Price $2.50

Reichert
Ophthalmic Instruments

INSTRUCTION MANUAL

Non-Contact™ II Tonometer

A CAMBRIDGE INSTRUMENTS COMPANY

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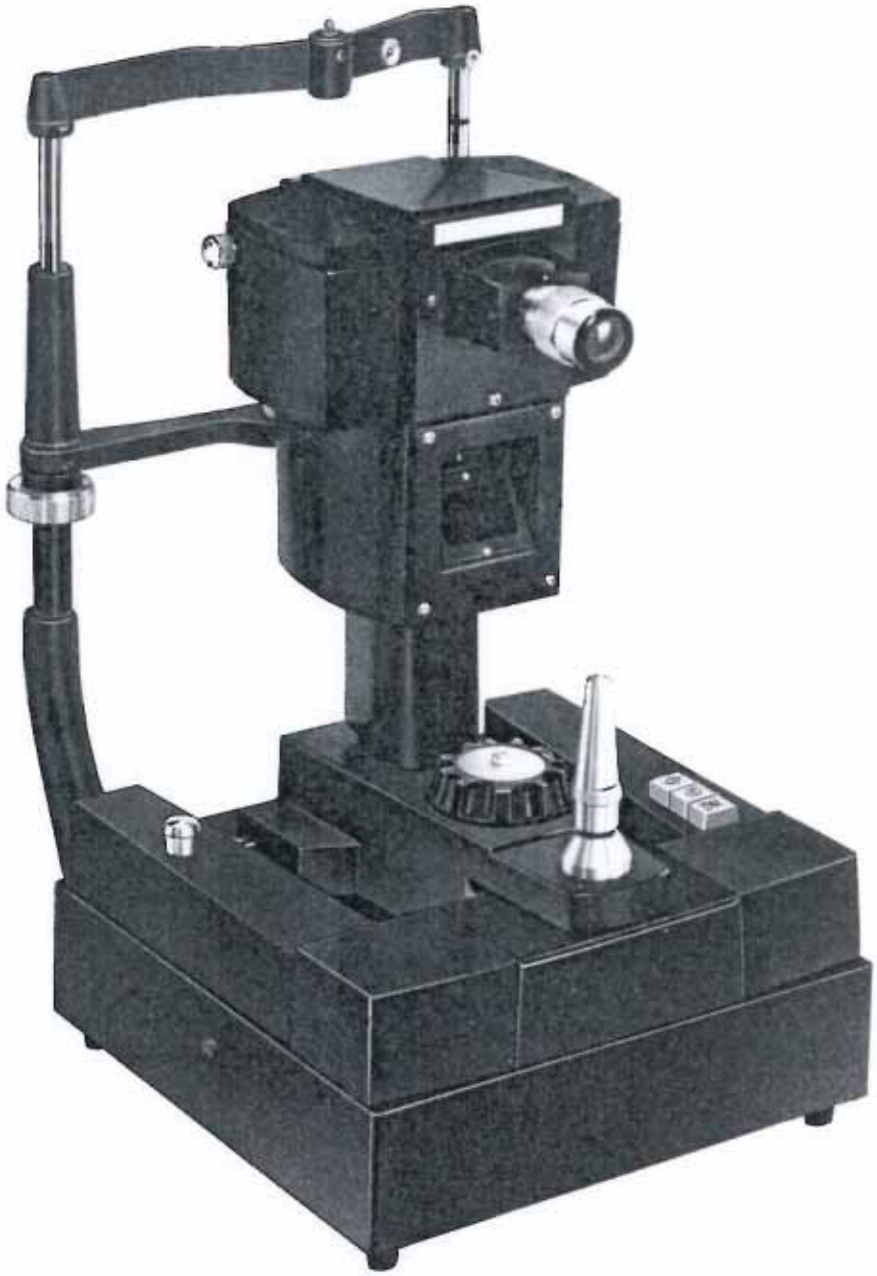
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Parts may be ordered from an Authorized Reichert Ophthalmic Instrument Distributor, or **Cambridge** Technical Service Center.

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MOUNTING INSTRUCTIONS

Mounting on Instrument Stand

1. Carefully lay Tonometer on its side.

2. Assemble No. 12418 adapter (optional accessory to the Tonometer base plate with three No. X1182 screws supplied (Figure 1).

