PRINCO™

Instrumentation designed

with the user in mind

The Princo Stokes McLeod Vacuum Gauge

Installation and Operating Instructions

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1.0 DESCRIPTION

1.1 GENERAL

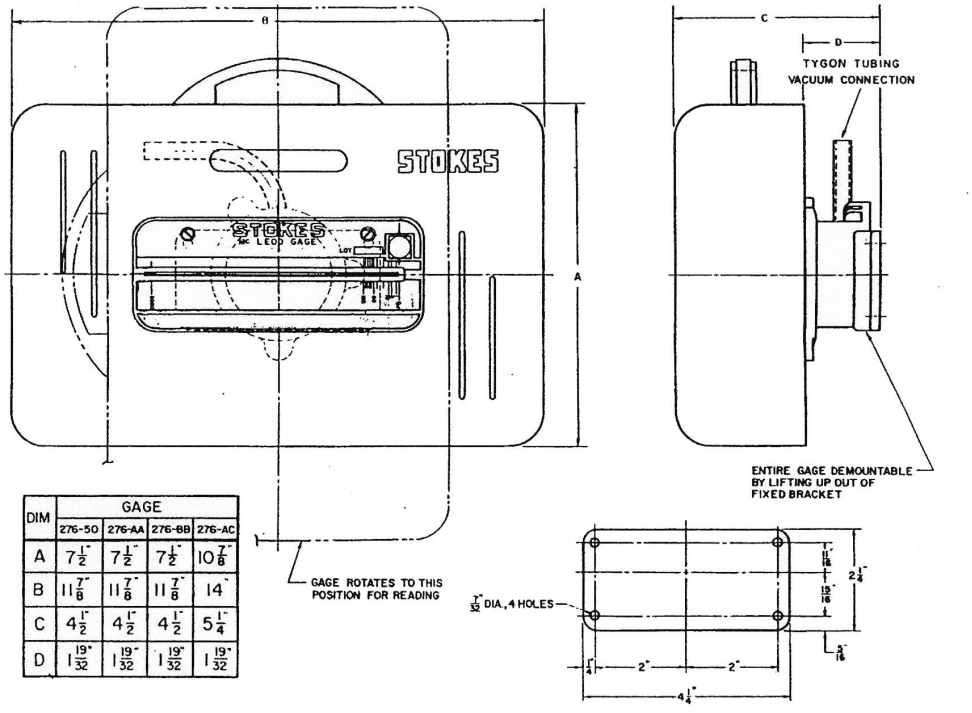
The Princo Stokes McLeod type vacuum gage is an absolute instrument because accuracy of the gage is dependent upon physical dimensions maintained in the measuring capillary. This gage is considered the calibrating standard for all other types of vacuum gages such as thermocouple, ionization, or other electrical type gages. It is ideally suited *to* convenient, accurate, field and/or plant measurements of high vacuum by virtue of its independence from electrical connections batteries, electronic components, etc.

The McLeod gage is light in weight, readily and safely carried about. The instrument is simply held or placed in a horizontal position and is connected to the vacuum system by means of rubber plastic or copper tubing. A swivel type-mounting bracket is included with the gage for mounting in one location. The connecting tubing from the swivel bracket does not rotate with the gage, because all movement is taken up inside the gage. An accessory standard is available for bench mounting (Product Code # 900-276-101).

Flexible tubing can go through back of mounting bracket, or through hole in top of bracket. The current style bracket permits the gage to be removed from the wall-mounted portion, and taken *to* another location readily, when the tubing is fed through the top hole in the swivel bracket.

1.2 VAPOR TRAP

No type of McLeod Gage can give correct readings if condensable vapors, e.g. water, alcohol, oils, etc., are present in the gage. Usually gages with condensable vapors present indicate pressures lower than the true pressure of the system. Gages of different ranges under these same conditions will also vary in the pressure readings, but both gages may be incorrect. To exclude condensable vapors from the gages - chemical vapor traps are used.



