

KAHL SCIENTIFIC INSTRUMENT CORPORATION

P.O. BOX 1166, EL CAJON (San Diego), CALIFORNIA 92022

Telephones: (714) 444-2158 and 444-5944

Factory: 737 W. Main St., El Cajon, Calif.

No. 35AM100 KAHLSCO UNIVERSAL SUNSHINE RECORDER

This sunshine recorder is an improved Campbell-Stokes type with leveling and alignment adjustments that allow it to be used anywhere in the world. Summer, Winter, and Equinox charts permit records of sunshine duration to be made throughout the year. This modernized model is more versatile, rugged and accurate than older designs.

TECHNICAL DATA

TYPE: Optical-mechanical sunshine recorder which concentrates solar radiation to burn a trace on paper charts.

RANGE: Records as much as 16 hours of sunshine at any latitude up to 60° North or South of the equator.

RECORDER: Spherical glass lens which concentrates and focuses the sun's rays on the chart as the sun moves across the sky.

CHARTS: Blue cardboard with vertical half-hour divisions, shaped to fit holder.

SENSITIVITY: Solar intensity of about 0.3 gm.cal./cm.²/min. is necessary to produce record.

POWER SUPPLY: None required, entirely mechanical operation.

AMBIENT OPERATING CONDITIONS: No limitations.

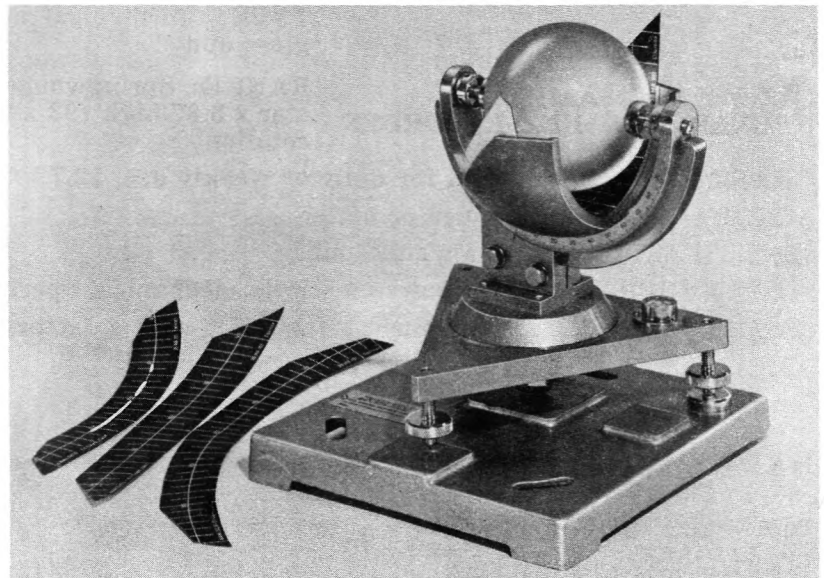
MATERIALS: Noncorrosive metals are used throughout.

DIMENSIONS: 8.3" x 11.4" x 9" (21 x 29 x 22.8 cm.).

WEIGHT: 11.25 lbs. (5.1 kg.).

ACCESSORIES FURNISHED: 400 charts.

The KAHLSCO Universal Sunshine Recorder has a 3.59" (92 mm.) diameter polished, optically clear glass sphere securely held by cushioned screws with lock nuts at the ends of an arc support. The latter has 4.8" (12 cm.) long scale with widely spaced 0 to 90 divisions, in 1° increments and numbered every 10°. The arc support is movable, in a clamp fixture, allowing the degree of latitude for the sunshine recorder installation to be set opposite an index line on the pedestal, which aligns the geographic meridian axis of the sphere. A concave chart holder is also affixed to the support, concentric with and at the focal point of the sphere. Three contoured sets of grooves retain the Summer, Equinox and Winter charts which are fixed in position by movable pins. The chart holder has a reference line, for the meridian plane of the sphere, to which the noon line of the charts must be aligned. The pedestal base is similarly marked and an indexing line is scribed into the triangular platform supporting all these components. A circular level vial and three adjusting screws allow the recorder to be precisely aligned horizontally. The mounting plate, on which everything rests, has a clamping mechanism for the pedestal base, seats for the leveling screws and three slots for securing bolts which affix the sunshine recorder to the foundation at the site.



35AM100 UNIVERSAL SUNSHINE RECORDER

As the glass ball is rigidly held by its clamps accidental breakage, malicious thievery and tampering with adjustments are reduced. The dark blue colored surface of the chart readily absorbs the heat of the sun's rays, which are concentrated and focused by the sphere. The concave shaped

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TELEX: 697906
CABLE: KAHLSCO SANDIEGO



Winter chart is 9" (23 cm.) long, the straight Equinox chart is 9.4" (23.8 cm.) long and the convex Summer chart is 11.8" (30 cm.) long, as measured along their center line. Every third hour, from 6:00 to 18:00, is numbered; half-hour divisions are provided. The chart markings are white, while the cardboard of the charts, which is carefully chosen to assure constancy in the burning rate with minimum physical changes due to moisture, is gray.

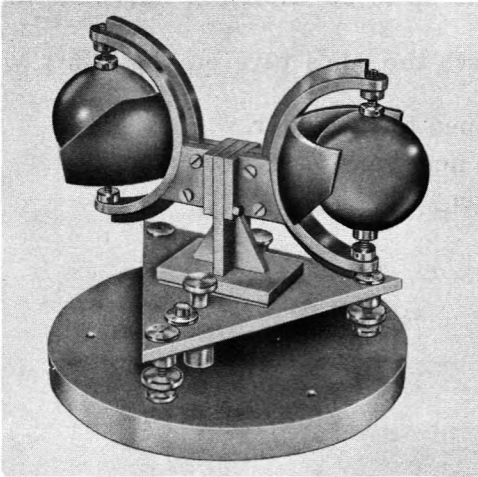
The index lines on the base and platform allow the meridian alignment to be adjusted, easily, at any time, which facilitates installation procedures.

35AM100 KAHLISCO Universal Sunshine Recorder, complete, as described above.

35AM102 Spare recorder charts; set of 100 each Summer, Winter; set of 200 each Equinox; 400 charts total.

No. 35AM120 Sunshine recorder is similar to 35AM100 but does not have the meridian alignment adjustment mechanism. The pedestal is affixed directly to the platform.

No. 35AM140 Sunshine recorder is similar to 35AM120 but does not have the leveling adjustment and platform. The pedestal of this model is permanently secured to the mounting plate.



**35AM160
POLAR SUNSHINE RECORDER**

No. 35AM160 Polar Sunshine Recorder is similar to 35AM120 but has two glass spheres with arc supports and pedestals, mounted 180° apart. The pedestals are held to a common base so that both spheres are unobstructed. This special sunshine recorder was designed for measurements between 60° and 90° latitude when more than 13 hours of sunshine occur.

No. 01AM100 KAHLISCO MECHANICAL ACTINOGRAPH

Global radiation intensities can be conveniently measured by this portable device. A triple Robitzsch type bimetallic sensor assures accurate recording at any locality. Adjustment mechanisms and integral thermal compensators allow this instrument to be used in any climate.

TECHNICAL DATA

TYPE: Mechanical actinograph with bimetallic sensor and glass dome.

RANGE: Springwound 8-day clockwork drive for 3.6" diameter x 3.8" high (93 x 98 mm.) drum with variable 1- or 7-day rotation.

CHART: Vertically divided for daily or weekly use, 12.7" x 3.6" (322 x 91 mm.).

ACCURACY: ± 5% of range or better.

SENSITIVITY: 0.03 gm.cal./cm.²/min.

POWER SUPPLY: None required, entirely mechanical operation.

CALIBRATION: Each instrument is furnished with a factory calibration certificate.

AMBIENT OPERATING CONDITIONS:

Temperature: -5° to +120°F. (-20° to +50°C.).

Humidity: 0 to 100% R.H.

MATERIALS: Noncorrosive metals are used externally with rubber O-rings and gaskets on housing seals.

DIMENSIONS: 15" x 10" x 7.5" (38 x 25.5 x 19 cm.).

WEIGHT: 13.5 lbs. (6 kg.).

ACCESSORIES FURNISHED: Extension key for clockwork, spare pen, pen cleaner, recording ink, 100 charts.

Global radiation is the energy flux received on a horizontal surface from direct solar emanation and secondary order, scattered and diffused, sky radiation. This is of prime importance in heat budget analyses and can be measured either electrically, as with KAHLISCO No. 28AM100 Star Pyranometer, etc., or mechanically, as with this recorder which is rugged, compact and well suited to field operation. Among the various radiometers (radiation flux measuring devices), actinographs, sometimes called pyranographs, measure the direct solar radiation at normal incidence while net radiometers (pyrrometers), such as KAHLISCO No. 29AM100, measure the resultant flux of solar (incident) and terrestrial (reflected) radiation.

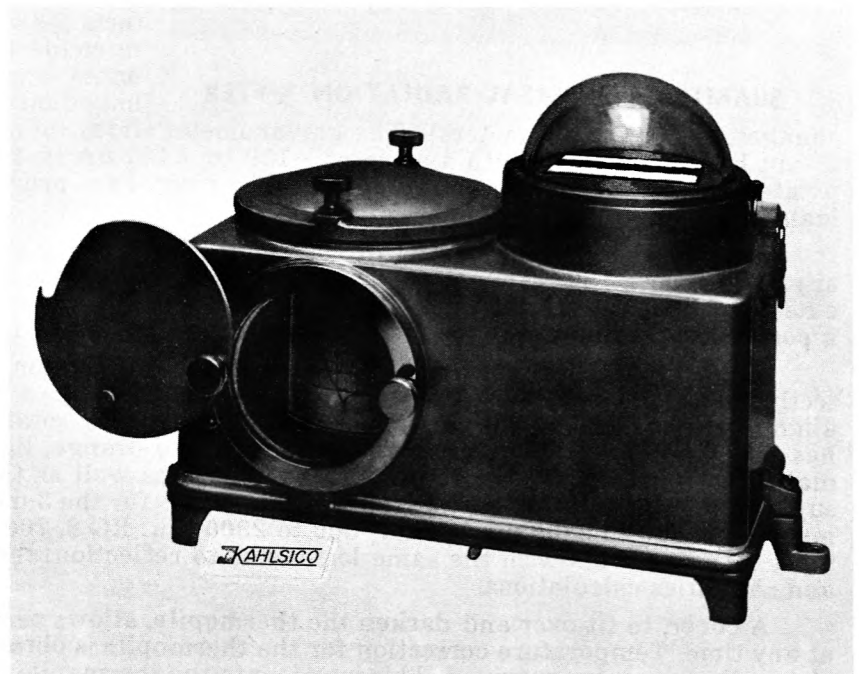
The housing of this actinograph has an extension at each end with a hole in it to allow the unit to be secured to a foundation once it has been positioned. The site should allow an unobstructed view of the sky and the sensor strips, visible beneath the glass dome at the top of the instrument, should be aligned in an East-West direction. Two knurled screws hold the plastic, round, recorder window (at left, on the housing) in place, together with a protective metal cover. The latter has a lifting knob at top and rests against a rod (at left of the window assembly) when fully opened. The 3.4" (86 mm.) diameter window allows part of the record, and the ink recording pen, to be seen at a glance, as well as the internal circular level vial which is used to horizontally align the recorder. At

the back side of the housing a large knurled fitting provides access to a removable chamber which is to be filled with desiccant in order to keep the inside of the actinograph dry and prevent the condensation of moisture on the inside of the glass dome, which would affect the measurements. The large cover (at top left of the housing) has a knurled captive screw in front, which, when loosened, allows the cover to be swung to the left, pivoting on the fixed knurled screw at rear. This exposes the recorder drum which has a winding key, for the spring driven clockwork, clamped to its top. A pen lifting arm, to prevent extraneous markings and smearing during servicing, is controlled by a lever below the front of the housing. When the drum is lifted out of the recorder the chart, which is tightly held by a spring clamp, can be exchanged. A flange at the bottom of the drum assures proper positioning of the seated chart. When the drum is turned over, the variable drive gear is visible and can be inverted for daily or weekly operation, as marked on the gear. The clockwork has a sliding door to protect the adjustment lever which is used to compensate for small differences in the accuracy of the spring drive, due to temperature variations or handling. To the right of the glass dome at the top of the housing is a knurled screw, attached by a small chain to a post at the right, rear corner. When this is removed the zero adjusting mechanism for the bimetallic sensor is accessible. A special wrench, which is tightly held by the post and secured to it by a small chain to prevent loss, is used to turn a screw, changing the position of the strips, and the zero point of the system, as necessary. As the strips must be horizontal for correct measurement of the sun's rays they must be adjusted if they deflect due to temperature extremes, which changes the angle of incidence of the solar radiation. In cold, polar regions, low temperatures would cause the bimetallic strip assembly to curve upwards. In the tropics, temperatures occur high enough to cause the strips to bend downward, even below the level of their surrounding reflection plate, which would cause them to be in shadow when the sun was not at its zenith. Daily changes in temperature are not of sufficient magnitude to cause problems, once the actinograph has been adjusted. This is done in the absence of solar radiation, usually at night.

METHOD OF OPERATION: The special borosilicate glass dome, which transmits more than 80% of the light between the wavelengths of 0.38 and 2.2 microns and is partially transparent from 0.32 to 2.75 microns, protects the three bimetallic sensor strips. The two outer strips are painted with a highly reflective white pigment which is superior to chrome plating as the latter is a good reflector only for some portions of the visible spectrum, and actually absorbs much energy, particularly in the infra-red, while the white chosen is an excellent and uniform reflector. These strips are attached to a rigid support at one end, which is secured to the housing, and to the black painted strip between them at the other. The standard Parson's black is used as this has high and uniform radiation absorption over a wide range of wavelengths. The free end of the black strip is coupled with the counterbalanced pen arm by a small, temperature compensated chain.

In operation, the white painted bimetallic strips deflect in proportion to the ambient temperatures (as they reflect most of the solar radiation) while the black bimetallic strip deflects in proportion to the heat produced by the combined ambient and absorbed solar radiations. As the movement of the white strips is opposite to that of the black strip, they compensate for variations in the ambient temperature and only the magnitude of the solar radiation is indicated by the recorder pen. Two white strips are used in order to avoid seasonal errors. The North and South movement of the sun during the year will cause the front of the housing to be in cool shadow while the back is in full, hot sun at some times, while in the opposite season the front would be heated and the back cool. Unavoidable internal convection currents are thus produced that rise and heat the sensor strip closest to the "hot" side more than that at the opposite side. If only 1 white

strip were used measurement errors would result, however, with white strips on both sides these differences are averaged out and compensation is affected. The middle, black strip is evenly exposed to these currents as it is in the center. Special alloys, with a difference of more than $150 \cdot 10^{-7}/^{\circ}\text{C}$. in their coefficient of expansion, are used to obtain the greatest possible movement of the bi-metal strips in comparison to the deviations in temperature. An air gap between the strips prevents horizontal heat transfer. The sensor is also isolated from its polished, flat reflector, which is in the same plane at the base of the dome. The thin bimetallic strips react rapidly to changes in temperature and provide reliable records of the solar radiation intensity. It has been found that a radi-



01AM100 MECHANICAL ACTINOGRAPH

ation variation of about 30% is registered in approximately 90 seconds with this system. The strip pigments have a special coating to inhibit reactions, assuring stability of calibration. The daily solar radiation can be accurately determined by measuring the total area of the record obtained (multiplying by 6 if a weekly record is being evaluated) and applying an instrument factor, which is given on the calibration certificate supplied with each unit and is dependent upon the mean ambient temperature. The radiation can also be quickly estimated by visually determining the average value for each hour and multiplying the sum by the instrument factor.

01AM100 KAHLISCO Mechanical Actinograph, Robitzsch type, complete, as described above.

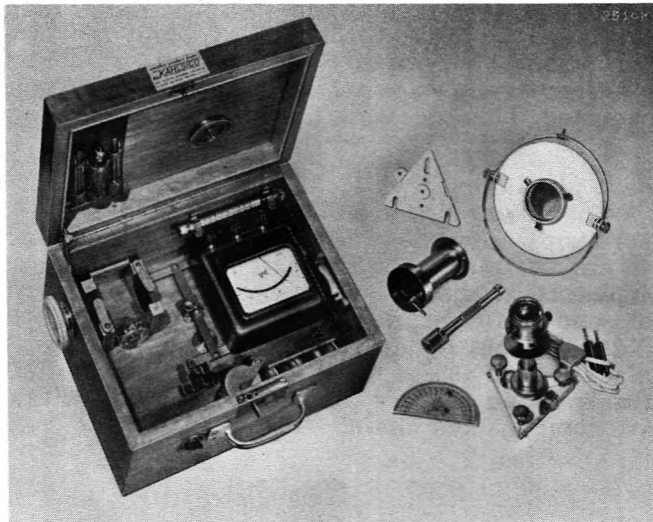
01AM102 Spare recorder charts; set of 100.

01AM111 Spare recording ink; per vial.

01AM113 Spare recording pen.

No. 30AM100 KAHLISCO UNIVERSAL RADIATION METER, GEORGI MODEL

This unique field kit can serve as a pyrliometer (for direct solar radiation measurement at normal incidence), pyranometer (for measurement of the solar and/or sky radiation), pyrgeometer (to measure the net atmospheric radiation), pyrriadiometer (for measurement of total (solar and terrestrial) radiation), and net pyrriadiometer (to determine the net total (sky, solar, and terrestrial) radiation). As it is portable, compact, and completely self-contained, it may be used to obtain data at any location. All of the parts are housed in a sturdy, compartmented wooden carrying case.



30AM100 UNIVERSAL RADIATION METER

changes, is 160 ft. (50 meters). The galvanometer slides out of the carrying case for field use. It has a taut band movement with a scale of -100 to $+400$ μA in 10 μA divisions. A mirror behind the pointer reduces parallax reading errors. Two ranges are provided by the 8 and 20 ohm input terminals.

The sensor may be mounted directly onto the carrying case cover, which may then be tilted to any angle over a 180° range, as measured by the protractor accessory, and clamped by a knob on the outside of the case. A triangular plate is also provided in the event it is desired to affix the sensor to a post or tree stump in the field. An extension bar is included to facilitate positioning of the sensor.

The actinometer tube can be placed on top of the sensor thermopile, after removing the protective glass dome, for direct solar measurements. This has a protective shutter in front and a solar alignment system. An external, color-coded, knurled disc rotates the filters inside the tube. The disc has four openings to accept the normally provided orange, light red, and clear glass Potsdam Normal filters (RG 2, OG 1, and WG 7 respectively) as well as the dark red RG 8 filter which can be supplied on special order. The transmission values for the 3 mm. thick filters are: RG 2, 630 to 2800 μm ; OG 1, 525 to 2800 μm ; WG 7, 300 to 2800 μm ; RG 8, 700 to 2800 μm . The clear glass filter provides measurements with the same losses due to reflection and absorption as with the color filters and simplifies calculations.

A cover, to fit over and darken the thermopile, allows zero readings and adjustment to be made at any time. Temperature correction for the thermopile is obtained from the -30° to $+50^\circ\text{C}$. in 1° divisions thermometer provided. This inserts into the thermopile holder after removal of a tapered plug. Two each, plastic and glass domes, are furnished. Their transmission ranges of 300 to over 50,000 μm and 350 to 2800 μm , respectively, permit good measurement in the long and short wave regions. Only a small correction, in the order of 12%, is necessary to obtain absolute values.

A 6.5" (14 cm.) diameter white shield can be placed over the thermopile holder in order to eliminate nearby surface reflections and reduce the second order scattering effects. A movable shadow band and wire loop to hold the shading disc are attached to the shield and can be adjusted for solar declination and polar axis to allow accurate measurements of the sky radiation. Tools, mounting screws, and miscellaneous parts are provided within the case.

30AM100 KAHLISCO Universal Radiation meter, complete, as described above.

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GEMWARE ELECTRO- ∇ MOTORIZED PSYCHROMETER (Patent Pending)



BULLETIN 02M64 - MOTORIZED PSYCHROMETER

TECHNICAL DATA

HOUSING: Molded from high impact plastics - Improved design - Sturdy construction for lifetime service - Non-corrosive, Fungus resistant.

THERMOMETERS: Workmanship to meteorological specifications - Accuracy: $\pm 0.3^{\circ}\text{F}$ - selected in matched pairs - Shock-mounted in protective frame - automatically positioned for easy and accurate reading of scales.

MOTOR: Self-lubricating, moisture sealed type, 4.5 volt battery powered - motor and fan assembly has low power consumption.

LIGHT: Internal light provides direct illumination of thermometers only.

CONTROL: Single knob control used to operate motor - vary light intensity.

SIZE: 10" x 4-1/4" x 2" - Weight: 2-1/4 lbs.

SERVICING: Screw driver only tool necessary. Completely disassembled with removal of five small screws.

ACCESSORIES: Compartmented padded carrying case holds Psychrometer, slide rule, spare parts and technical manual.

SPECIAL FEATURE: In emergency, removable thermometer frame may be whirled like a sling psychrometer.

The carefully engineered, flashlight-size battery powered psychrometer, illustrated above, is a hand operable instrument used to accurately determine relative humidity, dew point, and air temperature measurements. It is a primary instrument, fully reliable, and will not change its characteristics for the lifetime of the device. There are no mechanical, moving hygroscopic sensors or electrical resistance elements used; experience has shown that such devices change with time, temperature, salt-laden air, or contaminating atmospheres.

The GEMWARE ELECTRO- ∇ Psychrometer is lightweight, portable, and may be used in sunlight or at night, indoors or outdoors, at all altitudes or at sea, for meteorological observations or in Industry,

Mining, Agriculture, Forestry, or Air Conditioning work.

This new instrument is the latest in a series of field tested, motor driven precision psychrometers and embodies several new features as well as those proven engineering designs developed in earlier meteorological instruments. It is simple to use requiring only the wetting of a cloth wick on one thermometer bulb, turning on the motor for about 20 seconds, and reading both the wet and the dry bulb thermometer scales. A simple slide rule is provided for calculating percentage of relative humidity and the technical manual contains complete tables for determining relative humidity as well as dew point data.

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The photograph below shows the GEMWARE ELECTRO- ∇ Psychrometer complete with its carrying case which contains the Nylon strap, extra wicks with thread, spare screws, plastic dropper water bottles, extra light bulb, slide rule, and instruction manual complete with technical data and Tables.

The partitioned air duct for the thermometer bulbs and also the thermometer frame are white colored, in order to reflect incident radiation. The sturdy air duct will not crack with time or become damaged if dropped. It slides snugly in a pair of grooves on the housing case and is additionally secured by means of two spring clips attached to the thermometer frame. The housing has no lugs or weak sections to break off or crack. Aerodynamic design of the duct system and the motorized fan provides the required high air flow rate needed to cool and ventilate the thermometer bulbs.

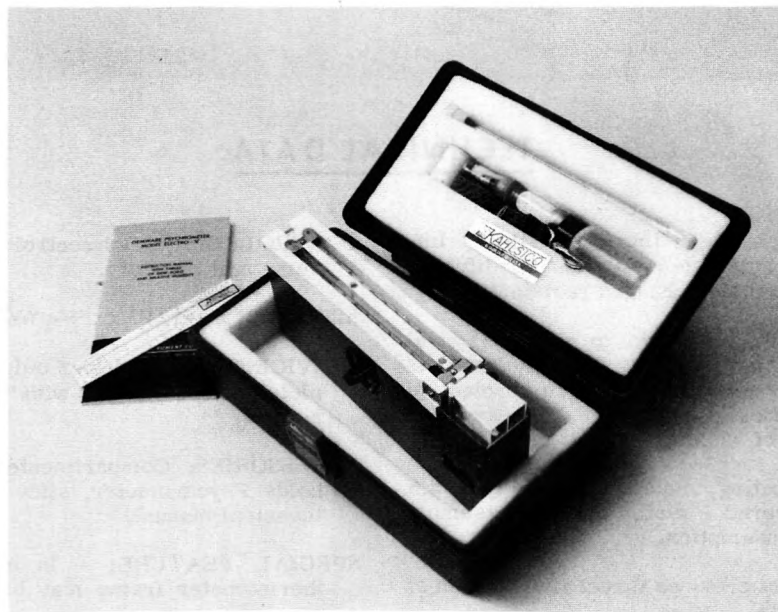
A spring clip contactor, of unique design, connects the batteries to the motor terminal; eliminating soldered wire connections. Three Type D flashlight batteries, obtainable in any local store, are used

to power the psychrometer. They are not furnished with the instrument.

The two thermometers are protectively recessed and shock-mounted in the thermometer frame. Thermometers are furnished with prismatic tubing, mercury filled bulbs or with red liquid filled bulbs, as indicated below. They are of best workmanship, accurate to within 0.3°F. A special metal holder automatically aligns them for easy reading and also holds them firmly to prevent any movement when whirled like a sling psychrometer, should battery failure occur.

The GEMWARE ELECTRO- ∇ Psychrometer meets meteorological and military requirements for battery operated psychrometric instruments. They are carefully inspected and tested after assembly and each instrument carries a one year's warranty against any defects which may occur during normal usage.

The thermometer ranges listed below are carried in stock. Other ranges are quickly procurable on special order. Some Centigrade Thermometers are stocked, in limited quantities.



PRICE EACH

27AM120	GEMWARE ELECTRO-∇ PSYCHROMETER with carrying case and accessories, mercury thermometers, Range 10-110°F in 1°F.	\$70.00
27AM160	Ditto, but with centigrade thermometers, -10 to + 45°C.	70.00
27AM140	Same as 27AM120, but for high air temperatures, Thermometers are red liquid filled, range 30-150°F in 1°F.	72.00
27AM180	Same as 27AM140, but with centigrade thermometers 0-65°C.	72.00
27AM120/ST	SPARE THERMOMETERS , set of 2 matched thermometers in any range specified; also may be ordered with either mercury or liquid filled bulbs.	9.00
34AM100/F	SPARE SLIDE RULE , Fahrenheit scale, 20 to 120°F.	2.50
34AM100/C	SPARE SLIDE RULE , Centigrade scale, -10 to +60°C. (+60°C)	2.50

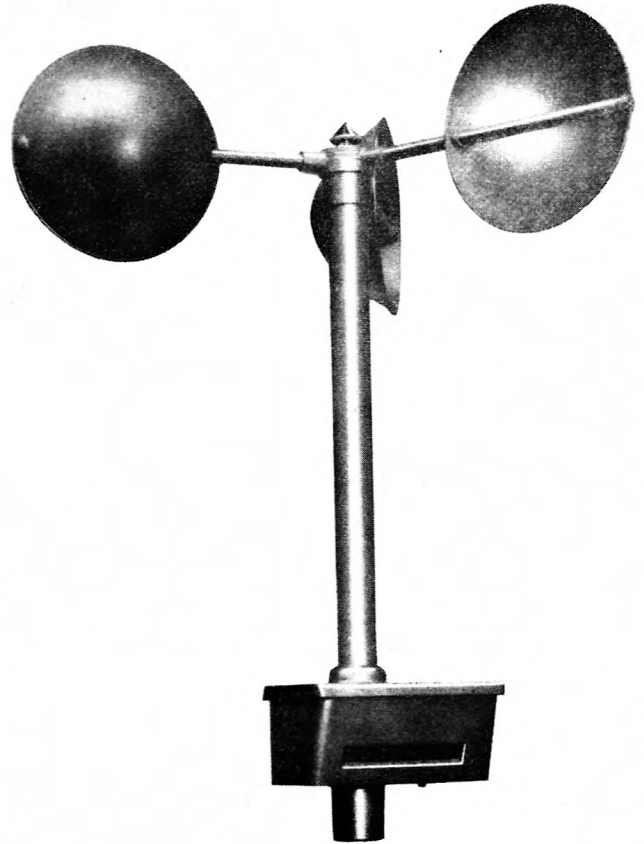
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No. 03AM848 Totalizing anemometer has a sensor similar to No. 03AM180 (see Bulletin 03MO5) electrical wind speed indicator or except its base is rectangular and has an integral mechanical totalizer. The 7-digit counter is easily seen from below (should the anemometer be mounted at some height above the ground) as well as from directly in front. The large, 0.25" (6 mm.) high, numerals are easy to read and differentiate as the full units are colored white while those for tenths and hundredths indication are red. The rolled edge cups are 3.9" (10 cm.) in diameter and have a 4.5" (115 mm.) radial center of rotation. Due to the special bearings, low mass and inertia factors, this anemometer has a sensitivity of 1 knot between 5 and 80 knot wind speeds. The base has a flange with a lock screw for mounting the anemometer on a 0.59" (14.5mm.) diameter rod. This type anemometer is usually mounted adjacent to evaporation pans to monitor the amount of wind passing the location; it may, however, be used in any location for this purpose. This unit will read to 99,999.99 statute miles. The sensitivity is 1 knot and the accuracy is ± 1 knot between 5 and 80 knots. The anemometer has dimensions of 13" x 14.8" (33 x 38 cm.) and weighs 5.5 lbs. (2.5 kg.)



- 03AM846 CUP COUNTER ANEMOMETER reading in kilometers
- 03AM848 CUP COUNTER ANEMOMETER reading in statute miles.
- 03AM840 CUP COUNTER ANEMOMETER reading in nautical miles.

