

## CLEANING, STERILIZATION, STORAGE AND HANDLING

### Cleaning Cautions

Several precautions must be observed when cleaning and sterilizing probes, as they are easily destroyed by improper handling. NEVER BOIL OR AUTOCLAVE THE VINYL JACKETED LEAD WIRE. The vinyl may safely be exposed to temperatures up to 100°C, but above 90°C the vinyl softens and can be deformed permanently by mechanical stress. Handle gently while hot. Avoid contact with strong, aromatic, chlorinated, ketone, ether or ester solvents. Prolonged immersion in alcohols or mild organic solvents, detergent solutions or highly alkaline solutions will cause the vinyl to lose flexibility. In medical applications, the user must determine that a probe is suitable and sufficiently flexible for esophageal or rectal use.

During cleaning or sterilization, probes should be handled gently. When wiping clean, hold the probe in one hand at the sensing tip and wipe the probe and lead wire toward the plug and connector. Excessive pressure could stretch the covering and break the internal wires, which would destroy the probe. Continued flexing of lead wires in use and cleaning will also break the internal wires. Failure from this cause is not covered by the warranty.

NOTE: YSI disposable probes are designed for a single use only. The reusable cable used with disposable probes may be disinfected or sterilized the same way as the standard, reusable probes.

### Disinfection

Probes may be disinfected and sanitized by washing with 3% hydrogen peroxide or 70% isopropanol. 70% ethanol is nearly as effective, but 100% alcohols are less germicidal. Dakin's solution (sodium hypochlorite in neutral buffer) is also suitable. Brief immersion of the probe in detergent solutions is not harmful. Activated aldehyde solutions, such as Oxoid, are also effective. Probe plugs and connectors should not be immersed.

If the connector on any extension or reusable instrument cable is inadvertently wetted during cleaning or disinfection, flush the connector with distilled or deionized water and dry it in a 40 to 80°C oven for at least an hour.

### Sterilization

NEVER BOIL ANY YSI SERIES 400 TEMPERATURE PROBE. The detachable probe portion of the YSI 416 and 421 may be autoclaved. On probes other than the 416 and 421, autoclaving may cause the insulation to fail, and may also cause the probe to give inaccurate readings.

Ethylene oxide sterilization does not damage the probes, but the gas is absorbed by the plastic parts. Before handling or use, probes must be safely and thoroughly ventilated to eliminate the absorbed EIO. Because of variations in EIO sterilization equipment, equipment cycles, and variations in absorption from one probe style to another, adequate outgassing must be determined by appropriate testing.

### Storage and Handling

When not in use, probes and leads should be formed into loose loops. If wires are stretched or wrapped tightly around instrument cases, stresses sufficient to cause mechanical failure may occur. Store probes at temperatures below 50°C, preferably at room temperatures. Store Super-Stable probes in cases supplied.

All probes should be handled with care, particularly those with delicate leads, and the Super-Stable probes which use glass-encapsulated thermistors. Mechanical shock can damage any probe.

### CUSTOMER INFORMATION

Probe Modifications  
The following probe modifications will be quoted on request.

Contact the YSI Customer Service Department.

YSI 402 — Length to 24"; Teflon® instead of vinyl.

YSI 403, 408, 410, 416, 418 — Lengths to 36"; bends to 90° with 3/8" to 1/2" radius.

YSI 404 — Lengths from 1" to 5".

YSI 405 — Probe without cage; longer probe stem to 12".

YSI 406 — Same as YSI 405, except 1/8" to 3/8" bend radius.

YSI 408 — Bends to 90°; probe length to 12".

YSI 418 — Lengths from 5" to 24".

YSI 419 — Lengths from 6" to 70".

YSI 409A, 421, 427 — Teflon® covered lead to 60" (consult factory for possible temperature error); epoxy encapsulated thermistor without stainless steel disc.

YSI 423 — Length to 5".

YSI 429 — Stainless steel sheath to 12".

Leads to 250" may be ordered for all but the Super-Stable and disposable probes. Consult factory for leads longer than 250".

Special probes manufactured to customer specification, including waterproof probes utilizing marine cable for deep water applications.

