



# JULIEN P. FRIEZ & SONS, INC.

(A Subsidiary of The Bendix Aviation Corporation)

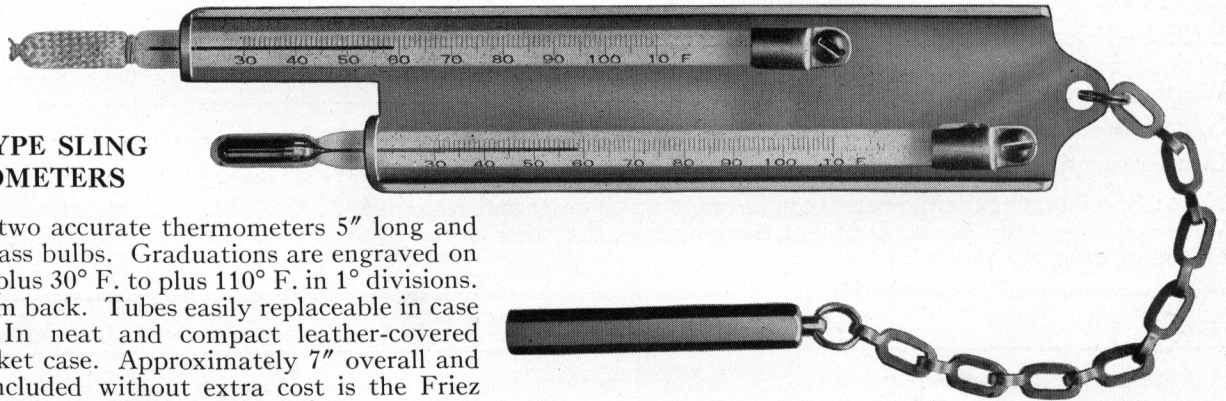
BALTIMORE, MARYLAND, U. S. A.

ESTABLISHED 1876

BULLETIN #S STANDARD MEASURING INSTRUMENTS—HUMIDITY Nov., 1936

## FRIEZ POCKET SLING PSYCHROMETER

CONSIDERED to be the standard means of measuring the moisture content of air, the Sling Psychrometer is an essential instrument to the Air Conditioning, Heating, Ventilating, Refrigeration, and Combustion Engineer or Dealer, and to Industrial, Plant, and Service Engineers.



### POCKET TYPE SLING PSYCHROMETERS

Incorporating two accurate thermometers 5" long and with normal glass bulbs. Graduations are engraved on the glass from plus 30° F. to plus 110° F. in 1° divisions. Rigid aluminum back. Tubes easily replaceable in case of breakage. In neat and compact leather-covered aluminum pocket case. Approximately 7" overall and 1½" wide. Included without extra cost is the Friez Pocket Psychrometric Slide Rule. (See details elsewhere in this Bulletin.)

#### TYPE

S/1—Friez Pocket Sling Psychrometer, **complete with case** and psychrometric slide rule..... **\$7.00 (C)**  
 (F. O. B. Baltimore)

S/1-a—Replacement thermometer (dry bulb or wet bulb) ..... (each) **1.90 (C)**

**Note:** Special range thermometers can be made up on order and at extra cost. Centigrade thermometers also available. Where ordering only one replacement thermometer, the other or the complete instrument should be returned here to enable us to match properly.

## FRIEZ STANDARD SLING PSYCHROMETER

Designed to fill the demand for a first-class Sling Psychrometer. Of comparable accuracy with the famous Friez Weather Bureau types and incorporating new features. The instrument shown here is ideal. A full-sized, yet conveniently carried instrument for the standard measurement of moisture content of air.



AIR CONDITIONING UTILITIES, INC.  
 8 W. 40th STREET  
 NEW YORK CITY  
 PHONE MEDALLION 3-4280-1-2

Fitted with accurate, carefully matched and seasoned thermometers of the new oval bore capillary, mercury filled pattern and mounted on to an aluminum frame.