BULLETIN 03MO3 TOTALIZING ANEMOMETER. WILD ANEMOMETER. MECHANICAL ANEMOGRAPH AND WIND TUNNEL

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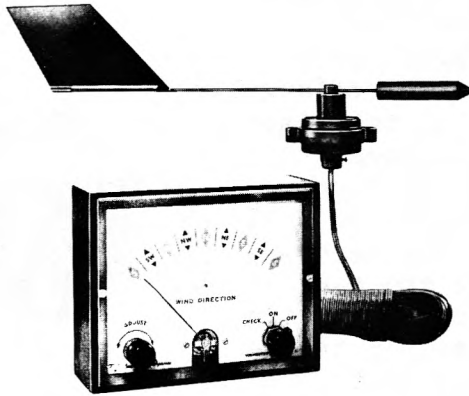


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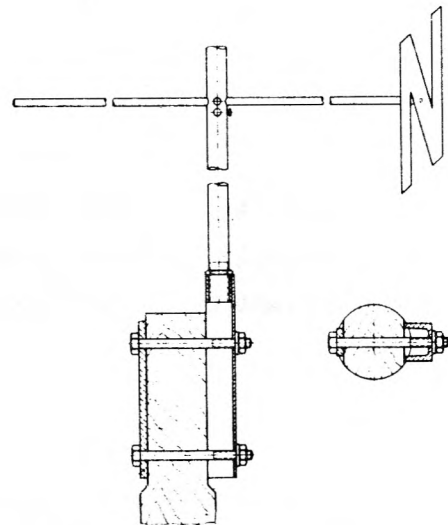
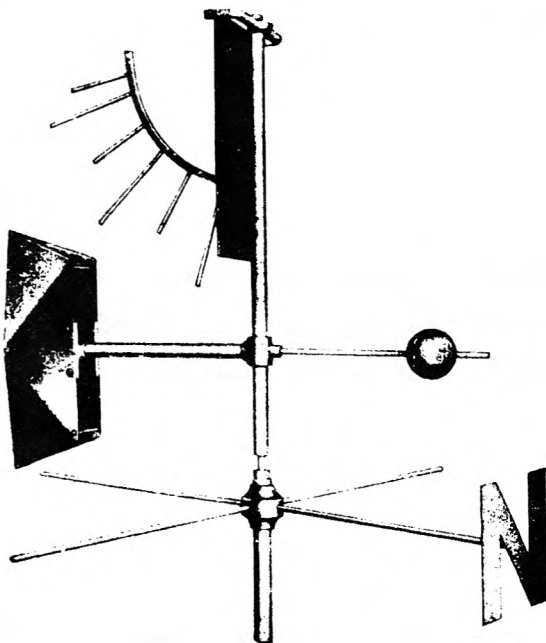


WIND DIRECTION INDICATOR



The No. 41AM120 Wind Direction Indicator has a mahogany finished case with the approximate dimensions of 6.3 in. by 5 in. (162 mm. by 130 mm.). The major compass points are clearly shown on the indicator, which is designed to be placed indoors. The instrument operates on a single flashlight battery. Complete with battery, approximately 60 feet (20 meters) cable, and instructions.

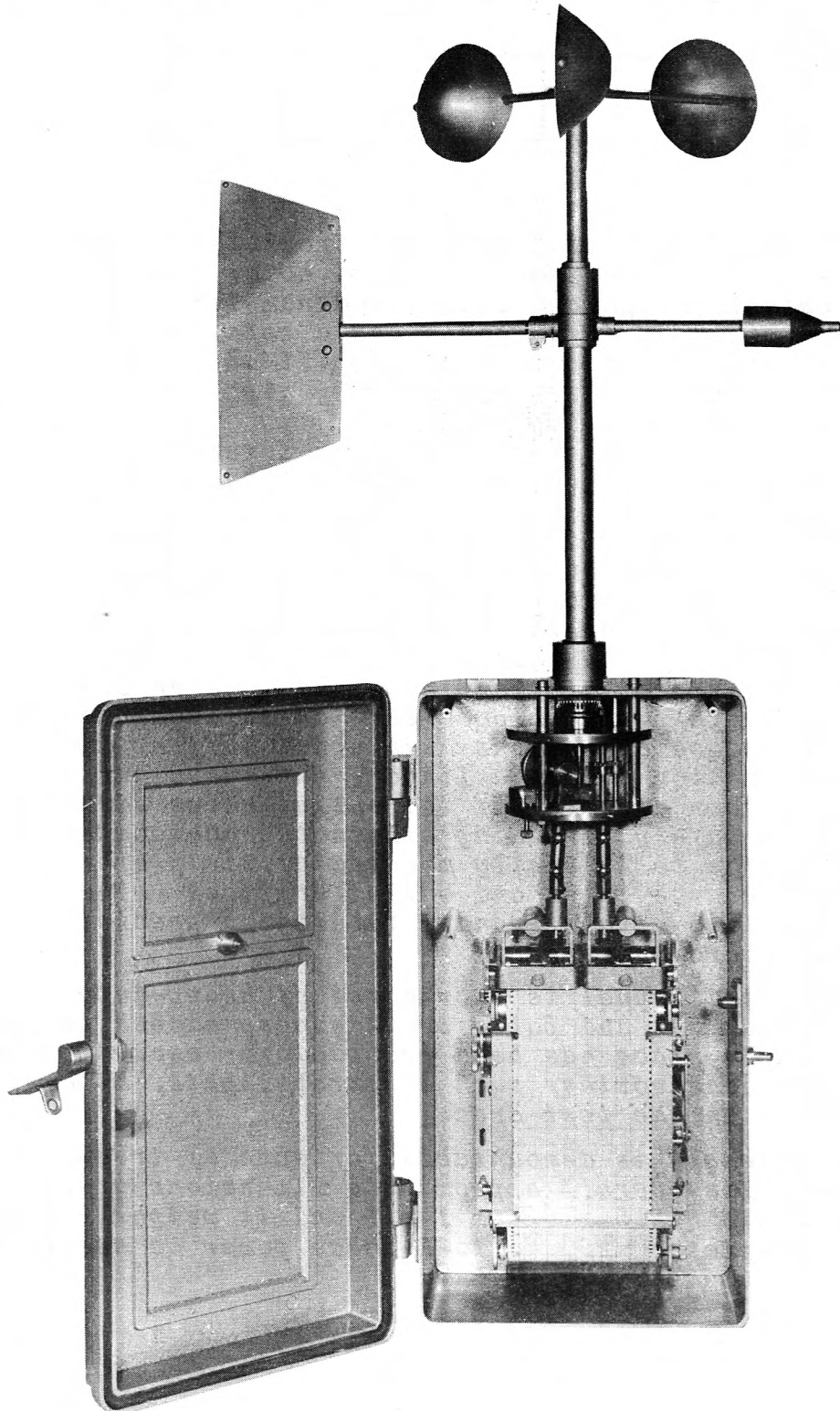
No. 03AM880 Wild Anemometer (pressure plate type)

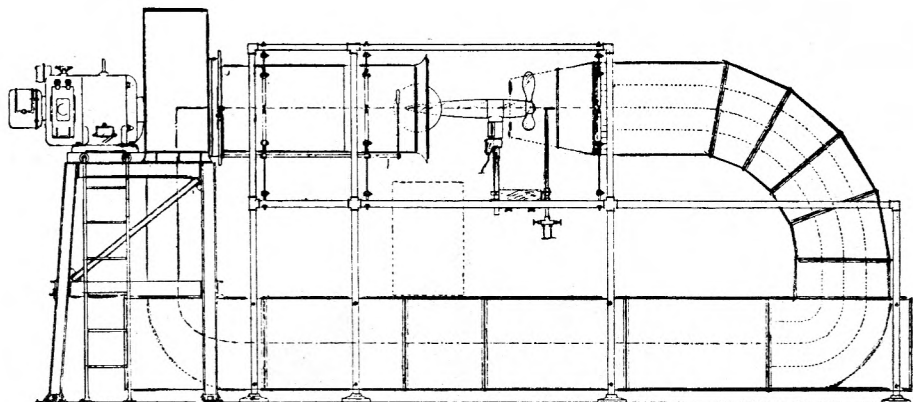


Mounting detail

No. 02AM300 MECHANICAL ANEMOGRAPH

Like 02AM100 (see Catalog 02M06) but a combined sensor recorder system with an integral housing for the hand wound strip chart recorder. Compact and easily transported for field studies.





No. 36AM120 KAHLISICO Wind Tunnel, recirculating blower system type, with conveniently located motor control panel, adjustable diaphragm and micromanometer. The 20 H.P. motor (at far left above) has a rotation for any selected constant speed, with stabilization for power fluctuations, and is protected by high and low rotation limit switches. It provides about 270 m.³/sec. (9530 ft.³/sec.) air movement which can furnish wind speeds up to 30 m./sec. (67 mph) with the standard 16.5" (42 cm.) diameter outlet orifice and 40 m./sec. (90 mph) with the tapered accessory outlet orifice (shown in dotted lines in the illustration above). Adjacent to the 24" (60 cm.) diameter inlet orifice is the control lever for the iris diaphragm, that is directly in front of the squirrel-cage type blower and allows fine adjustment of the wind speed to even below 1 m./sec (2.2 mph). The blower section is mechanically isolated, to reduce vibrations. Internal baffles and special construction assure a linear, non-turbulent, horizontal, uniform air flow at the outlet where adjustable framework with safety screening allows the anemometer or other test device to be easily mounted at the proper location between the inlet and outlet orifices. The tunnel is provided with a Prandtl tube and a precision, 0 to 120 mm micromanometer.

The KAHLISICO Wind Tunnel is fabricated of heavy-duty materials throughout and ports provide easy access to its interior. Ample space has been provided for securing instruments and accessories, such as strobelights, high speed cameras, etc., in the test area.

The tunnel assembly is demountable for ease of transportation and storage. Its overall approximate dimensions are: 8.3' x 21' x 3.3' (2.5 x 6.5 x 1 m.) and it weighs 2 tons (2000 Kg.) complete. 220 Volt, 3-phase power is needed for operation.

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No. 03AM220 KAHL SICO ELECTRICAL ANEMOMETER, FIELD TYPE

This versatile anemometer is suitable for field or station measurements as it may be operated independent of power lines by a hand generator built into the control-indicator box. Multiple readouts can be obtained by using additional indicator units. Two dials with moving pointers show wind speed and direction.

TECHNICAL DATA

TYPE: Electrical anemometer for use with line or hand generated power.

RANGE: Speed: 0 to 60 knots (0 to 70 miles/hr.) in 5-knot divisions, main scale and 5 to 20 knots (3.5 to 25 miles/hr.) in 1-knot divisions, expanded scale. Direction: 0° to 360° in 5° divisions.

INDICATORS: Dial type, 3.7" (9.5 cm.) square, with pointer. Wind speed scale is 3.3" (8.5 cm.) long.

ACCURACY:

Wind Speed

3 to 30 knots
±1 knot.

30 to 60 knots
±3 knots.

Direction

Better than ±5°.

SENSITIVITY: 3 knots is the minimum wind for indication.

POWER SUPPLY: Selectable 110, 125, 145, 160, or 220 volt, 50 or 60 cycles, or hand generated power (12 volts A.C.).

WIND SPEED OUTPUT: 0 to 5 volts A.C., 5 milliamps, maximum.

CALIBRATION: Each instrument is furnished with a factory wind tunnel calibration certificate.

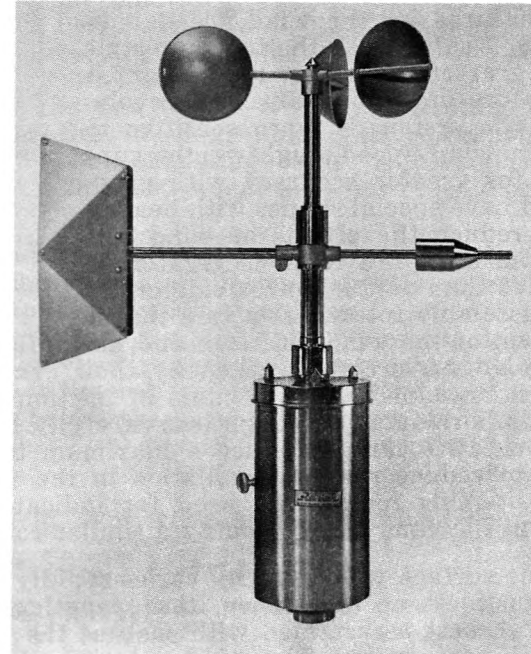
AMBIENT OPERATING CONDITIONS:

Temperature: -13° to +140°F. (-25° to +60°C.) under ice free conditions.
Humidity: 0 to 100% R. H.

MAXIMUM DISTANCE BETWEEN SENSOR AND INDICATOR: Any length 7-conductor cable having conductor resistance less than 5 ohms can be used. If 17 AWG (1 mm²) conductor, as normally furnished, is used then up to 820 ft. (250 meters) cable length is possible.

MATERIALS: Noncorrosive metals are used externally with sealed, precision ball bearings for rotating shafts. Weathertight sensor housing has a sturdy mounting flange threaded for 1" pipe.

ALIGNMENT DEVICE: Sensor housing has North-South markers to facilitate correct installation alignment.



03AM220 SENSOR

Sensor

DIMENSIONS: 21" x 22" x 21" (54 x 56 x 54 cm.)

WEIGHT: 13.5 lbs. (6 kg.)

Control Box

11" x 6" x 8" (28 x 14 x 19 cm.)

8 lbs. (3.5 kg.)

ACCESSORIES FURNISHED: 65 ft. (20 meters) of 17 AWG, armored, 7-conductor cable.

No. 03AM220 KAHL SICO Electrical Anemometer has a standard, metal, Robinson 3-cup anemometer with vane and counterbalance sensor connected by an electrical cable to the remote control-indicator box which has a hand generator permitting field operation independent of power lines. This is also an important feature for station or airport usage as it allows uninterrupted measurement in the event of power failure. Up to six indicators may be used with a single sensor, as at airports where simultaneous read-outs may be desired in the control tower, meteorological office.

EXPORT
DIVISION:



TELEX: 697906
CABLE: KAHL SICO SANDIEGO

P.O. BOX 947, EL CAJON, CALIF. 92022, U.S.A.



pilot briefing rooms, etc. If desired, panel mounted indicators are available as alternatives or for multiple read-out. Wind speed and direction indicators may be combined or separate, for individual locations. Wind velocity is a vector comprised of the wind speed and the direction. The latter is stated by convention, as the location from which it is blowing, with reference to true North. These KAHLISICO anemometers use a three-cup system to generate the electricity measured by the wind speed indicator. This is superior to the four-cup style sensor as greater torque per unit weight is exerted, more uniformly, during a revolution and the system is more sensitive to changes in wind speed. Lightweight cups are used for greater accuracy with gusty winds and have special shapes with beaded edges to reduce the effects of wind turbulence. As the wind force is greater on the concave than on the convex side of the cup, the assembly rotates, at a rate that is independent of the wind direction and insignificant of the air density. The large ratio of the cup diameters to the circle described by their centers provides higher sensitivity in measurement. The wind direction vane has a minimum of friction and pivots easily. It should be installed so that it is perfectly horizontal, although it is carefully balanced, to avoid bias towards any particular direction. KAHLISICO vanes produce a maximum torque in relation to their moment of inertia and are designed to reduce random oscillation in the wind as well as resonance at natural wind fluctuations. Positioning motors are used for indicating the wind direction so that any movement imposed upon the vane is followed by a similar rotation of the indicator.



03AM220 CONTROL INDICATOR

As the surface wind velocity varies rapidly and continuously, both in amplitude and period, causing gustiness or turbulence, the synoptic mean velocity is generally averaged over a 10 minute interval, best ascertained with such as the KAHLISICO 02AM280 Completely Self-Generating Electrical Anemograph. The wind velocity which, near the earth's surface, varies rapidly with height and is greatly affected by irregularities in the ground or nearby obstacles, should be measured 10 m. (33 ft.) above open, level terrain. Ideally, the distance between the sensor and any obstruction would be at least 10 times the height of the obstruction but, as this is rarely possible, the best suitable location must be chosen. Sites on steep hills or cliff edges should be avoided as the measurements would not represent the general wind. Anemometers should not be installed above large structures, such as buildings, because the air stream-lines are crowded together as the wind passes and falsely high measurements are obtained. As it is not always possible to mount the sensor at an unobstructed height of 33 ft. above the level of nearby obstacles (bushes, trees, etc.) correction can be made to the mean wind speed values:

Height above nearby obstacles	Correction
9 to 15 feet (2.75 to 4.6 meters)	add 20%
16 to 25 feet (4.8 to 7.6 meters)	add 10%
26 to 42 feet (7.9 to 12.8 meters)	0
43 to 74 feet (13.1 to 22.5 meters)	subtract 10%
75 to 140 feet (22.8 to 42.7 meters)	subtract 20%

KAHLISICO can supply any type of mounting system to support anemometers and other meteorological sensors. In most cases, however, a locally obtained pipe, installed in a well exposed location and secured by guy wires, suffices. The wires are used to adjust the mast until it is exactly vertical. They must be adequately anchored due to the large forces acting on them during high winds. If lightweight steel towers are used safety rails are recommended around the mounting platform to protect personnel during installation or servicing. As with all meteorological instruments mounted outdoors it is strongly recommended that lightning arrestors be used and indicating safety lights affixed to all towers.

The sensor housing has an integral mounting flange for threading onto a 1" support pipe. A set screw is provided to lock the unit in position once its North-South markers have been aligned with these cardinal points. A 7-conductor armored cable connects the sensor to the indicator; 2 conductors carry the output of the wind speed generator, 2 bring power to the direction system, 3 connect the directional synchro-motors. Any length connecting cable may be used provided the conductor resistance does not exceed 5 ohms for the 3 conductors for direction and the 2 power conductors; the 2 conductors for speed may have up to 100 ohms resistance. If power is available in the field the sensor may be connected directly to the line there, in which case the power conductors would no longer be necessary and a 5-conductor cable would be sufficient to connect the

sensor with the indicators. This feature allows a considerable saving in cable costs for large installations. The control-indicators are also available without the hand generator and line switch. The read-out meters, coded wire terminals, controls and hand generator are all housed in a compact, slope-faced cabinet. The speed indicator is a sensitive, large-faced, meter with moving pointer and mechanical zero adjusting screw, scaled from 0 to 60 knots (0 to 70 miles/hr. is available upon request). The DC meter, which has been chosen for its low consumption, has a built-in rectifier to convert the AC output of the sensor. A second, expanded scale, reading 5 to 20 knots, is provided for low wind measurements; this is activated by pressing a push button directly below the meter. KAHLISICO can provide 0 to 80 knots (0 to 90 miles/hr.) or other ranges on special order. The 360° direction indicator is divided in 5° intervals, having numerals every 30° as well as cardinal and intermediary lettering. The switch in the center of the cabinet selects line or hand generator operation. A line connector is located at left, below the 110 to 220 volt power selector with integral fuse. The crank handle for the hand generator is located at right. A 3-watt red lamp, below the wind direction indicator, indicates the intensity of the hand generated power by the brightness of its glow. This lamp also lights when the line power is used, indicating that the anemometer is ON. The 7 terminals at the back of the housing, numbered corresponding to those in the sensor housing, clamp the conductors of the connecting cable. A plexiglass safety shield protects the terminals. Under normal operation this instrument does not require any lubrication or maintenance other than cleaning.

METHOD OF OPERATION: After the cups, vane and counterbalance are attached to the sensor it is ready for use. As the cups rotate in the wind their shaft turns an electro-magnetic generator. The passage of 7.5 ft. (2.3 meters) of wind causes the cups to make one complete revolution. The output voltage, which is proportional to the wind speed, is brought to the indicating meter which is calibrated directly in wind speed. The shaft of the wind direction vane is connected to a synchro-motor which, when activated, causes a second synchro-motor in the indicating section to rotate and assume the same relative position. The direction is read from a scale below the pointer attached to its shaft. The 12-volt power for the synchro-motors is provided either by the hand generator or by a power transformer inside the housing.

03AM220 KAHLISICO Electrical Anemometer, Field Type, complete, as described above.*

03AM224/7 Extra 7-conductor cable, per yard (meter).

03AM230 Extra control-indicator box with sloping panel, hand generator, speed and direction indicators.

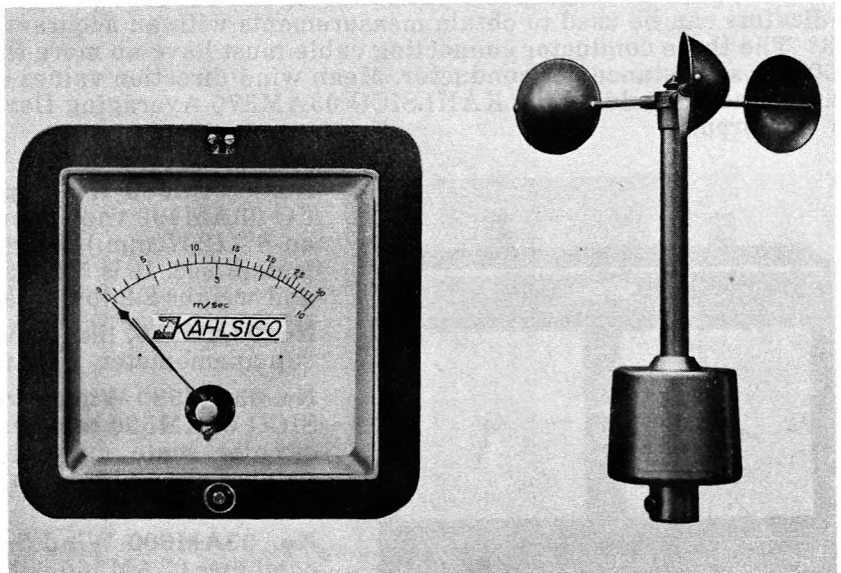
03AM230/S Alternative or extra control-indicator box, like 03AM230 but without hand generator.

03AM230/V Alternative or extra control-indicator panel, like 03AM230 but without box, for vertical mounting (horizontal or separate indicator types available upon request).

*When ordering instruments or parts, please specify wind measuring range and any additionally desired special features.

No. 03AM180 KAHLISICO ELECTRICAL WIND SPEED INDICATOR

This is a compact, accurate anemometer similar to KAHLISICO 03AM-220 except only wind speed is measured. Standard ranges are 0 to 60 knots with a 5 to 20 knots expanded scale, selected by push button, or 0 to 30 meters/sec. with a 2 to 10 meters/sec. expanded scale. Accuracy: ± 1 knot up to 30 knots, ± 3 knots from 30 to 60 knots. Other ranges can be provided upon request. 100 ohms is the maximum resistance for the 2-conductor connecting wire supplied. This 17 AWG (1 mm²) telephone type wire is normally provided in 65 ft. (20 meter) lengths but up to 3 miles (5 km.) can be used. The sensor can be affixed to any 0.7" (15 mm.) diameter pipe by its flange and set screw.



03AM180 WIND SPEED INDICATOR

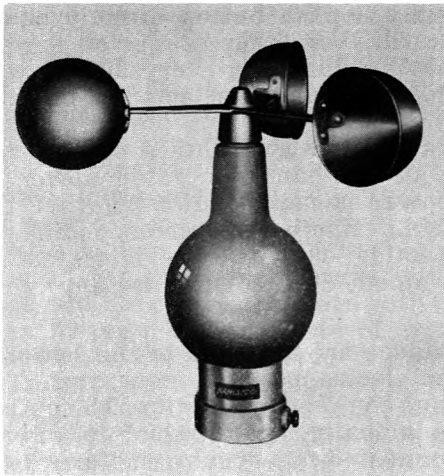
03AM184 Extra connecting wire, per yard (meter).

No. 03AM200 KAHLISICO ELECTRICAL WIND SPEED INDICATOR WITH ALARM

This anemometer is similar to KAHLISICO 03AM180 except the indicator housing has a second dial with a movable pointer to select the speed at which a relay will close. The anemometer

can also be supplied with a fixed contact at preferred. The relay switches 10 or 20 amps, 110 volts AC or 5 or 10 amps, 220 volts, as requested. The accuracy of the contact setting is better than ± 3 knots. Any signalling device such as a light, horn, whistle etc., can be activated whenever dangerous conditions are created by excessive wind. Such warnings are useful for railroad or construction work, open pit mines, bridges, tunnels, cranes, forest or desert areas, farms, plantations, tobacco or fruit growers, etc.

KAHLSICO also offers a wide variety of individual, electrical, wind speed and direction sensors, indicators and recorders. These include:



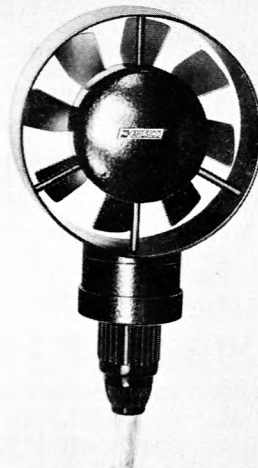
03AM480 SENSOR

No. 03AM460 Three-cup Anemometer with noncorrosive housing containing an A.C. generator suitable to measure from 1.3 to 35 meters/sec. (2.5 to 68 knots). This sensor can be connected with up to 6 indicators, which must have built-in rectifiers, such as KAHLSICO 03AM560 or 03AM600. The unit will operate from -31° to $+175^{\circ}$ F. (-35° to $+80^{\circ}$ C.) under ice free conditions. A 24-volt A.C., 15 V.A. heater assembly can be provided upon request to assure trouble free operation at low temperatures (this is designated by adding /H to the instrument number when ordering). The bottom of the housing has an opening which allows it to be clamped to any 1.85" (47 mm.) diameter mast. The sensor is 10" (26 cm.) high and the cups circumscribe a 12.5" (315 mm.) diameter circle. It weighs approx. 2.6 lbs. (1.2 kg.).

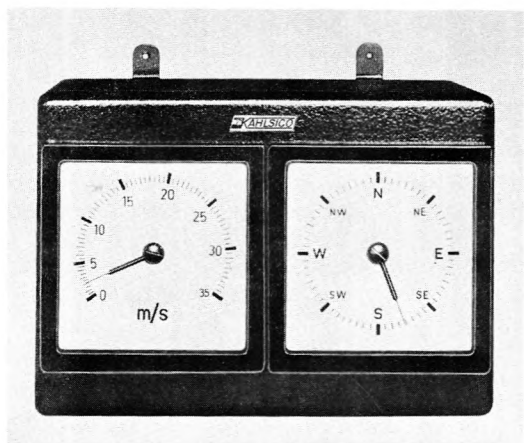
No. 03AM480, similar to 03AM460 but with a D.C. generator containing gold alloy contacts and 3-section commutator to minimize maintenance. These sensors can be used directly with indicators or recorders and can be replaced without requiring recalibration of the system.

No. 03AM490 Vane Anemometer for speed measurements of uni-directional air masses, with noncorrosive housing containing a D.C. generator. This sensor is particularly suitable for determining low speeds as it covers the range of 0.5 to 20 meters/sec. (9.7 to 39 knots). The cylindrical housing for the vane propeller is 4.25" (108 mm.) in diameter, the overall sensor height is 5.5" (138 mm.) and it weighs 2 lbs. (1 kg.).

No. 03AM500 Wind Vane direction sensor has a double-fin and counterbalance mounted on a housing like KAHLSICO 03AM460, and can also be provided with a heater. The vane moves the wiper arms of a potentiometer made of gold alloys which changes the ratios of its three outputs. The 12 volt D.C. power for the measuring circuit can be supplied by a battery or transformed line voltage. Up to 7 indicators, such as KAHLSICO 03AM580 or 03AM600, or a recorder, such as KAHLSICO 03AM300 or 03AM320, and up to 5 indicators can be used to obtain measurements with an accuracy of $\pm 3^{\circ}$. The three conductor connecting cable must have no more than 400 ohms resistance per conductor. Mean wind direction values can be obtained by adding the KAHLSICO 03AM370 Averaging Device to the circuit.



03AM490 SENSOR



03AM610 INDICATOR

No. 03AM560 Wind Speed Indicator for use with KAHLSICO 03AM490 vane anemometer. This square face meter has an 8" (207 mm.) long scale covering the range of 0 to 20 meters/sec. It is 5.6" x 5.6" x 4.7" (144 x 144 x 120 mm.) and weighs 2.2 lbs. (1 kg.).

No. 03AM570, like 03AM560 but for KAHLSICO 03AM460 cup anemometer, with range of 0 to 35 meters/second.

No. 03AM580 Wind Direction Indicator, for use with KAHLSICO 03AM500 wind vane, is similar to 03AM560 but has a circular scale marked at the cardinal and intermediate points. It can also be supplied graduated 0° to 360° upon request.

