell (4/17) and 8-16-cell (1/23) stage embryos.