### Accessories

Standard extensions are available as follows: junctions are not water-resistant (not for use with Super-Stable probes):

YSI 4010 — 10" YSI 4025 — 25" YSI 4050 — 50"

YSI 4009 Temperature Heat Shields: Used with any skin temperature probe to deflect heat, to shield probe from ambient temperature fluctuations, and to hold probe securely in place. Boxes of 100.

YSI 4900A and YSI 4910 Reusable Instrument Cables: Used with YSI Disposable probes. They are described at the end of the probe descriptions.

YSI 4004 Manifold Outlet: Used with the YSI 441 Airway Probe to connect it to a standard 22 mm respiratory airway. One is supplied with each 441 probe.

### Warranty

All reusable probes and instrument cables carry a one year warranty on workmanship and components. Damage through misuse or tampering is not covered. Probe life will vary from a few months to many years depending mainly on the amount of cable flexing. Normal life exceeds one year. Super-stable probe specifications are warranted for three years. YSI Series 400 Disposable Probes are warranted to be functional for one year from date of purchase for single-use applications only; sterility is warranted unless package is opened, damaged or wet.

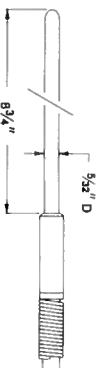
### Warning

All wire-lead patient-connected transducer assemblies are subject to reading error, local heating and possible damage from high-intensity sources of RF energy. Inadequately grounded electro-surgical equipment represents one such source in that capacitively-coupled currents may seek alternate paths to ground through probe cables and associated instruments. Patient burns may result. If at all possible, remove the probe from patient contact before activating the surgical unit or other RF source. If probes must be used simultaneously with electro-surgical apparatus, the instruments to which the probes are connected should be checked for adequate isolation from electrical grounds at radio frequencies. Hazards can be reduced by selecting a temperature monitoring point which is remote from the expected RF current path to the ground return pad, and by using pads having the largest practical contact area.

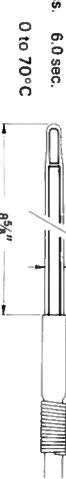
## YSI Series 400 Super-Stable Probe Styles

Probe No.	Description & Applications	Time Constant	Temperature Range	Configuration
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**407 SUPER-STABLE REFERENCE, METAL.** Stainless steel. For use as a secondary or transfer standard, and for those applications where long-term stability is essential. Useful for verifying accuracy of control probes in medical and scientific applications. Typically stable within ±0.015°C and warranted to an interchangeability within ±0.06°C for three years at measurement and storage temperatures between 0 and 70°C.



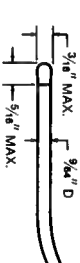
**411 SUPER-STABLE REFERENCE, GLASS.** Tubular glass. Same specifications as 407.



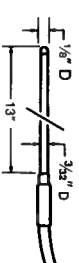
## YSI Series 400 Standard Probe Styles

Probe No.	Description & Applications	Time Constant and Maximum Temperature	Configuration
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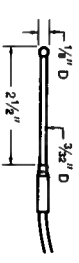
**401 GENERAL PURPOSE:** Esophageal or rectal temperature. Used for water temperatures (short term), and often buried for sub-soil readings. Used for air where fast response is not required. Most rugged probe. Vinyl tip and lead.



**402 SMALL FLEXIBLE VINYL:** Esophageal or rectal temperatures of infants, small animals. Cuvette temperatures. Vinyl sheath and tip.



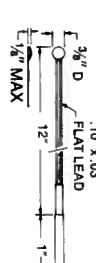
**423 SMALL SEMI-FLEXIBLE NYLON:** Frozen food package temperatures. Oral and rectal readings. Cuvette temperatures. Nylon with epoxy tip.



**408 "BANJO" SURFACE TEMPERATURE:** Skin, oral, axillary, water bath, and flat surface temperatures. Excellent for many air temperature applications. Handle aids in probe use. Stainless steel.



**409A ATTACHABLE SURFACE TEMPERATURE:** Stainless steel cup, epoxy backed with Teflon covered flexible wire. Easy to tape on flat surfaces. Good for heat loss or compression efficiency study of piping. CAUTION: This probe is fragile.