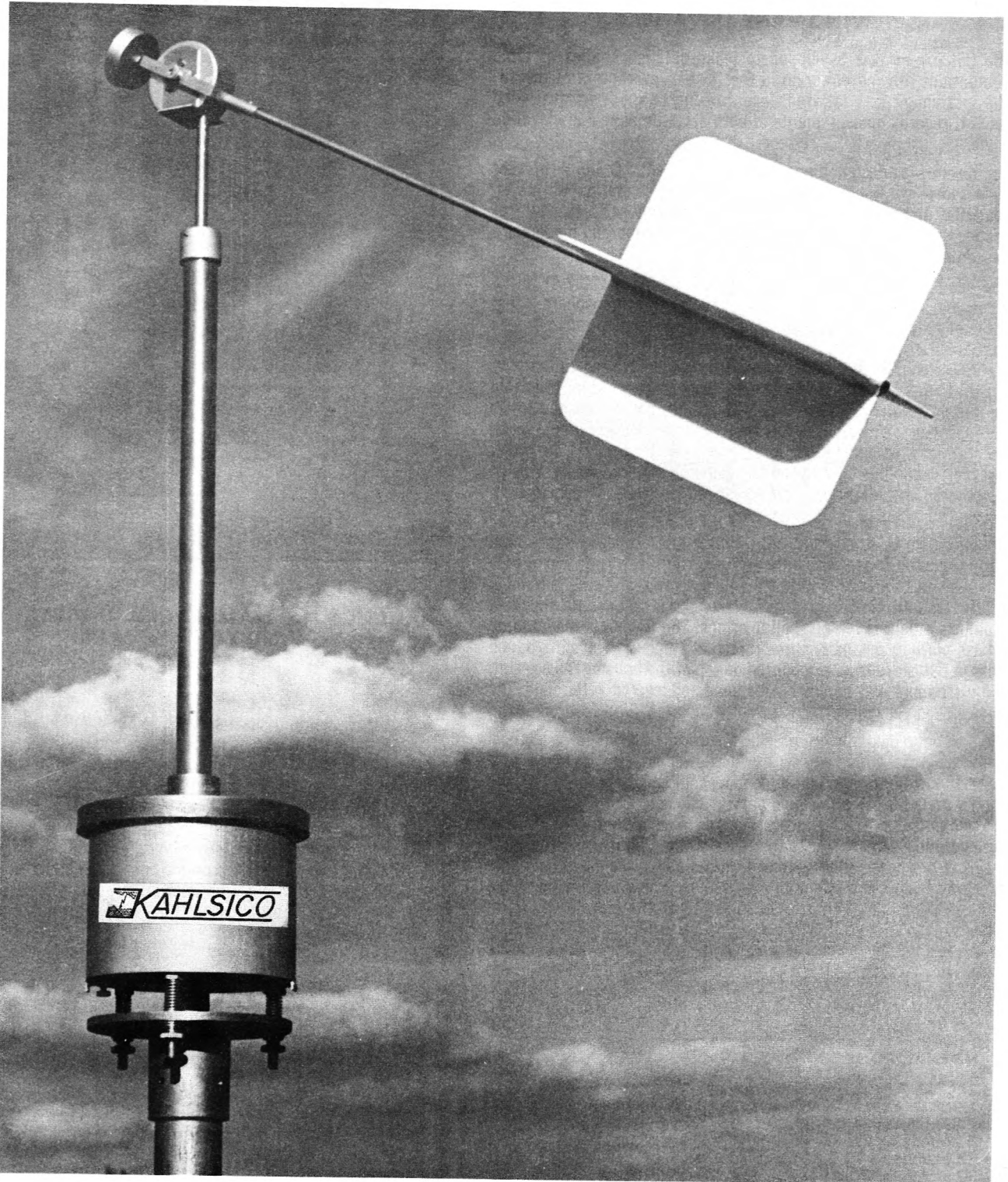
No. 03AM600 Wind Speed and Direction Indicating Panel combines 03AM560 with 03AM580 in a single housing 11.7" x 8.3" x 6" (298 x 210 x 155 mm.), weighing 10 lbs. (4.6 kg.)

No. 03AM610, like 03AM600 but combining 03AM570 with 03AM580.

KAHL SCIENTIFIC INSTRUMENT CORPORATION

P.O. BOX 1166, EL CAJON (San Diego), CALIFORNIA 92022
Telephones: (714) 444-2158 and 444-5944

Factory: 737 W. Main St., El Cajon, Calif.



BULLETIN 03M24 GILL BI-DIRECTIONAL WIND VANE (BIVANE)

KAHLSICO No. 03AM940 GILL BI-DIRECTIONAL WIND VANE (BIVANE)

EXPORT
DIVISION:



TELEX: 697906
CABLE: KAHLSCO SANDIEGO
P.O. BOX 947, EL CAJON, CALIF. 92022, U.S.A.



KAHLSICO No. 03AM940 GILL BI-DIRECTIONAL WIND VANE (BIVANE)

The Gill Bivane was developed to make detailed studies of rapid fluctuations in wind direction in the lowest few meters of the air. The instrument is a fast-response, low-inertia, bi-directional wind vane. It records measurements of both azimuth angle and elevation angle.

The Bivane was designed and developed by Gerald C. Gill, Professor of Meteorology at the University of Michigan. Professor Gill developed the original prototypes while at Massachusetts Institute of Technology over 15 years ago. The present commercial models are based on this working experience.

The need for this device became evident during a study of turbulence and diffusion in the lower levels of the atmosphere. Most commercially available vanes were found to have so much inertia that small scale gusts could not be measured. It was found that standard vanes would oscillate through much wider angles than the true angular fluctuation of the wind. During gusts of eight to twelve meters in wavelength some vanes would indicate swings as high as 250 per cent of true value. For the Bivane, overshoot under these oscillating wind conditions is 10 per cent or less. Under most weather conditions the Bivane will indicate wind variation with no overshoot. The instrument shows an almost perfect dynamic response for winds of four meters or more in wavelength.

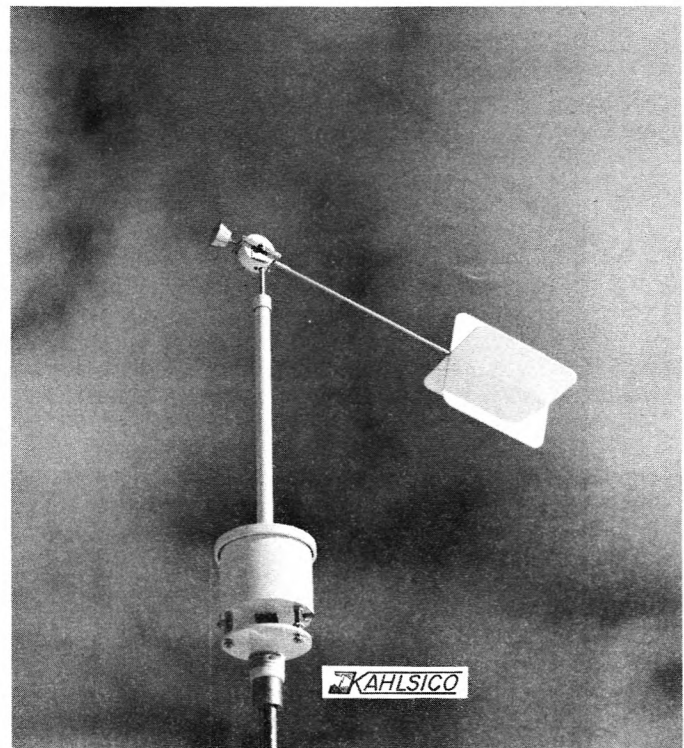
Construction is principally aluminum alloy, stainless steel, and chrome-plated brass. The tail section of the vane is provided with fins molded of low-density foamed polystyrene. The vane assembly rotates in both the horizontal and vertical axes on double-shielded, stainless steel instrument ball bearings. The Bivane is mounted on a base plate by means of three threaded studs with leveling thumb nuts. A bull's-eye level is mounted on top of the housing. As a result, the instrument may be quickly installed and leveled in the field. The base plate is machined to mount on standard 1½" pipe (1.90" dia.).

Wind direction signals are provided by means of two precision conductive plastic potentiometers in the lower housing. With the passage of each gust, the light vane moves up and down and from side to side trying to keep the wind pressure equalized on both the vertical and horizontal fin surfaces. Changes in azimuth are transmitted through the vertical shaft to the shaft of the azimuth potentiometer by a set of gears with one-to-one ratio. Changes in elevation angle are transmitted by a pulley to a small bead chain passing down the hollow vertical shaft to a pulley mounted on the elevation potentiometer. A counterweight on the lower pulley eliminates all backlash in the system. With constant voltage applied to the windings of the potentiometers, the voltage outputs are directly proportional to the vane's position.

METRIC CONVERSIONS:

1½" = 3,8 cm
1.90" = 4,8 cm
0.3-0.5 MPH = 0,48-0,8 km/h
6 pounds = 2,7 kg
25 pounds = 11,3 kg
30 inches = 76 cm
28 inches = 71 cm

6½" = 16,5 cm
16 inches = 40 cm
14 inches = 35,5 cm
3½ inches = 8,9 cm
50-foot = 15,2 m
4½" = 11,4 cm



KAHLSICO No. 03AM940 GILL BI-DIRECTIONAL WIND VANE (BIVANE)

A multiconductor cable connects the Bivane to the Power Supply Translator. The output signals of the azimuth and elevation potentiometers are fed through suitable calibration and damping circuits in the Power Supply Translator for recording on a standard dual channel galvo.type chart recorder (0-1 mA, 1500 ohm coil resistance). Independently adjustable voltage signals are available simultaneously for operation of a magnetic tape recorder or A/D converter. The azimuth and elevation signal output terminals of the Power Supply Translator are located on the rear panel along with all cable connections. All controls and calibration adjustments are located on the front. The Power Supply Translator is available either as a rack-mounted unit to fit standard 19" relay rack or as a bench-top unit.

ORDERING INFORMATION

KAHLSICO No. 03AM940

GILL BIVANE. Supplied with lightweight molded polystyrene vane. Instruction manual included. Shipped in a plywood field carrying case.

KAHLSICO No. 03AM941

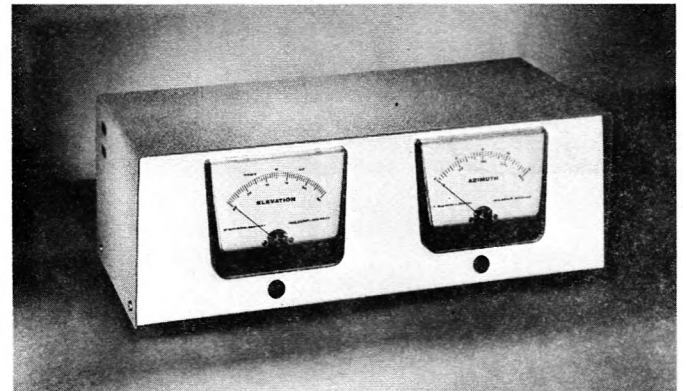
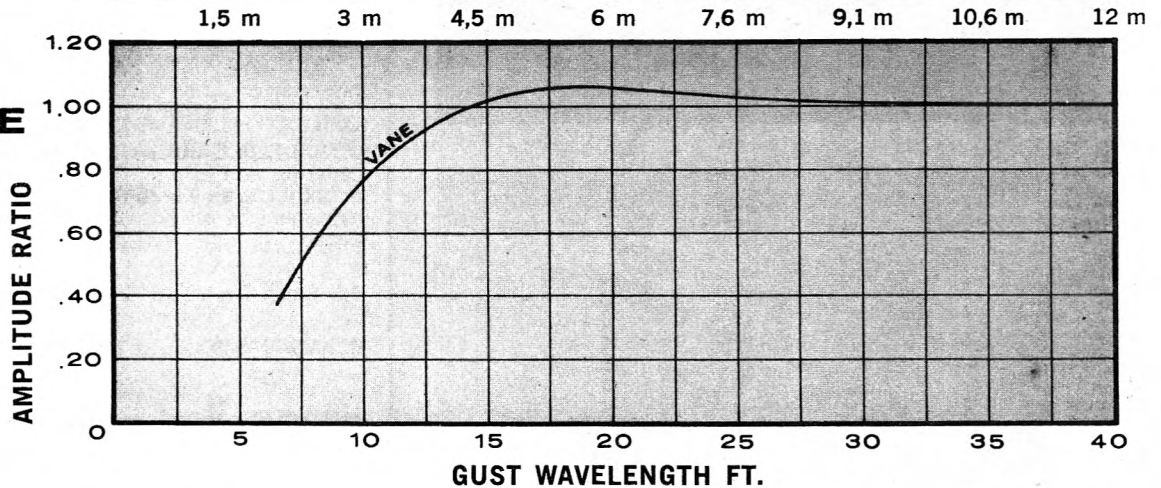
SPARE VANE ASSEMBLY (molded polystyrene).

SPECIFICATIONS: GILL BIVANE MODEL NO. 17002

Azimuth Range:	360 degrees mechanical rotation. Potentiometer winding 342°—continuous rotation (0-540° range available on special order).
Elevation Range:	Plus/minus 50 degrees. Normal wind fluctuations: plus/minus 40 degrees.
Threshold:	Threshold sensitivity: 0.3-0.5 MPH—both azimuth and elevation.
Dynamic Response:*	Delay distance (50% recovery): 3.2 feet (0.97 meters). Damped natural wavelength: 15.8 feet (4.8 meters). Theoretical undamped natural wavelength: 13.4 feet (4.1 meters). 53% critically damped (damping ratio H=.53). Maximum overshoot for sinusoidal gusts: 7%. See dynamic response curve.
Potentiometers:	Precision low-torque potentiometers, 1000 ohms resistance, linearity: 0.5%. Life expectancy: 50 million cycles (3-5 years normal use).
Signal Output:	0-1 milliamp thru 1500 ohms—both azimuth and elevation (when used with Power Supply-Translator which has proper damping and calibration circuits).
Weight:	Overall net weight: 6 pounds. Shipping weight: approx. 25 pounds.
Dimensions:	Overall height: 30 inches. Overall length of vane and counterweight: 28 inches. Diameter of base: 6½". Mounts on standard 1½" pipe.

*Nominal values

DYNAMIC RESPONSE



ORDERING INFORMATION

POWER SUPPLY—TRANSLATOR. Contains regulated power supply to provide constant voltage for azimuth and elevation potentiometers. Simultaneous outputs (voltage and current) provided for operation of galvo. recorders and magnetic tape recorder or A/D converter. Independent calibration adjustments provided for all outputs. Chassis measures 16 inches wide, 14 inches deep, 3½ inches high. 50-foot multiconductor cable included. (Longer cable available) 110 volt/50-60 cycle.*

No. 03AM950 KAHSICO Power Supply-Translator for No. 03AM940 Gill Bivane, Bench-Top Model.

No. 03AM950/r Ditto, but 19" Rack-Mount Model.

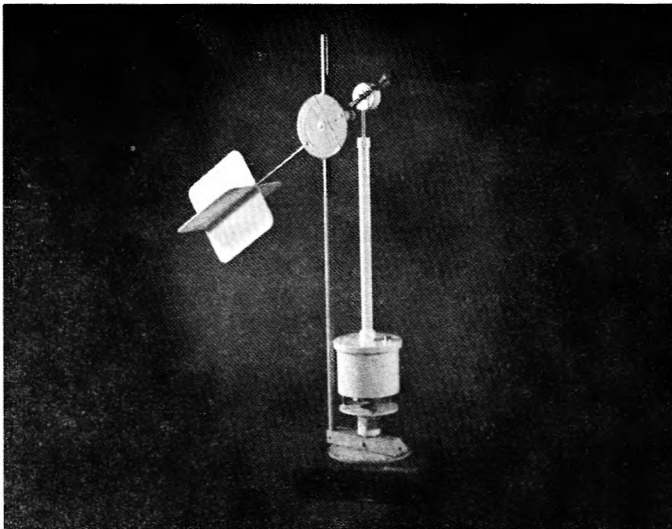
(0-540° azimuth range with automatic switching available—eliminates effect of potentiometer open spot. Write for quotation.)

INDICATOR PANEL. Two 4½" panel meters provide means of monitoring azimuth and elevation angle signals when recorders are not required or when using magnetic tape recorder or A/D converter. Panel can be supplied either as a rack mount or as a bench top unit.

No. 03AM955 KAHSICO Indicator Panel for No. 03AM950 Type Power Supply-Translator, Bench-Top Model.

No. 03AM955/r Ditto, but 19" Rack-Mount Model.

*Available for 230 volt/50 cycle operation.



ORDERING INFORMATION

KAHLSICO No. 03AM960

VANE CALIBRATION FIXTURE. Bench-top fixture mounts Bivane or Anemometer Bivane; has adjustable arms to locate and hold vane in any position (0 to 360° azimuth and $\pm 50^\circ$ elevation) for calibration. Protractors read to $\frac{1}{2}$ degree. Cable and receptacle built-in for convenient hook-up to Power Supply-Translator.

KAHLSICO No. 03AM961

BENCH TEST STAND. Support for bench testing and servicing Bivane. 12-inch diameter base, 11½-inch high support for instrument and cable.

KAHLSICO No. 03AM942 - 03AM945

RETRACTABLE MOUNTING ARM. Galvanized steel telescoping mounting arm is provided with universal mounting brackets for bolting to side of tower. Provides rigid upright mounting for instrument in all positions from fully retracted to fully extended.

For Small Towers (8"-20" (20-50,8 cm) side)

03AM942 5-FOOT RETRACTABLE MOUNTING ARM

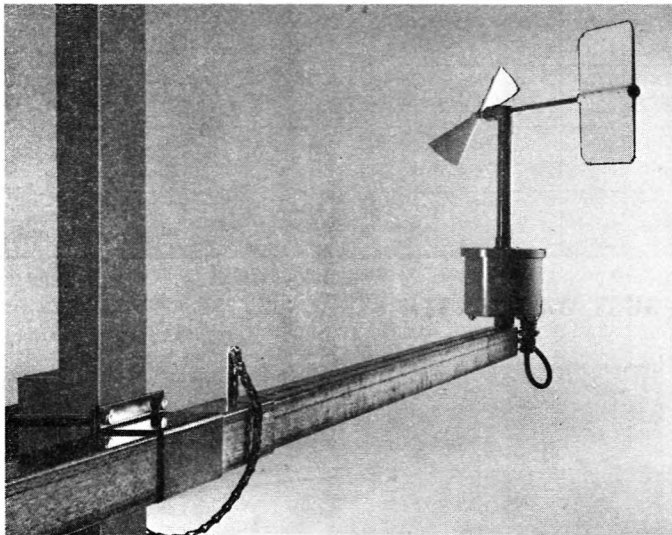
03AM943 6-FOOT RETRACTABLE MOUNTING ARM

For Larger Towers (20" (50,8 cm) and larger side)

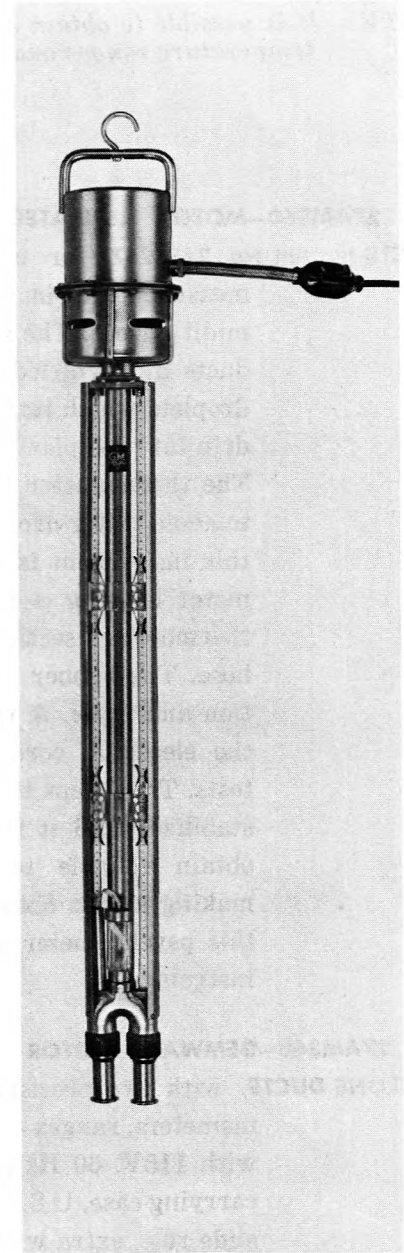
03AM944 8-FOOT RETRACTABLE MOUNTING ARM

03AM945 12-FOOT RETRACTABLE MOUNTING ARM

Note: Shown with Propeller Vane.



No. 27AM280—GEMWARE MOTOR ASPIRATED PSYCHROMETER (Patent No. 2431757), is an improved Assmann type of aspirated psychrometer that embodies all the desirable features of our earlier models which have been used for laboratory and meteorological studies for many years. The same high quality, 115 V 60 Hz, maintenance-free, high speed motor is used to produce adequate ventilation of both the wet and dry bulb thermometers. The weatherproof housing has a specially designed motor mounting plate which electrically insulates the motor from the thermometer assembly frame and also materially reduces vibration during use. Errors due to solar radiation are eliminated by the use of protective, curved, metal shields around the thermometers and tubular air duct shields for the thermometer bulbs. Each thermometer has a pair of air inflow metal tubes. The inner brass tube is insulated from the outer radiation shield tube to eliminate its acting as a heat sink. Both pairs of tubes are insulated from the main instrument frame by sturdy, threaded phenolic bushings. The outer tubes are reinforced with flared edges, to keep them concentric. All metal parts are highly polished and nickel plated in accordance with U.S.W.B. and W.M.O. requirements. The GEMWARE Aspirated Psychrometer is provided with a removable, plastic water reservoir and a long wick to connect to the wet thermometer bulb. The wick keeps the thermometer bulb wetted, even when the motor is not running, minimizing the time required for accurate wet bulb readings when making a series of measurements. A 115 V, 60 Hz motor is normally used, but it is possible to provide 6 V DC motors for battery operation. The thermometers are very carefully manufactured and supplied in matched pairs. They are calibrated against government certified standards and are extremely accurate. It is possible to obtain an official calibration certificate for each thermometer, on special order. 24" (60 cm) long fractional degree thermometers are provided with this model psychrometer for use in micro-meteorological studies or experiments. To minimize the possibility of breakage, the thermometers are firmly held by two pairs of spring clips, as illustrated, which absorb mechanical shocks. The motor housing has a handle and a suspension hook. A 6 ft (2 m) long electrical cord with ON-OFF Switch and a plug are provided. The instrument is supplied in a compartmented, wooden, hinged-cover, carrying case complete with U.S.W.B. book of Relative Humidity and Dew Point tables, a psychrometric slide rule, extra wicks and a plastic bottle for distilled water. The container for the thermometers is designed to accept an extra pair of matched thermometers, as spares, when so ordered. The overall measurements of the case are 26.5" x 8.5" x 6" (67.4 x 21.5 x 15 cm) and the total weight is 15 lbs (7 kg).



**No. 27AM280—GEMWARE
ASPIRATED PSYCHROMETER**

EXPORT
DIVISION:



P.O. BOX 947, EL CAJON, CALIF. 92022, U.S.A.

TELEX: 697906
CABLE: KAHLSICO SANDIEGO



No. 27AM280—GEMWARE MOTOR ASPIRATED PSYCHROMETER, as described above with 115 V, 60 Hz motor and two matched, precision-quality engraved stem thermometers, -20 to $+120^{\circ}$ F in 0.2° F, 24" long.

No. 27AM300—ASPIRATED PSYCHROMETER, like 27AM280, but with thermometers graduated from -10 to $+60^{\circ}$ C in 0.1° C, 60 cm long.

No. 27AM320—ASPIRATED PSYCHROMETER, like No. 27AM280, but in shorter lengths, with 12" engraved precision thermometers, range -20 to $+120^{\circ}$ F in 0.5° F.

No. 27AM340—ASPIRATED PSYCHROMETER, like No. 27AM320, with 30 cm long matched precision thermometers, ranges -10 to $+60^{\circ}$ C in 0.2° C.

SPARE THERMOMETERS (should be purchased in matched pairs).

No. 27AM281—PRECISION THERMOMETERS, 24" long, range -20 to $+120^{\circ}$ F in 0.2° F.

No. 27AM301—PRECISION THERMOMETERS, 60 cm long, range -10 to $+60^{\circ}$ C in 0.1° C.

No. 27AM321—PRECISION THERMOMETERS, 12" long, range -20 to $+120^{\circ}$ F in 0.5° F.

No. 27AM341—PRECISION THERMOMETERS, 30 cm long, range -10 to $+60^{\circ}$ C in 0.2° C.

NOTE: It is possible to obtain special thermometers for GEMWARE Psychrometers in any desired temperature ranges and subdivisions.

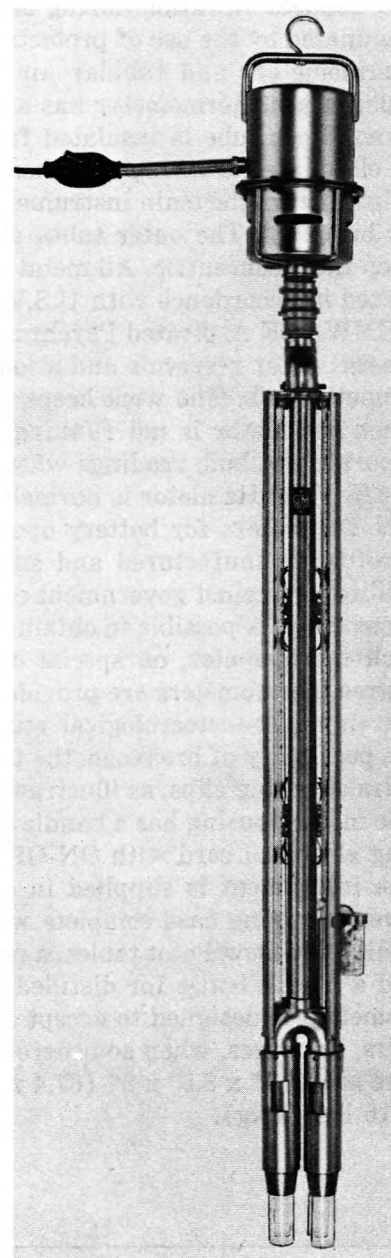
No. 27AM360—MOTOR ASPIRATED PSYCHROMETER, WITH CYCLONE DUCTS (Patent No. 2431757) for use in making relative humidity

measurements in cooling towers, or other high humidity areas. The air is drawn through ports in the ducts and whirled around to trap the small water droplets which impinge on the ducts' walls and then drip into the plastic cups at the bottom of the ducts. The thermometer bulbs are located above the ports to avoid water droplets from reaching them. Because this instrument is used in high humidity areas, the motor housing is fully insulated from the duct and thermometer section by a strong rubber connecting hose. The rubber also further reduces motor vibration and noise. A rheostat has been incorporated in the electrical cord to allow motor idling between tests. This keeps the wet bulb thermometer partially stabilized and it then takes less than a minute to obtain reliable temperature measurements when making a test. Except for the above novel features, this psychrometer is constructed like No. 27AM280 instrument.

No. 27AM360—GEMWARE MOTOR ASPIRATED PSYCHROMETER, WITH CYCLONE DUCTS, with two precision matched engraved stem thermometers, ranges -20 to $+120^{\circ}$ F in 0.2° F, 24" long, with 115V, 60 Hz high speed motor, complete with carrying case, U.S.W.B. book of tables, psychrometric slide rule, extra wicks and plastic bottle for distilled water.

No. 27AM380, like 27AM360, but thermometers graduated -10 to $+60^{\circ}$ C in 0.1° C, 61 cm long.

(Spare Thermometers are the same as 27AM281-301 Series)



**No. 27AM360
ASPIRATED PSYCHROMETER
WITH CYCLONE DUCTS
Printed in U.S.A.**

KAHL SCIENTIFIC INSTRUMENT CORPORATION

P.O. BOX 1166, EL CAJON (San Diego), CALIFORNIA 92022

Telephones: (714) 444-2158 and 444-5944

Factory: 737 W. Main St., El Cajon, Calif.

BULLETIN 08M49

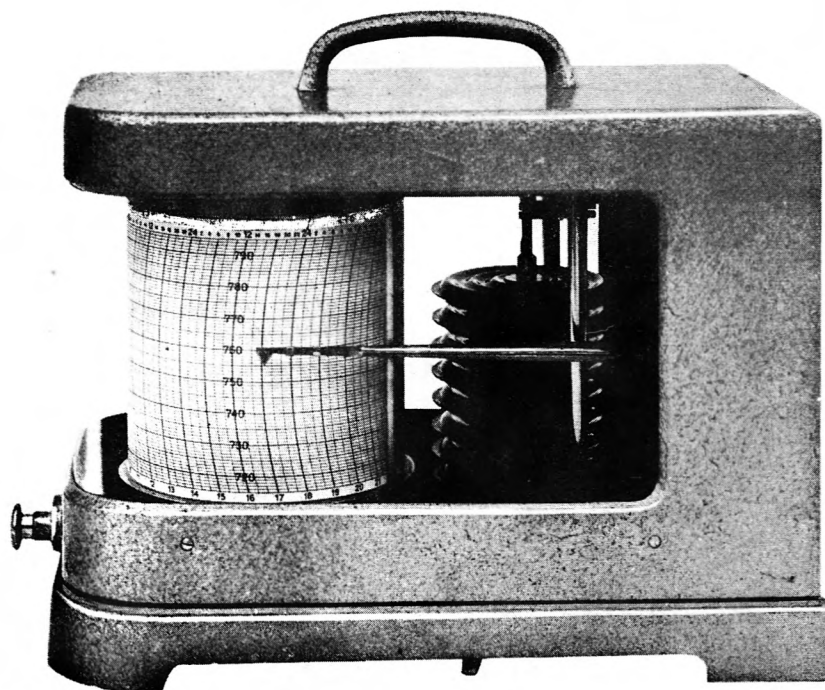
SMALL BAROGRAPH AND OPEN SCALE BAROGRAPH

Small Barograph.

The aneroid movement consists of a stack of 8 specially prepared copper-beryllium capsules which responds instantaneously to every pressure change. The sensitive unit is thoroughly compensated for temperature and has an adjustment screw for regular checking.

The 8-day clock movement is provided with 11 jewels, anchor-escapement and is permanently fastened to instrument base. Only the chart drum, not the movement, is removed when changing the chart. A reversible, double-sided gear inside the drum allows a 1-day or 7-day recording period to be chosen. The chart is vertically divided for daily and weekly use.

The instrument is mounted in a metallic case, with clear view plastic window. Corrosion resistant material is used throughout and the special hinge of the case has the pivot rotating in a brass shell which is included in the casting.



The instrument can be provided on request with a suspension spring with joint to assure verticality and a damping action when the barograph is used as on board a ship.

EXPORT
DIVISION:



P.O. BOX 947, EL CAJON, CALIF. 92022, U.S.A.