DIM	GAGE			
	276-50	276-AA	276-BB	276-AC
A	7 1/2"	7 1/2"	7 1/2"	10 7/8"
B	11 7/8"	11 7/8"	11 7/8"	14"
C	4 1/2"	4 1/2"	4 1/2"	5 1/4"
D	1 19/32"	1 19/32"	1 19/32"	1 19/32"

Figure 1 – General Arrangement

2.0 INSTALLATION

2.1 FILLING (Mercury)

Unpack the gage carefully. If the gage is not filled, enough mercury to fill the gage has been included with the shipment. *Depending on regulations mercury may not be included with gauge.*

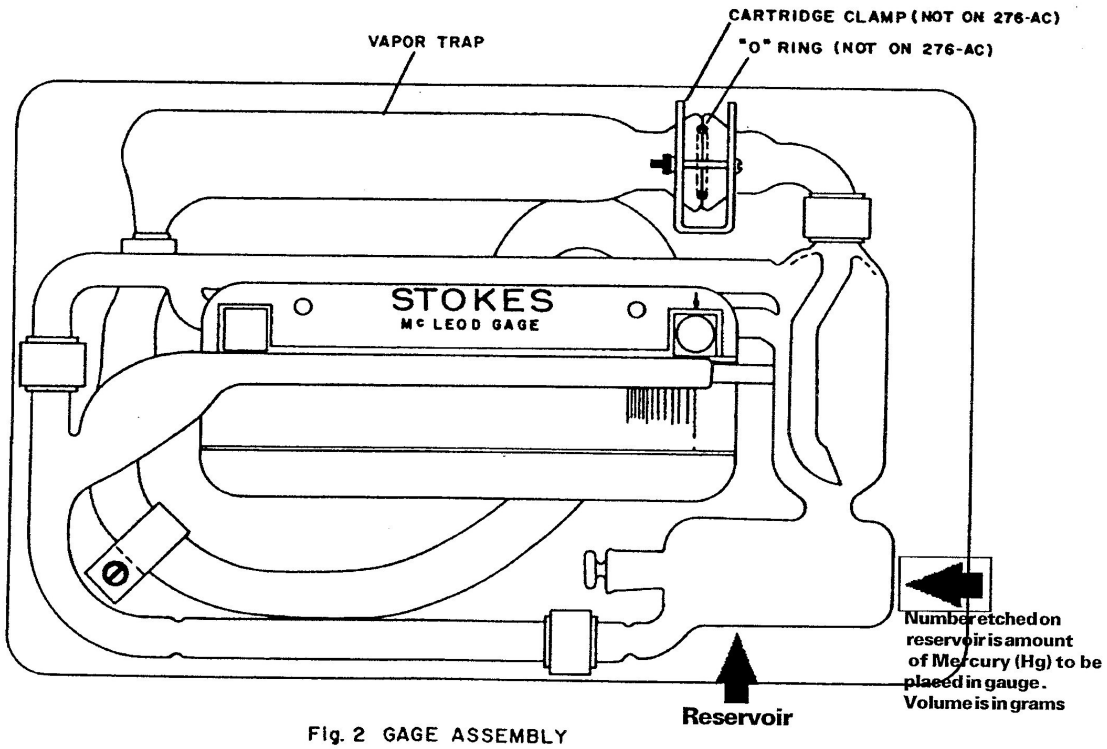
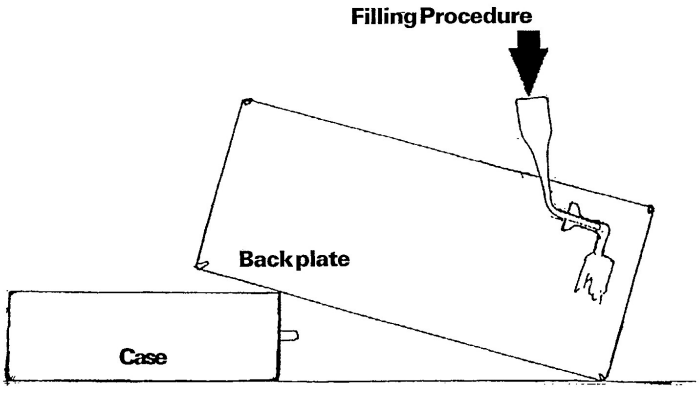


Fig. 2 GAGE ASSEMBLY

Product Code No.	900-276-12	900-276-15	900-276-18	900-279-11
Model No.	276-AA	276-BB	276-50	276-AC
Approx. Wt. Of Mercury	1 lbs	2 lbs	1 lbs	4 lbs

2.1.1 Models with Built-in Vapor trap (276-AA, 276-BB and 276-AC)

Refer to Fig. 3 for illustrations of filling and desiccant replacement. Remove the plastic gage case by unscrewing the (4) cap screws in the back plate. This will expose the gage glass and vapor trap assembly held together by a cartridge clamp. Remove cartridge clamp by backing off the (2) thumbscrews. Carefully separate the two flanges and remove "O" ring. (CARE MUST BE TAKEN NOT TO DAMAGE THIS "O" RING).