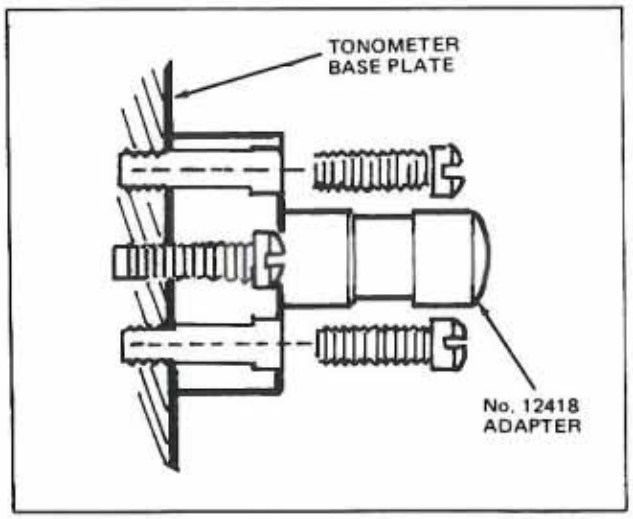


Figure 1.

3. Mount instrument to stand by inserting the adapter post into the mounting hole on the arm of the instrument stand.

4. Plug power cord of the arm into the receptacle at the base of the instrument.

NOTE: On any instrument stand without a 3-wire cable use No. 12417 3-wire Power Cord from the instrument direct to a 3-wire GROUNDED outlet.

Mounting Tonometer on No. 11730 Custom Tonometer Table

1. Position Tonometer in central area of the table with the operator's side of the instrument on the single leg side of the table (Figure 2).

2. Connect built in 3-wire cable to the instrument receptacle through the access hole in the table top.

3. Feed No. 11730-1 screws (2) from the bottom and screw them into the base plate of the instrument.

DUST PROTECTION

When the Tonometer is not in operation, the use of the supplied dust cover and objective cap is recommended.

Design considerations and recommended dust protection measures virtually eliminate any possibility of a foreign particle being propelled by the air puff. However, since the NCT pneumatic system develops its air pulse from the ambient atmosphere and no filtering of the air is exercised, the possible effect on the eye of particles discharged inadvertently from the NCT pneumatic orifice was investigated. Different sizes of various materials were loaded in the orifice and discharged individually against rabbit cornea. After discharge, the cornea was examined with a slit lamp and fluorescein dye. Superficial lesions were produced only after 3 discharges of glass slivers. A single projection of a steel lathe turning produced a superficial epithelial disruption; however, single discharges of glass or wood slivers were seen to bounce off the cornea, producing no detectable disturbances. As an added precaution, it is recommended that the instrument be discharged at least once with the selector switch in "D" (demonstrate) mode before each patient is positioned in the head and chin rests. Demonstration of the air puff on the patient's finger would fulfill this requirement.

BASIC OPERATING FEATURES

Controls and Switches (Figure 3)

Joy-Stick provides maneuverability of the Tonometer in the horizontal plane, i.e., for focusing (fore and aft) and for lateral alignment (sideways). The fine positioning of the instrument is also possible by tilting to a prime meridian and then twisting the joy-stick.

Elevation Control Knob provides vertical adjustment of the instrument for alignment.

Safety Lock Knob prevents the accidental moving of the instrument into contact with the patient's eye. Raise knob to disengage adjustable forward stop. After knob has been released, it will lock automatically within 1/10 inch additional forward motion of the instrument head.