TELEX: 697906
CABLE: KAHLSCO SANDIEGO



The charts normally stocked can be selected from the ranges given below.

GENERAL SPECIFICATIONS		CHARTS
Range :	80 mmHg. or 100 mb	mmHg.
Graduations:	.04" (1 mm)/mmHg. .03" (0.8 mm)/mb.	715 - 795
Accuracy:	± 1% of full scale	695 - 775
Drum :	3.6" x 3.8" (93 x 98 mm)	665 - 745
Chart :	12.6" x 3.6" (323 x 92 mm)	635 - 715
Time scale :	daily (30 h) .37 in/h (9.5 mm/h) weekly (180 h) .06 in/h (1.6 mm/h)	615 - 695
Dimensions:	11" x 8.4" x 5.5" (280 x 215 x 140 mm)	595 - 675
Weight:	6.4 lbs. (2.9 kg)	565 - 645
		blank scale in mb

08AM140/8 SMALL BAROGRAPH complete with 50 charts, spare pen, one bottle of ink and instructions.

08AM142 Set of 100 charts.

08AM145 Suspension spring and flange.

Open Scale Barograph.

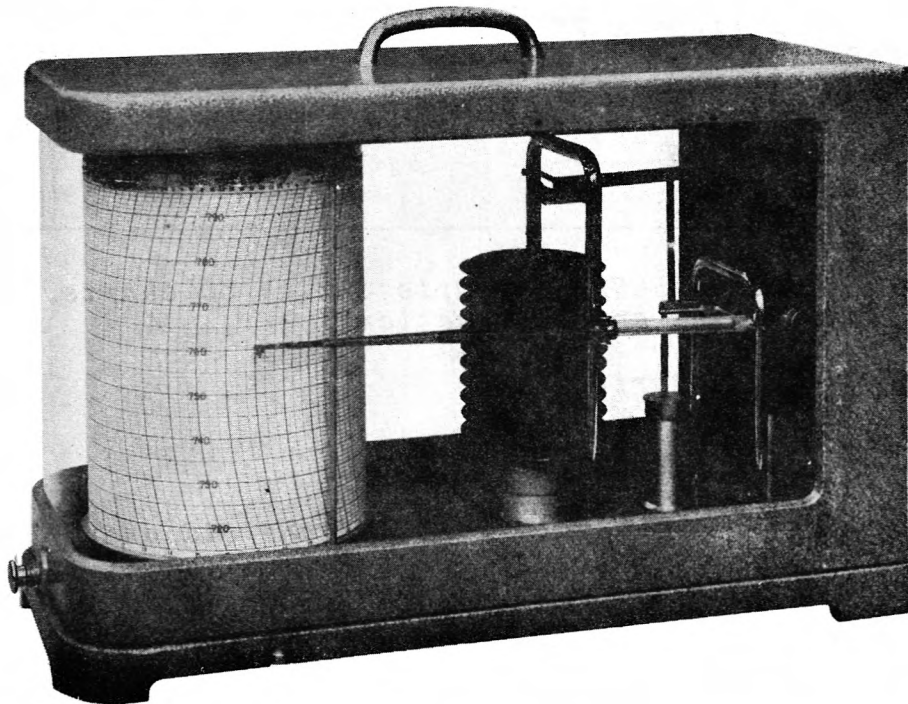
This instrument gives a magnified trace of barometric pressure.

The movement consists of a specially formed set of 12 capsules, fully compensated for temperature.

Dual, liquid filled dash pots are linked with the lever system to eliminate vibration from the record.

A pressure setting screw is provided for adjusting the instrument after relocating to a different elevation.

The range of the adjustment is sufficient to permit a large range of operation for the instrument.



The 8-day clock movement (11 jewels, anchor-escapement) is permanently fastened to instrument base. Only the chart drum, not the movement, is removed when changing the chart. A reversible, double-sided gear inside the drum allows a 1-day or 7-day recording period to be chosen. The chart is vertically divided for daily and weekly use.

The mechanism is enclosed and protected by plastic panelled cast aluminium case.

Charts are divided either into 80 or 100 divisions according to the unit (mmHg or mb). Ranges normally available are shown below. Lined, unnumbered charts are also available.

GENERAL SPECIFICATIONS	CHARTS
<p>Range: 80 mmHg or 100 mb</p> <p>Graduations: .08" (2 mm)/mmHg. .06" (1.5 mm)/mb.</p> <p>Accuracy: \pm 0.5% of full scale</p>	<p>mmHg.</p> <p>715 - 795</p> <p>695 - 775</p>
<p>Drum: 5.1" x 7" (132 x 180 mm)</p> <p>Chart: 17.4" x 6.7" (446 x 172 mm)</p> <p>Time scale: daily (30h) .53 in/h (13.5 mm/h) weekly (180h) .08 in/h (2.25 mm/h)</p>	<p>665 - 745</p> <p>635 - 715</p> <p>615 - 695</p> <p>595 - 675</p>
<p>Dimensions: 16.6" x 11.3" x 7" (425 x 290 x 180 mm)</p> <p>Weight: 18 lbs. (8.2 kg)</p>	<p>565 - 645</p> <p>blank scale in mb</p>

- 21BM100 OPEN SCALE BAROGRAPH complete with 50 charts, spare pen, bottle of ink and instructions.
- 21BM102 Set of 100 charts.
- 21BM120 Like 21BM100 but with 18-wafer aneroid and 5:1 amplification (microbarograph).

KAHL SCIENTIFIC INSTRUMENT CORPORATION

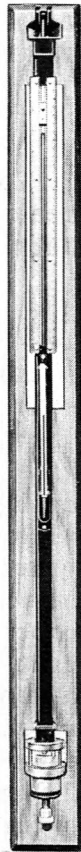
P.O. BOX 1166, EL CAJON (San Diego), CALIFORNIA 92022

Telephones: (714) 444-2158 and 444-5944

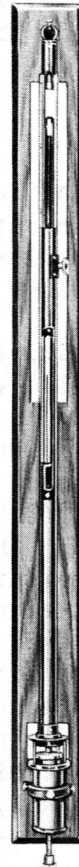
Factory: 737 W. Main St., El Cajon, Calif.

BULLETIN 09M39

MERCURIAL BAROMETERS



No. 09AM320 UNIVERSAL
METRIC-ENGLISH SCALE
MERCURIAL BAROMETER



No. 09AM360 PRECISION
METRIC-ENGLISH SCALE
MERCURIAL BAROMETER

KAHLSICO Universal Mercurial Barometers are usable from below sea level to as high as 3000 m (10,000 ft) altitude. They embody the basic features of other KAHLSICO barometers in a simplified design that permits lower costs.

The special, Fortin-type cistern construction allows the mercury to expand and contract during shipment without admitting air into the tube. The stainless steel scales have a friction-held, slidable vernier on the same plane to avoid reflections and parallax reading errors. This barometer may be rotated 360° to take advantage of the best lighting or to view the mercury column and cistern reservoir. The 4 mm (0.16") diameter bore in the barometer tube facilitates accurate reading of the height of the mercury column.

The barometer is shipped assembled, ready to set up and use, complete with mounting panel, suspension bracket, centering ring and a detailed instruction booklet containing correction tables for temperature and gravity. Its weight is approximately 3 kg (7 lbs).

EXPORT
DIVISION:



P.O. BOX 947, EL CAJON, CALIF. 92022, U.S.A.

TELEX: 697906
CABLE: KAHLSICO SANDIEGO



No. 09AM300 KAHSICO Universal Metric Scale Mercurial Barometer has dual measuring scales of 677 to 1050 mb, with 1 mb divisions, and 508 to 790 mm Hg, with 1 mm divisions, as well as a vernier for reading to 0.1 mb and 0.1 mm.

No. 09AM320 KAHSICO Universal Metric-English Scale Mercurial Barometer has dual measuring scales of 20 to 31 inches Hg, with 0.1 inch divisions, and 508 to 790 mm Hg, with 1 mm divisions, as well as a vernier for 0.01 inch and 0.1 mm readings.

KAHSICO Precision Mercurial Barometers are fabricated to U. S. Government specifications and their calibrations are traceable to the National Bureau of Standards. They will easily and quickly provide accurate readings of the barometric pressure from sea level up to 3700 meters (12,000 ft) altitude.

The Fortin-type cistern assures ease of operation and long life. Both the mercury and the pointed cone are clearly visible in the cylindrical glass cistern and the meniscus, readily visible against the white plastic plate at rear, is easily brought into contact with the fiducial pointer by turning the knurled knob at the bottom of the cistern, when adjusting the zero point of the barometer scale. The glass tube has a uniform inside diameter of 6.25 mm (0.25") for greater accuracy in reading and depression of the meniscus of the column. The reading scales are factory calibrated to adjust for capillary action and instrument error. Only temperature and gravity corrections are necessary to provide measurements of the highest accuracy. The white, plastic plate behind the scales allows the mercury in the barometer tube to be easily seen and the index, which has verniers for both scales, is readily brought into line with the meniscus by turning the adjacent, large, knurled knob which controls the rack and pinion movement of the index plate. An accurate thermometer, scaled in Centigrade and Fahrenheit, on the front of the barometer allows ambient temperature to be readily determined. The mounting panel, which is 9 x 106 cm (3.5" x 42") has a suspension hook for the barometer case, which is made of brass, and a ring-clamp for the cistern, facilitating vertical alignment of the barometer. Its weight is approximately 3.5 kg (8 lbs).

No. 09AM340 KAHSICO Precision Metric Scale Mercurial Barometer is designed for use between 900 meters (3000 ft) altitude and sea level. It has dual scales, 861 to 1060 mb, with 1 mb divisions, and 646 to 800 mm Hg, with 1 mm divisions, as well as a vernier for reading to 0.1 mb and 0.1 mm.

No. 09AM360 KAHSICO Precision Metric-English Scale Mercurial Barometer is similar to our No. 09AM340 but is has dual measuring scales of 25.5 to 31 inches Hg, with 0.1 inch divisions, and 646 to 800 mm Hg, with 1 mm divisions, as well as a vernier for 0.01 inch and 0.1 mm readings.

No. 09AM400 KAHSICO Absolute Precision Pressure Gauge has a measuring range of 0 to 150 mm Hg. A glass U-tube, sealed at one end and filled with mercury, is mounted inside a glass dome which has a metal base. Two connectors, for rubber hosing, allow this gauge to be installed between a pump and a vacuum chamber. Its scale reads from 75 to 0 to 75 mm Hg, so that the two readings of the mercury level are added to give the total absolute pressure. (The open end of the tube is sealed during shipment to prevent loss of mercury.)

KAHLSICO SCIENTIFIC INSTRUMENT CORPORATION

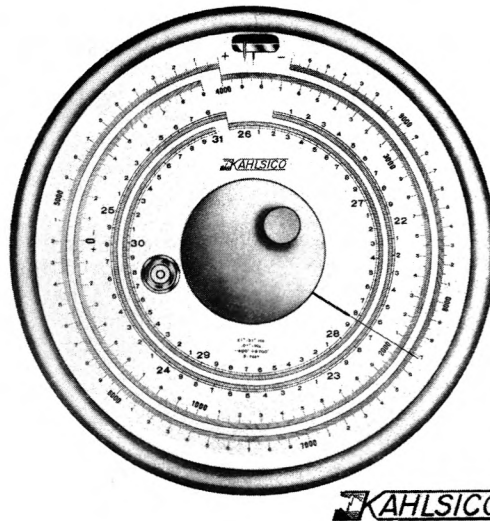
P.O. BOX 1166, EL CAJON (San Diego), CALIFORNIA 92022

Telephones: (714) 444-2158 and 444-5944

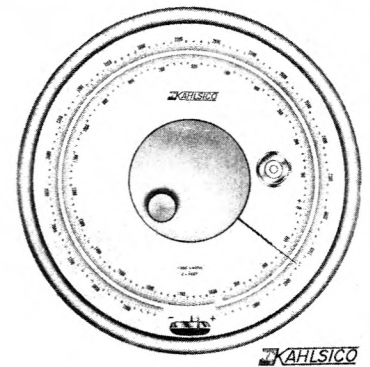
Factory: 737 W. Main St., El Cajon, Calif.



NO. 09BM100/BII
FIELD BAROMETER



NO. 09BM120/MI
ALTIMETER-BAROMETER



NO. 09BM130/Q
FIELD ALTIMETER

The balanced-beam barometers and altimeters offered by KAHLSICO afford the same higher accuracy and precision that are obtained from weighing scales of this type (as opposed to designs that rely on spring-extension for measurement), with a rugged, field-proven, low maintenance construction. As these barometers and altimeters are compact and fully portable, they may be used with full confidence for the most exacting measurements of barometric pressure or altitude at base stations, field sites, survey locations, etc. Their applications include the disciplines of cartography, engineering, forestry, geography, geology, meteorology, etc. as well as industrial usages such as in communications, mining, prospecting, etc. The barometers are sensitive enough to indicate the global diurnal barometric pressure changes, due to solar heating of the earth and its atmosphere, as well as the climatic variations, due to storms, winds, etc. The use of these altimeters saves time, personnel, maintenance and equipment costs since it eliminates the need for line-of-sight triangulation for field surveys of dams, reservoir sites, pipe lines, elevations, canals, etc.

The zero gauging method, as devised for precise analytical balances, has a beam (bar) with a needle-tipped pointer at its central pivot point that shows whether the system is balanced, or has tilted in either direction, as caused by expansion or contraction of the diaphragms of the sensitive, double aneroid attached to one end of the beam system, due to a change in the weight of the air column (barometric air pressure). The other end of the beam is affixed to a pair of precision balance-springs, the tension of which is varied by rotating a micrometer screw, secured to the lower end of the spring assembly, until it equals the atmospheric pressure on the aneroid system and balance is restored. A knife-edged reading pointer, that automatically eliminates parallax errors, moved in conjunction with the micrometer screw by an adjustment knob, indicates the atmospheric pressure, corresponding to this spring tension, on a large diameter, glare-proof, precision scale, with exceptionally clear, fine and distinct graduations. This has been carefully scribed to provide optimal readability and includes a mirrored portion to eliminate parallax reading errors of the balance indicating needle pointer. Since the scale pointer remains fixed in position until the next reading is taken, a second scale indicator, to show the previous measurement, is not necessary. The needle-tipped pointer is suspended by special coil springs, eliminating the need for fragile, jewel bearings, and readily shows even infinitesimal movements in the aneroid diaphragm system. It is oil-damped, to reduce vibration and facilitate its alignment with its zero (null) index line when the large adjustment knob, in the center of the dial, is rotated. A spring-loaded reset knob, on the adjustment knob, allows the knife-edged pointer to be placed at any desired position on the scale, as when correcting readings for altitude, etc.

BULLETIN 09M46 PRECISION BALANCED-BEAM BAROMETERS AND ALTIMETERS

EXPORT
DIVISION:



TELEX: 697906
CABLE: KAHLSICO SANDIEGO

P.O. BOX 947, EL CAJON, CALIF. 92022, U.S.A.



The use of a continuous, spiral, expanded scale on some models permits a wide measuring range with extraordinary accuracy in reading. As the aneroid diaphragms have mechanical stops that limit their expansion, damage due to shock, vibration or air pressures beyond the measuring range is minimized. Since they do not move the reading pointer, the force they expend is very small, which improves their reliability. Because the aneroid bellows system is always in exactly the same position when the mechanism has been balanced and a measurement is taken, errors due to inelasticity, hysteresis and irregularities are virtually eliminated and maximum sensitivity is achieved. This unique design, developed by Prof. Paulin, of Sweden, in the 1920's, excludes friction and lost motion from racks, pinions, pivots, bearings, linkages, etc., producing higher accuracy, dependability and sensitivity. Since there is no drift or lag, readings can be taken instantly, without the need to tap or vibrate the pointer system. A compact, rugged, portable recording micro-barometer is also available and is especially useful for correcting survey altimeters during field measurements (see Bulletin 09M47). An altimeter survey kit, which offers redundancy-safety in reading of the correct measurement, can be furnished and is particularly valuable for critical determinations where returning to the site to repeat the reading, due to instrument damage or human error, would be excessively costly. Alternatively, three altimeters with overlapping ranges or scaled in feet and meters may be chosen to make a highly versatile set of instruments that can readily be transported and used anywhere.

These superior quality barometers and altimeters are painstakingly fabricated with special materials and their aneroid bellows mechanisms are all fully temperature-compensated. They are lightweight, but extremely rugged, and will operate satisfactorily, even under the damp and dirty conditions often encountered in the field. Portable types are furnished with an integral, circular level vial, an attractive, sturdy leather carrying case with shoulder and hand straps, a magnifier, to facilitate readings, and an instruction book. A thermometer is supplied with the altimeters to correct the reading for changes in the density (pressure) of the air due to a variation from the air temperature at which it was calibrated, which causes discernable increases with cooling temperatures and decreases with warming ones. (The measuring system is fully temperature-compensated and does not require correction.) Wall mounted models have heavy gauge, spun brass, chromed cases with mounting holes. Each instrument is carefully packed in a special, cushioned carton that is suitable for air or surface shipment anywhere in the world.

Various scales and ranges are available for each of these instruments. All of them are offered as portable types, with a sturdy leather case (Style I); while the barometers are also available in heavy gauge brass housings, with polished chrome finish and holes for wall or panel mounting (Style II). When ordering, suffix the Code Letter for the range desired to the Model Number. The Style desired should also be suffixed to the Model Number (e.g. No. 09BM100/BII is a double scale, wall type barometer).

Each barometer is furnished with comprehensive instructions and each altimeter is supplied with an extensive operating manual.

No. 09BM100 BABEFIB, Balanced-Beam Field Barometer

DIMENSIONS & WEIGHTS:	<u>Diameter</u>	<u>Depth</u>	<u>Weight</u>
Style I (portable type)	13 cm (5")	8.5 cm (3.3")	1.2 kg (2.5 lbs)
Style II (wall type)	14 cm (5.5")	10 cm (4")	1 kg (2 lbs)

RANGES:

<u>Code Letter</u>	<u>Range</u>
A	600 to 1050 millibars, in intervals of 1 mb.
B	Double scale of 25.80" to 31.00" of mercury, in intervals of 0.01", and 874 to 1050 millibars, in intervals of 0.5 mb.
C	25.80" to 31.00" of mercury, in intervals of 0.01".
D	21.00" to 31.00" of mercury, in intervals of 0.01".
E	26.30" to 30.85" of mercury, in intervals of 0.002".

No. 09BM110 ESBE, Expanded Scale Balanced-Beam Barometer

DIMENSIONS & WEIGHTS:	<u>Diameter</u>	<u>Depth</u>	<u>Weight</u>
Style I (portable type)	20 cm (7.8")	11.5 cm (4.5")	1.8 kg (4 lbs)
Style II (wall type)	20.5 cm (8")	10 cm (4")	1.5 kg (3.5 lbs)

RANGES:

<u>Code Letter</u>	<u>Range</u>
F	530 to 786 mm of mercury, in intervals of 0.2 mm.
G	21.00" to 31.00" of mercury, in intervals of 0.01".
H	25.80" to 31.00" of mercury, in intervals of 0.01".
J	24.80" to 31.00" of mercury, in intervals of 0.001".

No. 09BM120 EXABAB, Expanded Scale Balanced-Beam Altimeter-Barometer

DIMENSIONS & WEIGHTS:

Style I (portable type), Style II (wall type): Same as No. 09BM110

RANGES:

Code Letter	Range
L	21.00" to 31.00" of mercury, in intervals of 0.01", and -900' to +9,700', in intervals of 5 feet (total altimeter range of 10,600 ft).
M	26.30" to 30.85" of mercury, in intervals of 0.002", and -760' to +3,600', in intervals of 2 feet (total altimeter range of 4,360 ft).

No. 09BM130 BABEFA, Balanced-Beam Field Altimeter

DIMENSIONS & WEIGHT:

Style I (portable type)

Diameter	Depth	Weight
13 cm (5")	8.5 cm (3.3")	1.2 kg (2.6 lbs)

RANGES:

Code Letter	Range
N	0 to 5,600 meters, in intervals of 5 m (total range of 5,600 m).
O	-260 to +3,000 meters, in intervals of 2 m (total range of 3,260 m).
P	-250 to +1,075 meters, in intervals of 1 m (total range of 1,325 m).
Q	-350' to +4,000', in intervals of 2 feet (total range of 4,350 ft).
R	-600' to +10,000', in intervals of 5 feet (total range of 10,600 ft).
S	-500' to +14,500', in intervals of 10 feet (total range of 15,000 ft).



NO. 09BM102 CASE WITH
NO. 09BM140/V ALTIMETER

No. 09BM140 ESABA, Expanded-Scale Balanced-Beam Altimeter

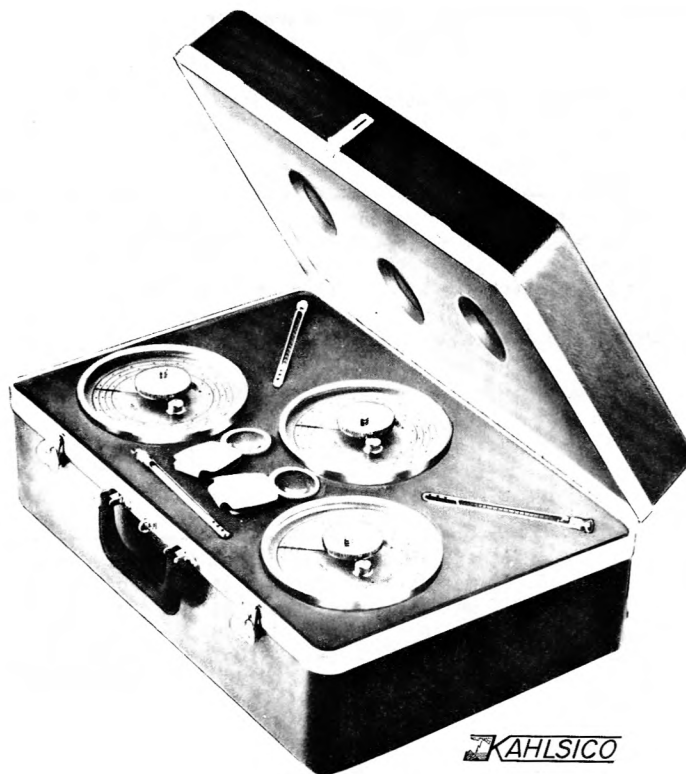
DIMENSIONS & WEIGHT:

Style I (portable type)

Diameter	Depth	Weight
18 cm (7")	10 cm (3.8")	1.8 kg (4 lbs)

RANGES:

Code Letter	Range
T	0 to 5,000 meters, in intervals of 1 m (total range of 5,000 m).
U	-100 to +2,500 meters, in intervals of 0.5 m (total range of 2,600 m).
V	0' to 15,000', in intervals of 5 feet (total range of 15,000 ft).
W	0' to 10,000', in intervals of 2 feet (total range of 10,000 ft).
X	0' to 6,000', in intervals of 1 foot (total range of 6,000 ft).
Y	-1,000' to +5,000', in intervals of 1 foot (total range of 6,000 ft).



NO. 09BM150 SURVEYING KIT

No. 09BM150 ASK, Altimeter Surveying Kit, for use with up to three No. 09BM140 Expanded Scale Balanced Beam Altimeters, has dimensions of 23 x 38 x 60 cm (9" x 15" x 23"). The rugged, compact, fully cushioned carrying case has a handle and lockable, hinged lid with safety clamps. The shock and vibration-resistant, foam-plastic inserts are contoured to gently but firmly hold the 3 altimeters with their accessory correction thermometers and scale magnifying lenses. Its complete weight, with 3 altimeters and accessories, is 7.5 kg (18 lbs). Suffix the Code Letter(s) of the Altimeter(s) desired to the ASK Model Number when ordering (e.g. 09BM150/V,W,X).

SPARE PARTS:

No. 09BM101 Leather Case, with shoulder and hand straps, 13 cm (5") diameter, for use with No. 09BM100 BABEFIB and No. 09BM130 BABEFA.

No. 09BM102 Leather Case, with shoulder and hand straps, 18 cm (7") diameter, for use with No. 09BM140 ESABA.

No. 09BM103 Leather Case, with shoulder and hand straps, 20 cm (7.8") diameter, for use with No. 09BM110 ESBEB and 09BM120 EXABAB.

No. 09BM104 Thermometer, in slotted armor case, pocket type; Range: 0° to 120° F.

No. 09BM105 Thermometer, like No. 09BM104 but with a range of -20° to +50° C.

No. 09BM106 Scale Magnifying Lens.

No. 09BM107 Altimeter Manual

KAHLSICO offers a comprehensive line of instruments for collecting ecological and other data. Devices include measuring and recording equipment for almost every environmental parameter as well as samplers for limnological and oceanographic research. We solicit your inquiries and will gladly recommend suitable standard or custom-designed instruments for your consideration, upon advice as to the exact nature of the investigations to be undertaken.

KAHL SCIENTIFIC INSTRUMENT CORPORATION

P.O. BOX 1166, EL CAJON (San Diego), CALIFORNIA 92022

Telephones: (714) 444-2158 and 444-5944

Factory: 737 W. Main St., El Cajon, Calif.



NO. 09AM080 PRECISION BAROMETER

No. 09AM080 PIRA, Pivot-Bar Precision Barometer, has a unique, counter-balanced measuring system that provides extraordinary accuracy and sensitivity without any of the problems encountered with traditional aneroid barometers. This highly reliable instrument has a sensitivity of 0.02% (full scale) which qualifies it for meteorological, surveying, marine, airport and similar uses. It has an internal, pivoted bar with a set of aneroid bellows at each end. The bellows are secured to the housing and their free ends, attached to the bar, move in opposite directions. This causes the bar to rotate at its pivot point as the aneroid wafers expand and contract, due to variations in the atmospheric pressure. A shaft connected to the bar, at the pivot point, has a knife-edged pointer affixed to it, for parallax-free reading of the exceptionally large, 40-cm (16") long, mirrored scale, which is calibrated in both mb and mm Hg.

As there are no gears, racks, pinions or other mechanical linkages, the pointer moves smoothly, instantaneously and without backlash. It responds to the slightest expansion or contraction of the temperature-compensated aneroid bellows. The system is also completely unaffected by attitude and will maintain its reading regardless of whether it is either in a vertical or a horizontal position. The flanged housing has mounting holes to allow the barometer to be securely attached to a wall, panel, table, etc.

This precision barometer has measuring sensitivities of 0.2 mb and 0.16 mm Hg for the dual-scale ranges of 915 to 1045 mb and 685 to 785 mm Hg, which can be easily read to accuracies of 3 mb and 2 mm Hg, respectively. The unusually large diameter of this barometer, and its special mechanical design, assure highly reliable determinations of the barometric pressure. These factors permit the PIRA to be used for surveying, altimeter setting, etc., as well as for standard atmospheric pressure measurements. The housing has a glass window with a movable, knife-edge pointer, which may be set against the scale reading, for future reference, and a sliding-cover for the access hole of its altitude correction system, which is adjusted by means of the accessory key provided. The unit is 25 cm (10") diameter by 10 cm (4") deep and weighs 4 kg (9 lbs).

BULLETIN 09M47 PRECISION PIVOT-BAR BAROMETER AND SURVEYING MICROBAROGRAPH

EXPORT
DIVISION:



TELEX: 697906
CABLE: KAHLSICO SANDIEGO

P.O. BOX 947, EL CAJON, CALIF. 92022, U.S.A.





NO. 08AM130 SURVEYING MICROBAROGRAPH

KAHLISCO No. 08AM130 SUM, Surveying Microbarograph, is an ingenious device with an automatic, nulling, zero-balancing Paulin system (see Bulletin 09M46) that provides ultra-sensitivity in recording barometric pressure. This rugged and compact device can easily be transported and used for measurements anywhere in the field. A spring-wound, precision clockwork rotates a carefully threaded shaft, which slowly moves the stylus from left to right, during its 15-hour excursion. This scribes a fine line on the pressure-sensitive chart affixed to the drum below it. The shaft-suspended drum has a gear at one end that is moved by the mechanical, zero-balancing, atmospheric pressure sensing system, which is powered by another clockwork in the base of the unit. A cylindrical housing, at right, protects the precision, fully temperature-compensated, aneroid bellows assembly that provides the extraordinary sensitivity of this device. It can be used for all types of short-term barometric pressure recordings, such as correcting survey altimeter readings from a base site, monitoring atmospheric pressure changes in relation to biological and physical investigations, etc. The sturdy, hinged, leather carrying case is easily opened to gain access to the instrument. A pressure-altitude table is included in the case to facilitate conversion of the readings. Locking devices protect the mechanism when it is not in use.

SPECIFICATIONS:

Operating Altitude Range: -1,000 ft to +13,000 ft.

Measuring Range: 1.5" Hg (38.1 mm Hg; 50 mb).

Chart Graduations: 0.005" Hg, readable to 0.001" Hg (0.03 mb) (equivalent to approximately 25.4 mm (1") elevation).

Recording Period: 15 hours.

Time Graduations: 10 minutes, readable to 1 minute.

Dimensions (with case): 19 x 30 x 38 cm (7.5" x 10.5" x 15").

Weight (with case): 9 kg (20 lbs).

SPARE PARTS:

No. 08AM131 Spare Charts, set of 100.

KAHLISCO offers a comprehensive line of instruments for collecting ecological and other data. Devices include measuring and recording equipment for almost every environmental parameter as well as samplers for limnological and oceanographic research. We solicit your inquiries and will gladly recommend suitable standard or custom-designed instruments for your consideration, upon advice as to the exact nature of the investigations to be undertaken.