Length of thermometers—8⅞"

Overall dimensions of instrument—14" x 1⅞" x 5⅞"

The frame incorporates a hinged handle with adequate bearings and is carefully designed to insure smooth and rigid action. The handle can be turned so as to facilitate carrying in case or pocket. The thermometers are protected from damage and from radiated heat by an extension of the frame around the bulbs, yet full ventilation is provided in the direction of the air movement. A bottle fitted with an applicator is furnished for carrying distilled water, and the Friez Pocket Psychrometric Slide Rule (suitable for approximate Relative Humidity readings) is included without extra charge, and there is also furnished with each instrument without cost the full set of U. S. Weather Bureau Psychrometric Tables. A leather case is available at extra cost as noted below.

Thermometers and wicks can be easily replaced. The whole operation of using this instrument can be performed with one hand, and those familiar with such instruments will immediately appreciate the attention that has been given to details and ease of handling in operation. This new Friez Sling Psychrometer provides means of measuring moisture content of air with a high degree of accuracy not found in most Sling Psychrometers in its price range. It is ideal for all phases of air conditioning in industrial and comfort work, for laboratory, field, and plant use. It embodies the Friez Company's 60 years experience in the building of fine hygrometric instruments for the U. S. Weather Bureau, Navy, etc.

#### TYPE

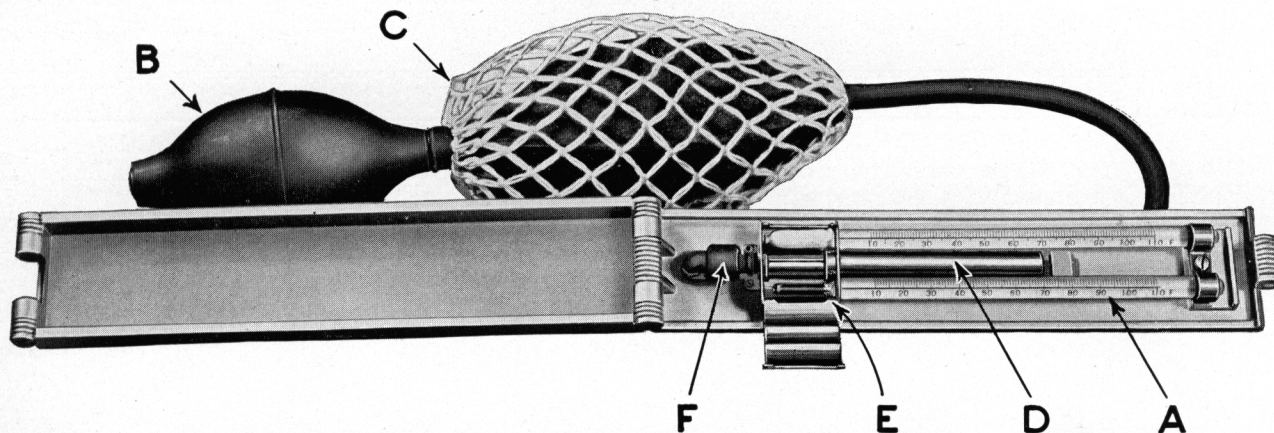
**LIST PRICE**  
(F. O. B. Baltimore)  
(C)

<b>S/552</b> —Friez Standard Sling Psychrometer, range 10°–110° F. with ½° graduations and including distilled water bottle and applicator, spare wicks, Pocket Psychrometric Slide Rule, full set of U. S. Weather Bureau Psychrometric Tables.....	<b>\$10.00</b>
<b>S/552-a</b> —Replacement thermometer (dry bulb or wet bulb) for above, each.....	<b>3.00</b>
Leather carrying case for above.....	<b>2.00</b>

**Note:** Special range thermometers can be made up on order and at extra cost. Centigrade thermometers also available. Where ordering only one replacement thermometer, the other or the complete instrument should be returned here to enable us to match properly.