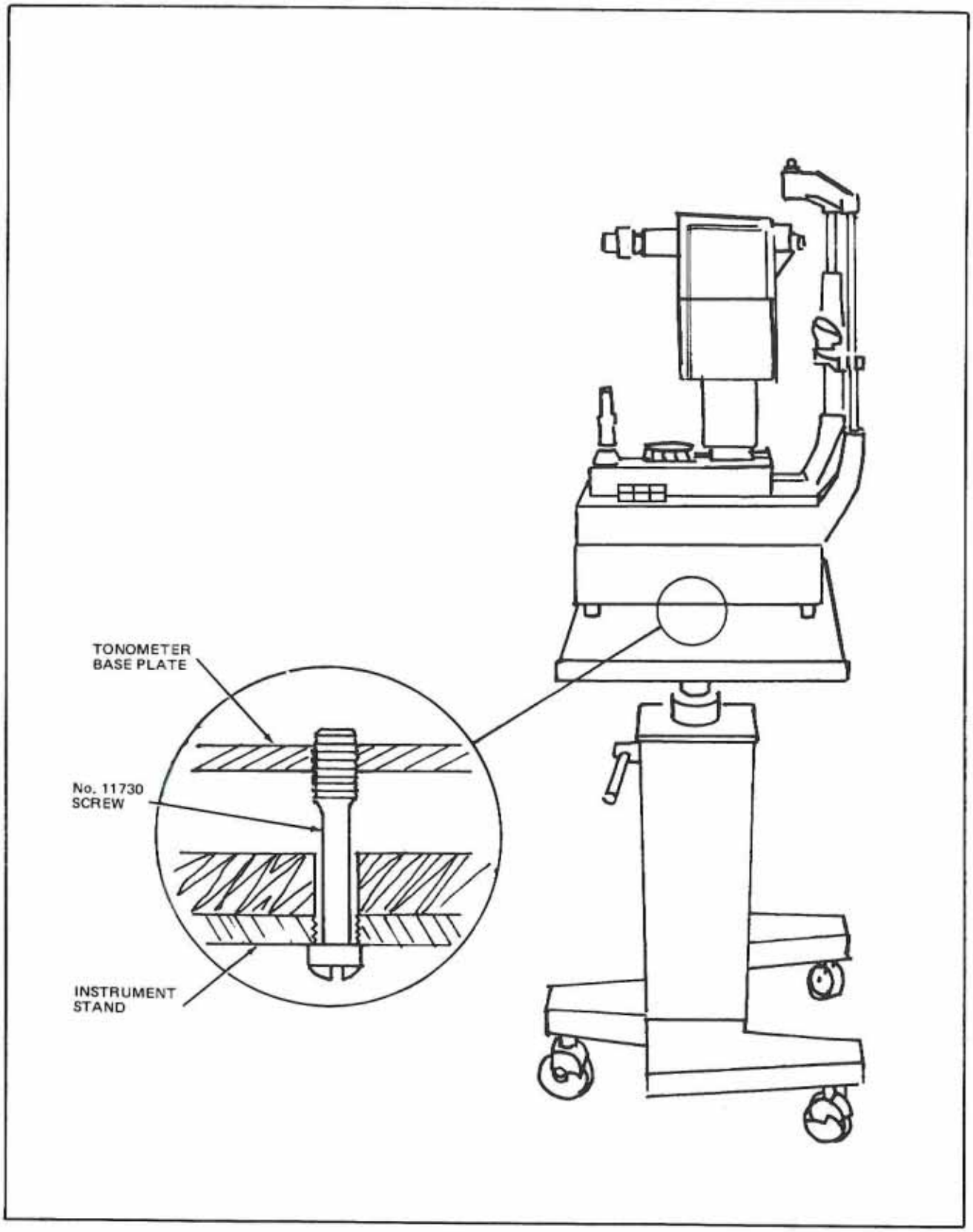


Figure 2.