KAHL SCIENTIFIC INSTRUMENT CORPORATION

P.O. BOX 1166, EL CAJON (San Diego), CALIFORNIA 92022

Telephones: (714) 444-2158 and 444-5944

Factory: 737 W. Main St., El Cajon, Calif.

Precision Aneroid Barometer.

This instrument combines a high degree of sensitivity and accuracy with a rugged design giving robustness and portability.

The movement employs one stack of 6 beryllium-copper capsules.

To minimize hysteresis and drift, the sensitive unit has been heat treated and aged by cyclic pressure variation.

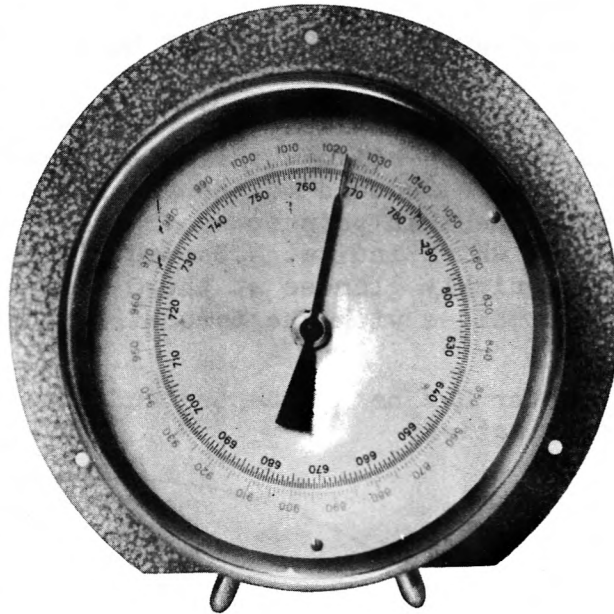
The temperature effects are compensated by the insertion of a bimetallic link in the lever magnification system and by leaving a small amount of dry air within the capsule, the internal volume when dilated being proportioned to the volume when compressed.

The whole movement is mounted on practically frictionless point bearing and is unaffected by position.

The instrument is fitted with zero-setting adjustment and with an overload safety device to avoid damage resulting from atmospheric pressures below or above the scale range.

The indicating pointer is knife-edged for better reading.

The dial is 4.875 in. in diameter and has a **double scale** in mmHg and millibars.



GENERAL SPECIFICATIONS

Range	620 to 800 mmHg 820 to 1060 mb	divided to 0.5 mmHg divided to 1 mb
Accuracy	± 0.5 mb	

Dimensions 7.8" x 3.5" (200 x 90 mm)

Weight 2.8 lbs. (1.3 kg)

- 09AM100 *PRECISION ANEROID BAROMETER. Range 620 to 800 mmHg divided to 0.5 mmHg and 820 to 1060 mb divided to 1 mb.*
- 09AM160 *Ditto, with a rotating magnifier lens.*
- 09AM140 *Ditto, with movable index for showing change in pressure.*
- 09AM180 *PRECISION ANEROID BAROMETER like 09AM100 but with expanded scale, range 880 to 1040 mb divided to 0.5 mb.*
- 09AM220 *Ditto, with a rotating magnifier lens.*
- 09AM240 *Ditto, with movable index for showing change in pressure.*

EXPORT
DIVISION:



P.O. BOX 947, EL CAJON, CALIF. 92022, U.S.A.

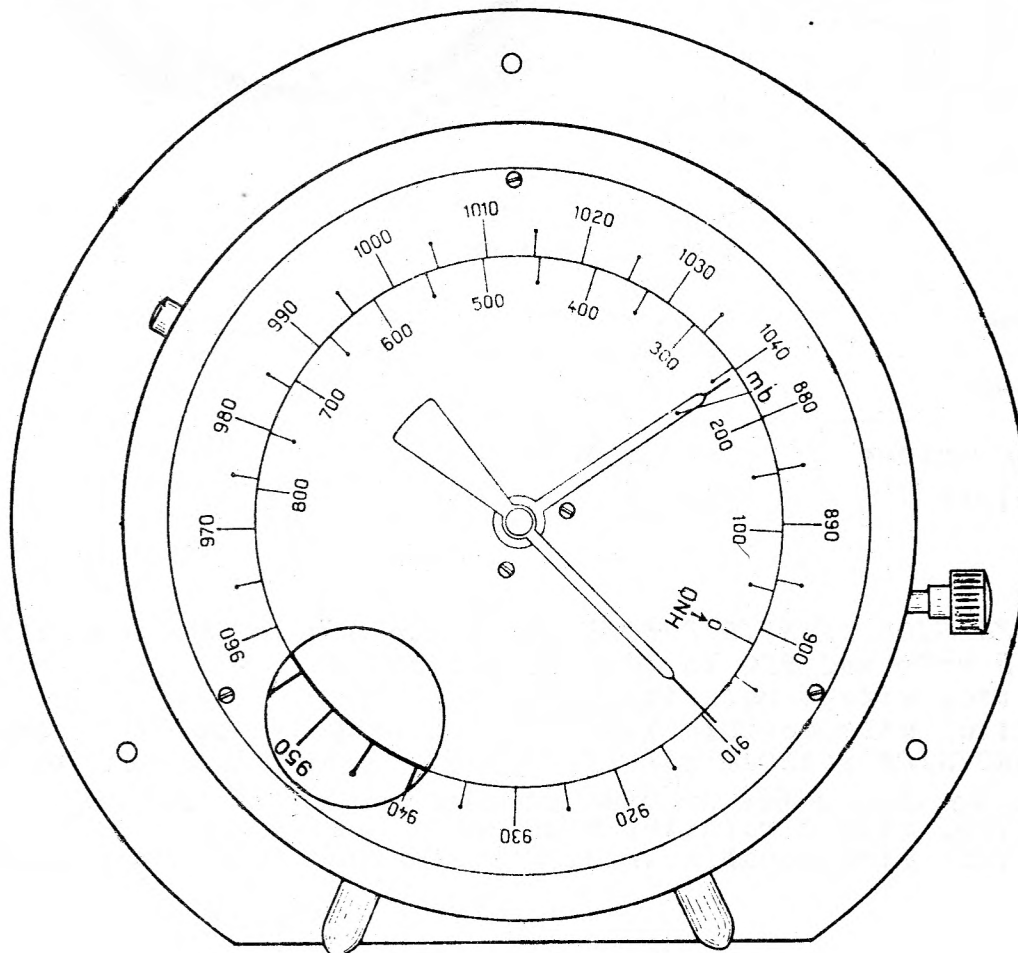
TELEX: 697906
CABLE: KAHLSCO SANDIEGO



The No. 09AM200 QNH instrument is a high precision type of aneroid barometer with a dial approximately 14 cm. diameter, reading 880-1040 mb. numbered every 10 and subdivided in 0.5 mb. It should be adjusted with a standard mercurial barometer at a known pressure. When installed at an airport, it must be corrected for the airport altitude only once. This adjustment is made by pushing in the button at the side of the QNH Barometer and rotating the knurled knob on the housing, located on the opposite side. When the button is pushed in, it locks the thin pointer located underneath the barometer pointer for pressure. Rotating the knob rotates the inner QNH scale, reading 0-800 meters or feet. The scale is rotated so that the thin pointer coincides to the exact height of the control tower at the airport. The pointer thereafter must NEVER BE MOVED; otherwise, reading errors will result.

The pilot aboard the airplane, in order to correct his altimeter reading and know his absolute height, calls in to the control tower asking for barometric pressure reduced to the SEA LEVEL READING. This is obtained by quickly moving the thin pointer so that it is aligned exactly underneath the larger pointer, which indicates barometric pressure at the airport. The observer then quickly glances at the 0 line on the height (meter) scale and wherever it coincides with the barometric scale, that point is the pressure at sea level.

The QNH Barometer has been accepted and adopted by the International Civil Aviation Organization.



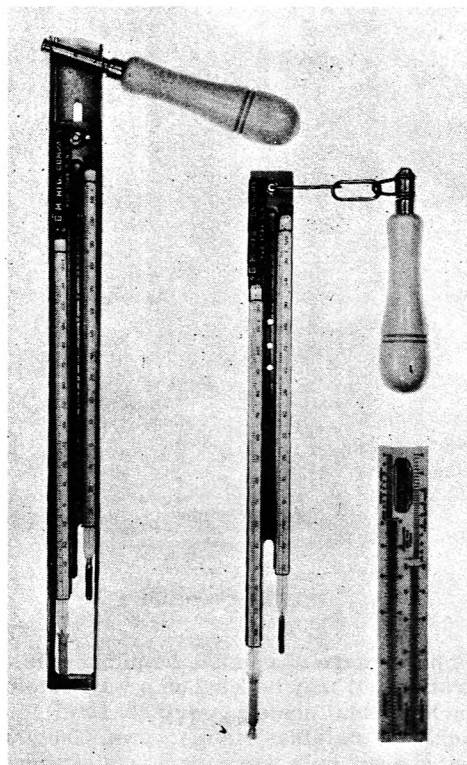
KAHL SCIENTIFIC INSTRUMENT CORPORATION

P.O. BOX 1166, EL CAJON (San Diego), CALIFORNIA 92022

Telephones: (714) 444-2158 and 444-5944

Factory: 737 W. Main St., El Cajon, Calif.

Bulletin 63-18-W PSYCHROMETERS-CALCULATORS-ANEMOMETER



* 27AM200 * 27AM220 * 34AM100

27AM200 PSYCHROMETER WITH PROTECTIVE HOLDER, U.S. Weather Bureau pattern, Type II, complete with U.S.W.B. psychrometer back with thermometers. The psychrometer is removable from frame. This is a new design and the protective frame is highly polished brass, nickel plated finish. Available in either temperature range A, B, or C, as listed under No. 18W-800. Frame length is 14"; weight 10 oz.

34AM100 PSYCHROMETRIC SLIDE RULE, useful for calculating percentage of relative humidity over temperature range of 20-120F. Rule has 6"-150mm and also F & C temperature conversion scales on back side. It is 6-1/4" long.

27AM220 U.S. WEATHER BUREAU PATTERN SLING PSYCHROMETER, with linked wooden handle for whirling. Made to U.S.W.B. specifications for observers on land or sea. Thermometers are available as listed under No. 18-W-800, ranges A, B, or C.

27AM240 POCKET PSYCHROMETER, aluminum back with folding swivel handle. Thermometers normally supplied with red-reading mercury tubing, 5-1/2" long, range 20-120°F. The 7-1/2" sturdy leather carrying case will hold a 16-W-902 Slide Rule.

27AM241 THERMOMETERS only, 20-120F range for Pocket Psychrometers.

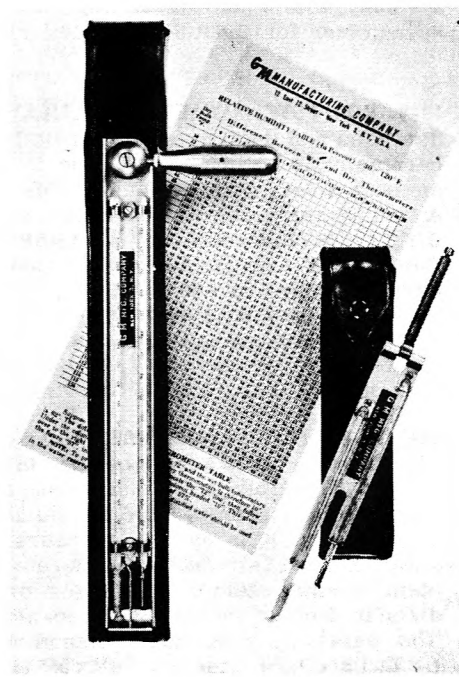
27AM260 FLANGED ALUMINUM BACK SLING PSYCHROMETER, with swivel metal handle for whirling. The flanged edges of the metal case protect the thermometers against accidental breakage. #18-W-800 U.S.W.B. type thermometers are supplied in ranges A, B, or C. The hand-sewn sturdy cow-hide leather case is 14" long.

27AM201 PSYCHROMETER THERMOMETERS, to fit all metal frames listed in this bulletin, except pocket type No. 16-W-901. These thermometers are made to U.S. Weather Bureau specifications and are of first-class workmanship and quality. They are 9-1/2" long, mercury filled, and are held to an accuracy tolerance of 0.3°F. Stock ranges are listed below; other ranges are available on order:

- | | |
|-------------|--------------------------------|
| No. 27AM202 | Range A, -20 to +120°F in 1°F. |
| No. 27AM203 | Range B, +10 to +145°F in 1°F. |
| No. 27AM204 | Range C, -20 to +55°C in 1°C. |

27AM110 SPARE WICKS, specially treated braided tubing, to fit all psychrometer thermometer bulbs, cut 3" long, packed 10 per tube. Other lengths available on special order.

* All Supplied with % Relative Humidity Chart



* 27AM260 * 27AM240

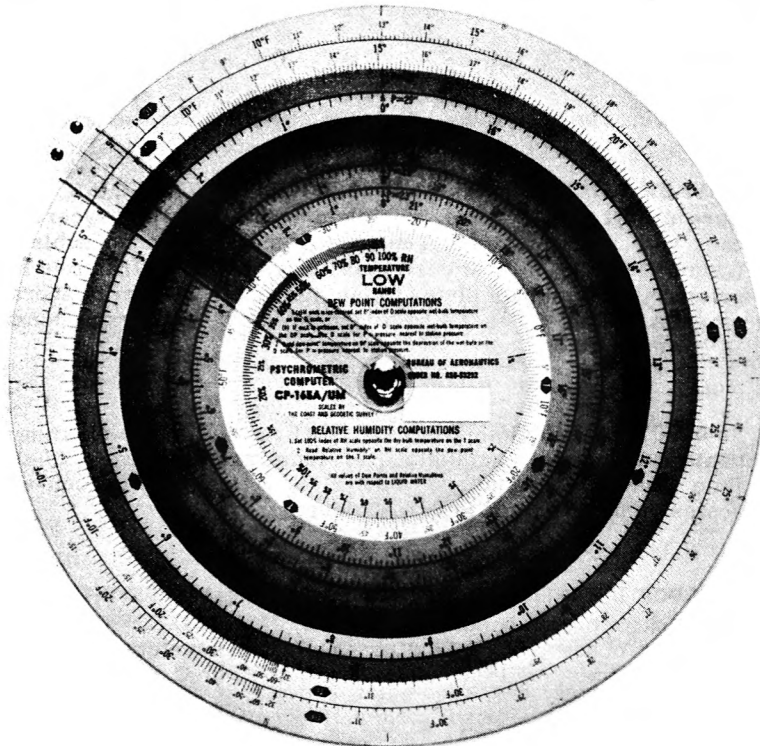
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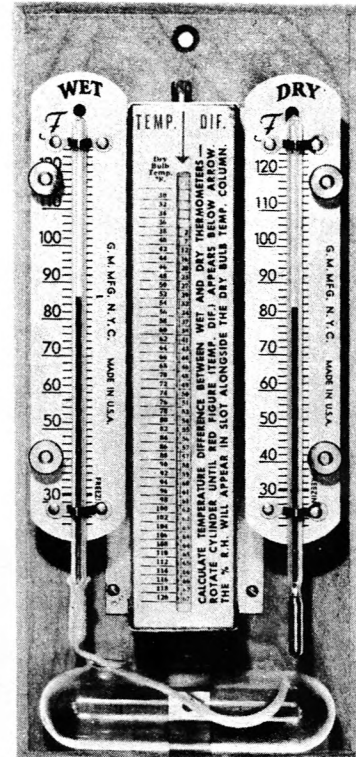
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34AM120



18AM100

18AM100 WALL HYGROMETER, with rotary calculator which indicates percentage of relative humidity. This is a reliable Mason type hygrometer, made to Government specifications. It may be hung on a wall or other upright device. The mercury thermometer tubes are secured to etched metal scales, range 20-120°F in 2°. All components are fastened to the 4" x 8" lacquered wooden back with stainless steel screws. The glass water cistern is removeable for refilling with clean water so that the wet bulb thermometer wick may be continuously moistened. The rotary calculator is simple to use and has printed instructions thereon. If used in a room with non-circulating air, it is best to fan the hygrometer for about 30 seconds for accurate readings.

34AM120 PSYCHROMETER CALCULATOR, for determining dew point and the percentage of relative humidity at different barometric pressures. The rule is 12" diameter, printed on both sides, with various scales in contrasting colors. A temperature conversion scale, subdivided in 0.1°F and 0.1°C, over the ranges of 32-130°F & 0-55°C, is provided. One side of the calculator is printed to cover the low temperature range of -60 to +50°F and the other side covers the range of -10 to +120°F. Plastic sheet is used and the calculator is made to Government specifications.

03AM440 STATIC ANEMOMETER, Pitot Tube type, used to measure the dynamic pressure of the wind or any air stream. The graduated scale covers a range of 0-110 ft/sec. The handle is removeable should the device be installed permanently. It is used to measure air flow in restricted areas such as air ducts, pipes, etc., as well as outdoors. Static Anemometers are available for other air speeds, with dials in feet or meters, with nozzles of different lengths. The carrying case with anemometer weighs 1-1/2 lbs (.5 kg.) and measures 8" x 5" x 2" (17cm. x 12cm. x 5cm.).



03AM440

KAHL SCIENTIFIC INSTRUMENT CORPORATION

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Assmann Psychrometer.

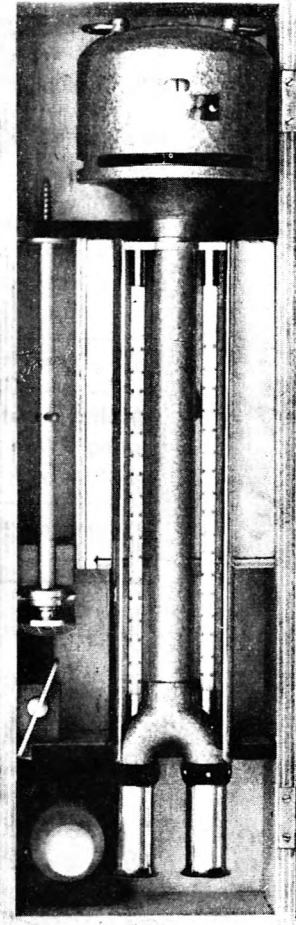
This is the improved Assmann Psychrometer with its basic principle, but modified to obtain greater accuracy and therefore it can be considered the most accurate instrument available for humidity measurements of the wet and dry bulb hygrometers type.

It consists of two thermometers, one wet bulb type and one dry bulb type, held in a metal frame and kept ventilated by means of a fan at an aspiration rate to insure equilibrium conditions. The bulbs are fully protected from radiation effects by two detachable metal shields which are isolated from each other as well as from the frame by plastic bushings.

The spring or electrically driven fan is attached to the upper end of the frame.

A rubber bulb with glass tube is supplied for use in moistening the muslin wick covering the wet bulb.

The instrument is supplied in a sturdy wood case with the accessories.



GENERAL SPECIFICATIONS	
Aspiration rate	electrically driven fan: 6 m/sec spring driven fan: 5-6 m/sec
Thermometers range: — 20 + 60 °C divided to 0.2 °C	

model	Dimensions	Weight
27AM460	18.3" x 4.9" x 5.9" (470 x 125 x 150 mm)	7.49 lbs (3.4 kg)
27AM440	18.3" x 4.9" x 5.9" (470 x 125 x 150 mm)	5.73 lbs. (2.6 kg)
27AM500	10.5" x 3.9" x 5" (270 x 100 x 130 mm)	2.75 lbs. (1.25 kg)

27AM460 ASSMANN PSYCHROMETER, complete with length of wick, wick moistener, suspension rod, wind shield, hygrometric tables and instructions in wooden carrying case.

27AM480 Ditto, electrically driven fan (advise voltage).

27AM440 Ditto, spring driven fan with an aspiration rate of 2.5 m/sec.

27AM500 ASSMANN PSYCHROMETER, similar to 27AM440 but of smaller dimensions and fitted with thermometers having a range — 20 to + 60° C divided 1° C.

27AM462 Spare Thermometer divided 0.2° C.

27AM502 Spare Thermometer divided 1° C.

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Interim Brochure E 1967

August Aspirated Hygrometer.

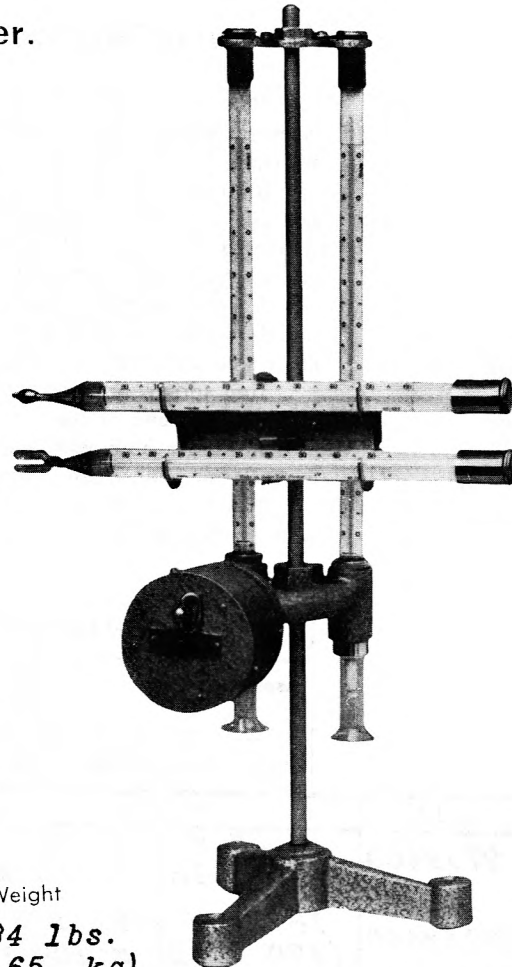
This is a special type of precision wet and dry bulb hygrometer for use in standard meteorological screens.

The two thermometers are held in a metal frame with the stems passing into a hollow « U » through O-rings, and the bulbs are centrally held in a radiation shield.

Air movement is forced past the bulbs by a spring or electrically driven fan at an aspiration rate of approximately 5 m/sec.

The instrument can be fitted with a couple of maximum and minimum thermometers with proper support.

GENERAL SPECIFICATIONS	
Aspiration rate	
spring driven fan : 5-6 m/sec or 2.5 m/sec	
electrically driven fan : 6 m/sec	
Thermometers range : — 30 + 60 °C	
divided to 0.2 °C	



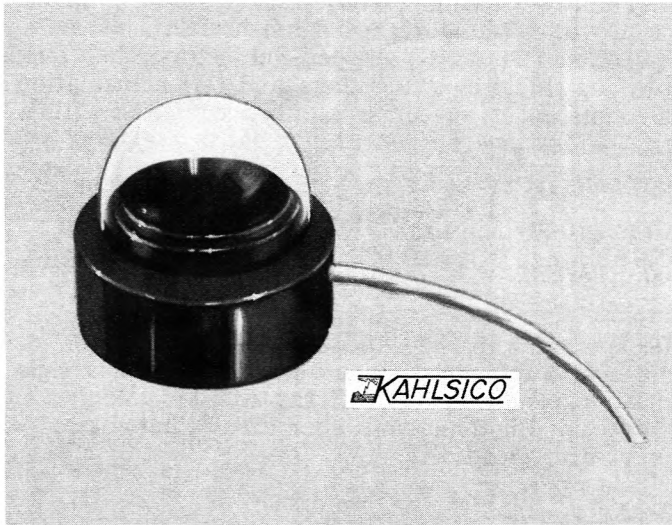
complete with maximum and minimum thermometers.

model	Dimensions	Weight
27AM080	7" x 20.3" x 9.7"	5.84 lbs.
27AM060	(180 x 520 x 250 mm)	(2.65 kg)
27AM100	7" x 20.3" x 8.6"	4.17 lbs.
	(180 x 520 x 220 mm)	(1.85 kg)

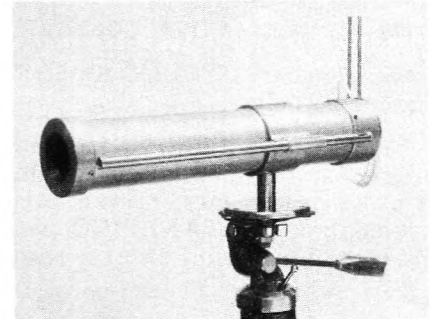
27AM080 AUGUST HYGROMETER complete with support, length of wick, wick moistener, hygrometric tables.

27AM060 Ditto, electrically driven fan (advise voltage)

27AM100 Ditto, spring driven fan with an aspiration rate of 2.5 m/sec.



No. 28AM500 MINI-PYRANOMETER



No. 28AM520 PYRHELIOMETER

BULLETIN 28M34 MINI-PYRANOMETER, STANDARD RADIOMETER, PYRHELIOMETER, mV METER

A unique feature of the KAHLSICO No. 28AM500 Mini-Pyranometer is its hermetically sealed dome that is first evacuated and then filled with dry, inert gas to prevent condensation on its inner surface. The sensor has been specially designed to provide a 180° angle of reception for the total sun and sky radiation and its angular response is, essentially, the Lambert cosine. It is ruggedly constructed to withstand field usage and extreme weather conditions. Special care and techniques have gone into the construction of the thermopile and associated wiring. All of the 160 copper-constantan thermocouple junctions have been metallurgically bonded, at the atomic level, to assure conformance to the normal EMF curve. Exacting standards of manufacture, quality control and calibration are employed during all phases of fabrication and testing. These devices have been used throughout aerospace flights and even on lunar landings, attesting to their superb characteristics.

The sensor has a special, fused coating of colloidal graphite base, covering the "hot" junctions of the thermopile, that is extremely stable and absorbs uniformly over the spectral range of 0.2 to 30 microns. The absorptivity of 0.89 has not been found to vary significantly, even after over 1000 hours exposure to intense ultra-violet radiation. Solar or other radiation between 0.35 and 2.5 microns will be uniformly transmitted by the dome and absorbed by the sensor. Wider measuring ranges can be provided on special order by use of domes made of other materials. Its response time is extremely rapid, requiring only 500 milliseconds to indicate 63% of the true value. Even the beam of a weakened flashlight is sufficient to evoke a practically instantaneous output from the sensor. Its high sensitivity provides a nominal 5 mV output per solar constant (1 solar constant = 1.9532 gm cal/cm²-min). No reference junction or external power supply is necessary for this entirely self-generating device. Connection can readily be made to a KAHLSICO No. 28AM530 Portable mV Meter, which has been specially designed for use with such sensors as its range can be quickly adjusted to match each one, a No. 28AM140 Strip-Chart Recorder with line or battery paper feed, or any suitable instrument with 100 k ohms minimum input impedance.

The KAHLSICO Mini-Pyranometer may be mounted in any orientation and will withstand temperatures ranging from -100° to +150° C (-150° to +300° F). The special design of the sensor allows reliable measurements over a wide outdoor temperature range. Even at low ambient temperatures it has good stability as shown by the following table:

°C	Increase in Output	°F
-40	4%	-40
-18	1.5%	0
- 7	0.6%	+20
+ 4	0	+40

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It is possible to embed a thermocouple in the base of the body on special order, to allow exact measurement of its temperature. This is specified by adding the suffix "/T" to the model number. The sensor is not affected by variations in atmospheric pressure; similar instruments have been used in the hard vacuum of outer space without any change in sensitivity. The 51 mm (2") diameter, 25.4 mm (1") high body is of anodized aluminum and can be provided with threaded mounting holes. The hemispherical glass dome is 38 mm (1.5") in diameter. The overall height of the sensor is 44.4 mm (1.75"). Normally, a 3-m (10-ft) length of flexible wire is provided (longer lengths can be furnished on special order). This special wire has two 0.2 mm² cross-section (24 AWG) copper conductors, each teflon insulated and color coded, with a tinned-copper, braided shield covering these and teflon insulation over all. The nominal impedance of the sensor is 100 ohms. Each sensor is supplied complete with a calibration curve.

No. 28AM500 MINI-PYRANOMETER, as described above.

No. 28AM501 EXTRA CONNECTING WIRE, per 3-m (10-ft) length.

No. 28AM502 LEVELLING BASE FOR No. 28AM500 COMPLETE, with 3 levelling screws, circular level vial, and securing bolts.

No. 28AM505 HIGH-OUTPUT MINI-PYRANOMETER is similar to No. 28AM500 but has a more sensitive, 320-junction thermopile and produces a nominal 10-mV output per solar constant. This is especially helpful when low energy levels predominate, such as at cloudy or overcast sky sites. A useful, ancillary instrument is the KAHL-SICO No. 23AM100 Universal Photometric-Radiometric Photometer which, while more limited in spectral response, has even greater sensitivity.



No. 28AM510 STANDARD RADIOMETER

For precise measurement of incident solar or other relatively low-level radiant energy KAHL-SICO offers the No. 28AM510 Ultra-Sensitive Standard Radiometer. This device is basically similar to the No. 28AM500 Mini-Pyranometer but has special design and construction features that entitle it to be considered useable as a Prime Standard. Its efficiency in measuring solar radiation or low level radiant energy, convective energy or total heat transfer from other low level energy sources is unexcelled. The low mass of the sensor permits the extraordinarily fast response time of 250 milliseconds with an output of 5 mV per solar constant. Its other nominal characteristics are 3% accuracy, 0.25% repeatability and 2% linearity. Despite these precision measurement factors it is also rugged, being capable of withstanding the shock, vibration and acoustics produced by airborne space vehicles. It is particularly well adapted to measuring solar radiation in satellites as well as in solar simulators. Deviations of less than 0.5% in 10 years of comparisons with International Standards have proven the suitability of this device for use as a Prime Standard.