### FRIEZ HAND-ASPIRATED PSYCHROMETER

A great deal of air-conditioning survey work has to be done in public buildings, theaters, stores, industrial plants, etc., and the distraction to employees, customers, and passers-by created by a person whirling the usual Sling Psychrometer is objected to by building operators, plant management, etc. Similarly, to the professional engineer, the necessity of publicly using the Sling Psychrometer is sometimes embarrassing. The Friez Company now offer a new means of accurately measuring the moisture content of air without the necessity of resorting to a Sling Psychrometer. At the same time the instrument described below gives a degree of accuracy equal to that obtained by a good Sling Psychrometer in the hands of a skilled operator, and largely removes the grave chances of error that exist with ordinary Sling Psychrometers in the hands of somewhat less skilled operators.



Showing instrument case opened for use and Thermometer Bulb Chamber (E) opened for wetting of wick.

The Friez Hand-Aspirated Psychrometer is of pocket size and offers great advantages as a new standard for the measurement of moisture content of air. It removes errors and doubt common with Sling Psychrometer methods and provides constant accuracy for the following reasons:

- (1) There is no doubt as to whether one has whirled the Psychrometer long enough or too long.
- (2) No error develops due to time lost in stopping the whirling and reading the Thermometers.
- (3) The Thermometers are stationary and one watches the wet bulb move down to finality of reading.
- (4) The Thermometers are guarded against radiation error by thermo-shielding.
- (5) The instrument can be placed as close as possible to the point at which the actual air conditions are to be tested.
- (6) The instrument may be used in confined spaces or congested locations where a Sling could not be properly employed.

The Friez Hand-Aspirated Psychrometer consists of the usual pair of good quality thermometers, A, such as are used on Sling Psychrometers but arranged so that the necessary aspiration over the bulbs is induced by a steady jet of air applied from a hand pump. Gentle pumping on the hand pump, B, inflates the flexible reservoir, C, (which is protected against over-inflation by a net covering), and the reservoir evens out the impulses of the hand pumping and



provides a steady supply of air to a nozzle, which nozzle is located inside Venturi tube, **D**. The nozzle is protected against clogging by an ample filter located at **F**. The action of this jet of air in the Venturi tube is to induce a larger supply of air to be drawn through the Venturi tube. This secondary air is drawn into the Venturi tube via the chamber, **E**, which surrounds the wet and dry bulbs and thus the thermometers are provided with the correct aspiration to give true wet and dry bulb temperatures. The cover of the chamber, **E**, can be opened to apply water by means of the supply carried in the bottle provided, and which bottle is in turn furnished with a dropper applicator. **The wet bulb wick should be thoroughly wetted while guarding against excessive free water being deposited around the bulbs.** Care should be taken to not allow any moisture to get near the dry bulb. The casing around the thermometer bulbs is highly polished to provide effective thermo shielding and gives greater accuracy than is possible with an ordinary unprotected Sling Psychrometer.

The handle of the instrument also forms the case and when not in use the thermometers and mechanism portion fold up inside the handle and results in a very compact pocket instrument,  $7\frac{1}{2}'' \times 1\frac{1}{2}'' \times \frac{3}{4}''$ , weight  $8\frac{3}{4}$  ounces. The rubber bulbs and tube can be disconnected if desired or just rolled around the handle for convenient carrying. **Within a maximum of two minutes, readings of great accuracy can be obtained without special skill, and the whole process can be performed without demonstration or fuss.**

Included without extra cost is a small carrying bottle for distilled water with proper applicator and also the Friez Psychrometric Slide Rule, which latter eliminates the necessity of carrying a bulky book of tables or complicated charts for ordinary humidity readings. The thermometers used are of high grade, covering the range  $10^{\circ}$ – $110^{\circ}$  F., graduated every  $1^{\circ}$ , and are particularly easy to read even in poor light.

It will at once be recognized that **the new Friez Hand Aspirated Psychrometer fills a very long felt need** and should form part of the essential equipment of all interested in any phase of air conditioning.