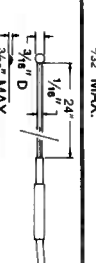
**409B ATTACHABLE SURFACE TEMPERATURE:** Tape on skin or flat surfaces. Good for heat loss and compression efficiency study of piping systems. Similar to 409A but less flexible and more rugged. Vinyl covered parallel lead. Stainless steel cup, epoxy backed.



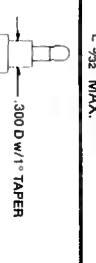
**421 SMALL SURFACE TEMPERATURE:** 24" Teflon covered flexible wire. Stainless steel disc with epoxy back. Can be autoclaved. Probe head electrically isolated, connector not isolated. Detachable lead. Fastest probe.



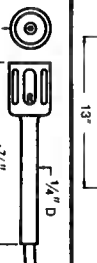
**427 SMALL SURFACE TEMPERATURE:** Like YSI 421, but with YSI 402 type juncture. Non-detachable lead, non-autoclavable.



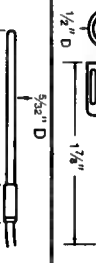
**441 AIRWAY TEMPERATURE:** For measurements in anesthesia and respiratory airways. Supplied with one YSI 408A Airway Probe Adapter. (32 to 122°F)



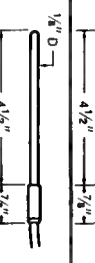
**405 AIR TEMPERATURE:** Test rooms, incubators, remote air readings, gas streams, etc. Stainless steel cage around epoxy encapsulated thermistor. (300°F)



**403 TUBULAR:** For rugged duty in liquid immersion. Fast response oral or rectal. Stainless steel. (300°F)



**406 THIN TUBULAR:** Same as YSI 403, except smaller diameter and is less rugged. Response is faster. (300°F)



**410 TUBULAR WITH FITTING:** For readings in pipes or closed vessels. Stainless steel. Fitting withstands 500 psi. (300°F)



# INSTRUCTIONS FOR YSI SERIES 400 TEMPERATURE PROBES

**Stem Effect**  
Stem effect refers to the potential error in measurement caused by heat transfer through the body or leads of a probe. The leads of some probes are relatively more massive for the sake of handling ruggedness; such leads introduce potentially greater stem effects. These effects may be lessened by minimizing the difference between probe tip temperature and lead temperature by means of appropriate insulation, isolation or immersion as each application dictates.

**Temperature/Resistance Characteristics**  
The table below lists the temperature/resistance characteristics for YSI Series 400 probes with standard leads. Probes with leads hundreds of feet long can be provided, but it may then be necessary to consider errors introduced by lead resistance, which is approximately 1.8 ohms per hundred feet. Generally, this is only significant at high temperatures.  
YSI probes are calibrated against reference standards traceable to NBS or to accepted values of natural physical constants.