The flat, optically ground and polished quartz window permits a spectral measuring range of 0.2 to 4.5 microns. It is mounted in a threaded, stainless-steel collar that allows a 150° angle of reception. The sensor itself has a wide angle of measurement tolerance for incident radiation. Up to 40° inclination from its perpendicular axis does not cause a noticeable variation, thereafter it approximates the cosine law (65% loss of measurement at 60° angle of incidence, 85% loss at 75°) down to 82°, after which it is no longer able to respond. The collar is readily removed to allow others, which can be supplied on special order, with different window materials such as plastic film, sapphire, etc. to be placed over the sensor, for different spectral ranges. Measurements may also be made, with a 180° angle of reception, by removing the window but protection against sensor surface contamination and convective energy components is lost. A calibration curve is furnished with each instrument, one with the window removed is available on special order.

The oxygen-free copper body of this disc-shaped probe, which is 38 mm (1.5") in diameter and 19 mm (0.75") thick, including the window-collar, has water jacketing for the sensor to maintain it at a constant temperature and permit the high accuracy of measurement that it is capable of producing. The water should be between 7° and 55° C (45° and 130° F) and flow at a rate of 400 ml/min (0.1 gpm). Two 3.9-mm (0.15") diameter, 100-mm (4") long stainless steel tubes are provided for the inlet and outlet connections. The body also has a pressure equilization vent for the window side of the sensor. If it is desired to monitor the internal temperature of the probe body then a thermocouple can be installed on special order by adding the suffix "/T" to the model number.

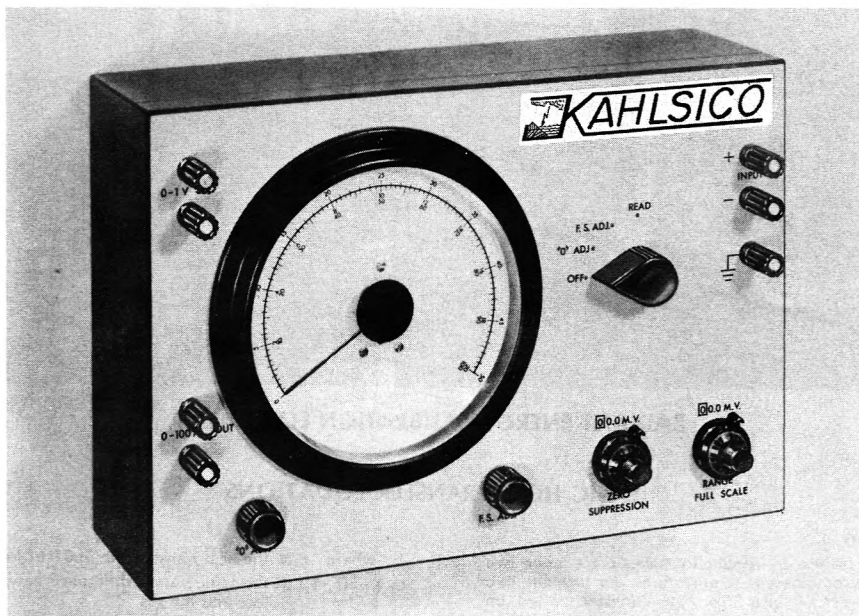
No. 28AM510 ULTRA-SENSITIVE STANDARD RADIOMETER, as described above.

No. 28AM511 SPARE COLLAR (without window).

No. 28AM515 HIGH-OUTPUT ULTRA-SENSITIVE STANDARD RADIOMETER is similar to No. 28AM510 but has a more sensitive thermopile and produces a nominal 10-mV output per solar constant.

An accessory collimator, KAHLSICO No. 28AM520, allows the No. 28AM510 sensor to be used as a Pyrheliometer. This collimator has an anodized aluminum barrel with a specially designed baffle system to eliminate all internal reflections and 5.7° angle of reception at its open end. It is 355 mm (14") long and has a fitting to hold the No. 28AM510 Ultra-Sensitive Standard Radiometer at its other end. It has an adjacent sighting tube to facilitate alignment, is ruggedly constructed and is provided with a mounting bracket for a tripod.

KAHLSICO can also supply high energy radiometers for energies up to 81 gm cal/cm²-min (5000 BTU/ft²-sec), as found in combustion processes. Facilities are available for calibrating almost any type of radiometer. These systems can also be supplied on special order for those wishing the ultimate in radiant thermal energy standardization and calibration equipment.



No. 28AM530 mV METER

The extremely versatile No. 28AM530 KAHLSICO Portable mV Meter is well suited to measuring all of these sensors as well as any instrument or transducer with a 0 to 100 mV output. A very useful feature is the ability to dial in the calibration factor of any linear DC output probe and obtain readings directly in engineering (measurement) units, making it unnecessary to convert from one scale to another or use different meters for different sensors. It is lightweight, compact, portable, self-contained, simple to use, easy to read and highly accurate. The 152-mm (6") diameter, 241-mm (9.5") long scale of the specially constructed indicating meter has 100 divisions. A 10-turn, range selector potentiometer allows the full scale reading of the meter to be set anywhere between 2 and 100 mV. The nominal accuracy is 1% of the span of the measuring range and the resolution is 0.5% of the full-scale reading. The input impedance is greater than 1 megohm and the zero drift is less than 20 microvolts/° C. Up to 1.5 volts can be put into the instrument without damage. The input at the positive, negative and ground terminals is short-circuit proof and the meter is electrostatically shielded. A switch is provided to reverse the input polarity (as when heat flows reverse direction). There is also a zero adjustment knob for the indicating meter. Three built-in mercury cells furnish up to 1000 hours of continuous operation. Its unique, solid-state circuitry offers many useful features not found elsewhere such as a self-checking capability that automatically cancels any errors.

A zero suppression adjustment is available on special order. This has another 10-turn potentiometer which allows the 0 of the meter scale to be "suppressed" and replaced by any selected value between 0 and 100 millivolts. This can be used to read a very short span on the long meter scale (as by setting the range selector at 2, for full scale, and the zero suppressor at 48, for the start of the scale, the 100 divisions of the scale would represent 48 to 50 mV) or to expand the measuring range up to 200 mV (by setting both potentiometers at 100 to obtain a scale representing 100 to 200 mV). The zero suppressor is obtained by adding the suffix "/ZS" to the model number.

If it is desired to record the reading shown on the meter then output terminals can be provided on special order by adding the suffix "/OT" to the model number. The 0 to 100 mV output is short-circuit proof. The special circuitry of this meter allows it to be used as a preamplifier for any 0-100 mV output device when connected to a suitable recorder, digital readout, oscilloscope, etc. To maintain 0.5% accuracy, the input impedance of the recorder should be 6 k ohm minimum. The non-linearity of the output is 0.1% and the temperature effect is 0.2%/°C maximum. The frequency response is 5 kHz.



RADIANT ENERGY CALIBRATION EQUIPMENT

BASIC HEAT TRANSFER EQUATIONS

Conduction

The transfer of heat by conduction takes place when two solid objects of different temperatures are brought into physical contact. A heat flow rate (transfer) is set up between the two objects that is proportional to the thermal conductivity of the intervening material, and inversely proportional to the thickness of that material. This equation is known as the steady state Fourier heat conduction equation and is defined as:

$$\dot{q} = \frac{k (T_1 - T_2)}{L}$$

- where \dot{q} = the heat transfer rate in BTU/ft²-sec.
- k = neutral materials thermal conductivity in BTU/ft²-hr°F.
- $(T_1 - T_2)$ = the temperature difference between the boundary interfaces at the neutral materials in °F
- L = thickness of the neutral material in feet

Convection

Convection heat transfer is similar to conduction heat transfer except that it deals with the transfer of heat between a solid surface and a fluid. The fluid may be either gas or liquid. The equation which governs heat transfer by convection is given by:

$$\dot{q} = h (T_1 - T_2)$$

- where \dot{q} = the heat transfer rate in BTU/ft²-sec.
- $(T_1 - T_2)$ = the temperature difference between the surface and the gas
- h = the convective heat transfer coefficient in BTU/ft²-sec°F

Radiation

Heat transfer by radiation is different from both convection and conduction heat transfers in that, there is no need for physical contact between the two objects in order to transfer heat between them. The single similarity between radiant heat transfer and convection or conduction heat transfer is that there must be a temperature difference between the radiating source and the receiving body. The equation governing the radiant heat transfer is:

$$\dot{q} = F\sigma\epsilon (T_1^4 - T_2^4)$$

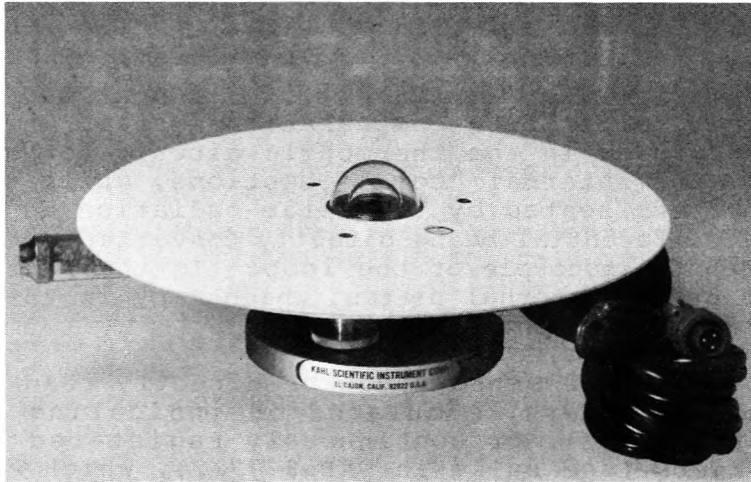
- where \dot{q} = heat transfer rate in BTU/ft²-sec
- F = geometric form factor between the source and receiver
- σ = Stephen-Boltzmann constant
- ϵ = emmissivity of the radiator (source)
- T_1 = absolute temperature of source
- T_2 = absolute temperature of receiver

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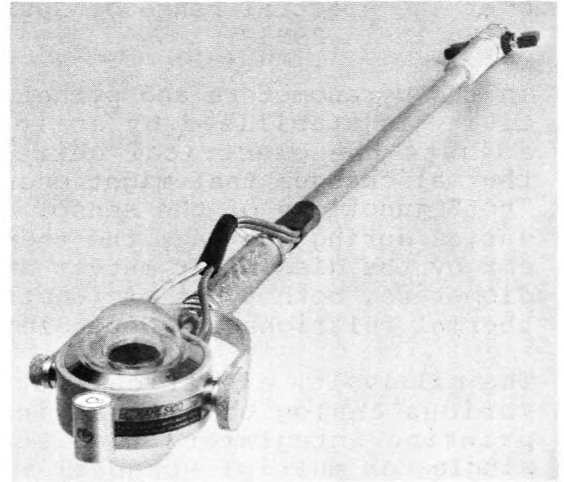
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Telephones: (714) 444-2158 and 444-5944

Factory: 737 W. Main St., El Cajon, Calif.



**NO. 28AM200
DOUBLE-DOME PYRANOMETER**



NO. 28AM230 ALBEDOMETER

KAHLSICO offers a large assortment of instruments to measure solar radiant energy, incorporating the renowned Funk thermopile, which provides an exceptionally compact, stable, sensitive, high-output, black-body sensor. These devices can be used for reliable, accurate, field or station determinations of incident, net, reflected or transmitted radiation. They are all simple to use and maintain, completely weatherproof, robustly constructed and ideal for measurement of solar, terrestrial or other emissions, even in remote areas, under all environmental conditions, including rain, for applications such as: agriculture, botany, climatology, entomology, forestry, horticulture, hydrology, limnology, meteorology, oceanography, and zoology, as well as architectural, energy conversion, environmental, heating, industrial, power, and transportation engineering. Each instrument is supplied complete, in a fitted wooden carrying case, with a calibration certificate (stating the number of $\text{mV}/\text{mW}/\text{cm}^2$ [$\times 70 \approx \text{mV}/\text{gcal}/\text{cm}^2/\text{min}$]) and accessories, as indicated.

The special sensing element of these extraordinary solar-energy measuring instruments, which converts a differential of radiative thermal energy to an electrical output, was designed in 1962 by J. P. Funk of C.S.I.R.O. and consists of a thermopile, with an exceptionally large number of junctions, made by a thin, even deposition of copper on one side of a flattened coil of fine constantan wire, mechanically affixed to a thermally conductive, blackened plate. This new technique avoids the fragility of the twisted-wire thermocouple design. These metals, and their processing, were chosen to produce a large and consistent output, affording unusually high sensitivity and accuracy in measurements. The mechanical design of the thermopile element and the energy absorbing metal plates of the sensor combines the necessary compactness and rigidity of components, with the required minimization of masses, to yield an optimal output of electrical power, in proportion to the intensity of radiation, with a negligible amount of errors due to reflection, absorption, heat transfer, thermal and electrical loss, energy conversion efficiency, sensitivity, response time, etc.

BULLETIN 28M50

DOUBLE-DOME PYRANOMETER, SHADOW BAND, STRIP PYRANOMETER, REFLECTOMETER, ALBEDOMETER, UV PYRANOMETER

EXPORT
DIVISION:



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TELEX: 697906
CABLE: KAHLSCICO SANDIEGO



The thermopile output is directly proportional to the amount of radiation reaching the sensor. Energy-transparent hemispheres are used to protect each sensor from the thermally disturbing effects of wind. The glass used effectively passes wavelengths from 300 to 2,600 nm [0.3 to 2.6 μ], while the inflatable, polyethylene, plastic-film hemispheres have a nominal 85% transmission over the spectral range of 300 to 100,000 nm [0.3 to 100 μ] (see Pyrradiometers in Bulletin 29M52).

In the pyranometers and pyrhelimeter (see Bulletin 28M51), instrument sensitivity is stabilized by an integral temperature compensation system, which adjusts the electrical current produced in the thermopile circuit for any thermal changes that might occur in the internal "cold" junctions, while the "hot" junctions of the sensor plate are heated by the solar radiation as it varies during the day; the thermal differential being directly converted to an emf by the dissimilar metals at each thermocouple of the loop. In the pyrradiometers, both types of junctions are on external plates, which vary in their thermal relationships depending upon the ambient conditions.

The millivolt, electrical outputs of these sensors can be directly read on various analog or digital indicating meters, cumulated on indicating or printing integrators (see Bulletin 13M53), or continuously registered by single- or multiple-channel recorders (see Bulletin WAP-8777/2), which are offered by KAHLISICO for operating in remote field locations or at meteorological stations.

The KAHLISICO No. 28AM200 DOP, Double-Dome Pyranometer, is a sensitive instrument for measuring global, short-wave, solar radiation, as it is received by a horizontal surface, in the range of 300 to 2,600 nm. The 82-junction, temperature-compensated thermopile has a 2-cm (0.8") diameter, black, sensor plate and is enclosed by two glass hemispheres; the outer one protects the sensor from thermal variations, caused by wind, and the inner hemisphere, with its entrapped air masses, precludes variations in the temperatures of the outer dome from affecting the thermopile. Rubber O-rings and gaskets are used to weatherproof the instrument and seal the hemispheres. This pyranometer has an anodized aluminum body, fitted with a circular bubble-vial, three levelling screws, a 3-conductor, weathertight, electrical connector (for the 2 sensor output wires and the cable-shield, which is connected to the body for electrical grounding, if it is mounted on a non-conductor) and a desiccant cartridge. The body is held by a tension-spring to a cast aluminum mounting base, with 3 pads, on which rest the screws that are used to accurately position the sensor horizontally. The 25-mm high by 115-mm diameter (1" x 4.5") base is tapped in the center for a 5/8-11 N.C. (5/8" Whitworth) threaded securing screw or post. A 2-mm thick, 25-cm diameter (0.07" x 10") white-painted, aluminum, reflector disc shields the instrument body from internal heating, due to direct radiation, and helps to maintain a stable cold junction for the thermopile. The desiccant, which keeps the air inside the hemispheres and sensor dry, even with changes in temperature and barometric pressure, is visible through the clear plastic walls of the cartridge, which is easily opened to replace the crystals, that are color-coded to show when they are no longer able to absorb moisture.

The DOP is supplied complete, with a 5-m (15-ft) length of shielded, 2-conductor cable with a mating connector for the body. Ground and polished glass hemispheres, which have superior optical qualities, are available as accessories, to be substituted for the molded types.

SPECIFICATIONS: Sensitivity: approx. 0.1 mV/mW/cm²
 Calibration Accuracy: $\pm 2\%$
 Internal Resistance: approx. 100 Ω
 Time Response (to 99% of signal): 90 secs
 Linearity: within 1%

DIMENSIONS: Overall Height: 8.5 cm (3.4"), from the bottom of the base to the top of the outer hemisphere
 Reflector Diameter: 25 cm (10")
 Wooden Carrying Case: 29 x 29 x 15.5 cm (11.5" x 11.5" x 6")

WEIGHT: 1 kg (2.2 lbs), net; 4 kg (9 lbs), gross

ACCESSORIES:

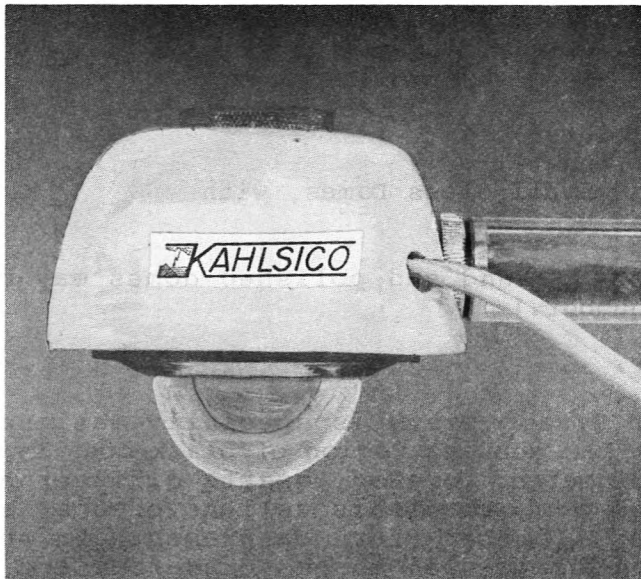
No. 28AM201 Spare Large Glass Dome (outer).
No. 28AM202 Spare, Mounted, Large Glass Dome (outer) with threaded ring.
No. 28AM203 Spare Small Glass Dome (inner).
No. 28AM204 Spare, Mounted, Small Glass Dome (inner) with threaded ring.

(Note: The above are molded glass domes, ground and polished domes may be ordered by suffixing "/GP" to the model number.)

No. 28AM206 Set of Spare Rubber O-rings and Gaskets.
No. 28AM208 Spare Desiccant Chamber.

The KAHLISICO No. 28AM205 SAB, Shadow Band, is a useful accessory holder for No. 28AM200 DOP, to shield the pyranometer from the direct solar rays when it is desired to measure the diffused (atmospheric) component of the global (sun + sky) radiation, which is normally less than 10% of the combined value. The SAB can be readily mounted parallel to the polar axis, to assure proper shading of the pyranometer sensor as the earth rotates beneath the sun. (The solar radiation component can be easily determined using the No. 28AM260 Pyrheliometer; see Bulletin 28M51.)

The KAHLISICO No. 28AM210 SIP, Strip Pyranometer, is a simple device, designed for use by agronomists to measure solar radiation between the rows of growing crops, in order to allow a determination of the amount of energy that passes the foliage and reaches the ground level. The comparison of this value to those of the incident (as measured by the KAHLISICO No. 28AM200 Pyranometer) and the radiation balance (as furnished by the No. 29AM200 Net Pyrradiometer) emittances is important for reliable biological solar energy conversion and radiation budget evaluations.



NO. 28AM220 REFLECTOMETER



NO. 28AM230 ALBO PROBE

The KAHLISICO No. 28AM220 REFO, Reflectometer, is similar to the No. 28AM200 Double-Dome Pyranometer, except it is designed to face downward and measure the global radiation reflected by the surface below it (vegetation, ground, etc.). It is often used in conjunction with the No. 28AM200 DOP to determine the albedo of the surface, which is the ratio of the amount of global radiation, reflected by the earth's surface, in comparison to that which is incident upon it, from the sun and the sky. This instrument has a bell-shaped, reflective-painted, metal shield which protects the body from incident radiation and is specially designed to minimize the area of the shadow that it casts on the surface being monitored, below it.

The top of the shield has a circular bubble-vial, for horizontally levelling the sensor. Electrical connection to the sensor is by means of terminals at the handle end of its long, tubular, aluminum, support-rod, which allows this probe to be properly suspended above the area being measured.

DIMENSIONS: Overall Length, with Handle: 80 cm (32")
Wooden Carrying Case: 95 x 14 x 14 cm (37" x 5.5" x 5.5")

WEIGHT: 3 kg (6.5 lbs), gross

The KAHLISICO No. 28AM230 ALBO, Albedometer, is a combination of the No. 28AM200 DOP and No. 28AM220 REFO, to simultaneously measure both the incident and reflected short-wave radiation. The compact design of the ALBO minimizes obstruction to radiation and permits the global :terrestrial ratio, which is termed the albedo, to be accurately determined. It has two, temperature-compensated thermopiles, with independent outputs. The sensors, each protected by two glass hemispheres, are mounted in a round housing which is held by a yoke affixed to a clear, plastic, cylindrical chamber with 0-ring seals, for the desiccant crystals, at the end of the 1.5-cm (0.6") diameter handle. The grip-section of the hollow handle terminates with 2 pairs of three-way electrical connectors, for the 2 wires inside the tubular handle from each thermopile. A small piece of hose connects the desiccant chamber to the probe, assuring dry air for the sensors and preventing condensation on the inside of the glass domes. A knurled clamp-nut on the yoke allows the ALBO to be secured in a horizontal position, using the bubble-vial on the probe-housing to level it, permitting a tilt of 30° or more, in either direction. A spanner-wrench is furnished to allow the gasketed mounting ring, with small and large glass domes, to be easily removed, when desired.

DIMENSIONS: 95 x 14 x 14 cm (38" x 5.5" x 5.5")
WEIGHT: 0.8 kg (29 oz), net; 3 kg (6.3 lbs), gross

ACCESSORIES:

No. 28AM201 Spare Large Glass Dome (outer).
No. 28AM203 Spare Small Glass Dome (inner).
No. 28AM207 Spare, Mounted Large and Small Glass Domes, with threaded ring.

(Note: The above are molded glass domes, ground and polished domes may be ordered by suffixing "/GP" to the model number.)

No. 28AM208 Spare Desiccant Chamber.

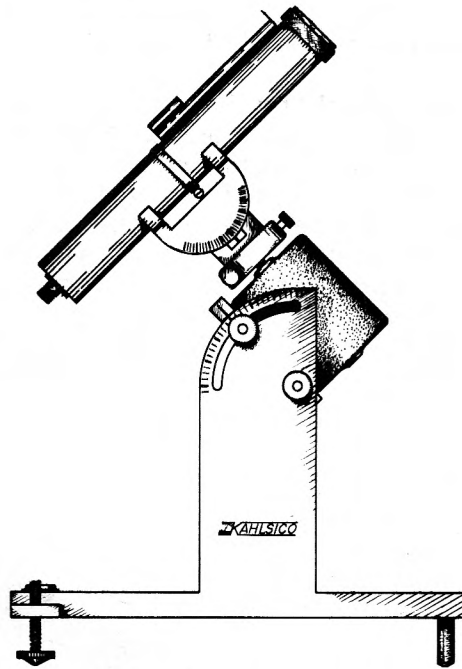
The KAHLISICO No. 28AM240 UVA, Ultraviolet Pyranometer, is specially designed for measuring in the spectral range below the sensing region of black-body type thermopile sensors. It has a 5-cm (2") diameter, beveled, quartz diffuser at the upper end of a cylinder, which houses a photovoltaic cell covered by an ultraviolet transmitting, black glass, UG 11 filter (for measurements in the 270-380 nm spectral region) and rests upon a base with three screw-feet and a bubble-vial for accurate levelling. A tube allows a desiccant chamber to be attached to the weathertight housing, to eliminate internal moisture. A 2-conductor, sealed, electrical connector is near the bottom of the cylinder.

KAHL SCIENTIFIC INSTRUMENT CORPORATION

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Factory: 737 W. Main St., El Cajon, Calif.



**NO. 28AM260 PYRHELIOMETER WITH
NO. 28AM285 TRACKING MOUNT**

The KAHLSICO No. 28AM280 PEL, Pyrheliometer, easily and precisely measures the solar radiation (excluding the diffused, sky component), by determining the intensity of the direct beam upon a black-body sensor that is placed perpendicular to it. This instrument has been specially designed to comply with the recommendations of the International Radiation Commission and consists of a sealed tube, with a quartz window (for maximum spectral transmissivity) and, at its opposite end, an 80-junction, temperature-compensated, Funk-type thermopile (see Bulletin 28M50, which also lists various indicating and recording devices) The tube, which contains 4 aperture plates and terminates in a weathertight, 2-conductor, electrical connector, has been purged with dry gas during manufacture. The 20-cm (8") distance between the 28-mm (1") diameter window-aperture and the 2-cm (0.8") diameter sensor, provides an opening angle (Z_0) of 4.0° and a slope angle (Z_ρ) of 1.1° , as prescribed. An integral sighting device facilitates alignment of the PEL with the sun. A multiple-filter disc and equatorial tracking mount are available, as accessories.

SPECIFICATIONS:

Sensitivity:	approx. 0.2 mV/mW/cm^2
Calibration Accuracy:	1.2%
Internal Resistance:	approx. 100
Time Response (to 99% of signal):	90 secs
Linearity:	within 1%

ACCESSORIES:

No. 29AM281 MID, Multiple Filter Disc, is a manually rotatable turret that will hold three optical filters, when measurements of various spectral bands of solar radiation are desired. This easily affixes to the No. 28AM280 PEL. Normally, the following filters, as recommended for use internationally, are supplied:

**EXPORT
DIVISION:**



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TELEX: 697906
CABLE: KAHLSICO SANDIEGO

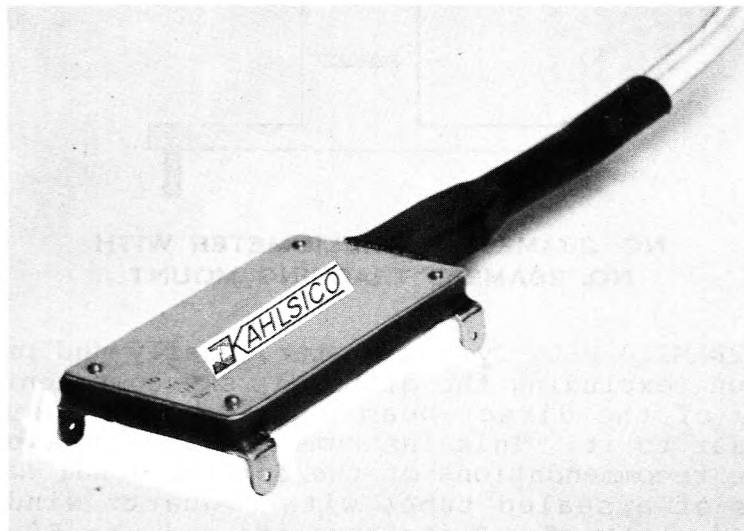


BULLETIN 28M51 PYRHELIOMETER, TRACKING EQUATORIAL MOUNT, HEAT-FLUX PLATE

<u>Model No.</u>	<u>Old Type</u>	<u>New Type</u>	<u>Transmission</u>	<u>Color</u>
29AM282	OG 1	OG 530	525-2800 nm	Orange
29AM283	RG 2	RG 630	630-2800 nm	Red
29AM284	RG 8	RG 695	710-2800 nm	Black

Other types can be furnished on special order.

No. 28AM285 ETO, Equatorial Tracking Mount, allows the No. 29AM280 PEL to be used with a recorder, as it automatically keeps the pyr heliometer aligned with the sun, while the earth revolves below it. This special mount securely clamps the PEL to a holder which is rotated by a synchronous drive motor, designed for operation with 220 V, 50 Hz or 110 V, 60Hz line power. The latitude (azimuth) setting system uses a worm-gear for precise adjustment over a range of 25°. A switch, which reverses the direction of the motor, permits operation of the mount in either the northern or southern hemisphere, without modification. The mount has a base plate with 3 levelling screws and a bubble-vial, for accurate horizontal alignment.



NO. 14AM200 HEAT-FLUX PLATE

The KAHLISICO No. 14BM200 HUP, Heat-Flux Plate, is a useful accessory probe, for terrestrial thermal transfer measurements in conjunction with the No. 29AM200 IDEPS, No. 29AM210 SEP or No. 29AM220 MEP (see Bulletin 29M52).

In energy budget studies, an important component of the heat balance is the heat flow into or out of the soil, which can be accurately determined with this sensor.

It has a 250-junction, copper-constantan thermopile that is sealed between two stainless steel plates. Its small size minimizes disturbance of the natural heat flux pattern in the soil and enables it to also be used for determining heat flows and gradients in various other materials. The instrument is supplied with 5 m (16 ft) of flexible, 2-conductor, electrical cable.

SPECIFICATIONS: Sensitivity: approx. 0.25 mV/mW/cm²
 Resistance: 20Ω
 Calibration Accuracy: ±5%

DIMENSIONS: 48 x 29 x 5 mm (2" x 1.2" x 0.2")

WEIGHT: 100 gms (3.5 oz), net

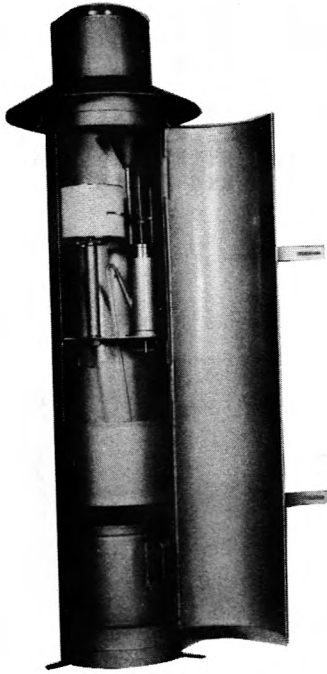
KAHL SCIENTIFIC INSTRUMENT CORPORATION

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Telephones: (714) 444-2158 and 444-5944

Factory: 737 W. Main St., El Cajon, Calif.