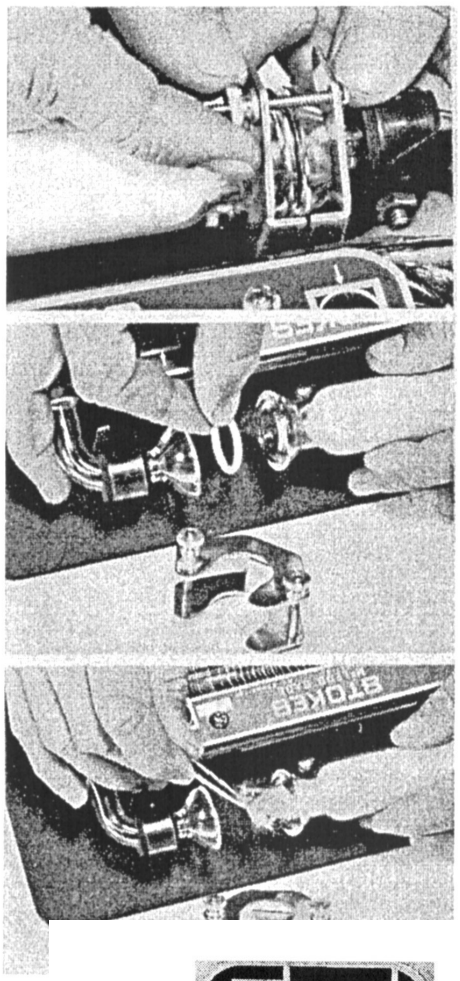


Rotate the gage glass to a 45-degree angle with the inlet flange facing up. Move the vapor trap to the inside far enough to allow the glass funnel to be inserted into the inlet flange Pour the mercury into this funnel and fill gage. The total supply of mercury shipped must be added to gauge.

To reassemble, remove funnel, if necessary lubricate "O" ring with vacuum grease or stopcock grease, and position it properly before replacing cartridge clamp. Replace plastic gage case.

Connect the gage filled with mercury to a vacuum system. Evacuate it in the horizontal position for several hours, and then tilt the gage to the vertical position. With gage under vacuum and in the vertical position, mercury should rise in the comparison capillary to the arrow or point just opposite the "O" mark under the reading capillary.

If any mercury has been lost or spilled in the filling operation it may be necessary to add further Mercury to accomplish this and, if so, do it in small increments (1ml.at a time) so as not to overfill.



CAUTION: AFTER FILLING GAGE, REPLACE THE VAPOR TRAP AS QUICKLY AS POSSIBLE.

To establish reading accuracy after filling the gage, place the gage under vacuum for about 10 minutes. Then turn the gage to vertical position.

The mercury can now be seen in leveling cap.

The mercury should be to the center of view port on the left of the metal nameplate. See figure 3A. This will tell you have the right amount.

NOTE: The 276-50 gage does not have vapor trap.

2.1.2 Model without Built-in Trap

Remove the tubing from end of gage glass and pour the mercury through a clean glass funnel into the gage. After filling, replace tubing and connect gage to vacuum system by following the procedure given above.

2.2 MOUNTING

Although the McLeod Gage is portable, permanent mounting can be arranged. A wall bracket is supplied with each gage. This should be firmly fastened in a convenient location so that the swivel bracket on the gage can easily slide in place to hold the gage in the horizontal position. A screw is located on the swivel bracket for fine adjustments to stop gage in the vertical or reading position with the mercury exactly in the arrow when the gage is turned rapidly without hesitation. A portable stand can also be purchased for mounting the gages, as well as extra wall brackets.

2.3 CONNECTING TO SYSTEM

Connect the gage to the vacuum system; using copper, tygon, saran, or other non-collapsible tubing, ¼" bore minimum diameter and 1/8" min. wall thickness. Any rubber tubing used must be non-gassing, sulphur-free, dry, and free of talc in the bore, otherwise the mercury may become contaminated and the gage will read falsely high. Be sure to blowout the tubing before it is connected to the gage. Connect the tubing to the system. Because of its porosity, all rubber tubing should be as short as possible. If the gage line is longer than 5 feet it should be one of a larger bore diameter, e.g., ½" to prevent lag In the pressure reading. On the model # 276-AC gage, ½" ID tygon tubing 18" in length is furnished with the gage. Continue with ½" ID copper tubing or larger to the vacuum system.