**Temperature Versus Resistance: -40 to +150°C**

Temp. °C	Res. Ohms	Temp. °C	Res. Ohms	Temp. °C	Res. Ohms		
-40	75.80K	+10	4484	+60	560.5	+110	115.2
-39	70.94K	11	4275	61	540.7	111	112.0
-38	66.42K	12	4076	62	521.7	112	109.0
-37	62.22K	13	3888	63	503.5	113	106.1
-36	58.31K	14	3710	64	486.1	114	103.2
-35	54.66K	15	3540	65	469.3	115	100.5
-34	51.27K	16	3380	66	453.1	116	97.8
-33	48.11K	17	3227	67	437.7	117	95.2
-32	45.17K	18	3083	68	422.8	118	92.7
-31	42.42K	19	2945	69	408.5	119	90.3
-30	39.86K	+20	2815	+70	394.8	+120	87.9
-29	37.47K	21	2691	71	381.5	121	85.6
-28	35.23K	22	2573	72	368.8	122	83.4
-27	33.15K	23	2461	73	356.6	123	81.3
-26	31.20K	24	2354	74	344.9	124	79.2
-25	29.37K	25	2253	75	333.5	125	75.2
-24	27.67K	26	2157	76	322.7	126	75.2
-23	26.07K	27	2065	77	312.2	127	73.3
-22	24.57K	28	1978	78	302.1	128	71.5
-21	23.17K	29	1894	79	292.4	129	69.7
-20	21.86K	+30	1815	+80	283.1	+130	68.0
-19	20.63K	31	1740	81	274.1	131	66.3
-18	19.48K	32	1668	82	265.4	132	64.7
-17	18.40K	33	1599	83	257.1	133	63.1
-16	17.38K	34	1534	84	249.0	134	61.5
-15	16.43K	35	1472	85	241.3	135	60.0
-14	15.53K	36	1412	86	233.8	136	58.6
-13	14.69K	37	1355	87	226.6	137	57.2
-12	13.90K	38	1301	88	219.7	138	55.8
-11	13.16K	39	1249	89	213.0	139	54.5
-10	12.46K	+40	1200	+90	206.5	+140	53.2
-9	11.80K	41	1153	91	200.3	141	51.9
-8	11.18K	42	1108	92	194.3	142	50.7
-7	10.60K	43	1065	93	188.5	143	49.5
-6	10.05K	44	1023	94	182.8	144	48.4
-5	9534	45	984.1	95	177.4	145	47.3
-4	9045	46	946.5	96	172.2	146	46.2
-3	8586	47	910.4	97	167.2	147	45.1
-2	8152	48	876.0	98	162.3	148	44.1
-1	7742	49	843.0	99	157.6	149	43.1
+0	7356	+50	811.5	+100	153.1	+150	42.1
+1	6991	51	781.3	101	148.7		
+2	6646	52	752.4	102	144.4		
+3	6320	53	724.7	103	140.3		
+4	6012	54	698.1	104	136.4		
+5	5721	55	672.7	105	132.5		
+6	5446	56	648.3	106	128.8		
+7	5185	57	625.0	107	125.3		
+8	4939	58	602.6	108	121.8		
+9	4705	59	581.1	109	118.4		

**GENERAL DESCRIPTION**  
YSI Series 400 probes are recommended for direct temperature measurement and control with YSI Tele-Thermometers, temperature controllers, or with other instruments specifically designed for use with these probes. Three classes of probes are offered: Standard, Disposable, and Super-Stable. All YSI Series 400 probes are electrically interchangeable.

Standard Series 400 probes come in many designs for a wide variety of applications. Probe modifications to suit specific purposes may be specially ordered for many of these probes. Disposable probes are designed for single-use applications. They are furnished in packages of 25 probes, each in a separate sterile pouch.  
Super-Stable probes are usable as secondary or transfer standards and for those applications where long-term stability is essential. See individual descriptions.

Maximum measurement temperatures or measurement temperature ranges are indicated in the individual descriptions for each probe.

**Construction**  
The thermistor, which is the temperature sensing element in each probe, is a small sintered metallic oxide disk that decreases in electrical resistance as the temperature increases. Thermistors are located within the tips of the flexible and tubular probes. In probes with a disk-shaped tip, the thermistors are near the centers of the disks; some of these probes have epoxy on one side of the disk; the other, metal side should be used for making measurements.

Probes have vinyl-jacketed leads, unless otherwise specified. Leads are terminated with a phone plug, except for the disposable models which plug into a 10' reusable instrument cable. Standard probe leads are 10' long. Disposable probe leads are 3', and Super-Stable probe leads are 5' long. The vinyl-covered lead wires and phone plugs should not be exposed to temperatures above 100°C.

Except as otherwise indicated in the individual descriptions, probes are constructed with the thermistor electrically isolated from the outer probe surfaces. However, since this isolation could be lost if the probe is damaged by abuse or mishandling, the instrument with which it is used must provide ground fault isolation. (Consult instrument specifications.) In medical use, the patient should be isolated from accidental electrical grounds.

**PROBE CHARACTERISTICS**  
**Interchangeability and Stability**  
YSI's unique manufacturing process produces thermistors with matching temperature/resistance characteristics. Standard Series 400 probes are interchangeable to within 0.1°C at measurement temperatures between 0 and 70°C, increasing to 0.25°C at -40°C and 0.4°C at +150°C. All probes are warranted to remain within interchangeability tolerances for a year.