BULLETIN 32M25 RECORDING RAINGAUGE, BAROGRAPH, HYGROGRAPH, THERMOGRAPH & ENVIRONMENTAL

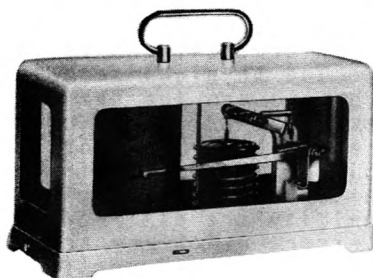


NO. 32AM120

RECORDING RAINGAUGE NO. 32AM120. Hellmann Type designed to continually record the amount of rainfall during a specific time interval. All components are carefully fabricated and are of guaranteed quality. Non-corrosive material is used throughout. The housing is 120cm high x 37cm dia. (48" x 14"). The weight is 13.5 kg. (30 lbs.) This instrument has proven itself over the years and it is an excellent mechanical device to accurately measure and indicate the rainfall in a given time period.

The receiver has a 200 sq. cm. surface area and is approx. 10cm. high. The rainfall goes from the receiver, thru a tube, into the measuring reservoir which has a movable float therein. The float rod extending above, is connected to a pen which makes an inked record on the rotating graph as the water level rises. Differences in the height of the water level are accurately indicated on the graph. When the reservoir becomes full, an overflow tube automatically empties the reservoir and the float falls, moving the pen to the zero position, setting for the next recording. The emptied water runs from the overflow tube into a collecting can at the bottom of the housing. This provides a means for physical checking the overflow volume of water.

Normally a 7 day spring motor is used, rotating the graph about 40mm/day. 1 day or 30 day motors are available. The drum is 93mm. high x 133mm. dia. (3½" x 4½"). Furnished with 54 graphs, ink, pen and measuring sticks.



NO. 08AM100

RECORDING BAROGRAPH NO. 08AM100.

Scale range 710-790mm. Hg but can be supplied with other ranges. Sturdy white enameled hinged case, with push-button lock release, size 11" x 5" x 6" (28 x 14 x 16cm). Normally a 24 hour springwound motor supplied which has a rotating speed of 1/2"/hhr. (12mm).

Drum is 3½" x 3½" (93 x 93mm.)

Fully guaranteed as to quality, accuracy, and workmanship. Ruggedly designed with shockproof bearings. Extremely sensitive. Has 7-cell pressure capsule for increased accuracy. Scales 670-750, or blank scales available.

EXPORT
DIVISION:

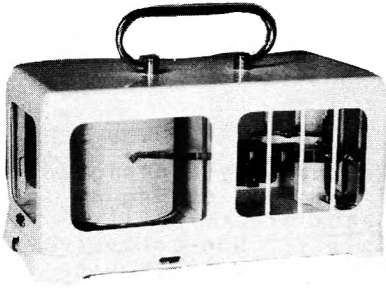


TELEX: 697906
CABLE: KAHLSCICO SANDIEGO

P.O. BOX 947, EL CAJON, CALIF. 92022, U.S.A.



HAIR HYGROGRAPH NO. 17AM100.



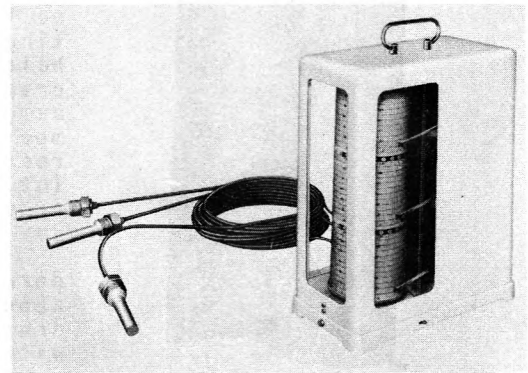
Improved treatment of the Hair elements makes this Hygrograph a reliable instrument, usable for many years. Careful attention has been given to the design of all mechanical movements to insure ruggedness and extreme sensitivity to changing conditions. The interchangeable hair strand unit can be replaced and easily calibrated in the field, without any special skills. Further, the hairs can be cleaned or regenerated (when exposed to long periods of very dry climate) with distilled water. Range 0-100%. Chrome plated metal parts add to appearance and give full protection. Accuracy 2% of the humidity range.

Case size 11" x 6" x 9" - 7 day clock movement furnished; others readily available. Standard drum size, namely 93 x 93mm. Weight 6l lbs. (3 kg.) Supplied with standard accessories, namely 1 set of charts, ink and extra pen.

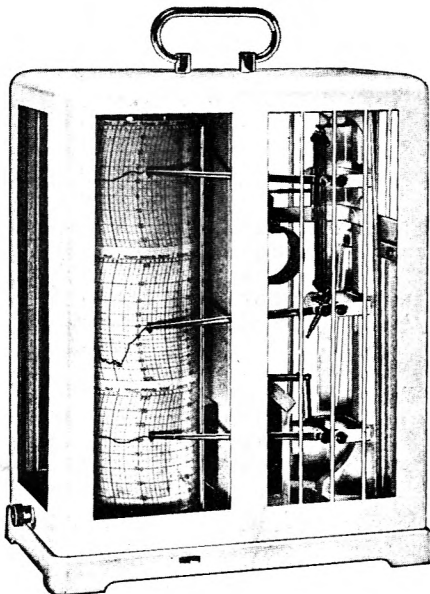
NO. 17AM100

3 PEN THERMOGRAPH NO. 3BAM700.

This meets the need for a meteorological instrument or a high quality industrial temperature recorder. Mercury filled bulbs, with threaded housing or plain casing, flexible stems can be any desired length and they are compensated. The same scale ranges are -30 to 120F (-30 to 45°C) other available at no extra charge. Drum 11" x 3 1/2" (270 x 93.3mm.) Housing 14" x 12" x 5" (35 x 28 x 14 cm.) with push-button release for hinged cover. Weight approx. 12 lbs. (5 kg.) Clock-motor normally 7 day, but 1 day, 14, or 30 day motors available. May be used for soil temperature measurements.



NO. 3BAM700



NO. 21AM100

ENVIRONGRAPH NO. 21AM100.

Developed to measure and record Temperature, Pressure and Relative Humidity. All sensing elements are designed for maximum efficiency to quickly and accurately indicate changes in these three variables. Each instrument is carefully calibrated and checked before shipment and is guaranteed as to quality of material, accuracy of performance, and reliability over the years. The physical measurements and clock movements are the same as used on THERMOGRAPH No. 22-WE-227. All components are easily accessible for inspection or adjustment. Ruggedly designed for field use. An important feature is that Temperature, Pressure, and Humidity are all recorded on one chart, avoiding errors which may arise of 3 different motors are used to drive individual charts. Further a single instrument is more economical than separate units as well as easier to transport.

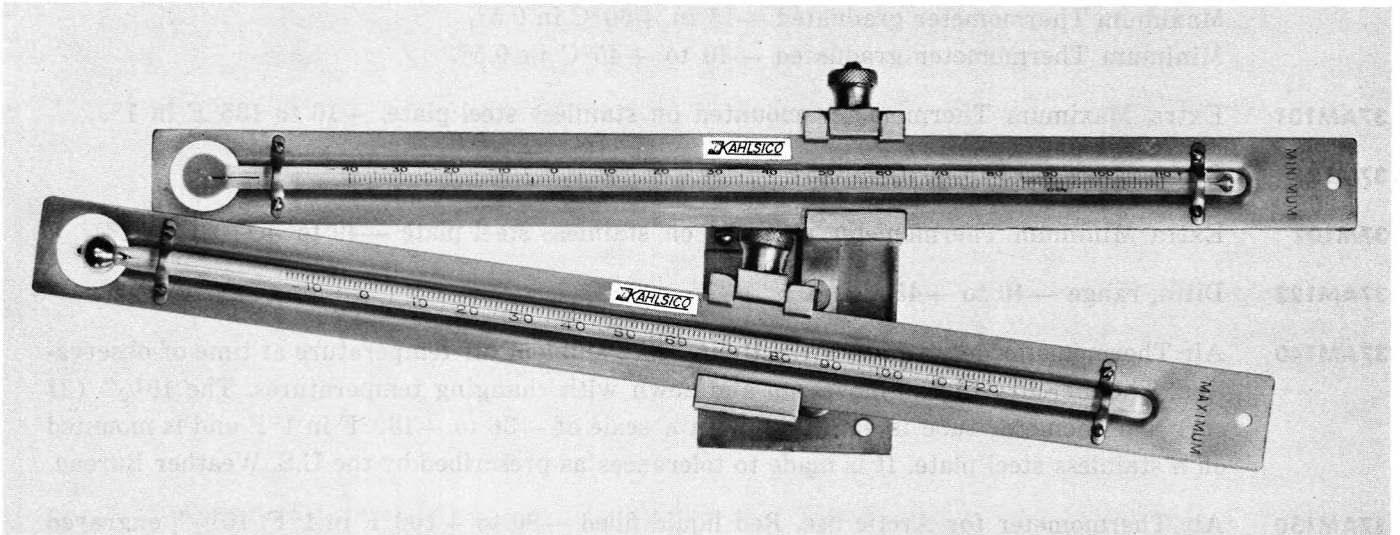
No. 21AM100 is daily recording type.
No. 21AM110 is monthly recording type.
No. 21AM120 is weekly recording type.

KAHL SCIENTIFIC INSTRUMENT CORPORATION

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Telephones: (714) 444-2158 and 444-5944

Factory: 737 W. Main St., El Cajon, Calif.



BULLETIN 37MT-64 MAXIMUM and MINIMUM THERMOMETER SET

No. 37AM100 MAXIMUM and MINIMUM THERMOMETER SET, made to U.S. Weather Bureau Specifications, of first quality workmanship, material and accuracy. The device consists of a weatherproof metal stand and base with two adjustable thermometer holders attached to rotatable metal posts; a maximum indicating thermometer and a minimum indicating thermometer, each secured to a stainless steel metal plate with clamps and screws. Deep longitudinal grooves are formed in the stainless steel metal plates to receive and protect the glass thermometers. The holder for the maximum thermometer has a spring catch at its base which locks and prevents rotation of the maximum thermometer until it is to be reset for ambient temperature. The holder for the minimum thermometer has a slot and pin assembly to allow turning 90° for reset. The mercury filled maximum thermometer is 10½" (26 cm) long with graduations and numerals etched in the glass. It has a constricted capillary just above the bulb which prevents the mercury from flowing back with lowering temperatures. It remains fixed at the warmest temperature to which it has been exposed. To reset, the thermometer is sharply rotated several times in its holder, centrifugal force pushes the mercury past the constriction into the bulb until the mercury thread in capillary stops moving at the ambient temperature. The thermometer will not indicate any temperatures lower than the ambient. The metal base has a lever and catch which is used to lock the thermometer holder post, after rotation. The minimum thermometer is also an etched stem type, 10½" long, similar to the maximum thermometer. It is alcohol filled, slightly colored, so that the ambient temperature can readily be observed. This thermometer does not have a constriction and the liquid in the capillary moves up and down with changing temperatures. It has a long thin, dark colored float, held in tension in the capillary by a very fine hair spring, which moves down towards the bulb with lowering temperatures. When the air temperature warms, the alcohol rises past the float, which remains fixed at the minimum temperature. To reset the minimum thermometer, it should be rotated 180° to bring the bulb to the top. The float then will slide down and stop when its lower end reaches the top of the alcohol in the capillary. The maximum thermometer has a scale range of +10 to +135°F in 1°. The minimum thermometer has a scale of -40 to 110°F in 1°. Other ranges are available on order. As shown in the photograph the thermometers are mounted slightly off the horizontal plane. This is particularly necessary for correct use of the minimum thermometer.

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DIVISION:



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TELEX: 697906
CABLE: KAHLSCICO SANDIEGO



- 37AM120** Same as No. 37AM100 with Centigrade Thermometers.
Maximum Thermometer graduated -15 to $+60^{\circ}\text{C}$ in 0.5° .
Minimum Thermometer graduated -40 to $+45^{\circ}\text{C}$ in 0.5° .
- 37AM101** Extra Maximum Thermometer mounted on stainless steel plate. $+10$ to 135°F in 1° .
- 37M121** Ditto, range -15 to 60°C in 0.5° .
- 37M102** Extra Minimum Thermometer mounted on stainless steel plate -40 to $+110^{\circ}\text{F}$ in 1° .
- 37AM122** Ditto, range -40 to $+45^{\circ}\text{C}$ in 0.5° .
- 37AM140** Air Thermometer designed to correctly indicate ambient air temperature at time of observation. The mercury thread moves up and down with changing temperatures. The $10\frac{1}{2}$ " (27 cm) Thermometer tube is engraved with a scale of -36 to $+130^{\circ}\text{F}$ in 1°F and is mounted on a stainless steel plate. It is made to tolerances as prescribed by the U.S. Weather Bureau.
- 37AM150** Air Thermometer for Arctic use. Red liquid filled -90 to $+100^{\circ}\text{F}$ in 1°F , $10\frac{1}{2}$ ", engraved laboratory thermometer mounted on a stainless steel back, 12" long. Thermometer is accurate to within 0.5°F and meets U.S. Weather Bureau requirements.
- 37AM160** Air Thermometer, as above, but centigrade -70 to $+50^{\circ}\text{C}$ in 0.5°C .
- 37AM180** **Earth Surface Thermometer**, designed with bulb horizontally recessed below the graduated stem. The bulb portion is placed horizontally below the surface layer to prevent direct exposure to sunlight or overhead radiation. The thermometer is 6" long with a graduated scale of -20 to $+120^{\circ}\text{F}$ in 2° . The red reading mercury capillary makes it easy to read.
- 37AM200** Same as 37AM180, but graduated -25 to $+50^{\circ}\text{C}$ in 1°C .
- 37AM181** **Earth Thermometer Set**, complete with carrying case, consisting of:
- 37AM182** Steel Pipe with cutting edge 25 mm dia. x 400 mm long (1" x 16"). The steel pipe may be hammered into the soil to depths up to 30 cm (12") in order to make a hole for the Earth Thermometer and protective case.
- 37AM183** Engraved glass thermometer 15" (37.5 cm) long, for 6" soil immersion, $+20$ to 60°F in 0.2°F , complete with protective brass case which has openings surrounding the mercury bulb and a longitudinal slot 8" long for viewing the thermometer scale.
- 37AM184** Same as 37AM183, thermometer graduated from $+50$ to $+100^{\circ}\text{F}$ in 2°F with metal case.
- 37AM185** Same as 37AM183, thermometer graduated from $+20$ to $+120^{\circ}\text{F}$ in 0.5°F with case.
- 37AM201** **Earth Thermometer Set**, as above, but with Centigrade Thermometers, in metal cases.
- 37AM202** -5 to $+17^{\circ}\text{C}$ in 0.1°C .
- 37AM203** $+15$ to 40°C in 0.1°C .
- 37AM204** -10 to 50°C in 0.2°C .

NOTE: *Earth Thermometers are available in other ranges and sizes, custom built to your specifications.*

KAHL SCIENTIFIC INSTRUMENT CORPORATION

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Telephones: (714) 444-2158 and 444-5944

Factory: 737 W. Main St., El Cajon, Calif.

Thermograph.

No. 38AM140 Bimetal sensor

No. 38AM140/L Bourdon tube sensor

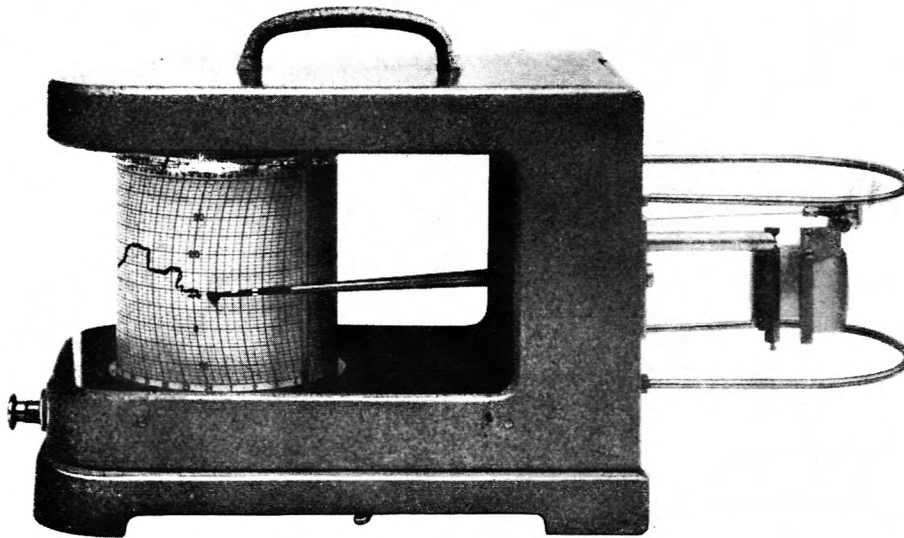
This instrument meets all the needs for a quality meteorological temperature recorder.

The sensing element is an improved, solid, liquid filled, Bourdon tube which is chrome plated for lasting protection. The tube operates, by a simple linkage, the recording pen arm. It is located outside the case for proper exposure and is protected from damage by sturdy side guards.

The clock fitted to the instrument is an 8-day movement, provided with an 11 jewels anchor-escapement which remains fixed to instrument base and only the drum is removed when chart is changed. A double-sided gear inside the recording drum may be reversed at any time to change from weekly to daily recording period, or vice versa. The chart is vertically divided for daily and weekly use.

The recording mechanism is housed in all-metal case with large plastic window. Its special hinge has the stainless steel pivot rotating in a brass shell which is included in the case casting. All moving parts and pivots are rust resistant.

Recording air temperatures within the range -35°C to $+75^{\circ}\text{C}$. The charts normally stocked are for those ranges shown below.



GENERAL SPECIFICATIONS		CHARTS
Range :	55°C or 80°C	$-35^{\circ} + 20^{\circ}\text{C}$ $-25^{\circ} + 30^{\circ}\text{C}$ $-15^{\circ} + 40^{\circ}\text{C}$ $-5^{\circ} + 50^{\circ}\text{C}$ $+5^{\circ} + 60^{\circ}\text{C}$ $-35^{\circ} + 45^{\circ}\text{C}$ $-25^{\circ} + 55^{\circ}\text{C}$ $-15^{\circ} + 65^{\circ}\text{C}$ $-5^{\circ} + 75^{\circ}\text{C}$ $+10^{\circ} + 120^{\circ}\text{F}$
Accuracy:	$\pm 1\%$ of full scale	Other ranges are available in fahrenheit scale.
Drum :	3.6" x 3.8" (93 x 98 mm)	
Chart :	12.6" x 3.7" (323 x 94 mm)	
Time scale:	daily (30h) = .37 in/h (9.5 mm/h) weekly (180h) = .06 in/h (1.6 mm/h)	
Dimensions :	14.4" x 8.4" x 5.5" (370 x 215 x 140 mm)	
Weight :	6 lbs. (2.7 kg)	

BULLETIN 38M73

THERMOGRAPH, HYGROGRAPH, THERMOHYGROGRAPH

EXPORT
DIVISION:



KAHLSICO INTERNATIONAL CORP.

TELEX: 697906

CABLE: KAHLSICO SANDIEGO

P.O. BOX 947, EL CAJON, CALIF. 92022, U.S.A.



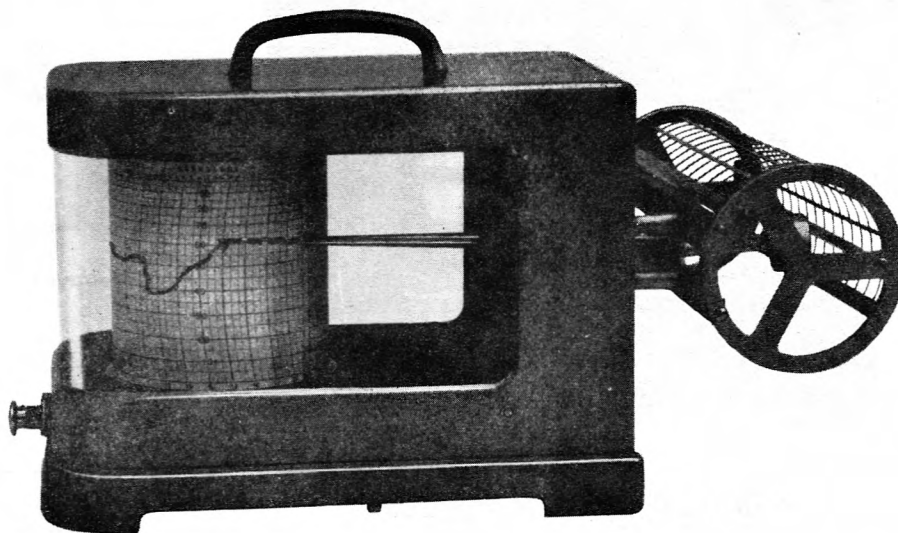
Hair Hygograph. No. 17AM140/H

This instrument gives a direct record of the relative humidity obtained from the change in length of a human hair element, specially selected and treated, coupled by a magnifying linkage to the recording pen.

The hairs are contained in a well ventilated protection guard with perforated metal strip which can removed for inspection. Any adjustment can be made easily by user without any special skills.

The 8-day clock movement, provided with an 11 jewels anchor-escapement is permanently fastened to instrument base. Only the chart drum, not the movement, is removed when changing the chart. A reversible, double-sided gear inside the drum allows a 1-day or 7-day recording period to be chosen. The chart is vertically divided for daily and weekly use.

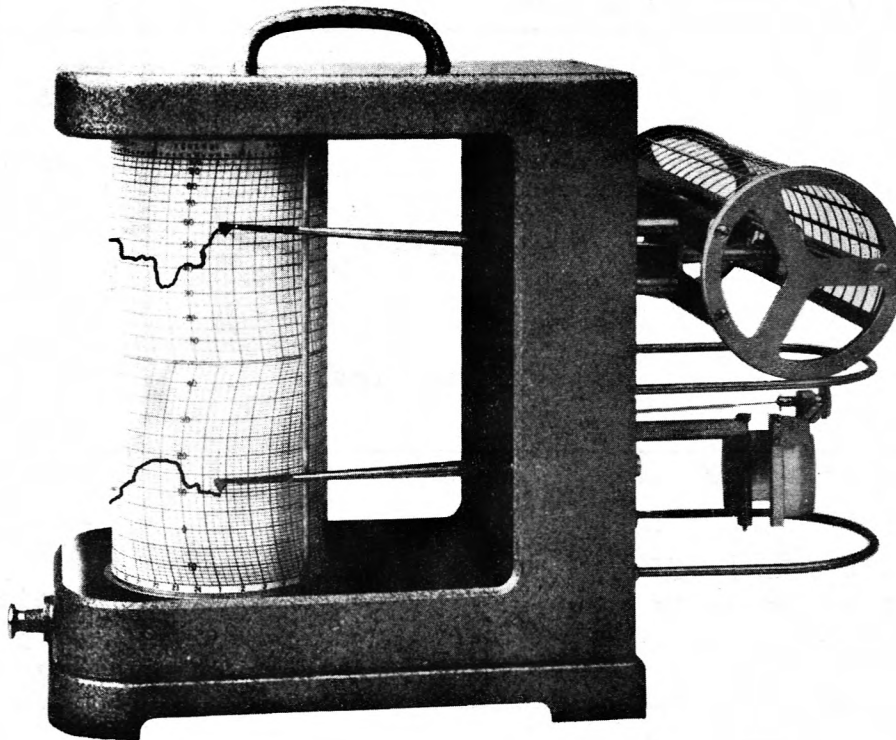
Careful attention has been given to the design of all mechanical movements to insure ruggedness and long life. The cast aluminum alloy case has corrosion resistant hinge and a large plastic window giving a clear view of the record.



GENERAL SPECIFICATIONS		CHART NUMBER
Range:	0 to 100% RH	5202
Accuracy:	$\pm 3\%$ RH	Weight: 6.6 lbs (3 kg)
Chart:	3.6" x 3.8" (93 x 98 mm)	Dimensions: 13.6" x 8.4" x 9" (350 x 215 x 230 mm)
Drum:	12.6" x 3.7" (323 x 94 mm)	
Time scale:	daily (30h)=.37 in./hr.(9.5mm./hr.) weekly (180h)=.06 in./hr.(1.6mm./hr.)	

Thermo-hygrograph. No. 19AM140/I

Simultaneous records of temperature and humidity are made on parallel sections of the same chart, thus making possible ready comparison of these two inversely related functions.



The temperature sensitive element is a highly polished Bourdon tube, which is constructed of German silver and chromium plated: it is filled with thermometric liquid and high accuracy and constant calibration are the main characteristics; the humidity element is a multiple strand of specially treated, hygroscopic human hair.

Through a system of linkages these elements operate individual recording pens. Both the elements can be readily adjusted so that the instrument may be regularly checked.

The 8-day clock movement, provided with an 11 jewels anchor-escapement, is permanently fastened to instrument base. Only the chart drum, not the movement, is removed when changing the chart. A reversible, double-sided gear inside the drum allows a 1-day or 7-day recording period to be chosen. The chart is vertically divided for daily and weekly use.

The recorder is enclosed in a die-cast corrosion resistant aluminum case with a plastic window, yielding a clear view of the record. Improved design features producing a very robust long life instrument: the brackets of the sensitive elements are of die-cast brass, while the guard rings of the Bourdon tube and the perforated metal protection of the hair are of stainless steel as are the pen arms, pens and pivots. The special hinge is fitted with pivot rotating in a brass shell which is included in the casting.

Temperature ranges within -35°C to $+65^{\circ}\text{C}$. The charts normally stocked can be selected from the ranges given below.

GENERAL SPECIFICATIONS		CHARTS	
		$^{\circ}\text{C}$	$\%RH$
		*	
		$- 35^{\circ} + 25^{\circ}$	0-100
		$- 25^{\circ} + 35^{\circ}$	0-100
Humidity: 0 to 100%, on a recording scale of 3.2" (82.5 mm)		$- 15^{\circ} + 45^{\circ}$	0-100
<u>Accuracy</u>		$- 5^{\circ} + 55^{\circ}$	0-100
Temperature:	$\pm 1\%$ of full scale	$+ 5^{\circ} + 65^{\circ}$	0-100
Humidity:	$\pm 3\%$ RH	$- 35^{\circ} + 55^{\circ}$	0-100
Drum:	3.6" x 7.3" (93 x 188 mm)	Dimensions:	
Chart:	12.6" x 7.2" (323 x 185 mm)	14.6" x 11.3" x 9" (375 x 290 x 230 mm)	
Time scale:	daily (30h) .37 in/h (9.5 mm/h) weekly (180h) .06 in/h (1.6 mm/h)	Weight: 10.5 lbs. (4.75 kg.)	

19AM140/L THERMO-HYGROGRAPH complete with 50 charts, spare pen, one bottle of ink, accessories and instructions.

19AM142/L Set of 100 charts.

* $^{\circ}\text{F}$ ranges are also available

KAHL SCIENTIFIC INSTRUMENT CORPORATION

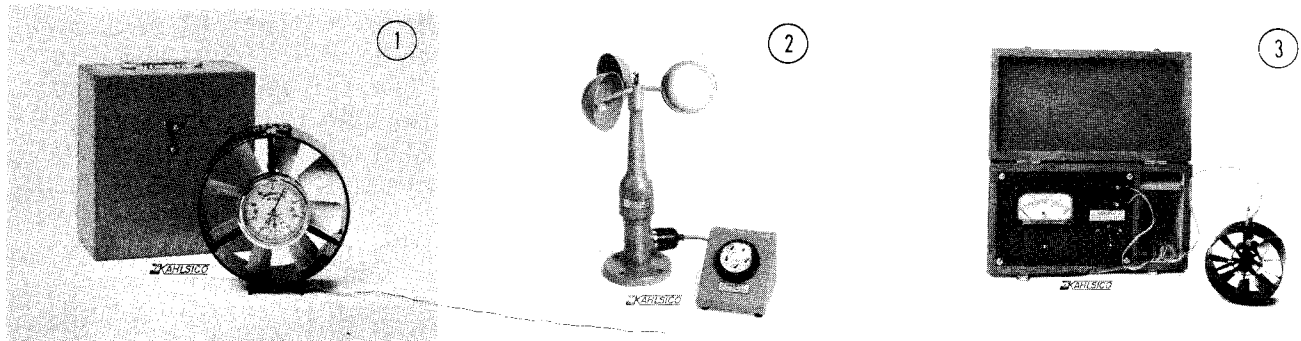
P.O. BOX 1166, EL CAJON (San Diego), CALIFORNIA 92022

Telephones: (714) 444-2158 and 444-5944

Factory: 737 W. Main St., El Cajon, Calif.

This condensed catalog lists a number of new KAHLSICO meteorological instruments, as well as several improved versions of selected models from our comprehensive line of reliable and useful equipment. All drum and strip-chart recorders are compact and readily portable, for field use. They have precision clockwork drives, either hand- or battery-rewind, which do not require any external power source. Most drum type recorders are furnished with interchangeable gears that permit 24-hour or 7-day rotation of the charts, which are marked accordingly. The maximum operating period for a drum recorder is 30 days whereas strip-chart types can be used up to 360 days. All recording instruments are supplied complete, ready for operation, with charts, a bottle of ink and a spare pen. They have hinged, sturdy metal housings with wide viewing windows, and their light weight makes them easily portable.