3.0 OPERATION

3.1 HOW TO READ GAGE

With Pinch Clamp open, allow the gage to be evacuated for several minutes in the horizontal position. Tilt the gage rapidly without hesitation to the vertical position until the mercury in the comparison capillary rises to arrow just opposite "O" of the scale. The pressure in the system may then be determined directly from the reading capillary. Between readings, return gage with an easy steady motion to its horizontal position and hold for at least 30 seconds to permit the pressures in the system and in the gage to balance. Too fast action at start of return movement will cause slugging of mercury in fine capillary.

3.1.2 Never allow the vacuum to be released in the gage while in the reading position. This could break the gage glass by driving the mercury into the closed end capillary.

3.1.3 To protect the gage and keep it dry, it is advisable to close the pinch clamp while still under vacuum:

(a) When readings are not desired.
(b) When the gage is to be disconnected from the system.
(c) When air is admitted to the system.

3.1.4 The #276-AC gage has a double scale. The fine scale covers 0 to 50 microns. The wide range scale covers 50 microns (which is where the fine scale stops) to 5000 microns as in # 276-AA gage. The 276-AC gage is recommended whenever fine readings below 50 microns are required. In vacuum applications below 10 microns this gage is essential. The wide range scale up to 5000 microns extends the reading in order to follow the evacuation of the system from 5000 microns down to the range below 50 microns. Thereby it overlaps sufficiently with mercury manometers and dial gages to cover the full range from atmospheric pressure to high vacuum.

3.2 VAPOR TRAP

To exclude condensable vapors from the gages, chemical vapor traps are used, and it is essential that the chemical in the trap is in proper condition. Readings of a gage so equipped should not be compared with another gage not equipped with a condensable vapor trap or one with chemical not in proper condition. The pinch clamp should be used to prevent entry of air into the gage and trap when vacuum is released in the system or when the gage is not in use. Several days under vacuum with new gage chemical may be necessary before gage will read accurately. This is also true of new gages.

3.2.1 The vapor trap is built into current models #276-AA, #276-BB and #276-AC. The user should inspect the crystals in the trap frequently. When the blue granules begin to turn pink, or when the pearl gray granules begin to show a developing brown tone, the Stokes gage chemical should be renewed. To preserve the gage chemical, the pinch clamp should be closed to prevent entry of air before vacuum in the system is released or when the gage is not in use.

3.2.2 Pour out all the contents of the trap. Loosely refill one third of the trap with glass wool, fill the center one-third with new gage chemical and loosely pack the remaining one third with new glass wool. Precautions should be taken to complete the refilling with a minimum of atmospheric moisture entering the trap. If the trap is dirty, it should be removed, cleaned and dried by baking.

4.0 CHECKING

4.1 LEAKAGE CHECK

The gage may easily be tested for leaks by checking the leakage rate. First evacuate the gage, then after closing the gage pinch clamp, take a reading every two minutes for ten minutes, then hourly, recording the readings. If the rise in pressure is no greater than 10 microns per minute, the leakage is not excessive. If it is excessive at high vacuum but not at higher pressure, the appearance of the leaks is false. It is due to condensable vapors or degassing.

4.1.1 The permissible leak rate of 10 microns per minute must not be taken as an indication that a large leak rate is tolerated. The volume of the gage is so small that the actual amount of air leaking in or out gassing (which causes that pressure rise of 10 microns per minute) is very small. This amount of air expended into a large vacuum system, say 10 cubic feet, will produce a negligible pressure rise. The 276-AA and 276-BB gages are approximately .01 cubic feet in volume and 276-50 gages are approximately.015 cubic feet. This means that the maximum permissible leakage or outgassing to produce a 10 micron pressure increase in the gage itself would increase the pressure in a 10 cubic foot system by only 0.01 microns per minute or 0.6 microns per hour.