TYPE	LIST PRICE (F. O. B. Baltimore) (C)
<b>HA/2</b> —Friez Hand-Aspirated Psychrometer, range $10^{\circ}$ – $110^{\circ}$ F., with $1^{\circ}$ graduations, and complete with water bottle and applicator, spare wicks, Pocket Psychrometric Slide Rule, and integrally constructed case. (NOTE—Add <b>\$1.00</b> list for equivalent Centigrade range.)	<b>\$15.00</b>
<b>HA/1-a</b> —Replacement thermometers (dry bulb or wet bulb) for above—Fahrenheit.....(each)	<b>2.00</b>
<b>HA/1-b</b> —Replacement thermometers (dry bulb or wet bulb) for above—Centigrade.....(each)	<b>2.50</b>

**Note:** Special range thermometers can be made up on order at **\$2.00** net extra.

Where ordering only one replacement thermometer, the other or the complete instrument should be returned here to enable us to match properly.

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### FRIEZ POCKET PSYCHROMETRIC SLIDE RULE

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A very convenient means of computing Relative Humidity from wet and dry bulb readings is provided by this small Slide Rule, size  $7\frac{5}{8}''$ . It has accuracy sufficiently close for most practical work and can be much more conveniently carried than bulky books of tables, complicated charts, etc. **Provided without extra charge with each new Friez Pocket, Standard, or Hand-Aspirated Psychrometer, but may be purchased separately as below.**

TYPE	LIST PRICE (F. O. B. Baltimore) (C)
<b>SR/1</b> —Friez Pocket Psychrometric Slide Rule.....	<b>\$0.75 (C)</b>

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### OTHER FRIEZ PRODUCTS FOR AIR CONDITIONING FIELDS

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As the largest and oldest American makers of hygrometric instruments, we manufacture a complete range of automatic controlling, indicating, and recording instruments for comfort and industrial air conditioning and invite your inquiries about other Friez Products:

**HUMIDISTATS**—(For the automatic control of relative humidity in comfort and industrial applications); **THERMOSTATS**—(for the automatic control of temperature); **DUAL HUMIDISTAT-THERMOSTAT** mechanisms mounted into single cases—(The FRIEZ “HYTHERSTAT”—which will be of interest wherever air-conditioning installations call for the use of both a Humidistat and a Thermostat); **EFFECTIVE TEMPERATURE CONTROLS**—(The FRIEZ “COMFORTROL,” providing Effective Temperature control for simple heating or cooling equipment, or whereby heating, cooling, humidifying, and dehumidifying functions are all controlled by a single instrument in terms of bodily sensitive conditions of comfort, and in accordance with the American Society of Heating & Ventilating Engineers’ Comfort Chart); **WINDOWSTATS**—(low-priced controls which prevent automatically window condensation in winter humidification); **HUMIDITY AND TEMPERATURE INDICATORS**—(which exactly match with Friez Wall Mounting or Insertion Humidistats and Thermostats).

**RECORDING INSTRUMENTS** for Humidity, Temperature, Electrical Operation or Running Time. Types available for permanent mounting; semi-portable applications, and fully portable field service conditions.

**THERMOMETERS; ANEMOMETERS; AND OTHER STANDARD MEASURING INSTRUMENTS.**

We can also supply motor-operated valves, damper motors and other auxiliary devices for use on Friez Control Systems. We offer a complete range of Automatic Controlling, Indicating, and Recording Instruments for Air Conditioning and Allied Fields, in addition to our world-famous Friez outdoor **Weather Instruments.**

(Write for other Friez Bulletins.)

## RELATIVE HUMIDITY TABLE

What are known as Wet and Dry Bulb Instruments and which include Sling Psychrometers, Hand and Electrically Aspirated Psychrometers (see Friez Bulletin "S" & "P"), consist of two thermometers. One thermometer is termed the "Dry Bulb Thermometer" and indicates the actual atmospheric temperature to which it is subjected. The other thermometer is termed the "Wet Bulb Thermometer," the bulb of which is covered with a wick and provided with suitable means of supplying moisture to the wick.

The Wet Bulbs of Sling Psychrometers are provided with wicks merely large enough to cover the bulb, the Wet Bulb being dipped into water before "slinging."

The use of such instruments for the measurement of Relative Humidity, Absolute Humidity, etc., is based on the principle that evaporation absorbs heat, hence, inversely, produces cold.

The two thermometers are similar in respect to size, scale range and accuracy and are suitably mounted for comparative observation.