Super-Stable probe models are typically stable within 0.015°C, and warranted to an interchangeability within 0.06°C, for three years at use and storage temperatures between 0 and 70°C. At temperatures between 70 and 150°C, their stability is typically within 0.03°C for at least a year.  
Disposable probe models are interchangeable within 0.2°C between 34 and 41°C, and within 0.5°C from 20 to 34°C and from 41 to 45°C.

Time constant, the standard measure of probe response time, is the time required for a probe to read 63% of a newly impressed temperature change. YSI time constants are derived from measurements in water moving past the probe at 3 ft/sec, except in the case of air or gas temperature probes which are measured in air at standard conditions flowing past the probe at 3 ft/sec (equivalent to 12 to 15 L/min, through a standard 22 mm respiratory airway). The time constant in air decreases as humidity increases. Approximately five time constants are required for a probe to reach 99% of the total change. Time constants are representative values and are subject to variation because of small differences in probe construction.

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Probe No.	Description & Applications	Time Constant Maximum Temperature	Configuration
416	TUBULAR-AUTOCLAVABLE: Like YSI 410, but with detachable lead. Useful in biological apparatus such as heart-lung, heat exchanger, etc.	3.4 sec. 150°C (300°F)	
404	TUBULAR-GLASS: Chemically inert for liquid immersion use. Thermometric titration. Freezing point determination. Pyrex.	4.2 sec. 150°C (300°F)	
415	TUBULAR-LONG GLASS: Like YSI 404 but longer. Pyrex.	4.2 sec. 150°C (300°F)	
418	TUBULAR-POINTED METAL: To pierce semi-solids such as meat, fruit, soil, tobacco, etc. Stainless steel.	3.7 sec. 150°C (300°F)	
419	TUBULAR-LONG POINTED METAL: Similar to YSI 418, but longer for deep insertion in semi-solids. Has handle and detachable lead. Stainless steel. Not electrically isolated.	4.3 sec. 150°C (300°F)	
433	TUBULAR-POINTED METAL: Stainless steel. For piercing semi-solids. Useful in processing of food products. Pointed tip. High temperature Teflon covered lead wire.	3.7 sec. 150°C (300°F)	
428	BURIAL PROBE: Long-term soil burial or continuous immersion to 250'. Max. continuous length 2000'. Straight phone plug. Long leads supplied with chart to correct for lead resistance. Probes made to order. Specify lead length.	150°C (300°F)	
429	DEEP WATER PROBE: Continuous immersion to 2000'. Max. continuous length 2000'. Straight phone plug. Long leads supplied with chart to correct for lead resistance. Probes made to order. Specify lead length.	150°C (300°F)	

## YSI Series 400 Disposable Probe Styles and Reusable Instrument Cables

Probe No.	Description & Applications	Time Constant Temperature Range	Configuration
491A	ESOPHAGEAL RECTAL: Used for short to medium term (several minutes to several days) temperature measurements and control in adults and infants for surgical, ICU, CCU, ER, hypo- and hyperthermia and rescue vehicle applications. Also useful for veterinary research. Vinyl tip with flexible 3-foot lead.	7.0 sec. 20 thru 45°C	
499A	SKIN: Used for short to medium term (several minutes to several days) temperature measurements and control in adults and infants for surgical, ICU, CCU, ER, hypo- and hyperthermia, rescue vehicle, infant incubator and physiological testing applications. Sensor disc is mounted on adhesive foam pad for ease in attaching to skin or to other surfaces. Foam pad provides some thermal isolation from environment. Flexible 3-foot lead.	7.0 sec. 20 thru 45°C	
4900A	REUSABLE INSTRUMENT CABLE: Used with YSI Series 400 Disposable Probes to connect with measurement device. 10-foot vinyl cable terminated with probe lead connector and phone plug. May be sterilized according to instructions, do not boil or autoclave. Not for internal use.		
4910	REUSABLE INSTRUMENT CABLE: Same as above except has connector for direct connection to Hewlett-Packard instruments.		