4.1.2 The formula used for the problem in question is as follows: The formula (Boyle's Law) PV=P1 x V1 applied to the example above:

McLeod Gage	System (Assumed 10 cubic feet)
Press. X Vol. =	Pres. X Vol.
10 x 0.01 =	X x 10
X =	0.01 Microns per minute
X =	0.6 Microns per hour

5.0 MAINTENANCE

5.1 GENERAL GAGE INFORMATION

5.1.1 STOKES GAGE CHEMICAL

Additional gage chemical is available on order. This gage chemical has a great affinity for moisture; consequently, it must not be exposed to the air any longer than absolutely necessary. The bolts must be tightly resealed for storage by wax-coating the stopper.

5.1.2 PRESSURES BELOW 1 MICRON

When continually dealing with pressure well below 1 micron, good vacuum practice calls for complete trapping of all condensable vapors from the entire vacuum system. In such case, the chemical trap is not needed.

5.1.3 HOW TO REMOVE DROP OF MERCURY FROM CENTER CAPILLARY

If a drop of mercury should lodge in the measuring capillary, place the gage under high vacuum. Turn until in a nearly horizontal position. With one hand hold gage firmly and with the other hand strike the base of case. This should dislodge the drop of mercury and it should move downward. If a reasonable amount of effort does not accomplish the desired result, proceed as follows with the use of heat. With the gage again under vacuum and in the same position mentioned above, gently warm the measuring capillary above the drop of mercury. Use an electric heat gun.

CAUTION: **This method must not be applied to models 276-A or 276-AC. This incandescent type of flame is one using gas without air or oxygen, and it should be of nearly pinpoint size. As the mercury moves downward, warm more and more of the capillary above the droplet until it is completely removed. The important point in warming glass with the flame is not to heat it too rapidly and avoid a sudden increase in temperature. To prevent recurrence of this condition, the gage should be kept in the horizontal position at all times (except when a reading is being taken) and particularly when the vacuum is broken.**

5.2 CLEANING GAGE

If normal precautions are taken to prevent dust and dirt from entering the gage, cleaning should not be necessarily. However, if cleaning becomes necessary, we recommend returning the gage to our plant.

When returning the gauge to our factory for cleaning or repairs,

DO NOT SHIP MERCURY.

a) Remove the gage glass from the case.
b) Gently heat the plug and surrounding glass, to soften cement and remove the plug.
c) Remove the gage glass from the back plate and pour out the mercury into a glass container being especially careful not to spill mercury anywhere else.

To return the gage to Princo, go to section 5.3 for packaging and shipping instructions.

If you choose to clean the gauge yourself and have had experience in cleaning laboratory glassware and have the proper facilities available, you may continue as follows:

a) Remove all residual cement using acetone.
b) Replace glass plug with a temporary rubber stopper.
c) Rinse the gage with 1:2 nitric acid.
d) To clean capillary, draw the solution up with vacuum (the same as with mercury in reading), preferably using water aspirator.
e) Drain the gage and rinse it with distilled water (using vacuum again to rinse the capillary), until litmus paper indicates the wash water is free of acid.
f) Remove all traces of moisture by drying the gage in a 250º oven for several hours, preferably under vacuum.

g) Replace the glass plug with vacuum cement (black Apiezon Wax "W") and heat this portion of the gage to soften the cement until a tight seal is assured.
h) After replacing the gage glass in the case, be sure to tighten the screws on the gage case.

CAUTION: The closed end of the measuring capillary of the model #276-AC gages is sealed with vacuum cement (Apiezon Wax "W") which may be dissolved with acetone. The measuring capillary may be cleaned by passing a fine wire through it. After cleaning, close this capillary with new cement to exactly opposite the "0" mark.

5.3 PACKAGING

5.3.1 RETURNING GAGE TO FACTORY

All work to restore gage is performed at the factory. Prior to shipping the gage, call Princo at 215-355-1500 to obtain an RMA (Return Material Authorization) number. Ship gage prepaid to the factory, clearly referencing the RMA number and if possible, enclosed a purchase order. Upon receiving and inspecting the gage, a price quotation will be provided for confirmation and authorization to perform the necessary work. No work will be performed without authorization. Give authorization by phone, fax, letter or purchase order change notice. When work is completed, the gage will be returned

5.3.2 PACKAGING AND SHIPPING INSTRUCTIONS

McLeod Gages are delicate precision instruments and are easily damaged in transit unless emptied of mercury [described in 5.2 a) to c) above] and properly packaged. Princo strongly recommends that customers retain all original packaging materials to provide for subsequent return of gages to the factory. When returning gages without the original packing materials, please adhere as closely as possible to the following standard specifications:

1. Heavy corrugated carton (16-3/8” L x 11-5/8” W. x 8-3/4” H)
2. Place gauge in a sealed plastic bag.
3. Cushion the gauge in the carton using shredded paper or Styrofoam with a minimum of 4" thickness on all four sides of the gage.
4. Mark cartons “Fragile, handle with care". Approximate weight is 12 to 24 pounds.
5. Ship the gage via UPS. Declared value should be shown on the express receipt.