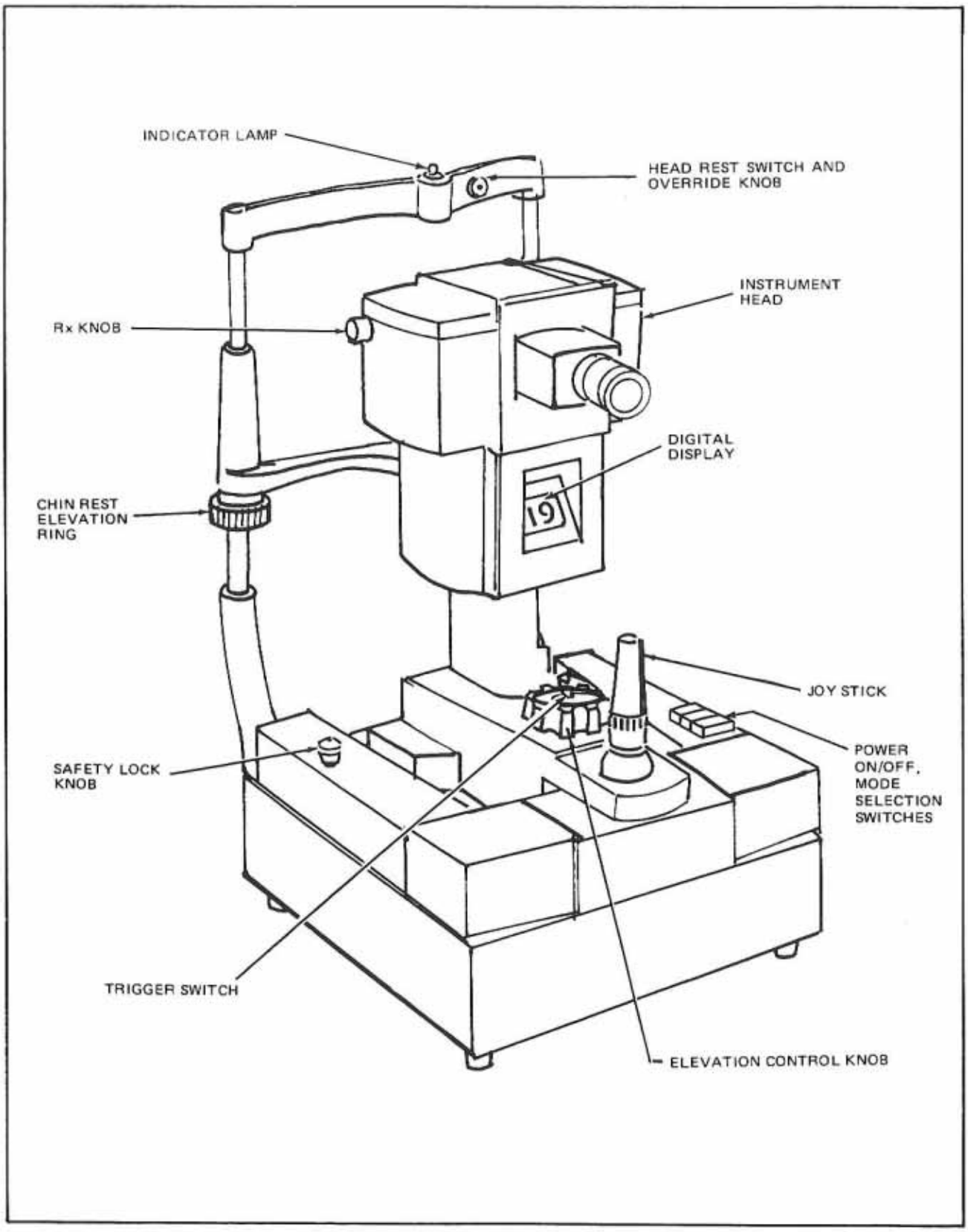

INDICATOR LAMP
HEAD REST SWITCH AND OVERRIDE KNOB
INSTRUMENT HEAD
Rx KNOB
DIGITAL DISPLAY
19
CHIN REST ELEVATION RING
JOY STICK
POWER ON/OFF, MODE SELECTION SWITCHES
SAFETY LOCK KNOB
TRIGGER SWITCH
ELEVATION CONTROL KNOB

Figure 3

Chin Rest Elevation Ring provides easy adjustment of the subject's head in respect to the Head Rest Buttons.

Rx Knob positions +14, +4, -3 and -10 diopter refractive corrections for the subject to enhance fixation. Indicator button on knob toward operator provides no correction. Black dot toward operator signifies positive corrections, red dot — negative corrections (two each).

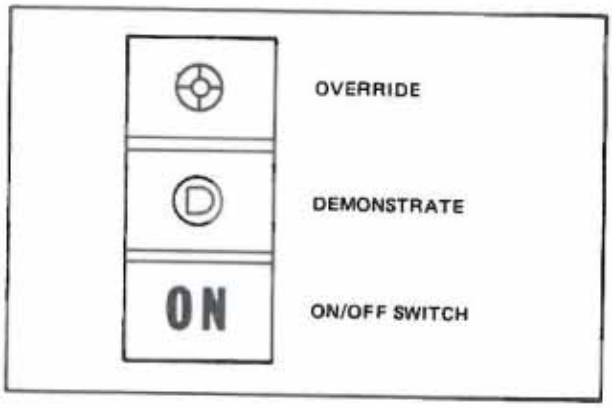
Head Rest Switch is intended to indicate to the operator whether or not the patient's head is properly positioned in the head rest. After the instrument is turned on, the internal fixation and alignment target lamp radiates at a low intensity. When the patient's forehead is pressed against the head rest, a microswitch located in one of the forehead rest buttons will cause the internal fixation and alignment target lamp to radiate at high intensity. Simultaneously, the head rest indicator lamp comes on when the patient's forehead is properly positioned against the head rest.