Obviously, if there is any evaporation of moisture from the wick on the Wet Bulb Thermometer the absorption of heat by this evaporation will lower the temperature of the bulb, and the Wet Bulb Thermometer will indicate a lower temperature than that indicated by the Dry Bulb Thermometer. The lower the moisture content of the atmosphere, the more rapid will be the evaporation from the wick, the lower will be the indication of the Wet Bulb Thermometer, and the greater will be the difference between the indications of the Wet and Dry Bulb Thermometers.

When the moisture content of the air is the maximum possible, i.e., when the Relative Humidity is 100%, there will be no evaporation from the Wet Bulb, and the two Thermometers will indicate the same temperature.

The Relative Humidity Table shown below is so arranged as to show the Dry Bulb Temperatures (indicated in the vertical columns marked "Air Temperatures"), and the DIFFERENCES between the Dry Bulb Temperatures and the Wet Bulb Temperatures (indicated in the horizontal column marked "Difference Between the Dry and Wet Thermometers"). The use of the table may be illustrated by the following hypothetical example, indicated by the HEAVY markings shown.

Assume that the Dry Bulb Temperature is 90° F. and the Wet Bulb Temperature is 80° F. The DIFFERENCE would then be 10°. Locate the figure 90 in the vertical column marked "Air Temperatures." Locate the figure 10 in the horizontal column marked "Difference, etc." Follow the co-ordinates to their intersection, as indicated by the HEAVY lines, and the figure 65 is arrived at. This indicates that when the Dry Bulb Temperature is 90° F. and the Wet Bulb Temperature is 80° F. there is 65% Relative Humidity.

These values have been computed by the United States Weather Bureau for Dry Bulb Temperatures as high as 140° F. The Forest Products

Laboratory of the United States Department of Agriculture, at Madison, Wisconsin, has computed the values for temperatures up to 200° F.

The Table shown below is based on these official computations, and due acknowledgment is made to these Government Departments.

The accuracy of the determinations depends, naturally, upon the accuracy of the Thermometers used, but also upon cleanliness of wick and water.

NOTE: New wicks should be used for accurate work, and distilled water should be employed.

Wall or Stationary Type Hygrometers cannot be relied upon to give accurate determinations, due to the fact that it has been set down by the United States Bureau of Standards that at least 15 feet of air per second must pass over the Wet Wick in order to achieve true Wet Bulb Temperature. Stationary Wet and Dry Bulb Thermometers, depending as they do on the variance of passing breezes and never receiving full required air movement, will clearly give inconsistent and inaccurate results.

In the past the most generally employed instrument for measuring wet and dry bulb conditions for the determination of Relative Humidity has been the **Sling Psychrometer**. Forced ventilation of the two Thermometers on these Psychrometers is obtained by whirling the instrument in the air by means of the chain or pivoted handle, after correctly moistening the wick on the wet bulb. If the slinging is too short in duration, the maximum effect is not produced; while if it is too long, the wick will dry, and the proper effect will be passed and missed. Where it is necessary to take quick readings in a number of different places, the Sling or Hand-Aspirated Psychrometer is most effective. Several careful checks should be taken, and results averaged. Lower results in terms of % R. H. are most likely to be accurate. The modern strictly portable instrument for accomplishing this purpose with greater accuracy and ease is the **Friez Hand-Aspirated Psychrometer** (see Friez Bulletin "S"). For extremely accurate checks of wet and dry bulb conditions in laboratories or industrial applications where a larger instrument may be used, the **Friez Thermally-Shielded Electrically-Aspirated Psychrometer** is now recognized as the most precise instrument of this type available. The necessary full 15 feet of air per second over the Thermometer bulbs is assured, and practically every conceivable error which could be encountered in this measurement has been guarded against in this instrument (see Friez Bulletin "P").

Detailed bulletins on other Friez products, including a complete range of instruments for the automatic controlling, indicating, recording, and measuring of air conditions, are available upon application. See also American Society of Heating and Ventilating Engineers Guide Book. U. S. Weather Bureau Bulletin No. 235 contains very complete tables fully corrected for Barometric pressure, etc.