These field-proven, moderately priced instruments can provide useful data from all the basic weather parameters as well as determinations of certain specialized phenomena.



1. BIRAM ANEMOMETER, No. 03AM722, 8-blade, ducted-propeller model, with 2 dials registering up to 999 linear meters of air passing the 11-cm (4.3") diameter sensor. This simple and versatile anemometer accurately measures low (starting speed: 0.5 m/sec (1.5 ft/sec)) and medium winds, up to 15 m/sec (45 ft/sec). The pointers have a start-stop control and a zero reset. A rating graph is furnished as well as a carrying case. Models reading to 99,999 meters are also available.
2. TOTALIZING ANEMOMETER SET, has a No. 03AM290, heavy-duty sensor with a 15-m (50-ft) long cable and a No. 03CM100, remote, totalizing indicator. The 5-dial counter reads to 9,999,900 meters for the total wind-run, as the anemometer switch closes briefly with the passage of every 100 m (330 ft) of wind. The sensor, which has a mounting flange with 4 holes, is built of corrosion resistant material, has a threshold value of 2 m/sec (4.5 mph) and an accuracy of 5% (of the full scale reading) over the range of 2 to 60 m/sec (4 to 135 mph). Any 4.5-V battery will power the circuit for the totalizing counter, which can also be used for other devices, such as rain gauges, current meters, etc. that provide a switch closure relating to a measurable parameter (precipitation, water flow, etc.). The KAHLSICO No. 05AM200 Event Recorder (Item #16) may be used for registering wind speed over a 7-day period.
3. REMOTE READING ANEMOMETER, No. 03AM630, with an 8-blade, ducted-propeller, has an AC generator, with a 0.5 m/sec (1 mph) threshold, and a 2-meter (6-ft) long connecting cable. The dual-scale indicator has a low range of 0 to 5 m/sec (0 to 10 mph) and a high range of 0 to 15 m/sec (0 to 30 mph), with an accuracy of 3%. The sensor, controls and indicator fit into a carrying

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DIVISION:

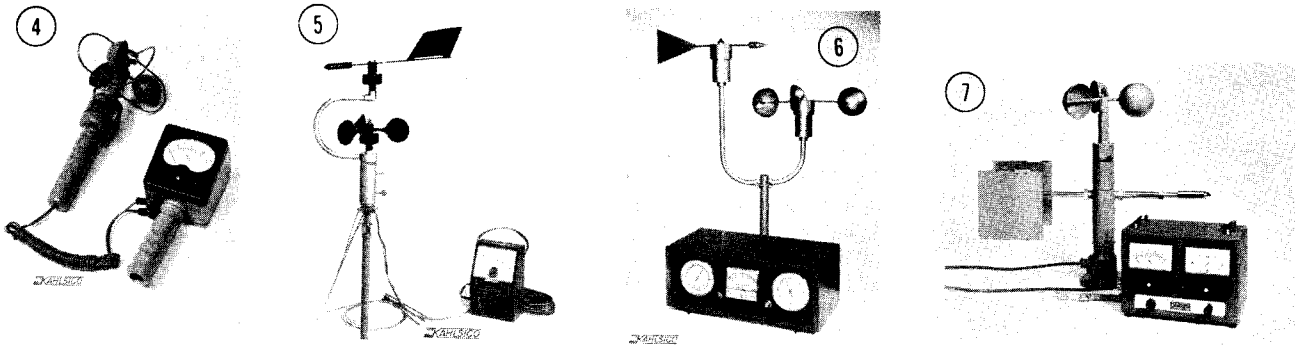


TELEX: 697906
CABLE: KAHLSICO SANDIEGO

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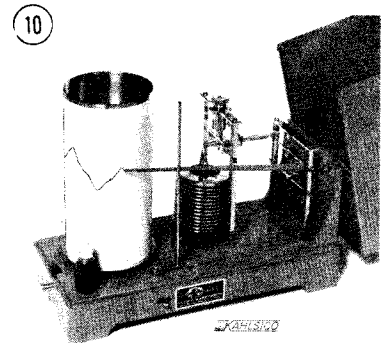
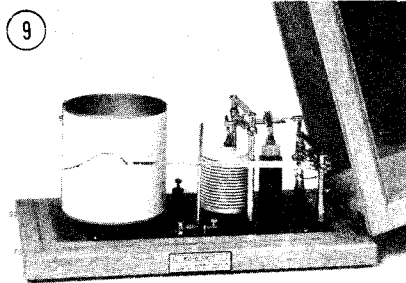
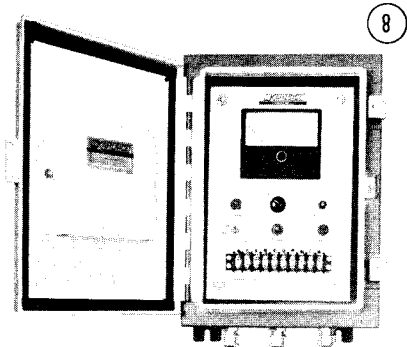


case which has a panel with binding posts for the connecting cable and a HIGH, OFF, LOW selector switch. This instrument is useful for measuring air speeds in mines, tunnels, overhead ducts, etc. as the sensor can be placed remote from the measuring unit which may be held by the observer or mounted in position.

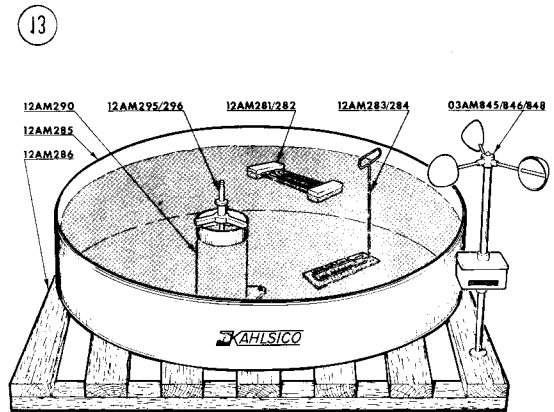
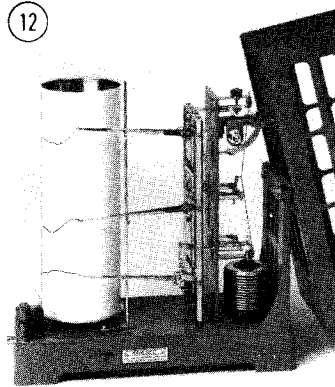
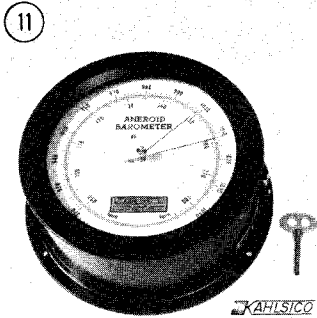


4. COMBINATION HAND ANEMOMETER, No. 03AM190, rectifies the AC voltage of the generator to drive the moving coil meter built into the handle. The scale is 2 to 40 m/sec (5 to 90 mph) with a starting speed of 2 m/sec and 5% accuracy. The sensor, which has a bracket to protect the 3 lightweight cups, is easily detached from its handle (which is hollow and may be affixed to an 18-mm (0.7") diameter post) and attached to an extension-piece. This has a 1.8-m (5.9-ft) long cable with connectors for the meter and a hand-grip for the sensor. This versatile anemometer is supplied in a compartmented carrying case.
5. FIELD ANEMOMETER, No. 03AM160, for measuring wind speed and direction at any location, comes complete with an extendable (2-m (6-ft) tall) mast, which has a tripod base, with levelling screws, and 3 guy wires, with ground stakes that serve to keep the anemometer upright, even in high winds. The indicating meters of the handy control module show wind speed (with dual scales of 0 to 20 m/sec (0 to 45 mph) and 15 to 40 m/sec (35 to 100 mph)), as well as wind direction (the scale is marked with the cardinal and intermediate points). A selector switch for the 3 scales is provided, as well as a test switch, and an aging adjustment for the replaceable 1.5-volt, D-cell battery inside the module that powers the potentiometric wind direction indicating system. An AC generator provides the output for wind speed measurements. The remote sensor has a 20-m (60-ft) long cable, with connector and adapter for attachment to the threaded (1/2-20 NF) top of the mast. This instrument provides great versatility as it can readily be transported and installed in any area selected without the need of an external power supply.
6. COMBINATION WIND SET, No. 03AM270, has separate indicators which display wind speed (0 to 75 mph, in 1 mph), wind direction (0° to 360°, cardinal and intermediate points) and barometric pressure (25" to 32", in 0.01"). The instrument is normally furnished with 30 m (100 ft) of connecting cable for the remote cup and vane sensor, which can be mounted on any 31 mm (1.25") diameter pipe. Reliability and long time service is assured because of the quality and design of this equipment. Gold and platinum contacts are used for the selsyns of the direction system, which is powered by 110 V, reduced to 6 volts for the sensor, for safety purposes. A switch allows the wind speed or direction reading to be selected; a pilot lamp shows when the anemometer is actuated.
7. TWIN-TAIL HEAVY DUTY ANEMOMETER, No. 03AM980, is ruggedly built for superior service, with a special tail for accurately tracking the wind's direction. The control console has indicating meters for air speed (scaled 0 to 30 m/sec (0 to 67 mph) and 10 to 60 m/sec (20 to 135 mph)) and direction (scaled with 16 cardinal and intermediate points). The potentiometric, direction measuring system will operate

from either 115 V AC or from a 12-V battery. The panel has an OFF, LOW and HIGH range switch as well as an OFF, AC and DC control switch. A 20-meter (60-ft) long, 5-conductor waterproof cable allows remote placement of the sensor, which has a mounting flange with 4 holes.



8. ANEMOMETER ALARM SYSTEM, No. 03BM080, has an indicating meter, scaled 0 to 100 mph in 1 mph and 0 to 45 m/sec in 1 m/sec, with a knife-edge pointer for reading the ambient wind speed as well as a movable set-pointer to select the alarm level. When the reading reaches or exceeds the alarm value, the relay and panel ALARM lamp are actuated. Terminals on the panel of the console allow a normally OPEN or a normally CLOSED circuit to be used, to actuate the remotely located signalling device. There is also a LATCH circuit, to keep the alarm signal functioning until the LATCHING RESET button is depressed. To prevent infrequent wind gusts from causing erratic warnings, an adjustable TIME DELAY is provided, assuring alarm actuation only when the average wind speed is above the selected value for a minimum time period. The console has a weatherproof, lockable housing. Any anemometer sensor, with an output of 5 volts (such as KAHLISICO No. 03AM990), can be used with this system. This is an extremely useful device as it provides a warning when the wind speeds tend to become dangerous. It is ruggedly built, for industrial use and meets O.S.H.A. requirements.
9. UNIVERSAL BAROGRAPH, No. 08AM150, contains a highly sensitive, bellows element with 14 convolutions, which records on a drum chart over a range of 940 to 1.045 mb with a full-scale accuracy of 0.2%. This reliable, temperature-compensated barograph can be used from sea level up to 500 m (1500 ft) altitude (models for 4,000 m (12,000 ft) elevation are also available).
10. MICROBAROGRAPH, No. 08AM155, is a wide-scale, fully temperature compensated, fast response, precision barograph, with a range of 990 to 1020 mb; accurate to within 0.15 mb. It reliably records, on a tall drum chart, the small pressure changes that are normally prevalent. Each 1 mb pressure change covers a 4.6 mm (0.2") space on the large chart. A 110-volt, line operated vibrator eliminates errors due to bearing and pen friction in the system.



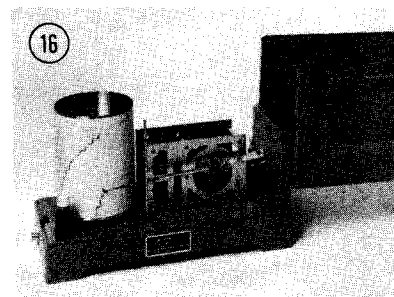
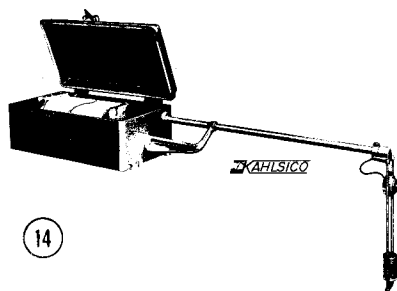
11. PRECISION ANEROID BAROMETER, No. 09AM080, has a 40-cm (16") long, large diameter scale for easy and accurate reading of the barometric pressure. The 250-mm (10") diameter case has a flange with holes for wall mounting and a clip for the altitude adjustment key. This highly reliable instrument has a sensitivity of 0.02% (full scale) which qualifies it for meteorological, surveying, marine, airport and similar uses. The dual scale is graduated from 915 to 1045 mb and 685 to 785 mm hg, accurate to 0.3% of full scale.
12. ENVIRONGRAPH, No. 21BM240, can be used as a recording weather station as it simultaneously and continuously measures the three basic meteorological parameters (temperature, relative humidity and barometric pressure) and scribes these values on the three sections of the drum chart. The temperature range of the bimetal sensor is -10° to $+45^{\circ}$ C, accurate to within 0.5° C; the bundled-hair humidity element provides an accuracy of 3% over most of the 0% to 100% RH range with 5% accuracy at the extreme ends of the scale; the aneroid pressure sensor has a range of 940 to 1045 mb, with an accuracy of 2%, of full scale. Models are also available with a temperature range of 0° to 110° F, in 2° F.
13. EVAPORATION STATION, No. 12AM300, U.S. Weather Bureau Pattern, consists of KAHLSICO No. 12AM285 Stainless Steel Evaporation Pan (120 cm (47.5") diameter and 25 cm (10") deep), No. 12AM290 Stilling Well (which facilitates readings by reducing water ripples), No. 12AM295 Micrometer Hook Gauge (which measures the drop in water level over a range of 0 to 100 mm, readable to 0.05 mm) (No. 12AM296 has a range of 0" to 5", readable to 0.01"), No. 12AM281 Floating Maximum-Minimum Thermometer (for surface temperatures over the range of -20° to $+55^{\circ}$ C in 0.5° C) (No. 12AM282 has a range of $+20^{\circ}$ to 110° F in 1° F), No. 12AM283 Submerged Maximum-Minimum Thermometer (for water temperatures, with Celsius range) (No. 12AM284 has a Fahrenheit range), and No. 03AM846 Totalizing Anemometer (which has a digital counter to indicate up to 99,999 km of wind run) (No. 03AM848 reads up to 99,999 statute miles). This is the standard Evaporation Station, used internationally. The components may be purchased separately.

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14. STRIP-CHART EVAPORATION PAN RECORDER, No. 12AM340, replaces the hook gauge to provide automatic and precise registration of the water height. It has a weather-tight housing and may be used with any evaporation pan. The electro-mechanical probe (which is battery operated and has a magnetic sensor that moves downward, towards the water surface, every hour, until it is actuated by a captive float) measures up to 125 mm (5") of water level change in the pan. The battery rewound clockwork provides a 1 mm (0.04")/hr, accurate and reliable movement for the 31-day chart, which is 25 cm (10") wide and has a 2 mm (0.08") space for each 1 mm (0.04") variation of water level in the pan.
15. EVAPORAGRAPH, No. 12BM220, uses the Piche principle to provide a continuous record of evaporation over range of 0 to 10 mm (0" to 0.4"), with a 1% accuracy. The water evaporated from the filter-paper disc probe is replenished, by a wick, from an adjacent supply reservoir which has a float that controls the movement of the pen that scribes the drum chart. A funnel, with drain tube, prevents any precipitation that might splash into the probe-hole in the cover, from entering the housing. The reservoir is easily filled and the water level in the system is readily adjusted.

REMOTE EVAPOROGRAPH, No. 12BM230, is like No. 12BM220, except that it has a movable filter-paper disc assembly with connecting tubing and a stand that enables the probe to be placed up to 1 meter away from the housing, for more natural measurements adjacent to a lake's surface, among plant foliage, etc.
16. EVENT RECORDER, No. 05AM200, registers electrical contacts received from a tilting bucket rainfall recorder, contact anemometer, etc. The reliable, double-ratchet stepping gear, with a precision cam, causes the pen to scribe up to 100 pulses, as ascending steps, on the rotating drum chart and then automatically drop down to the zero-line, to register additional pulses in the circuit which requires a 3-V battery for power. A damper-piston prevents excessive bouncing when the pen-arm drops. A strip-chart recorder, with battery rewound clockwork drive for up to 6 months operation, is available on special order.

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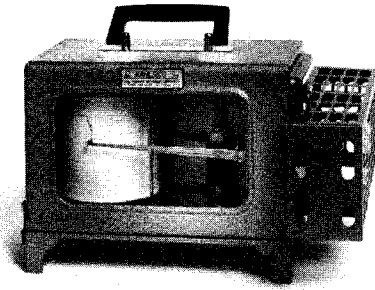


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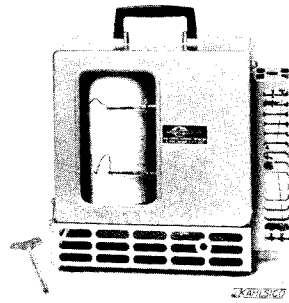
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CABLE: KAHLSICO SANDIEGO



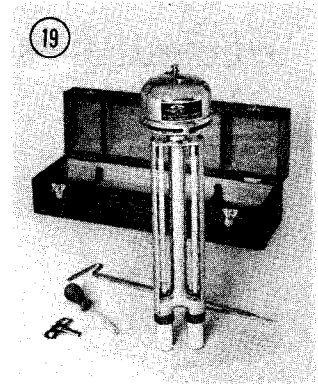
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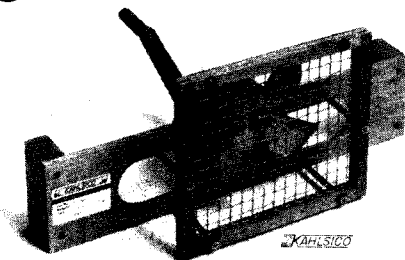
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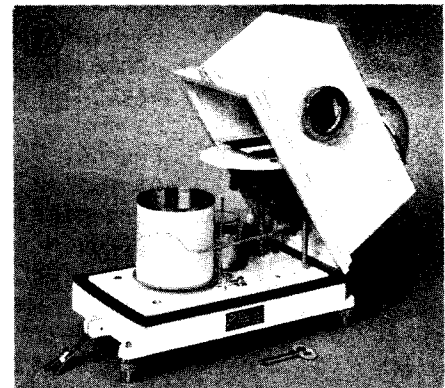
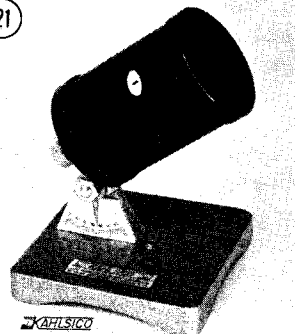
17. HYGROGRAPH, No. 17AM080, has a sensor comprised of a bundle of specially selected and treated human hairs mounted outside the housing, for maximum sensitivity, and protected by a screen. This hygrometer is calibrated to provide an accuracy of 3% over the prevalent range of 20 to 80% relative humidity; with an accuracy of 5% at the extreme ends of the 0 to 100% scale.
18. HYGROTHERMOGRAPH, No. 19AM240, has two sensors, a bimetallic element for temperature and a hair-bundle for relative humidity. The temperature chart has 55 divisions, covering a range of -10° to 45° C, in 1° C with 0.5° C accuracy (models with 0° to 110° F, in 2° F, are also available). The 0 to 100% relative humidity scale has the same accuracy as KAHLSICO No. 17AM080 Hygrometer.
19. ASSMANN PSYCHROMETER, No. 27AM570, has a heavy-duty, spring-wound clockwork for the turbine fan that aspirates air, at a speed of 2.5 meters per second, past the wet and dry thermometer bulbs, which have dual radiation shield tubes. A matched pair of porcelain scale thermometers (range: -30° to $+50^{\circ}$ C, in 0.2° C), assures high reliability and accuracy in measurement. The psychrometer has a wooden carrying case with bulb wicks, distilled water dropper, book of hygrometric tables, a suspension rod and a removable shield, which allows the fan to operate properly when used under windy conditions outdoors.

(Note: Assmann Psychrometers are available with electric motors and Fahrenheit or Celsius scales, with subdivisions in 0.5° , 0.2° and 0.1° , as desired. The KAHLSICO motorized psychrometer is designated in the A.S.T.M. specifications as the Standard Instrument for humidity determinations.)

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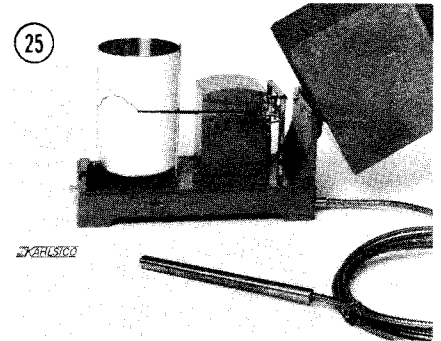
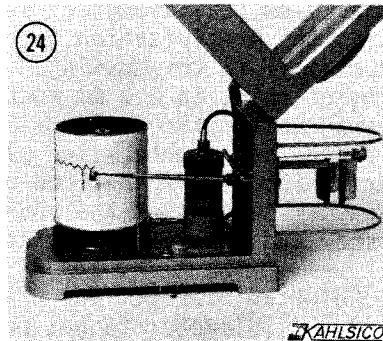
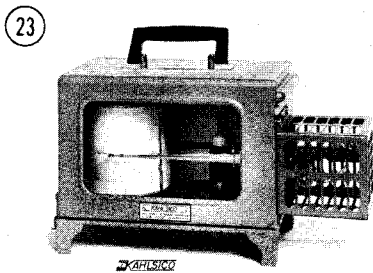


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20. GEARED HAND-FAN, No. 27AM700, is mounted on a wall inside an instrument shelter to circulate air past the thermometers, hygrometers, psychrometers, etc. The 15-cm (6") diameter fan, with a guard-screen and wooden bracket, is normally installed inside a U.S.W.B. Cotton-region Shelter, with its handle outside. Mounting screws and a screw-hook for suspending a wet- and dry-bulb psychrometer, are furnished.

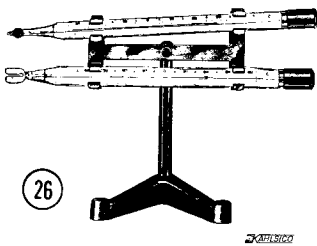
21. JORDAN SUNSHINE RECORDER, No. 35AM180, is a simple device to optically record the occurrence of bright sunshine, during the entire day, on a blueprint type, light-sensitive chart placed inside a closed, opaque tube. Narrow slits, at East and West locations on the cylinder and paper, permit the sun's rays to project through holes, during its morning and afternoon passage across the sky, onto the rolled chart which is numbered from 4 A.M. to 8 P.M. and lined every 10 minutes. The recorder is readily adjusted for use at 0° to 66° North or South latitude by a scale and clamp on its base.
22. ACTINOGRAPH, No. 01AM200, mechanically records the intensity of solar and atmospheric radiation, from 0 to 2 gcal/cm²/min, throughout the day, as incident upon a surface. Its highly sensitive, horizontal, bimetallic sensor, with black and white strips, connects to the recording pen via a compensator for ambient temperature variations. The weathertight housing has an optical quality glass dome, a wide window for viewing the chart and a level vial for installation. The glass has a 90% transmission coefficient for wavelengths from 0.35 to 2 microns.



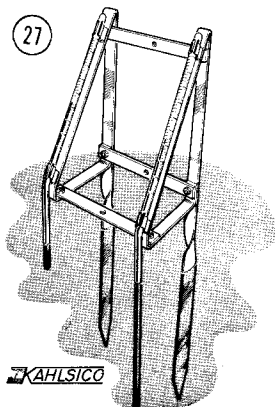
23. AMBIENT THERMOGRAPH, No. 38AM240, has a precision bimetallic sensor and a temperature measuring range of -15° C to +40° C (5° F to 104° F) with a 0.5° C accuracy. Models with a -40° C to +40° C (-40° F to 104° F) or Fahrenheit ranges are available on special order.
24. PRECISION THERMOGRAPH, No. 38AM180/L, has a liquid-filled, Bourdon tube, temperature sensor for highest accuracy and reliability. The drum has a special clockwork drive, rewound by a 1.5 V battery that provides power for up to one year. Charts are available for daily, weekly, fortnightly or monthly recording. The temperature range is -35° to +50° C with an accuracy of better than 0.5° C; other ranges (°C or °F) are available on special order.
25. REMOTE THERMOGRAPH, No. 38AM800, with corrosion resistant, metal, watertight capillary and bulb, is a reliable recording system for ambient air or liquid temperatures. The chart is marked -15° to +50° C, in 1° C. Models with a 10° to 120° F, in 2° F, range are also available. The reinforced, flexible capillary is 5 m (16 ft) long; 10-m (32-ft) length capillary or other ranges can be furnished on special order.

No. 38AM810 is like No. 38AM800, but has 2 sensors, capillaries, pens and chart sections.

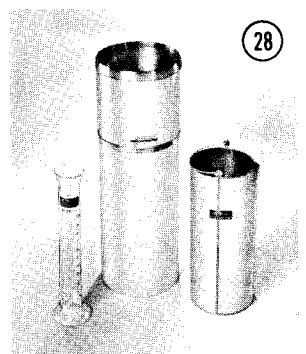
No. 38AM820 is like No. 38AM800, but has 3 sensors, capillaries, pens and chart sections.



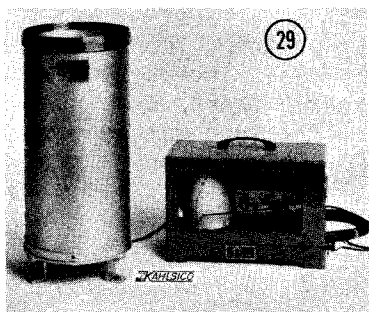
26. MAXIMUM and MINIMUM THERMOMETER SET, No. 37AM080, has precision-grade thermometers, weatherproof, enclosed scale type, complete with holder and stand for horizontal installation. They are patterned after the European models and are available with Celsius (-30° to $+45^{\circ}$ C range, in 0.5° C) or Fahrenheit scales. The minimum thermometer has a U-shaped bulb, for fast-response and a moveable index in the capillary that remains fixed at the lowest temperature to which it was exposed; it is easily reset by holding it vertically, bulb upward. The maximum thermometer has a capillary constriction which fixes the mercury column at its highest temperature; it is reset by shaking the mercury back into the bulb.



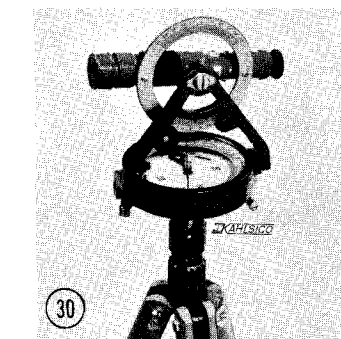
27. DUO-SOIL THERMOMETER SET, No. 37AM180, weatherproof, enclosed scale type, has 10 cm (4") and 20 cm (8") long stems for sub-surface soil temperature measurements. The two thermometers, which have a range of -10° to $+60^{\circ}$ C, in 0.5° C (accurate to 0.3° C), are mounted on a sturdy metal frame. Sets with more thermometers, other ranges or stem lengths are available.



28. COPPER-HOUSING RAIN GAUGE, No. 31PM170, is 60 cm (24") high and has a 20-cm (8") diameter, sharp, brass-edged funnel, which drains the precipitation into a measuring cylinder inside a copper pail in the housing. The glass cylinder is graduated to 10 mm of rain, in 0.1 mm increments, with a special line at its tapered bottom for 0.05 mm. Any excess rain, that overflows the cylinder, is caught by the pail, which has a spout to facilitate pouring into the funnel top of the cylinder, for measurement. The upper section of the housing can be removed for collection of snow and other frozen precipitation.



29. RECORDING RAIN GAUGE, No. 32AM450, has a remote probe with a 20-cm (8") diameter funnel and a tilting-bucket sensor which provides an electrical contact for each 0.5 mm of rainfall, with a measuring accuracy of 3%. The rain gauge sensor may be placed anywhere in the field and connected by 2 wires to the KAHLSICO No. 05AM200 Event Recorder (see Item #16), No. 03CM100 Totalizing Indicator (see Item #2), etc. The event recorder scribes a total of 50 mm of rain for each complete pen excursion up the chart. The count shown on the totalizer is simply halved, to obtain the number of mm of precipitation. A battery is needed to provide the power for the electrical circuit.



30. COMPASS THEODOLITE, No. 06AM080, complete with tripod, is a compact, lightweight, inexpensive, device, that is extremely suitable for elementary surveying, altitude determinations, triangulations, etc. Its simplified construction and use facilitates setting up and operation. The elevation (zenith) is scaled 0° to 50° , in 1° , above and below the horizontal, in both directions on the graduated telescope ring, which is easily moved by a single single knob. The telescope has a riflesight for quick alignment and adjustable focus for the object, as well as the ocular grid (which has vertical and horizontal lines). The vertical section can be unlocked and pivoted downward, onto the base, for compactness and ease of transport. The base contains 2 bubble-vials for levelling and a lockable, large compass, marked 0° to 360° in 1° . A pivot-clamp affixes the base, which has a lockable, vernier type azimuth adjustment, to the tripod.

These devices supplement the comprehensive KAHLSICO line of precision instruments developed for professional use by meteorologists worldwide. Descriptive bulletins provide detailed information and will be gladly sent upon request. Kindly list the instruments which are of interest to you or advise the nature of the investigations to be undertaken so that proper data can be furnished.