Head Rest Override Knob allows, in the case of an uncooperative patient, or very small child, the operator to lock the microswitch into the higher intensity position by pulling, then turning the knob one-half turn. Another half-turn (detent hold down) restores the automatic high-low function.

Use of the automatic high-low function mode is recommended because only under this condition can the Safety lock feature be employed to full advantage. Additionally, when the instrument routinely runs for the entire day, the life of the lamps is significantly extended.

Power ON/OFF and Function Switches

1. ON/OFF Switch up (not illuminated) all power turned off.
2. ON/OFF Switch depressed (illuminated) power on, ready to operate. Allow 30 seconds minimum warm-up time.



3. Depress Demonstrate Switch (illuminated) for Demonstration function, check calibration, and insure that orifice is clear of foreign objects.
4. Override Alignment verification; instrument will discharge when trigger is depressed regardless of focus or location of red dot.

NOTE: The Demo and Override switches are mechanically interlocked; both cannot be depressed at same time.

Indicator Lights

The Display indicates Intra-Ocular Pressure in mmHg after the measurement is complete. The same display is used to indicate the calibration check number.

If any of the electronic signals are not present, or do not meet the preset acceptance levels the display will blink indicating lack of confidence; try again.

CALIBRATION CHECK

The utilization of the logic circuits in the instrument, which are necessary to measure and record IOP, enables the operator to check the calibration of the pneumatic-electronic network in the following procedure:

1. Turn instrument "ON" by depressing "ON" switch. Disregard display numbers.
2. Remove objective cap and wait 30 seconds for "warm-up".

3. Depress Demonstrate Switch.

4. Depress Trigger Switch — display should read 50 ± 1.

PROCEDURE FOR IOP MEASUREMENT

CAUTIONS: See Cautions on Page 10 before proceeding.

NOTE: It is very important that the patient does not close or "squint" the eye not being tested, since a forced partial or full lid closure of the untested eye, or "quivering" lids of an anxious patient can easily raise the IOP of the tested eye 5mmHg or more. This increase is produced by the bilateral increase in musculature tonicity associated with the conditions described. Asking the patient to lightly lift his own lid is usually effective in eliminating the undesirable lid-induced effect.

Assuming that the dust cover and the objective cap have been removed and the instrument table or arm has been set to a convenient height for the operator, the following procedure is recommended to obtain a reliable IOP measurement of an eye:

1. Depress "ON" and Demonstrate Switches to "ON" positions.

2. Adjust eyepiece until ring reticle is in good focus.

3. Ask patient to place his index finger about one-half inch in front of the objective orifice. Explain that a puff of air is used to measure the pressure in his eye and that you are going to demonstrate the effect on his finger.

4. Trigger instrument (after 30 seconds warm-up) to demonstrate air-pulse intensity on patient's finger. In the process of demonstration, the calibration of the instrument is also checked, since the Demonstrate Switch serves a double function; reading should be 50 ± 1 as above.

5. Release Demonstrate Switch by depressing.

6. During next three steps, operator should observe patient and instrument from side.

7. To adjust chin rest height, turn knurled chin rest elevation ring until canthus of patient's left eye is aligned vertically with black canthus mark on left upright support. The forehead rest switch must be activated by patient's forehead pressure. Instruct subject about this requirement. If patient is unable to maintain pressure against head rest, use Override Knob to provide high illumination. Remove override at completion of measurement.

8. Raise Safety lock knob, adjust the instrument objective to pupil level and the orifice no closer than 1/4 inch from the cornea. Release Knob. A bright light spot reflected from the sclera is an excellent aid in adjusting to proper elevation.