The above information does not in any way guarantee safe delivery but only tends to minimize the possibility of damage in transit.

Ship to:

ATTENTION: Repair RMA # _____
Princo Instruments, Inc
1020 Industrial Boulevard
Southampton, PA 18966-4095

The Stokes McLeod Gage is sturdily constructed of extra-heavy fully annealed, shock-resistant Pyrex glass, mounted in a durable case.

FOUR MODELS ARE AVAILABLE

Model 276-50 provides measurement over a wide vacuum range of 10 microns to 50 millimeters.

Model 276-AA is designed for genera] industrial high vacuum service in the range from 1 micron to 5 millimeters.

Model 276-BB which clearly covers the range from 0.1 micron to 500 microns,

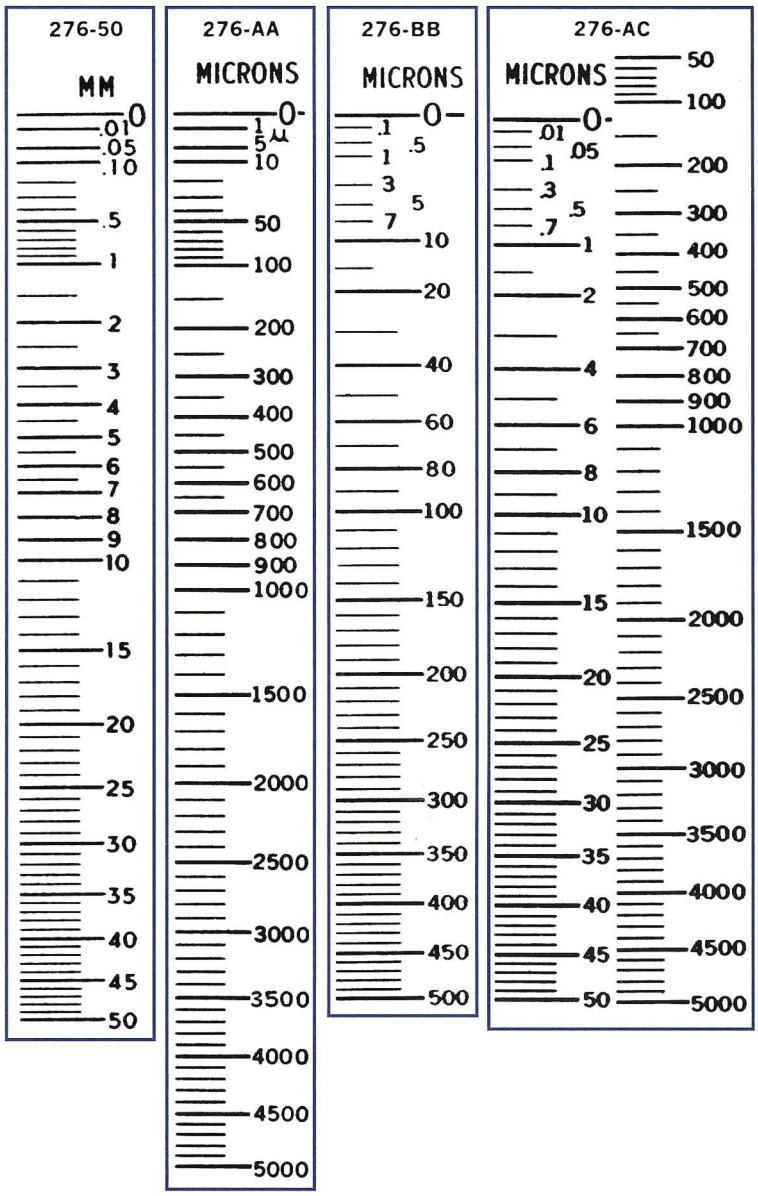
Model 276-AC for extremely accurate vacuum measurements from *0.01* micron to 5 millimeters.