### RELATIVE HUMIDITY TABLE

AIR TEMPERATURES	DIFFERENCE BETWEEN THE DRY AND WET THERMOMETERS.																																				AIR TEMPERATURES	
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35		36
30	100	89	78	67	57	47	36	26	17	7																											30	
35	100	91	82	73	65	54	45	37	28	19	12	3																									35	
40	100	92	84	76	68	60	53	45	38	30	22	16	8	1																						40		
45	100	92	85	78	71	64	58	51	44	38	32	25	19	13	7	1																					45	
50	100	93	87	80	74	67	61	55	50	44	38	33	27	22	16	11	6	1																			50	
55	100	94	88	82	76	70	65	59	54	49	43	39	34	29	24	19	16	10	6	1																	55	
60	100	94	89	84	78	73	68	63	58	53	48	44	39	34	30	26	22	18	14	10	6	2															60	
65	100	95	90	85	80	75	70	65	61	56	52	48	44	39	35	31	28	24	20	17	13	10	6	3													65	
70	100	95	90	86	81	77	72	68	64	60	55	52	48	44	40	36	33	29	26	23	19	16	13	10	7	4	1										70	
75	100	95	91	87	82	78	74	70	66	62	58	55	51	47	44	40	37	34	31	27	24	21	19	16	13	10	7	5	2								75	
80	100	96	92	87	83	79	75	72	68	64	61	57	54	51	47	44	41	38	35	32	29	26	23	20	18	15	13	10	8	6	3	1					80	
85	100	96	92	88	84	80	77	73	70	66	63	60	56	53	50	47	44	41	38	36	33	30	28	25	22	20	17	15	13	11	9	6	4	2			85	
90	100	96	92	88	85	81	78	75	71	68	65	62	59	56	53	50	47	44	41	39	36	34	32	29	26	24	22	20	17	15	13	11	9	7	5	3	2	90
95	100	96	93	89	86	82	79	76	72	69	66	63	60	58	55	52	49	47	44	42	39	37	35	32	30	28	25	23	21	19	17	15	13	11	10	8	6	95
100	100	97	93	90	86	83	80	77	74	71	68	65	62	59	57	54	51	49	47	44	42	39	37	35	33	31	29	27	25	23	21	19	17	15	14	12	10	100
105	100	97	93	90	87	84	81	78	75	72	69	66	64	61	58	56	53	51	49	46	44	42	40	38	35	33	31	30	28	26	24	22	20	19	17	15	14	105
110	100	97	94	90	87	84	81	78	76	73	70	67	65	62	60	57	55	53	50	48	46	44	42	40	38	36	34	32	30	28	27	25	23	22	20	19	17	110
115	100	97	94	91	88	85	82	79	76	74	71	69	66	64	61	59	57	54	52	50	48	46	44	42	40	38	36	34	33	31	29	28	26	24	23	21	20	115
120	100	97	94	91	88	85	83	80	77	75	72	70	67	65	62	60	58	56	54	51	49	47	45	44	42	40	38	36	35	33	31	30	28	27	25	24	22	120
125	100	97	94	91	88	86	83	80	78	75	73	70	68	66	64	62	59	57	55	53	51	49	47	45	43	42	40	38	37	35	33	32	30	29	27	26	24	125
130	100	97	94	91	89	86	83	81	78	76	74	71	69	67	65	62	60	58	56	54	52	50	49	47	45	43	42	40	38	37	35	33	32	31	29	28	27	130
135	100	97	94	92	89	86	84	81	79	77	74	72	70	68	65	63	61	59	57	55	53	51	50	48	46	45	43	41	40	38	37	35	34	32	31	30	28	135
140	100	97	95	92	89	87	84	82	79	77	75	73	71	68	66	64	62	60	58	56	55	53	51	49	48	46	44	43	41	40	38	37	35	34	33	31	30	140
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36		

Designed and Manufactured by  
**JULIEN P. FRIEZ & SONS, Inc.**  
*(A Subsidiary of the Bendix Aviation Corporation)*  
 BALTIMORE, MARYLAND, U. S. A.



REG. U. S. PAT. OFFICE

"THE MAKERS OF AMERICA'S WEATHER INSTRUMENTS"