9. Center objective laterally until the light disappears into the pupil and the red dot target becomes visible to the subject through the orifice; adjust Rx Knob, if necessary. If subject has poor or no vision in tested eye, use the external lamp in front of the other eye. An eye whose corrected vision is inadequate to see the fixation target presents a problem in alignment. When a measurement is made on a misdirected eye, the air-pulse is delivered obliquely, and part of the force is ineffectively vectored tangential to the cornea, thereby requiring greater force (or time) to achieve applanation. Therefore, misalignment causes erroneously higher NCT readings. For the unilaterally blind patient, an external fixation light may be presented to the sighted eye, in order to assist in alignment of the blind eye. Multiple measurements should be made with the blind eye in slightly different positions, and since errors are always on the high side, the lowest reading is the best determination.

Focus and Align Instrument

The illuminated red dot target of the instrument, as reflected from the corneal surface, should appear in good focus in the eyepiece focal plane and centered within the reticle ring when the Tonometer is properly focused and aligned.

After instructing the patient to open his eye wide (look surprised), several possible clues will direct the operator toward focus and alignment as viewed through the eyepiece. While maneuvering the instrument sideways on proper elevation and also changing focus with gentle motion in and out, the following clues may be observed:

1. Eye, eyelid or lashes magnified in focus — too far out, move in toward patient.

2. Dim background, red dot visible in circle but does not respond to alignment controls — too far out, move in.

3. Dark ring in white background responding to alignment controls — on axis. 4mm away from end point, move in slowly.

4. No image, Tonometer up against stop — too close, withdraw instrument.

5. When the moving red dot appears acceptable and within the reticle ring, depress the trigger. The instrument will respond and a reading in mmHg will be displayed. Repeat measurement two more times to verify reading accuracy. See Comments.

NOTE: Allow 8-10 seconds between measurements. Readings taken in too rapid succession will be automatically inhibited to prevent marginal test results.

If the Display blinks, it is recommended that the measurement be repeated, however, blinking does not necessarily indicate an inaccurate reading, it only warns the operator that the signal levels of that particular test were at marginal amplitude. If the display goes to "99", repeat test. "99" indicates no signal obtained from the eye, the instrument stopped at the top of its counting range.

If the instrument does not respond to the Trigger command, realign, refocus and try again. (See Maintenance notes.)

If the instrument fails to respond, there are several possible reasons to consider:

1. The red dot was not inside aiming circle. Repeat.

2. The objective annular lens may be dirty. See Maintenance notes for cleaning.

3. The cornea was highly astigmatic, irregular or edematous. In such cases measurement should be attempted in the Override mode.

Depressing Override switch disables automatic alignment monitoring system permitting instrument triggering regardless of alignment. It is worth noting that misaligned measurement may result in erroneous higher readings.

For the majority of patients, the instrument will work in the normal ON position. It will automatically clear and reset itself before each measurement. If either the head rest override or the alignment verification override switch have been activated, each should be deactivated prior to measurement of next patient.

COMMENTS

While experience teaches that elevated intraocular pressure is usually associated with glaucoma, "normal" pressure does not absolutely preclude the presence of glaucoma. In general, a definitive diagnosis of glaucoma is made when disc changes and/or field loss are also in evidence.

When, on a given eye, a series of several successive NCT measures of IOP are taken, not infrequently one or more readings may be acquired which appear to be irrelevant or erroneously high. The following three exemplary sequences illustrate that observation:

1) 16, 24, 14, 17
2) 18, 20, 26, 19
3) 13, 12, 18, 13.

Although in each measurement instance listed above, the IOP extant at that instant was accurately determined, grand averages computed for each of the three eyes would yield erroneously high IOP values. The following comments offer a rationale and procedure for processing the NCT measurement data.

An NCT measure is made in a few milliseconds and, because it occurs at random relative to the ocular pulse, one must anticipate a measurement range of 2, 3, or even 4mmHg due to the pulse amplitude. That would account for the modest variability (2-3mmHg) seen in each of the three sequences. What, then, is the large departure (underlined) present in each sequence?