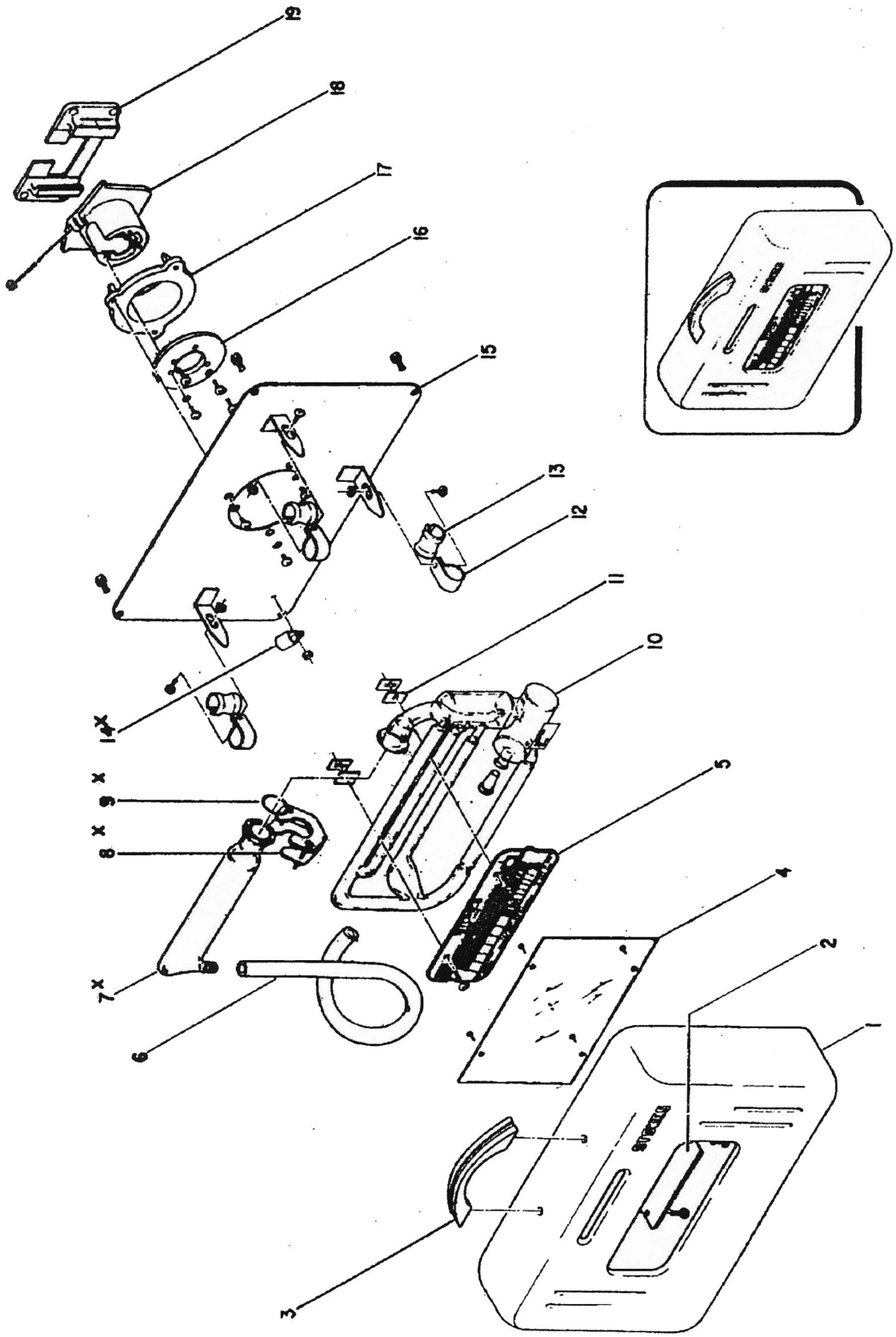
A renewable condensable vapor trap on models AA, BB and AC protects the gage from the possibility of contamination. Model AA, BB and 50 Include an external shutoff clamp to protect the gage when it is disconnected from the system.

Stokes McLeod Gages are shipped complete with:

Triple-distilled mercury
Vacuum Plastic Tubing (2 ft.)
Clamps (where required)

McLeod Gage Scales





X NOT USED ON 276-50

Fig. 4 EXPLODED VIEW OF GAGE