NCT-IOP measurement is routinely made without retraction of the lid or instruction to the patient regarding blinking. It is worth noting that the measurement requires a smaller palpebral fissure than any other tonometric instrumentation. Not infrequently, a measurement is started after a normal blink has been initiated. Studies[1] show that during a blink, the globe may be retracted into the orbit at least 2.5mm. Such a displacement

[1]Forbes, Max, et al, A Noncontact Applanation Tonometer, Arch. of Ophthal., pp. 134-140, Vol. 91, Feb. 1974.

implies imposition of significant forces on the globe by the lids and/or extraocular muscles. Miller[2] reported that the lid, in a normal blink, develops a pressure of approximately 10mmHg. It follows, therefore, that in addition to the variability associated with the ocular pulse, IOP, as measured by the NCT, is subject to the instantaneous and transient influence of the globe's environmental musculature.

Returning to the three sequences of measures cited above, and considering each in the light of the foregoing comments, the underlined disparate measures should be deleted before an average IOP is determined for each of the three eyes.

CAUTIONS

1. The Safety Lock mechanism is intended to prevent inadvertant contact between the NCT and the patient's eye. Its use, as described, in column 2 of pages 4 and 8, is recommended for all IOP measurements. Note that when setting the recommended ¼ inch safe distance spacing, the patient's forehead must be firmly up against the two forehead button rests.

As described on page 4, under "BASIC OPERATING FEATURES", focus and lateral alignment can be achieved by tilting and/or twisting the joy stick. Large distance adjustments can be made by holding the joy stick immobilized, and pushing or sliding the instrument laterally, or fore and aft. UNDER NO CIRCUMSTANCE, SHOULD THE OPERATOR EVER LIFT OR PULL THE JOY STICK UPWARD. Even at the forward limit of travel, as restricted by the Safety Lock, such an action (lifting) will cause the instrument head to tip forward slightly, and may affect contact with the patient's eye.

Inadvertant contact with the patient's cornea requires professional attention appropriate for circumstances wherein the integrity of the corneal epithelium has been compromised.

2. Use of the NCT is contraindicated in instances of:

   A. Edematous/ulcerated cornea
   B. Following keratoplasty
   C. Following penetrating trauma

[2]Miller, David, Pressure of the Lid on the Eye. Arch. of Ophthal., pp. 328-330, Vol. 78, Sept. 1967.

Air bubbles have been observed sub-epithelially (contraindication A) and in the anterior chamber (contraindication B). It is worth noting that in each of the few instances reported, they cleared without complication.

MAINTENANCE

The NCT is sturdily constructed and will normally require little care to keep it operationally perfect. Protection against dust is important and it is highly recommended that the supplied dust and objective covers be utilized.

Your nearest Reichert authorized distributor or Reichert Technical Services should be consulted for advice and assistance any time, when in your opinion, the calibration or pattern of performance of your Non-Contact Tonometer is in question.

Bulb Replacement

CAUTION: Disconnect instrument from its source of electrical power.

Target Illuminator Bulb

1. Remove instrument top by unscrewing 2 screws with a 3/32 Hex wrench.
2. Free bulb holder by loosening set screw with a 1/16 Hex wrench.
3. Pull out bulb holder.
4. Remove bulb by unscrewing knurled retainer ring.
5. Replace bulb with No. 12419 bulb and wipe bulb clean of finger prints (also GE 328)
6. Reconnect power and turn instrument "ON".
7. To adjust for maximum and even target illumination, view red dot target through the objective orifice (from patient's position) and adjust bulb holder on axis with power ON. Tighten set screw.
8. Replace and secure instrument cover.

Chin Rest

The chin rest is easily removable by twisting 90°, then pulling up. It is made of a durable material that can be sterilized (Max. 250°F) or washed in soap and water or alcohol.

Head Rest Cushions

Wipe clean with alcohol or acetone.

Eyepiece and Objective

The exposed surfaces of these optical elements should be kept free of dust, finger prints and smudges. Occasionally dust lens surfaces with a camel's hair brush.

The alignment target, as viewed by the operator, may become blurred by accumulation of grease from eyelashes on the annular aperture of the objective. Clean the annulus with a *dry* cotton tipped stick, approximately once each week.

After prolonged service or in a dusty or humid environment, the inside surface of the objective should be cleaned. Remove objective by unscrewing counterclockwise, dust surface with brush, or, if necessary, wipe clean with acetone dampened tissue paper. Reassemble finger tight.

Electronic Circuitry

The NCT electronic circuits have been developed, tested and adjusted to a high degree of reliability and precision for service free operation. However, if repair is necessary, the modular design lends itself to easy replacement of plug-in printed circuit boards.

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